Geophysical Research Abstracts, Vol. 8, 03947, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03947

Precipitation rate spectra as dependent on dynamic forcing: application to probabilistic forecasting

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Occurrence frequencies of 12-h precipitation amounts, P, at the stations in the former European USSR are displayed as dependent on dynamic forcing of vertical motions. The dynamic forcing is described by a “frontal parameter”, F (calculated in the points of objective analysis grid), as dependent on surface pressure field curvature and on baroclinicity in the lower half of the troposphere. The precipitation spectra, P(F), for 4 seasons and for 6 regions, as calculated from a large sample of data (7 years, about 650 000 values of P for each season), show a monotonous growth of occurrence frequencies of all ranges of $P > 1$ mm/12 h with F increase. The growth is especially significant for heavy precipitation. As a result, F is shown to be an informative predictor of P spectrum or of probability of any given range of P.

As a next step, two-dimensional spectra, P (F, LNB) are calculated, where LNB (level of neutral buoyancy in the gridpoint) is an estimate of grid-scale convective instability. On this basis, an approach to probabilistic forecasting is developed. As an predictand, probability distribution for P ranges is used. The approach can be also applied to estimate spatial distribution of P ranges within the gridsquare.

The work has been supported by Russian Foundation for Basic Research, Grant 04-05-64646.