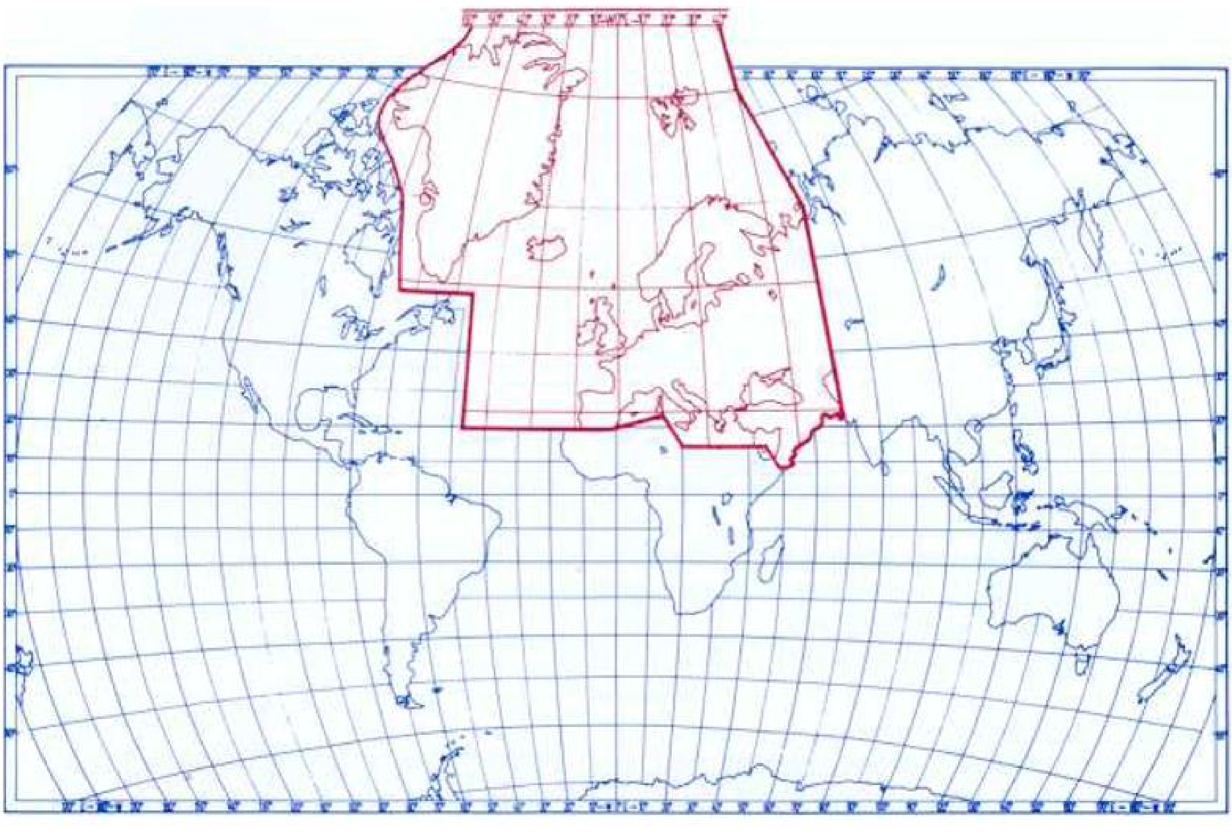
European Climate Support Network

World Meteorological Organization
World Climate Data and Monitoring Programme

Deutscher Wetterdienst

Annual Bulletin on the Climate in WMO Region VI
-Europe and Middle East-

2000



ISSN: 1438-7522
Internet version: http://www.gcmp.dwd.de/

Editor: **Deutscher Wetterdienst**
Postfach 70 04 21, D-22043 Hamburg, Germany
Phone: +4940 6690 1844
Fax: +4940 6690 1941

Responsible: Gudrun Rosenhagen
E-mail: gudrun.rosenhagen@dwd.de

Print: CaHo Druckereibetriebsges. mbH, Hamburg

Annual Bulletin
on the Climate
in WMO Region VI
- Europe and Middle East -
2000

The bulletin is a summary of contributions
of the following national meteorological services
and was co-ordinated by Deutscher Wetterdienst, Germany,

Albania
Armenia
Austria
Belarus
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Hungary
Iceland
Ireland
Israel
Jordan
Latvia
Lithuania
Moldova
Netherlands
Norway
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
Switzerland
The Former Yugoslav Republic of Macedonia
Turkey
Ukraine
United Kingdom
Yugoslavia

Furthermore, contributions to the WMO Bulletin article on consequences of abnormal weather in 2000 were referred from the following countries:
Bosnia and Herzegowina, Greece, Italy, Russian Federation, Syrian Arab Republic

List of Contents:

Foreword

Dr Iván Mersich
President of WMO RA VI

Outstanding Events and Anomalies in 2000

Temperature

- Warmest year on record in many places
- Warmest spring and autumn on record in parts of Central Europe
- Fierce cold spell in eastern Central Europe in May
- Extraordinary hot and dry summer on the Balkans and in Middle East

Precipitation

- Wettest year on record in south-eastern Norway
- Driest year of the century in south-eastern Hungary
- Drought in eastern Spain aggravates until October
- Abundant snow in northern Fennoscandia in late winter
- Severe flooding in north-eastern Hungary, Romania and Serbia in April
- Extreme drought in parts of south-eastern Europe from mid-April to July
- Extremely wet in Scandinavia in June and July
- Wettest autumn on record in England, Wales and Ireland with repeated floods
- Devastating floods in northern Italy, southern Switzerland and eastern Spain in October

Annual Survey:

Warmer than average **temperatures** prevailed in all seasons and except for Turkey, the annual temperature anomaly was positive all over Europe and in the Middle East. For wide parts of the Region, it was one of the warmest year on record and for parts of Central and North Europe, it was even the warmest of the century (see figures 0.1, 0.2, 0.3 and fig. xc (Croatia, Germany, Poland, Slovakia, UK)). For the Netherlands, it was together with 1999 and 1990, not only the warmest year of the century but also since the start of regular measurements of the temperature in 1706. For Vienna, Austria, and Prague, Czech Republic, the annual temperature means of 11,8 °C and 11,93 °C were the highest since the beginning of measurements in 1775.

Heavy **precipitation** resulting in flooding, loss of life and extensive property damage occurred at several places in the Region. The most notable events were the flooding in north-eastern Hungary, Romania and Serbia in April, in northern Italy and southern Switzerland in October and in the United Kingdom and France from September to December. April was the wettest April, and the autumn the wettest autumn on record in the 235-year monthly England and Wales precipitation series (see fig. 0.10, page xx). South-eastern Norway experienced the wettest year since measurements began in 1895.

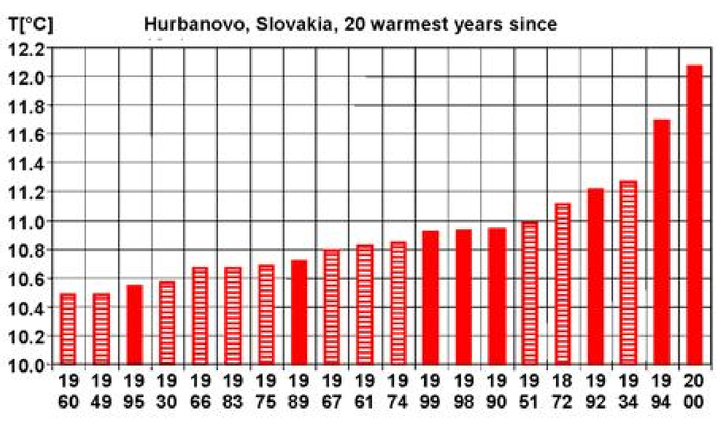
On the other hand, major droughts affected the south-eastern part of the Region engendering numerous wildfires and causing water shortages and high agricultural losses. Between mid-April and July, some parts of south-eastern Europe received hardly any precipitation. The Balkans and the Middle East had an extraordinarily hot, dry and sunny summer (see fig. 0.4, fig.xc (Croatia) p. xx,). For parts of south-eastern Hungary, it was the driest year of the century (see fig. xc, p.xx). During the year, the precipitation deficit in the large water-collection basins of Levante and the south-eastern mainland of Spain aggravated the drought from which the area was suffering: The precipitation total in the September 1998 to September 2000 period amounted to 614 mm, only. Such a low 2-year precipitation sum occurs on average once every 118 years. The deficit ended in October 2000 with an intense storm affecting most of the Mediterranean side of Spain (see fig. 0.5).

In Iceland, it was warm and very sunny. In Akureyri, the total number of bright sunshine hours was 1276. This is the highest number of sunshine hours there since the beginning of sunshine duration measurements in 1928 and 230 hours above the 1961-1990 average.

There was in general less **storminess** as in the preceding years. No fierce winter storms affecting larger regions occurred and the number of intense Atlantic winter cyclones was about normal (see fig. 0.6).

Most parts of the Russian Federation recorded normal to slightly reduced values of **total ozone.** For a few days around November 20, there was a deficit of 25 - 25 % over central European Russia and an absolute minimum of total ozone (196 Dobson units) was registered on November 18 over Moscow. At the meteorological observatory Hohenpeißenberg, southern Germany, subnormal ozone values prevailed almost over the year, resulting in the fifth lowest annual mean in the record of the station going back to 1968 (see article page xx).

__Fig. 0.1:__ Mean annual temperatures of the twenty warmest years at the Hurbanovo observatory in the 1871-2000 period (130 years), full columns indicate the years after 1988,
130-year mean: 9.76 °C,
standard deviation: 0.78 °C
anomaly in 2000: 2.31 °C, this is 3-times the standard deviation.
From: Slovak Hydrometeorological Institute



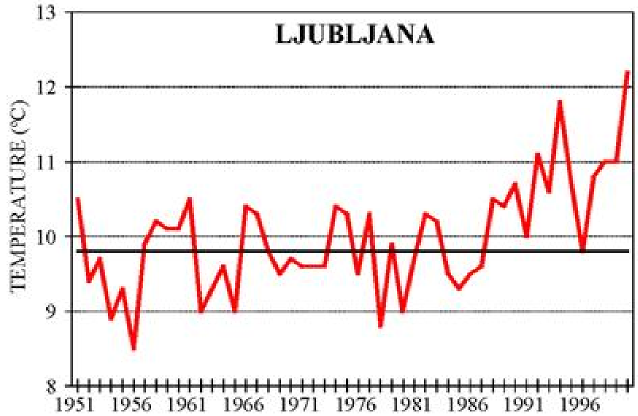


Fig. 0.2: *Mean annual temperature and 1961–1990 normal*
From: Hydrometeorological Institute of Slovenia

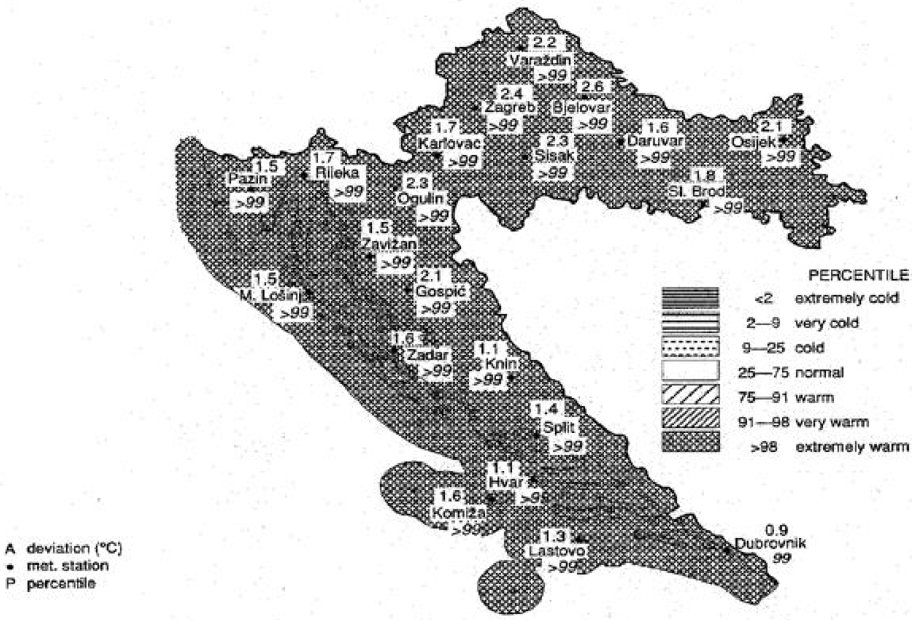


Fig. 0.3: *Percentiles of anomalies of the annual mean temperatures in Croatia, reference period 1961-90*
From: Meteorological and Hydrological Service, Croatia

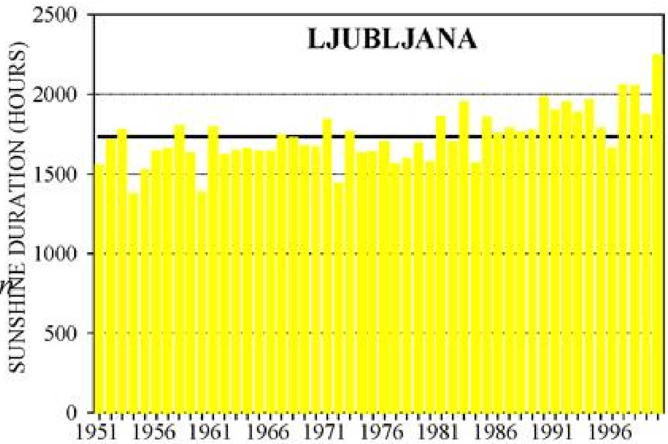


Fig. 0.4: *Annual sunshine duration between 1951 and 2000*
From: Hydrometeorological Institute of Slovenia

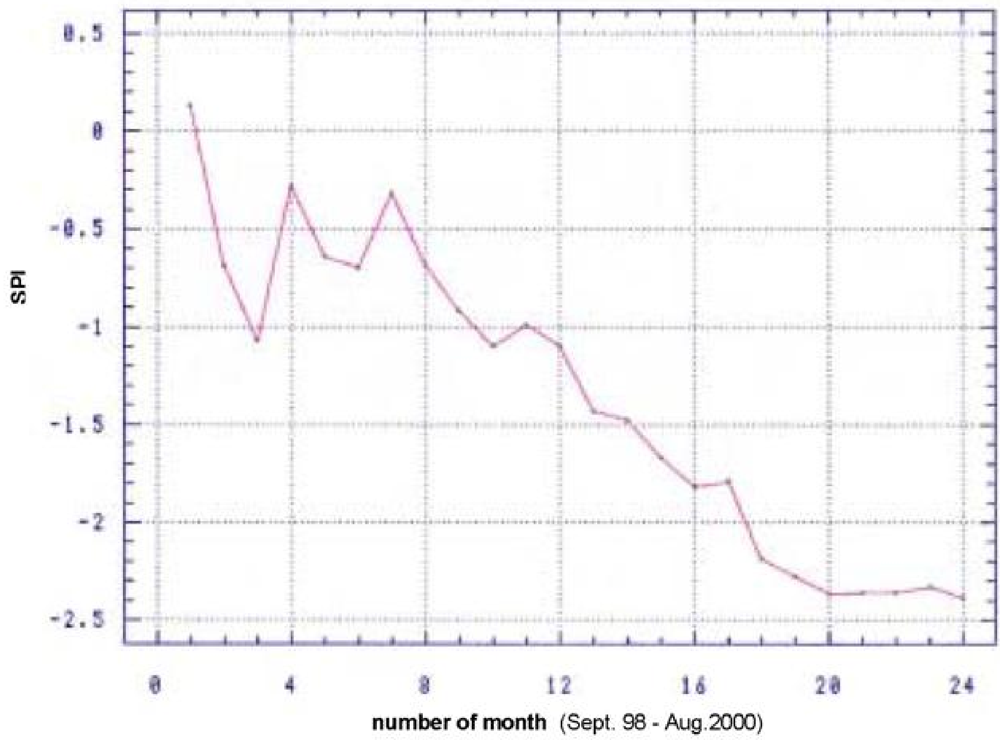


Fig. 0.5: *Standardised precipitation index (SPI) of the Levante basin between September 1998 and Augus 2000t, representing the standard deviation of the accumulated precipitation since September 1998*
From: Instituto Nacional de Meteorologia, Spain

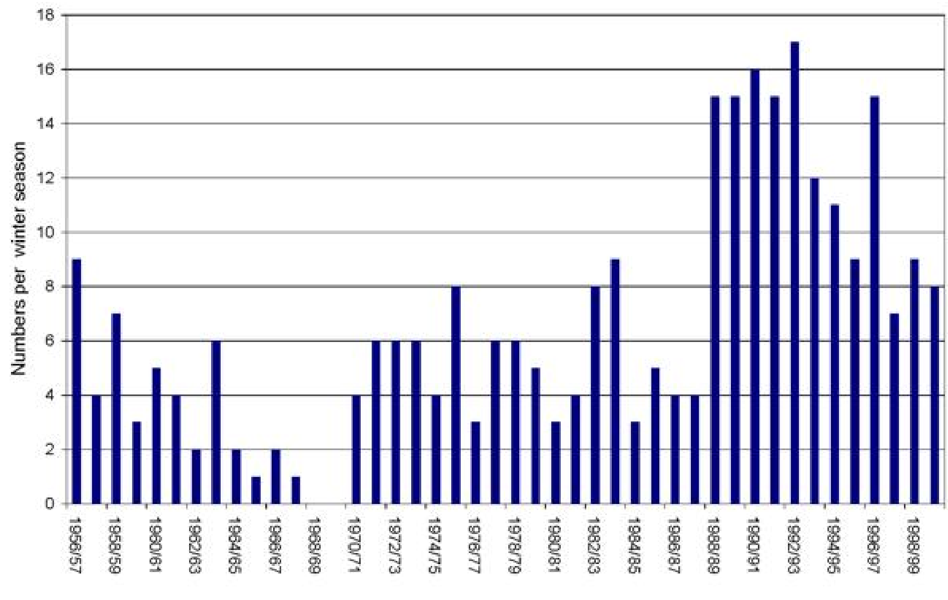


Fig. 0.6: *Numbers of North Atlantic low pressure systems with core pressure ≤ 950 hPa per winter season (November through March)*
From: Deutscher Wetterdienst, Germany

Seasonal Surveys

Winter 1999/2000 was mostly mild. In European Russia, it was one of the warmest of the last decades (see fig. xx, page xx). Temperature anomalies in north-eastern Europe exceeded 2 °C and locally the 98th percentile. Precipitation was distributed unevenly: Surpluses in the northern and south-eastern parts of the Region contrasted with extreme deficits in the Southwest (see fig. xx page xx). For Portugal it was the driest winter of the century. In France, it was the driest winter since 1949 in Provence and along the Mediterranean coast. Dryness affected adversely the agriculture and hydropower production in Italy. Across England and Wales, it was the sunniest winter since 1909. Wet and mild weather brought a lot of snow to northern Fennoscandia.

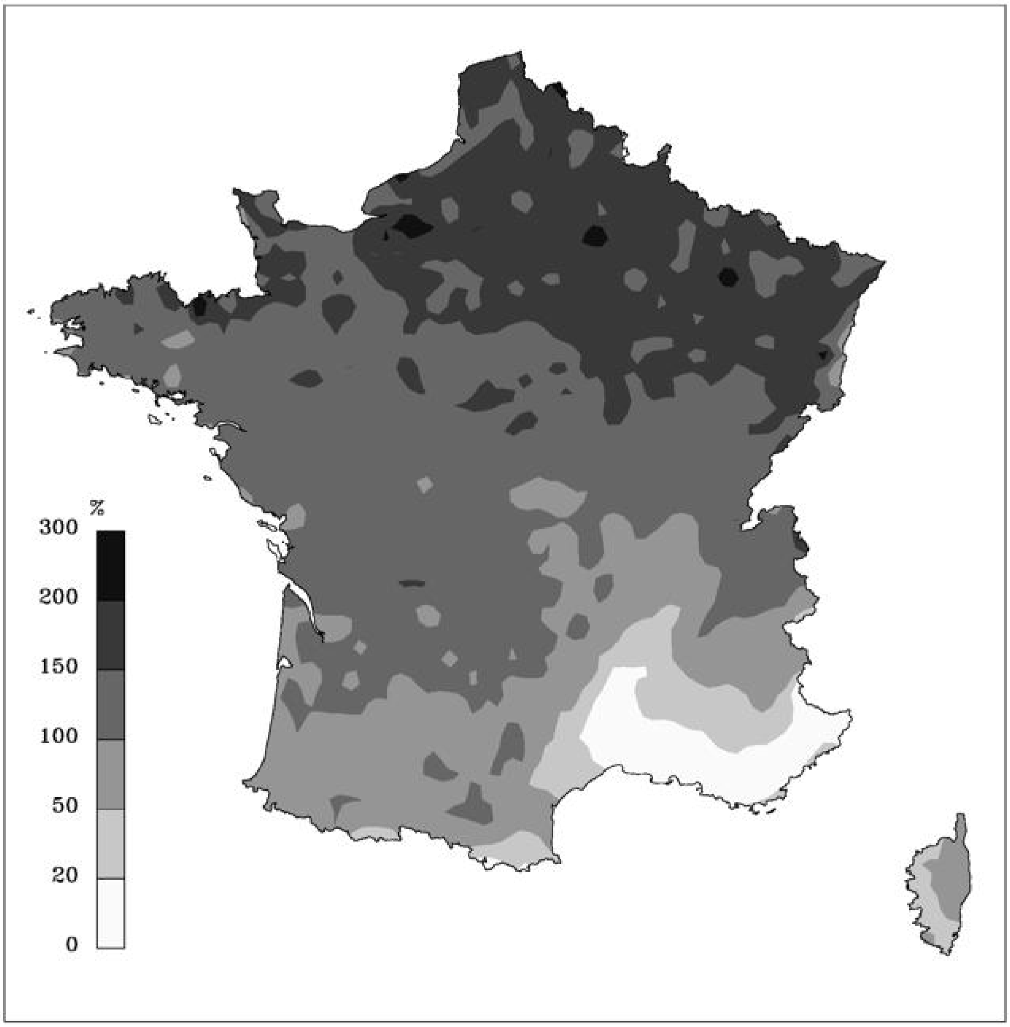


Fig. xx: *Winter precipitation in percentage of 1961-1990 normal in France from December 1999 to February 2000*
From: Meteo France

Spring 2000 was exceptionally warm in northern central Europe, parts of the Mediterranean area and the Middle East (see figures page xx). The spring was early and in general very mild. In Central Europe, the mild winter was followed by a warm spring (see fig. xx). For the whole of Germany, Slowakia and parts of Switzerland, spring 2000 was the warmest spring of the century (see fig. xx). However, in the eastern parts of Europe, a fierce cold spell caused considerable damage to the crops.

In south-eastern Europe, dry weather prevailed from mid-April to July. Some areas received hardly any rain. In contrast, April was the wettest April in the 235-year England and Wales Precipitation series and heavy rains and melting snow caused severe floods in norht-eastern Hungary, Romania and Serbia. In Israel, the 1999/2000 rainfall season ended in general drier than normal, in spite of a very wet January. Snow loads were extremely heavy in northern and eastern Finland, as the water content of the snow was high. However, the snow in Lapland melted away evenly and bare ground appeared in mid May.

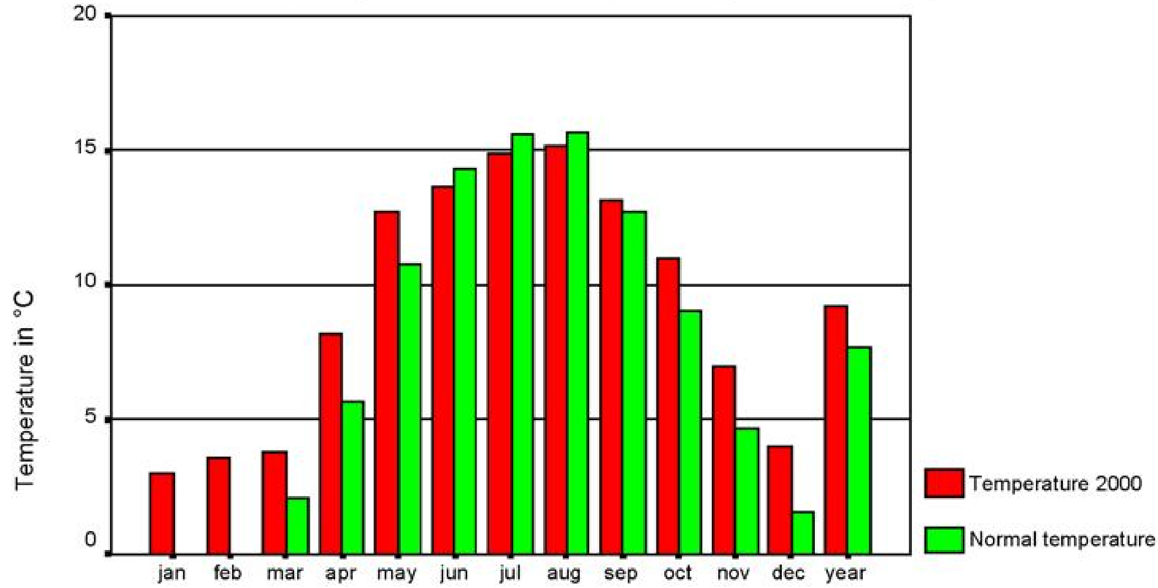


Fig. xx: *Monthly and annual temperature means in 2000 and 1961-1990 normal in Denmark*
From: Danish Meteorological Institute

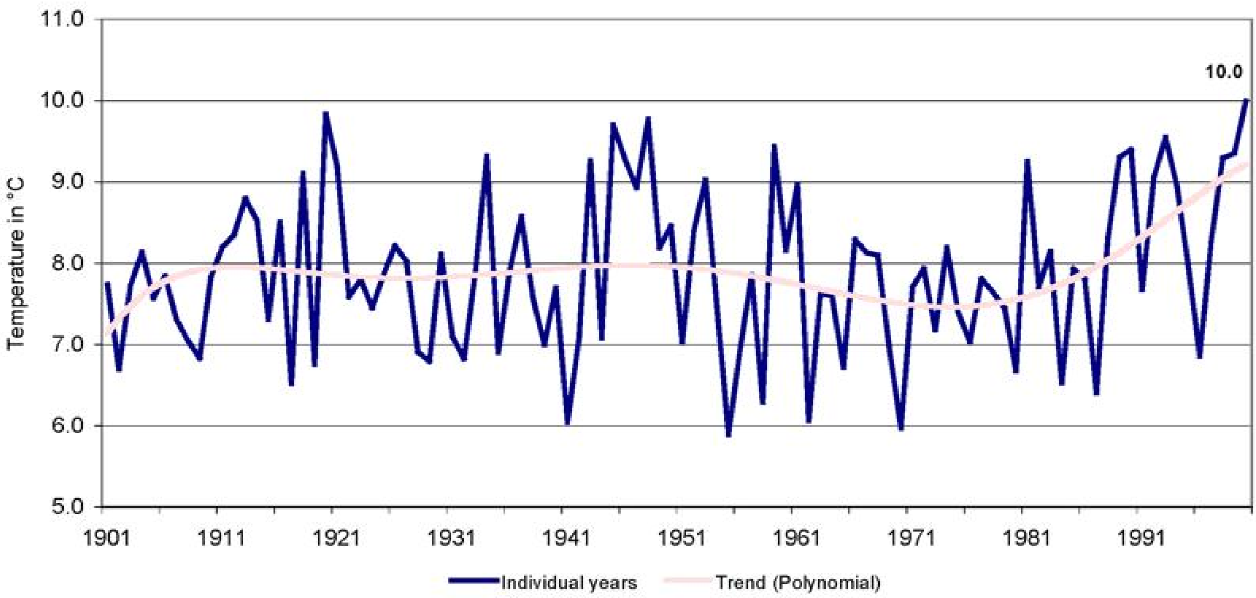


Fig. xx: *Areal mean of the spring temperature for Germany in 2000*
From Deutscher Wetterdienst, Germany

Temperatures in **summer 2000** were below normal in Scandinavia but elsewhere mainly above normal. It was extraordinarily hot and dry in south-eastern Europe and in the Middle East where the temperature anomalies surpassed the 98^{th} percentile (see figures page xx). For Armenia, it was the hottest summer of the century. Major droughts affected much of south-eastern Europe and the Middle East. In Armenia, shortage of precipitation (the rainfall total for the whole summer was only 28 % of normal) caused losses estimated to 110 million US$. In Bulgaria, the warm and dry conditions led to about 1150 wildfires that damaged 127,000 hectares forest and crop areas. Greece suffered from hundreds of fires during the height of the heat wave, particularly on Samos, where fire consumed one-fifth of the island. In Croatia, drought covered about 70% of the country by the end of August. In Hungary, May to August 2000 was drier than in any other year of the century (e.g. Szeged received 64 mm, that is 30 % less than the earlier record). Jordan reported the longest heat on record (since 1923) with temperatures up to 43 °C (see fig. 7.5 page xx).

Although the summer 2000 was not especially dry in the United Kingdom, rainfall total in England and Wales was consistent with the tendency for drier conditions in July and August since the mid-20^{th}century.

Autumn 2000 and the early winter were exceptionally warm from Scandinavia to Central Europe (see figures page xx) and the first frost appeared as late as December 17 at many places in the low-lands of Central Europe, which was the latest occurrence on record. For Slovakia, it was the warmest autumn on record. (since 1871).

Except for the south-eastern and south-western parts of the Region , wet conditions prevailed. In wide parts from the UK to northern Italy and in southern Scandinavia it was extremely wet. In much of England, Wales and Ireland, persistent wet weather began around mid-September and lasted beyond the end of the year. In all, the 503 mm of rain recorded was nearly twice the 1961 to 1990 average and there has been no wetter autumn in the 235-year England and Wales Precipitation series (EWP). (see figure xx). As a result there was widespread flooding in many parts of Britain. The worst affected areas were southern England, the headwaters and valley of River Severn in western England and east Wales, and Yorkshire. New precipitation records for autumn were also set in Ireland, which experienced over 60 consecutive days of rain in parts of the West and Southwest.

Two-months rainfall records for October-November were broken across many areas of France, leading to floods (especially in the North in November and in Britanny in December) and to saturated soils nearly everywhere at the end of October.

Torrential rains caused deadly flooding and mudslides in north-eastern Italy and southern Switzerland in October. The 10-day lasting river Po watershed flood was caused by severe rainfall with values never recorded before and recurrence periods exceeding in some sites 1000 years.

Extremely wet weather prevailed in southern Norway and Sweden from October to mid-December resulting in unprecedented high levels in lakes and streams. The biggest lake in Sweden, Vänern, rose to its highest level since regulations commenced in the middle of the 1930-ies.

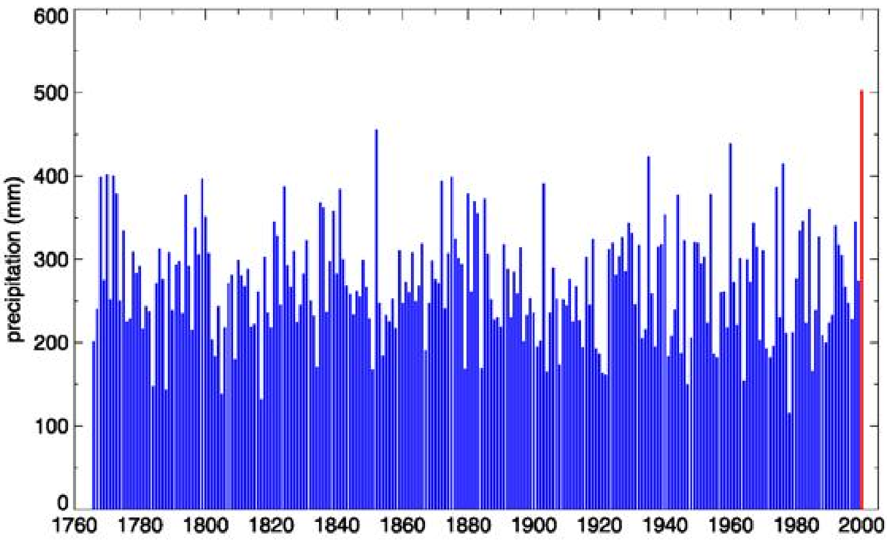


Fig. 0.10:*Yearly totals (mm) of autumn (September to November) precipitation in England and Wales from 1766 to 2000*
From: Hadley Center, Met Office, UK

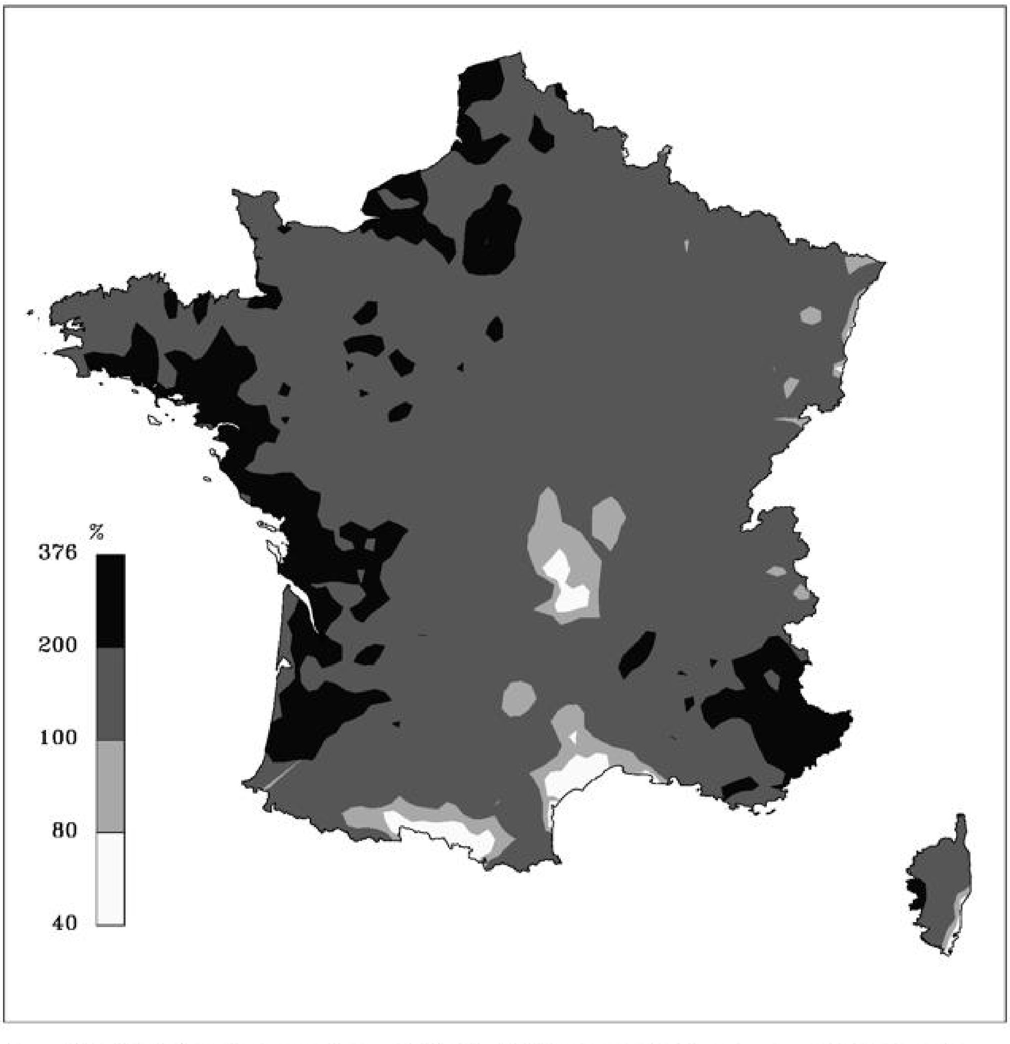
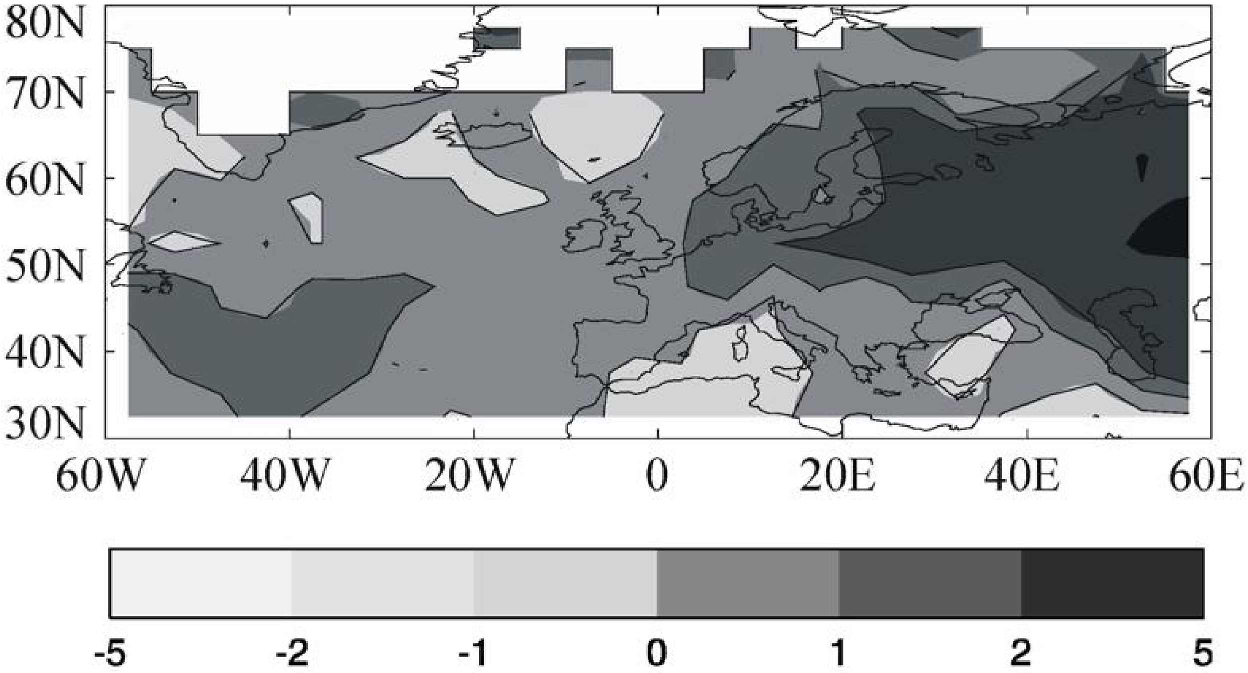


