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

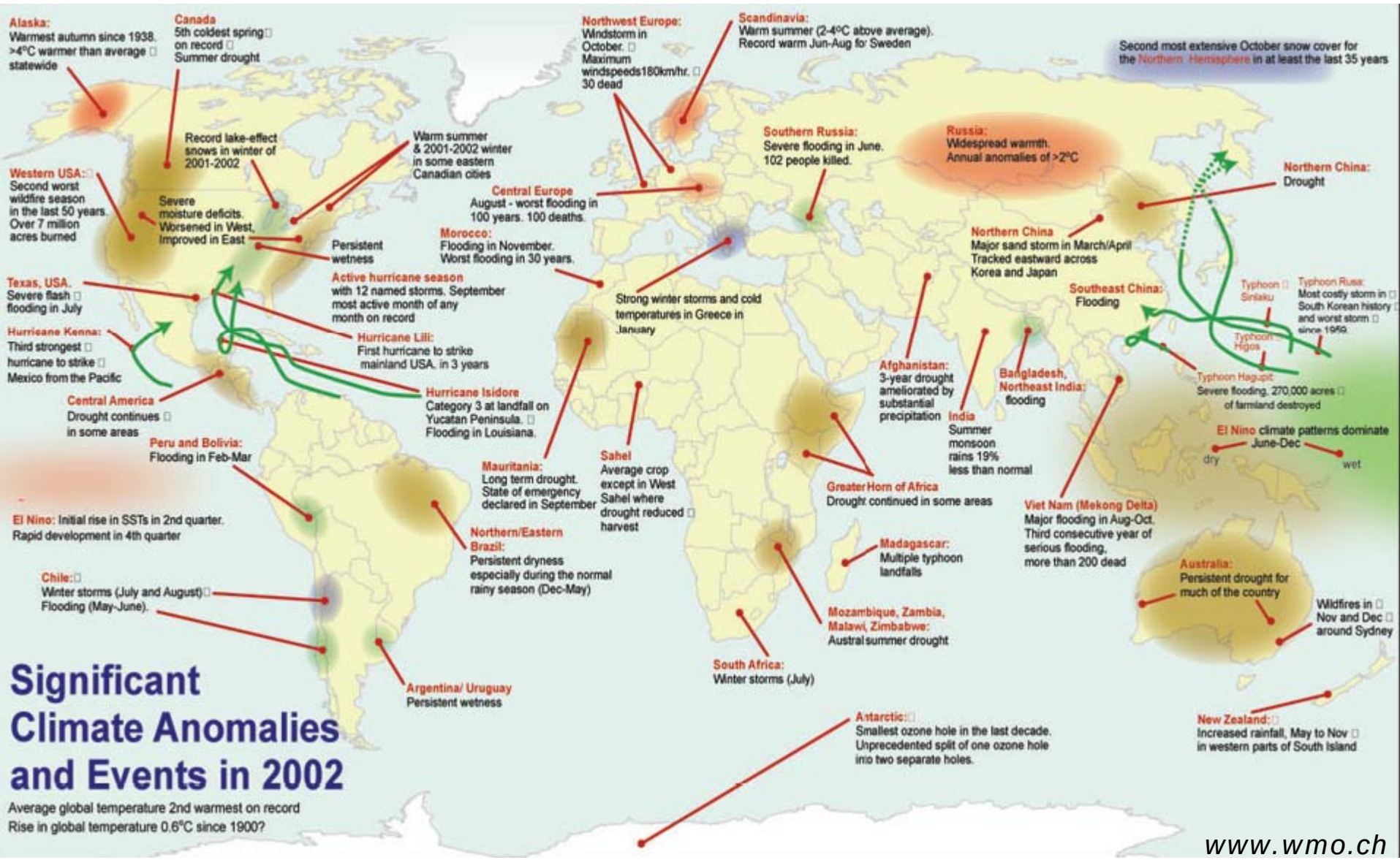
1. Projections

2. Observations

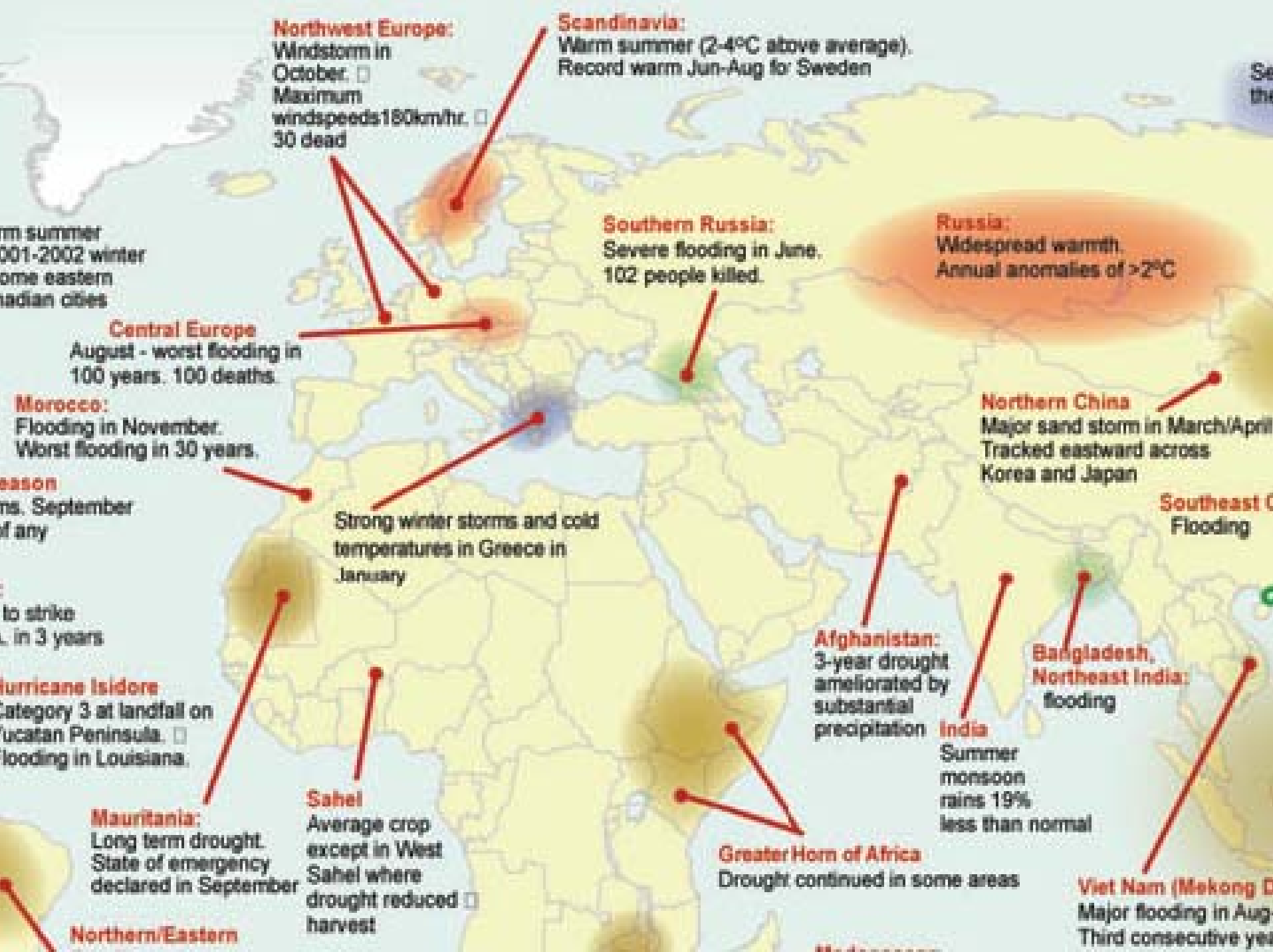
Topics:

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

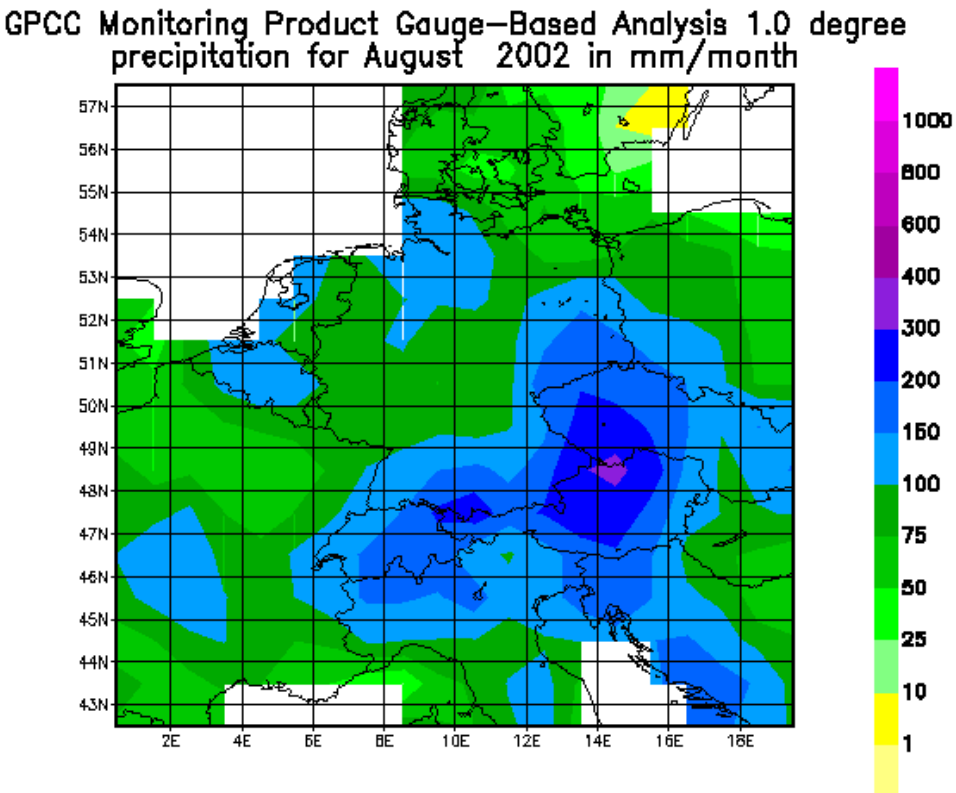
WMO status of global climate in 2002

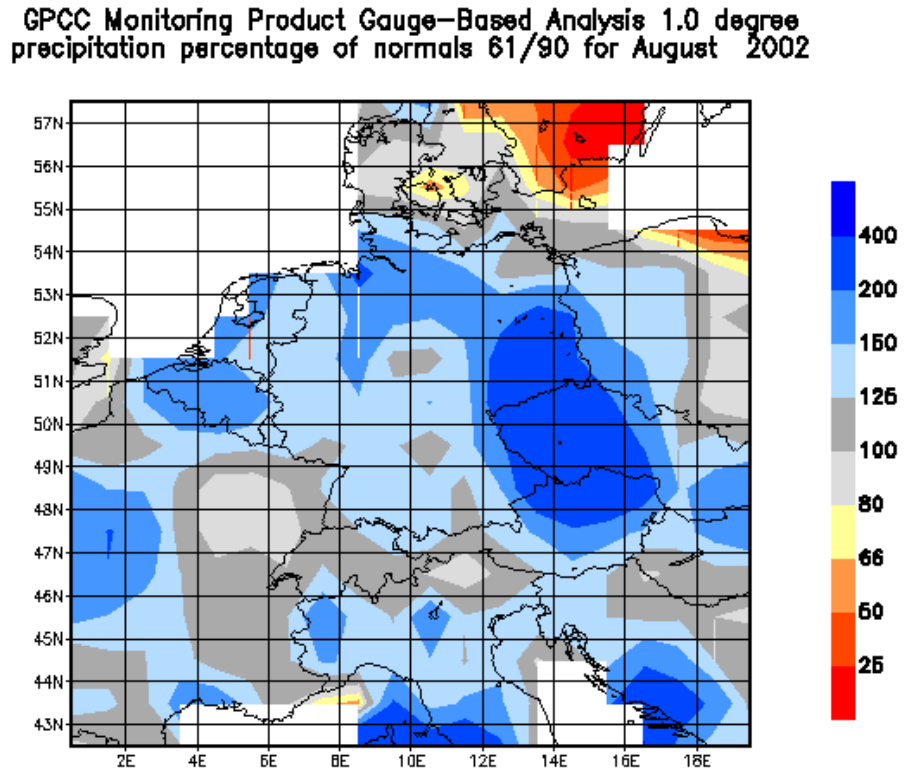


www.wmo.ch


Northwest Europe:
Windstorm in October.
Maximum windspeeds180km/hr.
30 dead
Scandinavia:
Warm summer (2-4°C above average).
Record warm Jun-Aug for Sweden
rm summer
001-2002 winter
ome eastern
nadian cities
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
eason
ns. September
f any
Strong winter storms and cold
temperatures in Greece in
January
Southeast
Flooding
to strike
. in 3 years
urricane Isidore
Category 3 at landfall on
ucatan Peninsula.
looding in Louisiana.
Afghanistan:
3-year drought
ameliorated by
substantial
precipitation
Bangladesh,
Northeast India:
flooding
India
Summer
monsoon
rains 19%
less than normal
Mauritania:
Long term drought.
State of emergency
declared in September
Sahel
Average crop
except in West
Sahel where
drought reduced
harvest
Greater Horn of Africa
Drought continued in some areas
Viet Nam (Mekong D
Major flooding in Aug
Third consecutive ye
Northern/Eastern

