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"In and Out Air Strategies. From Climate Change to Microclimate. Library, Archives and Museum Preservation Issues"

5-6 March 2009

Bibliothèque nationale de France

http://www.ifla.org/VI/4/pac.htm

WMO Climate
Data Rescue activities

Pierre BESSEMOULIN
Météo-France
President of WMO Commission for Climatology

Conference "From Climate Change to Microclimate.
Library Archive and Museum Preservation Issues"
Bibliothèque Nationale de France, Paris, 5-6 March 2009

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Summary of expected scientific benefits of Data Rescue activities

- Long-period and high-quality climatic instrumental time series are essential for the production of reliable assessments of the global climate system, with a view to better understand, detect, predict and adapt to global climate variability and change and their impacts;
- Save in a sustainable way hard copy media including original historical written manuscript records which in many cases are in danger of deteriorating and/or of being lost
  - To enable to place recent records in a much longer context;
  - To provide longer records for the calibration of natural and documentary proxies (ice cores, tree rings, sediments, corals,…) allowing to extend time series beyond instrumental records managed by NMHSs;
  - To provide longer records for reanalysis extensions further back in time;
  - To ensure that NMHSs and other potential users are aware of early data in their country and their possible shortcomings.

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Reliable instrumental records held at NMHSs rarely extend back for more than a century.

- The earliest documented daily meteorological measurements were made in Paris by Louis Morin from February 1665 to July 1713 (*Legrand and Le Goff, 1992*).
- Temperature, precipitation and pressure measurements were taken at Paris Observatory from the 1680s to the 1750s (see *Mémoires de l' Académie Royale des Sciences* from 1688 to 1754)
- See also e.g. London 1697-1708 pressure time series

- Permanent observational programmes were implemented in several locations (astronomical observatories, monasteries, medicine academies,…) in Europe during the XVIII th century e.g. Uppsala (1722), Padova (1725), St. Petersburg (1743), Prague (1752), Milano (1763), Hohenpeissenberg (1781), …

-Establishment of national meteorological services came much later: Germany (1847), Netherlands (1854), UK (1854 then 1867), France (1855), Sweden (1859), Spain (1860), South Africa and Mauritius (1862), Italy (1863), Norway (1866), Hungary and USA (1870), Canada (1871), Argentina and Denmark (1872), etc

Generally:

- sensors and units differ from those in use now: need for transfer functions necessitating in some cases to rebuild sensor or screen;

- metadata are essential for description of sensor and screen types, location, relocation, observational practices (e.g. observed variables, time of observations), and exposure history;

- QA/QC needed, including assessment of homogeneity of the time series: further corrections;

- best use of data if managed with modern tools, allowing user-friendly access, e.g. relational databases and SQL language

Reproduction of the old Montsouris stand and the new Stevenson screen. Dual temperature observations are taken with identical sensors sheltered in i) a Stevenson screen (back) and ii) in a Montsouris stand (front)

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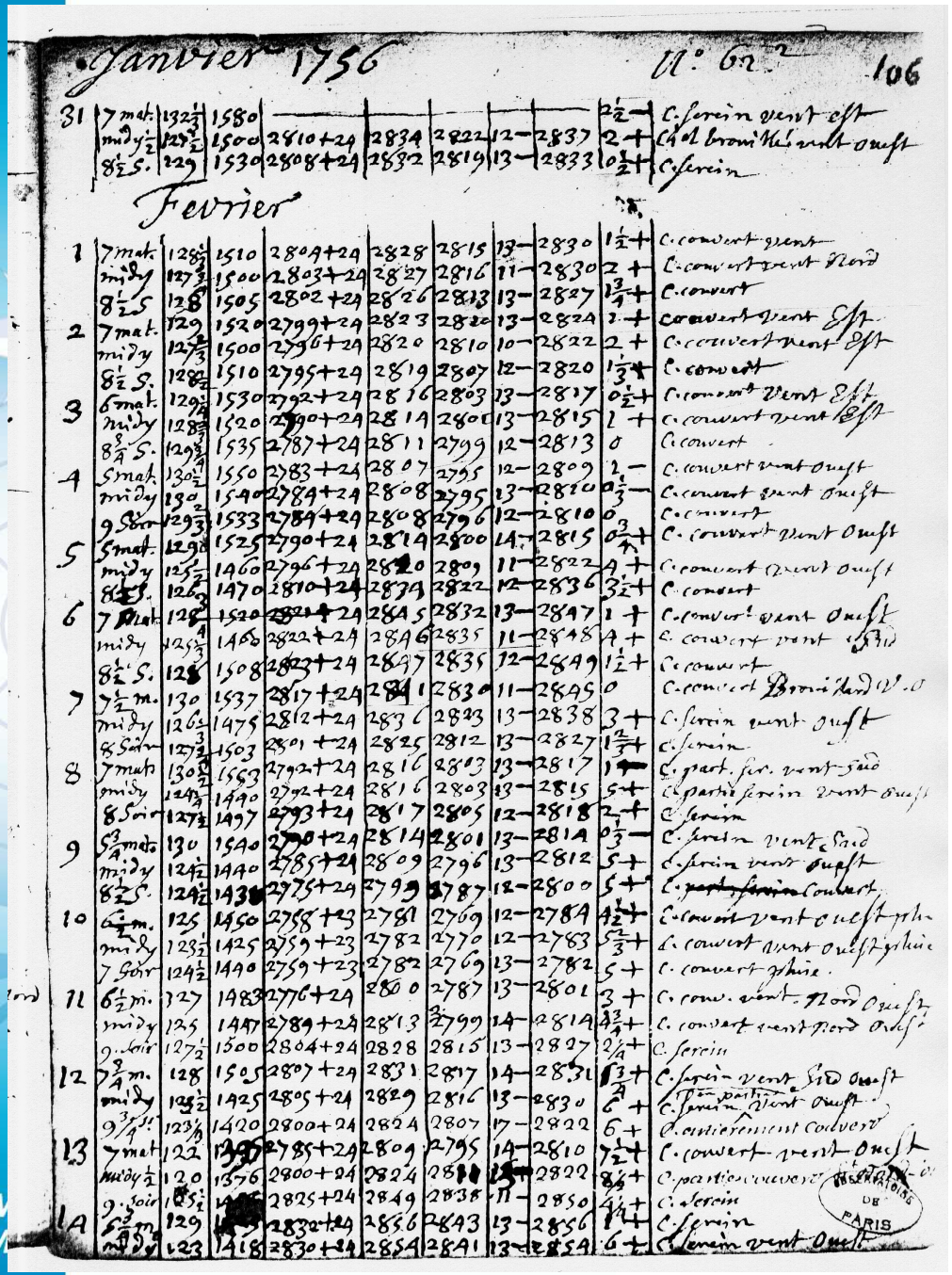


Joseph-Nicolas Delisle's Weather Diary (1747 – 1760, Paris)

- Three or four observations per day
- Temperature, pressure, state of the sky
- Readings from barometers
- Temperature scale problematic

Annales du Bureau Central Météorologique de France

Janvier 1878.

