MeteoSwiss Payerne:
Surface and Upper Air Developments

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Lindenberg 27.02.2008
GRUAN meeting
GCOS Reference Upper Air Network

• « …providing the foundation for long-term datasets used to reliably monitor and detect emerging signals of global or regional climate change… »

Some history around the MeteoSwiss time series available
1921: Observatory Arosa:
Ozone Layer time series...since then
...and some additional Brewers on the same site...
Total Ozone 2000 vs 1926-1970
75 years of continuous Ozone time series @ Arosa

Yearly Means, 1926 - 2000

Trend 1979-1997: -3.4 %/decade

Mean 1926-1979: 330 DU

Source: MeteoSwiss, Switzerland
UV index over Switzerland
Radiosonde in Switzerland over the last decades...

- 1942: Start of regular radiosoundings
- 1954: 4 Soundings/day
- 1968: 3 Ozone soundings/week
- 1990: Introduction of new SRS-400
- 2001: Change of Ozone sensor (BM->ECC)
...and QA assessment over the decades: Radiosonde Intercomparisons

- 1950: 1. Internat. WMO Radiosonde Intercomparison
- 1956: 2. Internat. WMO Radiosonde Intercomparison
- 1978: ASOND-78 (ALPEX) [ETHZ, Vaisala, etc.]
- 1980: ASOND-80 (ALPEX) [ETHZ, Vaisala, etc.]
- 1992: PREFRS (Crawley, UK) [UK Met Office, NASA, MeteoSwiss]
- 1993: SONDEX93 [UK Met Office]
- 1996: SONDEX/OZEX [NASA]
• First world comparison of radiosondes: at Payerne, 1950
• Second one at Payerne in 1956
• Reports are still available
Radiosonde results, 1950

- Within 95% of the cases, the differences between the data given by any two sondes on the same flight are not greater than:
  - 15 hPa
  - 2 degrés Celsius
  - 20% R. H. up to 700 hPa
  - 1% of the height of a given pressure level

- NB: the analyses were limited to 100 hPa (16 km)
Global Criteria for Tracing the Improvement of Radiosonde Performance over the last 2 decades

Temperature bias at 10 hPa, day

- UK 1984 Phase I
- USA 1985 Phase II
- URSS 1989 Phase III
- Japan 1993 Phase IV
- Brazil 2001 Phase V
- Mauritius 2005 Phase VI
Temperature bias at 10 hPa, day and night times

-4 -3 -2 -1 0 1 2 3 4

Temperature difference (Degree C)


UK 1984 Phase I
URSS 1989 Phase III
Brazil 2001 Phase V
Std. Dev.

USA 1985 Phase II
Japan 1993 Phase IV
Mauritius 2005 Phase VI
Envelope
Gravitational height bias at 10 hPa (night and day for all Phases)

Geopotential height difference (m)

- UK 1984 Phase I
- URSS 1989 Phase III
- Brazil 2001 Phase V (versus GPS)
- USA 1985 Phase II (versus radar)
- Japan 1993 Phase IV
- Mauritius 2005 Phase VI (only GPS)

Stand. Dev.

Envelope
Statistics of U comparisons from all flights
Statistics of V comparisons from all flights
Vaisala temperature cools least on emerging from top of cloud, whilst all relative humidity sensors were contaminated for a significant time after emerging from the cloud.

Vaisala temperature cools least on emerging from top of cloud, whilst all relative humidity sensors were contaminated for a significant time after emerging from the cloud

Top of cloud indicated by the start of evaporative cooling of the temperature sensors
Aerosol backscatter and extinction

PRR method

\[ \beta(R) = \alpha \beta_{PRR} \frac{P_{El}(R)}{P_{PRR}(R)} \]

\[ \alpha_{aer} = \frac{1}{2} \frac{d}{dR} \ln \frac{O(R)N(R)}{R^2 S_{PRR}(R)} - \alpha_m(R) \]

\[ O(R) = k \frac{S_{NFV}(R)}{S_{BFV}(R)} \]

GRUAN_Payerne_MeteoSwiss
Aerosol channel

Nd:YAG - 30 Hz
400 mJ @ 355 nm
Aerosol PRR polychromator

Separates PRR from elastic signal
Combines four PRR bands
Suppresses the elastic noise in PRR channels ( > $10^8$ )
Aerosol channel

Elastic telescope

Double grating polychromator

PRR filter and fiber holders

Grating
Fig. x. Linear fit of RALMO and Vaisala vertical water vapor mixing ratio profiles.

Linear regression using the following model:

\[ Vaisala(RALMO) = a \cdot RALMO + b \]

Coefficients (with 95% confidence bounds):  
\[ a = 24.7 \quad (24.54, 24.87) \]
\[ b = 0.003915 \quad (-0.01076, 0.01859) \]

SSE: 0.03573  
R-square: 0.9889  
Adjusted R-square: 0.9889  
RMSE: 0.006044
Viz sippican on the SRS 400

Renewal of the radiosonde facility in Payerne expected 2011-2012 (eg. fundings) :

Transition toward a new Water vapor sensor ??
3rd of May 2007, triple day time sounding

- black: temperature
- red: relative humidity:

  = thick line: SnowWhite

  = thinner line: Rotronic
  (replacement for our VIZ/Sippican operational carbon hygristor)

  = very thin line: RS92
Water vapor time series: 3 days

Water Vapor Profiles 12 -14 Dec 2006
He ight, km

wate r vapour, ppmv

Te mper at ur e, deg. C

HO asce nt
HO de scent

FL AS H-B / S R S-C Y S / S W HIGHT
FEB 30, 2021 PAYERNE (S1 N)

TEMPERATURE, DEG. C

HEIGHT KM

WATERVAOUR PPMV
Calibration values defined from the RS92 flight on 1.11.2007 ...never changed since...
- 4 SwissMetNet (SMN) stations at the NPP’s sites (plus 1 SODAR in Leibstadt ?)

- 3 SMN PBL stations on meteorological mast (100 to 250 m agl)

- 3 stations with wind and temperature profilers located upwind, downwind and in the centre of the domain
Wind and Temperature profilers @ Payerne
MeteoSwiss Payerne

- Payerne
  - O3+PTU+wind radiosonde
  - BSRN ref station
  - O3 passive microwave (strato)
  - H2O, T passive microwave (tropo)
  - WPs (tropo)
- JJOch ref site
- Arosa Dobson measurements

A candidate GRUAN site?
…with a companion site from a less favoured country:

Kenya Nairobi
THANKS!