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The evolution and extratropical transition of tropical cyclones from a GPM, ISS LIS and GLM perspective

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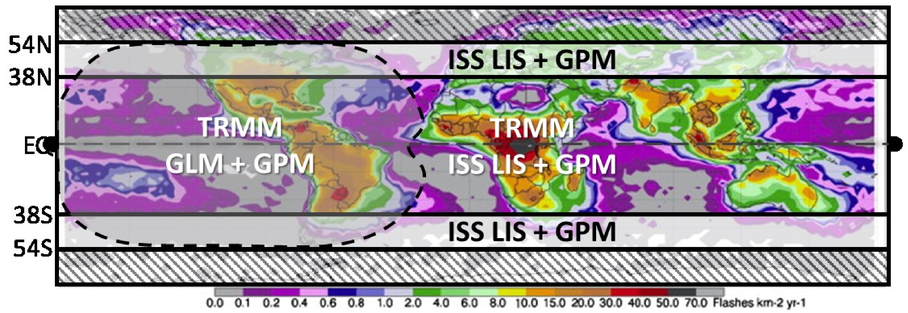
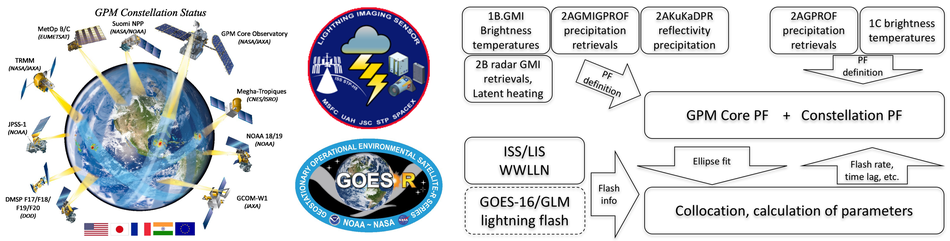
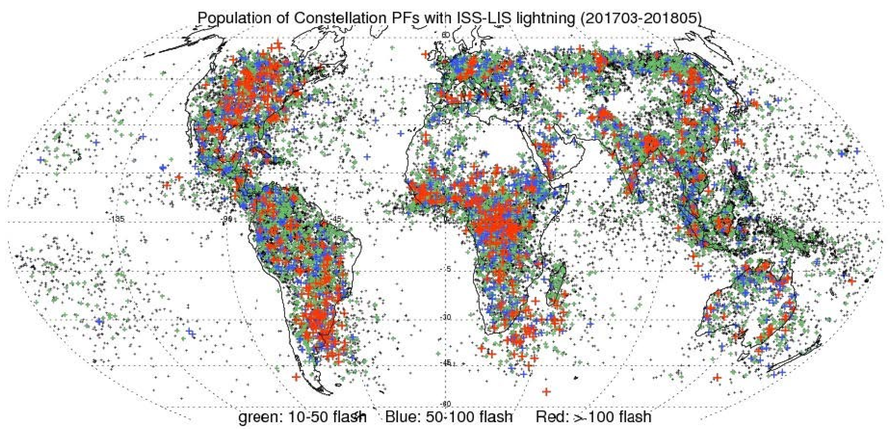
Abstract. Not much is known about the evolution of lightning within extra-tropical cyclones traversing the mid-latitudes, especially its oceans. To facilitate such studies we combine a recently constructed precipitation features (PF) database obtained from the Global Precipitation Measurement (GPM) mission constellation of satellites with lightning observations from the Geostationary Lightning Mapper (GLM) onboard GOES-16 and the Lightning Imaging Sensor (LIS) onboard the International Space Station (ISS). The goal of this study is to provide a new observationally-based view of the tropical to extra-tropical transition and its impact on lightning production. Such data fusion approaches, as presented here, will also be important in future satellite studies of convective precipitation.