Fig. 0.11: *Precipitation in percentage of 1961-1990 normal in France from October to December 2000*
From: Météo France

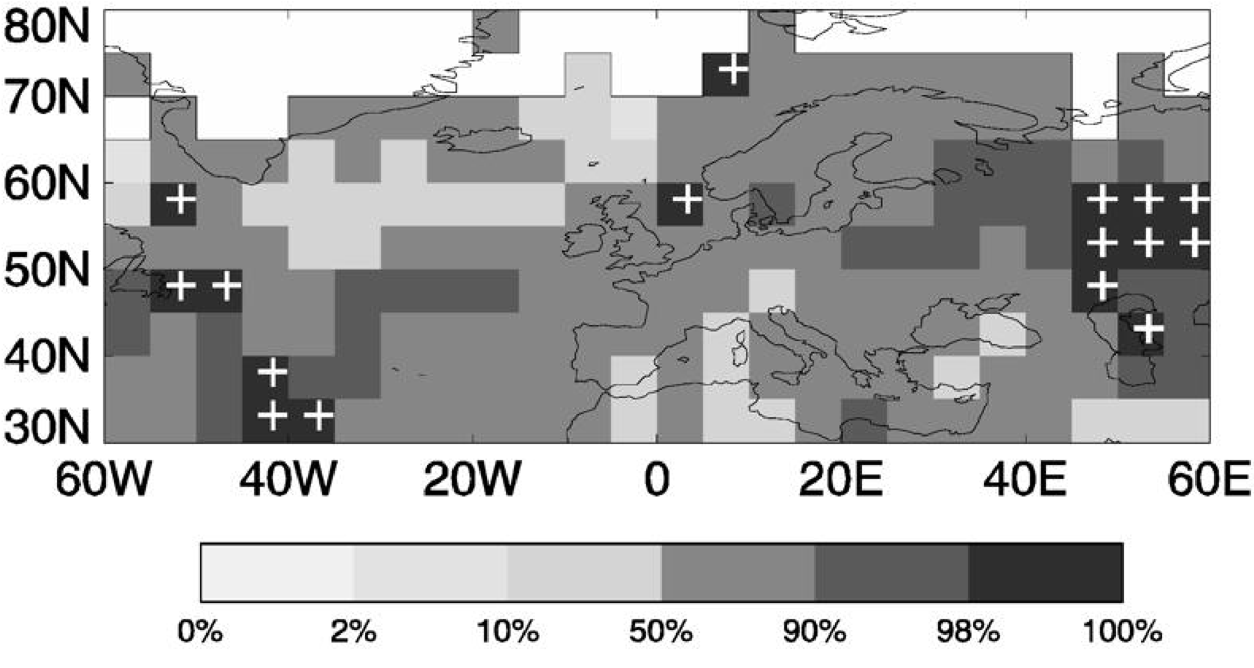
Seasonal Maps

Surface temperature anomalies: December 1999 - February 2000

From: Hadley Centre of Climate Prediction and Research



Departures from normal in °C

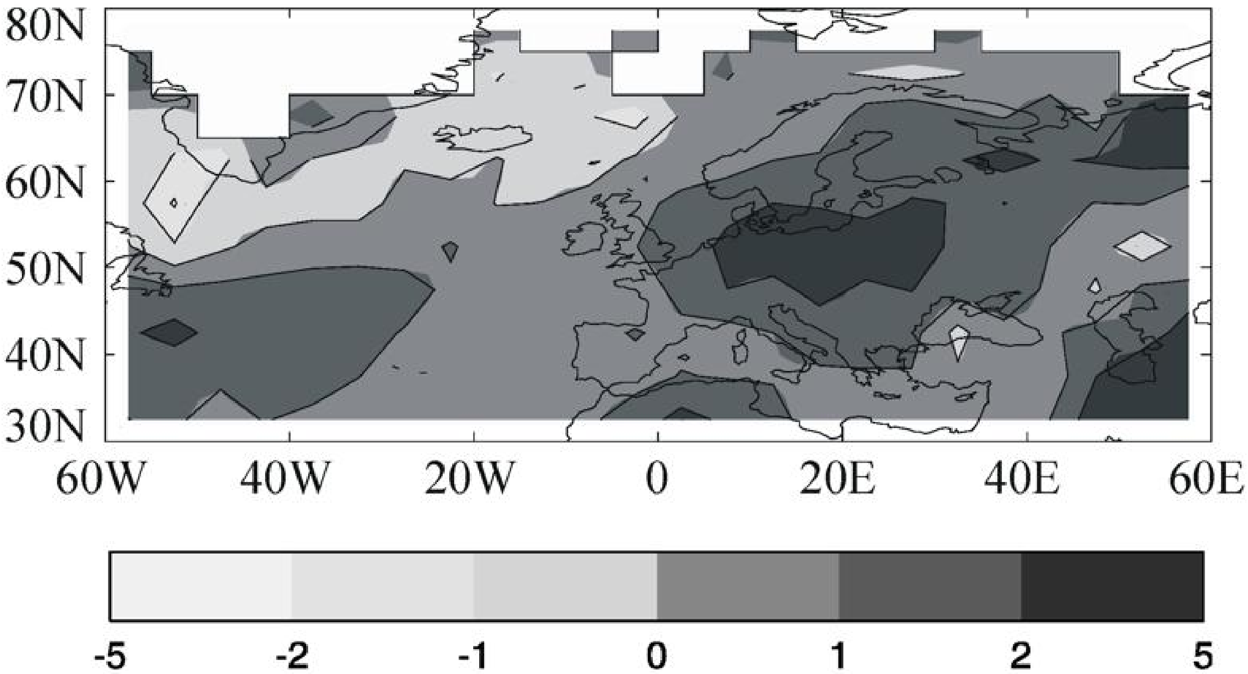


Percentiles (anomalies fitted to gamma distribution)

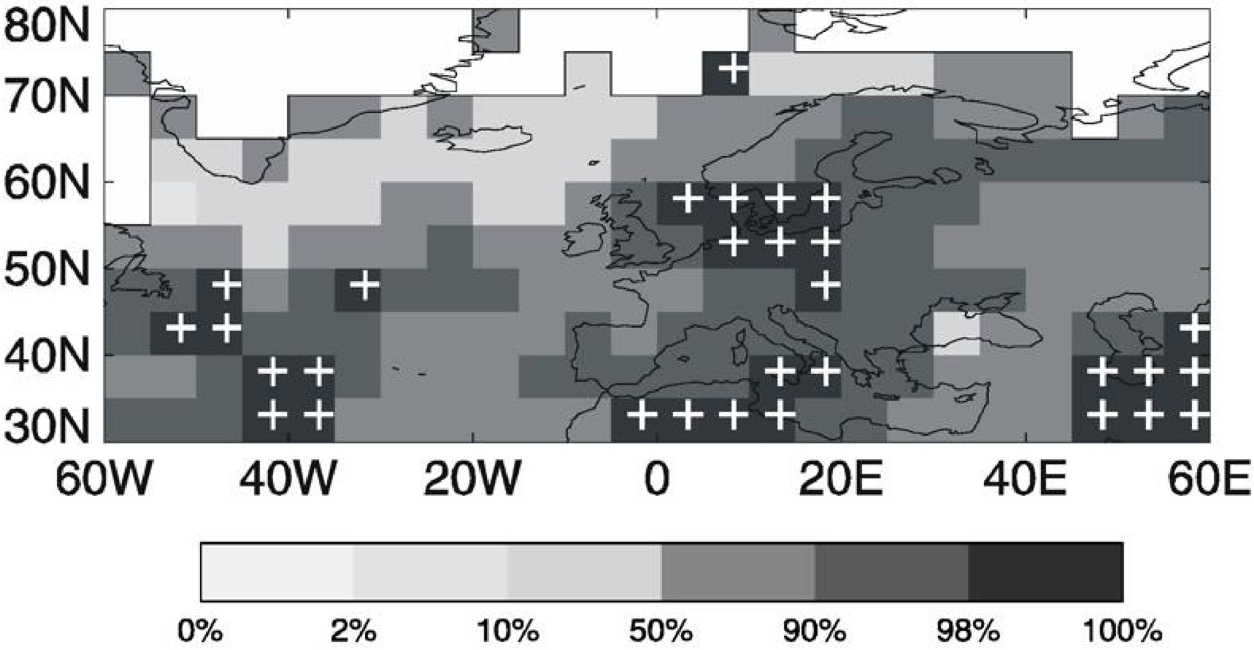
Reference period: 1961 – 1990

Surface temperature anomalies: March 2000 - May 2000

From: Hadley Centre of Climate Prediction and Research



Departures from normal in °C

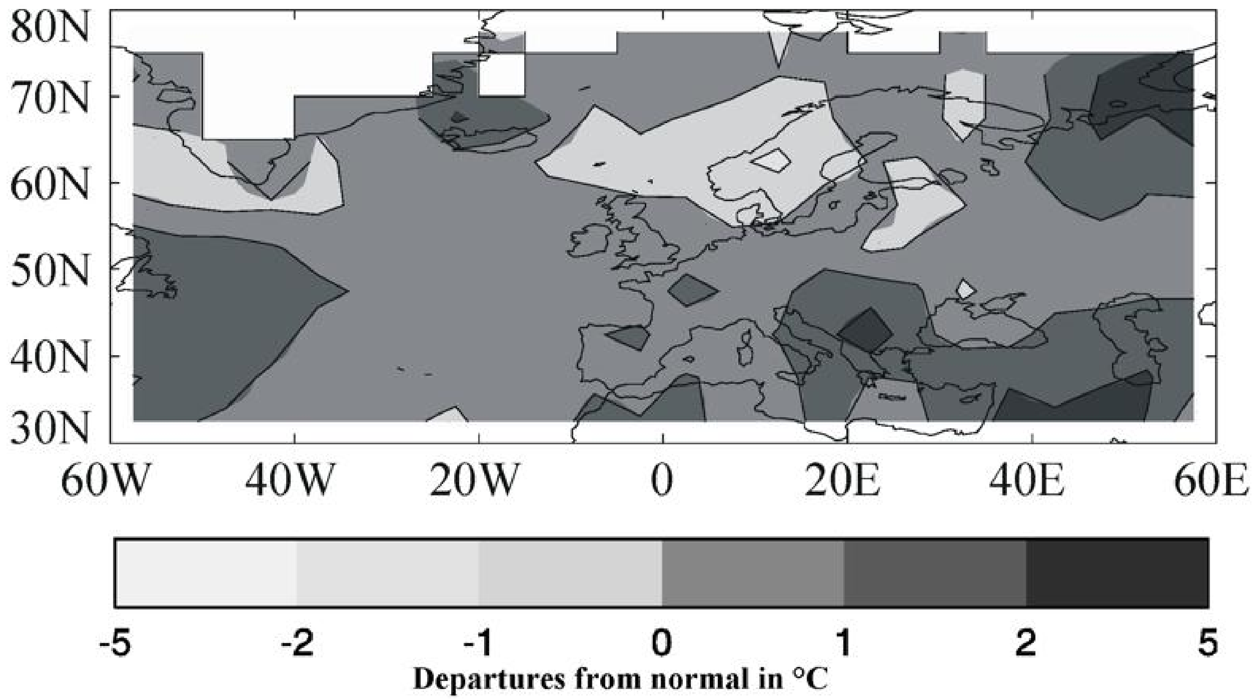


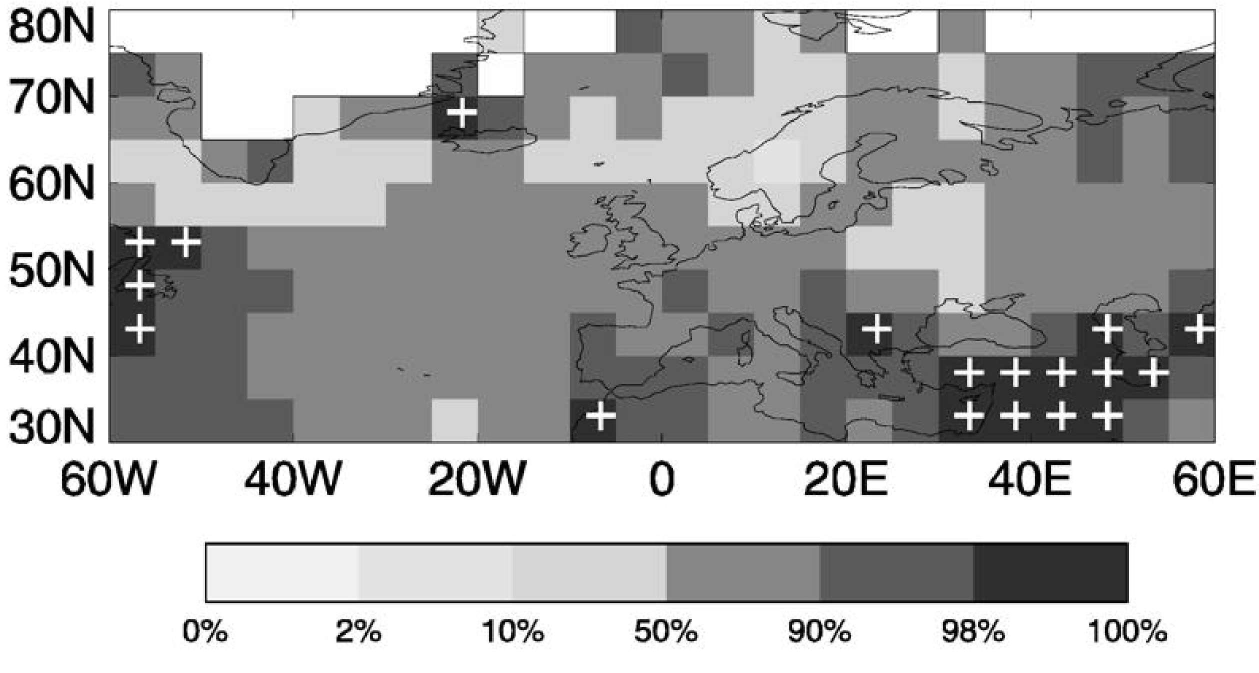
Percentiles (anomalies fitted to gamma distribution)

Reference period: 1961 – 1990

Surface temperature anomalies: June 2000 - August 2000

From: Hadley Centre of Climate Prediction and Research



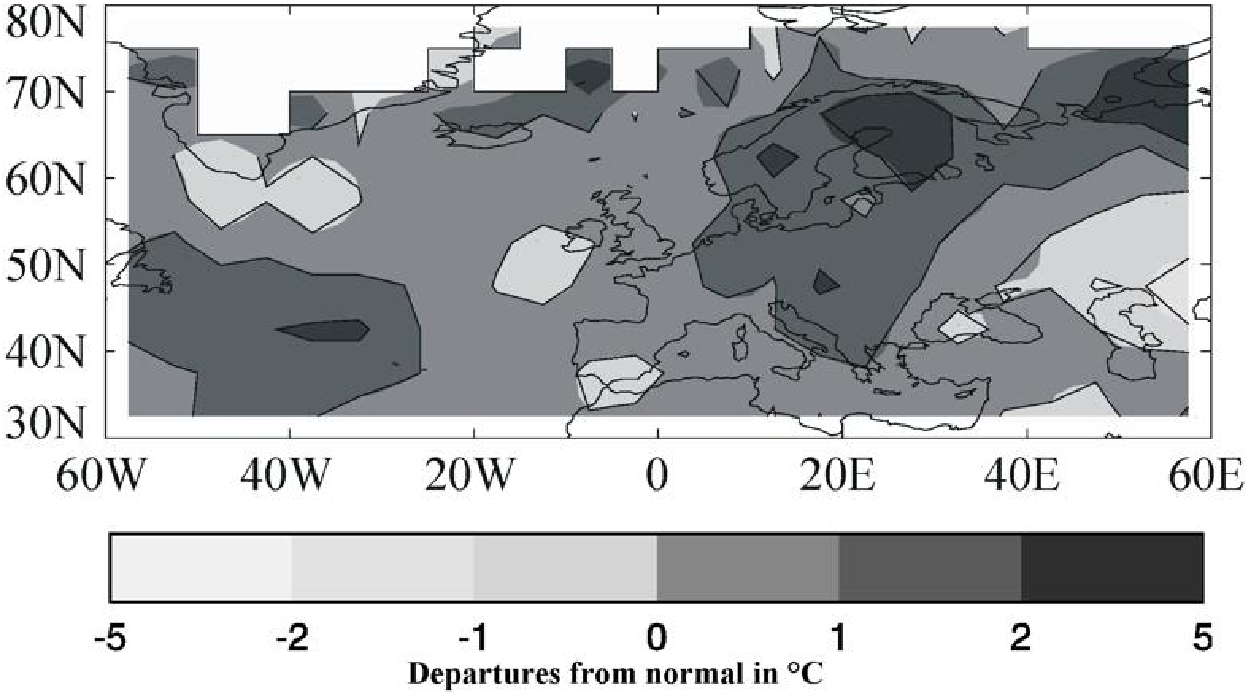


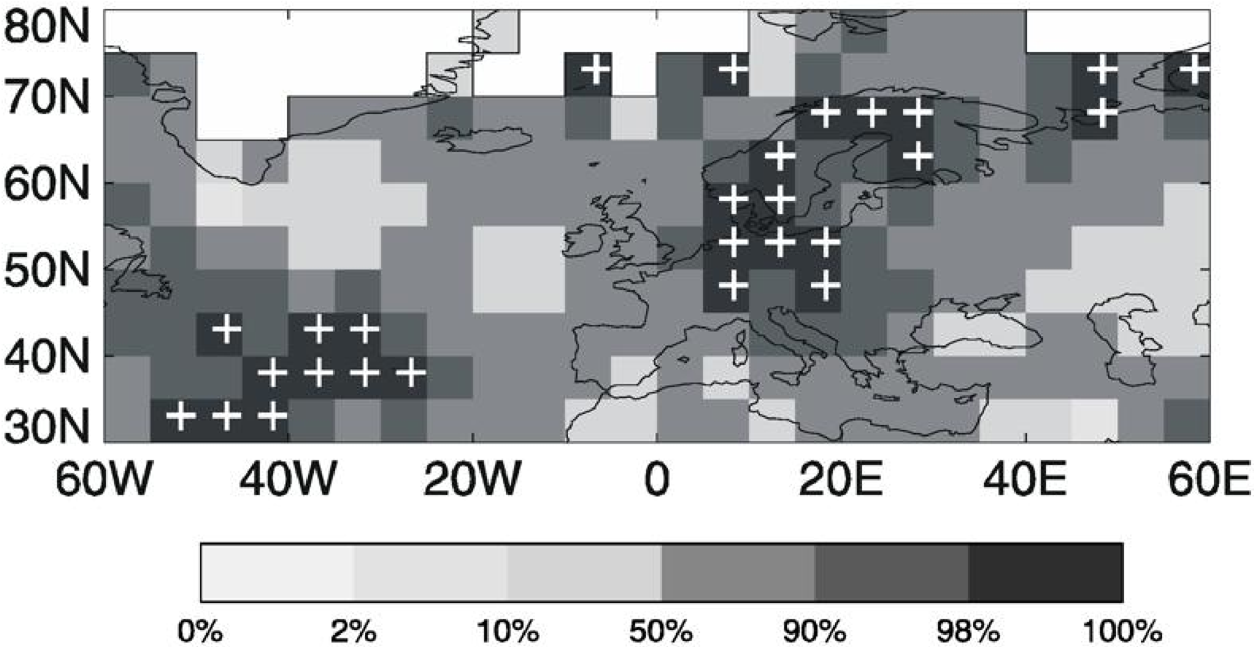
Percentiles (anomalies fitted to gamma distribution)

Reference period: 1961-1990

Surface temperature anomalies: September 2000 - November 2000

From: Hadley Centre of Climate Prediction and Research





Percentiles (anomalies fitted to gamma distribution)

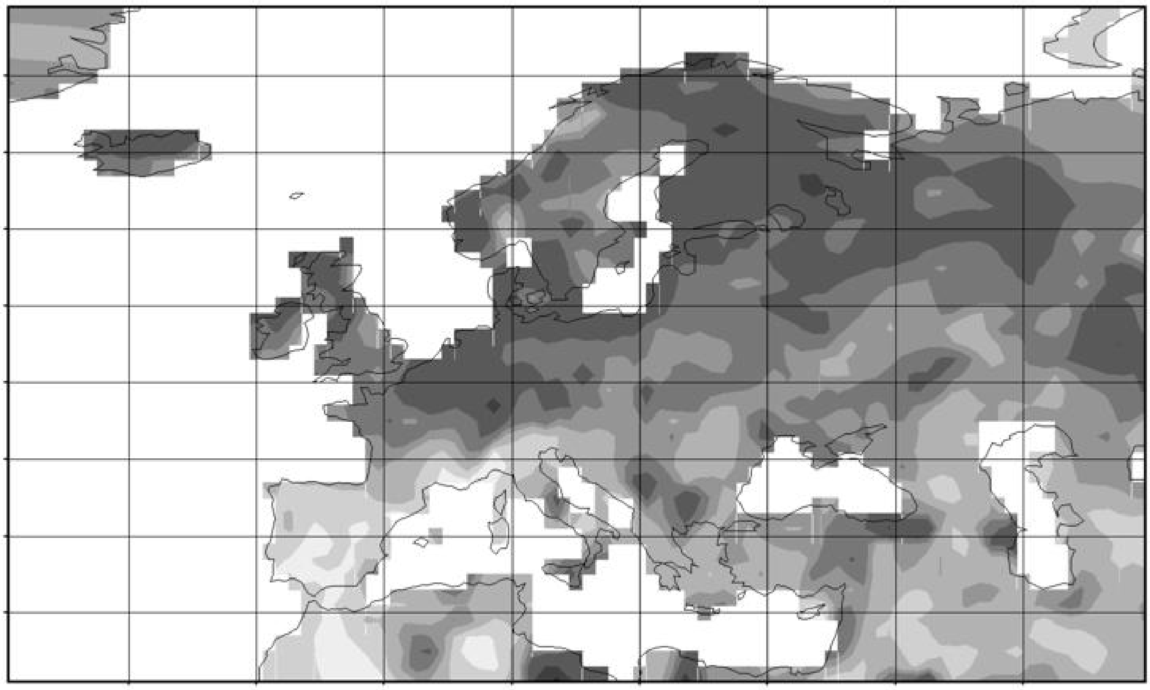
Reference period: 1961 – 1990

Precipitation in percentage of normal

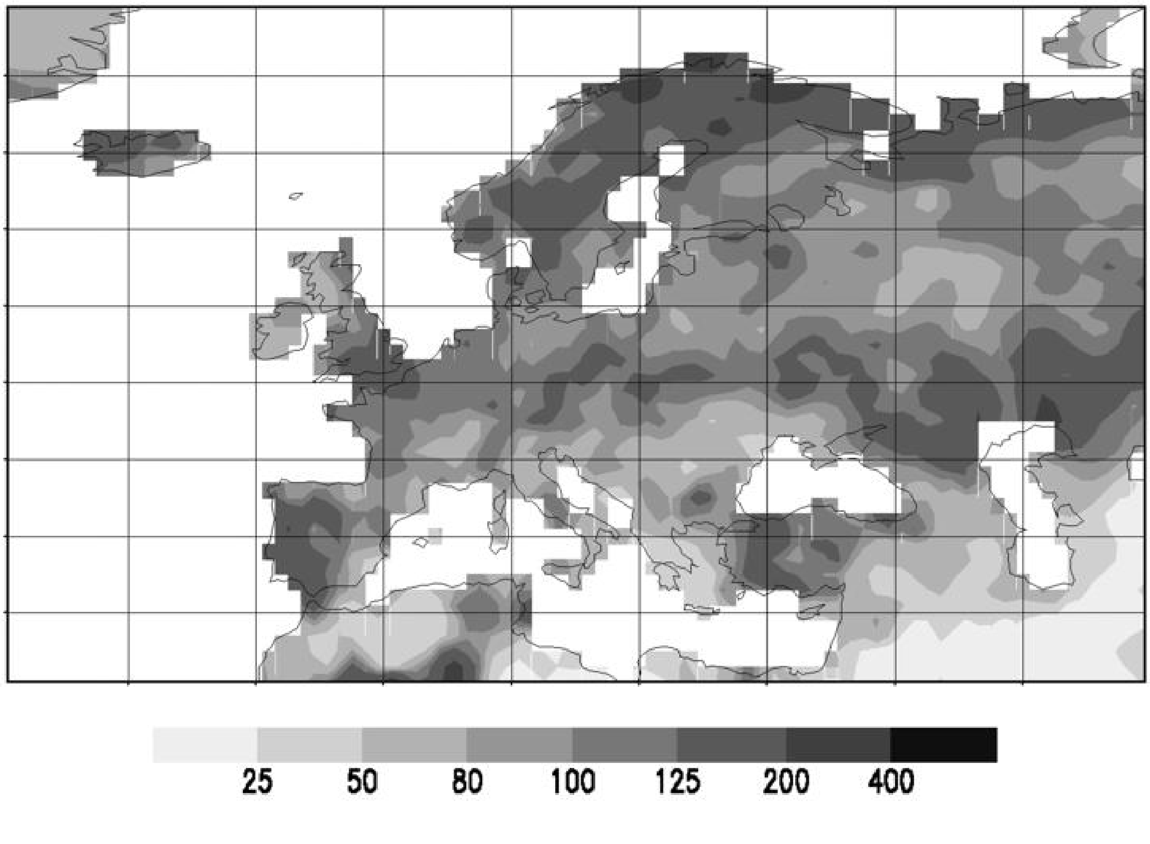
Gauge-Based Analysis 1.0 degree, reference period: 1961-1990

From: Deutscher Wetterdienst / GPCC

December 1999 - February 2000



March 2000 - May 2000

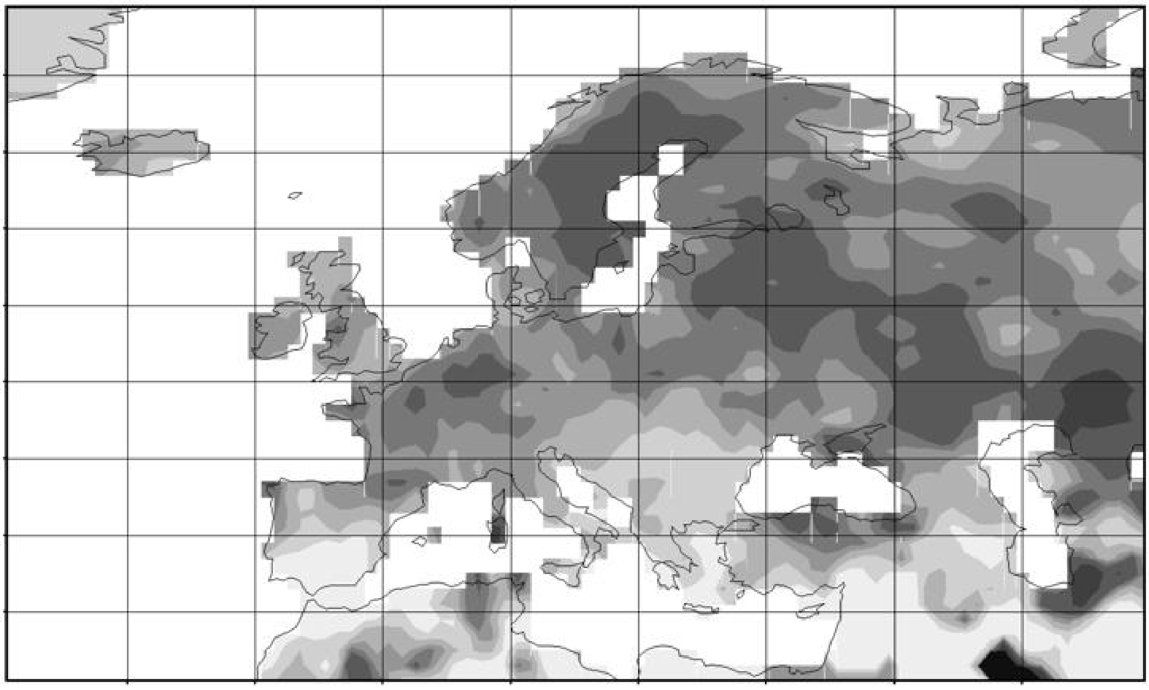


Precipitation in percentage of normal

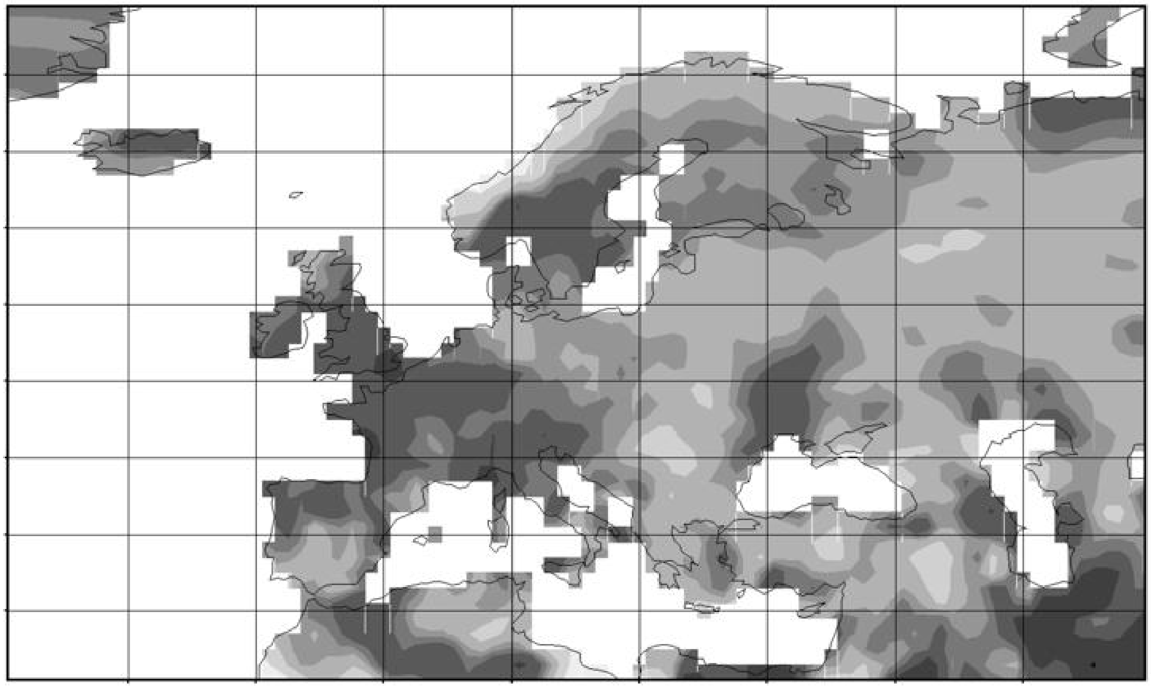
Gauge-Based Analysis 1.0 degree, reference period: 1961-1990

From: Deutscher Wetterdienst/GPCC

June 2000 - August 2000



September 2000 - November 2000



Monthly and Annual Tables

Temperature and precipitation values with departures from their 1961-1990 means

WMO No.	Station	January 2000 Temp. mean	(°C) dep.	Prec. sum	(mm) dep.	February 2000 Temp. mean	(°C) dep.	Prec. Sum	(mm) dep.
01008	Svalbard	-8.5	6.9	13	-1	-11.1	4.6	6	-13
01025	Tromsø	-1.6	2.4	224	143	-2.8	0.9	120	34
01492	Oslo-Blindern	-0.4	3.9	28	-21	-0.5	3.5	33	-3
02196	Haparanda	-8.2	3.9	68	24	-7.6	3.7	50	18
02485	Stockholm	-0.2	2.6	13	-26	0.5	3.5	10	-17
02974	Helsinki-Vantaa	-2.9	4.0	40	-1	-2.6	4.2	52	21
03091	Aberdeen	4.9	2.0	29	-51	4.8	1.7	20	-32
03772	London-Heathrow	5.8	1.6	17	-35	7.4	2.9	62	27
03967	Dublin (Casement)	4.9	0.5	38	-28	6.1	1.7	52	1
04030	Reykjavik	0.7	1.2	75	-1	-1.0	-1.4	85	14
04320	Danmarkshavn	-20.2	2.9	12	1	-20.0	4.3	29	18
04360	Angmagssalik	-5.2	2.3	113	1	-6.3	1.4	46	-45
06186	København-Landb.	2.7	2.2	30	-21	3.8	3.3	21	-10
06260	De Bilt	4.3	2.1	41	-25	5.9	3.4	102	53
06447	Uccle	4.0	1.4	46	-21	5.9	2.4	82	29
06590	Luxembourg	1.7	1.5	29	-42	3.9	2.5	84	24
06660	Zürich	0.1	0.2	31	-39	4.2	3.3	136	63
06700	Genève	1.3	0.6	19	-61	4.9	2.9	96	15
07510	Bordeaux	5.3	-0.5	17	-83	9.1	2.0	104	19
07650	Marseille	5.9	-0.8	2	-45	9.3	1.4	3	-51
08222	Madrid	4.8	-1.2	25	-21	10.7	3.3	2	-44
08314	Mahon / Menorca	9.9	-0.8	61	0	12.2	1.5	7	-46
08495	Gibraltar	13.0	-0.4	109	-12	15.5	1.7	0	-100
08515	St.Maria / Acores	13.9	-0.5	56	-44	15.1	1.1	34	-52
08535	Lisboa	9.6	-1.8	25	-85	13.9	1.6	25	-86
10384	Berlin-Tempelhof	1.6	1.8	46	3	4.5	3.7	61	27
11035	Wien-Hohe Warte	-0.6	0.1	46	8	5.0	3.7	36	-6
11518	Praha-Ruzyne	-1.2	1.2	21	-2	3.1	3.9	20	-3
11903	Sliac	-4.8	-0.9	31	-13	0.0	1.1	47	2
12160	Elblag	-0.5	1.9	65	18	2.5	4.7	57	32
12375	Warszawa-Okecie	-1.4	1.9	29	7	2.5	4.5	42	21
12843	Budapest-Lorinc	-1.5	0.1	14	-18	3.7	2.6	15	-17
13274	Beograd	-1.0	-1.4	27	-22	5.2	2.5	28	-16
14015	Ljubljana	-1.6	-0.5	4	-78	4.0	2.6	35	-45
14445	Split	5.9	-1.5	33	-50	8.6	0.5	20	-48
14654	Sarajevo	-3.7	-2.8	49	-22	1.2	-0.3	57	-10
15420	Bucuresti	-4.8	-2.4	37	-3	1.8	1.9	35	-1
15614	Sofia	-4.3	-2.7	39	12	1.4	0.9	31	-2
16158	Pisa	5.3	-0.8	64	-11	7.7	0.6	8	-65
16597	Luqa / Malta	11.2	-1.0	120	31	12.1	-0.3	118	57
16716	Athens (Hellinikon)	8.1	-2.1	8	-36	10.6	0.0	11	-32
16754	Heraklion / Kreta	10.7	-1.3	139	49	11.9	-0.2	52	-25
17040	Rize	4.3	-2.0	419	202	5.2	-1.4	215	42
17062	Istanbul-Goztepe	3.5	-2.1	92	-7	6.5	0.6	82	15
17130	Ankara / Central	-3.4	-3.5	47	0	-1.1	-3.0	43	7
17170	Van	-2.5	1.7	23	-12	-2.5	0.9	44	10
17609	Larnaca	10.2	-1.3	55	-10	11.5	-0.2	25	-32
22113	Murmansk	-8.0	3.7	40	7	-8.2	3.0	18	-4
26038	Tallina	-1.6	3.9	71	26	-0.8	4.9	39	10
26629	Kaunas	-2.5	2.5	39	2	1.0	5.3	44	17
26730	Vilnius	-3.3	2.8	43	2	-0.2	4.6	51	13
26850	Minsk	-3.9	3.0	35	-5	-0.6	5.2	47	13
27199	Wjatka (Kirov)	-9.9	4.3	50	12	-7.0	4.8	53	25
27612	Moskva	-6.1	3.2	42	-3	-2.7	5.0	56	19
33345	Kiev	-4.1	1.5	31	-16	0.0	4.2	37	-9
33815	Chisinau	-3.3	0.0	43	3	1.6	3.3	31	-7
34300	Charkov (Kharkiv)	-5.9	1.0	30	-14	-1.8	3.9	24	-8
34880	Astrahan'	-1.2	4.2	2	-11	1.4	6.3	3	-7
35188	Akmola	-14.0	1.8	15	-2	-10.8	5.1	20	6
37789	Yerevan	-1.7	1.5	36	7	-0.5	0.5	6	-32
40080	Damascus	5.3	-0.9	61	26	7.1	-0.8	73	41
40100	Beyrouth	13.3	-0.3	298	76	14.0	0.5	98	-38
40180	Tel Aviv (Airport)	11.9	-0.4	330	181	12.6	-0.3	47	-51
40270	Amman	6.9	-2.2	108	44	8.2	-1.8	17	-47
60030	Las Palmas /Gr.Can	17.3	-0.2	45	20	18.7	0.9	8	-19

