Bundesamt für
Kartographie und Geodäsie

SLR-GNSS analysis in the framework of the ITRF2013 computation

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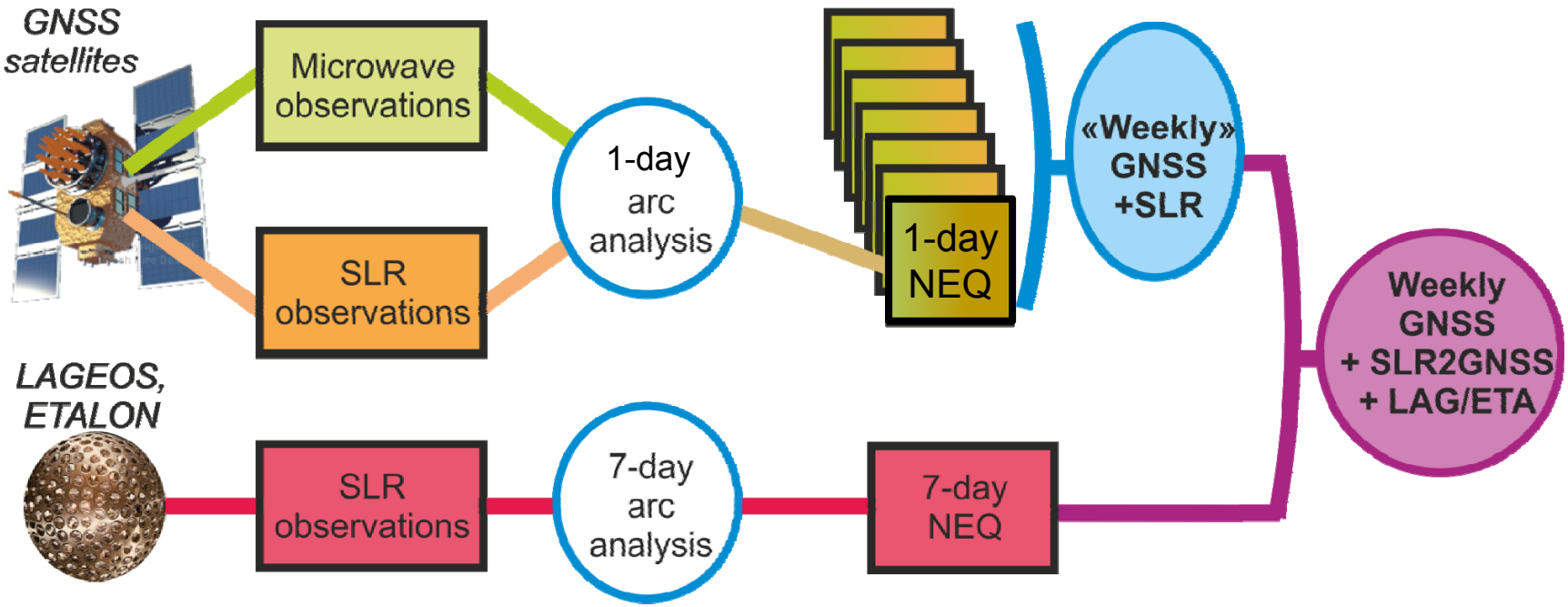
Overview

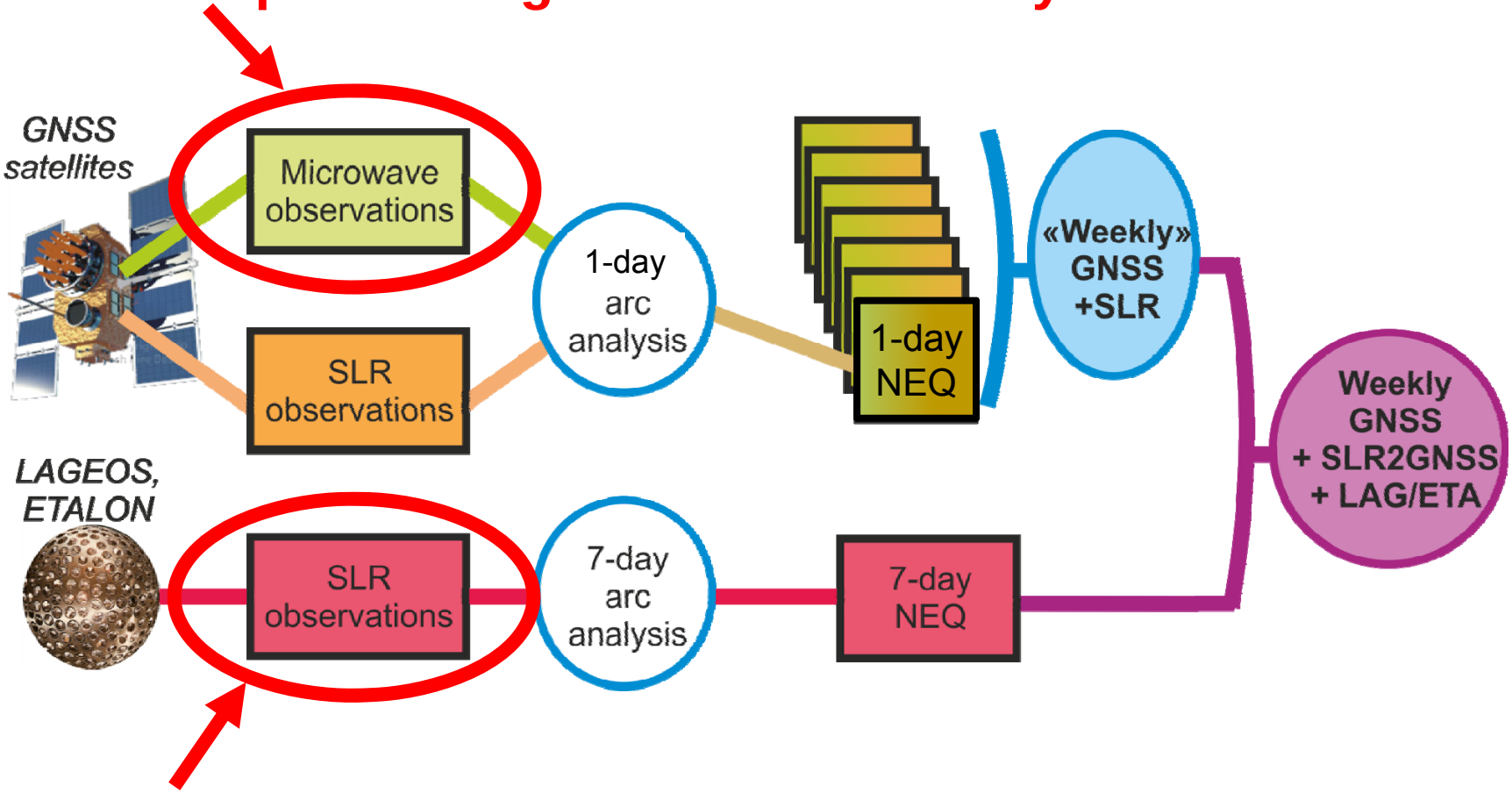
- ITRF2013 called for pre-combined solutions (for comparison purposes)
- SLR-GNSS combined solutions:
  - GPS / GLONASS: microwave observations
  - LAGEOS and Etalon: SLR observations
  - **GPS / GLONASS: SLR observations**
- Impact of datum definition on pre-combined solutions:
  - Geocenter
  - Scale
  - Earth Rotation Parameters (ERPs)

