Storm Surges

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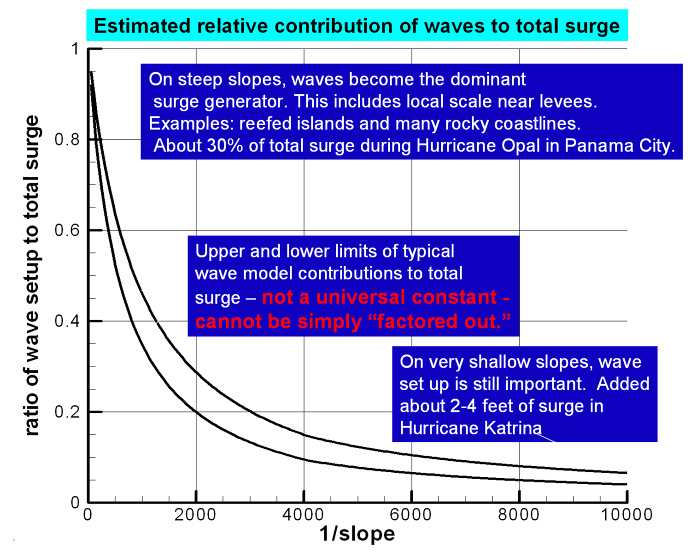
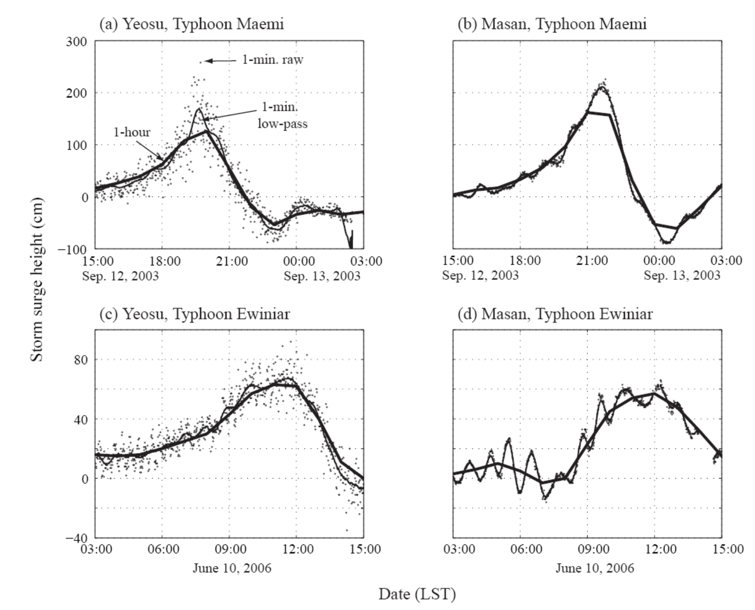
Summary

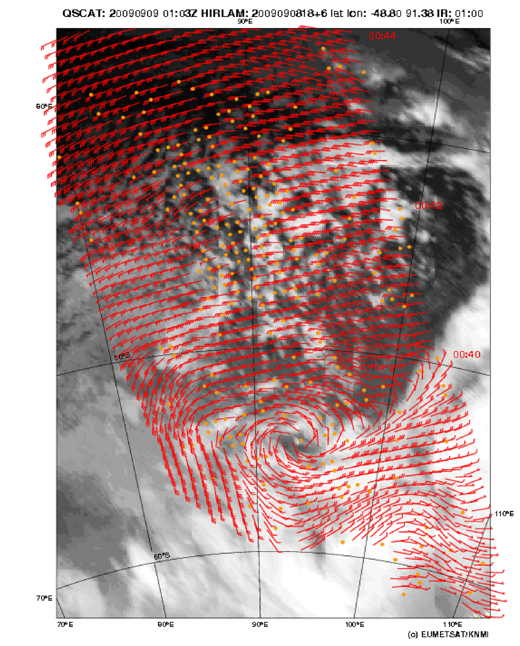
Storm surges and their associated coastal inundation, are major coastal marine hazards, both in tropical and extra-tropical areas. Of the 33 world cities predicted to have at least 8 million people by 2015, at least 21 are coastal, including 8 of the 10 largest, and highly vulnerable to coastal hazards including storm surges. This paper focuses primarily on the results from the recent JCOMM Scientific and Technical Symposium on Storm Surges (www.surgesymposium.org) , and in particular the recommendations proposed in support of improved storm surge forecasting and risk assessment.