Elbe flooding: August 2002 rainfall

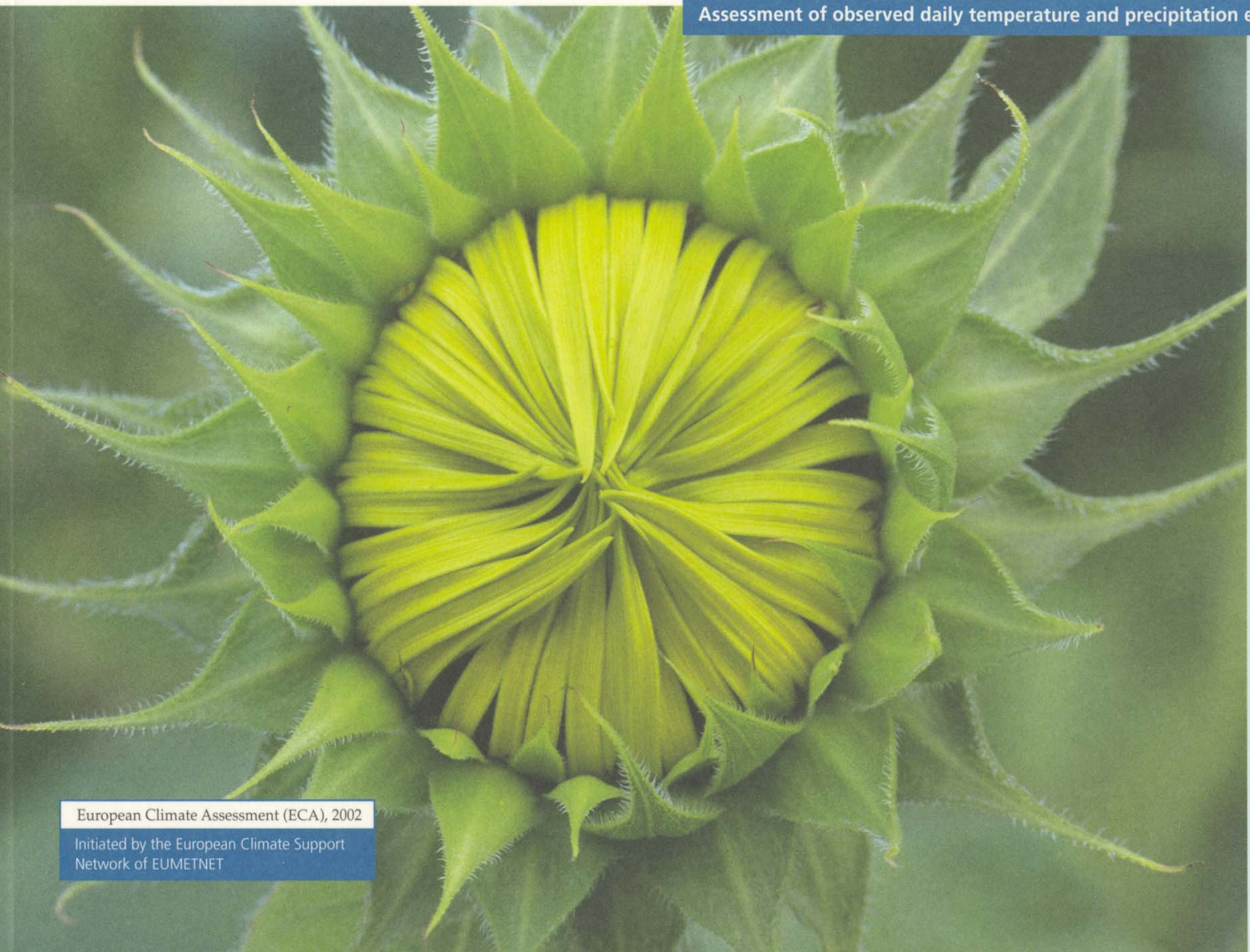




http://www.dwd.de/en/FundE/Klima/KLIS/int/GPCC/GPCC.htm

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

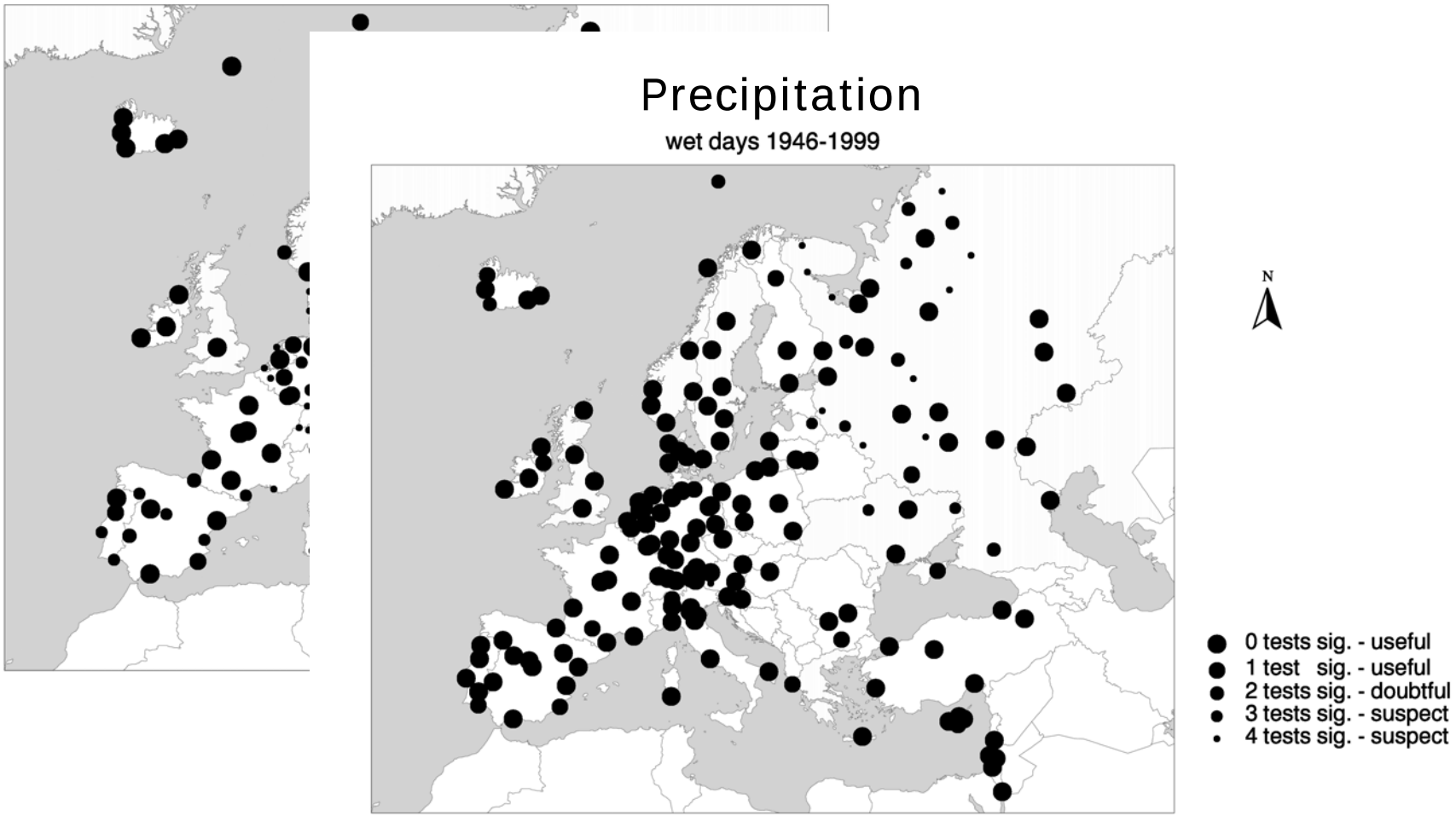
Data quality control and homogeneity

Temperature

vDTR 1946-1999

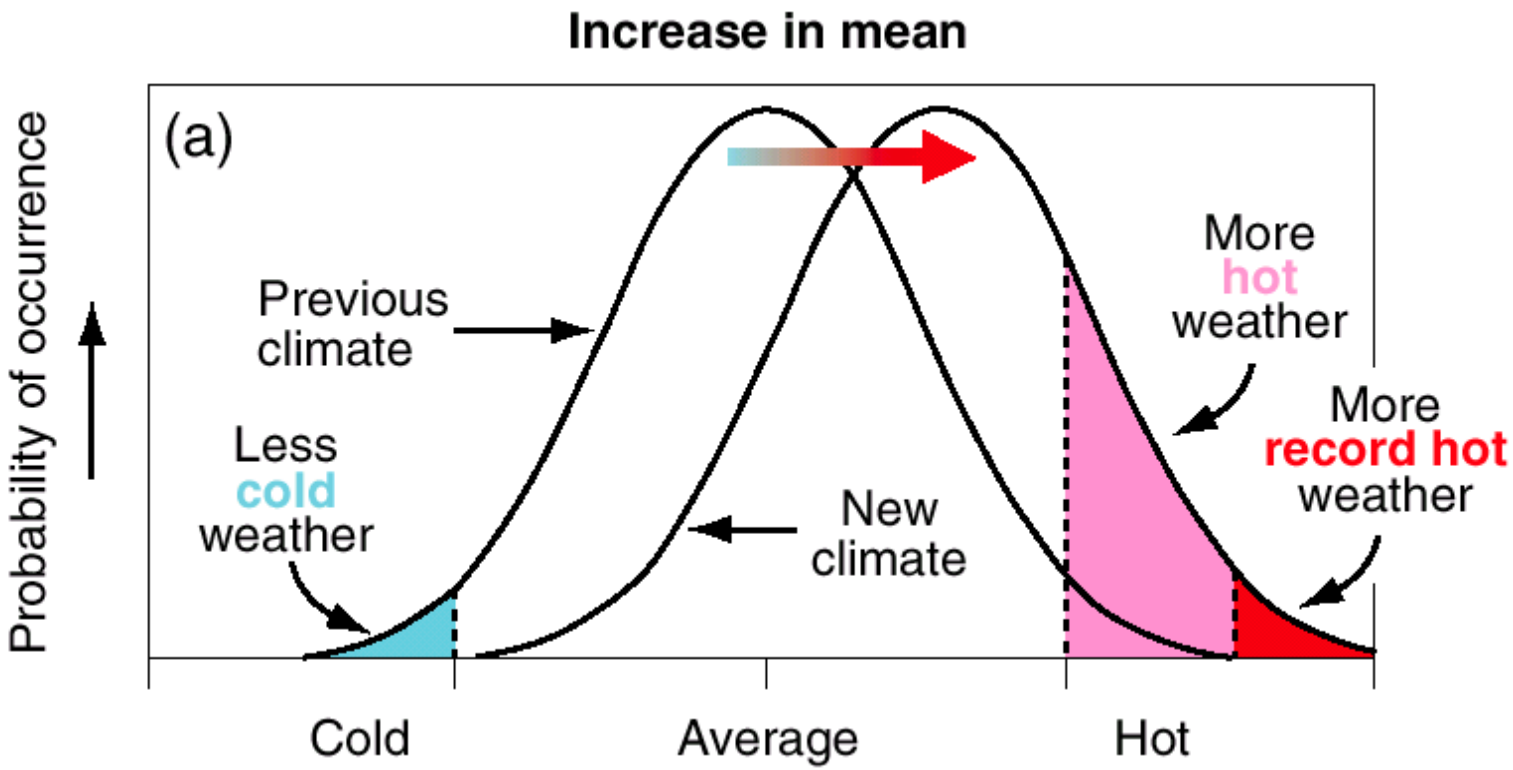
Precipitation

wet days 1946-1999



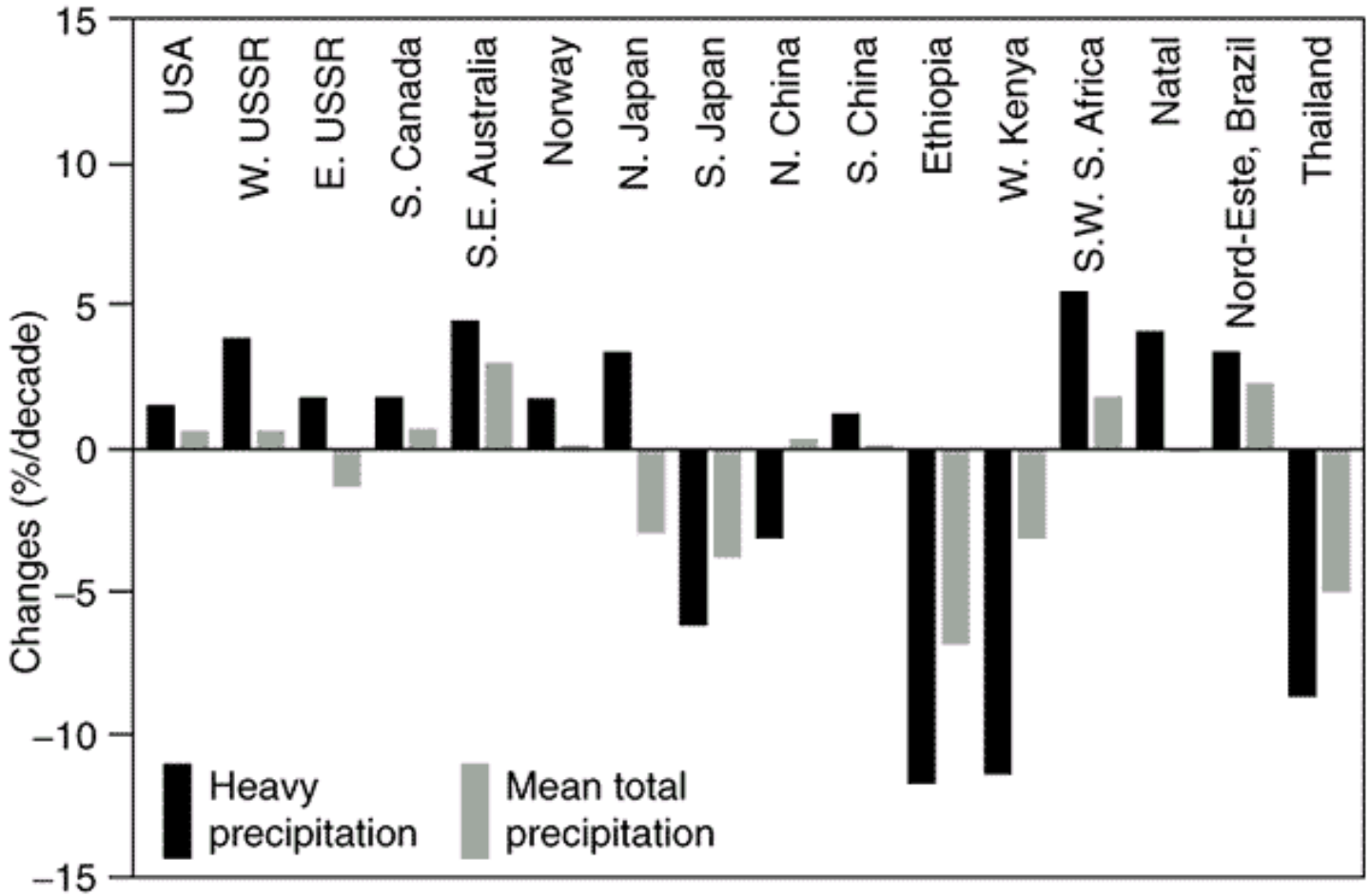
Wijngaard et al., Int. J. of Climatol., 2003

