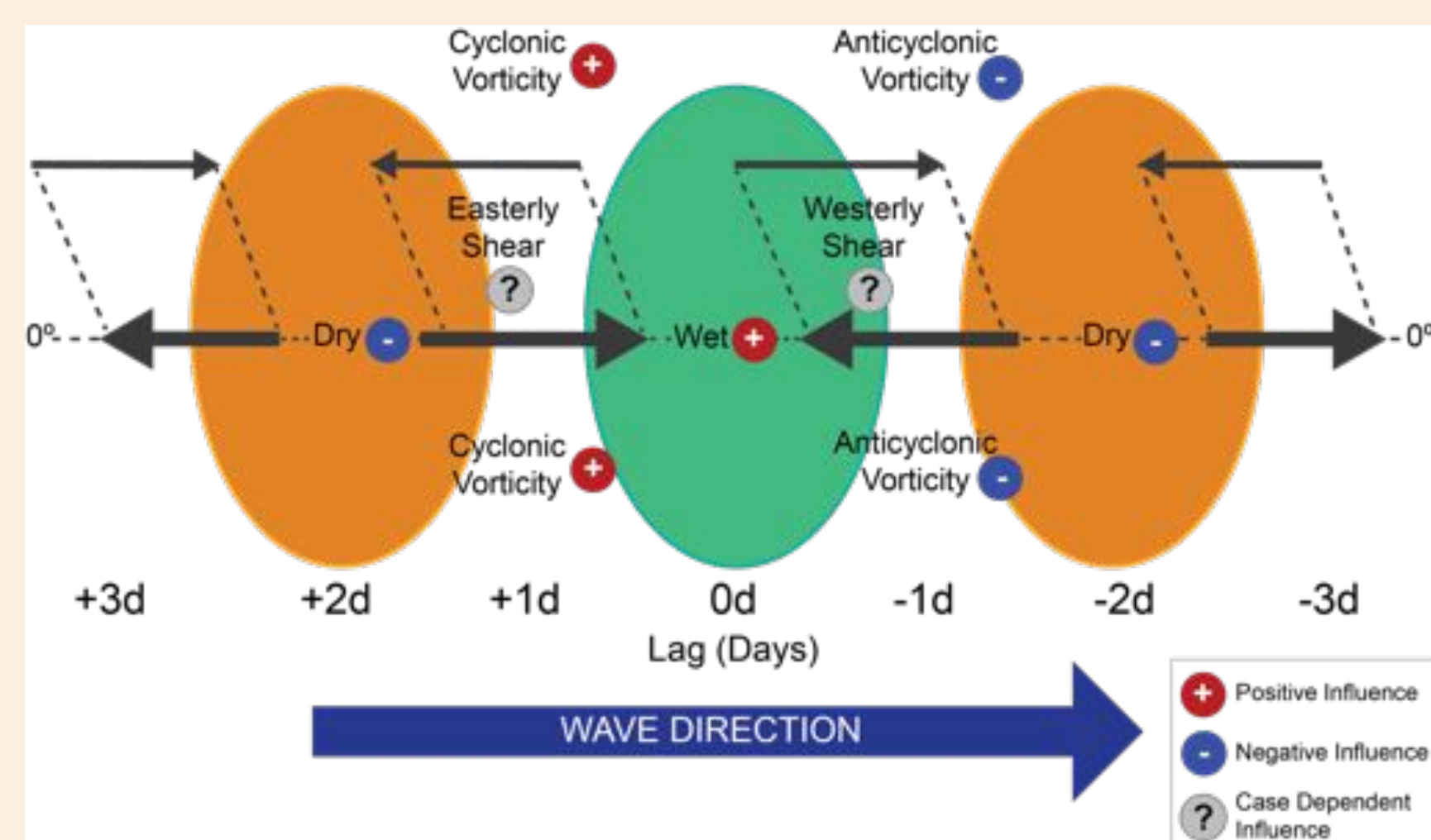# A Global Survey of Kelvin Waves and Tropical Cyclones

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