# Climate Change Impacts and Adaptation for Transport Networks and Nodes

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Working Party on Intermodal Transport and Logistics
62nd session

# Context

- Role of transport networks and nodes in national and regional economies / disruptions on those assets impacts economies and human well-being.

- High potential of severe disruption by extreme events caused to the transport networks

- Increasing frequency and harshness of extreme events

# Methodology

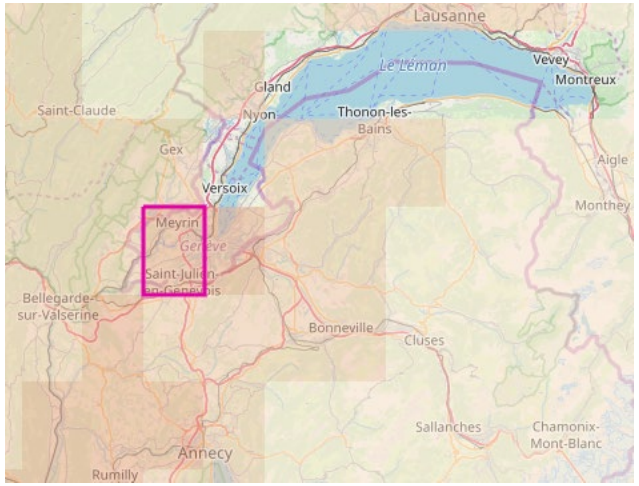
**6 climate indices:**

| 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. > 90$^{th}$ 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 |

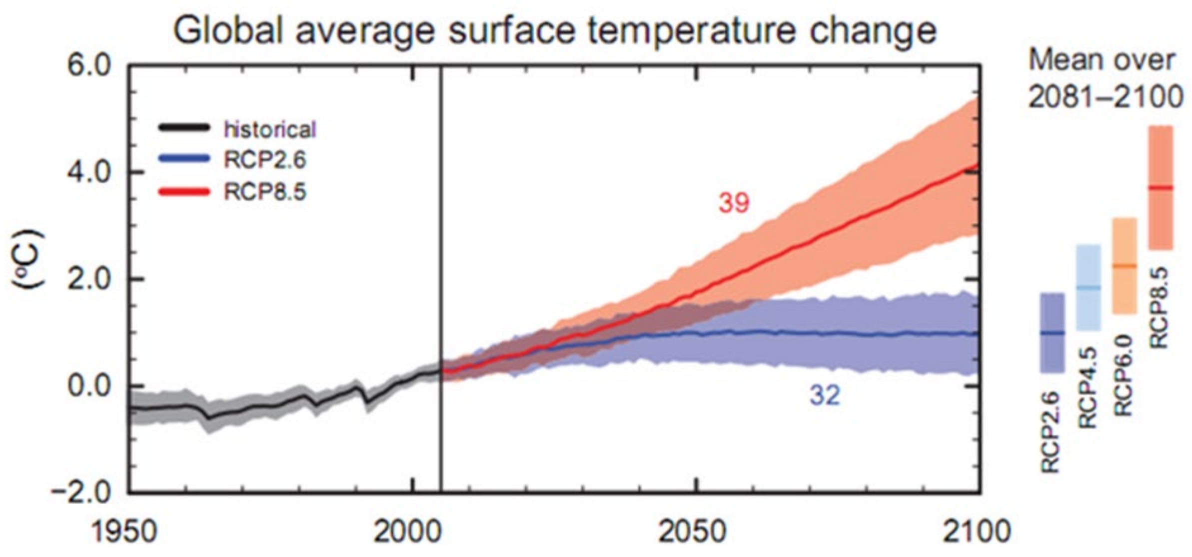
Data source

- Europe: data computed by the Climate Service Center Germany (GERICS) from the EURO-CORDEX project, spatial resolution of 12.5 km
- Canada: statistically downscaled multi-model ensembles, spatial resolution of 10 km

Other indices: riverine and coastal floods, provided by European Commission-Joint Research Centre (EC-JRC)



