Tropical Variability in the Super-CAM

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Outline

- Introduction
  - What are typical deficiencies of simulated tropical variability?
- Analysis of tropical variability
  - Total variability
  - Intraseasonal variability
  - Other modes of variability

Typical shortcomings of simulated tropical variability

- As summarized by Slingo et al, 1996
  - Simulated tropical variability tends to be too weak and spectrally too white.
  - MJO-type variability tends to be too fast, too weak, and not particularly convectively-coupled.

Analysis procedures

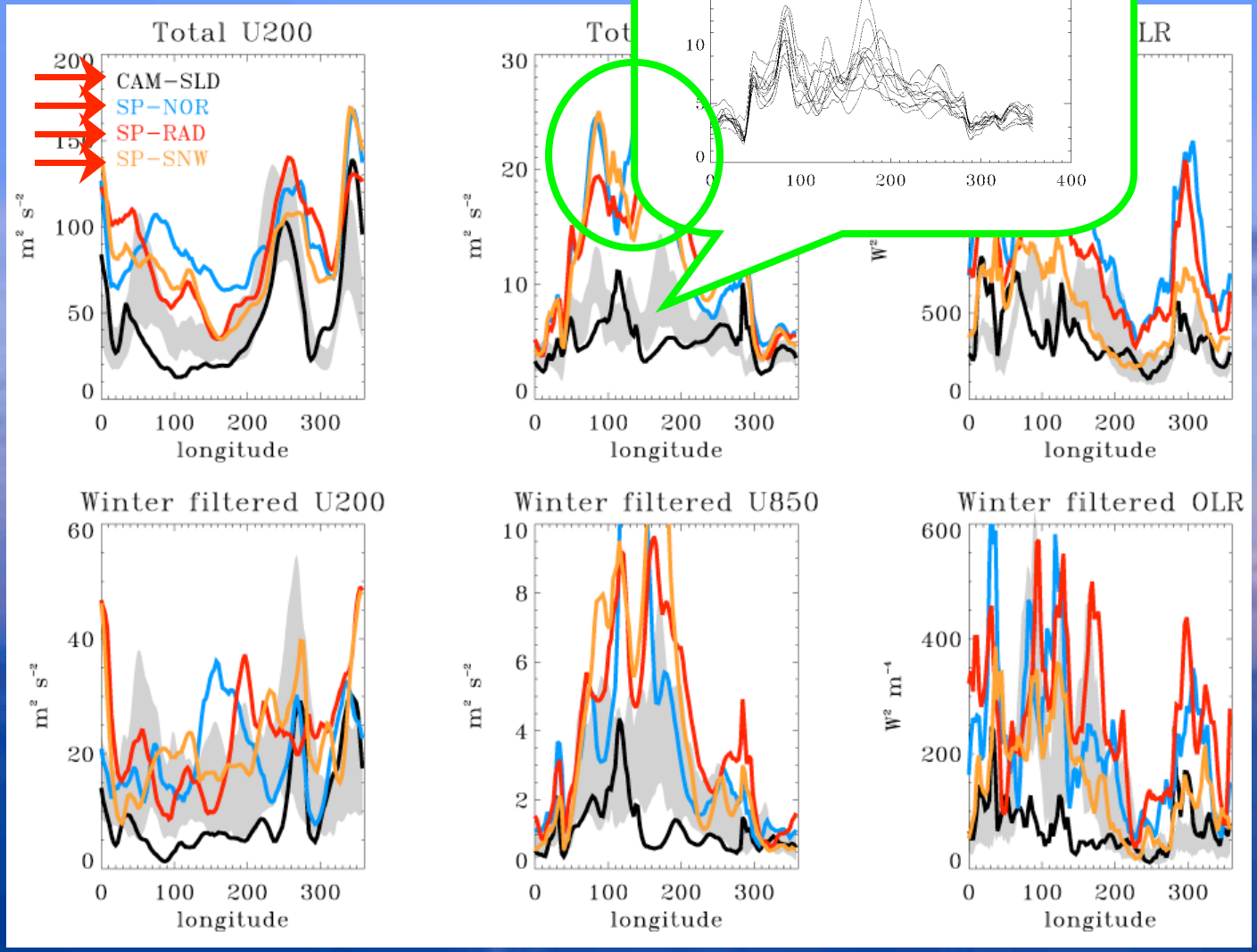
- Four model runs are compared to observations (NCEP winds, NOAA OLR).
  - CAM-SLD (standard parameterization)
  - SP-NOR (standard SP run)
  - SP-RAD (SP run with radiation computed on SP grid)
  - SP-SNW (SP-RAD with more efficient ice-snow conversion)
- Tropical variability (10N-10S) in the following fields is analyzed.
  - U200 and U850
  - OLR

