

# **Numerical study predictability of further development of frontal clouds by their rotational motion**

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Three-dimensional nowcasting and forecasting numerical models of frontal cloud systems with heavy rains passed over the Crimea have been used for theoretical interpretations of experimental measurements. Field investigation has been conducted in the eastern Crimea in September 2001. System “Antigrad” was used for radar measurements. Features of vertical movement in cumulus clouds and their nearest environment were basically investigated. Radio-echo cross-sections through cloudiness have been received and they have shown that convective clouds can rotate either in cyclone or in anticyclone directions. The angular velocity of such rotation was computed.

The theoretical interpretation of the depicted features with aid of the numerical models has been carried out. Convective cell and rainband formation and development were investigated. Theoretical researches specify two principal causes of occurrence such mesoscale structure into zones of atmospheric fronts due to vertical shifts of a wind and formation of zones of the highest horizontal gradients of temperature. At the analysis of results of numerical modeling high attention was devoted to revealing of baroclinic instability zones. A shift of wind was assessed by Richardson numbers.

Such mesoscale heterogeneities promote formation of cells and bands of frontal ascending movement which are responsible for moisture transportation mechanisms. Relative internal homogeneity of vertical movements, thermodynamic condensation rate, cloudiness, etc. is characteristic for the initial stage of development of frontal cloud bands. The evolution of cloudiness to the mature stage is accompanied by the perturbation of the homogeneity of thermodynamical structure and by the strong convection and formation of cloud cells of tens kilometers scale with cyclonic circulation in general. Theoretical interpretation of natural experiments by numerical modeling has shown that cyclonic vertical cells are peculiar to the initial stage followed by the stage of maximal development of convective cells. Existence of a pair of the cyclonic and anticyclonic vertical vorticity is characteristic for the initial decay stage of convective clouds. Decay of convective cells was followed by reduction of angular rotation speed and by anticyclonic circulation.