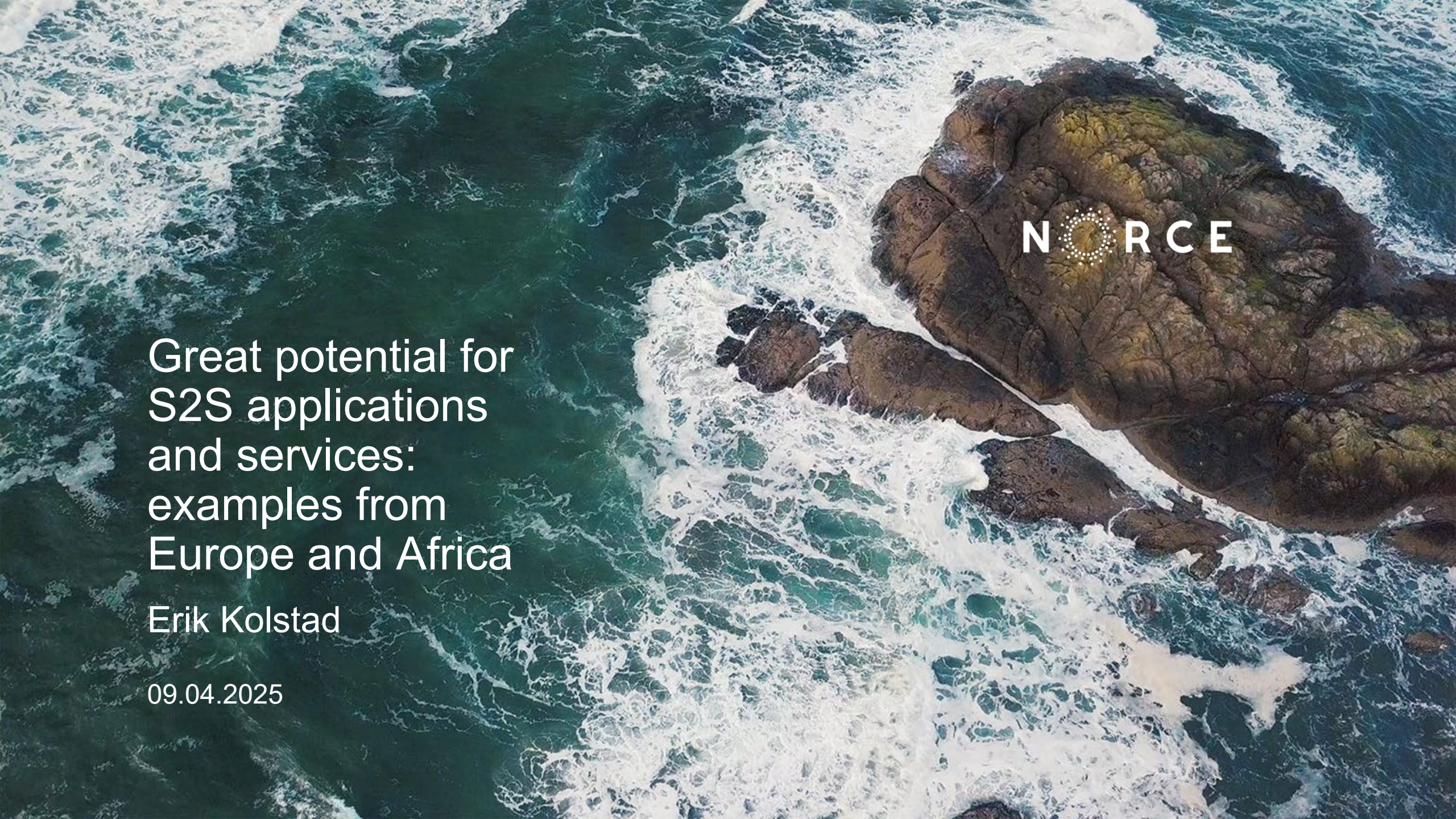
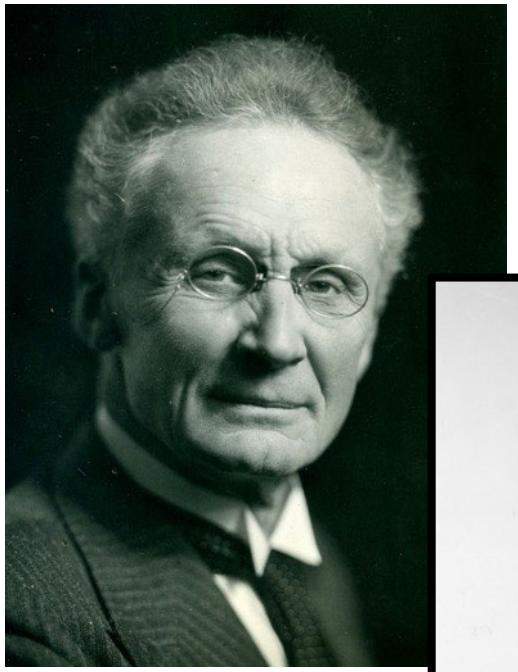


Great potential for S2S applications and services: examples from Europe and Africa

Erik Kolstad

09.04.2025

The Bjerknes Centre



Named after Vilhelm and Jacob Bjerknes, who spearheaded the Bergen School of Meteorology

The Geophysical Institute at the University of Bergen

Receiving and interpreting weather observations – early co-production

A failure

In the first project I lead (in 2015), we were meant to produce new climate information on very high resolution (3 km) for western Norway

We tried to engage the “users”, which were municipalities in the region, but we underestimated the need for keeping up a continual engagement, and we failed to produce a final result

This experience taught us many lessons about how to incorporate co-production in the design of projects

bams-bams-d-18-02...
Page 1 of 10

ESSAY

TRIALS, ERRORS, AND IMPROVEMENTS IN COPRODUCTION OF CLIMATE SERVICES

Erik W. Kolstad, Oda N. Sofienlund, Hanna Kvamsås, Mathew A. Stiller-Reeve, Simon Neby, Øyvind Paasche, Marie Pontoppidan, Stefan P. Sobolowski, Håvard Haarstad, Stina E. Oseland, Lene Omdahl, and Snorre Waage

An honest reflection on experiences in a climate services project is provided, with concrete recommendations on how to put ideas of coproduction into practice.

In September 2005, vast amounts of rain wreaked havoc along the western coast of Norway (Stohl et al. 2008). Major flooding occurred in many locations, and a landslide in Bergen led to the deaths of 3 people (10 people were hospitalized and 225 people were evacuated) (Lango 2011). This episode and others have raised the general awareness of the dangers associated with climate change in western Norway. Despite this, and even though it has been known for years that the precipitation in fall and winter is projected to increase in western Norway (Hanssen-Bauer et al. 2003), and that flooding is likely to become more intense (Lawrence and Hisdal 2011), many municipalities have yet to act on their experiences and apply available knowledge.

Realizing that a concerted effort to put climate adaptation on the agenda was required, special advisors at the county administration in Hordaland (the third largest county in Norway) joined with climate researchers to formulate a grant proposal for a pilot project. The main objective was for the researchers to downscale and customize quantitative climate knowledge for practical use in adaptation work for a selection of municipalities in Hordaland. The municipalities' role was to tell the researchers which specific issues they faced and where the need for

AFFILIATIONS: Kolstad and Stiller-Reeve—NORCE Climate, Bjerknes Center for Climate Research, and Center for Climate and Energy Transformation, University of Bergen, Bergen, Norway; Sofienlund*—Department of Geography, University of Bergen, Bergen, Norway; Kvamsås—NORCE Society, and Department of Geography, and Center for Climate and Energy Transformation, University of Bergen, Bergen, Norway; Neby—NORCE Society, and Center for Climate and Energy Transformation, University of Bergen, Bergen, Norway; Paasche, Pontoppidan, and Sobolowski—NORCE Climate, Bjerknes Center for Climate Research, Bergen, Norway; Haarstad and Oseland—Department of Geography, and Center for Climate and Energy Transformation, University of Bergen, Bergen, Norway; Omdahl and Waage—Hordaland Fylkeskommune, Bergen, Norway
***CURRENT AFFILIATION:** Sofienlund—Oslo Kommune, Oslo, Norway
CORRESPONDING AUTHOR: Erik W. Kolstad, erik.kolstad@uib.no

The abstract for this article can be found in this issue, following the table of contents.
DOI:10.1175/BAMS-D-18-0201.1
In final form 1 April 2019

Kolstad et al., *BAMS*, 2019

Key lessons learnt

Insufficient resources to co-production, including no budget for participation allocated to the user partners

Usability gaps were clear: the user partners did not know what kind of information they needed; this only came to light after extensive dialogue

Different realities: the information needed to be fit-for-purpose and provided at the right time related to decision processes

Key person dependency: we were too reliant on “champions”, which could potentially be replaced

Recommendations

Set aside sufficient funding for co-production, including salary, travel, and other costs associated with organising site visits and workshops.

Involve as many of the co-producers as possible already in the pre-proposal stage, and allow ample time for dialogue. This is important to avoid a feeling of being presented with a solution to a problem that may not exist.

