



Long-term trends and trend reversal detection in two decades of tropospheric NO₂ satellite observations

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In this work, observations from four different satellite sensors GOME/ERS-2, SCIAMACHY/ENVISAT, GOME-2/Metop-A and GOME-2/Metop-B are used to study the tropospheric NO₂ patterns and trends during the period 4/1996-9/2017. The GOME and GOME-2 data are "corrected" according to the SCIAMACHY observations to compile a self-consistent global dataset. The highest concentrations are observed over urban, industrialized and highly populated areas and over ship tracks in the oceans. It is shown that tropospheric NO₂ has generally decreased during the last two decades over the industrialized-highly populated regions of the so-called "Western World" (average decrease of the order of ~49% over the U.S., the Netherlands and the U.K., ~36% over Italy and Japan and ~32% over Germany and France) and increased over developing regions (average increase of ~160% over China and ~33% over India). Tropospheric NO₂ is very sensitive to socioeconomic changes (e.g. environmental protection policies, economic recession, warfare, etc.) which may cause either short term changes or even a reversal of the trends. The application of a method that detects the year when a trend reversal happened reveals that tropospheric NO₂ trends switched from positive to negative and vice versa over several regions around the globe. A country-level analysis revealed clusters of countries that exhibit similar positive-to-negative and negative-to-positive reversals. In addition, 29 out of 64 examined megacities and large urban agglomerations experienced a trend reversal at some point within the last two decades.