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# **Combination of TIGA solutions: Experiences gained from the TIGA Pilot Project**

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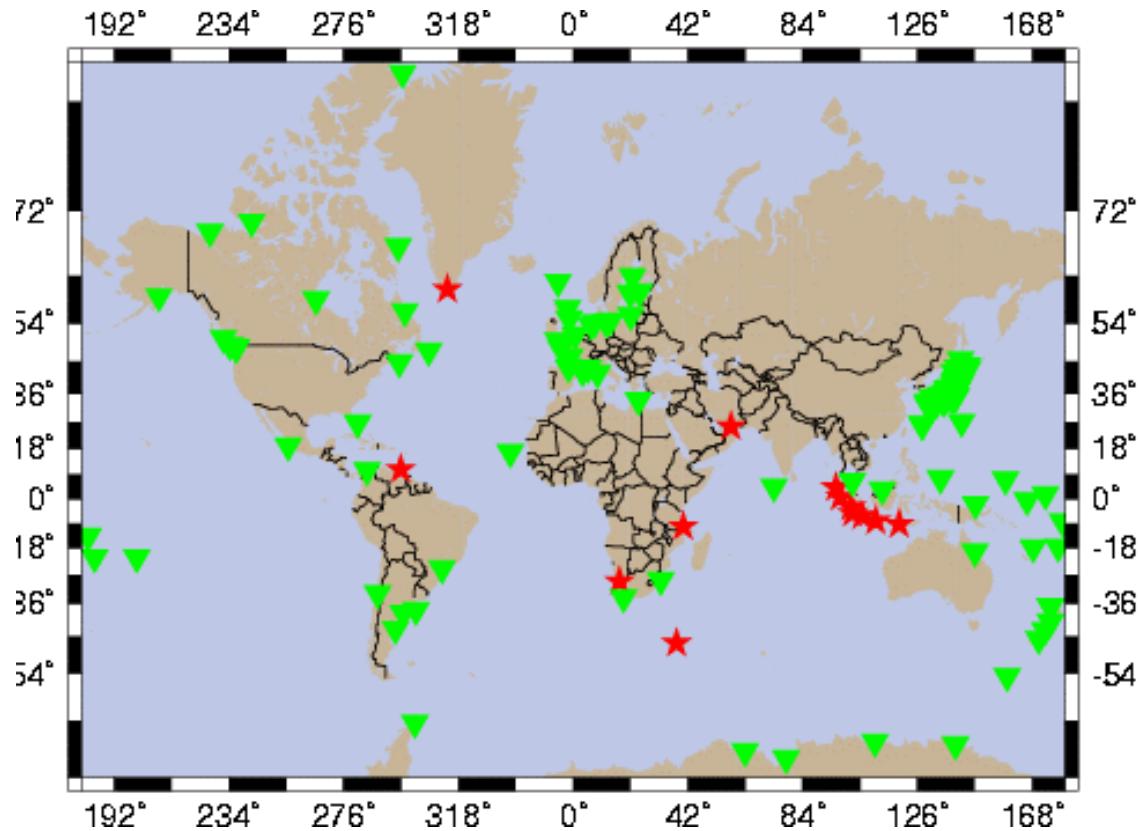
# Overview

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- Individual TIGA solutions
  - Availability
  - Network issues
- TIGA Observing Stations
  - Time series: Vertical trends
  - Agreement between individual contributions
- Conclusions

# Introduction: TIGA

- Project of the **IGS** (International GNSS Service)
- **GPS** observations at **tide gauges**
  - => Tide gauge records can be corrected by the **vertical trend** determined from GPS
- “Global” network of tide gauge sites:



# Introduction: TIGA

- Analysis strategy comparable to IGS
- several TIGA Analysis Centers (**TAC**)

## 1) **Global solutions:**

**CTA** (Universities of Canberra, Tasmania, Australian National)

**GFT** (GeoForschungsZentrum Potsdam)

**ULR** (University of La Rochelle)

## 2) **Regional solutions:**

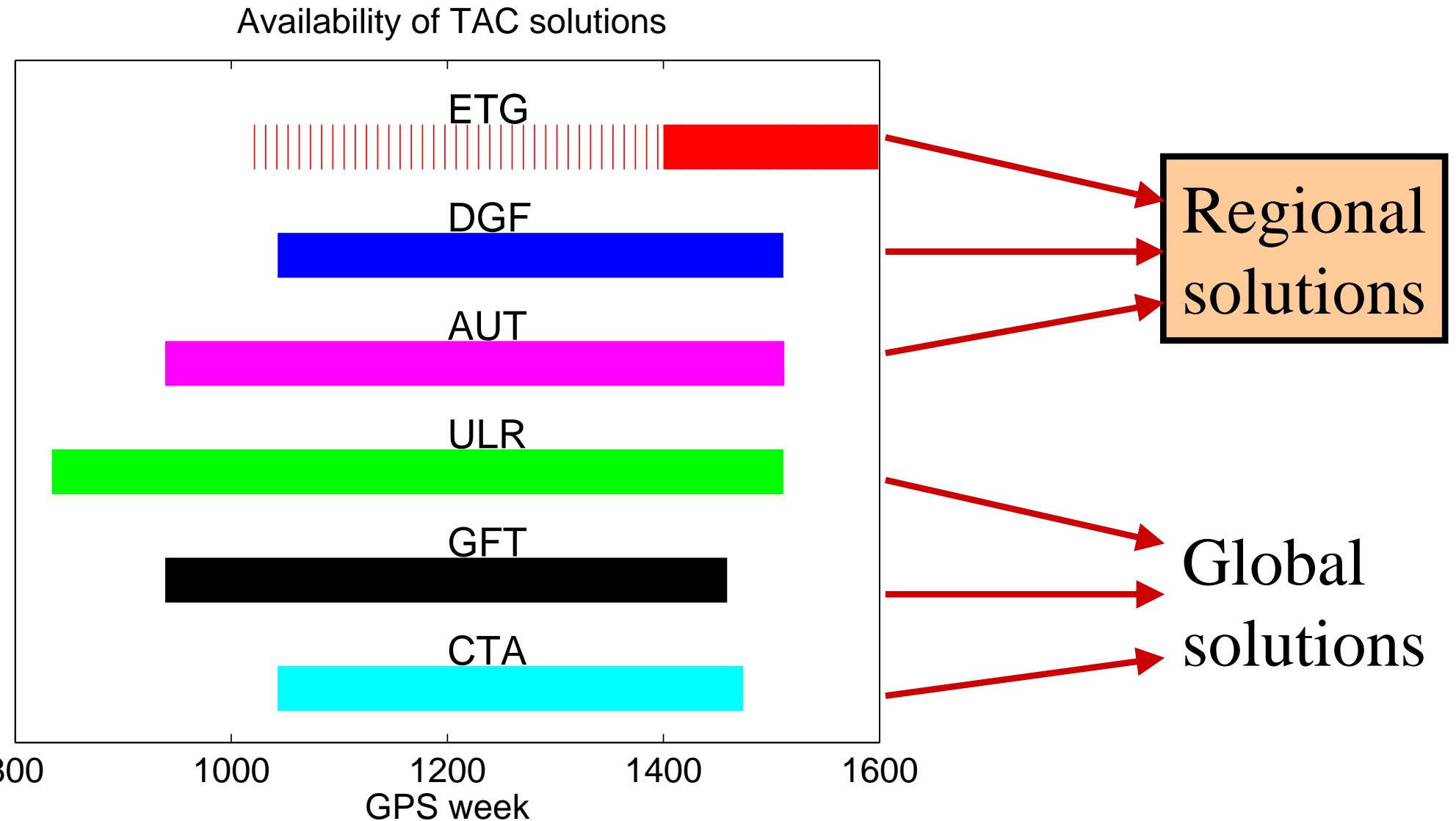
**AUT** (Geoscience Australia)

