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Improving SO_2 emissions from the point sources over the Middle East using satellite observations and inverse modeling.

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The Middle East faces important challenges from severe air pollution, marked by natural factors from frequent dust storms and human-induced emissions, notably SO_2 from power and desalination plants. These emissions significantly degrade air quality and contribute to sulfate aerosol formation, impacting climate and cloud formation. Accurate SO_2 emissions representation in this challenging environment is crucial. We aim to enhance the current SO_2 emission inventory by integrating satellite SO_2 observations and the FLEXPART-WRF model, driven by meteorological data from the WRF 10km resolution model run in 2016. In particular, we adapted the WRF-Chem's code for simulating the major SO_2 sinks (in cloud scavenging, dry and wet deposition, SO_2 oxidation by OH and H_2O_2) into the FLEXPART-WRF model. It allowed us to exclude the "background" SO_2 column loadings caused by the spatially distributed emissions and to invert the SO_2 emissions from the strong point sources on a daily basis. The improved SO_2 emission inventory is open to the community.