ATMOS Discussion Day 2

Ed Malina, ESA/ESRIN, 02/05/2024

→ THE EUROPEAN SPACE AGENCY

- Given the context of the studies shown in today's presentations, what can ESA do to help consolidate and enhance on-going work

- By ATMOS 2027, numerous GHG sensitive missions will be in orbit (e.g. Sentinel-5, CO2M), what can ESA to do help the Atmospheric Sciences communities to prepare for the data and undertaking scientific activities.

- How can ESA leverage advanced technologies e.g. cloud computing or AI/ML to further enhance retrieval algorithms.

- How can ESA interface with non-ESA missions, for example GHGSat, MethaneSAT, GOSAT-GW, and what do the community expect from these interactions?

- What new scientific studies were missing from today's agenda, and what new studies should ESA support?

Estimating CO2 emissions from global megacities using GOSAT lower troposphere partial column CO2 and TROPOMI NO2 - A. Kuze (JAXA)
- Effective split between LT and UT in GOSAT data
- Usage of NO2 for plume direction and wind speed

Global distribution of methane in the mid-troposphere as seen by IASI onboard three successive Metop platforms - N. Meilhac (Fx-conseil/lmd)
- Long-term IASI datasets from multiple IASI plattforms
- **AirCore data are very useful for validation, especially for sub-columns**
- Jump in IASI data in 2014

Results from greenhouse gas retrievals for the CO2M mission using the FOCAL method - S. Noël (University of Bremen)
- CO2M Algorithm FOCAL: proven on OCO-2, GOSAT-1 & GOSAT-2
- **Continued scientific support (L2 algo for CO2M) going into Phase E1/E2.**

Greenhouse gas retrievals for CO2M with the University of Bremen optimal estimation FUSIONAL-P algorithm: Expected performance on simulated orbits - A. Di Noia (University of Bremen)
- CO2M Algorithm FUSIONAL-LP: Combination of MAP and SWIR from CO2I to retrieve aerosol information
- **Need for validation of aerosol properties in SWIR wavelengths**

Combination of multi angular-polarimetric and SWIR spectrometric measurements for the simultaneous CO2, CH4 and aerosol retrieval in GRASP algorithm - M. Herreras-Giralda (GRASP-SAS)
- New combined MAP+SWIR retrieval based on GRASP will be developed for S5
- Computationally demanding to have this GRASP retrieval

Global satellite survey of landfill methane emissions - M. Dogniaux (SRON)
- Landfill emissions: a global-scale survey plus focus on urban areas
- Most emissions from active landfill areas
- **Further studies needed to fill gap between inventories and top-down involving all different players (including operators)**

A multi-year global synergetic satellite product of tropospheric CH4 - K. Shahzadi (KIT)
- **Combined products are needed to disentangle free tropospheric and lower tropospheric signals**
- Global synergetic tropospheric product from SWIR+TIR with increased surface sensitivity compared to IASI alone

Using TROPOMI observations to derive methane emissions and its driving factors over Lake Chad - M. Liu (KNMI)
- Estimation of methane emissions with divergence method
- **Focusing on methane in African wetlands. Need to combine and make easier available the official wetland products from EO to methane community.**

Summary:

- UNEP-IMEO MARS automatic methane emission notification and mitigation process has been launched and piloted successfully. After one year of pilot, 300 emissions have been notified.

- MethaneSAT has been launched and commissioning phase just ended. As an area mapper the mission will fill the gap between methane detection by global and local mapping. Emission products will be freely available.

- TANGO is a new ESA Scout mission to measure CO_2, CH_4 and NO_2 with two cubesat satellites with 300 m spatial resolution and 30x30 km image. Data and software will be open. Launch in ~2027.

- The approach to assess the GHGSat uncertainties are based on empirical analysis of the background noise that depends on the surface albedo. Emission detection limit and estimation accuracy are studied by controlled methane releases. Wind remains to be large source of uncertainty even if measured at the site.

- AVIRIS-NG flight campaign was conducted in 2021 to estimate emissions from oil and gas industry in Romania. It was highlighted that airborne imaging spectrometers are excellent tools for characterizing superemitters, with AVIRIS-NG they identified in two days 40% of the reported emissions.

Recommendations:
- Continue with studies related to simultaneous retrievals of CO_2 and NO_2 from satellites. Relevant for Paris Agreement related applications including CO2M, etc.

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- Continue with using various satellites to obtain information on important methane sources even for challenging applications such as offshore sources.

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- Continuity needed (e.g., beyond SMART-CH4 and MEDUSA) for using several satellites to obtain information on various important methane sources, including detailed comparisons, etc.