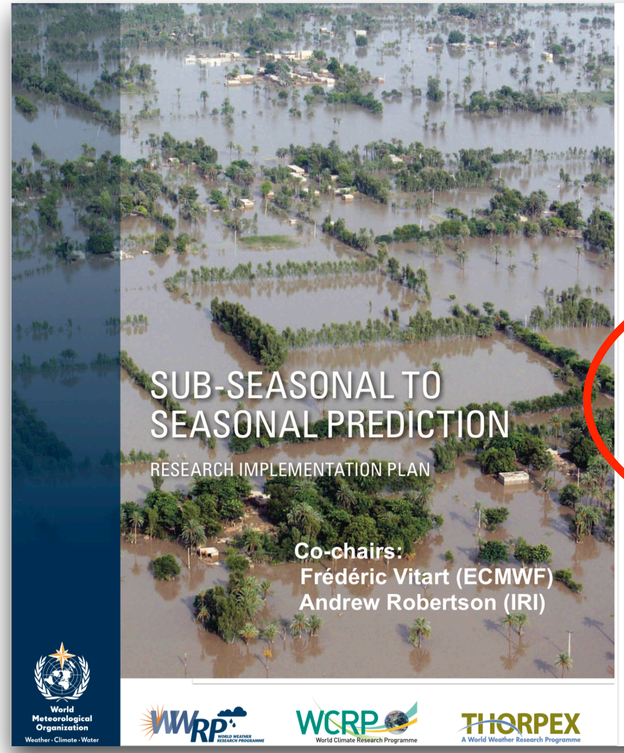
S2S Phase II Plans:
Applications research and demonstrations

