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Testing the scheme for calculation of multi–layer cloudiness and precipitation for climate models of intermediate complexity

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The scheme for calculation of characteristics of multi–layer cloudiness and associated precipitation designed for climate models of intermediate complexity (EMICs) is presented. This scheme considers three–layer stratiform cloudiness and single column convective clouds. It distinguishes between ice and droplet clouds as well. For convective clouds, universal vertical profile of of moisture content is prescribed based on observations. Precipitation is calculated by using cloud life time which depend on cloud type and phase as well as on statistics of synoptic and convective disturbances.

When the scheme is forced by the ERA–40–derived climatology for 1979–2001, it realistically reproduces basic features of fields of cloud amounts, cloud heights, cloud water/ice path, and precipitation. The simulated globally and annually averaged total cloud amount is 0.59 which basically agrees with the respective satellite-retrieved values. In agreement with observations, the largest stratiform cloud amounts are simulated in the regions of storm tracks, and the largest convective cloud amounts are simulated in the tropical regions where moisture convergence takes place. However, subtropical minima of cloud amounts are too deep in the model. While overall structure of the precipitation rate field is reproduced realistically by the scheme, precipitation is overestimated in the subtropics and in the eastern part of Eurasia. In turn, precipitation is underestimated in the regions of tropical convection. The globally averaged annual precipitation is $110\ cm/yr$ which is similar to the corresponding value obtained from empirical data.

The three–layer cloud and precipitation scheme has been implemented in the statistical–dynamical atmosphere model Aeolus which is the part of the new generation of the Climber–4 EMIC, as well as in the IAP RAS EMIC.