



# Data analysis for commissioning

Dominique Boutigny & Peter Ferguson



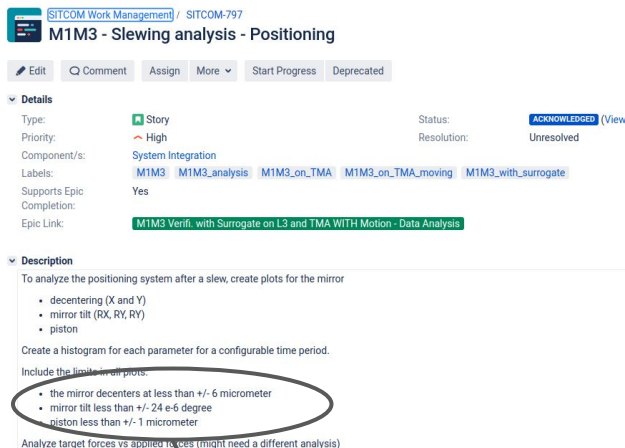
U.S. DEPARTMENT OF  
**ENERGY**

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# Mirror positioning - SITCOM-797



SITCOM Work Management / SITCOM-797

## M1M3 - Slewing analysis - Positioning

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**Details**

Type: Story Status: **ACKNOWLEDGED** (View)  
Priority: High Resolution: Unresolved  
Component/s: System Integration  
Labels: M1M3 M1M3\_analysis M1M3\_on\_TMA M1M3\_on\_TMA\_moving M1M3\_with\_surrogate  
Supports Epic: Yes  
Completion:   
Epic Link: M1M3 Verifi. with Surrogate on L3 and TMA WITH Motion - Data Analysis

**Description**

To analyze the positioning system after a slew, create plots for the mirror

- decentering (X and Y)
- mirror tilt (RX, RY, RY)
- piston

Create a histogram for each parameter for a configurable time period.

Include the **limits** in all plots:

- the mirror decenters at less than +/- 6 micrometer
- mirror tilt less than +/- 24 e-6 degree
- piston less than +/- 1 micrometer

Analyze target forces vs applied forces (might need a different analysis)

Get time serie datasets using the **Engineering Facilities Database** (InFluxDB)

- Contains a number of "topics" - Collections of actuators and sensors data -
- Doc: [https://ts-xml.lsst.io/sal\\_interfaces/MTM1M3.html](https://ts-xml.lsst.io/sal_interfaces/MTM1M3.html)
- Access through an API - no need to build complex queries
- Get results in a pandas Dataframe
- Merlin provides a very convenient set of tools to simplify data retrieval

