https://ntrs.nasa.gov/search.jsp?R=20160005339 2019-08-31T03:21:23+00:00Z

Legacy of Precipitation Feature Database from Satellite Passive Microwave radiometer and precipitation radar Observations

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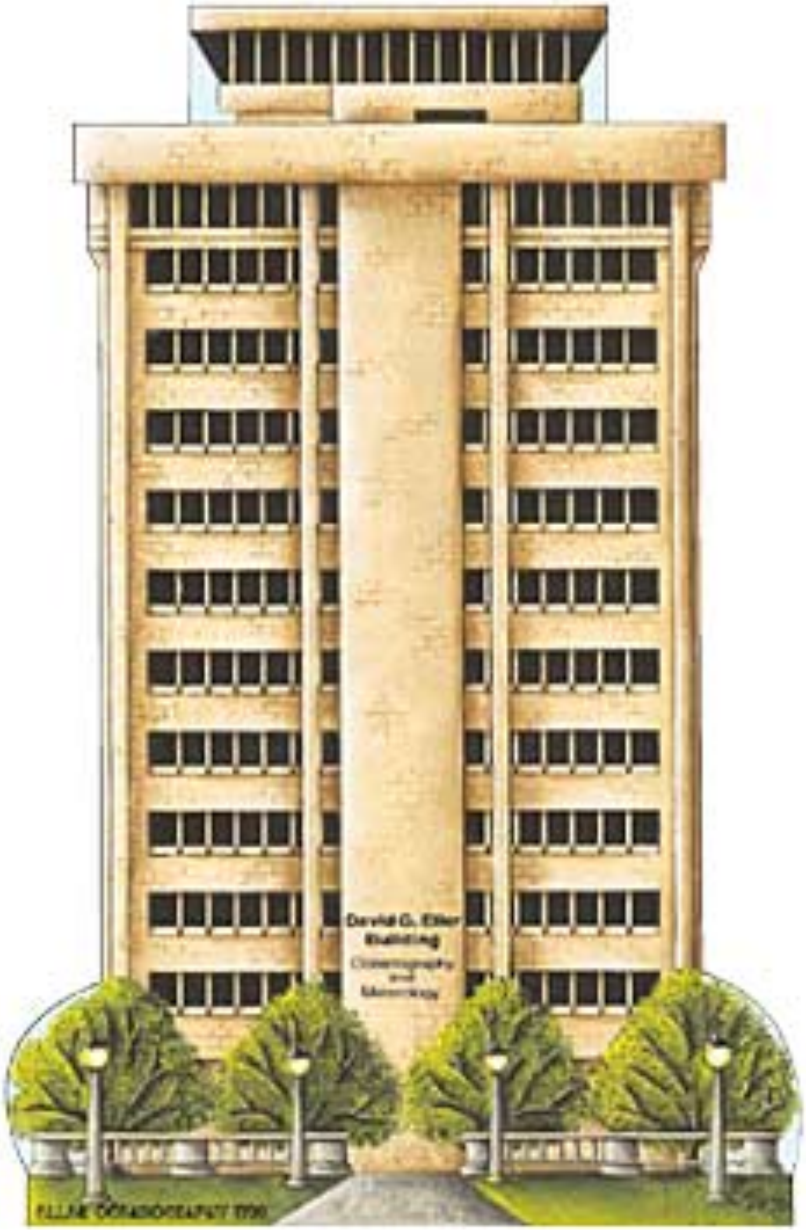


- Feature algorithm

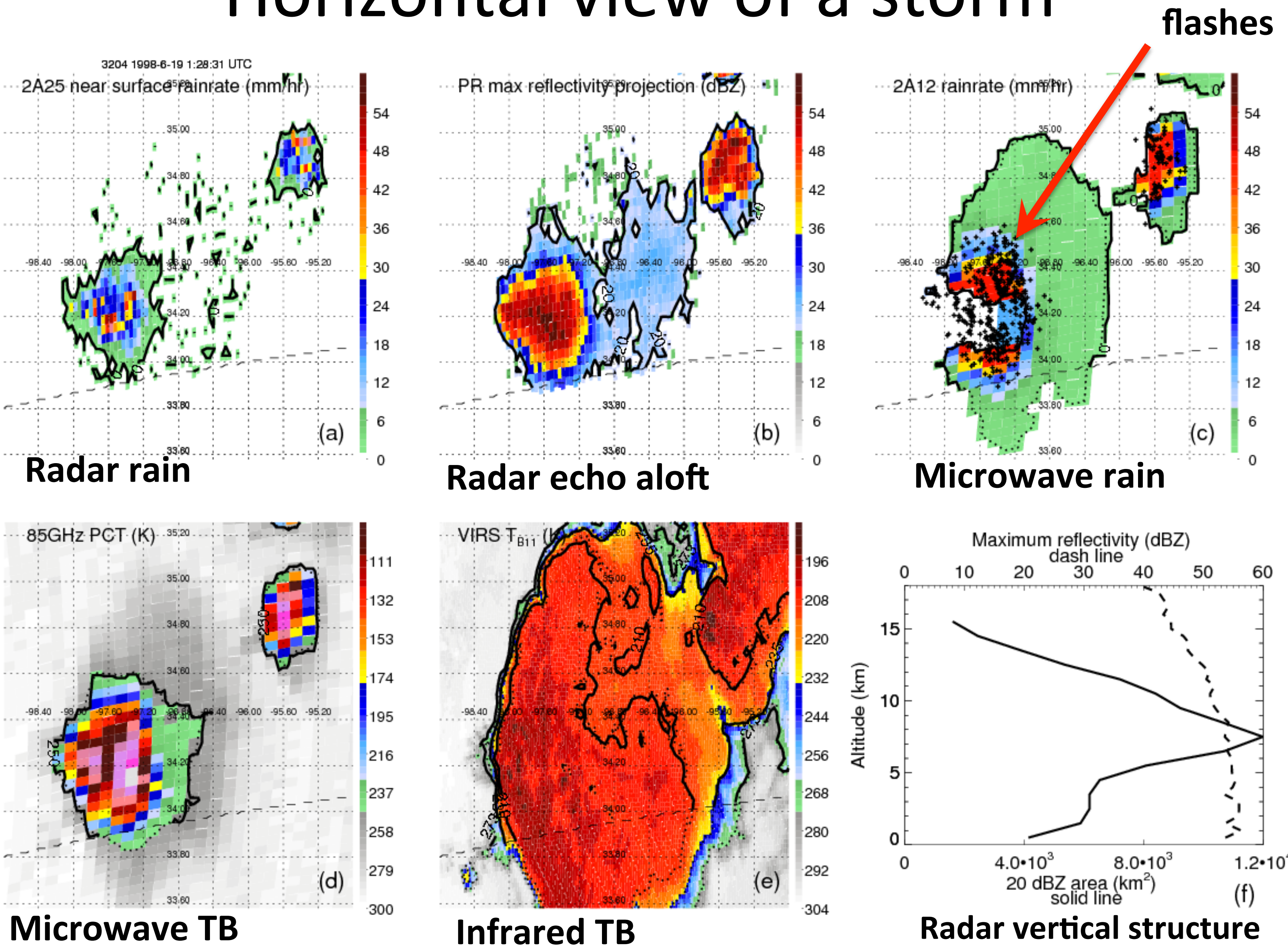
Define objects by grouping adjacent pixels with cold passive microwave TBs

Started by a small group of people at Texas A&M in mid 1990s

Edward Zipser; Gary McGaughey; Karen Mohr;

Rick Toracinta; Daniel Cecil; Steve Nesbitt

Horizontal view of a storm



Global distribution of intense convection

- features defined with SSM/I 85 GHz TBs

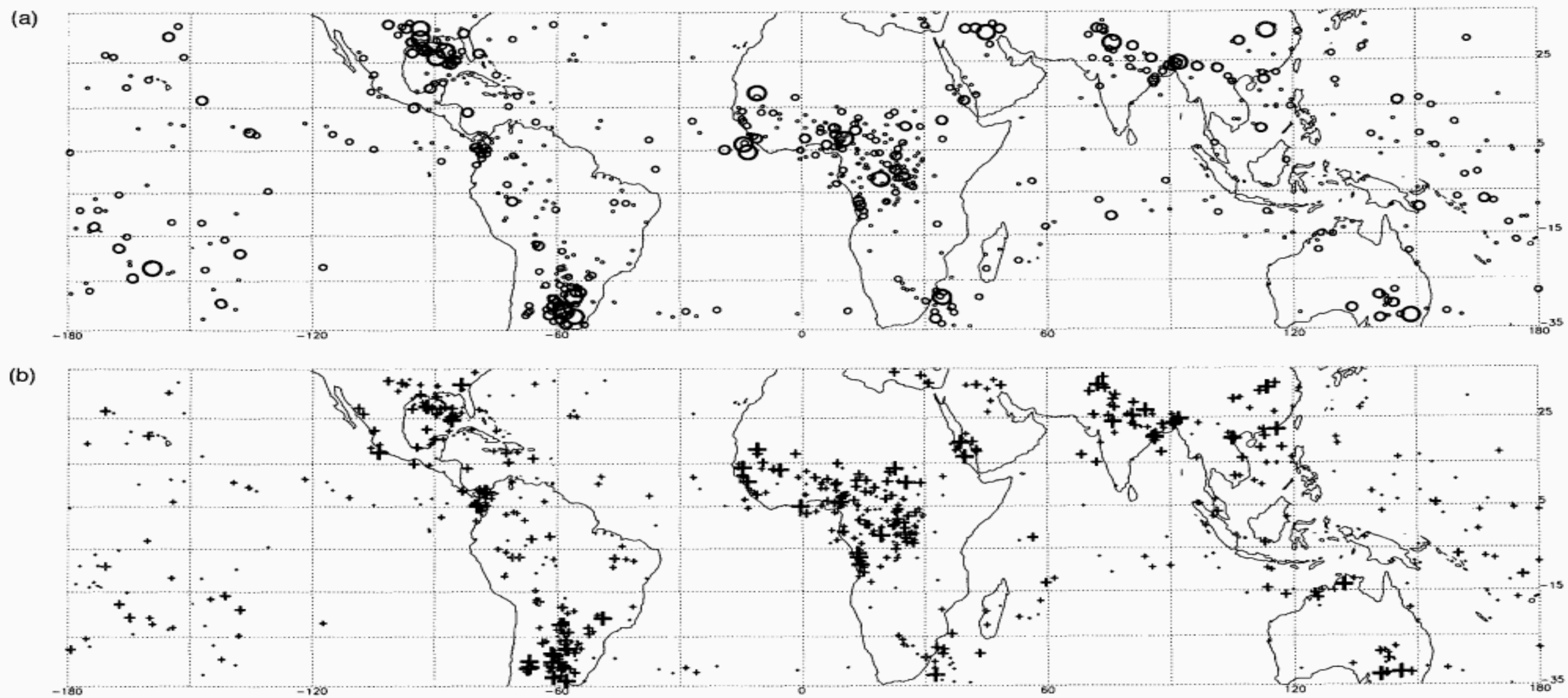


FIG. 13. (a) Intense MCSs by areas, all months. Plotting symbols are not proportional to the area of precipitation. (b) Intense MCSs by minimum PCT, all months.

