PSMC Thermal model update

new for 2015

Updated Oct 30, 2015

- On day 2015:302, Oct 29, 2015, the ACIS PSMC temperature 1PDEAAT was observed to be flickering between 56.05 and 58.62 C, a new mission high, and a violation of the yellow caution limit.
- For reference, the planning limit is 52.5 C, the yellow limit is 57.0 C, and the red limit is 62.0 C.
- We have recalibrated the 2015 PSMC model for this MSID.
- There is a one-to-one correspondence between hot cases where the model underpredicts 1PDEAAT and observations with 5 or 6 chips and pitch angles forward of about 60°.
- The root cause appears to be an underestimate of the heating rate at far forward pitch angles (forward of about 60°) when the model was calibrated. The data available at that time with the detector housing heater on were nearly all taken at aft pitch. This heater draws more current at forward sun.
- The model was fit to the data since the detector housing heater was turned on for good on 2015:223:09:23, through day 302, the day when the fit was conducted.
- The only parameters allowed to change were dP_45, dP_55, aciss_45, aciss_55, acisi_45, and acisi_55. After fitting, the aciss parameters were manually pushed further to obtain agreement on day 302, thus forcing the model to predict the mission high temperature.

Validation

- We present graphs of the model (blue) and the actual (red) temperatures, using the baseline and then the new model, for the latest two schedules, OCT1915 and NOV0215. Flashing back and forward between pages is a good way to compare the models. The time axes do not correspond exactly.
- Note several hot spikes (e.g. day 281 in OCT1915, and day 294 in NOV0215, which are not well fit by the baseline model. In some cases the new model overpredicts these which errs on the side of safety.
- The new model was forced to fit day 302 in NOV0215, when the yellow limit violation occurred. We are pleased to see that it accurately fit the day 303 hot observations as well.
- Further validation pages can be found on the web at these addresses:

`http://cxc.cfa.harvard.edu/acis/tmp/psmc_2015_10_30/OCT2315/index.html`
`http://cxc.cfa.harvard.edu/acis/tmp/psmc_2015_10_30/NOV0215/index.html`

