Plate motions from DORIS data
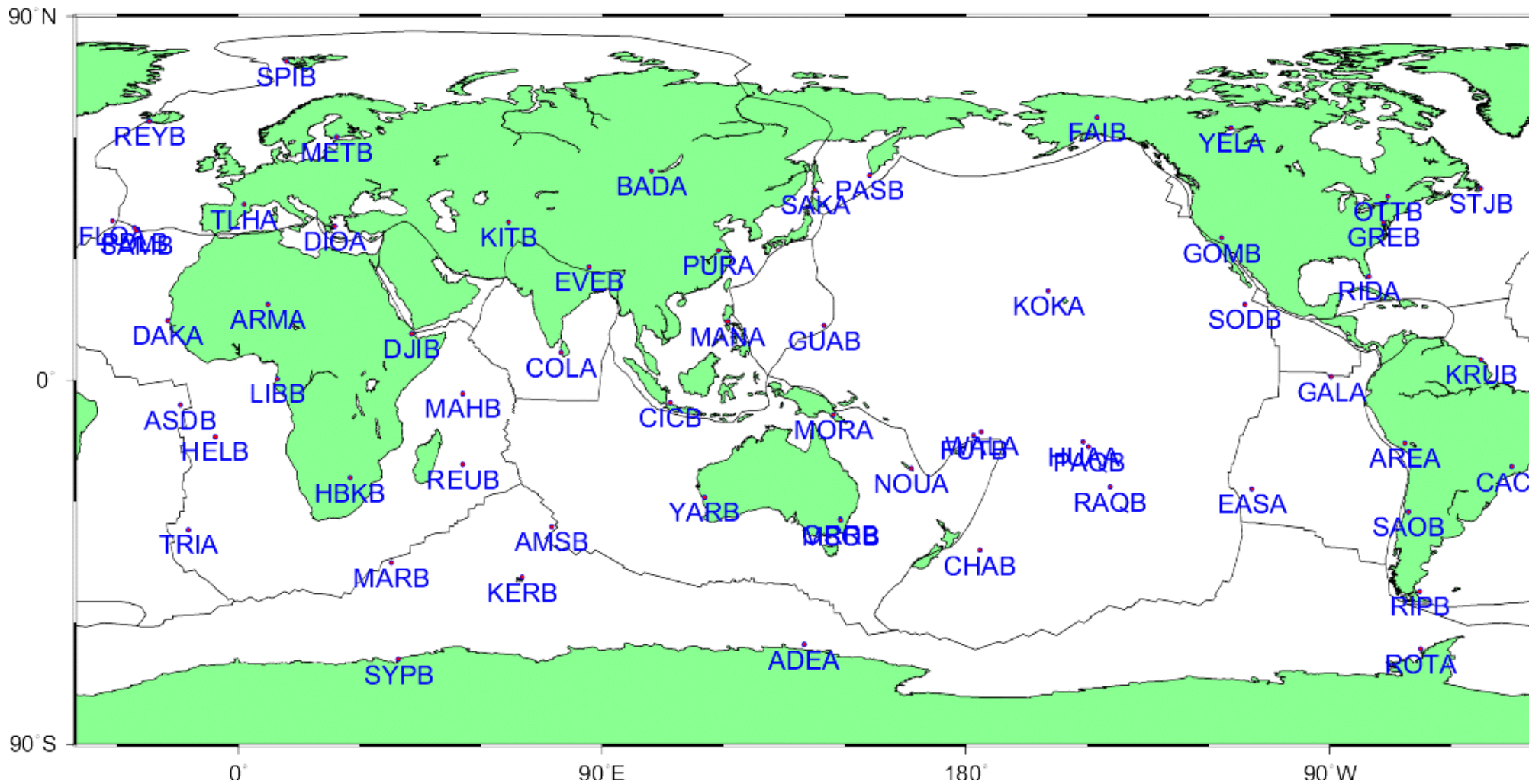
D. Argus[1], L. Soudarin[2], JF. Crétaux[3]