Mohr and Zipser, 1996 BAMS, MWR

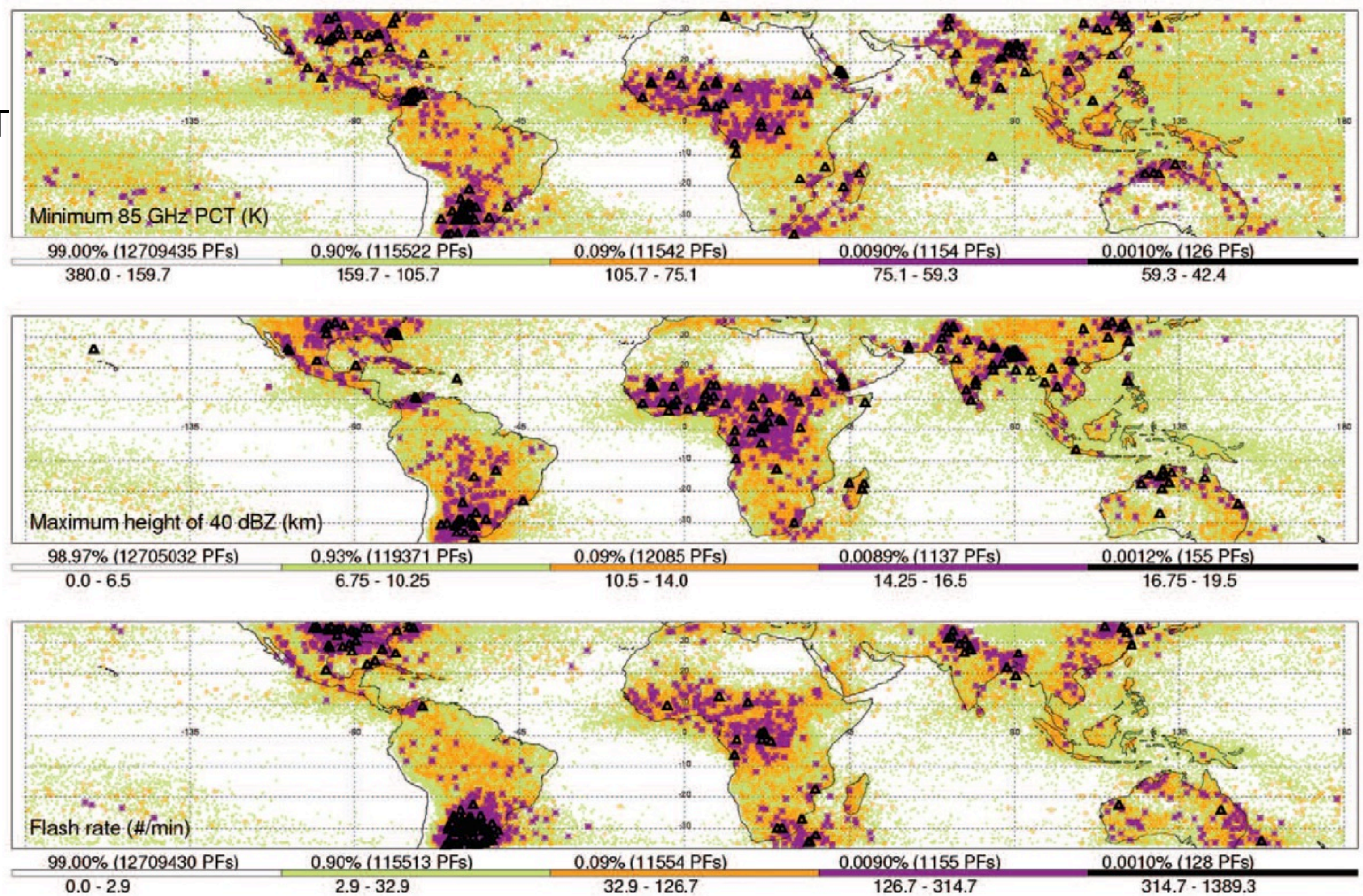
Global distribution of intense convection

