Global Survey of Multi-day MCS

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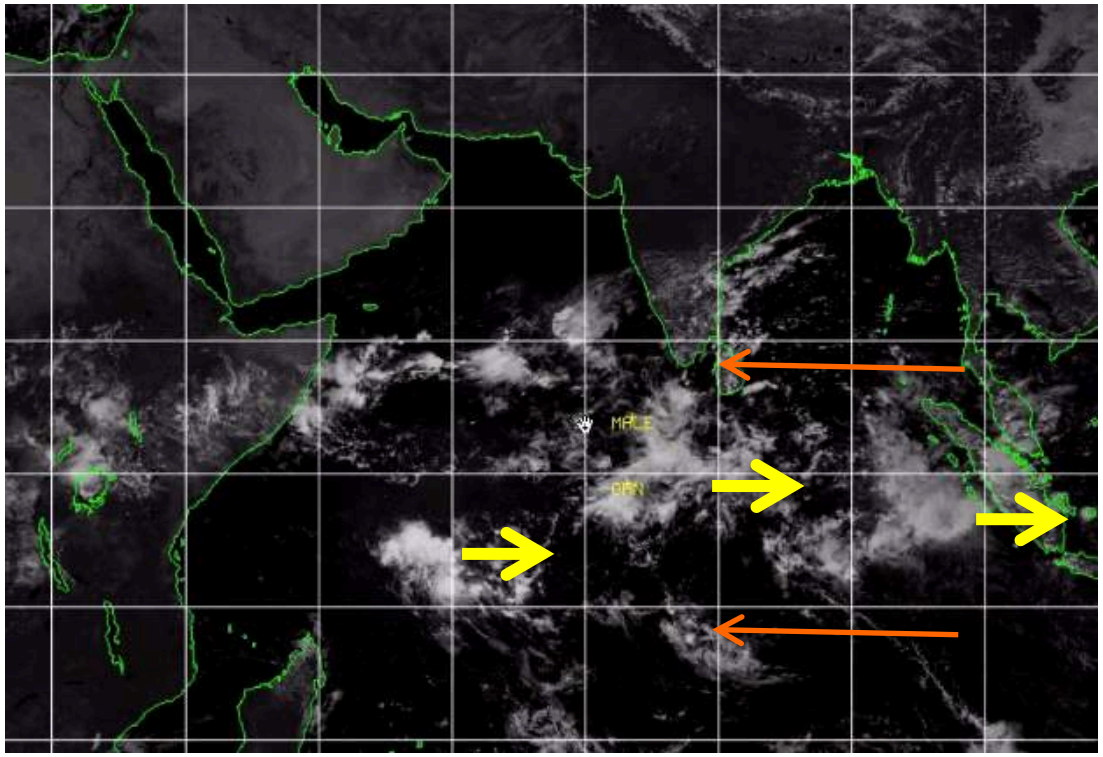
William Rossow Symposium, June 5-8, 2017

Bill's Place

(Historical re-enactment)

DIAGNOSTIC ANALYSIS AND CLOUD-SYSTEM MODELING OF ORGANIZED TROPICAL CONVECTION etc, etc.

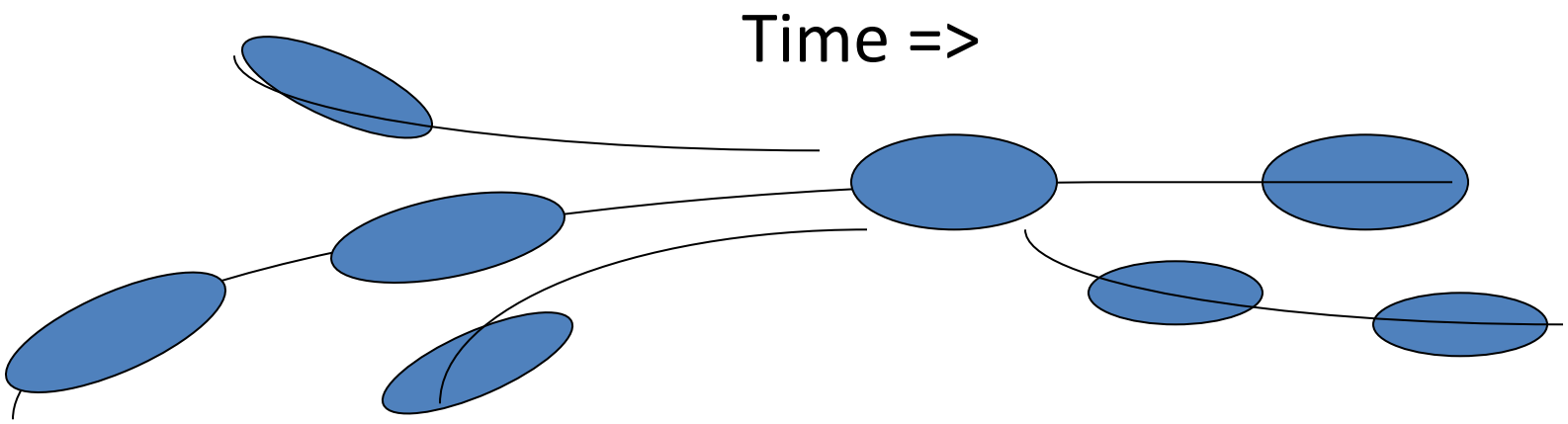
NSF grant to Rossow, Montcrief, Luo, Vant-Hull, Bacmeister



Madden-Julian Oscillation: the Ultimate Test

Climate models can not propagate convective activity from cell to cell. Compare observations to GCM and CRM

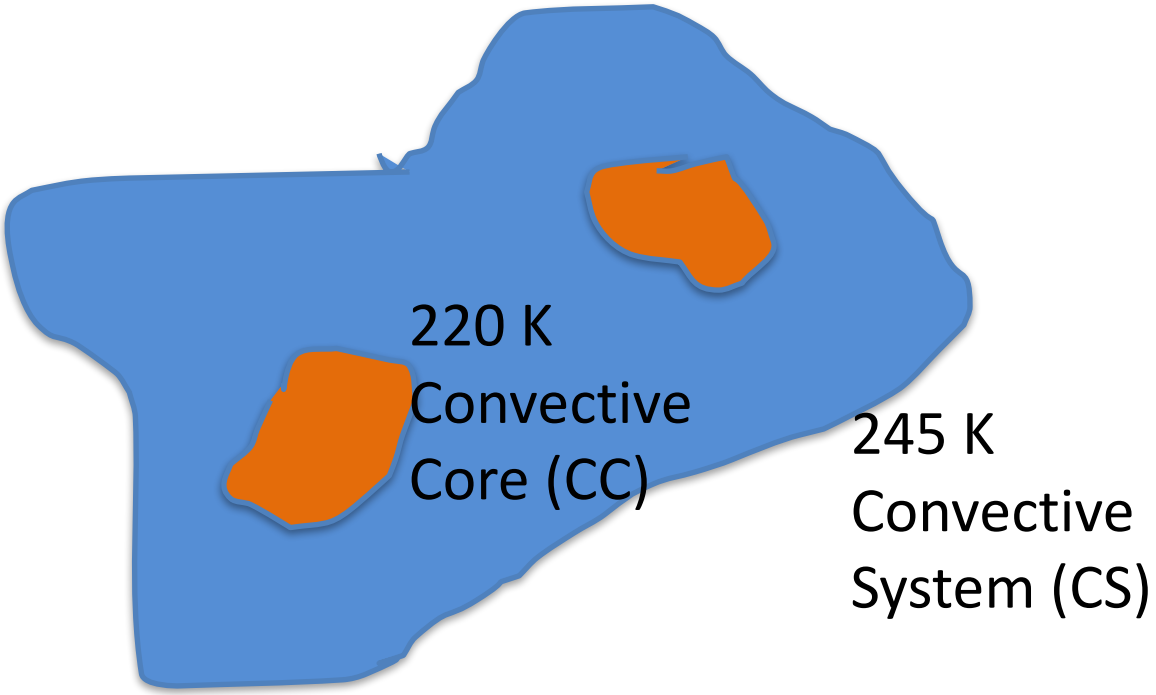
Families and Tribes



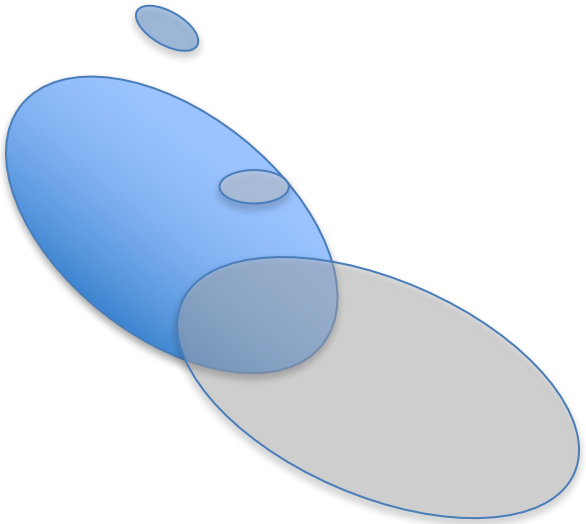
Family of mother -> daughter -> grand-daughter cloud cells
in successive snapshots of time.