Clarify expectations and responsibilities to prevent misunderstandings and frustration and ensure that the involved actors know their responsibilities and what is expected from them.

Reduce the gap between climate scientists and user partners by including boundary organisations.

BJERKNES CENTRE for Climate Research

NORCE

Norwegian Centre for Research-based Innovation

climatefutures

- €20 million research centre with > 30 partners (2020–28)
- Goal: co-develop solutions for addressing climate risk from 10 days to 10 years into the future

Examples of projects

MET Norway's YR API and app

Agriculture planning

Energy production

Aquaculture planning

Insurance

Hydro/wind power planning

Plant breeding

Shipping decisions

Financial investments

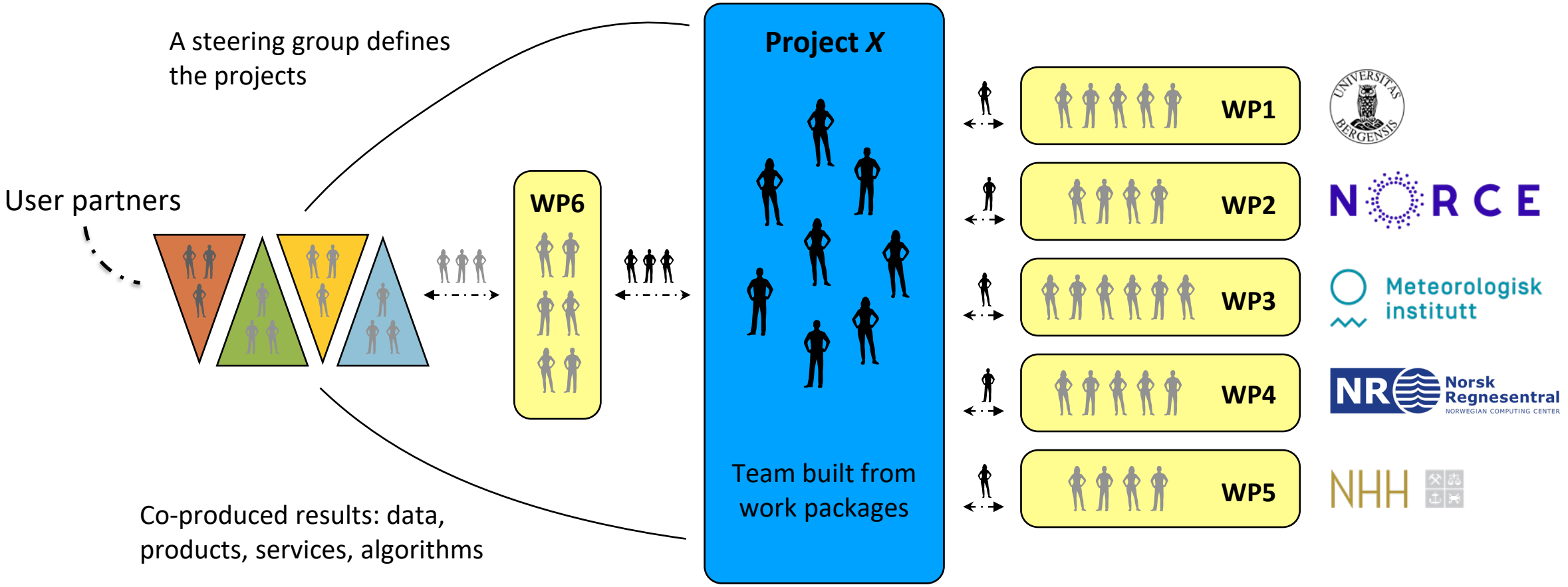
Marine heat waves

….

Norwegian Centre for Research-based Innovation

climatefutures

How we work

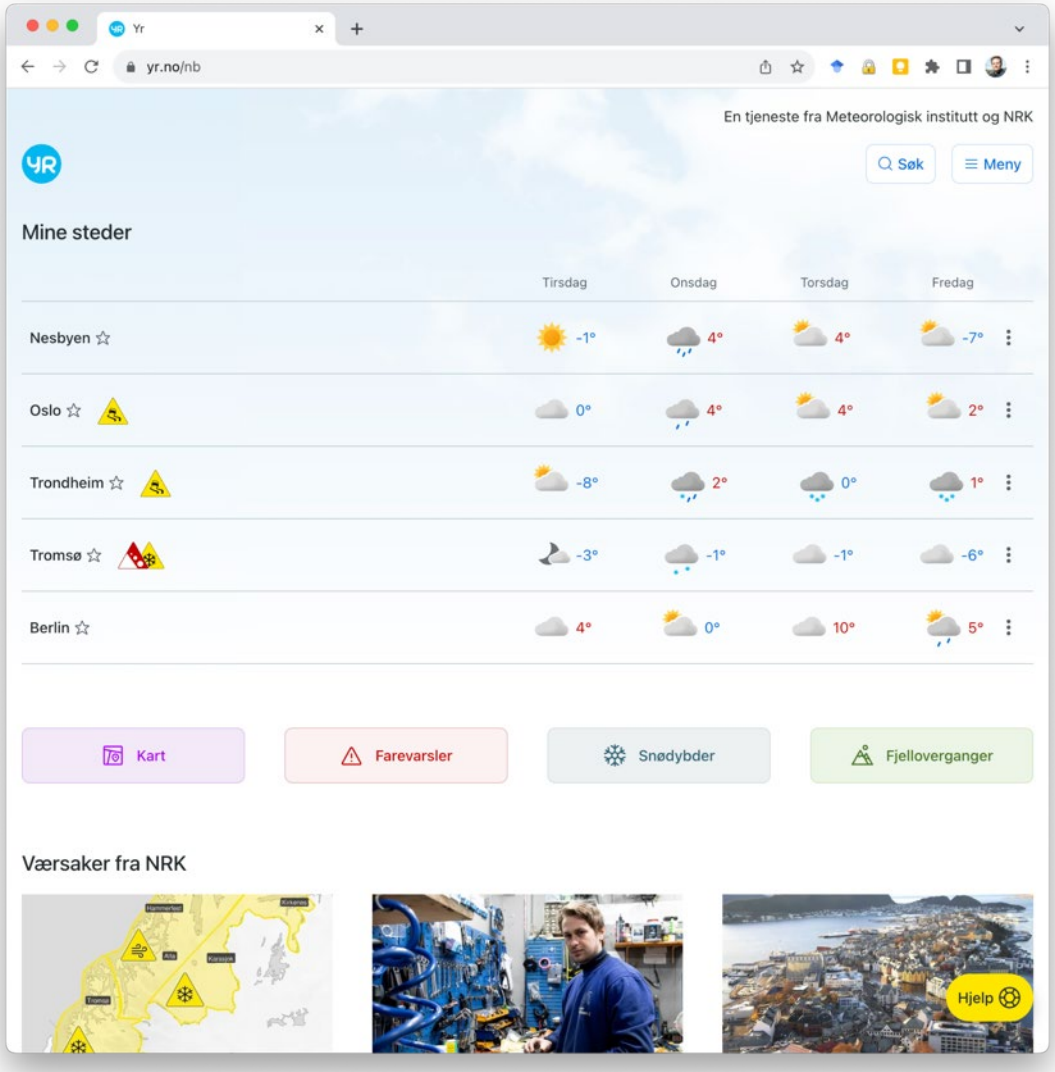

A steering group defines the projects
User partners
WP6
Project X
Team built from work packages
Co-produced results: data, products, services, algorithms
WP1
WP2
WP3
WP4
WP5
UNIVERSITAS BERGENSIS
NORCE
Meteorologisk institutt
NR Norsk Regnesentral
NORWEGIAN COMPUTING CENTER
NHH

User interface

Since 2007, the public Norwegian broadcaster NRK have developed the user interface for YR

Combining expertise in visualization, communication and meteorology has been very successful

New challenge in Climate Futures: combine 10-day weather forecast with 3-week S2S forecasts and provide data on street level



Ongoing work on insight, design and data

Service tested in summer 2023, accompanied by a survey

Is the 3-week forecast useful, in general?