# Methodology

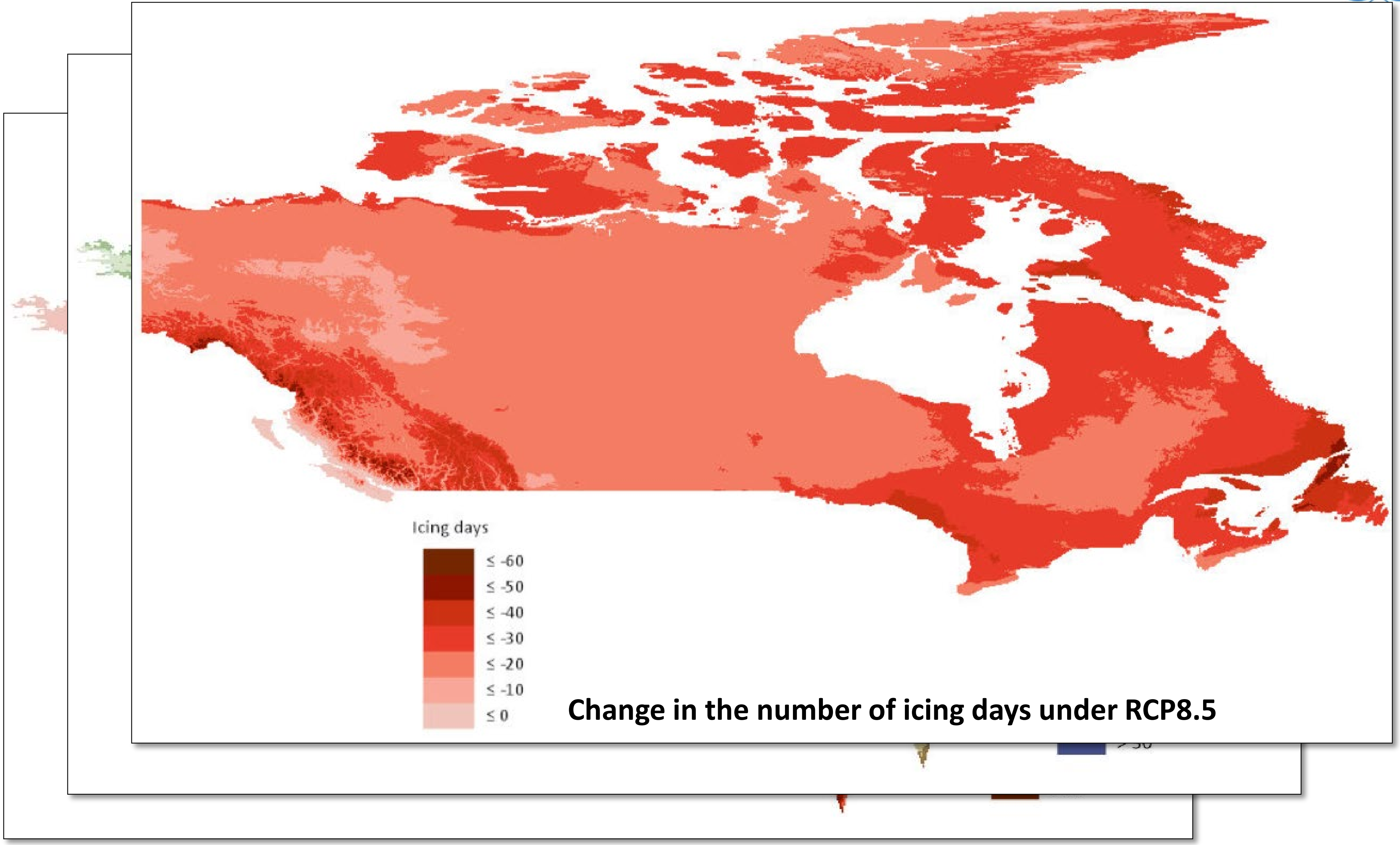



Two climate projection scenarios

- **RCP2.6 scenario:** stringent climate mitigation action (goals of the Paris Agreement)
- **RCP8.5 scenario:** “business-as-usual”

