The Midlatitude Response to Fluctuating Tropical Heat Sources

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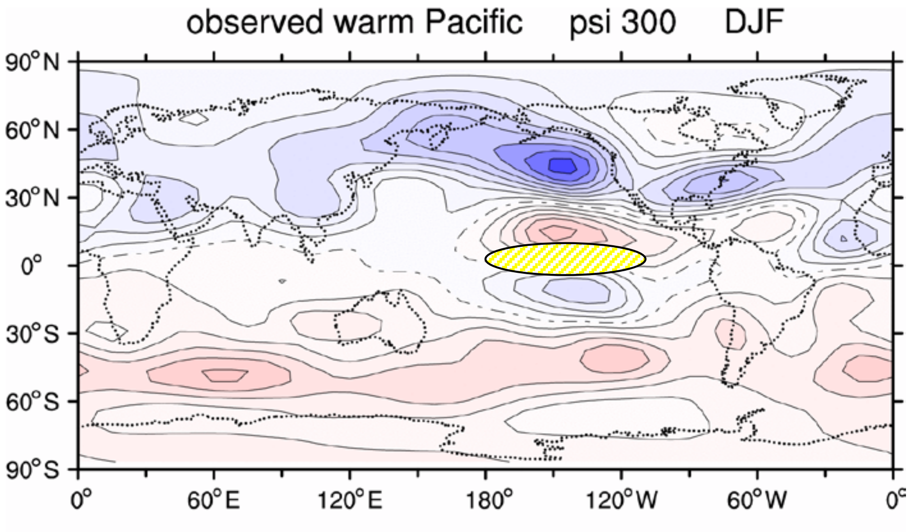
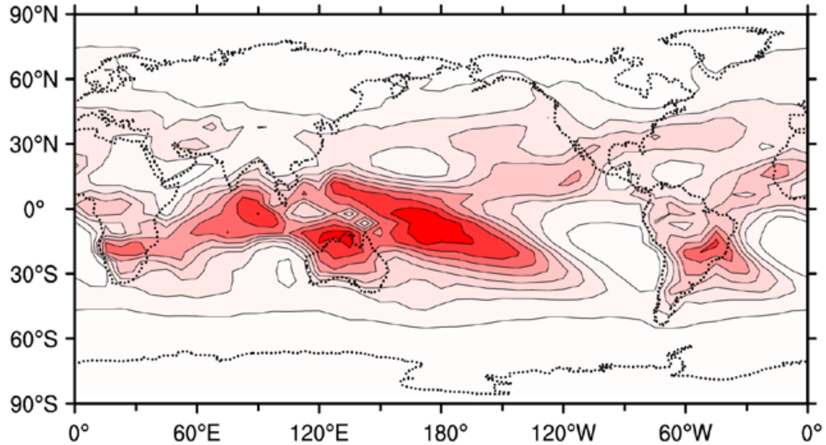
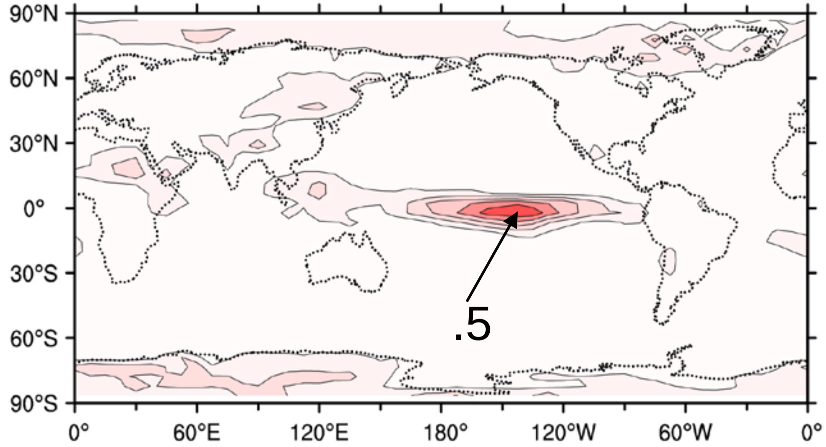
NCAR

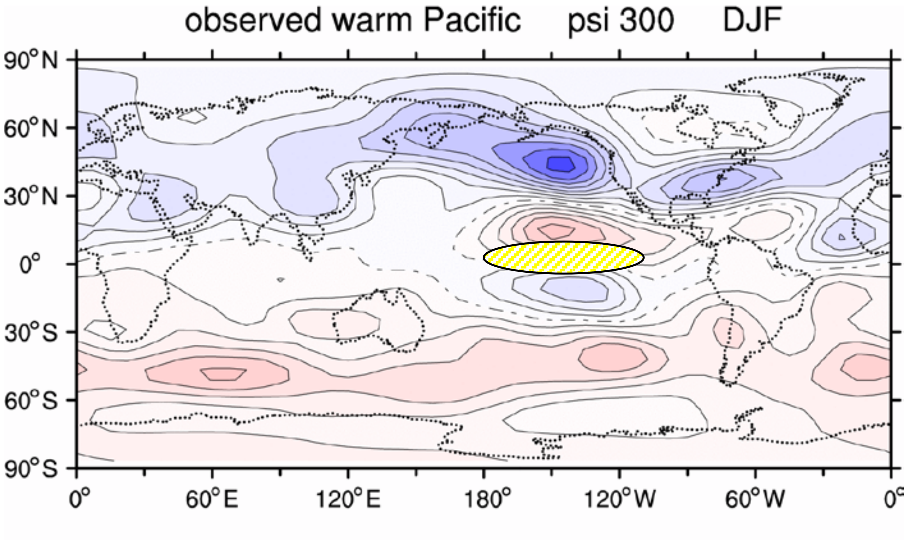


total OLR daily variance during DJFM



interannual/total

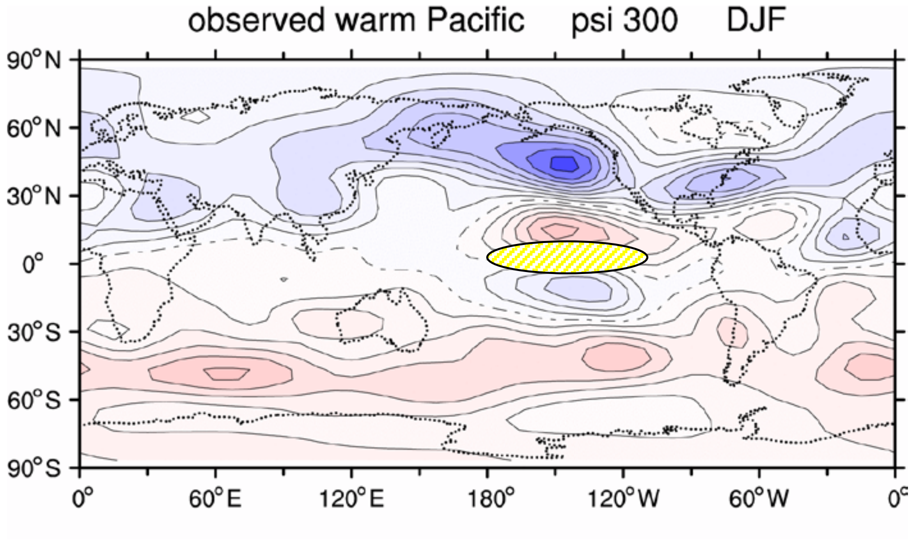




Lessons from the constant forcing case

① Planetary wave dispersion

- Garcia & Salby (1987)
- Li & Nathan (1994)
- Yang & Hoskins (1996)



