Review of observation impact studies:

The 4th WMO Workshop on the Impact of Various Observing Systems on NWP
Geneva, Switzerland, 19-21 May 2008

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(stolen material from Jean Pailleux and co-authors)

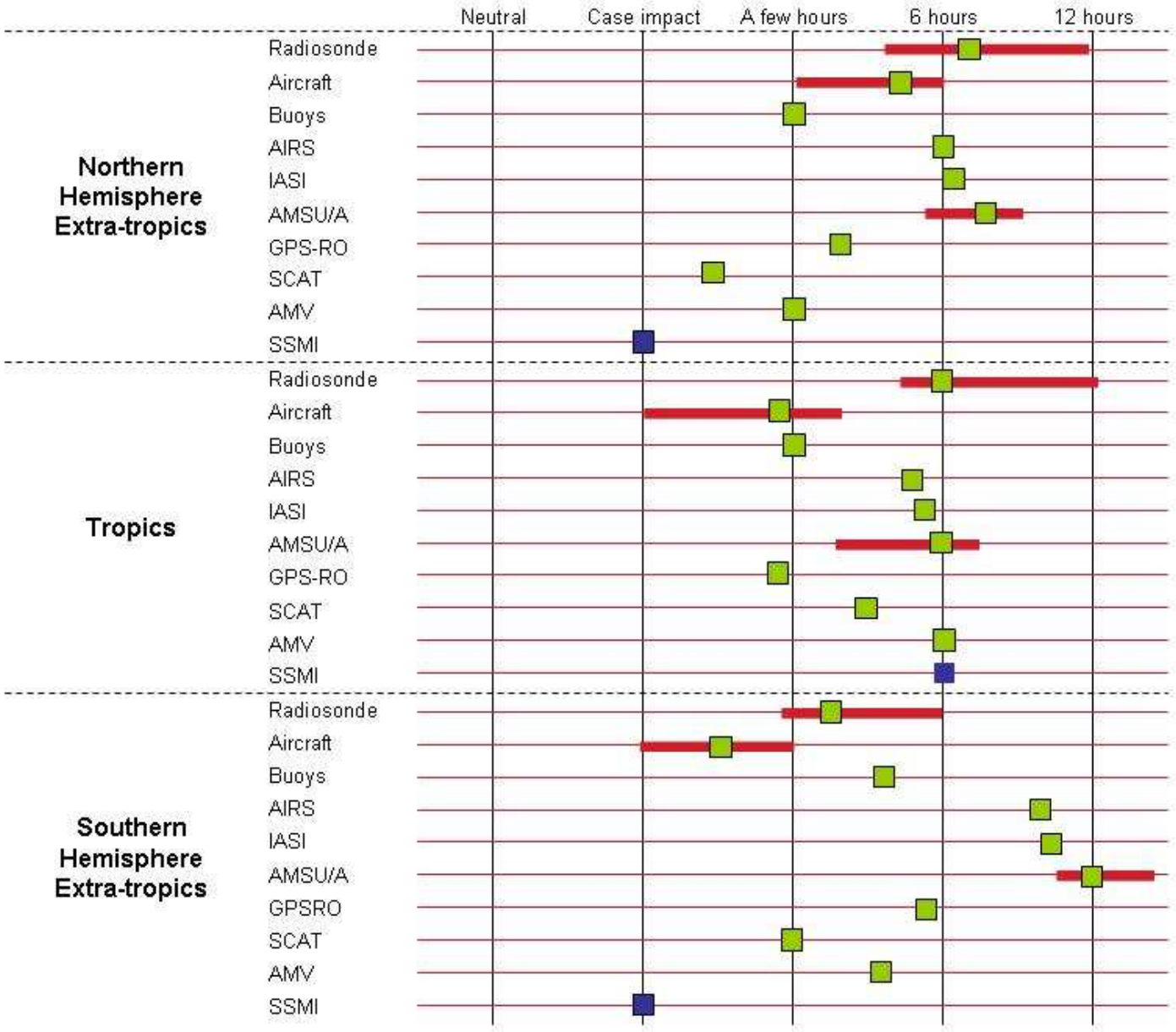
Overview

1. Venue
2. Impact studies in global and regional systems
3. Sensitivity and diagnostics
4. Recommendations

Venue

- About 40 participants (Us, Canada, Europe, Japan, Korea, S.A., Australia, Russia, …)
- Held at WMO headquarters in Geneva
- Follow-up workshop of Geneva (1997), Toulouse (2000) and Alpbach (2004)
- Goals:
  - Assess status of the present G.O.S.
  - Assess tools for O.I.S.
  - Optimal use of the observing system (targeting)
  - Issue recommendations on future requirements for improving the G.O.S.

Global impact studies: synthetic overview



A focus on regional (LAM) OIS … outside the SRNWP area !

- JMA: Doppler radial winds (importance of thinning strategy), RR retrievals from radar, ground-based GPS
- Australia: radiosondes (RS)
- Canada: some RS at high latitudes (where strong air mass contrasts can appear)
