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Nonlinear dynamics of the industrial city's atmospheric ventilation: New differential equations model and chaos

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Abstract: We present a new approach to analysis and modelling the nonlinear dynamics of the industrial city's atmospheric ventilation with elements of chaos. New approach is based on an approximation of "shallow water" (in contrast to the standard difference methods of solution, here we use the spectral expansion algorithm [1]) and the Arakawa-Schubert and Glushkov differential equations models, modified to calculate the current involvement of the ensemble of clouds, and advanced mathematical methods of modelling an unsteady turbulence in the urban system. For the first time the methods of a plane complex field and spectral expansion algorithms are applied to calculate the complex system ventilation characteristics. Such a chaos theory algorithms as correlation integral, false nearest neighbors, surrogate data ones, the Lyapunov's exponents and Kolmogorov's energy analysis, non-linear prediction schemes, predicted trajectories algorithms, spectral methods etc (in [1-3]) are used for analysis of the corresponding time series. As illustration of a new approach we present the results of series of the PC experiments on computing the ventilation characteristics for a few industrial regions (Odessa, Gdansk etc). References: [1] Khetselius O., BunyakovaY., Proc.of 8th Int. Carbon Dioxide Conf.-Jena, Germany, 2009. [2] Glushkov A.V., Methods of a Chaos Theory. Odessa: Astroprint, 2012. [3] Glushkov A.V., Khetselius O.Yu., Svinarenko A.A., Buyadzhi V.V., Methods of computational mathematics and mathematical physics, P.1. Odessa: TEC, 2015.

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