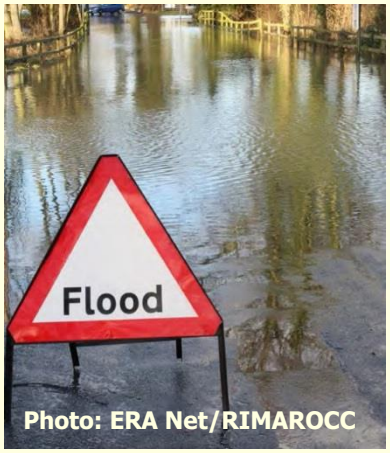

Methodology for the Rapid Assessment of Climate Impacts Along Transport Corridors incl. application between Madrid-Lisbon

Jerome Simpson &
Greg Spencer,
Smart Cities and Mobility

Monday 5th September, 2016

29th session of the UNECE Working Party on Transport Trends and Economics

REGIONAL ENVIRONMENTAL CENTER

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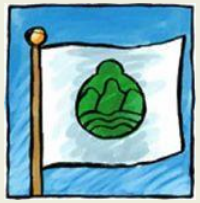
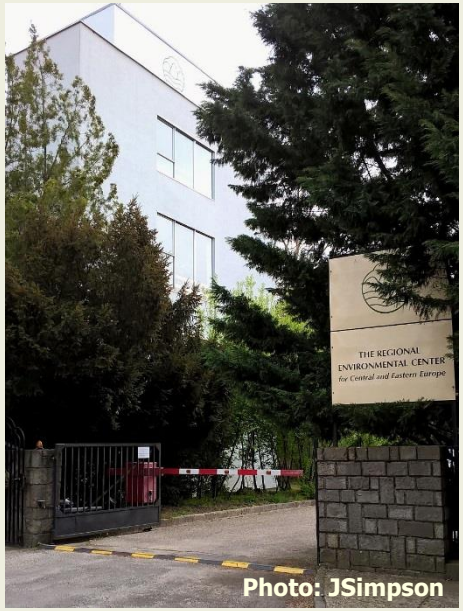


ABOUT REC



- Helps “solve environmental problems in the region” through 13 ‘Topic Areas’
- Head-quartered north of Budapest but with a network of country offices, established in 1990
- Activities across Europe, North Africa and beyond

Smart Cities and Mobility

Strategic Areas of Interest

- **Cleaner and Better Transport in Cities**
  - Secretariat services to European Mobility Week and the CIVITAS Initiative
  - Szentendre/Budaörs Bike-share Scheme Feasibility Study
- **Smarter Cities**
  - Secretariat services formerly to KIC InnoEnergy
  - Smart Cities and Communities Information System
  - SMART Move; Grow Smarter; OPTIMUM
- **Technology Development and Know-how Transfer**
  - Sustainable Commuting Initiative ☛…
  - CLIMACOR – Rapid Risk Assessment of Transport Routes
- **Information provision**
  - SEiSMiC - Societal Engagement in Science, Mutual Learning in Cities
  - Traffic Snake Game Network; PLANHEAT
- **Partnerships**
  - EC; EIT; EEA; UNECE; RCC; Morgan Stanley; Toyota

EUROPEAN MOBILITY WEEK 16-22 SEPTEMBER

eit Knowledge & Innovation Community KIC InnoEnergy

2020 CiViTAS Cleaner and better transport in cities

RegionalCooperationCouncil

The CLIMACOR Initiative(s)

Develop a risk assessment methodology on international passenger and freight corridors (road/rail/ports and waterways), test and pilot it

- Funded by the Ministry of Infrastructure and Environment of The Netherlands
- Contribution to the work of the Inland Transport Committee of the UNECE/WP5 (and EU acquis)
- December, 2015-September, 2016

Ministry of Infrastructure and the Environment

Refine and simplify the methodology and apply on two west Balkan corridors (one waterway, one road) and prepare state-of-the-art assessments

- Funded by the Regional Cooperation Council (RCC) Secretariat
- To support implementation of the "South East Europe 2020 Strategy" (and EU acquis)
- Collaboration with SEETO – South East European Transport Observatory
- July – Dec. 2016

RegionalCooperationCouncil

SEE2020
SOUTH EAST EUROPE 2020

SEETO
SOUTH-EAST EUROPE TRANSPORT OBSERVATORY

In Brief

Scope

- Transport infrastructure;
- Substitute routes and transport modalities;
- Other adaptation measures (i.e. resilience).

