Satellite Data for Verification of Air Pollution Modelling Results

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Several huge copper-nickel smelters in the Russian Arctic are continuously emitting large amounts of sulphur dioxide (SO_2) into the atmosphere. Due to atmospheric transport, dispersion, and deposition these emissions negatively influence at multi-scales on the environment and population health. Multi-scales and -processes modeling of air pollution is the modern research tool to support a decision-making process, and especially, for environment protection. However, here the important issue is verification of such modeling results, because of big distances at which pollution is transported by atmospheric flows, uncertainties and unknown parameters, broad range of modelling scales and process considered, etc. In recent year, the observations carried out by different satellites, or remote sensing data became more available for evaluation of the models performance.

The SRCES team involved in the TRAKT-2018 project (see photo) is actively using remote sensing data and modern Geographic Information System (GIS) tools for various assessment studies (*Tronin et al., 2009; Kalabin et al., 2018*).

In particular, there is OMSO2e AURA satellite, specially designed for the SO_2 daily concentration mapping globally (Fig. 1). AURA (details at aura.gsfc.nasa.gov) obtains measurements of key chemical species, gases and aerosols throughout the atmosphere.

Additionally the SENTINEL 5P European satellite with advanced technical specifications was launched in 2017. The SENTINEL-5 mission is part of the European Earth Observation Programme "Copernicus" (coordinated and managed by European Commission). Satellite is focused on air quality and composition-climate interaction; and its main mission objective is to measure anthropogenic and natural emissions of the main tropospheric pollutants such as O_3, NO_2, CO, CH_4, HCHO, CHOCHO, SO_2 and aerosols (see more details at sentinel.esa.int/web/sentinel/missions/sentinel-5).

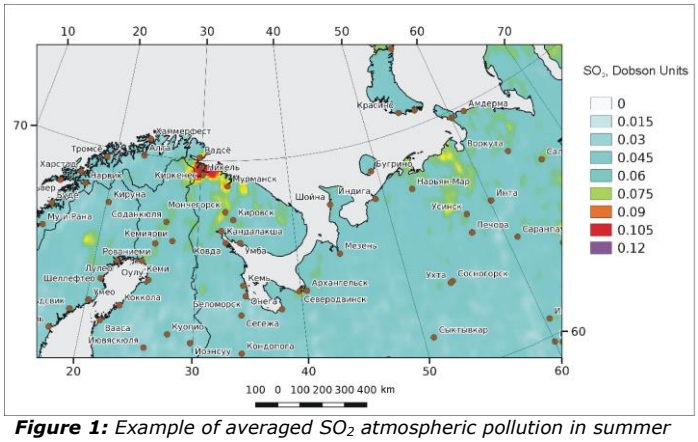

Figure 1: *Example of averaged SO_2 atmospheric pollution in summer (period 2005-2017) for northern territories of the Scandinavian countries and North-West Russia as observed by OMSO2e AURA satellite.*

Thus, remote sensing data provide, in addition to ground-based observations, an excellent possibility to compare at a quantitative level the satellite observation data with results of the modeling (for example, such as shown in Fig. 2; extracted from *Mahura et al., 2018*). At first, it can be done by using long-term archived data from the OMSO2e AURA satellite. At second, a verification that is more precise and model parametrizations can be done using the SENTINEL satellite data (available beginning 2018). After that, for the Russian Arctic the parameterized models and GIS tools can be used, for example, to compile various maps for risks of exceeding a threshold limit value concentration for different air pollutants, as well as maps for risks of mortality caused by negative influences of air pollution on the human health.

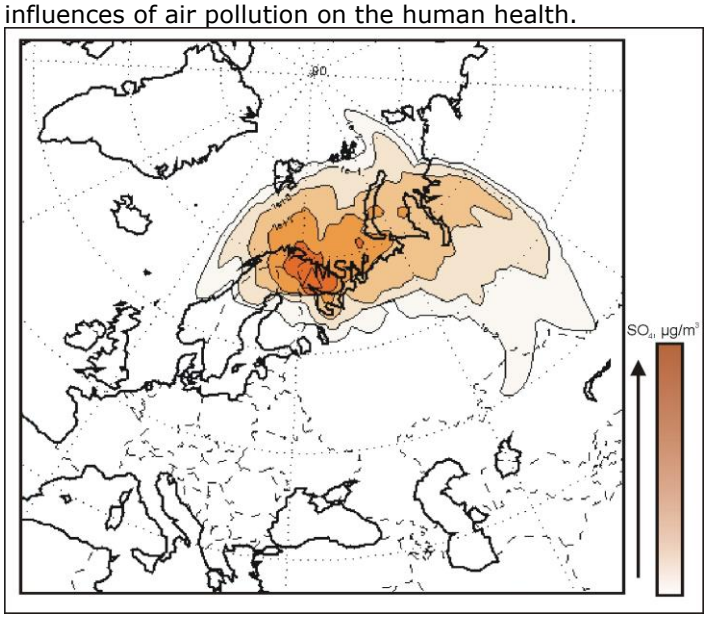

Figure 2: *Example of the DERMA model simulated results of SO_4 atmospheric pollution from the Monchegorsk smelter plant in June 2000.*

References

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