Digitisation of Surface and Upper-Air Observations in ERA-CLIM

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Thanks to co-workers

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**Sylvie Jourdain & Eméline Roucaute** (Météo-France, French Data Rescue)

**Jorge Guzman, Mariela Vasquez & Danilo Andrés Reyes** (Univ. del Pacífico, Santiago de Chile, Chilean Data Rescue)

**Rob Allan** (ACRE, Global Data Rescue Networking and Coordination)
Motivation

How do we know about the weather 86 years ago?

a) Digging into old newspapers or weather reports
b) Using (digital) observational records
c) Using reanalysis data

800 hPa GPH from 20CR
Wind data on 2,000 m asl from *Pilot Balloon Data, India* digitised in ERA-CLIM

Stickler et al. (2013, submitted to *BAMS*)
Outline

> What is ERA-CLIM?
> ERA-CLIM data rescue activities
> Highlights of historical upper-air data digitised at Univ. Bern
> Data rescue planned for ERA-CLIM 2
What is ERA-CLIM?

> European Re-Analysis of global CLIMate observations
> Total budget: 4.9 mio € (of which 3.5 mio € EU contribution)
> Project partners (in order of budget granted)

- ECMWF
- Univ. Bern (lead of WP1)
- EUMETSAT
- UK Met Office
- Univ. Vienna
- Météo-France
- Russian Research Institute for Hydrometeorological Information*
- Fundação da Faculdade de Ciências da Univ. de Lisboa
- Univ. del Pacífico (& Dirección Meteorológica de Chile)*

Red: members of WP1: Recovery, imaging and digitisation of historical observations and metadata

Star: Partners from countries that are not ECMWF/EUMETSAT members/associates

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What is ERA-CLIM?

> Project duration: 3 years, beginning in 1/2011, ending in 12/2013

> Goals:

— Input data for global high-resolution reanalysis suitable for climate studies, focus on the past 100 yrs, incl. information on quality (Observation Feedback Archive, OFA), using for the first time pre-1948 upper-air data

— New observational datasets (data recovery), focus on
  - Upper-air observations of pressure, GPH, T, wind, humidity made in the first half of the 20th century
  - Surface observations of pressure
  - Tropics, polar regions, World’s Oceans, but also early observations made in Europe and N America

— QC and homogenisation of new data
What is ERA-CLIM?
ERA-CLIM: Digitisation of Surface and Upper-Air Observations

ERA-CLIM data rescue activities: Tasks

> Overarching WP task: **Recovery, imaging and digitisation of historical observations and metadata**

— **Inventorying** of identified data sources and associated metadata

— **Imaging** of data sources

— Development of **job distribution tools and metadatabase**

— **Digitisation** of data and **reformatting** to agreed format

— Raw QC
ERA-CLIM data rescue activities: types of sources

- Daily weather and upper-air bulletins
- Institutional and observatory publications
- Meteorological/climatological annals or other periodicals (monthly or weekly)
- Books
- Articles in scientific journals
- Expedition, special mission and (formerly classified) military reports
- Original observation booklets
- Official public bulletins
- Annals or reports published by national academies of science, natural science societies and the International Commission for the Exploration of the Free Atmosphere
ERA-CLIM data rescue activities: types of sources

- Obtained via
  i. **Download** (particularly NOAA Central Library Foreign Climate Data)
  ii. **Proper** institutional **archives**
  iii. **Inter-library loan**
  iv. **Imaging on location** in library
ERA-CLIM data rescue activities: Surface inventory
ERA-CLIM data rescue activities: Upper-air inventory

IGRA stations, additional ERA-CLIM and CHUAN stations
ERA-CLIM data rescue activities: Upper-air inventory

IGRA stations, additional ERA-CLIM and CHUAN stations

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ERA-CLIM data rescue activities: Moving upper-air inventory
ERA-CLIM data rescue activities: Upper-air records vs. time
ERA-CLIM data rescue activities: Status

> Inventories online (metadatabase http://www.oeschger-data.unibe.ch/metads, anonymous read only access possible)

> Imaging

— > 450,000 hi-res images of data sources, centrally stored at Univ. Bern
— Photos will be made available online
ERA-CLIM data rescue activities: Status

> # of digitised / inventoried records (station days inventoried):

— 80 / 214 surface records (> 700,000 station days digitised)
— 735 / 1,783 upper-air records (≈ 750,000 station days digitised)
— 61 / 101 moving upper-air records (≈ 5,000 station days digitised)
  – Data from ships, aircraft, manned balloons etc.
— 13 / 16 atmospheric transmission records (≈ 3,500 station days)

> Data submitted to ECMWF and WP4 (Homogenisation and Quantification of uncertainties, Leo Haimberger, Univ. Vienna)
## Largest sources digitised

<table>
<thead>
<tr>
<th>Source</th>
<th>Type</th>
<th>Region</th>
<th>Start earliest record</th>
<th>End last record</th>
<th>Estimated number of station days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Air Data India</td>
<td>A/P/RB</td>
<td>India and surrounding region</td>
<td>1/1928</td>
<td>12/1936</td>
<td>113,779</td>
</tr>
<tr>
<td>Daily Weather Report (Cairo, Egypt)</td>
<td>P/R</td>
<td>Egypt and surrounding countries</td>
<td>1/1920</td>
<td>12/1956</td>
<td>68,072</td>
</tr>
<tr>
<td>Boletim mensal das observações meteorologicas</td>
<td>P/R</td>
<td>Mozambique</td>
<td>1/1937</td>
<td>12/1956</td>
<td>27,402</td>
</tr>
</tbody>
</table>
However: also many short/small but interesting records digitised

i. Expeditions
   - German East Africa Expedition 1908
   - Swiss Greenland Expedition 1912/13
   - Norwegian North Polar Expedition with the “Maud” 1918-25
   - German Atlantic Expedition with the research vessel “Meteor” 1925-27
   - Greenland Expedition of the Univ. of Michigan 1926-31
   - German Greenland Expedition 1930/31
   - Byrd Antarctic Expeditions 1928-30, 1930-35
   - Canadian Polar Year Expeditions 1932/33

ii. Reports of the Harvard, Lindenberg, Blue Hill, Mt. Weather, Samoa, Batavia, Helwan astronomical/meteorological/magnetic observatories

iii. Early E Asian data (China, Korea) from 1930s and WWII
Highlights of historical upper-air data digitised at Univ. Bern

