

## **El Niño–Southern Oscillation in ionospheric and thermospheric tides**

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El Niño–Southern Oscillation (ENSO) has been suggested as a potentially significant energy source that affects the Earth's upper atmosphere from the ocean and lower atmosphere. However, solid evidences and physical mechanisms still remain obscure due to the complex natural of the atmosphere-ionosphere-solar system. In this study, we analyze the 20-year (1996 to 2016) simulations of ionospheric plasma density and thermospheric temperature from the Whole Atmosphere-Ionosphere Coupled Model (GAIA), and show the ENSO signals in ionosphere and thermosphere. The agreements between the model simulations and the satellite observations from FORMOSAT-3/COSMIC and TIMED/SABER suggest that the ENSO signal generated from troposphere may affect the SPW4 in ionosphere via the interaction of the DE3 and DW1 in thermosphere.