Lessons from the constant forcing case

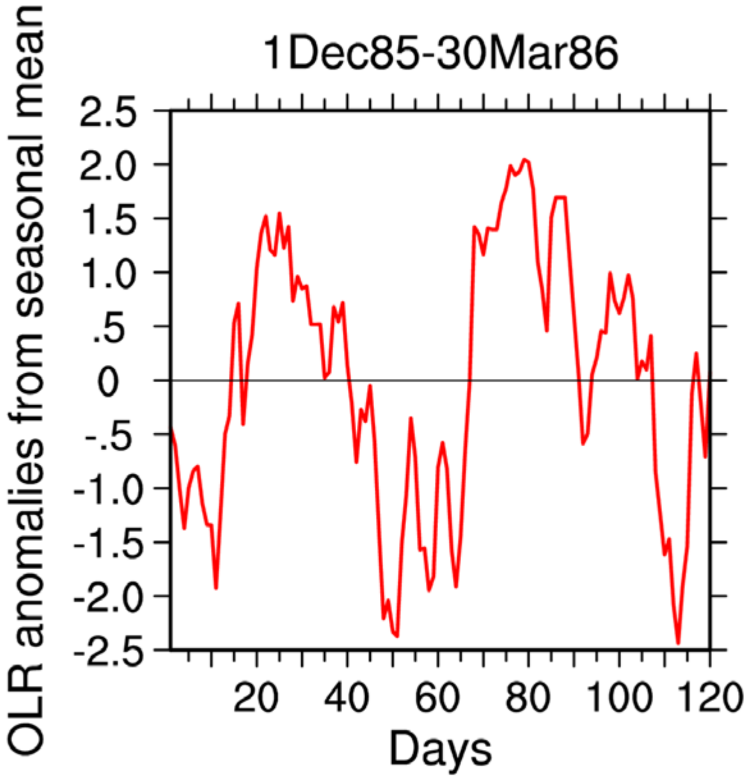
① Planetary wave dispersion

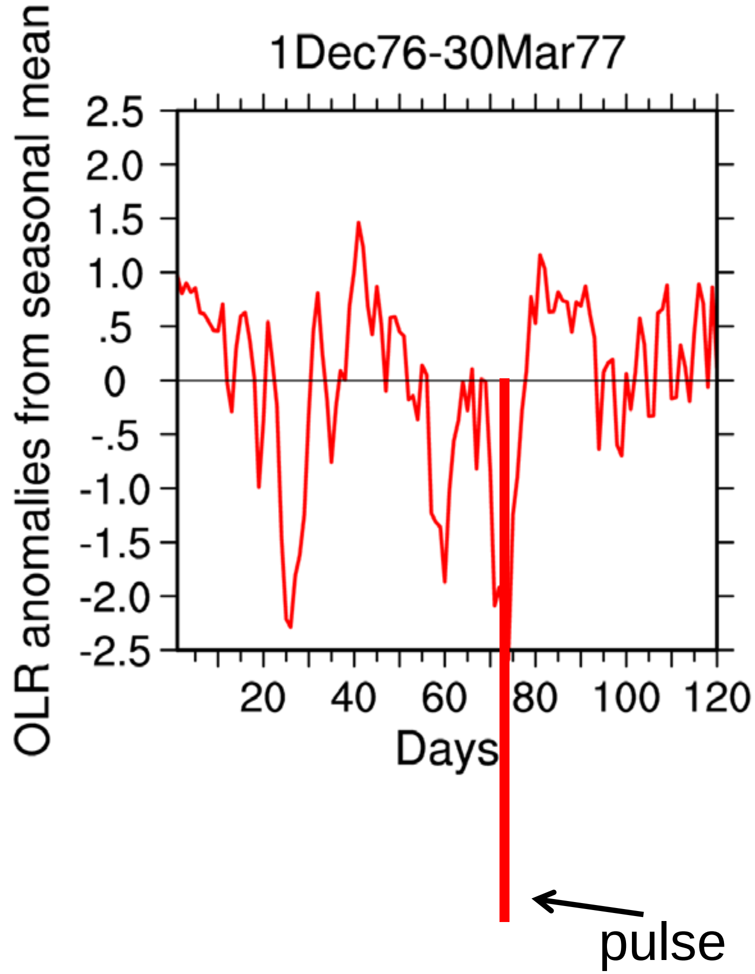
② Dynamical feedbacks & scale interactions

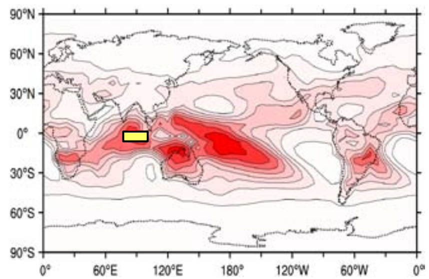
③ Additional factors: baroclinity, irrotational component, moisture, …

OLR at (90E,0N)

(20x8degree box)



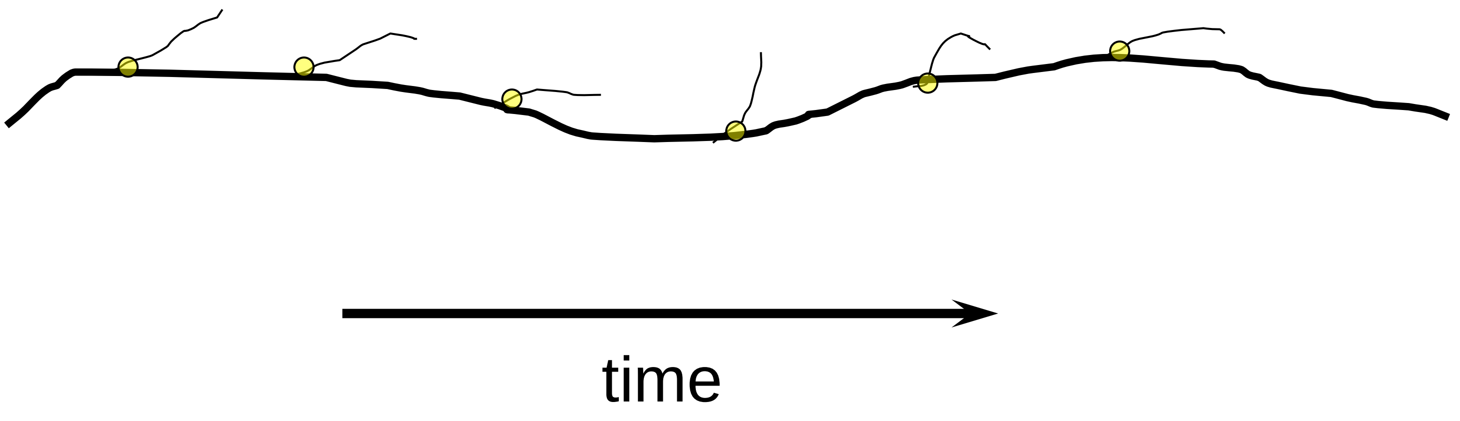




(C/day max equivalent)

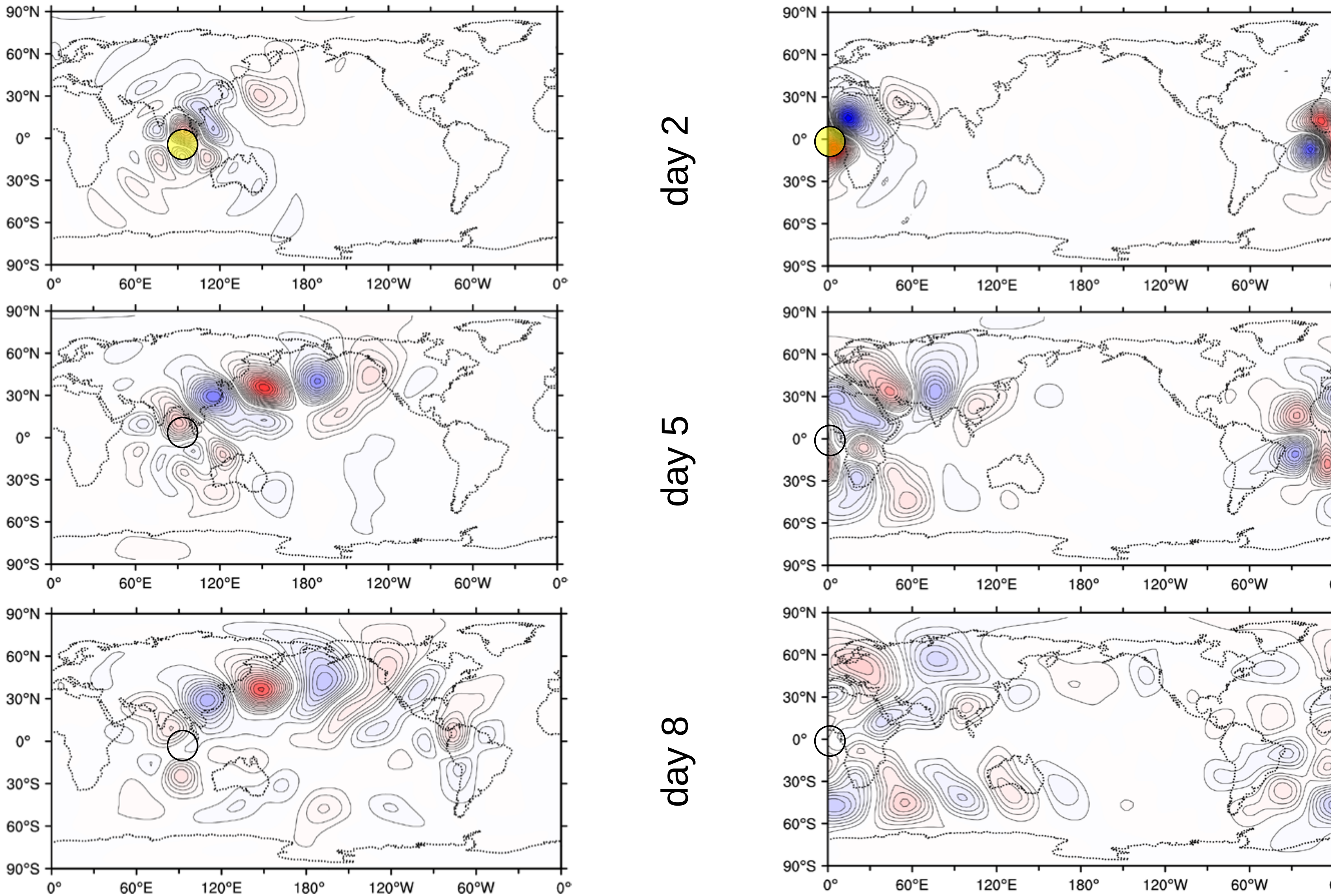
Basic building blocks:

Response to a pulse


time

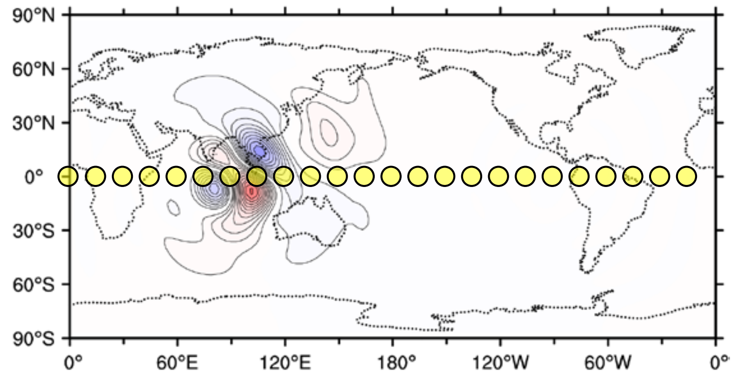
CAM3 <v300> response to 2-day heat pulses

(2000 member ensembles; difference positive and negative)



(0.1m/s contour)