	March 2000				April 2000				May 2000			
WMO	Temp.	(°C)	Prec.	(mm)	Temp.	(°C)	Prec.	(mm)	Temp.	(°C)	Prec.	(mm)
No.	Mean	dep.	sum	dep.	mean	dep.	sum	dep.	Mean	dep.	Sum	dep.
01008	-14.9	-0.2	18	-3	-12.8	-1.1	8	-4	-4.4	-0.7	5	-1
01025	-2.5	-0.3	175	111	0.0	-0.7	48	-12	5.8	0.9	100	52
01492	1.9	2.1	28	-18	6.3	1.7	75	33	12.5	1.7	95	43
02196	-4.8	2.0	35	0	1.1	1.6	89	60	7.7	1.6	23	-8
02485	2.1	2.0	30	4	6.8	2.2	25	-5	12.4	1.7	30	0
02974	-0.8	2.1	38	4	6.4	3.5	44	7	10.8	0.9	26	-9
03091	6.5	1.9	40	-21	6.1	-0.3	130	77	9.6	0.6	85	26
03772	8.6	2.1	16	-31	9.1	0.2	100	55	13.8	1.3	87	36
03967	7.3	1.3	15	-34	6.9	-0.9	71	24	11.0	0.5	71	13
04030	0.6	0.1	146	63	1.5	-1.4	28	-30	6.5	0.2	48	4
04320	-21.0	2.4	6	-11	-17.5	-0.2	2	-8	-8.0	-1.4	4	0
04360	-7.4	0.8	180	92	-2.1	2.0	65	-8	1.9	1.3	91	34
06186	4.0	1.4	51	9	9.4	2.8	41	-1	13.6	1.6	33	-10
06260	6.8	1.8	79	16	10.0	2.0	39	-13	14.7	2.4	85	24
06447	7.1	1.3	57	-15	10.5	1.7	65	8	15.1	2.2	86	15
06590	5.6	1.3	64	-4	9.6	1.8	49	-11	14.4	2.3	76	-1
06660	6.2	1.8	86	13	10.4	2.4	50	-44	15.2	2.9	137	33
06700	7.1	2.1	44	-34	10.8	2.1	79	14	16.5	3.6	53	-21
07510	9.7	0.9	52	-24	12.1	0.8	154	82	17.2	2.6	99	22
07650	11.3	1.1	71	27	14.2	1.0	96	48	19.5	2.4	26	-16
08222	12.1	2.1	37	4	10.7	-1.5	85	31	18.2	2.1	46	5
08314	13.3	1.5	13	-36	15.5	1.8	41	-4	19.7	2.7	6	-27
08495	16.1	1.1	20	-55	15.9	-0.3	145	85	19.0	0.5	43	8
08515	15.2	0.6	17	-62	15.0	-0.2	77	22	16.6	-0.1	50	20
08535	15.4	1.7	20	-49	13.6	-1.5	163	99	17.8	0.4	33	-6
10384	5.6	1.4	90	53	12.1	3.5	32	-9	16.8	2.9	29	-27
11035	6.3	1.0	81	40	13.5	3.3	12	-38	17.2	2.4	51	-10
11518	4.1	1.1	89	61	10.9	3.2	10	-28	15.2	2.5	55	-22
11903	3.4	0.4	112	69	11.8	3.3	46	-1	15.5	1.8	33	-30
12160	3.2	1.1	63	28	11.7	4.9	21	-21	13.9	1.0	21	-20
12375	3.4	1.4	41	13	12.4	4.6	14	-18	15.3	1.9	38	-21
12843	6.1	0.5	41	12	14.6	3.5	80	42	18.4	2.4	28	-27
13274	8.1	0.9	30	-20	16.2	3.8	42	-17	19.6	2.4	34	-37
14015	7.6	2.2	115	17	13.6	3.7	64	-45	17.0	2.4	93	-29
14445	10.4	0.0	43	-32	16.3	2.4	45	-21	21.7	3.3	14	-42
14654	5.0	-0.1	58	-12	12.7	3.3	51	-23	16.4	2.3	72	-10
15420	5.6	0.8	33	-5	14.0	2.7	51	5	17.8	1.1	38	-32
15614	4.9	0.3	37	-1	12.8	2.9	45	-5	16.4	2.1	13	-60
16158	10.3	0.8	64	-12	13.5	1.0	72	-7	18.2	1.9	14	-45
16597	14.2	0.8	6	-34	17.0	1.5	22	-1	21.1	2.0	5	-2
16716	12.5	-0.1	7	-34	17.6	1.5	12	-13	22.0	1.4	3	-13
16754	13.0	-0.4	22	-34	17.5	1.2	9	-21	20.8	1.0	8	-8
17040	6.6	-1.3	155	8	15.0	3.4	56	-45	16.0	0.2	97	-5
17062	7.7	0.2	105	43	14.3	2.3	88	39	16.7	0.2	33	2
17130	4.5	-1.6	41	5	13.0	1.8	76	28	15.5	0.0	17	-38
17170	0.9	-0.2	24	-19	9.5	2.2	36	-18	14.3	1.6	24	-25
17609	13.1	-0.2	18	-31	18.0	0.6	43	32	21.8	0.9	<1	-6
22113	-4.3	2.5	53	33	-0.3	1.6	72	51	4.7	0.9	43	11
26038	-0.2	2.0	37	8	7.3	3.9	23	-13	10.7	1.0	27	-10
26629	1.9	2.1	60	28	11.5	5.5	24	-19	13.1	0.4	42	-14
26730	1.3	1.9	49	10	11.3	5.6	34	-12	13.1	0.6	55	-7
26850	1.2	2.6	40	-2	10.8	4.8	83	41	13.4	0.5	19	-43
27199	-2.7	2.4	29	0	8.0	4.8	21	-15	8.9	-2.2	72	23
27612	-0.7	1.5	46	12	11.1	5.3	27	-13	10.8	-2.1	37	-21
33345	1.7	1.0	34	-5	12.7	4.0	28	-21	15.4	0.3	73	20
33815	4.2	1.3	29	-6	13.2	3.0	27	-15	17.6	1.5	5	-46
34300	0.8	1.1	66	39	13.6	4.7	22	-14	14.0	-1.6	46	-1
34880	4.2	2.9	5	-9	14.4	3.3	31	13	15.1	-3.2	35	11
35188	-7.2	0.9	11	-3	9.2	4.3	23	1	11.0	-2.1	83	50
37789	4.5	-0.6	7	-34	14.7	3.1	27	-24	16.0	-0.3	46	-14
40080	10.3	-0.9	11	-13	17.4	1.7	3	-9	21.0	0.6	<1	-4
40100	14.9	-0.2	69	-51	19.9	2.1	14	-37	21.5	1.1	0	-20
40180	13.9	-1.0	72	10	19.6	1.4	2	-21	21.8	0.7	0	-3
40270	10.5	-2.4	--	--	18.2	0.4	<1	-13	20.7	-1.2	<1	-3
60030	19.6	1.3	0	-11	19.2	0.4	3	-3	20.3	0.5	0	-2

WMO No.	Station	June 2000 Temp. mean	(°C) dep.	Prec. sum	(mm) dep.	July 2000 Temp. mean	(°C) dep.	Prec. sum	(mm) dep.
01008	Svalbard	2.1	-0.1	4	-6	6.1	0.1	23	10
01025	Tromsø	8.6	-0.7	63	10	11.7	0.0	10	-62
01492	Oslo-Blindern	13.6	-1.6	75	10	16.2	-0.2	71	-13
02196	Haparanda	13.0	0.2	80	39	16.7	1.2	58	8
02485	Stockholm	14.7	-0.9	77	32	16.2	-1.0	108	36
02974	Helsinki-Vantaa	14.4	-0.5	72	28	16.9	0.3	66	-7
03091	Aberdeen	11.5	-0.6	29	-24	12.9	-0.9	15	-46
03772	London-Heathrow	16.9	1.2	19	-32	16.9	-0.9	53	7
03967	Dublin (Casement)	13.6	0.3	42	-6	15.0	0.1	31	-23
04030	Reykjavik	9.4	0.3	62	11	11.5	0.9	41	-10
04320	Danmarkshavn	0.3	-0.4	2	-3	3.6	-0.1	19	5
04360	Angmagssalik	5.1	1.0	9	-43	6.1	-0.3	35	-14
06186	København-Landb.	14.9	-1.2	45	-9	16.0	-1.2	50	-19
06260	De Bilt	16.0	0.8	60	-8	15.5	-1.3	99	24
06447	Uccle	16.8	1.1	35	-44	15.3	-2.2	134	59
06590	Luxembourg	17.3	2.0	41	-28	14.9	-2.2	197	130
06660	Zürich	18.0	2.5	76	-51	15.9	-1.8	196	78
06700	Genève	19.9	3.5	23	-64	18.5	-0.5	121	58
07510	Bordeaux	19.8	2.0	55	-1	20.0	-0.2	59	12
07650	Marseille	22.7	1.8	13	-15	23.2	-0.6	15	1
08222	Madrid	23.1	2.5	22	-5	23.9	-0.5	18	5
08314	Mahon / Menorca	22.0	1.0	23	8	24.1	-0.2	2	-3
08495	Gibraltar	22.8	1.7	0	-11	23.8	0.1	0	-1
08515	St.Maria / Acores	19.4	0.7	19	-3	20.8	0.0	36	11
08535	Lisboa	21.6	1.4	<1	-20	22.3	-0.1	9	4
10384	Berlin-Tempelhof	19.0	1.6	27	-48	17.1	-1.7	70	18
11035	Wien-Hohe Warte	20.3	2.3	23	-51	18.9	-1.0	66	4
11518	Praha-Ruzyne	17.5	1.6	42	-31	15.6	-1.9	66	0
11903	Sliac	18.4	1.8	45	-41	17.4	-0.8	65	6
12160	Elblag	15.9	0.5	60	-34	15.6	-1.2	77	-17
12375	Warszawa-Okecie	17.8	1.2	14	-58	16.6	-1.3	120	53
12843	Budapest-Lorinc	21.8	2.7	12	-51	20.4	-0.5	67	15
13274	Beograd	22.9	2.8	16	-74	23.5	1.8	29	-37
14015	Ljubljana	20.9	3.1	104	-51	19.9	0.0	158	36
14445	Split	25.0	2.8	7	-44	25.6	0.2	19	-9
14654	Sarajevo	19.6	2.7	23	-68	20.4	1.5	52	-27
15420	Bucuresti	21.6	1.4	35	-42	24.0	2.0	38	-26
15614	Sofia	19.6	1.9	34	-38	22.9	2.9	11	-45
16158	Pisa	22.1	2.3	28	-16	22.2	-0.6	5	-18
16597	Luqa / Malta	24.0	1.0	0	-3	26.9	1.0	0	0
16716	Athens (Hellinikon)	27.1	2.0	12	5	29.4	1.6	0	-5
16754	Heraklion / Kreta	24.1	0.6	0	-3	27.3	1.6	0	-1
17040	Rize	20.2	0.3	150	22	24.2	2.0	37	-99
17062	Istanbul-Goztepe	21.1	0.0	30	9	25.1	1.9	11	-8
17130	Ankara / Central	19.8	0.2	35	-2	26.5	3.6	0	-14
17170	Van	19.4	1.8	3	-18	25.4	3.5	0	-4
17609	Larnaca	26.9	2.6	0	-1	29.1	2.2	0	0
22113	Murmansk	9.6	0.2	101	48	13.8	1.0	54	-6
26038	Tallina	13.7	-0.8	67	14	16.2	-0.1	113	34
26629	Kaunas	15.1	-0.9	64	-11	16.2	-0.9	113	45
26730	Vilnius	15.2	-0.6	59	-18	15.8	-1.1	209	131
26850	Minsk	16.1	0.0	64	-19	16.9	-0.4	79	-9
27199	Wjatka (Kirov)	17.8	2.2	57	-7	21.9	3.7	51	-35
27612	Moskva	16.2	-0.4	116	40	19.3	1.2	167	75
33345	Kiev	17.9	-0.3	65	-8	19.1	-0.2	82	-6
33815	Chisinau	20.5	1.1	8	-67	21.5	0.6	103	34
34300	Charkov (Kharkiv)	17.9	-1.0	13	-45	20.9	0.6	90	30
34880	Astrahan'	22.1	-0.8	12	-10	26.3	1.0	8	-15
35188	Akmola	19.6	0.6	37	2	20.2	-1.1	15	-35
37789	Yerevan	22.0	1.4	0	-29	28.5	3.9	4	-10
40080	Damascus	26.3	1.7	0	-1	30.1	3.5	0	0
40100	Beyrouth	25.2	1.6	0	-1	27.8	2.3	0	0
40180	Tel Aviv (Airport)	25.6	1.6	0	0	28.5	2.8	0	0
40270	Amman	25.0	0.0	0	0	29.6	3.2	0.5	0.5
60030	Las Palmas /Gr.Can	22.2	0.6	0	-0.5	23.8	0.7	0	0

	August 2000				September 2000				October 2000			
WMO No.	Temp. mean	(°C) dep.	Prec. sum	(mm) dep.	Temp. mean	(°C) dep.	Prec. sum	(mm) dep.	Temp. mean	(°C) dep.	Prec. sum	(mm) dep.
01008	5.2	0.4	16	-9	2.1	1.6	48	25	1.3	6.8	41	26
01025	10.8	-0.1	71	-11	8.1	1.3	108	14	6.5	3.6	47	-78
01492	15.3	0.1	148	58	11.3	0.5	54	-36	9.4	3.0	188	104
02196	13.8	0.5	53	-10	8.7	0.8	47	-16	6.3	3.8	110	46
02485	16.4	0.2	24	-42	12.0	0.8	18	-37	10.7	3.2	89	39
02974	15.4	0.4	52	-28	9.7	-0.3	12	-61	8.8	3.4	94	21
03091	14.2	0.6	82	7	12.4	0.7	102	34	9.2	0.1	120	42
03772	18.6	1.2	32	-19	16.3	1.3	106	55	11.7	0.0	155	97
03967	15.5	0.9	105	27	13.5	0.5	75	6	9.4	-0.9	80	12
04030	10.7	0.4	71	9	8.7	1.3	87	20	4.8	0.4	104	18
04320	1.8	-0.6	3	-11	-4.3	-0.1	12	1	-13.3	0.3	34	22
04360	6.0	0.0	42	-19	4.4	1.3	100	32	0.6	1.4	42	-40
06186	16.2	-0.8	28	-35	13.6	0.0	56	-6	11.7	1.8	49	-10
06260	17.4	0.7	43	-28	15.8	1.8	69	2	11.3	0.8	106	34
06447	18.3	1.0	35	-28	16.1	1.6	70	11	11.3	0.4	98	28
06590	18.4	1.7	62	-9	14.6	0.9	103	36	10.0	0.7	101	27
06660	19.0	2.1	143	9	15.1	1.0	128	34	10.4	0.9	72	0
06700	20.7	2.6	109	28	16.8	2.0	105	23	12.2	2.2	131	57
07510	21.8	1.9	26	-28	18.9	1.0	43	-31	14.1	0.1	159	71
07650	24.8	1.6	6	-23	20.8	0.5	77	30	15.9	-0.2	100	22
08222	24.4	0.5	0	-9	21.0	0.5	13	-17	14.9	0.1	26	-19
08314	25.7	1.2	4	-22	22.8	0.6	76	21	18.8	0.3	58	-26
08495	23.9	-0.3	0	-6	22.7	-0.1	9	-6	18.4	-1.1	86	22
08515	22.0	-0.2	26	-14	21.8	0.4	19	-38	20.2	0.9	49	-35
08535	23.0	0.2	5	-1	21.2	-0.5	19	-7	17.8	-0.7	26	-54
10384	18.8	0.4	82	21	14.5	-0.1	62	16	12.4	2.4	24	-12
11035	21.4	2.2	53	-12	15.2	-0.2	46	1	12.7	2.6	56	15
11518	18.8	1.8	39	-31	13.4	0.1	20	-20	10.6	2.3	54	24
11903	19.9	2.6	20	-51	13.4	0.0	24	-34	11.1	2.8	41	-9
12160	16.9	0.2	79	-2	12.2	-0.5	41	-29	12.0	3.1	13	-40
12375	18.1	0.8	62	-1	12.0	-1.2	53	10	11.6	3.3	5	-33
12843	23.4	3.1	11	-40	16.0	-0.4	25	-15	13.8	2.9	13	-21
13274	25.6	4.3	8	-44	17.9	0.2	71	20	14.6	2.2	17	-23
14015	22.1	3.0	34	-110	16.3	0.8	125	-5	12.9	2.5	175	60
14445	27.9	2.7	6	-44	21.6	0.2	52	-9	18.4	1.5	93	14
14654	21.8	3.3	16	-55	15.3	0.2	67	-3	12.8	2.4	83	6
15420	23.4	2.2	8	-50	15.5	-1.4	81	39	10.1	-0.7	1	-31
15614	22.8	3.4	1	-51	15.9	0.1	72	33	11.1	0.7	6	-31
16158	23.9	1.4	28	-29	20.2	0.7	94	5	16.3	1.0	138	18
16597	27.9	1.6	0	-7	25.1	1.0	23	-17	21.0	0.3	75	-15
16716	29.5	1.9	0	-5	24.6	0.4	5	-5	19.5	0.2	6	-46
16754	26.3	0.7	0	-1	24.0	0.9	0	-18	19.8	0.1	1	-75
17040	23.8	1.6	296	113	20.8	1.4	318	97	16.3	0.9	250	-22
17062	24.1	1.1	47	21	20.7	1.0	44	3	15.3	0.0	76	5
17130	22.8	0.2	24	12	18.9	0.6	5	-14	12.2	-0.4	21	-6
17170	22.9	1.7	0	-7	17.9	1.1	2	-12	11.8	1.7	3	-45
17609	28.6	1.5	0	0	26.2	1.1	2	2	21.9	0.6	24	5
22113	11.6	0.6	51	-14	7.8	1.1	42	-10	5.2	4.2	41	-1
26038	15.3	0.0	52	-32	10.1	-0.7	23	-59	8.9	2.6	62	-8
26629	16.1	-0.2	54	-9	10.6	-1.5	15	-44	9.6	2.7	4	-47
26730	16.0	-0.3	64	-8	10.2	-1.4	11	-54	9.3	2.7	7	-46
26850	17.1	0.6	72	0	10.5	-1.2	31	-29	8.7	2.4	2	-47
27199	14.8	-0.7	100	35	8.9	-0.3	51	-20	3.6	1.9	14	-48
27612	16.8	0.4	83	9	10.0	-0.9	51	-13	7.2	2.2	32	-26
33345	20.6	2.0	20	-49	12.3	-1.6	141	94	9.5	1.4	<1	-34
33815	23.1	2.6	49	4	14.9	-1.3	38	-10	10.7	0.6	6	-21
34300	21.2	1.7	2	-48	13.3	-0.8	66	25	8.2	0.9	9	-26
34880	24.6	1.3	19	0	16.7	-0.6	26	0	8.7	-0.4	3	-14
35188	19.3	1.6	15	-25	11.8	-0.2	32	8	0.1	-2.7	25	-5
37789	26.2	2.3	6	-3	21.7	1.9	2	-7	12.8	0.0	47	15
40080	27.6	1.4	0	0	24.0	0.7	0	0	17.7	-0.9	16	4
40100	28.0	1.6	0	-1	26.7	1.5	66	61	23.7	1.1	67	13
40180	27.9	1.8	0	0	26.4	1.6	7	7	22.5	0.5	111	85
40270	26.0	-0.4	0	0	23.7	-1.5	0	-0.3	18.6	-3.2	9	2
60030	24.7	0.8	0	0	24.7	0.9	0	-8	23.0	0.5	20	4

WMO	Station	November 2000				December 2000			
No.		Temp. mean	(°C) dep.	Prec. sum	(mm) dep.	Temp. Mean	(°C) dep.	Prec. sum	(mm) dep.
01008	Svalbard	-3.7	6.8	12	-1	-9.7	3.6	11	-1
01025	Tromsø	0.8	1.6	9	-95	-2.1	0.9	122	18
01492	Oslo-Blindern	5.8	5.1	279	204	1.2	4.0	99	43
02196	Haparanda	0.9	5.0	92	34	-6.3	3.2	64	22
02485	Stockholm	7.0	4.4	101	48	2.9	3.9	53	7
02974	Helsinki-Vantaa	4.6	4.5	133	61	1.3	5.4	81	23
03091	Aberdeen	5.7	0.5	138	63	4.6	0.9	120	47
03772	London-Heathrow	8.0	0.8	99	44	6.8	1.7	74	17
03967	Dublin (Casement)	6.4	-0.3	146	76	5.7	0.4	141	64
04030	Reykjavik	0.9	-0.3	10	-63	0.1	0.3	45	-33
04320	Danmarkshavn	-20.5	-0.6	5	-5	-24.0	-2.2	2	-11
04360	Angmagssalik	-1.7	3.0	37	-59	-7.2	0.0	20	-83
06186	København-Landb.	7.9	2.4	57	-5	4.3	2.1	42	-16
06260	De Bilt	7.8	1.9	118	37	5.1	1.9	92	12
06447	Uccle	7.9	1.8	87	11	5.7	2.2	59	-17
06590	Luxembourg	6.0	2.0	146	67	4.1	2.9	87	9
06660	Zürich	6.0	1.9	67	-18	3.9	3.2	37	-40
06700	Genève	7.3	2.3	149	57	5.3	3.4	68	-19
07510	Bordeaux	10.1	1.0	322	228	9.8	3.4	119	20
07650	Marseille	11.6	0.9	123	65	10.7	3.4	97	41
08222	Madrid	8.8	-0.6	89	25	7.6	1.2	127	78
08314	Mahon / Menorca	14.8	0.4	74	-3	13.5	1.7	55	-25
08495	Gibraltar	15.4	-0.7	165	24	14.6	0.5	293	147
08515	St.Maria / Acores	18.6	1.2	94	-8	15.6	0.2	104	9
08535	Lisboa	14.2	-0.3	189	75	13.8	2.0	285	177
10384	Berlin-Tempelhof	7.1	2.2	25	-24	3.3	1.9	39	-14
11035	Wien-Hohe Warte	7.6	2.8	33	-17	2.5	1.5	42	-2
11518	Praha-Ruzyne	5.0	2.2	28	-4	0.8	1.4	8	-18
11903	Sliac	6.8	3.8	99	32	0.4	2.1	51	-5
12160	Elblag	6.8	3.5	60	4	2.1	1.8	64	12
12375	Warszawa-Okecie	5.9	2.7	66	24	1.4	2.3	40	8
12843	Budapest-Lorinc	8.4	3.6	51	-1	2.2	1.8	41	1
13274	Beograd	11.9	4.9	21	-33	5.2	2.9	41	-17
14015	Ljubljana	8.4	3.8	312	177	4.9	4.9	145	44
14445	Split	15.2	3.0	162	54	10.9	2.2	95	-5
14654	Sarajevo	10.3	5.0	75	-19	3.2	2.9	94	9
15420	Bucuresti	7.8	2.6	18	-31	2.5	2.3	5	-38
15614	Sofia	8.9	3.9	5	-42	2.0	1.5	10	-29
16158	Pisa	11.9	1.5	374	250	9.7	2.9	101	16
16597	Luqa / Malta	18.9	1.9	15	-65	15.3	1.3	65	-44
16716	Athens (Hellinikon)	17.4	1.9	93	43	12.8	0.6	20	-51
16754	Heraklion / Kreta	17.6	1.0	60	1	14.3	0.5	102	28
17040	Rize	12.5	0.9	68	-182	9.5	1.2	208	-35
17062	Istanbul-Goztepe	13.6	2.0	17	-72	9.6	1.5	51	-71
17130	Ankara / Central	8.7	1.6	7	-26	2.2	-0.4	31	-18
17170	Van	5.6	1.6	14	-28	1.0	1.9	61	27
17609	Larnaca	18.1	1.7	121	77	14.1	0.9	132	56
22113	Murmansk	-1.1	4.0	29	-11	-8.2	1.1	23	-15
26038	Tallina	4.2	3.0	82	14	1.5	4.4	74	19
26629	Kaunas	5.4	3.3	70	17	1.4	3.8	44	0
26730	Vilnius	4.6	3.4	65	8	0.8	3.7	47	-8
26850	Minsk	3.8	3.0	60	8	0.2	4.0	57	4
27199	Wjatka (Kirov)	-5.8	-1.1	30	-22	-12.6	-2.3	40	-5
27612	Moskva	-0.1	1.0	43	-15	-2.6	3.5	82	30
33345	Kiev	4.5	2.4	44	-7	1.3	3.6	24	-28
33815	Chisinau	7.7	3.3	82	43	2.5	2.8	14	-24
34300	Charkov (Kharkiv)	1.2	-0.1	4	-40	0.7	4.1	45	0
34880	Astrahan'	1.4	-1.9	5	-14	0.2	2.1	16	1
35188	Akmola	-10.3	-4.4	14	-8	-10.5	2.1	32	15
37789	Yerevan	6.6	0.0	2	-28	1.0	0.5	36	10
40080	Damascus	11.2	-1.1	6	-21	8.1	0.5	23	-23
40100	Beyrouth	20.1	1.4	31	-73	16.6	1.8	123	-51
40180	Tel Aviv (Airport)	18.6	0.6	9	-59	14.8	1.0	92	-46
40270	Amman	14.3	-1.4	3	-26	10.0	-0.7	51	1
60030	Las Palmas /Gr.Can	21.1	0.4	4	-17	20.1	1.8	7	-15

Year 2000

WMO No.	Station	Temp. mean	(°C) dep.	Prec. sum	(mm) dep.
01008	Svalbard	-4.0	2.4	205	22
01025	Tromsø	3.6	0.8	1097	124
01492	Oslo-Blindern	7.7	2.0	1173	404
02196	Haparanda	3.4	2.3	769	217
02485	Stockholm	8.5	1.9	578	39
02974	Helsinki-Vantaa	6.8	2.3	710	59
03091	Aberdeen	8.5	0.6	910	122
03772	London-Heathrow	11.7	1.1	820	221
03967	Dublin (Casement)	9.6	0.3	867	132
04030	Reykjavik	4.5	0.2	802	2
04320	Danmarkshavn	-11.9	0.4	130	-2
04360	Angmagssalik	-0.5	1.2	780	-152
06186	København-Landb.	9.8	1.2	503	-133
06260	De Bilt	10.9	1.5	933	128
06447	Uccle	11.2	1.2	854	36
06590	Luxembourg	10.0	1.4	1039	198
06660	Zürich	10.4	1.7	1159	38
06700	Genève	11.8	2.2	997	53
07510	Bordeaux	14.0	1.3	1209	286
07650	Marseille	15.8	1.0	629	85
08222	Madrid	15.0	0.7	490	33
08314	Mahon / Menorca	17.7	1.0	420	-163
08495	Gibraltar	18.4	0.2	870	95
08515	St.Maria / Acores	17.8	0.3	581	-194
08535	Lisboa	17.0	0.2	800	47
10384	Berlin-Tempelhof	11.1	1.7	587	3
11035	Wien-Hohe Warte	11.7	1.7	545	-68
11518	Praha-Ruzyne	9.5	1.6	452	-74
11903	Sliac	9.4	1.5	614	-75
12160	Elblag	9.4	1.8	621	-69
12375	Warszawa-Okecie	9.6	1.8	524	5
12843	Budapest-Lorinc	12.3	1.9	398	-120
13274	Beograd	14.1	2.3	364	-320
14015	Ljubljana	12.2	2.4	1364	-29
14445	Split	17.3	1.4	589	-236
14654	Sarajevo	11.2	1.6	697	-235
15420	Bucuresti	11.6	1.0	380	-215
15614	Sofia	11.2	1.5	304	-259
16158	Pisa	15.1	1.1	990	86
16597	Luqa / Malta	19.6	0.9	449	-100
16716	Athens (Hellinikon)	19.3	0.8	177	-192
16754	Heraklion / Kreta	18.9	0.5	393	-108
17040	Rize	14.5	0.6	2269	97
17062	Istanbul-Goztepe	14.9	0.7	676	-21
17130	Ankara / Central	11.6	-0.1	347	-66
17170	Van	10.3	1.6	234	-151
17609	Larnaca	20.0	0.9	421	92
22113	Murmansk	1.9	2.0	567	89
26038	Tallina	7.1	2.0	670	3
26629	Kaunas	8.3	1.8	573	-35
26730	Vilnius	7.8	1.8	694	11
26850	Minsk	7.8	2.0	589	-88
27199	Wjatka (Kirov)	3.8	1.5	568	-57
27612	Moskva	6.6	1.7	782	94
33345	Kiev	9.2	1.5	580	-69
33815	Chisinau	11.2	1.6	435	-112
34300	Charkov (Kharkiv)	8.7	1.2	417	-102
34880	Astrahan'	11.2	1.2	165	-55
35188	Akmola	3.2	0.5	322	4
37789	Yerevan	6.4	0.9	383	-29
40080	Damascus	17.2	0.5	193	-1
40100	Beyrouth	21.0	1.2	766	-122
40180	Tel Aviv (Airport)	20.3	0.9	670	103
40270	Amman	17.6	-0.9	--	--
60030	Las Palmas /Gr.Can	21.2	0.7	87	-52

January 2000:

- **Very wet in the Middle East**
- **Cold in the South, but warm in the North**

Abundant rain poured down in the Southeast. In Israel, in many areas rainfall amounts were more than twice of normal. Near the coast, January 2000 was the second rainiest since the beginning of measurements in the late 1930s, and in some stations even the rainiest (fig. 1.1). Tel Aviv received 150-200 mm on January 4-5 causing severe flooding especially in the southern parts of the city. The same areas were flooded again on January 27-28 when 110-120 mm of rain fell on Tel Aviv within 24 hours. During this extreme event, heavy snow fell over the mountain areas. Snowfall occurred also in areas with an altitude of only 200-300 m above sea level – a rare event in Israel. Jordan received half of the year's rainfall (see fig. 1.2). Turkey recorded the maximum areal average precipitation value of the year 102.8 mm (see fig. 1.3) and snow caused again and again problems across the country. Heavy rains and local floods affected Crete on January 14-15.

Wide parts of south-eastern Europe suffered from cold and wet weather with plenty of snow and local blizzards. In Bulgaria, the snow cover reached a depth of 50 cm almost throughout the country in the beginning of the month. During the third decade, new snowfall and high wind speeds plagued the Northeast of Bulgaria. Abundant precipitation triggered local floods in northern Yugoslavia. In Croatia, drifting snow and a strong Bora with gusts up to 150 km/h afflicted the coastal regions. Some harbours in the middle Adriatic were partly frozen. In Armenia and the adjacent Russian districts, in the period from January 18 to 23 heavy snowfall and blizzards occurred and the avalanche risk was severe. Together with strong winds (up to 28-30 m/s), they caused the river Gavaraget to flood the coastal grounds, 50 houses in the village of Krasnoe were damaged.

The year started extremely cold in the South: New temperature records were set in Spain, e.g. Salamanca registered an average temperature of - 4.6 °C which has been 0.2 °C lower than the previous record of January 1976. It produced the lowest January minimum temperatures in 55 years of registration. On Cyprus, frost caused substantial losses to the agricultural crops. The cold weather mostly went along with dry conditions. Wide parts of Slovenia and Albania got less than 30 % of the 1961-1990 normal precipitation (see fig. 8.2 page xx and 11.4 page xx). In the central parts of Slovenia, the number of sunshine hours were twice as high as usual (see fig. 1.4).

From Iceland across Scandinavia to western Russia, it was unusually warm. While the far North received plenty of snow, long spells of mild weather reduced the snow depth in the southern and western parts of Finland and the Baltic states. The wet snow wrecked power lines and damaged forests.

An unusual high number of thunderstorms appeared in Central Europe: In Slovakia, where only during 10 January months since 1881 there had been one day with thunderstorm, altogether 5 days with thunderstorms were recorded between December 28, 1999 and January 29, 2000.

A severe winterstorm hit northern Germany, Denmark and Sweden on January 29-30. Four people died. Vast amounts of sand were eroded along the coasts.

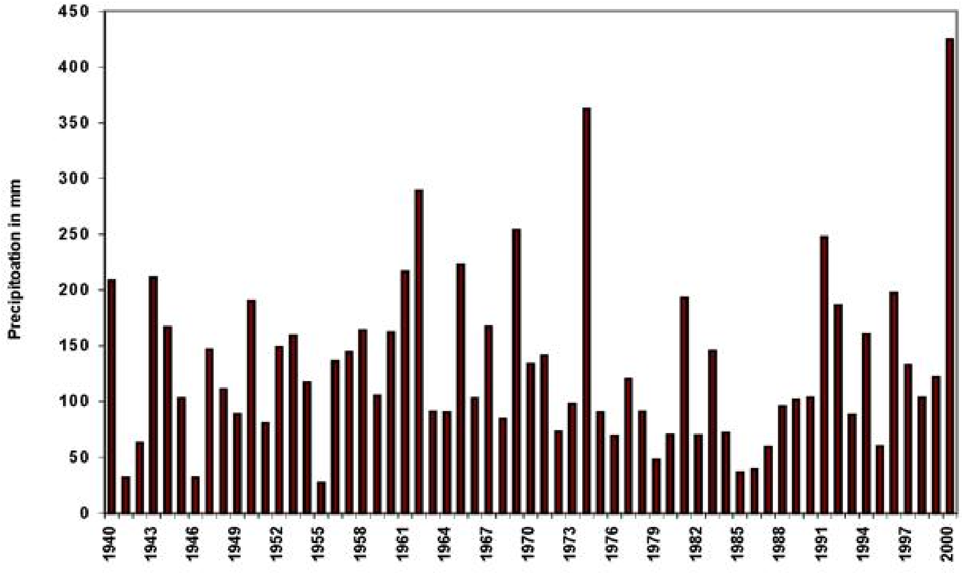


Fig. 1.1: *January rainfall totals in Tel Aviv between 1940 and 2000*
From: Israel Meteorological Service

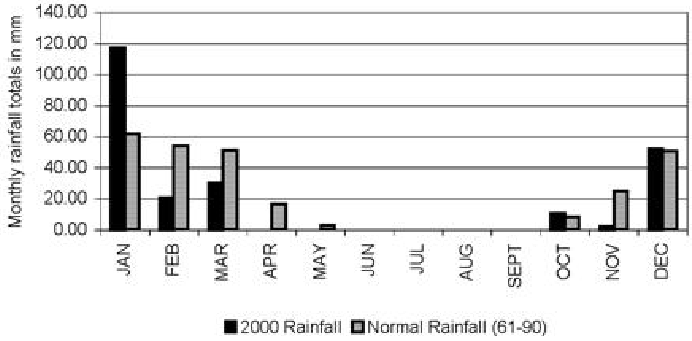


Fig. 1.2: *Monthly rainfall totals in Amman in 2000 and 1961-1990-normals*
From: Meteorological Department, H .K .of Jordan

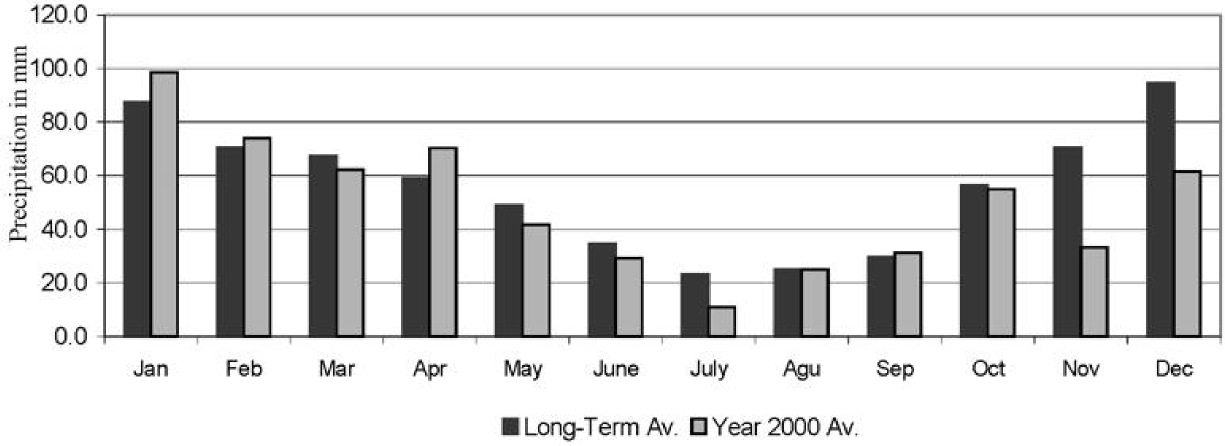


Fig. 1.3: *Monthly areal means of precipitation for Turke in 2000 and long term averages*
From: State Meteorological Service, Turkey

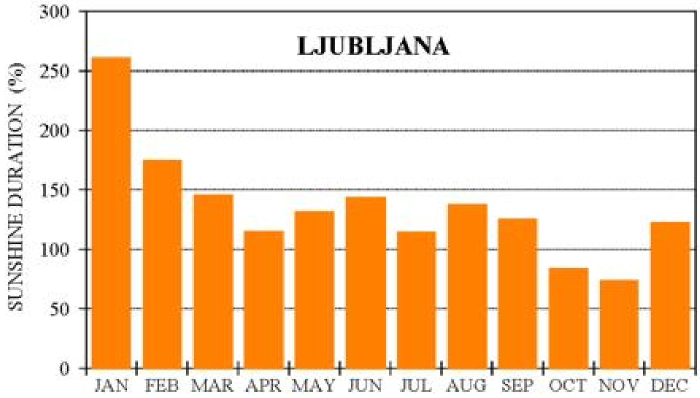


Fig. 1.4: *Monthly sunshine duration totals in % of 1961-1990 normal in Ljubljana*
From: Hydrometeorolgical Institute of Slovenia

February 2000

- **Mostly extraordinarily warm, especially in Eastern Europe**
- **Very dry in the South**

In nearly all parts of Europe, it was a warm month. The mild conditions peaked from Poland to Western Russia with anomalies surpassing +4-5 °C (see fig. 2.1 and 2.2). In Spain, some 30 % of the mainland stations registered new average maximum temperatures. Also new records of the monthly average temperature were recorded for 100-year reference periods, including Madrid, with 16.0 °C, which is 0.6 °C higher than the previous record. An abrupt temperature rise of 20-25 °C in the course of a day and snow, blizzards and gusty wind of up to 13 - 17 m/s occurred in St. Petersburg Oblast and Karelia, north-western Russia, on February 27-28. Ice floes broke away with over 1200 amateur fishermen; rescue operations were carried out, but six people died.

