The Bureau of Meteorology

Marine Heatwave Prediction from weeks to months to seasons

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Impacts of Marine Heatwaves

Above average ocean temperatures leading to marine heatwaves (MHW) have implications for many marine ecosystems and industries. The impacts felt include mass coral bleaching and mortality, altered aquaculture yields and changes in wild fish migration patterns. Impacts are related to marine heatwave severity, duration, and also event onset and decline rates. MHW definition is when the 90th percentile temperatures are exceeded for more than five days (Hobday et al. 2016), but they can persist for weeks, months, and even seasons.

Subseasonal to Seasonal Forecasting

Seasonal forecasts of marine heatwave risk covering timescales from weeks to seasons from dynamical ocean-atmosphere models can be very useful tools for marine managers, businesses and researchers. The Australian Bureau of Meteorology's seasonal forecast model ACCESS-S2 currently produces operational real-time forecasts of both sea surface (SST) and sub surface temperatures, which can be post-processed to produce marine heatwave metrics.

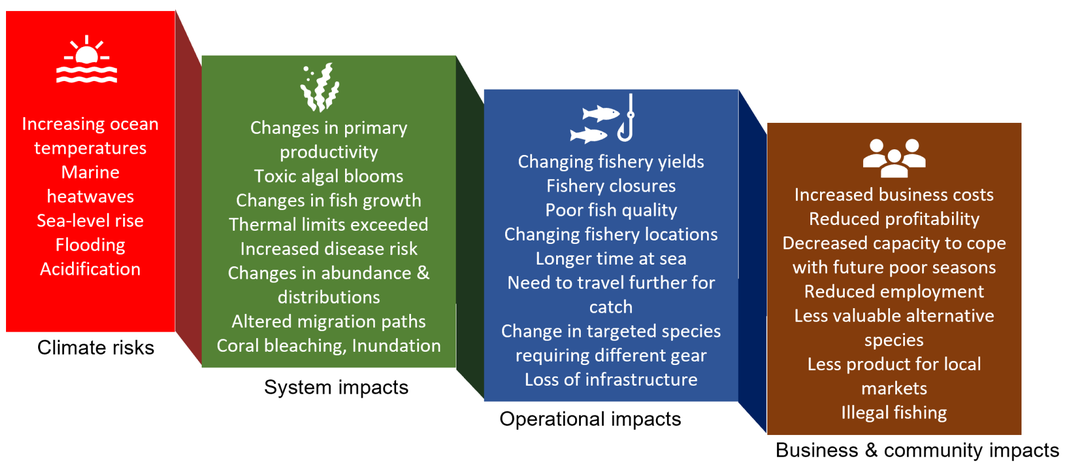
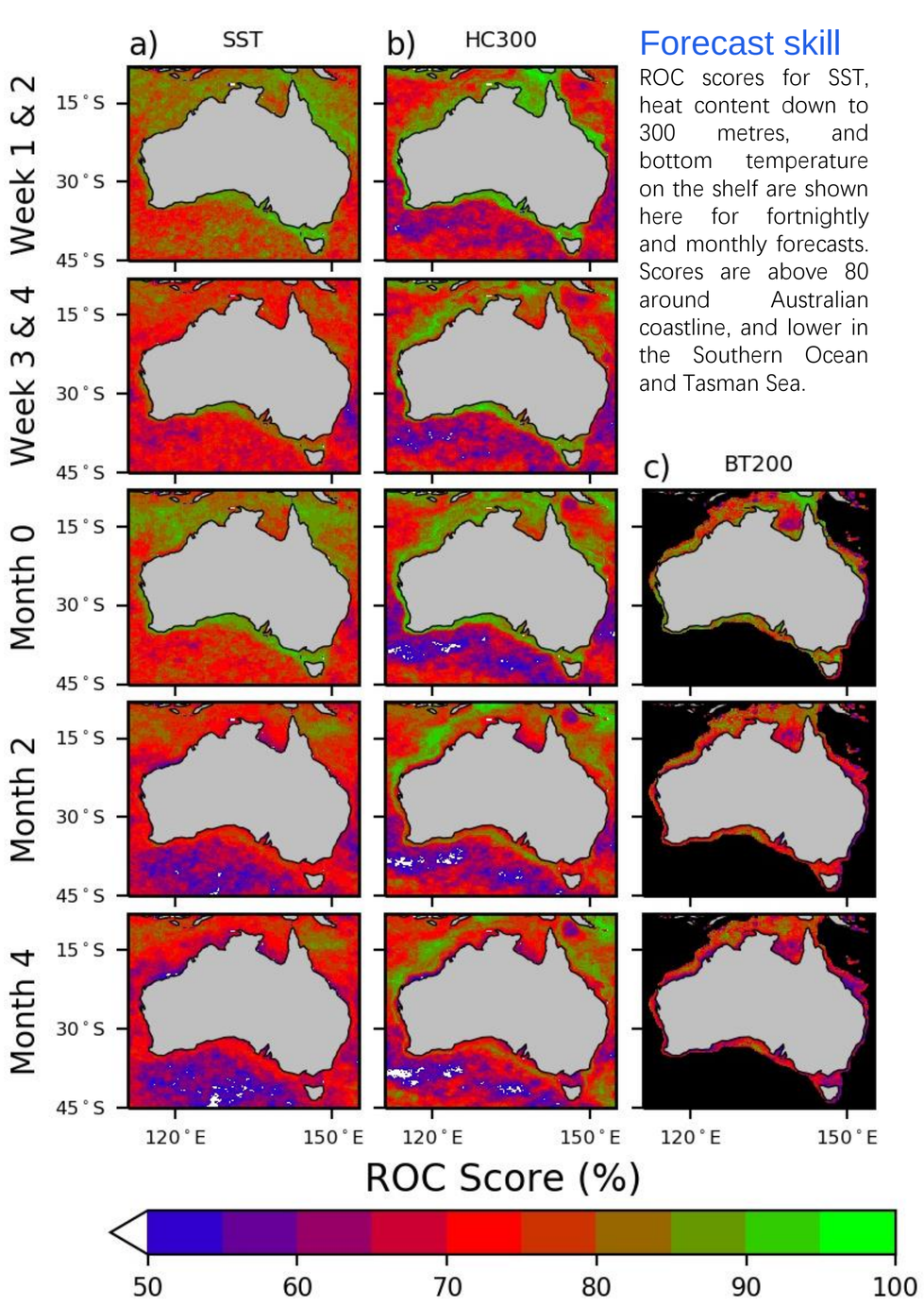


