Does the tropical atmosphere support Doppler shifted mixed Rossby-gravity waves?

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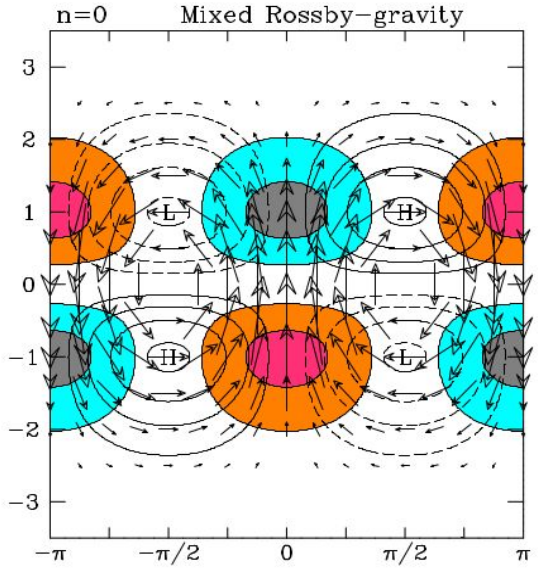
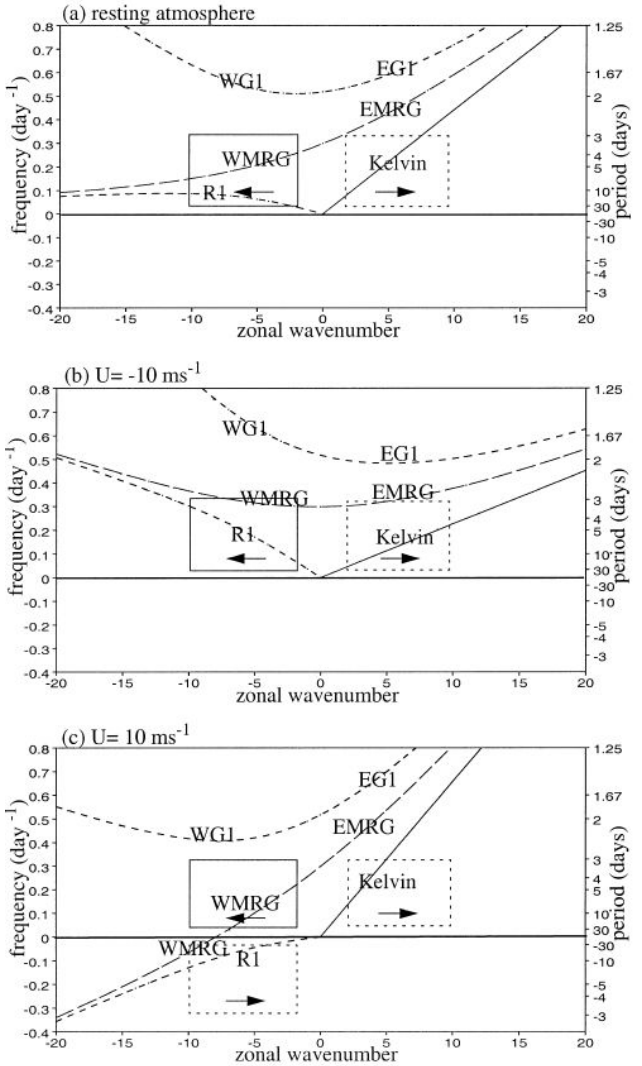
ECS