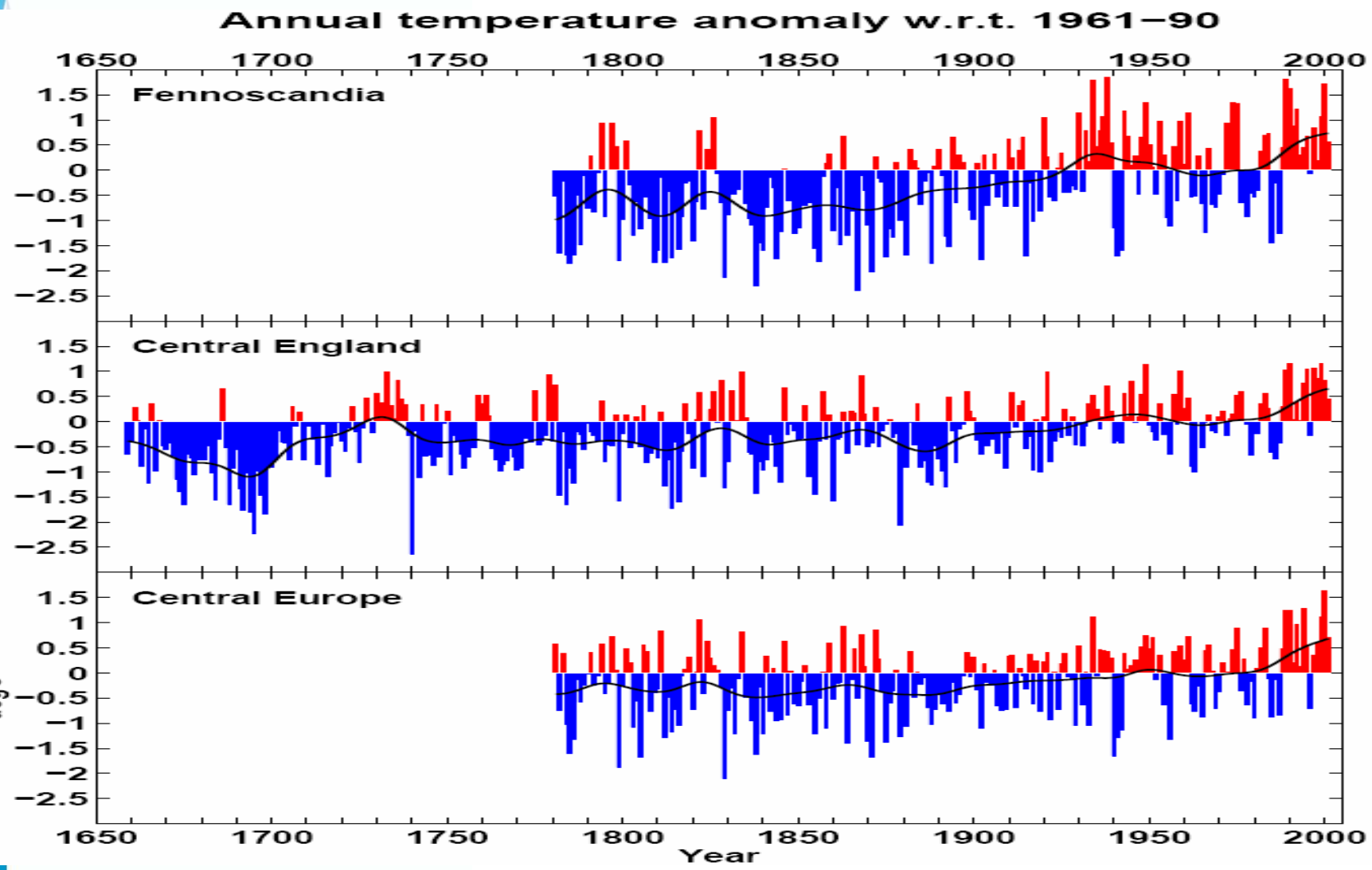
PARC DE SAINT-MAUR.

Longitude 0°0′36″ E. — Latitude 48°48′28″. — Altitude 46^{m},4.

PRESSION BAROMÉTRIQUE RÉDUITE A ZÉRO (700+).

DATES.	4^{h}	5^{h}	6^{h}	7^{h}	8^{h}	9^{h}	10^{h}	11^{h}	12^{h}	1^{h}	2^{h}	3^{h}	4^{h}	5^{h}	6^{h}	7^{h}	8^{h}	9^{h}	10^{h}
1	68.54	68.38	68.20	68.40	68.46	68.43	68.57	68.42	67.90	67.44	67.34	67.20	67.32	67.13	66.77	67.08	67.15	67.00	67.00
2	67.50	67.58	68.00	68.45	68.67	69.21	69.53	69.37	69.30	68.91	69.12	69.22	69.36	69.68	69.53	69.56	69.42	69.31	69.55
3	68.53	68.44	68.43	68.39	68.56	68.26	67.92	67.89	67.37	67.18	66.92	66.68	66.41	66.03	65.93	65.94	65.32	64.89	64.45
4	62.08	61.47	61.28	61.13	61.09	60.83	61.10	60.90	60.53	60.23	60.12	60.69	60.94	61.04	61.37	61.65	61.71	62.00	62.10
5	63.02	62.83	63.03	63.12	63.65	64.00	64.20	64.00	63.55	63.39	63.37	63.32	63.03	62.97	63.15	63.19	62.94	62.74	62.62
6	61.37	61.29	61.24	61.12	61.10	61.23	61.31	61.07	60.60	60.18	60.07	59.80	59.69	59.63	59.54	59.23	59.04	58.65	58.59
7	55.58	54.90	54.34	54.15	53.98	53.72	52.92	52.17	51.05	50.21	49.80	49.42	48.68	48.16	47.86	47.57	47.34	47.00	46.75
8	47.05	47.08	47.48	47.86	48.31	48.57	49.00	49.17	49.10	49.20	49.48	49.97	50.35	50.62	51.00	51.40	51.93	52.09	52.29
9	54.00	54.27	54.85	55.45	56.08	56.82	57.25	57.67	58.19	58.21	58.69	59.43	59.97	60.67	61.27	61.93	62.33	62.68	62.87
10	64.18	64.12	64.24	64.30	64.61	64.87	64.63	64.15	64.07	63.35	63.00	62.92	63.20	63.55	63.92	64.54	65.00	65.88	66.20
11	69.80	69.85	70.30	70.85	71.20	71.75	72.24	72.38	72.50	72.50	72.58	73.21	73.27	73.61	73.86	74.12	74.42	74.52	74.58
12	74.65	74.49	74.60	74.76	74.77	74.90	75.40	75.49	74.95	74.80	74.62	74.59	74.56	74.70	74.62	74.80	74.90	74.87	74.86
13	75.03	75.23	75.42	75.59	76.02	76.34	76.66	76.50	76.17	75.74	75.67	76.28	76.34	76.44	76.54	76.85	76.86	76.68	76.80
14	75.68	75.27	75.11	75.10	75.37	75.18	75.18	75.14	74.03	73.43	73.00	72.74	72.52	72.36	72.04	71.77	71.53	71.09	70.84
15	68.95	68.41	68.32	68.05	68.37	68.57	68.57	68.51	68.15	67.76	67.62	67.47	67.57	67.59	67.62	67.76	67.78	67.84	67.91
16	67.72	67.46	67.55	67.50	67.60	67.74	67.75	68.00	67.43	67.23	66.93	66.63	66.39	66.50	65.96	66.45	66.41	66.70	66.58
17	66.54	66.28	66.68	67.00	67.50	67.85	68.47	68.41	68.32	68.28	68.12	68.35	68.54	68.74	68.75	69.31	69.29	69.26	69.36
18	69.56	69.62	69.62	69.74	69.93	70.13	70.60	70.78	70.69	70.44	70.35	70.68	70.75	70.74	70.93	71.06	71.14	71.18	71.16
19	71.10	71.00	70.92	71.17	71.50	71.80	71.83	71.77	71.61	71.18	71.02	71.02	71.06	71.07	71.24	71.20	71.05	71.12	71.33
20	71.00	70.94	71.28	71.40	72.31	72.15	72.12	72.08	72.08	72.33	72.16	72.03	72.85	72.72	72.75	72.76	72.93	73.00	73.23
21	71.68	71.35	70.89	70.98	71.06	71.22	70.97	70.86	70.47	69.93	69.36	69.12	69.54	69.00	69.06	68.67	67.95	67.71	67.69
22	66.19	65.76	65.45	65.17	65.70	66.13	66.04	66.05	65.50	64.88	64.47	64.10	63.85	63.58	63.40	63.39	63.05	62.60	62.30
23	59.03	58.40	58.63	58.37	58.61	59.17	59.46	59.70	59.70	59.30	58.48	58.00	57.72	57.88	57.51	57.07	56.59	56.25	55.66
24	53.64	53.08	53.10	52.86	52.65	51.76	51.77	50.77	49.40	48.13	47.25	46.62	46.02	45.49	45.10	44.37	43.41	43.20	43.36
25	46.50	46.53	46.36	46.33	46.02	45.35	44.77	43.78	43.48	43.34	43.47	44.07	44.20	44.46	45.05	46.32	47.16	48.02	48.63
26	50.53	50.73	51.58	52.58	53.55	54.49	55.09	55.73	56.33	56.66	56.90	56.74	58 05	58.75	59.54	60.00	60.27	60.63	60.92
27	61.49	61.71	61.78	62.15	62.50	62.41	62.38	62.46	62.10	61.78	61.59	61.62	61.51	61.60	61.71	61.76	61.63	61.36	61.13
28	59.28	58.82	58.32	58.09	57.88	57.40	56.97	56.49	55.68	55.00	54.12	53.34	53.15	52.95	53.27	54.09	54.90	55.70	56.23
29	59.47	59.60	59.67	60.25	60.32	60.56	60.78	61.00	60.80	60.68	60.54	60.77	60.96	61.14	61.50	61.57	61.47	61.51	61.50
30	60.78	60.71	61.00	61.15	61.43	61.90	62.06	62.15	61.88	61.63	61.78	62.14	62.46	62.81	63.21	63.55	63.84	64.00	64.12
31	64.69	64.93	65.14	65.41	65.74	66.16	66.41	66.75	66.65	66.57	66.73	66.67	66.97	67.21	67.75	68.02	68.23	68.72	68.69
Moy.	63.71	63.57	63.64	63.77	64.02	64.16	64.26	64.18	63 86	63.54	63.39	63.38	63.46	63.51	63.60	63.77	63.77	63.81	63.85

