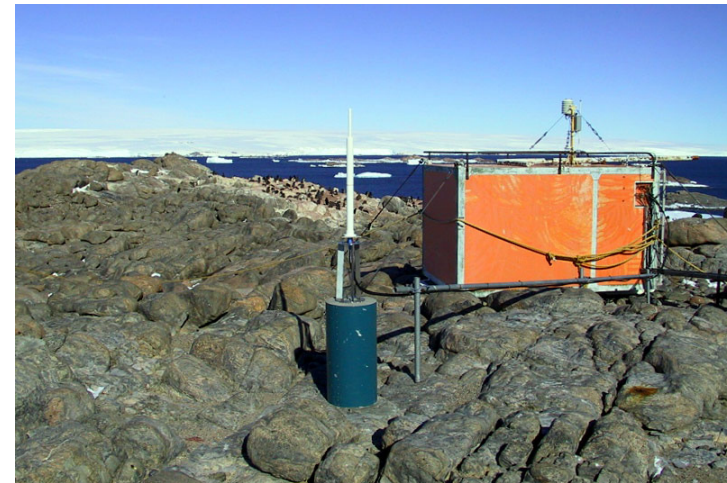


Le système spatial DORIS

Pascal Willis (IGN/IPGP)



Rikitea, Polynésie



Terre Adélie, Antarctique

Résumé

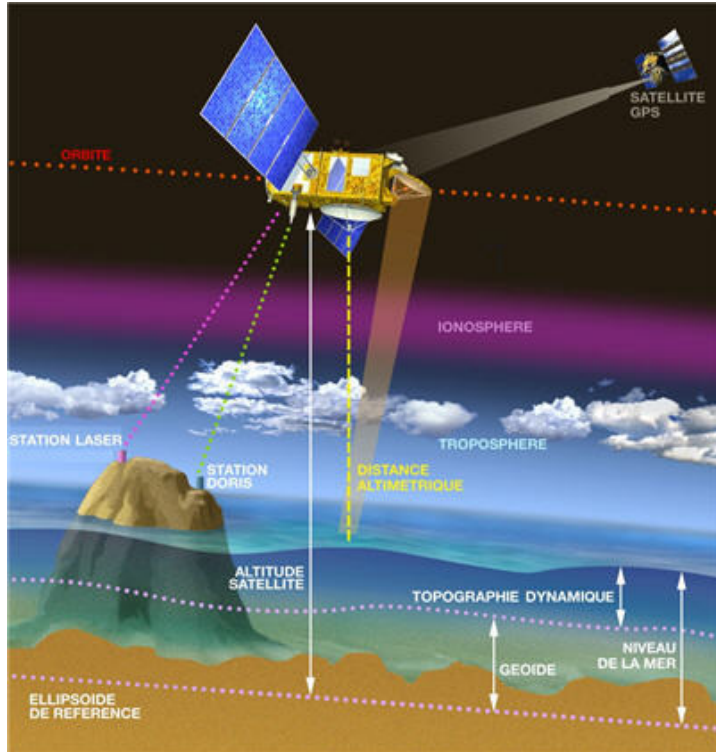
- ➔ **Le système DORIS: Les satellites, le réseau sol**
- ➔ **Orbitographie des satellites**
- ➔ **Géodésie spatiale**
 - Localisation précise, études méthodologiques
- ➔ **Géophysique**
 - Ex: Tectonique des plaques, volcanologie, atmosphère
- ➔ **Conclusions**

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Antenne DORIS (satellite)