MRG waves



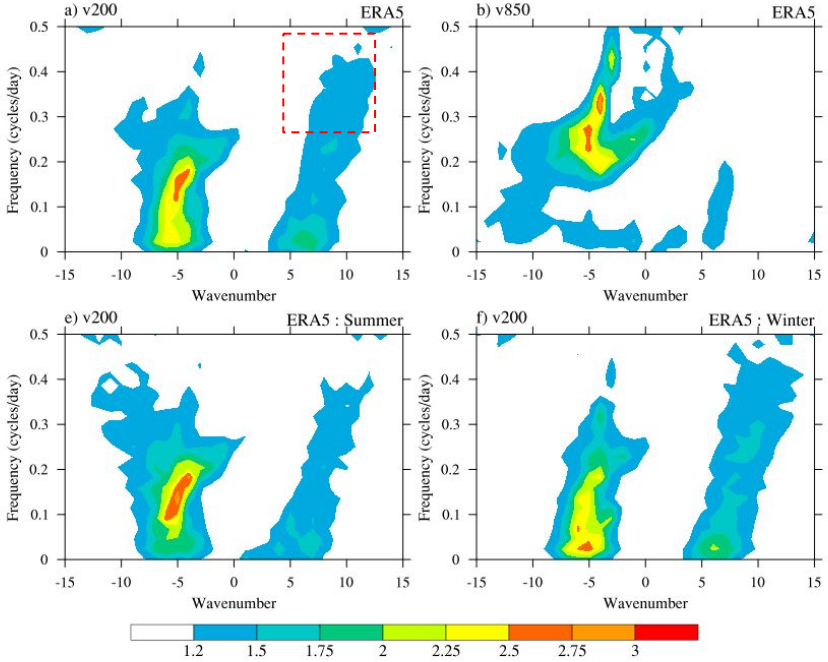
Kiladis et. al. 2016

- **Westward propagating, 3 to 8 day, 2000km to 10000km.**
- **Rotationally dominant wave modes.**
- **Unique features of the tropical atmosphere, exhibit mixed properties of Rossby and Inertio-Gravity waves.**

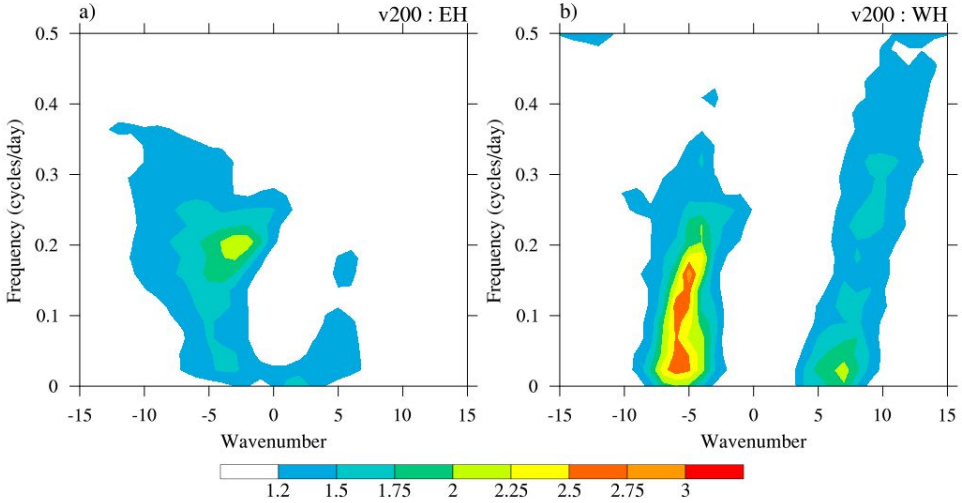


Yang et. al. 2003

Symmetric wavenumber and frequency power spectra of meridional wind



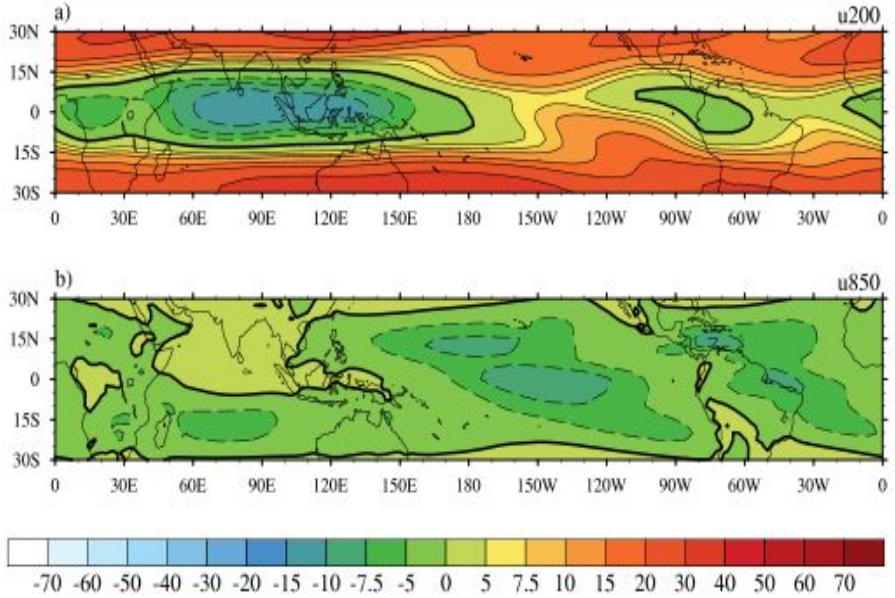
No power in the eastward wavenumbers for the 850 hPa w-k spectra.

