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Climate variability of free atmosphere in the polar regions: local and global perspective

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Local climate change of free atmosphere above the East-Siberian region is investigated with a new regional data set, which is being developed under joint IARC and AARI project "Study to identify the role of macro-scale circulation features in controlling the regional climate in the East-Siberian Region". The similarities and differences of atmospheric circulation in the east and west parts of the region are shown.

Long-term variations of the monthly mean air temperature and humidity in the free atmosphere above the North Polar Region (60-90N) were investigated with extended original database, created in the Arctic and Antarctic Institute, Russia by V. Maistrova. This database combines the results of soundings executed on 116 aerological stations, ship observations and observations on the drifting stations "North Pole". The analysis of temperature trends for 1959-2003 shows that the mean air temperature in the North Polar Region increased in the low and middle troposphere (850-400 hPa) and decreased in the upper troposphere and in the stratosphere. The total energy of the polar atmosphere attributed to the so-called "mean energetic level" shows weak positive trend with strong long-term variations. Preliminary estimates of temporal variability of mean specific humidity at 850, 700, 500, 400 and 300 hPa showed pronounced increase from surface to 850 hPa and decrease above 850 hPa. The spatial distributions of air temperature and humidity trends demonstrate strong inhomogenity of relevant meteorological fields with strongest negative trend of air temperature in the low stratosphere above Scandinavia and adjacent part of the Arctic Ocean.

Comparison the trends of the annual mean air temperature and humidity for 1959-2003 averaged for the whole North and South Polar Regions shows strong differences, especially in the low stratosphere, where negative trends in the Arctic much more pronounced contrary to model estimates, accounting observed increase of greenhouse

gases concentration.

The data demonstrates the increase of local instability in the polar upper troposphere and low stratosphere, which could be explained as a response to greenhouse effect. Another important factor could be the changes in the global circulation caused by the increase of ocean temperatures at lower latitudes.