NASA PMM Science Team Meeting
4–8 August 2014, Baltimore, MD

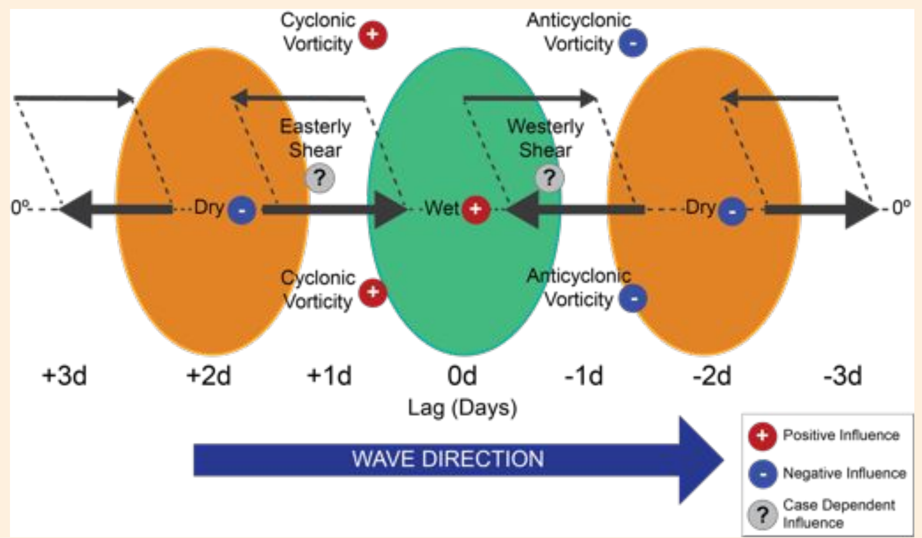
A Global Survey of Kelvin Waves and Tropical Cyclones

NASA PMM Grant NNX13AH47G
Poster #248

Carl J. Schreck III[1,2] and James P. Kossin[2]
[1]Cooperative Institute for Climate and Satellites – North Carolina (CICS-NC), North Carolina State University, and [2]NOAA's National Climatic Data Center (NCDC)

Inspire. Advance. Engage.

Introduction



Convectively coupled Kelvin waves

- Eastward propagation at 10–20 m s^{-1}
- 3–10 day period, 2000–4000 km wavelength

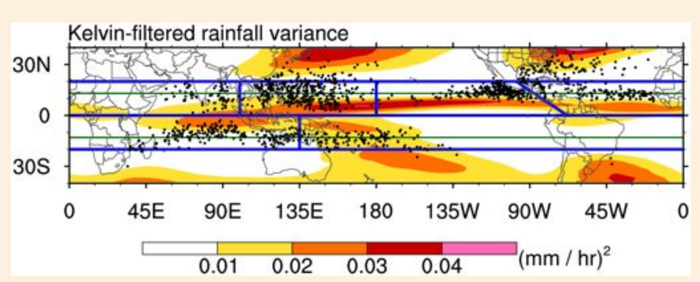
Kelvin Waves modulate key factors for cyclogenesis

