Position Paper

Reprocessing Issues, Standardization, New models

G F Z
P O T S D A M

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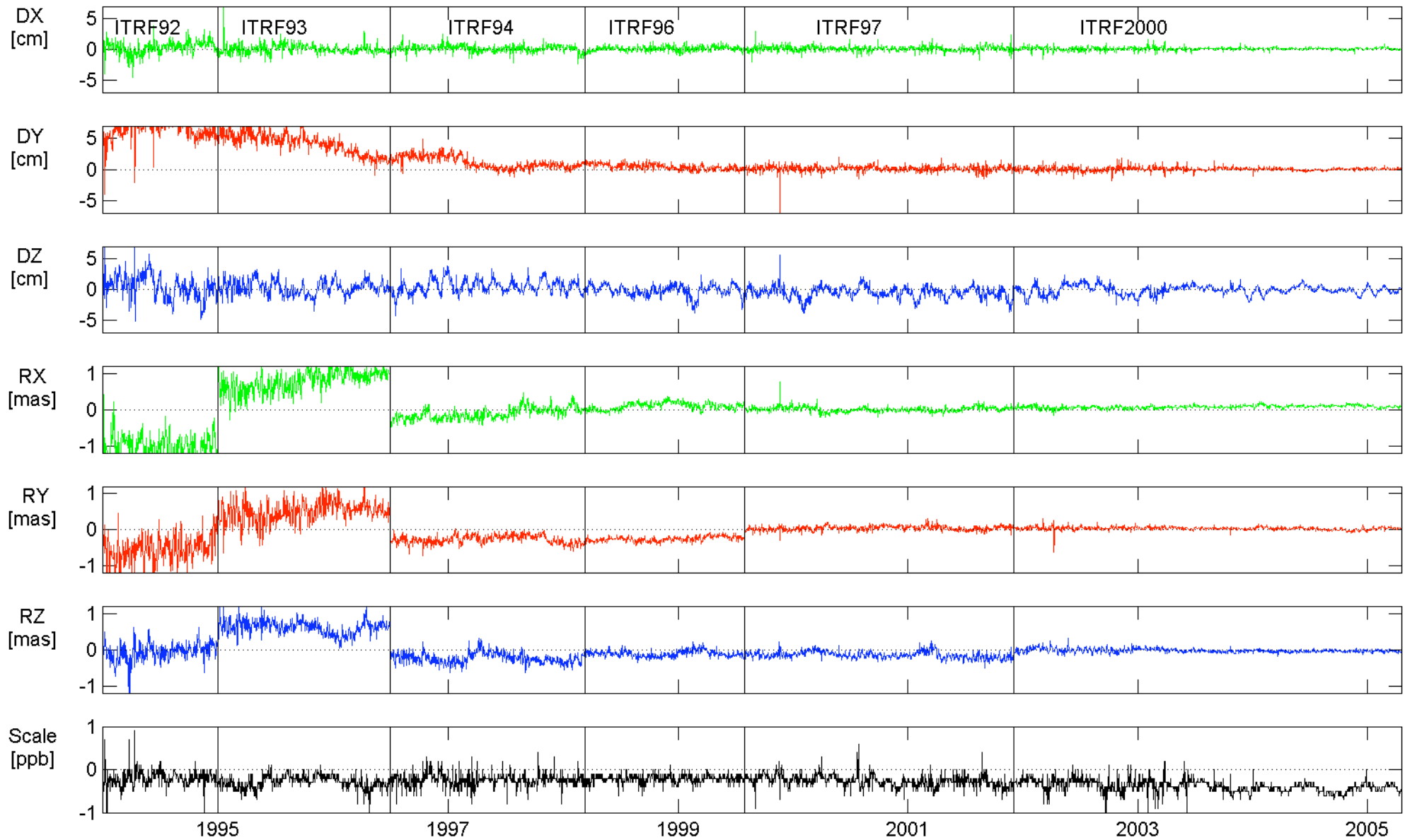
SOPAC

