



European Climate Assessment & possible role of the CHR

'Workshop and Expert Meeting on Climatic
Changes and their Effect on Hydrology and Water
Management in the Rhine Basin'

Ede, 24 June 2003

Albert Klein Tank
KNMI, the Netherlands



Scope



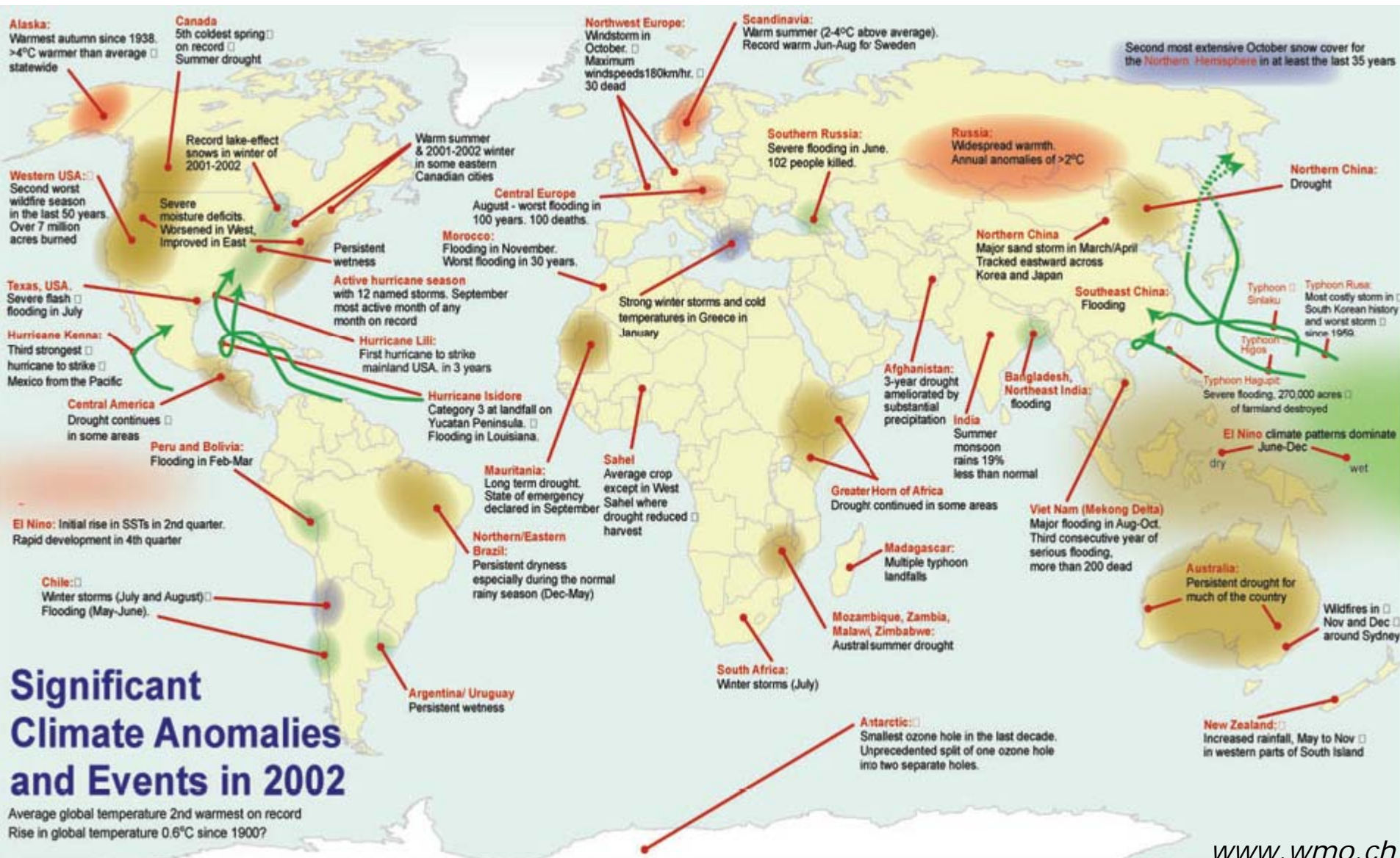
Topics:



- indices of extremes
- observed trends, 1946-now
- worldwide co-ordination
- role of CHR

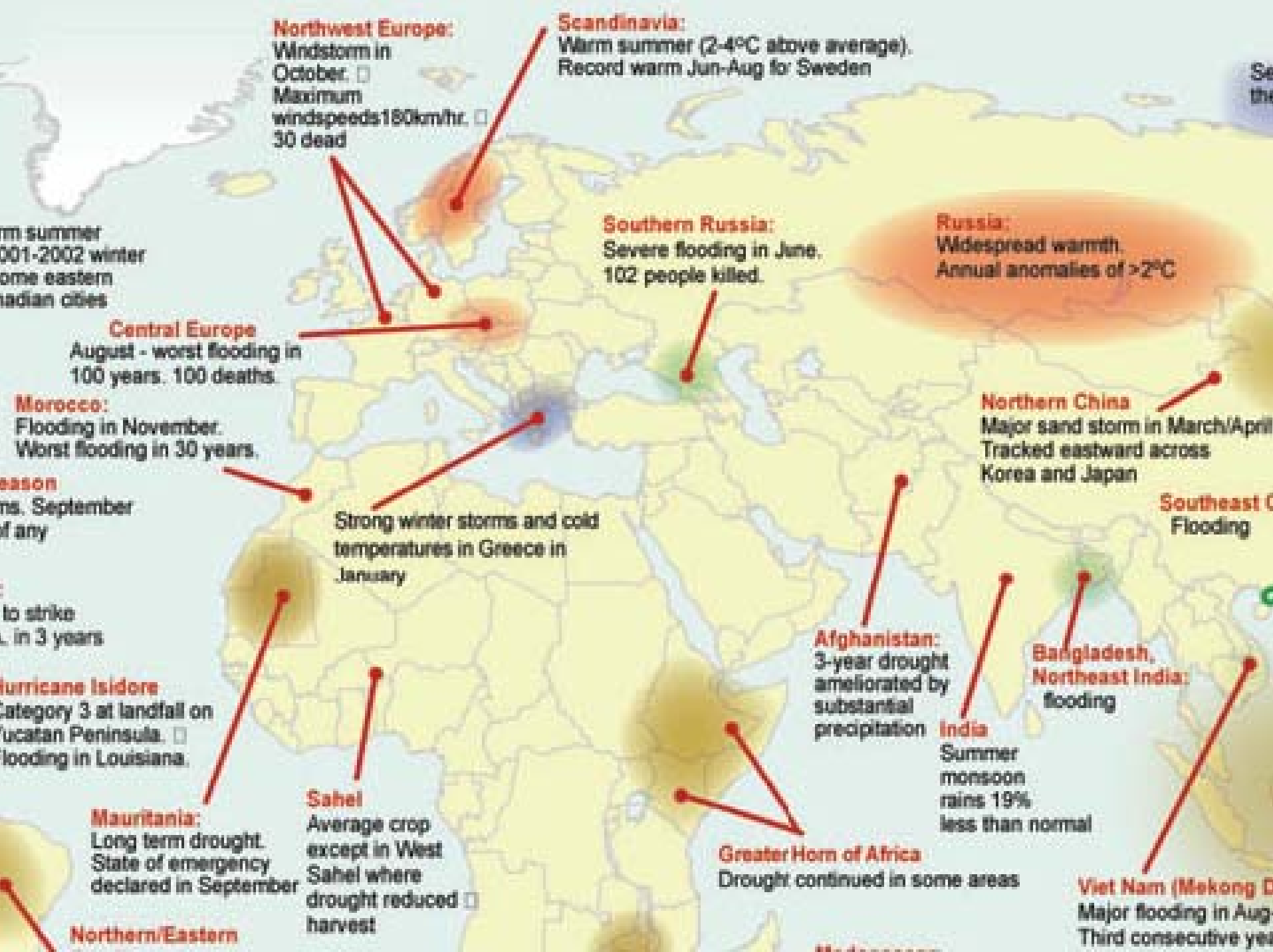


WMO status of global climate in 2002



Significant Climate Anomalies and Events in 2002

Average global temperature 2nd warmest on record
Rise in global temperature 0.6°C since 1900?



Northwest Europe:
Windstorm in October. □
Maximum windspeeds 180km/hr. □
30 dead

Scandinavia:
Warm summer (2-4°C above average).
Record warm Jun-Aug for Sweden

Southern Russia:
Severe flooding in June.
102 people killed.

Russia:
Widespread warmth.
Annual anomalies of >2°C

Central Europe
August - worst flooding in
100 years. 100 deaths.

Morocco:
Flooding in November.
Worst flooding in 30 years.

Northern China
Major sand storm in March/April
Tracked eastward across
Korea and Japan

Strong winter storms and cold
temperatures in Greece in
January

Southeast C
Flooding

Afghanistan:
3-year drought
ameliorated by
substantial
precipitation

**Bangladesh,
Northeast India:**
flooding

India
Summer
monsoon
rains 19%
less than normal

Greater Horn of Africa
Drought continued in some areas

Viet Nam (Mekong D
Major flooding in Aug-
Third consecutive year

Mauritania:
Long term drought.
State of emergency
declared in September

Sahel
Average crop
except in West
Sahel where
drought reduced □
harvest

Northern/Eastern

Warm summer
2001-2002 winter
Some eastern
Asian cities

Season
ns. September
of any

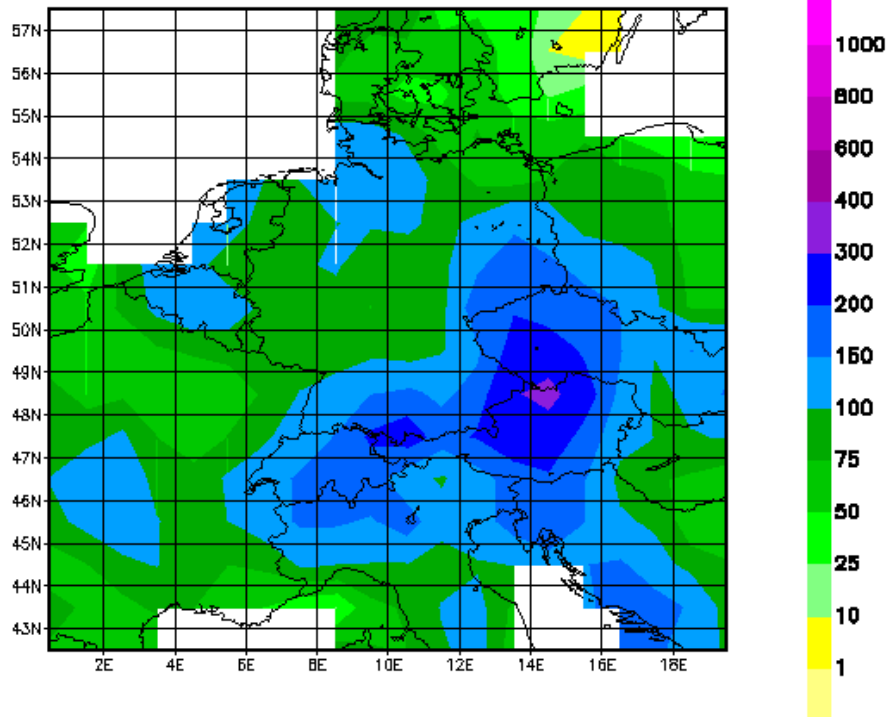
to strike
L. in 3 years

Hurricane Isidore
Category 3 at landfall on
Yucatan Peninsula. □
flooding in Louisiana.

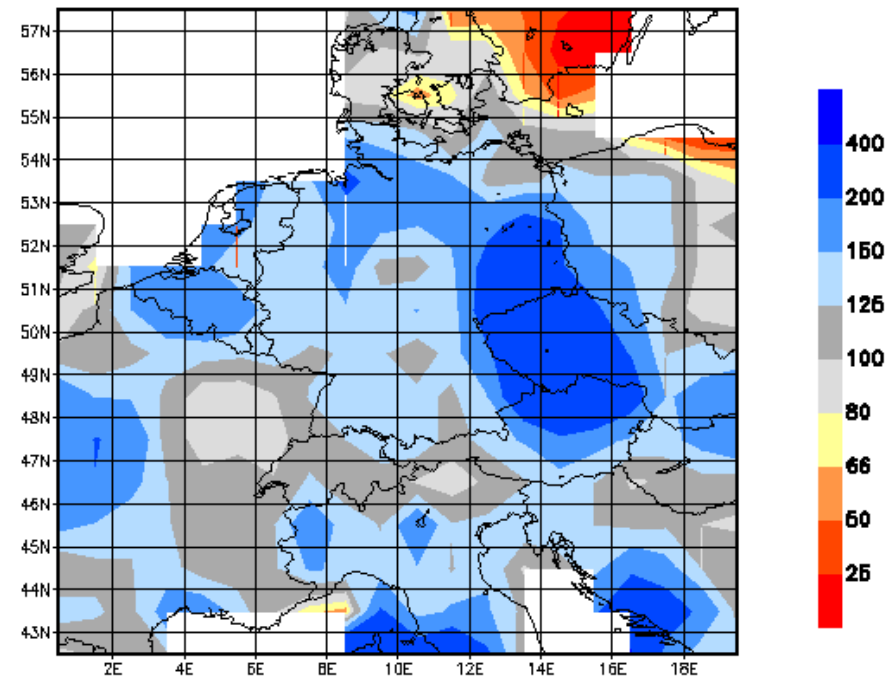


Elbe flooding: August 2002 rainfall

GPCC Monitoring Product Gauge-Based Analysis 1.0 degree precipitation for August 2002 in mm/month

