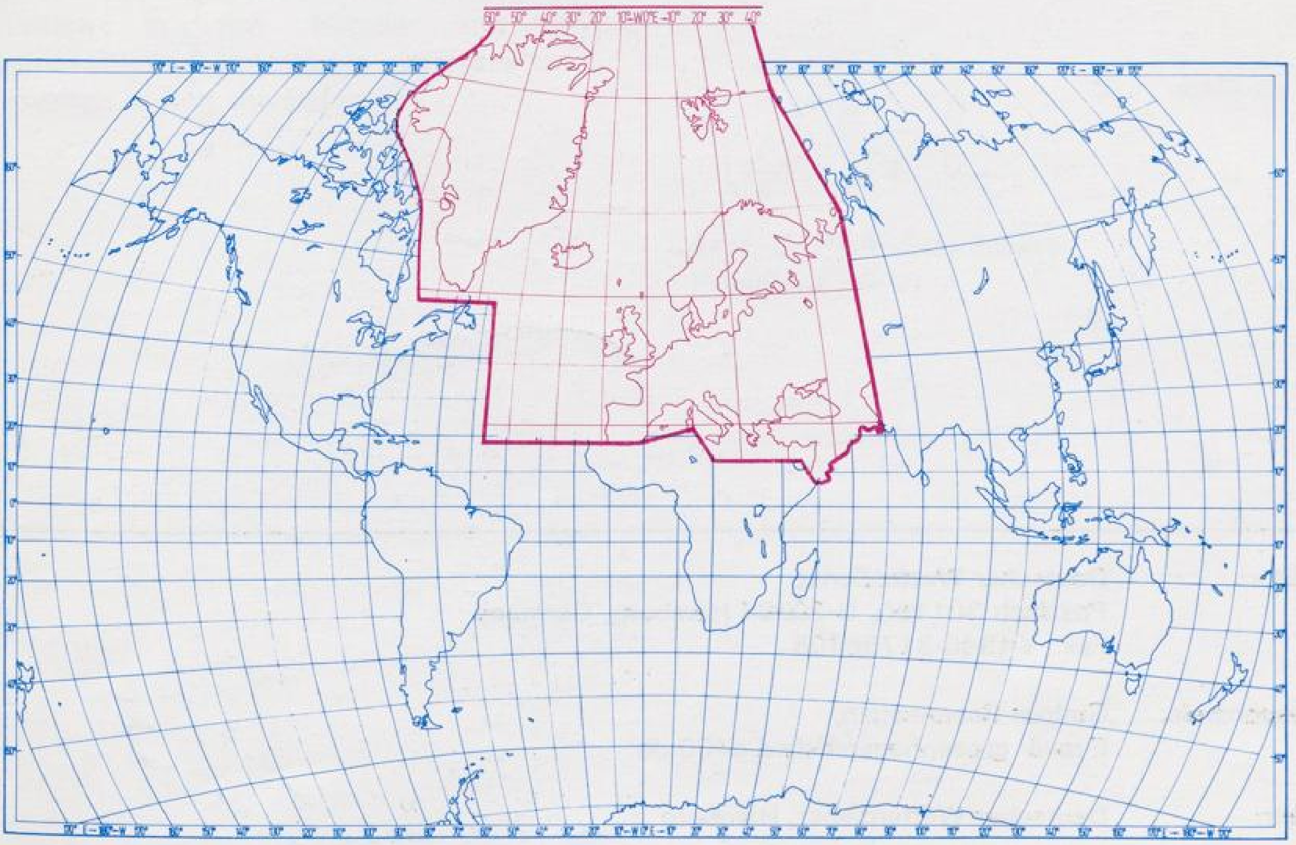
European Climate Support Network

World Meteorological Organization
World Climate Data and Monitoring Programme

Deutscher Wetterdienst

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

1996



Annual Bulletin on the Climate in WMO Region VI -Europe and Middle East- 1996

The bulletin is a summary of the information co-ordinated by Deutscher Wetterdienst, Germany, with input from the national weather services in:

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Turkey
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Furthermore, contributions to the WMO Bulletin article on consequences of abnormal weather in 1996 were referred from the following countries:
Austria, Georgia and Moldavia.

List of Contents:

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Foreword

One of the most significant climate-related meetings held in Region VI in 1996 was that of the Second Conference of the Parties to the United Nations Framework Convention on Climate Change which met in Geneva in July. One of the important results of the meeting was the recognition of the 1995 Second Assessment Report of the WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) as "the most comprehensive and authoritative assessment now available of the scientific and technical information regarding global climate change". According to the findings of the IPCC, the global average surface temperature relative to 1990 is projected to increase by about 2 °C (between 1 °C and 3.5 °C) by the year 2100.

Continued research and regional monitoring of the climate are needed to better comprehend and prepare for the regional implications of this projected global warming. It is intended that this third edition of the bulletin continue to provide recent information on state of the climate in the Region and on achievements in climate analysis and research during the past year.

Another important meeting in the Region last year was the first European Conference on Applied Climatology held in Norrköping, Sweden in May (for details, see page 44). Following the success of this first conference, the 2nd European Conference on Applied Climatology is being planned to be held in Vienna, Austria from 22-25 September 1998. Its purpose will be similar to the first in providing a platform for the interdisciplinary exchange of information on climate and climate prediction to enable the user community to make informed decisions in support of sustainable development and protection of the environment.

WMO is pleased to be a co-sponsor of this publication along with Germany and the European Climate Support Network (ECSN). The contributions of material from 37 WMO Member countries in the Region and the co-ordination and preparation of the document by Germany were greatly appreciated.

Prof. Dr Peter Steinhauser
President RA VI

Summary

At the end of 1995, a strong change in the North Atlantic Oscillation towards increased meridionality took place which was very well reflected in a substantial shift of temperatur and precipitation patterns. For the first time, after a series of ten or even more years with above-normal temperatures and after the two outstanding warm years 1994 and 1995, sub-normal temperatures dominated Region VI in 1996. It was a cold winter and spring over much of Europe with a bitterly cold end of the year. There were contrasting precipitation regimes. The Atlantic low pressure systems, repeatedly blocked by a strong anticyclone over continental Eurasia, moved towards the Mediterranean bringing copious quantities of rain and much-needed relief to the Iberian Peninsula that had been plagued by extreme dryness for the previous six years. However, excessive rain also resulted in local destructive flooding. In contrast, from the UK across central Europe to Russia, it was extremely dry, the driest year at several locations since regular observations began.

Important news for climatologists from the European Centre for Medium-Range Weather Forecast: the reanalyses of global atmospheric data has been performed and is available for climate research for the period December 1978 to February 1994 (see page 37).

Co-operation within the European climatological community continued. A number of European climatological conferences were held, including the First European Conference on Applied Climatology in Norrköping (see page 44). Some international projects started, others continued successfully. Good progress was reported from REWARD (Relating Extreme Weather to Atmospheric Circulation using a Regionalised Dataset), BALTEX (Baltic Sea Experiment), WASA (Waves and Storms in the North Atlantic) (see page 39), among others.

Annual survey

1996 was colder than normal over most parts of continental Europe (see fig. 1). In many places it was the coldest year since 1985, and in Austria, the coldest since 1965. Positive anomalies prevailed only in the far south- and northeast of the Region. For Cyprus it was the 8th warmest year since observations started in 1896 (see fig. 3e, page 6).
The cold annual means were due to a long and relatively cold winter at most places (see page 14). This can be seen very well in figure 2, describing the areal mean surface temperatures of the North Sea between 1971 and 1996. In 1996, from January to the end of July, it was the coldest year of the period. The maximum annual ice extent in the Baltic Sea returned to normal after 8 mild years (see fig. 4, page 7).

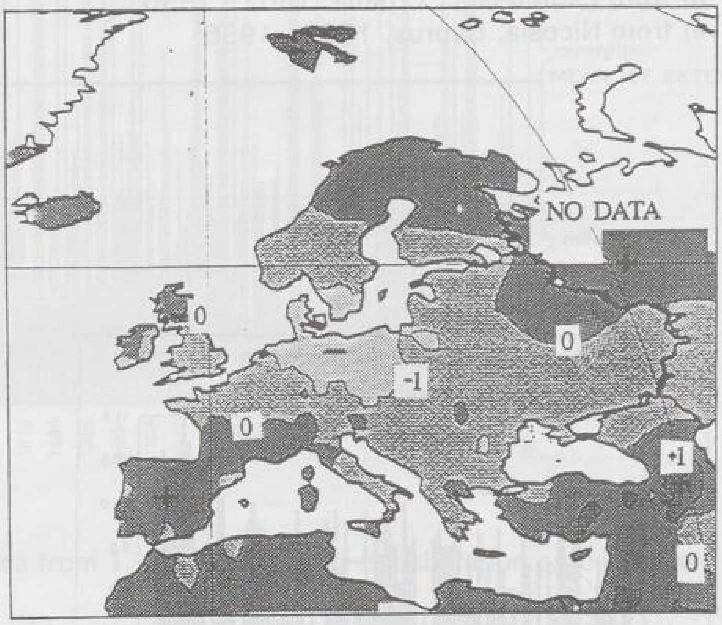


Fig. 1: Annual temperature anomalies in °C in 1996
Reference period: 1961-1990
(Source: Deutscher Wetterdienst)

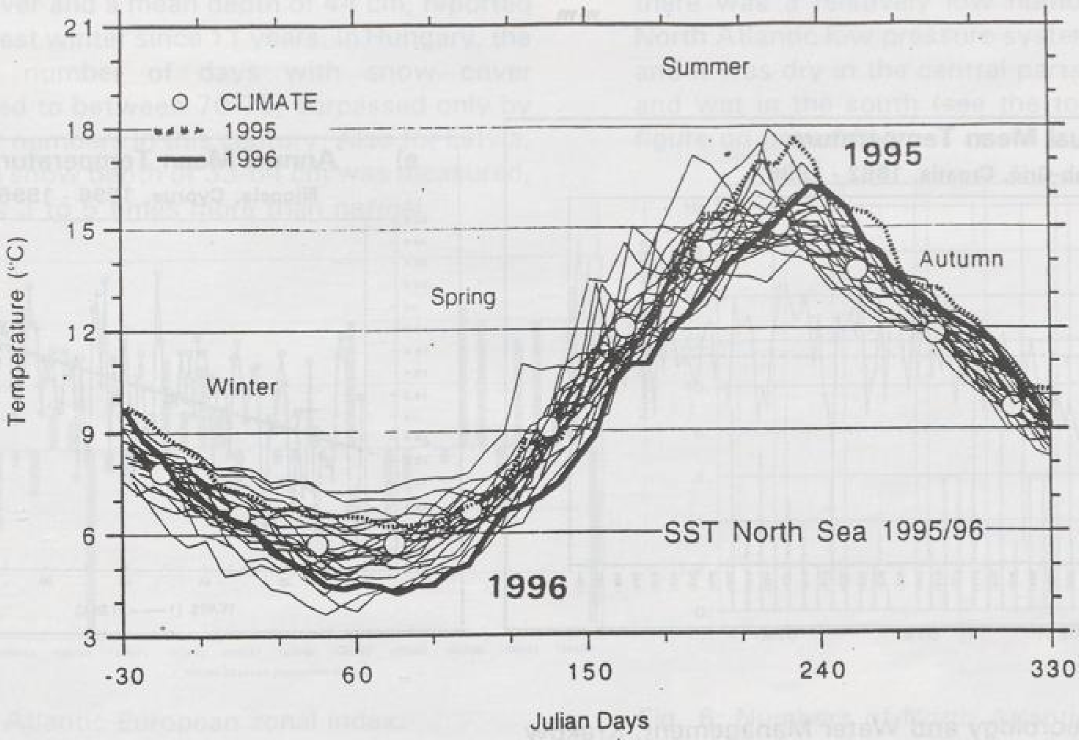
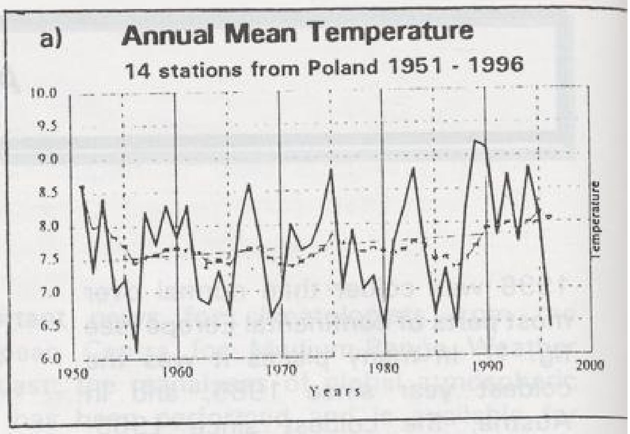
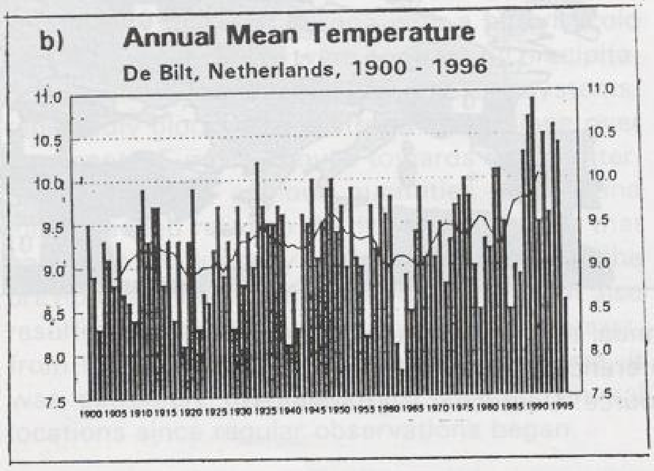


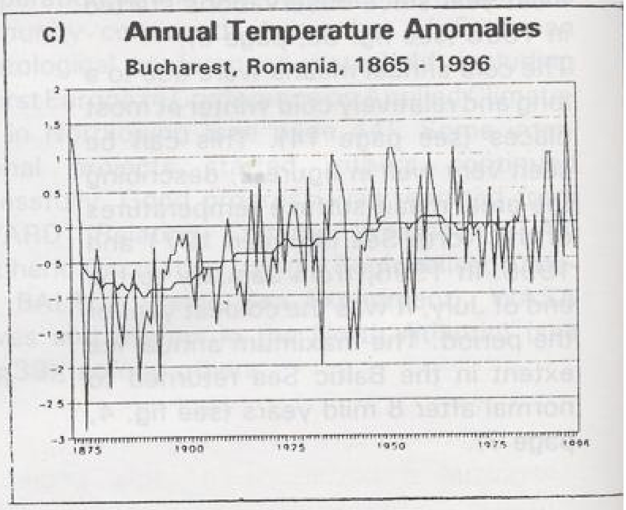
Fig. 2: Seasonal cycle of the areal mean SST of the North Sea from Dec. 1995 through Nov. 1996, superimposed on the ensemble of corresponding cycles between 1971 and 1996 (heavy line: Dec. 1995 - Nov. 1996, hatched line: Dec. 1994 - Nov. 1995, circles: 1971-93 means) (Source: Bundesamt für Seeschiffahrt und Hydrographie, Germany)

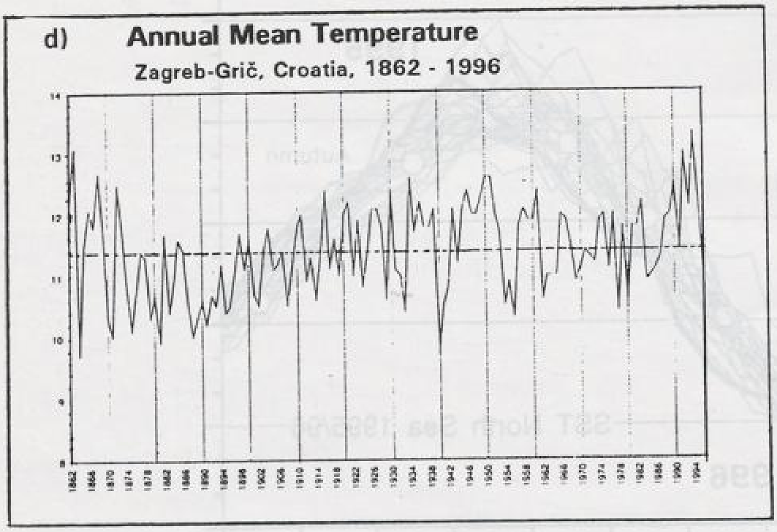
Fig. 3:
Annual mean temperatures or temperature anomalies:

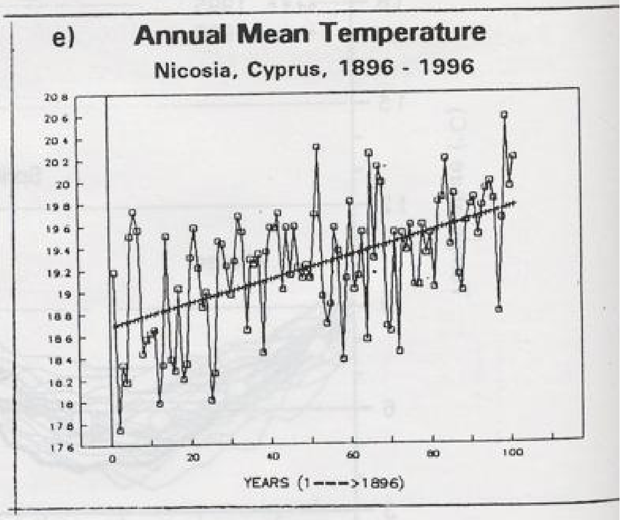
a) from 14 stations in Poland, 1951- 1996
b) from De Bilt, Netherlands, 1900 - 1996
c) from Bucharest, Romania, 1865 - 1996
d) from Zagreb-Grič, Croatia, 1862 - 1996
e) from Nicosia, Cyprus, 1896 - 1996











Source:
a) Inst. of Meteorology and Water Management, Krakow
b) KNMI, De Bilt
c) National Institute of Meteorology and Hydrology, Bucharest
d) Meteorological and Hydrological Service, Zagreb
e) Meteorological Service, Nicosia

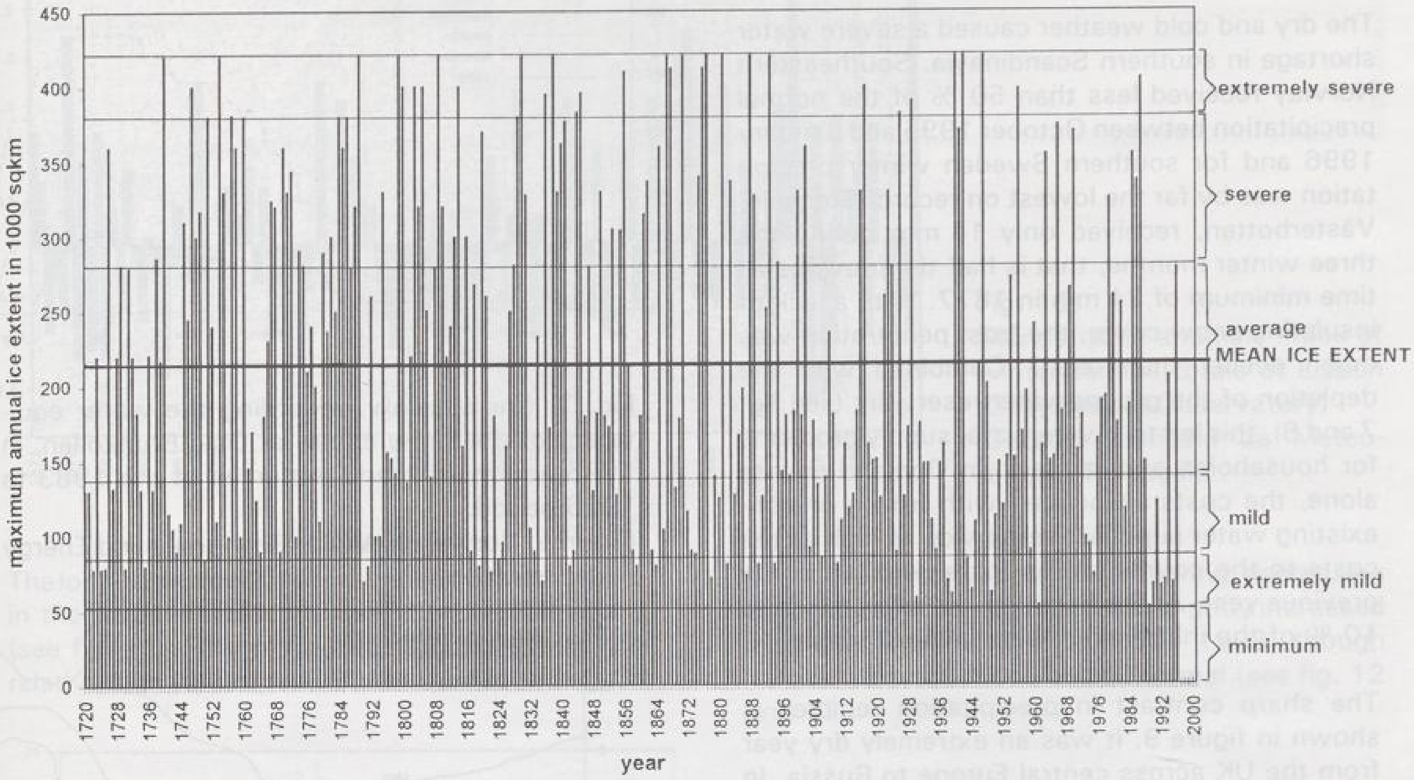


Fig. 4: Maximum annual ice extent in the Baltic Sea from 1720 to 1996 and classification of ice-winters after Seinä and Palosuo
(Source: Finnish Institute of Marine Research)

For Romania, though not particularly cold, it was the longest winter in the history of meteorological observations. Vienna, Austria, with 85 days of snowcover and a mean depth of 44 cm, reported the coldest winter since 11 years. In Hungary, the average number of days with snow cover amounted to between 70-75, surpassed only by 3 higher numbers in this century. Also for Latvia, extreme snow depth of 33-64 cm was measured, which is 3 to 5 times more than normal.

It is not surprising that winter 95/96 was influenced by an unusually high frequency of meridional weather situations (see fig. 5). Also, there was a relatively low number of extreme North Atlantic low pressure systems (see fig. 6), and it was dry in the central parts of the Region and wet in the south (see the top panel of the figure on page 18).

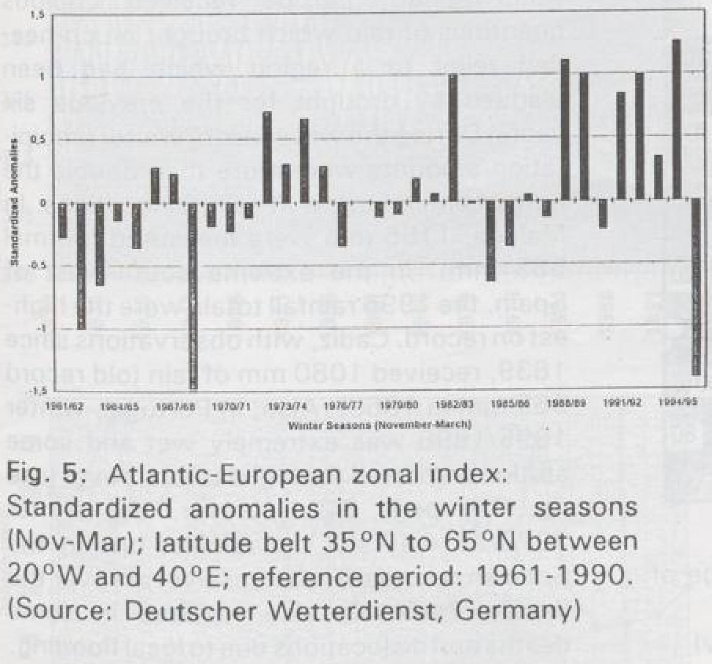


Fig. 5: Atlantic-European zonal index: Standardized anomalies in the winter seasons (Nov-Mar); latitude belt 35°N to 65°N between 20°W and 40°E; reference period: 1961-1990.
(Source: Deutscher Wetterdienst, Germany)

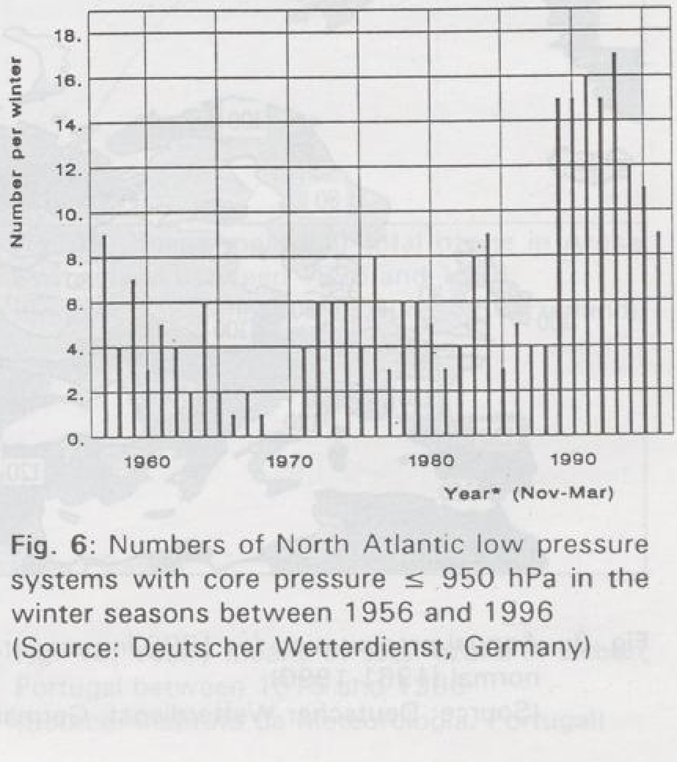


Fig. 6: Numbers of North Atlantic low pressure systems with core pressure ≤ 950 hPa in the winter seasons between 1956 and 1996
(Source: Deutscher Wetterdienst, Germany)

The dry and cold weather caused a severe water shortage in southern Scandinavia. Southeastern Norway received less than 50 % of the normal precipitation between October 1995 and January 1996 and for southern Sweden winter precipitation was by far the lowest on record. Stensele, Västerbotten, received only 14 mm during the three winter months, that is half the previous all time minimum of 24 mm in 1877. With a lack of insulating snow cover, the frost penetration was much deeper than usual. Combined with the depletion of the groundwater reservoirs (see fig. 7 and 8), this led to severe water supply problems for households and farmers. In Oppland county alone, the costs associated with frozen or non-existing water supplies were twice as high as the costs to the county of the extreme flood in the previous year. At the height of the crisis, close to 10 % of the inhabitants were without water.