**DGF** (Deutsches Geodätisches Forschungsinstitut)

**ETG** (EUREF computed at BKG)

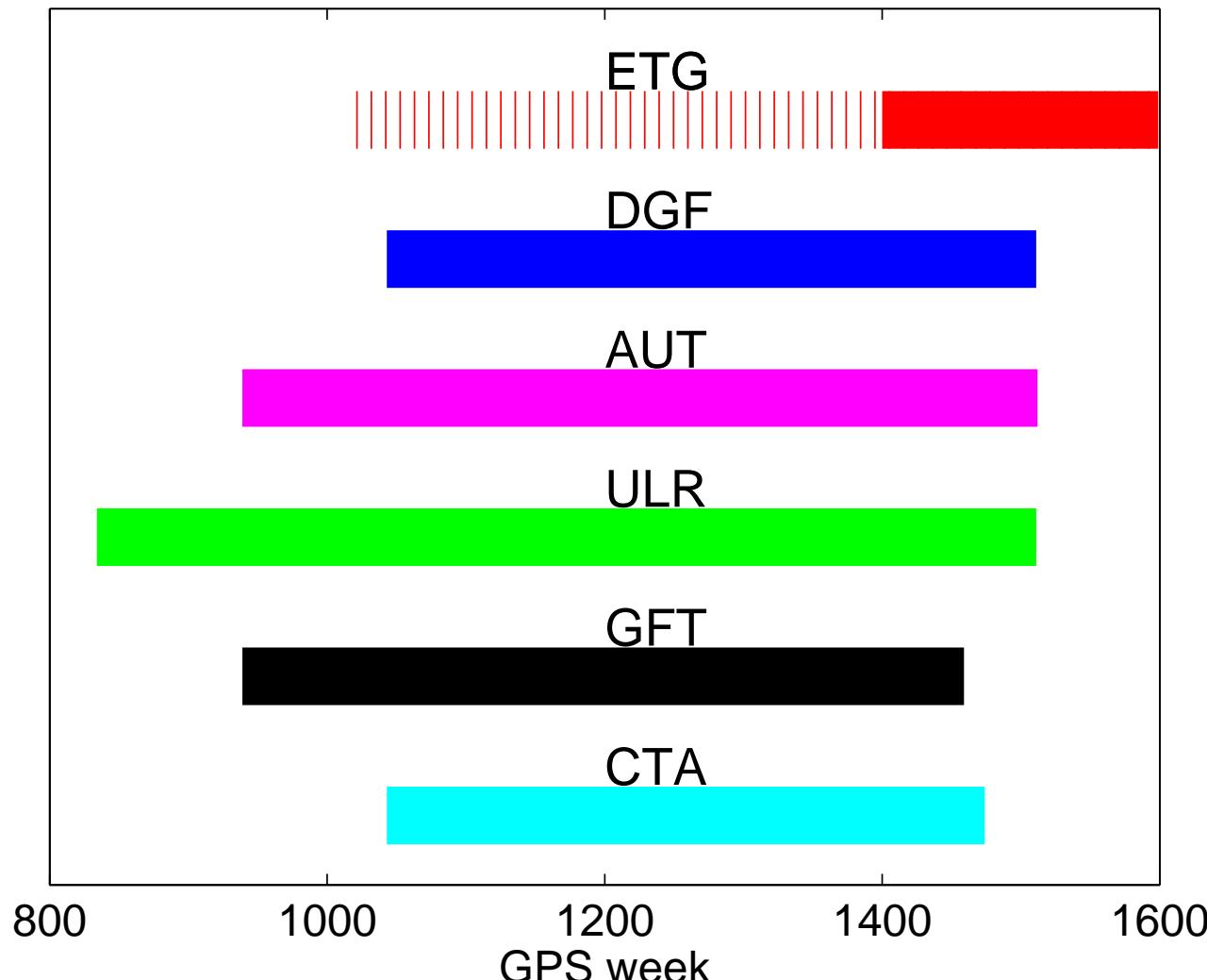
⇒ Combination of the individual TAC contributions:  
common reference frame for all tide gauge sites

# Availability of reprocessed TIGA solutions



# Availability of reprocessed TIGA solutions

Availability of TAC solutions



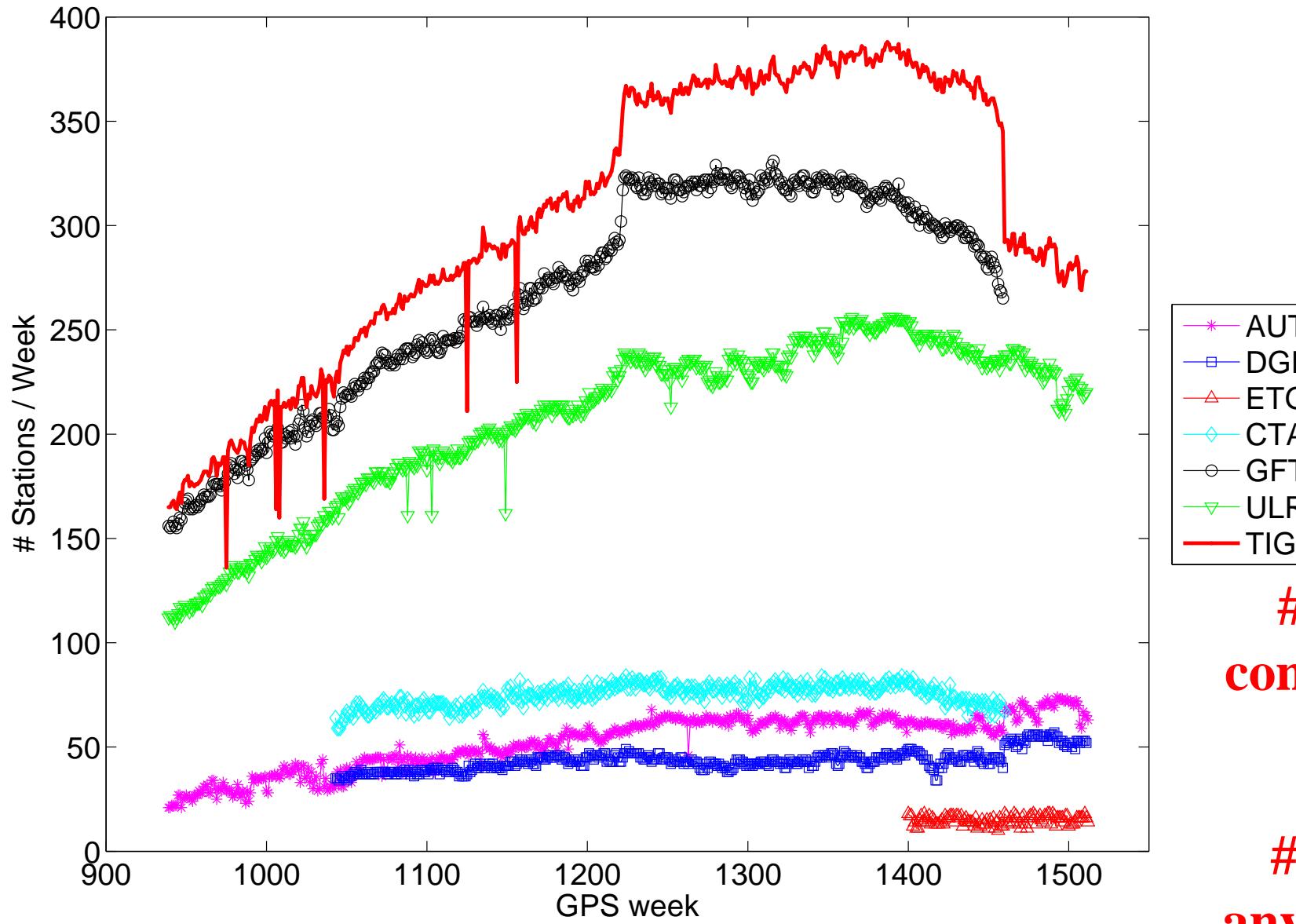
**Time span considered  
for combination:**

