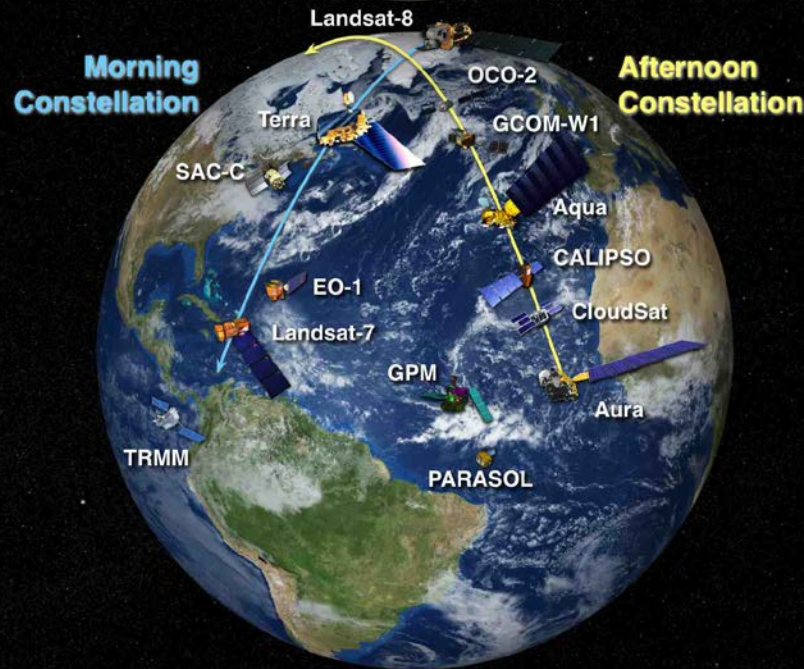




www.nasa.gov



International Earth Science Constellation Mission Operations Working Group June 12 – 14, 2018

CCS Control Box and Phasing Analysis Tool

David Knapick, Systems Engineer, a.i. solutions, Inc., Code 595

Agenda

- Discuss the mathematics and future enhancements of the Control Box and Phasing Analysis Tool
- Discuss the 01 December 2017 CloudSat inaccurate email notification

