

THOR: Thermohaline Overturning – at Risk?

Brief overview

Chiara Bearzotti
THOR project manager



Facts and figures

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- **Financed by the European Commission**
- **EU FP7 Collaborative Project**
- **Research focus:** Stability of the Thermohaline Circulation
- **Duration:** 4 years, 1 December 2008 – 30 November 2012
- 20 participating institutions from 9 European countries
- **5 Core Themes**, around 60 Researchers
- **Project cost:** 12.95 million Euro (actually more than that...)
- **EU Funding:** 9.27 million Euro



Participating institutes

No.	Beneficiary name		Country
1	University of Hamburg	UHAM	Germany
2	Max-Planck Gesellschaft	MPG-M	Germany
3	British Meteorological Office	Met O	U.K.
4	Université Pierre et Marie Curie	UPMC-LOCEAN	France
5	University of Bergen	UiB	Norway
6	The University of Reading	UREAD	U.K.
7	European Centre for Medium-Range Weather Forecasts	ECMWF	U.K.
8	Leibniz-Institute of Marine Science at the University of Kiel	IFM-GEOMAR	Germany
9	Royal Netherlands Meteorological Institute	KNMI	Netherlands
10	Danish Meteorological Institute	DMI	Denmark
11	Havastovan	HAV	Faroe Islands
13	Marine Research Institute	MRI	Iceland
14	Royal Netherlands Institute for Sea Research	NIOZ	Netherlands
15	The Centre for Environment, Fisheries and Aquaculture Science	CEFAS	U.K.
16	Scottish Association for Marine Science	SAMS	U.K.
17	Natural Environment Research Council	NERC	U.K.
19	Nansen Environmental and Remote Sensing Centre	NERSC	Norway
20	Centre National de la Recherche Scientifique	CNRS	France
21	Commissariat a l'Energie Atomique	CEA	France
22	Finnish Institute of Marine Research	FIMR	Finland



Why THOR?

December 2005: researchers from the UK's National Oceanographic reported results suggesting that the Atlantic circulation system, which transports heat from the tropics to the shores of Europe, may be slowing down

Circulation measurements made at 25 degrees North (the latitude of the Florida Keys) in 2004 seemed to show a slowdown of around 30% compared to four earlier datasets taken since 1957

Concerns were raised and widely reported that Europe's oceanic heat supply could break down, which would have dramatic effects on the regional climate

The issue clearly called for further investigation

These fears motivated first the UK/US programme MOCCA-RAPID, which put out moored measuring devices along 26° N, and on the European level the international research project THOR



Concept

THOR will establish an **operational system** that will **monitor and forecast** the development of the North Atlantic THC on **decadal time scales** and assess its **stability and the risk of a breakdown** in a changing climate

Through the assimilation of **systematic oceanic observations** at key locations into ocean circulation models it will provide a set of **geo-observational products** that will be used to forecast the development of the system using global coupled ocean atmosphere models

