

# Interactions of the IGS reprocessing and the IGS antenna phase center model

**Ralf Schmid, Peter Steigenberger, Urs Hugentobler**  
Technische Universität München, Germany

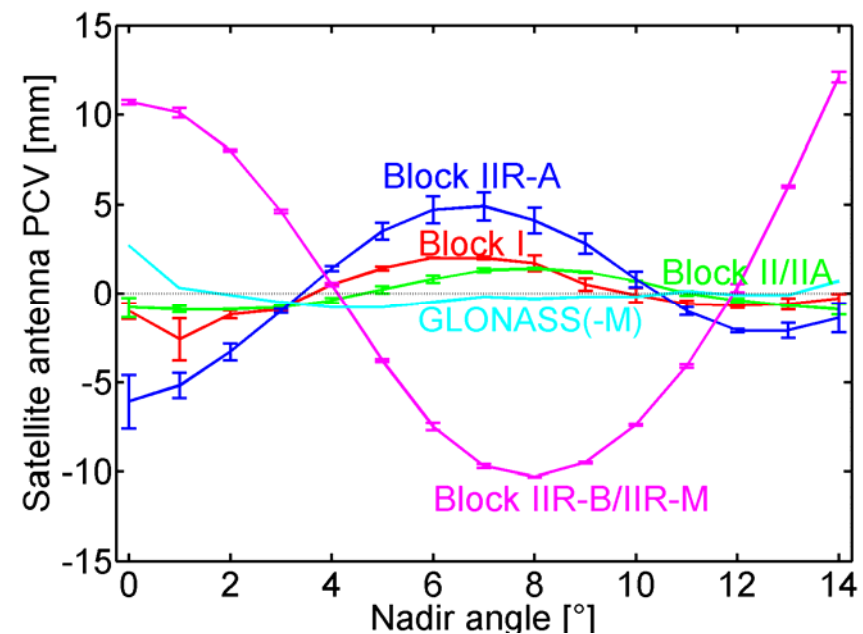
**Rolf Dach**  
University of Bern, Switzerland

**Martin Schmitz**  
Geo++ GmbH, Garbsen, Germany

**Florian Dilßner**  
European Space Operations Centre, Darmstadt, Germany

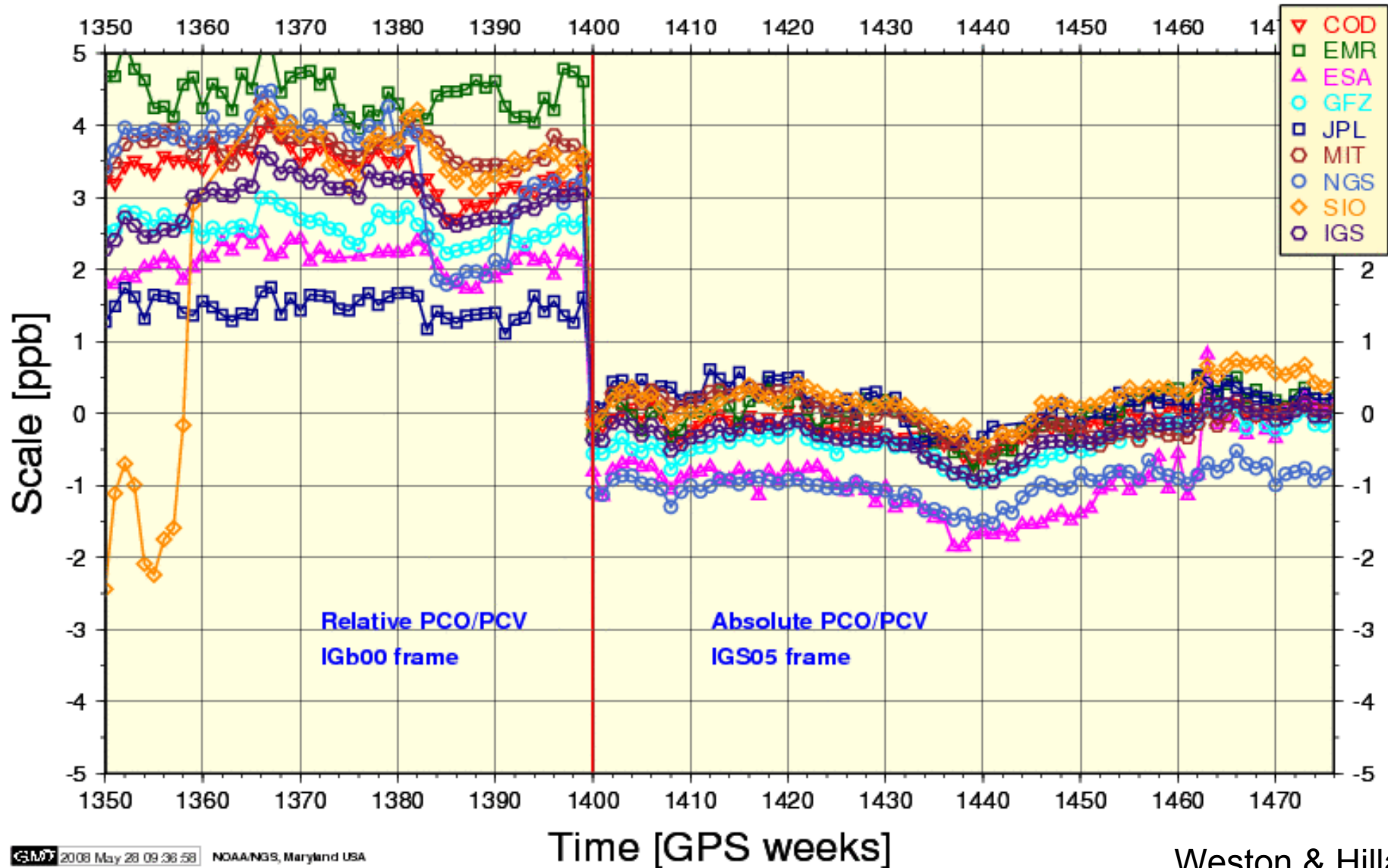
# Transition to absolute phase center modeling

