What is the accuracy of seasonal forecasts for informing agricultural decisions?

Seasonal forecasts - looking several months out into the future - are often perceived by decision-makers as lacking sufficient accuracy for use in agricultural decision-making. However, we find that a tailored seasonal forecast (e.g. a forecast of a variable on watershed level for growing season) does have the accuracy to inform at least some agricultural decisions.

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This research highlight is based on work in progress.

Even with the recent advances in seasonal climate forecasting systems, seasonal forecasts remain underutilized in agricultural decision-making. This can be attributed to a lack of availability of forecasts of decision-relevant variables and for decision-

Irrigation equipment on wheat and potato fields in Washington State.

timeframes, a mismatch between when the forecast is needed and when it is provided, and a perceived lack of accuracy. All these reasons ultimately led decision-makers to perceive that the forecast is not useful and/or its accuracy is not good enough.

Our goal was to assess the potential usefulness of seasonal forecasts in informing two characteristically different decisions with differing decision timeframes and variables. These were (a) whether to apply fertilizer in fall or wait until spring based on expected winter temperatures and (b) whether to initiate a drought response (e.g., lease water) or not based on expectations of drought. We conducted an assessment of seasonal forecasts to provide a quality metric of forecast that informs users "how good the forecast is relative to the observation or another reference forecast". We used a skill metric called "Heidke Skill Score" (HSS),

which ranges from -100 to 100%, with a positive HSS indicating that the forecast is better than the reference forecast (or historical average) and a negative HSS indicating the forecast performs worse than the reference forecast. Zero HSS indicates no skill, meaning the forecast is as good as the reference forecast.

Application of fertilizer to dryland spring crops in the fall provides logistical and management advantages to the farmers as it not only cuts down a time-intensive farm operation in the spring but also allows nutrients to be better positioned within the soil matrix to be efficiently taken up by the spring crops. It is crucial to have an advance knowledge of the upcoming winter temperatures (November through February) for this decision, as unusually warmer winters can lead to fertilizer loss

Applying liquid fertilizer to a wheat field.

through mineralization, causing economic losses to farmers. Our study reported a positive HSS for the majority of the Pacific Northwest region of the United States (PNW) for up to three months in advance (Figure 1). Moreover, the forecast has better skill/accuracy in predicting unfavorable conditions (i.e., unusually warmer winters) than favorable conditions, which has far greater economic importance. This knowledge is instrumental in assisting farmers in making informed decisions for optimizing agricultural practices in fertilizer

scheduling. Analogous to the fall fertilizer application decision, we conducted a skill assessment for a drought response decision, where decision-makers (such as water managers) have to take actions (e.g., lease water for the upcoming growing season) based on the drought or regional water supply forecasts. Water supply/drought forecasts are expected to be reliable around April 1st, when the peak snowpack accumulation occurs in PNW. However, decision-makers have already made their decision for the upcoming season by this time, thus, there is interest