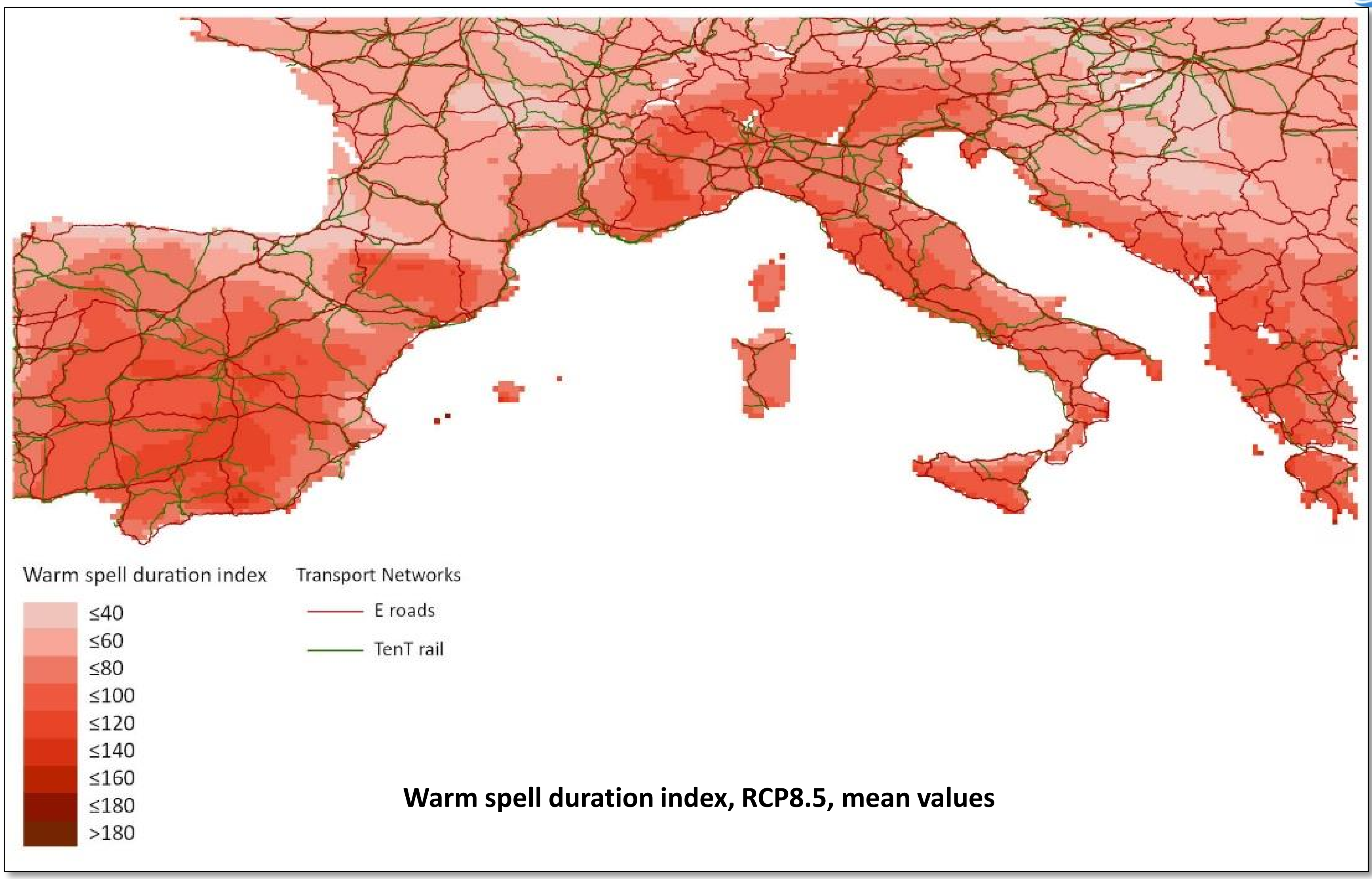
Baseline period: **1971-2000**
Projected period: **2051-2080**