Detection of “(a)symmetric warming”



IPCC-TAR, Ch.2, Folland and Karl

“Amplified” response of very wet days



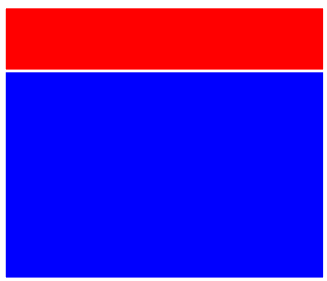
Linear trends in rainy season, last ~50 years

Easterling et al. (BAMS, 2000) in IPCC-TAR

Index: R95%tot

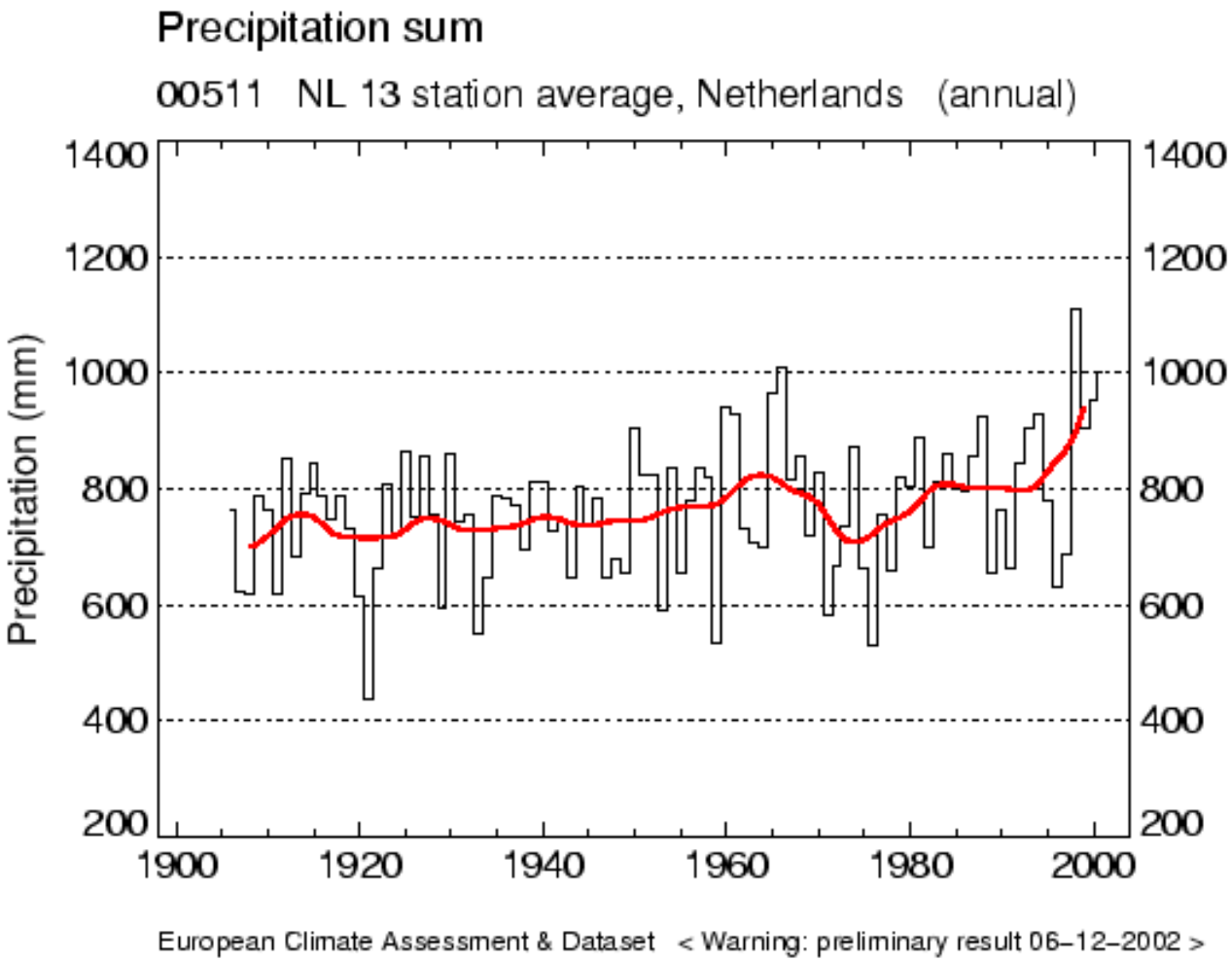
"Precipitation fraction due to very wet days"

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

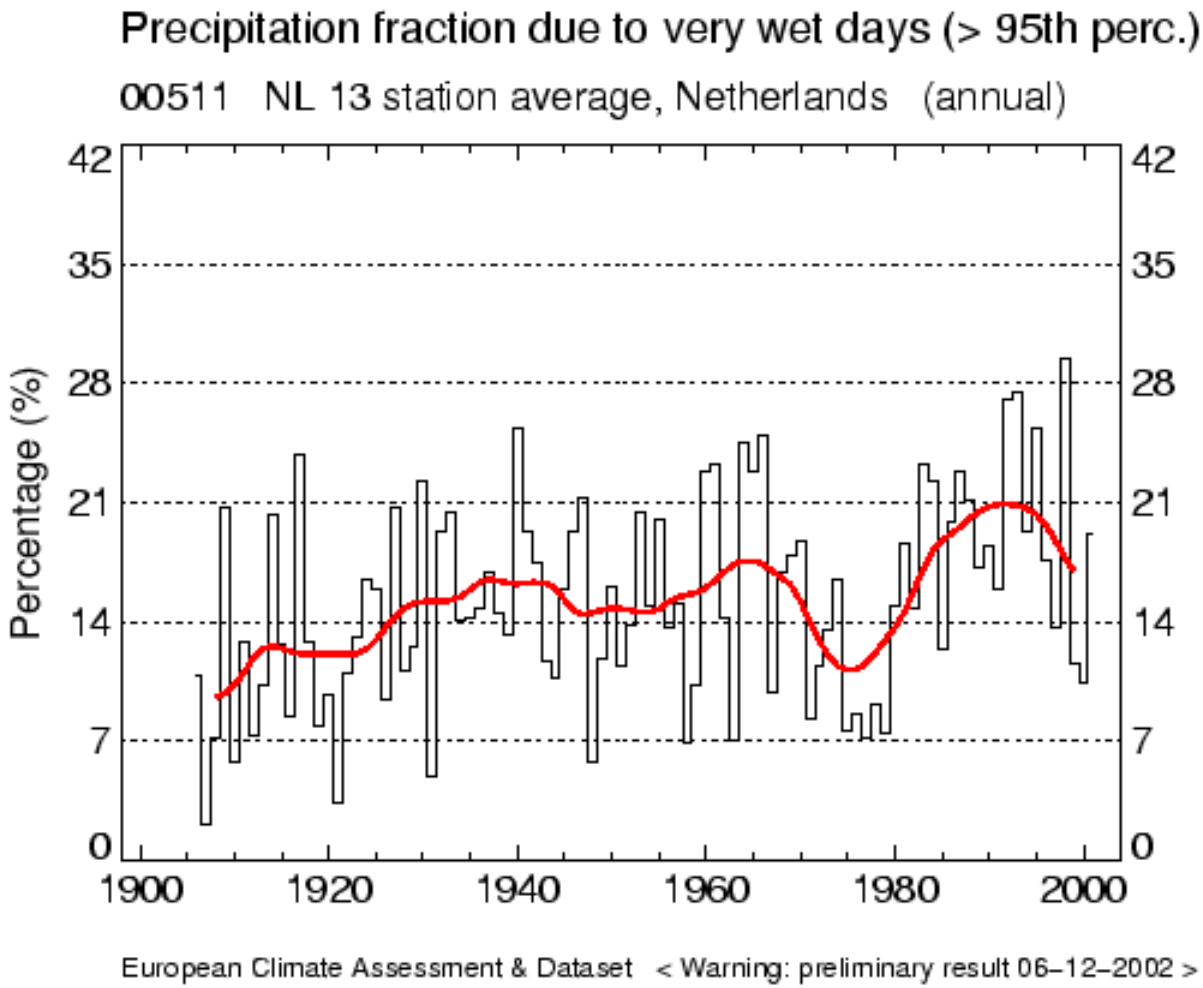


2) Determine fraction of total precipitation in each year that is due to these days

3) Trend analysis in series of fractions



www.knmi.nl/samenw/eca/



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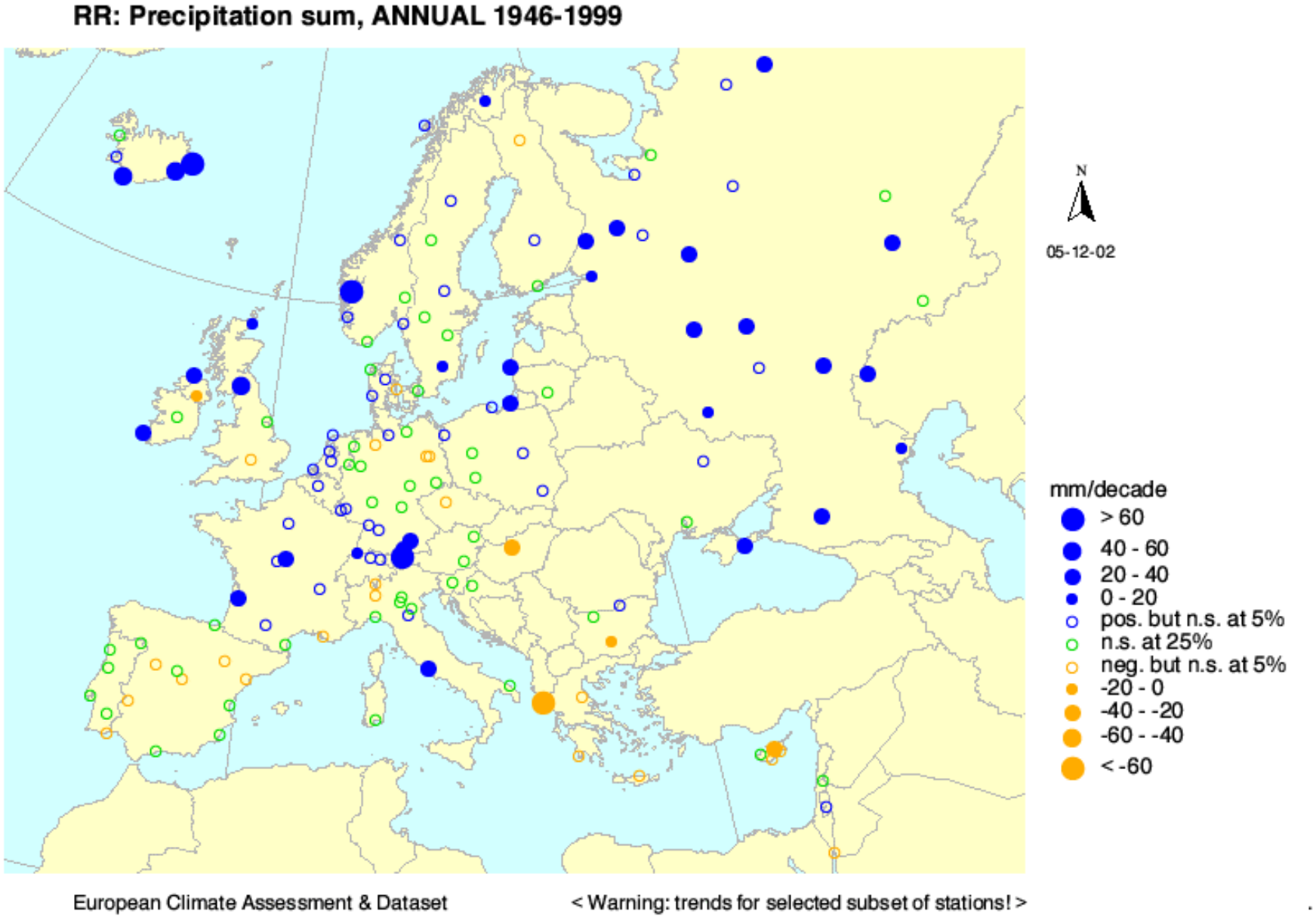
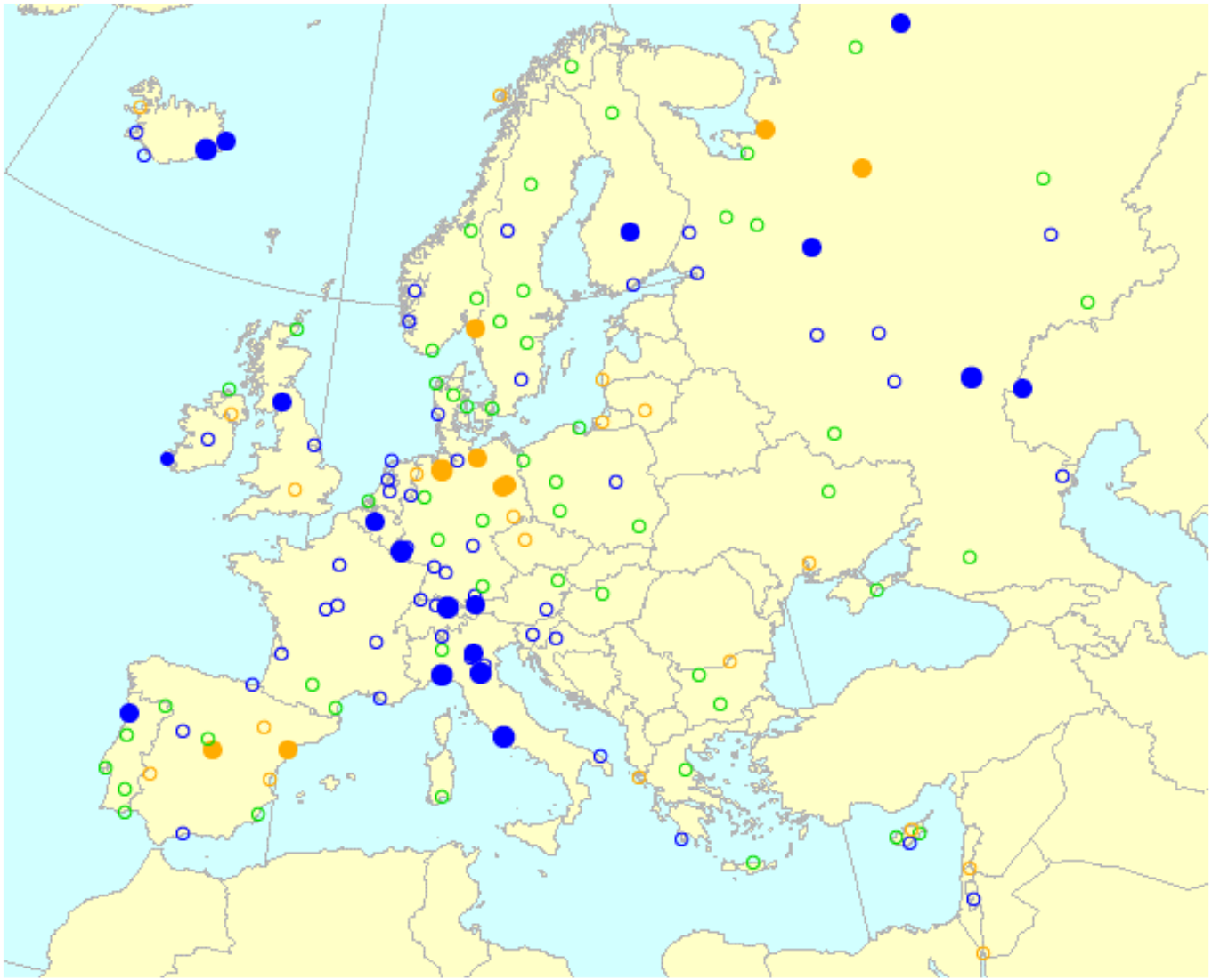


