INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

ARISCC
Adapting Rail Infrastructure to a Changing Climate

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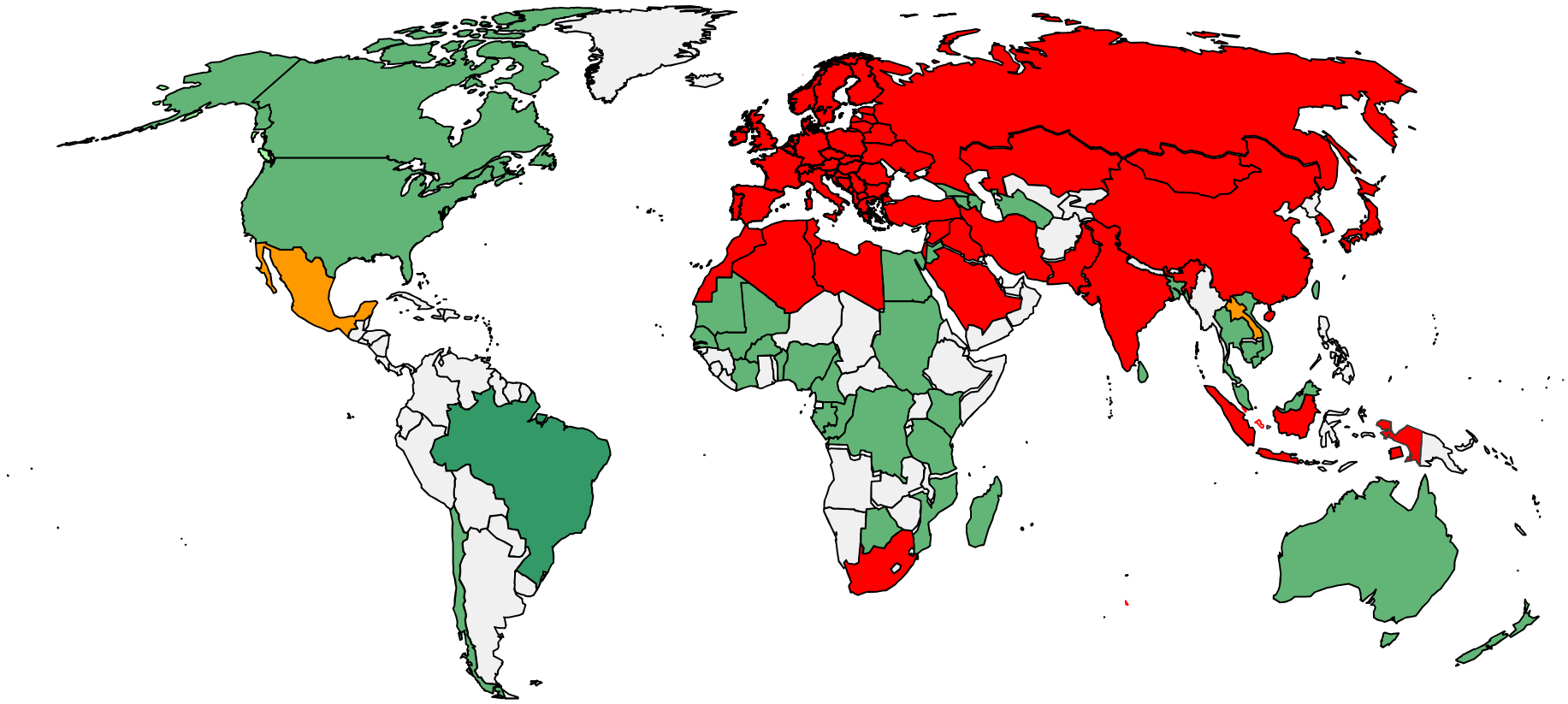
Environment Unit