GNSS-SLR combination: Satellite co-location



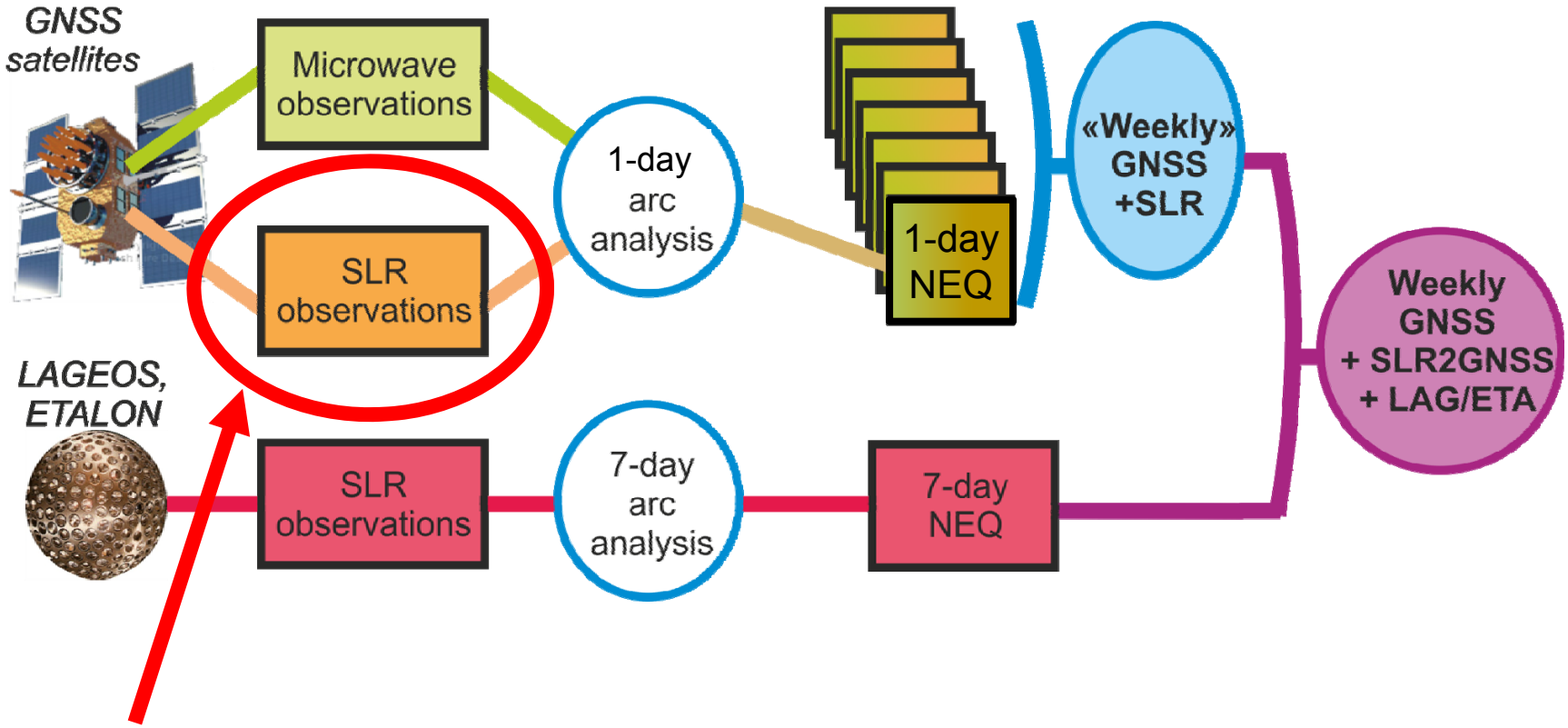
GNSS-SLR combination: Satellite co-location

