Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport 19th Session (Geneva, 1-2 October 2020)

Initiatives in climate change impact assessment and adaptation for inland transport in the UNECE Region

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Approaches to impact/risk assessment and adaptation of transport infrastructure under Climate Variability and Change (CV & C)

Approaches depend on the type of hazard:

Episodic hazards due to extreme events (e.g. pluvial/fluvial flooding and extreme heat waves) require risk reduction solutions including facility/network protection works;

Slow-onset hazards, e.g. permafrost thawing, permanent coastal flooding require long-term risk retention/resilience building through, amongst others, effective regulatory responses (e.g. regional and national adaptation plans/policies) (see UNFCCC, 2020, https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/2020_coastalzones/cfecc85aaa8d43d38cd0f6ceae2b61e4/2bb696550804403fa08df8a924922c2e.pdf)

Both approaches require various technological considerations and responses

Impact/risk assessment scales

Assessments are determined by the spatio-temporal scales and resolution as well as the available information (e.g. ECE, 2020).

•Large scale assessments (for the whole, or large swathes, of the ECE region) can inform regional and/or multi-national adaptation policies;

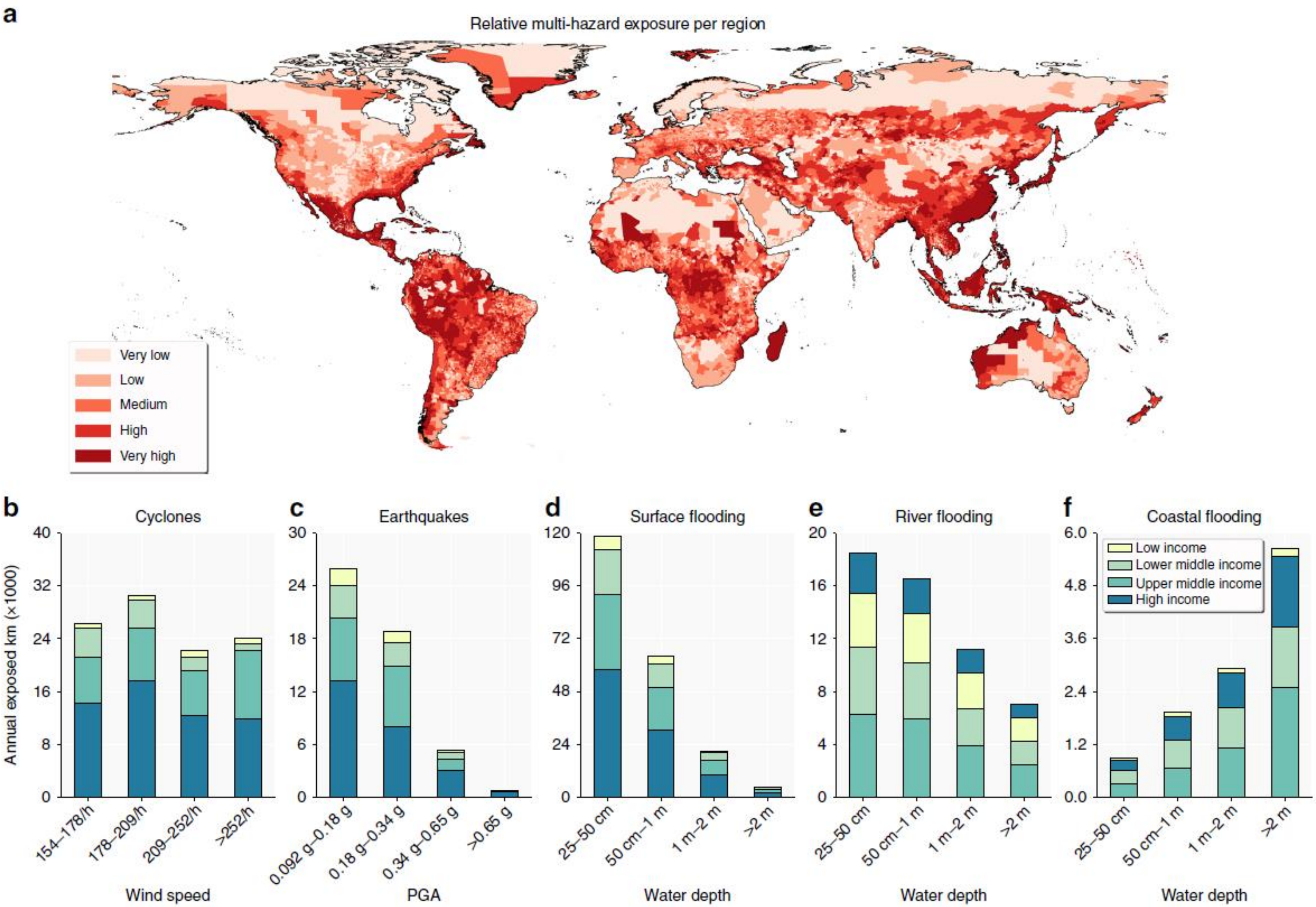
•National scale assessments can assist national adaptation policies and improve the allocation of human and economic resources;