Klein Tank and Können, J. Climate (in press)

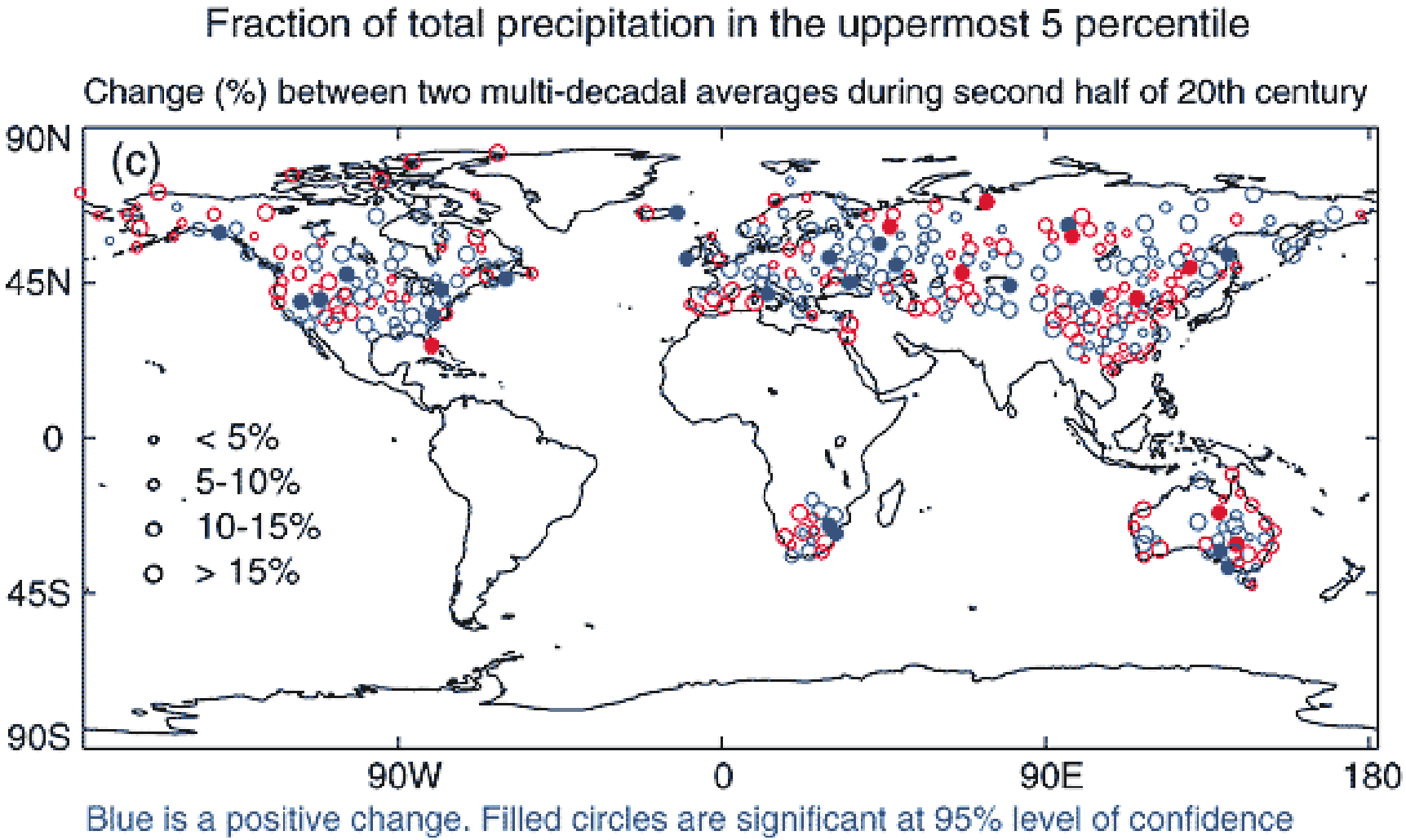
R95pTOT: Precipitation fraction due to very wet days (> 95th perc.), ANNUAL 1946-1999



European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

Klein Tank and Können, J. Climate (in press)



Frich et al. (Clim. Res., 2002) in IPCC-TAR

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)

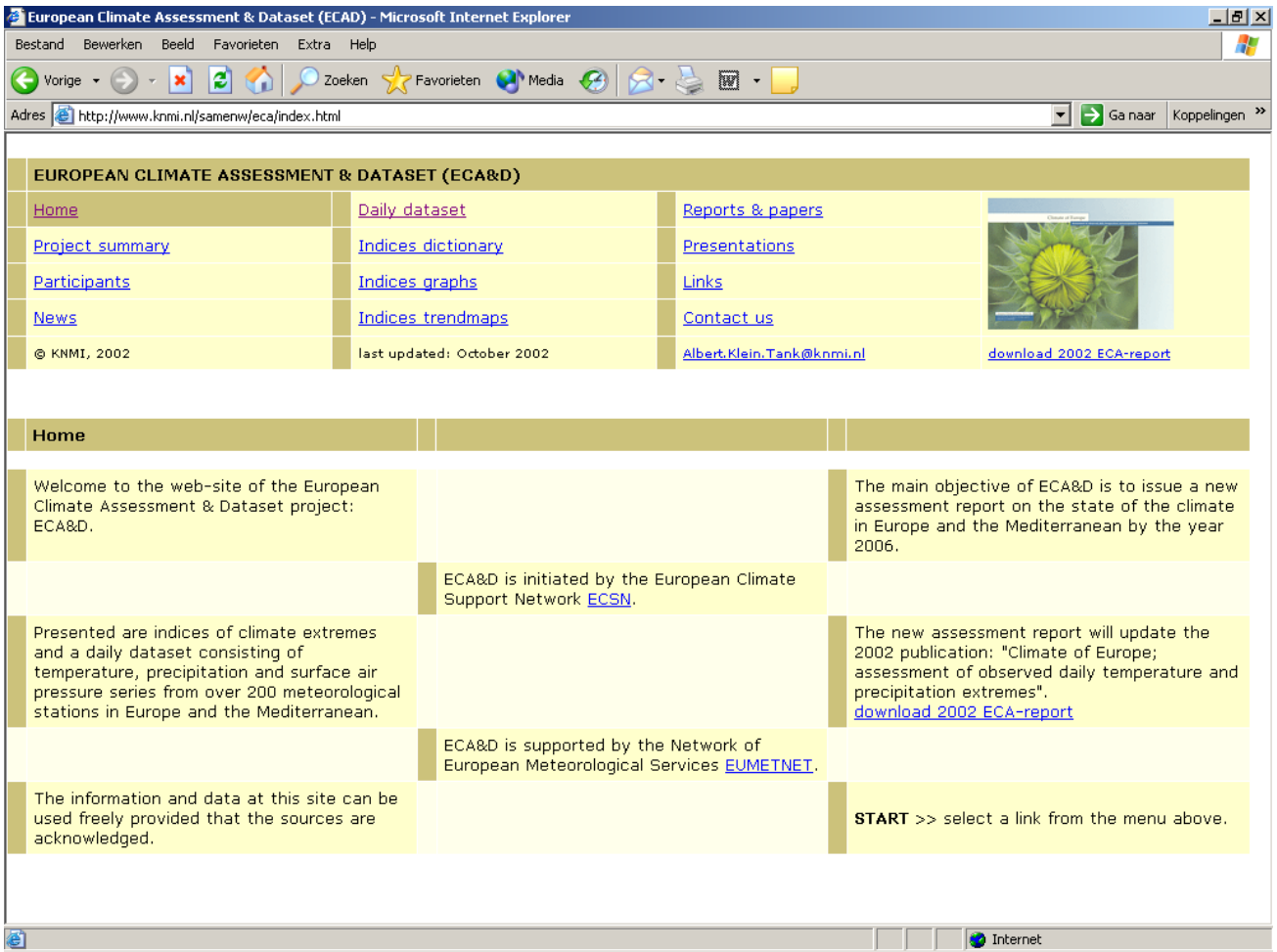
percentile-threshold indices increase per decade		absolute-threshold indices increase per decade	
R75%	**0.4** (0.1 – 0.7)	**R10mm**	**0.3** (0.1 – 0.5)
R95%	**0.2** (0.1 – 0.2)	**R20mm**	**0.1** (0.0 – 0.2)
R95%tot	**0.3** (0.1 – 0.5) %	**RX1day**	0.2 (-0.1 – 0.5) mm
		RX5day	**0.6** (0.0 – 1.2) mm

Klein Tank and Können, J. Climate (in press)

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




Wien
11., Alberner Hafen-zufahrtsstraße
11., 1. Molostraße


NEU..
NEU..


GREY HORSE
CAR PARK
FUN QUIZ

CHR and ECA&D

Some examples for the Rhine basin:

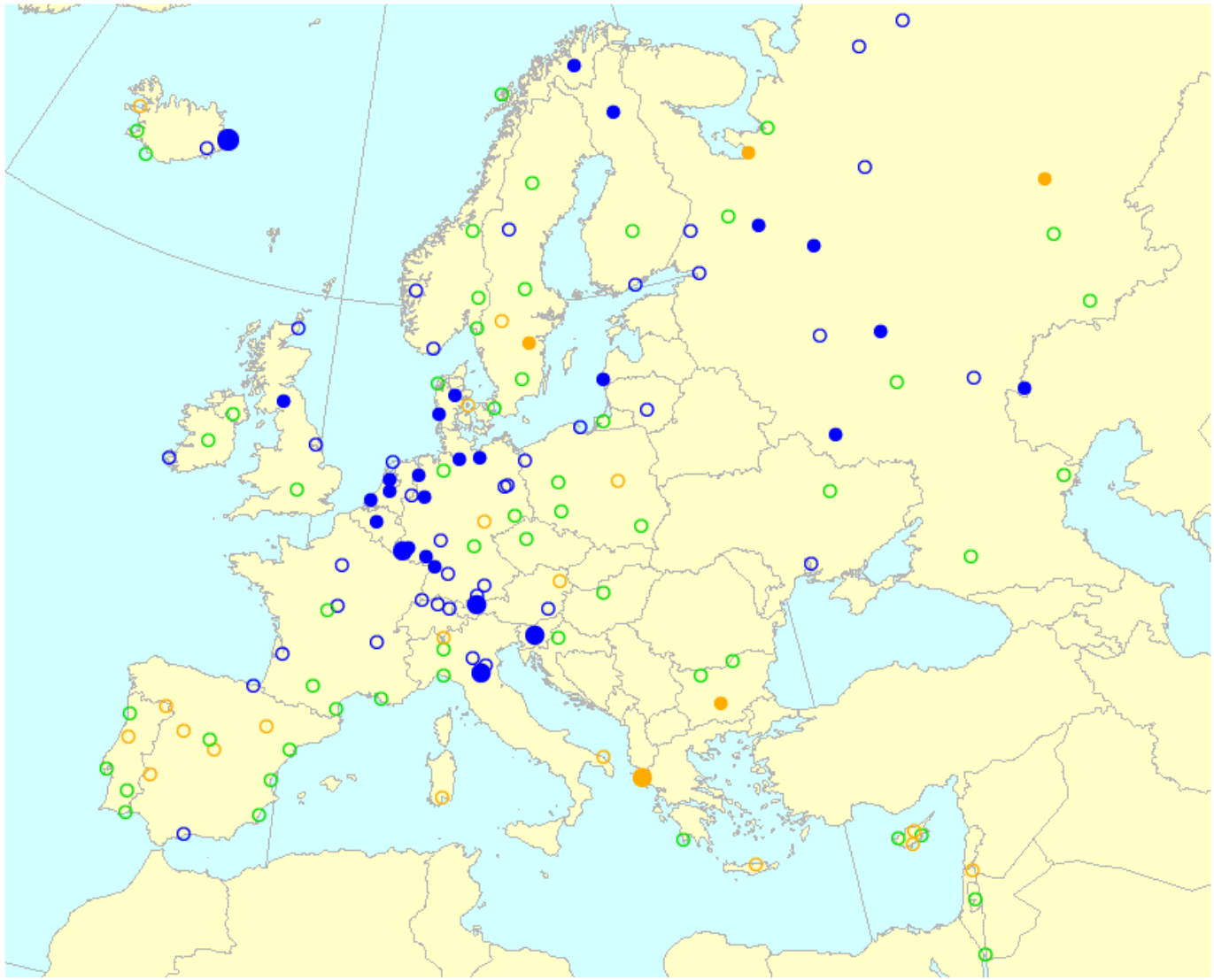
- Winter season (October–March) trends in:

  Highest 5-day precipitation amount
  Total precipitation
  Precipitation fraction due to very wet days (> 95th ptile)

- Summer season (April–September) trends in:

