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Beyond the tropical Pacific: Medieval climate dynamics and the role of Indian Ocean SSTs

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Proxy evidence suggests that climate during the Medieval Climate Anomaly (MCA) was marked by a distinctive pattern of winter aridity through much of the Northern Hemisphere subtropics, an intensified North Atlantic Oscillation (NAO), and there are clear indications for a cooler, drier eastern tropical Pacific. Similarly timed shifts in marine and terrestrial climate are seen in many other regions of the planet including the Southern Hemisphere. The global distribution, persistence and general coherence of these changes imply that tropical SSTs were a main forcing mechanism. To date, model experiments exploring this "tropically-forced MCA" hypothesis logically have focused on the idea of a "cool tropical Pacific". The results show that while the "cool tropical Pacific" simulations reproduce some important attributes of Medieval climate (e.g., aridity in the western US), other major attributes inferred from proxy records are not well reproduced – these include a strengthened NAO, well-defined SST changes in the North Atlantic, and increased aridity from northwest Africa into southwest Asia.

We have looked beyond the tropical Pacific for regions important to forcing large-scale MCA climate anomalies and present results from coupled model simulations in which tropical Indian and far western Pacific SSTs were warmed slightly (0.5-1.0C). The model response closely resembles many of the characteristics of MCA climate described earlier, and agrees with a number of climate proxy records for boreal summer as well. Among the features of the model response are a slightly cooler and much drier eastern tropical Pacific, reduced precipitation in western North America and a persistently enhanced NAO with related subtropical aridity extending through the Mediterranean, parts of North Africa and into southwest Asia. The model results also show changes in North Atlantic SSTs and sea ice in good agreement with marine proxy records. The simulated circulation changes are quite similar to those from other model experiments focused on the impacts of Indian Ocean during the second half of the 20^{th} century.