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TROPOMI on the ESA Sentinel-5 Precursor: Global Observations of the Atmospheric Composition for Climate and Air Quality Applications

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The ESA/GMES Sentinel-5 Precursor is the first of the Sentinel missions dedicated to atmospheric composition monitoring for climate and air quality applications. The payload of the Sentinel-5 Precursor is the TROPOspheric Monitoring Instrument (TROPOMI) nadir viewing shortwave spectrometer. TROPOMI is an initiative from The Netherlands and is developed in cooperation with ESA. The Sentinel-5 Precursor mission will extent the current data records from OMI (Ozone Monitoring Instrument) on NASA EOS Aura and SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CartograpHY) on ESA Envisat and is the link between the current scientific missions and the operational Sentinel-4/-5 missions. TROPOMI will make daily global observations of key atmospheric constituents, including ozone, NO_2, SO_2, CO, CH_4, CH_2O and aerosol properties.

TROPOMI will measure the UV-visible wavelength range from (270-500 nm), the near infrared (710-770 nm) and the shortwave infrared (2314-2382 nm). In the UV-visible and near infrared the spectral resolution is 0.5 nm, except for the wavelengths below 300 nm, where the spectral resolution is 1.0 nm. In the shortwave infrared the spectral resolution is 0.25 nm. TROPOMI will have an unprecedented spatial resolution of about 7x7 km^2 at nadir. The spatial resolution is combined with a wide swath to allow for daily global coverage. The high spatial resolution serves two goals: (1) emissions sources can be detected with more accuracy and (2) the number of cloud-free ground pixels will increase substantially. The latter is especially important for TROPOMI data products that are very sensitive for cloud contamination, such as the methane product. In addition to an improved spatial resolution, also the signal-to-noise of TROPOMI will be improved as compared to OMI and SCIAMACHY.

The Sentinel-5 Precursor will be launched into a Sun-synchronous early afternoon orbit. By using this orbit, the TROPOMI data can be used together with the GOME-2 (Global Ozone Monitoring Experiment 2) measurements in the morning to detect diurnal variations. This has already been demonstrated for NO_2 using OMI and SCIAMACHY observations. Over Europe, the diurnal variations will be observed by the geostationary Sentinel-4 mission after 2018. It is planned to fly the Sentinel-5 Precursor within 10 minutes of the USA NPP/JPSS missions. The high spatial resolution imagery of the VIIRS (Visible/Infrared Imager Radiometer Suite) instrument onboard of NPP/JPSS can be used for additional information on clouds and aerosols, which is especially important for the retrieval of methane, but can also improve the quality of several other data products.

This contribution presents the TROPOMI science and mission objectives, the mission and the instrument, and the data products. While building on a solid foundation of the heritage instruments, TROPOMI mission is an exciting step forward with a strong focus on the troposphere. This is achieved by a combination of a high spatial resolution, improved signal-to-noise, as well as dedicated data product development. It is anticipated that the Sentinel-5 Precursor mission will make a large contribution to the monitoring of the global atmospheric composition, as well as to the scientific knowledge of relevant atmospheric processes.