*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

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
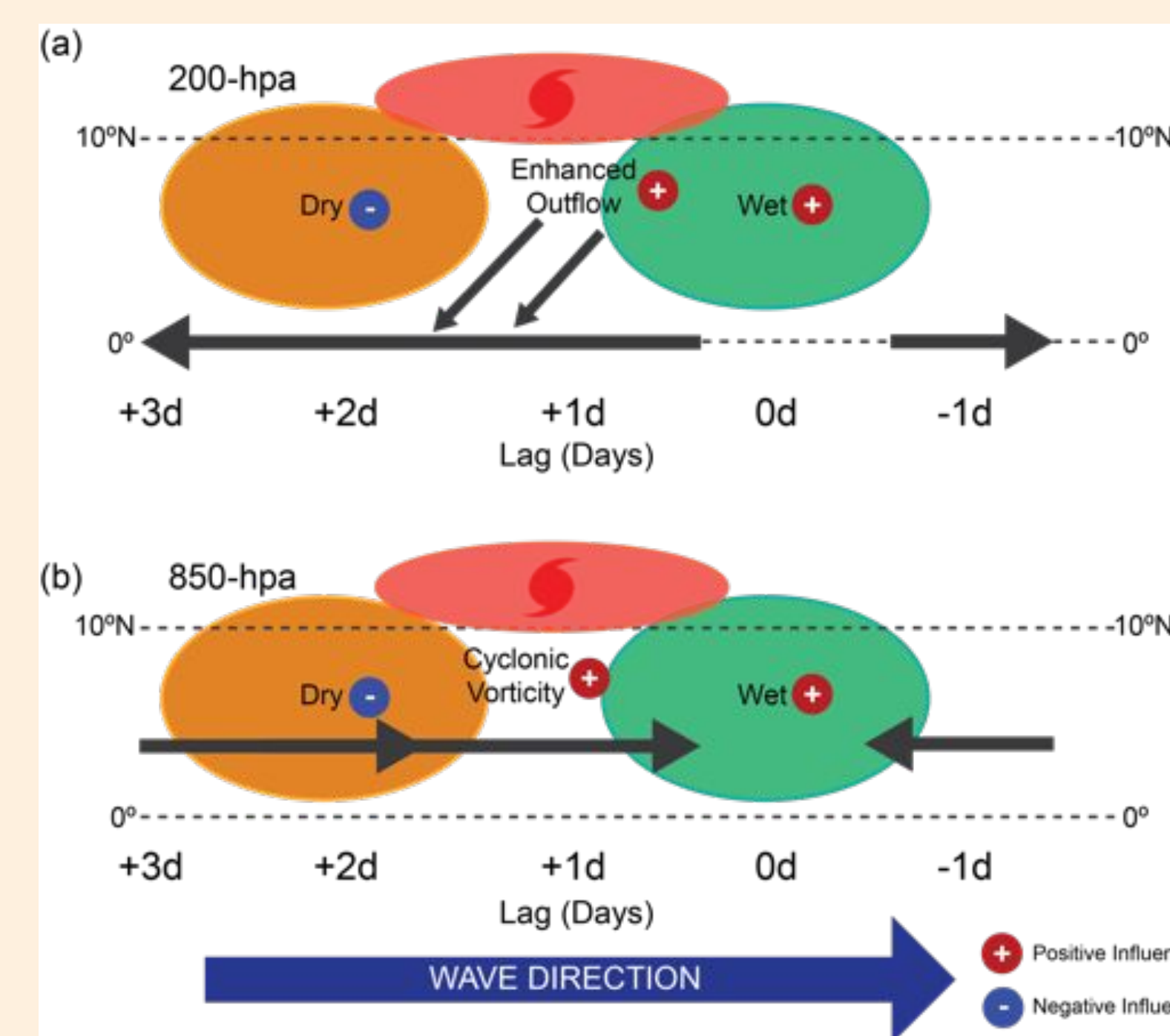