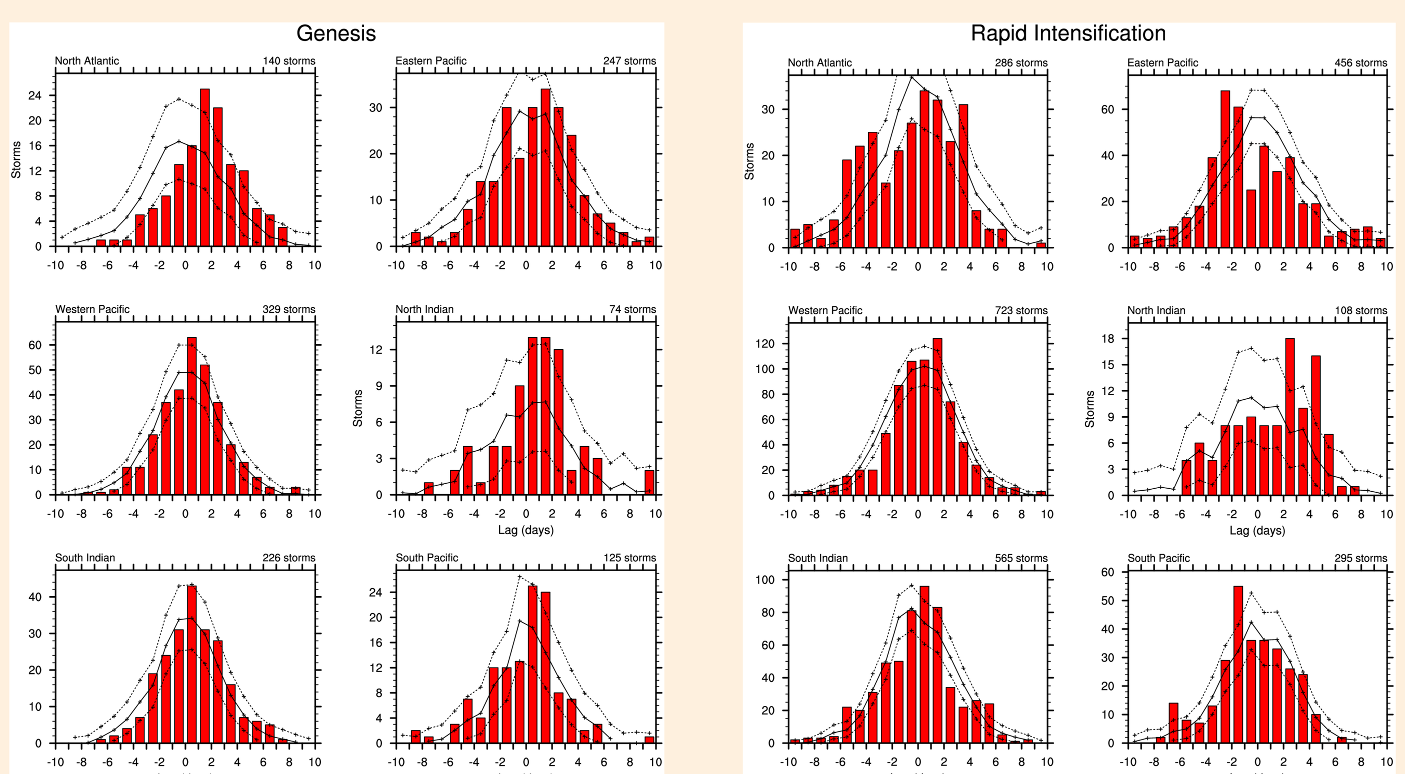
- Low-level vorticity, convection, vertical wind shear
- But net impact on tropical cyclone activity is uncertain

Genesis by Lag

Methodology:

- Identify storms in each basin within 20° of equator (blue boxes)
- Match storm with Kelvin-filtered TRMM 3b42 rainfall at the same longitude from 0°–13° latitude (green lines)
- Find lag between storm and nearest wave crest of at least 1-σ at same longitude as storm

