Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG38-02 Room:101A Time:May 21 09:15-09:30

Maintenance Mechanism of the Western Pacific Teleconnection Pattern and Its Impact on Sea Ice

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The Western Pacific teleconnection pattern (WP pattern; Wallace and Gutzler, 1981) that accompanies north-south dipolar anomalies in pressure over the Far East and western North Pacific is often observed in association with a cold outbreak over East Asia. It is known that during a prominent positive event of the WP pattern, whose northern center of action is anticyclonic anomaly, sea ice concentration tends to decrease in the Sea of Okhotsk and in the western Bering Sea, while it tends to increase in the eastern Bering Sea. Although the WP pattern has substantial influence on climate over the Far East, its maintenance mechanism has not yet been clarified.

We evaluated kinetic and available potential energy (KE and APE) conversions of the positive WP pattern to investigate maintenance mechanism of the WP pattern. The evaluation is based on a composite map of 32 strong positive monthly events in winter (DJF) for the period of 1948 - 2010. We found that baroclinic energy conversion (i.e., APE conversion from climatological-mean fields to anomalies of the WP pattern) works most efficiently to the maintenance of the WP pattern, and barotropic conversion (i.e. KE conversion from climatological-mean fields to anomalies) and feedback forcing of transient eddies through their momentum transport work less. Most of previous works have paid attention to the latters, but not to the former. This is because teleconnection patterns over the ocean have been considered to have equivalent barotropic structure, thus the barotropic conversion and feedback forcing of transient eddies have only been focused. In contrast to other teleconnection patterns, we have revealed that the composited monthly anomalies of the WP pattern exhibit baroclinic structure with their phase lines tilting southward or southwestward with height at the lower troposphere. The baroclinic structure of the positive WP pattern accompanies westward heat flux from the warmer Pacific ocean to the colder Eurasian continent around its northern center of action, which brings efficient baroclinic conversion. Anomalous heat exchange with the underlying ocean and release of latent heat by precipitation due to anomalous storm track dissipate APE of the WP pattern. Even if these dissipating processes being included, KE and APE conversions from climatological-mean field and barotropic feedback by transient eddies maintain and reinforce the anomalous field of the WP pattern.

Keywords: Teleconnection Pattern, Western Pacific Pattern, Sea of Okhotsk, Bering Sea, Baroclinic Energy Conversion