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What is Coastal Climate?

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1. INTRODUCTION

Historical definitions of what determines whether one lives in a coastal area or not have varied over time. According to Culliton (1998), a “coastal county” is defined as a county with at least 15% of its total land area located within a nation’s coastal watershed. This emphasizes the land areas within which water flows into the ocean or Great Lakes, but may be better suited for ecosystems or water quality research (Crowell et al. 2007). Some Federal Emergency Management Agency (FEMA) documents suggest that “coastal” includes shoreline-adjacent coastal counties, and perhaps even counties impacted by flooding from coastal storms. An accurate definition of “coastal” is critical in this regard since FEMA uses such definitions to revise and modernize their Flood Insurance Rate Maps (Crowell et al. 2007). A recent map published by the National Oceanic and Atmospheric Administration’s (NOAA) Coastal Services Center for the Coastal Change Analysis Program shows that the “coastal” boundary covers the entire state of New York and Michigan, while nearly all of South Carolina is considered “coastal.”

The definition of “coastal” one chooses can have major implications, including a simple count of coastal population and the influence of local or state coastal policies. There is, however, one aspect of defining what is “coastal” that has often been overlooked; using atmospheric long-term climate variables to define the inland extent of the coastal zone. This definition, which incorporates temperature, precipitation, wind speed, and relative humidity, is furthermore scalable and globally applicable - even in the face of shifting shorelines. A robust definition using common climate variables should condense the large broad definition often associated with “coastal” such that completely landlocked locations would no longer be considered “coastal.”

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Moreover, the resulting definition, “coastal climate” or “climatology of the coast”, will help coastal resource managers make better-informed decisions on a wide range of climatologically-influenced issues.

2. DEFINING COASTAL

As mentioned above, coastal watersheds have long been used to determine if a given city (point) was considered a “coastal” location. To demonstrate how this might work with an array of long-term climate stations, Figure 1 shows all the coastal watersheds in the coterminous United States (blue shaded regions). In addition, the blue dots represent those climatic stations from the Global Historical Climate Network (GHCN) – Daily, that lie within 200km of the coastline. Notice that some coastal watersheds extend well-inland from the coast, and well-beyond the 200km buffer of the coastline.

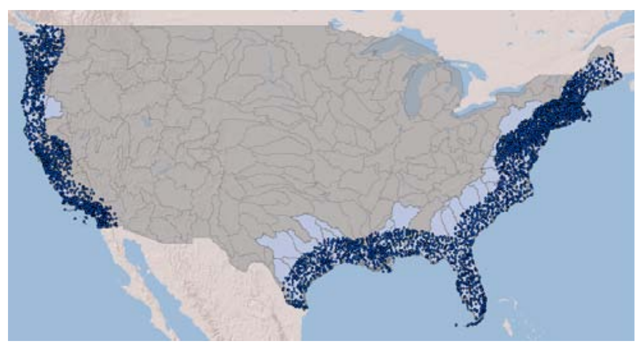

Figure 1 - Coastal watershed boundaries (light blue shaded regions), and locations of GHCN-Daily stations (blue dots). Note that several watershed boundaries extend well-inland from the coast.

However, the application of climatic data may be particularly useful in determining whether a city (point) is considered coastal. For meteorological and climatological applications, many cities are often represented by a long-term historical climate station. In this regard, the definition of “coastal” could be derived using historical climate and meteorological variables including temperature, dewpoint, rainfall, and average daily wind speed, rather than large aerial expanses of watersheds or counties. Each of these climate variables could then be collocated in space and time to visualize the gradient that develops between coastal locations and those farther inland.

Figure 2 shows the average dewpoint temperature for 2008 for the coterminous United States. Note the dramatic change in moisture along the coastlines and the gradient that develops as one heads inland. Ideally, a new definition would account for such gradients, include all types of climate data, and explore geophysical boundaries simultaneously. This is discussed further in the next section.

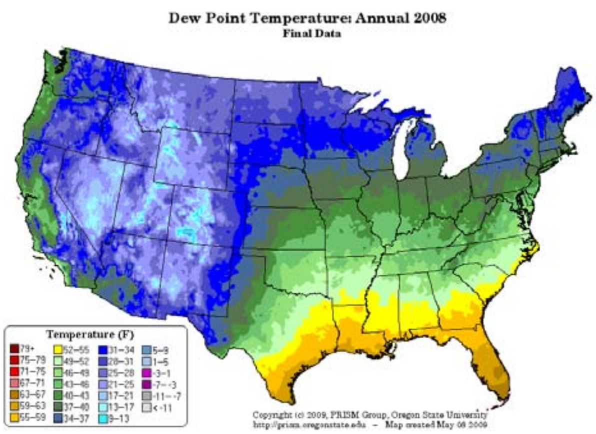

Figure 2 - United States annual average dewpoint temperature from 2008 from the PRISM group at Oregon State University.

3. DISCUSSION

Coastal gradients in temperature, wind speed, dewpoint, etc., can more readily be derived if the data are layered using a Geographic Information System (GIS). The use of GIS allows many layers to be added (or subtracted) for analysis, including topography (where it is especially important in defining "coastal" along the West Coast of the United States), climate divisions, watershed boundaries, and even maps of the littoral zone. Figure 3 shows an example of what this overlapping layers looks like when including watershed boundaries, NOAA coastal counties, the 2008 average annual dewpoint temperature, and the location of the climate stations that lie within 200km of the coastline.

However, the analysis indicates that further investigation is still necessary. In particular is the area of the northeast U.S., where little east-west gradient exists in temperature, but large north-south gradients dominate the long-term climate. On the West Coast it is a different story, where the coastal gradients are maximized leading up to the base of the Cascade mountains, serving as a potential natural boundary for defining what is "coastal." Along the Gulf Coast states, the natural north-south gradient in temperature and precipitation (not shown) are aligned parallel to the coastline, suggesting that a coastal-climate boundary definition in this part of the country is more readily achievable.

Finally, owing to the GHCN-Daily dataset which is available and used in this study, a new definition of "coastal" using historical climate data can be applied globally, so long as long-term climatic stations exist in that area. Nudging the definition of coastal towards long-term climate data and away from counties, watersheds, and fixed buffers suggests that such an approach is viable well into the future, even in the face of shifting shorelines.

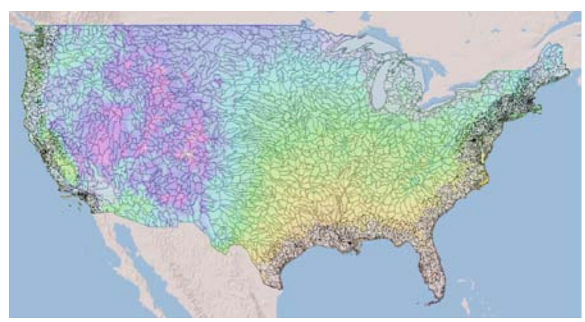

Figure 3 - Layered map identifying the complexity in determining what is "coastal."

4. REFERENCES

Crowell, M., S. Edelman, K. Coulton, and S. McAfee, 2007: How many people live in coastal areas? Journal of Coastal Research, **23**, 5

Culliton, T.J., 1998: Population: Distribution, Density, and Growth. NOAA's State of the Coast Report. Silver Spring, MD. National Oceanic and Atmospheric Administration, 33p.