UNCHAIN
UNPACKING CLIMATE IMPACT CHAINS

Case studies 8 & 9

Task and proposed implementation plan

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WAGENINGEN
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The project UNCHAIN is part of AXIS, an ERA-NET initiated by JPI Climate, and funded by FORMAS (SE), DLR/BMBF (D), AEI (ES) and ANR (FR) with co-funding by the European Union (Grant No. 776608).

JPI Climate

Horizon 2020
European Union Funding
for Research & Innovation

AXIS

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Background

- Two case studies all in the Netherlands

financial sector (Real estate) – case 8

Railway - case 9

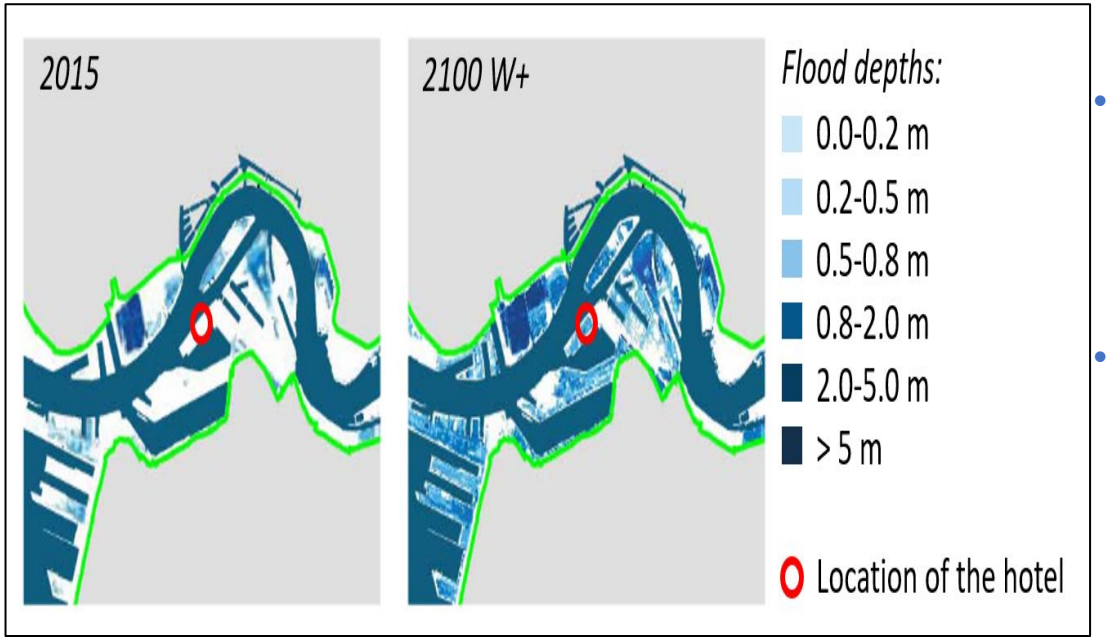
and funded by
European Union

Case 8: Financial sector (Real estate)

Financial sector (Real estate)-The hotel

- MGVM real estate and its client BNP Paribas REIM (Munchen) are interested in understanding the physical climate risk on the property.
- Hotel is in the part of the city (with about 40,000 people) outside of the area protected by the dikes.
- Therefore, potentially vulnerable to high water levels caused by flooding of sea and high river waters.

Financial sector (Real estate)-The hotel



- current flood risk is estimated relatively low, an increase is expected toward the end of the century
- The return period of flooding will increase from 1: 10.000 years to a 1: 1000 year under a 60 cm sea level rise by 2085

- The area is mostly elevated with quays ranging from 3m - 5.5m.
- Also protected by a large storm surge barrier which has a small chance of mechanism failure estimated around once every 50 – 100 closings.
- Under climate change sea levels will rise and river discharge may increase. This will result in a more frequent closing of the *Maeslandtkering (*storm surge barrier). Therefore, the risk of failure also increases as there is a chance of malfunctioning.