[1] *Jet Propulsion Laboratory, Pasadena, CA, USA*
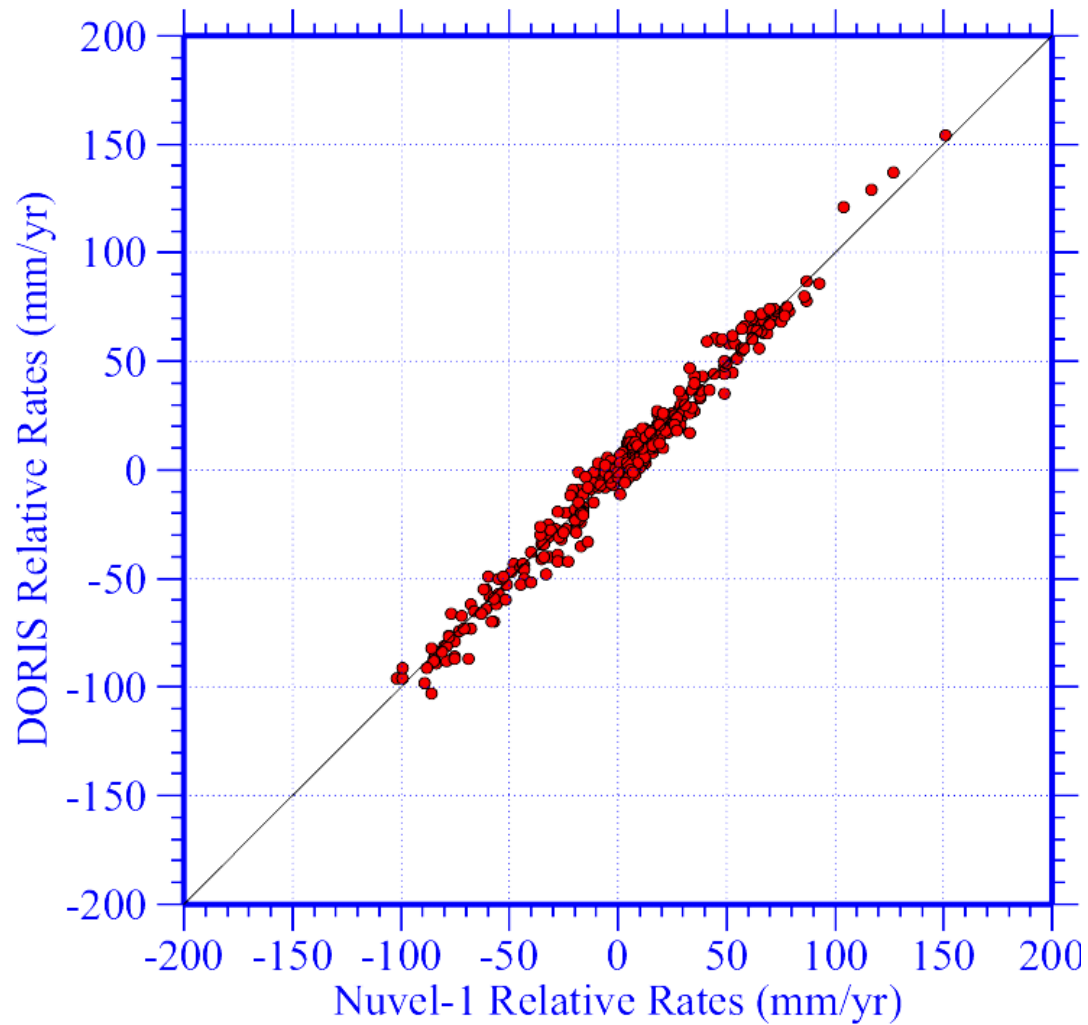[2] *CLS, Collecte Localisation Satellites, Ramonville, France*
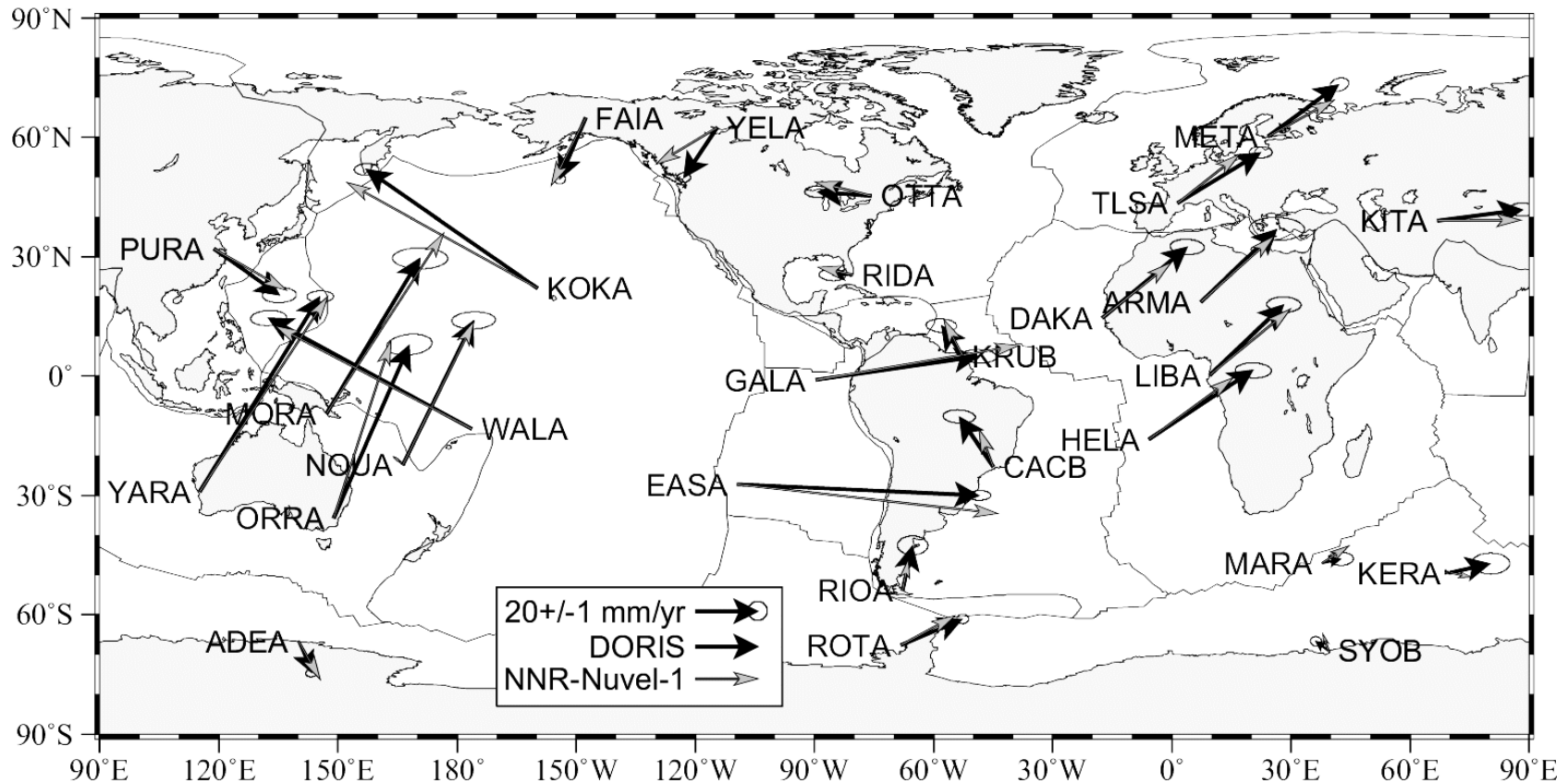[3] *LEGOS/GRGS (CNES/CNRS-UPS), Toulouse, France*