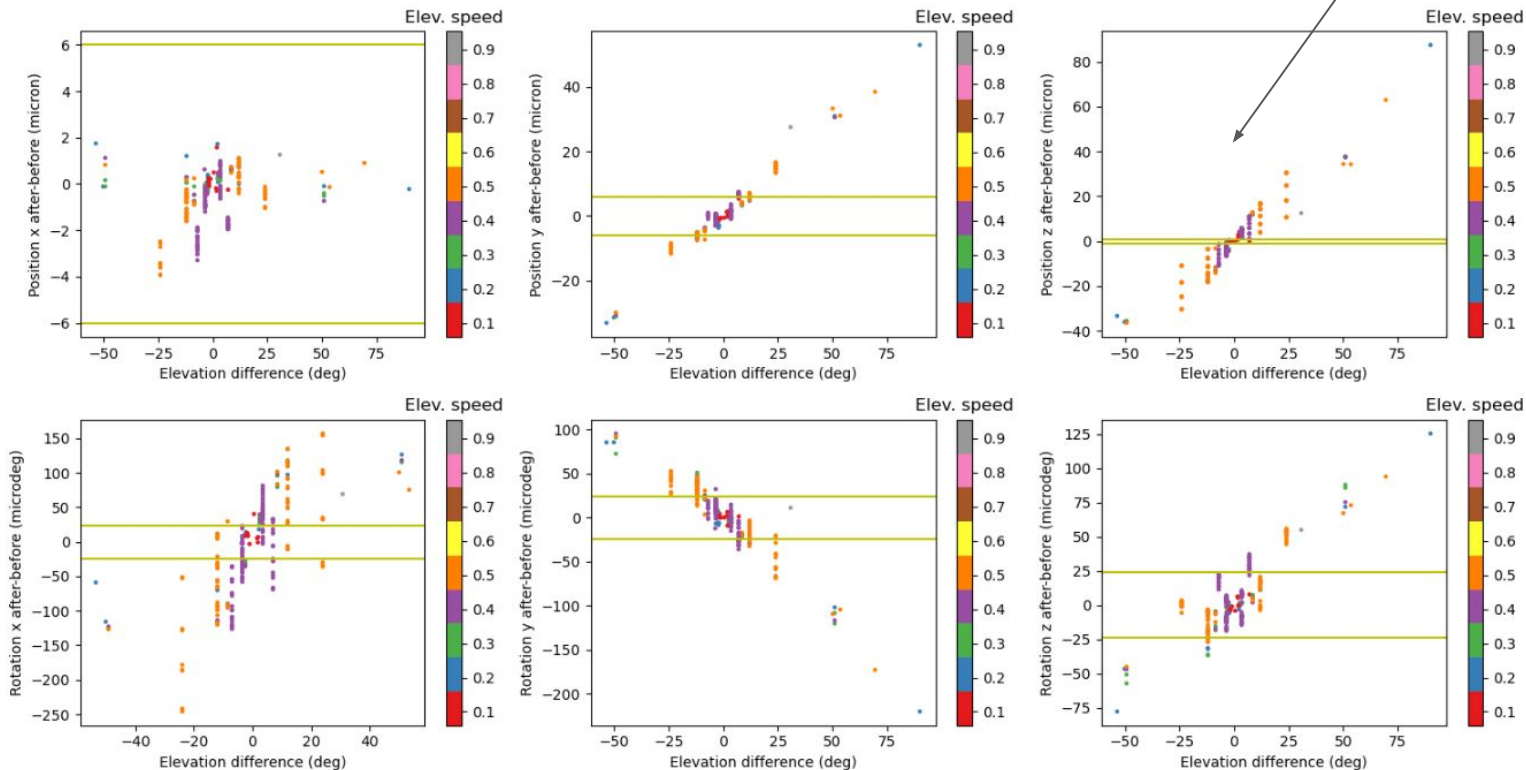
**For this study** : use the datasets associated to TMA elevation slews

- M1M3 Test Logs:  
<https://confluence.lsstcorp.org/display/LSSTCOM/M1M3+Test+Logs>

# Mirror positioning

$\pm \sim 70$  microns instead of  $\pm 1$  micron

SITCOM-797 Slewing analysis - Positioning - dayObs = 20230627



# Mirror positioning

SITCOM-797 Slewing analysis - Positioning - dayObs = 20230627

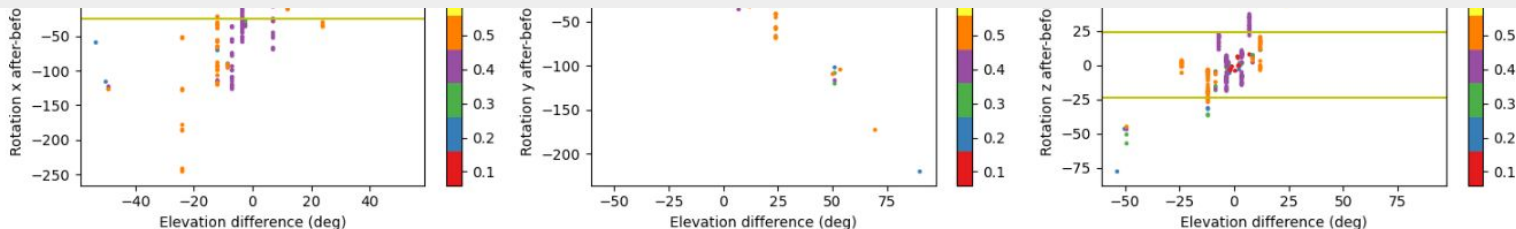


Input from Doug Neill:

