

Combination of DORIS TRF

JJ. Valette¹, L. Soudarin¹, Z. Altamimi²

¹ *CLS, Collecte Localisation Satellites, Ramonville, France*

² *Institut Géographique National, Marne-La-Vallée, France*



IDS Analysis campaign

2002 Analysis Campaign

Analysis

Software

Strategy for TRF combination

Monthly solutions analysis

Weekly solutions analysis

Future

2002 IDS analysis campaign

Nov. 2001 : call for participation

> Times series of DORIS station network coordinates with variance-covariance (sinex file)

Jun. 2002 : Biarritz IDS workshop

> Extension of the analysis to geocenter and EOP (Zuheir A. presentation)

Oct. 2002 : Munich IERS workshop

> Sinex2.0

> Solutions including EOP

Feb. 2003 : organization of the products in the Data Center (IDS coordinator, ...)

> structure, naming convention, description file,...

2002 IDS analysis campaign : participation

Group	Team – contact	Contribution to the station coordinates analysis
IGN-JPL (France-USA)	Pascal Willis (IGN) Yoaz Bar-Sever (JPL)	Multi-satellites Weekly solutions Monthly (from 1993 until 2002) global solutions
INASAN (Russia)	Suriya Tatevian Kuzin Sergey	Multi-satellites Weekly solutions
LEGOS/CLS (France)	Jean-François Crétaux (LEGOS/GRGS) Laurent Soudarin (CLS)	Multi-satellites Monthly solutions (from 1993 until end of 2001) Global solution

For operational use only

SOD/CNES (France)	Jean-Paul Berthias Adèle Guitar	All 2002 3 days multi-satellites solution a few days delay for station network control
SSALTO/CLS-CNES (France)	Jean-Jacques Valette	Monthly/weekly multi-satellites solutions (routine process, one-to weeks delay for station network control)

IDS analysis campaign : submitted solutions

<i>Analysis Center</i>	<i>Data Span</i>	<i>Solution*</i>	<i>Satellites</i>	<i>Constraints</i>
<i>IGN-JPL (IGN)</i>	<i>1993-2002</i>	<i>w/m</i>	<i>Spot2/3/4 Topex</i>	<i>Free + Projection</i>
<i>INASAN (INA)</i>	<i>1999-2001</i>	<i>w</i>	<i>Spot2/3/4 Topex</i>	<i>Free</i>
<i>LEGOS-CLS (LCA)</i>	<i>1993-2001</i>	<i>m</i>	<i>Spot2/3/4 Topex</i>	<i>Loose (1 m)</i>

operational calculation within a week delay

<i>SOD (SOD)</i>	<i>June 2002</i>	<i>w</i>	<i>Spot2/3/4/5 Topex/Jason (without Jason after 15/08/2003)</i>	<i>Loose (1-10m)</i>
<i>SSALTO (SSA)</i>	<i>since Jan.2001</i>	<i>w</i>	<i>Spot2/4/5 & Topex</i>	<i>Fixed orbit</i>

*** w : week, m : month**

Several submissions

A significant effort of the participants :

- *reprocessing when remove signals*
- *better solutions*
- *few solution with very bad residuals*
- *co-variance matrix*
- *Domes number*
- *file naming*
- *additional info (which data and satellites,...)*

CARTEF Analysis Software

IGN/LAREG software (Z. Altamimi & P. Sillard) :

- Comparison/combination of stations positions and velocities (Helmert Transf.)
physical and statistical models
- Minimum constraint equations implemented
allowing to express the combined frame in any external frame (ITRF2000)

Combination strategy

- **Minimum constraint applied equally to individual solutions**
- **Combination of individual solutions**
- **Estimation of variance factors**
- **Iteration as necessary**

Application for:

1/ A global combination of each time series or all together (expressed in ITRF2000)1/

2/ A combination of periodic solutions (month by month for ex., only positions)