The month was stormy and cold on Iceland with an unusually persistent snow cover in the south and west. Cold conditions prevailed also in the south-eastern parts of the Region (see fig. 11.xx (Cyprus) and 7.5 page xx)).

Whereas wet weather prevailed in the North, dryness predominated in the South. Drought was most extreme on the Iberian Peninsular where large parts received less than 25 % of normal. For the North of Spain as a whole, the average monthly atmospheric pressure levels were the highest registered for 40 years. Bilbao registered a level 1.5 hPa higher than the previous record (1961) and in the north-east, the 1962 record was exceeded by 2.4 hPa (see fig. 2.3). In Israel and Jordan, which had received excessive rainfall in the January, February was cool and dry (see fig. 1.2, page xx) with rainfall amounts of 40 % - 80 % of normal in the northern and central parts. The southern parts received almost no rain at all.

Dry and very sunny weather prevailed also on the Balkans. Primorska and Julian Alps, Slovenia got less than 30 % of the normal precipitation. Wild fires damaged 216 ha in Slovenia. In Ljubljana, more sunshine hours than this year were only recorded in February 1998.

There were plenty of rain and snow on the northern slopes of the Alps. A catastrophic flood caused 3 deads and high damage in northern Poland on February 2-3, where the dam of a water reservoir was broken. Heavy snowfalls, partly with storms caused problems in northern Norway and Sweden. Tromsö region got more than 0.5 m snow depth during a 24-hour period.

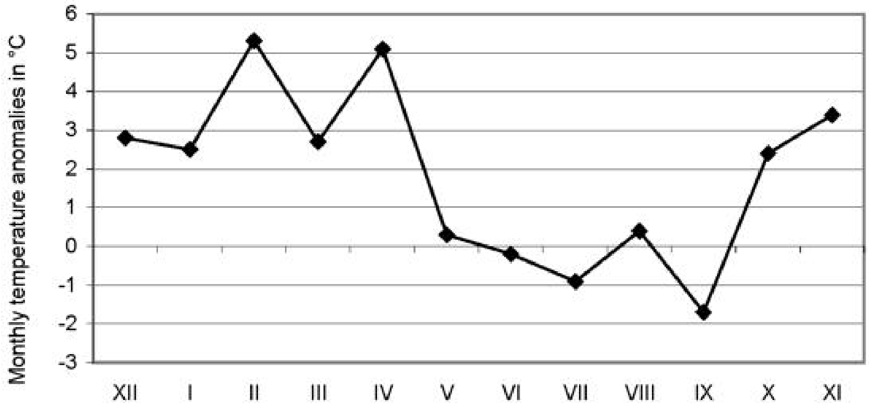


Fig. 2.1: *Monthly temperature anomalies in Belarus in 2000 (reference period: 1881-1990). From: State Committee for Hydrometeorology of the Republic of Belarus*

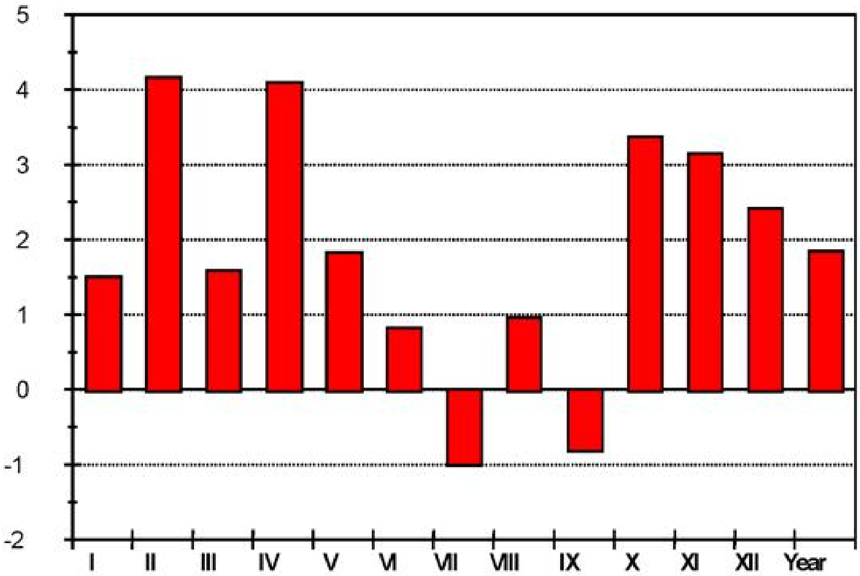


Fig: 2.2: *Monthly temperature anomalies in Poland in 2000 (reference period: 1961-1990. averages of 8 stations.*
From: Institute of Meteorology and Water Management, Kraków, Poland

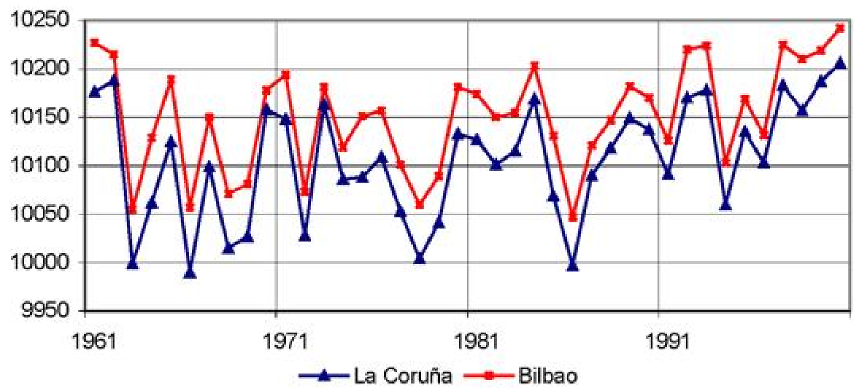


Fig. 2.3: *Mean sea level pressure (in 1/10 hPa) in La Coruña and Bilbao in February from 1961 to 2000.*
From: Instituto Nacional de Meteorologia, Spain

March 2000:

- **Heavy snowfalls in the North**
- **Very wet in wide parts of Central Europe**
- **Cool in the Southeast, elsewhere mostly mild**

Heavy snowfall continued in northern Fennoscandia. In Troms, Norway, roofs broke because of the heavy snow burden. Several settlements in Troms and Finnmark had to be evacuated for longer periods because of avalanche risk. Precipitation records were established at several stations in Troms, one of them with five times the normal precipitation amount of the month. In Sweden, one person was killed on March 6, when an avalanche crushed a house in the north-western mountains. Eastern and northern Finland had between 50 and 100 cm of snow, which was 20 cm above normal. The greatest snow depth of the winter (151 cm) was recorded in Haapovaara in Suomussalmi in early March.

Iceland experienced unusually adverse weather. A fierce storm hit the north-east coast on March 5. The precipitation total in Reykjavik was the highest since 1953. Heavy precipitation and snow melt caused landslides and local flooding in the western part of the country in late March.

Apart from the Southeast of the Region, mild weather prevailed also in March. Record high temperatures (up to 26.4 °C) were reported from southern Switzerland. Cold weather gripped Turkey. On March 7, several hundred people stranded in freezing temperatures on buses and trucks on a snow-blocked road in the north-eastern parts of the country. Fierce frosts caused considerable damage to the vineyards in Edirne region.

Whereas dry conditions prevailed in the western and southern parts of the Region, it was extremely rainy in Central Europe. The areal average rainfall of the Czech Republic amounted to 289 % of the 1961-90 normal and in Poland to 212 % (see fig. 3.1). In Slovakia, new daily precipitation records were set on March 9, some much higher than the monthly normal. The water equivalent of the snow cover reached extreme 53-years' extremes in the second half of the month (401 mm at Oravská Lesná (780 m above m.s.l.) on March 20, 528 mm at Štrbské Pleso (1354 m above m.s.l.) on March 27). Heavy rains and melting snow caused severe flooding in eastern Germany around March 15. A severe flood with a return period of 100 years occurred in the upper Labe river basin in north-eastern Bohemia. Precipitation totals during March 7 to 9 exceeded 100 mm and the additional contribution of melting snow was about 40-50 mm. For Tartu, Estonia, it was the 5th wettest March of the 1870 - 2000 period. The wet and mild weather resulted in a deep snow cover in the high mountains of the Alps. It led to a permanent snow cover for the whole year at Zugspitze, Germany, 2960 m above m.s.l.. A number of avalanches hit the upland regions of the northern Caucasian republics.

Cyprus experienced severe hailstorms on March 22 and 23.

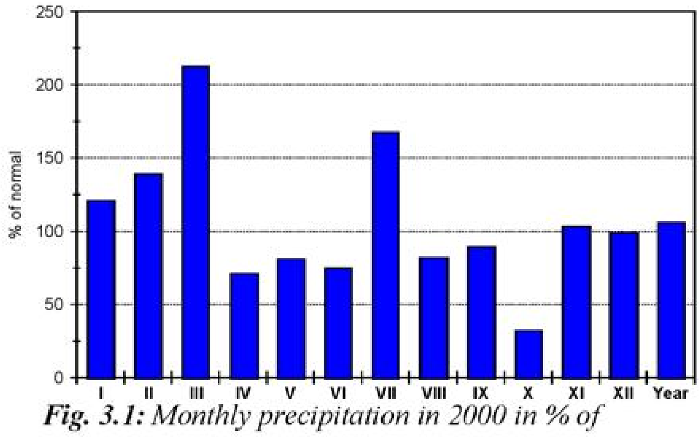


Fig. 3.1: *Monthly precipitation in 2000 in % of normal in Poland in 2000 (reference period: 1961-1990), averages of 8 stations. From: Institute of Meteorology and Water Management, Kraków, Poland*

APRIL 2000:

- **Mostly extremely warm**
- **Abundant rain from Spain across the British Isles to northern Scandinavia**
- **Severe floods in Hungary and Romania**
- **Very dry in south-eastern Europe and on Iceland**

It was another very warm month in the Region. Temperature anomalies surpassed +4 °C, locally +5 °C in the East (see fig. 2.1 and 2.2, page xx). A series of extremely warm days occurred at the end of the month. For Vilnius, Lithuania, it was the hottest ten-day period in April since 1881. Temperatures above 30 °C set a number of new records in Germany. In Tartu, Estonia, it was the warmest April in the 1866 to 2000 period. Norway had the warmest April since 1937. Several stations in southern Norway established new maximum records for April, with the warmest at Høland on April 19 with 26.2 °C. As a consequence of the unusually warm weather, the crop development was more than 14 days ahead of normalin many areas.

Israel experienced a large number of sharav events (hot and dry spells). The highest temperatures were recorded on April 12: 37 °C -38 °C in the coastal areas. The sharav event of April 18-19 ended with severe haze (the visibility throughout the country was less than 2 km) which lasted for three days. Also Cyprus reported extreme hazy conditions on April 19 with a visibility restricted to less than 300 m.

Only in the West of the Region temperatures were subnormal. In Iceland, it was cold, dry and unusually sunny, an unfavourable combination for some types of vegetation at that time of the year. The April records of bright sunshine hours were broken both in Reykjavik and Akureyri.

Dry weather prevailed and initiated in south-eastern Europe a drought that lasted for three months (see fig. 3.1 page xx). Some regions, e.g. western Slovakia, received hardly any rain at all. Whereas a cloud burst on April 25, caused high damage north of Cracow, Poland, most other parts of the country recieved monthly precipitation totals of less than 50 % of normal (e.g. Wroclav 11 mm or 29 % of normal).#

In the western part of the Region it was wet:

- On the Iberian Peninsula, westerly winds brought abundant rain to the river basins on the Atlantic side and to parts of the Ebro Basin. Several new rainfall records for April were set (e.g. Vigo 477 mm, Navacerrada NW of Madrid 375 mm, Spain and Beja and Oporto, Portugal).
- For the UK it was the wettest April in the 235-years' England and Wales precipitation series. The areal average was 143 mm against 139 mm in 1782 (the previous April record).
- In northern Norway, April brought the highest amount of precipitation in 100 years.

Rapidly melting snow in the Carpaths caused the highest water levels ever recorded in a more than 100 km section of river Tisza, Hungary, at the beginning oft the month. The flood also afflicted neighbouring Romania and northern Serbia. All in all 10 people died, 10.000 houses and 2.000 km^2 were flooded. On April 26, heavy precipitation engendered flooding in Bulgaria (daily totals up to 115 mm in Botev).

Southern Switzerland experienced heavy rain balancing the winter deficit (e.g. Locarno-Monti) received more precipitation than the January-April normal.

Frequent storms and hail caused considerable losses in Turkey (see fig. 1.3 page xx). Trees were broken, roofs and power lines destroyed. The maximum gust of the year for France, was recorded on April 4 at Cap-Béar (187 km/h). Storm winds brought sandy grains from the Sahara to Bulgaria on April 4-5.

May 2000:

- **Dry, sunny and warm in most parts**
- **Fierce cold spell in eastern Central Europe**

The dry weather that had started in April continued into May in many parts (see fig. 5.1 and 3.1 page xx). As a consequence, severe drought afflicted western Slovakia (e.g. Maldacky received only 5 mm of rain between April 6 and May 17 (7 % of normal), Kráľová pri Senci only 3 mm from April 6 to May 21, 2000 (5 % of normal)). In Belarus (see fig. 5.2), there was no rain from about April 20 to mid-May and together with very dry air the soil was extremely dry, causing high losses to the agriculture. In Poland, drought was worse in the Northeast: Suwalki received 13 mm of rain which is 22 % of normal. Eastern Austria experienced an unusually dry period from April 16 to May 17 (Vienna 4 mm) causing crop losses of up to 100 %. Also in Hungary, which had suffered from devastating floods in April, weather was hot, dry and sunny in May.

Temperatures were significantly above normal in most parts of the Region (except for the far East). New maximum temperature records were set. Kongsberg, SE Norway, recorded 30.0 °C on May 14, a temperature that had never been exceeded at any station in Norway so early in the year before. Ibiza, Spain, recorded a new absolute maximum for May with 30.4 °C in 50 years of observation. The first half of the month was warmest ever in the low lands of Switzerland. With a mean temperature of 15-18 °C, it was nearly as warm as in July. New records of maximum daily temperature means were reported from Germany. The Netherlands recorded a remarkable sequence of 12 consecutive "summer days", equalling the record set in 1992. It may be noted that this had not even happened in June before, where the present record is 10 such days in a row.

There was a number of severe cloudbursts and thunderstorms.

- Bracknell, southern England, experienced more than 50 mm of rain on May 7 and hail with diameters of 1.5 cm.
- Thunderstorms with heavy rain and hail hit Germany at the beginning of the month.
- Heavy rain and hail caused severe damage in north-western France and Belgium.
- On May 9, a heavy cloudburst hit western Poland.
- On May 27, some cornfields were completely damaged by severe thunderstorms with hail (diameters up to 4 cm) in Lower Silesia, Poland. Afterwards, the strong winds with hail crossed Poland from Cracow to Warsaw.
- Storms with local floods occurred in Croatia at the end of the month.
- Some stations in the Julian Alps, Slovenia, registered monthly totals of more than 250 mm.
- Turkey reported a number of hail events and local floods

In the eastern parts of the Region, the month started with a spell of fierce frost:

- Temperatures dropped to - 4 °C in Suwalki, Poland, on May 3.
- Soil temperatures fell to minus 5 - 10 °C in south-eastern Lithuania and Belarus.

The frost was especially disastrous, as it followed a period of very warm weather in April.

The Arkhangelsk Oblast experienced heavy snow with blizzards and gusty wind of up to 20 m/s on May 12-14. Wide-spread snow cover of 5-28 cm deepness (up to 77 cm in Mezen) destroyed power and telephone lines. On May 2, north-eastern Norway was hit by heavy snowfall and strong winds. Several roads were closed even in southern Norway.

On May 28, unusually strong winds for the season caused considerable damage in the forests and destroyed power lines in Germany. In the western parts of the Netherlands, the gusts reached 35 m/s. Some stations reported a maximum hourly wind speed of 25 m/s. Six people died, buildings were damaged, trees uprooted.

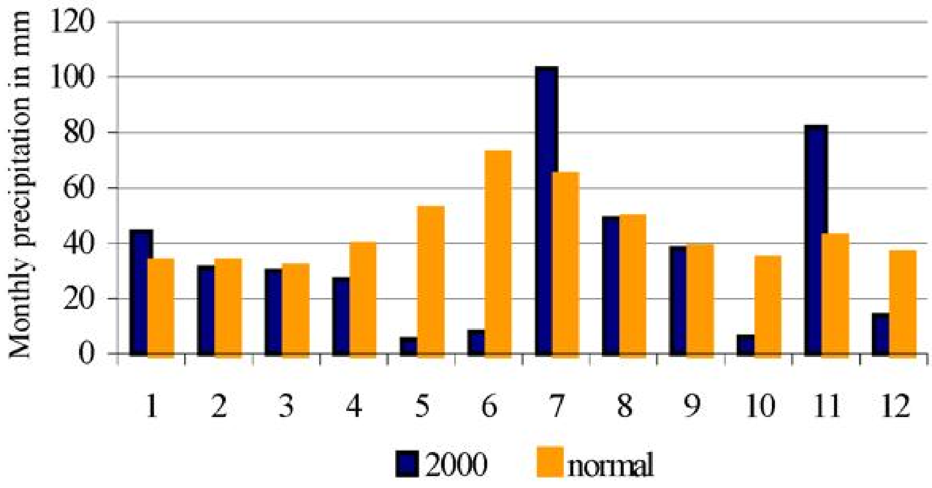


Fig 5.1: *Monthly precipitation totals in mm in 2000 and long-term means in Chisinau*
From: Hydrometeorological Service of the Republic of Moldova

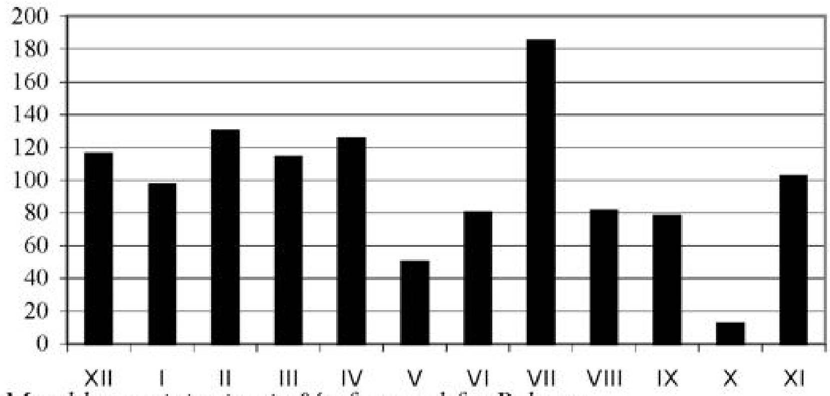


Fig. 5.2: *Monthly precipitation in % of normal for Belarus between December 1999 and November 2000, reference period: 1891-1990.*
From: Commitee for Hydrometeorology of the Republic of Belarus

June 2000:

- **Mostly extremely dry, very warm and sunny**
- **Wet and cool from Scandinavia to the Caspian Sea.**

For large parts of Central Europe it was the third dry month in a row (see fig. 6.2, 5.1 page xx) Together with extreme high temperatures the drought situation intensified. Hurbanova, Slovakia, received only 66 mm of rain during the April to June period which corresponds to a 93 mm deficit and mean temperature anomalies exceeded + 3 °C. In Warsaw, Poland, the monthly total precipitation was only 13 mm (18 % of normal). In Slovenia, water deficits varied from 100 mm to more than 200 mm causing the most severe drought since 1964. In northern Germany, the dryness engendered forest fires.

With prevailing high pressure influence, it was prevailingly sunny and warm. There was a new June record of bright sunshine hours in Akureyri, Iceland. For Slovenia it was the warmest June on record. At the mountain observatory Kredarica, there were only 7 days with snow cover, which is the lowest number ever recorded up to now.

An extreme hot spell occurred between June 20 and 23. On Poznan, Poland, temperatures climbed to 36.5 °C, Berlin's 36.1 °C were a new June record as well. 10 % of Spain's mainland stations registered record-high June average temperatures, notably La Coruña with 18.7 °C, exceeding by 0.3 °C the record for 130 years of observation (see fig; 6.1). Yugoslavia reported an exceptional number of "tropical days" (see fig. 6.3)

From Scandinavia across the Baltic States to the Caspian Sea it was wet and cool. In north-western Norway, several stations established new precipitation records. An outstanding cold spell occurred in mid-June, just after a torturing hot spell. Belarus recorded frosts and temperatures down to minus 5°C. Lithuania had morning frosts and Nagykaizsa, south-western Hungary, had a night minimum of 2.6 °C on June 17-18. such cool night's frequency is less than 1 % at this time of the year.

There was a high number of severe thunderstorms, local floods, hail events and storms:

- Heavy showers brought 50-80 mm of rain to the Southeast of the Netherlands on June 3-4.
- On June 5, a bursting thunderstorm and heavy rains caused a severe landslide in Carinthia, Austria. The small village Ingolsthal was badly devastated.
- Heavy thunderstorms , hail and flash floods haunted Switzerland on June 5, 11 and 13.
- Exceptional rains poured down in the Queyras region and Hérault, south-western France, causing severe flooding.
- Heavy rain and floods affected northern Spain.
- A new record-building regional rainfall of 28 mm on June 3, following several wet days led to flooding in north-eastern England.
- Heavy thunderstorms occurred in southern Germany on June 5 and 11. On June 14, hail covered the ground to a depth of 0.5 m in the eastern Allgäu area at the Alpine foothills.
- Poland reported severe thunderstorms some went along which with strong winds. A tornado destroyed several hectares of forest north of Bydgoszczon June 8. On June 15-17, heavy precipiation caused high water level of river Wisłoka.
- On June 16, the Mid-Wolga region experienced squalls of 24 - 31 m/s.
- North-western Tartastan was severely affected by hail with diameters up to 22 mm.
- An unusual deep depression (minimum core pressure < 970 hPa) passed by north-western Scotland in the middle of the month. Gusts up to 35 m/s set new records for June in Lerwick.
- A vast area with heavy thunderstorms caused considerable damage in parts of south-western Sweden on June 21. Several football players and camping youth were severely injured by lightning strokes. Intense thunderstorms caused several fires in late June.
- Several severe storms with hail occurred in Slovenia and Turkey.
- Thunderstorms damaged power-lines and forests in Estonia.

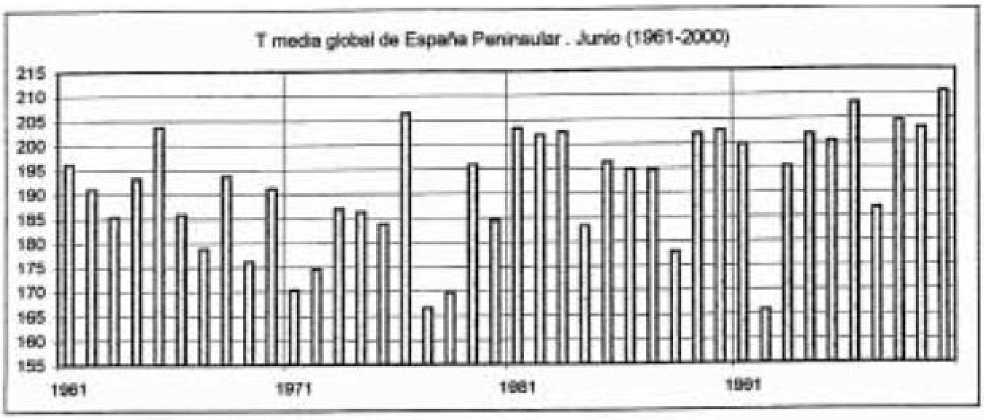


Fig. 6.1: *Mean June temperatures (in 1/10 °C) of the Spanish mainland between 1961 and 2000*
From: Instituto Nacional de Meteorologia, Spain

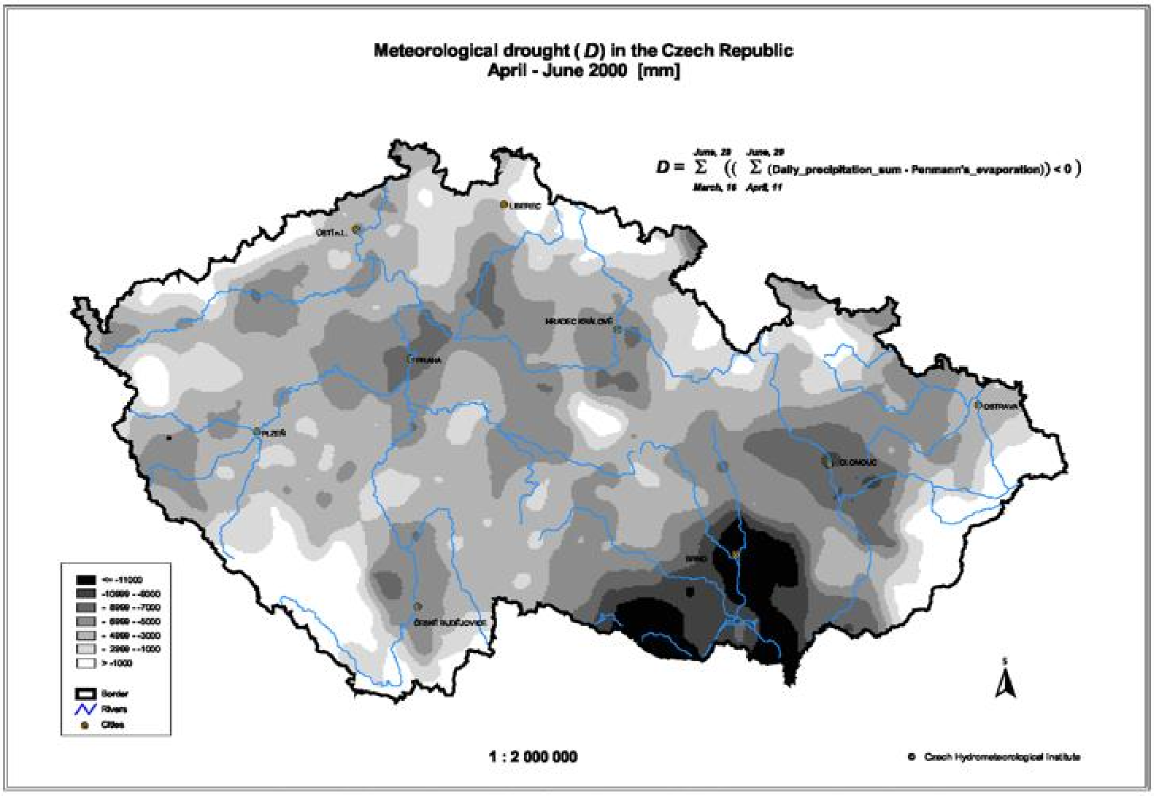
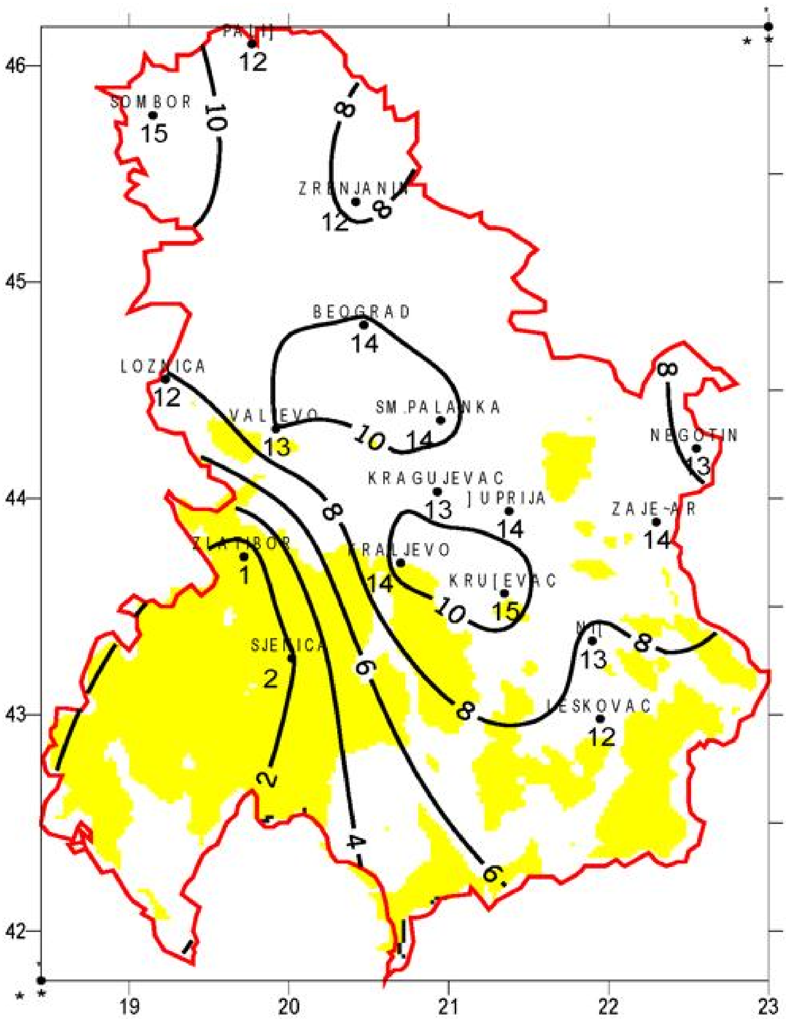


Fig. 6.2: *Meteorological drought in the Czech Republic between April and June 2000*
From: Czech Hydrometeorological Institute

Fig. 6.3: *Number of days with maximum temperatures > 30 °C in Yugoslavia in June 2000 (values below the station names) and deviations from 1961-1990-normal (isolines).*
From: Federal Hydrometeorological Institute of Yugoslavia



July 2000:

- **Abundant rains and flooding in Scandinavia**
- **Cool and rainy from France to Russia**
- **Severe hail storms in the Alps**
- **Hot and dry in the Southeast**

July was even wetter than June in most parts of Scandinavia. During the period July 12-25, more than 200 mm was recorded at several stations in southern Norrland, Sweden. The heaviest rains occurred July 18-19, when many streams and rivers rapidly rose to near record levels and hundreds of roads, bridges and railway embankments were severely damaged. Several houses were washed away, but no people lost their lives. In Norway, July was very dry in the west (Takle 18 mm), but extremely wet in the Southeast. Oksoy fyr received 84.3 mm which is a new July record for that station with measurements since 1875. Finland reported an extreme number of thunderstorms: Except for the last week in July, there was thunder almost every day in many regions and the Häme region had 28 rainy days.

After the outstanding warm early summer, wide parts of the Region from France to Russia experienced an unusual cool and rainy July (see fig. 5.1, 5.2 page xx and 3.1 page xx). Negative anomalies surpassed 2 °C in wide parts of Central Europe. A number of stations in France set new records of precipitation totals, minimum sunshine duration and lowest maximum temperatures (see fig. 7.1 to 7.3). In the Netherlands, only in July 1919, the sun shone less than this year. Heavy showers poured down 30-50 mm within a few hours on July 29. In north-western Lithuania, the monthly precipitation totals amounted up to 240 % of normal. Heavy rainfall and local floods occurred on July 17-18 in Vilnius (75 mm) and on July 27 in Rokiškis, where 53 mm were registered in 12 hours. In Latvia, it was the rainiest month of the year. Precipitation was most extreme between July 24 and 27. Near Jekabpils, a two-days' total of 89 mm was recorded, which is 10 mm more than the monthly normal. Severe thunderstorms with heavy rain and strong wind caused considerable damage in western Germany. Switzerland experienced one of the most severe storms ever on the southern slopes of the Alps on July 4 (gusts up to 38 m/s).

Three extreme hail events occurred in Austria:

- On July 3, heavy damage was caused by hailstones with diameters up to 5 cm along the line Kirchberg in Tirol – Saalfelden, Salzburg – Hartberg, Styria (more then 200 kilometers). Around the area of Saalfelden, 4000 roofs were damaged and many people wounded by hailstones.
- On July 4, the second extreme hail event followed along the line between the towns Salzburg and Enns, Austria: The hailstones with the size of tennis balls wounded a group of 12 girls and caused enormous damage to houses and crops. At the same time, gusts destroyed power lines and trees and blocked roads. There were wind speeds up to 39 m/s. One man was killed.
- On July 7, heavy hail damage was recorded in Styria, near the capital town Graz, with great crop losses of fruits and corn, and finally in Upper Austria there were in Hallstatt heavy damage due to hailstones with diameters up to 5 cm.

A cold front over Latvia in the morning of July 12 caused thunder, precipitation, hail and an abrupt temperature decrease from 28°C to 13°C within one hour. Local whirlwinds reached hurricane-strength. Power lines were destroyed, trees uprooted and hundreds of roofs were blown away or damaged. The risk for forest fires continued to be high in a number of other Russian regions (e.g. in the Arkhangelsk oblast and the Republic of Komi).

An unusual hot spell occurred in north-eastern Norway on July 20: Kirkenes had the highest maximum temperature for the country in 2000 with 30.2 °C. A number of stations in Finnmark had so called "tropical nights", with temperatures not below 20 °C. The minimum temperature on the night of July 20 at the lighthouse Makkaur fyr (70º 42`N, 30º 04`E) was 22.7 °C.

The Mediterranean region suffered from extreme hot and dry weather. In Greece, temperatures climbed up to more than 40 °C between July 4 -9 and 25-29. At places in the mainland, maximum temperatures of up to 43-45 °C and mean daily temperatures of up to 34 °C were recorded. The hot and dry weather engendered a number of severe wild fires. In Cyprus, the monthly mean temperature was 2.4 °C above normal and severe heat prevailed from July 6 to 14. About 80 % of the Bulgarian stations recorded new maximum temperature records (many surpassing 44 °C) on July 5.

Turkey reported the lowest monthly average precipitation mean of the year with 5.1 mm (see fig. 3.1 page xx). Armenia received only 7-16 % of the normal rainfall. Drought conditions prevailed also on the Balkans. In Slovenia, the dry weather caused high agricultural losses and the discharge of the rivers was on July 8 nearly the lowest one in 30 years. In Yugoslavia, monthly rainfall totals were only 20-50 % of normal.

In Israel, July was much warmer than usual. Temperatures were 3-4 °C above normal, and in many areas it was the hottest July since the beginning of measurements 40-50 years ago (see fig. 7.42), even in comparison with August (normally the hottest month) and only in August 1998 the monthly average temperature was higher. The month was characterised by a long period of hot weather – daily maximum temperatures exceeded 31 °C in the Coastal Plain and in the Foothills for 22 consecutive days and for 13-16 consecutive days in the Mountain Areas. The hot weather reached its peak towards the end of July – temperature in Jerusalem reached 40.8 °C, which is the highest temperature recorded in Jerusalem since 1942.

