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Sea Level Rise in Miami-Dade County Florida Implications for Management of Coastal Wetlands and the Everglades

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By 2100 sea level will have: 1) inundated much of coastal and interior Miami-Dade County, 2) seriously degraded freshwater availability county wide, and 3) changed the climate from a terrestrial to an oceanic process dominated system. Projected sea level rise will also result in ecological problems as anthropogenic altered areas are inundated. The IPCC (2007) has made global sea level rise projections to provide guidance for the next 100yrs but no detailed local information.

In order to better understand the meaning of various sea level scenarios, LIDAR data collected by the FIU/IHRC (2004) was used to map the physical impact of rising sea level on the coastal zone of Miami-Dade County. Because the data set overlaps the eastern edge of the historical Everglades, it is also possible to examine the effect there and to understand how the transverse glades will facilitate a change from a freshwater dominated system to a marine one.

The LIDAR data is used to generate a detailed topographic map with 0.3m contour intervals. ArcGIS software was used to create images representing each contour up to 3.3m. Impactsexpected to occur at the different stages are discussed:

Early onset rise (below 0.3-1m) will produce dramatic inundation of the coastal plain, the "Southeast Saline Everglades" (Egler, 1950), to the L-31E levee and coastal water management structures. The structures and levee maintain a freshwater stage between 1.7 and 2.3 ft above msl now and therefore restrict sea encroachment. Without these manmade structures the effects of the first 0.5m rise would be considerably more causing salt water encroachment to the toe of the break in slope at the coastal ridge. Each 0.3m rise in the unprotected southern Everglades is expected to produce a considerable acreage loss due to the low /shallow slope.

At 1 m stage major erosion of the coastal organic sediments will begin causing carbon export, nutrient loading and perhaps anoxic conditions, especially in northern Florida Bay. Most of the area in front of the coastal ridge is inundated or experiencing salt water encroachment and contamination of the ground water supply. The Miami River basin begins to flood inland threatening the valley up to the original fall line (about 27th Ave) and adversely affecting the county water quality. Coastal islands including Miami Beach, Virginia Key, and Key Biscayne and low lying coastal residential areas are at risk, as is the Turkey Point Power plant and SouthDade Landfill.

Between 1 and 2 m the Dade County shoreline turns into a rocky coastline with only a incomplete, narrow mangrove fringe. Anthropogenic structures create natural habitat migration barriers and totally new habitats (asphalt hardgrounds, rubble mounds) at this

stage. Some high karst areas along the coast will facilitate landward penetration of the coastal ridge by subterranean means. Caves and large scale karst pathways under the ridge would be expected to reverse flows particularly at flood tides which would introduce saltwater to underground freshwater systems in unknown ways. At plus 1.2m the Miami River basin and the northern rivers, Little River, Arch Creek, Oleta River will effectively be tidal channels allowing marine flow to low inland urban areas. This includes Miami Springs, the international airport including its important canal network, as well as many areas in northern-most Miami-Dade.

At 2m in stage the entire area in front of the coastal ridge is inundated. In addition the Everglades to the west is inundated with the transverse glades south of the Miami River becoming tidal passes. Arch Creek (Snapper) and the Oleta River open up to become major tidal passes to the new northern portion of an expanded Florida Bay. At this point, the processes controlling climate will change from terrestrial to ocean dominated which will result in drier conditions much like what is seen in Key Largo presently. After 2m of rise the available dry land will shrink rapidly until such time as the entire county is submerged.

At 3.3m stage the highest parts of Cutler Ridge and Silver Bluff along the Coconut Grove coastline, form a very narrow barrier island east of a loose collection of thirteen island groups, and are all that remain above sea level in Miami-Dade County. The biggest percentage of the remaining land would be less than five feet in elevation. Therefore most of the remaining exposed land would be subject to total submergence during storm events. We personally feel that a prediction of 2m rise during the next century is not unreasonable especially since the rise may not follow a steady state increase, and we are aware of credible predictions of 7m or more in this same time period. At these levels management of the Everglades turns into the management of a major estuary with extensive shelf ecosystems.

Coastal managers must pay attention to the effect of sea level rise and management strategies should be converted to adaptive management where possible. Difficulties will arise because of human modifications to the environment and a desire to save valuable properties such as landfills and power stations. As long as sea level continues to rise dramatically, ecosystem retreat is in order. Proper management of the GEER region will buy time and make the transition more economically and ecologically sound.

The implications of this potential anthropogenic perturbation result are both obvious and subtle for both coastal and Everglades restoration:

- damage to anthropogenic structures including those used to manage coastal ecosystems.
- loss of freshwater storage capacity with significant effect on habitability.
- loss of present coastal wetlands with resulting change in dependant biological systems.
- expansion of Biscayne Bay westward and Florida Bay northward.

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