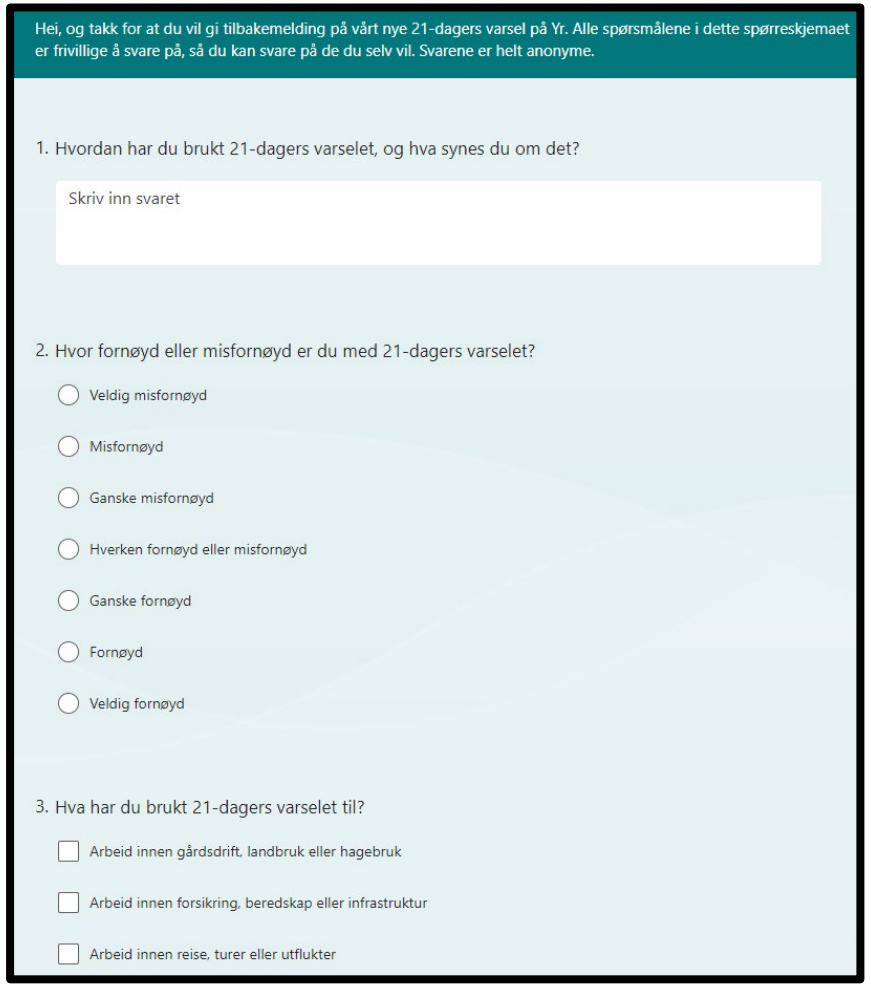
- Specific parts that are more useful?
- Specific parts that are demanding?

For what purpose is the forecast used?

- For example leisure, work (which sector)...
- Do we provide the right information/data?

Is it used on mobile, tablet, computer?

-> Iterations with data, design and concept



Hei, og takk for at du vil gi tilbakemelding på vårt nye 21-dagers varsel på Yr. Alle spørsmålene i dette spørreskjemaet er frivillige å svare på, så du kan svare på de du selv vil. Svarene er helt anonyme.

1. Hvordan har du brukt 21-dagers varselet, og hva synes du om det?

Skriv inn svaret

2. Hvor fornøyd eller misfornøyd er du med 21-dagers varselet?

- ○ Veldig misfornøyd
- ○ Misfornøyd
- ○ Ganske misfornøyd
- ○ Hverken fornøyd eller misfornøyd
- ○ Ganske fornøyd
- ○ Fornøyd
- ○ Veldig fornøyd

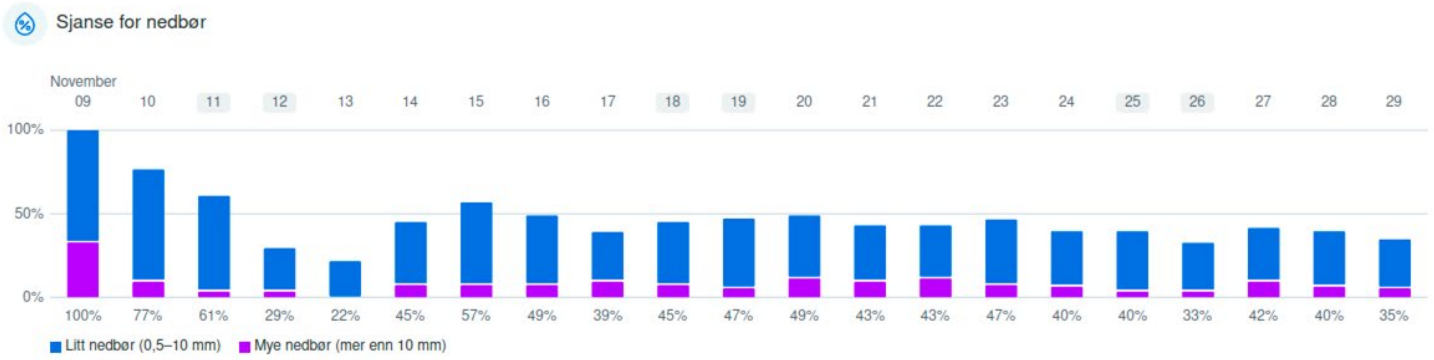
3. Hva har du brukt 21-dagers varselet til?

- ☐ Arbeid innen gårdsdrift, landbruk eller hagebruk
- ☐ Arbeid innen forsikring, beredskap eller infrastruktur
- ☐ Arbeid innen reise, turer eller utflukter

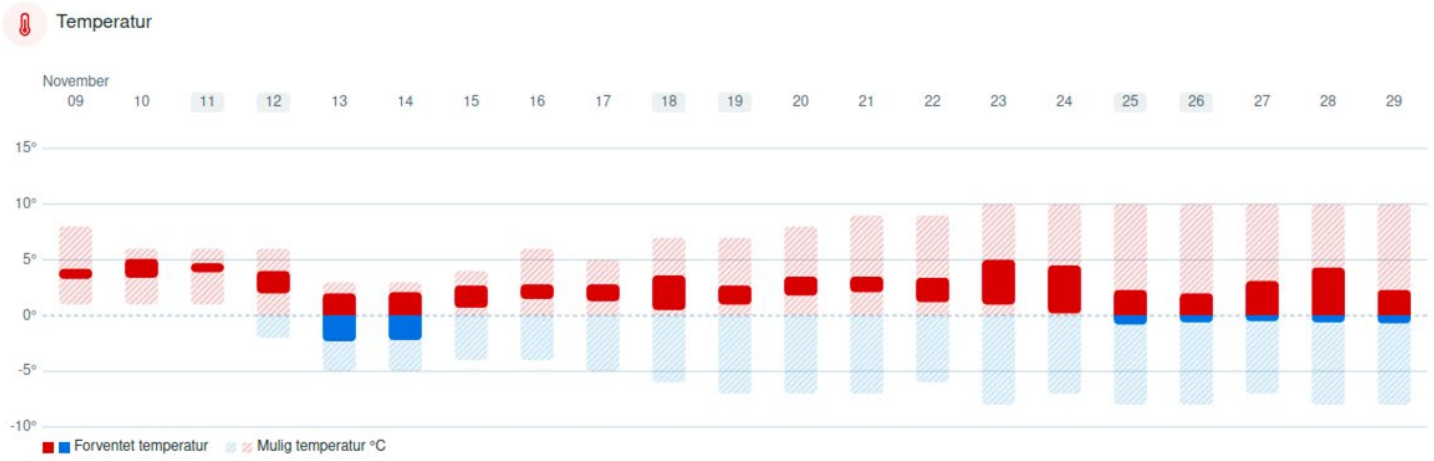
Oppsummering

Periode	Nedbør mm	Temperatur (høy/lav)	Sjanse for frost
9. nov.–15. nov.	24 (10–39)	5° / -2°	84%
16. nov.–22. nov.	10 (4–38)	4° / 1°	86%
23. nov.–29. nov.	14 (0–35)	5° / -1°	88%

Weekly summary



Precipitation summary



Temperature summary

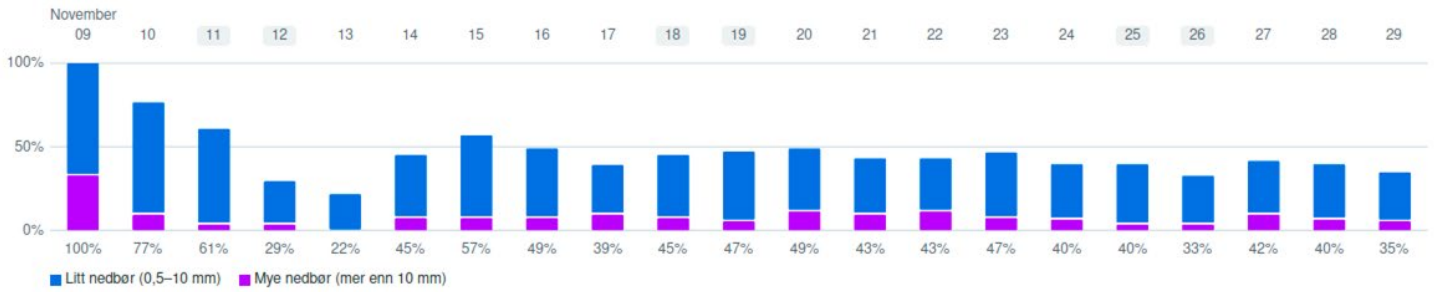
Norwegian Centre for Research-based Innovation

