EMS Annual Meeting Abstracts
Vol. 16, EMS2019-845, 2019

Comparison of high-detailed satellite field and model data on tropospheric NO_2 distribution in polluted areas

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A series of Russian satellite Resurs-P operate since 2013 in sun-synchronous orbit. Two more Resurs-P satellites are expected to launch in 2019-2021. A hyperspectral imager GSA is mounted on its board, which resolves more than 230 spectral bands from 400 nm to 1000 nm. It takes image of area of 30-km width and of several hundred km length with spatial resolution from 30 to 120 m. The main goal of the instrument is natural resource investigation. We developed an algorithm which use GSA/Resurs-P data for determing the content of NO_2 in the lower troposphere on a grid with a step of 120 m. Because the spectral resolution of GSA/Resurs-P is worse than the resolution of instruments developed for measurement NO_2 content (OMI, TROPOMI), the NO_2 retrieval error of GSA/Resurs-P measurement is bigger. But NO_2 retrieval error bacome comparable to ones obtained by other satellite instruments, when resolution of GSA/Resurs-P is about 2 km, while the most modern instrument for NO_2 measurement, TROPOMI, has a resolution of 3.5x7 km (currently 7x7 km). NO_2 on the grid with a 120 m step provide additional opportunities for detection of NO_2 local emissions and estimation their power.
For the first time, the high spatial resolution of the new method makes it possible to identify local sources of pollution and their plumes. Because of the absence of any experimental data comparable in resolution with our NO_2 fields, for the validation of highly detailed structures detected in the NO_2 fields of GSA/Resurs-P, we develop methods based on comparisons with chemical transport simulation data. The solution of the problem is achieved on the basis of the development and use of the methods of asymptotic analysis of multidimensional singularly perturbed problems for the nonlinear heat and mass transfer equation, as well as the use of effective numerical methods for solving problems for the nonlinear heat and mass transfer equation. The paper presents the first results of the comparison for measurements performed in 2016 over Hebei province of China which is one of the most NO_2 polluted regions in the word. The study was carried out with the financial support of the Russian Foundation for Basic Research in the framework of research projects 18-29-10080 and 18-35-00682.