Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

RAIN PROJECT

RAIN - Risk Analysis of Infrastructure Networks in Response to Extreme Weather – Project overview

RAIN Workshop

Critical Infrastructure Safety in the Context of Climate Change

Delft

4th April 2016

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This project is funded by the European Union

Introduction

- Project RAIN – ***R****isk* ***A****nalysis of* ***IN****frastructure Networks in Response to Extreme Weather*
- FP7 Theme 10 - Security Activity - 10.2 Security of Infrastructures and Utilities SEC-2013.2.1-2 - Impact of Extreme Weather on Critical Infrastructure'.

  'Activities will concentrate on targets of an incident or disaster of ***transnational importance****…, significant sites of political or symbolic value and utilities being those for energy (including oil, electricity, gas), water, transport (including air, sea, land), communication (including broadcasting), financial, administrative, public health, etc.*

  *A series of capabilities are required to cope with this mission area, many of which primarily relate to the phases "****protect****" but also "****prepare****".*

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Introduction

*The ambition is both to **avoid** an incident and to **mitigate** its potential consequences.*

*emphasis will be on issues such as: **analysing, modelling and assessing vulnerabilities of physical infrastructure** and its operations; **securing existing and future public and private critical networked infrastructures**, systems and services with respect to their physical, logical and functional side; control and alert systems to allow for quick response in case of an incident; **protection against cascading effects** of an incident, defining and **designing criteria to build new secure infrastructures and utilities**.'*

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RAIN Vision

To develop **a systematic risk management framework** that explicitly considers the **impacts of extreme weather** events on critical infrastructure and develops a series of **mitigation tools** to enhance the security of the pan-European infrastructure network.

To do this we must:

- **quantify** the complex **interactions** between weather events and land based infrastructure systems (i.e. transport, telecoms, energy etc.),
- develop an operational analysis framework that considers the impact of **individual hazards** and the **coupled interdependencies** of critical infrastructure through robust risk and uncertainty modelling,

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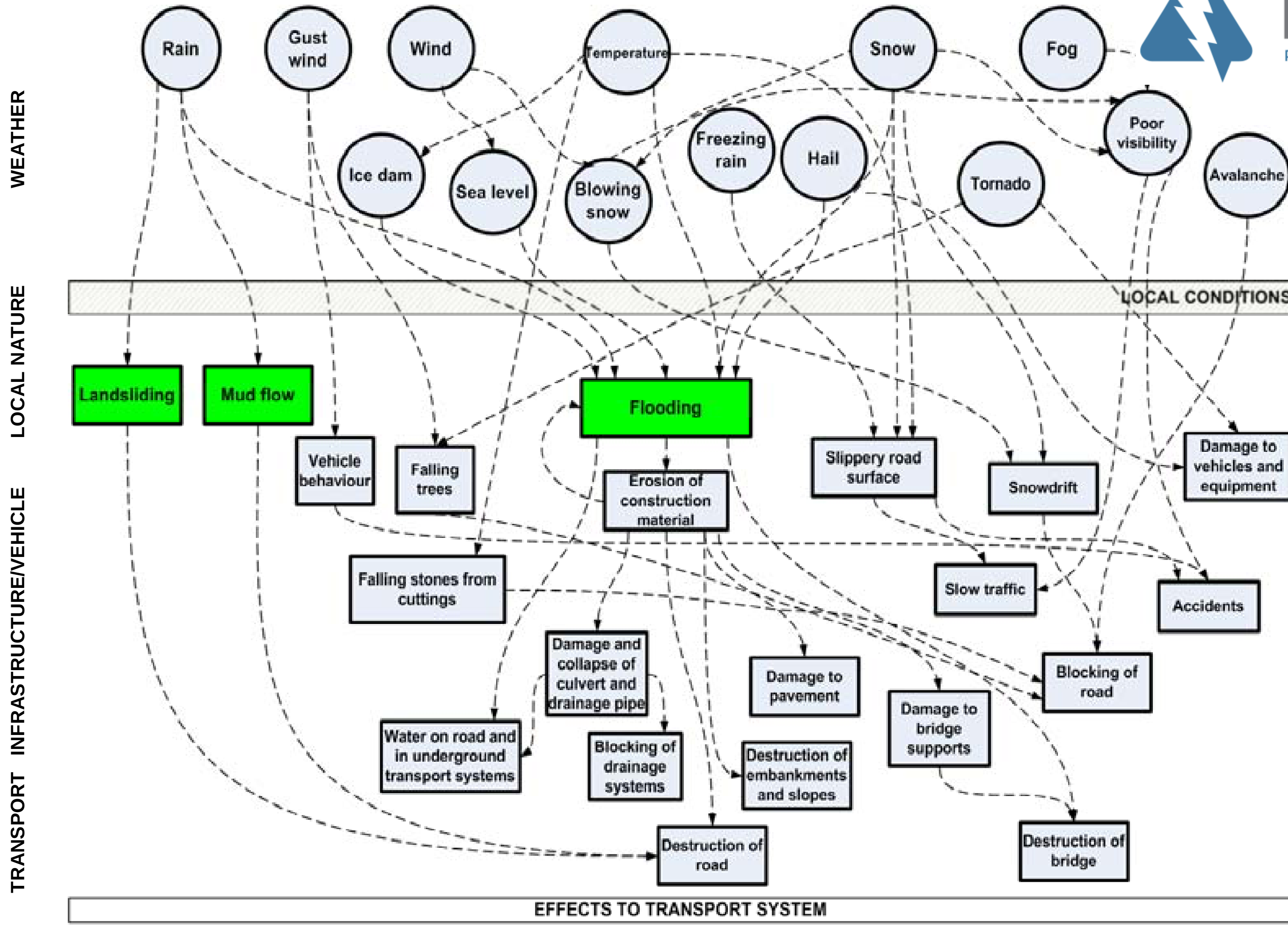