climatefutures

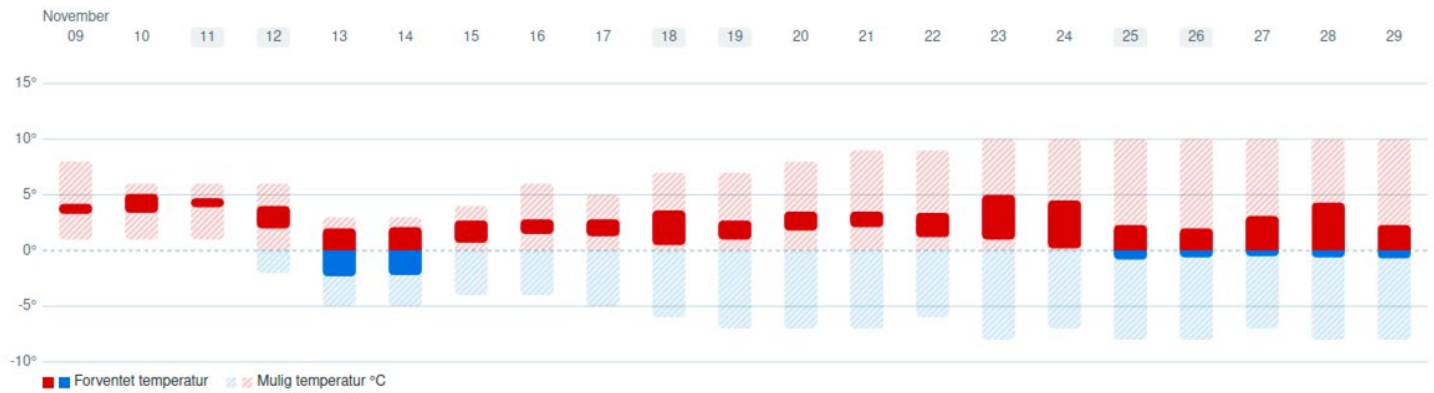
Oppsummering

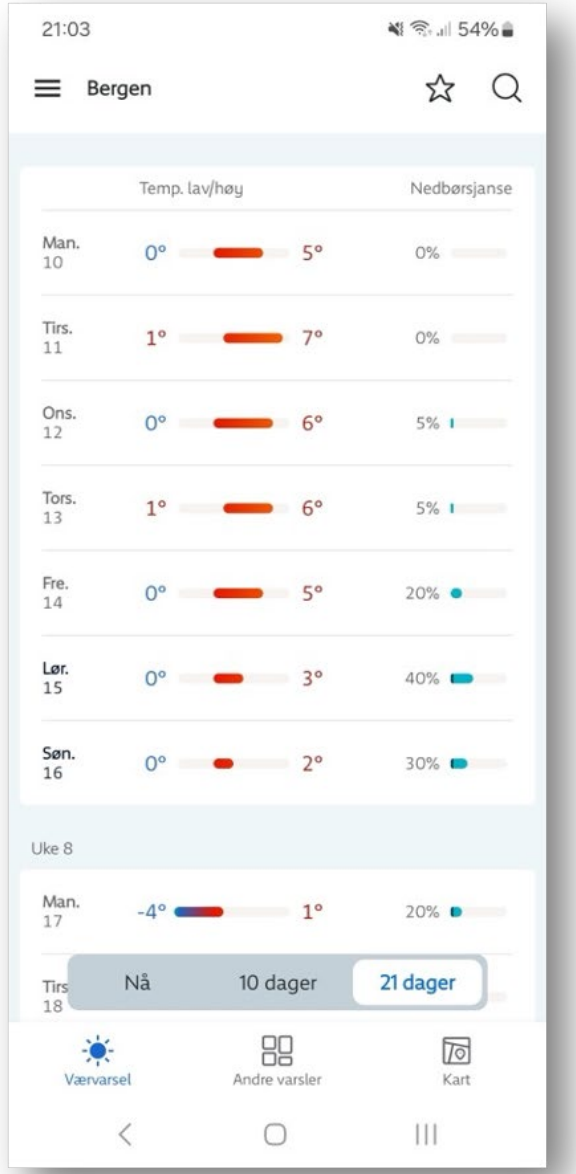
Periode	Nedbør mm	Temperatur (høy/lav)	Sjanse for frost
9. nov.–15. nov.	24 (10–39)	5° / -2°	84%
16. nov.–22. nov.	10 (4–38)	4° / 1°	86%
23. nov.–29. nov.	14 (0–35)	5° / -1°	88%

Sjanse for nedbør



Temperatur





Norwegian Centre for Research-based Innovation

climatefutures

Use of the 21-day forecast during summer 2023

800,000 users per week

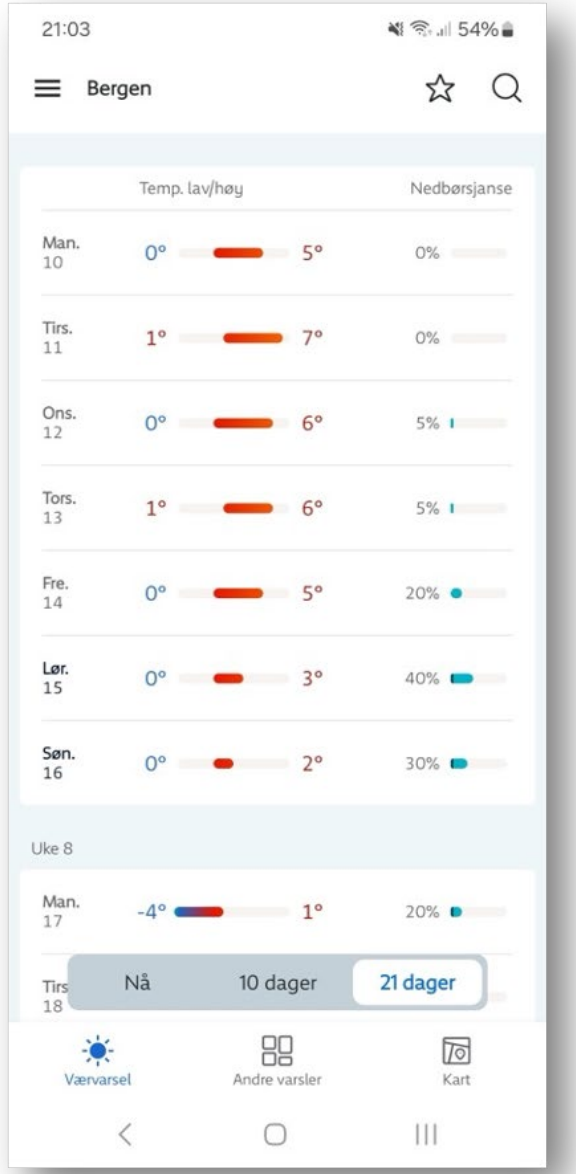
2 million page views first week of July

71% happy with the product

73% think the forecast is easy to understand

22% think precipitation is difficult

Paper by van Bijsterveldt et al., submitted to *BAMS*



Norwegian Centre for Research-based Innovation

climatefutures

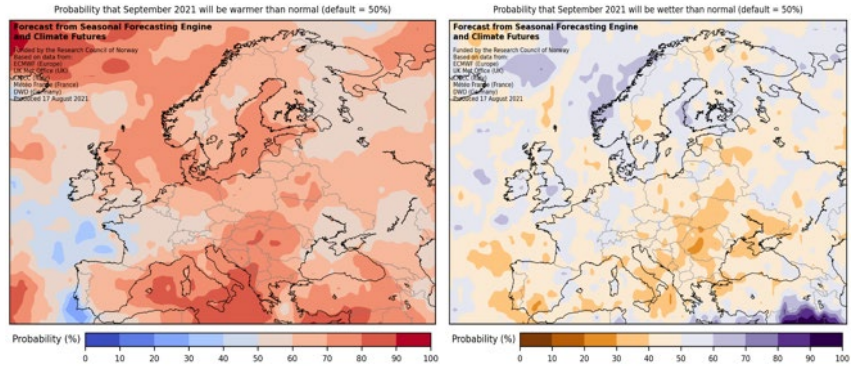
Agriculture planning

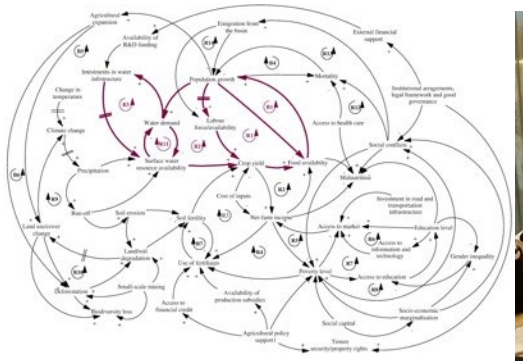
Might S2S forecasts have made a difference in handling a past crisis? (Drought in 2018)

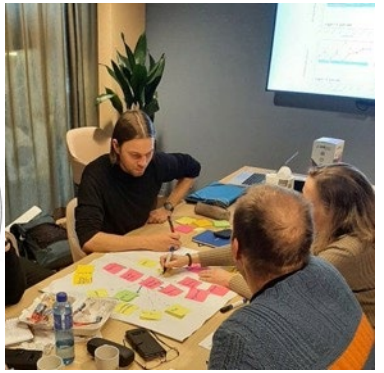
How can S2S forecasts help mitigate risk on different levels of the value chain? (Farm, distribution, governance)

How can S2S forecasts contribute to an enhanced resilience of the agriculture system?

