

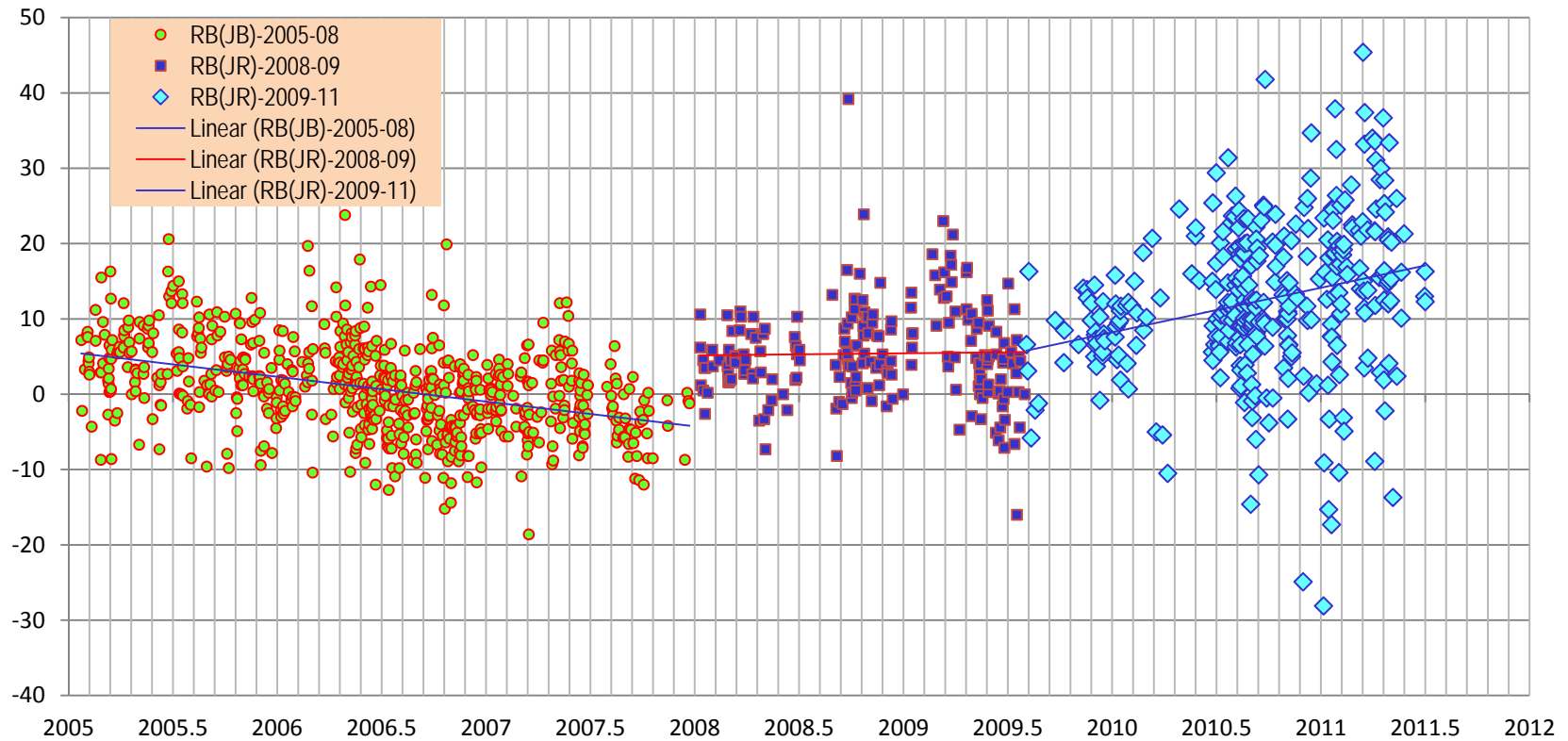
Moblas 4: Station Range Accuracy Issues and Required Corrective Engineering Actions