Examples of long European regional temperatures (from Phil Jones)



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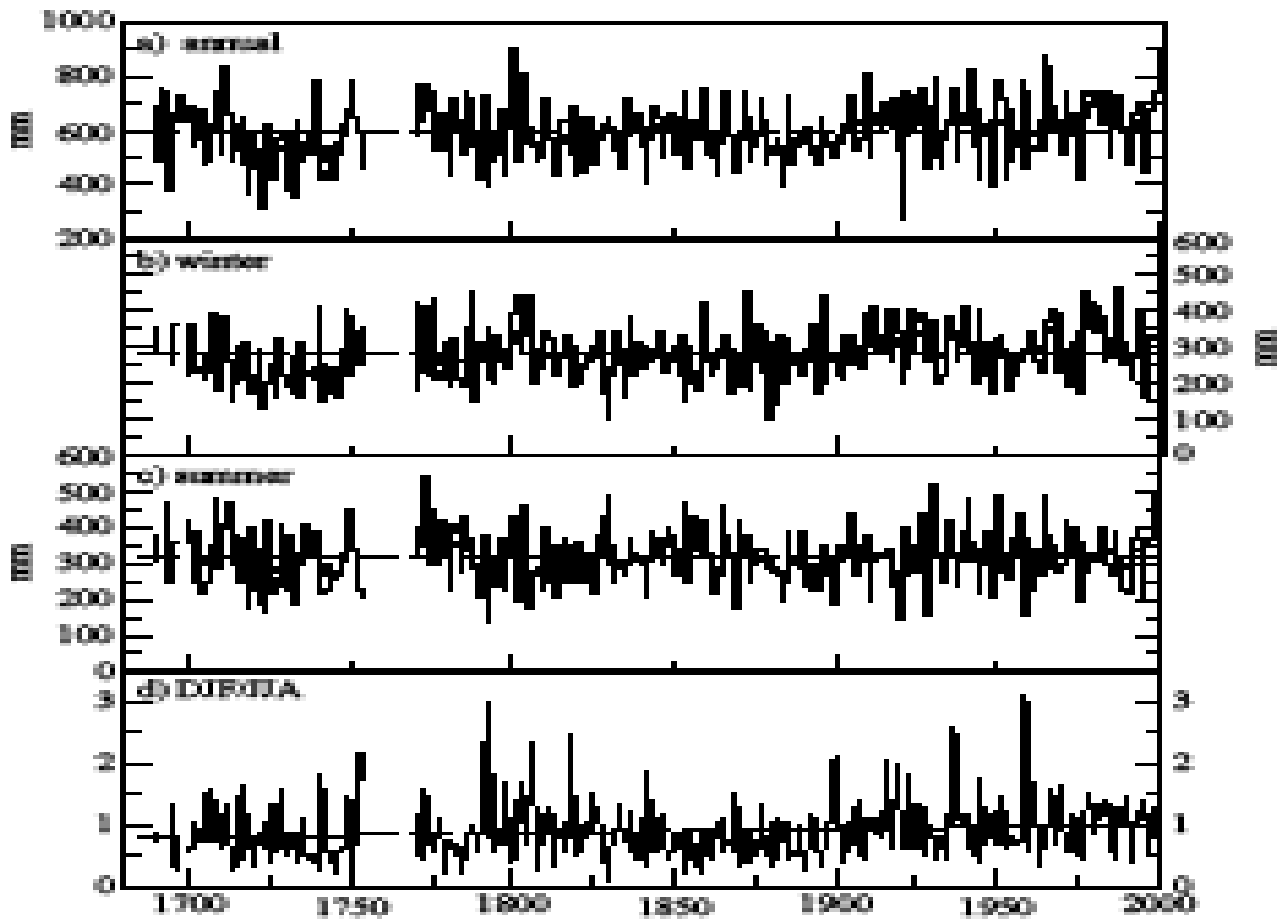
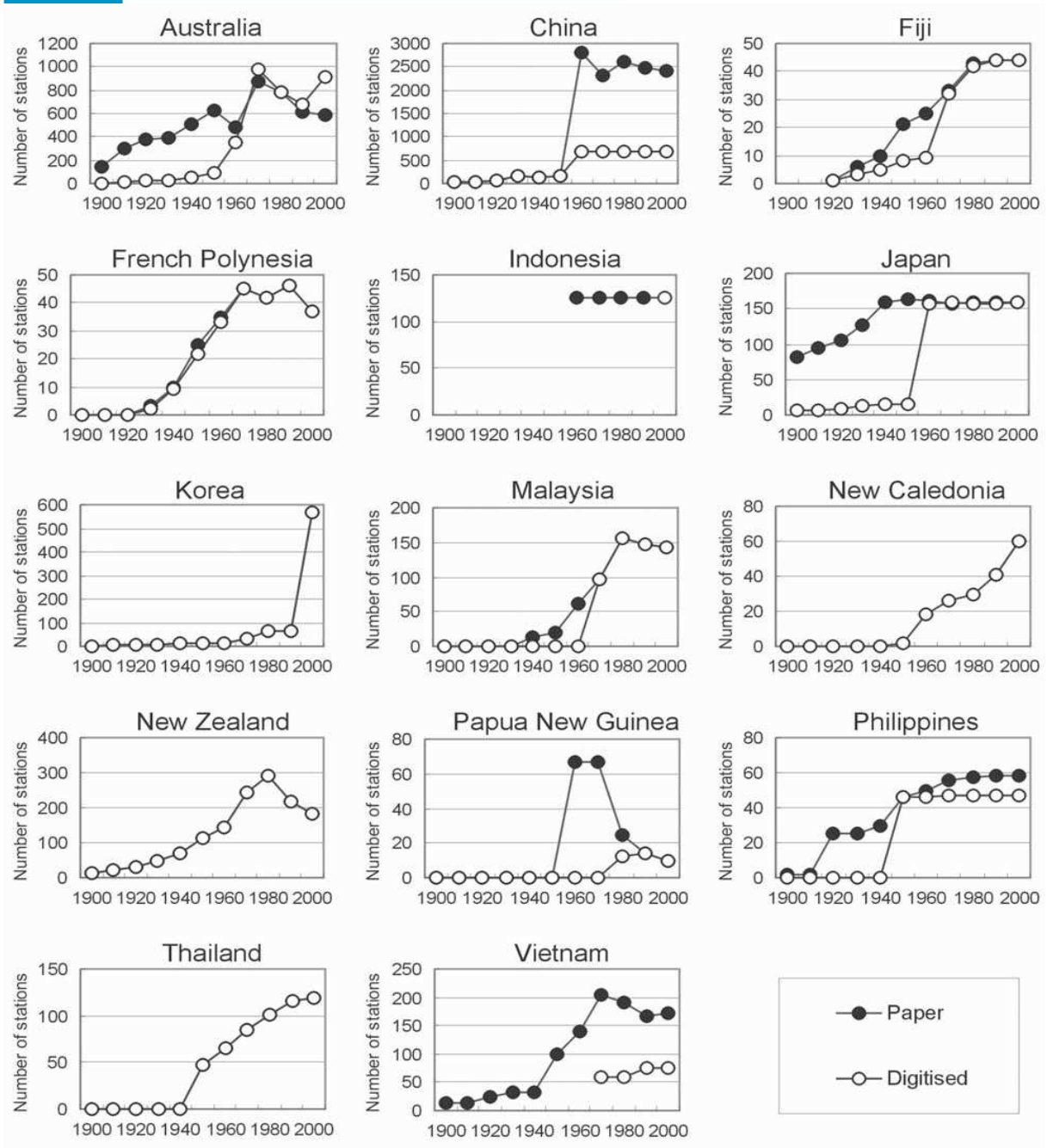
Paris annual and seasonal precipitation data (from V. Slonosky)





