Idealized Experiments on Tropical, Extratropical and Hybrid Cyclones over the North Atlantic Ocean in Autumn

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The North Atlantic Ocean in autumn is associated with diverse cyclone activity including tropical cyclones, extratropical cyclones, hybrid cyclones and inactive cyclone development. To examine whether the climatological environment explains the geographical distribution of the diverse cyclones, we conduct idealized numerical experiments using climatologically averaged environmental fields at different longitudes and latitudes. The experiments reproduce not only the zonal contrast between active cyclone development in the west and inactive cyclone development in the east, but also the meridional distribution of deep warm-core cyclones in the tropics, hybrid cyclones in the subtropics, and deep cold-core cyclones in the extratropics. The hybrid cyclones show multi-scale structures with tropical characteristics on a small scale and extratropical characteristics on a large scale. Sensitivity experiments show that vertical shear affects cyclone dynamics differently depending on the cyclone types. Thus, the idealized experiments demonstrate that the simplified environment can explain the geographical distribution of development and types of the diverse cyclones over the North Atlantic Ocean qualitatively, while some missing processes such as temporal variations and external forcing may be necessary for interpreting cyclone dynamics in the real atmosphere more quantitatively.