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Energy exchange between surface and atmosphere on the Severnaya Zemlya archipelago in 2013 – 2019 years

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Based on the data of meteorological observations, executed in 2013-2019 at Research Station “Ice base Cape Baranova” (RS) and original algorithm, taken into account accuracy of measurements and footprints, the components of surface heat budget are calculated. It is shown that in winter due to radiation cooling turbulent sensible heat flux (H) directs to underlying surface. In summer H due to radiation heating of surface with low albedo directs to atmosphere and reaches 25% of the incoming short-wave radiation. The turbulent latent heat flux (LE) in winter directs to atmosphere. Its value is not more than 10% of H. During summer LE has no predominant direction.

Comprehensive monitoring carried out at RS since 2013 allowed to examine the role of large-scale processes in the polar atmosphere and hydrosphere on the formation of local climate in the region. In 2016, 2018 and 2019 sea ice cover of the Barents and Kara Seas in October, the month of active freezing of active soil layer, occupied the minimal area starting 1978 year (http://wdc.aari.ru/datasets/d0042/). This circumstance along with peculiarities of circulation processes in the atmosphere had led to anomalous of temperature and humidity regimes of lower troposphere. These years monthly mean air temperature up to 700 hPa was about -4 °C compared to -7 - -11 °C in 2013 - 2015 and 2017. In 2016 the lower troposphere was warmer by 2 - 3 °C and specific humidity in atmospheric boundary layer was 30–60% higher its values in 2013–2015 and 2017. Even in 2018, when the area of open water adjacent to the Severnaya Zemlya archipelago was significantly larger than in 2016, specific humidity at altitudes up to 3 km was 4-12 percents less.

In 2016 monthly mean wind speed, mainly of southwestern direction, reached maximum value, more than 7 m/s. It led to weakening of atmospheric surface layer stratification ($z/L < 0.2$). The air specific humidity significantly increased also, up to 3.0 and 2.7 g /kg at 2 meters and at z_0 . Long-wave radiation fluxes increased by more than 15 – 20 W/m^2. Same time due to increase of underlying surface temperature, its long-wave radiation cooling, which was not compensated by the increase of incoming long-wave radiation increased up to -27 W/m^2. H, directed to the underlying surface, increased to 10 W/m^2 and LE, directed to atmosphere, increased almost 2 times, up to 12 W/m^2. As a result of multidirectional changes of heat fluxes, defining surface heat balance, its value in October 2016 (-31.6 W/m^2) was comparable to calculated for other years.

The most probable explanation of the revealed features of atmospheric boundary and surface layers in October 2016 are the absence of sea ice cover in the waters, adjacent to the archipelago, prevented cooling of atmosphere, and strong zonal component of the wind velocity, caused the transfer of warm and moist air masses of Atlantic origin into the study area.

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