A *tribe* includes all families that merge or split from each other.

ISCCP Cloud Tracking (CT) Dataset: Convective Systems and Cores



ISCCP Cloud Tracking (CT) Dataset: Cloud Tracking by Overlap

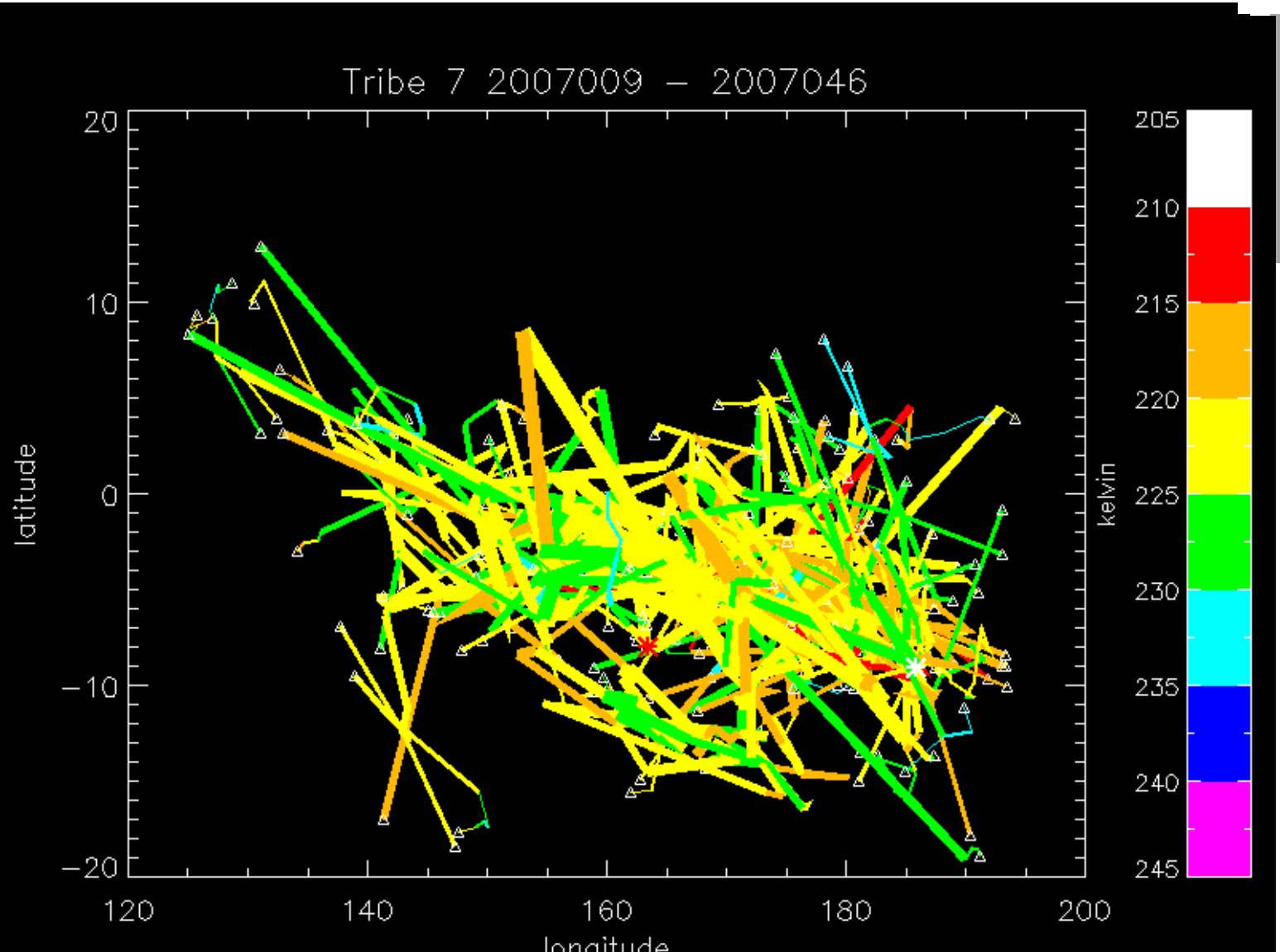


Tracking by maximum overlap works assuming
(Cell size)/(time step) > speed

Machado, Rossow, Guedes, Walker, 1998:

"just use the simplest method you can get away with"

Tropics: Sample Tribal Lifestyle



* First cell

* Last cell

Δ merge start

Colors: Average cloud top temperature

Thickness: Cloud area

Dataset Restrictions

Average tribe speed calculated from initial and terminal cloud cells

For this analysis, tribes are excluded *unless*

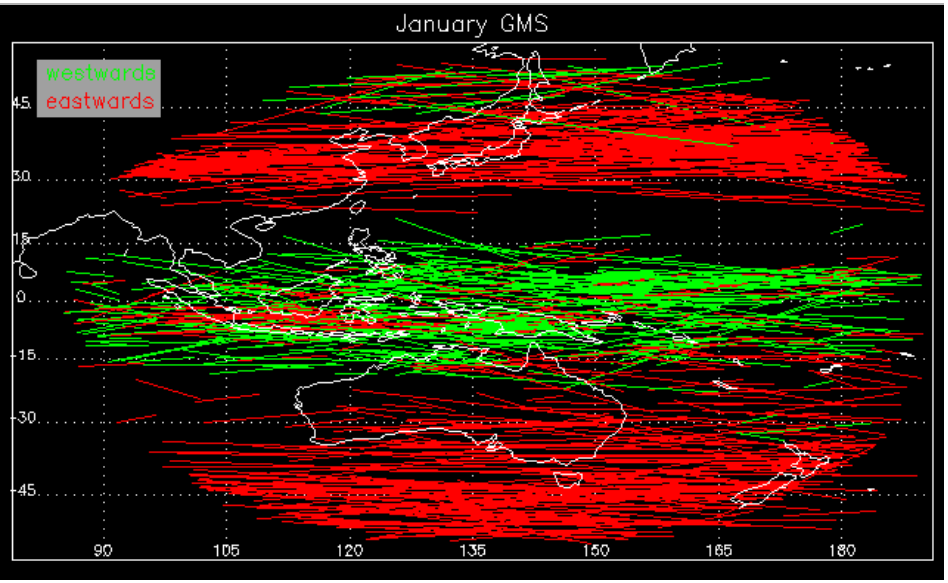
- **lifetimes > 1 day**
- **meridional velocity components < 300 km/day**

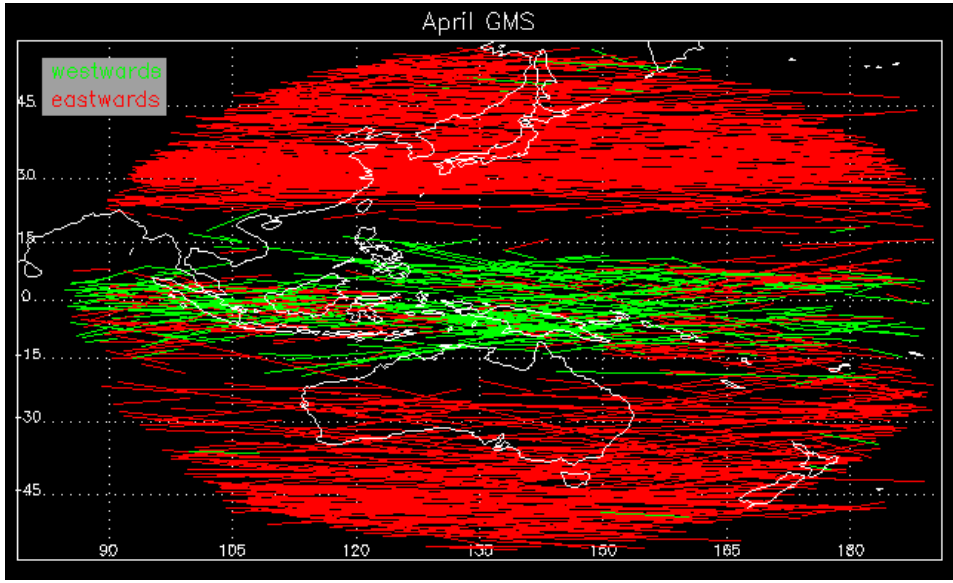
-2000 km/day < WESTWARD < -300 km/day

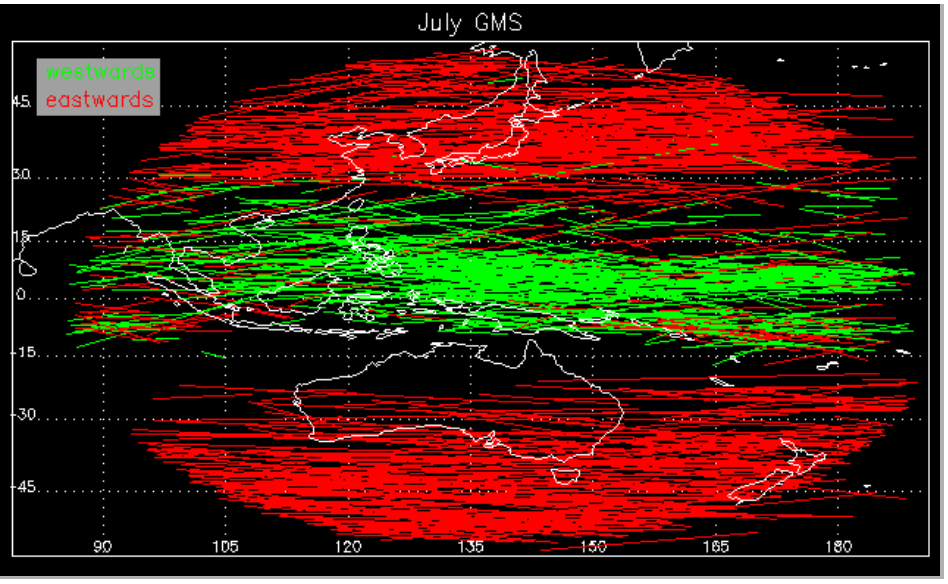
(Zonal component)