IGS processing at the CODE Analysis Center



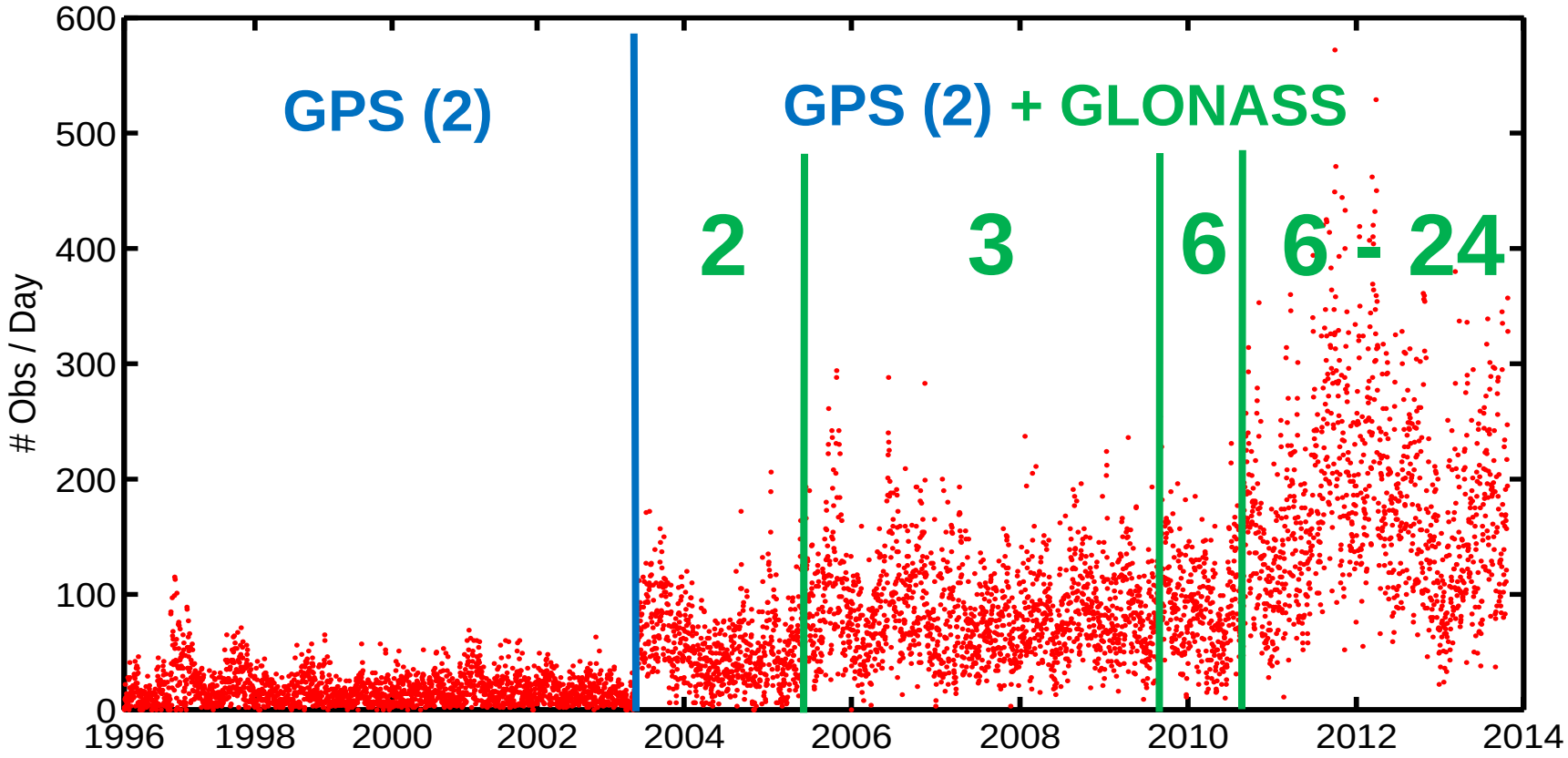
ILRS processing at the BKG Analysis Center

GNSS-SLR combination: Satellite co-location



- Using **co-locations at GNSS satellites** for connecting both techniques

GNSS tracking



Studies presented here:

