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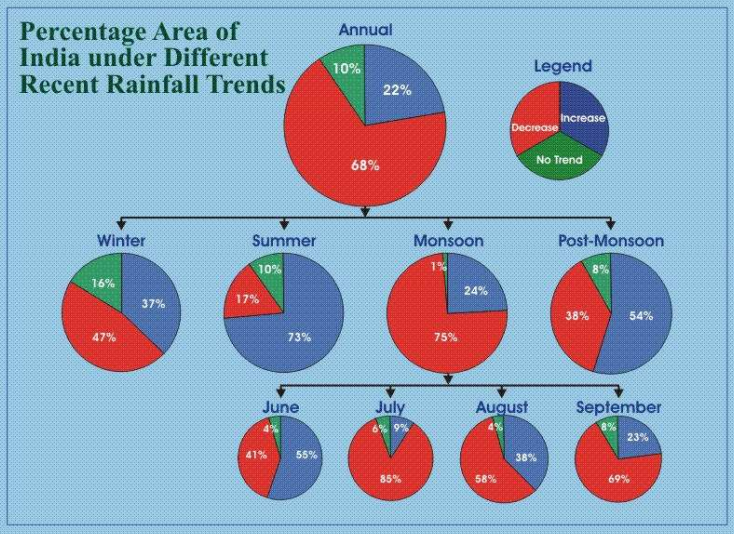

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Chief Features of Physiographic Rainfall Variations across India during Instrumental Period (1813-2006)

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ABSTRACT:

While occurrences of water bodies (rivers and canals; reservoirs, tanks and ponds; beels, oxbow lakes and derelict water; and brackish water) across the country depend upon physiographic settings and rainfall conditions, the recharging of the water bodies depends mostly on rainfall which is a highly variable parameter. In this study fluctuation characteristics of annual, seasonal and monsoon monthly rainfall have been reported for 15 physiographic divisions and 49 subdivisions/provinces using longest available instrumental rainfall records from well-spread 316 raingauge stations. For the period 1901-2006, with data available for all the selected raingauges, the area-averaged rainfall series has been prepared from simple arithmetic mean of the gauges in the particular region. Prior to 1901 (sometimes going back to 1813) the series has been constructed by applying established objective technique on the limited available raingauges. For 15 physiographic divisions longest rainfall series could be developed as (ending year is always 2006): the Western Himalaya 1844, the Northern Plains 1844, the Eastern Plains 1829, the Indo-Gangetic Plains 1829, the North Eastern Range 1848, the Western Plains 1861, the North Central Highlands 1844, the South Central Highlands 1844, the North Deccan 1826, the South Deccan 1835, the Eastern Plateaus 1848, the Western Hills 1829, the Eastern Hills 1852, the West Coastal Plains 1817 and the East Coastal Plains 1813. The recent trend in annual rainfall fluctuation over physiographic divisions is as: the Western Himalaya decrease since 1961, the Northern Plains decrease since 1999, the Eastern Plains increase since 1967, the Indo-Gangetic Plains decrease since 1999, the North Eastern Range increase since 1983, the Western Plains decrease since 1976, the North Central Highlands decrease since 1962, the South Central Highlands slight decrease since 1945, the North Deccan slight decrease since 1962, the South Deccan decrease since 1957, the Eastern Plateaus decrease since 1944, the Western Hills increase since 1966, the Eastern Hills increase since 1981, the West Coastal Plains decrease since 1962 and the East Coastal Plains increase since 1866. A quantitative-subjective approach to rainfall fluctuation analysis of 49 physiographic subdivisions/provinces suggested decrease in annual rainfall in recent years/decades over ~68% area of the country. Decline in winter and monsoon rainfalls over larger area is the main contributor to decrease in the annual rainfall. The summer and the post-monsoon rainfalls show increasing tendency over larger areas. Examination of geopotential height gradient of upper tropospheric isobaric levels from Tibetan Anticyclone region to southern tropical Indian Ocean region reveals a general decline in the intensity of the monsoon circulation from early 1960s which appears to be the main reason of decline in monsoon rainfall over the country.

1. INTRODUCTION

The physiography relates to the study of all the natural features on the earth's surface (landforms, climate, soil, vegetation, hydrology and distribution of flora and fauna) and delineation and description of regions from the viewpoint of landforms, including their origin and evolution, and the processes that shape them (Strahler, 1969). Surrounded between the parallels of 8°4′28″N and 37°17′53″N, and between the meridians of 68°7′53″E and 97°24′47″E a beehive-shaped India occupies geographical area of 3,287,263 sq. km. (including territorial sea) on the southern plank of the Asian landmass. The contiguous land area of the country is 3,279,501 sq. km; its north-south length is about 3,214 km and east-west breadth about 2,933 km. The land frontier is 15,200 km and the coastline 7,516.5 km. Andaman and Nicobar Islands in the Bay of Bengal and Lakshadweep in the Arabian Sea are parts of India. On the west of the country are Pakistan and Afghanistan, on the east Bangladesh and Burma, on the north Sinkiang province of China, Tibet, Nepal and Bhutan, and on the south Sri Lanka separated by a narrow channel of sea formed by the Palk Strait and the Gulf of Mannar. Physiography of the country shows large regional variations. There are seven mountain ranges- the Himalayas, the Patkai, the Vindhyas, the Satpura, the Aravalli, the Sahyadri and the Eastern Ghats. According to plate tectonics the Himalayas appear to have risen as a result of a collision between the northward drifting Indo-Australian plate at the rate of 6mm/year, and the relatively stable Eurasian plate about 50 million years ago. Its east-west extension is 2,500 km and covers an area of about 500,000 sq. km. World's highest peak Everest in the Himalayas is 8,848 m above sea level, and there are 10 more peaks rising above 7,500 km. Patkai and the mountain ranges along the Indo-Bangladesh-Burma Border have come into existence along with the Himalayas. The present Aravalli range is only a remnant of gigantic mountain system that existed in pre-historic time with several of its summits rising above the snow line and nourishing glaciers of stupendous magnitude which in turn fed many great rivers. Vindhyan range in central India is about 1,050 km long and its average elevation is some 300 metres. The range has been formed by the wastes created by weathering of the ancient Aravalli ranges. Satpura range with many of its peaks rising above 1000 metres near Ratnagiri extends for a distance of 900 km between the Narmada and Tapi rivers. Sahyadri (or Western Ghats) with an average height of 1,200 metres and length 1,600 km runs along the west coast of the Deccan Plateau between the river Tapi and Kanyakumari, the southern most point in India. The mountain range along the East Coast (or Eastern Ghats) is cut up by the powerful rivers into discontinuous blocks. Between the Godavari and Mahanadi rivers some of the peaks rise above 1,000 metres.

The main groups of the Indian soil types and their state-wise distribution are as follows (Raychaudhury et al. 1963): *Alluvial soil* (Andhra Pradesh, Assam, West Bengal, Bihar, Gujarat, Jammu and Kashmir, Kerala, Madhya Pradesh, Tamilnadu, Punjab, Rajasthan, Uttar Pradesh, Delhi and Tripura); *Black soil* (Andhra Pradesh, Gujarat, Madhya Pradesh, Tamilnadu, Maharashtra, Karnataka, Orissa, Rajasthan and Uttar Pradesh); *Red Soil* (Andhra Pradesh, Assam, West Bengal, Orissa, Rajasthan,

Uttar Pradesh and Manipur); *Laterite and Lateritic soil* (Assam, West Bengal, Kerala, Tamilnadu and Karnataka); *Mixed Red and Black soil* (Tamilnadu, Orissa, Rajasthan and Uttar Pradesh); *Coastal soil* (West Bengal, Maharashtra, Karnataka, Orissa and Pondicherry); *Teray soil* (West Bengal and Uttar Pradesh); *Gray and Brown soils* (Jammu and Kashmir); *Tea soil* (West Bengal); *Brown soil* (Jammu & Kashmir); *Podzolized soil* (Jammu & Kashmir); *Skeletal soil* (Madhya Pradesh); *Forest and Hill soils* (Tamilnadu, Tripura and Kerala); *Peaty soil* (Kerala); *Red and Grey soil* (Maharashtra); *Mixed Red, Yellow and Grey soils* (Karnataka); *Saline and Deltaic soils* (Orissa); *Red and Yellow soil* (Rajasthan and Tripura); *Saline and Alkali soils* (Uttar Pradesh); *Desert soil* (Rajasthan); *Mountain soil* (Jammu & Kashmir and Himachal Pradesh); and *Hill soil* (Jammu & Kashmir and Himachal Pradesh).

Natural ecosystems of the country display great diversity. The panorama of different forests spans over a wide range from evergreen tropical rain forests in the Andaman and Nicobar Islands to dry alpine scrub high in the Himalaya. One of the earliest forests classifications of Greater India is due to Champion (1936), which was later modified by Champion and Seth (1968) for present-day India. In their four-tier classification of the Indian forests types Champion and Seth (1968) suggested 6 major types, 16 groups, 20 subgroups and 221 micro-groups. The 6 major types (and 16 groups) and their distribution in the country are as: *Moist Tropical Forests* (Tropical Wet Evergreen Forests, Tropical Semi Evergreen Forests, Tropical Moist Deciduous Forests and Littoral and Swamp Forests) – extreme northeastern India, Brahmaputra Valley, northern Indo-Gangetic plains, Jharkhand, eastern Orissa, coastal Andhra Pradesh, Sahyadri Range, Rann of Kutch and coastal Tamilnadu; *Dry Tropical Forests* (Tropical Dry Deciduous Forests, Tropical Thorn Forests and Tropical Dry Evergreen Forests)– most part of the country excluding western Himalaya, northeast India, eastern plateau and Sahyadri range; *Montane Subtropical Forests* (Subtropical Broad-Leaved Hill Forests, Subtropical Pine Forests and Subtropical Dry Evergreen Forests)– Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Arunachal Pradesh, Nagaland, Manipur and Meghalaya; *Montane Temperate Forests* (Montane Wet Temperate Forests, Himalayan Moist Temperate Forests and Himalayan Dry Temperate Forests)– Arunachal Pradesh, Nagaland, Manipur, Mizoram, Uttaranchal, Himachal Pradesh and Jammu and Kashmir; *Subalpine Forests* and *Alpine Scrubs* (Sub-Alpine Forests, Moist Alpine Scrubs and Dry Alpine Scrubs)– Jammu and Kashmir, Himachal Pradesh and Uttaranchal. But the forest resource is fast depleting due to its overuse and misuse by modern civilized growing human population, about 25 crore in 1880 to more than 100 crore in 2001. Forest and other land use/land cover changes (LUCC) in the country as percentage of total geographical area from 1880 to 1980 are as: forest 20.35% to 12.27%; net cultivated 31.53% to 44.56%; built-up 1.17% to 3.15%; intermittent woods 11.9% to 7.61%; grasses 19.92% to 18.93%; barren land 11.31% to 9.49%; wetlands 1.98% to 1.27% and surface water 2.71% to 2.72%.

Due to large variation in intensity and frequency of rain-inducing disturbances (monsoon trough, monsoon/cyclonic storms/depressions, western disturbances, lows, thunderstorms, etc.) and summer and post monsoon circulations over different parts of the country rainfall occurrences exhibit large spatial variability. Hence areal representation of the areally-averaged rainfall series for the whole country is weak. Physiography of India has large diversity constituting plains, valleys, plateaus, scarplands, mountain ranges, basins, hills and peninsula. The Himalayan Mountains and the sea around the peninsula have a major role in maintaining the climate of the whole country by obstructing the monsoon winds and providing rain throughout the country as well as protecting from the cold winds which blow from the North. Orographic rainfall on windward side of mountain and hill ranges such as Aravalli, Sahyadri, Khasi and Jayanti hills play important role in isohyets over India giving wetter climate over windward side and drier/less wetter over the leeward side. The National Atlas & Thematic Mapping Organization (NATMO, 1986) has published a map of India 'Physiographic Regions' on the projection system '*Conical Equal Area Projection with two Standard Parallels*' and scale 1:6M showing boundary of physiographic divisions and subdivisions/provinces. Based on homogeneity in physiographic features the main land of the country is divided into 14 major divisions and 49 subdivisions/provinces. The divisions (and subdivisions/provinces) are as: The Western Himalaya (*North Kashmir Himalaya, South Kashmir Himalaya, Punjab Himalaya and Kumaun Himalaya*), The Eastern Himalaya, The Northern Plains (*Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains and Avadh Plains*), The Eastern Plains (*North Bihar Plains, South Bihar Plains, Bengal Plains and Bengal Basins*), The North Eastern Range (*Assam Valley, Meghalaya and Purvanchal*), The Western Plains (*Marusthali and Rajasthan Bagar*), The North Central Highlands (*Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar and Bundelkhand*), The South Central Highlands (*Malwa Plateau, Vindhyan Scarplands, Vindhya Range and Narmada Valley*), The North Deccan (*Satpura Range and Maharashtra Plateau*), The South Deccan (*Karnataka Plateau and Telangana Plateau*), The Eastern Plateaus (*Baghelkhand Plateau, Chhotanagpur Plateau, Mahanadi Basin, Garhjat Hills and Dandakaranya*), The Western Hills (*North Sahyadri, Central Sahyadri, South Sahyadri and Nilgiri Hills*), The Eastern Hills (*Eastern Ghats (north), Eastern Ghats (south) and Tamilnadu Uplands*), The West Coastal Plains (*Kutch Peninsula, Kathiawar Peninsula, Gujarat Plains, Konkan, Karnataka Coast and Kerala Plains*) and The East Coastal Plains (*Utkal Plains, Andhra Plains and Tamilnadu Plains*). The combined area of the Northern Plains and the Eastern Plains is known as the Indo-Gangetic Plains (IGPs) and is also considered additionally in this study as major physiographic division. Paralleling the Southern Himalayan Province, the IGPs are very important for food security of the south Asia. Due to large physiographic diversity coupled with large rainfall diversity a wide spectrum of natural and man-made fresh-water bodies (94 wetlands, 4291 dams and reservoirs, 500,000 minor irrigation tanks and ponds, and numerous canals, beels, oxbow lakes, abandoned quarries and derelict water) occur across the country. Development, management and

conservation of these water bodies are highly dependent upon rainfall variability. Long period area-average rainfall series of physiographic regions (units) provides vital input to the study on influence of rainfall variability on land formation, flora and fauna, as well as environmental consequences of dynamics of wetland, dryland, desert, forest, grassland, drainage etc. Studies have documented rainfall fluctuation characteristics for administrative (states), meteorological sub-divisions and hydrologic units (basins/catchments) of the country but perhaps none for physiographic units. The sole objective of the present report is to document detailed characteristics of annul, seasonal and monthly rainfall variations over different physiographic regions (divisions as well as subdivisions/provinces) of the country using longest available instrumental records from a dense network of raingauge stations.

2. RAINFALL DATA USED

Instrumental monthly rainfall data from a well spread network of 316 raingauge stations from earliest available year up to 2006 is used in the present study. For the period 1901-2006 all the 316 stations data available is used. Prior to 1901 the number of available stations from this network progressively decreases back in time- decreases to 314 raingauges up to 1900, to 312 up to 1871, to 196 up to 1870, to 101 up to 1861, to 80 up to 1860, to 70 up to 1851, to 60 up to 1846, to 57 up to 1844, to 13 up to 1842, to 6 up to 1829, to 4 (Chennai, Mumbai, Pune and Nagpur) up to 1826, to 2 (Chennai and Mumbai) up to 1817 and to lone station Chennai up to 1813. Missing observation in the continuous data sequence has been filled by the ratio method (Rainbird, 1967) using nearest available observation as reference value. Number of filled values is less than 2% of the total number of monthly rainfall records. Data up to 1900 is obtained from the India Meteorological Department (IMD) publication '*Monthly and Annual Rainfall of 457 Stations in India to the End of 1900*' (Eliot, 1902), and for the 1901-2006 period from the National Data Center and Hydrology Section of the IMD, Pune. An account of this dataset is described by Mooley and Parthasarathy (1984).

Blanford (1886) checked the reliability of then available data by applying two types of tests. First, he compared the average and variation of the earlier years at any given station with those of the last 10-12 years, during which much more care and attention had been given to rainfall registration. Second, he compared the variation in corresponding years and months between neighboring stations situated under approximately similar conditions. Records which failed to satisfy either of the above tests were rejected. He concluded that selected data were 'free from any serious error'. To compile and publish rainfall data for all the gauges over British India up to 1900 AD, Eliot (1902) also checked them thoroughly, but he did not mention the method employed. Regarding reliability of rainfall data of the Indian region, Walker (1910) had stated that 'long established observatories like Madras (Chennai), Bombay (Mumbai) and Calcutta (Kolkata) which have rainfall records available for earlier periods in the nineteenth century are trustworthy'.

3. DATA CREATED USING GIS

The National Atlas & Thematic Mapping Organization (NATMO, 1986) has prepared a map of India 'Physiographic Regions' on '*Conical Equal Area Projection with two Standard Parallels*' projection system and 1:6M scale showing boundary of physiographic divisions and provinces. The country has been divided into 14 physiographic divisions and 49 provinces. We have digitized the map of India 'Physiographic Regions' in four layers, i) all-India boundary; ii) boundaries of physiographic divisions; iii) boundaries of physiographic provinces; and iv) location of 316 raingauge stations. The physiographic divisions and provinces have been labeled by appropriate names and area of each physiographic division and province has been measured by creating attributes (Figure 1). Stations in different physiographic divisions and provinces out of total 316 available raingauge stations over the country have been identified with this map for development of longest rainfall series. The map is prepared using GeoMedia Professional 5.1 Geographic Information System (GIS) software package.

4. THE METHODS- DEVELOPMENT OF LONGEST RAINFALL SEQUENCE

Longest instrumental area-averaged annual, seasonal and summer monsoon monthly rainfall series for different physiographic regions (divisions/ subdivisions/provinces) have been developed in two parts: (i) simple arithmetic mean for the period with all available observations from the selected network and (ii) construction by applying established objective method for the period with lesser available observations. The complete process is described step by step for the Western Himalaya. In this region rainfall observation started in 1844 at Dehradun, in 1849 at Nainital, in 1853 at Dharamsala, in 1862 at Simla, in 1864 at Pithoragarh, in 1868 at Kulu, in 1889 at Joshimath, in 1891 at Srinagar and in 1901 at Jammu and Udhampur. Thus the monthly rainfall data for 10 stations is available from 1901 onwards. The computational steps are as follows (Singh, 1994; Wigley et al., 1984, Sontakke et al. 2008):

1. Prepare the area-averaged annual rainfall series for the period 1901-2006 of the Western Himalaya through simple arithmetic mean of all the 10 raingauges in the region;
2. Prepare the mean annual rainfall series (1901-2000) of the 8 raingauges for which the annual rainfall observations extend back to 1891;
3. Estimate the linear regression ($Y = a + bX$) of the representative 10-gauge mean series $\{Y_i\}$ on the 8-gauge mean series $\{X_i\}$ based on the period 1901-2000;

   (All constructions in this report have been done with respect to the '*reference period*' 1901-2000.)

Theoretically derived mathematical expression for the correlation ($R_{m,M}$) between M-gauge mean rainfall series and m-gauge mean series (m is a subset of M) is given by (Wigley et al., 1984):

$$R_{m,M} = \frac{1}{m\, s(m)} \sum_{i=1}^{m} s_i r_{i,M}$$

In the present example M is 10 and m is 8; s (m) is the standard deviation of the 8-gauge (here m = 8) mean series; s_i is the standard deviation of each of the 8 series; $r_{i,M}$ the correlation coefficient between each of the 8 gauge series and the M-gauge mean series. The correlation coefficientdirectly calculated between 10-gauge mean series (Y_i) and the 8-gauge mean series (X_i) and that calculated with the above equation were found equal.

4. Substitute the mean annual rainfall of the 8 gauges available during 1900 in the regression and estimate the representative mean annual rainfall for the Western Himalaya for the year 1900;
5. Inflate the variance of the estimated rainfall amount of the year 1900 by dividing its departure from long term mean by the correlation coefficient between 10-gauge mean series (1901-2000) and the corresponding 8-gauge mean series ($R_{8,10}$), and get the constructed mean annual rainfall of the Western Himalaya for the year 1900 (Klein et al., 1959);
6. Repeat the above process to estimate the rainfall of each of the four seasons (winter JF, summer MAM, monsoon JJAS and post-monsoon OND) for the year 1900;
7. Check if total of the estimated four seasonal rainfalls is equal to the estimated annual rainfall amount;
8. For any discrepancy between the two rainfall figures (generally of few mms) proportionately increase/decrease the seasonal rainfall amounts to get their finally constructed amounts; and
9. Estimate the monthly rainfall for June, July, August and September in a similar way, compare them with corresponding constructed monsoon (JJAS) rainfall amount, and get the constructed monsoon monthly rainfalls after suitable correction for the year 1900.
10. Take up the year 1899, 1898 ------ 1891 and repeat the above process sequentially.
11. Repeat the whole procedure depending on available number of gauges for each year of the period 1889-1890 ($R_{7,10}$), 1868-1888 ($R_{6,10}$), 1864-1867 ($R_{5,10}$), 1862-1863 ($R_{4,10}$), 1853-1861 ($R_{3,10}$), 1849-1852 ($R_{2,10}$) and 1844-1848 ($R_{1,10}$).

The correlation coefficient $R_{m,M}$ is an indicator of reliability of the constructed rainfall amount. The constructed amount is retained if $R_{m,M}$ exceeded the 5% statistical significance level otherwise rejected. In general for the constructed rainfall amount of the period 1813-1900 the $R_{m,M}$ ranged from 0.71 to 0.99. Especially in early years in very few cases the $R_{m,M}$ is weak (statistically significant but less than 0.7) when very few stations are available. In the absence of any quantitative data these constructed values based on instrumental observations could provide vital information.

5. PHYSICAL FEATURES AND LONGEST RAINFALL SEQUENCE OF DIFFERENT PHYSIOGRAPHIC DIVISIONS AND SUBDIVISIONS/ PROVINCES

For the 15 major, 49 subdivisions/provinces and all-India the longest rainfall sequences have been prepared up to 2006. Construction details for each region have been described. Area measured by the GeoMedia GIS Package, the mean annual PE, the mean annual rainfall, the seasonal rainfall as percent of annual rainfall, the annual number of rainy days and starting date, ending date and duration of the climatological rainy season are also given. Number of rainy days is the days with rainfall greater than 2.5mm (IMD, 1961) and rainy season is the 'continuous period with monthly rainfall greater than 50mm' (Singh, 1986). Abstract statistics (mean, median, standard deviation, coefficient of variation and the quintiles) for the rainfall series of 15 major, 49 subdivisions/ provinces and all-India based on the period 1901-2000 are tabulated in Table 1 to Table16 for the benefit of the users. Mean is measure of central tendency, standard deviation and coefficient of variation gives the nature of variability while quintiles are measures of the frequency distribution which divides the rainfall sequence into five equal parts. The table also lists the Index of Areal Representativeness (IAR), the mean correlation coefficient (CC) between the area-averaged series and the individual stations ($\bar{R}$) and the mean of CC between all possible combinations of raingauges that are averaged ($\bar{r}$)**.** The IAR is defined as the ratio of 'variance of area-averaged rainfall series' and the 'mean variance of the individual rainfall series averaged' expressed in percentage and it provides a measure of spatial representation of the area averaged rainfall series (Singh, 1994). The mathematical expression is:

$$IAR = \frac{S_R^2}{(1/M)\sum_{i=1}^{M} s_i^2} \times 100$$

$$\text{i.e.} \quad IAR = \frac{\text{variance of the area-averaged rainfall series}}{\text{mean variance of the rainfall series of all stations}} \times 100$$

The $\bar{R}$ is also an indicator of areal representation of area-averaged rainfall series and is very useful in theoretical derivation dealing with the problem of rainfall spatial variability. The $\bar{r}$ is a measure of spatial coherency in the rainfall field. The inverse of $\bar{r}$ provides a broad idea of number of observations optimally required to prepare that particular representative area-averaged rainfall series.

By applying subjective judgemental approach on the time series plots of the actual values, the 9-point Gaussian low-pass filtered values (Figure 2 to Figure 66) as well as Cramer's t_k statistic applied on 31-term running means, chief features of the rainfall fluctuations over the longest available period are deduced. In general, over the

period of available records rainfall fluctuation showed mostly 2-4 tendencies in combination of increase, decrease and no trend. Details of the tendencies are given for the individual regions in the following sub-sections. The recent rainfall tendency in rainfall fluctuations across the country are analyzed further.

The Western Himalaya (area: 308,486 km^2; mean annual potential evapotranspiration (PE): 1005.6mm; mean annual rainfall: 1562.1mm- winter 10.1%, summer 12.5%, monsoon 71.6% and post-monsoon 5.8%; annual rainy days: 76.1; rainy season: start- 28th June, end- 22nd September and duration- 238 days)- The physiographic division is composed of the states of the Uttaranchal, the Himachal Pradesh and the Jammu & Kashmir states. Earliest monthly rainfall record for Dehradun is available from 1844; and the continuous data for 10 stations is available since 1901. Longest area-averaged annual, seasonal and monsoon monthly rainfall series of the region could be developed for the period 1844-2006. The actual series along with 9-point Gaussian low-pass filtered values are shown in Figure 2. Important statistics of the rainfall series are given in Table 1. Chief features of the rainfall fluctuations are: annual-1845-1894 increase, 1895-1902 decrease, 1903-1960 increase, 1961-2006 decrease; winter-1845-1893 increase, 1894-1963 decrease, 1964-2006 increase; summer-1845-1938 decrease, 1938-2006 increase (1983-2006 above normal but decreasing tendency); summer monsoon-1844-1960 increase, 1961-2006 decrease; post-monsoon-1844-2006 increase; June- 1844-2006 decrease; July-1844-1959 increase, 1960-2006 decrease; August-1844-1885 increase, 1886-2006 decrease; and September-1844-1961 increase, 1962-2006 decrease. There are 4 provinces in the division. Rainfall data for North Kashmir Himalaya (151,418 sq. km) is not available. For other 3 provinces details are given below.

South Kashmir Himalaya (area: 54,538 km^2; annual PE: 874.0 mm; mean annual rainfall: 1084.4 mm- winter 15.7%, summer 19.8%, monsoon 56.3% and post-monsoon 8.2%; annual rainy days: 57.9; rainy season-I: start- 18th January, end- 7th April and duration- 80 days; rainy season-II: start- 27th June, end- 14th September and duration-80 days) is in the southwestern part of the Western Himalaya. From the selected network of three stations earliest monthly rainfall record for *Srinagar* is available from 1891 and for the other two stations (*Jammu and Udhampur*) from 1901. Longest rainfall sequence of the province could be developed for the period 1891-2006. The actual and filtered rainfall series (9-point Gaussian low-pass filter) are displayed in Figure 3. The important statistics of the actual series are given in Table 1. Chief features of the rainfall fluctuations are: annual- 1893-1937 decrease, 1938-1959 increase, 1960-1971 decrease, 1972-1996 increase, 1997-2006 decrease; winter- 1893-1963 decrease, 1964-2006 increase; summer- 1893-1971stationary but below normal, 1972-1983 increase, 1984-2006 decrease; summer monsoon- 1893-1959 increase, 1960-2006 decrease; post-monsoon- 1893-2006 increase; June- 1893-1960 decrease, 1961-2006 increase; July- 1893-1959 increase, 1960-2006 decrease; August- 1891-1955 increase, 1956-2006 decrease; and September- 1891-1954 increase, 1955-2006 decrease.

Punjab Himalaya (area: 55,020 km^2; annual PE: 870.8 mm; mean annual rainfall: 1820.1 mm - winter 10.5%, summer 12.5%, monsoon 71.5% and post-monsoon 5.5%; annual rainy days: 86.3; rainy season: start- 18th January, end- 23rd September & duration- 249 days) is essentially the Himachal Pradesh state. Earliest rainfall record of Dharamsala is available from 1853. The data for all the three stations of the selected network (*Dharamsala, Kulu and Simla)* is available from 1868. Longest rainfall sequence could be developed for the period 1853-2006. The actual and filtered series are shown in Figure 4. The important statistics of the rainfall sequences are given in Table 1. Chief features of the rainfall fluctuations are: annual- 1862-1967 increase, 1968-2006 decrease; winter-1862-2006 decrease; summer-1862-1921 decrease, 1922--2006 increase; summer monsoon- 1861-1907 decrease, 1908-1967 increase, 1968-2006 decrease; post-monsoon- 1861-2006 stationary; June-1861-2006 decrease; July-1861-1911 decrease, 1912-1967 increase, 1968-2006 decrease; August- 1861-2006 decrease; and September- 1861-1966 increase, 1967-2006 decrease.

Kumaun Himalaya (area: 47,517 km^2; annual PE: 1072.2 mm; mean annual rainfall: 1726.8 mm- winter 7.3%, summer 9.1%, monsoon 78.7% and post-monsoon 4.9%; annual rainy days: 82.1; rainy season-I: start- 27th January, end- 6th March and duration- 39 days; rainy season-II: start- 27th May, end- 30th September & duration- 127 days) is confined to the state of Uttaranchal. Earliest record for Dehradun is available from 1844. Continuous records for all 4 stations of the selected network (*Dehradun, Joshimath, Pithoragarh and Nainital*) are available from 1889. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered series are displayed in Figure 5. The important statistics of the rainfall sequences are given in Table 1. Chief features of the rainfall fluctuations are: annual- 1845-1954 increase, 1955-2006 decrease; winter- 1845-1898 increase, 1899-2006 decrease; summer- 1845-1937 stationary, 1938-2006 increase; summer monsoon- 1844-1936 increase, 1937-2006 decrease; post-monsoon- 1844-1956 increase, 1957-2006 decrease; June- 1844-2006 decrease; July- 1844-1934 increase, 1935-2006 decrease; August- 1844-1885 increase, 1886-2006 decrease; and September- 1844-1972 increase, 1973-2006 decrease.

The Northern Plains (area: 291,998 km^2; annual PE: 1484.2 mm; mean annual rainfall: 846.8 mm- winter 4.8%, summer 4.5%, monsoon 85.3% and post-monsoon 5.4%; annual rainy days: 41.4; rainy season: start- 19th June, end- 20th September and duration- 94 days)- The combined area of the Punjab, the Haryana and the Uttar Pradesh states is called the northern plains. Due to occurrence of persistent droughts rainfall observations at large number of stations in the plains started in 1844. The monthly rainfall data for 32 stations in the region is available since then. The data of additional 31 stations became available from 1871. Thus the total of 63 stations is available from 1871. Representative area-averaged rainfall sequence could be developed for the period 1844-2006. The actual and filtered series are displayed in Figure 6. The important statistics of the rainfall sequences are given in Table 2. Chief features of the rainfall fluctuations are as: annual- 1844-1998 increase, 1999-2006 decrease; winter- 1844-1941 stationary, 1942-1967 decrease, 1968-2006 increase; summer- 1844-1972 decrease,

1973-2006 increase; summer monsoon- 1844-1975 increase, 1976-2006 decrease; post-monsoon- 1844-1956 increase, 1957-2006 stationary; June- 1844-1965 decrease, 1966-2006 increase; July- 1844-1911 decrease, 1912-1980 increase, 1981-2006 decrease; August- 1844-1961 increase, 1962-2006 decrease; and September- 1844-2006 increase. There are 4 provinces in the division.

Punjab Plains (area: 85,222 km^2; annual PE: 1482.7 mm; mean annual rainfall: mm- winter 7.6%, summer 7.3%, monsoon 80.1% and post-monsoon 5.0%; annual rainy days: 31.8; rainy season: start- 30th June, end- 15th September and duration- 78 days) is the combined area of the Punjab and the Haryana states. The rainfall data of 7 stations (*Hissar, Gurgaon, Rohtak, Delhi, Ferozpur, Sirsa and Karnal*) are available from 1844; 15 more stations (*Ludhiana, Ambala, Jullunder, Gurudaspur, Hosharpur, Amritsar, Moga , Rupar, Ranike, Patiala, Kaithal, Jind, Sonepat, Bhiwani and Jatusana*) were added to the network in 1871. Representative rainfall sequence could be developed for the period 1844-2006. The actual and filtered series are displayed in Figure 7. The important statistics of the rainfall sequences are given in Table 2. Chief features of the rainfall fluctuations are: annual- 1844-1939 decrease, 1940-1974 increase, 1975-2006 decrease; winter- 1844-1872 decrease, 1873-1893 increase, 1894-1963 decrease, 1964-2006 increase; summer- 1844-1958 decrease, 1959-2006 increase; summer monsoon- 1844-1899 decrease, 1900-1974 increase, 1975-2006 decrease; post-monsoon- 1844-2006 stationary; June- 1844-1947 decrease, 1948-2006 increase; July- 1844-1911 decrease, 1912-1980 increase, 1981-2006 decrease; August- 1844-1937 stationary but mostly below normal, 1938-1976 increase, 1977-2006 decrease; and September- 1844-1945 increase, 1946-2006 decrease.

Ganga-Yamuna Doab (area: 69,791 km^2; annual PE: 1514.4 mm; mean annual rainfall: 802.8 mm- winter 4.4%, summer 3.7%, monsoon 86.6% and post-monsoon 5.3%; annual rainy days: 40.1; rainy season: start- 23rd June, end- 20th September and duration- 90 days) is a narrow strip on both sides of the Ganga River between Dehra Dun and Allahabad. The data of 15 stations (*Saharanpur, Muzaffarnagar, Delhi, Bulandshahar, Meerut, Aligarh, Mathura, Agra, Mainpuri, Farukhabad, Etawah, Kanpur, Hamirpur, Fatehpur and Allahabad*) is available from 1844; and one more station (*Etah*) ads to the network in 1860. Representative area-averaged rainfall series could be developed for the period 1844-2006. The actual and filtered series are displayed in Figure 8. The important statistics of the rainfall sequences are given in Table 2. Chief features of the rainfall fluctuations are: annual- 1844-1894 increase, 1895-1905 decrease, 1906-1961 increase, 1962-2006 decrease; winter- 1844-1861 decrease, 1962-1954 increase, 1955-2006 decrease; summer- 1844-1960 decrease, 1961-2006 increase; summer monsoon- 1844-1888 increase, 1889-1905 decrease, 1906-1961 increase, 1962-2006 decrease; post-monsoon- 1844-1956 increase, 1957-2006 decrease; June- 1844-1965 decrease, 1966-2006 increase; July- 1844-1888 increase, 1889-1911 decrease, 1912-1977 increase, 1978-2006 decrease; August- 1844-1961 increase, 1962-2006 decrease; and September- 1844-2006 increase.

Rohilkhand Plains (area: 49,486 km^2; annual PE: 1422.1 mm; mean annual rainfall: 1028.3 mm- winter 4.3%, summer 4.2%, monsoon 85.8% and post-monsoon 5.7%; annual rainy days: 45.6; rainy season: start- 14th June, end- 22nd September and duration- 102 days) is in northwestern parts of the Uttar Pradesh. Once upon a time this area was ruled by the Afghan Rohillas. The rainfall data of 5 stations (*Bijnor, Moradabad, Badaun, Barelli and Shahajahanpur*) is available from 1844; for *Pilibhit* the data became available from 1864 and for another 3 stations (*Kheri, Sitapur and Hardoi)* from 1867. Longest reliable rainfall sequence could be developed for the period 1844-2006. The actual and filtered series are displayed in Figure 9. The important statistics of the rainfall sequences are given in Table 2. Chief features of the rainfall fluctuations are: annual- 1860-1894 increase, 1895-1905 decrease, 1906-1960 increase, 1961-2006 decrease; winter- 1860-2006 stationary; summer- 1860-1954 decrease, 1955-2006 increase; summer monsoon- 1860-1890 increase, 1891-1905 decrease, 1906-1960 increase, 1961-2006 decrease; post-monsoon- 1860-1960 increase, 1961-2006 decrease; June-1860-1959 decrease, 1960-2006 increase; July- 1860-2006 decrease; August- 1860-1894 increase, 1895-1913 decrease, 1914-1961 increase, 1962-2006 decrease; and September- 1860-2006 stationary.

Avadh Plains (area: 87,499 km^2; annual PE: 1473.7 mm; mean annual rainfall: 1048.5 mm- winter 3.1%, summer 3.1%, monsoon 88.2% and post-monsoon 5.6%; annual rainy days: 51.0; rainy season: start- 14th June, end- 23rd September and duration- 103 days) is the eastern part of the Uttar Pradesh state, north of the Ganga River. The rainfall data of 7 stations (*Gorakhpur, Jaunpur, Azamgarh, Allahabad, Mirzapur, Varanasi and Ghazipur*) is available from 1844; and for 12 more stations (*Basti, Rai Bareilly, Faizabad, Bahraich, Unao, Lucknow, Nawabganj, Sultanpur, Pratapgarh, Gonda, Deoria and Ballia*) it became available from 1871. Reliable representative rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 10. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are: annual- 1844-1980 stationary, 1981-2006 decrease; winter- 1844-1942 stationary, 1943-2006 decrease; summer- 1844-1924 decrease, 1925-2006 increase; summer monsoon- 1844-1980 stationary, 1981-2006 decrease; post-monsoon- 1844-2006 decrease; June- 1844-1959 decrease, 1960-2006 increase; July- 1844-1980 stationary, 1981-2006 decrease; August- 1844-1938 increase, 1939-2006 decrease; and September- 1844-1982 increase, 1983-2006 decrease.

The Eastern Plains (area: 162,434 km^2; annual PE: 1372.7 mm; mean annual rainfall: 1460.4 mm- winter 2.4%, summer 10.4%, monsoon 79.1% and post-monsoon 8.1%; annual rainy days: 71.2; rainy season: start- 17th May, end- 15th October and duration- 152 days)– The combined area of the Bihar and the West Bengal states is referred to as the Eastern Plains. Earliest rainfall record of Kolkata is available from 1829. The data of all the 26 stations from the selected network is available from 1871. Longest rainfall sequence for the division could be developed for the period 1829-2006. The actual and filtered rainfall series are displayed in Figure 11. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are as: annual- 1829-1913 increase, 1914-1966 decrease, 1967-2006 increase;

winter-1829-1937 increase, 1938-2006 decrease; summer- 1829-1957 decrease, 1958-2006 increase; summer monsoon- 1829-1922 increase, 1923-1966 decrease, 1967-2006 increase; post-monsoon- 1829-1907 decrease, 1908-2006 increase; June-1829-1913 increase, 1914-1972 decrease, 1973-2006 increase; July- 1829-1926 increase, 1927-1961 decrease, 1962-2006 increase; August- 1829-1941 increase, 1942-2006 decrease; and September- 1829-2006 increase. There are 4 provinces in the division.

North Bihar Plains (area: 48,929 km^2; annual PE: 1393.5 mm; mean annual rainfall: 1213.8 mm- winter 2.3%, summer 6.7%, monsoon 84.6% and post-monsoon 6.4%; annual rainy days: 57.2; rainy season: start- 30th May, end- 7th October and duration- 131 days) is the northern part of the Bihar state, north of the Ganga River. For *Patna* the rainfall data is available from 1842. The data for 9 more stations (*Muzaffarpur, Bhagalpur, Motihari, Chapra, Madhipura, Purnea, Ballia, Darbhanga and Deoria)* became available from 1871. Longest rainfall sequence of the province could be developed for the period 1842-2006. The actual and filtered rainfall series are displayed in Figure 12. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are: annual- 1842-1899 increase, 1900-1967 decrease, 1968-1987 increase, 1988-2006 decrease; winter- 1841-1942 increase, 1943-2006 decrease; summer- 1842-1886 stationary, 1887-1957 decrease, 1958-2006 increase; summer monsoon- 1842-1922 increase, 1923-1958 decrease, 1959-1987 increase, 1988-2006 decrease; post-monsoon- 1842-1920 decrease, 1921-1977 increase, 1978-2006 decrease; June- 1842-1908 stationary but above normal, 1909-1972 decrease, 1973-2006 increase; July- 1842-1941 stationary, 1942-1981 increase,1982-2006 decrease; August- 1842-1914 increase, 1915-2006 decrease; and September- 1842-1920 stationary, 1921-2006 decrease.

South Bihar Plains (area: 35,080 km^2; annual PE: 1518.4 mm; mean annual rainfall: 1141.1 mm- winter 3.1%, summer 5.3%, monsoon 84.8% and post-monsoon 6.8%; annual rainy days: 58.0; rainy season: start- 11th June, end- 7th October and duration- 119 days) is the southern part of the Bihar state, south of the Ganga River. Patna is the earliest available from 1842; it is situated at the boundary of North Bihar and South Bihar plains, hence considered in both the regions. The data of all 5 stations of the selected network (*Patna, Bhagalpur, Gaya, Arrah and Jamui)* is available from 1870. Longest rainfall series could be developed for the period 1842-2006. The actual and filtered rainfall series are displayed in Figure 13. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are: annual- 1842-1899 increase, 1900-1966 decrease, 1967-1987 increase, 1988-2006 decrease; winter- 1842-1957 increase, 1958-2006 decrease; summer- 1842-1924 decrease, 1925-2006 increase; summer monsoon- 1842-1918 increase, 1919-1958 decrease, 1959-1987 increase, 1988-2006 decrease; post-monsoon- 1842-1907 decrease, 1908-1961 increase, 1962-2006 decrease; June- 1842-1909 increase, 1910-1960 decrease, 1961-2006 increase; July- 1842-1923 stationary, 1924-1958 decrease, 1959-2006 increase; August- 1842-1935 increase, 1936-2006 decrease; and September- 1842-2006 stationary.

Bengal Plains (area: 16,523 km^2; annual PE: 1131.3 mm; mean annual rainfall: 2521.9 mm- winter 1.1%, summer 13.6%, monsoon 79.3% and post-monsoon 6.0%; annual rainy days: 96.7; rainy season: start- 19th April, end- 19th October and duration- 184 days) is bounded by Sikkim in the north, Bangladesh in the south and Assam in the east. Earliest rainfall data is available for *Darjeeling* from 1837; the data for 4 more stations (*Malda, Jalpaiguri, Cooch Bihar and Itahar*) became available from 1871. Longest rainfall sequence could be developed for the period 1837-2006. The actual and filtered rainfall series are displayed in Figure 14. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are: annual- 1860-1916 increase, 1917-1978 decrease, 1979-1997 increase, 1998-2006 decrease; winter- 1860-1956 stationary, 1957-1967 decrease, 1968-2006 increase; summer- 1860-1937 stationary, 1938-1957 decrease, 1958-2006 increase; summer monsoon- 1860-1916 increase, 1917-1978 decrease, 1979-1997 highly oscillating, 1998-2006 decrease; post-monsoon- 1860-1900 decrease, 1901-1968 increase, 1969-1997 decrease, 1998-2006 increase; June- 1860-1895 decrease, 1896-1909 increase, 1910-2006 decrease; July- 1860-1931 highly oscillating, 1932-1985 increase, 1986-2006 decrease; August- 1860-2006 decrease; and September- 1860-1919 stationary but above normal, 1920-1957 decrease, 1958-1994 increase, 1995-2006 decrease.

Bengal Basin (area: 61,902 km^2; annual PE: 1453.8 mm; mean annual rainfall: 1534.1 mm- winter 2.5%, summer 12.7%, monsoon 75.0% and post-monsoon 9.8%; annual rainy days: 78.9; rainy season: start- 14th May, end- 18th October and duration- 158 days) is in the southern part of the West Bengal state. Earliest rainfall record for *Kolkata* is available from 1829; the data for 11 more stations (*Bankura, Malda, Suri, Hooghly, Midnapur, Burdwan, Krishnanagar, Sagar Island, Howrah, Baripada and Berhampore)* became available from 1871. Longest rainfall sequence could be developed for the period 1829-2006. The actual and filtered rainfall series are displayed in Figure 15. The important statistics of the rainfall sequences are given in Table 3. Chief features of the rainfall fluctuations are: annual- 1829-1940 stationary, 1941-1962 decrease, 1963-2006 increase; winter- 1829-2006 stationary; summer- 1829-1913 stationary, 1914-1957 decrease, 1958-2006 increase; summer monsoon- 1829-1961 stationary, 1962-2006 increase; post-monsoon- 1829-1861 increase, 1862-1908 decrease, 1908-1948 increase, 1949-1981 decrease, 1982-2006 increase; June- 1829-1913 increase, 1914-2006 decrease; July- 1829-2006 increase; August- 1829-1996 stationary, 1997-2006 decrease; and September- 1829-1922 stationary, 1923-2006 increase.

The Indo-Gangetic Plains (area: 454,431 km^2; annual PE: 1431.7 mm; mean annual rainfall: 1025.7 mm- winter 3.8%, summer 7.0%, monsoon 82.7% and post-monsoon 6.5%; annual rainy days: 51.2; rainy season: start- 13th June, end- 30th September and duration- 110 days) – The combined area of the northern plains and the eastern plains is called Indo-Gangetic plains. The area is very important for Indian summer monsoon studies as well as for the food security of south Asia. Earliest rainfall record is available for *Kolkata* from 1829; *Bankura* started in 1831, *Patna* in 1842 and for 32 stations (*Mainpuri, Gorakhpur, Jaunpur, Mirzapur, Varanasi, Ghazipur, Azamgarh, Farrukhabad, Etawah, Kanpur, Hamirpur, Fatehpur, Allahabad, Bijnor,*

Moradabad, Bareilly, Budaun, Shahjahanpur, Gurgaon, Rohtak, Saharanpur, Muzaffarnagar, Meerut, Delhi, Bulandshahar, Aligarh, Mathura, Agra, Firozpur, Karnal, Sirsa and Hissar) from 1844. The data for 55 more stations became available as follows: for 5 stations (*Muzaffarpur, Bhagalpur, Malda, Suri and Berhampore*) from 1848, for 4 stations (*Motihari, Chapra, Arrah, Gaya)* from 1849, for 2 stations (*Ludhiana, Ambala*) from 1850, for *Jalandhar* from 1852, for 2 stations (*Hoogly, Midnapore)* from 1854, for 2 stations (*Gurudaspur, Hoshiarpur)* from 1857, for 3 stations *(Amritsar, Etah, Burdwan)* from 1860, for *Krishnanagar* from 1861, for *Pilibhit* from 1864, for *Basti* from 1866, for 12 stations *(Hardoi, Faizabad, Sitapur, Pratapgarh, Kher, Sitapur, Lucknow, Bahraich, Nawabgunj, Unnao, Rai-Bareilly and Sagar Island*) from 1867, for 2 stations (*Howrah and Gonda)* from 1868, for 2 stations *(Jalpaiguri and Chaibassa*) from 1869, for 3 stations (*Madhipura, Jamui and Purnea)* from 1870, and 14 stations (*Moga, Rupar, Patiala, Ranike, Kaithal, Bhiwani, Jind, Jatusana, Sonepat, Deoria, Ballia, Darbhanga, Itahar and Baripada*) from 1871. In all data for 90 stations from selected network is available from 1871. Longest rainfall sequence could be developed for the period 1829-2006. The actual and filtered rainfall series are displayed in Figure 16. The important statistics of the rainfall sequences are given in Table 4. Chief features of the rainfall fluctuations are: annual- 1829-1998 increase, 1999-2006 decrease; winter- 1829-1942 increase, 1943-1964 decrease, 1965-1995 increase, 1996-2006 decrease; summer- 1829-1922 decrease, 1923-2006 increase; summer monsoon- 1829-1890 increase, 1891-1907 decrease, 1908-1998 increase, 1999-2006 decrease; post-monsoon- 1829-2006 stationary; June- 1829-1958 decrease, 1959-2006 increase; July- 1829-1861 increase, 1862-1911 decrease, 1912-1980 increase, 1981-2006 decrease; August- 1829-1855 decrease, 1856-1995 increase, 1996-2006 sudden decrease; and September- 1829-2006 stationary.

The North Eastern Range (area: 194,803 km^2; annual PE: 1093.0 mm; mean annual rainfall: 2287.0 mm- winter 2.1%, summer 24.3%, monsoon 65.1% and post-monsoon 8.5%; annual rainy days: 114.4; rainy season: start- 22nd March, end- 21st October and duration- 214 days) – The North Eastern India excluding the Arunachal Pradesh State is called as the North Eastern Range. Rainfall observation for 5 stations (*Silchar, Dibrugarh, Sibsagar, Nowgong and Guwahati)* is available from 1848; *Goalpara and Tezpur* stations were included in the network in 1849, *Shillong* in 1866, *Tura* in 1870, and 5 more stations (*Kohima, Imphal, Haflong, Agartala and Demagiri*) in 1871. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 17. The important statistics of the rainfall sequences are given in Table 5. Chief features of the rainfall fluctuations are as: annual- 1848-1947 stationary, 1948-1982 decrease, 1983-2006 increase; winter- 1848-1978 decrease, 1979-1993 increase, 1994-2006 decrease; summer- 1848-1947 stationary, 1948-1960 decrease, 1961-2006 increase; summer monsoon- 1848-2006 decrease; post-monsoon- 1848-1887 decrease, 1888-2006 increase; June- 1848-1896 decrease, 1897-1934 increase, 1935-2006 decrease; July- 1848-1859 increase, 1860-1887 decrease, 1888-1974 increase, 1975-2006 decrease; August- 1848-1905 increase, 1906-2006 decrease; and September- 1848-1878 increase, 1879-1962 decrease, 1963-1987 increase, 1988-2006 decrease. There are 3 provinces in the division.

Assam Valley (area: 56,756 km^2; annual PE: 1143.4 mm; mean annual rainfall: 2196.1 mm- winter 2.3%, summer 25.0%, monsoon 65.8% and post-monsoon 6.9%; annual rainy days: 109.6; rainy season: start- 23rd March, end- 18th October and duration- 210 days) is the Indian part of the Bramhaputra Valley. Rainfall record for 4 stations (*Guwahati, Nowgong, Dibrugarh and Sibsagar)* is available from 1848; 2 more stations (*Gopalpur and Tezpur*) were included in 1849. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 18. The important statistics of the rainfall sequences are given in Table 5. Chief features of the rainfall fluctuations are: annual- 1848-1884 decrease, 1885-1948 increase, 1949-1978 decrease, 1979-2006 increase; winter- 1848-1978 decrease, 1979-2006 increase; summer- 1848-1939 decrease, 1940-1956 increase, 1957-1979 decrease, 1980-2006 increase; summer monsoon- 1848-1884 decrease, 1885-1918 increase, 1919-2006 decrease; post-monsoon- 1848-1888 decrease, 1889-2006 increase; June- 1848-1896 decrease, 1897-1917 increase, 1918-2006 decrease; July- 1848-1894 decrease, 1895-1976 increase, 1977-2006 decrease; August- 1848-1904 stationary, 1905-2006 decrease; and September- 1848-1961 decrease, 1962-1987 increase, 1988-2006 decrease.

Meghalaya (area: 37,344 km^2; annual PE: 1023.8 mm; mean annual rainfall: 2720.2 mm- winter 1.2%, summer 21.2%, monsoon 68.3% and post-monsoon 9.3%; annual rainy days: 122.8; rainy season: start- 30th March, end- 24th October and duration- 209 days) province is essentially the Meghalaya state. Rainfall data for *Shillong* is available from 1866; *Tura* became available since 1870. Longest rainfall sequence could be developed for the period 1866-2006. The actual and filtered rainfall series are displayed in Figure 19. The important statistics of the rainfall sequences are given in Table 5. Chief features of the rainfall fluctuations are: annual- 1866-1922 stationary, 1923-1948 increase, 1949-2006 decrease; winter- 1866-1945 increase, 1946-1963 decrease, 1964-2006 increase; summer- 1866-1948 increase, 1949-1957 decrease, 1958-2006 increase; summer monsoon- 1866-2006 decrease; post-monsoon- 1866-2006 increase; June- 1866-1956 increase, 1957-2006 decrease; July- 1866-2006 stationary but 1962 onwards mostly above normal; August- 1866-2006 decrease; and September- 1866-2006 decrease.

Purvanchal (area: 100,709 km^2; annual PE: 1078.2mm; mean annual rainfall: 2233.5 mm- winter 2.1%, summer 24.9%, monsoon 63.3% and post-monsoon 9.7%; annual rainy days: 116.5; rainy season: start- 19th March, end- 21st October and duration- 216 days) province is the combined area of the Nagaland, the Manipur, the Mizoram and the Tripura states and eastern part of the Arunachal Pradesh. Earliest rainfall record for *Silchar* is available from 1848. The data for 5 more stations (*Kohima, Haflong, Imphal, Agartala and Demagiri*) became available from 1871. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 20. The important statistics of the rainfall sequences are given in Table 5. Chief features of the rainfall fluctuations are: annual- 1863-1947 increase, 1948-2006 decrease; winter- 1863-2006 decrease; summer- 1863-1915 increase, 1916-1965 decrease,

1966-2006 increase; summer monsoon- 1863-1965 stationary, 1966-2006 decrease; post-monsoon- 1863-1987 increase, 1988-2006 decrease; June- 1863-1966 increase, 1967-2006 decrease; July- 1863-1967 stationary, 1968-2006 decrease; August- 1863-2006 decrease; and September- 1863-1969 decrease, 1970 -2006 increase.

The Western Plains (area: 197,411 km^2; annual PE: 1753.9 mm; mean annual rainfall: 363.2 mm- winter 3.0%, summer 5.7%, monsoon 87.7% and post-monsoon 3.6%; annual rainy days: 20.1; rainy season: start- 14th July, end- 31st August and duration- 49 days) **–** Desert and semi desert regions of the western Rajasthan, east of Aravallis, form the Western Plains. Earliest record for Jaisalmer is available from 1861; for the Pali station the records became available from 1861. The data for all 12 stations of the selected network in the region is available from 1871. Longest rainfall sequence could be developed for the period 1861-2006. The actual and filtered rainfall series are displayed in Figure 21. The important statistics of the rainfall sequences are given in Table 6. Chief features of the rainfall fluctuations are as: annual- 1861-1975 increase, 1976-2006 decrease; winter- 1861-2006 decrease; summer- 1861-1916 stationary, 1917-1954 decrease, 1955-2006 increase; summer monsoon- 1861-1975 increase, 1976-2006 decrease; post-monsoon- 1861-1971 stationary, 1972-2006 increase; June- 1861-1968 decrease, 1969-2006 increase; July- 1861-1978 increase, 1979-2006 decrease; August- 1861-1944 increase, 1945-2006 decrease; and September- 1861-1958 stationary, 1959-2006 decrease. There are 2 provinces in the division.

Marusthali (area: 117,005 km^2; annual PE: 1838.9 mm; mean annual rainfall: 243.8 mm- winter 3.9%, summer 8.1%, monsoon 84.3% and post-monsoon 3.7%; annual rainy days: 14.9; rainy season: start- 22nd July, end- 11th August and duration- 21 days) is the desert part of the Rajasthan state. Earliest observation of *Jaisalmer* is available from 1861; the data for 3 more stations (*Barmer, Bikaner and Anupgarh*) became available from 1871. Longest rainfall sequence could be developed for the period 1861-2006. The actual and filtered rainfall series are displayed in Figure 22. The important statistics of the rainfall sequences are given in Table 6. Chief features of the rainfall fluctuations are: annual- 1861-1993 stationary, 1994-2006 decrease; winter- 1861-1974 decrease, 1975-2006 increase; summer- 1861-1949 decrease, 1950-2006 increase; summer monsoon- 1861-1993 stationary, 1994-2006 decrease; post-monsoon- 1861-1942 stationary, 1943-2006 increase; June- 1861-1950 decrease, 1951-2006 increase; July- 1861-1977 stationary, 1978-2006 decrease; August- 1861-1944 increase, 1945-2006 decrease; and September- 1861-1993 stationary, 1994-2006 decrease.

Rajasthan Bagar (area: 80,406 km^2; annual PE: 1667.5 mm; mean annual rainfall: 398.4 mm- winter 3.0%, summer 5.3%, monsoon 88.0% and post-monsoon 3.7%; annual rainy days: 21.5; rainy season: start- 13th July, end- 3rd September and duration- 53 days) is the semi desert area between Rajasthan desert (Thar) and Aravalli Range. The earliest record of *Pali* is available from 1867; the data for 8 more stations (*Anupgarh, Rajgarh, Jhunjhunu, Sikar, Sirohi, Nagaur, Jodhpur and Jalore*) is available from 1871. Longest rainfall sequence could be developed for the period 1867-2006. The

actual and filtered rainfall series are displayed in Figure 23. The important statistics of the rainfall sequences are given in Table 6. Chief features of the rainfall fluctuations are: annual- 1867-1975 slight increase, 1976-2006 decrease; winter- 1867-2006 stationary; summer- 1867-1916 stationary, 1917-1947 decrease, 1948-1982 increase, 1983-2006 decrease; summer monsoon- 1867-1916 stationary, 1917-1975 increase, 1976-2006 decrease; post-monsoon- 1867-1997 stationary, 1998-2006 decrease; June- 1867-1968 decrease, 1969-2006 increase; July- 1867-1918 decrease, 1919-1978 increase, 1979-2006 decrease; August- 1867-1972 stationary, 1973-2006 decrease; and September- 1867-1929 stationary, 1930-1975 increase, 1976-2006 decrease.

The North Central Highlands (area: 209,648 km^2; annual PE: 1525.5 mm; mean annual rainfall: 785.1 mm- winter 2.4%, summer 2.5%, monsoon 90.7% and post-monsoon 4.4%; annual rainy days: 39.0; rainy season: start- 23rd June, end- 18th September and duration- 88 days) – The region is spread over East Rajasthan, northwest Madhya Pradesh and southern Uttar Pradesh. Earliest rainfall record for Hamirpur is available from 1844; the data for all 22 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 24. The important statistics of the rainfall sequences are given in Table 7. Chief features of the rainfall fluctuations areas: annual- 1857-1905 decrease, 1906-1961 increase, 1962-2006 decrease; winter- 1857-1978 stationary, 1979-2006 decrease; summer- 1857-1895 stationary, 1896-1917 increase, 1918-1955 decrease, 1956-2006 increase; summer monsoon- 1844-1904 stationary, 1905-1961 increase, 1962-2006 decrease; post-monsoon- 1857-1985 increase, 1986-2006 decrease; June- 1844-1992 decrease, 1993-2006 increase; July- 1844-1911 decrease, 1912-1976 stationary, 1977-2006 decrease; August- 1844-1960 increase, 1961-2006 decrease; and September- 1844-1927 stationary, 1928-1961 increase, 1962-2006 decrease. There are 4 provinces in the division.

Aravalli Range (area: 52,167 km^2; annual PE: 1473.8 mm; mean annual rainfall: 695.4 mm- winter 1.6%, summer 2.9%, monsoon 92.0% and post-monsoon 3.5%; annual rainy days: 35.9; rainy season: start- 21st June, end- 17th September and duration- 89 days) divides the Rajasthan state into eastern and western parts. The earliest record for *Ajmer* is available from 1856; the data for 4 more stations (*Udaipur, Idar, Dungarpur and Alwar*) became available from 1871. Longest rainfall sequence could be developed for the period 1856-2006. The actual and filtered rainfall series are displayed in Figure 25. The important statistics of the rainfall sequences are given in Table 7. Chief features of the rainfall fluctuations are: annual- 1857-1899 stationary but mostly above normal, 1900-1956 increase, 1957-2006 decrease; winter- 1857-1947 stationary, 1948-2006 decrease; summer- 1857-1916 stationary, 1917-1948 decrease, 1949-2006 increase; summer monsoon- 1856-1899 stationary but above normal, 1900-1950 increase, 1951-2006 decrease; post-monsoon- 1856-2006 stationary; June- 1856-2006 increase; July- 1856-1936 stationary, 1937-2006 decrease; August- 1856-1998 stationary, 1999-2006 increase; and September- 1856-1928 stationary, 1929-1961 increase, 1962-2006 decrease.

