NORDRESS – WP 5.1 and 5.2 → Status and Future

5.1 Farrokh Nadim, Unni Eidsvig, Jón Kristinn Helgason, Charlotte Cederbom

5.2 Christian Jaedicke

Presented by Sigrún Karlsdóttir IMO and Unni Eidsvig NGI

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Nordic Centre of Excellence
On Resilience and Societal Security

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5.1 – Mitigation of risk posed by slope failures on transport infrasturcture

WP leader Farrokh Nadim (NGI)

- Team: Unni Eidsvig NGI;
  Charlotte Cederbom SGI;
  Jón Kristinn Helgason IMO

5.1 – Mitigation of risk posed by slope failures on transport infrasturcture

The Problem:

- Every year a number of incidents and accidents related to slope failures impact the roads and railways in Nordic countries. *These can be rock falls, landslides in natural or engeneered slopes, or failure of road or rail embankments triggered by hydro-meteorological events like heavy precipitation and temperatures oscillating around zero. The frequency and intensity of these events may increase in the future with climate change. Key vulnerability factors include aging constructions, poor maintenance, poorly dimensioned drainage systems, human activity changing runoff patterns and poor communication and coordination between infrastrucutre owners and land developers, which may be affected by legislation and institutional setup.

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The Study:

- Based on the existing damage data, an analysis of factors contributing to transport infrastucture vulnerability and resilience in the Nordic countries will be carried out. For selected engineered slopes and embankments, risk analysis will be performed to identify main sources of vulnerability. This will be done through case studies, modelling and stakeholder interaction. We will in particular investigate the impact of poor land use practices that e.g. may change runoff patterns during precipitation events. The activities will benefit from synergies with international EU and CEDR projects, as well as ongoing nation initiatives.

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WP 5.1 - Status

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Activity in 2017:

- Participation in the NORDRESS annual meeting in Reykjavík
- Participation in the IDRiM 2017 conference in Reykjavík:
  - 3 presentation – 1 invited and 2 related to NORDRESS WP 5.1
    - Hazard and risk management for natural threats – An engineer‘s viewpoint (by Suzanne Lacasse)
    - Temporal evolution of landslide risk for the municipality of Nocera Inferiore, Italy under the effect of climate changes (by Uzielli, Eidsvig et al.)
    - Multi-hazard assessment – A Bayesian network perspecitve (by Z. Liu)

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WP 5.1 - Status

Activity in 2017:

- **D5.1 was finalized – report prepared by NGI, SGI and IMO:**
  - Mitigation of risk posed by slope failures on transport infrastructure – Gaps and needs
    - Gaps and needs identified through causal analysis of adverse events as well as analysis of implementations in the aftermath of such events
    - Examples of previous events with slope failure impact on transportation infrastructure from Norway, Sweden and Iceland provided – to support its arguments and conclusions
    - The report also reviews findings from research projects related to the scope of the report.

WP 5.1 – Future Plans

- The budget to WP 5.1 is finished → No special NORDRESS activity expeced.
- However, further collaboration is expected through other research project related to the issue of reduction of risk associated with landslides:
  - EVOKED – Enhancing the value of climate data. European JPI Climate Project → NGI and SGI participate
  - MERRIC – Multiscale Erosion Risk under Climate change → NGI Strategic Project
  - PHUSICOS – Nature-based solutions for mitigation of risk associated with hydro-meteorological hazards in mountain regions → EC H2020 project led by NGI

