influence the model's climatology. The strength of the vertical eddy diffusivity also does not have much affect; however, excessive vertical diffusivity makes the vertical gradients of wind and temperature too smooth.

4 Summary

The stratospheric climatology of the CCSR/NIES atmospheric general circulation model (GCM) was investigated. The GCM reproduced the stratospheric climatology well. The model performance was comparable with those of other advanced GCMs in the world. However, two significant problems remain in the GCM, namely, a poleward shift of the stratospheric westerly jet and a cooling bias in the polar stratosphere. These problems, which many of the other GCMs in the world also confront, are related through the thermal wind balance. Some additional parameter studies suggest that gravity-wave drag has a large influence on the stratospheric climatology. Moreover, these studies also suggest that the introduction of another physical process into our model might improve the result qualitatively.

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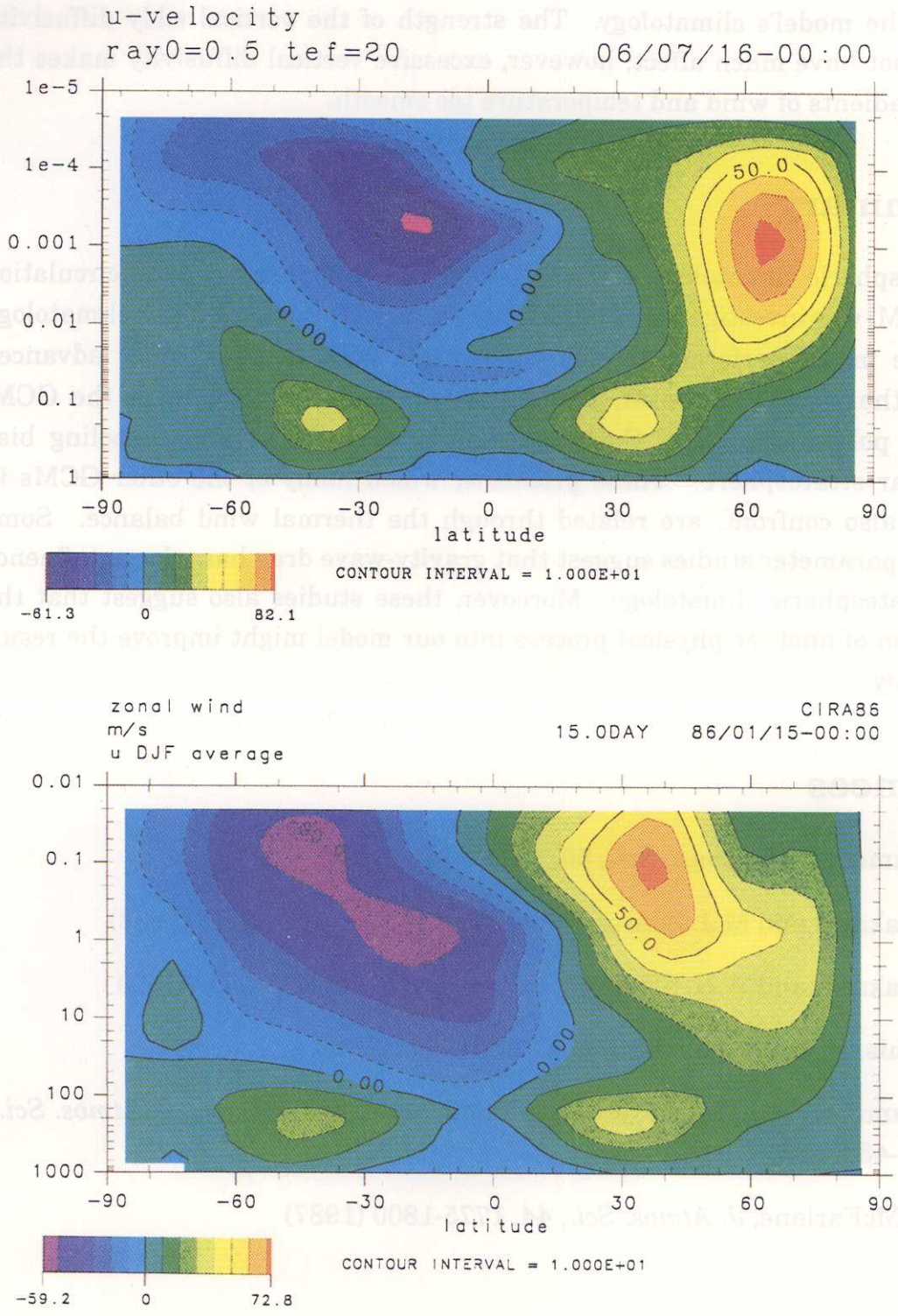