Number of stations in WMO RA V that have historical daily temperature data available in paper format (filled circles) and in digital format (open circles), from 1 Jan 1900 through 1 Jan 2000, and for each country. (from Page et al., *BAMS*, 2004)

The WMO Data Rescue (DARE) Project

The initial WMO Data Rescue (DARE) project launched in 1979 was aiming at:
-assisting countries in the management, preservation and use of climatic data over their own territories.
- commiting to microfilm and microfiche, and eventually to digital media the original historical written manuscript records which in many cases were in danger of deteriorating and of being lost.

See DARE website at http://www.wmo.int/pages/prog/wcp/wcdmp/dare/index_en.html

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Early WMO-Belgium DARE Projects

- From 1979 to 1997, the WMO/Belgium-funded Data Rescue projects assisted more than 40 African countries in preserving their climate data, at least on microfilms or microfiches.
- Data were digitized on magnetic tapes when appropriate funding was available
- Copies were given to each country
- Originals of the microfiches and microfilms were stored at the Belgian Royal Meteorological Institute (RMI), and at Agrhymet Centre then at ACMAD Centre in Niamey

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Evolution of DARE strategy

- In the mid-1990´s, technological advancements made it possible to optically scan climate data as a new method of creating digital climate archives.
- This technology permits the data not only to be preserved, but also to be in a form for exchange via computer media.
- However, it was recognized that these data must be inserted into digital databases for best use in climate analyses and climate change studies.
- Optically scanning images certainly preserves the data and is a major improvement over hard copy media, but placing the data in full digital usable form makes it accessible to many more.

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Evolution of DARE strategy (cont'd)

- An International Data Rescue meeting (Geneva, 2001) re-defined Data Rescue as :
  "An ongoing process of preserving all data at risk of being lost due to deterioration of the medium, and the digitization of current and past data into computer compatible form for easy access."
- This definition implies that:
  - Data should be stored as image files onto media that can be regularly renewed to prevent the deterioration of the medium (cartridges, CDs, DVDs, etc.)
  - Data should be key-entered in a form appropriate for CDMSs (Climate Data Management Systems using relational databases), that can be used for further climate analyses and products.
- New data rescue projects have been implemented in many countries (Vietnam, Rwanda, Jamaica, Honduras, etc..)
- Most recent one: MEDARE

POSSIBLE STEPS FROM RAW DATA TO USABLE DATA

- BASE MATERIAL
  - Hardcopy (original or copy)
  - Microfilms, Microfiches
  - Digital images obtained by scanning or digitally photographing the hardcopy documents
- TOOLS
  - Photocopier, Cameras, Film readers, Book scanners
- DIGITIZATION
  - Manual (dual) keying the data
  - Optical Character Recognition (OCR)
  - Automatic Curve Extraction software
- QA/QC
  - Of course remains necessary !
- INCLUSION INTO CLIMATOLOGICAL DATABASE
  - With relevant metadata

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RESCUING
DATA RECORDS
Scan
Index
Sort
Data
Images
Paper
Key Entry
Data Store
User

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Current Data Rescue (DARE) project

- New objectives as mentioned previously
- Activities conducted in the framework of the WMO World Climate Data Monitoring Programme (WCDMP), which is part of the World Climate Programme (WCP)
- An Expert Team on the Rescue, Preservation and Digitization of Climate Records has been appointed by the WMO Commission for Climatology (CCl)
- DARE support is provided through coordinated installations, workshops and training
- Specific DARE sub-project to rescue several Members' data from obsolete 7- and 9- track tapes
- Funding:
  - At national level: now part of the meteorological services normal business
  - Through WMO Voluntary Cooperation Programme (VCP), Climate Change Projects including GCOS
  - With partners such as World Bank, African Union Commission, African Development Bank, UN Economic Commission for Africa, …

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Data Rescue Brochure

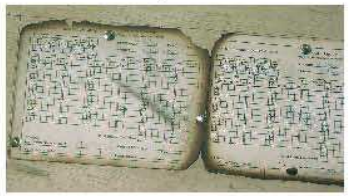
Why Rescue data?

"By defining and understanding past climate, we can better predict future climate"

While many countries have computer databases to manage their climate data, there are still millions of records that remain undigitized. These records are often daily and hourly climate observations dating back many decades and even into the nineteenth century. A consequence of this is that researchers, and other climate data users, are deprived of an essential resource for their work. In addition, many of the paper records are at risk of degradation, loss or destruction and so the risk remains that data may be lost forever.