•Local (facility) level assessments are prerequisites for on-the-ground decision making and the design of effective adaptation measures.

Risk assessment constituents of transport infrastructure/operations

Different constituent assessments:

- assessments of the climatic hazards induced by the changing climatic factors;
- assessments of the exposure of the transport infrastructure/operations in the hazard zones, which requires reasonably accurate information on the infrastructure location; and
- assessments of the vulnerabilities of the transportation assets/systems which depend on the available technologies/materials for requisite technical measures, the human/financial resources and the effectiveness of governance.



*Global multi-hazard transport infrastructure exposure. Panel **a** presents the exposure for each region in the world. The classification is based on 20th percentiles. Panels **b–f** presents the exposure for the four income groups per hazard and per hazard intensity band. See Methods for further discussions on the justification on these hazard bands (Koks et al., 2019)*

Approaches to CV & C impact/risk assessment for transport infrastructure/operations

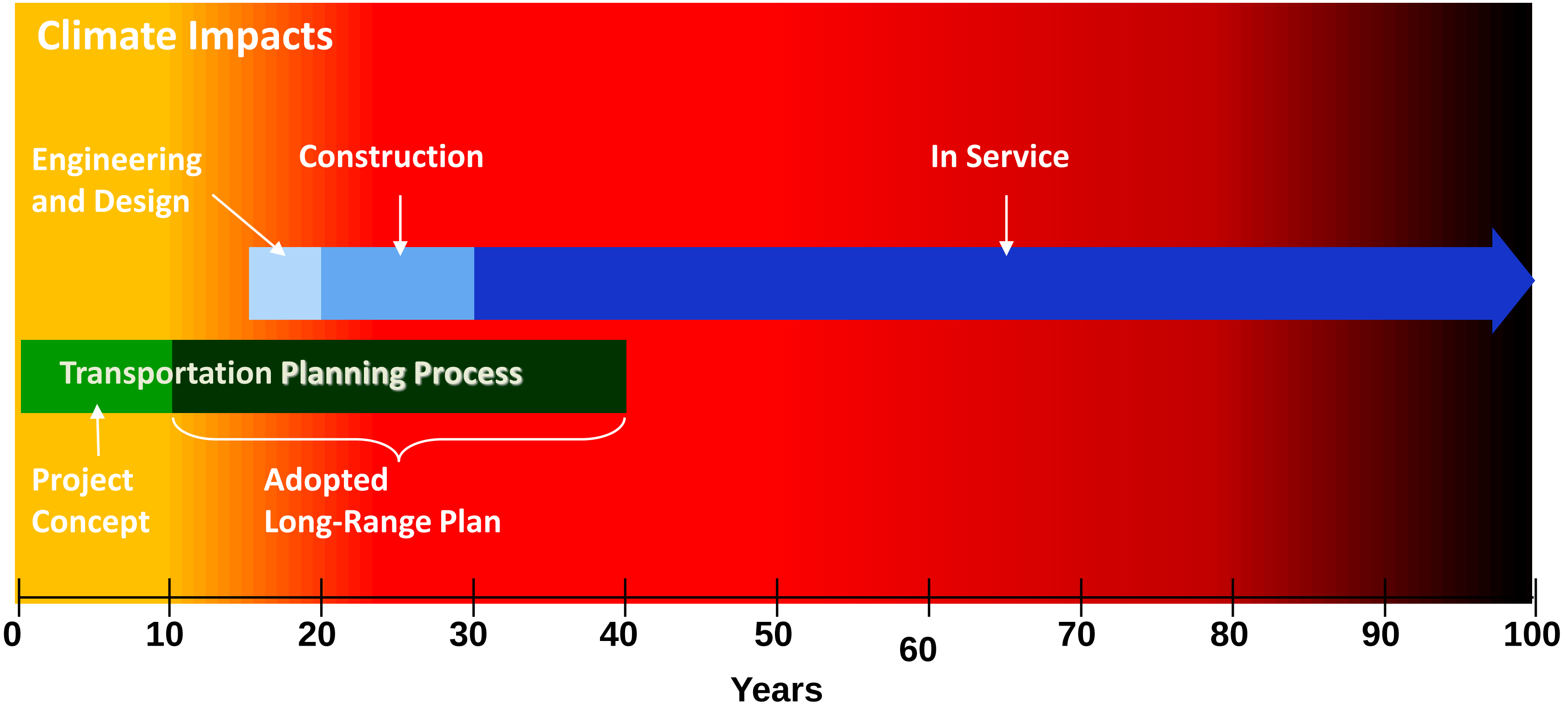
Recent approaches:

- new observation technologies/tools (e.g. https://www.openstreetmap.org, https://www.openrailwaymap.org) and
- improved, integrated models to project future hazards and risks.

The probability/severity of damaging climatic events can be then determined

The urgency of the adaptation responses could be then defined as e.g. the ratio between the time needed to plan/implement measures over the time available (Lenton et al., 2019).

Transportation Timeframes vs. Climate Impacts



Source: Savonis, 2011

CV & C adaptation challenges

CV&C adaptation may involve the construction of new resilient infrastructure and/or enhancing the resilience of existing infrastructure.

Challenges include (UNCTAD, 2020):

•lack of awareness of CV&C impacts and localized climate information;

•mismatches between the time-frames for facility planning, infrastructure lifetime and the hazard projections and their uncertainties;

•lack of adequate funding;

•inadequate regulation;

• constraints relating to relevant R&D; and

•lack of technical expertise and human capacity .

The need for regional (UNECE) impact/risk assessment

A prerequisite for raising awareness/encourage commitment for national and local assessments

For, e.g., pluvial (surface) and fluvial (riverine) floods, assessments should include:

- the technical characteristics of hazards (i.e. location, severity, frequency and likelihood of occurrence);
- the exposure of infrastructure and operations to those hazards; and
- the susceptibility of transportation assets/operations to hazard (vulnerability).

Ideally, the analysis of exposure/vulnerability should include:

- physical, socio-economic health/safety and environmental dimensions; and
- evaluations of the effectiveness of prevailing and alternative coping capacities under different scenarios.