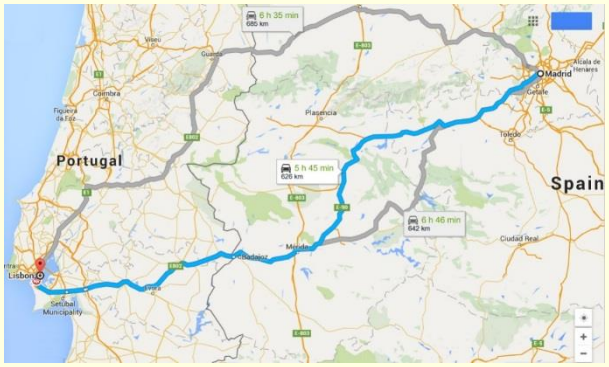
Target Countries

Trials and application in 2016:

- Kyiv, UA – Chisinau, MD; Lisbon, PT – Madrid, ES
- Sava, BiH – Duna, Srb;
  Orient/East-Med Corridor Srb, Kos* & fYRoM

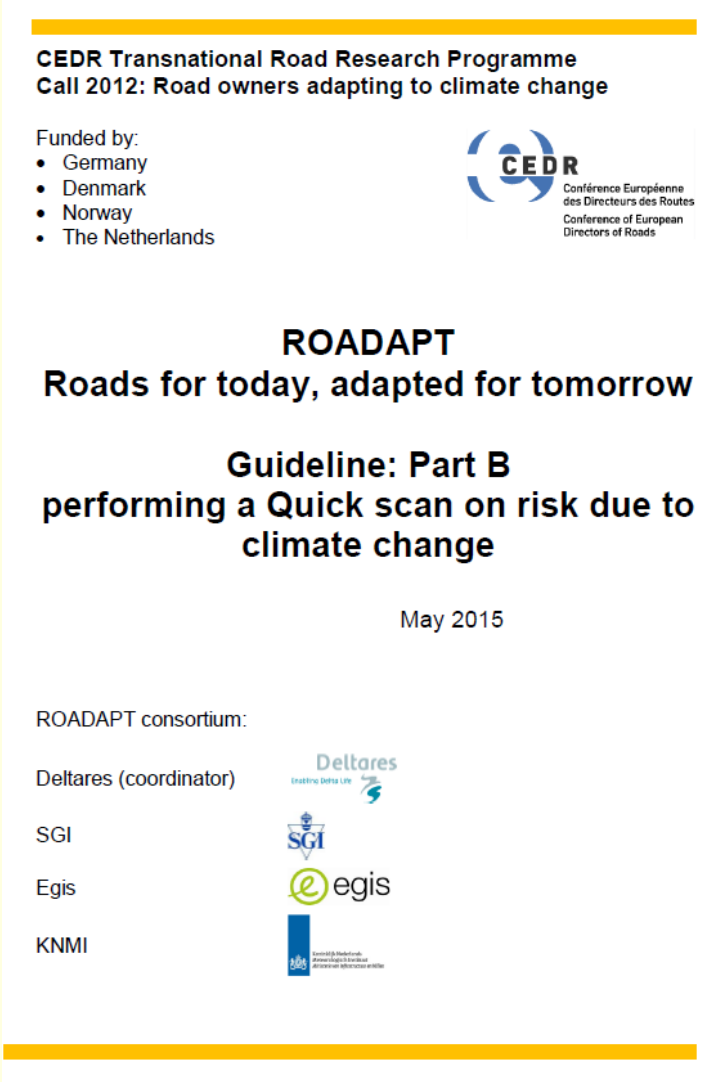
Approach and Rationale

- Borrow from existing methodologies;
- Must work in different countries & contexts
- Complete in a short time (4-6 weeks)
- Must be cost-effective