Les satellites DORIS

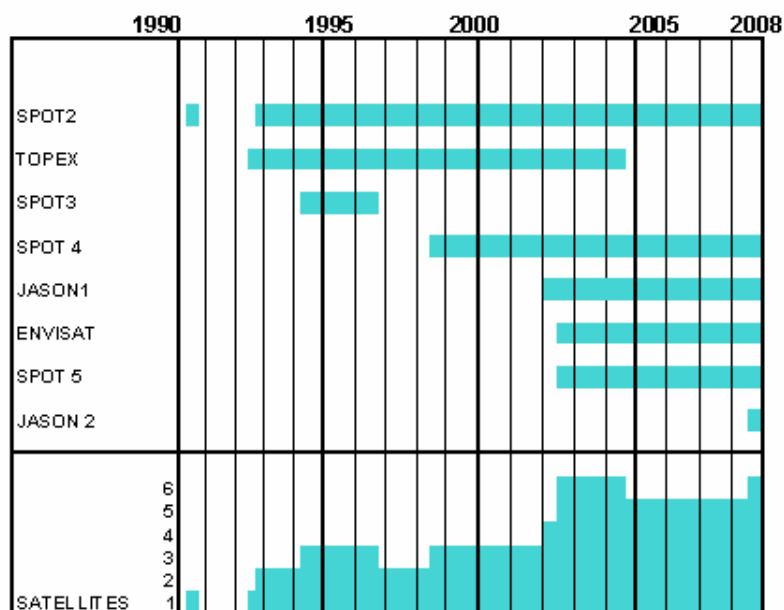


Satellites altimétriques
T/P, Jason1&2, ENVISAT



Satellites de télédétection
SPOT2, SPOT3, SPOT4,
SPOT5

Données DORIS au CDDIS et à l'IGN

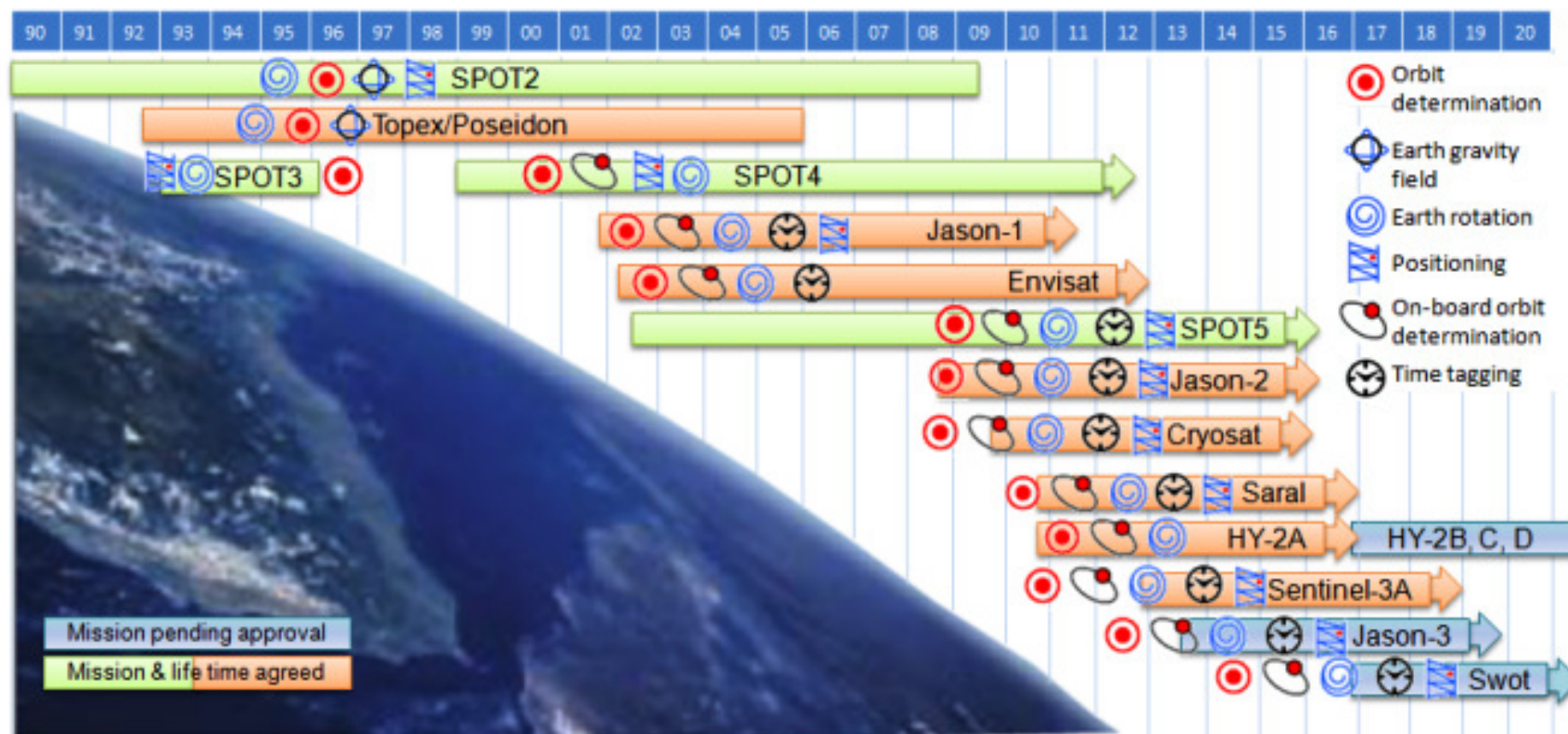


Données DORIS depuis
1990 (1993)