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Moblas 4: Range Bias Issues

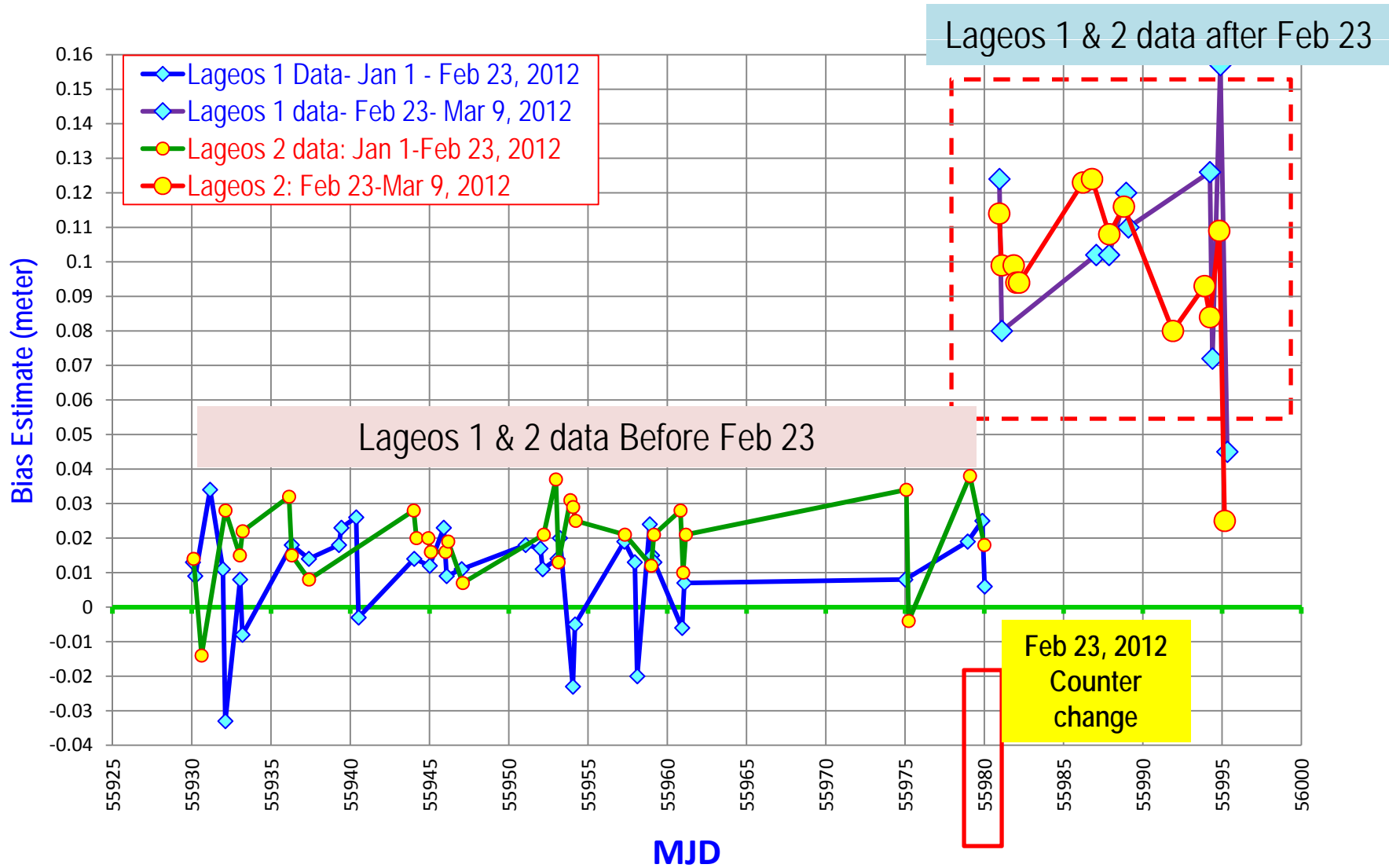
1. Monument Peak has been showing a monotonically increasing multiyear range bias (RB) reaching ~2cm in 2011; <see attached>
2. Time bias (TB) issues (increased scatter) were also observed on Lageos 1&2, Starlette and Stella, and Ajisai passes, apparently starting around the end of May 2010, and degrading further starting around the beginning of August 2011 ;
3. Orbit Analysis performed for dependencies of the TB on day-night as well as ascending-descending node differences are inconclusive at this time (some, but not all, satellites show high correlation with ascending-descending geometry);
4. 2010-2011 NP data (= +/- 2cm) shows larger dispersion than previous years; there is no apparent change in the geometry of the passes after April 2010. The mix of ascending/descending passes is similar, as is the maximum elevation, length of pass, and correlation between the bias and time bias. There is no obvious explanation for the increased 'noise' in the bias/time bias results, other than increased observation error
5. Extensive station survey was done in Nov 2011 to ascertain station height changes or calibration target changes; performed measurements were consistent at the 2-3 mm level to the previous survey performed in 2003;
6. GPS measurements performed in the proximity of M4 does not support the vertical changes observed by SLR;
7. There appears to be NO seasonal dependence to explain the magnitude of this problem;
8. System engineering has been under tighter scrutiny as a result of these observations;