The ClimaCor Method …

- Borrows the general approach of ROADAPT Quick Scan method – 'crowd sourcing' of experts, rather than gathering of data and mathematical analysis
- Adds in consideration of railways and inland waterways
- Simplifies and shortens procedure (3-day workshop to 1-day 'validation' event)
- Can be considered a "Pre-Scan" that can guide decisions about where to focus more scientific trouble shooting
- Centers on involving local climate and transport experts who:
  - Identify top climate threats in studied corridor*;
  - Map the main threats; and
  - Propose response strategies for these threats.



CEDR Transnational Road Research Programme
Call 2012: Road owners adapting to climate change

Funded by:
- Germany
- Denmark
- Norway
- The Netherlands

CEDR
Conférence Européenne des Directeurs des Routes
Conference of European Directors of Roads

ROADAPT
Roads for today, adapted for tomorrow

Guideline: Part B
performing a Quick scan on risk due to climate change

May 2015

ROADAPT consortium:

Deltares (coordinator)

SGI

Egis

KNMI

The ClimaCor Approach

Two lines of enquiry (horizontal/vertical):

- **transport assets**, filtered by their importance and by vulnerability to climate change; and
- **climate change threats**

Transport assets:

- Road surface and road infrastructure
- Railways
- Inland waterways and ports

Climate threats:

- Heat waves, droughts
- Increased precipitation, storms
- Heat and cold variability
- Erratic weather
- Higher wind force
- Melting permafrost

The ClimaCor Process

- **Identify and define *corridor/routes*** to be analysed
- **Engage a local consultant** to manage in-country process; *host a 'train-the-facilitator'* ***webinar*** *to illustrate the methodology*
- Consultant **assembles cca. 10-15 experts** with help of national ministries of environment and infrastructure:
  - climate change specialists
  - transport experts - road management agencies, inland port authorities, railway companies, etc.
  - NGOs, decisionmakers and other stakeholders..
- *Consultant* **surveys** experts' views on climate threats for given transport infrastructure, *assembles results into a scene-setting presentation* and **organizes/ hosts *validation* workshop** at key location to review/agree findings and recommend next steps.
- Local consultant **drafts country report** (according to template incl. maps, scenarios and recommendations)
- Coordinator prepares integrated **corridor assessment**


Photo credit: ERA Net/RIMAROCC


Photo: JSimpson

NB: Italics indicate alterations in phase two

The ClimaCor Survey

Identification and evaluation* of threats in four online steps:

- Identification of ***top 10*** threats
- Evaluation of **consequence** (i.e. if threat comes to pass, how serious are the human consequences?)
- Evaluation of **likelihood** (i.e. how often would the threat occur in the corridor, under current conditions and under worst-case scenario of climate change?)
- Evaluation of **risk** (i.e. a factor of consequence and likelihood)

