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Verification of sub-seasonal sea surface temperature forecasts for fish farms along the Norwegian coast

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Climate variations have the potential to strongly affect aquaculture production. By having access to reliable predictions at extended and long-range lead times, aquaculture can take preventative measures. For instance, variability in water temperature influences the growth and mortality rates of farmed fish. Fish farmers can, if they have reliable forecasts, take action against unfavorable changes in water temperature by moving the sea cages and alter feeding schemes and slaughter times accordingly. In this way, one can minimize production loss, and production can become more sustainable. We present how sub-seasonal forecasts from ECMWF can be used to provide skilful forecasts at lead times of two to four weeks at various fish farm locations in Norway by including post-processing methods that use on-sight observations as a predictor. Sub-seasonal forecasts are expected to capture grid scale variations and larger-scale phenomena in sea temperature. However, fish farms often lie in complex coastal areas and are therefore prone to local effects like river runoff and smaller scale currents, which are not adequately represented in the sub-seasonal forecast models. First, we assess the forecast skill for all seasons for the fish farms along the Norwegian coast. The Norwegian fish farms are located in various regions, from off-shore to practically closed-off fjord environments. It is clear that forecast skill is reduced the further in the fjords the fish farms are located. Post-processing the forecasts by including information on the persistence of water temperatures improves the skill in the fjords, compared to using the ECMWF sub-seasonal forecasts alone. The post-processing model is simple to implement and may enhance water temperature forecast skill in regions that are influenced by local processes. Moreover, this overview of forecast skill may guide forecasters and fish farmers on when, and where, to trust the sub-seasonal forecasts, which is crucial for decision making and can be beneficial for the economy and the industry's environmental sustainability.