

## Practical Information For Environmental Professionals

### Florida coastal regions face multiple challenges from rising seas

By MIKE JENKINS, PhD, PE

Sea level rise is increasingly noted as one of the key critical challenges facing the state of Florida. Surrounded on three sides by water, the state recognizes the issue as of particular interest to a large segment of coastal communities.

While the sea level rise has increased in visibility, there is little consensus between experts and elected officials regarding the extent of the problem and appropriate measures to address the concern.

Historic records of past sea levels within the region can provide some insight into the problem. In fact, the tidal record from Key West, FL, is the longest tidal record within the Western Hemisphere and provides a measure of sea level at the state's southernmost point dating back to 1846.

These data, along with other tidal records, have been studied extensively by Dr. George Maul, head of the Department of Marine and Environmental Systems at the Florida Institute of Technology.

"Our study of tidal records indicates that relative sea level within the state has been rising for at least the past century and a half at a rate of roughly nine inches per century," said Maul.

In addition to tidal records, recent advances in global positioning technology allow for the direct measurement of lateral and vertical land movement. This technology has been used to estimate the rate of land subsidence, one of the major contributors to relative sea level rise.

It is generally accepted that the land of Florida is sinking as a response to the last ice age. The large ice sheet that covered much of the continent depressed the continental land mass, thrusting the state upwards. Now that the glacial ice sheet is gone, the entire plate of North America is adjusting and the net result is a gradual readjustment (subsidence) of our region.

GPS measurements have supported this contention and have suggested a subsidence rate for most of Florida on the order of two inches per century, though there is considerable uncertainty within these measurements.

Relative sea level is the effective water position compared to the shoreline and is determined by a number of factors. Much of the recent controversy surrounding sea level rise is focused on the issue of global warming and the potential increase in

global, or "eustatic," sea level it may cause.

To date, estimates regarding this potential increase vary widely between sources. Tidal records in Florida have yet to demonstrate any recent increases that could be attributed to this effect.

"We have looked for evidence of recent acceleration but have as yet not seen any statistically significant increase in tidal measurements around the state," notes Maul.

While the jury may still be out regarding the future rate of sea level rise, tidal data from around the state strongly suggest that a rising sea level trend is likely to continue for the foreseeable future. Even at historic rates, this represents a significant concern around the state, particularly in low lying areas such as the Keys and portions of southern Florida.

This trend raises multiple concerns. Areas that are currently prone to flooding from high tides will continue flooding on a more frequent basis, and the extent of this type of flooding will continue to increase. Critical infrastructure will become more vulnerable to flooding, wave forces and erosion. Beach resources will face greater stresses as existing upland infrastructure in much of Florida becomes an obstacle to the natural recession of the shoreline in response to sea level rise.

Environmental resources may also be impacted since critical habitats within low-lying estuarine areas are particularly sensitive to small changes in water elevation. Storm vulnerability will also increase as storm surge will add to the increases in mean sea level.

Assuming the rate remains at or near historic levels (approximately nine inches per century), sea level rise represents a long-term, chronic condition, but it is one that can be addressed through sound planning and engineering efforts to some extent.

Areas of vulnerability can be identified and their uses and building requirements can be restricted to address the potential threat. Other infrastructure such as roads, bridges and seawalls can be upgraded to account for increased water levels.

Even the threat to beach areas can be minimized through existing beach management strategies and periodic renourishment.

The fate of undeveloped, natural areas, however, may prove less certain. The response of existing habitats to this additional stress is com-

plex and difficult to predict. Engineered responses are likely to be less practical for these areas. Any response will require a long-term commitment and significant investments in future planning and infrastructure needs.

One fundamental question at this point is whether the historic trends will continue or a dramatic increase in the rate of sea level rise will occur, as predicted by some sources.

Increases in global temperature have been reported, but a corresponding increase in sea level has been more elusive. If a dramatic increase does occur, the results could be severe.

We need only look as far as coastal Louisiana to gain some understanding of the socioeconomic and environmental impacts that would occur due to extreme sea level rise.

At present, most of coastal Louisiana is experiencing a rate of relative sea level rise several times the rate measured in Florida due to subsidence of the Mississippi River delta. This accelerated rate has resulted in catastrophic losses of coastal infrastructure, wetlands, and localized shoreline recession rates upwards of 50 feet per year.

It has been estimated that Louisiana is losing roughly 25 square miles of land each year. At this rate, it is projected that much of coastal Louisiana will be submerged within the next 50 years.

Significant resources have been spent to address the problem and ambitious regional restoration plans have been proposed. The price tag for any meaningful response, however, appears to be astronomical and perhaps beyond the capability of available resources to implement.

Fortunately for Florida, the current rate of sea level rise seems to be consistent with historic norms, and a significant increase due to global warming has yet to materialize.

There is no doubt that this issue represents a considerable uncertainty for long-term planning efforts and will present critical challenges to Florida's continued health and prosperity within our lifetime.

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