GINS software evolutions for the Jason-2 data processing: RINEX and DORIS 2.2 formats

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Summary

• GINS 8.3: upgraded for Jason2 and RINEX/DORIS
• Comparative use of RINEX/DORIS and DORIS 2.2
• Orbit results
• Contribution of Jason2 to multi-satellite combination
Software evolutions

Jason2:
- box & wing model and optical coefficients of Jason-1
- DORIS antenna and LRA, satellite mass and CoM: values given by L. Cerri (dorismail 552)

Data:
- DORIS 2.2 : no change; only measurements « considered to be good » (flag=0)
- RINEX/DORIS:
  • Retrieval of the daily files; header reading; record table preparation
  • phase measurements transformed into cycle numbers
RINEX/DORIS processing

- The ionospheric correction is calculated for each phase measurement (2 GHz)
  \[ \phi_{1\text{ (corrected)}} = \phi_1 + \frac{f_2}{(f_2^2 - f_1^2)} \times (f_1 \phi_2 - f_2 \phi_1) \]

- Deltaphase is formed
  \[ \Delta \phi(t_i) = - (\phi(t_{i+1}) - \phi(t_i)) \text{ where } t_{i+1} = t_i + 10 \text{ sec} \]

- Offset of the receiver’s clock is added

- Preprocessing indicators taken into account:
  - Central frequency (11, 21)
  - Discontinuity of measurement (12, 22)
  - Station on Restart Mode (51, 61)

If one of them is not null, the weight of the data is put to 0

- Satellite passes are formed for each station
RINEX/DORIS vs DORIS 2.2

Results of preliminary tests performed with one day of data (Jul.17 2008)
elevation cut-off = 12°

<table>
<thead>
<tr>
<th></th>
<th>RINEX/DORIS</th>
<th>DORIS 2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data used (% edited data)</td>
<td>16504 (38%)</td>
<td>16446 (30%)</td>
</tr>
<tr>
<td>Orbit residuals WRMS (mm/s)</td>
<td>0.316</td>
<td>0.315</td>
</tr>
</tbody>
</table>
# Orbit comparison

<table>
<thead>
<tr>
<th></th>
<th>Bias (cm)</th>
<th>Std Dev (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radial</td>
<td>Cross-Tr</td>
</tr>
<tr>
<td>Rinex / DORIS 2.2</td>
<td>-0.03</td>
<td>-0.02</td>
</tr>
<tr>
<td>Rinex / POE</td>
<td>-0.11</td>
<td>-0.30</td>
</tr>
</tbody>
</table>

The along-track bias of ~ -35 cm corresponds to the -51.83 micro-seconds propagation delay between the 2Ghz signal reception at the phase center of the antenna and the Top TDI inside Doris that provides the 10s OUS synchronism.

The correction of the files is planned mid-Nov.
Low residual RMS even for low elevation cut-off:
- quality of the tropospheric model
- efficiency of the downweighting low
applied to measurements below 20 dg

For elev_dg <= 20 dg:
Weight = Weight X F
where F = elev_dg**2 / 400
F=1 at 20 dg ; F=0 at 0 dg.
Orbits results

DORIS 2.2 and SLR data
Cy. 001-008 = weeks 1488 to 1498 (08/07/13 to 08/09/27)

3.5-day arcs, elevation cut-off = 12 deg.

• RMS residuals and measurements number
• Overlap orbits
• Orbit comparison to GDR-C (POD CNES)
DORIS residuals and number of measurements

DORIS Jason2

rms: 0.30 - 0.31 mm/s
~85000 mes. / 3.5d arc

Maneuver on Aug. 27

DORIS Jason1

rms: 0.31 - 0.32 mm/s
~50000 mes. / 3.5d arc

Maneuver on Jul. 31; Incident on Aug. 7
SLR residuals and number of measurements

Maneuver on Jul. 31
Incident on Aug. 7

Maneuver on Aug. 27
Orbit overlaps

Jason2 LCA orbit Overlap (3H)

Average Differences (m)

![Graph showing orbit overlaps with different markers for radial, cross-track, and along-track differences.](chart)

RMS Differences

GPS week

IDS Workshop, 12-14 November 2008 Nice, France
Orbit comparison to GDR-C (POD CNES)

Jason2 Rad/Crs/Alg Orbit Differences for LCA vs CNES_POD

- **Avg**
  - radial
  - cross-track
  - along-track

- **RMS**
  - radial
  - cross-track
  - along-track

GPS week
Positioning Results with Jason-2

DORIS 2.2 and SLR data
Cy. 001-008 = weeks 1488 to 1498 (08/07/13 to 08/09/27)

3.5-day arcs, elevation cut-off = 12 deg.

Comparison sp2/sp4/sp5/env vs 4 sat + jason2
  - Station coordinates
  - EOP
Weekly NEU rms for the whole network
Weekly multi-sat. solutions vs ITRF/DPOD2005

Scale
Weekly multi-sat. solutions vs ITRF/DPOD2005

Translations
EOP daily values: differences with EOP05C04
EOP: weekly WRMS w.r.t. EOP05C04
Conclusion

RINEX/DORIS: phase measurements are transformed into cycle numbers

RINEX vs 2.2 :
- same residuals WRMS of fit: ~0.31 mm/s
- 35 cm along-tr. differences but electronic propagation delay not taken into account (-51.83 microsec.)

Jason-2 DORIS 2.2 orbit results:
- residuals of fit: DORIS 0.31mm/s, Laser 10-15 mm
- orbit comparison with CNES POE: no bias; rms ~2cm in Rad. and Cross-tr., ~5cm Along-tr.

Multi-satellite weekly station solutions:
- 1-4 mm improvement in East and vertical.
- Effect on scale: 1 ppb

Multi-satellite EOP daily solutions:
- ~0.3 mas RMS with Jason2, ~0.5 mas RMS w/o Jason2
Backups
DORIS 2.2

DORIS 2.1 slightly adapted to the new orbit pre-processing (column 35) and new 7-channel feature of the DGXX receiver

Preprocessing indicators (column 35)
- 0 = point considered to be good
- 1 = point edited during pre-processing
- 2 = point edited during post-processing
- 3 = point edited: null Doppler measurement, possibly erroneous
- 4 = point edited: 3.0 beacon in restart mode (RS=1)

Channel indicator (column 90)
- First generation receiver (SPOT-2, SPOT-3, SPOT-4 & TOPEX/POSEIDON)
  1 = channel 1
- Second generation receiver (Jason-1, SPOT-5 & ENVISAT)
  1 = channel 1
  2 = channel 2
  3 = channel 1 & 2 (2 channels performing measurements on the same station)
- DGXX receiver (starting with Jason-2)
  i = channel i (i=1 to 7)
Orbit comparison to GDR-C (POD CNES)