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Subseasonal Predictability of the North Atlantic Oscillation

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Skillfully predicting the North Atlantic Oscillation (NAO), and the closely related Northern Annular mode (NAM), on “subseasonal” (weeks to a few months) timescales is a high priority for operational forecasting centers, because of the NAO’s association with high-impact weather events. Unfortunately, the relatively fast, weather-related processes dominating overall NAO variability are unpredictable beyond about two weeks. On longer timescales, the tropical troposphere and the stratosphere provide some predictability, but they contribute relatively little to total NAO variance. Moreover, subseasonal forecasts are only sporadically skillful, suggesting the practical need to identify the fewer potentially predictable events at the time of forecast. Here we construct an observationally-based Linear Inverse Model (LIM) that predicts when, and diagnoses why, subseasonal NAO forecasts will be most skillful. We use the LIM to identify those dynamical modes that, despite capturing only a fraction of overall NAO variability, are largely responsible for extended-range NAO skill. Predictable NAO events stem from the linear superposition of these modes, which represent joint tropical sea-surface temperature-lower stratosphere variability plus a single mode capturing downward propagation from the upper stratosphere. Our method has broad applicability because both the LIM (run operationally at NOAA’s Climate Prediction Center) and the state-of-the-art European Centre for Medium-Range Weather Forecasts Integrated Forecast System (IFS) have higher (and comparable) skill for the same set of high skill forecast events, suggesting that the low-dimensional predictable subspace identified by the LIM is relevant to real-world subseasonal NAO predictions.