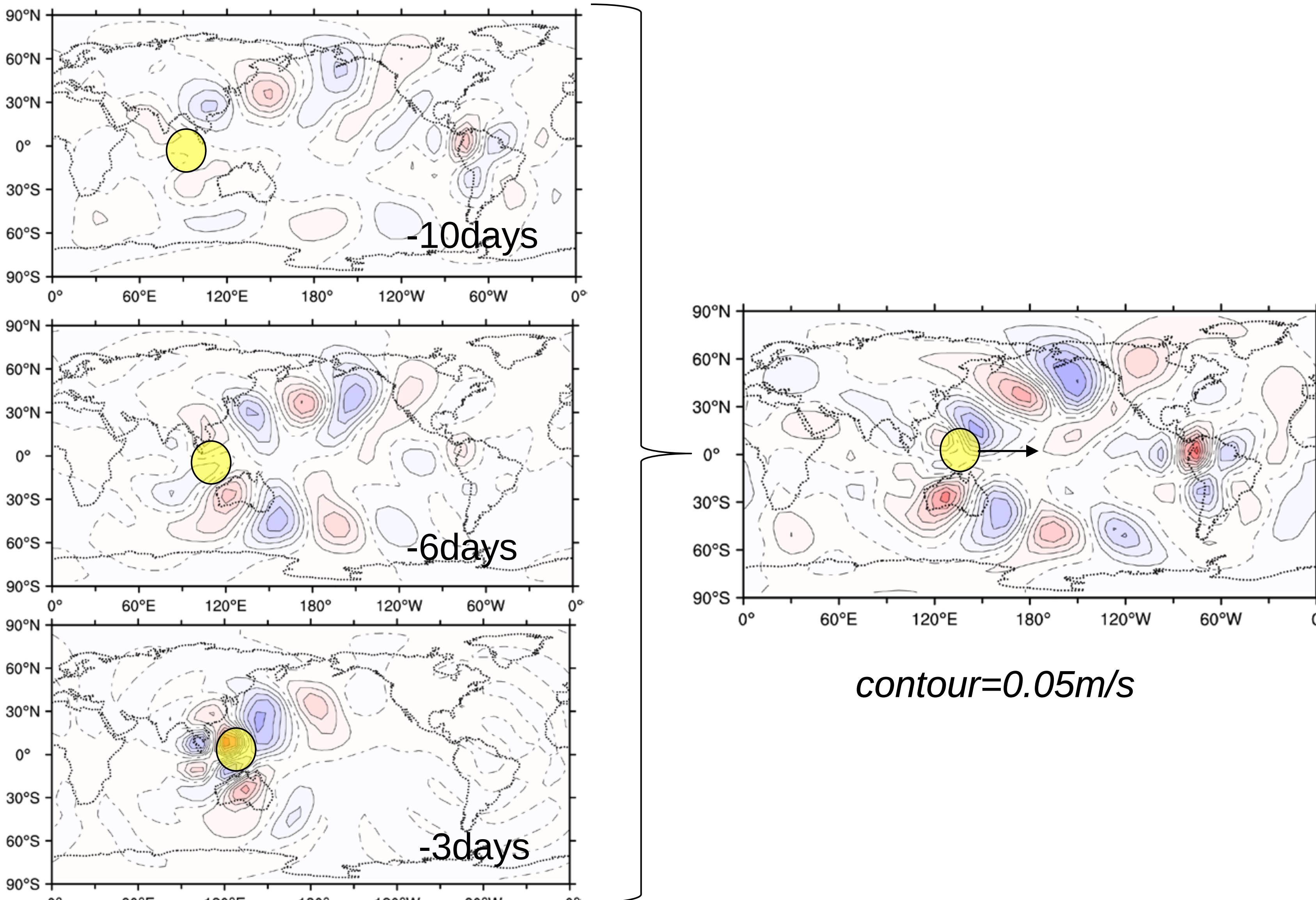
Constructing a Green's function



$$G(\lambda, \varphi, \underbrace{\lambda_h, \varphi_h}, t - \tau)$$

Decomposition of response to idealized MJO

CAM3 v300 response to +4deg/d heating at 135E

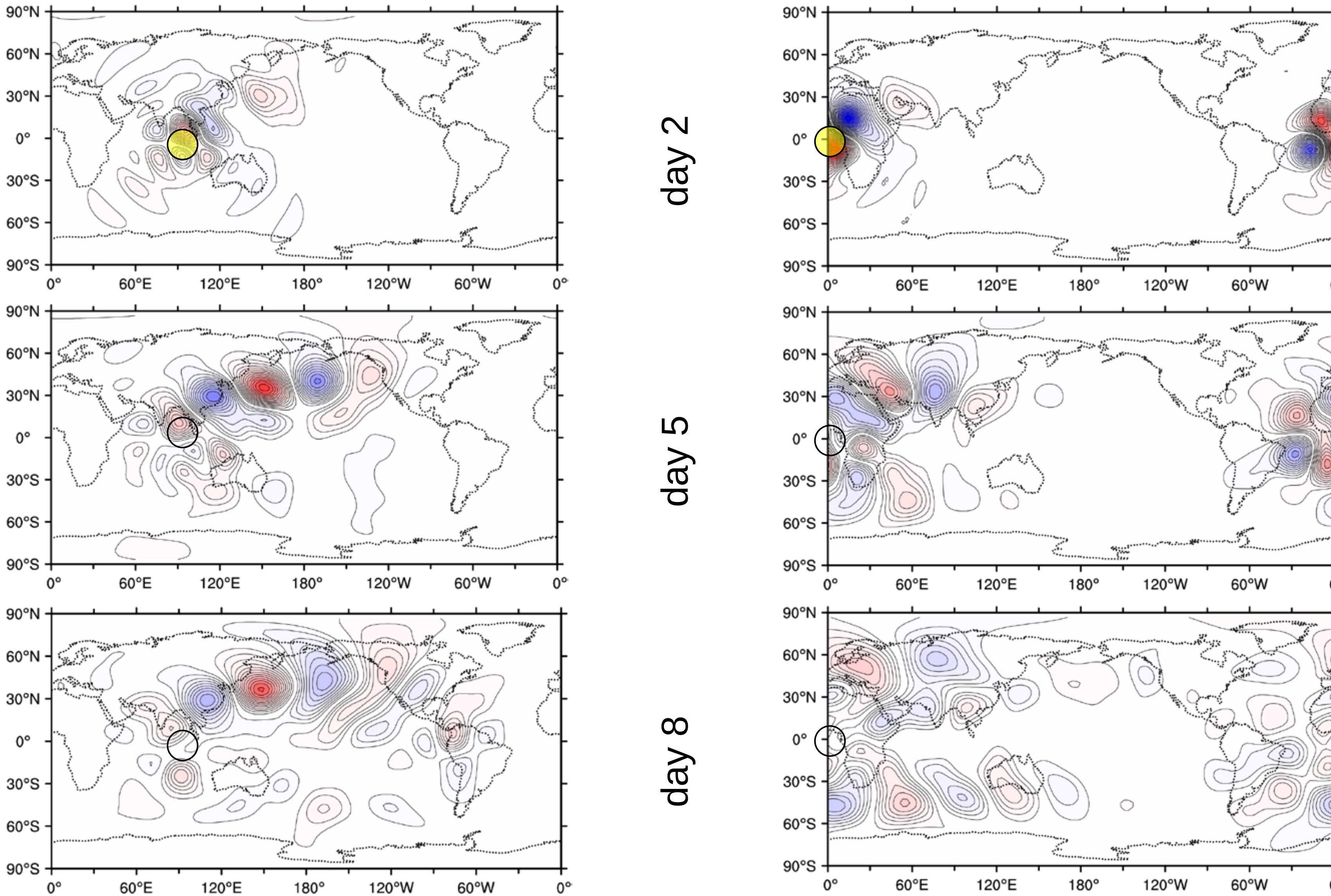


contour=0.5m/s

contour=0.05m/s

CAM3 <v300> response to 2-day heat pulses

(2000 member ensembles; difference positive and negative)