Work by Manuel Hempel, submitted to *Climate Risk Management*







Focus groups

Participants from

- Pollination/beekeeping
- Fruit production
- Berry production
- Grain production
- Fodder/Hay production

50 participants in total

Monthly group meetings

Feedback on the previous forecast:

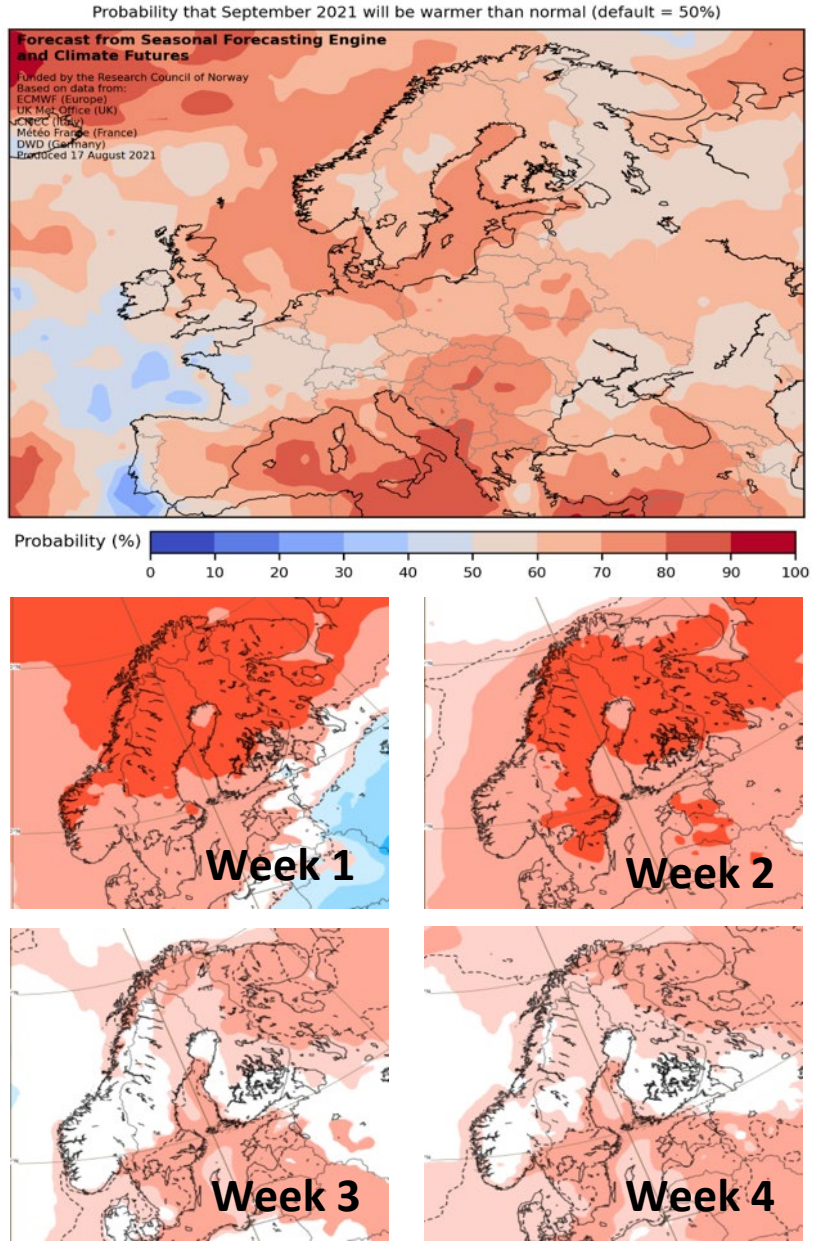
- Reliability? How did it do?
- Was the information used in decisions?

Feedback on the current forecast

- What does it mean for your operation?
- What is impacted?

General information:

- Which parameters are relevant?
- How to communicate the information?



Norwegian Centre for Research-based Innovation

climatefutures

Focus group results

Identification of relevant variables, barriers and challenges

Input on visualisation

Decision-making:

- Planting (grain)
- Timing of harvests
- Pesticides
- Insects
- Fungi
- Fertiliser
- Irrigation
- Prevention of environmental damage
- Migratory beekeeping

Key result: forecasts take some of the psychological strain off the farmers, even when they are wrong

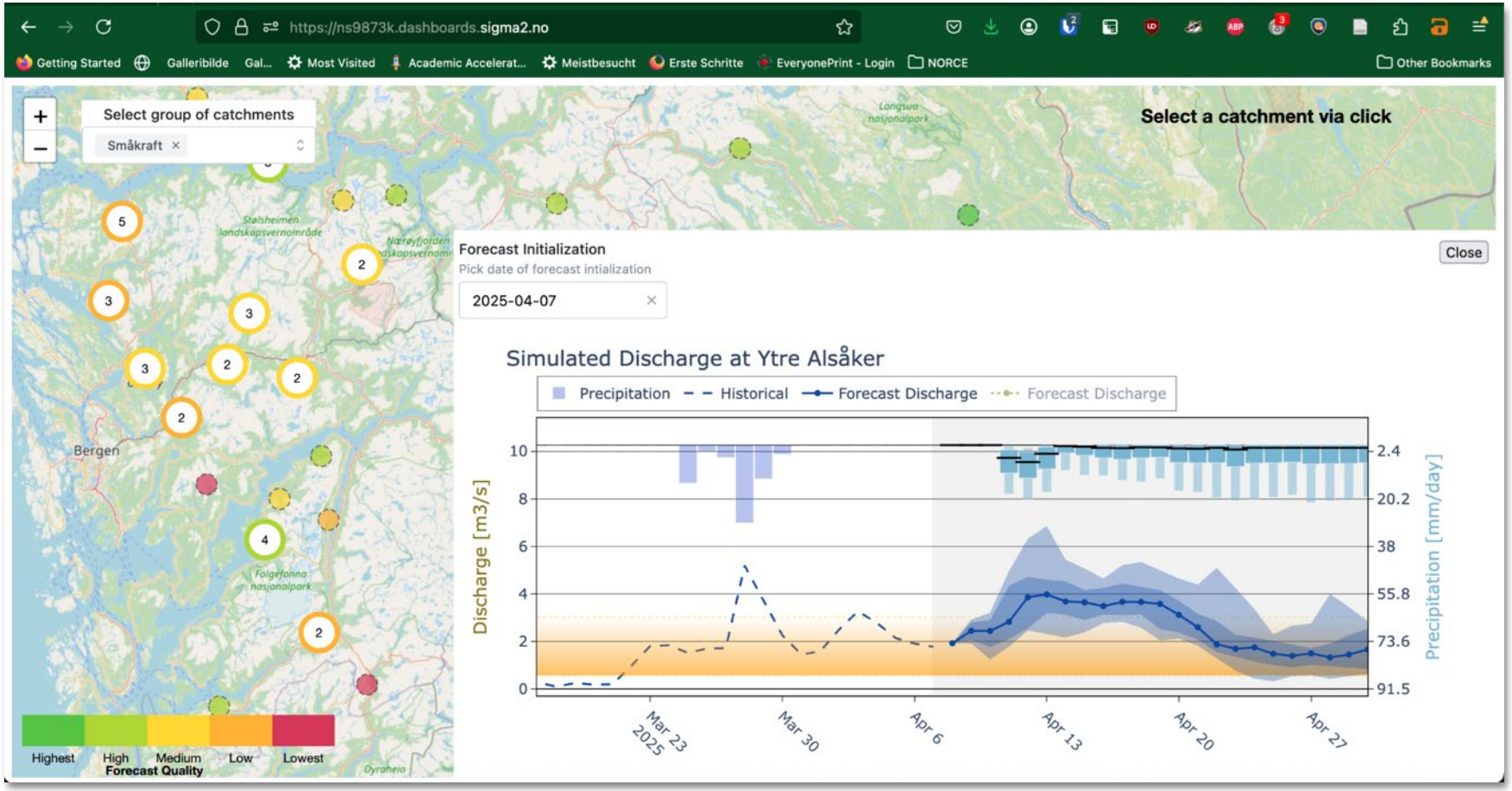






S2S river streamflow predictions

Based on the S2S data from Met Norway through an API, we've developed a 21-day discharge forecast for the hydropower producer Småkraft, even for rivers with no observations