The sharp contrast in precipitation regimes is shown in figure 9. It was an extremely dry year from the UK across central Europe to Russia. In Belgium, the period from July 1995 to July 1996 was the driest since regular observations began in 1833. For England and Wales, it was the third driest year since records began in 1766. Also, the far southeast of the Region was much drier than normal. In Cyprus, the slightly below normal precipitation (about 90 % of normal) and the dry weather in 1995 (51 % of normal), seriously affected the water resources of the island. And in Israel, during the last 70 years, only three years were drier in the September to December period.

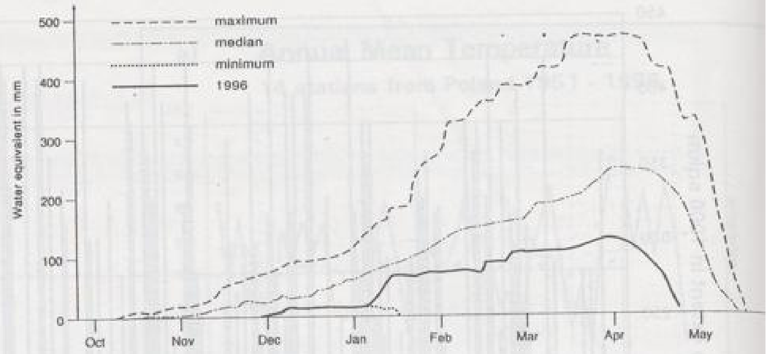


Fig. 7: Snow pillow, recording the water equivalent of the snow cover, at Oslo-Brunkollen, in 1996 and median and extremes of the 1983 to 1996 period.
(Source: Norwegian Water Resources and Energy Administration)

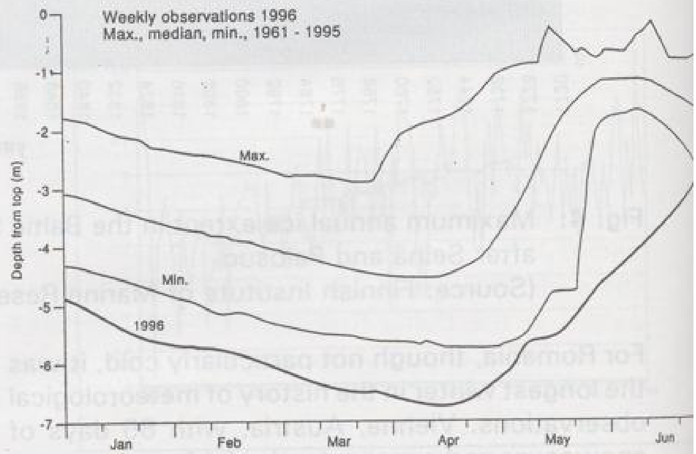


Fig. 8: Ground water levels in a well in Tisleifjord, southern Norway, in the first half of 1996 and median and extremes of the 1961 to 1995 period.
(Source: Norwegian Water Resources and Energy Administration)

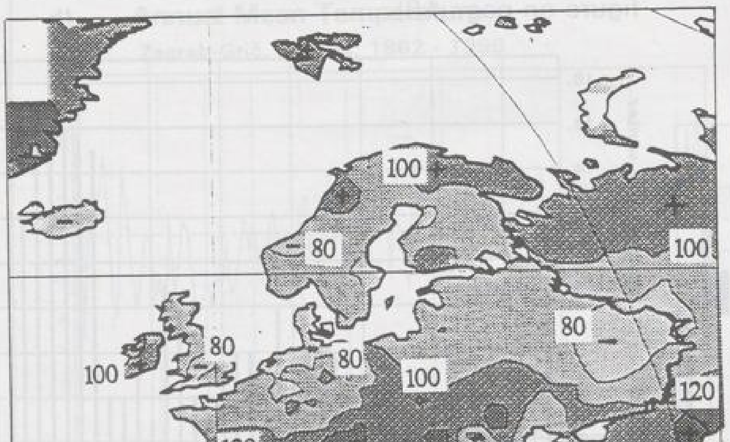


Fig. 9: Annual precipitation for 1996 in percentage of normal (1961-1990)
(Source: Deutscher Wetterdienst, Germany)

Southwestern Europe received copious quantities of rain which brought much-needed relief to a region which had been plagued by drought for the previous six years. During the wet season, winter precipitation amounts were more than double the normal annual totals at several locations. In Malaga, 1155 mm were measured (normal 583 mm). In the extreme south-west of Spain, the 1996 rainfall totals were the highest on record. Cadiz, with observations since 1839, received 1080 mm of rain (old record 969 mm in 1969). Also, in Portugal, winter 1995/1996 was extremely wet and some stations reported the highest totals ever (see fig. 10, page 9). However, the winter 1978/79 was still the rainiest one in the Spanish records. The excessive rain over the Iberian Peninsula also resulted in some deaths and dislocations due to local flooding.

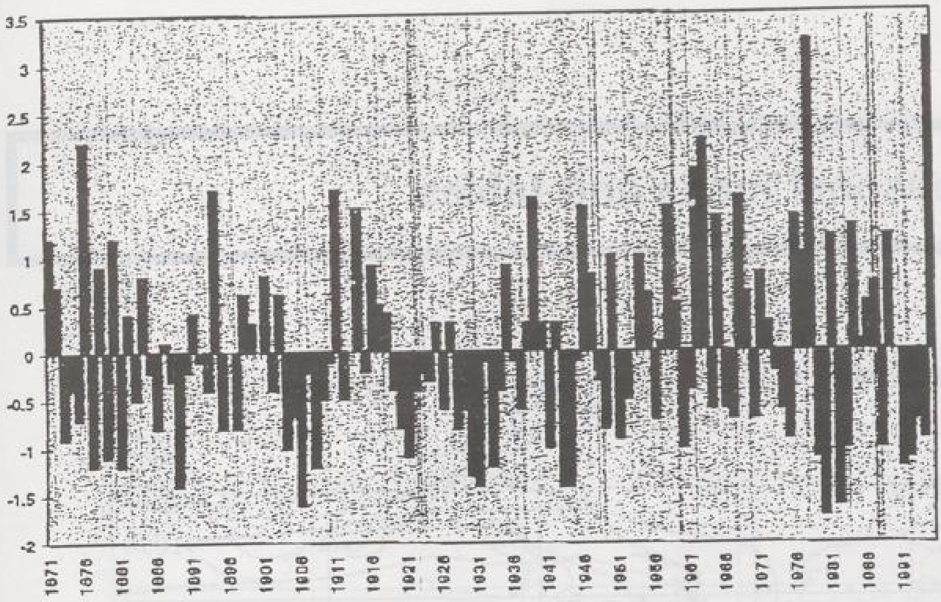


Fig. 10:
Standardized anomaly index of winter rainfall totals at Lisbon (Geophysical Observatory)
(Source: Instituto de Meteorologia, Portugal)

The long-term trend of rising ozone concentrations in the troposphere continued during all seasons (see fig. 11). The remarkable increase since the relative low values in 1993/94 carried on.

Total ozone concentration, showing decreasing tendency over the last decades, slightly increased after the extreme low values in 1993, though values were still much below normal (see fig. 12 and 13).

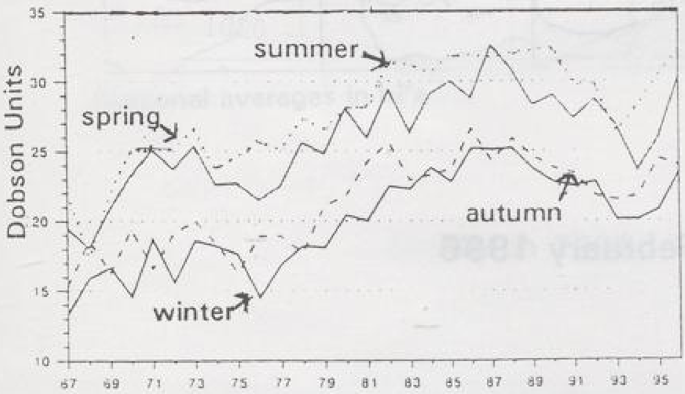


Fig. 11: Seasonal means of tropospheric (1-8 km) ozone in Hohenpeißenberg, Germany between 1967 and 1996
(Source: Deutscher Wetterdienst, Germany)

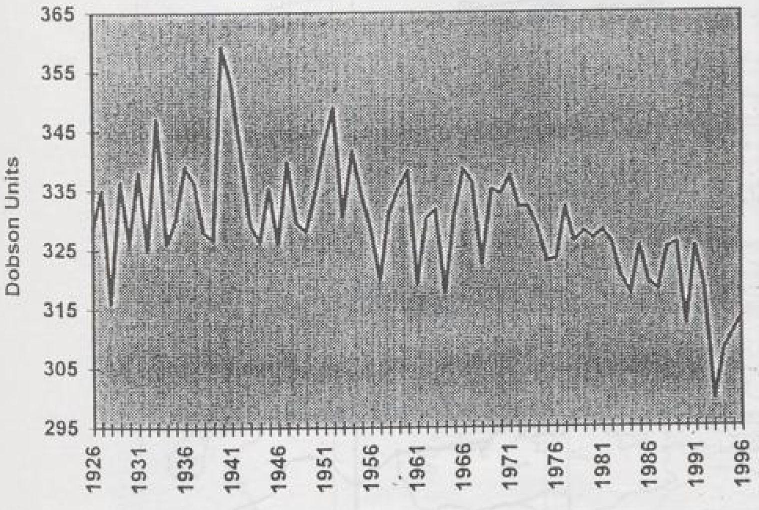


Fig. 12: Yearly means of total ozone in Arosa, Switzerland between 1926 and 1996
(Source: J. Staehelin, ETH Zürich, Switzerland)

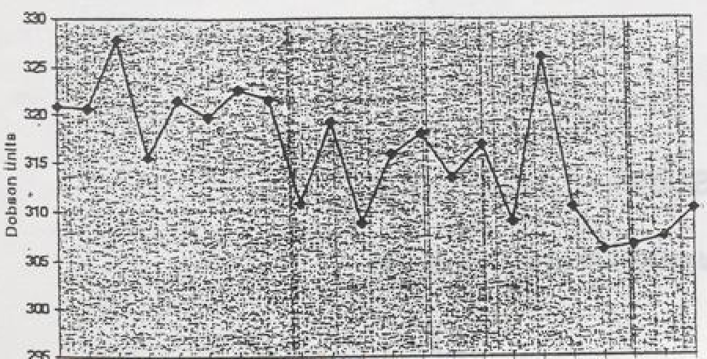
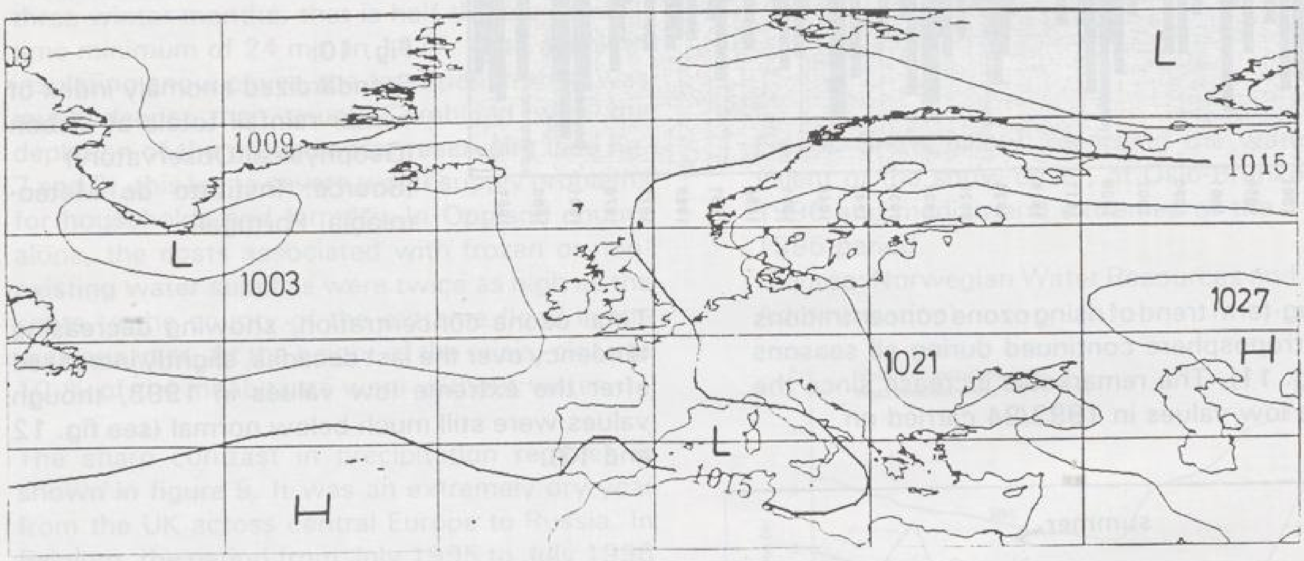


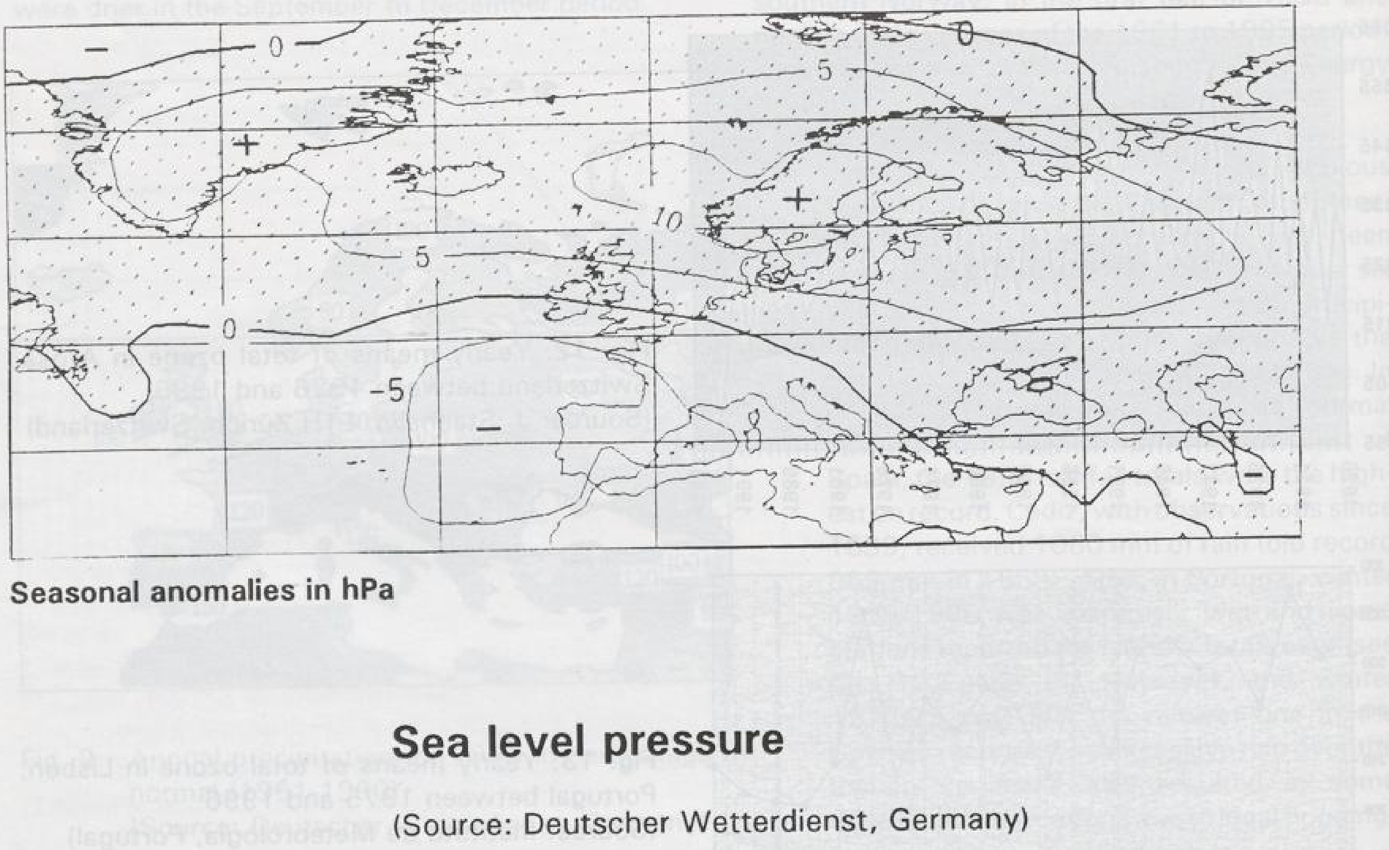
Fig. 13: Yearly means of total ozone in Lisbon, Portugal between 1975 and 1996
(Source: Instituto de Meteorologia, Portugal)

Seasonal maps and tables



Seasonal averages in hPa

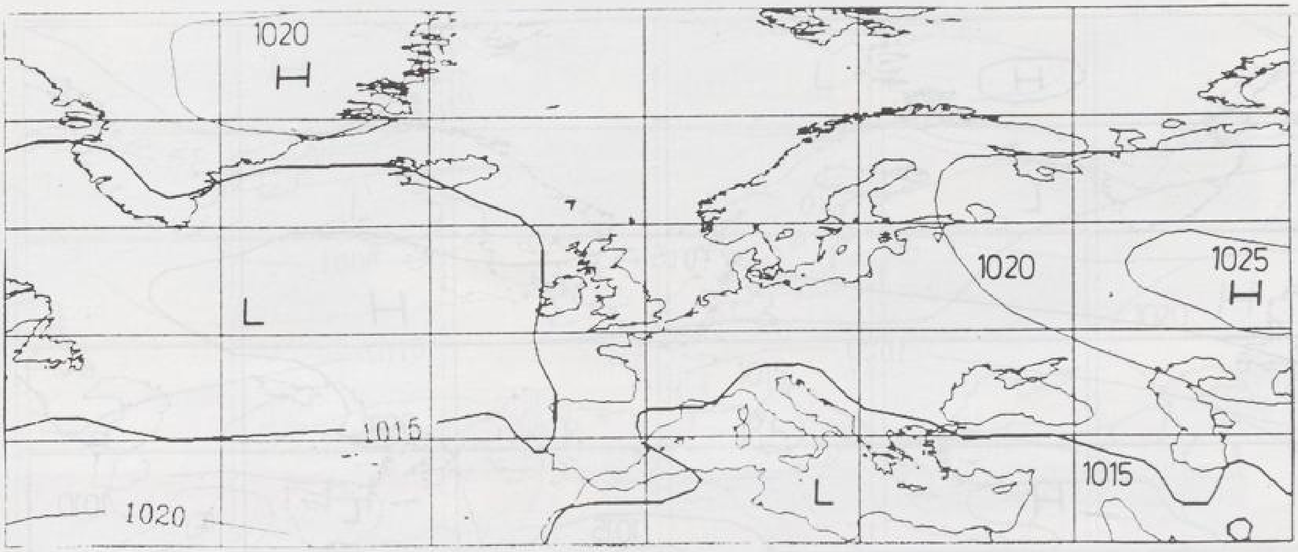
December 1995 - February 1996



Seasonal anomalies in hPa

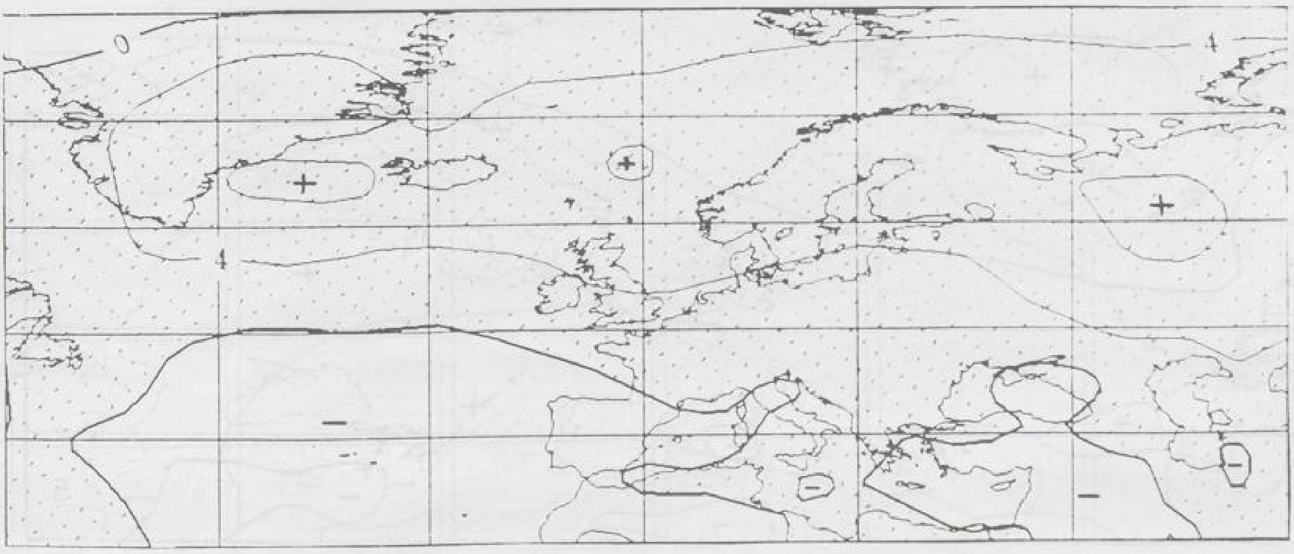
Sea level pressure

(Source: Deutscher Wetterdienst, Germany)



Seasonal averages in hPa

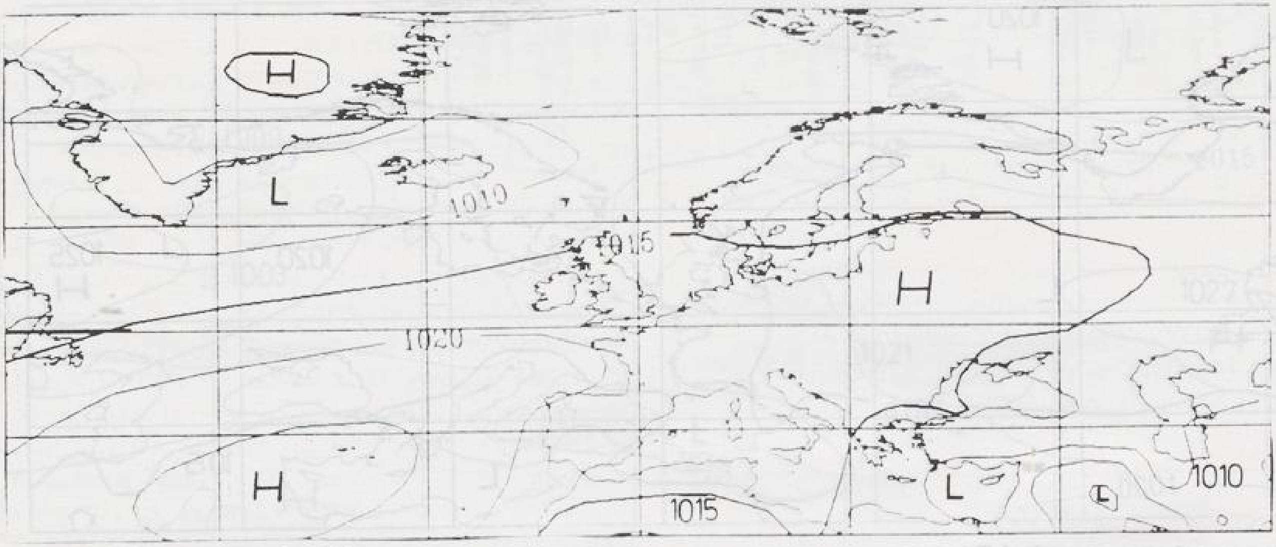
March 1996 - May 1996



Seasonal anomalies in hPa

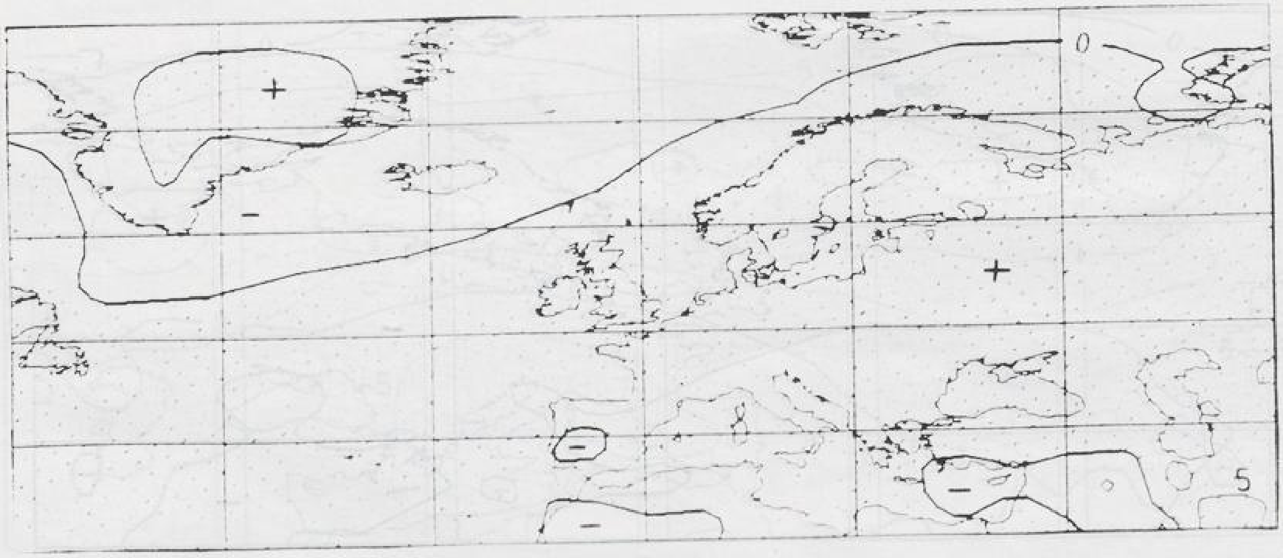
Sea level pressure

(Source: Deutscher Wetterdienst, Germany)



