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Impact of Absolute Phase Center Models on GPS Reference Frames

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Overview

- Examine effects of introduction of absolute phase center models
- Concentrate on two areas:
  - Scale variations
  - Estimates of satellite phase center locations using absolute models
    - Compare MIT and COD results (de-constrained SINEX)
  - Center of mass estimates and sensitivity to radiation parameter modeling

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Approach

- Two types of MIT analyses:
  - Daily solutions with loose orbit constraints on constant and once-per-revolution radiation parameters in Direct, Y-bias and B-axis directions
  - Weekly solutions where the process noise on the radiation parameters is set by day-to-day scatter. Some parameters are constant of the week.
- Use results from 2005.5 to 2007.2 and the IGS test re-processing interval 2000-2000.3)
- Analysis of Center for Orbit Determination Europe (CODE) post-week 1400 sinex files with satellite antenna offset constraints removed (only center where we have successfully removed constraints but even with CODE there are numerical problems).
- Reference frames realized using ~80 stations from the IGS05 (0611 version) coordinate files

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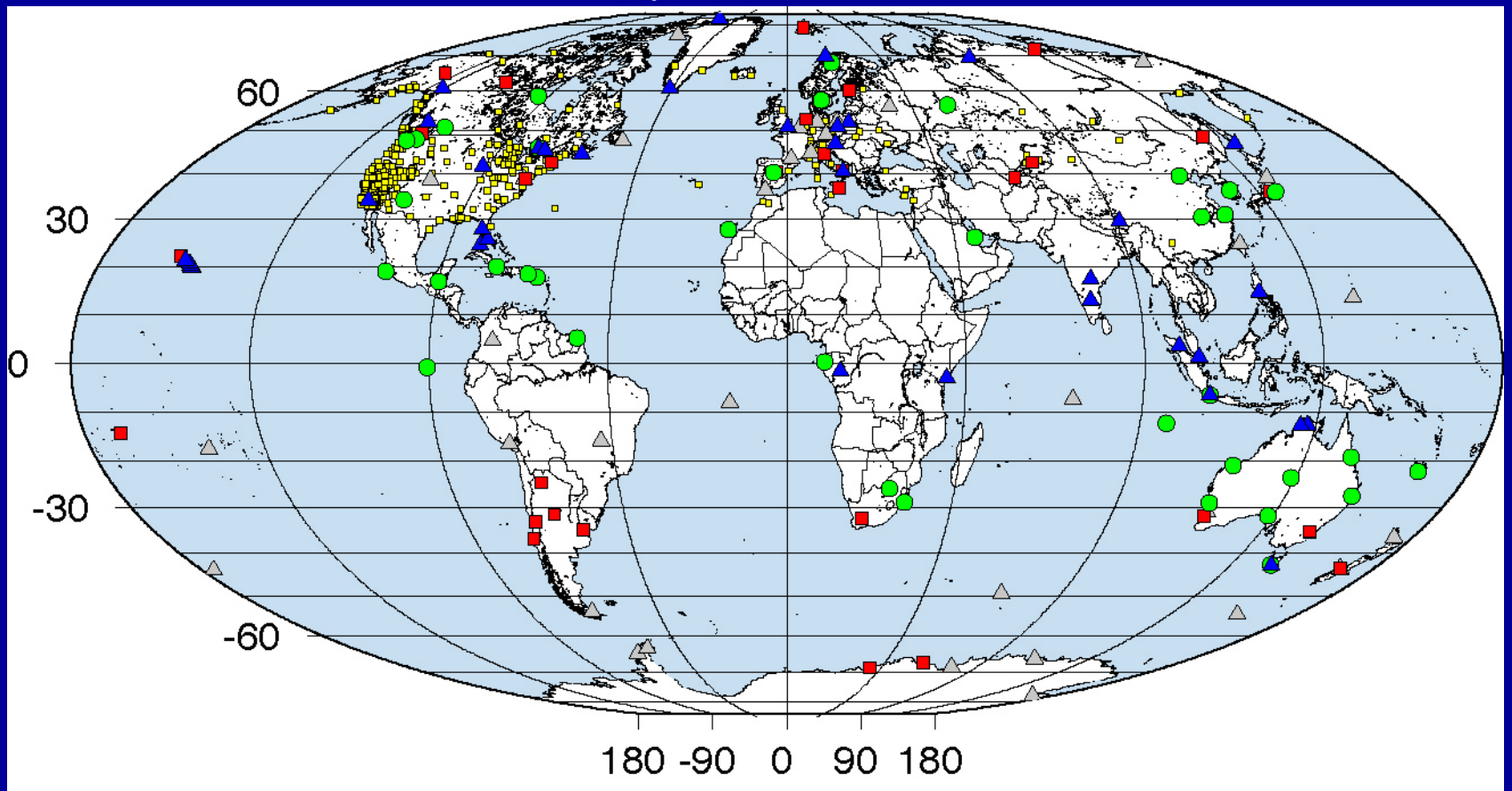
Typical recent MIT network (156 stations per day)

Four sub-nets are used (different colors, yellow available but not used)



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Results

- Scale estimates with satellite antenna offsets fixed to IGS values (relative to IGS05 reference frame)
- Scale results from relative phase center models
- Estimates of Z-coordinate of satellite antenna position from COD and MIT analyses.
- Z-translation estimates.

