# Evolution of Baroclinic Instability over Koshu Seamount Leading to the Kuroshio Large Meander

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The Kuroshio south of Japan shows bimodal path fluctuations between the large meander (LM) path and the nonlarge meander (NLM) path. The transition from the NLM path to the LM path is triggered by a small meander generated off southwestern Japan. The small meander first propagates eastward (downstream) along the Kuroshio and then rapidly amplifies over Koshu Seamount, located about 200 km south of Japan, leading to the formation of the LM path of the Kuroshio. Although Koshu Seamount is essential for the rapid amplification of the small meander, the underlying physical mechanism is not fully understood.

In this study, the role of Koshu Seamount is revisited using a two-layer quasi-geostrophic model that takes into account the effects of bottom topography. Numerical experiments show that the transition from the NLM path to the LM path can be successfully reproduced only when bottom topography mimicking Koshu Seamount is incorporated. In this case, the upper layer meander trough is rapidly amplified together with a lower layer anticyclone by baroclinic instability during their passage over the northern slope of Koshu Seamount. A linear stability analysis shows that baroclinic instability over a seamount is caused by resonant coupling between the upper layer Rossby wave in the eastward background flow and the lower layer seamount-trapped wave during their eastward propagation over the northern slope of the seamount. The spatial scale and structure of this baroclinically unstable mode are close to those of the numerically reproduced small meander in its early amplification stage over the seamount.

Furthermore, nonlinear evolution of this unstable mode is numerically simulated. It is shown that, as the unstable mode is amplified, the nonlinear effects come into play, gradually suppressing its growth, slowing down its eastward propagation, and broadening its horizontal scale. Consequently, a quasi-steady meandering state is finally achieved where a deep anticyclone occupies over the whole seamount. This nonlinear evolution of the unstable mode is similar to the latter-stage amplification of the numerically reproduced small meander.

 