Analysis of nonlinear interactions of stationary planetary waves

Анализ нелинейных взаимодействий стационарных планетарных волн

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The general form of the potential enstrophy balance:

$$\frac{1}{2}\frac{\partial\overline{P^2}}{\partial t} = -\frac{\bar{P}}{\rho_0}\operatorname{div}\left[\rho_0\left(\bar{P}\vec{\bar{V}} + \overline{P_1'\vec{V}_1'} + \overline{P_2'\vec{V}_2'}\right)\right] + \bar{P}\bar{R} \qquad (1)$$

$$\frac{1}{2}\frac{\partial\overline{P_1'^2}}{\partial t} = -\overline{\frac{P_1'}{\rho_0}\operatorname{div}\left[\rho_0\left(P_1'\overrightarrow{V_2'} + P_2'\overrightarrow{V_1'} + P_2'\overrightarrow{V_3'} + P_3'\overrightarrow{V_2'}\right)\right]} -$$
$$-\frac{1}{\rho_0}\operatorname{div}\left(\rho_0\bar{P}\overline{P_1'\overrightarrow{V_1'}}\right) + \frac{\bar{P}}{\rho_0}\operatorname{div}\left(\rho_0\overline{P_1'\overrightarrow{V_1'}}\right) + \overline{P_1'R_1'} \qquad (2)$$

$$\frac{1}{2}\frac{\partial\overline{P_2'^2}}{\partial t} = -\overline{\frac{P_2'}{\rho_0}\operatorname{div}\left[\rho_0\left(P_1'\overrightarrow{V_1'} + P_1'\overrightarrow{V_3'} + P_3'\overrightarrow{V_1'}\right)\right]} -$$
$$-\frac{1}{\rho_0}\operatorname{div}\left(\rho_0\bar{P}\overline{P_2'\overrightarrow{V_2'}}\right) + \frac{\bar{P}}{\rho_0}\operatorname{div}\left(\rho_0\overline{P_2'\overrightarrow{V_2'}}\right) + \overline{P_2'R_2'} \qquad (3)$$

Data and Method

$$A_1 \cos(m_1\lambda - \omega_1 t - \varphi) \longleftrightarrow A_2 \cos(m_2\lambda - \omega_2 t - \varphi)$$

$$\cos\alpha \cos\beta = \frac{1}{2}[\cos(\alpha - \beta) + \cos(\alpha + \beta)]$$

$$(m_1 + m_2, \omega_1 + \omega_2); \quad (m_1 - m_2, \omega_1 - \omega_2)$$

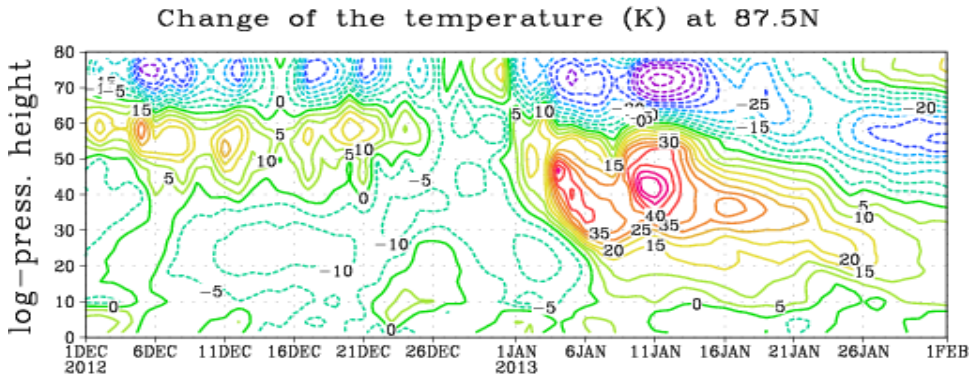

FIGURE 1. The time-altitude cross-sections of the changes of the zonal mean during December and January at 87.5N.