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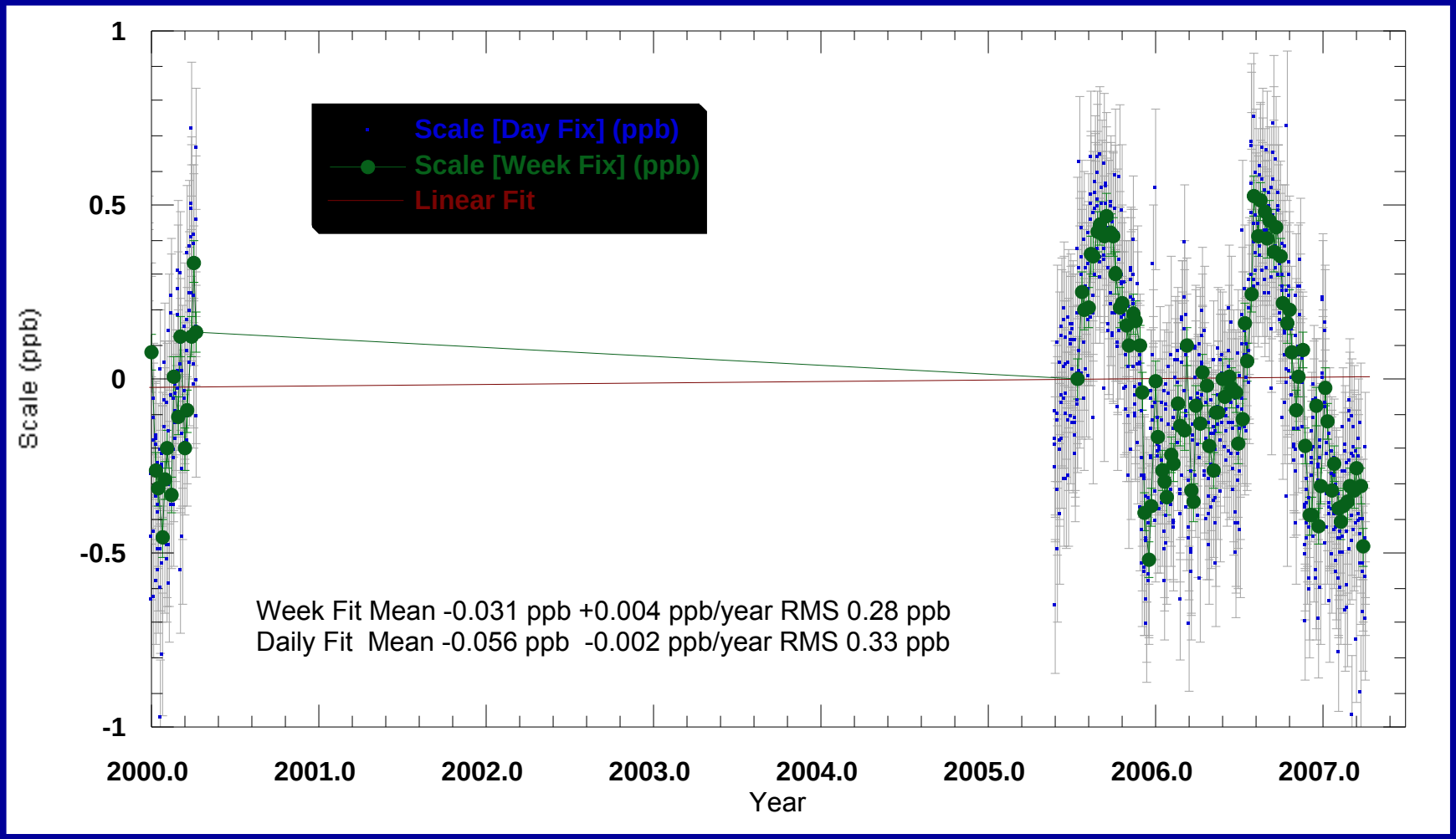
Scale estimates with satellite antenna offsets fixed

Daily and weekly consistent. Scale rate is 0.025 mm/year (rate could be biased by sampling) NOTE: Scale sign opposite normal.



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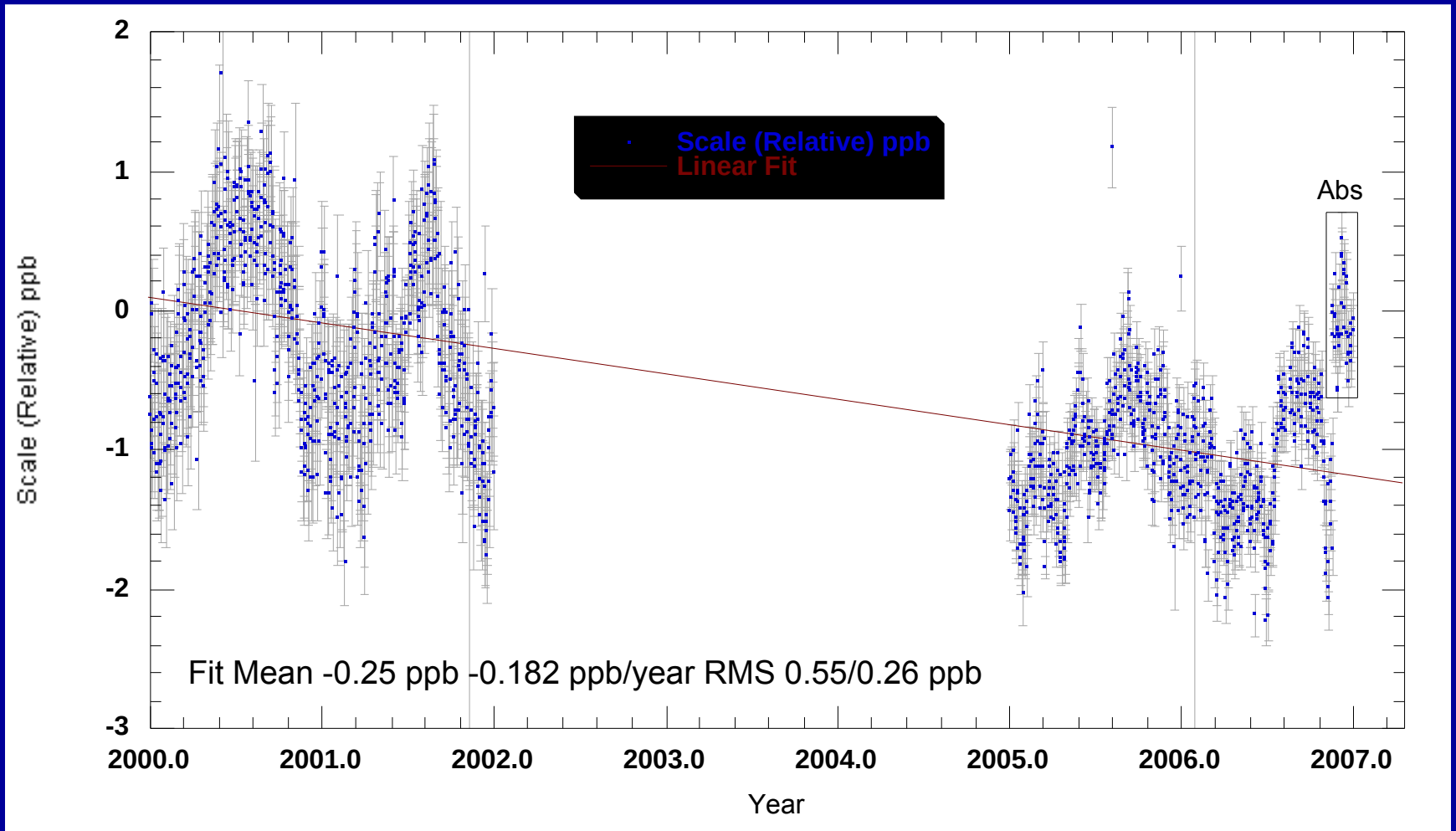
Results using relative model and IGS05 reference frame