- Mirror is expected to move in large slew
- It should be compensated by M2 / Camera automatic realignment using Lookup Table

"We should only be comparing the location of the M1M3 as defined by the IMS for the same elevation angles"

\* IMS = Independent Measurement System



# Mirror positioning

$\sigma \sim 5$  microns

Repeat analysis for several slews ending at a given elevation angle

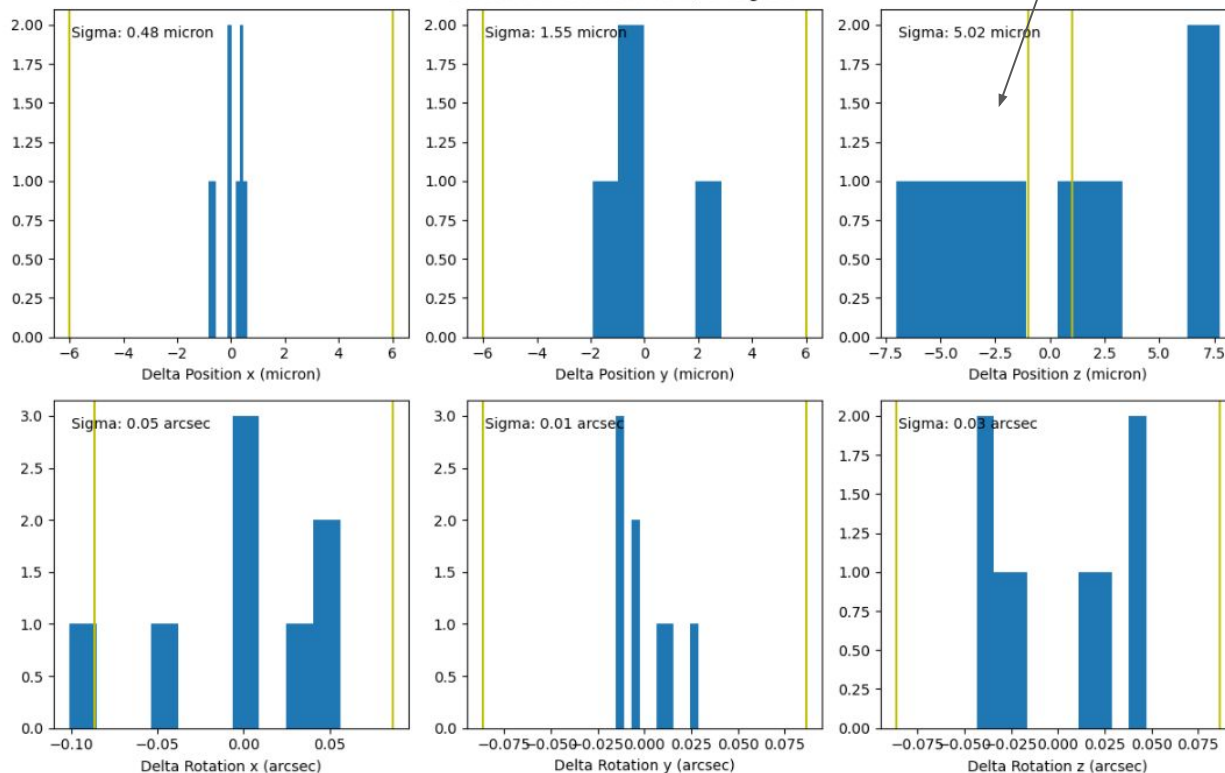
**Much closer to the specs** but still several things to understand

- Origin of outliers ?