Observational component

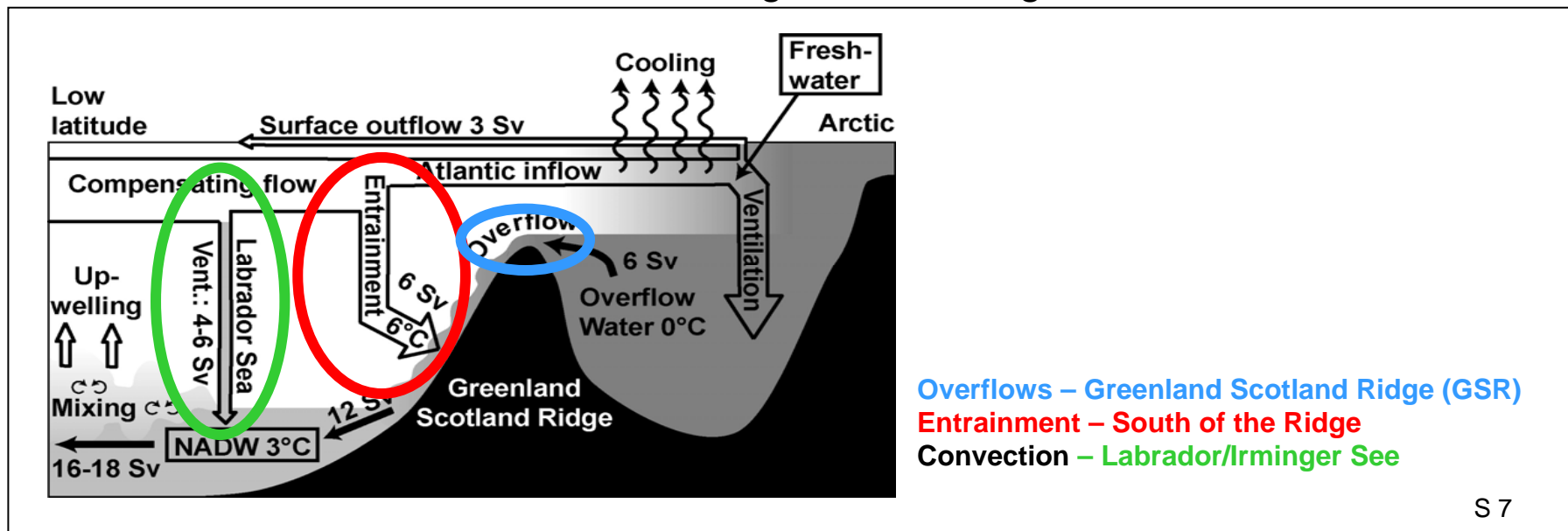


Modeling component



Goals

- Identify induced climate impacts of changes of the THC and the probability of extreme climate events
- Develop and operate an optimal ocean observing system for the North Atlantic component of the THC
- Forecast the Atlantic THC and its variability until 2025
- Assess the stability of the THC to increased freshwater run-off from the Greenland ice sheets for various global warming scenarios





Outcome

- The apocalyptic shutdown of the Atlantic circulation extrapolated from the data available seven years ago will not take place, at least not within the range of around 15 years, for which modellers can now make reasonably safe predictions
- “There is a risk that something might happen to the Atlantic circulation, but the timescale for this would be a few tens of years. We can be quite sure that disaster isn’t going to strike within the next ten years, and quite probably it won’t happen in the next 50 years either” (D. Quadfasel)
- Yet, a better understanding of the interaction between ocean circulation and climate change is still needed



Website

For more detailed reports on our activities and achievements:

www.eu-thor.eu



And after THOR...what is next?

Two **new research projects** are going to continue this work and extend it to the implications for fisheries and urban environments

