NOTES AND CORRESPONDENCE

The Structure of Stationary Planetary Waves in Winter: A Correction

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ABSTRACT

Due to a coding error, the amplitude and phases of stationary planetary waves in the mesosphere were incorrectly calculated by Schoeberl and Geller (1976, 1977). We report the corrected amplitudes and phases here, and note that our findings of strong sensitivity of the wave amplitude to the mean zonal wind profile remain unchanged.

Schoeberl and Geller (1976, 1977, hereafter referred to as Papers I and II) reported on the sensitivity of the vertical structure of stationary planetary waves in winter to the mean zonal wind state, the radiative damping rate and the zonal mean temperature state. After these results appeared in print, an error in the computer code was discovered which we found produced some incorrect values of planetary wave structure in the mesosphere. Our conclusions concerning the relative sensitivity of stratospheric wave structure to the mean zonal winds, radiative damping and mean zonal temperatures remain unchanged; that is to say, we still find that changes in the winds and damping rate in the stratosphere produce larger changes in wave structure than do realistic changes in mean state stratospheric temperatures. We do find that the mesospheric amplitudes and phases are altered to a greater or lesser degree depending on zonal wavenumber and basic-state parameters, however. These differences are described below.

For wavenumber 1, wind model I (60 m s^{-1} polar night jet), the difference between wave geopotential amplitudes shown in Paper I and those shown in Fig. 1a are quite small, but the phase structure is significantly altered in that the previously reported phase reversal (or phase pole) at the stratopause has disappeared. This phase reversal was accompanied by anomalous downward energy flow at the stratopause (see Fig. 16a of Paper II). Calculations of the energy flow vectors with the corrected wave solution indicates upward energy flow everywhere.

Fig. 1b shows the corrected results for $m=1$, wind model II (80 m s^{-1} polar night jet). We find that the mesospheric wave amplitudes are reduced from that reported previously (see Fig. 2 of Paper I) with the notable dispappearance of the strong local wave amplitude maximum at 80 km. The computed phase structure is similar to what was presented in Paper I.

For the wavenumber 2 calculations, the previously shown geopotential amplitudes in the mesosphere (Paper I, Fig. 3) are about a factor of 2 larger than our corrected results shown in Fig. 2. The overall phase structure is qualitatively similar but with significant quantitative differences for the corrected and uncorrected calculations.

Figs. 3 and 4 show our corrected calculations of the vertical variation of the amplitude and phase structure at 50°N. While these corrected results do differ from those previously shown in Paper I, it is still apparent that a strong variation in wave amplitude occurs in both the stratosphere and mesosphere with changed mean zonal winds in the middle atmosphere.

All of the calculations reported in this correction

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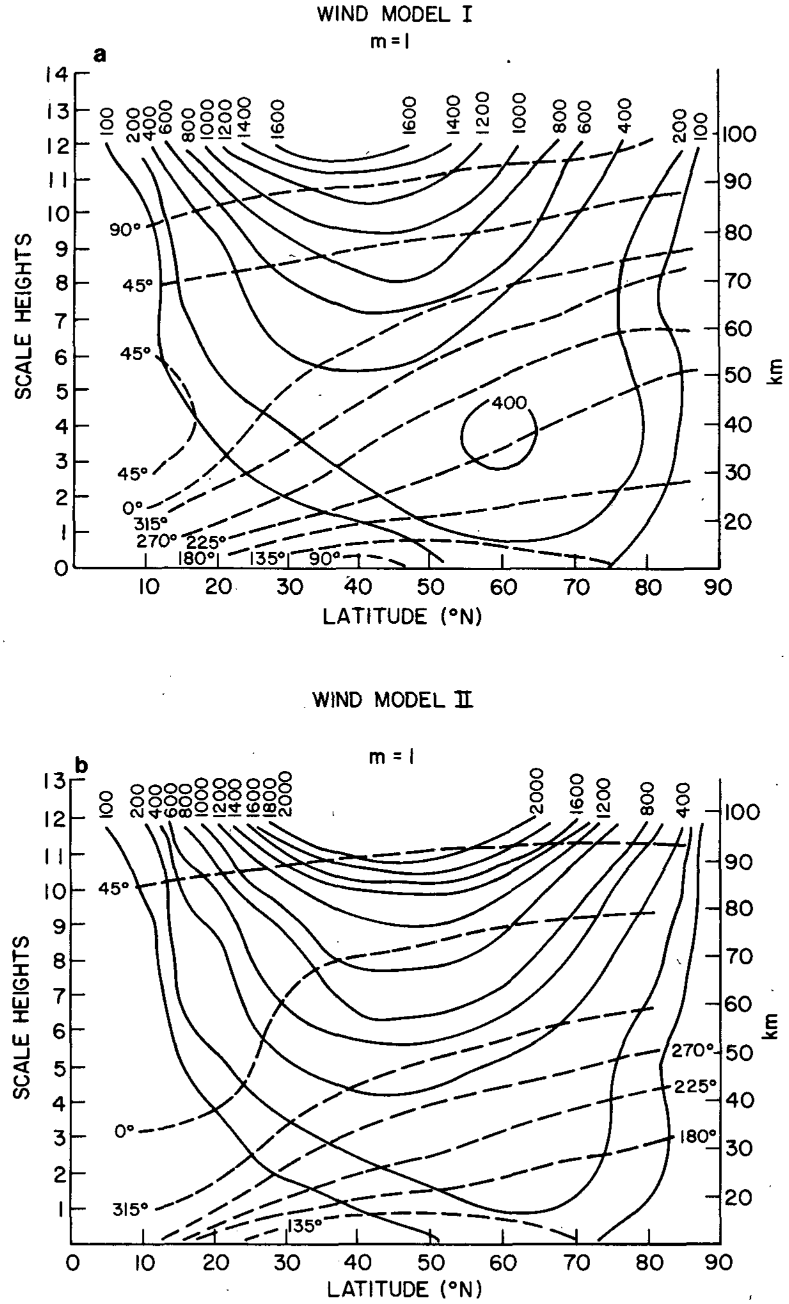