> *The objective for a DORIS technique combined product*

Monthly Solutions Analysis

IGN-JPL analysis center

1993-2002

SPOT2/3/4 and TOPEX

ignyydddM03.snz

LCA analysis center

1993-2001

SPOT2/3/4 and TOPEX

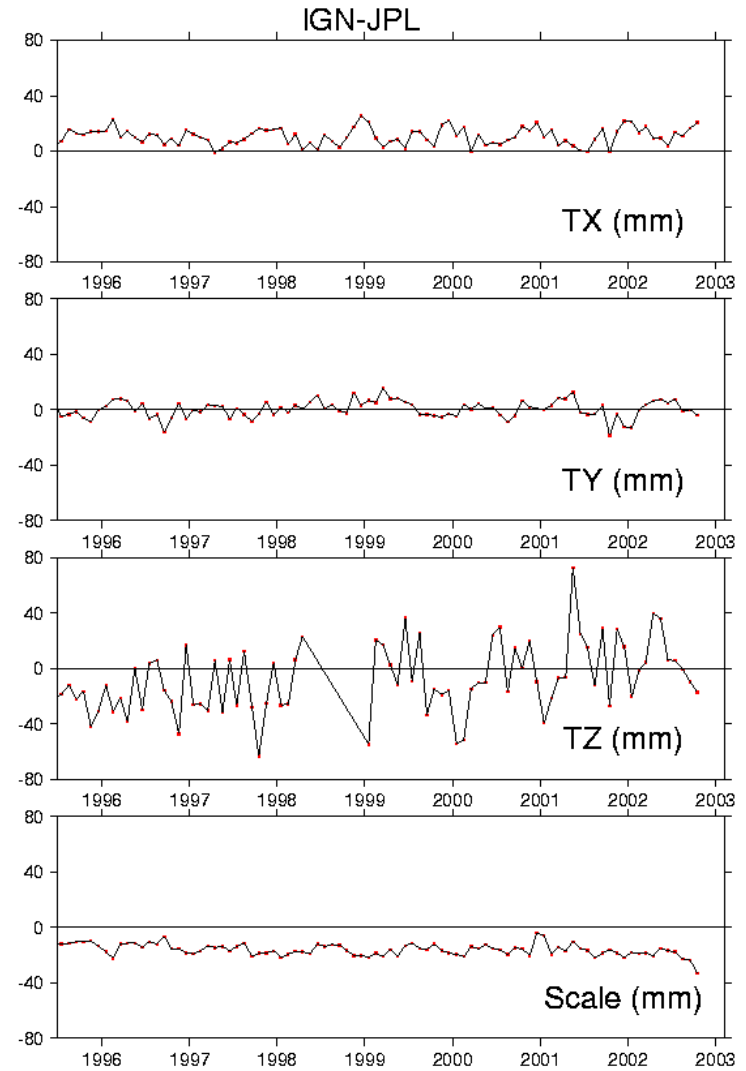
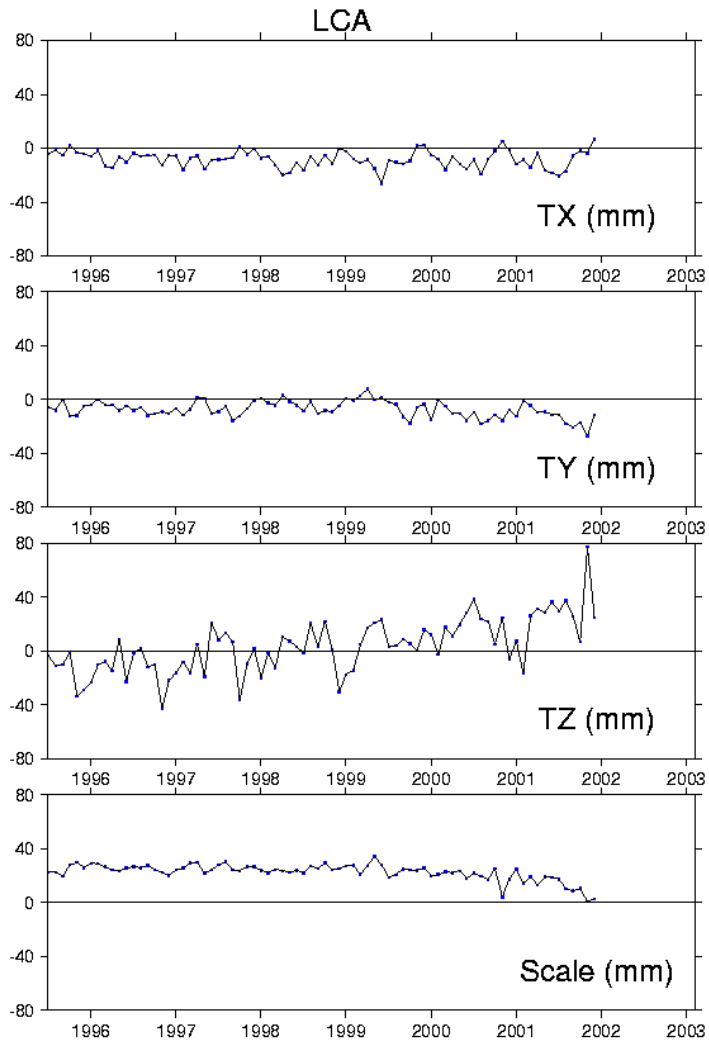
lcayydddM02.snz