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Financial sector (Real estate) - The wall

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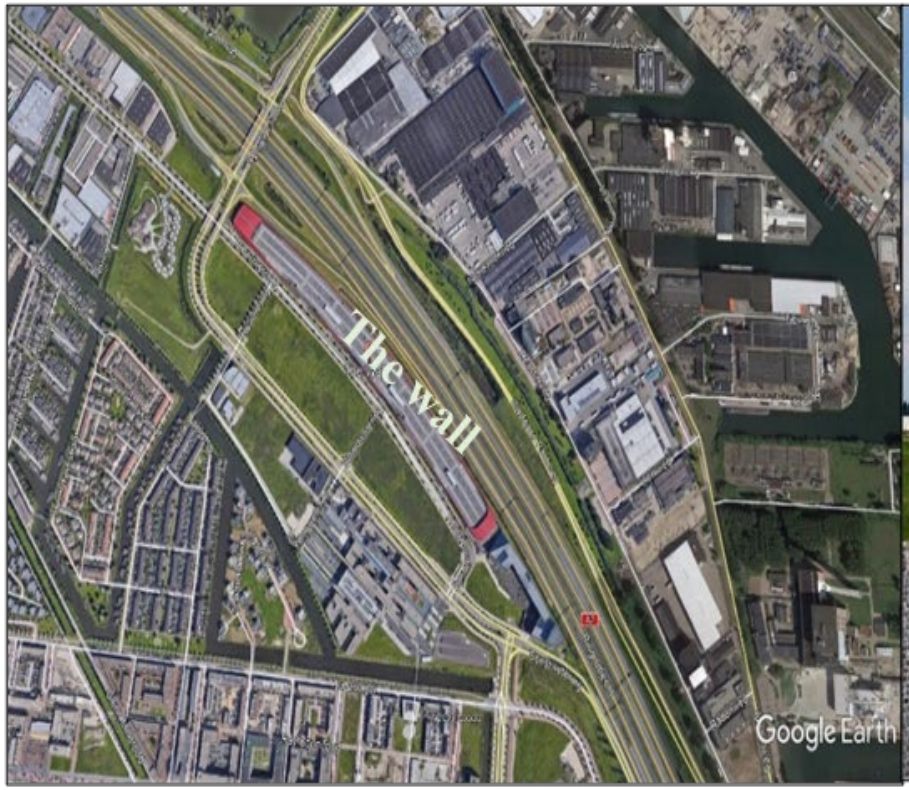
- The Wall is a 65 000m2 shopping center in Utrecht.
- It sits by the A2 highway (north-south connection). And connecting Amsterdam to other European markets, including Germany.
- The Wall is situated in low lying areas, between 20 to 60 km from the rivers Nederrijn-Lek, Eemmeer and Eem.
- Therefore, vulnerable to flood(increased magnitude and frequency of rainfall events), drought (subsidence). Also, venerable to heat stress.



Financial sector (Real estate) – The wall

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Potential flooding simulation following a 2 hour downpour of 70 mm/hr :

- The main access roads to The Wall and part of the A2 highway can be flooded and be inaccessible.
- Inundation depth is estimated between 20 - 30 cm: potentially damaging the buildings foundation, grid infrastructure or sewer systems, depending on threshold heights of the construction.
- Under current climate, a downpour like this may happen once every 100 years.
- With climate change, this will double towards the end of the century

