**Background**

- The radial distribution of lightning in tropical cyclones (TCs) is often characterized by the following (Molinari et al. 1999): 
  1. A weak maximum in the eyewall region (<100 km) 
  2. A minimum extending 100 km beyond the eyewall (moat) 
  3. A strong maximum in the outer rainbands (~210-290 km)

- The azimuthal distribution of lightning in TCs depends strongly on the deep-layer vertical wind shear (Corbino and Molinari 2002, 2003), to where environments with shear exceeding 5 m s\(^{-1}\) are characterized by the following: 
  1. In the inner core (<100 km), lightning peaks downshear left 
  2. In the outer rainbands, lightning peaks downshear right 

- Recent studies have found differing results on the link between lightning activity and intensity trends in TCs: 
  - Increased lightning activity precedes intensification (Price et al. 2009; Pan et al. 2010, 2014) 
  - Increased lightning activity precedes weakening (DeMaria et al. 2012; Thomas et al. 2010)

**WWLLN**

- The World Wide Lightning Location Network detects the very low frequency (VLF) wave bands of lightning strikes via Earth-ionosphere waveguide propagation, allowing detection several thousand of kilometers away 

- WWLLN consists of over 70 sensors spread out around the globe: 

- Global lightning detection efficiency is thought to be around 10% (Abarca et al. 2010), with detection efficiency highest over the oceans (Rudlosky and Shea 2013)

- Abarca et al. (2011) showed WWLLN captures the spatial structure of lightning in TCs despite the low detection efficiency

**Intensity Changes**

**Inner Core (IC) Lightning**

- Larger flash densities in weakening TCs vs. intensifying TCs in TDDS and HH12
- The IC lightning and intensity change relationship may be controlled by the location relative to the radius of maximum wind (RMW):
  - Inside the RMW → intensification by warming the core 
  - Outside the RMW → weakening by compensating subsidence over the core & broader heating profile

**Outer Rainband (OR) Lightning**

- Flash densities in the OR are much less than in the IC 
- Larger flash densities in intensifying TCs vs. weakening TCs in TDDS (East Pacific) and HH12
- Hypotheses suggest strong convection in OR could weaken (or intensify) TCs

**References**


This research was conducted under NASA Award NNH12AJ81G.

For more information on the case study of the lightning in Hurricane Earl (2010), please see our journal article: