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The Rise of Active Region Flux Tubes in the Turbulent Solar Convective Envelope MARIA WEBER, High Altitude Observatory and Colorado State University, YUHONG FAN, MARK MIESCH, High Altitude Observatory —
We use a thin flux tube model in a rotating spherical shell of turbulent convective flows computed separately from an existing 3D global simulation to study how active region scale flux tubes rise buoyantly from the bottom of the convection zone to near the solar surface. We investigate initial toroidal flux tubes at the base of the convection zone with field strengths ranging from 15 kG to 100 kG at initial latitudes ranging from 2 to 40 degrees. We find that the dynamic evolution of the flux tube changes from magnetic buoyancy dominated to convection dominated as we decrease the initial field strength from 100 kG to 15 kG. The mean properties of the final emerging loops with an initial field strength of 100 kG are in agreement with previous thin flux tube models in the absence of convection, whereas at low field strengths of 15 kG, the properties of the emerging loops are significantly changed. With convection, the rise times are drastically reduced, the loops are able to emerge at low latitudes, the majority of the emerging loops show tilt angles of the proper sign, and also show a field strength asymmetry consistent with the observed morphological asymmetry of active regions. We discuss the implications of these results with regard to the field strength of the dynamo generated large-scale toroidal magnetic field at the base of the solar convection zone.

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