Analysis of Terrestrial Reference Frame results from the IDS Analysis Campaign

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IDS Analysis campaign

History

Participation

Means and method

Results

Preliminary analysis

Future
IDS analysis : history

1999-2000  
IDS call for participation : 10 Analysis Center propositions  
but no analysis coordinator

Nov. 2001  
IGN/CLS proposition to initiate the analysis with station coord./veloc.  
call for participation to an IDS analysis campaign (TRF) : 5 propositions  
preparation : Doris info (IDS ftp server), sinex and time series spec.,  
data centers coordination

March 2002  
Martine Feissel is named as the coordinator

other newly analysis initiatives :
- orbits : Henno Boomkamp (ESA)
- EOP : Daniel Gambis (OBSPM)  
  10 series on line (http://hpiers.obspm.fr/eop-pcl/)  
  J. Ray and M. Rothacher
- geocenter : ?
## IDS analysis campaign: participation

<table>
<thead>
<tr>
<th>Group</th>
<th>Team – contact</th>
<th>Contribution to the station coordinates analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGN-JPL (France-USA)</td>
<td>Pascal Willis (IGN) Yoaz Bar-Sever (JPL)</td>
<td>Multi-satellites Weekly solutions Monthly – global solutions</td>
</tr>
<tr>
<td>INASAN (Russia)</td>
<td>Suriya Tatevian Kuzin Sergey</td>
<td>Weekly solutions</td>
</tr>
<tr>
<td>University of Texas/CSR</td>
<td>John Ries</td>
<td>Topex/Poseidon satellite</td>
</tr>
<tr>
<td>(USA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEGOS/CLS (France)</td>
<td>Jean-François Crétaux (LEGOS/GRGS) Laurent Soudarin (CLS)</td>
<td>Multi-satellites Monthly solutions (from 1993 until now) Global solution</td>
</tr>
</tbody>
</table>

For operational use only

<table>
<thead>
<tr>
<th>SOD/CNES (France)</th>
<th>Jean-Paul Berthias Alfred Piuzzi, Adèle Guitar</th>
<th>3 days multi-satellites solution a few days delay for station network control</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSALTO/CLS-CNES (France)</td>
<td>Jean-Jacques Valette</td>
<td>Monthly/weekly multi-satellites solutions (routine process 48 h delay) for station network control</td>
</tr>
</tbody>
</table>
## IDS analysis campaign : submitted solutions

<table>
<thead>
<tr>
<th>Analysis Center</th>
<th>Data Span</th>
<th>Solution*</th>
<th>Satellites</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGN-JPL (IGN)</td>
<td>1993-2001</td>
<td>w/m</td>
<td>Spot2/3/4 Topex</td>
<td>Minimum</td>
</tr>
<tr>
<td>INASAN (INA)</td>
<td>1999-2001</td>
<td>w</td>
<td>Spot2/3/4 Topex</td>
<td>Minimum</td>
</tr>
<tr>
<td>LEGOS-CLS (LCA)</td>
<td>1993-2001</td>
<td>m/g</td>
<td>Spot2/3/4 Topex</td>
<td>Loose (1 m)</td>
</tr>
<tr>
<td>[CSR (CSR)]</td>
<td>2002</td>
<td>m</td>
<td>Topex - Jason</td>
<td>prepared but not submitted</td>
</tr>
</tbody>
</table>

*for operational use, calculation within a week delay*

<table>
<thead>
<tr>
<th>Analysis Center</th>
<th>Data Span</th>
<th>Solution*</th>
<th>Satellites</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOD (SOD)</td>
<td>June 2001</td>
<td>w</td>
<td>Spot2/3/4 Topex</td>
<td>Loose (1-10m)</td>
</tr>
<tr>
<td>SSALTO (SSA)</td>
<td>since Jan.2001</td>
<td>w/m</td>
<td>Spot2/4 Topex/Jason</td>
<td>Non removable</td>
</tr>
</tbody>
</table>

* w : week, m : month, g : global*
Means and Method

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

- comparison/combination of stations positions and velocities (Helmert Transf.)
- physical and statistical models

TRF definition for each submitted solution:

- epoch is the median of data set
- constraints:
  - removable (10-5)
  - loose (> 1 m, 10 cm/y)
  - minimum

Analysis work:

- focus on internal consistency
- users need (system information, new stations, Jason,...)
Transformation parameters

**ITRF2000 projection**

DORIS/IGN-JPL Monthly Solutions

TX (mm)

TY (mm)

TZ (mm)

Scale (mm)
3D residuals histogram - monthly solutions

IGU/NPL

LEGOS/CLS

std = 0.0287

std = 0.0311

std = 0.0217

std = 0.0214

std = 0.0255

std = 0.0255
Monthly time series
station analysis

Station monthly solutions: mean of 3D residuals

IGN / JPL  LEGOS / CLS

Some stations with similar strong residuals:
Socorro, Pamatai, Ascension...
Tristan da Cunha: troposphere estimation problem?

