Evaluating a Real-Time Satellite-Derived Surface Current Product in the Intra-American Seas

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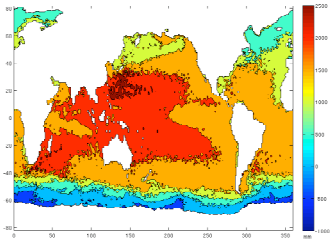
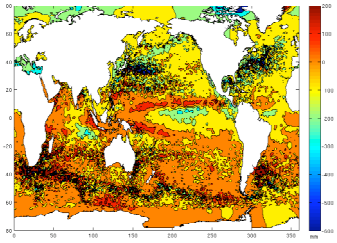
Abstract. A daily, global, high-resolution real-time sea surface height (SSH) product has been developed as a contribution to the updated version of the Ocean Surface Current Analysis Real-time (OSCAR), which produces daily, global, real-time surface current maps available via the web (http://www.oscar.noaa.gov). A discussion of the creation of the SSH map using a combination of the near real-time multi-altimeter AVISO and Naval Research Lab (NRL) products, along with extrapolation to real-time computed with the linear prediction method is presented. Preliminary results from an intercomparison with tide gauges and ADCP data in the Intra-American Seas (IAS) are also presented. The IAS are chosen as a stringent test of the altimetry due to their complex current structures and unique topography and bathymetry. Future work will include the construction of a 1st order climatology of the region given the results of this comparison.

Creating the Real-Time SSH Product.

Perform the necessary modifications to two multi-altimeter products in order to combine them and then use an extrapolation technique to bring the products to real-time. Arbitrarily chosen example maps below are from 01 May 2007.

- AVISO Near-Real Time (NRT)
  - SSH including background mean field
  - latitude-dependent grid (1/3° at equator)
  - approximately 14-day latency
- NRL
  - SSH anomaly
  - 1/8° grid
  - unknown latency





Making First Adjustments

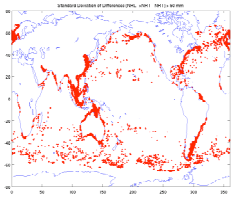
- Compute a long-term mean field from the AVISO delayed-time product to be added to NRL
- Use "nearest neighbor" interpolation to put NRL onto the AVISO grid
- Note: Adjusted NRL is referred to as "NRL-->NRT"

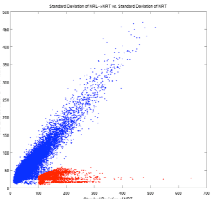
Determining NRL Latency and the Length of the Time Gap to Real-Time

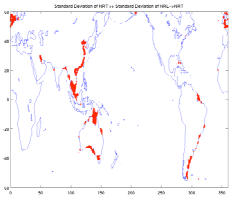
- Compute a global area-weighted lagged covariance between NRL and NRT
- NRL leads NRT by 5 days
- The length of the time gap to fill to real-time is 5 days
- Use linear predictive coding using model order 100 and a training period of 1 year to extrapolate to real-time
- Current work includes optimization of parameter choices for extrapolation
- Performance of the extrapolation is tested against persistence

Characterizing Differences between the NRT and NRL-->NRT Products

- Areas where the standard deviation of the differences between NRL-->NRT and NRT is > 50 mm (below left) are in high-energy areas and associated with high-wave number phenomena--where one would expect a difference in the amount of smoothing between the products to show up--and also include coastal areas where a global tidal model used in the creation of the altimeter product would be expected to perform badly
- Define values where the standard deviation of NRT greatly exceeds that of NRL-->NRT (below center, in red) as where the standard deviation of NRT is > 3 times that of NRL-->NRT and is > 100 mm
- A map of locations where the standard deviation of NRT >> standard deviation of NRL-->NRT (below right) shows areas where the local tidal range can vary greatly from typical tidal ranges, suggesting there is inconsistency between the tidal models or corrections being used by the NRT and NRL products

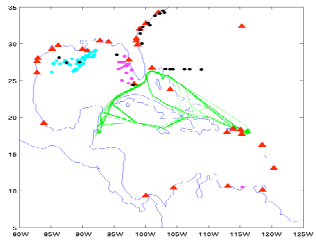






In-Situ Measurements in the IAS.