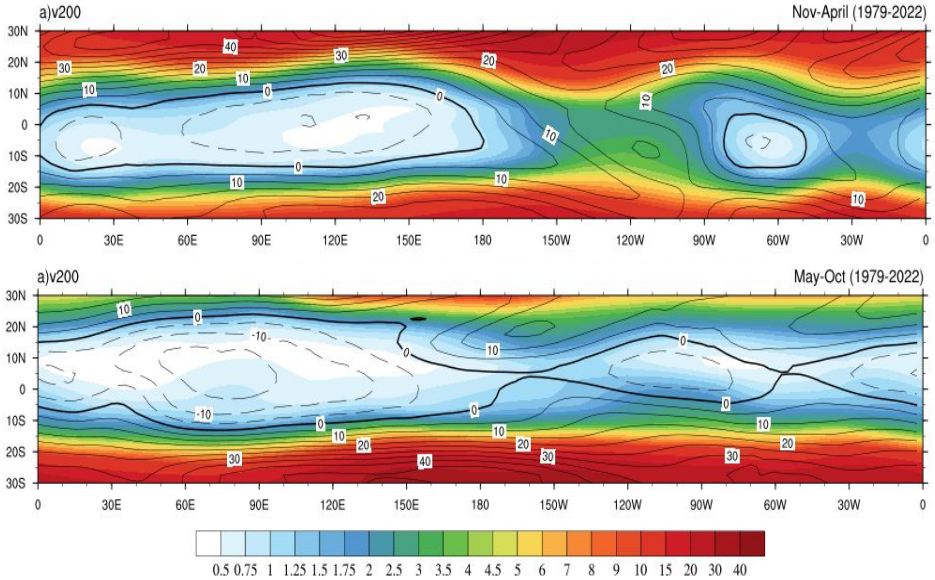


Stronger signal during winter

Western hemisphere (WH, 180E to 50E) accounts for majority of the power

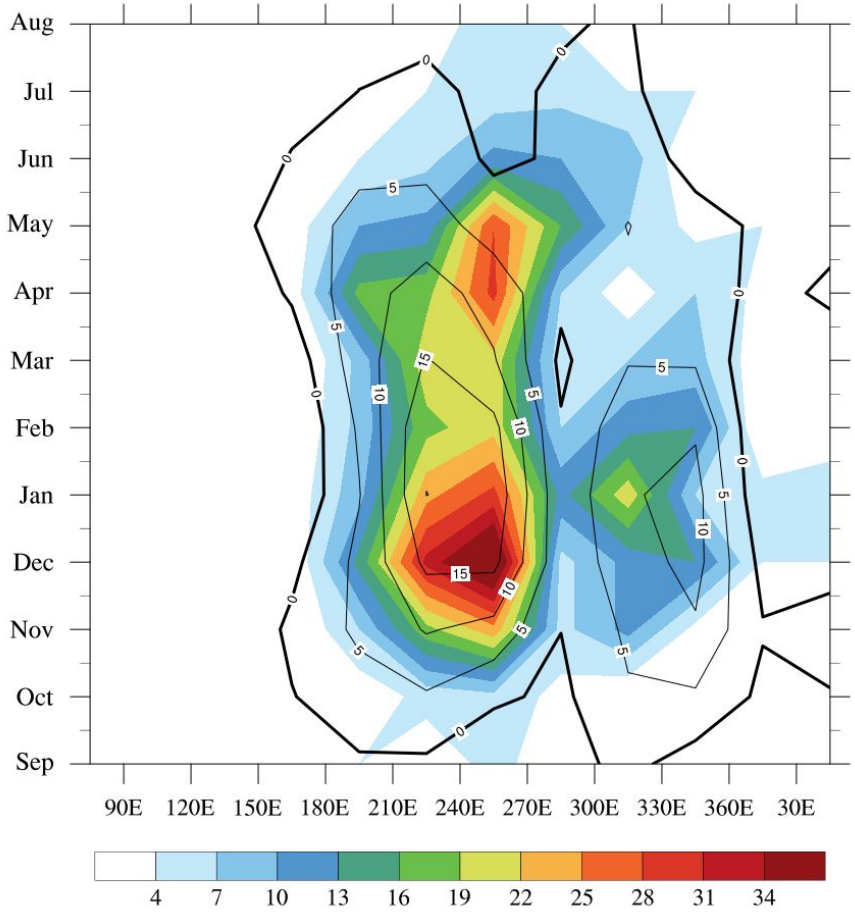
Time mean zonal wind