During this analysis with Craig Lage we discovered that a sensor is not working correctly (displacementLVDT4)

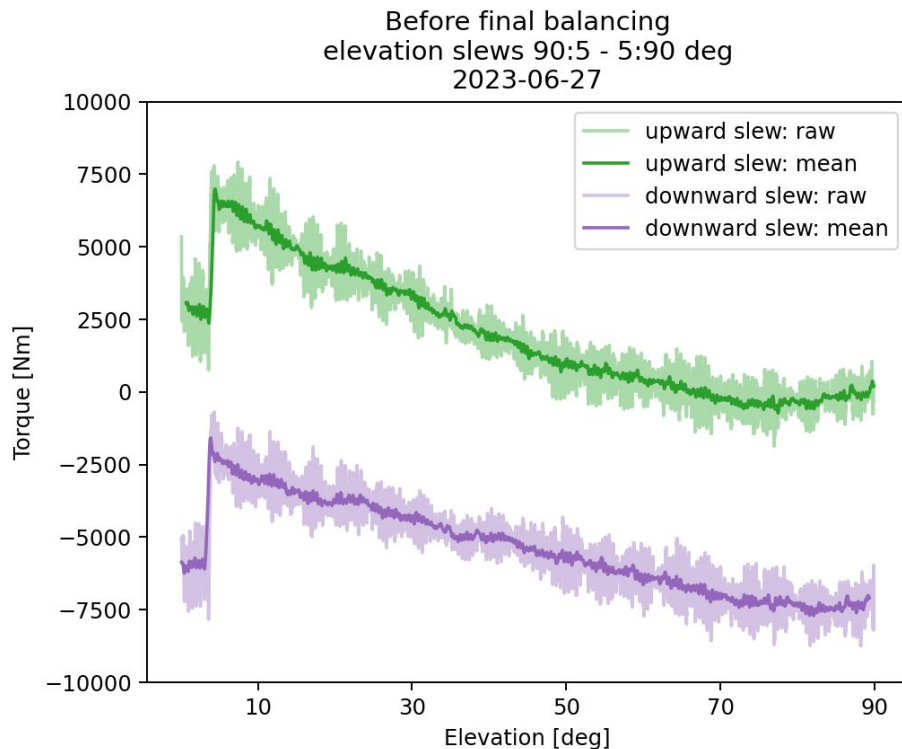
and others are probably incorrectly readout (breakawayLVDT)

SITCOM-797 Slewing analysis - Positioning - dayObs = 20230710  
start or end elevation: 45 +/- 2 degrees