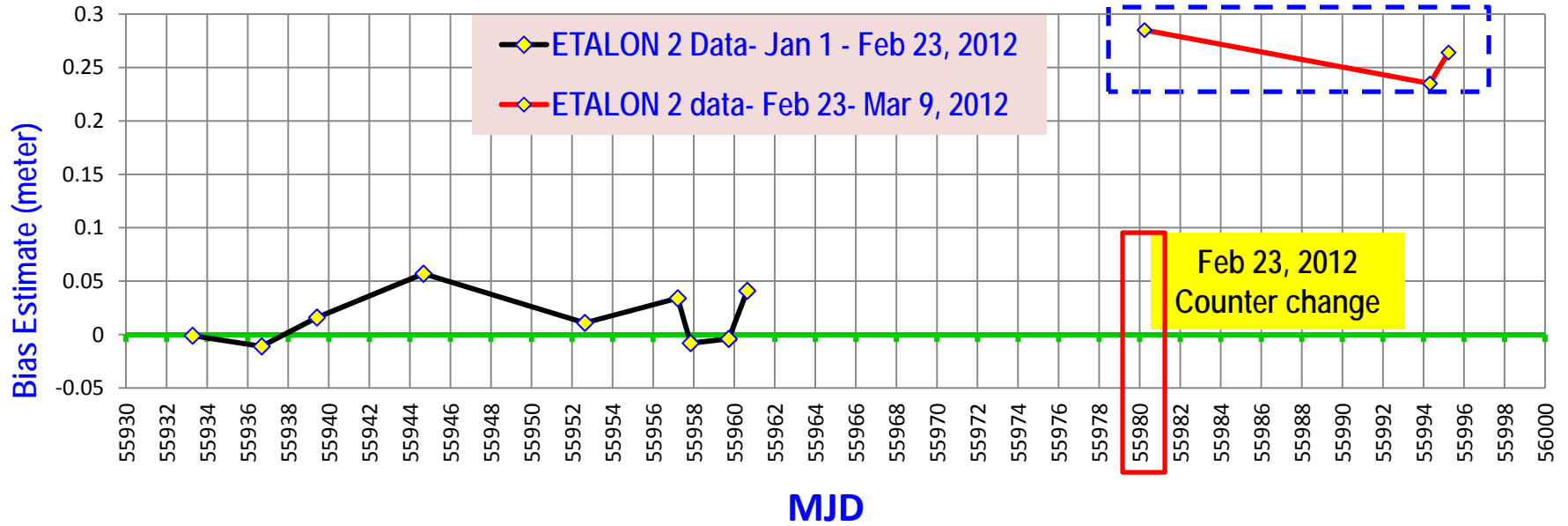
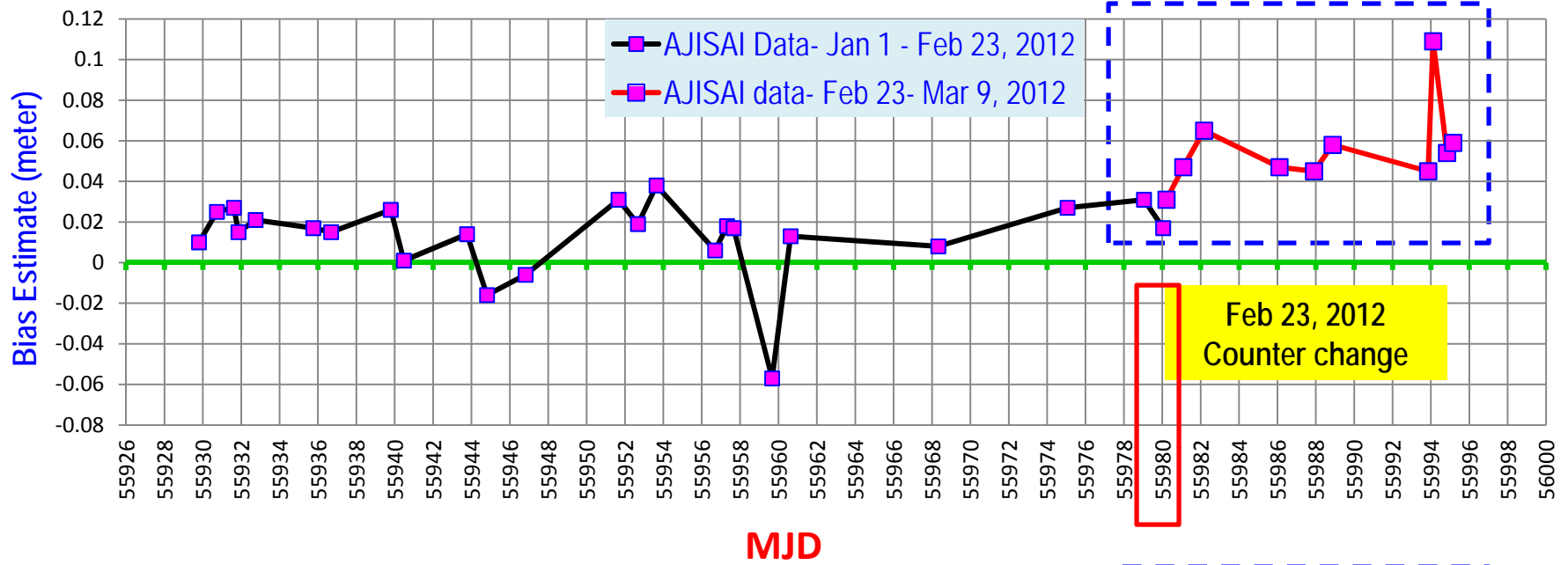
Moblas 4 : Lageos Multi Year RB Trend

