Dynamics of biweekly oscillations in the equatorial Indian Ocean

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Backgrounds

- Observational work

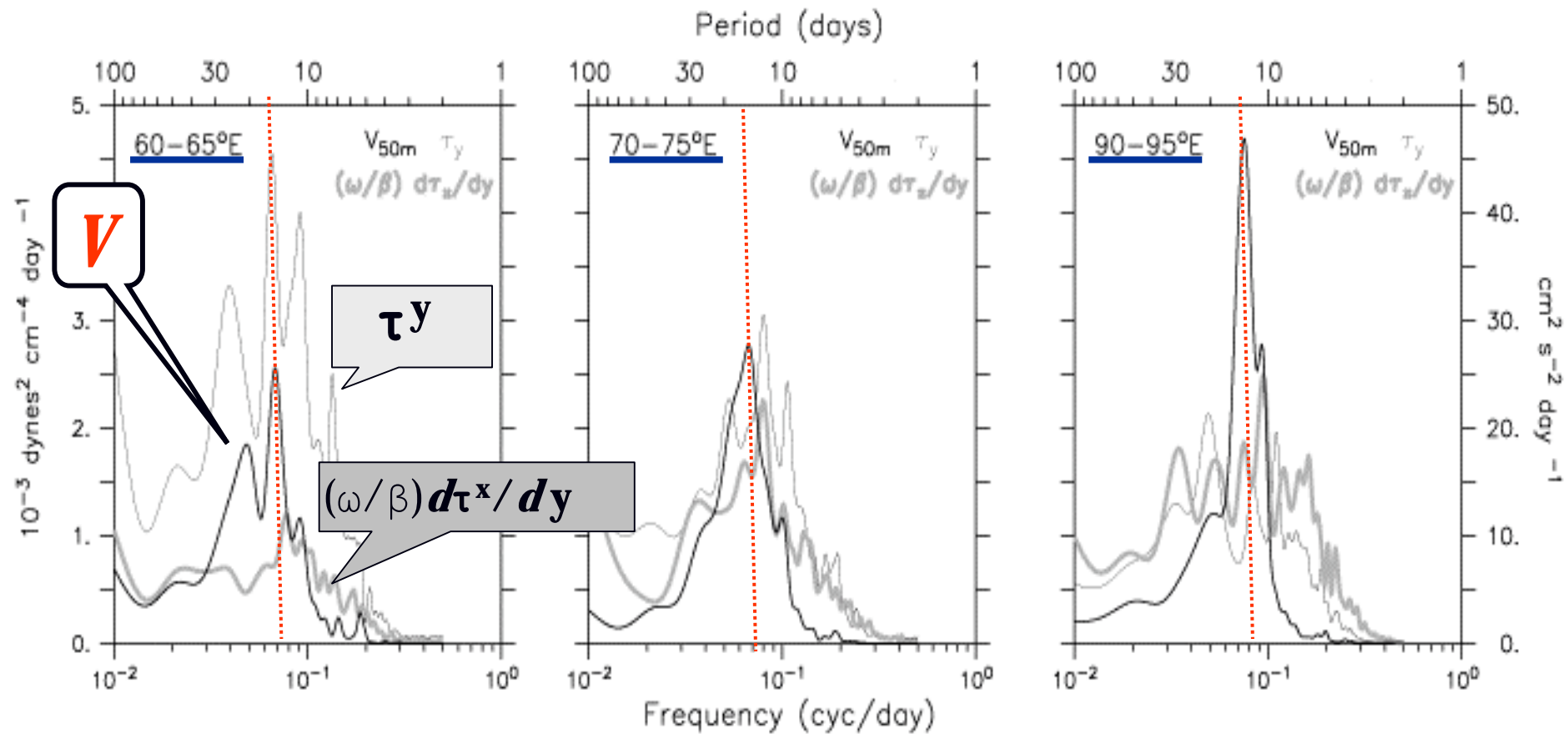 Schott et al. (1994), Reppin et al. (1999), Murty et al. (2002), Sengupta et al. (2004), Masumoto et al. (2004)

- Modeling Work

  Sengupta et al. (2001, 2004), Masumoto et al. (2004)