100 mb drift of the pressure sensor from 1993 until 1998

1mb is equivalent to 10 m in altitude

Mid-1999 sensor failure, corrections of the seasonal initial parameters

The zenithal bias depends on the surface pressure but also the mapping function not in the derivatives
Quick solutions - SSALTO /SOD

SSALTO / DORIS LOCALISATION

(48h MOE orbit from CNES/SOD, ITRF2000 reference)

Useful solutions for network control, new stations, seismic activity monitoring (Arequipa), Diode navigator,...

JJ. Valette, L. Soudarin, Z. Altamimi

IDS Workshop 13-14 June 2002 Biarritz, France.
ENCOURAGING

10 years of Doris data (Spot2/3/4 and Topex)

3 more satellites with new instrument generation (JASON, ENVISAT, SPOT5)
  dual channel, phase observations,...
  very stable Jason orbit (cross-track)

dynamism and synergy (recent questions around Jason data processing)

possible new AC participation
# FUTURE (2) : possible new AC participation

<table>
<thead>
<tr>
<th>Group</th>
<th>Team – contact</th>
<th>On-going developments and needs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AIUB/IGN</strong> (Switzerland/France)</td>
<td>Karine Le Bail (IGN) Urs Hugentobler (AIUB) Werner Gurtner (AIUB)</td>
<td>Integration of Doppler equation in Bernese software of Doris data format? RINEX transformation proposal?</td>
</tr>
<tr>
<td><strong>Geodetic Obs. of Pecny</strong> (Czech Republic)</td>
<td>Jan Kostelecky</td>
<td>Software under development Interested by a DORIS data processing software</td>
</tr>
</tbody>
</table>
| **IAA-RAS** (St-Petersburg)  | George Krasinsky                      | Preliminary results of Topex/Poseidon Doppler processing Need for outputs comparisons and information about the system (satellite models,…)

*No answer*
URGENT

A NEW DORIS DATA FILE SPECIFICATION:

- content (uso, time ref, new observation type, ionosp.)
- format
- delay

Old data conversion
to be discussed

More DORIS system information and better access

\(\text{uso behaviour, station events, satellite attitudes models,}...\)

TRF products specifications

\(\text{multi-satellites, mature monthly and global solutions}\)

Products validation process

Combination

Participation ?
Active contributors

P. Willis
J. Ries
JP. Berthias
C. Noll
J.M. Lemoine
A. Guitart
M. Feissel
P. Sillard
S. Kuzin
K. Le Bail
J.F. Crétaux
G. Beziat
F. Arib
Urs Hugentobler
Yoaz Bar-Server
...

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IDS Workshop 13-14 June 2002  Biarritz, France.
Sinex file naming convention

Station network coordinates (sinex format)

1/ Global sinex solutions (cf IERS convention)

CCCYYDVV.snx.Z
CCC = the center acronym 3 characters
YY = the 2-digit year of the solution submission
D = for DORIS

2/ Periodic sinex solutions

CCCYYDDDTVV.snx.Z
CCC = the center acronym 3 characters
YY = the 2-digit year of the first observation
DDD = the 3-digit day of year of the first observation.
T = the type of the solution with
   m/w/d for monthly/weekly/daily solutions
VV = the version number of the solution

Note that there is no inclusion of the satellites name but the information may be found in the headers of each file.
The sinex files are compressed (unix) for storage and lower caps are used for filenames.
Time series

CCCYYTVVAAAA
CCC = the center acronym 3 characters
YY = the 2-digit year of the solution submission
T = the type of the solution with
   m/w/d for monthly/weekly/daily solutions
VV = the version number of the solution
AAAA = the 4-letter identification of the station (unicity)

* Head lines of selected sinex blocs
*
+ File/reference
+ File/comment (reference system, ellipsoid)
+ Site/id
+ Solution/apriori (XYZ initial coordinates with the reference epoch)
*
* Solutions given in both cartesian and geographical coordinates systems
* Data description below (offset are versus the XYZ initial coordinates)
*
* format
*
* Year  Day  dx  sx  dy  sy  dz  sz  dlat  slat  dlon  slon  dh  sh