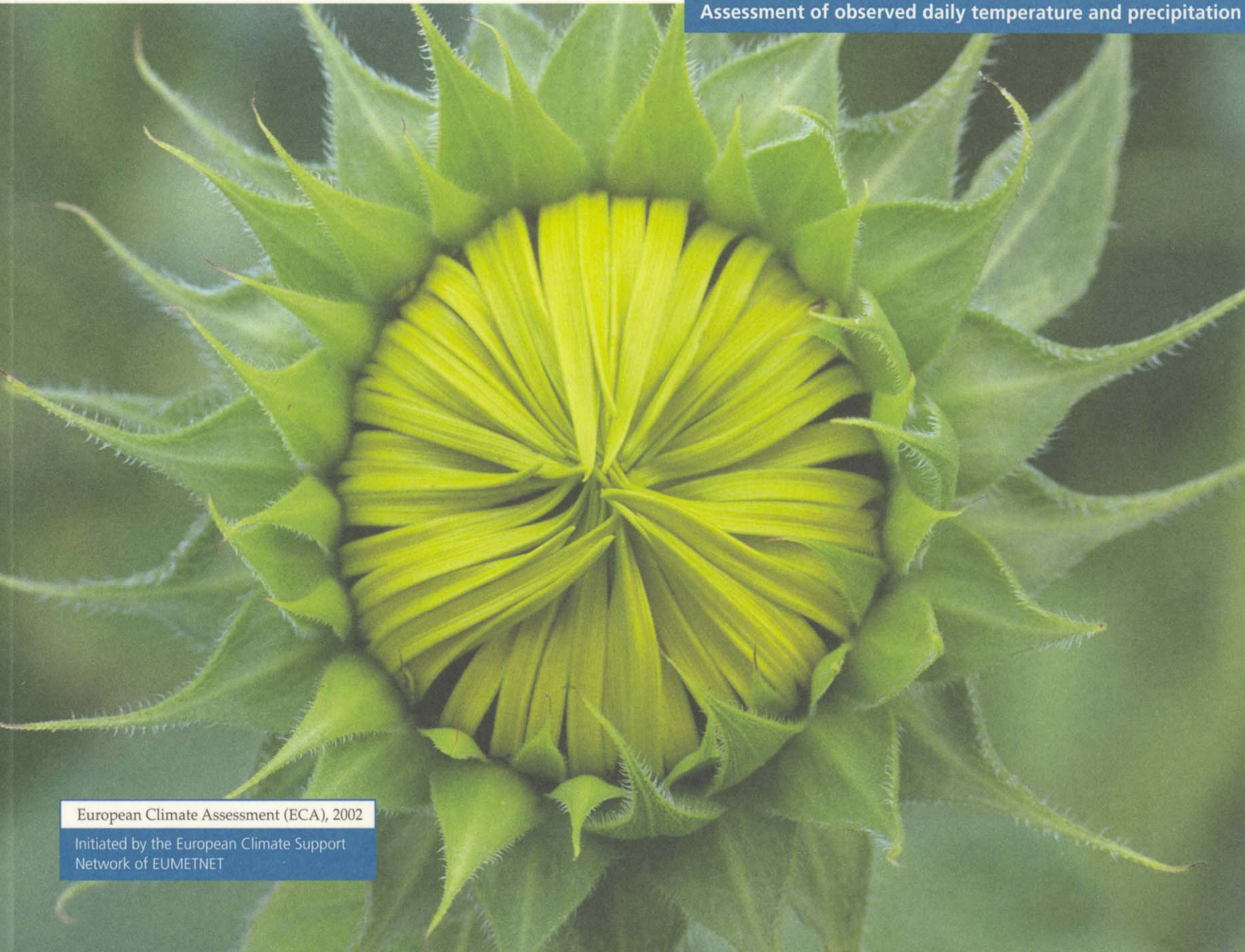


GPCC Monitoring Product Gauge-Based Analysis 1.0 degree precipitation percentage of normals 61/90 for August 2002



Climate of Europe

Assessment of observed daily temperature and precipitation extremes



European Climate Assessment (ECA), 2002

Initiated by the European Climate Support
Network of EUMETNET

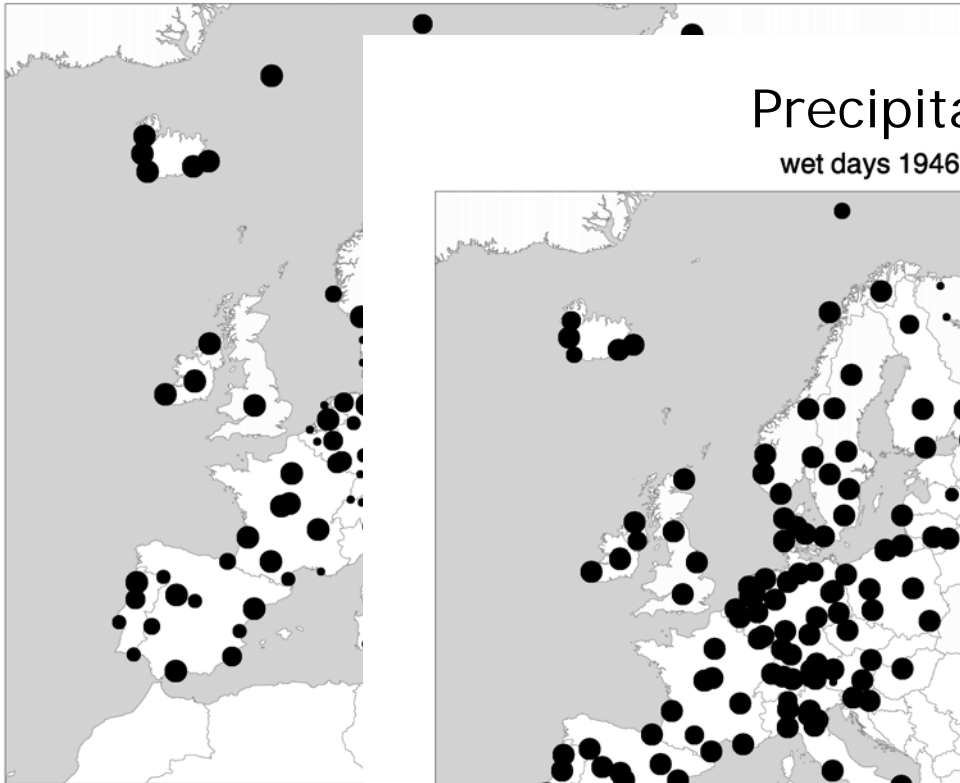


Data quality control and homogeneity



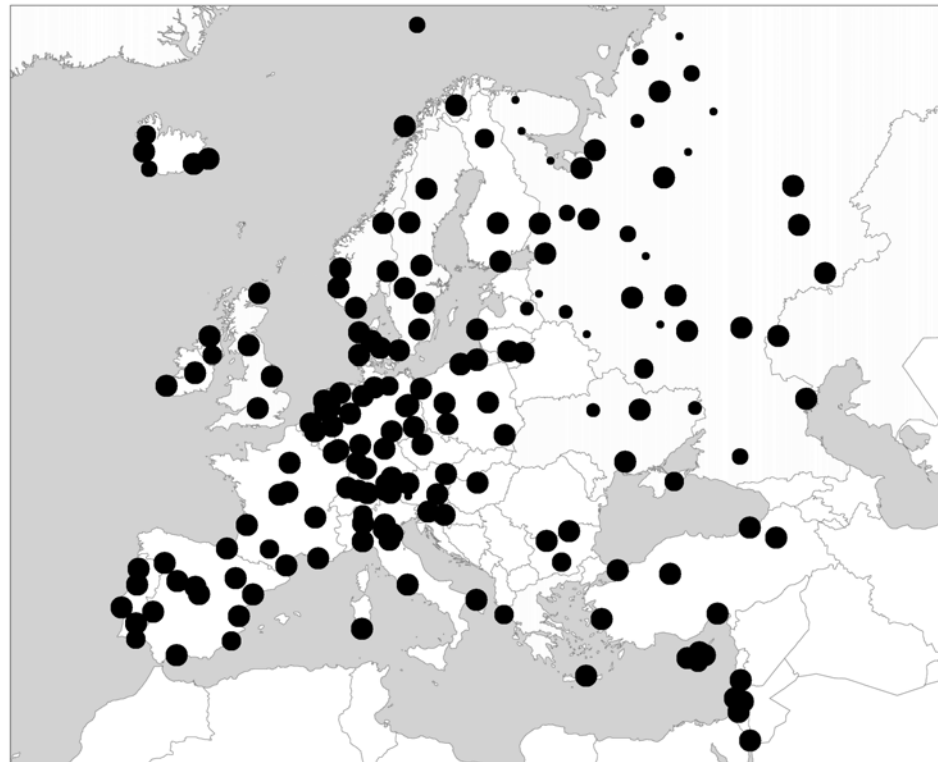
Temperature

vDTR 1946-1999



Precipitation

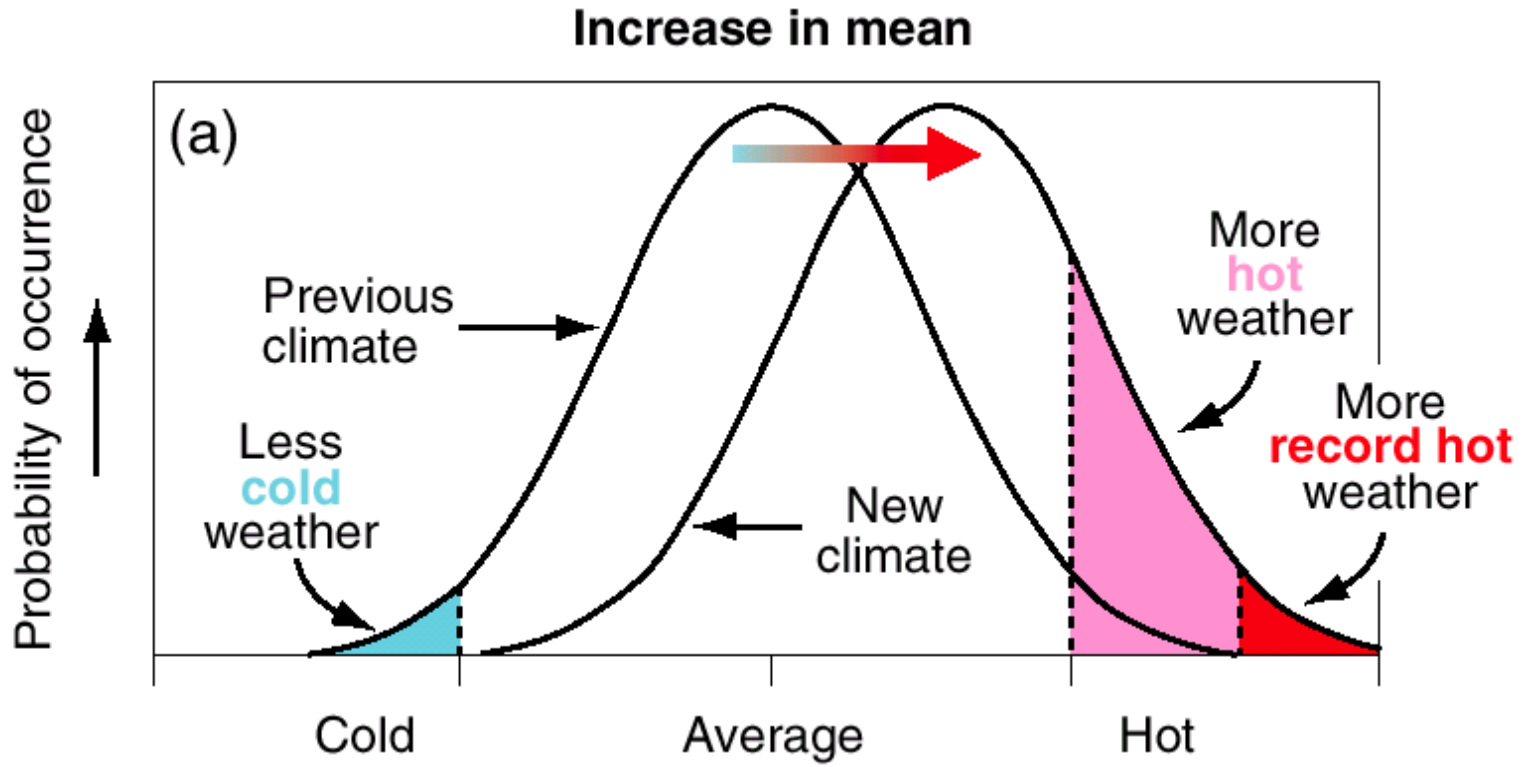
wet days 1946-1999



- 0 tests sig. - useful
- 1 test sig. - useful
- 2 tests sig. - doubtful
- 3 tests sig. - suspect
- 4 tests sig. - suspect

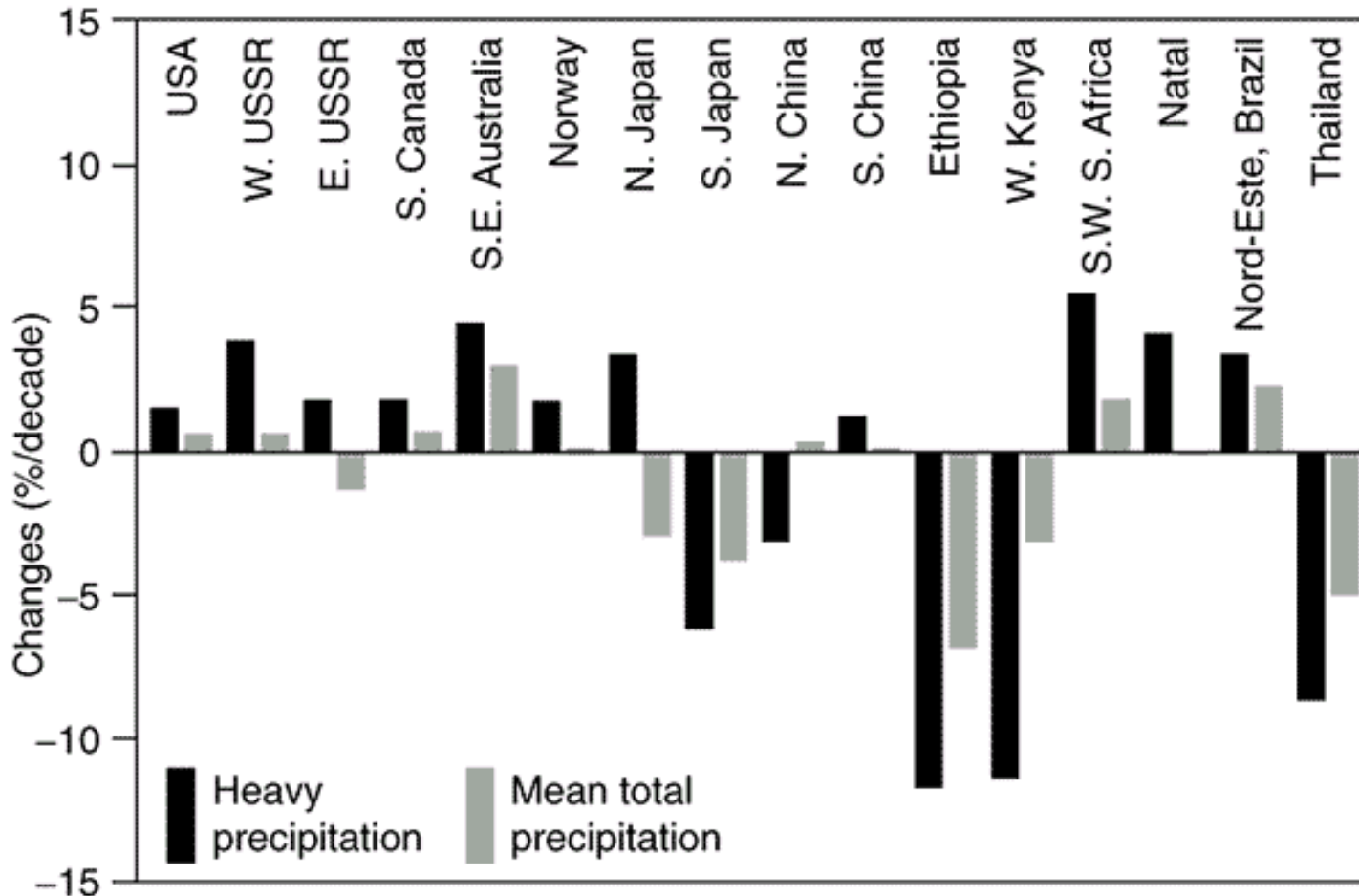


Detection of "(a)symmetric warming"





