A new approach to the study of equatorial thermospheric dynamics

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An upgrade to the Arequipa Fabry-Perot interferometer (FPI) located in southern Peru (16.2 S, 71.5 W) increased the sensitivity of this instrument for measurements of thermospheric winds and temperatures by 15 times; the resulting measurement precision was $\sim$6-7 ms-1 in the wind and $\sim$20 K in temperature for an integration period of 120 s. This improvement in measurement accuracy was achieved by replacing the photomultiplier detector with a bare CCD imaging detector camera. The improvement in measurement precision and temporal resolution allowed us to adopt a strategy of observing the 630-nm nightglow in 8 equally-spaced azimuthal directions in a total cycle time of $\sim$25 minutes. These results of Doppler shifts have been used to calculate the divergence and vorticity of the wind field and to prepare maps of the thermospheric wind field flow characteristics. The measurements of Doppler widths were used to determine meridional and zonal thermal gradients. The results for measurements during the winter solstice period (June,July of 2005) show that there is often seen a weak equatorward flow during the pre-midnight period. This flow is seen to be stronger when there is a significant midnight temperature maximum (MTM). For nights when this amplitude is greater than 50 K, there is also seen a gradient in the temperature field with hotter temperatures observed toward the equator. The magnitude of this gradient is 20 to 35 K across a separation of $\sim$800 km. It is suggested that these results imply higher order tidal components (terdiurnal) to explain the regular appearance of the wind field maps obtained from night to night.