Application of a new wave energy flux formulation to assessment of tropical wave propagation dynamics: Diagnostics for the tropical synoptic-scale wave disturbances in the Maritime Continent-northern Australian region

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A two-dimensional (horizontal) wave energy flux (WEF) formulation derived by Aiki et al. (2017, PEPS) is used to diagnose the dynamics of the tropical synoptic-scale waves (TSWs) propagating across the Maritime Continent and northern Australian (MCNA) region. The new WEF vectors are considered to be useful to assess energy dispersion characteristics of various types of waves in both the tropics and extratropics. The WEF is defined by adding a rotational flux term that includes Ertel potential vorticity (EPV)-based flow to the eddy geopotential flux. We computed eddy components of EPV-based stream function and corresponding wind fields from the atmospheric reanalysis (JRA-55) data using a numerical inversion technique to estimate the additional rotational flux term. The TSWs analyzed in this study have periods of about 2-8 days and zonal wavelengths of about 3000-4000 km (Fukutomi 2018, submitted to JGR). These waves propagate westward at approximately 8 m/s along the mean monsoon westerly flow extending from the Indian Ocean to the western Pacific. Wave troughs and ridges form a well-organized wave train in the MCNA region. Eastward amplification of wave troughs and ridges due to group propagation occurs along the monsoon westerly flow. WEF diagnostics confirm that wave energy propagation facilitates the downstream development of the synoptic-scale wave train and the mean monsoon westerly flow acts as a tropical waveguide. Distribution and behavior of the WEF vectors are compared with those of traditional wave activity and energy flux vectors. Applicability of this new tool to other types of the tropical waves and extratropical waves is also discussed.

Keywords: Tropical wave disturbances, Wave energy flux, Wave enegy dispersion