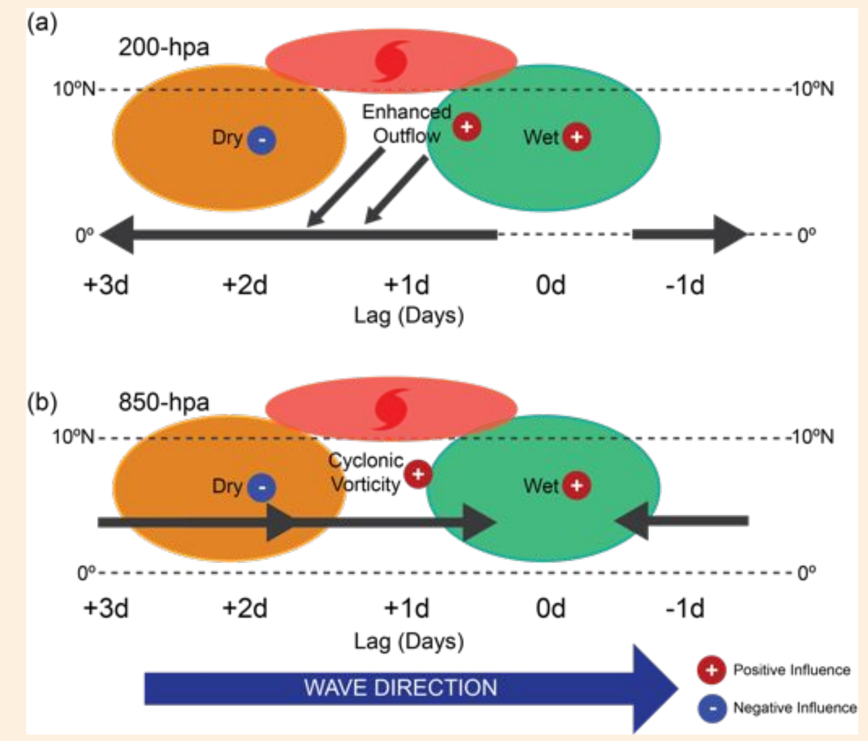




Histograms of tropical cyclogenesis (left) and rapid intensification (right, 25 kt in 24 h). Positive lags indicate that wave crest leads tropical cyclone activity. Black lines identify the 5th, 50th, and 95th percentiles based on climatological wave activity.

Summary

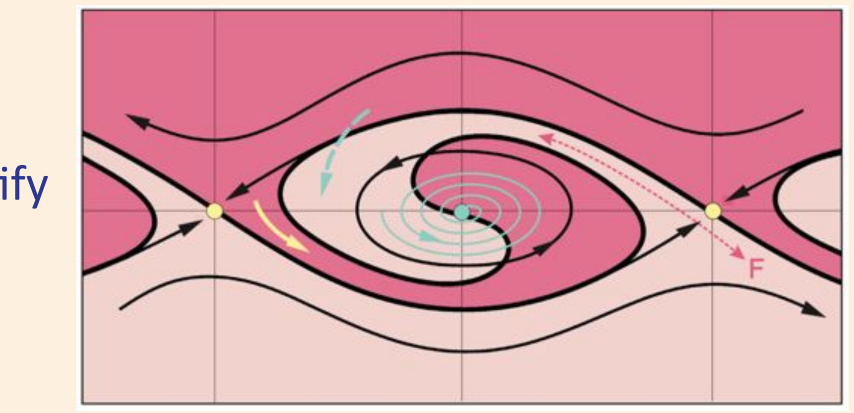
- **Tropical cyclones favored 0–4 days after Kelvin wave passage**
- **Short lags within MJO envelope**
  - Kelvin wave enhances MJO's favorable conditions
- **Circulation seems to be the dominant factor**
  - Low-level vorticity
  - Upper-level outflow
- **Minimal effects from other fields**
  - Humidity, Shear, PV, Temperature



Future Work

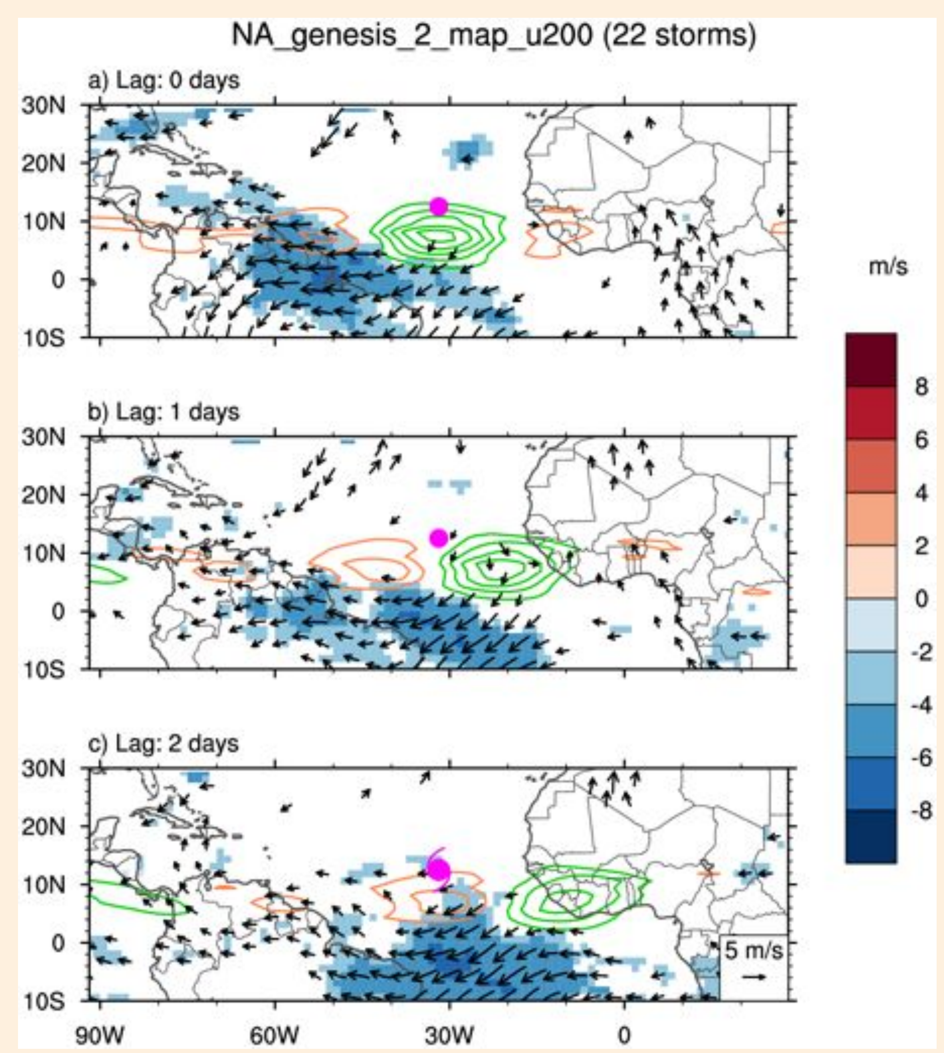
Do Kelvin waves affect Lagrangian recirculation?