"Amplified" response of very wet days



Linear trends in rainy season, last ~50 years

•••• Index: R95%tot



“Precipitation fraction due to very wet days”

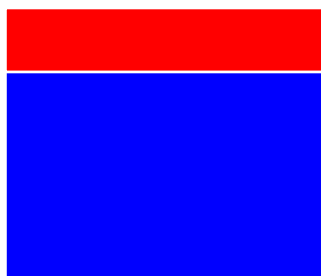
1) Identify very wet days using a site specific threshold = 95th percentile at wet days in the 1961-90 period



2) Determine fraction of total precipitation in each year that is due to these days



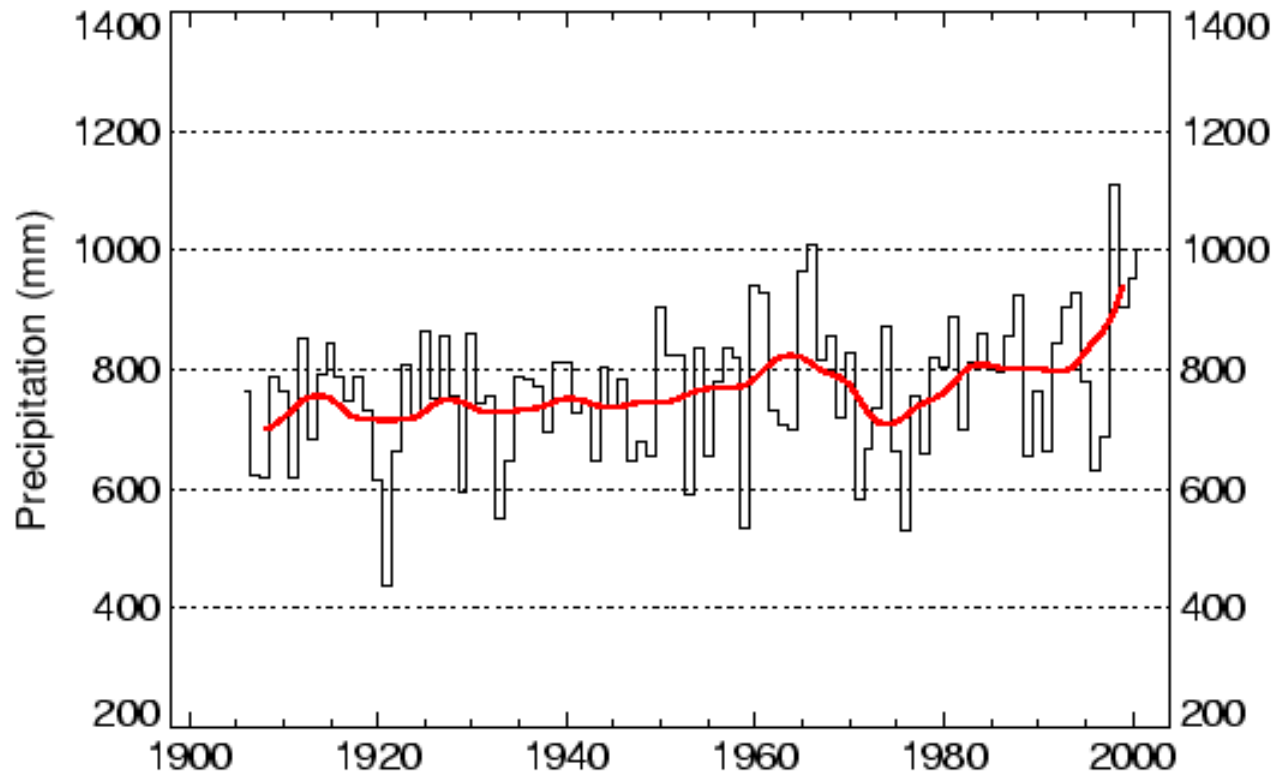
3) Trend analysis in series of fractions





Precipitation sum

00511 NL 13 station average, Netherlands (annual)

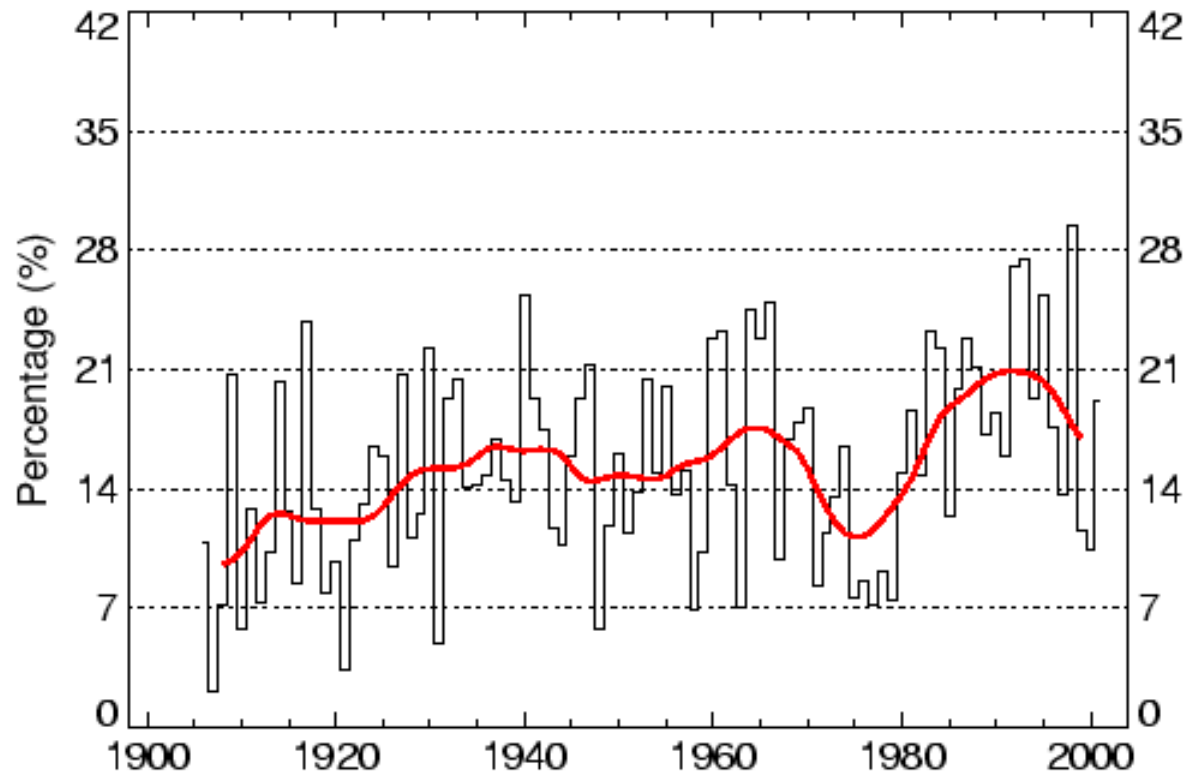


European Climate Assessment & Dataset < Warning: preliminary result 06-12-2002 >



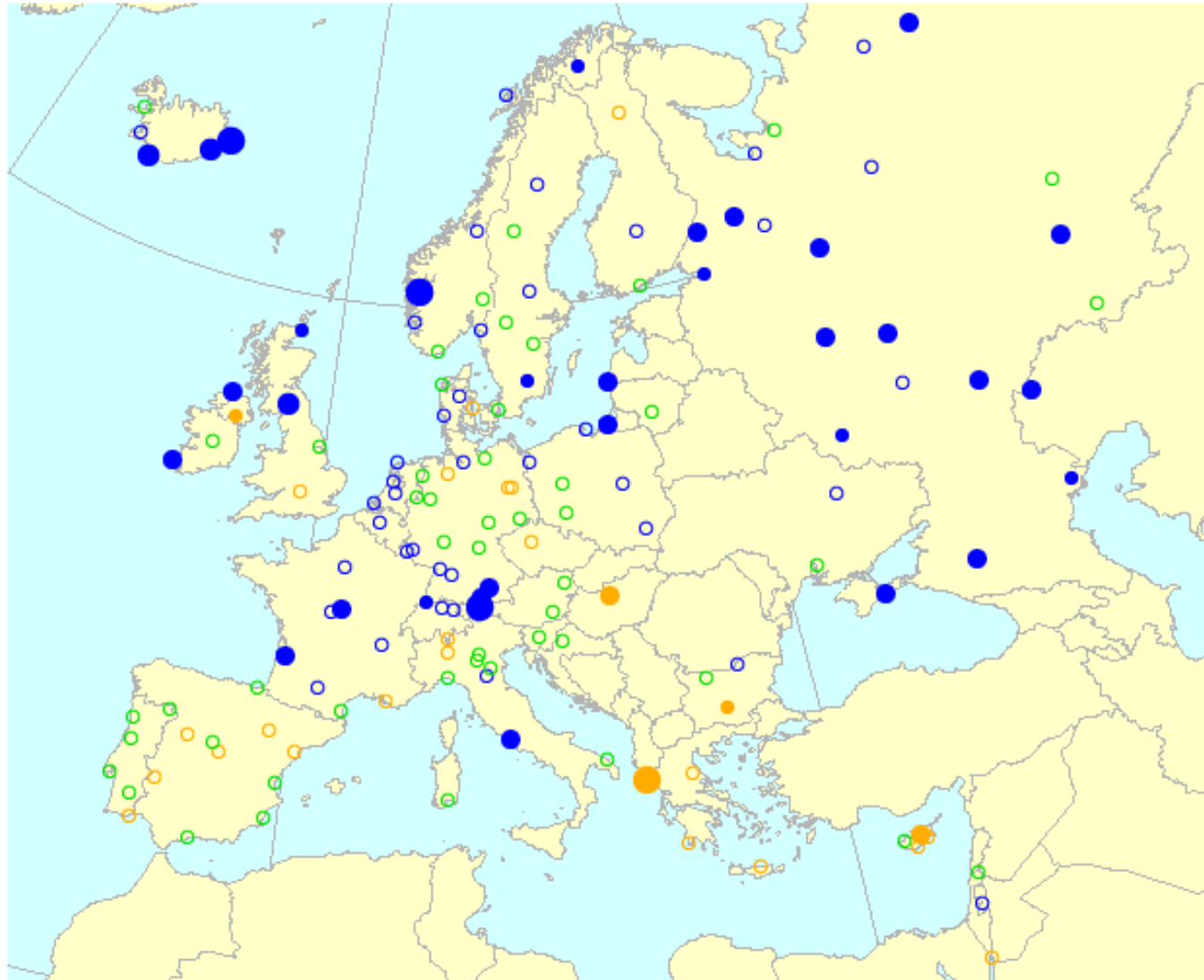
Precipitation fraction due to very wet days (> 95th perc.)

00511 NL 13 station average, Netherlands (annual)



European Climate Assessment & Dataset < Warning: preliminary result 06-12-2002 >

RR: Precipitation sum, ANNUAL 1946-1999

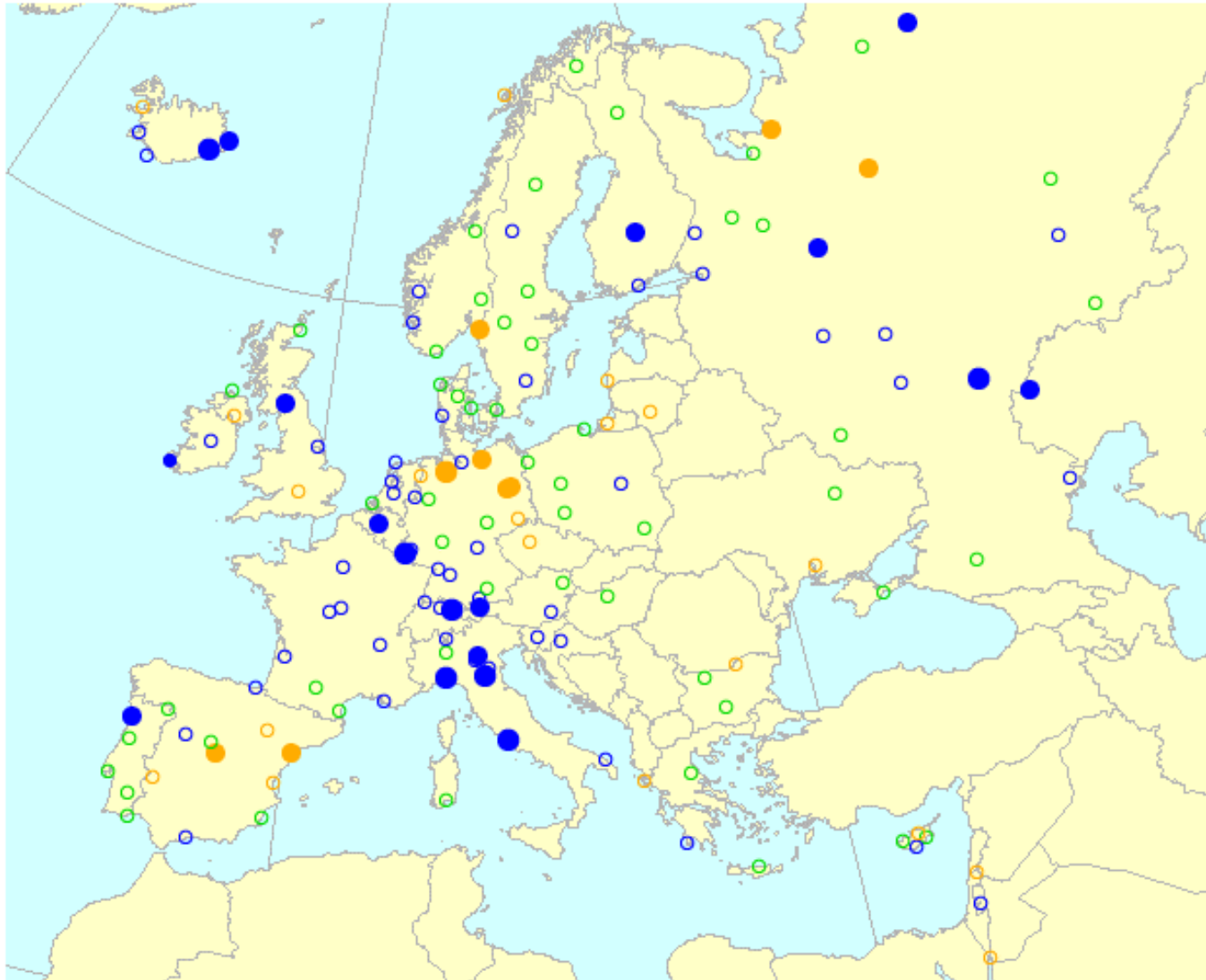


N
05-12-02

European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

R95pTOT: Precipitation fraction due to very wet days (> 95th perc.), ANNUAL 1946-1999