- Consensus
  - Wind forced wave
  - Yanai (Mixed Rossby-Gravity) Wave

Power spectra of $d\tau^x/dy$, τ^y (wind stress), v from the Sengupta et al. (2004)'s GCM at the western, central, and eastern Indian Ocean
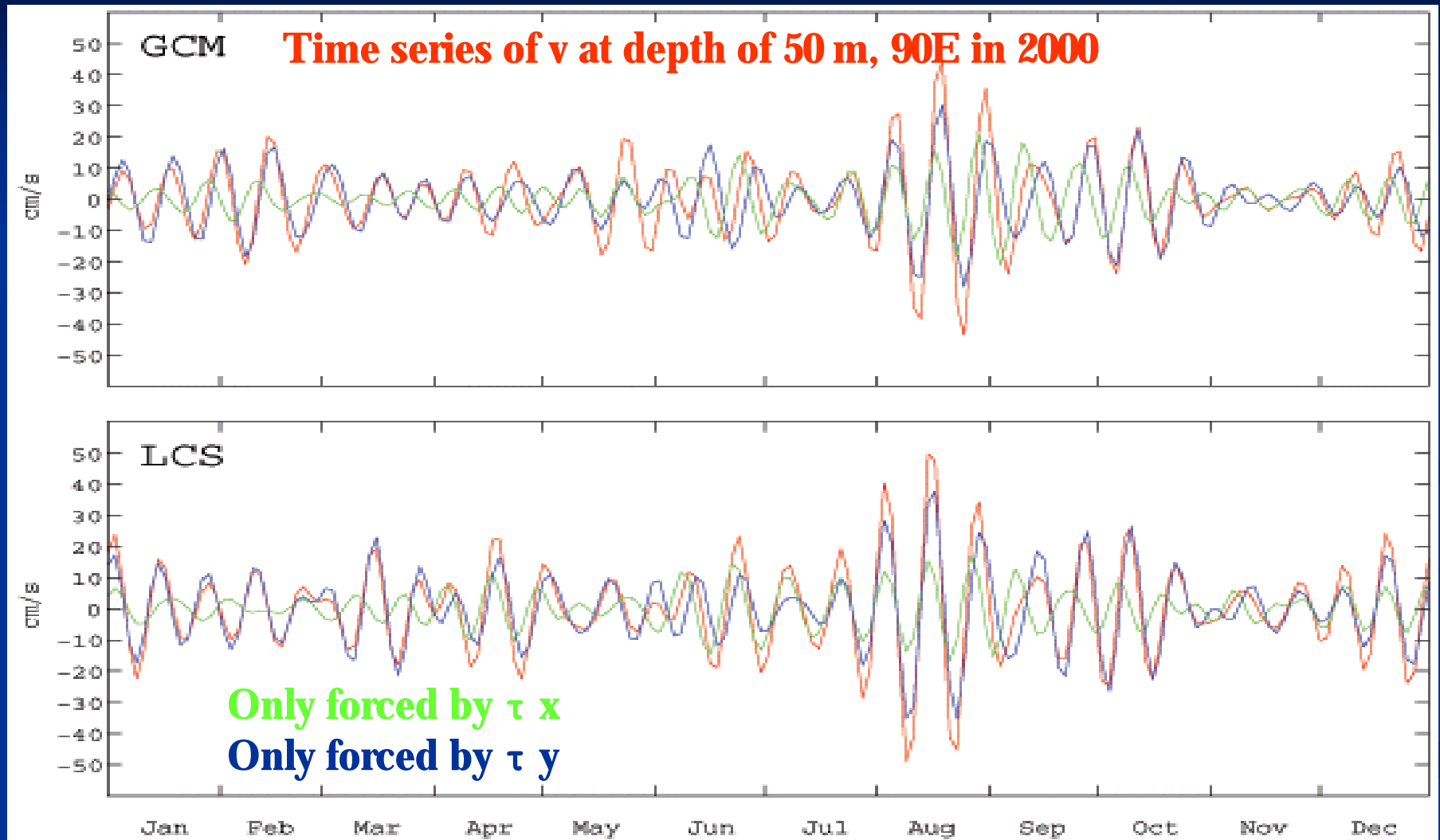
Question