East Rajasthan Uplands (area: 53,698 km^2; annual PE: 1745.2 mm; mean annual rainfall: 705.6 mm- winter 2.0%, summer 3.0%, monsoon 91.3% and post-monsoon 3.7%; annual rainy days: 35.0; rainy season: start- 25th June, end- 15th September and duration- 83 days) are in the east of Aravalli Range. Earliest record for *Bharatpur* is available from 1866; the data for 5 more stations (*Jaipur, Tonk, Sawai Madhopur, Bundi and Shahpura*) became available from 1871. Longest rainfall sequence could be developed for the period 1866-2006. The actual and filtered rainfall series are displayed in Figure 26. The important statistics of the rainfall sequences are given in Table 7. Chief features of the rainfall fluctuations are: annual- 1866-1898 stationary but mostly above normal, 1899-1942 increase, 1943-2006 decrease; winter- 1866-1907 increase, 1908-2006 decrease; summer- 1866-1916 stationary, 1917-1947 decrease, 1948-2006 increase; summer monsoon- 1866-1898 stationary, 1899-1942 increase, 1943-2006 decrease; post-monsoon- 1866-2006 increase; June- 1866-1961 stationary, 1962-2006 increase; July- 1866-1941 stationary, 1942-2006 decrease; August- 1866-1889 increase, 1890-1899 decrease, 1900-1946 increase, 1947-2006 decrease; and September- 1866-1946 stationary, 1947-2006 decrease.

Madhya Bharat Pathar (area: 55,426 km^2; annual PE: 1520.8 mm; mean annual rainfall: 814.2 mm- winter 2.1%, summer 2.0%, monsoon 91.7% and post-monsoon 4.3%; annual rainy days: 40.1; rainy season: start- 23rd June, end- 19th September and duration- 89 days) is bounded in the east by East Rajasthan Uplands, in the north by Ganga-Yamuna Doab, in the east by Bundelkhand Upland and in the south by Malwa Plateau. The data for 6 stations (*Bhind, Gwalior, Sabalgarh, Shivpuri, Kota and Jhalawar*) is available from 1871. Longest rainfall sequence could be developed for the period 1871-2006. The actual and filtered rainfall series are displayed in Figure 27. The important statistics of the rainfall sequences are given in Table 7. Chief features of the rainfall fluctuations are: annual- 1871-1913 decrease, 1914-1961 increase, 1962-2006 decrease; winter- 1871-2006 stationary; summer- 1871-1971 stationary, 1972-2006 increase; summer monsoon- 1871-1913 decrease, 1914-1961 increase, 1962-2006 decrease; post-monsoon- 1871-2006 increase; June- 1871-1931 decrease, 1932-2006 stationary and less variable; July- 1871-1918 decrease, 1919-1925 increase, 1926-2006 decrease; August- 1871-1913 stationary, 1914-1960 increase, 1961-2006 decrease; and September- 1871-1896 decrease, 1897-1961 increase, 1962-2006 decrease.

Bundelkhand Upland (area: 48,357 km^2; annual PE: 1501.1 mm; mean annual rainfall: 935.4 mm- winter 3.0%, summer 2.1%, monsoon 89.7% and post-monsoon 5.2%; annual rainy days: 43.6; rainy season: start- 20th June, end- 21st September and duration- 94 days) is spread over southern Uttar Pradesh and Northern Madhya Pradesh. The earliest records for *Hamirpur and Banda* are available from 1844; the data for *Jhansi* became available from 1860; for *Jalaun* from 1861; for *Nowgong* from 1868 and for *Tikamgarh and Datia* from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 28. The important statistics of the rainfall sequences are given in Table 7. Chief features of the rainfall fluctuations are: annual- 1860-1904 decrease, 1905-1961 increase, 1962-2006 decrease; winter- 1860-1942 increase, 1943-2006 decrease; summer- 1860-1911 stationary, 1912-1972 decrease, 1973-2006 increase; summer monsoon- 1860-1904 decrease, 1905-1961 increase, 1962-2006 decrease; post-monsoon- 1860-1961 increase,

1962-2006 decrease; June- 1860-1899 increase, 1900-2006 stationary; July- 1860-2006 decrease; August- 1860-1927 stationary, 1928-1961 increase, 1962-2006 decrease; and September- 1860-1973 stationary, 1974-1989 increase, 1990-2006 decrease.

The South Central Highlands (area: 179,593 km^2; annual PE: 1503.7mm; annual PE: 1598.7mm; mean annual rainfall: 1051.4 mm- winter 2.1%, summer 1.9%, monsoon 91.1% and post-monsoon 4.9%; annual rainy days: 51.0; rainy season: start- 13th June, end- 22nd September and duration- 102 days) **-** The region is in the central parts of the Madhya Pradesh state. Earliest rainfall records for 5 stations are available from 1844; the data for all 25 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 29. The important statistics of the rainfall sequences are given in Table 8. Chief features of the rainfall fluctuations are as: annual- 1844-1893 increase, 1894-1899 decrease, 1900-1944 increase, 1945-2006 slight decrease; winter- 1844-1942 increase, 1943-1967 decrease, 1968-2003 increase and mostly above normal; summer- 1844-1972 stationary, 1973-2006 increase; summer monsoon- 1844-1874 increase, 1875-1899 decrease, 1900-1944 increase, 1945-2006 slight decrease; post-monsoon- 1844-2006 increase; June- 1844-1893 increase, 1894-1902 decrease, 1903-2006 stationary; July- 1844-1876 increase, 1877-1918 decrease, 1919-1944 increase, 1945-2006 decrease; August- 1844-2006 increase; and September- 1844-1960 stationary, 1961-1979 slight decrease, 1980-2006 slight increase. There are 4 provinces in the division.

Malwa Plateau (area: 81,421 km^2; annual PE: 1590.3 mm; mean annual rainfall: 1001.9 mm- winter 1.6%, summer 1.7%, monsoon 91.8% and post-monsoon 4.9%; annual rainy days: 47.5; rainy season: start- 14th June, end- 21st September and duration- 100 days) is in the northwestern part of the Southcentral Highlands. Earliest record for Sagar station is available from 1844; the data for all 15 stations of the selected network (S*agar, Neemuch, Pratapgarh, Ratlam, Agar, Indore, Bhopal, Banswara, Jhabua, Ujjain, Sonkach, Vidisha, Raisen, Guna and Khilchipur*) is available from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 30. The important statistics of the rainfall sequences are given in Table 8. Chief features of the rainfall fluctuations are: annual- 1860-1899 decrease, 1900-1944 increase, 1945-2006 decrease; winter- 1860-2006 stationary but 1977-2006 mostly above normal; summer- 1860-1972 stationary, 1973-2006 sharp increase; summer monsoon- 1860-1918 decrease, 1919-1944 increase, 1945-2006 decrease; post-monsoon- 1860-1996 increase, 1997-2006 decrease; June- 1860-2006 decrease; July- 1860-1918 decrease, 1919-1944 increase, 1945-2006 decrease; August- 1860-1984 increase, 1985-1999 sharp decrease, 2000-2006 sharp increase; and September- 1860-1907 decrease, 1908-1961 increase, 1962-2006 decrease.

Vindhyan Scarplands (area: 39,333 km^2; annual PE: 1452.7 mm; mean annual rainfall: 1174.5 mm- winter 3.4%, summer 2.4%, monsoon 89.5% and post-monsoon 4.7%; annual rainy days: 57.5; rainy season: start- 14th June, end- 22 September and duration- 101 days) are in northeast of the South Central Highlands. For Damoh the rainfall data is available from 1844; the data for 3 more stations (*Panna, Sutna and*

Rewa) became available from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 31. The important statistics of the rainfall sequences are given in Table 8. Chief features of the rainfall fluctuations are: annual- 1863-1964 stationary, 1965-2006 increase; winter- 1863-1977 stationary, 1978-2006 decrease; summer- 1863-1983 stationary, 1984-2006 increase; summer monsoon- 1863-1964 decrease, 1965-2006 increase; post-monsoon- 1864-2006 stationary; June- 1863-1882 increase, 1883-1905 decrease, 1906-1997 stationary, 1998-2006 increase; July- 1863-1992 decrease, 1993-2006 increase; August- 1863-1996 increase, 1997-2006 decrease; and September- 1863-1973 stationary, 1974-2006 increase.

Vindhya Range (area: 27,662 km^2; annual PE: 1813.2 mm; mean annual rainfall: 1094.0 mm- winter 2.1%, summer 1.9%, monsoon 90.9% and post-monsoon 5.1%; annual rainy days: 52.9; rainy season: start- 12th June, end- 23rd September and duration- 104 days) is an elongated area along the southern border of the South Central Highlands, north of the Narmada river. Earliest record for *Indore* is available from 1868; the data for 3 more stations (*Sidhi, Raisen and Dhar*) became available from 1871. Longest rainfall sequence could be developed for the period 1868-2006. The actual and filtered rainfall series are displayed in Figure 32. The important statistics of the rainfall sequences are given in Table 8. Chief features of the rainfall fluctuations are: annual- 1868-1899 decrease, 1900-1944 increase, 1945-2006 decrease; winter- 1868-1981 stationary, 1982-2003 decrease; summer- 1868-1965 stationary, 1966-2006 increase; summer monsoon- 1868-1899 decrease, 1900-1944 increase, 1945-2006 decrease; post-monsoon- 1868-1886 increase, 1887-1899 decrease, 1900-1927 increase, 1928-2006 decrease; June- 1868-2006 decrease; July- 1868-1899 decrease, 1900-1942 increase, 1943-2006 decrease; August- 1868-1919 increase, 1920-1983 stationary, 1984-1999 decrease, 2000-2006 increase; and September- 1868-1895 stationary, 1896-1961 increase, 1962-2006 decrease.

Narmada Valley (area: 31,177 km^2; annual PE: 1347.3 mm; mean annual rainfall: 1122.1 mm- winter 2.4%, summer 2.2%, monsoon 90.1% and post-monsoon 5.3%; annual rainy days: 55.8; rainy season: start- 12th June, end- 22nd September and duration- 103 days) is the catchment area of the Narmada river between Jabalpur and south of Chhota Udepur. Earliest rainfall record for 3 stations (*Jabalpur, Narsimhapur and Hoshangabad*) is available from 1844; the fourth station *Barwani* was included in the network in 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 33. The important statistics of the rainfall sequences are given in Table 8. Chief features of the rainfall fluctuations are: annual- 1844-1891 increase, 1892-1899 decrease, 1900-1944 increase, 1945-2006 slight decrease; winter- 1844-2006 increase; summer- 1844-1971 stationary, 1972-2006 increase and less variable; summer monsoon- 1844-1891 increase, 1892-1899 decrease, 1900-1944 increase, 1945-2006 slight decrease; post-monsoon- 1844-2006 decrease; June- 1844-1893 increase, 1894-1970 stationary, 1971-2006 decrease; July- 1844-1887 increase, 1888-1918 decrease, 1919-1944 increase, 1945-1979 decrease, 1980-2006 increase; August- 1844-2006 increase; and September- 1844-2006 stationary.

The North Deccan (area: 351,838 km^2; annual PE: 1606.6 mm; mean annual rainfall: 956.6 mm- winter 2.1%, summer 4.3%, monsoon 84.2% and post-monsoon 9.4%; annual rainy days: 53.8; rainy season: start- 11th June, end- 5th October and duration- 117 days)– The region is spread over Maharashtra and Madhya Pradesh states. The earliest record for Pune and Nagpur is available from 1826; the data for all 30 stations of the selected network is available since 1871. Longest rainfall sequence could be developed for the period 1826-2006. The actual and filtered rainfall series are displayed in Figure 34. The important statistics of the rainfall sequences are given in Table 9. Chief features of the rainfall fluctuations are as: annual- 1853-1892 increase, 1893-1899 decrease, 1900-1961 increase, 1962-2006 slight decrease; winter- 1851-1947 increase, 1948-1976 decrease, 1977-2003 increase; summer- 1851-1911 decrease, 1912-1957 increase, 1958-2006 decrease; summer monsoon- 1853-1892 increase, 1893-1899 decrease, 1900-1961 increase, 1962-2003 slight decrease, 2004-2006 increase; post-monsoon- 1851-1886 increase, 1887-1909 decrease, 1910-2006 increase; June- 1851-1962 highly fluctuating, 1963-2006 increase; July- 1853-1887 increase, 1888-1918 decrease, 1919-1944 increase, 1945-1999 decrease, 2000-2006 increase; August- 1851-2006 increase; and September- 1851-1891 increase, 1892-1958 stationary, 1959-2006 decrease. There are 2 provinces in the division.

Satpura Range (area: 99,241 km^2; annual PE: 1432.2 mm; mean annual rainfall: 1169.5 mm- winter 3.1%, summer 3.3%, monsoon 87.2% and post-monsoon 6.4%; annual rainy days: 61.4; rainy season: start- 10th June, end- 22nd September and duration- 105 days) are spread over northern part of North Deccan of Narmada Valley. Earliest rainfall data for 3 stations (*Mandla, Seoni and Betul*) data is available from 1844; *Chindwara* was included from 1863 and *Khandwa* from 1864, *Balaghat* from 1867 and *Barwani and Sohagpur* from 1871. Longest rainfall sequence could be developed for the period 1844-2006. The actual and filtered rainfall series are displayed in Figure 35. The important statistics of the rainfall sequences are given in Table 9. Chief features of the rainfall fluctuations are: annual- 1863-1887 increase, 1888-1899 decrease, 1900-1944 increase, 1945-2006 decrease; winter- 1863-2006 increase; summer- 1863-1896 decrease, 1897-1926 increase, 1927-1984 decrease, 1985-2006 increase; summer monsoon- 1863-1884 increase, 1885-1899 decrease, 1900-1944 increase, 1945-2006 decrease; post-monsoon- 1863-1885 increase, 1886-1899 decrease, 1900-1927 increase, 1928-2006 decrease; June- 1863-2006 decrease; July- 1863-1882 increase, 1883-1918 decrease, 1919-1944 increase, 1945-2006 decrease; August- 1863-1984 increase, 1985-2006 decrease; and September- 1863-1960 stationary, 1961-2006 decrease.

Maharashtra Plateau (area: 252,597 km^2; annual PE: 1661.7 mm; mean annual rainfall: 887.4 mm- winter 1.6%, summer 4.6%, monsoon 83.4% and post-monsoon 10.4%; annual rainy days: 51.1; rainy season: start- 11th June, end- 6th October and duration- 118 days) is essentially the Maharashtra state excluding Sahyadri Range and West Coast. The data for Pune and Nagpur stations is available from 1826; for all 22 stations of the selected network (*Pune, Nagpur, Satara, Ahmedabad, Nashik, Kolhapur, Sholapur, Buldhana, Amraoti, Dhulia, Akola, Bhandara, Wardha, Chandrapur, Yeotmal, Aurangabad, Parbhani, Nanded, Bhir, Osmanabad, Sangli and Jalgaon*) the data is

available from 1871. Longest rainfall sequence could be developed for the period 1826-2006. The actual and filtered rainfall series are displayed in Figure 36. The important statistics of the rainfall sequences are given in Table 9. Chief features of the rainfall fluctuations are: annual- 1853-1933 increasing tendency in three steps, 1934-2006 stationary; winter- 1853-1947 increase, 1948-1972 decrease, 1973-2006 increase; summer- 1853-1983 decrease, 1984-2006 increase; summer monsoon- 1853-1996 highly oscillating, 1997-2006 increase; post-monsoon- 1853-1907 decrease, 1908-2006 increase; June- 1853-1966 slight decrease, 1967-2006 increase; July- 1853-1887 increase, 1888-1918 decrease, 1919-1944 increase, 1945-2006 decrease; August- 1853-1921 stationary, 1922-2006 increase; and September- 1853-1892 increase, 1893-1958 stationary, 1959-2006 decrease.

The South Deccan (area: 313,452 km^2; annual PE: 1653.6 mm; mean annual rainfall: 919.9 mm- winter 1.2%, summer 11.1%, monsoon 70.2% and post-monsoon 17.5%; annual rainy days: 55.1; rainy season: start - 26th May, end- 17th October and duration- 145 days)– The region is spread over Interior Karnataka and Eastern Andhra Pradesh. Earliest record for Bangalore is available from 1835; the data for all 27 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1835-2006. The actual and filtered rainfall series are displayed in Figure 37. The important statistics of the rainfall sequences are given in Table 10. Chief features of the rainfall fluctuations are as: annual- 1835-1956 increase, 1957-2006 decrease; winter- 1835-1886 decrease, 1887-1936 increase, 1937-1955 decrease, 1956-2006 increase; summer- 1835-1913 stationary, 1914-1962 increase, 1963-2002 decrease, 2003-2006 increase; summer monsoon- 1835-1988 increase, 1989-2006 decrease; post-monsoon- 1835-2006 slightly increase; June- 1835-1991 slight increase, 1992-2006 decrease; July- 1835-1961 increase, 1962-2006 decrease; August- 1835-1919 highly oscillating, 1920-2006 increase; and September- 1835-1857 decrease, 1858-1981 increase, 1982-2006 decrease. There are 2 provinces in the division.

Karnataka Plateau (area: 175,120 km^2; annual PE: 1611.3 mm; mean annual rainfall: 956.3 mm- winter 0.9%, summer 14.0%, monsoon 64.6% and post-monsoon 20.5%; annual rainy days: 58.0; rainy season: start- 19th May, end- 31st October and duration- 166 days) is the Karnataka portion of the South Deccan. Earliest record is available from 1835 for Bangalore; the data for all 17 stations of the selected network (*Bangalore, Shimoga, Tumkur, Mysore, Belgaum, Dharwar, Bellary, Bijapur, Mercara, Chitaldurg, Chikmagalur, Kolar, Mandya, Bidar, Gulbarga, Raichur and Hassan)* is available from 1871. Longest rainfall sequence could be developed for the period 1835-2006. The actual and filtered rainfall series are displayed in Figure 38. The important statistics of the rainfall sequences are given in Table 10. Chief features of the rainfall fluctuations are: annual- 1835-1882 increase, 1883-1918 decrease, 1919-1956 increase, 1957-2006 decrease; winter- 1835-1928 increase, 1929-2006 decrease; summer- 1835-1913 stationary, 1914-1962 increase, 1963-2006 decrease; summer monsoon- 1835-1897 increase, 1998-1918 decrease, 1919-1959 increase, 1960-2006 decrease; post-monsoon- 1835-1992 stationary, 1993-2006 decrease; June- 1835-1896 increase, 1897-1923 decrease, 1929-2006 increase; July- 1835-1960 increase, 1961-2006 decrease; August- 1835-1967 stationary, 1968-2006 increase; and September- 1835-1864 decrease, 1865-1981 increase, 1982-2006 sharp decrease.

Telangana Plateau (area: 138,332 km^2; annual PE: 1719.4 mm; mean annual rainfall: 862.5 mm- winter 1.8%, summer 7.1%, monsoon 77.8% and post-monsoon 13.3%; annual rainy days: 50.5; rainy season: start- 13th June, end- 12th October and duration- 122 days) is the Andhra portion of the South Deccan. For Hyderabad rainfall data is available from 1843; the data for all 11 stations of the selected network (*Hyderabad, Asifabad, Karimnagar, Nizamabad, Medak, Hanamkonda, Nalgonda, Khammam, Mehbubnagar, Kurnool and Anantapur*) is available from 1871. Longest rainfall sequence could be developed for the period 1843-2006. The actual and filtered rainfall series are displayed in Figure 39. The important statistics of the rainfall sequences are given in Table 10. Chief features of the rainfall fluctuations are: annual- 1843-1988 increase, 1989-2006 decrease; winter- 1843-1873 decrease, 1874-1936 increase, 1937-1954 decrease, 1955-2006 increase; summer- 1835-2006 stationary; summer monsoon- 1843-1919 stationary, 1920-1988 increase, 1989-2006 decrease; post-monsoon- 1843-1908 decrease, 1909-2006 increase; June- 1843-1977 stationary, 1978-2006 decrease; July- 1843-1988 increase, 1989-2006 sharp decrease; August-1843-1891 stationary, 1892-1919 decrease, 1920-1983 increase, 1984-2006 decrease; and September- 1843-1963 stationary, 1964-2006 decrease.

The Eastern Plateaus (area: 337,487 km^2; annual PE: 1438.6 mm; mean annual rainfall: 1361.7 mm- winter 3.0%, summer 6.0%, monsoon 84.1% and post-monsoon 6.9%; annual rainy days: 71.4; rainy season: start- 9th June, end- 10th October and duration- 124 days)– It is spread over Chhattisgarh, Jharkhand, Orissa and West Bengal states. Earliest rainfall data for 3 stations is available from 1848; the data for all 21 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 40. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are as: annual- 1860-1943 increase, 1944-2006 decrease; winter- 1860-1944 increase, 1945-2006 decrease and mostly below normal; summer- 1860-1954 decrease, 1955-2006 increase; summer monsoon- 1860-1943 increase, 1945-2006 decrease; post-monsoon- 1860-1905 decrease, 1906-1959 increase, 1960-1981 decrease, 1982-2006 increase; June- 1860-1910 stationary and above normal, 1911-1974 decrease, 1975-2006 increase; July- 1860-1892 increase, 1893-1918 decrease, 1919-1929 increase, 1930-2006 decrease; August- 1860-1944 increase, 1945-2006 decrease; and September- 1860-1961 increase, 1962-2006 decrease. There are 5 provinces in the division.

Baghelkhand Plateau (area: 48,114 km^2; annual PE: 1407.5 mm; mean annual rainfall: 1335.5 mm- winter 3.8%, summer 3.1%, monsoon 88.1% and post-monsoon 5.0%; annual rainy days: 66.6; rainy season: start- 10th June, end- 23rd September and duration- 106 days) is in the northwest part of the eastern plateaus. Monthly rainfall data for all 3 stations (*Sidhi, Ambikapur and Sohagpur*) of the selected network is available from 1871. The rainfall sequence for the period 1871-2006 has been prepared from simple arithmetic mean of 3 stations. The actual and filtered rainfall series are displayed in Figure 41. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are: annual- 1871-1925 increase, 1926-2006 decrease and 1954 onwards mostly below normal; winter- 1871-1978 stationary,

1979-2006 decrease; summer- 1871-2006 stationary; summer monsoon- 1871-1925 increase, 1926-2006 decrease and 1954 onwards mostly below normal; post-monsoon- 1871-1927 stationary, 1928-2006 decrease; June- 1871-2006 decrease; July- 1871-1918 decrease, 1919-1929 increase, 1930-2006 decrease and 1949 onwards mostly below normal; August- 1871-1923 increase, 1924-2006 decrease; and September- 1871-1965 stationary, 1966-2006 increase.

Chhotanagpur Plateau (area: 102,078 km^2; annual PE: 1405.5 mm; mean annual rainfall: 1318.9 mm- winter 3.2%, summer 7.6%, monsoon 81.3% and post-monsoon 7.9%; annual rainy days: 72.8; rainy season: start- 28th May, end- 13th October and duration- 139 days) is in the northeast of the Eastern Plateau. Rainfall data for 4 stations (*Suri, Hazaribagh, Ranchi and Purulia*) is available from 1848; the data for *Chaibasa* was included from 1869, for *Daltonganj and Jamui* from 1870 and for *Dumka and Gobindpur* from 1871. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 42. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are: annual- 1860-1942 increase, 1943-1966 decrease, 1967-2006 increase; winter- 1860-1927 increase, 1928-2006 decrease; summer- 1860-1956 stationary, 1957-2006 increase; summer monsoon- 1860-1941 stationary, 1942-1966 decrease, 1967-2006 increase; post-monsoon- 1860-1907 decrease, 1908-1959 increase, 1960-1967 decrease, 1968-2006 increase; June- 1860-1911 increase, 1912-1926 decrease, 1927-2006 increase; July- 1860-1899 increase, 1900-1911 decrease, 1912-1928 increase, 1929-1966 increase, 1967-2006 stationary; August- 1860-1942 increase, 1943-2006 decrease; and September- 1860-2006 increase.

Mahanadi Basin (area: 79,134 km^2; annual PE: 1487.1 mm; mean annual rainfall: 1379.4 mm- winter 2.5%, summer 4.2%, monsoon 88.1% and post-monsoon 5.2%; annual rainy days: 68.5; rainy season: start- 8th June, end- 3rd October and duration- 118 days) is in the central part of the Eastern Plateau. Earliest record for *Sambalpur* is available from 1861; the data for *Bilaspur and Raipur* was included from 1863 and for *Raigarh, Bolangir and Durg* from 1871. Longest rainfall sequence could be developed for the period 1861-2006. The actual and filtered rainfall series are displayed in Figure 43. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are: annual- 1861-1936 increase, 1937-2006 decrease; winter- 1861-1943 increase, 1944-1991 decrease, 1992-2005 increase; summer- 1861-1987 decrease, 1988-2006 increase; summer monsoon- 1861-1936 increase, 1937-2006 decrease; post-monsoon- 1861-1980 stationary, 1981-2006 increase; June- 1861-2006 decrease; July- 1861-1892 increase, 1893-1911 decrease, 1912-1940 increase, 1941-2006 decrease; August- 1861-1896 increase, 1897-1946 stationary, 1947-2006 decrease; and September- 1861-1961 increase, 1962-2006 decrease.

Garhjat Hills (area: 47,769 km^2; annual PE: 1539.9 mm; mean annual rainfall: 1434.3 mm- winter 3.4%, summer 8.4%, monsoon 79.5% and post-monsoon 8.7%; annual rainy days: 76.3; rainy season: start- 24th May, end- 15th October and duration- 145 days) is in the eastern part of the plateau. Rainfall data for all 3 stations (*Rajgangapur, Keonjhargarh and Dhenkanal)* of the selected network is available from

1871. Area-averaged rainfall series for the period 1871-2006 has been prepared from simple arithmetic mean of the 3 stations. The actual and filtered rainfall series are displayed in Figure 44. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are: annual- 1871-1946 increase, 1947-2006 decrease; winter- 1871-1969 stationary, 1970- 2006 decrease; summer- 1871-1972 decrease, 1973-2006 increase; summer monsoon- 1871-1943 increase, 1944-2006 decrease; post-monsoon- 1871-1908 decrease, 1909-1959 increase, 1960-1981 decrease, 1982-2006 increase; June- 1871-1935 stationary, 1936-1976 decrease, 1977-2006 increase; July- 1871-1940 increase, 1941-2006 decrease and 1949 onwards mostly below normal; August- 1871-1907 increase, 1908-2006 stationary; and September- 1871-1919 decrease, 1920-1956 increase, 1957-2006 decrease.

Dandakaranya (area: 60,392 km^2; annual PE: 1422.3 mm; mean annual rainfall: 1378.1 mm- winter 1.7%, summer 6.0%, monsoon 84.7% and post-monsoon 7.6%; annual rainy days: 74.4; rainy season: start- 8th June, end- 12th October and duration- 127 days) is in southern part of the plateau. Rainfall data for 2 stations *Bhawanipatna and Kondgaon* is available from 1871. Area-averaged rainfall series (1871-2006) has been prepared from arithmetic mean of 2 stations. The actual and filtered rainfall series are displayed in Figure 45. The important statistics of the rainfall sequences are given in Table 11. Chief features of the rainfall fluctuations are: annual- 1871-1919 stationary, 1920-1945 increase, 1946-2001 decrease, 2002-2006 increase; winter- 1871-1919 increase, 1920-1955 decrease, 1956-2006 stationary; summer- 1871-1939 stationary, 1940-1973 decrease, 1974-2006 increase; summer monsoon- 1871-1919 stationary, 1920-1945 increase, 1946-2006 decrease; post-monsoon- 1871-1954 stationary, 1955-1981 decrease, 1982-2006 increase; June- 1871-2006 decrease; July- 1871-1916 stationary, 1917-1944 increase, 1945-2006 decrease; August- 1871-1944 increase, 1945-1998 decrease, 1999-2006 increase; and September- 1871-1944 stationary, 1945-2006 decrease.

The Western Hills (area: 75,223 km^2; annual PE: 1222.9 mm; mean annual rainfall: 2141.7 mm- winter 0.7%, summer 7.9%, monsoon 79.6% and post-monsoon 11.8%; annual rainy days: 114.3; rainy season: start- 20th May, end- 10th November and duration- 175 days)– The upper portion of Sahyadri Range is referred to as the Western Hills. Earliest record from 1829 is available for *Ootacamund*; *Mercara* became available from 1863 and *Ahwa* and *Punalur* from 1871. Longest rainfall sequence could be developed for the period 1829-2006. The actual and filtered rainfall series are displayed in Figure 46. The important statistics of the rainfall sequences are given in Table 12. Chief features of the rainfall fluctuations are as: annual- 1863-1961 increase, 1962-1965 decrease, 1966-2006 increase; winter- 1863-1909 increase, 1910-2006 decrease; summer- 1863-1926 stationary, 1927-1955 increase, 1956-1985 decrease, 1986-2006 increase; summer monsoon- 1863-2006 increase sharp from 1964 onwards; post-monsoon- 1863-2006 stationary; June- 1863-1896 increase, 1897-1966 decrease, 1967-2006 increase; July- 1863-1960 stationary, 1961-2006 decrease; August- 1863-2006 steep increase; and September- 1863-1954 increase, 1955-1982 decrease, 1983-2006 steep increase. There are 4 provinces in the division.

North Sahyadri (area: 34,555 km^2; annual PE: No data; mean annual rainfall: 1934.3 mm- winter 0.2%, summer 1.1%, monsoon 94.2% and post-monsoon 4.5%; annual rainy days: 81.5; rainy season: start- 7th June, end- 7th October and duration- 123 days) is in the northern part of the Western Hills. Long period rainfall data for lone station *Ahwa* is available from 1871. The station is treated as representative of the North Sahayadri physiographic subdivision. The actual and filtered rainfall series are displayed in Figure 47. The important statistics of the rainfall sequences are given in Table 12. Chief features of the rainfall fluctuations are: annual- 1871-2006 increase steep from 1974 onwards; winter- 1871-2006 stationary; summer- 1871-2006 stationary; summer monsoon- 1871-2006 increase sharp from 1974 onwards; post-monsoon- 1871-2006 increase; June- 1871-2006 increase steep from 1987; July- 1871-2006 increase; August- 1871-2006 increase steep from 1974 onwards; and September- 1871-1907 stationary, 1908-2006 increase steep from 1980 onwards.

Central Sahyadri (area: 20,369 km^2; annual PE: 1264.6 mm; mean annual rainfall: 3249.8 mm- winter 0.3%, summer 7.1%, monsoon 83.4% and post-monsoon 9.2%; annual rainy days: 132.4; rainy season: start- 22nd April, end- 10th November and duration- 203 days) is in the Karnataka portion of the Sahyadri range. The earliest rainfall record is available from 1863 for the lone station *Mercara*. The station series would represent the Central Sahayadri subdivision. The actual and filtered rainfall series are displayed in Figure 48. The important statistics of the rainfall sequences are given in Table 12. Chief features of the rainfall fluctuations are: annual- 1863-2006 stationary; winter- 1863-1906 increase, 1907-2006 decrease; summer- 1863-1961 increase, 1962-1986 decrease, 1987-2006 increase; summer monsoon- 1863-2006 stationary; post-monsoon- 1863-1995 stationary, 1996-2006 decrease; June- 1863-1896 increase, 1897-1966 decrease, 1967-2006 increase; July- 1863-1960 stationary, 1961-2006 decrease; August- 1863-2006 increase; and September- 1863-1949 stationary, 1950-2006 decrease.

South Sahyadri (area: 16,283 km^2; annual PE: 1413.3 mm; mean annual rainfall: 2923.8 mm- winter 1.9%, summer 20.0%, monsoon 53.7% and post-monsoon 24.4%; annual rainy days: 138.4; rainy season: start- 17th March, end- 4th December and duration- 263 days) is spread over the Kerala and Tamilnadu states. The rainfall data for the lone station *Punalur* is available from 1871. The Punalur station would represent the South Sahayadri region. The actual and filtered rainfall series are displayed in Figure 49. The important statistics of the rainfall sequences are given in Table 12. Chief features of the rainfall fluctuations are: annual- 1871-1919 increase, 1920-1986 decrease, 1987-1999 increase, 2000-2006 decrease; winter- 1871-1991 stationary, 1992-2006 increase; summer- 1871-1936 increase, 1937-2006 decrease; summer monsoon- 1871-1893 decrease, 1895-1924 increase, 1925-2006 decrease; post-monsoon- 1871-1946 increase, 1947-1960 decrease, 1961-2006 increase; June- 1871-2006 decrease; July- 1871-1924 increase, 1925-2006 decrease; August- 1871-2006 stationary but 1952 onwards mostly below normal; and September- 1871-2006 stationary.

Nilgiri Hills (area: 4,016 km^2; annual PE: 1106.8 mm; mean annual rainfall: 1002.5 mm- winter 2.7%, summer 20.3%, monsoon 46.8% and post-monsoon 30.2%; annual rainy days: 104.7; rainy season: start- 21st April, end- 30th November and duration- 224 days) is spread over Kerala and Tamilnadu states. For lone station *Ootacamund* in the hills the data is available from 1829. The Ootacamund station is treated as representative of the Nilgiri Hills region. The actual and filtered rainfall series are displayed in Figure 50. The important statistics of the rainfall sequences are given in Table 12. Chief features of the rainfall fluctuations are: annual- 1871-1911 increase, 1912-2006 decrease; winter- 1871-1909 increase, 1910-2006 decrease; summer- 1871-1916 stationary, 1917-1955 increase, 1956-2006 decrease; summer monsoon- 1871-1897 increase, 1898-2006 decrease; post-monsoon- 1871-1938 stationary, 1939-2006 decrease; June- 1871-1896 increase, 1897-2006 decrease; July- 1871-1924 increase, 1925-1929 decrease, 1930-1960 increase, 1961-2006 decrease; August- 1871-1932 stationary, 1933-2006 decrease; and September- 1871-1957 decrease, 1958-2006 increase.

The Eastern Hills (area: 195,098 km^2; annual PE: 1731.1 mm; mean annual rainfall: 1015.3 mm- winter 2.1%, summer 11.1%, monsoon 63.4% and post-monsoon 23.4%; annual rainy days: 59.2; rainy season: start- 25th May, end- 11th November & duration- 171 days) - The elongated strips spread over Tamilnadu, Coastal Andhra Pradesh and Orissa states, west of east coastal plains, is referred to as Eastern Hills. Earliest record from 1852 is available for Cuddappah and Salem; the data for all 8 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1852-2006. The actual and filtered rainfall series are displayed in Figure 51. The important statistics of the rainfall sequences are given in Table 13. Chief features of the rainfall fluctuations are as: annual- 1852-1956 increase, 1957-1980 decrease, 1981-2006 increase; winter- 1852-1926 increase, 1927-1974 decrease, 1975-2006 increase; summer- 1852-2006 stationary; summer monsoon- 1852-1956 increase, 1957-1979 decrease, 1980-1989 increase, 1990-2006 decrease; post-monsoon- 1852-2006 increase; June- 1852-2006 stationary; July- 1852-1964 increase, 1965-2006 decrease; August- 1852-1967 stationary, 1968-1991 increase, 1992-2006 decrease; and September- 1852-1897 increase, 1898-1976 decrease, 1977-1988 increase, 1989-2006 decrease. There are 3 provinces in the division.

Eastern Ghats (North) (area: 70,672 km^2; annual PE: no data; mean annual rainfall: 1510.4 mm- winter 1.7%, summer 7.9%, monsoon 81.0% and post-monsoon 9.4%; annual rainy days: 82.8; rainy season: start- 27th May, end- 16th October and duration- 143 days) is in the northern part of the Eastern Hills. Rainfall data for 2 stations *Phulbani* and *Koraput* is available from 1871. From simple arithmetic mean of these two stations area-averaged rainfall series (1871-2006) of the region has been prepared. The actual and filtered rainfall series are displayed in Figure 52. The important statistics of the rainfall sequences are given in Table 13. Chief features of the rainfall fluctuations are: annual- 1871-1933 increase, 1934-1979 decrease, 1980-1994 increase, 1995-2006 decrease; winter- 1871-1944 increase, 1945-2006 stationary; summer- 1871-1953 decrease, 1954-1989 increase, 1990-2006 decrease; summer monsoon- 1871-1933

increase, 1934-1974 decrease, 1975-1994 increase, 1995-2006 decrease; post-monsoon- 1871-1905 decrease, 1906-1931 increase, 1932-1981 decrease, 1982-2006 increase; June- 1871-1935 stationary, 1936-2006 decrease; July- 1871-1939 increase, 1940-2006 decrease; August- 1871-1926 increase, 1927-1980 decrease, 1981-2006 increase; and September- 1871-1953 stationary, 1954-2006 decrease.

Eastern Ghats (South) (area: 78,901 km^2; annual PE: 1696.7mm; mean annual rainfall: 873.7 mm- winter 2.4%, summer 8.2%, monsoon 63.6% and post-monsoon 25.8%; annual rainy days: 49.9; rainy season: start- 16th June, end- 11th November and duration- 149 days) is in the southern part of the Eastern Hills, of the Tamilnadu Uplands. Earliest record of *Cuddappah* is available from 1852. *Chittor* became available from 1863 and *Karimnagar* from 1871. Longest rainfall sequence could be developed for the period 1852-2006. The actual and filtered rainfall series are displayed in Figure 53. The important statistics of the rainfall sequences are given in Table 13. Chief features of the rainfall fluctuations are: annual- 1852-2006 increase; winter- 1852-1936 increase, 1937-1951 decrease, 1952-2006 increase; summer- 1852-1943 increase, 1944-1964 decrease, 1965-2006 increase; summer monsoon- 1852-1987 increase, 1988-2006 decrease; post-monsoon- 1852-1950 stationary, 1951-2006 increase; June- 1852-2006 increase; July- 1852-1988 increase, 1989-2006 decrease; August- 1852-1909 increase, 1910-1930 decrease, 1931-2006 increase; and September- 1852-2006 stationary.

Tamilnadu Uplands (area: 45,525 km^2; annual PE: 1765.5mm; mean annual rainfall: 826.7 mm- winter 2.2%, summer 18.0%, monsoon 42.0% and post-monsoon 37.8%; annual rainy days: 52.8 days; rainy season: start- 18th May, end- 16th November and duration- 183 days) is in the southern part of the eastern Hills, north west of Tamilnadu plains. Earliest record of *Salem* is available from 1852. *Coimabatore* became available from 1853 and *Dharampuri* from 1871. Longest rainfall sequence could be developed for the period 1837-2006. The actual and filtered rainfall series are displayed in Figure 54. The important statistics of the rainfall sequences are given in Table 13. Chief features of the rainfall fluctuations are: annual- 1863-2006 increase; winter- 1863-1932 increase, 1933-2006 decrease; summer- 1863-1912 decrease, 1913-1955 increase, 1956-2001 decrease, 2002-2006 increase; summer monsoon- 1863-1903 increase, 1904-1957 decrease, 1958-1996 increase, 1997-2006 sharp decrease; post-monsoon- 1863-2006 increase; June- 1863-1995 stationary, 1996-2006 decrease; July- 1863-1989 stationary, 1990-2006 sharp decrease; August- 1863-1881 increase, 1882-1989 decrease, 1990-1998 increase, 1999-2006 decrease; and September- 1863-1894 stationary mostly below normal, 1895-1948 decrease, 1949-1988 increase, 1989-2006 decrease.

The West Coastal Plains (area: 223,923 km^2; annual PE: 1642.3 mm; mean annual rainfall: 1765.2 mm- winter 0.7%, summer 7.8%, monsoon 80.3% and post-monsoon 11.2%; annual rainy days: 72.9; rainy season: start- 18th May, end- 5th November and duration- 172 days)- The plain area parallel to the west coast from Gujarat to Kerala forms the West Coastal Plains. Earliest record of Mumbai is available

from 1817. The data for all the 34 stations of the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1817-2006. The actual and filtered rainfall series are displayed in Figure 55. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are as: annual- 1838-1961 increase, 1962-2006 decrease; winter- 1838-1928 increase, 1929-2006 decrease; summer- 1838-1866 decrease, 1867-1960 increase, 1961-1983 decrease, 1984-2006 increase; summer monsoon- 1817-1855 decrease, 1856-1961 increase, 1962-2006 decrease; post-monsoon- 1838-1932 increase, 1933-1971 decrease, 1972-2006 increase; June- 1817-1962 decrease, 1963-2006 increase; July- 1817-1959 increase, 1960-2006 decrease; August- 1817-1845 decrease, 1846-1983 increase, 1984-1990 decrease, 1991-2006 increase; and September- 1817-1839 decrease, 1840-1954 increase, 1955-1999 decrease, 2000-2006 increase. There are 6 provinces in the division.

Kachchh Peninsula (area: 15,564 km^2; annual PE: 1897.1 mm; mean annual rainfall: 347.1 mm- winter 1.5%, summer 3.5%, monsoon 89.3% and post-monsoon 5.7%; annual rainy days: 16.2; rainy season: start- 10th July, end- 7th September and duration- 60 days) is in the northwest part of the Gujarat State. For lone station *Bhuj* the data is available from 1861 and the station is treated as representative of the Kachchh Peninsula. The actual and filtered rainfall series of the Bhuj station are displayed in Figure 56. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1861-2006 stationary; winter- 1861-1941 stationary, 1942-2006 decrease; summer- 1861-2006 stationary; summer monsoon- 1861-2006 stationary; post-monsoon- 1861-1942 stationary, 1943-2006 increase; June- 1861-1950 decrease, 1951-2006 increase; July- 1861-1958 stationary, 1959-1987 decrease, 1988-2006 increase; August- 1861-1894 decrease, 1895-1979 increase, 1980-1999 decrease, 2000-2006 increase; and September- 1861-2006 stationary.

Kathiawar Peninsula (area: 58,467 km^2; annual PE: 1826.7 mm; mean annual rainfall: 543.4 mm- winter 0.6%, summer 1.6%, monsoon 92.6% and post-monsoon 5.2%; annual rainy days: 24.9; rainy season: start- 18th June, end- 11th September and duration- 87 days) is the peninsular portion of the Gujarat state. Earliest record of Rajkot is available from 1861. The data for 5 more stations (*Wadhawan, Porbandar, Amreli, Dwarka and Bhavnagar)* became available from 1871. Longest rainfall sequence could be developed for the period 1861-2006. The actual and filtered rainfall series are displayed in Figure 57. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1861-1918 decrease, 1919-2006 increase; winter- 1861-1904 stationary, 1905-2006 decrease; summer- 1861-2006 stationary; summer monsoon- 1861-1918 decrease, 1919-2006 increase; post-monsoon- 1861-1981 increase, 1982-2006 decrease; June- 1861-1950 decrease, 1951-2006 increase; July- 1861-1886 increase, 1887-1918 decrease, 1919-1959 increase, 1960- 2006 decrease; August- 1861-1925 decrease, 1926-1979 increase, 1980-1993 decrease, 1994-2006 increase; and September- 1861-1999 stationary, 2000-2006 increase.

Gujarat Plains (area: 66,904 km^2; annual PE: 1678.0 mm; mean annual rainfall: 925.8 mm- winter 0.4%, summer 1.1%, monsoon 95.1% and post-monsoon 3.4%; annual rainy days: 40.5; rainy season: start- 12th June, end- 20th September and duration- 101 days) is surrounded by Kathiawar Peninsula in the southwest, Kutch Peninsula in the west, western plains in the north, Central Highlands in the northeast/east and North Deccan in the southeast. Earliest record from 1843 is available for *Ahmedabad*. The data for 9 additional stations of the selected network (*Deesa, Kaira, Broach, Surat, Idar, Baria, Bulsar Radhanpur and Baroda*) became available from 1871. Longest rainfall sequence could be developed for the period 1843-2006. The actual and filtered rainfall series are displayed in Figure 58. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1856-1899 decrease, 1900-1959 increase, 1960-2006 decrease; winter- 1856-1919 stationary, 1920-2006 decrease; summer- 1856-1950 stationary, 1951-1992 increase, 1993-2006 decrease; summer monsoon- 1856-1899 decrease, 1900-1959 increase, 1960-1998 decrease, 1999-2006 increase; post-monsoon- 1856-2006 stationary; June- 1856-1948 stationary, 1949-2006 increase; July- 1856-1971 stationary, 1972-2006 increase; August- 1856-1983 stationary, 1984-1999 decrease, 2000-2006 increase; and September-1856-1954 increase, 1955-2006 decrease.

Konkan (area: 23,876 km^2; annual PE: 1624.0 mm; mean annual rainfall: 2445.9 mm- winter 0.1%, summer 1.7%, monsoon 93.4% and post-monsoon 4.8%; annual rainy days: 85.1; rainy season: start- 24th June, end- 14th October and duration- 114 days) is coastal area of the Maharashtra state. Earliest record from 1817 is available for *Mumbai*. *Ratnagiri and Thane* became available from 1844, *Goa* from 1860 and *Alibag* from 1871. Longest rainfall sequence could be developed for the period 1817-2006. The actual and filtered rainfall series are displayed in Figure 59. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1847-2006 increase; winter- 1847-2006 decrease; summer- 1847-2006 increase; summer monsoon- 1817-1918 decrease, 1919-2006 increase; post-monsoon- 1847-1907 decrease, 1908-1931 increase, 1932-2006 decrease; June- 1817-1925 decrease, 1926-2006 stationary; July- 1817-1917 stationary, 1918-1954 increase, 1955-2006 decrease; August- 1817-1922 decrease, 1923-2006 increase; and September- 1817-2006 stationary.

Karnataka Coast (area: 8,426 km^2; annual PE: 1400.4mm; mean annual rainfall: 3341.2 mm- winter 0.1%, summer 5.4%, monsoon 87.1% and post-monsoon 7.4%; annual rainy days: 111.6; rainy season: start- 11th May, end- 6th November and duration- 180 days) is coastal area of the Karnataka state. Earliest record from 1853 is available for *Mangalore* and *Karwar* became available from 1861. Longest rainfall sequence could be developed for the period 1853-2006. The actual and filtered rainfall series are displayed in Figure 60. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1853-1920 decrease, 1921-2006 increase; winter- 1853-2006 decrease; summer- 1853-1910 decrease, 1911-1961

increase, 1962-1987 decrease, 1988-2006 increase; summer monsoon- 1853-1996 increase, 1997-2006 decrease; post-monsoon- 1853-1908 decrease, 1909-1929 increase, 1930-1989 decrease, 1990-2006 increase; June- 1853-1961 stationary, 1962-2006 increase; July- 1853-1993 increase, 1994-2006 decrease; August- 1853-1936 stationary, 1937-1982 sharp increase, 1983-2006 sharp decrease; and September- 1853-1939 stationary, 1940-1961 increase, 1962-2006 decrease.

Kerala Plains (area: 24,144 km^2; annual PE: 1590.1 mm; mean annual rainfall: 2824.0 mm- winter 1.1%, summer 14.0%, monsoon 66.8% and post-monsoon 18.1%; annual rainy days: 121.6; rainy season: start- 15th April, end- 21st November & duration- 221 days) is relatively plain area of the Kerala state. Earliest record from 1838 is available for *Thiruvananthapuram*. The data of other 9 stations from the selected network (*Cochin, Cannanore, Kozhikode, Palghat, Trichur, Kottayam, Haripad, Punalur and Ponnani*) became available from 1871. Longest rainfall sequence could be developed for the period 1837-2006. The actual and filtered rainfall series are displayed in Figure 61. The important statistics of the rainfall sequences are given in Table 14. Chief features of the rainfall fluctuations are: annual- 1838-1924 increase but mostly below normal from 1838-1918, 1925-2006 decrease; winter- 1838-1884 decrease, 1885-1928 increase, 1929-2006 decrease; summer- 1838-1858 increase, 1859-1866 decrease, 1867-1960 increase, 1961-1996 decrease, 1997-2006 sharp increase; summer monsoon- 1838-1924 increase, 1925-2006 decrease; post-monsoon- 1838-1876 decrease, 1877-1946 increase, 1947-1982 decrease, 1983-2006 increase; June- 1838-2006 decrease; July- 1838-1925 increase, 1926-2006 decrease; August- 1838-1931 increase, 1932-2006 decrease; and September- 1838-2006 increase.

The East Coastal Plains (area: 168,481 km^2; annual PE: 1699.0 mm; mean annual rainfall: 1111.0 mm- winter 3.4%, summer 9.6%, monsoon 49.7% and post-monsoon 37.3%; annual rainy days: 56.3; rainy season: start- 27th May, end- 6th December & duration- 194 days)**–** Relatively plain area along the east coast stretching from Tamilnadu, Andhra Pradesh and Orissa states is referred to as the East Coastal Plains. Earliest record from 1813 is available for Chennai. The data of other 23 stations from the selected network is available from 1871. Longest rainfall sequence could be developed for the period 1813-2006. The actual and filtered rainfall series are displayed in Figure 62. The important statistics of the rainfall sequences are given in Table 15. Chief features of the rainfall fluctuations are as: annual- 1813-1865 decrease, 1866-2006 increase; winter- 1813-1887 decrease, 1888-1923 increase, 1924-1973 decrease, 1974-2006 increase; summer- 1813-1921 decrease, 1922-1943 increase, 1944-1985 decrease, 1986-2006 increase; summer monsoon- 1813-1931 stationary, 1932-2006 increase; post-monsoon- 1813-2006 slight increase; June- 1813-1995 stationary, 1996-2006 decrease; July- 1813-1865 decrease, 1866-2006 increase; August- 1813-1922 stationary, 1923-2006 increase; and September-1813-1902 stationary, 1903-1934 decrease, 1935-2006 increase. There are 3 provinces in the division.

Utkal Plains (area: 28,690 km^2; annual PE: 1586.6 mm; mean annual rainfall: 1478.0 mm- winter 2.8%, summer 9.8%, monsoon 71.0% and post-monsoon 16.4%; annual rainy days: 70.6; rainy season: start- 28th May, end- 3rd November and duration- 160 days) is along the east coast of the Orissa state. Earliest rainfall record for *Puri* is available from 1848. *Baleshwar* became available from 1859, *Cuttack* from 1867 and *Gopalpur and Baripada* from 1871. Longest rainfall sequence could be developed for the period 1848-2006. The actual and filtered rainfall series are displayed in Figure 63. The important statistics of the rainfall sequences are given in Table 15. Chief features of the rainfall fluctuations are: annual- 1848-1905 decrease, 1906-1940 increase, 1941-1979 decrease, 1980-2006 increase; winter- 1848-1923 increase, 1924-2006 decrease; summer- 1848-1957 decrease, 1958-2006 increase; summer monsoon- 1848-1901 decrease, 1902-1940 increase, 1941-1949 decrease, 1950-2006 increase; post-monsoon- 1848-1905 decrease, 1906-1955 increase, 1956-1982 decrease, 1983-2006 increase; June- 1848-1964 decrease, 1965-2006 increase; July- 1848-1907 stationary, 1908-1939 increase, 1940-1955 decrease, 1956-2006 stationary; August- 1848-2006 increase; and September- 1848-1940 decrease, 1941-1961 increase, 1962-1995 decrease, 1996-2006 increase.

Andhra Plains (area: 61,323 km^2; annual PE: 1655.3 mm; mean annual rainfall: 1005.2 mm- winter 2.2%, summer 7.3%, monsoon 54.5% and post-monsoon 36.0%; annual rainy days: 51.4; rainy season: start- 16th June, end- 18th November and duration- 156 days) is along the east coast of the Andhra Pradesh state. Earliest record from 1852 is available for *Guntur*. *Kakinada, Ellore, Masulipatnam and Nellore* became available 1861, *Vishakhapatnam* from 1866; *Ongole* from 1870 and *Srikakulam* from 1871. Longest rainfall sequence could be developed for the period 1852-2006. The actual and filtered rainfall series are displayed in Figure 64. The important statistics of the rainfall sequences are given in Table 15. Chief features of the rainfall fluctuations are: annual- 1852-2006 increase; winter- 1852-1889 decrease, 1890-1936 increase, 1937-1975 decrease, 1976-2006 increase; summer- 1852-2006 slight increase; summer monsoon- 1852-2006 increase; post-monsoon-1852-1878 increase, 1879-1909 decrease, 1910-1930 increase, 1931-1965 decrease, 1966-2006 increase; June-1852-1944 stationary, 1945-2006 slight increase; July-1852-1988 increase, 1989-2006 decrease; August-1852-1867 stationary, 1868-2006 increase; and September-1852-1968 stationary, 1969-2006 increase.

Tamilnadu Plains (area: 78,467 km^2; annual PE: 1762.6 mm; mean annual rainfall: 1021.2 mm- winter 4.7%, summer 11.1%, monsoon 32.2% and post-monsoon 52.0%; annual rainy days: 53.4; rainy season: start- 28th May, end- 17th December and duration- 204 days) is along the east coast of the Tamilnadu state. Earliest record from 1813 is available for *Chennai*. The data for 10 other stations of the selected network (*Tiruchirapalli, Madurai, Cuddalore, Tirunelveli, Vellore, Chingelput, Tanjavore, Pudukottai, Ramanathapuram and Nagarcoil*) became available from 1871. Longest rainfall sequence could be developed for the period 1813-2006. The actual and filtered rainfall series are displayed in Figure 65. The important statistics of the rainfall sequences are given in Table 15. Chief features of the rainfall fluctuations are: annual- 1813-1867 decrease, 1868-1920 increase, 1921-1952 decrease, 1953-2006

increase; winter- 1813-1886 stationary, 1887-1923 increase, 1924-2006 decrease; summer- 1813-1910 decrease, 1911-1943 increase, 1944-1985 decrease, 1986-2006 increase; summer monsoon- 1813-1865 stationary, 1866-1910 increase, 1911-1934 decrease, 1935-1961 increase, 1962-2006 decrease; post-monsoon- 1813-1948 stationary, 1949-2006 increase; June- 1813-1979 stationary, 1980-1996 increase, 1997-2006 decrease; July- 1813-1915 stationary, 1916-1939 decrease, 1940-1984 increase, 1985-2006 decrease; August- 1813-1966 increase, 1967-2006 decrease; and September- 1813-1864 decrease, 1865-1903 increase, 1904-1934 decrease, 1935-2006 increase.

The Whole India (area: 3,188,111 km^2; annual PE: 1522.2 mm; mean annual rainfall: 1165.9 mm- winter 2.7%, summer 8.7%, monsoon 77.8% and post-monsoon 10.8%;annual rainy days: 57.4; rainy season: start- 29th May, end- 11th October & duration- 136 days)- As general information longest monthly, seasonal and annual rainfall series have also been prepared for the whole country. Details of available rainfall data of 316 stations are given in '*Rainfall Data Used*'. For the period 1813-1900 the different rainfall series have been constructed and for the period 1901-2006 the series are simple arithmetic mean of the 316 raingauges. Longest annual, seasonal and monsoon monthly rainfall sequence of the whole country could be developed for the period 1813-2006. The actual and filtered rainfall series are displayed in Figure 66. The important statistics of the rainfall sequences are given in Table 16. Chief features of the rainfall fluctuations are as: annual- 1813-1838 decrease, 1839-1893 increase,1894-1899 decrease, 1900-1961 increase, 1962-2006 slight decrease; winter- 1813-1944 increase, 1945-1964 decrease, 1965-1995 increase, 1996-2006 decrease; summer- 1813-1922 decrease, 1923-1943 increase, 1944-1966 decrease, 1967-2006 increase; summer monsoon- 1813-1848 decrease, 1849-1892 increase, 1893-1899 decrease, 1900-1961 increase, 1962-2006 decrease; post-monsoon- 1813-1908 decrease, 1909-2006 increase; June- 1813-1893 increase, 1894-1962 decrease, 1963-2006 increase; July- 1813-1882 increase, 1883-1918 decrease, 1919-1942 increase, 1943-2006 decrease; August- 1813-1855 decrease, 1856-1963 increase, 1964-2006 decrease; and September- 1813-1845 decrease, 1846-1961 increase, 1962-2006 decrease.

6. A SUMMARY OF RECENT TENDENCY IN RAINFALL FLUCTUATIONS OVER THE COUNTRY

The physiographic subdivisions/provinces are grouped in three categories based on recent tendency (increase, decrease or no trend) in each of annual, seasonal and monsoon monthly rainfall fluctuations. The percentage area of the country under different tendency has been worked out from total area of the subdivisions/provinces.

1. Annual rainfall- **22.4% area of the country shows increasing trend** (*Bengal Basin, Assam Valley, Vindhyan Scarplands, Chhotanagpur Plateau, North Sahyadri, Eastern Ghats (South), Tamilnadu Uplands, Kathiawar Peninsula, Konkan, Karnataka Coast, Utkal Plains, Andhra Plains, Tamilnadu Plains*), **68.1% decreasing trend** (*Punjab Plains, Ganga-Yamuna Doab, Rohilkhand*

Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Bengal Plains, Meghalaya, Purvanchal, Marusthali, Rajasthan Bagar, Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar, Bundelkhand Upland, Malwa Plateau, Vindhya Range, Narmada Valley, Satpura Range, Karnataka Plateau, Telangana Plateau, Baghelkhand Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, South Sahyadri, Nilgiri, Eastern Ghats (North), Gujarat Plains, Kerala Plains)) and remaining **9.5% no trend** (*Maharashtra Plateau, Central Sahyadri, Kachchh Peninsula)*. Figure 67 depicts geographical distribution of recent tendencies in annual rainfall and pie diagram shows area under different tendencies. Annual rainfall over India from 1944-1969 to 1970-2006 has decreased by 4.11%.

2. Winter rainfall- **37.1% area of the country shows increasing trend** (*South Kashmir Himalaya, Punjab Plains, Bengal Plains, Assam Valley, Meghalaya, Marusthali, Narmada Valley, Satpura Range, Maharashtra Plateau, Telangana Plateau, Mahanadi Basin, South Sahyadri, Eastern Ghats (South), Andhra Plains*), **46.6% decreasing trend** (*Punjab Himalaya, Kumaun Himalaya, Ganga-Yamuna Doab, Avadh Plains, North Bihar Plains, South Bihar Plains, Purvanchal, Aravalli Range, East Rajasthan Uplands, Bundelkhand Upland, Vindhyan Scarplands, Vindhya Range, Karnataka Plateau, Baghelkhand Plateau, Chhotanagpur Plateau, Garhjat Hills, Central Sahyadri, Nilgiri, Tamilnadu Uplands, Kachchh Peninsula, Kathiawar Peninsula, Gujarat Plains, Konkan, Karnataka Coast, Kerala Plains, Utkal Plains, Tamilnadu Plains*) and remaining **16.3% no trend** (*Rohilkhand Plains, Bengal Basin, Rajasthan Bagar, Madhya Bharat Pathar, Malwa Plateau, Dandakaranya, North Sahyadri, Eastern Ghats (North))* (Figure 68a). The winter rainfall over the country from 1892-1948 to 1949-2006 has decreased by 17.18%.

3. Summer rainfall- **73.3% area of the country shows increasing trend** (*Punjab Himalaya, Kumaun Himalaya, Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Bengal Plains, Bengal Basin, Assam Valley, Meghalaya, Purvanchal, Marusthali, Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar, Bundelkhand Upland, Malwa Plateau, Vindhyan Scarplands, Vindhya Range, Narmada Valley, Satpura Range, Maharashtra Plateau, Chhotanagpur Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, Central Sahyadri, Eastern Ghat (South), Konkan, Karnataka Coast, Kerala Plains, Utkal Plains, Andhra Plains, Tamilnadu Plains*), **16.9% decreasing trend** (*South Kashmir Himalaya, Rajasthan Bagar, Karnataka Plateau, South Sahyadri, Nilgiri, Eastern Ghats (North), Tamilnadu Uplands, Gujarat Plains*) and remaining **9.7% no trend** (*Telangana Plateau, Baghelkhand Plateau, North Sahyadri, Kachchh Peninsula, Kathiawar Peninsula*) (Figure 68b). The summer rainfall over the country from 1962-1996 to 1997-2006 has increased by 18.10%.

