Making Sea Level Rise Projections Actionable for Engineering

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Focusing Questions

Most sea level rise (SLR) projections are academic in origin and not specifically developed to support engineering processes.

- ❑ Are some of the most common SLR projection formats essentially unactionable for engineering?
- ❑ What specific formats and data are necessary to make a SLR projection actionable?

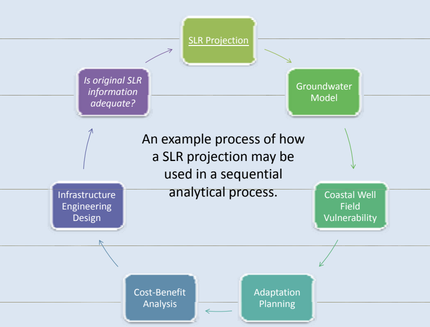
Abstract

As adaptation to sea level rise moves from discussion to action in south Florida, the role of sea level rise projections in support of engineering design is examined. Projections of sea level rise are available from many sources and in many forms. However, there is often a gap between the information provided by these projections and the actionable information required for design of coastal infrastructure. Given that adaptation planning for sea level rise is in a nascent form, the improvements in projections that would be produced by iterative feedback during their application, has been limited. Projections originally crafted to support discussion of adaptation options, the initial step in the adaptation process, are in many cases insufficient for subsequent engineering in their present form. Common limitations can be overcome by including:

- Local, not global, projections
- Projections given relative to specific, standardized tidal and orthometric datums
- (e.g. Mean Higher High Water and North American Vertical Datum of 1988)
- Specifying a reference period (e.g National Tidal Datum Epoch 1983-2001)
- Specifying a base year for the start of the projection
- Clear quantification and communication of uncertainty
- Integration of the projections into the context of tides, extratidal high water events, and storm surge

Additional improvements come from the recognition that sea level projections may not be the final decision support product, but are an input to other statistical evaluations, modeling, or economic analyses supporting engineering. The projection's format can be adjusted for compatibility with these secondary processes. Finally, in a region with multiple projections in use, projections must be designed to be transparent and intercomparable to facilitate harmonious adaptation of complex, dependent systems under the management of a wide range of agencies and actors.

Integration with Other Processes & Projections



As adaptation to climate change moves from the initial phases and on to action, SLR projections will serve as inputs to several processes. These may include modeling, mapping, vulnerability assessment, financial analysis of impacts/adaption alternatives, decision support tools, and engineering design. These processes may require information not typically represented in SLR projections of academic origin.

Adaptation planning in regions managed or regulated by multiple agencies, each with their own SLR projections, will inevitably bring the need for intercomparison among projections. By building in the features needed for intercomparison, a projection's utility for integrated planning can be increased.

Example SLR Projection for Naples, FL

This sea level rise projection was developed using the methods of USACE Engineering Circular 1165-2-211 (USACE, 2009). It was developed using sea level rise rates and tidal datums calculated by for Naples, Florida using NOAA National Ocean Service (NOS) data.

Reference to Datums

By referencing an *orthometric* datum and a *tidal* datum a projection can more easily be connected to subsequent engineering processes.

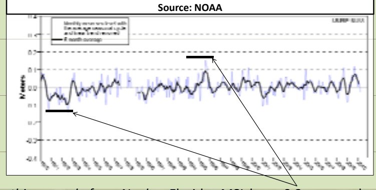
Orthometric datums (e.g. NAVD88) establish a connection to subsequent processes such as surveying, mapping, and engineering design.

Tidal datums (e.g. MSL, MHHW) quantify local tide characteristics in a standardized format. A projection may reference locally derived tidal datums for NOAA's current National Tidal Datum Epoch (NTDE 1983-2001). The NTDE of 1983-2001 has been adopted so that all tidal datums throughout the United States will be based on one specific common reference period

Specify Reference Period

The current National Tidal Datum Epoch (NTDE) of 1983-2001, provides a good reference period for SLR projections in the United States. The Intergovernmental Panel on Climate Change (IPCC), a common source of SLR projections, uses the year 1990 for a reference period.