N
05-12-02

- %/decade
- > 3
 - 2 - 3
 - 1 - 2
 - 0 - 1
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -1 - 0
 - -2 - -1
 - -3 - -2
 - < -3

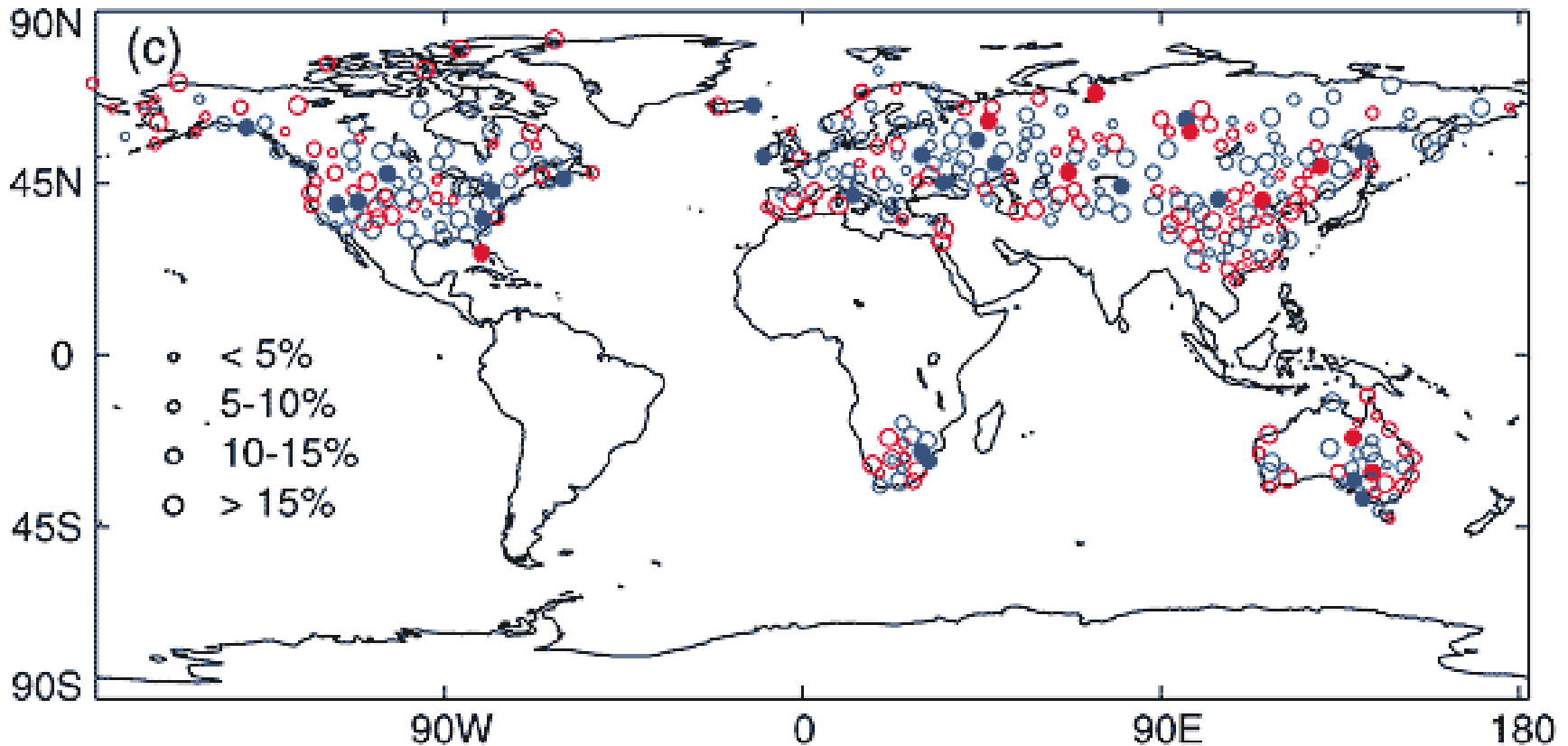
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Fraction of total precipitation in the uppermost 5 percentile

Change (%) between two multi-decadal averages during second half of 20th century



Blue is a positive change. Filled circles are significant at 95% level of confidence



European trends 1946-1999

increase per decade in annual precipitation amount: **7.6** (0.7 – 14.5) mm

increase per decade in annual number of wet days: 0.4 (-0.5 – 1.3)

percentile-threshold indices increase per decade

R75%	0.4 (0.1 – 0.7)
R95%	0.2 (0.1 – 0.2)
R95%tot	0.3 (0.1 – 0.5) %

absolute-threshold indices increase per decade

R10mm	0.3 (0.1 – 0.5)
R20mm	0.1 (0.0 – 0.2)
RX1day	0.2 (-0.1 – 0.5) mm
RX5day	0.6 (0.0 – 1.2) mm



European precipitation trends

- Averaged over Europe, all indices of wet extremes saw increases between 1946-1999, although spatial trend coherence is low and many station trends are not significant
- The index that represents the fraction of the annual amount due to very wet days gives a signal of disproportionate large changes in the extremes
- IPCC-TAR:
 - *"2 to 4% increase in frequency of heavy events in mid- and high latitudes of the NH"*
 - *"in regions where total precipitation has increased ... even more pronounced increases in heavy precipitation events"*



ECA&D website: www.knmi.nl/samenw/eca

European Climate Assessment & Dataset (ECA&D) - Microsoft Internet Explorer

Bestand Bewerken Beeld Favorieten Extra Help

Vorige Zoeken Favorieten Media

Adres <http://www.knmi.nl/samenw/eca/index.html> Ga naar Koppelingen

EUROPEAN CLIMATE ASSESSMENT & DATASET (ECA&D)			
Home	Daily dataset	Reports & papers	
Project summary	Indices dictionary	Presentations	
Participants	Indices graphs	Links	
News	Indices trendmaps	Contact us	
© KNMI, 2002	last updated: October 2002	Albert.Klein.Tank@knmi.nl	download 2002 ECA-report

Home		
Welcome to the web-site of the European Climate Assessment & Dataset project: ECA&D.		The main objective of ECA&D is to issue a new assessment report on the state of the climate in Europe and the Mediterranean by the year 2006.
	ECA&D is initiated by the European Climate Support Network ECSN .	
Presented are indices of climate extremes and a daily dataset consisting of temperature, precipitation and surface air pressure series from over 200 meteorological stations in Europe and the Mediterranean.		The new assessment report will update the 2002 publication: "Climate of Europe; assessment of observed daily temperature and precipitation extremes". download 2002 ECA-report
	ECA&D is supported by the Network of European Meteorological Services EUMETNET .	
The information and data at this site can be used freely provided that the sources are acknowledged.		START >> select a link from the menu above.

Internet



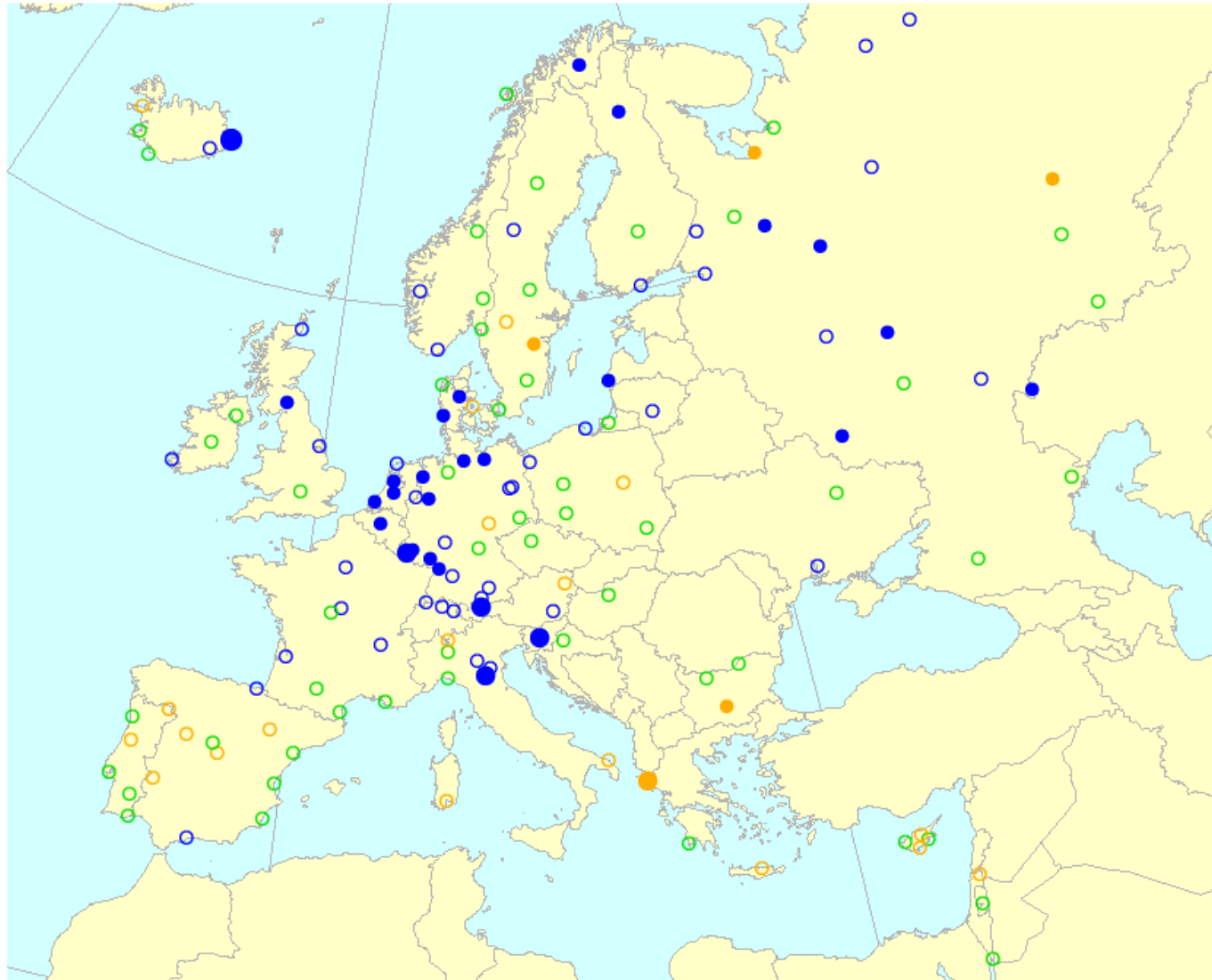


CHR and ECA&D

Some examples for the Rhine basin:

- Winter season (October–March) trends in:
 - Highest 5-day precipitation amount
 - Total precipitation
 - Precipitation fraction due to very wet days ($> 95^{\text{th}}$ ptile)
- Summer season (April–September) trends in:
 - Maximum number of consecutive dry days

RX5day: Highest 5-day precipitation amount, WINTER-HALF 1946-1999



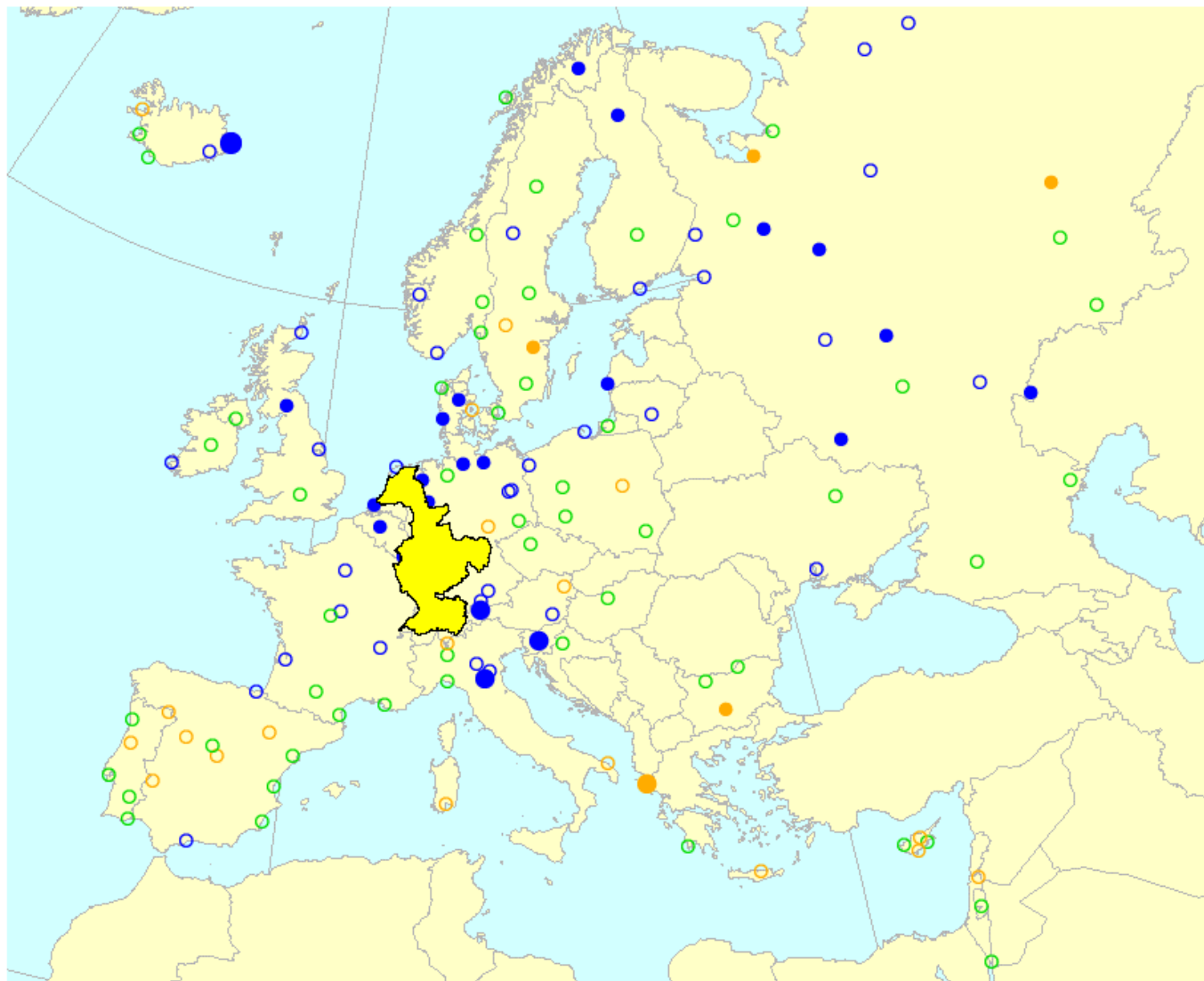
N
28-05-03

- mm/decade
- > 15
 - 10 - 15
 - 5 - 10
 - 0 - 5
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -5 - 0
 - -10 - -5
 - -15 - -10
 - < -6

