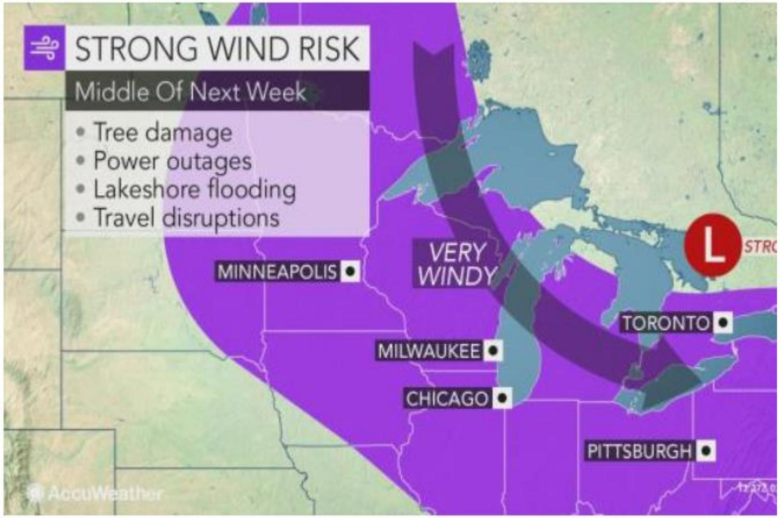
Extremes and their impacts on vulnerable sectors

Dr. Hilppa Gregow, Head of Unit, FMI

8.3.2017 ECRA GA



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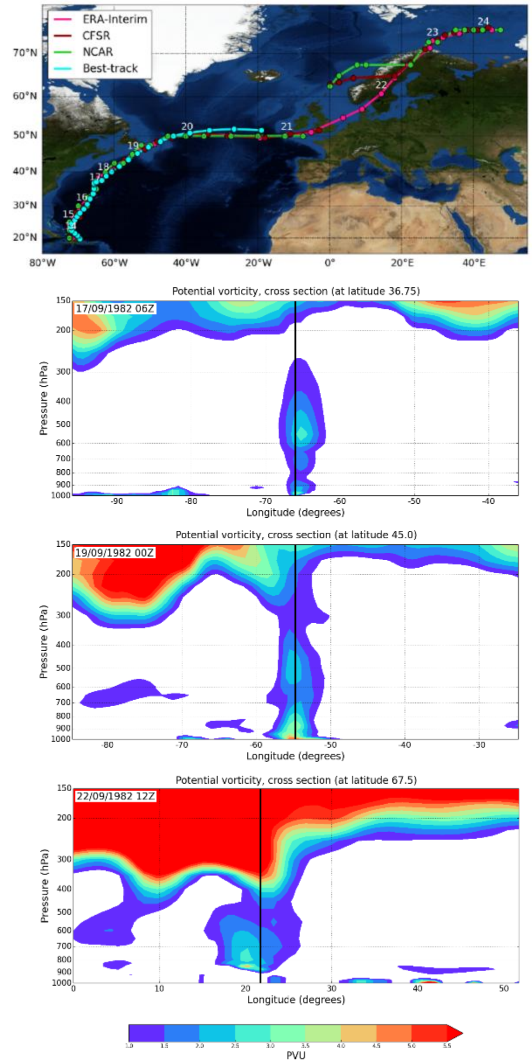
Outline

- ✓Global risks 2016 and known extremes
- ✓Agriculture, food and water
- ✓Economic impacts of floods
- ✓Health and biodiversity
- ✓Energy, transport and tourism
- ✓Forestry and bioenergy
- ✓Extratropical storms and change point
- ✓EU support in research
- ✓C3S Data Evaluation for Climate Models

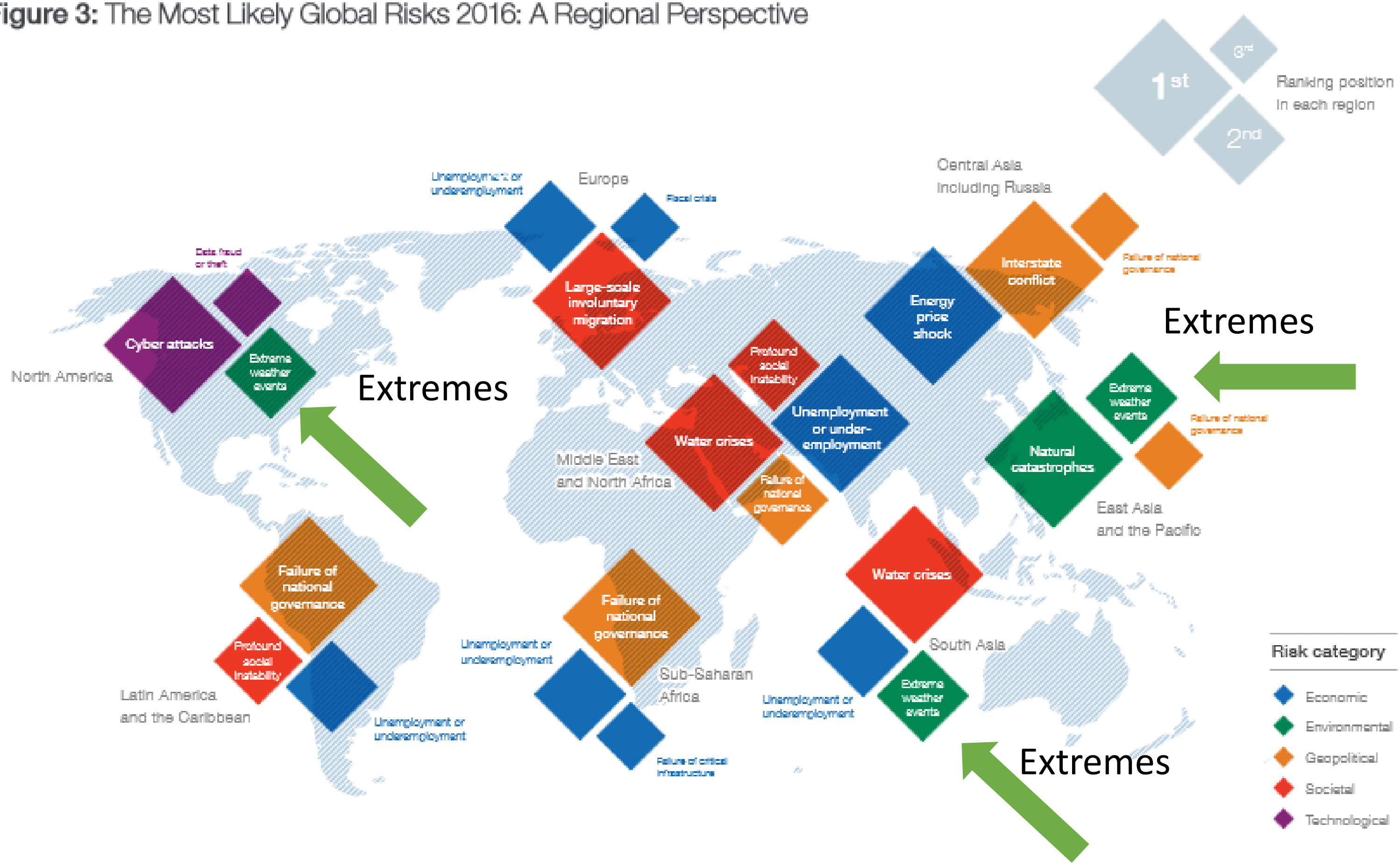
Hurricane Debby 22.9.1982



Source: Terhi Laurila

IMPACT LANDSCAPE: awareness and beliefs

Figure 3: The Most Likely Global Risks 2016: A Regional Perspective



Source: Global Risks Perception Survey 2015.
Note: Respondents were asked to select the three global risks that they believe are the most likely to occur in their region. For legibility reasons, the names of the global risks are abbreviated; see Appendix A for the full name and description. Oceania is not displayed because of the low number of respondents.

