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Early Results of the ClimaCor Project

Methodology for the Assessment of the Climate Impacts on Transport Corridors

REGIONAL ENVIRONMENTAL CENTER

In this presentation …

- Background of ClimaCor project
- Basis for the method
- Description of the method
- Trials in on two transport corridors
- Lessons learned
- ClimaCor follow-up project

Key details about ClimaCor

- **Purpose**
  To develop and test a methodology for assessing climate impacts on passenger and freight transport corridors. It will advance the work of the UNECE Transport Committee and help implement the EU *acquis* in the Eastern Partnership Countries of Ukraine, Moldova and Georgia.
- **Focus**
  - transport infrastructure;
  - substitute routes and transport modalities; and
  - other adaptation measures.
- **Duration**: December, 2015-September, 2016 (about 9 months)

Key details about ClimaCor (cont'd)

- **Target countries**: Methodology should be globally applicable, and was trialed in two economically, geographically distinct corridors:
  - Kiev, Ukraine to Chisinau, Moldavia;
  - Lisbon, Portugal to Madrid, Spain
- **Deliverables**
  - Developed methodology
  - Draft conclusions/recommendations from two methodology trials
  - Presentation at today's working group meeting
  - Final report (September)

Approach and Rationale

Need a method that:

- Borrows from existing methodologies
- Works in different countries and contexts
- Takes a short time (4-6 weeks -- ClimaCor's time limit)
- Doesn't cost a lot (limited budget of ClimaCor)

Looked at five widely cited methodologies

1. **ROADAPT** (ROADs for Today, ADAPTed for Tomorrow), funded by Conference of European Directors of Roads (CEDR) implemented by Dutch consultancy DELTARES;
2. **Climate Change & Extreme Weather Vulnerability Assessment Framework** by US Department of Transport's Federal Highway Administration;
3. **RIMAROCC** (Risk Management for Roads in a Changing Climate), funded by ERA-NET ROAD and EC's FP6· Also implemented by DELTARES;
4. **WEATHER** - Weather Extremes: Impacts on Transport Systems and Hazards for European Regions: Vulnerability of Transport Systems, funded under EC's FP7, led by Fraunhofer-Institute for Systems and Innovation Research (ISI) in Karlsruhe.

Looked at … methodologies (cont'd)

5. **Framework to Analyze the Vulnerability of European Road Networks due To Sea-Level Rise and Sea Storm Surges**, completed by the EC's Joint Research Center (JRC) and Istanbul Technical University

Also examined:

- **ECCONET (Effects of Climate Change on Inland Waterway Networks)** from EC's FP7, led by TM Leuven; and
- **EWENT project,** which looked at impacts of extreme weather events on EU transport systems. Funded under FP7.

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)
- Can be considered a "Pre-Scan" that can guide decisions about where to focus more scientific trouble shooting
- Centers on a workshop 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.

The ClimaCor Method

Preparation

- **Identify and define corridor** to be analysed
- **Assemble expert team** for assessment workshop: Definitely should include climate experts and transport experts (road management agencies, inland port authorities, railway companies, etc.). May also include NGOs, local governments and other stakeholders. Get help from national ministries of environment and infrastructure.
- **Send invitations.** For most participants, it means committing one day for an assessment workshop. Some experts should help with preparation and presentations.
- **Book venue and services** for number of anticipated participants (not many more than 10).

Organising ClimaCor Workshop (cont'd)

- **Gather relevant climate threats** from local expert(s). Sending checklist clarifies this task.
- **Gather inventory of transport assets**, listed by importance, from local experts (road, railway and waterway experts)
- **Book introductory speakers**, including climate expert and transport expert(s) to give introductory talks at workshop.