European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

RX5day: Highest 5-day precipitation amount, WINTER-HALF 1946-1999



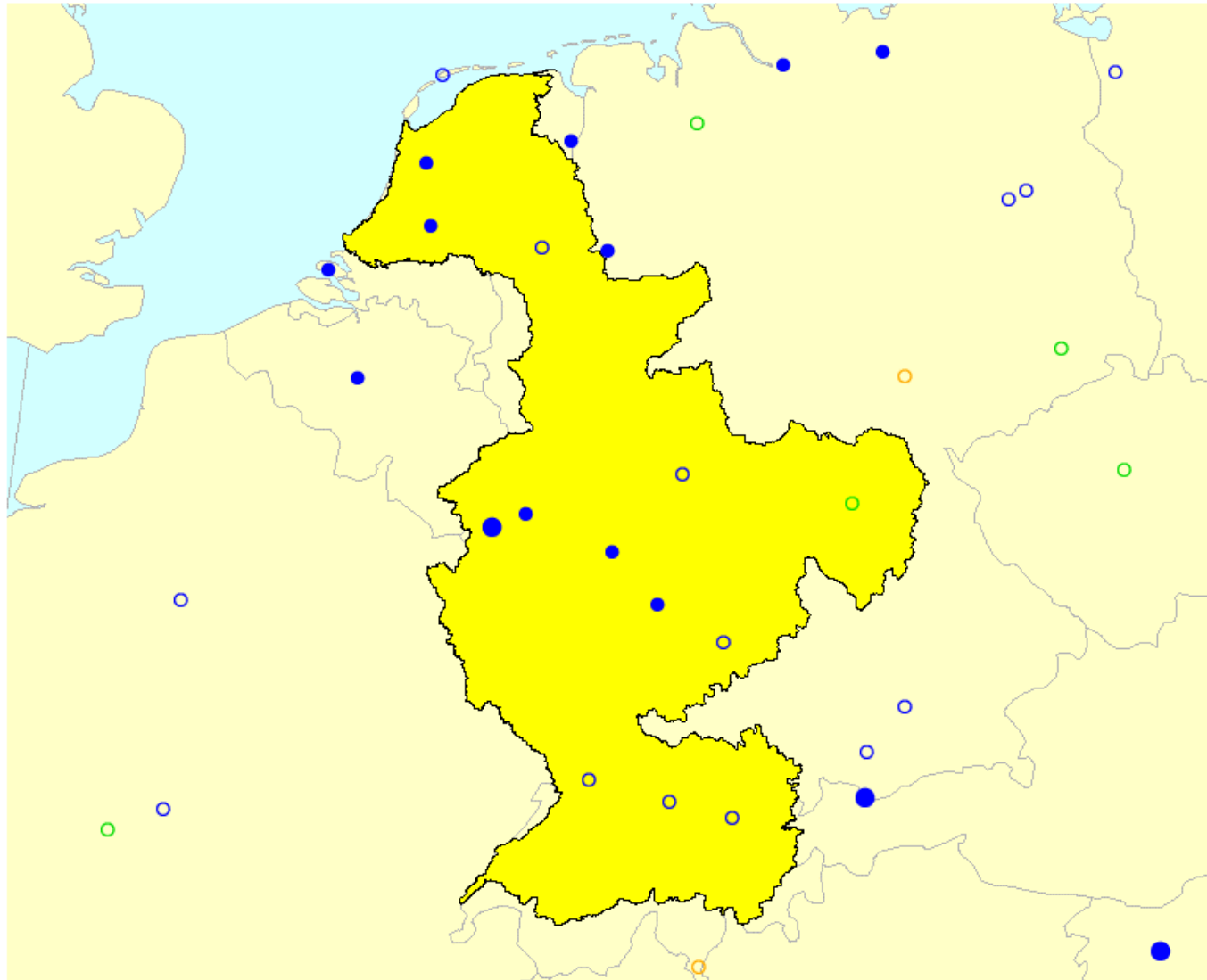
N
28-05-03

- mm/decade
- > 15
 - 10 - 15
 - 5 - 10
 - 0 - 5
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -5 - 0
 - -10 - -5
 - -15 - -10
 - < -6

European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

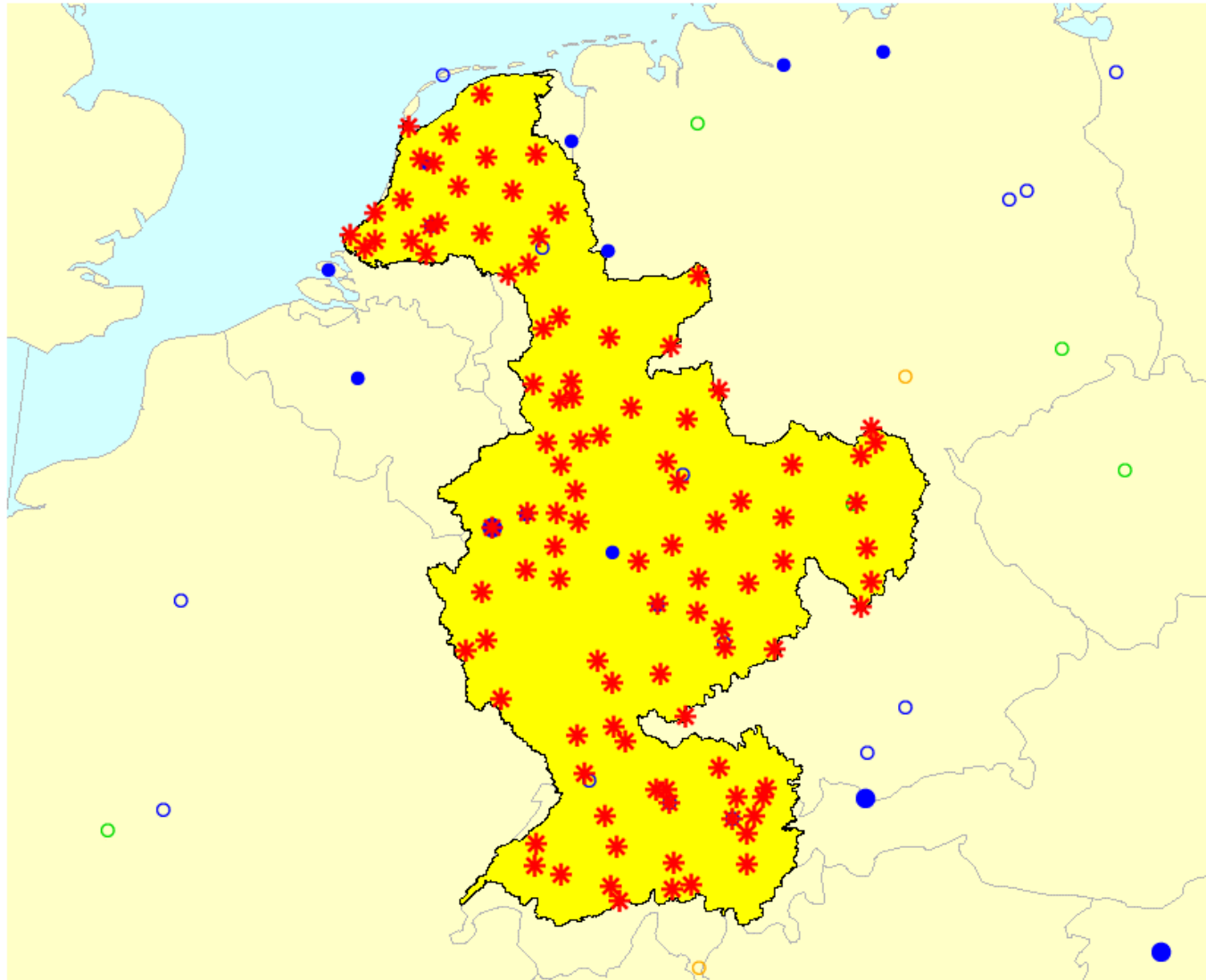
RX5day: Highest 5-day precipitation amount, WINTER-HALF 1946-1999



European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

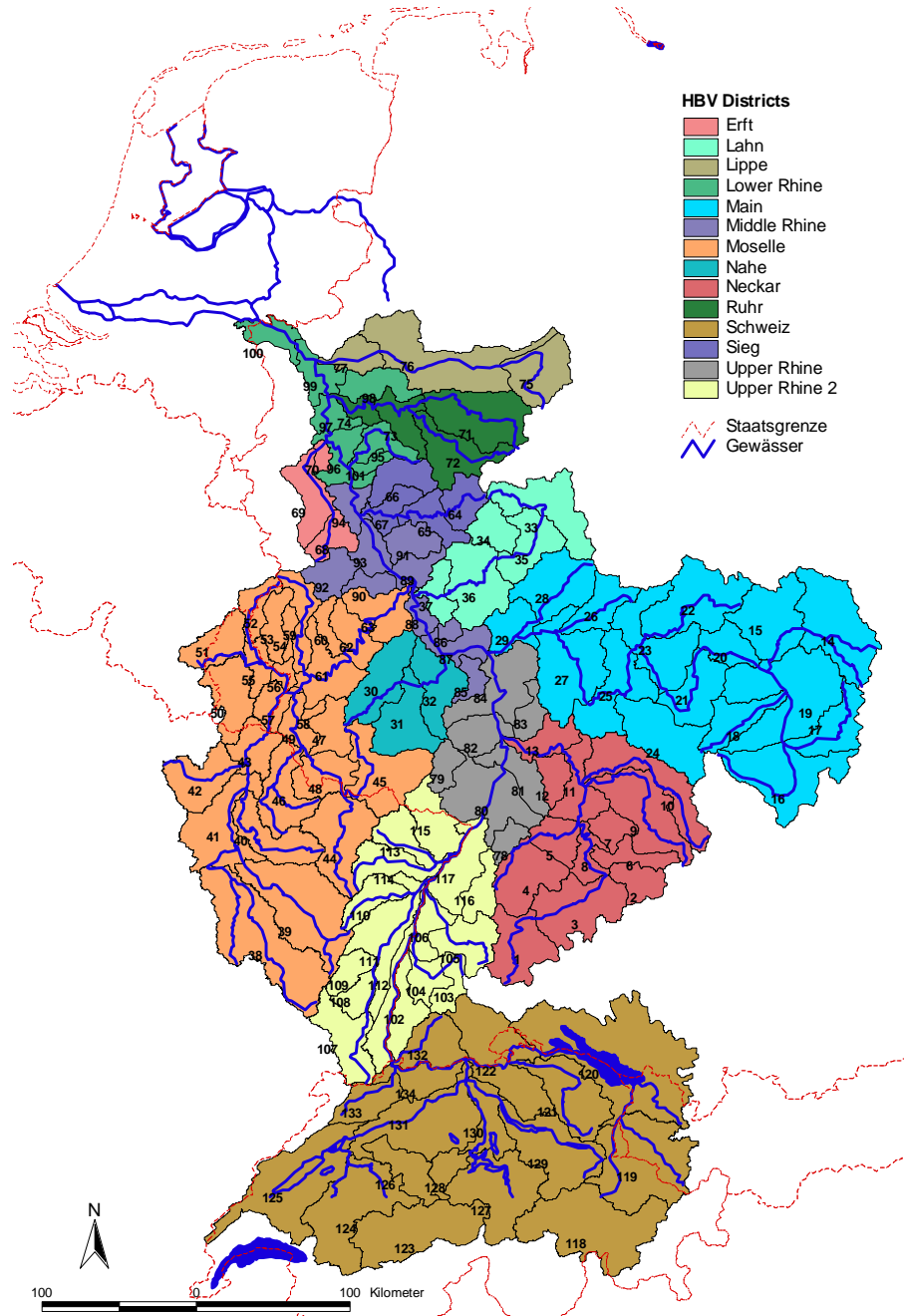
RX5day: Highest 5-day precipitation amount, WINTER-HALF 1946-1999



