

The impact of extreme weather conditions on the life of settlers in the Central Russia in X - XVI centuries

Irina Graves (1), Viacheslav Nizovtsev (1), and Natalia Erman (2)

(1) Lomonosov Moscow State University, Moscow, Russian Federation (nizov2118@yandex.ru), (2) S.I. Vavilov Institute for the History of Science and Technology of the Russian Academy of Sciences (erman.natalie@mail.ru)

A special place in the reconstruction of climate dynamics takes an analysis of extraordinary meteorological phenomena. These extreme weather events in the first place impact the functioning of, the rhythm and dynamics of the landscapes and determine not only the features of economy, but also certain aspects of historical development. In the analysis of primary chronicles and published data, along with the direct climatic characteristics (hot, warm, cold, wet, dry, etc.) a lot of attention was paid to abnormal (extreme) natural phenomena and indirect indications of climate variability (floods, crop failures, hunger years, epidemics, etc.). As a result, tables were compiled reflecting climatic basic characteristics and extremes for each year since 900 BC.

X-XI centuries was a period of minor climatic optimum - the climate was warmer and drier than the modern one. In addition to higher temperatures (up to 1-3 [U+F0B0] C above than modern), during this period there were no severe winters. A small amount of summer rainfall has led to a reduction in the number of small water reservoirs and flooding rivers. This is evidenced by Slavic settlements on floodplains of a number of rivers in the Moscow region. It is in this favorable climatic time the way "from the Vikings to the Greeks" was open. Catastrophic natural events had a minimum repeatability. For example, during the X century the Russian chronicles mentioned 41 extreme event, but for the XIII century - 102. Most of the villages and towns were located on the low floodplain terraces of rivers. The main farmland was concentrated there as well.

In the "period of contrasts" (XIII - XIV centuries) there was an increase of intra-seasonal climate variability, humidity and widespread reduction in summer temperatures by 1-2 [U+F0B0] C. The number of extreme weather events increased: cold prolonged winters, long rains in summers, cold weather returns in the early summer, early frosts in late summer - early autumn. Such conditions often resulted in crop damage and famine.

From the XIV century the little Ice Age began. Year average temperature becomes lower by 1.4°C and summer temperature - by 2-3°C. In the XIV century the chronicles mentioned a total of 100 extreme natural phenomena, as a result of which Russia experienced more than 37 years of famine. The climate was particularly variable in late XIV - early XV century and XVI - XVII centuries, when there were years of particularly cold winters and increased humidity (due to winter precipitation). The duration of the crop growing season was reduced by three weeks. At the beginning of the XVII century spruce became dominant in the spruce-deciduous forests and co-dominant in deciduous forests. There was a transfer of settlements and agricultural land to interfluvial areas and higher river valleys. The determining factors were demographic, socio-economic and historical factors, but the role of natural factors cannot be overlooked.

The end of the XVI century was marked by the most severe political and economic crisis in the Russian State (oprichnina (political and administrative apparatus established by Ivan IV) and Livonian Wars by Ivan IV), which, combined with deteriorating environmental conditions (increased humidity of the climate, the average annual temperature drop) caused massive desolation of the lands. Many hundreds of villages turned into wasteland. In this period the Moscow land was reported as a "wild desert, covered with shrubs, bogs and imbanks", there were also memories of the past navigation on small rivers, data on mills on the streams. The climate deterioration caused the agrarian revolution in Russia in XIV-XVI centuries. Slash-and-burn and shifting cultivation was replaced by plow farming system (two- and three-field), which was more adapted to the harsh climatic conditions.

The work is performed under project № 17-05-00662 of the Russian Foundation for Basic Research