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

	A	B	C	D	E
1	Transport asset threated	Importance Criteria			
2		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

Organising ClimaCor Workshop (cont'd)

Hold the workshop

- **Climate and transport experts set the scene,** describing the transport routes under study as well as relevant climate threats, in *current conditions* and in a *worst-case scenario of climate change* in 30-50 years into future

Vira Balabub, Ukrainian climate change expert, at ClimaCor Kyiv worshop, May 24th

- **Organiser describes aims** of workshop and general approach

Organising ClimaCor Workshop (cont'd)

- **Scoring of threats:** the heart of the meeting
  - **Climate threats are ranked**, one by one, according to two criteria:
    - **Probability**, or how frequently the threat can be expected to occur under both *current conditions* and in a *worst-case scenario of climate change*
    - **Human consequence**, in the event the threat occurs.
  - **Human consequence**, is itself a factor of two subcriteria:
    - **Impact on usability** of the transport asset
    - **Impact on human safety**

	A	B	C	D	E	F
1		Consequences				
2		Availability	Availability weight	Safety	Safety weight	
3	**Threats**					**Total**
4	1. Розмив мостів (автомобільні, залізничні та водні шляхи) Bridge scour due to heavy showers (roads, railways or waterways)	3.25	10	4	6	3.53125
5	2. Перевантаження і вихід з ладу гідравлічних стічних систем (автомобільні та залізничні шляхи) Overloading and failure of hydraulic systems crossing inland transport infrastructure due to heavy showers (roads or railways)	1	10	1.5	6	1.1875
6	3. Затоплення прибережних ділянок морів та річок (водні шляхи) Coastal or fluvial flooding of storage platforms due to heavy showers (waterways)		10		6	0
7	4. Ерозія та зсуви насипів вздовж доріг чи залізничних колій (автомобільні та залізничні шляхи) Erosion and slide of embankments due to heavy showers (roads or railways)	2	10	1	6	1.625
8	5. Постійні повені можуть зробити порти нерентабельними (водні шляхи) Permanent flooding can render ports inoperable due to heavy showers (waterways)		10		6	0

Consequence score sheet, Ukraine

Organising ClimaCor Workshop (cont'd)

- **Ranking is done through group discussion**, by consensus or averaging of individual scores.
- **Criteria scored on ordinal scales** of 1-4
- **Calculation of risk:** Group scores for likelihood and consequence multiplied to get an indicative score for risk. Threats can then be sorted from highest to lowest risk, with scores above '8' or '9' proposed for further steps (i.e. mapping and deciding on response strategies).

	A	B	C	D	E	F
1	**Amenazas (Threats)**	**Consecuencias**	**Probabilidad bajo las condiciones actuales** Likelihood under current conditions	**Probabilidad en el caso de cambio climático** Likelihood under climate change	**Riesgos actuales** (current risk)	**Riesgo ante el cambio climático** (risk under climate change)
2	1.a. Bridge scour due to heavy showers (roads) **Socavación de puentes debido a las fuertes lluvias (carreteras)**	3.3	1	1.5	3.3	4.95
3	1.b. Bridge scour due to heavy showers (railways) **Socavación de puentes debido a las fuertes lluvias (vías férreas)**	1.9	2	3	3.8	5.7
4	2.a. Overloading and failure of hydraulic systems crossing inland transport infrastructure due to heavy showers (roads) **Sobrecarga y fracaso de los sistemas hidráulicos de la infraestructura que cruza el transporte terrestre a causa de las fuertes lluvias (carreteras)**	2.05	2	2.1	4.1	4.305
5	2.b. Overloading and failure of hydraulic systems crossing inland transport infrastructure due to heavy showers (railways) **Sobrecarga y fracaso de los sistemas hidráulicos de la infraestructura que cruza el transporte terrestre debido a las fuertes lluvias (vías férreas)**	1.6	2	2	3.2	3.2
6	3.a. Erosion and slide of embankments due to heavy showers (roads) **Erosión y el tobogán de terraplenes debido a las fuertes lluvias (carreteras)**	1.65	1	1.5	1.65	2.475
7	3.b. Erosion and slide of embankments due to heavy showers (railways) **Erosión y el tobogán de terraplenes debido a las fuertes lluvias (vías férreas)**	1.6	2.8	3	4.48	4.8
8	4.a. Increased ground subsidence, rock fall, landslide, or collapse on transport infrastructure due to heavy showers (roads) **El aumento de hundimiento del suelo, caída de rocas, deslizamientos de tierra, o el colapso de las infraestructuras de transporte debido a las fuertes lluvias (carreteras)**	3	2.5	3	7.5	9
9	4.b. Increased ground subsidence, rock fall, landslide, or collapse on transport infrastructure due to heavy showers (railways) **El aumento de hundimiento del suelo, caída de rocas, deslizamientos de tierra, o el colapso de las infraestructuras de transporte debido a las fuertes lluvias (vías férreas)**	3.35	2.5	3	8.375	10.05
10	5.a. Damage to energy supply, traffic communication networks due to heavy showers (roads) **El daño al suministro de energía, redes de comunicación de tráfico debido a las fuertes lluvias (vías férreas)**	1	3	3	3	3
11	5.b. Damage to energy supply, traffic communication networks due to heavy showers (railways) **El daño al suministro de energía, redes de comunicación de tráfico debido a las fuertes lluvias (vías férreas)**	1	1	1.5	1	1.5
12	6. Debris flow due to heavy showers (roads) **Flujo de escombros debido a las fuertes lluvias (carreteras)**	1	1	1	1	1
13	7. Fluvial flooding due to heavy showers (overland flow after precipitation, groundwater level increase) (roads) **Inundación fluvial debido a las fuertes lluvias (flujo superficial después de la precipitación, aumento del nivel freático) (carreteras)**	2.35	2	2	4.7	4.7
14	8.a. Overloading of hydraulic systems crossing inland transport infrastructure due to long periods of rain in catchment area (roads) **Sobrecarga de los sistemas hidráulicos de la infraestructura que cruza transporte terrestre debido a los largos períodos de lluvia en la zona de de captación (carreteras)**	1.8	2.2	2	3.96	3.6

