

Storm surge for an Ivan-like Hurricane making landfall near Tampa Bay

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What is storm surge?

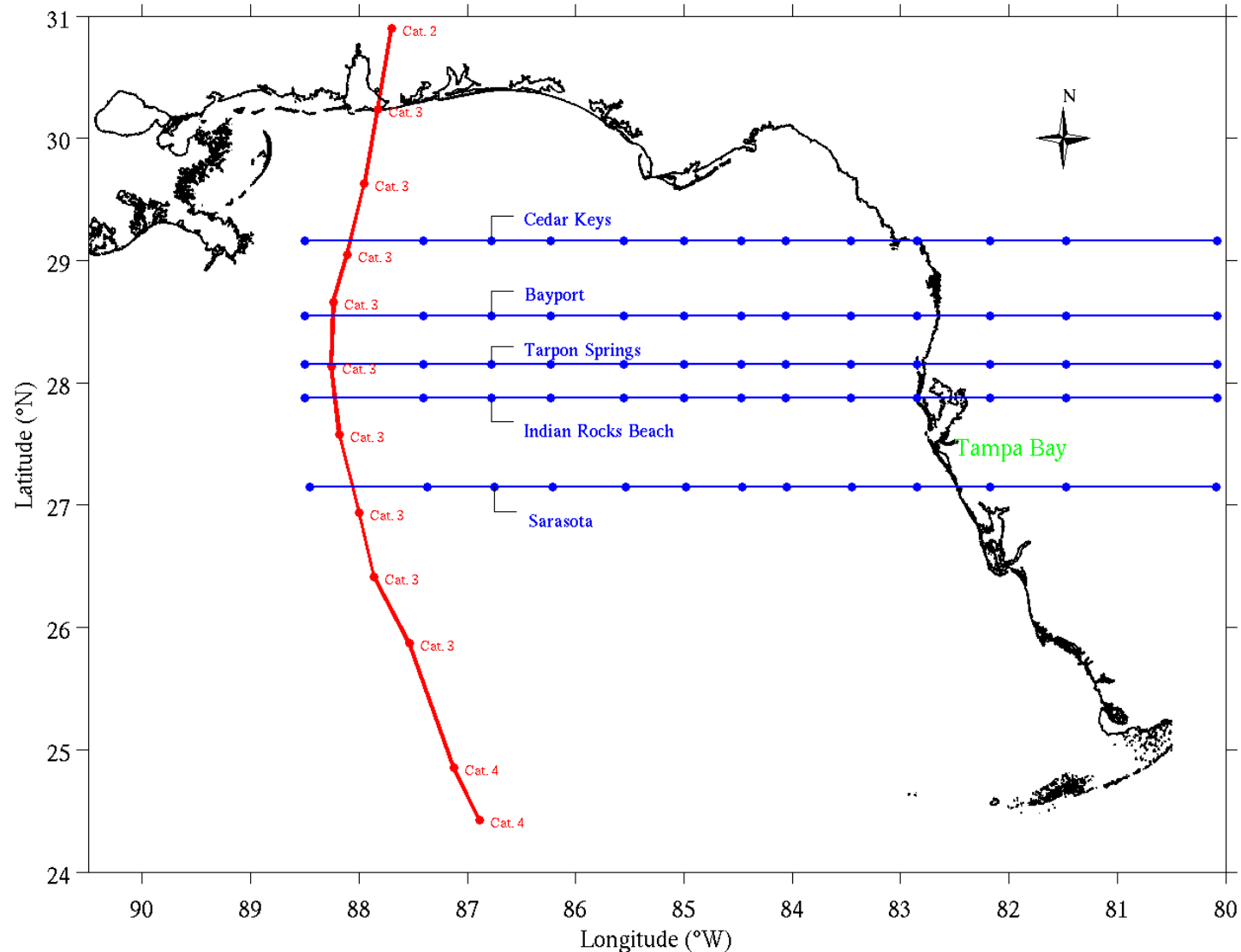
Storm surge is an abnormal sea level change caused by wind, pressure, and waves.

