

Changes in pan and visible evaporation over European Russia territory

Nina A. Speranskaya

State Hydrological Institute, St. Petersburg, Russia

Location of pan-evaporation stations



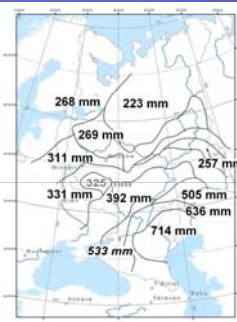
Regions where pan evaporation changes had similar features



Mean pan evaporation up to 1977

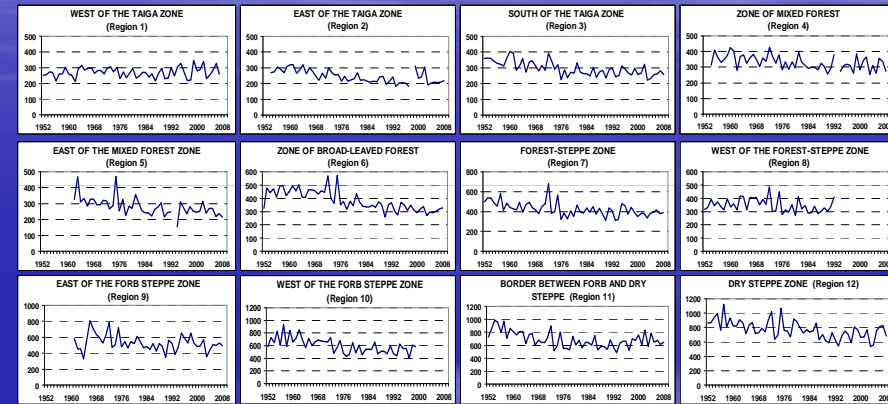


Mean pan evaporation since 1978



Estimates for the 1978-1992 period are in grey; estimates for the 1978-2000 period are in italics.

Pan evaporation changes within selected regions



Definitions and Data

- Pan evaporation observations in the USSR began in the middle of the 1950s. At the peak of the network extent (in the middle of 1980s) more than 150 stations performed these observations operating over European Russia. From 1990s the number of stations was significantly reduced, and at present data up to 2008 are available only for 25 stations. Using all available pan evaporation data from yameter GGI-3000 (for 98 stations), the territory of European Russia was partitioned into 12 regions in which trends and interannual variability of pan evaporation during the warm period (May-September) are similar. For two regions pan evaporation data are not available after 1992 (Region 8) and 2000 (Region 10).
- "Visible" evaporation, V_v , is defined as the difference between pan evaporation (E_p) and precipitation (P). It characterizes actual evaporation from the water surface and serves as an indirect index of losses of energetic resources on evaporation process in the land-atmosphere column. Positive V_v values indicate "dry" conditions signaling that the regional moistening is insufficient. When precipitation predominates above evaporation, V_v values are negative ("humid" conditions). The more negative the V_v value, the wetter is the territory, implying that more water is available for runoff.
- For our analyses of visible evaporation during the warm part of the year (May-September), we use a dense precipitation network from the RIHM—WDC archive that contains data of 780 stations over European Russia for 1966-2008.

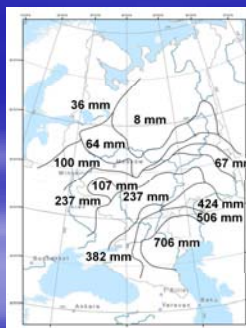
Results

Over the entire European Russia, a decrease in **pan evaporation** is observed. However, in the taiga zone, the changes are insignificant. Southward, the changes become more apparent except for region 8, where we do not have observations since 1993. Pan evaporation changes in the dry steppe zone and in its surroundings are non-linear. Up to the 1990s, pan evaporation decreased here, but since the end of the 20th century tendencies of increase were documented.

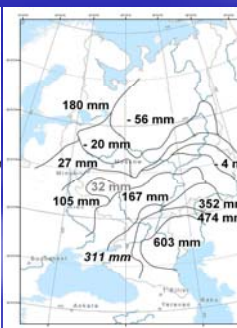
Changes in **visible evaporation during** the past 40 years show a tendency towards more humid conditions practically over the entire European Russia. In the west of the taiga zone systematic changes in V_v are negligibly small, and "dry" (pan evaporation is more than precipitation) periods become more prolonged than in the past. In region 8, the number of "humid" years exceeds the number of "dry" years since the middle of 1970s up to 1992 (when our last pan evaporation data are available for analyses). Within the steppe zone, pan evaporation exceeds precipitation, and the conditions of insufficient moistening are typical for this zone. However, the differences $E_p - P$ (i.e., V_v) are decreasing here, thus indicating an improvement in the zonal moistening. V_v changes in the dry steppe zone and semi-desert (region 12) differ from the common tendency of changes. Since 1990s, we observe in this region: drier conditions and V_v has increased.

Interannual variability of both pan evaporation and visible evaporation in the last 15 years became less than in the previous decades. It can be an indicator that heat- and moisture exchanges within the surface-atmosphere system in the European Russia have been weakening. Only the west of the taiga zone (Region 1) is an exception and interannual fluctuations of V_v here become more apparent.

Mean visible evaporation for 1966(61) - 1977



Mean visible evaporation since 1978



Estimates for the 1978-1992 period are in grey; estimates for the 1978-2000 period are in italics.

Visible evaporation changes within selected regions