Total and intraseasonal variability

U200

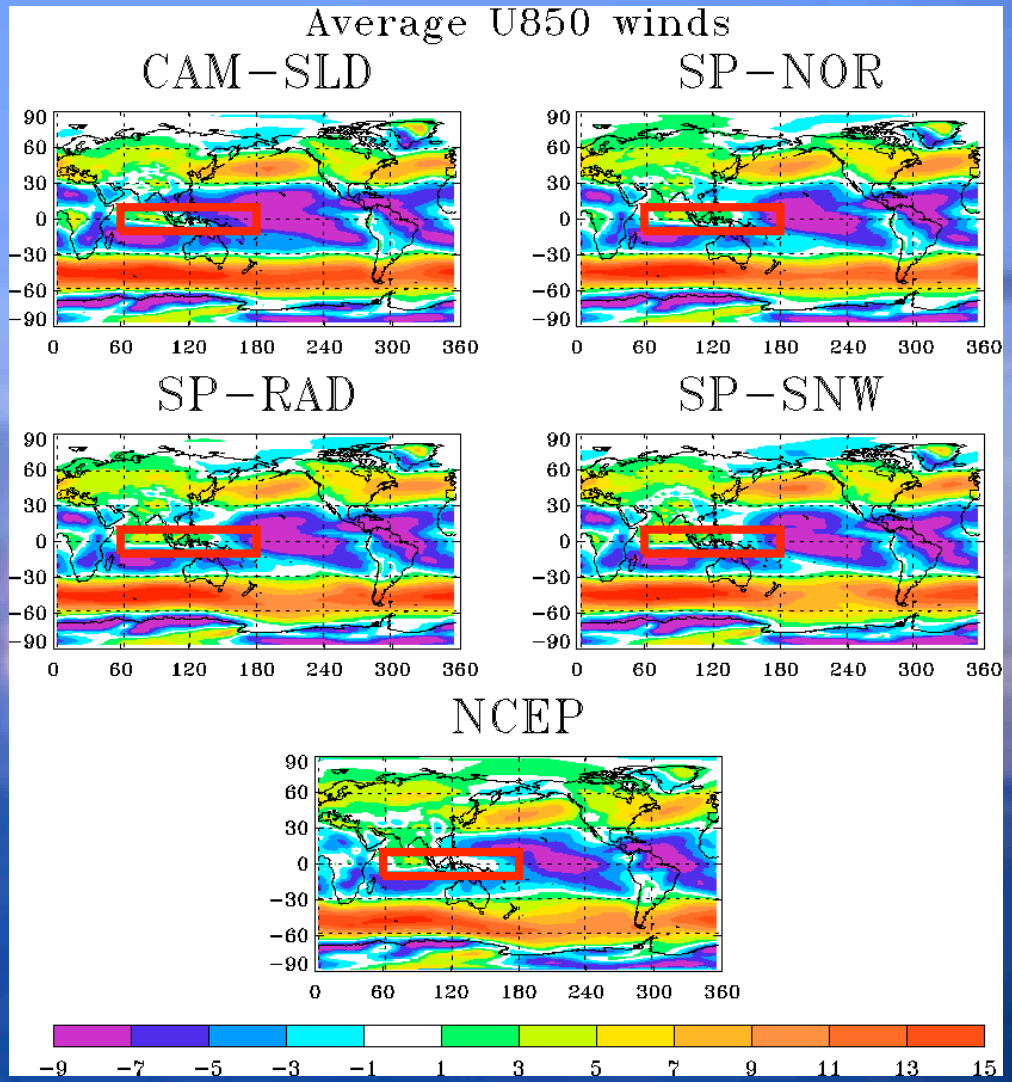
Total

20-100 day Filtered



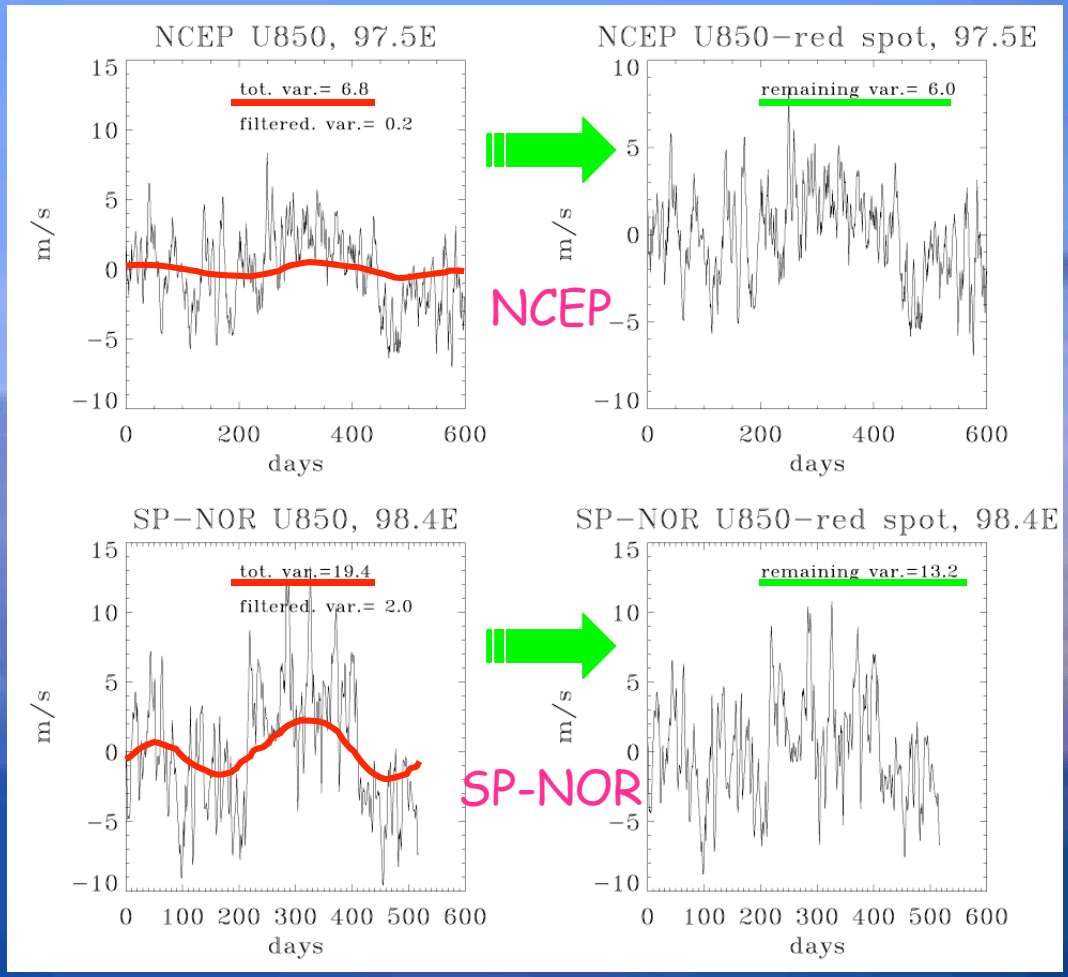
The Great Red Spot

- Anomalously high west Pacific precipitation that maximizes in summer months.
- Anomalously high U850 winds bracket this period at very low frequencies.