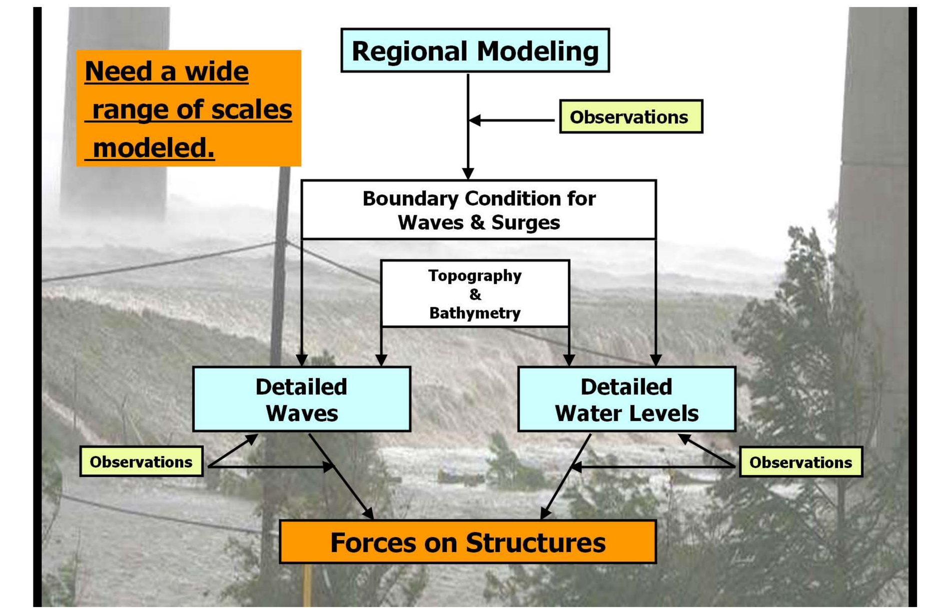
Wave height adds to total surge



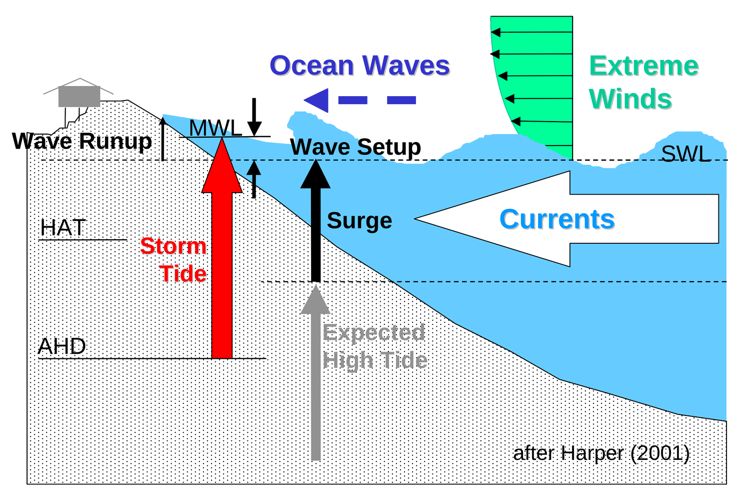
Water level measurements should be 1-minute samples to avoid missing peaks of events (after Lee et al, 2009)



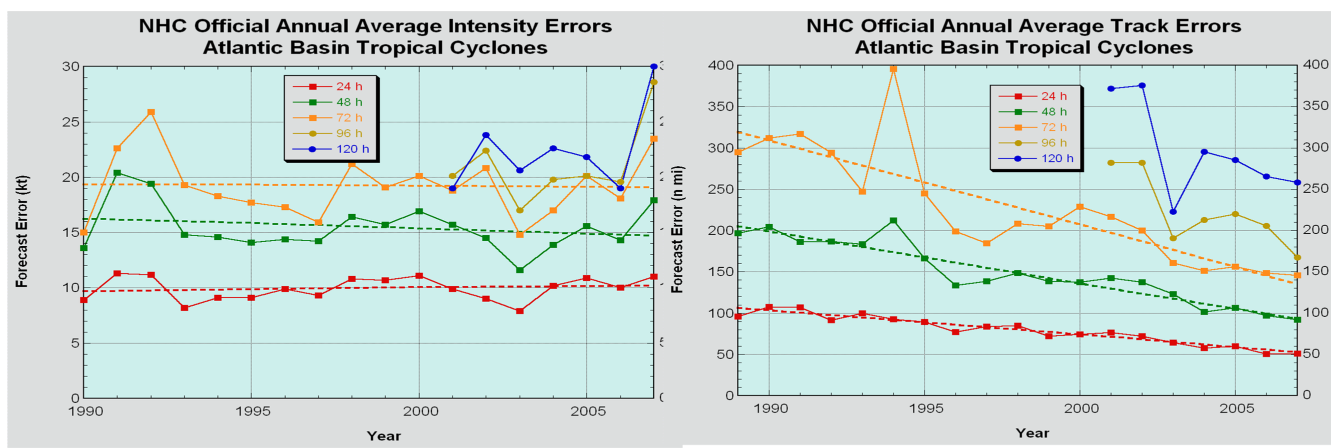
Scatterometer and other satellite wind products are vital contributions to operational storm surge forecasting



