Development of an Enhanced Geophysical Data Record for the TOPEX mission: Analysis of TMR data flags

Sidharth Misra and Shannon Brown

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

INTRODUCTION

An Enhanced Geophysical Data Record for TMR on the TOPEX mission is being generated that improves upon various variables such as, a coastal land contamination corrected wet tropospheric path delay, enhanced land flags that correct for overestimation of the TMR antenna beam-width, as well as improved ice and rain flags. Several geophysical variables are derived from altimetry data, such as significant wave height H, standard deviations of height estimates, attitude, sea-level anomalies (below) etc. An incorrect interpretation of altimetry data due to unflagged precipitation events can lead to erroneous conclusions *(Quartly et al. 1996)*.
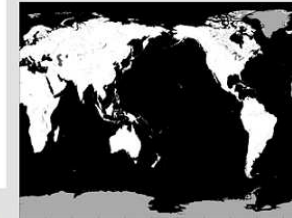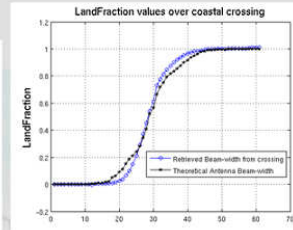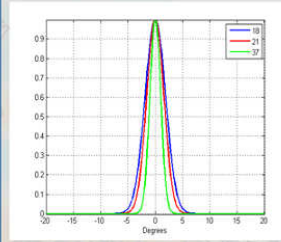
The algorithms used for generation of three improved TMR flags (Land, Ice and Rain) are presented. The Ice and Rain flags are compared with JMR flags during the tandem periods for performance evaluation.
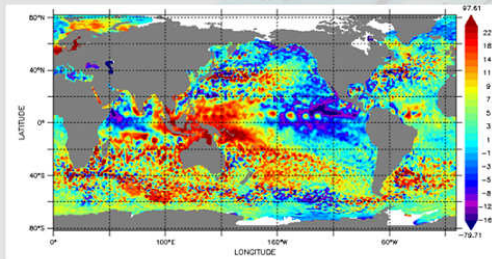

Maps of Sea Level Anomalies Merged (cm)

Land Flag

LandFraction values over coastal crossing

$$LF_{new}(f) = LF(f) - n(f)\sin(2\pi LF(f))$$
$$LF_{new}(f) \in [0,1]$$

- A simulated symmetric antenna pattern (top-left) with half-power beam widths based on (Janssen, 1995) was used on the high resolution land mask (top right) to estimate the amount of land fraction per TMR sample near the coastal areas.
- Evaluating simulated beam-widths with coastal-crossings TBs (top middle) indicated overestimation of TMR beam-widths.
- The antenna beam-widths were empirically adjusted to match PD values by varying the parameter n in the equation above.
- As a result, improved land fraction and hence land-flag values are obtained aiding in coastal wet tropospheric path delay correction

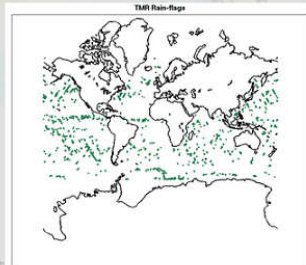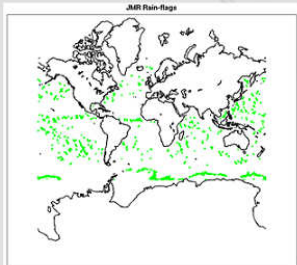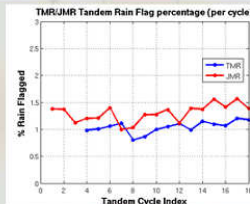## JMR / TMR Tandem Results
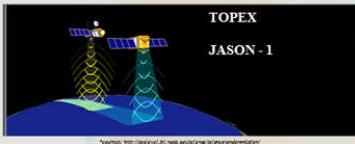
TOPEX

JASON - 1

- Jason and TOPEX made tandem co-incident measurements for a brief period of 33 cycles
- This gives an excellent opportunity to compare improved TMR rain and ice flags with concurrent JMR flags
- Preliminary results point towards some differences in the two flagging techniques

Rain Flag

- Rain is flagged by observing anomalously high cloud liquid water or TB at 18GHz
- Rain is absorptive at microwaves and hence increases the TB observed over the ocean
- TMR TBs are used to calculate cloud liquid water, and if this value is above 0.6kg/m^2 or if TB18 is above 180K the rain flag is triggered
- It should be noted though that TMR precipitation flag is slightly less than JMR over the same period

TMR/JMR Tandem Rain Flag percentage (per cycle)

$$f_{rain} = \begin{cases} 0 & ,if\ TB_{18} > 180K\ or\ CLB > 0.60kg/m^2 \\ 1 & ,else \end{cases}$$

JMR Rain-flags

TMR Rain-flags
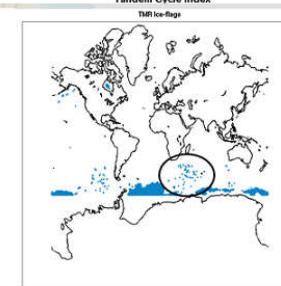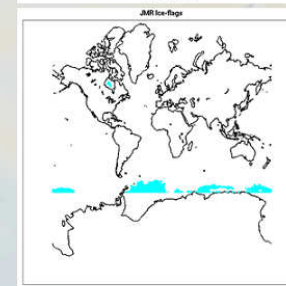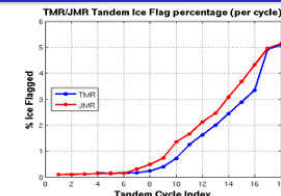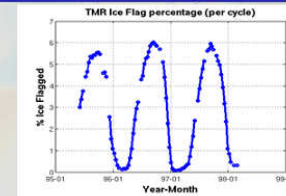
Ice Flag

- In order to generate the ice flag a simple spectral difference algorithm was applied
- The emissivities of sea ice at TMR frequencies are around 1 and has very little spectral dependence
- Hence TBs of ice around 18GHz and 37GHz are very similar to each other
- If the difference between the two TBs is less than 20K then the measured footprint is considered to be contaminated by ice
- As noted from the tandem measurements the flag percentage agrees well between JMR and TMR
- TMR flags though do seem to be picking up a few more ice signatures as marked by the circle that needs to be investigated further

TMR Ice Flag percentage (per cycle)

TMR/JMR Tandem Ice Flag percentage (per cycle)

$$f_{ice} = \begin{cases} 0 & ,if\ |TB_{18} - TB_{37}| < 20K \\ 1 & ,else \end{cases}$$

JMR Ice-flags

TMR Ice-flags

Summary

- An Enhanced GDR for TMR is currently under development and validation phase
- Initial land flag calculations based on TB retrievals indicated an overestimation of antenna beam-width due to simulated TMR antenna patterns, this beam-width is corrected by tuning the correction parameter to model PDs
- JMR and TMR tandem cycles were used to evaluate the performance of the rain and ice flag
- The improved TMR rain flag shows consistent results when compared to JMR, though the precipitation percentage per cycle is lower for TMR
- The ice flag seems to be performing nominally, with excellent match up with JMR
- There are a few additional regions flagged as ice by TMR that need to be investigated before releasing the enhanced data product