300 km/day < EASTWARD < 2000 km/day

Note that typical zonal wind of 10 m/s ~ 900 km/day
MJO propagation of 4-8 m/s -> 350-700 km/day







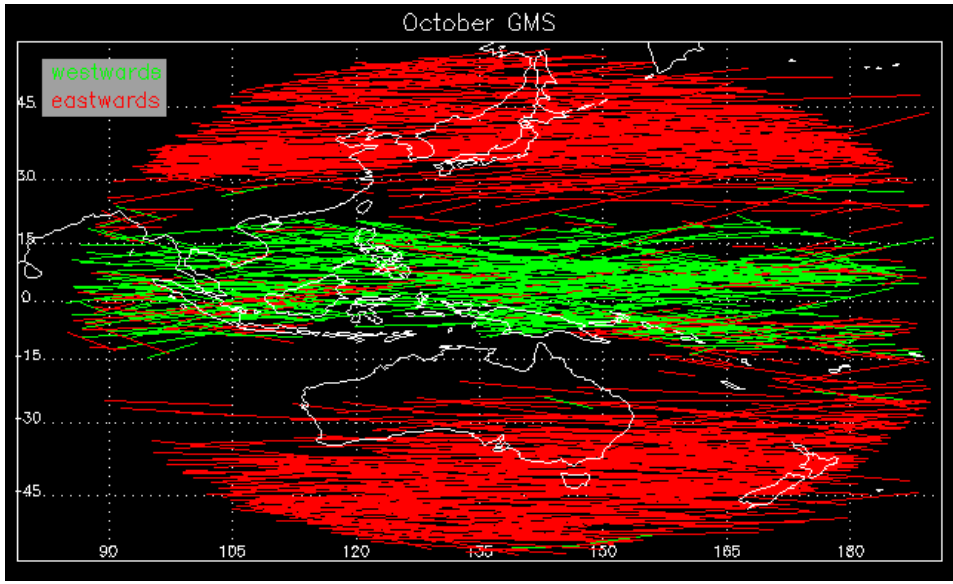


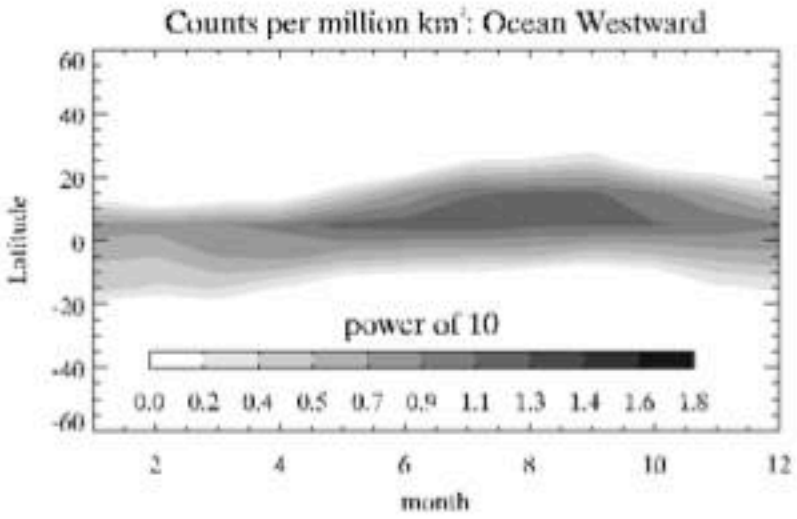
Figure 2a: Westward moving (green) and Eastward moving (red) cloud tracks for the GMS satellite (Western Pacific), for Jan, Apr, Jul, Oct.