DORIS network
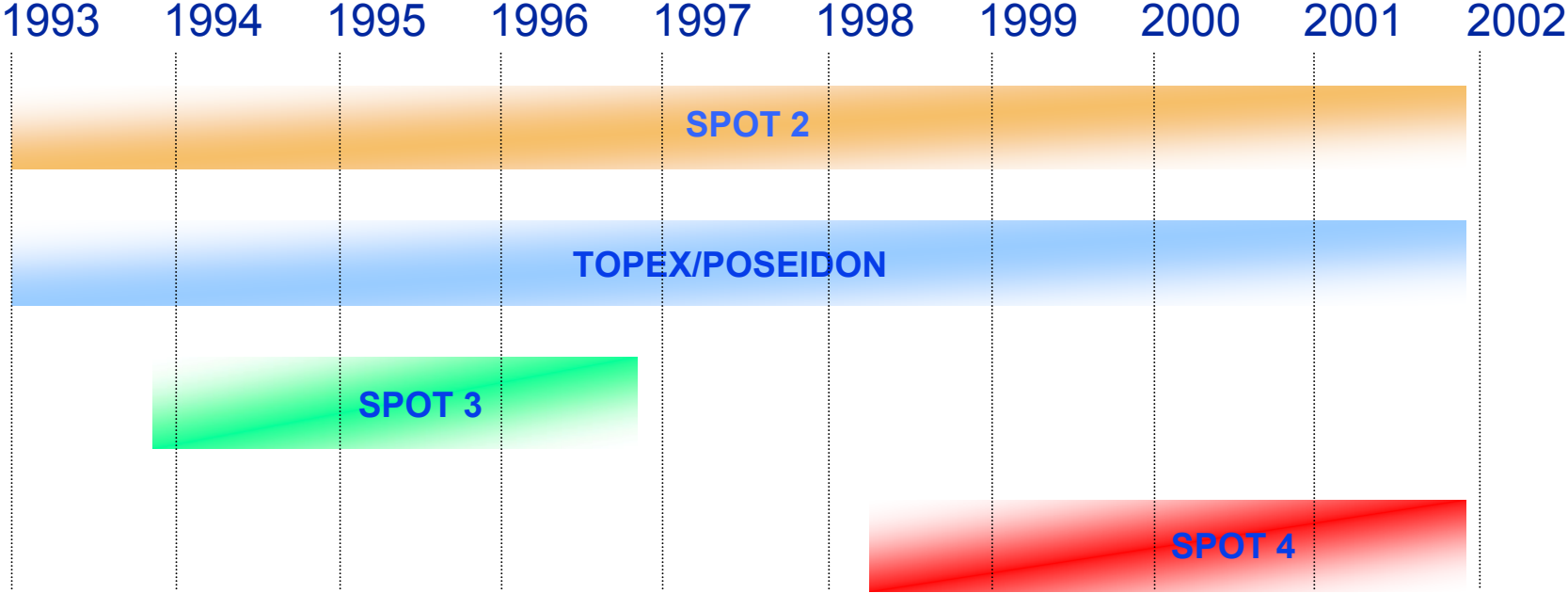
Previous results: DORIS/NUVEL1
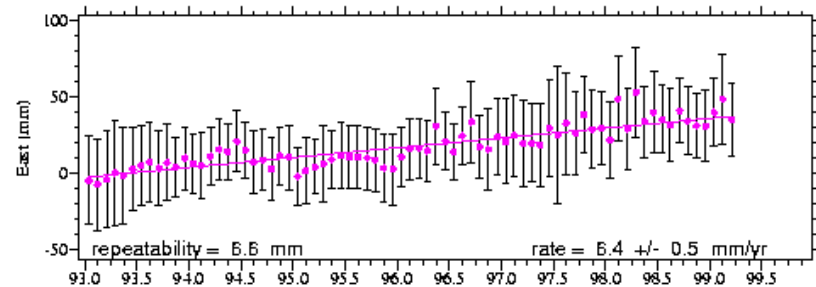

Crétaux et al., 1998
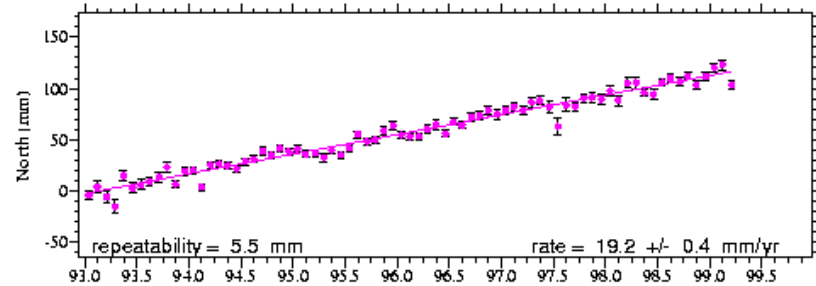
Crétaux et al., 1998

