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Group of Experts on Climate Change Impacts and Adaptation for Transport Networks and Nodes

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Discussions on the final report of the Group of Experts

Case study: A methodology to assess the risks due to climate change on transport networks – the case study "DIR Med"

Submitted by the Government of France

This document informs about methodology developed and tested in France to evaluate risks due to climate change on transport networks. The Group of Experts should consider this document and discuss its inclusion in chapter 3 of the final report.

A methodology to assess the risks due to climate change on transport networks – the case study "DIR Med"

I. Aim of the study

In 2017/2018, on the supervision of Cerema[1], Carbone 4[2] has led a risk assessment on a large state-owned road network in the Southeast of France, using the methodology designed by Cerema. The road authority: "DIR Méditerranée", three entities of the French Ministry and various specialists of transport infrastructures also took part to the working group. One of the aim of the study was to test the applicability of the methodology. The result was successful and the methodology is currently being applied on other networks.

II. Scope

The entire road network maintained and operated by the DIR Méditerranée – over 750 km wide with about 1000 engineering infrastructures – has been assessed to identify the road sections and infrastructures the most vulnerable to climate change. Some of the road sections are part of the international E-road network (A7/E714, A51/E712).

The area of study experiences multiple climates from the Mediterranean seashore up to the Alps (high mountains, coastal plains, great forests, rocky creeks, ponds, etc.).

III. Scoring of extreme climate events

The analysis of the impacts of past climate hazards reveals the heterogeneous exposure of the area. For instance, the Alps are subject to a large number of freezing days while there is a high risk of coastal flooding, drought and wildfire along the Mediterranean seaside.

A large range of climate variables have been analysed: extreme hot and cold temperature, heavy rains, drought, frost, flooding. Current and future values that characterize their intensity and occurrence have been mainly extracted from the French web portal on climate projections DRIAS[3]. The model used is CNRM 2014 (ALADIN) with a spatial resolution of 8km.

Scenarios		
RCP 2.6	RCP 4.5	RCP 8.5
Optimistic	*Likely to occur*	*Pessimistic*

Time periods		
1961-1990	2021-2050	2071-2100
Reference	*Short-term*	*Long-term*

The evolution of each climate variable has been scored, to assess the current and the future exposure of the road network at short and long-term.

IV. Scoring of the vulnerabilities of the infrastructures

The road network has first been classified into categories of infrastructures (road, bridge, tunnel, retaining wall, safety net, etc.) and components (surface layer, inner structure, traffic signs, etc.).

[1] Cerema is a French resource centre for scientific and technical expertise, in support of the definition, implementation and evaluation of public policies, carried by national and local authorities.
[2] Carbone 4 is a consulting firm on the issues of climate change mitigation and adaptation.
[3] http://www.drias-climat.fr/

Then, the physical impacts of climate events have been analysed. For example, landslides may cause a partial or total destruction of the roads and safety nets, cracks may appear on the road surface due to extreme heat waves, and freeze-thaw cycles foster corrosion on concrete structures. Vulnerability factors have been identified to discriminate the vulnerability of different road structures, different drainage system, etc. They are mainly based on the type of material and the condition of the infrastructure for example.

Finally, a score has been assigned to the vulnerability of each infrastructure and component to each climate event previously analysed.

V. Scoring of the risk linked with the road functionalities

First, the operational impact of a road failure – traffic interruption or slowdown due to a climate event, with or without damage for the infrastructures – has been analysed. The level of importance of the different road sections has been assessed on the basis of traffic data.

These two parameters have been combined with the levels of vulnerability to score the risk of different road sections.

Risk assessment "DIR Med", an example of result – Level of vulnerability of a road component facing heat waves for the climate scenario RCP8.5 at the horizon 2071-2100. The results have been anonymised.

Sources: Cerema, DirMed and Carbone 4 // Scoring: Carbone 4