Soutenance de thèse de Gyundo Pak

Gyundo Pak

Mechanisms of the interannual to decadal thermal variability of the upper ocean in the western boundary region of the North Pacific
Le 04-05-2016 à 09h00

Membres du jury:

French jury : Young-Hyang Park (Thesis Director, LOCEAN), Frederic Vivier (LOCEAN), Fabio d'Andrea (LMD)

Korean Jury: Kyung-Il Chang (Thesis Director, SNU), Kwang-Yul Kim (SNU: videoconference), Sang-Wook Yeh (Hanyang Univ: videoconference)

Résumé :

As part of the first defence (among three) of a PhD Thesis carried out under the UPMC-SNU (Seoul National University) Dual PhD Program, Mr. Gyundo Pak from SNU will present his thesis work on the western North Pacific upper-ocean thermal variability.

The delayed ocean dynamics generated by central Pacific atmospheric forcing causes prominent upper-ocean thermal variability in the Kuroshio-Oyashio Extension (KOE) region, leading to ocean-to-atmosphere feedback via turbulent heat flux especially in the boreal winter, although the exact time delay and major forcing modes are still in debate. For better understanding the upper-ocean thermal variability of the KOE region and western North Pacific in relation to atmospheric forcing, the relative importance of each atmospheric circulation pattern for the spatial distribution of the SST variability as well as their inter-relationship is investigated. The two outstanding surface atmospheric circulation patterns (East Asian winter monsoon and North Pacific Oscillation), which are tightly linked to the upper-level blockings, have nonstationary and regime-dependent relationship with the sea surface temperature. During the 1973-87 strong winter monsoon epoch, the EAWM and NPO were significantly correlated to each other, but their correlation practically vanishes during the 1988-2002 weak winter monsoon epoch. This nonstationary relationship is related to the pronounced decadal weakening of the Siberian high system over the Eurasian continent after the 1988 regime shift as well as the concomitant positive NPO-like dipole change and its eastward migration in tropospheric circulation over the North Pacific.

To investigate quantitatively the variability of the winter temperature and atmosphere-ocean interactions, the upper 400 m heat budget in the western North Pacific is analyzed for the 1984-2013 period using outputs from a realistic, high-resolution (1/12°) ocean general circulation model (ORCA12). Model-generated winter heat storage rate in the KOE region on interannual to decadal time scales is always dominated by the oceanic heat advection rather than by the net air-sea heat flux, which becomes particularly prominent and widely spread over the entire western North Pacific after the 1990 regime shift. The net heat flux in the model damps the temperature anomaly caused by the ocean dynamics, consistent with the ocean-to-atmosphere feedback in the KOE region. Changes in the ocean dynamics and upper-ocean heat content of the region are
associated principally with the meridional shift of the Oyashio Extension front and secondarily with that of the Kuroshio Extension front. The meridional shift of the Oyashio Extension front is related to the zero line of integrated wind stress curl, which is significantly correlated with both the West Pacific (WP) and Pacific-North America (PNA) teleconnection patterns. Although partly consistent with previous works, the present study emphasizes multiple lags (zero to 4 yr) for significant correlations between the climate indices of stationary atmospheric circulation (WP, PNA) and KOE thermal variability. This suggests that the KOE response to atmospheric forcing is more complex than previously thought in that both local and remote forcing of the WP and PNA control collectively the KOE thermal variability with multiple lags, rather than a simple linear Rossby wave-related lagged response with a single lag of a few year to remote atmospheric forcing in the central North Pacific.

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