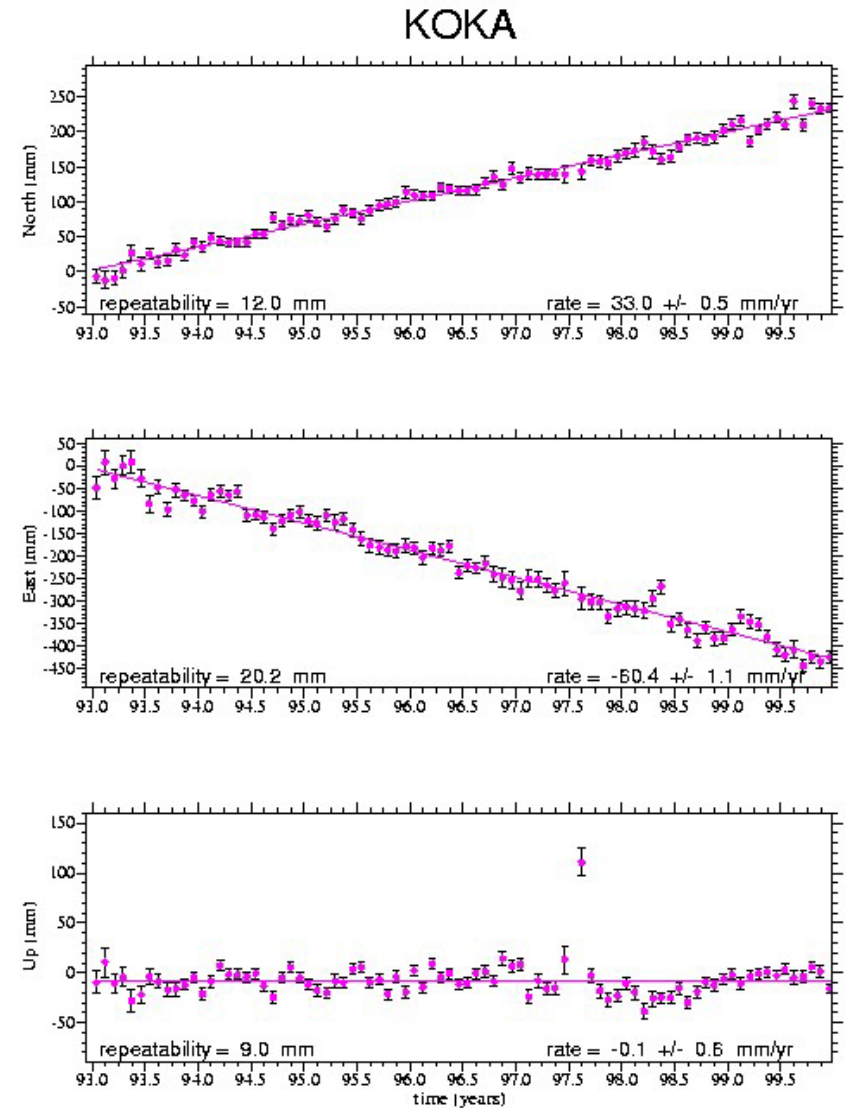# Analysed Data

Coordinate time series
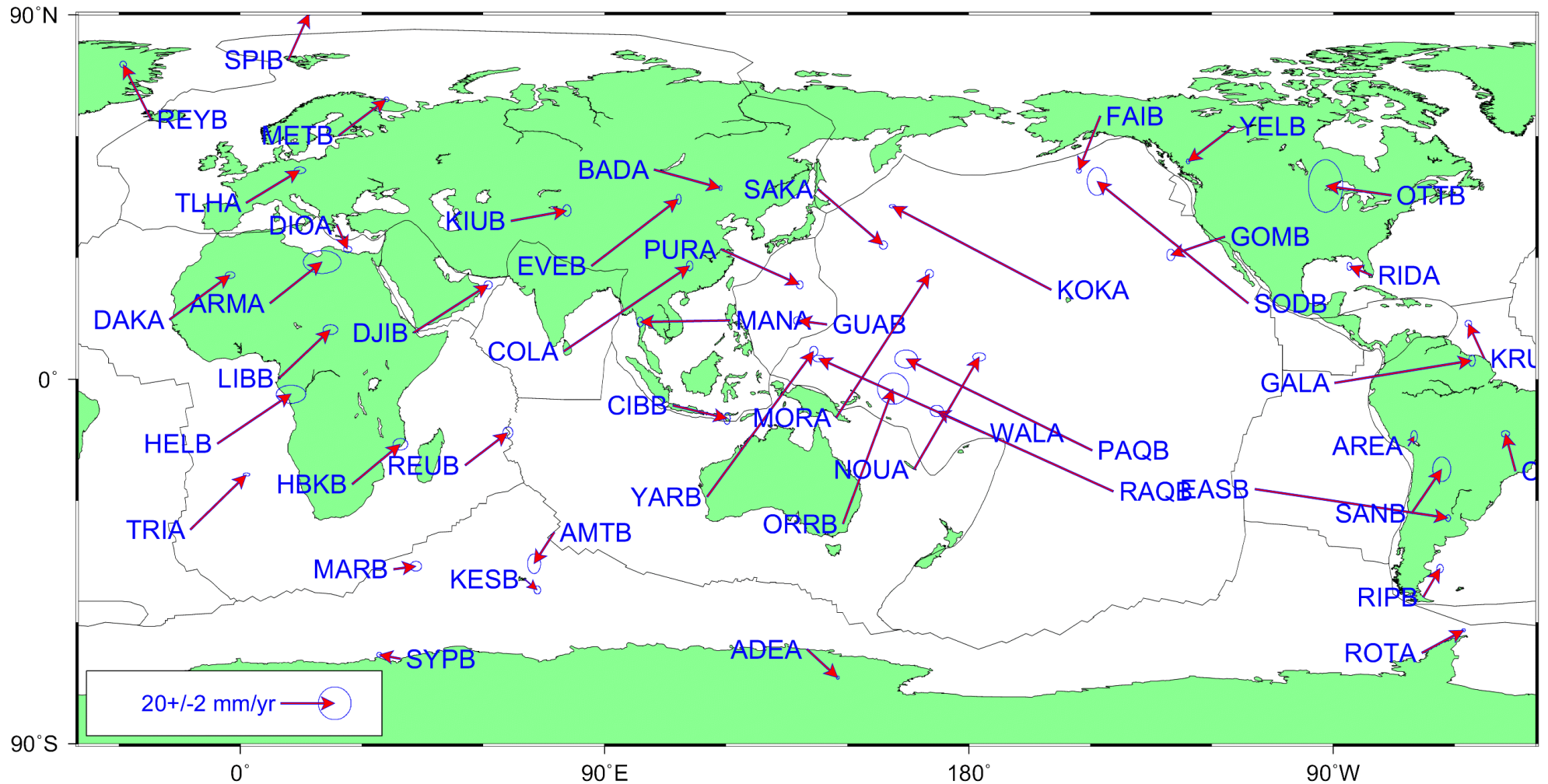
Ny-Ålesund - Doris Station
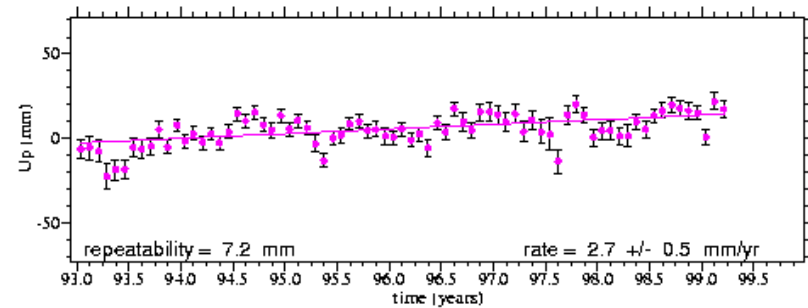
Coordinate time series