Figure 1. Climate risks result in impacts on marine systems which flow through to affect operational aspects of marine businesses and ultimately marine industries and coastal communities (Hartog et al. 2023).

Model skill in forecasting extreme events like marine heatwaves depends on time of year, forecast lead time, event intensity and duration, and the timing of event. These factors also impact systems, operations, and business/community (Figure 1) depending on user agility to deal with such events. The skill metric relative operating characteristic (ROC) scores have been calculated and shown in Figure 2. ROC scores indicate the model's ability to discriminate events (>90th percentile) with non-events, with scores above 50% deemed acceptable.



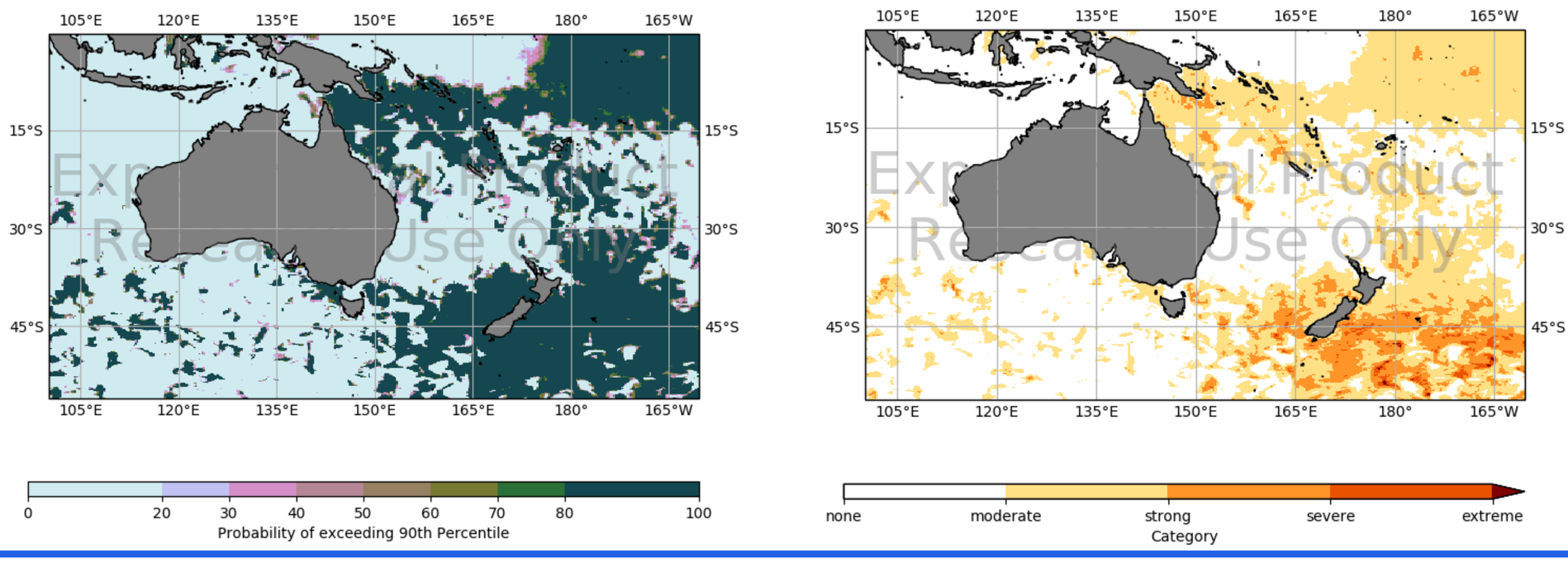
Forecast skill

ROC scores for SST, heat content down to 300 metres, and bottom temperature on the shelf are shown here for fortnightly and monthly forecasts. Scores are above 80 around Australian coastline, and lower in the Southern Ocean and Tasman Sea.

Figure 2. Monthly and fortnightly ROC scores for exceeding the 90th percentile for a) SSTA, b) HC300 and c) bottom temperature (BT200) anomalies for all start dates (Smith & Spillman, 2023).

Marine Heatwave Forecast Products

Experimental products based on marine heatwave metrics using subseasonal to seasonal forecasts and probabilities of exceeding the 90th percentile have been developed. Products are based on probabilistic as well as ensemble mean forecasts, including detail on likely MHW category (Hobday et al. 2018). These new products will complement existing operational accumulated thermal stress forecast products developed for coral bleaching to improve both the understanding and the management of these events.



References

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https://research.csiro.au/cor/climate-impacts-adaptation/marine-heatwaves/dynamical-forecasting-of-marine-heatwaves/

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