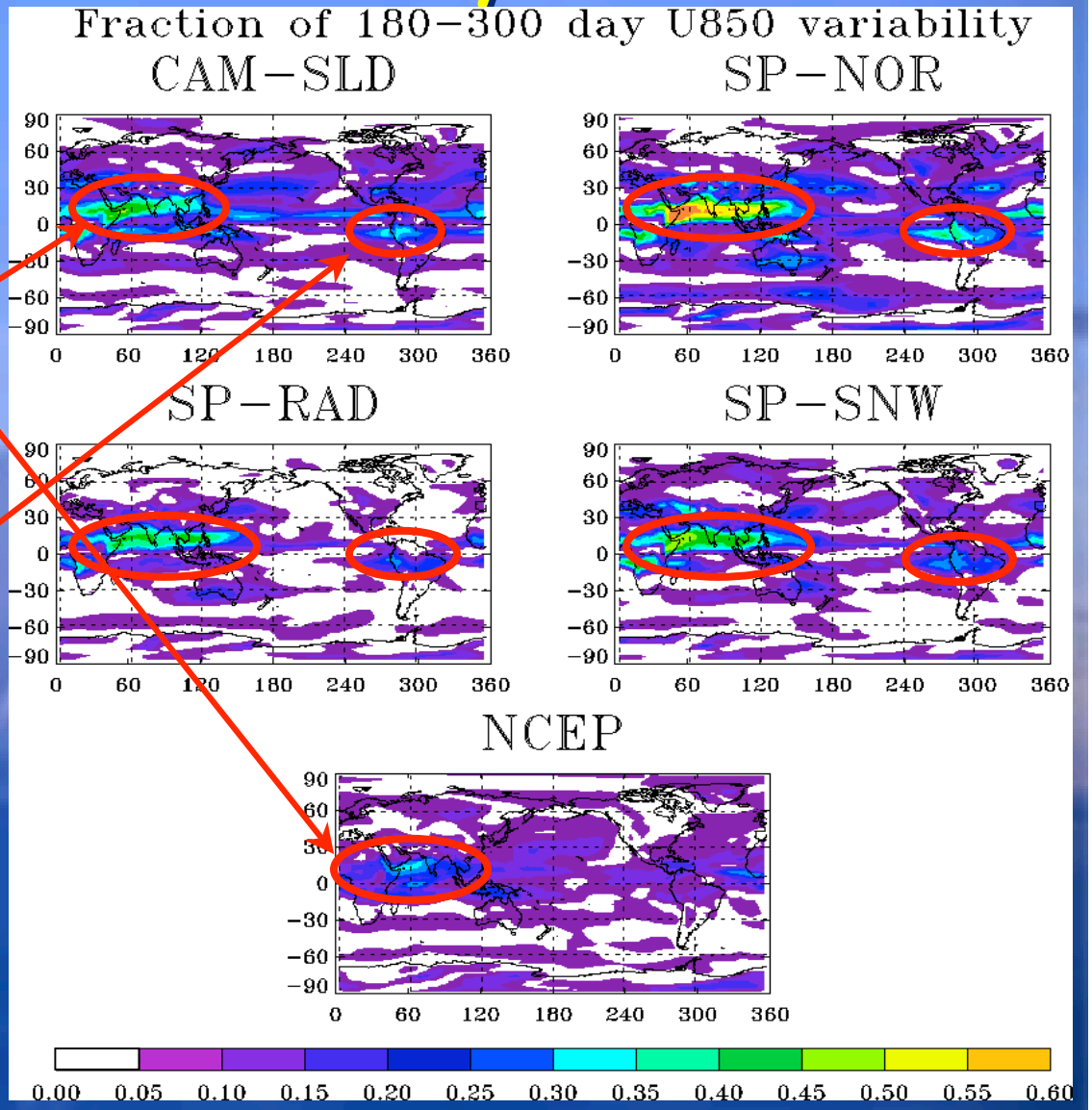
"Out, damned spot!"

- Subtract 180-300 day filtered time series from original time series.
- Express difference between "new" and original variance as a fraction of original variance.