Seasonal averages in hPa

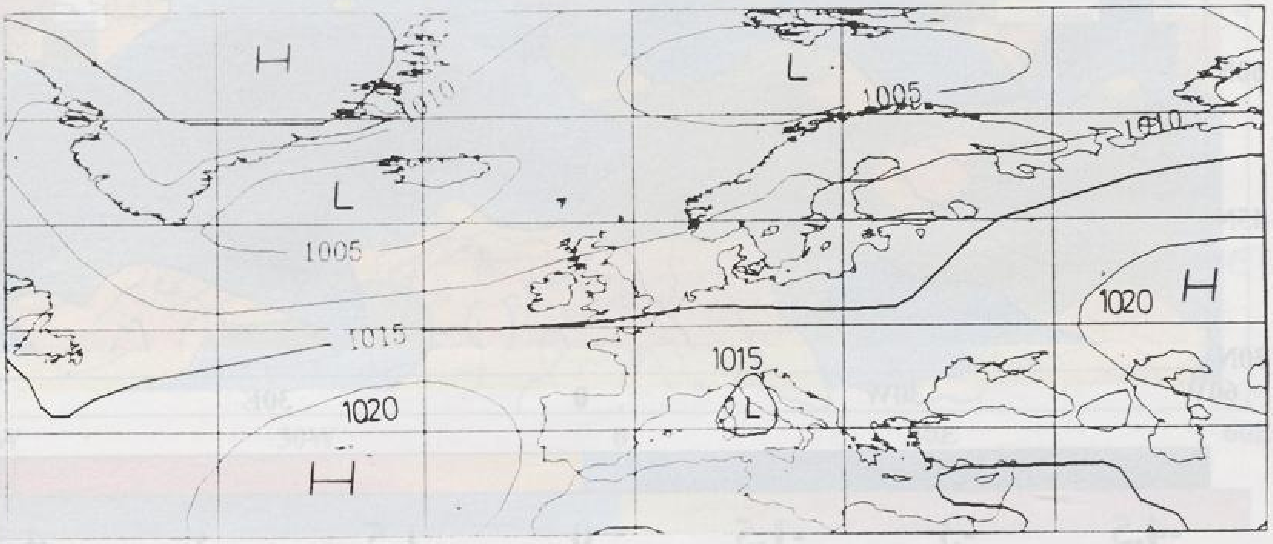
June 1996 - August 1996



Seasonal anomalies in hPa

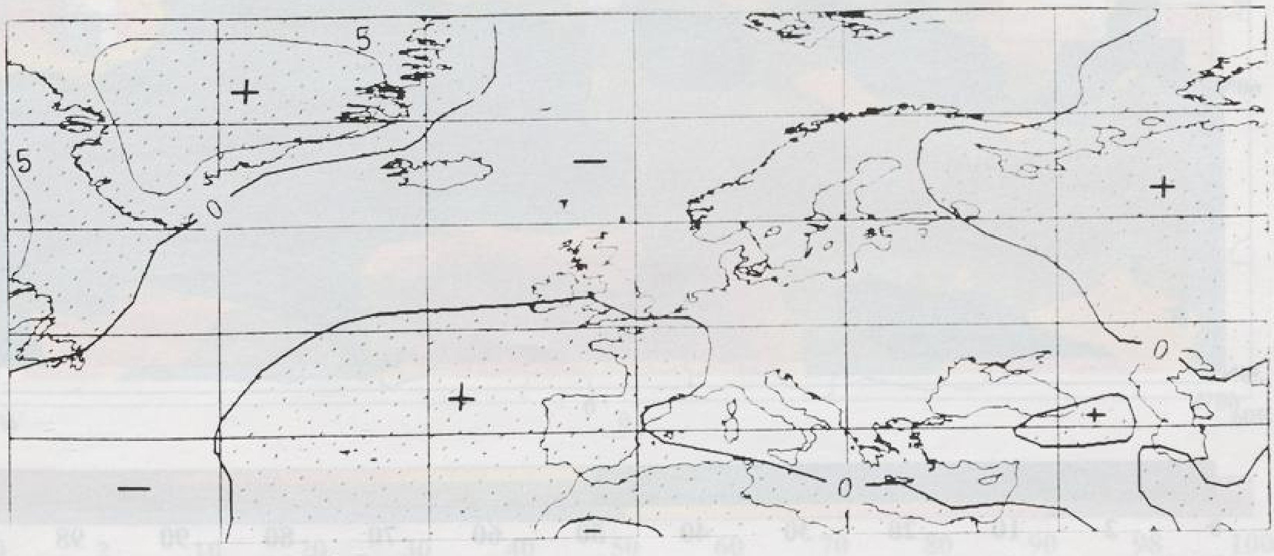
Sea level pressure

(Source: Deutscher Wetterdienst, Germany)



Seasonal averages in hPa

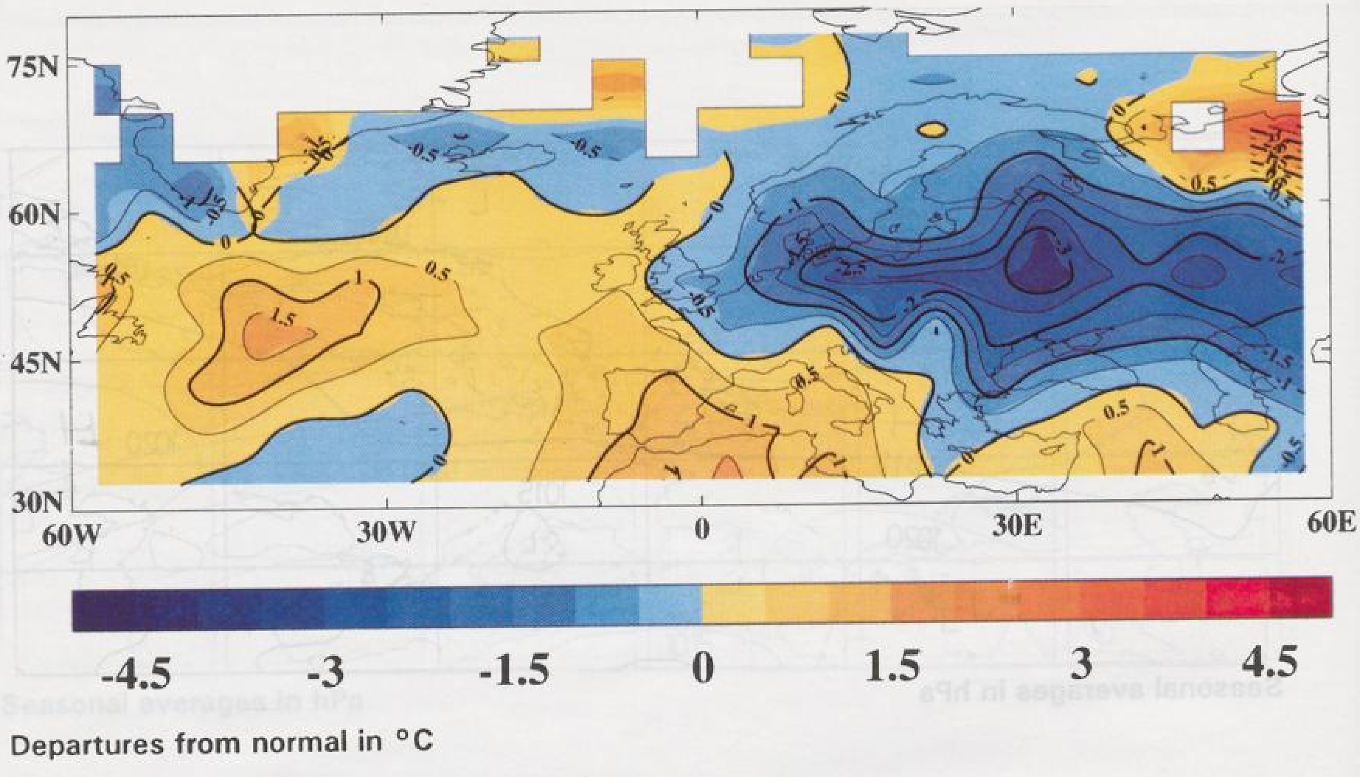
September 1996 - November 1996



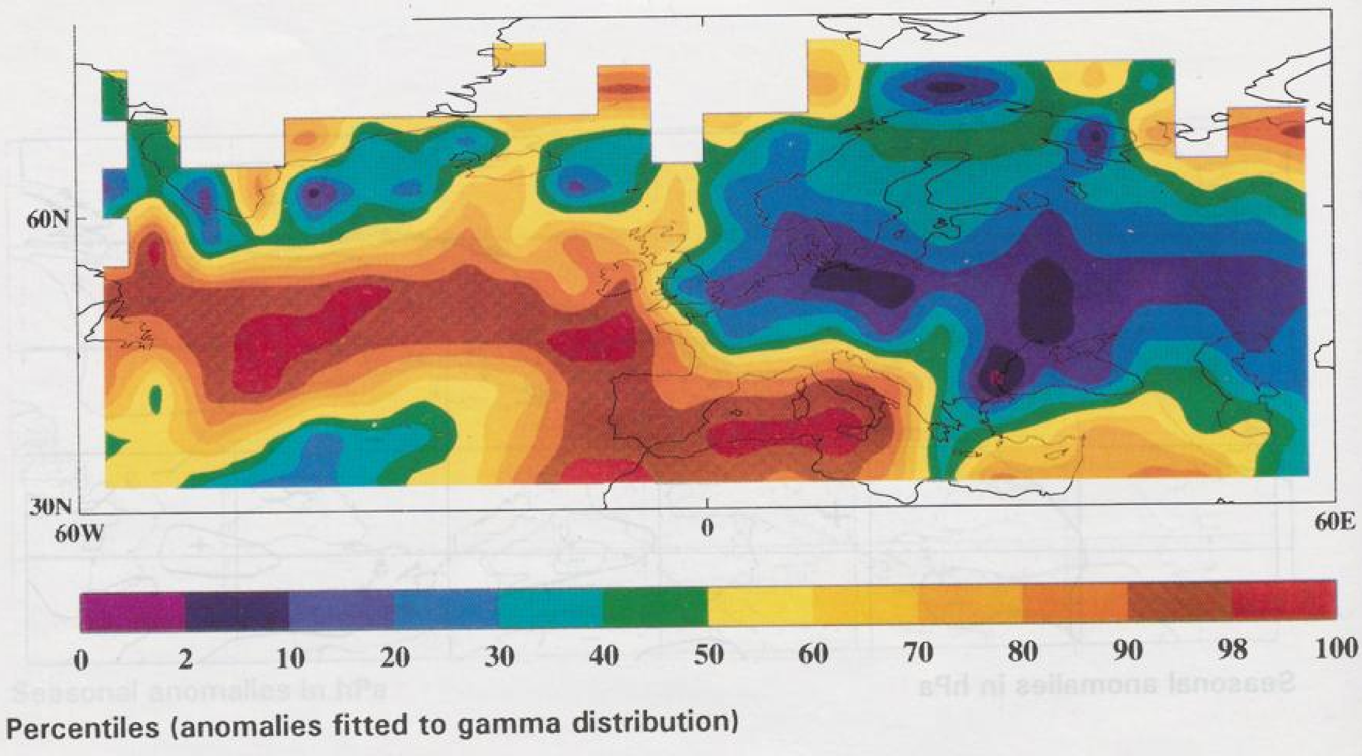
Seasonal anomalies in hPa

Sea level pressure

(Source: Deutscher Wetterdienst, Germany)



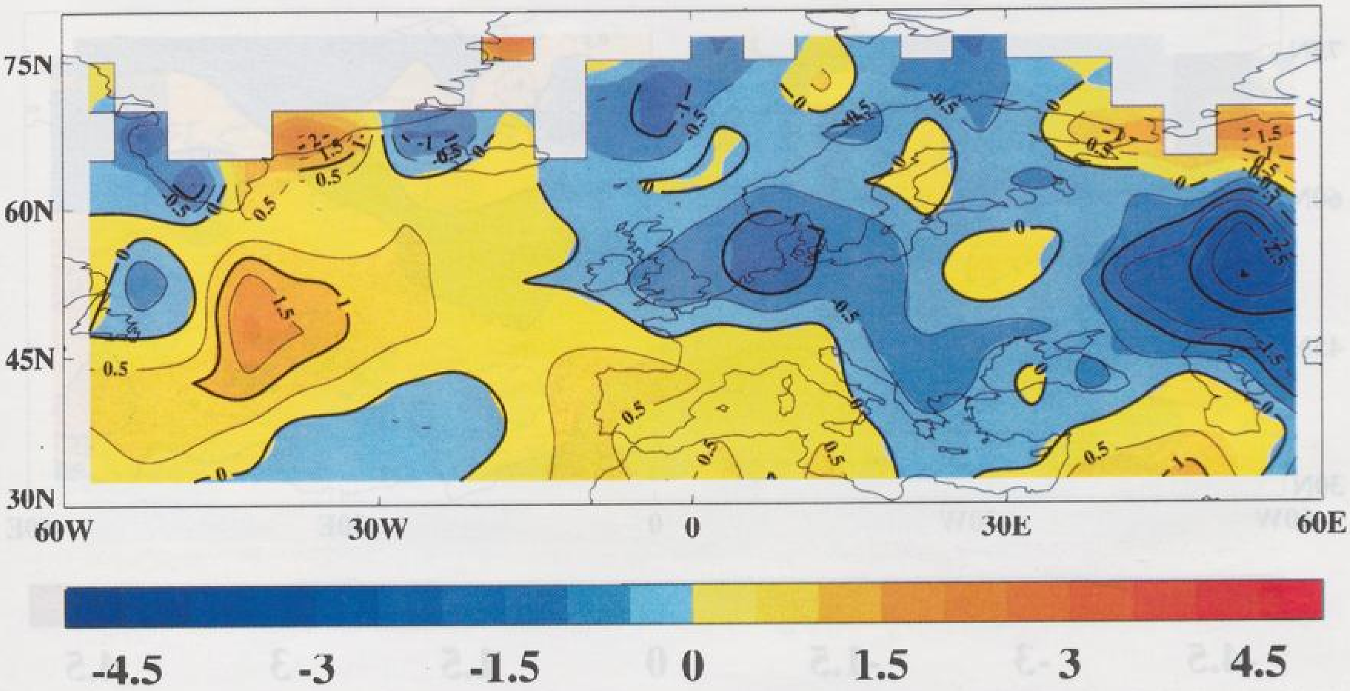
December 1995 - February 1996



Surface temperature anomalies

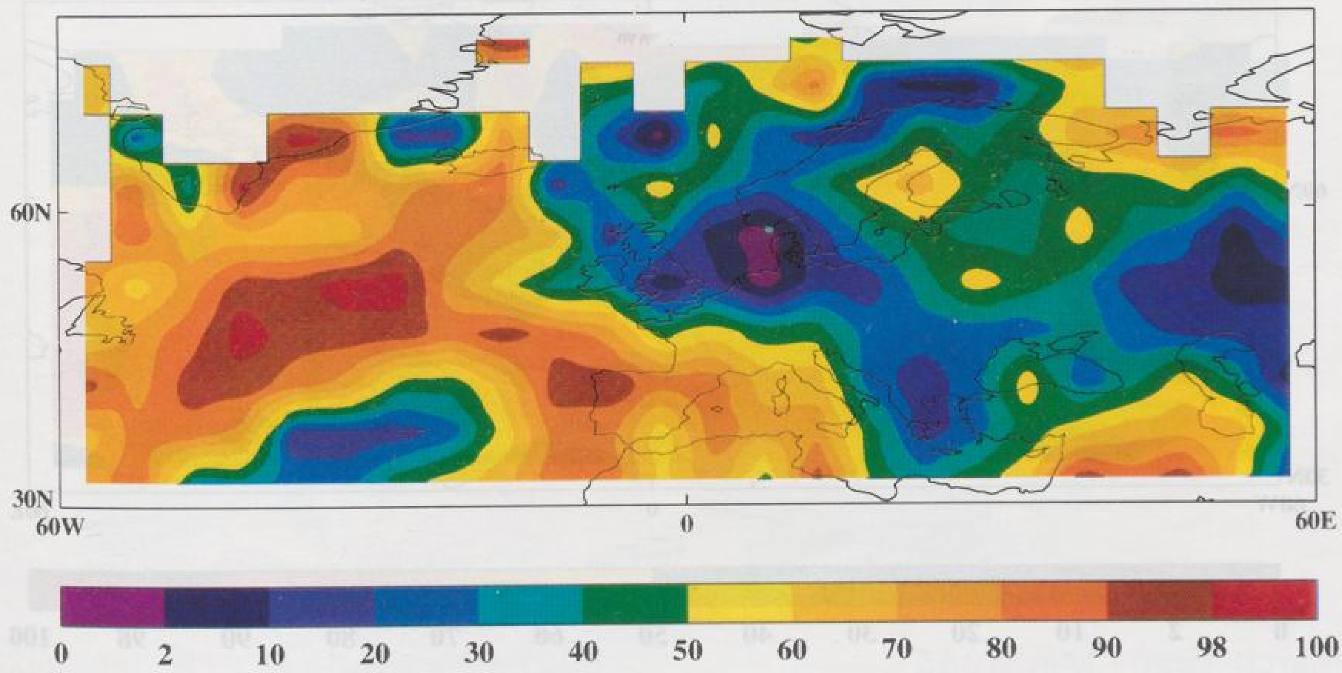
Reference period: 1961 - 1990

(Source: Hadley Centre, land data provided by the University of East Anglia)



Departures from normal in °C

March 1996 - May 1996

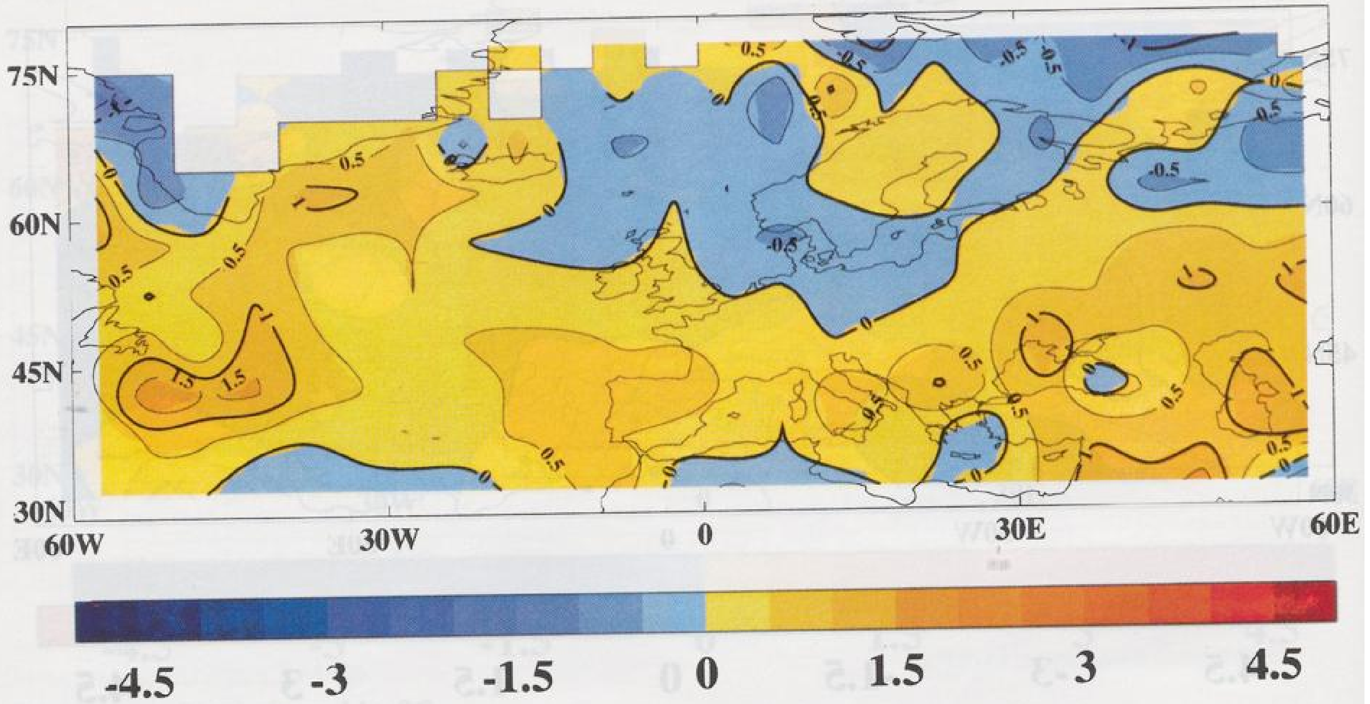


Percentiles (anomalies fitted to gamma distribution)

Surface temperature anomalies

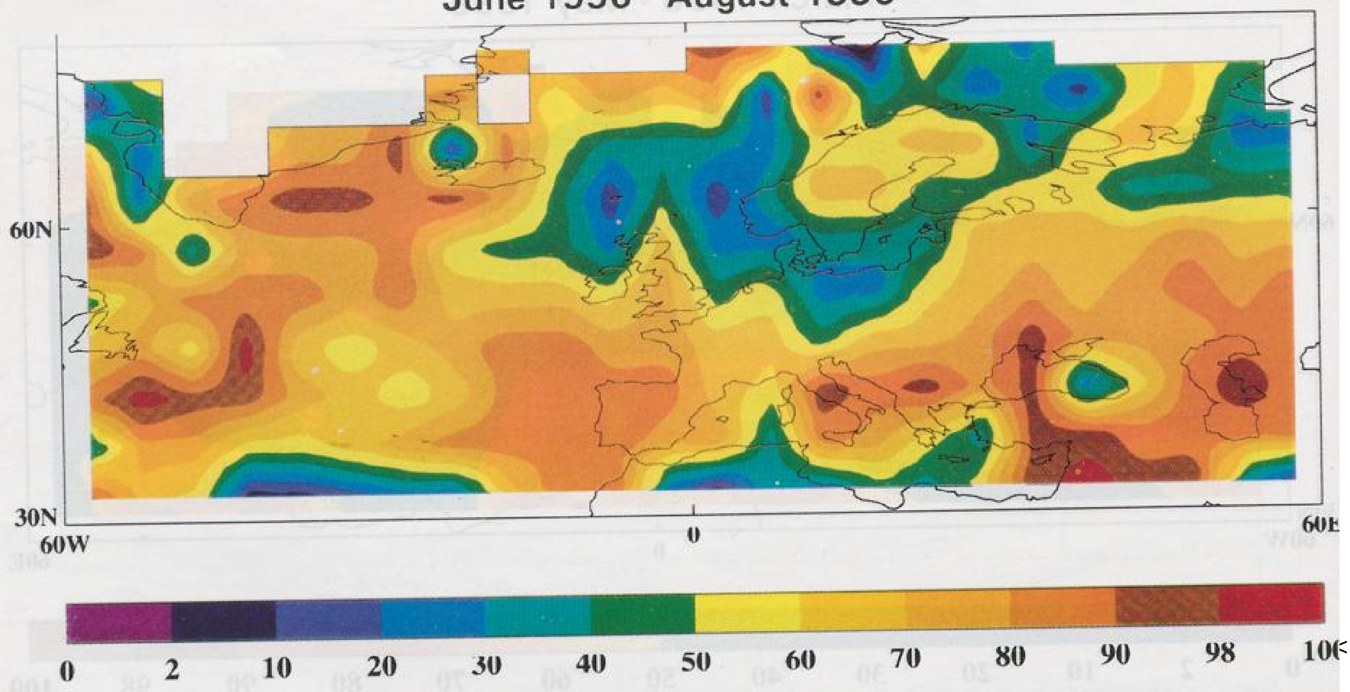
Reference period: 1961 - 1990

(Source: Hadley Centre, land data provided by the University of East Anglia)



