SHARAD radar sounder for the MRO Mission

SHARAD Instrument and Operations Status

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Presentation Overview

- **Instrument**
  - **SHARAD Safing Events & Status**

- **SHOC Operations**
  - **Overall Status**
  - **Targeting approach**
  - **Uplink activities status**
  - **Downlink activities status**
  - **Data archiving and delivery status**

SHARAD Safing Events & Status

- SHARAD in SAFE mode as a consequence of the MRO safing from DOY2009-238T12:45 (Aug 8, 2009) to DOY2009-343T18:58 (Dec 9, 2009)
- SHARAD in SAFE mode from DOY2010-116 to DOY2010-117
- SHARAD is now operating nominally

SHARAD Safing Status

- **SHARAD safed from DOY2009-238T12:45 (Aug 8, 2009) to DOY2009-343T18:58 (Dec 9, 2009)**
  - **Reason not clearly known**
  - **It is believed that a sudden peaked and short noise source might have affected the on-board MRO C&DH**
  - **SHARAD used by MRO Anomaly Investigation Team in the attempt to detect any anomaly EMI signals**

SHARAD Anomaly Investigation

- **Analysis results**
  - **data showed same behavior**
  - **no significant differences among them**
  - **no strong EMI signal detected**

SHARAD Safing Status

- **SHARAD safed at 2010-116T03:38:04**
  - the SHARAD safing event was driven by a malfunctioning of the planning/commanding ground sw tools
  - OSTs associated with two observations scheduled on orbit 17564 was wrongly assigned
  - This caused the lost of the observation time stop for the second acquisition, the instrument did not come out of science mode, and the sharad target block run the safing sequence
  - No issue with the instrument

- **SHARAD powered on at 2010-117. All telemetry is nominal**

SHOC Operations – Overall Status

- All operation tasks performed in a timely way without major problems
- Coordination with SHARAD Science Team
  - Science team members select continuously targets through the web page
  - New policies on rolled targeting and campaigns targeting
  - Telecons with the science team held regularly to coordinate also for the science campaign & targets selection
    - A Scientist is nominated every 2 weeks to compile the target request list
    - Target request list for first & second week of each cycle is submitted regularly. It includes request for:
      - Rolled targets
      - Nadir targets
      - Campaigns targets

SHOC Operations –Targeting Approach

- **Different targeting approach is in use**
  - **Reviewed policy for SHARAD rolled observations targeting**
  - **Reviewed policy for the SHARAD campaigns**
  - **Updated targets observation priority**
  - **More targets included into SHARAD target list**

SHOC Operations –Targeting Approach

- **SHARAD Large-Rolls policy: new approach**
  - **With the start RM085 on Jan30, MRO reached in-contact and out-contact roll angle limits period. For the next several months, roll limits for MRO will be constrained to the point that large numbers of highest-priority observations cannot be made.**
  - **Resumption of non-limited rolls will not occur again until Feb of 2011.**
  - **Following PI/TL, SOWG & SHARAD Science Team telecons, it was agreed to manage the SHARAD highest-priority large rolls request by means of 4 non-communication window. When in non-comm window time, science data downlink is turned off and MRO can exceed roll limits.**
  - **Starting from RM087, the non-comm-windows-for-SHARAD policy was applied**

