Advanced Sounding

V1.2, 26 March 2012

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Advanced Sounding (1)
Potential observation gaps in geostationary IR sounding

The WMO vision of the GOS in 2025 asks for a complete coverage of infra-red sounders in geostationary orbit; current implementation plans of space agencies only partially consider an implementation.

There is a growing concern of potential observation gaps, particularly over America and the Pacific Ocean

Recommendation to space agencies (e.g. NOAA, Jaxa): Devise plans to fill these gaps.

Advanced Sounding (2)
High spectral resolution MW sounding

Vertical resolution of temperature and water vapour soundings in the microwave region have been limited through noisy receivers. Recent advancements in microwave receiver technology enable high spectral resolution measurements in the microwave regions between 118 and 183 GHz with low noise.

Recommendation to space development agencies (e.g. NASA, ESA, Jaxa):

1. Pursue the development of advanced microwave sounders with high spectral resolution in order to enhance vertical resolution of temperature and moisture soundings under partial and non-precipitating cloud conditions.
2. Extend developments of microwave receiver technology to enable high spectral resolution measurements in the 50-60 GHz region.

Advanced Sounding (3)
Infra-red IFOV size

Along with high radiometric and spectral resolution the user communities need infra-red sounders with higher spatial resolution and denser spatial sampling to increase the likelihood of clear soundings and achieve better spatial sampling of the Field of Regard (FOR), commensurate with finer grid size of future NWP models

With new technological developments the employment of infra-red detector arrays seems feasible, which allow for higher spatial resolution at reasonable noise increase. Increasing horizontal resolution will also demand an increase in vertical resolution. The highest vertical resolution can only be obtained by utilising active techniques such as lidar, radar, and GPS.

Recommendation to space agencies:

1. Conduct studies to trade off benefits of spectral, radiometric, and spatial resolutions of infra-red sounders.
2. Consider the development of active techniques for future systems (lidar, radar, GPS)

Recommendation to NOAA:

1. Develop plans for the next generation infra-red sounders (evolution of CrIS) for the JPSS-2 and follow-on satellites
2. Pursue the development of next generation sounders, which support higher spatial resolution and denser spatial sampling, complementary to the high spectral and high radiometric resolution of IASI-NG; this includes the highest spectral resolution being maintained in all bands and the elimination of band gaps.

Advanced Sounding (4)
Apodisation of CrIS data

While CrIS provides a spectral resolution that is closely adapted to the CO_2 line spacing, the apodisation of the spectra reduces the resolution to an extent that information is lost in radiances of single spectral samples which in turn has a damaging effect on the vertical resolution. Most NWP users today make use of a sub-set of spectral samples and therefore will suffer from lost vertical resolution if they select apodised radiances.

Users must be enabled to access the full hyper-spectral resolution information content of the CrIS data

Recommendation to users(?):

1. Preserve hyper-spectral information in CrIS data by utilising either all CrIS channels or unapodised radiances if a sub-set of spectral samples is utilised;
2. Develop radiative transfer codes for the use with unapodised radiances,
3. Develop radiative transfer codes in PC space and educate users to make use of these in data assimilation (and retrieval);

Or 4. Ensure apodised radiance channel sub-set is representative, i.e. channel subset sufficiently covers spectral band(s) of interest and noise representation includes apodisation and inter-channel correlation

Recommendation to EUMETSAT:

Preserve hyper-spectral resolution information in CrIS data from EARS by either distributing all CrIS channels or disseminating unapodised spectral samples if a sub-set needs to be distributed.

Advanced Sounding (5)
Full resolution CrIS data

While CrIS data are measured at high spectral resolution only spectrally sub-sampled data in mid- and short-wave bands are down-linked from the Suomi NPP satellite and distributed to users. The users desire full-resolution spectra in all three bands to fully exploit the data.

Recommendation to NOAA:
Down-link full resolution data from the CrIS instrument and distribute it to users.

Advanced Sounding (6)
Data compression

Future high-resolution sounders will provide data volumes that demand data compression for space-to-ground links as well as for ground transportation. Compression techniques must be exploited to reduce data transmission costs.

Action to ITWG: Report current state of compression techniques.

Recommendation to space agencies: Pursue advancement of loss-less compression techniques for hyper-spectral sounders.