

## **SO<sub>2</sub> Emission Monitoring with Remote Sensing for Turkey**

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### **Extended Abstract**

In recent years, greenhouse gas and pollutant emission inventory studies have become more important issues after the ratification of international clean air acts, such as Kyoto Protocol. Emission inventories based on satellite based measurements of atmospheric trace gases are powerful improvement tools as compared to measurements from conventional platforms. They allow the use of data from global monitoring with uniform instrumental features in long time series as well as the identification and quantification of different pollution sources like biomass burning [1], ship emissions [2], volcanic activities [3], lightning [4] and anthropogenic emissions [5]. Typically, there are three sensor types used for remote sensing, they are ground based, airborne, and space borne, respectively. In literature, there are many studies used as separately or in combinations of these three types of sensor data.

For the region where Turkey is located, many emission inventory studies are prepared on the basis of bottom-up approach in general or in regional scales [6]. Some of these studies have carried out on sectoral basis [7], however some are prepared by taking total emissions into account. Yet, there are not any emission inventory studies that are prepared with the use of remote sensing on the basis of top-down approach for Turkey. Therefore, it is aimed to prepare an emission inventory on the basis of top-down approach with remote sensing.

In this study, Polar Orbiting Meteorological Satellites (MetOp-A), The Global Ozone Monitoring Experiment-2 (GOME-2), Satellite Application Facility for Atmospheric Composition and UV Radiation (O3M-SAF) offline data products are used for the aim of SO<sub>2</sub> emission mapping for Turkey. O3M-SAF offline data products are gathered from European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) [8], within the membership of Turkish State Meteorological Service. Hierarchical Data Format (HDF) files of this data products are transformed to usable data formats for Geographic Information System (GIS) applications with MATLAB software. SO<sub>2</sub> vertical column data are retrieved from this data collection between January to May of 2014. Statistically quality check performed to prepare this data set for GIS applications which are performed via MapInfo software. This five month data is in the range of 0.0014-4.8642 DU with average of 1.003 DU, and the median of 0.821 DU. In highly populated cities and specific areas at where fossil fuelled power plants or industrial parks are located, pollution intensity can be easily observed from this SO<sub>2</sub> emission map of Turkey.

### **References**

- [1] M. Amraoui, M. L. R. Liberato, T. J. Calado, C. C. DaCamara, L. P. Coelho, R. M. Trigo, and C. M. Gouveia, "Fire activity over Mediterranean Europe based on information from Meteosat-8," *Forest Ecology and Management*, vol. 294, pp. 62-75, 2013.
- [2] E. Marmer, F. Dentener, J. v. Aardenne, F. Cavalli, E. Vignati, K. Velchev, J. Hjorth, F. Boersma, G. Vinken, N. Mihalopoulos, and F. Raes, "What can we learn about ship emission inventories from measurements of air pollutants over the Mediterranean Sea?" *Atmos. Chem. Phys.*, vol. 9, no. 18, pp. 6875-6831, 2009.
- [3] W. Thomas, T. Erbertseder, T. Ruppert, M. v. Roozendael, J. Verdebout, D. Balis, C. Meleti, and C. Zerefos, "On the retrieval of volcanic sulphur dioxide emissions from GOME backscatter measurements," *J. Atmos. Chem.*, vol. 50, no. 3, pp. 295-320, 2005.
- [4] S. Beirle, U. Platt, M. Wenig, and T. Wagner, "NO<sub>x</sub> production by lightning estimated with GOME," *Advances in Space Research*, vol. 24, pp. 793-797, 2004.
- [5] R. V. Martin, "Satellite remote sensing of surface air quality," *Atmospheric Environment*, vol. 42, pp. 7823-7843, 2008.
- [6] S. Cetin Dogruparmak and B. Ozbay, "Investigation correlations and variations of air pollutant concentrations under conditions of rapid industrialization," *Clean Soil Air Water*, vol. 39, pp. 597-604, 2011.

- [7] S. Y. Aslanoglu and M. Aydinalp Koksak, "Determining and forecasting regional carbondioxide emission of Turkey," in *Proceedings of ASME 15<sup>th</sup> International Conference on Energy Sustainability*, Washington, DC, 2011, no. ES2011-54560, pp. 881-889.
- [8] EUMETSAT. (2014, June 17). GOME-2 [Online]. Available: <http://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Metop/MetopDesign/GOME2/index.html>