

## Impacts of Future Climate Change on Ukraine Transportation System

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Transportation not only affects climate, but are strongly influenced with the climate conditions, and key hubs of the transportation sector are cities. Transportation decision makers have an opportunity now to prepare for projected climate changes owing to development of emission scenarios.

In the study impact of climate change on operation of road transport along highways are analyzed on the basis of RCP 4.5 and RCP 8.5 scenarios. Data contains series of daily mean and maximum temperature, daily liquid (or mixed) and solid precipitation, daily mean relative humidity and daily mean and maximum wind speed, obtained for the period of 2011 to 2050 for 8 cities (Dnipropetrovsk, Khmelnytskyi, Kirovohrad, Kharkiv, Odesa, Ternopil, Vinnytsia and Voznesensk) situated down the highways. The highways of 'Odesa-Voznesensk-Dnipropetrovsk-Kharkiv' and 'Dnipropetrovsk-Kirovohrad-Vinnytsia-Khmelnytskyi-Ternopil' are considered. The first highway goes across the Black Sea Lowland, the Dnieper Upland and Dnieper Lowland, the other passes through the Dnieper and Volhynia-Podillia Uplands. The both highways are situated in steppe and forest-steppe native zones. For both scenarios, significant climate warming is registered; it is revealed in significant increase of average monthly and yearly temperature by 2-3°C in all cities in questions, and also, in considerable increment of frequency of days with maximum temperature higher than +30 and 35°C, except Kharkiv, where decrease number of days with such temperatures is observed. On the contrary, number of days with daily mean temperature being equal to or below 0°C decreases in the south of steppe, is constant in the north of steppe and increases in the forest-steppe native zone. Extreme negative temperatures don't occur in the steppe zone, but takes place in the forest-steppe zone. Results obtained shows that road surface must hold in extreme maximum temperature, and in the forest-steppe zone hazards of extreme negative temperatures must be considered.

Frequency of winter events that make road surface worse such as glaze-clear ice, frozen snow that had initially melted on a warm road surface, ice and snow slippery coats etc., are high enough, especially in the forest-steppe zone. In the Black Sea Lowland among winter events the frozen snow that had initially melted on a warm road surface is most commonly observed, that is connected with high occurrence of the thaws. Because of increase in frequency of shower precipitation in all cities wet road surface is observed most frequently, especially in May and June; it must be taken into account for construction of roads, too.

Monthly mean wind speed shows that in Odesa and Kharkiv significant increase in average monthly and yearly wind speeds are observed, by 0,5-1 m/s in comparison with the period of 1961 to 1990. On the contrary, in Dnipropetrovsk, wind speed decreases by 0,7 m/s.

Frequency distribution of maximum wind speed shows that high wind speeds are more frequent in the winter months.