interactions between weather events and land based transportation systems (source: Makkonen, Törnqvist and Kuusela-Lahtinen, VTT)

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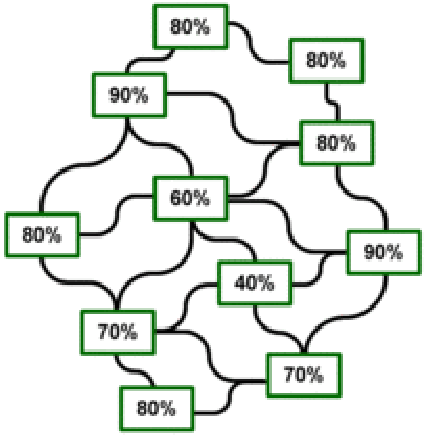
RAIN Vision

- considering **cascading hazards**, cascading effects and time dependent vulnerability



Network Performance

- Develop **Technical and Logistic solutions to minimise the impact of these extreme events**, include novel early warning systems, decision support tools and engineering solutions to ensure rapid reinstatement of the infrastructure network

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RAIN Consortium

1 (Coordinator)	The Provost, Fellows, Foundation Scholars & The Other Members of Board of the College of the Holy & undivided Trinity of Queen Elizabeth Near Dublin	TCD	Ireland
2	European Sever Storms Laboratory	ESSL	Germany
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10	Istituto di Sociologia Internazionale di Gorizia I.S.I.G	ISIG	Italy
11	PSJ	PSJ	Netherlands
12	Ilmatieteen Laitos	FMI	Finland
13	Youris.com	Youris	Belgium
14	Independent Power Transmission Operator (IPTO) SA	IPTO	Greece
15	Aplicaciones En Informatica Avanzada SL	AIA	Spain

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Background

In recent years, the complex interdependencies of the European/International infrastructure networks have been highlighted through multiple failures during extreme weather events. These failures have been the driver for this project, e.g.

Hurricane and Severe Storm damage (2012) **-** Hurricane Sandy - largest Atlantic storm on record devastated portions of the Caribbean, Mid-Atlantic and North Eastern United States

- **193** people were **killed** along the path of the storm in seven countries
- **damage >$20 billion**(USD) losses (including business interruption) > $50 billion
- Jamaica: winds left **70% of residents without electricity**, blew roofs off buildings, killed one, and caused about $55.23 million in damage.