Scale rate here is 1.2 mm/yr height equivalent;

Results from SOPAC loose gamit h-files (available through anonymous ftp)



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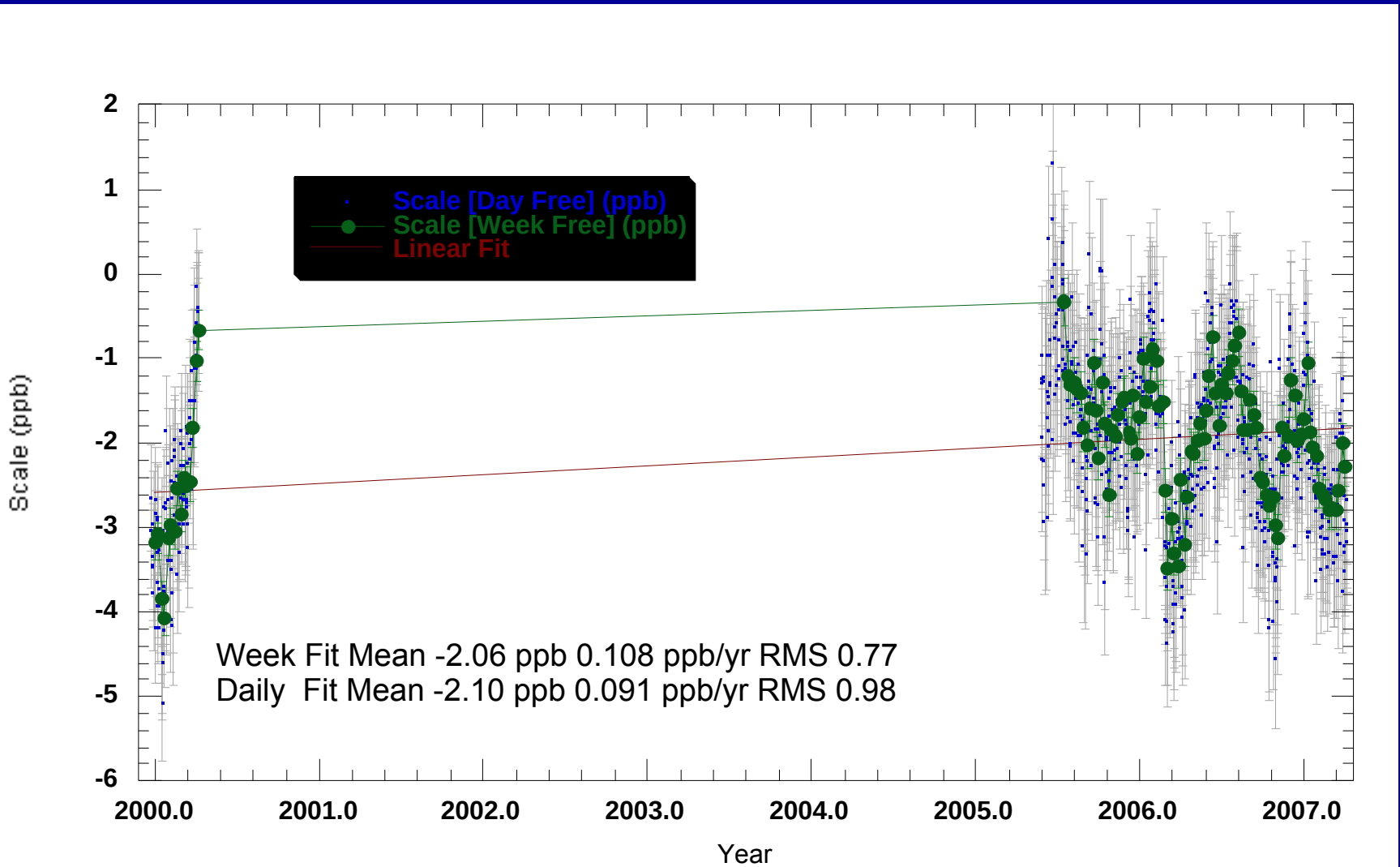
Absolute model estimates with satellite antenna offsets estimated