Andrew W. Robertson and F. Vitart

Applications dimension of S2S Phase I

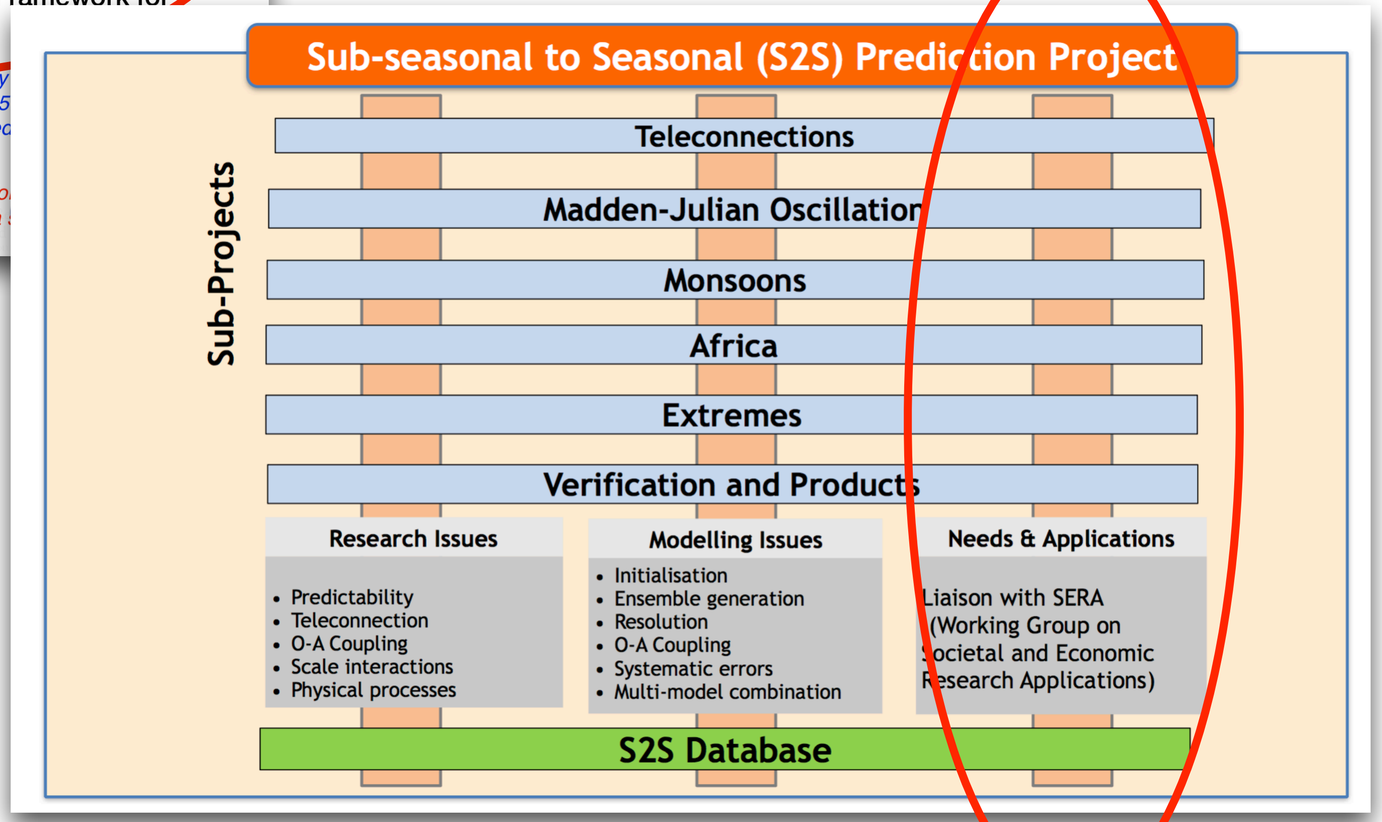


Subseasonal-to-Seasonal S2S Prediction Project

- Improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events
- Promote the initiative's uptake by operational centres and exploitation by the applications community
- Capitalize on the expertise of the weather and climate research communities to address issues of importance to the Global Framework for Climate Services

The S2S Database, hosted by CMA, went online in May 2015
Coordination Office hosted

The project focuses on the fo between 2 weeks and a



Outcomes?

Presentations under Themes 3-4 of this conference!

METEOROLOGICAL APPLICATIONS
Meteorol. Appl. (2017)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/met.1654

