Summary

Aim and scope

The aim of the INCAH program is to provide strategic but scientifically underpinned intelligence on the interconnection between climate change, hotspots, infrastructures and governance for adaptation. The focus is on transport, energy and water networks in the Rotterdam-Rijnmond and Amsterdam/Schiphol; its objective is to help the hotspots to develop robust adaptation strategies.

Research

Working with our European, Australian, Japanese and American partner scientific institutions, a systemic approach will bring together and advance knowledge from multiple domains to (1) establish what climate change effects will impact which infrastructures (2) elucidate the physical effects on subsoil behaviour and impact on infrastructure components such as roads, tunnels, water services and power cables (3) to construct models to simulate the effects on operation of infrastructures, their reliability, availability, capacity and socio-economic productivity (4) adopt a network perspective and explore how we can avoid congestion, service interruption, system breakdown or even systemic crisis through reinforcing effects rippling through interconnected infrastructures by network design and asset management strategies.

Models will be developed for a number of hotspot infrastructure networks to test policies, strategies and governance for adaptation of infrastructure components, asset management or network design. Simulation is used to assess whether these measures make our economic hot-spots robust and resilient to climate change and to explore what change of institutional structures, governance and decision making may be required.

Programme

INCAH's four work packages have been designed to foster synthesis, integration and application of knowledge generated. A platform for dialogue facilitates collaboration between researchers and practitioners throughout the WP's. Senior researchers, postdocs and PhDs address integrated cases on transport, energy and water networks and elaborate these in interaction with stakeholders. The knowledge obtained in the program will be translated to roadmaps for the hotspots involved.

Overview of main research questions on three levels

Program Level

INCAH's main research questions (MRQ) are

1. What are relevant effects of climate change on infrastructures?
2. To what extent do these effects threaten the safe, sound, reliable operation of infrastructures, their availability and socio-economic productivity?
3. How can we avoid congestion, service interruption, system breakdown or even systemic crisis through reinforcing effects rippling through interconnected infrastructures?
4. Through what policies, strategies and governance can we adapt infrastructure networks and make our economic hot-spots robust and resilient to climate change?

Work packages and projects

WP1 - Adaptation strategies for hotspots - is about "how to integrate and valorize the knowledge from WP2-4" by

- creation of a platform for dialogue between researchers and practitioners
- development of a systems model to assemble and structures existing and new knowledge
- compilation of flexible adaptation strategies

Project WP1-1 addresses all INCAH MRQ's, and specifically:

- What - technical, organizational and economic - measures ameliorate system robustness?
- What governance, financial, spatial conditions foster implementation of these measures?
- How to support decision-making – a roadmap: what measures to implement when?

WP2 - Effects on physical infrastructure as a result of climate change- primarily addresses MRQ-1, while providing input on MRQ's 2-4. Its main research challenges are

1. to gain insight in type and magnitude of the effects of changing climate factors on physical infrastructure components
2. to investigate changing subsoil behavior in a changing climate.
3. to determine and quantify vulnerabilities and effects on infrastructure integrity and quality
4. to conclude with adequate adaptation measures (for hotspots)

In WP2-1 elaborates these questions for the Schiphol and Rotterdam infrahubs, WP2-2 analyzes the effects on existing roads, railways and tunnels and explores adaptation measures for a required level of functionality and for climate proof design. WP2-3 focuses on drinking water and sewerage pipeline infrastructure. WP2-4 is about climate change working through subsoil to effect infrastructure, analyses what climate changes effect the physical conditions of subsoil and what associated loads on soils can be determined. How do soils then behave, are they robust and how to quantify this and what effects on infrastructures can be attributed to subsoil behavior?

In WP3 -Infrastructure Network Robustness and Adaptation- all MRQ's are addressed for infrastructure networks. WP3-1 liaises with WP1 and synthesizes WP3's main questions: 1) "what are the sensitivities of transport, ICT and energy infrastructure to climate change; how may climate change affect infrastructure robustness (system integrity, operation, safety, reliability etc.)" 2) "what asset management and design of infrastructure networks provide short term robustness and long-term resilience to climate change," and 3) "under what (policy, regulatory) conditions and incentives may such systems emerge."

WP3-2 is concerned with "how can road and energy networks be made more robust against the effects of climate change" and "how to model climate events and associated network failure over time, while taking into account network design and learning?" In concert with WP1 and WP2 it will be analyzed "what currently are the most vulnerable components of transport and energy networks with respect to failure caused by extreme climate events."

WP3-3's main question is "how to construct agent-based models of infrastructure evolution that provide sufficient resolution and reliability to represent the effect of climate change?" How to model relevant actor

behavior and the dominant factors that shape infrastructure networks and make it possible to explore effects of adaptation strategies by simulation?

The main research question of WP3-4 is “how can we incorporate the required robustness of our infrastructures regarding climate change into the asset management of our (physical) infrastructures?”

In WP4 -Socio-economic effects of climate change on mainports and on urban infrastructure networks- the central question is “What are the socio-economic effects of climate change via changes in the reliability and usability of transport and electricity infrastructures and via the physical infrastructure in the hotspot regions and what are potential flexibility-oriented adaptation approaches?”

WP4-1’s research question is “what costs are associated with transport infrastructure damage and associated reduction in the reliability and usability of (1) the road and railway transport networks for travelers of Schiphol airport (2) of the road, railway and waterway corridors for freight transport to and from the Port of Rotterdam.

In a similar fashion, WP4-2 will analyze the electricity infrastructure on the local-and Randstad level due to climate change, while WP4-3 focuses on the benefits and costs of a flexible infrastructure adaptation strategy for specific cases in the Schiphol and Rotterdam hotspot regions.