4 satellites après 2002.4
= meilleurs résultats

Willis et al., *Adv. Space Res.*, 2010

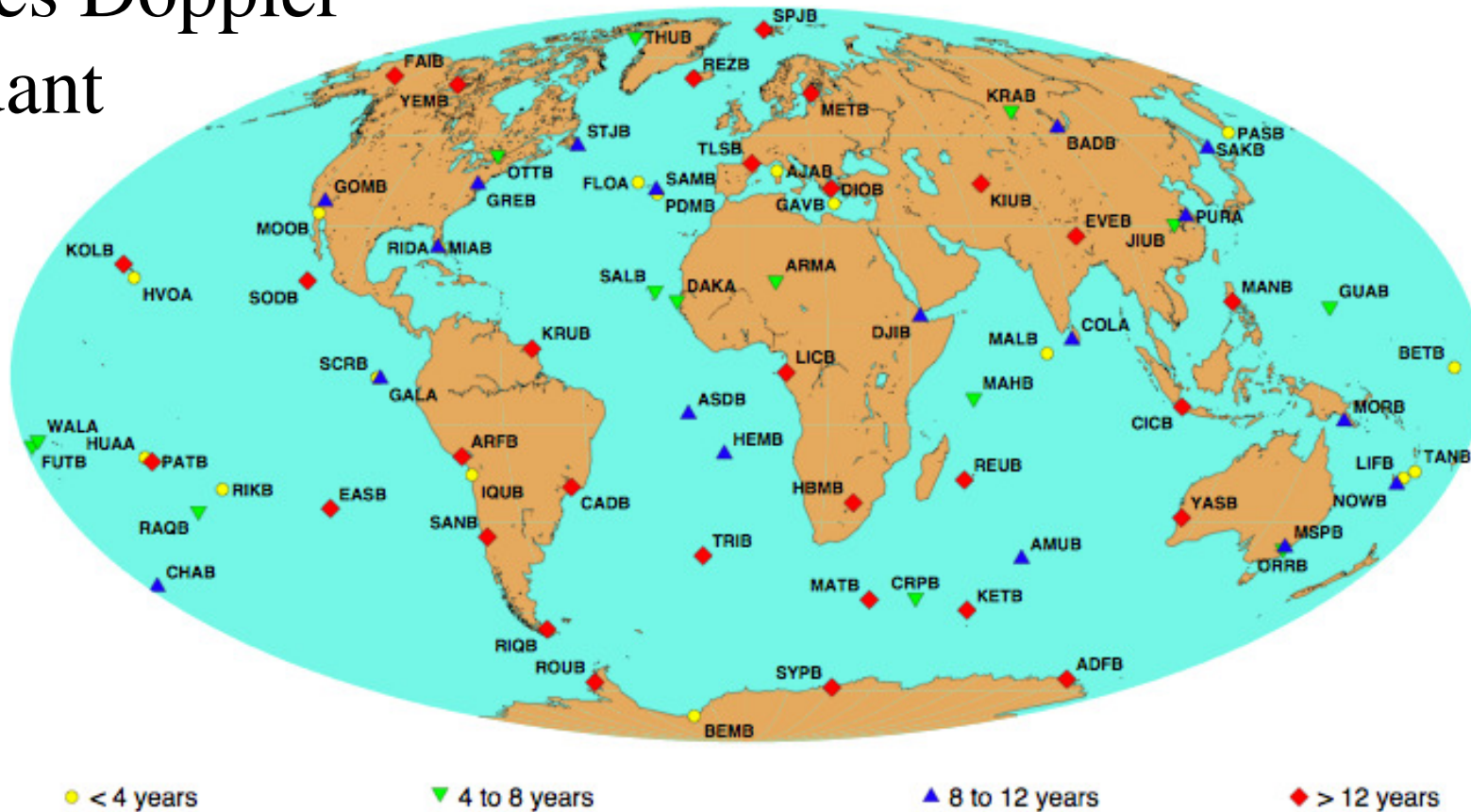
Futurs satellites DORIS



(Source CNES)
4-8 satellites DORIS jusqu'en 2016

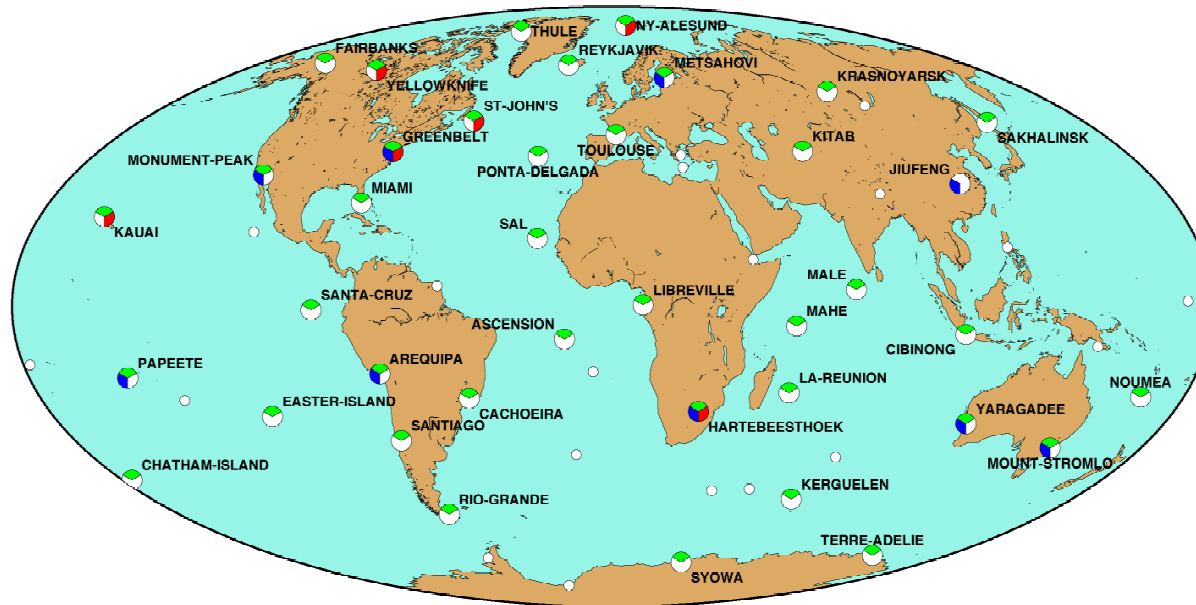
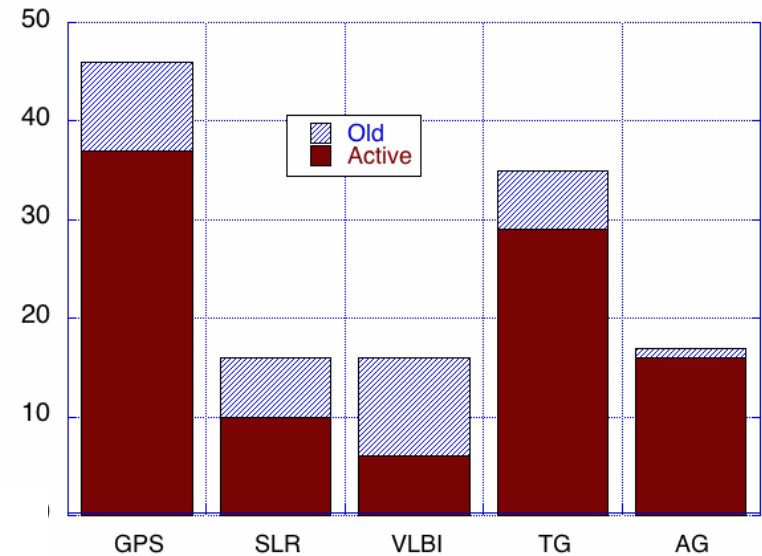
Observations DORIS depuis 1993.0

Mesures Doppler ascendant

Willis et al., *Adv. Space Res.*, 2010

Colocations DORIS

DORIS stations



● GPS (IGS)