Model	Receiver antenna			Satellite antenna	
	PCO	PCV	Radome	PCO	PCV
<b>igs01.pcv</b> (1996-2006)	<b>relative</b> to reference antenna AOAD/M_T		<b>ignored</b>	block-specific	<b>ignored</b>
<b>igs05.atx</b> (2006-2010)	<b>absolute</b> , i.e., independent of a reference antenna		considered, if calibration available	satellite-specific	block-specific




# Discontinuities in time series (week 1400)

TRF scale difference w.r.t. IGB00/IGS05



# Timeline: antenna model vs. IGS reprocessing

- 
- 2005 Estimation of GPS satellite antenna corrections with scale fixed to IGb00 (based on **relative** receiver antenna corrections); radome calibrations added afterwards
- 2006 GLONASS satellite antenna corr. from **separate** solution
- 5 Nov **Switch** from relative to absolute antenna model and from  
2006 IGb00 to IGS05; IGS05 station coordinates corrected for differences from parallel AC processing
- Feb Start of first IGS reprocessing campaign repro1 with  
2008 igs05.atx **unchanged**; repro1 period: 1994-**2007**
- 2010 Compilation of igs08.atx using repro1 SINEX files and operational solutions (**2008-2010**)

# Benefit from IGS reprocessing

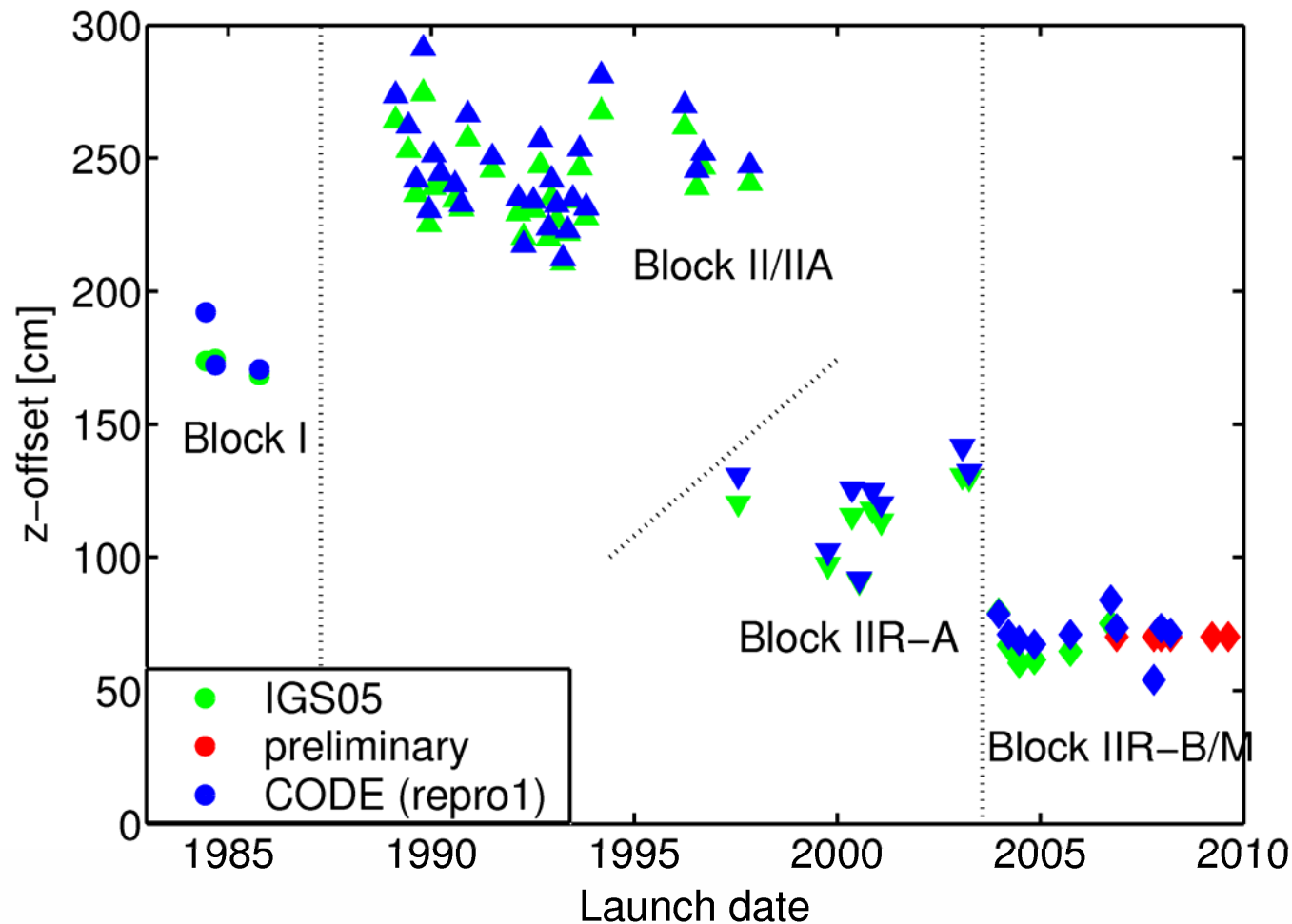
- Repair of **discontinuities** (e.g., in week 1400)
- Update of **receiver** antenna corrections (up to five years old) before or after the reprocessing campaign
- repro1 started without an update of the antenna model
  - pros: consistency between repro1 and operational solutions
  - cons: inconsistency between new reference frame and antenna model, if update afterwards
- Update of **satellite** antenna corrections
  - new satellite-specific z-offsets for latest satellites
  - based on longer time span: 11 years → 16 years
  - more analysis centers: 2 → 3-5 (GPS); 1 → 2 (GLONASS)

# First IGS reprocessing campaign repro1

Phase center estimates in repro1 AC SINEX files:

Analysis Center	GPS satellite antennas		GLONASS satellite antennas	
	PCO	PCV	PCO	PCV
CODE		<b>SINEX format extension necessary</b>  → no update	GLONASS observation data will probably be considered for follow-up campaign <b>repro2</b>  → separate solution necessary	
NRCan				
ESA				
GFZ				
JPL				
MIT				
NGS				
PDR				
SIO				