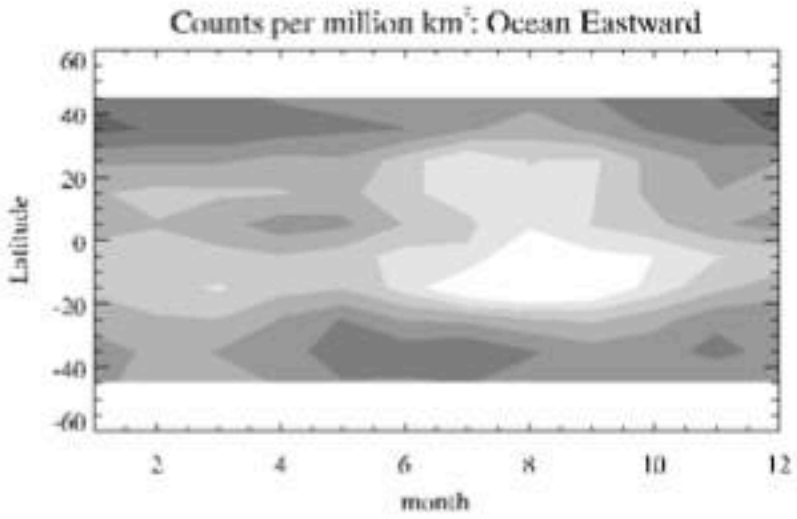
MCS Density by Latitude and Season

WESTWARD

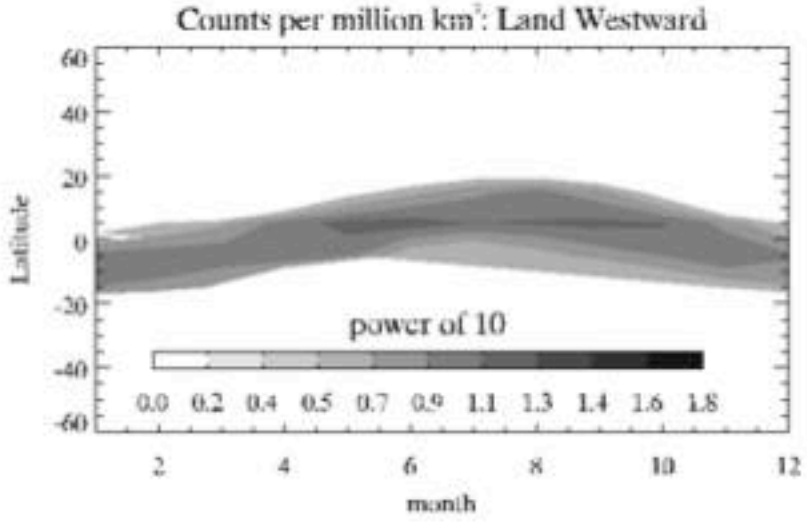
EASTWARD

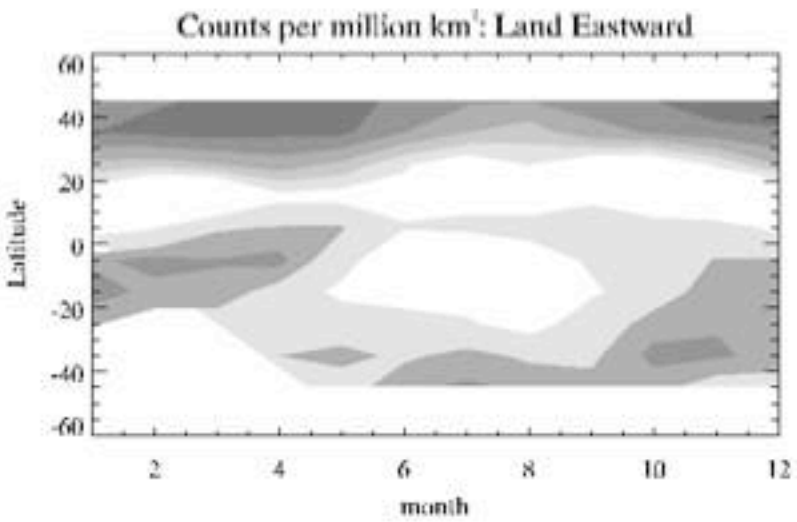
OCEAN

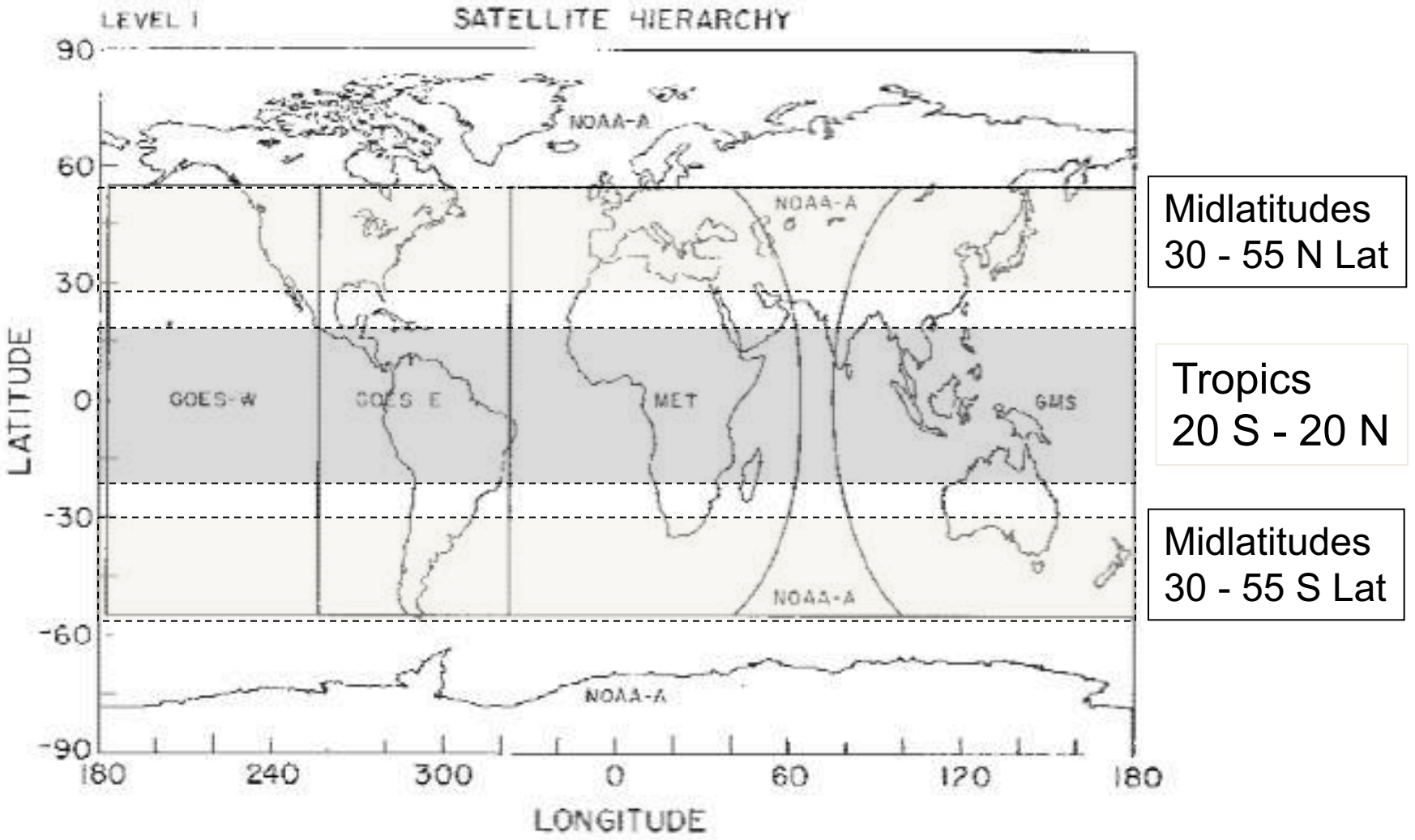




LAND







Latitude zone, with midlatitudes combined, Land and Sea

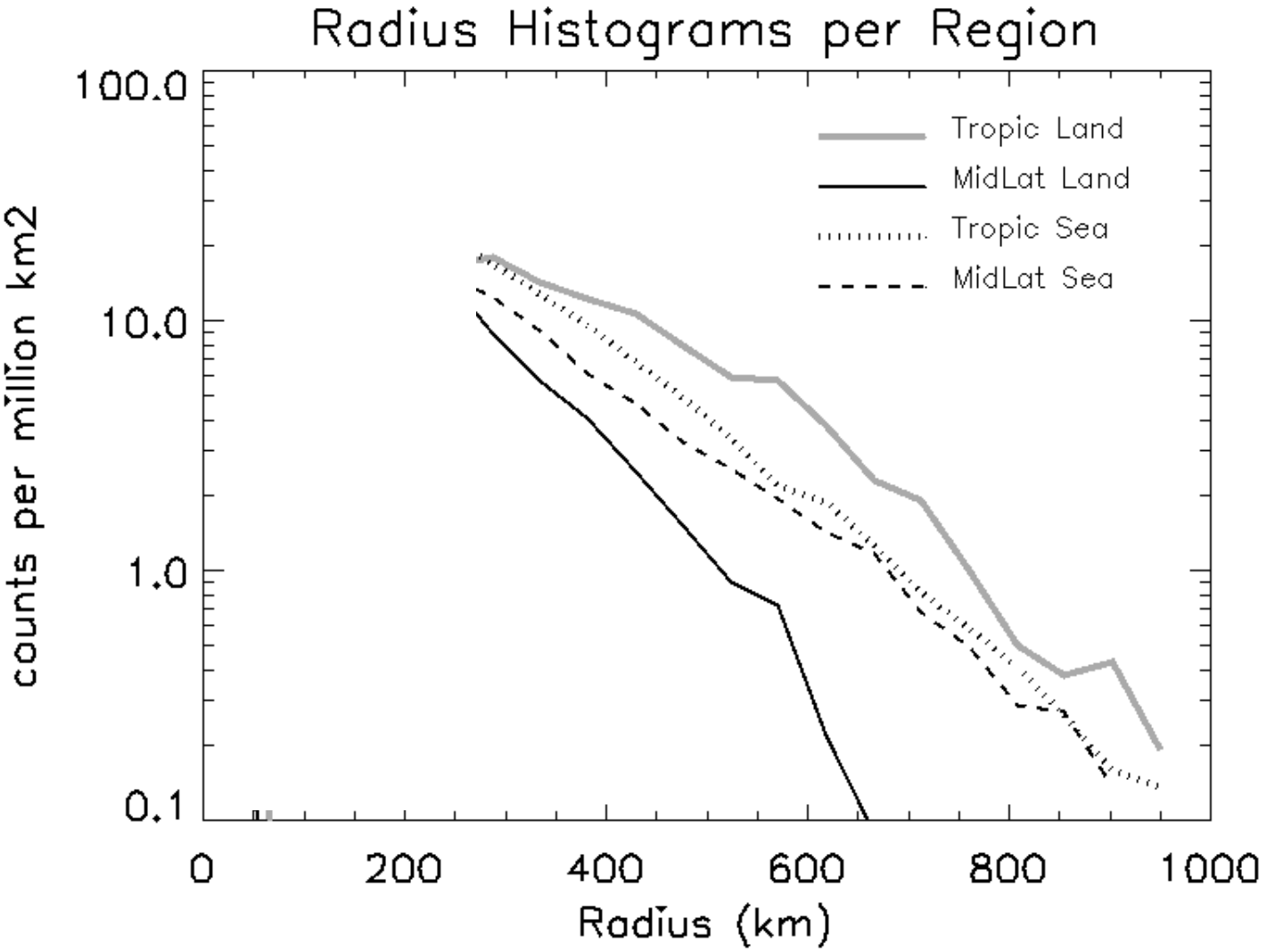
SOLID: Land

DASHED: Sea

DARK: MidLats

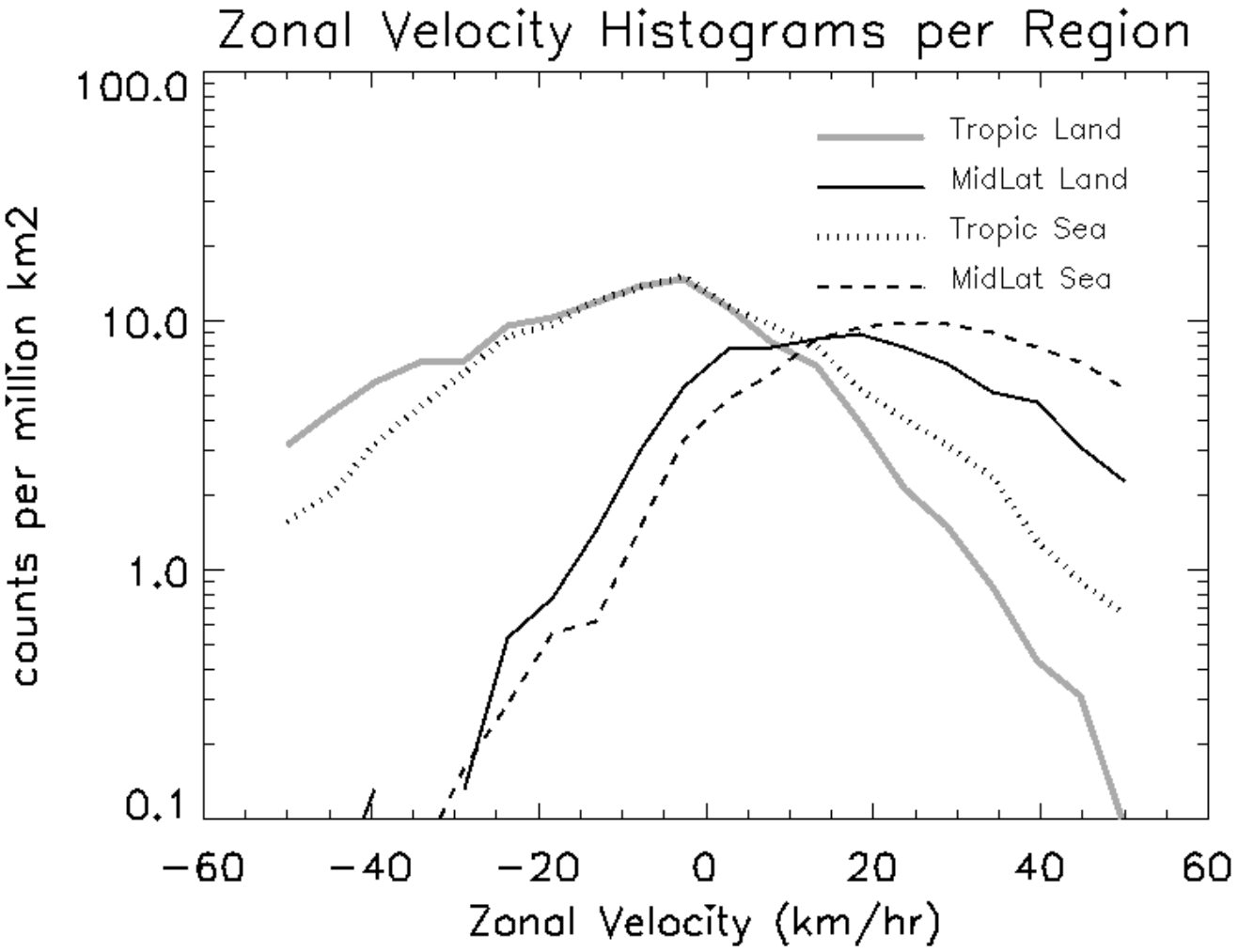
GRAY: Tropics