Peng Fang
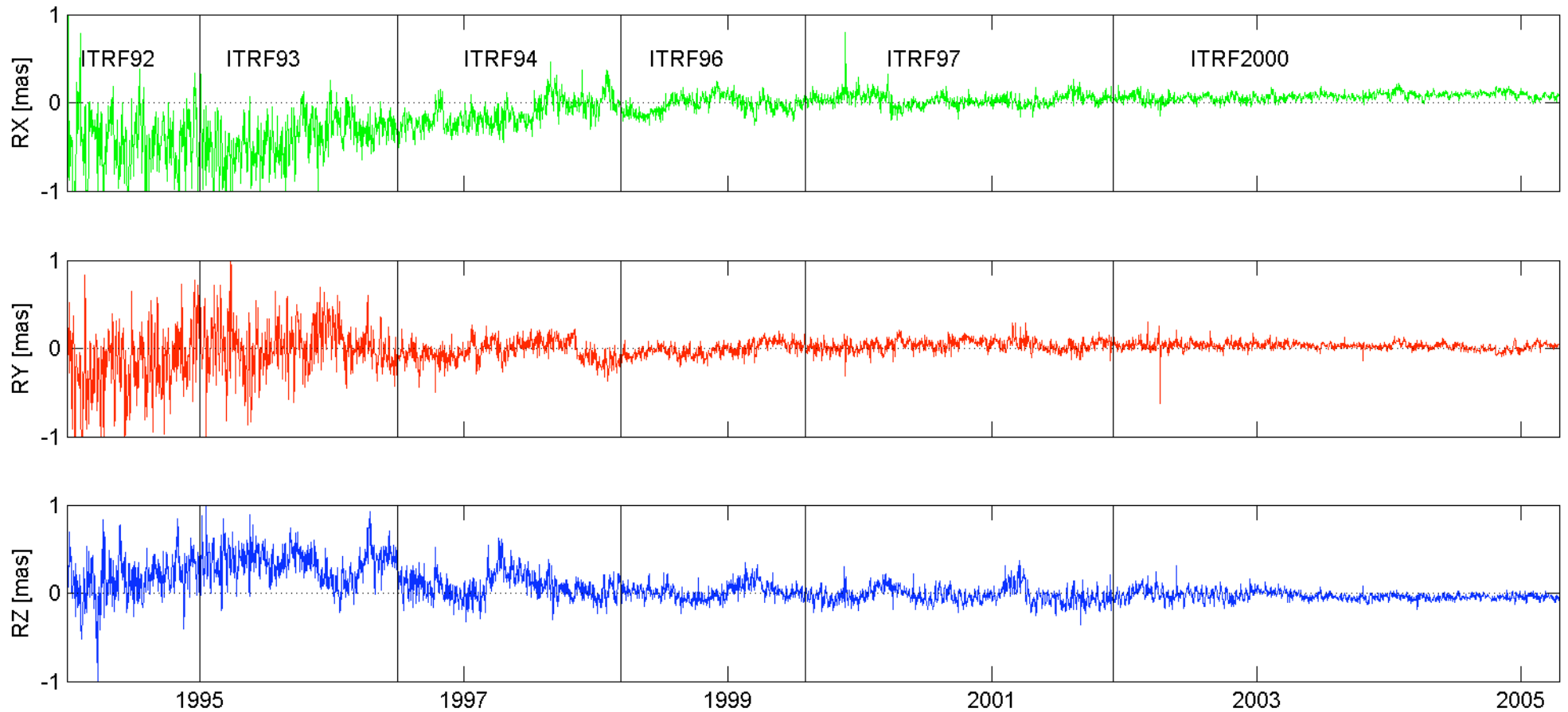Scripps Institution of Oceanography

Contents

- Examples for inhomogeneous IGS Products

- Motivation for IGS reprocessing

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- Products

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- Summary and Outlook

Operational IGS Orbits vs. Reprocessed Orbits

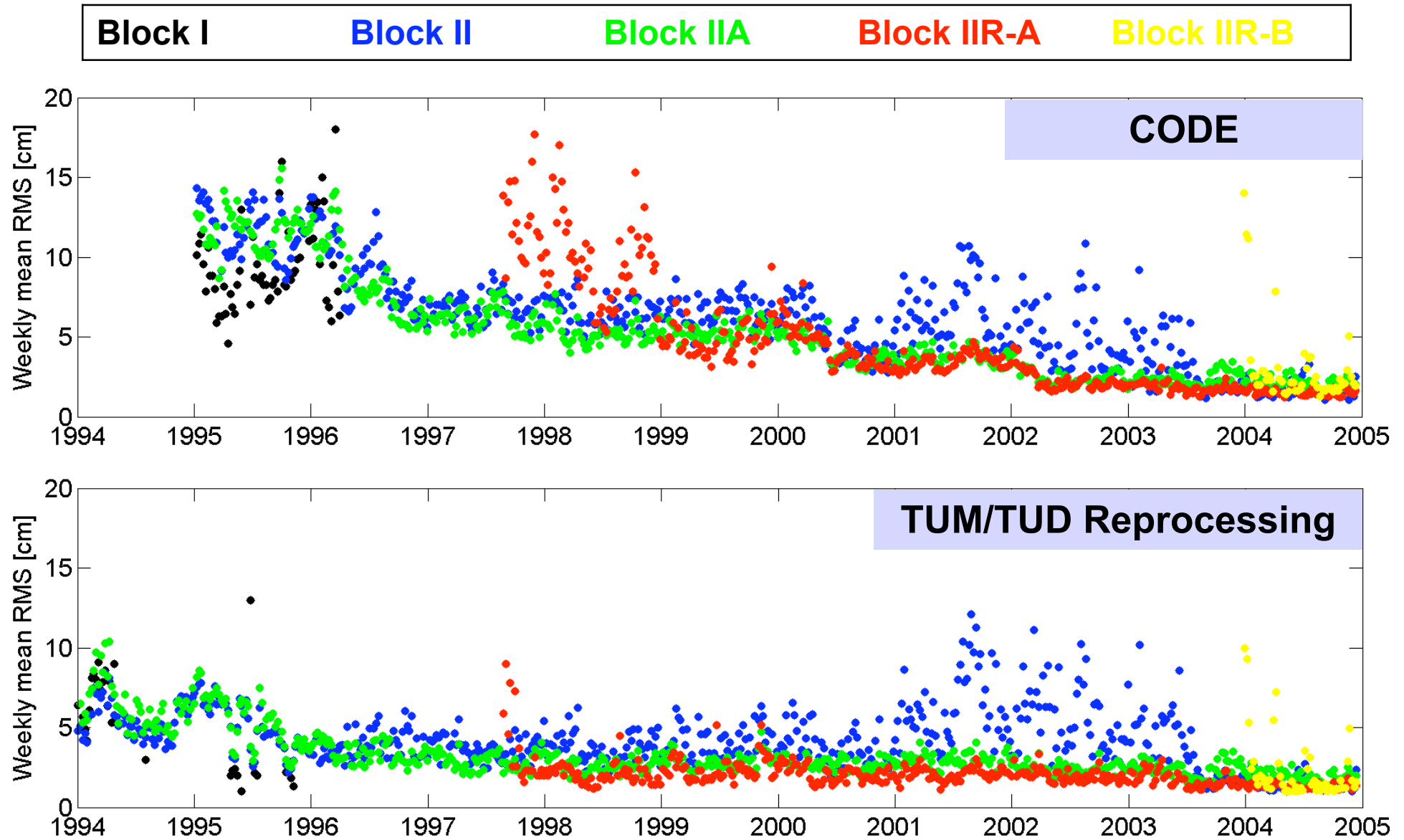# Transformed IGS Orbits

Operational IGS orbits transformed to ITRF2000

Orbit Consistency: Operational vs. Reprocessed

Block I **Block II** **Block IIA** **Block IIR-A** **Block IIR-B**

CODE

TUM/TUD Reprocessing

IGS Workshop 2006, Darmstadt

Motivation for IGS Reprocessing

- **Numerous improvements** in modeling and processing of GNSS observations since the establishment of the IGS in 1994, e.g.

    - Reference frame changes

    - Additional effects (e.g., ocean loading, receiver antenna phase center variations, ...) taken into account

    - Ambiguity resolution

    - and many more ...