- features defined with TRMM PR

85 GHz PCT

40 dBZ top

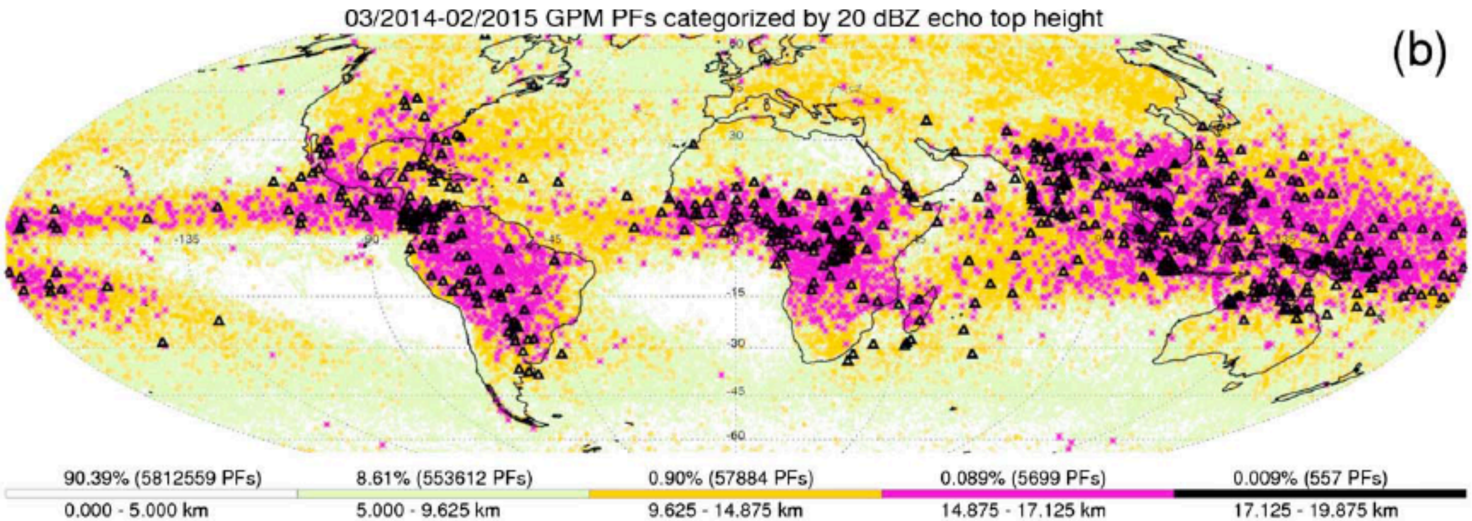
Lightning rate

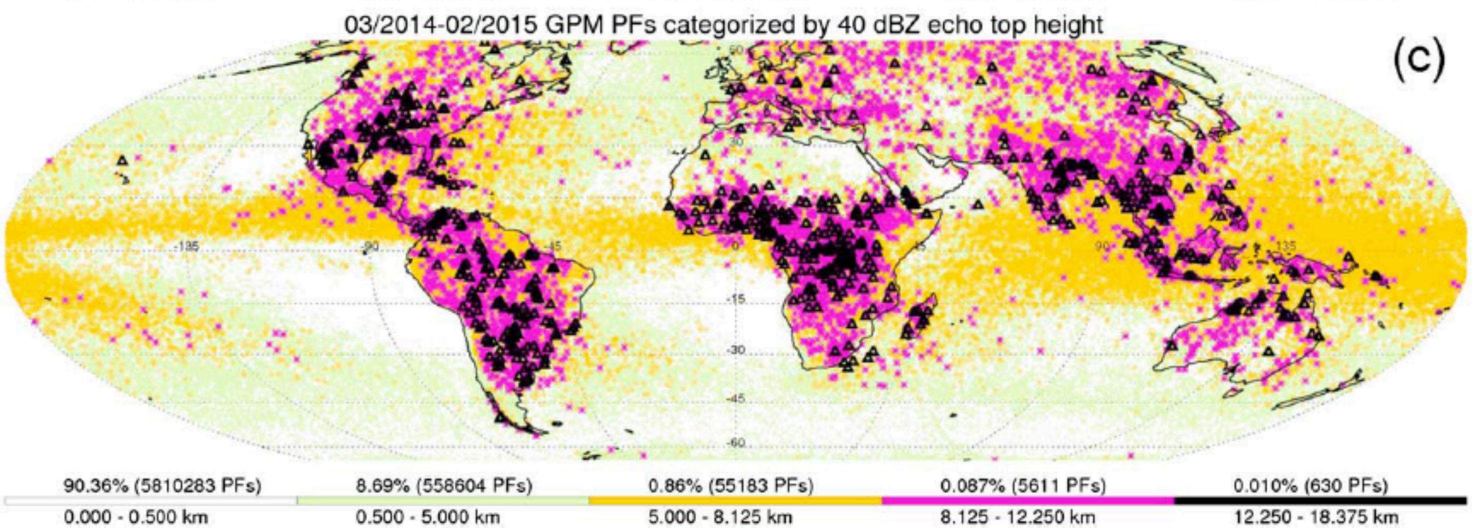


Zipser et al, 2006 BAMS

Global distribution of intense convection

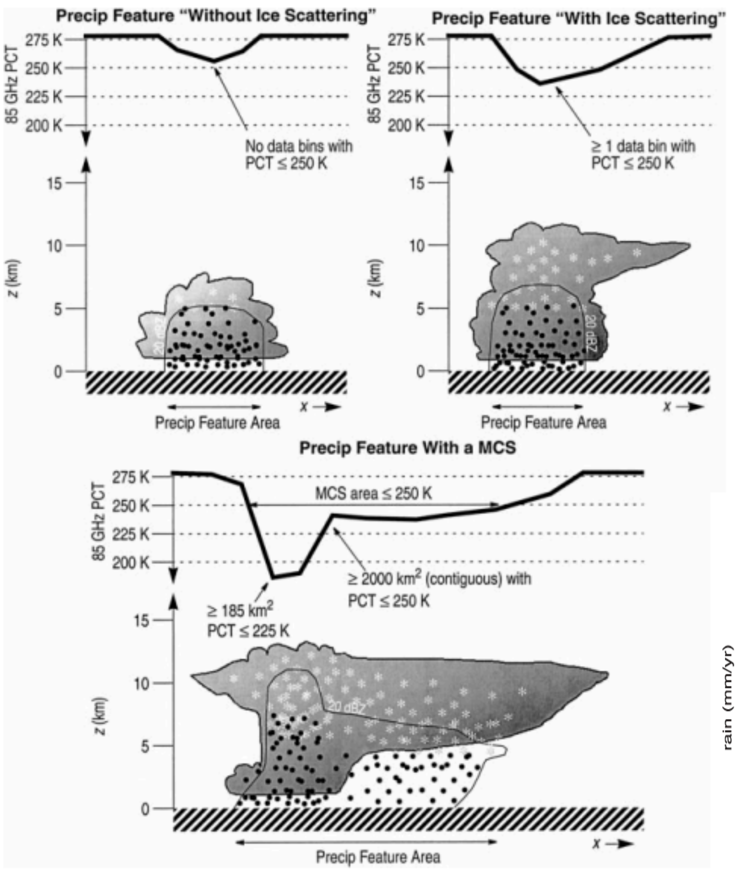
- features defined with GPM DPR

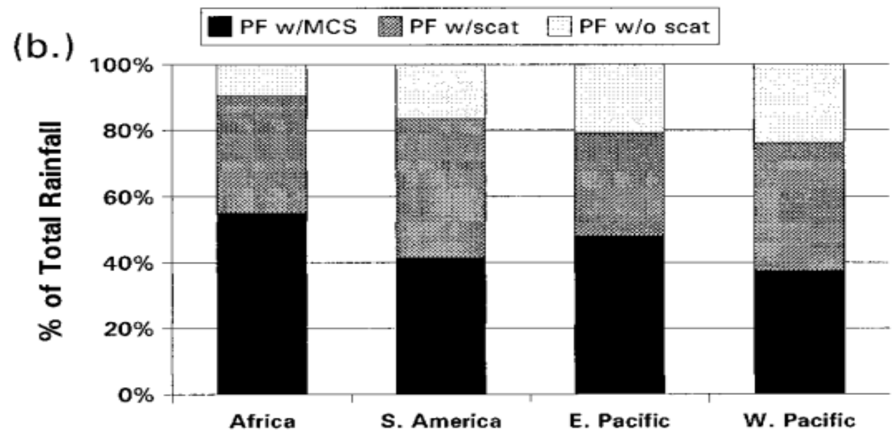


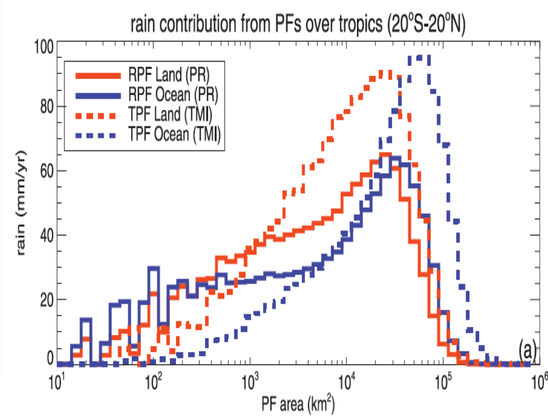


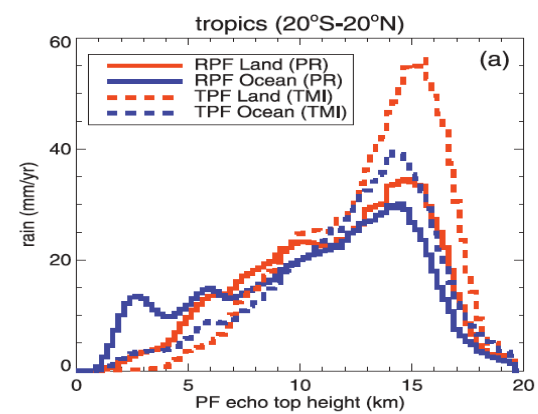
Liu and Zipser, 2015 GRL

Rainfall from various precipitation systems



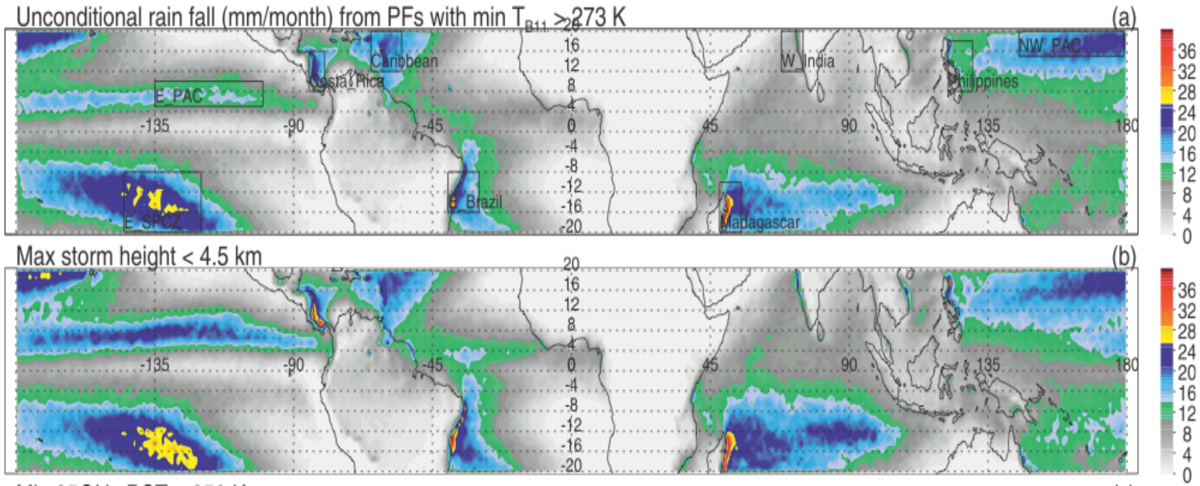






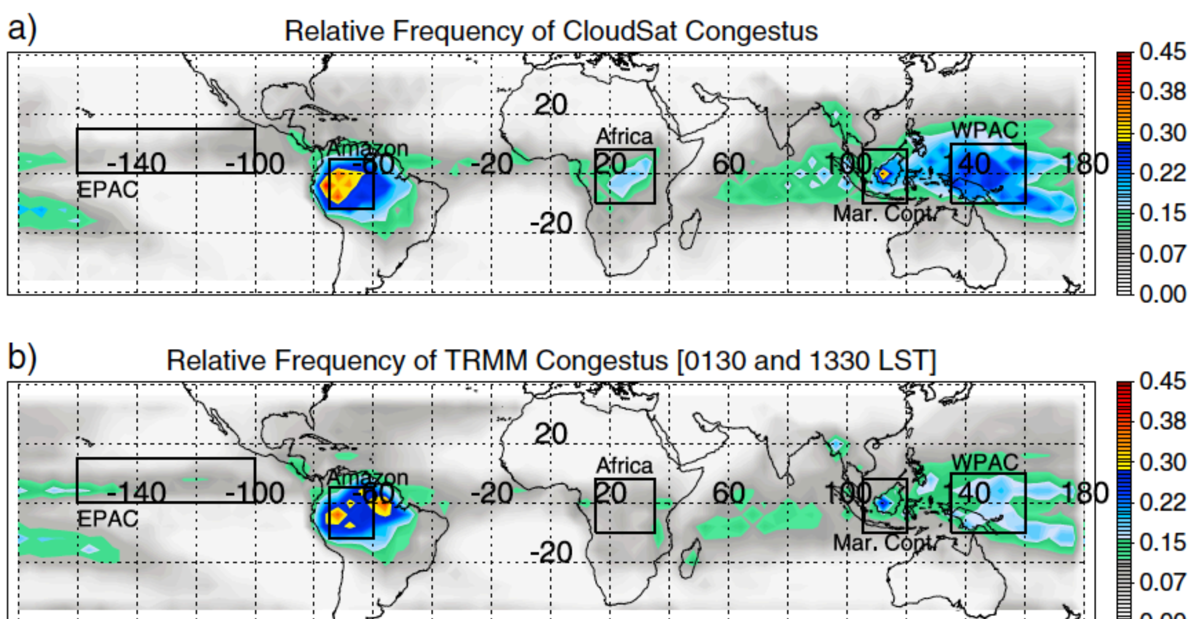
Mohr et al. 1999 JAM; Nesbitt et al. 2000 J. Climate; Liu 2012 J. Hydrometeor.

