DYNAMICS OF THE NIGHTTIME THERMOSPHERE AT ARECIBO

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Incoherent scatter radar observations of the nighttime F layer at Arecibo, Puerto Rico, are used to determine the O^+ diffusion velocity at different altitudes. Further analysis allows evaluation of the neutral wind and the ion-drag force in the direction of the magnetic meridian. The local acceleration of the meridional neutral wind is also determined. The possibility of evaluating the viscous force using incoherent scatter radar data has also been investigated. Preliminary results indicate that, at certain times and at altitudes above about 350 km, viscous drag may be a significant term in the neutral equation of motion. Combining these results allows height profiles of the meridional pressure gradient to be deduced. The pressure gradient thus derived is compared with that determined from measurements of the horizontal temperature gradient and that given by the MSIS model atmosphere.

Geophysical parameters that may be measured or derived from incoherent scatter (radar) or optical (FPI) observations at Arecibo

parameter	symbol	vertical variation	horizontal variation
electron density	N	radar	radar
ion temperature	T_i	radar	radar
electron temperature	T_e	radar	radar
neutral temperature	T_n	MSIS	FPI
meridional ion velocity	v_x	radar	radar†
zonal ion velocity	v_y	radar	-
meridional neutral velocity	u_x	radar†	FPI
zonal neutral velocity	u_y	-	FPI

† The diffusion velocity, which may be derived from the observed slope of the electron density profile and the MSIS model atmosphere, is also required to evaluate these parameters.