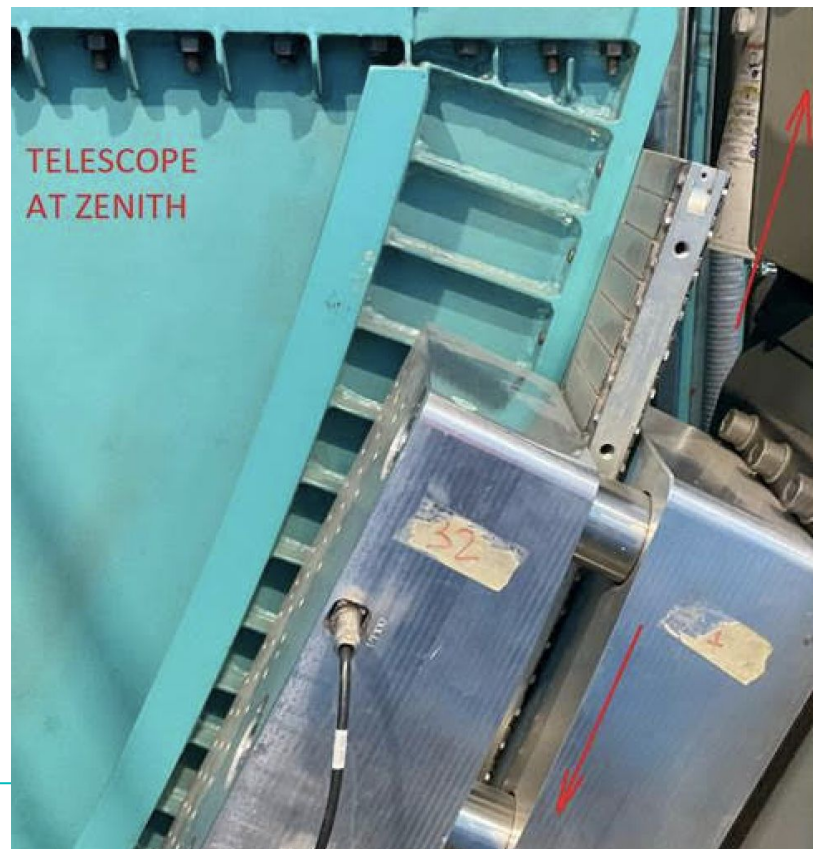
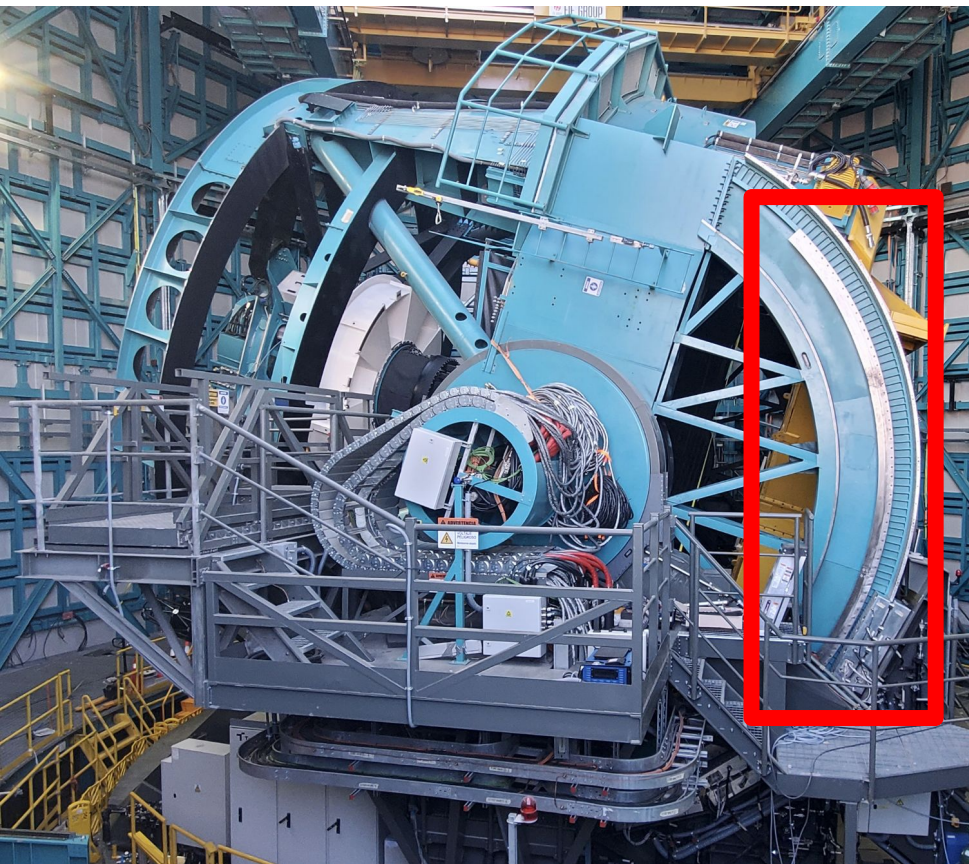
# TMA re-balancing with m1m3 cell ([sitcomtn-80](#))

- Data identification/exploration done using chronograf
- Plots made in rsp using [summit utils](#) to query efd data ([analysis notebook here](#)) running on usdf
- Unlike LVV tests (last presentation) this was a reactive analysis we did not plan to be doing
- Freddy Muñoz did most of the work for this