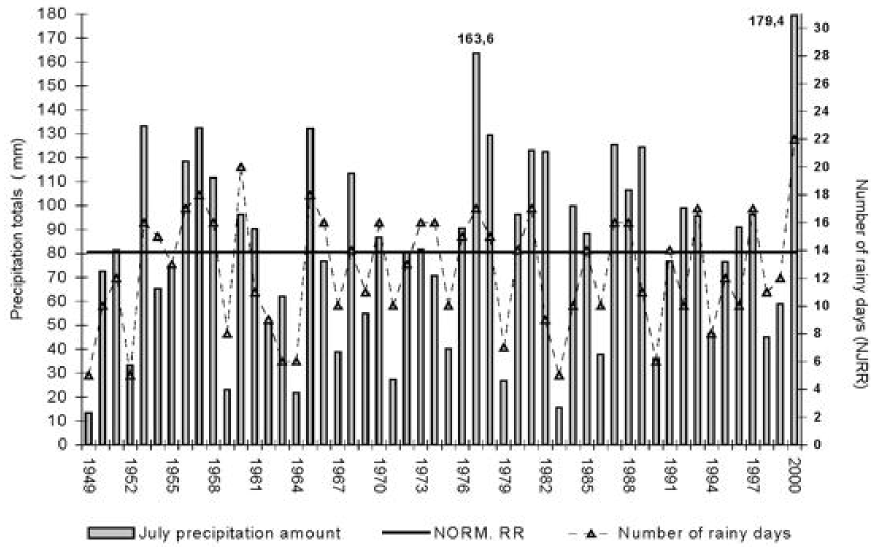


Fig. 7. 1:
Precipitation totals and number of rainy days in Besançon (Doubs) in July between 1949 and 2000 and 1961-1990 normal
From : Météo France

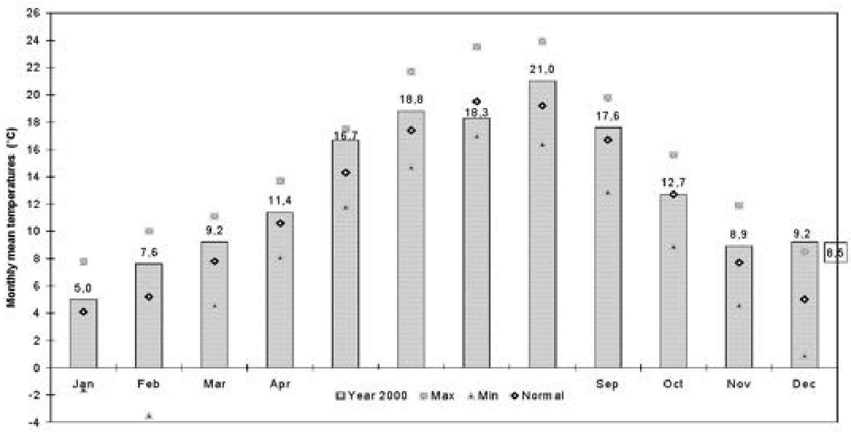


Fig. 7.2:
Monthly temperature means in 2000 compared with 1961-1990 values in Paris-Montsouris
From: Météo France

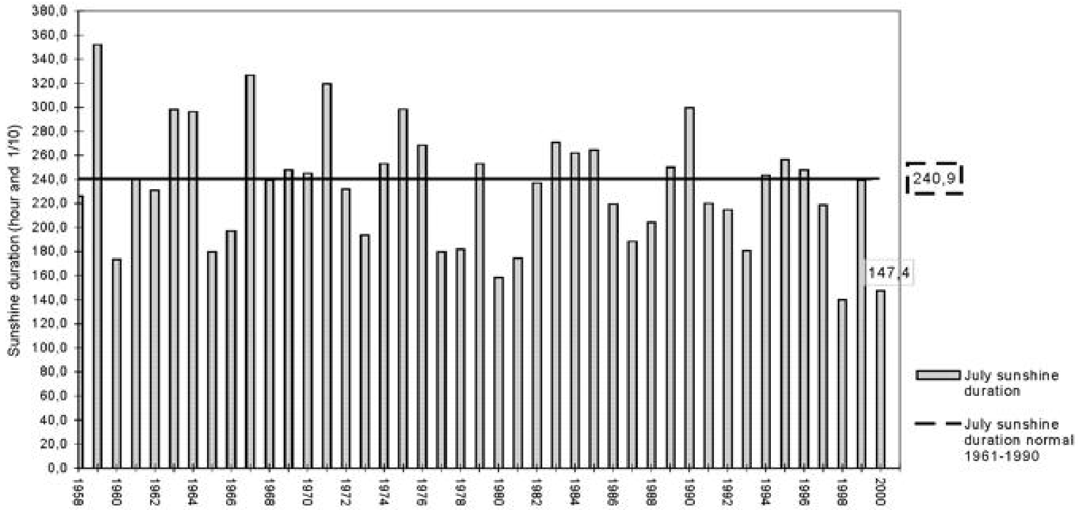


Fig. 7.3: *Sunshine duration in July in Paris- Montsouris between 1958 and 2000 and 1961-1990 July mean*
From : Météo France

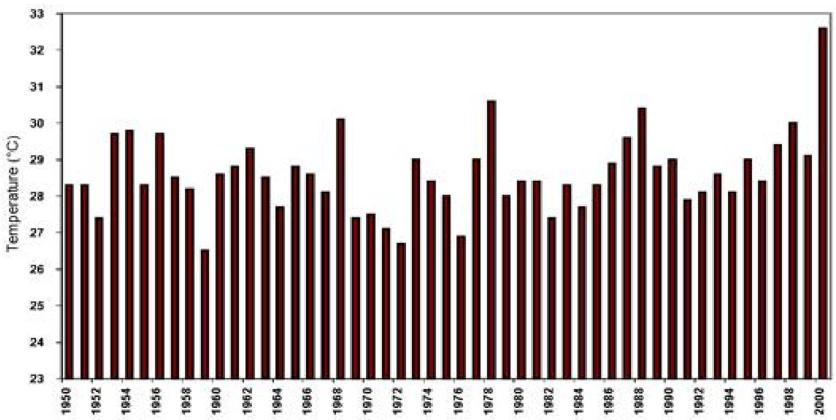


Fig. 7.4: *Mean Daily Maximum Temperature in Jerusalem in July 1950-2000*
From: Israel Meteorological Service

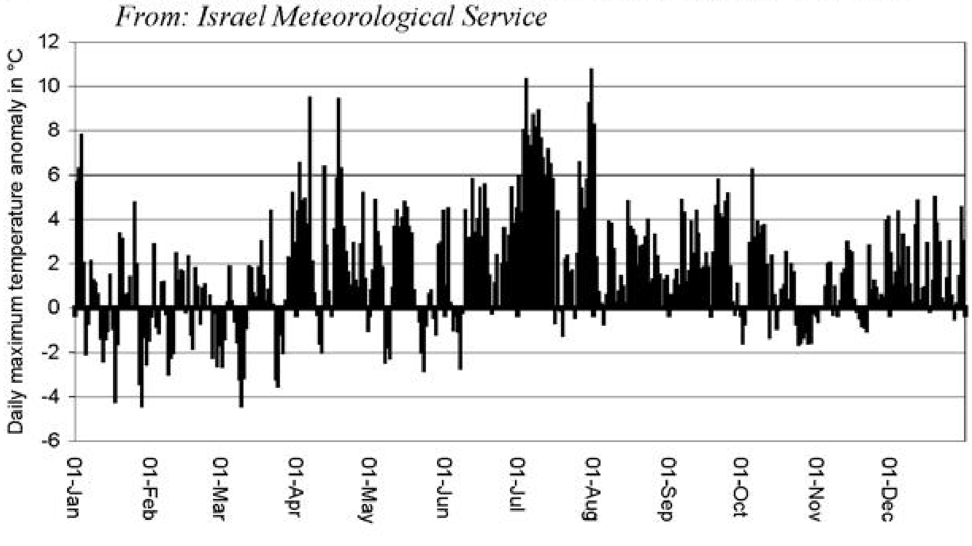


Fig. 7.5: *Anomalies of the daily maximum temperatures in Amman in 2000, reference period 1961-1990.*
From: Meteorological Department, H.K. of Jordan

August 2000:

- **Mostly warm, especially in the Southeast**
- **Very dry in the South**

A severe hot spell scorched the Balkans. Temperatures climbed up to 41.7 °C in Békéscaba on August 21, setting a new record for Hungary. Also Croatia (see fig. 8.1) reported new maximum temperature records (e.g. 41.4 °C in Knin on August 22, surpassing the old record, set in 1950, by 1.0 °C). In Slovenia, with unusually dry and warm weather (see fig. 8.2) the amounts of available soil water for most crops diminished seriously and resulted in severe water stress. Yugoslavia reported precipitation deficits of 10-50 %. The water levels in the rivers were very low, e.g. river Savahad had on August 31 the lowest level of 80 years' observation. The dry conditions in July continued as precipitation totals reached only 20-40 % of normal and it was unusually warm again, in Armenia (see fig. 8.3). Losses due to the drought were estimated to 100 million $. In Cyprus, it was extremely hot between August 14-16 and 21-22. In Israel, August was not as extreme as July, yet it was still warmer than normal.

Nice, stable weather prevailed from Iceland across the UK to Germany. In the Netherlands, it was the sunniest month of the year with 223 h of bright sunshine (normal 192 h). Summer storms were comparatively rare. However, a high number of local thunderstorms and hail events with strong winds occurred in Poland. Heavy rain, hail and gusts ravaged near Moscow, Russian Federation, at the beginning of the month. On August 25, a mountain torrent and rains washed away river banks and roads in the Republic of North Ossetia-Alania. Heavy hailstorms caused severe damage in wide parts of Bulgaria, on August 28.

In the Gulf of Finland, a number of powerful waterspouts occurred in early August. A whirlwind downed hundreds of trees on its 150 m wide track in the Trakai district, Lithuania, on August 19. A tornado north of Lublin, Poland, destroyed about 100 buildings in the village of Ciotcza on August 20. Gusts up to 34 m/s raged in northern Switzerland on August 21.

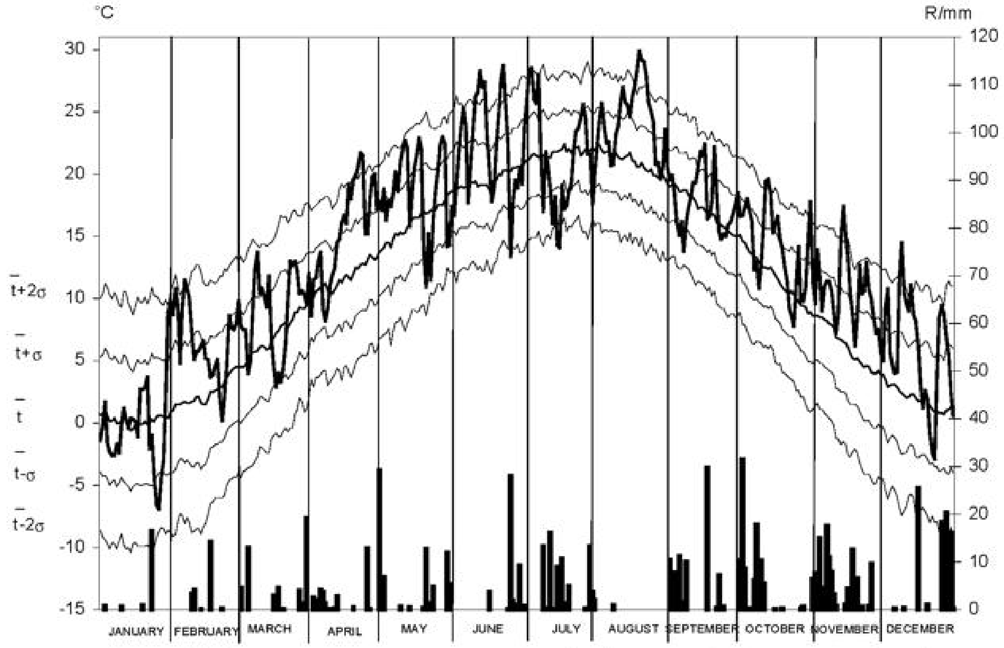


Fig. 8.1: *Mean daily air temperatures in Zagreb-Grič in 2000 compared to long-term means and standard deviations (1862-1995).*
The columns indicate the daily precipitation amounts for 2000.
From: Meteorological and Hydrological Service of Croatia

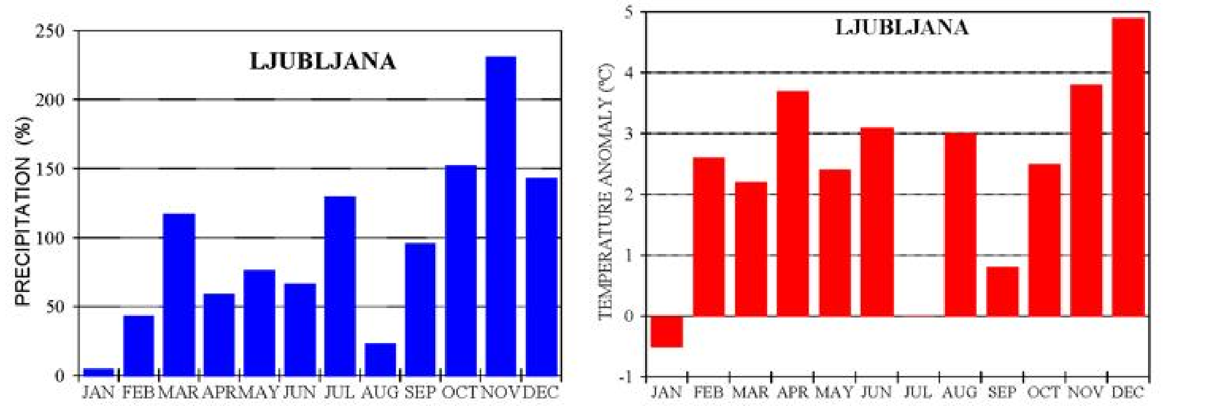


Fig. 8.2: *Monthly precipitation in % of normal and temperature anomalies in Ljubljana in 2000 reference period 1961-1990*
From: Hydrometeorolgical Institute of Slovenia

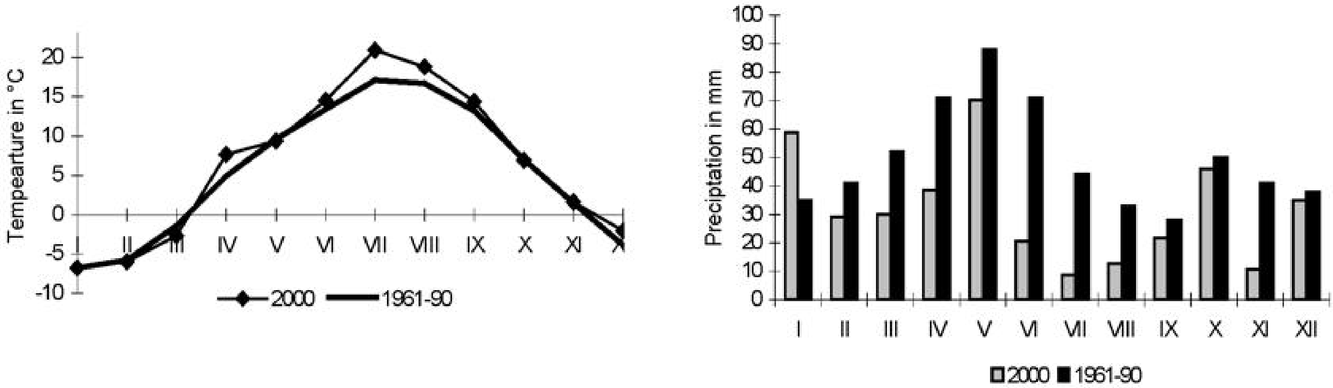


Fig. 8.3: *Monthly temperature means and precipitation totals in 2000 compared with 1961-1990 normal in Armenia*
From:Department of Hydrometeorology of the Republic of Armenia

September 2000:

- **Cold in eastern Europe**
- **Dry in northern and south-eastern Europe**
- **Regionally heavy rainstorms**

September was cool in eastern Europe (see fig. 2.1, 2.2 Page xx). Lithuania reported 19 nights with morning frosts, which from September 16 to 19 occurred everywhere in the country with soil surface temperatures down to minus 5 - 8°C.

Greece experienced unusual dry and warm weather. From September 18 - 23, temperatures climbed up to 34 - 38 °C. 37 °C was also recorded in south-western Bulgaria.Under high pressure influence, it was extremely sunny and dry in Scandinavia and the Baltic States. In Finland sunshine reached record levels and even exceeded the July figures. In Estonia, it was the driest September in 50 years (24 % of normal).

In mid-September persistent wet weather begun in much of England and Wales (see fig. 9.1). It should last beyond the beginning of the next year. Torrential rains poured down in places on the 15th and it was the wettest September in England and Wales since 1981. On September 7-8, the city of Stavropol, Russian Federation, experienced heavy rain, gave wind gusts of up to 20 m/s and hail of 20-25 mm diameter. On September 13, a severe thunderstorm with hail completely destroyed about 1500 ha of cereals within 20 minutes near Strzelin in Lower Silesia, Poland. By September 18, thunderstorms with hail and heavy rain caused significant damage in wide parts of Bulgaria. On September 19 south-eastern France saw in some places more rain in a few days than the annual normal. Heavy rains were reported from southern Switzerland and northern Italy on September 19-20 and 29-30. On September 22, once again there was flooding caused by rain in the area south of the Danube, Germany. In Yugoslavia, it was the only month of the year with abundant rain. Heavy rains caused flooding in parts of Turkey and Cyprus between September 24 and 28.

The most severe storm, however, occurred in Italy's southern region of Calabria. Torrential rain triggered flooding and mudslides between September 8 and 10 (see fig. 9.2). Several villages were fully or partially isolated, a state of emergency was declared. Worst affected was the town of Soverato, where 13 people died.

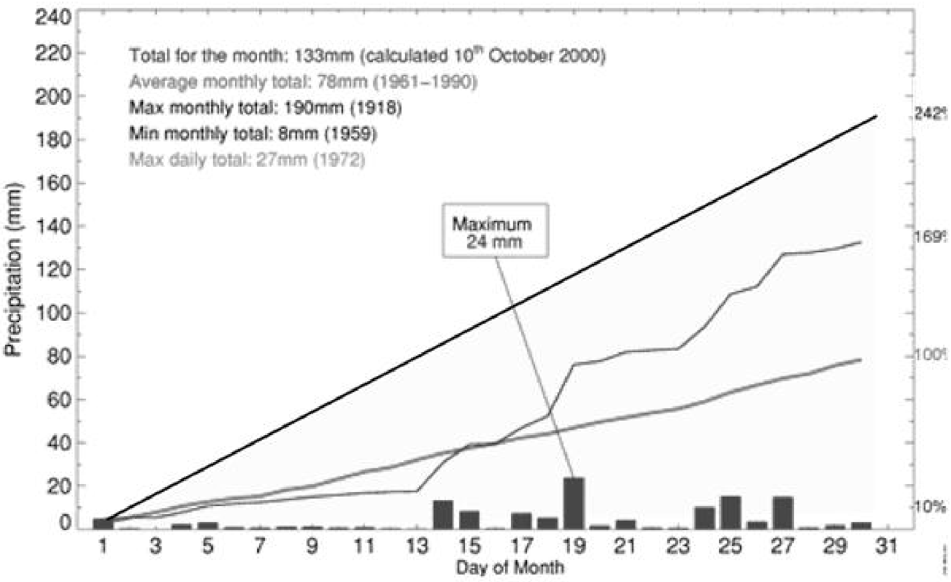


Fig. 9.1: *England and Wales daily precipitation totals in September 2000*
From: UK Met Office

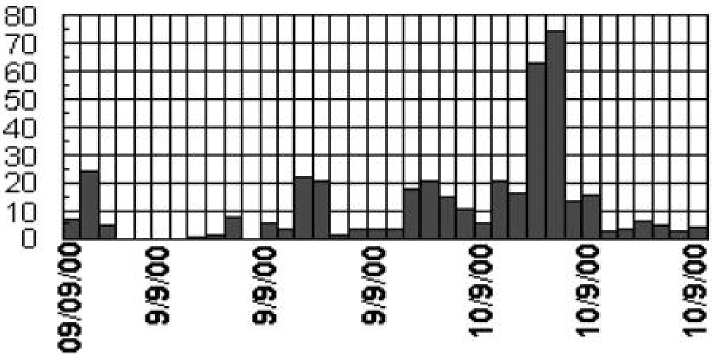


Fig. 9.2: *Hourly rainfall totals (in mm) in Chiaravalle, Calabria, on September 9-10*
From: Servicio Idrografico e Mareografico Nazionale, Italy

October 2000:

- **Very warm in northern and Central Europe**
- **Rainiest October on record in the UK, South Scandinavia and Israel**
- **Devastating floods in north-eastern Italy, southern Switzerland and eastern Spain**
- **Severe first winter storm**

It was exceptionally warm in Northern and Central Europe. For Norway, it was the second warmest October since 1866 (the warmest was in 1961). The station Tafjord in western Norway recorded a maximum temperature of 25.4 °C on October 1; this is the highest official October temperature ever measured in Norway. In parts of Poland, monthly temperature means equalled those of September and anomalies were above 4.8 °C (see fig. 2.2 page xx).

From Poland across the Baltic states to western Russia, precipitation was subnormal (see fig. 5.1 and 5.2 page xx). Poland as a whole received only 32 % of normal (see fig. 3.1 page xx) and in Suwalki, the monthly precipitation total was only 3 mm (6 % of normal). In Lithuania, too, a number of stations received only 1 - 4 mm.

In the UK, the wet weather that had started in September continued (see fig. 10.1 and 12.2 page xx) and in the England and Wales precipitation series (EWP), it was the wettest October since 1903 with 188 mm. Several coastal areas in southern English were inundated at the beginning of the month. On October 9-10, 103 mm of rain poured down in East Sussex and the 122 mm recorded in West Freugh, SW Scotland, have an estimated return period of once in 311 years. Potent wave depressions brought widespread floods and gales to much of England and Wales at the end of the month. The EWP figure of 40 mm on the 29th was the largest daily total in October in the 70-year daily series. Also in southern Scandinavia, the month was unusually wet. Lillehammer, Norway, recorded a monthly total of 227 mm, which is 324 % of normal.

In Israel, the 2000/2001 rainfall season started with very heavy rain. In some areas, it was one of the rainiest Octobers ever recorded (see fig. 10.2). On October 15, 44 mm of rain fell over Sede Boqer in the Negev Desert within less than one hour (almost 50 % of the average annual rainfall). This caused river flooding and 100 travellers had to be rescued by helicopters. The heaviest rains occurred on October 23-25, mostly in the Coastal Area with rainfall amounts above 100 mm. In the southern parts of Tel Aviv 150-160 mm of rain fell in 24 hours and 190-200 mm in 48 hours. Such an event is rare - in Miqwe Yisrael, a station located a few kilometre south of Tel Aviv, with rainfall measurements since 1925. Greater amounts of rain in 24-48 hours were recorded only 3 times for the whole rainy season. The heavy rains caused severe damage. The southern parts of Tel Aviv were flooded for the third time this year (twice in January). Jordan reported cool and wet weather (see fig. 1.2 page xx and 7.5 page xx). Rains and thunderstorms raged all over Greece between October 6 and 10. Heavy rain caused flooding in Cyprus on October 9 and in northern Turkey on October 11 (Giresun) and 22 (Kocaeli).
Very rainy and cloudy weather was reported from western Slovenia. Station Lod pod Mangartom in the Julian Alps (650 m above m.s.l.) received 638 mm of rain (286 %of 1961-1990 normal) and Bilje in the Vipava valley, recorded only 88 sunshine hours, which is 56 % of the 1961-1990 normal.

For all parts of France, it was extremely wet and at the end of the month, the soil was saturated nearly everywhere.

The most outstanding event of the month, however, was a flood that lasted ten days in the Po river shed. From October 11 to 16, southern Switzerland, the north-western sector of Piedmont and the Valle d'Aosta were affected by heavy rain (up to 335 mm/day, and in 6 consecutive rainy days up to 800 mm (see fig. 10.3), with values never recorded before and recurrence periods exceeding 1000 years at some sites). Many Po tributaries were inundated in alpine valleys. Downstream the Dora Baltea and the Po partly flooded the town of Turin. The Maggiore lake reached the highest level since 1868 with 4.66 m and the water level rose 3.87 m in a week. Thanks to artificial control of inundation of the floodplain losses, similar to those during the 1951 flooding of the Polesine, when about 70 people died, were avoided. However, the death toll amounted to 38, and the material losses were estimated to 8,500 million US $.

October brought intense rain to the Mediterranean side of Spain, from the Pyrenees to Almería, causing river overflow and flooding, especially on the western side of the Sistema Ibérico and in Levante. Between October 21 and 24, new records were established for 24-hour precipitation values in many locations in the mid and lower Ebro basin, some setting 50-years' records. Castellon registered 120 mm of rain on October 24.

Between October 7 and 9, a wind wave in the Taganrog Bay, Russian Federation, stranded 98 vessels on river Don. The month ended stormy and wet: An intense storm hit the southern parts of Britain, northern France, the Netherlands and Germany on October 29-30. 50 mm of rain poured down over already saturated river catchments. Winds exceeding 43 m/s were recorded on exposed southern coasts of England and Wales. North of the storm centre 15 cm of snowcover was reported in Durham, north-east England. Gusts of up to 35 m/s and 80 - 90 mm of rain were recorded on the Frisian Islands in the Netherlands causing local flooding.

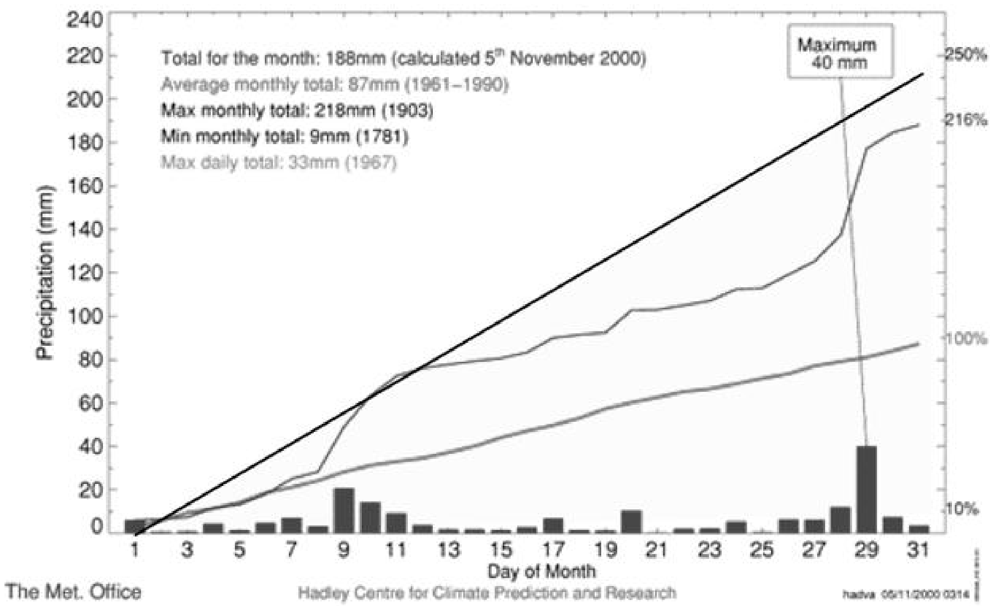


Fig. 10.1: *England and Wales daily precipitation totals in October 2000*
From: UK Met Office

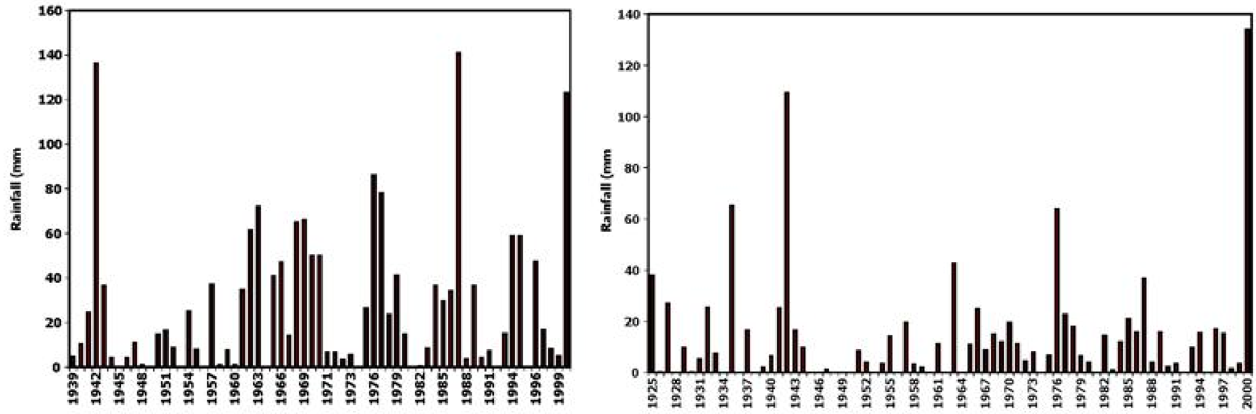


Fig. 10.2: *October rainfall totals from 1939 to 2000 (left) and maximum daily rainfall totals in Miqwe Yisrael in October from 1925 to 2000 (right)*
From: Israel Meteorological Service

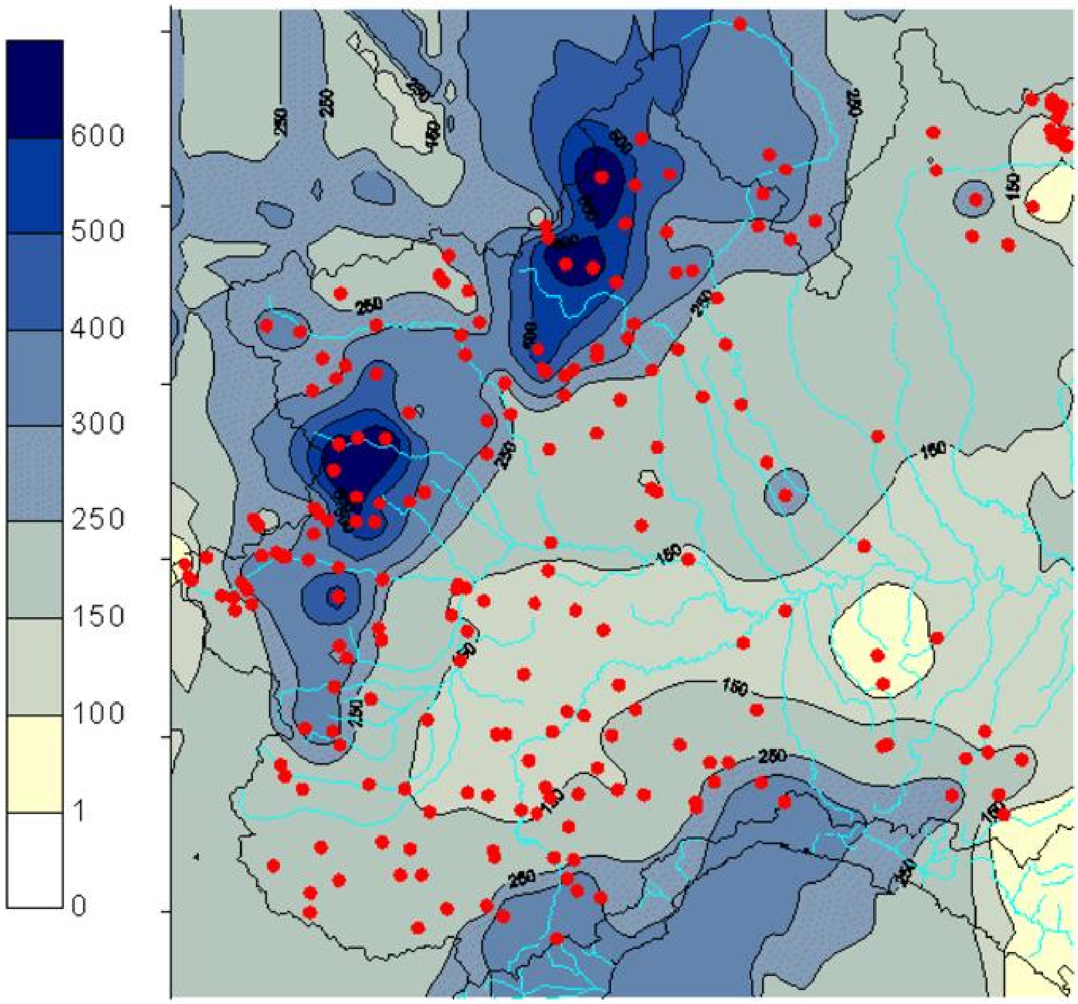


Fig. 10.3: *Precipitation totals(in mm) in the river Po basin from October 11-17, 2000*
From: Servicio Idrografico e Mareografico Nazionale, Italy

November 2000:

- **Another warm month**
- **Abundant rain in South Scandinavia and West Europe**

It was very warm in most parts of the Region. Temperature anomalies above 3 °C were recorded from Scandinavia across the Baltic states, Poland and Belarus to the Balkans (see fig. 2.1 page xx, fig. 8.1 page xx, fig. 11.1). In large parts of Norway and Sweden, it was the warmest November ever, with 6-7° C above normal at many places in south-eastern Norway. The monthly mean temperature in Svinoy (9.1 °C), western Norway, was the highest November temperature since the Norwegian Meteorological Institute was established in 1866. The unusual November weather enabled farmers in certain areas in Western Norway to harvest for a third time during the year, which never had happened before. The bears started their hibernation much later than normal this year! With an average temperature anomaly of 3.2 °C, it was the another extremely warm month for Poland (see fig. 2.2 page xx). The highest deviation from normal was recorded in south-eastern Poland (+ 5.6 °C in Lesko). Central and southern Greece experienced a very warm first fortnight with maximum temperatures of 28-29 °C.

Southern Scandinavia experienced another rainy month causing unprecedented high water levels in lakes and streams, especially in Värmland, Dalsland and Bohuslän, Sweden, near the border to Norway. The largest precipitation amount of 545 mm during the two months October and November was recorded in Östmark, western Värmland. This can be compared with 181 mm, which is the normal value for these two months together. In the city of Arvika large areas close to the bay Glafsfjorden were inundated. The water levels rose to more than three metres above normal. The biggest lake in Sweden, Vänern, rose to its highest level since regulations commenced in the middle of the 1930-ies. Southern and south–eastern Norway had the wettest November ever. One of the stations near Oslo received precipitation every day during 87 days from 24 September to 19 December. Certain areas received more than 5 times the normal amount of precipitation for November. The heavy precipitation amounts caused floods and damage to roads, railway lines etc.

n the British Isles, wet weather that had brought widespread flooding in the preceding weeks continued and more heavy rain fell early in November (see fig. 11.2). On November 2, Leeming in New Yorkshire recorded its wettest November day, a total of 48.4 mm fell. The England and Wales Precipitation (EWP) series showed 32 mm on November 5, setting a new daily record for November. Until November 6, many areas had more than their normal monthly rainfall, particularly in the east and at the end of the month, the EWP had its highest November figure since 1970. In parts of south-eastern Ireland, more than 100 mm of rain poured down within 24 hours on November 5-6. Dublin (Phoenix Park) measured 76.2 mm, its highest daily rainfall for November in over 150 years of record.

In the Netherlands, excessive rainfall caused local flooding in the Westland area.100 mm of precipitation was recorded locally during November 7-11 in the western parts (see fig. 11.3).

There was also abundant rain in wide areas of France: Daily totals exceeded 100 mm in the Southeast on November 6, leading to flooding and landslides. Floods and landslides occurred also in Carinthia and Eastern Tyrol, Austria, where monthly precipitation totals up to 300 - 400 % of normal were recorded (see fig. 11.4). In the Julian Alps, Slovenia, some stations registered more than 1000 mm (station Soča 1493 mm, resp. 494 % of 1961-1990 normal). The most catastrophic landslide, occurred in Log pod Mangartom. Half of the village was destroyed and there were a number of casualties. Water levels of many rivers and of the lakes reached record heights.

Heavy rainfall affected the north-eastern sector of Italy. Large areas were inundated. New maximum records of monthly totals were recorded (Reisa 1482.4 mm, Stolvizza 1352.4 mm). In the Adige River, during November 13-18 two flow peaks triggered widespread flooding near Trento. Recurrent flash floods affected the Ligurian District between November 5 and 24. Towns and villages along the "Riviera di Ponente" were inundated.

Torrential rains caused flooding in north-western Corfu. Ioannina received 206.0 mm within 12 hours (maximum so far 126.9 mm). A severe storm caused flooding on Corfu and the southern Peleponnissos. Torrential rain and strong winds wreaked havoc on Cyprus on November 27. The monthly rainfall totals surpassed the long-term mean by more than 100 % (see fig. 11.5).

It was extremely rainy in the north-eastern parts of the Iberian Pensinsula. Record monthly totals were registered at almost all stations in Galicia, with monthly values of 590.6 mm in Vigo, 493.4 mm in Pontevedra and more than 300 mm in adjacent areas.

The excessive rainfalls were in contrast to drought conditions in other parts of the Region. In Reykjavík, Iceland, it was the driest November since the beginning of continuous registration in 1920. In Norway, it was very dry in the western, middle and northern parts, with record low amounts of precipitation at many places (Vaernes near Trondheim had the driest November since 1952) which resulted in water restrictions in certain area. Substantial precipitation deficits occurred in the south-eastern parts of the Region (see fig. 1.3 page xx). For Macedonia, it was the 6[th] dry month in a row (see page 11.6). In most parts of Israel and Jordan, rainfall totals were just 10-40 % of normal (see fig 1.2 page xx).

A fierce winter storm on November 26-27 caused severe damage in Moldavia and Ukraine with widespread power failures.

Sao Miguel Island, Azores, was hit by a severe flash flood. Many streets in Ponta Delgada were flooded and trees uprooted.

Around November 20, deficits of totals of ozone of 25-30 % were recorded over Central European Russia and on November 17, an absolute minimum of total ozone (196 Dobson units) was registered in Moscow (previous minimum 214 Dobson units on December 7, 1996).

