



(Indices for) Climate Extremes

RA VI CLIPS workshop
Erfurt, Germany, 12-18 June 2003

Albert Klein Tank
KNMI, the Netherlands

Acknowledgement: ECA&D-participants



Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)

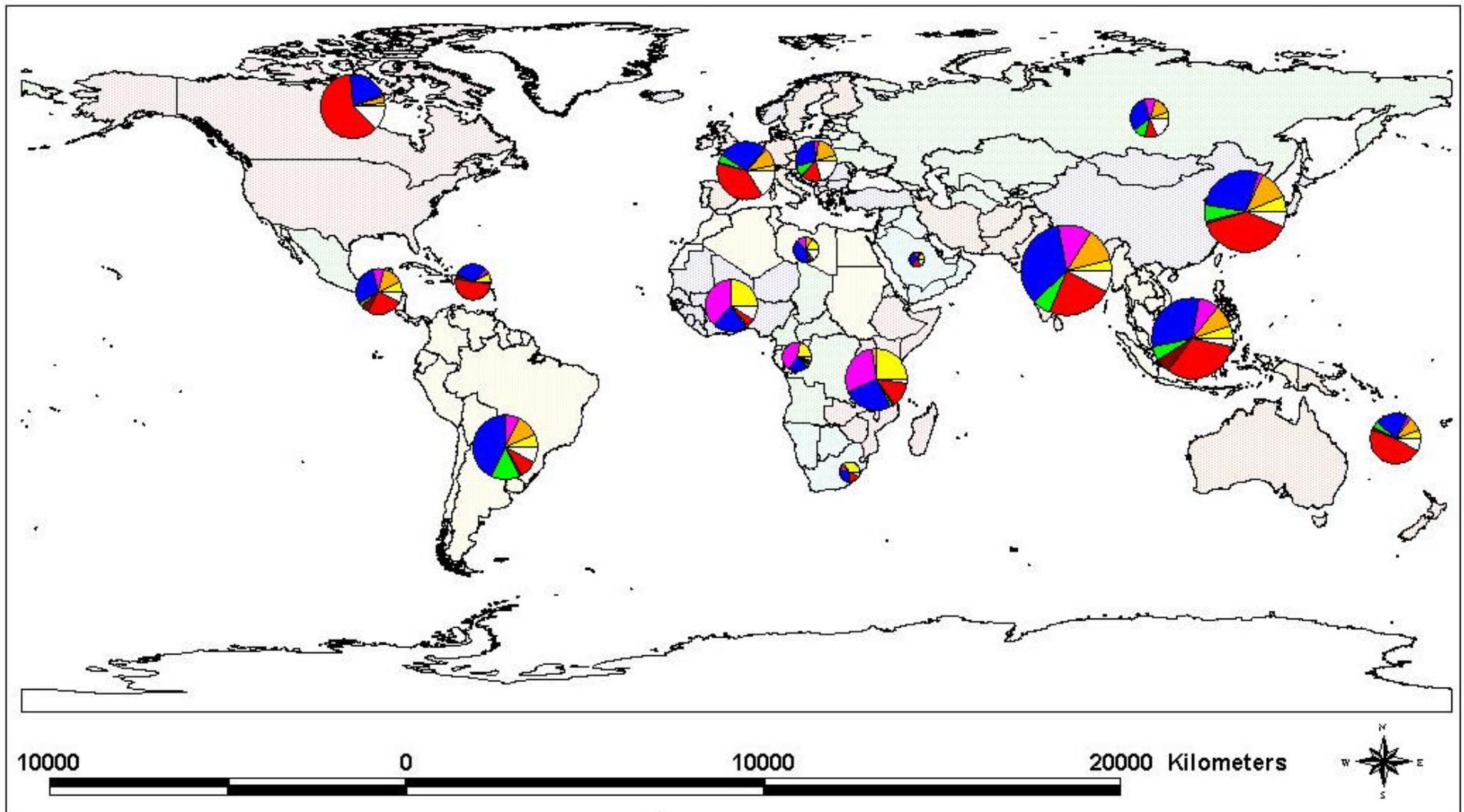
[thanks Volker(H), Patricia & Stefan]



Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)

Distribution of natural disasters, by region and type of phenomena (1975-2001)

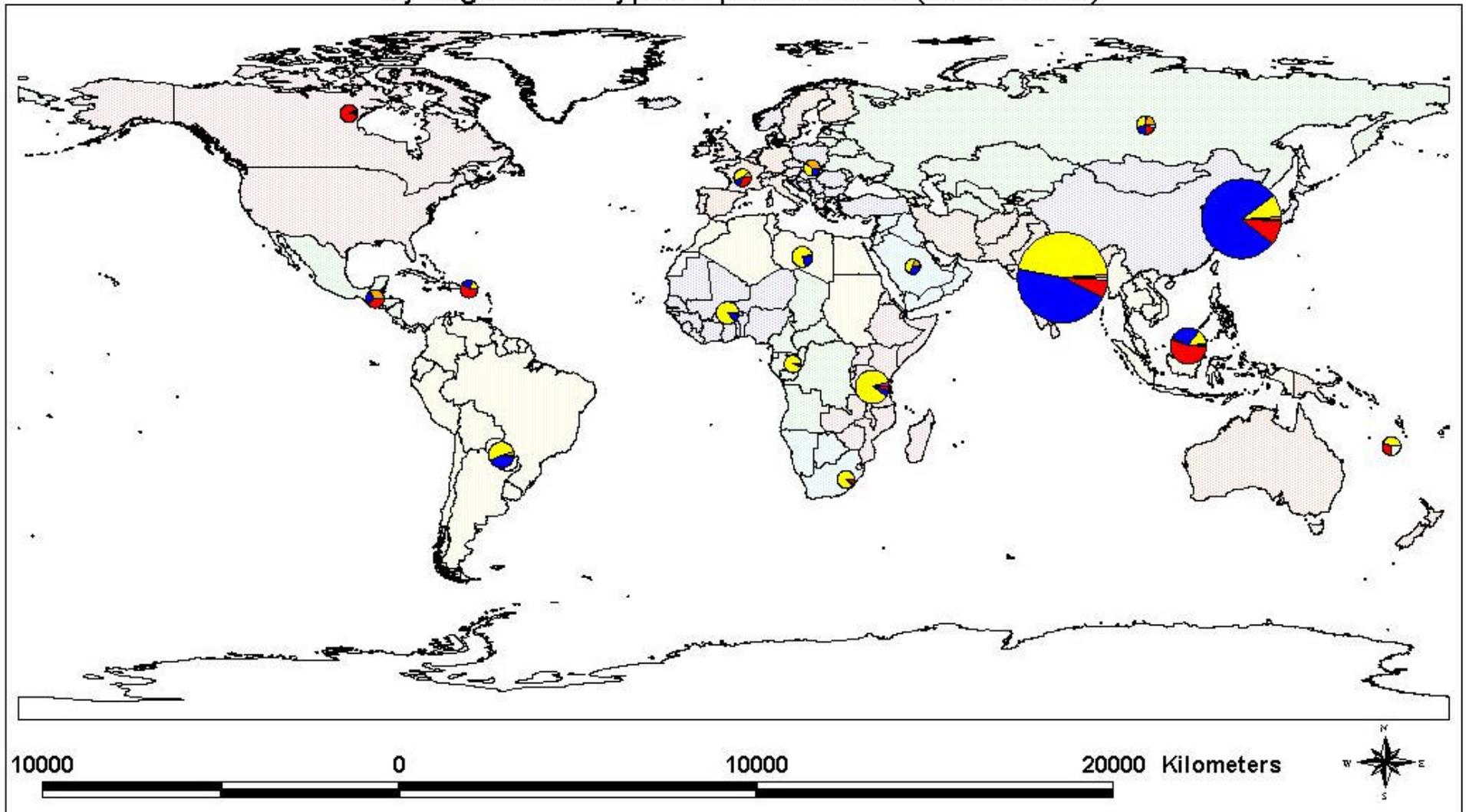


EM-DAT: The OFDA/CRED International
 Disaster Database
 (<http://www.cred.be>; email: cred@epid.ucl.ac.be)

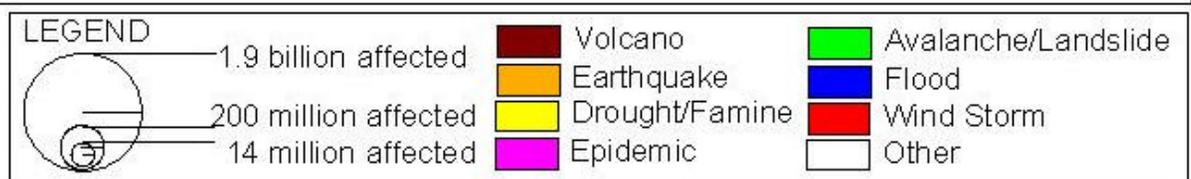
LEGEND



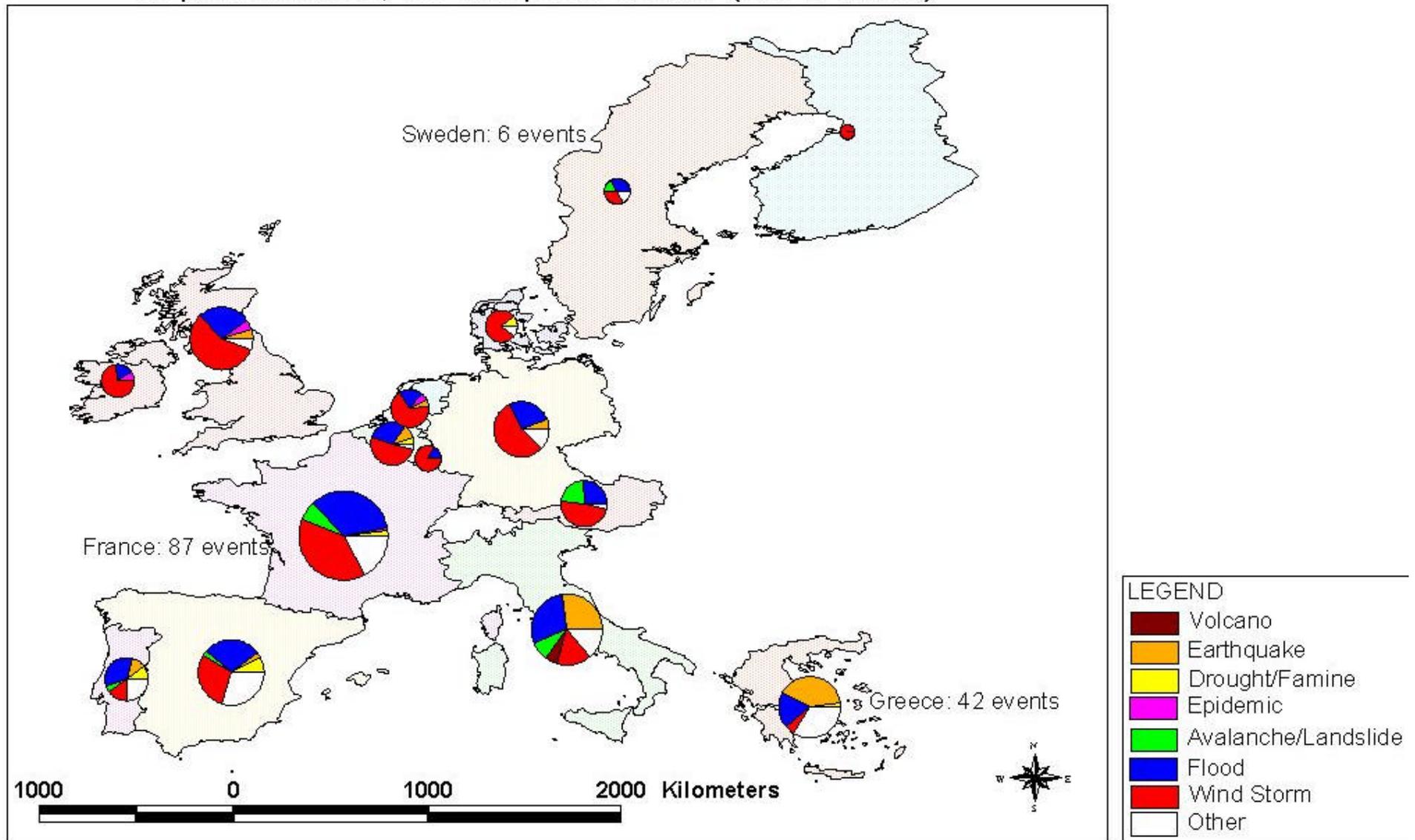
Distribution of people affected by natural disasters, by region and type of phenomena (1975-2001)



EM-DAT: The OFDA/CRED International
Disaster Database (<http://www.cred.be>;
email: cred@epid.ucl.ac.be)



Distribution of natural disasters, by country and type of phenomena, in European Union (1975-2001)



EM-DAT: The OFDA/CRED International Disaster Database

(<http://www.cred.be> ; email: cred@epid.ucl.ac.be)

Disaster response information on current natural disasters and archival material dating back to 1981, listed chronologically.

