GFZ POTSDAM

Some Effects of Data Handling and Background Models on the SLR Dynamical and Geometrical Reference Frame

R. König, K.H. Neumayer, M. Vei

EGU General Assembly
Vienna, 15-20 April, 2007

G F Z
POTSDAM

Motivation

- Effect of
  - individual stations / network configuration
  - systematic corrections to range observations
  - a priori coordinates
- on the
  - dynamic
  - geometric
- reference frame

G F Z
POTSDAM

Introduction

- 2 Solutions:
  - SLR test solution for year 2004 within GGOS-D
  - 14-year series 1993-2004 within ILRS reanalysis
- GGOS-D standards different than for ILRS AC duties for pos&eop
  - EIGEN gravity model
  - FES2004
  - Corresponding ocean tide loading site displacements
- Recently introduced systematic corrections within ILRS ACs for pos&eop
  - Stanford counter range biases for individual stations and periods
  - Tropospheric range correction model change
- ITRF2000 / ITRF2005(rescaled)

G F Z
POTSDAM

Parametrization

- Solved for parameters in weekly solutions from LAGEOS-1 and -2

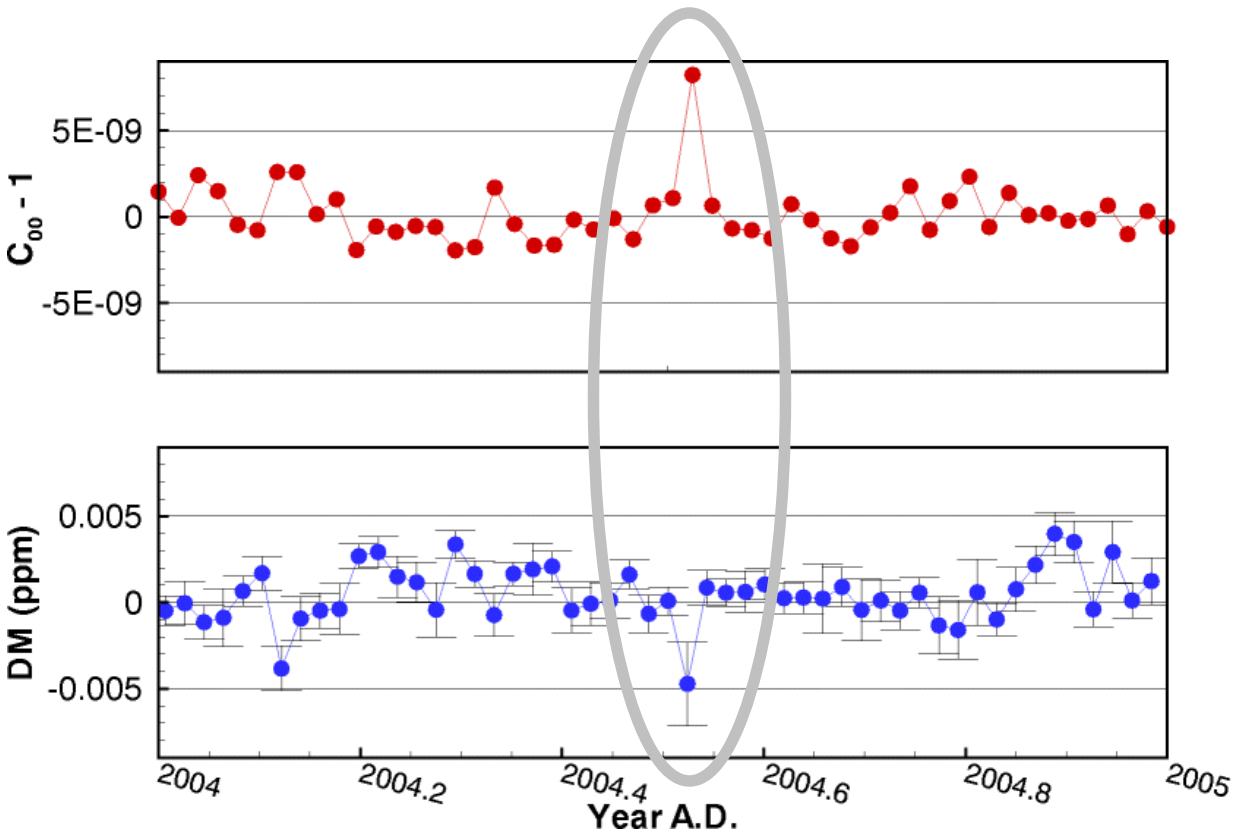
GGOS-D:	ILRS AC:
Station coordinates, a priori sigma 1 m	dto.
X-, Y-pole, UT1; @0:00; a priori sigma 1 m	dLOD; @12:00
Degree 0 to 2 harmonics, a priori sigma 1 m	NO
Range biases for a few stations, free	dto.
Initial states of LAGEOS-1 and -2, free	dto.
Empirical accelerations for LAGEOS-1 and -2, free	dto.