Figure 1.1(a): Flooding in New York Subway following Hurricane Sandy (30th October 2012)

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Background

- Haiti: Sandy's outer bands brought flooding that **killed** at least **54**, caused **food shortages**, and left about **200,000 homeless**,
- Cuba: extensive coastal flooding and wind damage inland, **destroying** some **15,000 homes, killing 11**, and causing $2 billion in damage,
- United States: affected at least **24 states**, from Florida to Maine and west to Michigan and Wisconsin, with particularly severe damage in New Jersey and New York.
  - Its storm surge hit New York City on October 29, **flooding streets, tunnels and subway lines and cutting power** in and around the city.
  - **New York Stock Exchange** remaining **closed** for trading for two days.
  - **7 subway tunnels** under the East River were **flooded**, which the Metropolitan Transportation Authority stated early on October 30 "*that the destruction caused by the storm was the worst disaster in the 108-year history of the New York City subway system*".
  - **Gas shortages** throughout the region.

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Flash Floods

Central Europe, 2002

- **deaths** of approximately **150** people and an estimated **€150 Billion** worth of damage,
- In Germany and the Czech Republic, the worst affected areas
  - **electricity** failures, disconnected **telecommunication** links, damage to approximately **250 roads** and **256 bridge** structures,
  - disruption to the **Gas** service due to damaged pipelines and **contamination of clean water** with flood water.
  - restoration of important services to full capacity took approximately 1 month for electricity, 2 months for Gas and 3 months for telephone communications.

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Flash Floods

Central Europe, **2013**

- deaths of 19 people and €bn's worth of damage
- Germany, Hungary and the Czech Republic, the worst affected areas
- 23,000 people leave homes in German city of Magdeburg where waters rose to 7.44m (normal 2m)!!

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Flash Floods

Finland August 2010

- Finland was hit with severe storms, particularly 'downbursts' following an unusually period of high temperatures. Falling trees cut off roads, destroyed buildings and caused devastation to property,
- The **water and electricity networks were cut off** in wide areas in Central and South-East Finland,
- Forest damage represented some 8.1 million m^3 and 240, 000 hectares.
- **35,000 kilometres** of the **electricity network** was **destroyed** or damaged. 9,000 distribution substations were left without electricity, leaving **480,000 households in the dark**. Repair work to the damaged networks amounted to nearly 200,000 hours (over 120 man-years).

Downpour in Oulu disrupts power supply, vehicular movements

FTimes-STT Report, July 1

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CNN

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'As bad as it gets': Australia braces for worst of wildfires

By **Kevin Voigt, Jessica King** and **Robyn Curnow**, CNN

October 23, 2013 -- Updated 0526 GMT (1326 HKT)

New South Wales Rural Fire Service crew members fight a fire near Mount Wilson in the Blue Mountains of Australia on Thursday, October 24. Wildfires threatened the western suburbs of Sydney on Wednesday as high winds and temperatures created at least a dozen new fires that were blazing across a 1,000-mile stretch of New South Wales.