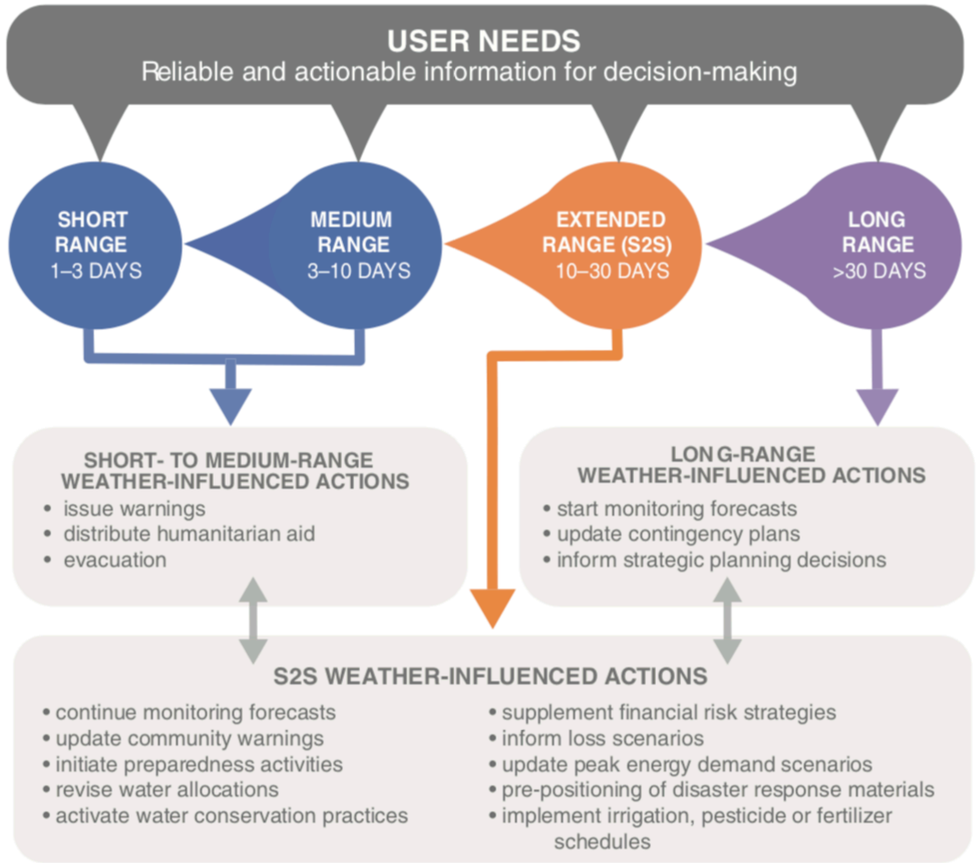
RMetS
Royal Meteorological Society

Review

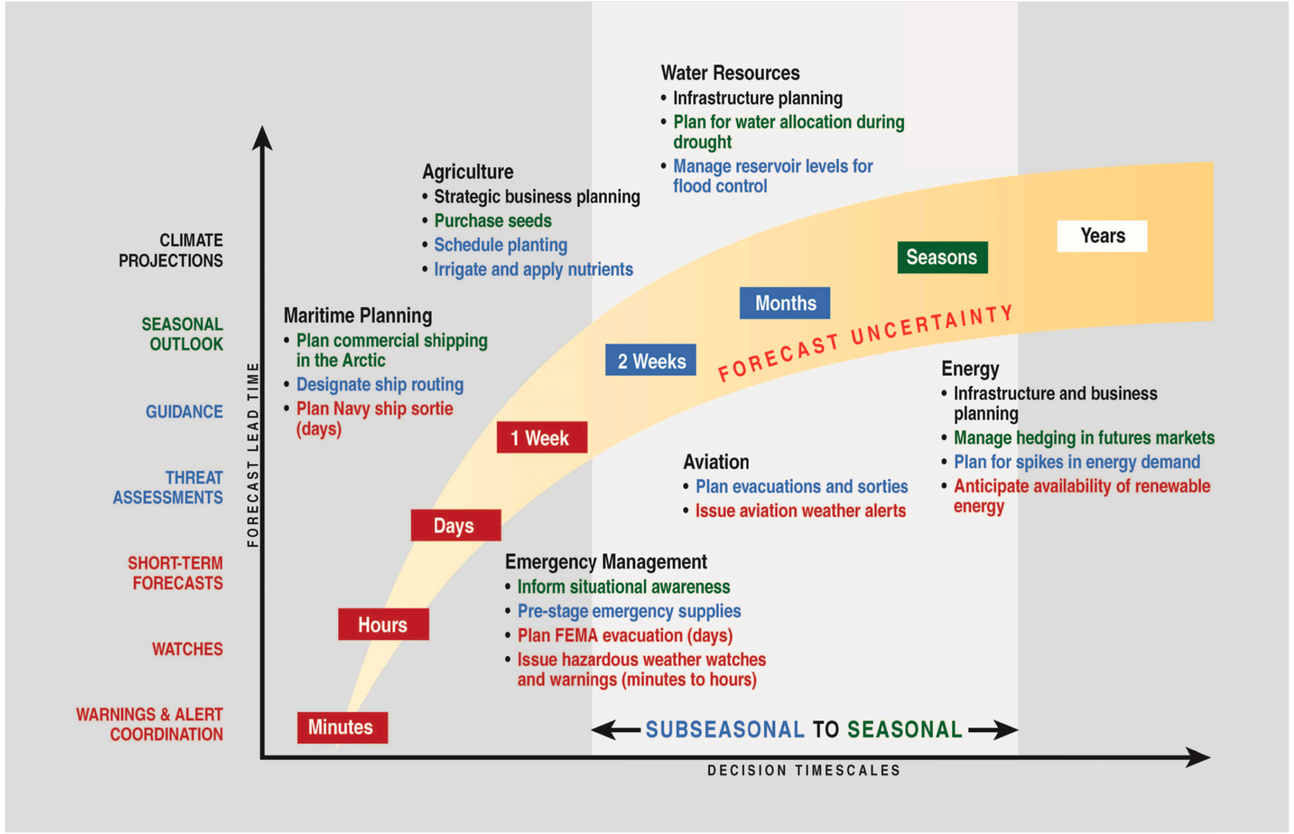
Potential applications of subseasonal-to-seasonal (S2S) predictions