Departures from normal in °C

June 1996 - August 1996

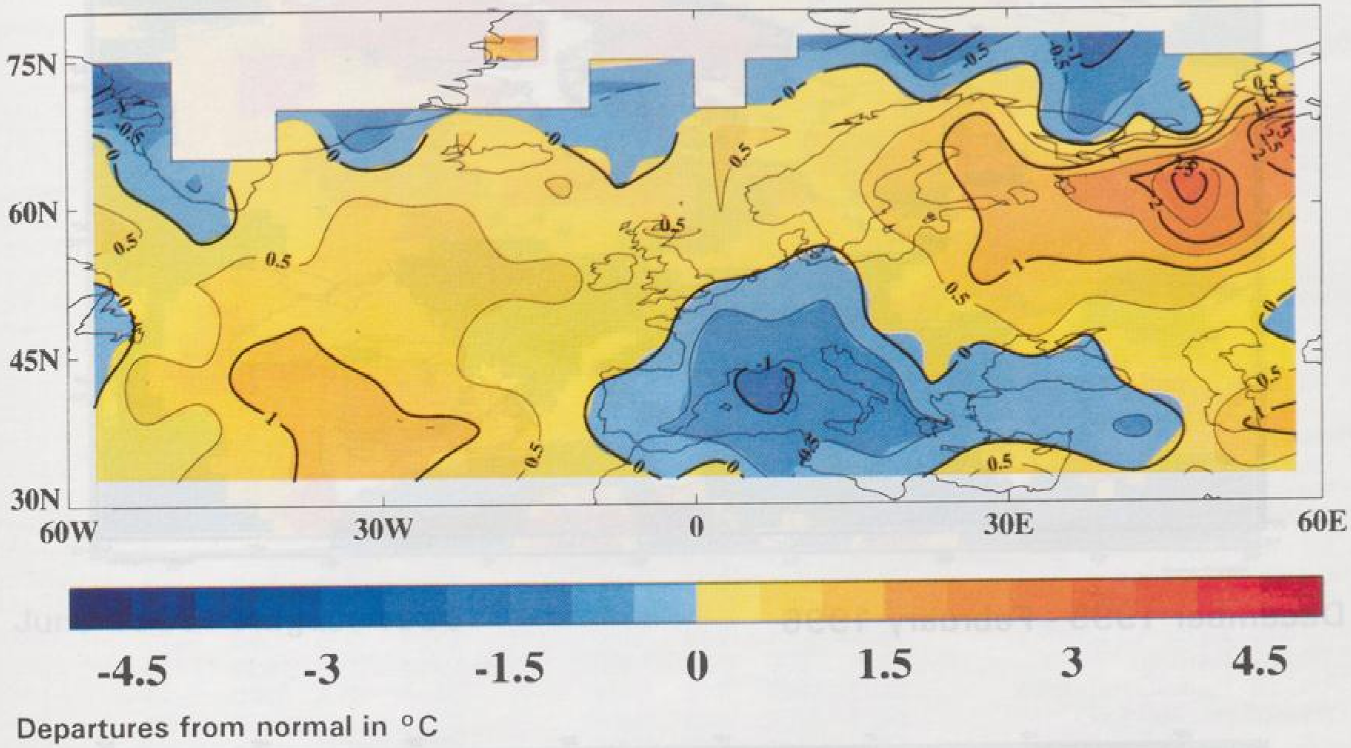


Percentiles (anomalies fitted to gamma distribution)

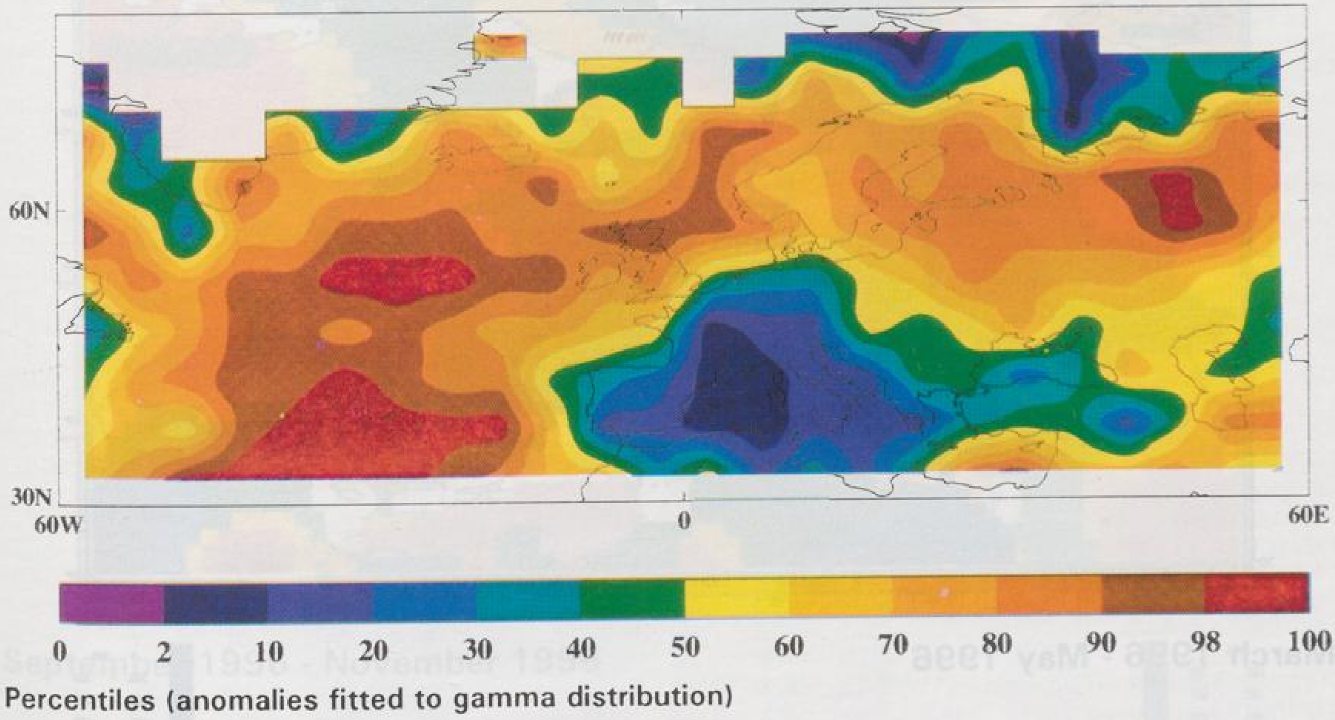
Surface temperature anomalies

Reference period: 1961 - 1990

(Source: Hadley Centre, land data provided by the University of East Anglia)



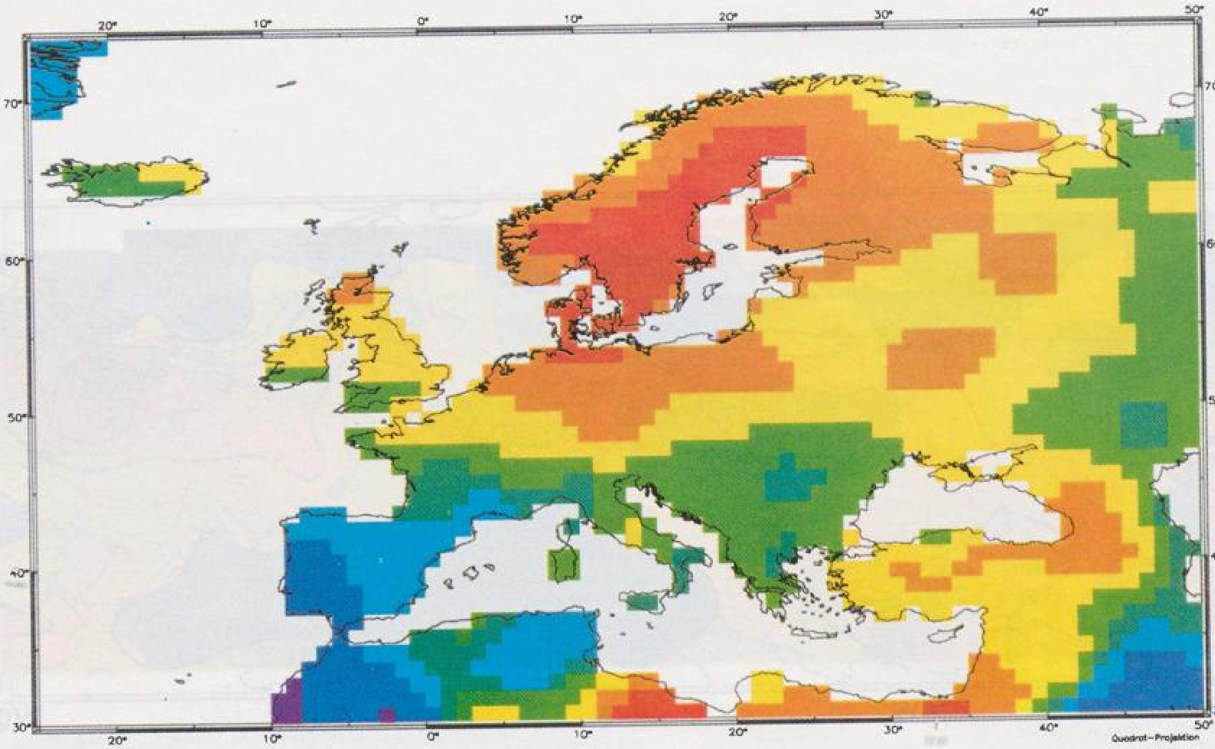
September 1996 - November 1996



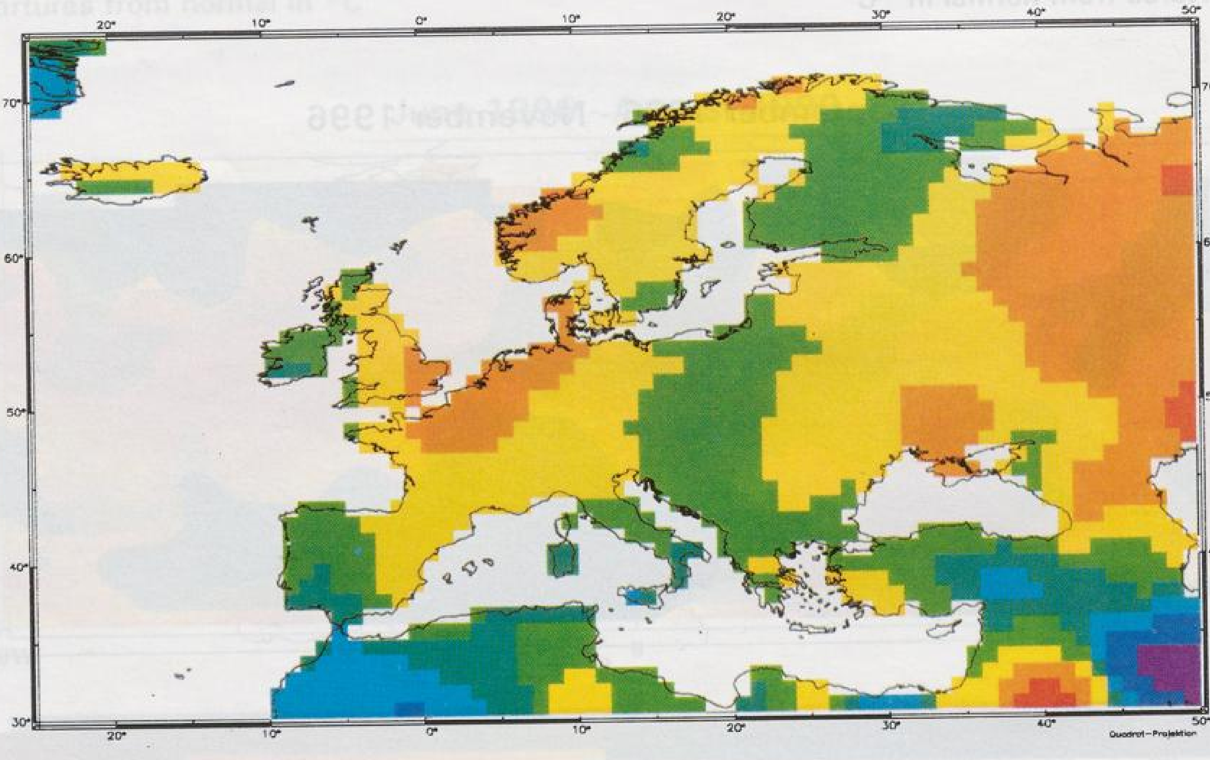
Surface temperature anomalies

Reference period: 1961 - 1990

(Source: Hadley Centre, land data provided by the University of East Anglia)



December 1995 - February 1996

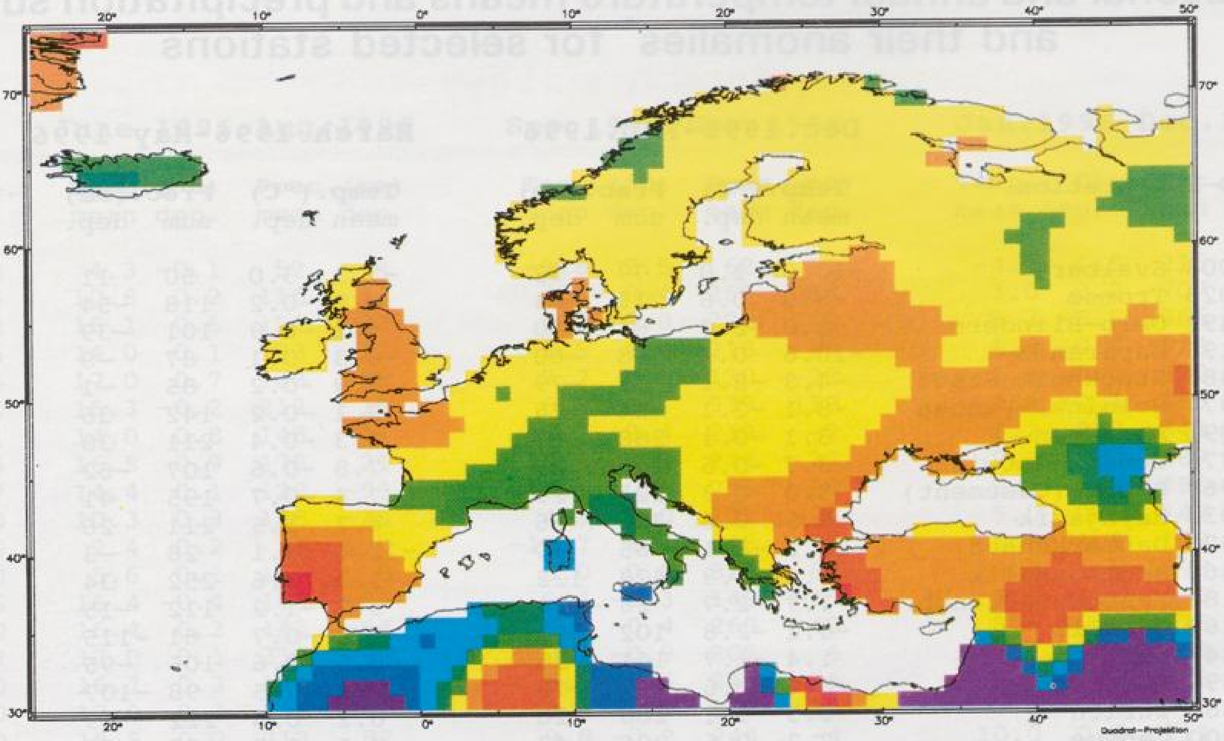


March 1996 - May 1996

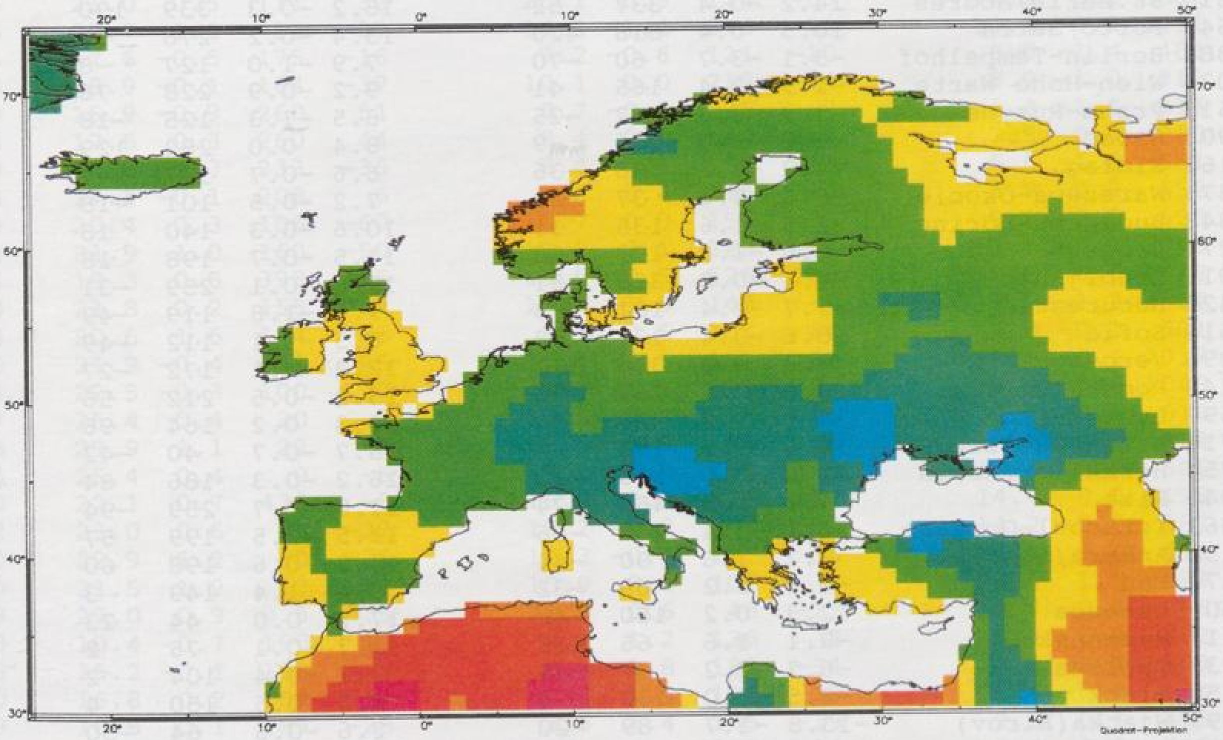
Precipitation in percentage of normal

Reference period: 1961 - 1990

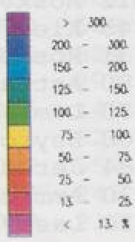
(Source: Global Precipitation Climatology Centre/Deutscher Wetterdienst, Germany)



June 1996 - August 1996



September 1996 - November 1996



Precipitation in percentage of normal

Reference period: 1961 - 1990

(Source: Global Precipitation Climatology Centre/Deutscher Wetterdienst, Germany)

Seasonal and annual temperature means and precipitation sums and their anomalies* for selected stations

WMO-No.	Station	Dec.1995-Feb.1996 Temp.(°C) mean	dep.	Prec.(mm) sum	dep.	March 1996-May 1996 Temp.(°C) mean	dep.	Prec.(mm) sum	dep.
01008	Svalbard	-13.8	1.0	77	32	-7.1	3.0	50	11
01025	Tromsø	-3.0	0.6	215	-54	0.9	-0.2	118	-54
01492	Oslo-Blindern	-6.0	-2.3	81	-60	4.2	-0.9	101	-39
02196	Haparanda	-10.6	0.3	58	-60	-0.3	0.1	87	-8
02485	Stockholm-Stadt	-4.3	-2.1	33	-79	4.9	-0.2	85	-1
02974	Helsinki-Vantaa	-8.1	-2.1	54	-76	3.1	-0.2	142	36
03091	Aberdeen	3.1	-0.1	288	83	6.3	-0.4	211	38
03776	London-Gatwick	3.7	-0.5	240	29	7.8	-0.6	107	-62
03967	Dublin(Casement)	5.0	0.3	223	29	7.4	-0.7	195	41
04030	Reykjavik	0.5	0.6	311	86	4.7	1.5	211	26
04320	Danmarkshavn	-23.2	-0.1	65	30	-12.6	3.1	28	-3
04360	Angmagssalik	-5.6	1.9	428	122	-1.3	2.6	252	34
06186	København-Landb.	-1.7	-2.7	26	-114	5.9	-1.2	112	-15
06260	De Bilt	-0.1	-2.8	102	-93	7.8	-0.7	61	-115
06447	Uccle	1.4	-1.7	161	-36	8.6	-0.6	105	-95
06590	Luxembourg	-0.6	-1.5	134	-75	7.6	-0.5	98	-107
06660	Zürich	-0.5	-1.1	200	-20	8.2	0.0	222	-49
06700	Genève	2.2	0.6	206	-42	9.5	0.7	137	-80
07510	Bordeaux	7.6	1.4	444	164	12.3	1.0	177	-44
07650	Marseille	8.6	1.6	258	106	13.7	0.5	90	-41
08222	Madrid	7.6	1.0	225	84	13.3	0.6	132	4
08314	Mahon/Menorca	12.7	1.7	273	79	14.5	0.4	160	33
08495	Gibraltar	14.5	0.7	896	529	16.9	0.3	330	160
08515	St.Maria/Acores	14.2	-0.4	337	52	15.2	-0.3	339	190
08546	Porto/Serra	10.5	0.4	818	420	13.4	-0.2	276	93
10384	Berlin-Tempelhof	-3.1	-3.7	60	-70	7.9	-1.0	127	-8
11035	Wien-Hohe Warte	-1.9	-2.4	165	41	9.2	-0.9	228	76
11518	Praha-Ruzyne	-3.9	-2.6	47	-25	6.5	-1.3	125	-18
11903	Sliac	-3.2	-1.0	136	-9	8.4	0.0	282	129
12160	Elblag	-4.9	-3.5	88	-36	6.6	-0.7	117	-1
12375	Warszawa-Okecie	-5.5	-3.4	37	-38	7.2	-0.5	101	-18
12843	Budapest-Lorinc	-1.6	-1.6	135	31	10.6	-0.3	140	18
13274	Beograd	0.5	-1.3	173	22	11.5	-0.7	198	18
14015	Ljubljana	-0.1	-0.3	328	51	10.0	0.1	259	-31
15420	Bucuresti	-2.7	-2.4	131	-3	9.6	-1.8	119	-49
15614	Sofia	-0.6	-0.4	137	38	8.5	-1.1	112	-49
16090	Verona	3.3	0.8	316	170	12.2	-0.1	172	-27
16242	Roma-Fiumicino	9.6	1.0	269	20	13.2	-0.5	212	56
16597	Luqa/Malta	14.1	1.2	351	91	16.3	0.2	164	96
16716	Athens(Hellinikon)	10.9	-0.1	154	-4	15.7	-0.7	40	-42
16754	Heraklion/Kreta	12.6	0.0	230	-11	16.2	-0.3	186	84
17040	Rize	7.2	0.2	453	-174	11.0	-0.7	259	-94
17062	Istanbul-Goztepe	6.1	-0.4	232	-56	11.5	-0.5	199	57
17130	Ankara/Central	3.2	1.6	90	-44	10.3	-0.6	198	60
17170	Van	-0.9	2.2	69	-32	8.4	1.4	149	3
17609	Larnaca	12.3	0.2	150	-48	17.2	0.0	44	23
22113	Murmansk	-9.1	1.6	65	-28	-1.7	-0.1	75	2
26038	Tallina	-6.7	-2.2	77	-49	3.1	-0.4	104	2
26850	Minsk	-8.5	-3.0	130	4	6.3	0.5	150	4
27199	Wjatka(Kirov)	-13.8	-1.7	89	-20	2.6	-0.5	64	-50
27612	Moskva	-9.7	-2.0	88	-46	6.4	0.9	82	-50
33345	Kiev	-7.4	-3.5	110	-29	8.3	0.0	115	-23
34731	Rostov-na-Donu	-5.1	-1.9	124	-41	9.2	-0.6	187	48
34880	Astrahan'	---	---	20	-18	10.2	0.0	46	-10
40080	Damascus	7.4	0.2	75	-38	16.2	0.4	19	-22
40100	Beyrouth	14.5	0.6	334	-198	18.4	0.6	241	50
40184	Jerusalem	9.2	0.0	258	-147	15.0	-0.4	220	76
40270	Amman	9.8	1.0	123	-35	16.7	0.8	75	2
60030	Las Palmas/Gr.Can	18.6	0.8	168	94	19.9	0.9	32	13

