Satellite maneuvers for AMR calibration on JASON-3

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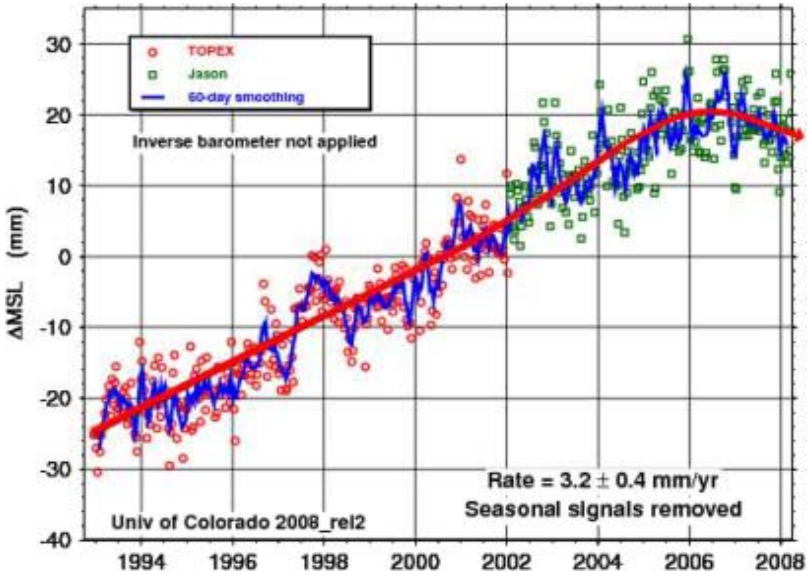
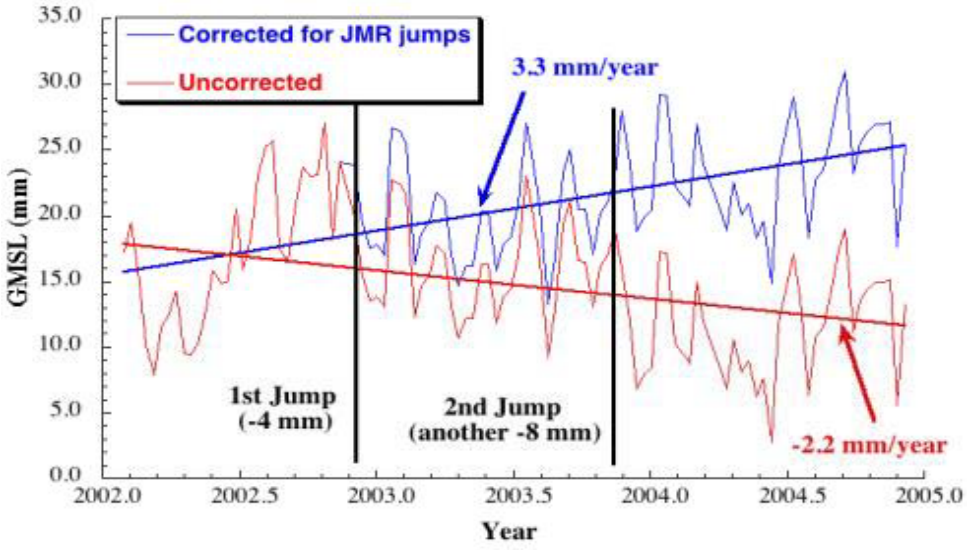
JASON Radiometer Calibration

- **Altimeter measurement system stability is critical for tracking sea level change into the next decade**
- **On long spatial and temporal scales, radiometer measurement can be the largest source of error in the global mean sea level (GMSL) time series**
- **Altimeter radiometers use relative internal calibration references and are not referenced to any calibration standard – (but, no moving parts)**

Any long term drift must be detected and accounted for in post processing





OSTST Recommandations

- **2009 OSTST (Seattle) : consider improving the stability of the wet path delay provided by the radiometer (largest source of error in the estimate of global mean sea level) :**
  - Topex, Jason-1, Jason-2 and Jason-3 radiometers require calibration to external stable sources (vicarious on-Earth calibration targets) to meet mm/year PD stability requirements
  - On-board external calibration hardware provide very stable long term calibration reference

- **2010 OSTST (Lisbon) : Jason-3 project shall continue to consider as a goal the possibility of improving the AMR stability through on board calibration to the extent feasible within budget and scheduling constraints**
  - Goal: Jason-3 shall measure globally averaged sea level relative to levels established during the cal/val phase with zero bias +/- 1 mm (standard error) averaged over any one year period.
  - Latency: As a goal, the project will attempt to design Jason-3 to meet this level of accuracy with a latency of 2 months, in time for production of the GDR.