**Scorings are based on experts' subjective judgements*

Threat category	Main threat	Sub-threat	Mark an "x" next to those sub-threats relevant to the transport corridor under study
Extreme precipitation	*Heavy showers [mm/h]*	Bridge scour (roads, railways or waterways)	
		Overloading and failure of hydraulic systems crossing inland transport infrastructure (roads or railways)	
		Coastal or fluvial flooding of storage platforms (waterways)	
		Erosion and slide of embankments (roads or railways)	
		Permanent flooding can render ports inoperable (waterways)	
		Increased ground subsidence, rock fall, landslide, or collapse on transport infrastructure (roads or railways)	
		Failure of inland links can render ports inoperable (waterways)	
		Damage to energy supply, traffic communication networks (roads or railways	
		Debris flow (roads)	
		Fluvial flooding (overland flow after precipitation, groundwater level increase) (roads)	
		Loss of driving ability due to reduced visibility and vehicle control (roads)	
	Long periods of rain in the catchment area [mm/day]	Bridge scour (roads, railways or waterways)	
		failure of flood defence systems of rivers and lakes (roads and railways)	
		Changes in river morphology, navigation (waterways)	
		Overloading of hydraulic systems crossing inland transport infrastructure (roads and railways)	
		Damage to banks (waterways)	
		Erosion or slides of infrastructure and embankment (roads and railways)	
		Ground subsidence, slide, or collapse on inland transport infrastructure (roads and railways)	
		Rock fall (roads and railways)	
		Fluvial flooding (overland flow after precipitation, groundwater level increase) (roads)	
	Increase in seasonal average rainfall [mm / 3 months]	Weakening of foundation by standing water (roads and railways)	
		Reduced clearance under bridges (waterways)	
		Erosion or slides of infrastructure and embankment (roads and railways)	
Higher mean temperatures	*Thawing (of the permafrost) [number of days with temperature zero-crossings]*	Failure of flood defence systems of rivers and lakes (roads and railways)	
		Fluvial flooding (overland flow, groundwater level increase) (roads)	
		Melting of continental glaciers in long-term will cause severe river flow reduction (waterways)	
		Erosion and weakening of embankments and foundations (cave-in) (roads and railways)	
		Decreased utility/restriction of roads and bridges that rely on frozen ground for passage (roads and railways)	
		Longer shipping seasons (waterways)	
		Shorter shipping routes (less fuel) (waterways)	
		Road buckling (roads)	
		Rail track damages (railways)	
		Damages in port infrastructure (waterways)	
	Increased variability in warm/cool days [number of days with temperature zero-crossings]	Erosion of embankments and foundations (roads and railways)	
		Shorter maintenance windows, decreased lifetime, increased maintenance costs (roads and railways)	
		(roads)	
		Track buckling (railways)	
		Snow avalanches (roads and railways)	