For hurricanes, the across shore wind component causes the largest surge, whereas the waves cause the most destruction.

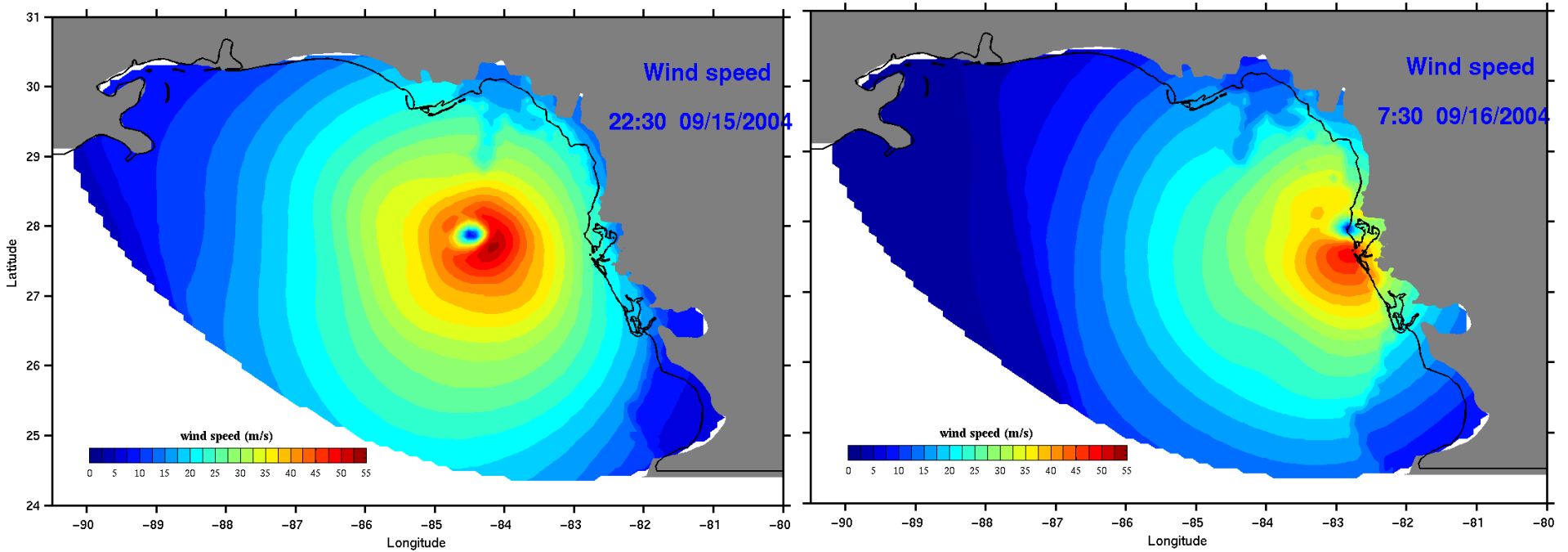
We address two questions:

- 1) What may have happened here had Hurricane Ivan made landfall near Tampa Bay instead of at the Florida/Alabama border, and**
- 2) What are the surge differences between simulations made using 2D or 3D models.**

We took Ivan winds (and pressure), rotated these and sent them into Sarasota, Indian Rocks Be, Tarpon Spgs, Bayport, and Cedar Keys using computer models to estimate both surge and waves.



