The Fifth WMO Workshop on the Impact of Various Observing Systems on NWP

Sedona, AZ, 22 - 25 May 2012

By the Organising Committee:

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Outline

- **Why the 5th workshop?**
- **Main outcomes**
- **Science questions**
- **Recommendations**

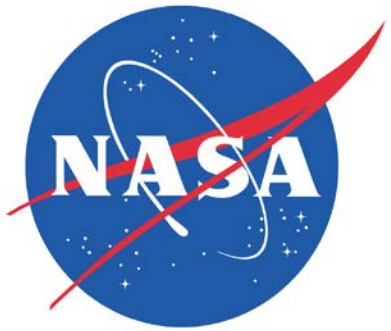
Why the 5th workshop?

- **WMO has sponsored a series of Workshops on the Impact of Various Observing System on NWP:**
  1. **Geneva, Switzerland (1997)**
  2. **Toulouse, France (2000)**
  3. **Alpbach, Austria (2004)**
  4. **Geneva, Switzerland (2008)**
  5. **Sedona, Arizona, USA (2012)**
- **The purpose is to**
  - **Review latest OSE, ADJ, OSSE results**
  - **Inform the evolution of the Global Observing System (WMO)**
  - **Provide guidance for satellite agencies and other providers**
- **Each workshop outcome is documented in a comprehensive WMO report**

The 5th workshop!

- **56 experts from 13 countries participated**
- **Three sessions, each followed by discussion sessions**
  1. **Global forecast impact studies**
  2. **Regional forecast impact studies**
  3. **Scientific questions**

THORPEX
A World Weather Research Programme



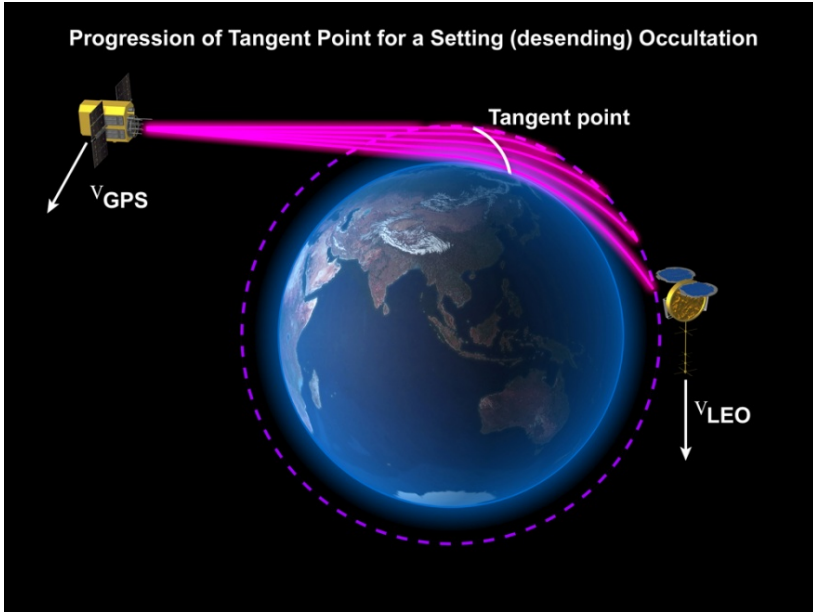
Observation impact in global NWP

- **The highest ranked contributors for the forecast error reductions are:**
  - **AMSU-A, AIRS/IASI, radiosonde, aircraft, AMVs**
  - **GPS-RO also has substantial impact, but the data volume is declining approaching the end of COSMIC lifetime.**
- **Several satellite sensors contribute to forecast skill. There is not a single, dominating one**
  - **More complementarity is seen, compared to previous years.**
  - **The GOS has become more resilient, but this resilience is threatened by expected decline of the operational polar orbiting satellites**
  - **When one observation type is missing or removed the contribution of other systems tend to increase without fully compensating**

Observation impact in global NWP

- **Humidity observations - Increased evidence of beneficial impact**
  - **Questions about defining the appropriate metrics**
- **All-sky radiance assimilation leading to improved impact**
- **Emissivity modelling leads to improved radiance ass. over land.**
  - **Good impact on humidity analysis over tropical area**
- **Additional radiosonde during AMMA campaign**
  - **Have clear humidity impact, locally**
  - **The radiosonde data over Western Africa can reduce the longer range forecast error over Europe (downstream) 2 to 3 days later.**