2009/Jan – 2013/Oct

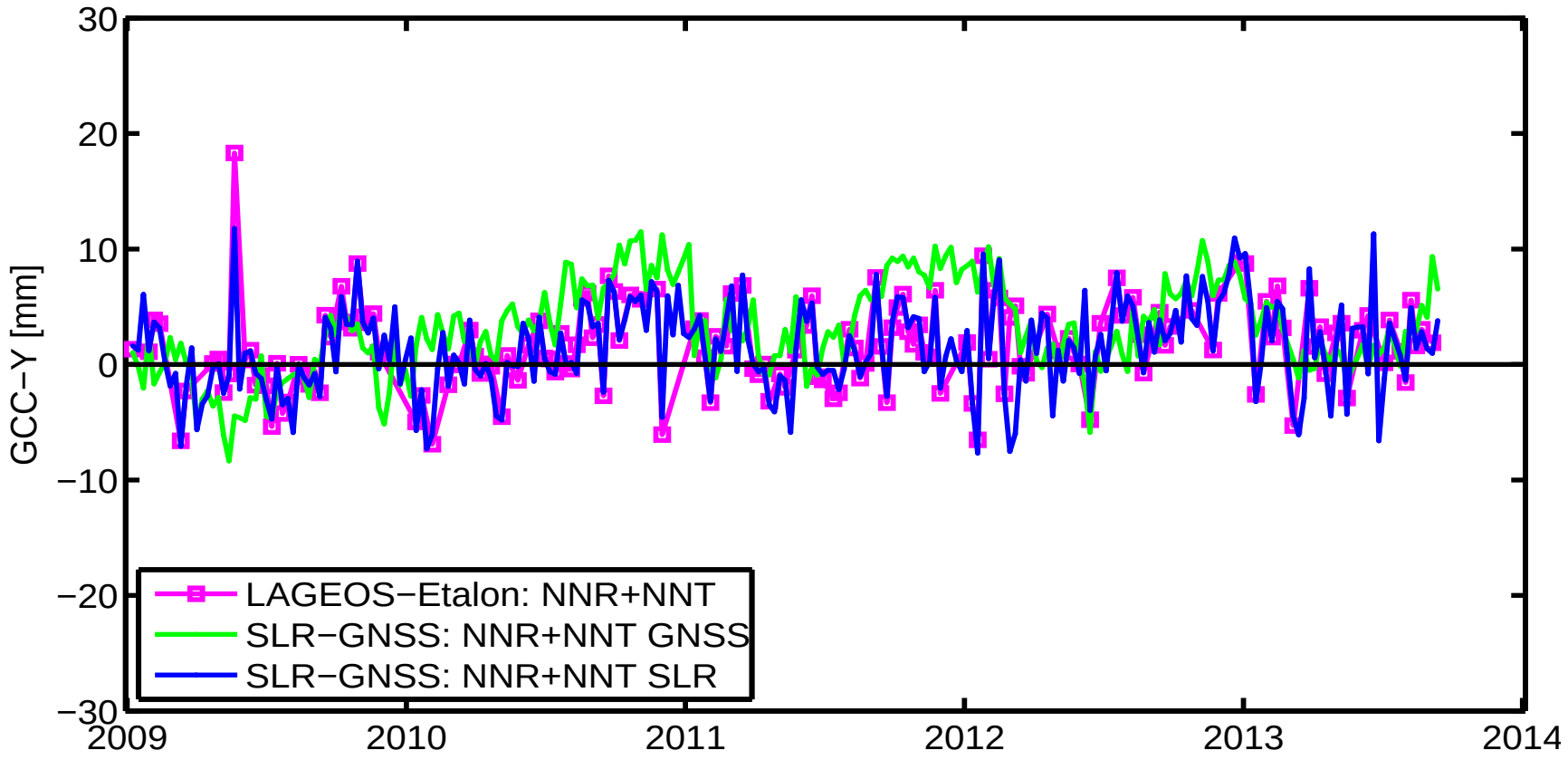
Strategy for datum definition

1) Use GNSS core network (~ 90 sites)
   - Dense network / many stations
   - (almost) identical network for each week
   - Orientation (= ERPs) should be defined well
   - Problems in geocenter may occur (artefacts from GNSS orbit modeling)

2) Use SLR core network (usually < 10 sites)
   - Sparse network
   - Changing network configuration from week to week
   - Orientation (= ERPs) may suffer
   - Geocenter should be unaffected by GNSS orbit modeling issues

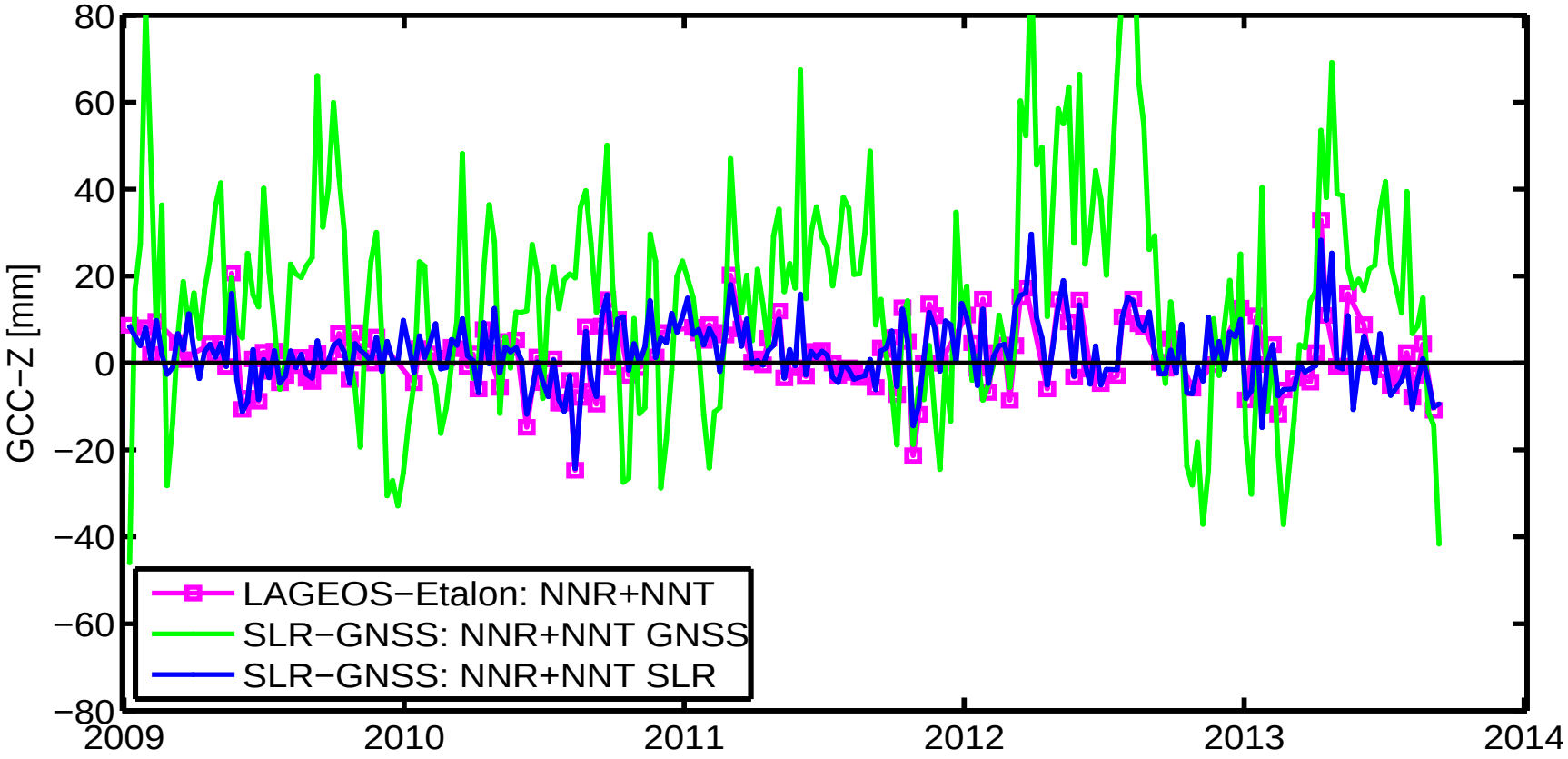
3) Use combined GNSS+SLR core network
   - Benefit from GNSS (-> ERPs) and SLR (-> origin) ???
   - Not independent from local ties used in reference frame (ITRF2008)