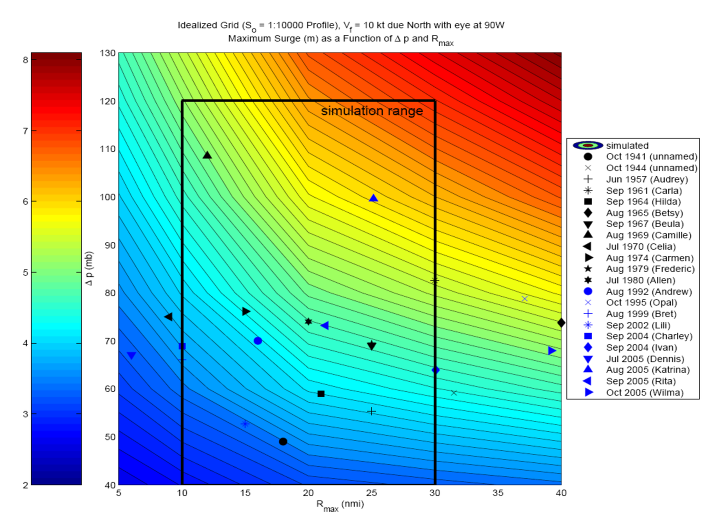
In-situ and remotely sensed observations and numerical model input, on multiple scales, are required for accurate storm surge prediction



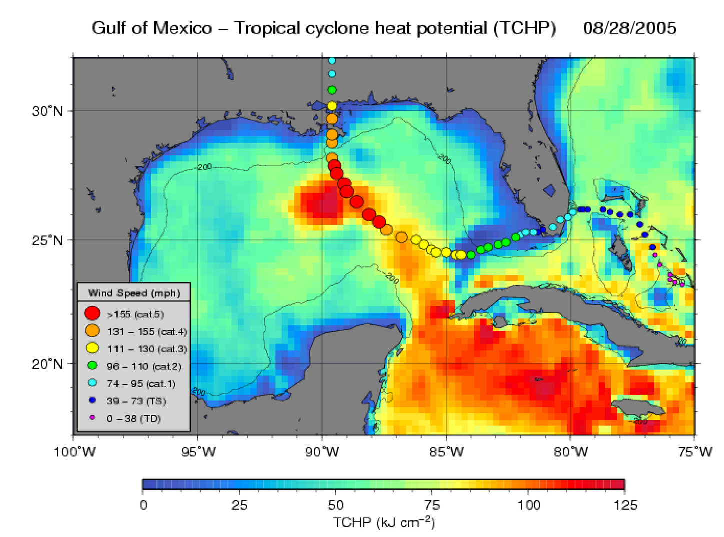
Total Water Level Envelope (TWLE) prediction is the most important quantity for inundation estimates



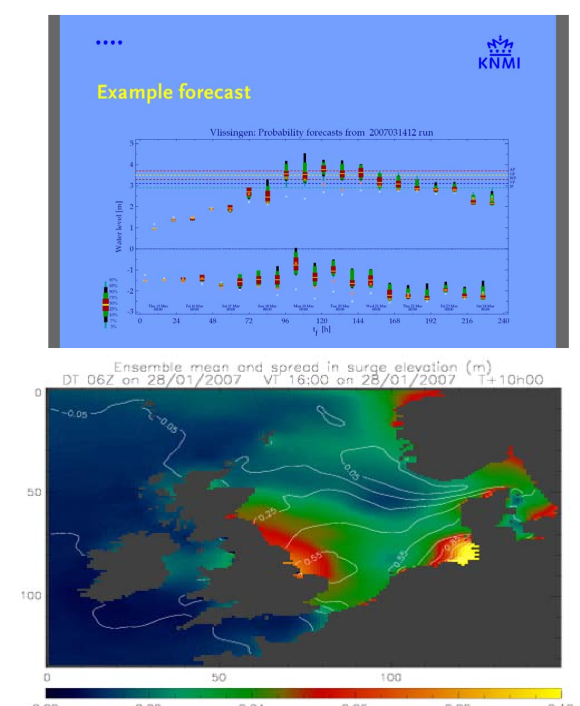
Tropical cyclone track and intensity predictions are crucial inputs for storm surge forecasting – both require improvement, but especially intensity