Picture by Ole Wulff

Norwegian Centre for Research-based Innovation

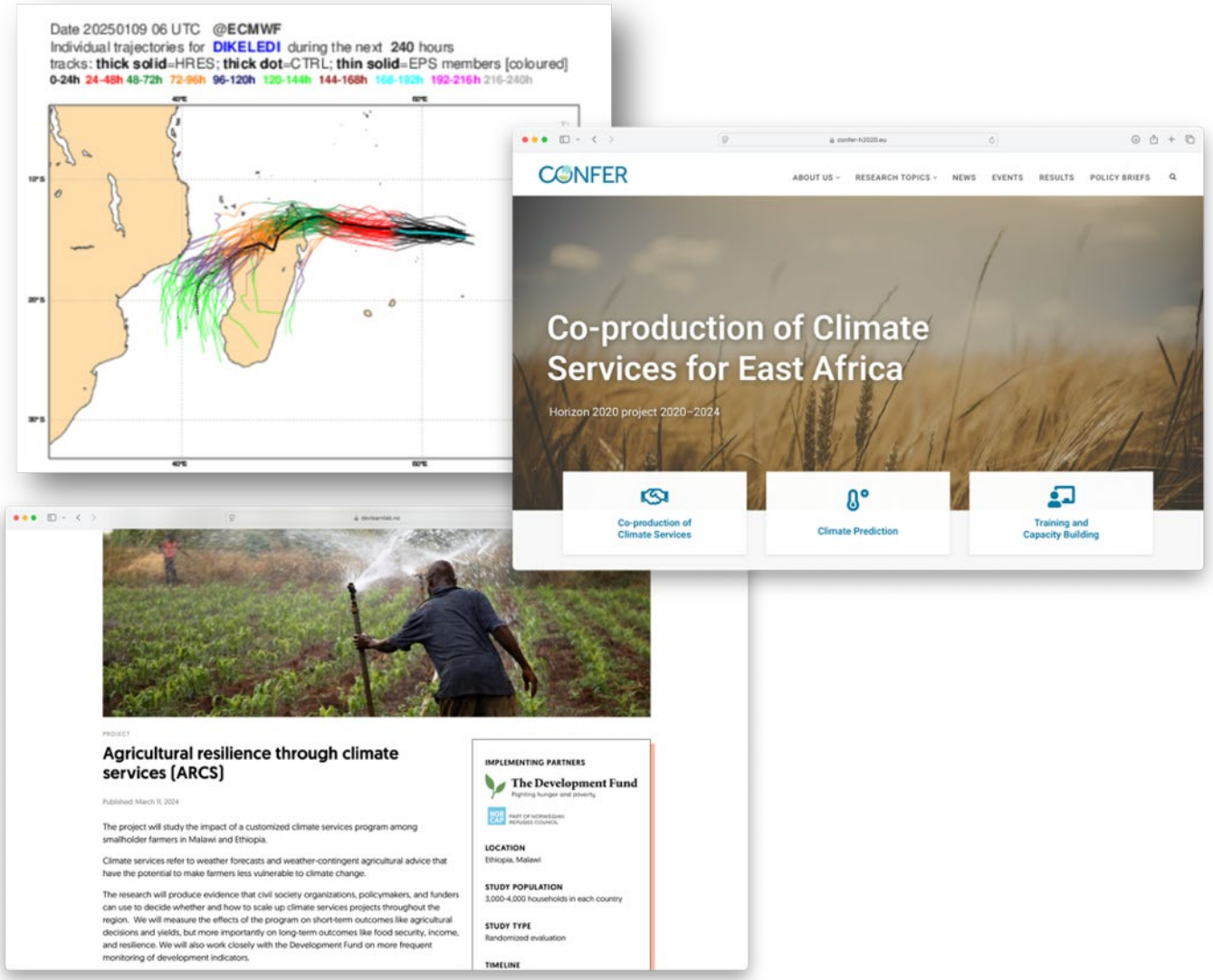
climatefutures

Projects in Africa

CONFER (EU, 2020–24): Co-production of climate services for East Africa

ACACIA (EU, 2024–28): Co-development and application of early warnings (S2S) for tropical cyclones in Madagascar and flooding in East Africa

ARCS (NORAD, 2024–28): Co-development of climate services for agriculture in Malawi and Ethiopia



Emphasis on *co*-production

In CONFER, nearly 25% of the total number of person months were dedicated to co-production

We did not know beforehand which climate services to develop; this was determined through communication with stakeholders

The Greater Horn of Africa climate outlook forum events were key

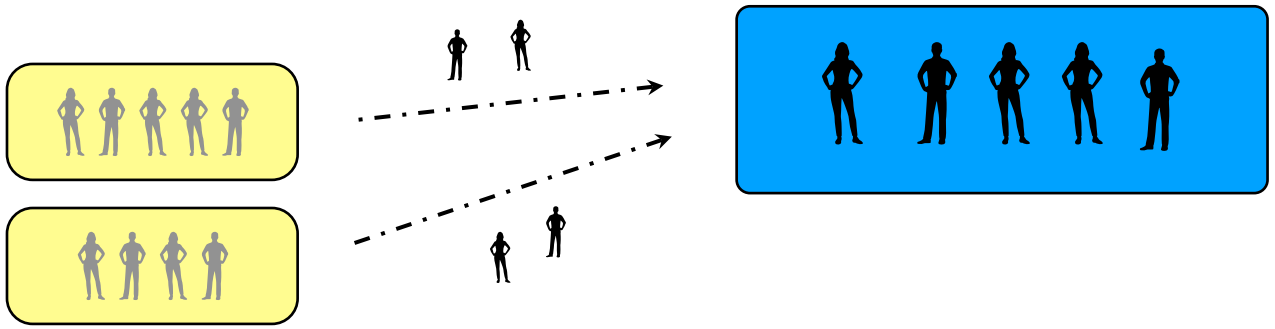
From GHACOF 66 in Kampala, Uganda

European Commission | Horizon 2020 European Union funding for Research & Innovation

CONFER

Work packages to *workstreams*

The workstream concept was conceived by Marta Bruno Soares, University of Leeds



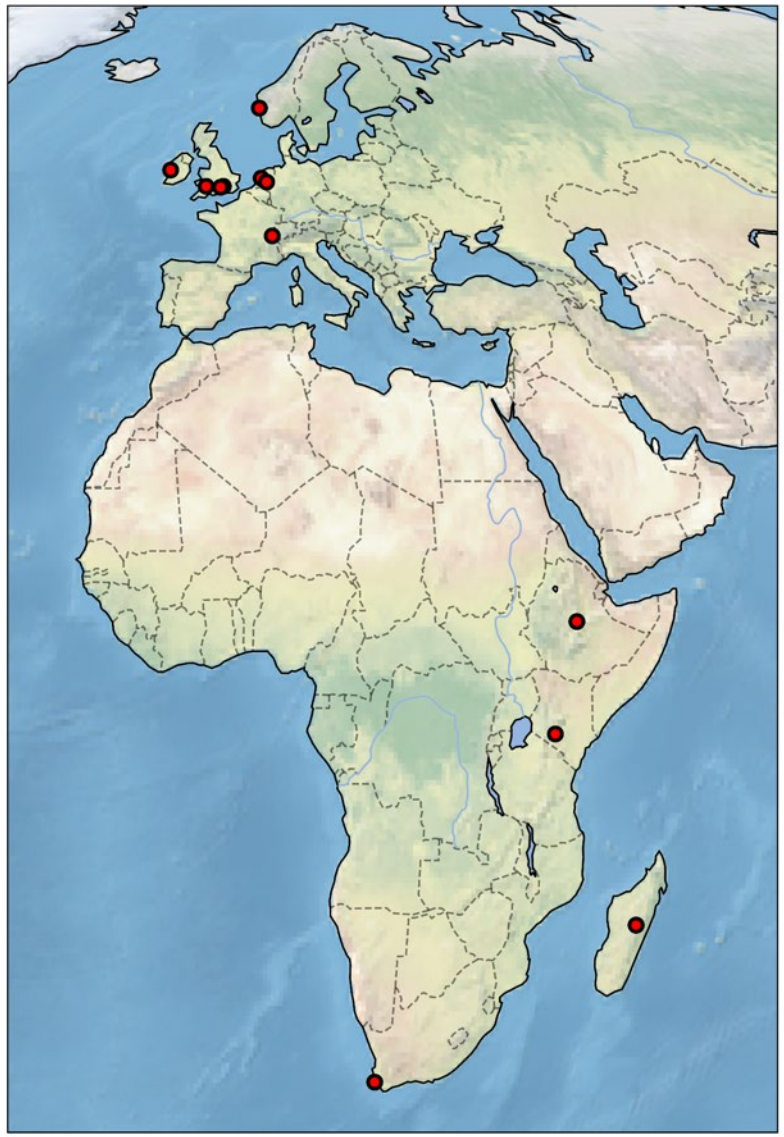
After one year, we created 8 workstreams, dedicated to:

- co-developing a new climate service
- enhancing existing services
- developing foundational science
- suggesting improvements in the flow of information

European Commission | Horizon 2020 European Union funding for Research & Innovation