- Lagrangian framework can identify moisture recirculation within easterly waves
- We will investigate how this recirculation is affected by the equatorial easterlies and westerlies from Kelvin waves



Schematic of an easterly wave embedded in latitudinal shear (Dunkerton et al. 2009).

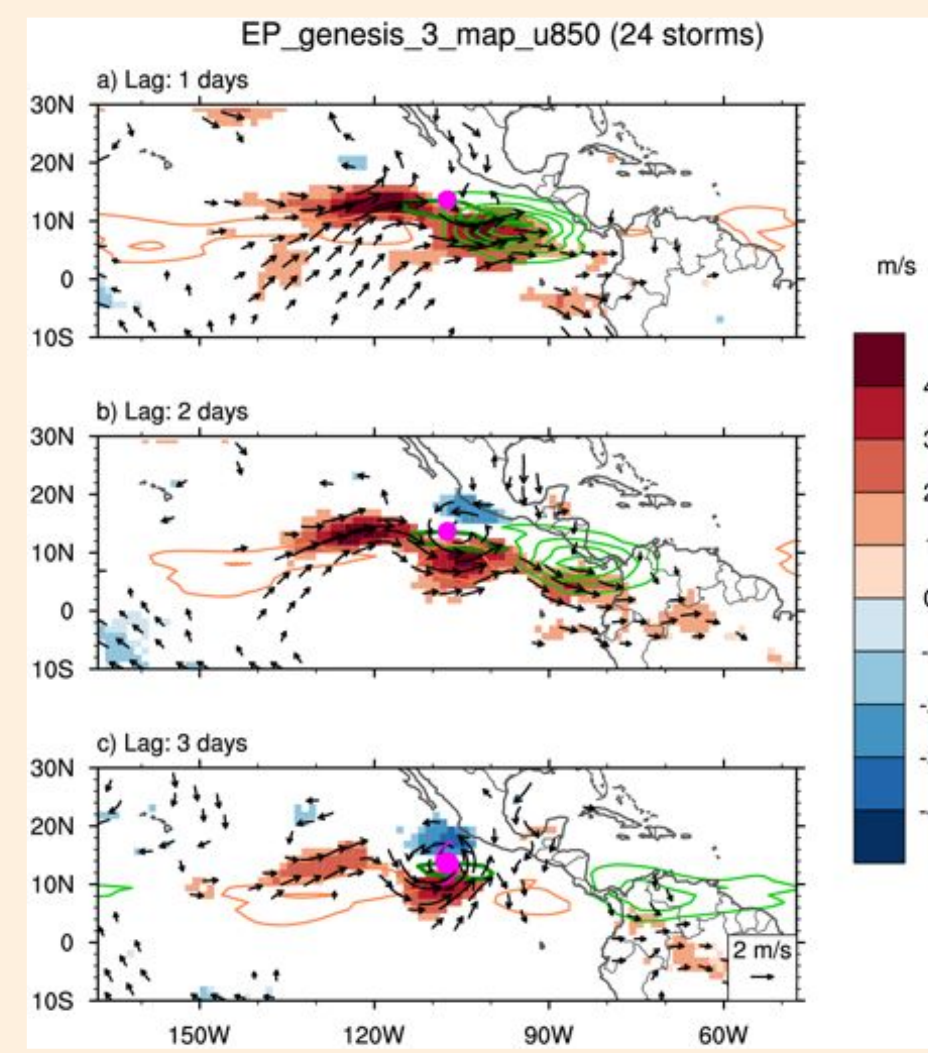
Atlantic: Outflow



Composite 200-hPa winds (zonal component shaded) for Atlantic storms forming 2.00–2.75 days after Kelvin wave passage