Meteorological data have increased value when records have been kept for a long period, possess a high degree of completeness and have a large component of observations recorded at the same time each day.

According to the latest Intergovernmental Panel on Climate Change assessment it is clear that climate change is already having significant effects on life on earth. Longer high-quality records are essential for better understanding of the climate change and its potential impacts. The overall value of Data Rescue is difficult to quantify but is no doubt substantial. Long term climate information can provide important contributions to decision making, risk assessment and policy development within a range of sectors including health, agriculture, natural resource management, sustainable living, urban planning and construction, insurance and weather derivatives.



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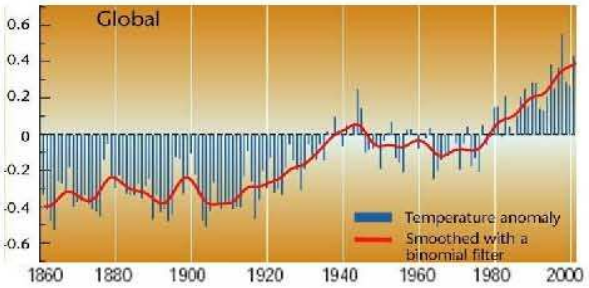
Data Rescue

World Climate Programme



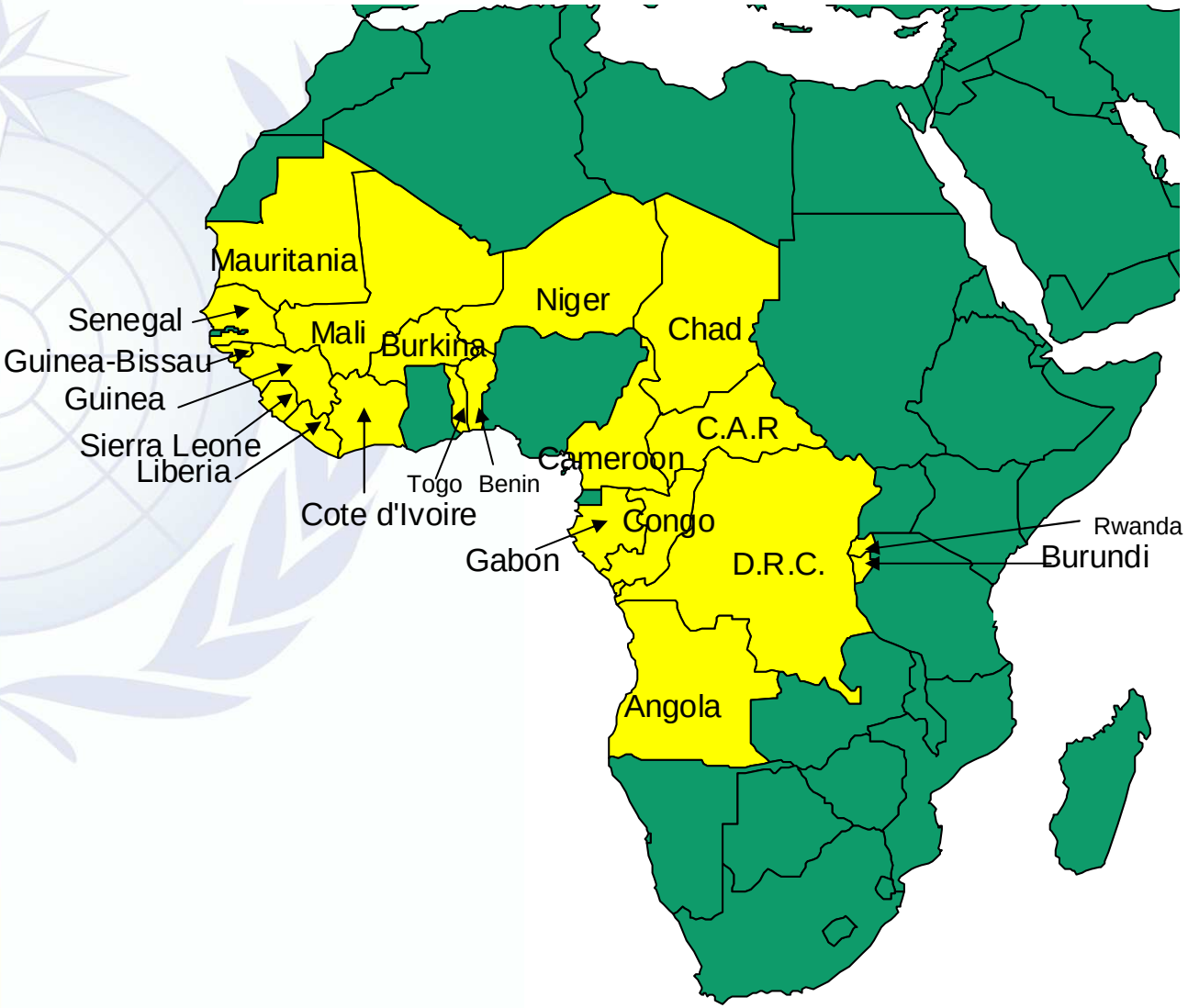
Saving our Heritage

"Through understanding the past, we can predict the future"

World Climate Data and Monitoring Programme

World Meteorological Organization

Countries in WMO RA I having received PCs, Digital cameras and CDs



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MEditerranean climate DAta REscue (MEDARE) initiative

- **The long-term goal of MEDARE is to develop:**
  - **a common Great Mediterranean Region (GMR) inventory of the longest possible instrumental climate records available within NMHSs as well as other valuable sources of weather and climate records available in the archives of various centres and organizations;**
  - **a comprehensive high quality instrumental climate dataset for the GMR with a focus on the Essential Climate Variables (ECV) of GCOS.**
- **Such a dataset will support and improve our ability to monitor, detect and predict climate variability and change at regional and national levels, thereby allowing countries of the GMR to develop robust strategies for managing climate related risks and adapting to climate change**