Datum definition

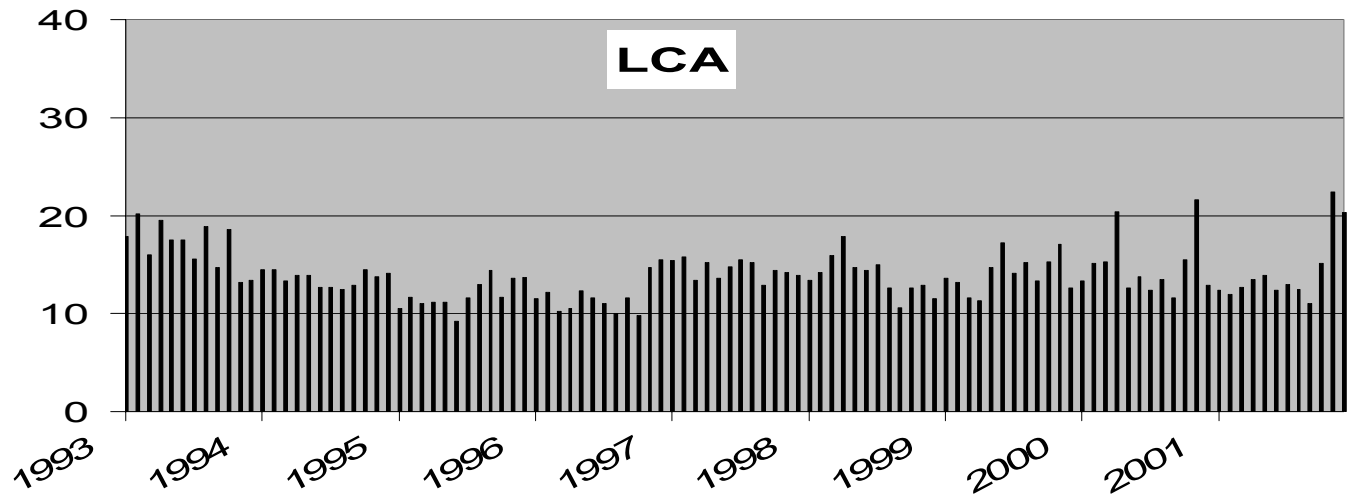
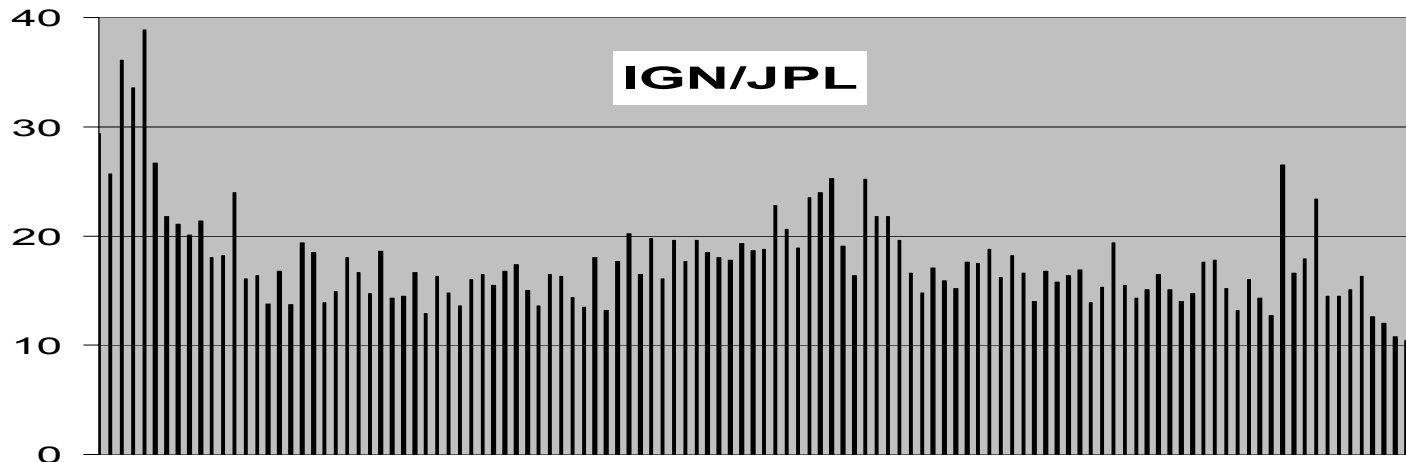
ITRF2000 sub-network : best stations that are also included in all solutions

*CODE	PT	DOMES	T	STATION DESCRIPTION	APPROX_LON	APPROX_LAT	APP_H
ADEA	A	91501S001		ILE DES PETRELS antenn	140 00 05.1	-66 39 45.6	0.9
AREA	A	42202S005		AREQUIPA antenna	288 30 24.9	-16 27 56.6	2493.7
BADA	A	12338S001		BADARY antenna	102 14 05.7	51 46 11.0	812.3
CACB	A	41609S001		CACHOIERA PAULISTA ant	314 59 52.8	-22 40 57.8	571.1
CIBB	A	23101S001		CIBINONG antenna	106 50 55.8	-6 29 26.4	161.1
COLA	A	23501S001		COLOMBO	79 52 27.0	6 53 31.4	-76.8
DAKA	A	34101S004		DAKAR antenna	342 33 59.9	14 43 54.9	44.6
DIOA	A	12602S011		DIONYSOS antenna	23 55 58.3	38 04 42.2	513.6
DJIA	A	39901S002		DJIBOUTI antenna	42 50 47.9	11 31 34.7	716.0
EASA	A	41703S008		EASTER ISLAND antenna	250 36 58.8	-27 08 52.2	120.1
EVEB	A	21501S001		EVEREST antenna	86 48 47.3	27 57 29.3	4962.0
GALA	Z	42004S001		SAN CRISTOBAL antenna	270 23 01.6	-0 54 02.5	5.3
GOMB	A	40405S037		GOLDSTONE antenna	243 12 29.1	35 14 54.1	1041.1
GUAB	A	50501S001		GUAM antenna	144 54 50.4	13 32 23.0	290.9
KERB	A	91201S003		KERGUELEN antenna	70 15 45.7	-49 21 07.5	62.6
KOKA	A	40424S008		KAUAI antenna	200 20 04.7	22 07 23.2	1165.7
KRUB	A	97301S004		KOUROU antenna	307 21 36.7	5 05 55.0	109.8
MANA	A	22006S001		MANILLE antenna	121 02 28.2	14 32 07.6	87.0
META	A	10503S013		METSAHOVI antenna	24 23 04.2	60 14 31.2	62.9
NOUA	A	92701S001		NOUMEA antenna	166 24 37.4	-22 16 10.1	85.3
PURA	A	21604S003		PURPLE MOUNTAIN antenn	118 49 29.3	32 04 01.7	263.5
RIDA	A	40499S016		RICHMOND	279 36 39.7	25 37 25.4	-18.5
ROTA	A	66007S001		ROTHERA antenna	291 52 32.2	-67 34 09.5	26.9
TRIA	A	30604S001		TRISTAN DA CUNHA ant.	347 41 14.9	-37 03 55.0	48.6
WALA	A	92901S001		WALLIS antenna	183 49 13.9	-13 15 56.7	158.9
YELA	A	40127S007		YELLOWKNIFE antenna	245 31 11.6	62 28 51.3	186.4

