HUMAN-ASSOCIATED EXTREME EVENTS: FREEZING PRECIPITATION

*Pavel Groisman[1,4,6], Xungang Yin[2], Olga Bulygina[3], Sergey Gulev[4], Irina Danilovich[5]

1. NC State University Research Scholar at NOAA National Centers for Environmental Information, Asheville, North Carolina, USA, 2. ERT, Inc., at NOAA NCEI Federal Building, 151 Patton Avenue, Asheville, North Carolina, 28801, USA , 3. All-Russian Research Institute of Hydrometeorological Information - World Data Centre, Obninsk, Russia , 4. P.P. Shirshov Institute for Oceanology, Russian Academy of Sciences, Moscow, Russia, 5. Center of Hydrometeorology and Control of Radioactive Contamination and Environmental Monitoring, Minsk, Belarus , 6. Hydrology Science and Services Corporation, Asheville, North Carolina, USA

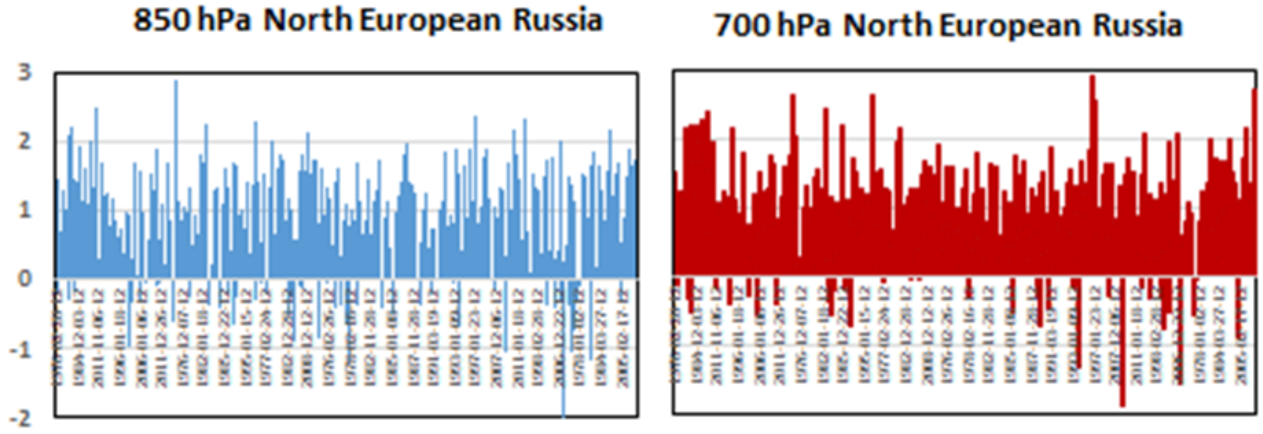
Freezing precipitation events intertwine with agriculture, recreation, energy consumption, and seasonal transportation cycles of human activities. While not rare, such events are known as "human-associated extremes" (HAE) and deserve our attention, especially when their intensity, timing, and type begin changing. We have already observed significant changes in freezing precipitation occurrences in the past decade. Can we project the future changes in pattern of this HAE over the northern extratropics under conditions of increasing lower tropospheric temperatures, changes in the atmospheric circulation, water content, and vertical structure? The problem here is that the synoptic reports about the freezing rain (FR) and freezing drizzle (FD) occurrences cannot be projected into the future, are not regularly available in the existing synoptic reports, are affected (masked) by other weather event reports (Russia and Belarus), or have been severely contaminated during switches to automated weather reporting (FD and weather code reporting itself). Therefore, the objective of our study is to build a combination of standard weather variables to reveal ***weather conditions conducive to freezing precipitation*** (WCCFP) and thereafter to extrapolate the occurrence of these conditions toward the regions without synoptic observations and to the future. The first part of this scientific program, construction of WCCFP parameters, will be presented.

We used supplementary synoptic information to evaluate the weather conditions during the freezing events observed at more than 1,500 long-term (i.e., 40+ years) stations in North America and Northern For these stations, we estimated the near-surface temperature (T) and humidity (H) intervals, within which the freezing events do occur. It appears that within these T and H intervals the other precipitation events occurred also and they are not necessary characterized by freezing. Therefore, we used Integrated Global Radiosonde Archive to blend our synoptic data with collocated upper air soundings and selected those that corresponded to freezing events at the ground. For freezing events, we found and quantified (a) unusually warm air as compared to long-term climatology values of corresponding Julian day; (b) much warmer low tropospheric air temperature than in the "nearby" days without freezing event at the ground; (c) frequent near surface temperature inversions, when the air at the 850 hPa is warmer than at the surface and the troposphere temperatures are warm enough to let the snowflakes to be condensed into rain drops, and (d) the lowest troposphere and near surface temperatures are cold enough to cool the temperature of these rain drops below freezing.

Combination of these meteorological variables (near-surface temperature, humidity, and the low troposphere temperature anomalies and gradients) allows us to build a set of the weather conditions that are *conducive* to freezing precipitation occurrence when it rains.

Keywords: freezing rain, freezing drizzle, weather conditions conducive to freezing precipitation, northern extratropics

Upper air normalized temperature anomalies at 850 and 700 hPa for freezing events at 7 stations of East European taiga



Anomalies are expressed in fractions of standard deviations of "normalized" daily temperature values at 12 UTC. Seasonal cycle variability of mean daily values and variances are eliminated by normalizing. Russian stations from 55°N to 62°N west of the Urals.