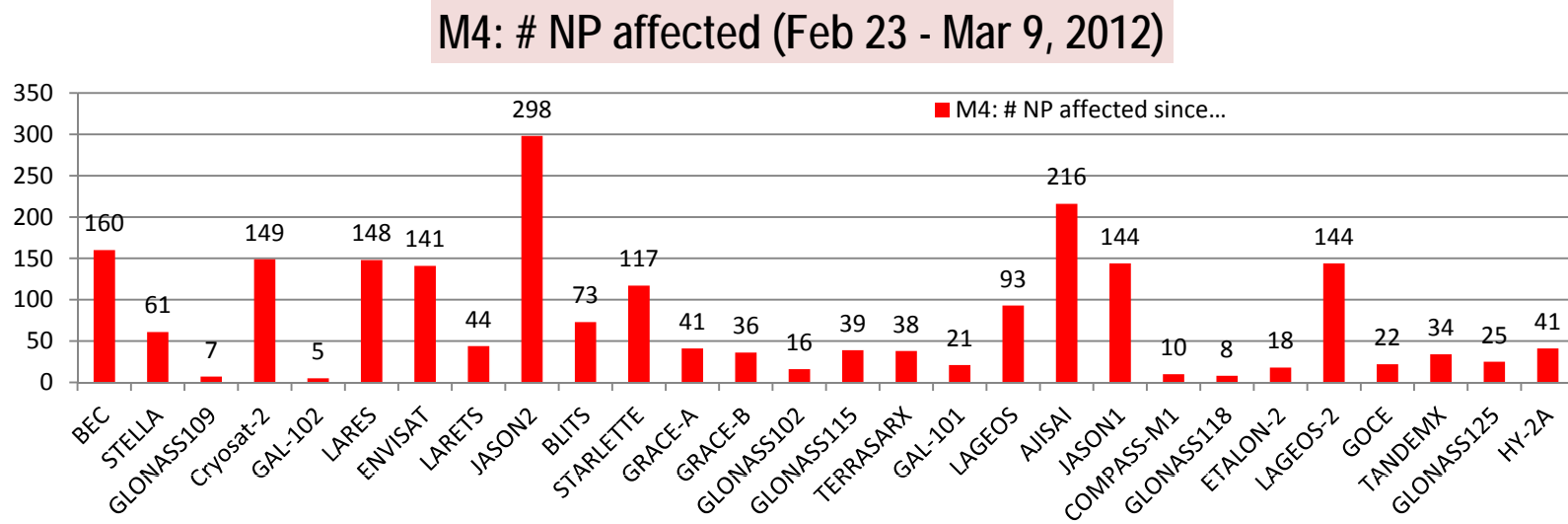
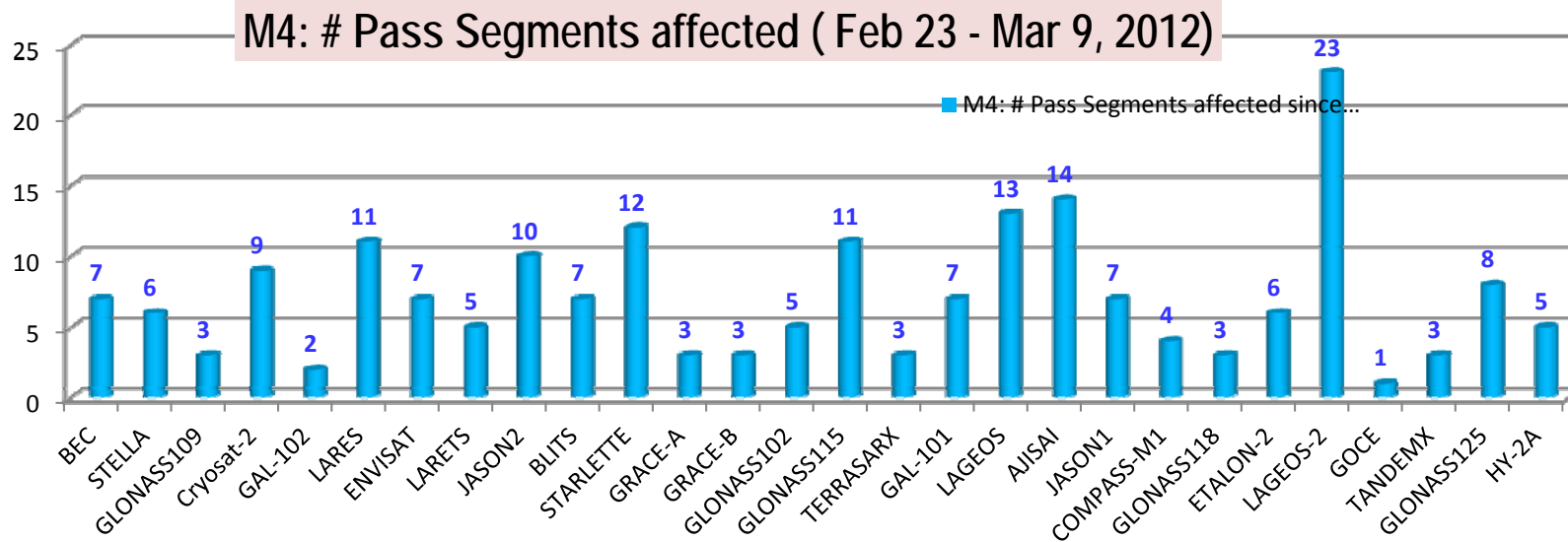