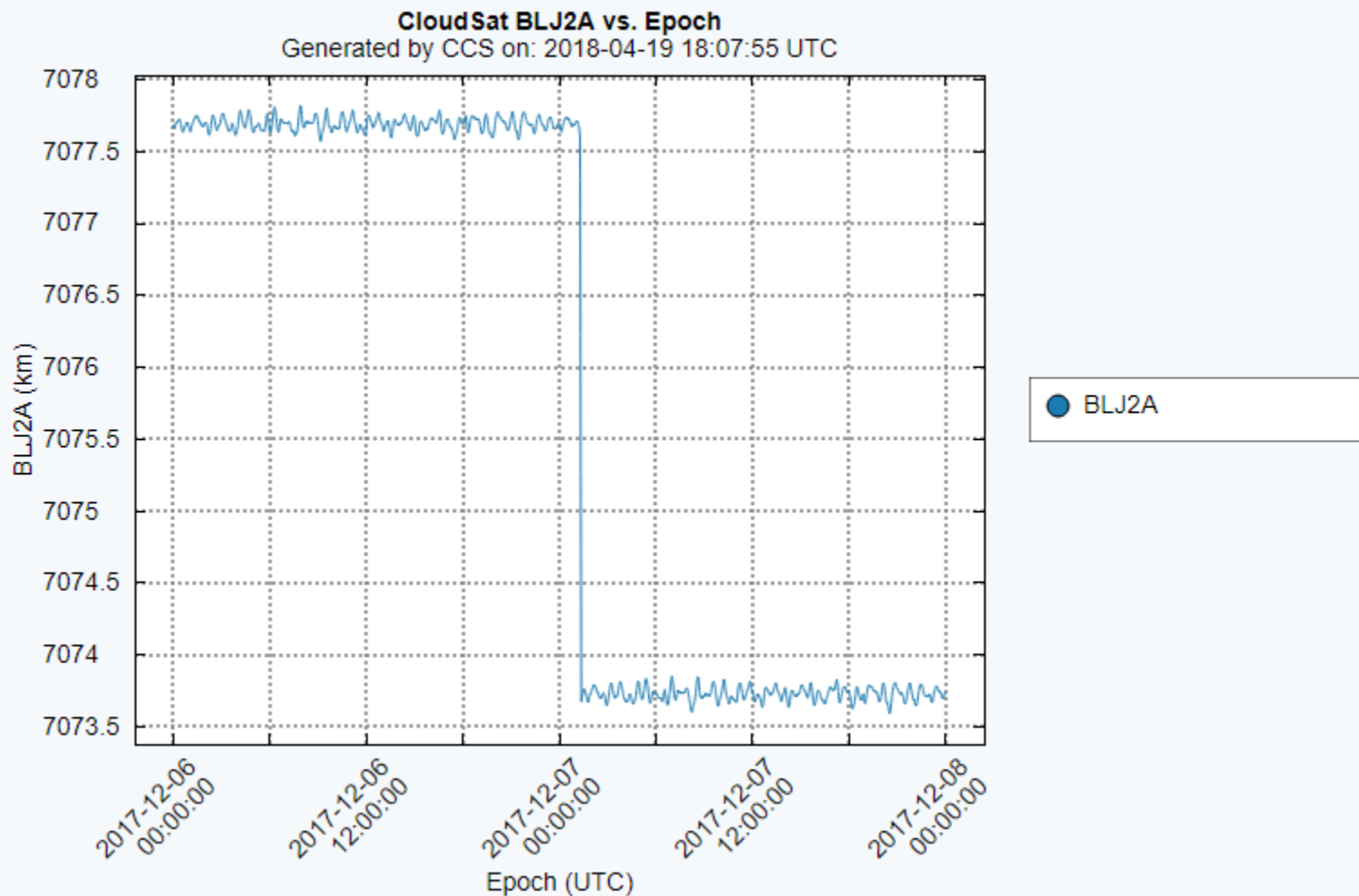
What is the CBA tool?

- The Control Box and Phasing Analysis tool allows you to visualize a mission relative to its mission defined Control Box over a specific time period, and determine if any violations occur during that time frame
- This tool also provides the data for the automated MLT analyses on the CCS home page
 - AutomatedMLTAnalysis_PredictedCurrent.txt
 - AutomatedMLTAnalysis_Future.txt