Models

- Sengupta et al. (2004)'s GCM   (reference)
- Linear, continuously stratified (LCS) model (McCreary, 1994)
  - Linear system vertically composed of 30 normal modes.
  - Includes **<u>vertical mixing</u>**
  - Horizontal resolution: ¼ deg.
  - Coastline of the Indian Ocean
  - Spun up for 10 years.
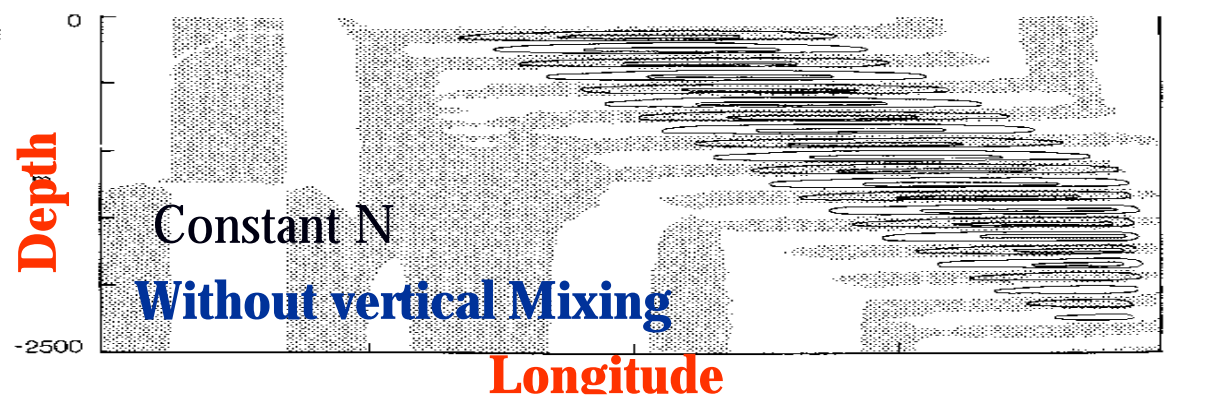 - The forcing: **QuikSCAT** (the same forcing as the GCM).

GCM VS Linear model

Time series of v at depth of 50 m, 90E in 2000

GCM

LCS

Only forced by τ x
Only forced by τ y

Linear model reproduces the GCM result very well!

McCreary 1984 "Equatorial Beams"

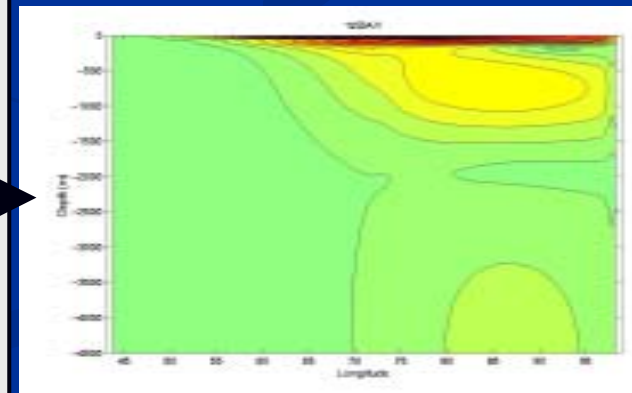Meridional velocity   ↓ ~42day oscillation

Depth

Constant N

Without vertical Mixing

Longitude

m

-25

For higher frequency, Yanai-Wave is no longer available (regime of gravity wave)

