

Long-range Forecast

A long-range forecast is a forecast for a period of 1 month to 2 years. The subject of long-range forecasting is not the weather, but generalized statistical characteristics of the atmosphere, for example, averaged values of meteorological elements or their anomalies.



A long-range forecast provides useful information for various sectors of the economy in terms of long-range planning and implementation of risk management activities.

In long-range forecasts, a coupled "atmosphere-surface" system is considered. The system takes into account the influence of external slow impacts on the atmosphere, for example, anomalies in ocean surface temperature, soil moisture, and temperature, in the extent and thickness of sea ice and snow cover. These parameters change much more slowly than the weather, but bring signals into long-range atmospheric changes. Currently, the basis of long-range forecasts is physically complete multi-component global numerical models, such as general circulation models of the atmosphere, ocean, land surface, sea ice, small gas components, etc.



A coupled atmosphere-surface system

The aim of short and middle-range numerical weather forecasts is to achieve a horizontal resolution close to 1 km, but for long-range forecasts, it is hardly possible, because calculations are performed not for 5 - 7 days, but for longer time intervals (up to several months). Some international teams of climate change research carry out calculations for much longer time intervals - tens, hundreds, and thousands of years, in order to develop solutions for mitigation and adaptation to climate changes. Currently, computing resources and data storage systems do not allow global long-range models to achieve such resolution as in shorter-range models, especially when the ensemble approach in calculations is used. As a rule, the resolution of global long-range models ranges from several tens to hundreds of kilometers. Calculations for the required areas are refined by long-range regional models with a resolution of about 20 - 50 km. In such models, a transition to the full equations of a non-hydrostatic atmosphere is made. These equations are free from a number of simplifications applied in modern global models.

Another promising approach to long-range forecasting is the development of seamless forecast systems for reproducing the model processes of all time scales - mesoscale, synoptic, seasonal, and interannual. The latest generation of climate models includes parameterizations of subgrid-scale processes that were previously considered important only for short-term weather forecasting.

The long-range forecast system in MicroStep-MIS includes all the above achievements of the long-range modeling field. The IMS4 Model Suite module, designed by the company's specialists, provides an individual approach, based on customer requirements, to choosing a model and its technologies. Models can be presented in both global and regional versions.

The basic duration of long-range forecasts implemented in MicroStep-MIS is 3 months. Calculations are performed on the basis of a multicomponent numerical global model. Next, the global model solution is refined using a regional model with high spatio-temporal resolution in the specified region. The spatial step of such a long-range regional model is 25 km; the time step of output variables is 1 hour. MicroStep-MIS also provides a solution based on the global long-range model only - in this case, the spatial step will be about 100 km, and the time step will be 6 hours or more.

Results of the model calculations and post-processing are stored in an integrated IMS4 CLDB database, and visualization and data output is carried out in the IMS4 Maps module. Long-range forecast data (anomalies in surface temperature and moisture, extent, and thickness of sea ice and snow cover, and other characteristics) can be visualized as interactive maps (or as summary tables) or in other convenient and intuitive form.