The Mediterranean Data Rescue Initiative

http://www.omm.urv.cat/MEDARE/

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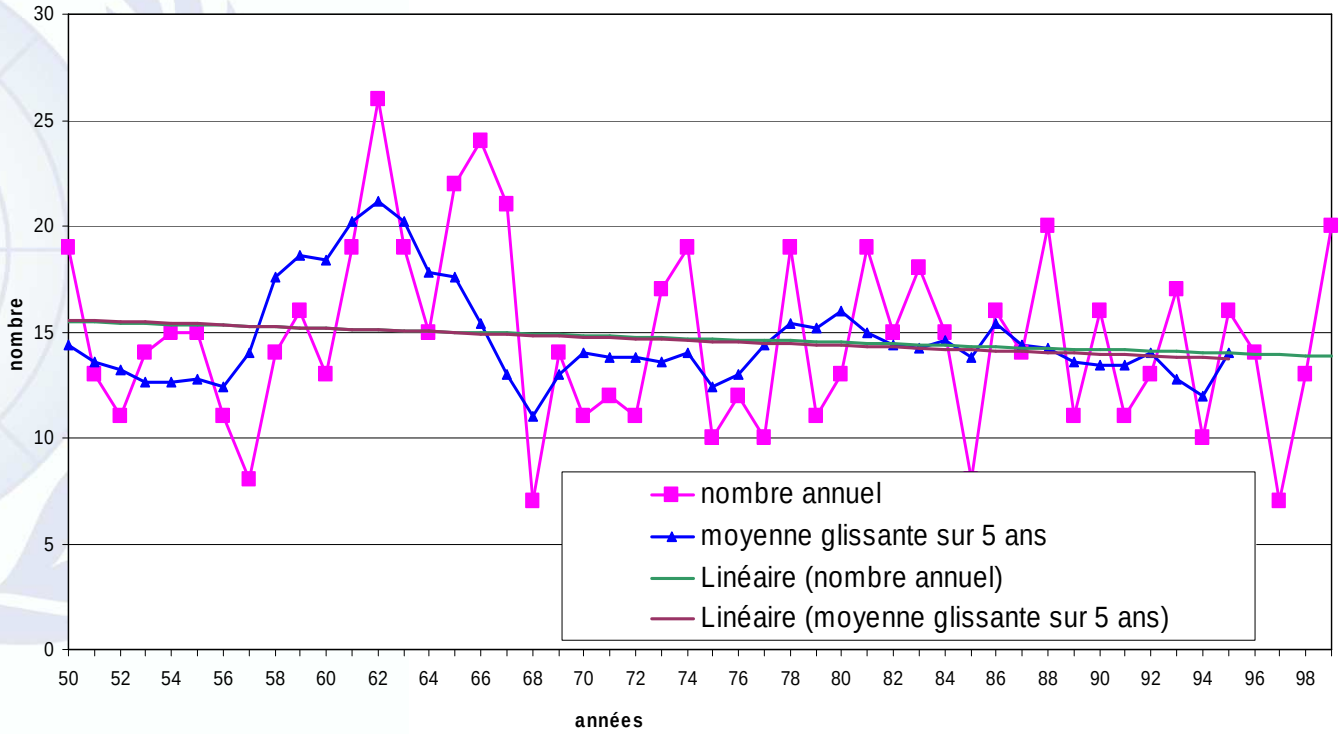
Number of windstorms observed in France from 1950 to 1999

- **Windstorm (WS) defined as an event starting on a given day when at least 5% of synoptic stations in operation on the national territory recorded a wind gust > 100 km/h**
  - **737 WS (14,74 per year on the mean)**
- **Criteria for Strong WS (SWS): at least 20% of synoptic stations in operation on the national territory recorded a wind gust > 100 km/h**
  - **76 SWS (1,5 per year on the mean)**
- **Windstorm definitions consistent with French insurance sector ones**
- **Events separated by less than 72 h are considered as a single one**

Number of windstorms observed over France from 1950 to 1999



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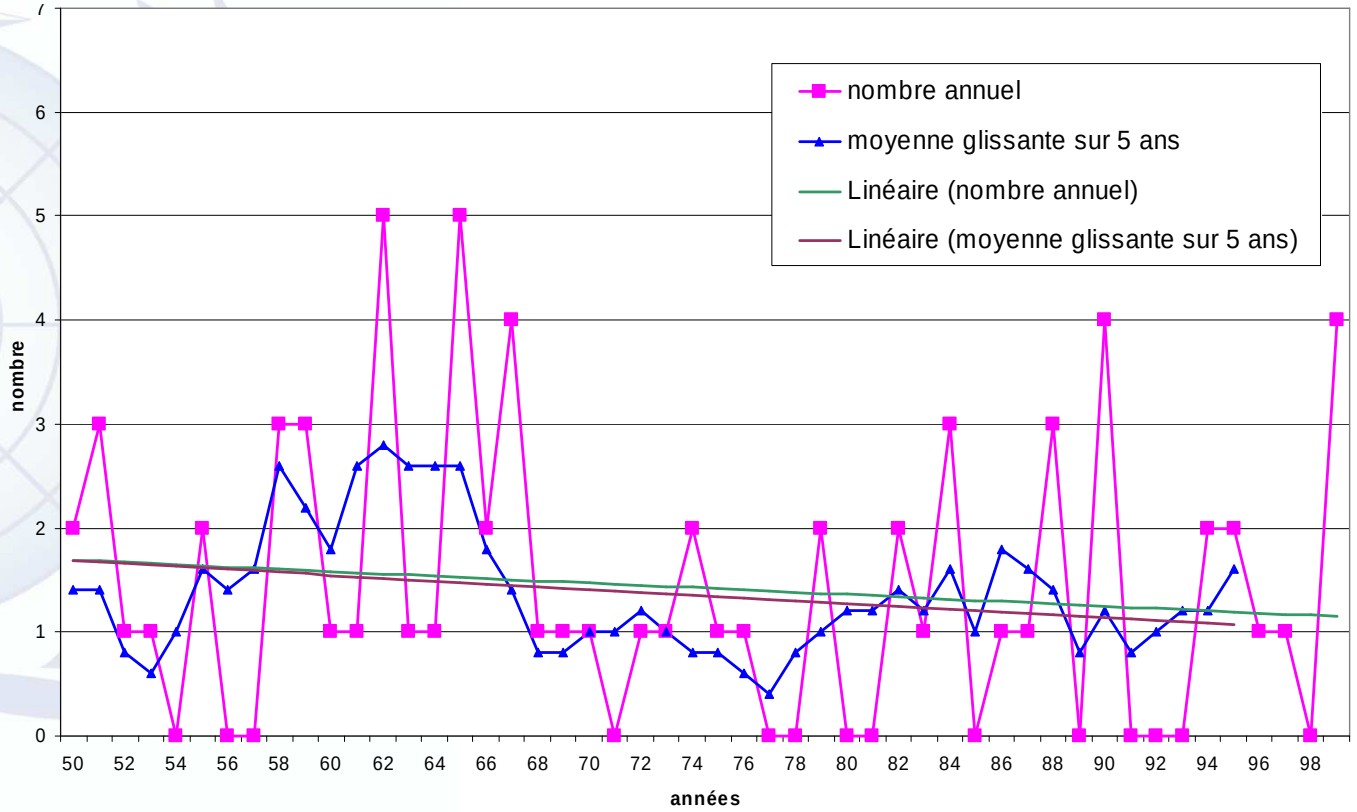
Number of strong windstorms observed over France from 1950 to 1999