Future Work

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
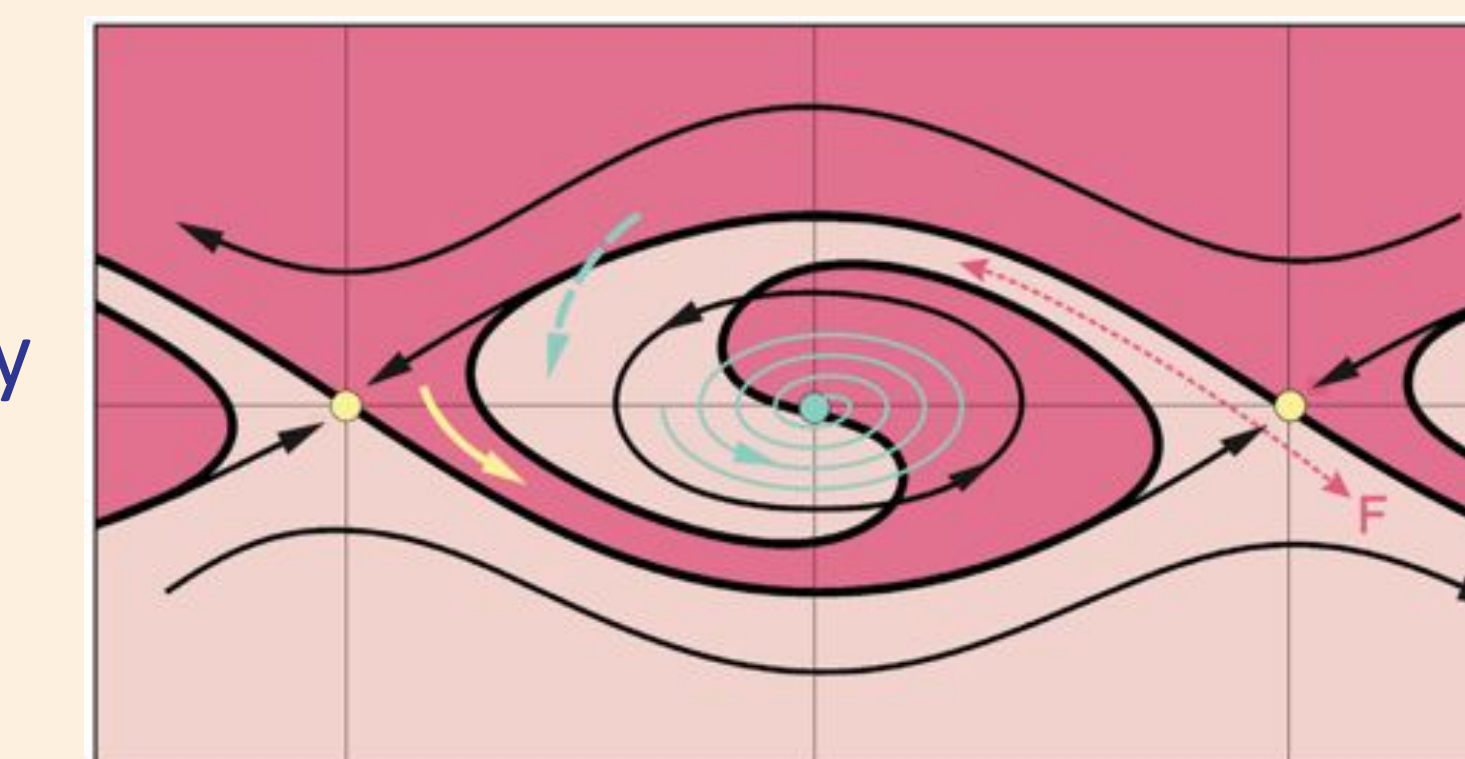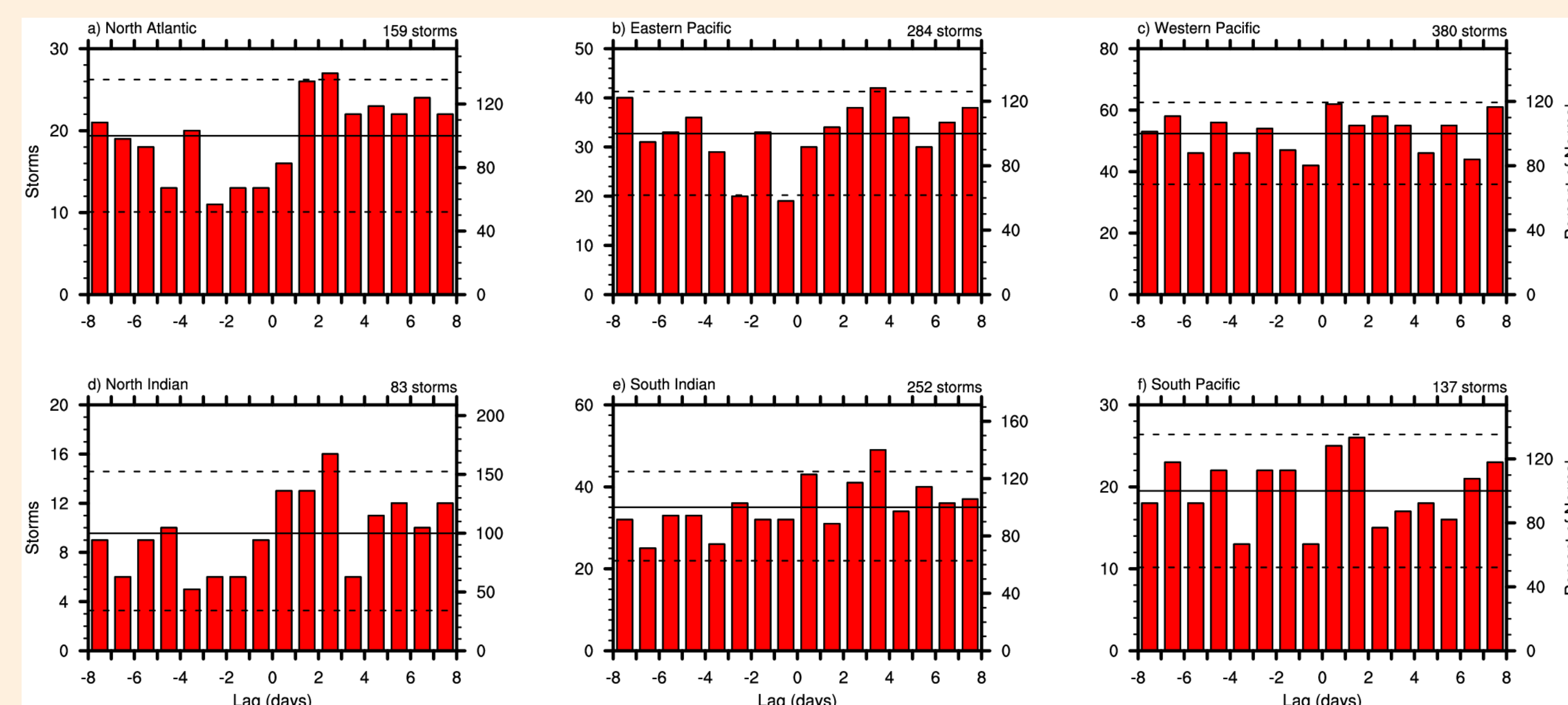