Satellite-based Global Storm Tracking, Climatology, and Life Cycle Evolution

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Motivation

- Lagrangian storm tracking and life cycle of storms on the globe helps
  - Study whole evolution of storm
  - Determine transport of moisture
  - Learn how individual storms form and decay
- Goal: develop a comprehensive global picture of storm tracks, types, characteristics, and life cycles using satellite measurements
- Applications
  - Improve meteorological forecasts
  - Quantify individual storm water cycle contributions
  - Assess/validate current and future satellite missions

Data and Methods

June 28, 2012

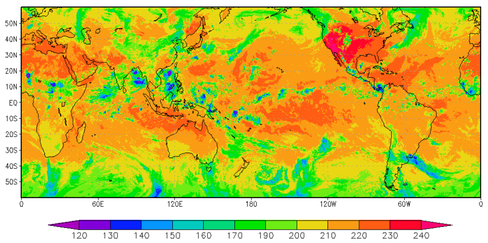

Figure 1 - IR dataset NCEP-CPC 4km Cloud Top Temperature

- 30 min brightness temp.
- GOES, METOSAT, GMS
- Interpolation used to fill in satellite coverage gaps
- Examined DJF 2001-2011

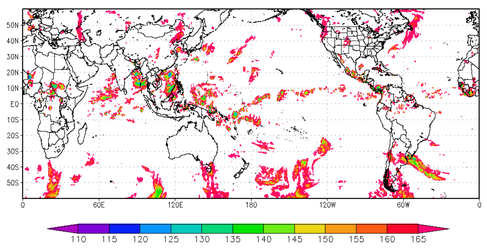

Figure 2 - Cloud clusters using ForTraCC tracking technique (Vila et. al, 2008)

Capture thresholds:

- Temperature < 245 K
- Area > 100 pixels

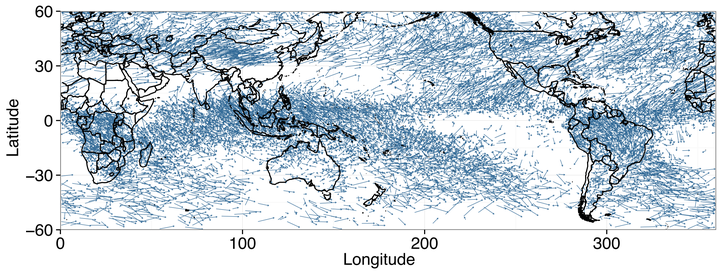

Figure 3 - Tracking storms with 8-hour lifetime DJF 2001-2011

- Detection by area overlap, both forward and backward in time
- Centroid of cloud cluster followed to determine storm tracks
- Storm tracks (fig. 3) outline features consistent with DJF:
  - Midlatitude storm tracks across North America
  - Intertropical Convergence Zone (ITCZ) close to equator

*Data will be available soon: http://stormtracks.umd.edu

Results

What is the global distribution of storms?

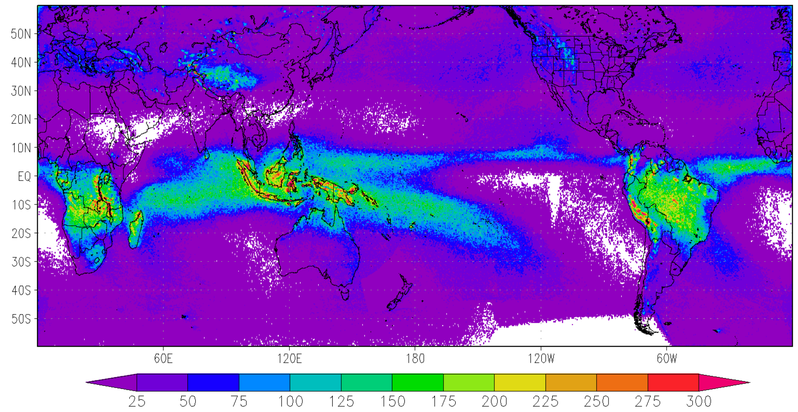

Figure 4 - Storm initiation frequency, binned by 0.5x0.5 degrees DJF 2001-11

What are the temperature and size properties?