CONFER

ACACIA



NORCE

University of Reading

CMI CHR. MICHELSEN INSTITUTE

Climate Centre

Croix-Rouge Malagasy

የኢትዮጵያ ሚቲዎሮሎጂ ኢንስቲትዩት
Ethiopian Meteorology Institute

IGAD
ICPAC

CLIMATE SYSTEM ANALYSIS GROUP
CSAG

WMO

WAGENINGEN UNIVERSITY & RESEARCH

Met Office

Ollscoil na Gaillimhe
University of Galway

ECMWF

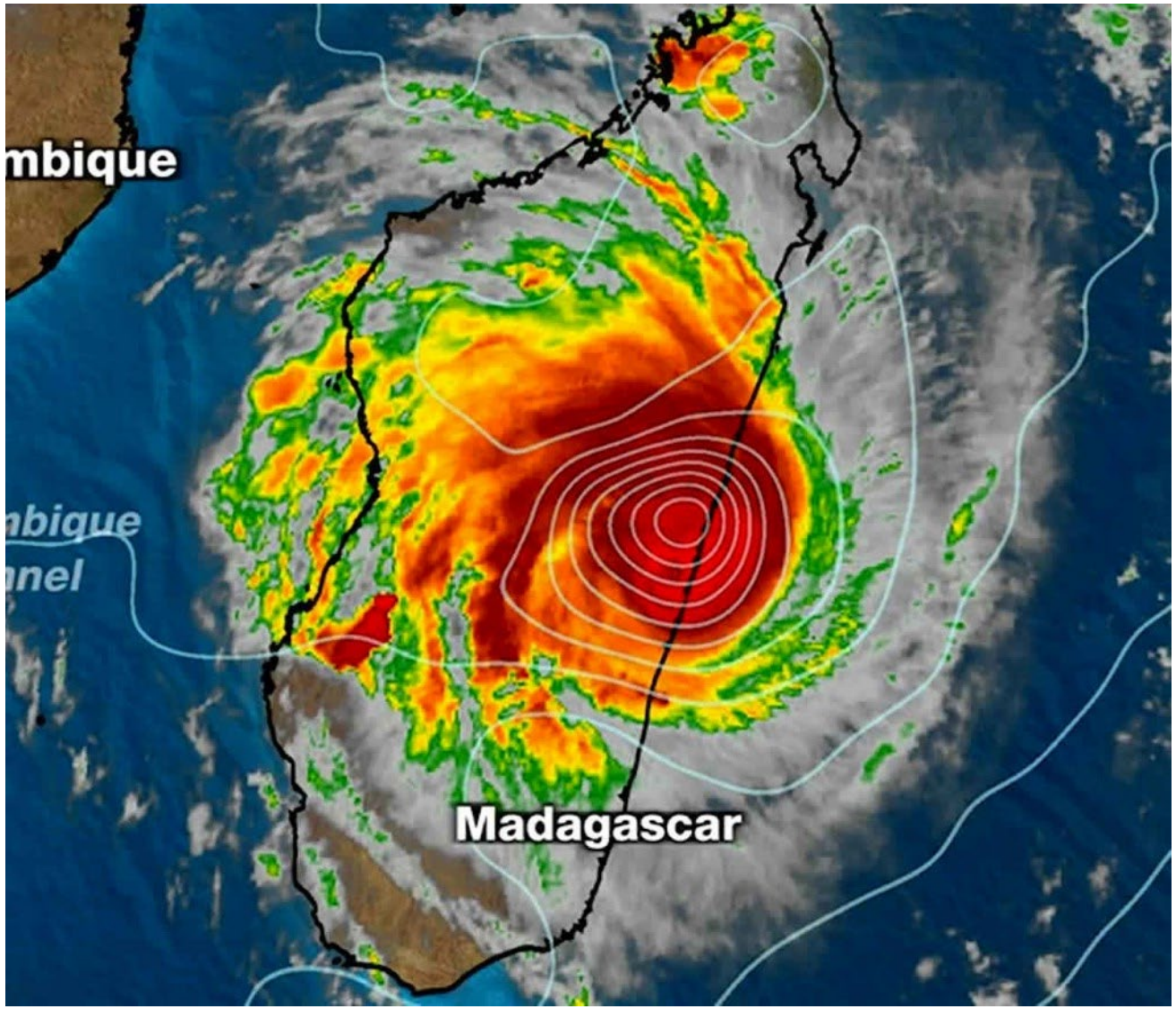
METEO Madagascar

European Commission

ACACIA

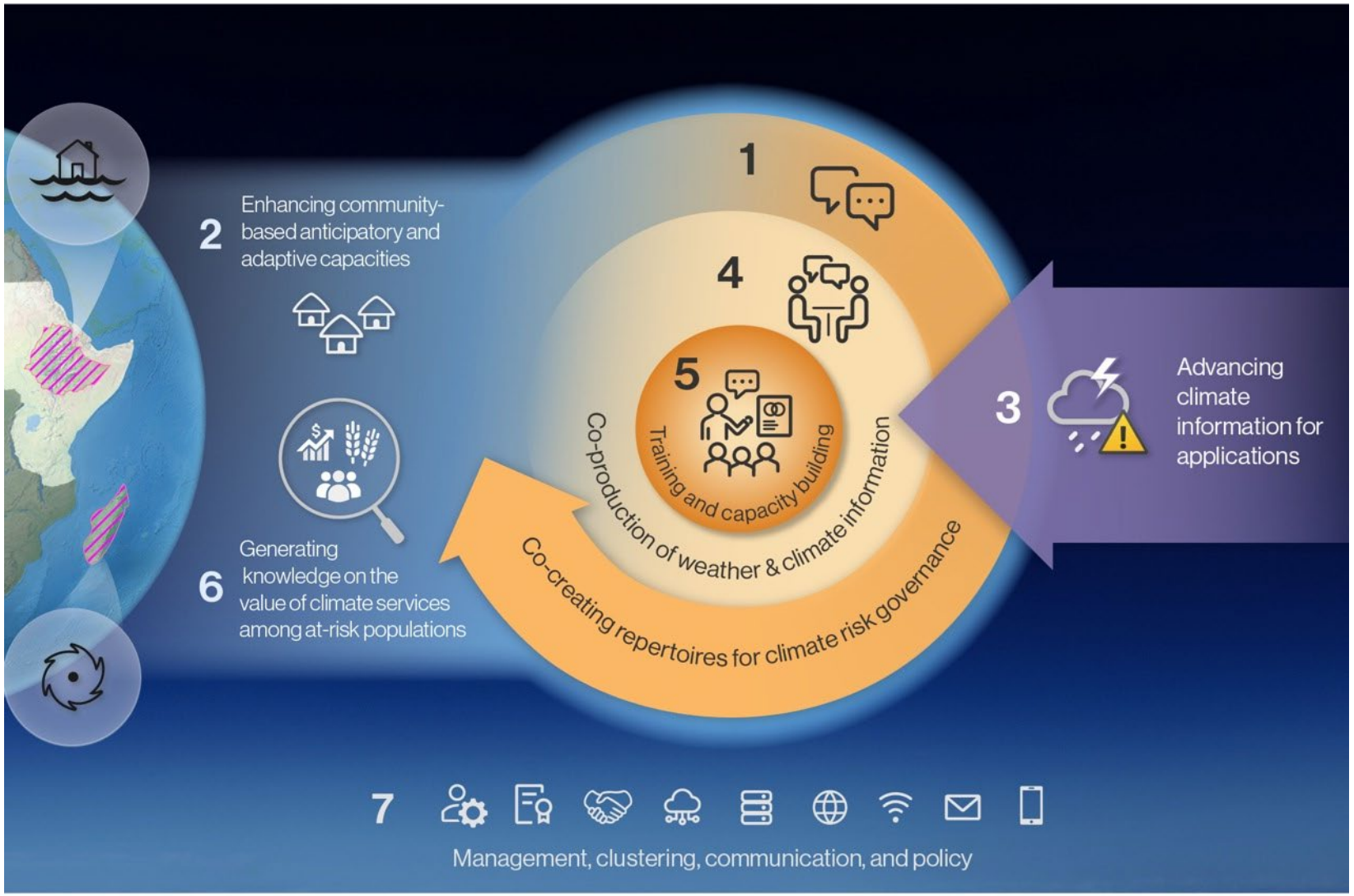
Objective:

Improve the quality and relevance of early warnings of **floods and tropical cyclones** in East Africa and Madagascar, by improving the ways climate services are produced, communicated and used in decision-making



