STATE UNIVERSITY

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Ocean Surface Topography From Space

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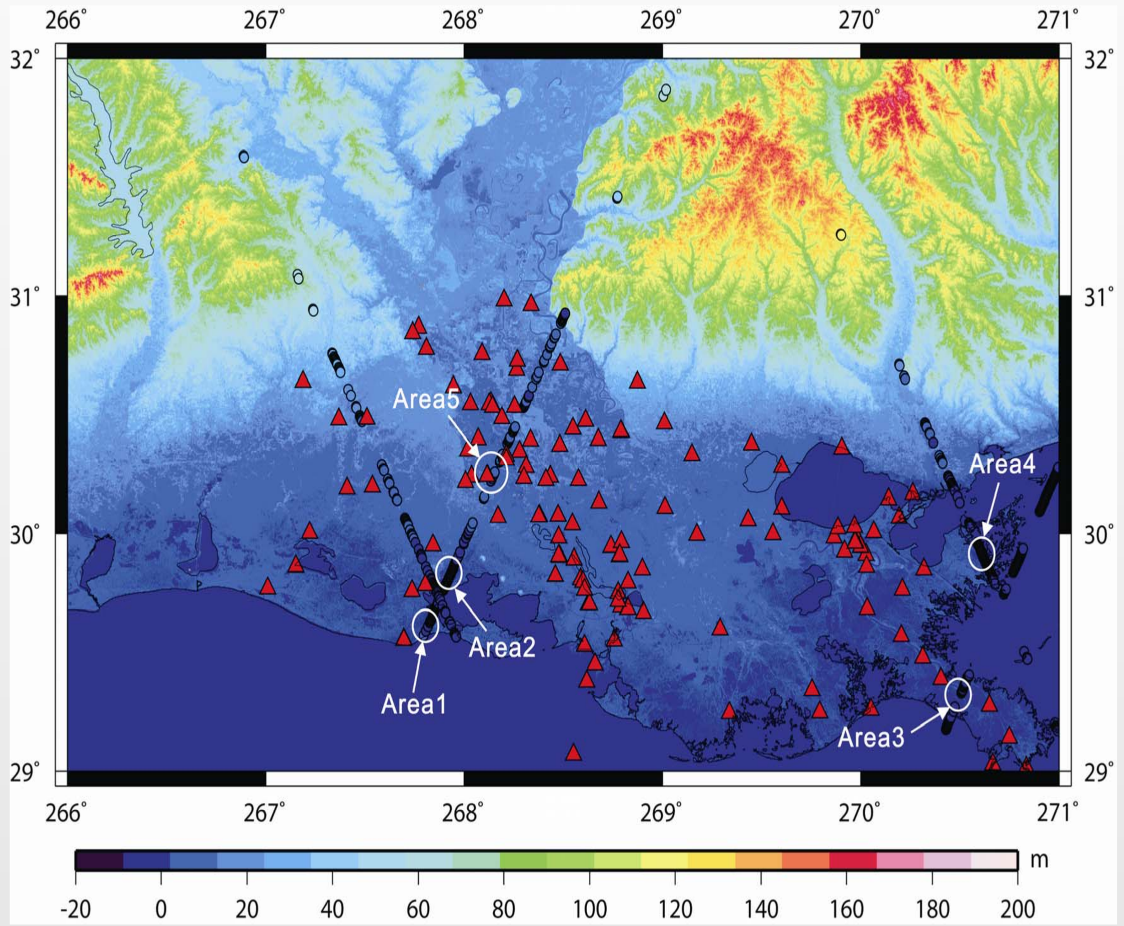
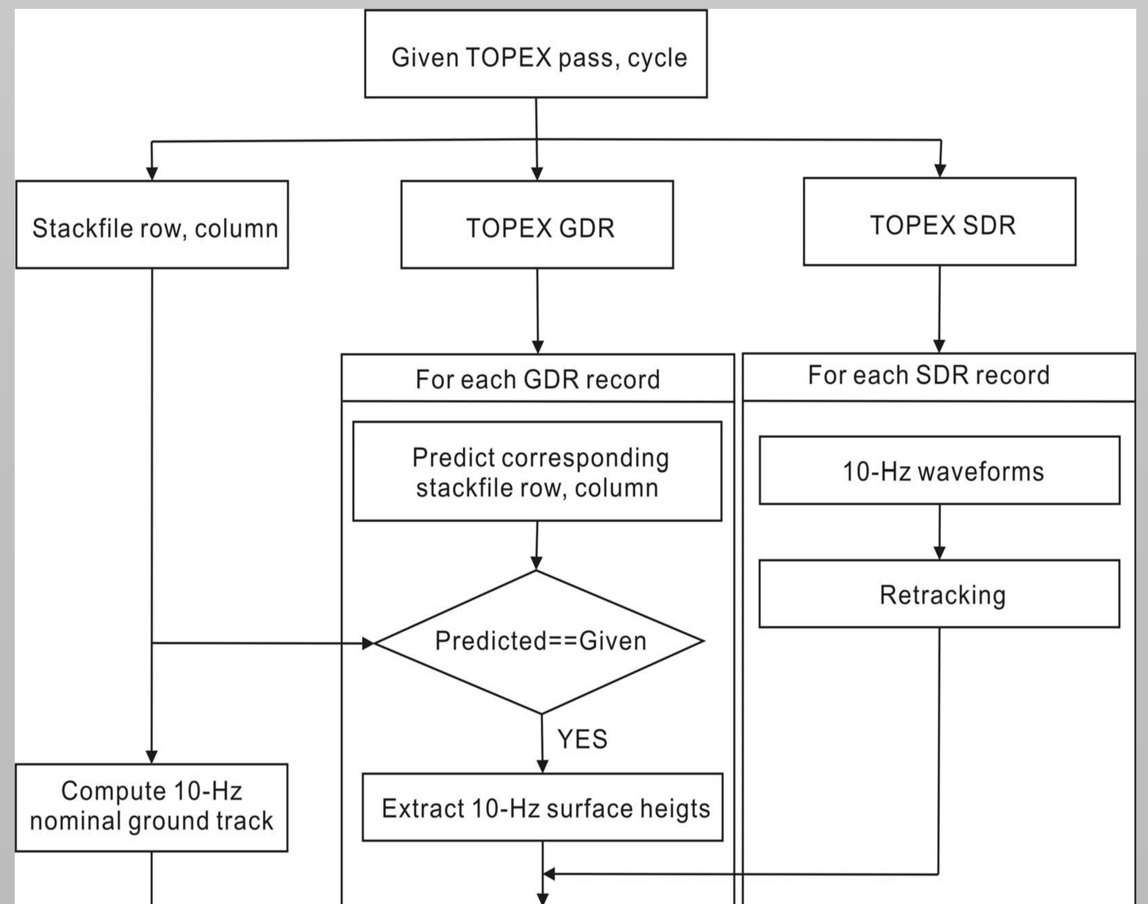
Introduction