Global combination of individual monthly series - *Transformations*



Combination of individual monthly series - **WRMS**

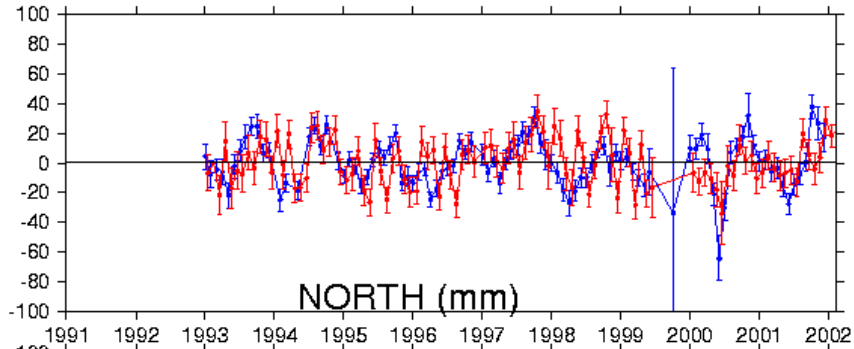


42-52 stations

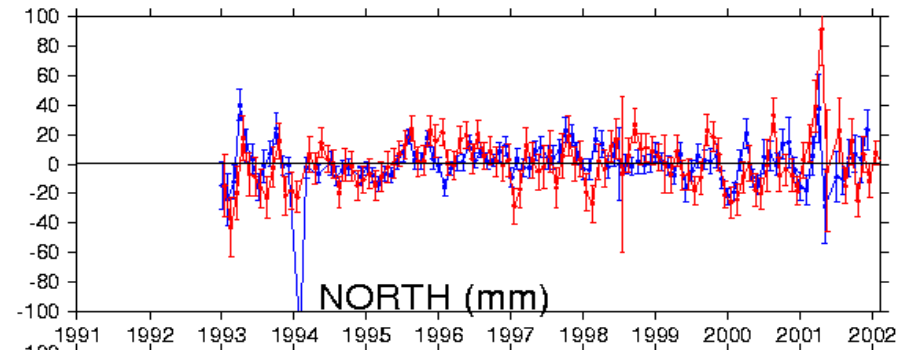
Combination of individual monthly series – **Consistency**

LCA
IGN-JPL

FAIA



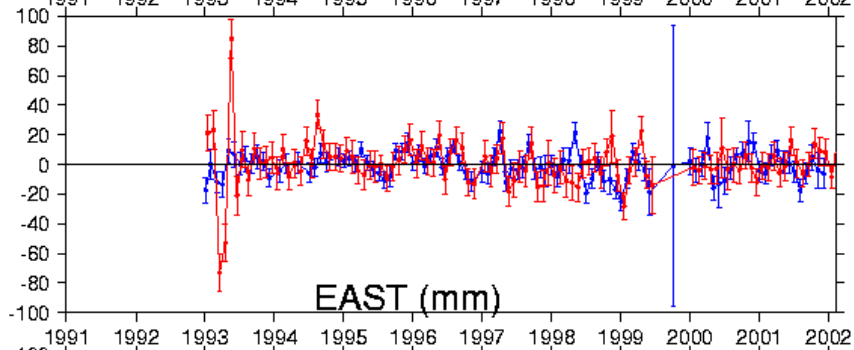
DJIA



NORTH (mm)

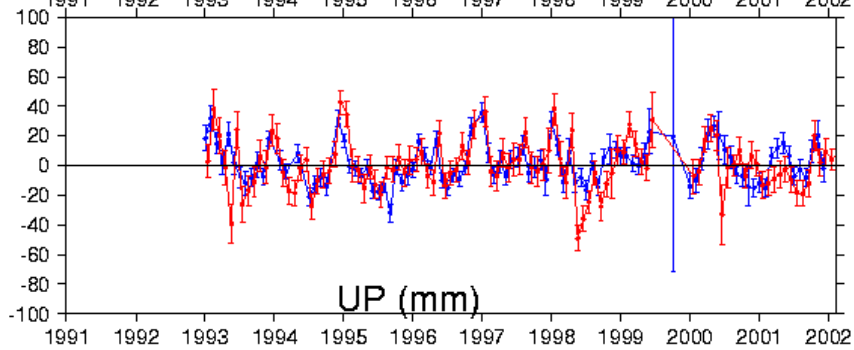
NORTH (mm)