Offset: 13 mm; Rate 0.7 mm/yr



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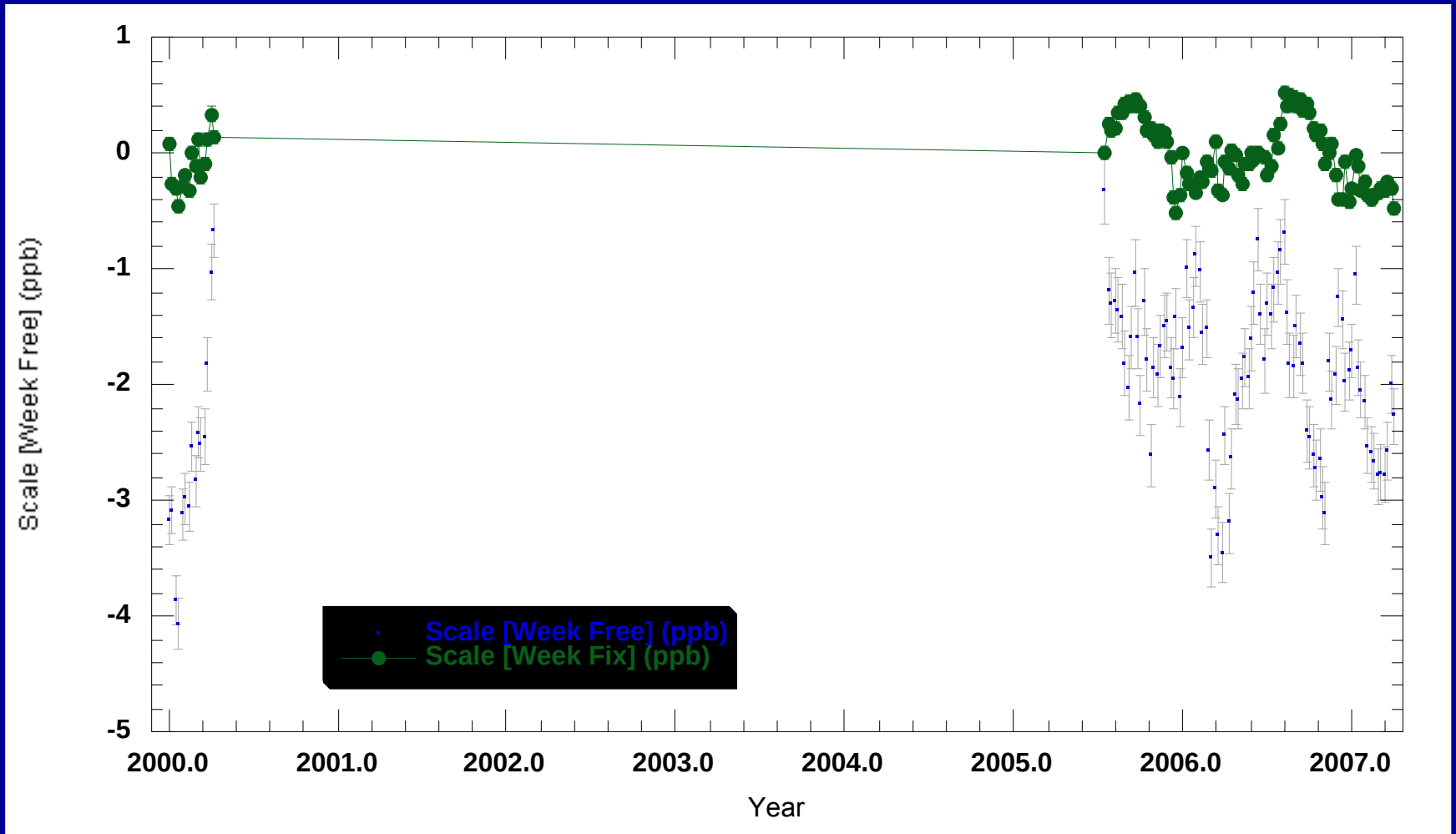
Weekly satellite antenna offset free and fixed estimates