Figure 1: Meridional sections of zonal mean zonal wind averaged through December to February, for the CCSR/NIES GCM (upper panel) and for satellite observation data (CIRA86; lower panel). Ordinates are labeled by sigma (σ = pressure/surface pressure; upper panel) and by pressure (lower panel), respectively. Contour intervals are 10 m/s and 10 K, respectively.

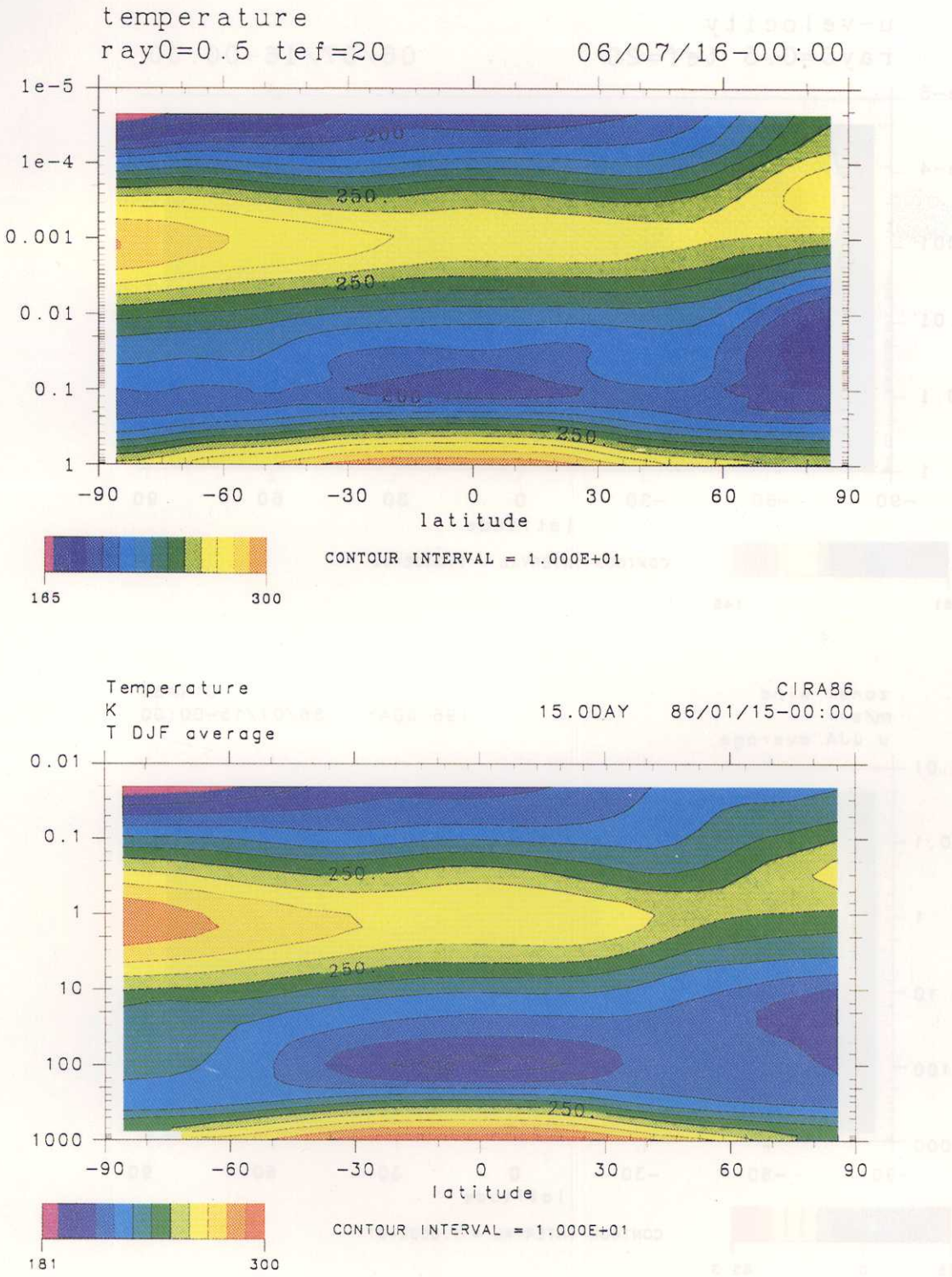

Figure 2: As in Fig. 1, except for temperature.