Geocenter coordinates



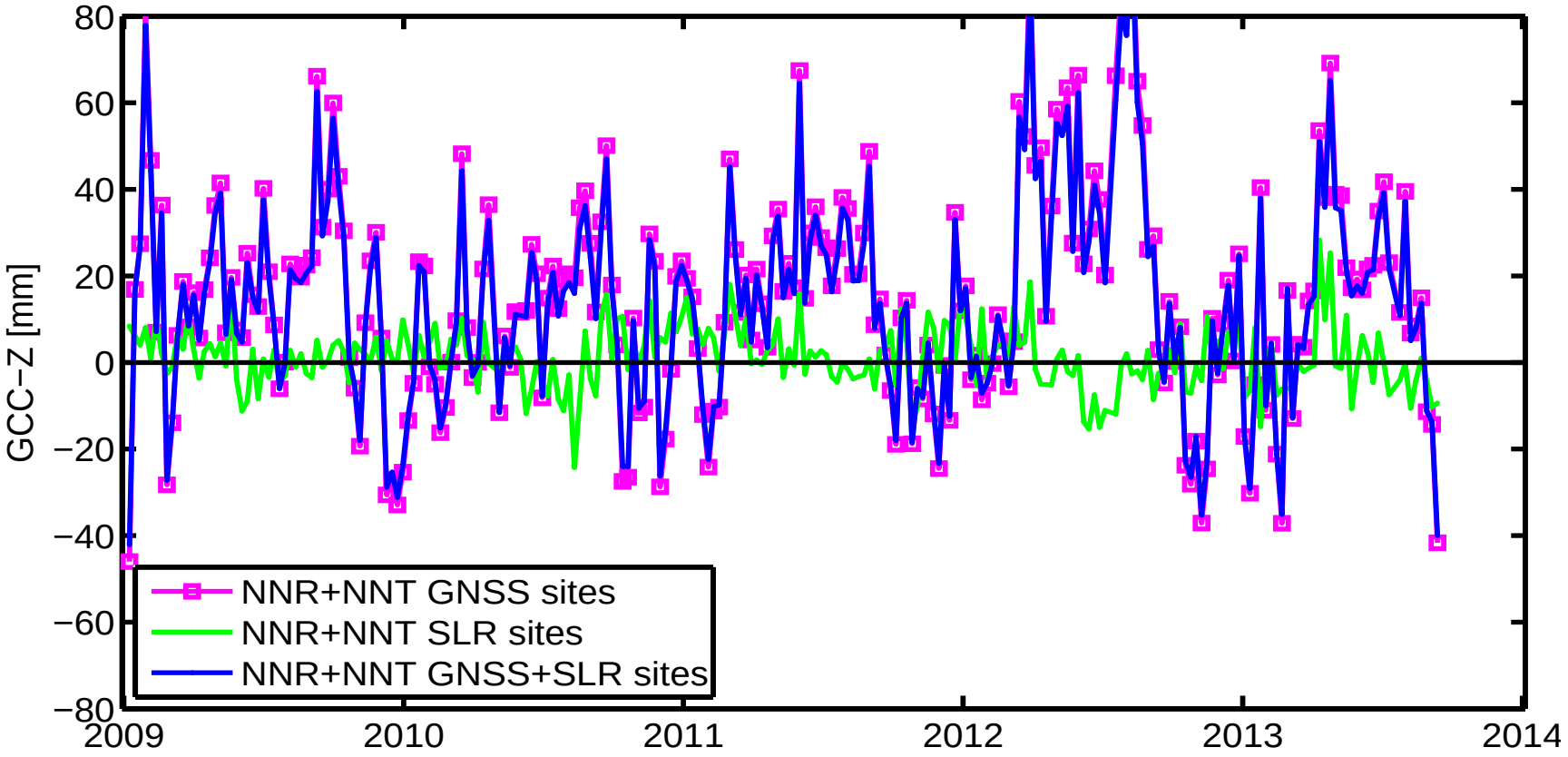
- Using GNSS sites shows slightly different signal than using SLR sites
- Using SLR sites reproduces SLR-only solution

