03

Putting the user first: (potential) applications of S2S predictions for decision making
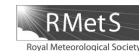
Sectoral applications of S2S predictions:
Putting the user first

Churchill Fellowship in 2014: aim was to gain information about the progress international research institutions are (1) making in the development and use of 'S2S forecasts and/or longer-term climate predictions of extreme events, and (2) to explore potential applications of these forecasts for a range of decision–makers and sectors.

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

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ABSTRACT: While seasonal outlooks have been operational for many years, until recently the extended-range timescale referred to as subseasonal-to-seasonal (S2S) has received little attention. S2S prediction fills the gap between short-range weather prediction and long-range seasonal outlooks. Decisions in a range of sectors are made in this extended-range lead time; therefore, there is a strong demand for this new generation of forecasts. International efforts are under way to identify key sources of predictability, improve forecast skill and operationalize aspects of S2S forecasts; however, challenges remain in advancing this new frontier. If S2S predictions are to be used effectively, it is important that, along with science advances, an effort is made to develop, communicate and apply these forecasts appropriately. In this study, the emerging operational S2S forecasts are presented to the wider weather and climate applications community by undertaking the first comprehensive review of sectoral applications of S2S predictions, including public health, disaster preparedness, water management, energy and agriculture. The value of applications-relevant S2S predictions is explored, and the opportunities and challenges facing their uptake are highlighted. It is shown how social sciences can be integrated with S2S development, from communication to decision-making and valuation of forecasts, to enhance the benefits of 'climate services' approaches for extended-range forecasting. While S2S forecasting is at a relatively early stage of development, it is concluded that it presents a significant new window of opportunity that can be explored for application-ready capabilities that could allow many sectors the opportunity to systematically plan on a new time horizon.
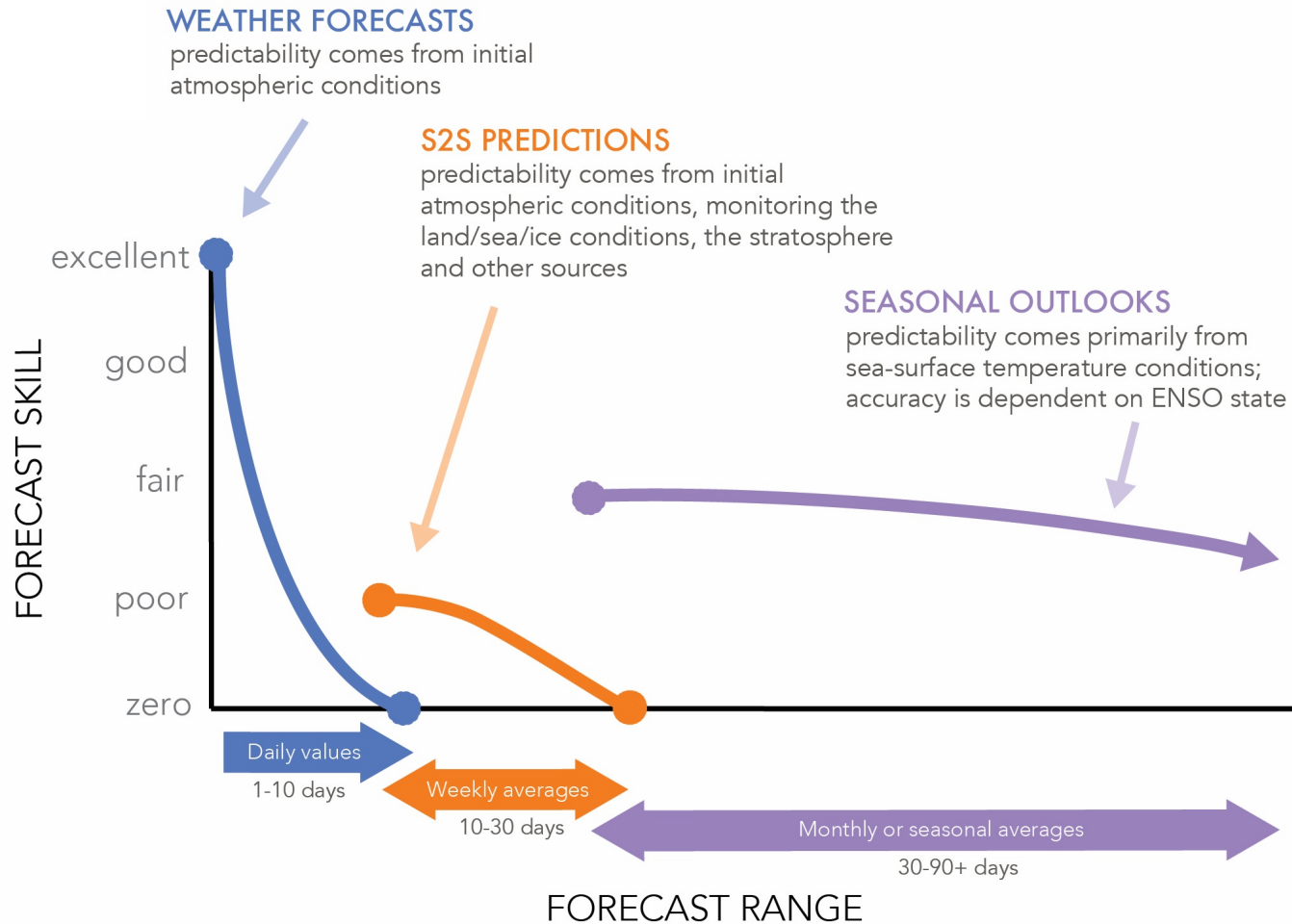
KEY WORDS climate prediction; forecasting; decision-support; ensemble forecasts; extremes; extended-range; seasonal prediction