Threats list according to risk, Spain

Homework

One day is not enough time for everything, so two further steps are proposed as 'homework':

- **Mapping**: In this step, transport asset authorities are asked to use their internal GIS maps to highlight places in the corridor where the top threats are most likely to occur.
- **Deciding on response strategies**: not about detailed planning, but assigning general categories of response. For example:
  - for more serious threats: 'investing in asset upgrade or reinforcement',
  - for less serious threats: 'preparation or revisiting of storm contingency plans',
  - for least serious ones, 'monitoring and business as usual maintenance')

Trial workshops:

Approach was to hold separate workshops in each country (Ukraine, Moldova, Portugal, Spain) rather than two international corridor workshops (Kyiv-Chisinau, Lisbon-Madrid). Practical reasons:

- More convenient for participants
- Savings on travel costs
- No need for multi-language, simultaneous interpretation

To ensure international exchange, we invited two participants from other side of border to each national workshop.

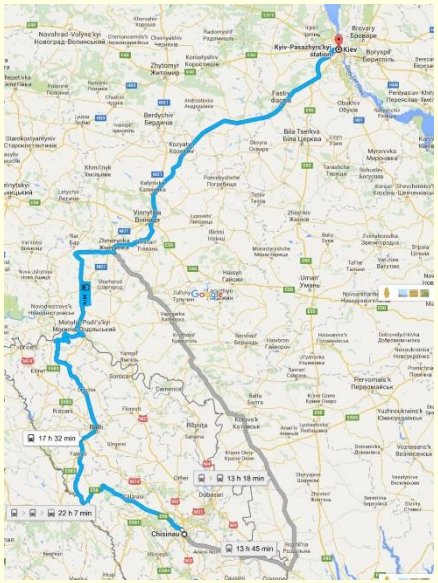
Methodology trials: Kyiv (UR)-Chisinau (ML)

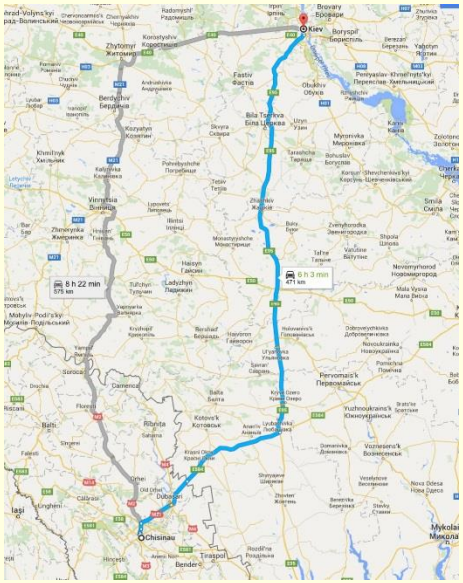
Chosen for its:

- economic importance
- Eastern Europe location

Comprised of:

- two major roads
- one rail link





Main climate threats

Increased **heat waves** causing rutting and cracking of roads, more frequent **rain storms** causing fluvial flooding of roads, bridge scour; increased **snow and hail storms** causing unsafe driving conditions; increased **wildfires** threatening infrastructure

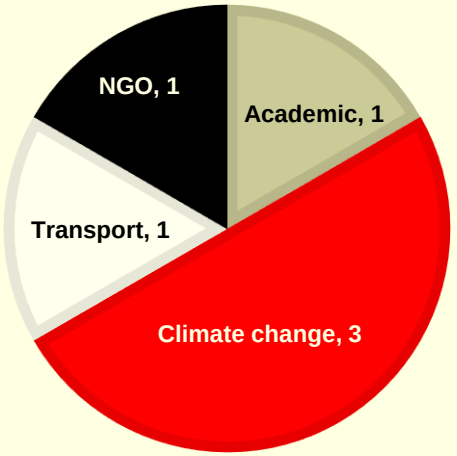
Kyiv workshop (May 24, Ibis Hotel)

Attendance: 6 total

- 1 transport expert – clean fuels specialist, International Standardisation Committee
- 3 climate experts – Ukrainian Hydrometeorological Institute, consultant,OSCE
- 1 academic – (Scientific Research Center of the Earth)
- 1 NGO, National Environmental Centre of Ukraine)

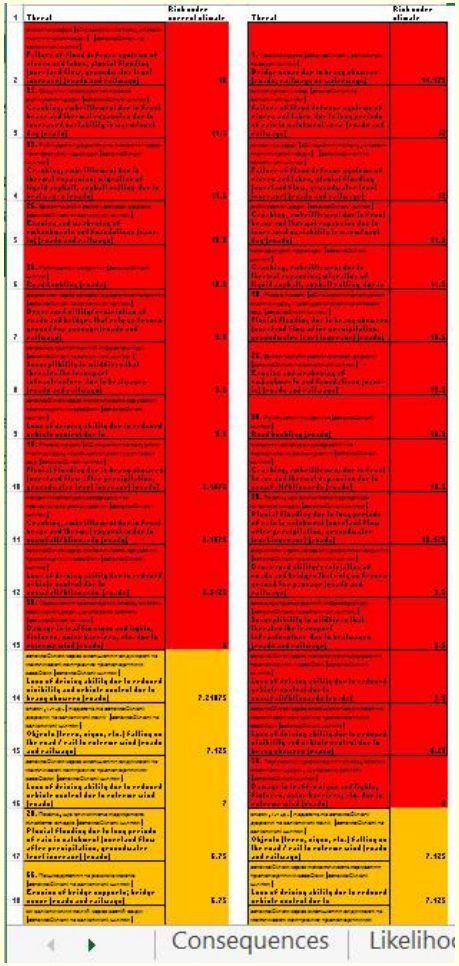
No Moldovan participants

Kyiv ClimaCor workshop

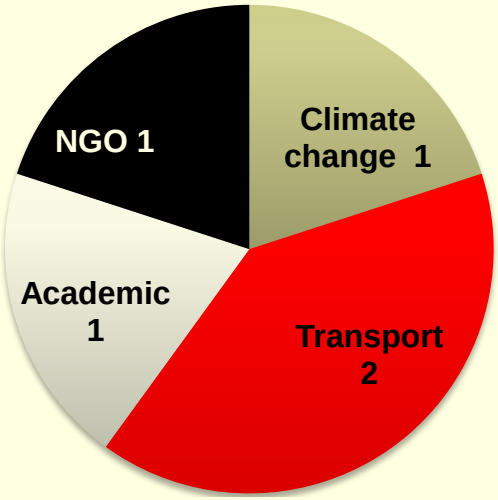


Kyiv workshop summary

- Started with list of **60 relevant threats**, (Compiled from several submissions)
- **Introductory briefing from climate expert,** Ukraine's Ukrainian Hydrometeorology Institute
- **Narrowed threats list** to 12 high-risk threats under current climate conditions and 15 high-risk threats under climate change
- Agreed not to take further steps, participants said the method is good for spurring discussion but not scientific enough to be used by decision makers