4. Summer monsoon rainfall- **24.1% area of the country shows increasing trend** (*Bengal Basin, Vindhyan Scarplands, Maharashtra Plateau, Chhotanagpur Plateau, North Sahyadri, Kathiawar Peninsula, Gujarat Plains, Konkan, Utkal Plains, Andhra Plains*), **74.7% decreasing trend** (*South Kashmir Himalaya, Punjab Himalaya, Kumaun Himalaya, Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Bengal Plains, Assam Valley, Meghalaya, Purvanchal, Marusthali, Rajasthan Bagar, Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar, Bundelkhand Upland, Malwa Plateau, Vindhya Range, Narmada Valley, Satpura Range, Karnataka Plateau, Telangana Plateau, Baghelkhand Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, South Sahyadri, Nilgiri, Eastern Ghats (North), Eastern Ghats (South), Tamilnadu Uplands, Karnataka Coast, Kerala Plains*) and remaining **1.2 % no trend** (*Central Sahyadri, Kachchh Peninsula, Tamilnadu Plains)* (Figure 68c). The summer monsoon rainfall over the country from 1931-1964 to 1965-2006 has decreased by 4.72%.

5. Post-monsoon rainfall- **54.4% area of the country shows increasing trend** (*South Kashmir Himalaya, Bengal Plains, Bengal Basin, Assam Valley, Meghalaya, Marusthali, Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar, Maharashtra Plateau, Telangana Plateau, Chhotanagpur Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, North Sahyadri, South Sahyadri, Eastern Ghats (North), Eastern Ghats (South), Tamilnadu Uplands, Kachchh Peninsula, Karnataka Coast, Kerala Plains, Utkal Plains, Andhra Plains, Tamilnadu Plains*), **37.5 % decreasing trend** (*Kumaun Himalaya, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Purvanchal, Rajasthan Bagar, Bundelkhand Upland, Malwa Plateau, Vindhya Range, Narmada Valley, Satpura Range, Karnataka Plateau, Baghelkhand Plateau, Central Sahyadri, Nilgiri, Kathiawar Peninsula, Konkan*) and remaining **8.1 % no trend** (*Punjab Himalaya, Punjab Plains, Vindhyan Scarplands, Gujarat Plains)* (Figure 68d). The post-monsoon rainfall over the country from 1827-1914 to 1915-2006 has increased by 13.32%.

6. June rainfall- **55.1% area of the country shows increasing trend** (*South Kashmir Himalaya, Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Marusthali, Rajasthan Bagar, East Rajasthan Uplands, Vindhyan Scarplands, Maharashtra Plateau, Karnataka Plateau, Chhotanagpur Plateau, Garhjat Hills, North Sahyadri, Central Sahyadri, Eastern Ghats (South), Kachchh Peninsula, Kathiawar Peninsula, Gujarat Plains, Karnataka Coast, Utkal Plains, Andhra Plains*), **40.7% decreasing trend** (*Punjab Himalaya, Kumaun Himalaya, Bengal Plains, Bengal Basin, Assam Valley, Meghalaya, Purvanchal, Aravalli Range, Malwa Plateau, Vindhya Range, Narmada Valley, Satpura Range, Telangana Plateau, Baghelkhand Plateau, Mahanadi Basin, Dandakaranya, South Sahyadri, Nilgiri,*

Eastern Ghats (North), Tamilnadu Uplands, Kerala Plains, Tamilnadu Plains) and remaining **4.2% no trend** (*Madhya Bharat Pathar, Bundelkhand Upland, Konkan)* (Figure 69a). The June rainfall over the country from 1944-1969 to 1970-2006 has increased by 11.33%.

7. July rainfall- **9.4% area of the country shows increasing trend** (*South Bihar Plains, Bengal Basin, Vindhyan Scarplands, Narmada Valley, North Sahyadri, Kachchh Peninsula, Gujarat Plains*), **85.1% decreasing trend** (*South Kashmir Himalaya, Punjab Himalaya, Kumaun Himalaya, Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, Bengal Plains, Assam Valley, Purvanchal, Marusthali, Rajasthan Bagar, Aravalli Range, East Rajasthan Uplands, Madhya Bharat Pathar, Bundelkhand Upland*, *Malwa Plateau, Vindhya Range, Satpura Range, Maharashtra Plateau, Karnataka Plateau, Telangana Plateau, Baghelkhand Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, Central Sahyadri, South Sahyadri, Nilgiri, Eastern Ghats (North), Eastern Ghats (South), Tamilnadu Uplands, Kathiawar Peninsula, Konkan, Karnataka Coast, Kerala Plains, Andhra Plains, Tamilnadu Plains*) and remaining **5.5% no trend** (*Meghalaya, Chhotanagpur Plateau, Utkal Plains)* (Figure 69b). The July rainfall over the country from 1920-1969 to 1970-2006 has decreased by 7.99%.

8. August rainfall- **37.6% area of the country shows increasing trend** (*Aravalli Range, Malwa Plateau, Vindhya Range, Narmada Valley, Maharashtra Plateau, Karnataka Plateau, Dandakaranya, North Sahyadri, Central Sahyadri, Eastern Ghats (North), Eastern Ghats (South), Kachchh Peninsula, Kathiawar Peninsula, Gujarat Plains, Konkan, Utkal Plains, Andhra Plains*), **58.3% decreasing trend** (*South Kashmir Himalaya, Punjab Himalaya, Kumaun Himalaya, Punjab Plains, Ganga-Yamuna Doab, Rohilkhand Plains, Avadh Plains, North Bihar Plains, South Bihar Plains, Bengal Plains, Assam Valley, Meghalaya, Purvanchal, Marusthali, Rajasthan Bagar, East Rajasthan Uplands, Madhya Bharat Pathar, Bundelkhand Upland, Vindhyan Scarplands, Satpura Range, Telangana Plateau, Baghelkhand Plateau, Chhotanagpur Plateau, Mahanadi Basin, Nilgiri, Tamilnadu Uplands, Karnataka Coast, Kerala Plains, Tamilnadu Plains*) and remaining **4.2% no trend** (*Bengal Basin, Garhjat Hills, South Sahyadri*) (Figure 69c). The August rainfall over the country from 1939-1997 to 1998-2006 has decreased by 10.90%.

9. September rainfall- **23.5% area of the country shows increasing trend** (*Ganga-Yamuna Doab, Bengal Basin, Purvanchal, Vindhyan Scarplands, Baghelkhand Plateau, Chhotanagpur Plateau, North Sahyadri, Nilgiri, Kathiawar Peninsula, Kerala Plains, Utkal Plains, Andhra Plains, Tamilnadu Plains*), **68.3% decreasing trend** (*South Kashmir Himalaya, Punjab Himalaya, Kumaun Himalaya, Punjab Plains, Avadh Plains, North Bihar Plains, Bengal Plains, Assam Valley, Meghalaya, Marusthali, Rajasthan Bagar, East Rajasthan*

Uplands, Aravalli Range, Madhya Bharat Pathar, Bundelkhand Upland, Malwa Plateau, Vindhya Range, Satpura Range, Maharashtra Plateau, Karnataka Plateau, Telangana Plateau, Mahanadi Basin, Garhjat Hills, Dandakaranya, Central Sahyadri, Eastern Ghats (North), Tamilnadu Uplands, Gujarat Plains, Karnataka Coast) and remaining **8.3% no trend** (*Rohilkhand Plains, South Bihar Plains, Narmada Valley, South Sahyadri, Eastern Ghats (South), Kachchh Peninsula, Konkan*) (Figure 69d). The September rainfall over the country from 1942-1964 to 1965-2006 has decreased by 12.23%.

7. POSSIBLE REASON FOR RECENT LARGE-SCALE CHANGES IN MONSOON RAINFALL

Gradient in the geopotential height (GPH) of the upper tropospheric isobaric levels from Tibetan Anticyclone (TA) region to southern tropical Indian Ocean (STIO) region can be used as index of intensity of Indian monsoon circulation (Singh et al. 2006). For the present study combined area of the Iranian High (32.5°N-40°N; 50.0°E-72.5°E) and the West Tibet (27.5°N-37.5°N; 72.5°E-85°E) is considered as TA region and the area between parallels 45.0°E to145°E and meridians 5°S to 20°S as STIO region. For June, the interannual variation (1949-2006) of the geopotential height gradient (GPHG) at 300 hPa (NCEP/NCAR reanalysis data, Kalnay et al. 1996) from TA to STIO region is shown in Figure 70A on standardized scale along with rainfall over India (north of 18°N). The correlation coefficient (CC) of 0.77 between the two parameters is significant at 0.1% level and above. For July, August and September the GPHG of the 200 hPa level is used, the time series of the GPHG and the corresponding period rainfall on standardized scale are shown in Figure 70A. The bottom most panel of Figure 70A gives the time series of the two parameters for the whole season. For July CC is 0.67, for August 0.51, for September 0.60 and whole season 0.72 and in every case the CC is significant at 0.1% level and above. Interesting to notice is that the two parameters are in excellent agreement during extreme years which suggest possibility of exploring cause and effect relationship between them.

To know salient features of the low frequency mode fluctuations the 9-point Gaussian low-pass filtered values of the two parameters are shown in Figure 70B for the four monsoon months and the whole season. The two parameters for June show rising tendency from late 1950s, but for other three monsoon months and the season they show declining tendency. The June GPH of the 300 hPa is rising over the TA region at the rate of 5.96 m/decade (significant at 1% level) and over the STIO region at the rate of 4.93 m/decade (significant at 0.1% level). Therefore the GPHG shows mild increasing tendency which is producing slight increase in June rainfall over the country. During July, August, September and the whole season the GPH of the 200 hPa level over the STIO region is rising at the rate of 5.03 m, 5.47 m, 4.59 m and 5.0 m per decade respectively, all significant at 0.1% level, but over the TA region the rising rate is 3.84 m/decade (significant at 10% level), 5.03 m/decade (significant at 1% level), 1.27 m/decade (not significant) and 4.03 m/decade (significant at 5% level) respectively.

The rising tendency in the 200 hPa GPH is at a faster rate over the STIO region compared to the TA region, therefore, the GPHG from the TA region to STIO region shows slight decreasing tendency (statistically not significant). This weaker GPH in the upper tropospheric level contributes partially to reduction in rainfall over the country. Possible cause of decline in the upper tropospheric GPHG (and the monsoon circulation intensity) is being investigated. Preliminary correlation analysis between tropospheric vertical temperature field and the 200 hPa level GPH did not produce satisfactory results. Over the TA region, the GPH of the 300 hPa level for June and the 200 hPa for July, August and September show rising tendency but mean temperature of 600-300 hPa tropospheric column shows decreasing tendency. Of course, over the STIO region both the GPH and the mean tropospheric temperature show steep rising trend (significant at 0.1% level and above) while fluctuating coherently. The CC between the GPH and the mean tropospheric temperature over the STIO region is 0.92 for June, July and August and 0.89 for September and 0.58 for the whole season, all CCs are significant at 0.1 % level and above.

8. CONCLUSION

From quantitative-subjective analysis of rainfall fluctuation over 49 physiographic subdivisions/provinces the annual rainfall is found showing decreasing tendency in recent years/decades over ~68% area of the country. Decreasing tendency in annual rainfall is due to decrease in winter and summer monsoon rainfalls, winter rainfall shows decrease over ~47% area and monsoon over ~75% area. The summer and the post-monsoon rainfall shows increasing tendency over ~73% and ~54% area respectively. During monsoon, declining tendency is seen in July rainfall over ~85% area, August rainfall over ~58% area and September rainfall over ~69% area but June rainfall showed increasing tendency over ~55% area of the country.

Decrease in the GPHG of the upper tropospheric isobaric levels from the TA region to the STIO region, indicating decline in the intensity of monsoon circulation, appears to be the major reason of large-scale decrease in the monsoon rainfall over the country. Possible causes of the changes in the intensity of the monsoon circulation are being investigated and results will be published elsewhere. Further investigations are also underway for possible causes of changes in winter, summer and post-monsoon rainfalls.

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Table1: Important statistics and the parameters of the spatial coherency and representation of annual, seasonal and monsoon monthly area-averaged rainfall series (1901-2000) of the Western Himalaya and its subdivisions/provinces

THE WESTERN HIMALAYA									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1562.1	158.4	195.0	1118.8	89.9	139.5	397.6	400.1	181.5
Median (mm)	1540.0	152.7	185.7	1116.0	81.8	127.8	406.1	385.8	174.4
SD	225.5	63.6	75.7	220.8	59.4	66.2	107.5	103.5	89.4
CV(%)	14.4	40.2	38.8	19.7	66.1	47.5	27.0	25.9	49.3
Q_1 (mm)	1336.1	97.2	129.2	948.5	40.7	84.1	306.8	316.9	107.9
Q_2 (mm)	1488.4	137.1	165.3	1035.1	68.5	115.4	372.4	361.4	143.6
Q_3 (mm)	1592.7	168.0	201.0	1160.4	88.9	144.0	421.3	413.1	203.6
Q_4 (mm)	1768.5	217.1	260.9	1306.8	118.6	187.5	476.5	478.9	253.3
$\bar{r}$	0.14	0.45	0.49	0.20	0.50	0.29	0.17	0.17	0.32
$\bar{R}$	0.47	0.70	0.72	0.49	0.74	0.59	0.47	0.48	0.61
IAR(%)	20.1	58.0	59.4	22.2	48.2	27.0	21.5	21.6	31.6
South Kashmir Himalaya									
Mean (mm)	1084.4	170.5	215.1	609.6	89.2	59.6	222.2	231.8	96.0
Median (mm)	1066.3	162.5	199.6	585.8	74.8	51.1	210.8	235.6	77.6
SD	234.2	79.3	101.7	205.5	63.3	41.7	102.9	107.2	74.0
CV(%)	21.6	46.5	47.3	33.7	71.0	70.1	46.3	46.3	77.1
Q_1 (mm)	848.2	99.6	130.3	419.0	33.9	27.4	129.0	130.5	32.2
Q_2 (mm)	1023.1	140.0	177.0	536.9	57.2	42.4	180.0	187.3	66.0
Q_3 (mm)	1108.5	189.0	215.4	633.7	91.6	56.7	246.4	254.9	88.5
Q_4 (mm)	1292.0	245.7	311.2	767.9	138.2	83.8	306.7	312.4	141.1
$\bar{r}$	0.36	0.52	0.53	0.20	0.58	0.31	0.24	0.22	0.41
$\bar{R}$	0.74	0.81	0.82	0.63	0.85	0.71	0.66	0.65	0.75
IAR(%)	54.3	62.2	62.2	42.0	70.7	53.4	45.0	41.6	55.5
Punjab Himalaya									
Mean (mm)	1820.1	189.6	225.7	1297.0	97.7	138.2	483.2	482.8	202.7
Median (mm)	1780.9	186.6	208.4	1276.8	82.5	126.0	476.3	480.3	188.6
SD	362.9	75.5	92.9	377.6	70.5	76.5	187.8	172.5	122.7
CV(%)	19.9	39.8	41.2	29.1	72.2	55.3	38.9	35.7	60.5
Q_1 (mm)	1531.2	117.1	142.0	1053.7	38.6	70.5	344.1	342.8	82.1
Q_2 (mm)	1694.5	160.8	182.8	1207.5	67.1	99.5	452.5	425.4	145.8
Q_3 (mm)	1843.9	197.2	241.4	1331.9	99.3	140.9	523.5	517.9	234.2
Q_4 (mm)	2068.0	254.8	292.3	1566.2	144.0	206.4	591.6	577.8	305.4
$\bar{r}$	0.27	0.51	0.68	0.41	0.64	0.40	0.32	0.42	0.49
$\bar{R}$	0.65	0.82	0.89	0.71	0.87	0.75	0.65	0.72	0.76
IAR(%)	43.1	67.4	78.1	44.8	73.2	55.2	42.0	46.2	52.0
Kumaun Himalaya									
Mean (mm)	1726.8	125.8	156.9	1359.5	84.5	200.5	465.0	464.3	229.8
Median (mm)	1713.5	121.9	149.1	1340.8	63.5	186.7	465.0	449.2	211.8
SD	285.0	62.2	71.1	265.0	76.6	107.7	121.6	135.6	128.3
CV(%)	16.5	49.4	45.3	19.5	90.7	53.7	26.2	29.2	55.8
Q_1 (mm)	1456.2	70.7	87.8	1136.8	30.6	114.0	367.4	339.5	119.0
Q_2 (mm)	1651.2	105.3	130.0	1251.7	50.5	158.6	429.5	432.4	180.9
Q_3 (mm)	1804.6	139.6	168.5	1428.1	69.0	198.9	488.2	480.0	221.3
Q_4 (mm)	1939.1	171.6	222.0	1575.3	130.6	256.7	570.8	558.8	327.7
$\bar{r}$	0.09	0.46	0.45	0.14	0.68	0.42	0.15	0.18	0.49
$\bar{R}$	0.54	0.77	0.76	0.56	0.87	0.74	0.56	0.58	0.78
IAR(%)	30.0	58.0	56.6	31.7	70.2	47.6	33.5	36.4	57.5

Table 2: Same as in Table 1, but for the Northern Plains and its subdivisions/ provinces

THE NORTHERN PLAINS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	846.8	40.6	38.5	722.0	45.8	81.5	245.5	241.8	153.2
Median (mm)	848.3	35.7	31.8	729.1	35.2	76.5	244.8	236.7	151.7
SD	148.2	24.0	24.0	139.4	42.0	44.7	75.8	66.4	63.7
CV(%)	17.5	59.1	62.3	19.3	91.9	54.9	30.9	27.4	41.6
Q_1 (mm)	700.1	19.4	19.9	599.3	11.2	41.2	182.8	188.3	100.1
Q_2 (mm)	822.0	31.2	26.5	684.0	26.0	63.3	228.0	217.5	137.8
Q_3 (mm)	889.0	42.5	36.3	768.7	41.6	83.4	258.9	256.4	167.4
Q_4 (mm)	961.2	61.2	55.3	836.1	67.6	114.4	310.5	297.4	201.5
$\bar{r}$	0.30	0.52	0.46	0.30	0.45	0.36	0.32	0.25	0.27
$\bar{R}$	0.56	0.72	0.68	0.56	0.67	0.60	0.57	0.51	0.53
IAR(%)	30.7	49.8	43.6	30.1	43.5	34.3	31.5	26.0	26.5
Punjab Plains									
Mean (mm)	637.8	48.7	46.7	510.2	32.2	51.4	183.2	174.3	101.2
Median (mm)	633.3	42.7	41.2	510.3	21.9	49.9	179.4	161.6	80.3
SD	159.0	28.8	30.9	154.9	37.5	33.0	75.3	79.1	88.1
CV(%)	24.9	59.2	66.2	30.4	116.5	64.1	41.1	45.4	87.0
Q_1 (mm)	493.4	22.3	21.9	379.8	6.1	18.3	125.4	102.4	26.6
Q_2 (mm)	576.3	36.2	33.9	461.7	15.6	35.1	166.7	146.5	61.2
Q_3 (mm)	667.9	52.3	46.4	539.6	29.8	55.7	192.7	175.1	92.9
Q_4 (mm)	760.5	78.9	66.9	632.8	49.1	77.5	230.6	237.1	150.3
$\bar{r}$	0.46	0.60	0.57	0.48	0.60	0.43	0.43	0.46	0.56
$\bar{R}$	0.70	0.78	0.77	0.71	0.78	0.67	0.68	0.69	0.76
IAR(%)	46.9	58.0	57.1	48.7	56.6	44.2	44.7	46.5	55.5
Ganga-Yamuna Doab									
Mean (mm)	802.8	35.3	29.7	695.2	42.5	69.0	232.9	248.7	144.5
Median (mm)	799.6	30.5	23.6	710.4	27.7	58.8	235.8	237.4	139.2
SD	163.2	23.4	23.0	154.4	45.2	49.6	81.8	87.0	76.1
CV(%)	20.3	66.2	77.4	22.2	106.5	71.9	35.1	35.0	52.7
Q_1 (mm)	684.8	16.4	11.5	566.4	10.1	27.5	161.3	177.2	75.4
Q_2 (mm)	772.6	25.9	17.8	684.5	22.0	47.5	203.8	221.6	118.1
Q_3 (mm)	846.9	35.4	30.3	736.1	35.0	63.4	264.1	270.3	168.5
Q_4 (mm)	949.8	53.1	41.2	824.0	67.8	94.6	306.7	316.8	200.8
$\bar{r}$	0.40	0.59	0.57	0.39	0.55	0.48	0.37	0.40	0.44
$\bar{R}$	0.66	0.78	0.77	0.65	0.76	0.71	0.64	0.66	0.69
IAR(%)	42.4	57.2	56.5	41.3	56.9	49.5	37.2	43.7	46.7
Rohilkhand Plains									
Mean (mm)	1028.3	44.5	42.9	882.8	58.2	112.0	299.0	288.8	182.9
Median (mm)	1045.1	40.1	34.2	896.7	31.2	102.9	304.9	275.8	176.1
SD	233.2	31.6	31.3	216.8	71.0	76.7	110.7	104.9	100.5
CV(%)	22.7	71.0	72.9	24.6	122.0	68.5	37.0	36.3	55.0
Q_1 (mm)	831.0	18.5	16.3	711.6	10.4	44.3	196.1	191.9	92.6
Q_2 (mm)	992.8	30.6	26.2	824.2	23.3	86.0	278.2	251.7	152.4
Q_3 (mm)	1080.9	44.9	42.4	925.4	41.6	116.0	323.5	314.9	197.8
Q_4 (mm)	1200.8	67.0	67.5	1063.3	98.9	164.7	381.4	367.3	268.6
$\bar{r}$	0.48	0.68	0.57	0.47	0.71	0.53	0.50	0.44	0.51
$\bar{R}$	0.73	0.85	0.79	0.73	0.86	0.77	0.74	0.71	0.75
IAR(%)	53.5	69.5	60.9	53.2	73.7	58.6	55.3	50.6	55.5

Avadh Plains									
Mean (mm)	1048.5	33.0	33.0	923.7	58.9	112.7	306.1	295.0	209.9
Median (mm)	1035.5	31.5	28.4	915.0	39.7	100.5	304.0	285.0	212.2
SD	202.0	23.1	23.2	192.3	57.5	63.1	109.0	82.4	90.9
CV(%)	19.3	70.0	70.4	20.8	97.7	56.0	35.6	27.9	43.3
Q_1 (mm)	891.1	13.5	12.1	777.6	12.5	54.6	214.9	230.1	126.9
Q_2 (mm)	1005.7	24.1	22.5	888.6	28.9	81.7	278.2	265.9	176.7
Q_3 (mm)	1071.5	36.0	34.2	931.0	54.9	124.7	323.6	308.8	231.6
Q_4 (mm)	1173.8	44.8	49.4	1037.4	99.7	160.8	389.0	369.1	286.3
$\bar{r}$	0.46	0.63	0.52	0.46	0.66	0.47	0.49	0.34	0.45
$\bar{R}$	0.70	0.81	0.73	0.70	0.82	0.70	0.72	0.61	0.69
IAR(%)	48.5	64.7	51.3	48.8	66.5	46.9	51.2	36.9	46.9

Table 3: Same as in Table 1, but for the Eastern Plains and its subdivisions/ provinces

THE EASTERN PLAINS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1460.4	34.4	152.5	1155.1	118.4	232.8	345.9	325.0	251.4
Median (mm)	1466.7	30.3	147.7	1152.8	107.1	215.9	344.6	318.1	245.6
SD	184.7	23.6	55.2	146.9	64.7	79.7	74.5	66.5	68.1
CV(%)	12.6	68.6	36.2	12.7	54.6	34.2	21.5	20.5	27.1
Q_1 (mm)	1279.7	14.7	99.4	1012.0	63.4	168.2	277.4	271.8	192.9
Q_2 (mm)	1404.4	25.4	137.0	1115.1	90.1	198.8	327.3	300.9	235.6
Q_3 (mm)	1509.7	36.6	166.3	1182.1	117.0	232.5	357.5	334.6	258.1
Q_4 (mm)	1603.3	53.7	192.4	1266.1	167.0	285.3	402.8	373.6	301.5
$\bar{r}$	0.30	0.43	0.43	0.25	0.45	0.40	0.24	0.20	0.25
$\bar{R}$	0.57	0.67	0.66	0.52	0.68	0.65	0.52	0.47	0.53
IAR(%)	30.4	36.9	37.4	25.5	43.0	37.9	23.7	20.5	25.8
North Bihar Plains									
Mean (mm)	1213.8	28.0	81.7	1026.3	77.8	174.8	320.5	305.7	225.3
Median (mm)	1217.7	22.3	79.7	1012.6	57.3	153.6	315.7	293.0	233.1
SD	200.7	20.4	41.3	184.9	65.9	85.5	104.7	101.4	86.4
CV(%)	16.5	73.0	50.5	18.0	84.7	48.9	32.7	33.2	38.3
Q_1 (mm)	1049.0	10.3	43.7	877.1	20.9	102.6	223.2	211.1	137.4
Q_2 (mm)	1138.1	17.6	68.4	982.1	45.0	141.7	281.3	268.9	196.7
Q_3 (mm)	1282.2	29.7	90.6	1059.5	73.1	181.0	340.2	318.6	246.8
Q_4 (mm)	1388.1	43.0	113.0	1167.3	128.4	223.0	412.7	378.4	293.6
$\bar{r}$	0.41	0.63	0.50	0.41	0.62	0.53	0.46	0.40	0.41
$\bar{R}$	0.68	0.82	0.73	0.68	0.81	0.76	0.72	0.68	0.68
IAR(%)	46.2	66.5	50.3	46.3	65.2	57.2	51.0	46.1	46.2
South Bihar Plains									
Mean (mm)	1141.1	35.3	60.2	968.4	77.3	156.7	300.3	295.5	215.9
Median (mm)	1150.2	24.9	55.6	956.9	58.6	134.4	291.2	281.2	215.6
SD	209.1	30.4	36.4	191.4	64.3	85.3	105.7	92.5	82.9
CV(%)	18.3	86.1	60.5	19.8	83.2	54.4	35.2	31.3	38.4
Q_1 (mm)	960.2	11.8	23.0	790.6	18.7	81.7	205.6	216.1	130.3
Q_2 (mm)	1099.4	18.5	48.7	924.4	48.3	110.4	272.8	251.3	187.1
Q_3 (mm)	1192.7	37.1	66.3	994.7	74.9	174.4	303.8	294.2	230.4
Q_4 (mm)	1312.6	53.6	89.9	1105.2	138.4	226.7	377.7	366.3	297.5
$\bar{r}$	0.43	0.69	0.56	0.41	0.67	0.57	0.52	0.38	0.37
$\bar{R}$	0.74	0.86	0.80	0.73	0.86	0.81	0.78	0.71	0.70
IAR(%)	54.2	67.9	61.8	52.4	72.5	64.8	61.4	50.4	48.6

				Bengal Plains					
Mean (mm)	2521.9	28.3	342.7	2000.6	150.4	495.7	608.8	486.2	409.9
Median (mm)	2497.9	23.3	319.6	1981.9	127.3	486.2	608.3	461.0	392.8
SD	337.7	21.6	96.5	304.3	101.6	138.2	154.0	167.8	134.3
CV(%)	13.4	76.5	28.2	15.2	67.6	27.9	25.3	34.5	32.8
Q_1 (mm)	2213.1	10.8	262.1	1773.8	69.8	385.6	470.0	351.2	294.2
Q_2 (mm)	2430.4	19.4	301.8	1899.0	106.8	451.0	558.7	429.6	360.7
Q_3 (mm)	2589.7	27.0	360.7	2034.9	144.4	510.8	645.7	507.7	421.7
Q_4 (mm)	2771.5	44.9	420.9	2241.8	212.3	606.6	732.9	575.4	509.6
$\bar{r}$	0.30	0.52	0.26	0.31	0.55	0.31	0.30	0.44	0.27
$\bar{R}$	0.66	0.78	0.61	0.66	0.80	0.65	0.64	0.73	0.64
IAR(%)	42.0	59.8	37.4	42.9	61.2	42.5	42.4	52.8	41.3
				Bengal Basins					
Mean (mm)	1534.4	38.7	194.8	1150.4	150.4	250.0	329.1	318.4	252.9
Median (mm)	1494.0	31.2	194.0	1120.9	135.6	230.8	330.2	301.0	233.5
SD	230.4	32.4	76.8	176.1	82.4	98.4	83.7	80.4	86.9
CV(%)	15.0	83.7	39.4	15.3	54.8	39.3	25.4	25.3	34.4
Q_1 (mm)	1335.7	12.8	123.1	970.6	82.4	166.6	254.5	251.4	182.9
Q_2 (mm)	1433.9	26.0	166.3	1078.6	118.7	213.4	301.3	279.1	217.6
Q_3 (mm)	1584.5	37.3	210.3	1197.3	149.5	259.5	347.3	323.3	256.4
Q_4 (mm)	1736.3	61.3	249.9	1288.5	212.8	326.8	396.9	382.3	311.1
$\bar{r}$	0.42	0.56	0.51	0.36	0.56	0.54	0.32	0.33	0.42
$\bar{R}$	0.68	0.76	0.74	0.65	0.77	0.76	0.61	0.62	0.68
IAR(%)	45.6	49.5	53.3	41.3	56.4	57.5	35.6	37.7	45.1

Table 4: Important statistics and the parameters of the spatial coherency and representation of different area-averaged rainfall series (1901-2000) of the Indo-Gangetic Plains

	THE INDO-GANGETIC PLAINS								
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1025.7	38.7	71.4	848.6	66.9	125.5	274.7	266.2	182.2
Median (mm)	1012.6	36.4	68.3	851.7	55.3	115.2	272.8	264.9	182.6
SD	128.3	21.3	28.0	115.3	41.3	48.2	65.6	51.6	53.3
CV(%)	12.5	55.1	39.2	13.6	61.6	38.4	23.9	19.4	29.2
Q_1 (mm)	924.1	18.7	45.4	738.7	32.6	79.3	217.1	223.2	134.1
Q_2 (mm)	986.2	29.5	59.9	818.6	49.2	104.5	254.5	252.0	169.2
Q_3 (mm)	1051.8	39.5	78.0	876.3	61.9	131.3	290.8	275.4	191.0
Q_4 (mm)	1136.9	57.5	95.8	940.1	101.8	164.5	331.1	308.9	226.0
$\bar{r}$	0.21	0.41	0.36	0.19	0.34	0.30	0.23	0.15	0.18
$\bar{R}$	0.46	0.64	0.58	0.45	0.58	0.54	0.48	0.39	0.44
IAR(%)	19.7	36.2	23.8	18.9	29.7	25.7	21.8	14.6	17.6

Table 5: Same as in Table 1, but for the North Eastern Ranges and its subdivisions/ provinces

THE NORTH EASTERN RANGES									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	2287.0	47.2	556.0	1489.1	194.7	426.9	419.3	364.1	278.8
Median (mm)	2286.9	43.1	549.1	1483.2	195.2	424.4	406.9	359.5	275.5
SD	215.1	26.2	115.9	146.9	76.5	81.6	83.1	70.5	63.9
CV(%)	9.4	55.5	20.8	9.9	39.3	19.1	19.8	19.4	22.9
Q_1 (mm)	2087.4	28.1	456.4	1380.8	126.1	365.8	350.9	300.2	219.3
Q_2 (mm)	2212.7	37.4	514.1	1440.2	172.3	395.8	389.5	343.5	261.7
Q_3 (mm)	2334.2	52.2	572.8	1526.3	212.3	444.9	436.1	381.9	288.1
Q_4 (mm)	2467.2	64.7	650.5	1591.1	249.3	489.1	488.4	414.3	333.6
$\overline{r}$	0.23	0.48	0.33	0.15	0.42	0.22	0.19	0.19	0.23
$\overline{R}$	0.53	0.72	0.61	0.46	0.67	0.52	0.50	0.49	0.53
IAR(%)	26.4	48.4	34.4	21.5	41.6	26.3	26.3	24.0	27.1
Assam Valley									
Mean (mm)	2196.1	51.5	549.4	1443.2	152.2	392.4	427.7	360.6	262.5
Median (mm)	2174.5	51.9	541.5	1439.8	151.2	392.6	423.8	346.2	253.8
SD	226.0	24.7	130.5	159.4	65.4	80.2	90.8	81.0	74.2
CV(%)	10.3	48.1	23.8	11.0	43.0	20.4	21.2	22.5	28.3
Q_1 (mm)	2005.5	29.8	431.7	1290.5	89.7	324.5	353.4	291.5	208.4
Q_2 (mm)	2126.7	43.0	499.7	1395.6	127.3	377.6	399.7	331.2	234.6
Q_3 (mm)	2213.4	54.5	571.4	1464.6	171.7	410.0	439.6	374.7	271.4
Q_4 (mm)	2396.4	70.3	649.9	1550.0	202.1	452.6	488.3	437.8	317.4
$\overline{r}$	0.24	0.50	0.41	0.17	0.49	0.23	0.26	0.22	0.31
$\overline{R}$	0.60	0.76	0.71	0.55	0.76	0.59	0.62	0.59	0.65
IAR(%)	33.6	55.7	47.9	29.5	54.3	34.2	38.0	34.4	40.7
Meghalaya									
Mean (mm)	2720.2	32.4	577.8	1856.3	253.7	563.0	503.9	424.0	365.3
Median (mm)	2723.6	29.9	548.8	1855.6	222.6	546.3	445.1	402.7	350.7
SD	422.2	21.8	179.7	350.6	144.7	170.0	205.8	153.6	136.6
CV(%)	15.5	67.2	31.1	18.9	57.1	30.2	40.8	36.2	37.4
Q_1 (mm)	2299.2	12.3	437.1	1579.4	133.1	421.5	326.4	295.3	258.6
Q_2 (mm)	2618.9	22.1	513.1	1761.2	176.7	506.5	402.7	370.8	314.3
Q_3 (mm)	2779.7	34.4	583.0	1917.4	274.8	592.2	530.1	427.7	373.1
Q_4 (mm)	3057.0	51.2	699.3	2134.3	350.9	676.4	662.8	537.1	457.1
$\overline{r}$	0.44	0.60	0.47	0.46	0.65	0.38	0.51	0.44	0.33
$\overline{R}$	0.85	0.89	0.85	0.85	0.91	0.83	0.87	0.83	0.82
IAR(%)	72.0	79.9	72.0	72.3	82.5	68.8	74.9	68.4	66.5
Purvanchal									
Mean (mm)	2233.5	47.8	555.4	1412.6	217.6	416.1	382.8	347.6	266.2
Median (mm)	2237.8	43.2	535.6	1403.5	210.7	401.7	363.7	345.9	261.0
SD	244.6	34.8	134.4	162.0	91.6	102.4	81.7	67.0	66.3
CV(%)	11.0	72.8	24.2	11.5	42.1	24.6	21.3	19.3	24.9
Q_1 (mm)	2022.7	17.9	430.6	1269.1	138.6	329.8	304.7	293.7	217.6
Q_2 (mm)	2145.1	34.2	502.9	1363.2	183.3	373.0	344.2	328.8	245.4
Q_3 (mm)	2299.0	50.4	602.9	1447.5	227.9	426.9	399.8	363.4	282.8
Q_4 (mm)	2437.3	75.5	675.5	1546.5	286.2	503.0	457.5	401.4	322.0
$\overline{r}$	0.24	0.55	0.40	0.15	0.46	0.31	0.18	0.11	0.25
$\overline{R}$	0.60	0.79	0.70	0.53	0.74	0.64	0.55	0.50	0.60
IAR(%)	34.3	60.5	44.3	28.7	51.1	39.8	32.1	25.2	35.8

Table 6: Same as in Table 1, but for the Western Plains and its subdivisions/ provinces

THE WESTERN PLAINS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	363.2	11.0	20.7	318.2	13.2	36.3	115.9	115.6	50.5
Median (mm)	346.0	7.5	14.6	300.4	7.0	29.9	107.5	101.3	36.6
SD	126.5	11.0	20.0	116.1	17.9	28.7	62.4	74.9	46.1
CV(%)	34.8	99.7	96.6	36.5	135.7	79.3	53.9	64.8	91.2
Q_1 (mm)	262.4	2.1	7.2	215.4	1.3	11.5	62.0	51.0	9.1
Q_2 (mm)	308.5	5.5	10.7	276.5	3.9	25.0	83.9	83.0	20.6
Q_3 (mm)	368.9	9.0	18.7	323.9	9.8	35.0	129.5	114.0	46.7
Q_4 (mm)	453.7	16.3	30.8	408.0	18.0	54.1	161.5	155.5	91.5
$\bar{r}$	0.47	0.47	0.51	0.44	0.48	0.38	0.42	0.46	0.40
$\bar{R}$	0.72	0.71	0.74	0.69	0.72	0.65	0.68	0.70	0.67
IAR(%)	50.1	49.1	53.0	46.7	47.8	41.9	45.2	48.7	42.1
Marusthali									
Mean (mm)	243.8	9.4	19.7	205.6	9.1	23.2	74.7	76.6	31.2
Median (mm)	230.6	6.4	13.8	194.9	3.2	16.8	65.5	63.7	19.6
SD	101.1	10.0	20.9	92.2	14.7	23.8	47.7	60.7	34.3
CV(%)	41.5	105.9	106.0	44.8	162.5	102.5	63.9	79.2	110.1
Q_1 (mm)	167.4	1.8	4.7	137.9	0.6	4.1	34.2	29.3	3.2
Q_2 (mm)	217.6	4.2	10.3	171.0	2.1	12.5	52.0	51.5	11.5
Q_3 (mm)	252.1	7.6	17.0	215.3	6.2	22.8	83.2	75.9	27.1
Q_4 (mm)	323.0	15.9	26.8	281.3	13.1	36.8	115.4	107.7	57.4
$\bar{r}$	0.42	0.45	0.52	0.38	0.50	0.36	0.38	0.44	0.31
$\bar{R}$	0.75	0.76	0.80	0.73	0.78	0.72	0.73	0.75	0.69
IAR(%)	56.1	58.2	62.3	53.1	59.1	52.8	52.8	55.0	47.6
Rajasthan Bagar									
Mean (mm)	398.4	11.8	21.2	350.8	14.5	40.2	128.0	126.5	56.1
Median (mm)	378.2	7.8	14.6	331.1	8.6	34.7	123.3	113.4	39.5
SD	136.0	11.9	20.9	125.7	19.7	31.6	69.9	80.0	50.8
CV(%)	34.1	100.7	98.5	35.8	135.7	78.6	54.6	63.2	90.6
Q_1 (mm)	290.3	2.3	7.3	238.4	1.0	13.3	69.8	54.4	11.0
Q_2 (mm)	347.8	6.4	11.4	307.1	4.9	28.3	95.4	92.9	24.2
Q_3 (mm)	411.5	10.3	19.5	365.1	10.8	38.6	144.4	131.9	55.5
Q_4 (mm)	522.1	18.6	30.4	455.9	20.4	60.4	178.3	181.5	101.8
$\bar{r}$	0.48	0.49	0.52	0.45	0.48	0.40	0.44	0.46	0.42
$\bar{R}$	0.73	0.73	0.76	0.71	0.73	0.68	0.71	0.71	0.69
IAR(%)	51.8	51.6	55.0	48.8	50.3	45.0	49.3	50.3	45.0

Table 7: Same as in Table 1, but for the North Central Highlands and its subdivisions/provinces

THE NORTH CENTRAL HIGHLANDS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	785.1	18.5	19.7	712.8	34.2	70.2	256.4	257.7	128.5
Median (mm)	795.3	13.0	14.8	721.6	22.1	62.9	254.8	266.4	129.2
SD	168.4	15.2	17.5	156.2	36.7	45.8	87.1	91.8	75.8
CV(%)	21.5	82.0	89.2	21.9	107.2	65.3	34.0	35.6	59.0
Q_1 (mm)	637.0	6.2	6.9	580.2	7.0	29.2	186.9	165.5	54.6
Q_2 (mm)	737.9	10.9	11.7	668.7	16.0	49.3	235.5	219.1	96.6
Q_3 (mm)	816.3	15.6	16.9	744.9	26.8	70.4	274.3	280.6	142.9
Q_4 (mm)	927.4	31.1	24.9	834.6	56.6	106.1	329.2	323.6	178.8
$\bar{r}$	0.38	0.45	0.46	0.37	0.50	0.43	0.35	0.39	0.43
$\bar{R}$	0.64	0.68	0.69	0.63	0.72	0.67	0.61	0.64	0.67
IAR(%)	38.2	44.7	37.7	37.0	48.5	42.8	37.6	40.8	42.1
Aravalli range									
Mean (mm)	695.4	11.1	20.3	639.4	24.6	76.3	237.9	213.6	111.5
Median (mm)	676.1	7.7	12.9	624.5	11.0	68.0	235.6	187.8	93.9
SD	189.2	12.2	21.6	180.8	36.0	52.0	98.0	101.8	88.6
CV(%)	27.2	109.2	106.5	28.3	146.1	68.2	41.2	47.7	79.4
Q_1 (mm)	527.7	2.4	5.0	473.9	1.2	30.9	155.3	128.2	26.7
Q_2 (mm)	633.4	5.4	10.9	593.1	9.2	48.2	205.6	169.8	69.0
Q_3 (mm)	723.5	9.9	15.6	665.3	19.4	82.1	246.3	222.7	121.7
Q_4 (mm)	871.2	15.7	28.4	801.8	42.0	112.5	325.1	305.8	168.5
$\bar{r}$	0.39	0.55	0.48	0.37	0.63	0.41	0.31	0.40	0.52
$\bar{R}$	0.71	0.79	0.76	0.69	0.84	0.72	0.66	0.71	0.78
IAR(%)	48.1	56.7	58.3	46.8	69.0	52.3	44.4	49.1	60.4
East Rajasthan Uplands									
Mean (mm)	705.6	14.4	21.3	643.8	26.1	62.3	243.0	239.8	98.6
Median (mm)	691.5	10.1	13.5	614.2	14.5	45.6	234.3	232.4	85.5
SD	205.7	13.8	23.6	197.8	37.9	53.1	109.4	116.0	75.2
CV(%)	29.1	95.5	111.1	30.7	145.0	85.2	45.0	48.4	76.2
Q_1 (mm)	581.1	3.4	6.5	522.5	2.1	22.5	152.3	123.8	32.7
Q_2 (mm)	644.5	7.6	10.3	585.9	10.1	35.5	205.0	196.2	65.6
Q_3 (mm)	744.1	13.3	17.3	679.8	16.7	56.4	265.4	264.1	100.6
Q_4 (mm)	861.2	24.8	29.9	800.8	37.8	101.3	337.6	326.8	159.0
$\bar{r}$	0.49	0.54	0.45	0.51	0.60	0.45	0.43	0.58	0.57
$\bar{R}$	0.76	0.78	0.70	0.77	0.81	0.73	0.72	0.80	0.80
IAR(%)	57.2	59.7	37.1	59.0	57.3	49.1	52.5	63.9	62.7
Madhya Bharat Pathar									
Mean (mm)	814.2	16.9	16.6	745.8	34.9	69.2	270.8	273.6	132.2
Median (mm)	807.7	11.1	11.4	742.5	21.0	59.3	264.8	269.9	125.5
SD	192.1	15.7	15.5	180.0	38.1	51.1	103.2	102.1	83.3
CV(%)	23.6	93.0	92.9	24.1	109.2	73.9	38.1	37.3	63.0
Q_1 (mm)	616.4	3.5	4.8	578.9	5.4	24.9	179.5	189.2	50.6
Q_2 (mm)	770.6	8.5	9.5	691.9	13.5	45.1	241.1	230.3	99.5
Q_3 (mm)	848.6	15.7	14.0	777.1	28.4	71.6	281.6	292.6	144.5
Q_4 (mm)	969.1	30.3	26.6	905.9	56.3	98.1	361.5	352.4	205.7
$\bar{r}$	0.47	0.56	0.46	0.45	0.53	0.52	0.40	0.41	0.53
$\bar{R}$	0.75	0.80	0.74	0.74	0.78	0.78	0.71	0.71	0.78
IAR(%)	54.5	63.4	54.5	52.9	59.4	58.8	49.6	50.1	59.4

				Bundelkhand Upland					
Mean (mm)	935.4	28.3	19.4	839.5	48.2	77.9	286.4	306.3	168.8
Median (mm)	925.7	20.5	13.2	829.6	26.9	63.9	287.3	300.5	143.3
SD	214.8	26.0	18.4	197.0	55.6	54.9	107.6	117.1	109.6
CV(%)	23.0	92.0	94.5	23.5	115.3	70.4	37.6	38.2	64.9
Q_1 (mm)	763.6	6.6	4.5	707.1	7.4	29.9	191.4	203.6	73.0
Q_2 (mm)	881.9	15.9	9.7	789.5	21.5	55.9	250.6	273.4	122.2
Q_3 (mm)	968.3	24.4	19.4	871.5	39.3	73.8	310.5	338.1	169.1
Q_4 (mm)	1101.3	43.5	28.5	1004.9	78.8	126.4	368.7	381.9	247.4
$\bar{r}$	0.47	0.63	0.59	0.45	0.71	0.56	0.50	0.49	0.56
$\bar{R}$	0.73	0.83	0.81	0.72	0.87	0.79	0.75	0.75	0.78
IAR(%)	49.2	67.0	63.8	48.3	73.0	61.5	56.3	55.9	57.3

Table 8: Same as in Table 1, but for the South Central Highlands and its subdivisions/provinces

THE SOUTH CENTRAL HIGHLANDS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1051.4	21.7	20.0	958.0	51.7	120.9	333.0	325.1	179.0
Median (mm)	1035.6	17.6	16.8	947.4	45.9	108.3	325.8	318.6	163.3
SD	188.9	17.2	15.3	173.9	41.2	64.8	97.3	103.6	100.1
CV(%)	18.0	79.0	76.4	18.2	79.7	53.6	29.2	31.9	55.9
Q_1 (mm)	893.6	7.3	7.3	808.6	14.6	64.8	248.6	229.5	86.8
Q_2 (mm)	989.8	12.8	12.7	888.3	31.0	92.9	302.5	275.3	135.2
Q_3 (mm)	1097.0	20.1	19.6	1000.3	57.4	129.3	358.6	349.4	187.4
Q_4 (mm)	1193.4	36.3	30.7	1116.7	82.1	176.5	410.3	413.1	266.0
$\bar{r}$	0.40	0.41	0.36	0.37	0.47	0.49	0.34	0.40	0.49
$\bar{R}$	0.65	0.64	0.62	0.63	0.70	0.72	0.61	0.65	0.72
IAR(%)	41.4	40.2	36.4	39.0	48.9	50.0	36.9	41.2	51.1
				Malwa Plateau					
Mean (mm)	1001.9	16.3	16.9	919.9	48.9	113.9	323.2	310.2	172.6
Median (mm)	998.2	10.8	13.1	907.5	40.3	104.0	309.3	290.9	153.2
SD	203.8	14.4	13.9	192.7	41.6	62.8	106.4	114.1	108.7
CV(%)	20.3	88.9	82.5	21.0	85.1	55.1	32.9	36.8	63.0
Q_1 (mm)	808.9	4.2	5.6	748.6	8.9	56.2	232.9	201.2	72.4
Q_2 (mm)	939.3	7.5	10.4	853.4	30.0	92.2	296.2	258.7	112.9
Q_3 (mm)	1035.7	15.1	16.3	958.0	55.1	122.7	332.0	324.8	191.7
Q_4 (mm)	1178.6	28.8	25.2	1105.8	74.3	162.8	406.9	403.4	270.1
$\bar{r}$	0.45	0.45	0.36	0.43	0.49	0.51	0.38	0.46	0.57
$\bar{R}$	0.70	0.69	0.63	0.69	0.72	0.74	0.65	0.71	0.77
IAR(%)	48.3	45.0	38.9	46.8	51.6	53.8	41.4	50.1	59.9
				Vindhyan Scarplands					
Mean (mm)	1174.5	39.5	27.8	1051.7	55.5	116.8	363.9	376.9	194.2
Median (mm)	1154.8	30.8	22.8	1030.9	41.2	96.0	354.8	367.9	178.5
SD	232.5	33.6	23.8	216.7	52.2	82.4	127.1	135.6	115.2
CV(%)	19.8	85.1	85.5	20.6	94.2	70.6	34.9	36.0	59.3
Q_1 (mm)	974.7	12.4	10.2	865.3	9.8	42.8	238.0	264.1	98.4
Q_2 (mm)	1087.1	22.0	18.3	971.9	26.5	79.9	320.7	338.8	159.3
Q_3 (mm)	1240.6	37.6	25.2	1098.3	54.4	107.8	387.9	388.1	199.6
Q_4 (mm)	1387.5	65.9	41.1	1238.9	95.2	184.3	471.6	478.8	253.9
$\bar{r}$	0.53	0.76	0.54	0.52	0.68	0.68	0.51	0.53	0.67
$\bar{R}$	0.81	0.91	0.81	0.80	0.87	0.87	0.79	0.80	0.87
IAR(%)	63.8	81.7	65.2	62.5	74.8	76.1	62.4	62.8	74.1

				Vindhya Range					
Mean (mm)	1094.0	22.5	20.8	994.8	56.0	137.0	332.9	328.5	196.4
Median (mm)	1089.1	17.8	15.9	1008.6	45.2	128.3	326.9	331.2	187.3
SD	195.7	18.8	18.6	173.0	43.7	74.3	95.5	99.1	109.2
CV(%)	17.9	83.6	89.6	17.4	78.1	54.3	28.7	30.2	55.6
Q_1 (mm)	904.4	5.6	5.7	840.7	11.6	64.8	255.8	232.9	91.3
Q_2 (mm)	1056.6	14.0	12.6	952.1	34.1	111.0	312.2	285.5	151.8
Q_3 (mm)	1126.5	24.6	19.4	1038.4	67.0	145.7	339.5	357.5	212.7
Q_4 (mm)	1244.5	35.5	31.3	1126.1	96.5	186.4	413.0	409.7	276.6
$\bar{r}$	0.29	0.38	0.33	0.23	0.49	0.43	0.24	0.24	0.43
$\bar{R}$	0.68	0.69	0.69	0.65	0.79	0.75	0.65	0.65	0.75
IAR(%)	44.8	44.6	43.9	40.5	62.0	54.6	40.4	40.6	56.9
				Narmada Valley					
Mean (mm)	1122.1	27.3	24.9	1010.2	59.7	139.4	347.9	334.1	188.8
Median (mm)	1100.0	22.7	20.4	996.7	48.5	122.9	321.5	330.9	168.8
SD	220.4	24.3	20.4	204.8	50.5	76.0	109.2	108.4	109.0
CV(%)	19.6	89.1	81.7	20.3	84.7	54.5	31.4	32.5	57.7
Q_1 (mm)	928.4	5.1	9.0	834.0	12.3	75.6	254.3	225.4	98.6
Q_2 (mm)	1030.2	14.7	15.8	944.2	32.2	110.5	292.1	300.0	138.9
Q_3 (mm)	1162.1	27.8	24.4	1059.6	64.7	146.7	362.4	349.1	199.5
Q_4 (mm)	1299.9	44.0	37.1	1179.1	94.0	185.0	436.9	418.1	267.1
$\bar{r}$	0.46	0.36	0.38	0.45	0.51	0.45	0.32	0.39	0.48
$\bar{R}$	0.77	0.70	0.72	0.76	0.79	0.77	0.69	0.72	0.78
IAR(%)	60.6	56.1	54.5	59.5	63.8	59.6	50.7	54.1	62.2

Table 9: Same as in Table 1, but for the North Deccan and its subdivisions/ provinces

THE NORTH DECCAN									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	956.6	20.1	41.1	805.2	90.2	148.9	264.2	222.5	169.6
Median (mm)	950.2	13.5	36.4	802.9	90.7	149.4	258.3	220.3	171.9
SD	150.1	16.6	23.5	127.6	50.1	53.0	58.7	60.3	66.4
CV(%)	15.7	82.6	57.1	15.8	55.6	35.6	22.2	27.1	39.1
Q_1 (mm)	826.2	6.7	20.5	683.5	39.6	101.6	215.3	164.1	106.3
Q_2 (mm)	911.3	11.1	30.0	760.1	69.5	134.3	246.5	207.7	154.8
Q_3 (mm)	990.0	17.0	41.7	847.0	100.9	159.9	276.4	235.9	179.9
Q_4 (mm)	1086.3	35.7	59.8	927.2	131.8	194.9	320.6	279.3	226.9
$\bar{r}$	0.36	0.35	0.35	0.32	0.43	0.31	0.24	0.29	0.33
$\bar{R}$	0.61	0.59	0.61	0.58	0.67	0.58	0.51	0.55	0.59
IAR(%)	35.7	33.8	34.1	32.1	43.5	33.3	25.4	28.2	35.5
				Satpura Range					
Mean (mm)	1169.5	35.7	39.0	1019.9	74.9	160.4	352.4	318.7	188.4
Median (mm)	1151.1	28.1	34.2	1016.3	64.9	150.8	353.3	310.5	179.7
SD	197.4	28.3	29.0	171.2	53.3	75.4	91.0	85.8	94.8
CV(%)	16.9	79.2	74.4	16.8	71.2	47.0	25.8	26.9	50.3
Q_1 (mm)	992.9	9.9	15.6	846.4	21.3	93.8	265.3	240.9	104.5
Q_2 (mm)	1127.3	21.7	27.9	991.0	51.9	129.7	331.0	282.4	151.3
Q_3 (mm)	1210.8	33.7	38.3	1066.1	83.6	169.6	375.4	332.7	197.9
Q_4 (mm)	1327.7	56.7	54.2	1169.2	118.0	217.8	424.5	378.8	256.6
$\bar{r}$	0.37	0.43	0.45	0.33	0.47	0.46	0.33	0.32	0.49
$\bar{R}$	0.66	0.69	0.71	0.64	0.73	0.73	0.64	0.64	0.75
IAR(%)	43.2	52.7	53.7	40.3	52.9	51.7	41.5	39.3	55.2

				Maharashtra Plateau					
Mean (mm)	887.4	14.3	40.9	740.2	92.1	143.7	242.0	193.6	161.0
Median (mm)	893.1	8.9	37.8	736.3	93.1	142.0	240.9	190.8	165.7
SD	149.2	13.7	23.7	131.0	49.8	51.0	59.4	65.9	66.7
CV(%)	16.8	96.0	58.0	17.7	54.0	35.5	24.5	34.0	41.4
Q_1 (mm)	749.1	3.2	19.2	626.5	43.8	100.2	190.2	133.2	95.5
Q_2 (mm)	853.3	6.2	29.0	696.7	71.2	134.2	223.9	172.4	145.7
Q_3 (mm)	912.9	11.3	42.1	781.0	104.3	146.8	261.8	205.4	177.6
Q_4 (mm)	1011.1	25.6	56.7	848.2	130.0	183.0	295.6	248.6	210.4
$\overline{r}$	0.38	0.35	0.35	0.36	0.41	0.31	0.27	0.36	0.35
$\overline{R}$	0.64	0.60	0.61	0.62	0.66	0.58	0.54	0.62	0.62
IAR(%)	39.7	34.0	35.1	37.4	43.2	33.9	26.9	37.7	38.7

Table 10: Same as in Table 1, but for the South Deccan and its subdivisions/ provinces

	THE SOUTH DECCAN								
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	919.9	11.3	102.2	645.3	161.0	123.6	197.9	166.0	157.8
Median (mm)	919.7	6.9	95.2	636.3	160.7	124.5	197.1	163.3	151.5
SD	124.2	11.7	30.6	103.8	61.8	32.7	52.2	50.5	50.2
CV(%)	13.5	103.5	29.9	16.1	38.4	26.4	26.4	30.4	31.8
Q_1 (mm)	811.8	1.4	77.0	560.2	109.3	93.4	158.2	124.7	107.5
Q_2 (mm)	879.2	5.1	87.0	605.3	138.0	111.4	181.7	152.0	139.1
Q_3 (mm)	943.4	10.4	104.4	648.8	172.7	134.1	207.8	177.6	160.7
Q_4 (mm)	1000.4	19.2	125.0	745.5	206.4	153.4	236.5	209.1	200.8
$\overline{r}$	0.28	0.30	0.24	0.30	0.37	0.17	0.28	0.30	0.26
$\overline{R}$	0.55	0.56	0.51	0.56	0.63	0.43	0.53	0.56	0.53
IAR(%)	26.6	27.4	23.5	26.1	38.3	17.0	20.5	25.2	28.1
				Karnataka Plateau					
Mean (mm)	956.3	8.3	133.7	618.2	196.0	123.8	194.2	153.6	146.6
Median (mm)	942.8	5.0	124.6	615.6	191.4	119.1	189.1	153.6	143.0
SD	129.2	9.2	39.3	94.9	74.8	35.8	56.1	49.2	48.1
CV(%)	13.5	110.6	29.4	15.3	38.2	28.9	28.9	32.0	32.8
Q_1 (mm)	853.9	0.4	102.0	538.7	135.3	92.5	150.3	103.9	106.3
Q_2 (mm)	914.9	3.0	114.0	585.7	163.6	113.8	180.3	139.9	129.9
Q_3 (mm)	974.0	7.2	137.7	636.9	209.6	131.9	206.5	165.6	156.2
Q_4 (mm)	1057.0	15.9	163.0	699.8	259.5	150.3	226.5	198.9	187.4
$\overline{r}$	0.29	0.30	0.27	0.27	0.44	0.22	0.28	0.34	0.29
$\overline{R}$	0.57	0.58	0.55	0.54	0.69	0.48	0.52	0.60	0.57
IAR(%)	27.4	32.3	30.0	22.0	47.5	18.8	20.6	24.4	28.9
				Telangana Plateau					
Mean (mm)	862.5	15.8	61.1	671.1	114.5	121.6	201.4	179.2	169.0
Median (mm)	851.2	9.4	51.0	669.3	107.0	114.5	199.2	171.3	159.0
SD	161.4	18.3	31.5	143.4	63.9	44.8	68.4	68.7	70.3
CV(%)	18.7	116.3	51.5	21.4	55.8	36.8	34.0	38.3	41.6
Q_1 (mm)	704.3	0.5	33.6	540.8	55.8	79.8	145.0	122.3	106.7
Q_2 (mm)	813.9	5.3	48.3	621.7	90.7	103.3	180.9	154.1	139.7
Q_3 (mm)	884.7	12.1	61.4	700.7	122.6	126.1	209.2	181.5	177.1
Q_4 (mm)	994.0	27.5	85.8	782.2	162.9	167.0	243.2	234.8	232.3
$\overline{r}$	0.45	0.39	0.36	0.47	0.49	0.30	0.43	0.43	0.44
$\overline{R}$	0.70	0.66	0.65	0.72	0.73	0.60	0.69	0.69	0.70
IAR(%)	49.3	39.2	40.7	51.2	53.2	38.0	46.9	47.4	49.5

Table 11: Same as in Table 1, but for the Eastern Plateaus and its subdivisions/ provinces