Warm rain and Congestus



IR warmer than 0ºC

Echo top < 4.5 km

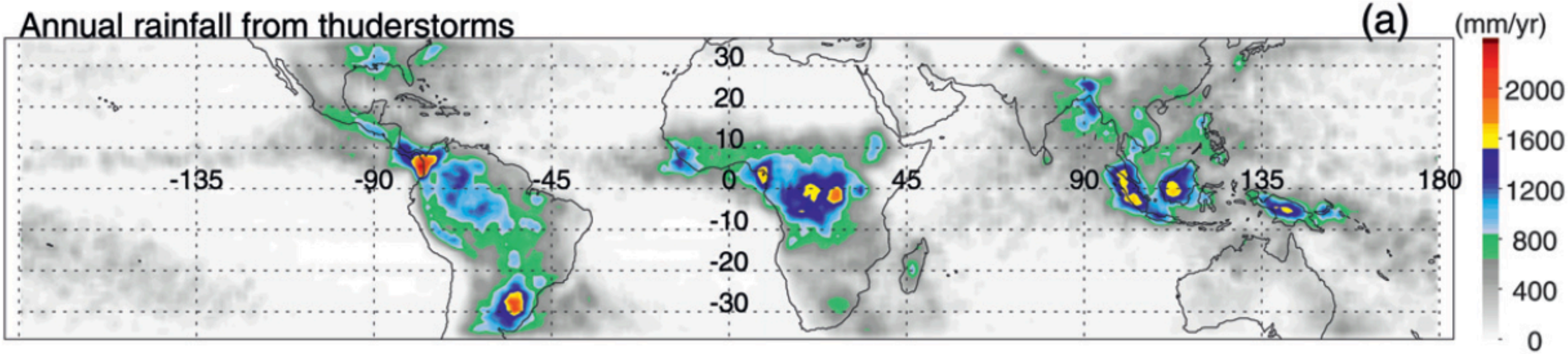


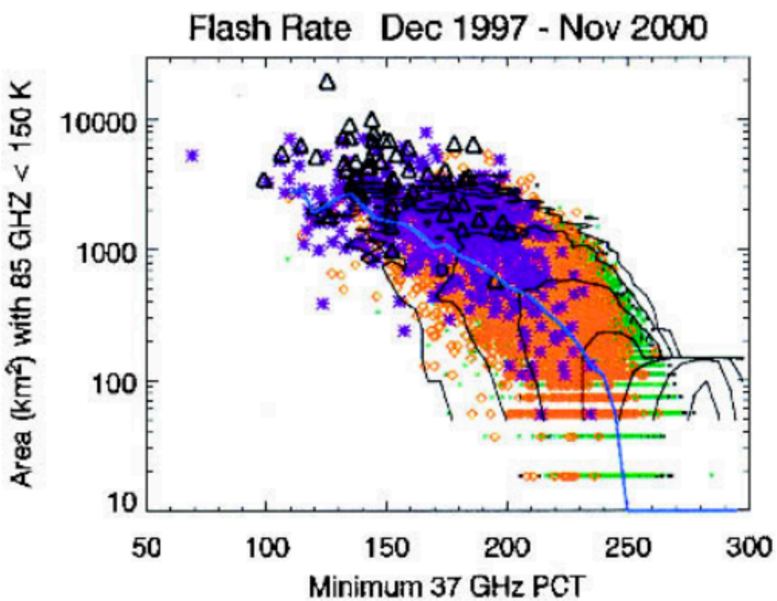
Echo top 5- 8km

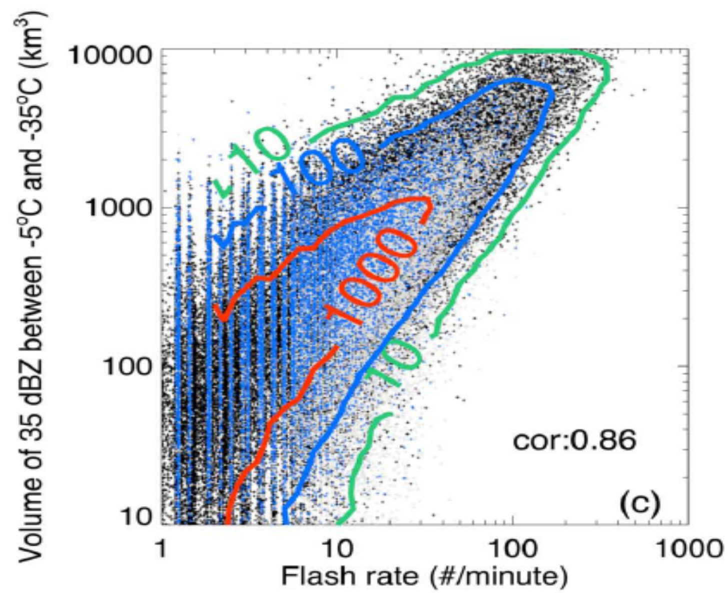
260 K < IR < 273 K + surface rainfall

Liu and Zipser 2009 J. Climate; Wall et al. 2013 JGR

Thunderstorms

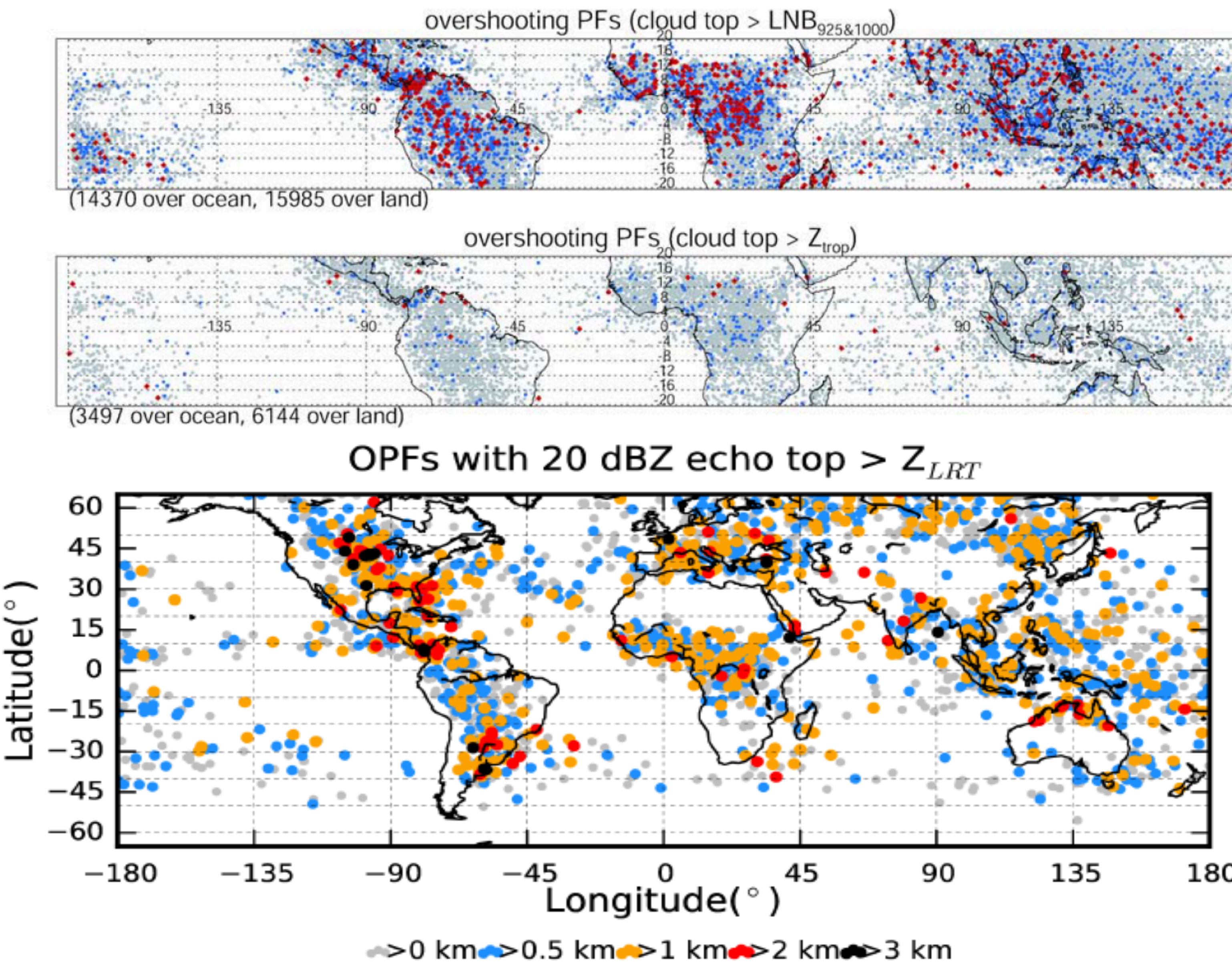






Toricinta et al 2002; Cecil et al. 2005 MWR; Xu et al. 2010 J Climate; Liu et al. 2011, 2012 JGR; Peterson and Liu 2011 JGR; Peterson and Liu 2013 JGR; Bang and Zipser 2015 GRL

