Discussion: Simulation and Extremal Analysis of Hurricane Events by Edward Casson and Stuart Coles

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Overview

- What data set is used for generating hurricane simulations?
  - Best Track Data set.
  - What is in this data set?
  - When did pressure data become available?
  - What is the limitation of this data set?
- What steps are used to generate hurricane tracks (Summary on page 238).
  1. Track Simulation
  2. Pressure Template Applied (Time Scaled)
  3. Minimum Pressure (minp)
  4. Rescale Pressure up to landfall then use Kaplan-DeMaria
  5. Sample Rmax (fixed quantile) and Calculate Wmax

Questions on Procedure

- What assumptions are involved in this procedure?
  - Independence of each step from the other.
  - Assumption of linear scaling for time series and pressures.
  - Reasonable conversion of Wmax to pmin for many records in Best Track.
  - Validity of using GEV distribution for pmin.
  - Others?
- What is the implications in linearly scaling historical pressure series time axis and pressure values?
  - Does not affect procedure for land falling storms.
  - Does affect storms that come close to coast but do not make landfall.
  - Does affect simulated intensification rates.

Extreme Value Theory

- How is extreme value theory used to estimate pmin?
  - $P(\Delta(p) < x) = \exp[1+\xi(x-\mu)/\sigma)_+]^{-1/\xi}$
  - Regression Equations, for landfalling and over ocean storms for $\Delta(p)$
    - $\mu=\mu_0+\mu_1 \cdot \log(T)+\mu_2 \cdot y_{t_{pmin}}$, $\sigma=\sigma_0, \xi=\xi_0$
    - $\mu=\mu_0+\mu_1 \cdot \log(T)$, $\sigma=\sigma_0+\sigma_1 \cdot y_{t_{pmin}}$, $\xi=\xi_0$
  - What value of Track length(T) and latitude (y) in table 1 give the same values for μ and for σ ?
  - Is track length correlated with minimum pressure?
  - How does increasing σ affect p_{min} distribution?
  - How does increasing track length,T, affect p_{min} distribution?

Extreme Value Theory 2

- Would the results be different if Wmax was used instead of p_{min}?
  - $Wmax \approx .865*[6.02 \cdot (1013-p_{min})^{1/2}-R_{max} \cdot f/2]+s/2$
    - $f=\omega*\sin(\phi)$, $\omega \approx 7.3*10^{-4}$/sec
    - s is translational speed (page 239)
    - Note that Wmax and Rmax are related, are they correlated?

Correlated Extreme Values

- What two measure are used to determine correlation between extreme events?
  - Extremal Measure of Correlation:
    - Page 163 Coles: An Introduction to Statistical Modeling of Extreme Values (u1 and u2 are u=((rank(v)-.5)/length(v)) or use GEV distribution

$$\begin{aligned} \chi &= \lim_{u \to 1} P(U_2 > u | U_1 > u) \\ P(min(U_1, U_2) > u) &= \chi \cdot (1 - u) \\ \hat{\chi} &= \hat{p}(min(U_1, U_2) > u^*)/(1 - u^*) \end{aligned}$$

  - Distribution of the number of mile markers exceeding n year return level in the same year that marker j exceeded n year return level. $P(N_j(n))=0,1,\ldots$.
- Is this correlation important?
  - How does this affect insurance loss predictions?