Weeks **0939 – 1512**

4. Jan 1998 - 3. Jan 2009

⇒ **574 weeks**  
**11 years**

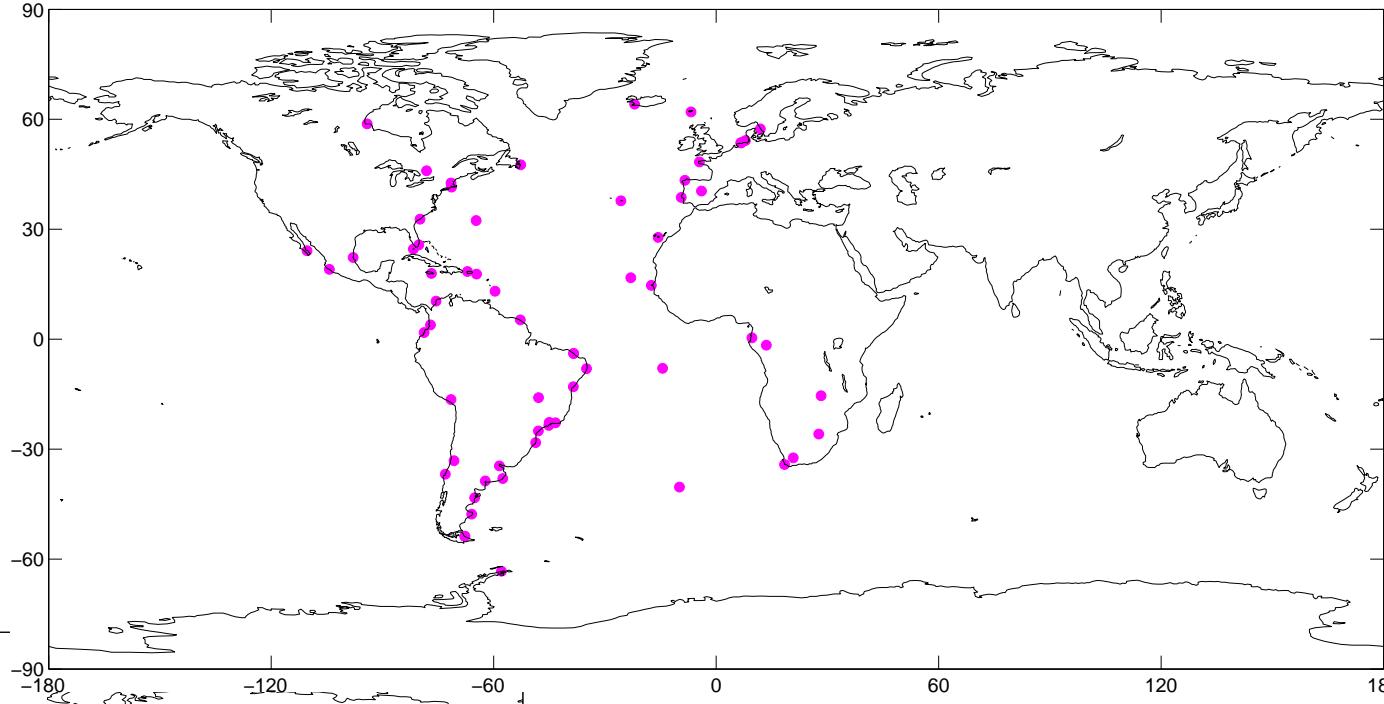
# Stations in weekly combined solutions



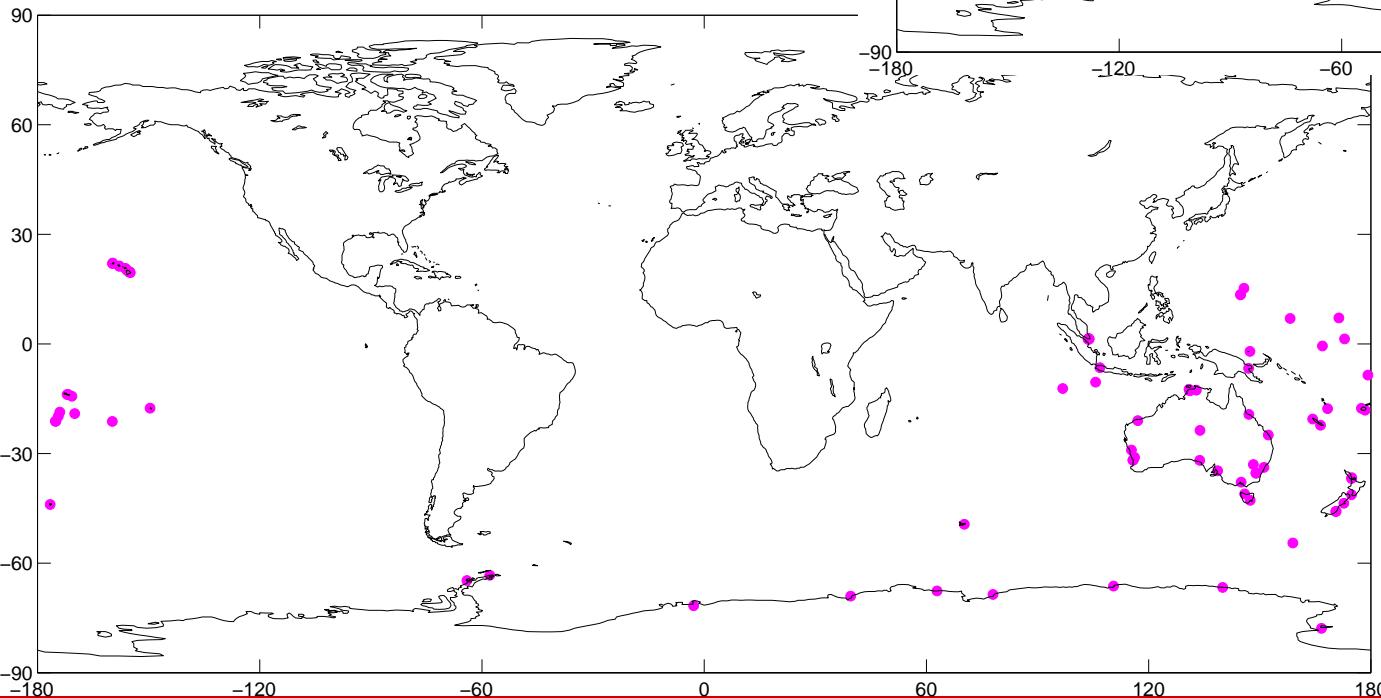
# stations in  
combined solution  
>  
# stations in  
any single solution

