The life-cycle of annual waves in the Pacific Ocean as identified by a seamless diagnosis for the energy flux

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Synoptic-scale waves play an important role in tropical-extratropical interactions, that has been little investigated in terms of the transfers of wave energy owing to the lack of an appropriate diagnosis scheme in previous studies. A recent theoretical study has derived a seamless scheme that is able to identify the direction of group velocity for both gravity and planetary waves at all latitudes. This new scheme has been used in the present study to provide a first-ever energetic view for the life-cycle of annual waves in the Pacific Ocean in a set of shallow-water model experiments with climatological wind forcing. The new scheme is able to show, in particular for the third baroclinic mode, the signals of eastward energy flux associated with equatorial Kelvin waves that are distributed in the eastern part of the tropical Pacific Ocean. Waves in the tropical and subtropical regions are connected each other at the eastern boundary of the Pacific Ocean that has been viewed, for the first time in the history of geophysical fluid dynamics, in terms of the circulation of wave energy. Concerning the low-pass filtered time evolution of the energy flux, the reflection of equatorial waves at the western boundary is more clearly identified than that at the eastern boundary. These results for the analysis of climatological annual waves provide a basis for the analysis of waves with interannual variations in a future study to better understand, for example, tropical-extratropical interactions during El Nino and La Nina.

Keywords: tropical-extratropical interaction, seasonal climatology experiment, group velocity

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