Floods

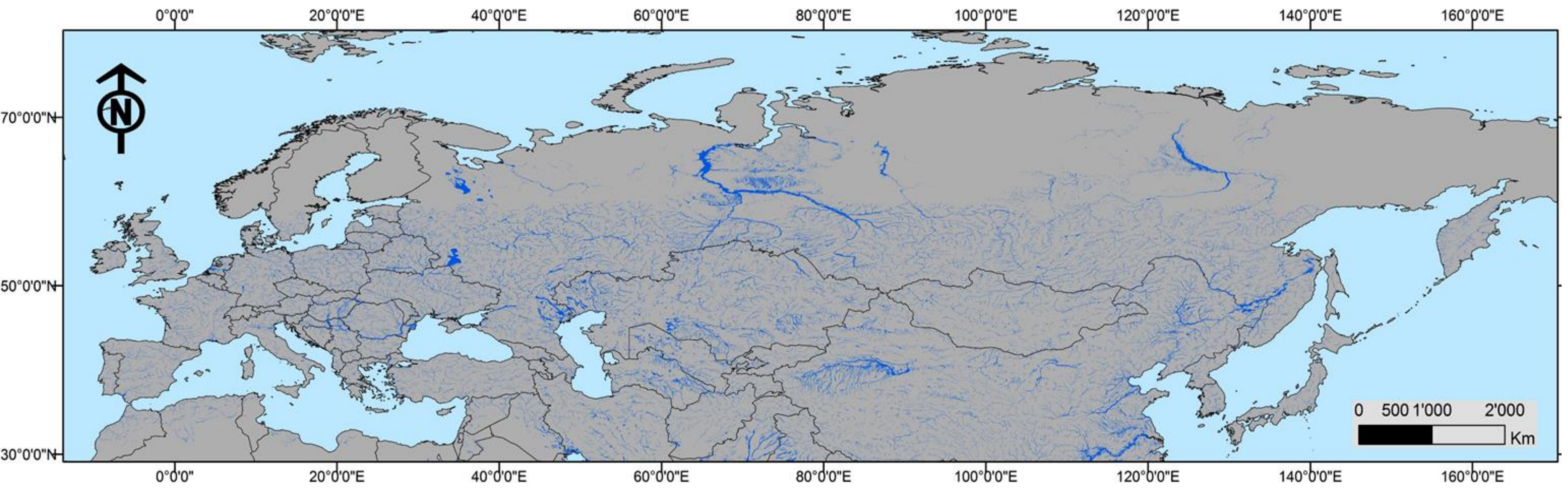
Recent modelling efforts for fluvial flooding (by river bank overtopping) and pluvial flooding (caused by extreme rainfalls) have been based on flood hazard datasets

Sampson et al. (2015) have worked on a gridded dataset (c. 90 m resolution) on the distribution of maximum projected water depth (in m) for 10 return periods (1 in 5 years to 1 in a 1000 years recurrence). This data set has a global coverage for the