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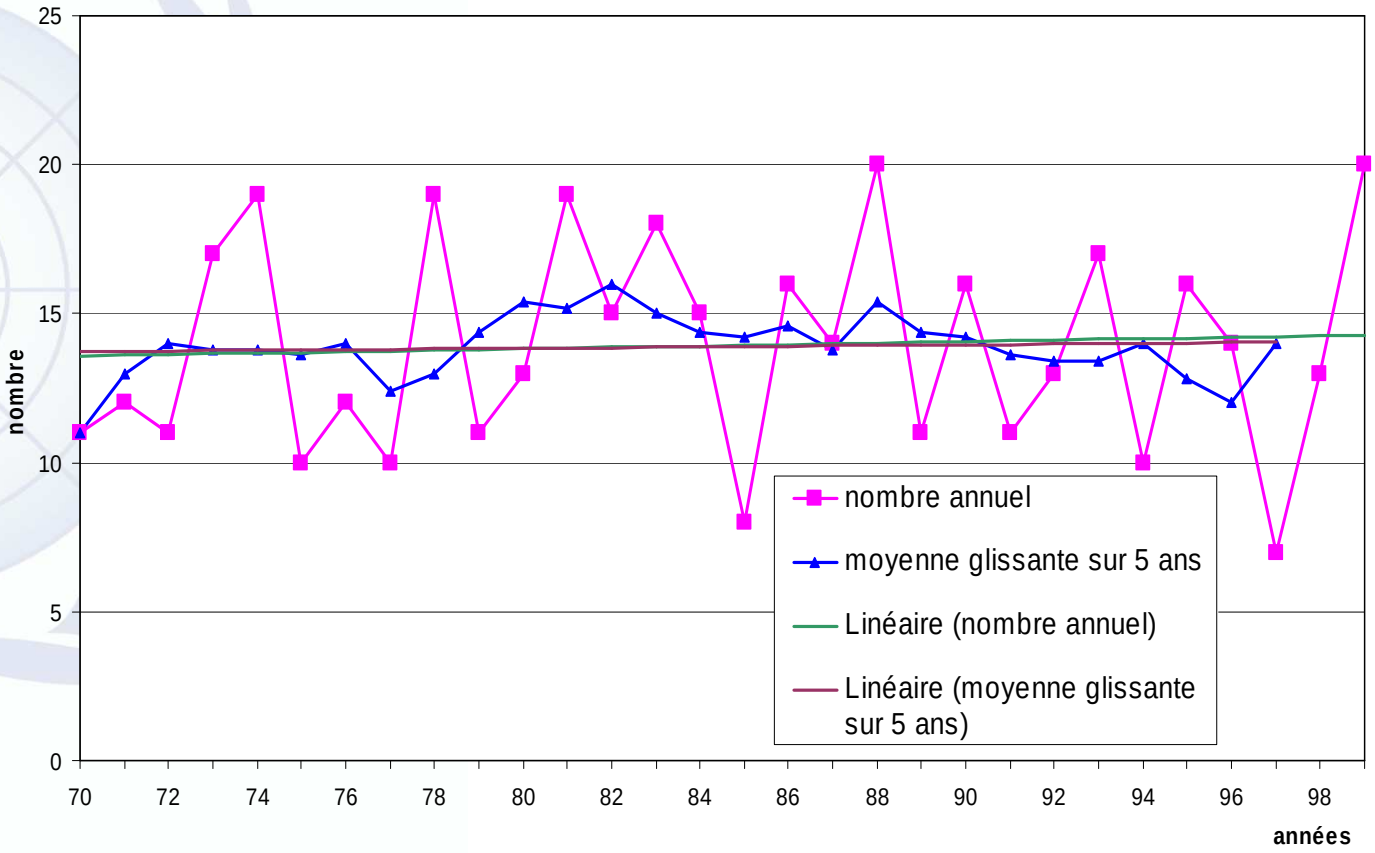
Number of windstorms observed from over France 1970 to 1999



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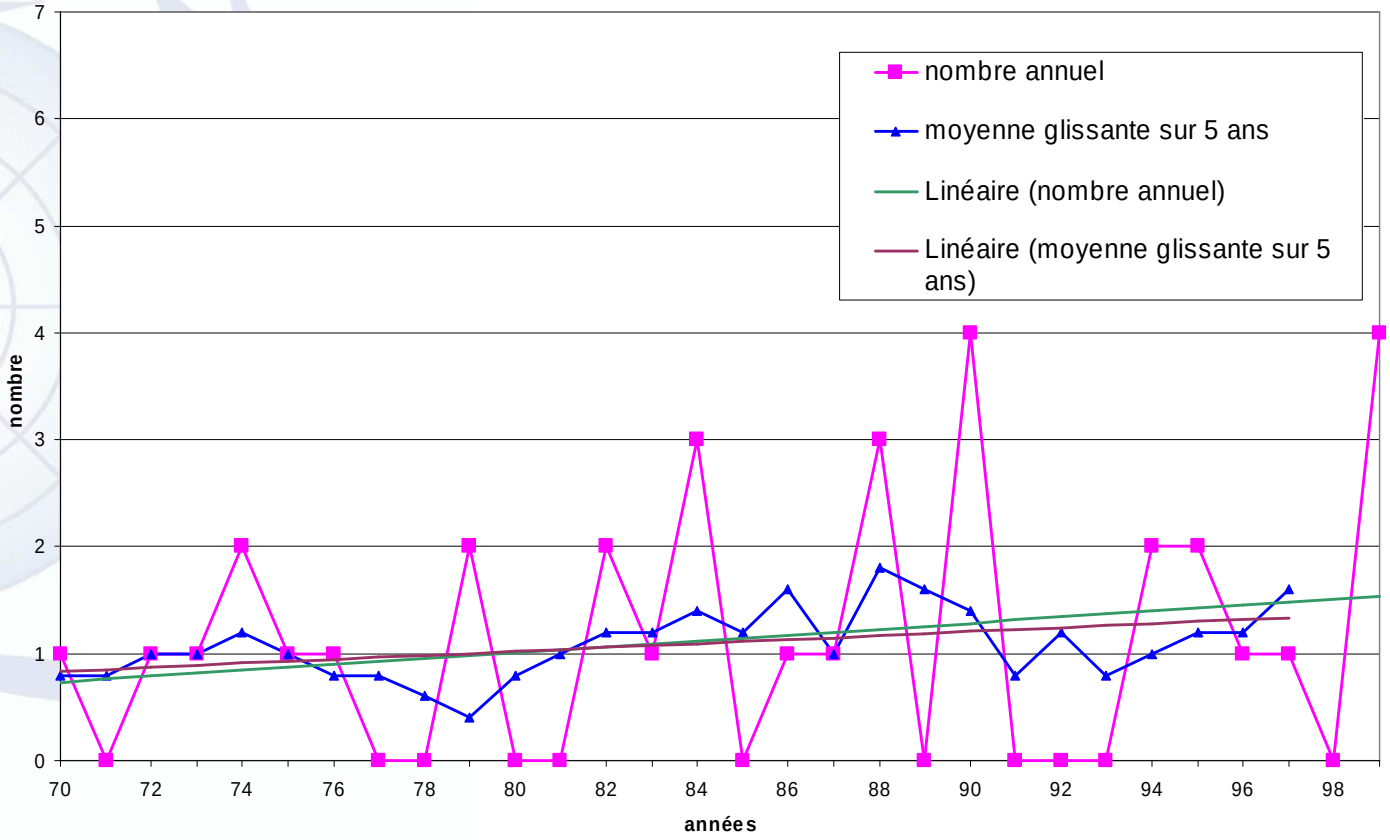
Number of strong windstorms observed from 1970 to 1999 over France