- Rank deficiency without a priori sigmas = 3
  - the rotations need a datum — dto.

GFZ POTSDAM

Spurious Stations

- Peak in C(0,0) and in HT (Helmert transformation) scale (DM) time series
  - Standard data screening and processing sees no spurious station



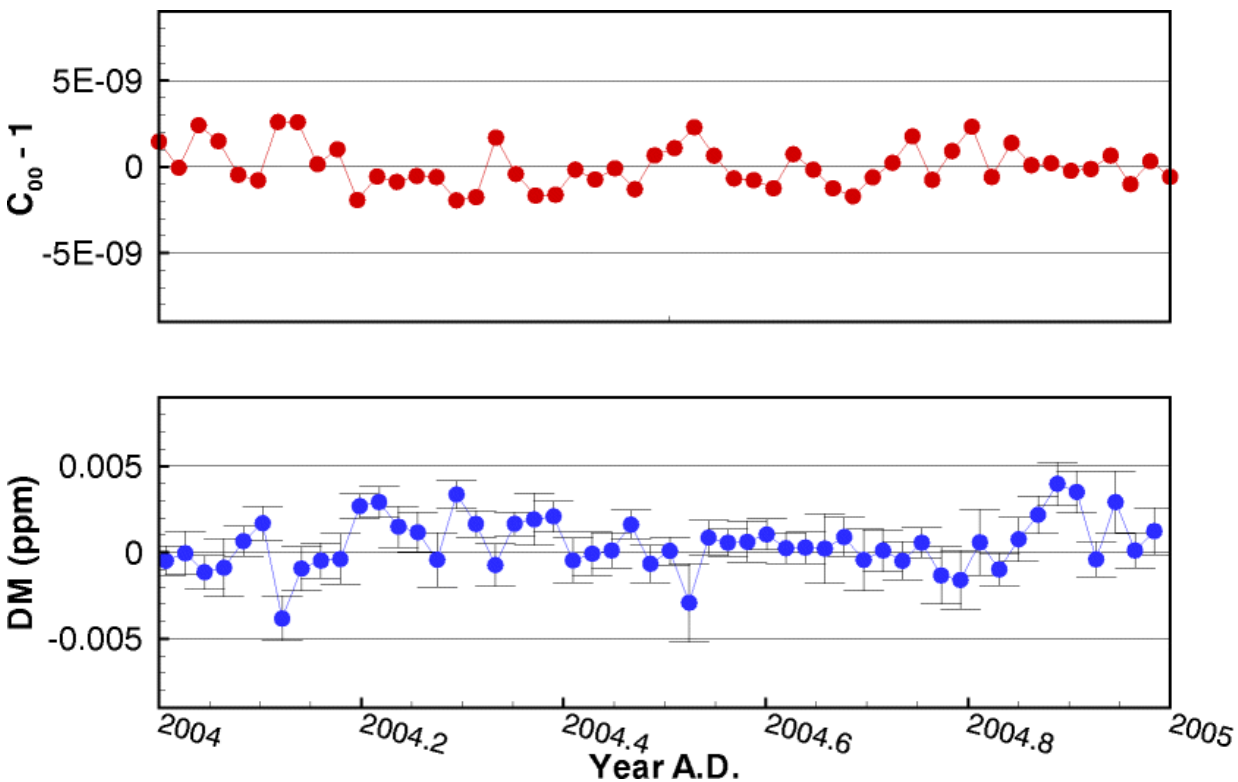
G F Z
POTSDAM

Spurious Stations, II

- **Empirical remove-restore search for peak driving station**
  - **Spurious from C(0,0):**