	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
THE EASTERN PLATEAUS									
Mean (mm)	1361.7	40.8	81.7	1145.4	93.8	199.5	360.6	358.8	226.6
Median (mm)	1355.8	36.2	78.1	1145.9	85.8	177.1	358.1	350.1	225.3
SD	172.8	29.9	36.0	140.2	54.0	85.8	76.5	71.1	61.1
CV(%)	12.7	73.3	44.1	12.2	57.6	43.0	21.2	19.8	27.0
Q_1 (mm)	1205.8	15.4	49.3	1032.5	43.5	123.1	289.6	293.2	167.8
Q_2 (mm)	1330.4	32.1	61.5	1113.3	71.9	160.9	344.2	329.8	210.1
Q_3 (mm)	1391.0	41.5	86.8	1180.8	99.7	211.5	372.4	375.5	241.4
Q_4 (mm)	1485.3	55.8	113.2	1250.8	139.5	275.1	414.2	425.4	272.8
$\bar{r}$	0.32	0.49	0.40	0.25	0.44	0.46	0.24	0.24	0.25
$\bar{R}$	0.59	0.71	0.65	0.53	0.68	0.70	0.52	0.53	0.53
IAR(%)	34.9	51.1	39.9	28.4	44.9	48.7	28.2	27.8	27.9
Baghelkhand Plateau									
Mean (mm)	1335.5	50.5	42.1	1176.4	66.5	164.9	391.9	402.9	216.8
Median (mm)	1315.9	43.9	32.8	1153.3	54.1	142.0	384.5	388.6	210.4
SD	254.3	39.2	36.0	226.9	51.1	106.9	131.6	126.1	103.0
CV(%)	19.0	77.6	85.6	19.3	76.8	64.9	33.6	31.3	47.5
Q_1 (mm)	1115.2	16.3	14.7	992.3	21.6	75.4	273.6	292.3	119.4
Q_2 (mm)	1256.1	29.5	27.3	1111.5	48.1	99.0	359.7	343.7	172.0
Q_3 (mm)	1390.9	53.3	37.8	1220.4	65.9	154.9	416.3	427.7	231.7
Q_4 (mm)	1566.1	89.3	65.4	1378.5	107.9	246.0	484.5	517.8	297.9
$\bar{r}$	0.48	0.68	0.55	0.48	0.55	0.58	0.51	0.42	0.48
$\bar{R}$	0.81	0.89	0.84	0.81	0.84	0.85	0.82	0.78	0.81
IAR(%)	64.9	78.2	69.5	65.1	68.0	70.3	67.2	61.2	65.2
Chhotanagpur Plateau									
Mean (mm)	1318.9	42.6	100.0	1072.2	104.1	196.6	326.0	319.0	230.5
Median (mm)	1303.7	36.8	95.3	1058.4	89.3	174.8	323.0	316.6	222.3
SD	183.2	32.1	43.5	151.9	68.1	90.2	83.0	73.6	79.5
CV(%)	13.9	75.5	43.5	14.2	65.4	45.9	25.5	23.1	34.5
Q_1 (mm)	1171.2	16.3	57.1	948.2	43.8	119.4	258.1	253.2	162.1
Q_2 (mm)	1254.9	28.4	85.7	1024.9	72.9	158.0	305.3	290.5	206.6
Q_3 (mm)	1349.1	43.4	108.9	1105.2	100.2	218.8	339.9	329.7	248.2
Q_4 (mm)	1490.6	63.5	133.7	1198.5	159.1	273.0	385.1	372.2	278.3
$\bar{r}$	0.38	0.62	0.52	0.33	0.60	0.56	0.33	0.31	0.41
$\bar{R}$	0.67	0.81	0.76	0.64	0.80	0.78	0.64	0.62	0.69
IAR(%)	44.1	65.5	56.6	39.6	63.0	60.9	39.5	37.8	46.5
Mahanadi Basin									
Mean (mm)	1379.4	34.5	58.6	1215.3	71.1	202.4	395.8	395.7	221.4
Median (mm)	1378.5	25.9	51.3	1207.2	63.9	178.2	391.9	406.7	204.5
SD	232.8	31.6	39.4	207.6	48.6	111.0	99.7	100.1	94.9
CV(%)	16.9	91.6	67.3	17.1	68.3	54.8	25.2	25.3	42.8
Q_1 (mm)	1187.7	6.6	25.8	1035.8	25.9	107.7	305.4	297.3	144.3
Q_2 (mm)	1321.2	19.0	41.0	1158.1	45.8	150.0	369.4	380.2	186.2
Q_3 (mm)	1435.1	31.9	58.2	1265.4	77.1	198.6	416.6	432.9	232.0
Q_4 (mm)	1522.0	55.0	81.4	1366.0	114.0	293.1	479.3	470.4	284.6
$\bar{r}$	0.50	0.66	0.55	0.45	0.52	0.67	0.37	0.37	0.56
$\bar{R}$	0.76	0.85	0.79	0.74	0.77	0.85	0.69	0.69	0.79
IAR(%)	58.0	71.2	61.8	53.8	58.6	72.2	47.2	46.6	62.9

				Garhjat Hills					
Mean (mm)	1434.3	49.0	120.5	1140.2	124.6	212.3	352.5	348.5	226.9
Median (mm)	1439.7	35.8	110.2	1129.7	108.8	198.0	332.3	344.3	220.1
SD	205.6	49.6	59.7	183.1	79.7	86.2	130.2	98.2	74.6
CV(%)	14.3	101.4	49.6	16.1	64.0	40.6	36.9	28.2	32.9
Q_1 (mm)	1270.9	9.6	72.9	996.7	47.2	137.7	255.1	256.2	153.4
Q_2 (mm)	1366.6	29.1	95.3	1093.5	90.5	173.7	311.1	321.6	196.8
Q_3 (mm)	1481.7	41.8	120.7	1173.1	129.9	214.6	351.9	366.8	240.4
Q_4 (mm)	1606.3	77.3	158.8	1329.0	200.3	290.3	452.5	426.0	292.5
$\bar{r}$	0.23	0.75	0.45	0.24	0.50	0.39	0.50	0.41	0.25
$\bar{R}$	0.69	0.91	0.79	0.70	0.81	0.77	0.81	0.78	0.70
IAR(%)	48.3	82.8	61.1	49.0	64.3	58.6	65.0	60.0	49.9
				Dandakaranaya					
Mean (mm)	1378.1	23.5	82.8	1167.3	104.4	215.6	351.5	363.5	236.6
Median (mm)	1377.4	16.3	70.3	1167.9	89.4	200.0	358.5	361.0	222.7
SD	257.4	26.4	51.2	231.6	75.5	108.5	122.2	112.8	90.4
CV(%)	18.7	112.0	61.8	19.8	72.3	50.3	34.8	31.0	38.2
Q_1 (mm)	1150.6	1.7	38.6	961.3	43.2	136.1	233.9	261.8	157.8
Q_2 (mm)	1261.9	9.4	60.6	1090.7	65.8	181.6	301.1	310.1	203.1
Q_3 (mm)	1462.0	21.5	79.3	1217.4	111.6	221.3	368.8	381.5	237.6
Q_4 (mm)	1608.3	37.1	125.0	1367.7	157.7	270.7	453.6	462.2	305.1
$\bar{r}$	0.49	0.57	0.36	0.44	0.58	0.57	0.56	0.35	0.34
$\bar{R}$	0.86	0.89	0.83	0.85	0.89	0.88	0.88	0.82	0.82
IAR(%)	74.4	78.6	68.1	71.9	79.0	78.0	78.1	67.5	66.9

Table 12: Same as in Table 1, but for the Western Hills and its subdivisions/ provinces

	THE WESTERN HILLS								
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	2141.7	15.7	168.1	1704.6	253.3	331.6	658.7	468.7	245.6
Median (mm)	2147.3	10.0	156.5	1701.1	241.6	320.6	640.4	467.2	232.9
SD	294.0	19.4	65.3	284.2	81.7	118.7	190.3	136.8	105.0
CV(%)	13.7	123.9	38.8	16.7	32.3	35.8	28.9	29.2	42.7
Q_1 (mm)	1898.2	1.9	112.9	1491.4	178.0	211.9	539.5	347.0	151.5
Q_2 (mm)	2060.9	6.0	138.9	1594.6	209.0	292.7	591.8	403.5	198.8
Q_3 (mm)	2207.8	12.3	175.3	1763.3	270.8	347.0	670.6	483.1	261.8
Q_4 (mm)	2354.7	23.5	214.9	1913.7	341.2	415.9	800.8	573.6	349.5
$\bar{r}$	0.00	0.23	0.26	0.06	0.20	0.17	0.13	0.06	0.08
$\bar{R}$	0.55	0.68	0.68	0.57	0.68	0.65	0.62	0.56	0.58
IAR(%)	33.4	47.8	49.9	36.0	47.8	45.9	38.4	40.8	42.9
				North Sahyadri					
Mean (mm)	1934.3	4.7	21.0	1822.0	86.6	243.7	716.4	544.3	317.6
Median (mm)	1813.0	0.0	3.4	1689.6	57.5	227.7	646.7	510.4	271.8
SD	622.7	16.1	34.0	596.4	98.6	159.0	357.2	255.3	228.6
CV(%)	32.2	341.9	161.9	32.7	113.8	65.2	49.9	46.9	72.0
Q_1 (mm)	1463.3	0.0	0.0	1375.2	9.8	102.1	421.0	308.1	102.4
Q_2 (mm)	1697.5	0.0	0.0	1609.3	36.3	171.5	500.4	434.6	225.0
Q_3 (mm)	1935.4	0.3	10.4	1856.0	70.2	267.0	751.0	558.5	327.2
Q_4 (mm)	2383.8	4.8	40.6	2167.6	147.8	360.4	974.6	758.6	494.8

				Central Sahyadri					
Mean (mm)	3249.9	9.1	231.4	2711.0	298.4	607.1	1079.3	736.1	288.5
Median (mm)	3217.8	2.7	223.5	2679.5	270.7	547.7	1112.0	713.9	267.3
SD	552.3	16.3	113.3	526.9	114.6	239.4	375.0	259.7	142.4
CV(%)	17.0	179.0	49.0	19.4	38.4	39.4	34.7	35.3	49.4
Q_1 (mm)	2821.2	0.0	135.4	2309.6	202.4	406.6	750.6	490.2	159.7
Q_2 (mm)	3125.2	0.0	195.3	2563.4	245.4	489.6	1007.1	644.9	234.7
Q_3 (mm)	3341.8	3.8	238.0	2801.4	294.4	639.8	1160.0	759.7	304.0
Q_4 (mm)	3623.1	12.7	284.9	3058.7	405.1	842.6	1325.9	954.5	409.4
				South Sahyadri					
Mean (mm)	2923.8	56.3	584.8	1569.8	712.9	522.0	476.1	313.0	258.6
Median (mm)	2854.0	41.4	547.2	1460.0	727.6	503.6	460.1	292.4	221.4
SD	588.4	56.4	218.9	427.5	237.1	221.8	192.7	147.1	165.3
CV(%)	20.1	100.2	37.4	27.2	33.3	42.5	40.5	47.0	63.9
Q_1 (mm)	2349.1	8.6	422.1	1182.7	509.2	341.3	324.1	176.0	109.7
Q_2 (mm)	2718.8	27.4	478.3	1410.0	650.0	454.2	426.7	257.2	187.2
Q_3 (mm)	3002.8	59.4	590.5	1582.0	766.6	549.8	485.4	336.4	276.6
Q_4 (mm)	3267.7	85.0	726.2	1928.9	867.4	669.5	596.9	416.6	400.6
				Nilgiri					
Mean (mm)	1241.0	33.2	252.0	580.9	374.9	144.0	180.4	125.8	130.6
Median (mm)	1205.1	18.7	229.1	557.1	368.5	133.4	152.1	115.9	119.3
SD	289.4	42.9	107.8	198.5	138.1	97.8	120.8	70.0	66.6
CV(%)	23.3	129.4	42.8	34.2	36.8	67.9	66.9	55.6	51.0
Q_1 (mm)	1002.5	2.5	172.6	414.2	263.4	77.5	102.9	70.6	74.4
Q_2 (mm)	1114.5	11.0	206.8	509.6	326.4	111.2	137.4	96.6	106.9
Q_3 (mm)	1274.8	28.0	251.6	628.1	402.2	146.3	176.3	132.6	135.2
Q_4 (mm)	1469.1	52.0	333.8	687.1	482.4	181.6	226.6	169.2	177.0

Table 13: Same as in Table 1, but for the Eastern Hills and its subdivisions/ provinces

THE EASTERN HILLS									
	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1015.3	21.7	112.6	643.8	237.2	113.5	179.2	186.7	164.4
Median (mm)	1008.3	16.0	109.4	634.1	230.0	109.4	177.1	185.8	160.7
SD	123.6	19.6	36.2	88.1	74.9	38.8	45.2	45.8	35.8
CV(%)	12.2	90.3	32.1	13.7	31.6	34.2	25.3	24.5	21.8
Q_1 (mm)	901.9	4.6	80.9	569.3	172.9	80.5	143.7	147.7	137.3
Q_2 (mm)	965.5	11.8	99.8	614.7	208.1	102.3	167.9	173.5	152.2
Q_3 (mm)	1049.0	19.1	115.0	648.3	250.7	119.2	187.5	196.2	167.5
Q_4 (mm)	1126.1	36.3	137.0	724.9	308.0	134.1	209.6	223.8	193.6
$\bar{r}$	0.16	0.29	0.21	0.12	0.24	0.14	0.13	0.10	0.07
$\bar{R}$	0.50	0.61	0.55	0.44	0.58	0.45	0.43	0.42	0.42
IAR(%)	23.6	31.9	30.9	18.7	34.3	20.7	19.0	16.8	16.9
Eastern Ghats (North)									
Mean (mm)	1510.4	28.2	119.0	1220.5	142.7	212.7	381.6	387.6	238.6
Median (mm)	1491.0	19.2	104.2	1246.4	126.4	192.5	368.6	364.6	227.7
SD	281.5	28.4	60.1	255.8	103.1	113.8	142.5	140.7	80.7
CV(%)	18.6	101.0	50.6	21.0	72.2	53.5	37.3	36.3	33.8
Q_1 (mm)	1262.8	3.0	71.2	976.4	67.3	118.2	250.3	273.6	163.2
Q_2 (mm)	1434.5	12.7	93.4	1150.2	108.8	163.1	321.5	337.3	206.5
Q_3 (mm)	1579.5	25.3	119.6	1275.7	141.4	206.2	405.0	387.6	252.9
Q_4 (mm)	1720.5	49.1	166.9	1417.9	190.0	284.0	496.8	513.3	312.9
$\bar{r}$	0.38	0.43	0.47	0.34	0.63	0.36	0.43	0.38	0.23
$\bar{R}$	0.83	0.84	0.86	0.82	0.90	0.82	0.85	0.83	0.78
IAR(%)	68.9	69.2	73.4	67.0	80.8	67.5	71.3	68.9	61.3
Eastern Ghats (South)									
Mean (mm)	873.7	21.2	72.0	556.1	224.4	101.3	149.8	145.6	159.4
Median (mm)	873.7	11.3	63.9	549.0	217.0	99.5	151.9	141.6	156.0
SD	165.8	28.1	42.3	132.2	89.7	46.8	56.7	70.6	63.9
CV(%)	19.0	132.2	58.7	23.8	40.0	46.2	37.9	48.5	40.1
Q_1 (mm)	723.6	1.1	33.4	440.9	145.1	60.6	97.5	86.5	95.8
Q_2 (mm)	830.9	7.1	50.2	510.7	200.1	86.1	127.9	114.9	141.5
Q_3 (mm)	901.2	15.1	72.5	579.7	230.5	106.7	158.9	155.2	169.3
Q_4 (mm)	1014.4	34.9	104.2	662.3	296.1	132.5	198.9	192.4	204.4
$\bar{r}$	0.26	0.30	0.25	0.37	0.30	0.23	0.29	0.28	0.28
$\bar{R}$	0.71	0.70	0.70	0.76	0.71	0.70	0.72	0.72	0.72
IAR(%)	50.4	44.6	48.6	57.3	53.3	47.1	51.2	52.2	50.7
Tamilnadu Uplands									
Mean (mm)	826.7	17.9	149.0	346.9	312.9	59.7	73.5	93.8	119.9
Median (mm)	812.1	10.2	150.2	343.9	293.7	56.5	61.9	89.3	118.9
SD	153.0	21.9	52.3	92.4	112.1	31.0	42.6	50.9	56.3
CV(%)	18.5	122.5	35.1	26.6	35.8	52.0	57.9	54.3	47.0
Q_1 (mm)	679.4	0.5	106.3	257.2	224.9	32.0	43.2	51.8	73.3
Q_2 (mm)	771.5	3.2	132.0	314.0	269.4	48.7	53.8	73.9	97.9
Q_3 (mm)	868.0	14.8	160.2	366.0	312.2	63.0	67.4	96.6	133.4
Q_4 (mm)	948.0	35.9	188.0	430.7	399.3	79.6	90.5	126.8	165.5
$\bar{r}$	0.34	0.59	0.44	0.32	0.46	0.22	0.27	0.37	0.44
$\bar{R}$	0.75	0.85	0.79	0.73	0.80	0.69	0.71	0.73	0.78
IAR(%)	56.7	72.5	63.0	55.9	63.6	49.1	53.8	56.3	62.2

Table 14: Same as in Table 1, but for the West Coastal Plains and its subdivisions/ provinces

	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
THE WEST COASTAL PLAINS									
Mean (mm)	1765.2	11.5	138.2	1418.4	197.2	402.6	513.2	314.9	187.6
Median (mm)	1770.1	9.2	123.2	1428.9	199.1	416.0	509.1	308.3	186.1
SD	223.8	8.2	63.2	213.9	58.4	92.5	122.6	111.1	91.6
CV(%)	12.7	71.3	45.8	15.1	29.6	23.0	23.9	35.3	48.8
Q_1 (mm)	1597.8	4.2	86.5	1254.3	145.1	314.8	426.8	205.8	103.9
Q_2 (mm)	1712.5	7.1	115.1	1360.1	188.2	376.0	471.6	286.6	148.8
Q_3 (mm)	1815.2	11.9	132.6	1487.9	207.2	432.9	544.1	338.5	206.5
Q_4 (mm)	1934.6	18.6	185.8	1566.1	239.4	482.9	616.9	396.3	271.1
$\overline{r}$	0.26	0.16	0.25	0.27	0.27	0.25	0.26	0.35	0.37
$\overline{R}$	0.52	0.31	0.44	0.54	0.48	0.49	0.52	0.60	0.62
IAR(%)	24.4	11.4	25.1	26.8	21.7	22.7	25.9	34.2	37.5
Kachchh Peninsula									
Mean (mm)	347.1	5.3	11.8	310.0	19.9	30.0	140.0	89.8	50.2
Median (mm)	303.0	0.4	0.0	273.8	2.8	10.3	104.3	63.9	20.5
SD	234.6	10.6	40.2	219.9	42.5	40.5	140.9	96.3	75.6
CV(%)	67.6	199.0	340.6	70.9	213.1	134.8	100.6	107.3	150.7
Q_1 (mm)	131.2	0.0	0.0	111.4	0.0	0.0	29.0	14.3	0.5
Q_2 (mm)	246.9	0.0	0.0	229.9	0.3	3.6	74.2	41.4	8.0
Q_3 (mm)	356.5	2.5	1.0	318.3	7.2	18.5	125.6	81.3	33.3
Q_4 (mm)	505.0	6.3	6.3	455.4	24.6	58.6	232.4	158.5	72.0
Kathiawar Peninsula									
Mean (mm)	543.4	3.2	8.8	503.1	28.2	90.2	209.5	122.5	80.9
Median (mm)	525.7	0.9	2.8	494.1	9.7	70.7	199.2	105.7	61.4
SD	206.9	4.7	18.5	194.3	45.2	76.8	118.3	97.7	70.8
CV(%)	38.1	147.5	208.7	38.6	160.2	85.2	56.5	79.8	87.5
Q_1 (mm)	371.6	0.0	0.3	339.0	0.8	18.2	104.9	42.9	20.1
Q_2 (mm)	468.6	0.4	2.0	433.1	4.4	53.4	166.2	89.1	42.0
Q_3 (mm)	578.6	2.6	3.6	546.1	19.8	93.9	235.7	126.8	87.5
Q_4 (mm)	715.3	5.3	9.3	667.9	38.0	147.8	283.8	181.3	135.2
$\overline{r}$	0.52	0.31	0.38	0.51	0.52	0.46	0.45	0.63	0.49
$\overline{R}$	0.77	0.64	0.68	0.77	0.77	0.73	0.74	0.83	0.76
IAR(%)	59.7	38.2	49.3	58.6	58.3	50.8	53.5	68.4	56.5
Gujarat Plains									
Mean (mm)	925.8	3.6	10.5	880.3	31.4	133.4	356.0	243.8	147.2
Median (mm)	934.3	1.2	2.6	896.1	14.5	126.7	327.2	207.7	117.6
SD	286.3	5.8	19.7	278.4	42.9	90.1	162.9	137.8	122.8
CV(%)	30.9	163.7	187.6	31.6	136.4	67.5	45.8	56.5	83.4
Q_1 (mm)	656.4	0.0	0.2	610.2	1.1	43.8	214.8	122.4	32.2
Q_2 (mm)	856.4	0.8	1.5	801.8	9.1	97.5	279.4	184.9	82.2
Q_3 (mm)	976.9	2.0	4.9	960.2	20.4	140.7	369.9	250.4	144.1
Q_4 (mm)	1158.6	5.8	12.3	1128.9	51.3	201.5	470.9	371.0	236.5
$\overline{r}$	0.55	0.34	0.48	0.55	0.59	0.53	0.49	0.61	0.62
$\overline{R}$	0.77	0.63	0.71	0.77	0.79	0.74	0.73	0.81	0.81
IAR(%)	54.9	39.1	36.1	54.5	59.0	45.7	48.0	61.6	64.4

				Konkan					
Mean (mm)	2445.9	2.6	40.5	2285.3	117.5	654.6	830.9	500.8	299.1
Median (mm)	2429.4	0.2	14.0	2314.3	105.3	663.7	854.0	487.0	277.4
SD	446.4	5.9	67.7	421.6	92.2	195.6	245.2	225.2	164.6
CV(%)	18.3	225.2	166.8	18.4	78.5	29.9	29.5	45.0	55.0
Q_1 (mm)	2166.8	0.0	3.4	2023.8	38.6	448.8	619.5	302.0	157.2
Q_2 (mm)	2383.0	0.0	8.3	2248.8	74.7	621.1	763.8	426.9	243.4
Q_3 (mm)	2506.5	0.4	19.3	2355.2	115.6	724.9	894.0	520.3	315.5
Q_4 (mm)	2805.3	3.4	49.9	2564.7	164.3	804.8	1002.8	644.5	399.0
$\overline{r}$	0.55	0.37	0.71	0.55	0.62	0.47	0.61	0.68	0.65
$\overline{R}$	0.80	0.69	0.87	0.80	0.83	0.76	0.83	0.86	0.85
IAR(%)	63.5	48.1	62.1	62.7	68.9	57.4	67.8	74.0	72.1
				Karnataka Coast					
Mean (mm)	3341.2	3.2	179.8	2910.4	247.9	973.8	1034.0	621.5	281.1
Median (mm)	3280.2	0.0	116.1	2889.0	248.0	964.7	1008.8	545.1	252.3
SD	532.0	7.9	168.6	481.5	113.4	237.7	286.2	247.8	163.3
CV(%)	15.9	249.0	93.8	16.5	45.7	24.4	27.7	39.9	58.1
Q_1 (mm)	2869.1	0.0	53.8	2491.9	148.7	769.6	770.0	411.0	151.8
Q_2 (mm)	3195.8	0.0	97.4	2789.3	200.8	867.8	949.6	496.7	207.4
Q_3 (mm)	3458.1	0.0	150.7	2947.0	266.2	1011.4	1110.6	651.3	285.4
Q_4 (mm)	3761.6	3.3	283.7	3293.1	345.3	1197.4	1257.9	828.8	389.9
$\overline{r}$	0.53	0.24	0.79	0.51	0.50	0.45	0.64	0.67	0.76
$\overline{R}$	0.87	0.74	0.95	0.87	0.87	0.85	0.90	0.91	0.94
IAR(%)	76.4	58.0	89.3	75.3	75.0	72.4	81.8	83.3	87.8
				Kerala Plians					
Mean (mm)	2824.0	31.2	396.6	1884.5	511.7	656.5	627.0	369.8	231.2
Median (mm)	2802.5	25.1	362.5	1839.7	519.6	634.1	616.0	352.3	206.9
SD	375.5	25.8	164.2	344.1	148.4	189.2	196.0	152.2	120.6
CV(%)	13.3	82.8	41.4	18.3	29.0	28.8	31.3	41.1	52.1
Q_1 (mm)	2446.6	9.3	258.5	1555.9	359.3	510.8	453.6	250.6	132.8
Q_2 (mm)	2685.0	18.8	329.9	1774.6	474.5	599.3	578.3	305.4	181.1
Q_3 (mm)	2879.1	29.9	384.4	1928.8	563.4	687.6	661.3	374.8	261.3
Q_4 (mm)	3136.8	55.3	513.2	2164.5	647.8	797.0	759.1	476.5	345.4
$\overline{r}$	0.50	0.34	0.60	0.60	0.53	0.63	0.64	0.68	0.64
$\overline{R}$	0.74	0.62	0.80	0.80	0.76	0.82	0.82	0.84	0.82
IAR(%)	52.3	36.7	63.6	62.1	57.1	65.6	64.1	68.8	66.5

Table 15: Same as in Table 1, but for the East Coastal Plains and its subdivisions/ provinces

	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
THE EAST COASTAL PLAINS									
Mean (mm)	1111.0	37.9	106.6	551.9	414.6	98.9	140.0	157.4	155.6
Median (mm)	1105.7	29.7	97.6	545.5	413.1	94.4	141.1	158.9	151.1
SD	127.8	31.0	48.1	73.9	101.2	30.4	29.7	30.5	34.7
CV(%)	11.5	81.8	45.1	13.4	24.4	30.7	21.2	19.4	22.3
Q_1 (mm)	1008.0	10.8	72.7	489.0	325.3	77.0	112.2	131.1	127.1
Q_2 (mm)	1073.7	23.7	89.1	526.2	391.9	89.8	129.6	146.1	142.4
Q_3 (mm)	1137.6	34.9	103.2	566.4	443.7	102.7	151.9	165.7	159.3
Q_4 (mm)	1229.5	52.5	130.8	615.5	504.6	113.5	165.0	180.8	184.4
$\bar{r}$	0.17	0.29	0.28	0.18	0.22	0.16	0.13	0.11	0.13
$\bar{R}$	0.45	0.56	0.55	0.45	0.50	0.41	0.38	0.37	0.40
IAR(%)	20.7	31.9	30.2	18.2	24.6	15.7	13.2	11.4	15.5
Utkal Plains									
Mean (mm)	1478.0	41.3	145.2	1049.0	242.5	205.0	286.5	310.0	247.5
Median (mm)	1461.3	31.8	133.3	1052.0	226.6	205.0	283.4	308.3	239.2
SD	227.6	35.1	80.2	166.3	143.0	83.4	90.3	87.0	74.4
CV(%)	15.4	84.9	55.3	15.9	59.0	40.7	31.5	28.1	30.1
Q_1 (mm)	1283.4	10.0	86.6	890.7	93.8	124.9	204.7	231.2	188.1
Q_2 (mm)	1397.7	26.5	122.1	1016.9	178.5	178.1	256.0	281.1	223.5
Q_3 (mm)	1516.3	41.6	150.4	1074.3	276.7	222.8	300.1	325.6	250.0
Q_4 (mm)	1637.1	67.1	186.9	1162.9	361.0	275.9	352.5	386.5	301.1
$\bar{r}$	0.40	0.50	0.60	0.34	0.67	0.42	0.40	0.27	0.33
$\bar{R}$	0.72	0.77	0.82	0.69	0.86	0.73	0.72	0.64	0.68
IAR(%)	52.3	59.6	67.8	47.0	69.8	53.3	51.5	41.1	45.8
Andhra Plains									
Mean (mm)	1005.2	21.8	73.8	547.7	361.9	97.0	148.2	144.2	158.3
Median (mm)	974.6	12.5	53.6	529.1	352.2	88.9	146.6	139.0	147.7
SD	187.0	26.6	67.4	120.9	136.8	48.7	50.9	52.4	62.7
CV(%)	18.6	122.0	91.3	22.1	37.8	50.2	34.3	36.3	39.6
Q_1 (mm)	831.4	1.9	28.9	431.2	246.7	62.7	103.2	96.5	98.6
Q_2 (mm)	931.0	6.1	38.7	514.1	323.2	76.2	130.8	129.7	138.5
Q_3 (mm)	1016.4	19.5	67.4	559.7	398.8	95.2	153.8	152.7	164.7
Q_4 (mm)	1158.0	36.0	114.5	643.3	490.1	129.9	185.3	190.2	201.8
$\bar{r}$	0.39	0.43	0.62	0.41	0.45	0.38	0.35	0.36	0.39
$\bar{R}$	0.68	0.70	0.82	0.69	0.71	0.68	0.65	0.66	0.68
IAR(%)	46.0	45.1	65.6	48.5	48.1	43.7	43.4	44.2	45.5
Tamilnadu Plains									
Mean (mm)	1021.2	48.0	113.0	329.1	531.1	52.1	67.5	97.7	111.9
Median (mm)	1016.6	31.9	103.6	322.4	524.3	48.5	58.2	89.5	111.6
SD	164.4	52.1	49.6	73.3	151.9	26.0	33.4	39.7	40.0
CV(%)	16.1	108.4	43.9	22.3	28.6	49.9	49.5	40.6	35.7
Q_1 (mm)	887.6	7.9	72.1	263.3	394.7	33.4	44.1	61.8	78.1
Q_2 (mm)	961.6	22.3	95.6	301.5	474.9	46.5	54.0	81.1	99.2
Q_3 (mm)	1049.9	37.9	110.7	338.2	554.5	52.6	64.6	102.2	123.2
Q_4 (mm)	1164.1	79.3	144.3	391.0	655.6	64.2	90.2	128.7	145.0
$\bar{r}$	0.32	0.60	0.29	0.27	0.44	0.24	0.31	0.24	0.25
$\bar{R}$	0.61	0.79	0.59	0.58	0.70	0.53	0.61	0.55	0.56
IAR(%)	37.6	60.3	33.3	32.2	46.7	22.9	35.9	31.5	31.4

Table16: Important statistics and the parameters of the spatial coherency and representation of different area-averaged rainfall series (1901-2000) of the Whole India

THE WHOLE INDIA

	Ann	Win	Sum	Sum mon	Post mon	Jun	Jul	Aug	Sep
Mean (mm)	1165.9	31.5	101.6	906.5	126.3	169.1	297.4	263.4	176.6
Median (mm)	1177.2	29.9	100.5	919.4	126.3	166.0	300.4	264.6	177.0
SD	105.8	13.4	21.3	88.2	35.2	37.1	40.5	37.6	42.2
CV(%)	9.1	42.5	21.0	9.7	27.8	21.9	13.6	14.3	23.9
Q_1 (mm)	1060.7	18.2	81.9	831.9	92.8	138.0	270.5	232.8	137.0
Q_2 (mm)	1143.2	26.5	91.7	893.3	113.8	161.4	291.1	250.1	161.8
Q_3 (mm)	1190.6	33.0	106.2	944.1	130.7	176.1	310.4	279.4	185.5
Q_4 (mm)	1244.0	42.7	119.3	978.7	150.6	201.7	328.3	296.7	213.5
$\bar{r}$	0.13	0.17	0.15	0.11	0.19	0.14	0.08	0.07	0.11
$\bar{R}$	0.37	0.41	0.36	0.34	0.42	0.37	0.28	0.28	0.34
IAR(%)	11.1	13.5	6.9	9.8	12.2	10.8	7.0	6.9	11.7

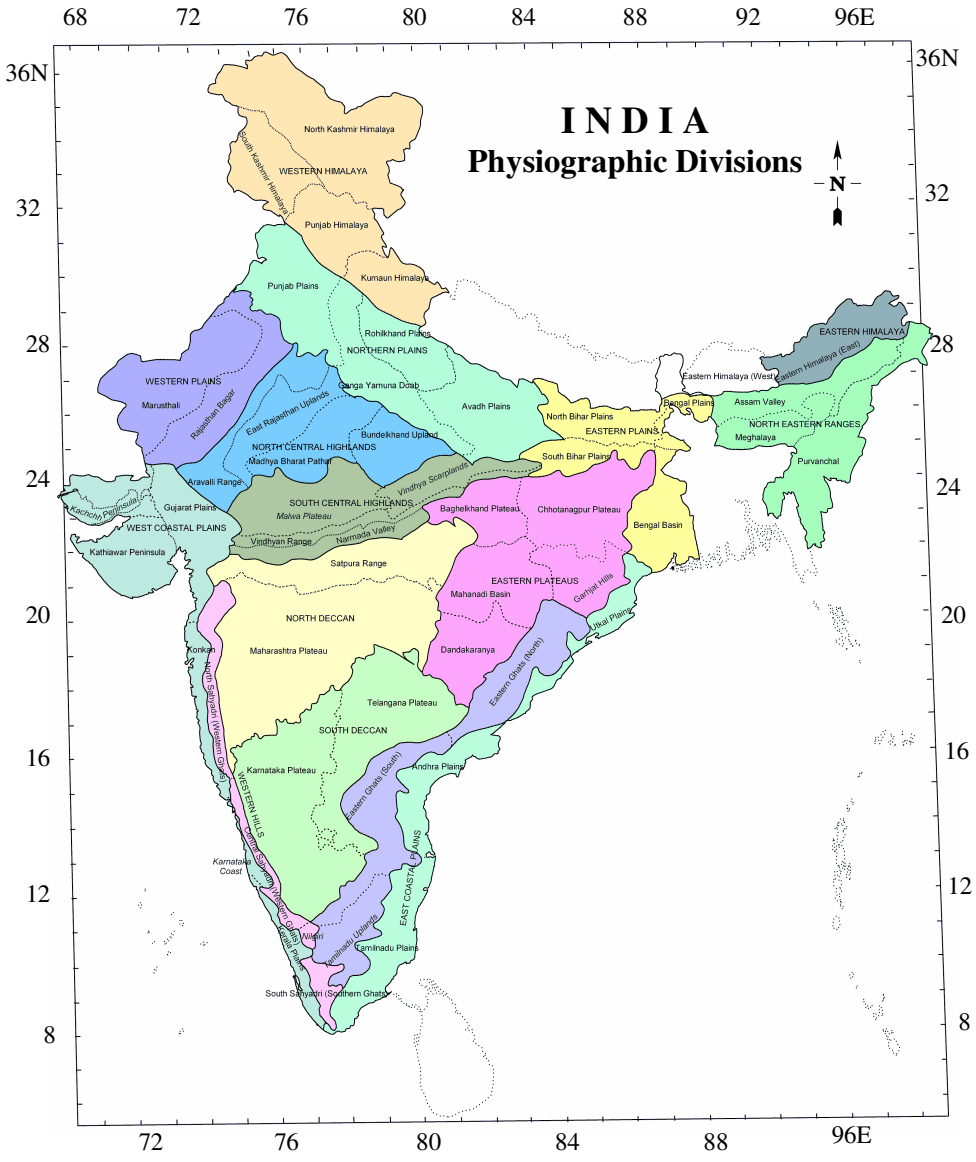

Figure 1: Location of 316 rainguage stations and boundary of physiographic divisions and subdivisions/provinces of the country.

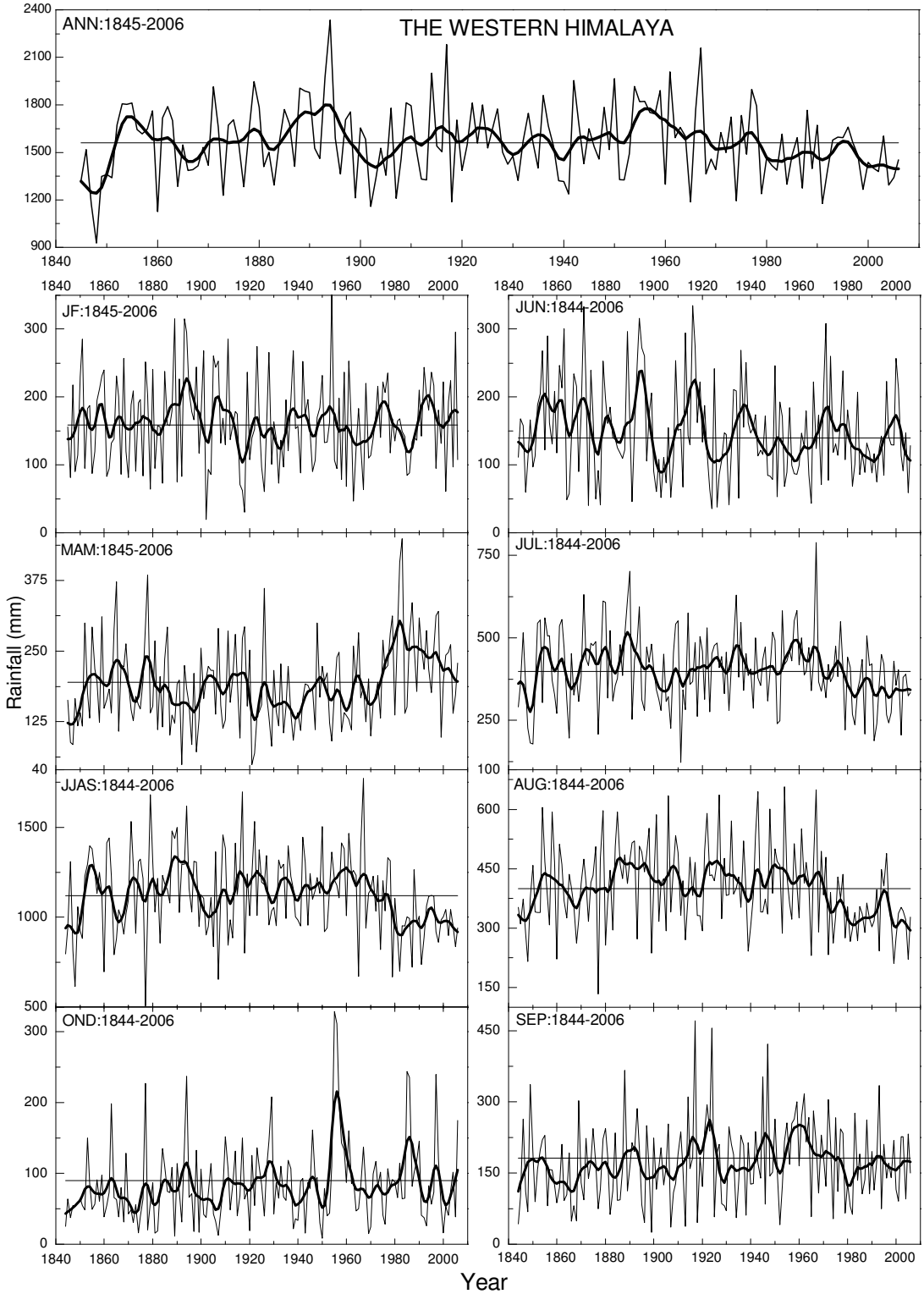

Figure 2: Time series plots of the annual, seasonal, summer monsoon monthly rainfall. Thin curve represents actual values and thick curve 9-point Gaussian low-pass filtered values with truncated end points

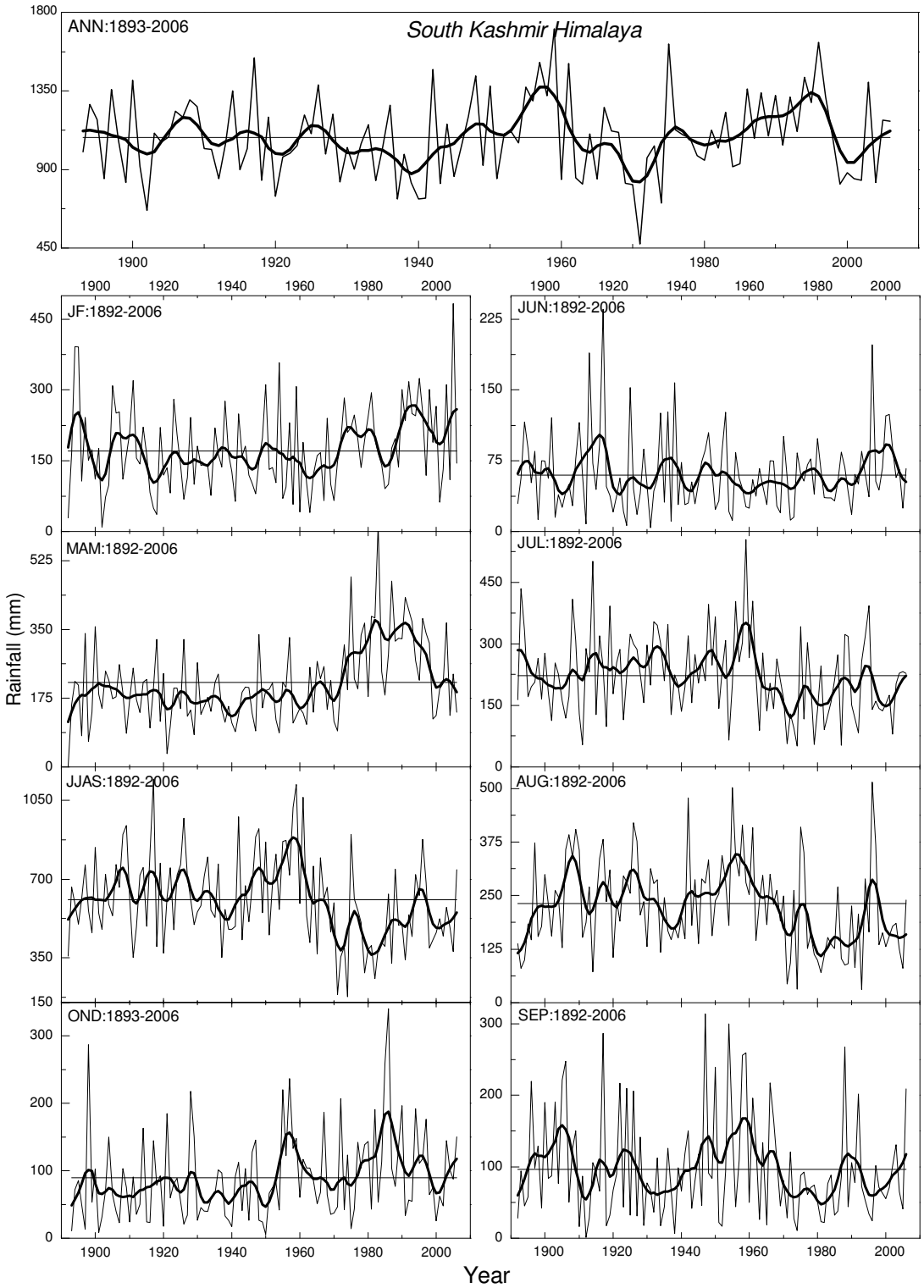

Figure 3: Same as in Figure 2.

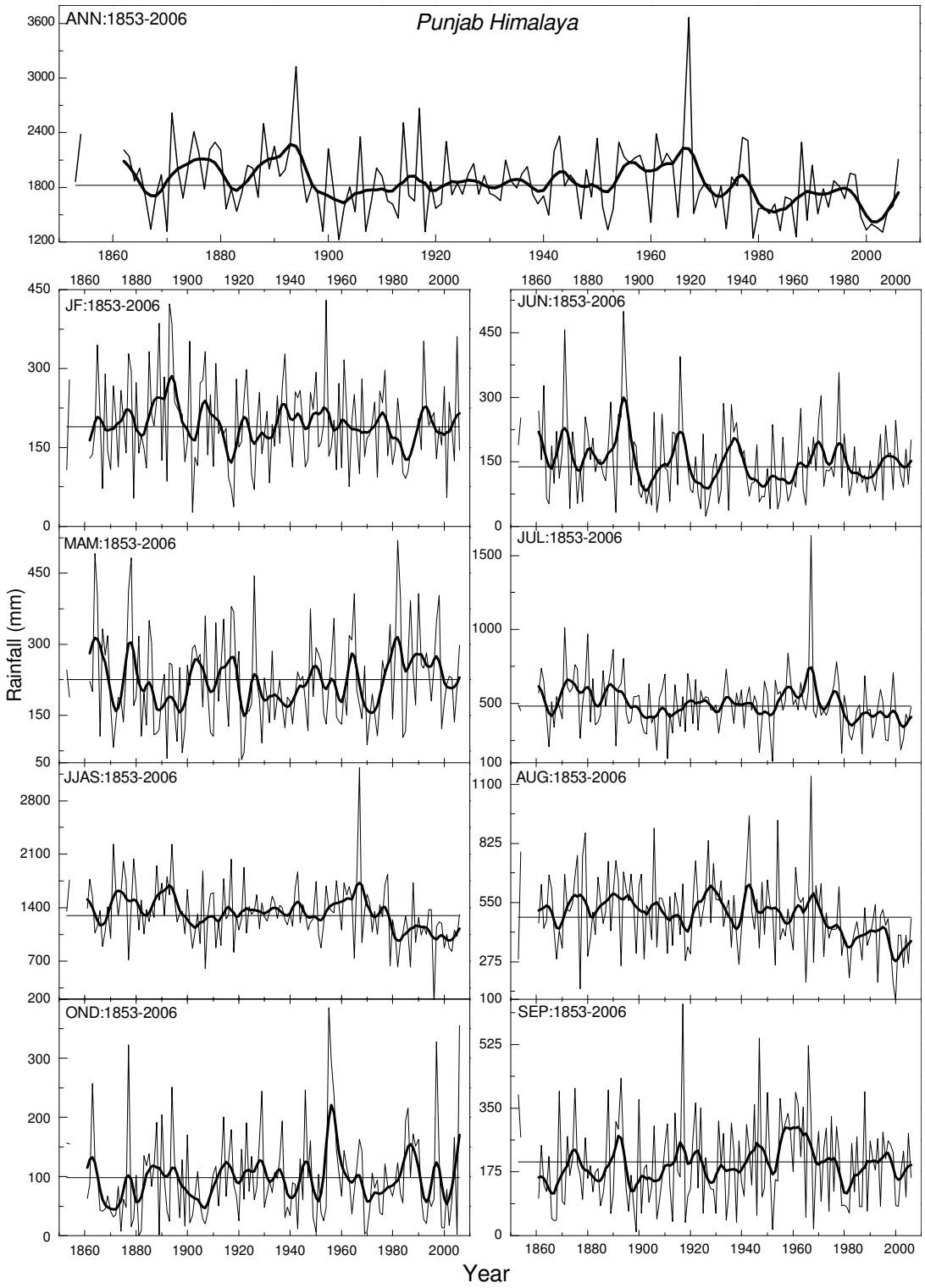

Figure 4: Same as in Figure 2.

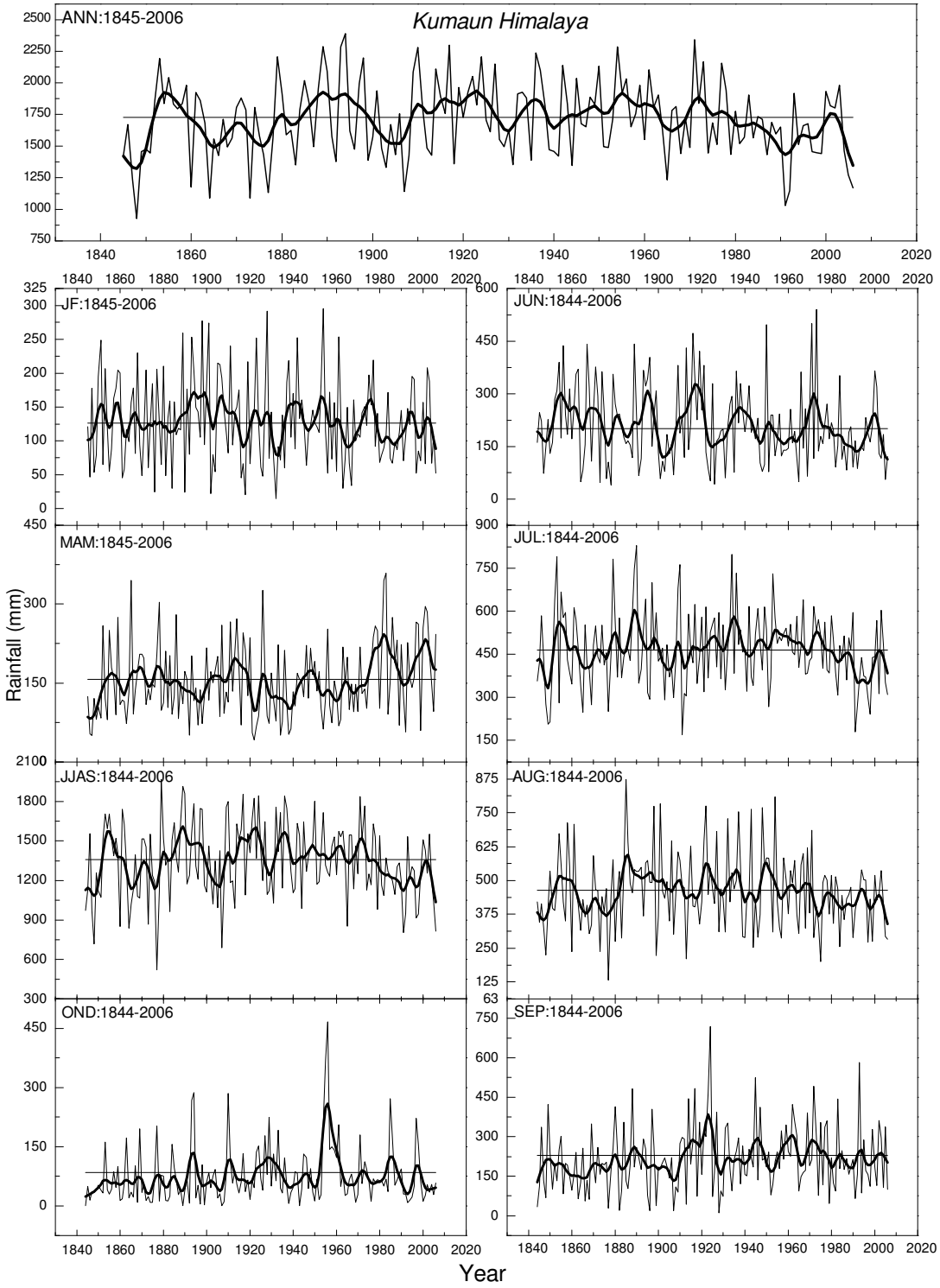

Figure 5: Same as in Figure 2.

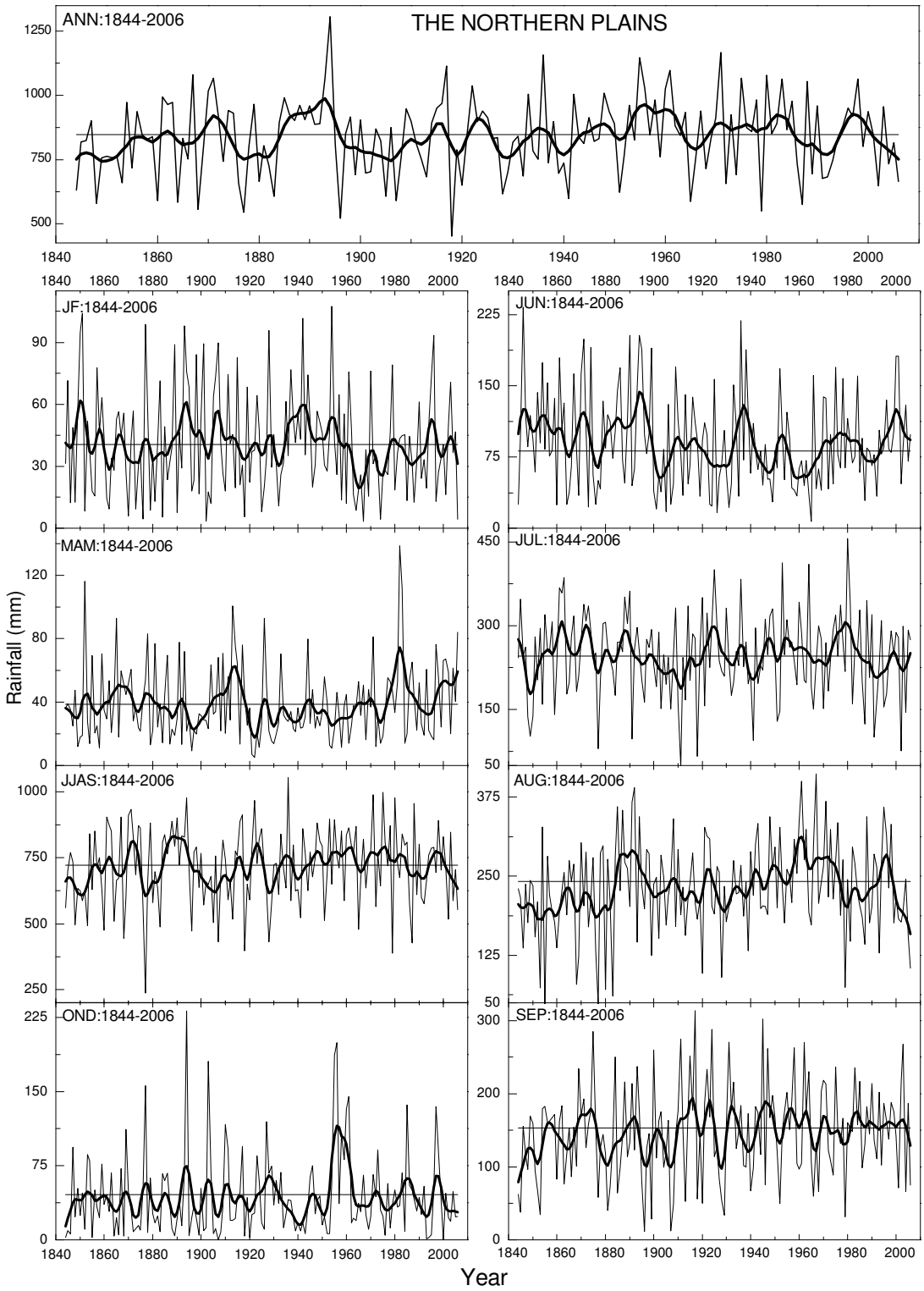

Figure 6: Same as in Figure 2.

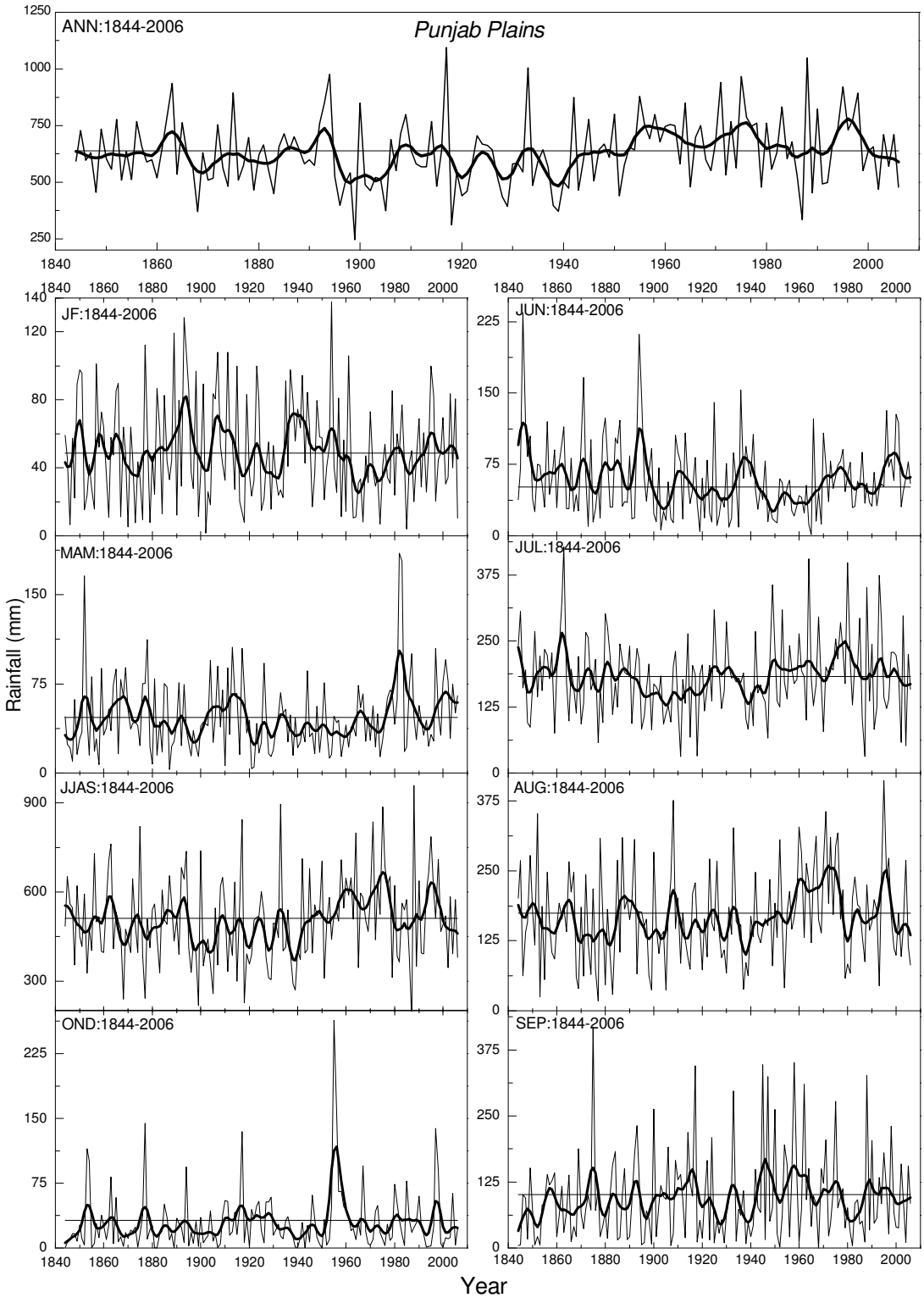

Figure 7: Same as in Figure 2.