- Time series of IGS products are **inhomogeneous**

- **Complete and consistent reprocessing** is common practice for the other space geodetic techniques (DORIS, SLR, VLBI)

- **Two major changes** will take place in the near future

    - ITRF2005 (IGS05)

    - Absolute antenna phase center model

The IGS Reprocessing Effort

- **Goal:** Generation of a consistent set of IGS products

- **Call for participation** in July 2005 (IGSMAIL 5157)

- **Time period**: 1 January 1994 till present time

  - Very sparse tracking network in 1993

  - No absolute antenna offsets for some Block I satellites in 1993

- The IGS reprocessing will **only** include **GPS** (not GLONASS) at this time

- **Each IGS station** should be processed by **at least 3 analysis centers**

- Inclusion of NGA (formerly NIMA) and TIGA stations

- More details on station selection: Talk by I. Romero

- **Separate reprocessing** of the **Ionosphere** Working Group: Talk by R. Orus

Participating Institutions

Institution	Abb.	Software
Natural Resources Canada (NRCan)	EMR	GIPSY
European Space Agency	ESA	NAPEOS (BAHN)
GeoForschungsZentrum (GFZ) Potsdam	GFZ	EPOS
University of Newcastle upon Tyne	NCL	TANYA
National Geodetic Survey	NGS	page5
GFZ/TU Dresden (formerly TU Munich/TU Dresden)	PDR	Bernese
Scripps Institution of Oceanography	SIO	GAMIT
University of Nottingham	UNT	Bernese

IGS Analysis Center	IGS Global Network Associate Analysis Center	Other Institution

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Products of the IGS Reprocessing

Product	Format	Sampling
Orbits	SP3c	15 ^{min}
Clocks	RINEX_CLK	5 ^{min} (30 ^{sec}?)
Station coordinates	SINEX	7^d (1^d?)
Earth rotation parameters	SINEX	1^d
Tropospheric zenith delay	SINEX_TRO	2^h

Satellite antenna offsets (at least SATA_Z) should be included in SINEX

Combination	Institution	Name
SINEX	NRCan	R. Ferland
	NCL	P. Clarke
Orbits and Clocks	IGS ACC: GFZ	G. Gendt
Timescale	NRL	K. Senior
Tropospheric zenith delay	open	

Daily vs. Weekly SINEX Files

Weekly SINEX files
+ Established within the IGS

Daily SINEX files

+ Higher temporal resolution

+ More flexibility for a rigorous combination with other techniques

+ Better continuity of Earth rotation parameters

+ A posteriori corrections of high frequency effects are more accurate

+ Loss of observations can be minimized (discontinuities, outlier)

+ Weekly files can be generated from daily files but not vice versa

- Computer resources and disk space

Daily files could be combined per AC and per week and then the current procedure could be used

Only minor changes to the current procedure necessary for combining daily files

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Common Standards

To generate a **consistent set** of reprocessed IGS products a
number of **common standards** should be fulfilled by the analysis centers:

- **IERS Conventions 2003 + latest updates**: Talk by J. Ray

- Reference frame: **IGS05** the IGS realization of ITRF2005 will be available a few weeks after the release of ITRF2005

- Antenna Phase Center Model: **igs05_wwww.atx** (Antenna Session)

- **Differential Code Biases**: Talk by S. Schaer

- **Troposphere Mapping Function**

**Discussion at the end of the session**

Mapping Functions

- Niell Mapping Function (**NMF**) developed by Niell (1996) still used by most IGS Analysis Centers despite its **deficiencies,** e.g.

  - seasonal behavior of the northern and southern hemisphere is the same

  - polar regions are described by the 75°N latitude profile

- Recent mapping functions like the Isobaric Mapping Function (IMF) and the Vienna Mapping Functions (VMF, VMF1) are based on data from **numerical weather models**

- The **Global Mapping Function** (**GMF**) developed by Boehm et al. 2006 uses mean values from numerical weather models:

  - As easy to use as NMF (Input: latitude, longitude, height, time)

  - Reduction of systematic errors

  - Talk by J. Boehm on Thursday: Mapping functions for atmospheric delay modeling in GNSS analysis

GMF recommended for the IGS reprocessing

Global Mapping Function

Height differences between NMF and GMF (simulation with ECMWF data)

