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The analysis of three-dimensional geometry of atmospheric fronts

Philipp L. Bykov[1,2], **Vladimir A. Gordin**[1,3]

[1] *Hydrometeocentre of Russia, Moscow, Russia*
[2] *Moscow State University, Moscow, Russia*
[3] *Higher School of Economics, Moscow, Russia*

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The atmospheric fronts' geometry is evaluated on standard baric levels according to data of the objective analysis (or of the forecast) of basic meteorological fields on global regular grids. The traditional predictors of the fronts are 1) vertical component of the wind's vorticity; 2) Laplacian of pressure upon a sea level; 3) temperature gradient. We use (instead of the first ones) maximal eigenvalues of the following matrices: a symmetric part of matrix Jacobi horizontal wind and the second horizontal derivatives (matrix Hesse) geopotential (or pressure upon a sea level), correspondingly. Then we search the optimal weight for these three predictors' combination.

We use high order approximations (Fourier transform and compact scheme approaches).

Heuristic methods of construction of the frontal thin zones along "crests" in the predictor's 2D field are developed. Also we use some algorithms for a vertical adjustment of the frontal lines.

A validation of the geometry's evaluation is considered, too. We calculate two kinds of correlation functions (CF) for the basic meteorological fields. CF are functions of the distance between to points. Two clusters of points' pair are used: the points are divided by a frontal zone and points not are divided by a frontal zone. Our algorithm (with optimal weights) provides significant difference (in the integral norm) between these CF.

Thus, we demonstrate an algorithm and codes that construct frontal surfaces with complex geometry in 3D space.

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