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Multi-year forecast of Atlantic tropical cyclone activity using EC-Earth

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Seasonal forecasts of Atlantic hurricane activity are now routinely performed by various groups and have become relatively successful at forecasting basin wide activity a few months before the official start of a hurricane season. Part of the skill in predicting the level of tropical cyclone activity for a given season comes from the ability to predict the behaviour of ENSO, which strongly impacts (through teleconnections) hurricane formation over the Atlantic. Over the same basin, the $\sim$100 years of available hurricane records also show variations at the decadal timescale. This decadal fluctuation appears linked to an oscillation in North Atlantic sea surface temperatures (SSTs). Coined the Atlantic Multi-decadal Oscillation (AMO), a successful multi-year forecast of this oscillation offers the potential to produce a skillful multi-year forecast of hurricane activity. Such forecast could help mitigate against (potentially huge) hurricane-related losses through improved preparedness and improved insurance schemes.

Using EC-Earth, a coupled global atmosphere-ocean model, we perform a series of ensemble decadal re-forecasts at 5 year intervals between the 1965-2005 period and investigate the ability of these re-forecasts at capturing observed variations in North Atlantic SSTs (in essence, the AMO) as well as other large-scale fields known to impact cyclogenesis. We also use an automated procedure to track the tropical cyclones produced in these re-forecasts, which then allows direct comparison with the actual number of tropical cyclones that formed over the equivalent period.

Preliminary analysis shows that EC-Earth re-forecasts manage to capture variations in large-scale fields relatively well, especially variations in the AMO, which suggests a potential for skillful multi-year forecast of Atlantic tropical cyclones. However, direct comparison of simulated and observed TC numbers does not offer the same level of skill. Tropical cyclone numbers in the re-forecasts are biased low, and this appears to result not only from the low-resolution of the simulation ($\sim$1.125°), but also from a drift in simulated SSTs. This drift brings surface temperature below the 26°C threshold required for tropical cyclone formation, effectively shutting down storm formation over large parts of the tropical Atlantic. Potential solutions to circumvent these limitations are currently being considered and will be discussed.