JASON-3 response to OSTST recommendation

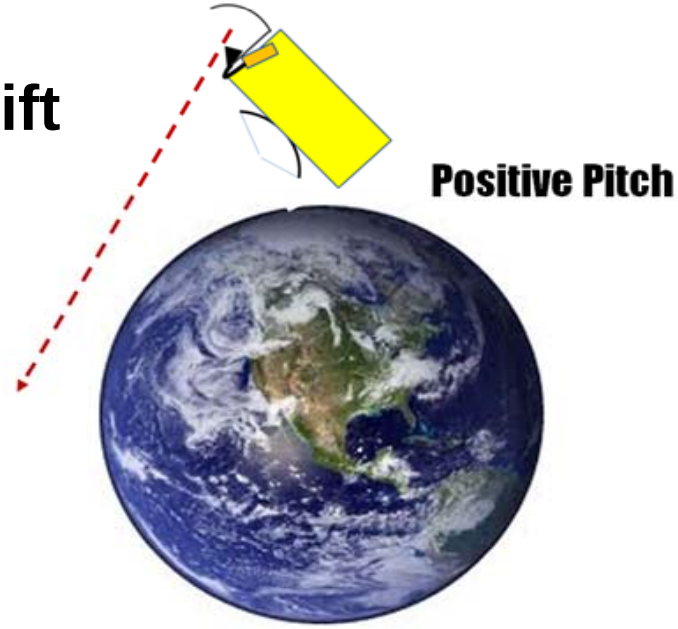
- **JPL performed a feasibility study to assess the possibility of adding an on-board absolute calibration reference to JASON-3 AMR**
  - Addition of a secondary reflector, periodically positioned in front of the feedhorn to obtain a cold sky and supplement the noise diode calibration

- **JASON-3 4 Partner Project team conclusion was presented at System Synthesis Design Review (SSDR, Feb 2011) :**
  - The study concluded that the AMR calibrator was not feasible within existing Jason-3 platform design (missing thermal lines), budget and scheduling constraints
  - JASON-3 Joint Steering Group endorsed this proposition

- **SSDR review board recommendation : identify if a satellite maneuver could be a good alternative to periodically calibrate AMR by getting a periodic cold space view through the main reflector**
  - A second study was performed to assess the feasibility of this option

Performance Assessment of Cold Sky Maneuver

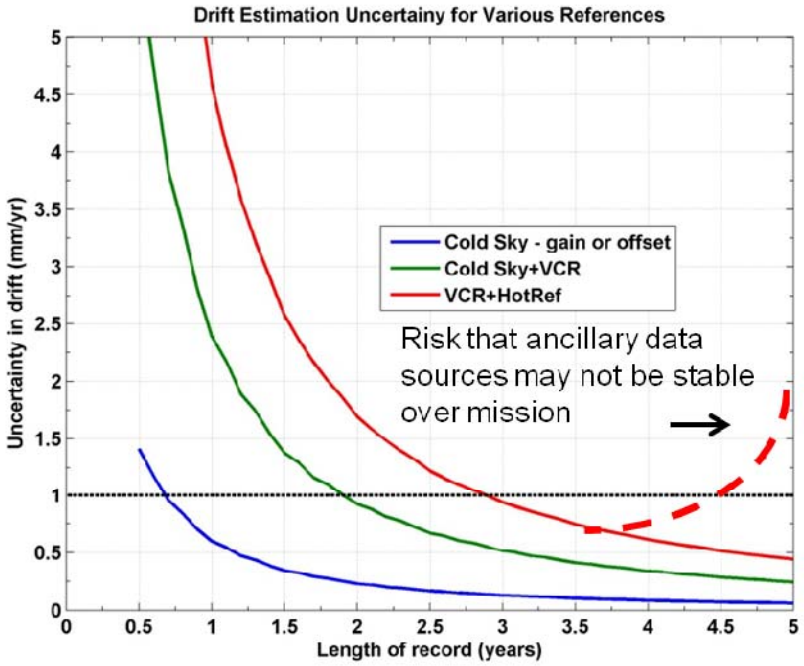
- To maintain 1mm/yr path delay stability, the radiometers TBs must be stable to 0.1K/yr
- Cold sky maneuver provides a view of a stable single-ended TB calibration reference through the main antenna
- When performed over time, provides unambiguous detection of radiometer drift
- Also provides an absolute calibration reference for the radiometer



Performance Assessment of Cold Sky Maneuver

- **Simulations show that the radiometer residual drift uncertainty can approach 1mm/yr with only an 8 month record**
  - **Ancillary information used to distinguish gain vs offset drift**

- **Cold sky maneuver reduces dependence of long-term calibration on ancillary data sources with uncertain stability on long-time scales**



AMR calibration Requirements

- **Mission constraints (backup slide)**
- **Project constraints : costs, schedule, complexity**
  - **Minimize impacts on the core mission**
  - **Minimize impacts at spacecraft and payload level**
  - **Easy implementation in the ground system**

⇨ **Requirements**

☑ *Maneuvers performed only over lands*

☑ *Attitude maneuvers on pitch (+Ysat) axis, magnitude 80° angle off nadir*

☑ *Satellite in sun eclipse*

☑ *Guidance mode : yaw fix ⇨ calibration ⇨ yaw fix*

☑ *Min 24 hours before or after any guidance mode change or other maneuver*

☑ *AMR calibration may be postponed in case of conflict with other operations with higher priority (station keeping maneuvers,…)*

…

Conclusion

- **A few figures : with these constraints, we could perform**
  - one AMR calibration ***every 2 months***
  - for a duration around ***6'30"*** (nominal case) up to 11'30" (sizing case) (figures based on JASON-2 inertia hypothesis)

- **JASON-3 implementation**
  - Change request in progress, due date for final decision : Mid November 2011
  - Implementation in line with JASON-3 schedule (tests)

- **Coordination with JASON-2 :**
  - The rationale of this solution can be applied to JASON-2 (same radiometer and same platform)
  - Decision of operational implementation : JASON-2 internal process, after validation on JASON-3

BACKUP SLIDE

Summary of Mission Constraints

- **AMR feedhorn aiming at cold sky, with a minimum Earth contribution in the antenna back lobes**
- **Time to spend within calibration : 10 to 30”**
- **No pointing nor stability requirement within calibration**
- **Frequency : No specific requirement, but drift uncertainty improves with increased frequency**