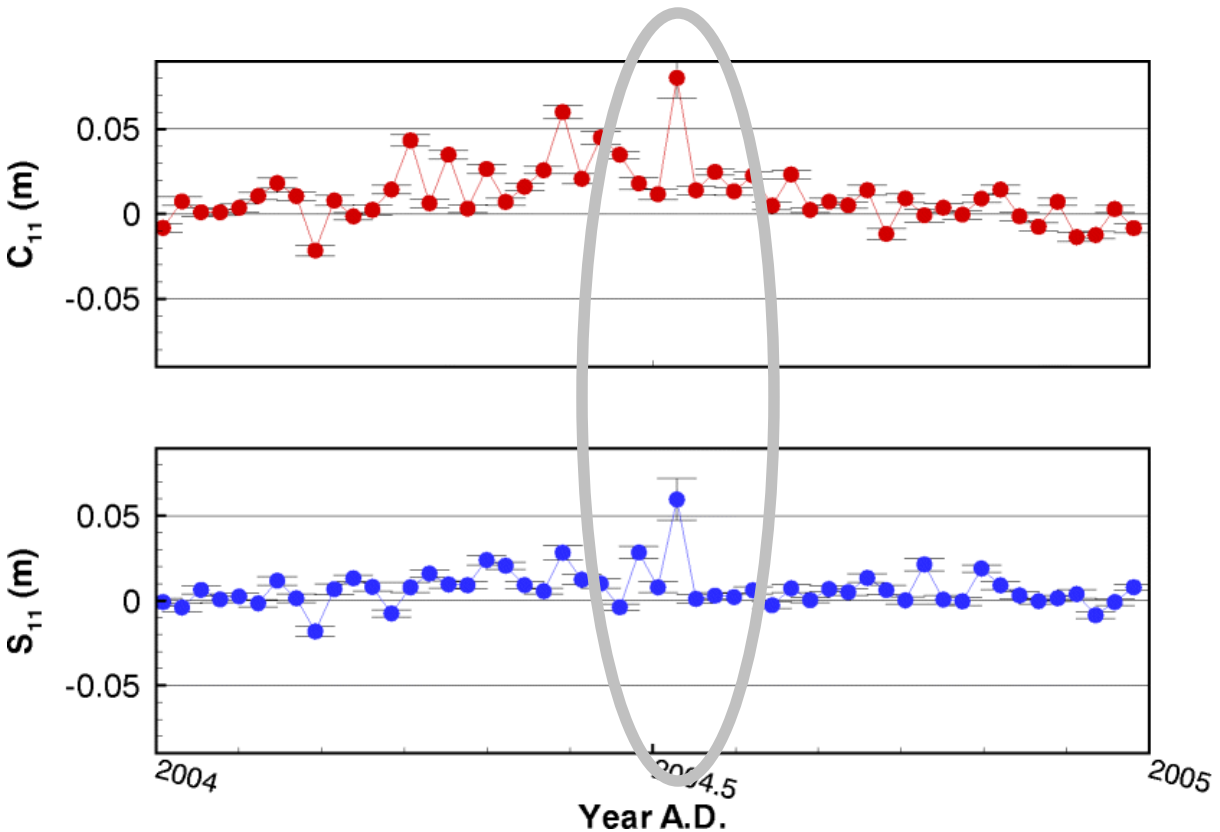
    7355 Urumqi
  - **dto. from HT scales:**

