Slovak Hydrometorological Institute, The Department of Climatology

CLIMATIC CHARACTERISTICS USED IN THE DESIGN ROADWAY

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INTRODUCTION

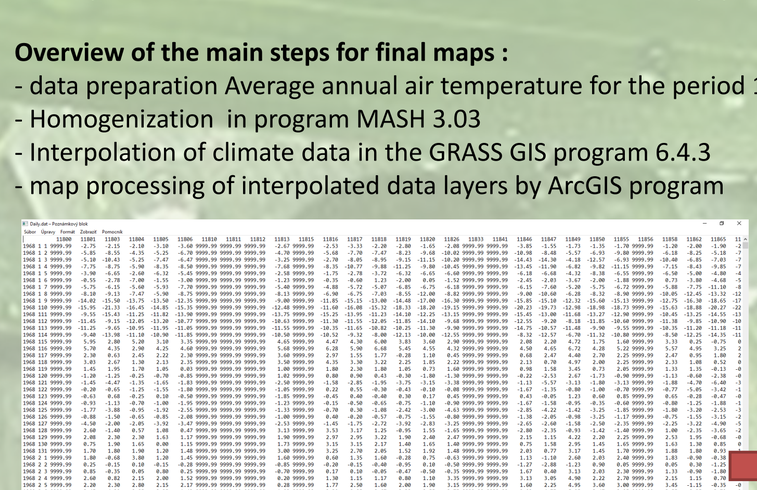
The main aim was to update the standard for the design of roads and traffic areas loaded with non-rail traffic and climatic effects. The main output are three maps for the periodicity n = 0.10; n = 0.15 and n = 0.25 and map with the average annual air temperature for the period 1968 – 2017 in Slovakia.

Data and Methods

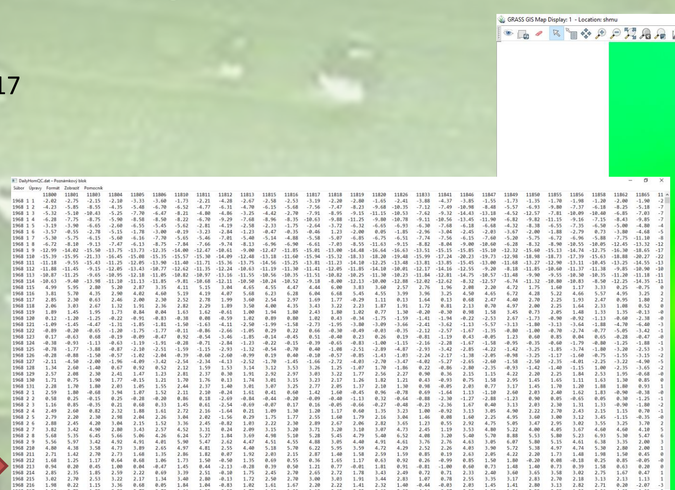
The following climatic characteristics are used when designing pavements:
- average annual temperature
- frost index

These characteristics are obtained by evaluating air temperature measurements. According to international conventions, this temperature is measured at 2 m above the ground at 7:00, 14:00 and 21:00. during the day. For the needs of Slovakia these measurements are regularly performed by the Slovak Hydrometeorological Institute. For practical purposes, changes in daily temperatures are expressed by the average daily air temperature. The design value Tm is determined from long-term air temperature measurements and the average annual temperature map is used for road construction needs.
The frost index Im [° C] is determined as the sum of the absolute values of consecutive negative average daily temperatures in winter. The frost index is the most commonly used climatic characteristic in the field of road design in Slovakia. For experimental air temperature measurements, the frost index is determined by adding the negative average daily air temperatures Ts in winter.
For the purpose of developing map products of the frost index, we used the MASH program to homogenize the average daily air temperature data.
The MASH software, which was developed for homogenization of monthly and daily data series, includes also quality control and missing data completion units for the daily as well as the monthly data. Depending on the climate elements, additive or multiplicative model can be used. In our case we used the additive model. The version of the software is MASHv3.03 that includes new developments for automation. These automatic ‘user friendly’ procedures make the homogenization easier for the users.