NACLIM <http://naclim.zmaw.de>

European Commission funded project 2012-2017

International partnership

Coordination: Univ. Hamburg, Institute of Oceanography, Prof. Detlef Quadfasel



RACE <http://race.zmaw.de>

German funded project 2012-2015

German partnership

Coordination: Univ. Hamburg, Institute of Oceanography, Prof. Detlef Stammer



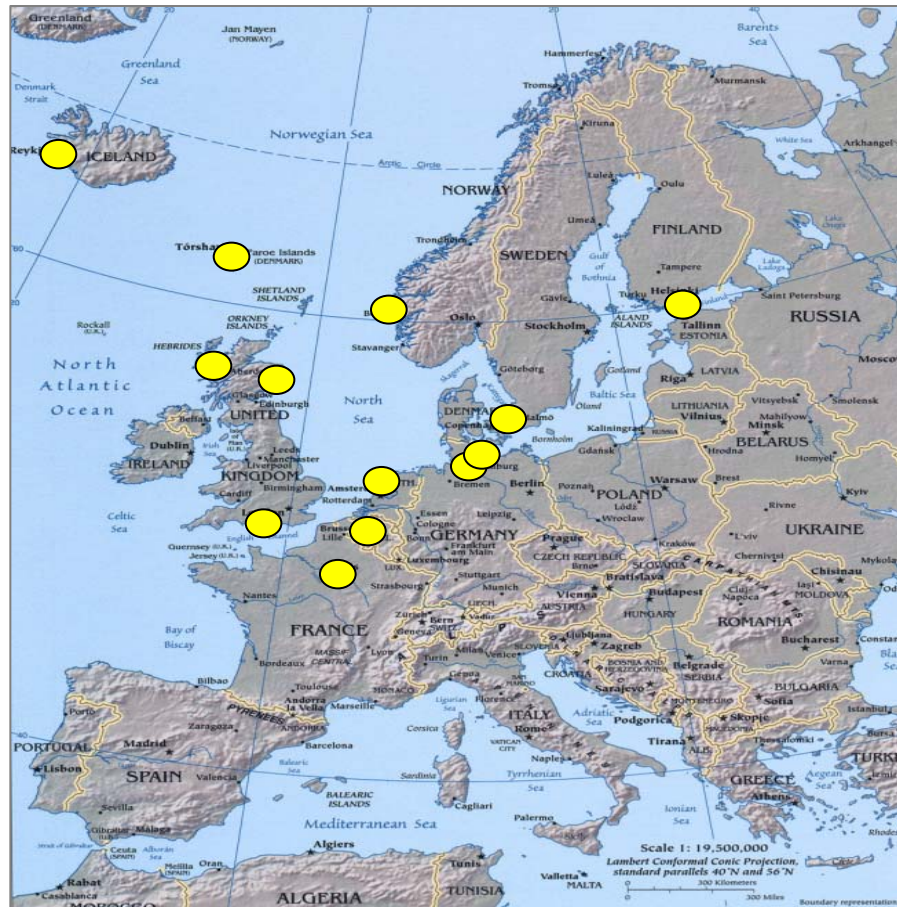
NACLIM: North Atlantic Climate Brief overview

**Chiara Bearzotti
THOR project manager**

Facts and figures

- **Financed by the European Commission**
- **FP 7 Collaborative Project**
- **Duration:** 4 years + 3 Months, 1 Nov. 2012 – 31 Jan. 2017
- **Research Focus:** Assessment of decadal climate forecasts
- **Partners:** 19 participating institutions from 9 European countries
- **5 Core themes**, 12 work packages
- **Project costs:** approx. 12 M€
- **EU contribution:** approx. 9 M€

Partners distribution



Partners



Participant no.	Participant legal name	Country
1	University of Hamburg (UHAM)	Germany
2	Max Planck Gesellschaft (MPG)	Germany
3	Universite Pierre et Marie Curie (UPMC), including CNRS	France
4	Universitetet i Bergen (UiB)	Norway
5	Uni Research AS (UniRes)	Norway
6	Helmholtz-Zentrum für Ozeanforschung (GEOMAR)	Germany
7	Danmarks Meteorologiske Institut (DMI)	Denmark
8	Havstovan (HAV)	Faroe Islands
9	Finnish Meteorological Institute (FMI)	Finland
10	Hafrannsóknastofnunin (MRI)	Iceland
11	Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek (NIOZ)	Netherlands
12	The Scottish Association for Marine Science (SAMS)	United Kingdom
13	Natural Environment Research Council (NERC)	United Kingdom
14	Stiftelsen Nansen Senter for Fjernmaaling (NERSC)	Norway
15	Flemish Institute for Technological Research (VITO)	Belgium
16	Geographic Information Management (GIM)	Belgium
17	Danmarks Tekniske Universitet, National Institute of Aquatic Resources (DTU AQUA)	Denmark
18	The Scottish Ministers acting through Marine Scotland (MSS)	United Kingdom

Why NACLIM?