Christopher J. White,[a,b]* Henrik Carlsen,[c] Andrew W. Robertson,[d] Richard J.T. Klein,[c] Jeffrey K. Lazo,[f] Arun Kumar,[g] Frederic Vitart,[h] Erin Coughlan de Perez,[d,i] Andrea J. Ray,[j] Virginia Murray,[k] Sukaina Bharwani,[l] Dave MacLeod,[m] Rachel James,[n] Lora Fleming,[o] Andrew P. Morse,[p] Bernd Eggen,[q] Richard Graham,[r] Erik Kjellström,[s] Emily Becker,[g] Kathleen V. Pegion,[t] Neil J. Holbrook,[u] Darryn McEvoy,[v] Michael Depledge,[o] Sarah Perkins-Kirkpatrick,[w] Timothy J. Brown,[x] Roger Street,[y] Lindsey Jones,[z] Tomas A. Remenyi,[b] Indi Hodgson-Johnston,[b] Carlo Buontempo,[r] Rob Lamb,[aa,ab] Holger Meinke,[ac] Berit Arheimer[s] and Stephen E. Zebiak[d,ad]

[a] *School of Engineering and ICT, University of Tasmania, Hobart, Australia*



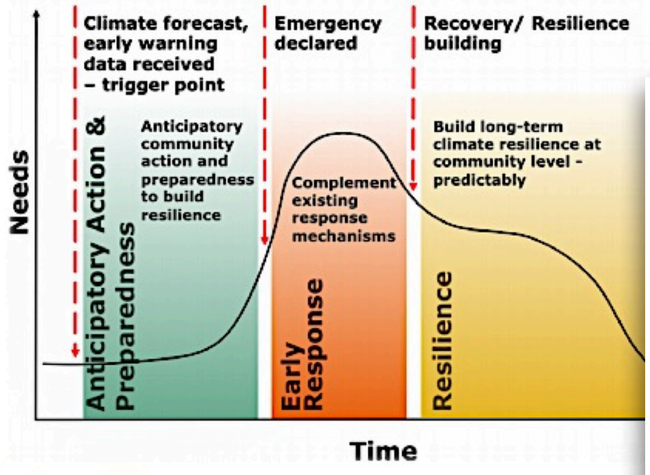
U.S. National Academy of Sciences Study 2016: Next Generation Earth System Prediction: Strategies for Subseasonal to Seasonal Forecasts



Experience from seasonal forecasting

WFP's Food SECuRE

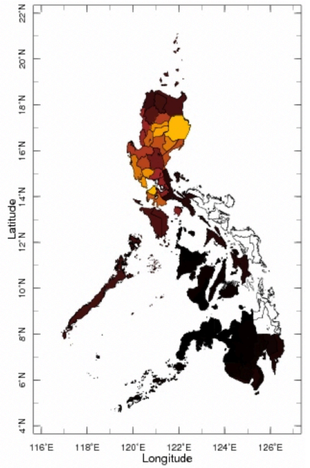
Pioneering Example of **Forecast-based Financing**



IRI S-I

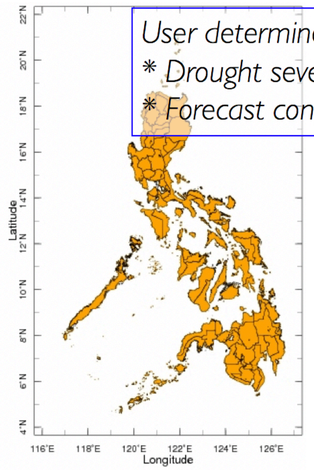
WFP's Food SECuRE – Drought Triggers

Non-exceedance of 50%-ile



Made Sept. 2015

"ACTIVE TRIGGERS"



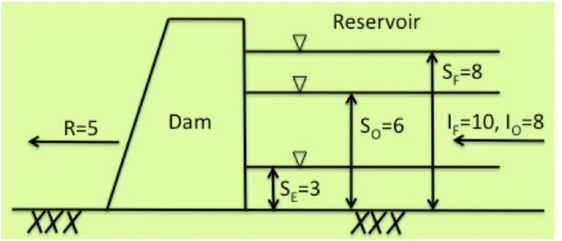
User determines:
* *Drought severity*
* *Forecast confidence*

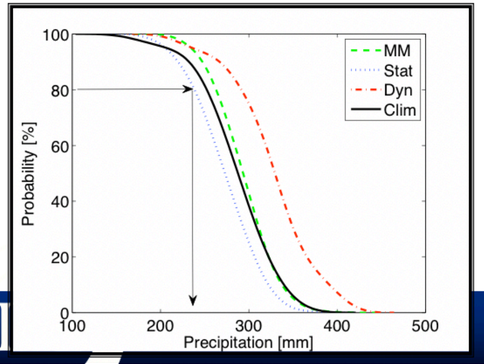
Jan-Apr 2016 Forecast issued September 2015