# Results – Examples: maps of climate change indices




Change in the number of icing days under RCP8.5

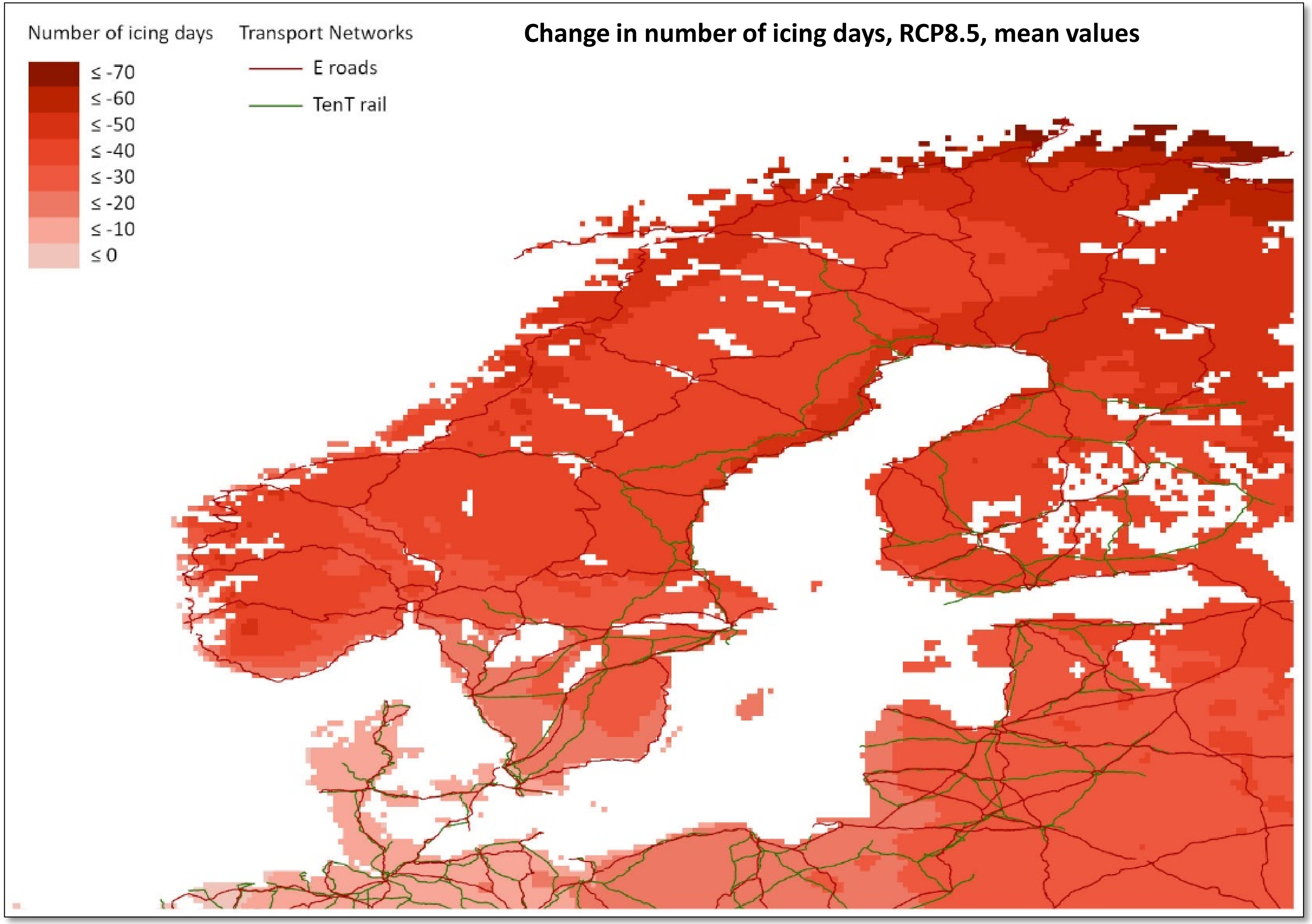
# Results example – Warm spell duration index and transportation