Kokee Park (Kaui) - Doris Station

DORIS absolute velocities

Rotation vectors

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

Velocity of a station on a plate: **v=Ωxr**

Ω : rotation vector of the plate

r, **v** : position and velocity vectors of the station

Observations equations:

$$V_\varphi = R(\omega_x \sin \lambda - \omega_y \cos \lambda)$$

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

Unknows:

$$\Omega_p = \sqrt{\omega_x^2 + \omega_x^2 + \omega_x^2}$$

$$\varphi_p = \sin^{-1} \frac{\omega_z}{\Omega_p}$$

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

ω_x, ω_y, ω_z : plate angular velocity coordinates

ϕ_p, λ_p : plate pole coordinates

Ω_p angular velocity magnitude

R: Earth's mean radius

φ, λ : station latitude and longitude

V_φ, V_λ : station north and east velocity

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
GPS [from M. Heflin, Jet Propulsion Laboratory] data from 1991 to April 2001.

➢sites assigned to plates on the basis of geological observations

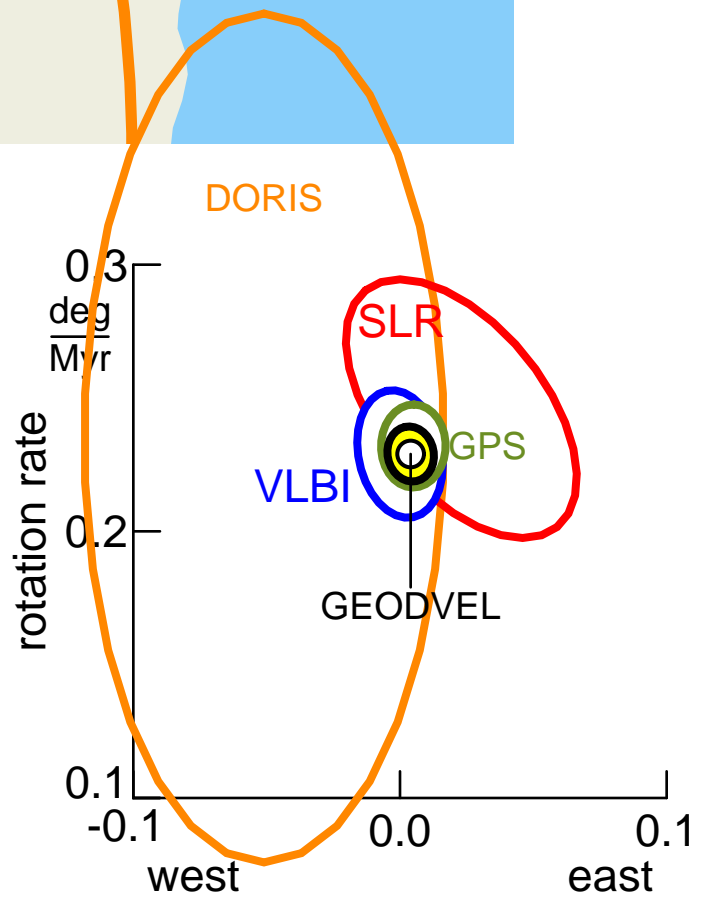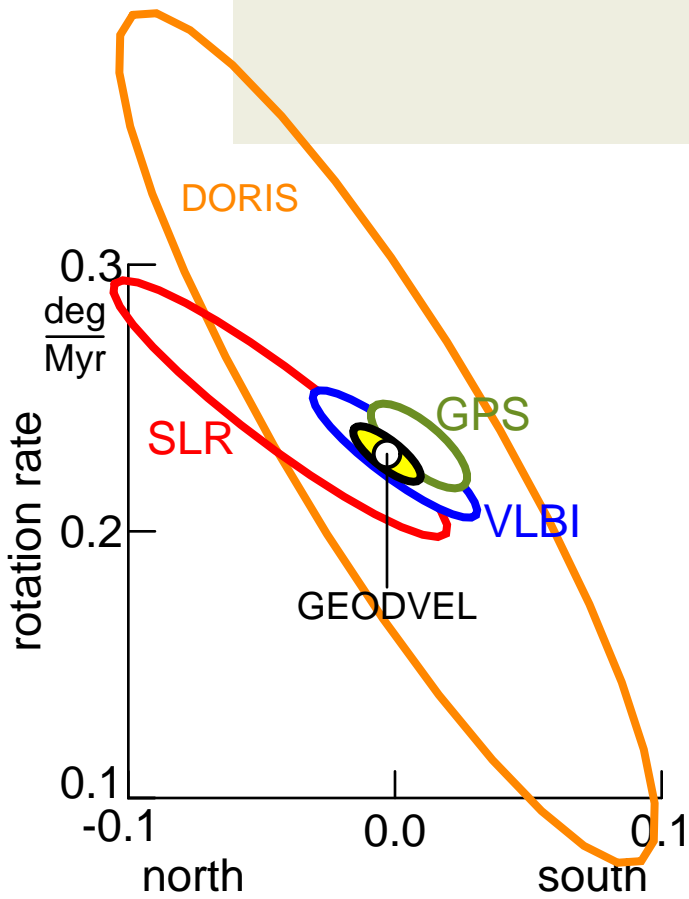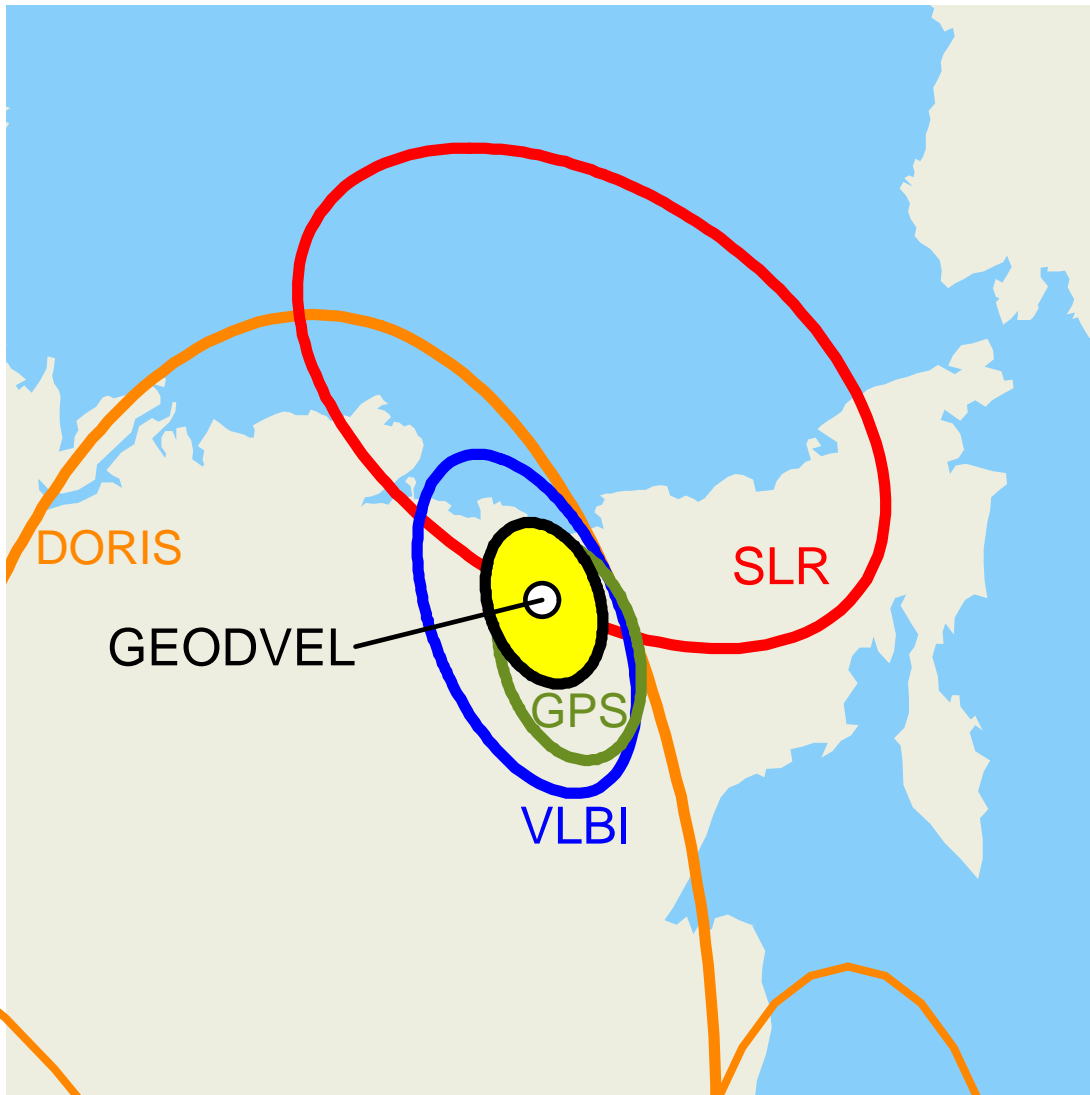# Vector differences between the DORIS and GEODVEL velocities