# GPS satellite antenna z-offsets

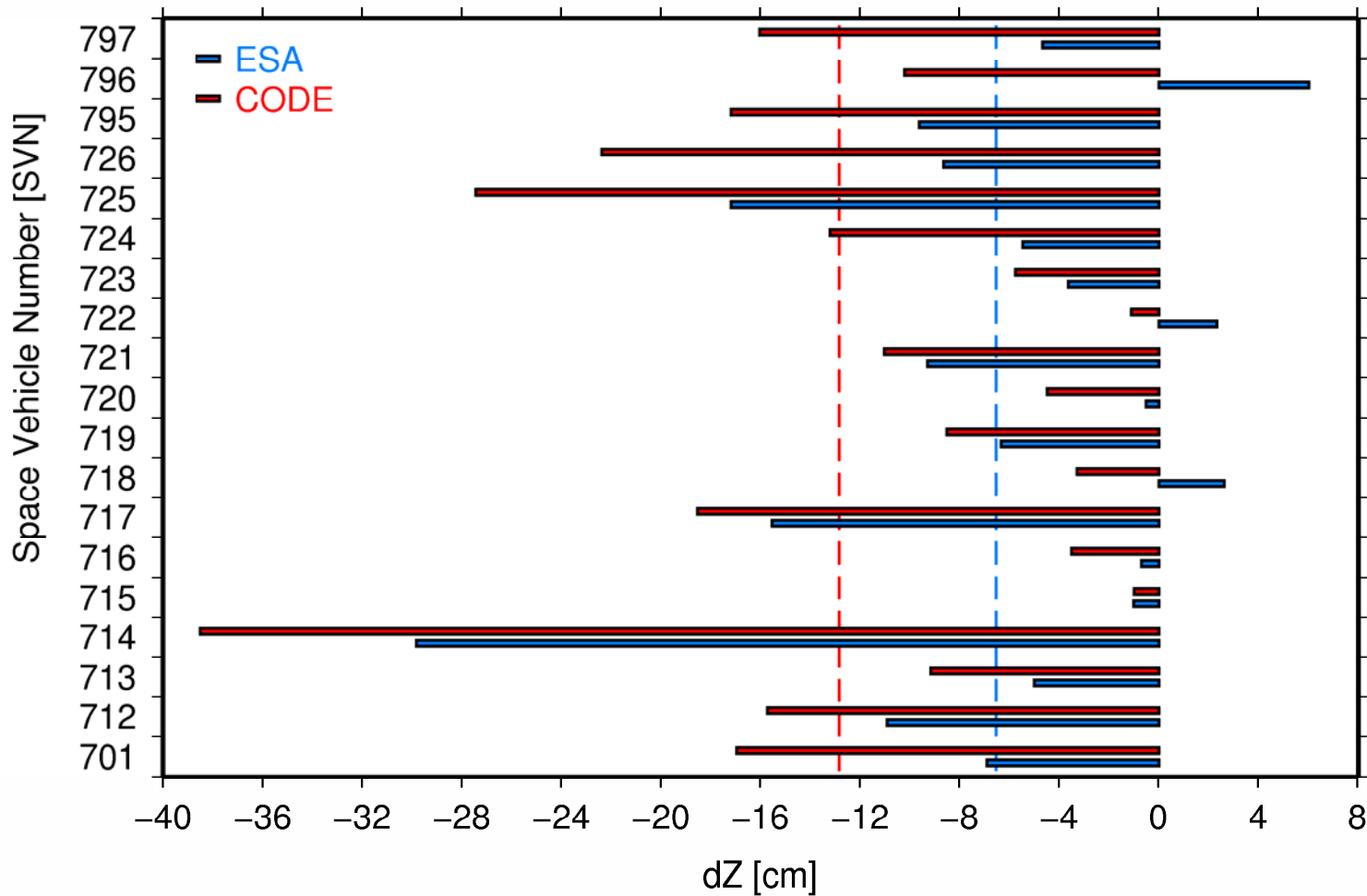


Mean **bias**:  
5.4 cm

- **dm level biases** between individual analysis centers
- estimation of satellite-specific z-offsets for the **latest satellites**
- deviation of about 15 cm from block mean value for SVN55

# GLONASS satellite antenna corrections

AC Z-Offsets minus IGS05 Z-offsets



Time span:

ESA: 1.5 a

CODE: 6.5 a

Mean bias:

6.3 cm

- GLONASS constellation completely changed since 2005/06
- scale difference partly due to differing albedo modeling
- impact on station coordinates: **< 1 mm** (small impact of GLONASS)



# Receiver antenna calibrations

## GPS:

- additional robot calibrations (e.g., for TPSCR3\_GGD)
- impact on station coordinates: up to **several mm**
- update for existing robot calibrations

Statistics for stations in the IGS network (December 2009):

Model	absolute calibration	converted field calibration	uncalibrated antenna/ radome combination
igs05.atx	62%	18%	20%
igs08.atx	<b>69%</b>	<b>11%</b>	<b>20%</b>

## GLONASS:

- GLONASS-specific calibrations not considered so far
- available for about **60%** of the combined GPS/GLONASS stations
- impact on station coordinates: **< 1 mm**

# Timeline for igs08.atx

- Jan/Feb 2010: generation of IGS08 **reference frame**