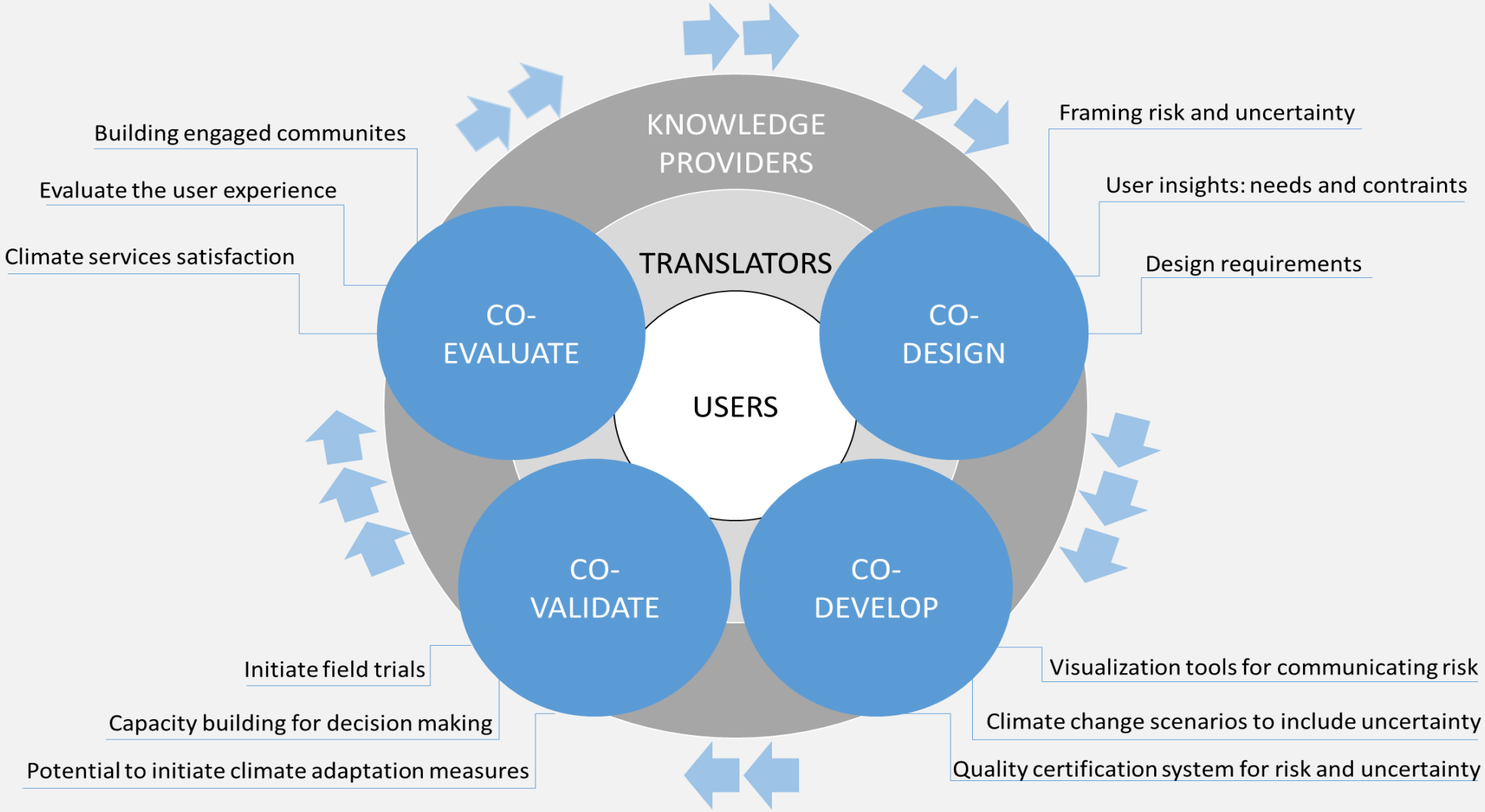
WP 5.1 – Future Plans

- **Future collaboration and possibilities (continuations)**
  - Klima 2050 – Centre of Research-based Innovations (SFI) financed by the Research Council of Norway and industry partners.
    - Aims at reducing the societal risks associated with climate changes and enhanced precipitation and flood water exposure within the built environment. → NGI is one of the main research partners.
  - Opportunities in upcoming H2020 projects
  - Continuing collaboration – knowledge and knowhow exchange between partners.