HIDE CAPTION

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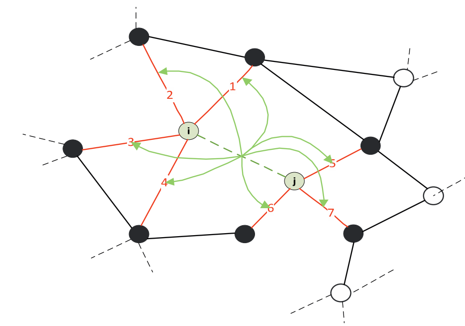
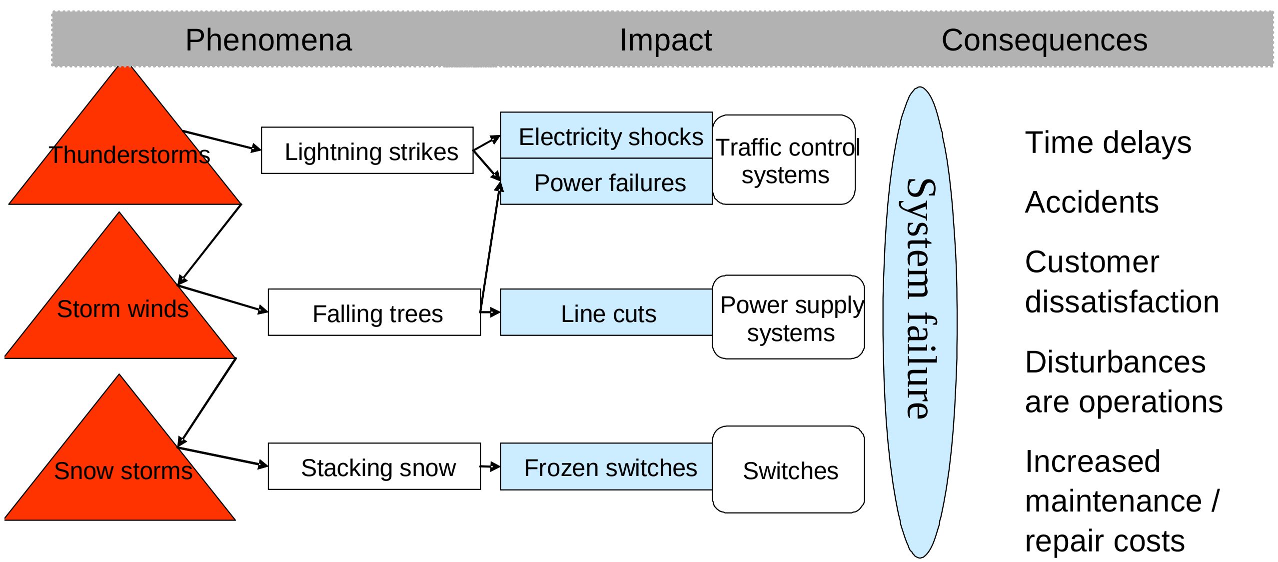
Objective



Risk Analysis of Infrastructure Networks must therefore:

1. **quantify the complex interactions** of the existing infrastructure systems and their interrelated damage potential in the event of specific extreme weather events,



(source: EWENTS FP7 Project)

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Objective

Risk Analysis of Infrastructure Networks must therefore:

2. **improve the robustness** of Infrastructure Networks so that they will not experience disproportionate damage or disruption in the case of extreme events, i.e.:
   - increase the level of redundancy in the infrastructure networks at critical nodes,
   - improve the performance of key infrastructure and
   - developing detailed plans for a range of potential emergency scenarios.

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Objective

Risk Analysis of Infrastructure Networks must therefore:

3. develop systems that will accelerate **re-establishing infrastructure links post an extreme event**. This objective will require developing engineering solutions to assess the safety of land based structures, networks and substructures which facilitate **rapid replacement** of key infrastructure and emergency systems where necessary. Additionally we must seek to **optimise the use of the in-tact network** post any significant event.

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Concept

Risk Analysis of Infrastructure Networks must therefore accept that extreme events (e.g. “100 year events”) are happening with alarming frequency. Thus preparing for these events is of vital importance.

We must attempt to quantify and thereby reduce uncertainty and gain a better understanding of how our critical infrastructures will cope and adapt to weather events to help ensure the security of vital utilities.

Requires interaction between several entities i.e. emergency planners, utility operators, first responders, engineers and most importantly the citizens living in the area of the extreme event.

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Concept

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Concept

Risk Analysis of Infrastructure Networks must:

1. **consider the citizen as central**. The citizen is the most important consideration in an extreme event. We must put the societal impacts of infrastructure failures in extreme weather events at the heart of any approach and develop risk mitigation strategies to minimise the risks of loss of life and disruption to quality of life.

2. minimise the risk of chaos in extreme weather events by predicting, using the most advanced statistical methods, **how weather patterns are likely to emerge and then how our infrastructures will react under these events**.