Histograms: land/sea, tropic/midlats



Over land, Tropical MCS tend to be larger than Mid-latitudes; but over ocean the sizes in both zones are roughly equal on average.

Histograms: land/sea, tropic/midlats

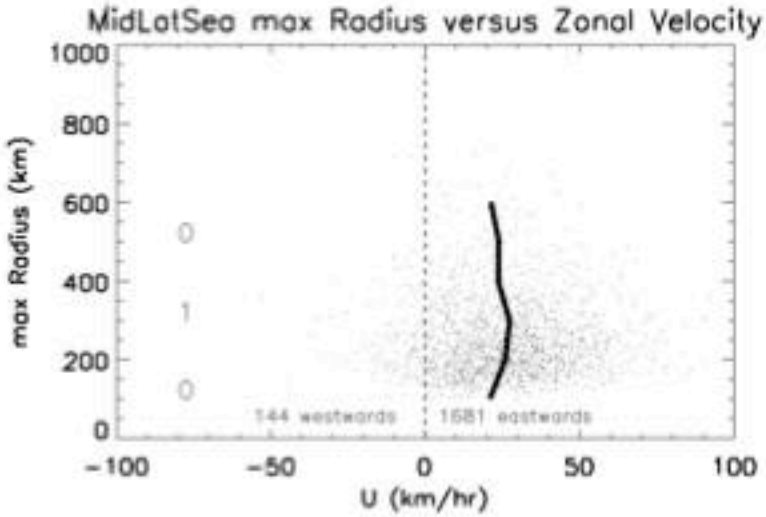


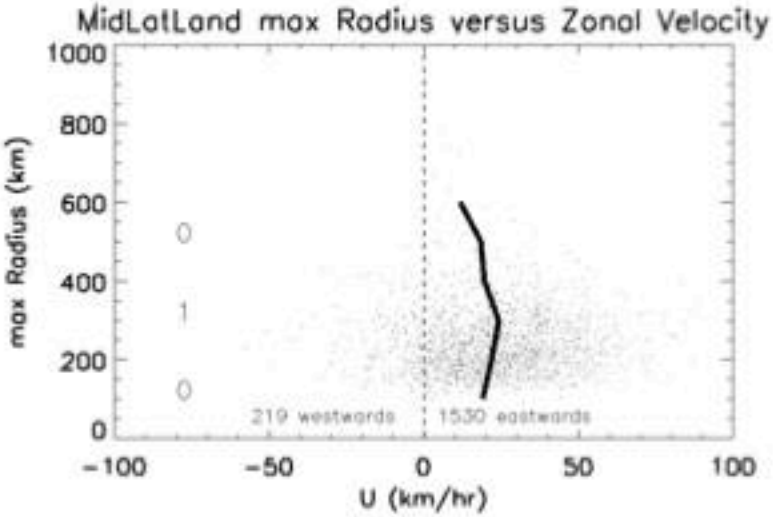
Tropical motion is weighted towards west, midlat motion towards the east; but in both zones the oceanic systems are more weighted to eastwards motion than land.

