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# Improving Climate Resilience in HDM-4


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VIRTUAL | VIRTUEL

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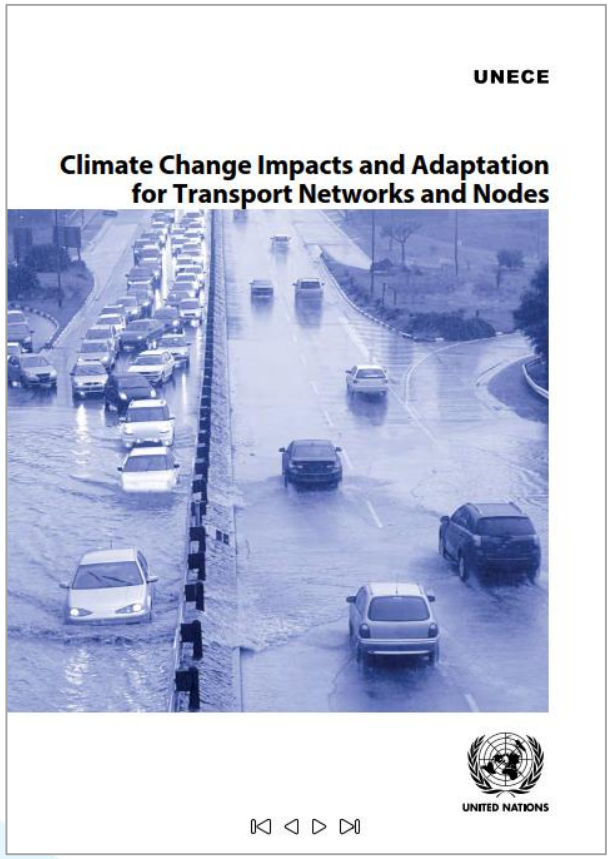
# Overview

- Impacts of climate change on road infrastructure
- Responses available to roads agencies
- Current models and applications in HDM-4
- Scope for future expansion in HDM-4

# Impacts of climate change on roads




UNECE report analysed several climate variables related to transport networks and nodes in the ECE region (August 2020)

Intended to raise awareness of the importance of considering climate change and extreme weather in planning, construction, maintenance and operations

Stimulate work for local and regional assessments, and identification of specific transport assets at risk which may require adaptation efforts