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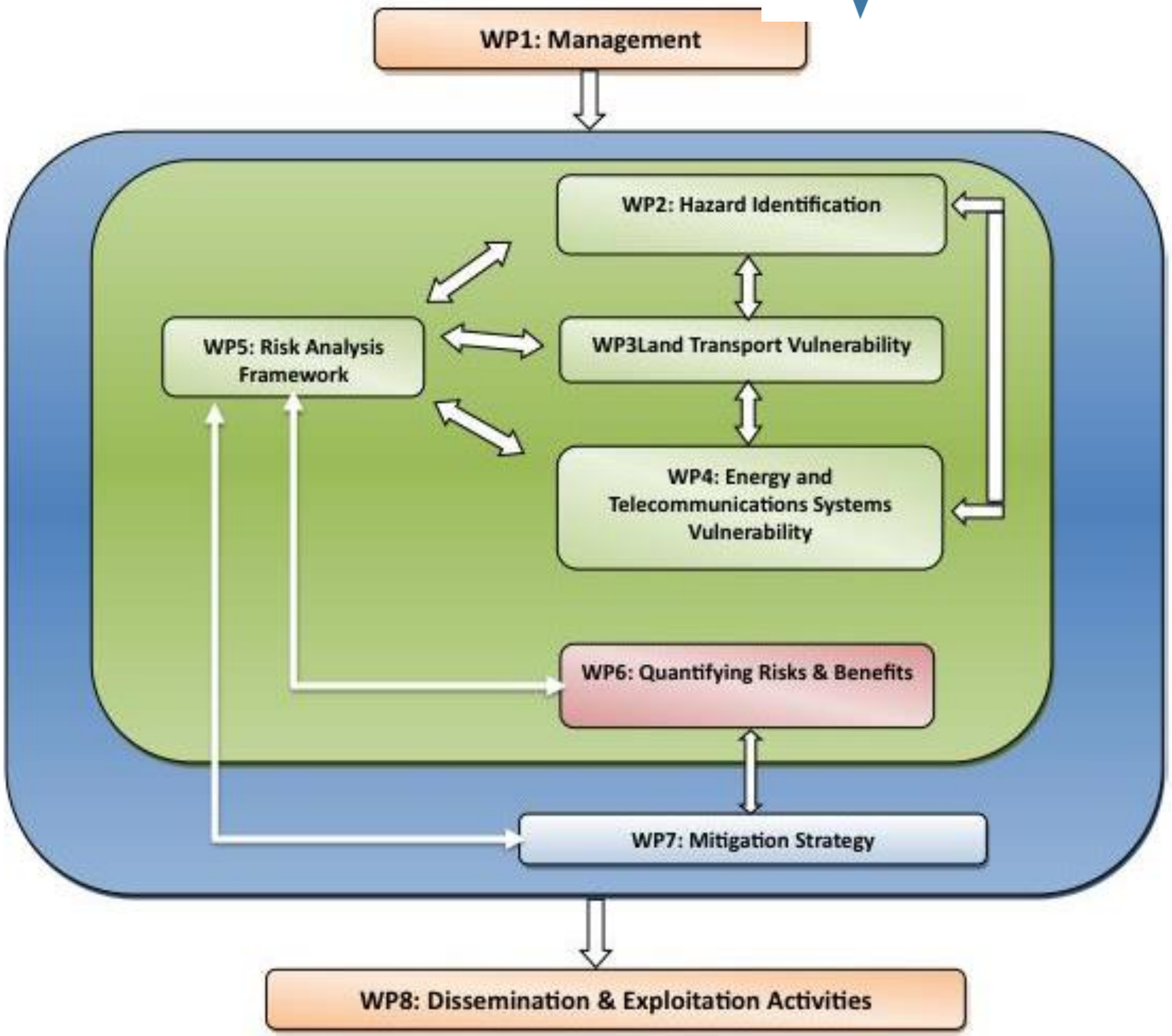
- Work Package Structure
- WP Leaders
- WP1 – TCD
- WP2 – ESSL
- WP3 – UNIZA
- WP4 – AIA
- WP5 – TU_Delft
- WP6 – ROD
- WP7 – GDG
- WP8 – Youris



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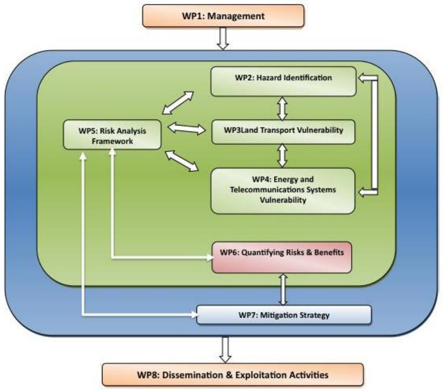