↑
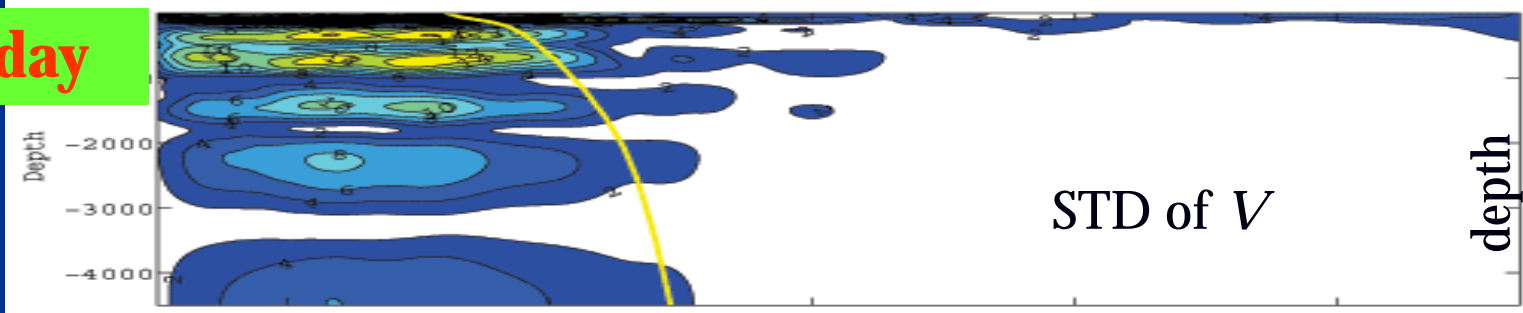12-day forcing
With vertical mixing

STD of meridional velocity

1. **For higher (lower) frequency, less (more) vertical wave numbers.**
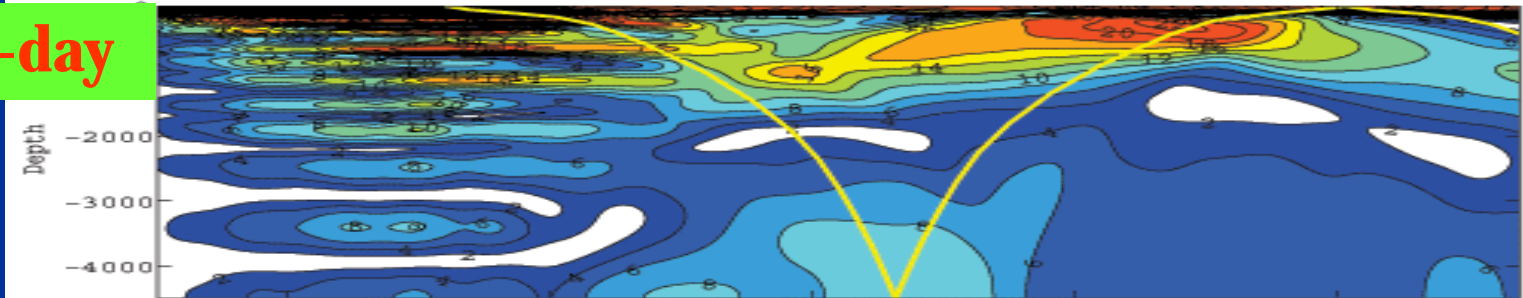2. **With vertical mixing, waves with high vertical numbers dissipates.**
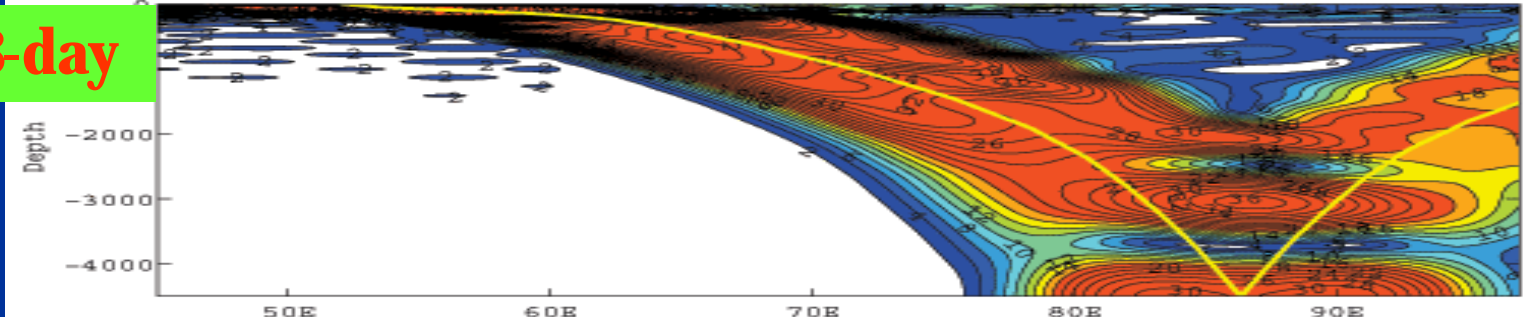
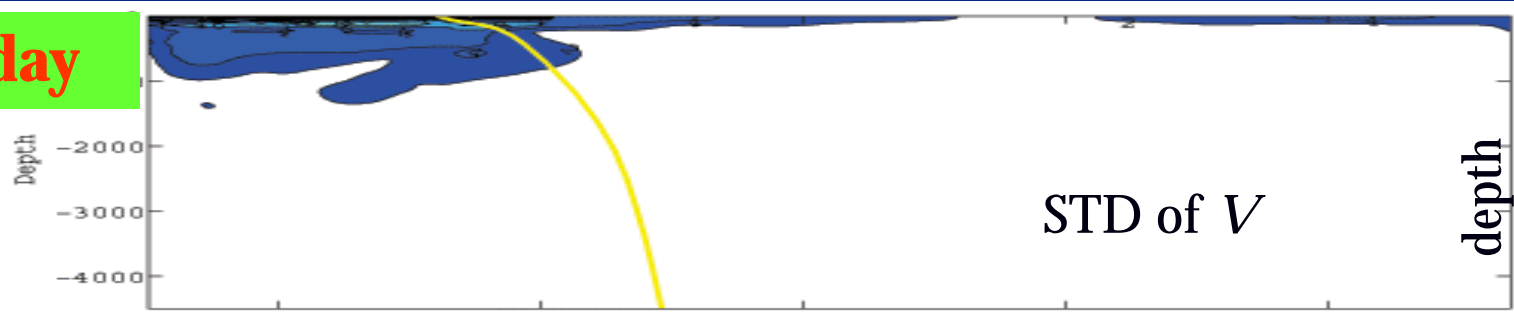# Idealized solution (1) Without vertical mixing