areas between 56°S and 60°N (includes large part of the ECE region). Further north? .

There has been also work currently carried out to assess the coastal flooding hazards for seaports, which can be also used to ‘close transportation network gaps)

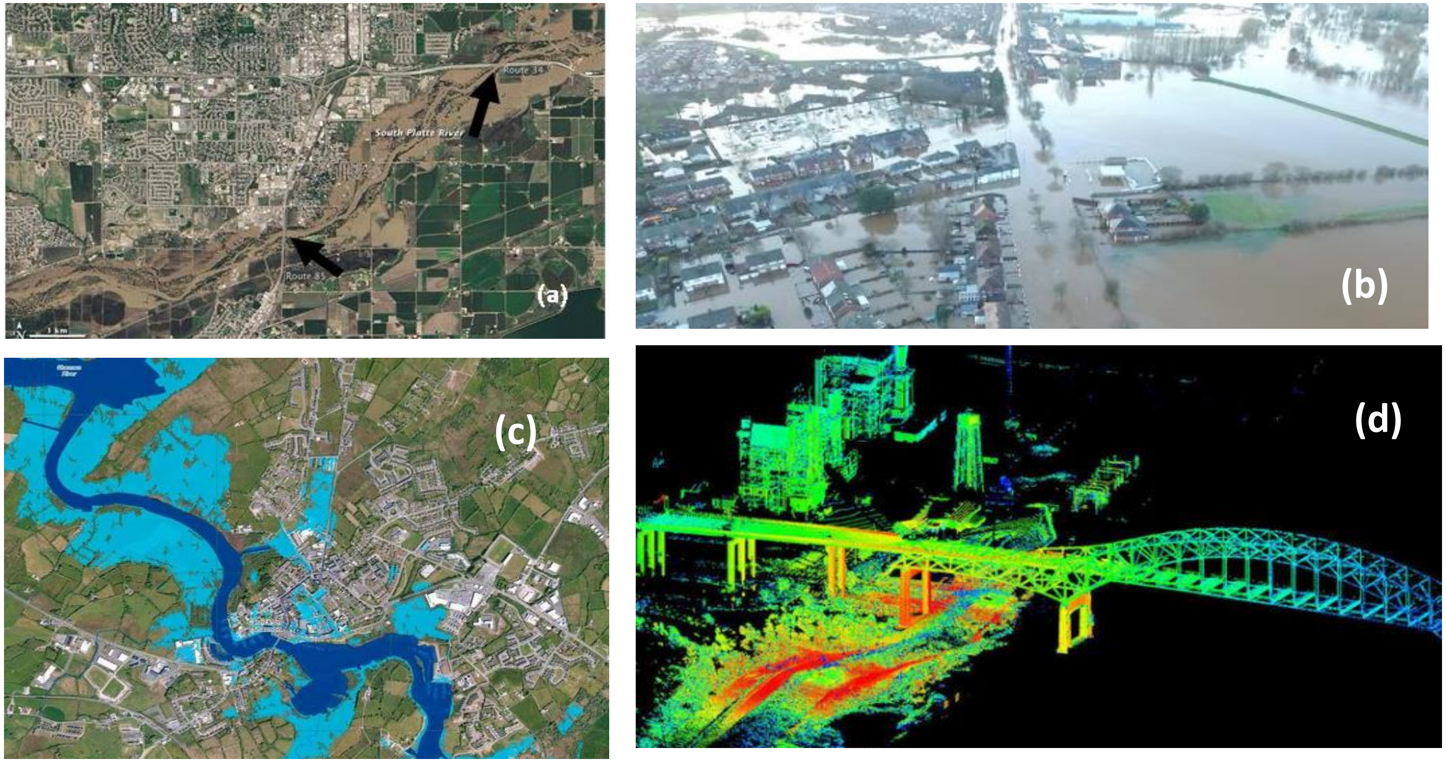
This information together with the infrastructure spatial information and flood design standards (e.g. Scussolini et al., 2016) could be used in the flood risk assessments