RAIN Vision

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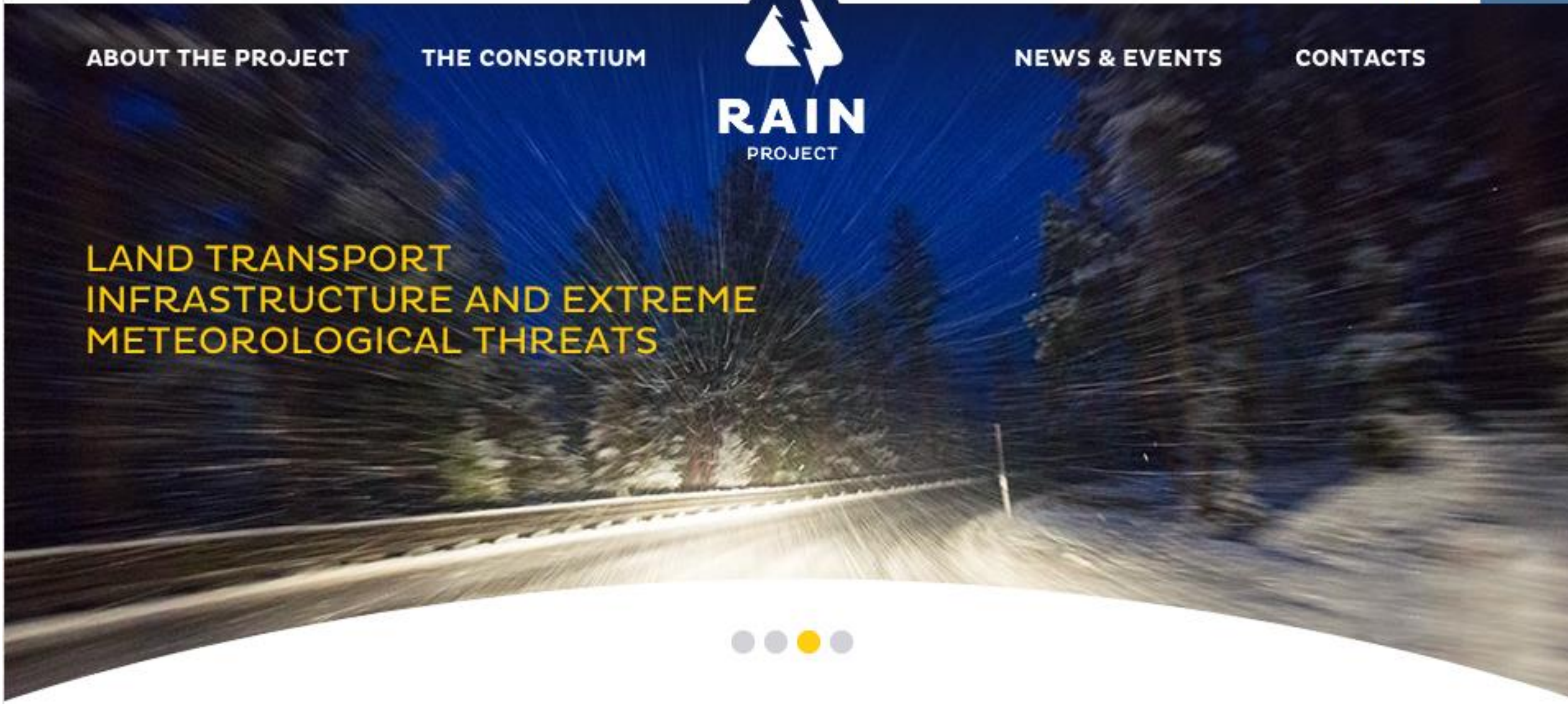

HOW VULNERABLE ARE OUR TRANSPORT, ENERGY AND TELECOMMUNICATION INFRASTRUCTURES?

RAIN contributes to minimising the impact of extreme weather events on transport, energy and telecommunication networks. The project will develop early warning systems, decision support

NEWS

Beatriz Martinez Pastor is a PhD student in the Department of Civil Engineering at Trinity College Dublin whose work within the RAIN project consists of developing mathematical models to assess resilience in transport networks under... Read More

Some partners of the RAIN Consortium presented first results of their work onnational and regional state-of-the-artrisk monitoring and early-to- medium-range warning systems as a talk at the "European Conference on Severe Storms" (ECSS2015) in Wiener Neustadt, Austria: The...