- Feb/Mar 2010: back-solve repro1 (1994-2007) SINEX files and operational solutions (2008-2010) with ITRF2008/IGS08 kept fixed to get **GPS satellite antenna z-offsets**
- Mar 2010(?): long-time combined solutions by CODE and ESA with GPS z-offsets kept fixed to get **GLONASS satellite antenna z-offsets/PCVs**
- Apr 2010: compilation of igs08.atx (satellite and **receiver antenna corrections**, including GLONASS-specific values)
- Apr/May 2010: analysis of **coordinate jumps** due to antenna model update by certain analysis centers
- May 2010: adoption of new IGS reference frame and igs08.atx in operational solutions

# Conclusions

- **Consistency between ITRF2008/IGS08 and igs08.atx** will be far better than between IGS05 and igs05.atx
- Ex post update of receiver antenna calibrations causes slight **inconsistencies between reference frame and igs08.atx**
- Transition to igs05.atx was much more dramatic, but accompanied by an extensive parallel AC processing
- Improved percentage of IGS stations with state-of-the-art calibrations, whereas **uncalibrated radomes** remain a problem
- Highly improved GLONASS satellite antenna corrections (more satellites/tracking stations/analysis centers)
- **SINEX format extension** desirable in order to estimate satellite antenna PCVs from repro2 SINEX files

**Thanks for your attention!**



**Kellyville, Greenland**