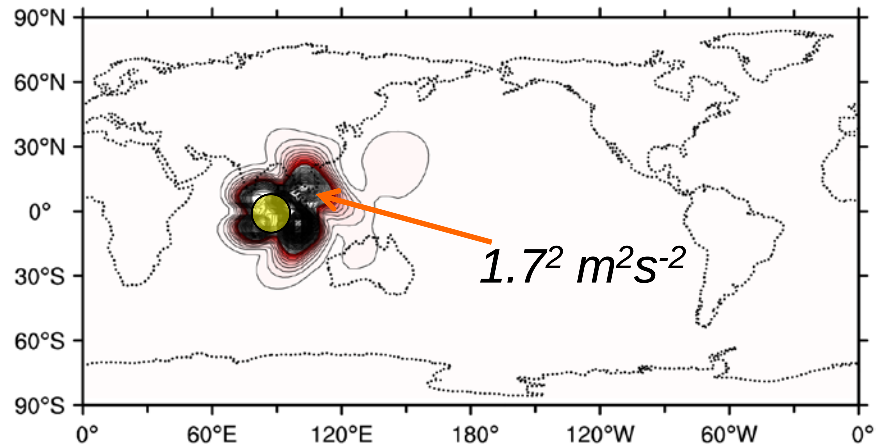


(0.1m/s contour)