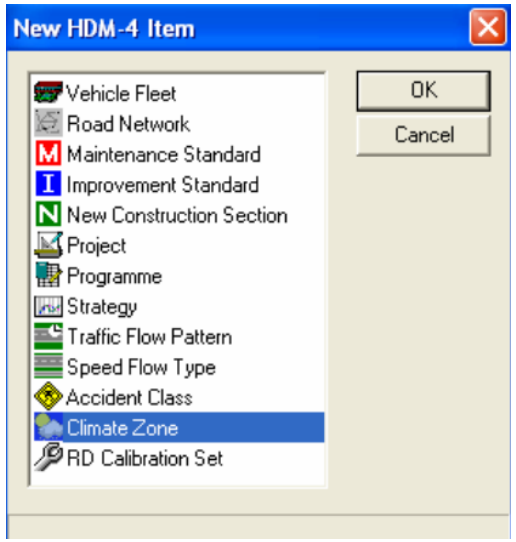
# Impacts of Climate Change on Roads

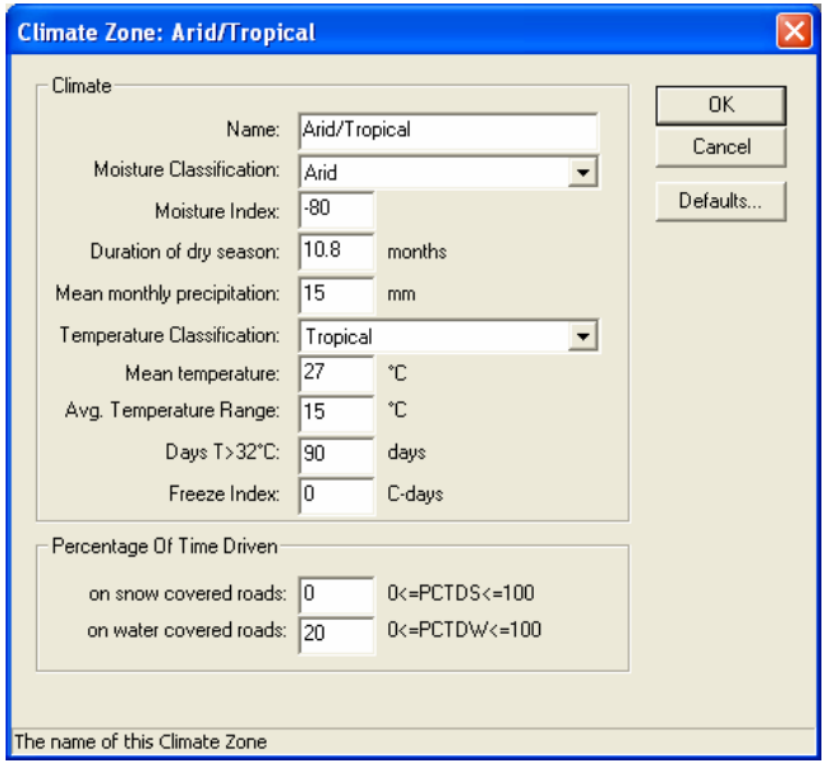
| Factor / Hazard | Impact on Roads |
|---|---|
| Temperature: Higher mean temperatures; heat waves/ droughts; changes in the numbers of warm and cool days | Thermal pavement loading and degradation; asphalt rutting; thermal damage to bridges; increased landslides in mountainous roads; asset lifetime reduction; increased needs for cooling (passenger and freight); occupational health and safety issues during extreme temperatures; shorter maintenance windows; increased construction and maintenance costs; potential changes in demand; reduced integrity of winter roads and their shortened operating seasons |
| Temperature: Reduced snow cover and arctic land and sea ice; permafrost degradation, quick ice thawing | Damage and deterioration of roads; decreases in travelling days; slope instability and embankment failures; coastal erosion affecting coastal roads |
| Precipitation: Changes in the mean values;  changes in intensity, type and/or frequency of extremes (floods and droughts) | Inundation, damage and wash-outs of roads and bridges; increased landslides, mudslides; bridge scouring earthwork and equipment failures; poor visibility that can increase accidents; reduced vehicle traction; more frequent slush flows; delays; changes in demand |
| Windstorms: Changes in frequency and intensity of events | Damage to fences; increased risk for road accidents due to reduced vehicle stability; damage to road structures (including signage and traffic signals); obstructions (e.g. due to fallen power lines/trees); bridge closures |
| Sea levels / storm surges: Mean sea level rise (SLR) | Increased risks of permanent inundation; erosion of coastal roads; flooding, damage and wash-outs of roads and bridges |

# Responses available to roads agencies

- Review and update policies and standards for planning, programming, design and maintenance
- Alignment of policies with National Adaptation Plans (NAPs)
- Provide the required funding to carry out regular periodic and routine maintenance
- Improve monitoring of infrastructure
- Research and implement new materials and technologies
- Conduct Climate Risk and Vulnerability Assessments of their assets
- Enforce stricter specifications and quality assurance during construction

# Current models and applications of HDM-4




**HDM-4 Volume 4 Part C – Road Deterioration Models**

It discusses the key variables that affect deterioration, which include climate and environment effects, traffic, and pavement history.

# Current models and applications of HDM-4

Climate Model in HDM-4 was developed long before climate change became a major international issue

It is possible to adjust HDM-4 calibration factors to mimic the effects on road deterioration, e.g. by changing the Adjusted Structural Number (SNP) to represent the pavement becoming weaker due to longer wet seasons or more intense rainfall.

Also, modify drainage conditions on the network to influence pavement deterioration rates

# Scope for future expansion in HDM-4

Areas for expansion could include:

Improve granularity of the models – for example mean monthly precipitation does not reflect impact of increase in rainfall intensity; mean annual temperature ranges does not reflect impact of heatwaves

Model off-carriageway assets, particularly slopes and drainage

Allow climate model or parameters to change throughout the analysis period

# Summary

Fundamentally, the existing HDM-4 climate model is basic in its models and application.

Call for funding of HDM-4 will allow development of a new climate module to include important variables, improve the sensitivity to others, and gear it towards modelling pavements in a changing climate.

Also need to incorporate models for new technological solutions.