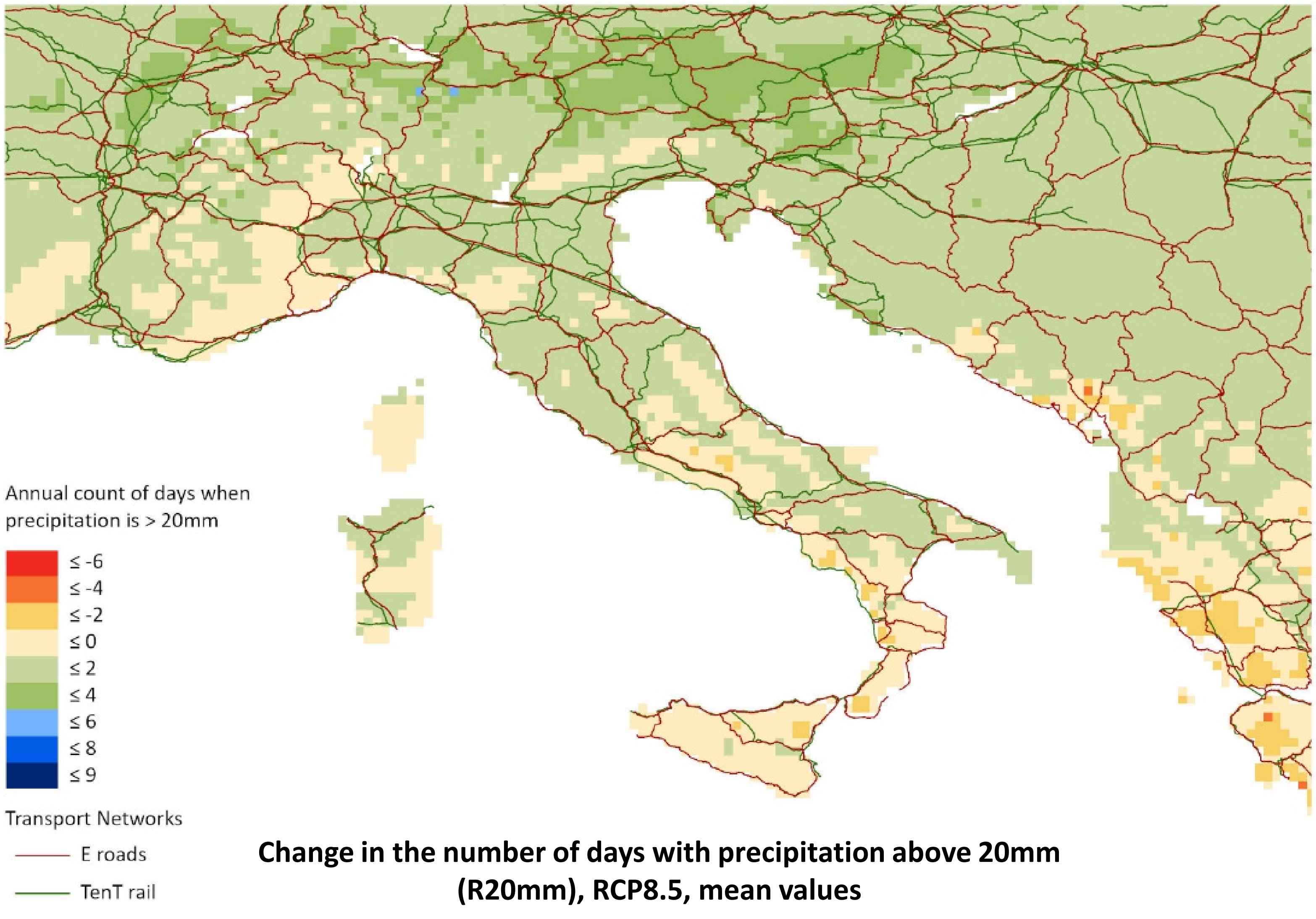

**Warm spell duration index, RCP8.5, mean values**

Projected impacts on E80 and E712 in south-east of France, E45, E55 and E80 in Italy, E65 in the Western Balkans, E01, E80, E82 and E90 in Portugal, E05 and E15 in Spain, E55 in Greece, and E84 and E87 in Turkey