EAST (mm)

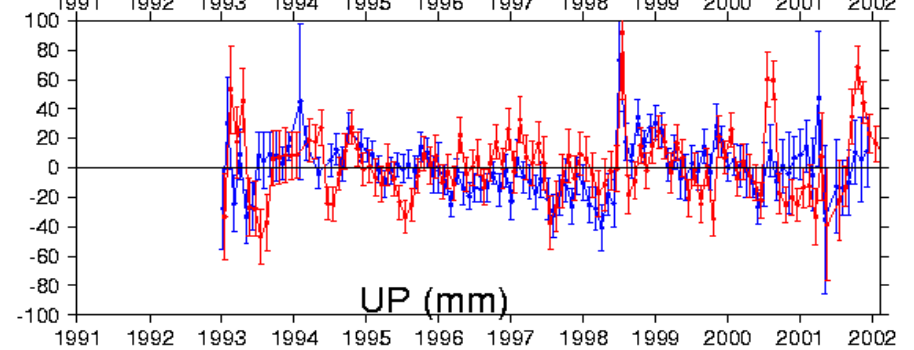
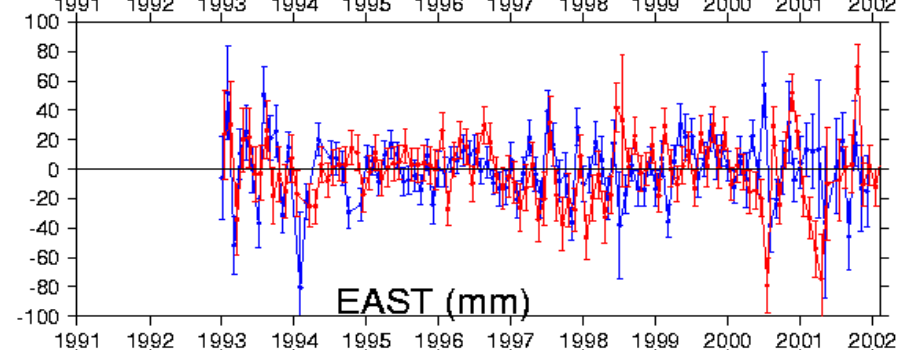


EAST (mm)

UP (mm)



UP (mm)

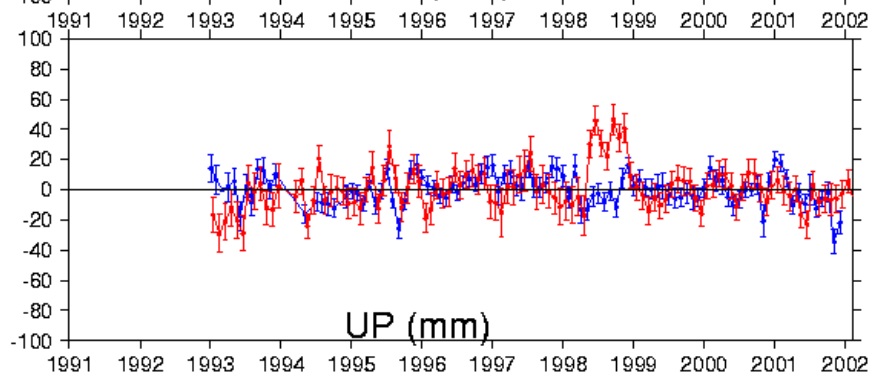
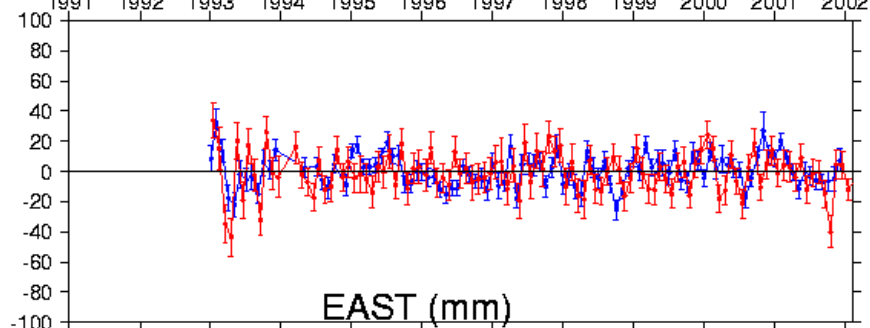
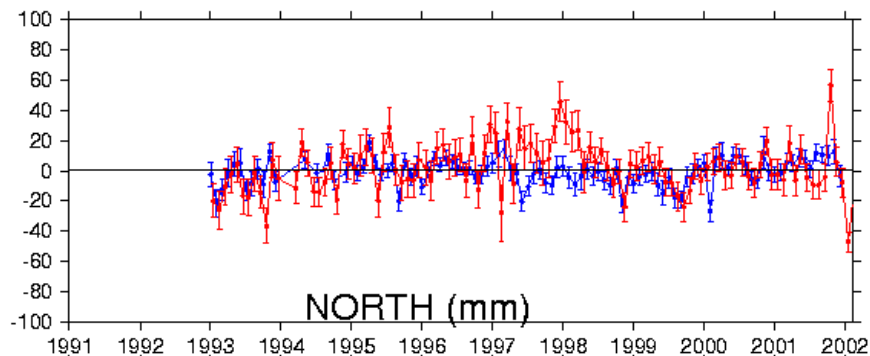