ELASTINEN-project summary on extremes

World region	Extreme events	
	Observed	Projected
Europe (Kovats *ym.* 2014)	More frequent hot days, tropical nights and heat waves since 1950, but fewer cold spells and frost days.	Marked increase in heat waves, droughts (southern and central areas) and heavy precipi… (norther… contin… area…
Asia (Hijioka *ym.* 2014)	Increasing heat wave frequency since the mid-20th century. More heavy precipitation in the north, east, south and southeast.	Changes in cyclone and monsoon systems disrupt precipitation patterns with unpredictable results. Uncertain projections of h…vy r… w…, ea… …d sou…

World region	Extreme events	
	Observed	Projected
Africa (Niang *ym.* 2014)	More frequent heat waves over northern and southern areas, ar… heavy rai… droughts… eas…	Increase in heat waves in the north and south. Uncertair… tions of i… ing hea… cipitatio… west an… …ve… the…
Australasia (Reisinger *ym.* 2014)	Extreme rainfall decrease in north and east and increase in west of NZ since 1930.	Increasing frequencies of heat waves and fires in the south of Aus. Drought frequency is projected to increase in southern Au… and in… reg… is
North America (Romero-Lankao *ym.* 2014)	Increase in frequency of heat waves in central parts and heavy …ecipitati… …hole re… …e 20th c…	More frequent heat waves for the whole region.
Central and South America (Magrin *ym.* 2014)	More heavy rainfall in the southeast and Amazonas.	Dry spells in eastern Amazonia and n… SA. H… precipit… the sou… western… nia, and… west

Hildén M, Groundstroem F, Carter T R, Halonen M, Perrels A & Gregow H. 2016. **Ilmastonmuutoksen heijastevaikutukset Suomeen**. Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 46/2016. 62 s.

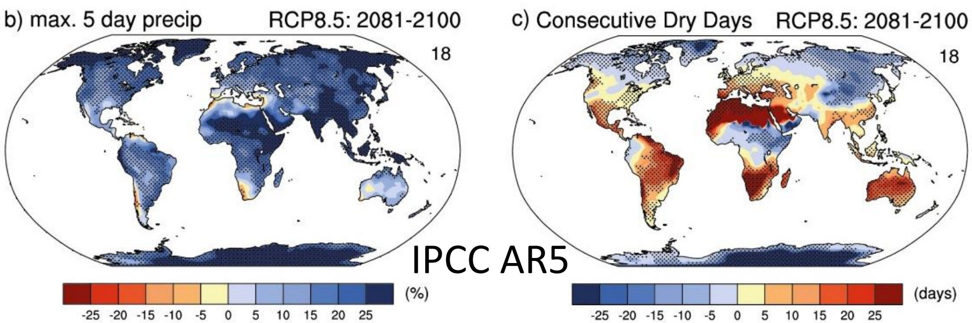
Agriculture, food and water

+ Moderate warming and more carbon dioxide in the atmosphere can increase growth of some plants

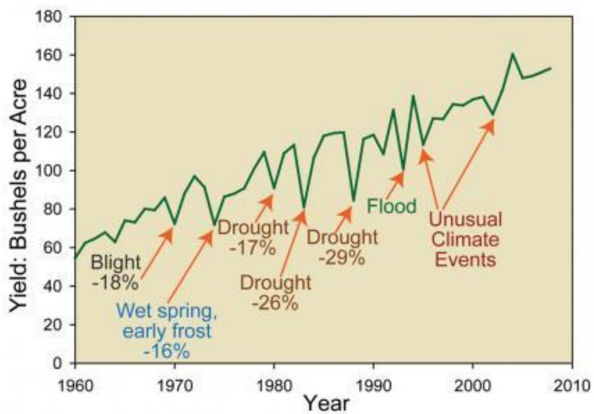
- More severe heat, floods and drought reduce yields

- Livestock is at risk with heat stress and drought

- Fisheries suffer from changes in water temperature due to invasion of species and health problems



IPCC AR5

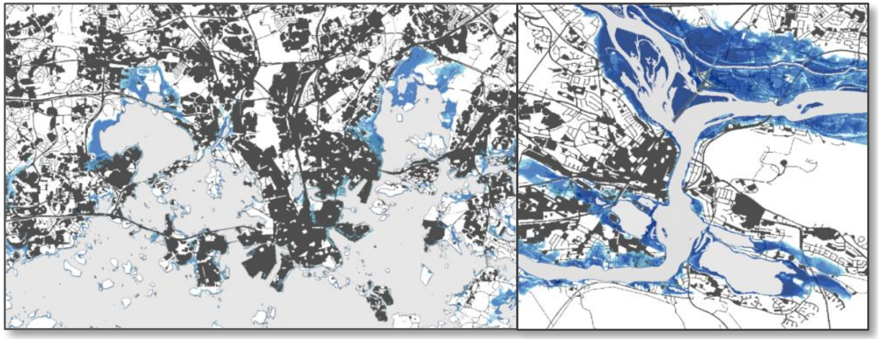


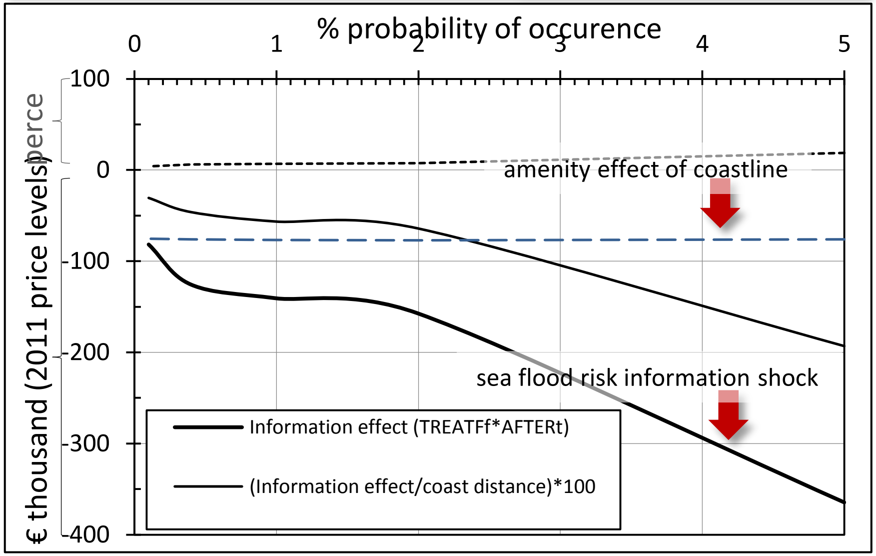
https://www.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply#crops