● SLR

● VLBI

○ No active co-location < 10 km

GPS

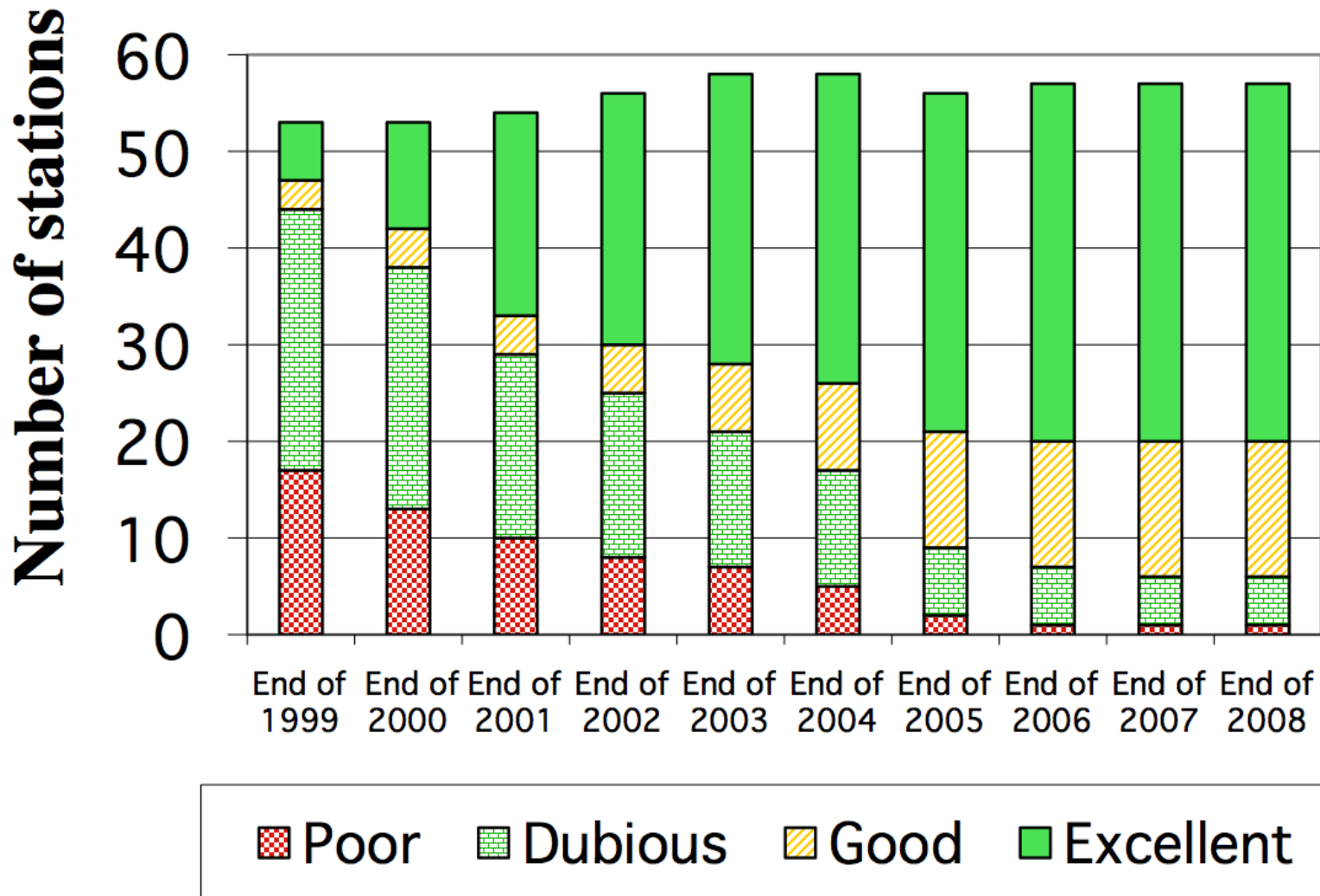
SLR= télémétrie laser

VLBI

TG = marégraphes

AG= gravimètres absolus