UIC: The International Union of Railways

200 members worldwide



Members Active Associate Affiliate

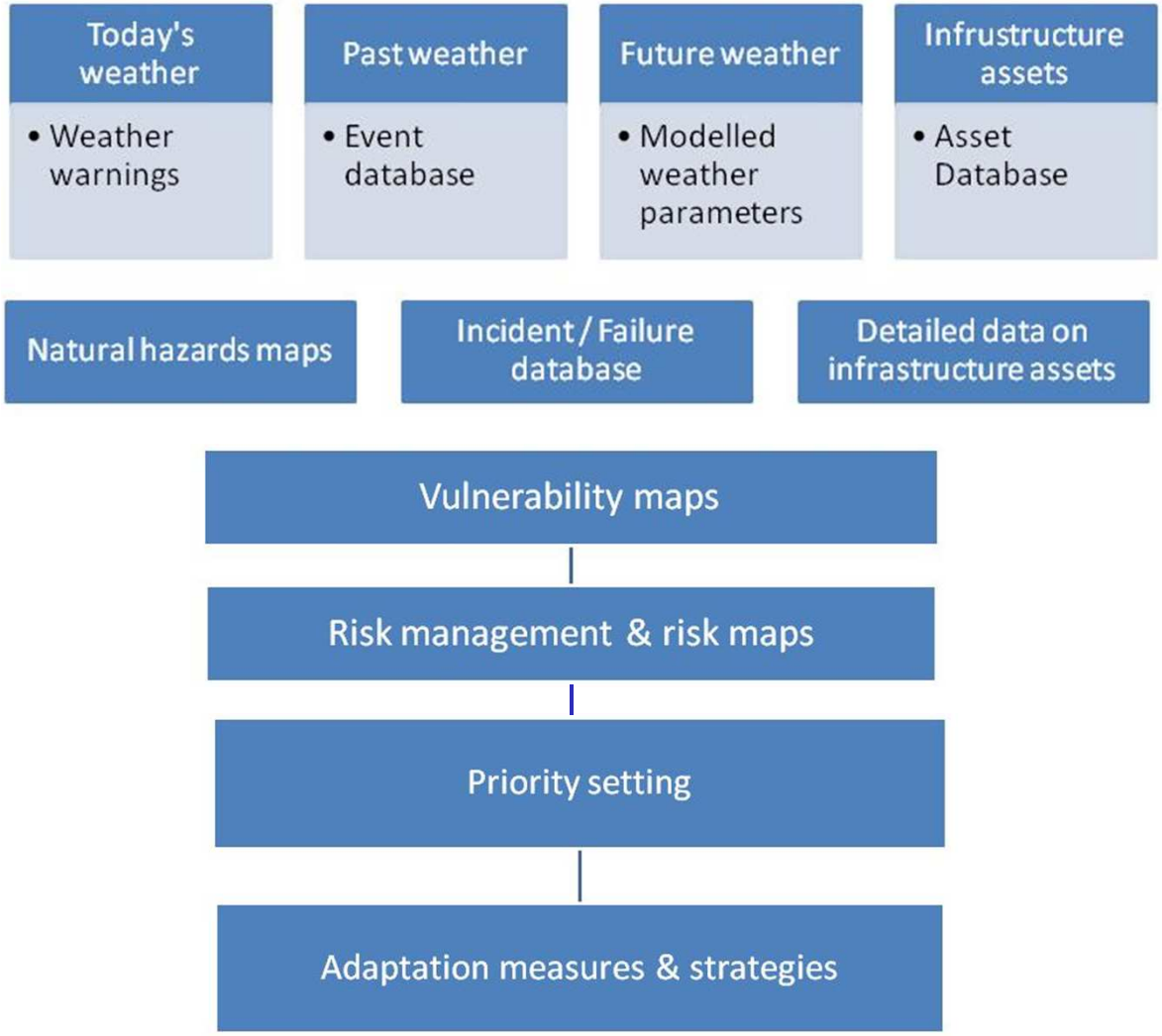
UIC environment unit

- Promote environmental benefits of rail to international audiences e.g. United Nations, World Bank, UNEP
- Develop and manage carbon footprint tools: EcoPassenger and EcoTransIT
- Developed targets for environment for European railways, together with CER
- Manage various research projects including
  - Noise
  - Energy Efficiency
  - Pollution
  - Sustainability Indicators and Reporting
  - Roadmaps to meet environmental targets
  - Climate adaptation
- Organise workshops, conferences and events to disseminate research
- Website: www.uic-environment.org