Flood risk information affects the housing market

- Results:
  1. Measured **significant information shock** on housing prices of properties affected by information.
  2. In Helsinki-Espoo, the information effect is **sensitive to sea flood probability**.
  3. Identified both the **risk** and **amenity** effect of the **same water body concurrently.**

More info: Dr. Athanasios Votsis
https://helda.helsinki.fi/handle/10138/173459





Health and biodiversity sector

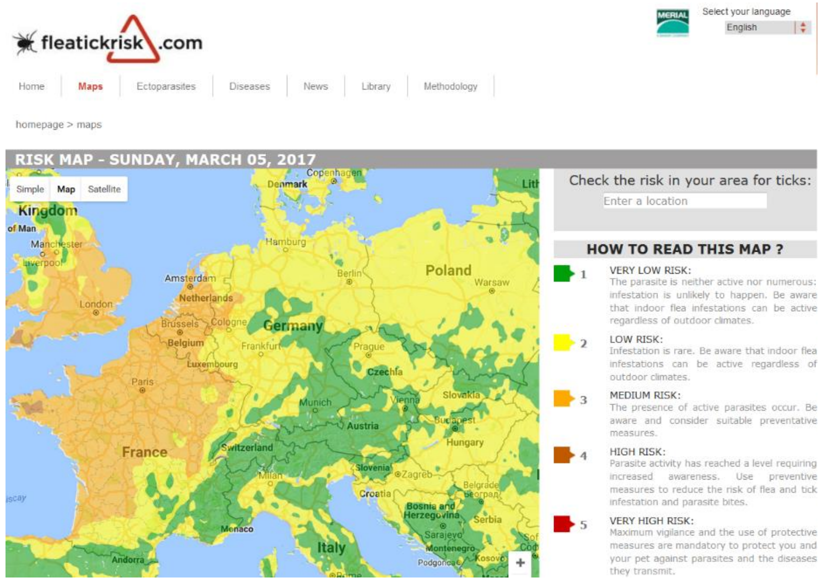
- Impacts of humidity and heat extremes and climate change:

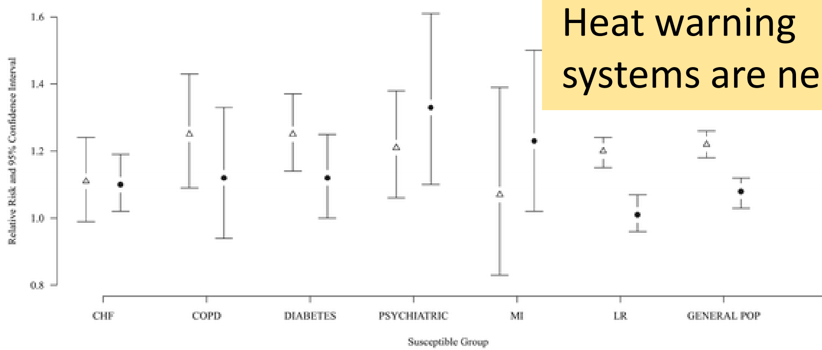
  More vector-borne diseases:

  - The beginning of growing season in spring is sooner
  - The end of growing season in fall is later
  - Wet and warm summers pose a risk

  Mortality increases:

  - **Heat and cold spells increase mortality**
  - **Flash floods and storms** risky for people on coastal and mountaneous areas





Heat warning systems are needed!

The effect of heat waves on mortality in susceptible groups: a cohort study of a mediterranean and a northern European City Åström et al. 2015 Environmental Health **14**:30 **DOI:** 10.1186/s12940-015-0012-0

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RAIN PROJECT

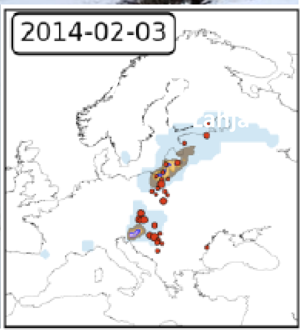
TYÖ- JA ELINKEINOMINISTERIÖ
ARBETS- OCH NÄRINGSMINISTERIET
MINISTRY OF EMPLOYMENT AND THE ECONOMY

Energy, Transport, Tourism sector

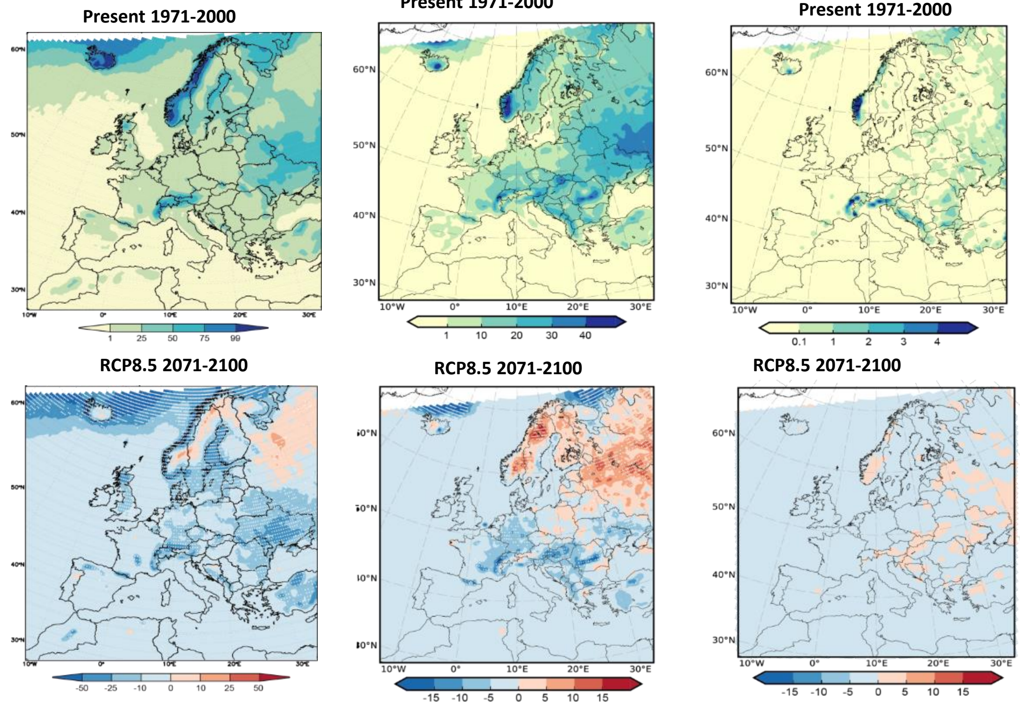
Severe winter phenomena impact critical infrastructure CI