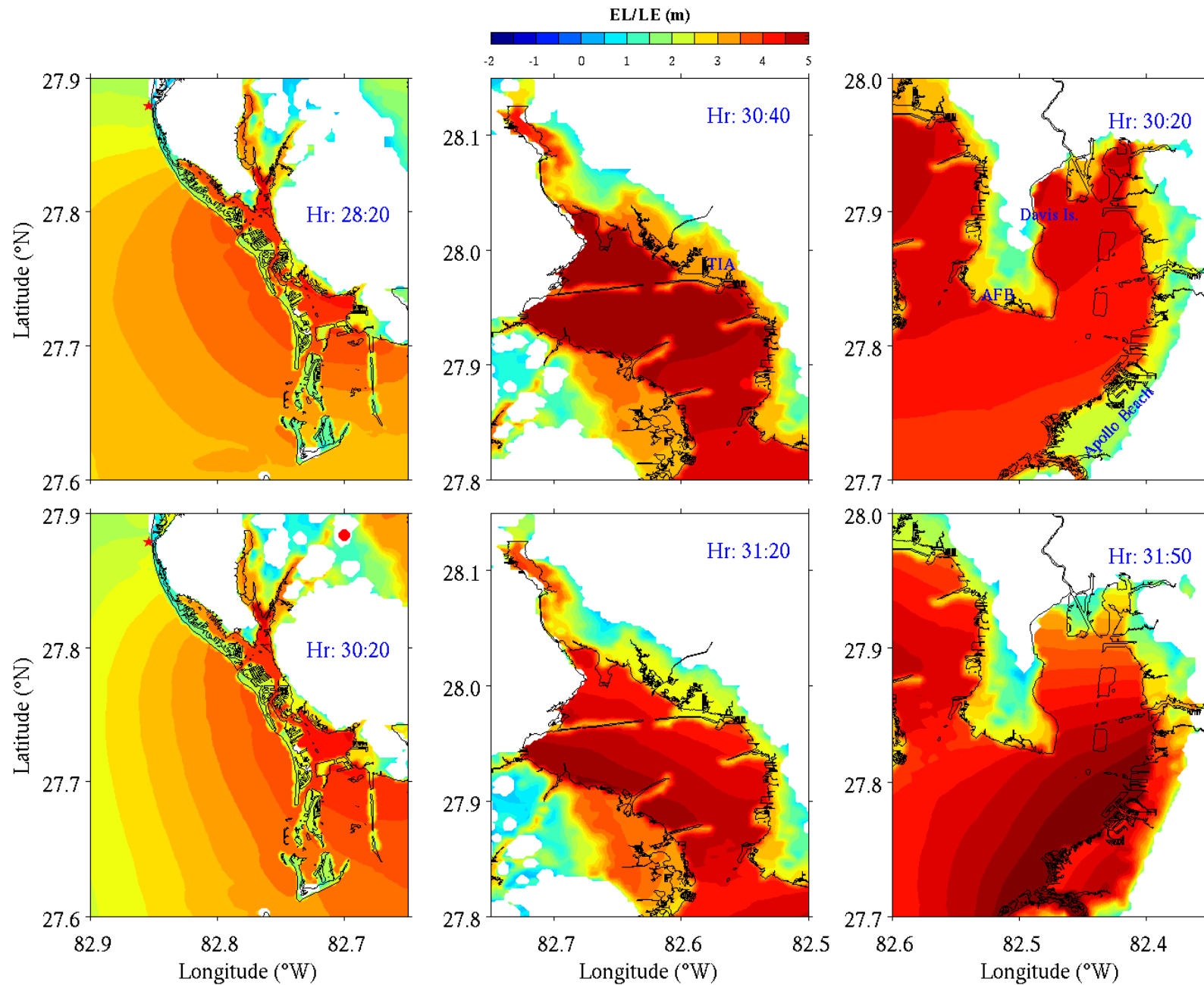
Ivan H*Winds on approach and at Landfall