- KMA: extensive experiment with extra RS in strong convective rainfall cases + impact of model microphysics
- South Africa: AMDAR, RS
- Specific WRF regional studies over Antarctica and Asia => COSMIC radio occultation, AIRS, MODIS winds, radar radial winds

Regional impact studies: overview

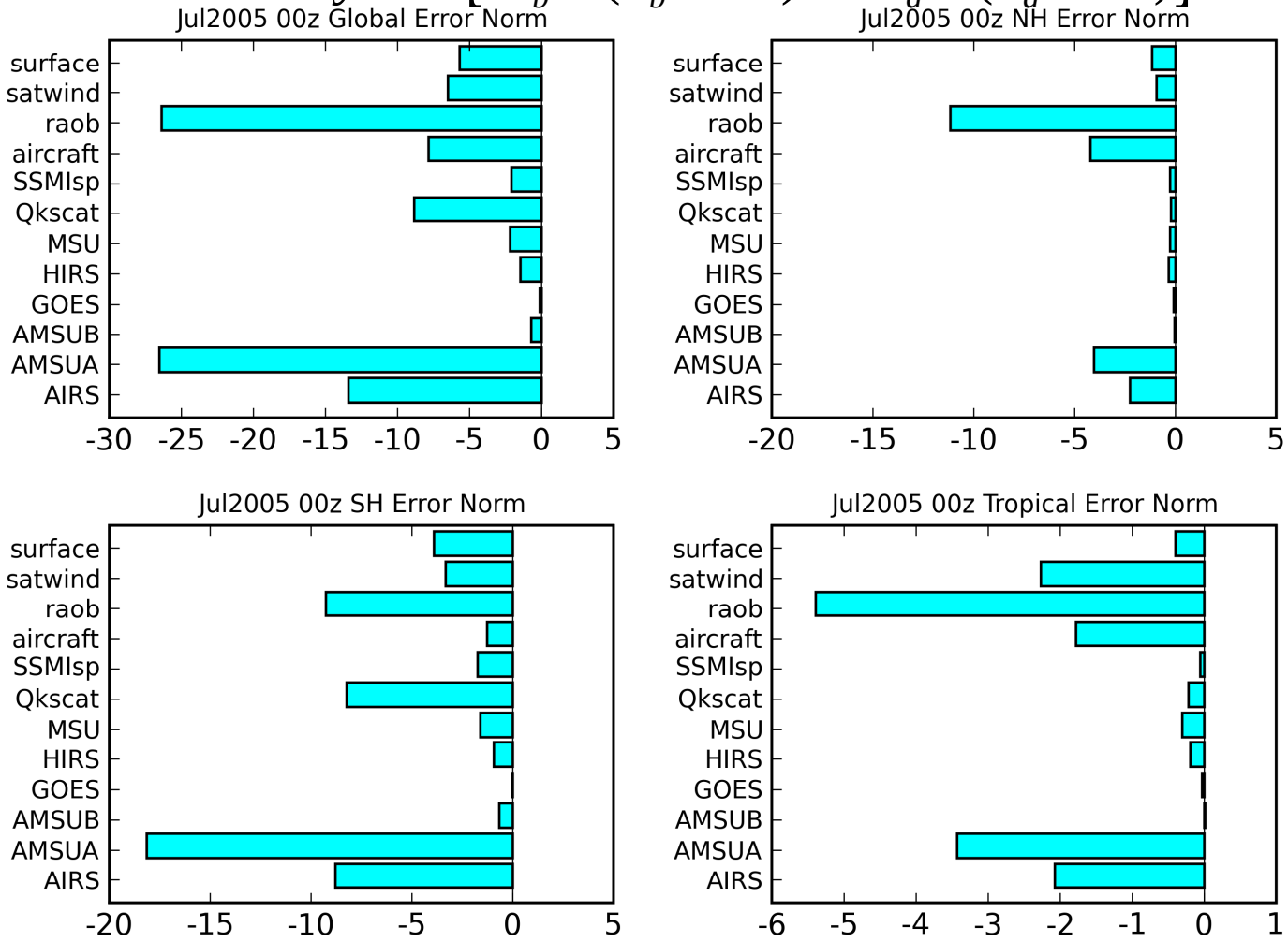
- Radiosondes are relatively more important for regional models than for global models; isolated profiles of wind and temperature (from radiosondes, AMDAR?) are crucial for NWP.
- Radiances from geostationary satellites are used in several regional systems with a small positive impact: there is still a lot of potential to improve the use of this type of data.
- Wind profilers have shown neutral impact on average: slightly positive in some impact studies, slightly negative in others => somewhat disappointing ? => Quality control and screening procedures in data assimilation are issues which affect the results and should be further studied.
- Radar data and GPS surface observations have demonstrated their positive impacts on regional assimilation systems, and on some occasions also on global systems.