Changes in annual probabilities (%) of snow events and freezing rain

Telecommunication, road and energy infrastructure



Snow loads | **Freezing rain** 5 mm/24h | 25 mm/24h



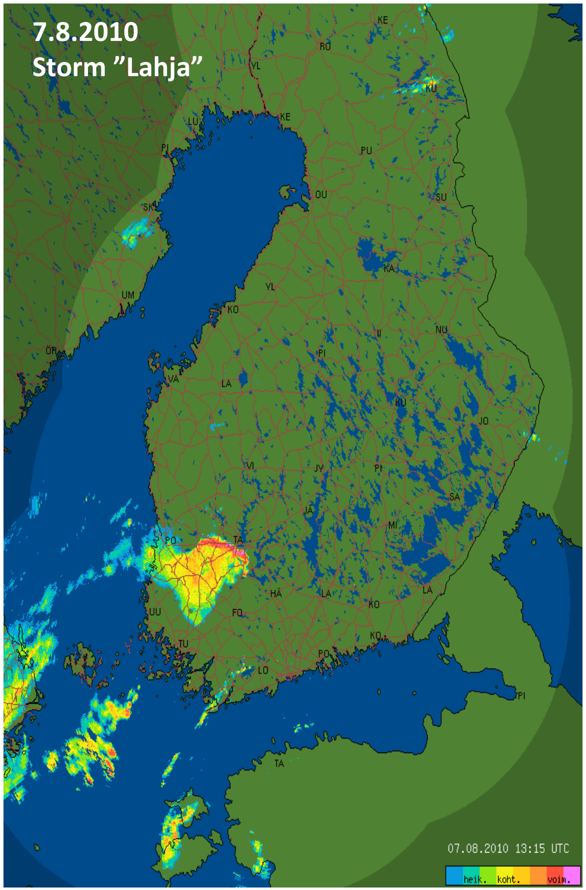
Kämäräinen *et al.* 2017: A method to estimate freezing rain climatology from ERA-Interim reanalysis over Europe, Nat. Hazards Earth Syst. Sci., 17, 243-259, doi:10.5194/nhess-17-243-2017.

Groenemeier et al. (11 co-authors), 2016. Present and future probability of meteorological and hydrological hazards in Europe. http://rain-project.eu/wp-content/uploads/2016/09/D2.5_REPORT_final.pdf

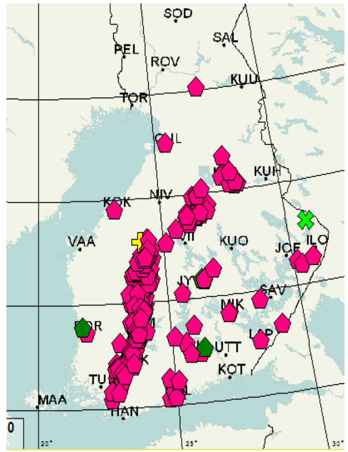
Several sectors

Severe summer phenomena impact differently – people are more outside

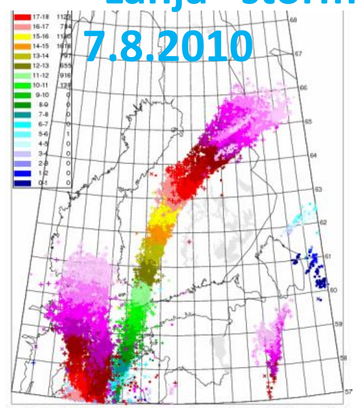
Thunderstorms, tornadoes, significant hail, downbursts

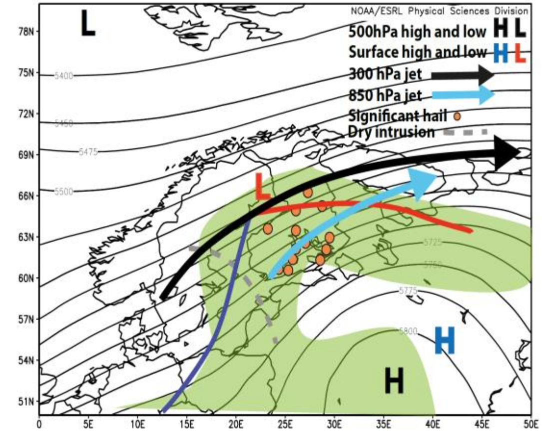


Rescue missions



"Lahja" storm 7.8.2010

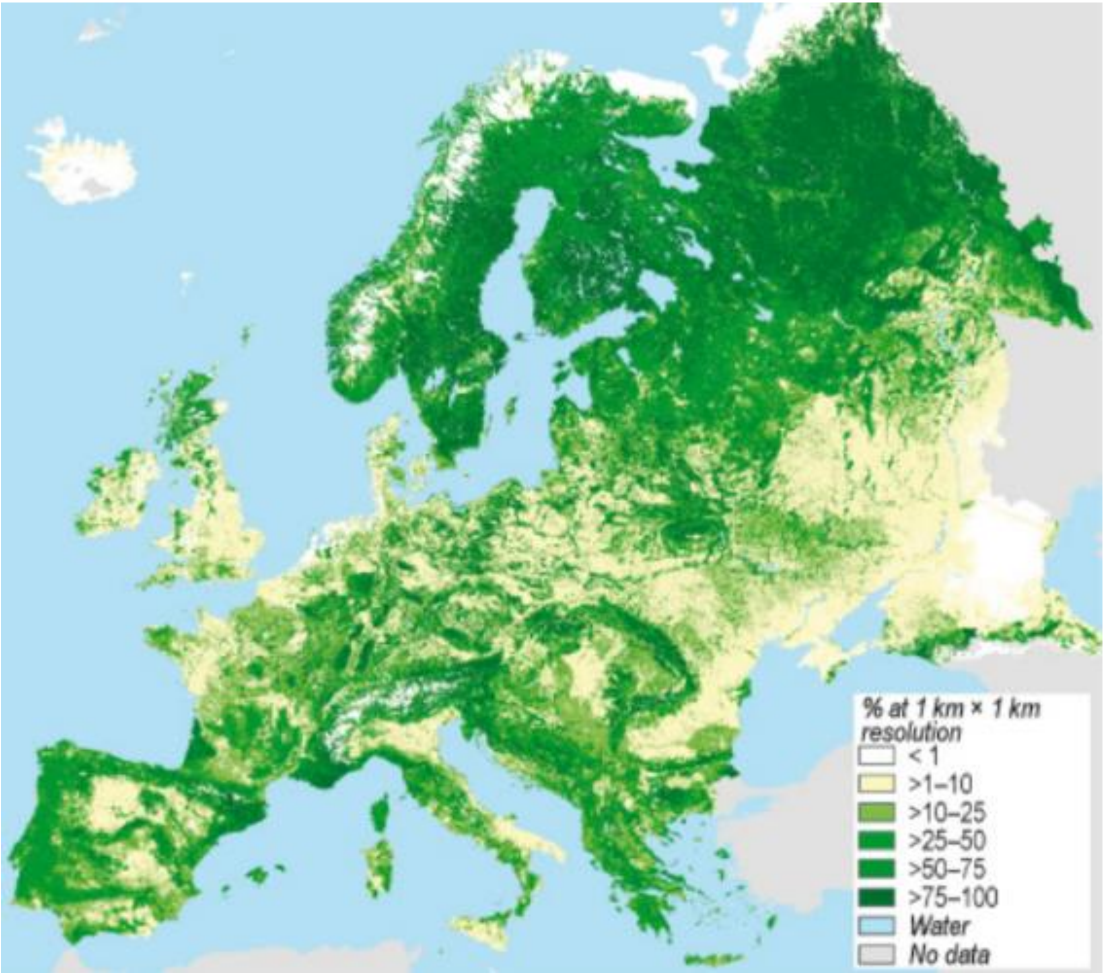




Rauhala et al. 2017. Atmospheric conditions and circulation patterns favouring severe convective storm weather in Finland: synoptic setting of significant hail. EXWE SAFIR D.1.1.4