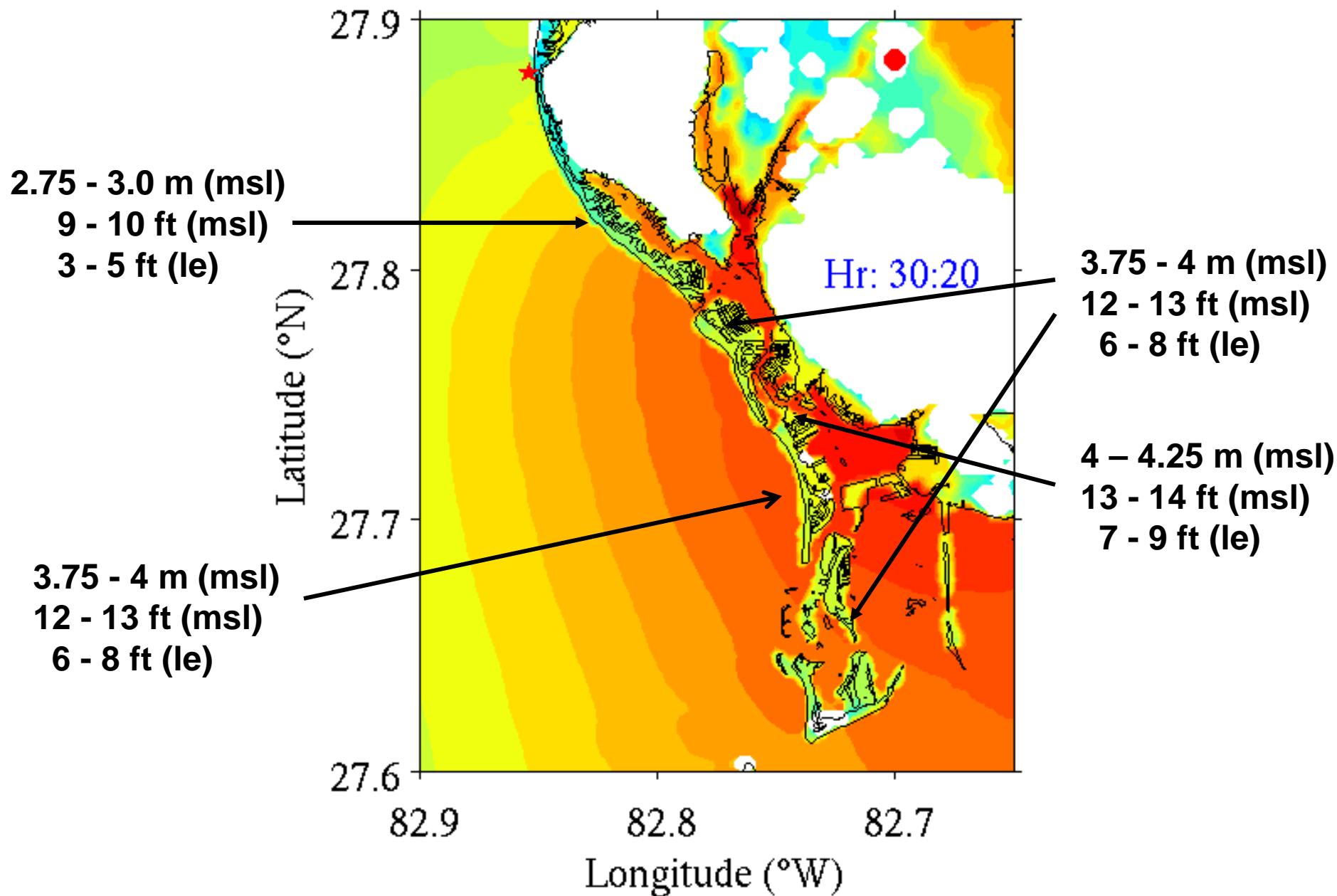
While Ivan reached category 5 in the Caribbean it was a 4 upon approach and a 3 at landfall.

<u>Category</u>	<u>mph</u>	<u>knots</u>	<u>m/s</u>
1	74-95	64-82	33-43
2	96-110	83-95	44-49
3	111-130	96-113	50-59
4	131-155	113-135	60-70
5	>155	>135	>70