To be upgraded to Google Survey Format

The ClimaCor Survey: Consequence

Evaluation of degree of consequence

To be upgraded to Google Survey Format

Proposed weighting of 3 for availability, 7 for safety

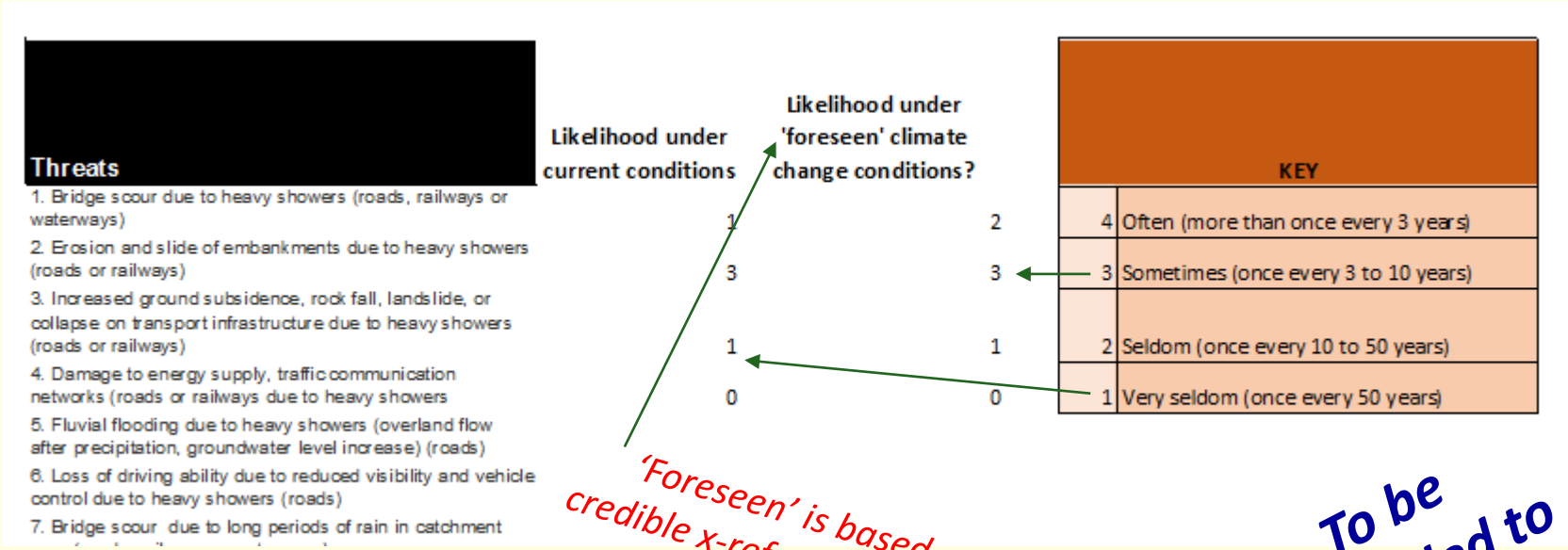
Threats	Consequences: B. Availability	C. Availability weight (3)	D. Safety	E. Safety weight (7)	B*C+D*E/C+E = Weighted average
1. Bridge scour due to heavy showers (roads, railways or waterways)	3.8	3	1.6	7	2.26
2. Erosion and slide of embankments due to heavy showers (roads or railways)	3.6	3	3.7	7	3.67
3. Increased ground subsidence, rock fall, landslide, or collapse on transport infrastructure due to heavy showers (roads or railways)	1	3	1	7	1
4. Damage to energy supply, traffic communication networks (roads or railways due to heavy showers	1	3	1	7	1
5. Fluvial flooding due to heavy showers (overland flow after precipitation, groundwater level increase) (roads)					
6. Loss of driving ability due to reduced visibility and vehicle control due to heavy showers (roads)					
7. Bridge scour due to long periods of rain in catchment area (roads, railways or waterways)					

THREAT TO ROUTE AVAILABILITY/USABILITY	
Score	Severity
1	Negligible impact on the availability (Up to a few hours)
2	A minimal negative impact on the availability (up to a day)
3	A serious impact on the availability (several days, up to a month)
4	A catastrophic impact on the availability (more than a month of unavailable transport to significant numbers of people)

HUMAN & ROUTE SAFETY HAZARD	
Score	Severity
1	A negligible impact on user safety (light material damage), injuries that won't result in hospital visit
2	An influence that reaches the boundaries of acceptable user safety, with as a consequence a number of extra accidents with temporary loss of health or injuries without absence (material damage, slight injuries)
3	An influence to such extent that the boundaries of user safety are exceeded, with as a consequence a serious increase of the number of accidents with permanent loss of health (serious material damage, heavy injuries)
4	A catastrophic influence on user safety, with as a consequence extra deadly danger during normal use (serious material damage, heavy injuries, casualties)

The ClimaCor Survey: Likelihood

Evaluation of likelihood (current conditions vs worst-case climate change scenario)



'Foreseen' is based on credible x-referenced sources explained during the workshop opening

To be upgraded to Google Survey Format

The ClimaCor Survey: Risk

To be upgraded to Google Survey Format

Evaluation of risk (factor of consequence and likelihood)

Threat	B: Consequences	C: Likelihood under current conditions	D: Likelihood under climate change	B*C: Risk under current conditions	B*D: Risk under climate change
1. Bridge scour due to heavy showers (roads, railways or waterways)	2.6	1.0	2.0	2.6	5.2
3. Increased ground subsidence, rock fall, landslide, or collapse on transport infrastructure due to heavy showers (roads or railways)	3.7	3.0	3.0	11.0	11.0
4. Damage to energy supply, traffic communication networks (roads or railways due to heavy showers					
2. Erosion and slide of embankments due to heavy showers (roads or railways)					
5. Fluvial flooding due to heavy showers (overland flow after precipitation, groundwater level increase) (roads)					