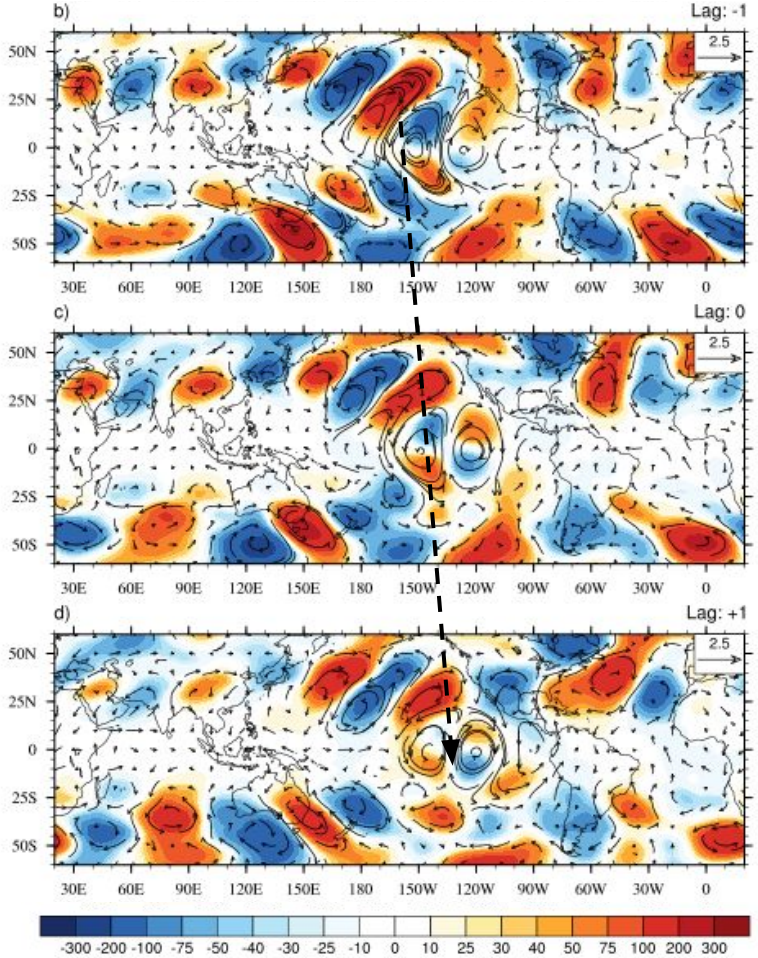
- **Westerly duct well developed over western hemispheric longitudes during NH winter at 200hPa.**
- **Maximum eastward amplitude in v200 and westerly ducts over east Pacific and Atlantic are collocated.**