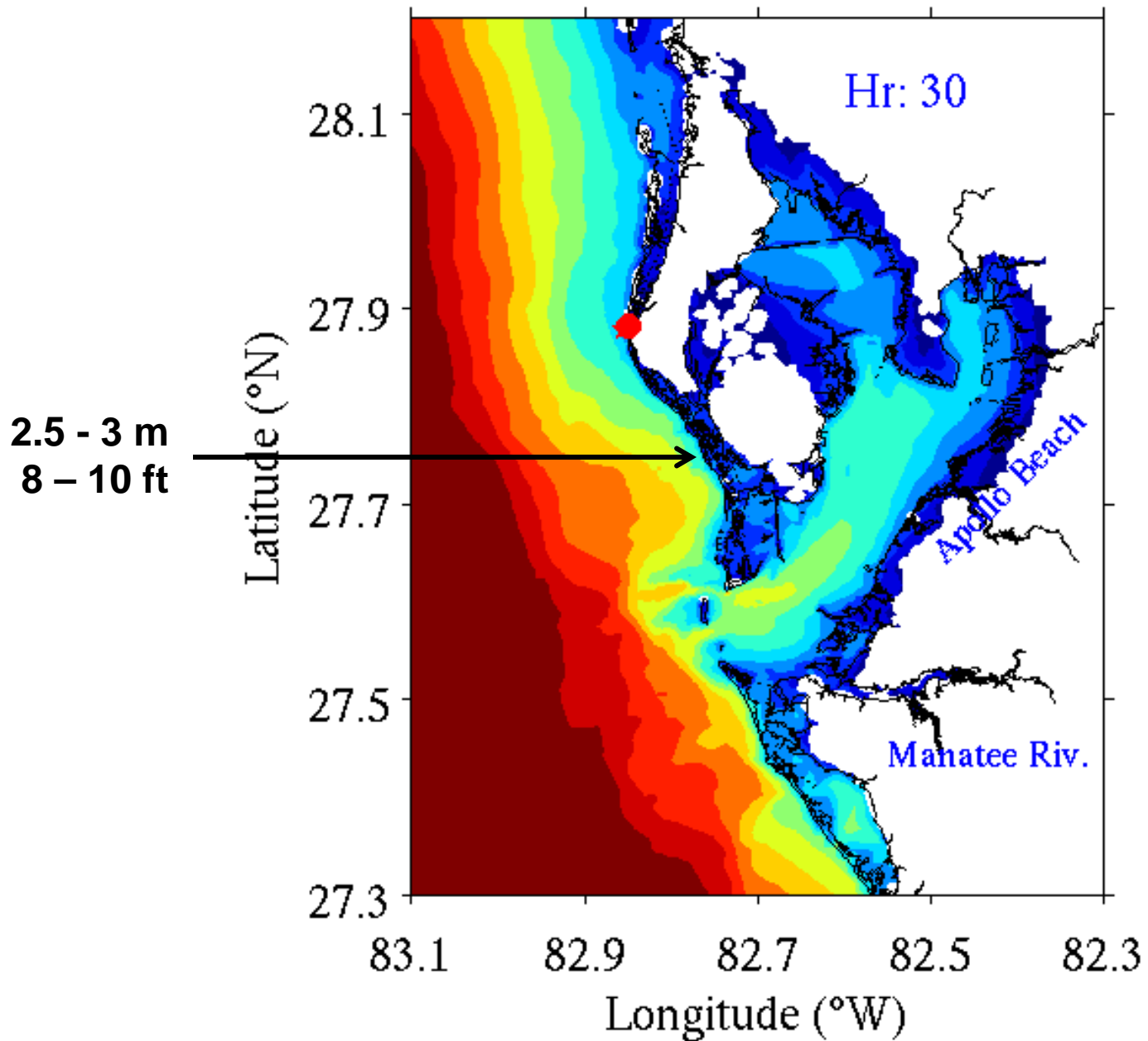
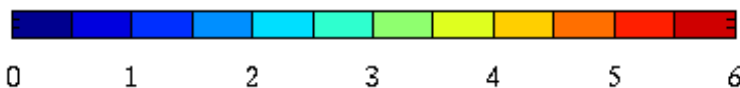
Maximum surge heights relative to land elevations at St. Pete Be. (left), Old Tampa Bay (middle), and Hillsborough Bay (right).