180-300 day variability effects

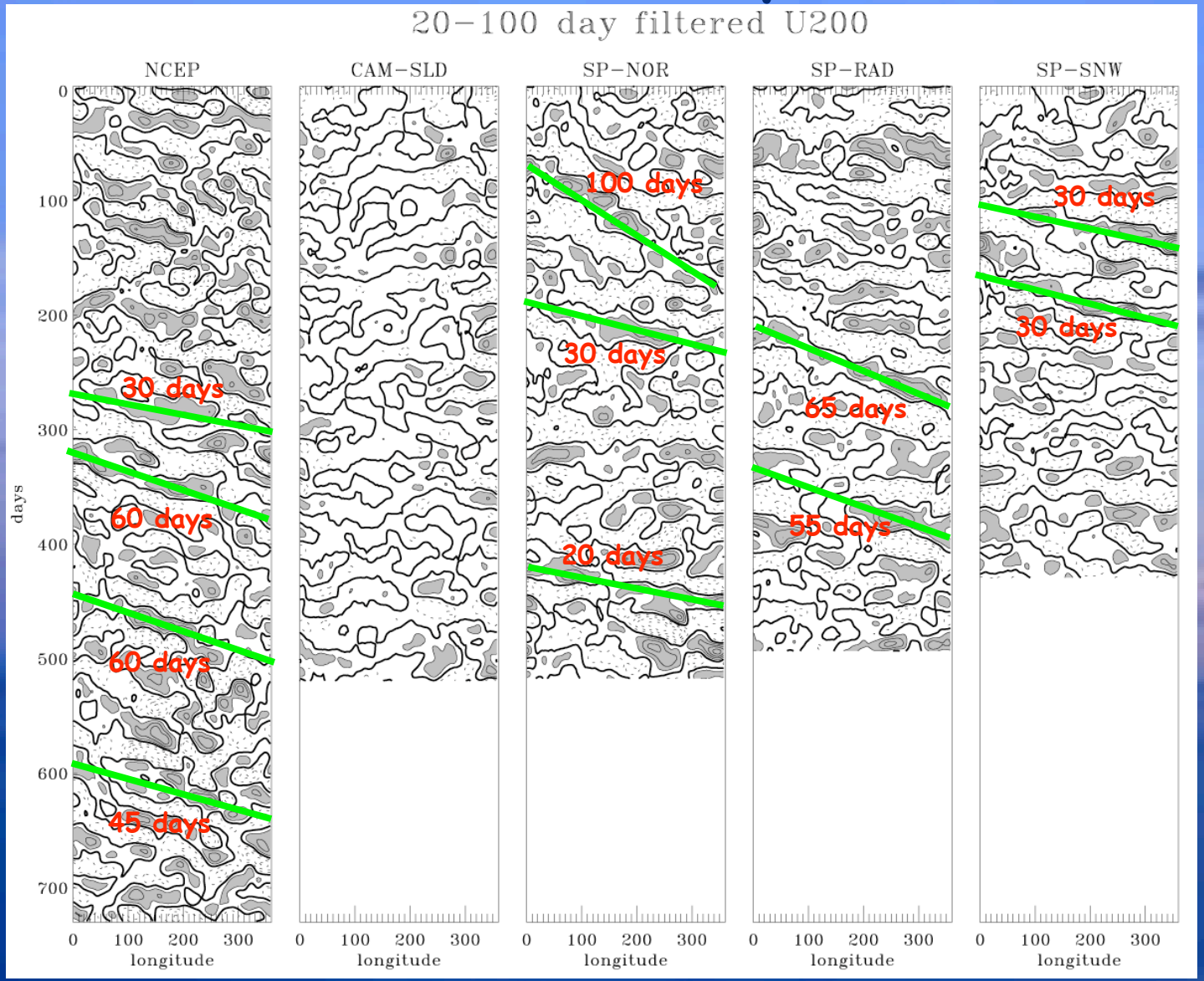
- Indian Ocean red spot variability appears in both observations and CAM-SLD.
- CAM-SLD also puts some variability over the Andes.
- SP runs enhance pre-existing red spot variability.