Month versus longitude distribution of EMRG wave events and mean u200



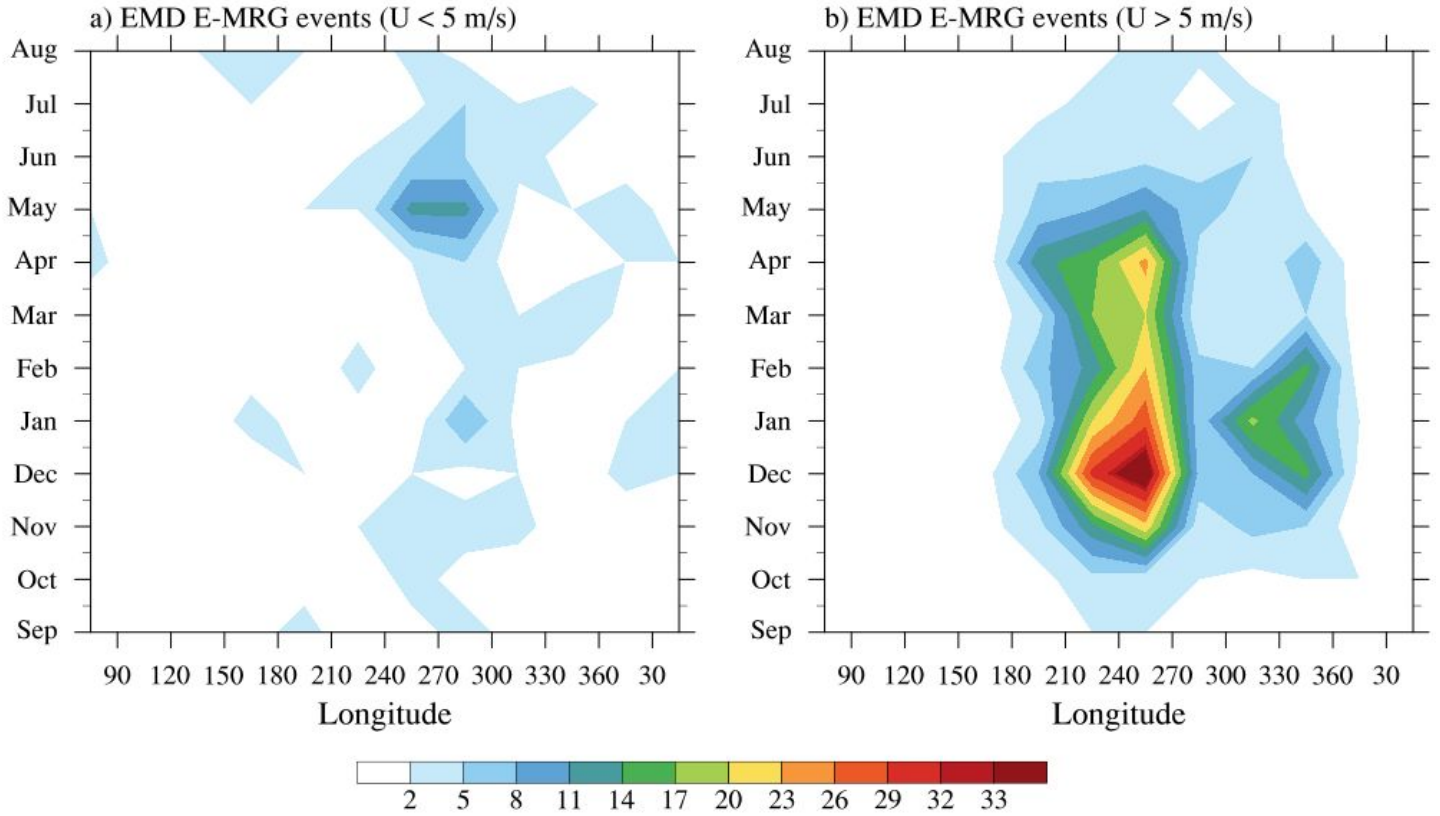
- **Maximum activity observed over east Pacific and Atlantic.**
- **East Pacific bimodal season peak - Nov to Feb and March to June.**
- **Atlantic preferred season Nov to Feb.**
- **Events over EP and AO during NH winter coincide with regions of strong westerly background winds.**
- **Secondary peak over east Pacific during March to June associated with weak westerly winds (less than 5 m/s).**