7-day

14-day

28-day

STD of V

depth

Realistic Stratification

Longitude

Idealized solution (2)
With vertical mixing

7-day

14-day

28-day

STD of V

depth

Depth

Realistic Stratification
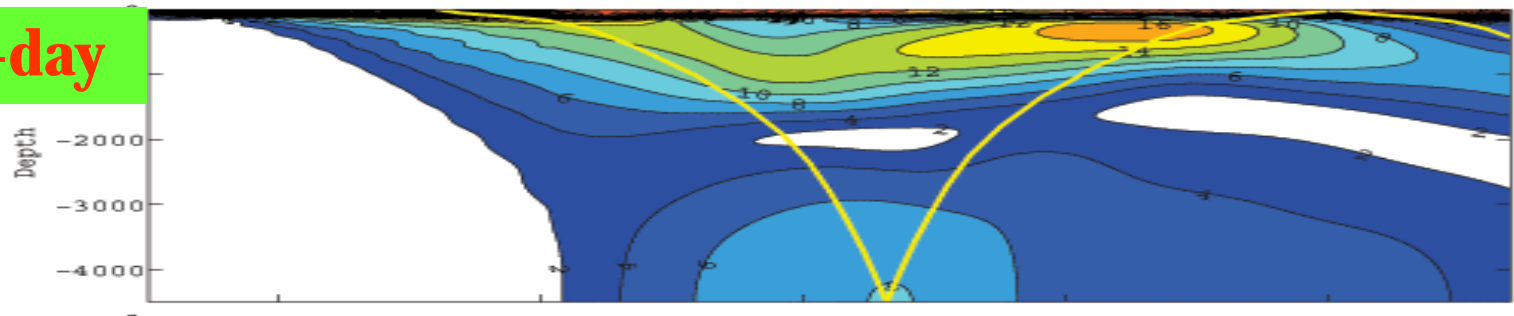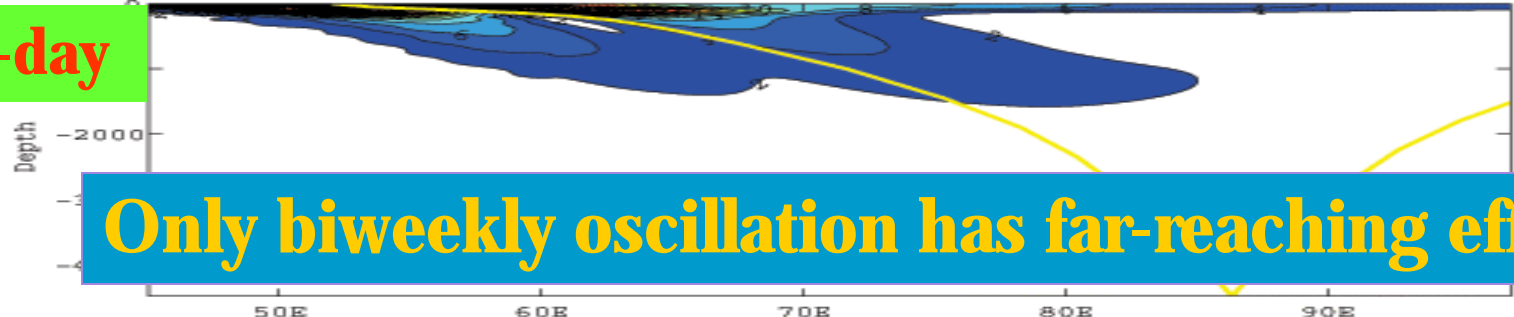
Longitude

