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[2]IGCR, Frontier Research System for Global Change, SEAVANS-N, Shibaura, Tokyo, Japan

[3]IARC, Frontier Research Syetem for Global Change, SEAVANS-N, Shibaura, Tokyo, Japan

A near-surface manifestation of the Arctic Oscillation (AO), defined as the leading EOF of November-April monthly sea-level pressure (SLP) anomalies over the extratropical Northern Hemisphere (22% of the total variance accounted), includes a signature of an interannual seesaw between the Aleutian and Icelandic Lows (AL and IL, respectively). Recently, we have shown that the seesaw is evident only in late winter (February through mid-March) and it develops in association with the propagation of wave activity accumulated over the North Pacific in early to mid-winter into the North Atlantic in the form of a stationary Rossby wavetrain across North America. With this particular seasonality of the AL-IL seesaw, it is interesting to examine how the relationship between the AO and seesaw changes from early to late winter.

For this purpose, we applied an EOF analysis to monthly SLP anomalies north of 20°N separately for November-January (NDJ) and for February-April (FMA). The same analysis was applied also to monthly 250-mb height (Z250) and 50-mb height (Z50) anomalies. The data are based on the NMC operational analyses or NCEP/NCAR reanalyses for the period 1973-1994. Each of the first EOFs of SLP for NDJ (22%) and FMA (24%) includes an AO-like axially-symmetric seesaw between the polar region and midlatitudes, but those EOFs differ substantially over the North Pacific. The EOF for FMA exhibits significant anomalies over the North Pacific, but that for NDJ does not. Therefore, a signature of the AL-IL seesaw is much stronger in FMA than in NDJ. Furthermore, the southern center of action of the North Atlantic Oscillation (NAO) is more apparent in NDJ than in FMA. A more pronounced difference is found between the first EOFs of Z250 between NDJ (19%) and FMA (20%). The NDJ pattern is characterized by a polar-midlatitude seesaw with a large contribution from the NAO. The FMA pattern, in contrast, is characterized by a combination of the PNA (Pacific/North American) and WA (Western Atlantic) patterns as an upper-tropospheric manifestation of the AL-IL seesaw, but no significant anomalies appear in the Arctic region. It is suggested that the formation of the AL-IL seesaw in late winter results in the substantial seasonal dependence of the tropospheric AO and its weak signature over the North Pacific in its original definition based on the November-April monthly SLP reflects the late-winter formation of the AL-IL seesaw. The first EOFs of Z50 for NDJ (45%) and FMA (46%) are very similar and both manifest the annular mode, which suggests that the influence of the seesaw may be confined in the troposphere.

In addition, the life cycle of the AL-IL seesaw is well reproduced in the 45-day moving-averaged Z250 anomalies that are regressed linearly against the interannual time series of the first principal component (PC1) of SLP for FMA. But only the polar-midlatitude seesaw in the early to mid-winter period is reproduced when regressed against the PC1 of SLP for NDJ. The same is true, when the moving-averaged Z250 anomalies from which the life cycle of the AL-IL seesaw has already been removed for each winter by a linear regression method are regressed against the November-April mean PC1 of SLP (i.e., the original AO index). It is therefore concluded that the late-winter formation of the AL-IL seesaw substantially changes the characteristics of the tropospheric signature of the AO.

A51E-12 1145h

Positive Feedback between Arctic Oscillation (AO) and Baroclinic Instability in Planetary Waves

Hiroshi L. Tanaka[1] (81-298-53-4502; tanaka@atm.geo.tsukuba.ac.jp)

Hiroki Tokinaga (81-298-53-4502; tokinaga@luft.geo.tsukuba.ac.jp)

[1]Institute of Geoscience, University of Tsukuba, 1-1-1, Tenoudai, Tsukuba 305-8571, Japan

Arctic Oscillation (AO) is characterized by its barotropic structure throughout the troposphere and stratosphere as is often the case for low-frequency variability of the atmosphere. AO, defined by its pressure field, is also related to the intensity of the polar vortex. When the vertical mean polar vortex is strong, the barotropic height anomaly is negative, indicating lower pressure over the Arctic, and vice versa. The intensity of polar vortex is largely controlled by the radiative Charney mode (M_1), which has poleward eddy momentum transport over the whole hemisphere.

According to the comparison of baroclinic instability for strong and weak polar vortices, it is found that the M_1 mode is intensified for strong polar vortex and is weakened for weak polar vortex. Further analysis shows that the M_1 mode is excited by the baroclinicity associated with polar night jet, in contrast with the M_c mode which is excited by the subtropical jet. Since the M_1 mode transports eddy westerly momentum poleward, the polar night jet is intensified by the M_1 mode. Hence, there is a positive feedback between the polar vortex and the M_1 mode baroclinic instability in planetary waves. This feedback may be responsible for the appearance of AO which is characterized by two weather regimes of strong and weak polar vortices.

A51F MC: 309 Friday 0830h

Atmospheric Modeling and Dynamics

Presiding: **D J Allen**, University of Maryland; **D L Mauzerall**, Princeton University

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A51F-01 0830h

The impact of enhanced regional resolution on trace gas distributions in a global CTM

Dale J Allen[1] (301-405-7629; allen@atmos.umd.edu)

Kenneth Pickering[1] (301-405-7639; pickerin@atmos.umd.edu)

Georgiy Stenchikov[3]

Michael Fox-Rabinovitz[2]

[1]University of Maryland, Dept. of Meteorology 3433 Computer and Space Science Building, College Park, MD 20742-2425

[2]ESSIC, University of Maryland 2207 Computer and Space Science Building, College Park, MD 20742-2425

[3]Rutgers University, Department of Environmental Sciences, New Brunswick, NJ 08901

Simulations on a stretched horizontal grid (ie., a grid where the spacing between grid points is relatively small and uniform within a region of interest and stretches gradually with latitude and longitude outside of this region) are useful for looking at the effect of small-scale mixing processes on the larger or global scale chemical balance. Examples include the mixing associated with deep convection and stratosphere-troposphere exchange. Stretched-grid simulations with enhanced regional resolution are also useful when measurements and/or high resolution chemical emission data are available for only a portion of the globe. The impact of enhanced regional resolution on upper tropospheric trace gas distributions (e.g., carbon monoxide (CO), and/or total odd nitrogen (NO_y)) over the eastern United States and the western North Atlantic will be investigated during the SONEX period (fall 1997) by comparing SONEX measurements with model-calculated trace gas distributions from simulations (the Stretched-Grid University of Maryland/Goddard Chemical-Transport Model (SG-GCTM)) driven by dynamical fields from assimilations using the Goddard Earth Observing System Stretched-Grid Data Assimilation System (GEOS SG- DAS) on a uniform and a stretched-grid. Both assimilations utilize the same number of grid points; however, the resolution for the uniform grid run is 2.5° in the east- west by 2.0° in the north-south while the resolution for the stretched-grid run varies from 0.9375° by 0.75° in the region of interest (25°-50° N, 90°-30° W) to 6.6° by 5.2° on the opposite side of the globe.

A51F-02 0845h

Measurement and Model Analysis of Transport and Chemistry of the Pacific Basin