Rénovation du réseau DORIS



Fagard, J. Geod., 2006

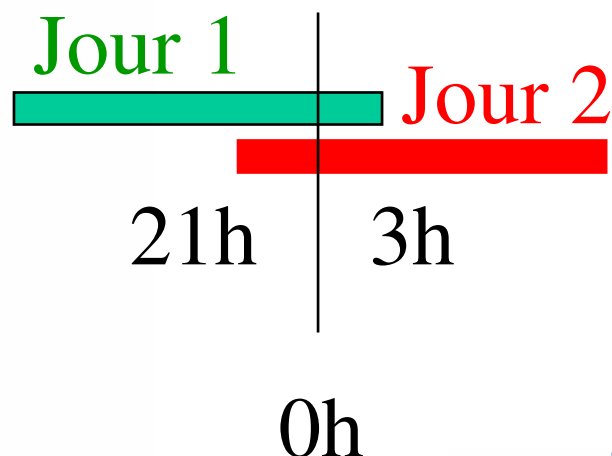
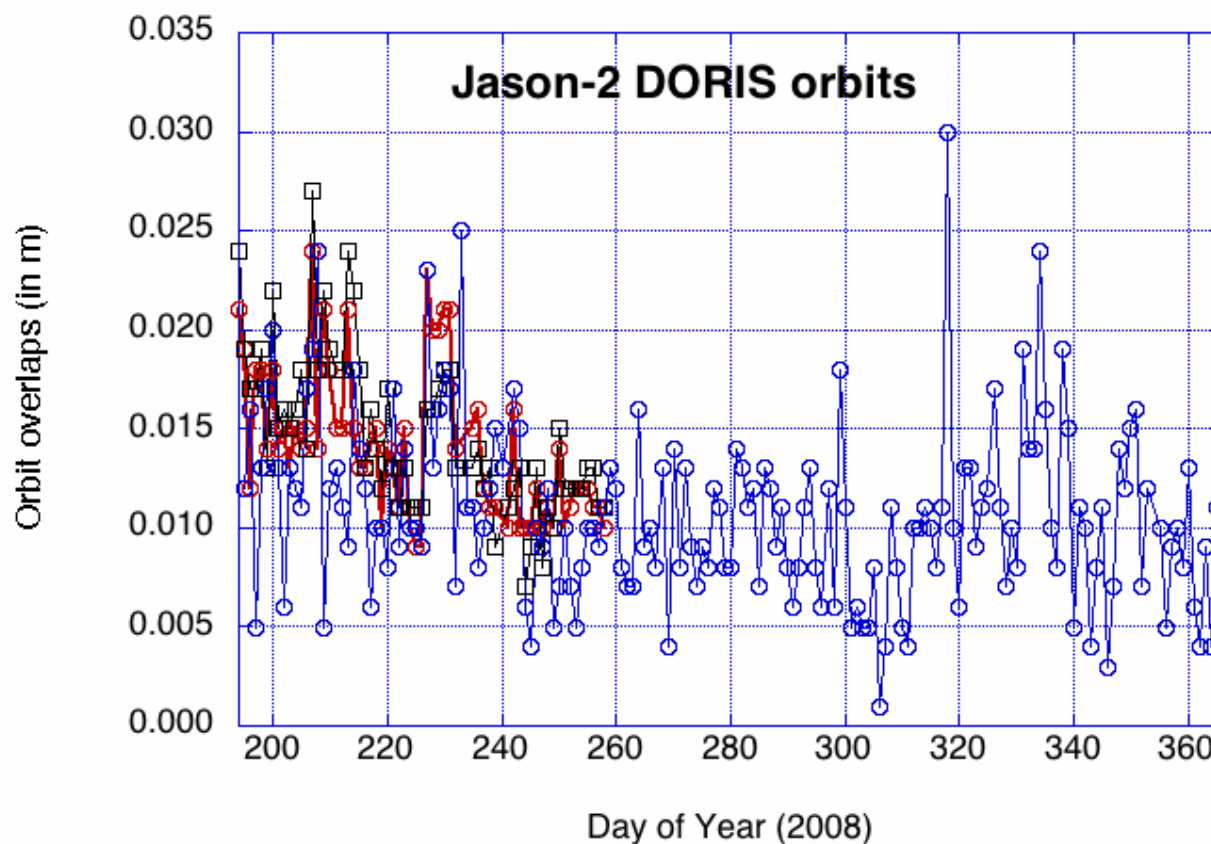
Orbitographie DORIS