Tropopause reaching convection



Liu and Zipser 2005 JGR; Liu and Liu 2016 JGR

Tropical cyclone studies

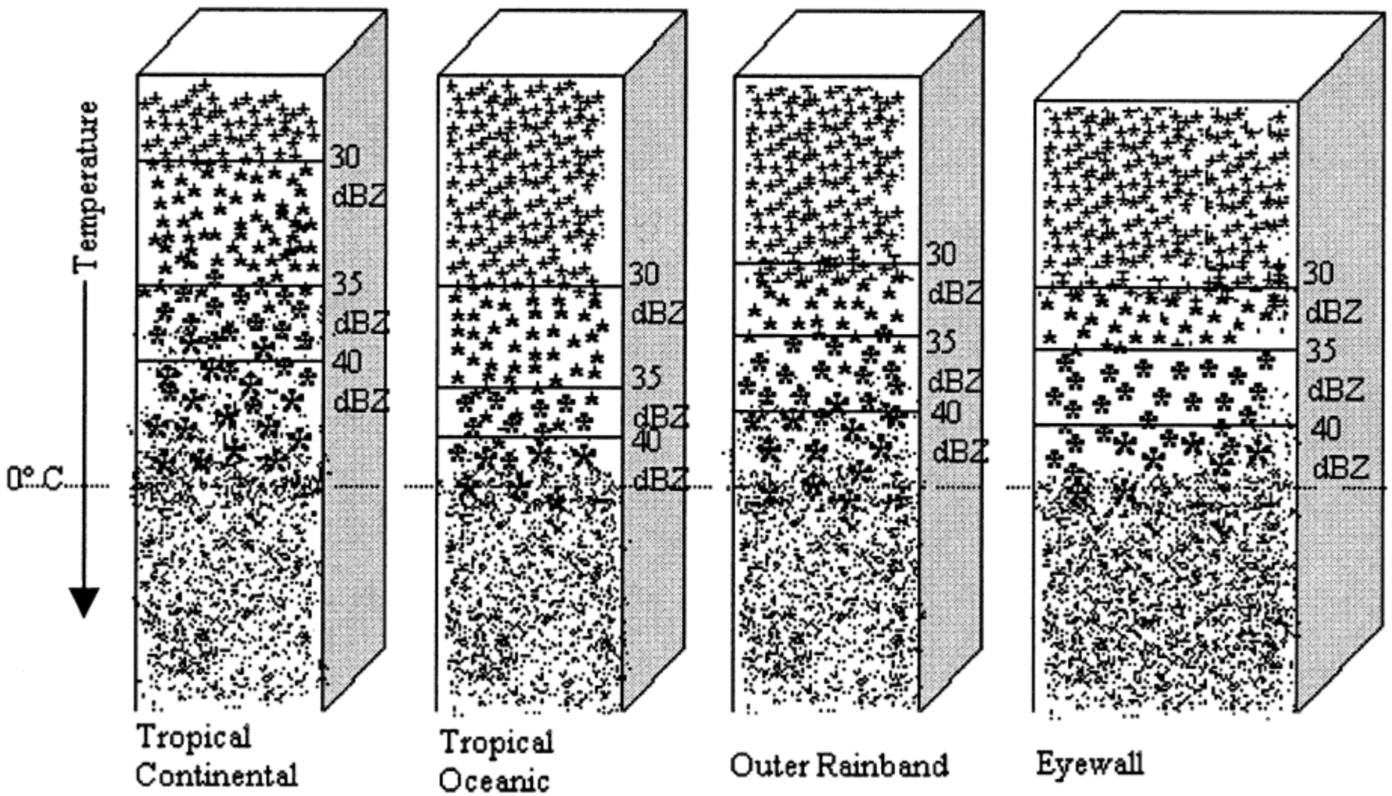


FIG. 16. Schematic depicting vertical microphysical profiles in the convective cores of precipitation features with similar brightness temperatures (~150 K at 85 GHz) from tropical continental, tropical oceanic, outer rainband, and eyewall regions. Dots indicate liquid hydrometeors, and stars indicate frozen hydrometeors with increasing symbol

Cecil and Zipser, 1999 , 2002a MWR, 2002b MWR; Kerns and Zipser 2009 MWR
Jiang et al. 2011 JAMC; Zawislak and Zipser 2014; Susca-Lopata et al. 2015 …

Other research topics

Topics	papers
Regional studies	Wall et al. 2012, J. Hydrometeor (SEUS); Xu et al. 2009, MWR (China) Xu et al. 2012, MWR (TiMREX); Salio et al. 2007, MWR (SALJEX) Varble et al. 2011, JGR (TWP-ICE); Yokoyama et al. 2014 JClimate (EPAC); Chen and Liu 2015 Jclimate (EPAC)
Model Validations	Li et al. 2008 MWR; Zhang et al. 2008 JGR; Varble et al. 2014a 2014b JGR
Precipitation retrieval evaluation	Nesbitt et al. 2004 JAM; Wang et al. 2009 JMSJ; Gopalan et al. 2010 JTech.; Liu and Zipser 2014 JHydrometeor.
Convection vertical structure	Cecil et al. 2005 MWR; Liu et al 2008 JAMC; Liu and Zipser 2013 JGR; Xu and Zipser 2012 GRL
Diurnal variation	Nesbitt and Zipser 2003 J. Climate ; Liu and Zipser 2008 GRL; Xu and Zipser 2011 J. Climate
Aerosol influences	Wall et al. 2014 JAS
Latent heating	Liu and Zipser 2015 JClimate
Morphology of convection	Nesbitt et al. 2006 MWR; Liu and Zipser 2013 JGR
Hail storms	Cecil 2009 JAMC; Cecil 2011 JAMC; Cecil and Blankenship 2012 J Climate;
convective transport water vapor into the tropical stratosphere	Liu 2007 JGR; Liu et al. 2008 GRL; Liu and Zipser 2009 JGR
Global electric circuit	Liu et al. 2010 JAS; Peterson et al. 2015 JTech
…	…

Challenges to come

- **How can we help models with all the knowledge learned in these storms? To go beyond the validation?**

  e.g. relationships between large scale environments and properties of subgrid scale convection

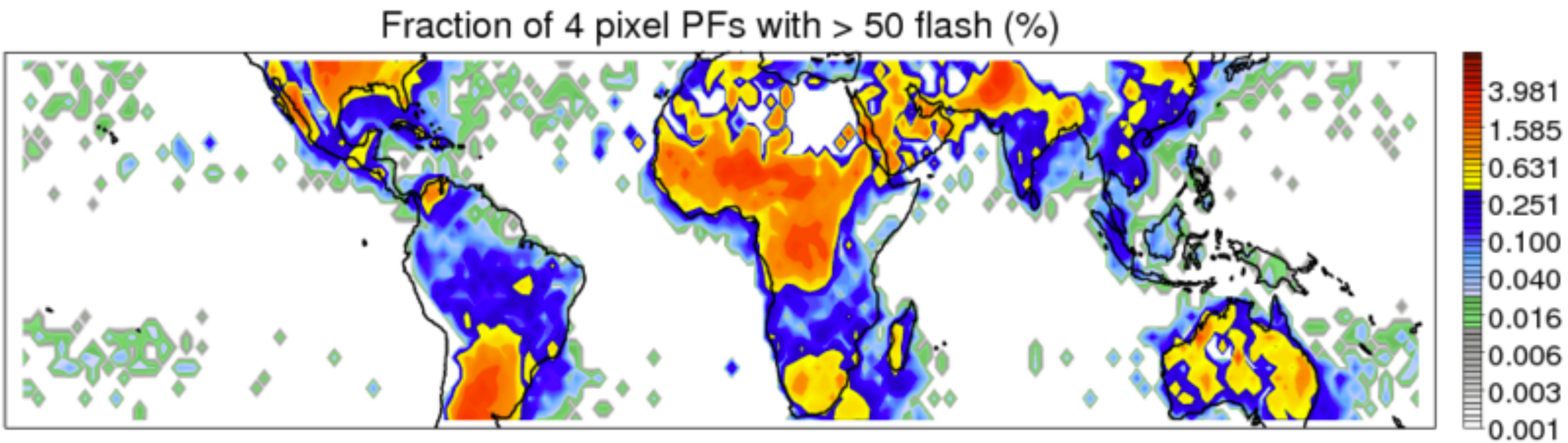
- **With more and more instruments and observations becoming available, how do we utilize all the information together?**

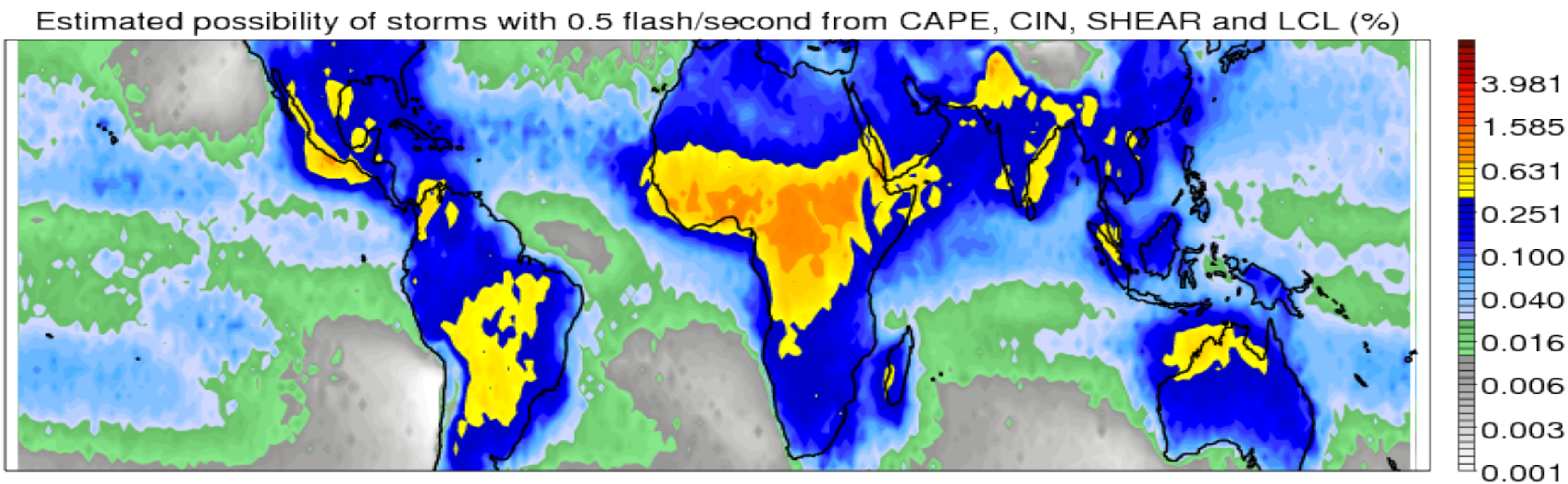
  e.g. Properties of the precipitation features derived from multi-satellites/ resources