Combination of individual monthly series - *Discrepancies*

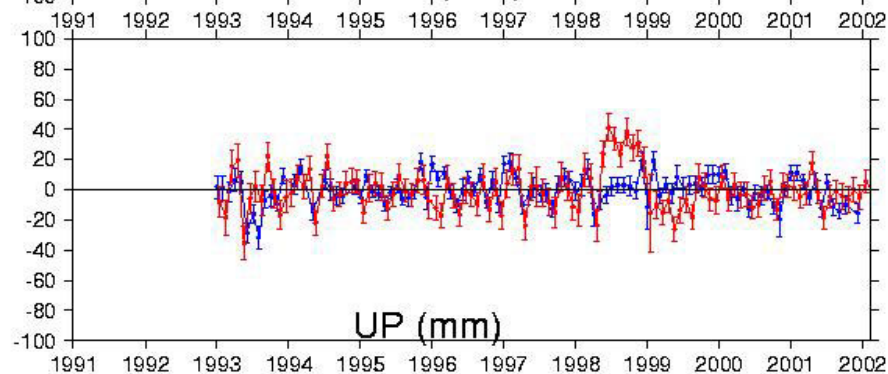
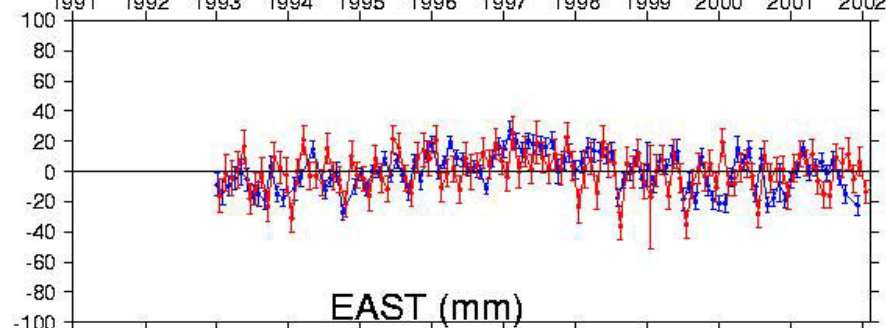
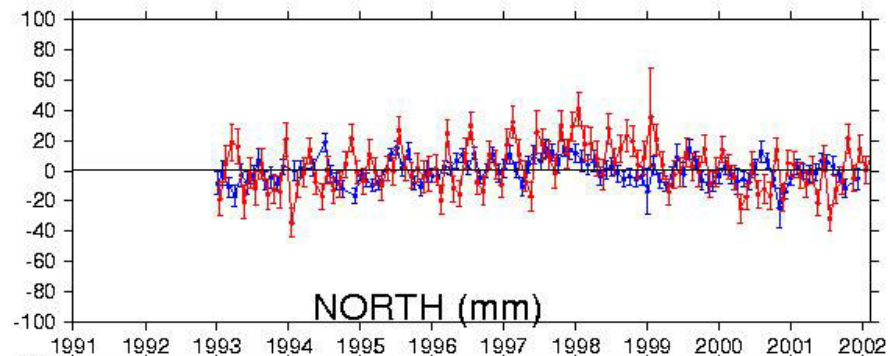
LCA

IGN-JPL

ROTA



ADEA



Month by month combination – year 2000

Only two solutions available, Reference system is arbitrary fixed with one solution

7 parameters estimation

Only the discrepancies may be observed : about 40-50 mm (2001 combination)

Worst systematic differences:

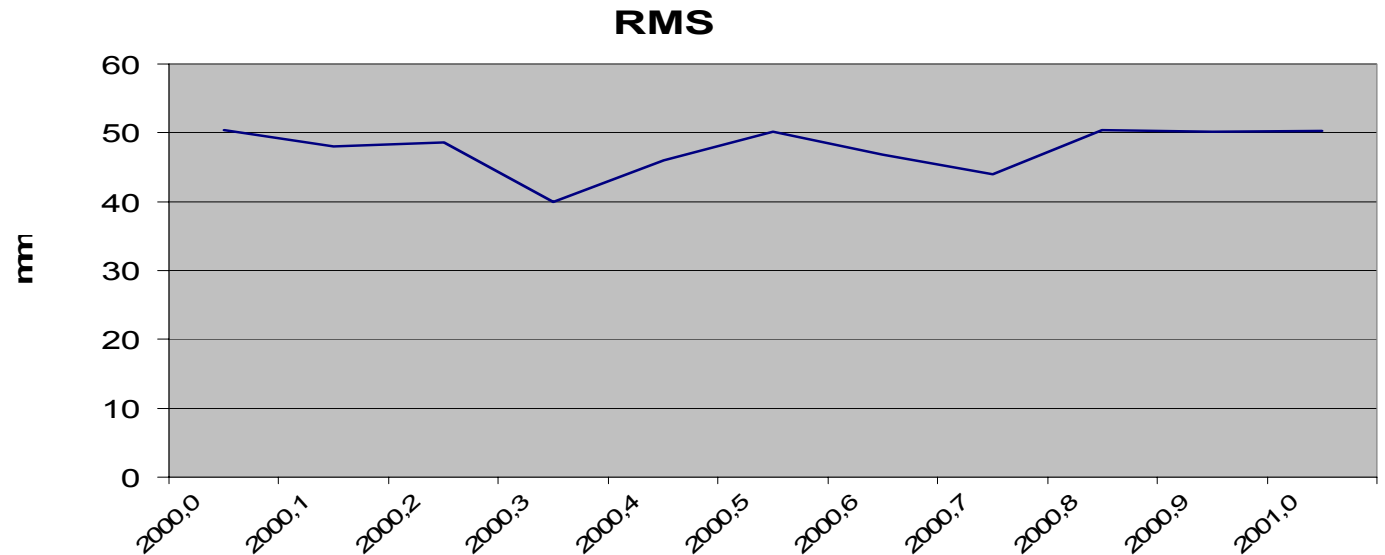
> BADA FAIB RIOB ROTA

also :

ADEA CACB GOMB

HBLA KERB KITB

KOKA ...



Monthly analysis : results

Global combination:

TX, TY about 20 mm

TZ \pm 40 mm

Most WRMS from 10-20 mm (nearly 50 stations)

Monthly combination:

More solutions for a real combination

Discrepancies of 50 mm > models investigation

LCA solutions are not estimated at the median epoch of the observations

Weekly (or near) Solutions Analysis

SSA SSALTO/CNES analysis center

2001-2002

SPOT2/3/4/5 and TOPEX

ssayyddM01.snx

No covariance matrix (apriori MOE orbit)