Interannual Variation in Monthly Mean Sea Level since 1980
For Tide Station 8725110 Naples, Florida
Source: NOAA

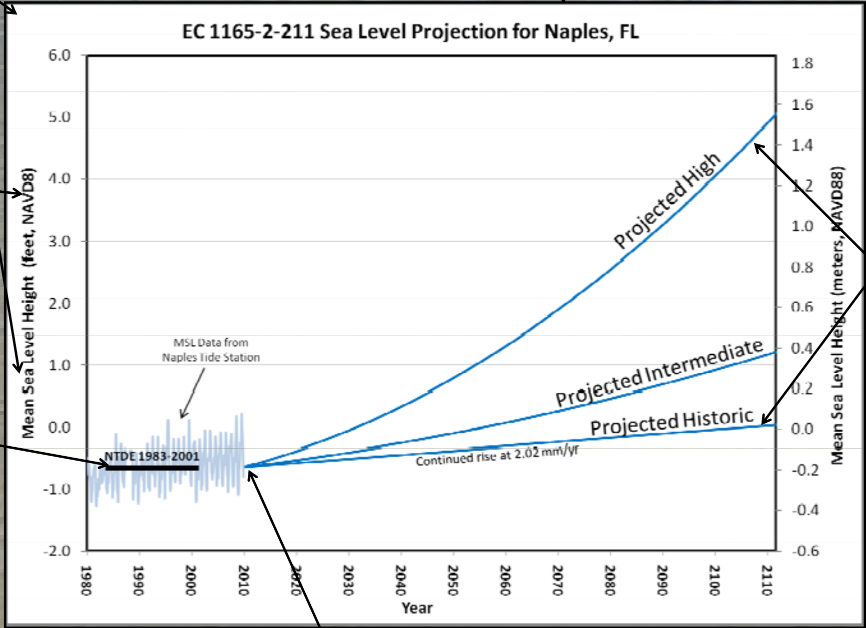


For this example from Naples, Florida, MSL has a 0.3m range due to interannual variability alone. This is equivalent to 148 years of SLR at the historic rate. This underscores the danger of using a single year as a reference for SLR.

Site Specific Projections

Global projections are adequate for initial discussion purposes. However, as a project enters the design phase, more site-specific information is required including local tide data and uplift/subsidence data.

This projection includes locally derived sea level rise rates (2.02 mm/yr) and tide data recorded at a local tide station.

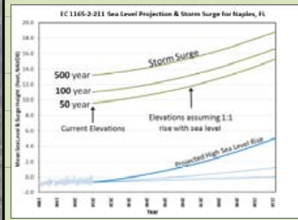


Specify a Base Year

A base year establishes a datum from which one can project sea level rise. Without a base year direct comparisons to other projections is difficult (i.e. some projections are relative to the year 1990, others 2000, and some are completely unspecified).

Include Context of Tides & Surge

Sea level rise projections are often represented as thin, monotonic lines when in reality the rise occurs within the context of tides and storm surge. The figure below represents potential surge elevations for Naples, Florida assuming a 1:1 rise in surge heights with sea level rise.



Incorporation of Uncertainty

Sea level rise projections are uncertain. Multiple methods of representing this uncertainty are in use with varying levels of utility to engineers. A scenario approach (low/historic, intermediate, and high) is used by EC 1165-2-211. A subjective probability method was developed by Titus and Narayanan (1995) and is in use by Florida's regional planning councils.

References

James G. Titus and Vijay Narayanan. 1995. Washington, D.C.: U.S. Environmental Protection Agency. 186 pp. EPA 230-R95-008

USACE. 2009. Engineering Circular 1165-2-211.Water Resource Policies and Authorities, Incorporating Sea-Level Change Considerations in Civil Works Programs.