- **How do we help the weather prediction, aviation operations?**

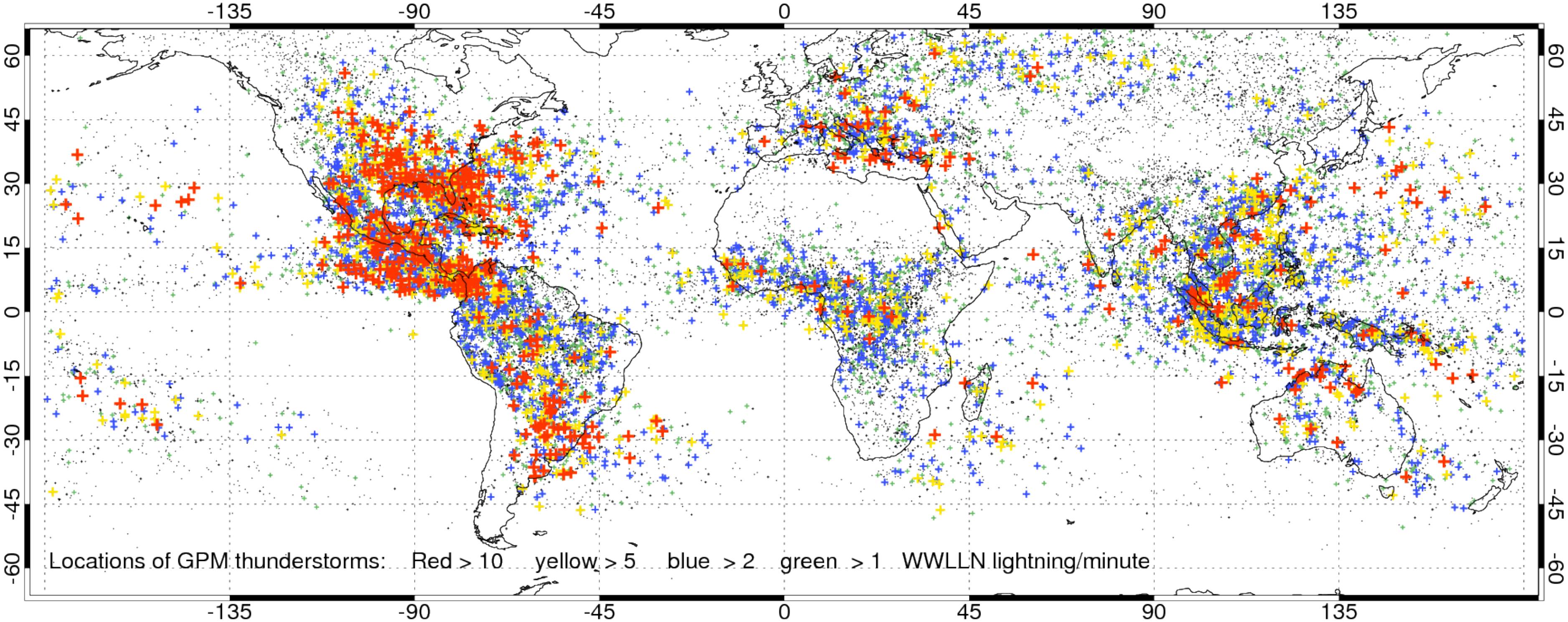
  e.g. Life cycle of the precipitation systems using multi satellites

Why intense storms favor those hotspots?



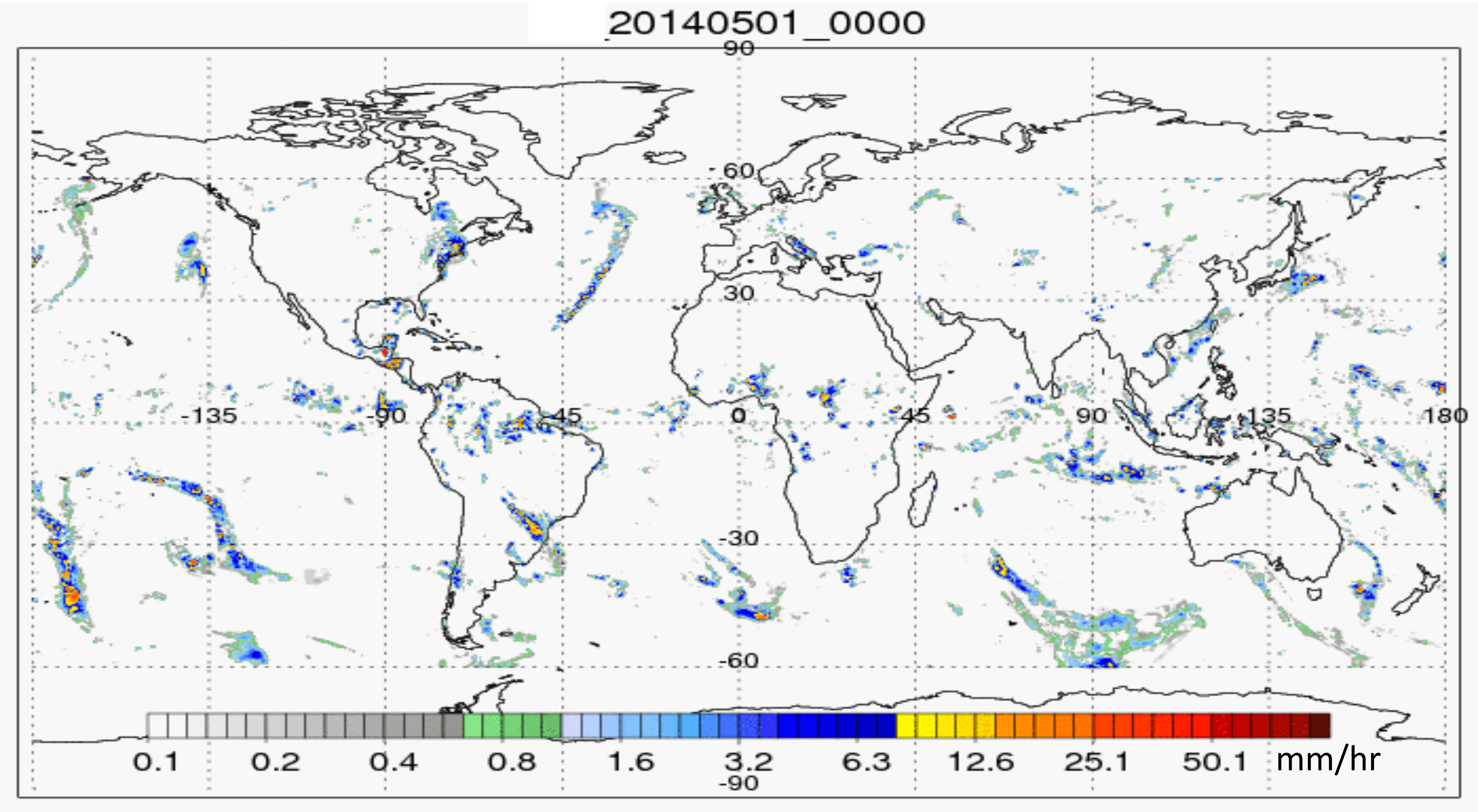


Global distribution of thunderstorms GPM + WWLLN



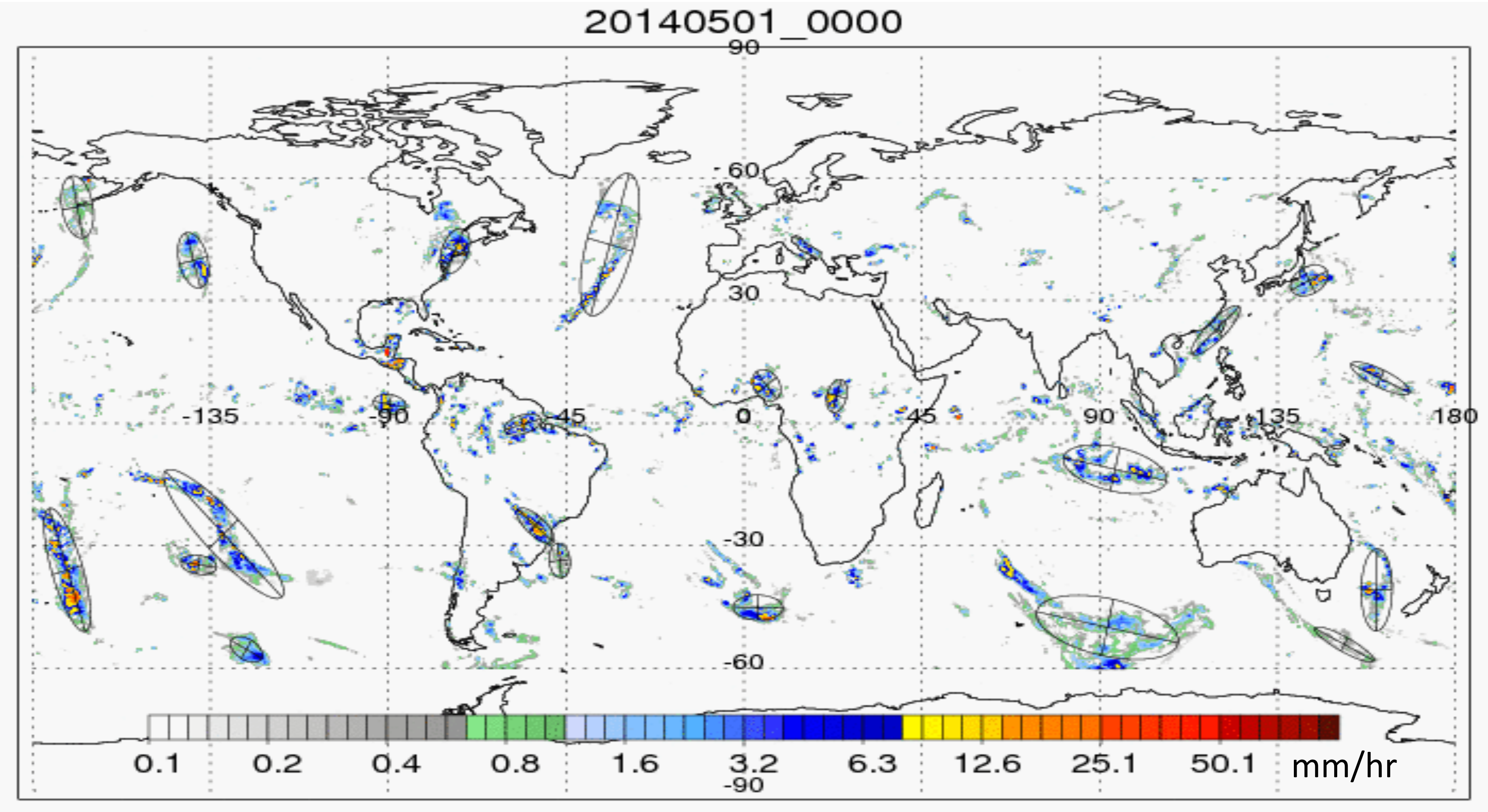
The bias of WWLLN detection efficiency is obvious over central Africa and Pakistan Therefore, we have to be cautious using this dataset in understanding the geo-graphical distributions. However, since we have the information of lightning strike rates before and after PF snapshots, some interesting analysis can be done!