  Maximum number of consecutive dry days

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

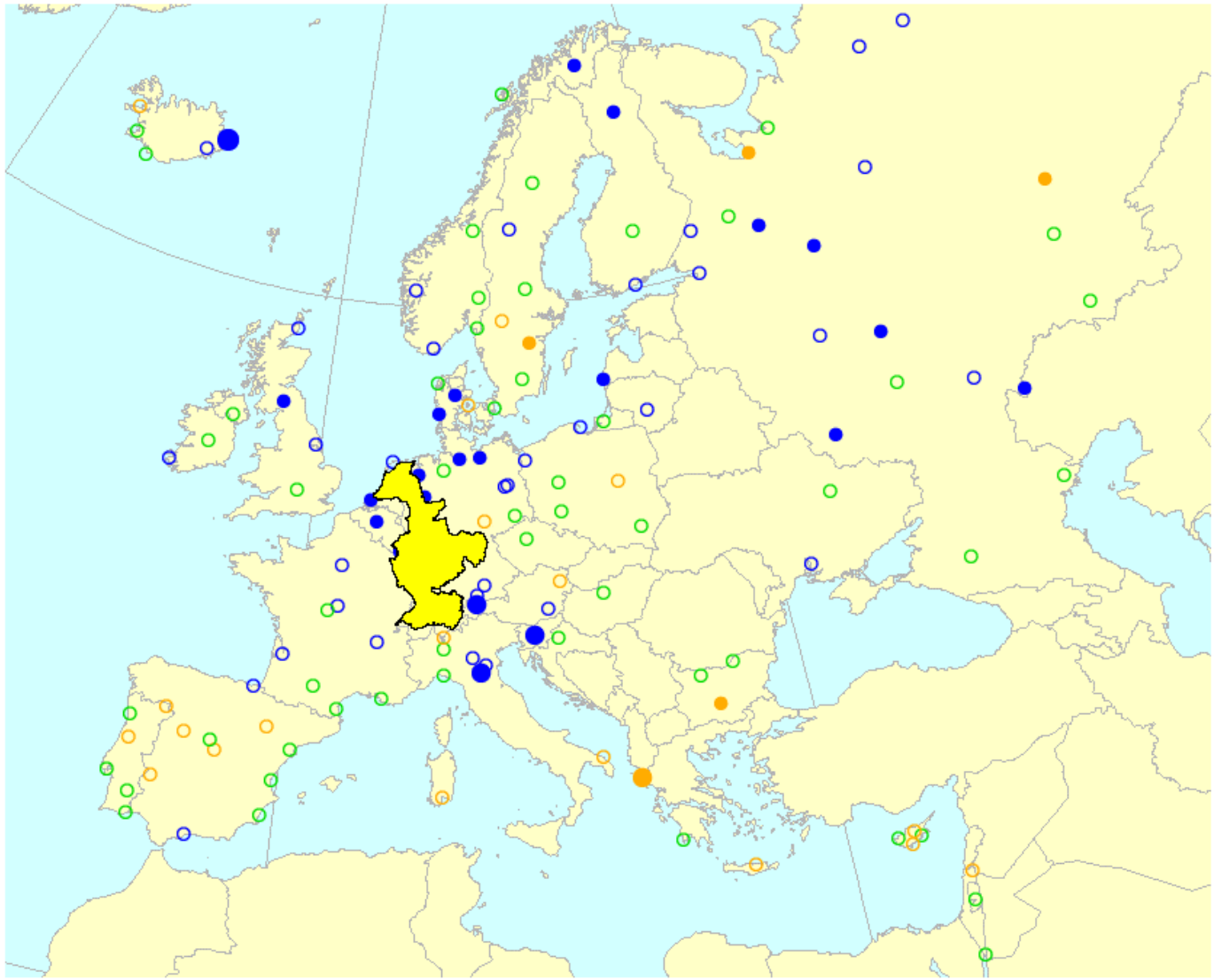


European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

www.knmi.nl/samenw/eca/

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



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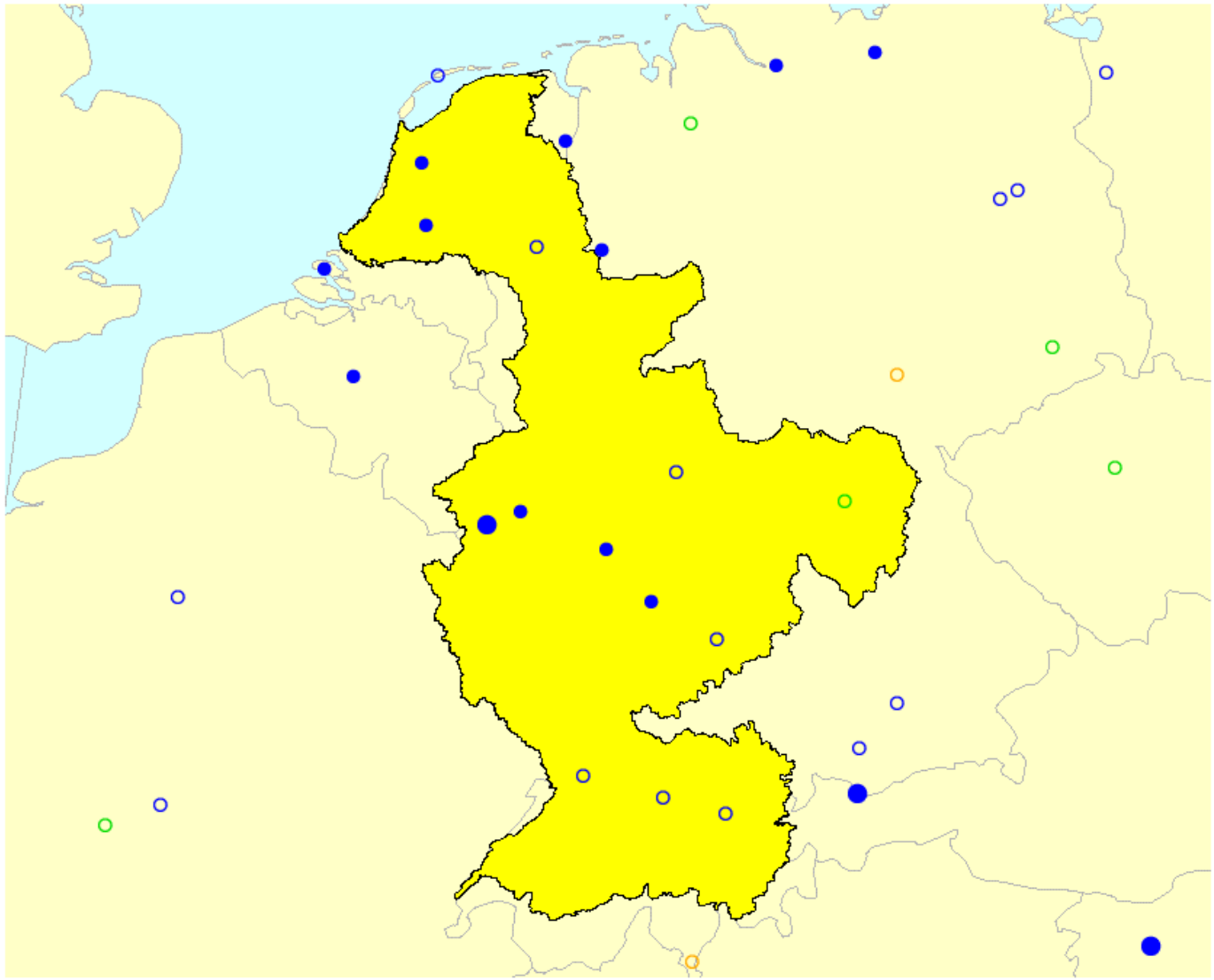

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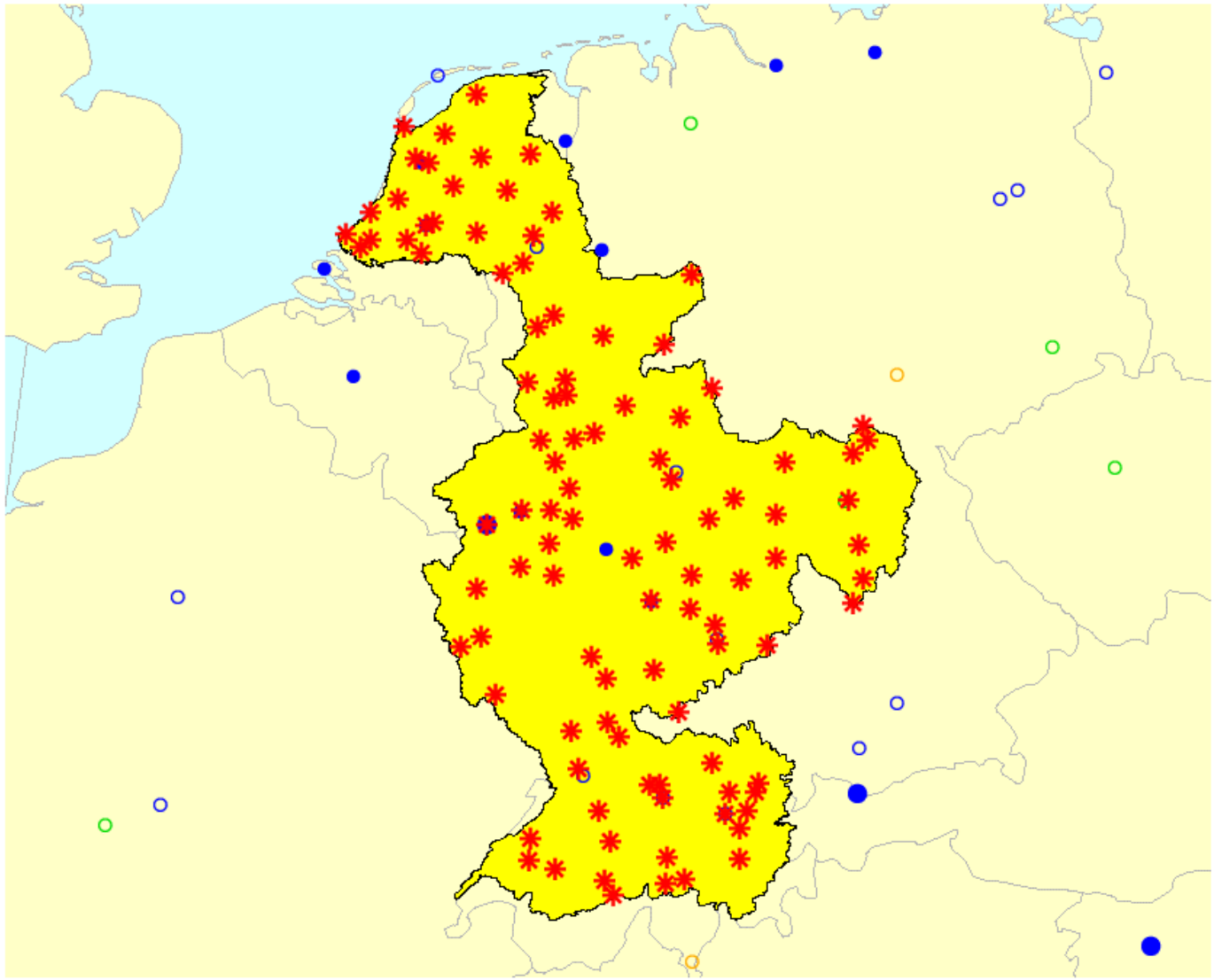