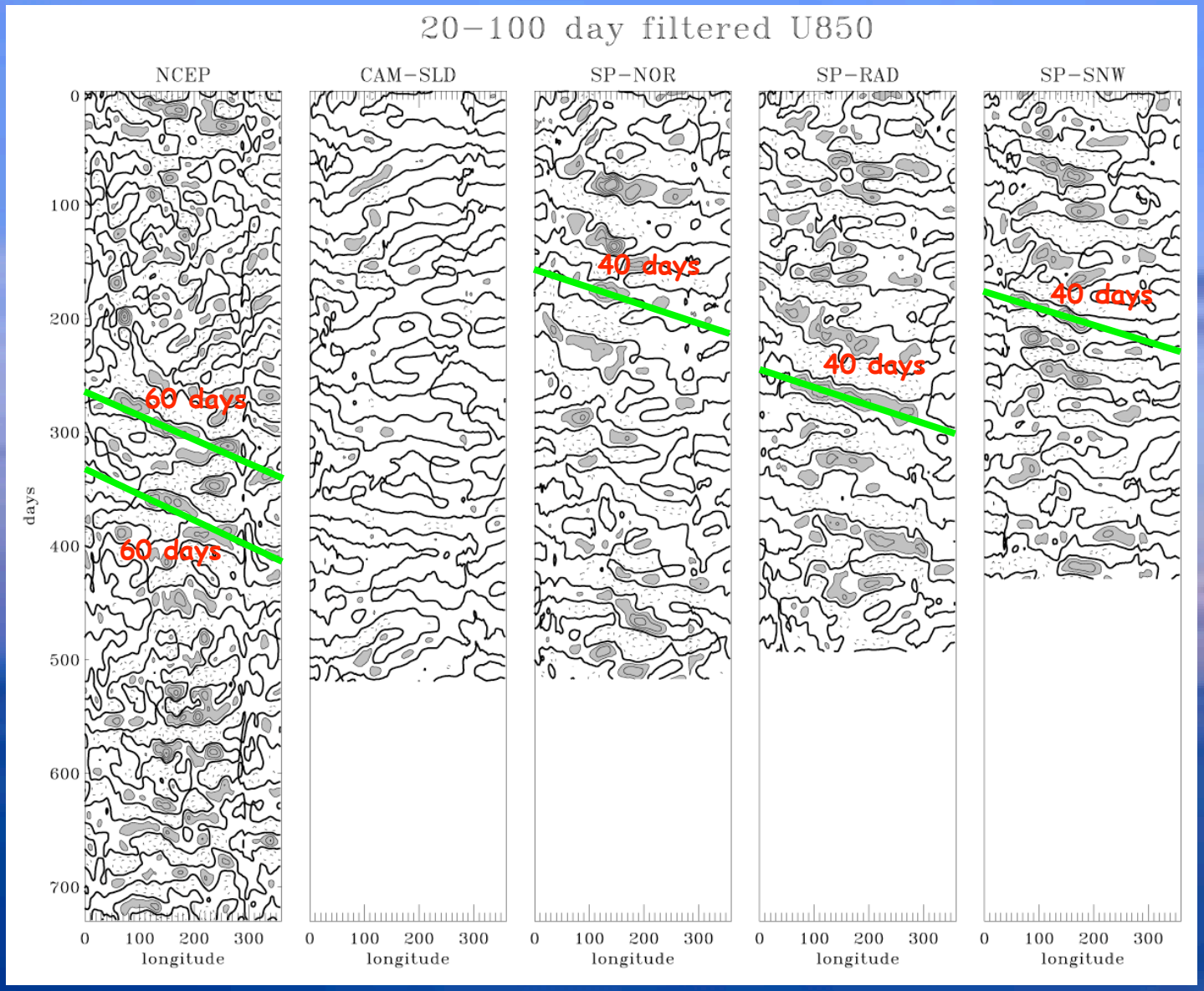
"Great Red Spot" summary

- Intra-annual variability in found in observations and models.
  - Observed in both winds and precipitation.
  - Primarily located in Indian Ocean and western Pacific.
  - Exaggerated in all four model runs.
  - Addition of SP-scale radiation calculation and ice-to-snow conversion appear to mitigate effect over SP-NOR.
- What is it?
  - An overenthusiastic Somali jet?
  - Terrain effects (e.g. Andes)?