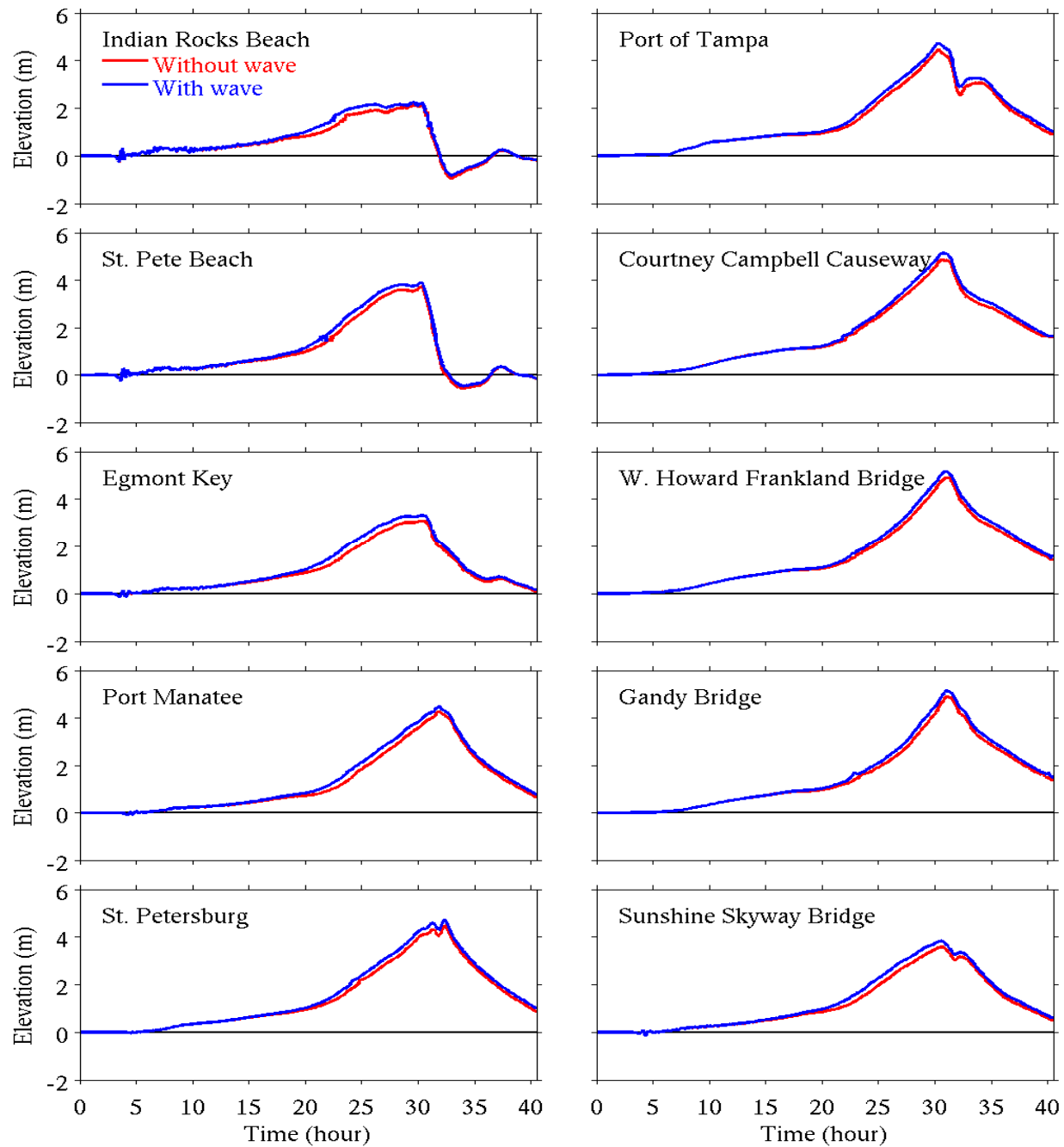
EL/LE (m)