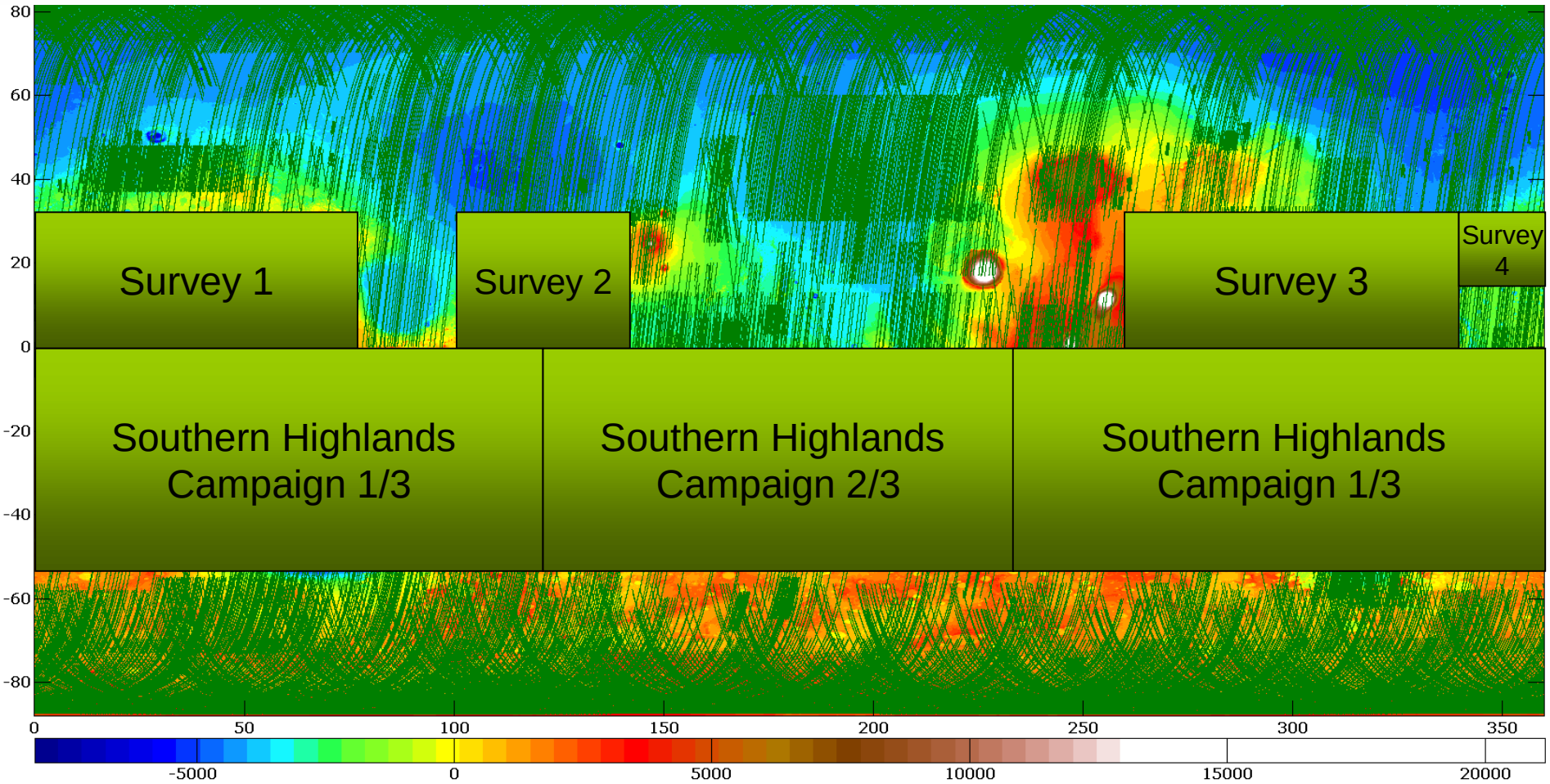
SHOC Operations –Targeting Approach

- **SHARAD Small-Rolls**
  - **SNR analysis conducted on images effected by MRO small-rolls**
  - **Small rolls has no effect on image quality improvement when MRO is rolled of small angles (<14°)**
  - **The Science team is not interested in acquiring small-rolls data and decided to drop the small rolls targeting for the remaining of the MRO roll limit period (starting from RM088)**

SHOC Operations –Targeting Approach

- **SHARAD Campaigns**
  - **North and South Polar Campaign and Hellas Campaign targeted to fill gaps**
  - **A Survey Campaign has been set up to fill uncovered areas and increase SHARAD coverage of Mars**