ARISCC

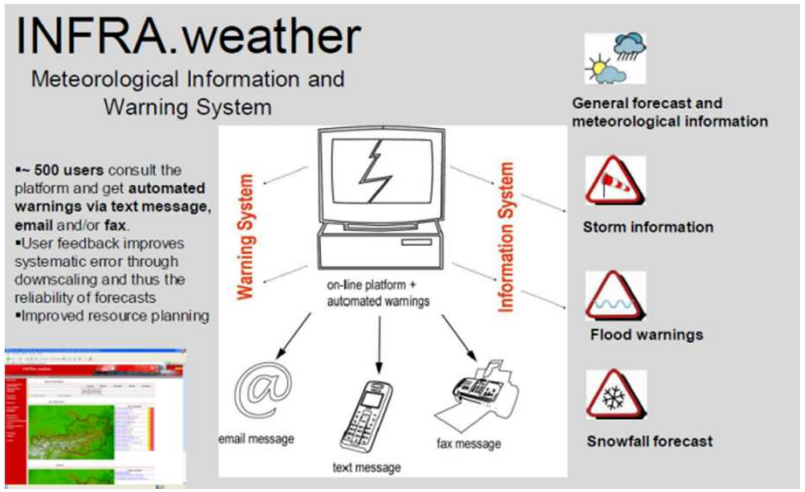
- Two-year project funded by UIC members
- European scope
- Aims
  - Find and disseminate good practice for weather event / natural hazard management
  - Find good examples of how railways are assessing infrastructure vulnerability
  - Understand how railways can incorporate longer term climate predictions into infrastructure management and planning process
  - Propose new management approaches to bring these issues together
  - Disseminate results

Natural hazard management approach that can adapt to climate change



Weather – now and past

- Today's weather: Generic weather warnings are insufficient. OBB have invested in more detailed weather warning systems.
- Past weather: It is useful to catalogue extreme weather events & impact on rail, e.g. SBB "DERI NR" database
- This data can be used to create hazard maps showing impact on rail infrastructure



Mapping natural hazards

- ARISCC team recommend three-stage process
- 1st Level: Screening – Identification of those parts of the network with a high exposure to natural hazards (priority areas)
- 2nd Level: Investigation of priority areas by modelling efforts, development of maps of potential natural hazards
- 3rd Level: Detailed investigation of priority areas by on site inspections and development of high resolution natural hazard maps

Figure 9: Example for a hazard map: Flooding hazard in Canton Zug in Switzerland for a return period of 30-100 years.

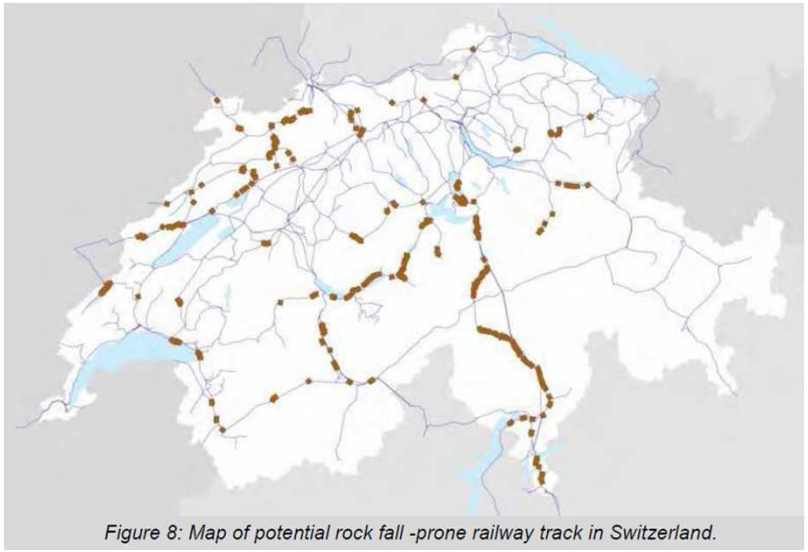


Figure 8: Map of potential rock fall -prone railway track in Switzerland.

Natural hazard management good practice

- ARISCC provides a broad collection of good practice examples for integrated natural hazard management

Area covered	Number of good practice
Weather Warning	3
Event Recording/Database	6
Impact Assessment	5
Vulnerability Mapping	5
Risc Assessment & Risk Management	10
Asset inventory	4
Asset Management	3
Regional Climate Modelling	2

Risk analysis for railway route	S	Drainage Engineers' network	UK	Bridge Scour Monitoring System	CH
Inventory of Drainage System (culverts)	S	Network Rail Dedicated Weather Website	UK	Vulnerability maps	CAN
High Speed Rail Service for Sweden	S	Track Buckle Risk Management	UK	CC Adaptation for London's Transport System	UK
Risk Models & Risk Assessment	S	Water Risk on Earthworks Assessment	UK	UKCIP2009 – Climate Projections	UK
Copenhagen-Ringsted CC Impact Assessment	DK	INFRA.wetter	A	FUTURENET	UK
DB Süd Weather Information & Warning	D	Event database (incidents and damage)	A	The Financial Risk of Climate Change	UK
Analysis Delays vs. Extreme Weather Events	D	Full scale asset inventory	A	Klima Atlas	D
Dedicated Weather Warning System	FIN	Vulnerability maps	A	Paramount	EC
Online Wind Monitoring at East coast Main Line	UK	Mapping of potential hazards	CH	CALAR	EC
Assessment of coastal defenses at Dawlish	UK	Natural Hazard Event Maps (per year)	CH	Monitor I	EC
Drainage integrated policy	UK	Vulnerability Maps	CH	Monitor II	EC
TraCCa	UK	Event database & evaluation + GIS	CH	RIMADIMA	EC