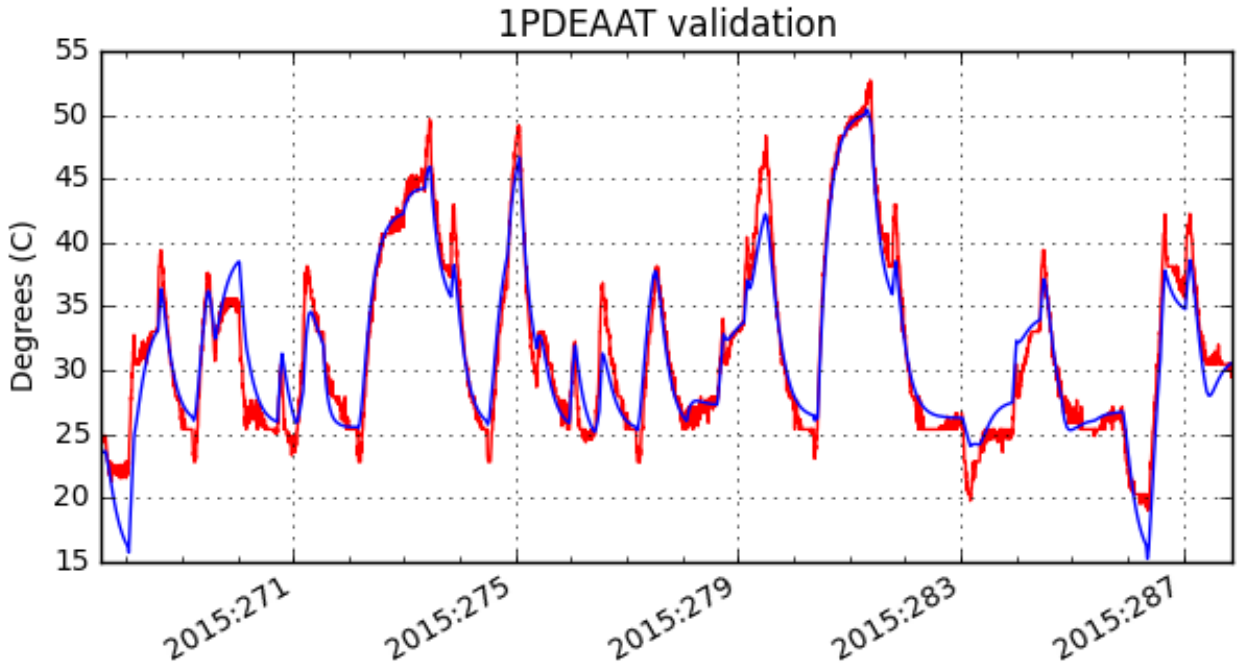

Figure 1: Baseline model validation for OCT1915 week

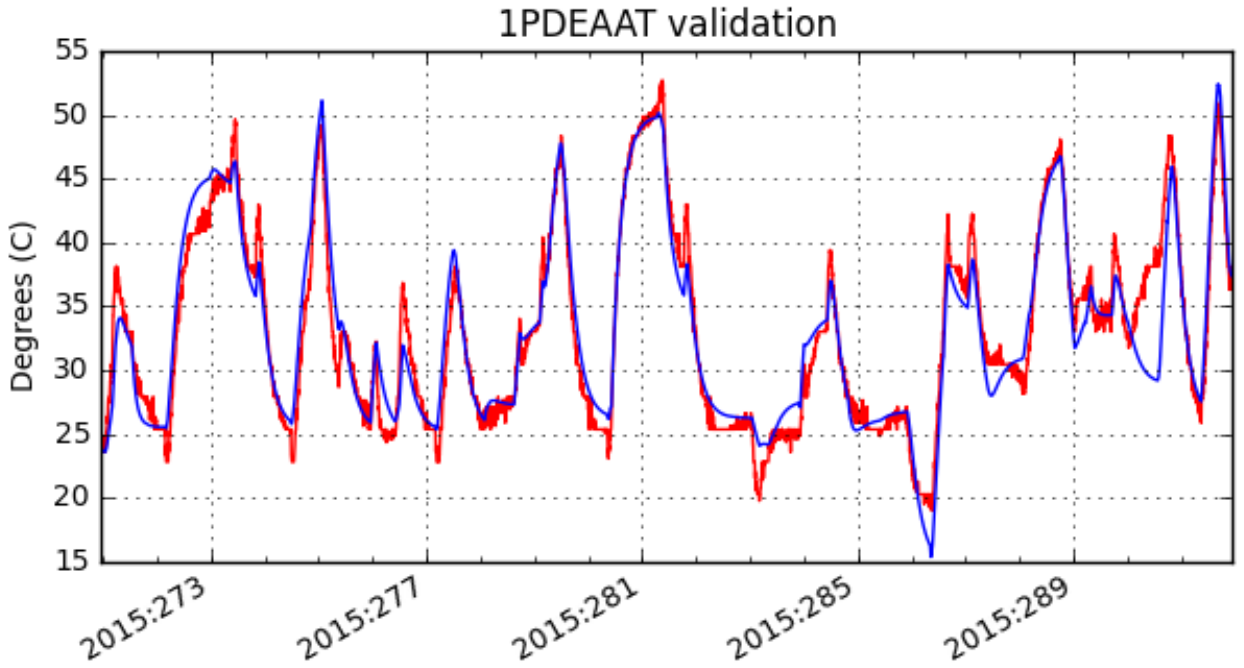

Figure 2: New model validation for OCT1915 week

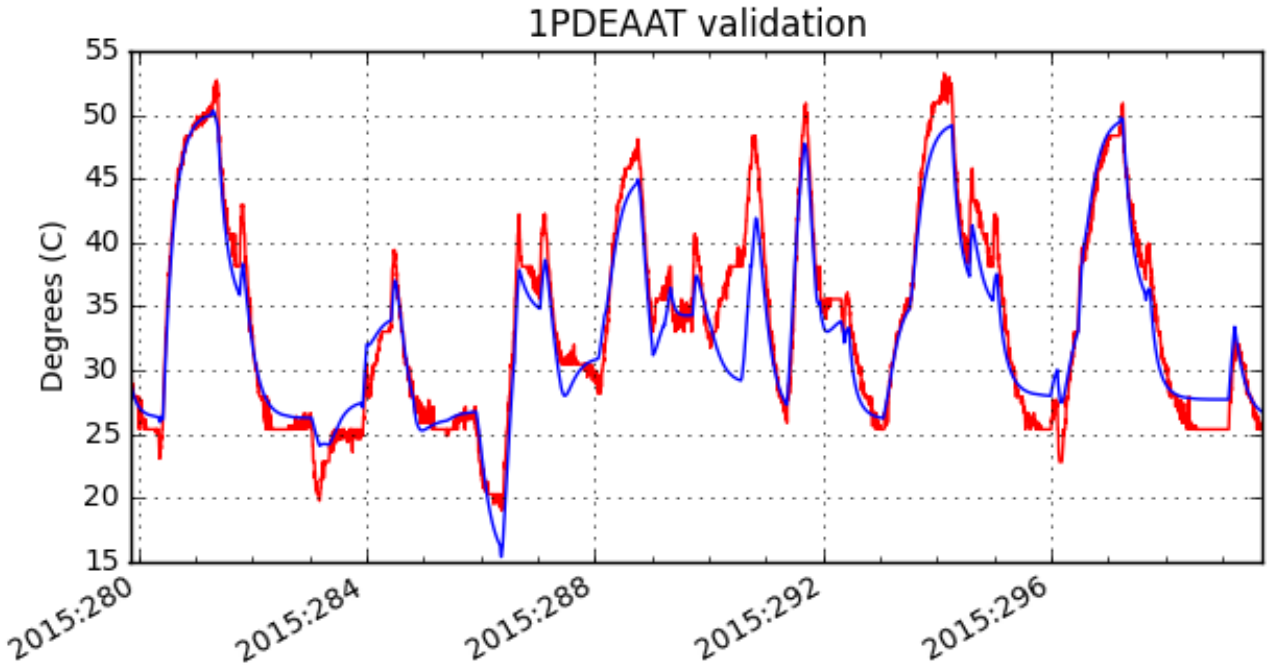

Figure 3: Baseline model validation for NOV0215 week

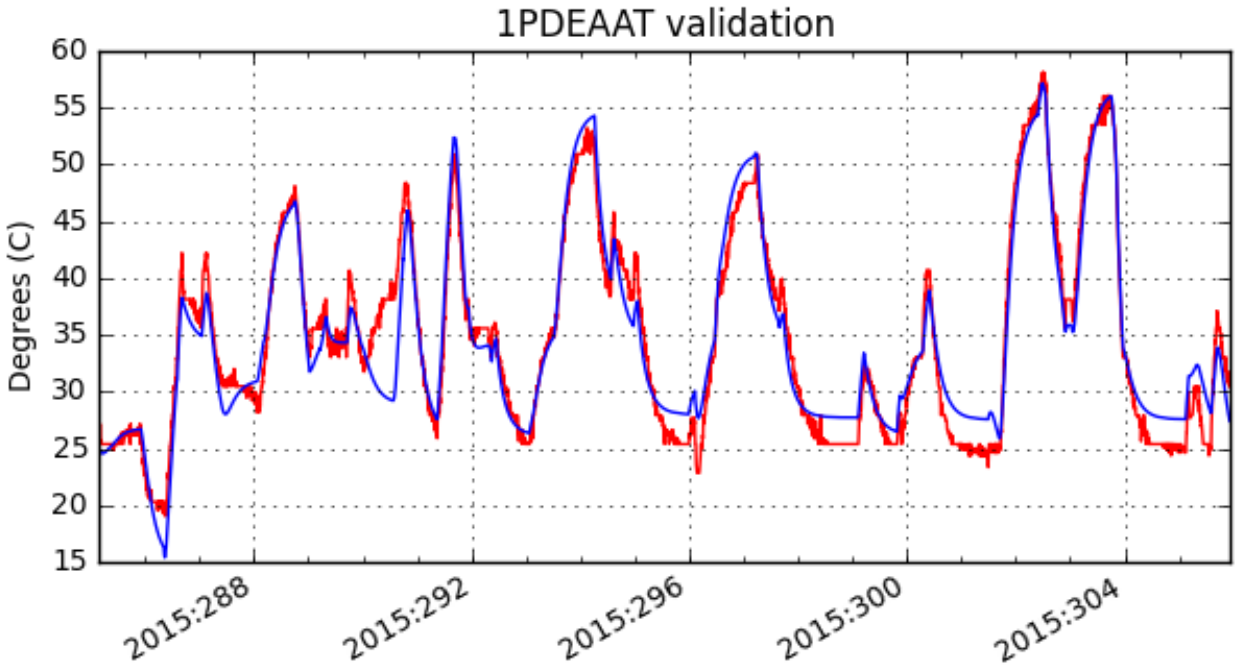

Figure 4: New model validation for NOV0215 week

Plan for NOV0215 week

- On the next page is the predicted trace for the week of NOV0215.
- There is a predicted planning limit violation on day 312. The maximum temperature predicted is 55.16 C, at about 2015:312:01:32.
- This excursion is undesireable, but less severe than the day 302 maximum. With good confidence in the model, there is very little chance it will exceed the red limit. We therefore recommended on Friday Oct 30 that the NOV0215 load be allowed to execute as planned.
- If there should be a replan for some other reason, to start before day 312, we would appreciate a chip drop for this observation, which is obsid 16750. The model shows a maximum temperature during the maneuver to the following observation, 18672.