MJO variability, U200

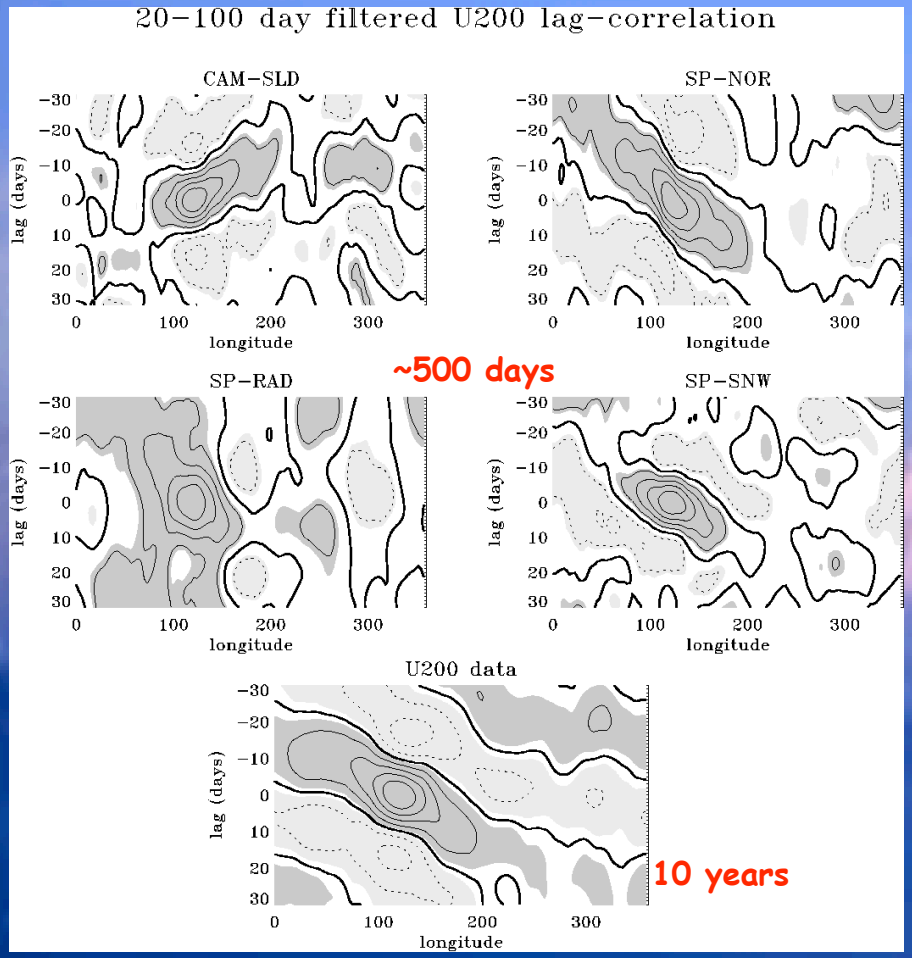


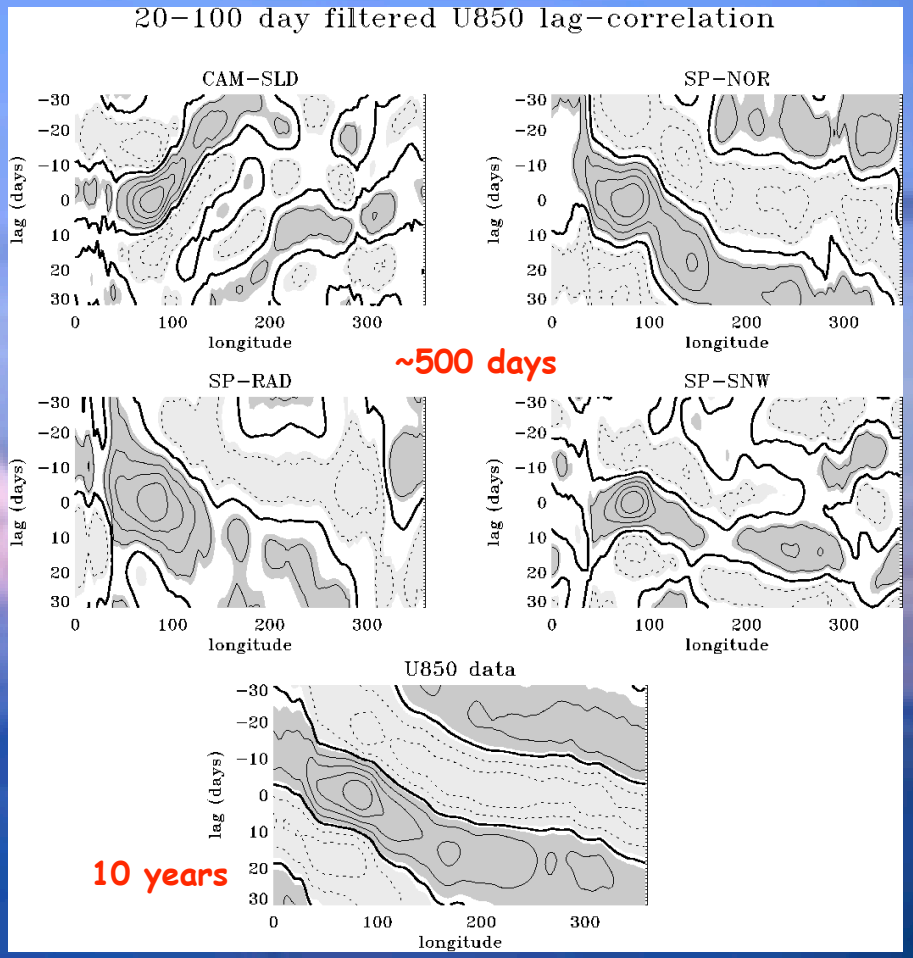
MJO variability, U850



Lag-correlation analyses, winds

U200 **20-100 day filtered** U850

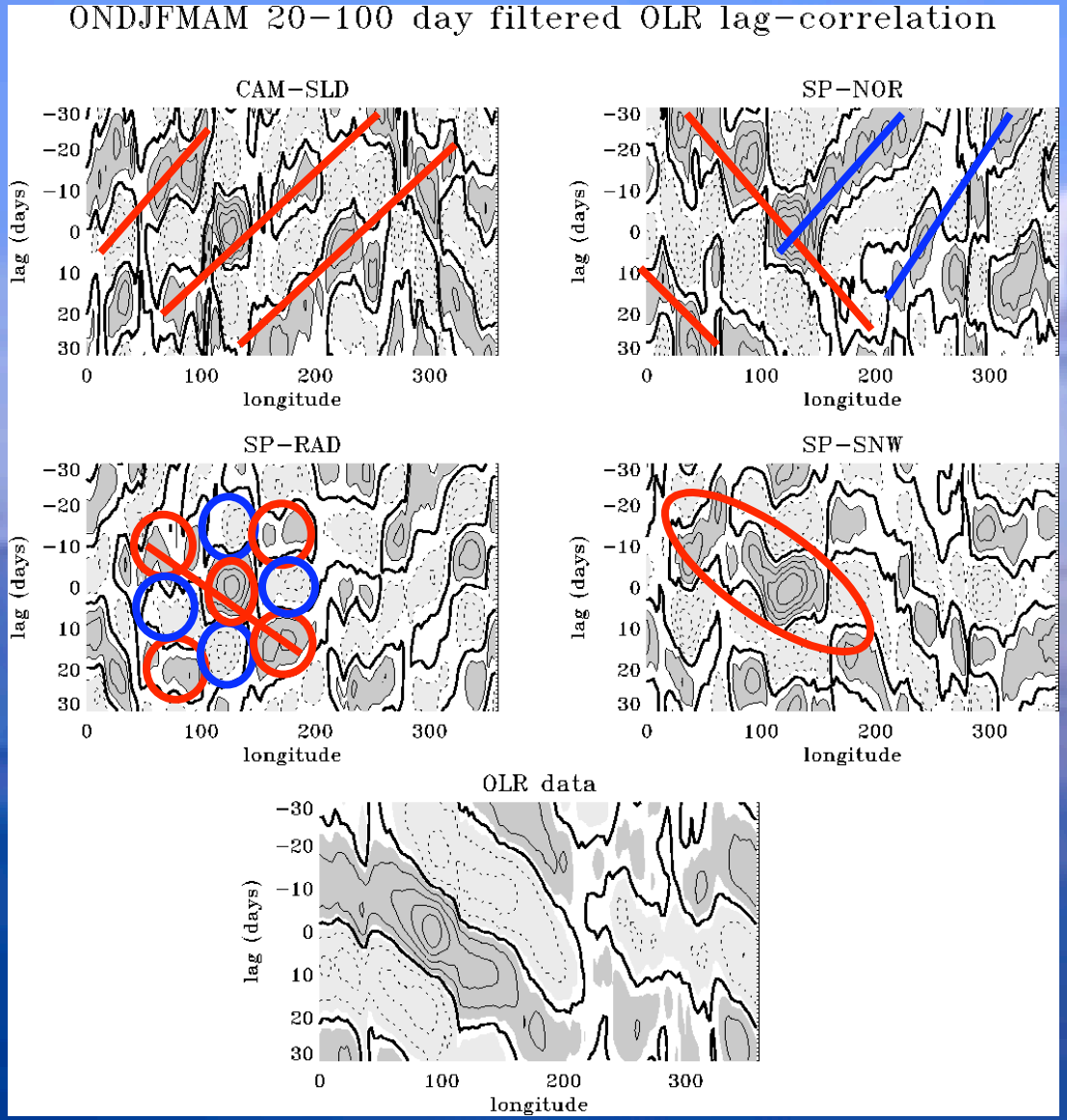




Lag-correlations, OLR

Mostly westward propagation

Discrete eastward propagation via standing waves



Westward and eastward propagation

Evidence of continuous eastward propagation

MJO summary

- Control run produces no discernable MJO signal.
- Each SP run produces variability with MJO-like characteristics.
  - Baroclinic structure.
  - Eastward propagation at correct frequencies.
  - Convective coupling at MJO frequencies.
- Addition of cloud-scale radiation calculation and enhanced ice-to-snow conversion results in best MJO signal.

Conclusions

- SP runs improve many characteristics of tropical variability over the control run, such as the MJO.
- Excessive 180-300 day variability is seen in all four simulations.
  - Not simply an artifact of super-parameterization.

Final thoughts

- Ice microphysics and its interaction with radiation play an important role in tropical variability in SP simulations.