Geocenter coordinates



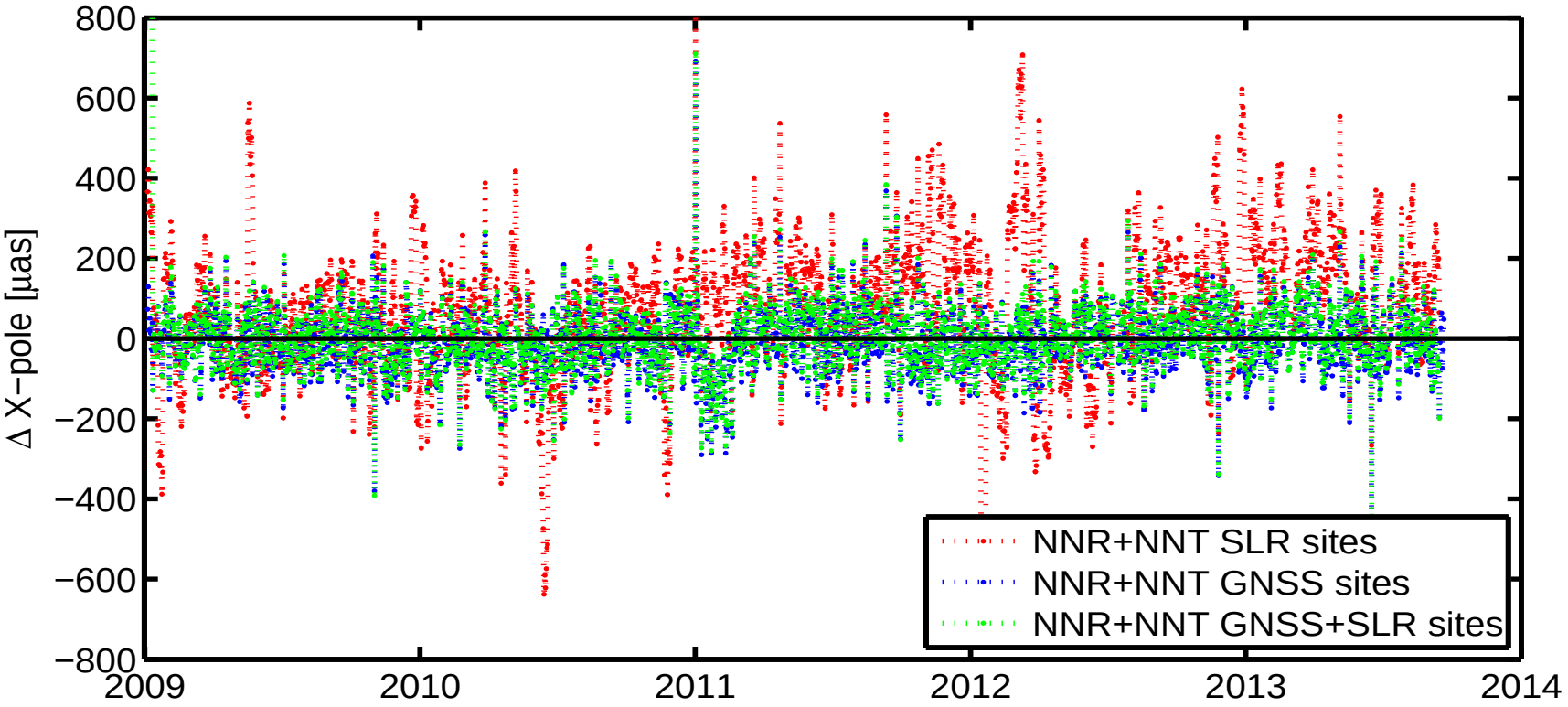
- Using GNSS sites shows clearly different signal than using SLR sites: **draconitic year**
- Using SLR sites reproduces SLR-only solution

Geocenter coordinates



- Using GNSS+SLR sites for datum definition does not improve situation: GNSS is still dominating
- GNSS orbit modelling issues propagate into combination

Earth rotation parameters



- Using SLR core sites results in noisier time series than using GNSS core sites
- Using GNSS+SLR sites slightly better than GNSS-only

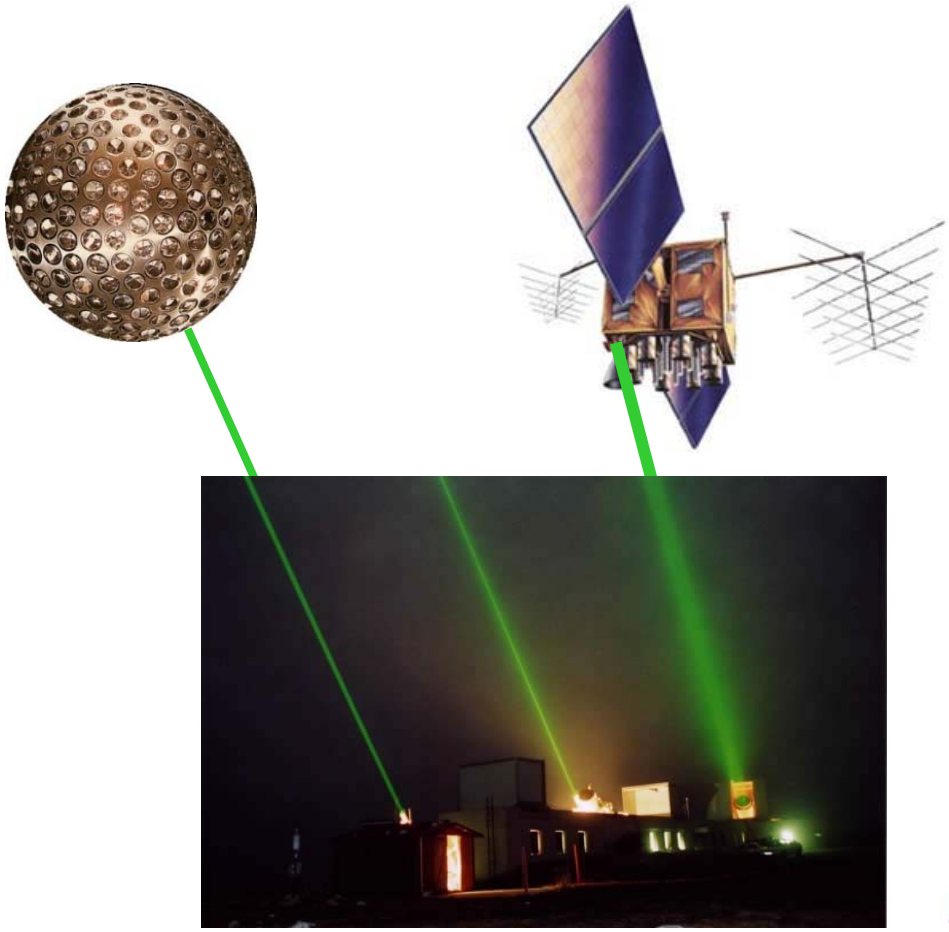
Summary and outlook -1-

- Weekly pre-combined GNSS-SLR solutions using satellite co-locations were studied
  - SLR observations to GPS/GLONASS are additionally used (compared to „standard“ ITRF contributions)
- **Geocenter coordinates** are highly influenced by GNSS orbit modelling as soon as GNSS core network is included in datum definition
- **ERPs** are more stable if dense GNSS core network is included in datum definition
- **Scale** is independent of the set of core sites used (not shown here)

Summary and outlook -2-

- There is no set of core sites that is optimal for all parameters of interest
- GNSS orbit modelling (solar radiation pressure) is still a big issue:
  - Using 3-day orbits (instead of 1-day orbits) would help already
  - Constraining of once-per-rev parameters reduces the impact on geocenter
- The increased amount of SLR tracking to GLONASS helps to strengthen the connection via satellites

Thanks for your attention!