# Results example – Icing days and transportation



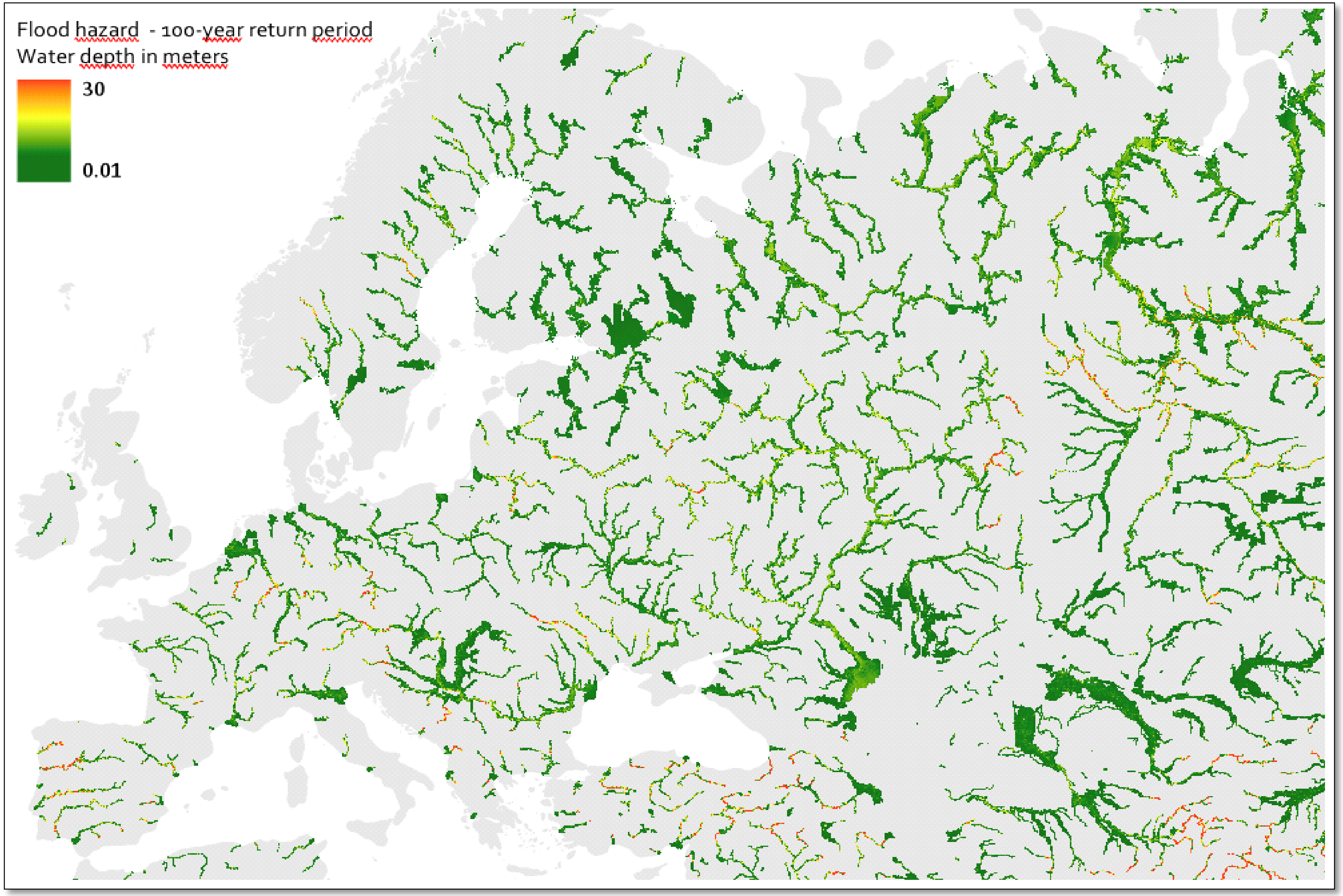
# Results example – Precipitations above 20mm and transportation




**Change in the number of days with precipitation above 20mm (R20mm), RCP8.5, mean values**

E roads potentially impacted: E04, E06 and E18 in the north of Europe, E35, E45 and E55 crossing through the Alps; E65 in the Balkans; E50 and E58 crossing through the Carpathians; and E70 and E97 along the eastern and south-eastern coast of the Black Sea.

# Results example – Flood hazards



# Results example – Seal levels


**Projections of extreme sea levels (in m) for the 100-year event (ESL100) at the end of the twenty-first century (RCP8.5 scenario)**

# Results – Case studies: approaches, practices, methodologies and tools for analysing climate change impacts on transport

**Germany**

- Adapting the German transport system to climate change
- Reviewing railway operation regulations and policies regarding potential climate change

**Canada**

- Methodology for assessing infrastructure vulnerability to climate change in Canada

**France**

- Measures concerning transport from the National plan for Adaptation to Climate Change

**Poland**

- Polish practice in carrying out sensitivity, vulnerability and risk analysis for the identification of hotspots on transport infrastructure due to climatic factors

**Netherlands**

- Development of a Climate Adaptation Strategy for the InnovA58 highway in the Netherlands

**Romania**

- Early Warning Intelligent System for Road Transportation Risks

**UNCTAD**

- Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States (SIDS)

