Climate Change Impacts and Adaptation for Transport Networks and Nodes

UNECE

WORLD METEOROLOGICAL ORGANIZATION

Context

Inland transport networks and nodes of international importance (roads, railways, waterways, terminals, ports) are instrumental to ensuring market access for people and goods. Medium to longer-term disruptions on those assets may lead to adverse effects on economies but also human well-being. **Extreme climatic events** could potentially cause severe disruptions to the transport networks, and there is a critical need for a long term transformation in the face of **climate change**.

Strategy

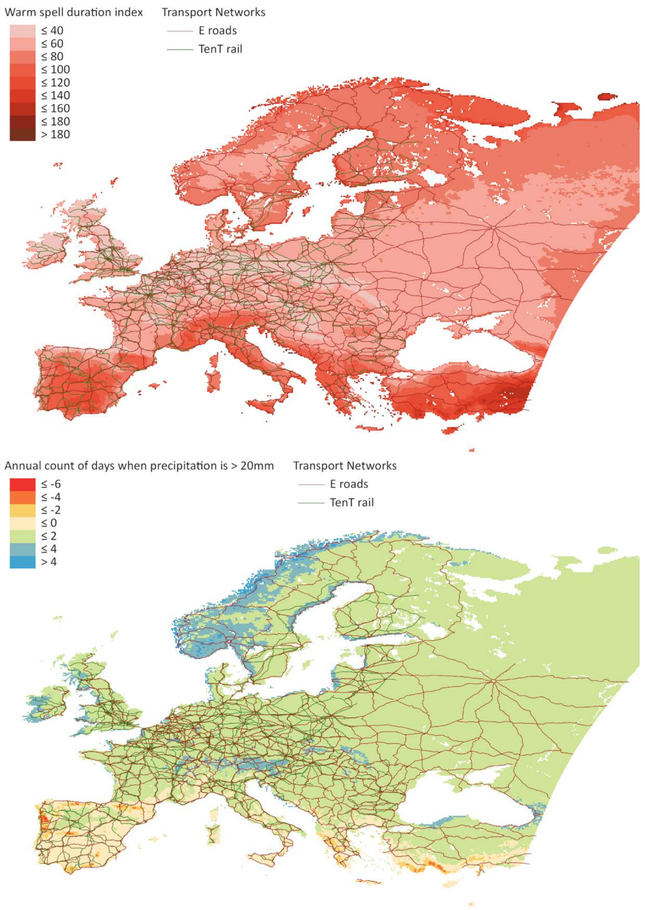
The UN Economic Commission for Europe (**UNECE**), in collaboration with the World Meteorological Organization (**WMO**), has been working on **identifying inventories of transport assets vulnerable to climate impacts** and on awareness raising, using a multi-model ensemble of regional climate model simulations from the Euro-CORDEX project. A "business-as-usual" scenario (RCP 8.5) and a low-emission one demanded by the goals of the Paris Agreement (RCP 2.6), were used.

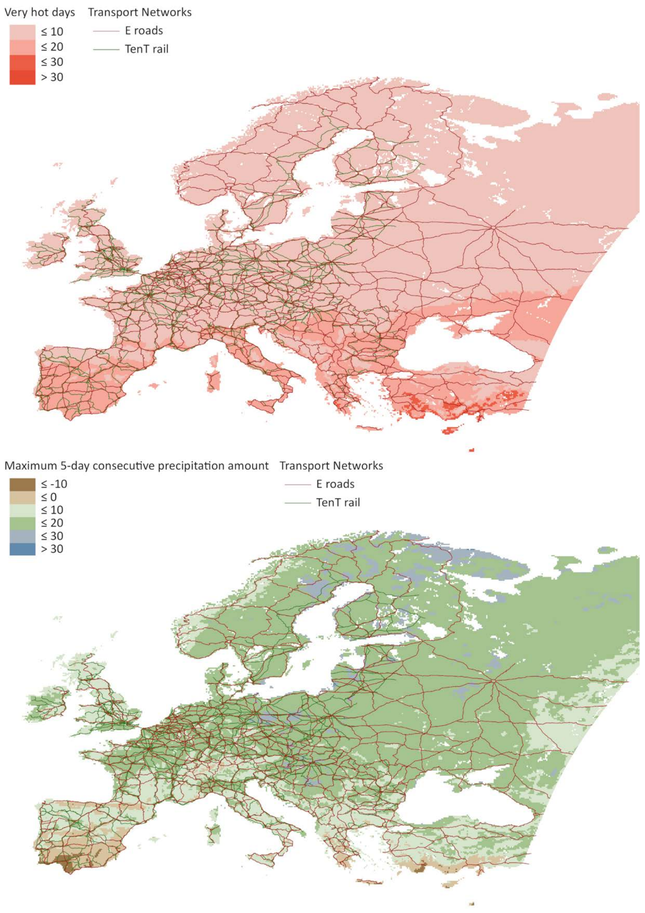
Some examples of climate change impacts on transportation infrastructure and operations