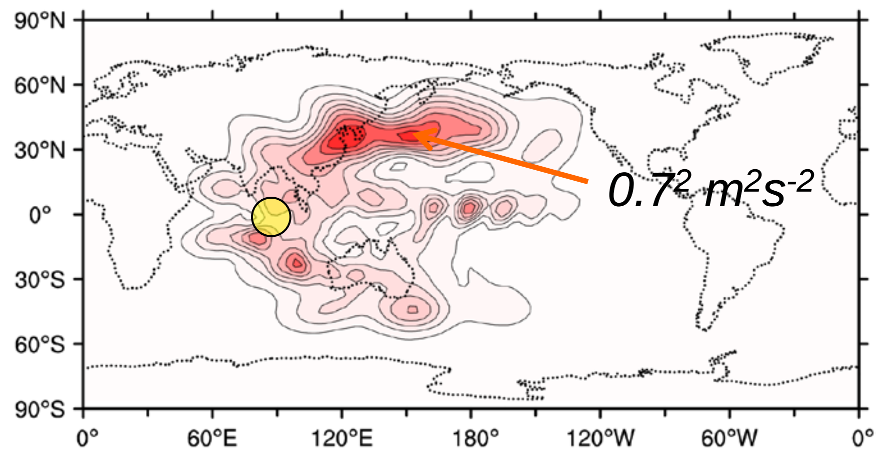
translation mean <v300>^{2}

5C/day 2-day pulse

day 2

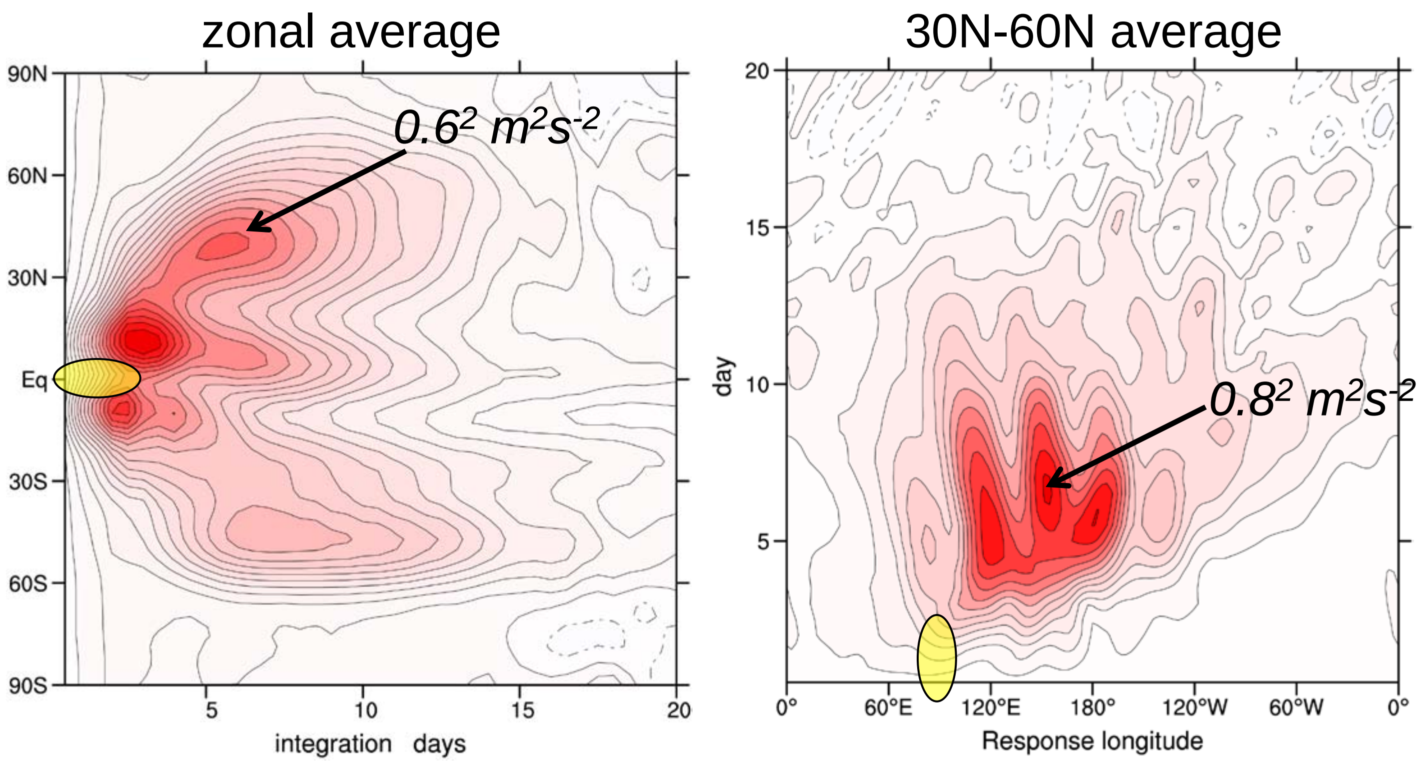


day 5



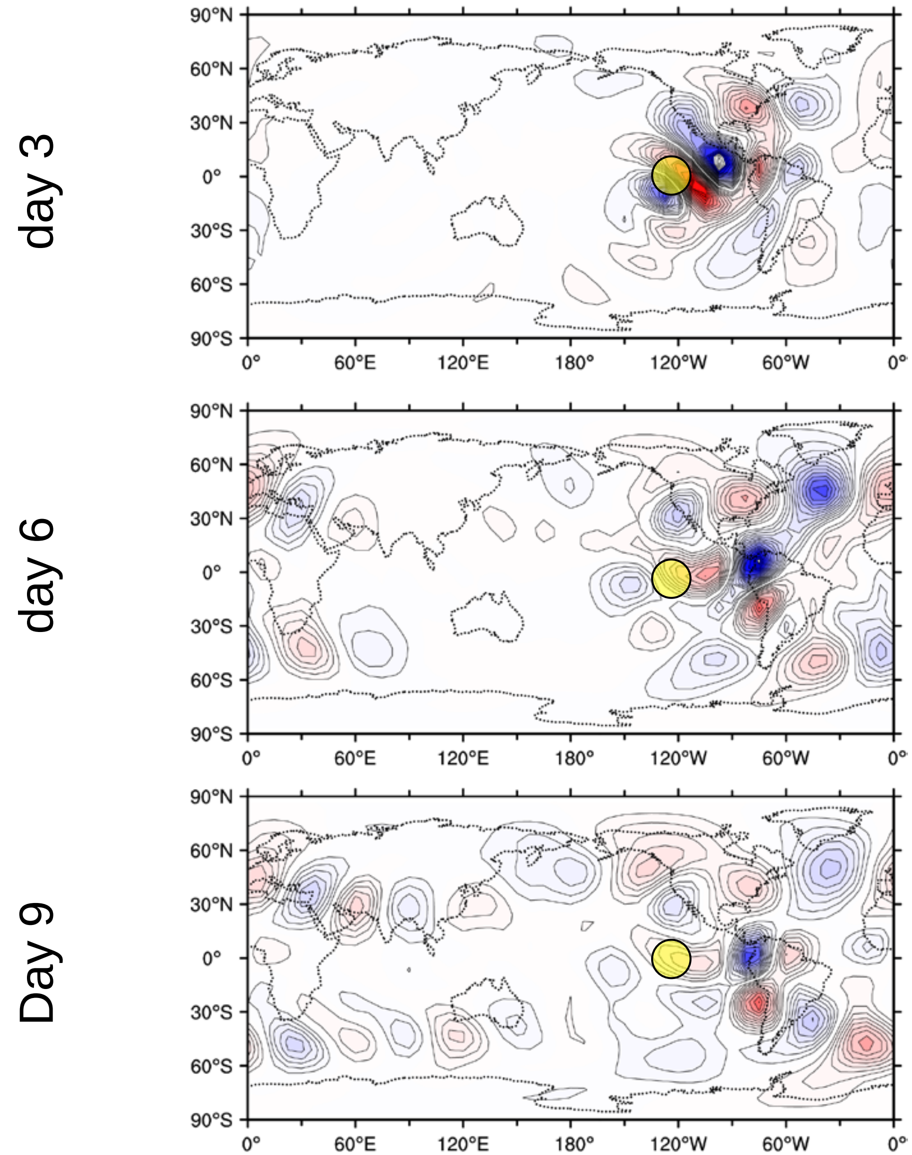
translation mean <v300>^{2}

5C/day 2-day pulse



CAM3 response to a pulse

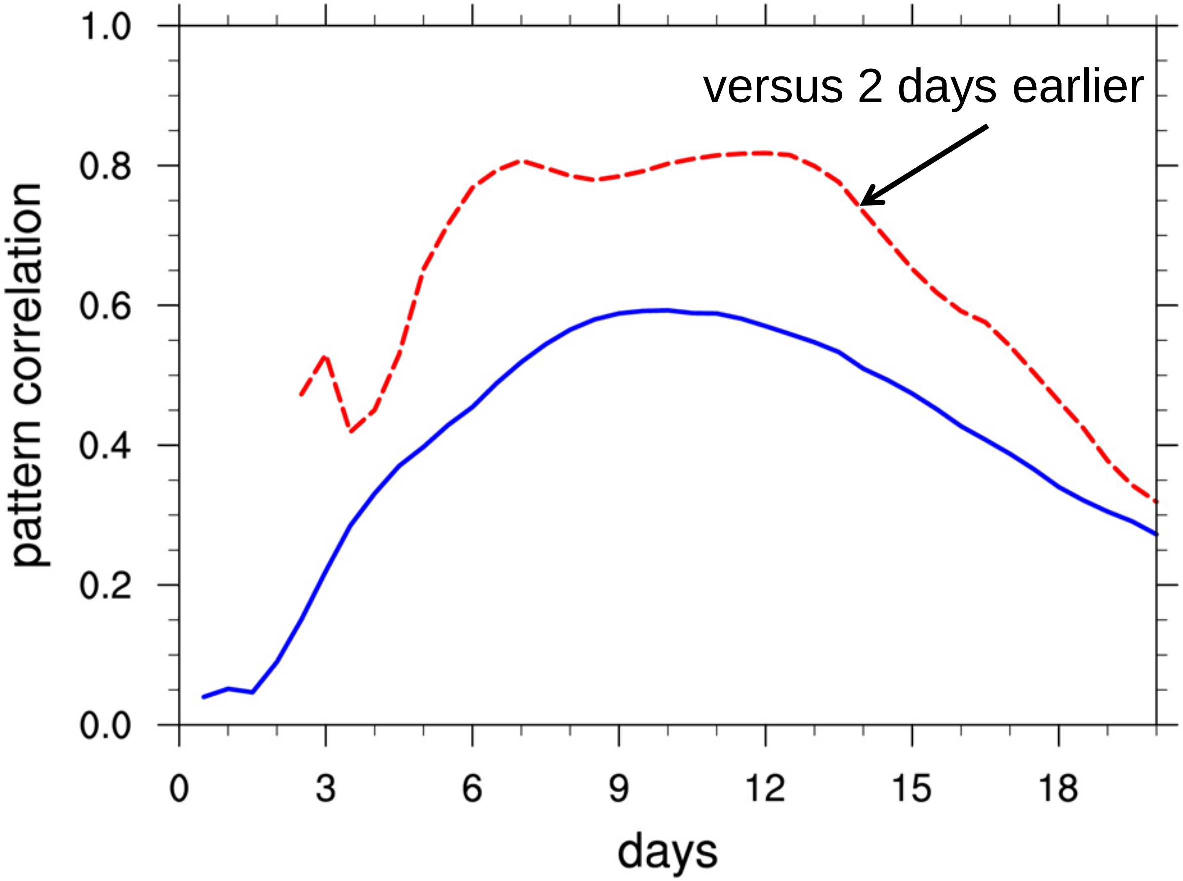
<v300>

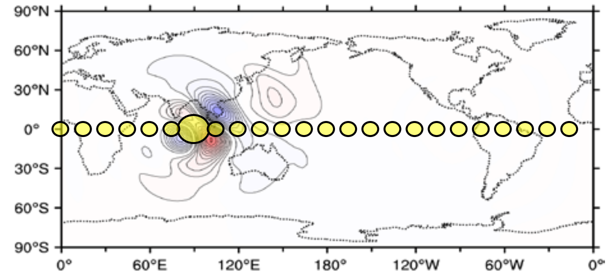


(0.08m/s contour)