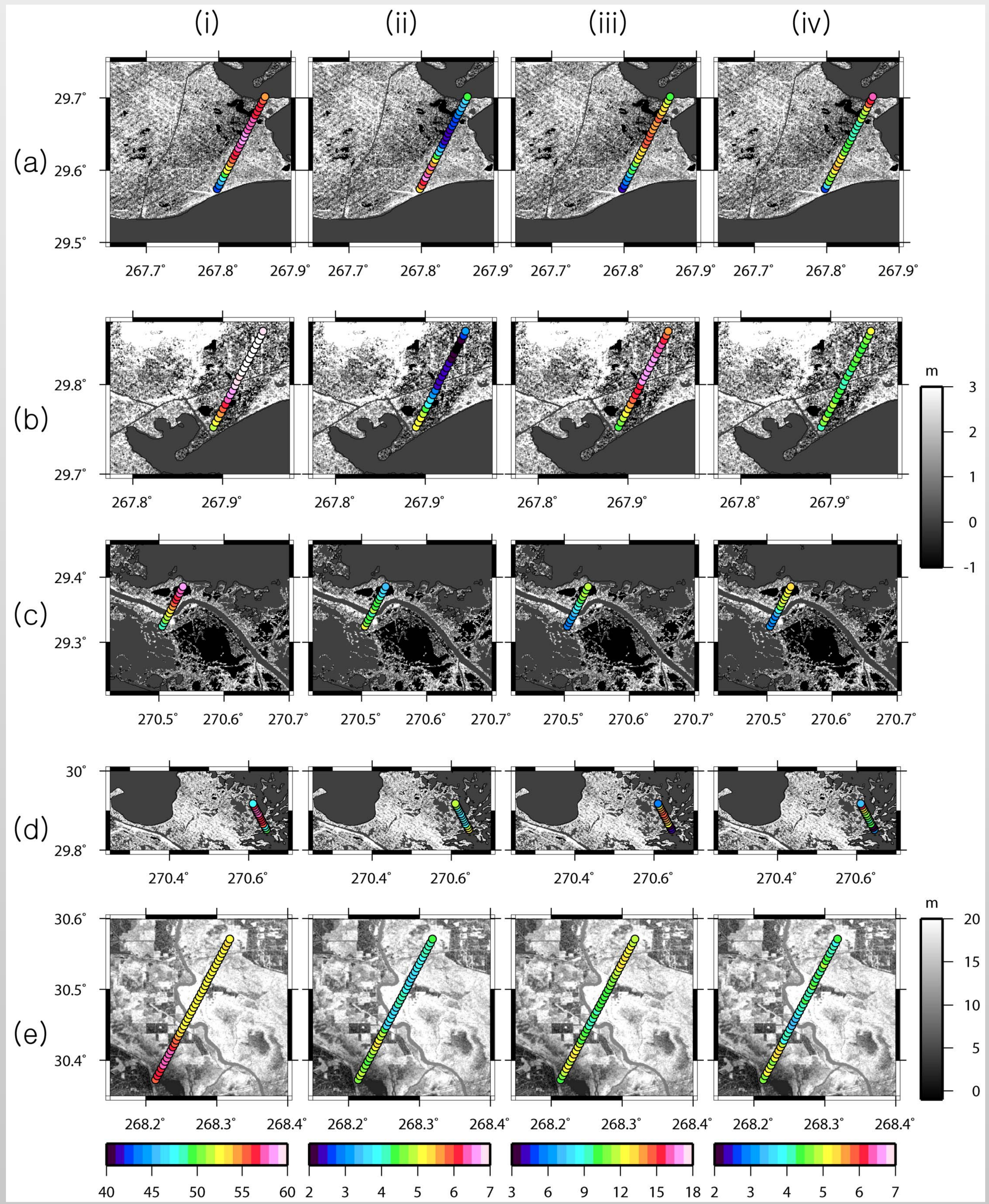
Interferometric synthetic aperture radar (InSAR) has been proven to be useful to measure centimeter-scale water level changes over Amazon flood plain (Alsdorf et al., 2000, 2001) and Everglades wetland (Wdowinski et al., 2004) using L-band SAR imagery. Furthermore, ERS-1/2 C-band InSAR data have been used to demonstrate its feasibility to monitor water level changes over Louisiana wetlands (Lu et al., 2005). In addition, satellite radar altimetry has been used to measure inland water level variation over large river basins (Birkett, 1998; Birkett et al., 2002). In this study, we use decadal (1992-2002) TOPEX/POSEIDON (T/P) data to measure water level changes over Louisiana wetlands. Unlike all of the previous studies, which spatially average 10-Hz data over a distance corresponding to the intersection between the satellite ground track and water body, we employ 10-Hz regional land stackfile technique over Louisiana wetlands. As a result, for the first time, measuring water level change over each 10-Hz stackfile bin, which has along-track ground spacing of ~660 m, is enabled. We also demonstrate the feasibility of applying retracking corrections whereas previous studies (Birkett, 1998; Birkett et al., 2002; Maheu et al., 2003) considered radar returns from nominal tracking mode contained in TOPEX Geophysical Data Records (GDRs) adequate.