Lahja, Asta, Veera, Sylvi storms
Injured 40-50 people
8,1 Mm^3 tree damage
Electricity break 481000 houses
Distribution failure cost 10,3 M€
Insurance costs 82 M€
(Gregow et al. 2016; ELASTINEN final report)
http://en.ilmatieteenlaitos.fi/elastinen

Forests


% at 1 km × 1 km resolution
< 1
>1–10
>10–25
>25–50
>50–75
>75–100
Water
No data

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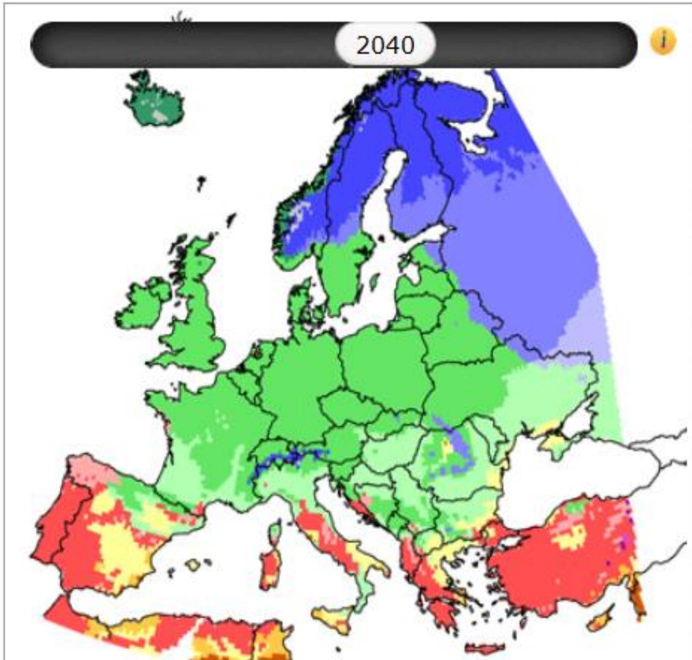
Changes of climatic zones in Europe

In this module, you can examine how the climatic zones in Europe are projected to change within the future decades.



The darker the blue, green or purple, the shorter and cooler the summers are.

The darker the red or orange, the hotter the summers.

Polar climates
- Tundra climate

Climates with cold winters
- Precipitation throughout the year
- Dry summers

Climates with mild winters
- Precipitation throughout the year
- Dry summers

Dry climates
- Steppe climate
- Desert climate

Köppen climate classification

Combines two important and familiar climate variables: temperature and precipitation.

- The classification takes into account the average annual and monthly temperatures and precipitation. In addition, the classification is affected by the seasonality of precipitation.
- The classification can also be used to describe changes in vegetation zones.
- In reality, the change from one climatic zone to another doesnt occur as sharply as depicted in the maps.

As an example, climate of the city of Tampere: In the 1980s: Climate with cold winters, precipitation throughout the year, summers relatively short and cool. (Darkest blue) Change by 2080s: Winters more mild, still precipitation throughout the year, warmer and longer summers. (Middle green)

Climate guide.fi FINNISH METEOROLOGICAL INSTITUTE

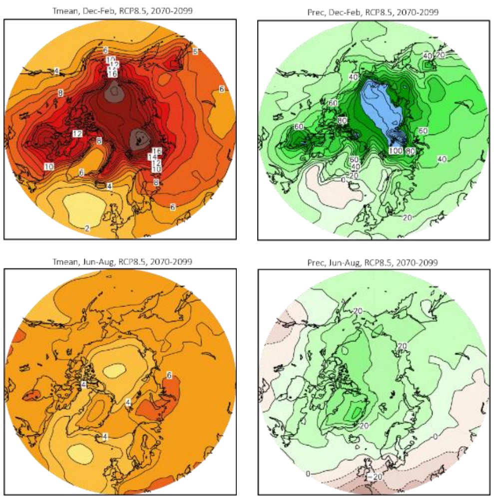
For further information take the cursor over the symbol

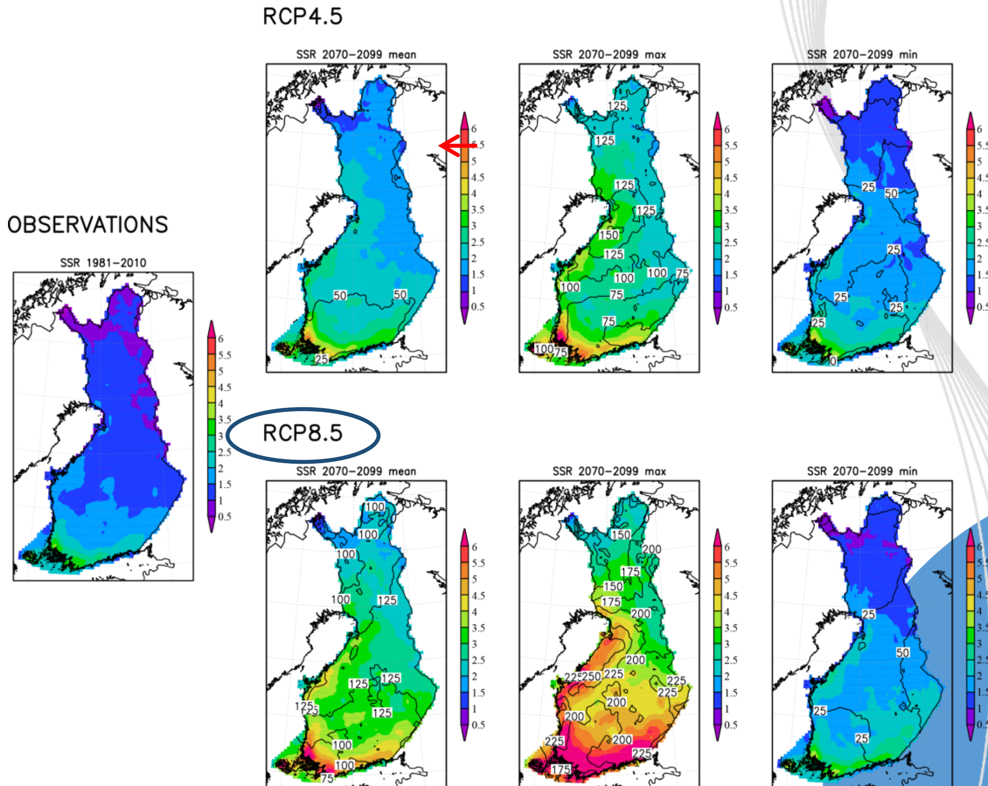
References and further information

Forests and forestry

Modelled **forest-fire danger** in Finland in 1981–2010 and 2070–2099

- using high resolution dataset derived from CMIP5 (SA-ADAPT)





Changes in temperature (°C) and precipitation (%)

- from 1971-2000 to 2070-2099, RCP8.5, multi-model means (28 GCMs)

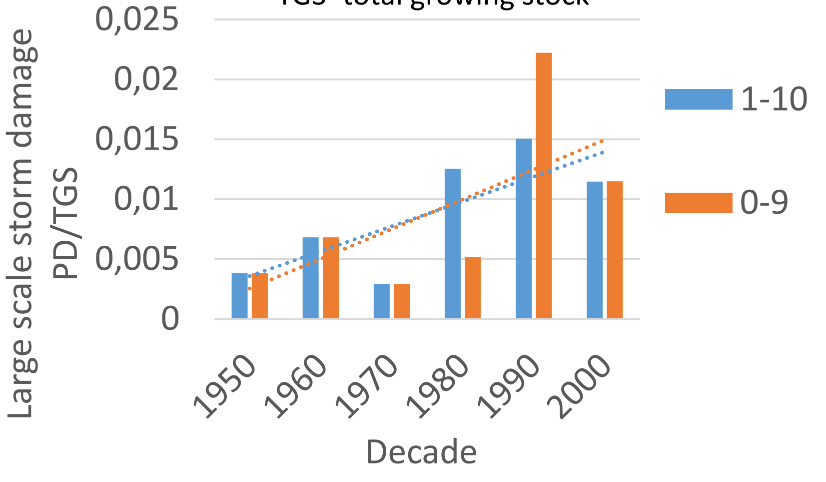
Source: K. Ruosteenoja

Lehtonen et al. Risk for large-scale fires in boreal forests of Finland under changing climate, Nat. Hazards Earth Syst. Sci. Discuss., 3, 4753-4795, doi:10.5194/nhessd-3-4753-2015, 2015

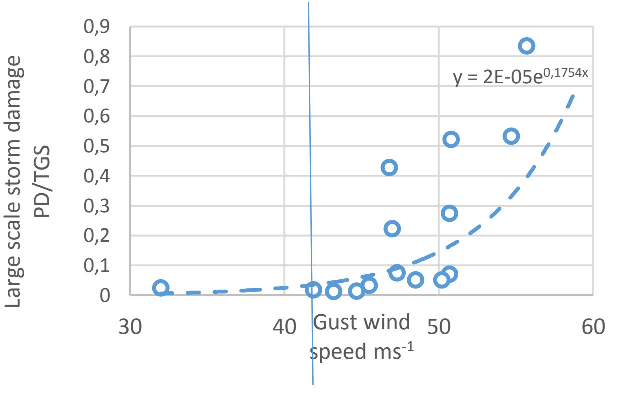
Forestry and bioenergy sector in Europe

- Impacts of extremes => **huge economic losses, effects on forest health, timber quality, tree species distribution and growth**:
  - **Stormwinds** are the worst for forest owners
  - **Harvesting conditions** are impacted by heat: during *winter* an ”heat” impacts soil carrying capactiy and during *summer* it poses a forest fire risk

PD=primary damage
TGS=total growing stock

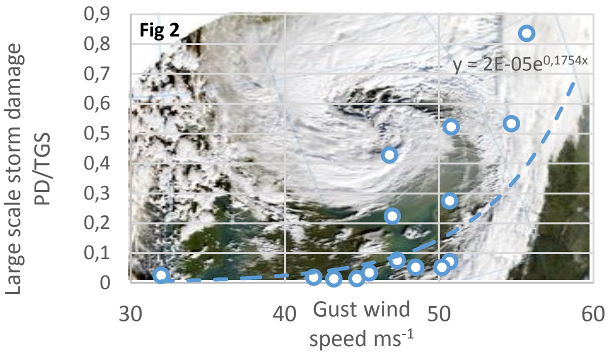


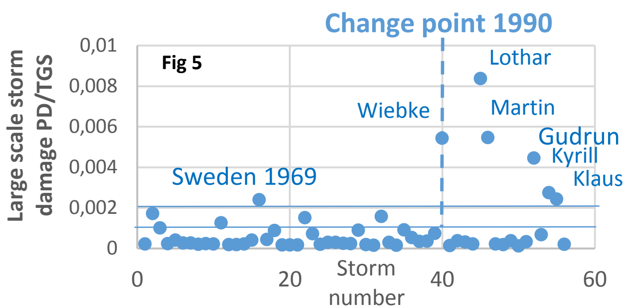
Critical limit 42 ms^{-1}

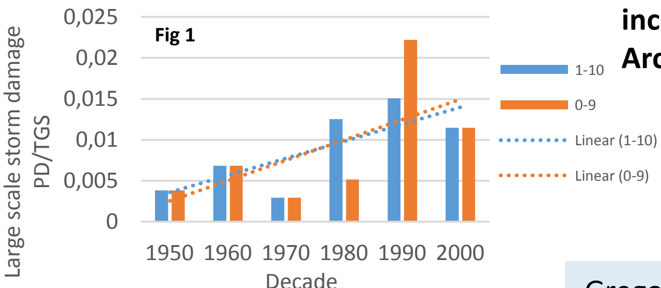


Increasing intensities of catastrophic storms hitting Europe in 1951-2010 (AMS 2017)

Dr. Hilppa Gregow[1], Prof. Ari Laaksonen[1,2], Dr. Muzaffer Ege Alper[1] Finnish Met Institute[1], Uni. Eastern Finland[2]

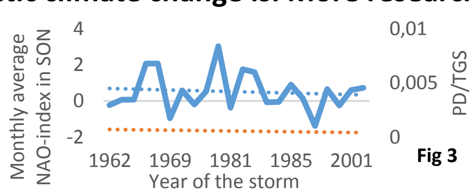


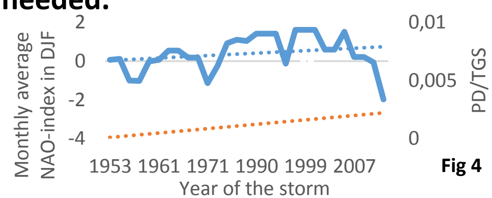




1. We used forest damage reports (PD) of FORESTSTORMS database.
2. We constructed total growing stock (TGS) statistics for Western, Central and Northern Europe based on TGS reports from 17 countries.
3. We homogenized the datasets as PD/TGS for the period 1951-2010.
4. We analyzed 56 large scale storms with PD/TGS at least 0.012% for the decades (starting on year 0 and 1)(**Fig1**)
5. Out of 56 storms 15 were assessed also with the gust wind speeds (**Fig2**), namely storms from 1981, 1984, 1986, 1987, 1990 (4 storms), 1999 (3 storms), 2005, 2007, 2009, 2010.
6. We further compared storm intensity to NAO-index during SON (decrease in both) (**Fig3**) and DJF (increase in both) (**Fig4**)
7. We divided the storm distribution to destructive (PD/TGS < 0.08%), highly destructive (0.08% ≤ PD/TGS ≤ 0.2%), and catastrophic storms (PD/TGS > 0.2%). (**Fig5**)
8. We performed a change point-analysis of the full time-series and found that year 1990 represents a shift in the timeseries. The analysis shows that the 1990 change-point is significant at the 95% level (**Fig5**).

