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The variability of atmospheric circulation of the Southern Hemisphere and its association with the culmination of the warm and cold phases of ENSO events

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Connections between the Southern Hemisphere atmospheric circulation anomalies and variability at mid- and high latitudes are examined and the important role of El-Nino – Southern Oscillation (ENSO) in these connections was estimated. Method of empirical orthogonal function (EOF) decomposition was applied for investigation of the low-frequency atmospheric circulation variability. Data sources for this decomposition were the NCEP/NCAR daily zonal wind and geopotential fields on the 850, 500 and 200 hPa pressure levels for Januaries (1958 – 2011). Linear trends were removed previously. The variability was examined both for 53 years integrally, and during the most extreme events of warm (1982/83 and 1997/98) and cold (1973/1974 and 1983/1984) phases of ENSO.

Analyze has shown the main areas of zonal wind variability during 53 years ("climatic" variability) are associated both with fluctuations of the general macro-scale circulation processes and the different frequency of many synoptic-scale features, resulting from the warm and cold phases of ENSO. It appears in the spatial distribution of zonal velocity anomalies, which corresponds to the well-known canonical schemes of development and culmination of ENSO both at upper and at lower troposphere.

During the several years these areas of variability have intensified, amplified, some secondary ones have appeared most of cases. At the same time, the scale of anomalies has increased in respect of "climatic" variability anomalies. It says about the increasing of intensity of these anomalies, their extraordinary development during examined years. The correspondence of temporal behavior of anomalies during the several years has ascertained with the warm ENSO events (1982/83 and 1997/98) chronology using classification of westerly wind bursts activity.

The second EOF mode has shown the maximal variability areas associated with the central equatorial Pacific. This region has maximal variability of tropical cyclogenesis during the culmination of ENSO cycle. Therefore, the synoptic-scale processes, such as tropical cyclogenesis and mid-latitudes cyclonic activity, make a considerable contribution in the formation and development of the atmospheric circulation anomalies during extreme ENSO events.

The precise interactions were revealed between maximal variability areas at tropical zone and mid- and Antarctic latitudes of Pacific and other oceans of the Southern Hemisphere. At that, these interactions appear most strikingly at Pacific ocean, where main events of ENSO cycle occur. Similar chains can be interpreted as the following coupled consequence of anomalies: discharge of cold air from Antarctica – intensification of the extra-tropical cyclogenesis at the Great Western Transfer – strengthening of the conclusive anticyclone at the cyclonic series rear on the polar front – regeneration of the subtropical anticyclone – intensification of the tropical trade winds circulation – amplification of the South-Pacific Convergence Zone, appearing in activation of tropical cyclogenesis.