DFG Forschergruppe
Referenzsysteme

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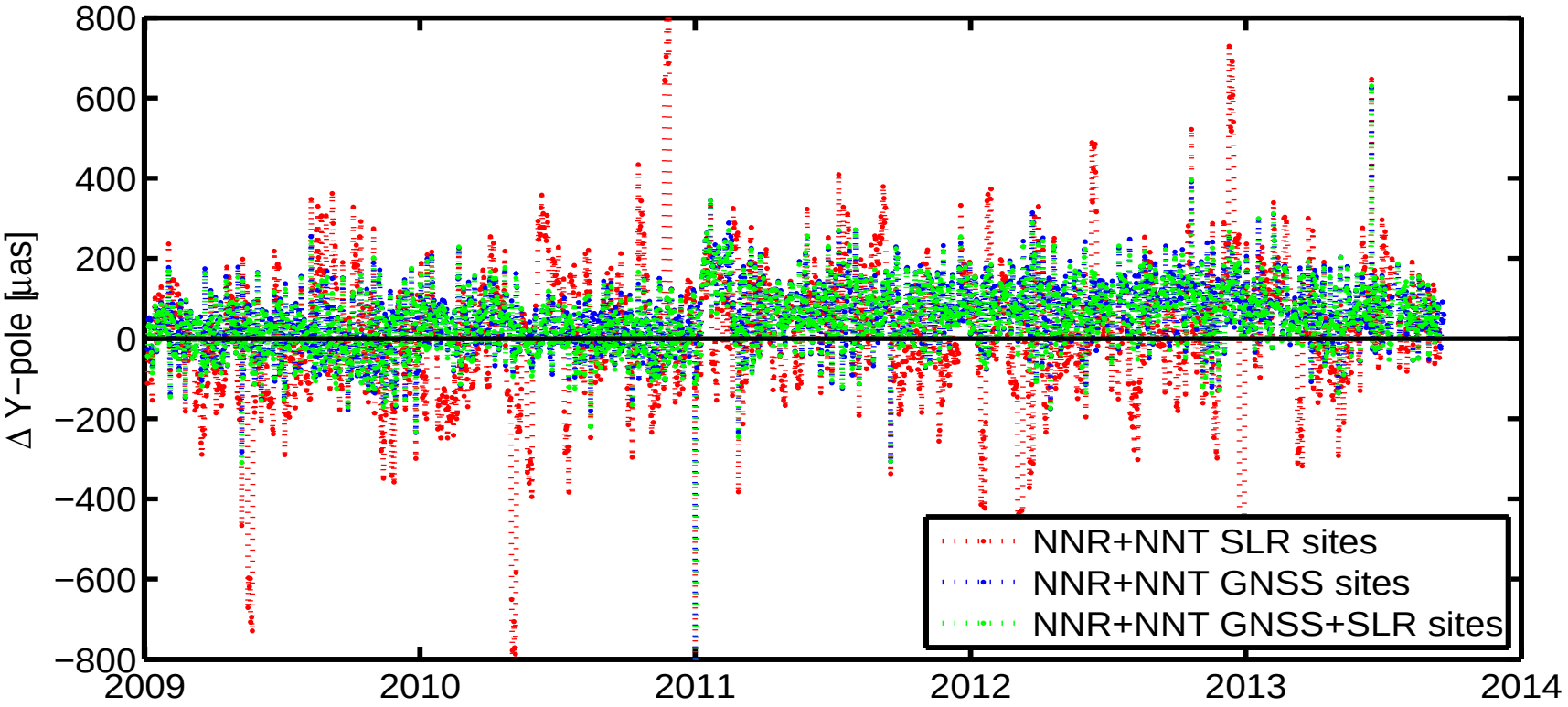
Earth rotation parameters