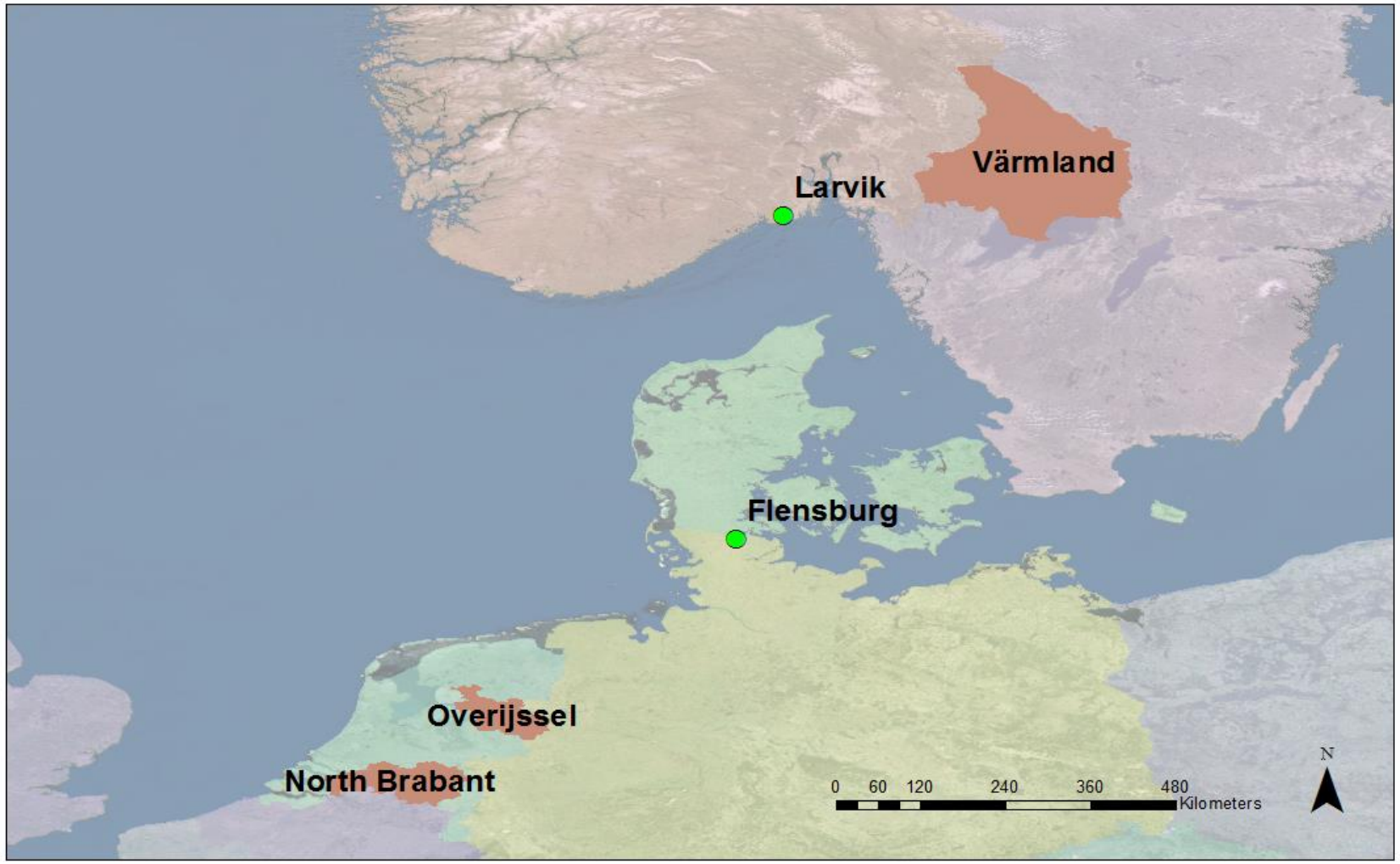
The objective of EVOKED

- to re-frame the risk and uncertainty associated with climate data **into knowledge products more understandable and useful for end-users** concerned with risk mitigation and adaptation. This enhances the value of the data the scientific community produces for end-users and for decisions related to adaptation planning.