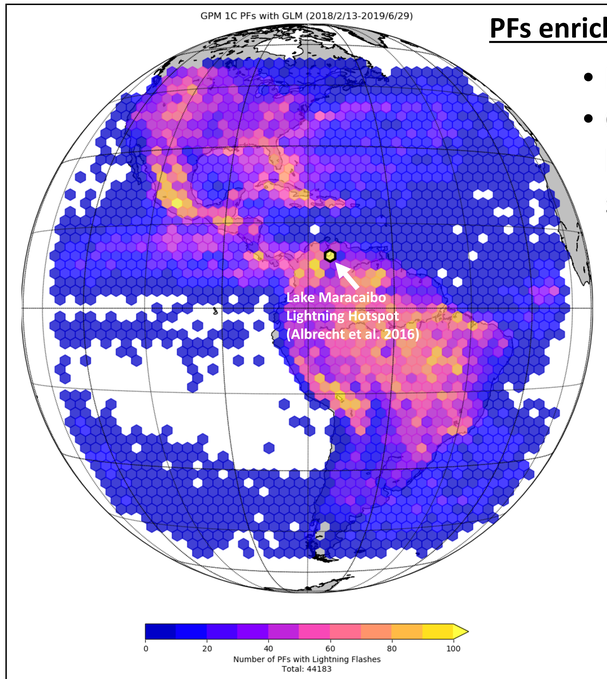
Overview Lightning-enriched PF database





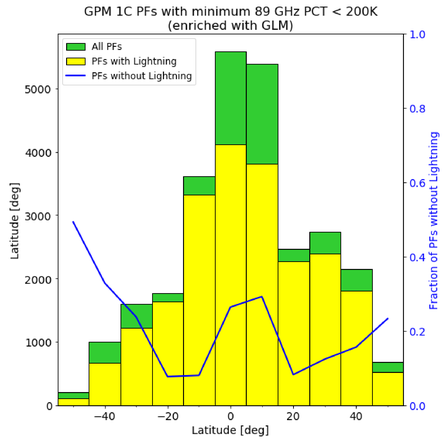


0.05% of GPM GMI/AMSR2 1C PFs have at least one ISS-LIS lightning flash



PFs enriched with GOES-16 Geostationary Lightning Mapper

- Facilitates storm-scale evolution
- Greatest number of GPM 1C PFs with lightning observed by GLM occurred in northwestern South America and southwestern Mexico (Feb. 2018 to June 2019)



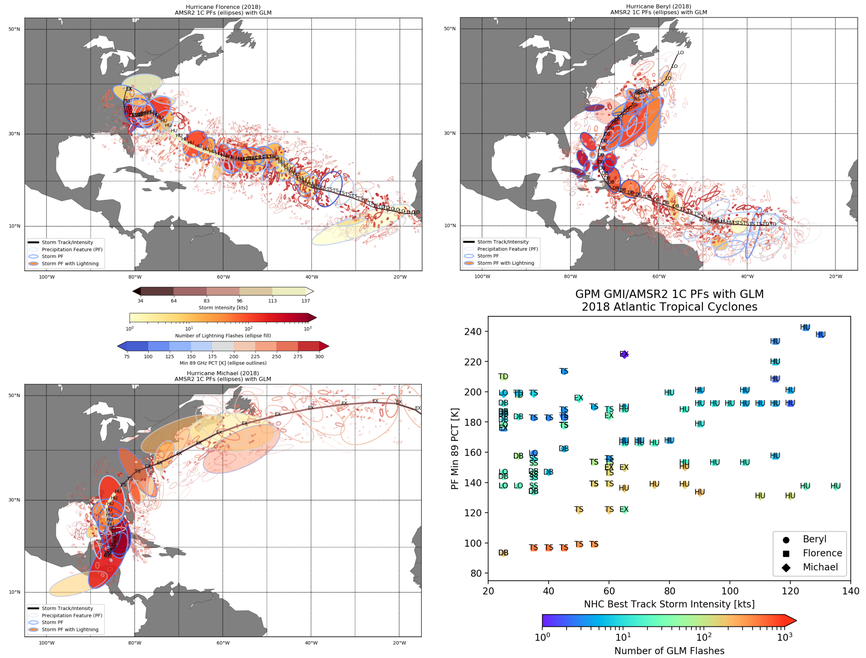
- PFs with 89GHz PCT<200K highly expected to have lightning (Liu et al. 2011)
- Only 78% of them have GLM observed lightning
- Enhanced in tropics and high mid-latitudes
- GLM detection deficiencies near edges of FOV and low altitude flashes obscured by deep clouds

Tropical Cyclone Season of 2018

- 17 named tropical storms in the Atlantic Basin
- Hurricane Michael reached category 5 and caused over $25 billion in damage
- AMSR2 observed 2x the number of PFs as GPM (nearly ½ the swath width)
- Increase in number of PFs during transitioning phases
- PFs with most lightning observed in Tropical Storm Florence
- No clear relationship between storm intensity and PF characteristics*

Storm Name	Total PFs (AMSR/GMI)	PFs with lightning (AMSR/GMI)
Beryl	1973/1284	289/165
Florence	2419/1574	319/175
Michael	856/466	120/67

**Based on initial results*



Ongoing work: deeper dive into 1C PFs; use other global lightning observing networks; convective precipitation features

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