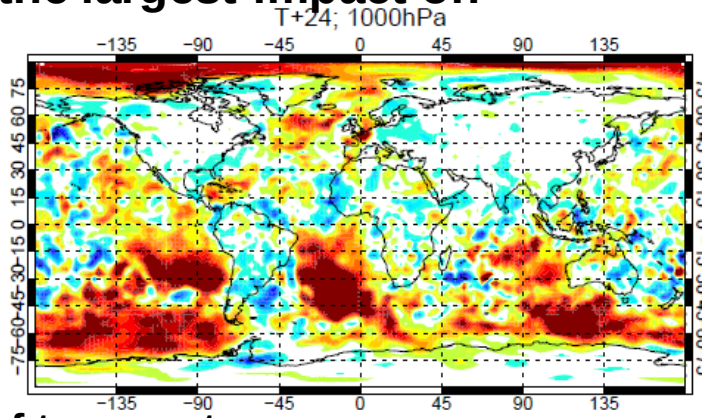
Global impact (cont.)



- **GPSRO**
  - **Has become a critical component of the GOS, through the absolute anchoring of temperature biases at upper levels.**
- **AIRS/IASI and CrIS**
  - **Can be used as reference radiance data (for calibration of other sounders). Such inter-satellite calibration is very important for GOS.**
- **Scatterometers**
  - **Their importance has been demonstrated at previous workshops**
  - **Two scatterometers on well-separated orbits are required.**

Other details from Adjoint FSO studies

- **Conventional observations and GPS-RO have the largest impact on per-observation basis.**
- **The impact of buoy data is particularly large.**



- **On radiosonde and aircraft data:**
  - **The impact of wind components is larger than of temperature.**
  - **Combined impact is larger than single component impact.**
  - **The main impact is found in the troposphere at 200 hPa and below.**
- **Concordiasi campaign over the Antarctica:**
  - **AIRS/IASI has large impact, but difficult to be used at lower levels.**
  - **GPS-RO has good impact in Polar Regions**
  - **Good impact of AMSU-B/MHS is demonstrated with sea-ice surface emissivity modelling**

Regional NWP

- **The observation with highest impact is different**
  - **from global NWP**
  - **among different regional NWP centers.**
- **The beneficial impact of data assimilation was shown in convective-scale NWP, by comparing with “down-scaling”**
- **Substantial progress on data assimilation was reported for:**
  - **Satellite radiances**
  - **Radar reflectivities**
  - **Doppler winds**

Science questions

- **There is a strong requirement for observing system impact assessments coming from both the WMO members (NMHSs), the space agencies and other managers of observing networks**
- **It is essential to keep a visionary outlook, appropriate for the long-term evolution of the GOS and the realisation of the Vision for the GOS in 2025. The observation impact work should not be driven exclusively by the current political and budgetary situation.**
- **There is a general recognition that additional metrics are needed beyond the traditional objective scores such as ACC, RMS error and total energy in the case of FSO. Metrics that are more closely related to high-impact weather and service delivery should be developed and explored.**
- **Study of observation impact on the forecasting of tropical cyclone and other severe weather events deserves particular attention.**

Science questions (2)

Current global observing systems are heavily skewed towards mass observations over wind measurements, especially for the satellite components. And yet many studies presented at the Workshop pointed to a higher than average impact of wind observations, both on a component and on a "per-observation" basis.

- **There is a need to invest in enhanced wind observations in the tropics and over the oceans especially. A relatively cost-effective enhancement would be to increase the collection of aircraft observations.**
- **From the classical atmospheric dynamics view wind becomes increasingly important at smaller horizontal scales and winds become increasingly important at deeper vertical scales.**
- **This is also true in data assimilation, with the additional consideration that accurate analysis of strongly ageostrophic flows (associated with jet entrance and exit regions, and convective clusters for example) requires wind observations also in mid and high latitudes.**

Workshop Recommendations

- **Increase GPSRO to 10K profiles per day**
- **Augment the profiling network e.g. by extending coverage of ascending and descending aircraft observations to regional airports**
- **There is a need to invest in enhanced wind observations in the tropics and over the oceans especially.**
- **Study observation impact that is more closely related to high-impact weather (including TCs) and service delivery to customers and forecast users**
- **Encouraged studies of impact per observing system or per observation linked to their cost**
- **Define appropriate impact metrics for**
  - **humidity and**
  - **regional NWP including precip and other sfc weather elements**