



HAO Colloquium Series

(Refreshments served)

Speaker: Hanli Liu, HAO/NCAR

Time: 1:30–2:30 pm

Date: Wednesday, March 28, 2012

Location: CG1-South Auditorium

Title: Atmospheric waves and upper atmosphere variability

Abstract:

The mesosphere, thermosphere and ionosphere are highly variable, not only due to solar and magnetospheric forcing, but also by perturbations from the lower atmosphere, as is increasingly appreciated by recent observational and theoretical studies. These studies also suggest that atmospheric waves are likely the key agent for coupling the upper atmosphere with the lower atmosphere. We investigate two possible mechanisms through which the lower atmosphere can affect the ionospheric variability at low latitudes: namely tidal variability due to its interaction with quasi-stationary planetary waves, and secondary generation of gravity waves excited by the body forcing from dissipation of primary gravity waves from the lower atmosphere. The former may be most significant during stratospheric sudden warming events when the quasi-stationary planetary waves become large, as evidenced by recent observations. It is found that the modification of the E-region dynamo by the change of tides plays a key role in the ionospheric variability in this process. The contribution of various tidal components to the wind dynamo change, and the dependence of the ionospheric responses to solar activities are also studied. The secondary gravity waves, on the other hand, can introduce large wind perturbations in both E and F regions. Depending on the local time, the wind dynamo in the E or/and F regions are affected. The impacts on the ionospheric plasma drifts and plasma transport can extend after local-midnight. The importance of quantifying atmospheric waves is also examined in the context of upper atmosphere predictability. Using the NCAR Whole Atmosphere Community Climate Model, we studied the features of error growth from the lower to the upper atmosphere. It is found that the error growth in the middle and upper atmosphere is largely determined by the loss of skills in quantifying atmospheric waves, and the error growth therein can thus be effectively reduced if the atmosphere fields are constrained at the tropopause. This also indicates that neutral dynamics (e.g. nonlinearity, wave-mean flow interaction, and atmosphere instability) in the middle and upper atmosphere may not significantly impact the predictability of those regions.

The National Center for Atmospheric Research (NCAR) is sponsored by the National Science Foundation (NSF).

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