Periodic signal nature is different between analyses



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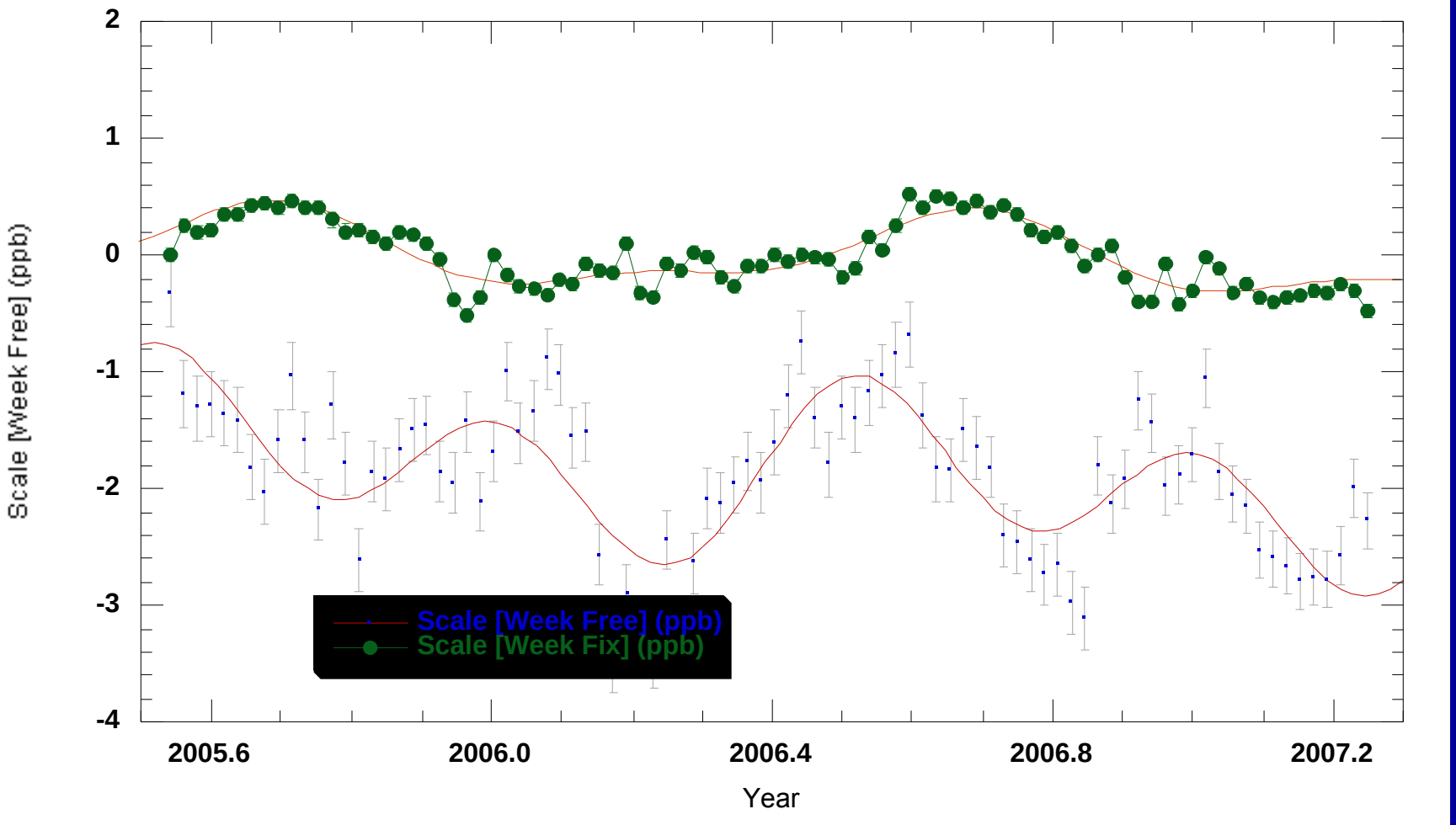
Estimate of annual and linear trend

Annual amplitudes: 0.28 ppb; semi-annual in free results amplitude 0.5 ppb



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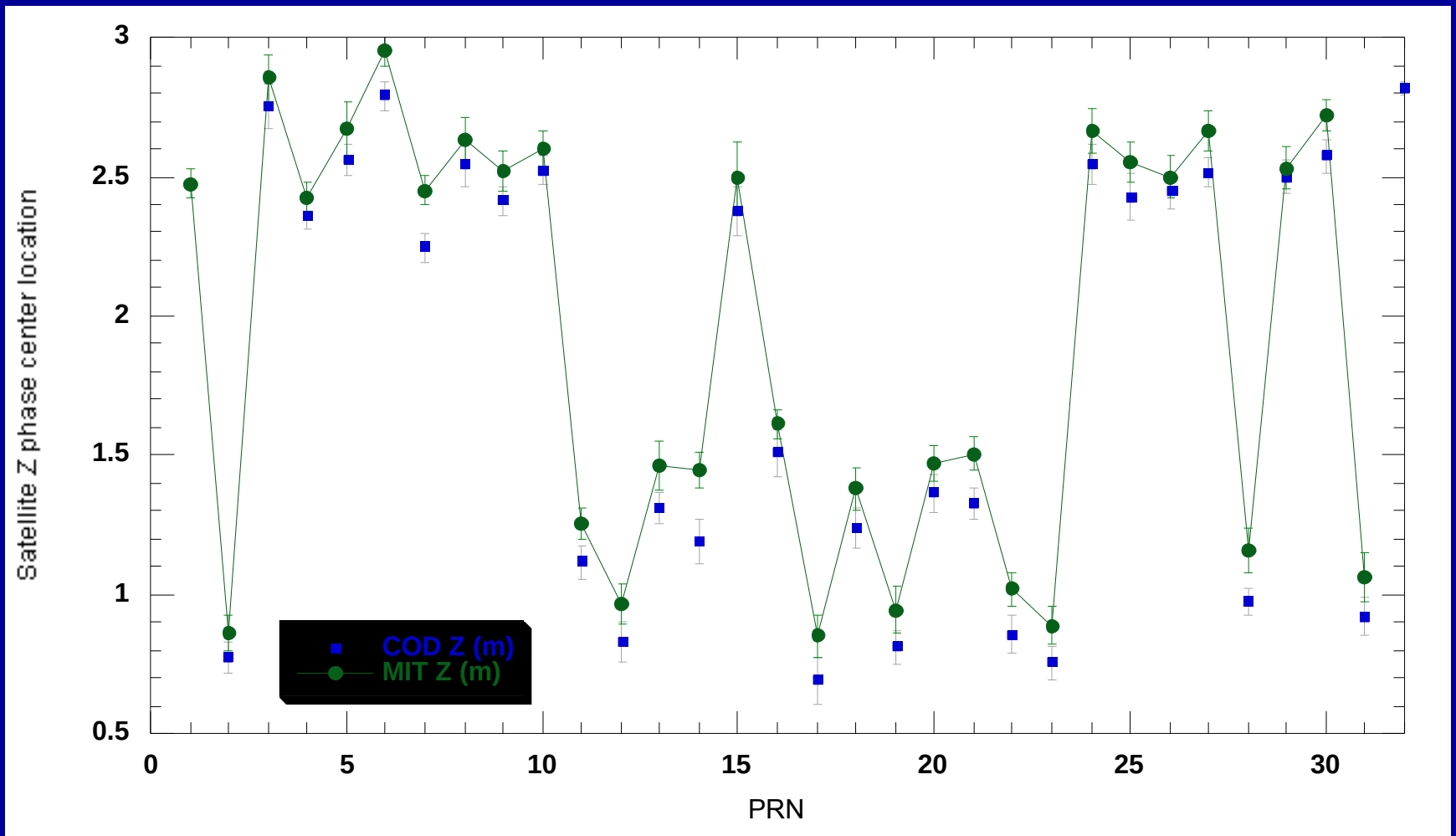
Estimates of satellite antenna Z-position