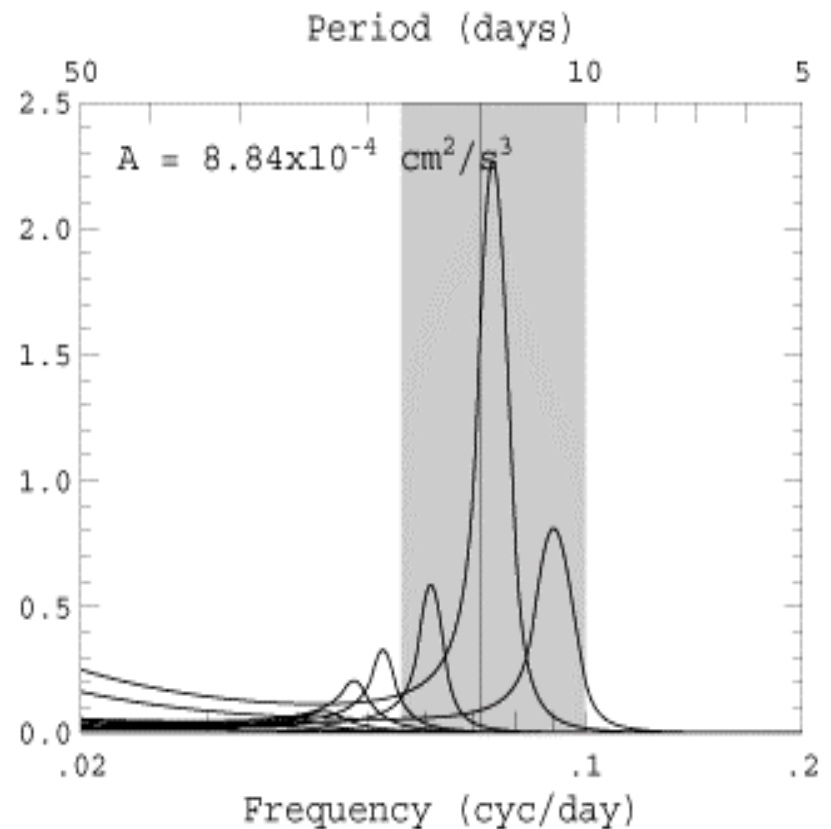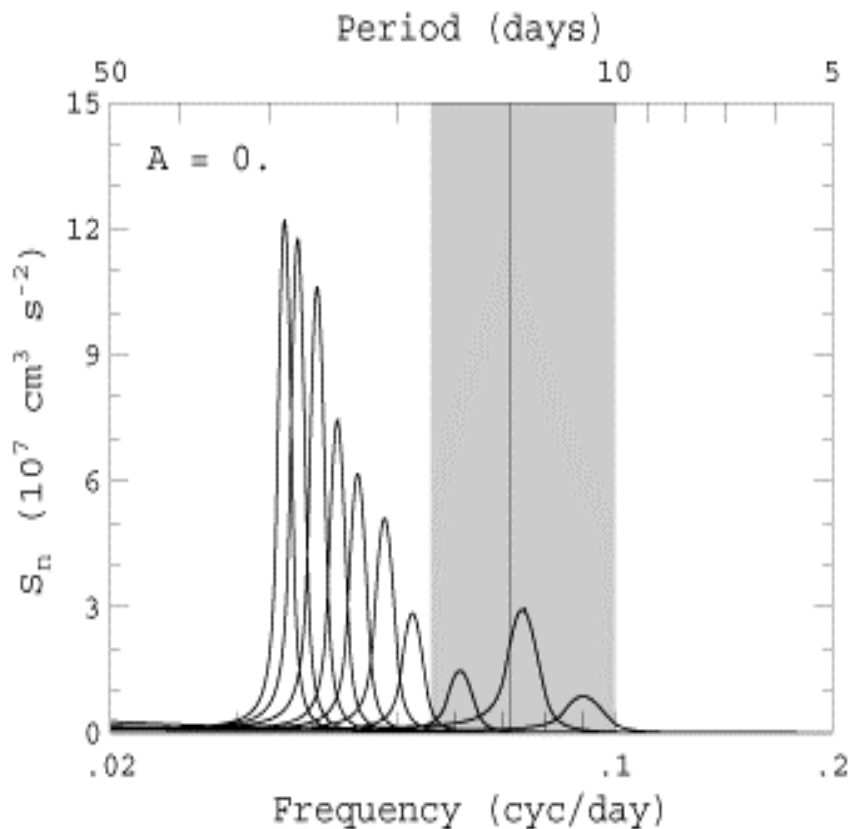