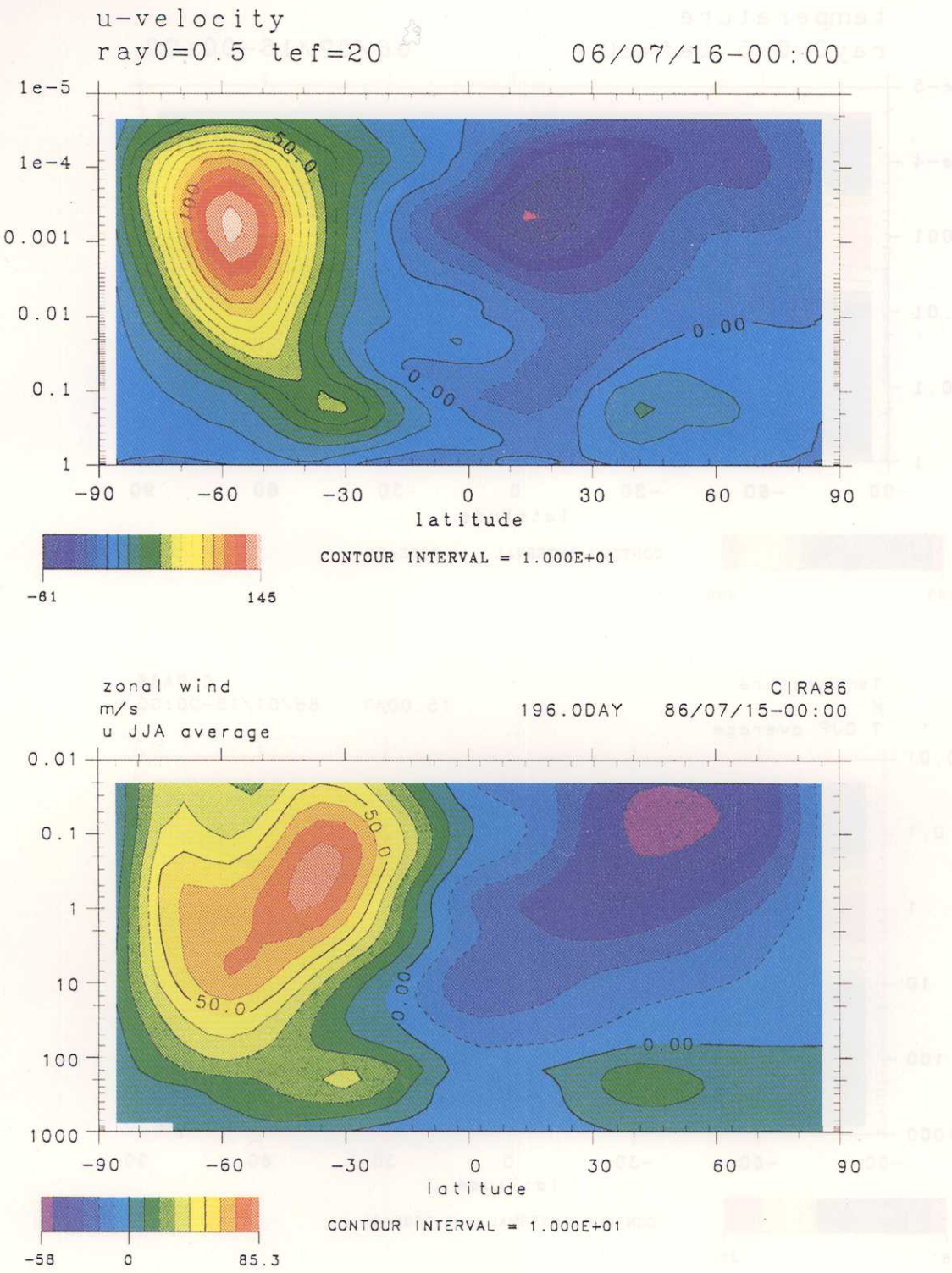

Figure 3: As in Fig. 1, except for zonal wind averaged through June to August.