Extreme river floods: Current hazard in Eurasia



<u>Current flood hazard</u> (95 % probability) in the Eurasian region of the ECE for the 100-year flood from a global GIS model based on river discharge time-series. DEM resolution 90 m. Areas over 60^0 N are not fully covered (From UNEP-GRID and UNISDR, 2008). (ECE,2013)

River Flood Impacts



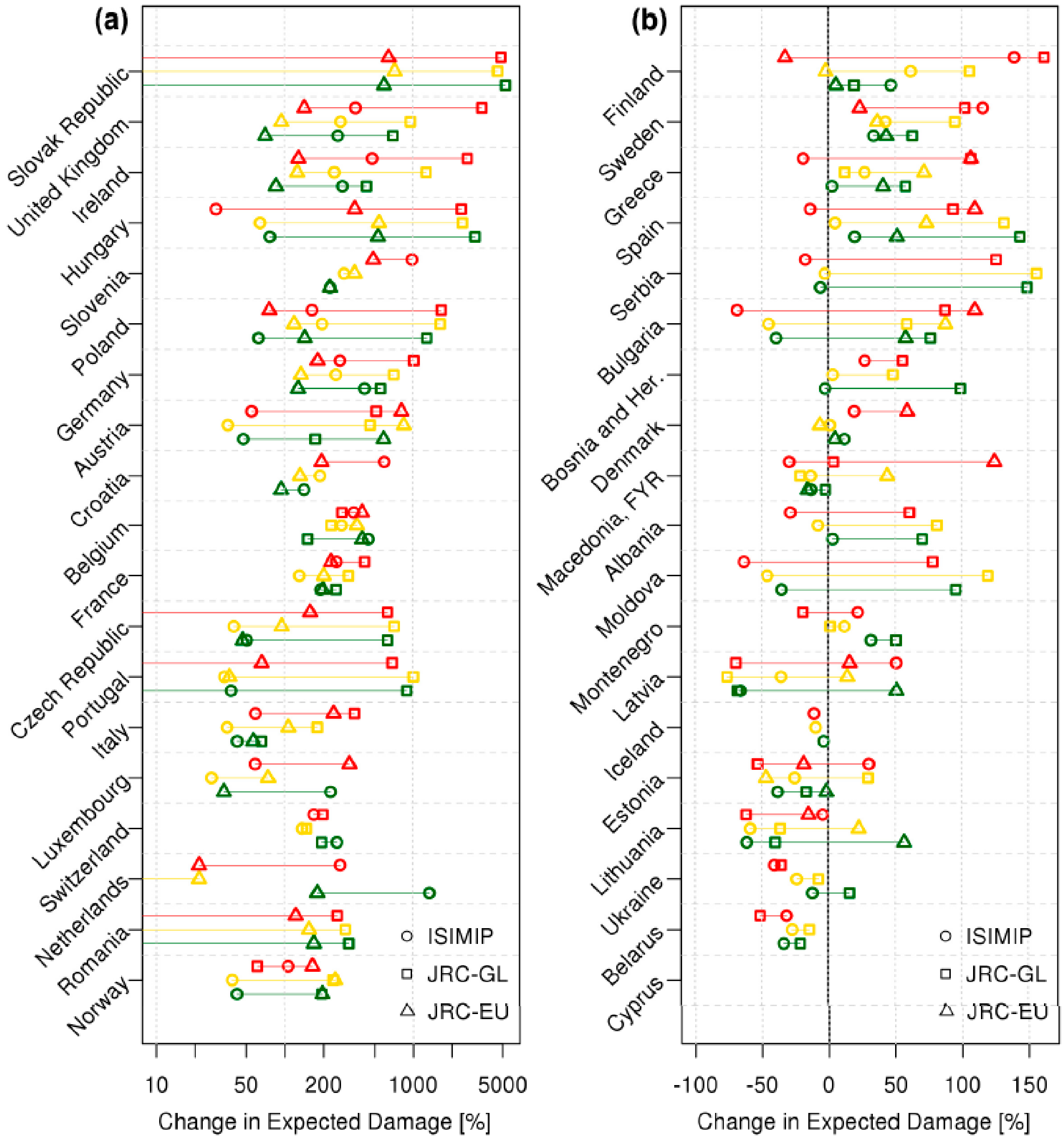
(a) *Sections of the US Highway 34 (black arrows) washed away (S.Platte River fl;oods, Colorado,USA, 09/ 2013) (ECE, 2015).*