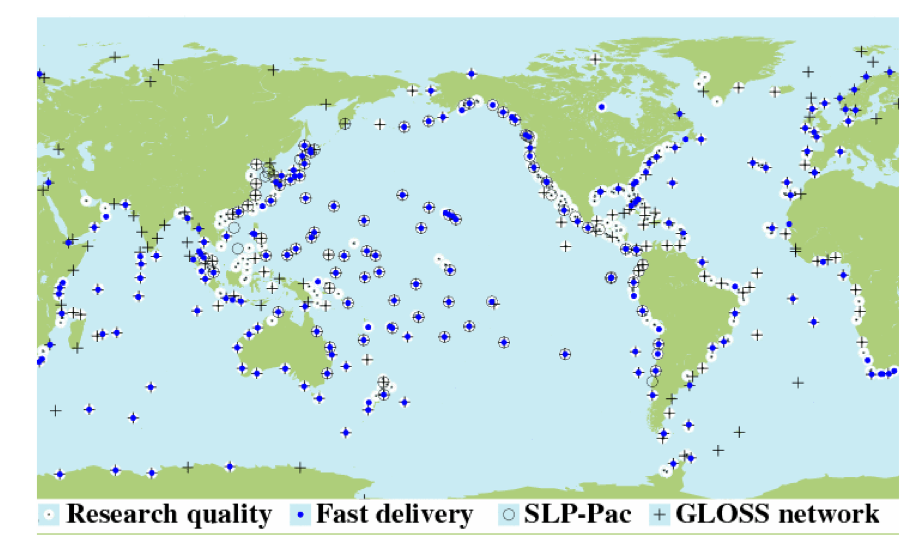
Storm size is important as well as intensity



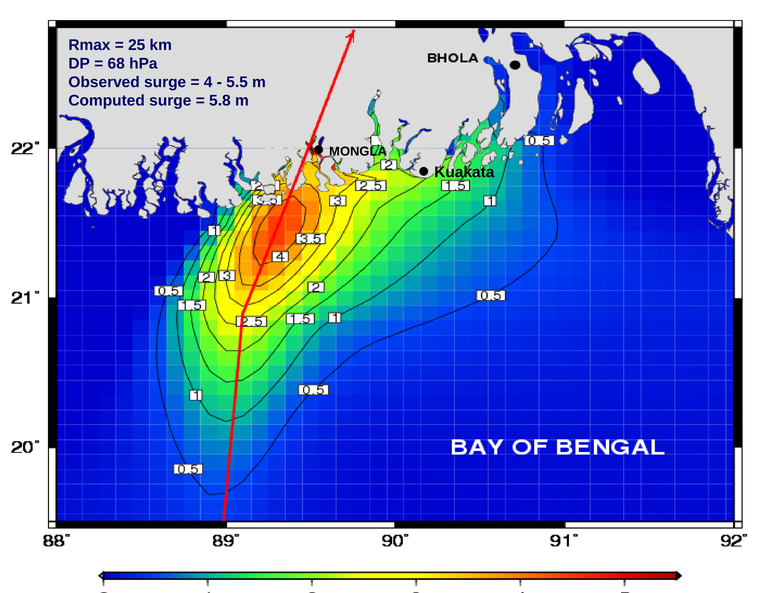
Altimeter measurements of water level contribute to model validation (sometimes assimilation) and to heat content estimates which contribute to intensity predictions