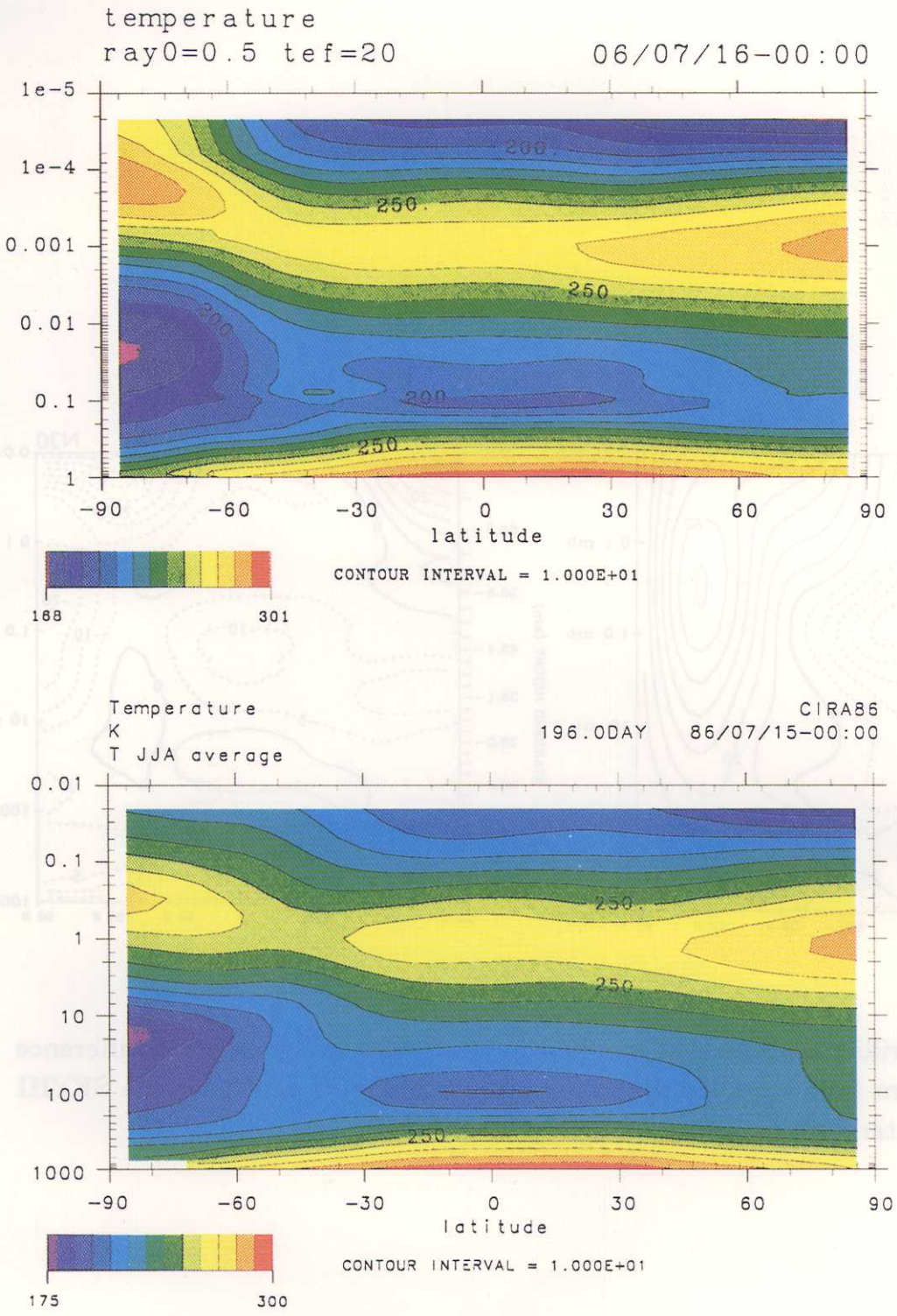

Figure 4: As in Fig. 3, except for temperature.

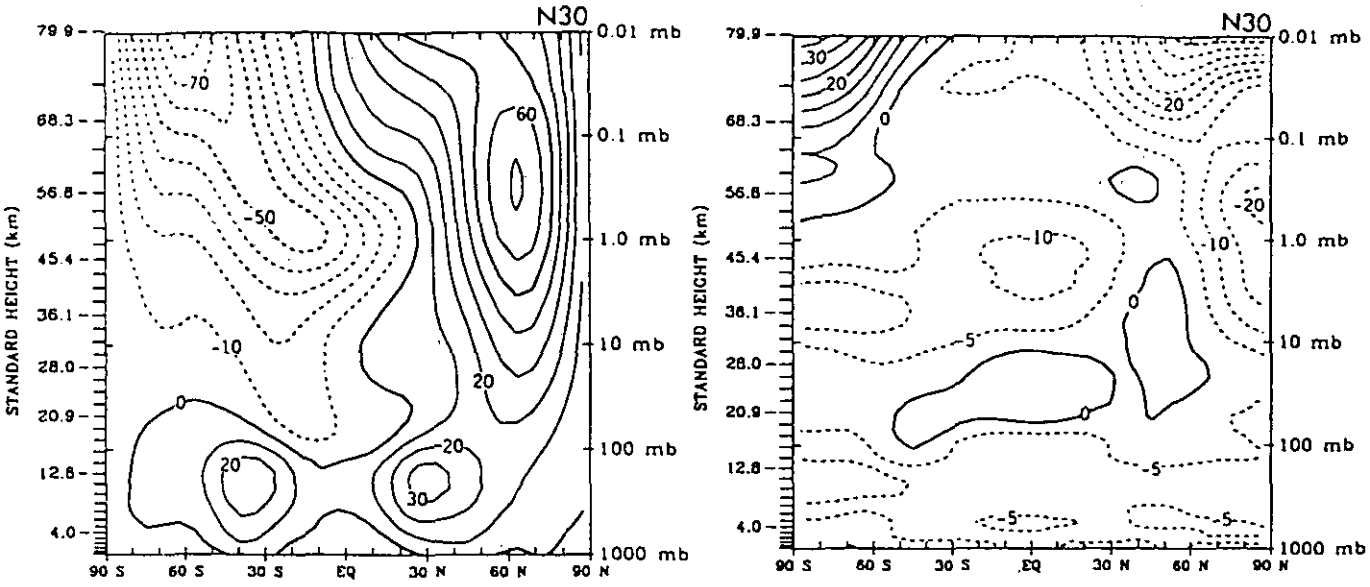

Figure 5: Meridional sections of zonal mean zonal wind (left panel) and difference of temperature from satellite observation (CIRA86; right panel) for the SKYHI model for winter. Ordinates are labeled by height (km).

