Advanced tropospheric ozone monitoring by data fusion and assimilation

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Ozone is a significant greenhouse gas that is formed and destroyed by chemical reactions involving other species in the atmosphere and a key constituent for understanding the interactions between climate and chemistry. In contrast to most GHGs, tropospheric ozone is produced photo-chemically via its precursors, notably nitrogen oxides, carbon monoxide, CH4 and non-methane hydrocarbons, all of which have large anthropogenic sources. Crucial uncertainties however remain in the assessment of the tropospheric ozone budget, its precursors, and the chemical and physical processes involved. Large spatial and temporal variability is observed in tropospheric ozone, resulting from important regional differences in the factors controlling its concentration. For all these reasons, accurate global measurements of ozone vertical profiles are essential. Instruments developed over recent decades to monitor ozone from space exploit a large range of observation geometries and spectral regions. However, due to the inherent limitations of each space-borne measurement technique, none of the existing systems can cover the needs for accurate ozone observations from the surface up to the mesosphere. AURORA (Advanced Ultraviolet Radiation and Ozone Retrieval for Applications) is a three-year project supported by the European Union in the frame of its H2020 Call EO-2-2015 with the overarching objective to simulate the provision of synergistic data products, having unprecedented accuracy, for the vertical profiling of atmospheric ozone and to assess their quality with respect to the one expected for the operational products of the geostationary (GEO) mission Sentinel-4 and of the Low Earth Orbit (LEO) missions Sentinel-5p and Sentinel-5. The main scientific purpose of AURORA is to investigate the potential of synergistic exploitation of complementary measurements of ozone acquired in different spectral regions – from the UV over the visible to the thermal infrared - through the assimilation of fused GEO and LEO ozone profile products resulting from application of an innovative data fusion method. The impact of combining complementary capabilities of the atmospheric Sentinels observations, especially in terms of vertical sensitivity, might result in advanced performances that are of specific relevance for tropospheric ozone monitoring. An extensive ozone product validation system is being developed in the frame of the project to assure that the AURORA ozone profile and tropospheric ozone data products will be warily verified and documented by means of thorough QA/validation studies. In a longer term perspective, demonstration of successful application of the AURORA concept to ozone might foster further scientific and technological developments towards exploitation of this innovative approach for other GHGs monitoring.