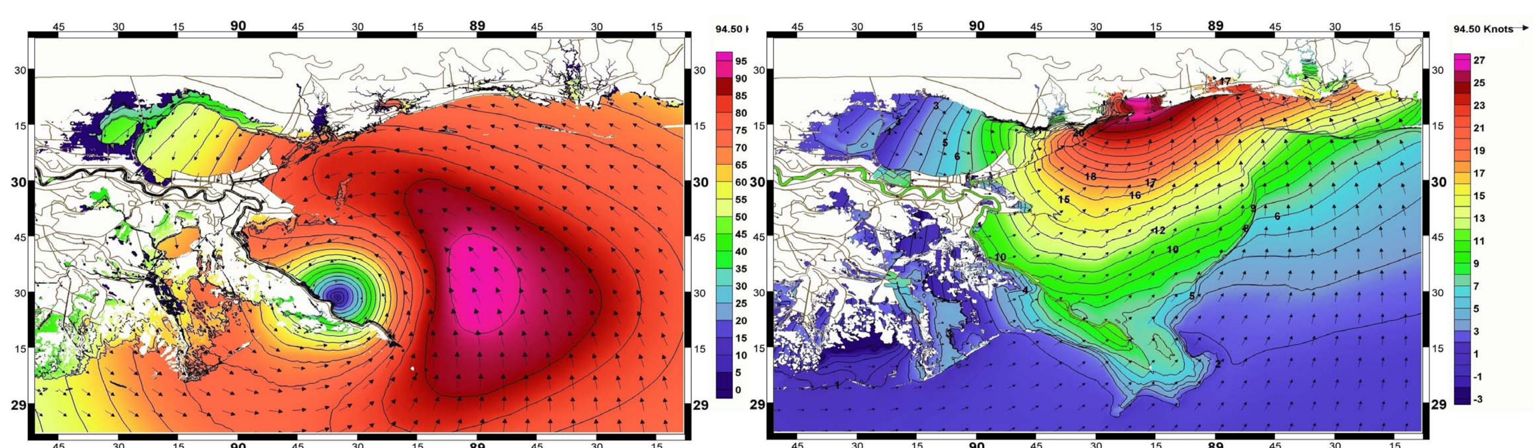


Ensemble predictions provide useful information on probability of exceeding thresholds and indicating uncertainty

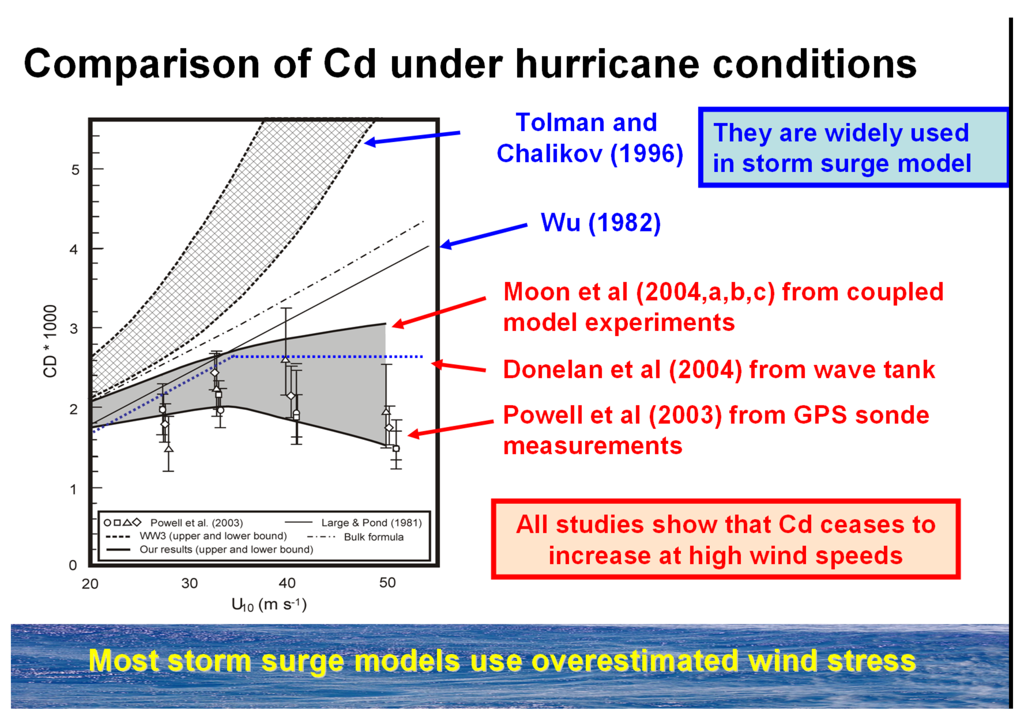


The UHSLC water level network. Measurements are important for nowcasting and model validation but spatial coverage for storm surge studies is less than optimal