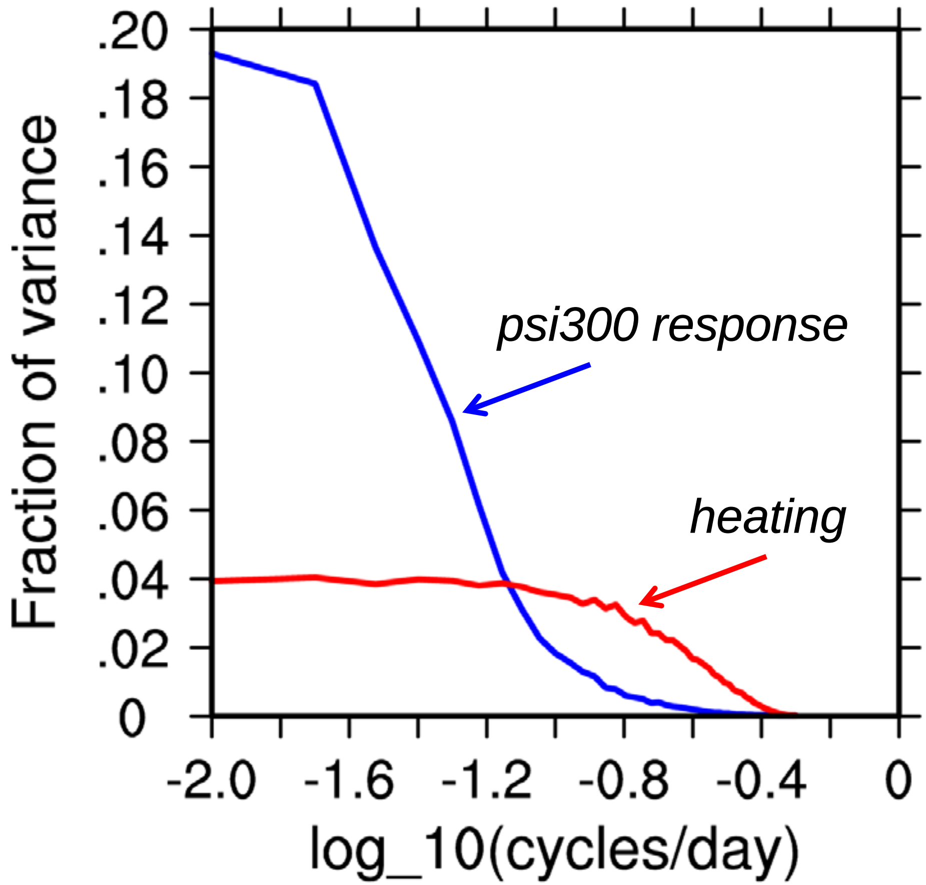
Structure of <v300> response to 2-day pulse