EMRG events: lead-lag composite for U > 5 m/s (Oct-Feb)



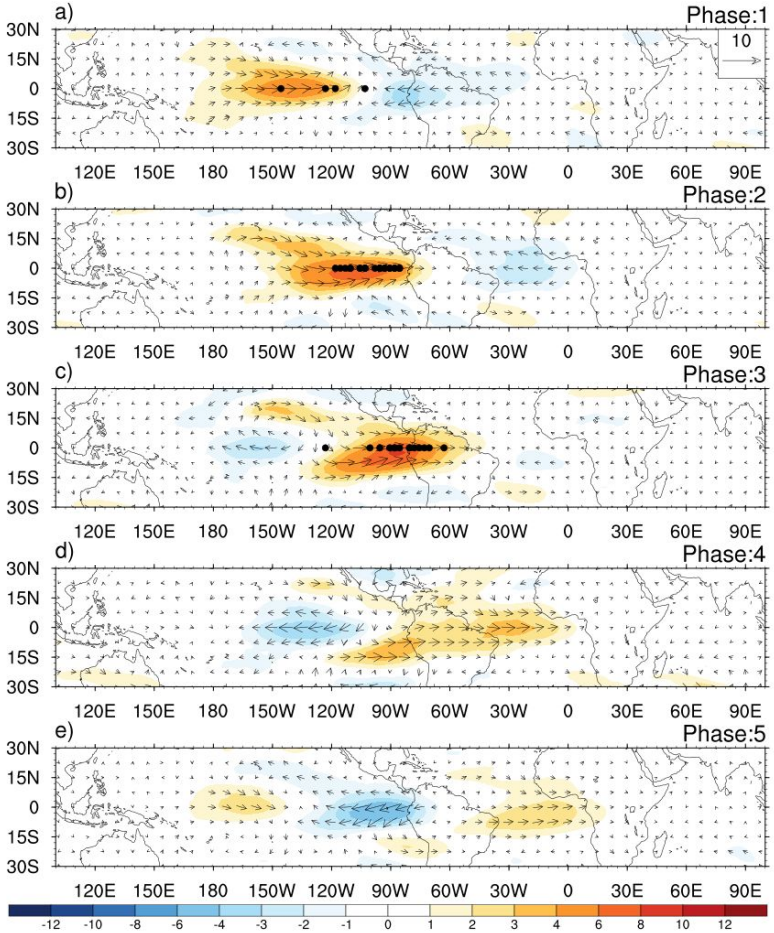
- **The composite plots cohere with theoretical structure of MRG waves and show an eastward phase propagation, validating the method of identification used.**
- **Extratropical wave intrusions from the NH and SH can be observed.**

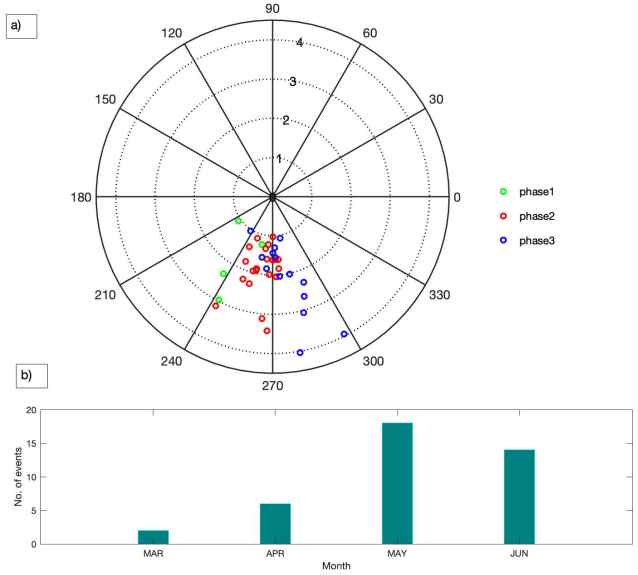
Monthly-longitude distribution of number of occurrences of E-MRG events for different mean U200