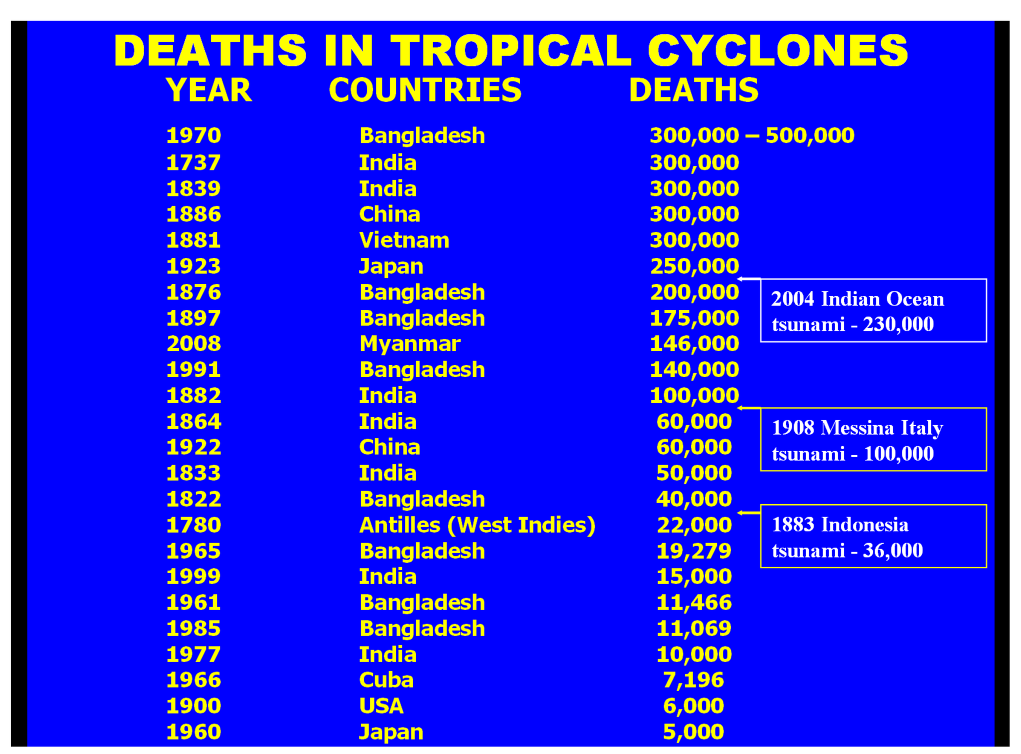




Storm surge model results for Cyclone Sidr (left) , and Katrina (above)



Wind stress relationships in extreme storms are an important ongoing research requirement (after Moon et al., 2007)



DEATHS IN TROPICAL CYCLONES

YEAR	COUNTRIES	DEATHS
1970	Bangladesh	300,000 – 500,000
1737	India	300,000
1839	India	300,000
1886	China	300,000
1881	Vietnam	300,000
1923	Japan	250,000
1876	Bangladesh	200,000
1897	Bangladesh	175,000
2008	Myanmar	146,000
1991	Bangladesh	140,000
1882	India	100,000
1864	India	60,000
1922	China	60,000
1833	India	50,000
1822	Bangladesh	40,000
1780	Antilles (West Indies)	22,000
1965	Bangladesh	19,279
1999	India	15,000
1961	Bangladesh	11,466
1985	Bangladesh	11,069
1977	India	10,000
1966	Cuba	7,196
1900	USA	6,000
1960	Japan	5,000

2004 Indian Ocean tsunami - 230,000

1908 Messina Italy tsunami - 100,000

1883 Indonesia tsunami - 36,000

Most fatalities in tropical storms are due to storm surge. All casualty figures are estimates which vary widely according to source.

Data Requirements

Before a storm surge event – bathymetry – 100 m horizontal resolution, 1 m vertical, every 5 years, on shelf
coastal elevation – 5 m horizontal resolution, 0.5 m vertical, every 10 years

After a storm surge event – surveys of inundation extent, depth and duration – 25 m resolution

During an event and the preceding few days – metocean forcing and water level response

Storm track and intensity, near shore wind fields, wave heights, surface water levels, surface pressure fields, surface currents, sea surface temperatures, vertical temperature profiles, sea surface height anomalies

Data sources – altimeter, scatterometer, synthetic aperture radar, tide gauges, metocean buoys, dropsondes, HF radar, Doppler radar, NWP and parametric models, ensemble models, shoreline weather observations, manned and unmanned aircraft observations