◀ Previous Next ▶

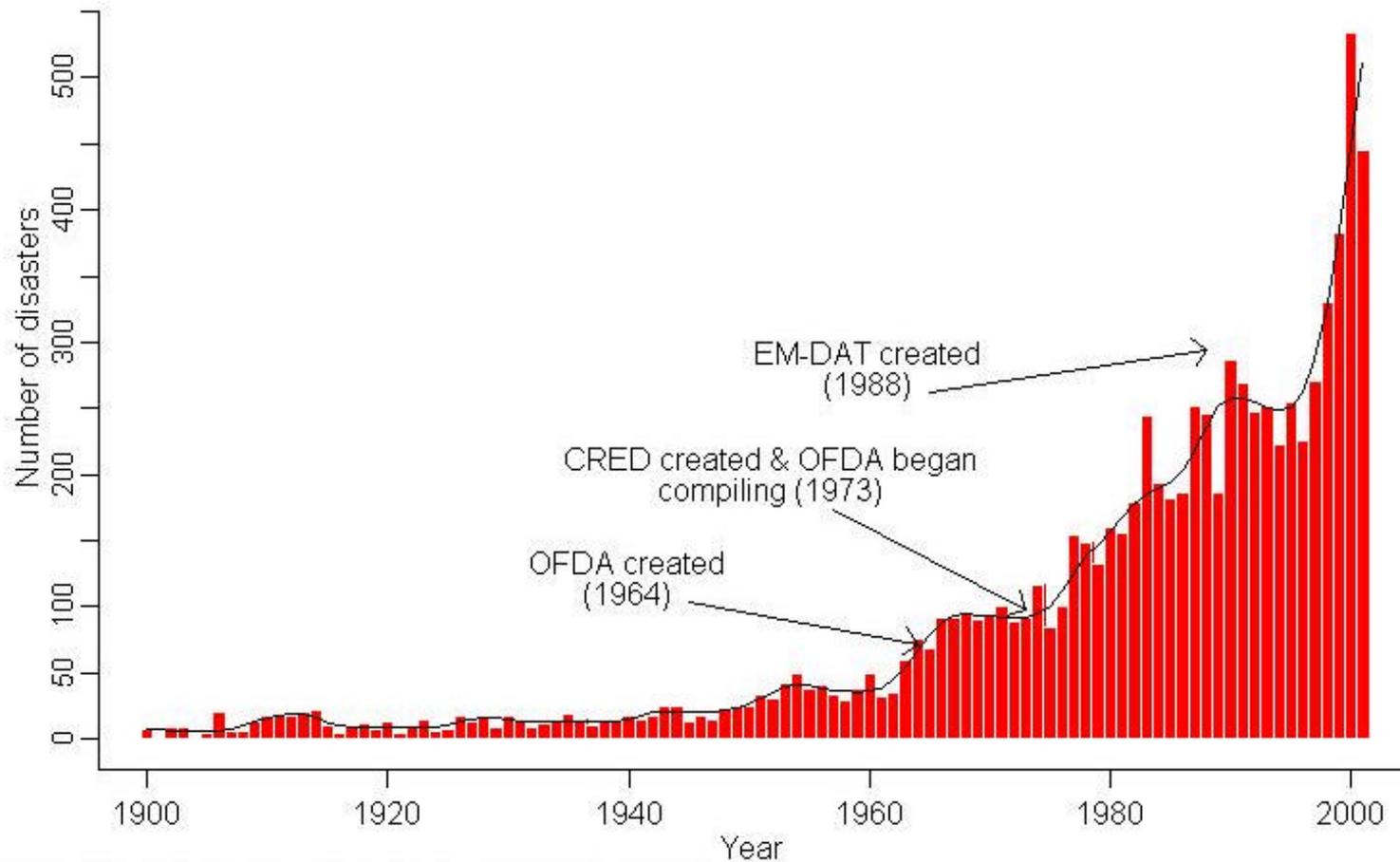
- [Vanuatu: Earthquake - Dec 2002 **NEW!**](#)
- [Costa Rica/Panama: Floods - Dec 2002](#)
- [Mongolia: Dzud - Dec 2002](#)
- [Morocco: Floods - Nov 2002](#)
- [Indonesia: Floods - Nov 2002](#)
- [Pakistan: Earthquake - 21 Nov 2002](#)
- [India: Cyclone - Nov 2002](#)
- [Ecuador: Volcanic Eruption - Nov 2002](#)
- [Pakistan: Earthquake - Nov 2002](#)
- [Mexico: Hurricane Kenna - Oct 2002](#)
- [Paraguay: Drought - Oct 2002](#)
- [Indonesia: Earthquake - Oct 2002](#)
- [Thailand: Floods - Oct 2002](#)
- [Albania: Floods - Sep 2002](#)
- [Mauritania: Drought - Sep 2002](#)
- [Caribbean: Tropical Storm Lili - Sep 2002](#)
- [Russian Federation: Avalanche - Sep 2002](#)
- [Caribbean: Tropical Storm Isidore - Sep 2002](#)
- [Guatemala: Landslide - Sep 2002](#)
- [Seychelles: Tropical Depression - Sep 2002](#)
- [Central America: High Tides and Floods - Sep 2002](#)
- [Papua New Guinea: Earthquake - Sep 2002](#)

Highlights

- ▶ [Mongolia: "Multiple Dzud" and Drought - Feb 2000](#)
- ▶ [Viet Nam: Floods - Aug 2002](#)
- ▶ [Cambodia: Drought - Aug 2002](#)
- ▶ [Central America: Drought - Jul 2001](#)
- ▶ [India: Floods - Jul 2002](#)
- ▶ [China: Floods - Jun 2002](#)
- ▶ [Afghanistan: Drought - Apr 2000](#)



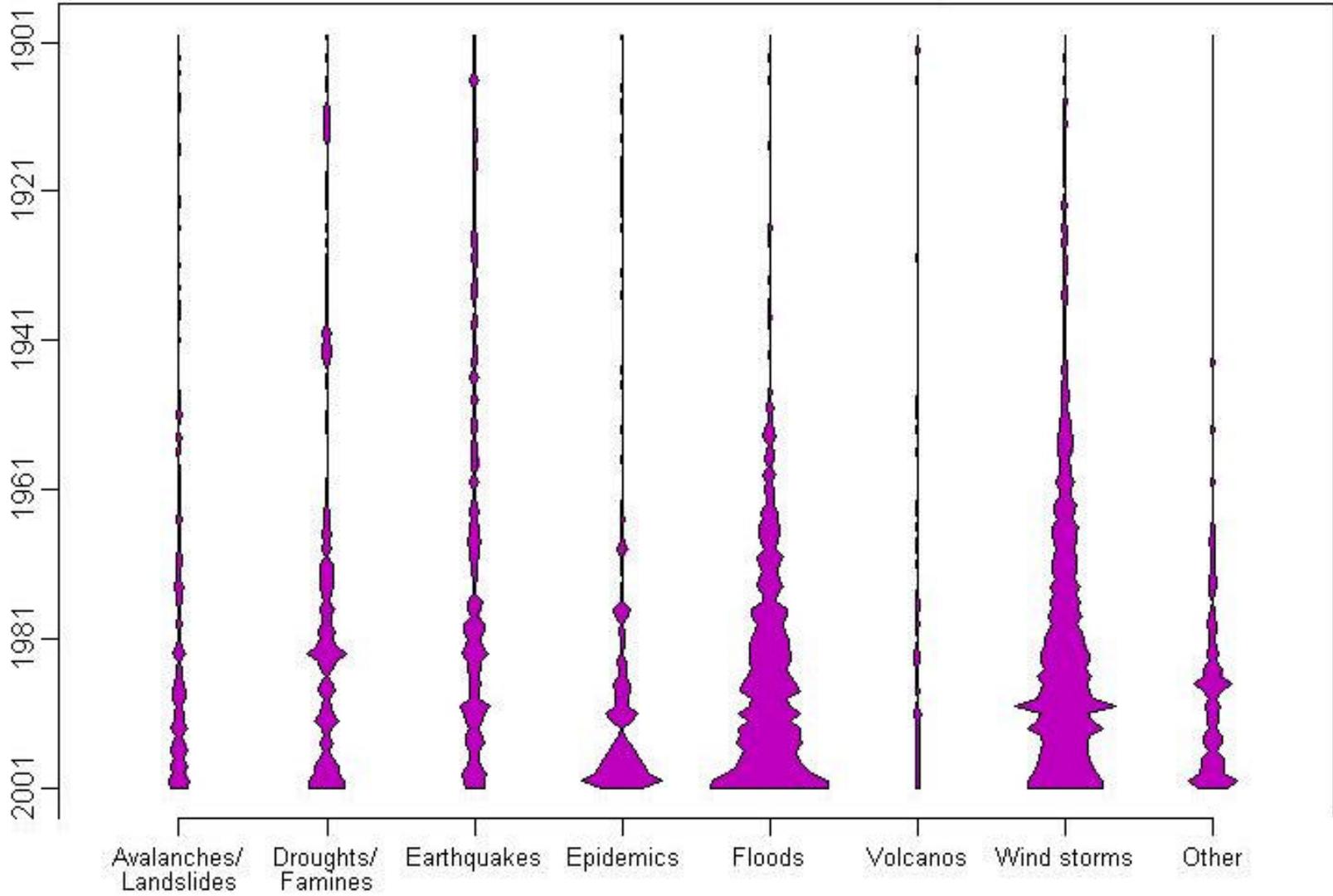
Natural disasters reported !



EM-DAT: The OFDA/CRED International Disaster Database
(<http://www.cred.be>)

www.cred.be

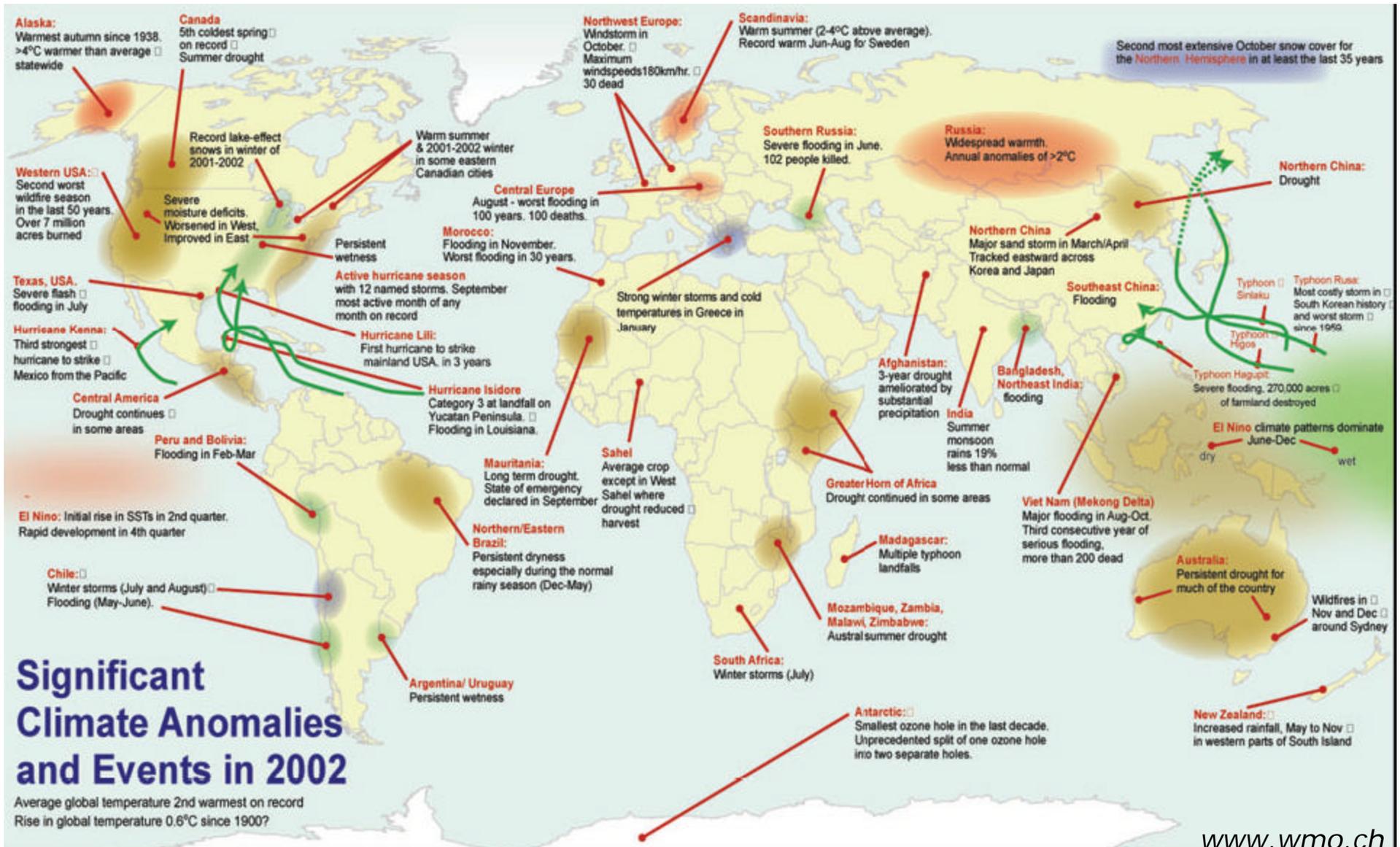
Number of natural disasters reported

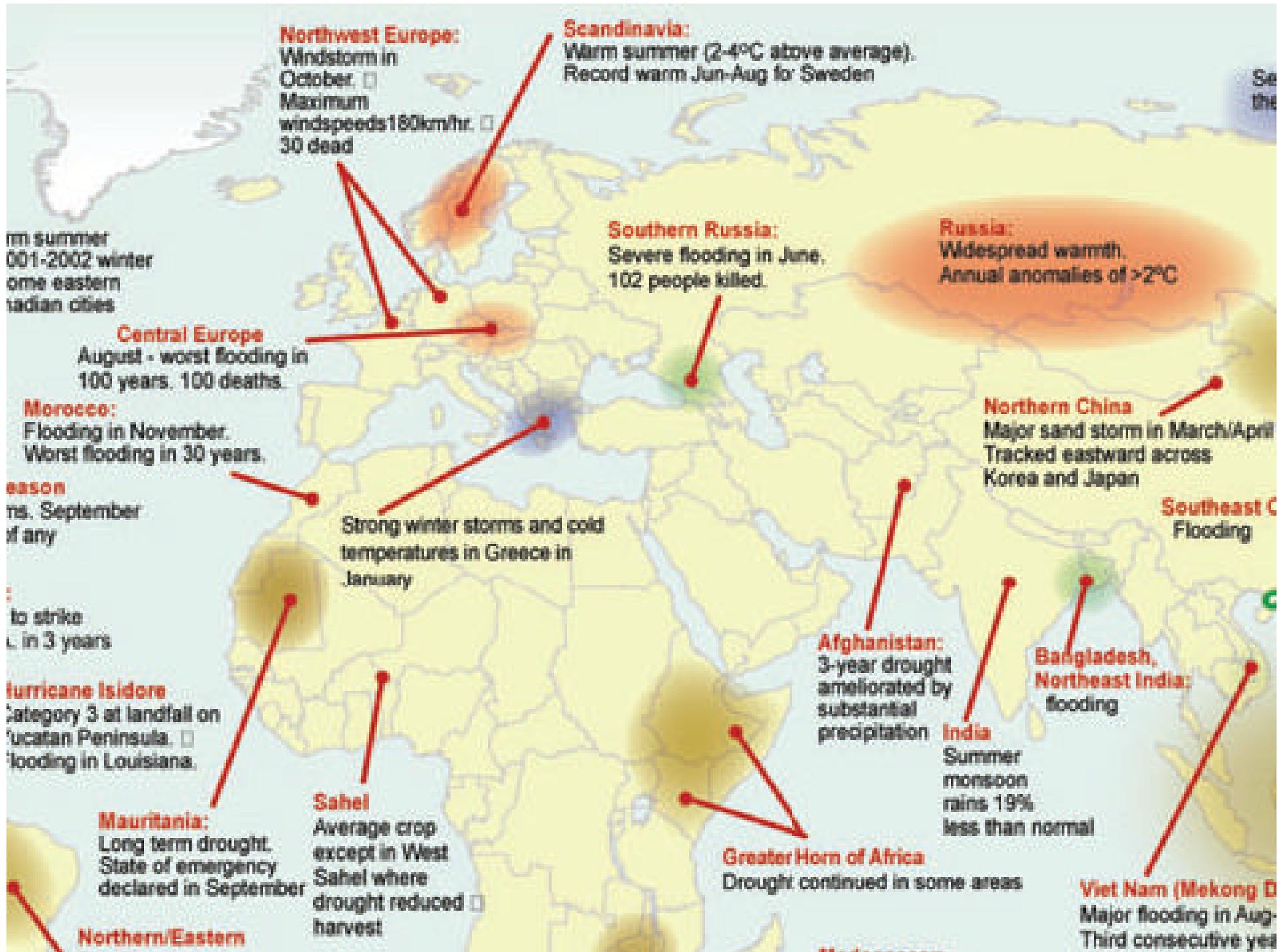


EM-DAT: The OFDA/CRED International Disaster Database
(<http://www.cred.be>)