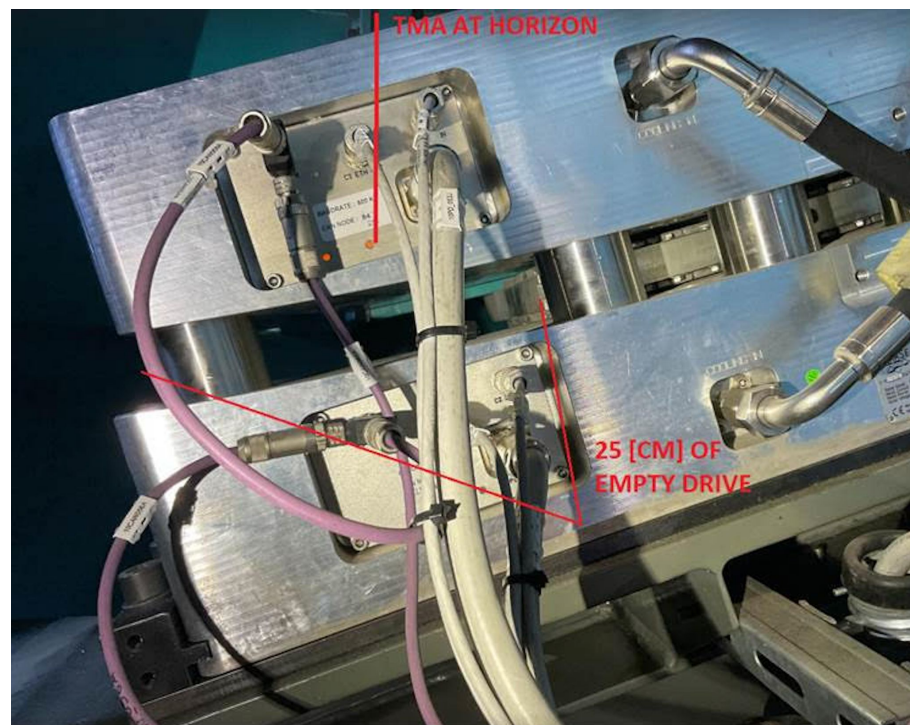
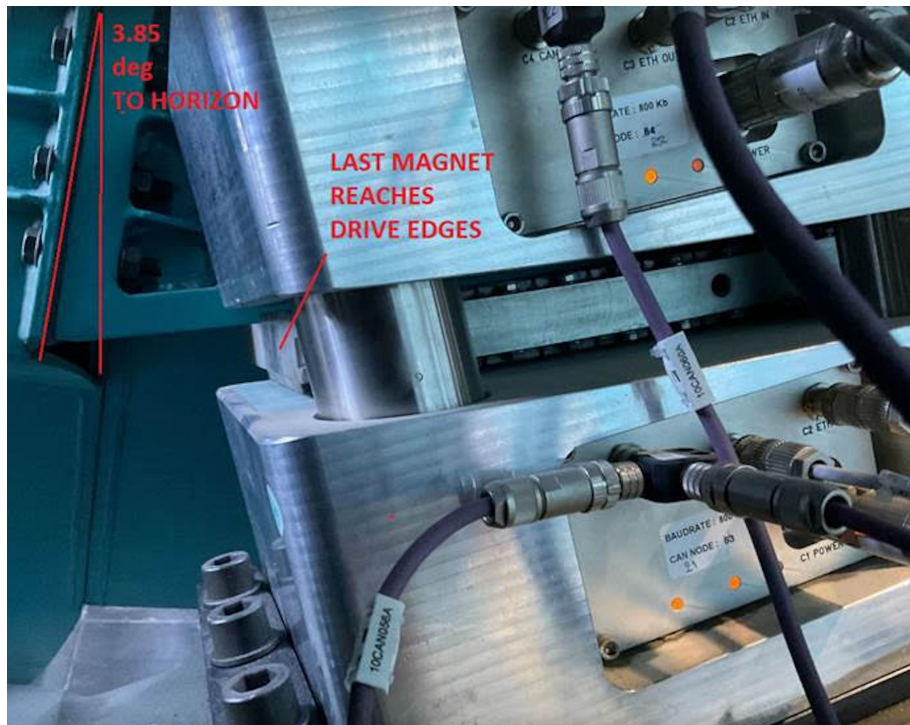