poleward of 30^{o}



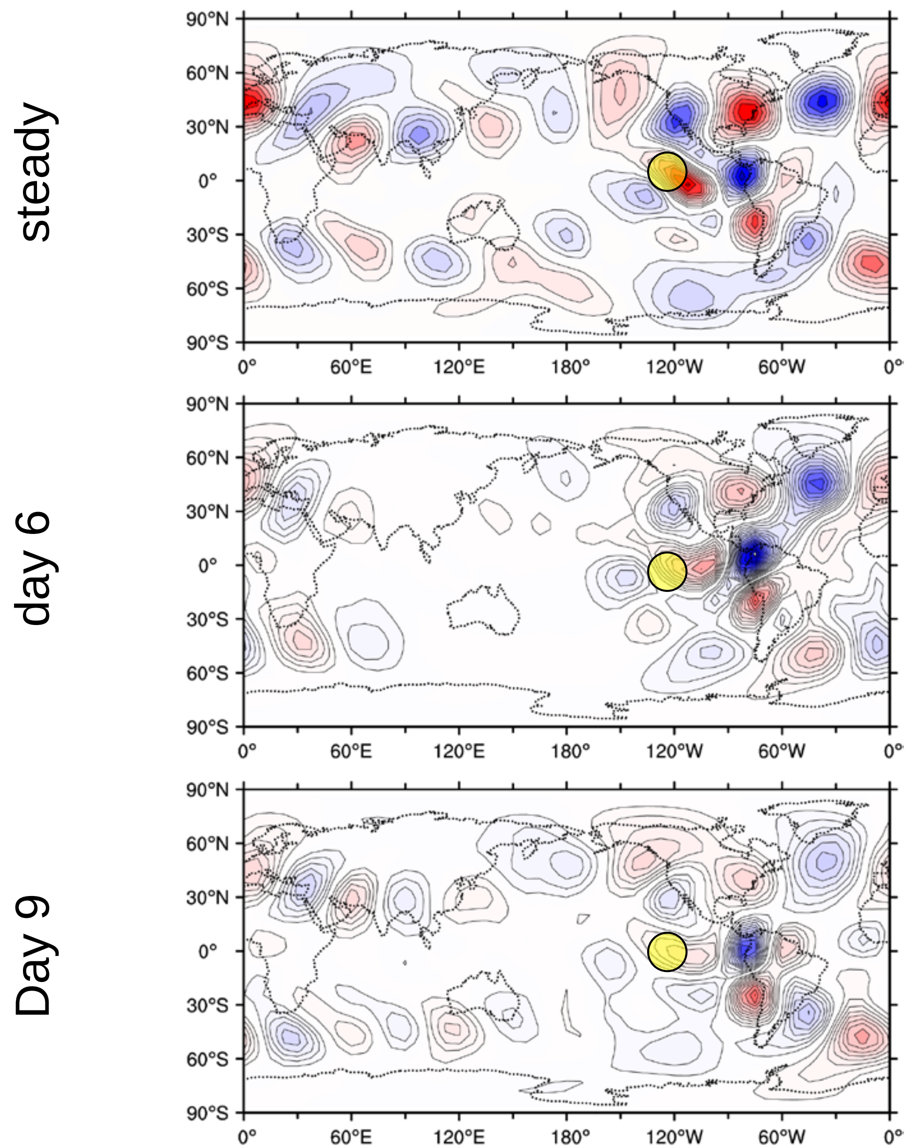


Normalized spectra for pulse heating and response

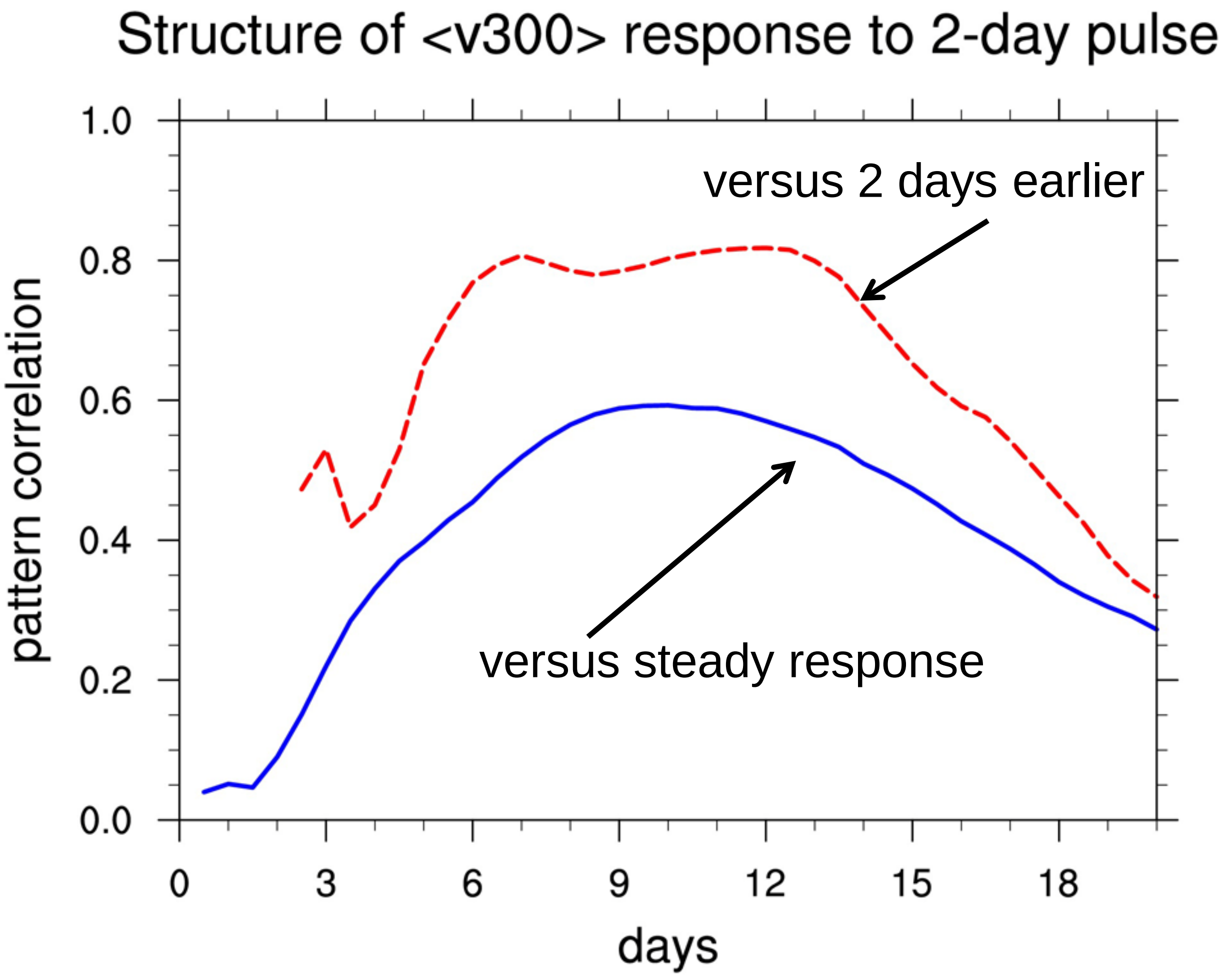


CAM3 response to a pulse

<v300>

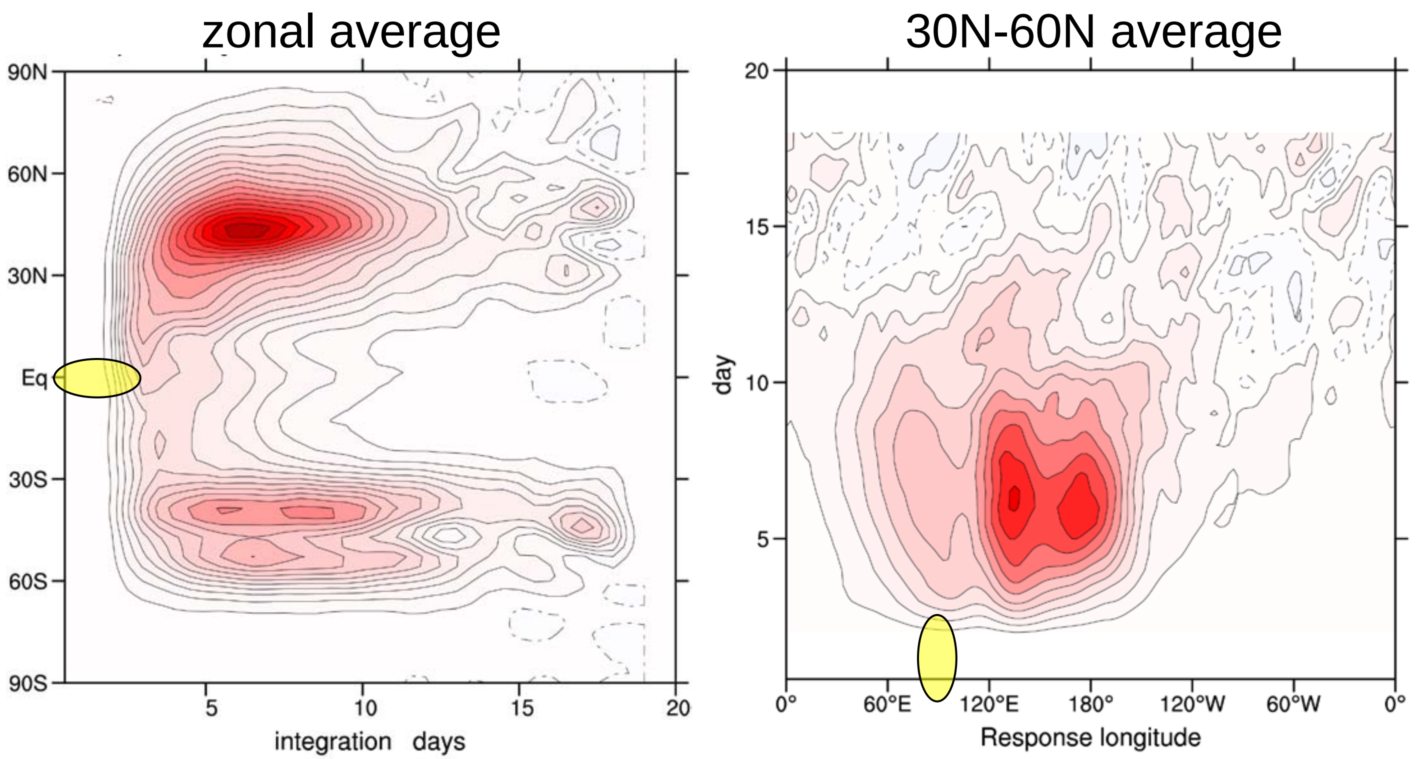


(0.08m/s contour)


Structure of <v300> response to 2-day pulse
pattern correlation
1.0
0.8
0.6
0.4
0.2
0.0
0
3
6
9
12
15
18
days
versus 2 days earlier
versus steady response

translation mean <var(psi300$_{bp}$)>^{2}

5C/day 2-day pulse



Remember

- Even short-lived tropical heating events can affect remote midlatitude locations
- The reaction is delayed, long-lived, and persistent
- Many midlatitude fields are affected, including the synoptic eddies
- Hence short-lived tropical heating may produce predictability of the second kind for a couple of weeks