WMO status of global climate in 2002

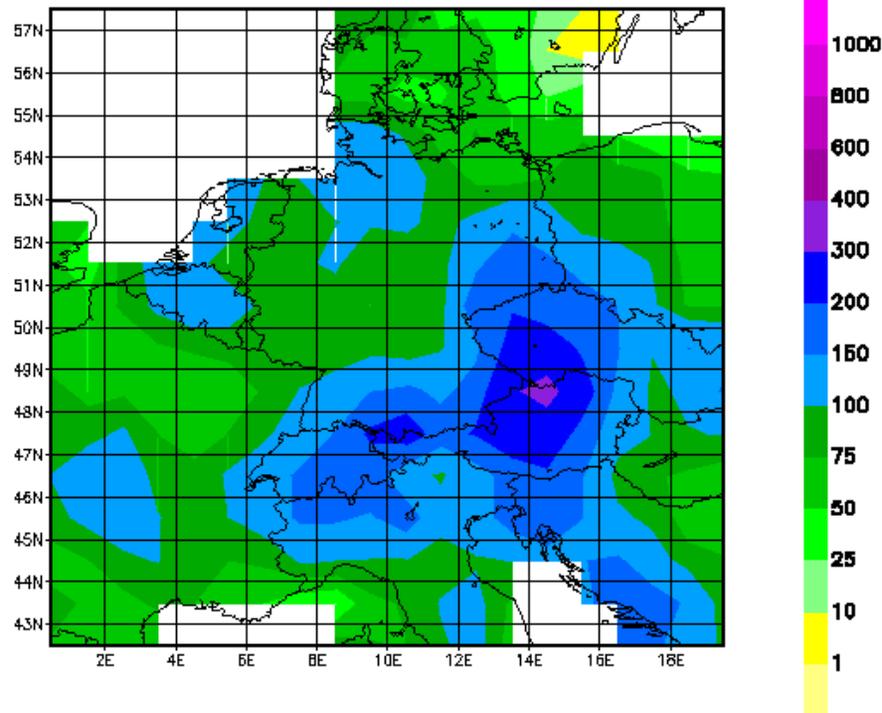




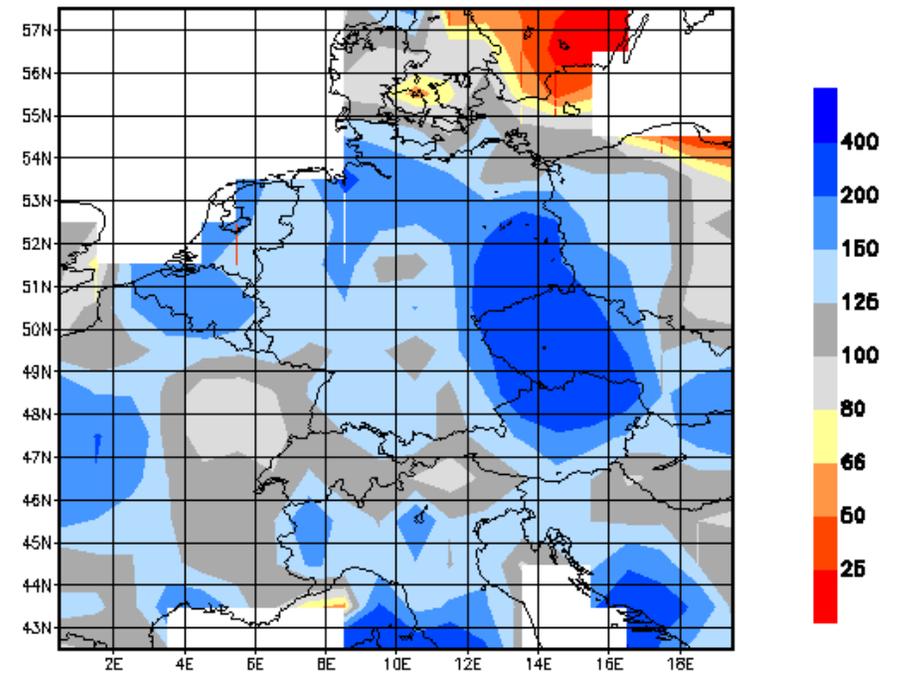




GPCC Monitoring Product Gauge-Based Analysis 1.0 degree precipitation for August 2002 in mm/month



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





Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)



Recall from yesterday: ECA&D

- ✍ Initiated by ECSN/EUMETNET
- ✍ Co-ordinated by KNMI
- ✍ (Voluntary) participation of RA VI countries
- ✍ Report and papers issued in 2002
- ✍ New start in January 2003; next report in 2006
- ✍ Now is the time to join!

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	

Home		
<p>Welcome to the web-site of the European Climate Assessment & Dataset project: ECA&D.</p>		<p>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.</p>
	<p>ECA&D is initiated by the European Climate Support Network ECSN.</p>	
<p>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.</p>		<p>The new assessment report will update the 2002 publication: "Climate of Europe; assessment of observed daily temperature and precipitation extremes". download 2002 ECA-report</p>
	<p>ECA&D is supported by the Network of European Meteorological Services EUMETNET.</p>	
<p>The information and data at this site can be used freely provided that the sources are acknowledged.</p>		<p>START >> select a link from the menu above.</p>

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

Climate of Europe

Assessment of observed daily temperature and precipitation extremes

If you want your free copy,
just send an e-mail to:
kleintan@knmi.nl

European Climate Assessment (ECA), 2002

Initiated by the European Climate Support
Network of EUMETNET



Concept of ECA&D

- ✍ Copies of daily data series collated at KNMI
- ✍ Core set of indices for extremes calculated using fixed definitions (CCL/CLIVAR ETCCMD)
- ✍ Results presented at website and discussed with participants
- ✍ Results are European input to worldwide analyses (e.g. in preparation for IPCC 4AR)
- ✍ Results are also used by e.g. EEA



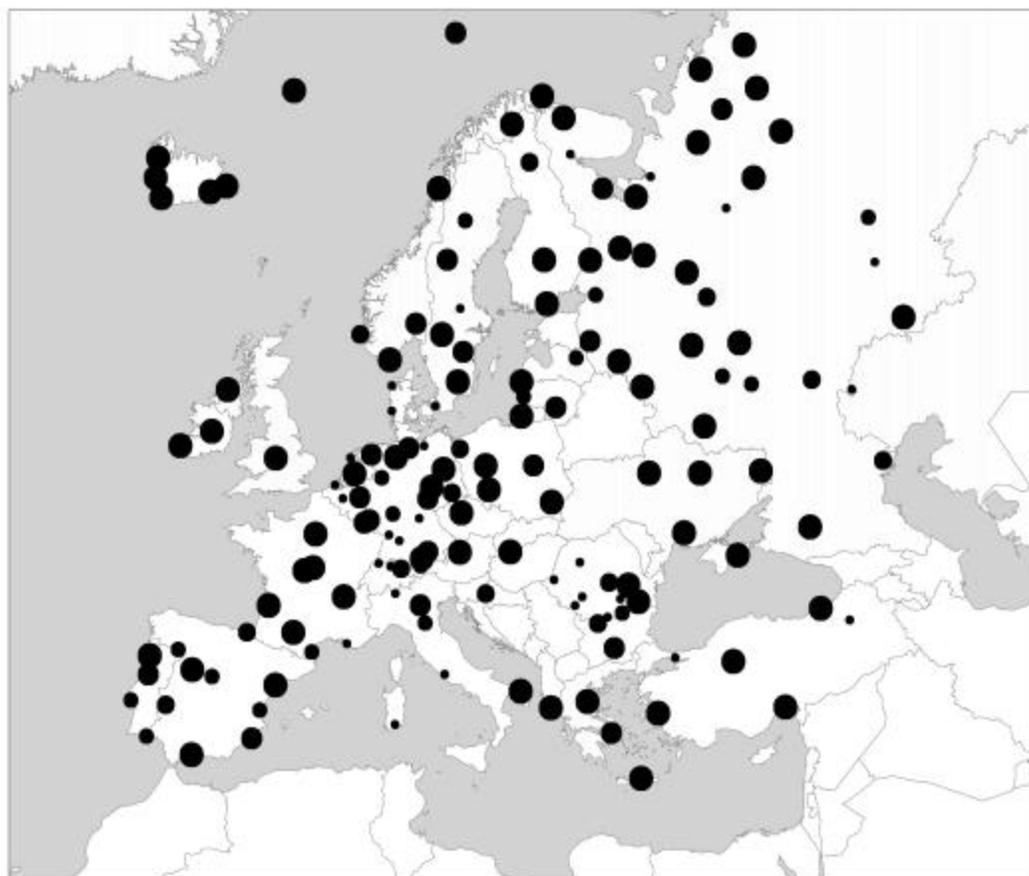
Data QC & Homogeneity

- ✍ Participants perform QC on daily data submitted
- ✍ 4 common statistical tests applied on derived monthly and annual series
- ✍ Only confident station series kept for further analyses
- ✍ Use of MASH for homogenisation of monthly series explored in co-operation with HMS (Szentimrey)
- ✍ How to homogenize daily series is still an open question



Temperature

vDTR 1946-1999



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

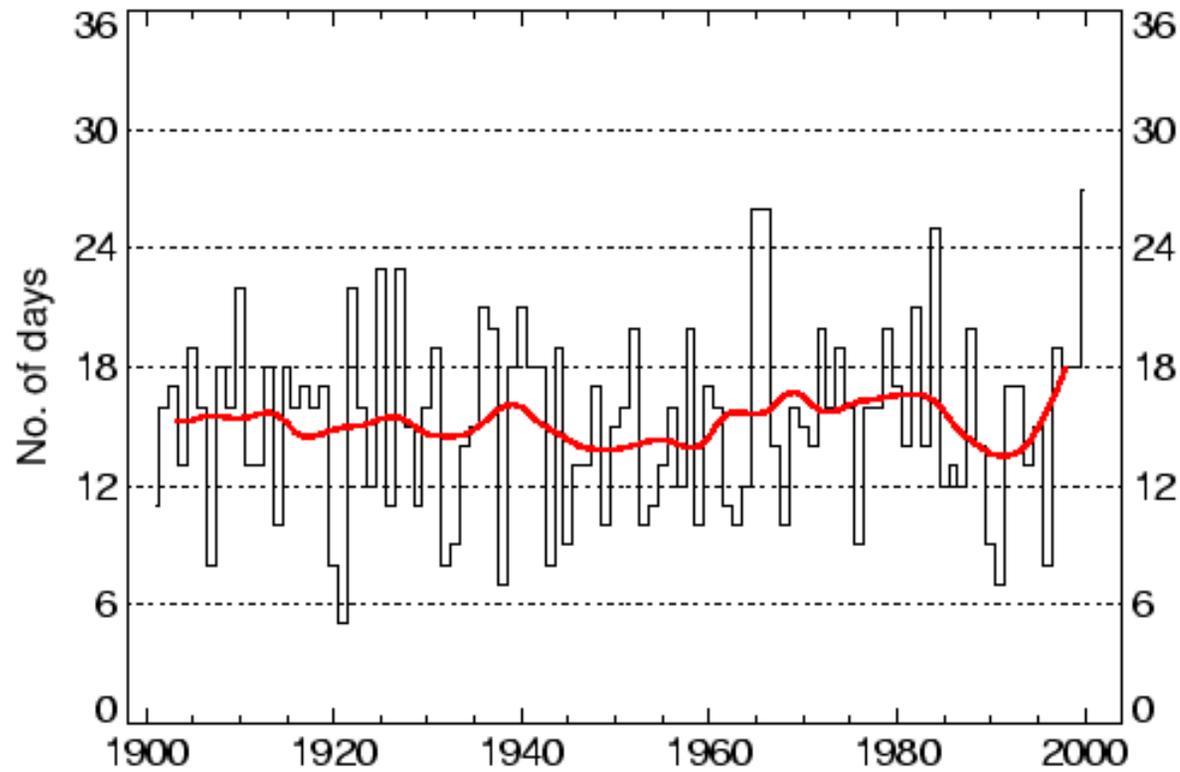


Day-count indices of extremes



Heavy precipitation days (precipitation ≥ 10 mm)

00125 Paris-14E Parc Montsouris, France (annual)



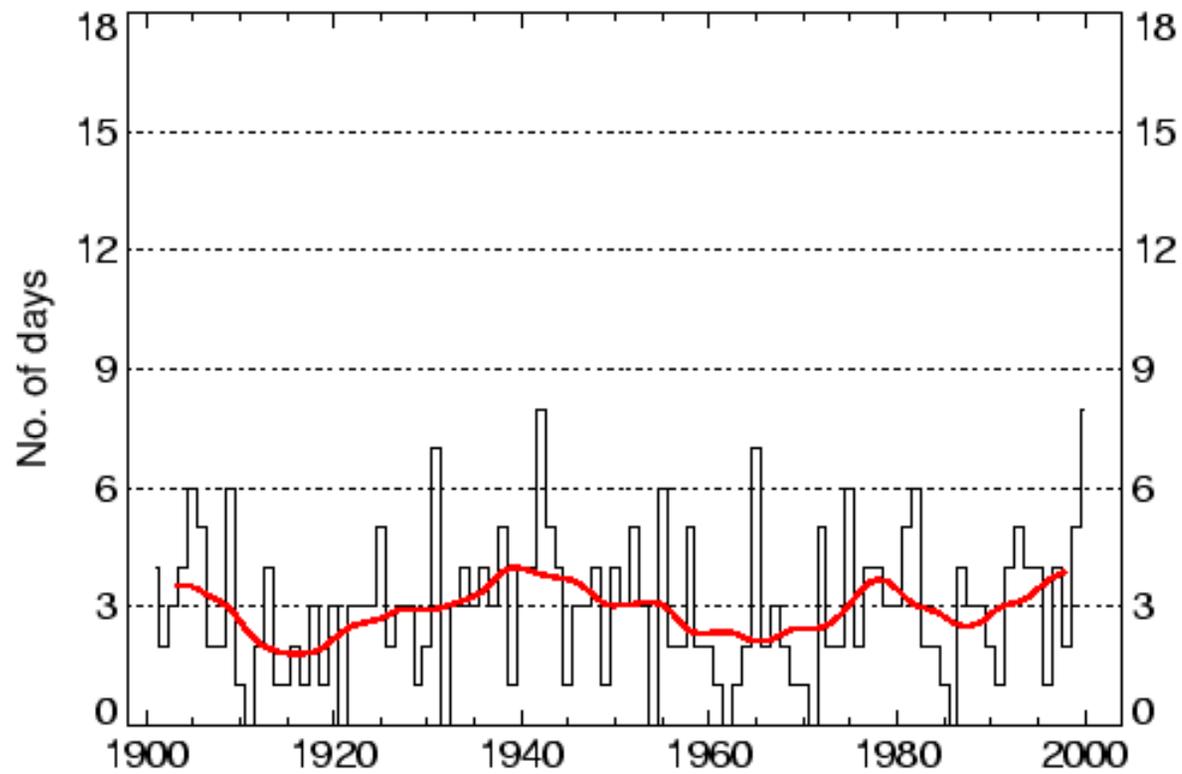
European Climate Assessment & Dataset < Warning: preliminary result 27-10-2002 >