(b) *(b) Floods damages in NW UK (10/2012-09/2015). http://waterbucket.ca/gi/2016/01/03/united-kingdom-flooding-december-2015-how-a-town-in-yorkshire-worked-with-nature-to-stay-dry/ .*

(c) (c) Flood projections in Ireland for 01/2016. http://www.independent.ie/irish-news/storms/cold-snap-to-deepen-weather-misery-as-flood-costs-top-60m-34335997.html.

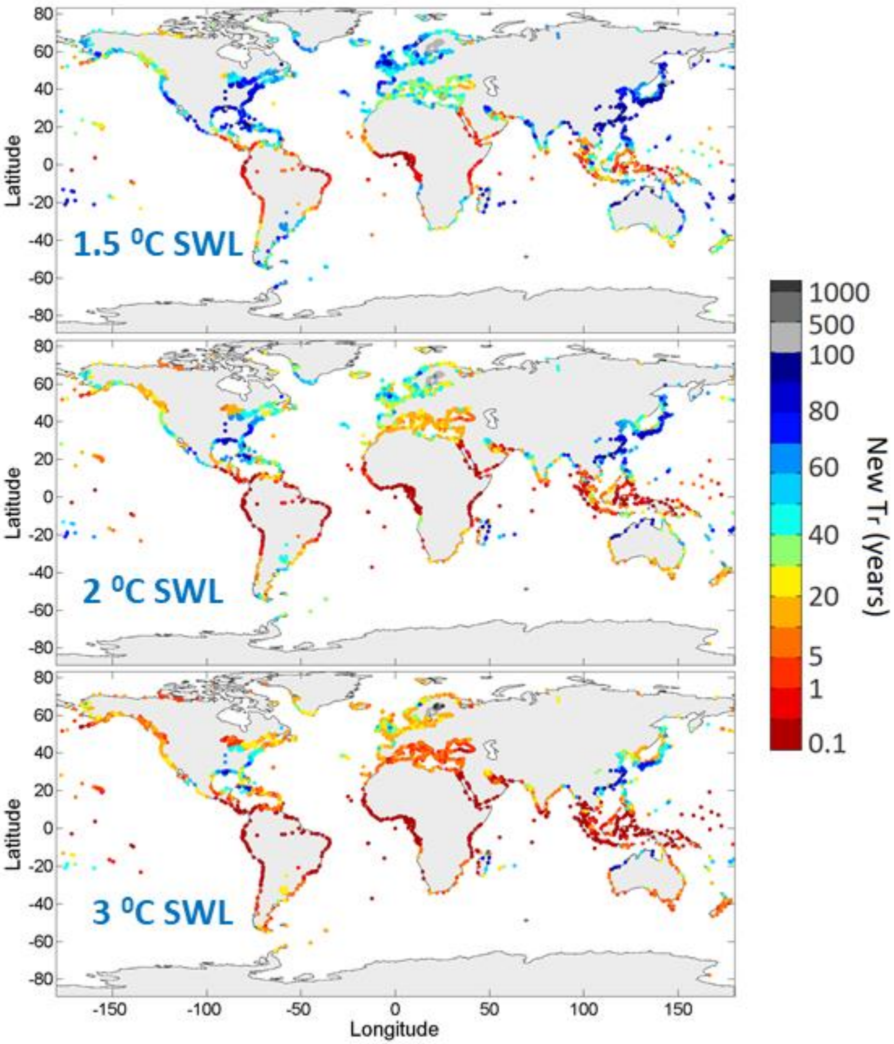
(d) (d) Flood impacts (undercutting, shown by *lidar scan) on the New Orleans' I-510 bridge (Isaac hurricane, 31/08/2012). http://www.huffingtonpost.com/2012/09/06/hurricane-isaac-3d-satellite-photos_n_1860966.html*