	Vector difference (deg/Myr)	Chi-square
EURA-NOAM	0.0548	3.9
NOAM-PCFC	0.0425	0.9
PCFC-ANTA	0.0643	15.7

Eurasia plate: TLSA, SPIA, META
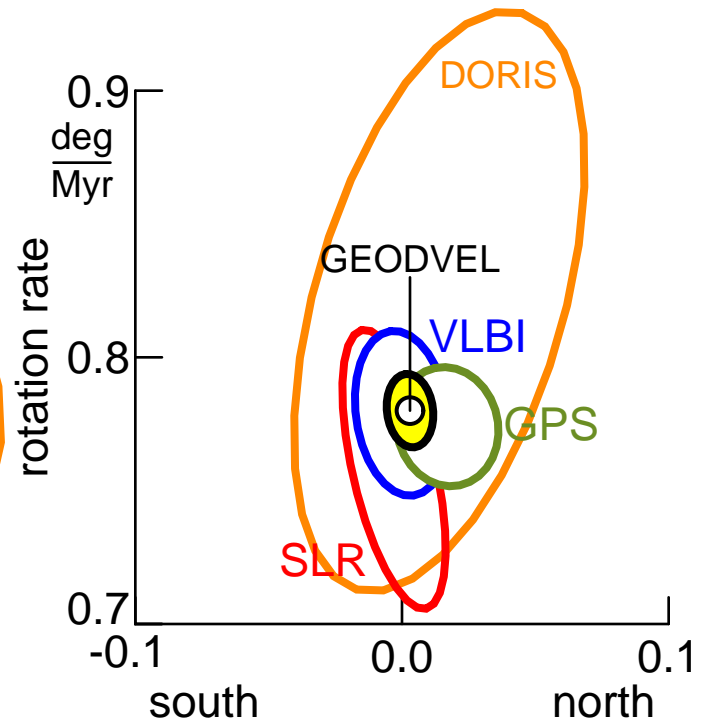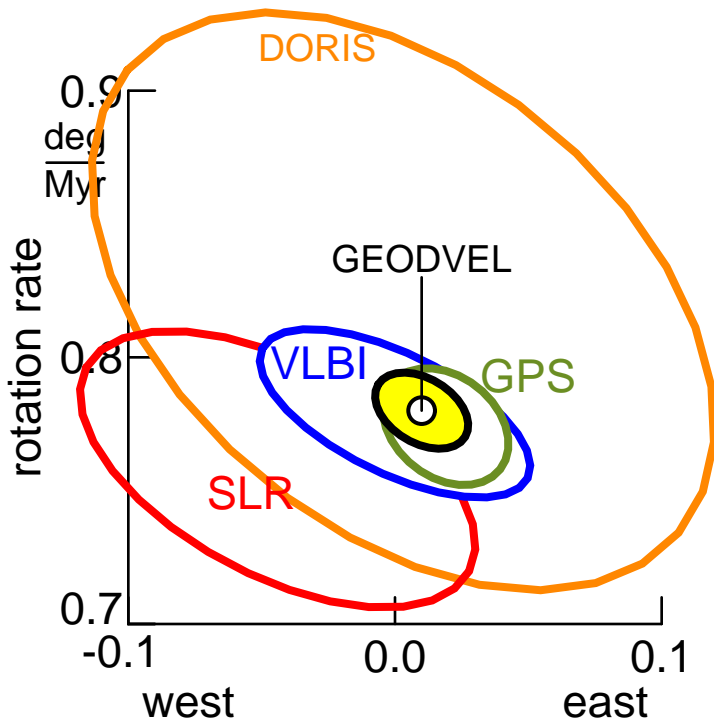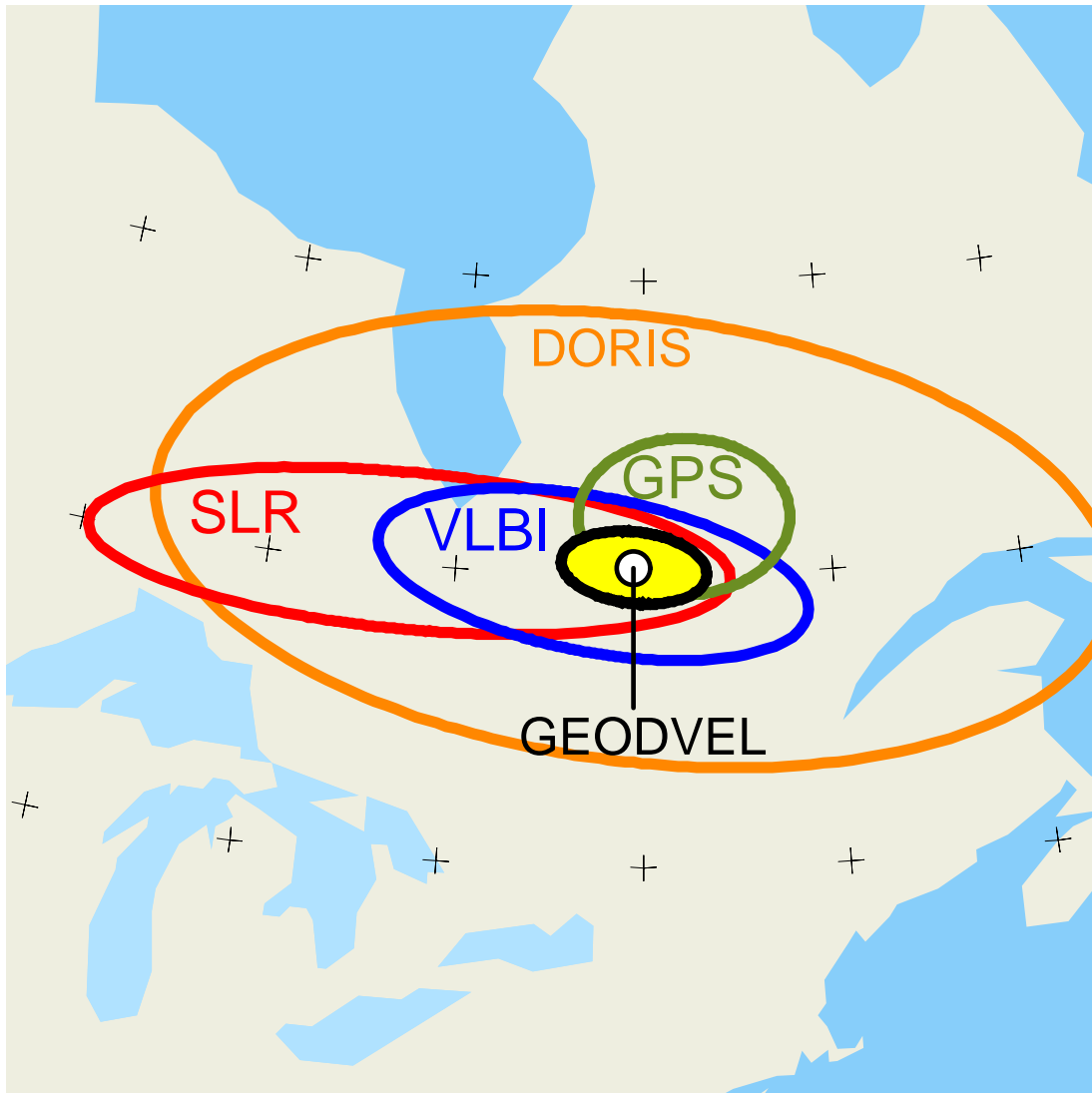North America plate: YELA, RIDA, OTTA
Pacific plate: WALA, KOKA, PAQB, RAQB