Tide gauge and velocity measurements are gathered from various sources. Velocity measurements are both shipboard and stationary.



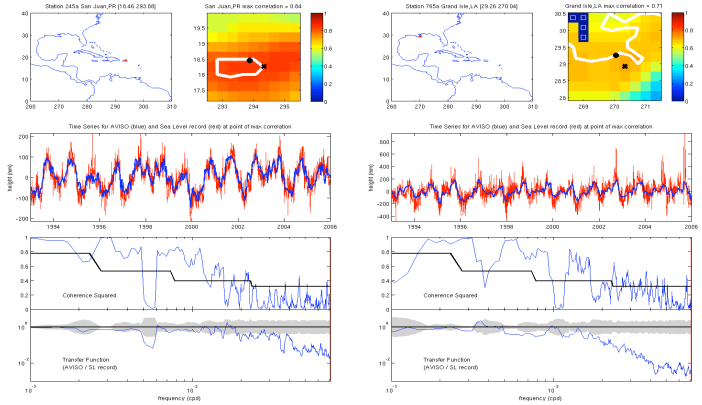
Thanks to all those who provided these data:

- University of Hawaii Sea Level Center
- Minerals Management Service
- Ocean Circulation Group at the USF College of Marine Science
- National Data Buoy Center
- National Oceanographic Data Center
- Rosenstiel School of Marine and Atmospheric Science
- LATEX and NEGOM shipboard ADCP data (not shown) courtesy of Texas A&M University and the Minerals Management Service

- Sea level data from tide gauges will be compared to AVISO SSH and velocity measurements will be compared to surface geostrophic velocities inferred from AVISO SSH gradients.

Preliminary Results.

Determine whether or not a tide gauge record and AVISO capture the same information. The AVISO series used in the comparison (location marked by the black X) has the highest temporal correlation with the tide gauge series (black dot) in the immediate vicinity of the tide gauge. The black line in the coherence squared (CS) plot is the 95% confidence level for the variable-width smoothing used. The black line in the transfer function (TF) plot is the = 1 value, while the gray shaded area is the 95% confidence interval.



- The time series show a fair bit of agreement across the record length except for high-frequency variability recorded by the tide gauge that AVISO cannot capture, but in frequency space, marked differences become apparent
- San Juan, Puerto Rico (above left)
  - The CS shows a significantly large deficiency in AVISO occurs in a frequency band corresponding to 170-198 days and includes the semi-annual frequency--it is suspected this could be attributed to tide model error
  - The TF roll-off occurs at a frequency corresponding to approximately 50 days, showing where the amount of smoothing done to AVISO begins to affect the comparison
- Grand Isle, Louisiana (above right)
  - The CS is low in a frequency band corresponding to 85-97 days and may not be easily explained by tide model error
  - The TF roll-off occurs at a frequency corresponding to approximately 62 days, a lower frequency than for San Juan, perhaps indicating that the amount of smoothing in AVISO differs depending on location

Future Work.

A first order climatology will be constructed based on the results of the intercomparison.

Dominant features described taking into account strengths and weaknesses of the altimetry in the IAS could include variability in the structure and flow of the Caribbean Current, Loop Current and Florida Current, as well as the structure and frequency of occurrence of eddies in the Caribbean, Gulf of Mexico and along the Gulf Stream.

Acknowledgments.

Thanks to the **Centre National d'Études Spatiales** for the AVISO NRT product, to the **U.S. Naval Research Laboratory** for the NRL product and to **NASA**, **NOAA** and **ONR** for funding for this project.