Theory (21 November 2023)

Predictors based on literature:

- Sea surface temps over Atlantic main development region and Atlantic subpolar gyre region
- Could determine periods either using spectral analysis???
- QBO is often used on seasonal time scales but could try to put in our model for decadal

Literature notes

Takaya et al. (2023 WOW): Recent advances in seasonal and multi-annual tropical cyclone forecasting

- ENSO less used as prediction has progressed as it is not always a useful predictor
- ENSO neutral hurricane season: Rossy wave breaking (RWB) and Indian Ocean Dipole
- RWB: impact on vertical wind shear over MDR (shear increases on the "downstream slope of midlatitude high potential vorticity streamers that penetrate tropical environment"
- Criticisms: "A common issue in constructing statistical models is the selection of model predictors, which is usually done by choosing parameters based on correlation scores. Often correlations between ENSO and climate predictors are no more significant than those produced with time series of pairs of Gaussian noise. The shortness of the instrumental record can suggest swings in model predictands may be correlated with low-pass-filtered modes of climate variability, but they may just reflect the typical stochastic nature of random processes (Gershunov et al. 2001)."
- OVERVIEW OF MULTI-ANNUAL FORECASTS :D
    - Proxy index using multi model esemble of GCM is base don relative difference between MDR SST and SST over entire tropicas has been shown to correlate with various measures of TC activity
    - Atlantic Multidecadal Variability – through tropical SST anomalies it modulates TC activity

Lee et al. (2012): Muti-decadal variations of ENSO, the Pacific Decadal Oscillation and tropical cyclone in the Western Pacific (bummer)

- Used empirical model decomposition (EMD) and Hilbert spectral analysis to determine influence of Multivariate ENSO index (MEI) and PDO on TC activity in WPAC
- 13 and 32.5 years from MEI and 16.7 and 32.8 years from PDO
- 15 and 37 year time scales of low frequency multi decadal oscillation of intense (cat 4 and 5) TC occuracne

Chang and Wang (2019): Multi-Year Hybrid Prediction of Atlantic Tropical Cyclone Activity and the Predictability Sources

- Study built Hybrid statistical-dynamical model:
    - SST averages over Atlantic main development region (MDR) and Atlantic subpolar gyre region (SPG) and skillfully predicts TC frequency (among other things)

    - SPG SST more important than MDR (because better AMOC prediction) and is associated with vertical wind shar and precipitable water over tropical Atlantic
- MDR SST: chosen based on "thermodynamic consideration" that is: warmer SST → tropospheric warming → destabilizing of atmosphere → convection → more TC activity
- Importance of SPG SST emphasized in studies by Smith et al. (2010) and Dunstone et al. (2011)
- Vecchi et al. (2013) and Caron et al. (2014) used MDR SST and tropical mean SST to predict Atlantic hurricane frequency
- SPG where Atlantic multidecadal oscillation is – largest low-frequency SST variance
- AMO also modulates tropical SST, SLP, vertical wind shear, tropical precip, low level vorticity and low tropospheric convergence on decadal to multidecadal time scales
- AMO tied to AMOC – also suggested to be driven by NAO (Meredith addition: NAO used as seasonal prediction by National Weather Service US) – but AMO physical mechanisms are topic of debate
- DATA: SST from initialized Community Earth System Model datasets (sources in paper)
- Chosen predictors based on pearson correlation coeff b/t TC freq and SST obs at every grid point (also looked at N Pac SST and Niño-3.4)
- Poisson regression model
- PHYSICAL EXPLANATIONS FOR PREDICTORS IN HERE

Gray 1993: Seasonal predictions of Tropical Cyclones (*could be interesting to connect to decadal if we wanted*)

- Gray 1984a,b: use seal level pressure anomaly (inverse relationship b/t anomaly and activity: indicative of presence of ITCZ) and 200 mb zonal wind anomalies (proxy for wind shear and affected by ENSO) over Caribbean basin and whether or not it is a warm ENSO year
- Gray et al 1992a: previous year's rainfall over W. Africa
- QBO: east phases shown to suppress activity and west phases shown to enhance (Gray 1984a and Shapiro 1989)
- West African SLP and temp gradient (difference between interior and coastal regions): affect rainfall and TC activity