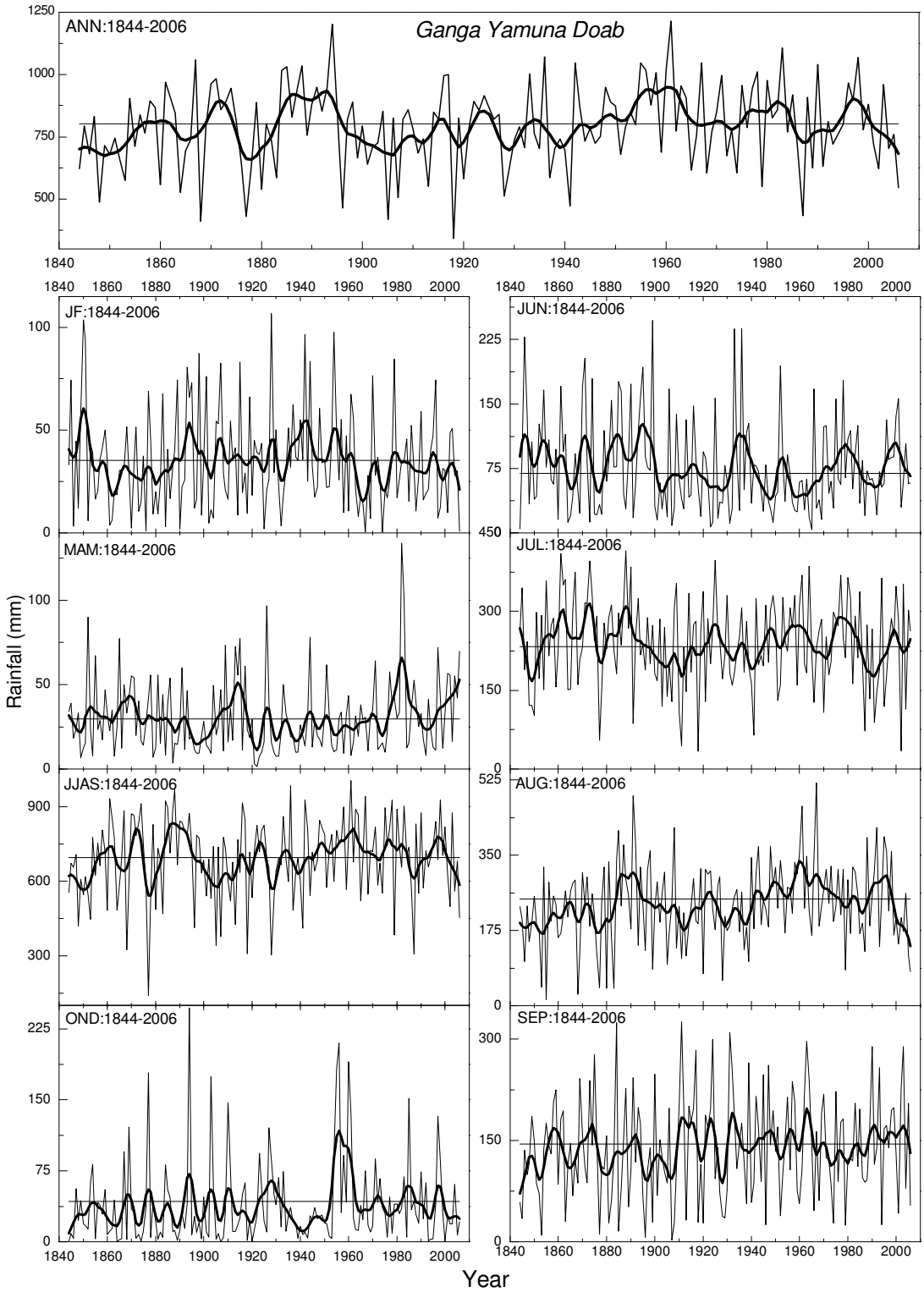

Figure 8: Same as in Figure 2.

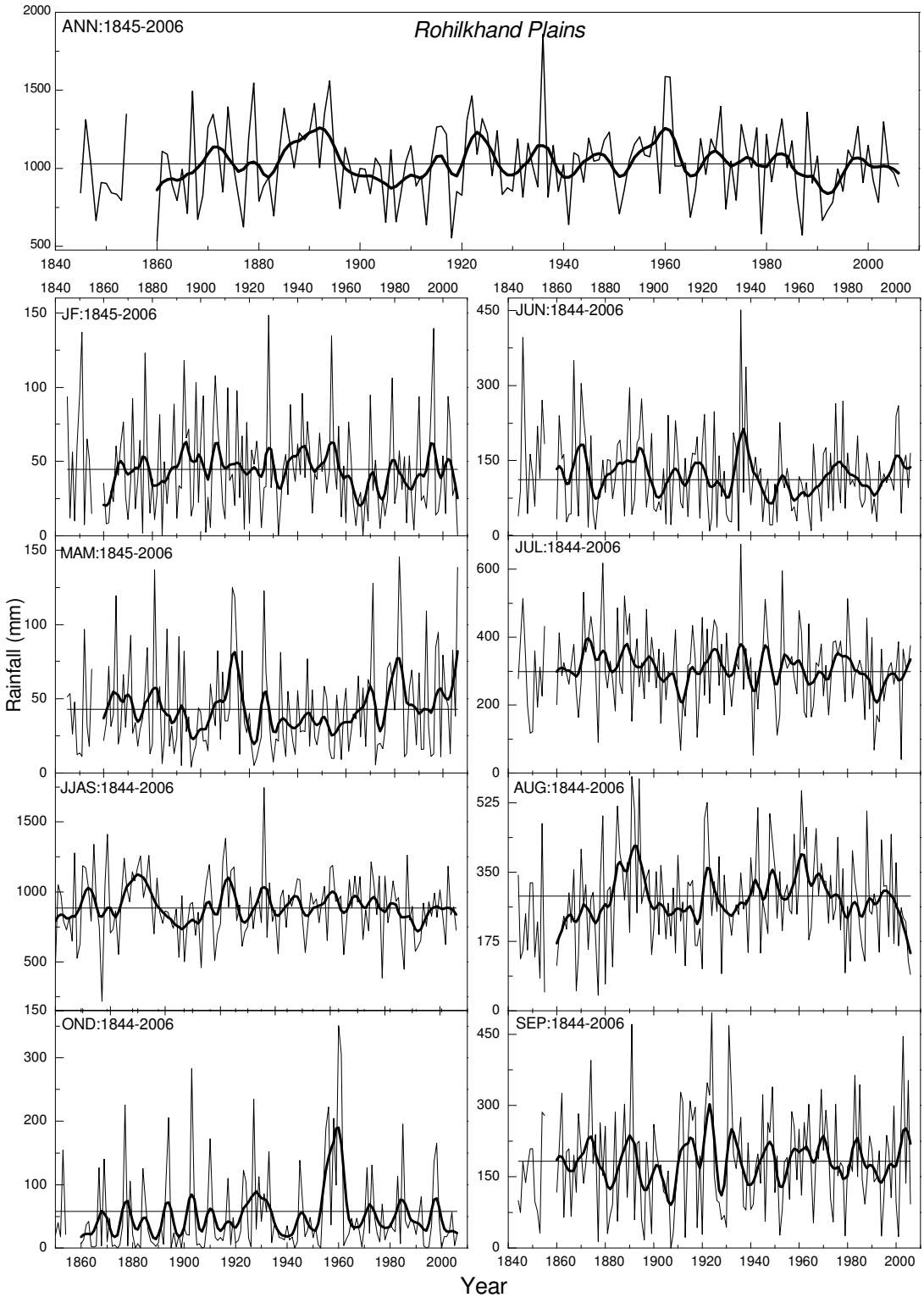

Figure 9: Same as in Figure 2.

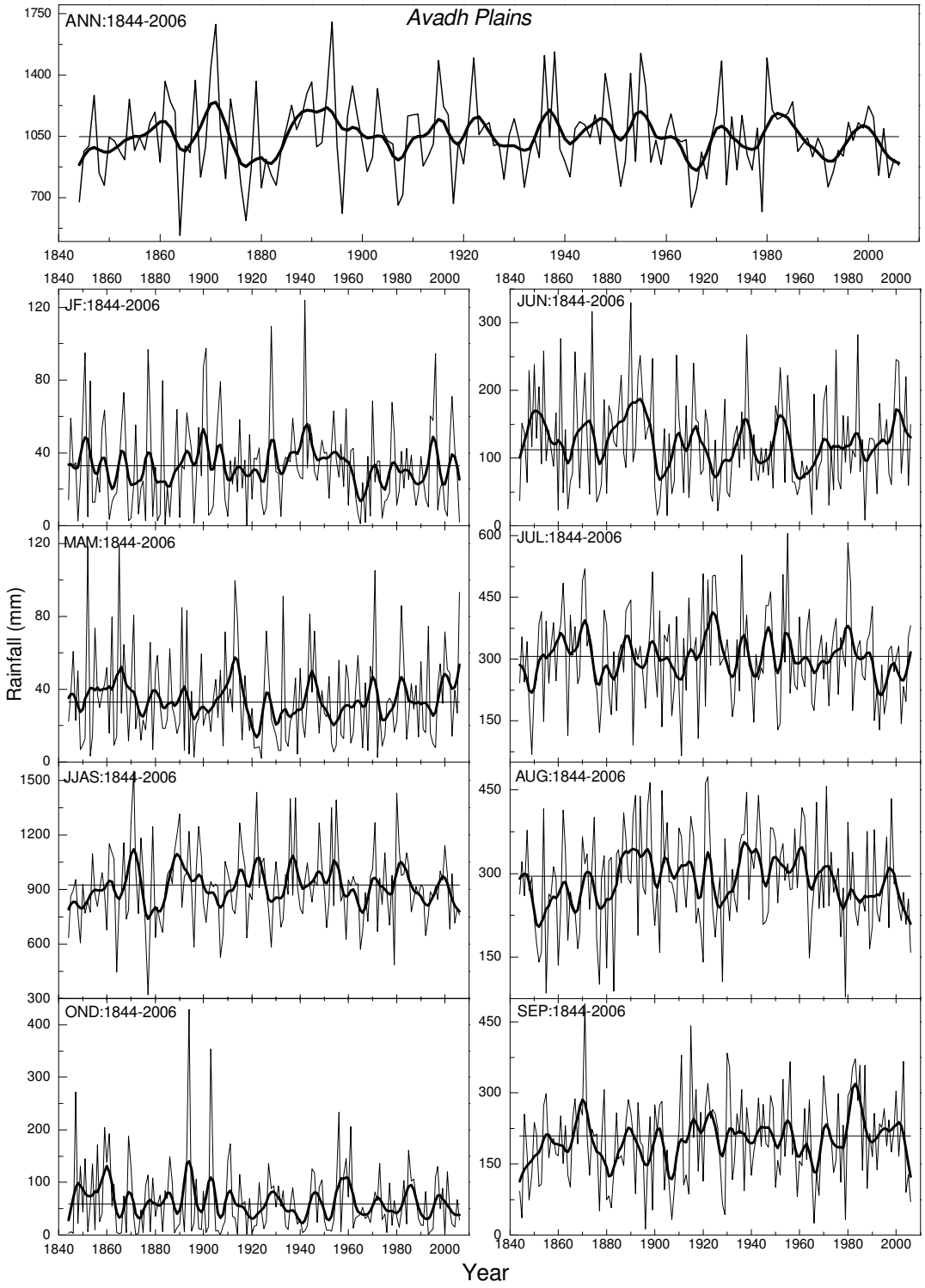

Figure 10: Same as in Figure 2.

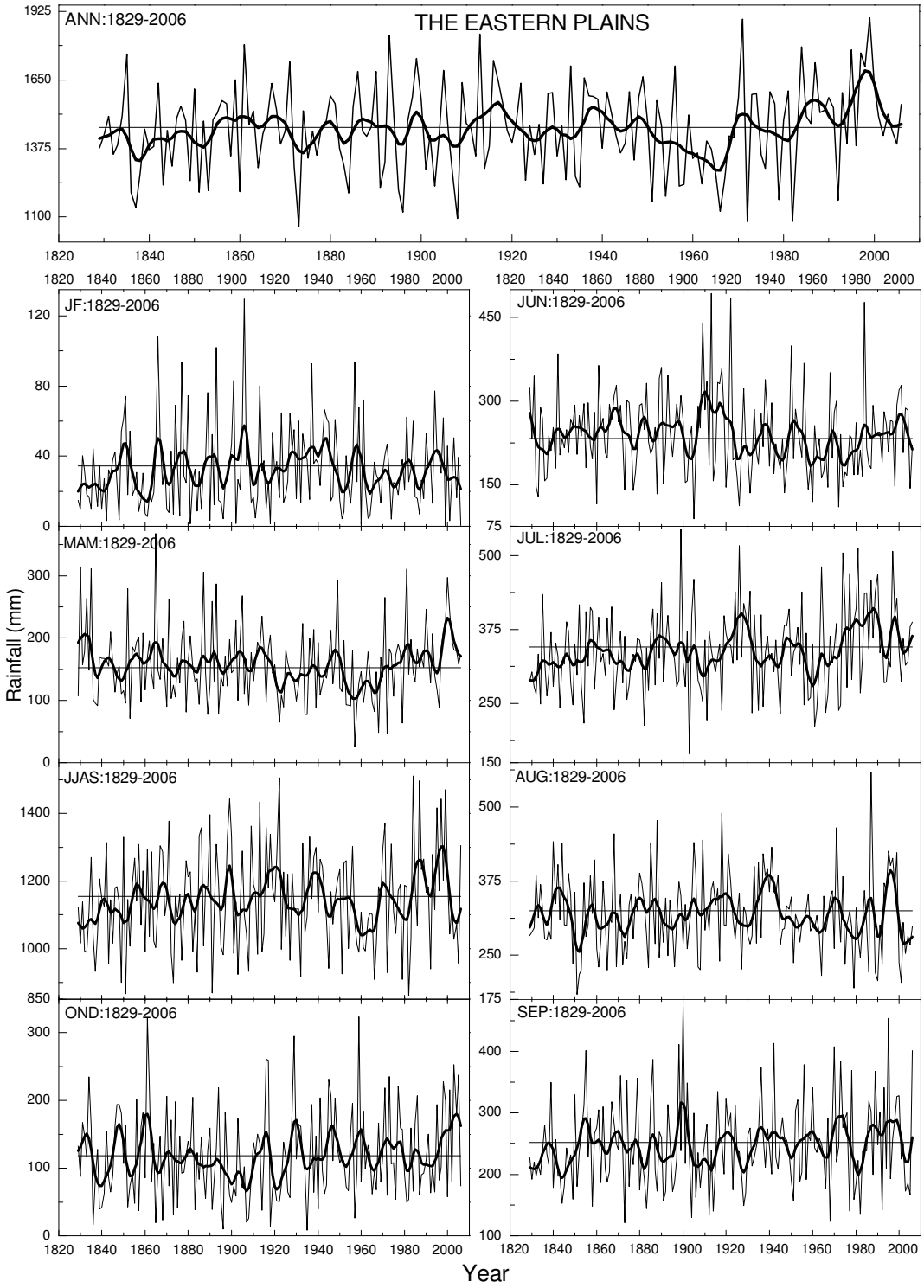

Figure 11: Same as in Figure 2.

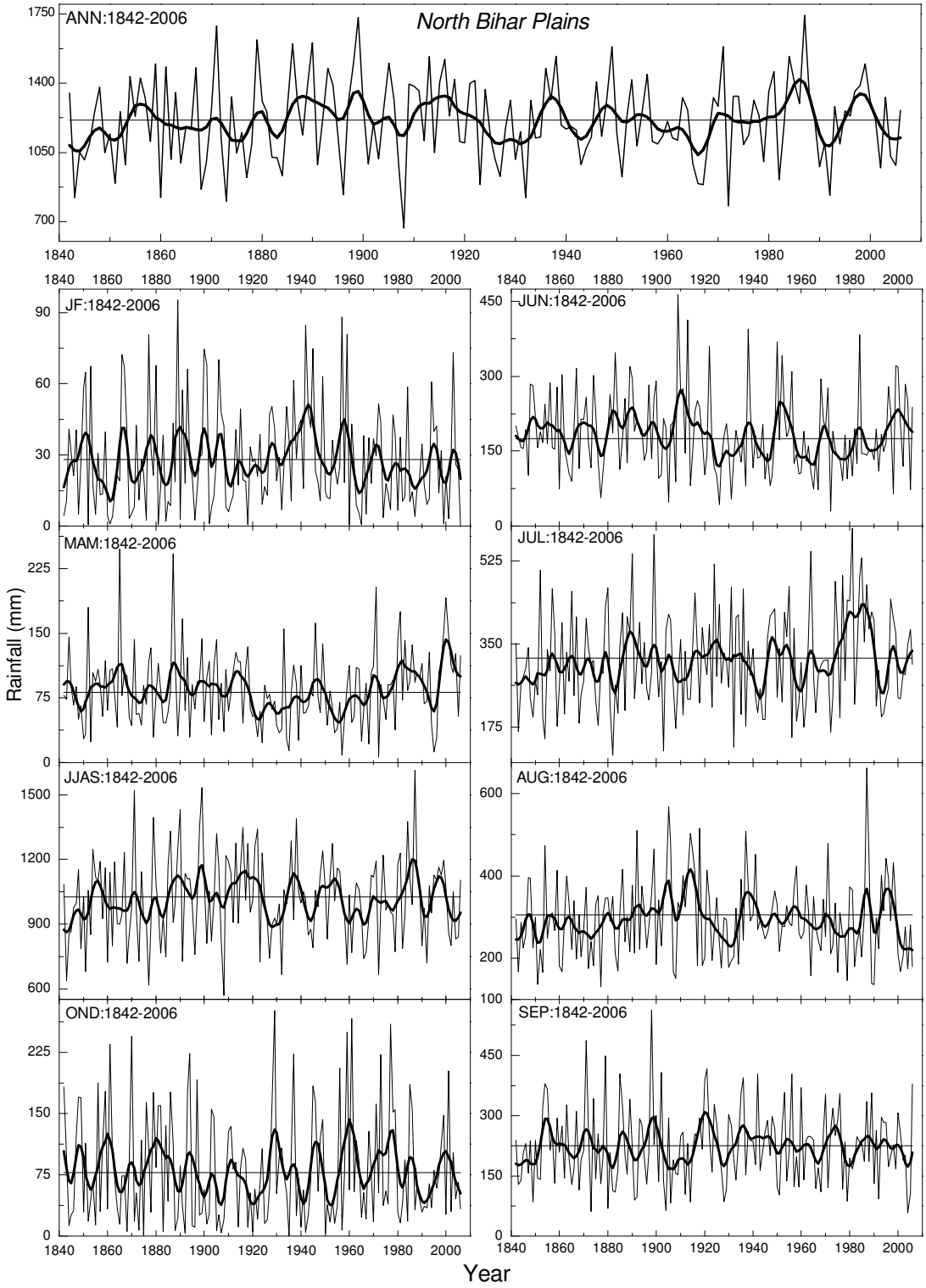

Figure 12: Same as in Figure 2.

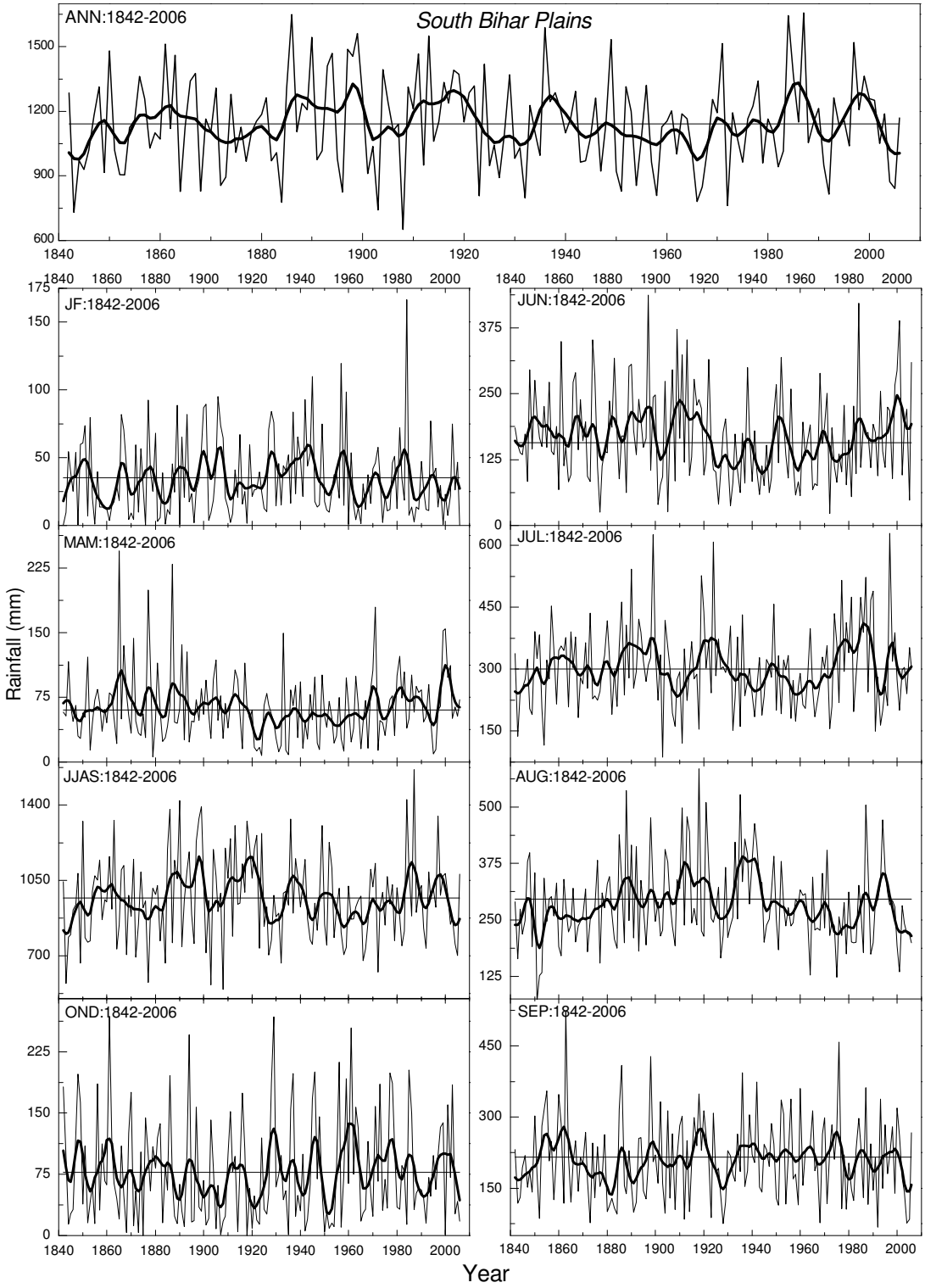

Figure 13: Same as in Figure 2.

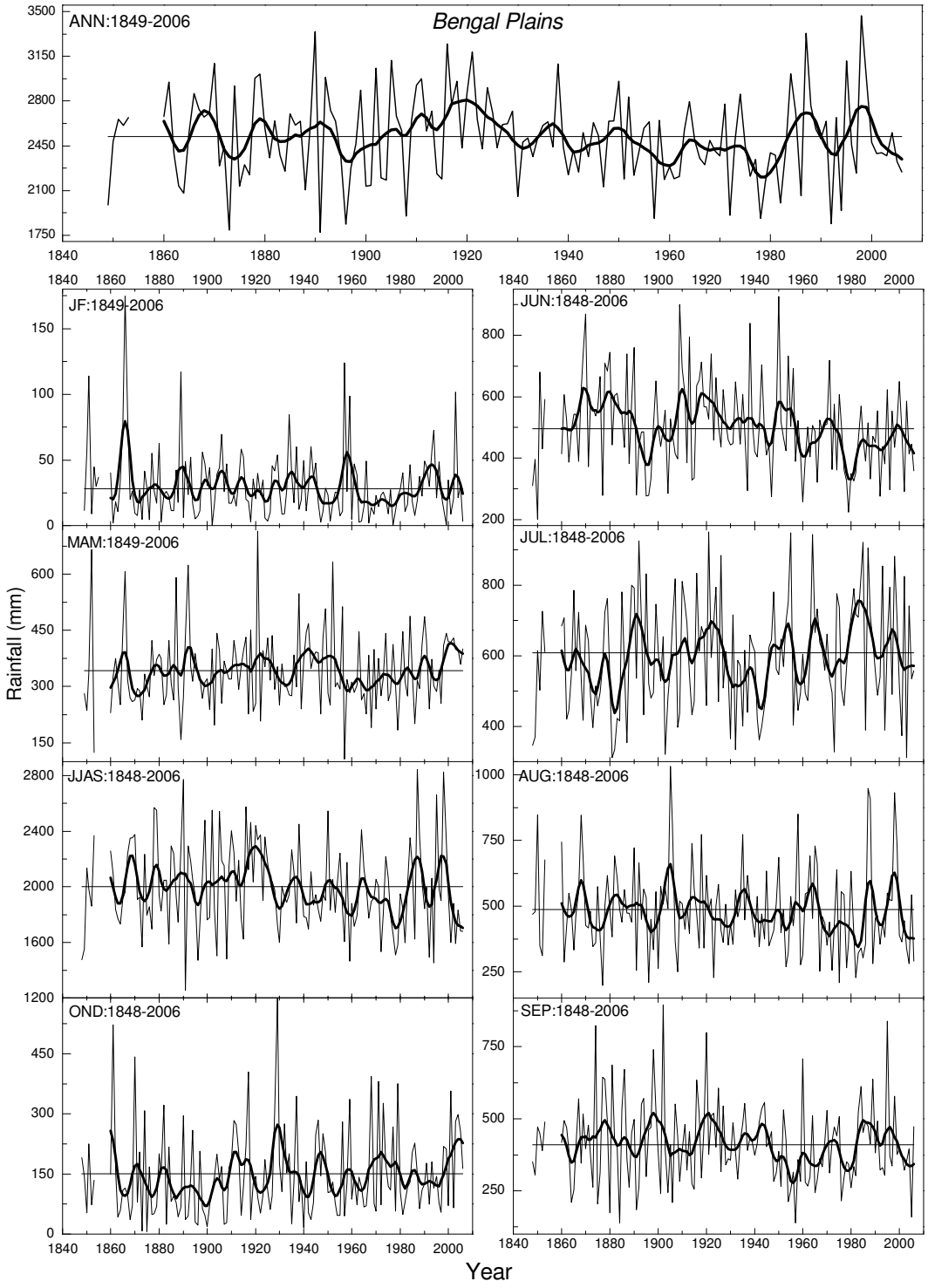

Figure 14: Same as in Figure 2.

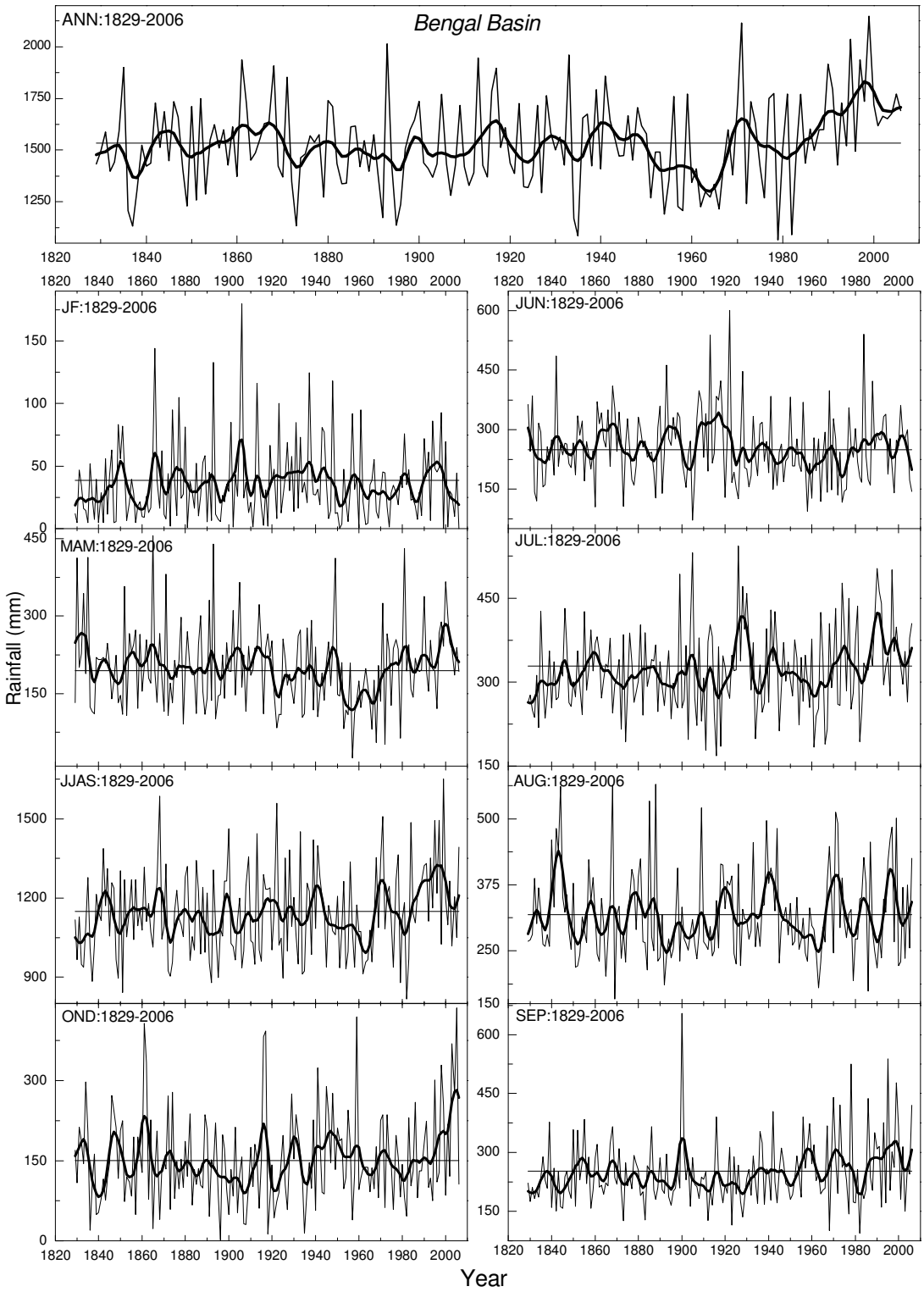

Figure 15: Same as in Figure 2.

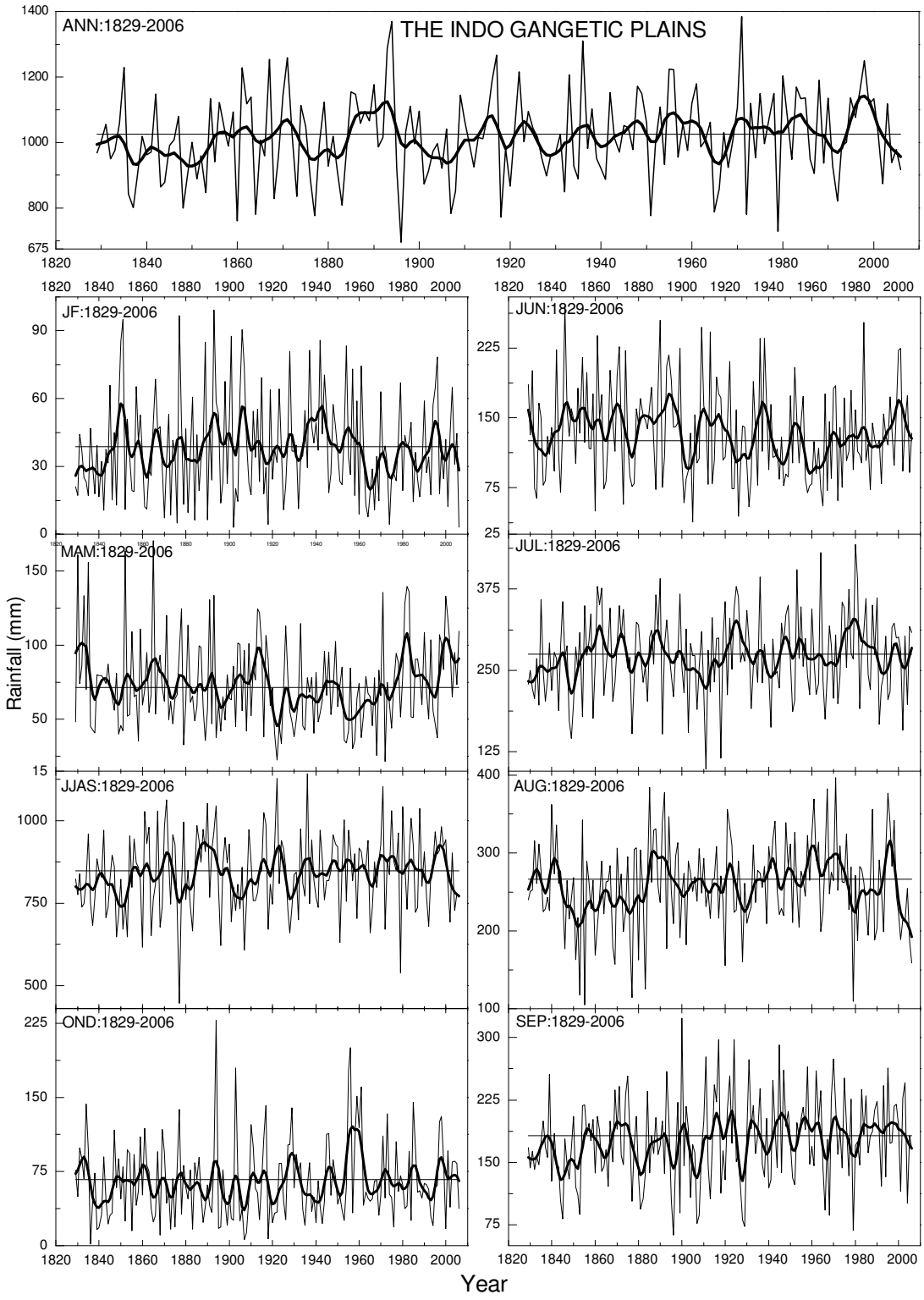

Figure 16: Same as in Figure 2.

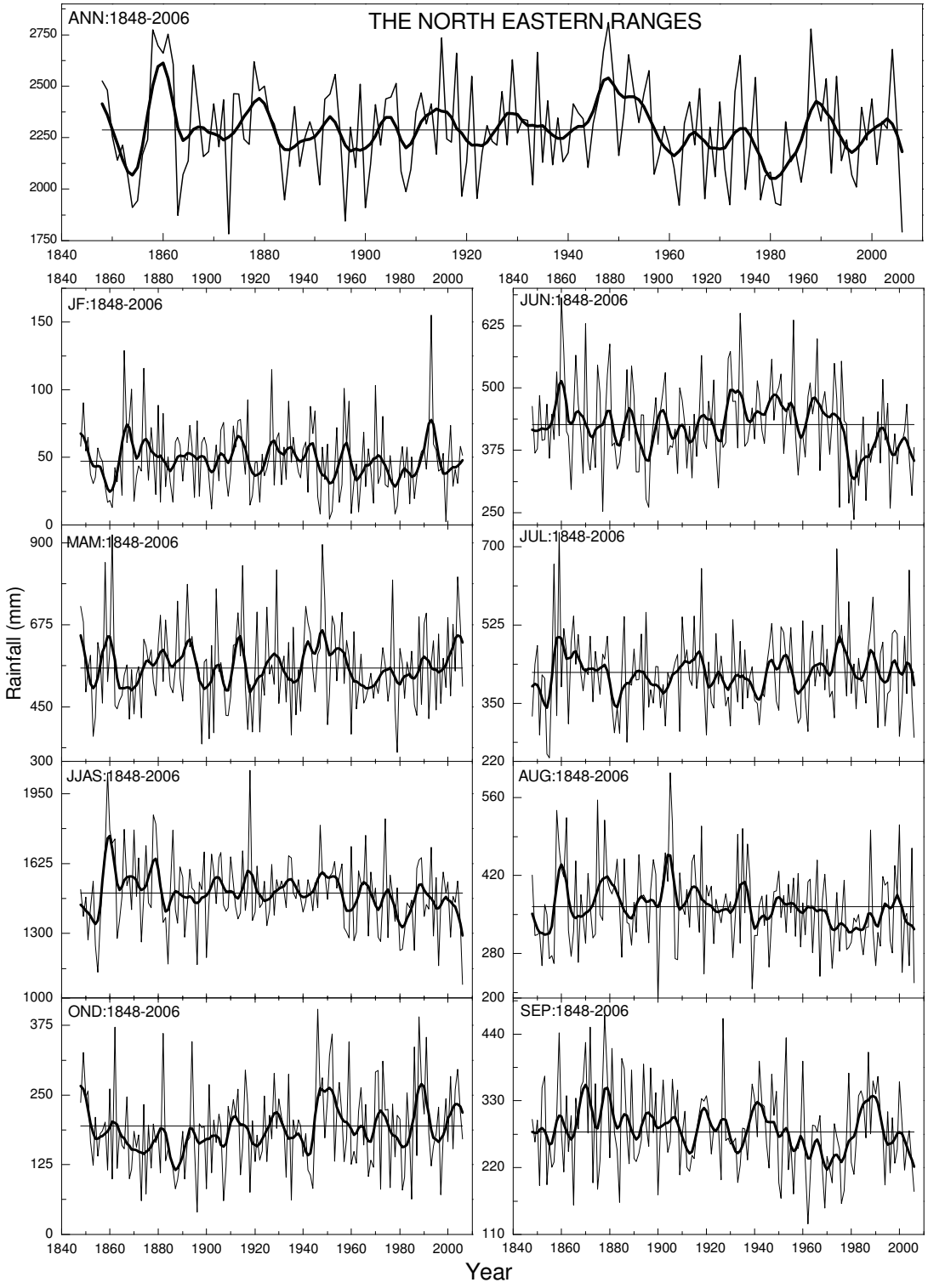

Figure 17: Same as in Figure 2.

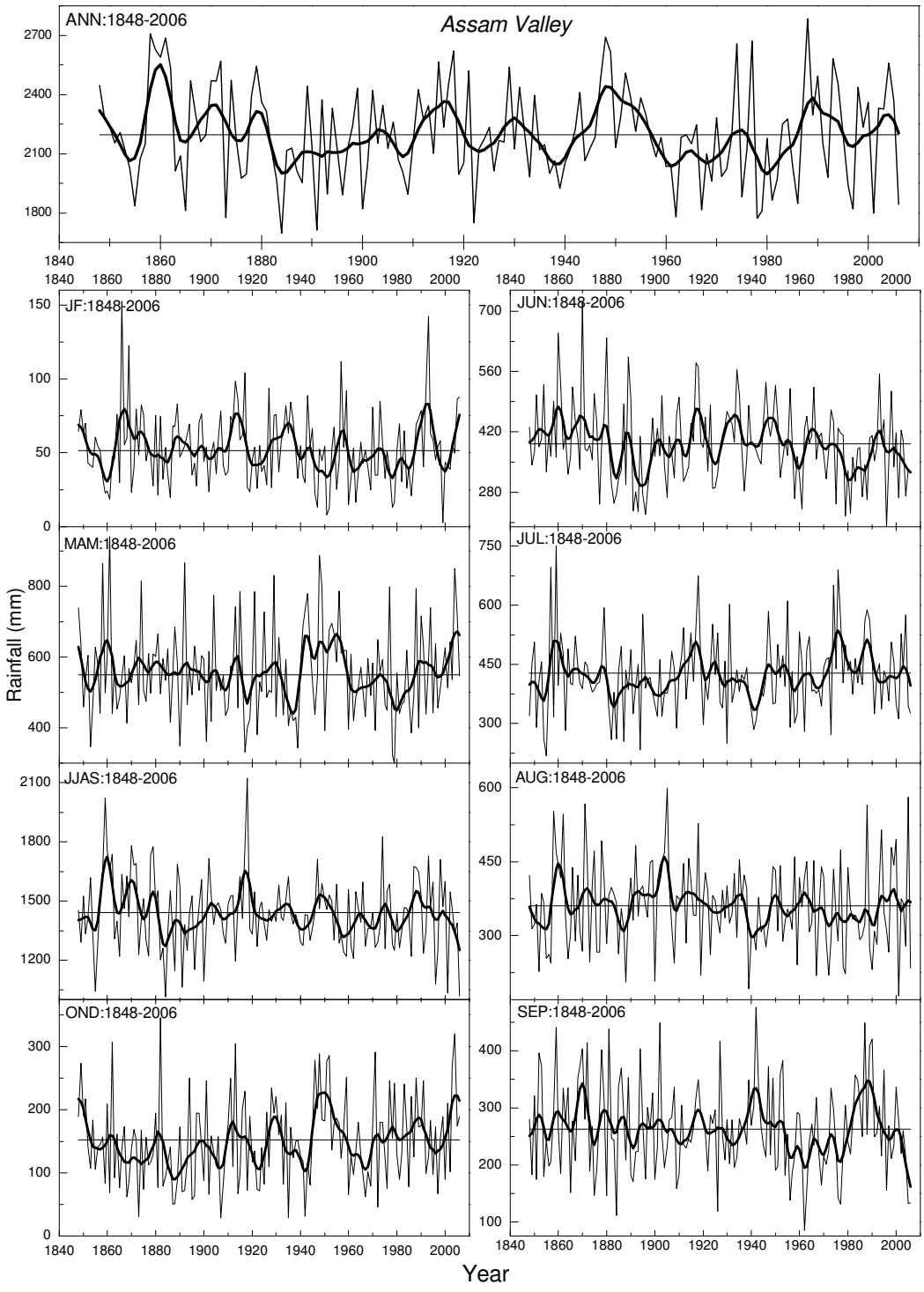

Figure 18: Same as in Figure 2.

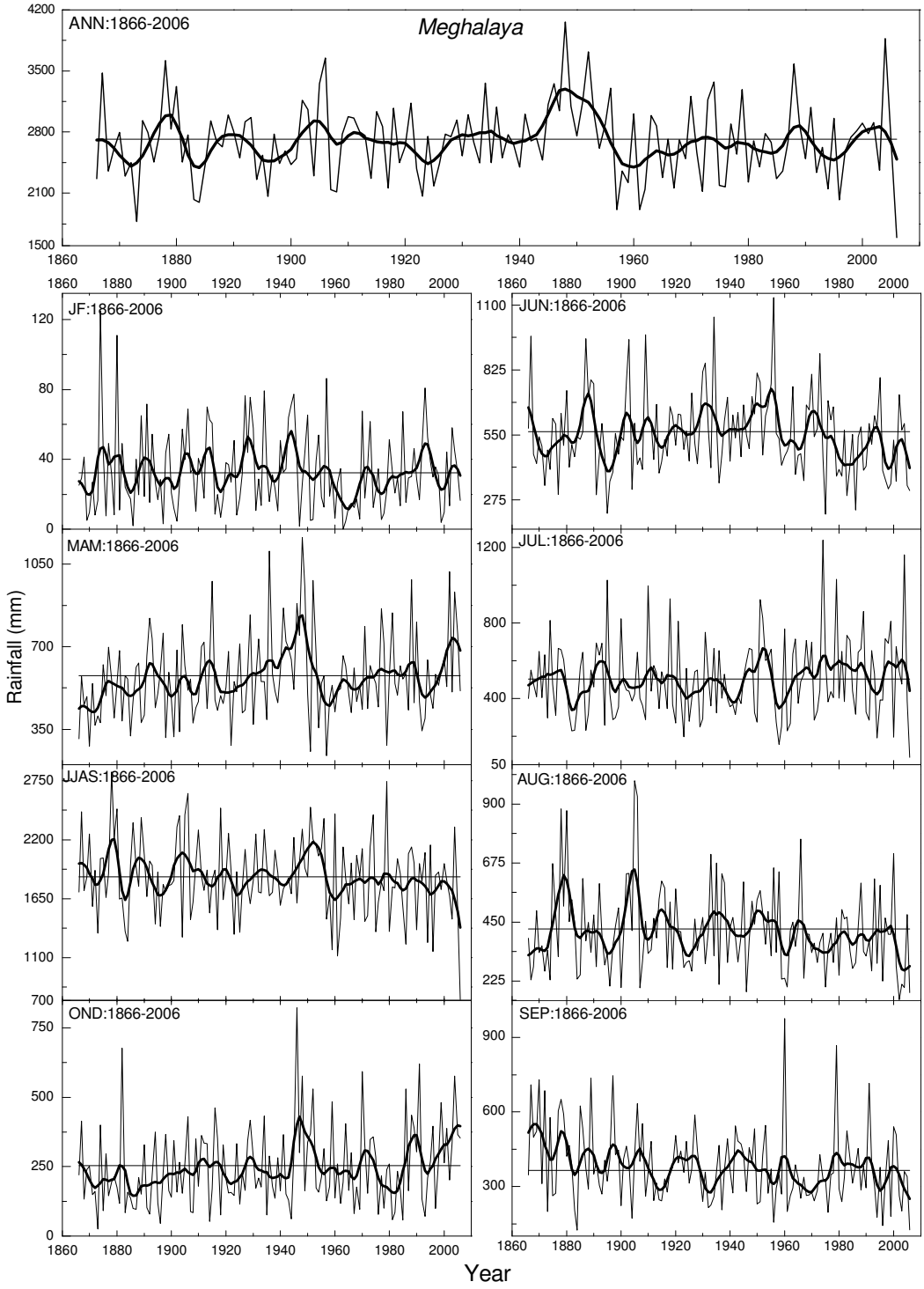

Figure 19: Same as in Figure 2.

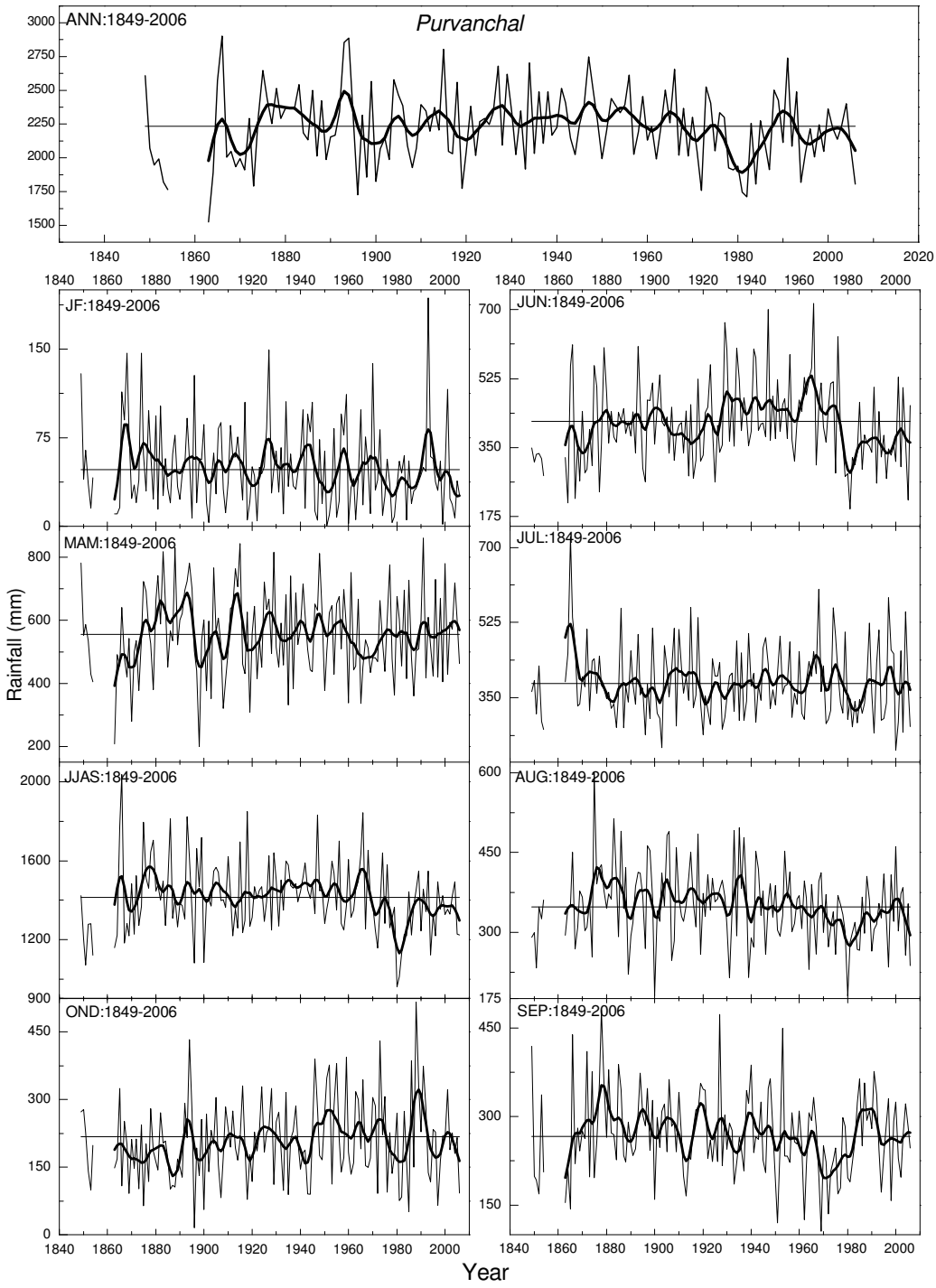

Figure 20: Same as in Figure 2.

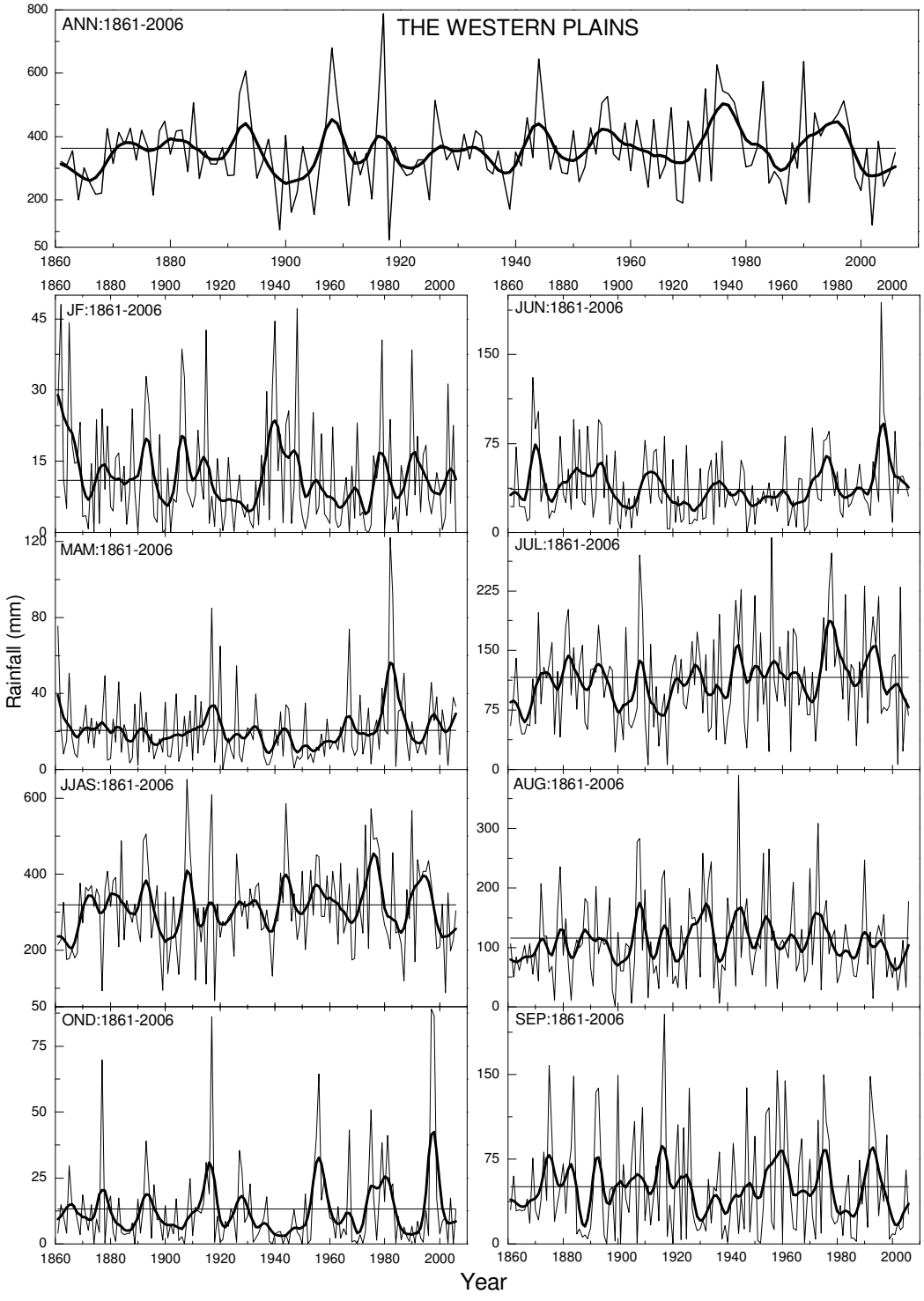

Figure 21: Same as in Figure 2.

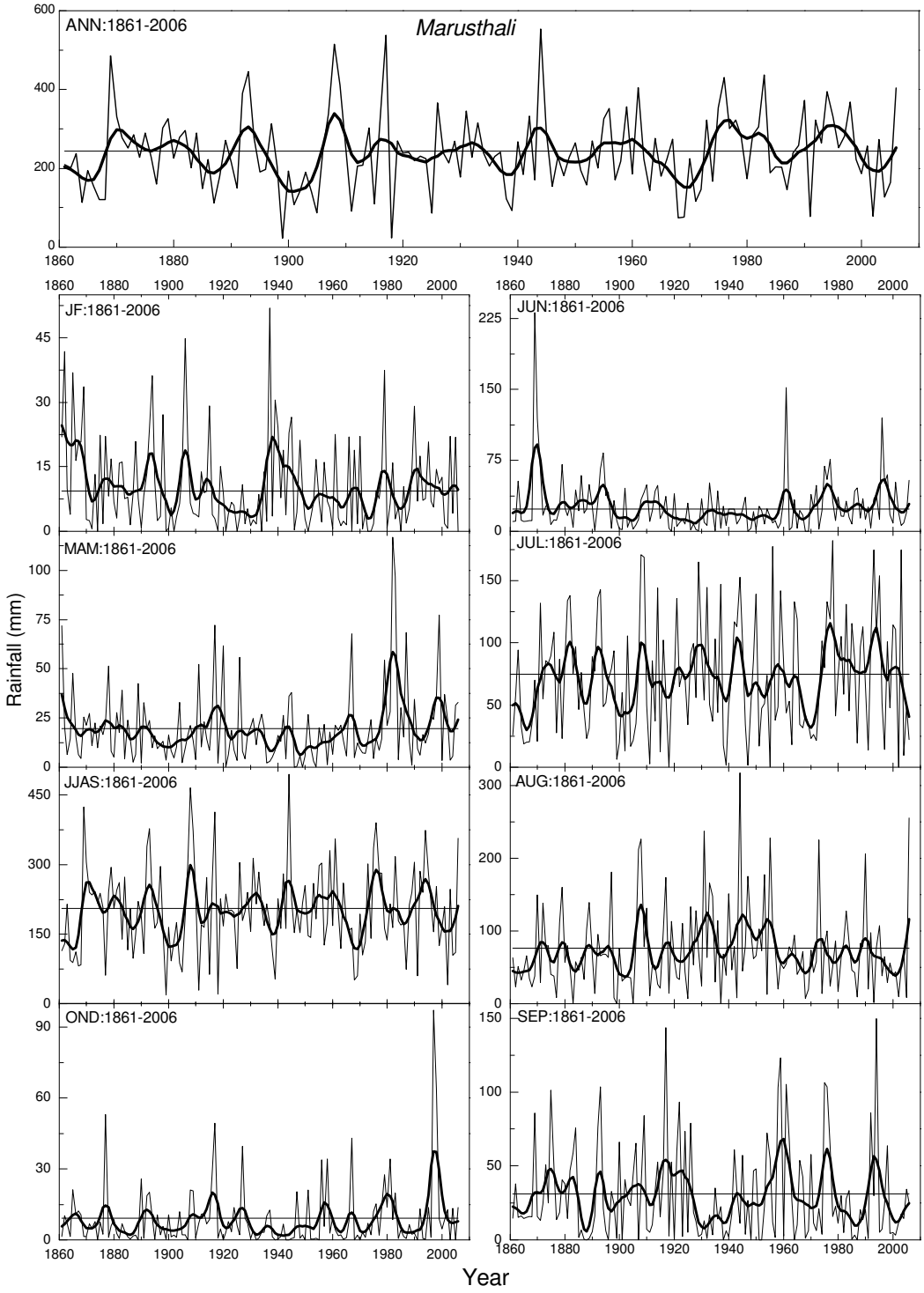

Figure 22: Same as in Figure 2.

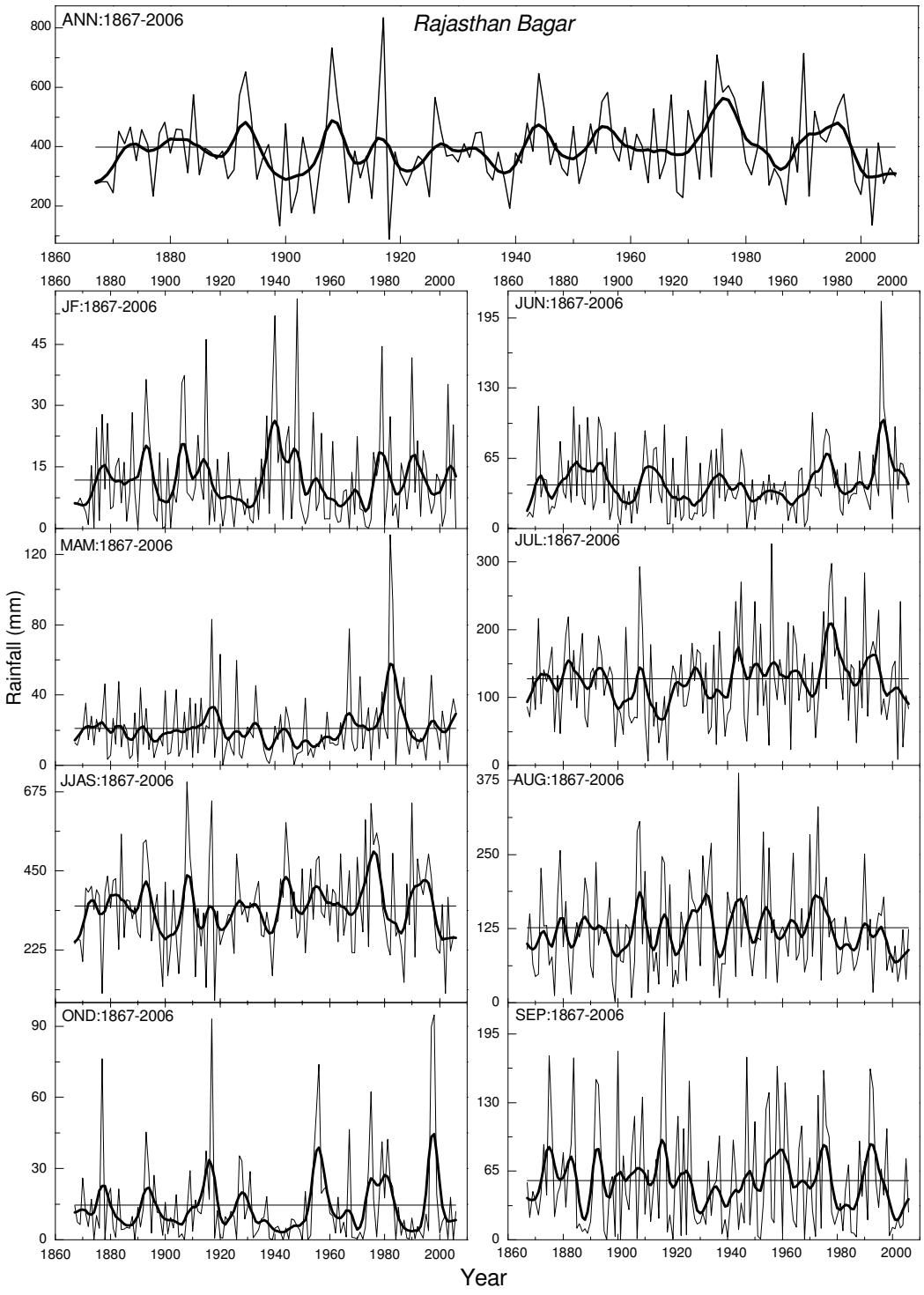

Figure 23: Same as in Figure 2.

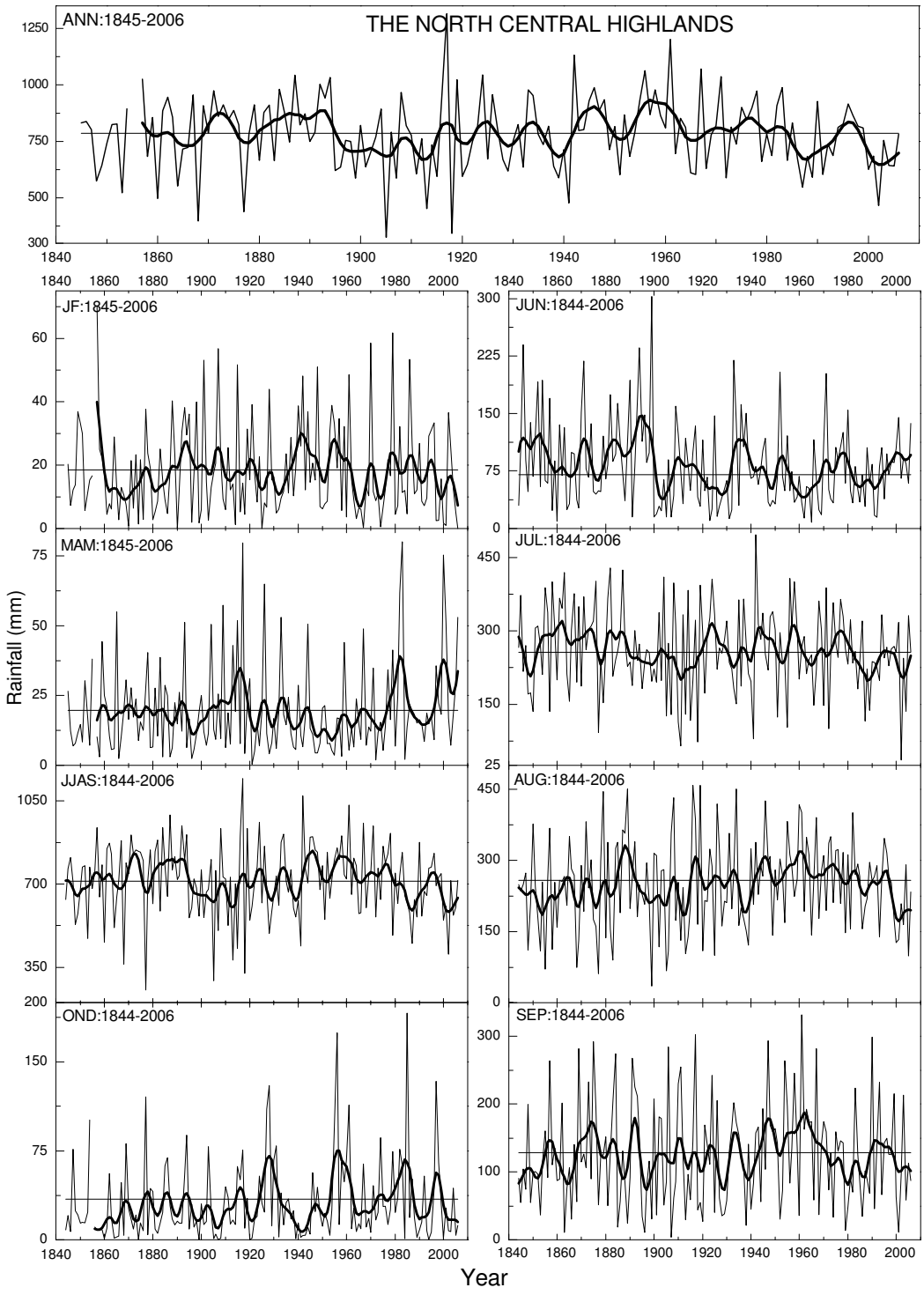

Figure 24: Same as in Figure 2.

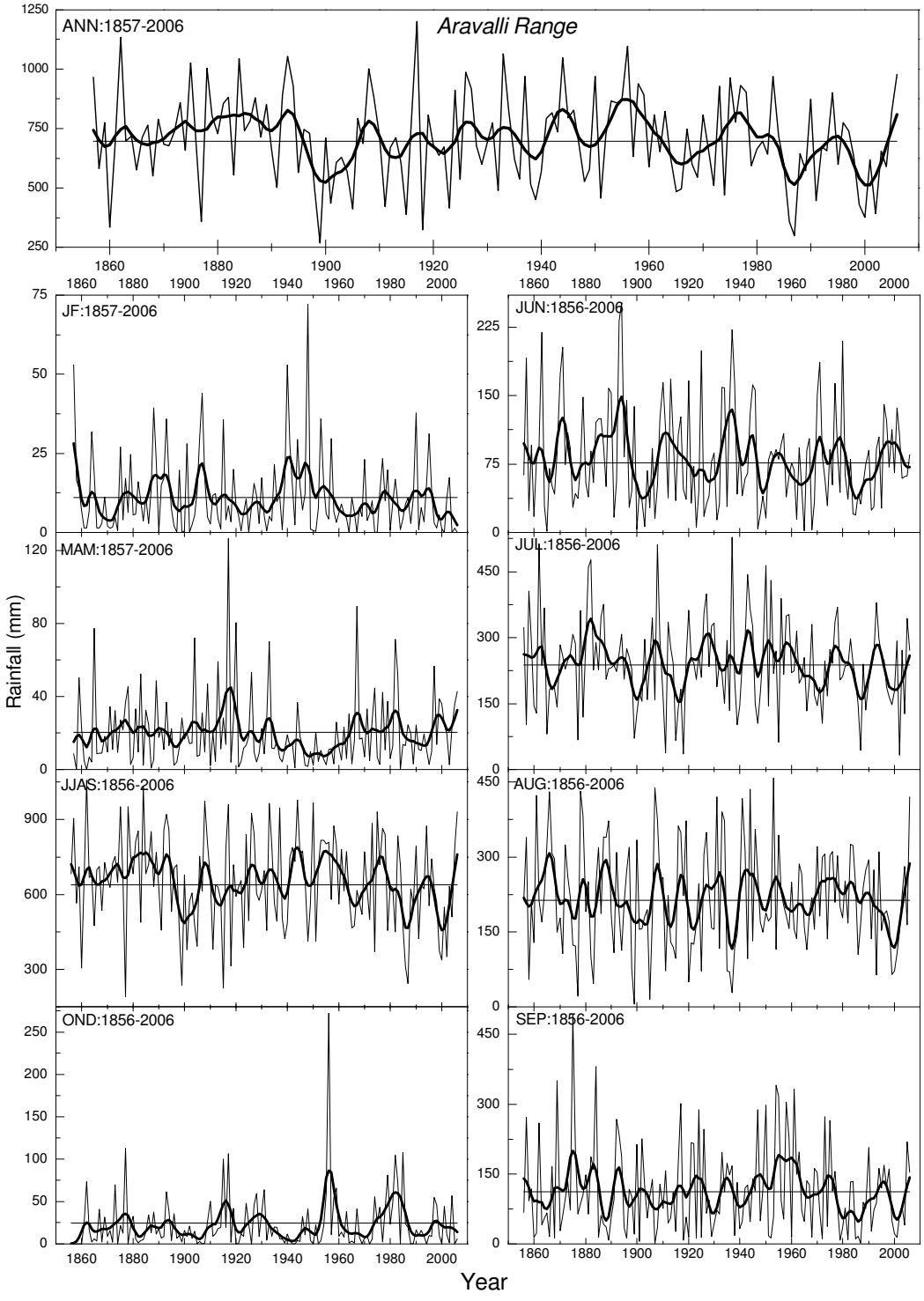

Figure 25: Same as in Figure 2.

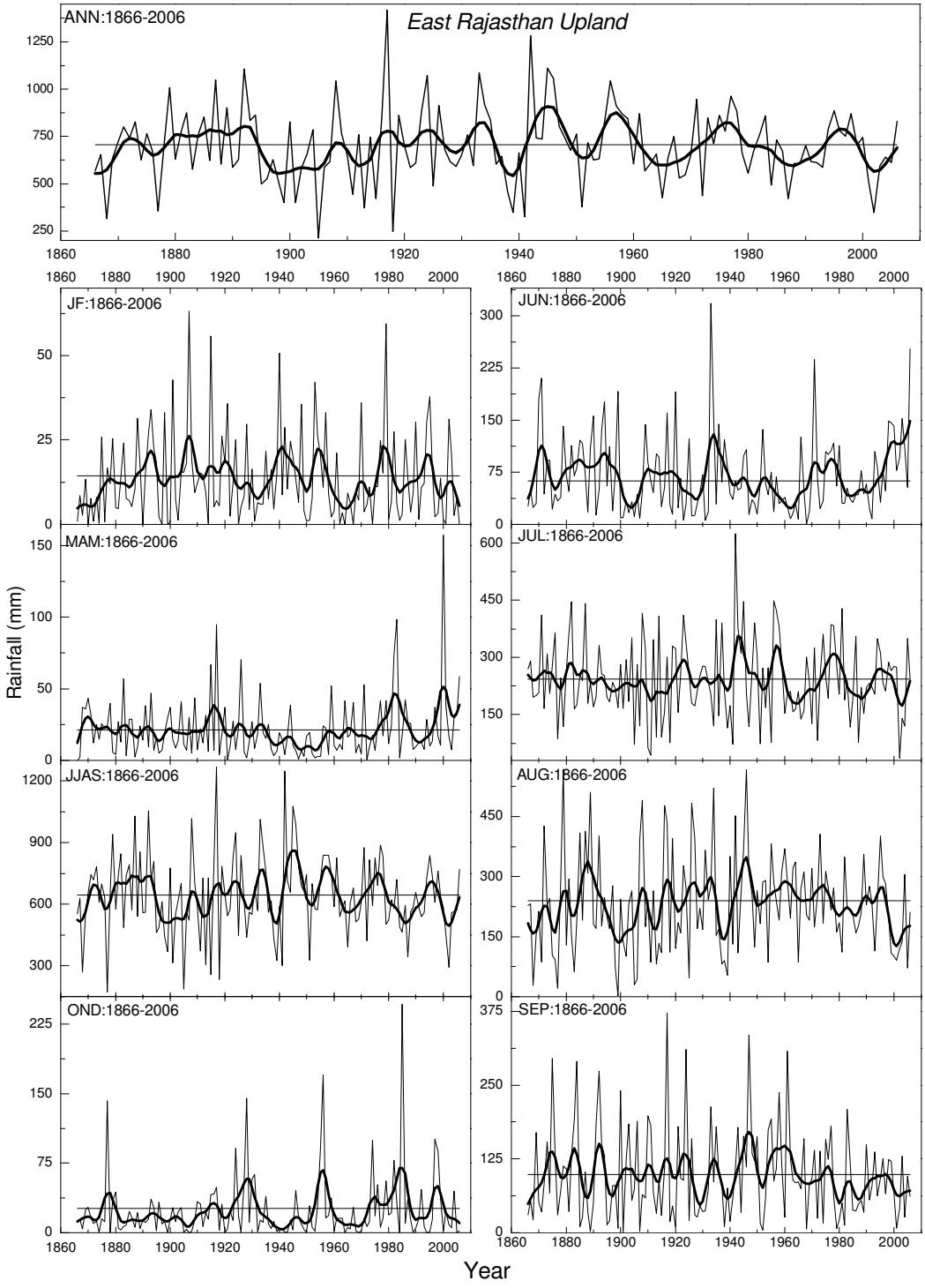

Figure 26: Same as in Figure 2.

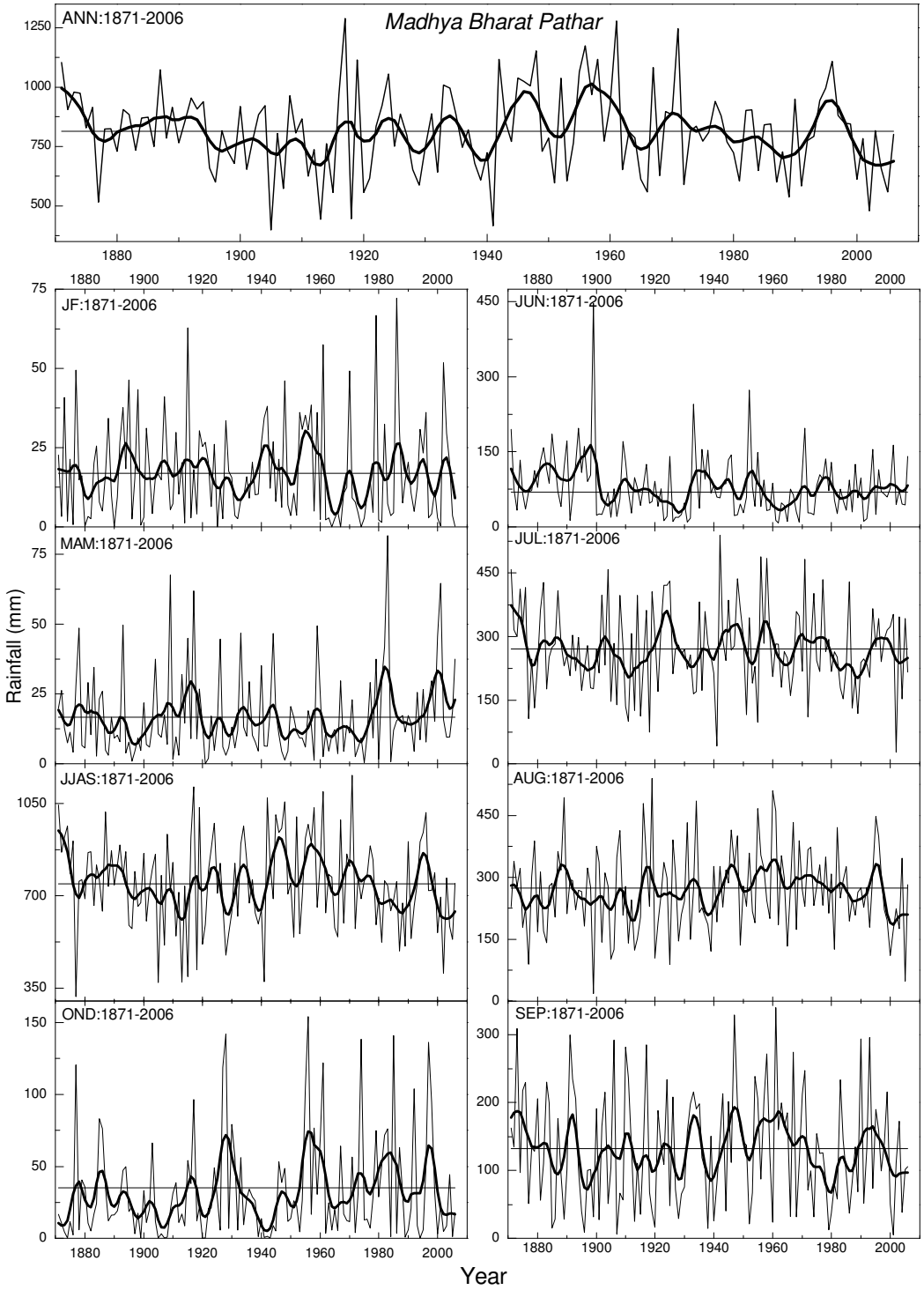

Figure 27: Same as in Figure 2.

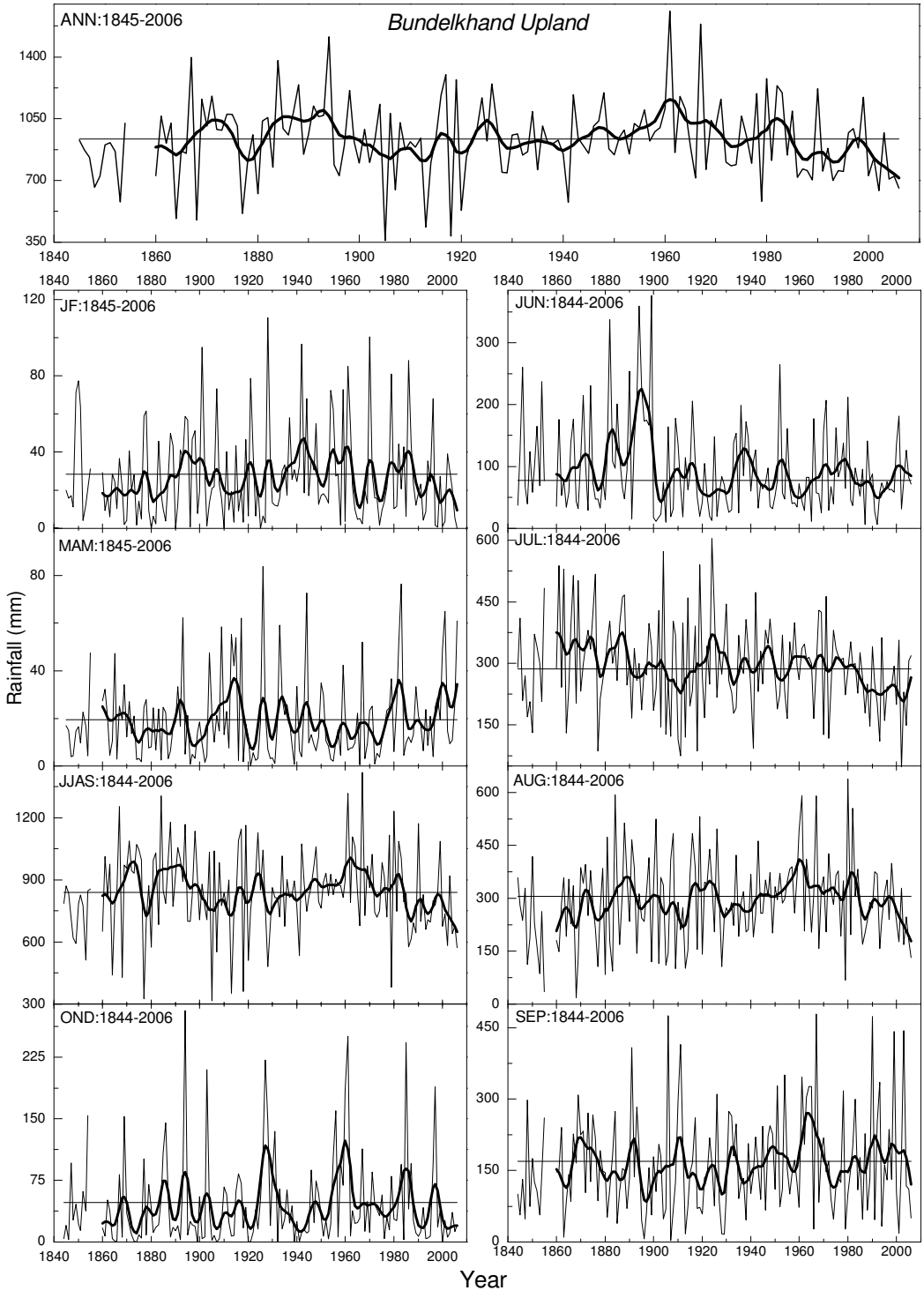

Figure 28: Same as in Figure 2.

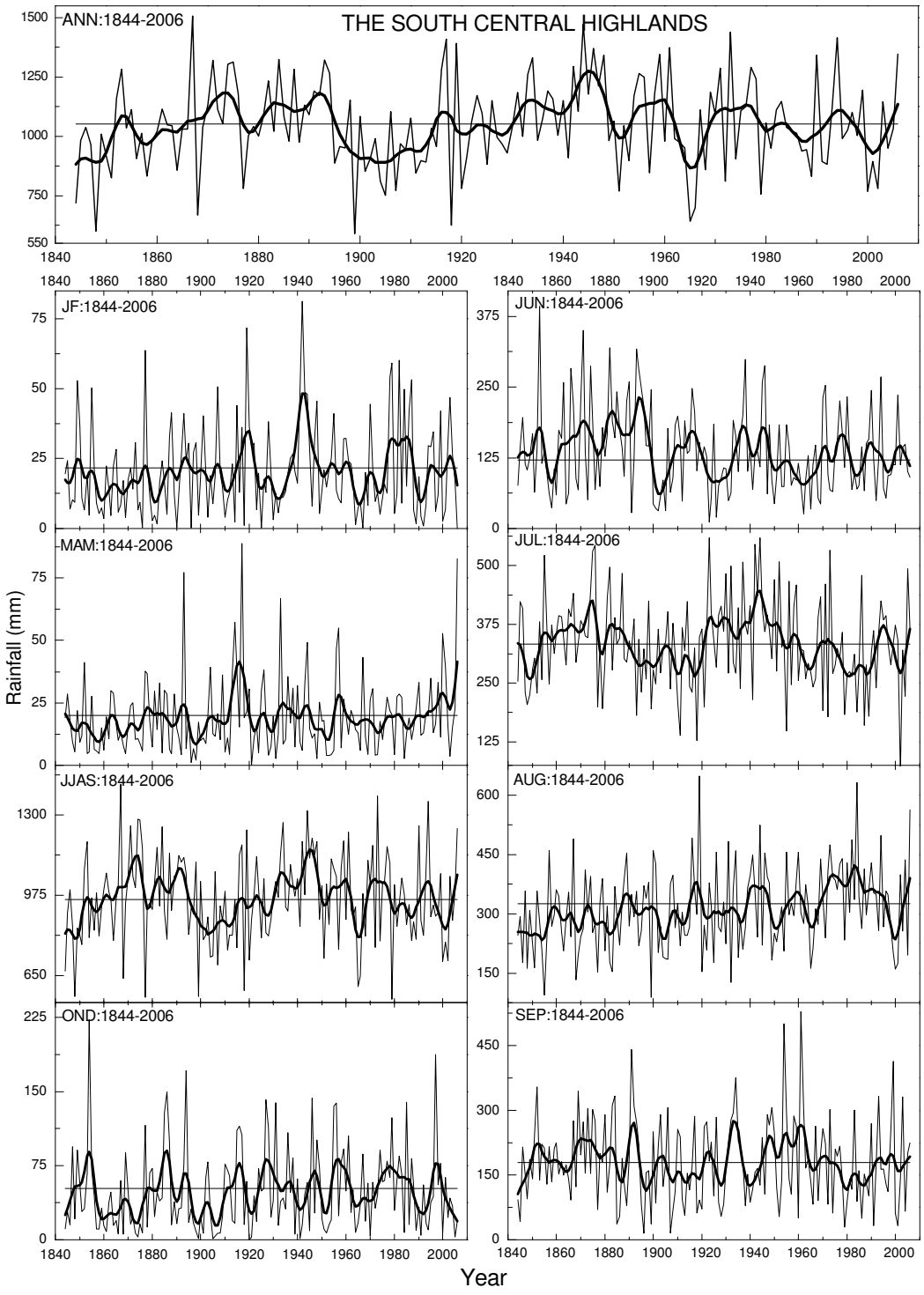

Figure 29: Same as in Figure 2.

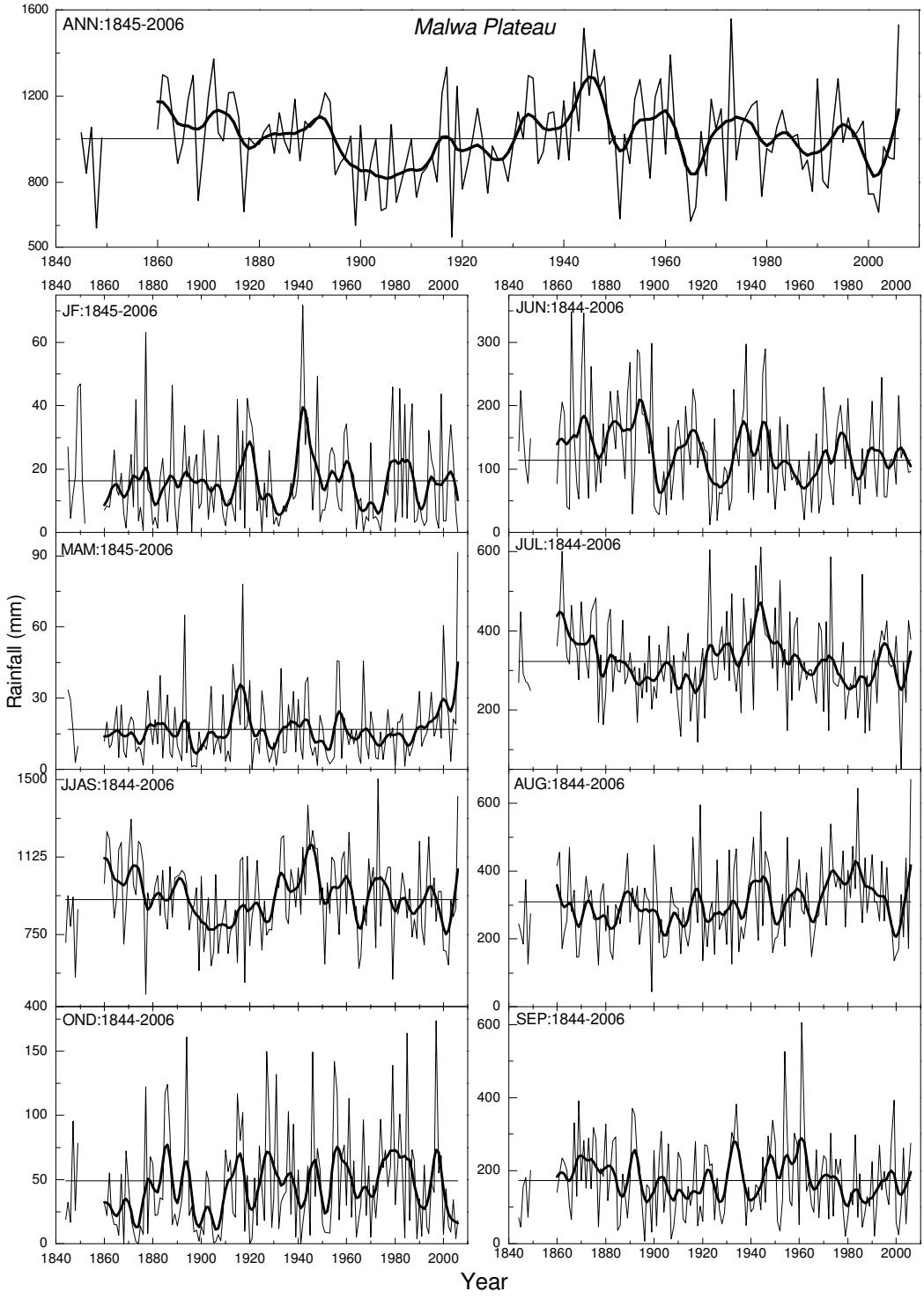

Figure 30: Same as in Figure 2.

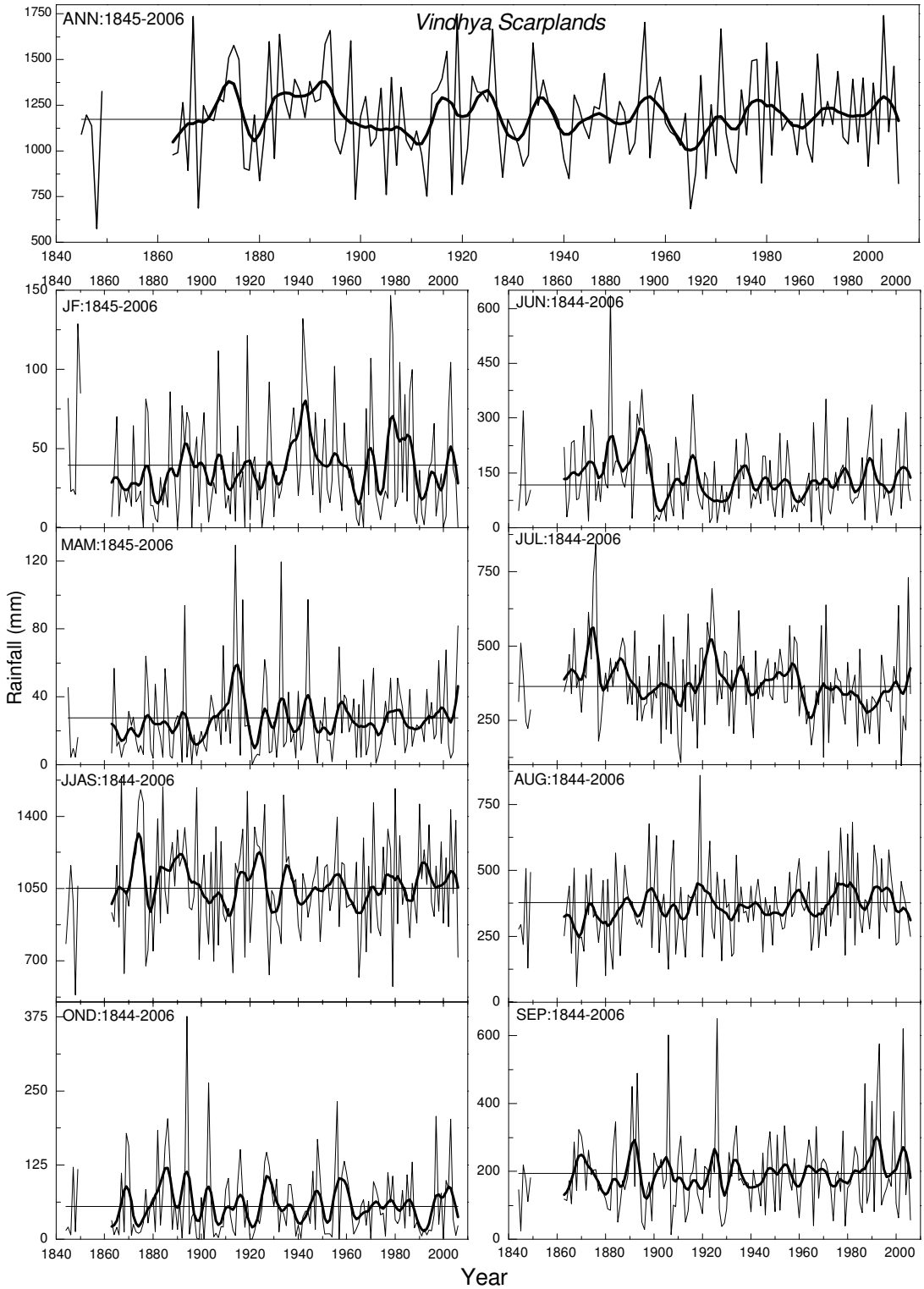

Figure 31: Same as in Figure 2.

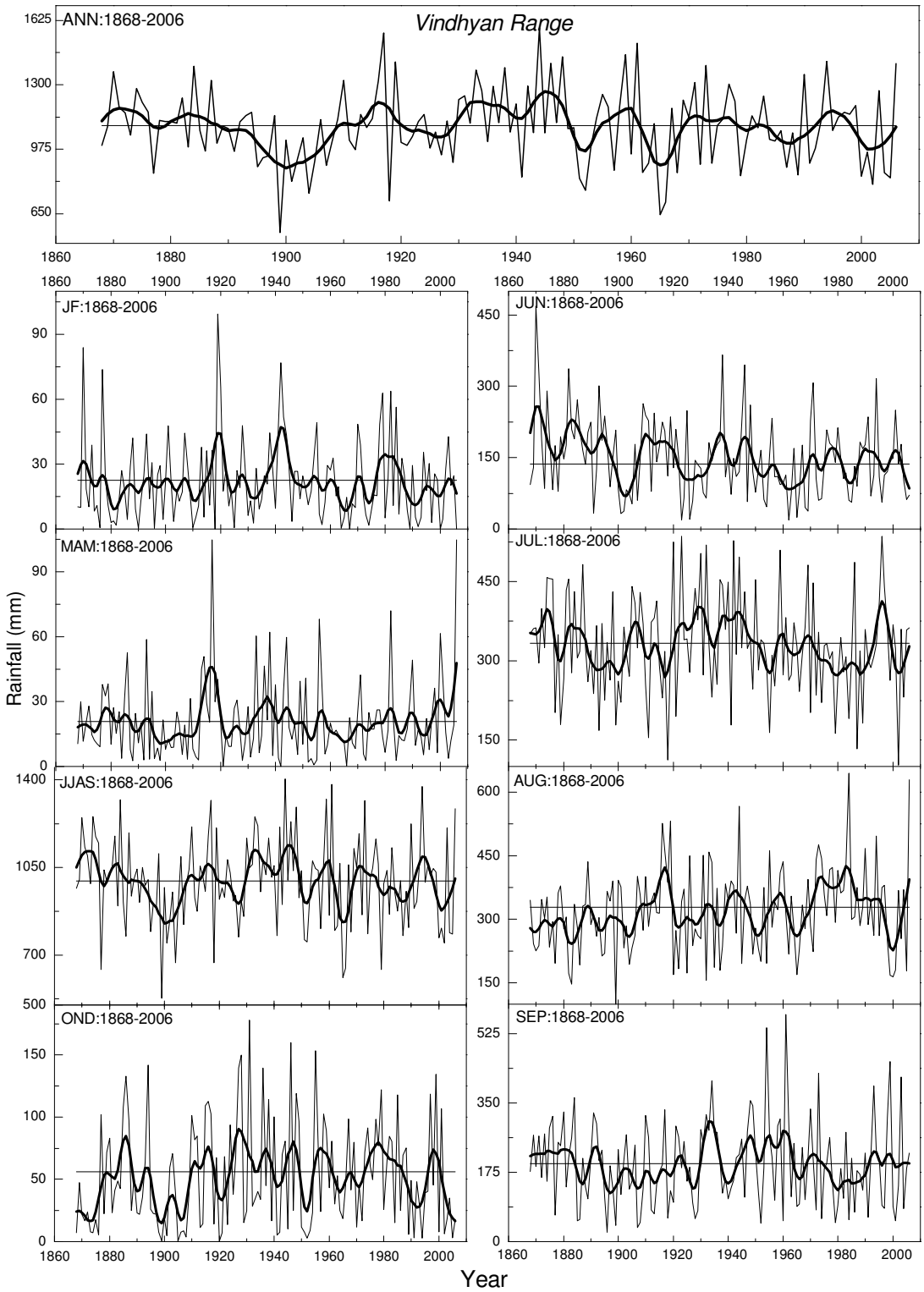

Figure 32: Same as in Figure 2.

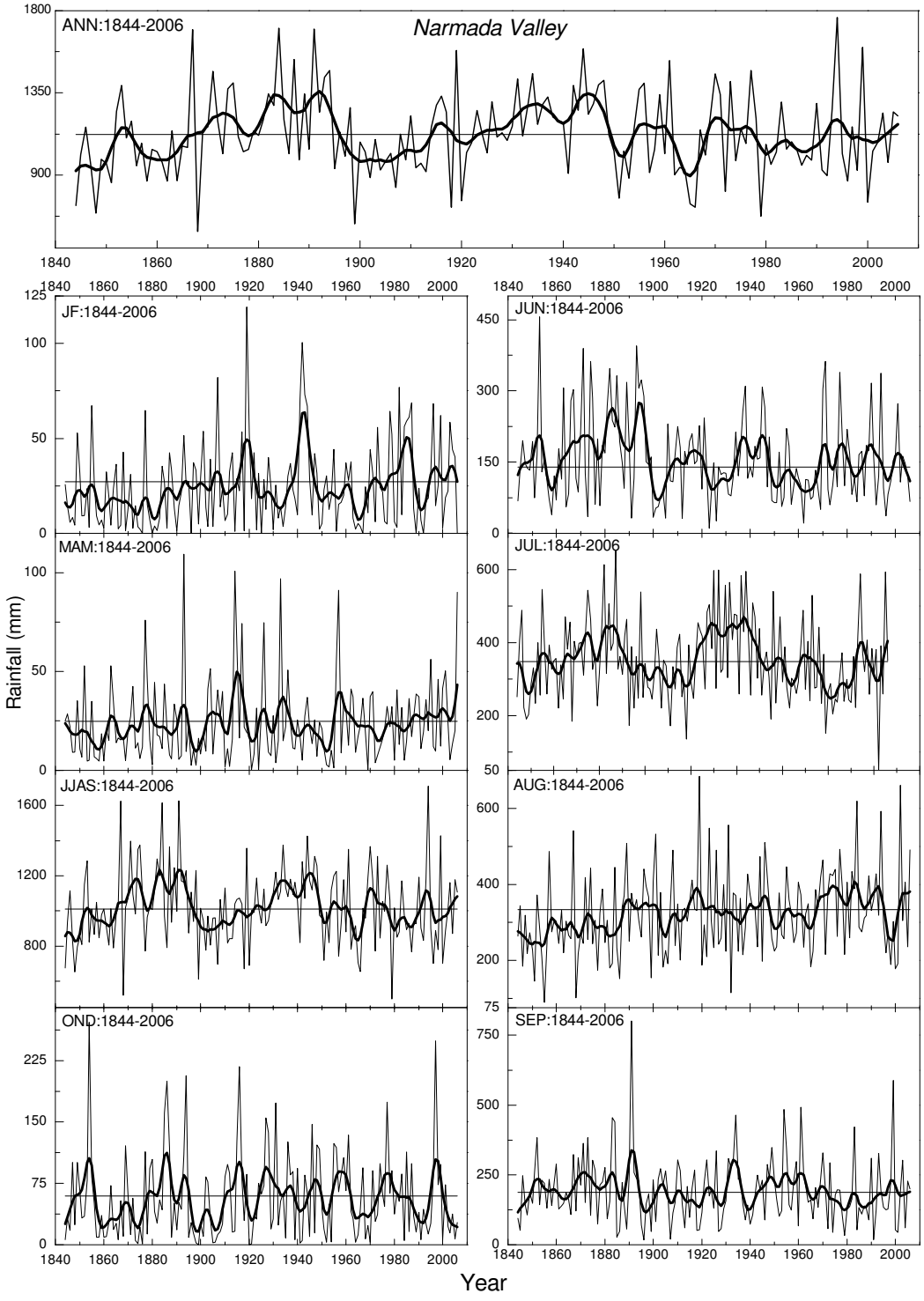

Figure 33: Same as in Figure 2.

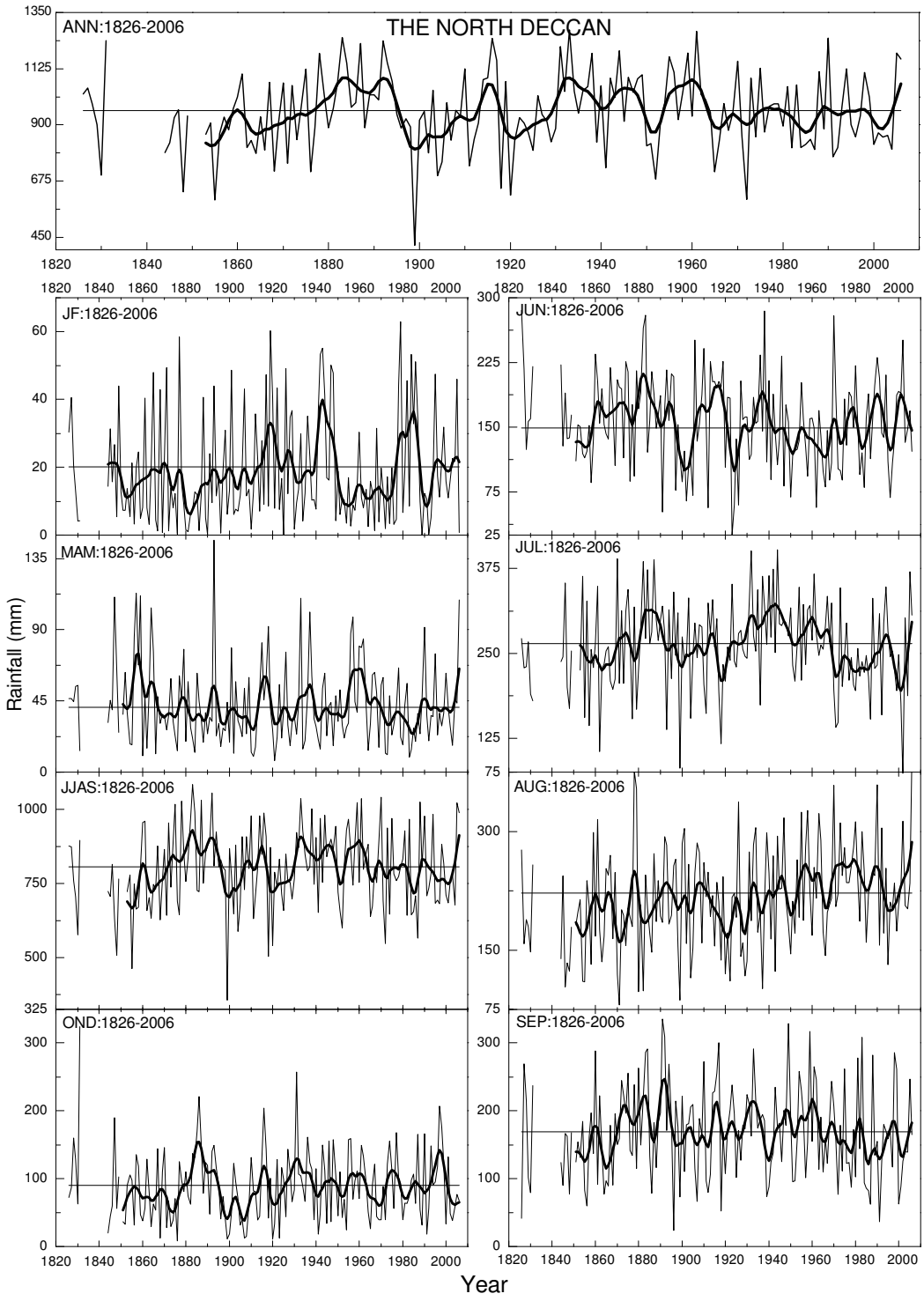

Figure 34: Same as in Figure 2.

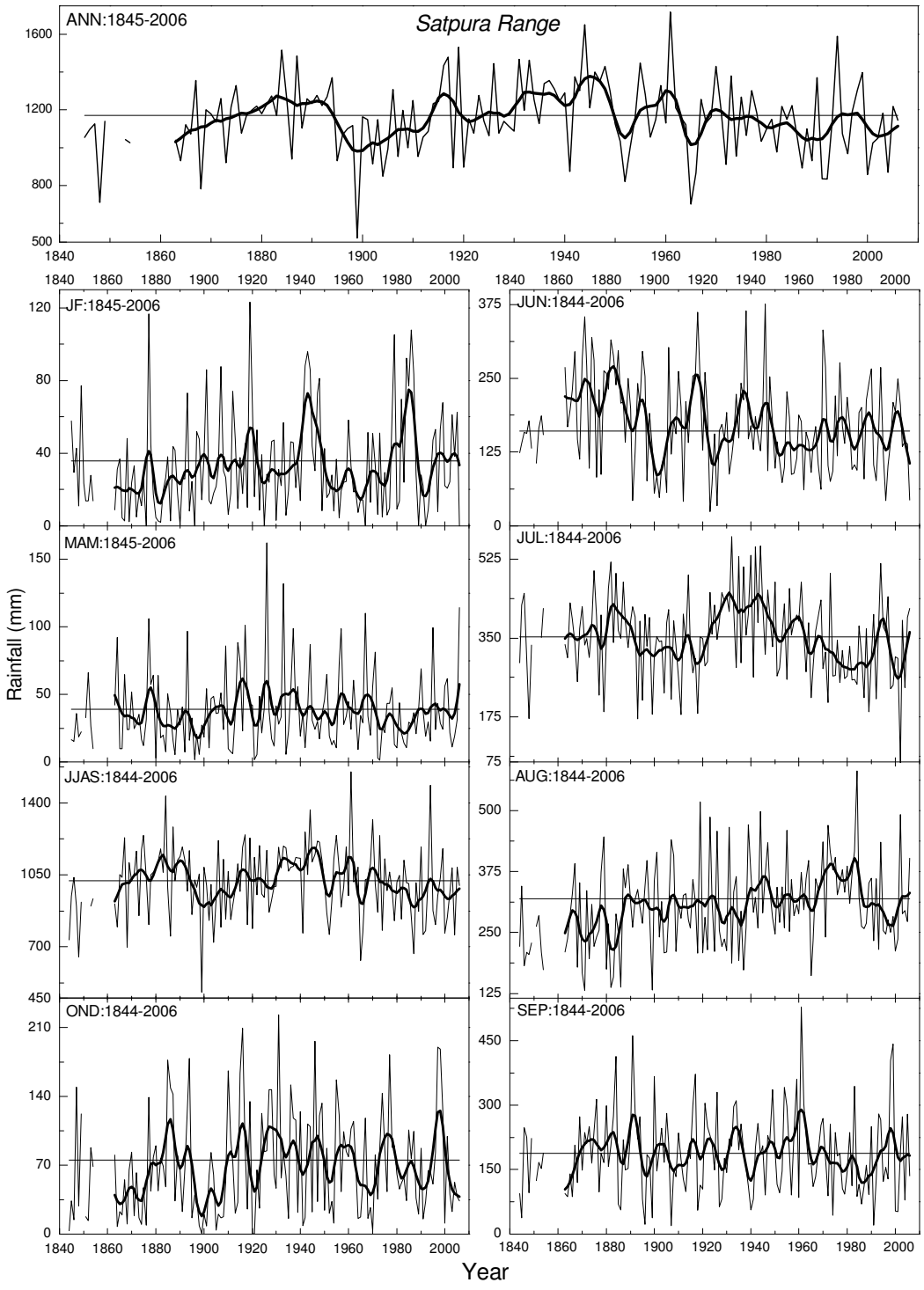

Figure 35: Same as in Figure 2.

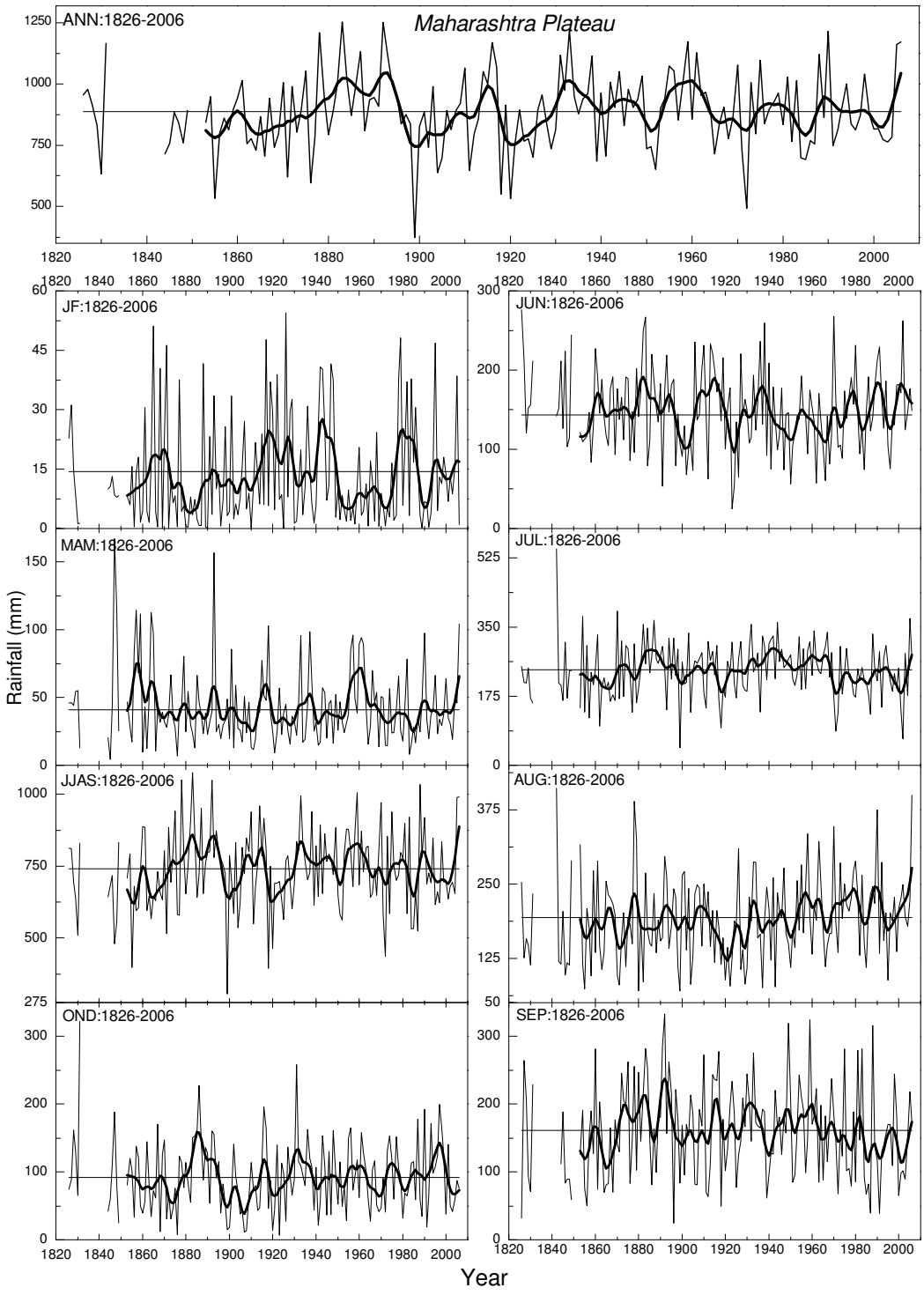

Figure 36: Same as in Figure 2.

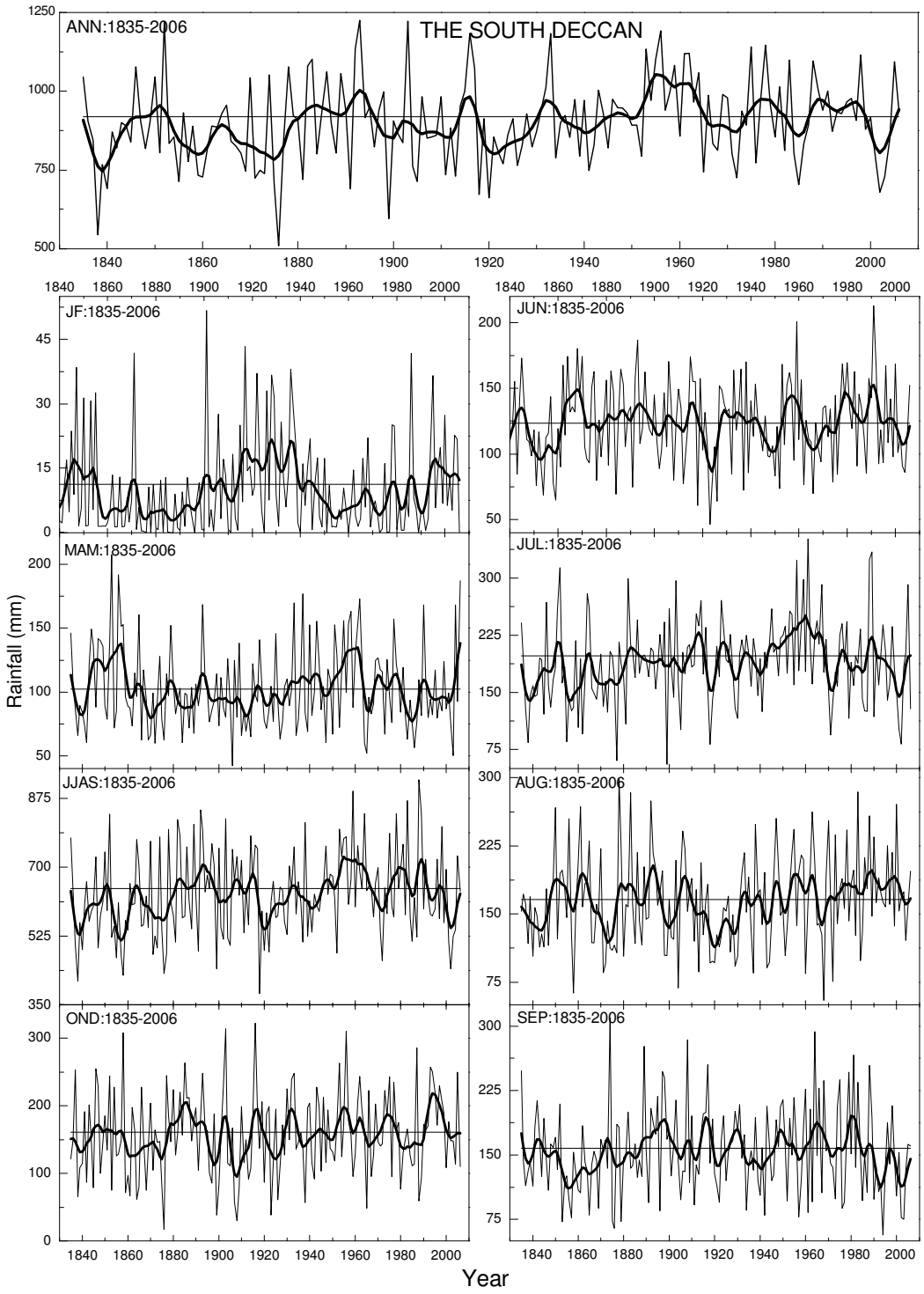

Figure 37: Same as in Figure 2.

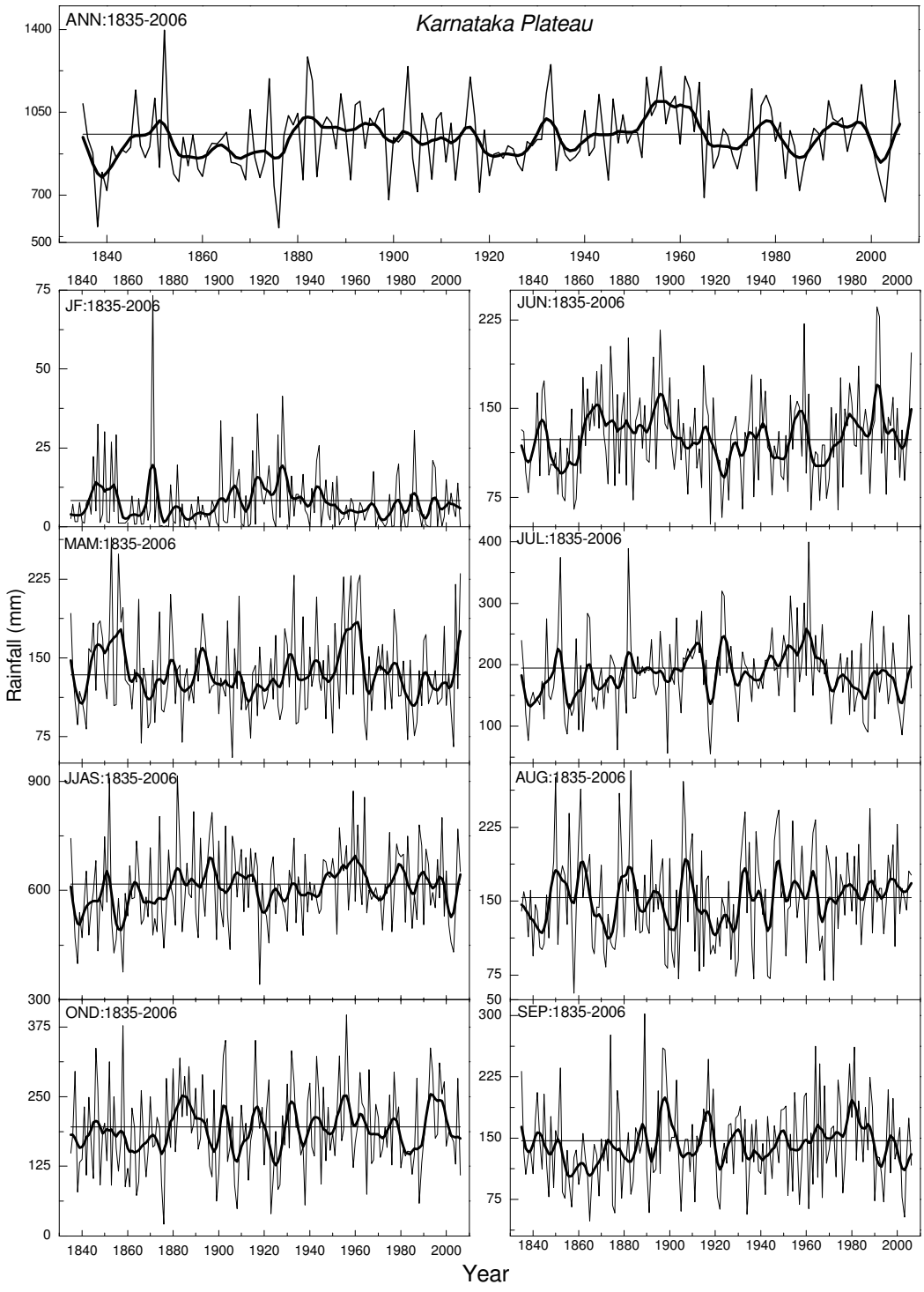

Figure 38: Same as in Figure 2.

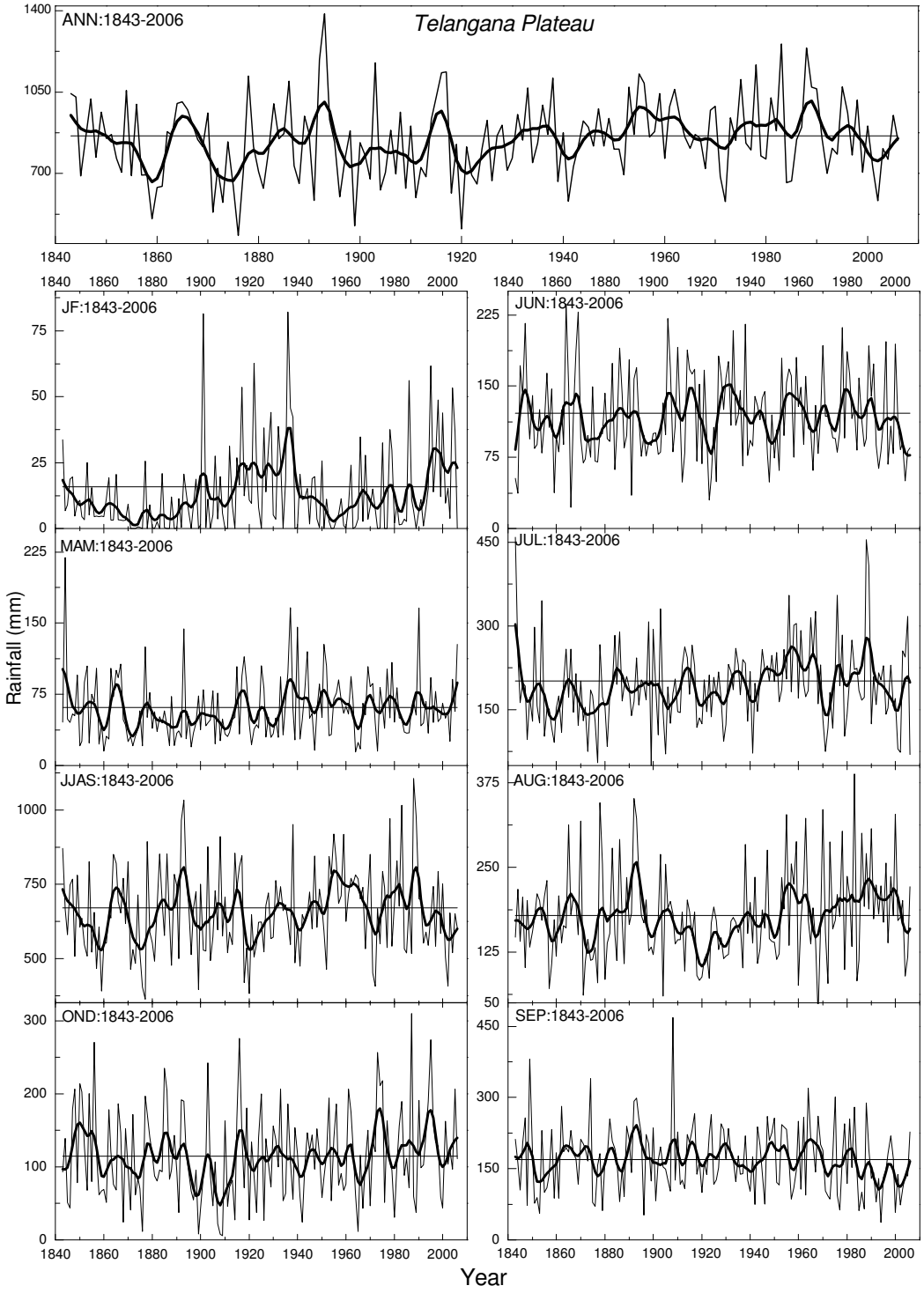

Figure 39: Same as in Figure 2.