Climate models – predicting future weather

- Regional climate models can provide indications of likely weather patterns

- Models for the Rhine Valley and West Coast Main Line predict:
  - Higher average temperatures and increased likelihood of heat waves
  - More rain particularly in winter. Increased chance of flooding.
  - Storms and gales – more difficult and controversial but significant increases in frequency and intensity of storms are possible

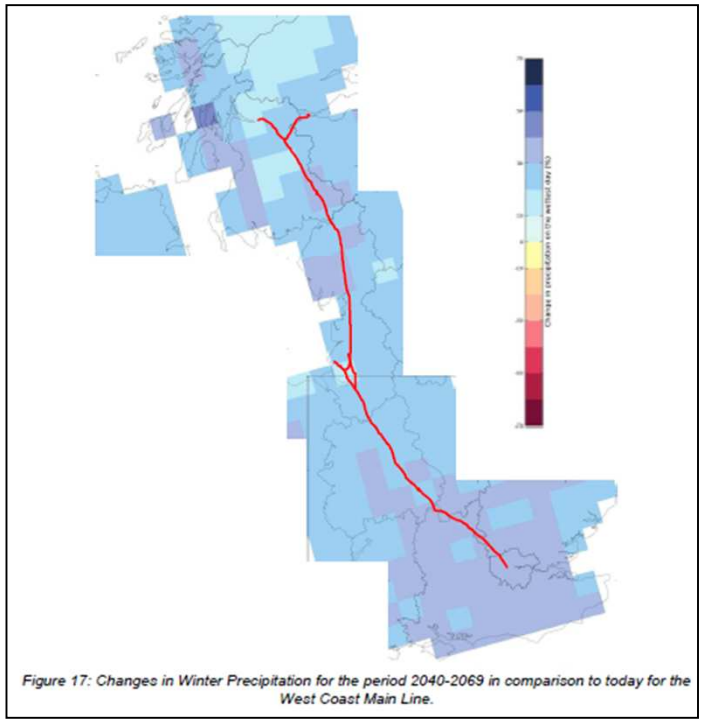


Figure 17: Changes in Winter Precipitation for the period 2040-2069 in comparison to today for the West Coast Main Line.

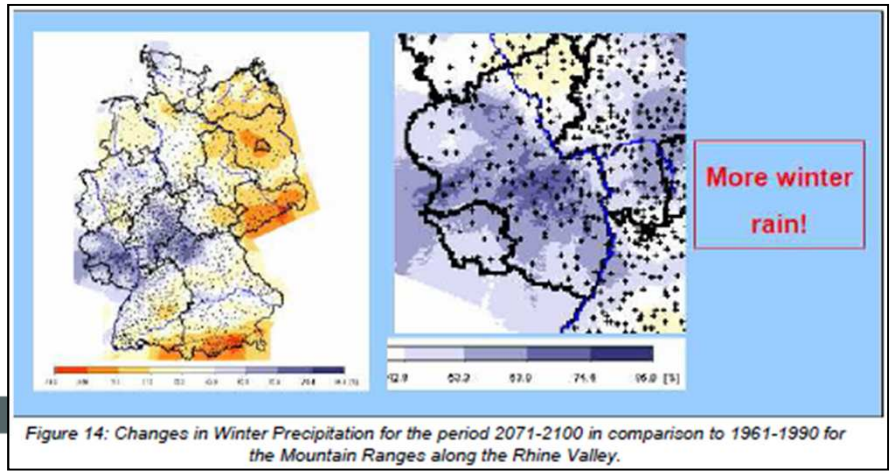


Figure 14: Changes in Winter Precipitation for the period 2071-2100 in comparison to 1961-1990 for the Mountain Ranges along the Rhine Valley.