The North Atlantic Ocean is one of the most important **drivers for the global ocean circulation** and its variability on time scales beyond inter-annual

Global **climate variability** is to a large extent **triggered** by changes in the **North Atlantic sea surface state**

The quality and skill of climate predictions depends crucially on a good knowledge of the **northern sea surface temperatures (SST)** and **sea ice distributions**

On a regional scale, these parameters strongly impact on **weather and climate in Europe**, determining precipitation patterns and strengths, as well as changes in temperature and wind patterns

Knowledge of these factors, and of their development in the years to come, is of paramount importance for **society and key economic sectors**, which have to base their planning and decisions on robust climate information

Concept

Investigating and quantifying the **predictability on interannual to decadal time scales of the climate in the North Atlantic/European sector** related to North Atlantic/Arctic Ocean surface state (SST and sea ice) variability and change

NACLIM will partly build on the **multi-model decadal prediction experiments** currently performed by a number of leading European and worldwide research institutions as part of the Coupled Model Intercomparison Project Phase 5 (**CMIP5**)

Rather than running climate forecasts within the project, **we will analyze the CMIP5 predictions and critically assess their quality** for the near-future stage of atmospheric and oceanic quantities

NACLIM full title is:
Predictability of the Climate in the
North Atlantic/European sector related to
North Atlantic/Arctic Ocean temperature
and sea ice variability and change

Goals

To quantify the **uncertainty of state-of-the-art climate forecasts** by evaluating the ability to model the most important oceanic and atmospheric processes in the North Atlantic and Arctic Oceans, and by comparing key quantities with observations

To **optimize the present North Atlantic observation system** by evaluating the impact of its components on the quality and quality control of model forecasts, and their value in determining the present ocean state and its past variability

To **quantify the impact on oceanic ecosystems and on European urban societies** of predicted North Atlantic/Arctic Ocean variability (case study 1)

To critically assess the **use of climate forecast parameters for use by stakeholders in society, politics and industry** (case study 2)

Focus on ecosystems – Link to marine biology



Changes in the ocean circulation can have dramatic consequences for fish populations and consequently for the fishing industry

Key example: the blue whiting

Blue whiting



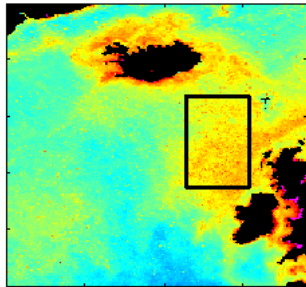
NACLIM researchers hope to be able to predict the effect of physical changes on fisheries, providing information that would also be very useful economically

WP 4.1 leader: Mark Payne, DTU Copenhagen

Focus on ecosystems – Link to marine biology



“We can see the signature of the sub-polar Gyre all the way throughout the North Atlantic ecosystem, from phytoplankton and zoo-plankton to pilot whales and puffins” (Mark Payne)