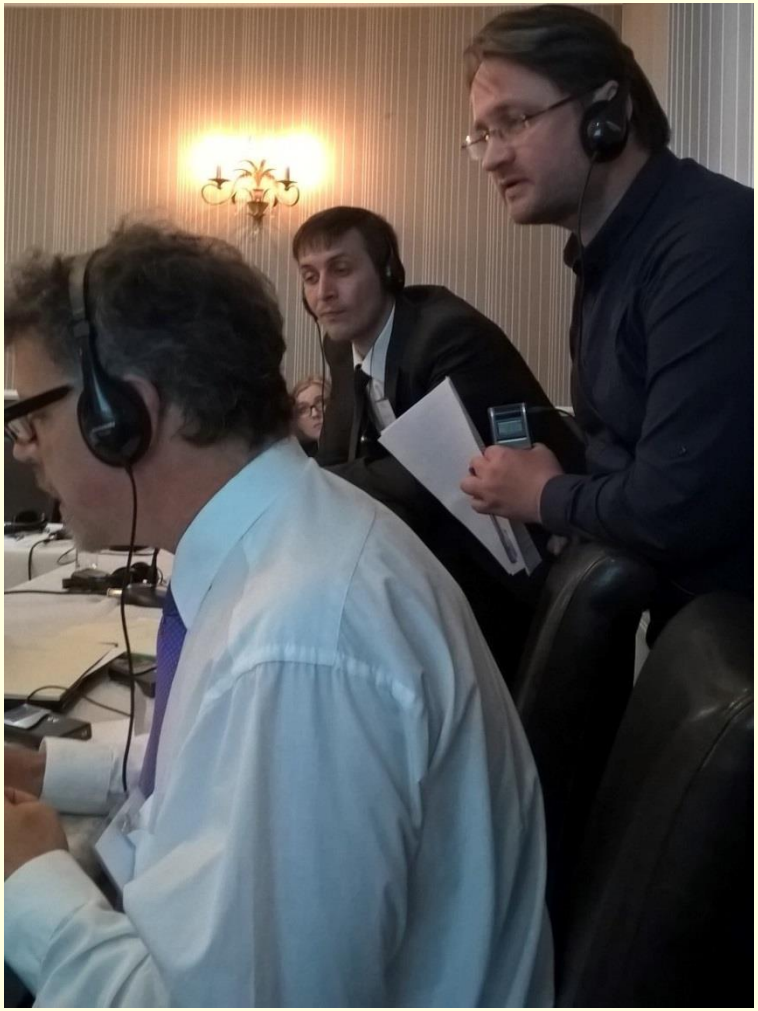
Data copied from previous sheets

Scale of risk (per threat) is generated for current and future climate change conditions (i.e. 2 scenarios) which can then be ranked to generate a priority list, with alternative scenarios added during workshop if consensus not found

The ClimaCor Workshop

Validation Workshop Structure - Facilitated by local expert (host)

- Welcoming remarks - Donor/client
- Introduction to project and methodology - REC
- Present state of the *'in-focus'* transport infrastructure and foreseen climate change conditions – Project partner/client
- *Present preliminary results* (ppt slides) of survey of experts' threats, consequences, and their likelihood to the given transport infrastructure - host
- Review the findings, agree on the rankings and the different resulting scenarios - host
- Prepare recommendations on how to tackle foreseen climate threats/risks through future investments *in/ex-situ* - 2-3 working groups
- AOB incl. feedback on method - host
- *After: Fold the workshop results into a country report (aka vulnerability assessment)* - host