Life cycles of MCSs and mid-high latitude cyclones



GPM – IMERG half hourly, global, 0.1° near real time precipitation

Life cycles of MCSs and mid-high latitude cyclones



GPM – IMERG half hourly, global, 0.1° near real time precipitation

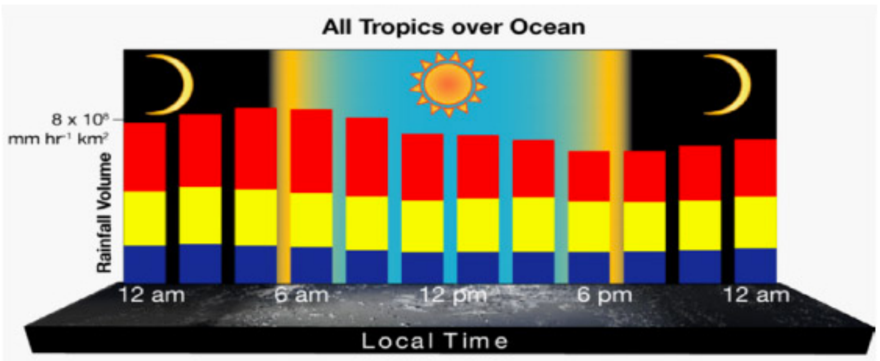
Summary

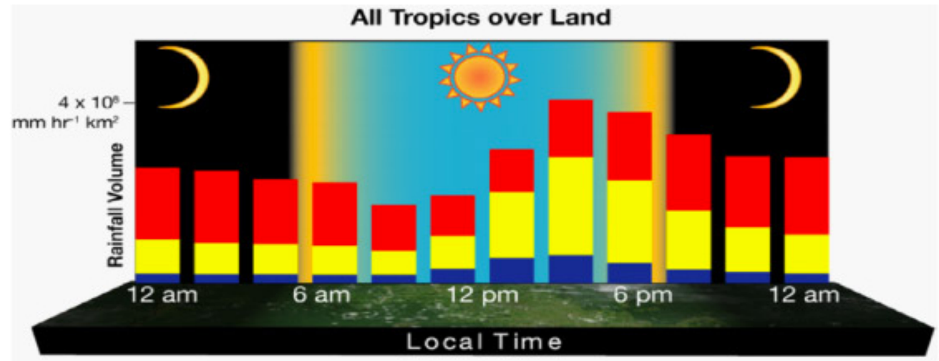
- Precipitation feature database is a great tool
- Ed has been inspirational in past **two decades**
- It is **free**

