METHODS of GEOINFORMATION MODELING and APPLICATION to ATMOSPHERIC POLLUTION TASKS

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Geoinformation modeling is developed simultaneously with geoinformatics and technologies of geoinformation systems (GIS) creation /1/. This direction appeared as symbiosis of cartographic and mathematical modeling and is leaned on databases and geoinformation systems' software. Such approach presents the unique opportunity for researcher-model developer to fulfill the whole work on the base of the real data characterizing the territorial processes under simulation.

In the report there are presented the main principles of geoinformation modeling, the modeling sub-system (MS) in the GIS frameworks and the tools to be included are described. Two tasks of pollutant transfer in atmosphere are considered as an example of sub-system application.

The first task is connected with modeling of traffic pollution in the atmosphere of the city of Almaty. The problem is very actual one because of extremely high concentration levels, mainly, due to motor transport emission. On the base of the city's climatic features analysis there have been developed the statistical model for atmospheric pollution, information support to be realized in GIS frameworks. Here emissions have been calculated with the usage of CAR International model /2/. The real data on traffic intensity and streets-highway system have been used. Three scenario – (1) current situation, (2) optimistic prognosis and (3) pessimistic one – have been carried out. There have been calculated the concentration fields for main pollutants: carbon monoxide CO, nitrogen dioxide NO_2, nitrogen oxides NO_x, hydrocarbons HC, benzene C_6H_6, lead Pb and small particles PM. The calculations show very high air pollution level.

The second task deals with monitoring of dust storms in the Aral region. Here the complex model for dust and sand particles emission and transfer has been built as hierarchy of the following procedures:

- Identification of possible particles arising from the Aral Sea dried bottom on the base of land-use map to be built with the usage of remote sensing data;
- Calculation of particle size structure on ground surface on the base of empirical function of particle size distribution;
- Calculation of dynamical friction velocity u_* threshold value in dependence on sand particle average size and emission power of sources;
- Calculation of vertical parcel of aerosol to be formed beyond saltation layer through turbulent diffusion;

- Modeling of far distance transfer of plumes from the Aral Sea dried bottom with the usage of Gaussian models.

For the most character episodes identified in the space monitoring system there has been made comparative analysis against the results of simulation (see Figure). The correlation coefficient of space images' brightness and modeling results is equal to 0.78 for cross-section and to 0.95 for along plume section.

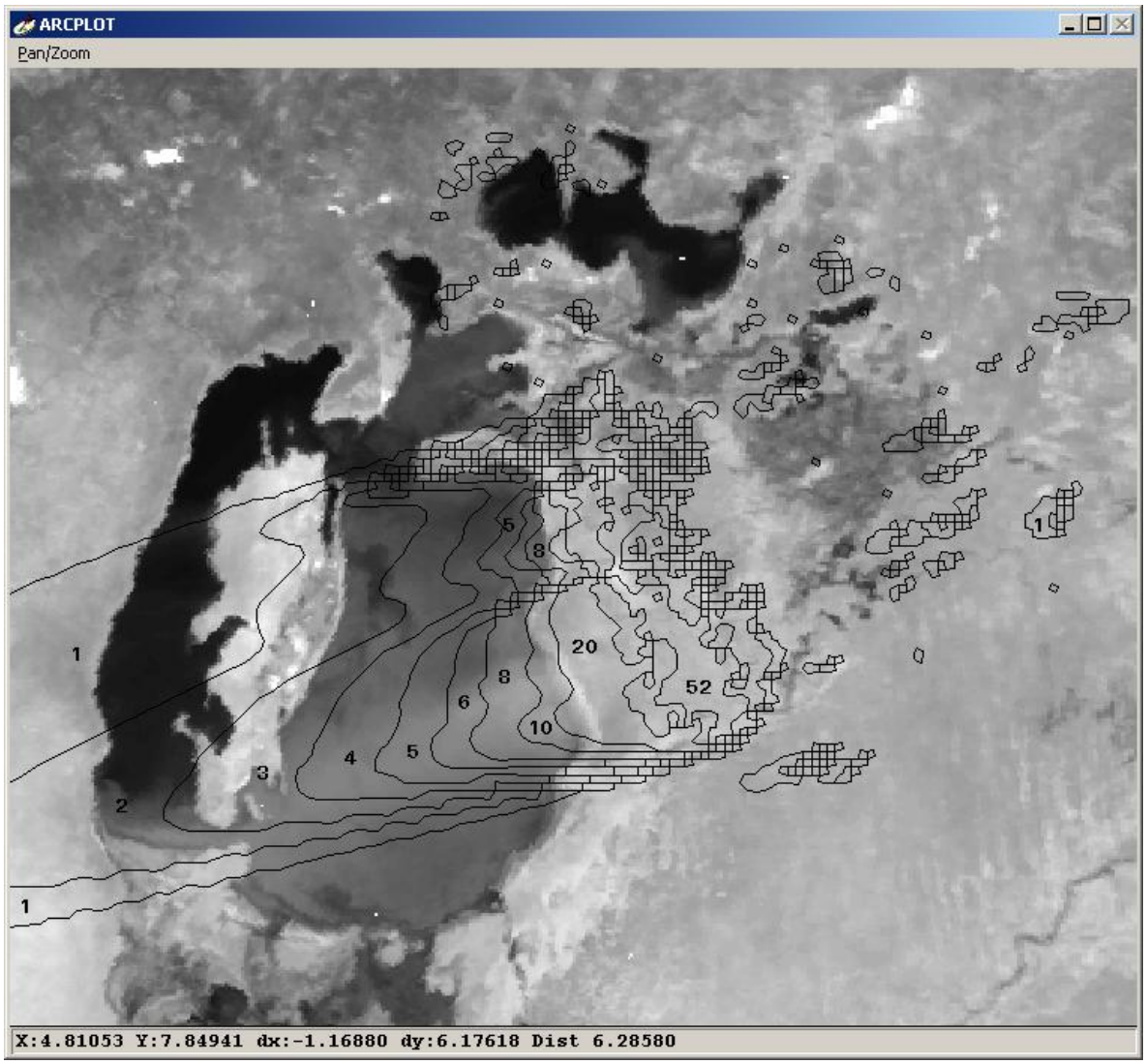

Figure. Composition of the calculated isolines of aerosol concentration with space image on September, 18, 1998

1. Michael Zeiler. Modeling our World. // ESRI Press. – 1999, 199 p.
2. Eerens H.C., Sliggers C.J. and van den Hout K.D. The CAR Model: The Dutch method to determine city air quality. // Atmospheric Environment. 27B. – 1993, pp. 389-399.