The hydrodynamic short-range of the local weather forecasting

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A method of the hydrodynamic short-range forecast of weather [1,2] has been improved. A system coupling a basic large-scale model with a three-dimensional atmospheric boundary layer (ABL) model has been applied in the real time [3,4]. The Weather Forecasting System (WFS) operated at the Hydrometeorological Research Centre of Russia . The basic principle of the system lies in reconstruction of both synoptic-scale and mesoscale weather patterns from the output product of a large-scale prediction model by means of the ABL model algorithms and locally-adapted parameterisations: of the radiative heating effects on the near-surface air temperature variation, of a moist convection for prediction of convective precipitation as well as of some other physics . The system provides 48 h forecast of weather patterns for cities in Russia and neighbouring regions. It includes the forecast of temperature, moisture, wind, cloudiness and precipitation as well as the profiles of temperature, moisture, wind and turbulence characteristics in the lower 2-km atmospheric layer. The system of local weather forecasting, which is currently operated at the Hydrometeorological Research Center of Russia , has been developed further towards improved simulation of sharp weather changes. The goal of the system is 48 h forecasting weather elements for locations in a limited area and also for the urban and suburban areas of a longed city (like Moscow). The experience gained at its application indicates that the skill of the resulting forecasts is superior to that of the synoptic forecasts as 83 to 49 in 2002. However, proper simulation of sharp weather changes connected with significant variations in the meteorological fields calls for fine resolution in the background prediction; at the same time, the background forecast area should be sufficiently large to simulate correctly large-scale weather processes developing during 48 hours over this area.

The skill of WFS is presented here by verification statistics . The corresponding data on temperature, precipitation, and wind predictions for Moscow in 2002 are given in Table which reproduces the mean absolute forecast error of daily minimum and daily maximum temperatures ($\delta T_{\min}$, $\delta T_{\max}$; °C), 12-h precipitation amount (δP_r , mm), and wind speed (δV , m·s^{-1}).

We demonstrate the improvement of WFS forecasts over persistence (forecast error- FE and persistence error -PE).)., because there are no currently available another objective short-range weather forecasting techniques for Moscow, which we could compare our forecasts with.

	dT_{mi}	dT_{ma}	dP_r			dV			
	Projection (h)								
	0 ---	36	00-12	12-24	24-36	12	24	36	48
FE	1.7	1.9	1.0	1.1	1.4	2.0	1.8	2.1	2.0
PE	2.9	2.9	2.0	1.9	1.9	2.5	2.2	2.9	2.6

Operational forecasts calculated from operational database for Russian cities demonstrate about the same skill as shown in Table.

Further improvement to the local weather forecasting, along with development of more advanced models, calls for more complete initial observation data. In the nested fine-grid domain considered early [5], the number of currently available surface station observations is about 1-2 % of the grid-point number. Data from observations of this type are insufficient for mesoscale objective analysis, which calls for utilization of high-resolution data provided by all other available observation systems. Accordingly, data on thermophysical and dynamical characteristics of the underlying surface and on their seasonal variability with spatial resolution comparable to the model resolution are necessary. Also further developments being partly in progress now are:

- improvement of the air humidity prediction through implementation of a simplified land surface hydrology model;
- parameterized treatment of the impact of atmospheric fronts upon the evolution of meteorological variables in the boundary layer and free atmosphere; and
- development and implementation of parameterised treatment of the anthropogenic heating impacts to improve the technique of detailed weather forecasting for a large city .

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