Day-count indices of extremes

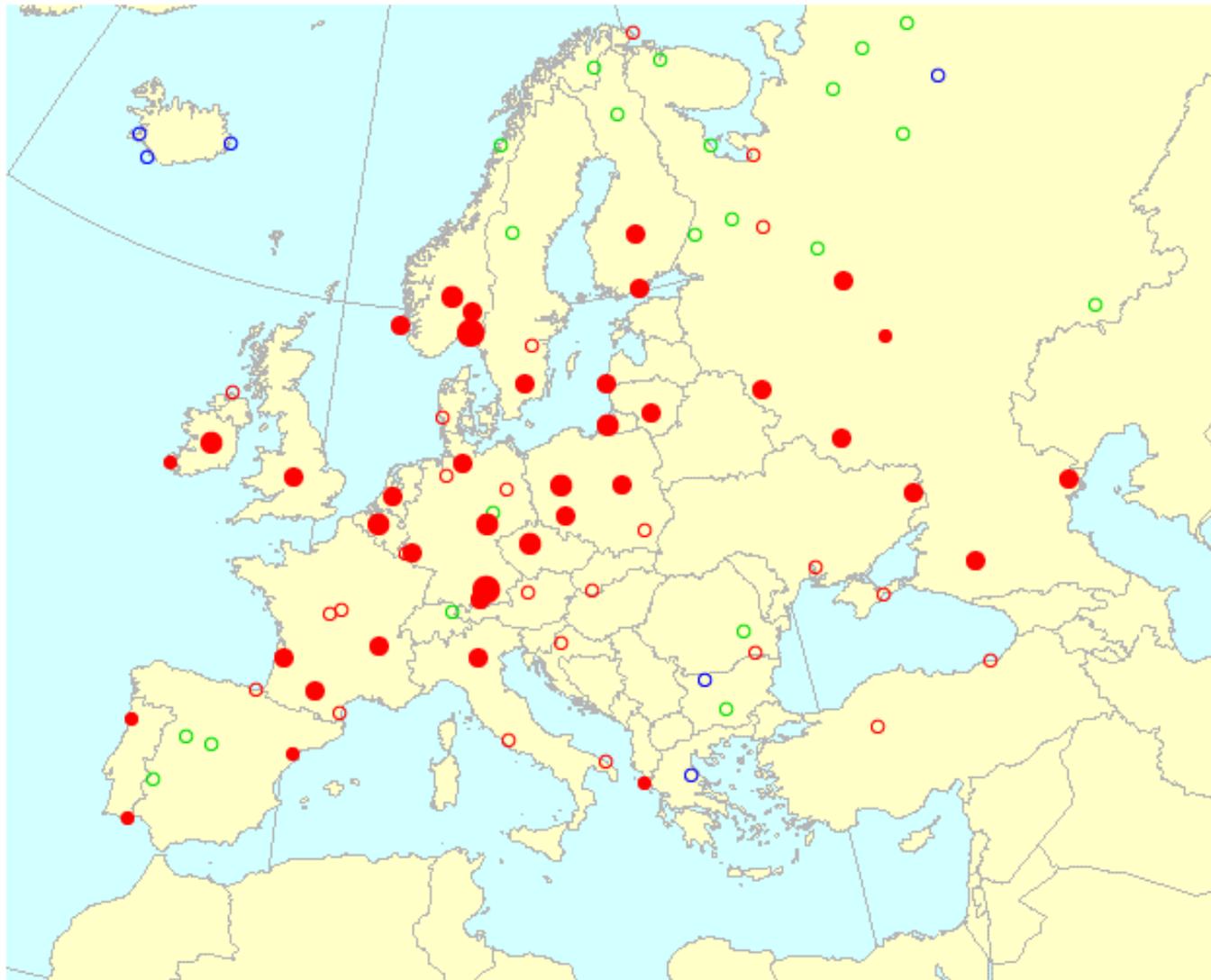
Very heavy precipitation days (precipitation ≥ 20 mm)

00125 Paris-14E Parc Montsouris, France (annual)



European Climate Assessment & Dataset < Warning: preliminary result 28-10-2002 >

FD: Frost days (TN < 0oC), ANNUAL 1946-1999



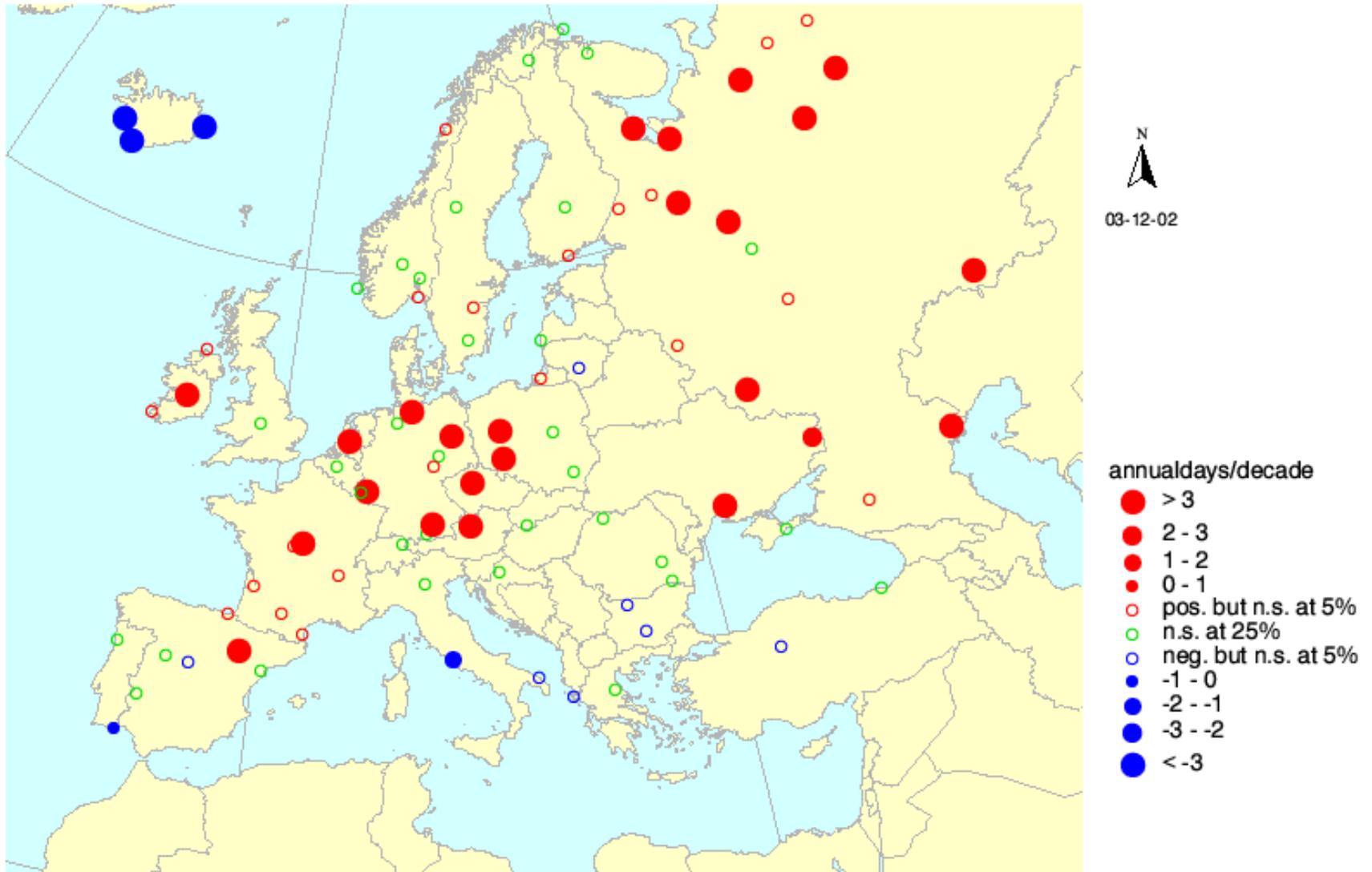
N
03-12-02

- annualdays/decade
- -6
 - $-6 - -4$
 - $-4 - -2$
 - $-2 - 0$
 - neg. but n.s. at 5%
 - n.s. at 25%
 - pos. but n.s. at 5%
 - $0 - 2$
 - $2 - 4$
 - $4 - 6$
 - > 6

European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

GSL: Growing season length, ANNUAL 1946-1999



European Climate Assessment & Dataset

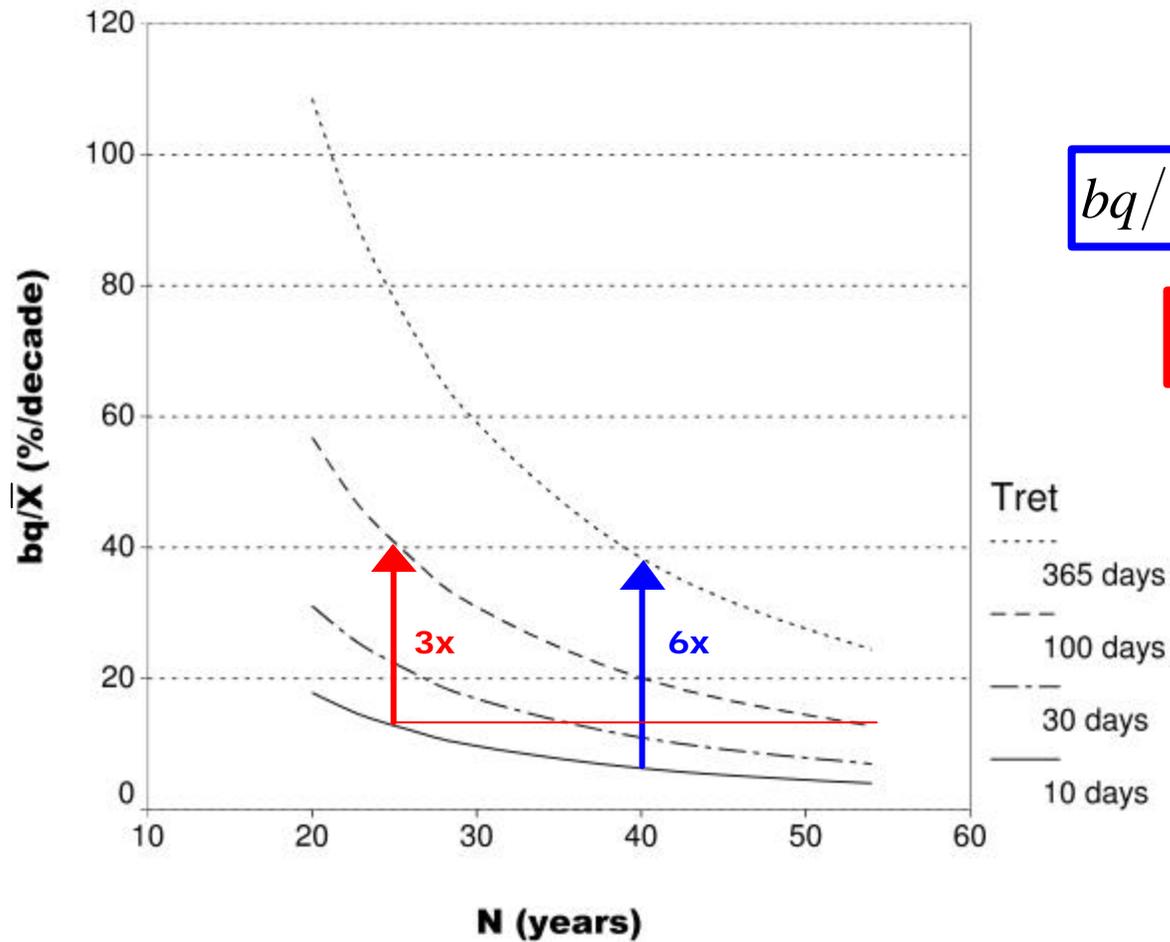
< Warning: trends for selected subset of stations! >



Day-count indices of extremes



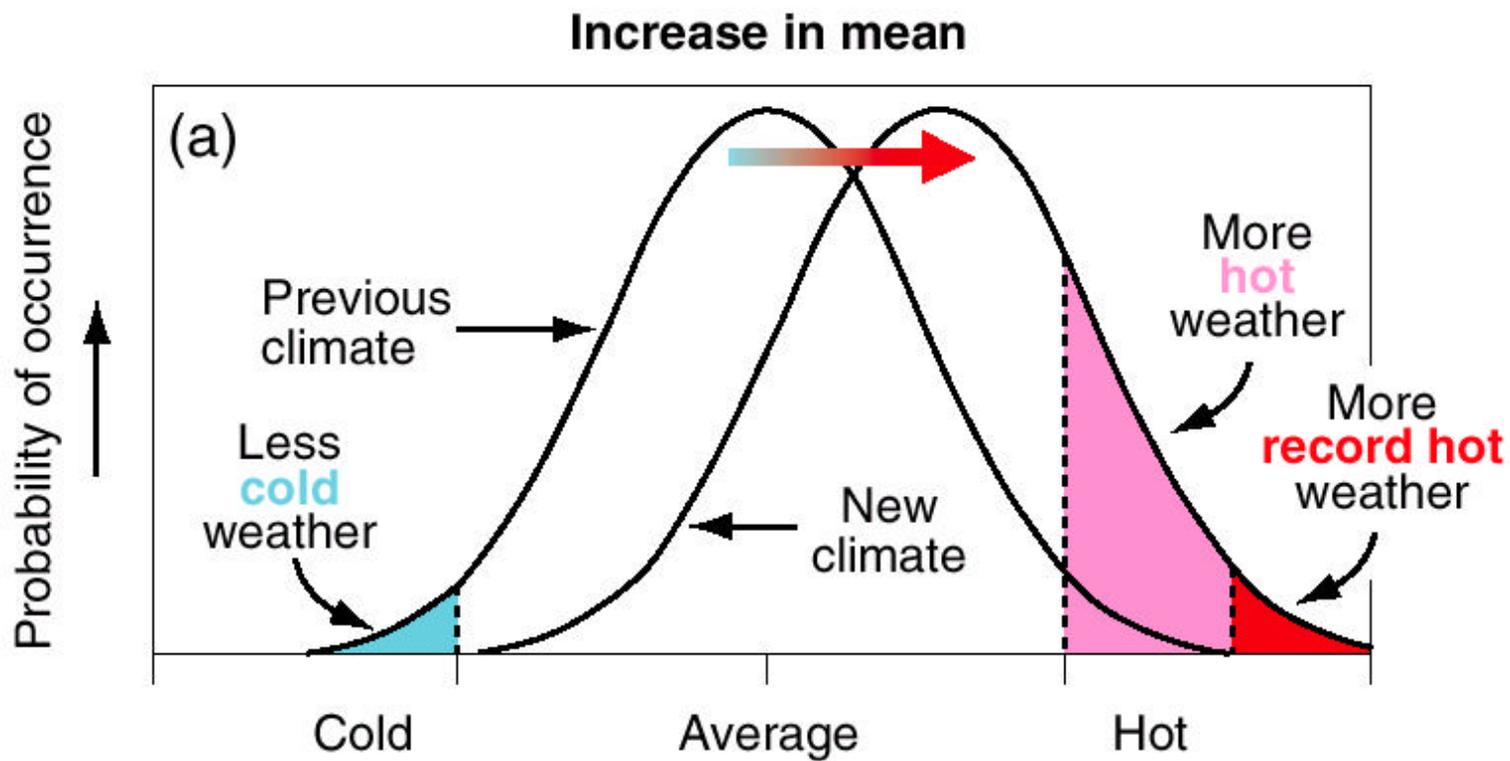
Relation between relative trend bq/\bar{X} required for 80% detection probability (5% level) and series length N for extreme events with average return period T_{ret}