10-Hz Stackfiles Procedure



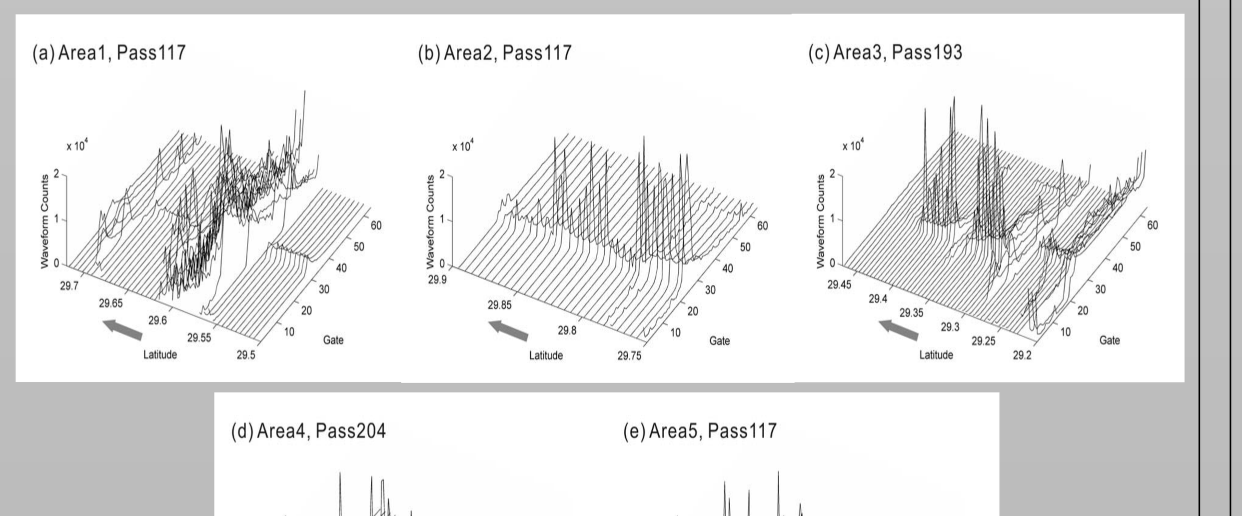
Target Selection

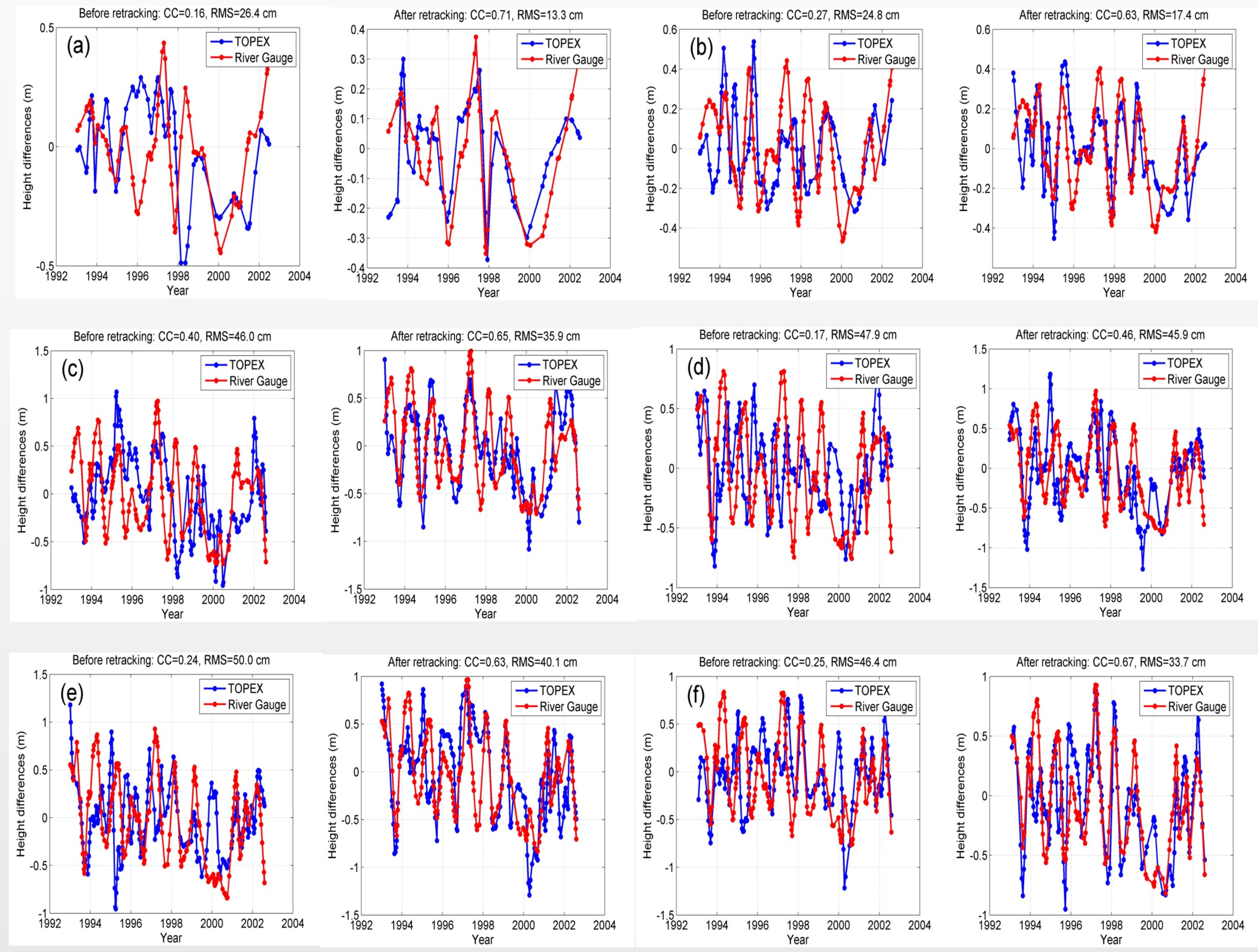
Our study area comprises the Teche/Vermillion Basin (Area1 and Area2), Barataria Basin (Area3), Lake Pontchartrain Basin (Area4), and Atchafalay Basin (Area5) of coastal Lousiana. Geographic boundaries of the study areas are selected using the land classification map from Louisiana Gap Analysis Program (GAP) by including only marsh regions which are intersected by the satellite passes and excluding agricultural cropland/grassland. Accoding to the land cover map from the Louisiana Gap project and other studies (Visser et al., 1998, 2000) vegetation