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Air quality assessment and control of emission rates

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The release of toxic gases from enterprises and cars constitutes a serious hazard to human health and environment. Therefore it is of great importance to monitor and control such dangerous emissions. There are two approaches for protecting the ambient air against the violation of air quality sanitary norms in large industrial regions. The first one, so-called "technological way", deals with "green" technologies allowing maintaining the lowest level of a harmful pollutant emission. The second approach considered here provides control of emissions from main pollution sources and is of considerable mathematical interest.

Mathematical methods based on the adjoint model approach are given for the air-pollution estimation and control in an urban region. The adjoint method is applied to solve a few important air quality problems produced by industrial (point) and automobile (linearly distributed) sources. A simple 2D (vertically integrated) advection-diffusion-reaction model for quasi-passive pollutants is used here for illustrating the methods. The methods developed can be applied to any 3D pollution transport model.

An adjoint model is used to derive dual pollution concentration estimates in ecologically important zones and to develop two non-optimal strategies and one optimal strategy for controlling the emission rates. A linear convex combination of these strategies represents a new sufficient strategy. A method for detecting the industries, which violate the emission rates prescribed by a control, is given. It can be used to detect infractions and to apply sanctions. A method for determining an optimal position for a new industry in the region is also described. The criterion for optimisation is the requirement that a new plant position will not violate the sanitary norm currently in force. As an example, the method have been applied to the Guadalajara City Metropolitan Area for a quite simple case when only two types of climatic wind (the rainy season wind and dry season wind), eleven enterprises and three ecologically most important zones have been taken into account.