# Results – Case studies: socioeconomic impacts and implications from climate change on transport infrastructure

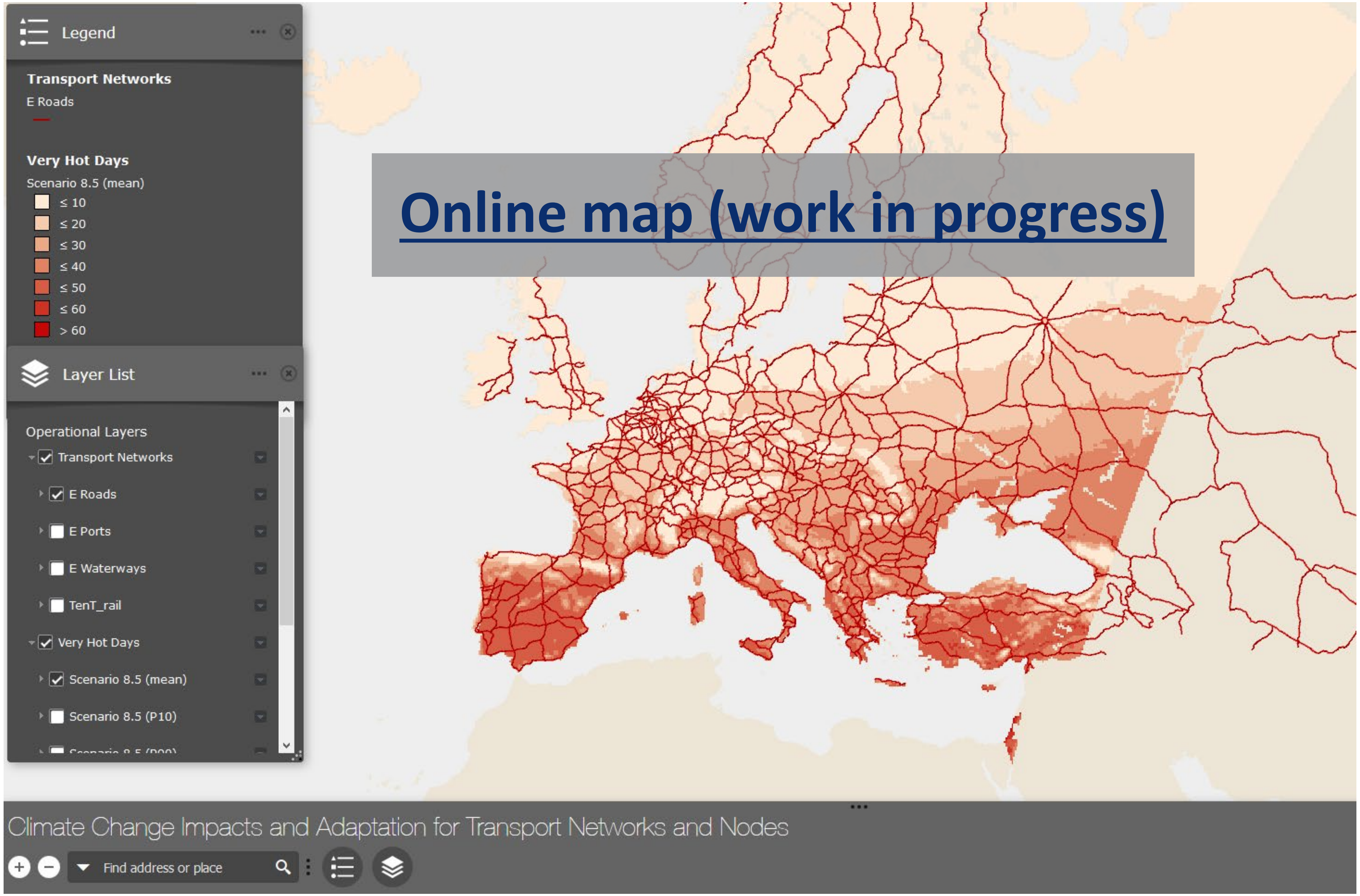
**Canada**
- All-Season Roads in Northern Canada and Implications of Climate Change
- Winter Roads in Canada and the Implications of Climate Change

**Finland**
- New Guidelines for Winter Maintenance of Roads in Finland

**Germany**
- Low flow extremes of the Rhine river – Causes, impacts and adaptation of the most important inland waterway in Europe
- Impact of climate change on the water management of the Kiel Canal
- Influence of weather and climate extremes on supra-regional traffic flows – Stress test scenario Middle Rhine

**Iceland**
- Sea level changes, guidelines and adaptation

# [Online map (work in progress)]



# **Lessons learned** (1/3)

- Complex tasks

- Limited experience in countries (some countries as forerunners)

- Data limitations
  - on transport infrastructure (geo-coded) and on usage data (traffic volumes, freight processed)
  - no one climatic data set for UNECE region

# **Lessons learned** (2/3)

- First step analysis as a good basis – exposure identified

- First step analysis insufficient / complementary analysis needed (natural and anthropogenic factors, characteristics of specific asset, downscaling of projections, impact modelling….)