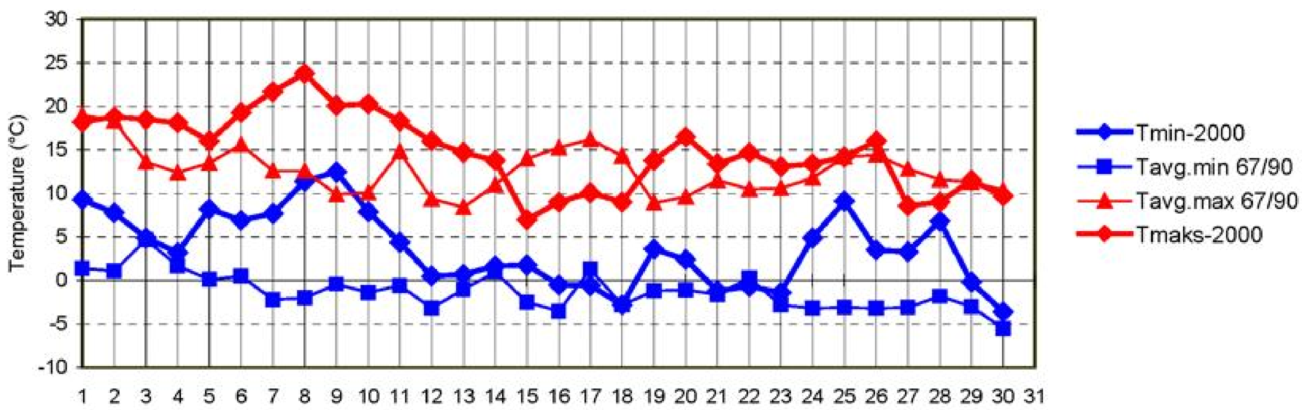


Fig. 11.1: *Daily minimum and maximum temperatures in November 2000 and 1967-1990 means in Skopje Petrovec*
From: Republic Hydrometeorological Institute, Macedonia

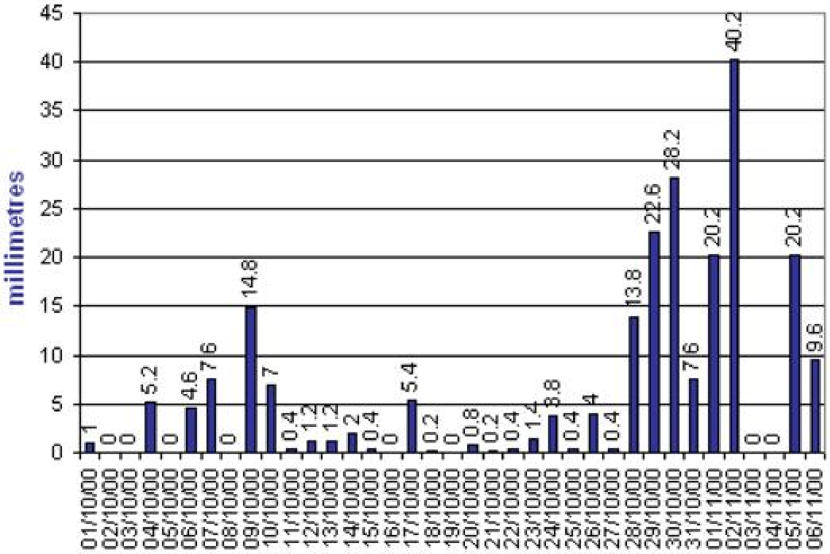


Fig. 11.2: *Daily rainfall totals at Linton-on-Ouse between 2000, October 1 -November 6*
From: UK Metoffice

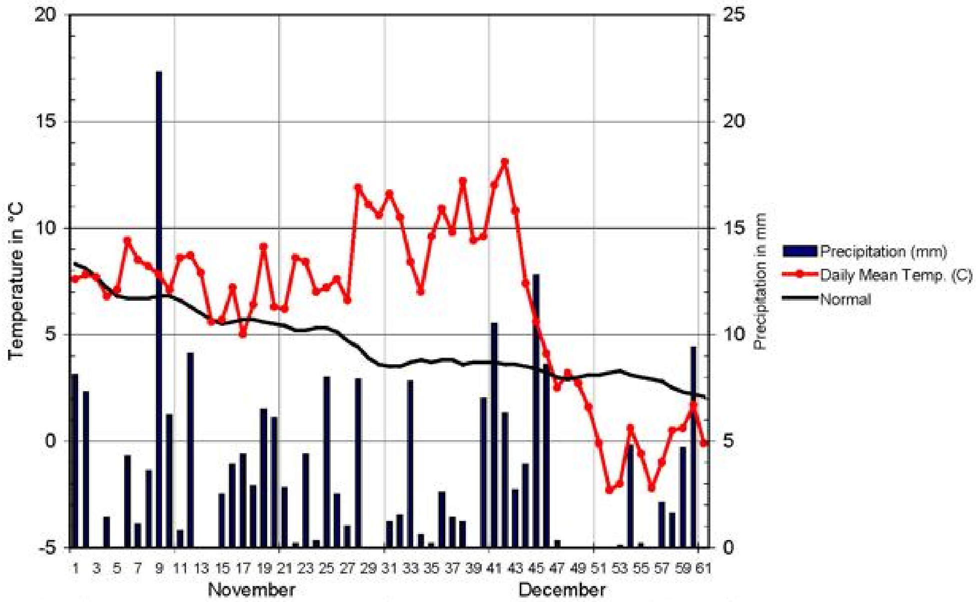


Fig. 11.3: *Daily mean temperatures and precipitation totals in De Bilt in November and December 2000*
From: KNMI, The Netherlands

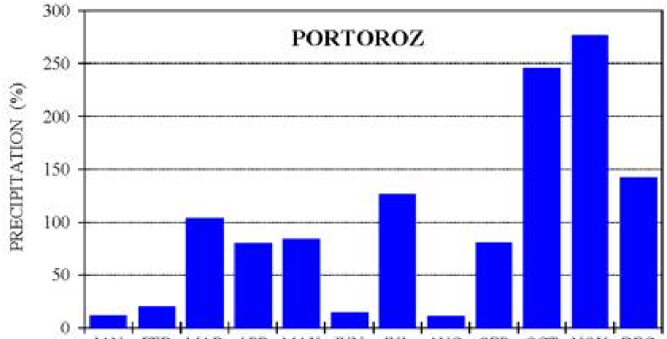


Fig: 11.4: *Monthly precipitation totals in Portoroz in 2000 in % of 1961-1990 normal*
From: Hydrometeorolgical Institute of Slovenia

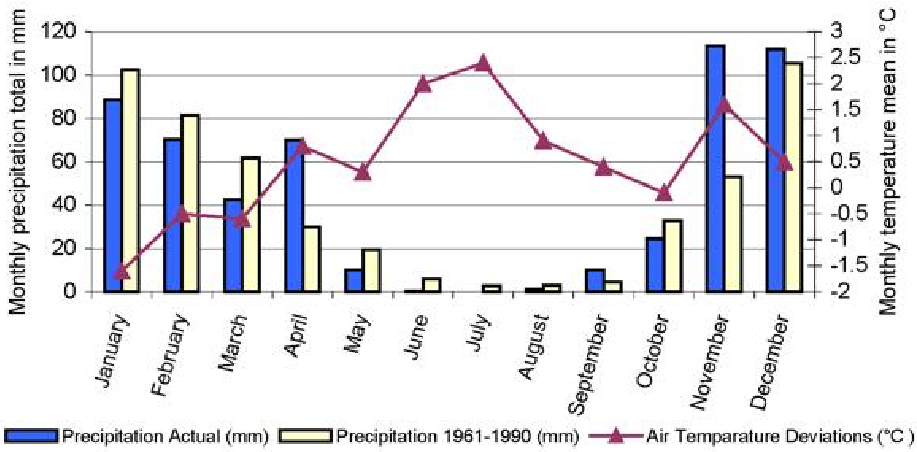


Fig. 11.5: *Monthly areal average precipitation and temperature anomalies in Cyprus*
Reference period: 1961-1990
From: Meteorological Service of Cyprus

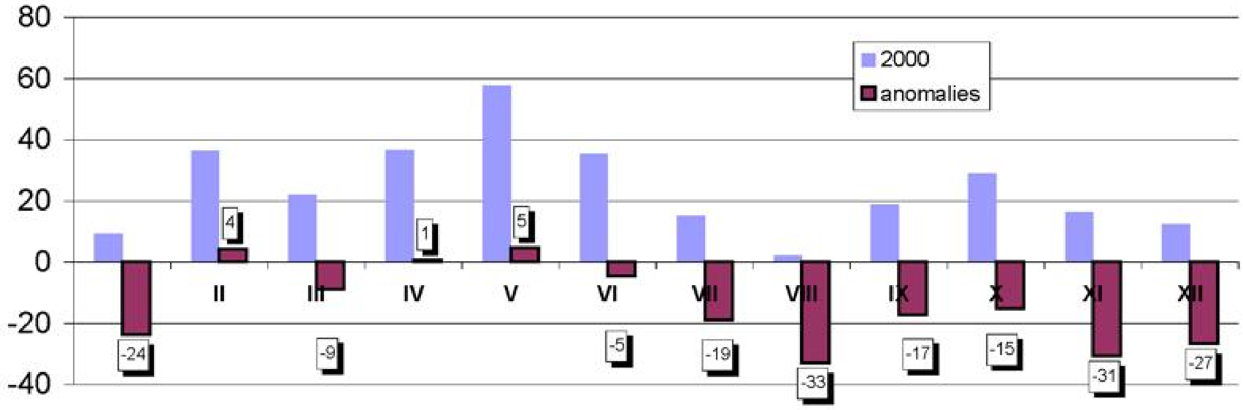


Fig. 11.6: *Monthly precipitation anomalies in Skopje in 2000, reference period 11961-1990.*
From: Republic Hydrometeorological Institute, Macedonia

December 2000:

- **Record warm**
- **Abundant rain in the far South-west and South-east**

A belt of monthly temperature anomalies above 4 °C stretched from southern Scandinavia across Finland to the Baltic states. In France, December was warmer than November. The high monthly values were due to an extremely warm start which grasped nearly all Europe (see fig. 12.1, fig. 8.1 page xx, fig. 11.3 page xx). For many stations, from the Canary Islands across Spain, France and the Netherlands to Germany and from Scandinavia across eastern Europe to the Balkan, it was the warmest first decade on record. The very warm start was slightly balanced by cold conditions later in the month. The Netherlands and the low-lands in Germany recorded the first frost of the winter season only between December 17 and 19. Never before had this event occurred so late in the year. Only 4 days with snow cover were recorded at Štrbské Pleso, Slovakia, up to December 15 which had been the absolute minimum since the beginning of observation in 1921.

A cold spell with snow and blizzards occurred in wide parts of Europe around Christmas. This led to a breakdown of the electricity supply for some 40,000 households just before New Years Eve in southern Sweden. Snow fell quite widely on December 27-28 in West and Central Europe. North-west England, Wales, Ireland and the northern parts of the Netherlands got a snow cover of over 20 cm.

Dry weather prevailed from the Aegean Sea to the Ukraine (see fig. 1.3 page xx, fig. 5.1 page xx). For Iceland, it was another dry month threatening the water supply in some rural areas. From the Iberian Peninsula across northern France to Scandinavia, it was wet again. Record high monthly precipitation totals were recorded in Portugal. Bragança (with registrations since 1941) totalled 352 mm. Oporto received 481 mm, the second highest value of the century. New records of daily precipitation totals were set in Castelo Branco and in Beja (registrations since 1941 resp. 1899). The number of days with precipitation (≥1 mm) was more than twice the mean of the 1961-1990 reference period. The heavy precipitation caused flooding and landslides, that resulted in some cases in loss of lives and destruction of homes. Strong winds contributed to the uprooting of trees, breakdown of power supply, telephone lines and road obstruction. There were still abundant rains and floods in Brittany, France. Monthly precipitation totals were more than 200 % of normal at some places in Norway. In Finland, there was hardly any sunshine in November and December. In Jyväskylä, there was only one hour of sunshine recorded for both months. Southern Greece reported heavy rain and thunderstorm on December 6-7.

Fogs were frequent this month. Slippery roads due to freezing rain caused many traffic accidents in Germany on Christmas Eve. In wide parts of Lithuania, traffic obstruction after freezing rain on December 28-29 lasted for almost three days.

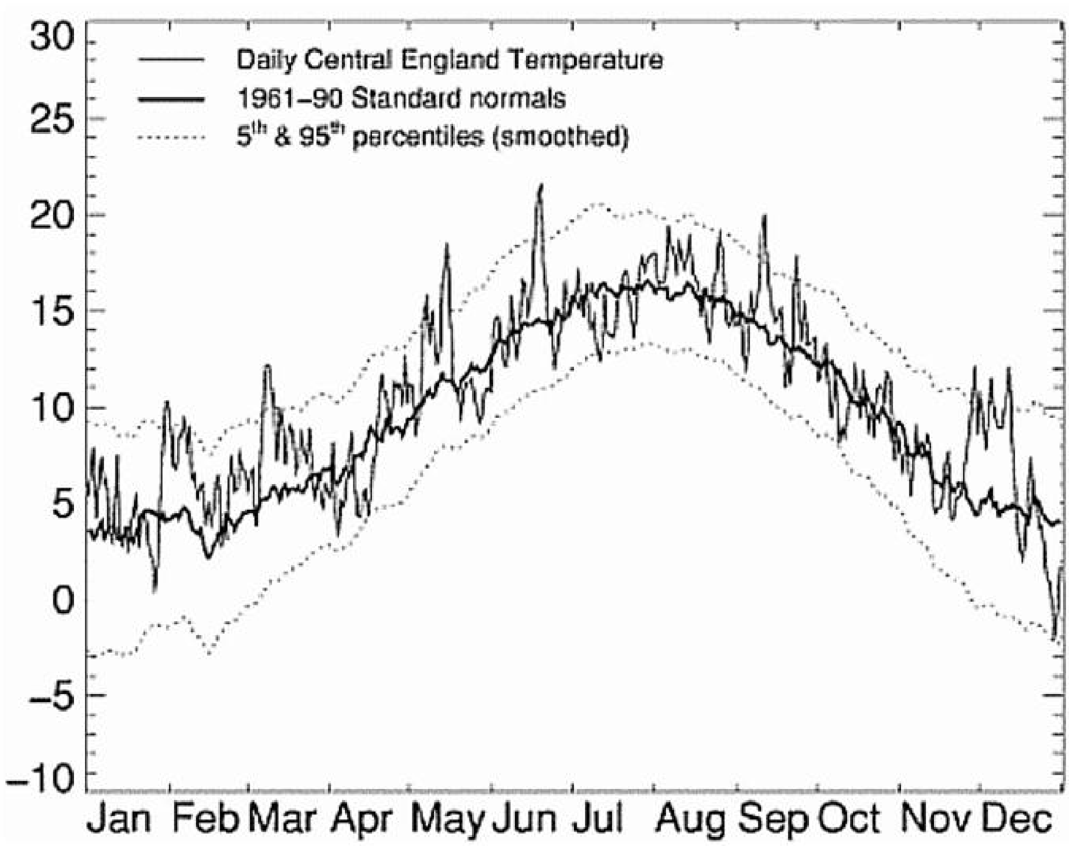


Fig. 12.1: *Daily Central England temperatures in 2000*
From: UK Met Office

Activities and Results of European Climate Centres

Report on ECSN activities

by: José Antonio Lopez Diaz, INM

The year 2000 was the last of the three-year period during which the INM was the Responsible Member of the EUMETNET ECSN project. This job has been taken over by MeteoSwiss, with Dr Walter Kirchhofer as new Manager. An outline of the activities in the different projects is as follows:

- European Climate Assessment 2000 (KNMI)

  This project is now in its final stage. It has amassed daily precipitation and temperature data from more than 170 stations in Europe and the Middle East. Almost all daily series cover the standard normal period 1961-1990, and about 50 % extend back to 1925 or earlier. A draft version of the publication was presented at the Pisa ECAC 2000 Conference. It begins with sections dealing with the data availability and the homogeneity analyses carried out on them. Temperature trends for mean, maximum and minimum values in each season of the year and through the two periods 1910-1945 and 1946-1999 are visualised and discussed. They are also compared when possible with the corresponding trends in the Jones temperature dataset. The precipitation amounts and a few related indices receive a similar treatment, using for comparison the Hulme dataset.

  This analysis is extended to a number of indicators for temperature and precipitation extremes (11 for temperature and 6 for precipitation), with the NCEP/NCAR data used for comparison. Most of these indices are based on the counts of days exceeding certain thresholds that can be either fixed for the whole region (for instance number of frost days) or site dependent (based on fractiles of the series analysed.

- European Atlas (Meteo France)

- Climate Databases (DNMI)

  After successfully holding its first workshop in 1999 in Oslo, the project this year started focussing on establishing some kind of forum for discussion among participants through the Web. However for technical reasons this has not been possible. The collaboration of DNMI inside the NORDKLIM project has been a source of ideas for the ECSN project in this period, but the person in charge at DNMI got a new job so that at the moment this project has to find a new leader. The second workshop will be held by DWD in November 2001, with a point in the agenda dealing with recommendations for the EUMETNET project UNIDART.

- Generate Climate Monitoring Products (DWD)

  This project's objective is to fill the gap in comprehensive and coherent climate monitoring products, including significant events, at the European scale. Its raw input is mostly already being done at the national level, but to integrate it technical problems related to different practices, choice of variables, smoothing across frontiers, language, etc have to be overcome.

  The project showed some provisional web-pages (still restricted to internal use) developed at DWD in the EAC meeting in Tenerife (December 2000). The structure envisioned contains the following headings: European Climate Monitoring products, National Climate Monitoring products, RAVI Bulletin issues and Significant Climate Events. The next step starting after the summer will be a pilot phase, using mainly existing products so as to assess the possibilities and needs.

- GIS in climatological applications (ZAMG)

  This new technology is gaining rapidly importance in the field of climatological applications, and with this the need to share expertise is becoming evident. This ECSN project is a first step in this direction. It has produced a questionnaire on the use of GIS in the NMS's and guidelines for the use of interpolation methods. For the future it is important that more NMS's get actively involved and to clarify the relation with the similar COST 719 action that has started this year. At the Tenerife EAC meeting it was agreed that the continuation of this ECSN project will be reconsidered at the end of this year, though it looks likely that its activities will be integrated in the COST action.

- Drought project (OMSZ)

  The participant countries (Hungary, Spain and Portugal) have made some progress towards achieving the initial objectives, namely in the study of long series of drought indices (Hungary, Portugal), the intercomparison of indices (Hungary) or the introduction of a daily operational water balance using the SPI index (Spain). The project will produce a final report in 2001.

- ECSN Climate Dataset (KNMI, DNMI)

  This project's aim to build a daily dataset of temperature, precipitation and a few more parameters with a density of around 2 stations per 100,000 km^2 . Its first phase will comprise the data already collected by the ECA2000 project. In a meeting in April this year between both leading partners the working plan for next year was discussed. According to it, in a year's time the project expects to produce a CD-ROM and provide access through Internet to the data.

The Third European Conference on Applied Climatology - ECAC-2000
16-20 October 2000, Pisa, Italy

by: Walter Kirchhofer, Meteo Swiss

ECAC-2000 was the third European Conference on Applied Climatology and it gave clear evidence that the field of applied climatology is still growing. At the first conference that was held in Norrköping, Sweden, there were 130 papers, at the second conference in Vienna, Austria, there were about 200, and in Pisa there were about 300 contributions on the programme. Over 300 participants, most of them from European countries, attended the conference. With Prof. Giampiero Maracchi as Chairman, the conference was excellently organised by the National Research Council - Institute of Agrometeorology and Environmental Analysis for Agriculture, Florence, Italy.

The high number of about 140 oral papers had to be given in parallel sessions most of the time. Additionally, there were 7 poster sessions, with about 160 presented posters.

ECAC-2000 was structured around seven themes:

- Climate Prediction and Climate Variation for Climate Applications
- Climate, Agriculture and Forestry
- Development and Integration of Climate Data Sets

- Remote Sensing and GIS
- Urban Health and Tourism
- Air Pollution and Renewable Energy Sources
- Extreme Events and Risk Assessment

The proceedings of the conference are available in printed form (short abstracts) and on CD-ROM (extended abstracts) by CNR-IATA, Via Caproni n.8, 50145 Florence, Italy.

The 4th European Conference on Applied Climatology, ECAC-2002, will be held in Brussels, Belgium.

CM-SAF Training Workshop in Dresden

by: Peer Hechler, Deutscher Wetterdienst

Officially started in 1999, a five year's international project is currently being in execution in order to develop methods to exploit data of new EUMETSAT satellite generations MSG (Meteosat Second Generation) and EPS-METOP (European Polar System- Meteorological Operational Satellites) for climatological purposes (for reference see Klimastatusberichte 1997, page 74ff and 1999, page 128f and http://www.dwd.de/research/event.htm).

DWD -kindly sponsored by EUMETSAT and WMO and supported by the project partner institutes- organised a first CM-SAF Training Workshop in Dresden from 20 – 22 November 2000. Nearly 100 scientists –mainly climatologists and satellite experts- from 30 countries convened, amongst them well-known scientists as Prof. Hartmut Grassl, EUMETSAT's Director-General Dr. Tillmann Mohr, WMO Director Dr. Michael J. Coughlan, Prof. Ehrhard Raschke and DWD's President Udo Gärtner.

The aim of the Workshop was threefold:

- make potential users aware of the CM-SAF, its plans and future products
- consolidate the definition of user requirements for the forthcoming Operational Phase
- initiate training activities in the use of CM-SAF products.

The Workshop was accompanied by a public exhibition and a press conference. On the occasion of the latter Dr. Mohr announced that all Member States finally approved EUMETSAT's amended Convention which now widens the Organisation's objectives to include the operational monitoring of the climate and detection of climate change.

CM-SAF plans to derive cloud-, radiation- and water vapour products as well as parameters of the ocean's surface and interior (see background information) were presented and discussed during the Workshop sessions. It can be summarised that DWD together with its partner institutions gained common consent for the strategic direction chosen with the CM-SAF effort.

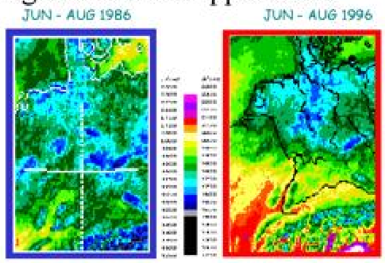
In this context major results and recommendations have been:

- to strengthen the CM-SAF involvement in international projects and activities
- to discuss the feasibility of common data formats and processing algorithms for the whole SAF network
- to explore the definition of homogeneous products covering both MSG and METOP processing areas.

Background: The CM-SAF Products

Cloud and Radiation: Determination of consistent parameters suitable for regional climate applications

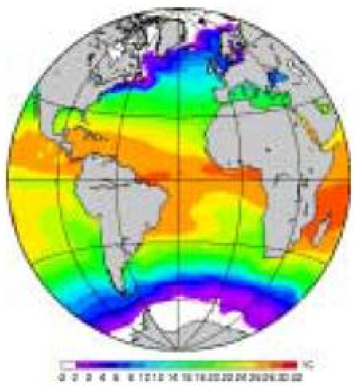
The SAF on Climate Monitoring fills a gap in providing consistent data sets of cloud and radiation budget parameters for an area which covers Europe (including parts of the North Atlantic Ocean). The spatial resolution will be 15 km (except of components of the radiation budget at the top of the atmosphere where a spatial resolution of 50 – 70 km is envisaged). Besides surface- and top of the atmosphere radiation budget components (including albedo), several cloud parameters, such as fractional cloud cover, cloud classification, cloud top temperature and height and others will be derived.



Downward Surface Short-wave Radiation over Germany

Global Ocean State Estimate: Dynamical extrapolation of sea surface observations into the global ocean interior

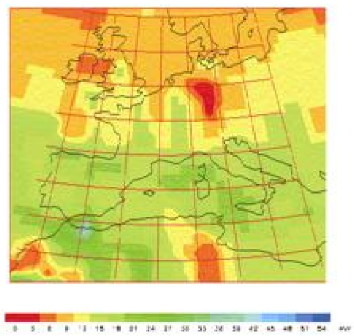
The ocean assumes the central role in the planet's climate system on behalf of its immense capacity to store and redistribute water, heat and radiatively active trace substances. Climate monitoring and predictions therefore require the continued assessment of the state of the interior ocean. By merging data from remote sensing facilities with numerical models of the global ocean circulation the SAF on Climate Monitoring will generate an estimate of the state of the global ocean circulation at monthly time intervals. The estimate includes sea-ice extent, temperatures and salinities of the ocean interior as well as circulation velocities.



Global SST, January 1996

Water Vapour in the Atmosphere: Validation and merging of satellite derived water vapour information

Water vapour in the atmosphere is for several reasons of special interest in climatology: as a greenhouse gas, as a component in the water cycle and because of the latent heat and its role in atmospheric dynamics. The SAF on Climate Monitoring will contribute merged and gridded daily data sets of total precipitable water as well as layer precipitable water (3 layers) based on operational level-2.0 satellite products and validated with in-situ observations as well as ground-based remote sensing data. With an initial spatial resolution of 100 km x 100 km the products cover Europe and parts of the North Atlantic.



Total precipitable water over Europe, 26.12.99

European Ozone Centre at the Meteorological Observatory Hohenpeissenberg

by: Ulf Köhler, Hans Claude, Wolfgang Steinbrecht, Deuscher Wetterdienst

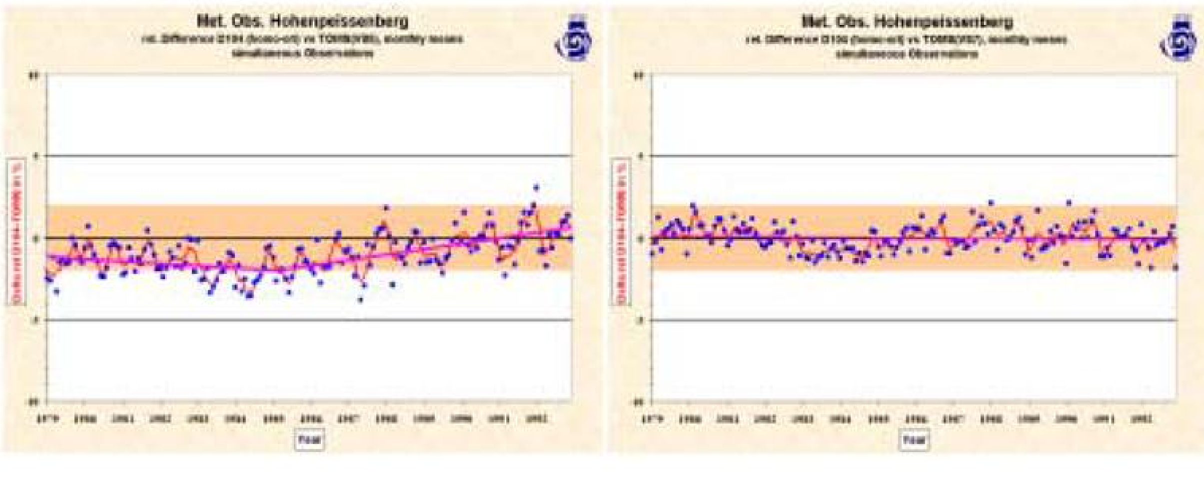
An important part of the global ozone monitoring network GO_3OS within the WMO GAW programme are Dobson spectrometers measuring the total ozone amount. To ensure data quality of these intruments a system of 1 World (NOAA, Boulder, USA) and several Regional Dobson Calibration Centers (RDCC) has been installed. For WMO Regional Association VI (Europe and Middle East) the Meterological Observatory Potsdam had been in charge of this task until the beginning of the 1990s. When the task of European Ozone Centre was assigned to the Meteorological Observatory Hohenpeissenberg (MOHp) in 1994, the function of the RDCC in RA VI (and the Regional Standard Dobson No. 064) were transferred to MOHp as well. After setting up the necessary facilities the RDCC at MOHp (in close co-operation with the Solar and Ozone Observatory in Hradec Králové, Czech Republic) began regular work with two International Dobson calibration campaigns in 2000. In total 7 of the approx. 30 operational European instruments were examined and calibrated during these first campaigns. The main tasks of an RDCC are:

- Service, maintenance and calibration of Dobson spectrometers at least once every 4 years
- Technical and scientific support to Dobson stations incl. training of Dobson operators
- Improvement of technical equipment (Dobson instrument, calibration and repair tools etc.)
- Dissemenination of Standard Operation Procedures (SOP's)
- Providision of software for data processing

The goal is to keep the data quality of Dobson total ozone records on the high level obtained over the last decades. This high quality level is absolutely necessary for:

- Reliable trend analyses
- For validation and verification of satellite data (ground truthing)

***Fig. 1a and b**: Monthly averages of the relative difference (in %) between simultaneous total ozone measurements by MOHp-Dobson No. 104 and by TOMS on NIMBUS 7. Left panel shows the comparison for TOMS Version 6 data, right panel for TOMS Version 7 data.*



The two graphs in Figure 1a and 1b are an example for ground truthing of satellite data with data from a well maintained and calibrated Dobson instrument. The left panel shows a clear indication of a gradual change of the calibration level of one instrument, in this case of the satellite instrument TOMS. After implementation of corrections the TOMS Version 7 data fit much better to Dobson 104.

Only long term ozone records (> 30 years) acquired by reliable instruments like the D104 allow meaningful comparisons of one year's ozone levels with a climatic baseline.

Figure 2, for example, shows, that 2000 was a year with subnormal ozone values almost over the entire year, resulting in the fifth lowest annual mean in the MOHp-record since 1968. From April to June (absolute record minimum) the ozone layer was unusually thin, which led to very high UV-doses compared to years with normal ozone. Although the ozone deficit in February and March 2000 is higher (up to –20 %) the low ozone values later in the year are much more relevant for the amount of UV-radiation penetrating to the earth's surface due to higher sun elevation.

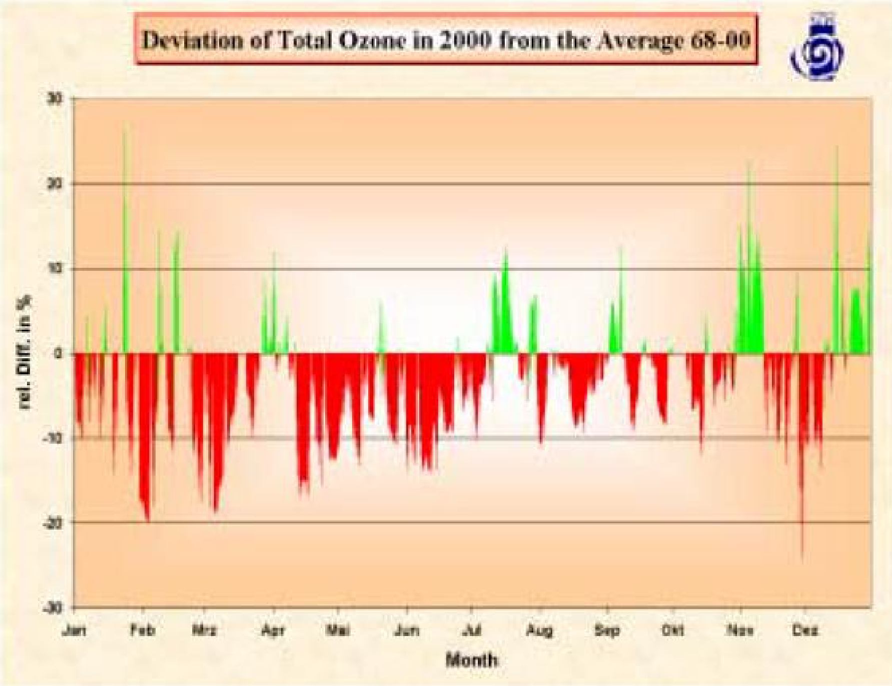


Fig.2: *Relative difference (in %) of the daily total ozone amount over the year 2000 compared to the baseline defined by period 1968 – 2000, for Hohenpeissenberg (Southern Bavaria).*

Figure 3 shows the complete record of June averages of total ozone (solid line) and UV-B radiation at 305 nm (columns) since 1968. It is obvious, that the strongly depleted ozone layer after the eruption of the Philippinian volcano Mt. Pinatubo in the early nineties has not recovered until today, although the volcanic aerosol load has been back to normal values since 1995. At the same time the UV-B-radiation has increased, culminating in a record maximum in 2000. While the strongest negative trends for the entire period 1968–2000 are found for January to April, the last 10 years are characterized by consistently low values in May/June. Recent investigations revealed, that the observed ozone depletion cannot be explained only by chemical reasons (CFC's). Approx. one third of the trend, particularly in spring, is caused by climatic changes (tropospheric warming, stratospheric cooling,

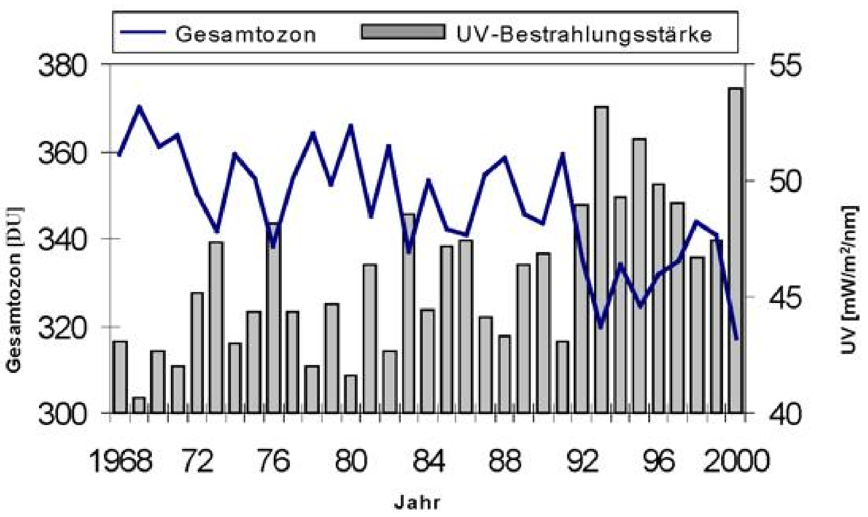


Figure 3: *Trend of total ozone (solid line) and UV-B at 305 nm (columns).*

change of atmospheric circulation) which appear to be related to the increase of greenhouse gases. This might substantially reduce the positive effect on the chemical ozone depletion expected from the stop of CFC-production after the Montreal and following Protocols.

Long-term meteorological changes and UV-Irradiance

by: Sebastian Trepte and Peter Winkler, Deutscher Wetterdienst

The long-term decrease of total ozone observed at Hohenpeissenberg (48°N, 11°E) led to a very low monthly average value in June 2000. At the same time, erythemal UV-irradiance for high solar elevation and clear sky conditions peaked at very high values, which are usually seen over Southern Europe only. Under clear sky conditions (and an otherwise unchanged atmosphere) the long-term ozone decrease clearly plays the key-role for UV-irradiance. However, matters become much more complicated when other factors, like cloud cover or visible irradiance, are considered. In contrast to the increase of UV-irradiance under clear sky conditions, global (total) irradiance shows a significant decrease since 1953 (Fig. 1, left).

This decrease is related to the observed increase in the frequency of high cirrus clouds (Fig.1, right). Since cirrus clouds attenuate visible radiation but also UV-B-irradiance, it is quite possible that the average UV-dose has remained unchanged or even gone down, whereas peak values have increased.

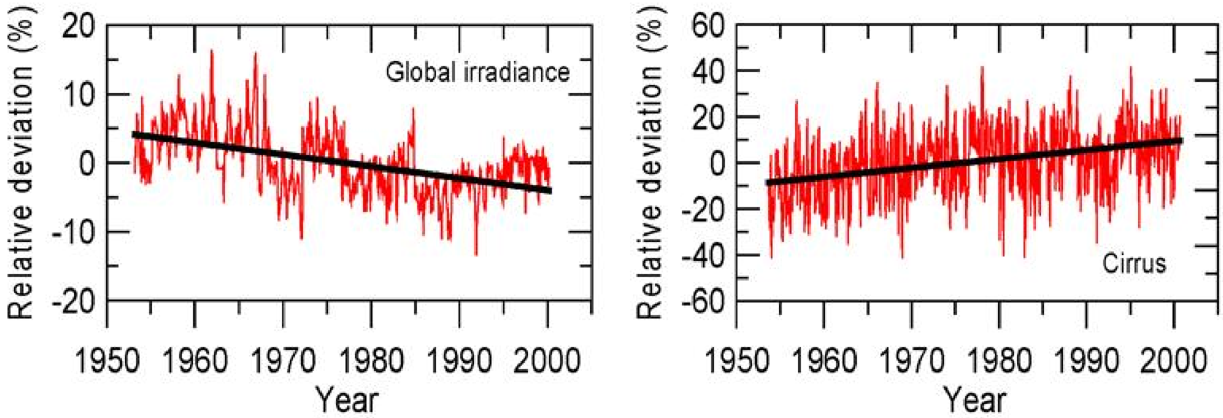


Figure 1: *Left: Monthly deviations of global irradiance from long-term means at Hohenpeissenberg. Data are for sunshine and for solar elevations greater than 10 deg in the period 1953-2000. To eliminate diurnal and annual* variations *the measured global irradiance is normalized with the calculated irradiance of a turbidity-free atmosphere. The fitted trend line shows a long-term decrease of 1.8 % per decade. Right: Monthly deviations of the relative frequency of cirrus clouds, same data sampling as in the left panel. Here the trend line shows an increase of 3.9 % per decade.*

For sunshine situations, cirrus clouds have changed in frequency by 3.9 % per decade. This explains about 20 % of the global irradiance decrease. Cirrus might have also changed in spatial coverage and/or in optical depth. For spatial coverage we found no significant long-term change.

Another aspect is that increased absorption by increasing atmospheric water vapor may have contributed to the reduction of global irradiance as well. Positive long-term trends of the air temperature at Hohenpeissenberg suggest an increasing water vapor content.

Figure 2 shows how increasing cirrus coverage affects UV-irradiance: Compared to clear sky conditions, the erythemal UV-irradiance is attenuated by about 20 % when 7/8 of the sky are covered by cirrus clouds. Note, however, that for short time periods and moderate sky-coverage UV-irradiance can be increased by increased scattering from clouds. In these situations, clouds and total ozone contribute to UV-irradiance peaks.