    7249 Beijing
  - **=> both removed**



Spurious Stations, III

- **BUT: peaks in C(1,1), S(1,1), TX, TY and other series, e.g. S(2,2), remain**



G F Z
POTSDAM

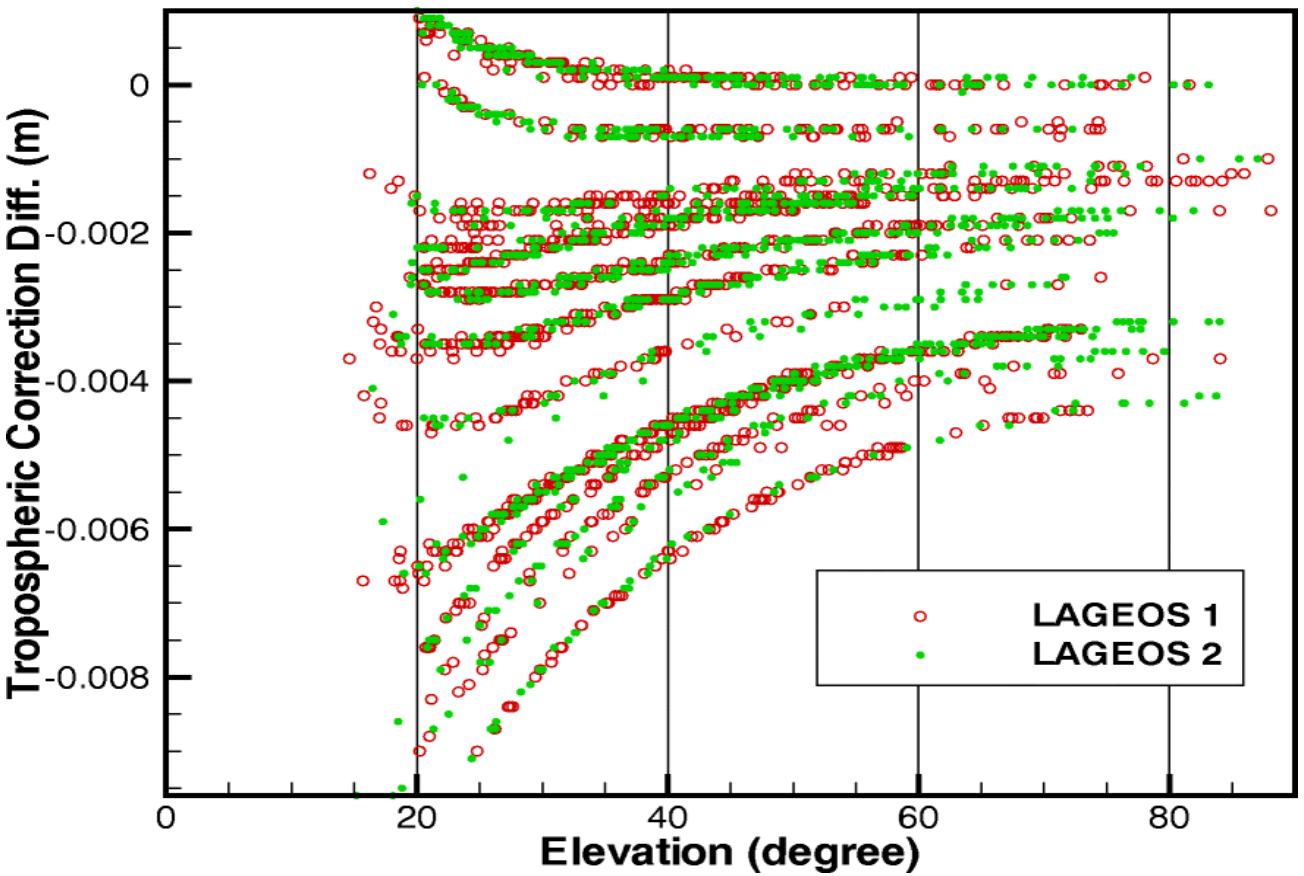
Stanford Counter Range Bias Corrections

1824 San Fernando	16 mm	since 99:314
1893 Katsively	10 mm	since 98:171
7231 Wuhan	10 mm	since 99:001
7249 Beijing	22 mm	since 01:020
7406 San Juan	10 mm	since 06:020
7810 Zimmerwald	11 mm	since 97:001
...		
7840 Herstmonceux	18.5 mm	from 93:001 to 02:032
	8.5 mm	from 02:032 to 07:042
...		

G F Z
POTSDAM

Tropospheric Range Correction

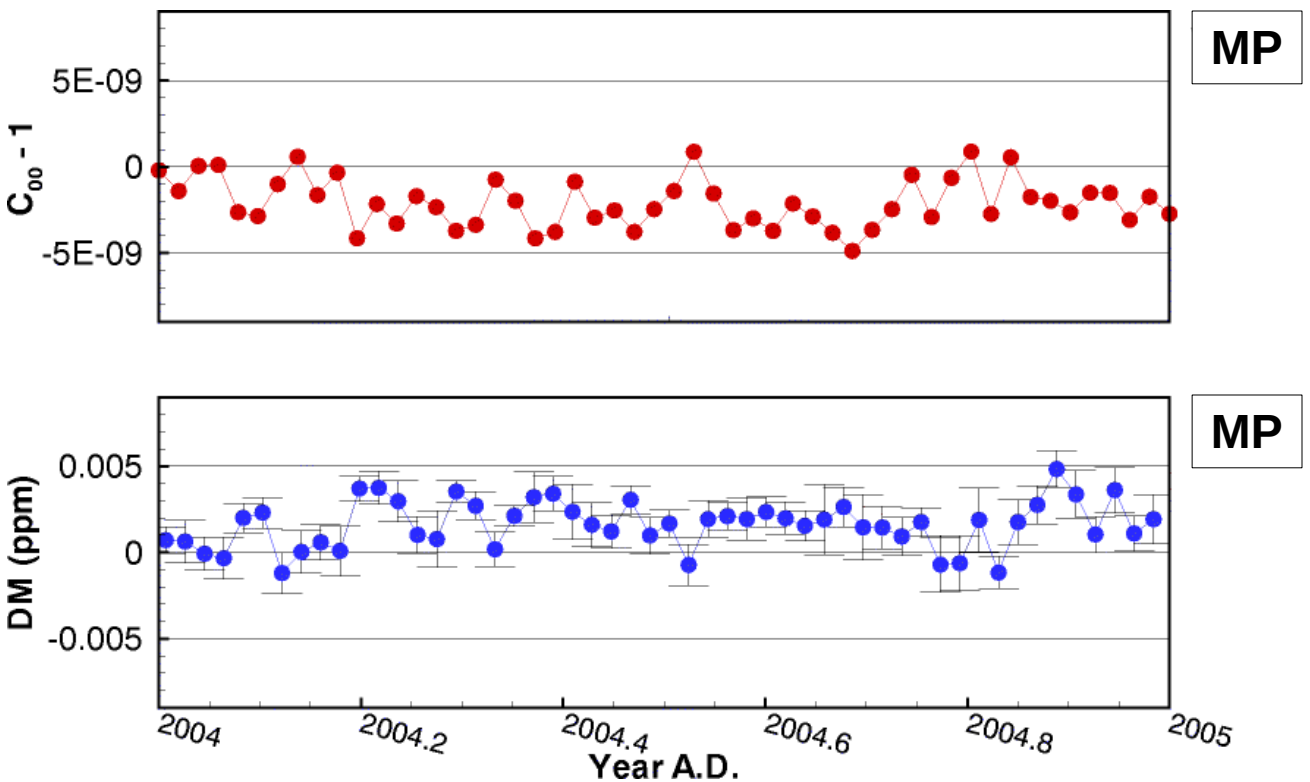
Difference of the Mendes-Pavlis model to Marini-Murray for a one-week arc



Tropospheric Range Correction, II

- **Impact on scale:**

	MM [ppb]	MP [ppb]	MM–MP [ppb]
C(0,0)	-0.4	-2.5	2.1
s	*0.1*	*0.2*	*0.2*
DM	0.8	1.8	-1.0
s	*0.2*	*0.2*	*0.3*
Dorbit			-0.6
s			*0.02*



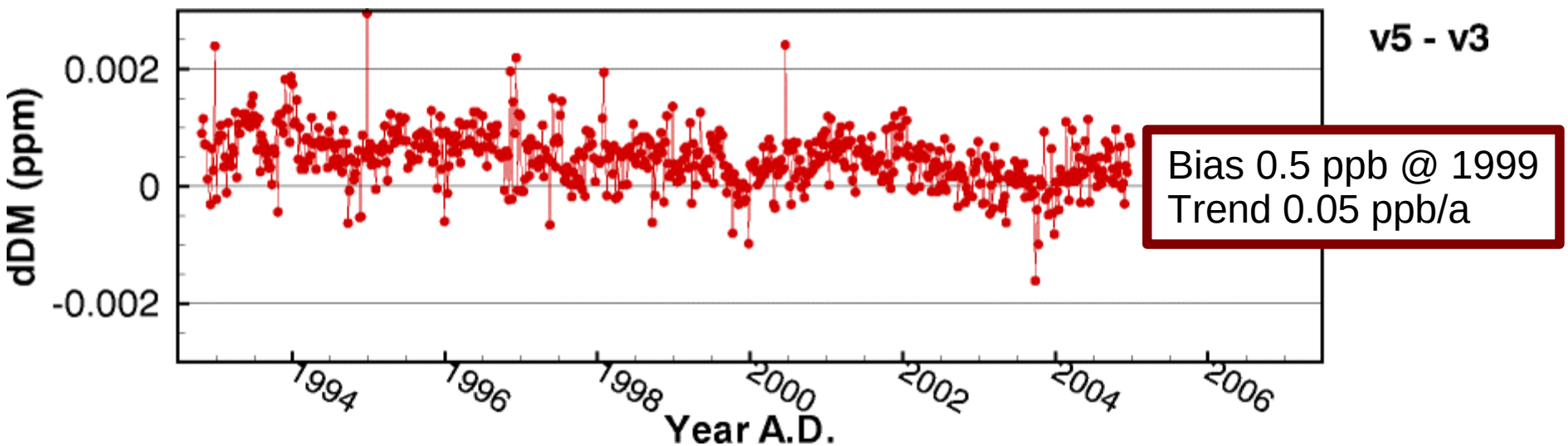
- **Missing 0.5 ppb:**

  3 mm / 6,000 km = 0.5 ppb

G F Z
POTSDAM

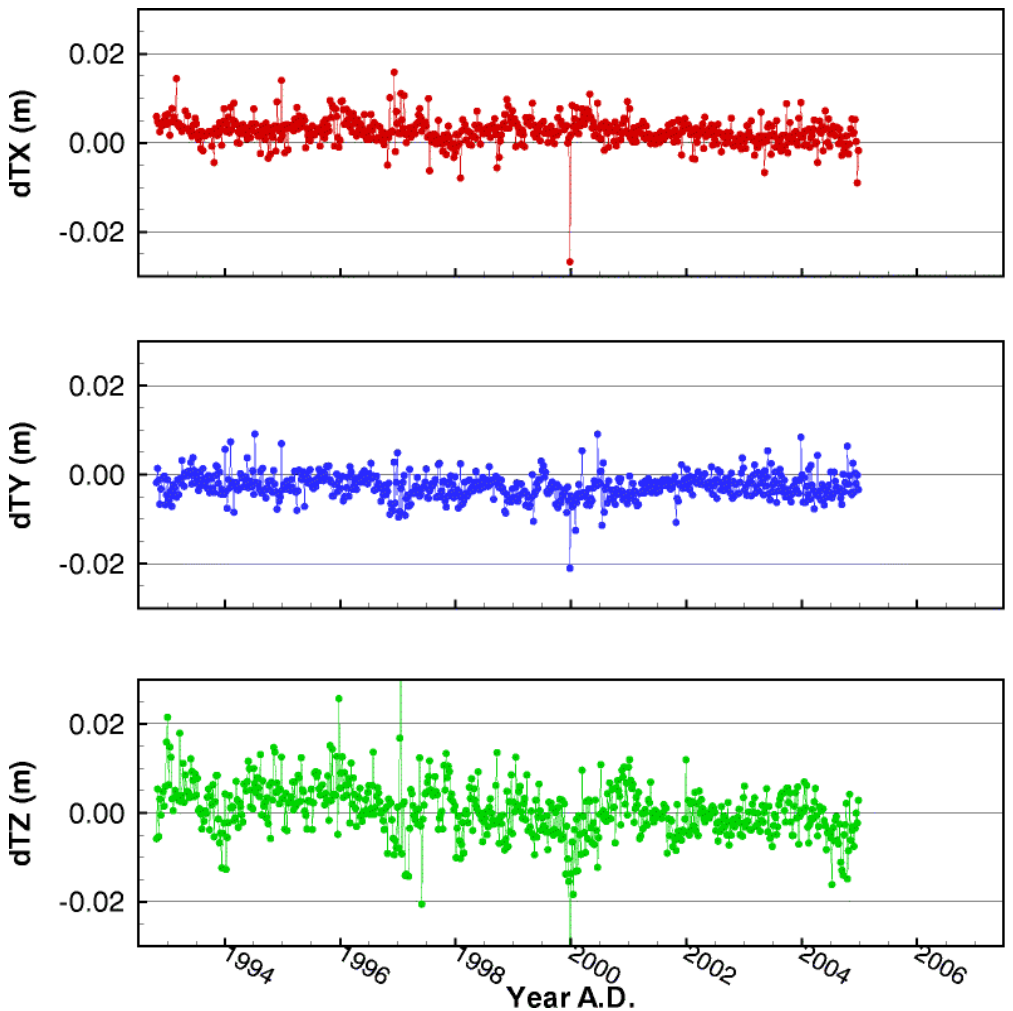
Long Series ILRS Reanalysis

- **Pos&eop standards: (low degree harmonics not solved for !!)**
  - **v5 - v3:**
    - **Stanford counter range biases applied**
    - **Mendes-Pavlis tropospheric correction applied**



G F Z
POTSDAM

Long Series ILRS Reanalysis, II



Bias 2.5 ± 0.1 mm
Trend -0.2 ± 0.03 mm/a

Bias -2.6 ± 0.1 mm
Trend -0.1 ± 0.03 mm/a

Bias 0.6 ± 0.2 mm
Trend -0.6 ± 0.07 mm/a

G F Z
POTSDAM

ITRF2000 / ITRF2005("rescaled") as A Priori

- **Impact on scale:**

	ITRF2000 [ppb]	ITRF2005r [ppb]	2000-2005r [ppb]
C(0,0)	-2.5	-2.5	0.0
s	*0.2*	*0.2*	*0.3*
DM vs. ITRF2000	1.8	1.4	0.4
s	*0.2*	*0.2*	*0.3*
DM vs. ITRF2005r	1.5	1.1	0.4
s	*0.2*	*0.2*	*0.3*
Dorbit			0.0
s			*0.0*

- **Difference ITRF2000 vs. ITRF2005_rescaled amounts to 0.4 ppb in 2004**

G F Z
POTSDAM

Ocean Loading Site Displacements

- **Old: Scherneck/Schwidersky, hard-coded (not all stations)**
- **New: Scherneck, FES2004, Earth CoM considered**

	Old	New
Orbital Fit	1.06 cm / 134,638	0.96 cm / 134,638
C(1,1)	0.89 ± 0.18 cm	0.19 ± 0.11 cm
S(1,1)	0.49 ± 0.11 cm	0.18 ± 0.08 cm
TX	-1.27 ± 0.26 cm	-0.24 ± 0.18 cm
TY	-0.90 ± 0.17 cm	-0.49 ± 0.12 cm

- **Orbital fit improves considerable**
- **Geocenter X and Y series move closer to E{ . } = 0 and become more stable**

G F Z
POTSDAM

Summary

- Weak network (<15 stations, <1000 observations / week) could produce spurious results
- Systematic corrections of the range observations have influence on scale and origin of the reference frame:
  - Tropospheric range correction change: ~0.5 ppb
  - Long term: 0.5 ppb / 10 a in geometric scale
  - Significant biases in the millimeters and trends in the sub-millimeters per year for the geometric origin
- ITRF2000 to ITRF2005r changes geometric scale by 0.4 ppb in 2004
- Up-to-date ocean loading site displacement models improve dynamic and geometric origin and more