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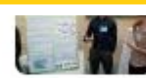
ENERGY AND TELECOMMUNICATION INFRASTRUCTURES?

RAIN contributes to minimising the impact of extreme weather events on transport, energy and telecommunication networks.



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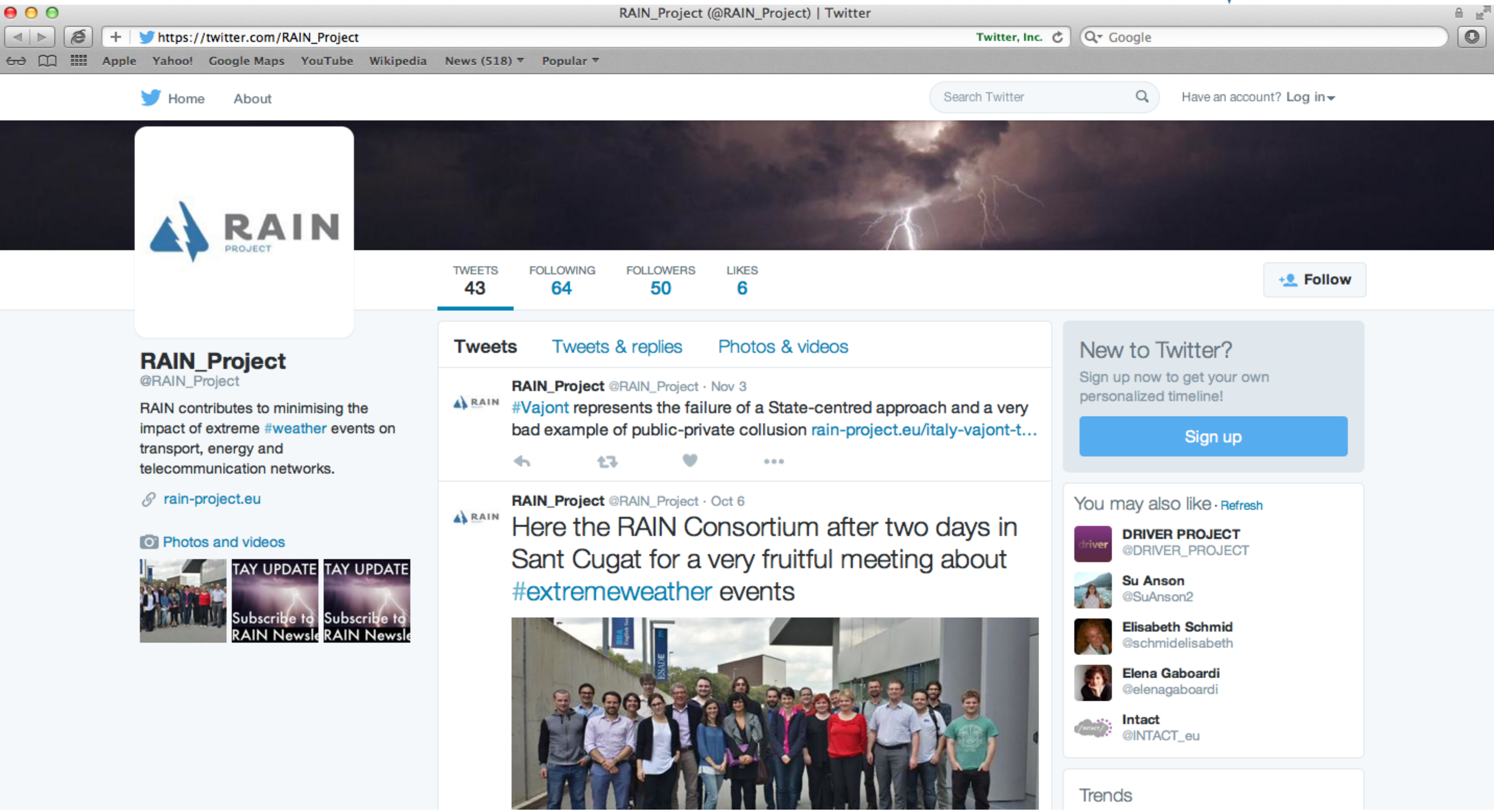

