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Transboundary Atmospheric Pollution of Oil-Gas Industry Emissions from North Caspian region of Kazakhstan

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The Atyraus region (Republic of Kazahstan) is occupied with more than 60 oil-gas fields which are actively developing. Moreover, a new world largest field so-called Kashagan has been discovered on the Caspian Sea shelf and its exploitation is planned by the end of 2012. In our study, this region has been selected as a source region of sulphates emissions accounting about 15 tons (2009 estimates). Three locations have been chosen in the region covering adjacent Caspian Sea aquatoria, and emissions were equally distributed among these locations (with an emission rate of 4.72*10-4 kg/sec). From original sulphates emissions between 46-82% are subjected to atmospheric transport away from the sources. Releases were considered to be continuous.
The long-term modelling of atmospheric transport, dispersion and deposition of sulphates was done employing the Lagrangian type model called DERMA, run at the NEC SX6 supercomputing facilities. After each day of release the atmospheric transport has been tracked for the next 2 week period. Input meteorological 3D fields were obtained from the ECMWF data archives. The generated output included air concentration (at model levels), time integrated air concentration, dry and wet deposition (at the surface). The results of dispersion modelling had been post-processed and integrated into GIS environment (using ArcGIS). These have been further used to calculate annual averaged and summary concentration and deposition fields for administrative regions, counties and cities of Kazakhstan, as well as territories of the neighboring countries.
It has been found that on an annual scale, the dominating atmospheric transport of pollution from the Atyraus region is toward east and north-east, mostly due to prevailing westerlies. Although on a hemispheric scale, the wet deposition dominates over dry (63 vs. 37%), for Kazakhstan the wet deposition contribution is slightly larger (65%). For Turkmenistan, dry deposition is almost twice higher compared with wet (65 vs. 35%) which is due to significantly smaller precipitation in this country. Considering total deposition during transboundary atmospheric transport, it should be noted that 80.3% of transported sulphates will be deposited over territories of Kazakhstan, 13.8% - Russia, about 2% each – Turkmenistan and Uzbekistan, and less than 1% over other countries. Among considered 14 Regions of Kazakhstan and 8 Federal District of Russia, the highest concentrations and depositions were identified in the Atyraus and Magistaus regions of Kazakhstan as well as in the South Federal District of Russia. For Kazakhstan, the lowest values were identified in the Almaty, East-Kazakhstan, Dzhambul and Pavlodar regions. Among most populated cities the city of Atyrau (Kazakhstan), Astrakhan (Russia) and Baku (Azerbaijan) showed the largest concentrations during transboundary atmospheric transport.