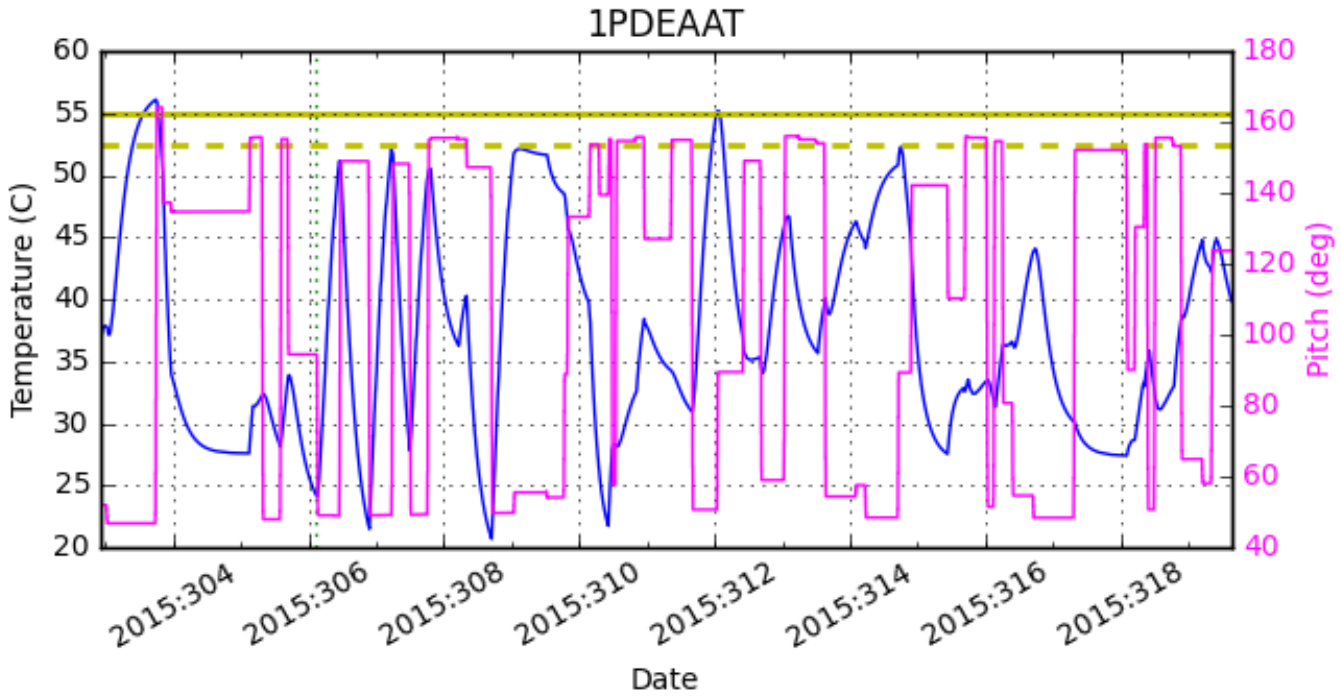

Figure 5: New model prediction for NOV0215 week. Note spike on day 312. Note the solid yellow line is not drawn at the actual yellow caution limit.

Discussion

- The new model is much better at capturing hot case performance of 1PDEAAT, with multiple chips clocking at forward pitch.
- Mark Baski reports that he has implemented this model in the testing version of the FOT Matlab Tools.
- Going forward, if the FOT MP can plan to violate neither this PSMC model nor the baselined one, we should be safe. Dropping chips should help mitigate a hot PSMC.
- We recommend promoting this model to flight as soon as is practicable.
- While the new model is not perfect, even at hot temperatures, it is a substantial improvement.
- We also suggest, until confidence in the model is improved, dropping chips for observations forward of 60° pitch. We're open to discussion on the best way to codify this.

LATE BREAKING: The forecast spike overnight, 2015:306, was underpredicted by this model. The prediction was 51.14 C and the data briefly show 56.05 C. Clearly further effort will be required going into the hot season to calibrate a predictive model.