# Connecting the individual contributions

DGF

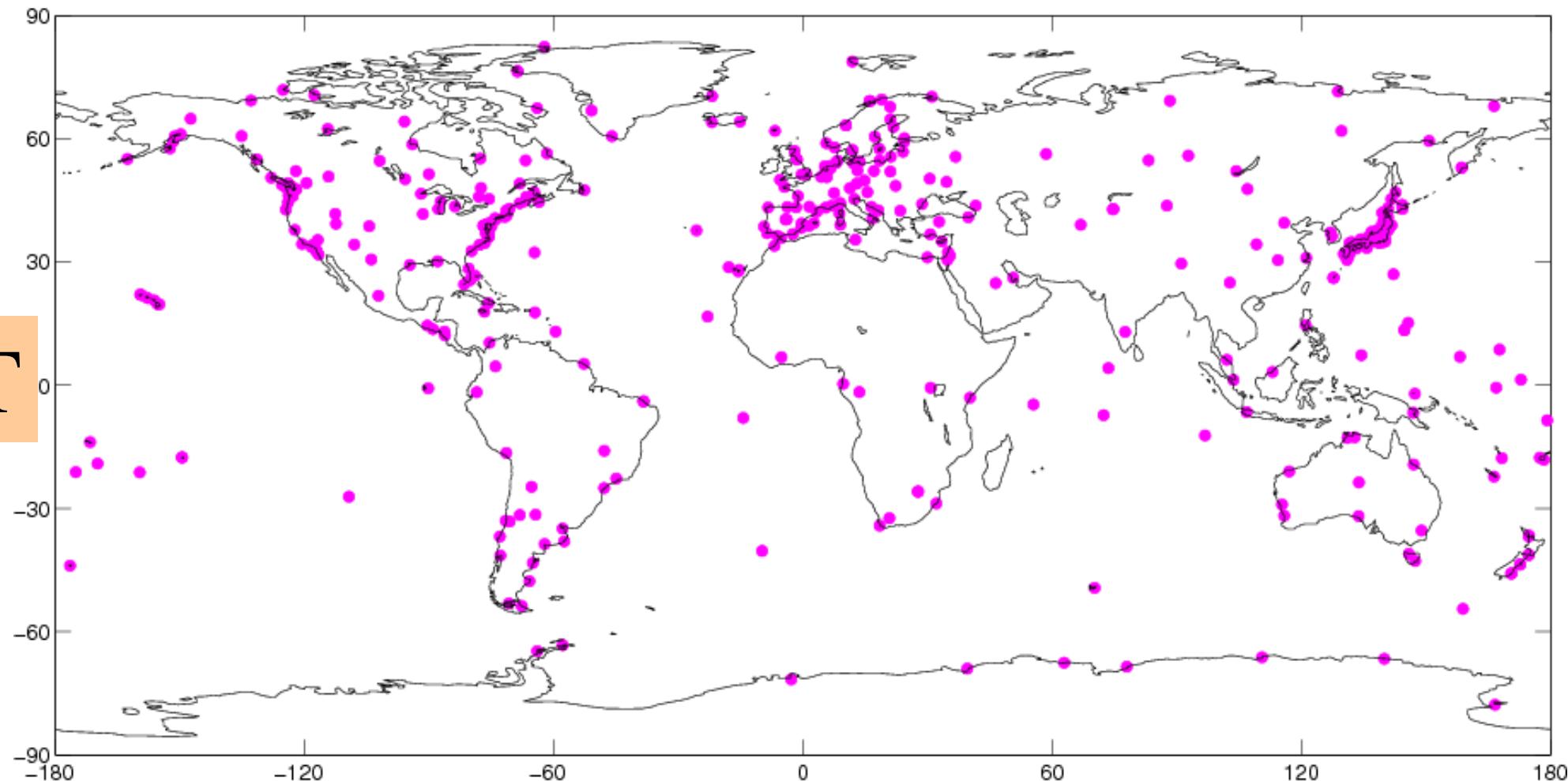


AUT



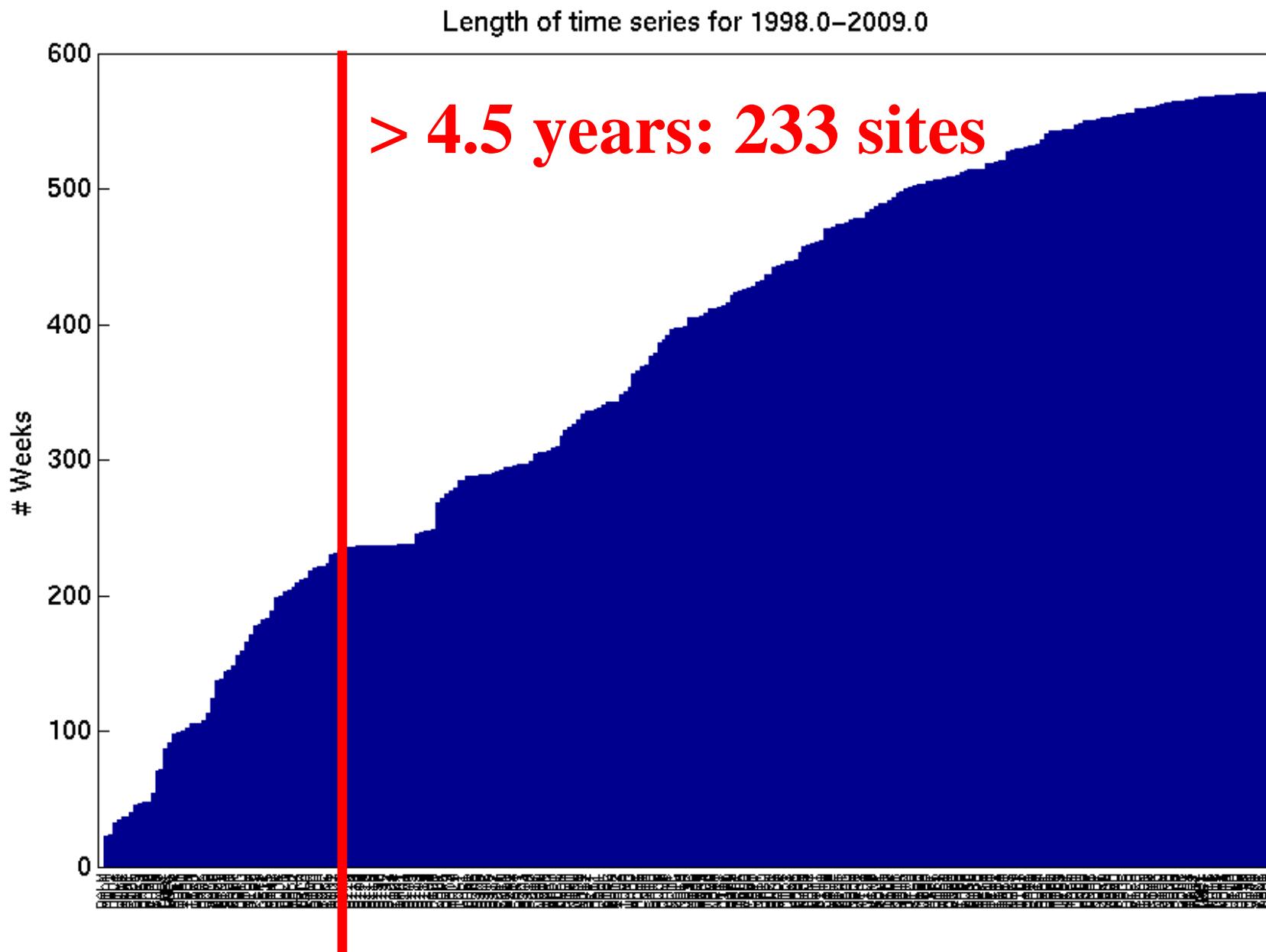
# Connecting the individual contributions

GFT



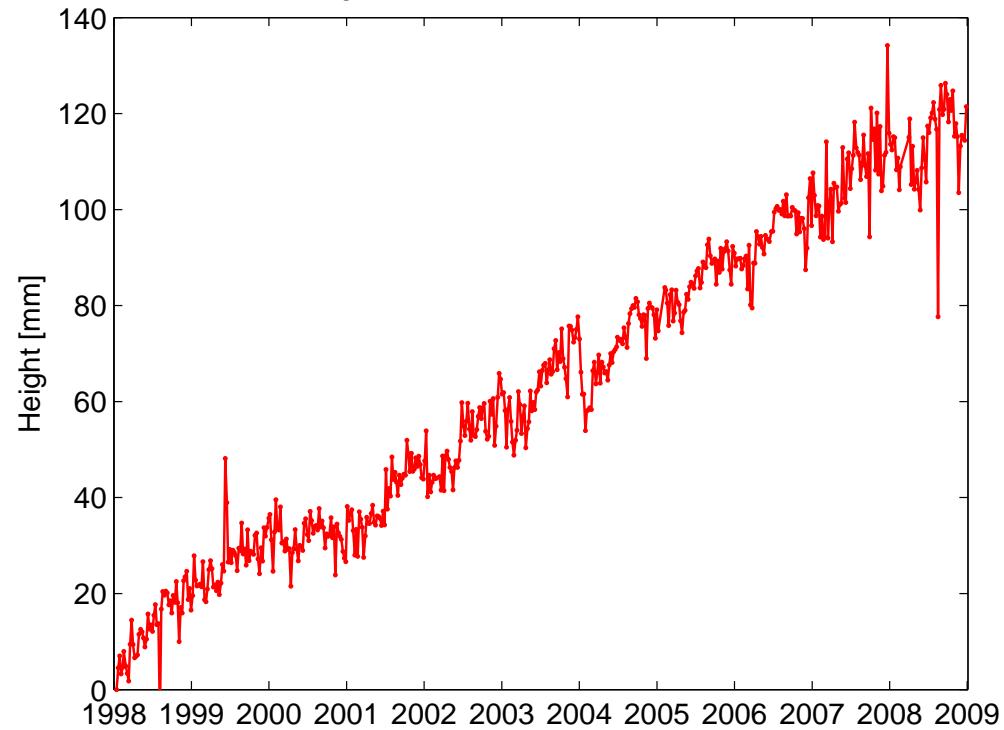
Global solutions needed to connect regional solutions