type of Area1 and Area2 is brackish marsh of which the measured mean mudline elevation is approximately 28 cm (Gammill et al., 2002). Area3 and Area4 are covered by saline marshes which are adjacent to the bays. Area5, upstream Atchafalaya Basin, is covered by swamp forest which are composed of moderately dense trees ranging from 10 to 25 m in height (Lu et al., 2005).

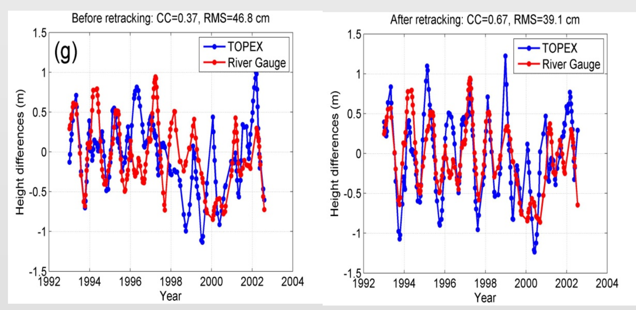


(i) Averaged AGC (dB) (ii) Standard deviation of AGC (dB) (iii) Averaged Pulse Peakiness (iv) Standard deviation of Pulse Peakiness over each 10-Hz stackfile bin of Area1 to Area5 ((a)~(e)). The background is SRTM DEM elevation (m) with its colour-bar on the right side.