* reference period: 1961-1990

WMO-No.	June 1996-Aug.1996 Temp.(°C) mean	dep.	Prec.(mm) mean	dep.	Sep.1996-Nov.1996 Temp.(°C) mean	dep.	Prec.(mm) mean	dep.	Jan.1996-Dec.1996 Temp.(°C) mean	dep.	Prec.(mm) mean	dep.
01008	4.3	-0.1	52	4	-2.6	2.5	62	11	-4.9	1.5	216	33
01025	10.8	0.2	116	-91	3.4	0.4	260	-63	3.0	0.2	707	-266
01492	16.1	0.5	156	-83	6.0	0.0	291	42	5.3	-0.5	666	-103
02196	14.0	0.1	133	-21	3.5	1.4	218	33	1.9	0.7	525	-27
02485	17.0	0.7	103	-80	7.7	0.6	130	-28	6.5	-0.1	372	-167
02974	15.3	-0.2	212	15	6.3	1.2	337	119	4.4	-0.1	765	114
03091	14.0	0.8	148	-41	9.1	0.4	219	-2	8.2	0.3	841	53
03776	16.5	0.9	178	21	10.6	0.1	243	27	9.7	0.0	687	-66
03967	14.4	0.1	127	-53	10.1	0.1	236	29	9.2	-0.1	750	15
04030	10.3	0.3	128	-36	4.3	0.0	192	-34	5.0	0.6	747	-53
04320	2.4	0.2	13	-20	-10.7	1.7	48	15	-9.9	1.5	137	5
04360	5.6	0.1	162	0	0.0	0.8	329	83	-0.2	1.5	1198	266
06186	16.4	-0.4	103	-83	9.4	-0.3	140	-43	7.6	-1.1	387	-249
06260	16.4	0.2	147	-67	9.7	-0.4	260	40	8.6	-0.8	575	-230
06447	17.0	0.1	310	93	9.6	-0.9	209	4	9.1	-0.8	744	-75
06590	16.7	0.3	154	-53	8.4	-0.6	244	24	7.9	-0.7	626	-215
06660	17.0	0.3	378	-1	8.4	-0.9	279	28	8.2	-0.4	1005	-116
06700	18.5	0.7	313	82	9.8	-0.2	244	-4	10.0	0.4	911	-33
07510	20.4	1.4	273	117	13.1	-0.2	388	140	13.2	0.8	1108	203
07650	22.9	0.5	115	46	14.4	-1.0	293	111	15.0	0.5	700	166
08222	23.8	0.8	7	-42	14.5	-0.4	116	-23	14.7	0.4	516	59
08314	23.6	0.3	87	41	17.7	-0.7	283	67	17.0	0.3	755	172
08495	23.2	0.2	6	-12	18.9	-0.6	244	24	18.2	0.0	1771	996
08515	21.0	0.5	111	32	20.1	0.9	174	-69	17.5	0.1	858	102
08546	20.7	1.1	52	-37	14.5	-1.4	316	-79	14.6	-0.2	1411	269
10384	17.6	-0.5	175	-16	9.2	-0.6	121	-10	8.0	-1.4	465	-122
11035	18.9	-0.1	164	-37	10.1	0.0	210	74	8.9	-1.0	712	99
11518	15.9	-0.9	260	51	7.7	-0.4	95	-7	6.3	-1.5	515	-11
11903	17.6	0.3	260	44	8.4	0.1	133	-42	7.5	-0.4	780	91
12160	16.6	0.3	233	-36	8.4	0.1	166	-13	6.6	-1.0	601	-89
12375	17.1	-0.1	208	6	8.6	0.4	116	-7	6.9	-0.9	452	-67
12843	20.4	0.3	106	-60	10.7	0.0	151	25	9.9	-0.5	526	8
13274	21.9	1.0	160	-50	12.2	-0.1	222	73	11.5	-0.3	793	103
14015	19.3	0.5	398	-55	10.6	0.5	526	148	9.8	0.0	1449	51
15420	21.8	0.2	155	-27	10.3	-1.5	142	-2	9.9	-1.2	537	-91
15614	20.6	1.6	144	-36	9.9	-0.5	187	64	9.6	-0.1	581	18
16090	21.9	-0.4	258	25	12.4	-0.6	277	62	12.5	-0.1	1019	226
16242	22.5	-0.3	100	23	15.3	-1.4	397	124	15.0	-0.4	1043	288
16597	25.4	0.4	20	7	20.8	0.2	158	-55	19.1	0.5	619	65
16716	27.9	1.1	22	5	19.4	-0.3	83	-29	18.5	0.0	329	-40
16754	25.4	0.4	0	-5	19.8	0.0	122	-31	18.6	0.1	585	84
17040	22.1	0.7	438	-8	16.0	0.6	979	236	14.4	0.5	2195	32
17062	23.0	0.6	35	-32	15.2	-0.3	201	0	14.2	0.0	687	-11
17130	22.9	1.2	30	-35	12.3	-0.4	117	38	12.5	0.8	478	63
17170	21.5	1.2	13	-17	10.9	0.6	107	3	10.4	1.8	389	8
17609	27.0	0.9	0.5	-0.5	21.5	0.6	46	-17	19.7	0.4	266	-63
22113	10.4	-0.7	190	12	2.1	1.2	136	2	0.7	0.9	492	14
26038	15.2	-0.1	198	-9	6.9	0.8	185	-34	4.8	-0.4	607	-47
26850	16.8	0.2	167	-76	7.3	1.1	186	29	5.6	-0.2	660	-13
27199	16.5	0.1	187	-28	3.5	1.4	166	-19	2.5	0.1	495	-130
27612	17.6	0.5	187	-55	6.6	1.7	213	33	5.4	0.5	562	-126
33345	19.1	0.5	188	-35	8.8	0.8	239	107	7.3	-0.4	649	17
34731	22.7	0.6	101	-49	9.7	0.0	222	97	9.2	-0.5	629	50
34880	24.1	0.3	132	68	10.4	0.5	62	0	---	---	294	74
40080	26.8	1.0	0	-1	17.9	-0.2	27	-12	17.3	0.6	149	-45
40100	26.5	1.3	0.5	-1.5	23.1	0.9	185	22	20.8	1.1	826	-62
40184	23.1	0.5	0	0	18.7	0.0	39	-54	16.7	0.2	557	-85
40270	26.2	1.6	0	0	19.8	0.5	31	-3	18.3	1.2	246	-19
60030	23.9	1.1	1	1	23.1	0.7	37	-8	21.4	0.9	210	72

Monthly surveys

January:
- **Driest January of the century in central and northern Europe**
- **Abundant rain on the Iberian Peninsula and in parts of the Mediterranean**
- **Cold from the North Sea to southwestern Russia**
- **Mild in the north and southwest**

The cold air mass which lay over northern Europe in December 1995 moved southward and gripped central Europe from the North Sea to southwestern Russia. Numerous people died or were injured in accidents on snowy or slippy roads and some homeless froze to death. High material losses were caused by frost, snow and sleet. Persistent freezing hindered the coastal and inland navigation.

In Moldowa, where hoar frost up to 52 mm occurred, power lines were brought down and some villages were without electricity all the month.

At the same time, under high pressure influence (Stockholm registered the highest average pressure since 1838), it was extremely dry. Some places received no rain at all and January 1996 was the driest on record (e.g. in the Netherlands, Germany, northern Sweden).

The high pressure situation was often accompanied by a pronounced and continous inversion. This resulted in the low-lying areas being generally dull and cold and in the mountains being mild. The Feldberg in the Black Forest, Germany, with an altitude of almost 1500 m, experienced the warmest January on record and was the warmest station from all over Germany.

In Switzerland, three different climatological records were broken. A period of strong Foehn, 10-12 January, brought regionally new record high temperatures up to 17 °C and the month was the dullest and driest of this century, in the eastern parts of the country. The sparse precipitation often fell as rain leading to dangerous black ice.

It was unusually warm in far north and in most parts of the Mediterranean. In northern Fennoscandia and southern France, monthly mean temperature anomalies exceeded +4 °C and reached +9 °C in the Tundra of Russia (Nar'yan Mar +9,4 °C).

In the western British Isles, the Balkans and in the Mediterranean, heavy precipitation, together with melting snow, caused severe regional floodings. As a consequence of the extreme precipitation and melting during the last weeks of 1995, 1996 began with threatening floods in the southeastern parts of Hungary. Heavy snowfalls hampered supply and troop convoys of the NATO Bosnian peacemaking force. In the beginning of the month, Romania was hit by the worst flooding in 25 years.

On the Iberian Penisula, the rainy weather which had brought the first relief after 3 to 5 years of drought in December 1995, continued and January was extremely wet in many regions (see fig. 14). Lisbon and Beja, in Portugal, as well as the province of Huelva, Spain, reported record monthly precipitation totals for this century or even longer with 354 mm, 291 mm and 380 mm, respectively. Floods occurred e.g. in the Douro and Tejo river basins.

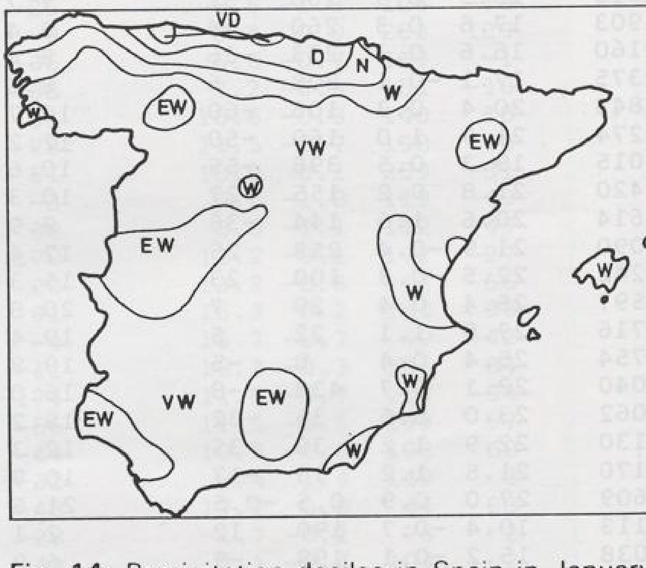


Fig. 14: Precipitation deciles in Spain in January 1996
VD: very dry (1-2), D: dry (2-3),
N: normal (4-6), W: wet (7-8),
VW: very wet (8-9), EW: extremely wet (9-10)
(Source: Servicio de Climatologia, Madrid)

Rainstorms, some with hail plagued also Greece and Turkey. In Israel, daily precipitation totals up to 121 mm and gusts exceeding 150 m/s caused high damage.

Torrential rains (up to more than 200 mm) triggered flash floods in the Herault department in southern France on January 28 (see fig. 15). In the Béziers region, three rivers left their banks, causing significant damage. The situation was aggravated by the warm water of the Mediterranean Sea (13-14°C), the saturated soil from rain in December and wind from sea which slowed the discharge from rivers.

In the following night, heavy rain caused floods on the island of Corsica cutting off some roads and submerging highway bridges.

In southern Italy, 50 % of the mean annual precipitation poured down within the month and, on 10 January, 133 mm in a few hours drenched the town of Genova.

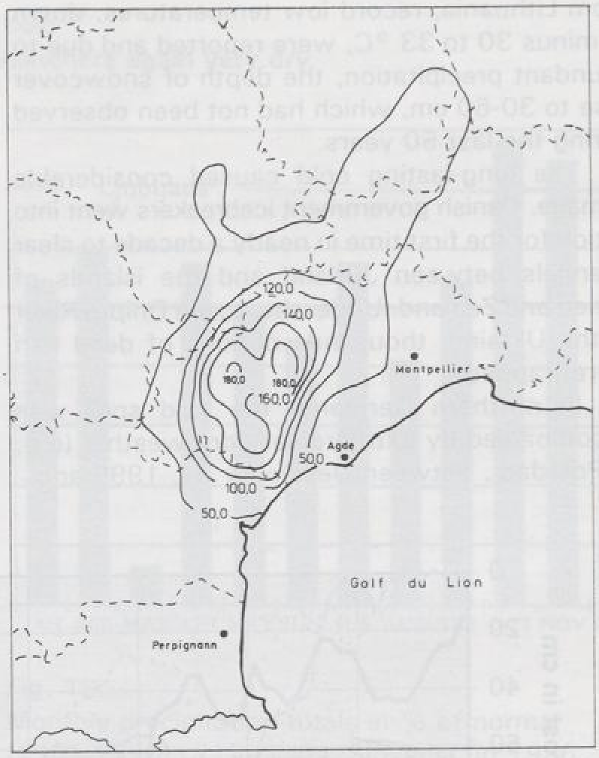


Fig. 15: Precipitation totals in the district of Herault on January 28 (Source: Météo France)

February: • **Cold**
• **Mostly dry, but some severe blizzards**

Except for the utmost north of Russia and the Middle East, the Region was gripped by cold weather with frequent winter problems, numerous accidents and frost damage. In some countries, e.g. in Hungary and Lithuania, February was even colder than January, which is usually the coldest month (see fig. 16). Many parts were snow-covered.

Over many parts of Britain, blizzards were the worst since 1947 and in some areas of Scotland, a state of emergency was declared. Although generally dry, heavy snow storms caused severe problems in southern Sweden. In Austria, from January 17-19, snowfall blocked the traffic on the roads, esp. in Carinthia. One snowfall of around 60 cm caused many accidents and avalanches killed 7 persons in Tyrol.

Snow drifts and ice paralysed much of central and eastern Europe and it was the worst snow situation since 1985 or even 1978/79. Villages were cut off, schools closed and roads became impassable. Fierce snowstorms caused electric outrages across the Black Sea peninsula of Crimea, a region that rarely sees significant snowfall.

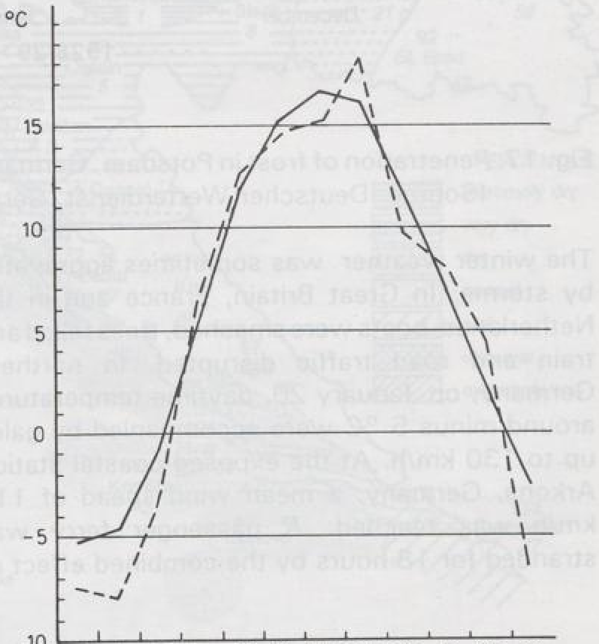


Fig. 16: Mean monthly temperatures in Lithuania (Source: Lithuanian Hydrometoeorlogical Service)

From Lithuania, record low temperatures, down to minus 30 to 33 °C, were reported and due to abundant precipitation, the depth of snowcover rose to 30-60 cm, which had not been observed during the last 50 years.

The long-lasting cold caused considerable damage. Danish government icebreakers went into action for the first time in nearly a decade to clear channels between Jutland and the islands of Funen and Zealand. Under the frozen Dnipro River in the Ukraine, thousands of tons of dead fish were trapped.

In northern Germany, the cold spell was accompanied by extraordinary dry weather (e.g. in Potsdam, between December 27, 1995 and February 11, 1996 the precipitation total amounted to 2,5 mm, between December 1 and February 11 only 2 days were free of frost and on 13 days, temperatures dropped below minus 10 °C). At the Potsdam observatory, a record frost penetration depth of 153 cm was measured (see fig. 17), 7 cm more than the old record of February 1929. The other reason for the extreme value beside the long-lasting frost and lack of snow was the extremely dry soil, esp. in the layer beneath 50 cm. Frozen pipes caused difficulties in maintaining the water-supply and, in some parts, households had to be supplied with water via emergency pipes or from tankers.

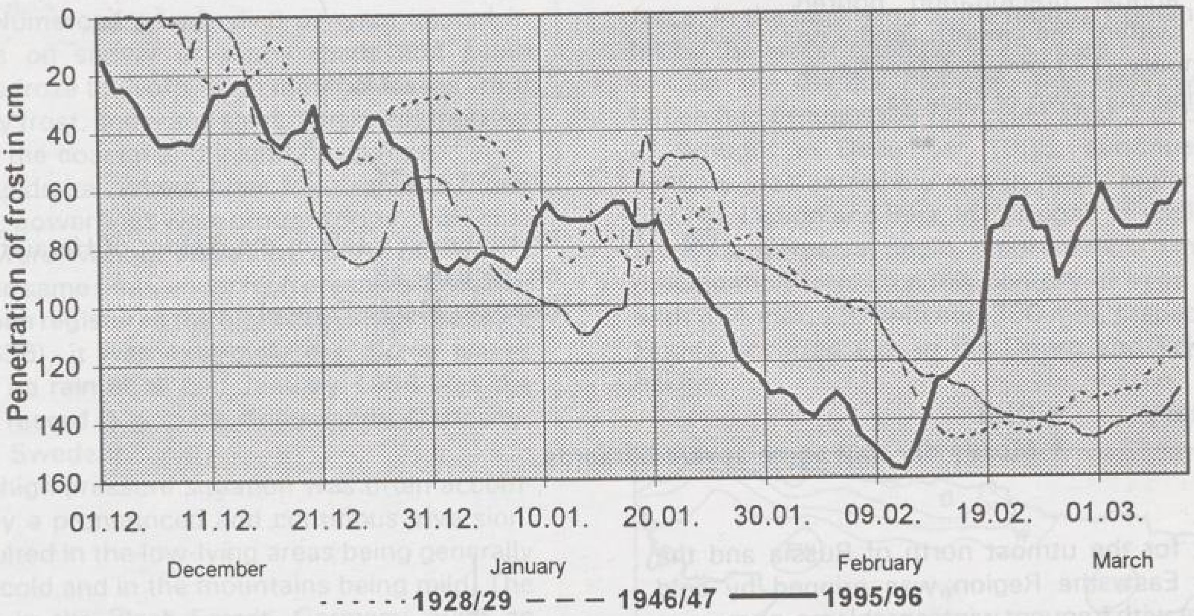


Fig. 17: Penetration of frost in Potsdam, Germany, in the extreme winters 1928/29, 1946/47 and 1995/96. (Source: Deutscher Wetterdienst, Germany)

The winter weather was sometimes aggravated by storms: In Great Britain, France and in the Netherlands, boats were smashed, trees felled and train and road traffic disrupted. In northern Germany, on January 20, daytime temperatures around minus 5 °C were accompanied by gales up to 130 km/h. At the exposed coastal station Arkona, Germany, a mean wind spead of 110 km/h was reached. A passenger ferry was stranded for 18 hours by the combined effect of storms and thickening sea-ice.

Rough sea, heavy snowfalls and blizzards closed Romania's Black Sea port of Constanta and disrupted Danube River traffic.

In southern Spain, which had received plenty of rain in the two preceding months, February was very dry and cold. In Israel, though very dry in general (30-40% of normals), two extreme rainfall events occurred in the Negev desert, triggering floods.

March: • Mild in northern Europe, elsewhere cold
• Extremely wet in the Middle East, elsewhere again very dry

Whereas in the north the mild weather continued, with temperature anomalies up to + 8 °C on Svalbard, elsewhere the cold winter persisted. Temperatures averaged minus 4 to minus 5 °C below normal across the Balkans, with the largest departures in Bulgaria.

An unusual intense cold snap was reported from the Canary Islands in mid March and frosty weather dominated as far south as central Turkey.
In Central and eastern Europe, inland navigation came to a standstill.

At the coasts, expecially the Baltic coast, the long-lasting freeze led to intense ice formation. Driven by strong northeasterly winds, the ice build up to a height of 6 m on the shore of Rügen, Germany. Reinforcements on the banks were damaged.

In most parts of the Region, again, extreme dry conditions prevailed and high moisture deficits developped in northern and Central Europe.

In De Bilt, Netherlands, with a monthly total of 11 mm against an average of 63 mm, only March 1929 had been drier this century. Unusually dry conditions were reported from Coatia and Slovenia, as well (see fig. 18, 19).
However, abundant rain fell in Israel, with some stations recording their highest values ever. On March 6/7, heavy showers caused flooding near Adana, Turkey (Bahçe: 120,5 mm in 24 h), wrecking roads and bridges. 49 cm of newfallen snow brought down electrical power lines near Konya, Turkey.

In Georgia, on March 18, with the extreme pressure gradient of 15 to 18 hPA at a range of 200 km, between the towns of Tblisi and Kutaisi, the wind velocity reached 35 - 38 m/s, causing damage estimated at US$ 2.5 million.

Good news came from Iceland, where it was very sunny: Akureyri reported record (since the beginning of measurements in 1924) sunshine total for March of 154 hours.

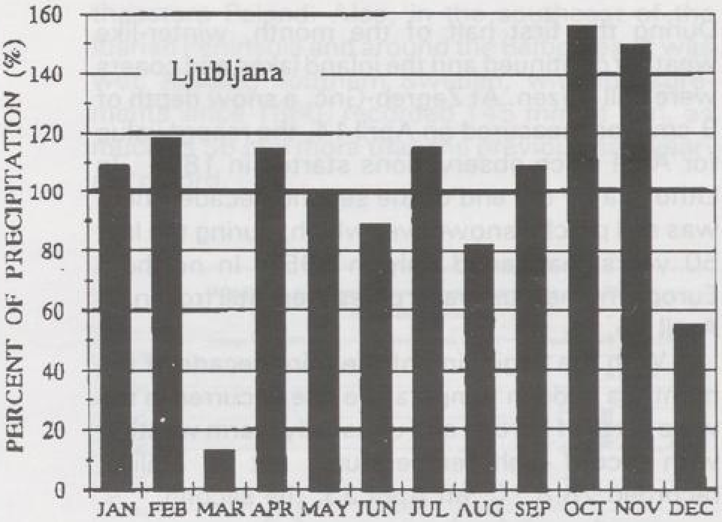


Fig. 18:
Monthly precipitation totals in % of normal (1961-1990) of Ljubljana, Slovenia, in 1996.
(Source: Hydrometeorological Institute of Slovenia

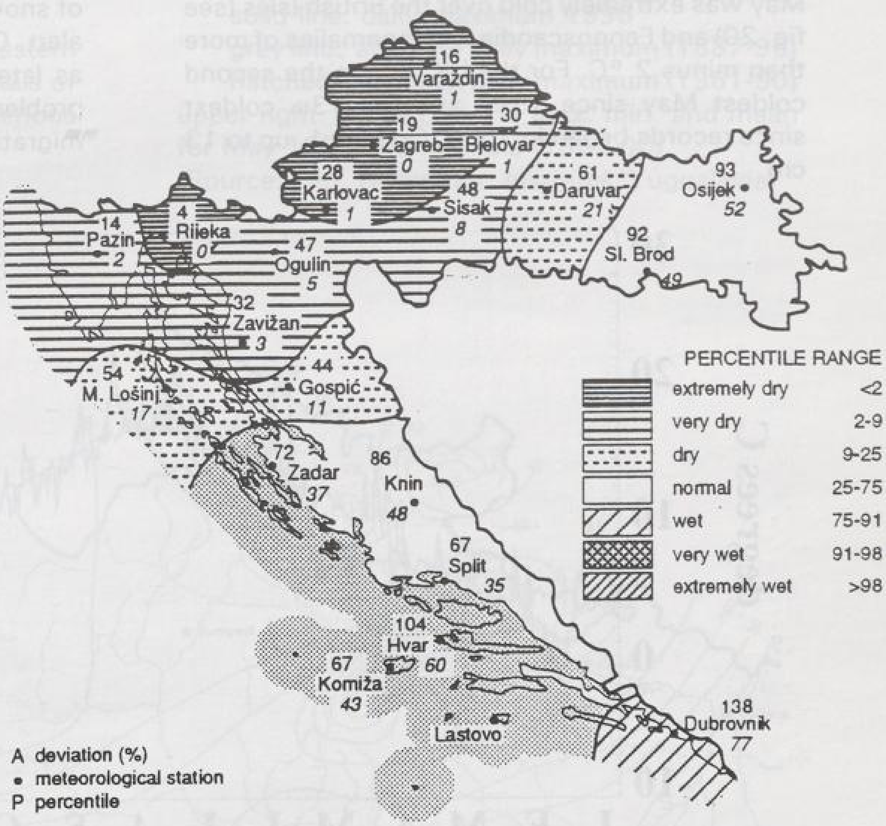


Fig. 19: Monthly precipitation totals in % of normal (1961-1990) of Croatia in March.
(Source: Meteorological and Hydrological Service, Croatia)

April: • **Long winter ends abruptly after mid-month, only in the east colder than normal**
• **Moisture shortages still prevailing**

During the first half of the month, winter-like weather continued and the inland lakes and coasts were still frozen. At Zagreb-Grič, a snow depth of 9 cm was measured on April 14, the record value for April since observations started in 1895 . In Lithuania by the end of the second decade, there was still patchy snowcover which, during the last 50 years, happened only in 1958. In northern Europe, numerous water pipes were still frozen on April 15.