Moblas 4 Data: Range Bias (Feb 23- Mar 9, 2012)

1. Station Bias seems to take a reversal of the RB trend from prior years since December 2011, though this is less clear;
2. Since Feb 23, RB distinctly shows a divergence (>7 cm on Lageos) from its past multi-year value (~2 cm for Lageos); the RB magnitude is >4 cm for Ajisai and >25 cm for Etalon (only one pass is available); <see attached chart>
3. The above change followed a routine HW (Time Interval Counter) change; problem could be due to one or more of the following problems: (a) counter (high probability) gone bad; (b) frequency source feeding the counter has gone astray; (c) noise source on the frequency output, (d) interfacing cables are bad, (e) TIC clock was set on Internal vs. External.
4. Observed bias (varying with satellite Range), if found to be predictable with range, may be correctable at the 1cm level for the above period;
5. Since the signature is explicitly clear and attributable to a known event that happened, we have an effort underway to replace the suspected pieces of HW, which includes the Counter and Station Time and Frequency Standard;
6. Above Hardware will go into the station effective Mar 14, 2012;
7. Todate we have 198 Satellite Pass Segments and associated 2149 NP affected by this problem in CDDIS data archives. <see attached chart>







M4: Engineering Action Plan including Data Quarantine

- Engineering recommends the station to be put under **quarantine** at the present time;
- Standard quarantine protocol for data flow to be followed;
- Station will replace the hardware on Mar 14, 2012 and will subsequently collect data with particular emphasis on Lageos, Etalon, Starlette, and Stella, departing from the ILRS priority;
- For the above satellites, passes will be taken from 20 degrees to 20 degrees except for Etalon, for which 30 minutes segment pass will be taken;
- Station will collect other satellite data in the ILRS priority list based on available opportunities after performing the above;
- Station is scheduled to take Test Data from Mar 9-Mar 14 to provide the basis required to correct (if error is systematic) the data since Feb 23 to date;
- We are optimistic that we can collect adequate number of passes with the new configuration within a week (weather permitting) to return the station to full operations (based on AWG recommendations).