Temperature and Wind Variations in the Equatorial Stratosphere: Instability and the Semiannual Oscillation

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Three years of temperature observations from the UARS Microwave Limb Sounder have been analyzed for temporal variability using Fourier analysis. One recurring equatorial feature has the following properties:

1) The zonal mean temperature (T) exhibits a cold anomaly, symmetric about the equator, which typically lasts 10-20 days. 'T' changes of about 12 K have been detected. 2) The perturbation in T occu rs nearly simultaneously over a broad vertical scale, from about 10 to 1 hPa, peaking at about 2 hPa. 3) These anomalies occur near the solstices, are stronger during northern winter than summer and can precede strong winter polar events such as sudden warmings. 4) Zonally asymmetric equatorial variations detectable by MLS (zonal wavenumbers 1-7, vertical scales greater than 5 km) during these events are not large.

Additional wind data from the UK Meteorological office (provided through the efforts of R. Swinbank and A. O'Neil) show that: 6) These anomalous temperature events are accompanied by a sudden, dramatic, sustained change from mean zonal (u) westerlies to easterlies throughout the affected altitude region and that the strength of the temperature and wind anomalies are well correlated. 7) These events also occur during periods where the meridional shear in u is strong enough so that the Ertel potential vorticity is negative as far north as about 10 degrees.

Past observations of T have led to suggestions that the cold anomalies are a result of a residual circulation induced by polar wave activity. The current observations suggest instead that the cause may be inertial instability, although the simple linear theory does not match the observed structure.

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