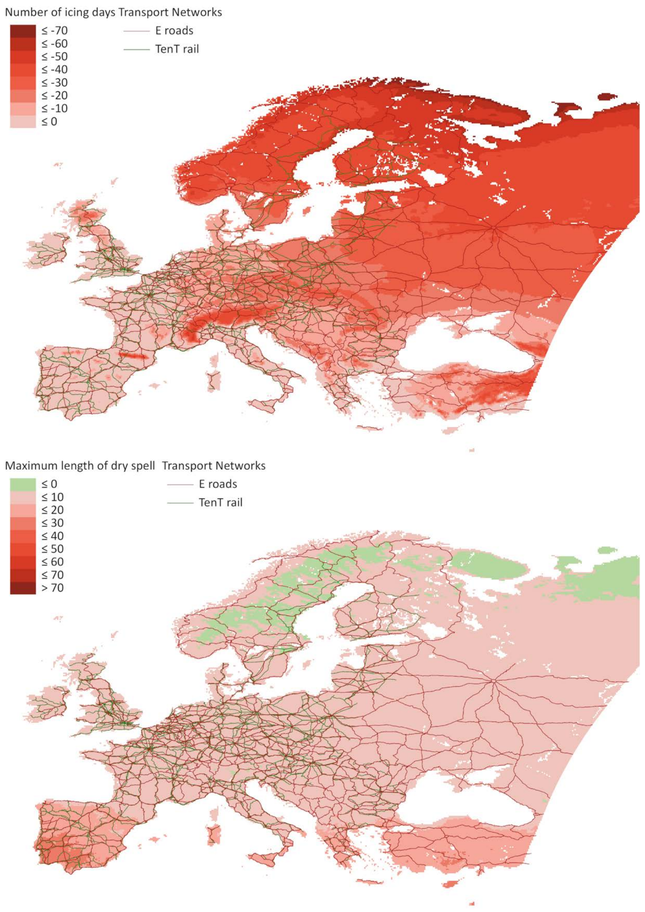
	Road	Rail	Waterways and ports
Temperature • Higher mean temperatures; heat waves/droughts; changes in the numbers of warm and cool days • Reduced snow cover and arctic land and sea ice; permafrost degradation and thawing	• Thermal pavement loading and degradation • Asphalt rutting • Thermal damage to bridges • Increased landslides • Increased needs for cooling • Reduced integrity of winter roads and shortened operating seasons • Slope instability	• Track buckling • Infrastructure and rolling stock overheating/failure • Slope failures • Signaling problems • Speed restrictions • Asset lifetime reduction • Higher needs for cooling • Shorter maintenance windows • Higher construction and /maintenance costs • Demand changes	• Damage to infrastructure, equipment and cargo • Higher energy consumption for cooling • Potential reductions in snow/ice removal costs • Extension of the construction season • Occupational health and safety issues during extreme temperatures
Precipitation • Changes in the mean values; changes in intensity, type and/or frequency of extremes	• Inundation, damage and wash-outs of roads and bridges • Increased landslides • Impacts on bridges	• Flooding, damage and wash-outs of bridges • Problems with drainage systems and tunnels • Delays	• Infrastructure inundation • Navigation restrictions in inland waterways due to river water levels changes
Sea levels/storm surges • Mean sea level rise • Increased extreme sea levels	• Erosion of coastal roads • Flooding, damage and wash-outs of roads and bridges	• Bridge scour, catenary damage at coastal assets • Disruption of coastal train operation	• Asset inundation • Navigation channel sedimentation • Maintenance costs

6 Climate indices

Heatwave	Heat on rail and road	Permafrost thaw	Downpours / flashfloods	Flooding	Low river flow
Warm spell duration index. Annual count of days with at least 6 consecutive days when daily max. temp. > 90th percentile	Number of very hot days Annual count of days when daily maximum temperature > 30°C	Number of icing days. Annual count of days when daily maximum temperature < 0°C	R20mm Annual count of days when precipitation is > 20mm	Rx5day Maximum 5-day consecutive precipitation amount	Maximum length of dry spell. Maximum number of consecutive days when daily precipitation is < 1 mm
Road and rail networks	Rail and road networks	Road network	Road and rail networks	Road and rail networks	Waterways







Further effort is required to understand in detail the effect of climate changes at the local scale of the transport networks and nodes.

A second-step analysis should include assessing transport asset geomorphology, its conditions and quality and its specific structures.

Geographical data for inland transport networks and nodes, at least for infrastructure of international importance, should be made available and shared by Governments for a better assessment of climate change impacts and possible adaptation measures.

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