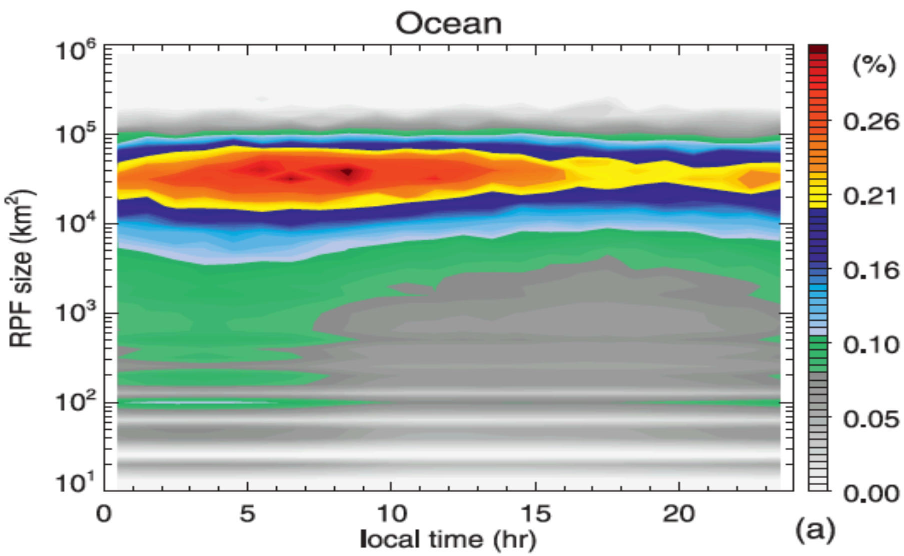
http://atmos.tamucc.edu/trmm/

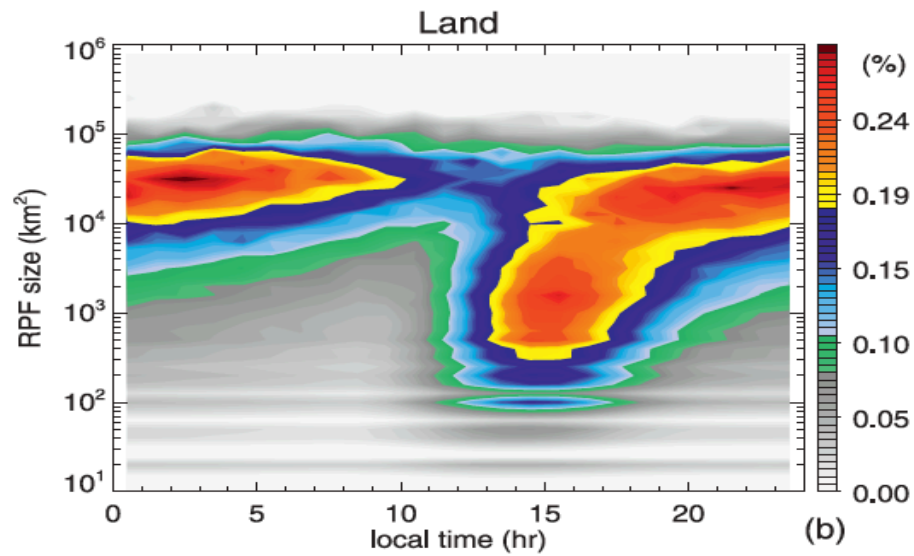
http://trmm.chpc.utah.edu/

Diurnal cycle





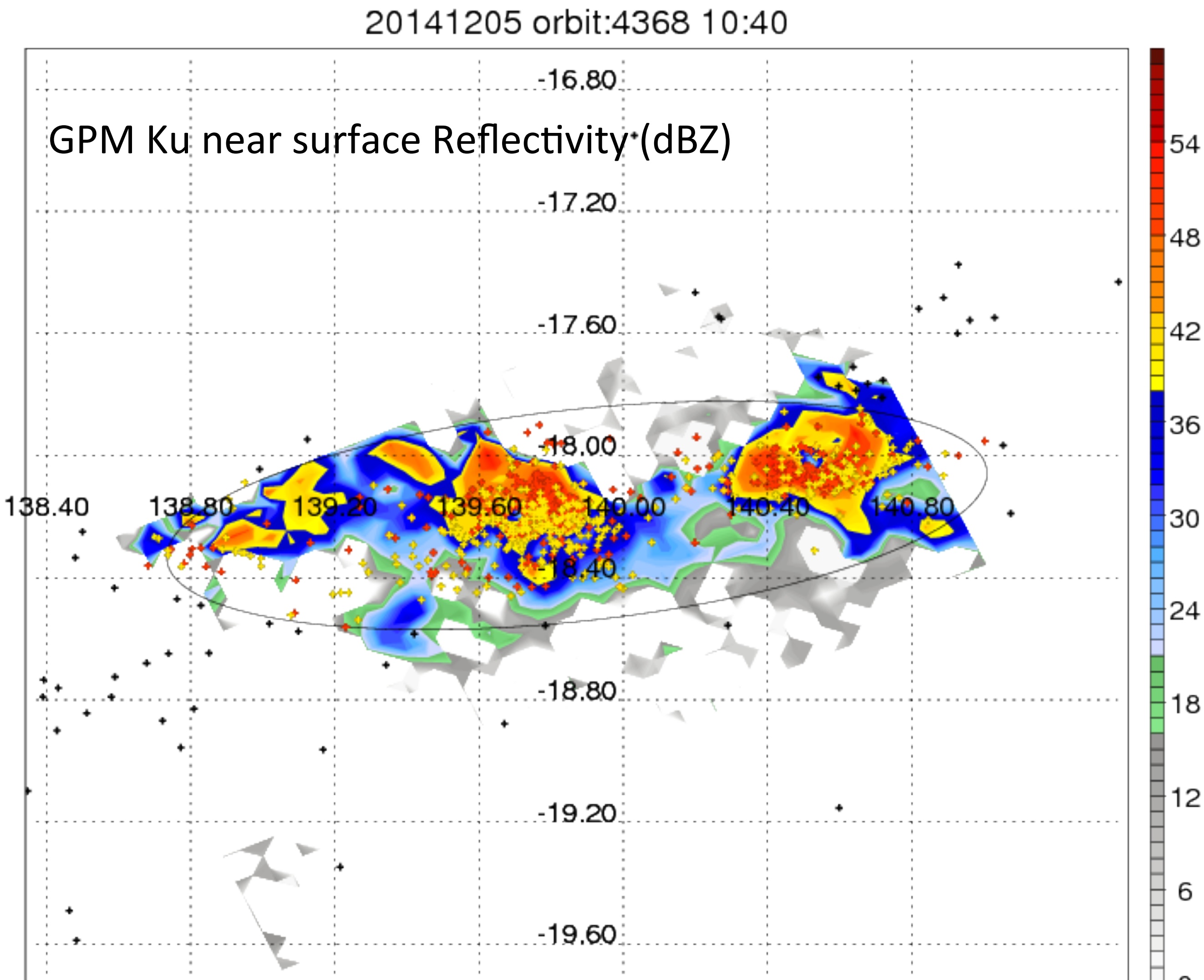




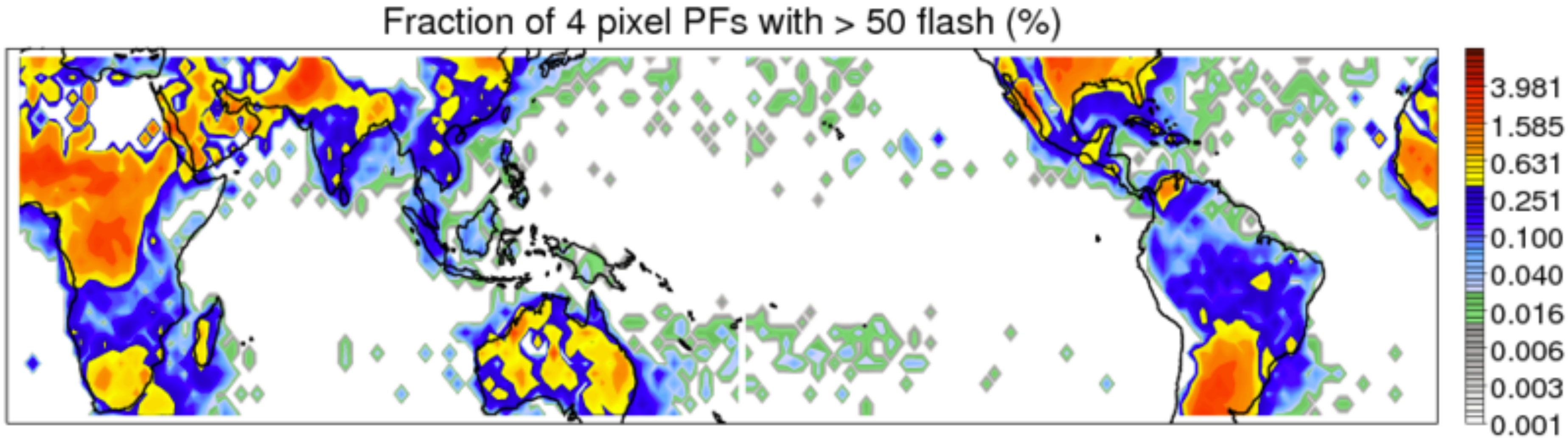
Nesbitt and Zipser 2003 J. Climate ; Liu and Zipser 2008 GRL; Xu and Zipser 2011 J. Climate; …

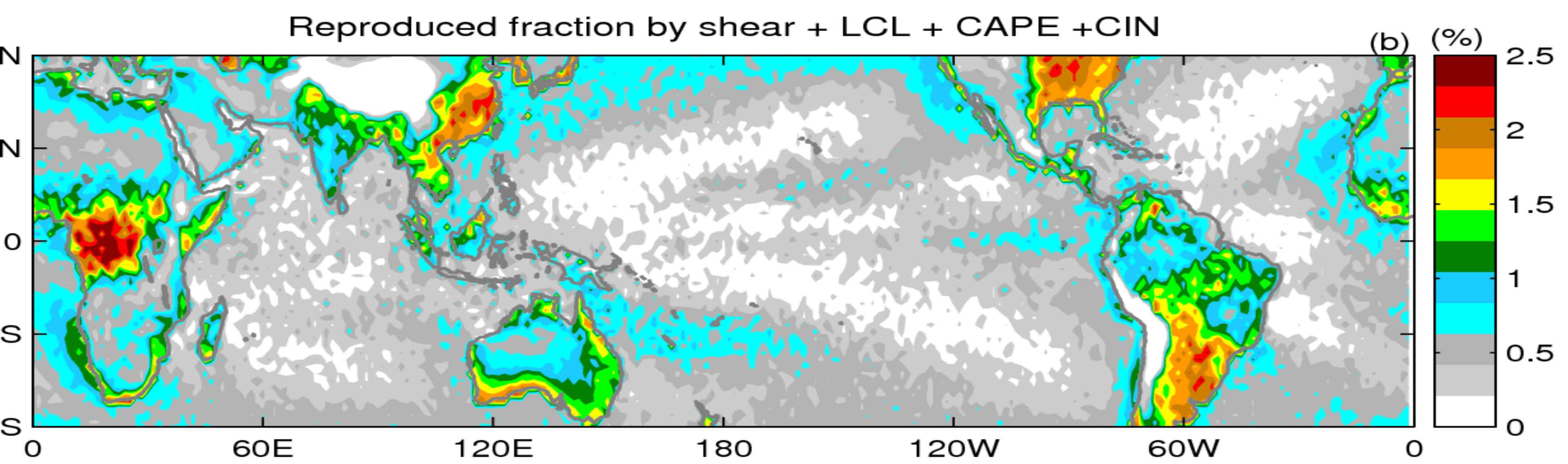
Thunderstorms GPM + WWLLN ...+GLM?

- Collocate PFs with WWLLN lightning strikes



Why intense storms favor those hotspots?





Global distribution of intense convection

- first look from space using passive microwave radiances

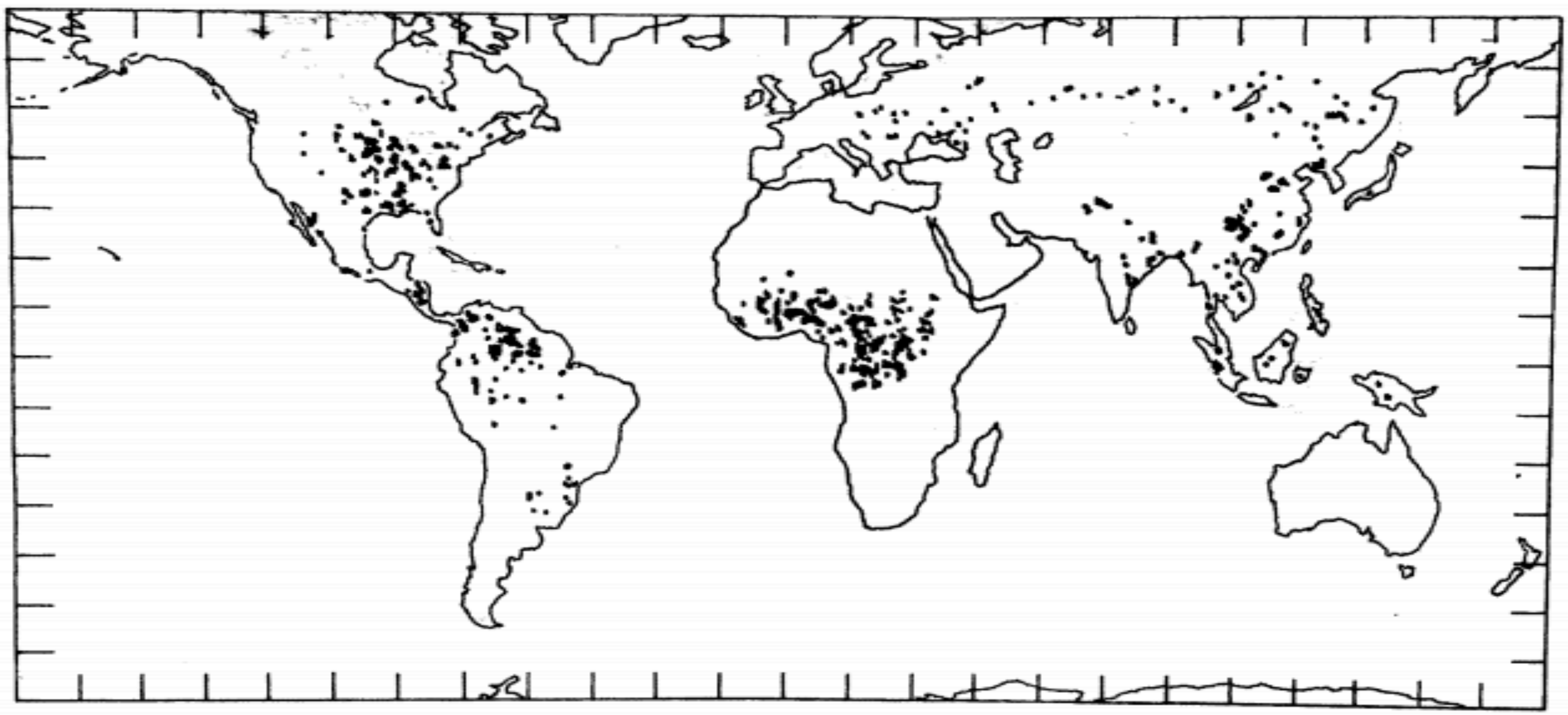


FIG. 2. The global distribution of SMMR-observed intense convective signatures over land during 1 June–31 August 1980, based upon the screening procedure presented in Table 1.

Nimbus-7 SMMR   Spencer and Santek, 1985 JAMC

TRMM Tropical cyclone database

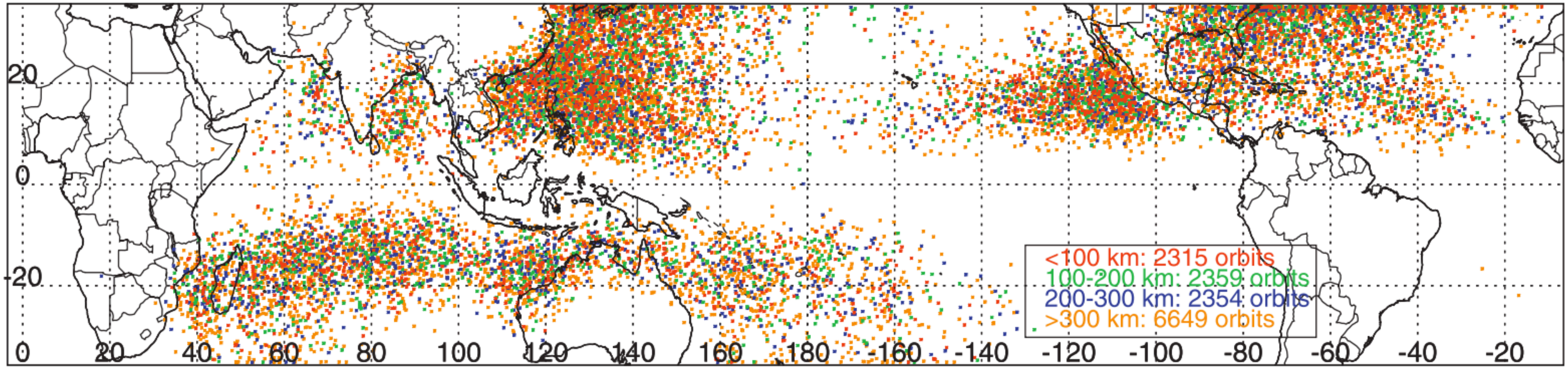


FIG. 3. Geographic distribution of TC observations from 1998 to 2009 in the FIU–UU TRMM TCPF database. Distances between TC center and the TRMM swath center are indicated in color.

Jiang et al. 2011 , JAMC

More details see Haiyan's talk