Interpreting Sea Level Rise Maps

Major Choices & Assumptions:

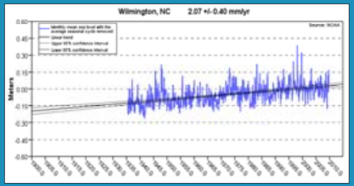
Choice #1: Selecting the Rate of Sea Level Change

Issues:

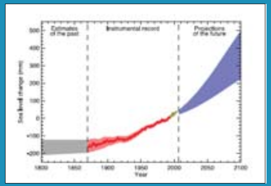
1) Changes in sea level do not occur at a consistent, linear rate.
2) The rate of SLR varies along coasts around the world.
3) Long term sea level measurements, which are needed to assess trends, are not available along all coastlines.
4) Most sea level data and maps are presented in the metric system.
5) Selecting an appropriate sea level change scenario.
   - High or low scenario. Predicting the amount sea level change involves many uncertainties, including future levels of greenhouse gases (GHG) emissions and climate sensitivity to GHG concentrations. This leads to high and low scenarios of rates of change.
   - Melting ice. Understanding the response of Antarctica, Greenland, glaciers, and other ice sheets to climate change is very difficult. Some projections, such as the those from the IPCC, do not include contributions from melting ice. Estimates that include potential contributions from melting ice are much higher.

Sea Level Rise Projections (1990-2100)

IPCC (2007):	18-59 cm	(does not include melting ice)
Rahmstorf, S. (2007):	55-125 cm	(includes melting ice)



Source: NOAA (2010)

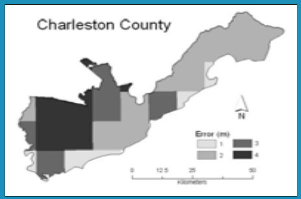


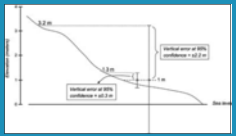
Source: IPCC (2007)

Choice #2: Obtaining the Most Accurate Digital Elevation Models (DEMs)

Issues:

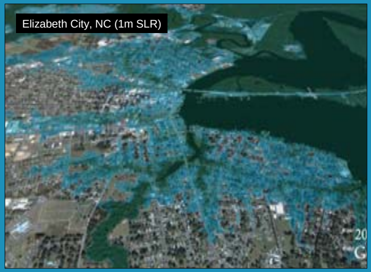
1) **Availability**: Budget constraints and data availability mean that not all places have access to the same data.
2) **Quality:** The magnitude of error in vertical accuracy may be large compared to projected SLR.
   - USGS DEMs vertical accuracy must be better than ± 15 m (7 m preferred).
   - Lidar (Light Detection and Ranging) data availability and vertical accuracy varies from place to place, but the vertical accuracy available for the Carolinas ranges from ± 15 – 80cm.
3) **Assumptions:** Many maps are so-called "bathtub" models, which simply raise the water level but do not incorporate other likely changes.
   - DEMs represent current, not future shorelines. Changes in wave climates will affect the location of future shorelines.
   - Human adaptations, such as sea walls or beach nourishment are important factors in determining the impacts of SLR.




Source: CCSP (2009)

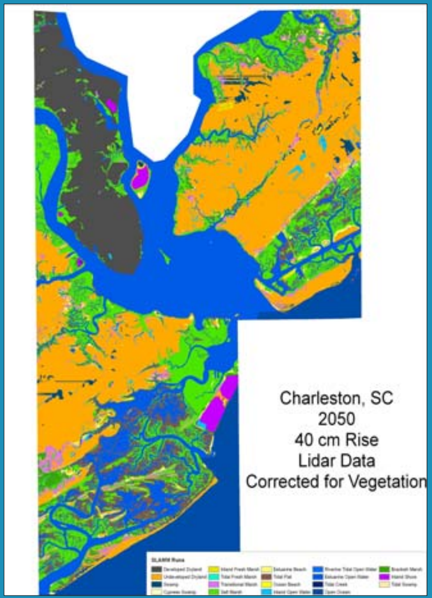
Introduction:

Sea level rise (SLR) maps must bring together scientific understanding of possible future changes across diverse coastlines. Maps are created using different assumptions and with imperfect knowledge of coastal elevations and processes. Cartographers must also decide what information can be clearly presented on a map. Those assumptions and choices are not always included in the presentation of SLR maps. This poster discusses the choices and assumptions, then identifies what to look for when interpreting SLR maps.



Source: Architecture 2030 (2010)

Source: Weiss and Overpeck (2010)



What to identify when interpreting SLR maps

- ✓ Rate of SLR (constant or accelerated)
- ✓ Scenario of SLR (high or low/ ice or no ice)
- ✓ Source of sea level data
- ✓ Quality and sensitivity of DEM
- ✓ Tidal datum (high or low tide)
- ✓ Impact shown

N.P. Kettle [1,2], S. Chhotray[1,2], K. Dow[1,2], and J. Whitehead[2,3,4]

[1] University of South Carolina; [2] Carolina Integrated Sciences and Assessments;
[3] South Carolina Sea Grant Consortium; [4] North Carolina Sea Grant

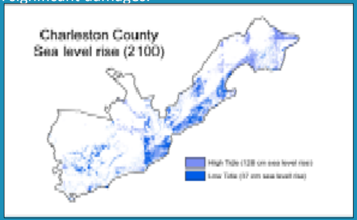
Complicating the Interpretation:

High or Low Tide?

Issues:

1) High or Low Tide: Tidal datums are standard elevations defined by a certain phase of the tide (e.g. mean high water, mean sea level). It is important to understand which tidal datum a map uses, especially in low lying areas with large tidal ranges.

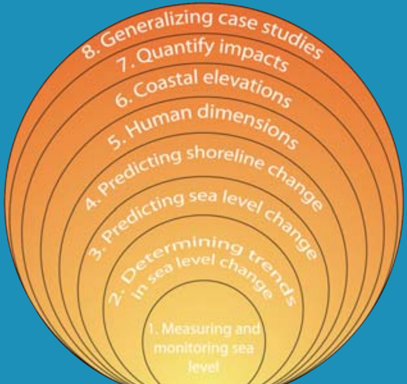
2) Impact shown: Maps may represent permanent (inundation) or temporary flooding. Increased frequency of flooding can also result in significant damages.



Key Uncertainties:

Uncertainty: The degree to which a value is unknown. It is often represented by a range of values.

There are numerous sources and types of uncertainty in SLR assessments. These uncertainties lead to the range of different SLR rates and impacts. The figure below characterizes many of the major sources uncertainty in SLR assessments. Note how the amount of uncertainty increases in the different stages of the assessment process.



References:

Architecture 2030. 2010. Coastal Impact Study: Nation Under Siege. www.architecture2030.org Accessed Jan. 2010.

CCSP. 2009: Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region. U.S. Environmental Protection Agency, Washington D.C., USA.

NOAA. 2010. Tides and Currents: Sea Level Trends. www.tidesandcurrents.noaa.gov Accessed Jan 2010.

IPCC. 2007. Observations: Oceanic Climate Change and Sea Level. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.*

Rahmstorf, S. 2007. A Semi-Empirical Approach to Projecting Future Sea-Level Rise. Science 315: 368-370.

Weiss, J., and J. Overpeck. 2010. Climate Change and Sea Level: Maps of Susceptible Areas. www.geo.arizona.edu Accessed Jan. 2010.