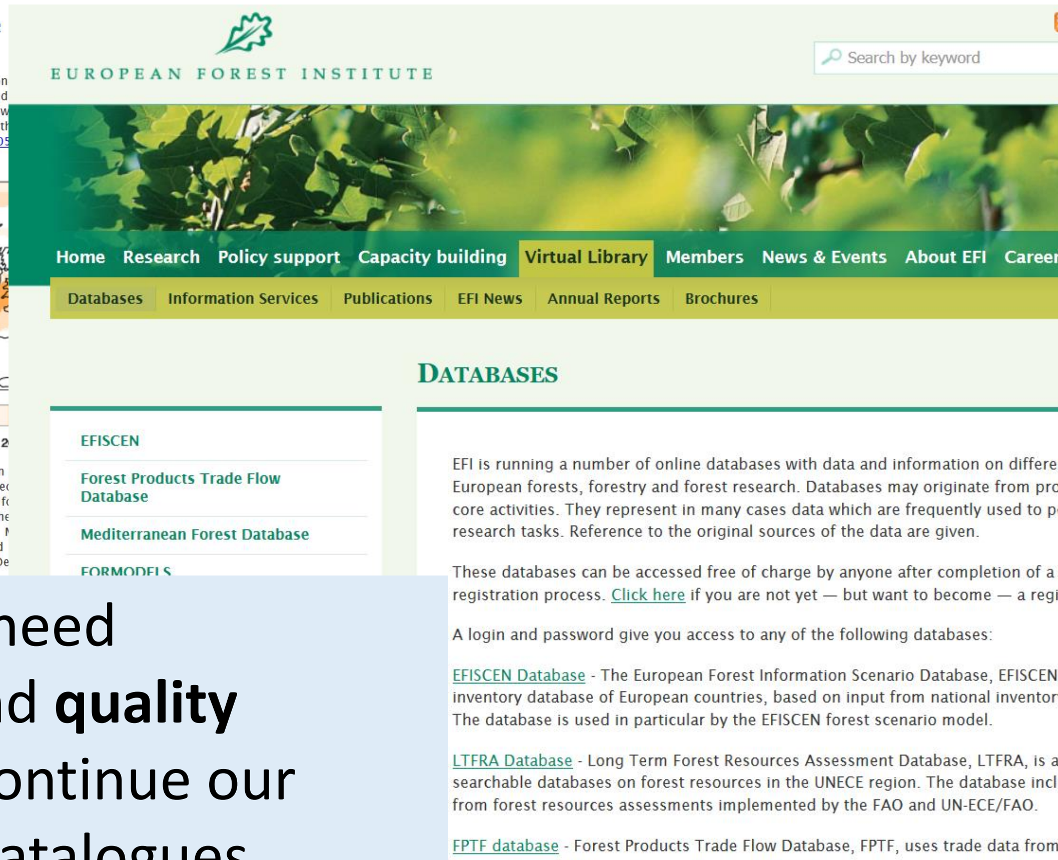
Our conclusions are: Storm intensity of the catastrophic storms has increased by a factor of 3,5. NAO is not driving the change but most probably Arctic climate change is. More research is needed.





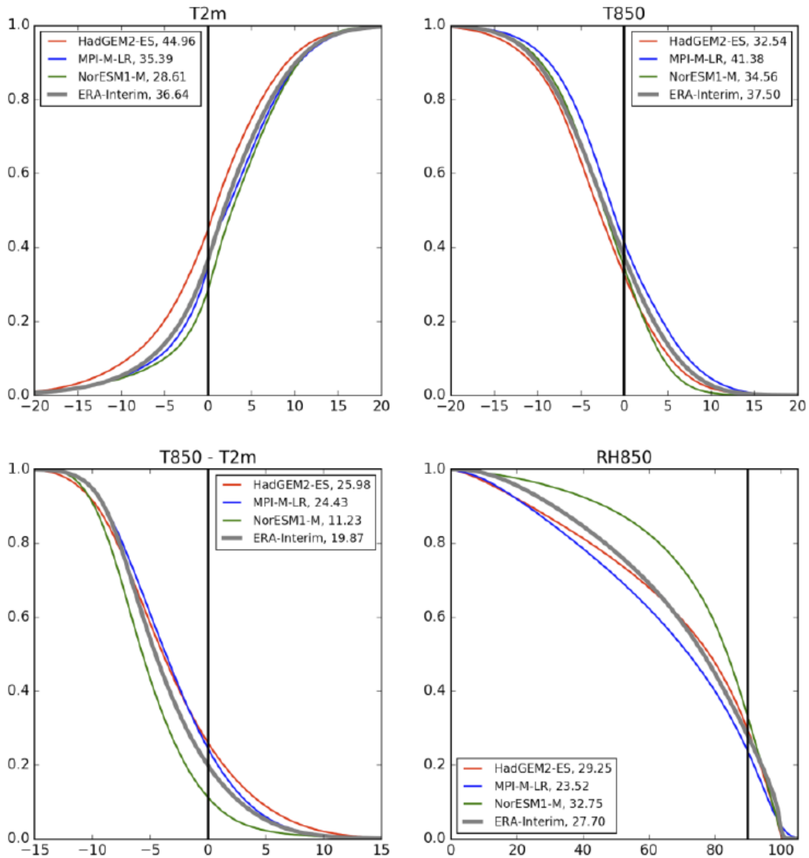
Gregow et al. 2017. https://www.nature.com/articles/srep46397

EU-funded data catalogues are of great help for open science



In research we would need **systematic updates** and **quality control** to be able to continue our work that uses these catalogues.

Validation of models is also important



Dataset \ Joint probability	Pr > prLim & T2m < 0	Pr > prLim & T850 > 0	T2m < 0 & T850 > 0	P T T
ERA-Interim	10.9	11.9	4.0	0
EC-EARTH				
HadGEM2-ES	13.4	10.0	6.0	0
MPI-M-LR	12.4	11.9	4.6	0
CanESM2				
CNRM-CM5				
IPSL-CM5A-MR				
NorESM1-M	8.5	13.6	1.3	0

Figure 3. Wintertime cumulative probability distributions of the key variables used in the freezing rain indicator. Near-surface air temperature (T2m), temperature and relative humidity at the 850 hPa level (T850 and RH850),

Climate Change

ABOUT C3S NEWS & MEDIA EVENTS TENDERS PRODUCTS SERVICES HELP

The Evaluation and Quality Control (EQC) projects of C3S aim to evaluate and foster the development of climate services. The EQC function assesses the technical and scientific quality of the service including the value to users.

Effective evaluation and quality control will ensure C3S represents the latest developments in climate science and that innovative service elements are introduced reflecting current research. C3S contracts expert organisations from across Europe to carry out its evaluation and quality control (EQC).