N

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

European Climate Assessment & Dataset

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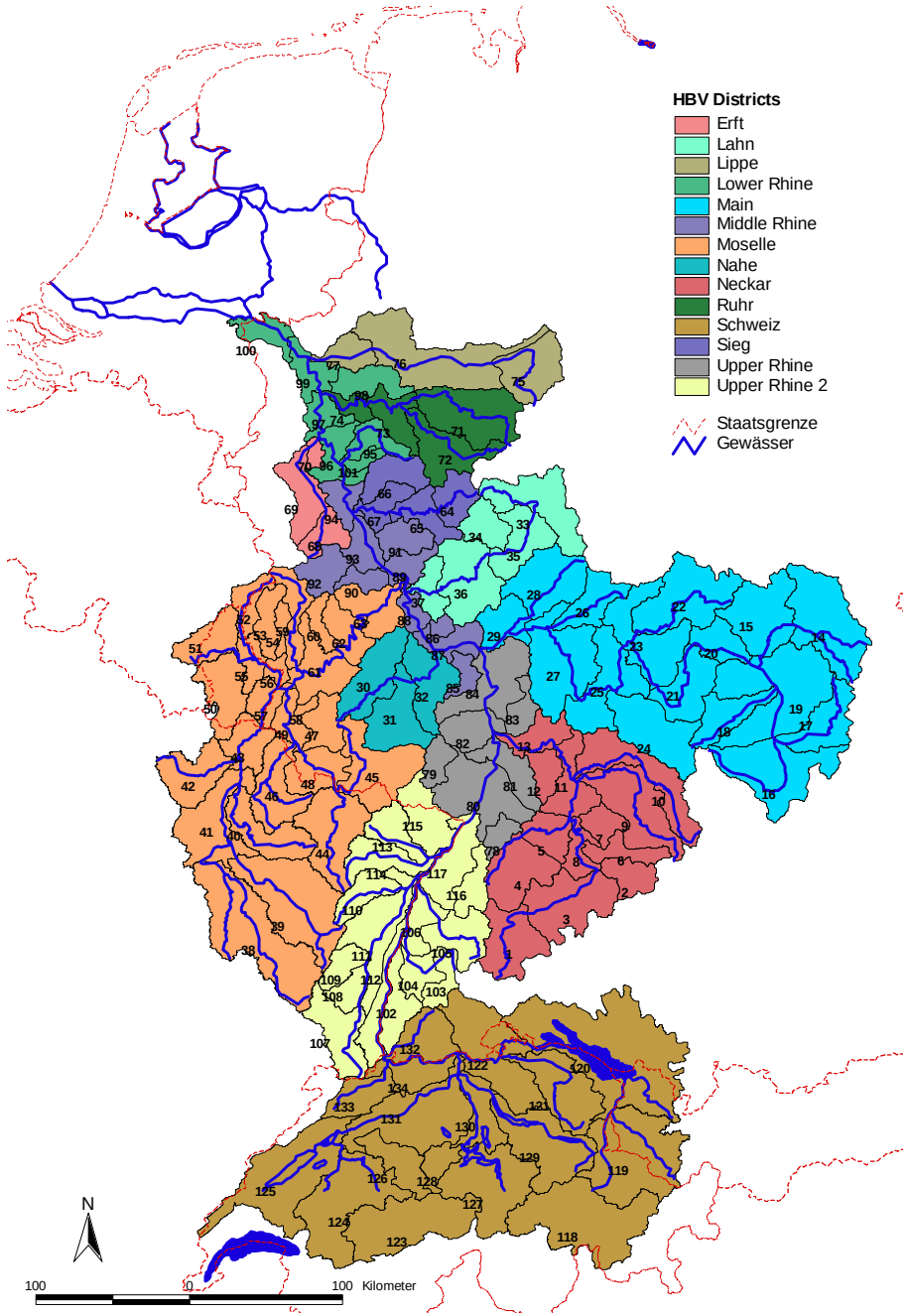
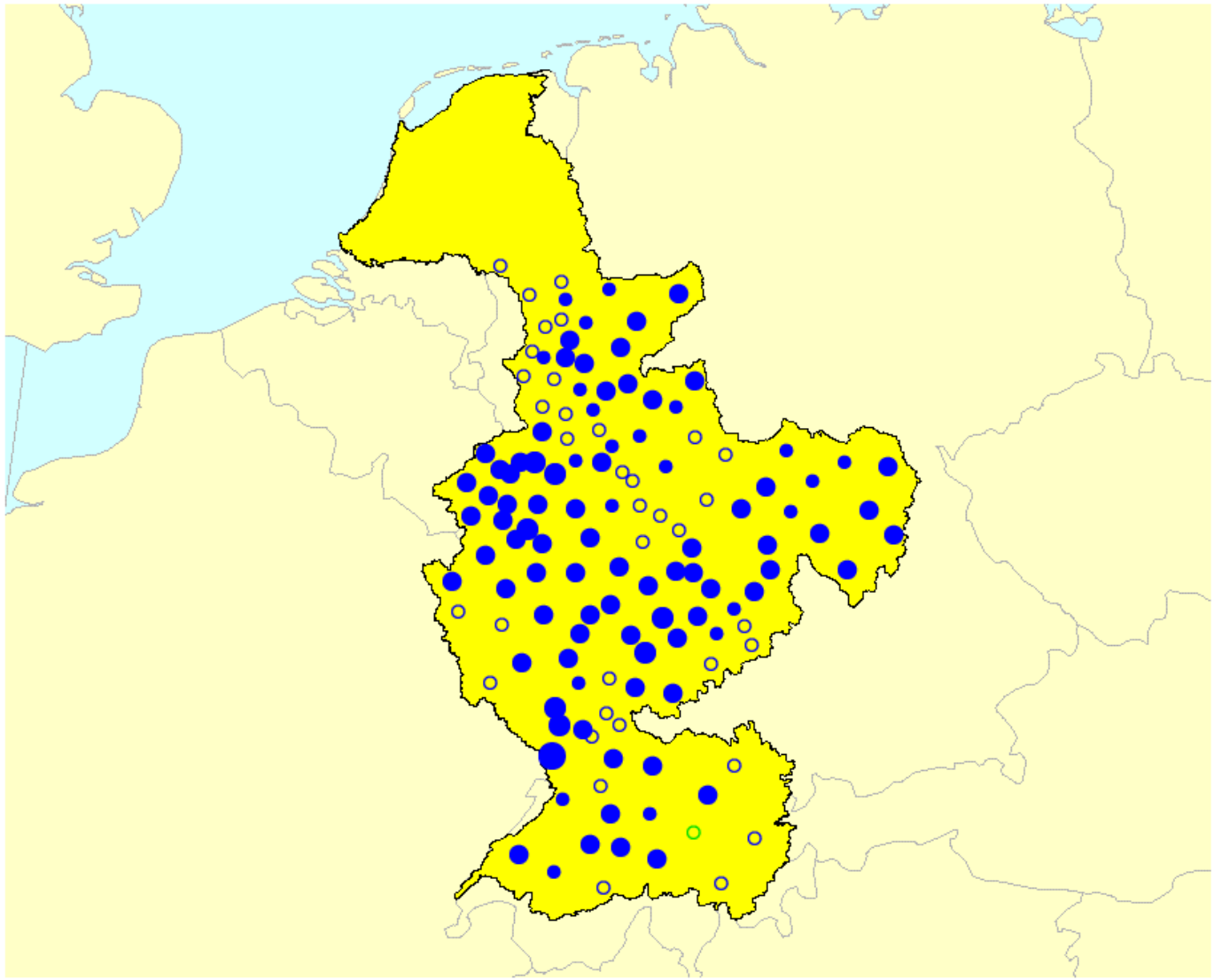
www.knmi.nl/samenw/eca/



CHR dataset:

Daily series of area-averaged precipitation

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



European Climate Assessment & Dataset

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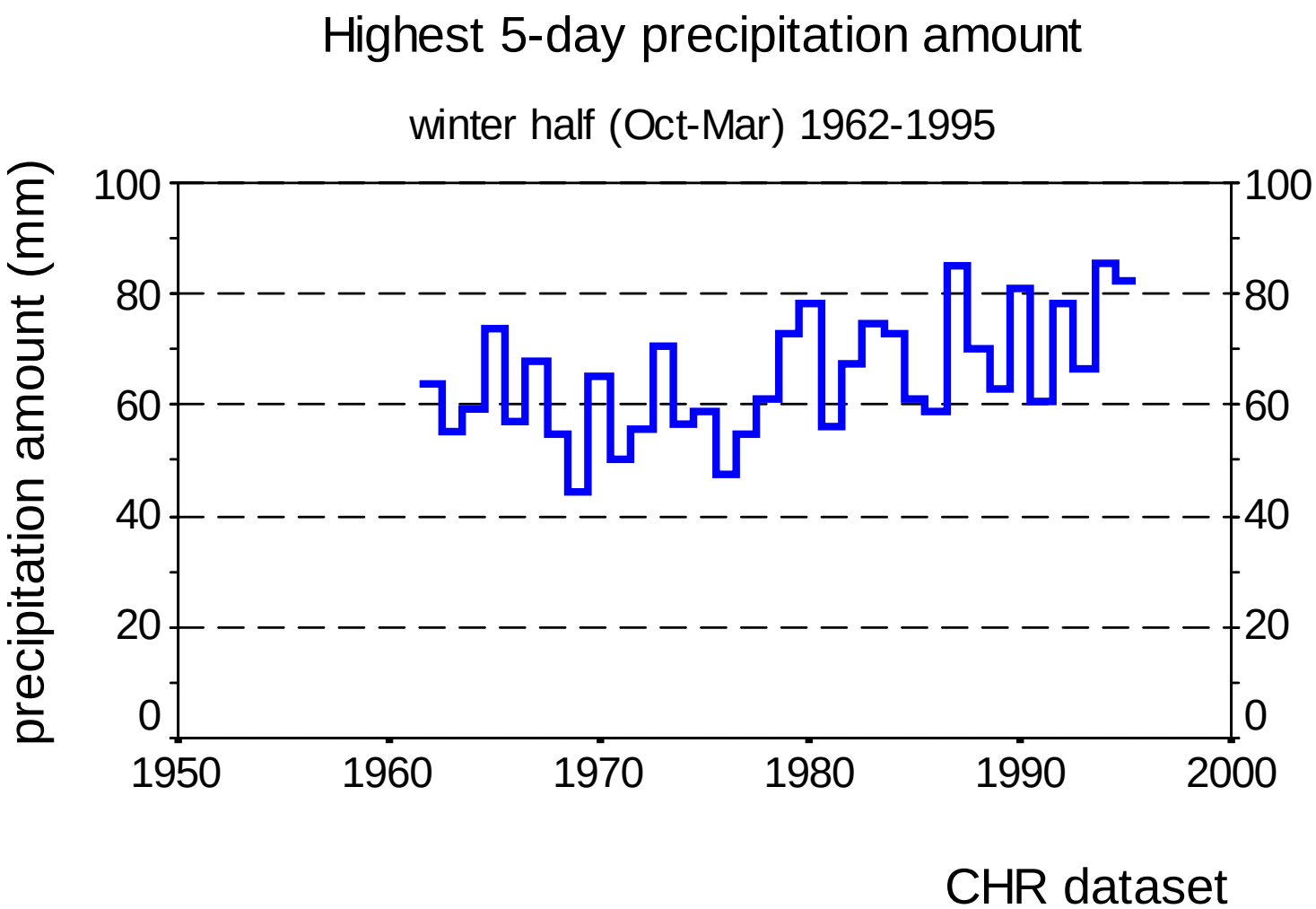
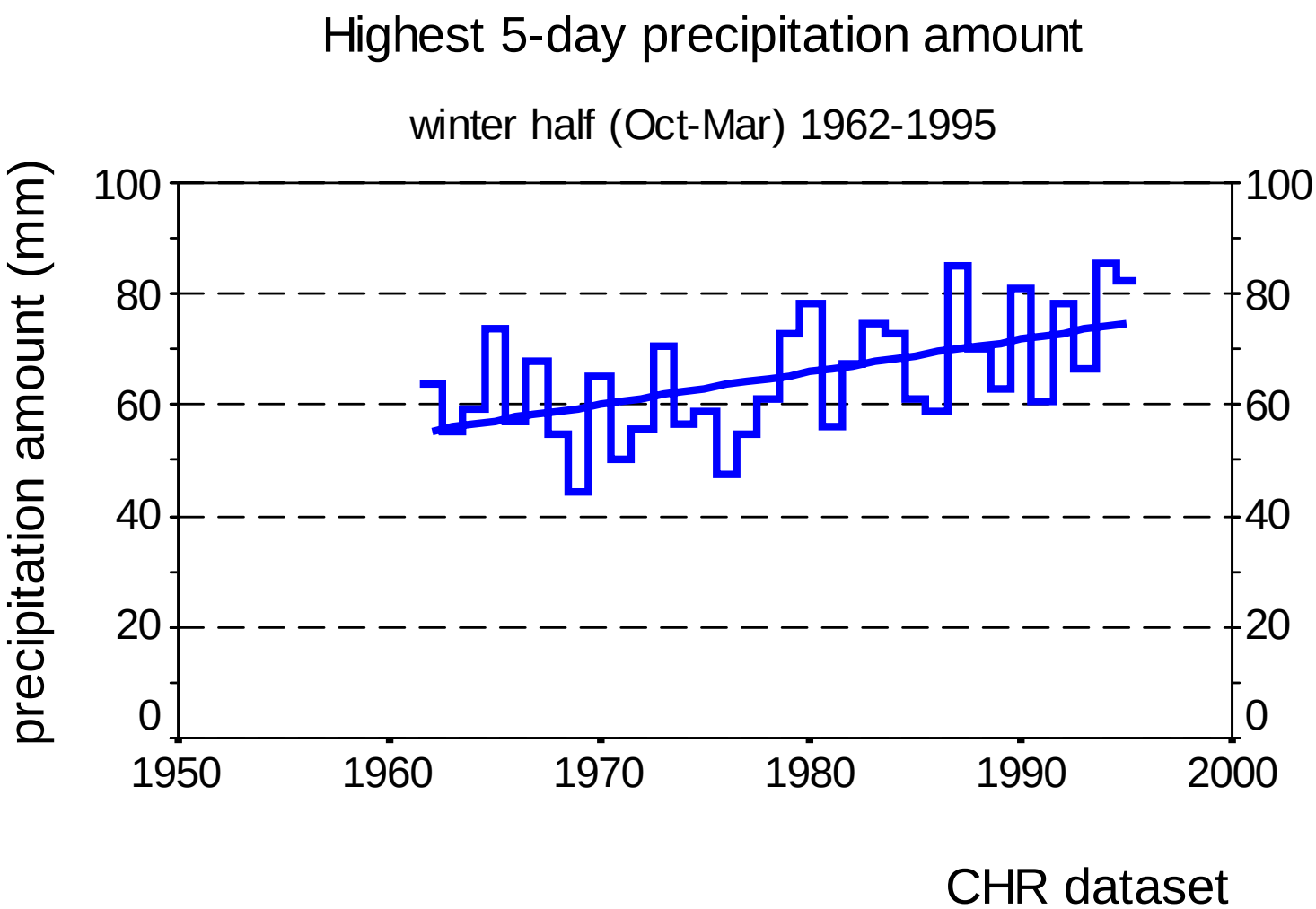
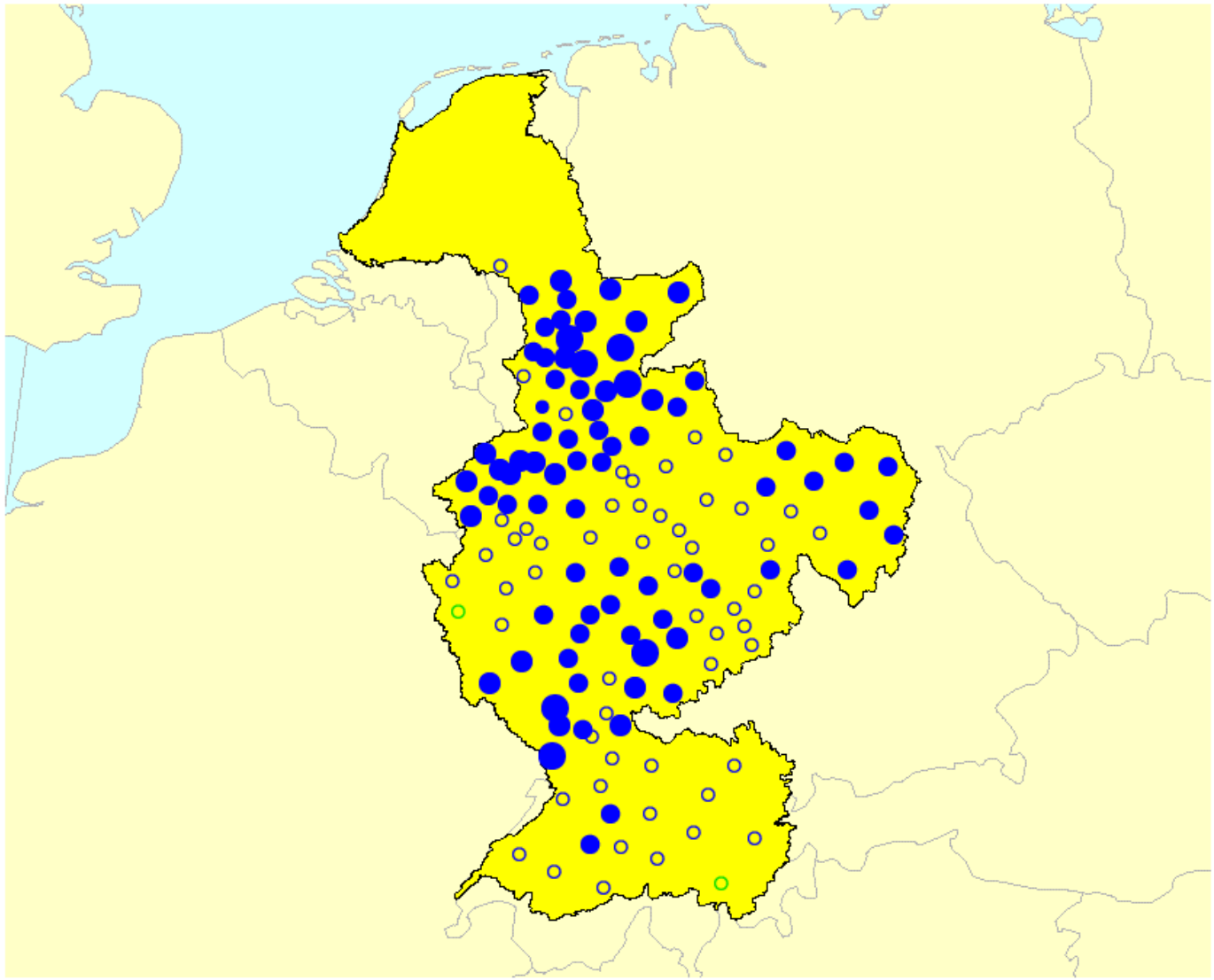
CHR dataset