Overview of the main steps for final maps :
- data preparation Average annual air temperature for the period 1968 - 2017
- Homogenization in program MASH 3.03
- Interpolation of climate data in the GRASS GIS program 6.4.3
- map processing of interpolated data layers by ArcGIS program



Data series



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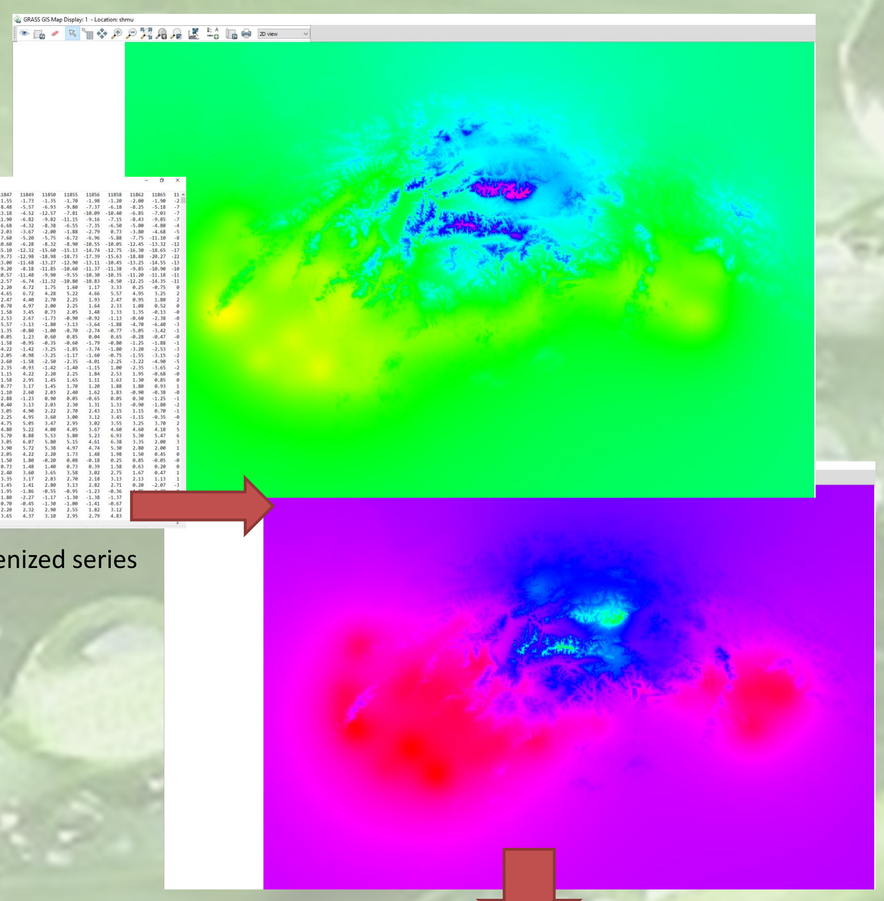
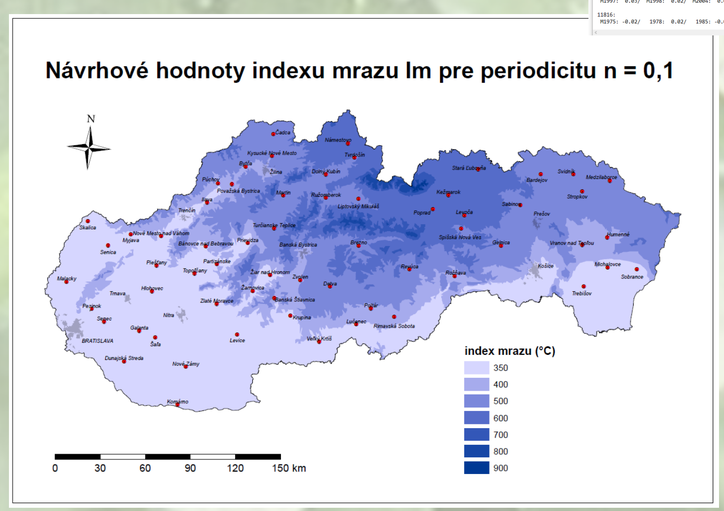
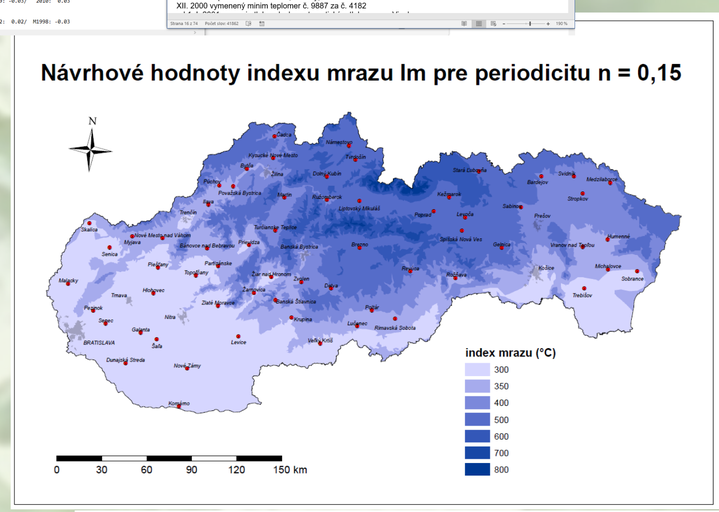
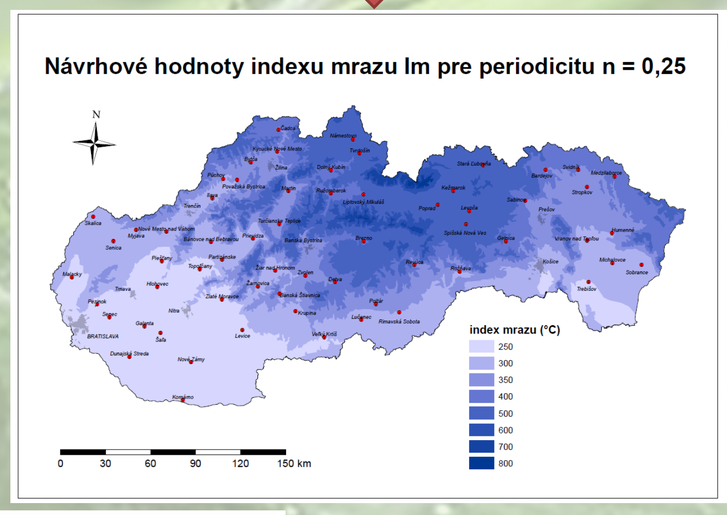