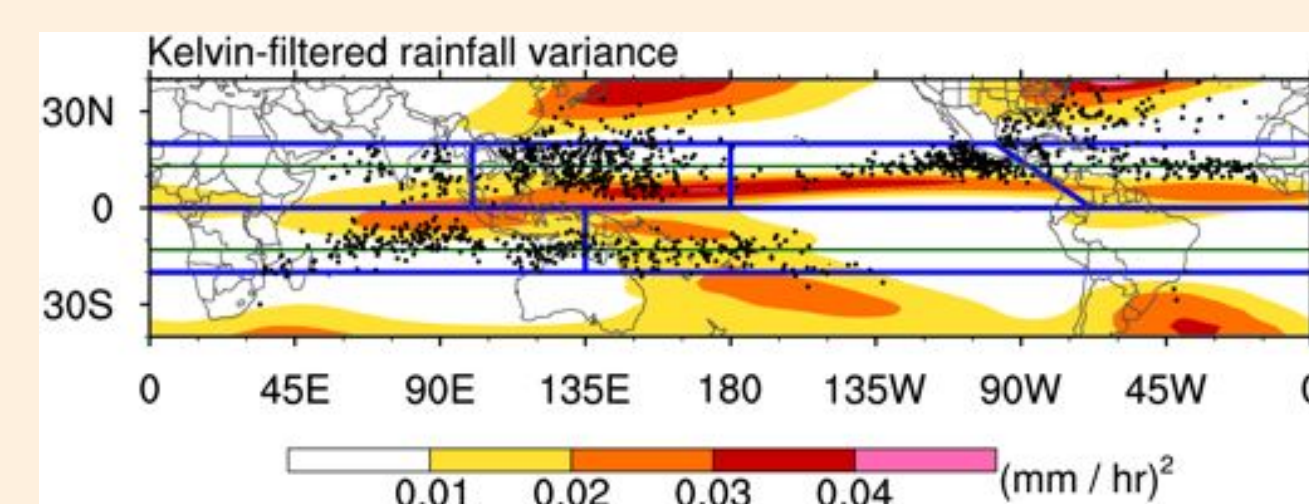

Schematic of an easterly wave embedded in latitudinal shear (Dunkerton et al. 2009).