FIG. 1. Computed amplitude and phase structure for stationary wave geopotential with zonal wavenumber 1 for wind models I (a) and II (b). Solid lines indicate amplitude in units of 10^5 cm^2 s^{-2}. Dashed lines indicate the west longitude of the ridge.

used the wave forcing functions that were described in Paper II (see Fig. 3) and the "slow" Newtonian cooling coefficient (Fig. 5 of Paper II). The wind models are shown in both Fig. 1 of Paper I and Fig. 4 of Paper II.

The nature of the coding error that was discovered in the earlier computations was that the effects of radiative damping were incorrectly calculated. This led us to reexamine our remarks on the influence of changes in

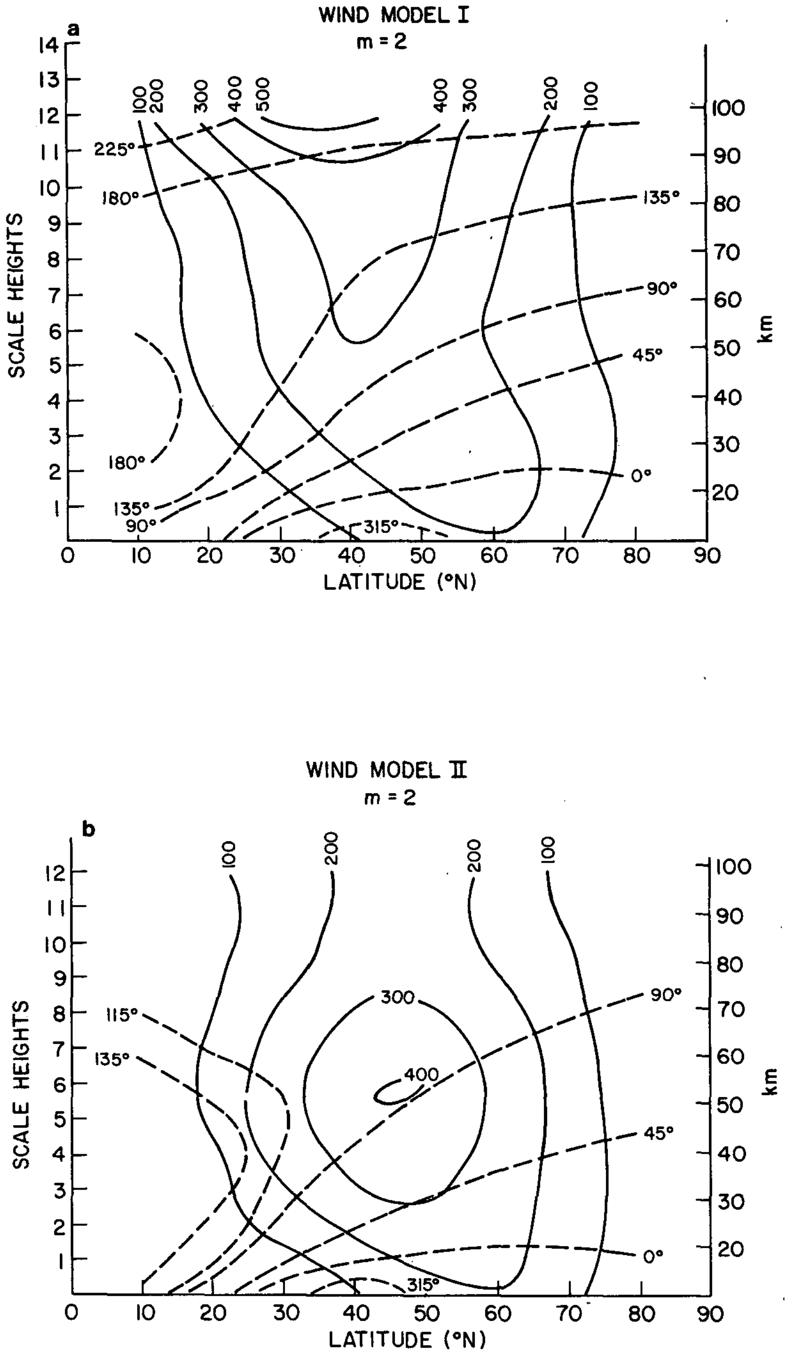
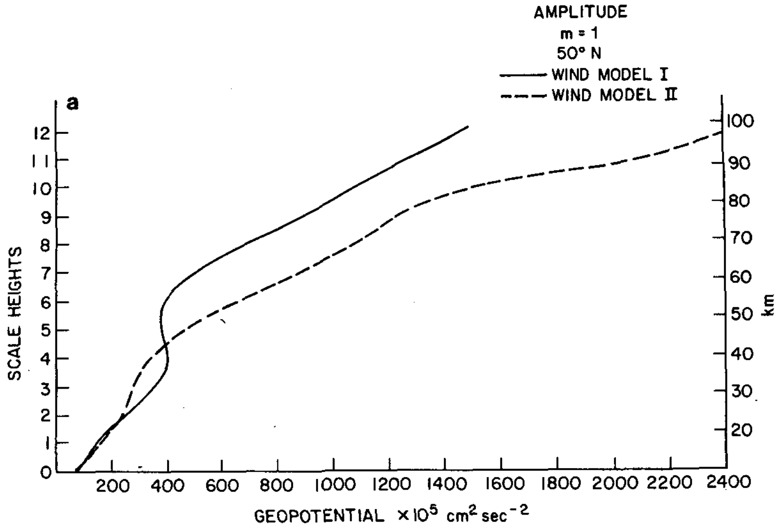