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FORM

Financial sector (Real estate) –The wall

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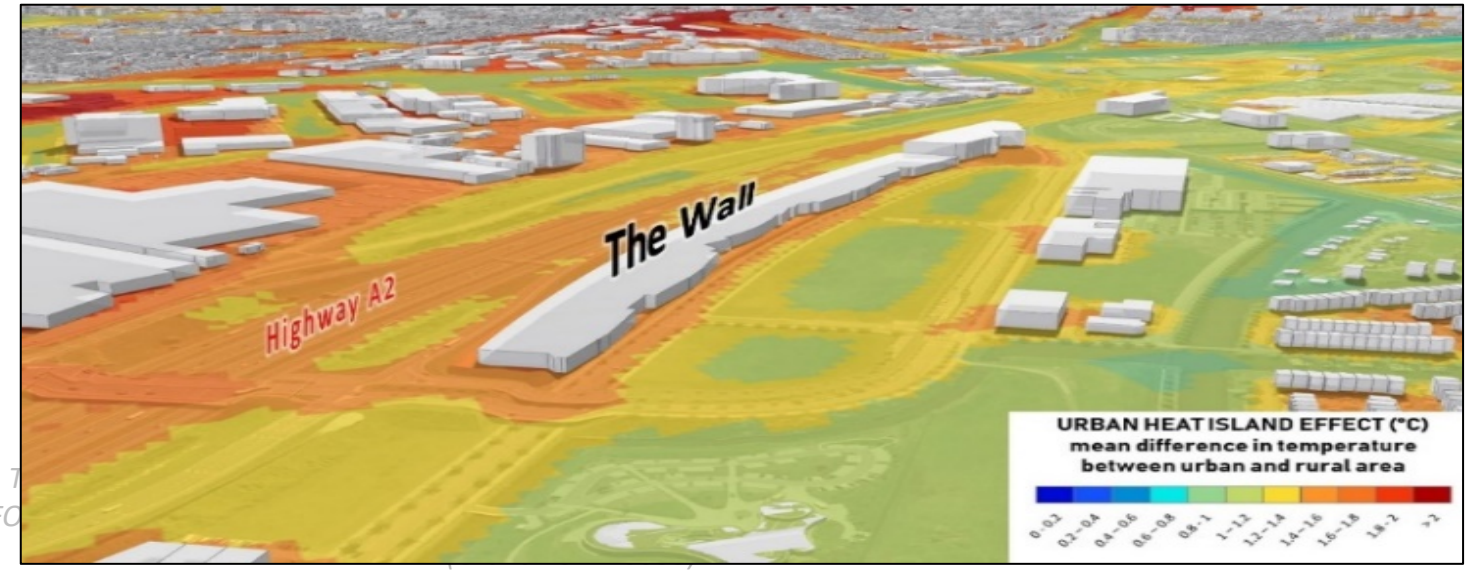
- The expected total soil subsidence (in cm) when no adaptation measures are being taken for the period until 2050.
- Additional 25% of the subsidence (5-10 cm) subsidence may occur as a result of climate change under all KNMI14 climate change scenarios.

(Grant No. 776608).

Financial sector (Real estate) –The wall

- Using the fourteen KNMI climate change scenarios:
- number of days above 30 degrees is likely to increase from around 4 days on average per year to up to 13 days by 2050 and 21 days by the end of the century.
- Cooling degree days (as an indicator for energy use required for cooling in the summer period) will go up by a factor of 5 by 2050 and a factor of 10 by the end of the century.
- Energy use for air conditioners in The Wall likely to increase over time - higher operating costs and potentially higher greenhouse gas emissions.



Financial sector (Real estate)-Vulnerability

- Developed property score based on building
- **Flooding**

✓ Threshold height entrance

✓ parking basement,

✓ installations below street level, e.g. gas, heat electric meters

✓ Small inflow points e.g. ventilation, cellar window, butt joints.

✓ Underground space : basement

✓ Flooding in the past and damage in eur

Heat stress

✓Active cooling
✓Green roof
✓Summer /night ventilation
✓Sun/heat resistant foil
✓Blinds/shutters
✓Glass surface
✓Glass sunfactor(g-value
✓Insulation value(Rc value)
✓Colour of roof