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 by lag relative to Kelvin wave crests for each basin. Positive lags indicate that the wave crest preceded cyclogenesis. Solid horizontal lines denote the mean for all lags, while dashed lines identify the 95% probability range. Numbers in the upper right indicate the number of storms analyzed in each basin.
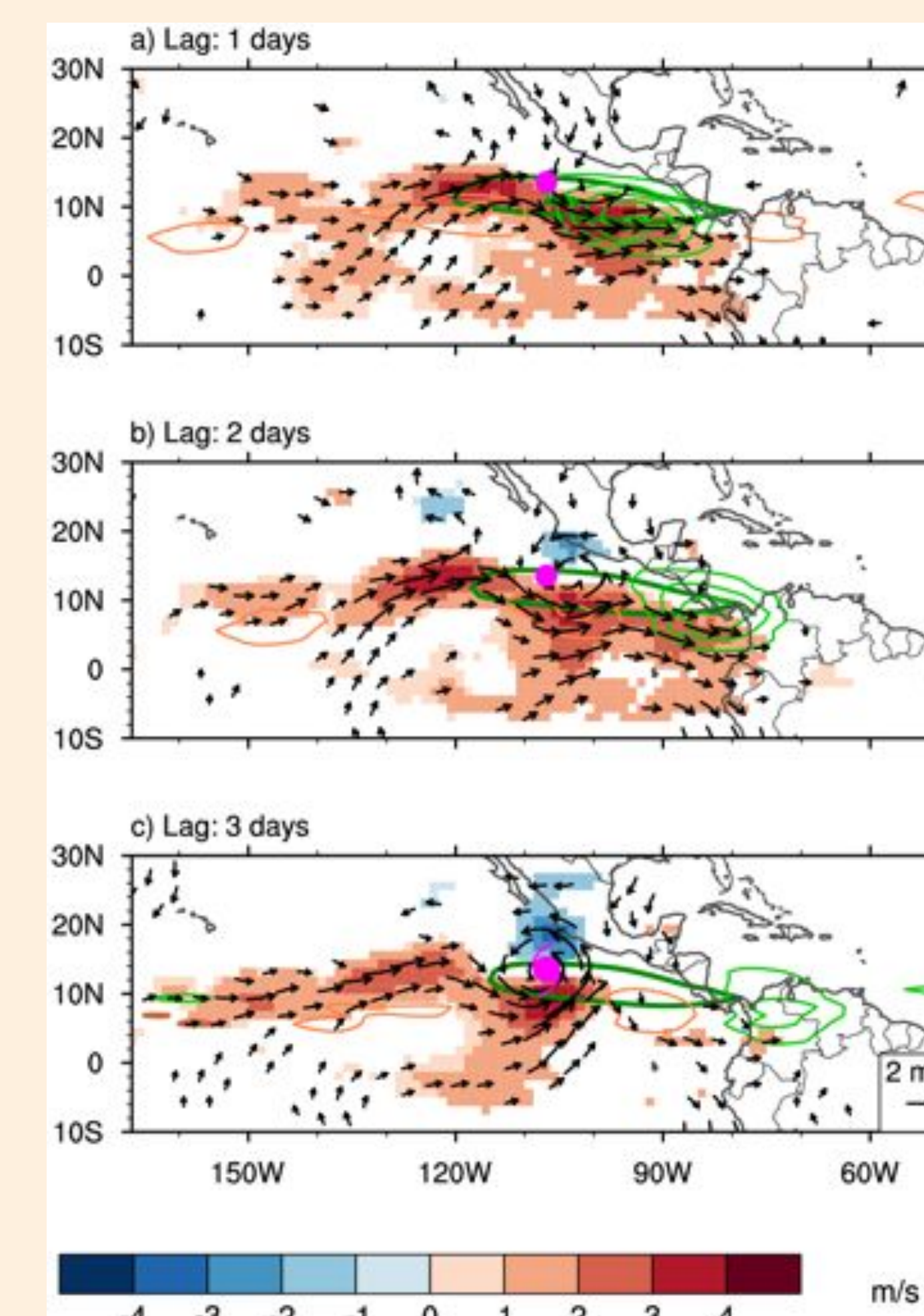
Atlantic: Outflow
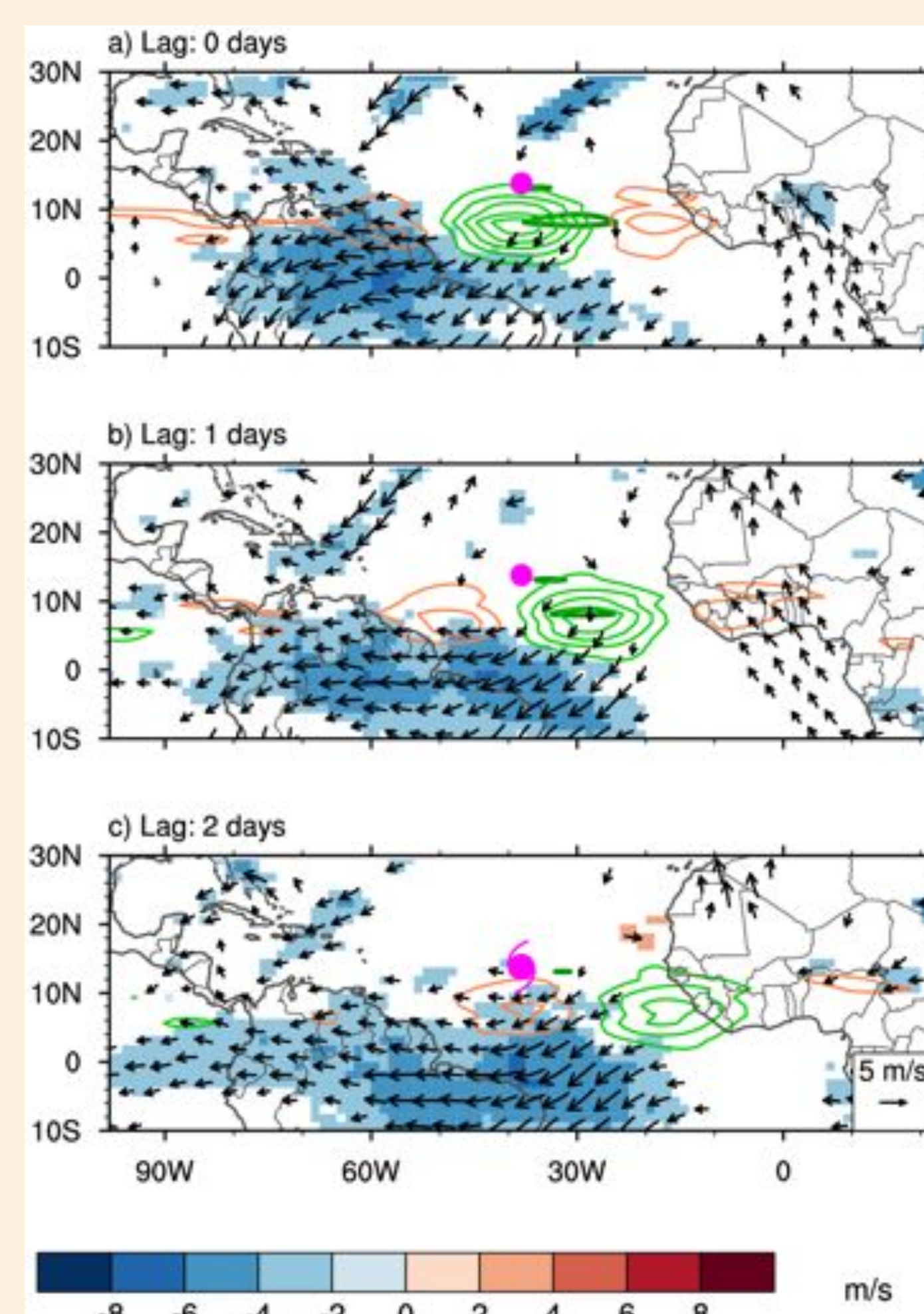
Composite 200-hPa winds (zonal component shaded) for Atlantic storms forming 2.00–2.75 days after Kelvin wave passage

- 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
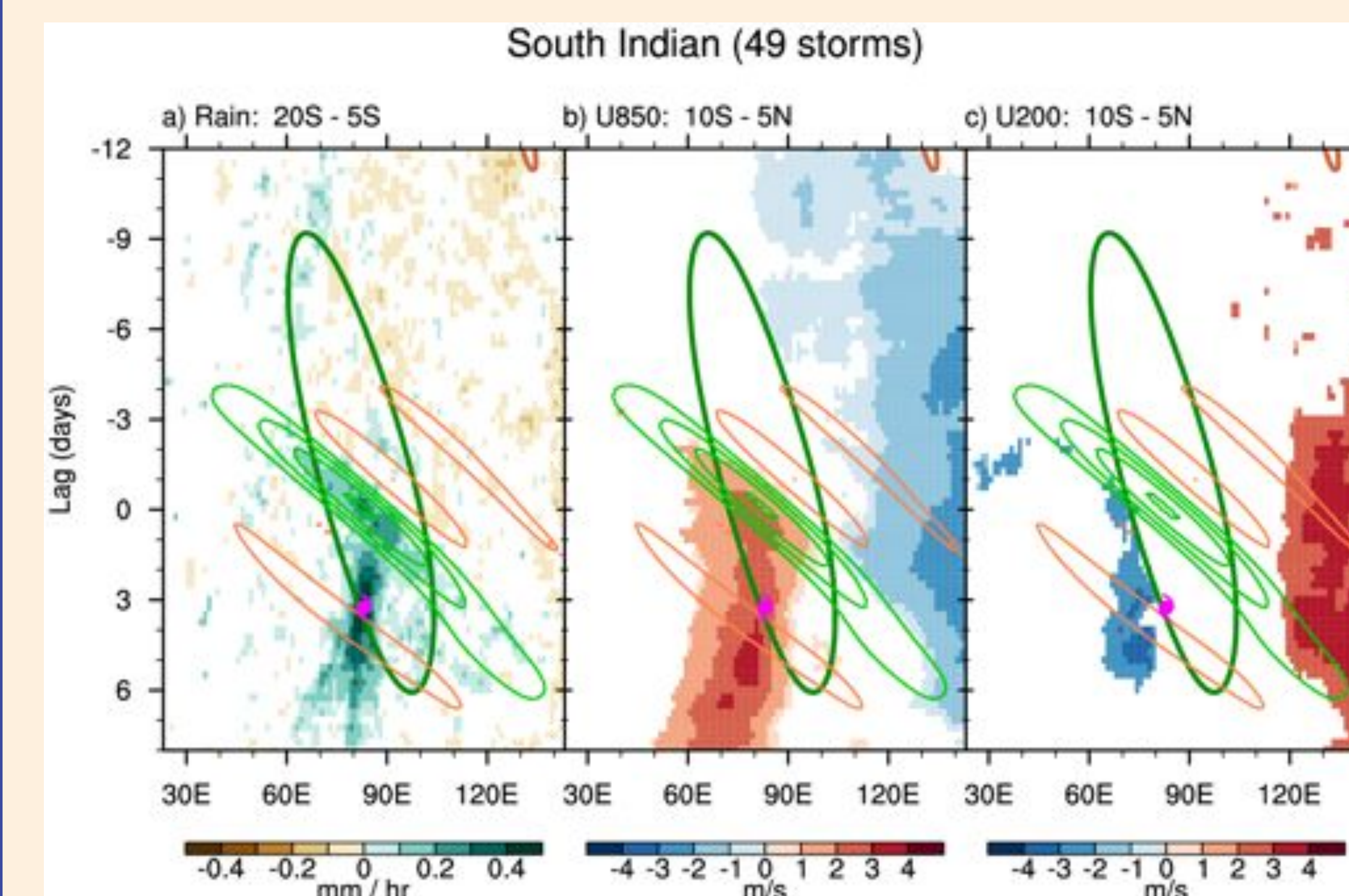
Composite TRMM rainfall for South Indian storms forming 3.00–3.75 days after Kelvin wave passage

- Kelvin wave (thin contours) is embedded within MJO (thick contours)
- MJO's heaviest rain and westerlies coincides with the Kelvin wave
- Similar surge occurs with Kelvin wave in MJO's transition from low-level easterlies to westerlies