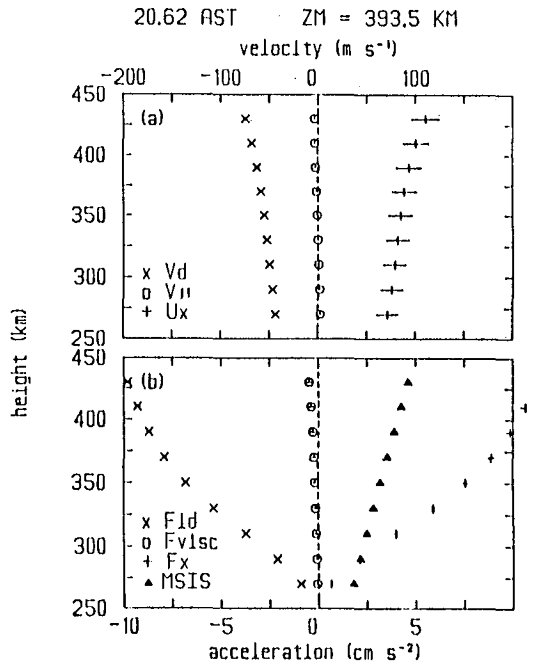
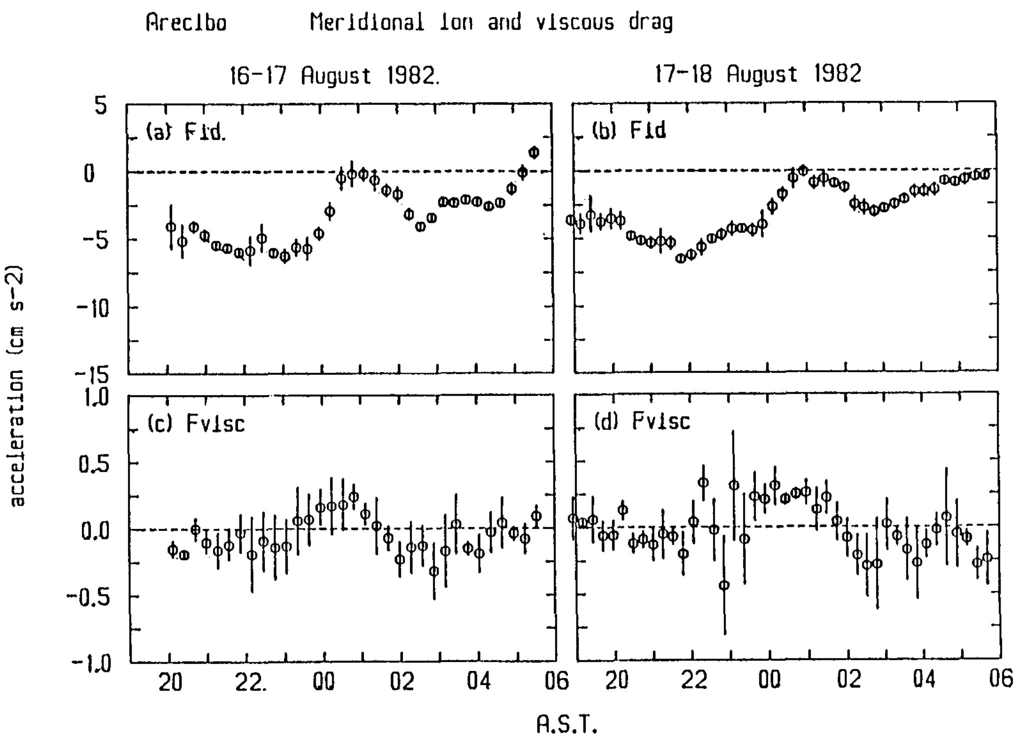
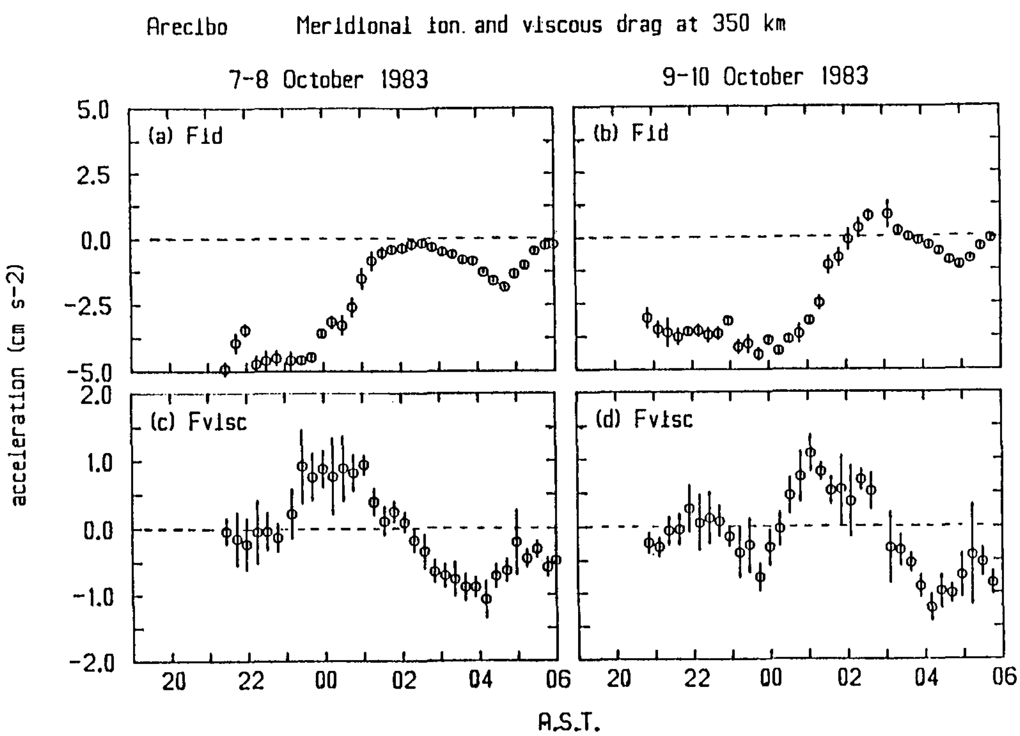
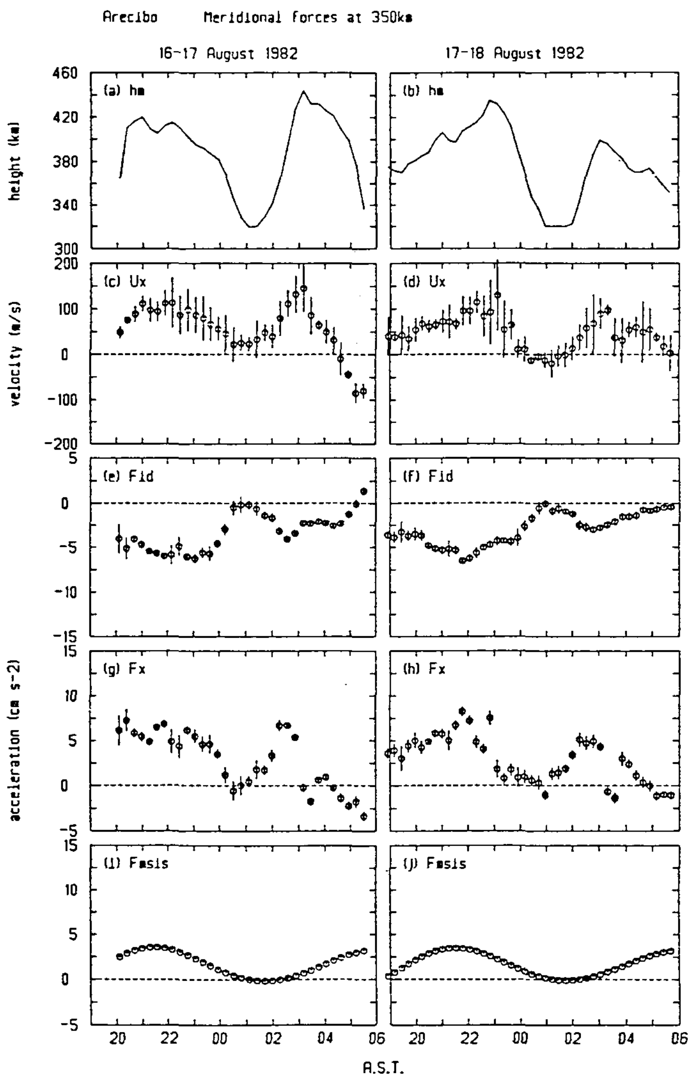