SHOC Operations –Targeting Approach



SHOC Operations –Targeting Approach

- **Current targets priority order**

1. Rolled Targets (pre-sum=4, bitXsample=8)
2. Nadir Targets
   i. Targets excluded from rolled targeting (pre-sum=4, bitXsample=8)
   ii. SOW targets (pre-sum=4, bitXsample=8)
   iii. Small targets (pre-sum=4, bitXsample=8)
   iv. Northern Plain Campaign (pre-sum=4, bitXsample=8)
   v. Polar Filling Coverage (pre-sum=8, bitXsample=6)
   vi. Survey (pre-sum=4, bitXsample=8)
      Southern Highlands Campaign
      Survey Coverage
   vii. Hellas Filling Coverage (pre-sum=4, bitXsample=8)
3. CEZ (if any) (pre-sum=8, bitXsample=6)

SHOC Operations – Uplink

- **Activities Status**
  - **IO and NIO Planning performed on a regular basis**
    - **By now, last planned session is NIO RM091_b**
    - **Eight rolled observations acquired regularly (when allowed) for each IO Session since RM063 and up to RM087**
    - **3 Must-have rolled observations + 5 non Must-have rolled observations policy applied from RM084 and up to RM086**
    - **4 non-comm windows policy applied since RM087**
    - **Small-rolls targeted only on RM087 (and then droped)**
  - **Commanding on a regular basis each week with the last SPICE received**

SHOC Operations - Downlink

- **Activities status**
  - **Monitoring of engineering data performed regularly, together with science data deformatting**
    - **Status email sent to the JPL MRO Team regularly each week on Monday (on Tuesday if Monday is holiday)**
  - **Processing L1A & L1B performed regularly:**
    - **L1A processed up to RM089-b**
    - **L1B processed up to RM088-b**
  - **Data visualization:**
    - **Data Archived up to RM088-b**
  - **Data archiving:**
    - **Data Archived up to RM085-b**
  - **Daily Data delivery**
    - **Data delivered up to RM073b**

SHOC Operations - Data Delivery

- **Data Delivery #13**

Successfully delivered to PDS Node on Apr. 21, 2009

- **Mission months boundaries: 33 – 36**
- **Time boundaries: Aug. 09, 2009 – Nov. 08, 2009**
- **Products boundaries: 14213 - 15392**
- **Cycle boundaries: RM072a – RM079b**

- **Delivery#13 contains only 9 products that range from 14430 – 14470 (RM072a – Part of RM073b) because of MRO safe**

Observation Statistics

- **Up to RM089_b SHARAD acquired 7082 Sub-Surface observations**

- **Up to RM089_b SHOC received ~1.605 TB of raw data**
  - **About 4.12 TB of L1A (EDR) and L1B (RDR) data products delivered to PDS Node since the beginning of PSP (up to Release 12 - *up to Release 13 waiting for ASI ACK*)**

Future Activities

- Continue the routine operation activities for uplink and downlink
- Continue support to the Science Team
- Test of SHARAD sw running on MRO SOPC machines due to Sol9 to Sol10 OS upgrade
- Complete on-going scientific activities