IRI S-I International Research for Climate and Society, Earth Institute | Columbia University

Linked Model System *(example: Ethiopia)*

Monthly reservoir update based on forecast and observations





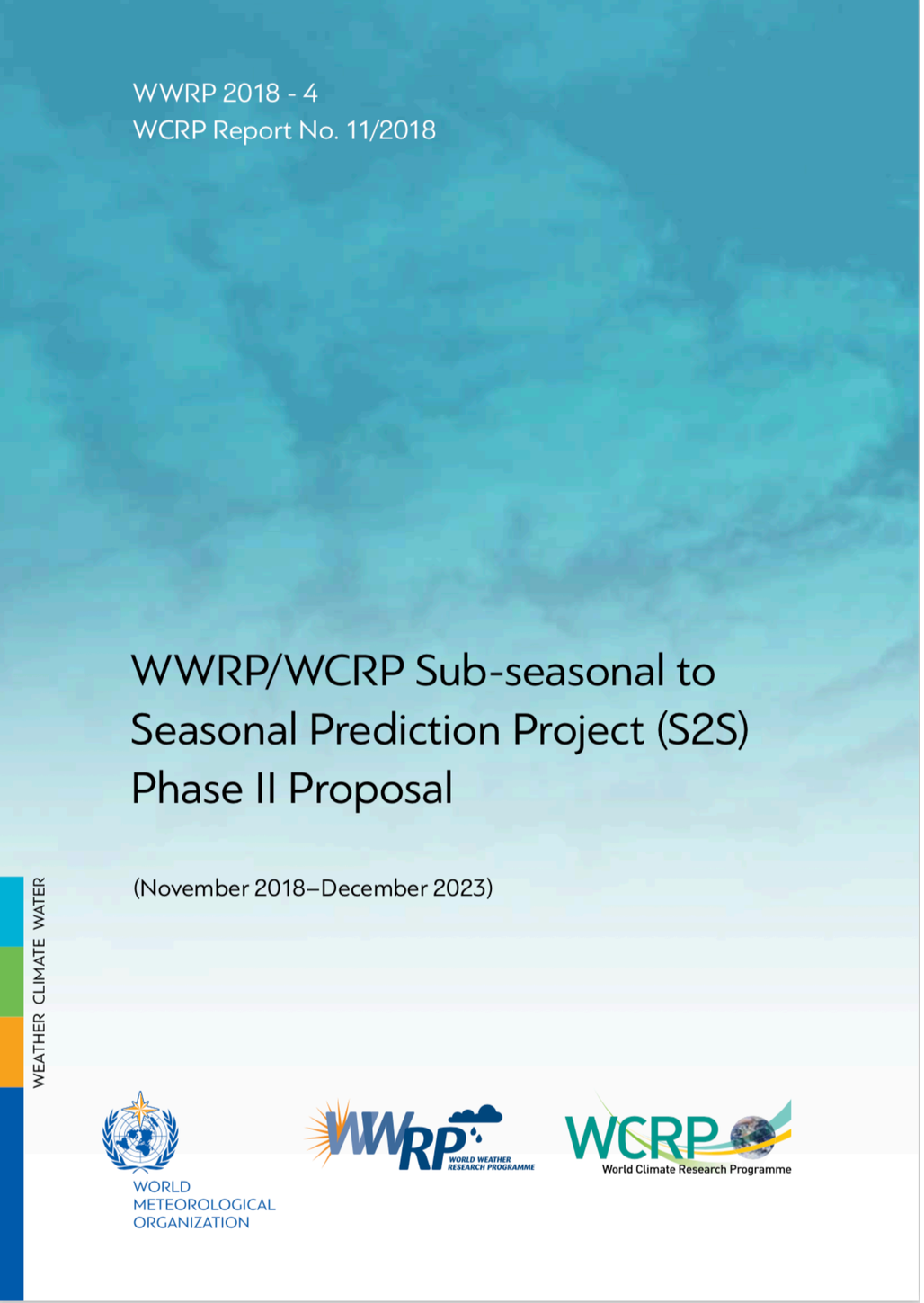
Select precipitation exceedance probability, apply to prediction ensemble

(Block and Goddard, 2012, WRR)

International Research Institute for Climate and Society, Earth Institute | Columbia University

From Lisa Goddard's Monday talk

What can the S2S Project do in Phase 2 to promote forecast uptake and applications use?