Phytoplankton



Zooplankton



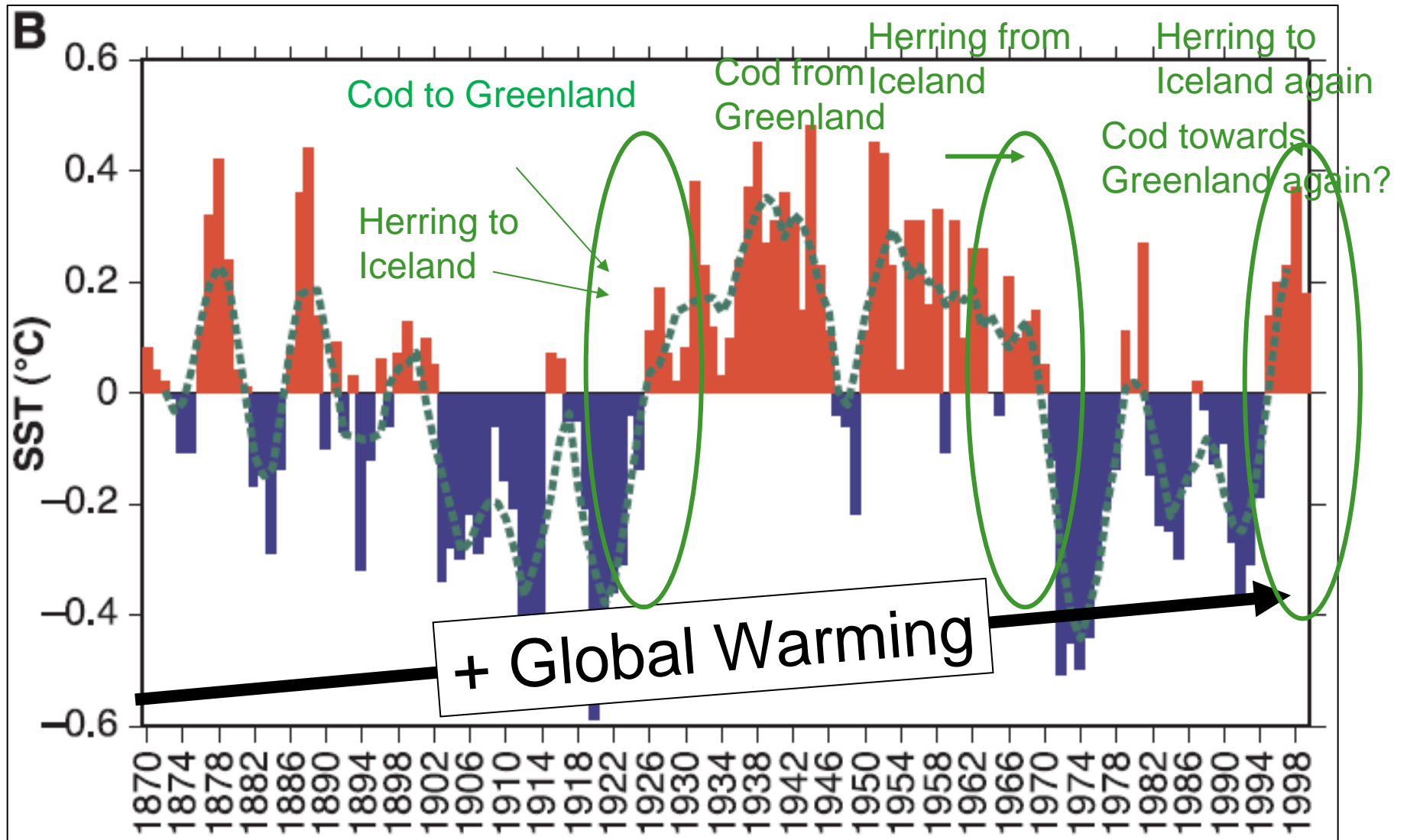
Pilot whales



Puffins

Subpolar gyre- Sea surface temperature

Source: Mark Payne, DTU Copenhagen



Focus on urban societies

Cities cover only 1% of the earth's surface, yet are home to half of the world's population