Back up slides

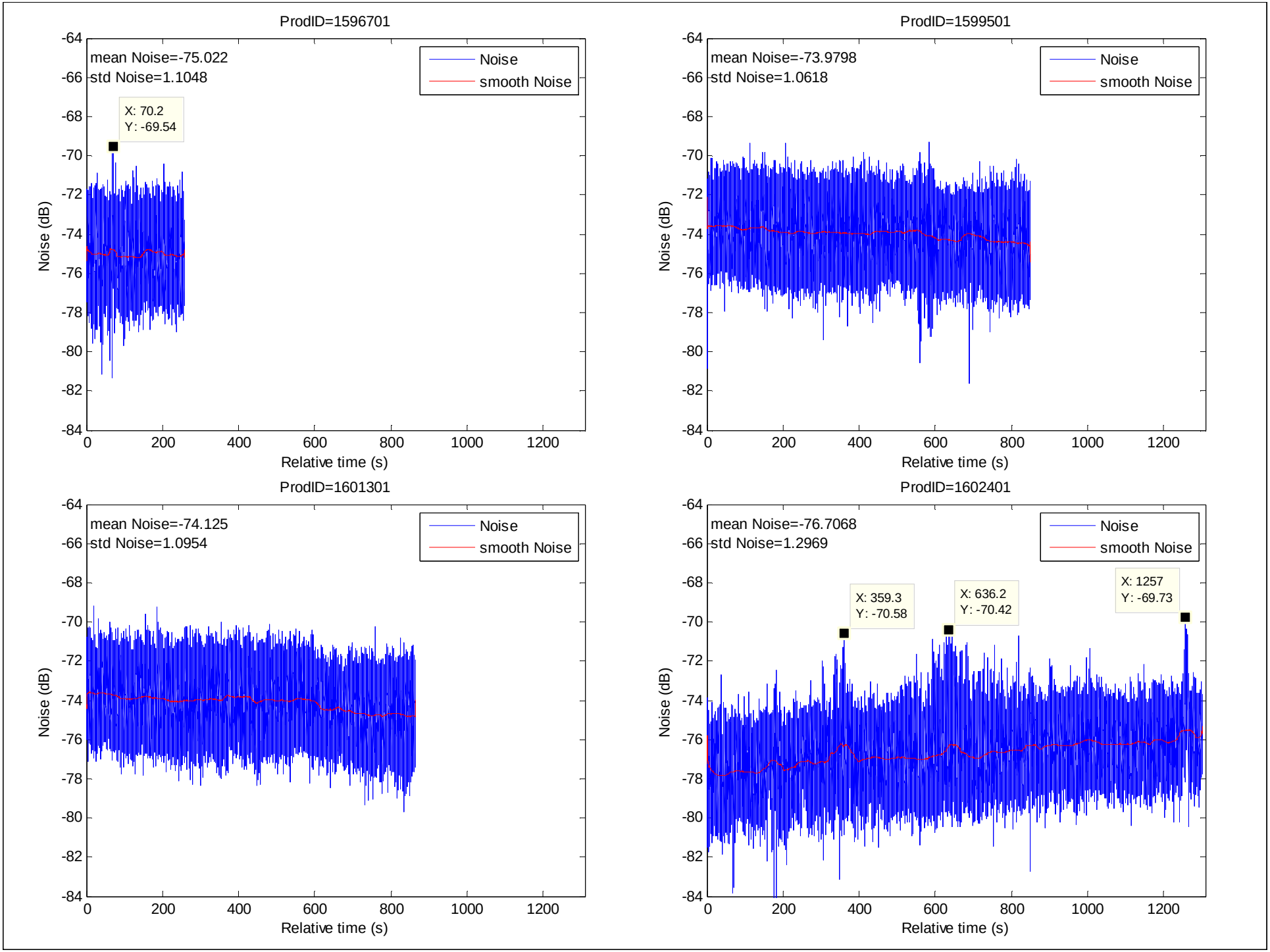
SHARAD Anomaly Investigation

- **Considering that:**
  - **SHARAD operates at ~700 Hz frequency rate, i.e. every 1428μs (and then repeats)**
  - **SHARAD opens a 135 μs "acquisition" window as part of the 1428μs period**
  - **The SHARAD receiver digitizes data at a 26.67 MHz sampling rate (~ 40 ns sample spacing) – 3600 data points per "acquisition" window**
  - **Those parameters are not programmable**
  - **SHARAD has been designed and tested to operate up to 30 minutes every orbit**

SHARAD Anomaly Investigation

- SHARAD provides:
  - Receive-Only mode
    power spectral density every 1428μs at ~ 40 ns sampling space (26.67 MHz)
  - Sub-Surface mode
    noise level value every 1428μs x pre-summing

- SHARAD measurements are useful if
  - the tone pulse is higher compared to SHARAD mean noise level and of longer duration compared to SHARAD PRF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Noise
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Noise (dB)
Relative time (s)
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Noise (dB)
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Noise (dB)
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Noise
smooth Noise
Noise (dB)
Relative time (s)