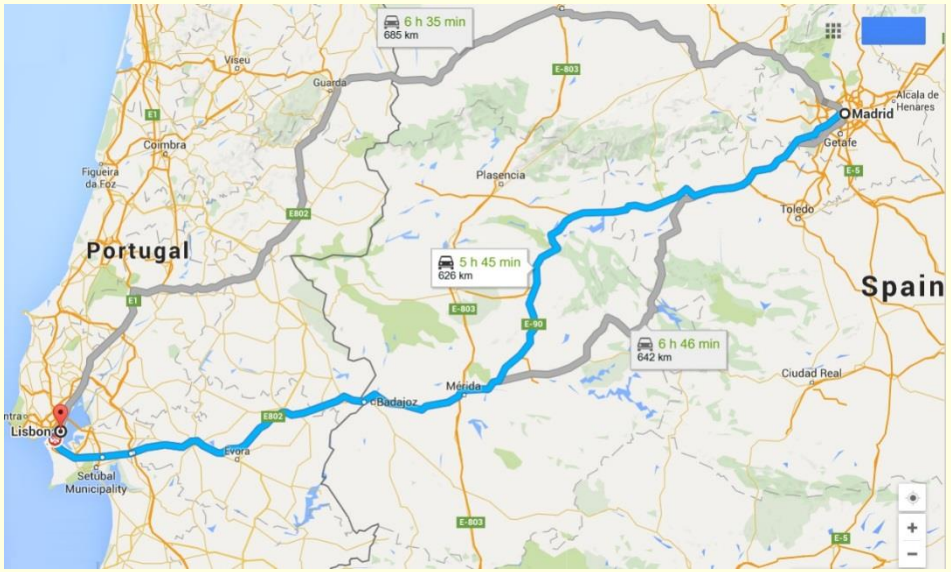
Case Study: **Lisbon-Madrid international transport corridor**

Chosen for its:

- Economic importance
- Location in Western Europe

Comprised of:

- Two major motorways
- One rail link



•**Key motorways on Lisbon-Madrid corridor**

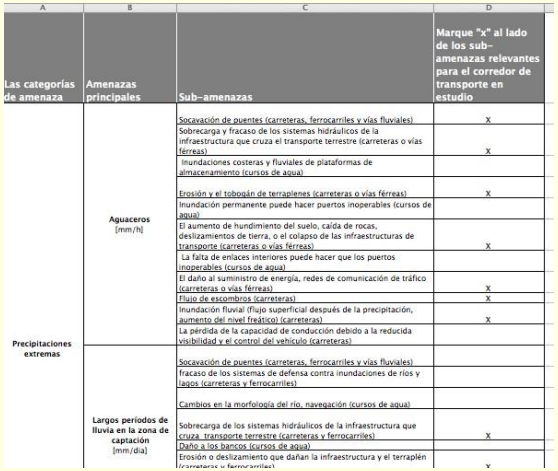
Main Climate threats:

- Heavy showers run the risk of **ground subsidence**, **rock fall** and **landslides** onto roads and railways.
- Future threats include more frequent **bridge scour** at river crossings.

Madrid-Lisbon Process

Study carried out in spring 2016 to identify priority climate threat along major transport routes. Included three phases:

- **Preparation:** Spanish and Portuguese experts inventoried transport assets and submitted preliminary list of relevant climate threats
- **Workshop:** 12 transport and climate change experts (10 from Spain, two from Portugal) met in Madrid and discussed and agreed by consensus on priority threats needing government action
- **Homework:** Where national transport experts map threats and propose response strategies



