Intercontinental tropospheric teleconnection by planetary wave reflection in the stratosphere

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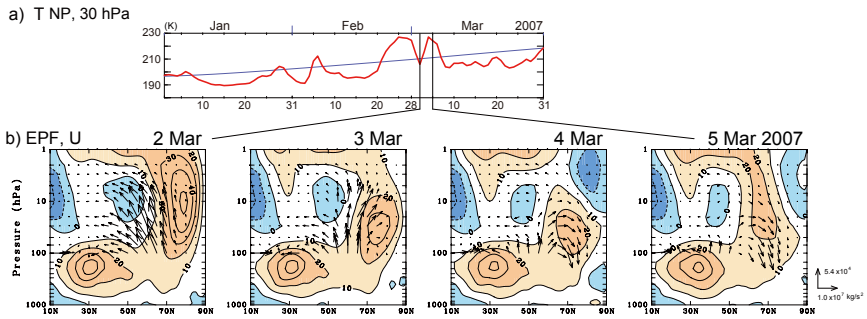

Figure 1
(a) Time series of the north polar temperature at 30hPa from January 1 to March 31, 2007 (red line). Climatology is represented by a blue line. (b) Meridional sections of the daily mean zonal-mean zonal wind (contours) and the total E-P flux (arrows) from March 2 to 5, 2007 (indicated by vertical lines in Figure 1a). Contour interval is 10ms-1. Positive (negative) values are indicated by reddish (bluish) colors. Arrows in the right bottom of panels indicate the scale of vertical and meridional components of the E-P flux

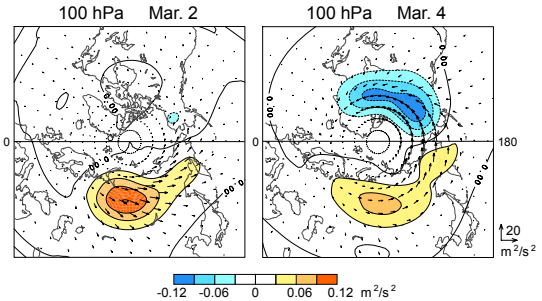

Figure 2
The 3-D Plumb flux for zonal-wave 1 to 3 at 100 hPa on (left hand) March 2 and (right hand) March 4, 2007. Vertical and horizontal component are indicated by contours and arrows, respectively. Counter interval is 0.03 m2s-2, and arrows in the right bottom of the panels correspond to horizontal component of 20 m2 s-2.

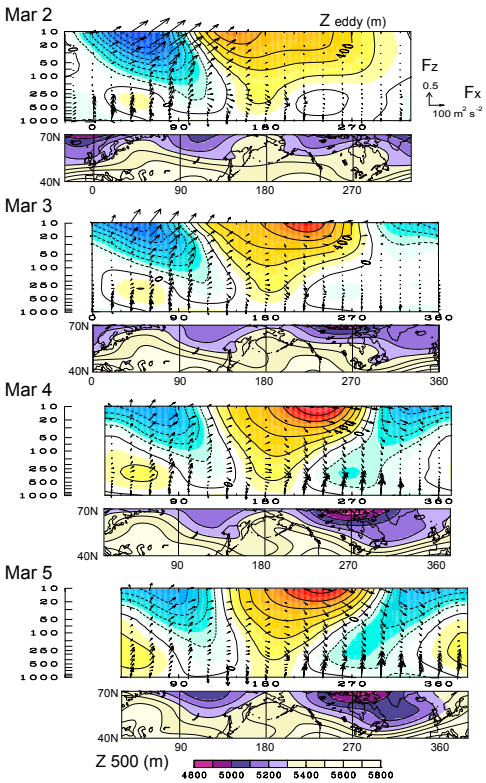

Figure 3
Longitude-height sections of eddy geopotential height (contour interval: 200m) and vertical and zonal components of the 3-D Plumb flux (arrows) calculated from wave 1 to 3 components averaged over 60° to 70° N latitudes. Arrows in the right bottom of the top panel indicate the magnitude of the vertical and zonal components of Plumb flux scaled by the inverse of the pressure. The panel under each longitude-height section depicts the 500hPa geopotential height for the zonal-wave 0 to 3 (contour interval: 100m) for the 40 ° N to 70 ° N latitude band. From top to bottom, daily mean value of March 2 to 5, 2007. Figures are shown for 360 ° from the longitude where the upward propagation of stratospheric waves starts.

A reflection of stratospheric planetary waves and its impact on the troposphere during a stratospheric sudden warming of March 2007 are investigated.

Strong upward propagation of the planetary waves occurred on March 2 and 3, but on March 4, planetary waves propagated downward (Fig. 1).

It can be seen in Fig. 2 that the upward propagation occurs over Siberia but the downward propagation develops over the American sector.

Zonal propagation and reflection of the planetary waves are clearly seen in the longitude-height sections of the eddy geopotential height and the vertical and zonal component of Plumb flux. A wave packet propagating upward and eastward from Eurasian continent was reflected by a negative wind shear in the upper stratospheric westerly jet caused by the stratospheric warming (Fig. 3).

Waves then propagated downward to the American-Atlantic sector of the troposphere, which led to the formation of a deep trough over the Atlantic and brought cold weather to the northeastern part of the American continent (Fig. 4).

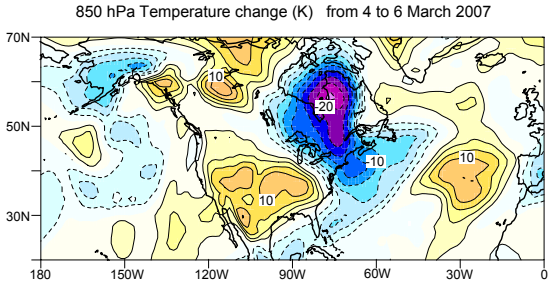

Figure 4
Air temperature change at 850hPa (contour interval: 2.5 K) from 4 to 6 March 2007. Figure illustrates a domain of 20° N to 70° N and 180°W to 0°E and zero contour lines are omitted.

Published 23 Aug. 2008
Kodera, K., H. Mukougawa, and S. Itoh (2008), Tropospheric impact of reflected planetary waves from the stratosphere, Geophys. Res. Lett., 35, L16806, doi:10.1029/2008GL034575