- ➔ Résultats récents Jason-2
- ➔ Calculs temps réel - logiciel DIODE/CNES

Jason-2 / orbites DORIS vs GPS

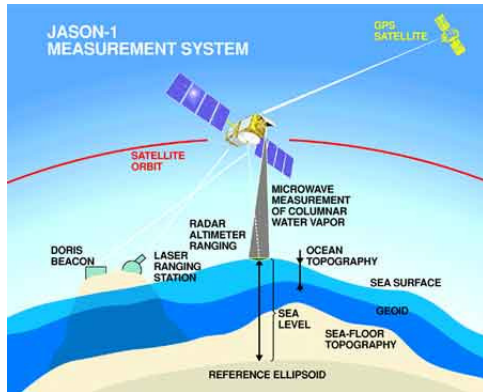
- DORIS vs GPS dyn (H)
- DORIS vs GPS red dyn (H)
- DORIS vs DORIS (H)

DORIS vs GPS dyn (30 hour overlaps) : **14 mm** (median RMS)
DORIS vs GPS red dyn (30 hours overlaps) : **13.5 mm** (median RMS)
DORIS vs DORIS (6 hour overlaps): **10 mm**



Orbitographie temps réel

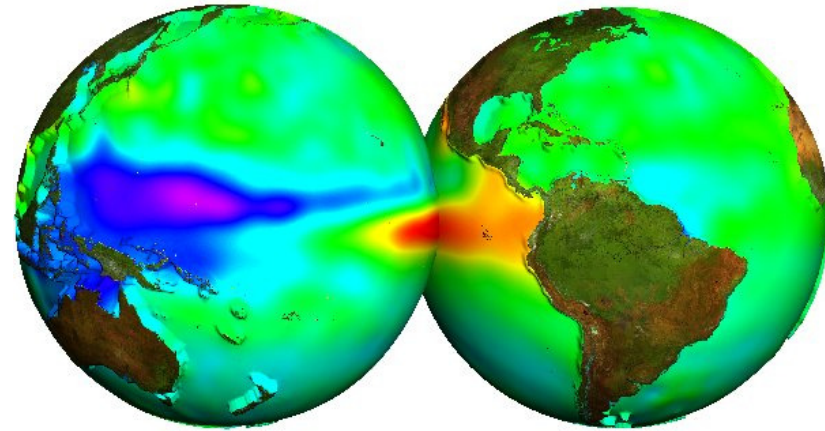
QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.



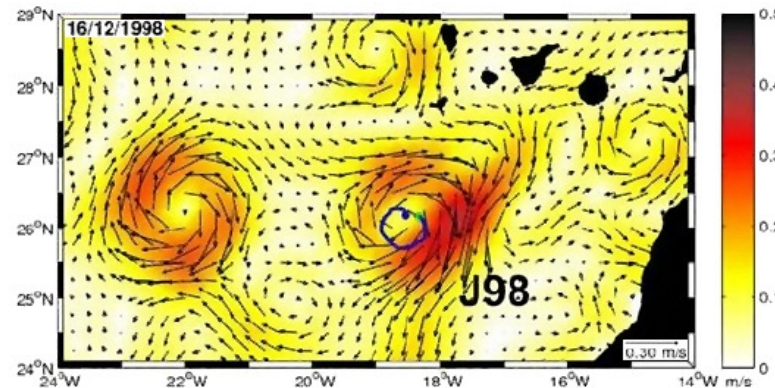
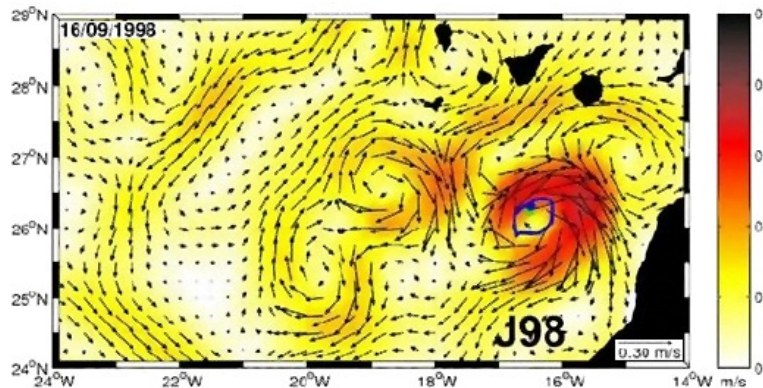
➔ Logiciel DIODE (CNES)