Next stage underway

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Case 9:
Railway

Railway sector

ProRail - Netherlands

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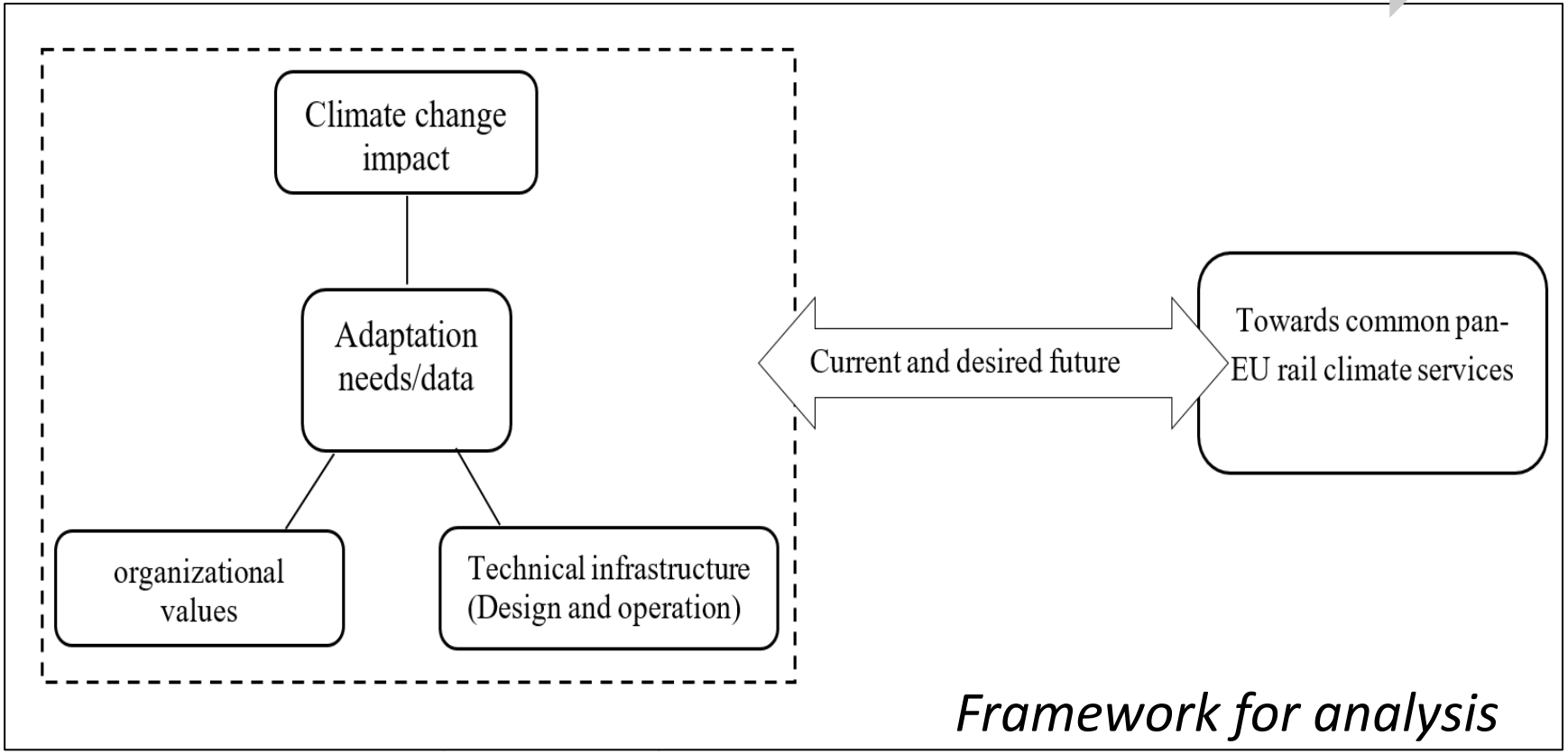
What climate risk information is needed to support the adaptation needs of the rail sector?.

Methods



Framework for analysis

Railway sector - Identified climate change impacts

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Climate change	Hazard	Impact
Low precipitation	Increased fire risk	• Disruptions • Wooden railway sleepers catch fire • Burning of cables (for signaling energy supply)
	Low groundwater levels	• Rotting of willows in railways for stability • Rotting of wooden foundation infrastructure works • Insufficient water in wells for extinguishing fire
	Low humidity	• Good impact: signaling less failures of electrical equipment
	Uneven subsidence	• The sag of station tracks, tunnels, support strictures(also: differences in foundation)
	High precipitation after drought	• Overhead line support structures sag
High precipitation	Flooding	• Railway saturated and become unstable • Flooded tunnels • inaccessible platforms and stations • Rail erosion • Short circuits • Failing switches • Damage to electronic equipment (e.g. location cases
Low temperature	Frost / freeze thaw	• Slip and fall accidents • Project planning threatened • Corrosion of materials due to salt sprinkling • Failing switches (freezing elements)

Railway sector - Identified climate change impacts

Climate change	Hazard	Impact
High temperature	Heat stress	• Overhead lines sag (expansion of cables) • Failing electrical equipment at stations (elevators) • Decreased lifetime conversation system steal bridges • Expansion of concrete works • Track expansion • Track buckling • Problems with moving elements: bridges, switches • False alarms occupied tracks • Heat stress travellers and workers • Thermal degradation of elements (e.g. copper)
	Change of climatic zones	• Health issues because of the processionary caterpillar
Sea level	Storm surge	• Big impacts on the entire infrastructure
Thunderstorms	High winds	• Discomfort travellers (lack of shelter) • Moving overhead lines • Fallen signposts • Decrease availability of movable bridges • Trees on track / overhead lines
	Lightning and electrical storms	Damage and disrupt electrical systems