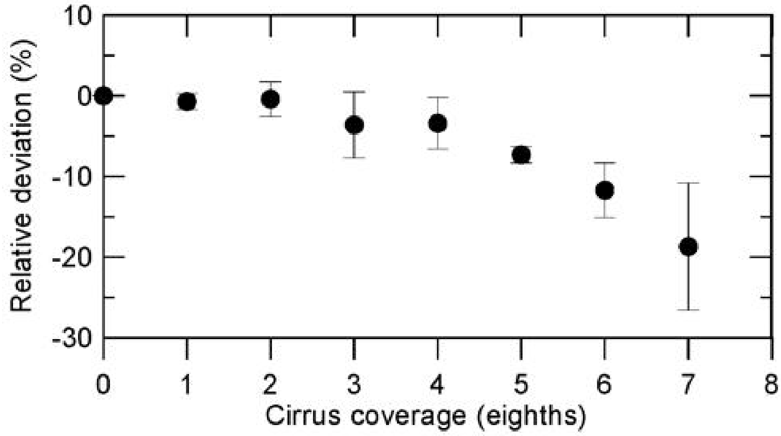


Figure 2: *Averaged attenuation of UV-irradiance (308 nm) for different fractions of sky-coverage by cirrus. Values are given relative to clear sky conditions. Data are for the period 1990-1998. Seven classes of solar elevations between 30° and 45° have been used. Error bars show the standard deviation of these classes.*

Other important meteorological processes relevant for long-term changes in UV irradiance are:

- Global warming leads to an upwards shift of the tropopause and to a cooling of the lower stratosphere. It should also result in an intensification of the water circulation. All these factors would increase the probability of cirrus formation.
-
- A high tropopause is usually coupled with low total ozone. The resulting increase of UV-irradiance may be partially compensated by increased frequency and optical depth of cirrus clouds. However, this compensation would not occur for UV peak values under clear or slightly cloudy sky conditions.

Surface Temperatures of the North Sea in 2000

by: Peter Löwe, Bundesamt für Seeschifffahrt und Hydrographie, Germany

An annual mean sea surface temperature (SST) of 10.4°C made 2000 the 6th warmest year on the record dating to 1971.

Exempting June and July, North Sea SSTs exceeded climatological monthly means at all times and all over the place. Spatio-temporal monthly means assumed ranks between 2 and 6 within the 30-year observational record.
The seasonal warming in June averaged only 1.4K which is 50 % short of the usual heating rate. This caused the jump-like change from anomalously warm conditions in May to a widespread cold anomaly that grew even more intense in July making it the 4th coldest July since 1971. The mean SST of 13.4 °C remained 2.1K behind the 2nd warmest July of 1999.

While usually seasonal cooling sets in around mid-August, August 2000 was special in that a belated extreme increase in SST of 2K occurred which exceeded the average heating rate by 200 %. This again was associated with a rapid return to anomalously warm conditions. The warm anomaly strengthened during fall which underlines the significance of too warm SSTs in fall during the past decade of the 1990s.

Additional information is available at http://www.bsh.de/Oceanography/Climate/Climate.htm

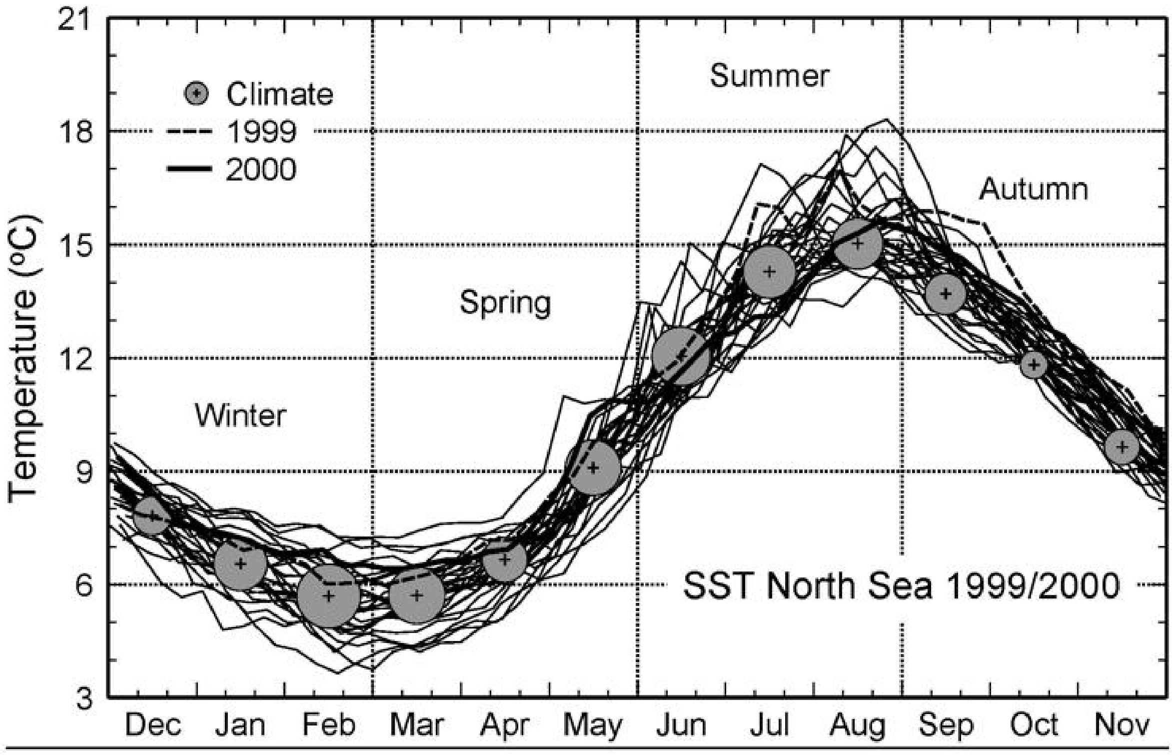


***Figure**: Seasonal cycle of the areal mean SST of the North Sea from December 1999 through November 2000 and ensemble of corresponding cycles since 1971. "Climate Bullets" are for the base period 1971-1993, their size (radius) is equivalent to 1 standard deviation.*

Climate of the Region in the 20th Century

This chapter contains a variety of articles and graphs with long-term perspective concerning the climate of the 20th century mostly out of national scope. Contributions of the national meteorological services of following countries are presented:

Belarus	Latvia
Bulgaria	Moldova
Croatia	Poland
Denmark	Portugal
Germany	Slovakia
Hungary	Sweden
Ireland	United Kingdom

Belarus: Temperature and Precipitation Anomalies

Committee for Hydrometeorology of the Republic of Belarus

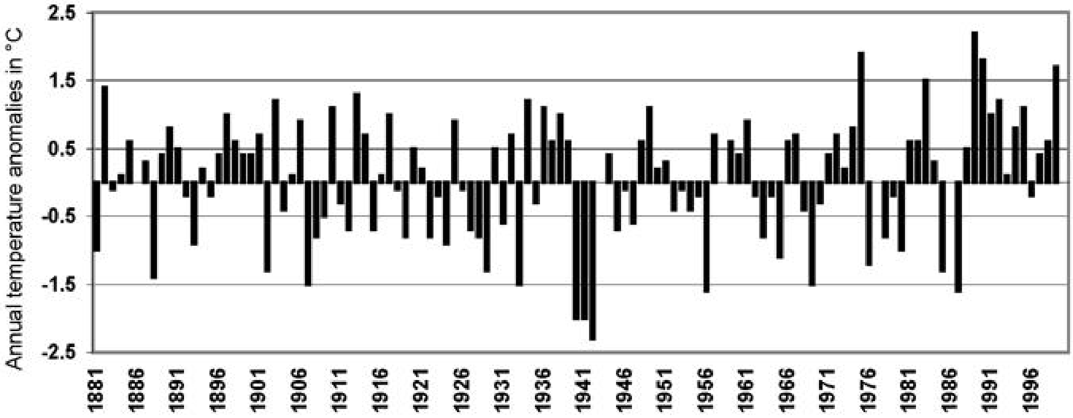


Fig 1: *Anomalies of the annual temperature means of Belarus from 1881 to 2001*

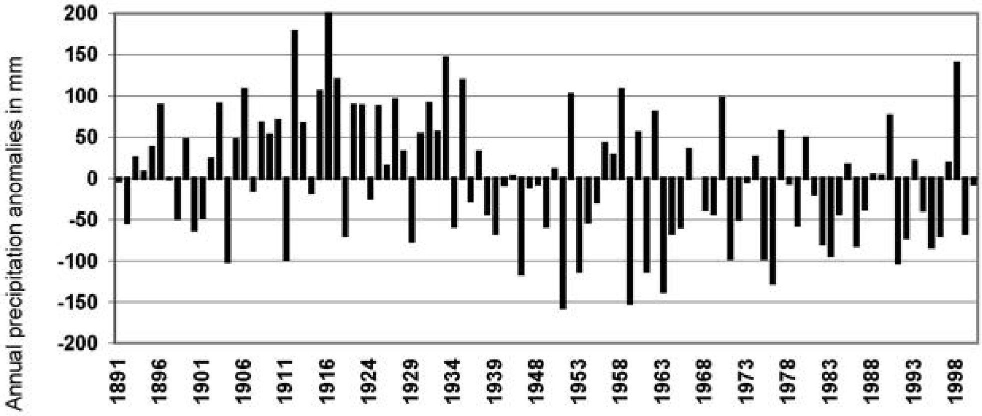


Fig 2: *Anomalies of the annual precipitation totals for Belarus from 1891 to 2001*

Bulgaria: Temperature and Precipitation Anomalies

E. Koleva, National Institute of Meteorology and Hydrology, Bulgaria

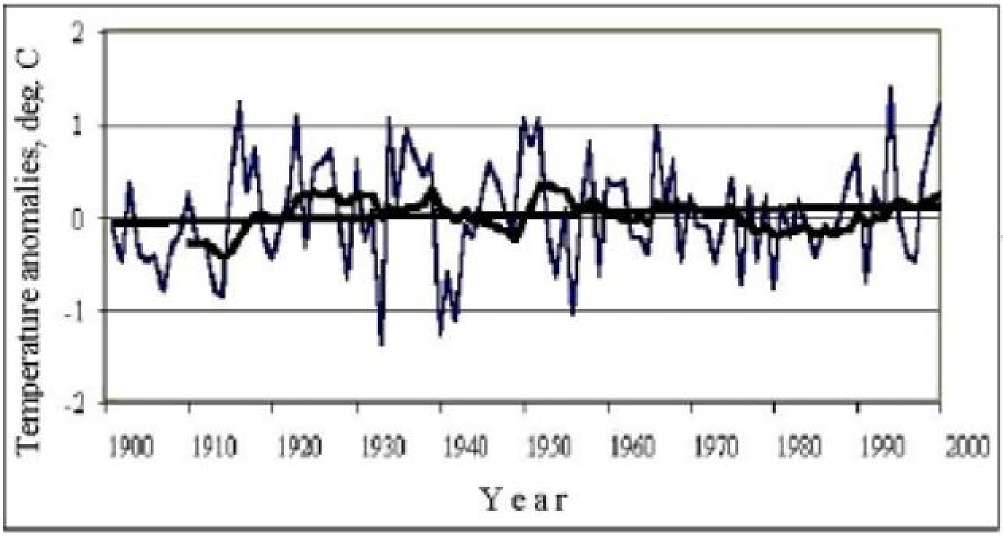


Fig.3: *Anomalies of annual mean temperature from 1901 to 2000 relative to 1961 - 1990, 10-years running smooth line and linear trend for Bulgaria*

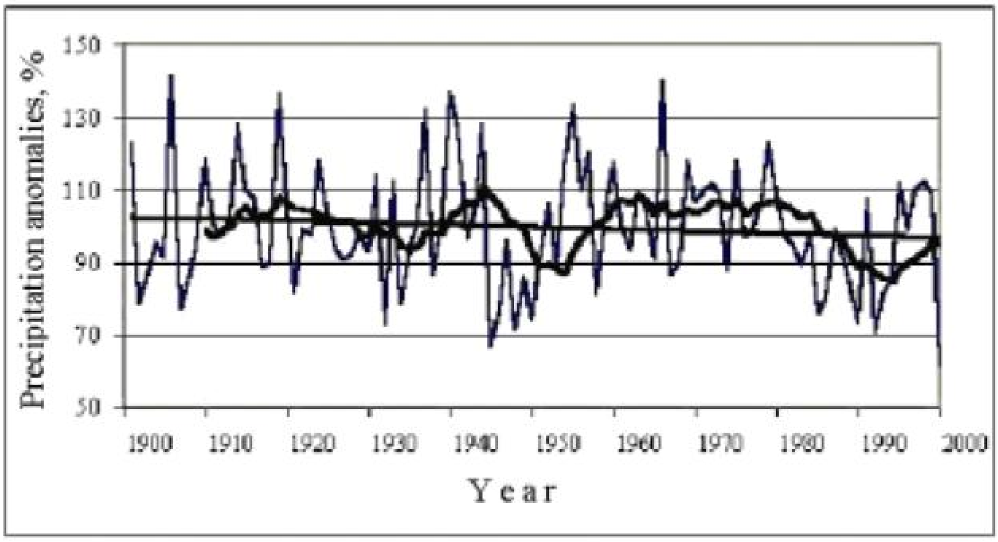


Fig. 4: *Precipitation in percent of 1961 -1990 normal from 1901 to 2000 relative to 1961 - 1990, 10-years running smooth line and linear trend for Bulgaria*

Croatia: Temperature and Precipitation Anomalies

Meteorological and Hydrological Service, Croatia

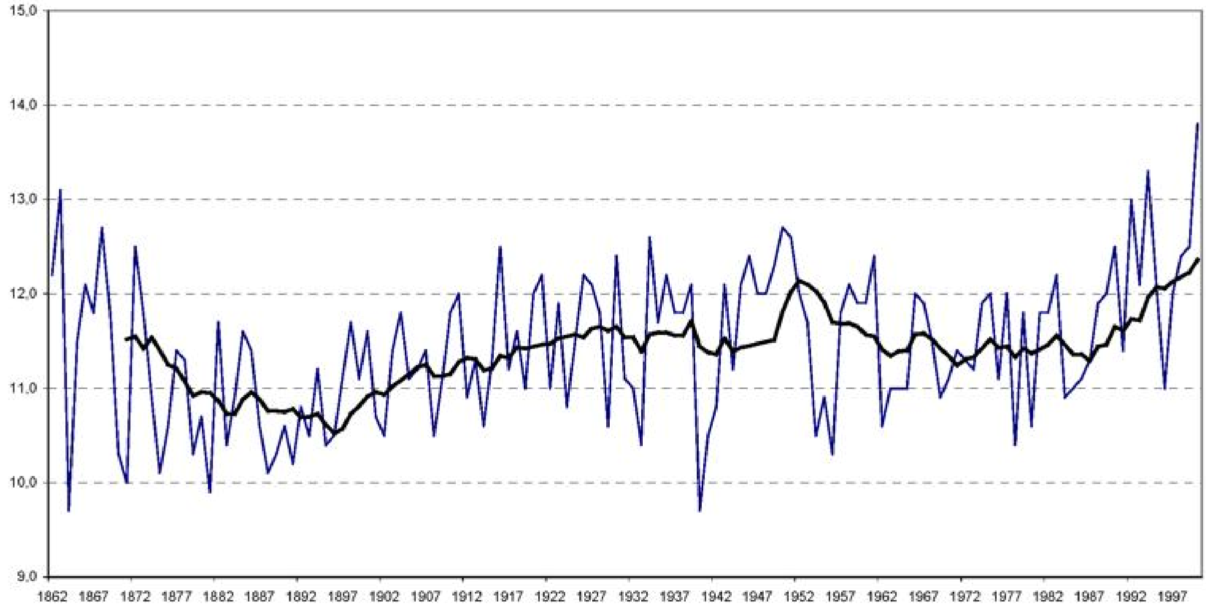


***Fig. 5**: Annual mean temperatures and 10-year moving average in °C in Zagreb Grič, between 1862 and 200*

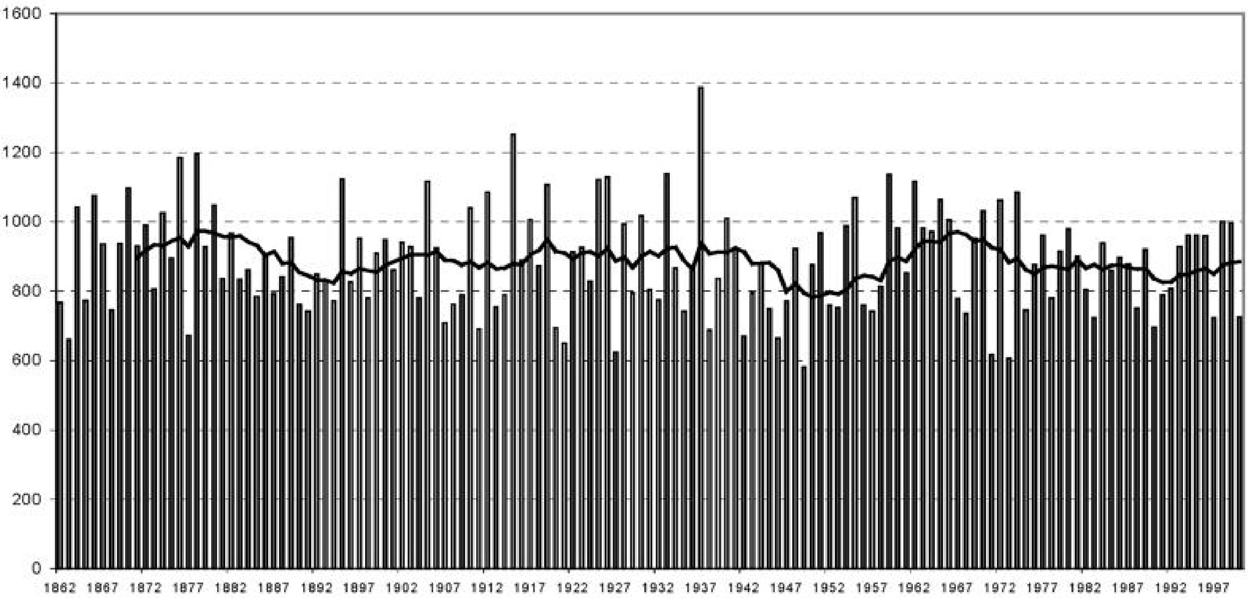


***Fig 6:** Annual precipitation totals and 10-years moving average in mm in Zagreb Grič, Croatia, between 1862 and 2000*

Denmark: Annual Temperature in Denmark, Faroer and Greenland between 1873 and 2000

The Danish Meteorological Institute

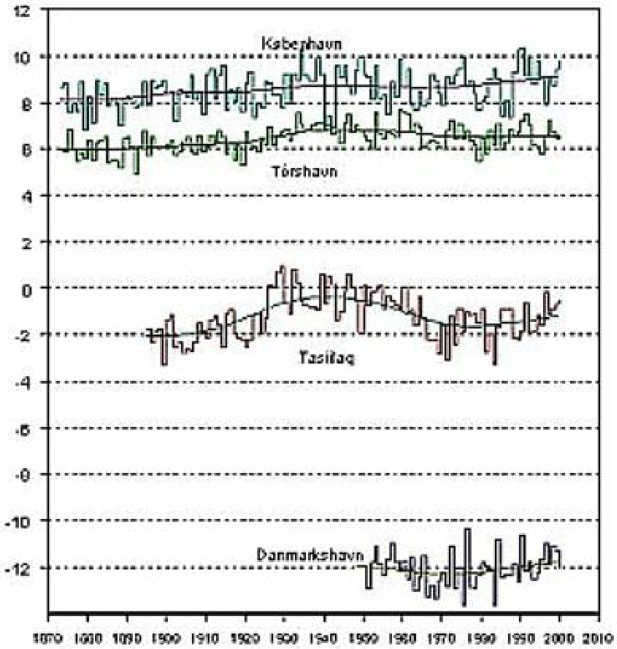


Fig 6: *Mean annual temperatures in °C in København, Tórshavn, Tassilaq and Danmarkshavn between 1873 and 2000*

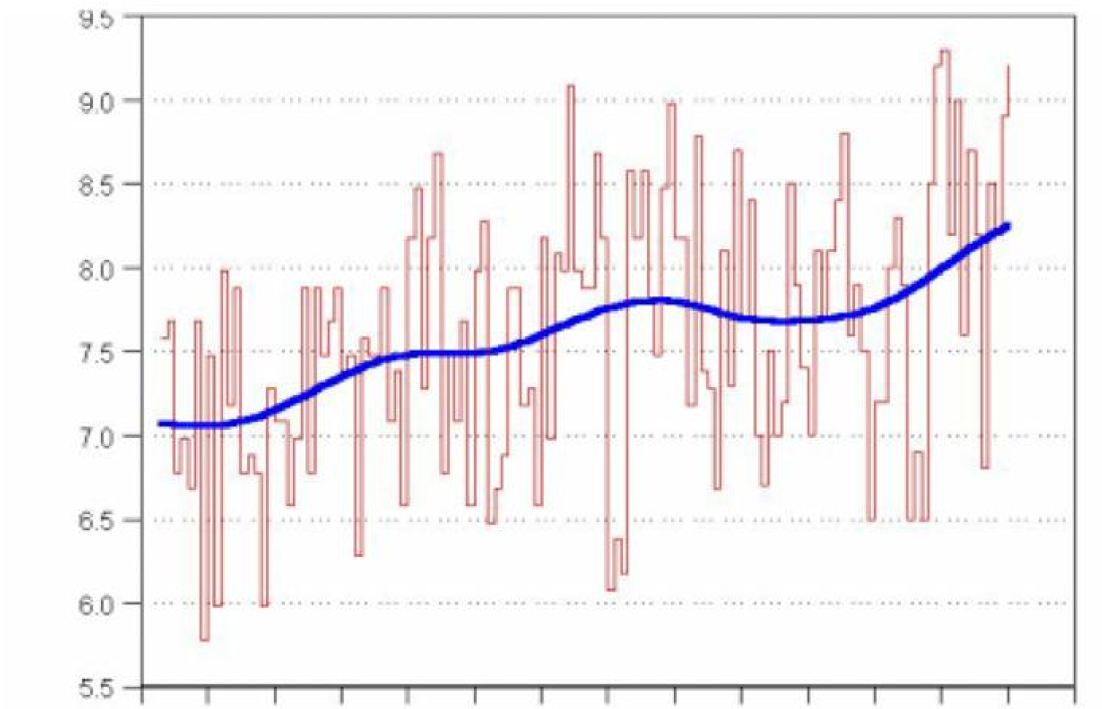


Fig 8: Mean annual temperature in °C in Denmark, between 1873 and 2000

Germany: Annual Mean Temperatures and Precipitation Totals between 1901 and 2000

Deutscher Wetterdienst

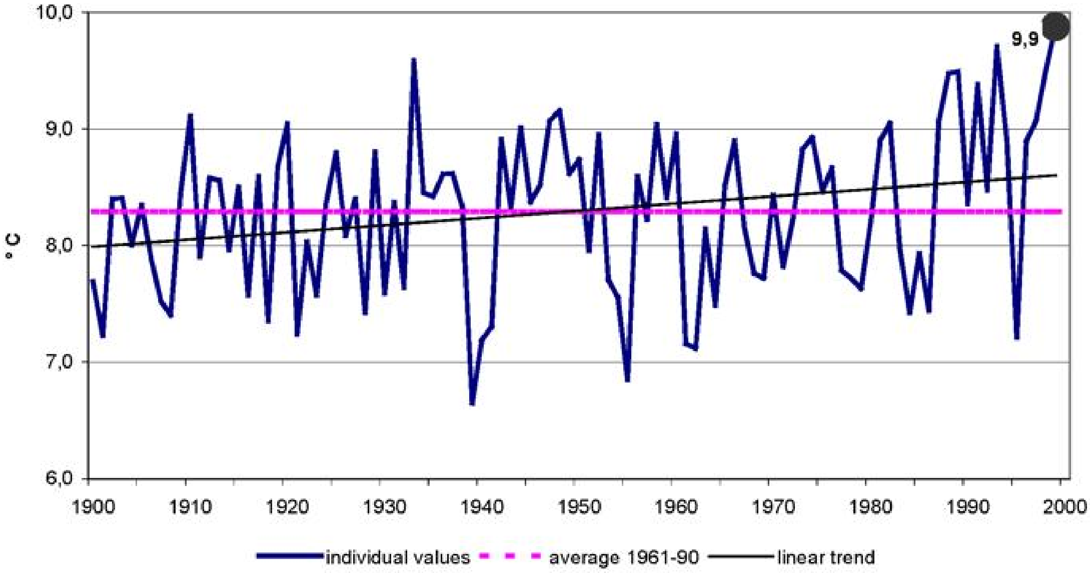


Fig xx: Annual mean temperatures in Germany between 1901 and 2000

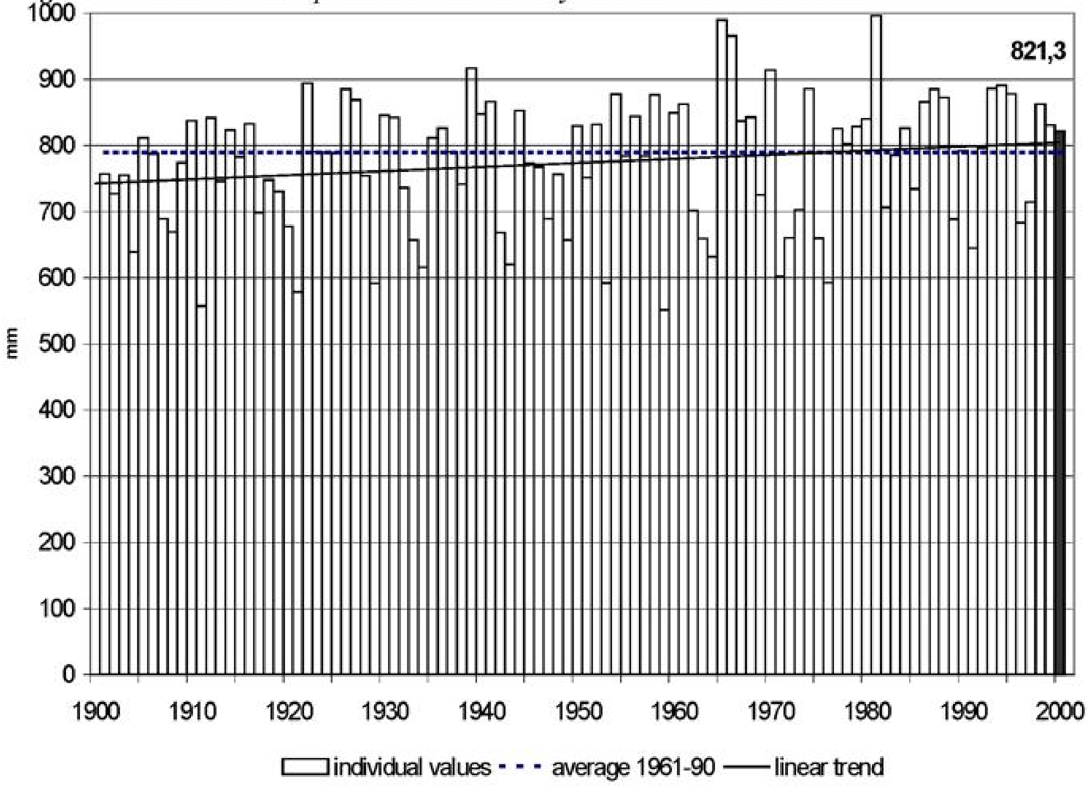


***Fig. xx:** Annual amount of precipitation in Germany between 1901 and 2000*

German Bight storminess between 1879 and 2000

H. Schmidt, Deutscher Wetterdienst

A time series of geostrophic winds has been calculated as a first order approximation from the pressure readings of three stations forming a nearly equilateral triangle with a side length of about 250 km covering the German Bight. Data base were the three climatological pressure readings per day from meteorological annuals. From 1970 on the pressure data were taken from synoptic observations. Basically, the triangle was formed by the stations List/Sylt, Borkum and Hamburg. For several reasons, however, all of these stations had to be replaced temporarily by neighbouring stations.

The data correction was rather difficult, especially for the first decades. Here, error detection could only be performed by plausibility checks. Later on, more neighbouring stations existed, allowing also for cross checks. Most of the errors found were misprints, erroneous pressure readings, or scanning errors. Some errors, especially those of minor magnitude, may still be present in the data.

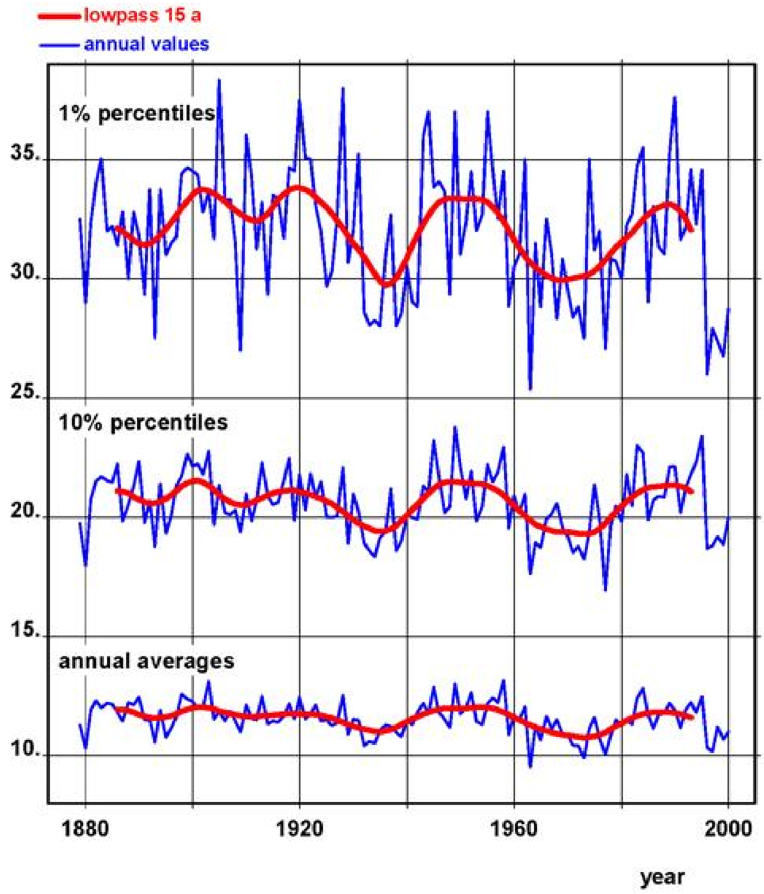


Fig. 9: Statistical parameters of the annual frequency distributions of geostrophic wind speed. The original annual values are plotted in blue. Smoothed values, calculated with a 15 years low pass filter, are plotted in red. The lower curve are the annual averages. The curves above are those geostrophic wind speeds, which are exceeded by 10 % and 1 % of all of the wind speeds per year, respectively

The time series of the three distributional parameters are rather similar, only their variance increases with wind speed. There are strong irregular interannual variations. The dominant feature, however, is a low frequency variation with a period of about 35 years, for which no explanation can be given. It also seems to be an irregular variation. The spectral energies of all other periodicities are much lower. All three time series exhibit a slight negative trend, which is -0.4 ms^{-1} per century in the annual averages. Due to the strong variability of the annual wind values this trend cannot be regarded as statistically significant. Similar results were found by SCHMIDT and VON STORCH (1993) for the German Bight, and by ALEXANDERSSON et al. (1998) for triangles covering the whole northwestern Europe.

The much discussed positive "trend" of the last three decades now appears as part of a low frequency variation. The last five years had very low wind values, which are among the lowest of the century. The smoothed curves already clearly begin to drop since 1990. This was also found by ALEXANDERSSON et al. (2000). But they point out, that "it is, however, dangerous to trust too much in the tails of these smoothed curves, as they will change, when new data points are added".

Literature

Alexandersson H., Schmith T., Iden K., Toumenvirta H. (1998): Long-term variations of the storm climate over NW-Europe. Global Atmos. Ocean Syst. 6, pp 97-120

Alexandersson H., Schmith T., Iden K., Toumenvirta H. (2000): Trends of storms in NW Europe derived from an updated pressure data set. Clim. Res. 14, pp 71-73

Schmidt H., von Storch H. (1993): German Bight storms analysed. Nature, Vol.365, p 791

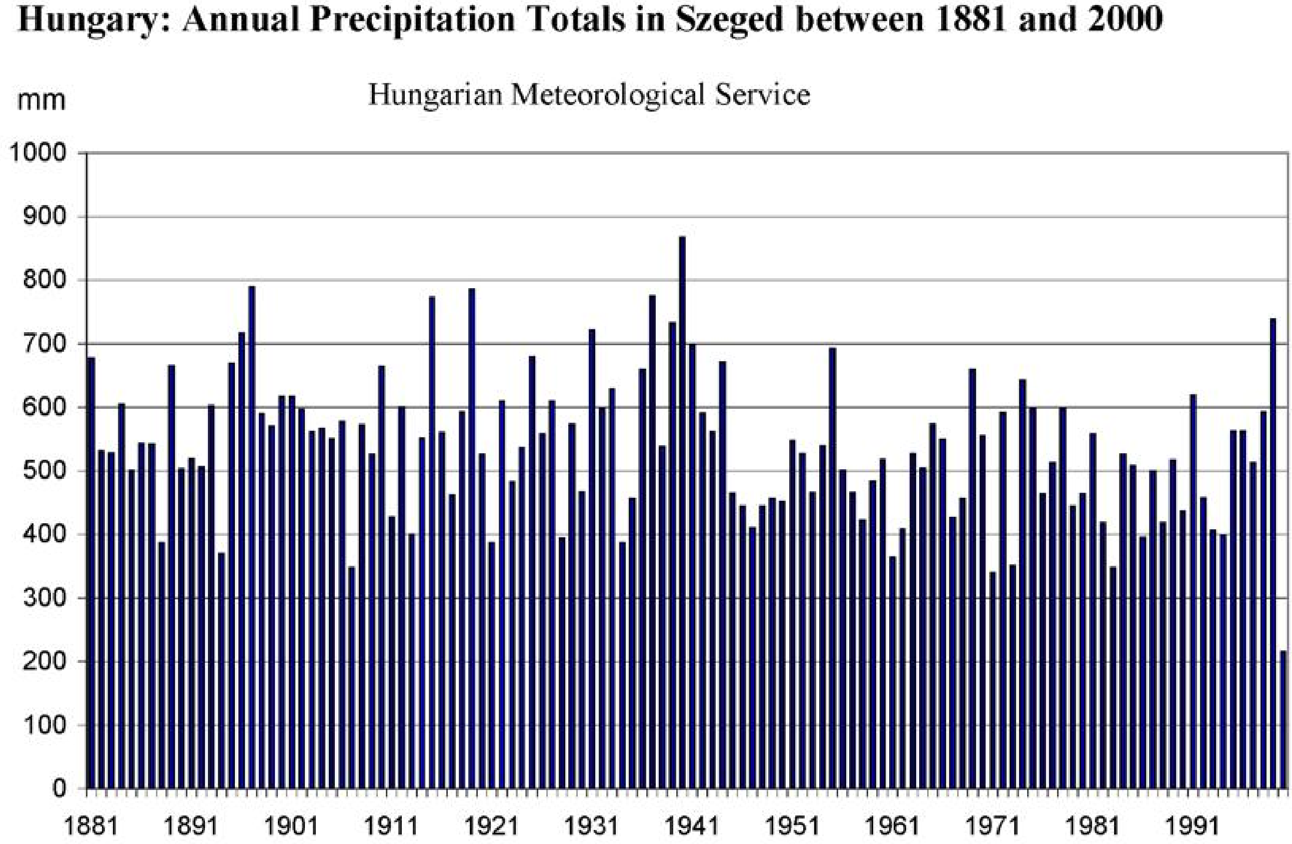


Fig 8: *Annual precipitation totals in Szeged between 1881 and 2000*

Ireland: Weather of the 20th Century in Ireland

Met Eireann, Ireland

Trends from long-term stations show a sharp rise in mean air temperatures during the 1990s, the warmest decade of the century. Four of the warmest ten years of the century were recorded since 1995; these include 1997, which was the warmest year at almost every station. This trend follows the global pattern, as figures from the World Meteorological Organisation show that the 1990s was the warmest decade of the century globally, which itself was the warmest century of the millennium. In Ireland, the warmest month of the century was August 1995, when mean temperatures were around 18 °C, up to four degrees above normal. The highest temperature on record in Ireland, 33.3 °C at Kilkenny Castle in June 1887, was not exceeded during this century, but values of over 32 °C were recorded during June 1976 and in July of 1921, 1934 and 1983. The coldest months of the century were February 1947 and January 1963, when mean monthly air temperatures were below freezing in places and there were also significant snowfalls during both months. The lowest air temperature of the century, -18.8 °C, was recorded at Lullymore, Co. Kildare, on January 2nd 1979, very close to the lowest temperature measured in Ireland, -19.1 °C at Markree Castle, Co. Sligo, in January 1881.

At the long-term stations of Valentia Observatory and Malin Head, the last two decades were the wettest of the century, but elsewhere there was little variation in decadal means of rainfall. The highest monthly total of the century, 790mm, was recorded at one of the mountain gauges in the Cummeragh Mountains of Kerry during October 1996. In contrast, there were a number of months during the century when no measureable rainfall was recorded in places, particularly April 1938, February and September of 1986 and during May 1991. Daily rainfalls of around 200mm were recorded in the east of the country during the 'Hurricane Charley' storm of August 25th 1986, but the highest daily total of the century, 243.5mm, was recorded at Cloone Lake, Co. Kerry, on September 18th, 1993. Over a shorter time span, just over 75mm of rain was recorded in an hour in the Mount Merrion area of Dublin during an intense thunderstorm on June 11th, 1963.