Highest 5-day precipitation amount
winter half (Oct-Mar) 1962-1995
precipitation amount (mm)
100
80
60
40
20
0
1950
1960
1970
1980
1990
2000
CHR dataset


Highest 5-day precipitation amount
winter half (Oct-Mar) 1962-1995
precipitation amount (mm)
100
80
60
40
20
0
1950
1960
1970
1980
1990
2000
CHR dataset

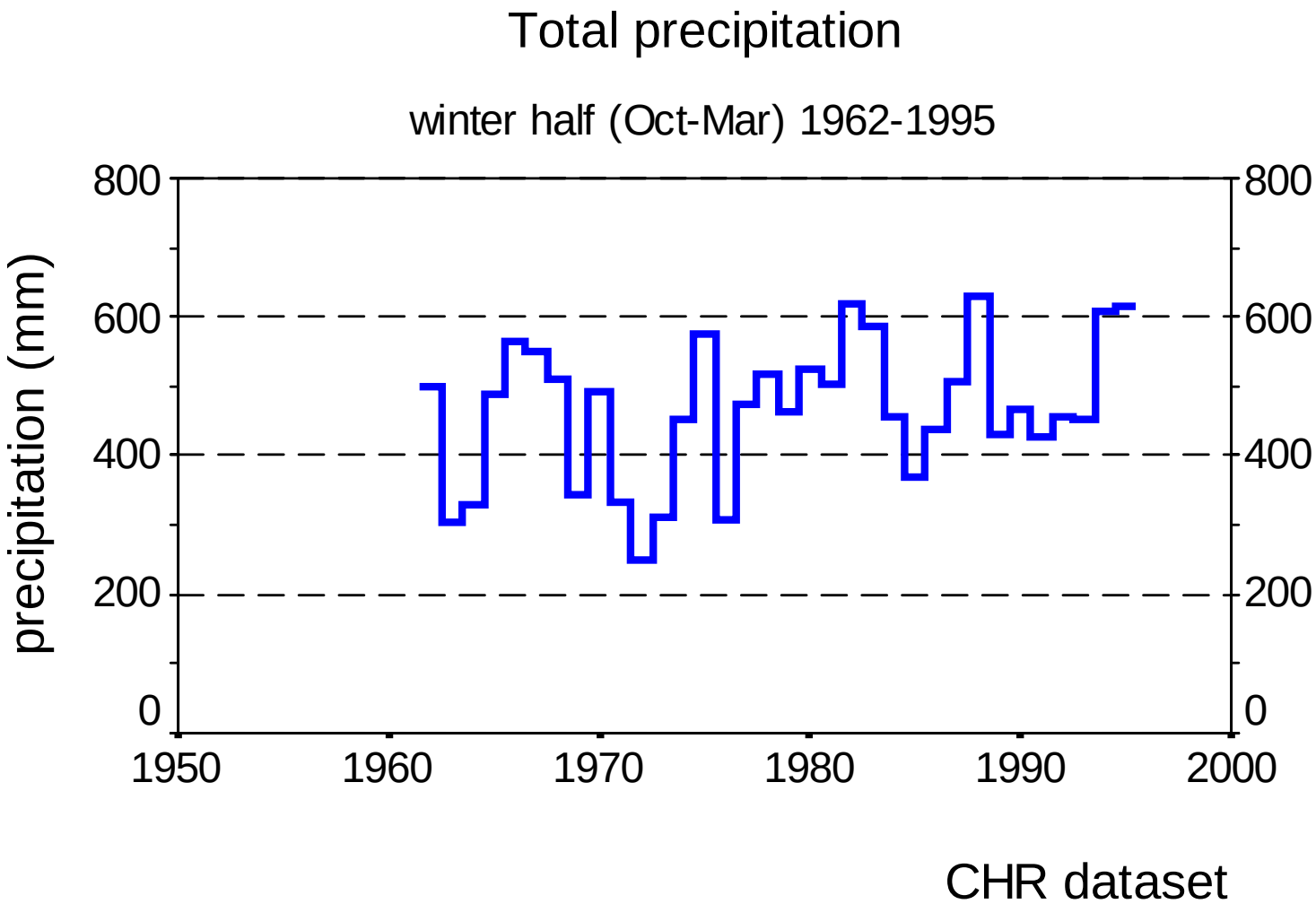
RR: Precipitation sum, WINTER-HALF 1962-1995



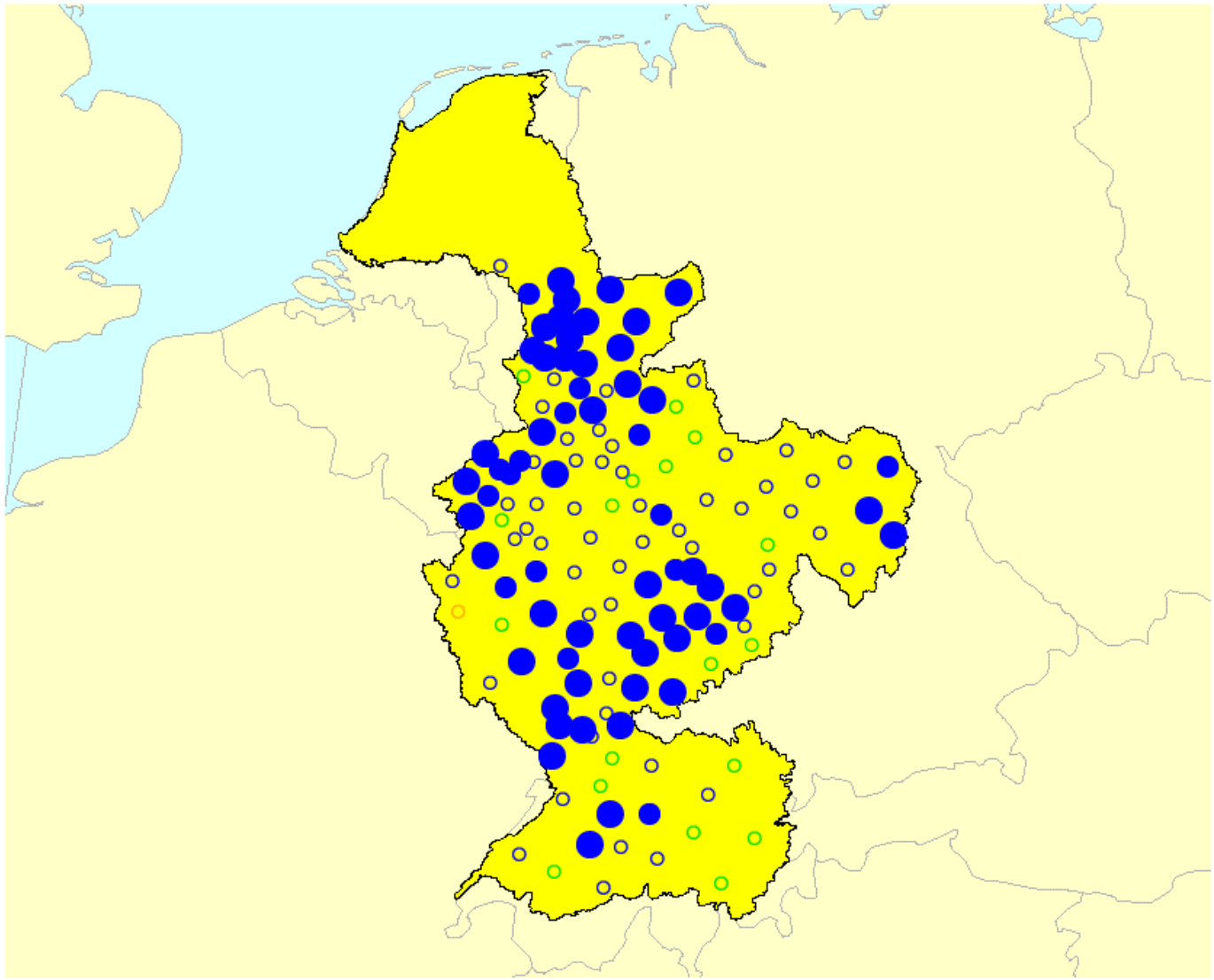
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

CHR dataset


Total precipitation
winter half (Oct-Mar) 1962-1995
precipitation (mm)
800
600
400
200
0
1950
1960
1970
1980
1990
2000
CHR dataset