EVOKED: Enhancing the value of climate data – translating risk and uncertainty utilizing a Living Labs approach



End-users are central in EVOKED



PHUSICOS - 'According to nature' in Greek

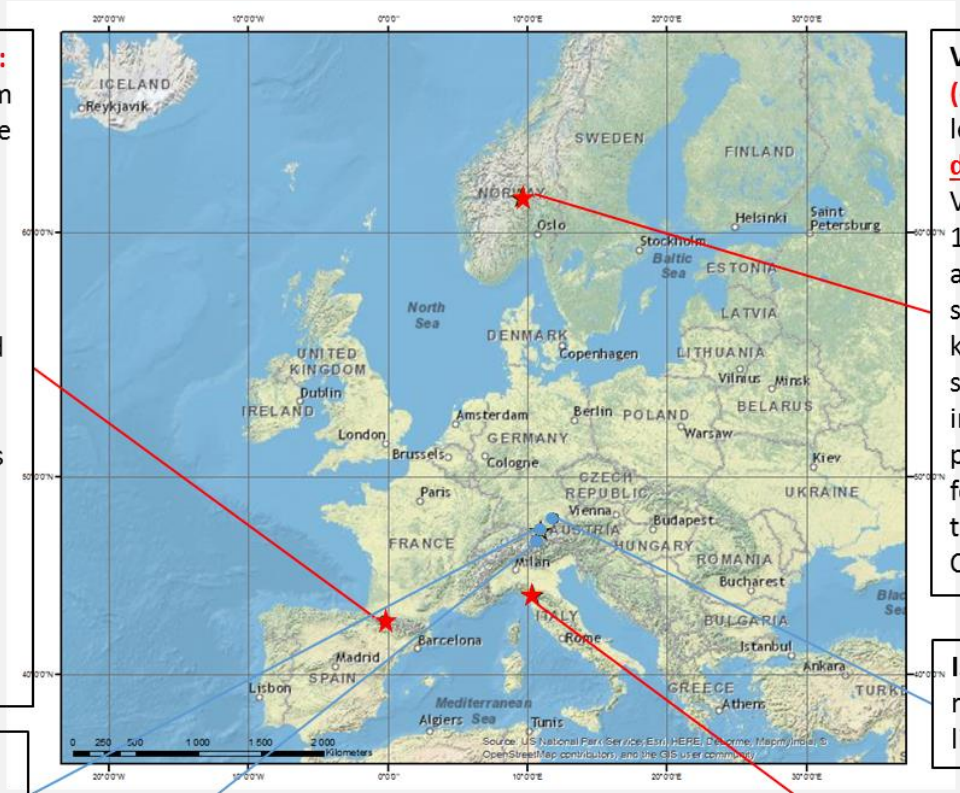
- The main objective is to **demonstrate** that nature-based/nature-inspired solutions for reducing the risk of extreme weather events in particularly vulnerable areas such as rural mountain landscapes, are technically viable, cost-effective and implementable at regional scale. Furthermore, they increase the ecological, social and economic resilience of local communities.

PHUSICOS Case study sites

The Pyrenees, France-Spain (demonstrator site): The Pyrenees mountain range spans 415 km from the Mediterranean Sea to the Atlantic Ocean. The mountain bioregion is mostly rural and is highly vulnerable to climate change with a risk of flooding, landslides and debris flows. In 2010, the Consortium Pyrenees Working Community launched the Pyrenees Climate Change Observatory in order to monitor and understand the effects of climate change as well as initiate studies to identify actions necessary to limit its impact and adapt to its effects. Reforestation has demonstrated its usefulness to cope with hydro-climatic extreme events by reducing the hazard intensity at the local scale; however upscaling to also include input from local communities is needed. Partners in charge: Working Community of the Pyrenees (CTP), BRGM.

Tyrolean Inn Valley, Austria (concept case): Basin is shrinking due to global warming and resulting in significant flood risk.

Kaunertal valley, Austria (concept case): Landslides, rock fall and debris flows as a result of extreme weather events.



Valley of Gudbrandsdalen, Norway (demonstrator site): Extreme precipitation has led to increased risk of flooding, landslides and debris flows along the more than 100 km long Valley of Gudbrandsdal, with a catchment area 10,000 km^2. This has resulted in damage to agricultural land and infrastructure. Nature-based solutions are expected to contribute to knowledge transfer, hydraulic water course scenario modelling and stakeholder involvement in planning and implementation phases. A NBS pilot study is to be implanted in 2017 with design for additional phases of implementation expected to start in 2018. Partners in charge: Oppland County Authority, NGI.

