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十年スケールにおけるロスビー波に対する黒潮続流ジェットの応答
Decadal response of the Kuroshio Extension jet to Rossby waves

佐々木 克徳 [1*], 見延 庄士郎 [1], Niklas Schneider[2]
SASAKI, Yoshinori[1*], MINOBE, Shoshiro[1], Niklas Schneider[2]

[1] 北海道大学理学研究院, [2] ハワイ大学国際太平洋研究センター
[1]Graduate School of Science, Hokkaido University, [2]IPRC, University of Hawaii

This study examines interannual to decadal variability of the Kuroshio Extension (KE) jet using satellite altimeter observations from January 1993 to December 2010. The leading Empirical Orthogonal Function (EOF) mode of low-frequent sea level variability in the KE region represents the northward (southward) shift of the KE jet, followed by the strengthening (weakening) of the KE jet with a few month lag. This result indicates that the latitude changes of the KE jet are a key process in the sea level decadal variability in the KE region.

A Singular Value Decomposition (SVD) analysis between sea level anomalies (SLAs) and 1000-hPa geopotential height reveals that the shift of the KE jet is lagged to atmospheric fluctuations in the eastern North Pacific by about three years. Consistent with the lagged relation, broad SLAs emerge in the eastern North Pacific 3-4 years before the KE jet shift, and propagate westward to the KE region along the KE jet axis (see figure). In the course of the propagation, the meridional scale of the SLAs gradually decreases, although their amplitude gradually increases.

This westward propagation of SLAs is attributed to the westward propagation of the meridional shift of the jet axis from the dateline to the upstream KE region with a phase speed of about 5 cm s^{-1}. This mechanism for westward propagation signals is explained by the thin-jet theory by Sasaki and Schneider (Decadal shifts of the Kuroshio Extension jet: Application of thin-jet theory, 2011, JPO), which indicates that the meridional shifts of the jet propagate westward as Rossby waves trapped along a potential vorticity jump accompanied by the jet. The reconstruction of SLAs on the basis of the thin-jet theory indicates the strong relation of westward propagation signals between SLAs and the shift of the jet. This result also suggests that the meridional scale change of the SLAs results from the amplitude change of the meridional jet displacement. In addition, the gradual decrease of SLAs to the east is likely attributed to the decay of the jet. Interestingly, this change of the strength of the jet is inversely proportional to the change of the amplitude of the jet shifts, suggesting the conservation of volume (quasi-geostrophic potential vorticity) anomalies during the westward propagation. This conservation also indicates that broad-scale positive (negative) SLAs in the eastern North Pacific likely induce the northward (southward) shift of the downstream jet around the dateline.

After the westward propagation signals of the positive (negative) SLAs reach at the east coast of Japan, the upstream KE jet strengthens (weakens) due to the coherent intensification (weakening) of the northern and southern recirculation gyres. Hence, the time-lag between the shift of the jet and its strength change can be considered as a response time of the recirculation gyres. It is worth noting that this strength change of the KE jet propagates eastward with a speed of about 6 cm s^{-1}, suggesting an importance of potential vorticity advection associated with a higher-mode Rossby waves from the western boundary in response to the incoming Rossby waves.

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