# TMA re-balancing with m1m3 cell ([sitcomtn-80](#))





# TMA re-balancing with m1m3 cell ([sitcomtn-80](#))



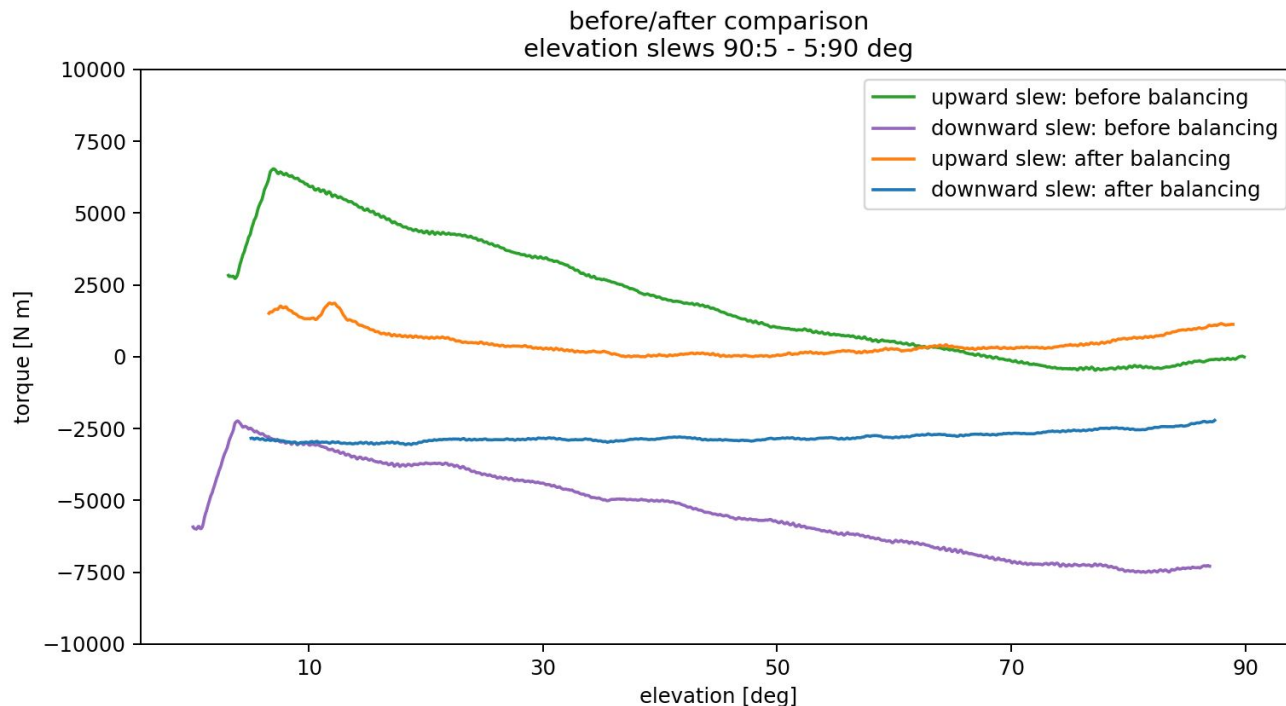


# TMA re-balancing with m1m3 cell ([sitcomtn-80](#))

TMA balancing must mask out the region where there is no magnetic rail on the elevation axis.

There is still slightly more hysteresis that we would expect, but torques are within tolerances.

we are in communication with UTE/Techniker to improve performance



# Summary

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There are regular opportunities to help with data analysis including

- planned LSST Verification and Validation analyses (LVV)
  - likely easier to onboard with due to less time pressure
- more reactive analyses (TMA balancing, M1M3 oscillations)
  - Where we need brain cycles quickly

Our analysis tools are becoming easier to use, which should make contributing easier

- [Chronograf](#)
- [Summit utils](#)
- [Notebooks V&V](#)

So far we have had tag up meetings twice a week to provide support (you can follow along m1m3 analysis at [#rubinobs-m1m3-analysis](#))