MTG – IRS Science Plan

3. Support for operational meteorology

- Comprises assimilation for the **full range of NWP from global to high resolution convection resolving models**, applications for **NWC** as well as **evolving systems merging NWP and NWC methods for seamless predictions** from observation time to hours and days *(ref.: SINFONY ..).*
- Strong overlap of methods to the ones used with established hyperspectral data from polar orbiters *(ref: IASI-NG science plan)*
- As geostationary hyperspectral **MTG-IRS offers especially**
    - **very high temporal sampling** with high spatial resolution, allows better understanding and model validation of representation of diurnal cycle
    - enhances applications in **NWC and very short range forecasting**, analyses of temporally evolving structures, evolution of pre-convective situations, wind fields
    - potential for **much better definition of humidity and wind fields, key potential esp. for low latitude areas/tropics**, large expected benefits for global and convection-resolving NWP
- Applications, esp. for **NWC and convection-resolving short range forecasts,** imply very short cut-off times for data usage, i.e. **strong constraints on data timeliness, ideally NRT data generation no later than 15 min.. (current requirements stated in EURD:**

3.1 NWP

3.1.1 Use of temperature, humidity, cloud and trace gas information:

- Assimilation of data in the form of
    - Radiances either as **reconstructed radiances or PC scores** *(ref: Matricardi et al. …, Smith, …, May et al.,…)* based on the operationally distributed PC compression of the full spectra. Alternative of raw radiances limited for users receiving the full spectrum.
    - **Transformed retrievals** (scaled projected state *(ref.: Migliorini),* or retrievals with full error covariances/averaging kernels.
      Tests performed with transformed retrievals produced by operational EUMETSAT L2 processing, using e.g. ECMWF prior *(ref: Antonelli, KNMI, MF, ECMWF)* and retrievals based on the same NWP model *(ref: MO plans).*
- Key challenges:
    - **Using the full spectral information** at high spatial and time resolution whilst **meeting stringent time constraints** of operational forecasting/WP run time schedules. This will partly guide the choice and technical setup of the assimilation method used.
    - **Full use of data over land** (Ts, emissivity retrieval), **esp. for many regional high-resolution models for short range forecasting** and as basis for merged NWC NWP methods *(ref.: Pavelin, …)*

- **Assimilation of cloud affected data; using information on scene heterogeneity** provided through the onboard imaging channel at higher resolution and possibly from the FCI on MTG-I platform.
- **Improvement of diurnal cycle representation in models for atmosphere, clouds and convection and surface/soil variables** to allow successful assimilation
- Data and radiative transfer accuracy: further improvements in fast and precise radiative transfer *(e.g. ref RTTOV, …)* relying on accurate line-by-line models *(e.g. ref LBLRTM, others …)* and updates of spectroscopy.
- **Use of data with high zenith angles, slant path assimilation** and preparation of RT models for this geometry *(ref.: Bormann,…; August,…)*
- **Technical support** for users provided e.g. through the NWP SAF with **packages like RTTOV** *(ref: ….)* offering fast radiative transfer (e.g. IRS included since RTTOV v.xx) and **IRS-PP** offering decoding, transformation from PC scores to RR and between different PC vector bases, applying different apodizations, …

3.1.2 Use of implicit wind information esp. from tracing WV structures

- Assimilation of data likely relevant in two forms:
  - **direct derivation through implicit tracking in DA systems** *(ref: 4DVar/Lupu et al., ensemble based DA systems/Pondrom et al....)*
  - **ingestion of derived AMVs as L2 product** as with current AMV products from GEO and LEO satellites *(ref: methods: classical methods, applications …)*;
- Challenges for use of L2 wind product:
  - **establishment of best tracking methods** to yield good coverage,
  - dependence on retrieved L2 humidity fields in case of tracking retrieved humidity structures,
  - **evaluation of error characteristics of L2 products** (esp. error correlations)

3.2 Nowcasting & very short range forecasting

- Several areas of key interest exploiting IRS potential:
  - Location of areas with the **potential for heavy convection (instability)** at sufficiently high spatial resolution with a **focus on its evolution during the day** to enhance prior warning times for heavy convection. IRS information **complementary to FCI due to much better vertical profile and stability information.**
  - **3D fields of humidity**, potentially low level humidity ? (based on characteristic lines in spectrum)
  - **3D wind field**
  - **Aerosol products (e.g. for radiation forecasts)**
  - Use of products to **complement observations for NWC/VSRF** and in systems under development combining NWC and NWP techniques for the first forecasting hours which provide guidance on phenomena not sufficiently represented in the available

NWP forecast. Products are also important for the validation of the available model forecast. **Stringent time constraints.**

- **Need for combined products integrating information from FCI and IRS**, to be achieved either in product generation or in the systems developed at NMSs. Ere , more research is needed *(any ref: ?).*

- **Efforts to establish operational forecaster use of profile retrievals:**
  - Satisfy **forecaster needs for model independent information** whilst providing them with the best vertical resolution information. Ongoing studies with EUMETSAT operational algorithm using either **FCT or PWLR prior** *(ref: evaluation studies…)*
  - Forecaster training and development of technical interfaces to use products *(ref: MTGUP!)*

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