The Atlantic coastal US had a 12-year period without hurricane landfalls of major intensity until Hurricane Harvey in 2017. Harvey is known as one of the costliest tropical cyclones on record, tied with Hurricane Katrina.

**MOTIVATION**
- How has the overall rate of movement from starting location to ending location changed with time?
- Are hurricanes moving further North?
- What factors led to the 12-year period between major hurricane landfalls?
- What environmental factors contribute to the changes over time?

**DATA DESCRIPTION**
We utilize satellite data in the form of NetCDF, recorded daily at 6-hour intervals from NASA Modern-era Retrospective Analysis for Research and Applications (MERRA 2) and Japanese Meteorological Agency – 55 year Reanalysis Data (JRA). We also combine the National Hurricane Center’s North Atlantic historical hurricane data (HURRDAT2).

**APPROACH**
To analyze hurricane movement we model the overall average movement rate (the rate at which a hurricane moves from starting point to finishing point, across the map, in miles per hour) for each hurricane as a function of time (seasons). We can then make inference about the changes in rate over time.

**Models**

**Model 1:**
Let $y_j$ be the overall average movement rate of hurricane $j$ in season $t$. Then let $θ_j$ be the average rate of hurricane movement for all hurricanes in season $t$, $t = (1980, ..., 2017)$. We set up a Bayesian hierarchical model to explore the changes in average rate across each year.

$$y_j | θ_j, σ^2 ∼ N(θ_j, σ^2) \quad t = 1, ..., T; j = 1, ..., m_2$$

$$θ_j | μ, τ^2 ∼ N(μ, τ^2)$$

$$σ^2 | ϕ_0, ϕ_2 ∼ IG(ϕ_0, ϕ_2)$$

$$μ ∼ N(μ_0, ω).$$

We have assigned conjugate priors and select hyperparameters $ϕ_0, ϕ_2, ω, α_j, β_j$ so that $θ_j$ reflect the data. We apply a Gibbs sampling algorithm to draw from the full posterior distribution.

**Model 2:**
Note that model 1 relies on the hurricane count for each year, $m_t$. Thus, we also seek to analyze the changes in hurricane counts over time. Let $m_t$ be the total hurricane count for hurricane season $t$. Let $λ_t$ be the rate of hurricane occurrence for season $t$.

$$m_t ∼ Pois(λ_t) \quad t = 1, ..., T$$

$$λ_t ∼ Gamma(α, β)$$

We assign non-informative values to $α, β$ and $α$ and apply a Gibbs sampling algorithm to explore the posterior distributions.

**CONCLUSION & FUTURE WORK**
We hope to explore the factors contributing to the decrease in the overall average movement rate (Figure 4) by incorporating pressure, wind speed, El Niño-Southern Oscillation Index, and other variables. From figures 5-6, predicting a year in which an abnormally high number of hurricanes occurs, such as in 2005, would be useful.