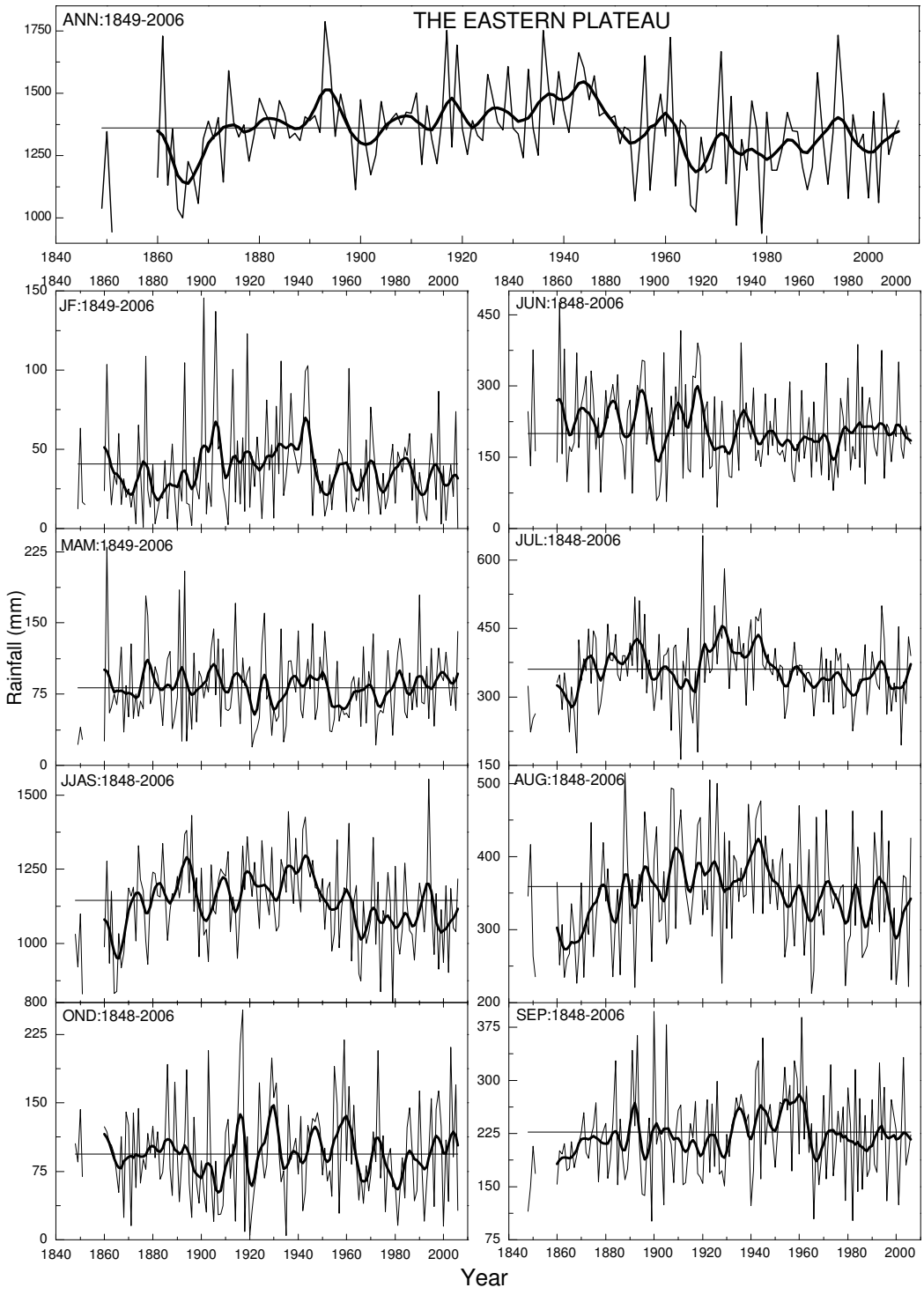

Figure 40: Same as in Figure 2.

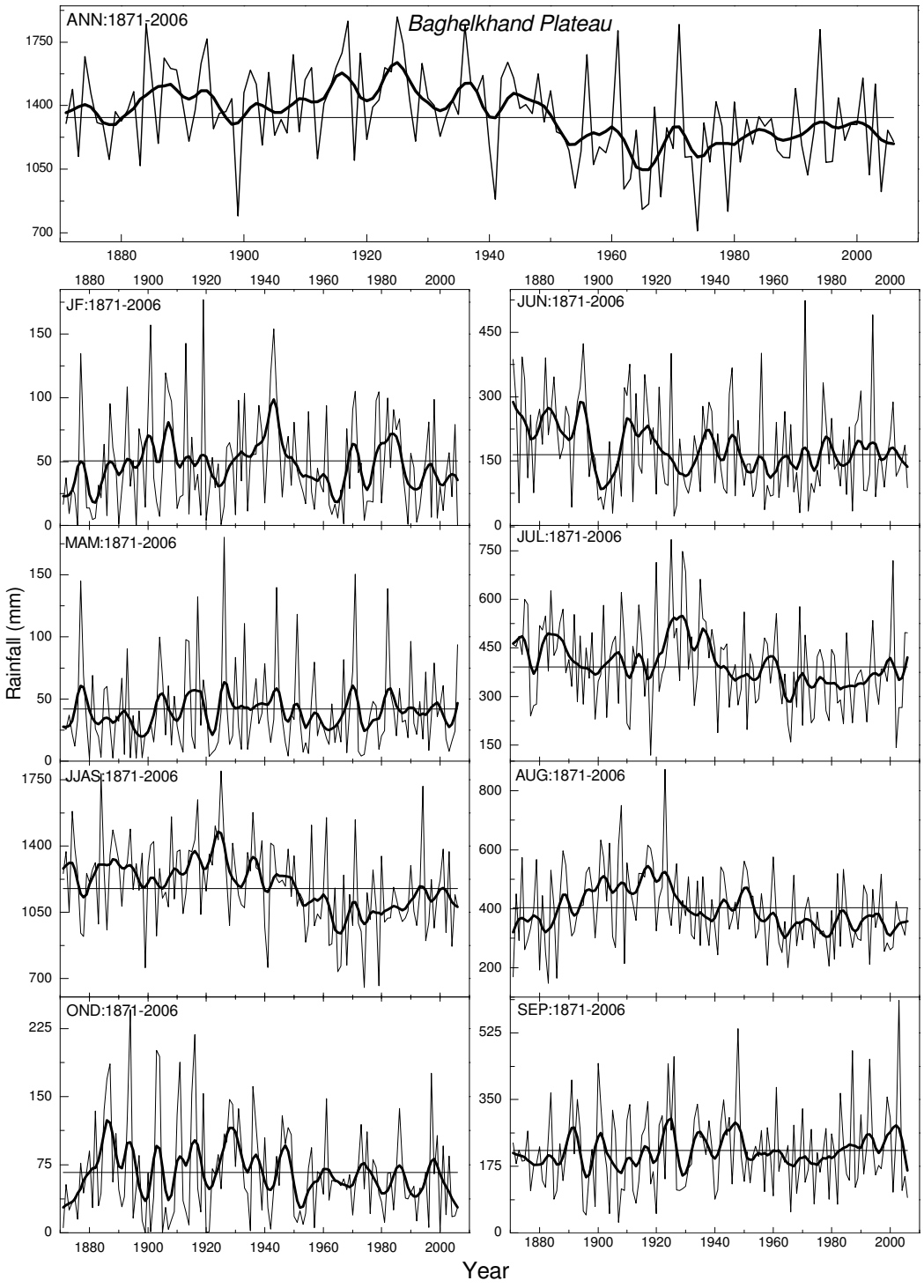

Figure 41: Same as in Figure 2.

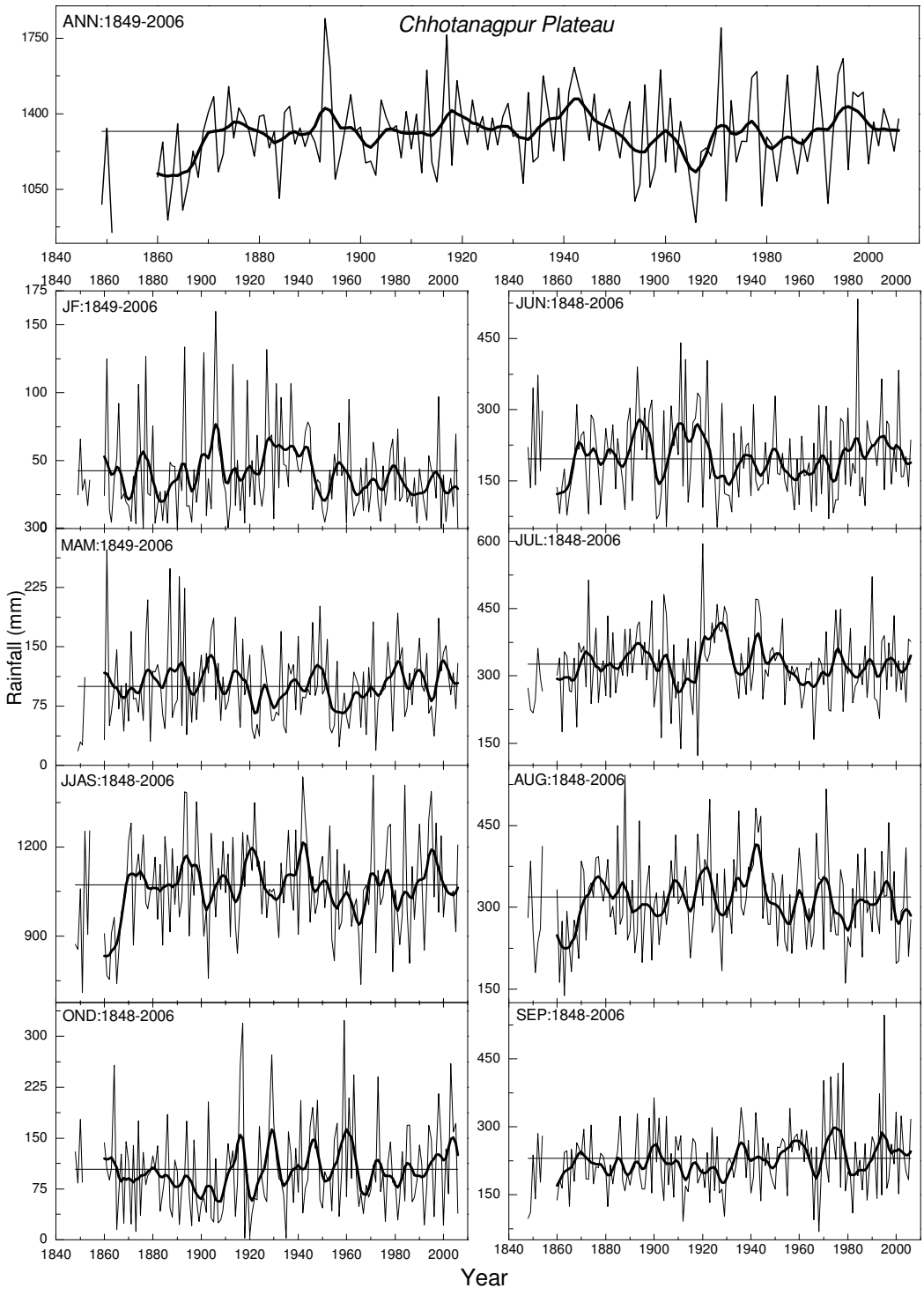

Figure 42: Same as in Figure 2.

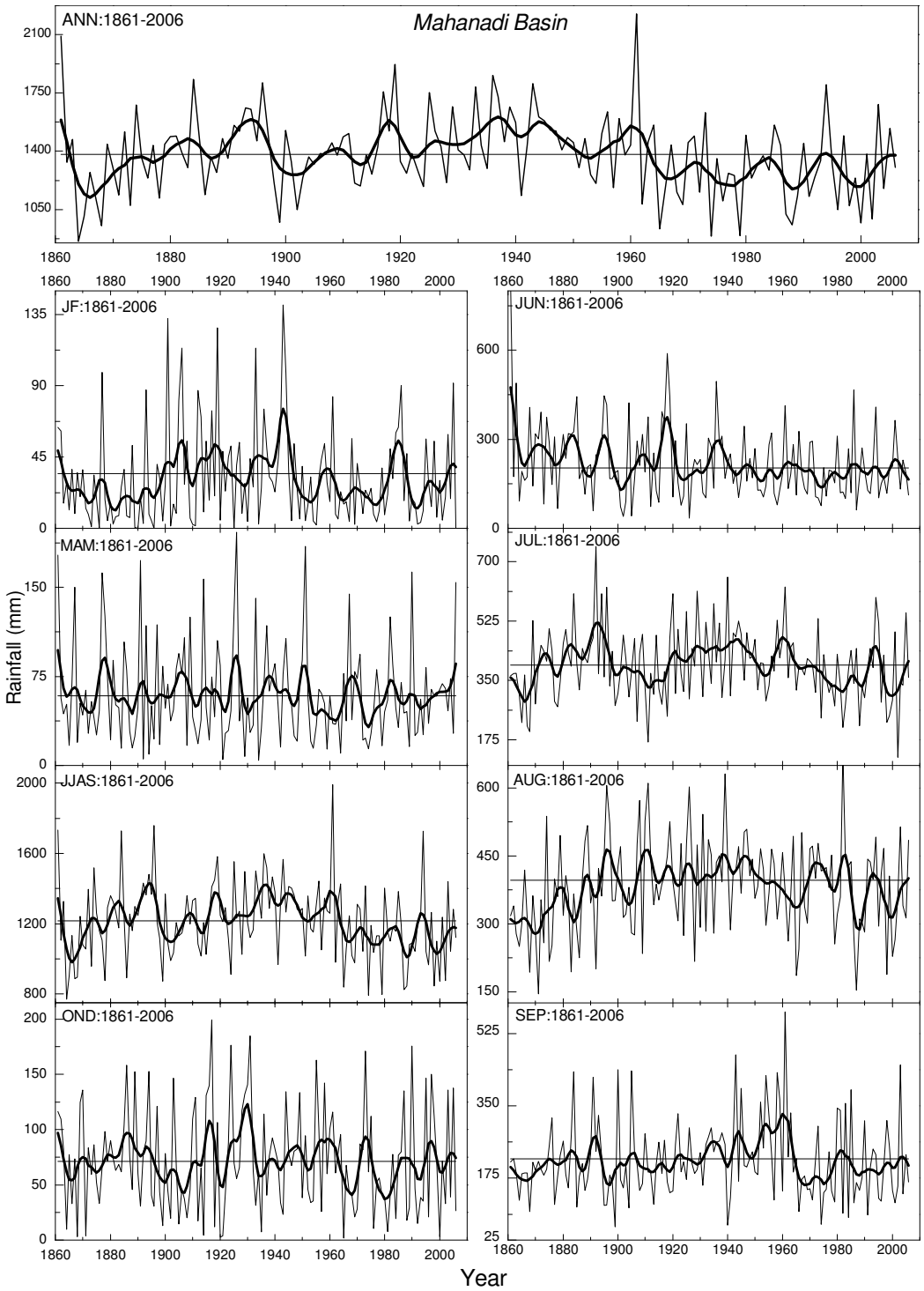

Figure 43: Same as in Figure 2.

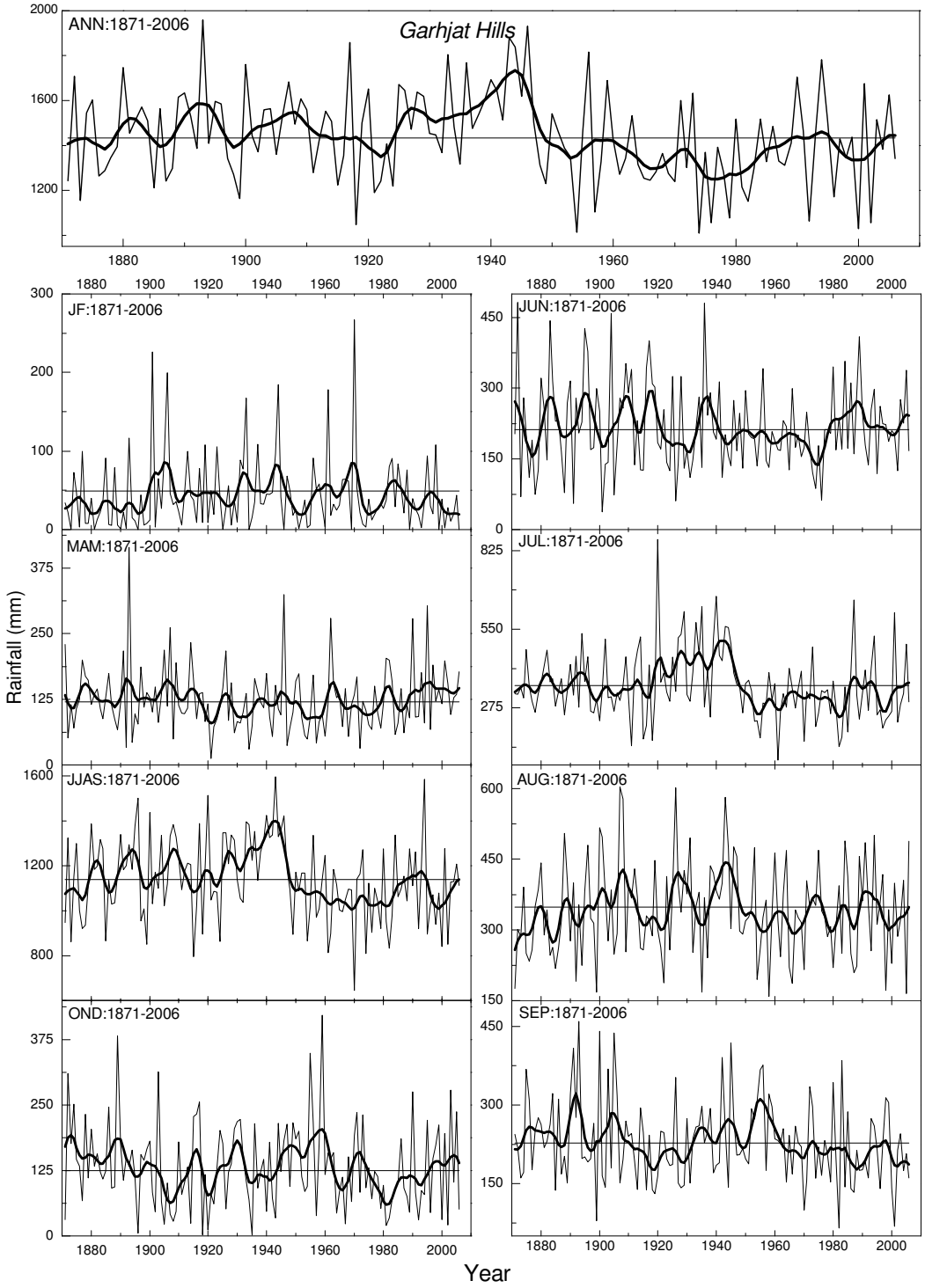

Figure 44: Same as in Figure 2.

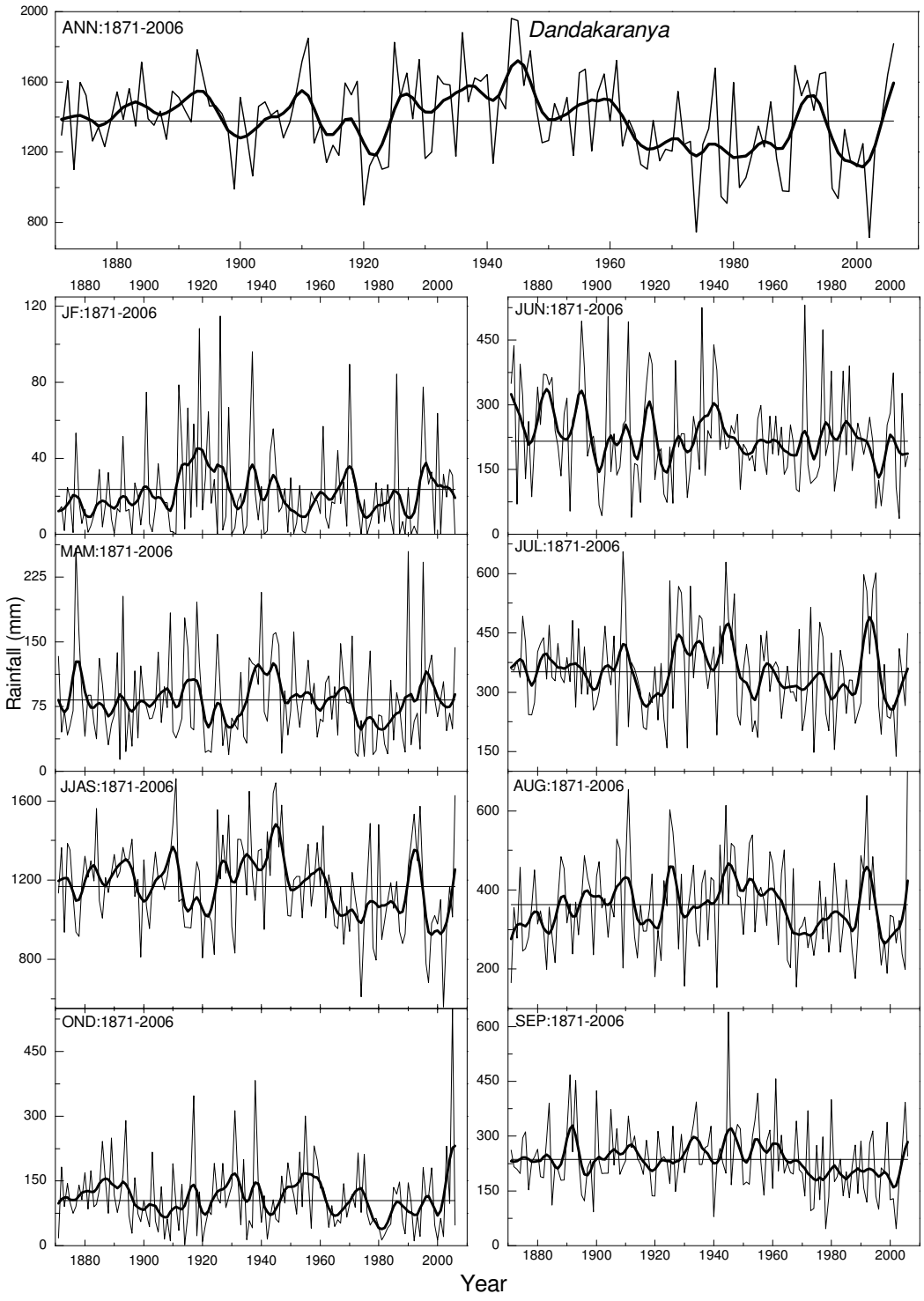

Figure 45: Same as in Figure 2.

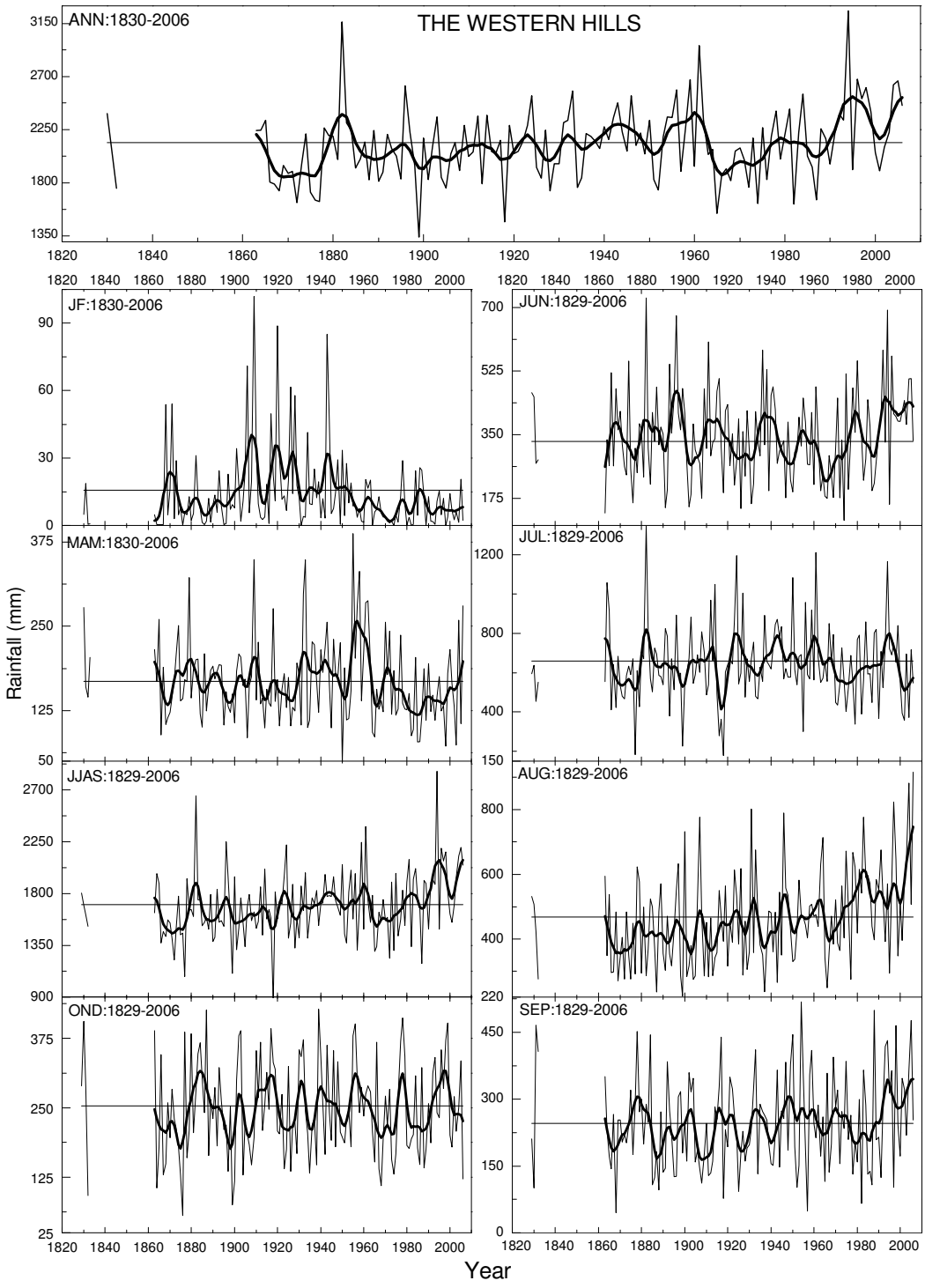

Figure 46: Same as in Figure 2.

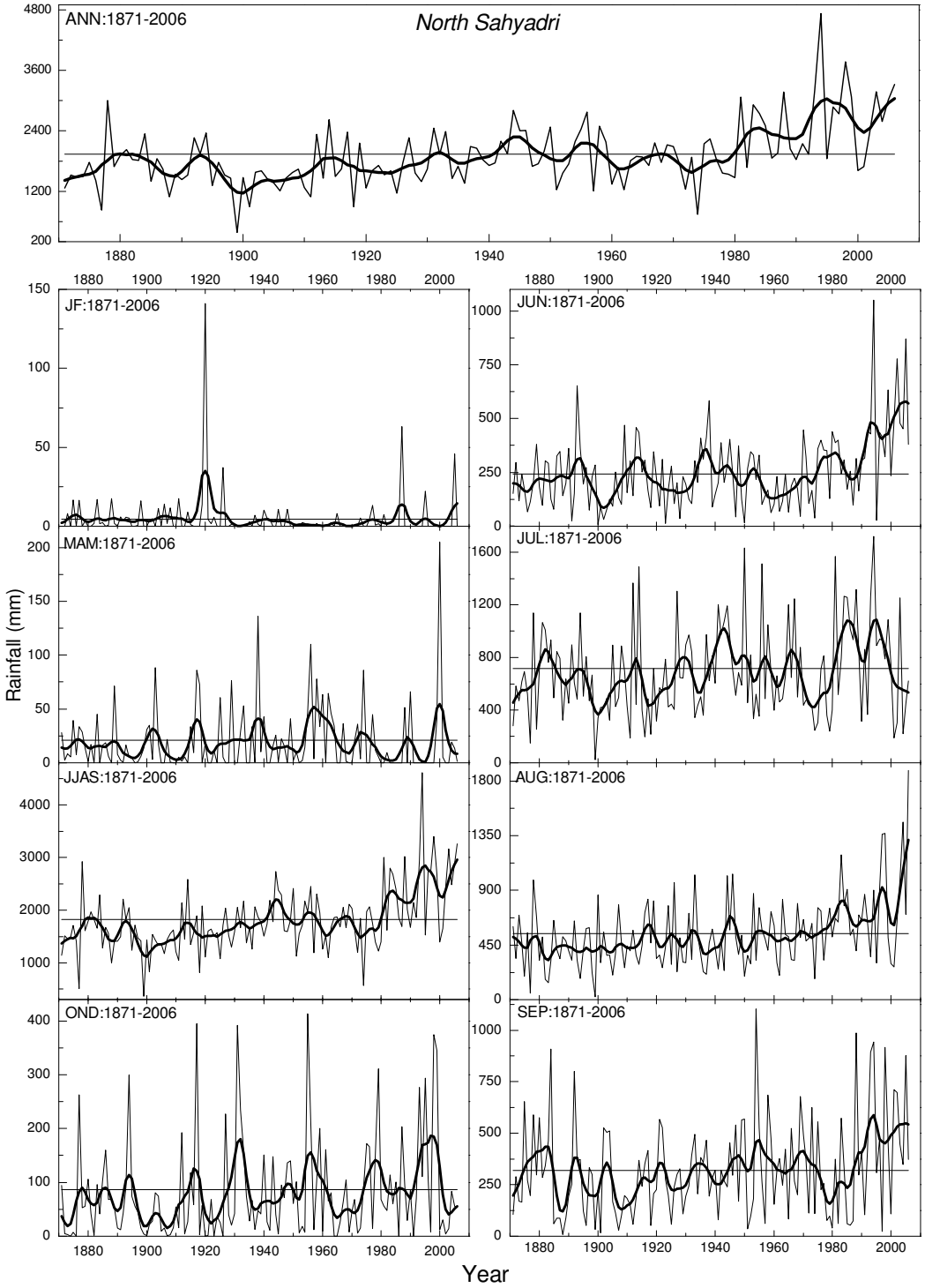

Figure 47: Same as in Figure 2.

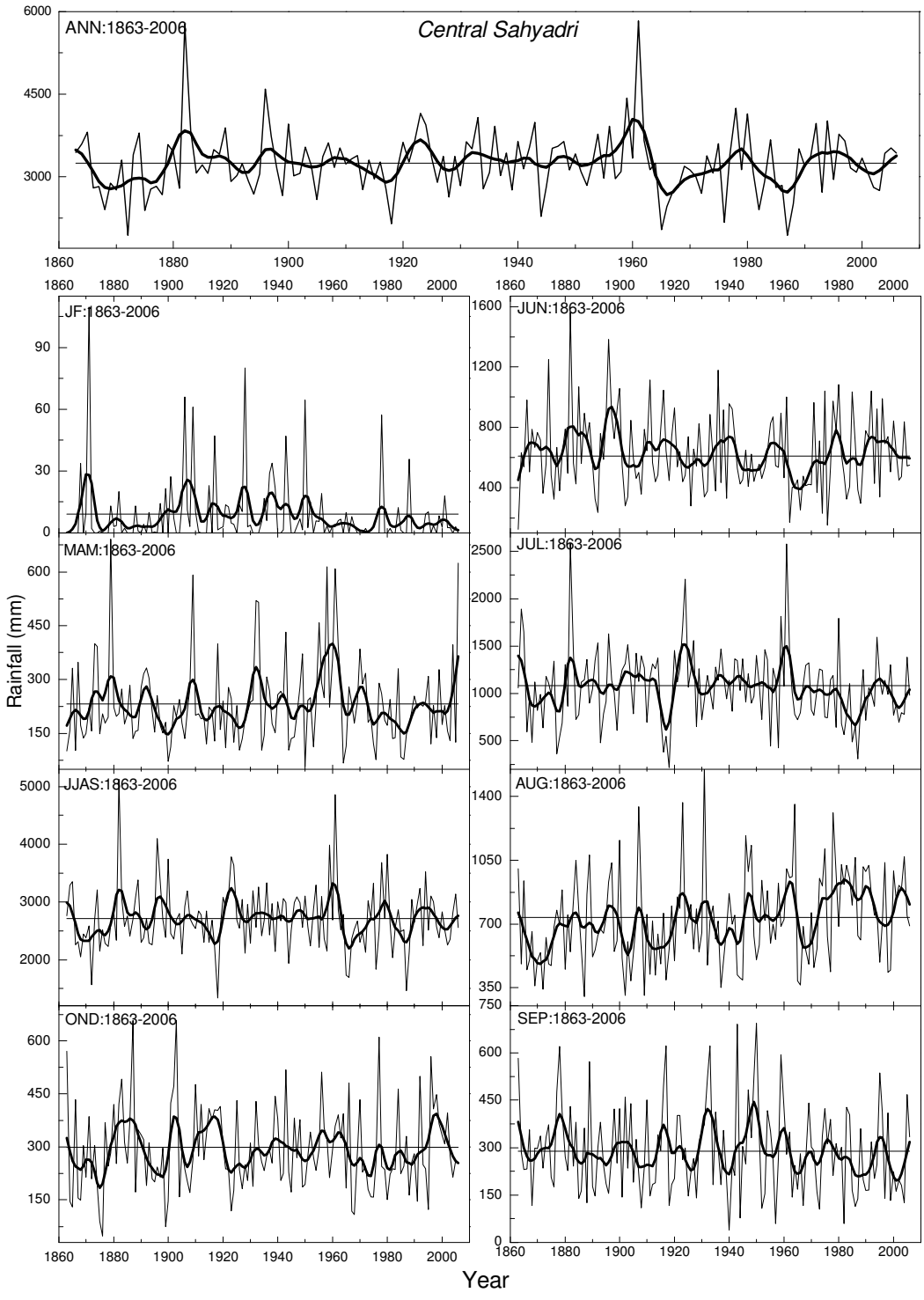

Figure 48: Same as in Figure 2.

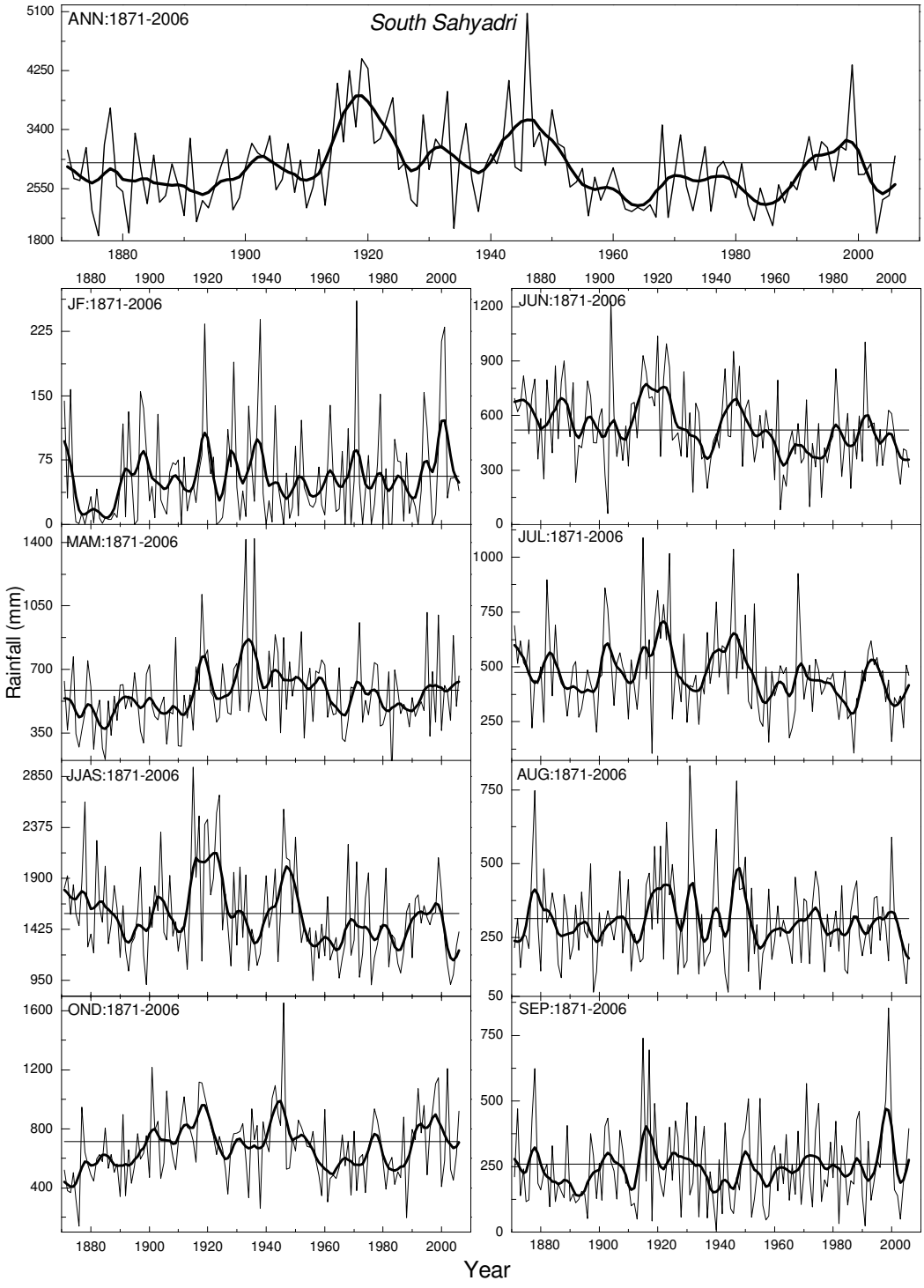

Figure 49: Same as in Figure 2.

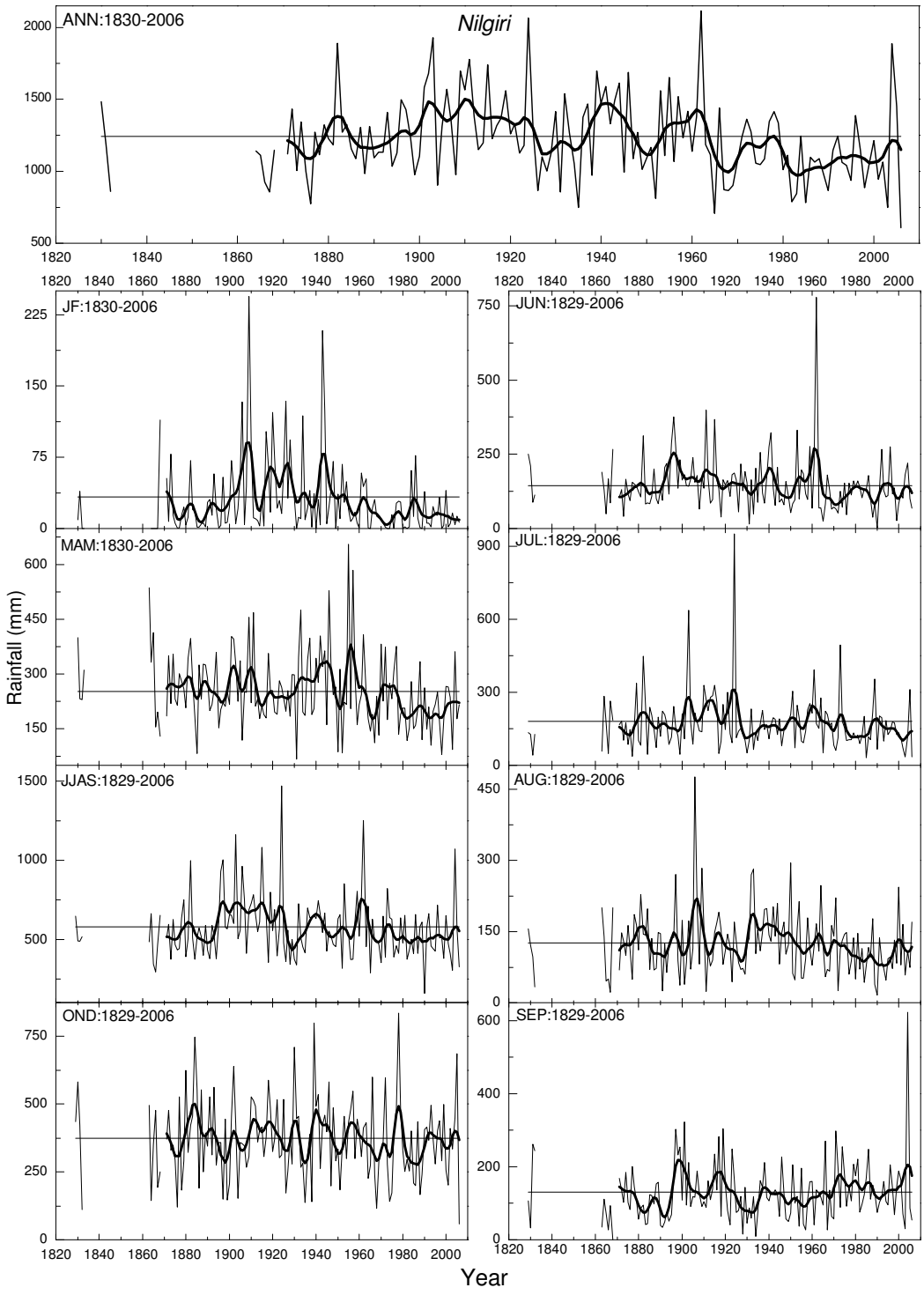

Figure 50: Same as in Figure 2.

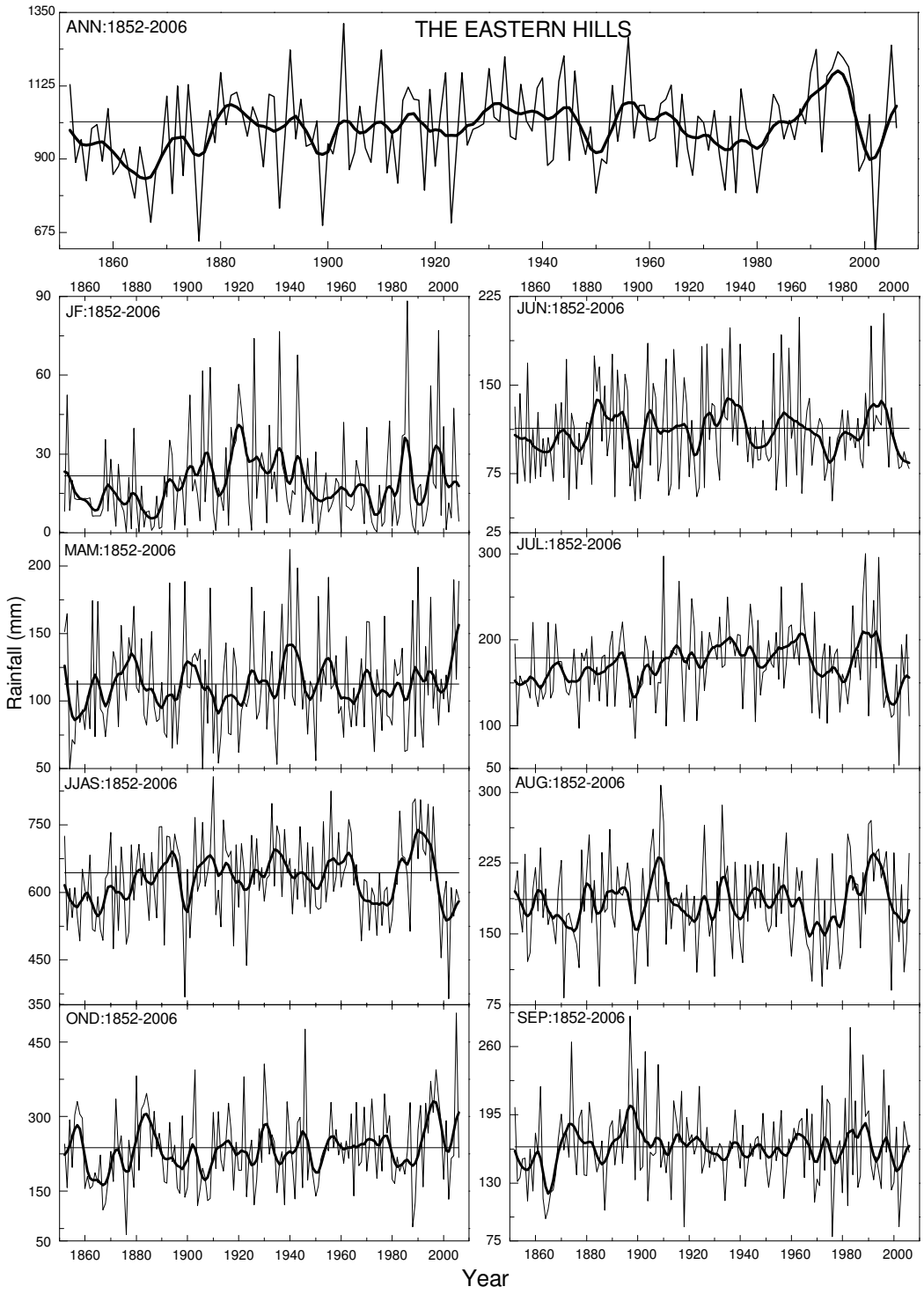

Figure 51: Same as in Figure 2.

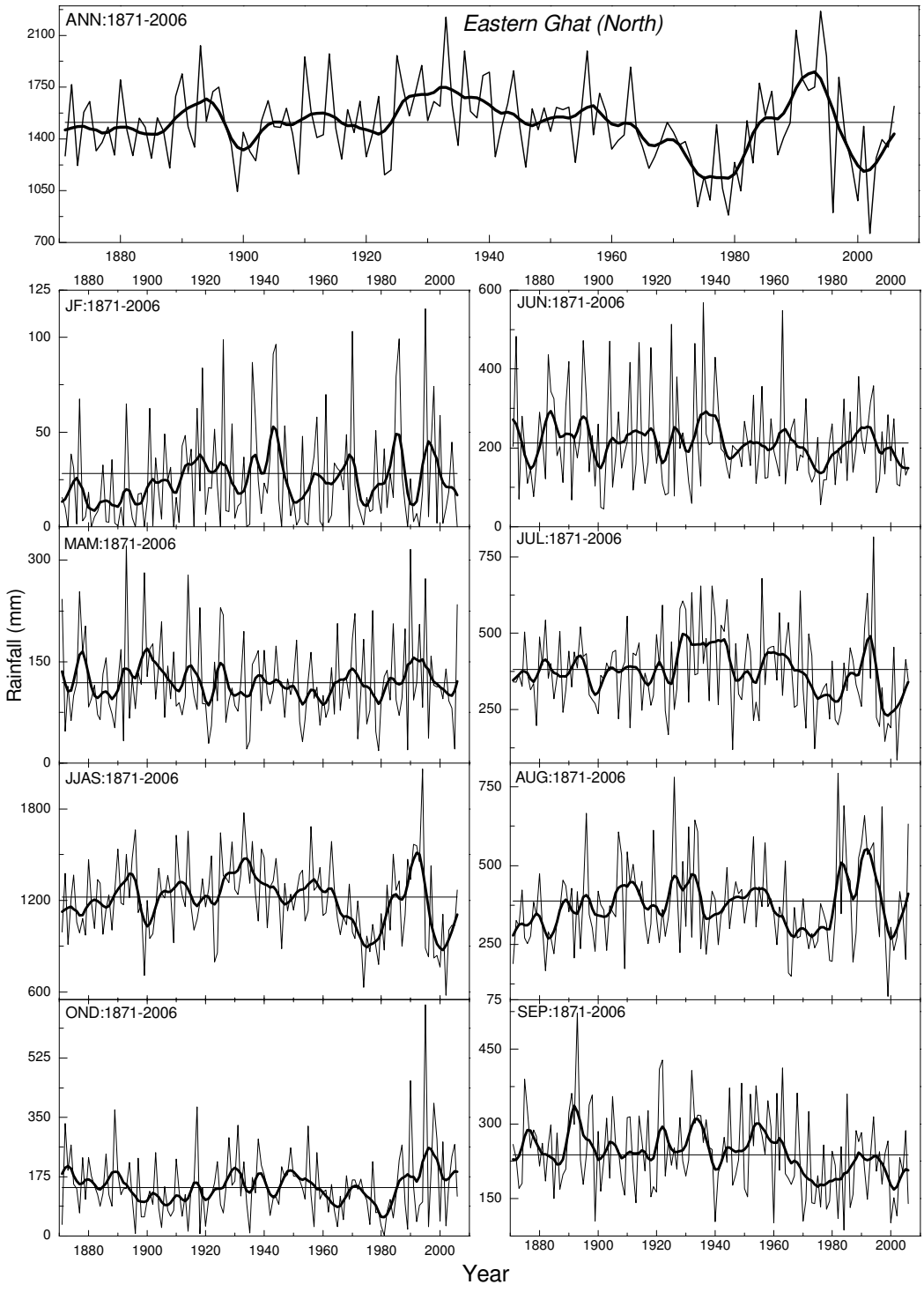

Figure 52: Same as in Figure 2.

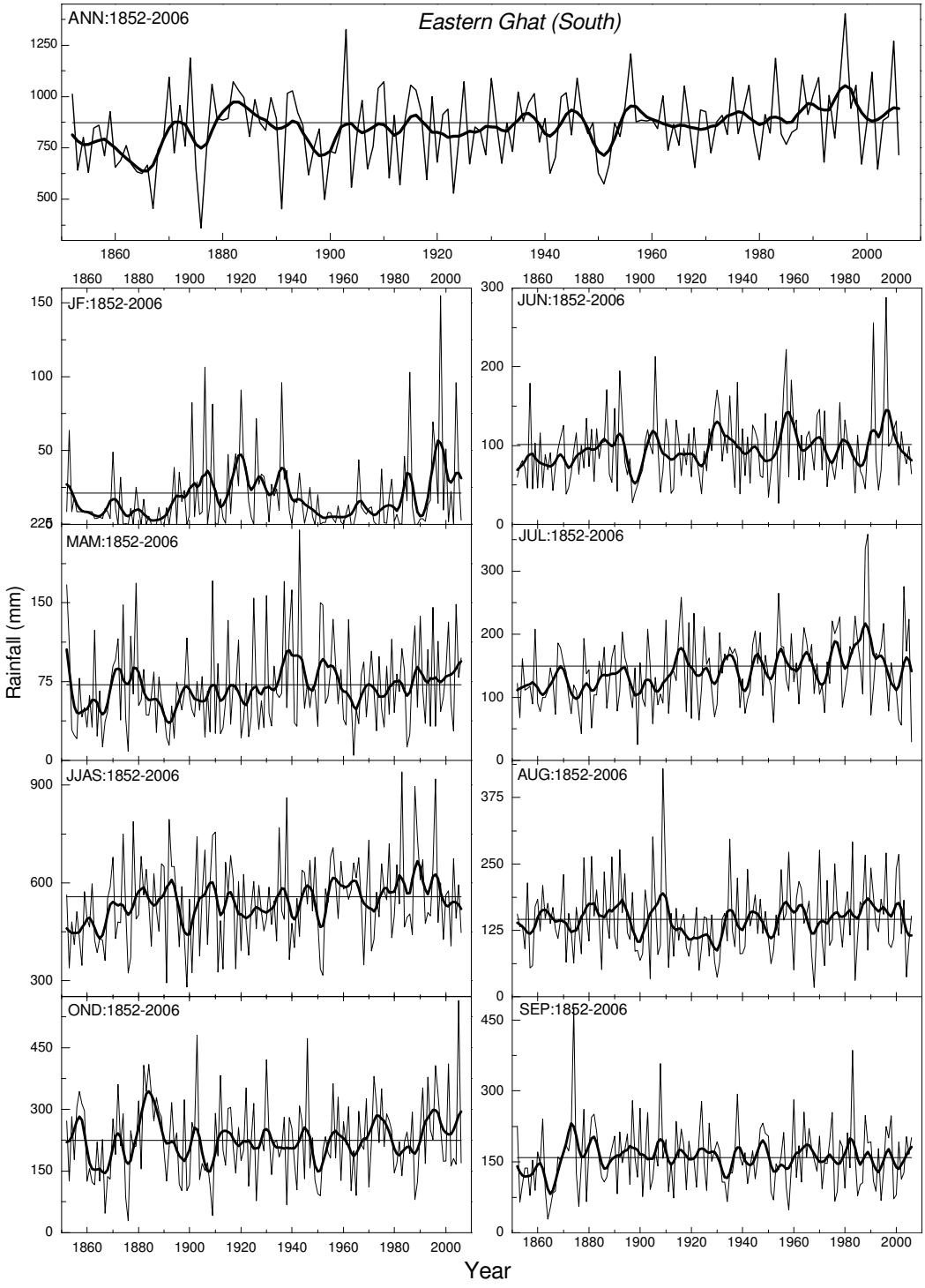

Figure 53: Same as in Figure 2.

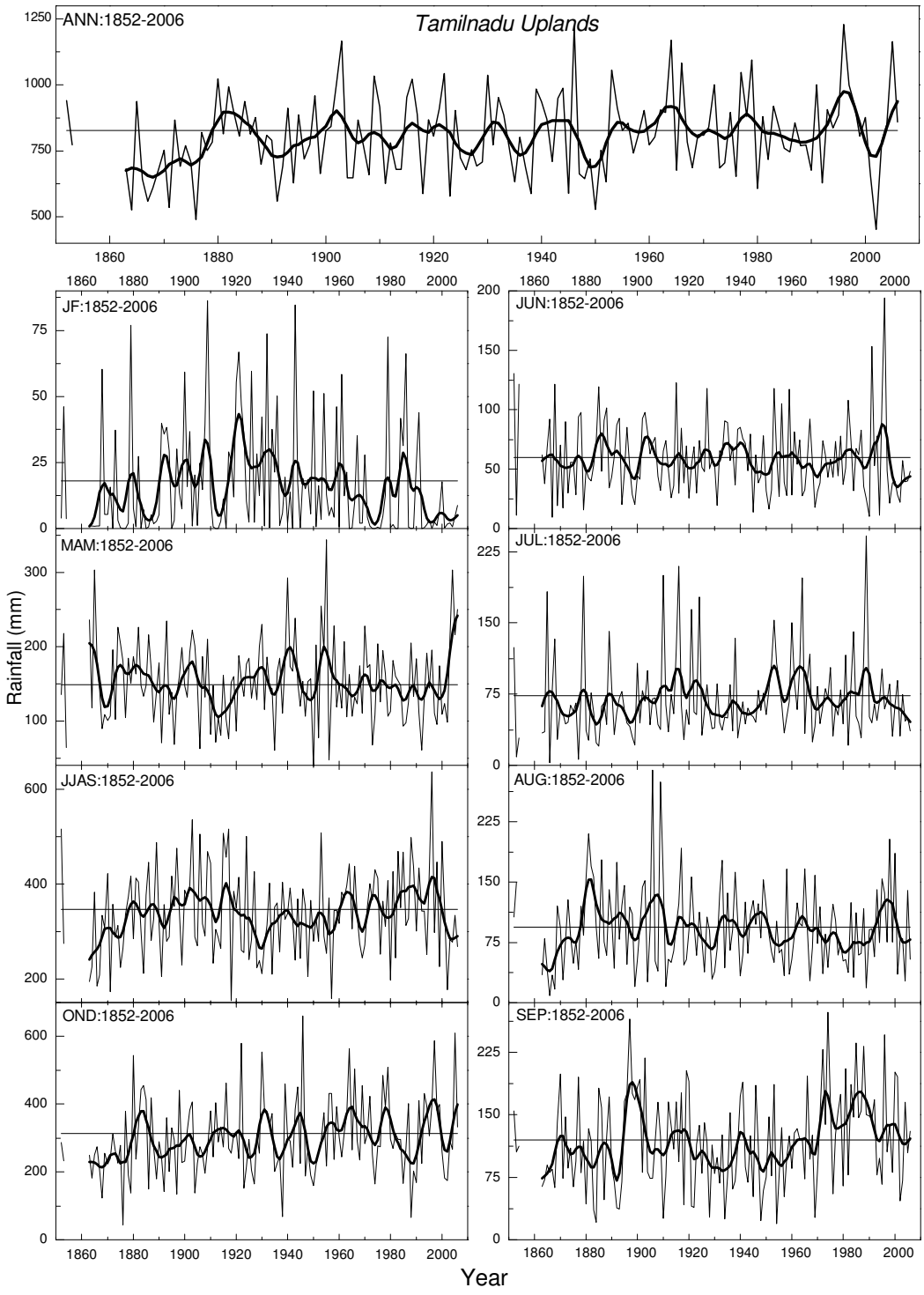

Figure 54: Same as in Figure 2.