Fig. 2. As in Fig. 1 for zonal wavenumber 2.

the Newtonian cooling on planetary wave structure that were made in Section 6e of Paper II. Our correctly calculated results with "fast" Newtonian cooling do not show any phase poles. These calculations indicate that using the "fast" Newtonian cooling in our calculations gives amplitudes of wavenumbers 1 (2) that are diminished by about one-third (one-tenth) above ~45 km (40 km) with relatively small change in the phase



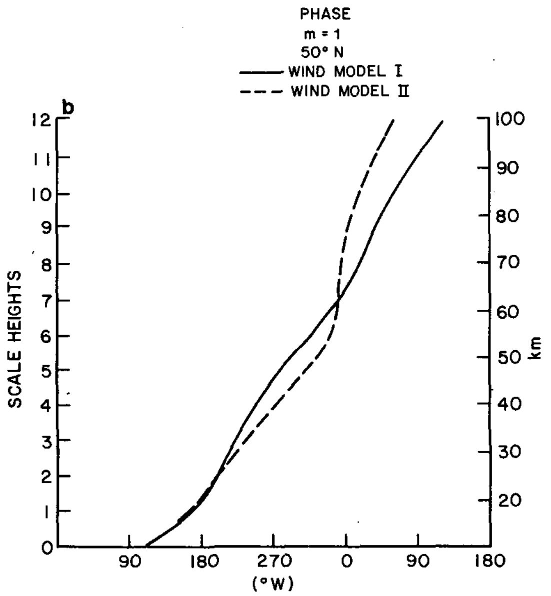


FIG. 3. Height variation of amplitude (a) and phase (b) of stationary wave geopotential with zonal wavenumber 1 at 50°N as computed with wind models I and II.

structure from what is calculated using the "slow" radiative damping rate. Thus, our corrected computations indicate that for fixed planetary wave forcing at 100 mb planetary wave structure is most sensitive to changes in the mean zonal winds, is less sensitive to changes in the radiative damping rates, and is least

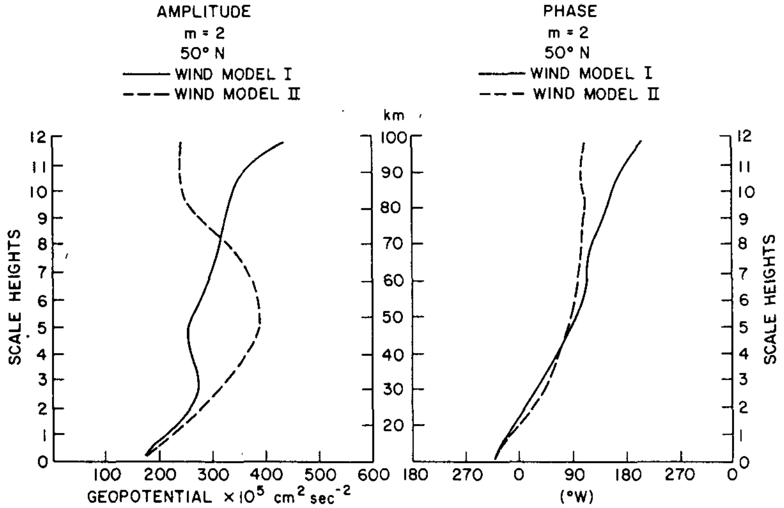


FIG. 4. As in Fig. 3 for zonal wavenumber 2.

sensitive to changes in the zonal mean temperature state.

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