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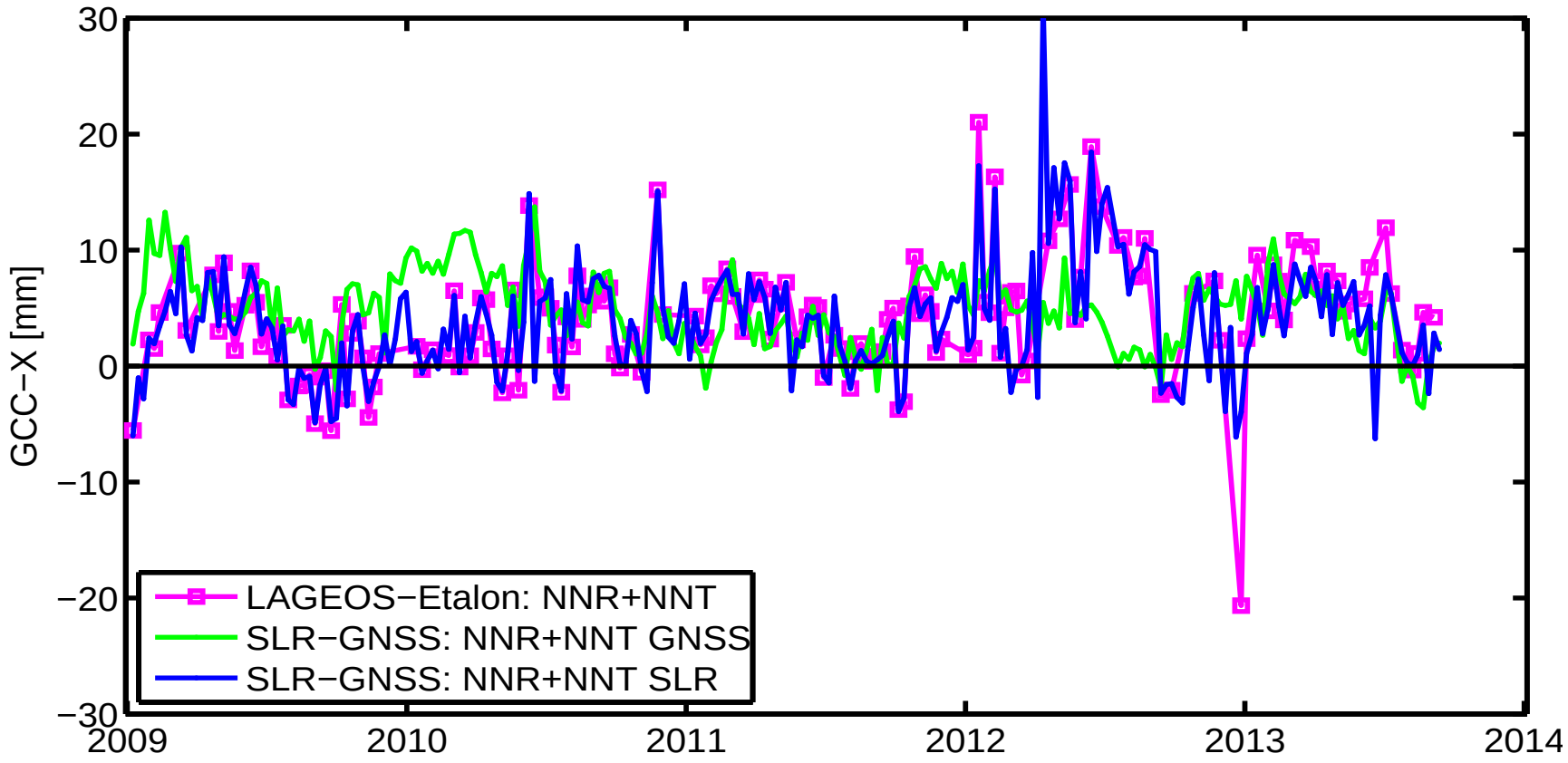
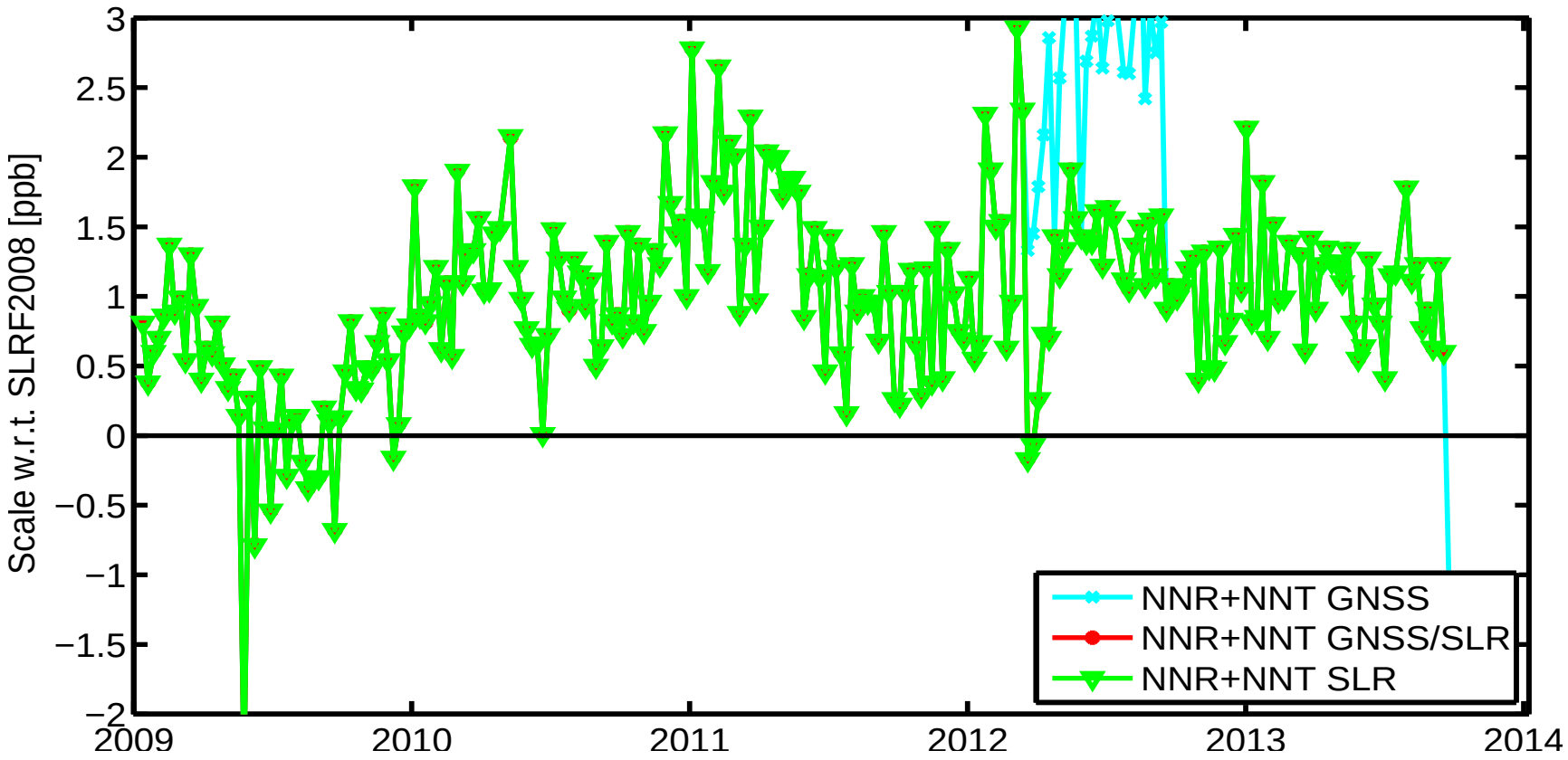
Geocenter coordinates



Scale


Scale w.r.t. SLRF2008 [ppb]
3
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
2009
2010
2011
2012
2013
2014
NNR+NNT GNSS
NNR+NNT GNSS/SLR
NNR+NNT SLR