# TIGA observing stations



# Time-series of station heights

Height for station CHUR; Solution TIG



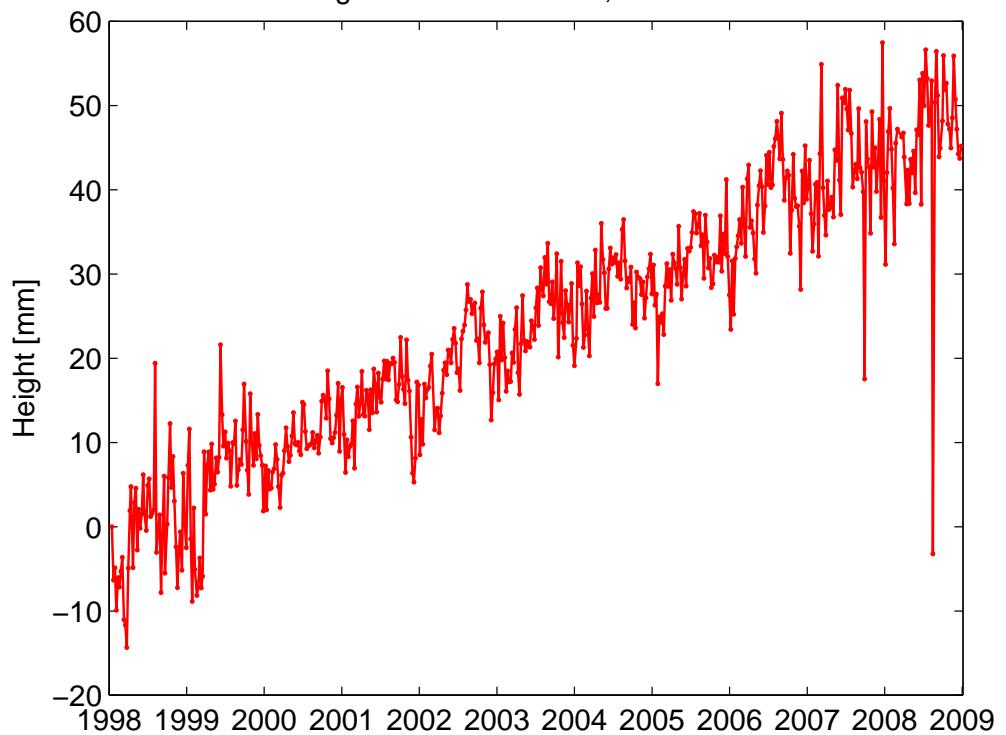
**CHUR:**

Trend = 10.25 mm/y

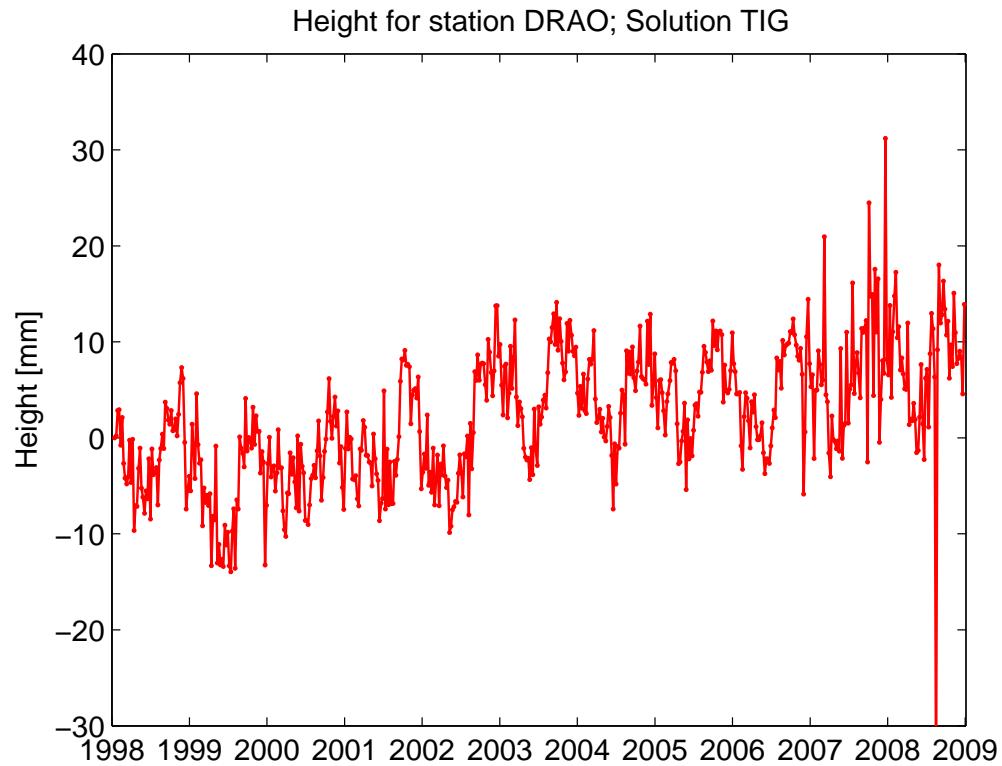
WRMS = 5.55 mm

**METS:**  
Trend = 4.58 mm/y  
WRMS = 5.22 mm

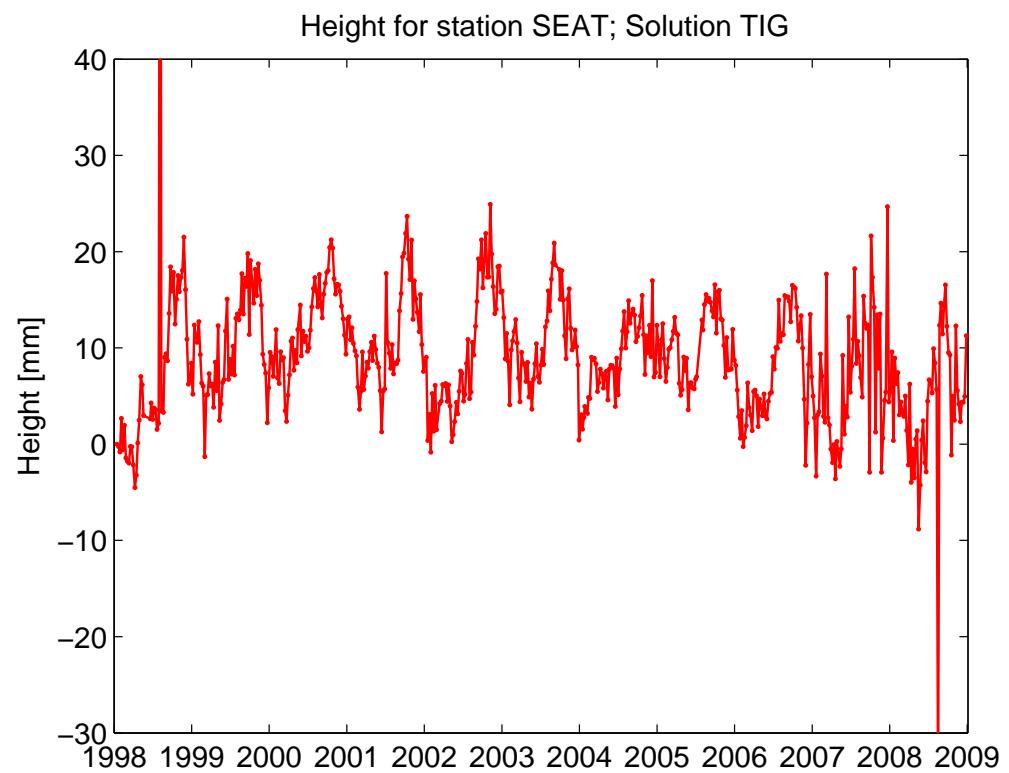
Height for station METS; Solution TIG



# Time-series of station heights

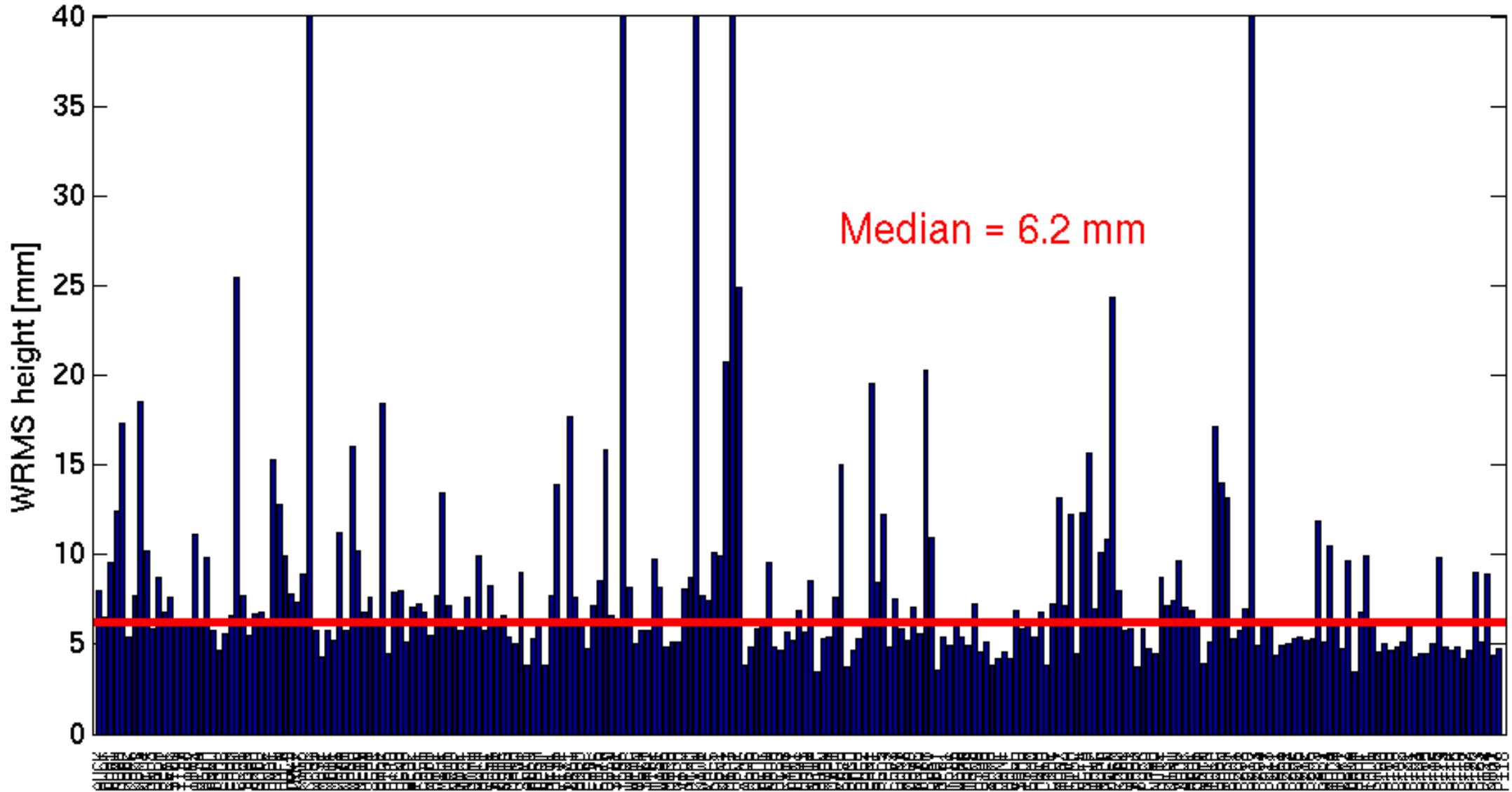