Developing adaptation strategies

- The analysis summarized above can be used to develop an approach to adaptation. The ARISCC team recommend the following:

- Produce Vulnerability and Risk Maps
  - Risks to asset integrity, environment, operation, safety

- Priority setting
  - Risk classes, cost/benefit assessment, cost scenarios

- Adaptation measures & strategies
  - Alarm systems
  - Monitoring systems
  - Protective measures
  - Change of standards
  - Relocation of assets

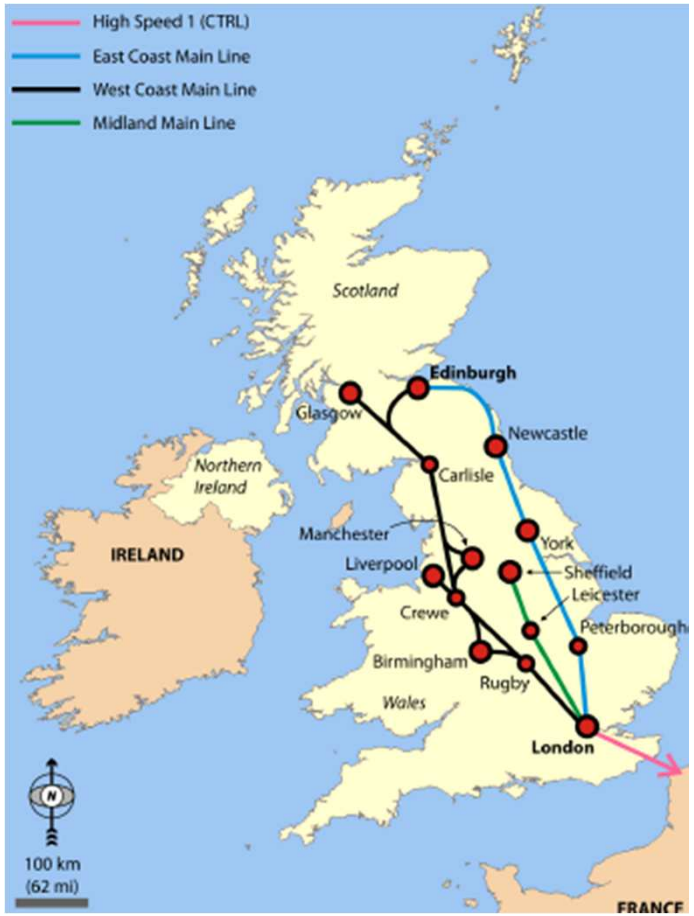
Case Study: West Coast Main Line

- **Identifying vulnerabilities**
  Expert workshops to identify main weather and climate factors and their impact on rail infrastructure. This resulted in a table of risks structured by type of climate impact.

- **Analysis of current and future vulnerabilities**
  Investigate the impact of climate change on performance and safety in more detail. Model most important hazards e.g. heat waves, river and surface flooding, landslips and storm throw.

- **Vulnerability maps** for the West Coast Main Line will be developed. Other outputs will include
  - Recommendations for “quick wins” for adaptation, and procurement options for dealing with current weather impacts
  - Preliminary recommendations for asset management policy up to 2040s
  - Specification for a tool to evaluate policy options for adaptation and weather resilience

- *NB: This work is funded by TRaCCA – Tomorrow’s Railway and Climate Change Adaptation (Network Rail / RSSB)*



Case Study: Rhine Valley

- **Vulnerability screening process**
  Identify parts of Rhine Valley Route that are in areas with increased likelihood of natural hazards

- **Analysis of vulnerable sections**
  Analyze vulnerable parts of the route identified by the screening process including data base for delay minutes, focusing on weather related delays

- **Analysis of current and future vulnerabilities**
  - Interviews with people responsible for the route segments
  - Analysis of status of infrastructure assets.
  - Discussion of how future climate loads can impact the local railway infrastructure.
  - Identify especially vulnerable assets

- **Measures for the improvement of infrastructure robustness will be identified and discussed in detail.**

Figure 10: Location of the railway line for the case study Rhine Valley.

Concluding thoughts

- ARISCC has produced a comprehensive survey of how European railways manage weather information (past and present) and natural hazards. It has picked out some good practice examples which others can learn from.
- ARISCC has also explored the ways in which future climate models can be used to assist with infrastructure planning and maintenance in the future. There are uncertainties with climate models, particularly storms and gales, but modelling experts seem confident about temperature and precipitation predictions.
- Question – does the railway sector have close enough links with the climate forecasting community? Are future climate changes being considered for new infrastructure projects, and maintenance programs?
- It is easier to plan for new infrastructure (new standards and so on) to account for a changing climate, than it is to modify existing assets. There is a clear business case for “climate-proofing” new infrastructure!