Geophysical Research Abstracts
Vol. 14, EGU2012-3829, 2012
EGU General Assembly 2012

Mechanism and Predictability of Persistent Euro-Russian Blocking in Summer of 2010 Examined by Ensemble Hindcast and Forecast Dataset

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We investigate the mechanism and predictability of a sequence of strong Euro-Russian blocking with an extraordinary duration from mid-June to mid-August 2010 using a hindcast experiment performed on MRI (Meteorological Research Institute)/JMA (Japan Meteorological Agency) AGCM and the operational 1-month ensemble forecast of the JMA.

First, a detailed examination on the time sequence of this blocking event based on JRA-25/JCDAS reanalysis dataset reveals that the persistent blocking could be decomposed into three evolutionary stages: (1) In Stage I from mid-June to late-June, the blocking resides over the Atlantic (around 10˚W) and is maintained due to the interaction with high-frequency synoptic disturbances of relatively high activity in comparison with the other two Stages. (2) In Stage II from late-June to late-July, the blocking is located over western Europe (around 30˚E). (3) At the beginning of Stage III from late-July to mid-August, the blocking shifts its location from western Europe to Russia (around 50˚E). The low-frequency components, rather than the high-frequency components, contribute to this transition and maintenance of the Russian blocking during this stage.

Second, the time variation of the predictability of this blocking event is quantitatively investigated by a series of hindcast experiment carried out every 6 hours by MRI/JMA AGCM (TL95L40). Predictability of blocking occurrence is estimated every 6 hours by Brier Score constructed from recent 5-day initial conditions of 20 ensemble members in terms of the Lagged Average Forecasting (LAF) method. It is found that the predictability is considerably reduced during the transition period of the evolutionary stages such as late-June and late-July. The forecast skill also becomes significantly worse during the decay period of the Russian blocking in mid-August.

Third, precursory signals of low-frequency components related to the enhancement of the blocking high over Russia in late-July are examined through the lag-regression analysis using all 25 ensemble members of the operational 1-month ensemble prediction of the JMA. The regressed map shows that the deepening of an upstream cyclonic anomaly over Italy about a few days before the peak period of the blocking is significantly related to the blocking strength, whereas further upstream perturbations are insignificant to the blocking development. Thus, it is suggested that the Russian blocking in late-July is formed through the energy propagation of quasi-stationary Rossby wave trains emanated from the adjacent upstream cyclonic anomaly over Italy. This near-field triggering process of the Russian blocking would be connected with the limited predictability of the blocking formation. The formation mechanism of the cyclonic anomaly will be also discussed.