**SEAT:**  
Trend = 0.58 mm/y  
WRMS = 5.74 mm



# Time-series of station heights

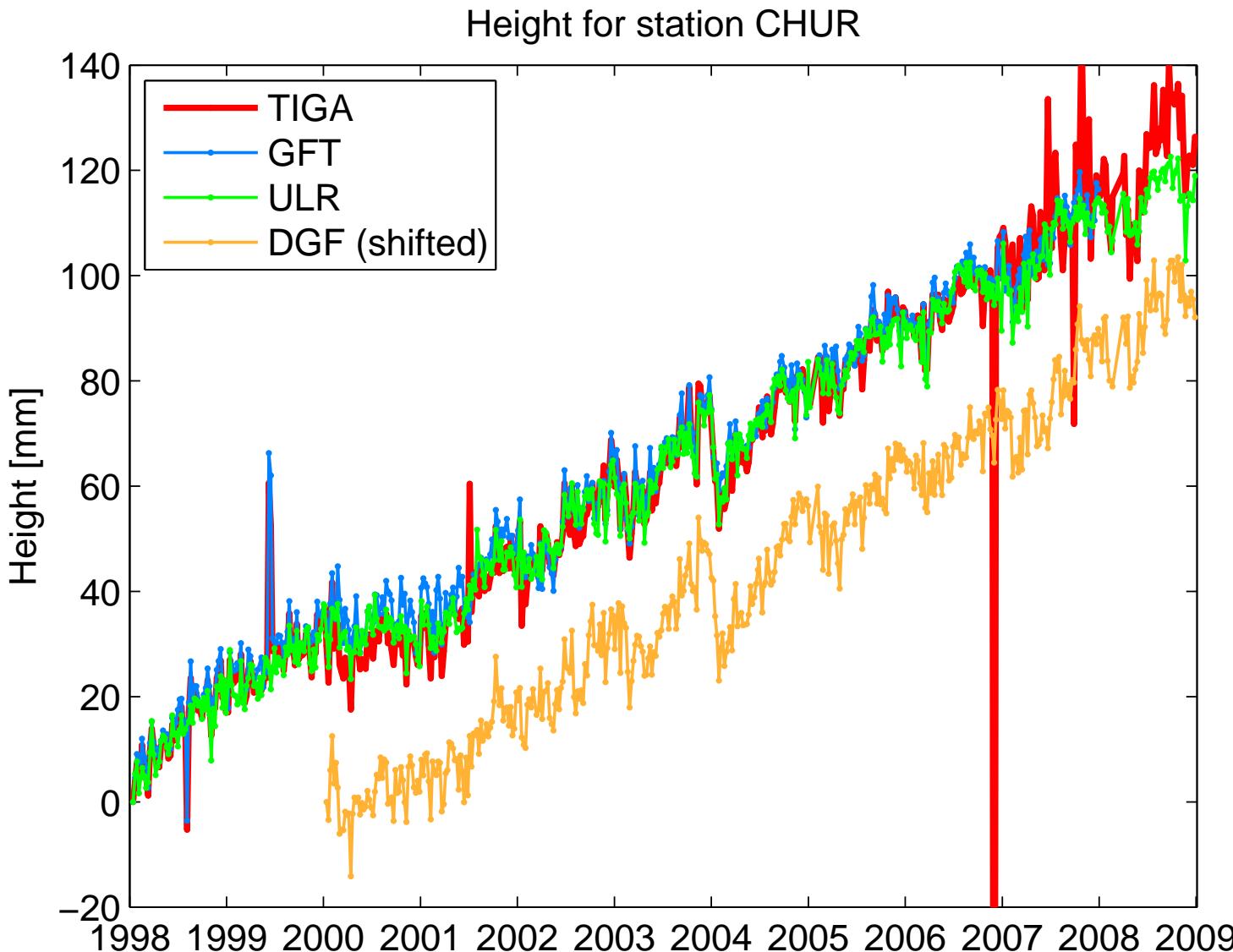
WRMS of de-trended height time series (> 4.5 years, sorted)



11 years

4.5 years

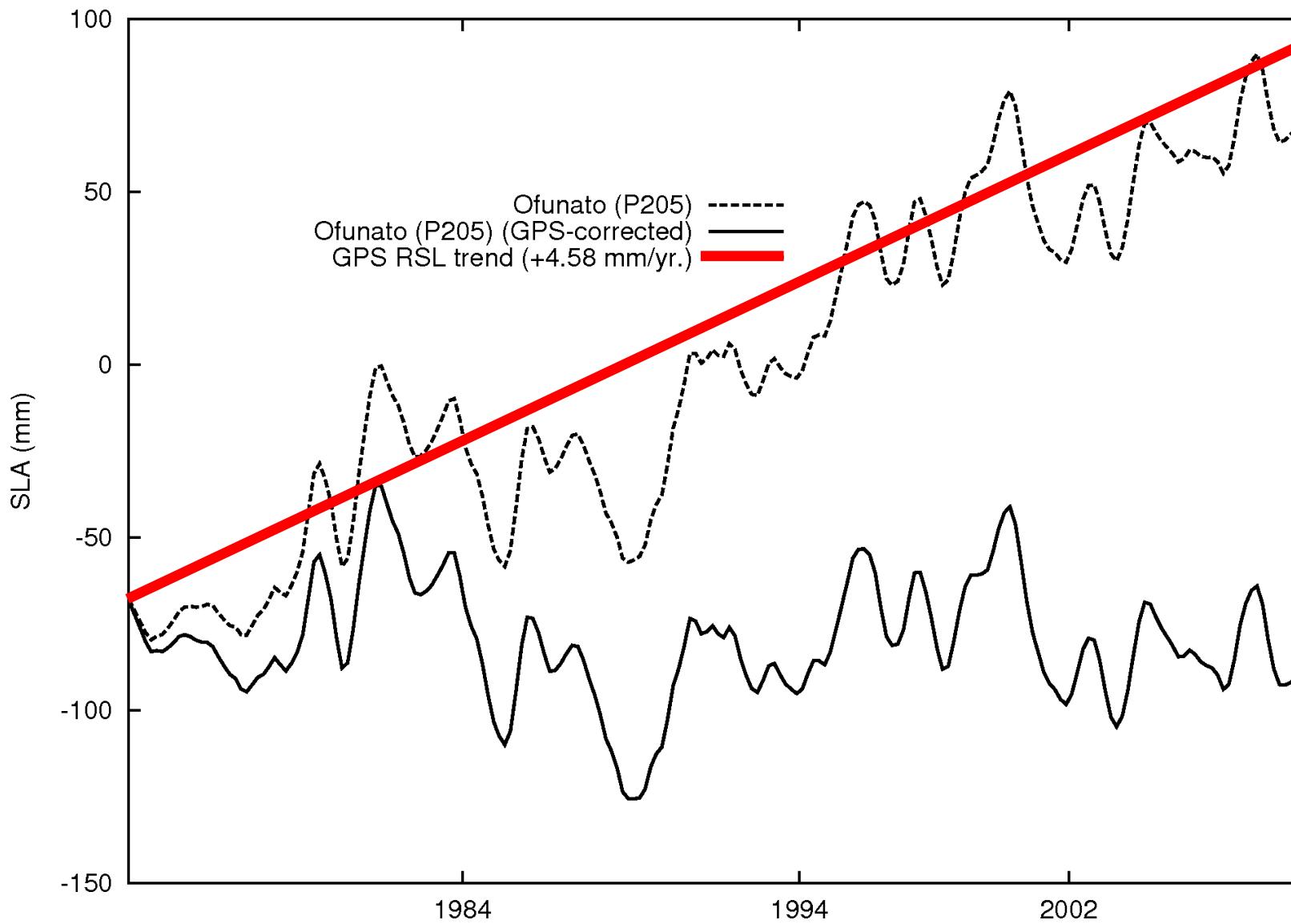
# Time-series of station heights



**Agreement of  
Vertical trends:**

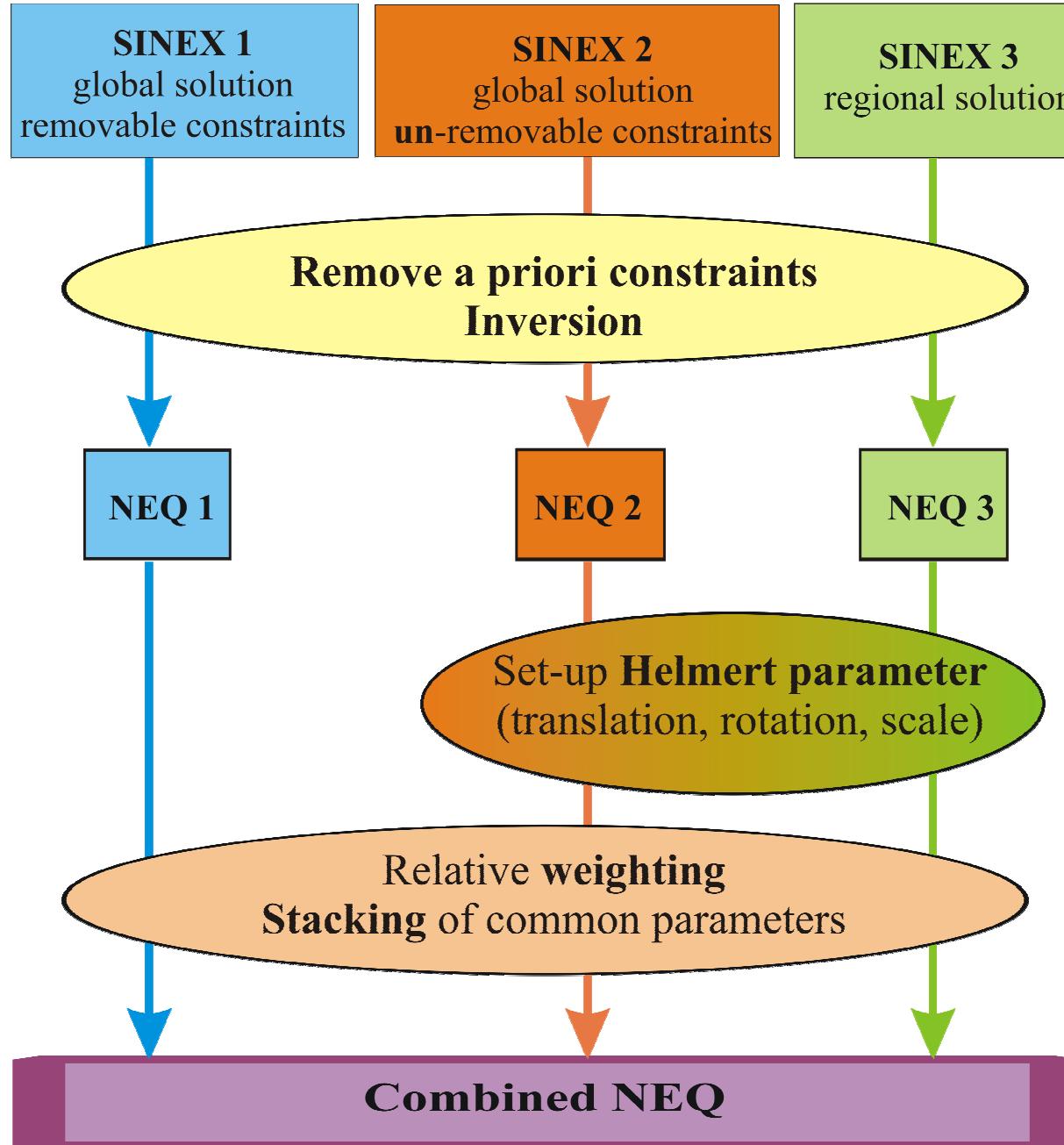
GFT	10.12 mm/y
ULR	10.24 mm/y
DGF	11.21 mm/y
TIGA	10.25 mm/y