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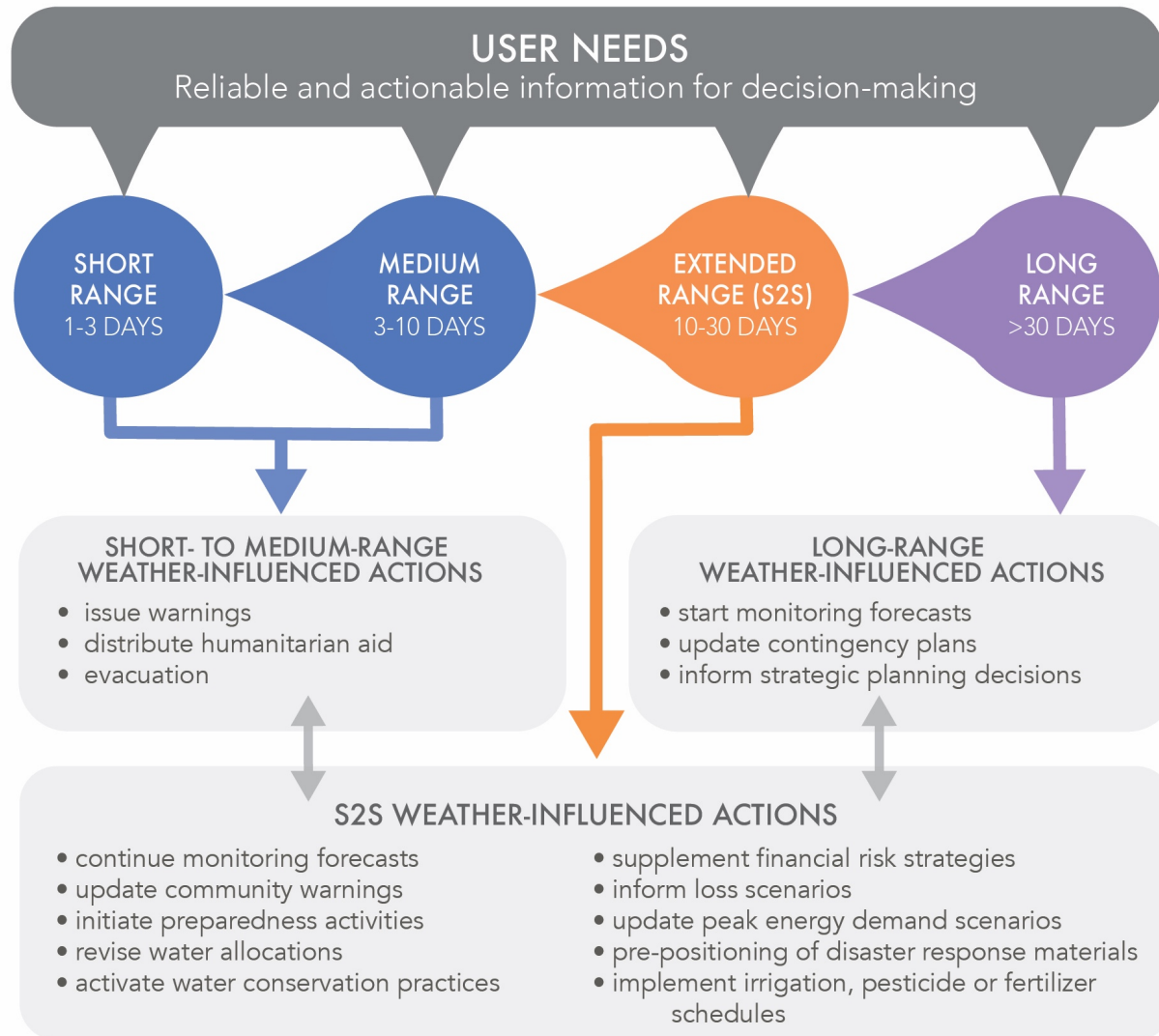
2013 CHURCHILL FELLOW

White, C.J. *et al.* (2017) Potential applications of subseasonal-to-seasonal (S2S) predictions, *Meteorological Applications*

The subseasonal-to-seasonal (S2S) timescale:
A relatively unexplored predictive timescale

WEATHER FORECASTS
predictability comes from initial atmospheric conditions

S2S PREDICTIONS
predictability comes from initial atmospheric conditions, monitoring the land/sea/ice conditions, the stratosphere and other sources