Large increase in river flood damages under CV & C



*Relative average change in expected damage for 1.5 °C (green), 2 °C (yellow), and 3 °C (red) warming scenarios with respect to the baseline, calculated at country level for the three ensembles (**a,b**). Note that the x-axis in (**a**) uses a logarithmic scale (Alfieri et al., 2018)*

Flood hazard for global seaports under CV & C



Changes in the recurrence of the 100 year extreme sea level event (ESL100 for the global ports under CV & C (Asariotis et al. in prep.)

The work of the Group of Experts

The work of the Group of Experts:

- is to be guided by its Terms of Reference as contained in ECE/TRANS/2020/6; is expected to deliver on the various tasks shown in ToR and the preparation of its final report.

The detail of this work will be resource dependent, as it requires utilisation of new information and tools as well as substantial human resources ECE/TRANS/WP.5/GE.3/2020/1 3

The work of the Group of Experts

In the previous ECE Expert Groups work (UNECE, 2013; 2015; 2020), the major climatic factors/hazards posing risks for transportation have been analysed. These include:

- pluvial and fluvial flooding;
- mean and (particularly) extreme temperature increases;
- extreme wind changes and,
- for coastal transporation assets, mean and extreme sea level and wave changes.

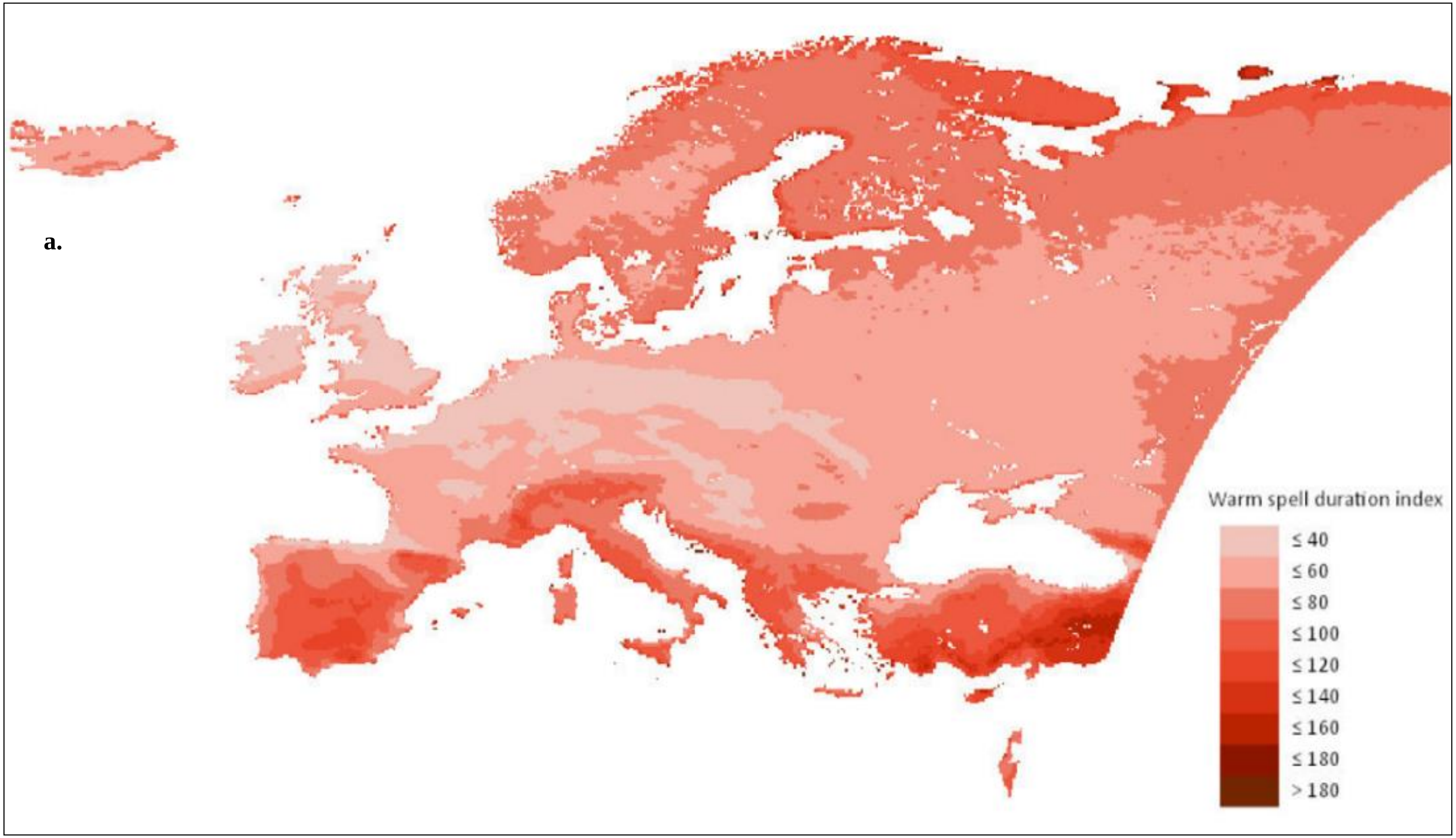
In the latest report (UNECE, 2020), several indices have been selected/used

UNECE (2020) provided regional CV&C impact projections for some of the climatic factors using these indices (e.g. temperature, precipitation/droughts) on the basis of the CORDEX projections (euro-cordex.net/).

It is proposed that in the new work this effort including these indices should continue/updated on the basis of evolving climatic projections/scenaria (please see ECE/TRANS/WP.5/GE.3/2020/2).

A more complete work based on new data sets/tools, including more complete infrastructure data, can be undertaken

Projections of warm spell duration in Europe



Change in the warm spell duration index WSDI under a) RCP8.5 and b) RCP2.6 for period 2051-2080 with respect to the 1971-2000 baseline period. The maps show the multi-model mean values, and changes are in units of days per year. (UNECE, 2020)

Infrastructure data

In addition to the road and railway infrastructure information collated/held by ECE (ECE, 2020), open access data for roads, railways, bridges can be found in: www.openstreetmap.org/#map=8/46.825/8.224 ,and www.openrailwaymap.org/.

IWW ports and seaports, which have been already mapped by various organisations could also been included

Depending on the available resources, collation, classification (in classes of different importance) and storing in an accessible/upgradeable GIS format within ECE will be of key importance

This data base could form a major contribution of the commencing Expert Group.

Collaboration with other initiatives

It appears that the issues relating to CV&C impacts and adaptation gain traction

There are several current initiatives and research projects dealing with the CV&C effects on (transport) infrastructure, funded by e.g. the European Commission and other international organisations

It is proposed that the Group of Experts will take into consideration of and collaborate (when feasible) with these initiatives/project.

This will give added value to its work

Thanks for your attention!