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

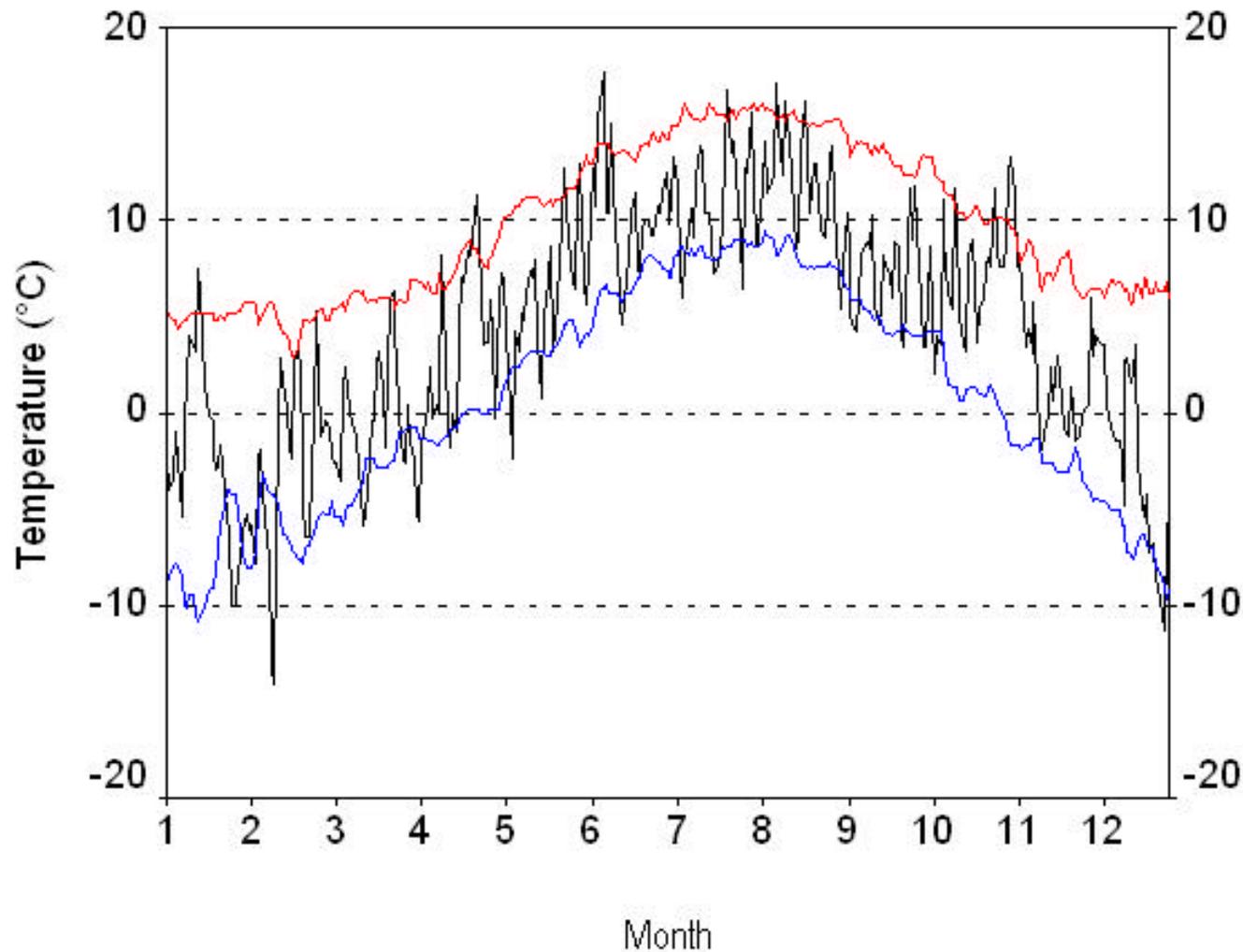
$$bq/\bar{X} \sim N^{3/2}$$







Minimum temperature at De Bilt



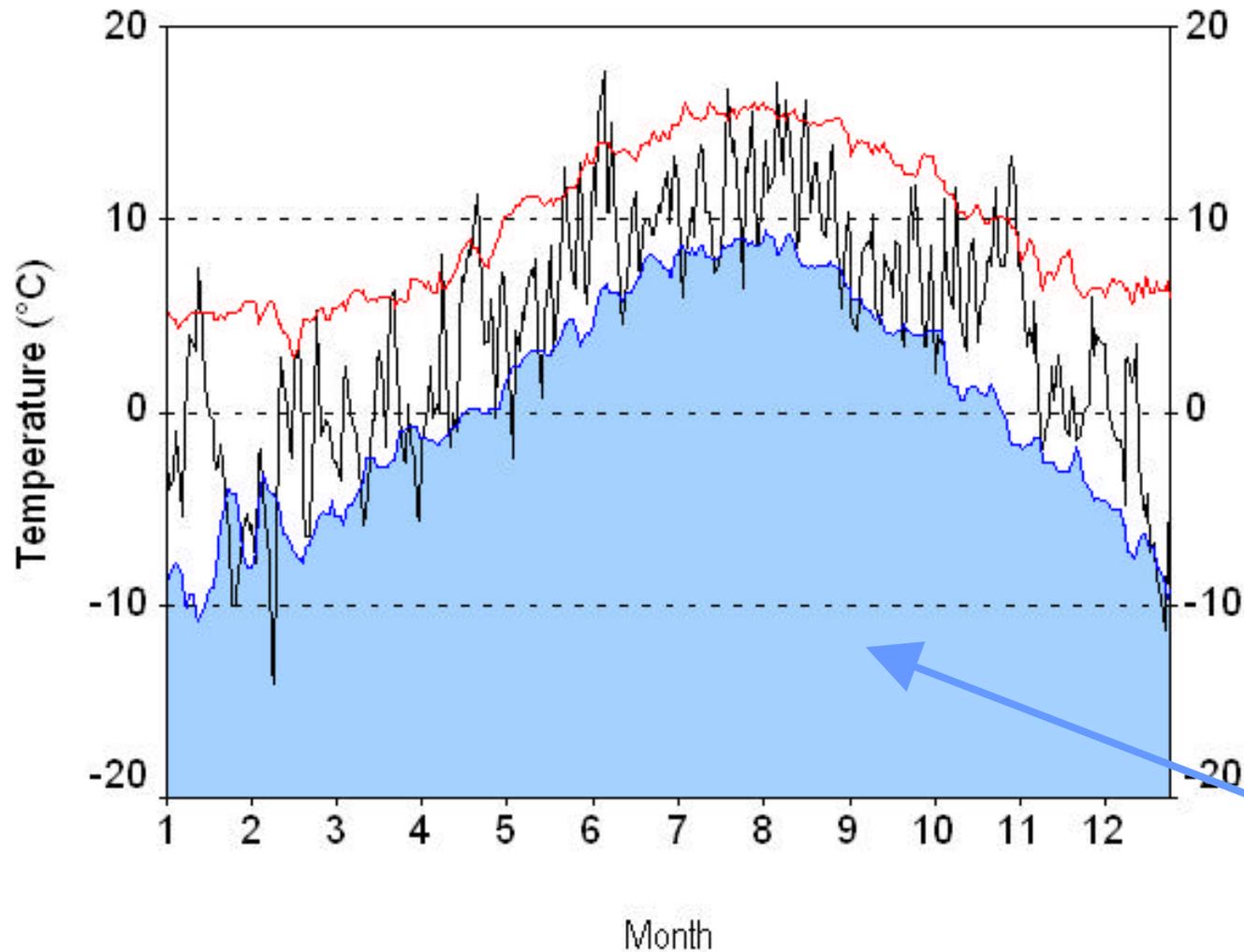
upper 10-ptile
1961-1990

the year 1996

lower 10-ptile
1961-1990



Minimum temperature at De Bilt



upper 10-ptile
1961-1990

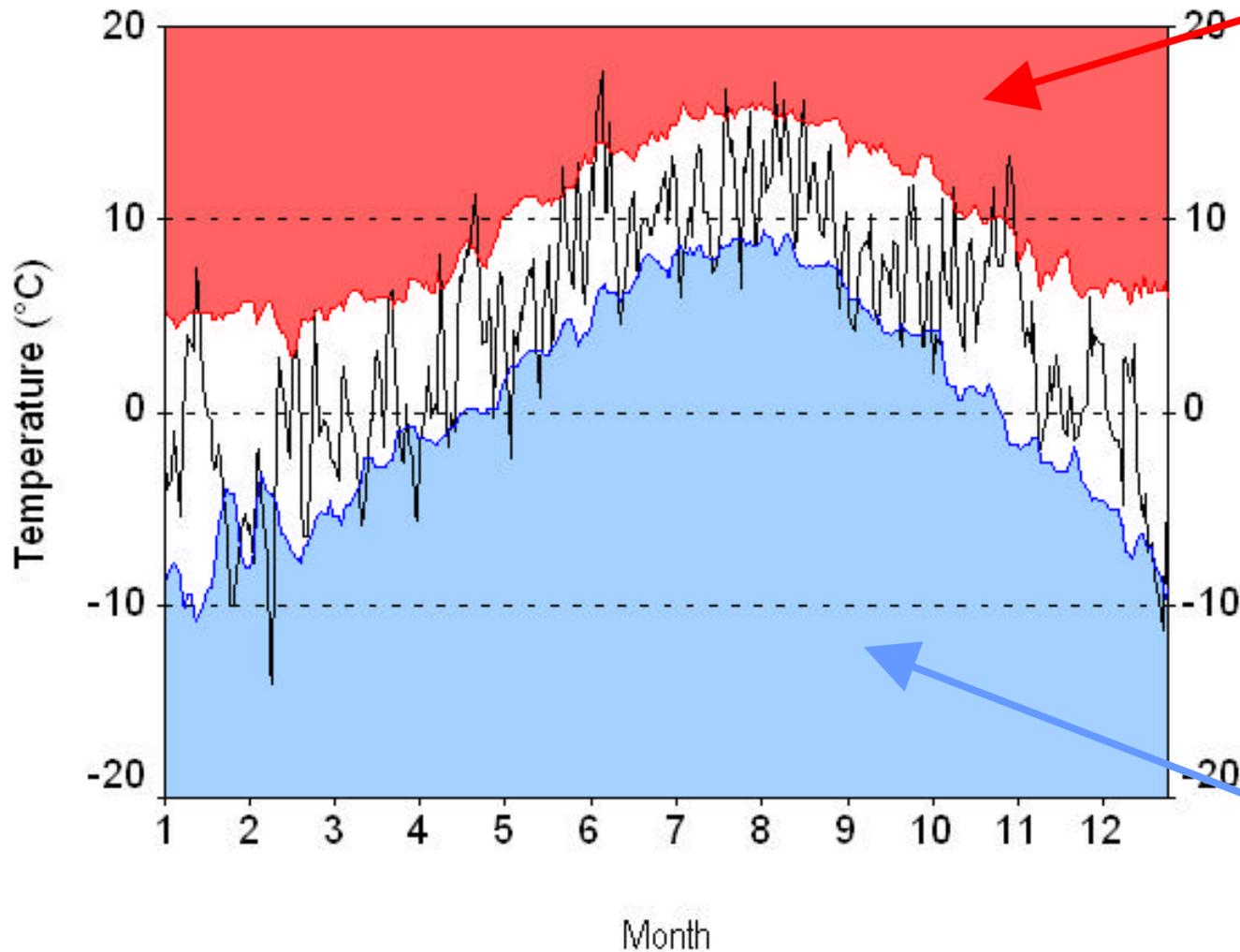
the year 1996

lower 10-ptile
1961-1990

"cold
nights"



Minimum temperature at De Bilt



“warm nights”

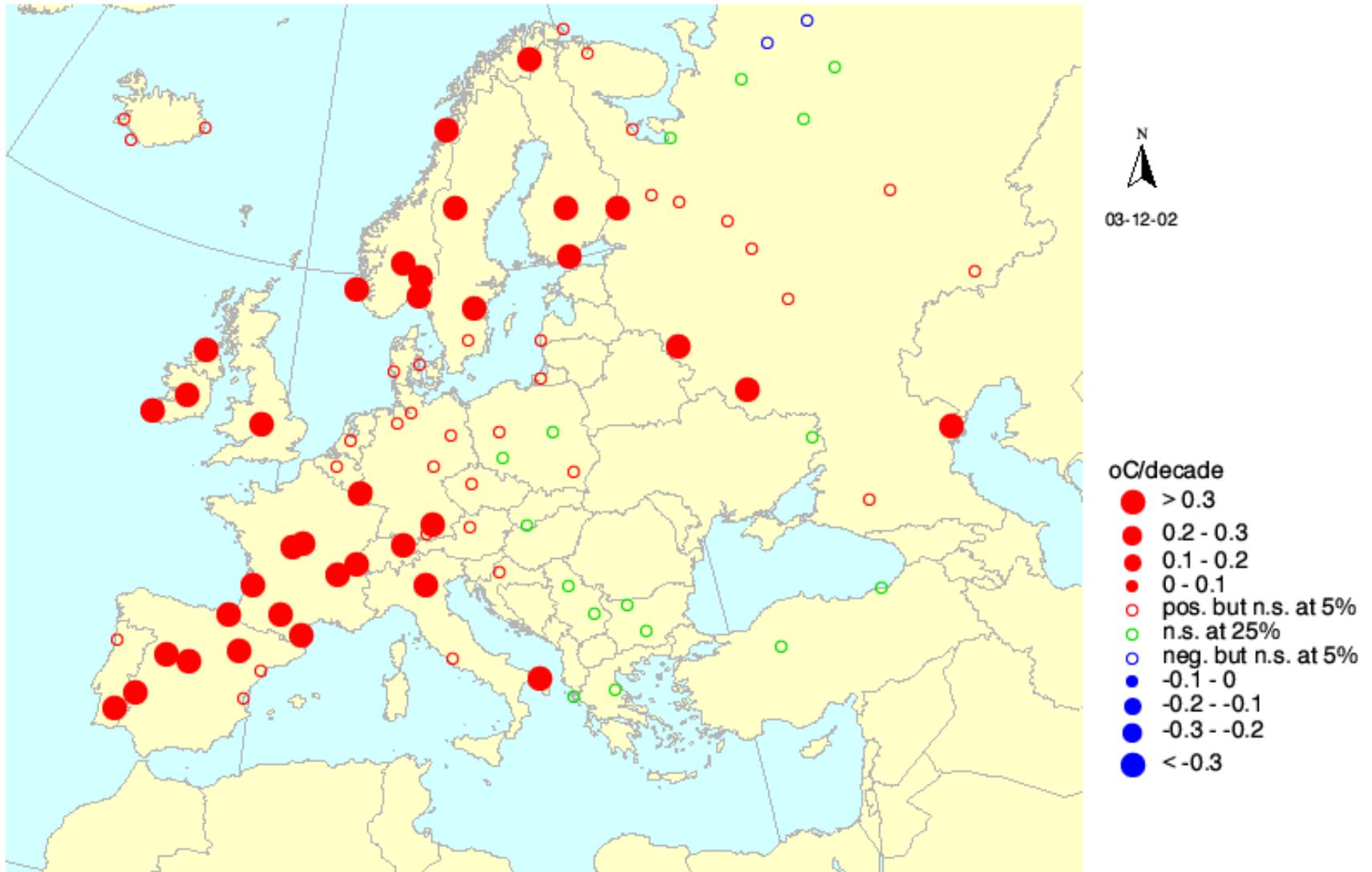
upper 10-ptile
1961-1990

the year 1996

lower 10-ptile
1961-1990

“cold nights”