SEASONAL OUTLOOKS
predictability comes primarily from sea-surface temperature conditions; accuracy is dependent on ENSO state

FORECAST SKILL — excellent, good, fair, poor, zero

Daily values — 1-10 days

Weekly averages — 10-30 days

Monthly or seasonal averages — 30-90+ days

FORECAST RANGE

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University of **Strathclyde**

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Sectoral applications of S2S predictions: Humanitarian and development sectors

S2S could support early warning and disaster risk reduction activities by tracking the progress of evolving (and potentially threatening) climate modes throughout the transition from seasonal outlooks to weather forecasts, i.e. shift the conversation from **response** to **resilience**.
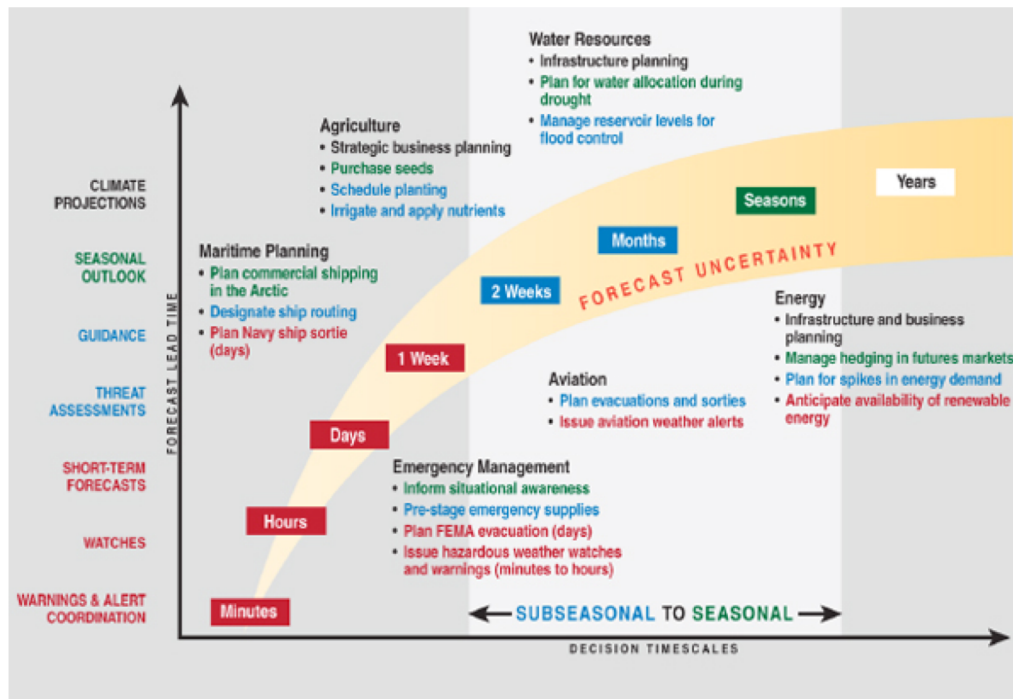
National Academies of Sciences, Engineering, and Medicine. 2016. *Next Generation Earth System Prediction: Strategies for Subseasonal to Seasonal Forecasts*. https://doi.org/10.17226/21873

Sectoral applications of S2S predictions:
Water management

S2S lead times cannot be used to make specific flood predictions but S2S could bridge the flood and streamflow forecasting communities to provide seamless flood forecasting with longer lead times, with benefits for sub-seasonal water resource management decision-making.

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Moderate to high skill

Low skill or missing climate data

Very low skill or missing antecedent condition data

Pie chart legend

■ Likelihood of high flow (%)
■ Likelihood of near median flow (%)
■ Likelihood of low flow (%)

Sectoral applications of S2S predictions: Agriculture

S2S predictions could supplement the current use of forecasts through supporting early action in the face of weather extremes, for example scheduling irrigation and pesticide application around heavy rainfall events or heat waves. Forecasts on the S2S timescale could also be used to support dynamic updates of crop yield estimates, which could support early planning to alleviate food security issues.

Sectoral applications of S2S predictions:
Energy

Energy pricing, production and usage is intricately tied to weather-related risk. Weather forecasting is already routinely used in many areas of the energy sector, so the development of successful relationships and the integration of S2S forecasting may be easier to achieve compared to other sectors. S2S forecasts could also be used to manage infrastructure and schedule maintenance, for example on wind farms where work can be stopped (and money lost) during high winds.

Sectoral applications of S2S predictions:
Public health

Public health has been highlighted as a key potential area for the application of seamless weather-to-climate forecasts, since decisions here cover a range of timescales that impact health outcomes (e.g. expected disease outbreak patterns, available medical supplies). This is particularly the case for developing nations, where climate-sensitive diseases threaten millions of people.

① Whole pollen grains get swept up into cloud as storm matures.
Flowery grasses **Whole grain fragments**

② Moisture in the cloud fragments the pollen into smaller pieces.

③ Dry, cold outflows carry pollen fragments to ground level, where people breathe them into their lungs.
Pollen fragments