Dynamics of Atmospheric Centers of Action

I.I. Mokhov, N.A. Nikitina
A.M. Obukhov Institute of Atmospheric Physics RAS, Moscow, Russia
mokhov@ifaran.ru

Interannual and long-term changes of atmospheric centers of action (ACAs) in the Northern (NH) and Southern (SH) Hemispheres were analyzed using different data sets based on reanalyses data and global climate model simulations with different CMIP5 scenarios (see also (Mokhov and Khon, 2005; Khon and Mokhov, 2006)). In particular, monthly-mean sea level pressure (SLP) data for different ACAs obtained from reanalyses ERA40 (period: 1957–2002; resolution: 2.5°x2.5°), ERA-Interim (1979–2011; 0.75°x0.75°), NCEP-NCAR(R1) (1948–2011; 2.5°x2.5°) and NOAA 20th-Century Reanalysis (Version 2) (1871-2010; 2°x2°) were analyzed. Also, we analyzed SLP simulations with different climatic general circulation models, including INM-CM4, IPSL (IPSL-CM5A-LR), HadCM3 with historical (1850-2005) and RCP scenarios (http://cmip-pcmdi.llnl.gov/cmip5/). Tendencies of change of ACAs were estimated with the use data from (http://www.cru.uea.ac.uk/cru/data/temperature/) for surface air and sea surface temperature.

Figure 1 shows interannual variations of the SLP anomalies (relative to corresponding means for the basic period 1961-1990) for the Siberian High in January based on different reanalyses data and climate model simulations. There is a large interannual variability for the Siberian High intensity. Nevertheless, Fig. 1 exhibites a general tendency of decrease in the Siberian High intensity (SLP at its center) under warming in the 21st century with RCP anthropogenic scenarios. This decrease is faster for the RCP 8.5 scenario than that for the RCP 4.5 scenario.

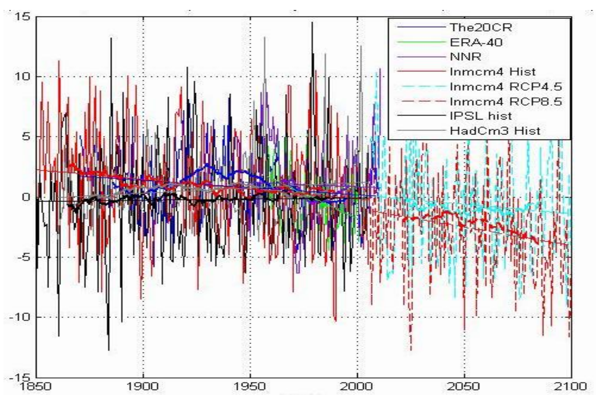

Fig. 1. SLP anomalies (hPa) at the center of the Siberian High in January obtained from various reanalyses data and global climate model simulations for the 19th-21st centuries.

Remarkable variations were also noted for other ACAs, in particular for the Aleutian Low in winter.

The relationship of the ACA characteristics with climate changes can be revealed with the use of cross-wavelet analysis (see (Jevrejeva et al., 2003)). Figure 2 shows local coherency between the intensity of Siberian High from the NOAA 20th-Century Reanalysis (Version 2) data and NH surface temperature in March. It was exhibited significant interdecadal and longer-term coherency in the second half of the 20th century and at the beginning of the 21st century, especially during early spring (March) and late fall (November).

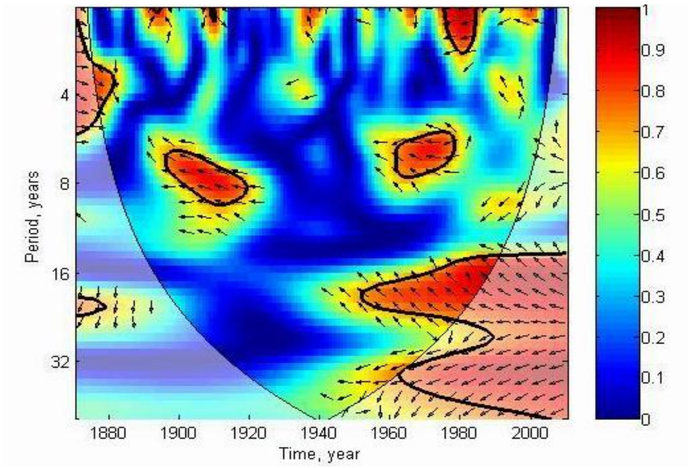

Fig. 2. Local coherency between the intensity of Siberian High and NH surface temperature in March.

Cross-wavelet analysis reveals also relationships between different ACAs. In particular, significant coherency was exhibited for long-term variations of polar ACAs. Figure 3 shows local coherency between the Arctic and Antarctic High intensities in January obtained from the NOAA 20th-Century Reanalysis (Version 2) data.

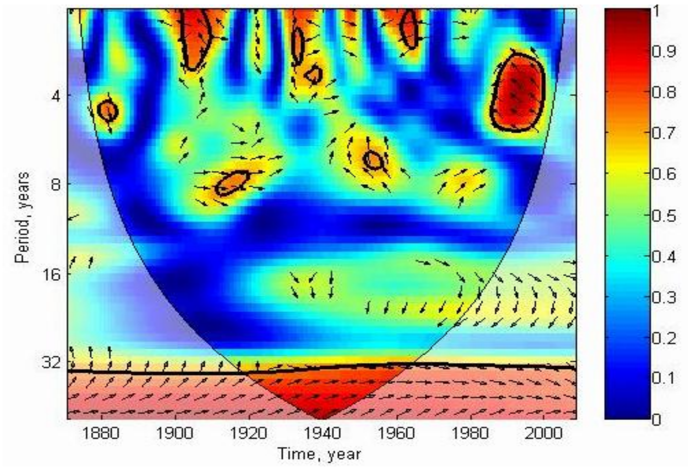

Fig. 3. Local coherency between the Arctic and Antarctic High intensities in January.

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References

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