CNES orbit solutions

OSTST Venice 2006 – POD & Geoid session

CNES POD Team (*) , with entries from Jason-1 POD Group

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Preparation of reprocessing:

- evolution of configurations
  
  earth potential
  parameterisation
  Doris preprocessing
  Doris along track biases
  SAA frequency corrections, weightings
  GPS antenna map
  SLR (network, parameterisation, weighting)

-(re)processing of data sets

  GPS orbits
  GPS/SLR/Doris orbits
- Jason and Envisat analyses

- important change of POE configurations

  New configuration applied since sept. 2005 on request of altimetry

  Jason cycle 136
  Envisat cycle 41

  Similar to the reprocessing configuration

  New models (earth potential...)
  GPS/Doris/SLR orbits for GDR Jason
## Configurations (1)

### New configurations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Jason</th>
<th>Envisat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth potential</td>
<td>EIGEN3</td>
<td>EIGEN3</td>
</tr>
<tr>
<td>Tides</td>
<td>FES2004</td>
<td>FES2004</td>
</tr>
<tr>
<td>Atmosphere model</td>
<td>DTM94</td>
<td>MSIS86</td>
</tr>
<tr>
<td>Solar radiation pressure</td>
<td>modified (0.97)</td>
<td>reference</td>
</tr>
<tr>
<td>Satellite radiation</td>
<td>ref. Aviso model</td>
<td></td>
</tr>
</tbody>
</table>

### Parameterisation

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Quaternions</th>
<th>Theoretical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/rev terms (T,N)</td>
<td>12 hours</td>
<td>24 hours</td>
</tr>
<tr>
<td>Drag (every 2 orbits)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>New configurations</td>
<td>Jason</td>
<td>Envisat</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>---------</td>
</tr>
<tr>
<td>Doris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>preprocessing</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>along track bias</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SAA weighting</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>GPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in GDR since cy 136</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>antenna map (phase)</td>
<td>new JPL model</td>
<td></td>
</tr>
<tr>
<td>constellation</td>
<td>JPL (backup IGS)</td>
<td></td>
</tr>
<tr>
<td>SLR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>network definition</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>weighting, biases</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
reprocessing: new configurations and GPS/Doris/Laser for Jason

GPS only: jpl constellation solution (some gaps)

GPS only: igs constellation solution (110 - 135)

Doris only solutions (Jason, Envisat) for Doris along track bias estimation
Doris residuals

Exploitation solutions Doris/SLR and Doris/SLR/GPS

nb. mes

ry

rms Doris (mm/s)

0.70

0.66

0.62

0.58

0.54

0.50

0.46

0.42

0.38

0.34

0.30

0

20

40

60

80

100

120

140

160

instrument change

new configuration
GPS phase residuals
(JPL or IGS constellation)
GPS centre of phase variations

GPS antenna position adjusted (cy 110 – 135):

- **GPS/Doris/SLR solutions**
  - 1 cm bias in Y (direction of solar array axis)
  - 6 month periodic term in X and Z

No important radial effect observed on the orbits
GPS centre of phase adjustment (1)

JASON1 – (CP GPS) AJUSTE – ORBITE 3T

Xsat
Zsat
Ysat

Y sat covariance

Zsat

1 cm

Cycle
GPS centre of phase adjustment (2)

Small effect

More important during high $\beta'$

Orbits with or without centre of phase adjustment
Crossover

New solutions:

**crossover rms**

improvement versus GDR
GPS and GPS/Doris/SLR solutions are very close

**crossover mean**

bias 0.5 cm
periodic 60 days
    important on GPS solutions: 0.5 cm
Crossover mean

JASON1 – MOY XNG PRE-REJEUX POE


Moyenne (cm)

Cycle
Crossover rms

JASON1 – RMS XNG PRE-REJEUX POE


GDR
Doris New
GPS New
GPS/Doris/SLR New
Satellite direct radiation model

**Aviso model (satellite radiation):**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Power (W)</th>
<th>Acceleration (m/s²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>40</td>
<td>-1.83 $10^{-10}$</td>
</tr>
<tr>
<td>Y</td>
<td>80</td>
<td>-3.67 $10^{-10}$</td>
</tr>
</tbody>
</table>

Some differences observed on fixed yaw periods:

- asymmetry in the adjusted drag (X satellite is along track)
- can be improved by applying a positive value on X acceleration (see J. Ries remarks)

Adjusting the X value gives better results (remark the + sign)

4.5 $10^{-10}$ m/s² to 5.0 $10^{-10}$ m/s²

- SLR residuals improved
- adjusted drag more realistic
Drag acceleration around flip (cy 125) effect of X radiation term

Initial Xrad value

Adjusted Xrad value
SLR residuals
effect of X radiation term

SLR residuals

<table>
<thead>
<tr>
<th>cy</th>
<th>SLR</th>
<th>SLR corr.</th>
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<tbody>
<tr>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>149</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Crossover rms

effect of X radiation term
Conclusion

The new configuration (since Jason cy 136) produces very good products (GPS/Doris/SLR GDR orbits) these products have been tested by altimetry.

Some older Jason cycles have been reprocessed with the same configuration in order to have longer solution series (GPS only, GPS/Doris/SLR).

GPS and GPS/Doris/SLR orbits are very close. The tri-technique product is more robust in cases of data gaps in GPS, or in Doris.

The corresponding configuration (since Envisat cy 41) shows similar performance improvements.