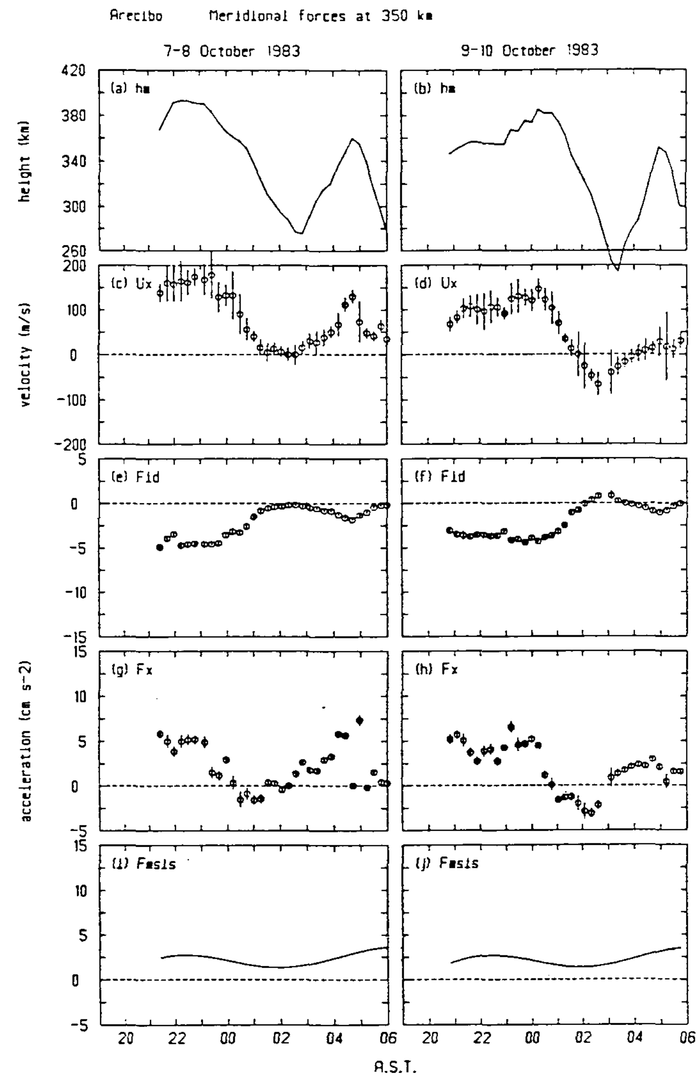
Figure 1. (a) Parallel ion velocity (v_{11}), diffusion velocity (v_d), and inferred southward neutral wind (u_x) on 17-18 August 1982. (b) Derived ion and viscous drag accelerations, and the net southward pressure gradient.





Figures 2 and 3. Examples of meridional ion and viscous drag at 350km above Arecibo.





Figures 4 and 5. h_m = height of F layer peak. u_x = southward neutral wind velocity. F_{id} = inferred ion drag. F_{visc} = viscous drag. F_x = inferred net southward pressure gradient. F_{msis} = pressure gradient predicted by MSIS-83 model atmosphere.