Height Change [mm]
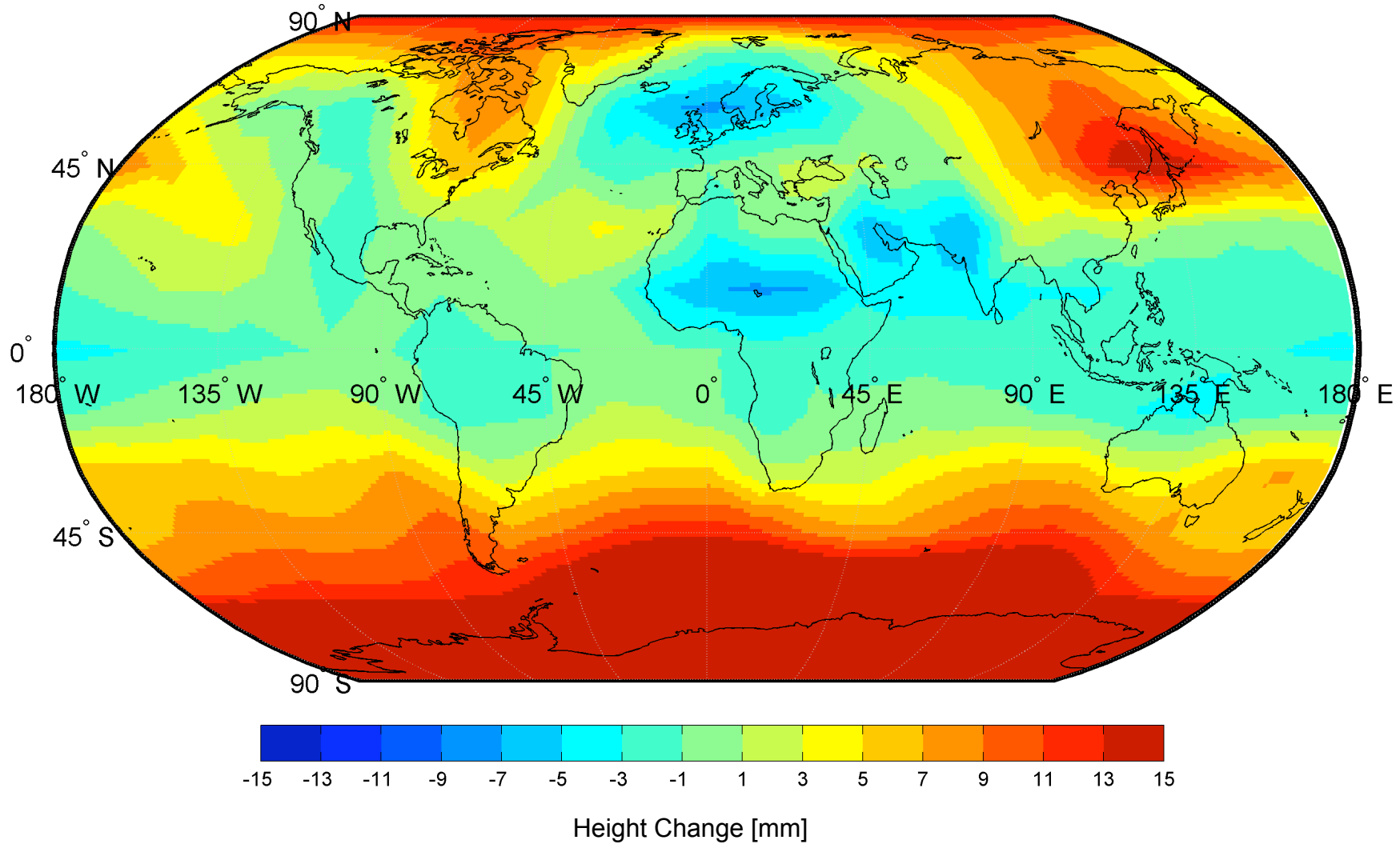
Conclusions and Outlook

- **Common standards** are **essential** a homogeneous and consistent set of reprocessed IGS products

- **Reprocessing Pilot Project** should start shortly after IGS05 and the absolute antenna model are adopted in the official products

    - First three months of the year 2000 (GPS week 1043 till 1055)

    - Identify and solve problems

- **Complete reprocessing** is expected to take at least six month to one year

- The IGS reprocessing is a **challenging but promising** task for the near future

- The IGS reprocessing should not be an unique task but **repeated** whenever **important changes** are implemented in the IGS processing