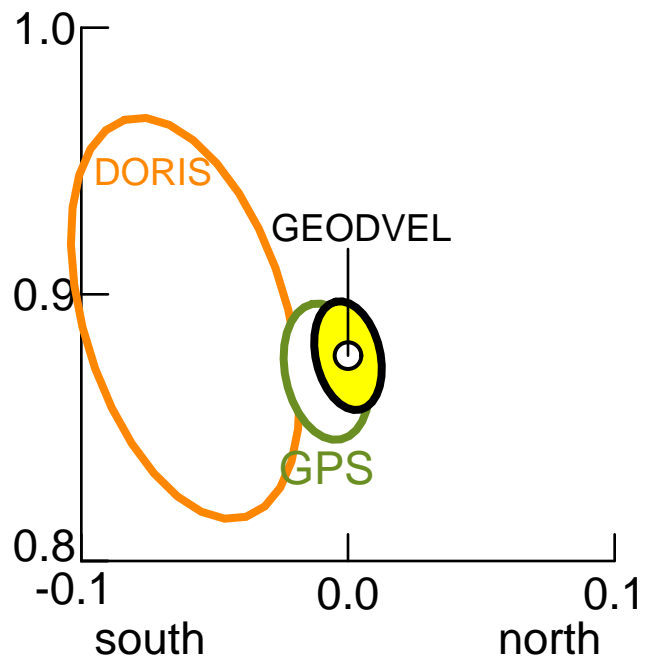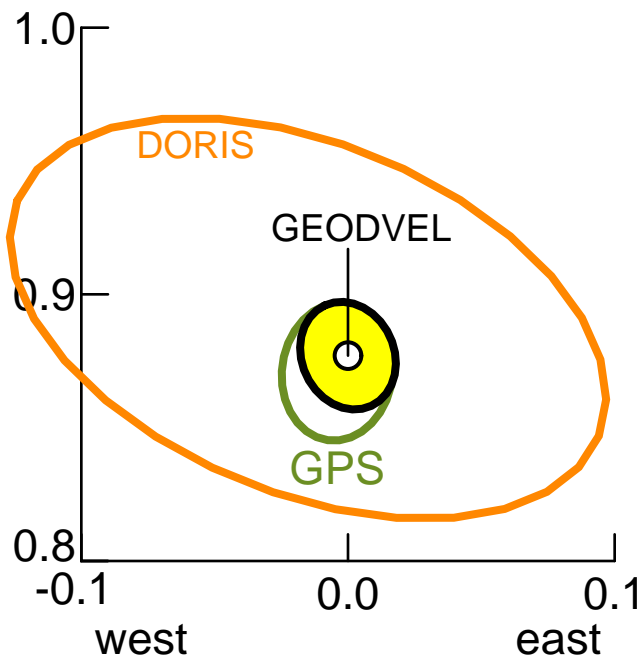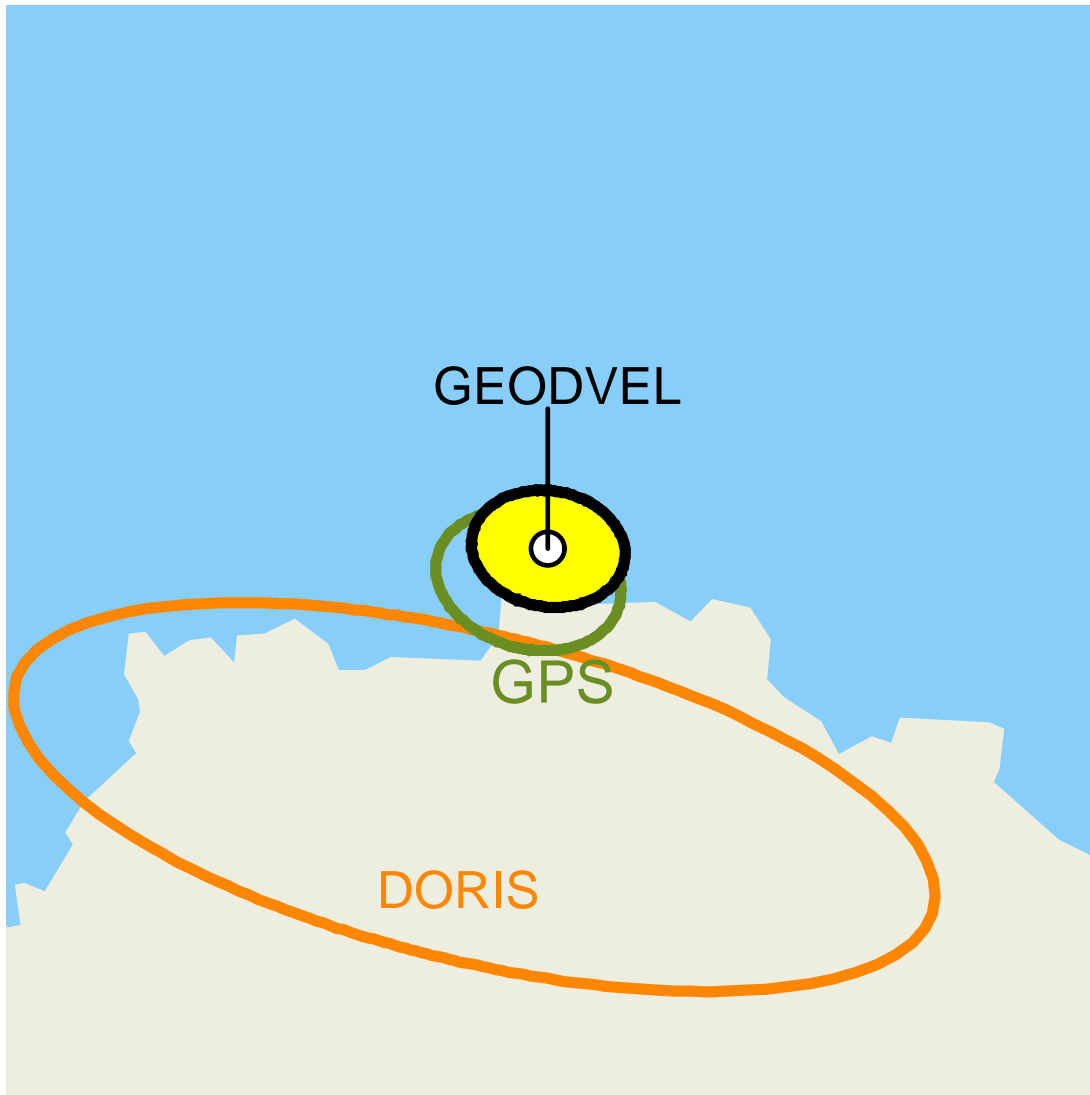# Eurasia–North America

North America–Pacific

Pacific–Antarctica

GEODVEL

GPS

DORIS

1.0

0.9

0.8

-0.1   0.0   0.1
west   east

1.0

0.9

0.8

-0.1   0.0   0.1
south   north

DORIS

GEODVEL

GPS

DORIS

GEODVEL

GPS

Several groups are using DORIS results for combination with other techniques

- Argus (JPL): including DORIS in GEODVEL (in process)
- Altamimi (IGN): plate model from ITRF2000 (in press)
- 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

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