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nomena as clear air turbulence or dangerous sea waves). Therefore, the use of reanalysis for such tasks is impossible. However, improved resolution often leads to poor simulation results when compared with observational data. We found that the reason of wind underestimation in numerical experiments with the WRF-ARW model is the unrealistically high surface roughness used in the model, which causes the so-called separation of the boundary layer. The correction of the roughness length was carried out in accordance with the observational data on the meteorological mast installed in Tiksi, where strong downslope windstorms are observed. The use of the observed roughness length in the model leads to a 2–3-fold reduction in the wind speed error.

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Variability of characteristics and conditions leading to the formation of extreme precipitation events in the south of Western Siberia

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Against the background of the socio-technical development of territories there is a growth of the damages in economic and social spheres caused by increasing frequency of hazardous events' occurrence. Global warming is happening now, and the changes in the statistics of extreme events are diagnosed in various regions of the Earth. Humidification conditions relate to the most essential indicator of both global and regional climate. Indicators of humidification regime variability, which also includes hazardous events in the precipitation regime, vary significantly in different regions. In this context, taking into consideration ongoing climate changes, it is relevant to elaborate on a regional approach to assessing the availability of moisture resources and possible risks in connection with extreme events in the rainfall regime.

In the present study, we used the term-hours data taken from 54 weather stations of Tomsk, Kemerovo, Novosibirsk regions and Altai Krai for the period 1966-2018. The following cases with the hazardous event (HE) have been chosen: “heavy rain” which defined as rainfall greater than 35 mm in 12 hours and “severe rain” (significant liquid or mixed precipitation, namely rain, rain shower, sleet, wet snow greater than 50 mm in 12 hours). For each foregoing event, a number of days, repeatability and maximum duration has been computed and analyzed. In addition, the potential of using satellite remote sensing data for their analysis was investigated.

During the 50 years considered, periods without precipitation are twice exceeded the number of periods with precipitation and predominately more extended. Withal, there is a decrease in short-term periods (1–5 days in duration) and an increase in longer ones (6–10 days), both for cases with/without precipitation. The maximum continuous dry periods generally lasts longer than the duration of periods with precipitation and in most of the territory of the region goes up by a rate of 0.8 days per decade (Sredny Vasyugan station). At several stations, mostly in Altai Krai, the maximum duration of the period with precipitation declines at a rate of -0.6 days per decade (Aleksandrovskoye station, Tomsk region).

In the period under consideration the largest number of cases with “heavy rain” (19) was observed at Berezovka weather station located in Tomsk region. The mean number of “heavy rain” cases varies spatially from 9 in Novosibirsk region and Altai Krai to 11 in Tomsk and Kemerovo regions. On average, “severe rain” has been reported two times over the territory. The largest number of cases with “severe rain” (6) was registered at Kuzedeevo station in Kemerovo region.

It has been found that during the period of accelerated global warming the frequency of extreme precipitation remained almost unchanged within the study area.

Throughout the year, precipitation regime is determined by synoptic patterns peculiar to Western Siberia. An increased cyclonic activity in some years (once every 15–20 years) provides conditions that are conducive to excess moisture in the summer.

To analyze the conditions for the formation of areas affected by extreme precipitation we used satellite-based sensing data along with WAREP (warning reports). Thirty cases were considered (15 – severe rain and 15 – heavy rain) closest to the time of the satellite pass and the beginning of the anomaly, i.e. no more than 12 hours. The satellite information allow identifying the type of cloud systems, optical thickness, cloud top height and cloud liquid water content. Heavy rain in 8 out of 15 cases relate to mesoscale convective systems (MCSs);

in four cases, the hazard was associated with the passage of cold fronts, and in three cases – with mesovortices. Severe rain mostly observed during MCSs (8) and cold fronts passing (4); in two cases, precipitation was caused by cyclonic cloud system with a trail and one – by mesovortex clouds.

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The effect of atmospheric circulation in the Northern Hemisphere on hydrothermal extremes in Siberia

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Atmospheric circulation over Siberia is a part of the planetary circulation of the Northern Hemisphere. Its main features are the dominance of the west-east transfer; intense transformation of air masses in the warm season; presence of high-altitude planetary frontal zone over 60° N where the intersection of the paths of the northwest and southwest cyclones occurs and meridional air exchange associated with the flatness of the territory and its openness from the North and the South.

Macrocirculation processes are an important factors in the development of droughts and floods phenomena. Changes in atmospheric circulation regimes associated with changes in the global and regional climate affect the frequency and intensity of climatic extremes, which in turn have a significant impact on land ecosystems. Drought is a consequence of the complex physical interaction of factors that can be divided into external and internal. External factors include the restructuring of atmospheric circulation schemes [Trenberth, Guillemot, 1996], which determines the transport of air masses that affect the occurrence of aridity or humidity and temperature fluctuations.

The features of the orography and the difference in the thermal conditions of the continent and the ocean determine the formation of stable meridional flows in the troposphere over the Asian territory of Russia. In this regard, the zonal flow in the troposphere over this territory is much more perturbed than over other areas. The baric field for the summer period is mainly determined by the position of the high pressure ridge, oriented from Northeast China to the eastern regions of Yakutia and the Magadan region. Two depressions are situated on both sides of these regions: one is directed from the polar basin to the Bering Sea, and the second is from Taimyr to Transbaikalia. The speed of cyclones propagation in summer over the continent is slower than over the sea due to the thermal conditions of the underlying surface. Near the coast the speed of cyclones increases [Arkhangelsky, 1956].

Areas of extreme droughts / over moistening conditions coincide with the centers of baric formations (anticyclones / cyclones) [Utkuzova et al., 2015a], and are well described and correlate with the typification of atmospheric circulation according to Katz [Katz, 1960] and with the Dzerdzeevsky classification [Dzerdzeevsky et al., 1946].

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