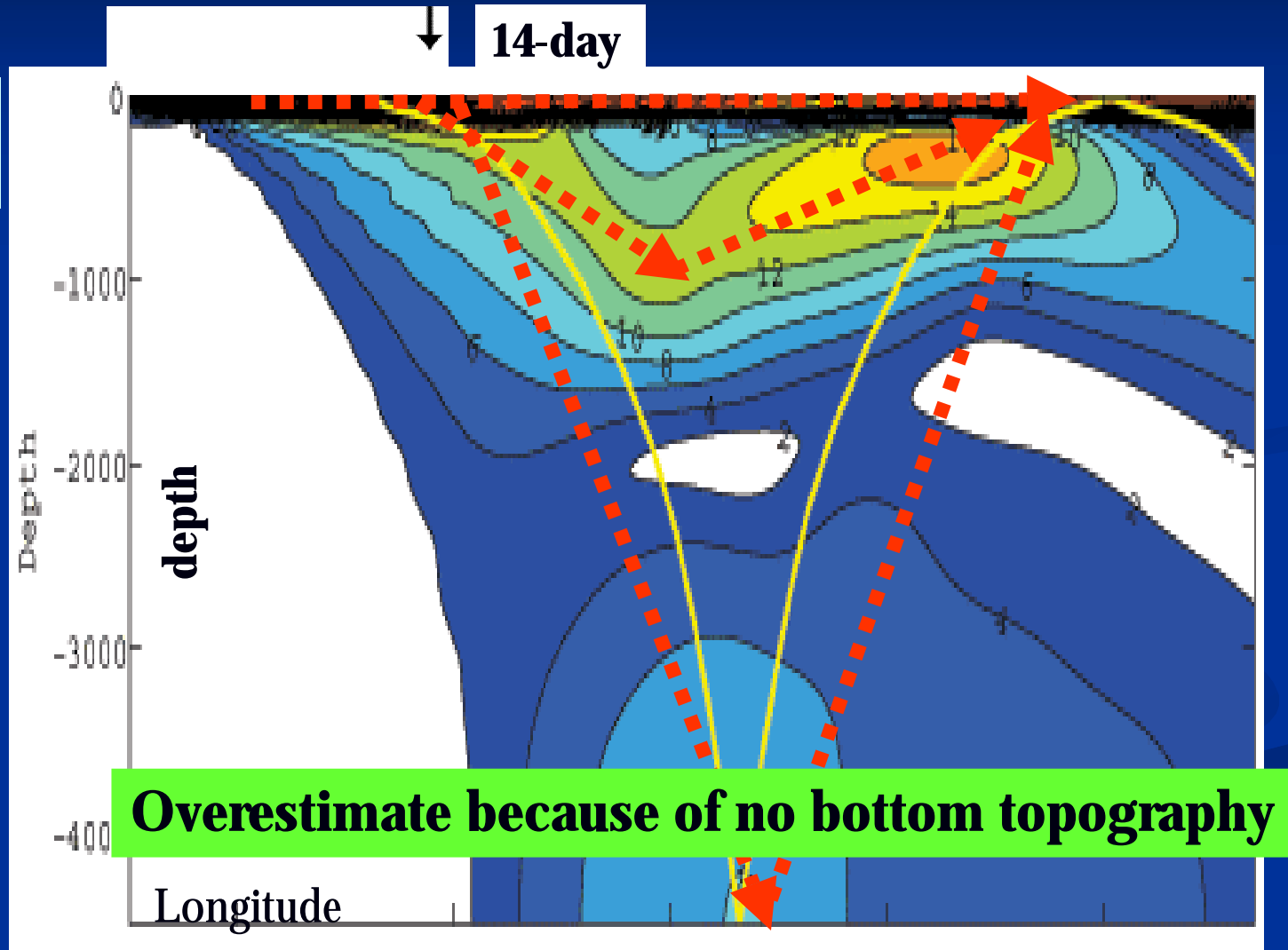**Only biweekly oscillation has far-reaching effect !**