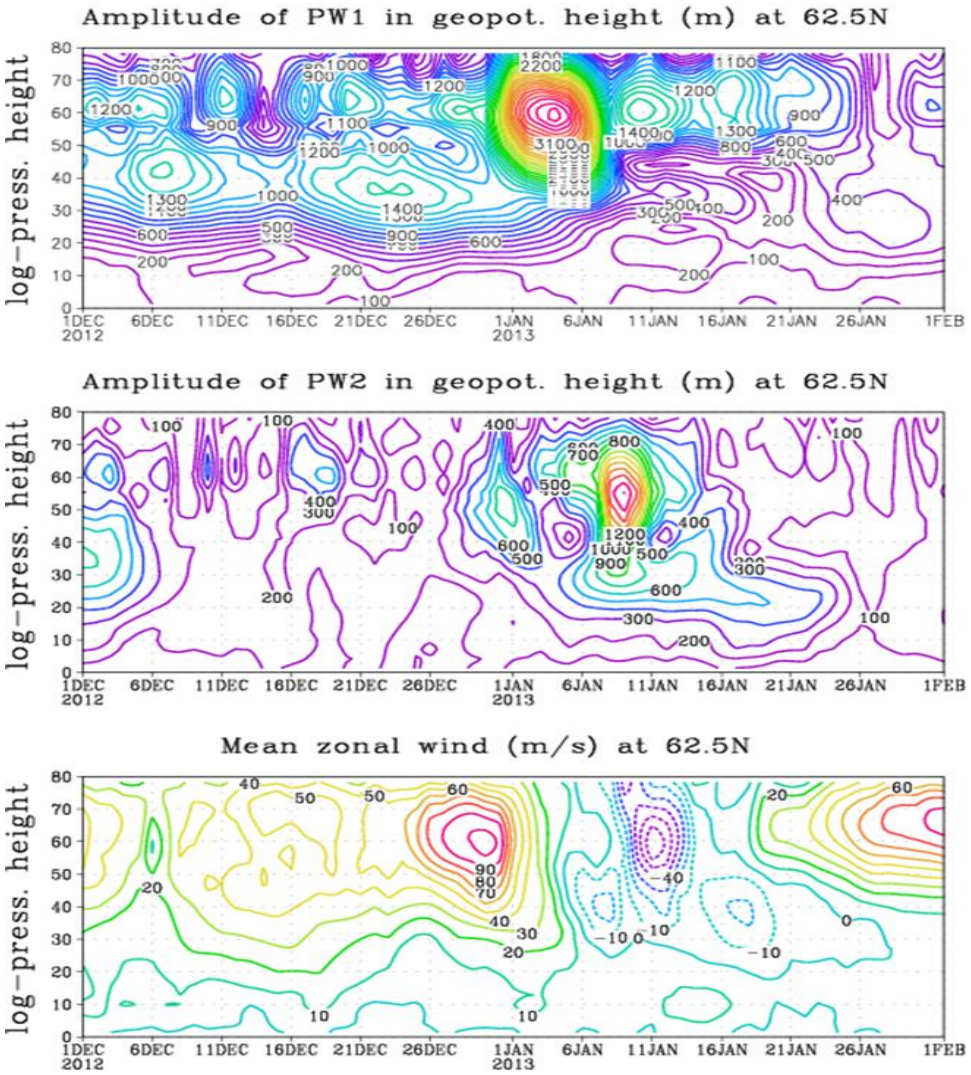

FIGURE 2. The time-altitude cross-sections of the amplitude of zonal harmonic with zonal wave number m = 1 and m=2 in the geopotential height (upper and middle panels); the mean zonal wind (lower panel) at latitude 62.5N during December and January.

Calculation results

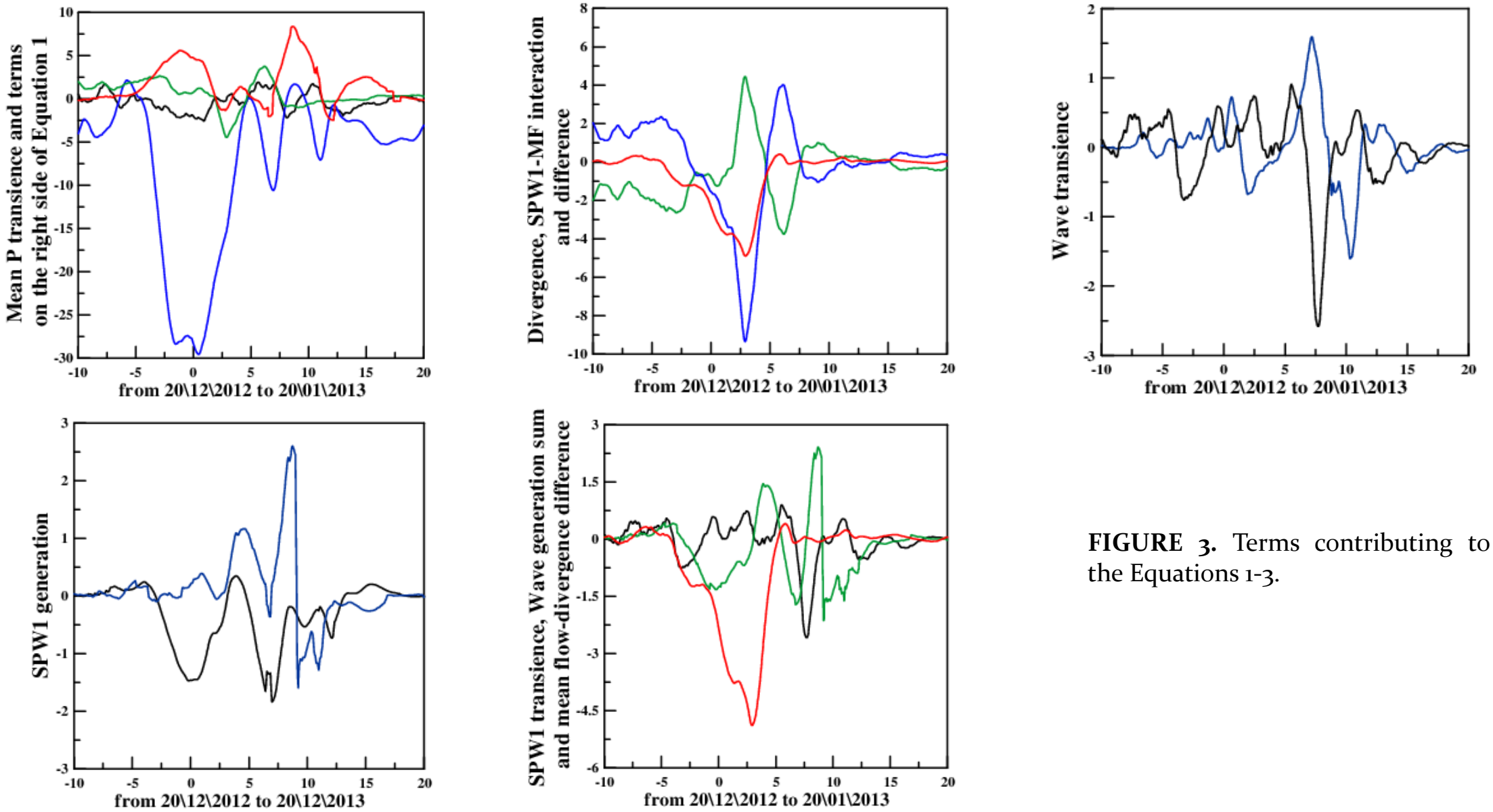

FIGURE 3. Terms contributing to the Equations 1-3.