MIT and COD estimates. Error bars are RMS of values (weeks 1400-1421)



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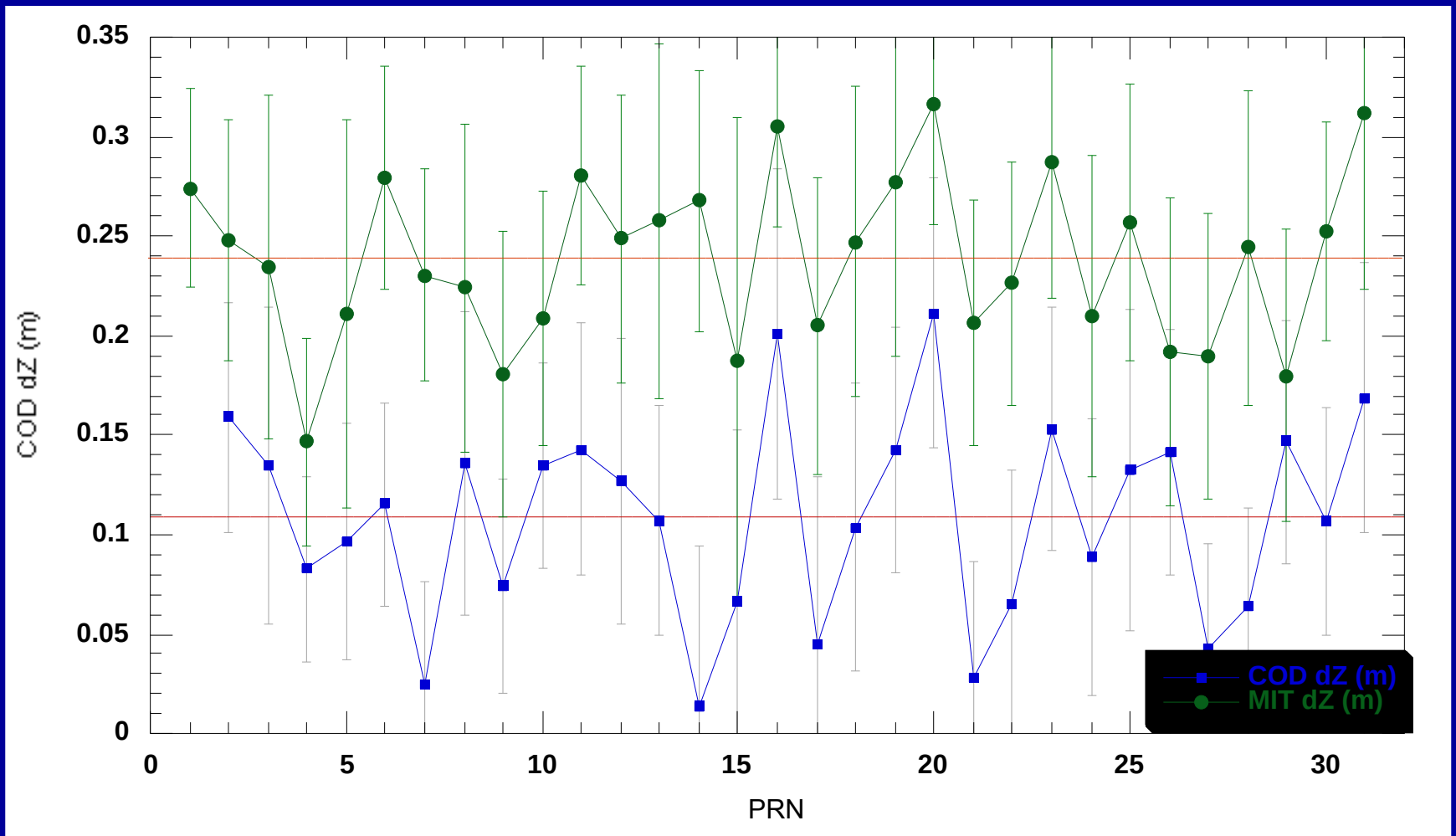
Estimates of adjustments to apriori satellite antenna Z-coordinates

Means: MIT 0.24 m, RMS 0.04 m; COD 0.11 m, RMS 0.05 m
Difference may be partly due to SINEX constraints. De-constained MIT Sinex files similar to COD result.