● A bord du satellite:

- ◆ Données DORIS
- ◆ Logiciel / calculs
- ◆ Résultats: orbite / altitude



El Nino, source AVISO

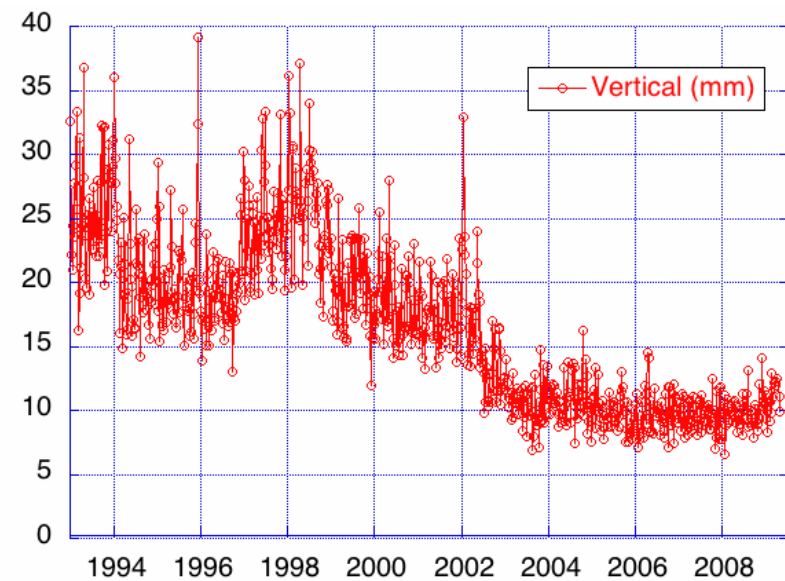
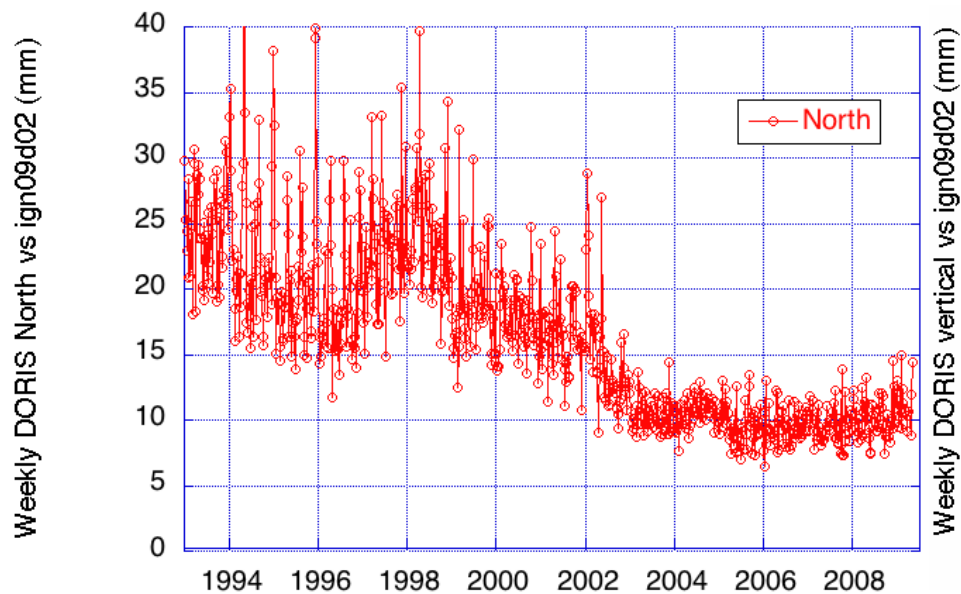


Source AVISO

Géodésie DORIS

- Performances actuelles
- Améliorations récentes (études méthodologiques)

Nouveaux résultats DORIS (préparation pour l'ITRF2008)



Position de station: 10 mm pour 1 semaine d'observation
(après 2002.4, en rajoutant SPOT-5 + Envisat)