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



European Climate Assessment & Dataset

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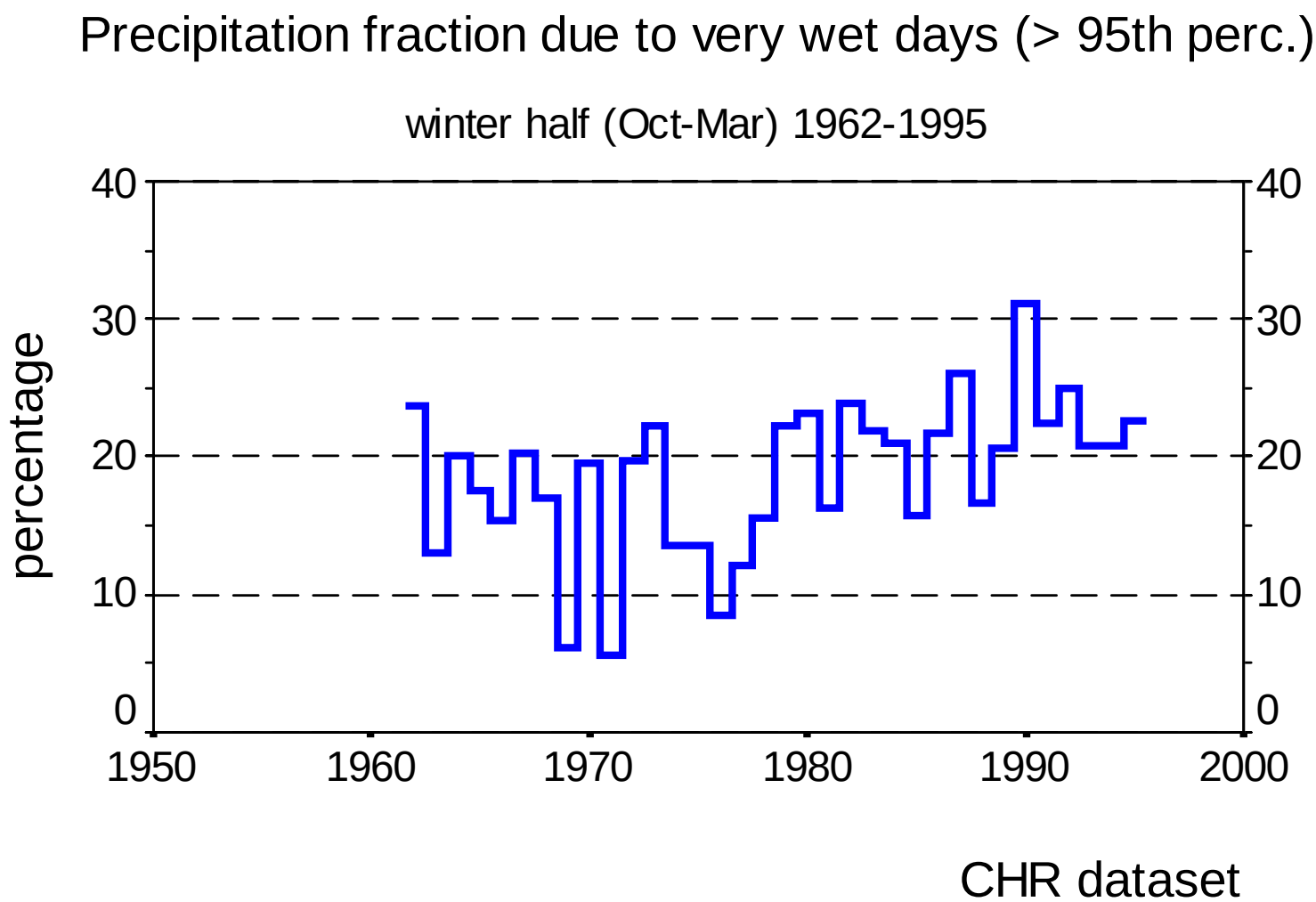
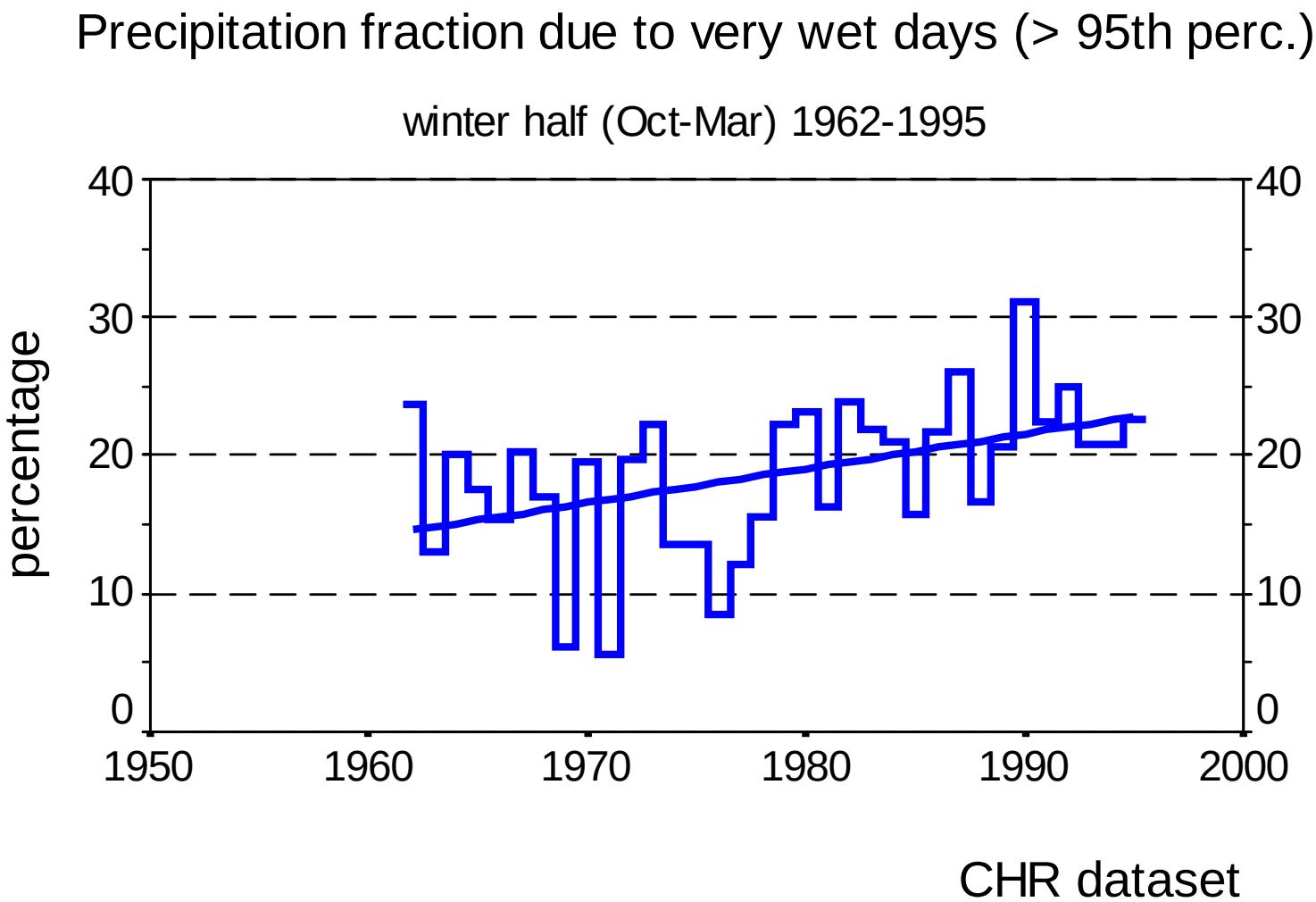
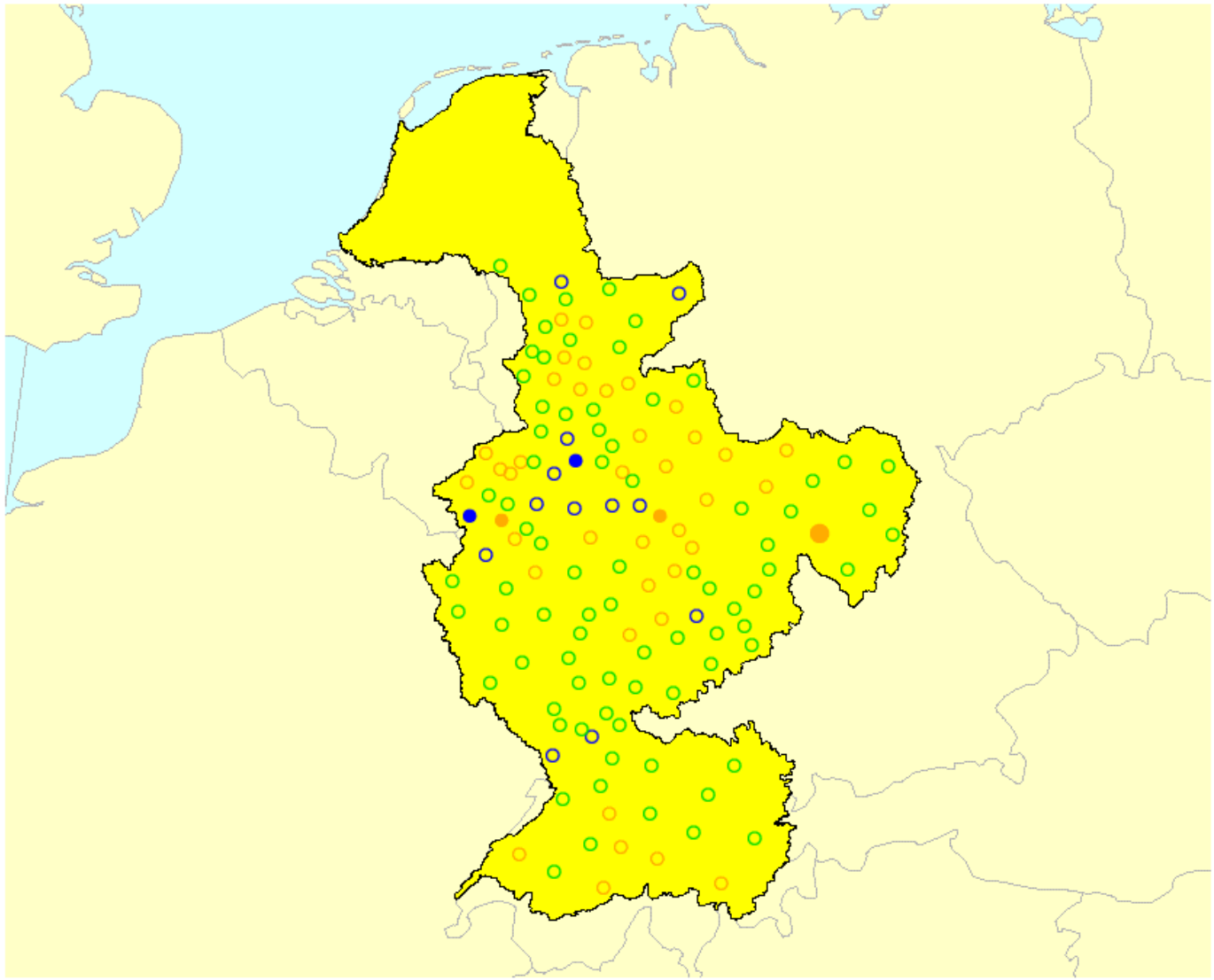
CHR dataset


Precipitation fraction due to very wet days (> 95th perc.)
winter half (Oct-Mar) 1962-1995
percentage
40
30
20
10
0
1950
1960
1970
1980
1990
2000
CHR dataset


Precipitation fraction due to very wet days (> 95th perc.)
winter half (Oct-Mar) 1962-1995
percentage
40
30
20
10
0
1950
1960
1970
1980
1990
2000
CHR dataset

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



European Climate Assessment & Dataset

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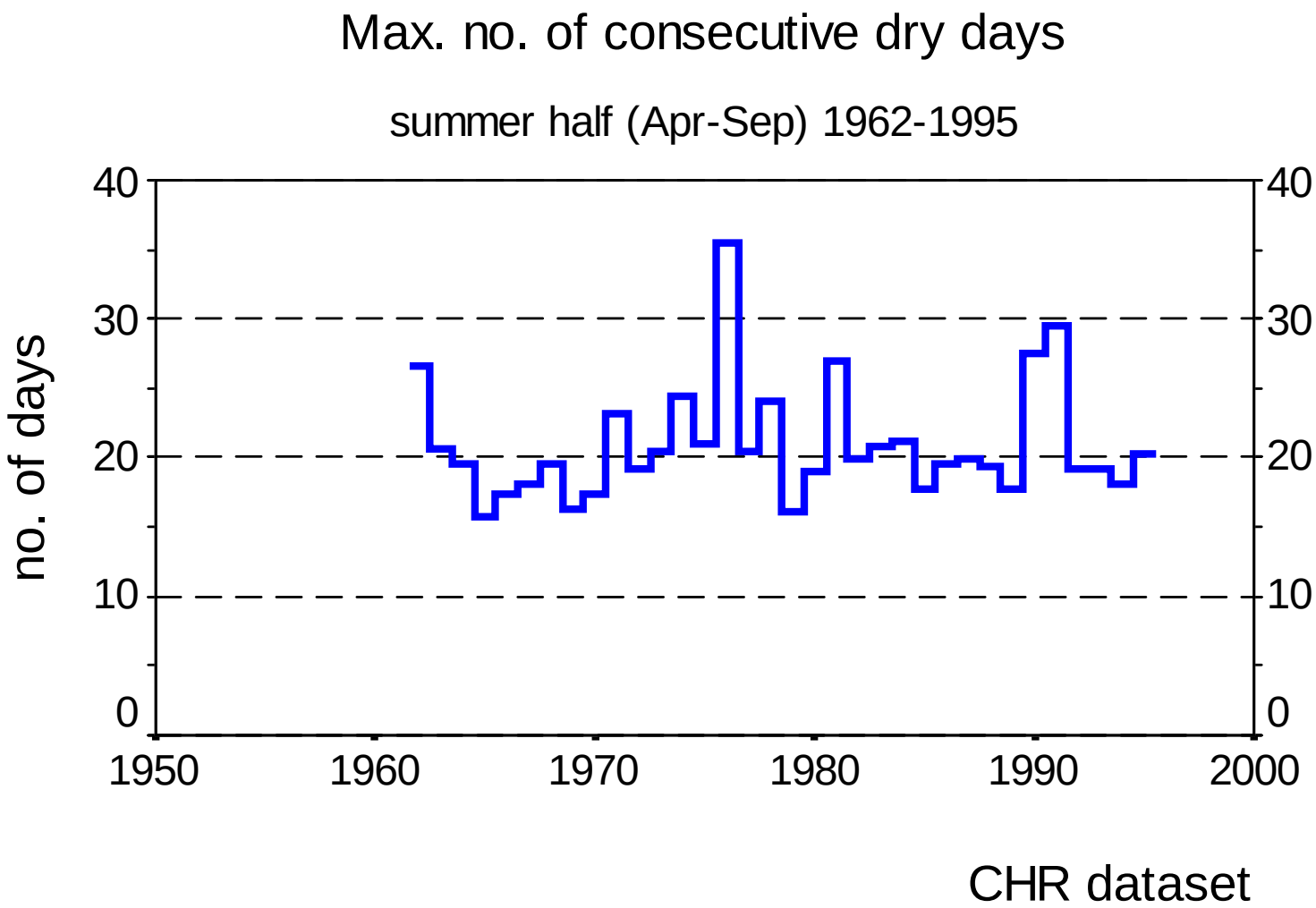
CHR dataset


Max. no. of consecutive dry days
summer half (Apr-Sep) 1962-1995
no. of days
40
30
20
10
0
1950
1960
1970
1980
1990
2000
CHR dataset

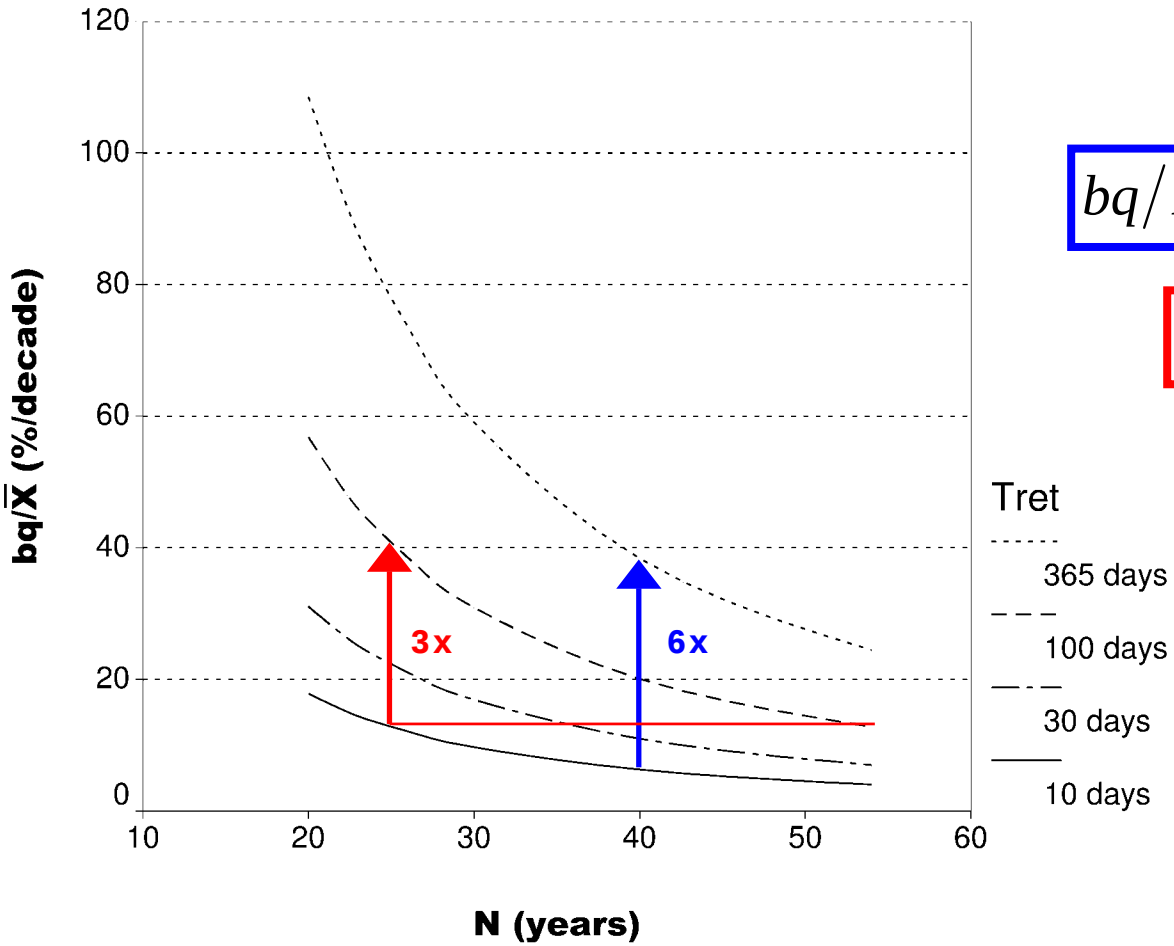
Conclusions

- 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 / $\overline{X}$** required for 80% detection probability (5% level) and series length **N** for extreme events with average return period **Tret**



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

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

Klein Tank and Können, J. Climate (in press)