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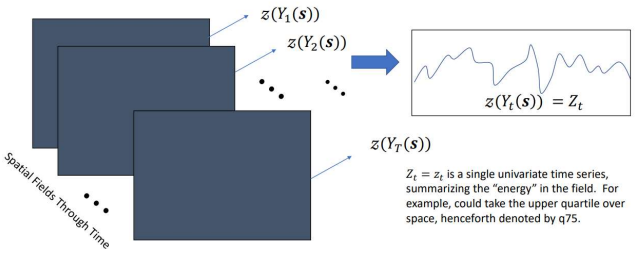
Abstract

Risk-level estimation is tightly bound with the idea of return levels, the amount exceeded on average once every T-years. However, phenomena of interest typically involve spatial quantities and their estimation often ignores the properties associated with their rarity; particularly their uncertainty. This talk gives an armchair overview of the propinquity model that allows for estimation of a spatially meaningful quantity of return level that can be used with extreme-value analysis to appropriately account for rare events. An example using a large-scale indicator for severe weather using climate models is provided.

Model Approach



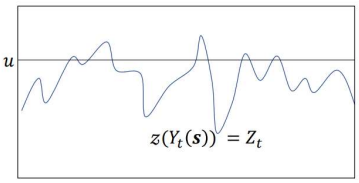
$Z_t = z_t$ is a single univariate time series, summarizing the "energy" in the field. For example, could take the upper quartile over space, henceforth denoted by q75.

Condition space-time process, $Y_t(s)$, on $Z_t > u$, for u large.

Model dependence between the process, $Y_{t|Z_t>u}(s)$ and $Z_{t|Z_t>u}$. Dependence between $Y_t(s_i)$ and $Y_t(s_j)$ for $i \neq j$ is indirect through $\psi(Y_t(s_1),, \ldots, Y_t(s_n), Z_t | Z_t > u, s_i \in \mathcal{D})$.

Identify a summary measure for the "energy" in the field (e.g., the sum over space) to create a time series of this energy summary. Condition on days where the energy is extreme.

Results allow for comparing future climate model output with current observations (e.g., Gileland et al. 2016; doi: 10.5194/ascmo-2-137-2016) or simulate future climate extremes to obtain return levels via the Heffernan and Tawn model (e.g., Gilleland et al. 2013; doi: 10.1002/env.2234).



Heffernan and Tawn (2004, https://doi.org/10.1111/j.1467-9868.2004.02050.x)

$$\mathbb{P}\left[\frac{X_1 - a(Y)}{b(Y)} \leq z_1, \ldots, \frac{X_n - a(Y)}{b(Y)} \leq z_n, Y > y | Y > u\right] \rightarrow_{u \rightarrow \infty} G(\boldsymbol{z}) e^{-y}$$

Heffernan and Resnick (2007, Ann. Appl. Prob., 17, 537 – 571)

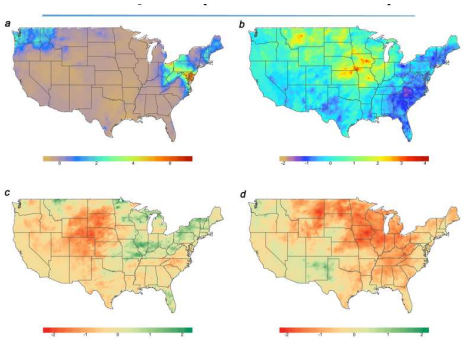
What is the propinquity model?

From Wikipedia: In social psychology, **propinquity** (/prəˈpɪŋkwɪti:/; from Latin *propinquitas*, "nearness") is one of the main factors leading to interpersonal attraction.

People who live on the same floor of a building have a higher propinquity than those who live on a different floor, unless they live near the staircase.

Photo of Endless stairway at KPMG, Munich, Germany by Oliver Raupach, Creative Commons Attribution-Share Alike 2.5 Generic

Using the term propinquity for the model from 2013 also G. et al. 2016, DOI: 10.5194/ascmo-2-137-2016). Though it is a new term not used in those papers.



Kholodovsky and Liang (2021)

(a) October 2012 Superstorm Sandy (W = 4); (b) The May to October Great Flood of 1993 (W = 180). Examples of NEF: (c) The 2002 Drought, April – June 2002 (W = 90); (d) The 1988 Drought, March - July 1988 (W = 150).

Click here for more details. See also, Kholodovsky and Liang (2021)

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