Maximum Radius versus Zonal Velocity

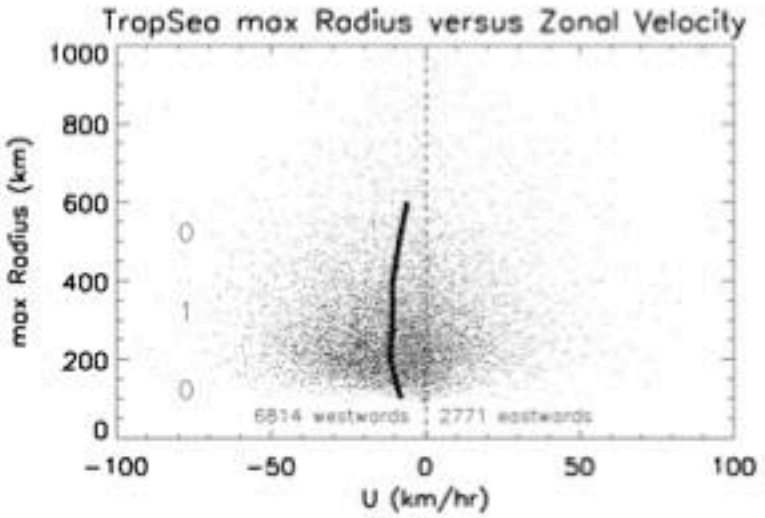
Sea | **Land**

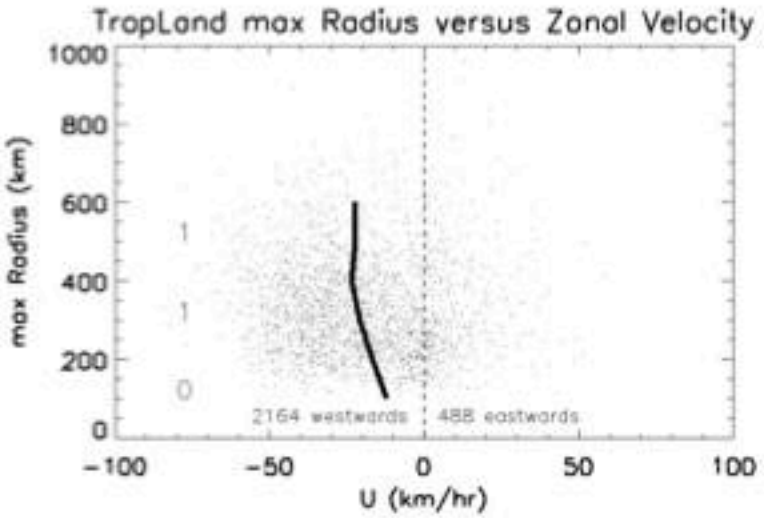
Mid Lat





Trop ical





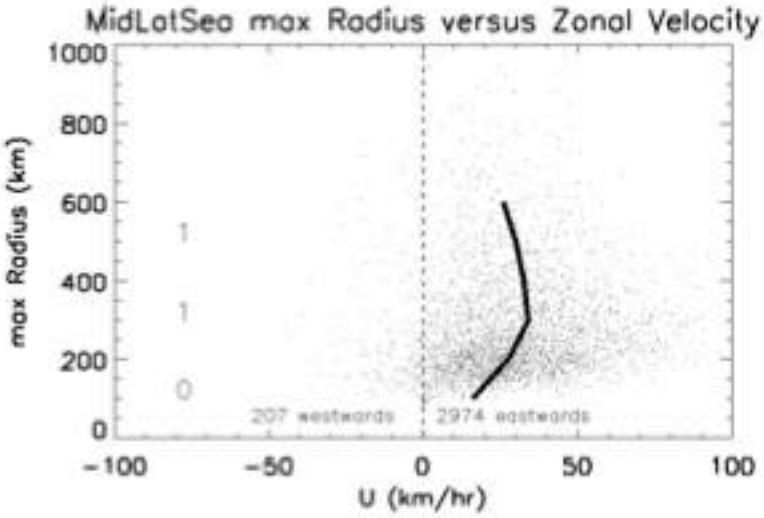
SUMMER

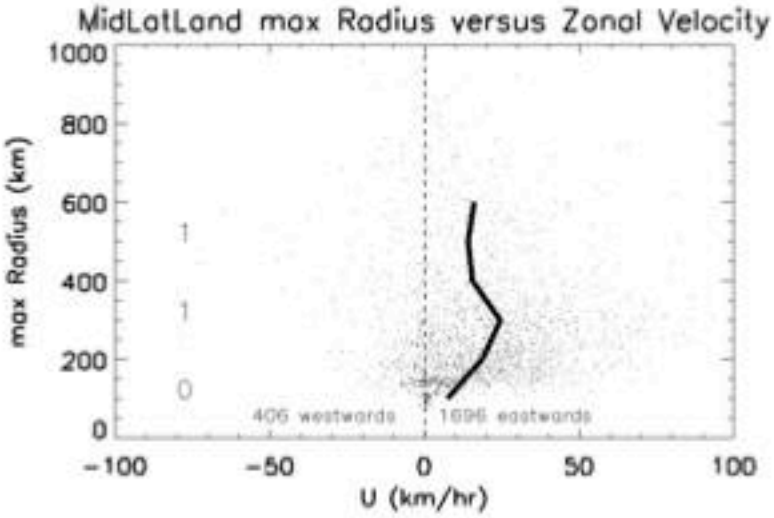
Maximum Radius versus Zonal Velocity

Sea

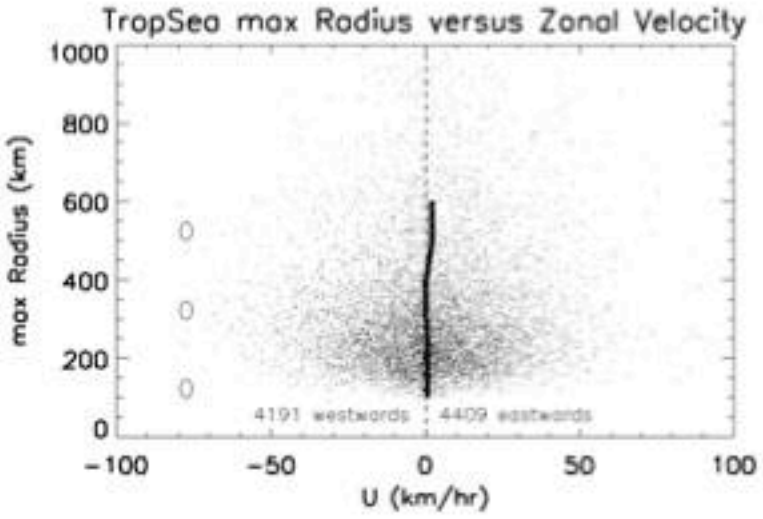
Land

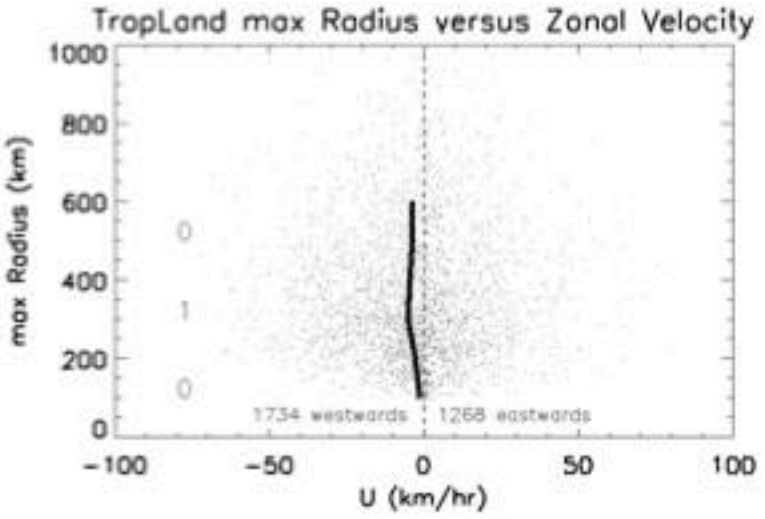
Mid Lat





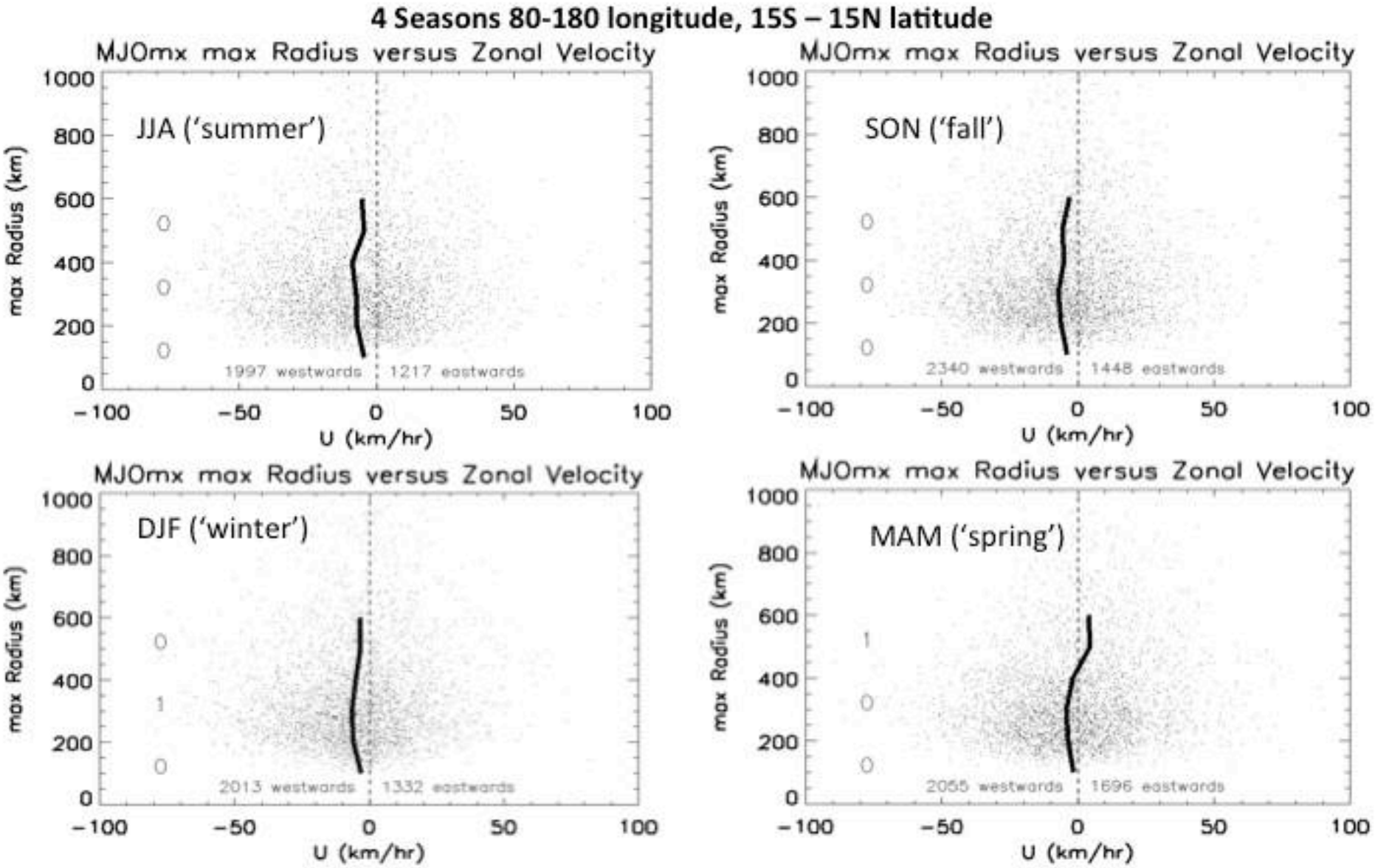
Trop ical



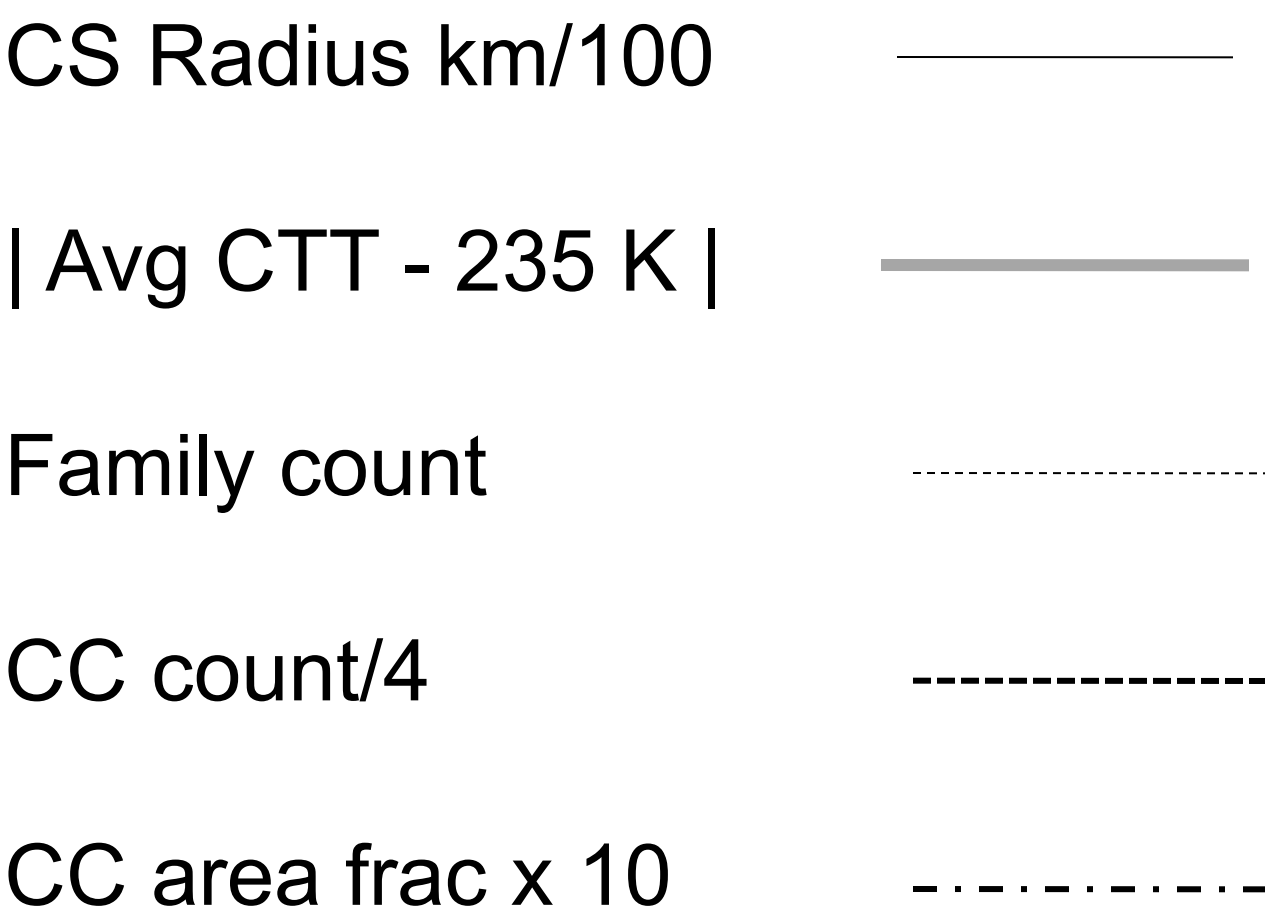


WINTER

Seasonal Effects, Indian Ocean/West Pacific



Legend

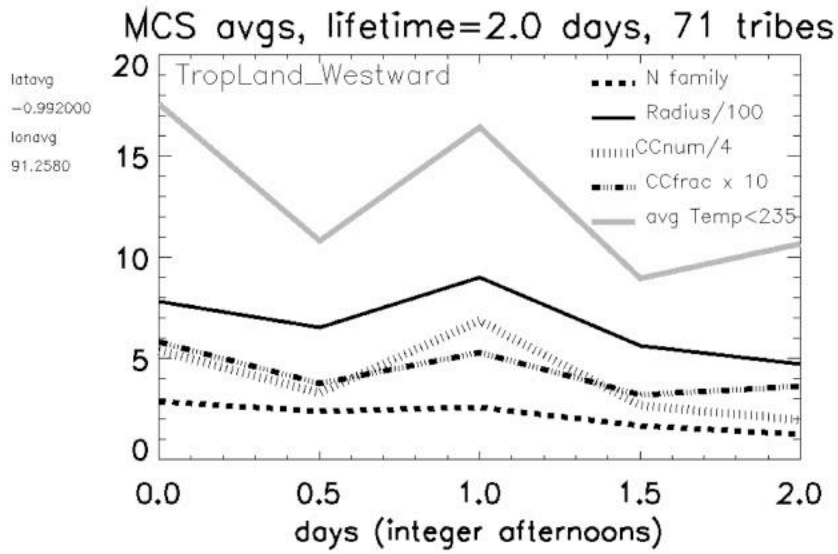

