Geophysical Research Abstracts
Vol. 16, EGU2014-12304-1, 2014
EGU General Assembly 2014

Observed increase of convective clouds in the Atlantic Arctic during the last century

Alexander Chernokulsky (1), Igor Esau (2,3), Olga Bulygina (4), Igor I. Mokhov (1), Vladimir Semenov (1,5)

(1) A.M.Obukhov Institute of Atmospheric Physics RAS, Laborathory of climate theory, Moscow, Russian Federation (a.chernokulsky@ifaran.ru, 7(495) 9531652), (2) Nansen Environmental and Remote Sensing Center, Bergen, Norway, (3) Centre for Climate Dynamics at the Bjerknes Centre, Bergen, Norway, (4) All-Russia Research Institute of Hydrometeorological Information - World Data Centre, Obninsk, Russia, (5) GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

Cloudiness play a key role in the Arctic climate system since it controls the radiation balance of the surface. The Arctic cloudiness were intensively studied using satellite data products, which cover the last 30 years period. There are significantly less studies based on the long-term surface observations, which cover the period before the satellite era. Our study analyses cloud cover variability in the Atlantic part of the Arctic (the Norwegian, Barents and Kara Seas) utilizing surface observations from Norwegian and Russian meteorological stations. These data records reveal changes not only in the cloud cover but also in the cloud type (stratocumulus, stratus, etc). The cloud types are good indicators of the physical processes in the lower atmosphere, in particular, the change in amount of convective cloud types reflects the change in the atmospheric vertical mixing. We found that total and low cloud fractions have their maximums during the early 20th century warming (1930-1950) and are increasing in the recent decades. These tendencies are noted for all seasons. Clouds tend to warm surface air in all seasons except summer when they have a cooling effect. Thus, the revealed cloudiness changes are consistent with a seasonal asymmetry of the early 20th century warming.

The cold 1970s are characterized by high fraction of clear sky reports in the data sets. We also found that the occurrence of overcast conditions decreases while the occurrence of reports with broken clouds increases during the whole period. The analysis of the cloud types identified a pronounced increase of the convective cloud types (cumulonimbus and stratocumulus) and decrease of the stratiform cloud types (stratus and nimbostratus) in the observational records. These changes are the strongest over coastal and open-water stations. Over ice-band stations an increase of the occurrence of high-level cloudiness is found.

The quantitative and qualitative changes in cloudiness are the indicators of the decadal-scale changes in the Arctic atmosphere and its circulation patterns. The tendency towards more frequent convective cloud types signals certain a decrease of the atmospheric static stability (an increase of the lapse rate), which is in good agreement with physical understanding of the amplified surface-layer warming of the Arctic. The differences in the cloud type changes during the early warming period and the present one presumably contain a fingerprint of the anthropogenic warming signal.