Integrating Sea Level Rise, Riverine and Flood Models in Marin County, CA

AGU/TEX Project

Marin County and other coastal areas have experienced coastal flooding in the past, and with the observed global/regional rise in sea level there is concern for flooding events occurring more frequently and/or with greater severity. Initial estimates of areas vulnerable to inundation by coastal waters, whether in the bay or along the open coast, can be developed by use of a "bathtub" model: on a map of the elevation of the land surface, identify areas that are less than a foot above existing high tide levels (or 2 foot, or whatever the projected sea level rise is for the planning horizon of interest). Improved bathtub models include transient sea level maxima associated with seasonally higher high tides ("king tides") and storm surges due to wind or wave effects. These transient peaks in water level exhibit more spatial heterogeneity, requiring a more refined model and also one that can consider the time it takes for effects to propagate in from the ocean to the bay and from the bay to tributary creeks and sloughs. While there is more uncertainty at the scale of specific infrastructure or other assets, these models are robust and provide a clear idea of vulnerable coastal sites.

Low-lying coastal regions can also experience flooding during high river flow following a rain event. This type of flooding is typically well mapped through flood management models that consider how fluvial runoff may back up at constrictions in the channel, resulting in overflow from the channel. With climate change it is anticipated that rainfall will change and there is a high likelihood of more intense precipitation events, which will lead to greater flow peaks. Further, changes in land use affect the rate of runoff from areas adjacent to river channels and this may also increase peak flows, which in turn lead to higher fluvial flooding levels in low-lying lands near the coast.

In projecting risk to coastal infrastructure, society and habitats, both sources of flood risk need to be accounted for – and, further, the scenario where both occur at the same time. The highest water levels and greatest flooding in coastal regions will happen when high river flows occur at the same time as the base level (water level in the receiving water) is at a maximum elevation. The probability of this happening and the predicted flood levels are not available for Marin County (or elsewhere in the Bay Area, except Damon Slough in Alameda). Several flood vulnerable sites in Marin County may be subject to much higher flood risk than is presently expected from considering sea level rise and river floods independently – specifically sites near the mouth or floodplains of larger creeks (e.g., Easkoot Creek, Novato Creek, Coyote Creek, Redwood Creek, Lagunitas Creek, Pine Creek).

There are three approaches for identification of these high-risk sites:

- Collate records of prior floods in Marin County and highlight areas that are near the mouth of creeks and stormwater channels. May corroborate with "head of tide" protocol.

- Use an existing bathtub model (e.g., COSMOS) to project sea level rise and highlight areas that are near the mouth of creeks and stormwater channels.
- Develop a coupled model of river flow and sea level to explore flooding scenarios under different flow/sea level conditions (e.g., Damon Slough report; Easkoot Creek report). To develop an estimate of the likelihood of these scenarios, either data or models can be used to quantify the probability and co-probability of high river flow and high sea level.

The third approach will provide the best quantitative information, but also will require the largest technical effort. Identification of high-risk, high-value sites may be done through one of the first two approaches and, the third approach could be applied only to one or two priority sites (e.g., Damon Slough in Alameda). The priority of addressing specific flood-risk areas depends on the risk itself and also on the assets that will be flooded (both value and also whether flooding has a temporary impact, or a long-term impact through irreversible damage).