N
28-05-03

* synop station

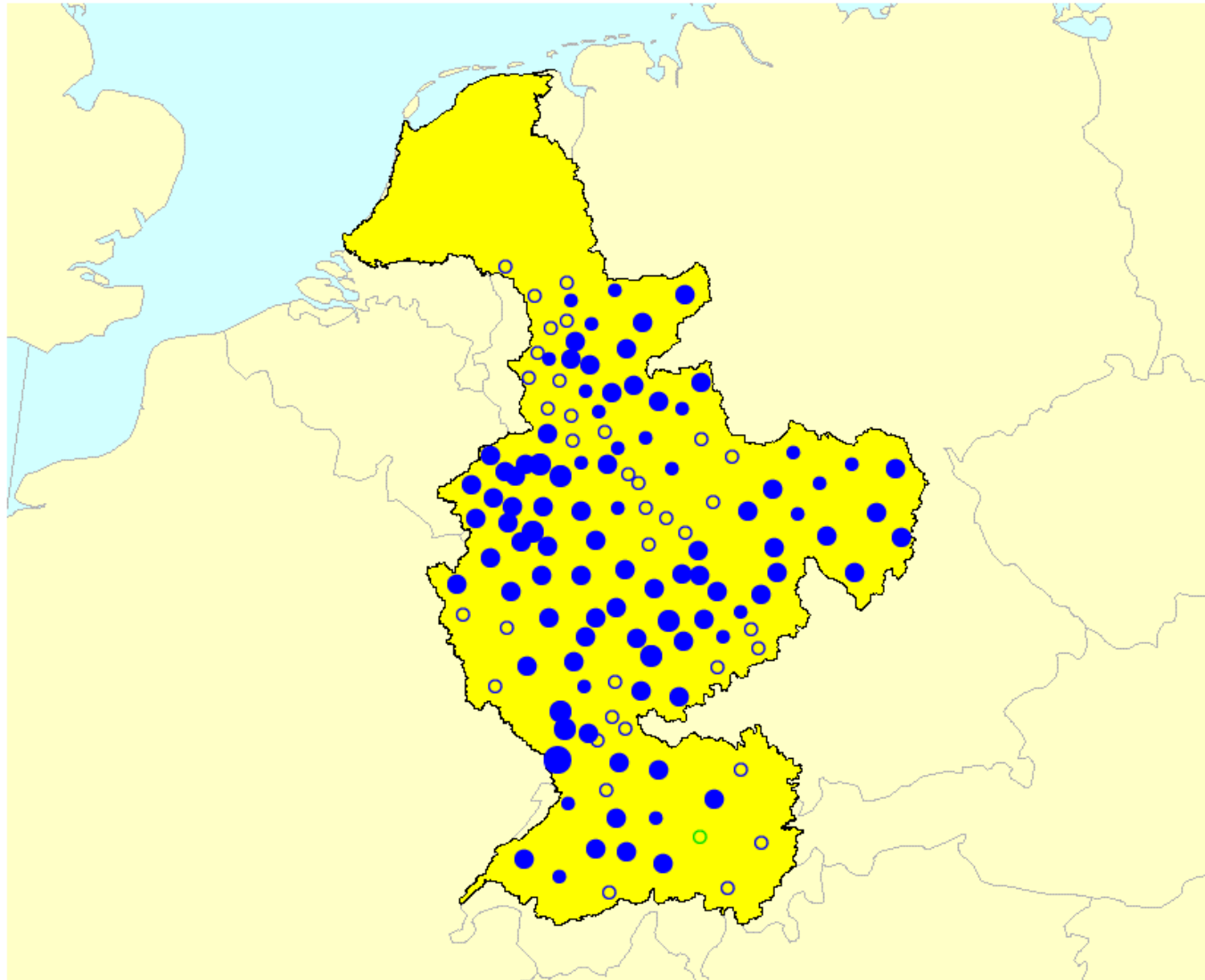
- mm/decade
- > 15
 - 10 - 15
 - 5 - 10
 - 0 - 5
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -5 - 0
 - -10 - -5
 - -15 - -10
 - < -6



CHR dataset:

Daily series of
area-averaged
precipitation

RX5day: Highest 5-day precipitation amount, WINTER-HALF 1962-1995



N
11-06-03

- mm/decade
- > 15
 - 10 - 15
 - 5 - 10
 - 0 - 5
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -5 - 0
 - -10 - -5
 - -15 - -10
 - < -6

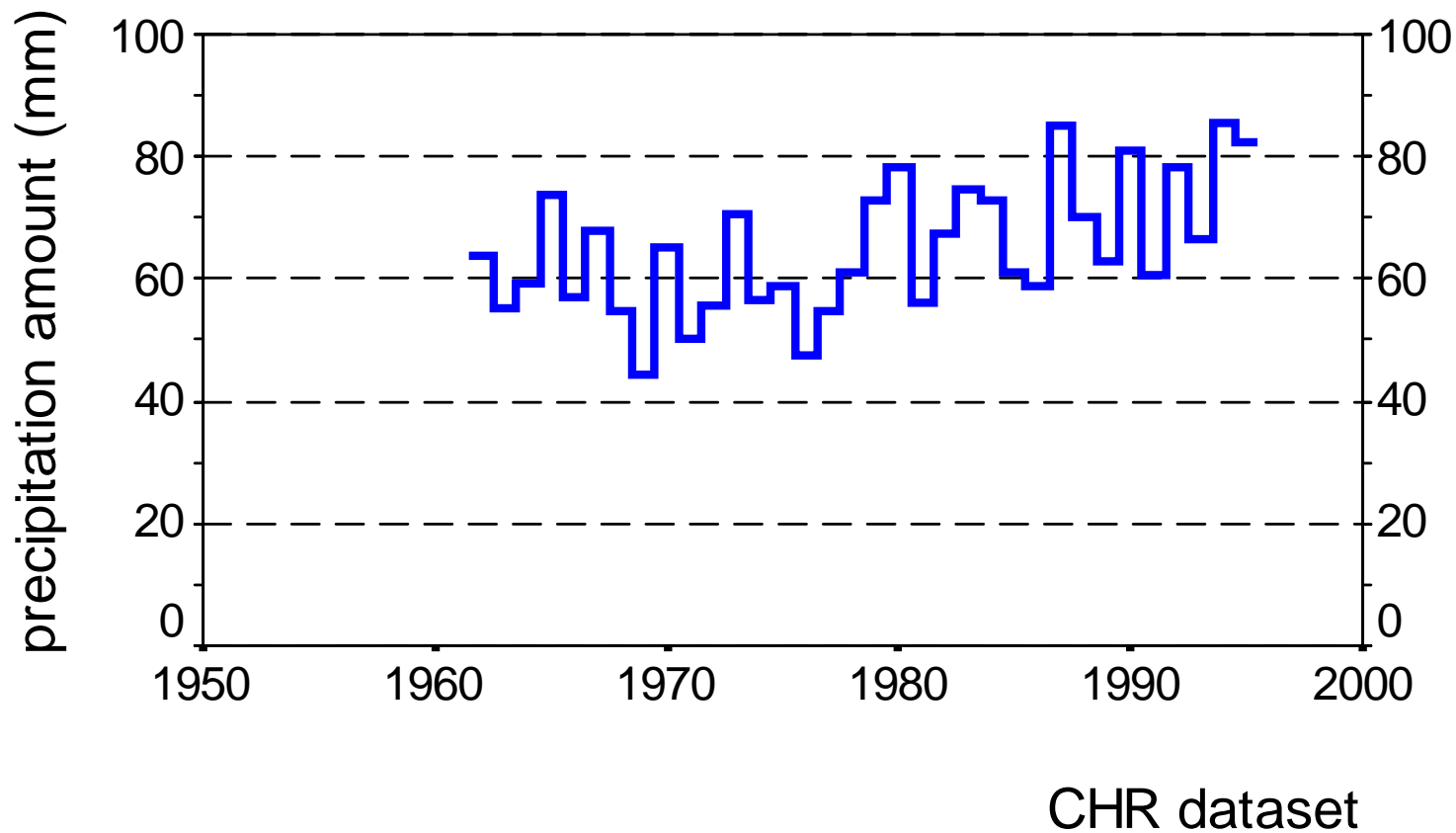
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Highest 5-day precipitation amount

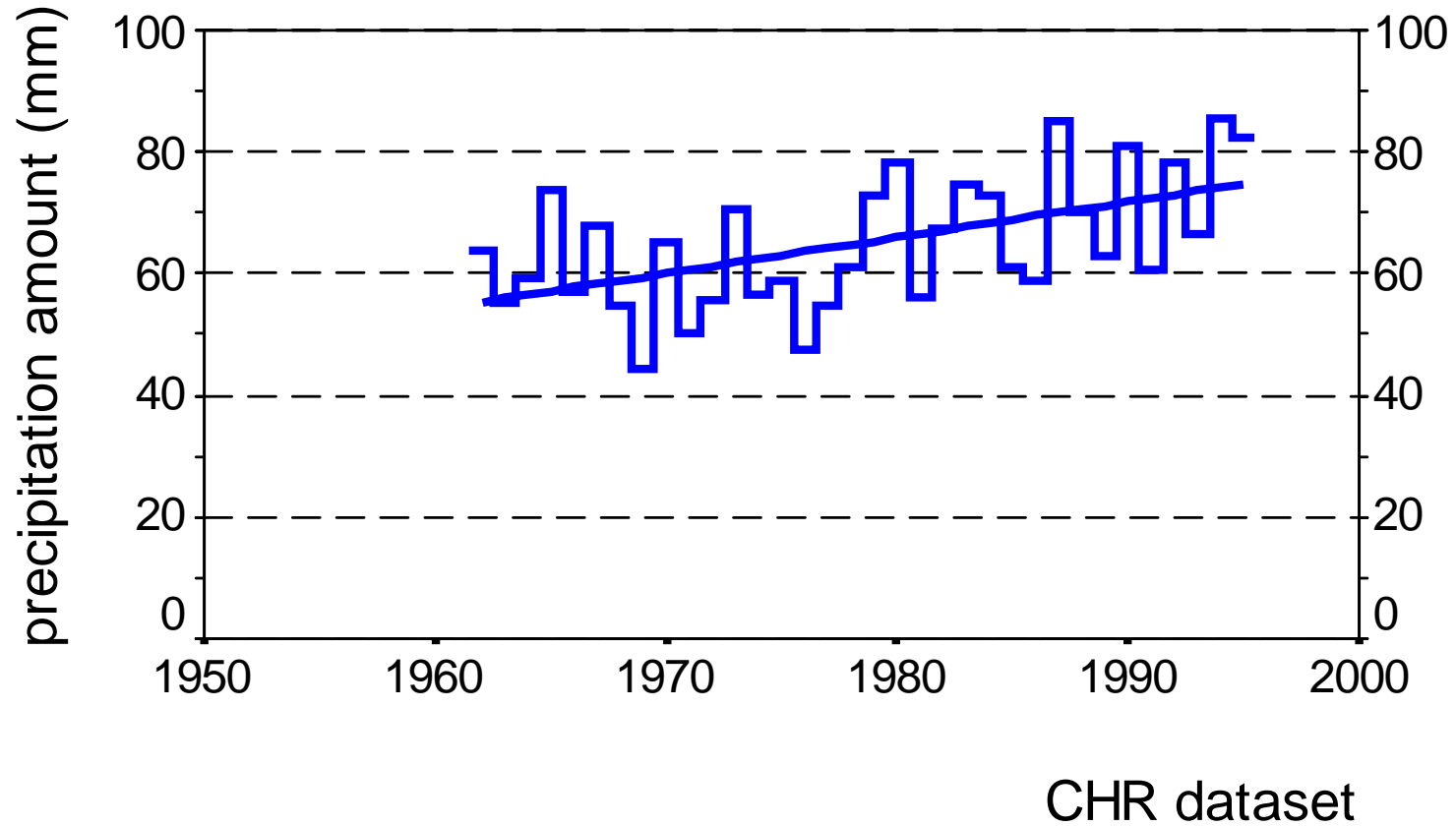
winter half (Oct-Mar) 1962-1995



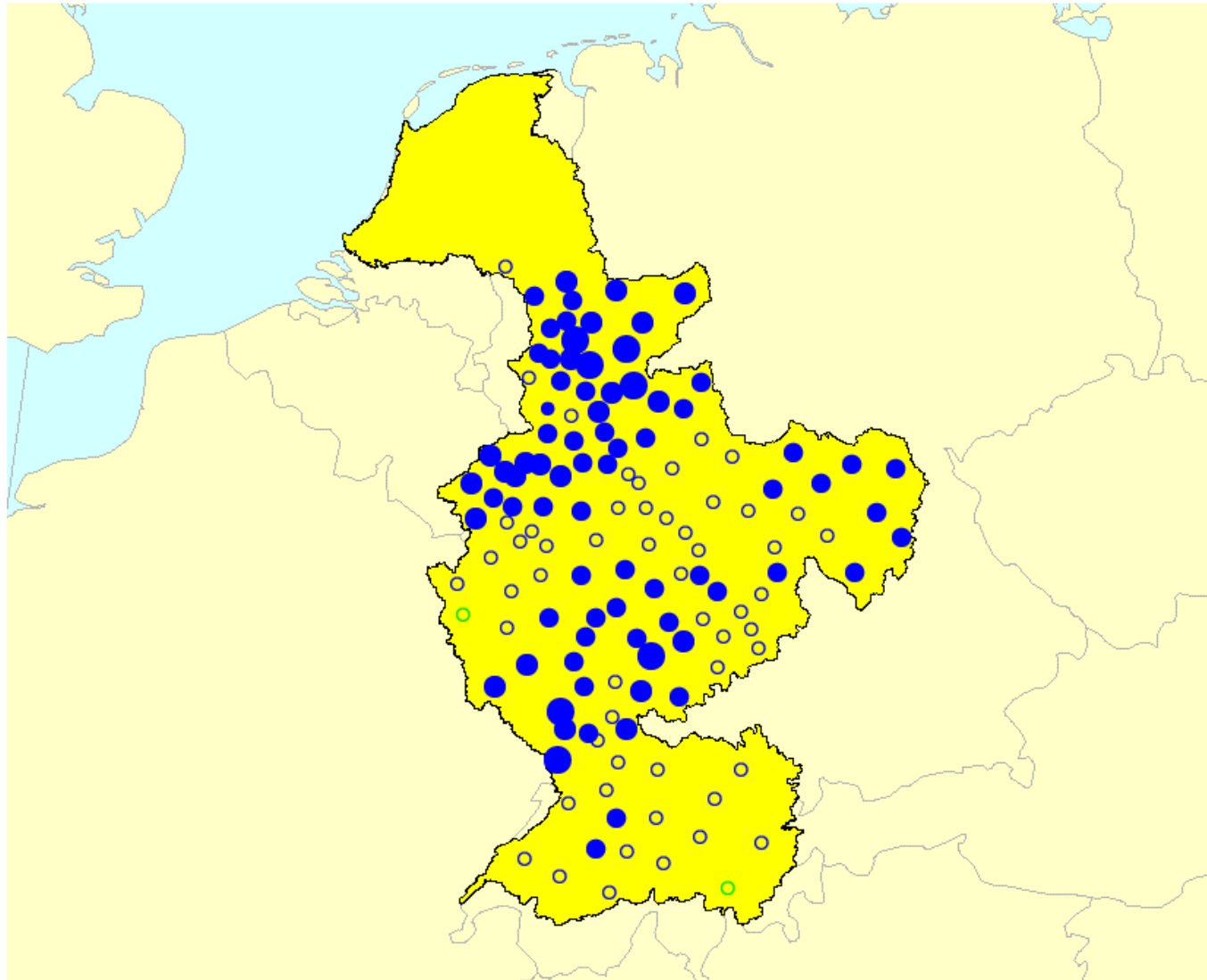


Highest 5-day precipitation amount

winter half (Oct-Mar) 1962-1995



RR: Precipitation sum, WINTER-HALF 1962-1995



N
14-06-03

- mm/decade
- > 60
 - 40 - 60
 - 20 - 40
 - 0 - 20
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -20 - 0
 - -40 - -20
 - -60 - -40
 - < -60