Retracking

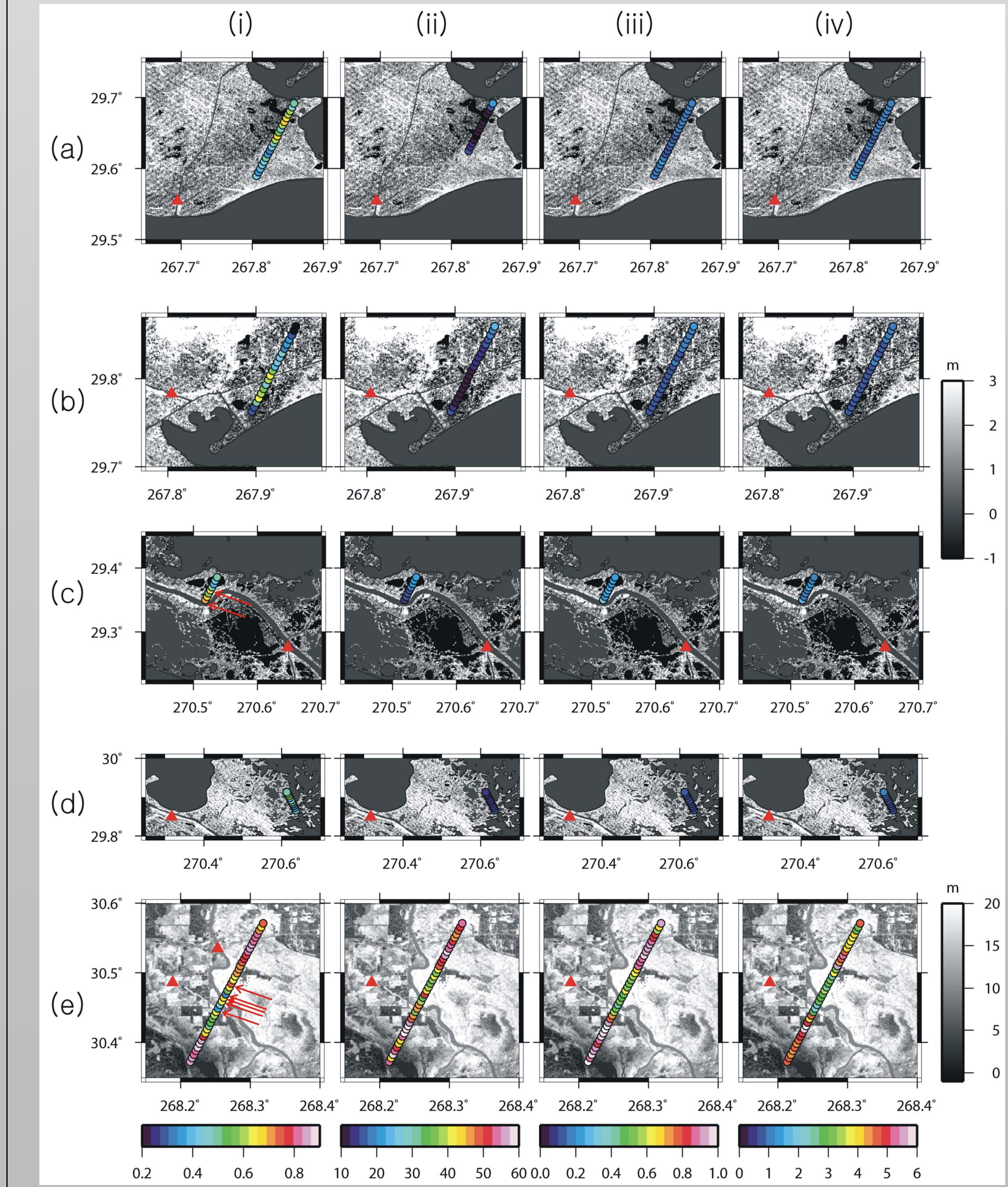






Comparison of TOPEX and nearby river gauge water level time series before and after retracking over (a) Area3_6, (b) Area3_9, (c) Area5_15, (d) Area5_17, (e) Area5_18, (f) Area5_19, and (g) Area5_22, respectively. Note the higher correlation coefficient and smaller RMS differences after retracking.