High level breakdown

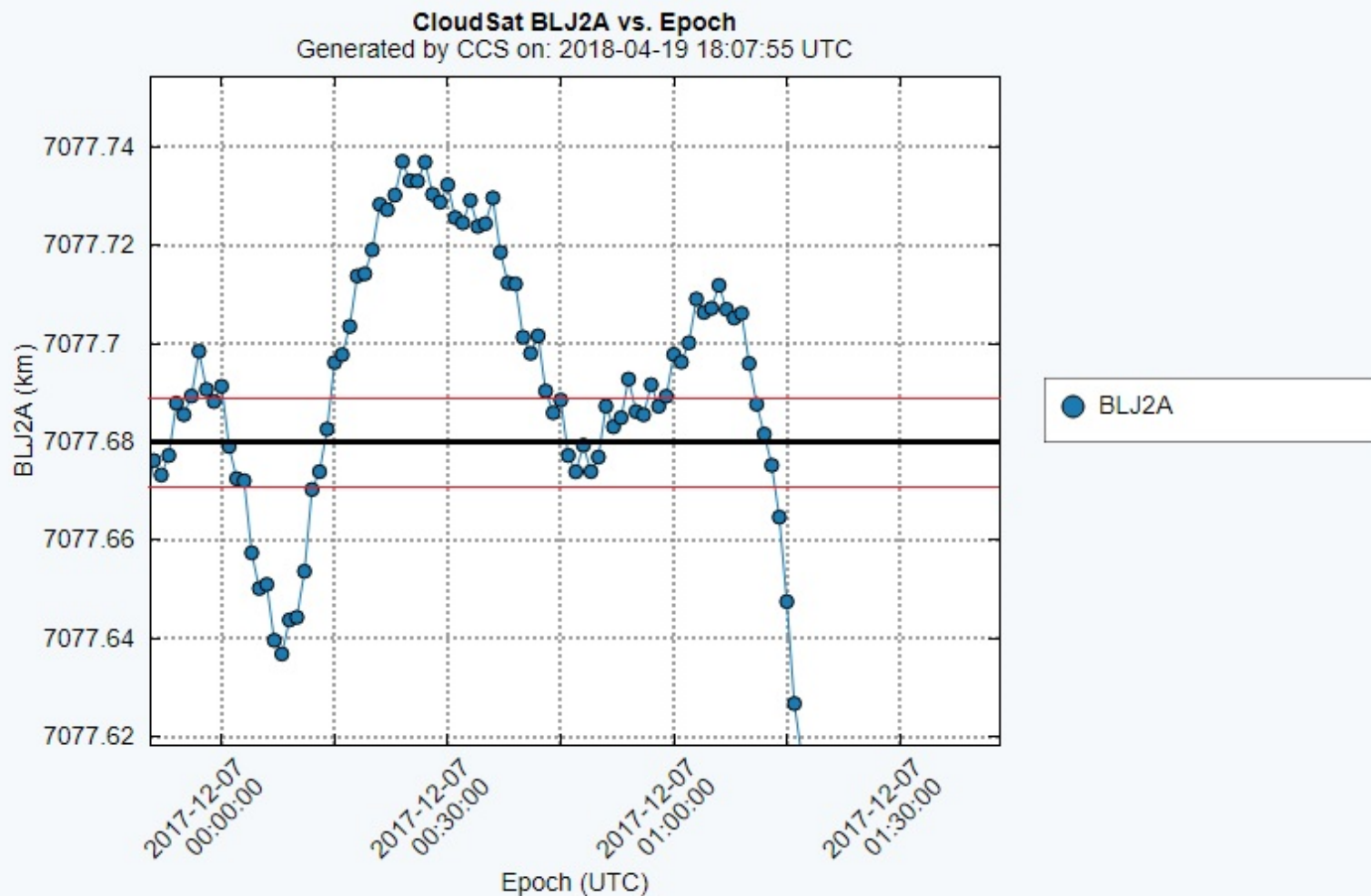
- Step 1:
 - Find all the descending node epochs for all of the spacecraft
 - Find parabolic arcs to the Ground Track Error (GTE)
- Step 2:
 - Detect the number of maneuvers in the ephemerides
- Step 3:
 - Report nominal data
 - GTEControlBoxAnalysis.txt
 - PhaseControlBoxAnalysis.txt
- Step 4:
 - Create trend arcs and report violation data
- Step 5:
 - Plot relative phasing

