Estimates of anthropogenic CO2 emissions from satellite and ground based measurements

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In recent years, satellite methods have played an important role in CO2 monitoring. Various satellite instruments (SCIAMACHY, AIRS, GOSAT, OCO-2, etc.) validated by ground-based and aircraft measurements allow to retrieving the column averaged CO2 mixing ratio (XCO2) with high accuracy (0.25–1.0%). The relatively high spatial resolution of a number of instruments (for example, OCO-2) allows studies of spatial and temporal CO2 variations, that, under appropriate conditions, makes it possible to estimate anthropogenic emissions from different cities.

Various techniques (source pixel mass balance method, plume dispersion model and atmospheric inversion system) for determining anthropogenic greenhouse gas emissions from data of satellite measurements are considered.

On the basis of three-dimensional modeling and comparison with the results of various local and remote measurements, numerical models of the atmosphere were adapted to different megacities of Russia. Based on numerical experiments, the errors of various satellite techniques for determining emissions caused by various factors (measurement errors, quality of used a priori and additional experimental information, adequacy of used numerical atmospheric model, etc.) were evaluated. Anthropogenic CO2 emissions in St. Petersburg, Moscow and other cities of Russia are estimated using various satellite measurements. These estimates of anthropogenic emissions are compared with data obtained by different methods and for different cities.