# Time-series of station heights



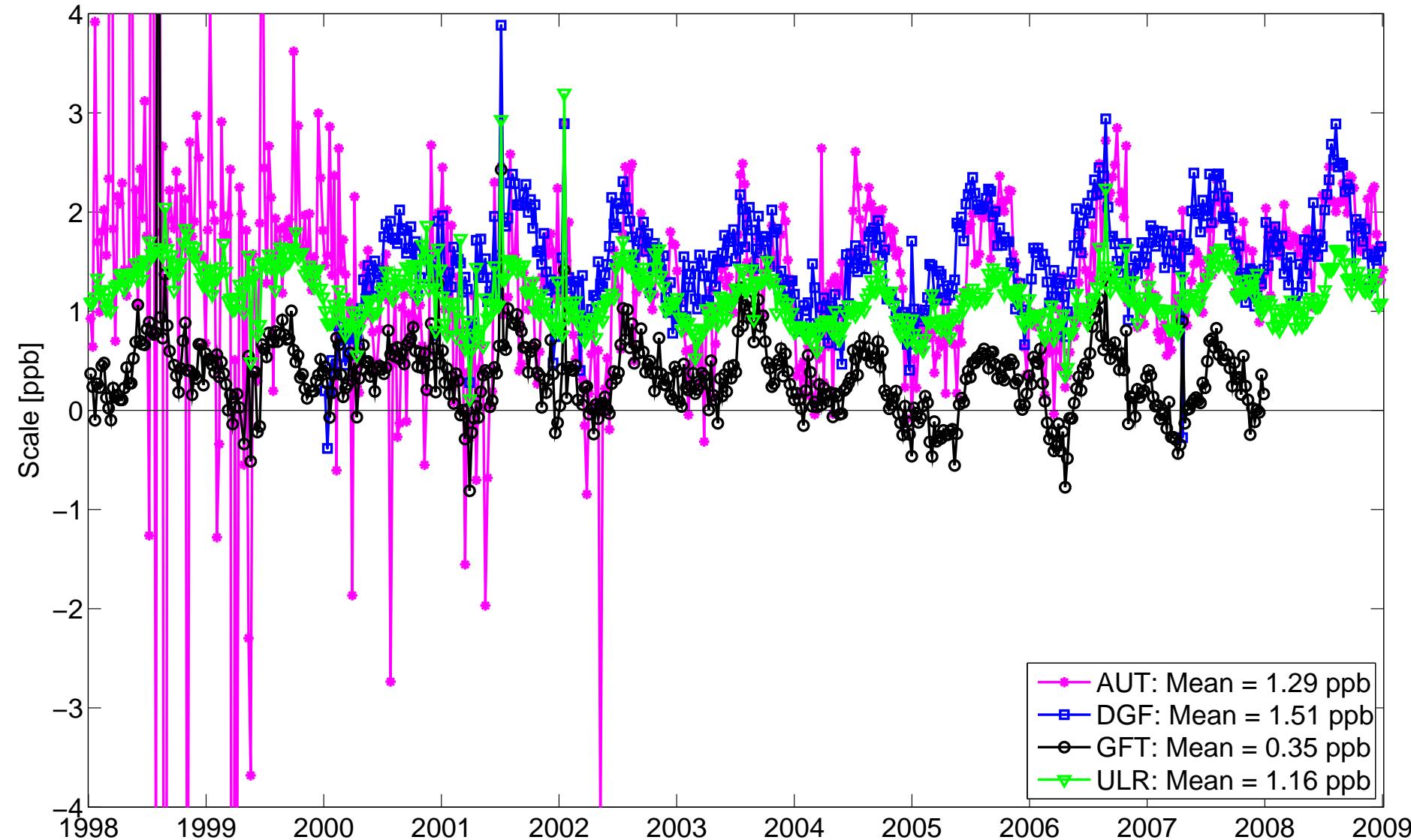
*PhD thesis Nana Schön*

# TIGA combination



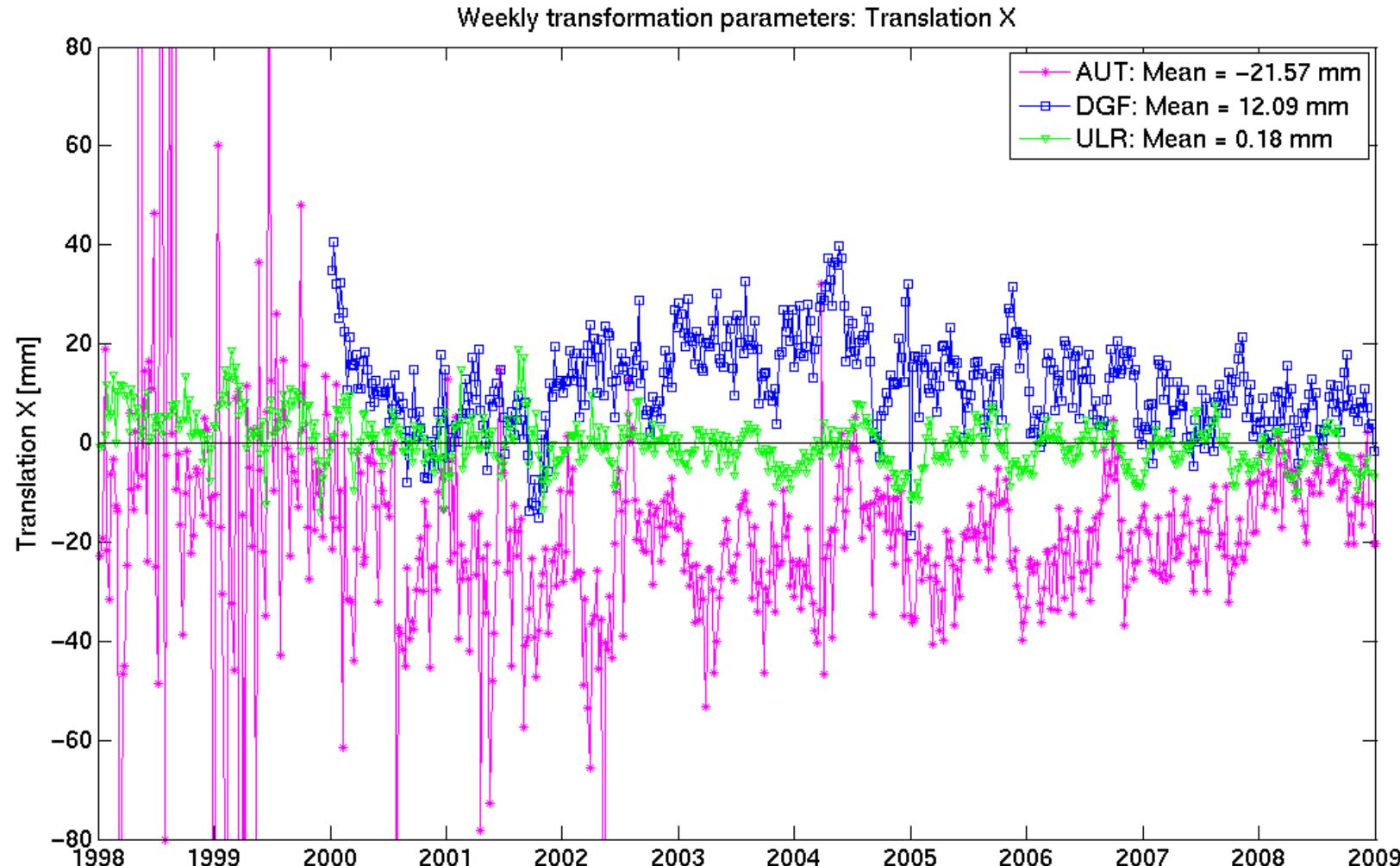
# Estimated Helmert parameters: Scale

Weekly transformation parameters: Scale



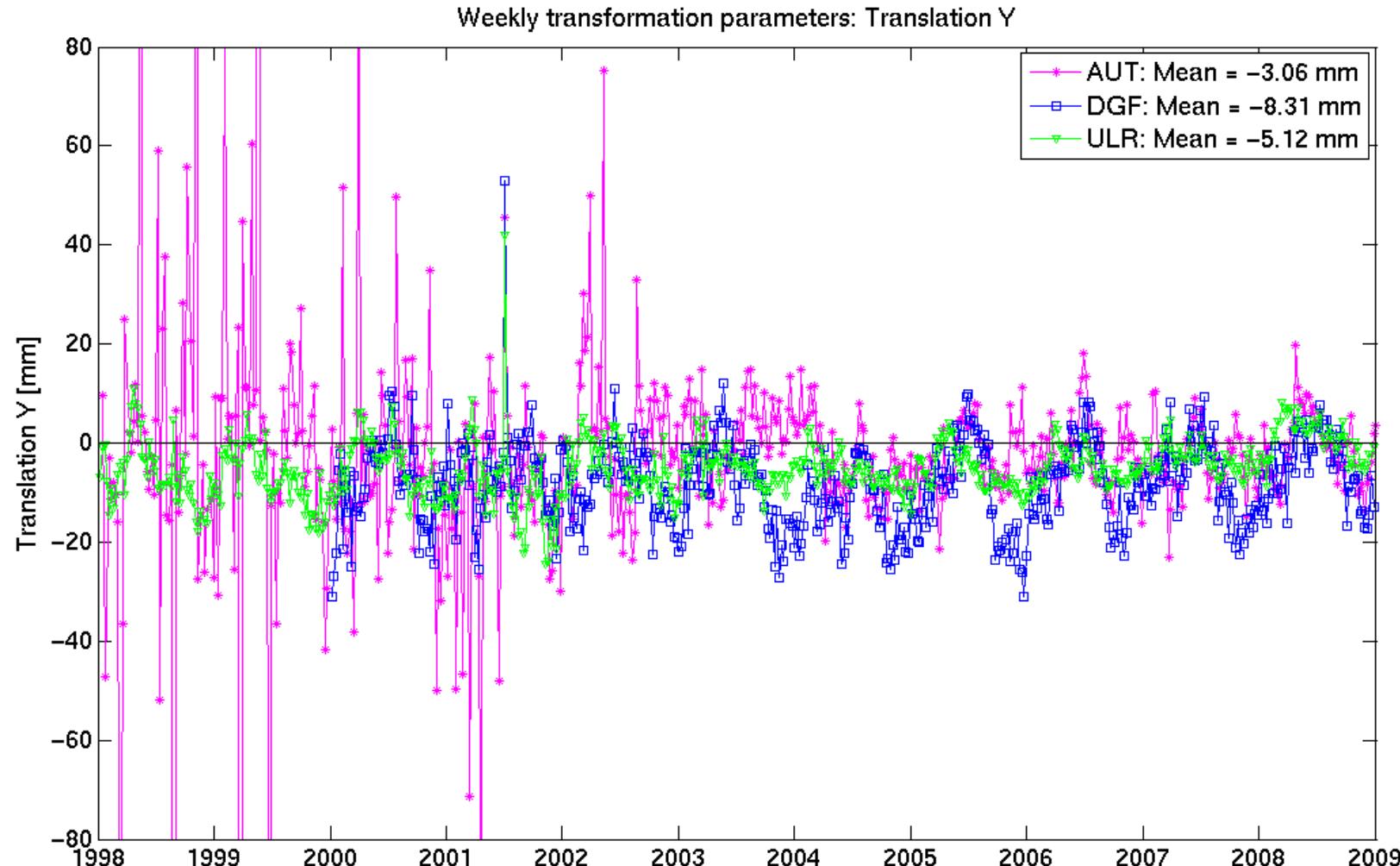
GFT: Satellite antenna offsets in SINEX  $\Rightarrow$  could be changed from igs05.atx to igs08.atx

# Estimated Helmert parameters: X-Translations



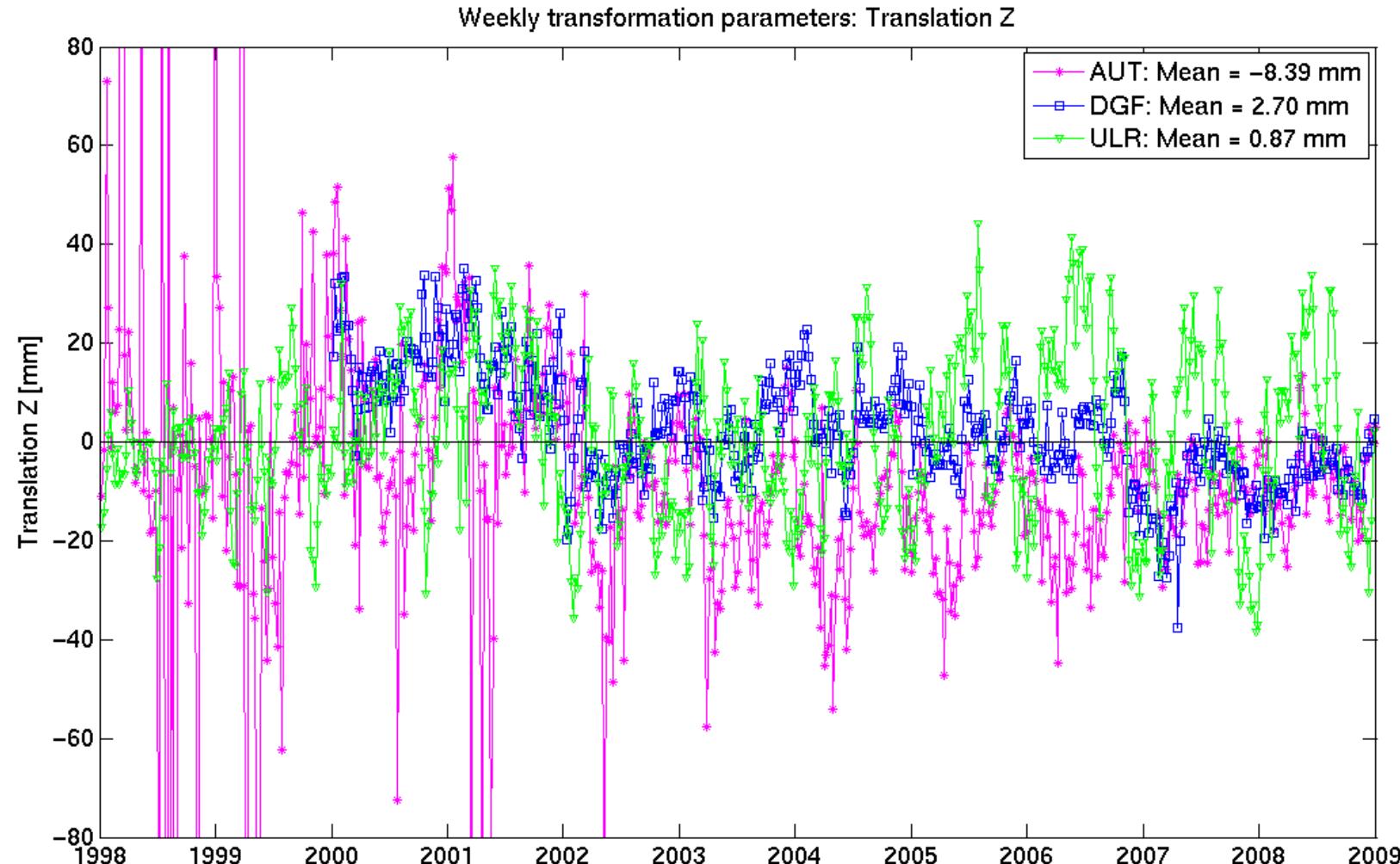
Set-up weekly translations is a „must“ for:  
⇒ regional solutions  
⇒ global solutions with non-removable constraints

# Estimated Helmert parameters: Y-Translations



Set-up weekly translations is a „must“ for:  
⇒ regional solutions  
⇒ global solutions with non-removable constraints

# Estimated Helmert parameters: Z-Translations



Set-up weekly translations is a „must“ for:  
⇒ regional solutions  
⇒ global solutions with non-removable constraints

# TIGA issues

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- **Distributed processing** makes sense
  - # sites combined solution  $>>$  # sites individual TAC
  - **Combination** needed
- **Regional vs. Global contributions:**
  - enough **common sites** needed
  - **Redundancy**: Stations included in at least 3 solutions
  - **Datum information** implicitly contained is not removable  
⇒ Global solutions are preferred
- Careful **analysis of each individual contribution** is necessary:
  - Handling of **SINEX** files
  - **NEQs** would be preferred (instead of covariance matrices)
  - **Station names** (use DOMES numbers whenever possible!!!)