German E Africa Expedition, 1908

Talk by S. Brönnimann @ 3 p.m.: Historical Upper-air Data from Expeditions to the Tropics and Comparison with the Twentieth Century Reanalysis

Temperature profiles from balloon ascents made by ASSMANN in Lindenberg in 1901 and 1902 (blue) and by BERSON in East Africa in 1908 (red), Brönnimann & Stickler (Met. Z., 2013)

Berson (1910)
Highlights of historical upper-air data digitised at Univ. Bern

Polar Expeditions

- **Canadian Polar Year Expeditions**, 1932-33, Met. Services of Canada (1940)
- **Swiss Greenland Expedition**, 1912/13, de Quervain (1920)
- **German Greenland Expedition**, 1929-31, Holzapfel et al. (1939)
- **Univ. of Michigan Greenland Expedition**, 1926-31, Hobbs & Fergusson (1931)
- **Byrd Antarctic Expeditions**, 1928-30 & 1933-35, Grimminger & Haines (1939)
Highlights of historical upper-air data digitised at Univ. Bern

**German Atlantic Expedition with R/V Meteor, 1925-27, Kuhlbrodt & Reger (1933)**
Highlights of historical upper-air data digitised at Univ. Bern

Bull. of the Mt. Weather Obs., USA, 1907-12
Planned contribution of Univ. Bern to ERA-CLIM 2

> Proposal for 3-yr follow-up project accepted
> More project partners, broader scope
> Goals:
  — Extended climate reanalysis of the 20th century, with consistent descriptions of the global atmosphere, ocean, land-surface, cryosphere, and the carbon cycle
  — New reanalysis of the satellite era with near-real time data updates for climate monitoring
  — Continued data rescue and homogenisation efforts
Planned contribution of Univ. Bern to ERA-CLIM 2


- Pilot balloon, radiosonde and aircraft data from Egypt, India and Pakistan incl. surrounding regions
Planned contribution of Univ. Bern to ERA-CLIM 2

Daily Weather Report (Germany) (9/1920-1934 & 1939-45)

1904-19 already digitised

Pilot balloons, registering balloons and aircraft in large parts of Europe, incl. some data from ships

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Planned contribution of Univ. Bern to ERA-CLIM 2

> Lindenberg Observatory 1903/04

<table>
<thead>
<tr>
<th>4. Febr.</th>
<th>5. Febr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.20p</td>
<td>12.20a</td>
</tr>
<tr>
<td>32</td>
<td>50</td>
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<td>90</td>
<td>500</td>
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<td>20</td>
<td>1000</td>
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<td>21</td>
<td>1135</td>
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<td>40</td>
<td>200</td>
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<td>766.9</td>
<td>752</td>
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<td>751.5</td>
<td>725.5</td>
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<td>5.4</td>
<td>1.7</td>
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<td>6.4</td>
<td>5.7</td>
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<tr>
<td>82</td>
<td>88</td>
</tr>
<tr>
<td>SW5</td>
<td>W</td>
</tr>
<tr>
<td>Barometer steigend.</td>
<td>Bew. 100 Unterwolken, ni. Tiefste Temperatur in 1000 m. Von 2.30 ab ⊗. In etwa 1000 m mehrfach Böen, die den Drachen herunterwarfen.</td>
</tr>
<tr>
<td>WNW</td>
<td>WNW</td>
</tr>
<tr>
<td>1 Drachen (4 m²), 2000 m Draht.</td>
<td>Wind unter WSW 5. Bew. 100 Unterwolken in 500 m, ni. ⊗1. Zwischen 500 und 750 m isotherm. Bar. 767.6.</td>
</tr>
</tbody>
</table>

1901-02 already digitised

Kites & registering balloons

Longest, almost uninterrupted upper-air record worldwide
Planned contribution of Univ. Bern to ERA-CLIM 2

> Very early balloon observations:
75 manned “Berliner Luftfahrten”, 1888-1899 captive balloon “Meteor” and balloonsondes

Earliest inventoried upper-air records

Photo: 1st flight of manned balloon „Herder“ on 23 June 1888 from Berlin to Bunkenburg (close to Celle, N Germany, 215 km)
Planned contribution of Univ. Bern to ERA-CLIM 2

> Aerological observations (Netherlands) (1926-40)

Aircraft ascents at 3 stations + 1 yr daily observations at Reykjavik
5 pilot balloon stations + 1 yr 2-3 daily obs in Tasiilaaq (Greenland)
Planned contribution of Univ. Bern to ERA-CLIM 2

> International Days (1923, 1925-28)

1923: pilot balloons from many regions worldwide, additionally kites, reg. balloons and aircraft from Europe incl. Russia and North America

1925-28: pilot balloons from 315 stations worldwide, 8 kite stations in the US and Soviet Union, 58 reg. balloon/aircraft stations
Thank you for your attention!