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Climate impacts on the coastal environment of South Florida: Marine Heat Waves and Coastal Flooding

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Abstract Text:

The coastal marine environment around South Florida hosts coral reef fragile ecosystems and is ground zero for climate related adverse effects. We present two such threats that can directly impact both the natural and urban environments: Marine Heat Waves (MHWs) and coastal flooding, around the coral reefs and near a densely populated metropolitan area (Miami). Both phenomena are increasingly recognized as important factors in the sustainability of coastal environments (both natural and urban), in the context of climate change. We investigate MHW formation during the last three decades, focusing on their relationship with the spatial and temporal SST variability. The long-term variability and trends of sea level and the respective coastal inundation over the low-lying Miami areas were also investigated. We have adopted a methodology that uses continuous high-resolution satellite observations, field observations, meteorological data, and numerical simulations (hydrodynamic and coastal flooding). The main study motivation is to contribute to the understanding of climate change impacts around coastal areas, by examining the increasing temperature and sea level trends in the surrounding ocean waters and the resulting impacts on the marine and urban environments. This can be potentially useful to the research on the implications between physical and biochemical properties. We also evaluate the environmental met-ocean factors that are responsible for the interannual SST variability and long-term trend, analyzing the related MHW impacts. The interannual MHW positive trend was 0.75 events/decade with 7.4 days/decade duration increase and was associated to the generally increasing SST trend

over the entire region ($0.19^{\circ}\text{C}/\text{decade}$), following the respective atmospheric temperature ($0.21^{\circ}\text{C}/\text{decade}$) and the heat flux ($\sim 5000 \text{ J}/\text{m}^2/\text{decade}$) increases. Based on continuous sea level measurements during the last three decades, the interannual sea level increase over the Miami urban environment was estimated to $7 \text{ cm}/\text{decade}$, with significantly high peaks after 2006, intensifying the flooding events in the coastal zone. The latter may cause severe impacts to inhabited urban spaces and built infrastructures, with the maximum inundation area exceeding the value of 500 acres in a region of 70 Km^2 in South Miami Beach.

Plain-Language Summary:

The coastal marine environment around South Florida hosts coral reef fragile ecosystems and is ground zero for climate related adverse effects. We present two such threats that can directly impact both natural and urban environments: Marine Heat Waves (MHWs) and coastal flooding, around the coral reefs and near a densely populated metropolitan area (Miami). Both phenomena are increasingly recognized as important factors in the sustainability of coastal environments, in the context of climate change. We investigate MHW formation during the last three decades (focusing on their relationship with the spatial and temporal SST variability), the long-term variability and trends of sea level and the respective coastal inundation over the low-lying Miami areas. The interannual MHW positive trend was $0.75 \text{ events}/\text{decade}$ with $7.4 \text{ days}/\text{decade}$ duration increase. The interannual sea level increase over the Miami urban environment was estimated to $7 \text{ cm}/\text{decade}$, with significantly high peaks after 2006, intensifying the flooding events in the coastal zone, with the potential of severe impacts to inhabited urban spaces and built infrastructures.

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CC010. Mind the gap - Understanding and Predicting Future Coastal Ocean Climates

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