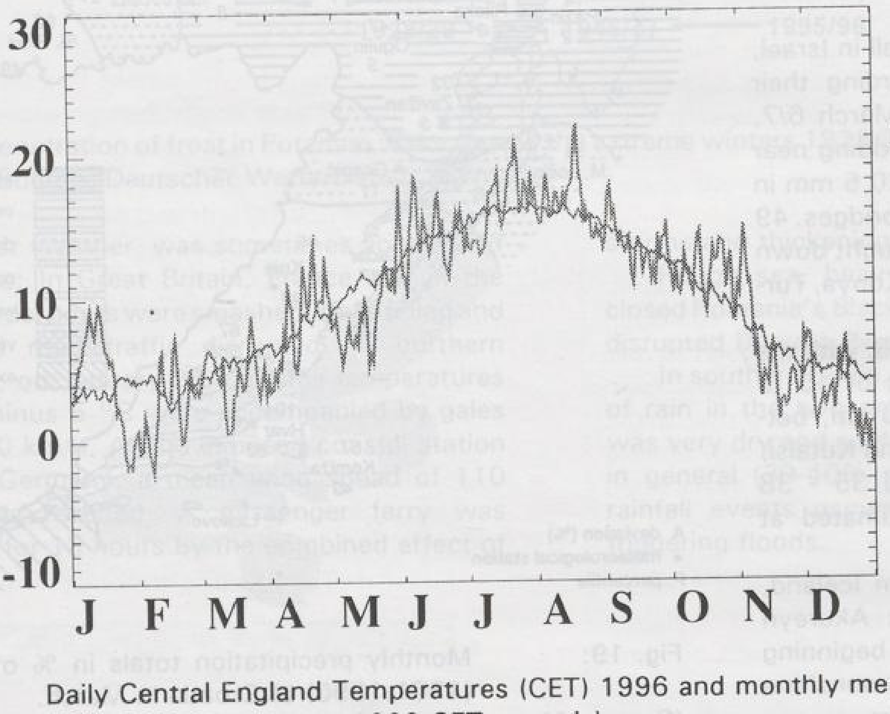
With the beginning of the third decade of the month, a sudden temperature rise occurred in the wide parts of Europe and unusually warm weather with record high temperatures set in. Målilla, recorded 28,8 °C, on April 23, the second highest April temperature ever for Sweden. The warm spell, after the long winter, caused a rapid plant vegetation.

In central and southwestern Europe precipitation was rare and moisture shortages persisted. In the Netherlands, with a monthly total of 8 mm, it was the driest April of the century and with 228 h of bright sunshine (normal 154 h) it was the sunniest month of the year. In Germany and Switzerland, after the dry winter, some extended forest and bush fires were engendered.

On April 8, a storm with wind speeds up to 28 m/s, caused substantial agricultural damage in the Kalmyk Republic.

May: • **Cold in the northeast, warm in the southwest**
• **Dry in the eastern Mediterranean, elsewhere mostly wet**

May was extremely cold over the British Isles (see fig. 20) and Fennoscandia with anomalies of more than minus 2 °C. For the UK, it was the second coldest May since 1923 and the 13th coldest since records began in 1659. On May 1, up to 13 cm of snow fell in southern Scotland, causing a flood alert. Central Sweden received 10 -25 cm snow, as late as May 16, causing considerable traffic problems and deadly threat to the newly returned migrating birds.



Monthly Means		
1961-1990	1996	
3.8	4.3	January
3.8	2.5	February
5.7	4.5	March
7.9	8.5	April
11.2	9.1	May
14.2	14.4	June
16.0	16.5	July
15.8	16.5	August
13.6	13.6	September
10.6	11.7	October
6.6	5.9	November
4.7	2.9	December
9.5	9.2	YEAR

Fig. 20: Daily Central England Temperatures (CET) 1996 and monthly means (central line is 1961 to 1990 CET normals) (Source: Hadley Centre for Climate Prediction and Research, UK)

In eastern Europe and western Asia, the warm spell, which had started in April, lasted to the third decade of May and the month ended with widespread temperature anomalies of + 2 °C and more. A hot spell dominated the Balkans and Turkey, the Ukraine, southern European Russia and western Kazakhstan, reaching 39 °C in parts of the later region. In Belgrade, Yugoslavia, on the 19th, the absolute maximum temperature of 34,9 °C exceeded the previous monthly record of 32,7 °C in 1887 (see fig. 21).

The warm weather was accompanied by local heavy thunderstorms, rain and hail. On May 14, 42 mm of rain within 30 minutes and hail caused heavy damage over the Ararat valley in Armenia, on May 14. Hail with diameters of 35 to 45 mm was reported from Dagestan, Russia, on May 31.

A rain period from May 11-14 triggered a severe highwater situation on the tributaries of the river Danube in the county of lower Austria. The river Kamp recorded the highest level in 30 years. In northern Moravia, Czech Republic, heavy rainfall (see fig. 22) caused high water levels that only occur with recurrence intervals up to 20-50 years in the basins of rivers Odra and Morava. In the northwestern parts of Hungary, the monthly precipitation totals reached nearly 400 % of the average.

Heavy rains poured down on southeastern Poland between May 13 and 18. Hourly totals of rainfall exceeded 100 mm and caused serious damage.

In some parts of Poland, small tornadoes occurred, a rare phenomena in this region. One of them destroyed many houses near Lomza, northeastern Poland. Also, in the southeast of the Iberian Peninsula and around the Baltic Sea, it was wet. Kalmar, southern Sweden, with measurements since 1860, recorded 145 mm of rain, as much as 56 mm more than the previous one-year-old record.

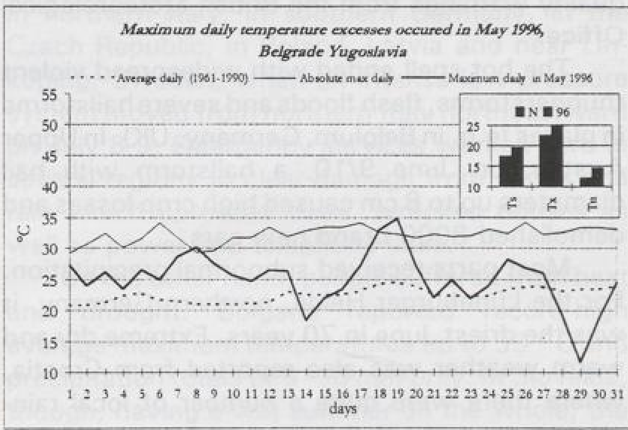


Fig. 21:
Daily maximum temperatures in Belgrade in May
solid line: daily maximum 1996
grey line: absolute daily maximum (1887-96)
hatched line: mean daily maximum (1961-90)
upper right: tx, tn,ts being max. min. and mean for May 1996 and normals (1961-90)
(Source: Fed. Hydromet. Institute, Yugoslavia)

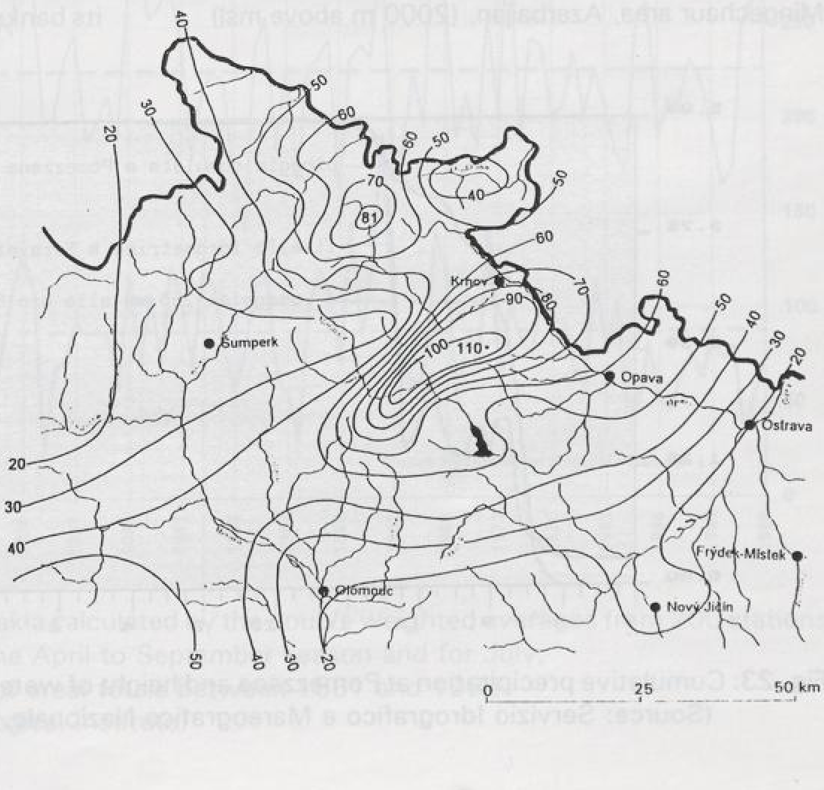


Fig. 22: Daily precipitation totals (mm) in the northeastern parts of the Czech Republic on May 13, 1996
(Source: Czech Hydrometeorological Institute)

June:
- **Warm in southwest, cool in northeast**
- **Mostly dry, severe flooding in northern Italy**

A week-long heat wave, unusually intense for the time of year, brought sweltering conditions to many parts of mainland Europe at the beginning of the month. For Switzerland, the first half of June was the warmest of the century. Over southern Britain, the sunny weather brought along summer smog conditions, and the issuance of air quality warnings from the British Meteorological Office.

The hot spell ended with widespread violent thunderstorms, flash floods and severe hailstorms in places (e.g. in Belgium, Germany, UK). In Upper Austria, on June 9/10, a hailstorm with hail diameters up to 8 cm caused high crop losses and demolished 8000 brand new cars.

Most parts received subnormal precipitation. For the Lüneburger Heide, northern Germany, it was the driest June in 70 years. Extreme dry and warm weather was also reported from Croatia, where there were quite a number of local rainstorms.

Heavy rain triggered water and mud floods in Georgia on June 3/4 and in Dagestan, Russia, on June 5, roads up to 100 km in length were washed away and several bridges and houses destroyed.

On June 7/8, in Baku, Azerbaijan, three times the monthly normal rainfall fell within 24 hours, 14 bridges were destroyed and power lines broken.

Severe hailstorms were reported from Armenia, on June 16 and 17. In the Sheki-Mingechaur area, Azerbaijan, (2000 m above msl) snowfall and landslides caused considerable agricultural damage, between June 18 and 24.

On June 13, a violent cold front plagued the central part of Yugoslovia, with hail, thunderstorms, stormy gusts and torrential rain (amounting up to 173 mm/4h) with flash floods causing high damage (esp. in the surrounding of the Kolubara river and its tributaries and in the suburbs of Belgrade).

Destructive thunderstorms, with gusts above 35 m/s occurred in the vicinity of Lublin, Poland, on June 26. In Hungary, many extremely strong storm and hail events and even tornadoes occurred, which hardly ever happens in this region. Destructive tornadoes were also reported in the Republics of Mordova and Chubaisk, Russia, on June 28, where in addition to considerable material losses, 3 persons were killed and 11 injured.

The most severe flooding, however, took place in the Italian Alps and in Austria, between June 19 and 23, isolating 16 villages and causing the loss of 38 lives. On June 19, in Pommezzano, northern Italy, 480 mm of rain poured down within 12 hours (178 mm/h, 113 mm/30 min and 31 mm/5 minutes, see fig. 23), triggering a devastating flood and numerous landslides (300 - 400 km^2 affected). An unusually strong hailstorm and heavy rain caused enormous damage in Carinthia, southern Austria, on June 21/22. Finally, on June 22/23, north of Venice, the Tagliamento river left its banks and caused a large number of landslides.

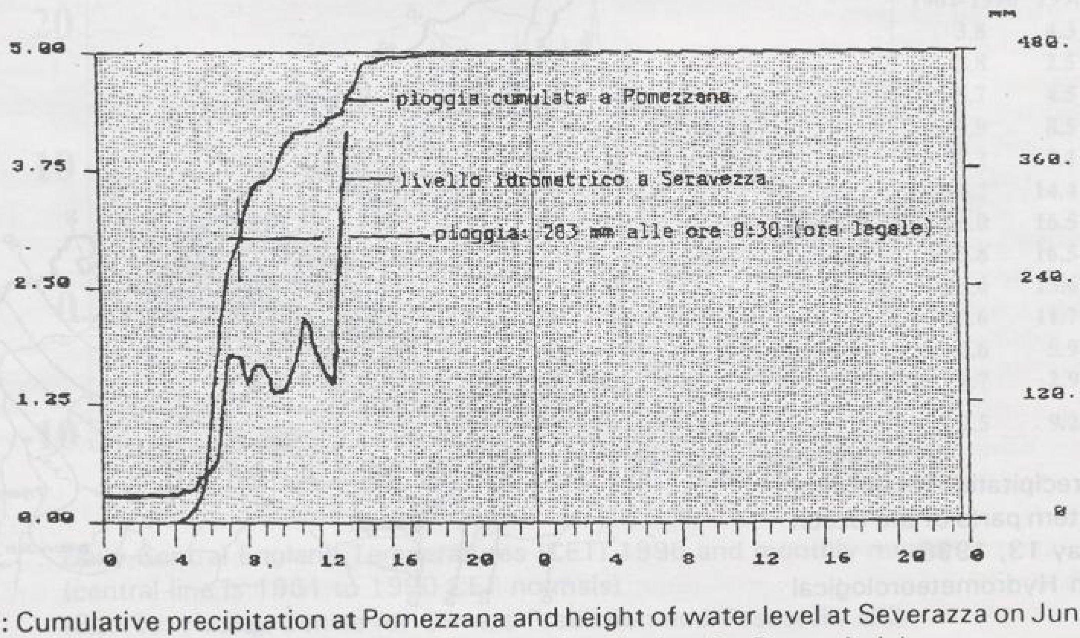


Fig. 23: Cumulative precipitation at Pomezzana and height of water level at Severazza on June 19/20, 1996 (Source: Servizio Idrografico e Mareografico Nazionale, Rome, Italy)

July: • Very cool in central and northern Europe, warm in the southeast
• Dry in Greece and around the Black Sea, wet in northeastern Europe

Northeastern and Central Europe reported an unusually cold July with temperature anomalies around minus 2 °C from Finland to Poland. In Vienna, Austria, it was the coldest July in 12 years. Unseasonably heavy snowfalls blanketed parts of the French Alps and the Pyrenees, forcing a change of route for the Tour de France cycle race. At several places, record low July temperatures were reported. In the Mazury District, absolute minimums of 3 to 4 °C were reported and in Hungary, between July 20-25, the morning values were as low as 7 °C, which were the lowest on record since 1881, and in some regions in the northwest of the country, it almost froze. At the same time, it was mostly rainy in this part of the Region.

On July 6, heavy rain fell in the Kazakh and Gyanja regions of Azerbaijan, destroying 480 ha of wheat, 320 ha of maize and 500 ha of grapes. A thunderstorm with gusts of 27 m/s and more devastated parts of Latvia on the same day. Makkaur Fyr in Norway (71°N, 30°E) received a record 12-hour amount of 61 mm on July 15, an enormous amount for regions boarding the Arctic Ocean. In Georgia, on July 29, again heavy downpours falling on saturated soil, triggered record floods.

Plenty of rain (60 - 90 mm at places), violent squall lines and thunderstorms caused high losses in northern Italy, in southern Germany, in the Czech Republic, in Poland, Latvia and near Linköping, Sweden, when an intense low pressure system moved from northern Italy northeastward on July 8-9. Emergency services worked hard in several regions to clear damage from winds and rain which uprooted trees, wrecked houses as well as power and telephone lines.

On the other hand, people suffered from heat and drought. Bulgaria reported record-high average maximum temperatures up to 35 °C and precipitation totals of 5 -10 mm only. In Slovakia, though, having a wet summer on the whole, the decreasing trend of July precipitation of the last 20 years, continued (see fig. 24)

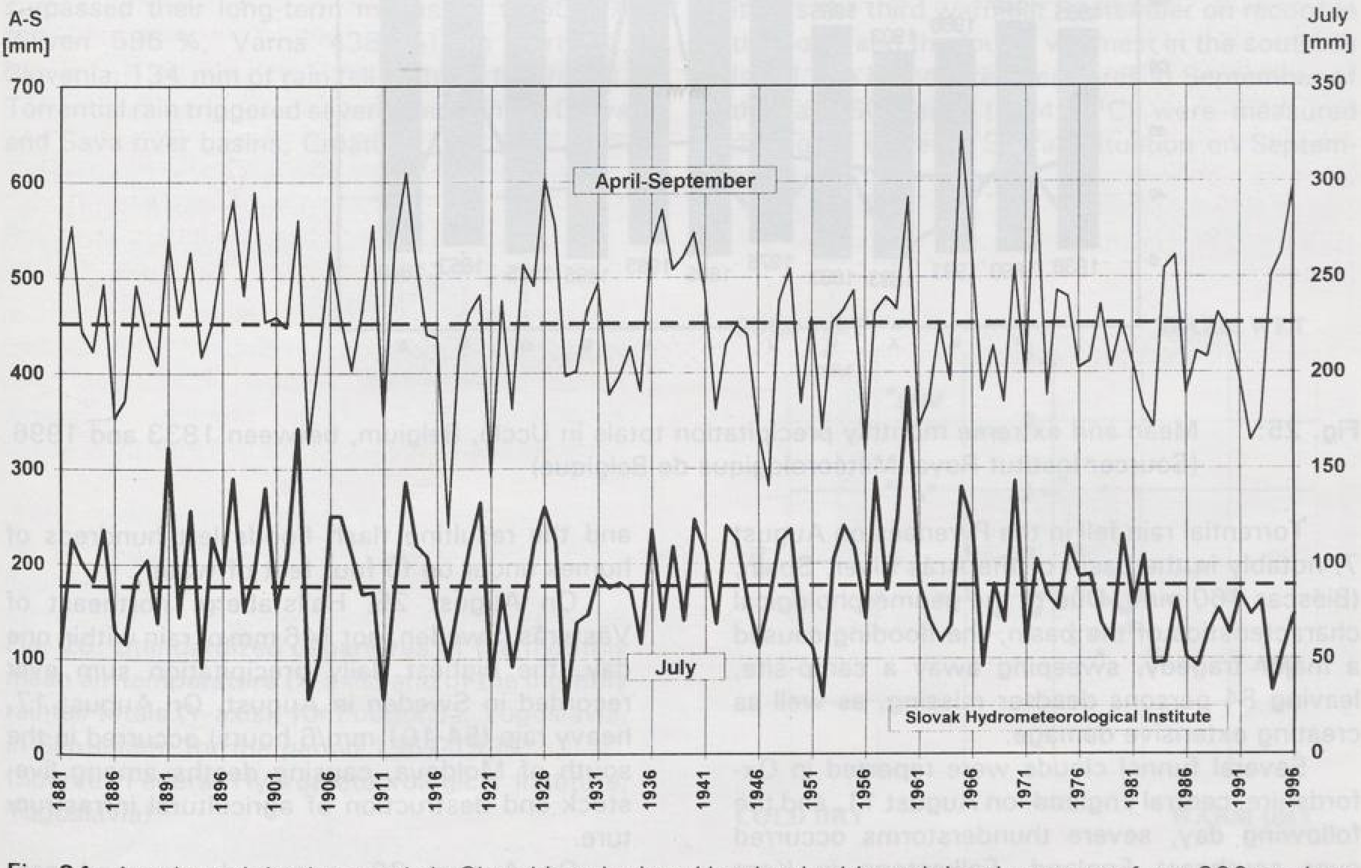


Fig. 24: Areal precipitation totals in Slovakia calculated by the double weighted averages from 200 stations between 1881 and 1996 for the April to September season and for July, dashed lines: long-term mean of areal totals between 1881 and 1996.
(Source: Slovak Hydrometorological Institute)

August:
- **Very warm in the northeast, cold in the southwest**
- **Mostly dry, but local severe floodings**
- **Flood catastrophy in Pyrenees**

In contrast to the wet and chilly preceding summer months, August was extraodinarily hot in Fennoscandia and the Baltics. Stockholm, Sweden, experienced its warmest August since 1846. In Norway, the highest temperature was recorded in Saltdal near the Arctic circle with 32,6 °C.

At the same time, little or no precipitation fell from eastern Germany to western Russia and in the eastern half of Fennoscandia. The low precipitation values combined with hot weather led to an abnormal drought in many parts. In Finland, monthly precipitation totals remained mostly around 50 % of their long-term averages. In Helsinki, with a total of 1 mm, a new record-low value was measured. In Latvia, the sunny and hot weather engendered forest fires.

Some parts of Lithuania received only 1 to 25 % of their precipitation normals and water shortages seriously affected the agricultural industry. Ukraine reported one of the worst droughts in decades, adding to the difficult economic situtation. On the other hand totals of 30 to 100 mm were widespread over Central Europe and southern Scandinavia and some severe flash floods occurred.

Belgium, having suffered from 13 months of dry weather (a precipitation deficit of 328,4 mm was recorded in Uccle between July 1995 and July 1996, the highest deficit since observations started in 1833) received plenty of rain (Uccle 231,2 mm) and August 1996 turned out to be the wettest month ever (see fig. 25).

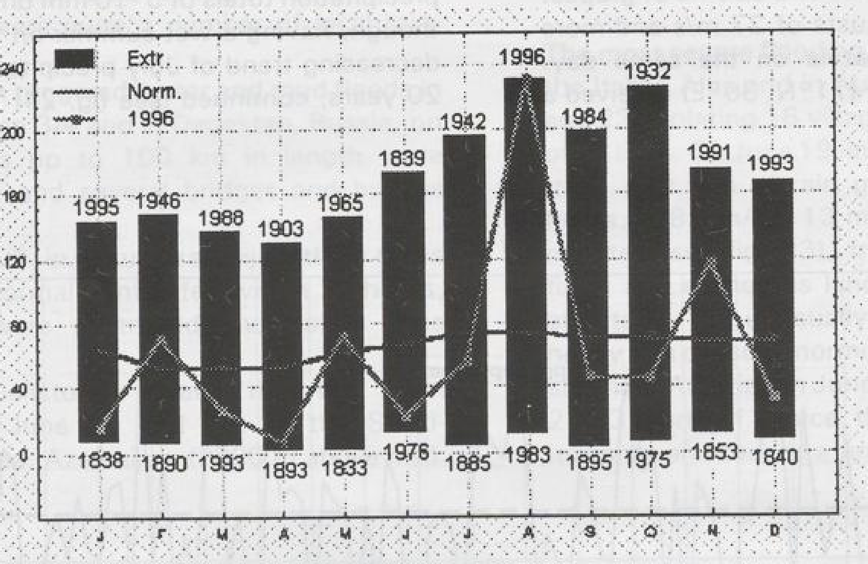


Fig. 25: Mean and extreme monthly precipitation totals in Uccle, Belgium, between 1833 and 1996 (Source: Institut Royal Météorologique de Belgique)

Torrential rain fell in the Pyrenees on August 7, notably in the basin of the Arás River, Spain, (Biescas 160 mm). Due to the geomorphological characteristics of the basin, the flooding caused a major tragedy, sweeping away a camp-site, leaving 84 persons dead or missing, as well as creating extensive damage.

Several funnel clouds were reported in Oxfordshire, central England, on August 11, and the following day, severe thunderstorms occurred over southeast England. Folkestone in Kent recorded nearly 100 mm of rain in seven hours and the resulting flash floods left hundreds of homes under up to four feet of water.

On August 25, Hallstaberg, northeast of Västerås, Sweden, got 146 mm of rain within one day, the highest daily precipitation sum ever recorded in Sweden in August. On August 17, heavy rain (54-101 mm/6 hours) occurred in the south of Moldova, causing deaths among livestock and destruction of agricultural infrastructure.

On August 30, a tornado ravaged near Krakow and Mikolajki, Poland.

September: • **Widespread, very cold weather**
• **Abundant rain from Spain to the Black Sea, dry in northern Europe**

In the Tatra Mountains, Poland, a snow cover appeared on September 6, lasting to the end of the month. Early frost was reported from Lithuania, Switzerland and in southern Germany it was the coldest September since 1931. Snow fell in the Alps down to an altitude of 800 m in the middle of the month, so that the grazing season ended prematurely.

The cold area, with temperature anomalies up to minus 4 °C, was centred over southeastern Europe, where it was very wet at the same time. The mean monthly temperature of 13,6 °C at the observatory Zagreb-Grič, Croatia, was the third coldest since records started in 1862. The month was extremely wet and cold all over Yugoslavia. The coldest temperature anomalies of minus 4,4 °C and monthly rainfall departures of 222 % (390 mm, 1961-90 average 121 mm) were recorded in Podgorica (see fig. 26). On September 2/3 and 12/13, violent storms and flash floods took several human lives and destroyed bridges and houses in the southwestern parts of Yugoslavia.

In Bulgaria, monthly precipitation totals surpassed their long-term means up to 500 % (Sliven 596 %, Varna 438 %). In Portorož, Slovenia, 134 mm of rain fell within a few hours. Torrential rain triggered severe floods in the Drava and Sava river basins, Croatia.

The monthly precipitation amount of 136 mm of Vienna, Austria, was the highest since 1922. In the eastern parts of Hungary, monthly rainfall totals of 500 % of the average caused considerable agricultural losses. In Moldova, rainstorms on September 22-24, caused floods with extreme river water levels. In the Naples region, Italy, record rainfalls engendered floods in the highly urbanized Sarno region.

Torrential rains were also reported from Catalonia and Levante, Spain, reaching 140 mm on September 3, in the county of Maresme (near Barcelona) and about 500 mm on September 11 in Gandia (near Valencia). Though these values are not extraordinary in autumn, they caused an appreciable amount of local flooding and material damage.

In northern Europe, dryness persisted and most regions received less than 50 % of their long-term means. In the UK, September was dry and sunny, the driest in fact, since 1986 and among the driest of this century.

However, it was unusually warm in far northwest and southeast of the Region. In Iceland it was the third warmest September on record in the north and the fourth warmest in the south. In Israel, the highest temperatures in September of the last 50 years (41-43 °C) were measured during an extreme Sharav situation on September 6.