Frequency selection: Analytical solution

Idealized solution: Stratification and ray path

Realistic Stratification

14-day

depth

Longitude

Overestimate because of no bottom topography

STD of V at 50 m in 10-18day band forced by realistic wind

GCM

Forced by total wind

Only forced by τ y
Only forced by τ x

LCS

Forced by total wind

Only forced by τ y
Only forced by τ x

Locally forced (non-radiating) part
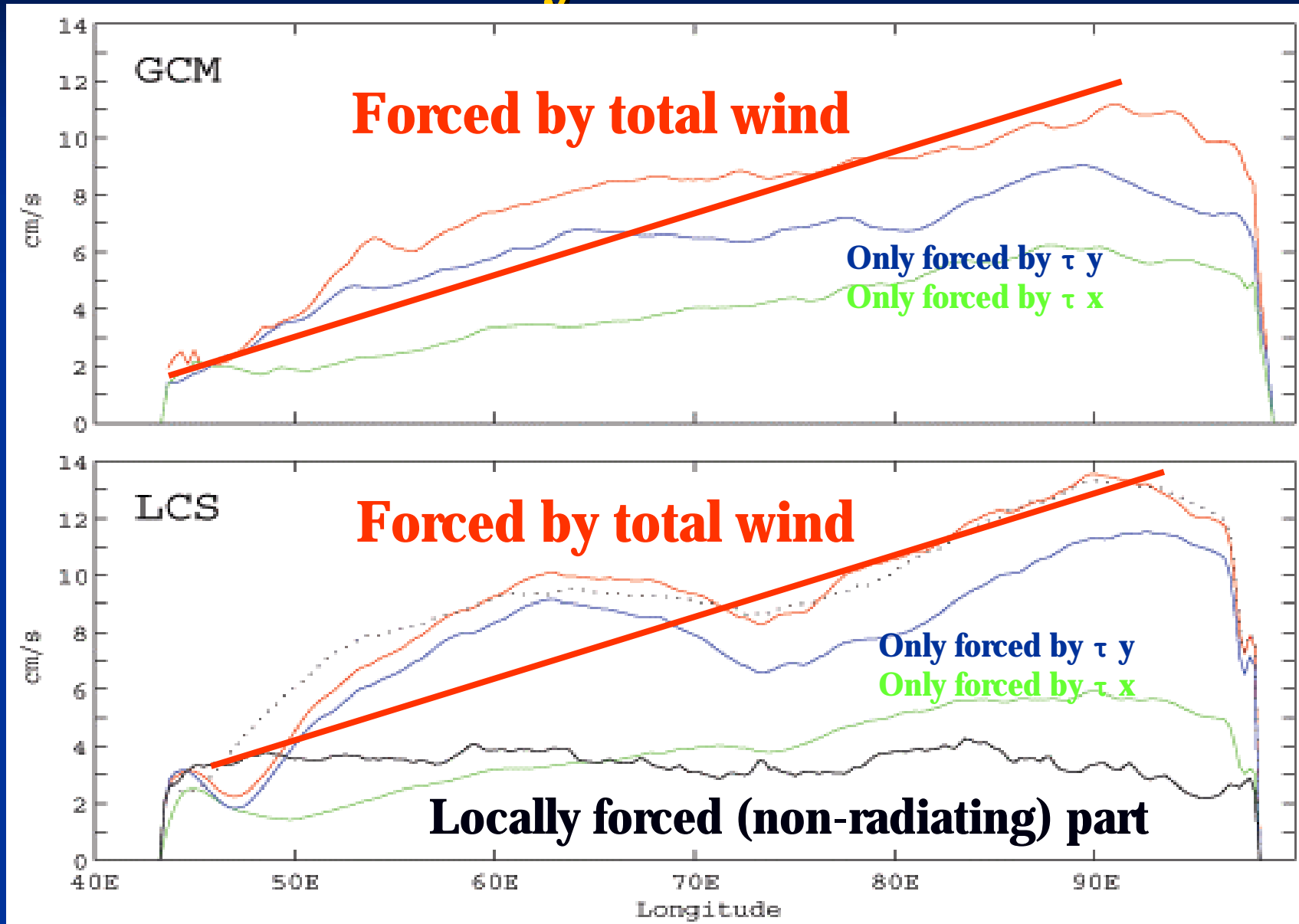
Conclusions

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Future Work

- Monthly oscillation is missing in Sengupta et al. (2004)'s GCM as well as the linear model. Due to too large vertical mixing? Or entirely different mechanism?

- Is there any effect on climate variability (air-sea coupling) from the frequency selection mechanism?