Las categorías de amenaza	Amenazas principales	Sub-amenazas	Marque "x" al lado de los sub-amenazas relevantes para el corredor de transporte en estudio
Precipitaciones extremas	Aguaceros [mm/h]	Socavación de puentes (carreteras, ferrocarriles y vías fluviales)	x
		Sobrecarga y fracaso de los sistemas hidráulicos de la infraestructura que cruza el transporte terrestre (carreteras o vías férreas)	x
		Inundaciones costeras y fluviales de plataformas de almacenamiento (cursos de agua)	
		Erosión y el tobogán de terraplenes (carreteras o vías férreas)	x
		Inundación permanente puede hacer puertos inoperables (cursos de agua)	
		El aumento de hundimiento del suelo, caída de rocas, deslizamientos de tierra, o el colapso de las infraestructuras de transporte (carreteras o vías férreas)	x
		La falta de enlaces interiores puede hacer que los puertos inoperables (cursos de agua)	
		El daño al suministro de energía, redes de comunicación de tráfico (carreteras o vías férreas)	x
		Flujo de escombros (carreteras)	x
		Inundación fluvial (flujo superficial después de la precipitación, aumento del nivel freático) (carreteras)	x
		La pérdida de la capacidad de conducción debido a la reducida visibilidad y el control del vehículo (carreteras)	
	Largos períodos de lluvia en la zona de captación [mm/día]	Socavación de puentes (carreteras, ferrocarriles y vías fluviales)	
		fracaso de los sistemas de defensa contra inundaciones de ríos y lagos (carreteras y ferrocarriles)	
		Cambios en la morfología del río, navegación (cursos de agua)	
		Sobrecarga de los sistemas hidráulicos de la infraestructura que cruza transporte terrestre (carreteras y ferrocarriles)	x
		Daño a los bancos (cursos de agua)	
		Erosión o deslizamiento que dañan la infraestructura y el terraplén (carreteras y ferrocarriles)	x

•**Threat checklist, Spain**

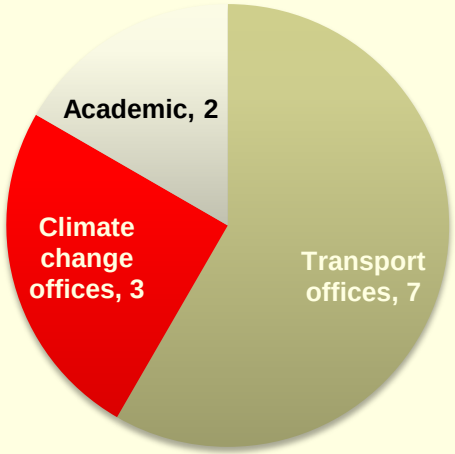
	Transport asset threated	Importance Criteria			
		Traffic intensity	Economic significance	Redundancy	Cumulative score
3	Madrid M-50 (16+130)-Navalcarnero (34+540)	3	3	1	7
4	Navalcarnero (34+540)-Maqueda (74+1160)	3	2	1	6
5	Maqueda (74+1160)-Navalmoral de la Mata (185+060)	2	2	1	5
6	Navalmoral de la Mata (185+060)-Trujillo (248+030)	1	1	1	3
7	Trujillo (248+030)-Santa Amalia (315+530)	1	1	1	3
8	Santa Amalia (315+530)-Mérida Norte (339+080)	2	1	1	4
9	Mérida Norte (339+080)-Mérida Sur (343+140)	2	1	1	4
10	Mérida Sur (343+140)-Talavera La Real (379+920)	2	1	1	4
11	Talavera La Real (379+920)-Badajoz Este (394+340)	2	2	1	5
12	Badajoz Este (394+340)-Frontera (407+830)	1	2	1	4

•**Transport asset inventory, Spain**

Madrid workshop – June 2

Thirteen total participants

- 11 participants from Spain, two from Portugal Ministry of Infrastructure



Madrid workshop summary

- Started with list of **27 relevant threats**, (Submitted by Spain's Ministry of Environment)
- **Introductory briefing from climate expert,** Spanish State Meteorological Agency State Meteorological Agency
- **Narrowed threats list** to 2 high-risk threats under current climate conditions and 5 high-risk threats under climate change
- Agreed on homework (mapping of threats, response strategies). Still pending.

•Threats list by priority, Spain

Case study lessons

- **Describe the method early and clearly**. Applying expert judgement – subjective opinion -- in scientific assessment is new to many people, so they need convincing that this approach can be useful – not as a replacement for scientific analysis, but as an additional tool for practitioners.
- **Manage expectations**. This approach is a first step in a larger programme of risk assessment. Before responses are agreed and funded, more focused research is needed.
- **Results depend on the participants.** A good range of experts is desirable – representing scientific, political, environmental and transport viewpoints. Essential are at least one climate change expert and transport experts with authority on all the modes in the studied corridor.

Thank you!

Jerome Simpson, Project Manager

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