- Strongest 200-hPa easterlies move eastward with wave
- Too far south to affect shear
- Enhances outflow for nascent tropical cyclone

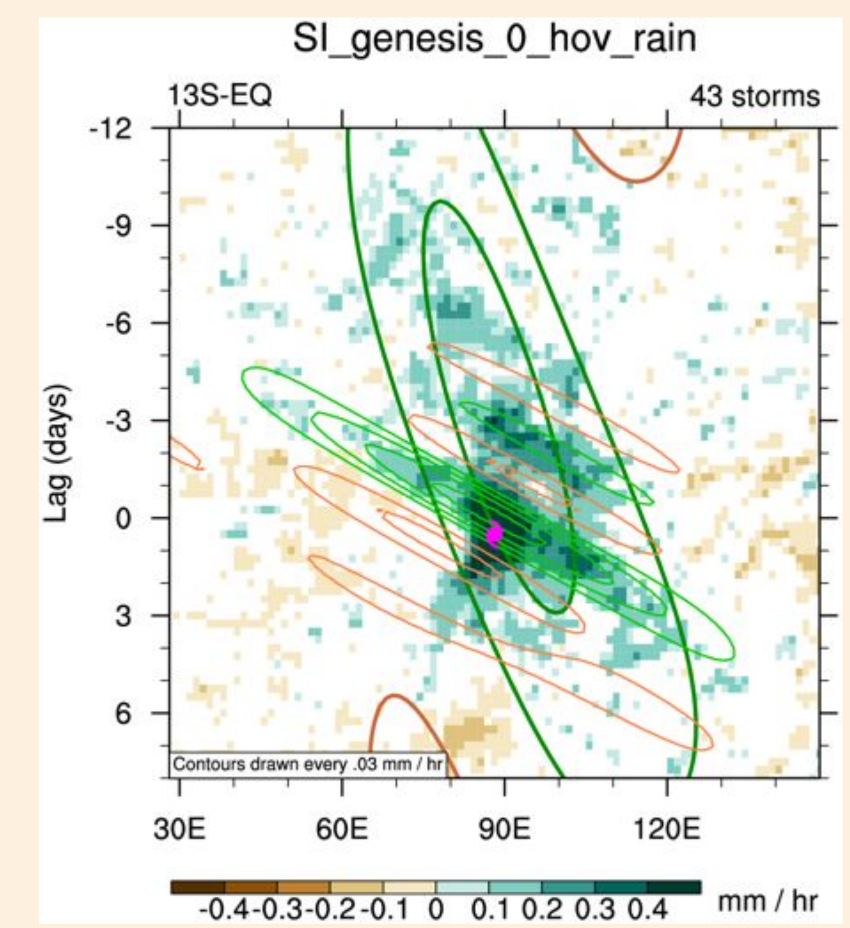
E. Pacific: Vorticity



Composite 850-hPa winds (zonal component shaded) for East Pacific storms forming 3.00–3.75 days after Kelvin wave passage

- 850-hPa westerlies spread eastward in wake of convection
- Westerlies occur in a narrow latitude band
- Undulations suggest genesis from barotropic breakdown

S. Indian: MJO's Peak



Composite TRMM rainfall for South Indian storms forming 0.00–0.75 days after Kelvin wave passage

- Kelvin wave (thin contours) is embedded within MJO (thick contours)
- MJO's heaviest rain coincides with the Kelvin wave
- Similar surge occurs with Kelvin wave in MJO's transition from low-level easterlies to westerlies (not shown)

NC STATE UNIVERSITY

CICS – NC
Cooperative Institute for Climate and Satellites – North Carolina

NOAA's National Climatic Data Center
Asheville, North Carolina

cjschrec@ncsu.edu

pdf of this poster