Plate motions from DORIS data

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Previous results: DORIS/NUVEL1

Crétaux et al., 1998
Previous results: DORIS absolute velocities and NUVEL1-NNR

Crétaux et al., 1998
Analysed Data


- SPOT 2
- TOPEX/POSEIDON
- SPOT 3
- SPOT 4
Coordinate time series

Ny-Ålesund - Doris Station

- SPIA
  - Repeatability: 5.5 mm
  - Rate: 19.2 μm/yr ± 0.4 mm/yr

- Rainfall
  - Repeatability: 8.6 mm
  - Rate: 8.4 μm/yr ± 0.5 mm/yr

- Soil
  - Repeatability: 7.2 mm
  - Rate: 2.7 μm/yr ± 0.5 mm/yr
Coordinate time series

Kokee Park (Kauai) - Doris Station
DORIS absolute velocities

20 +/- 2 mm/yr
Rotation vectors

Plate motions can be expressed through Euler poles and angular velocities.

Velocity of a station on a plate: \( \mathbf{v} = \Omega \times \mathbf{r} \)

\( \Omega \): rotation vector of the plate
\( \mathbf{r}, \mathbf{v} \): position and velocity vectors of the station

Observations equations:

- \( V_\varphi = R (\omega_x \sin \lambda - \omega_y \cos \lambda) \)
- \( V_\lambda = R (-\omega_x \cos \lambda \sin \phi - \omega_y \sin \phi + \omega_z \cos \phi) \)

\( \omega_x, \omega_y, \omega_z \): plate angular velocity coordinates
\( \phi_p, \lambda_p \): plate pole coordinates
\( \Omega_p \): angular velocity magnitude

Unknowns:

\[
\Omega_p = \sqrt{\omega_x^2 + \omega_y^2 + \omega_z^2}
\]

\[
\phi_p = \sin^{-1} \frac{\omega_x}{\Omega_p}
\]

\[
\lambda_p = \tan^{-1} \frac{\omega_y}{\omega_x}
\]

At least two beacons needed per plate sufficiently far away from active deformation zones.
GEODVEL

GEODVEL : GEODeSy VElocity model [Argus et al.]

➢ model of the angular velocities among 9 major plates, using observations from GPS, VLBI, and SLR

GLB1122 [VLBI, from C. Ma, Goddard Space Flight Center] data from 1979 to June 1999
CSR00l01 [SLR, from R. Eanes, Center for Space Research] data from 1976 to March 2000

➢ sites assigned to plates on the basis of geological observations
Vector differences between the DORIS and GEODVEL velocities

<table>
<thead>
<tr>
<th>Vector difference (deg/Myr)</th>
<th>Chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>EURA-NOAM</td>
<td>0.0548</td>
</tr>
<tr>
<td>NOAM-PCFC</td>
<td>0.0425</td>
</tr>
<tr>
<td>PCFC-ANTA</td>
<td>0.0643</td>
</tr>
</tbody>
</table>

Eurasia plate: TLSA, SPIA, META
North America plate: YELA, RIDA, OTTA
Pacific plate: WALA, KOKA, PAQB, RAQB
Several groups are using DORIS results for combination with other techniques

- Argus (JPL): including DORIS in GEODVEL (in process)
- Gerasimenko (Institut of Applied Mathematics, Vladivostok, Russia): definition of Kinematics Reference Frame (paper in preparation), combination with other techniques

DORIS bring key new constraints to crustal movements for plates few or not covered by other techniques (ANTA, NUBIA, SOMALIA)

Suggestions for new DORIS installations

- Caribbean and Cocos plates
- Indian plate (second site)
- Greenland (cover of NOAM; ice studies)