P-12. Long-period variations of stationary planetary waves

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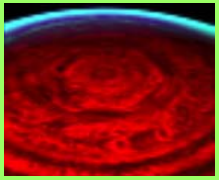
Why it is important:

•the need to study dynamical and photochemical processes impacts on observed climatic changes of atmospheric temperature;

•there is a growing evidence that additional extended-range tropospheric forecast skill may also come from slow variations of the circulation and planetary waves in the stratosphere.

Planetary waves

are oscillations with typical periods of about 2–30 days having large-scale (global) character predominantly of tropospheric origin.



Example of Saturn's waves of ionized particles http://photojournal.jpl.nasa.gov/catalog/PIA09186

2 main types:

1 - the stationary planetary waves (SPW), associated with the quasi-steady meteorological structures;

2 - the traveling planetary waves, which propagate predominantly westward, even though sometimes (rarely) the eastward propagation dominates.

Goals:

• analysis of the long-term changes of the zonally averaged temperature, wind, geopotential height and wave activity of the SPW1 and SPW2 during the last decades using NCEP/NCAR assimilated fields from 1948 to 2007;

• simulation of the SPW propagation on the basis of the observed changes of the zonal-mean wind in the troposphere as an input parameter for the linearized model of planetary waves;

• comparison of observed and simulated changes of SPW.

Data:

•Temperature, geopotential height and zonal wind distribution in the tropo- and stratosphere

• in December, January and February during 1948 and 2007 period of NCEP re-analysis;

•$2,5^0$ * $2,5^0$ grid, 6 hours interval;

•Global Grid with 144x73 points

•1000, 500, 400, 300, 200, 100, 30, 10 hPa levels

(Kalnay, 1996, Kistler, 2001)

Previous results:

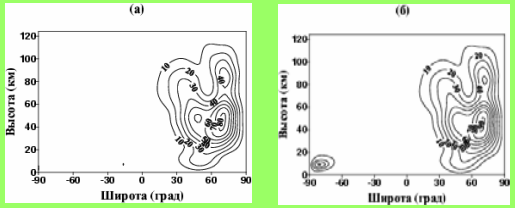
*noticeable climatic changes of the temperature in the lower atmosphere which have different signs at low and high latitudes;

*changes of the positions and intensity of tropospheric jets are in a good agreement with an increase of temperature latitudinal gradient;

*the results of simulation with the background zonal wind typical for 1960 and 2000 show an increase in amplitude of the SPW1 in the stratosphere and mesosphere of the winter hemisphere during the last decades.

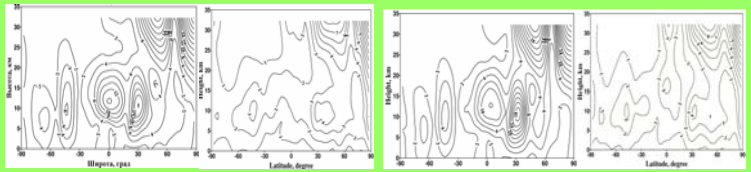
Amplitudes of geopotential height perturbations for SPW1 calculated with the linearizad model *(Pogoreltsev, 1999, 2001)*

1960 ***2000***



SPW1 amplitudes averaged over 1959-1980 and 1981-2002. Zonal mean wind (left) and its STD (right), m/s, NCEP/NCAR

1959-1980 ***1981-2002***



References:

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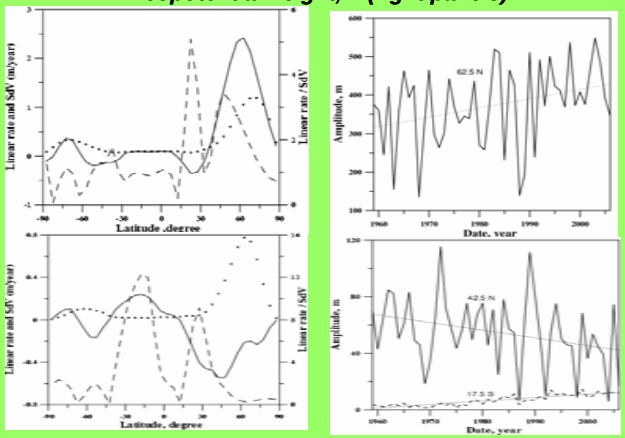
SPW1(upper) and SPW2(lower) amplitude variations heopotential height,m (right panels)



Summary:

• According to previous results we assume that variability of the mean flow will cause the changes of the SPW propagation conditions.

•The simulation of the SPW1 performed with the linearized model supports this assumption and shows that during the last 40 years the amplitude of the SPW1 calculated in the stratosphere and mesosphere increased substantially.

•The analysis of the SPW amplitudes extracted from the geopotential height and zonal wind NCEP/NCAR data supports the results of simulation and shows that during the last years there exists an increase in the SPW1 activity in the lower stratosphere.

•These changes in the amplitudes are accompanied by increased interannual variability of the SPW1 also.

•Analysis of the SPW2 activity shows that changes of its amplitude have a different sign in the winter (northern) hemisphere and at low latitudes in the summer (southern) hemisphere.

•Value of the SPW2 variability differs latitudinally and can be explained by non-linear interference of the primary wave propagation from below and secondary SPW2.

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