Figure 1. Heidke Skill Score (HSS) of average temperature for the November – December – January – February (NDJF) season in the Pacific Northwest. The subplots from left to right correspond to the forecast lead month from the beginning of a season (i.e., when the forecast is made available for a particular season). The top row exhibits the HSS for the forecast of cold winters versus non-cold winters, whereas the bottom row shows the HSS for the forecast of warm winters versus non-warm winters.
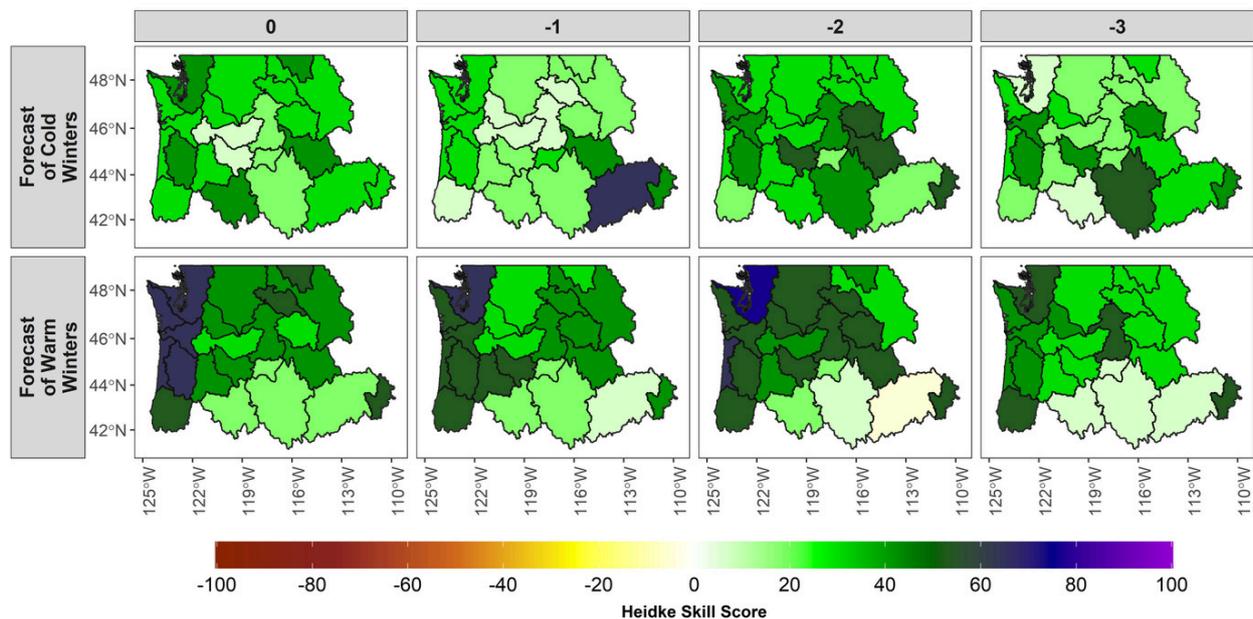
in the earlier availability of forecasts. Our findings indicate an overall positive skill/accuracy for the eastern irrigated watersheds. Additionally, the skill does not substantially degrade for forecasts made up to two months in advance (Figure 2). This has important implications for drought management in this region, the

ability to have similar skill in drought prediction up to two months in advance of the start of the irrigation season (i.e., in February) will allow better facilitation of emergency drought declarations and programs, and strategies, such as water leases, to mitigate the impacts of drought.

The use of seasonal forecasting approaches shows promise for informing agricultural decisions related to fall fertilizer application and drought response, as they provide relatively accurate information for the desired locations and at the time when decisions need to be made.

Figure 2. Heidke Skill Score (HSS) of drought forecast based on the regional water supply for the growing season in the Pacific Northwest. The x-axis orientation is the same as Figure 1.
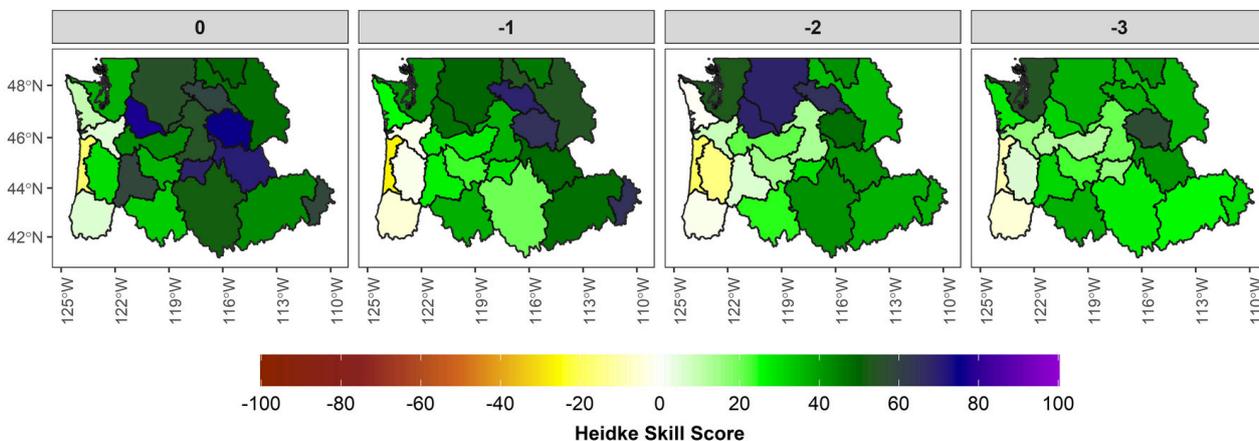
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