Isar River Basin, Germany (concept case): Local restoration projects have been implemented to limit erosion during flooding.

Serchio River Basin, Italy (demonstrator site): The hydrological network of SRBA (1,565 km^2) consists of the Serchio River and its tributaries, and the Lake Massaciuccoli. The area has experienced extreme drought and flooding. A diversion channel from the lake of Massaciuccoli is currently being designed and implemented to mediate the risk of drought and flooding in the river basin. Nature-based solutions that assess the effectiveness of the proposed solution as well as barriers to social and cultural acceptance are useful. Partners in charge: Serchio River Basin Authority, AMRA and CGT.

Scope of the MERRIC project

The project aims to investigate relevant erosive and mass-flow processes in the coastal zone, along rivers, and in lakes. Further, the knowledge and tools to be developed within the project aim to reduce the risk associated with these processes, through appropriate land-use planning and innovative mitigation measures.

The project is thematically subdivided into the following five work packages:

- WP1: Modelling of erosion processes in rivers, at the coast and in mass movements
- WP2: Floods, debris flows and sediment mobility in complex topography
- WP3: Coastal hydrodynamic processes
- WP4: Monitoring, warning and non-physical mitigation measures
- WP5: Dissemination and knowledge sharing

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About Klima 2050

- Centre for research-based innovation
- Risk reduction through climate adaptation of buildings and infrastructure
- 2015-2023
- 220 million NOK (~ 27 million USD)
- Financing: Norwegian Research Council + partners
- Work packages:

WP1: Climate exposure and resilient moisture-buildings

WP2: Stormwater management in small catchments

WP3: Landslides triggered by hydro-meteorological processes

WP4: Decision-making processes and impact

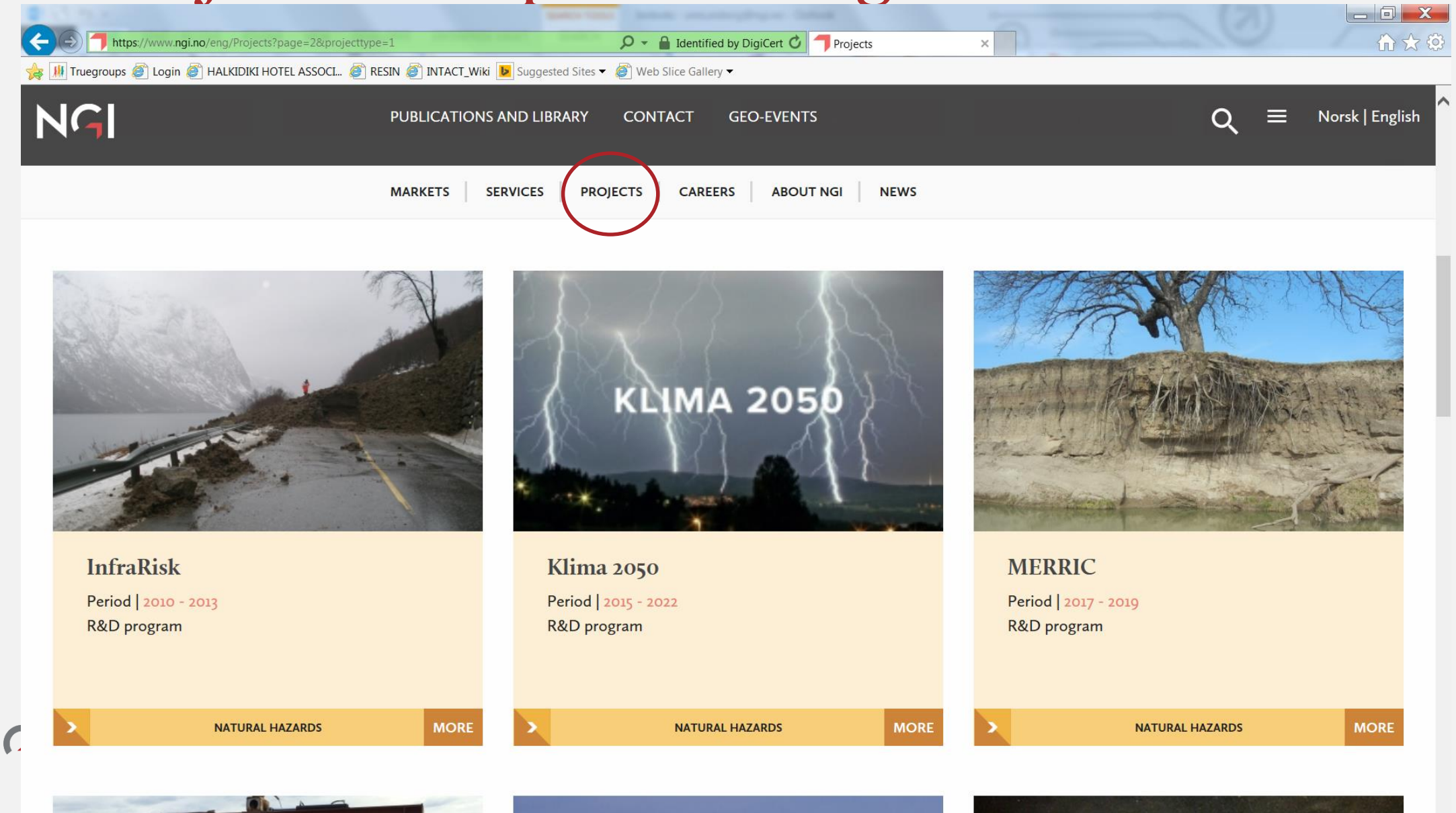
About WP3: Landslides triggered by hydro-meteorological processes