Maneuver Detection

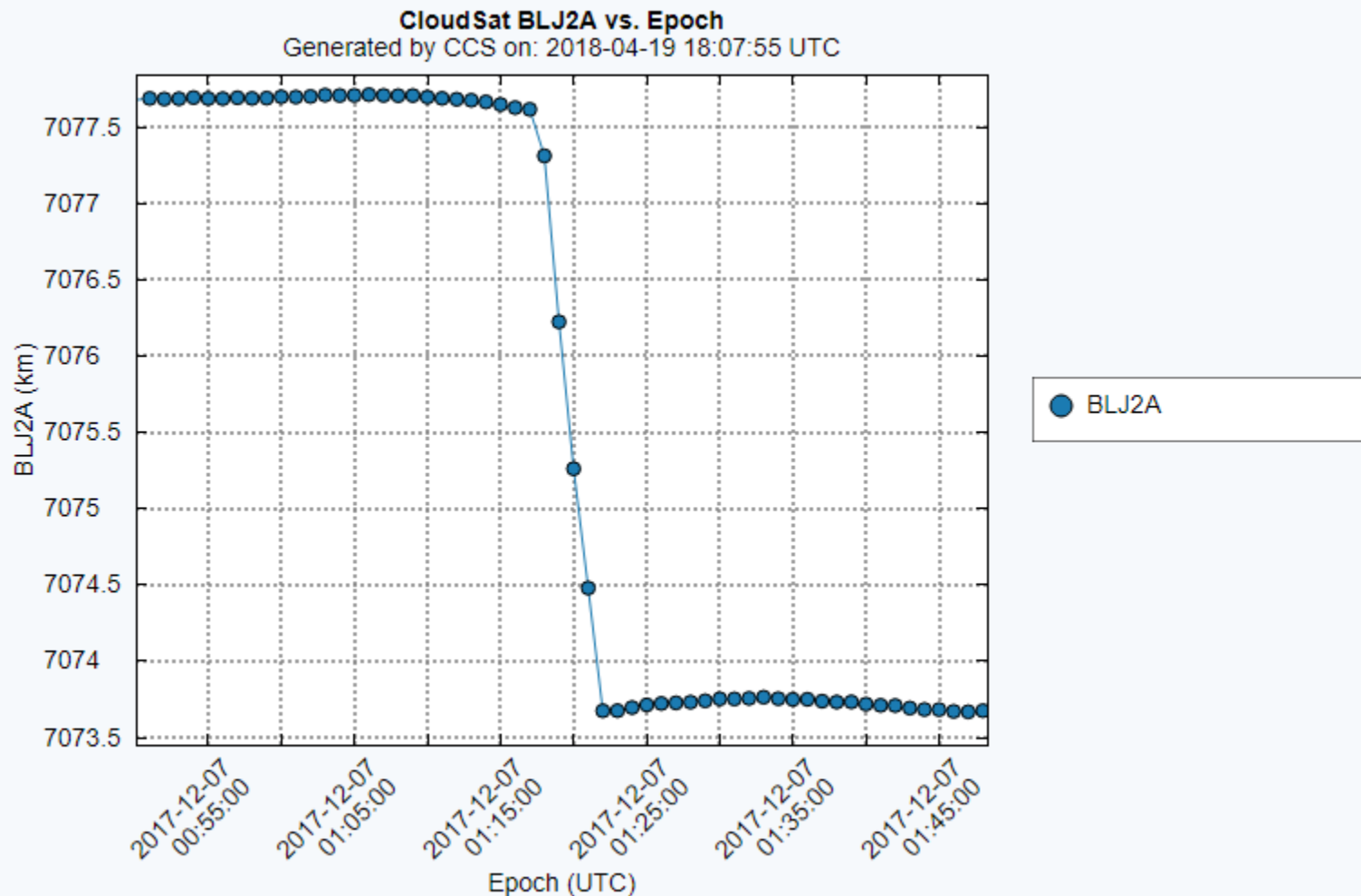


CLOUDSAT_PREDEPHAN_20171201_01.E (2 day time span)

Maneuver Detection



Maneuver Detection



Trend Arcs

- The trend arcs are the quadratic fit to the GTE
 - Directly related to the phasing of the spacecraft
- Trend arcs are created for each segment of the maneuver
 - i.e. 2 maneuvers -> 2 trend arcs
- For the CloudSat ephemeris file
CLOUDSAT_PREDEPHAN_20171201_01.E the trend arcs are as follows:
 - 2017 Dec 01 00:00:00.000 to 2017 Dec 07 01:36:57.401
 - 2017 Dec 07 02:26:19.015 to 2018 Dec 08 00:00:00.000