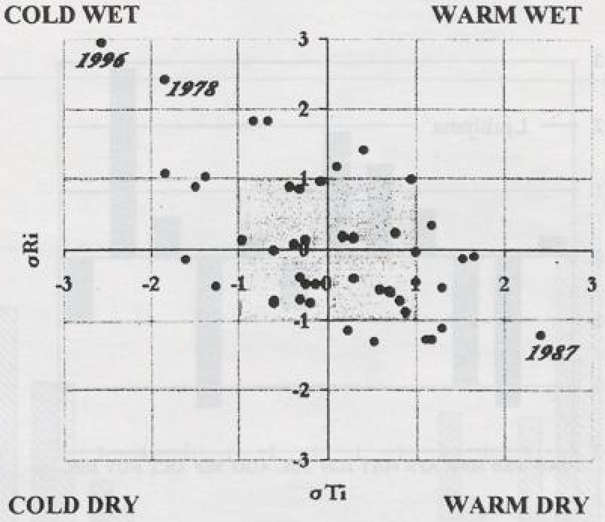


Fig. 26: Standardized departures of the monthly mean air-temperature (X-axis) and of the monthly rainfall totals (Y-axis), for Podgorica, Yugoslavia, in September for the period 1951-1996 (Source: Federal Hydrometeorological Institute, Yugoslavia)

October:
- Cold in the Mediterranean, warm from the UK to northern Russia
- Wet from the North Sea to southern Italy and in the Middle East

In October, negative temperature anomalies up to 2 °C in the Mediterranean, opposed positive values of more than 2 °C between Lappland and Sibiria. Whereas northeastern Europe reported moisture shortages which extended to more than 10 weeks, in some places. Elsewhere, heavy rain with floods were reported.

The Italian Adriatic coast, near Rimini and Lecce, received the highest daily precipitation totals in more than 50 years, between October 6 and 10. An even more dramatic rainfall event (148 mm within 2 hours) occurred on October 15 in the Esaro watershed and involved the town of Crotone, Calabria. Due to recent urbanization, 5 km^2 of new factories and civil settlements were inundated and 6 people lost their lives. Near the town of Rize, Turkey, 178,8 mm of rain poured down on October 14, wrecking houses and causing landslides.

Continuing rain caused high water situations and floods in several regions of Austria, from October 20 and 22. Villages and parts of cities were flooded with up to two meters of water. The town of Steyr was hit worst. In Vienna, the river Danube increased its level from 3 up to 6 meters. In addition to water damage 5 people died.

October brought the first autumn storms. On the 12th, the Lofoten area, Vesterålen and Troms in northern Norway were hit by severe storms, with economic losses in the order of millions of NOK. Ex-hurricane "Lilly", caused high casualities in Great Britain, northwestern Germany, northern France and in the Netherlands, (27-31). Gusts up to 163 km/h were reported in mountainous areas (Brocken, Germany, Oct. 29). A North Sea oil rig platform with 69 people on board drifted from its moorings off the coast of Scotland.

November:
- Warm in eastern Europe, cold in the northwest.
- Predominantly wet

November turned out extremely warm in eastern Europe, with monthly anomalies of 4 to 6 °C over Russia. Readings soared to 28 °C in Georgia. Extreme high temperatures were measured, especially in the first half of the month, on the Balkans (see fig. 27), resulting in monthly departures up to 3 °C.

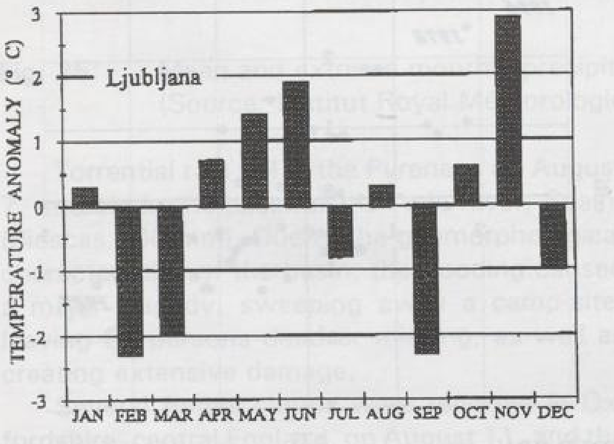


Fig. 27: Monthly mean air temperature anomalies in Ljubljana, Slovenia, in 1996. (Source: Hydrometeorological Institute Slovenia)

On November 5, in Yugoslavia at Loznica (121 m asl.) and Zlatibor (1028 m asl.), record temperatures of 29,1 °C and 21,2 °C were reported, the highest in this region since 1931. On the 13th, 19,1 °C was observed in Budapest, Hungary, which is the highest on record (since 1881). An intense Foehn occurred over the northern Alps with gusts up to 190 km/h in eastern Switzerland on November 11/12, causing a train to derail near Wengen. It resulted in an exceptional 19,1 °C in Munich, Germany, breaking the date-record set in 1969 by a whole degree.

In northwestern Europe, November 1996, went down in climatological memory as an unusually early winter month. In Iceland, though extremely sunny, it was the coldest November for at least 125 years. An extreme temperature drop happened in the UK between November 3 and 11; it can be seen very well in the Central England Temperature curve (see fig. 20, page 26), which fell steadily from 15,6 to 2,9 °C.

The Shumen region, Bulgaria, reported snowdrifts up to 1 m on November 8/9. An early snow cover appeared in the northern plains of continental Europe. More than 30 cm fell on the Lüneburger Heide, northern Germany, in the second decade of the month; but the effect of the still warm Baltic kept the coastline snow-free. At the end of the month, there was up to 20 cm of snow in the lowlands.

The first snow of the winter fell in the UK on the 19th where two people died as blizzards swept large areas of the country. Up to 20000 homes were blacked out across North Wales as power lines were brought down. The following weekend brought further heavy snow to northern Britain, causing chaos to road transport but bringing joy to winter sports enthusiasts.

In the southern Alps of Switzerland, heavy snowfall, up to 150 cm, on November 13/14, isolated villages. The first widespread snowfall all over the Alps started on November 25/26. At the end of the month, several new absolute maximum depths of snow cover were recorded (e.g. St. Anton, Arlberg, 110 cm).

There was abundant rain in many areas. In Finland, the low ground water level of the preceding three months was recharged during an abnormal rainy November. Helsinki Airport received a record November total of 216 mm (normal 78 mm).

The Foehn situation over the northern Alps brought plenty of rain to the southern slopes. At Mosogno, Switzerland, 471 mm poured down within 48 hours, a new record since 1924. An extreme precipitation amount was recorded in Reisach, Carinthia; where 110 mm fell within 12 hours, 170 mm fell within 24 hours, causing landslides and cutting connections to some valleys.

On November 18, highwater of 134 cm asl affected 75 % of the ancient town of Venice, Italy, the maximum elevation attained during a period of 10 days with values always above 110 cm asl.

In the regions of Zlatograd and Devin, Bulgaria, precipitation between November 25 and 30, exceeded the monthly normal by 2 to 3 times, triggering inundations and high losses. In Slovenia, where it was again unusually rainy (see fig. 18, page 25), some rivers inundated. In Yugoslavia, heavy rain triggered flash floods on November 19-23. The Raška river flooded, causing damage of about US$ 1 million. In Greece, on November 30, severe thunderstorms with intense rain (184 mm/12 h in Xanthi) induced flooding. Three people died, and there were high economic losses.

However, further to the east, it was extremely dry. In Israel, the rainy season, which had started very well in October, was interrupted. The monthly totals reached only 10 to 29 % of normal. An extremely dry spell occurred from November 9 to 15: On November 14/15, the relative humidity at noon was only 3 to 6 %, the lowest values for this month during the last 40 years, and for some parts of the country the lowest values for the whole year. Also in Cyprus, it was exceptionally dry with precipitation totals of 25 % of normal (see fig. 28).

In the afternoon of November 6, the most devastating weather event of the year in Sweden took place, when two tornadoes followed an intense low from west to east over the southern parts of the country. One tornado hit the village of Moheda, damaging several buildings and turning a car with passengers upside down. The other tornado killed many cattle as it completely destroyed three barns at Åsle. The value of destroyed property amounted to several million Swedish Crowns.

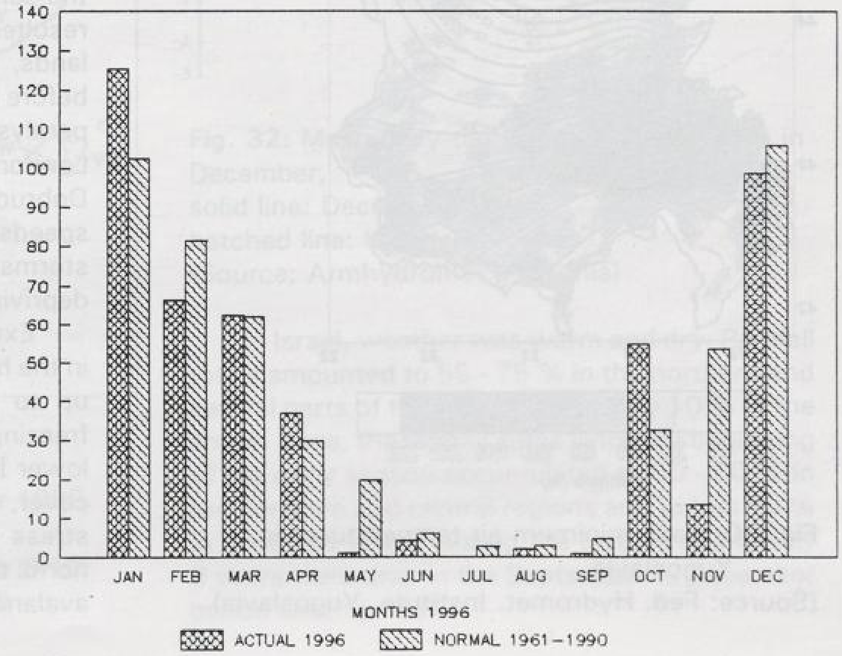


Fig. 28: Monthly areal average precipitation in Cyprus (Source: Meteorological Service, Cyprus)

December: ● In southern Europe wet and mild
● Elsewhere bitterly cold and mostly dry

Extreme negative temperature deviations predominated in December 1996 (see fig. 29). The year ended bitterly cold over most parts of Europe. In Poland the monthly mean air temperature was 4-5 °C lower than normal, and December 1996 was the second coldest in the 1951-1996 time series. In Latvia, the monthly mean minimum temperature was 17 19 °C below normal. Freezing intensified in the third decade of the month when Arctic air penetrated under the influence of a Scandinavian-Russian high and the decade was in many regions one of the coldest reported this century. More than 170 people froze to death between Poland and Spain and there was extreme winter damage.

On the last day of the year, in northern Yugoslavia, an extreme temperature gradient existed. From north to south, at a distance of 450 km, the difference in minimum temperature reached 20 °C (see fig. 30).

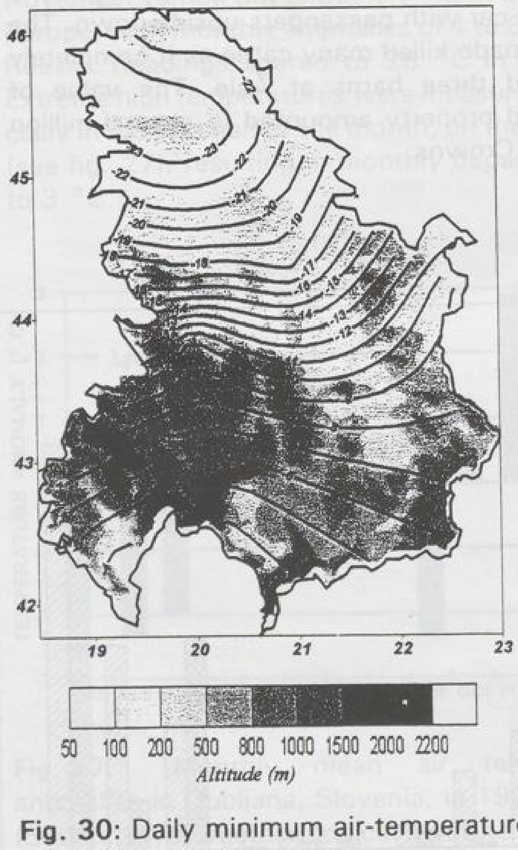


Fig. 30: Daily minimum air-temperatures in Yugoslavia
(Source: Fed. Hydromet. Institute, Yugoslavia)

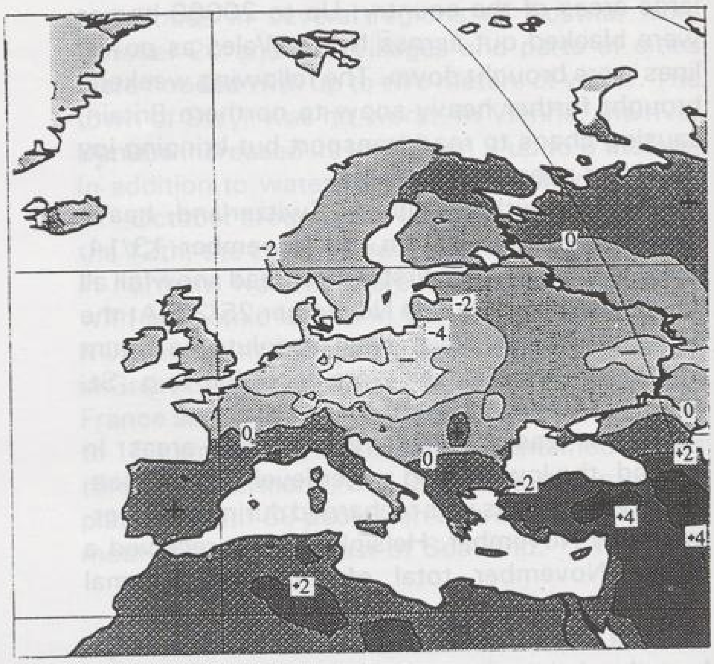


Fig. 29: Temperature anomalies in December 1996
Reference period: 1961 - 1990
(Source: Deutscher Wetterdienst)

Extreme rime ice, hoar frost and black ice caused much damage. Trees, power and telephone lines broke. In northeastern Latvia, where the hoar frost reached diameters up to 3 cm, an emergency alert was declared. High windspeeds (20 m/s) and frost up to -12 °C compelled to close the port of Varna, Bulgaria, for the first time since 15 years.

In Central Europe, where it was mostly dry at the same time, frost and little or no snow cover resulted in high agricultural losses. In the Netherlands, the third decade of December had never before been so sunny. Elsewhere, heavy snowfall paralysed communication system. Thus it was London's first white Christmas in 20 years. In the Dobrudha region of northern Bulgaria, high wind speeds caused drifts up to 1-1,5 m. The snowstorms and the wet snow damaged power lines, depriving 396 settlements of electricity adversely.

Extreme snowfall affected Georgia, too. While in the high mountains, a snow cover with a depth up to 3-4 m developed, frequent changes of freezing and thawing, snow and rain, occurred in lower levels, building a 40 -120 cm deep snow cover, highly saturated with rainwater. Snow stress reached 600-1000 kg/m² exceeding the norm three to sixfold. An extremely intensified avalanche activity, not seen in four to five generations, was reported. More than 300 people were trapped by an avalanche on the Transcaucasian Road.

Between December 25 and 29, snow drifted by Bora winds with gusts up to 210 km/h, badly hit the eastern Adriatic coast. Heavy snowfall was reported from northern Italy on December 30/31 affecting road and air traffic, industries and all human activity. In the Marche, a snowcover with a depth of 140 cm was measured, the highest value since 1956.

Abundant rain, 360 mm within five days in Antalya, caused floodings in the Turkish Riviera at the beginning of the month. On December 6-9, an intense low pressure system over the western Mediterranean with thunderstorms and torrential rain ravaged southern France and Corsica (Ghisoni, Corsica: 275,4 mm on December 7-9 and Palairac, l'Aude: 337,2 mm on December 6-9). The worst inundation was that of the river Tarn, where homes were flooded, villages evacuated including Béziers and rain links and roads were cut. Nearly the entire Iberian Peninsula, included Balearic and Canary Islands received abundant rain (see fig. 31) and at many places new all-time records were set (see following table)

Table: Record high rainfall totals in Spain in December 1996

Station	new record	old record	first observation
Burgos	149mm	141mm(1959)	1862
Ciudad Real	220mm	154mm(1958)	1863
Huelva	386mm	252mm(1989)	1903
Cadiz	396mm	378mm(1958)	1805

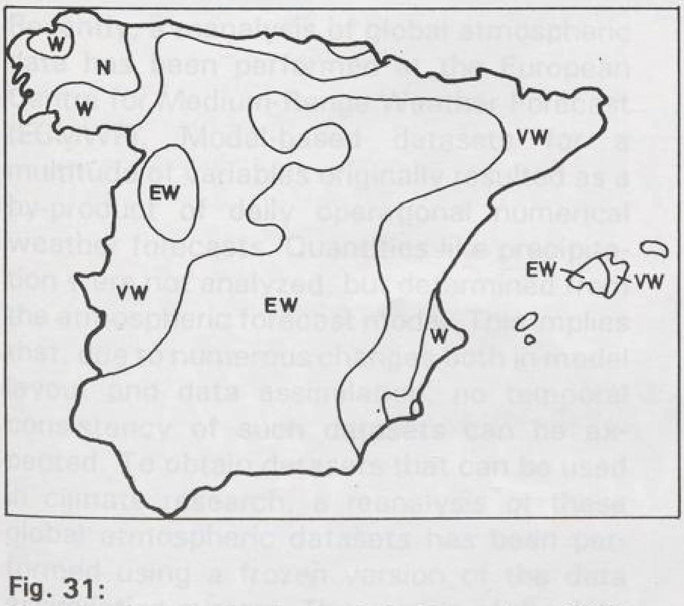


Fig. 31:
Precipitation deciles in Spain in December 1996
N: normal(4-6) W: wet = 7-8
VW: very wet(8-9) EW: extremely wet (9-10)
(Source: Servicio de Climatologia, Madrid)

The downpours caused major damage in Andalucia to the infrastructure (5000 million pesetas) and to the farming industry (14000 million pesetas). In Portugal, flooding was reported from the Douro and Tejo river basins and from a number of other places. Devastating tornadoes hit Portugal and Spain on December 19/20. In the township of Matalascañas, province Huelva, it caused massive damage over a strip of land of 1000 x 40 metres.

Heavy precipitation and thawing triggered catastrophic floods in Georgia. The flooding on December 24-25 on the western Pron, Kviril and Rioni rivers were the worst, submerging the riparian areas within the boundaries of the protective dams. The flood wave broke dams and flooded several villages in the Abashsky region.

December turned out to be extremely warm over the far southeast of the Region with departures from normal surpassing + 5 °C. In Yerevan, Armenia, where it was particularly warm in the third decade (see fig. 32), the monthly mean of 5,2 °C, exceeded the normal value by 5,2 °C, which had not been observed for 40 years.

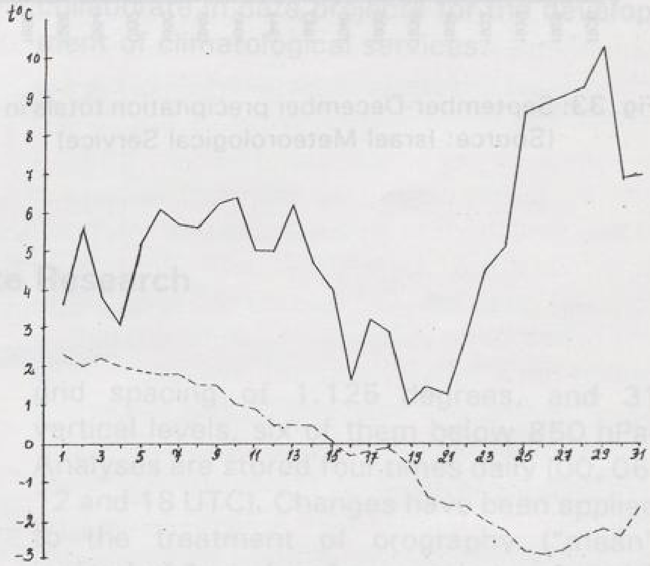


Fig. 32: Mean daily temperatures in Yerevan in December,
solid line: December 1996,
hatched line: long-term means
(Source; Armhydromet, Armenia)

In Israel, weather was warm and dry. Rainfall totals amounted to 55 - 75 % in the northern and central parts of the country, and only 10 % in the south. Thus, the rainfall sums since the beginning of the rainy season accumulated to 50 - 60 % in the northern and central regions and to just 10 % in southern Israel. During the last 70 years only 3 years were drier in the September to December period (see fig. 33).

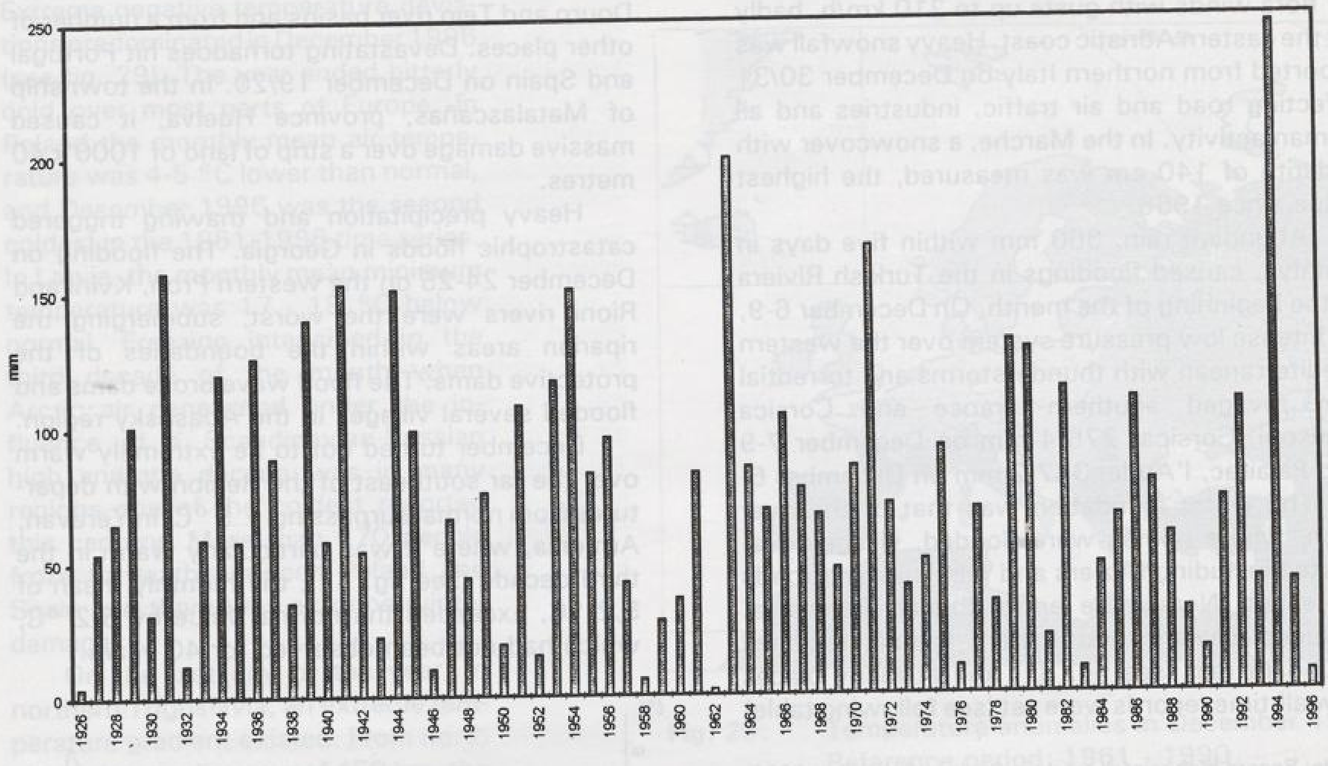


Fig. 33: September-December precipitation totals in Be'er Sheba, southern Israel, between 1926 and 1996 (Source: Israel Meteorological Service)

Activities of European Climatological Centres

News from the European Climate Support Network (ECSN)

On 17 May 1996, both the ECSN Board and the Council of EUMETNET (Conference of the National Meteorological Services in Europe) decided to terminate ECSN in its current form, by 30 June 1997. It has been reorganised as a programme within EUMETNET, will also be called ECSN, taking over the main current ECSN functions.

The objective of EUMETNET is to promote a co-operation of its members, working together as a network to help in providing:
- leading expertise on weather, climate, environment and related activities
- technical support to the corresponding scientific community
- high quality basic data and products.

Accordingly, the ECSN is now undergoing some organisational change and is developing in new directions. ECSN is involving other organisations in its project including additional European NMSs. The European Centre for Medium Range Weather Forecasts will make a valuable contribution with its re-analysis project of recent climates. EUMETSAT has been widening its mandate to include climate observations. Other leading European research institutes will be included.

The main new direction for ECSN will be to collaborate in data projects for the development of climatological services.

ECMWF Reanalyses Available for Climate Research

Recently, a reanalysis of global atmospheric data has been performed at the European Centre for Medium-Range Weather Forecast (ECMWF). Model-based datasets for a multitude of variables originally resulted as a by-product of daily operational numerical weather forecasts. Quantities like precipitation were not analyzed, but determined from the atmospheric forecast model. This implies that, due to numerous changes both in model layout and data assimilation, no temporal consistency of such datasets can be expected. To obtain datasets that can be used in climate research, a reanalysis of these global atmospheric datasets has been performed using a frozen version of the data assimilation system. The version of the data assimilaion in the reanalysis uses a horizontal resolution of T106, which is equivalent to a grid spacing of 1.125 degrees, and 31 vertical levels, six of them below 850 hPa. Analyses are stored four times daily (00, 06, 12 and 18 UTC). Changes have been applied to the treatment of orography ("mean" instead of "envelope" orography) and to the parameterization of soil moisture, radiation and gravity wave drag. A new prognostic cloud scheme has been included to forecast cloud water and cloud coverage. These quantities, as well as the specific humidity, are advected in grid point rather than in spectral space. Data are available for the period December 1978 to February 1994.