Railway sector-information needs

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Operational standards					
Impact/ Variable	Classes/values	Relevant for standard	Spatial resolution & coverage	Temporal resolution & coverage	Format
Heat stress for rail workers and passengers **Variable: Temperature+ humidity+ clothing + age**	Risk ranges, e.g. low, medium, high	-Working conditions -Passenger comfort and health	Regional classes	-Time steps of 10 years, or user can define -Historical conditions -Projections up to 50 years	-Graph or number indicating the risk for heat stress. -Dashboard allowing users to select: clothing type, age etc.
Temperature related impacts **Variable: Air Temperature**	Number of days/year Air temperature is above certain degrees celsius	Multipurpose Purposes e.g. Checking for risk track buckling etc.	Regional classes	Historical & Future climate User can define timesteps (e.g. based on lifetime asset)	Dashboard allowing users to enter a temperature threshold and explore frequency or enter lifetime asset
Precipitation related impacts **Variable: Precipitation**	1. return periods of extreme rainfall events 2. number of days / time period exceeding an amount of rainfall in mm.	Flooding related Standards	Regional classes	-Historical & Future climate -thresholds for days, months, seasons and years. -flexible timesteps (e.g. lifetime asset)	User can explore: - Predetermined set of return -periods extreme rainfall events - thresholds for days, months, seasons and years
Drought related impacts **Variable: precipitation**	Number of days without precipitation. Number of consecutive days without precipitation	Drought related standards	Regional classes	-Historical and Future climate -Flexible timesteps (e.g. based on lifetime asset)	Dashboard allowing users to for example e.g. enter type of lifetime asset
Wildfires	Indicator for fire risk (if possible) and frequency of fires	Fire related standards	Regional classes	-Historical and Future climate -Temperature threshold wildfire events	Dashboards with different temperature threshold for wildfire events

Railway sector-information Needs

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Design standards					
Impact / Variable	Classes/values	Relevant for standard	Spatial resolution & overage	Temporal resolution& coverage	Format
Lightning	-Amount of lightning strikes per year	Regional classes	Distribution of lightening	Per decade	Map
Wind gusts	Max gusts	wind related standards	Regional classes e.g. 10 that cover full spread	Decadal	Map
Diurnal temperature difference	diurnal temperature	All Temperature related standards	Classes	Decadal	Map
Temperature range	Difference between max. and min. yearly temp	All T related standards	Classes	Decadal	Map
Heavy rain after drought	Heavy precipitation days after dry period. e.g. number of times when average maximum dry period is followed by T1 hourly rainstorm	Structural	Classes	Decadal	Map
Hottest and coldest day per month	Average hottest day per month	T related	Classes	Decadal Map	Map
Coldest and hottest night per month	Average coldest night per month	T related	Classes	Decadal	Map
Hot days	Days above 25, 30 Celsius and days above current 90,95 percentile	T related	Classes	Decadal	Map
Max number of days w/o precipitation	T1, T2, T5, T10, T25, T50, T100events	Subsidence, sag, stability	Classes	Decadal	Map
Precipitation deficit	T1, T2, T5, T10, T25, T50, T100 events for cumulative rainfall anomaly for meteorological year	Subsidence, sag	Classes	Decadal	Map
Peak river flow	Change in 90, 95, 99 percentile	Flooding of tracks, use of bridges	Classes	Decadal	Map
Hourly data on precipitation	Hourly T10, T25, T50, T100, T200,T250, T500 rainstorms		Classes	Decadal	Map

Railway sector – Risk assessment

- Many climate impacts of concern
- Yet to decide on one for the risk assessment.

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Reflecting forward

- **Policy relevance:**

- *Real estate:*

1. For investment decisions

2. Might facilitate and reduce the difficulties in obtaining flood insurance in the Netherlands

- *Railway:*

1. Might lead to a standardised operational and design metrics

- **Improving the impact chain methodology**
- Co-production as a central innovation to advance the method
- Co-production and uncertainty management

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Thank you

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