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Low troposphere monitoring with TRAQ Mission

T. Phulpin, B. Beghin and P. Hebert
Centre National d’Études Spatiales (CNES), C. Camy-Peyret (LPMAA), C. Clerbaux (SA), J. Hadji-Lazaro (SA), P.-F. Coheur (ULB), J.-F. Leon (LOA), L. Lavananat (CMS), P. Levell (KNMI)

Air Quality Monitoring from space

- With cross-validation techniques only key species like the NO₂ or SO₂ are well retrieved from IASI sensors, but there is still some disagreement between products. The O₃ estimate is good in the stratosphere but not so satisfactory in the troposphere. Some promising results have been obtained with TES. CO is retrieved with good precision by MOPITT. First encouraging results for CO and CH₄, CO and O₃, have also been presented by S-GSAMMV. Simultaneous satellite products from TES/IASI/MOPITT/SM3/NDACC are available.
- Studies to define proper tropospheric missions are slow in progress. There are noticeable differences between the requirements of C - CAPACITY, MTG and IGACO.
- Access to low tropospheric trace gases and microparticles has to be promised.

The instrument was designed by CNES and manufactured by Alcatel, with co-funding from CNES. MetOp series (European polar meteorological satellites) from 2006 to 2020.

PARASOL
- The satellite is a micro-satellite in the A-Train. The instrument is the follow-up of POLDER on ADEOS 1 and 2. Its main characteristics are.

TRAP PAYLOAD
- OCAPI is a multi-channel imaging radiometer polarimeter. It inherits from POLDER/Parasol but with higher spatial resolution and MODIS (SWIR channels)
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CONCLUSIONS
- To get profiles of polluting species and specially low tropospheric contents, thermal infrared spectrometers are deemed necessary along with UV-VIS sensors. Shortwave infrared is also useful to get CO in the boundary layer.
- Multidirectional polariometry is the only spaceborne technique available to detect aerosol micro-particles and should be included in a payload devoted to Air Quality monitoring.
- TRAQ is a mission offering the opportunity of improving our knowledge on Air Quality but also allowing to define the characteristics of a future operational mission within the GMES framework.

Simulation of performances:

- The gain in resolving cloud screening has been estimated using 5km strata and a dedicated aerosol mask. This is done for typical cloud coverage at different seasons.
- Hole-filling: Classified Clouds occurrence with dedicated aerosol mask. Emerging in local validation.
- Satellite FOVs per pixel and sub-pixel footprint (1 km²).

FOCUS
- High revisit frequency: typically every two hours during daytime
- Low troposphere profiles: Access to primary pollutants in the BL, specially NO₂, SO₂, CO, VOCs and O₃
- Micro-particles: PM10, PM2.5 or total burden

LOW ORBITS WITH HIGH REVISIT OVER MID-LATITUDES
Several types of orbits were studied: GEO, MEO, Molnya, LEO
The ones offering the best trade-off afford a revisit of 2 hours in a phased inclined orbit already studied at CNES for:
- JUICE: the orbit is a 1200 km, inclined at 64°, 1-hour phased orbit
- TRAC: A dedicated orbit was studied for TRAC proposal to SGA Earth Explorer.

Technical issues are power availability and consistency with data acquisition cycles. Solutions like yaw steering or yaw flip are well-mastered by CNES.

Main requirements
- The spatial resolution is 12 km with a basic sampling every 12 km. The spatial resolution is decided by pointing to the cloud field as determined in real time by an improved sub-pixel cloud detection algorithm (CLIM, CLIM, intelligent pointing).

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