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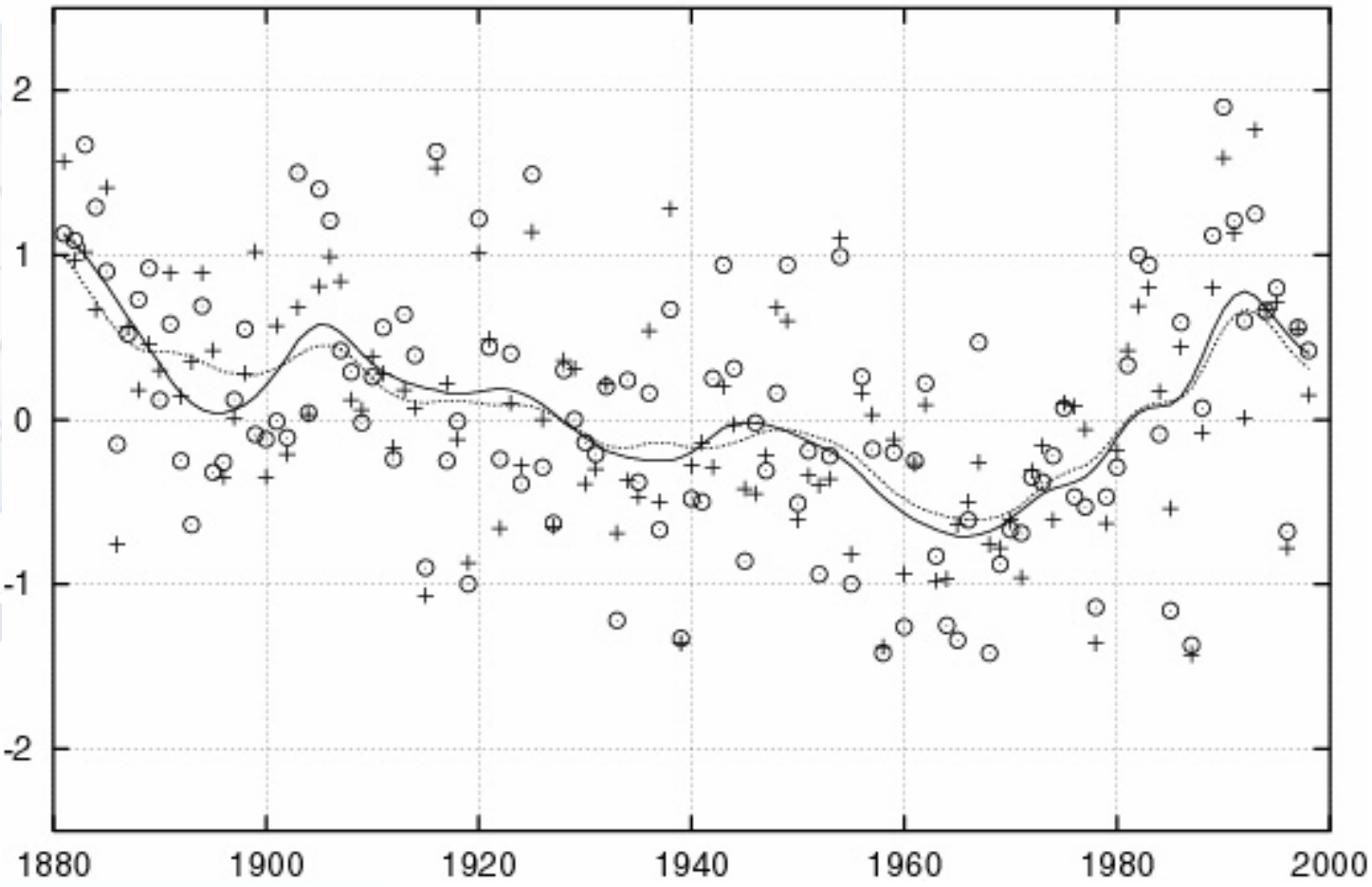
Standardized Storminess Index in the British-Isles, North Sea and Norwegian Sea region (1881-1998)

From WASA Group, 1998



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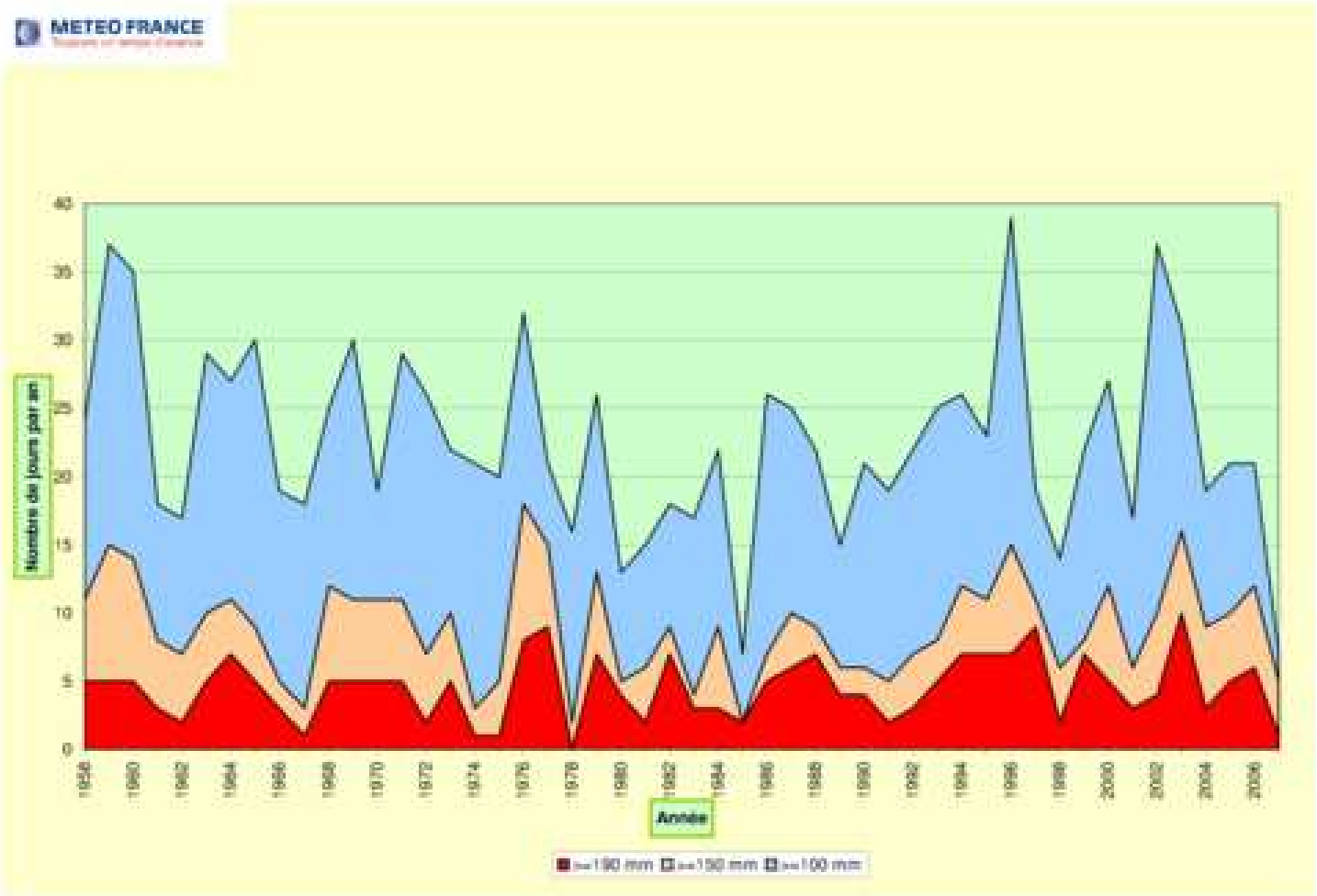
Evolution of heavy rain events (> 100, 150, 190mm) over Southern France from 1958 to 2007



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CONCLUSIONS

- Data rescue is an essential activity:
  - for saving in a coordinated and sustainable way records which in many cases are in danger of deteriorating and/or of being lost
  - for extending time series beyond those already digitized by NMHSs, especially within the framework of climate change studies
- Longer climate records than currently archived at NMHSs are generally available
- Climate records need finding, QA/QC, digitizing and then assessing for homogeneity
- Old climate records are often located in libraries and/or archives, sometimes outside NMHSs, sometimes in other countries
- There is a strong interest in DARE projects such as MEDARE aiming at publishing catalogues of relevant sources of information available in each country (not only national data)
- Climate Data Rescue is well coordinated by WMO (methodology, equipment supply, workshops, capacity building), as well as complementary activities (e.g. specifications for Climate Data Management Systems, support to their implementation, Guidance from measurements to data processing and homogeneity tests)

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Thank You

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