Chisinau workshop – May 26



Five total participants

- 1 climate change expert, Ministry of Environment
- 2 transport experts, Ministry of Transport
- 1 academic, enviro-social science PhD candidate
- 1 NGO, environmental advocate

Ukrainian participants did not attend

Chisinau workshop summary

- Started with list of **43 relevant threats**, (compilation of lists from multiple participants)
- **Introductory briefings from two experts,** one climate expert and one transport expert
- **Narrowed threats list** to 15 high-risk threats under current climate conditions and 17 high-risk threats under climate change
- Agreed on homework (mapping of threats, response strategies). Work pending.

Threats list by priority, Moldova

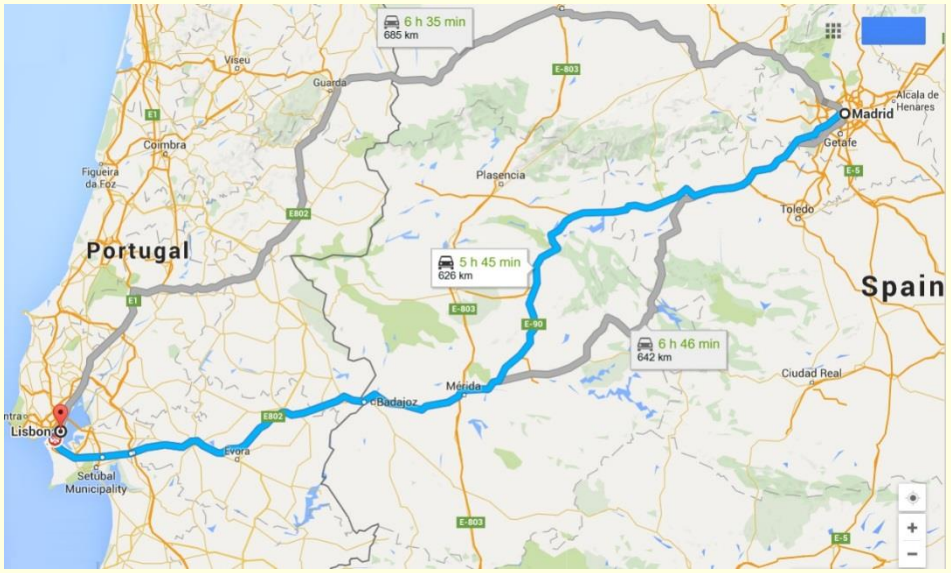
Methodology trials: **Madrid-Lisbon**

Chosen for its:

- Economic importance, and
- Location in Western Europe

Comprised of:

- Two major motorways
- One rail link



Key motorways on Lisbon-Madrid corridor

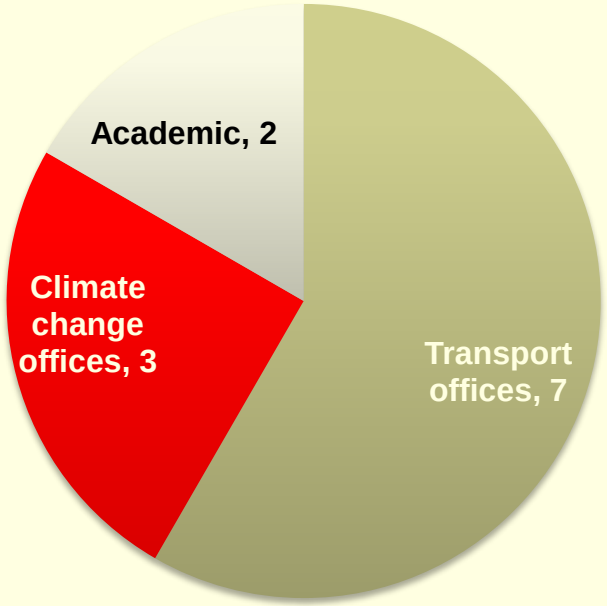
Main Climate threats:

Heavy showers threaten **ground subsidence**, **rock fall** and **landslides** onto roads and railways. Threats increase in future to include increased incidence of **bridge scour** at river crossings.

