Effects of atmosphere and ocean horizontal model resolution on upper ocean response forecasts in four major hurricanesEffects of atmosphere and ocean horizontal model resolution on upper ocean response forecasts in four major hurricanes

A coupled atmosphere-ocean model is necessary for tropical cyclone (TC) prediction to accurately characterize ocean feedback on atmospheric processes within the TC environment. Here, the ECMWF coupled global model is run at horizontal resolutions from 9 to 1.4 km in the atmosphere, and from 25 to 8 km in the ocean, to identify how resolution impacts forecast accuracy of four major TCs in the Atlantic: Irma, Florence, Teddy and Ida. Salinity and temperature observations from Air-Launched Autonomous Micro-Observer (ALAMO) floats are used to validate modeled upper ocean response, including mixed layer deepening, sea-surface cooling, and near inertial waves in the wakes of TCs. Increasing atmospheric resolution leads to more realistic TC structure and stronger winds, significantly improving TC intensity forecasts and modestly improving track errors. Ocean resolution impacts the upper ocean response but does not influence atmospheric forecasts for the fast-moving TCs considered here. Stronger mixing, sea-surface cooling, and near-inertial oscillations are found for both higher atmosphere and ocean resolutions, provided the initial upper ocean state is the same for the two ocean resolutions. Whether this agrees better with the ALAMO observations also depends on the realism of the initial upper ocean state in the model, emphasizing the importance of ocean initialization for the accurate upper ocean response.

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