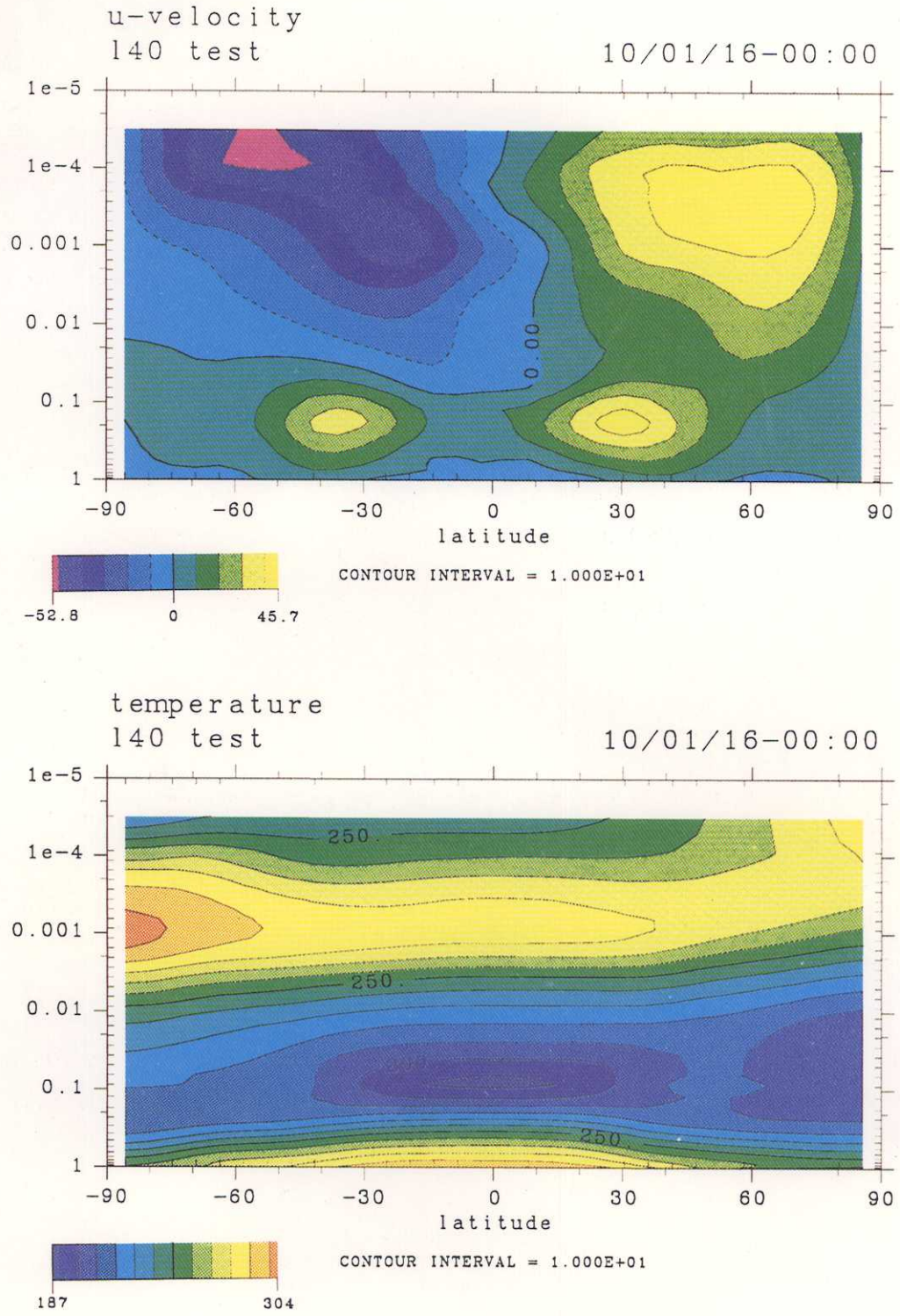

Figure 6: Meridional sections of zonal mean zonal wind (left panel) and temperature (right panel) for the CCSR/NIES GCM with a vertical level $L40$ for winter.