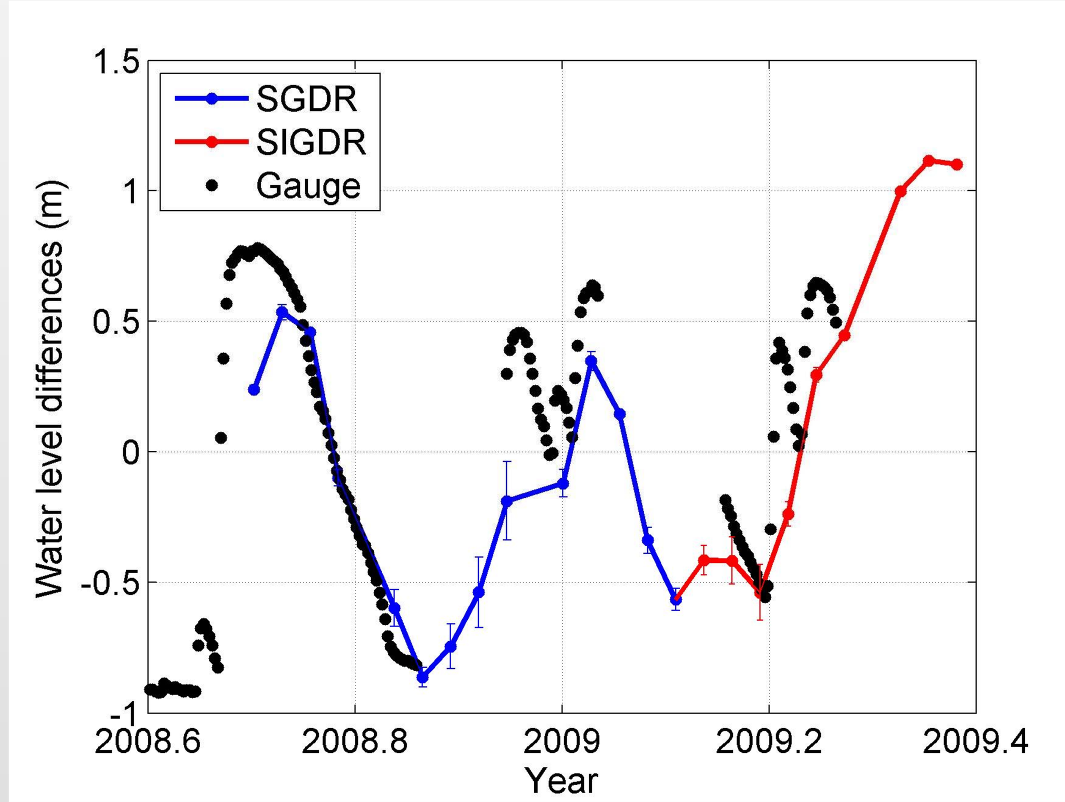
Wetland Water Level Variation from TOPEX



(i) Correlation coefficients and (ii) RMS differences (cm) between

Area1 and Area2, which are covered by brackish marshes with relatively low canopy, show smaller spatial variation among the 10-Hz stackfile bins. However, Area3 and Area4 have distinct changes in their water level trends from bin to bin, which may get influenced by the surronding ocean. The variation of the water level trends can be seen more clearly over Area5.

Jason-2 Retracked Measurements



Jason-2 GDRs and IGDRs have been successfully used to monitor water level variation over Area5 which has vegetation type of swamp forest. ICE-1 retracked measurements are used. Given the short delay in data availability (1-2 days) of Jason-2 IGDRs, it can be an important source of complementing regular river gauges.

Conclusions

An innovative technique to estimate the water level variation using TOPEX radar altimetry in Louisiana wetlands was developed and demonstrated. The 10-Hz *stackfile* procedure was used to map the water level change over each of the 10-Hz *stackfile* bin with the highest along track spatial sampling (~660 m) achievable from TOPEX. Furthermore, the need for retracking over vegetated wetlands was examined by computing the retracked gates and comparing the water level time series from TOPEX and river gauge before and after retracking. Most of the study sites, which did not show improvement after retracking, are distributed around the brackish marsh which has relatively low canopy. None of the study areas showed higher correlation between the time series from TOPEX and river gauge as the 10-Hz *stackfile* bins become closer to the river gauge station, which may indicate the complex nature of the wetlands flow dynamics due to the levees, dredging, and impoundment. These observations could help to quantify the depletion or rise of water level in wetlands and to provide precise estimates of water storage over wetlands. These observations can also be used to improve the hydrologic modeling by providing large-scale calibration data sets to precisely estimate hydrological parameters for numerical modeling. Improving hydrological modeling is a critical step to enhance prediction and assessment capabilities for future flood events over wetlands.

Acknowledgements