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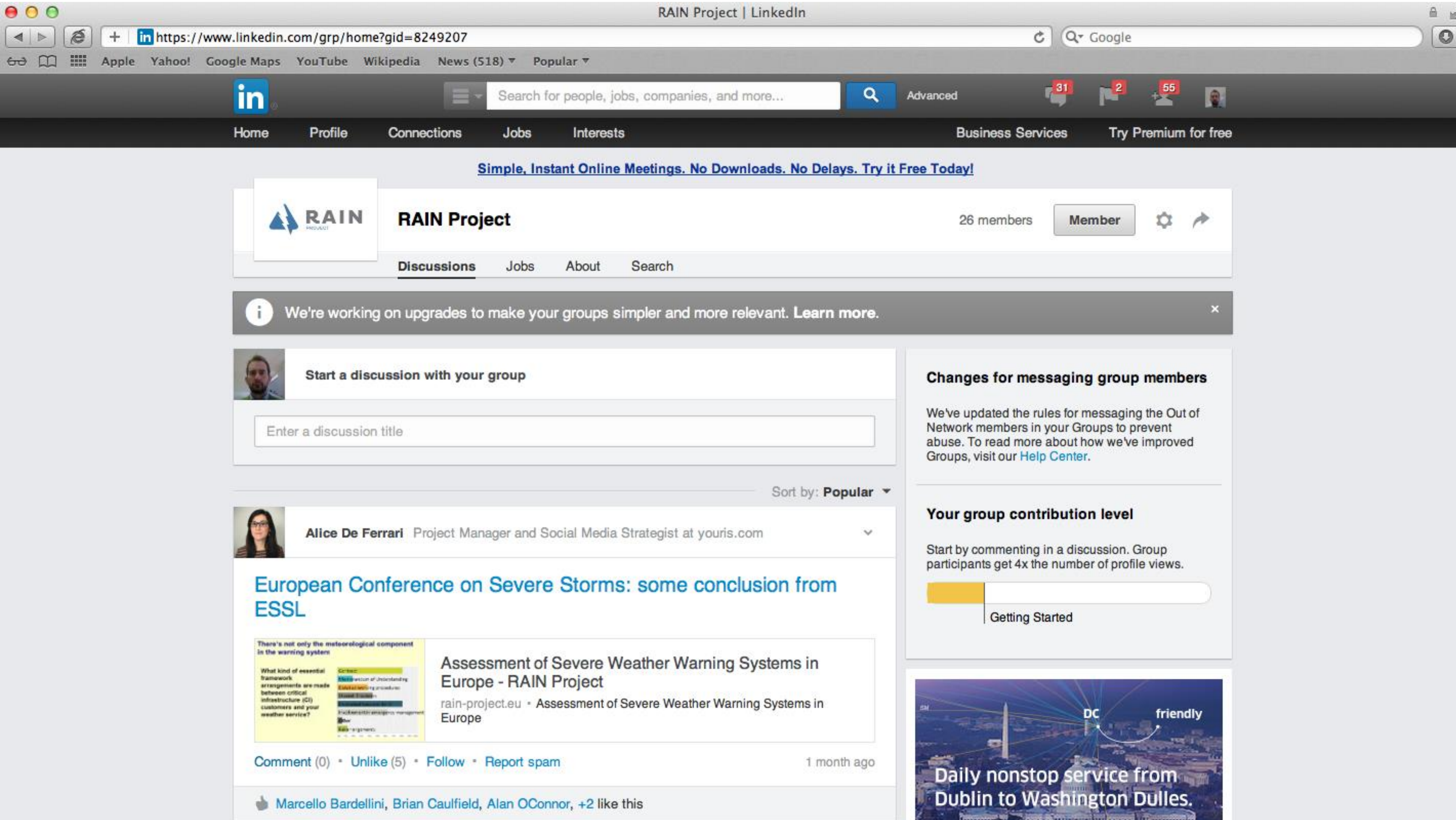

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