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Identifying the origin of precipitation moisture within the tropical cyclones outer radius in the North Atlantic basin

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Tropical cyclones (TCs) are one the principal natural hazards for coastal regions in tropical and subtropical latitudes. On a global scale, around 90 TCs form annually, and approximately 16% of them originated in the North Atlantic (NATL) basin. Heavy rainfall, one of the major hazards associated with TCs, can cause catastrophic flash flooding, landslide and related health and socio-economic problems. Therefore, understanding the precipitation origin during the passage of TCs is important to significantly aid in disaster mitigation and risk analysis. This work seeks to identify the origin of precipitation moisture within the TCs outer radius in the NATL basin from 1980 to 2018 by applying a Lagrangian moisture tracking method to air parcel trajectories. The TC information (intensity and position) was retrieved from the HURDAT2 database, while the outer radius was from the TCSize dataset. The pathways of air parcels that precipitated within the TC outer radius were obtained from the global outputs of the FLEXible PARTicle dispersion (FLEXPART) model fed by ERA-Interim reanalysis provided by the European Center for Medium-Range Weather Forecasts. The spatial moisture sources pattern exhibited a north-south split around 10ºN, coinciding with the mean position of the Intertropical Convergence Zone (ITCZ) during the boreal summer. The highest moisture contribution (~39%) during the genesis and peak of maximum intensification was from the tropical Atlantic Ocean north of ITCZ, including ~11% from the Caribbean Sean and ~6% from the Gulf of Mexico, followed by the western NATL (WNATL) with 23.8% and eastern NATL (ENATL) with 16.6%. Curiously, ~10% of moisture was from the Atlantic Ocean south of ITCZ and ~2% from the eastern Pacific Ocean. During the dissipation phase, the moisture sources shifted poleward as TCs moved, with the highest moisture support (~60.3%) from the subtropical north Atlantic Ocean (WNATL + ENATL) and ~11.2% from the NATL north of 50ºN. This behaviour shows that moisture sources for TCs precipitation are located circa to their positions. Indeed, by investigating the moisture uptake pattern along the TCs trajectories, we detected that the highest moisture uptake generally occurred within 3-5º from the TC track. Likewise, the moisture uptake within 2000 km from the TC centre was approximately two times higher during the rapid intensification than during the slow intensification process. Furthermore, the relative position of moisture sources to the TC centre changed from 24 hours before the extratropical transition (ET) process to 24 hours after. That is, before ET, the moisture sources were located in the southwest-south sector, while after ET appeared in the west-southwest sector. Overall, this work provides new insights into the TCs' climatology in the NATL basin. Additionally, these findings can be used as a reference to understand future changes in the origin of precipitation moisture for TCs precipitation under different climate changes scenarios.