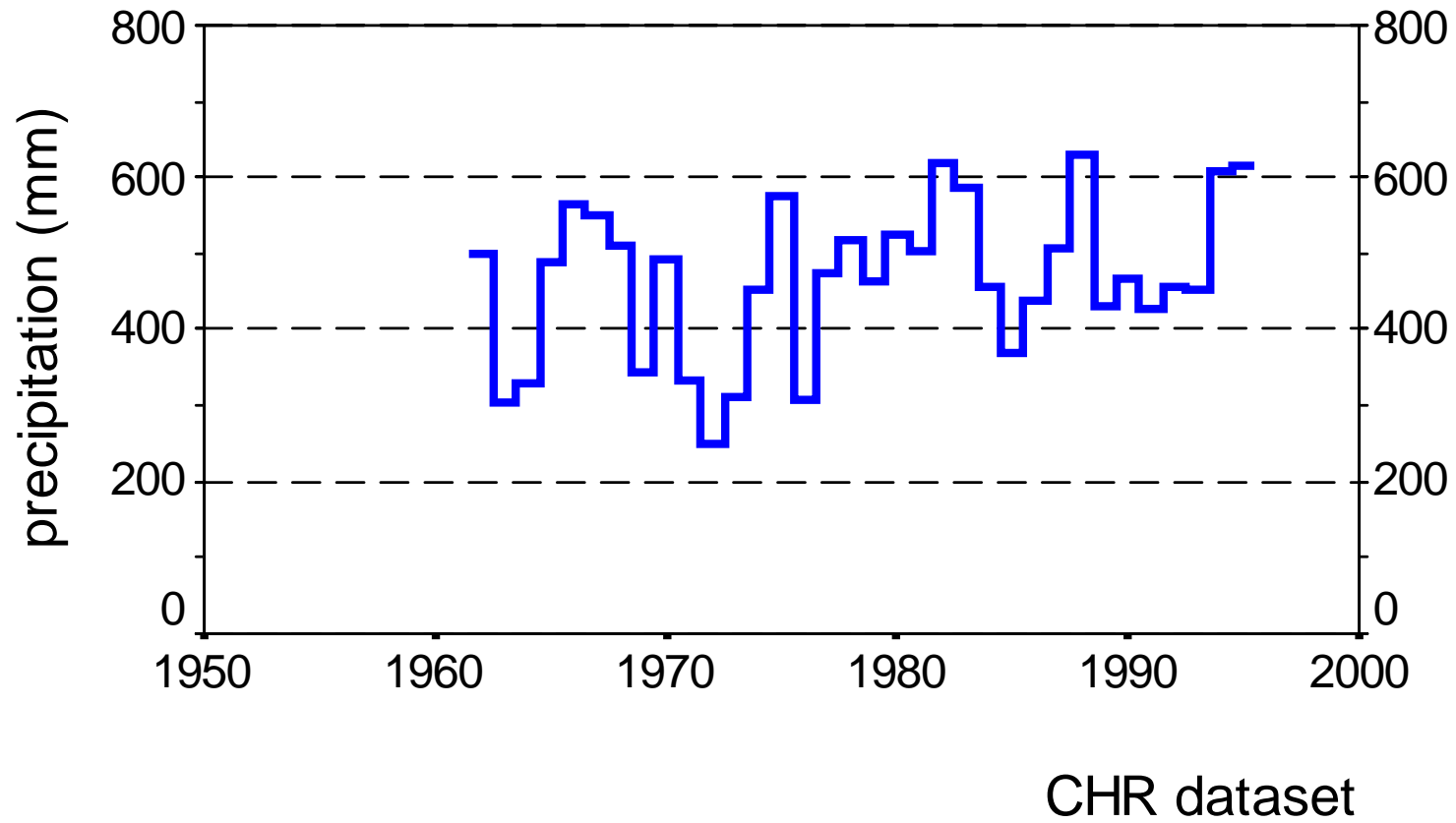
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

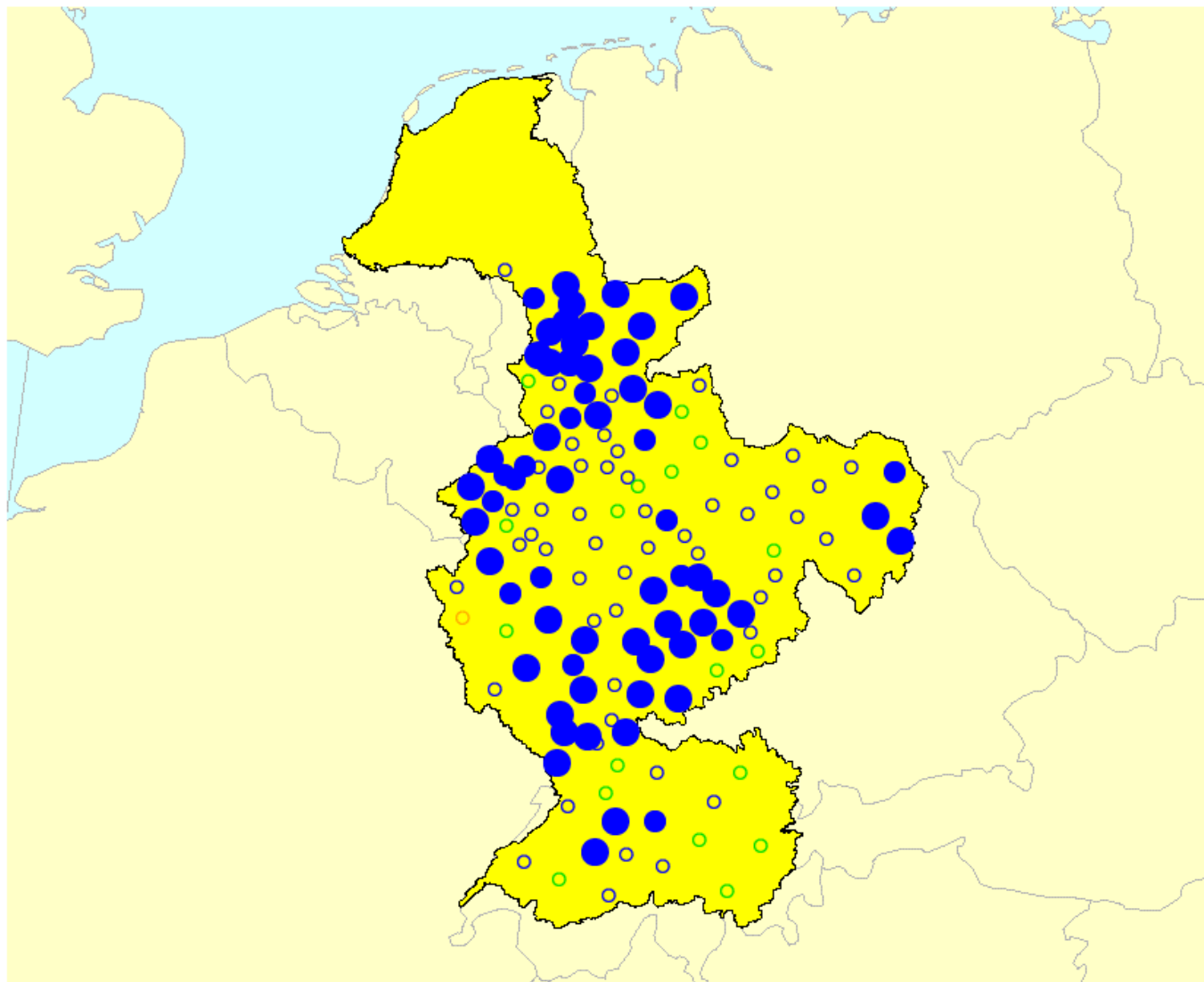


Total precipitation

winter half (Oct-Mar) 1962-1995



R95%tot: Precipitation fraction due to very wet days (> 95th perc.), WINTER-HALF 1962-1995



N
21-06-03

- %/decade
- > 3
 - 2 - 3
 - 1 - 2
 - 0 - 1
 - pos. but n.s. at 5%
 - n.s. at 25%
 - neg. but n.s. at 5%
 - -1 - 0
 - -2 - -1
 - -3 - -2
 - < -3

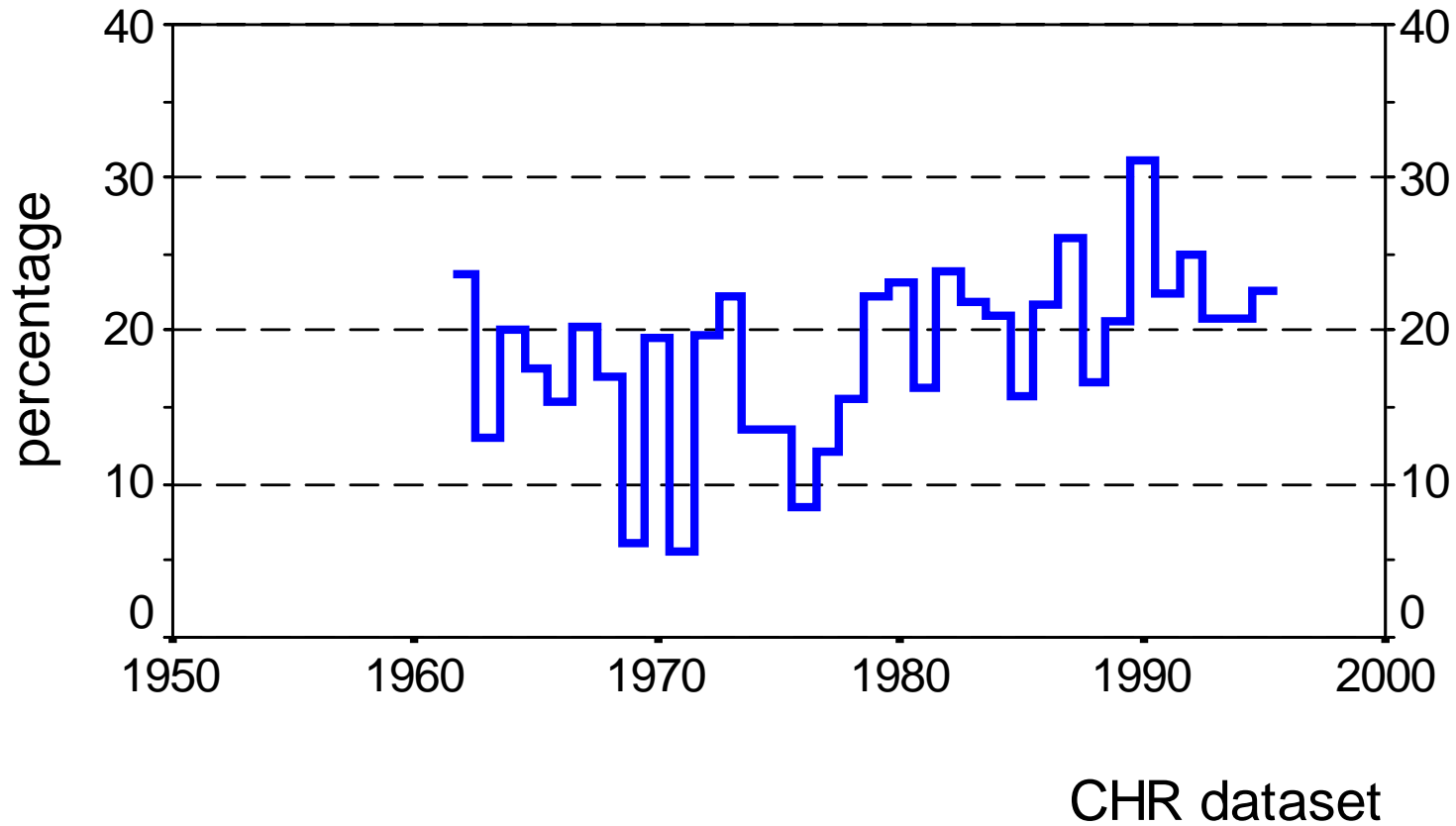
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Precipitation fraction due to very wet days (> 95th perc.)