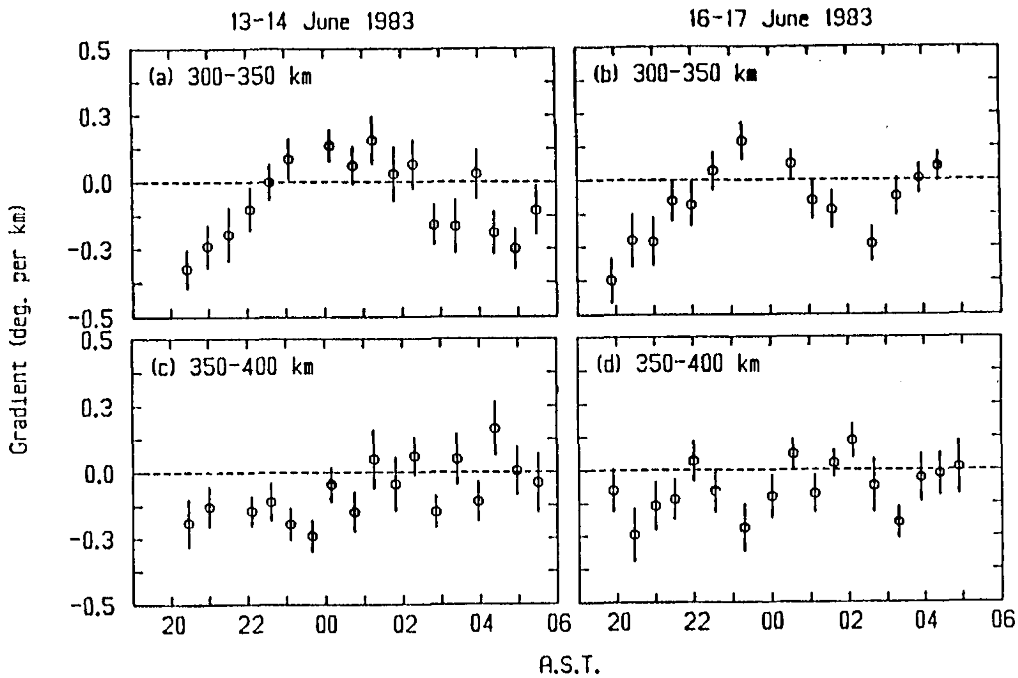


Figure 6. Observed meridional gradients in ion temperature from incoherent scatter measurements at Arecibo.