SOD analysis center

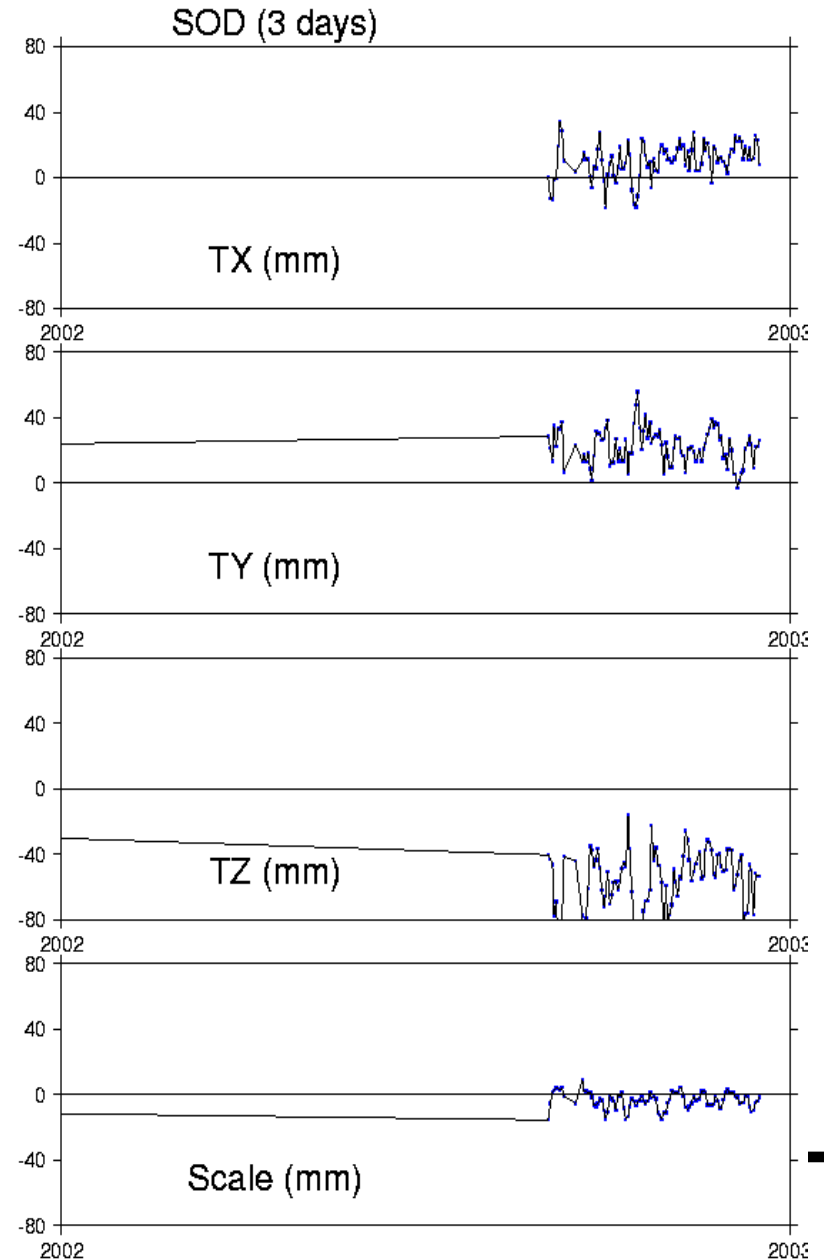
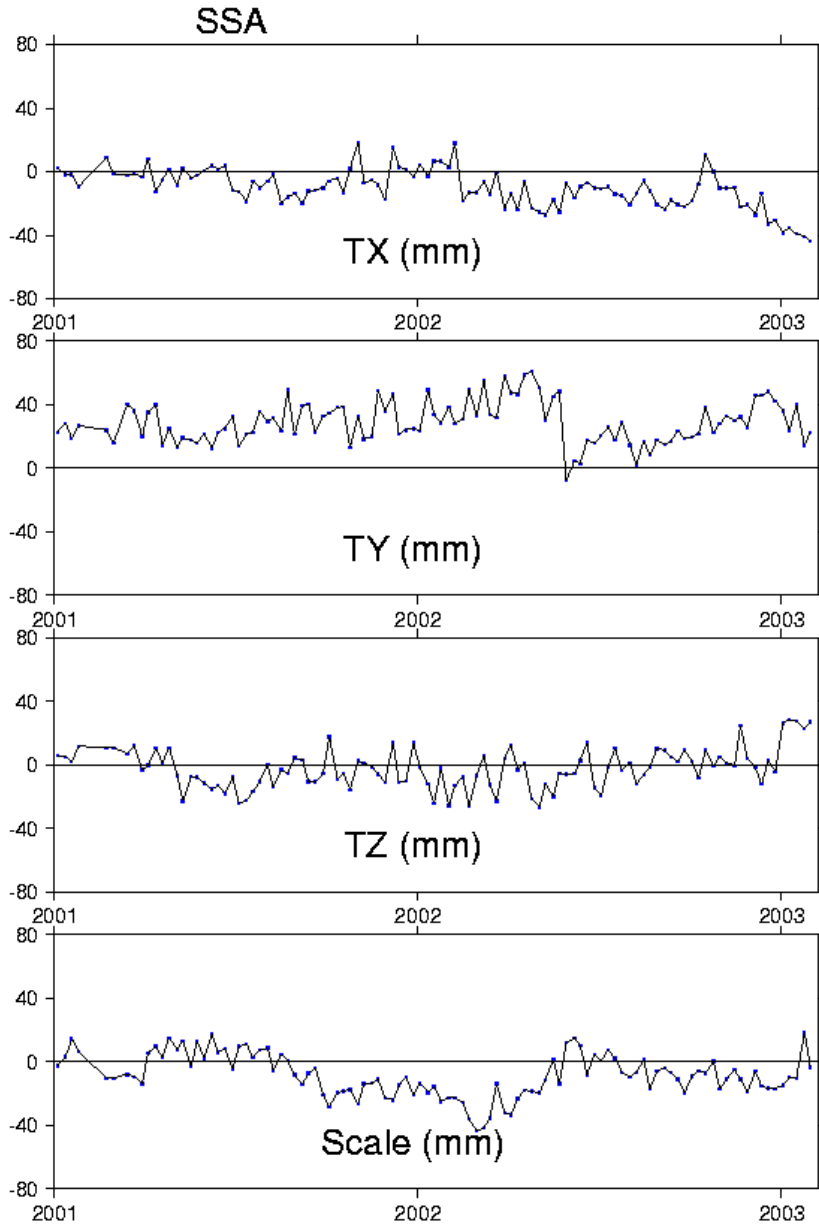
2002

3 days solutions, MOE computation

SPOT2/3/4/5, TOPEX

JASON from Jan. 2002 up to mid-Aug. 2002

Global combination of individual weekly series - *Transformations*



Weekly (or near) analysis : results

WRMS = 2 to 4 cm

Quick production: a few days delay

Not the best algorithms

But interested solutions for:

- new stations,*
- antenna position changes*
(bad weather conditions, on field erosion, earthquakes,...),
- network control*

Future possible products

possible products for TRF

Global solutions (positions and velocities)

*Monthly solutions 6 months delay every 2 months (INA/LCA/JPL)
+ weekly solutions ?*

Rapid weekly solutions 1-2 weeks delay once a week (SOD/SSA)

Need for identical inputs

- domes number, antenna changes*
- solution periods, epoch of estimated solutions*

Need for more Analysis Centers

possible new Analysis Center participation

Group	Team – contact	On-going developments
IAA-RAS (St-Petersburg)	George Krasinsky	Preliminary results of Topex/Poseidon Doppler processing Need for outputs comparisons and information about the system (satellite models,...)
Geodetic Obs. of Pecny (Czech Republic)	Petr Stepanec Jan Kostelecky	Bernese software
CSR	John Ries	Solutions for Topex & Jason
AUSLIG	Ramesh Govind	Microcosm software Solutions for Topex

DORIS training in Paris/Toulouse