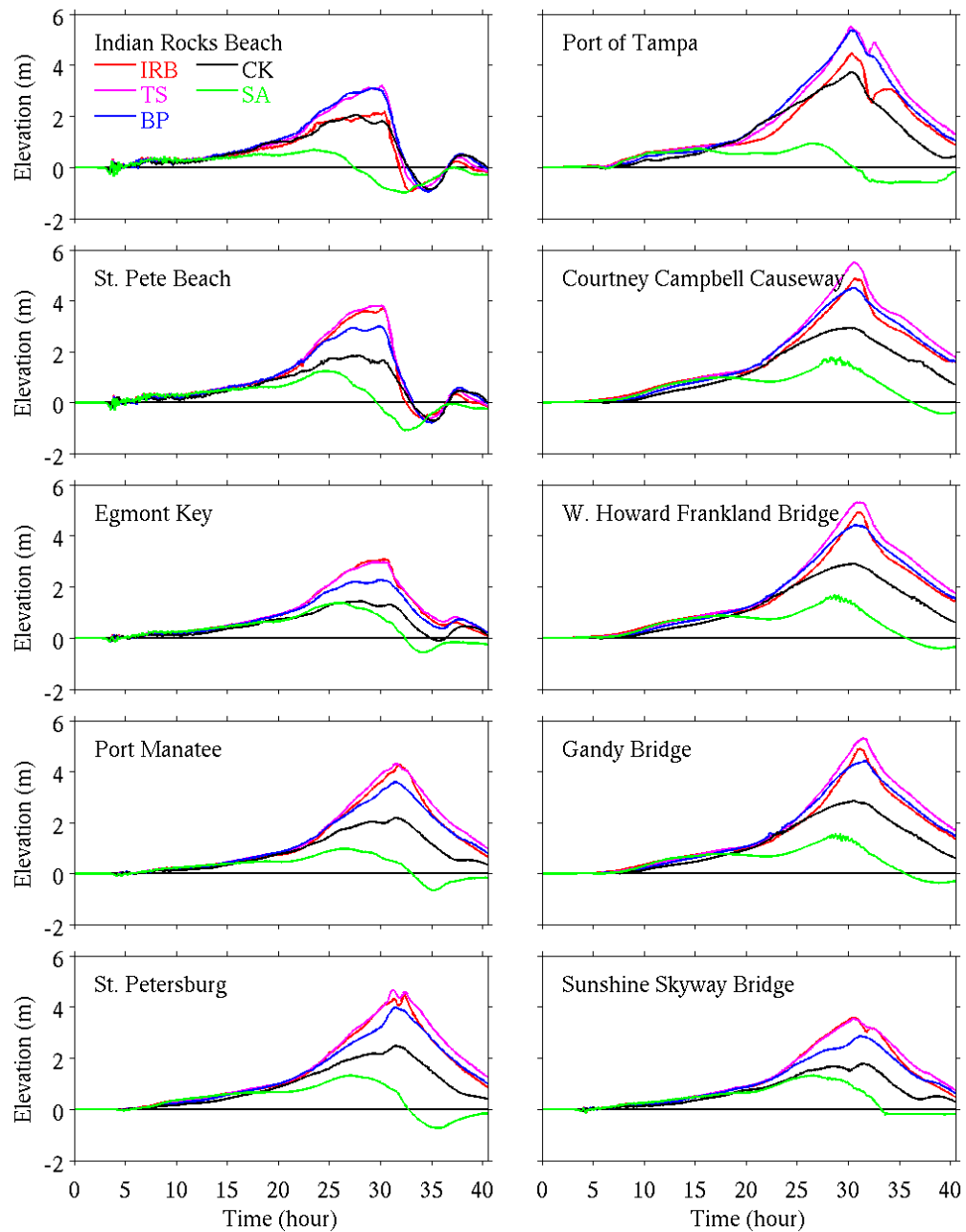
Significant wave height (m)



Surge height with/without wave radiation stress.



Surge height evolution at selected locations. Note the sensitivity of surge to landfall location from Sarasota to Cedar Keys