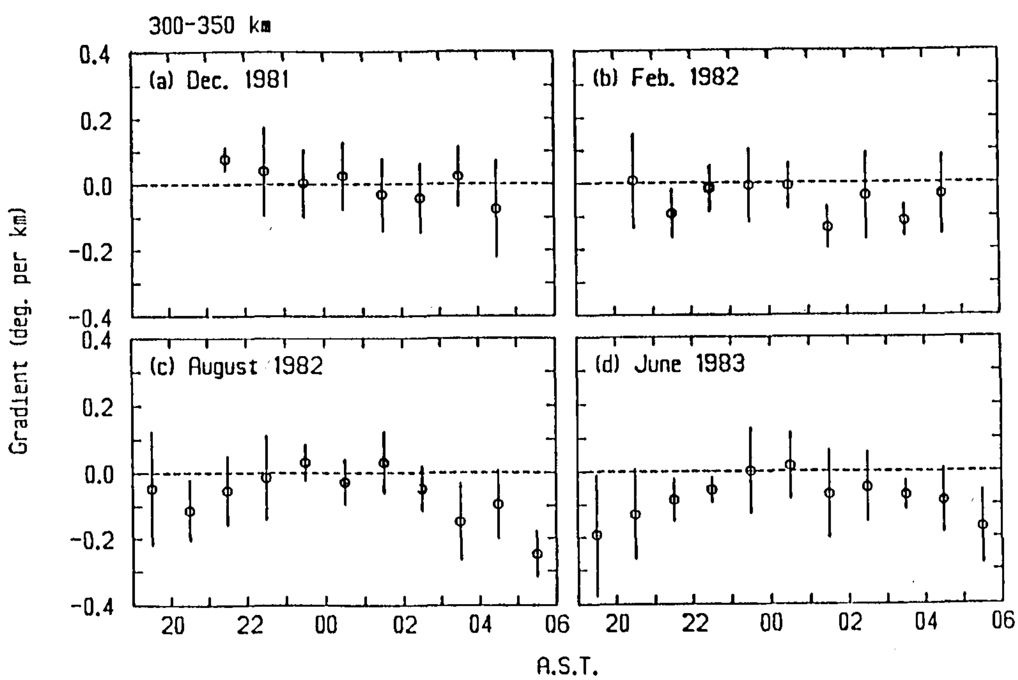
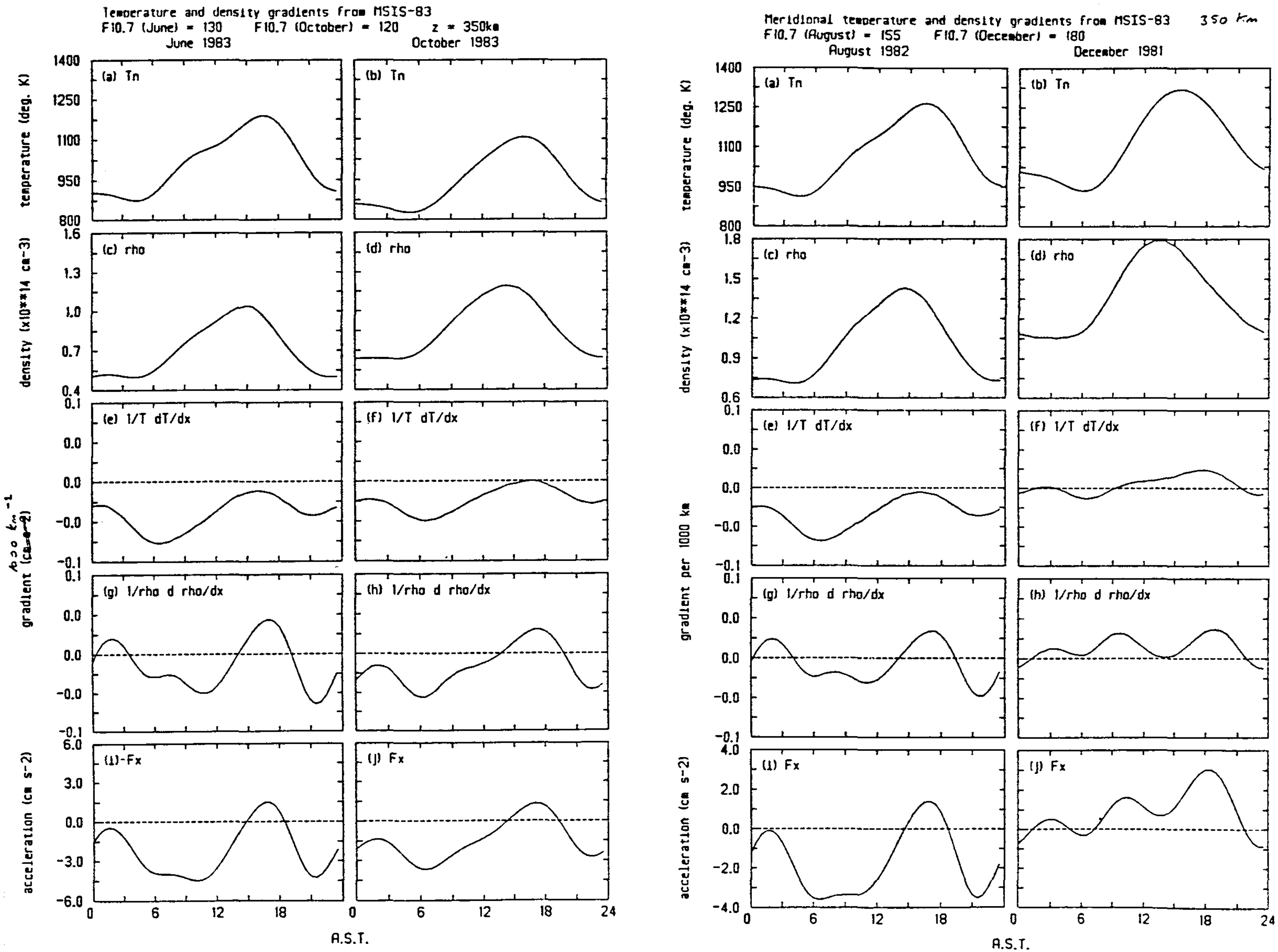


Figure 7. Monthly mean values of meridional ion temperature gradient for four different seasons.



Figures 8 and 9. Examples of meridional temperature and density gradients at Arecibo, and the net southward pressure gradient predicted by the MSIS-83 model atmosphere.