Learning from a failed prediction: A multimodel study of a subpolar North Atlantic cold extreme

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The subpolar North Atlantic (SPNA) Ocean was near-record cold during 2015, contributing to summer heatwaves in Europe. Climate prediction systems, however, struggle to predict the 2015 “cold blob,” even when initialized only a season or two in advance of its peak. Given the increased likelihood for future background SPNA cold conditions, analysis of why this event was particularly challenging is needed to identify directions for future prediction system development and to assess when we can and cannot realistically expect predictability for extreme cold events. Here we compare the observed evolution of the 2015 cold blob to that in eight different climate prediction system hindcasts initialized two to nine months in advance of the blob’s peak. Most prediction systems were initialized with a well-placed weak cold blob at the surface, but by summer 2015, few hindcast ensemble members produced the 2015 cold blob’s intensity or spatial extent. One clue for the discrepancy is found in the upper ocean temperature: although the cold blob in the upper 300m persists from initialization through summer 2015 in the hindcasts, its extent is always too spatially limited. Another key feature that sustained the observed cold blob through the winter – the very positive winter North Atlantic Oscillation (NAO) – is generally not present in the hindcasts. While NAO predictability on seasonal to multiyear timescales has been demonstrated in past studies, it was not demonstrated by the hindcasts in this case. The few hindcast members that do have a very positive winter NAO also have a cold blob. Finally, we examine the modest early summer surface cooling that led to the blob’s amplification; some hindcasts have sufficient spread in this field, while others do not. Together, these results suggest that improved upper ocean initial conditions may lead to a more sustained cold blob prediction, but that possibly unpredictable atmospheric variability drove much of the event’s evolution.