Contribution of the new satellites to the positioning performances

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Question

Until end-2001: 3 DORIS-equipped satellites

best positioning performances with the 3 instruments:
  • station coordinates: 1 to 1.5 cm monthly repeatability
  • EOP: 1 to 1.5 mas compared to IERS series

From mid-2002: 3 new instruments are flying
  • dual-channel
  • better OUS
  • instrumental noise reduced

Are the positioning performances improved?
# DORIS-equipped satellites

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Launch date</th>
<th>Altitude (km)</th>
<th>Incl. (deg)</th>
<th>Mission end</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPOT-5</td>
<td>04 May 2002</td>
<td>800</td>
<td>98.7</td>
<td></td>
</tr>
<tr>
<td>ENVISAT</td>
<td>01 Apr 2002</td>
<td>790</td>
<td>98.6</td>
<td></td>
</tr>
<tr>
<td>JASON-1</td>
<td>07 Dec 2001</td>
<td>1320</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SPOT-4</td>
<td>24 Mar 1998</td>
<td>800</td>
<td>98.7</td>
<td></td>
</tr>
<tr>
<td>SPOT-3</td>
<td>26 Sep 1993</td>
<td>800</td>
<td>98.7</td>
<td>09 Nov 1996</td>
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<tr>
<td>TOPEX</td>
<td>10 Aug 1992</td>
<td>1320</td>
<td>66</td>
<td></td>
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<tr>
<td>SPOT-2</td>
<td>22 Jan 1990</td>
<td>800</td>
<td>98.7</td>
<td></td>
</tr>
</tbody>
</table>
Analysed Data 1/2

Processing (GINS software)
- 4 months: July-October 2002 (17 weeks, 123 days)
- each satellite processed independently
- 1-day arcs (w/o common parameters)
- same dynamical parameters for Spot-n and Envisat; for Topex and Jason

Combinations (DYNAMO software)
- unweighted
- global, monthly, weekly (daily)

Estimated parameters:
- monthly solutions: PX, PY (unconstrained), positions (1 meter)
- weekly and daily solutions: positions (no rotation in longitude)
Notes:

SAA stations removed in Jason data processing
KRUB AREB ASDB CACB EASB HBKB HELB LIBB SANB GALA PAQB MAHB PDDB TRIB

less data for Topex in August (manoeuvres)

less data for Envisat (acquisition pbs)
Issues

Instruments:
• performances of the 2nd generation receivers vs 1st-generation

Combinaison:
• 6 satellites better than 3?
• Constellations: « Old » (sp2, sp4, tpx) vs « New » (sp5, jas, env)
• Orbite: « Spots + Envisat » vs « Topex + Jason »
• Future: without sp2, without tpx

Observation time span:
• can we obtain high-precision results over shorter periods?
The various solutions of EOP daily values are compared to the IERS 97C04 series.

Results are presented as RMS (in mas; mean removed) of the series differences for the X and Y components.
EOP results: from 1 to 6 satellites

RMS (in mas) (mean removed)
EOP results: 1-satellite solutions

- sp2sp4tpx: 1.17, 1.47
- sp5: 5.87, 4.73
- env: 23.59, 21.77
- jas: 2.75, 2.17
- sp4: 2.77, 2.74
- tpx: 3.77, 4.76
- sp2: 3.93, 3.94

RMS (in mas) (mean removed)
EOP results: «old», «new», global constellations

- sp2sp4sp5tpxjas: PY 1.01, PX 1.25
- 6sat: PY 1.02, PX 1.24
- sp5jasenv: PY 1.46, PX 1.67
- sp2sp4tpx: PY 1.17, PX 1.47

RMS (in mas) (mean removed)
EOP results: Spot/Envisat orbit vs Topex/Jason orbit

RMS (in mas) (mean removed)

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EOP results: various combinations

- sp4sp5pxjas
- sp2sp4pxjas
- sp2sp4sp5jas
- sp4sp5jas
- sp4sp5px
- sp4sp5tpxjas
- sp2sp4jas
- sp2sp4tpxjas
- sp2sp4tpx
- 6sat

RMS (in mas) (mean removed)