The reanalyses can be obtained directly from the ECMWF (era@ecmwf.int). A copy of this dataset is also available at the German Climate Computing Centre (DKRZ) in Hamburg (hellbach@dkrz.de).

Upper air data available include spectral coefficients of geopotential, temperature, vertical velocity, vorticity, divergence and relative humidity, which have been interpolated to 17 pressure levels between 1000 and 10 hPa. Surface fields include precipitation (both stratiform and convective), snow cover, evaporation, runoff, fluxes of latent and sensible heat, sea level pressure, cloud cover (low, medium, high and total clouds), surface temperature, dew point and wind, soil moisture and temperature, short- and long-wave radiation, wind stress and gravity wave drag. The data are stored in WMO GRIB format and can be read with the appropriate software. The total amount of data is roughly 450 gigabytes. As an example of the effect of the frozen data assimilation scheme, Figure 35 shows a latitude-time cross section of zonally averaged vertical velocity in 500 hPa. The dramatic changes in the magnitude of the Hadley cell in the operational analyses (upper panel) due to several model changes are clearly visible. Compared with this, the reanalysis (lower panel) shows an interannual variability that is much more realistic.

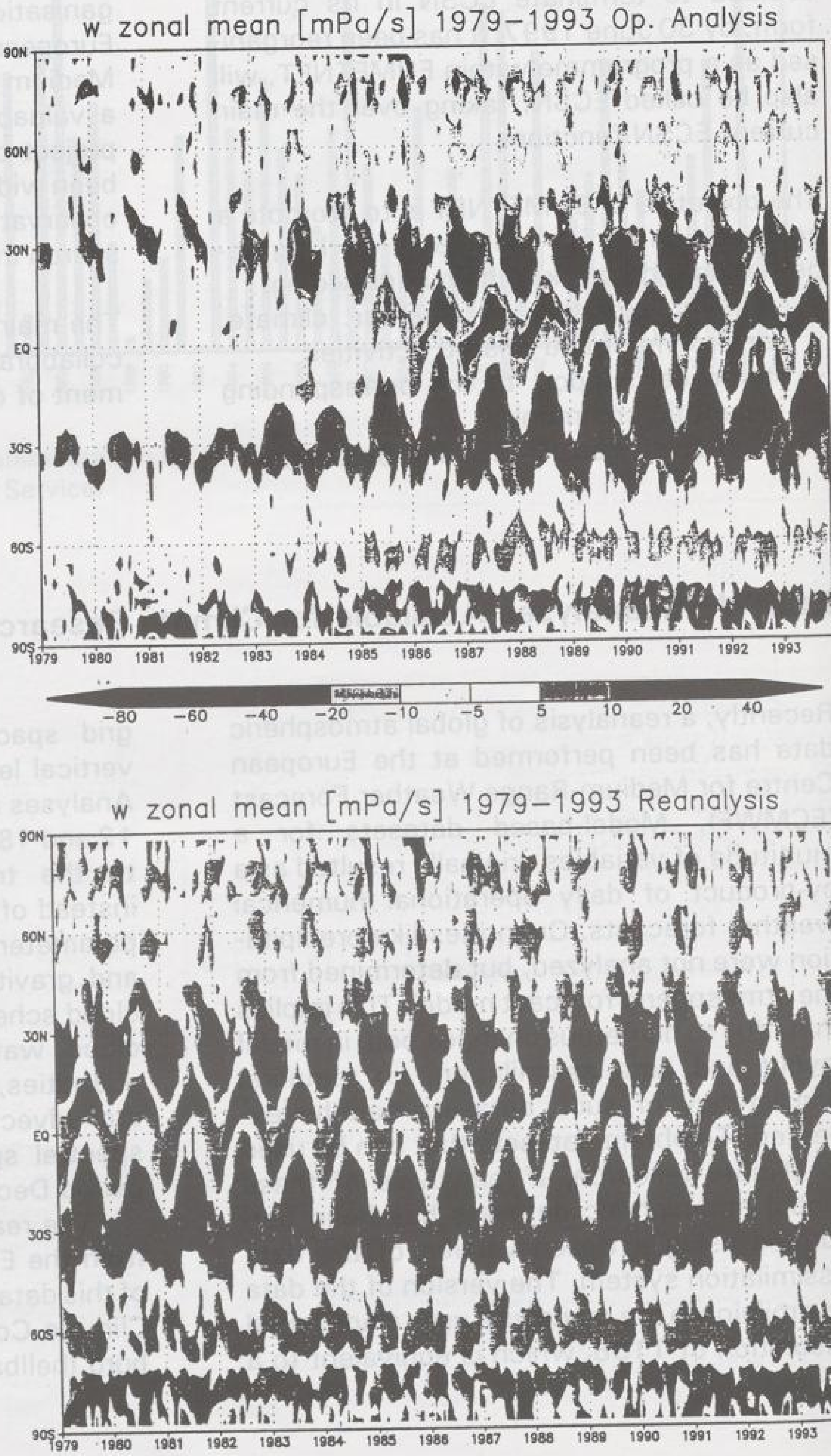


Fig. 34
Latitude-time cross section of zonally averaged vertical velocity (mPa/s) in 500hPa taken from an operational analysis (upper panel) and by the ECMWF reanalysis (lower panel).
(Source: DKRZ, Germany)

WASA Project

WASA is an abbreviation of Waves and Storms in the North Atlantic. The project was funded by the European Union's Environment program from 1994-1996.
Project participants are:
Clima Maritimo, Madrid, Spain
Det Norske Meteorologisk Institutt, Bergen, Norway
Max-Planck-Institut für Meteorologie; Hamburg, Germany
Institut für Gewässerphysik, GKSS, Geesthacht, Germany
Danmarks Meteorologiske Institut, Copenhagen, Denmark
Sveriges Meteorologiska och Hydrologiska Institut, Norrkoeping, Sweden
Koninklijk Nederlands Meteorologisch Instituut, De Bilt, The Netherlands
RIKZ, The Netherlands
Proudman Oceanographic Laboratory, Bidston, United Kingdom

The project has been set up for verifying, or falsifying hypotheses of a worsening storm and wave climate in the Northeast Atlantic and its adjacent seas in the present century.

A major methodical obstacle for the assessment of changes in the intensity of storm and wave events are the inhomogeneities of the observational records, both in terms of local observations and of analyzed products (such as weather maps), which usually produce an artificial increase of extreme winds. Therefore the assessment about changes in storminess is based on local observations of air pressure and high-frequency variance at tide gauges. Data of this sort is available for 100 years and sometimes more. The assessment about changes in the wave climate is achieved by a two-step procedure; first a state-of-the-art wave model is integrated with 40 years of wind analysis; the results are assumed to be reasonably homogeneous in the area south of 70N and east of 20W; then a regression is built which relates monthly mean air-pressure distributions to intra-monthly percentiles of wave heights at selected locations with the help of the 40 year simulated data; finally observed monthly mean air pressure fields from the beginning of this century are fed into the regression model derive best guesses of wave statistics throughout the century.

The statistics of geostrophic wind, which is considered a homogeneous proxy for variations in near surface wind variations, show a clear increase in the percentiles in the last 30 or so years. But the present levels of wind speeds are comparable to wind speeds early this century. Indeed, a statistical model confirms this hypothesis. Obviously, an analysis of a few decades of data is insufficient for the assessment of natural variability of the storm climate.

The atmospheric circulation model used is a T106 version of ECHAM 3 which has been forced with present SST and sea ice conditions as well as superimposed SST and sea ice anomalies simulated in a fully coupled atmosphere ocean GCM. Also the carbon dioxide concentration has been doubled. Because of the computational costs, both the control, and the "2CO_2" runs have been simulated only for about 5 years. The analysis results in weak increase of storm activity and (extreme) wave heights in the Bay of Biscay and in the North Sea, while storm action and waves slightly decrease along the Norwegian coast and in most of the remaining North Atlantic area in this scenario. A weak to moderate increase of storm surges in the southern and eastern part of the North Sea is expected. The projected anthropogenic changes at the time of CO_2 doubling fall well within the limits of variability observed in the past. However, the changes of wind speed and wave height statistics are derived from one relatively short climate simulation; therefore, the found changes in wind speed and wave heights may reflect mere sample (year-to-year) variations unrelated to a deterministic signals related to changes in the composition of the atmosphere.

The new EU sponsored project STOWASUS, coordinated by Eigil Kaas, DMI, will create a new scenario of this sort, with a more modern atmospheric model integrated over a long time. This project will begin in 1998.

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Wind Data on the World Wide Web - an EU - Joule Project

By Kurt S. Hansen, Department of Energy Engineering, Technical University of Denmark, Lyngby and Michael S. Courtney and Jorgen Hojstrup, Wind Energy and Atmospheric Physics Department, Roskilde, Denmark

Vast amounts of wind data have been measured in many different locations. Of the thousands of hours of time series collected, only a tiny proportion are available for use by the wind turbine and wind engineering communities. The project aims at collecting a small but representative portion of these data and making them available on the World Wide Web.

A wide variety of terrain types will be represented together with significant amounts of data measured in and close to wind farms. Data will have a typical temporal resolution of 1-20 Hz and, as such, are intended for design and simulation studies as opposed to wind resource applications. Much emphasis is being placed on ensuring an adequate level of documentation and presenting this in a manner appropriate to the World Wide Web. Similarly, a search and data selection system is being developed that fully utilises the interactive nature of the Web.

In order to implement a suitable search system, we have constructed a database for the detailed recording of field measurements, ranging in scope from the administrative level down to the mounting details of individual sensors. Wind data are quality checked according to a number of different criteria such as the presence of spikes, noise and trends. Subsequently, data are indexed using a variety of parameters, including conventional statistics and extremes, turbulence intensity, gust, acceleration and wind shear. All these data reside in an SQL server accessible using both a traditional client/server combination and also from the World Wide Web.

After quality control and indexing, the actual wind data are copied in a standard format to CD-ROM's. All CD-ROM's reside in a juke box containing up to 150 disks, giving a capacity of around 100 GB (with present CD technology). The juke box is accessible via ftp which also allows direct downloading of data files from a web browser.

Data are provided by all the participants of the project, covering most of the countries of the European Union and with a certain amount of data from the USA. The intention is to extend this coverage, particularly with additional data from North and Central America. By autumn 1997, we will have gathered and processed a large amount of the data planned under the context of the current project (40-60 GB). Progress on the web interface should be sufficiently advanced to permit demonstration of the system at the conference. A test version should also be available at that time, with final release planned for the first half of 1998.

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Results from the Swiss National Research Programme 'Climate Changes and Natural Desasters', NRP 31:

Severe Storms over Northern Switzerland. A Climatology of Hail- and Winterstorms.

By H.-H. Schiesser, Atmospheric Physics, Federal Institute of Technology, Zurich

In the framework of the National Research Programme 31 "Climate changes and natural disasters" (NRP31), a study was undertaken of whether a global warming of the atmosphere would have an influence on the frequency and/or the intensity of severe storm events, such as hailstorms of the summer season and westwind storms of the winter season. The analysis of the summer storms was performed using weather radar measurements and hail damage information. For the winter storms, a rather long time series (130 years) was available of daily wind measurements. The observational domain was restricted to the part of Switzerland north of the alpine ridge, whereas for some further meteorological considerations (synoptic weather situation), the whole North-Atlantic-European area was included into the analysis.

To examine recent trends in the frequency of stormy events, several time-series were established of various time-spans. For the most recent time period (1983-1995) very detailed information about single hailcells was derived from radar observations. In contrast, the damage data yielded three different series, which were simpler but available for a much longer period:
1) Yearly number of hail days since 1881, which was weighted according to the average percentage of hail days in each category of a common european weather classification.
2) Yearly number of hail days and the daily number of Swiss communities reporting damage since 1920.
3) The most comprehensive database was obtained from the daily information of hail damage for each Swiss community and this was available continuously from 1949 onwards. Using the knowledge about the location of the damage reporting communities, damage areas (so called damage clusters) have been extracted. Clusters of a minimum length of 25 km were categorized to be severe events. For the extratropical winter storms a time series of days with a minimum wind force of Beaufort 7 (the same for Beaufort 8 and 9) was established for the period from 1864 for a record of the mesonet station Zurich-SMI (Swiss Meteorological Institute).

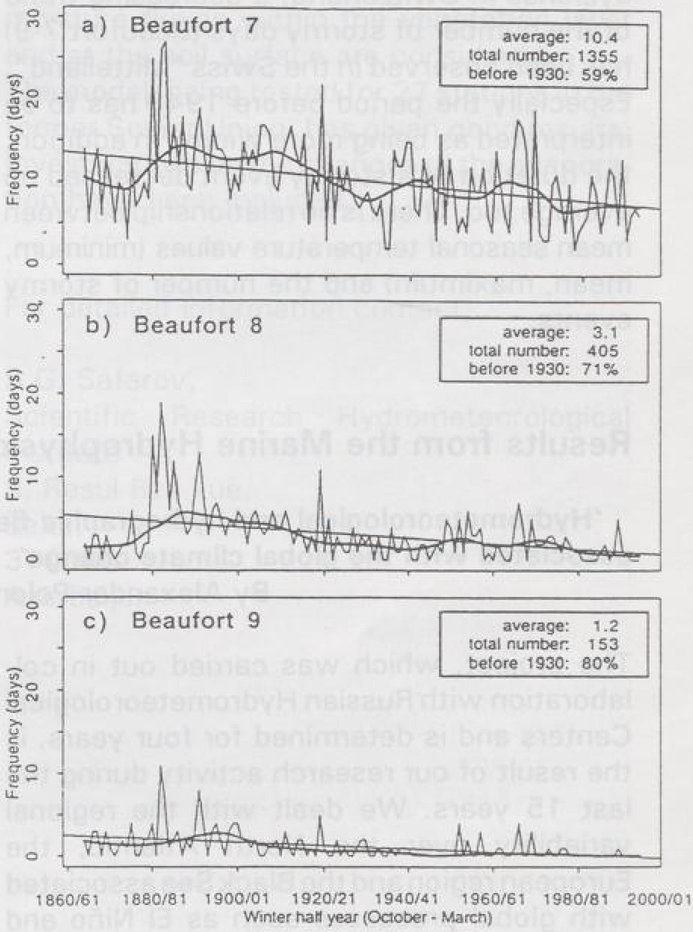

Fig. 35: Time series (1864/65 - 1993/94) of the seasonal frequency (October - March) of days having wind speeds of at least equivalent to Beaufort 7 (a), of at least Beaufort 8 (b) and of at least Beaufort 9 (c). The measurements were taken from the station Zurich. The bold curve represents a 1/6 period (about 22-year) filter function and the straight line represents the trend over the whole observed period.

For hailstorms, the following results were obtained: The number of days with agricultural hail damage has increased. The days, which experienced severe events (damage clusters) and the yearly number of damage clusters show a large variability from year to year. Therefore, the determination of a significant trend is more difficult than for the simple hail days. Weak events correlate probably better with a general warming than strong events, which need an optimal interplay of synoptic and mesoscale conditions. Because of the large variability the available time-series of the severe events are still too short (although now available for 48 years).

In relation to the influence of extratropical cyclones in Switzerland, a decreasing trend of the number of stormy days (Beaufort 7-9) has been observed in the Swiss "Mittelland". Especially the period before 1940 has to be interpreted as being more windy. In addition, the duration of a stormy event decreased on average too. There is no relationship between mean seasonal temperature values (minimum, mean, maximum) and the number of stormy events.

In spite of an increase of cyclonic westwind situations during the last decades, Switzerland was hit by fewer storms. Presumably the whole westwind belt has moved further north where a deepening of the cyclones was observed. However, Switzerland was usually situated at the most southern edge of the particular storm fields (with exceptions like storm "Vivian") and therefore not influenced by strong gales.

In general, it does not seem possible to answer the question related to the future trend of severe storm events using simple scenarios (increased mean seasonal temperature values and percentage change of seasonal precipitation) as prescribed for NRP31, since severe storms depend on many factors, which provide the necessary environmental conditions and which occur very seldom.

Results from the Marine Hydrophysical Institute, Sevastopol:

'Hydrometeorological and hydrographic fields' variability over the Black Sea coastal zone associated with the global climate change'

By Alexander Polonsky, Sevastopol, Ukraine

The project, which was carried out in collaboration with Russian Hydrometeorological Centers and is determined for four years, is the result of our research activity during the last 15 years. We dealt with the regional variability over the North Atlantic, the European region and the Black Sea associated with global processes such as El Niño and "conveyor belt". Concurrently, we took part in the Ukrainian National Program "Global Changes of Environment and Climate" dealing with the human activity and medical aspects of climate change. It is clear that the study of the natural variability of the coupled ocean-atmosphere system is absolutely necessary to describe, explain and forecast the changes of the global and regional climate.

Recent results show that there is significant impact of interannual to intradecadal climate change on the Black Sea rivers' run off and on the regional conditions over the Black Sea. The most intense response of the regional hydrometeorological and hydrographic fields on the global climate changes is in the coastal zone.

The principal objectives of this project are as follows:

- to revise the parameters of the low-frequency changes of the coupled ocean-atmosphere system over the North Atlantic and associated changes over the Eastern Europe and the Black Sea in the 20th century using historical data sets and recent statistical technique;
- to separate the quasi-periodical and abrupt (jump-like) decadal to interdecadal changes in the hydrometeorological and hydrographical fields over the North Atlantic Ocean, eastern Europe and the Black sea;
- to clarify the role of the North Atlantic Ocean in the decadal to interdecadal regional climate change.

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Results from the Hydrometeorological Institute of Azerbaijan:

The utilization of an energy-mass-exchange model for the assessment of climate change on the water economy of the soil

By S. G. Safarov, Baku

For most regions of the world, the productivity of the ecosystem and agricultural benefit are highly correlated to changes of surface humidity. Accordingly, within the discussion of climate change and global warming, the knowledge of the effects on the water economy is of utmost interest.

For investigations in this scientific field, several dynamic models are available. One way for the verification of the results of the models is to take into account probable climate changes by estimating the water storage in current climate conditions in different regions.

The Hydrometerorological Institute of Azerbaijan has developed a new dynamical model simulating an acreage under cultivation with and without plants. The model pays attention to the daily course of meteorological elements, which are decisive for the water and thermal economy of the ecosystem during the warm period of the year.

The model is based on the equations of moisture and thermal conductivity of the soil, the water and thermal economy of the vegetation layer and the thermal economy of the soil surface. Furthermore, the turbulent heat and moisture fluxes within the vegetation layer and at the soil surface are considered.

The model, being tested for 27 stations in the former Soviet Union, has given good results. Investigations on the changes of the evaporation have been included.

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Conferences and workshops

First European Conference on Applied Climatology

7 - 10 May 1996, Norrköping, Sweden

More than 200 participants attended the First European Conference on Applied Climatology held in Norrköping co-organized by the SMHI and ECSN. The opening speeches and concluding remarks have been collected in the fourth issue of the ECSN Newsletter which appeared in June 1996. An ECSN Workshop on Climate Databases in Europe took place in parallel on 8-9 May.

On the objective and achievements of the Conference, it may be openly said that the Conference achieved the stated objective of providing the participants with the latest information on the state of the European climate, its variability, recent detection studies and envisaged climate prediction capabilities.

A few notable examples of this were:

i) the explanation offered of the recent Eurasian warming trend;
ii) the demonstrated capability of atmospheric models (AOGCMs) forced with climatological sea surface conditions of producing realistic low frequency variability in the middle and high latitudes, and even in the tropics;
iii) the description of recent detection studies which involve forcing ensembles of atmospheric GCMs with the observed sea surface temperatures and with a range of credible atmospheric forcings (CO_2, aerosols, and stratospheric ozone). These provide good correlations between models and observations from a radiosonde climatology, although they are still unable to explain land surface warming;
iv) the good progress being made in the use of ocean/atmosphere models for ENSO predictions; and
v) the preliminary results on work towards seasonal prediction which gives confidence that at least in certain conditions seasonal forecasts are possible with model ensembles giving good predictions of the sea surface temperature.

The other major focus of the Conference was the application of climate information in different sectors of European economy and society. A wide range of examples of the use of current conventional climate data in the energy, agriculture and insurance sectors on country wide or smaller scales were presented although quite independently of the climate model outputs. The need for and the possibility to improve climatological services were emphasized in the description of the WMO project CLIPS which aims to ensure that comprehensive information on present and future climate and its variations will be delivered to users on a timely basis and in a suitable format.

International Conference on Tropical Climatology, Meteorology and Hydrology - in memoriam F. Bultot (1924-1995)

22 - 24 May 1996, Brussels, Belgium

The international conference "Tropical Climatology, Meteorology and Hydrology (TCMH-96)" was held in memory of Professor Franz Bultot (1924-1995) who dedicated a large part of his scientific career to the study of the climatology, meteorology and hydrology of central Africa. His research in that field culminated in the publication of the monumental 4-volume "Atlas Climatologique du Bassin Congolais/Zairois" published at Brussels between 1971 and 1977. Besides that, Franz Bultot was the author of about 50 papers on the above-mentioned subjects.

The international conference TCMH-96 was jointly organized by the Royal Academy of Overseas Sciences (KAOW/ARSOM) and the Royal Meteorological Institute of Belgium (KMI/IRM) and took place under the high patronage of H.M. King Albert II of Belgium.

The Academic Opening Ceremony was held at the "Palais des Académies" in the presence of H.R.H. Prince Laurent of Belgium, President of KINT/IRGT highlighted the career of Franz Bultot in the field of TCMH. More than 200 representatives of the corps diplomatique, of international and national organizations, and scientists were present.

The activities of the international conference were split up into different sessions according to the following themes: palaeoclimatology; climatology; meteorology; remote sensing; agrometeorology; sustainable development; hydrology. For each theme keynote speakers addressed the state of the art in the given field and introduced the presentations. About 70 oral presentations and 15 posters were presented during the 2 1/2 days of the scientific meeting.

The international colloquium proved to be successful. It attracted more than 150 scientists, among them about 15 from Africa. A very large national response was encountered showing that the subjects are lively in the Belgian scientific community although no formal structures exist. At the same time, an effort was made to provide a meeting point for scientists from north and south to enable them to discuss in an open forum matters in the fields of tropical climatology, meteorology and hydrology. Several of the presentations by African scientists did receive considerable interest from the participants. One of the repeated messages from the conference pointed to the overall lack of recent scientific data from the target area.

The large response to the sections on "Remote Sensing" and on "Sustainable Development" underline the efforts deployed by the Belgian Federal Services for Scientific, Technical and Cultural Affairs of the Ministry of Science Policy for the Research Programme on Sustainable Development.

The success of the initiative induced the organizers the plan to call for the second international conference on "Tropical Climatology, Meteorology and Hydrology (TCMH-2000)", to be held in Brussels, May 2000.

The proceedings of TCMH-96 are scheduled to be published in early 1997.

Seminar on Homogenization of Surface Climatological Data

6-12 October 1996, Budapest, Hungary

The seminar was held at the headquarter of the Hungarian Meteorological Service, Budapest. Twenty-nine scientists from 20 countries of RA VI attended the meeting and presented 15 papers. The World Meteorological Organization and the European Climate Support Network sponsored the seminar. It is planned to hold biennial seminars, which can serve as a forum for exchange of experiences, methods and evaluations of the latest results in the field of homogenization.

The goals of the seminar were:

- to present new and recently developed methods;
- to give an overview of the homogenizations practices in the databases of different countries;
- to promote the exchange of expertise on different methods.

In accordance with the goals, three methods were discussed in detail:

- the Alexandersson's method developed in SMHI and widely used especially in the Nordic countries,
- the French method developed by H. Caussinus and O. Mestre and
- the Hungarian method, which author is T. Szentimrey.

Nine countries presented their databases and explained their experiences. For training purposes, a one-day PC session was held, where participants were given the opportunity to use methods and discuss the results with the authors of methods.

The seminar closed by accepting recommendations. One of the recommendations has been fulfilled. News on all homogenization related activity is available available through the e-mail address:

homogenization@met.hu

The proceedings of the seminar are published and distributed. A limited number of copies are available at the HMS.

Informal Meeting on the Situation of Databases in Central Europe

17 December 1996, Budapest, Hungary

Representatives of six countries met at the headquarter of the Hungarian Meteorological Service HMS: Bulgaria, Croatia, Czech Republic, France, Slovakia and Hungary. France participated at the meeting, because Météo France has bilateral contacts in the field of climate database management systems (CDMS) with many of the countries of the region and supports these countries with its expertise.

The goals of the meeting were:

- to inform other countries about the developments and plans of national CDMS;
- to investigate different forms of co-operation; and
- to discuss the further role of Météo France in the further development of DBs.

Among the participants Bulgaria, Croatia, France and Hungary have ORACLE, Slovakia has INGRES and Czech Republic CLICOM systems. Some other countries in the region have ORACLE, but SYBASE is used as a CDMS, too.

After the discussions, the participants chose the following fields for possible co-operation:

- safety problems;
- data quality control;
- GIS system.

There is a good possibility of co-operating in the field of GIS systems, because it is a new technique at the meteorological institutes and most of the countries have the ARC/INFO system.