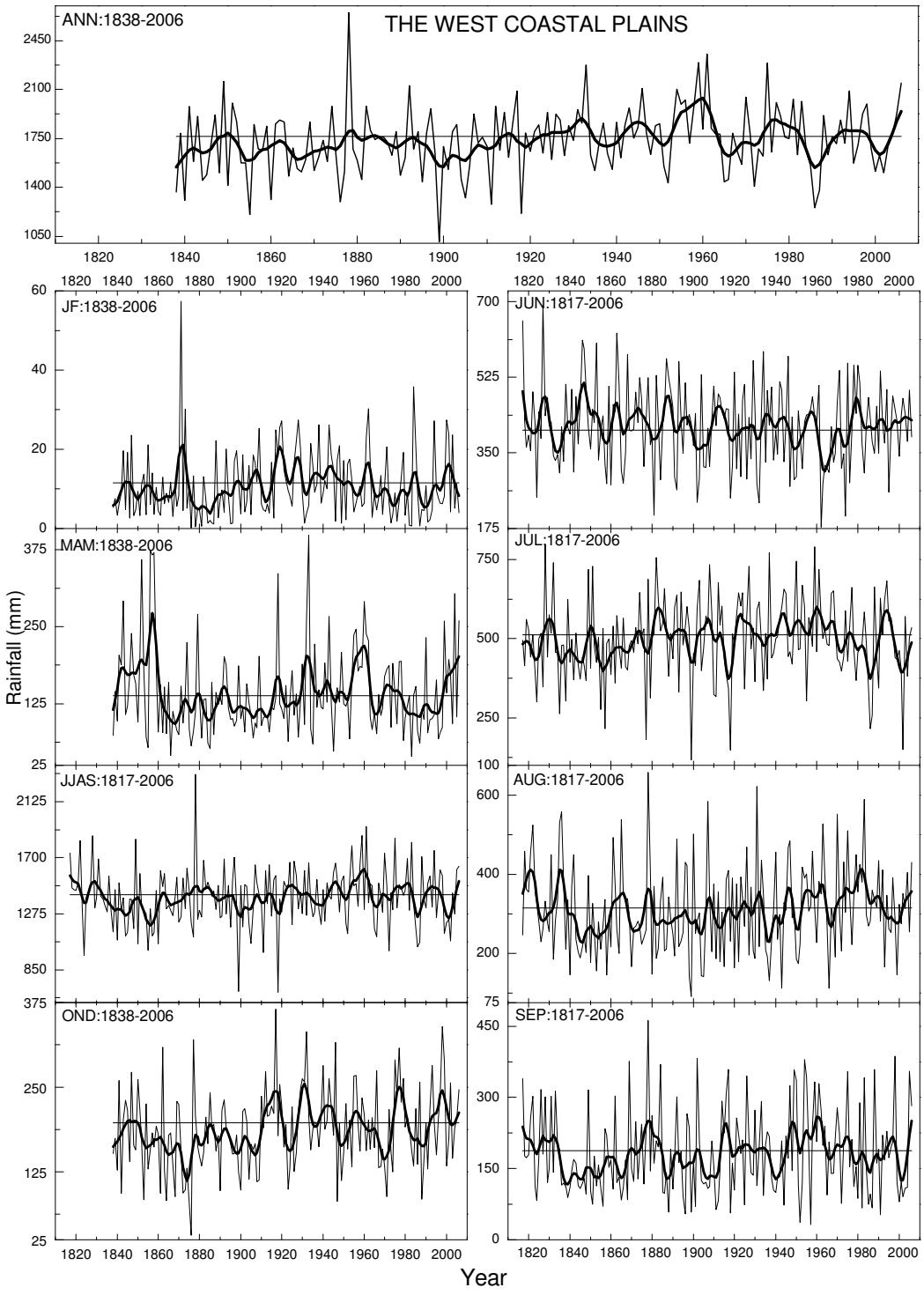

Figure 55: Same as in Figure 2.

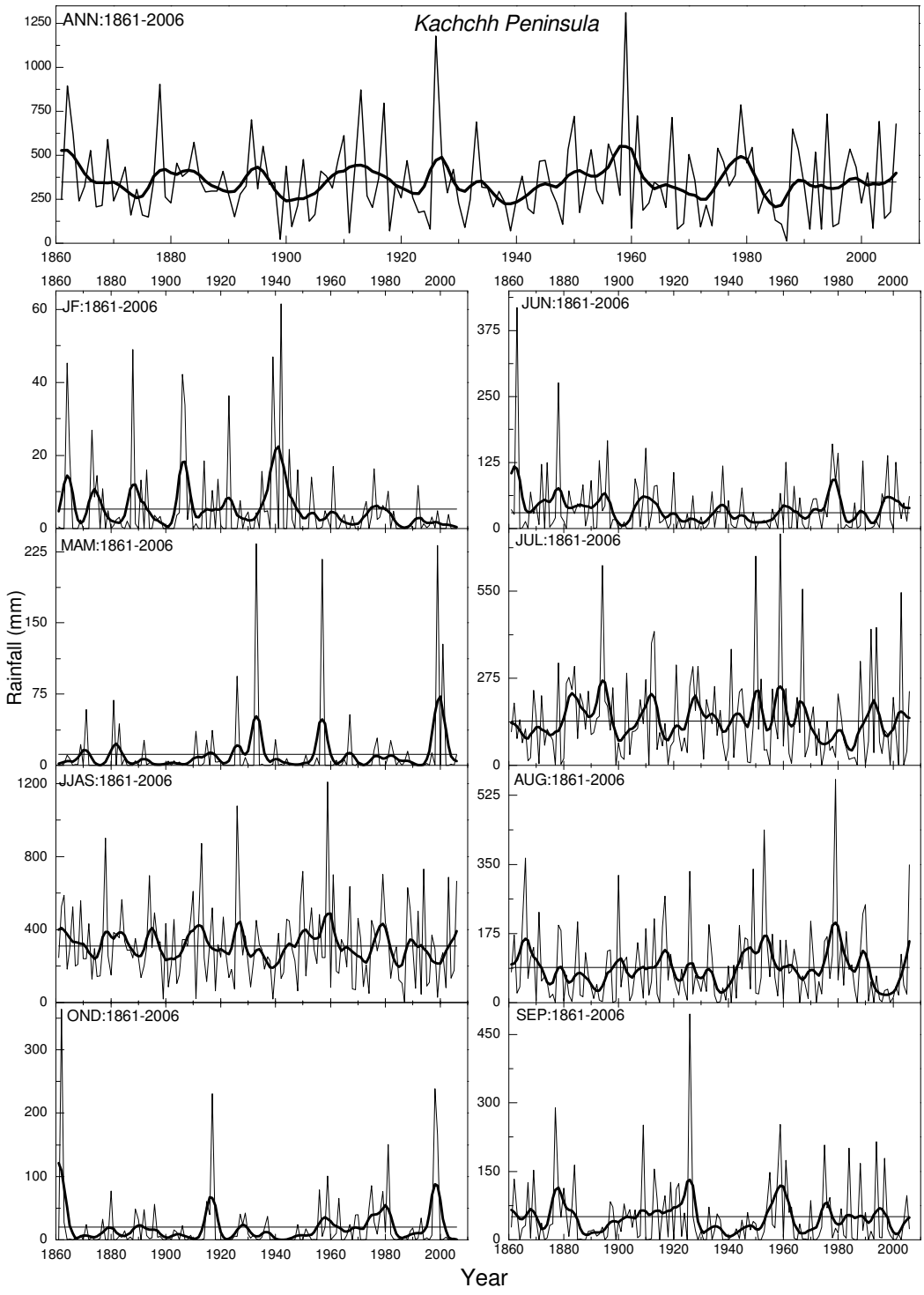

Figure 56: Same as in Figure 2.

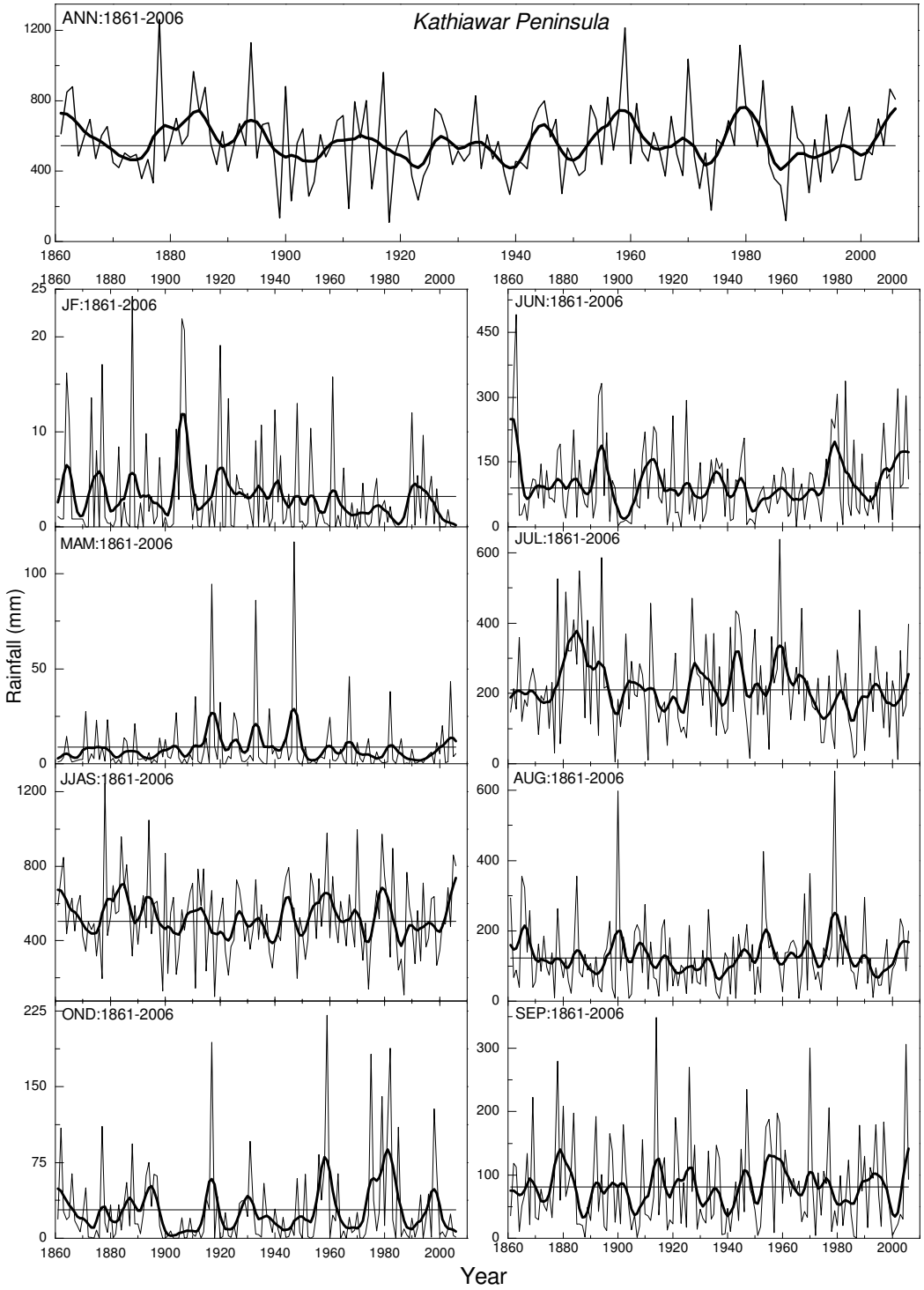

Figure 57: Same as in Figure 2.

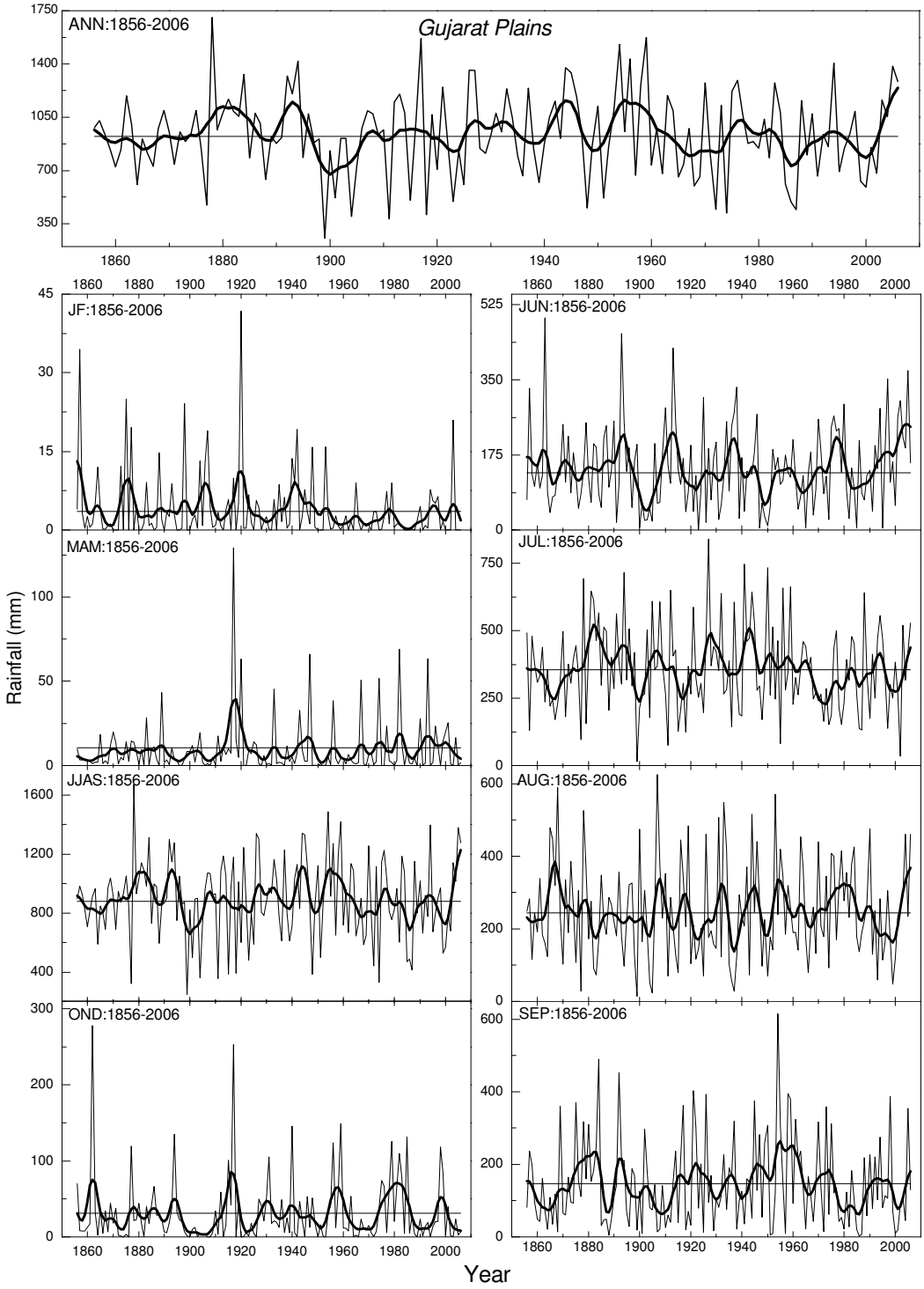

Figure 58: Same as in Figure 2.

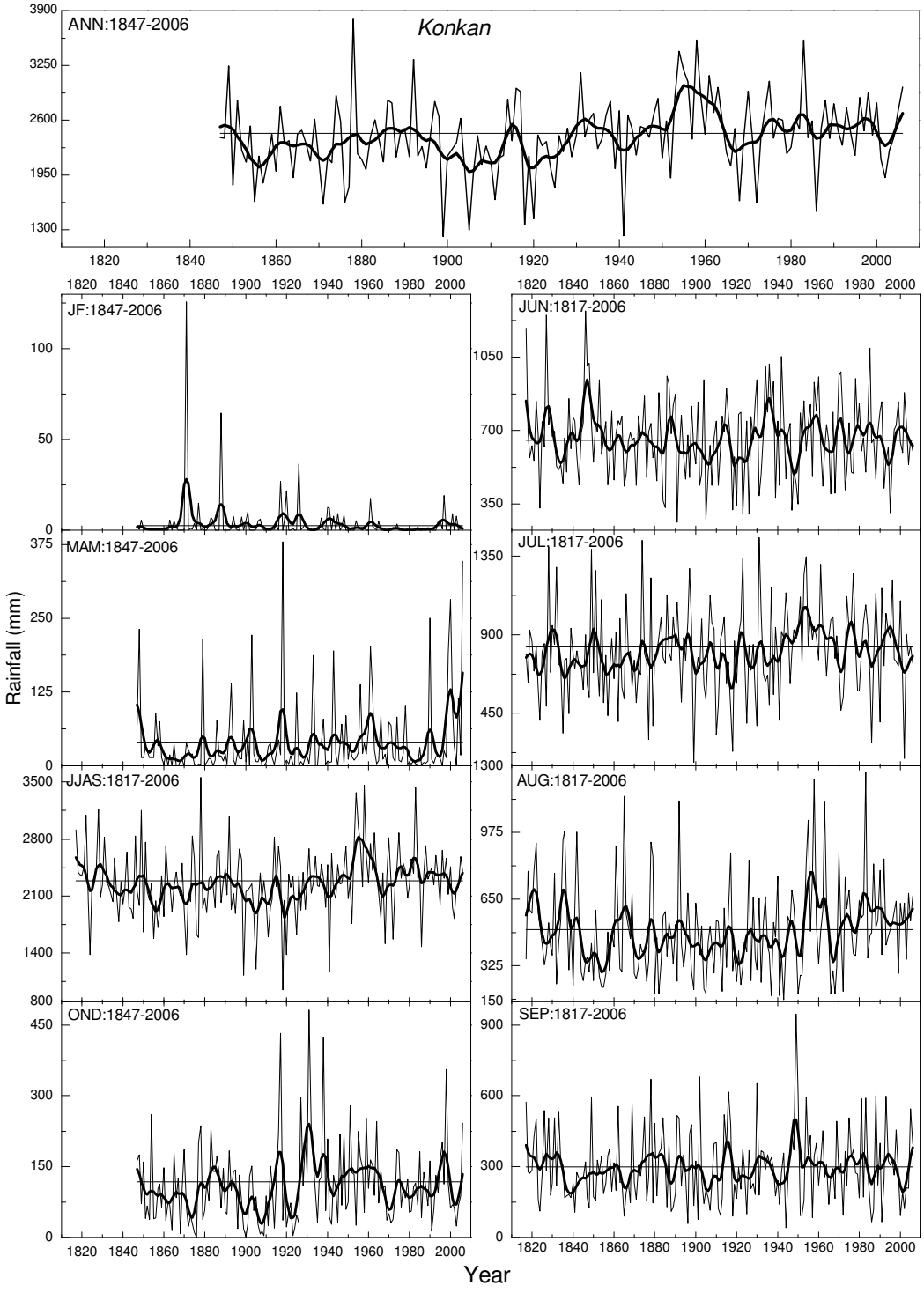

Figure 59: Same as in Figure 2.

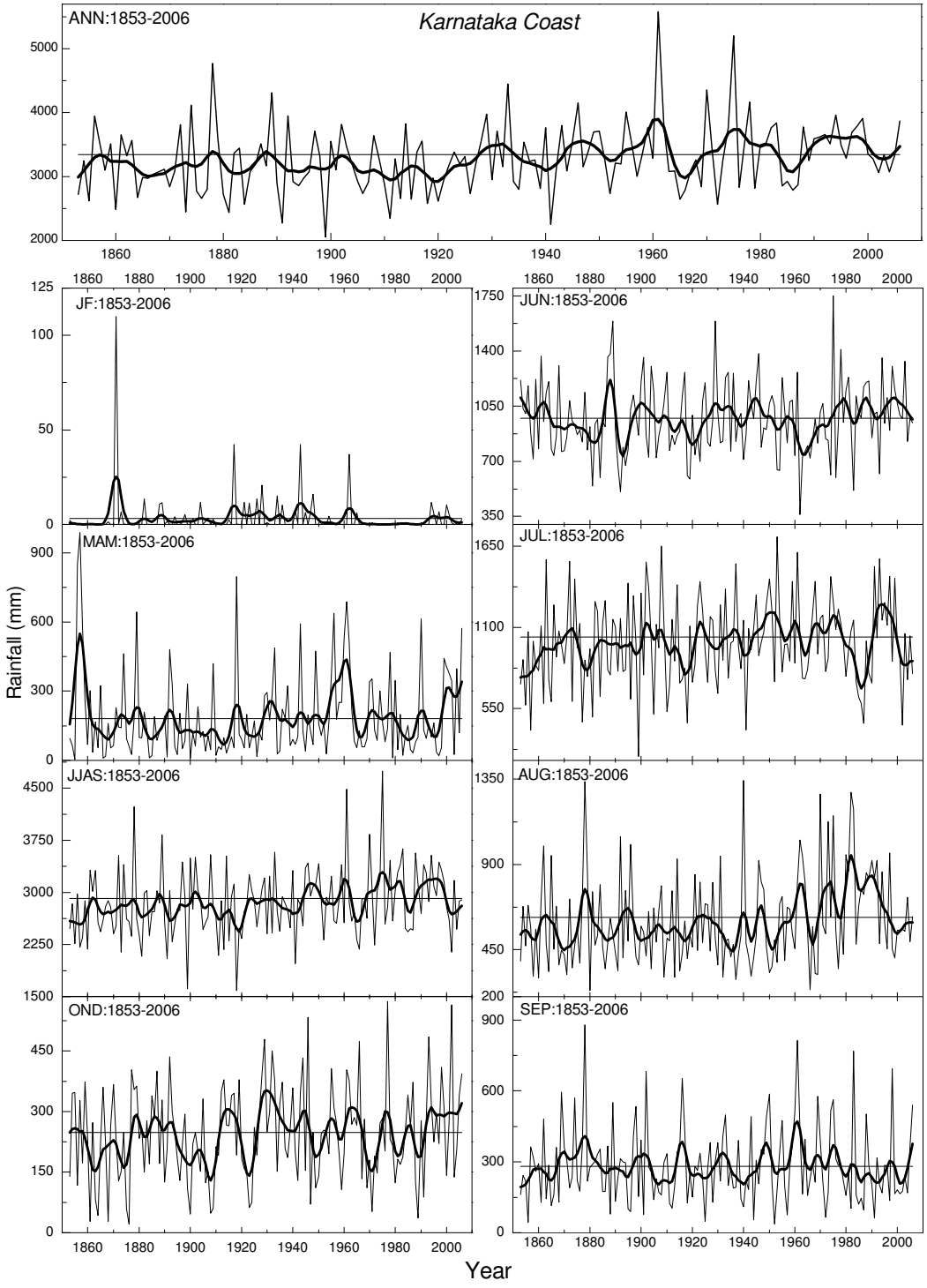

Figure 60: Same as in Figure 2.

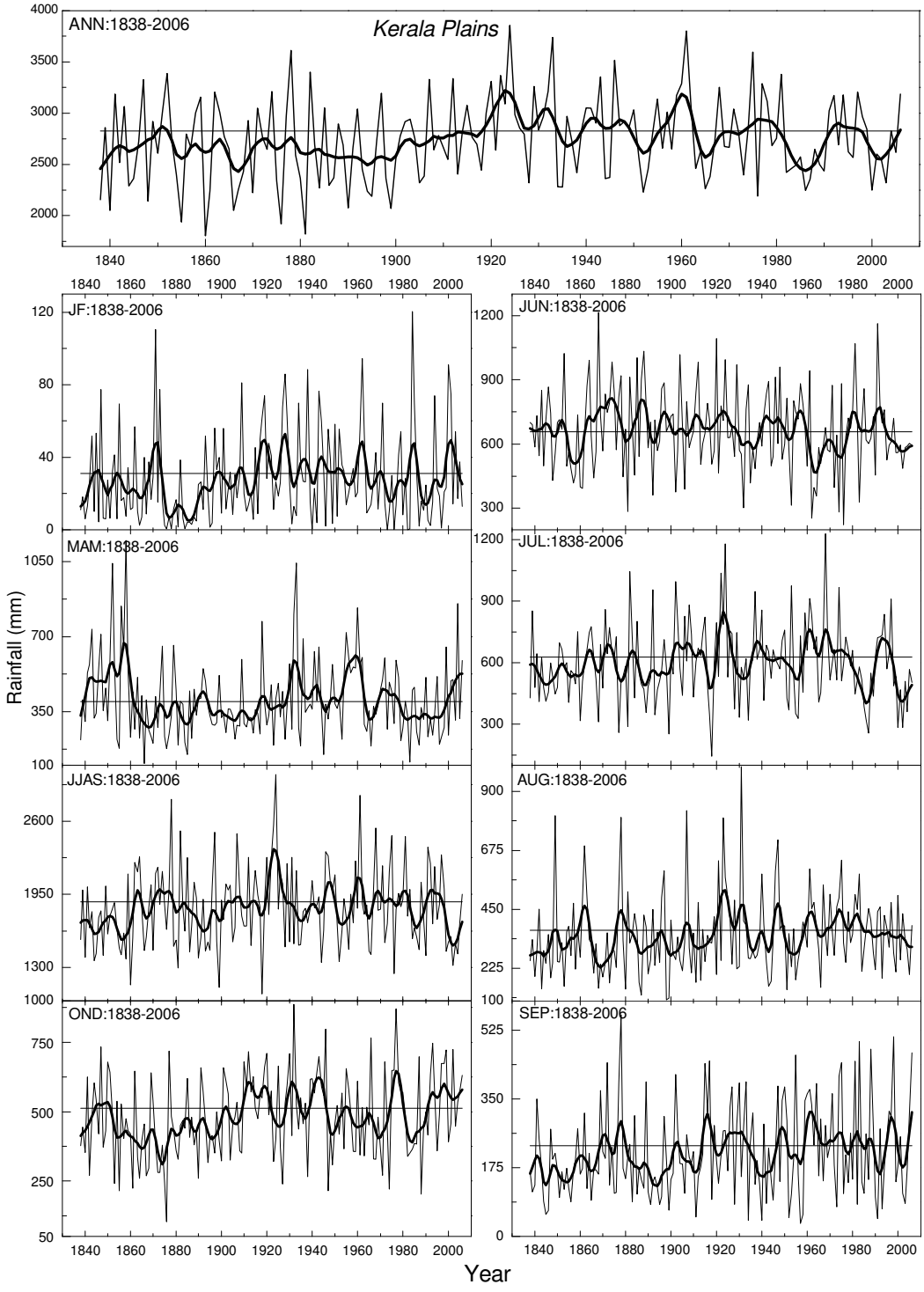

Figure 61: Same as in Figure 2.

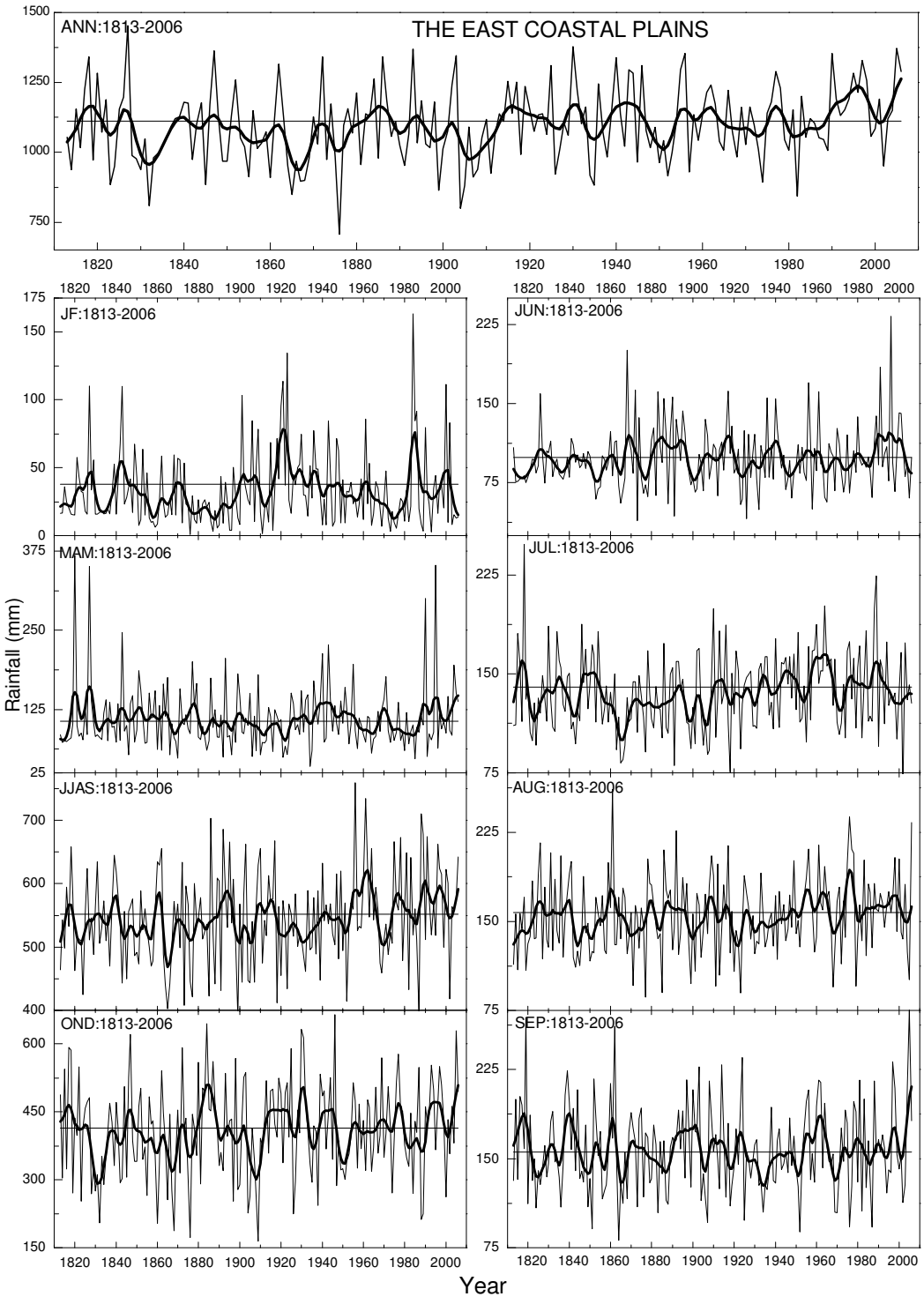

Figure 62: Same as in Figure 2.

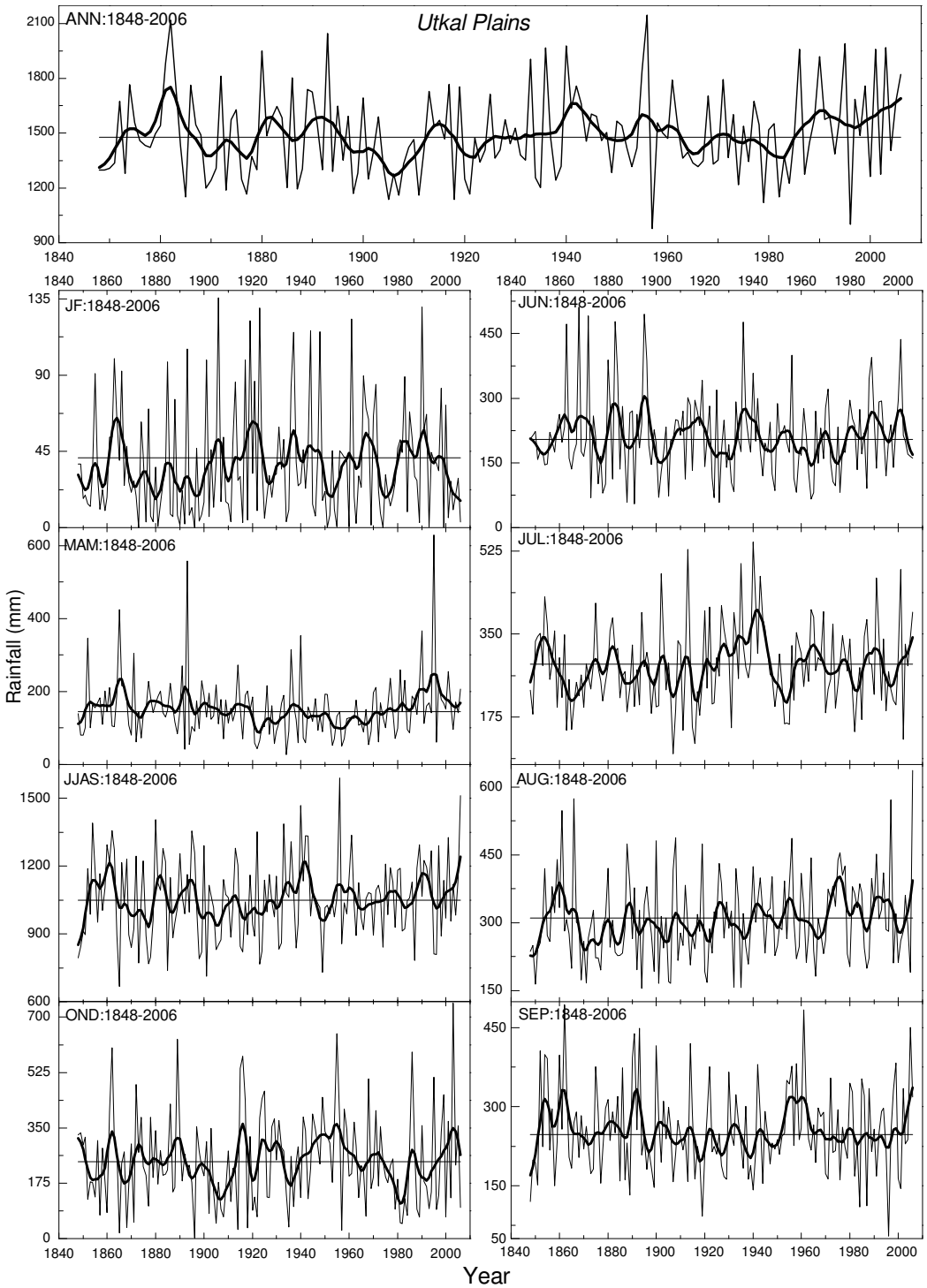

Figure 63: Same as in Figure 2.

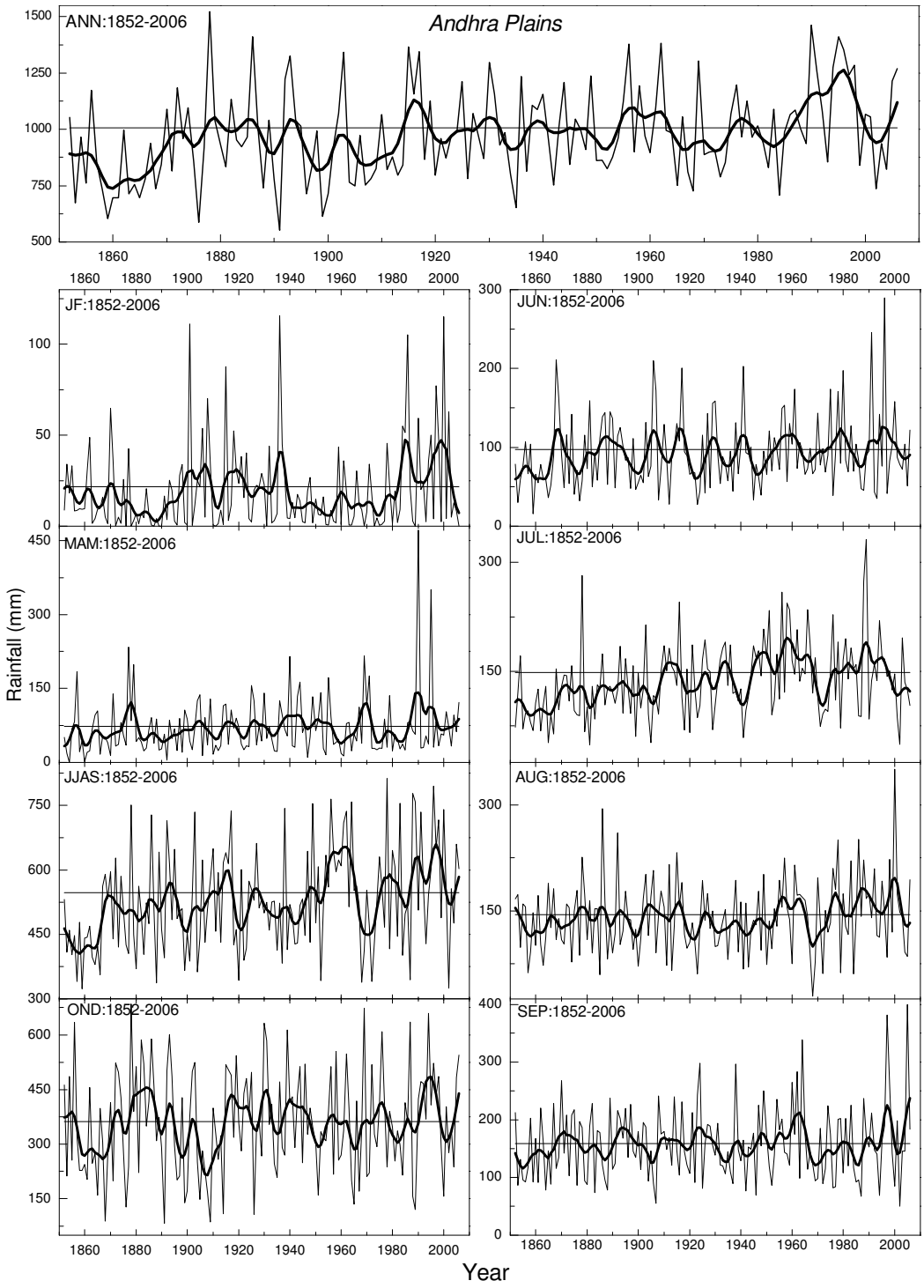

Figure 64: Same as in Figure 2.

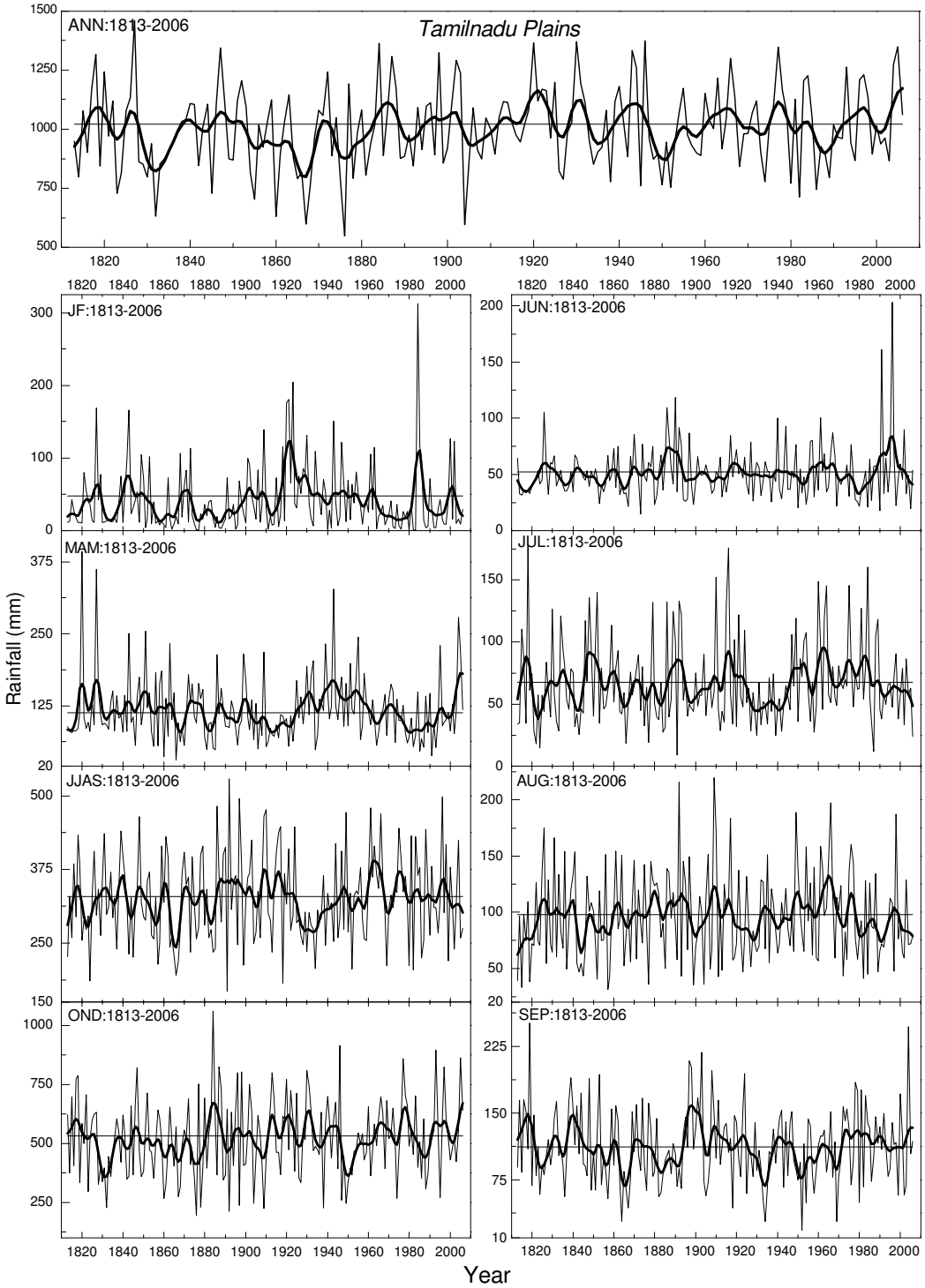

Figure 65: Same as in Figure 2.

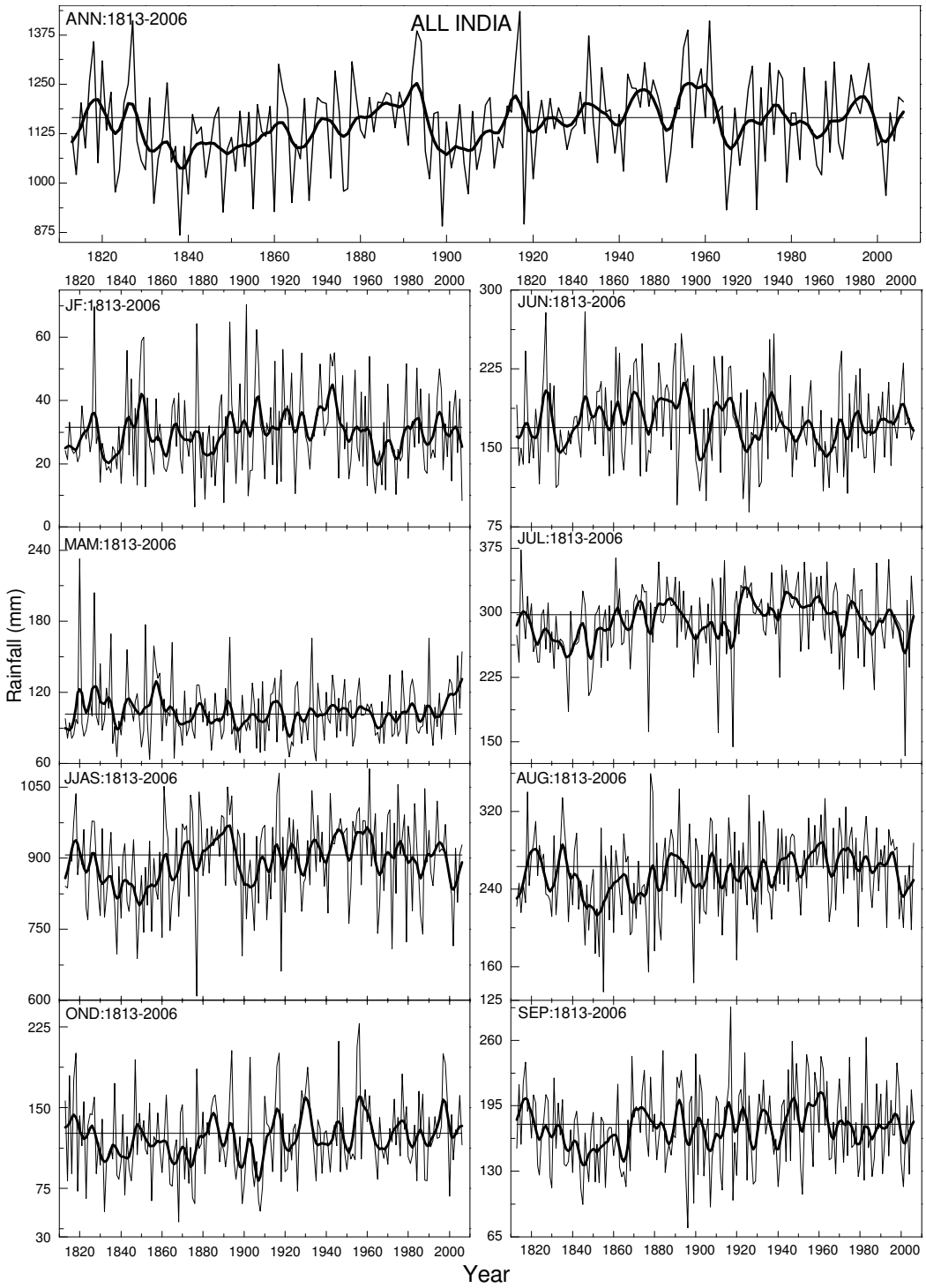

Figure 66: Same as in Figure 2.

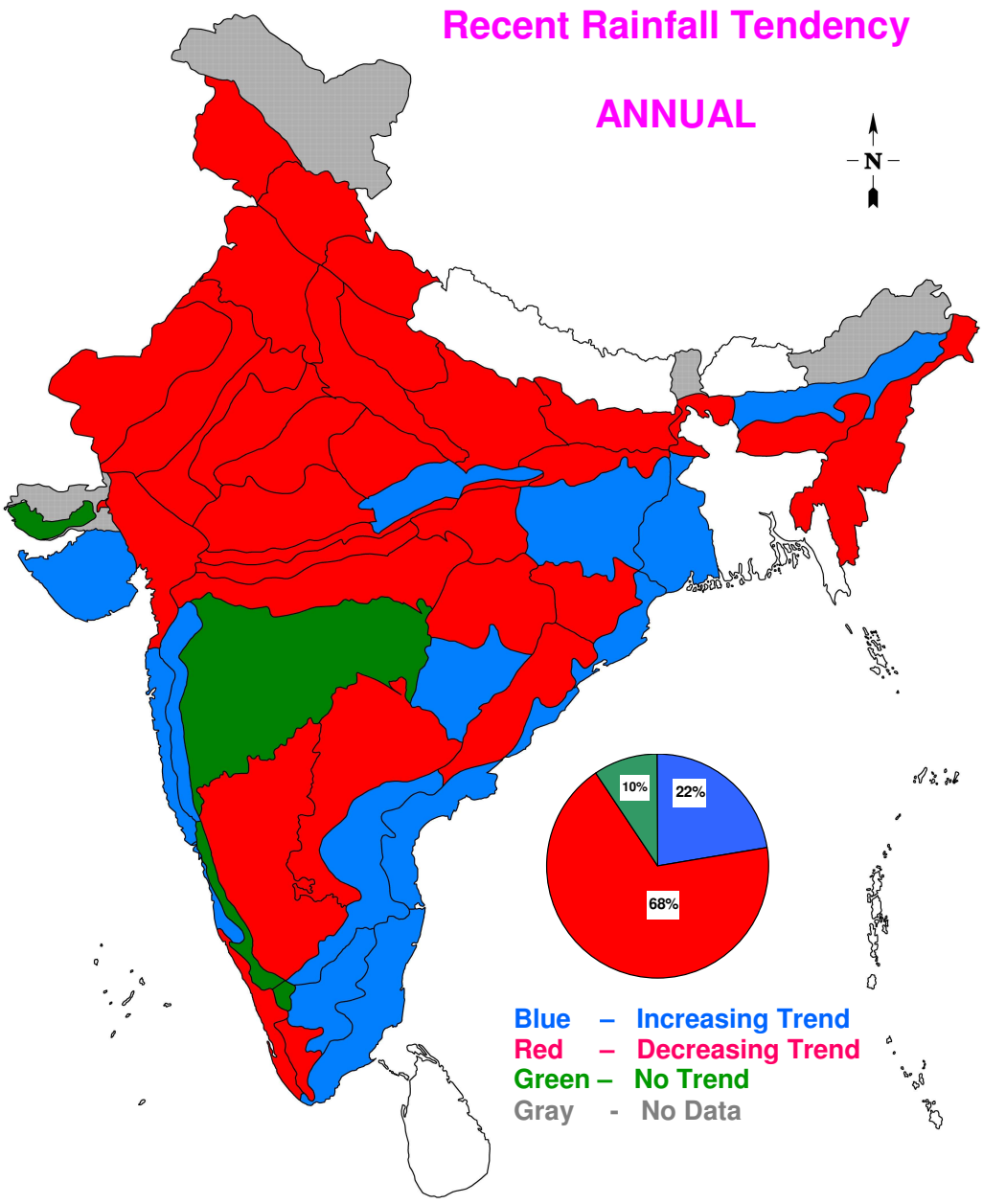

Figure 67: Geographical distribution of recent tendencies in annual rainfall across India and pie diagram showing percentage area under different trends

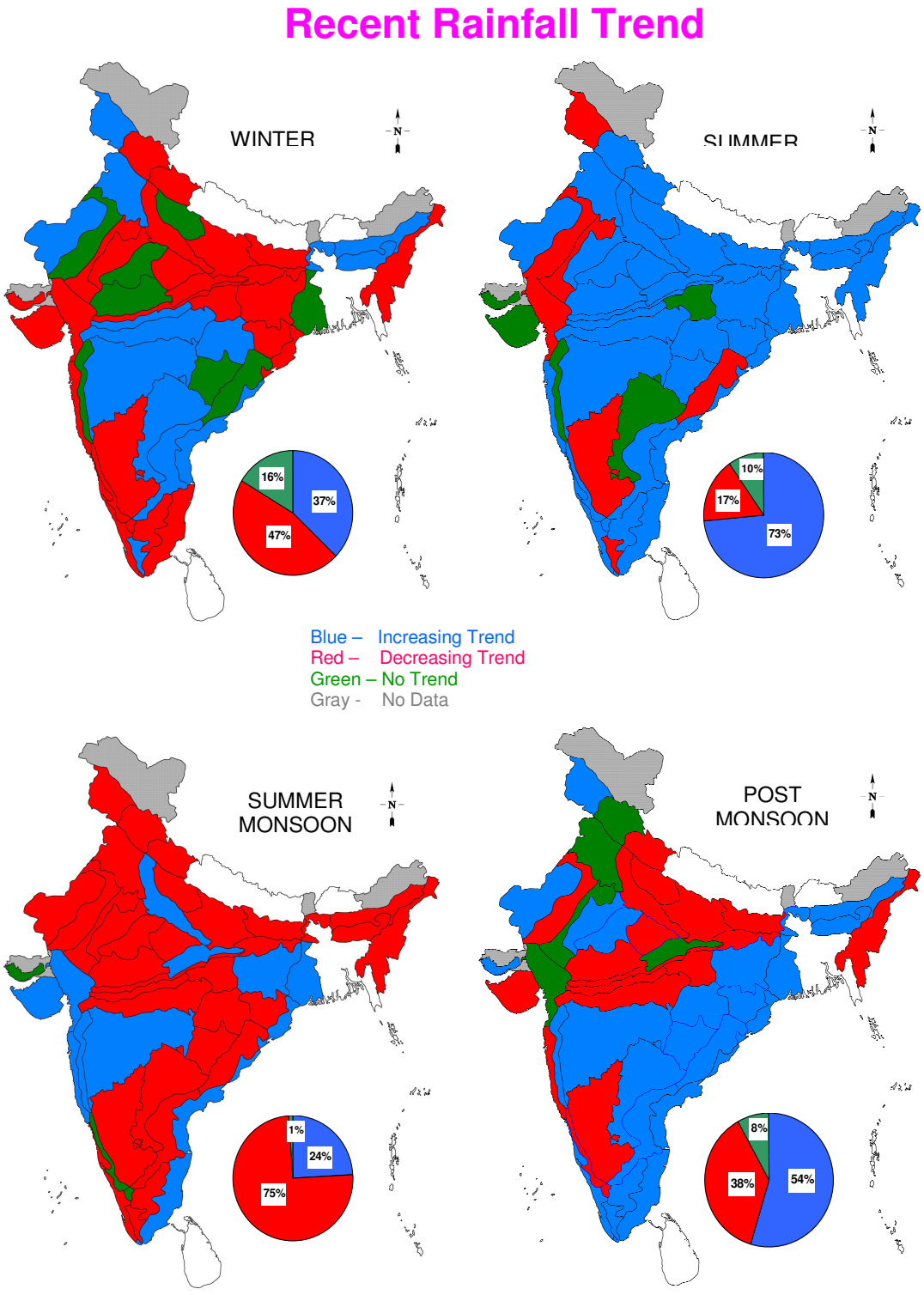

Figure 68: Same as in Figure 67 but for seasonal rainfall

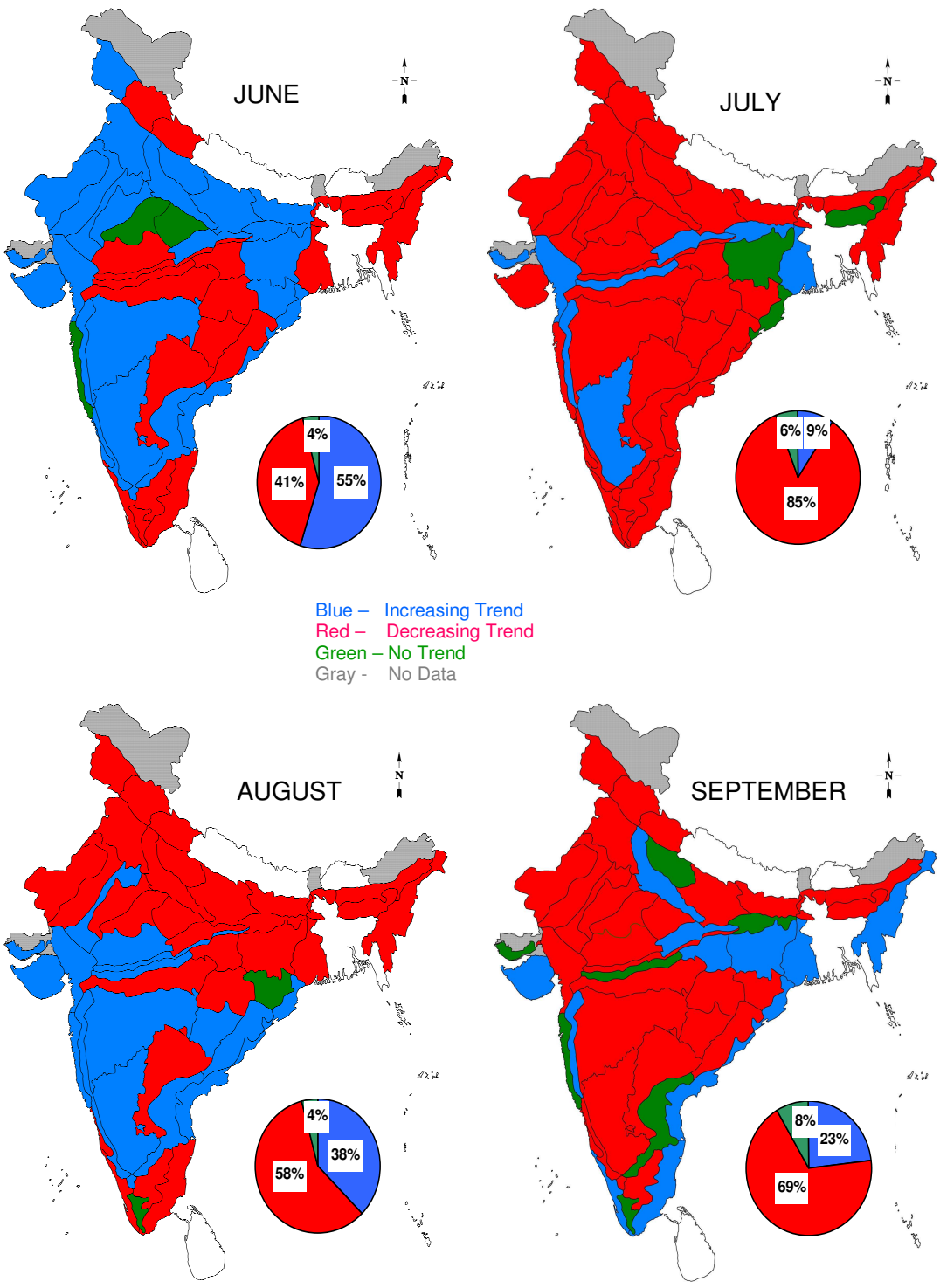

Figure 69: Same as in Figure 67 but for monsoon monthly rainfall

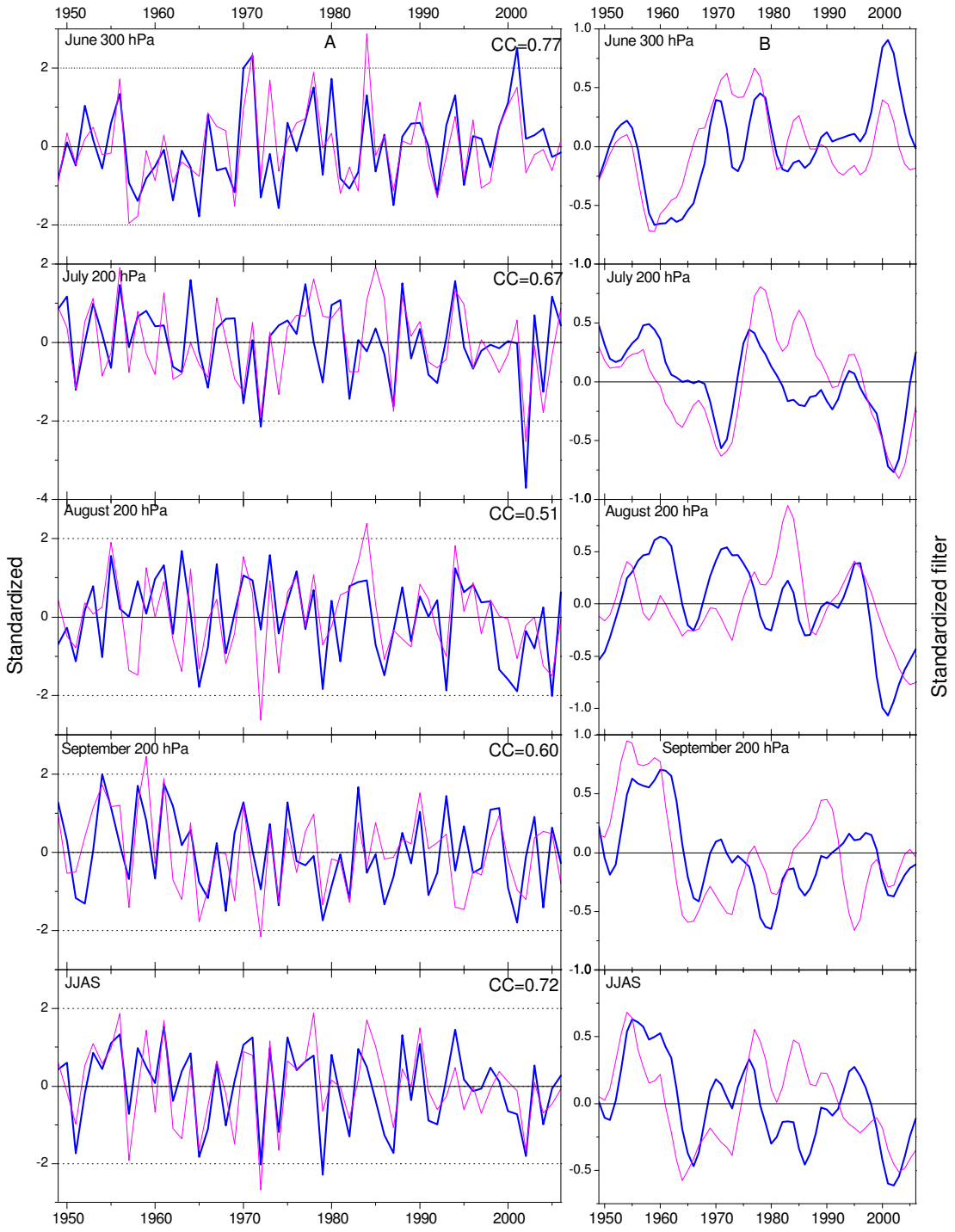

Figure 70: Time series (1949-2006) plots of the standardized geopotential height gradient (GPHG) from TA region to STIO region and rainfall over India (north of 18°N) (A); and 9-point Gaussian low-pass filtered values of the GPHG and the rainfall (B). Blue line indicates the rainfall and magenta the GPHG.