Gap Analysis

- To inform future plans, a questionnaire was circulated to the research, modelling and operational communities for feedback.
- Frequently mentioned gaps included: land-surface processes and initialization; ensemble generation, including initialization, perturbation methods and stochastic physics; coupled data assimilation and the role of the ocean and sea ice on the sub-seasonal forecasts; stratospheric processes; and understanding model systematic errors and error growth.
- Some of the database and operational gaps raised include: need for more convenient and faster access to popular suites of variables, including ensemble means, model climatologies, indices, and map displays;
  - need for multi-model calibrated forecast product development;
  - desire for more extensive re-forecast sets (number of years and ensemble members) for verification and forecast calibration,
  - encouraging centres to harmonize re-forecasts;
  - request for more ocean data including 3D fields,
  - increased model horizontal and temporal resolution; and desire for real-time access.

Barriers to S2S Forecast Uptake: Stakeholder Mini-Survey

For the applications/service/donors/wider stakeholder audience, a set of 8 semi-structured interviews was carried out by **SERA.** The interviewees were stakeholders in agriculture (Australia, Uruguay), energy (Uruguay), transport (Canada), water management (Canada, USA), bushfire management (Australia), and humanitarian aid (global and Peru).

They generally agreed that while the potential benefits of skilful S2S forecasts are high, several barriers hinder their realization, namely:

- Lack of accuracy/poor skill - high level of accuracy is required for many types of decision-making;
- Lack of post-processing - need for statistical post-processing techniques to calibrate forecast for reliable probabilities;
- Lack of forecast verification: request that forecasts always be provided with verification information;
- Lack of stability in forecast model output: instability/persistence of the rainfall in the forecasts prevented the use of the forecast, or they became reliable only close to the actual event;
- Challenges in interpretation of probabilities - a large share of users struggle to interpret probabilities and can have low expertise in risk management.

Proposed Real-time pilot project

- To be credible with stakeholders, the proposed pilot recognizes that demonstrations of forecast applications need to include issuing forecasts in real time, in addition to assessments over a hindcast period and previous events.

- Build upon the stakeholder survey to co-develop a set of demonstration projects in partnership with users spanning the GFCS priority areas, representing both developing and developed countries.

- Goal is to catalyze research on demonstrating S2S forecast value by making near-real-time forecasts available for a limited period of time, e.g. 2019-2020, emphasizing a concerted preparation phase beforehand.

- It could be designed to overlap with other “Years of” programmes, and coordinated activities (e.g. a competition) could be organized.

- Simple provision of real-time data will not be sufficient to promote user uptake of S2S forecast information: **Co-developed applications** often produce bespoke tools and services, which address the needs of specific users.

- Work with selected/interested users to establish guiding principles that could be picked up and used by NMHS's who wish to pull through S2S research into operational products now and in the future.

- Identify what is required in order to make the forecast data usable and how this varies between users in different sectors,

- Would certain users prefer raw forecast information? Do they have capacity to do their own analysis of the information? Do they require a product/tool to translate the forecast information into something usable? How would they want to engage with the information? How should uncertainty, skill and reliability be described/integrated? Once the data is available in real time, user engagement will be essential.

- Continued engagement will assess how the available data is used and whether it is useful, meets user requirements and has led to positive changes in the way decisions are made.

Discussion

- S2S forecast opportunities/needs by sector?
  - Disaster risk management
  - Agriculture & Food Security
  - Water resource management
  - Health (diseases, air quality, heat/cold waves)
  - Energy (supply & demand)
  - Maritime climate services (marine heat waves, sea level, sea ice)
  - …
- “Climate-smart” management vs early warning?
- “Seamless” climate-weather services, forecast updating, frequency?
- Forecast product formats, probabilities of user-defined shocks?
- Forecast downscaling/tailoring/coupling with sectoral models?
- Assessment of S2S forecast value? Verification, Co-production with stakeholders?