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1.1A TROPOSPHERIC-STRATOSPHERIC EXCHANGE

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The topic of interaction between the troposphere and stratosphere has been reviewed recently by MURGATROYD and O'NEILL (1980) and HOLTON (1983), the highlights of which are described below. Circulation in the extratropical winter stratosphere is characterized by a zonal westerly flow and planetary waves of zonal wave numbers 1 and 2, which appear to be driven by vertically propagating forced planetary waves from the troposphere. The tropospheric sources attributed to these waves are orographic forcing and differential heating. On the other hand, the easterly flow of the summer extratropical stratosphere is undisturbed as planetary waves are blocked from reaching the annual variation, transient planetary wave activity varies the mean flow, resulting in stratospheric sudden warmings, which are attributed to the breakdown of the stratospheric polar night jet and coincide with enhanced upward fluxes of eddy energy from the troposphere. In contrast, the tropical stratospheric circulation is dominated by the 26-month period quasi-biennal oscillation which is driven by wave-mean flow interactions between eastward Kelvin waves and westward Rossby waves. These Kelvin and Rossby waves are forced in the troposphere, possibly by large-scale tropical convective disturbances.

Much of the observational evidence of large scale tropospheric-stratospheric exchange has been obtained by radiosonde and satellite radiance data. So far MST radars have made minimal contributions, in part due to their recent use as a meteorological tool, intermittent operation at some facilities and sparse geographic distribution. However, as more MST facilities come on-line in more locations, the good time and height resolution data throughout the troposphere and much of the stratosphere obtainable by MST radars will enhance the detail of stratospheric and tropospheric circulations and interactions. On smaller scales MST radars have already been used to examine convective forcing from the troposphere into the stratosphere and subsequent launching of gravity waves (LARSEN et al., 1982). Observations of persistent turbulent layers in the stratosphere over Arecibo, attributable to inertial oscillations, appear to propagate away from a source region near the tropopause (SATO and WOODMAN, 1982).

While much observational and theoretical interest has been devoted to effects of the troposphere on the stratosphere, few observations have been made and little is known of stratospheric effects on the troposphere. HOLTON (1983) suggests that the QBO may affect the interannual variability of the equatorial troposphere and sudden warmings may affect high latitude regions. MURGATROYD and O'NEILL (1980) suggest that stratospheric conditions may affect the upward propagation of planetary waves and cite two possible mechanisms. One proposed by Hines is the reflection of energy from higher altitudes to the regions of planetary-wave generation in the troposphere and subsequent constructive or destructive interference. The other proposed by Bates is a sensitive connection between planetary-wave structure and horizontal heat fluxes in the troposphere and stratospheric wind profile and static stability.

In summary, MST radars offer the availability of high resolution wind data in height and time needed to observe interactions between the troposphere and stratosphere. The lack of geographic coverage (e.g. equatorial regions) and insufficient data bases at many MST facilities presently inhibit studies of large-scale interactions. At present MST radars can be used to examine smaller scale interactions.

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