75% of the E-MRG wave events occurred in the westerly ducts

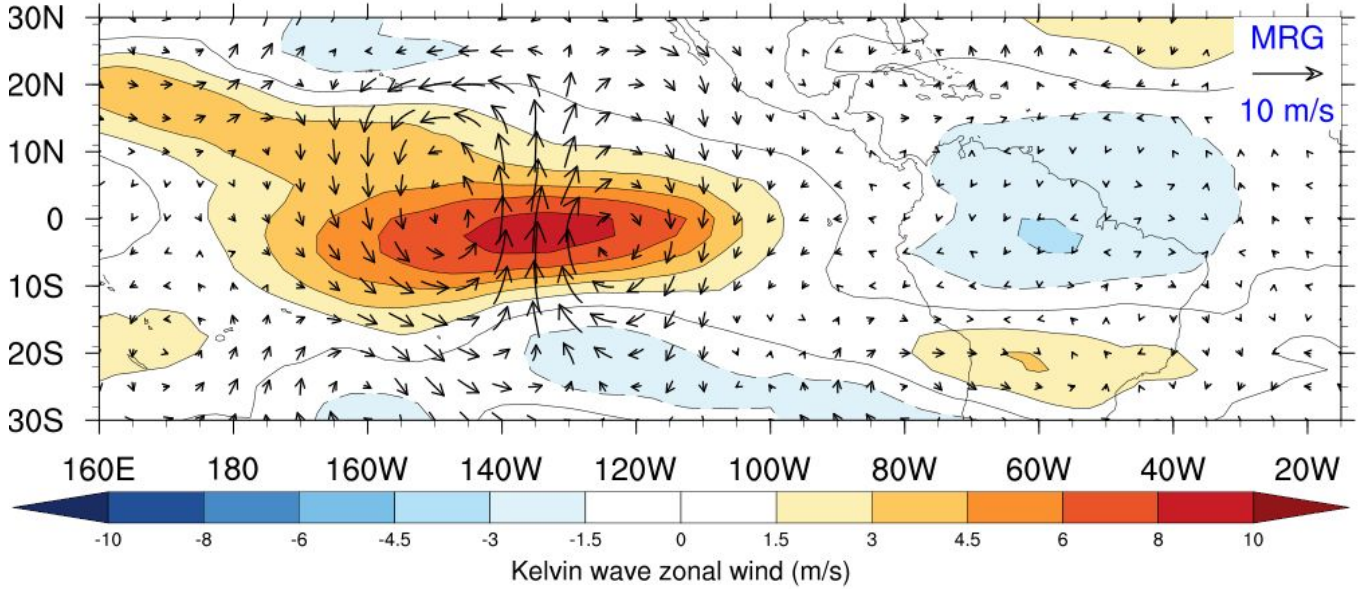
Kelvin wave phase composite at 200 hPa for east Pacific from March to June





- **70% of the EMRG events with U < 5m/s over the east Pacific (180E to 300E) during March to June were facilitated by the westerly phase of the Kelvin waves.**
- **Total 57 events occurred, 40 of them fell under westerly phase of the large amplitude and large scale Kelvin waves corresponding to wavenumbers 2 to 3.**
- **Easterly phase during of the Kelvin wave is suppressed.**

EMRG embedded in westerly phase of the Kelvin wave



- **One full EMRG wavelength completely embeds into the westerly phase of the large scale Kelvin wave.**
- **Supporting evidence for the Doppler shifting of EMRG waves by transient local Kelvin wave eddies even when the background zonal winds are easterly or weak westerly.**

Conclusions

1. **730 Doppler shifted eastward propagating MRG (EMRG) wave events were identified for a period of 44 years (1979 to 2022).**

2. **75% EMRG events occur over a local westerly background (U > 5 m/s).**

3. **70% EMRG wave events associated with U < 5 m/s occur during March to June over the westerly phase of large scale and large amplitude Kelvin wave eddies.**

Thank you

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