A number of EQC projects are already under way:

- **SECTEUR - Sector Engagement for the Copernicus Climate Change Service: Translating European User Requirements**
  The project brings together organisations with vast expertise in climate and business, to engage directly with end-users and analyse their requirements, identify gaps and deliver recommendations on future needs to support better decision-making. The Sectors covered are: Agriculture & Forestry, Coastal areas, Health, Infrastructure, Insurance and Tourism.
- **QA4Seas - Quality Assessment Strategies for Multi-model Seasonal Forecasts**
  Activities in this project will address multi-model seasonal forecast products. Multi-model products by design provide uncertainty information from ensembles of forecasts produced by multiple-models. A C3S multi-model seasonal forecast product capability is currently being developed at ECMWF. It will rely on contributions from multiple providers who maintain their own seasonal forecast systems.
- **DECM - Data Evaluation for Climate Models**
  Climate model data play a key role informing climate change adaptation strategies. To make sure that the climate model data is delivered to the different end-users in the best way, C3S maps and analyses user requirements, assesses data availability and applicability and identifies the gaps that need filling. C3S's data evaluation project examines the climate model data according to these requirements and provides the recommendations for its Evaluation and Quality Control framework. The data will also be part of the C3S Climate Data Store (CDS).

Copernicus Climate Change Service aims to guarantee a sustained and quality controlled climate service regarding data and products

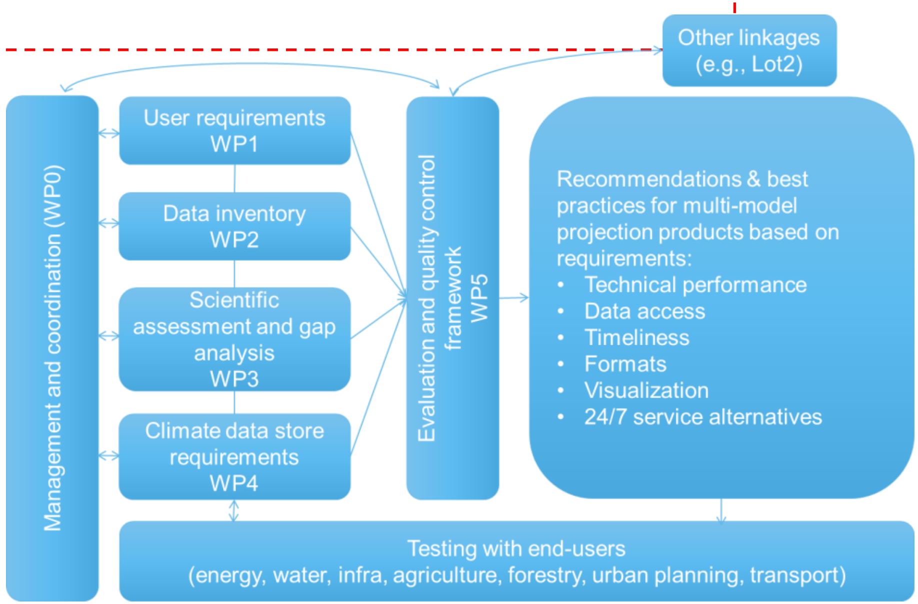
Climate Change

Data Evaluation for Climate Models

- WP0: project management and organization of cooperation with other Lots
- WP1: identification of user requirements regarding technical needs and scientific quality of the data by literature review and survey

RELEVANT TO/IN ECRA

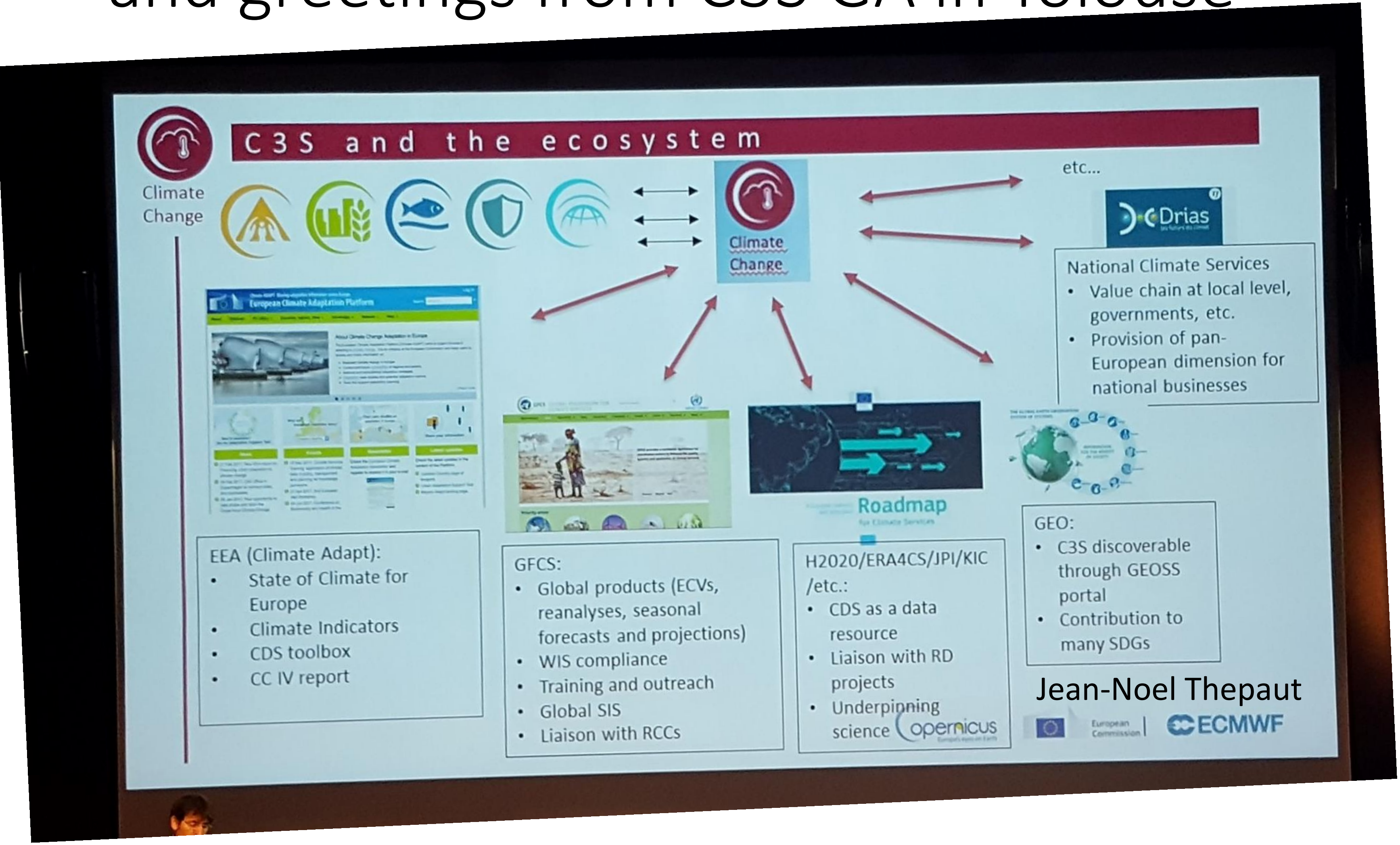
- WP2: climate model data inventories
- WP3: sectoral use of scenario data and the gaps in the multi-model scenarios and distillations needs
- WP4: specification of climate projection data access, tools, methods, inter-comparison tools and visualization techniques
- WP5: summary and conclusion report for the whole project, recommendations based on the end-user needs for the EQC



C3S_51_Lot4

This project is funded by the European Union

Thank you for listening and greetings from C3S GA in Tolouse



Jean-Noel Thepaut