Annual sunshine totals show a downward trend during the century at all stations, but the 1990s were a little sunnier than the 1980s, which was the dullest decade everywhere. The sunniest years of the century were recorded during the first 20 years and also during the 1950s, particularly 1955. July of that year was the sunniest month of the century, when Valentia Observatory measured a total of 308 hours, or almost 10 hours sunshine per day. Winds gusting to around 100 knots have been measured on a few occasions during the century: 98 knots (113 m.p.h.) was recorded in a gust at Malin Head during the 'Hurricane Debbie' storm of September 16th 1961, while a gust of at least this value was recorded at Foynes, Co. Limerick, on January 18th 1945. Mean windspeeds of violent storm force 11 (over 55 knots, or 63 m.p.h.) are extremely rare events at inland stations, but these were recorded in the Dublin area in February 1903 and at both Cork and Shannon Airports during the Christmas Eve storm of 1997.

Monthly extremes recorded at the majority of stations:

Warmest Month: ***August 1995***
Mean temperatures over four degrees above normal in places

Coldest Months: ***February 1947, January 1963***
Mean temperatures below freezing at some inland stations

Wettest Month: ***Variable***

December 1978 in much of east & southeast

Driest Months: ***April 1938, February & September 1986, May 1991***
No measureable rainfall at a number of stations

Sunniest Months: ***July 1955, June 1957, August 1995***
Totals over 250 hours in many places

Dullest Months: ***December 1977, November 1983***
Less than 20 hours sunshine at some stations

Latvia: Temperatures in Riga between

Latvian Hydrometeorological Agency

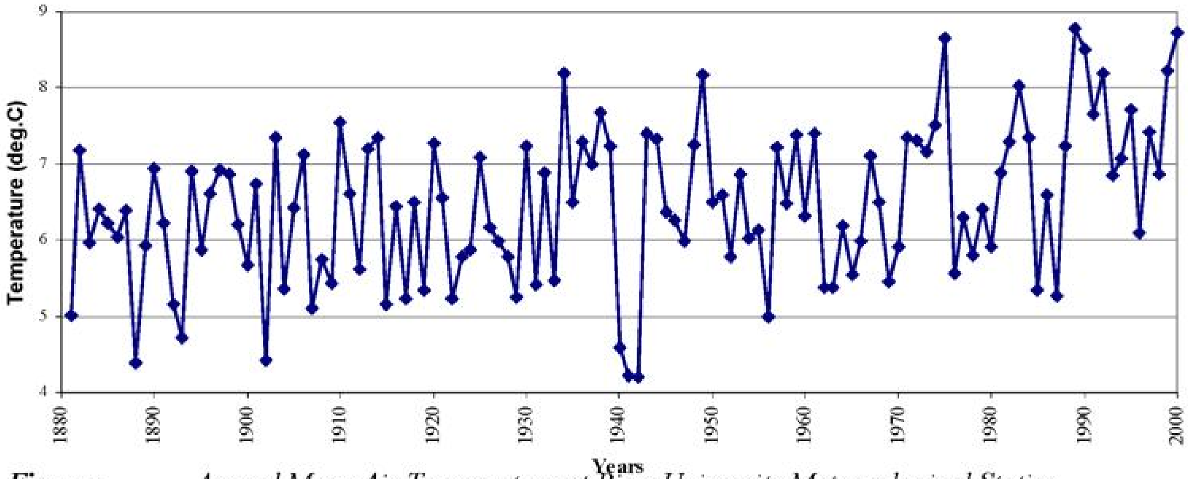


Fig. xx: *Annual Mean Air Temperature at Riga-University Meteorological Station between 1881 and 2000*

Moldova: Climate Change Tendencies in the Republic of Moldova

Hydrometeorological Service, Republic of Moldova

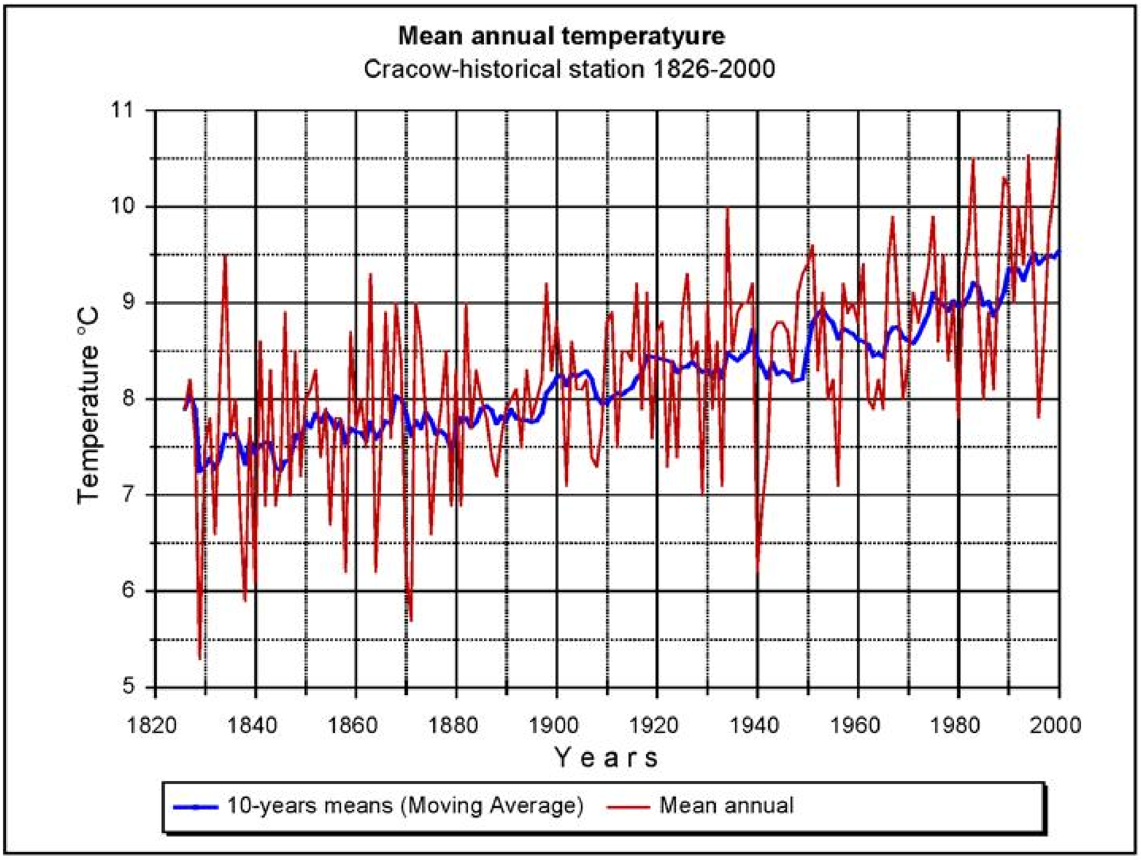
The last ten years, 1991 – 2000, were characterised by a high temperature regime in comparison with many years' period. The yearly average air temperature on the territory during this period was 8.4 – 10.1 °C, exceeding the norm with about 0.5 °C. It is important to be mentioned that especially in these ten years the yearly average air temperature reached twice the highest amounts 9.5 – 11.5 °C, 1994 and 2000, in the observation period of 100 years. The lowest yearly average temperatures were observed in 1996 and 1997 with 7.1-9.3 °C.

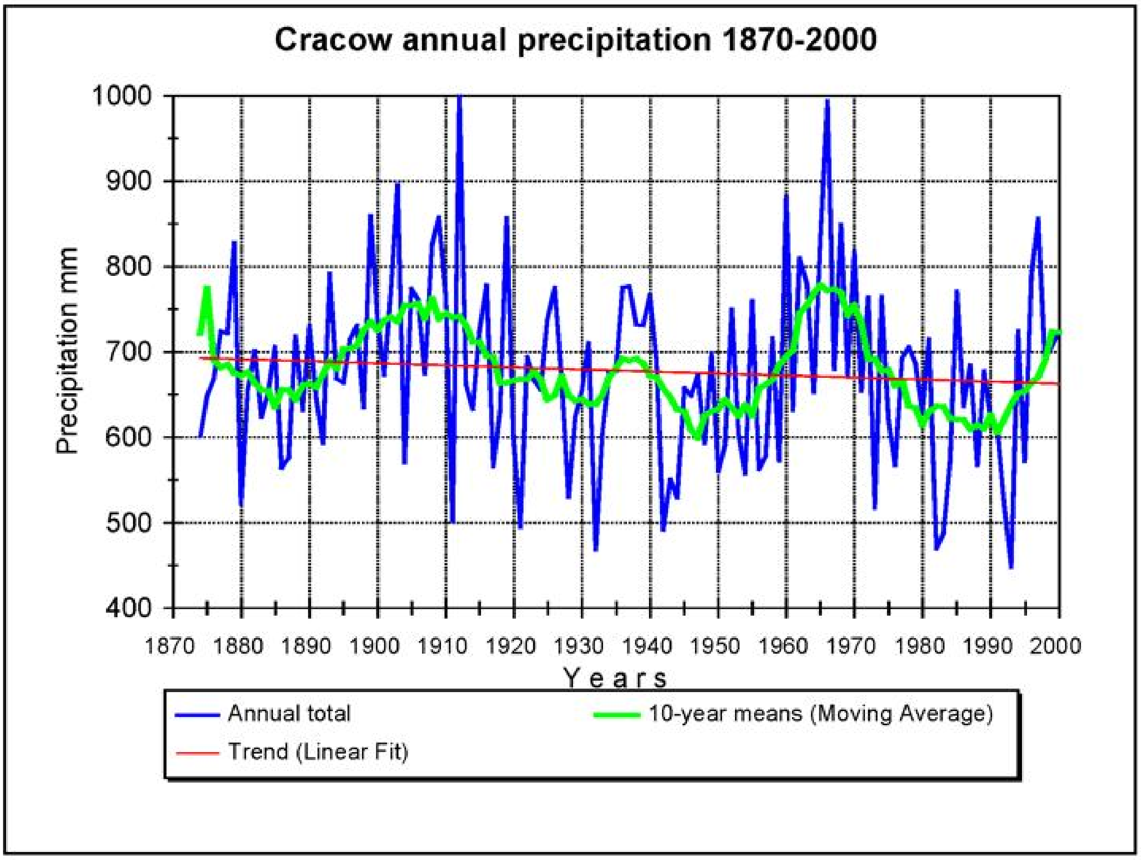
The yearly precipitation quantity average of the territory between 1991 and 2000 was close to the norms of 520 – 620 mm. The precipitation totals of some years oscillated between 400 mm (1994) and 890 mm (1998).

A special characteristic of the last decade was that of a higher temperature regime in **winter**, spring and summer. The average air temperature in winter was -0.9 – -2.3 °C, which is 0.2 – 1.4 °C warmer than usual. Out of 10 seasons, the average temperature exceeded the norm in 9 winters and only the 1995/1996 winter was anomalous cold. Its seasonal average temperature was lower than norm with 3 °C. The warmest winter was in 1993/1994, the average air temperature in Chisinau was 0.9 °C, as for some days in February the temperature reached 17.6 °C. In **spring** the seasonal average air temperature was 8.6 –10.1 °C, exceeding the norms with 0.5 °C. The warmest spring (exceeding the norms with 2 °C) was in 1994 and 2000; the coldest in 1991. The summer in this decade exceeded many years norms' with 0.5 – 0.9 °C and was 19.1 – 21.4 °C. The warmest **summer** was in 1999, the average of the seasonal temperature for the territory oscillated from 20.8 to 23.0 °C. The coldest summer of this decade was in 1993, the temperature was 17.5 – 20.3 °C. The **autumn** temperature regime (8.1 – 10.2 °C) was closer to many years norms. The autumn of 1994 was warmer, the air average temperature was between 9.7 and 11.7 °C. The coldest autumn was 1993 (6.4-8.7 °C).

Poland: Mean annual Temperature and Precipitation

Institute of Meteorology and Water Management, Kraków





Portugal: Climate in the 20th Century

Instituto de Meteorologia, Portugal

1. Introduction

One of the most relevant features of the climate in Portugal during the 20th century was the generalised increase in air temperature. The air temperature increase rate was larger in the growing towns, where there was a larger increase in time of the "urban island effect". When the mean trend related to the urban effect is removed, it is found that the mean air temperature has increased at a rate similar to the global warming rate for similar periods.
When the mean trends of air temperature increase are computed over the whole century, it is found that the maximum air temperature raise was larger than the increase rate in the minimum temperature. This implies an increase in the mean diurnal temperature range *DTR* over the century. Fig. 1 shows, as an example, the time series of the annual averages of minimum, maximum and mean air temperatures in Lisbon Geofisico from 1901 to 2000; the other secular time series show similar behaviour.
However, it is well known that, in recent years, the increase in minimum air temperature has been larger than the increase in maximum air temperature, that is, in the recent years the diurnal temperature range has decreased. This behaviour is generally interpreted as being associated with the increase of the greenhouse effect.
Several questions seem pertinent:

- When did the change in the sign of the trends in *DTR* occur?
- Did the change occur simultaneously in different places and regions?
- Did this change occur just in urban areas or is it a larger scale phenomenon?

2. Analysis of Portuguese Diurnal Temperature Range Time Series

The air temperature series from Lisbon - Geofisico and Coimbra – Geofisico, the best long series of air temperature in Portugal, were analysed to try to find at least preliminary answers to these questions. In Lisbon, the urban island effect is significant and has a considerable effect in the temperature rise; this has been found to be relatively small in Coimbra, a much smaller town.
The time series of *DTR* at Lisbon – Geofisico and Coimbra – Geofisico are represented in Fig. 2; the graph also shows the 5 years moving averages.
It is clearly visible that the series show opposite trends in the beginning and at the end parts. Also there is an acceleration in DTR increase near 1939 and a change of sign in the trends in the vicinity of 1945.
To locate the years of change in the signal of *DTR* two methods where used:

i) Locate the local maxima of moving averages (5 years).
ii) Identify trough Singular Spectral Analysis trends and slow variation principal components and use the time series reconstructed by using only these components to find the local maxima.

With the first method the inversion in the trends is estimated to occur in both series in 1945. With the second one the change is located between 1946 and 1947 for Lisbon and between 1947 and 1948 for Coimbra.
The metadata with the history of the two stations were checked.
For Coimbra there is no registered change in those years. In Lisbon, in 1941, there is a change in the thermometer height from 23.8 m to 1.6 m. This change should have produced a jump in *DTR* of about +0.08 ºC (small compared with the amplitudes of the *DTR* variation of the order of some ºC); however, it can not explain the change from an increasing trend to a decreasing trend in the *DTRs*.
In Fig. 3 the time series of diurnal temperature range in Lisbon – Geofisico and Coimbra – Geofisico are shown, together with the trend lines fitted from 1901 to 1945 and from 1946 to 2000. The trends, of +0.04ºC/year and –0.03ºC/year for Lisbon and of +0.06ºC/year and –0.03ºC/year for Coimbra, are statistically significant (level lower than 0.01).

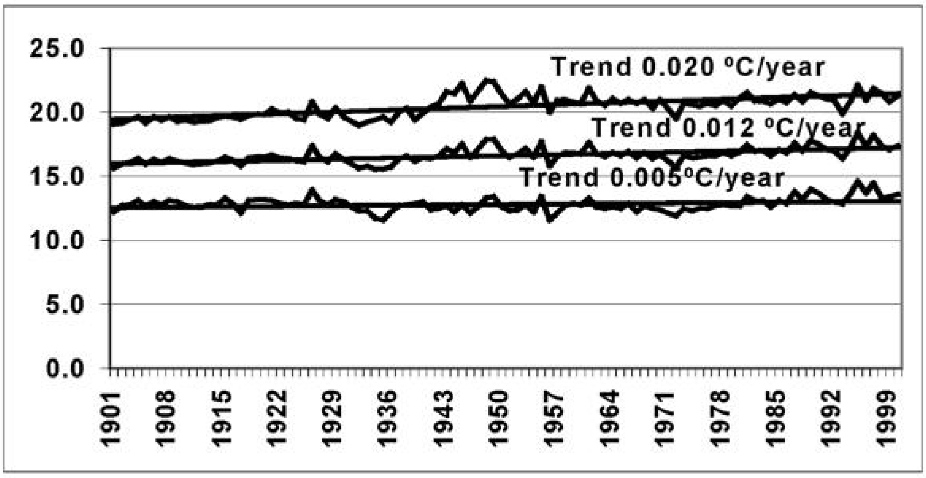


Fig. 1 *- Annual averages of minimum, maximum and mean air temperature at Lisbon and respective trendlines.*

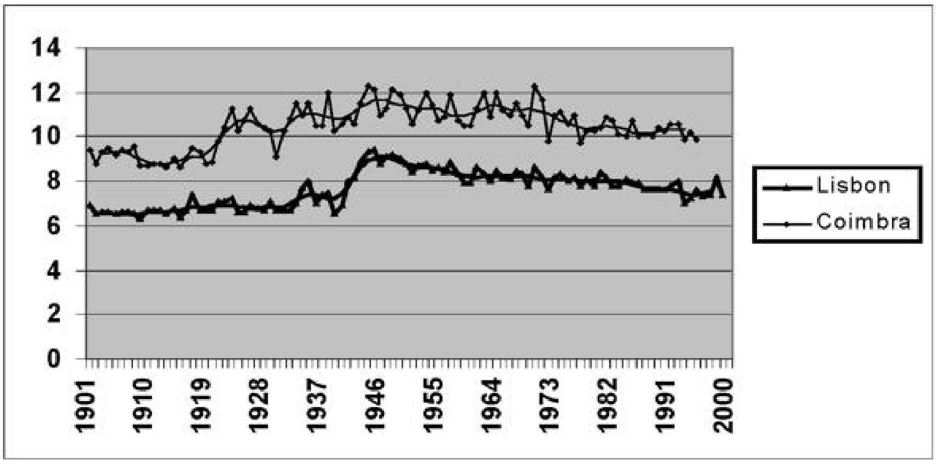


Fig. 2*: Annual averages of Diurnal Temperature Range at Lisbon and Coimbra and 5 years moving averages.*

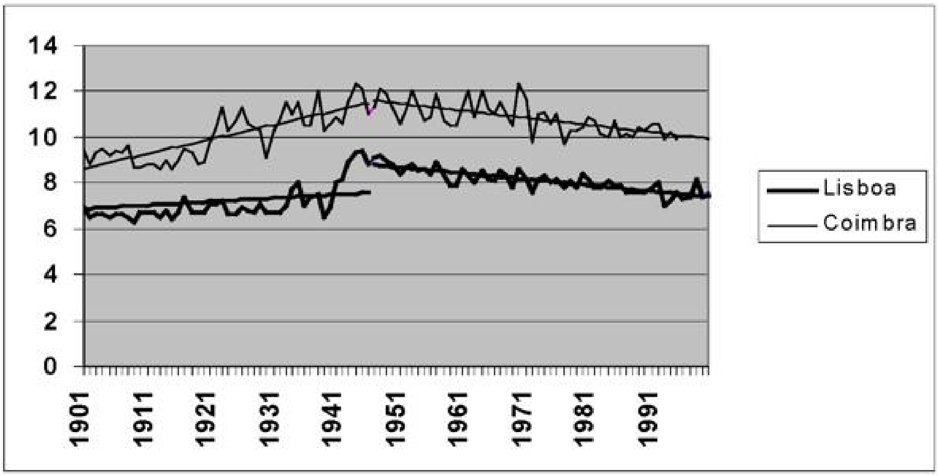


Fig. 3*: Annual averages of Diurnal Temperature Range at Lisbon and Coimbra.*
Trend from 1901 to 1945 and from 1946 to the end of the series.

3. Comparison with other European Series of Diurnal Temperature Range

A reversal of trends in *DTR* about the year of 1945, or in the just following years, similar to that observed in Portugal, can be found looking at the graphs of several other European climatological series of *DTR* that are available trough the European Climate Assessment (ECA). Some of those where this behaviour is most obvious are:
Basel Binningen (Switzerland), Stensele (Sweden), Praga Klementinum (Czech Republic) and Uccle (Belgium) – see Fig. 4.

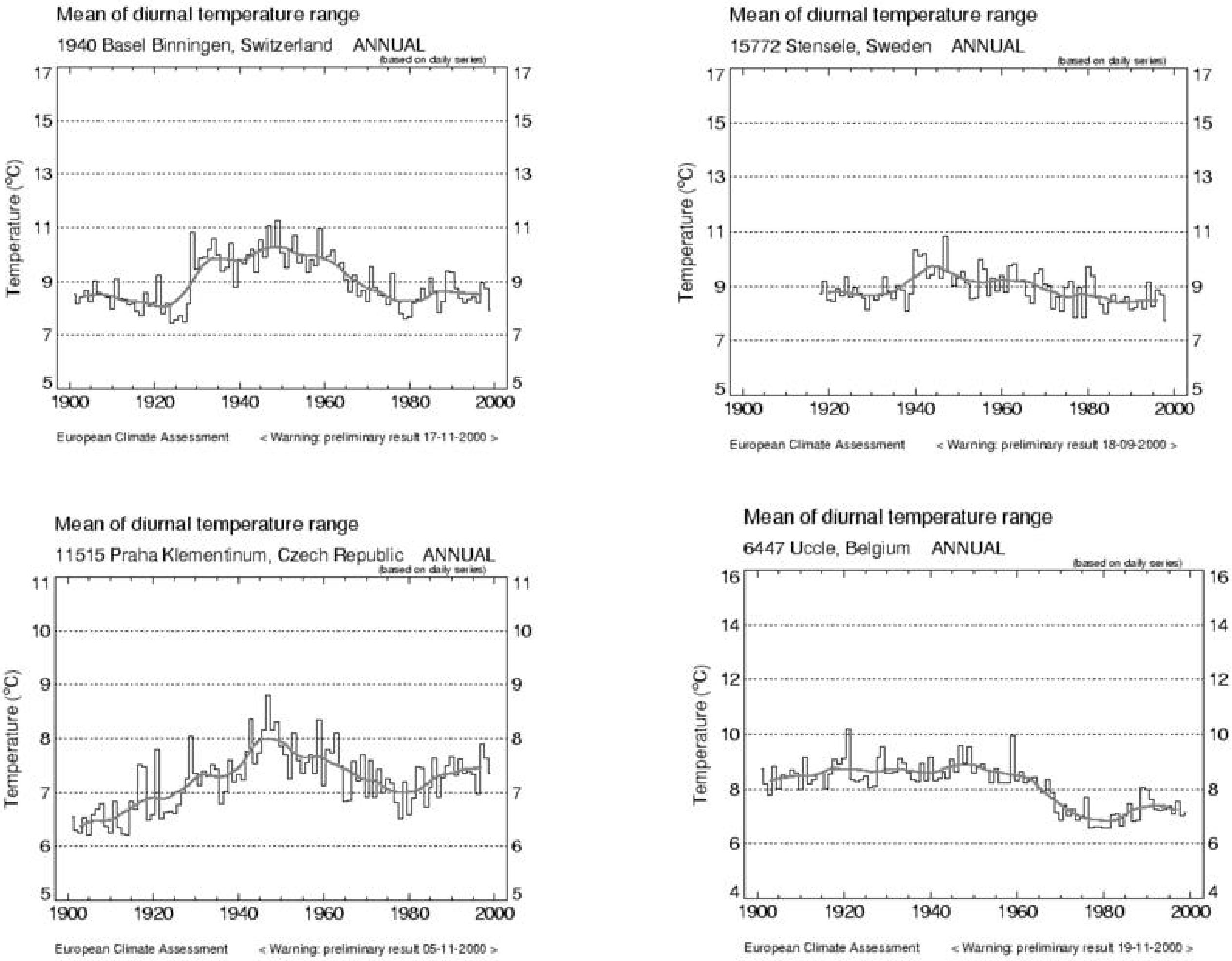


Fig. 4 - Annual averages of Diurnal Temperature Range at Basel Binningen (Switzerland), Stensele (Sweden), Praha Klementinum (Czech republic) and Uccle (Belgium).

SLOVAKIA: The Climate in Slovakia in the 20th Century

Climate Service Division of Slovakia

Significant increase in mean annual temperature by about 1.1 °C was observed in whole Slovakia in the 20th century. This increase can be illustrated also as the deviation of decade mean temperatures from the 1901-2000 average. In January 1991-2000 it was +1.5 °C and in August 1991-2000 it was +1.6 °C, but in December 1991-2000 the decrease by -0.1 °C and in September, October and November 1991-2000 the increase only by 0.4 °C was observed. Figure 1 shows the temporal development of annual temperature means. There can be seen exceptional high values between 1988 and 2000. Only the year 1996 can be considered as slightly below normal, the years 2000 and 1994 were in Slovakia probably the warmest since 1775. Frequent cold summers were observed in Slovakia in the 1901-1920 period and frequent cold winters occurred in the 1928-1947 period. The year 1940 was the coldest in the 20th century, but February 11, 1929 with -41 °C temperature measured at Viglas Pstrusa (central Slovakia) was the day with the lowest minimum temperature in Slovakia. Development and trends of annual precipitation totals show Figure 2. In southern Slovakia decreasing trends up to 15 % was observed in the 20th century. Some stations at the northern border of Slovakia have slightly increasing trends up to 5 %. The areal average annual precipitation totals calculated from 203 precipitation stations have decreasing trends by 5.8 % (Figure 2). The 1986-1993 period had the lowest precipitation totals in Slovakia in the 20th century. The Figure 3 illustrates an occurrence of the highest daily precipitation totals in Slovakia (Hurbanovo observatory). No significant trend in the maximum daily totals can be seen, some increase was observed in the 90ies. The absolute maximum daily total observed in Slovakia in the 20th century was 231.9 mm at Salka (lowland in southern Slovakia) on July 12, 1957. June 29, 1958 can be considered as the most rainy day in the 20th century with daily totals above 100 mm at 36 stations in Slovakia.

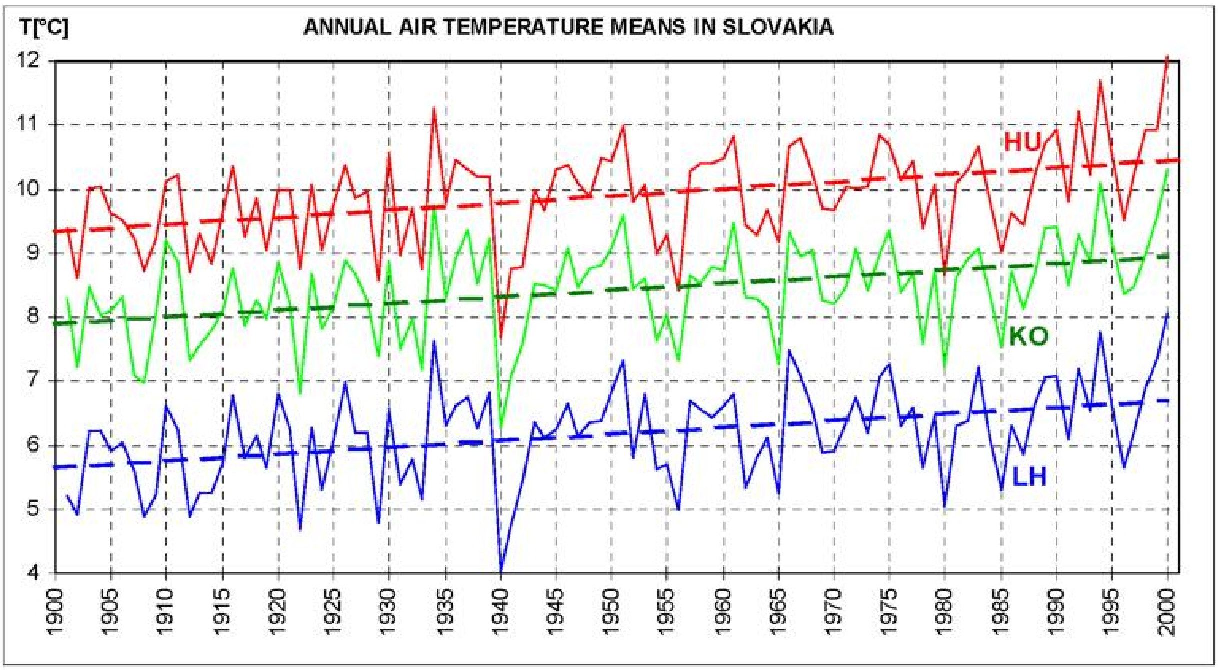


Fig. 1 *Annual air temperature means at the main climatological stations in Slovakia in 1901-2000 and linear trends (HU - Hurbanovo, SW Slovakia, 115 m a.s.l., 47°50'N, 18°12'E, KO - Košice, SE Slovakia, 230 m a.s.l., 48°40'N, 21°13'E, LH - Liptovský Hrádok, N Slovakia, 640 m a.s.l., 49°02'N, 19°44'E)*

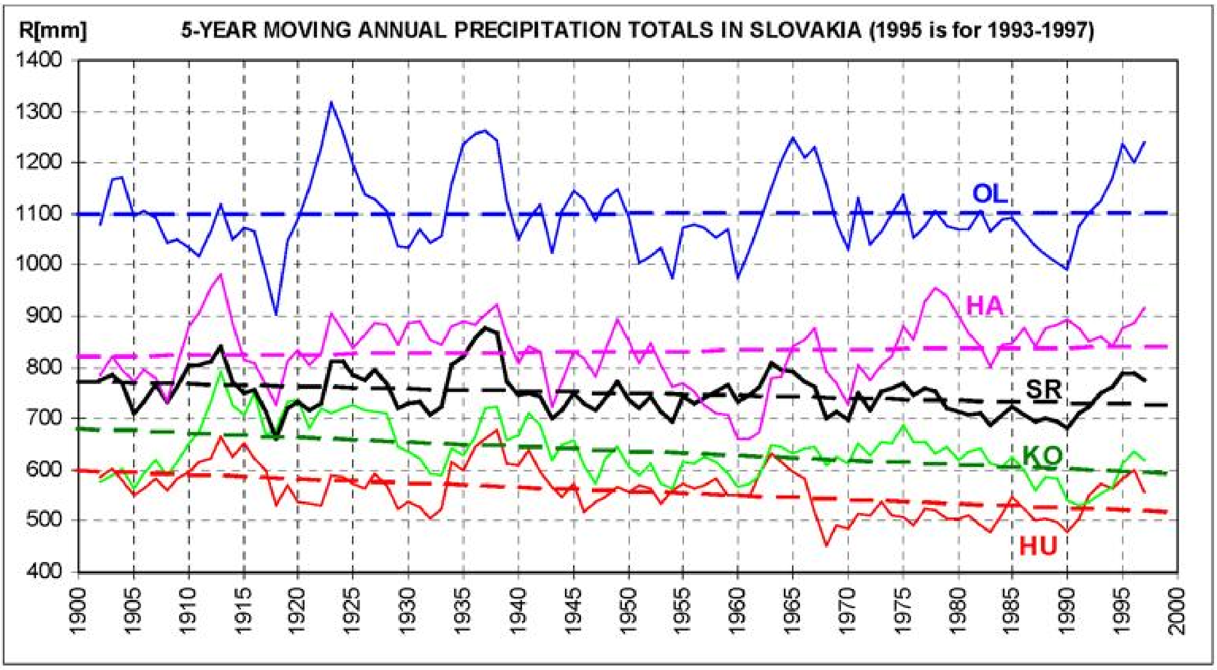


Fig. 2 *Five-year moving annual precipitation totals at the main precipitation stations in Slovakia in 1901-2000 and linear trends (HU - Hurbanovo, SW Slovakia, 115 m a.s.l., 47°50'N, 18°12'E, KO - Košice, SE Slovakia, 230 m a.s.l., 48°40'N, 21°13'E, SR - areal average from 203 stations in Slovakia calculated by double weighted averages method, HA - Habura, NE Slovakia, 372 m a.s.l., 49°19'N, 21°52'E, OL - Oravská Lesná, 780 m a.s.l., 49°22'N, 19°11'E)*

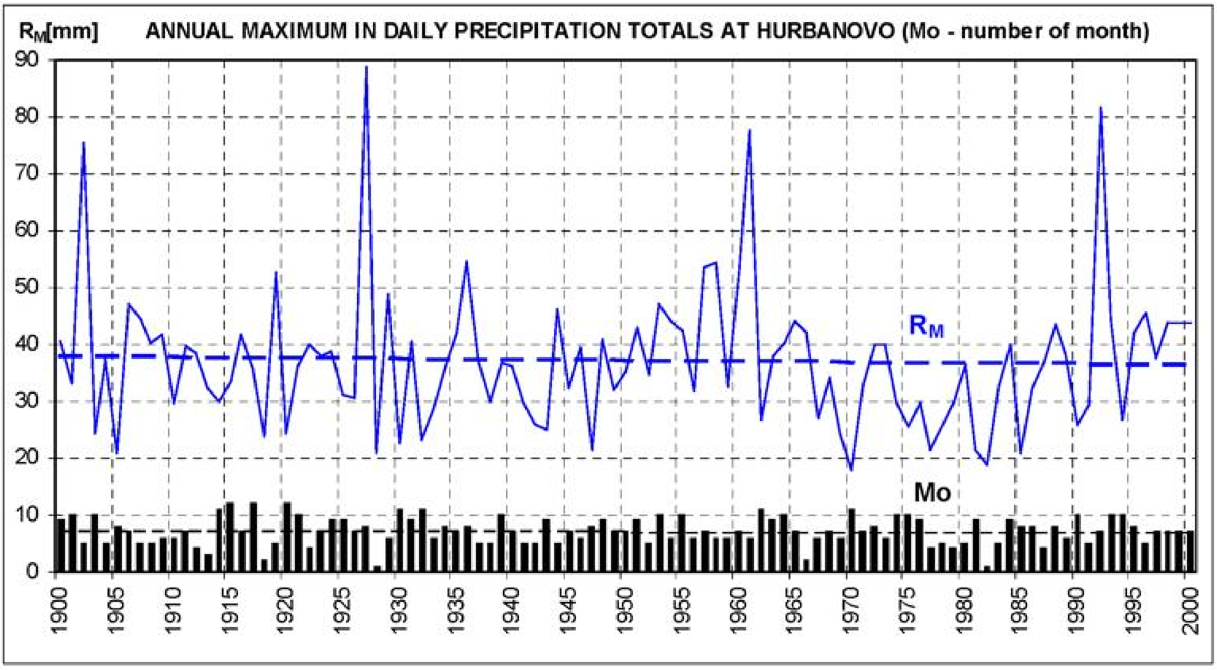


Fig. 3 *Annual maximum in daily precipitation totals at Hurbanovo 1901-2000 (R_M) and linear trend, number of month with maximum daily total (Mo); Hurbanovo, SW Slovakia, 115 m a.s.l., 47°50'N, 18°12'E, Mo = 12 (December), Mo = 7 (July); no significant trends in R_M and Mo values was observed*

Sweden:

see Annual Bulletin on the Climate in WMO Region VI - 1999, pages: 50-51

United Kingdom: Temperature Anomalies in Central England between 1878 and 2000

UK Meteorological Office

A century time-scale perspective on Central England Temperature is given in the following figure. Analyses indicate that about a quarter of the warming in recent decades has arisen because of changes in atmospheric circulation. The series has been designed to avoid urban warming, and the absence of this is confirmed by the equality of warming trends on calm days (when any urban warming would be most evident) and windy days (when any urban warming would be dissipated).

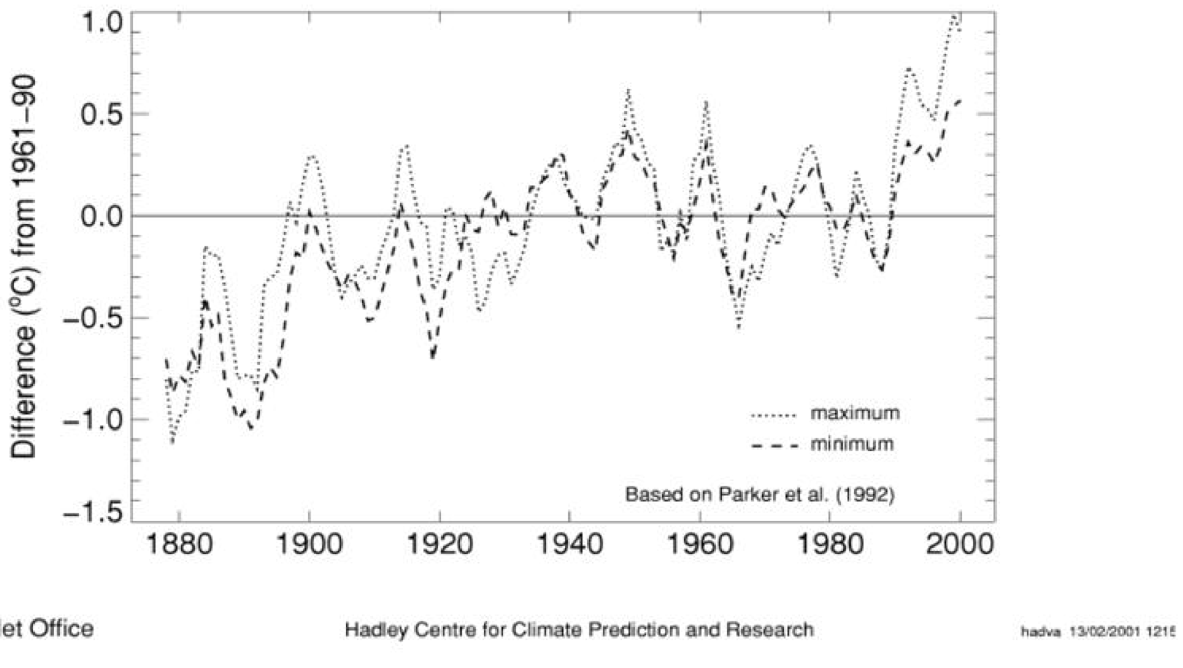


Fig. xx: *Central England maximum and minimum air temperature annual anomalies between 1878 and 2000*