Sensitivity and impact measures of observations

- Classical OSE's: assess performance of forecasts after adding or retrieving obs.
- Measures derived from the adjoint of the D.A. obs+model operator:
  - Forecast Impact of Observations (FIO): impact of any obs subset on a selected measure of the short-range forecast
  - Degrees of Freedom of Signal (DFS): assesses the relative weight of different observations in the analysis
- OSE and FIO can be viewed as complementary tools; FIO could possibly pinpoint negative impacts of some observations

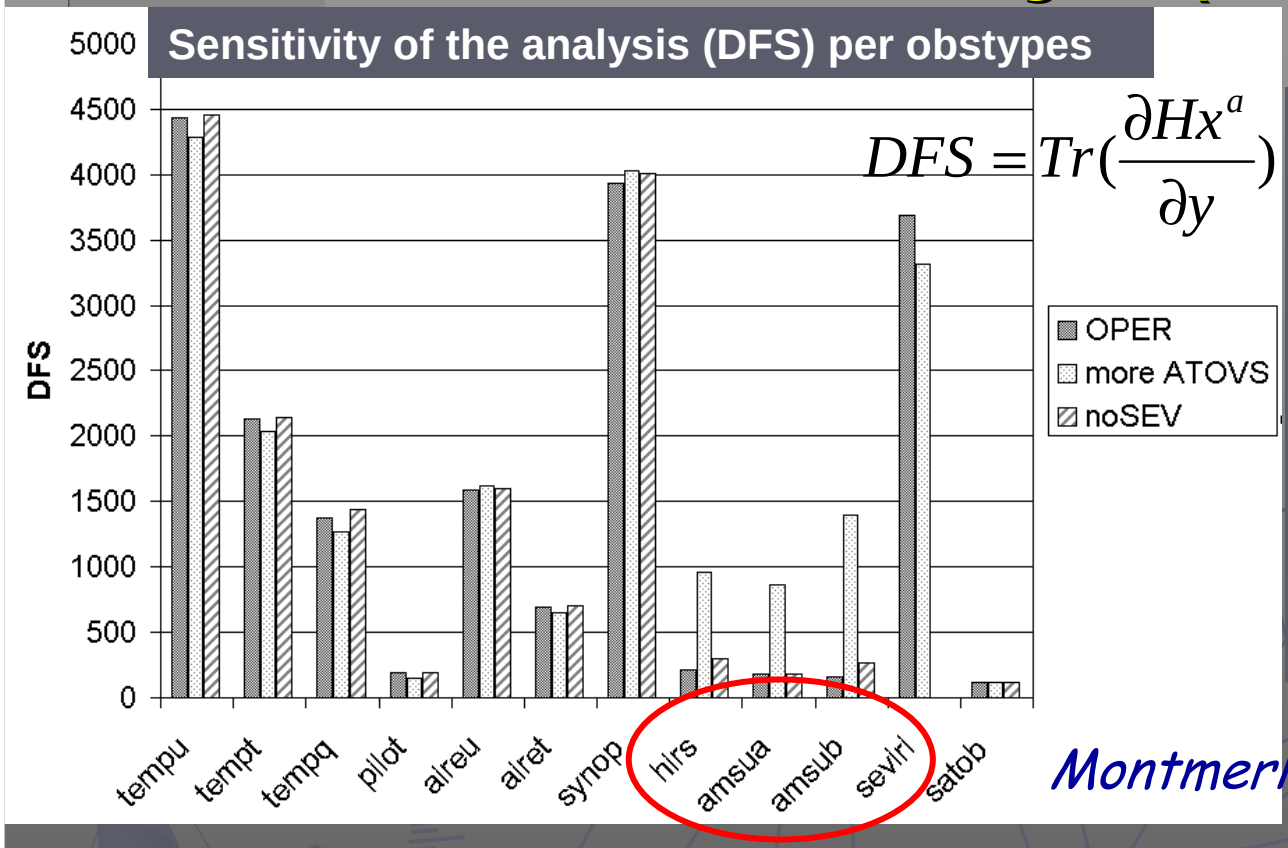
Monthly Total Observation Impact on GEOS-5 24h Forecasts (FOI)

$$\delta e \approx \delta y^T K^T \left[M_b^T C(x_b^f - x^t) + M_a^T C(x_a^f - x^t) \right]$$



(Reduction in energy-based error measure for different regions for 00UTC July 2005)

Impact of radiances as measured by the Degree of Freedom of Signal (DFS)



$$DFS = Tr\left(\frac{\partial H x^a}{\partial y}\right)$$

OSEs:

OPER: ALADIN/France oper

moreATOVS: OPER with **denser ATOVS data** (AMSUA, AMSUB and HIRS) : 1 pixel/80 km vs. 1/250 km)

noSEV: OPER **without SEVIRI**

Montmerle etal,, QJRMS, 2007

⇒ OPER: about equal info. Content for TEMP / aircraft / SYNOP & SEVIRI

⇒ large increase of DFS for ATOVS data (especially AMSUB) for moreATOVS coupled with a decrease for SEVIRI: **the influence of SEVIRI data in the analysis is reduced by the new information brought by extra ATOVS data**

⇒ without SEVIRI data, DFS values for HIRS and AMSUB almost double

Recommendations

- Practically all O.S. show positive impacts in almost all D.A. systems => good overall quality of G.O.S.
- Tremendous activity in regional D.A., exploring new data types
- Exchange of data, even globally:
  - Radar radial winds and reflectivities
  - Ground-based GPS networks
- More efforts needed for a timely transmission of polar-orbiting satellite data
- Additional (to satellites) observations required for coverage of polar regions
- Use all possible opportunities for AMDAR profiles in data-poor regions

Und zu guter Letzt, was ich auf keinem Fall noch die Zeit haben werde, zu sagen ...

- EUCOS program was presented to the participants
- Data Targeting System (DTS) portal
- Situation of RS in Siberia was discussed by the Russian representative (MGO)
- EUMETSAT plans
- Report from THORPEX Data Assimilation and Observing Strategies W.G.