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Two Dimension Larger-Scale Stability and Subtropical High Zonal Behaviours

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There is a conjecture that zonal motion of subtropical High (SH) should link closely to some larger-scale earth' parameters or constant, such as earth' radius or velocity of earth' rotation etc because of behaviours of SH possessing hemisphere-scale characteristics. The goal of paper is to search for formulas which should be comprised of such lager-scale parameters. so as to reach this aim and to evaluate accurately longitude location of Subtropical High Ridge Point(SHRP) , the mathematical and physical model called "Postulate Zonal Equilibrium is put forward to deduce those formulas depending completely on a group of equations containing Absolute Vorticity Conservative Equation, Geostrophic Equilibrium Equation,Thermal-Wind Equation,Static Equilibrium Equation and Equation of State, finally some significant formulas are figured out like bellow through analysing and emphasis on distinct longitudinal differences and perpendicular discrepancy of physics quality at scale of hemisphere.

$$\lambda - \lambda_0 = R^2(T_L - T_H)(T_E - T_W)\big/ f\Omega R_e \cos\varphi g\Delta z\Delta x$$

$$\lambda - \lambda_0 = v_H - v_L/\Omega R_e \cos\varphi$$

$$v_H - v_L = R^2(T_L - T_H)(T_E - T_W)\big/ fg\Delta z\Delta x$$

Here λ is longitude of SHRP , unit is radian, λ_0 is initial location of SHRP, z the vertical coordinate, x the zonal coordinate, R_e is radius of earth ,g being the acceleration of gravity, Ω is velocity of earth' angular rotation, f is Coriolis parameter, R is gas constant (=$287 m^2 s^{-2} k^{-1}$), φ is a given latitude of SHRP, T is temperature, but subscripts of E, H etc denote the position of T respectively, for instance, in T_E foot"E" means the temperature of east orientation in atmosphere. Similarly subscripts of H and L in meridian wind v denote high level and low level respectively. Therefore, $(T_L - T_H)/\Delta z$ is vertical temperature gradient, $(T_E - T_W)/\Delta x$ is east-west temperature gradient, ΩR_e is earth self-rotation speed at its equator , $g\Delta z = \Delta\Phi$ is different gravitational potential from high level to low level .Moreover, here it deserve stressing that $R^2(T_L - T_H)(T_E - T_W)\big/ f\Omega R_e \cos\varphi g\Delta z\Delta x$ is non-dimensional number, in addition to,$v_H - v_L$is meridian wind vertical shear, more important, $(R(T_H - T_L)/\Delta z)/g$is the static stability(non-dimensional number), standing for the ratio of perpendicular thermal expansion force to gravity , correspondingly $(R(T_E - T_W)/\Delta x)/f\Omega R_e$ is the zonal stability(similarly non-dimensional numbers), also denoting the ratio of zonal thermal expansion force to larger-scale geostrophic force as well, here$f\Omega R_e$ possibly represents one kind of hemisphere -scale geostrophic force.

Conclusions (1) the zonal shift degree of SHRP is proportional to size of two Dimension Larger-Scale Stability involving zonal stability and static stability as a whole. (2) Generally SHRP zonal displacements correspond to summer monsoon or winter monsoon circulation owing to opposite meridian wind vertical shear. (3) Non-dimensional number would be used as a measure of zonal baroclinic instability of atmosphere, even in comparison with Eady growth rate $(0.31(f/N)\,|dv/dz\,|$,$N^2 = (g/\theta)(\partial\theta/\partial z))$

Then it is uncovered Non-dimensional number not only estimate zonal baroclinic instability of atmosphere but also reveals some information of atmospheric meridian circulation such as "seasonally turning-over circulation". (4) Formula in other form is expressed as

$$\lambda - \lambda_0 = (v_H - v_L)R_e\big/\Omega R_e^2 \cos\varphi$$

the formula above could be explained by total angular momentum balance occurring in the atmosphere-solid earth system, $(v_H - v_L)R_e$ is one kind of "New Relative Angular Momentum ", ΩR_e^2 is the Axis' Angular Momentum at earth equator, thus on the premise without variety of Ω, SHRP will leap-eastward(westward) into bigger (smaller) longitude when $(v_H - v_L)R_e$ increases (decrease) , also on assumption without variety of meridian wind speed , SHRP will take west(east)-toward movement if the earth' rotation speed becomes faster (slower). (5) If it was supposed that $R^2(T_L - T_H)(T_E - T_W)\big/(v_H - v_L)\Delta x = const(m^2 s^{-3})$, then $fg\Delta z = f\Delta\Phi \approx f\bar{\Phi} = const(m^2 s^{-3})$ which is very useful to be utilized to interpret why west (east) section of SH usually is consistent to uplifting (descending) motion, there an overbar represents averaged geopotential height between high level and low level.

In a word, to some extent, this mathematical and physical model could improve our understanding of SH features in zonal direction.

Note: zonal is referred to in west-east or east-west direction and meridian means in north-south or south-north direction in this paper.