# **Lessons learned** (3/3)

- Sharing country experience key to identification and prioritization of transport adaptation needs

- Intermodal, cross-sectoral interactions and transboundary impacts key to avoid maladaptation

# **Recommendations** (1/3)

- Create awareness and understanding of urgency (WP.5/sec)

- Disseminate approaches, tools and methodologies (MS/WP.5/sec)

- Improve availability of geo-coded networks and nodes data (call to WPs managing the infrastructure agreements) (MS/WPs)

- Geo-code networks and nodes data and present them in GIS (MS/sec)

# **Recommendations** (2/3)

- Share data on use (census by WP.6) (MS/WP.6)

- Attempt to obtain consistent data projections for UNECE region (through CORDEX-Core project) (WP.5/sec)

- Expand the analysis on climate impacts (absolute/relative terms, additional indices) (WP.5/sec)

- Implement national projects (with assistance where necessary) to better understand vulnerability to climate change of transport systems (MS/WP.5/sec)

# **Recommendations** (3/3)

- Establish a knowledge database with
    - features and conditions that make a section of a network or a node vulnerable to climate change (WP.5/sec)
    - adaptation measure and their cost-effectiveness (WP.5/sec)

- Elaborate guidance and /or mechanisms for better integration of climate change impacts and projections into planning and operational processes (WP.5/sec)

# Next steps

UNECE

- Consider the recommendations

- Design response to the existing demand

Possible response – Group of Experts on assessment of climate impacts and adaptation for inland transport as subsidiary body of WP.5 (ECE/TRANS/WP.5/2019/4)

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

**Requested follow-up**

- Geo-code AGTC network (CPs to send to UNECE shapefiles for their AGTC lines and installations) and AGTC Protocol's network
- Support WP.6 in the collection of the traffic data

Annex I

RAILWAY LINES OF IMPORTANCE FOR
INTERNATIONAL COMBINED TRANSPORT

(1) Portugal */

| | |
|---|---|
| C-E 05 | (Fuentes de Oñoro-) Vilar Formoso-Pampilhosa- Coimbra-Lisboa / Porto |
| C-E 90 | Lisboa-Entroncamento-Marvão (-Valencia de Alcántara) |

(2) Spain */

| | |
|---|---|
| C-E 05 | (Hendaye-) Irún-Burgos-Medina del Campo-Fuentes de Oñoro (-Vilar Formoso) |
| C-E 07 | (Hendaye-) Irún-Burgos-____Avila____-Madrid / Aranda de Duero |
| C-E 053 | Madrid-Córdoba-Bobadilla-Algeciras |
| C-E 90 | (Marvão-) Valencia de Alcántara -Madrid-Barcelona-Port Bou (-Cerbère) |
| C 90/1 | Valencia-Barcelona |

General note and explanation of line numbers

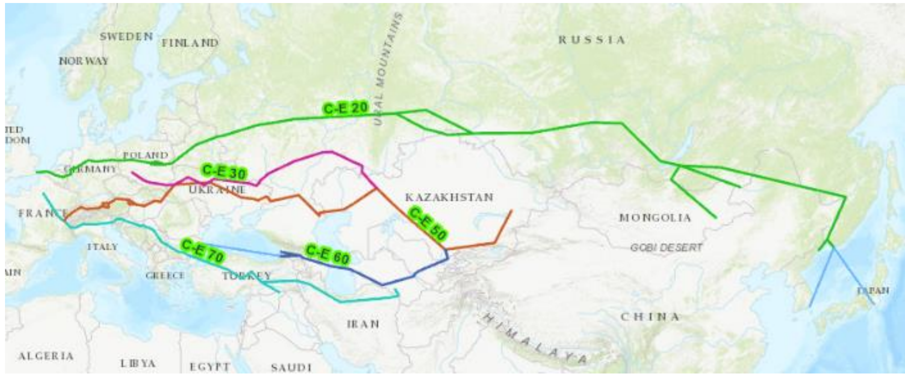
"C-E" denotes railway lines essentially identical to relevant E lines of the European Agreement on Main International Railway Lines (AGC) of 1985.

"C" denotes other lines important for international combined transport. "C" line numbers are identical to those of the nearest E line and are sometimes followed by a serial number.

The E number has been placed for easy reference and comparison with the lines contained in the AGC. It in no way indicates whether States are or intend to become Contracting Parties to the AGC.

*/ Symbols employed

| | | |
|---|---|---|
| ( ) | = | Station outside country concerned [for instance: (Hendaye-)]. |
| ____ | = | Alternative routes [for instance: ____Avila____ / Aranda de Duero]. |
| ------- | = | Section of an AGC line important for international combined transport (concerns only C-E lines). |
| ......... | = | Section of line important for combined transport, but not part of the relevant AGC line (concerns only C-E lines). |



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