CS Radius km/100
| Avg CTT - 235 K |
Family count
CC count/4
CC area frac x 10

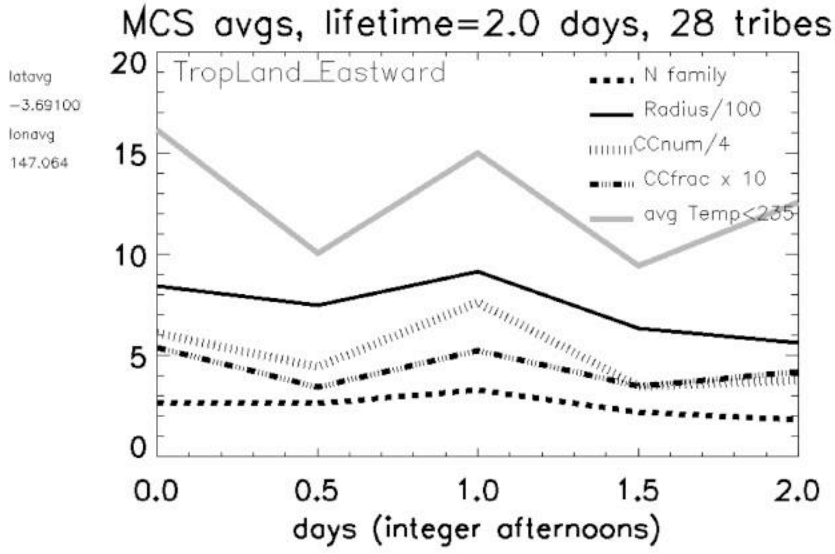
Tropical Two-Day Lifecycles

Westward

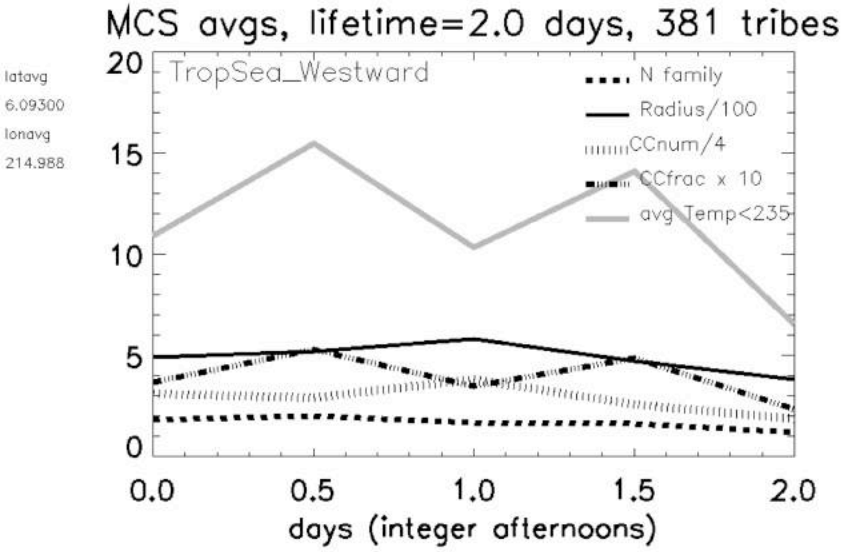
Eastward

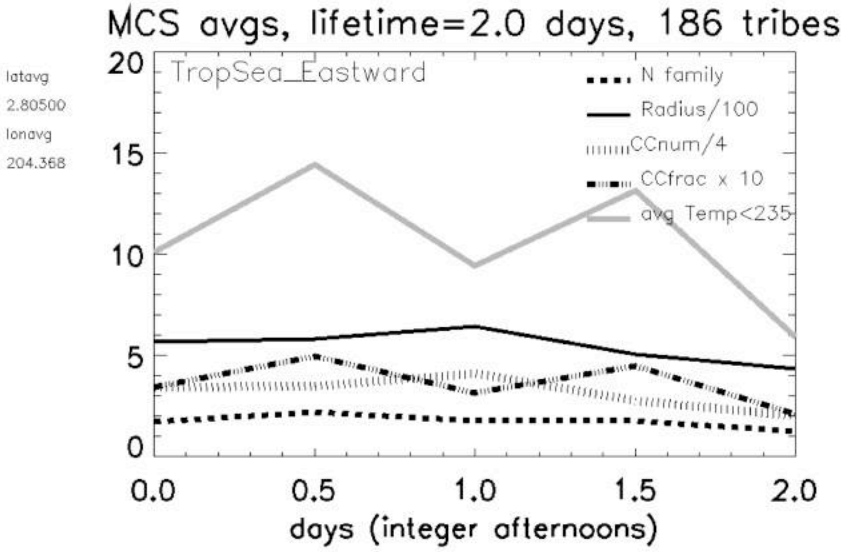
Land



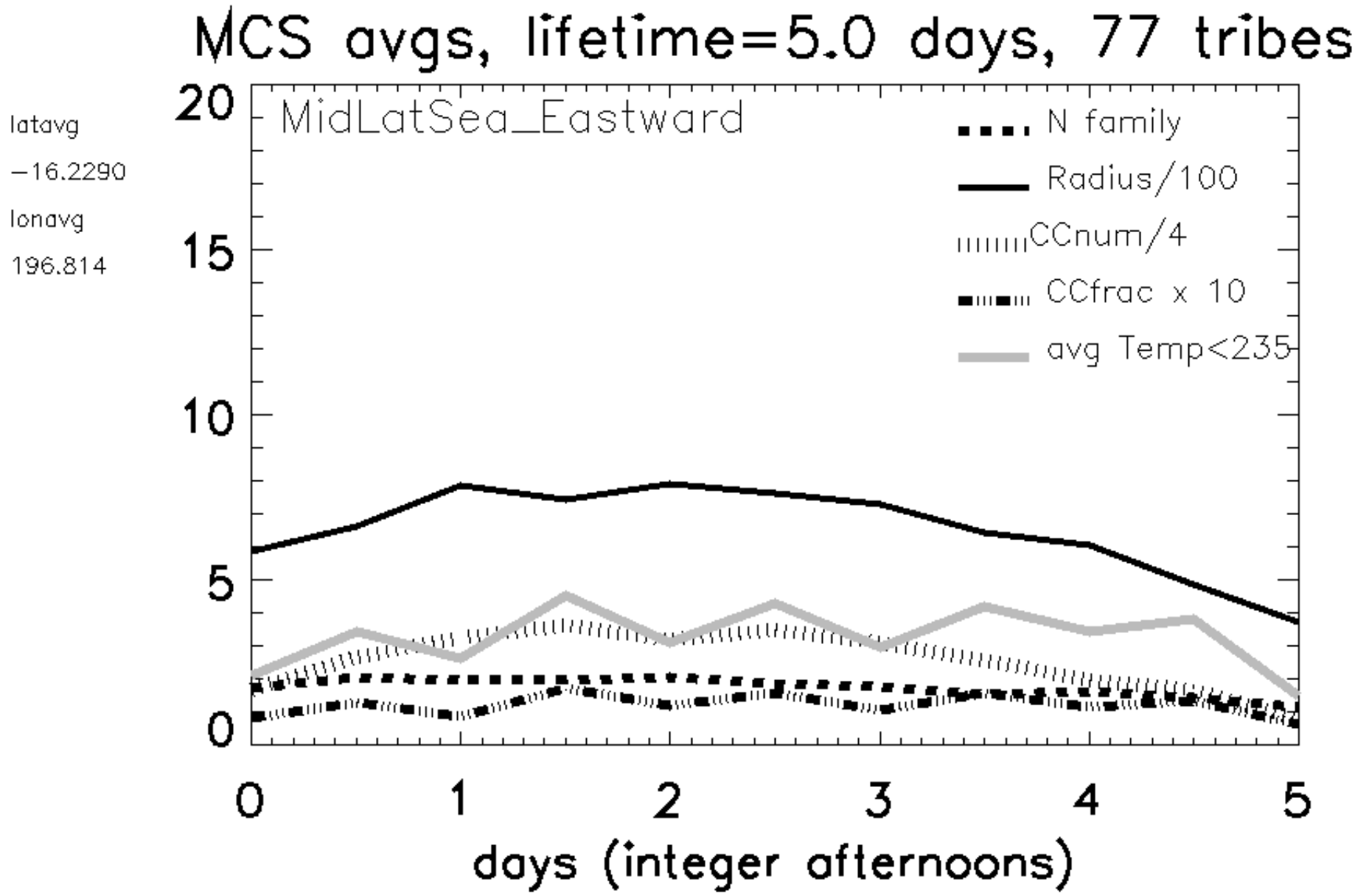


Sea

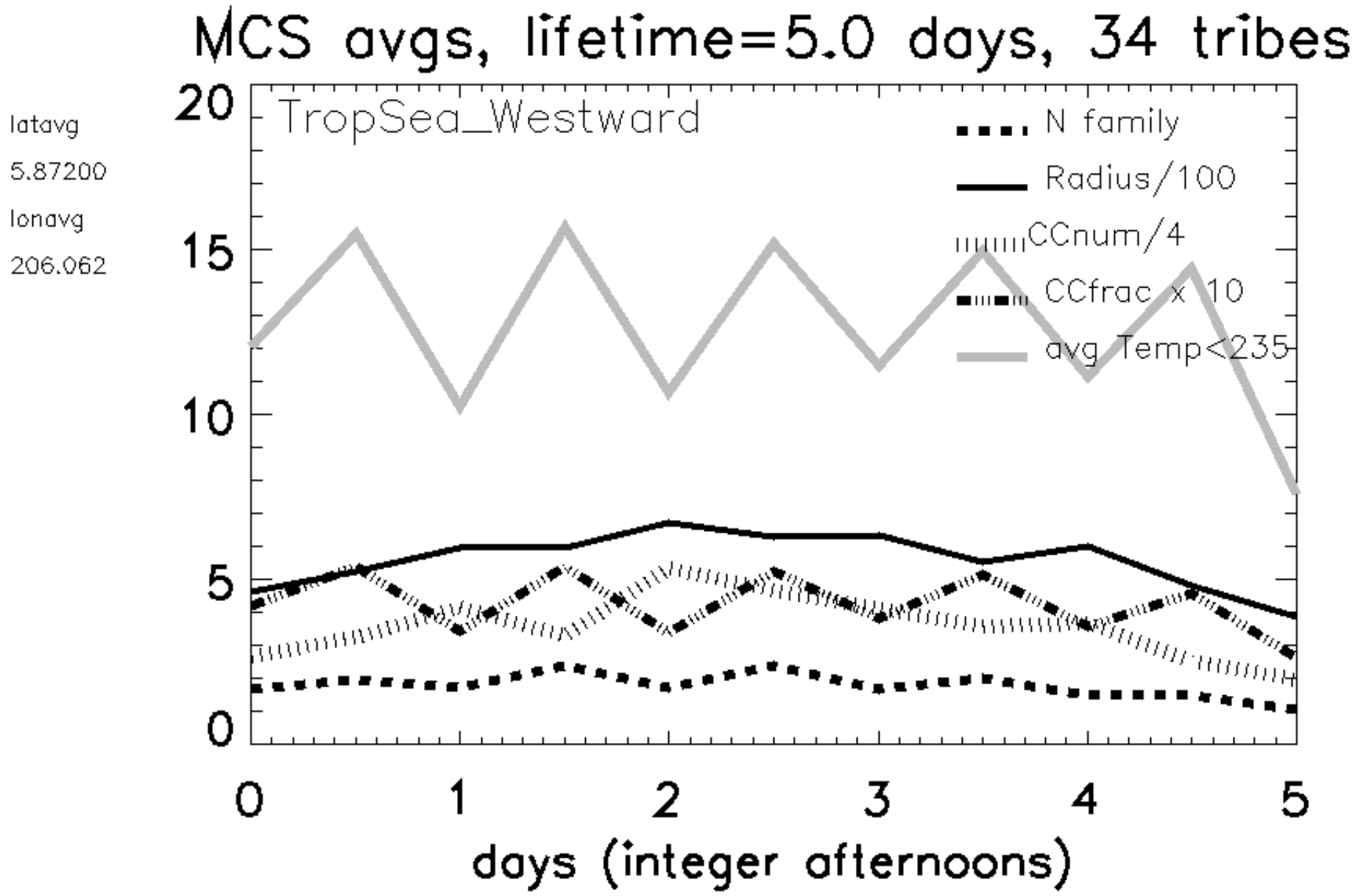




Mid-latitude, Sea, Eastwards 5-Day Lifecycles



Tropical Sea, Westward, 5-Day Lifecycles



Interesting Points

- The expected MJO-related eastward moving tropical systems seems to be a shift in the overall ensemble of velocities, not changes in system properties such as size or min temperature.
- Once established, multi-day systems have fairly stable properties throughout their lifecycle, with only a ~50% change in radius.
- Size distributions are generally larger over tropical land than mid-latitudes, but are the same over the oceans.
- Oceanic motion is more weighted to the east compared to land.

Vant-Hull, B. W. B. Rossow, C. Pearl, 2016: Global Comparison of Regional Lifecycle Properties and Propagation of Multi-day Convective Systems: Tropics, Mid-Latitude; Land and Ocean. *Journal of Climate,* **29, (**16), 5837-5858.