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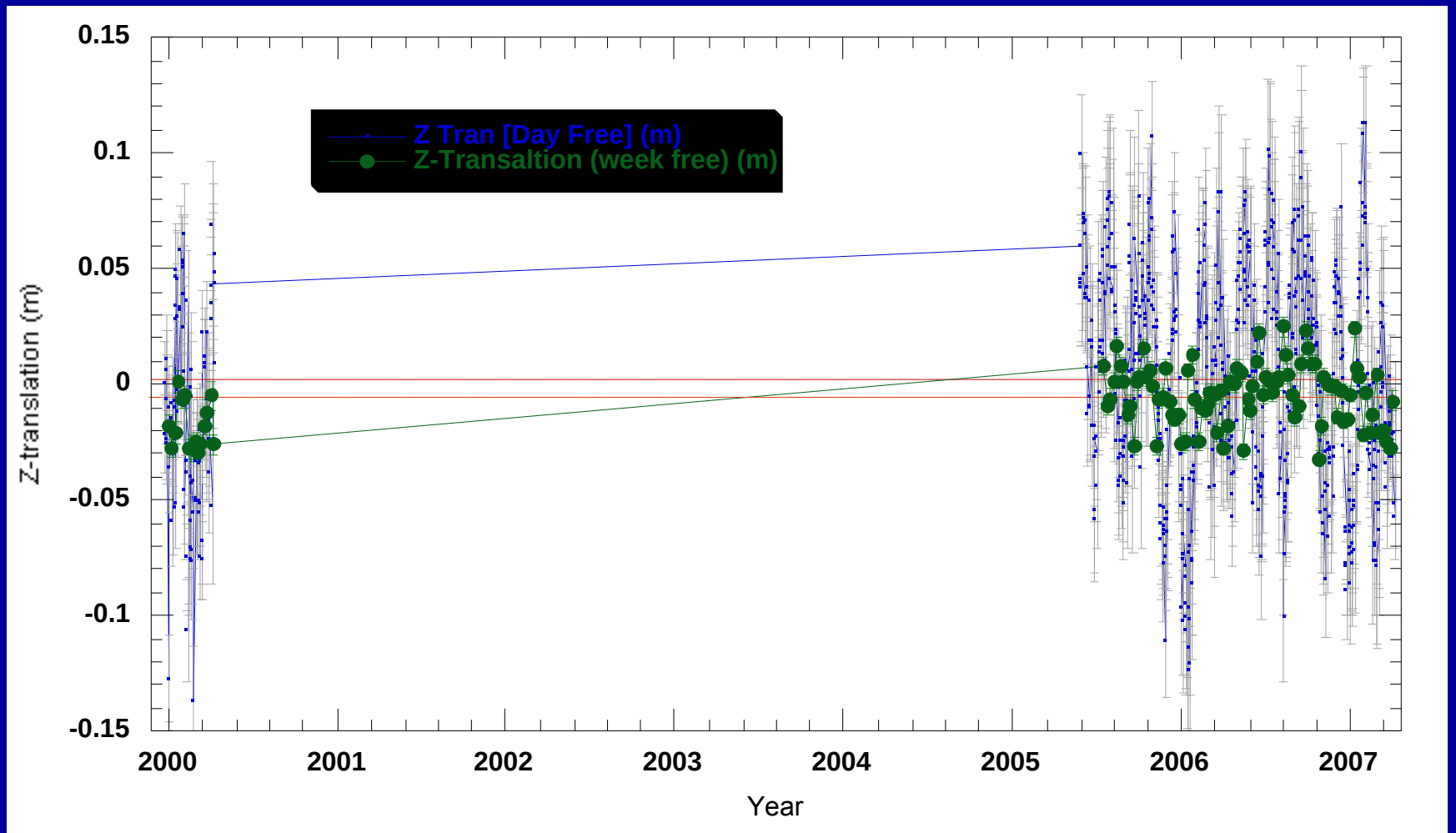
Estimates of terrestrial frame Z-translation (satellite antenna offsets free)

Mean: Day 4 mm, RMS 44 mm; week -5 mm, RMS 13 mm



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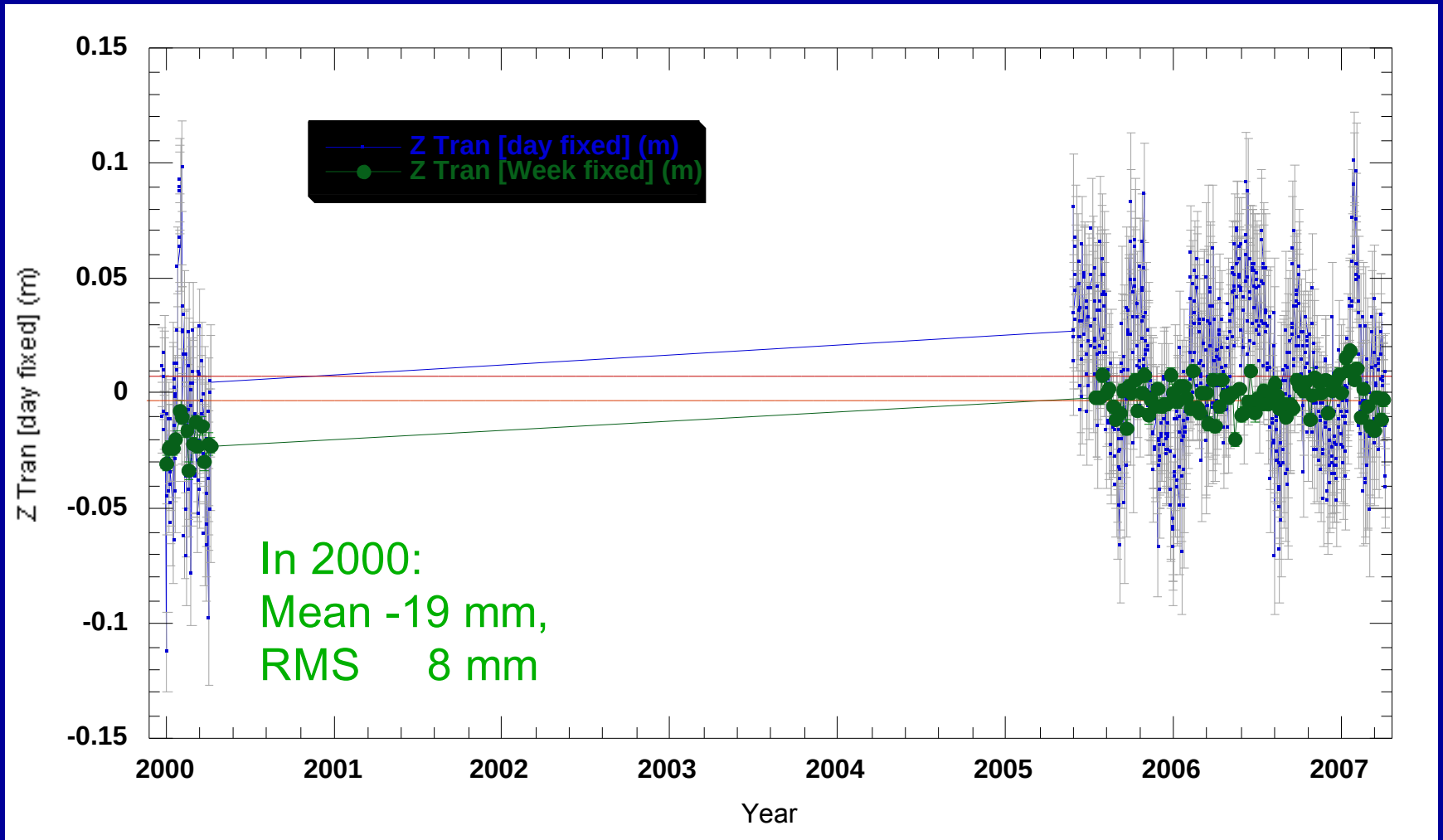
Terrestrial Z-translation; Antenna offsets fixed