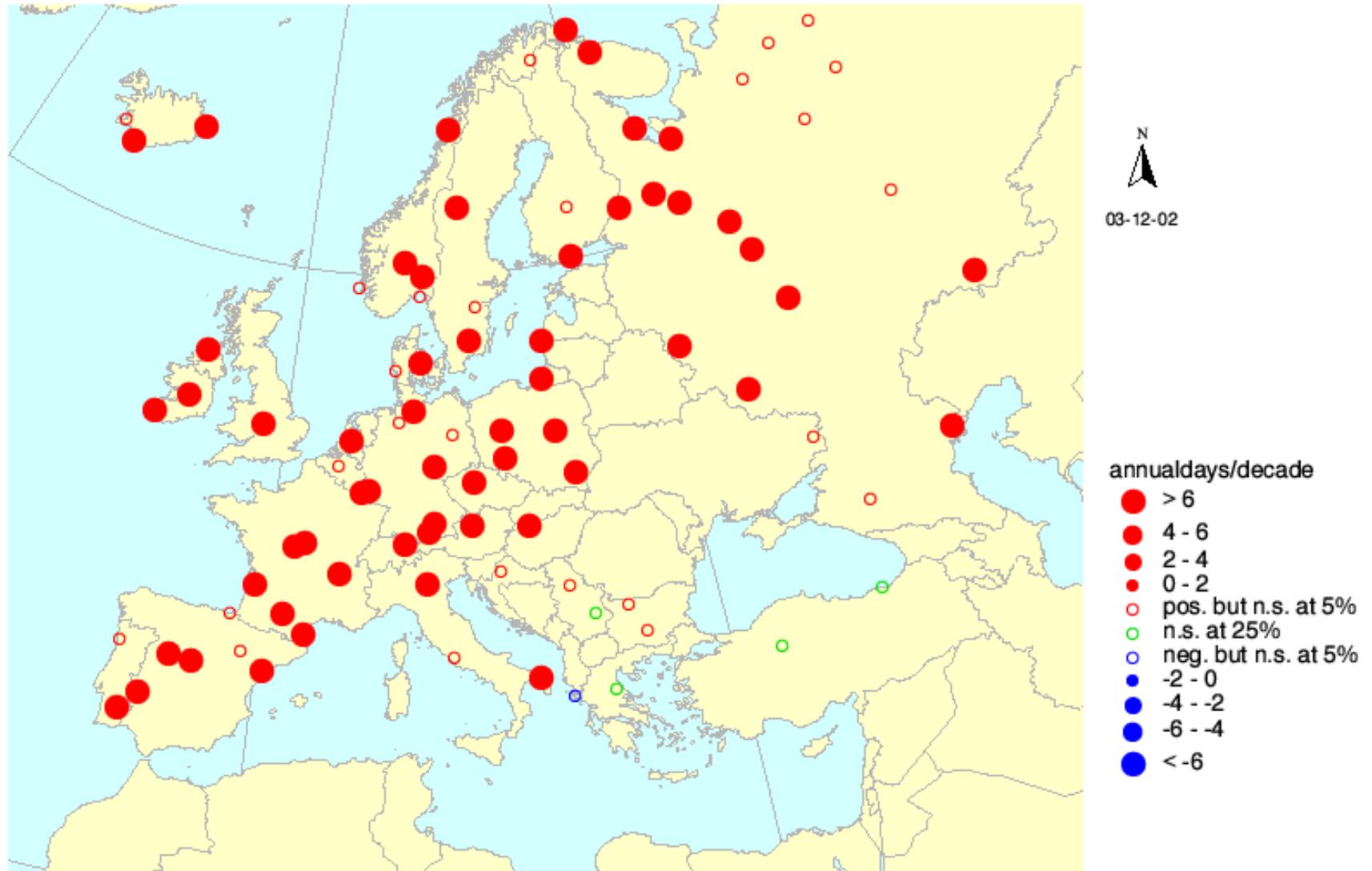
TG: Mean of daily mean temperature, WINTER-HALF 1976-1999



European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

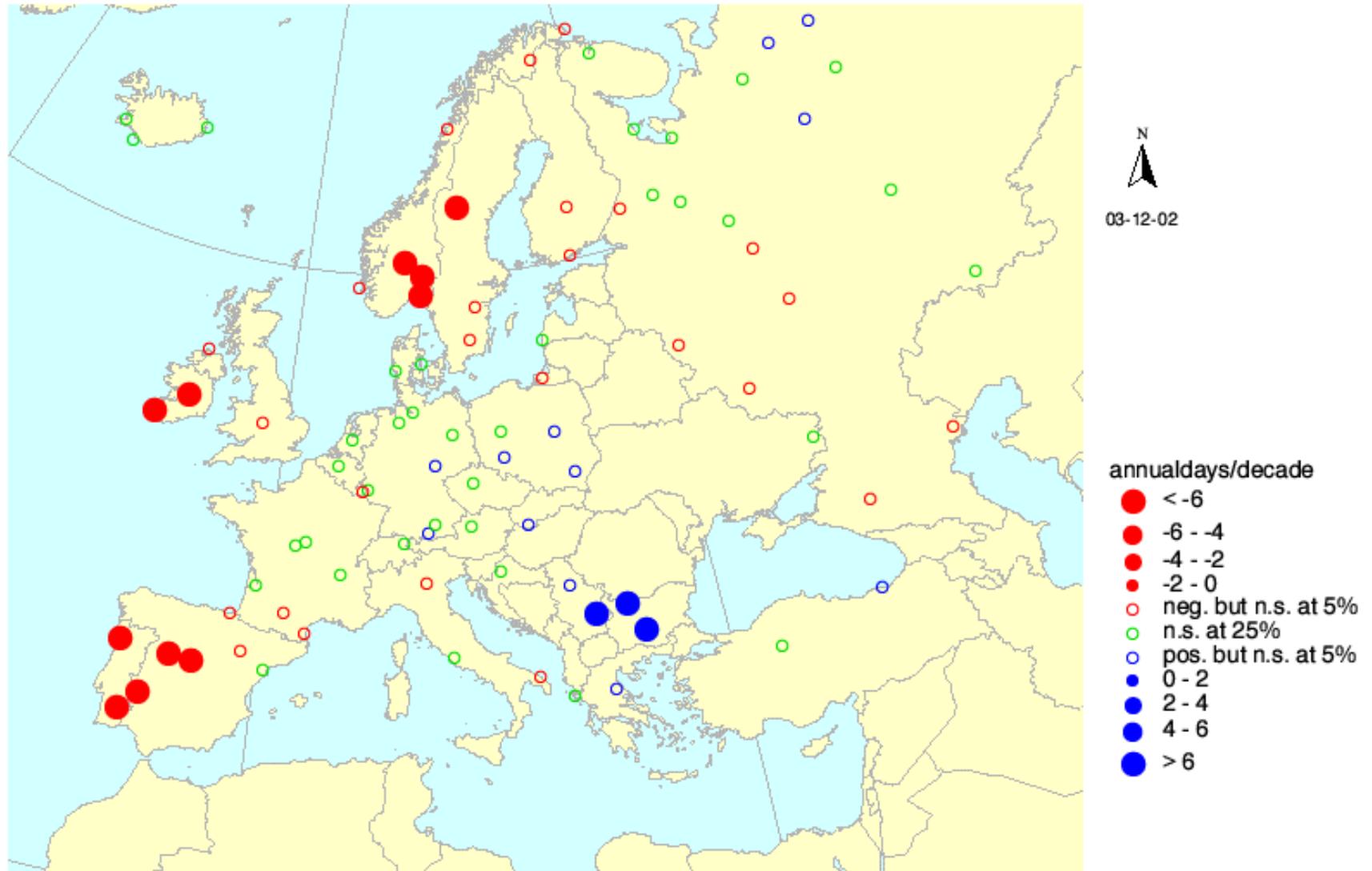
TG90p: Days with TG > 90th perc. of daily mean temp. (warm days), WINTER-HALF 1976-1999



European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >

TG10p: Days with TG < 10th perc. of daily mean temp. (cold days), WINTER-HALF 1976-1999



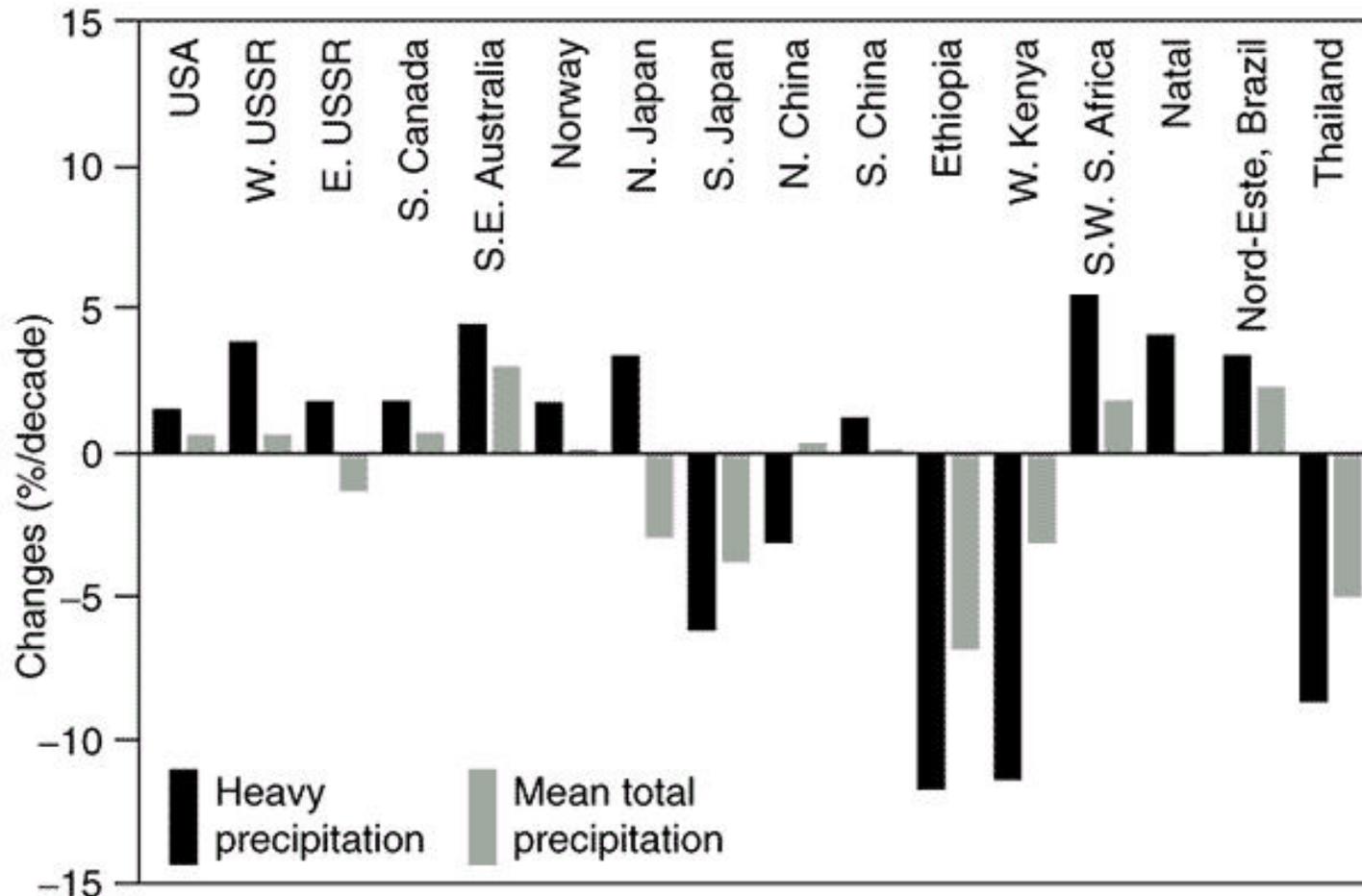
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >





“Amplified” response of very wet days



Linear trends in rainy season, last ~50 years



Precipitation fraction due to very wet days "R95%tot"

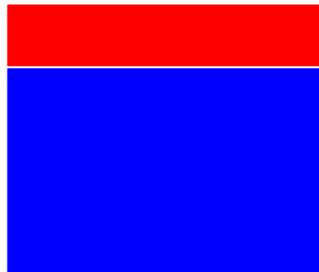
1) Identify very wet days using a site specific threshold = 95th percentile at wet days in the 1961-90 period



