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Forecasting the weather
- ensemble techniques
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One Candidate Mechanism of Low-Frequency Oscillation - Coriolis Parameter Variance Associated with Latitude

W.-L. Wang (1,2) and W.-G. Wang (3)

(1) Wuhan University, School of Resource and Environmental Science, Wuhan, China, 430079, Research Centre of climate and atmospheric environment, Wuhan, China (xiaowanw2002@yahoo.com), (2) Wuhan Regional Climate Center, CMA, Wuhan, 430074, China, (3) Department of Atmospheric Science, Yunnan University, Kunming, China, 650091

Although there being a notion that the atmosphere is not determinedly predictable beyond a few weeks due to that non-integrable properties of the atmosphere may produce chaos, but recent some papers have confirmed the facts of oscillation of low-frequency existing in atmosphere, such as Blocking; MJO, Kelvin Wave and Monsoon Trough whose vary periodicities is various from one week to 70 days, some of them especially perform eastward-propagation from tropical ocean, however, what mechanism exactly of this kind of low-frequency vibration still remain unclear hitherto, at least is not agreed unanimously among scientists, so this issue motivate many researcher to do further studying the cause of atmospheric low-frequency fluctuation, particularly paying attention to large-scale persistent flow patterns. So as to explore and explain low-frequency phenomenon here the model is employed to establish a nonlinear differential equation based on the Non-Equilibrium between geostrophic force and pressure gradient force, therefore, the one-dimension nonlinear differential equation may be expressed like below:

$$L\frac{\mathrm{d}^2\theta}{\mathrm{d}t^2} = (2\Omega V\sin\varphi - \frac{1}{\rho}\frac{\partial p}{\partial x})\cos\theta + (g - \frac{1}{\rho}\frac{\partial p}{\partial z})\sin\theta \tag{1}$$

Here$x$the zonal coordinate;$z$the vertical coordinate;L equal to the earth radius (R_e) added by altitude of middle level in troposphere; undoubtedly L is approximately R_e; meridian wind is V; g being the acceleration of gravity ;$2\Omega\sin\varphi$ is just Coriolis parameter (f); p is pressure; t is time;ρ is air density; θdenote the angle between two line of earth radius of the cone fixed in the center of earth, θ is also oscillation angle. Using the approach of linearization and series then the periodicity of low-frequency geostrophic waver may be calculated by below formula (2).

$$T = \frac{2\pi}{\sqrt{\frac{\bar{\theta}}{L}(2\Omega V\sin\varphi - \frac{1}{\rho}\frac{\partial p}{\partial x})}} \tag{2}$$

$\bar{\theta}$ is about 1.0, the rest symbols is same as equation (1) above, besides $\partial p/\partial x = 1hPa/300Km$;

$\rho = 1.3kg\cdot m^{-3}; V = 8m\cdot s^{-1}; \Omega = 7.3\times10^{-5}s^{-1} L \approx R_e = 6.378\times10^6 m;\varphi$ is different latitude from 12.8 to 80, so the various periodicities of low frequency vibration calculated via formula (2) is showed in follow table 1.

Table 1 the periodic oscillation associated with latitudes

Latitude(˚N)	12.8	14	15	20	30	40	50	60	70	80
Period (days)	70	42	34	21	14	11	10	9	8.7	8.4
∂p/∂x	1hPa/300km									

Main conclusion: (Eq. 1) owing to the existing probability of absolute geostrophic balance almost reaches zero in real atmosphere, so that in most cases non-geostrophic equilibrium dominate in the atmosphere, or is often referred as quasi-geostrophic equilibrium which is ubiquitous in real atmosphere, this is possibly one source of low-frequency oscillation; (Eq. 2) it is inferred that low frequency oscillation (30-70days) initiate from tropical region (low latitude), especially commence from tropical ocean area; relatively, shorter periods of oscillation (one week or so) originate from high latitude; furthermore, there is exist of two weeks-oscillations in mid-latitude.(3)

depending on a properties of continuous medium in atmosphere, the so-called "high frequency" of shorter than one week similar to Rossby wave trains generally propagate possibly from high-latitude toward to low-latitude.