Mean: Day 10 mm, RMS 31 mm; Week -1.5 mm, RMS 7 mm



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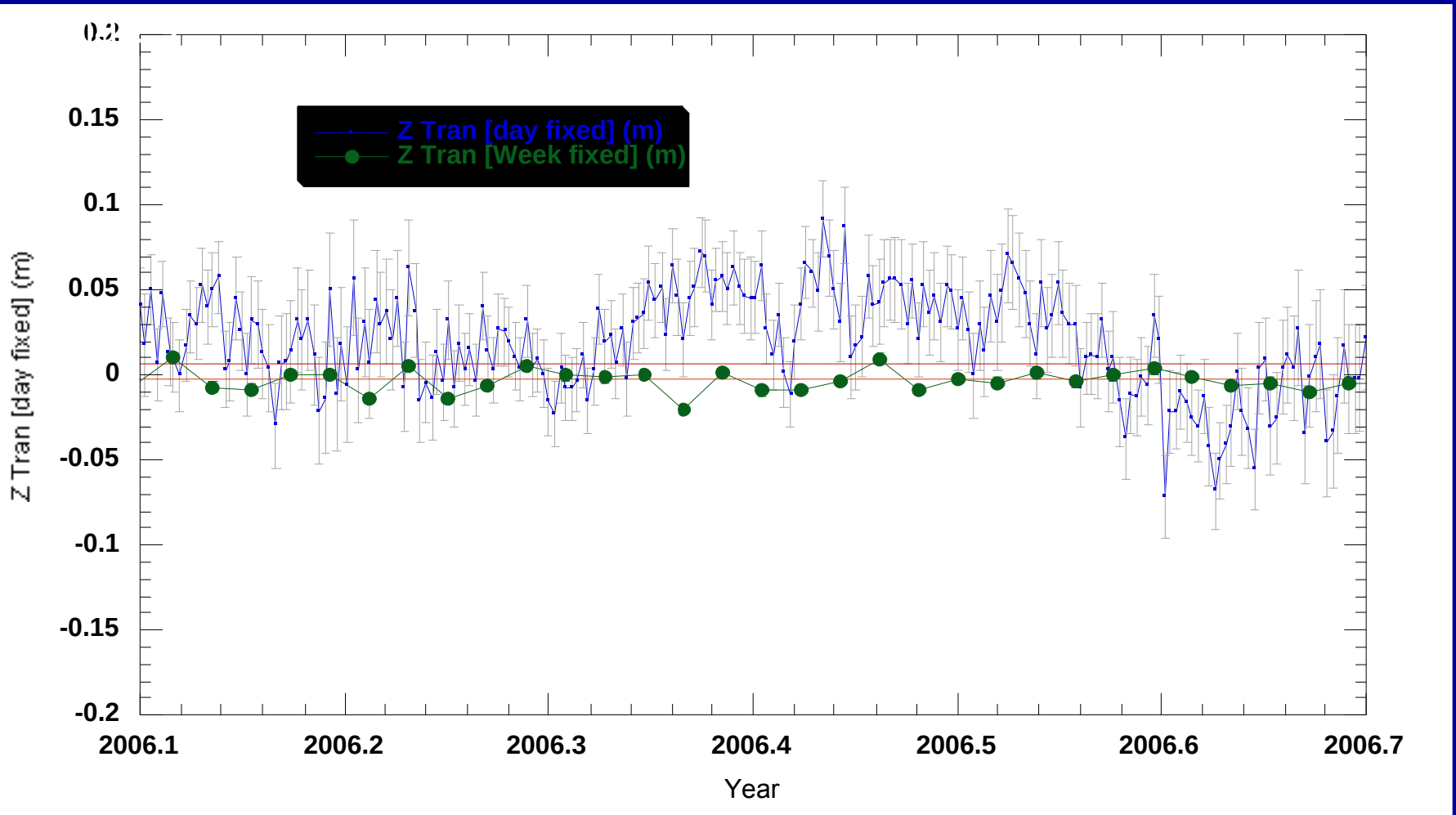
Expanded view showing bias between daily and weekly analyses

Constraints from weekly averaging of radiation parameters causes systematic shift in frame center location. This does not happen with scale e



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Conclusions

- Applications of absolute phase center models have improved the consistency in IGS products for scale and Z-translation with ITRF 2005.
- Some dependence of treatment of radiation parameters on estimates especially seasonal signal in Z-translation.
- Both MIT and COD analyses still show systematic shift in mean satellite antenna locations when estimate allowed (only 21-weeks of comparison). However, there are issues here with deconstraining COD sinex files.
- There are also offsets in position time series to radome additions to phase center tables. Most of relative to absolute model change in from of scale.