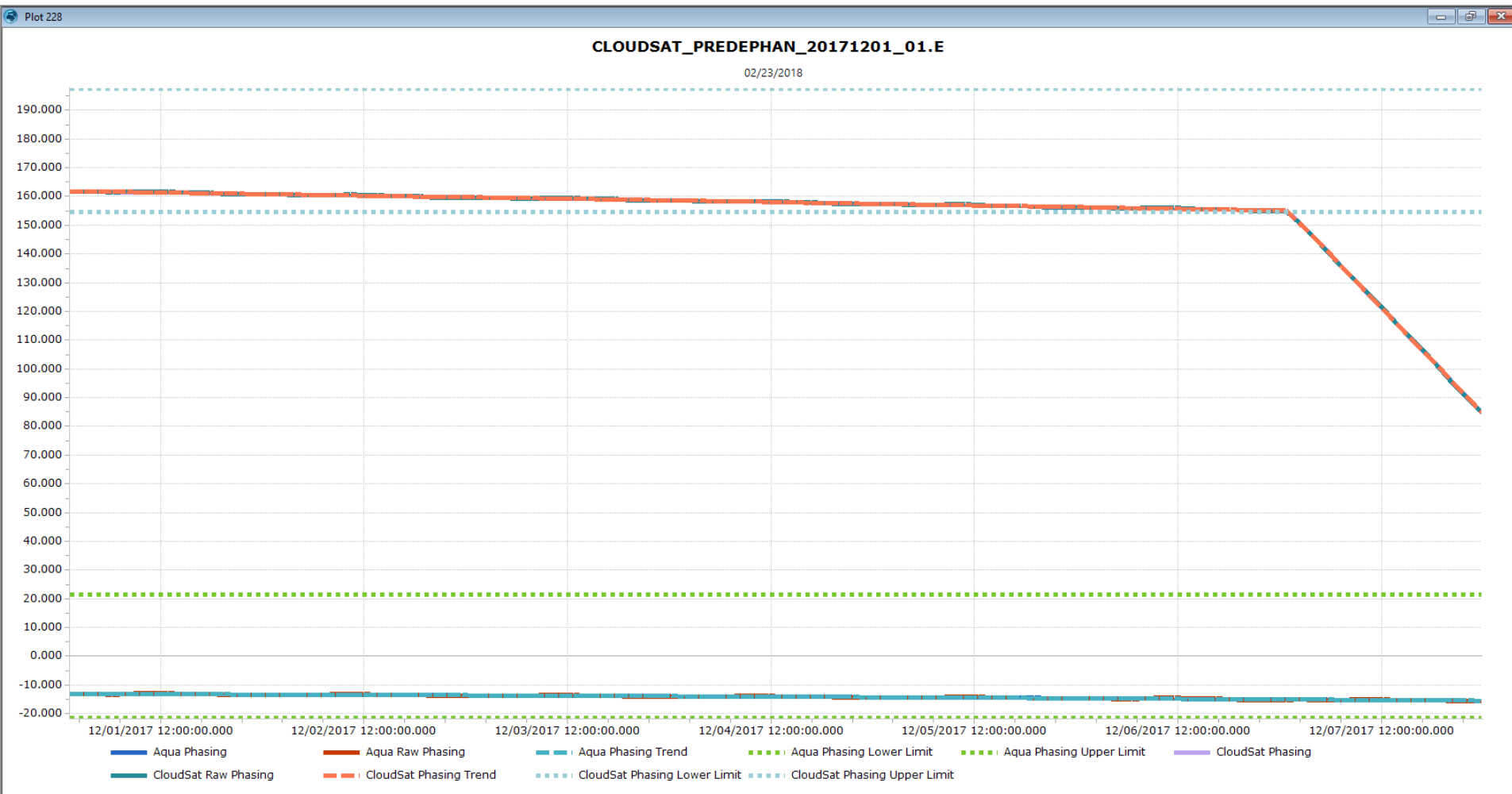
Excursion Rate and Re-entry Epoch

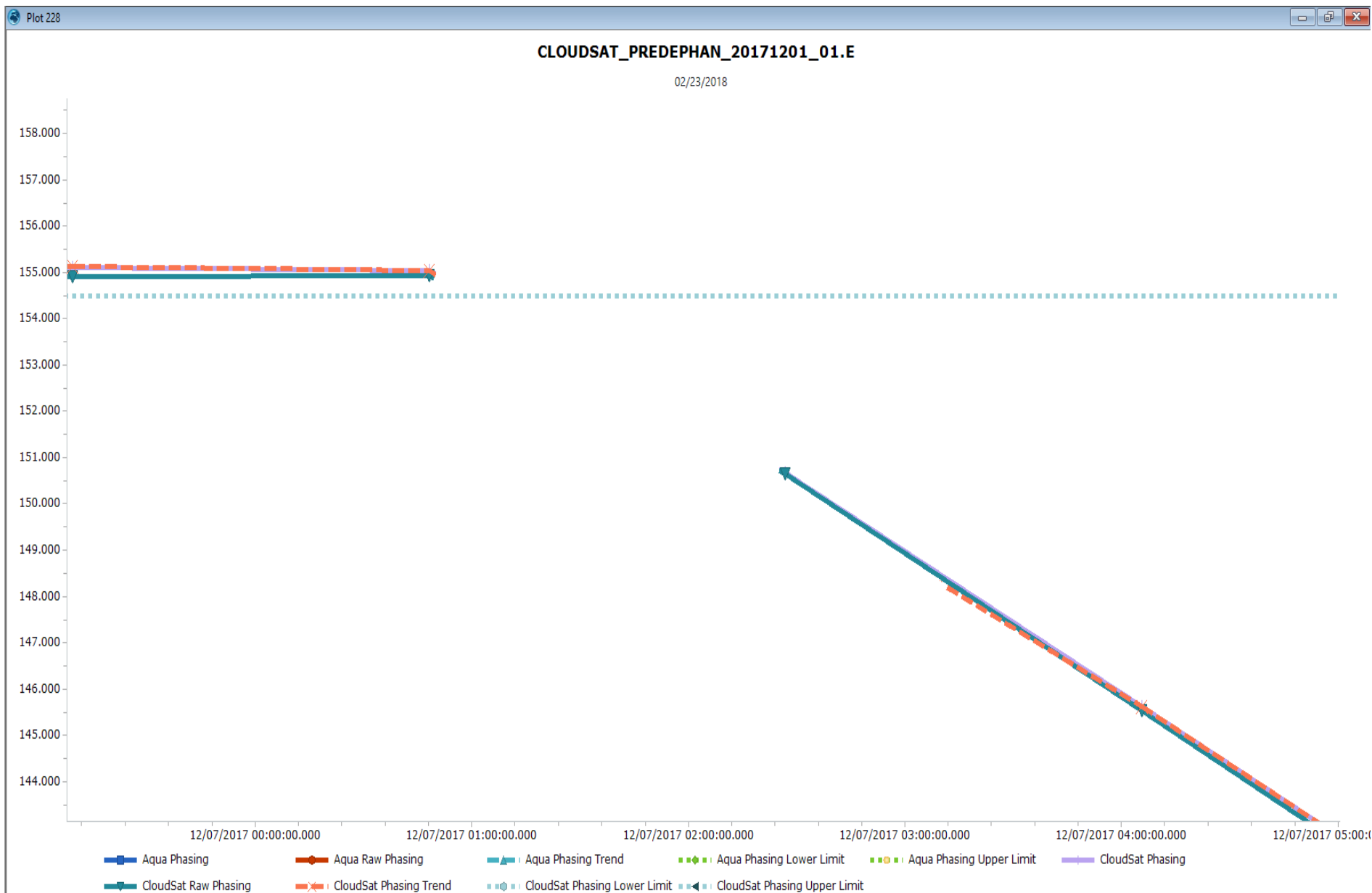
- If the quadratic fit is con-cave down, then the spacecraft will not re-enter its' control box
- Con-cave up is inclusive
- Therefore, a re-entry epoch is determined by using “fzero” which finds the roots of nonlinear functions
- The excursion rate is the slope of the quadratic fit at time T

01 December 2017 Email

- On 01 December 2017, the automated Control Box Analysis (CBA) tool on CCS sent an inaccurate email stating that CloudSat was currently violating its control box when CloudSat was still inside of its control box

CBA Plot





Future enhancements

- Our plan to remediate this going forward is to implement a new way of determining when a spacecraft is outside of its control box that does not depend on an exit epoch when crossing from inside to outside of the control box.

Back up

CBA Demo

Feedback

- Thank you for your continued support!
- For all CCS communications please contact:

ccs-support@lists.hq.nasa.gov