R-Cliper (Rainfall Climatology and Persistence) Model

- Considers:
    - Storm radius/size
    - Wind intensity
    - Radial distribution of rainfall
- Assumes symmetric, neglects topography/landmasses

TCR (Tropical Cyclone Rainfall) Model

- Considers effects of:
    - Surface frictional convergence
    - Vortex stretching
    - Topography
    - Baroclinity
- Simplified from MSR

MSR (Modified Smith Rainfall) Model

- Improved azimuthal [symmetry] rainfall estimates
- Only for open-water/near-water

PHRaM (Parametric Hurricane Rainfall) Model

- Rcliper + shear + topography (parametric representations)
- Incorporates rainfall asymmetry
    - Adds an azimuthal fourier decomp (shear)
    - Adds low-level gradient of ground elevation (topography)
- Shear introduces time dependence/difference
- Based of avg statistical behavior
    - Fails at strong asymmetries

Rule of Thumb (basic models)

- Model rainfall using only storm speed+size

IPET (Interagency Performance Evaluation Task Force Rainfall Analysis)

- Measures mean rainfall intensity
- Considers: (depends on landfall location, intensity, angle of approach, storm size, forward speed)
    - Storm position
    - Time
    - Radius of maximum winds
    - Central pressure deficit

P-Cliper (PDF Precipitation Climatology and Persistence) Model

- R-cliper, additionally considers departure from the average rainfall intensity (frequency)

Eventually want to use ^ in hazard model

GFDL (Geophysical Fluid Dynamics Lab) Model

- Higher pattern correlation w obs than R-CLIPER
- More so for track forecasts, less so for intensity forecasts

- Multiple nested system?
- Need high resolution since TC produce highest rainfall over small areas over land
- Bias score = # forecasts/observations??
- Equitable threat score = #successful loc??

- Overpredicts low amts of rain (more biased than R-CLIPER, better at position?)
    - Similar mean rainfall errors
- Didn't explain much spatial variance
- HIGH BIAS

- MEASURES OF SKILL (how good a model is)

TRMM (Tropical Rainfall Measuring Mission) data

- Uses: microwave imager (TMI), precipitation radar (PR), visible&infrared radiometer system (VIRS)
- Tc location, intensity, speed, direction of motion every 10 secs
- Radius of 500 km (bad data coverage beyond)
- Over ocean – underestimates rain over land
- Lots of missing data -> interpolation (linear?)

- Cat12, cat35, TS storms (34-48m/s, >49m/s, 18-33m/s wind speed respectively)

- For each 10km wide annulus, used first order fourier coeff to represent/measure asymmetries (spatial, relative to **storm motion**) — smaller asymm @ center
    - In future study relative to shear
- Construct PDFs (inputs: TC intensity, location)
    - Analyzed to compare TRMM distributions w previous studies
        - Generally agrees, doesn't w smaller rain rates (maybe due to resolution of TMI)
- Frequency distribution to rainfall to estimate quality of TMI observations

2004 paper

- asymmetries greater in weaker storms (tropical storms)
- Stronger storms are more symmetric