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



3) Trend analysis in series of fractions

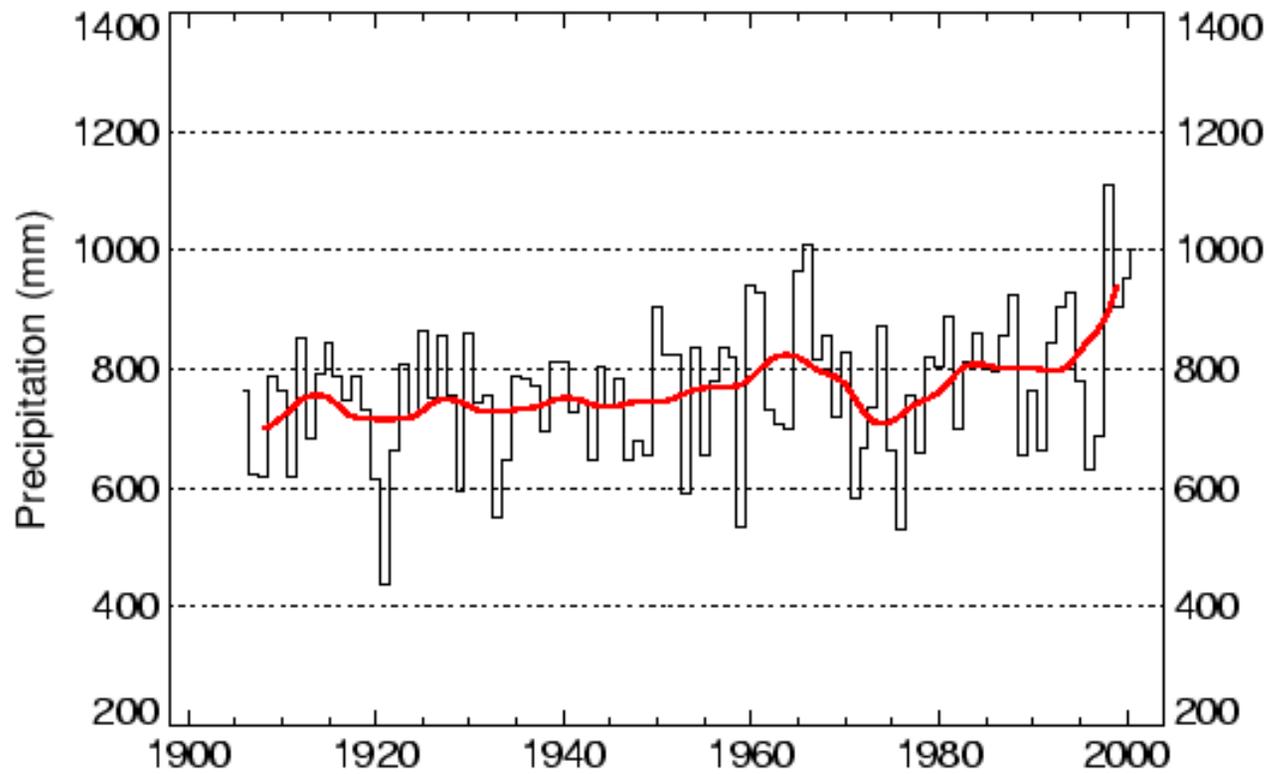






Precipitation sum

00511 NL 13 station average, Netherlands (annual)

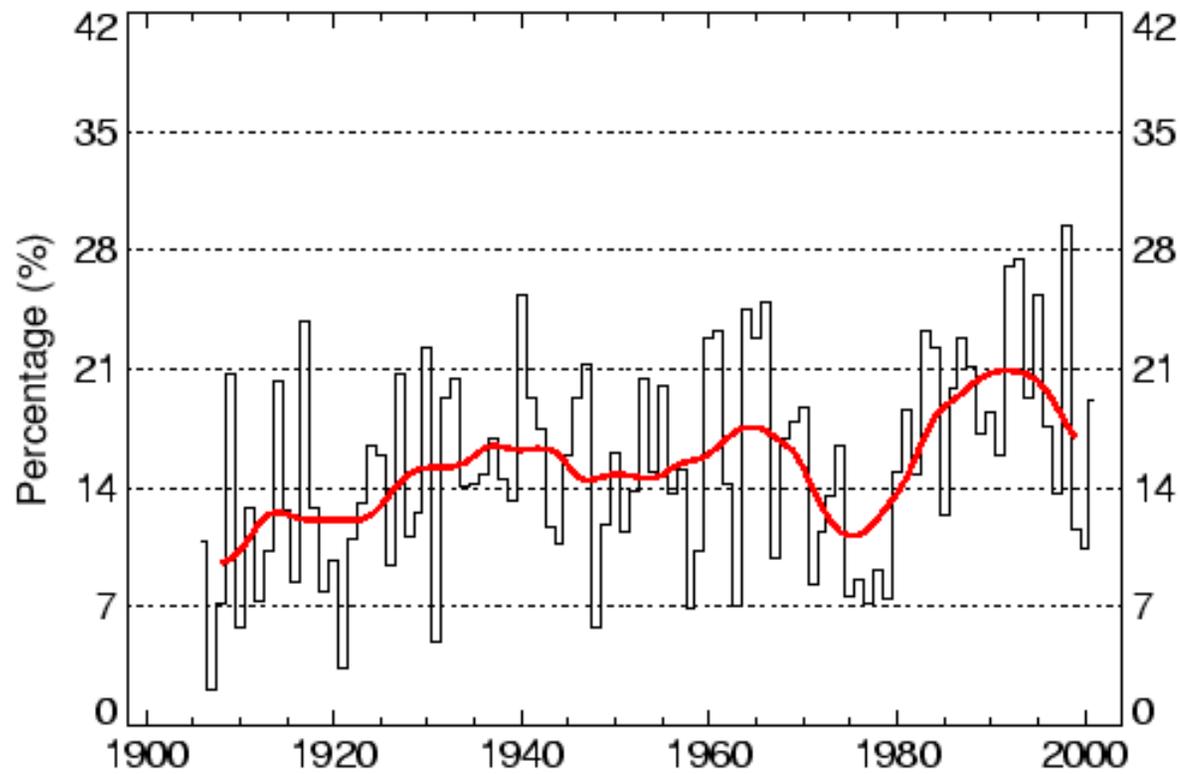


European Climate Assessment & Dataset < Warning: preliminary result 06-12-2002 >



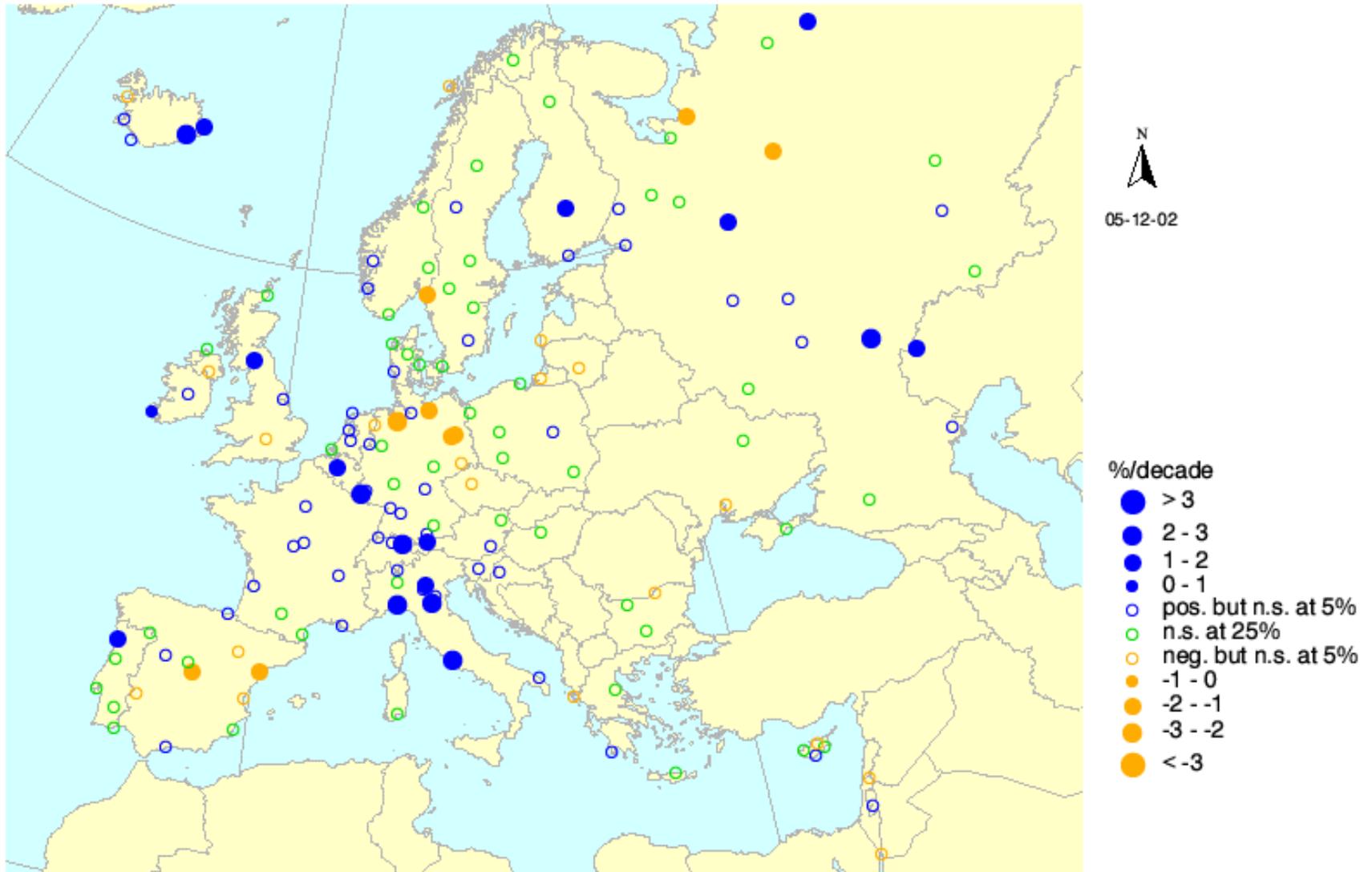
Precipitation fraction due to very wet days (> 95th perc.)

00511 NL 13 station average, Netherlands (annual)



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

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



European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)



European temperature trends

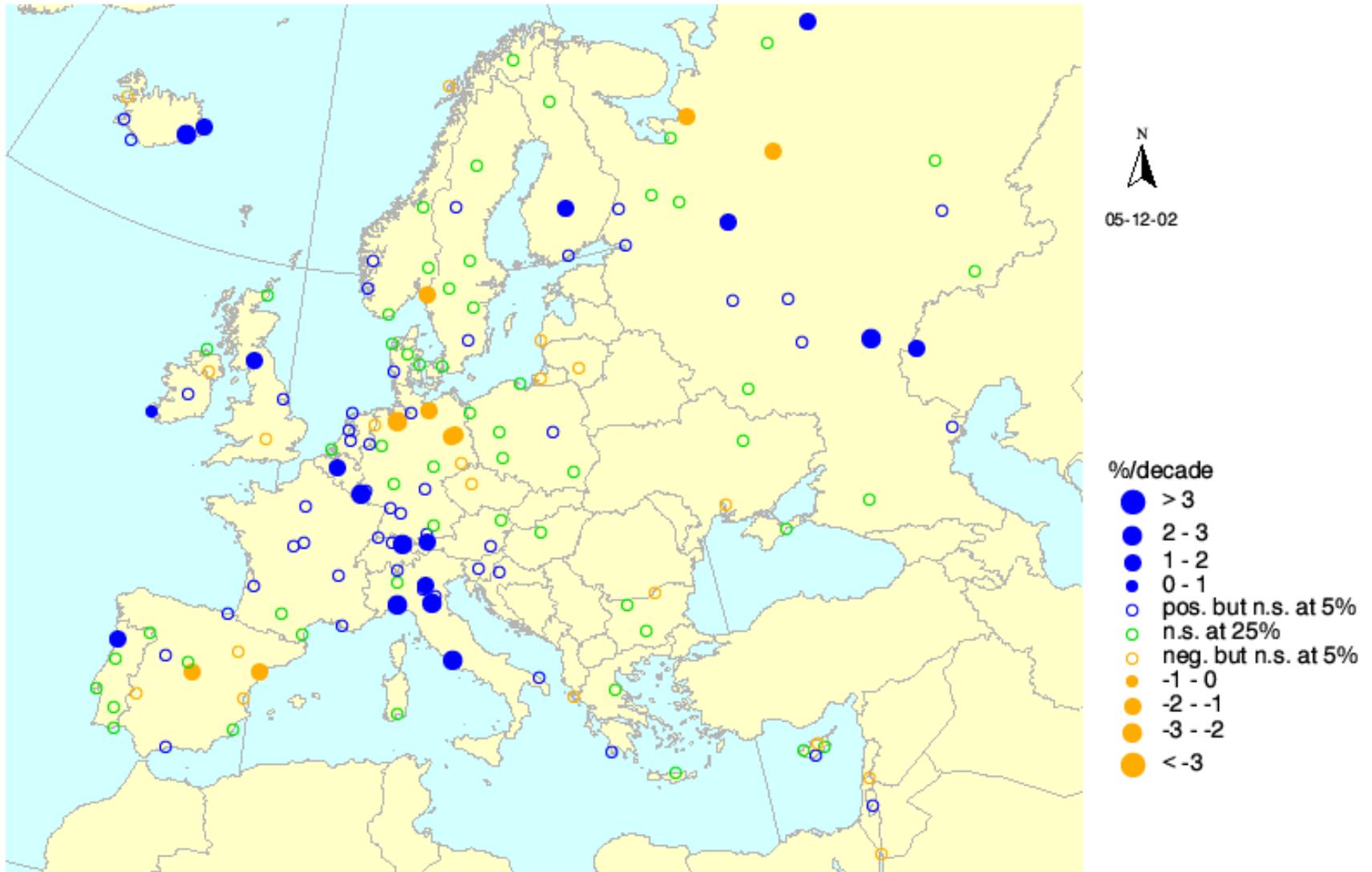
- ✦ Recent trends (1946-1999) in temperature extremes reflect the general warming: fewer cold extremes, more warm extremes
- ✦ Averaged over all stations, the first decades of slight cooling saw narrowing of temperature distributions, whereas the last decades of strong warming saw widening of temperature distributions
- ✦ **IPCC-TAR:**
 - ✦ *“lengthening of the freeze-free season in most mid- and high latitude regions”*
 - ✦ *“reduction in frequency of extreme low monthly and seasonal average temperatures and smaller increase in frequency of extreme high average temperatures”*



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"*

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



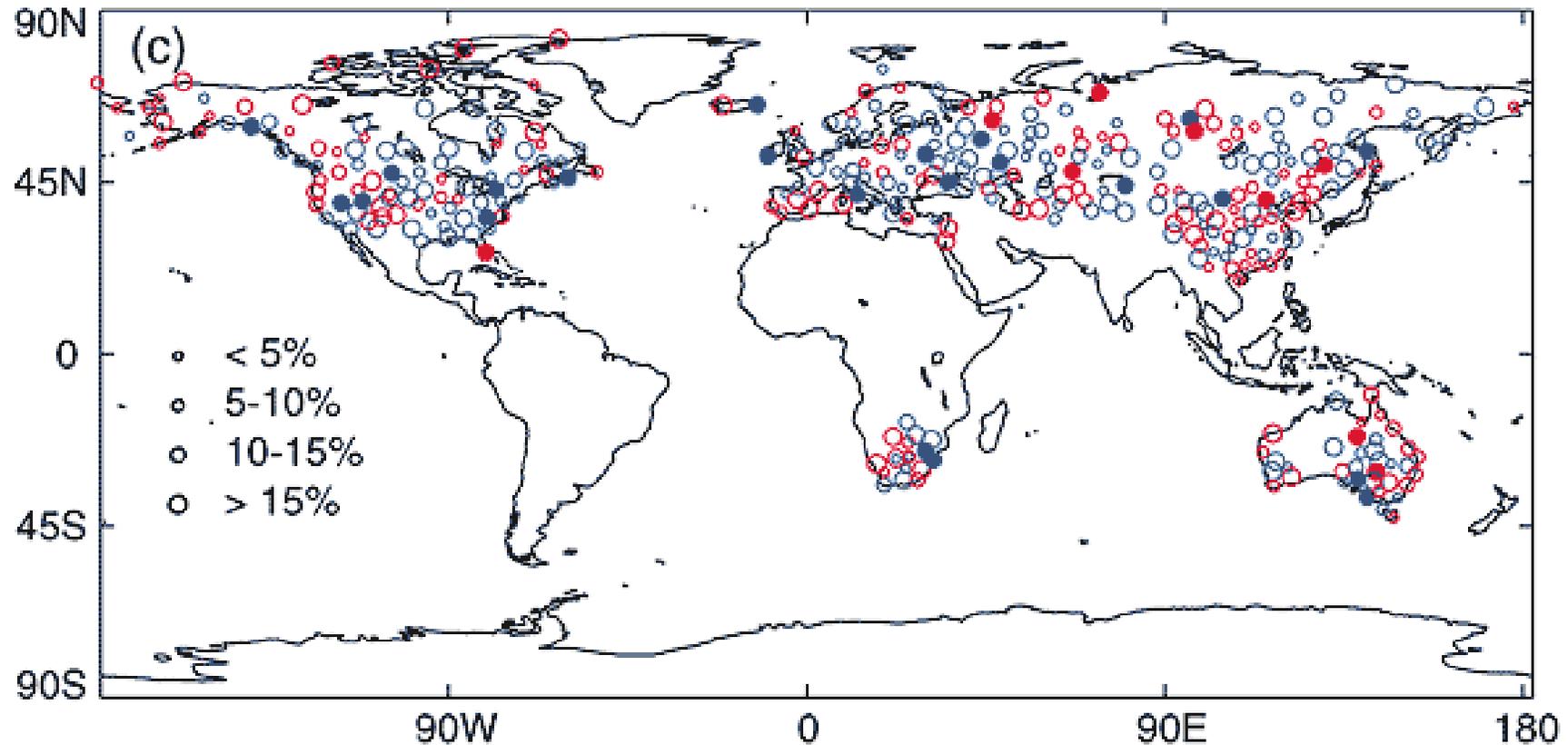
European Climate Assessment & Dataset

< Warning: trends for selected subset of stations! >



Fraction of total precipitation in the uppermost 5 percentile

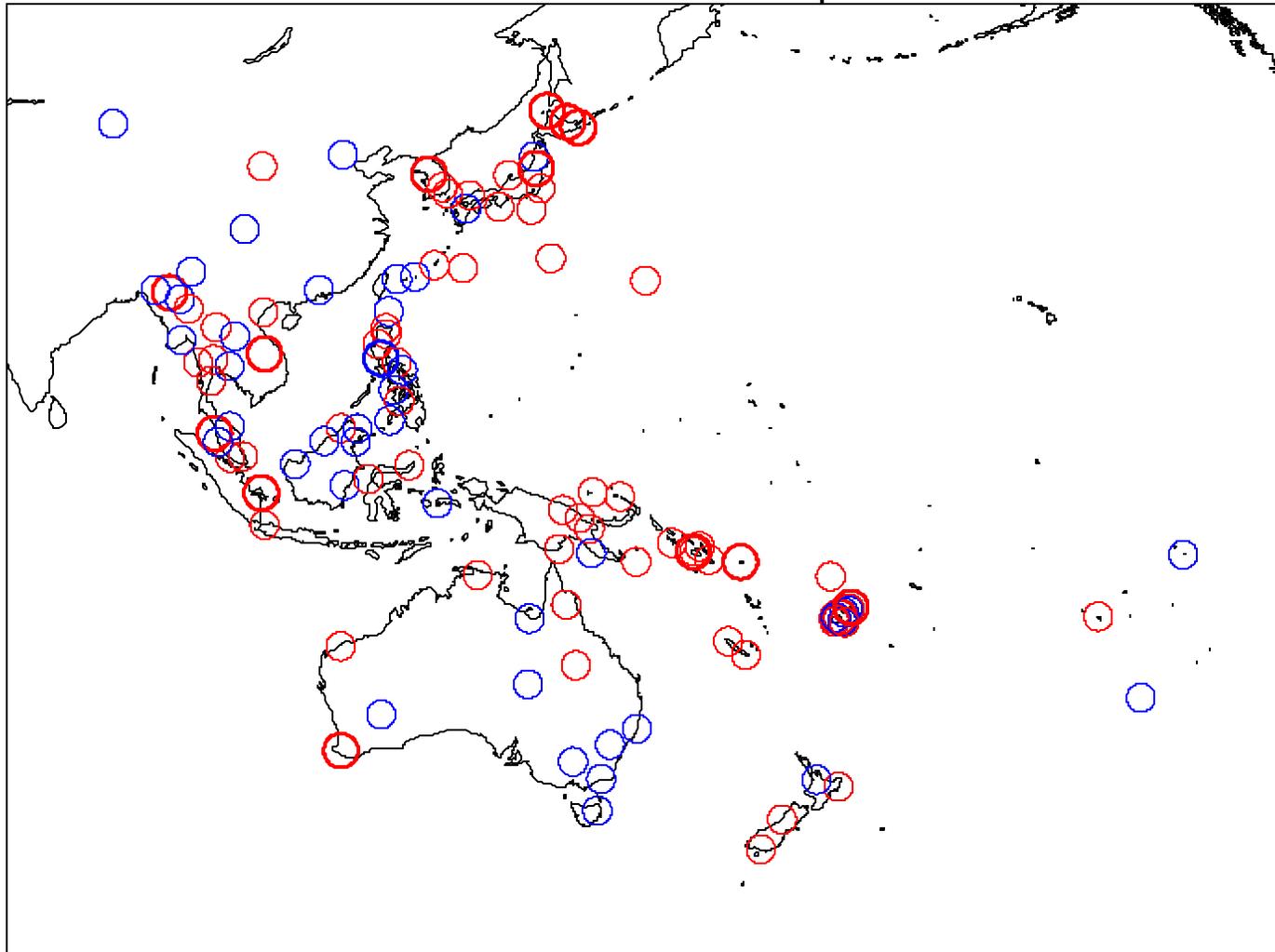
Change (%) between two multi-decadal averages during second half of 20th century



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

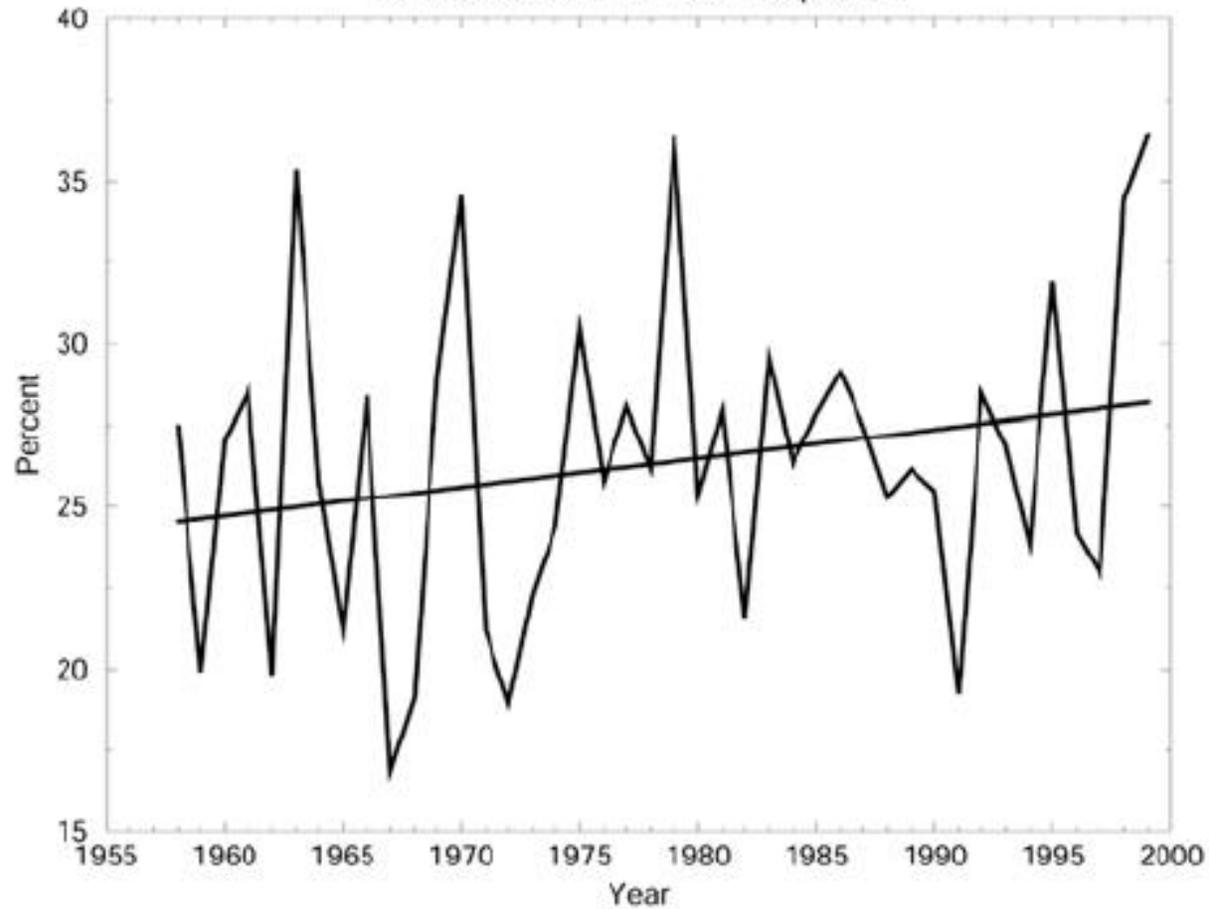
•••• Trends 1961-2001

Rainfall Extreme Proportion





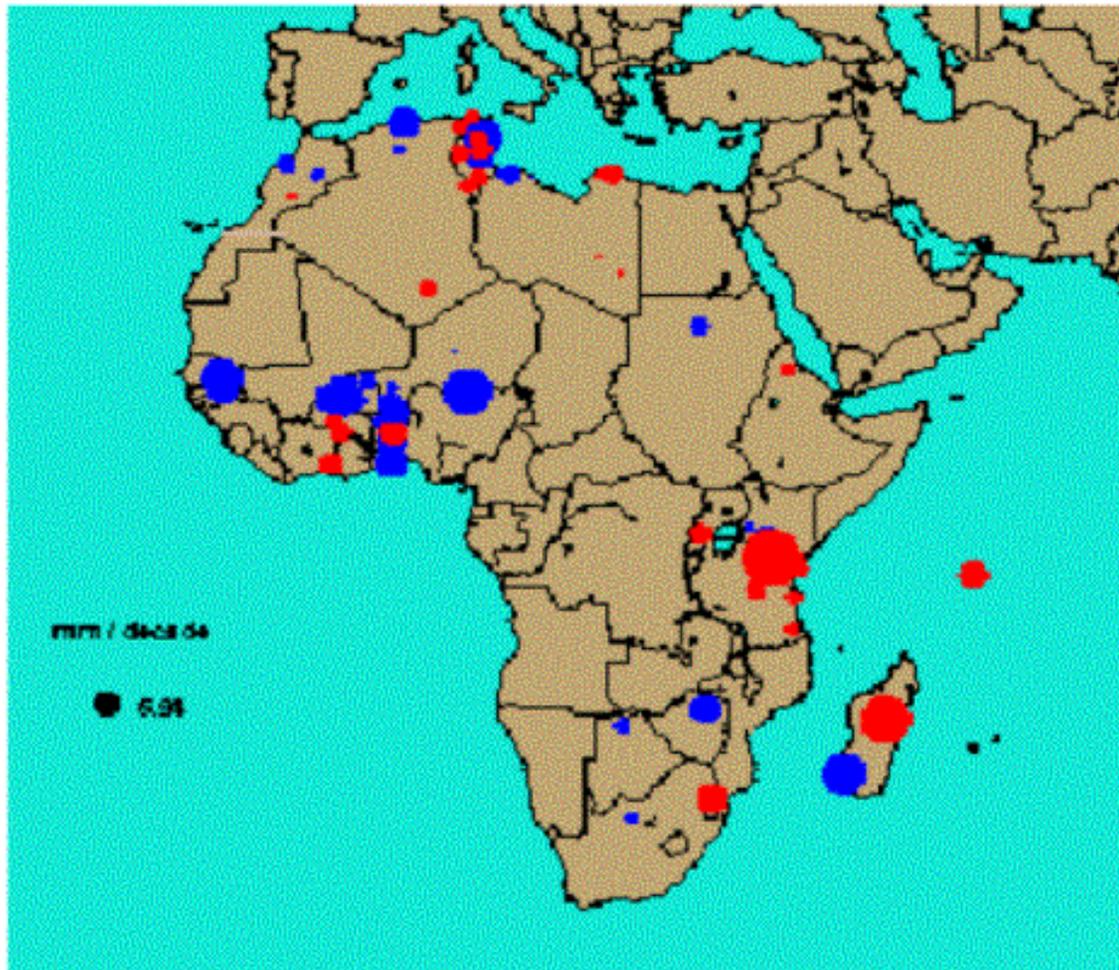
Precipitation due to Events Above the 95th Percentile As Percent of Annual Total Precipitation



Caribbean workshop, Jamaica 2001 (Peterson et al., 2002, JGR)



Trends in 5-day rainfall total 1961-1990





WMO/CCL

1. OPAG2: Monitor. and Anal. of Clim. Var. and Change
 - ✍ 2.3 ETCCDMI; indices of daily to seasonal extremes in observations and models

2. OPAG3: CLIPS
 - ✍ 3.8 ET on Health-related climate indices and their use in early warning systems (Jendritzky)
 - ✍ 3.10 Rapporteur(s) on use of climate indices in various application areas (Akentyeva/Khlebnikova)



Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)



Indices and applications/climate services

- ✎ Indices give no answer to the question of the 'return period' concept under climate change conditions
- ✎ Core set of indices designed for research (CCD), but clear impact relevance:
 - ✎ Physical limits like in "Fd" index: no. of frost days
 - ✎ Growing season length, heating degree days, no. of consecutive dry days
 - ✎ Percentile thresholds -> local infrastructure is designed to withstand local climate
- ✎ Indices for more common events can be regarded as indicative for more extreme events causing disasters



Some final comments

- ✍ ECA&D needs to include few 'missing' countries and consider more elements
- ✍ ECA&D has to address the cause of observed changes/trends in subregions/countries, e.g. by studying the relation with variability in atmospheric circulation (NAO)
- ✍ Need to consider more advanced analysis to supplement the 'simple' descriptive indices
- ✍ For climate services:
need to consider multi-element/complex indices and user/application-specific indices



Guide

1. How to define extremes and analyse changes in extremes?
2. Indices for daily T and R extremes in ECA&D
3. Observed trends in Europe, 1946-now
4. Indices and applications / climate services
5. Hands-on training using ClimDex (NCDC/NOAA)



Hands-on training ClimDex

- ✍ Need for standardized procedures and software
- ✍ ECA&D website lists internationally agreed definitions of a basic set of core indices for extremes
- ✍ ClimDex software for calculating subset of core indices written by Gleason/Peterson (NCDC/NOAA)
- ✍ ClimDex was used in WMO sponsored APN, Caribbean & African workshops on extremes
- ✍ Still recognize the need for more complete guide on indices and software



ClimDex: www.ncdc.noaa.gov/oa/wmo/ccl