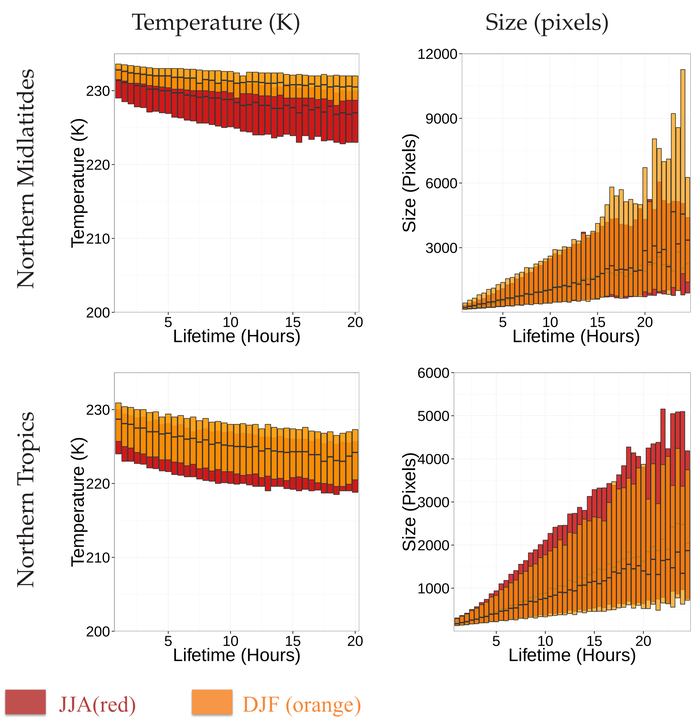

Figure 5 - Regional and seasonal storm properties

Results - Life Cycle Evolution

How frequent are short and long lived storms?

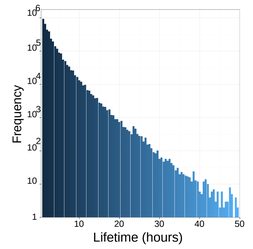

Figure 6 - Count of storm lifetimes

- Majority of storms live < 3 hours
- High resolution data needed to track storms

How do storms evolve over their lifetime?

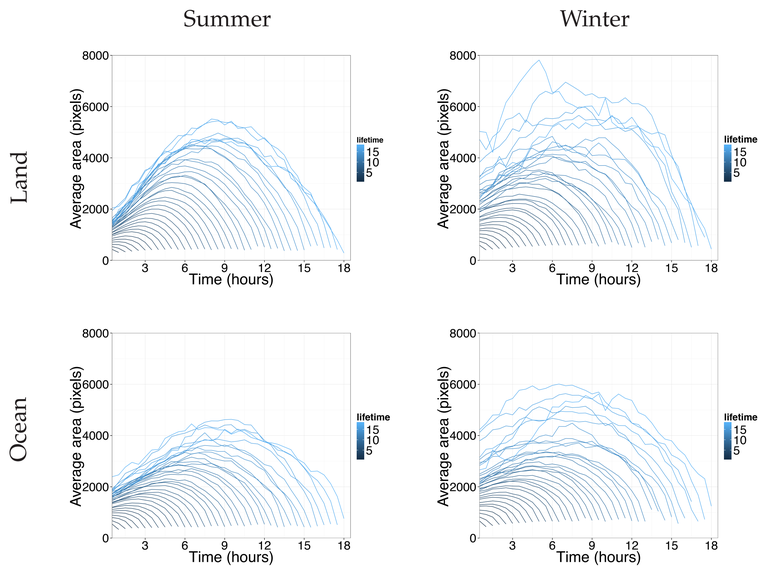

Figure 7 - Regional life cycles: ave. size evolution by lifetime Summer: JJA (North) and DJF (South). Winter: DJF (North) and JJA (South).

- Evolution non-linear; varies by season, location, and storm classes

Conclusions

- Lagrangian analysis coupled with satellite IR yield global analysis
- Storm initiation higher over convergence zones, rainforest, Pacific islands
- Short lived storms more frequent, warmer, and smaller than longer lived
- Lifecycle shows regularity - can potentially develop model to estimate life cycle duration

References and Affiliations

- Vila, D. A., Machado, L. A. T., Laurent, H. and Velasco, I., 2008: Forecast and Tracking the Evolution of Cloud Clusters (ForTraCC) Using Satellite Infrared Imagery: Methodology and Validation. Weather and Forecasting 23, 233-245.
- Machado, L.A.T., Rossow, W.B., Guedes, R.L., Walker, A.W., 1998. Life Cycle Variations of Mesoscale Convective Systems over the Americas. Monthly Weather Review 126, 1630-1654.
- Houze, R.A., 1993. Cloud Dynamics. Academic Press, San Diego.

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