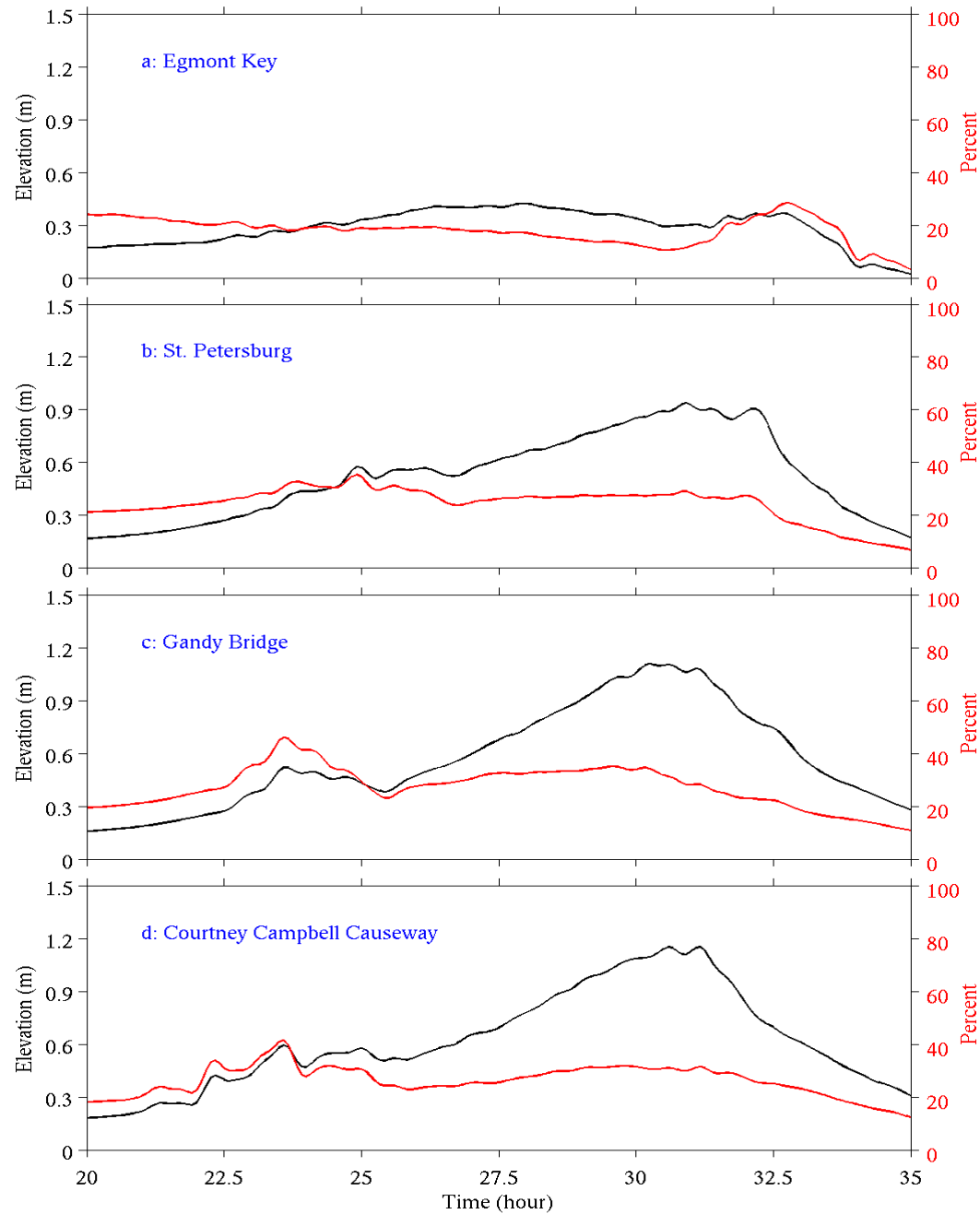
Are surges simulated with 3D models different from those simulated with 2D models?

- Why bother: agencies use 2D models (e.g., NOAA: SLOSH; FEMA and USACE: ADCIRC).
- Whereas storm surge dynamics are 3D:

$$\rho g H \zeta_x = \tau^w - \tau^b$$

- The problem is: 2D dynamics overestimate bottom stress and therefore underestimate surge height.

Surge differences between 2D and 3D simulations



Conclusions

1. Local:

Tampa Bay, FL is as vulnerable to hurricane storm surge damage as was coastal Mississippi for H. Katrina.

2. General:

A. Storm surge is not a solved problem. It is sensitive to the model and to uncertainties in surface and bottom stress.

B. Agencies (NOAA, FEMA, USACE) employ 2-D models. *Our findings suggest that the 2D model underestimates the surge and it will be necessary to employ 3-D model.*