

## FUTURE CLIMATE CONDITIONS FOR SUMMER ROADS IN LITHUANIA

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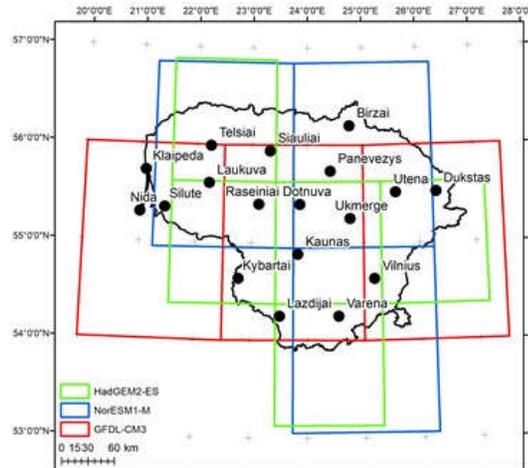
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Usually traffic safety and driving conditions were associated with winter roads. However, summer roads could be very dangerous to traffic accidents because of weather conditions (1). Recent changing climate conditions already brought new challenges for summer maintenance specialists in Lithuania. In summer, at a temperature of (25–30) °C, road pavement surface heats up to (40–45) °C (2). The problem of deformation of asphalt pavement due to hot air temperature are possible. Moreover, the summer months typically bring higher numbers of traffic deaths, with July and August being considered the most dangerous months of the year to be on the roads (3)

Adverse weather conditions usually cause severe road network disruptions, no matter the location or time of the year (4). During summer, such conditions usually include high winds and intense precipitation (rain and hail), caused by some form of a storm passing through the region (local or advective). This significantly decreases the visibility and causes the drivers to slow down or even stop, moreover, flooding might occur in some areas, causing the transportation network to halt (5).

Projected climate changes will have a different impact on transport system than other sectors, thus its adaptation and mitigation strategies require special assessment of meteorological data (6). The aim of this research is to investigate what future climate conditions that influence transport system will take place in Lithuania during summers until the end of 21<sup>st</sup> century. A better understanding of what to expect will help decision and policy makers to evaluate and choose proper adaptation and mitigation strategies.

The data from eighteen meteorological stations (MS) covering 20 years period from 1986 to 2005 were used in this research (Fig. 1). The daily data included maximum air temperatures (°C), precipitation amount (mm), maximum wind speed (m/s) and atmospheric pressure (hPa) for summer (May-September). Three Global Circulation Models (GCM) were chosen for projections of future climate conditions for winter roads in Lithuania: GFDL-CM3, NorESM1-M and HadGEM2-ES. CMIP5 (Coupled Model Intercomparison Project Phase 5) project outputs (7) of daily meteorological variables were used in the research downloaded from NOAA GFDL database and World Data Center for Climate / CERA at DKRZ. GCMs daily values obtained for reference period (1986-2005), near-term (2016-2035) and long-term (2081-2100) futures. Near- and long-term projections were made using 4 RCPs (Representative Concentration Pathway): RCP2.6, RCP4.5, RCP6.0, and RCP8.5. GCMs have different grid cell distribution (Fig. 1) over Lithuania: we used 3 cells for GFDL-CM3 and NorESM1-M; 5 cells – HadGEM2-ES. The value of grid cells assimilated to nearest MS using statistical downscaling methods.



**Fig. 1.** Meteorological stations in the territory of Lithuania and grid cells of 3 GCMs (GFDL-CM3, NorESM1-M and HadGEM2-ES).

Three new adjusted meteorological parameters database of 21<sup>st</sup> century projections was created for every MS, which allowed us to estimate dangerous and adverse climatic conditions for summer roads in Lithuania:

- Hot Dry days (HD) – number of days per summer when maximum air temperature is  $>28$  °C, atmospheric pressure  $>1018$  hPa and no precipitation recorded (0.0 mm). It can be the reason for road pavement (asphalt) deformation. The rutting of asphalt could affect driving comfortability and safety, and rise the costs of roads reconstruction.
- Fine Weather days (FW) – number of days per summer when atmospheric pressure is  $>1018$  hPa, no precipitation recorded (0.0 mm) and maximum air temperature stay between 20 and 30 °C. It could be a reason of more busy traffic on roads and more relaxation of drivers, etc. which could be a reason for traffic accidents.
- Severe Summer Weather days (SSW) – number of days per summer, when maximum air temperature is above 18 °C, maximum wind speed exceeds 10 m/s and there is at least 5 mm of precipitation. These conditions describe a situation when there's a high chance of having a front or a squall line passing through and significantly worsening driving conditions. During summers, at the second half of a hot day there's a high chance for local thunderstorms forming too, therefore, this parameter provides an insight in averaged frequency changes of such stormy days in the future.

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