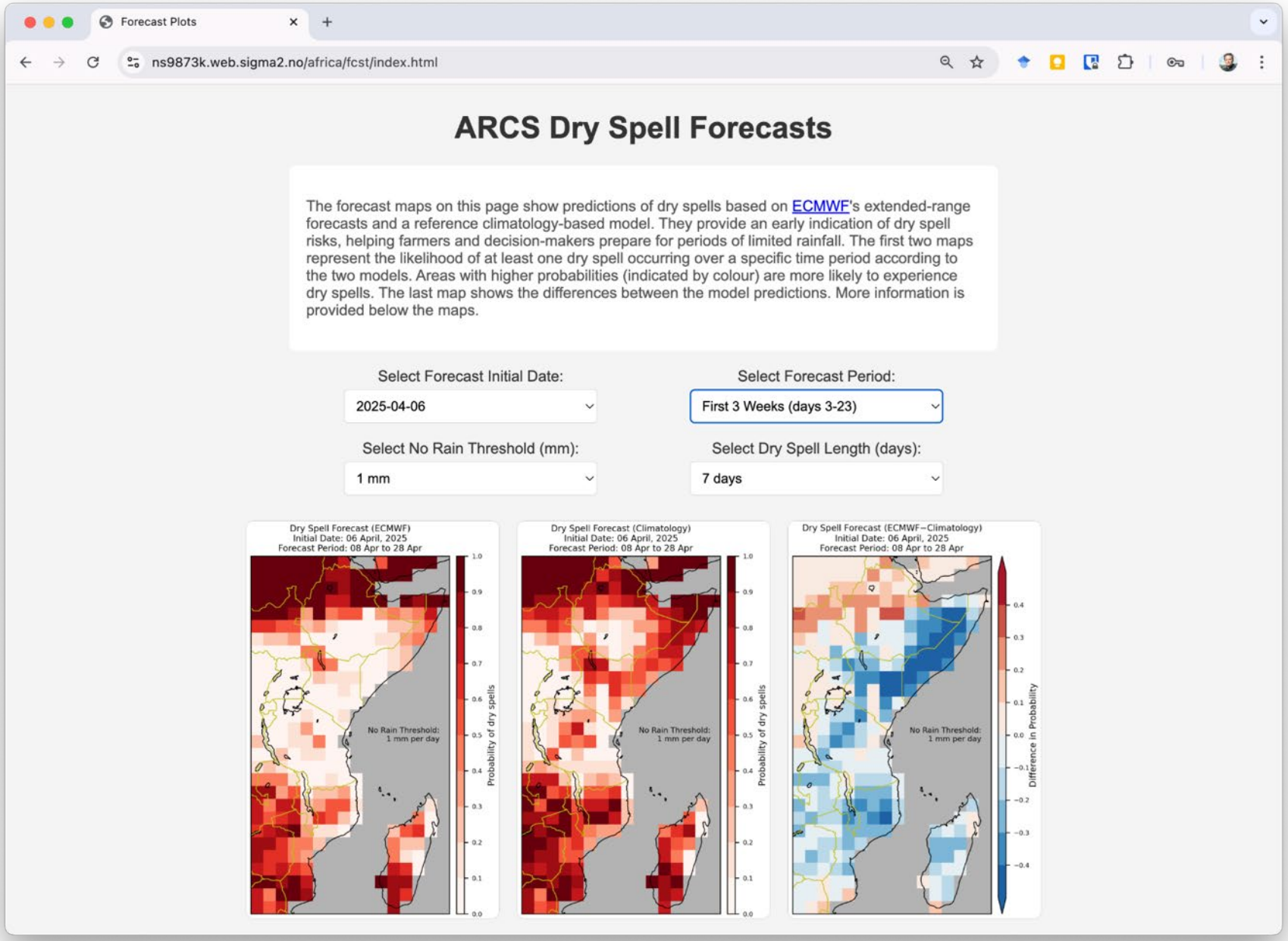
European Commission

Interdisciplinary collaboration



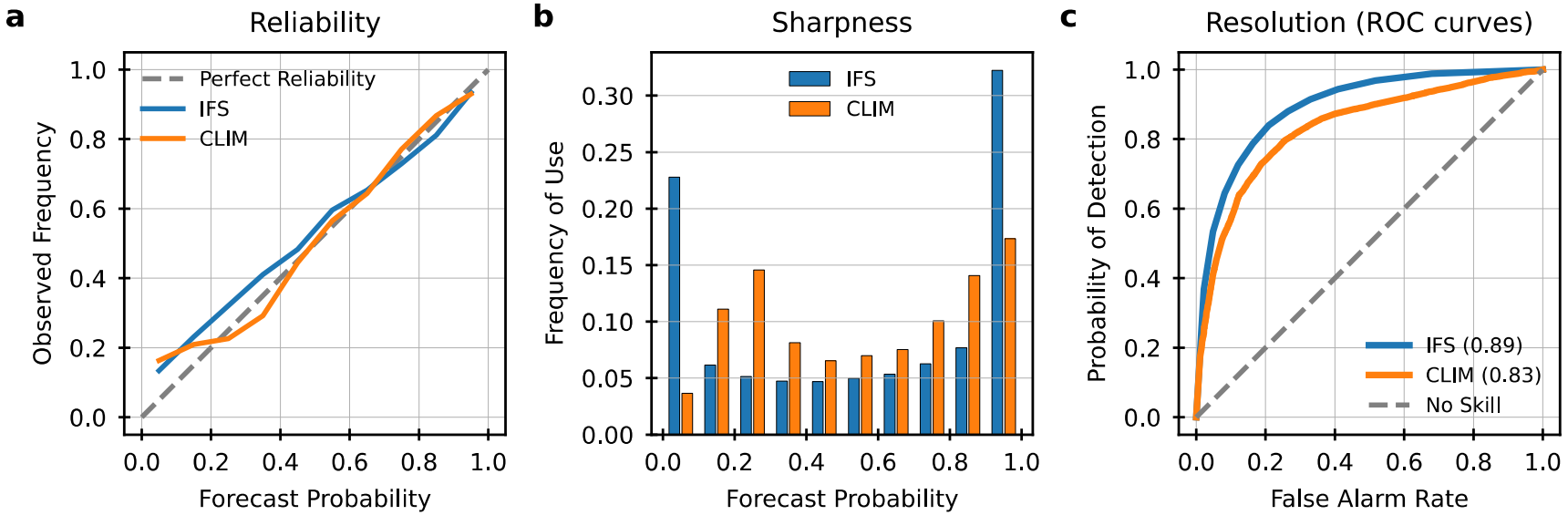
In the ARCS project, we've developed an S2S dry spell forecast based on ECMWF, motivated by a clearly articulated need by farmers

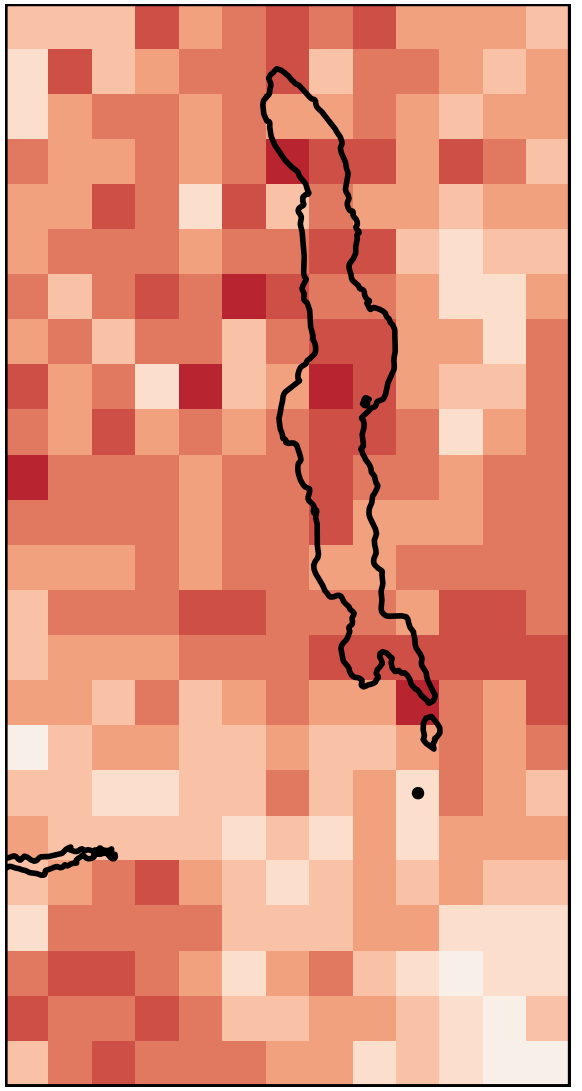
By sharing the code, we hope this will be implemented at regional and country levels



Validation

A validation of the dry spell forecast for Malawi is under review in *Climate Dynamics*





ARCS Interventions (Malawi and Ethiopia)

Still being developed, but a key component will be S2S rainy season onset and dry spell forecasts. However, these are only part of the full intervention:

- **Training:** on how to interpret S2S predictions and translate them to recommended actions (plant, delay planting, fertilise, harvest, etc.)
- **Communication:** SMS? Knocking on doors? Radio?
- **Sustain** interactions with communities to discuss forecasts (every 1-2 weeks)
- **Hedging**: insurance, forecast-based loans, etc.

Concluding reflections

The “old” model of designing research based on the researchers’ perceived need, or driven by curiosity, is still important – there is still a need for disciplinarity!

Yet, when the research aims to solve real-world problems, through e.g. developing climate services, it is crucial to involve people with different expertise, and not least to involve the people who will be using the services

It takes a very long time and sustained engagement to build a climate service that is useful and used (and trusted)

In our experience, the S2S timescale is important for making decisions in many sectors (beyond agriculture)

CATER: 5-year programme for *Climate Action Transdisciplinarity in Education and Research*

2023 Kenya, 2024 Tanzania, **2025 Madagascar (Nosy-Be)**

Student-steered focus on climate science, climate risk, ethics, policy, vulnerability, and action

Deadline **May 4**