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Numerical simulation of thermodynamic and microphysical features of heavy snowfall caused by Mediterranean cyclones over Ukraine

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Three-dimensional time-depend and time-independ numerical models for complex and plain relief developed in UHMI have been used in numerical experiments for investigation of thermodynamic and microphysical conditions of heavy snowfall formation on the territory of Ukraine caused by Mediterranean cyclones in December 2009. The winter 2009-2010 was very snowy in northern hemisphere, especially heavy snowfalls were in December on the territory of Ukraine. Heavy snowfalls covered the whole Ukraine except for west regions. Cases of these snowfalls in different parts of Ukraine have been investigated. Heavy snowfall near Bilgorod-Dnistrovsky on December 15 was chosen for presentation in detail. Complex researches including natural measurements and numerical simulations based on all possible data were used in the study of inner structure of atmospheric front and its cloud systems.

The three-dimensional diagnostic numerical models were used to diagnose the atmospheric state during whole snowfall period. These models helped to investigate the features of atmospheric characteristics such as temperature, pressure at the sea-level and complex relief, supersaturation, condensation rate, ice nuclei concentration (INC) etc. every 12 hours.

The three-dimensional prognostic models were used for numerical simulation of the evolution of the most interesting cases to find out key parameters caused heavy snowfall. Series of numerical experiments were fulfilled using different combination of precipitation formation mechanisms by variation of INC, coagulation intensity, surface relief. Experiment showed that catastrophic precipitations are caused by including: 1) coagulation of rain drops with cloud drops; 2) optimal INC; 3) complex relief. The main reason of such dangerous events was the moving of three active Mediterranean cyclones to the Black Sea and their blocking by powerful cold anticyclone with its centre in Moscow.

Key words: Mediterranean cyclones, numerical models, heavy snowfall.