<table>
<thead>
<tr>
<th>Combination</th>
<th>RMS PY</th>
<th>RMS PX</th>
</tr>
</thead>
<tbody>
<tr>
<td>sp4sp5pxjas</td>
<td>1.08</td>
<td>1.3</td>
</tr>
<tr>
<td>sp2sp4pxjas</td>
<td>1.1</td>
<td>1.34</td>
</tr>
<tr>
<td>sp2sp4sp5jas</td>
<td>1.23</td>
<td>1.47</td>
</tr>
<tr>
<td>sp2sp4sp5px</td>
<td>1.01</td>
<td>1.24</td>
</tr>
<tr>
<td>sp4sp5jas</td>
<td>1.42</td>
<td>1.55</td>
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<tr>
<td>sp4sp5px</td>
<td>1.19</td>
<td>1.18</td>
</tr>
<tr>
<td>sp2sp4jas</td>
<td>1.39</td>
<td>1.61</td>
</tr>
<tr>
<td>sp2sp4tpx</td>
<td>1.17</td>
<td>1.47</td>
</tr>
<tr>
<td>6sat</td>
<td>1.02</td>
<td>1.24</td>
</tr>
</tbody>
</table>
EOP results

Pole results as a function of the number of satellites

![Graph showing pole results as a function of the number of satellites. The graph plots the number of satellites on the x-axis and the position of the pole on the y-axis. The lines represent PX and PY results.](image-url)
The various monthly, daily or weekly solutions of the network coordinates are compared to a same type 4-month solution (ex: the 4 monthly combined Spot2/Spot4/Topex solutions are compared after a 7-parameter transformation to the 4-month combined Spot2/Spot4/Topex solution).

Results are presented as 3-D residuals rms and rms for the north, east and up components.
1-satellite monthly precision: 3D rms

- env: 30.3 mm
- jas: 26 mm
- tpx: 24 mm
- sp5: 15.8 mm
- sp4: 17.6 mm
- sp2: 18.5 mm

rms (mm)
<table>
<thead>
<tr>
<th>Satellite</th>
<th>Up (mm)</th>
<th>East (mm)</th>
<th>North (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>env</td>
<td>39.7</td>
<td>38.3</td>
<td>38.3</td>
</tr>
<tr>
<td>jas</td>
<td>27.8</td>
<td>28.2</td>
<td>20.8</td>
</tr>
<tr>
<td>tpx</td>
<td>24.3</td>
<td>27.9</td>
<td>19.5</td>
</tr>
<tr>
<td>sp5</td>
<td>14.4</td>
<td>19.7</td>
<td>12.1</td>
</tr>
<tr>
<td>sp4</td>
<td>17.4</td>
<td>22.0</td>
<td>11.2</td>
</tr>
<tr>
<td>sp2</td>
<td>18.9</td>
<td>20.0</td>
<td>14.2</td>
</tr>
</tbody>
</table>
Monthly precision: 3-D rms

- tpxjas: 26,5
- sp4sp5txp: 11
- sp2sp4txp: 11,7
- sp2sp4sp5: 11,4
- sp4sp5txjas: 12,4
- sp2sp4sp5txp: 10,5
- sp2sp4sp5txjas: 11,5
- 6sat: 11,5
Weekly precision: 3-D rms

- sp4sp5tpx: 23.2
- sp2sp4tpx: 27.3
- sp2sp4sp5: 24.4
- sp2sp4sp5tpx: 23.2
- sp2sp4sp5tpxjas: 21.4
- 6sat: 21.5

rms (in mm)
Weekly precision

- sp4sp5tpx: 19.7, 16.2, 30.7
- sp2sp4tpx: 18.4, 25.1, 35.3
- sp2sp4sp5: 20.5, 17.1, 32.3
- sp2sp4sp5tpx: 20.3, 16.4, 30.3
- sp2sp4sp5txjas: 19.7, 15.4, 27
- 6sat: 18.7, 14.9, 28.3

rms (mm)
6-satellite precision

Monthly, daily, weekly precision with 6 satellites

- **rms (mm)**
  - North: 50.7 daily, 33.8 weekly, 14.9 monthly
  - East: 65.9 daily, 45.5 weekly, 28.3 monthly
  - Up: 50.7 daily, 21.5 weekly, 11.5 monthly

- **3D**
  - Daily: 50.7
  - Weekly: 65.9
  - Monthly: 28.3

- **3D**
  - North: 33.8
  - East: 45.5
  - Up: 11.2

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