- Soil slides and debris flows
- Hydro-meteorological factors: conditioning and/or triggering
- Norwegian conditions or similar settings in other countries/regions
- Tasks:
  - 3.1 Numerical and analytical methods
  - 3.2 Slope stabilisation measures
  - 3.3 Protection of critical infrastructure
  - 3.4 Early-warning systems
  - 3.5 Risk management
- ~ 3.1 (6.2) million USD over 8 years (2015-2023)

Main objectives for the initial 3 years

- Providing numerical models for landslide evaluations
- Development of a toolbox for appropriate mitigation measures
- Instrumentation and monitoring of selected site(s)

Project descriptions at ngi.no



5.2 – Mitigation of risk posed by snow avalanches on transport infrasturcture

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Team:

Christian Jaedicke NGI (WP leader);

Harpa Grímsdóttir IMO

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5.2 – Mitigation of risk posed by snow avalanches on transport infrasturcture

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The Problem:

- Norway, Sweden and Iceland all face dangers of snow avalanches that may threaten lives and societal infrasturcture, including transport. Mitigation includes physical measures such as protection walls and non-physical measures such as prediction and warning. The problem is that physical measures are very costly and inflexible while prediction models need to be improved to increase their reliability.

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The study:

- To improve warning, a probabilistic snow avalanche exposure model will be developed to estimate probability of an exposed road/railway being hit by a snow avalanche in the coming 24 hours. The model will consider triggering and run-out and will be calibrated using existing snow avalanche data. Existing mitigation measures reducing risk to transport infrastructure will be mapped. Detailed analysis will be carried out of selected cases considering cost effectiveness of physical protection measures versus use of monitoring and warning, including an analysis of the cost of „false alarms“ when tranpsort lines are closed.

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5.2 – Mitigation of risk posed by snow avalances on transport infrasturcture

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Ongoing work:

- Probabilistic avalanche forecasting system
  - To be tested for selected roads both in Norway and Iceland
  - Presentation provided at EGU 9. – 13. April 2018
    - *Probabilistic evaluation of snow avalanche runout* by Sylfest Glimsdal, Galina Ragulina, Marco Uzielli and Christian Jaedicke

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NORDRESS support

NORDRESS NSSA:

- Enhanced collaborations
- Strengthened exchanged of knowledge and knowhow
- Building up networks
  - Workshops and meetings related to flashfloods and landslides

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