Homogenized series

Interpolated data

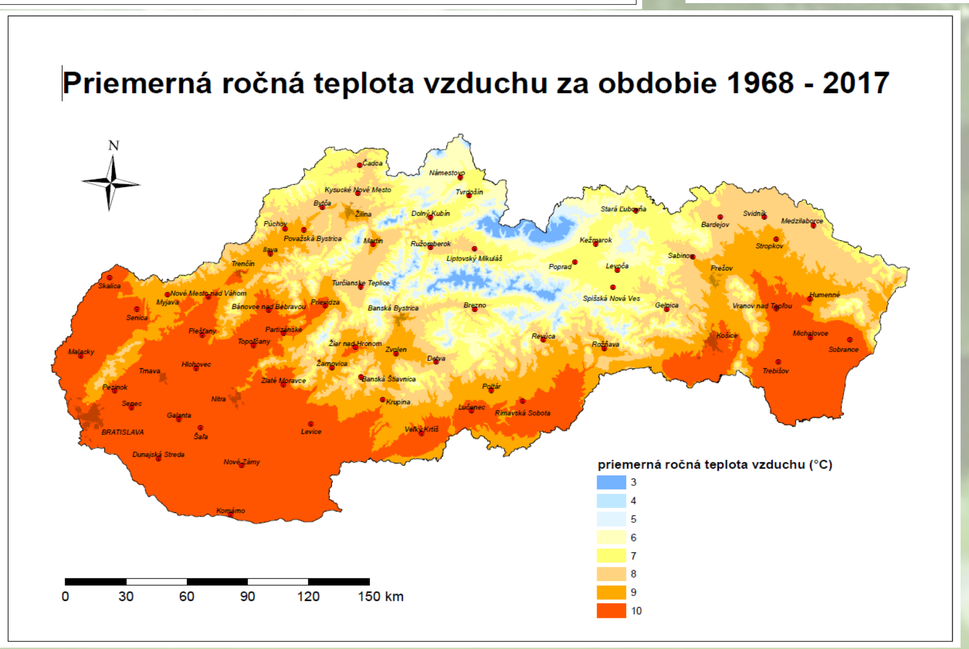






The maps frost index for the periodicity n = 0.10; n = 0.15 and n = 0.25

Conclusion:
The results presented in the paper show changes in the design values of the frost index for periodicity n = 0.10; n = 0.15 and n = 0.25 and changes in average annual air temperature for the period 1968 – 2017 in Slovakia. We used 93 meteorological stations for homogenization. Most inhomogeneities were caused by relocating the station or changing the observer, or replacing the instrument. We calculated the frost index using the Pearson coefficient.
The maps of average date temperature and frost index, were interpolate with 3D method in GIS Grass.
The resulting maps form the basis for updating the standard and are intended to adapt to the new climatic conditions for the design of roads and traffic areas burdened by non-rail traffic and climatic effects.



The map average annual air temperature for the period 1968 – 2017 in Slovakia

References:
Szentimrey T. 2011. Manual of homogenization software MASHv3.03, Hungarian Meteorological Service, 64 pp.

Photo: Steffan Enbom, Finland