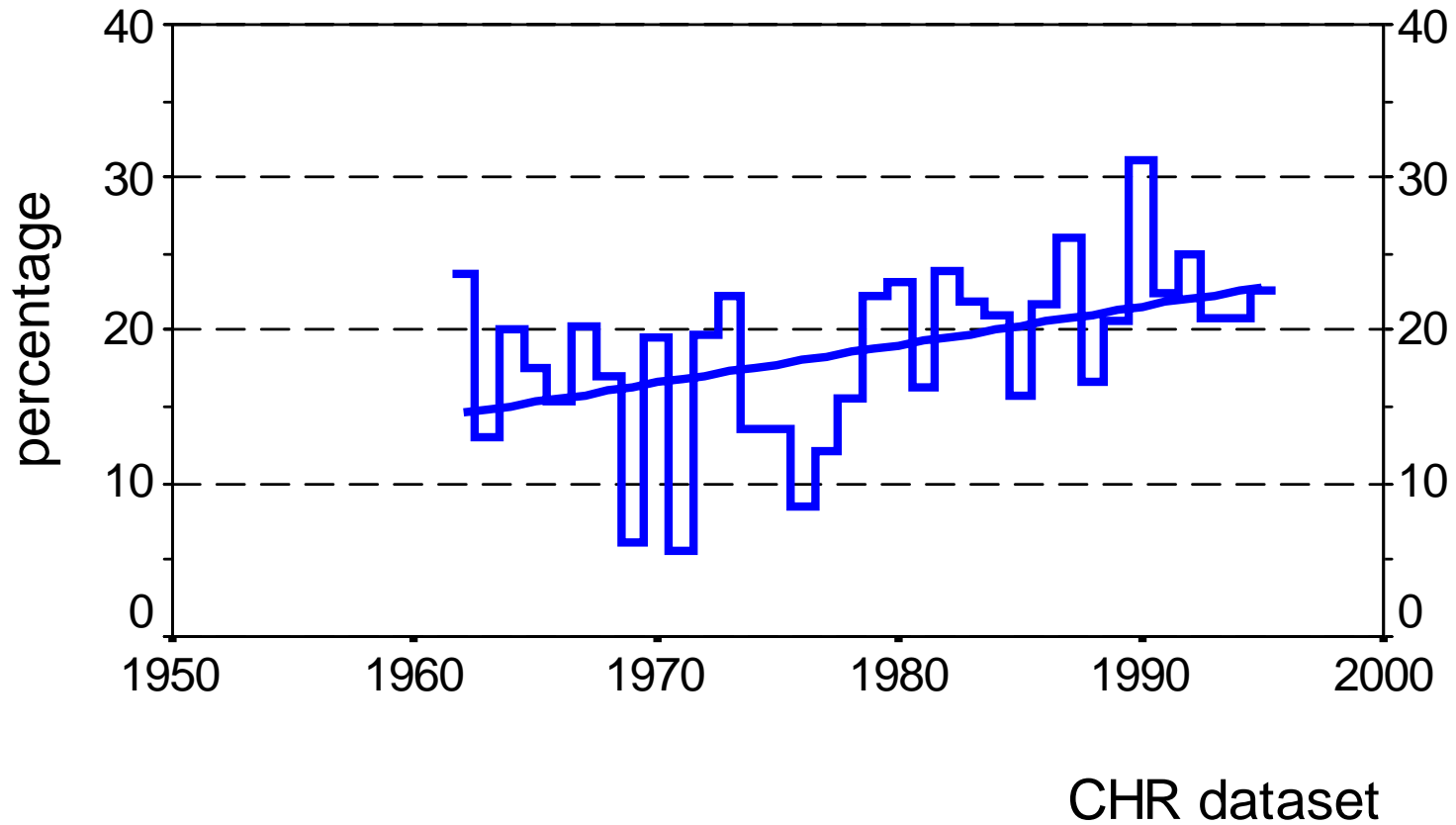
winter half (Oct-Mar) 1962-1995



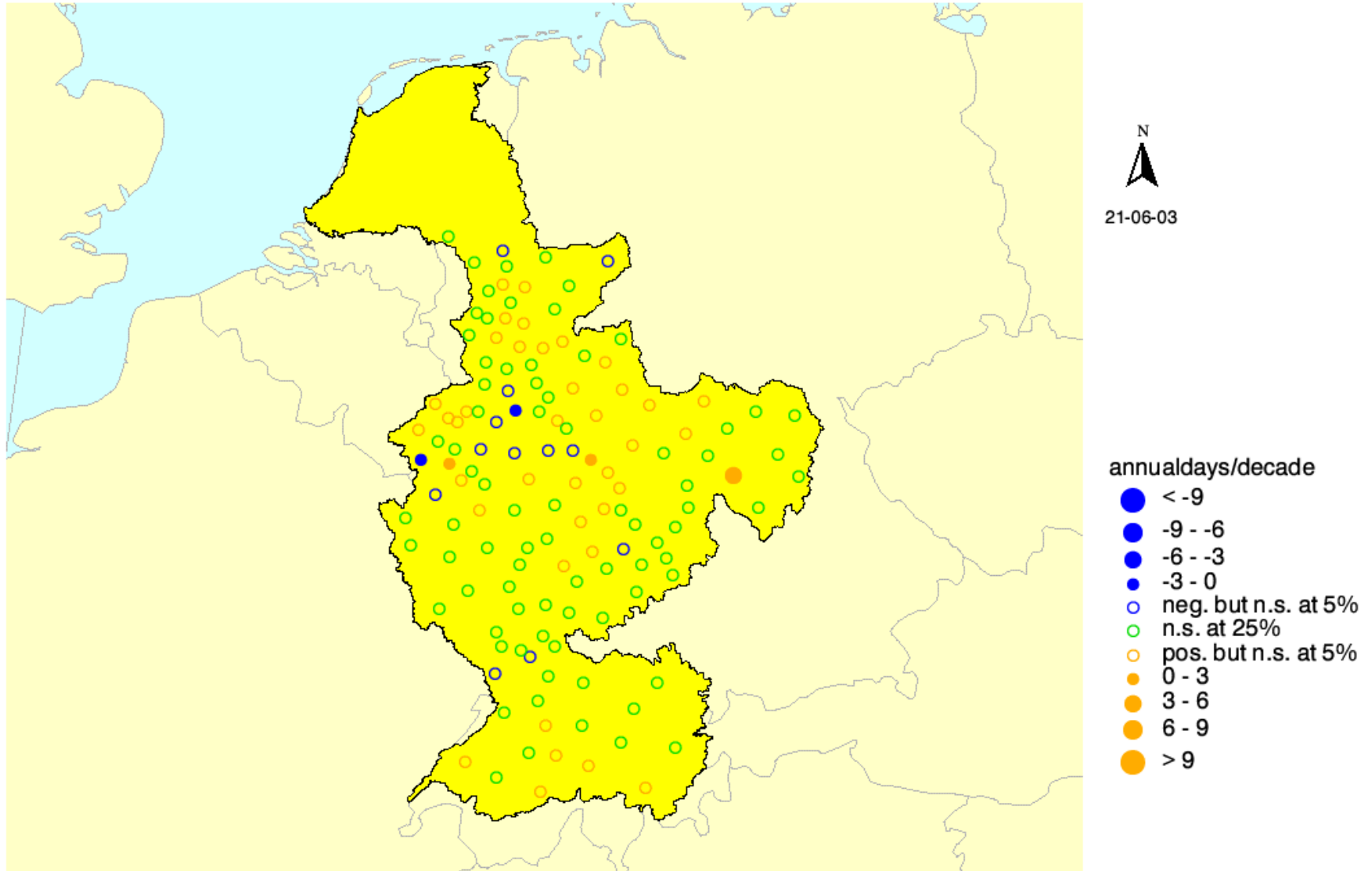


Precipitation fraction due to very wet days (> 95th perc.)

winter half (Oct-Mar) 1962-1995



CDD: Maximum no. of consecutive dry days (RR < 3 mm), SUMMER-HALF 1962-1995



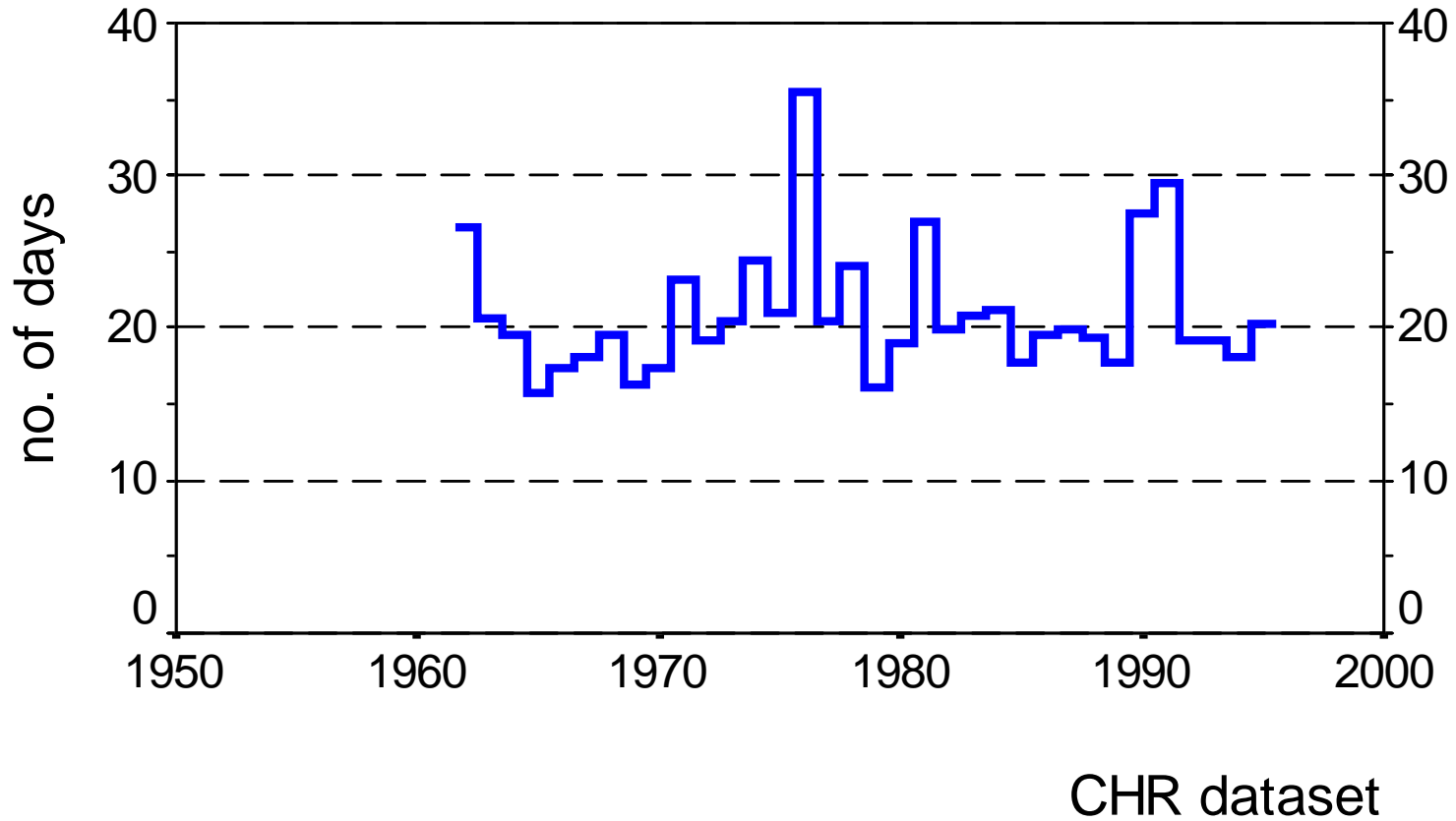
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Max. no. of consecutive dry days

summer half (Apr-Sep) 1962-1995





Conclusions

- The indices reveal clear changes in precipitation extremes over Europe in the last ~50 years
- Need to investigate the causes/underlying mechanisms, e.g. how are observed trends related to variability and change in atmospheric circulation
- The examples show that it is interesting to study the ECA indices in more detail for the Rhine Basin, which requires a dense network of daily station series



- the end; ...questions?

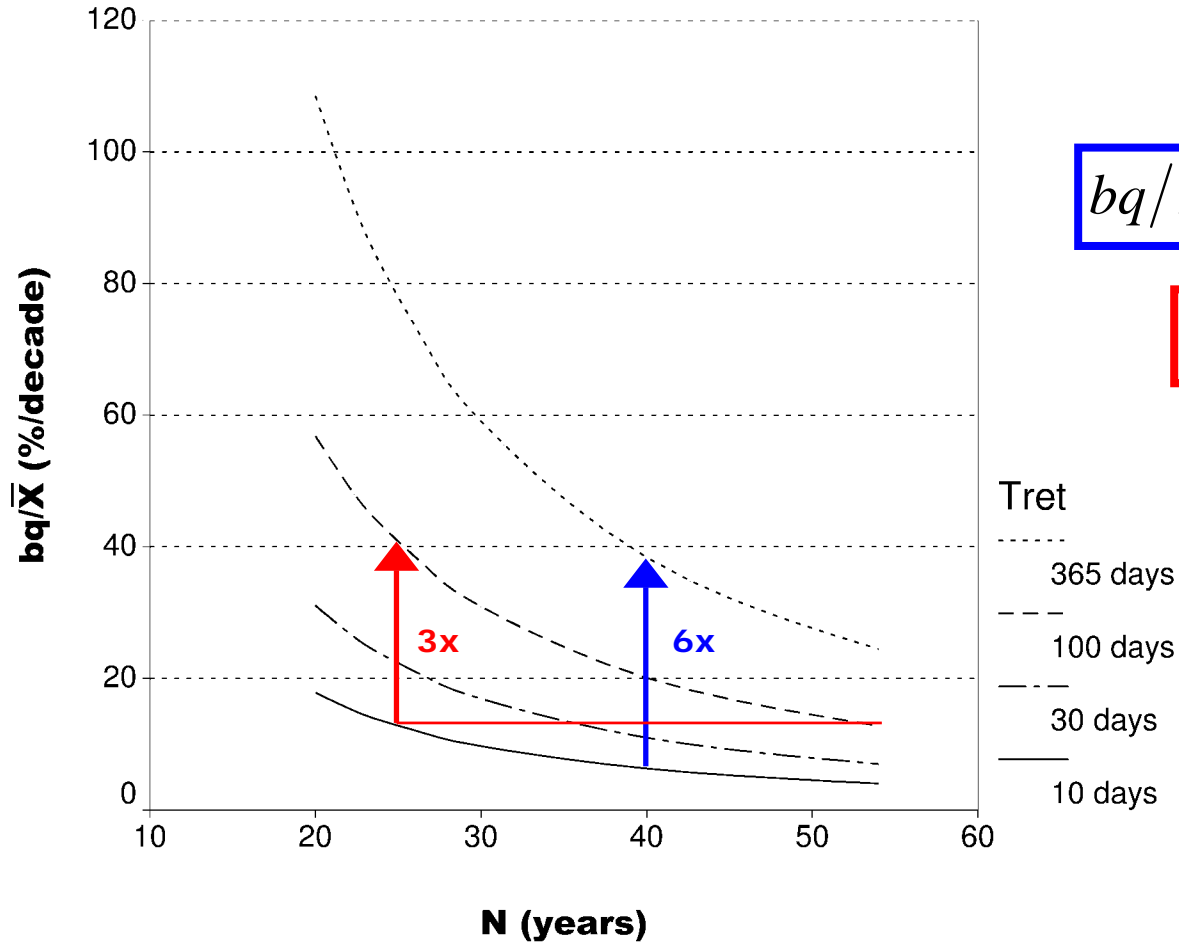




Day-count indices of extremes



Relation between relative trend bq/\bar{X} required for 80% detection probability (5% level) and series length N for extreme events with average return period T_{ret}



$$bq/\bar{X} \sim (T_{ret}/365)^{1/2}$$

$$bq/\bar{X} \sim N^{-3/2}$$

- Tret**
- 365 days
 - 100 days
 - .-.-.- 30 days
 - _____ 10 days