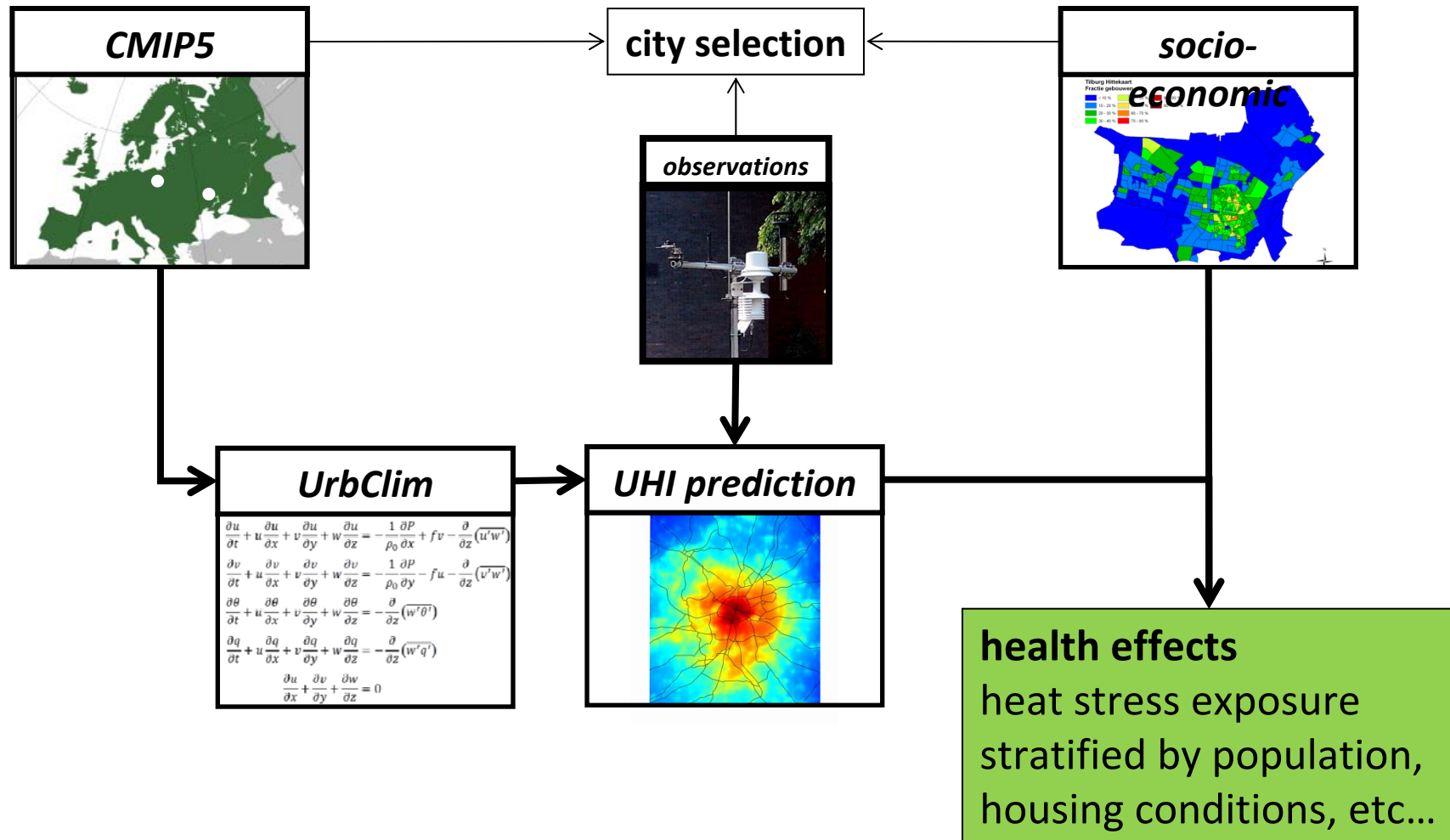
Large amounts of people working and living together on a relatively limited surface area: the result is usually a significant ecological footprint that endangers the quality of life, vitality and accessibility of our cities, as well as the security of its inhabitants

The NACLIM project will also look into the links between the ocean and climate systems and urban societies

The aim is to make the climate predictions, which have so far had poor spatial resolution, specific to cities, such that they can be used to make decisions, for instance in the area of healthcare

WP4.2 leader: Koen de Ridder, Flemish Institute of Technology (VITO)

Urban heat islands



Downscaling

The project will downscale the CMIP5 European climate change predictions to the urban scale, using a deterministic urban climate model in order to **match the scale of interest for local stakeholders**

The resulting high resolution urban climate predictions will be coupled to relevant socio-economic data for **a number of European cities** in order to **produce heat risk maps**

Dissemination of the urban climate risk results to
local stakeholders
city authorities, the private sector or the industry etc

Communication with stakeholders

To put science in societal context, the communications with stakeholders should be improved

“Scientists need to understand the questions of the stakeholders and need to build a dialogue. Although the next climate change-related disaster may not arrive the day after tomorrow, it is safe to predict that it will arrive one day, and we’d better be prepared “ (Hans von Storch)

Key results and recommendations obtained within NACLIM will be disseminated to:

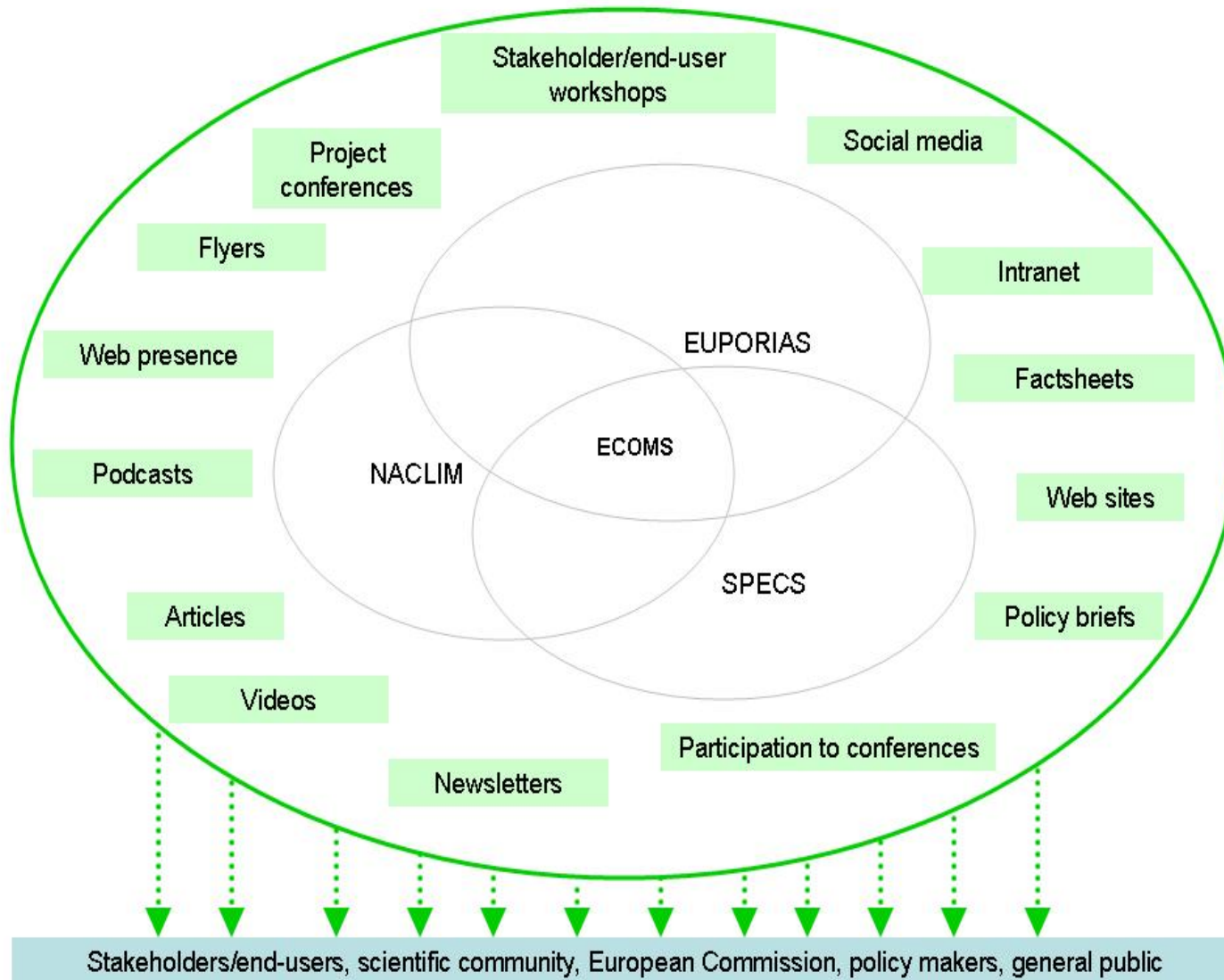
- relevant end-users
- climate service community
- other international and national prediction agencies



Communication cluster

For this purpose, the NACLIM project has been **clustered** with two other complementary projects, EUPORIAS and SPECS **by the European Commission (!!!)**

Joint dissemination activities will be set up in order to maximise the outreach and optimise communication reaching the final beneficiaries of the 3 projects





Interested?

<http://naclim.zmaw.de>