Projection of changes in water balance components across irrigated lands of Central Asia using a high-resolution modeling system

*Anastasiia Pikaleva[1], Ekaterina Nadyozhina[1], Alexandra Sternzat[1], Boris Egorov[1], Sergey Efimov[1], Igor Shkolnik[1]

1. Voeikov Main Geophysical Observatory

The economy of arid regions in Central Asia is largely based on irrigated agriculture, which critically depends on the amount of regional water deficit. The insufficiency of water resources requires an accurate estimation of water balance components from irrigated lands in order to develop the optimal strategy of water consumption across Central Asia in a changing climate. This is particularly important for irrigated areas with typical spatial scales several kilometers, not captured by up-to-date regional climate models and thus requiring an explicit description of subgrid processes using a sophisticated high-resolution atmospheric boundary layer model.
A series of climate simulations using MGO regional climate model (RCM) at 25 km resolution and a 150-level atmospheric boundary layer model (ABLM) have been carried out aimed to improve the estimation of evapotranspiration from irrigated lands. It has been shown that the detailed description of boundary layer structure over the irrigated area pushes the RCM simulated temperature towards observations (assuming that CRU observational analysis to some extent accounts for the effect of irrigation on temperature).
A sensitivity study has been conducted in order to assess the impact of the changes in the Aral sea mirror during the second half of the 20th century –early 21st century on regional heat and moisture balance. This helps to build a methodology for optimizing the land use on the coastal areas of internal water bodies in the arid zones.
A series of ensemble (30 members) regional climate change projections by 2050-2059 relative to 1990-1999 has been conducted using the RCM-ABLM chain under IPCC RCP8.5 scenario. The analysis shows that the deficit of moisture over the irrigated areas increases by the mid-21st century during the growing season. This implies that the conditions for cultivating traditional agricultural crops in the region will deteriorate if the sources of irrigation water remain unchanged.