Madrid workshop – June 2

Thirteen total participants

- State climate change offices-3
- Transport administration-7 (3 railway experts, 4 roads experts)
- Academics-2 (both climate scientists)



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

Madrid workshop summary

- Started with list of **27 relevant threats**, (Submitted by Ministry of Environment)
- **Introductory briefings 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

Lisbon workshop – to be carried out online

- With just 1 confirmed participant and less than a week before workshop (May 30), workshop was cancelled
- Invitees were sent a notice and encouraged to take part in Madrid workshop June 2 (with ClimaCor funding travel)
- Two representative of Portugal's Ministry of Infrastructure took part, contributing to Spanish discussion, and scoring threats on Portugal's section of the corridor.
- As homework, they agreed to:
  - Involve additional Portuguese experts in the scoring of threats on Portugal's part of corridor
  - To map top threats on in-house GIS software

Participant feedback

- In Moldova, participants were excited about the method. It was seen as an effective, quick way to assess climate threats, with potential for broader application in Moldova. Ministerial support would be needed, which would require good arguments – especially concerning economic value.
- In Spain, it was seen as a good way to spur discussion on the issue of climate change and a way to "get all the right people in the same room" (Spanish roads manager).
- Kyiv participants were more skeptical, believing climate change assessment can only be done with verifiable scientific data (i.e. probability of climate threats). They agreed it was "better than nothing" but didn't think it would be useful for decision makers.

Lessons

- **Describe the method early and clearly**. Applying expert judgement – subjective opinion -- in scientific assessment is new to many people, so they need convinced 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. ClimaCor's method can point up risks that need more focused research and analysis.
- **Results depend on the participants.** A good range of experts is desirable – representing scientific, political, environmental and transport viewpoints. Absolutely essential are at least one climate change expert and transport experts with authority on all the modes in the studied corridor.

Lessons (cont'd)

- **Aim for a shorter list of climate threats.** Perhaps gather the list from a single well-established expert, and have the list validated as an early step in the workshop. It was noted that in Ukraine and Moldova, lists were very long, partly because several people in both countries submitted lists.
- **Disaggregate transport modes in threat assessment.** For instance, 'bridge scour' can have very different impacts on roads and on rail because of particulars of the two infrastructures in the corridor.
- **Engage a committed country focal point.** The Spanish workshop was the best attended and had the best complement of experts partly a local expert helped in recruiting participants.

Lessons (cont'd)

- **Keep discussion focused!** In discussion of threats, questions are very narrow. For example, 'What could happen if bridge scour due to heavy showers impacts road network?' Discussion needs to focus on this, and not on how often it might happen (this is dealt with in probability discussion) or whether there are bigger threats due to heavy showers (another separate question). This might be solved by having someone other than the workshop leader take the role of moderator.

ClimaCor II – follow-up in Southeast Europe

- REC will carry out a modified ClimaCor assessment of two Trans-European Transport Networks in Kosovo, Bosnia, FYR Macedonia and Serbia
- Will streamline method by conducting scoring exercise online and focusing workshops on results validation and response strategies
- July-October 2016
- Funded by the Southeast Europe Transport Observatory (SEETO)

Orient/East-Med Corridor in South East Europe

From the 'DoW'

Passes through Serbia, Kosovo* and the former Yugoslav Republic of Macedonia (former so-called Corridor X, now extended and the highway along former Route7 to be constructed between Nis and Pristina)

Inland Waterways Network: TEN-T Rhine-Danube Corridor

From the 'DoW'

Concerns the Danube and Sava River in Bosnia and Herzegovina and Serbia


25 Years • 1990-2015
REC • For a Sustainable Future
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