Mouvements du géocentre

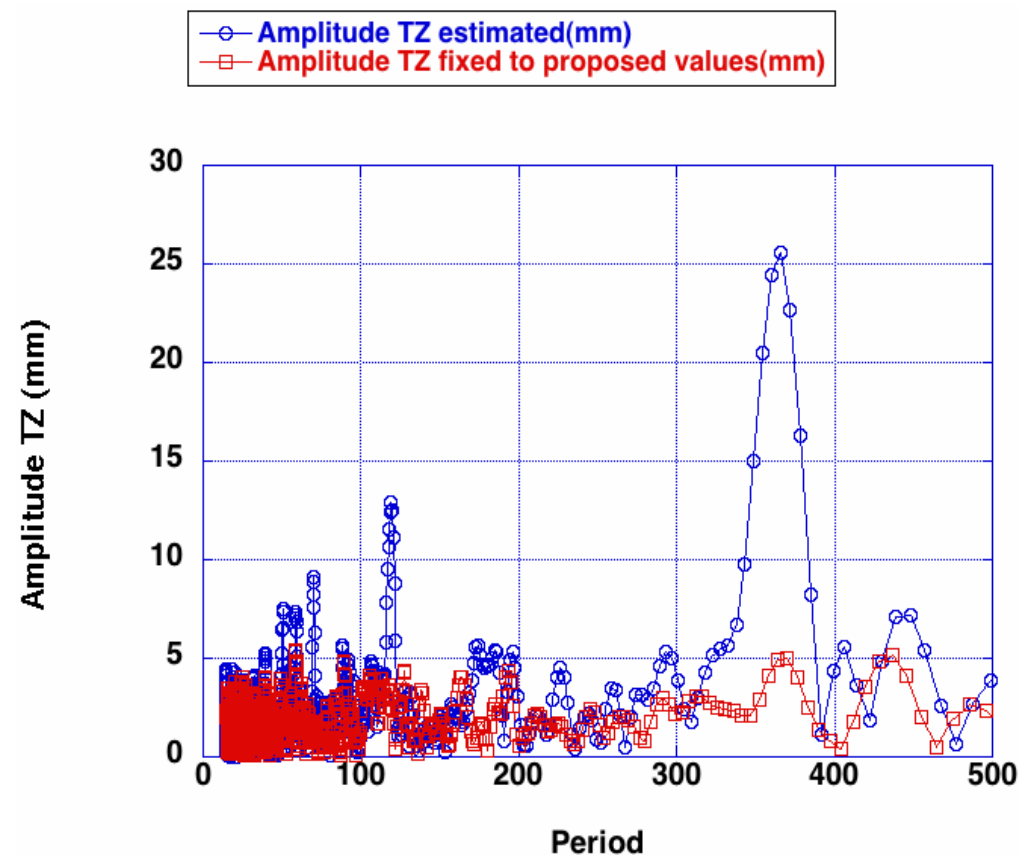
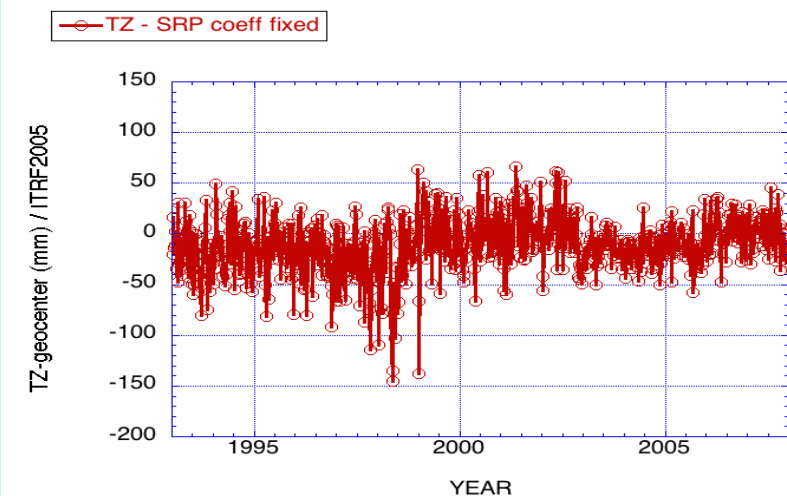
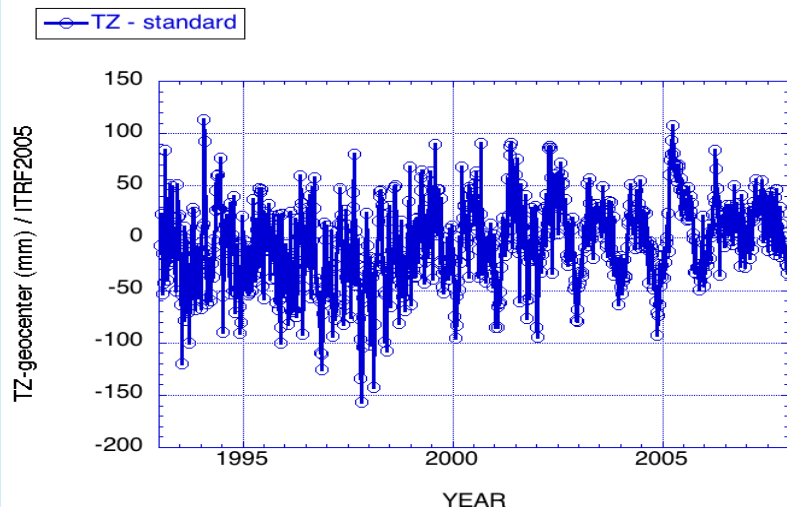


Déplacements des masses
dans le système:

Terre-Atmosphère-Océans

Typiquement 2-5 mm
(annuel)

Pression de radiation solaire et géocentre

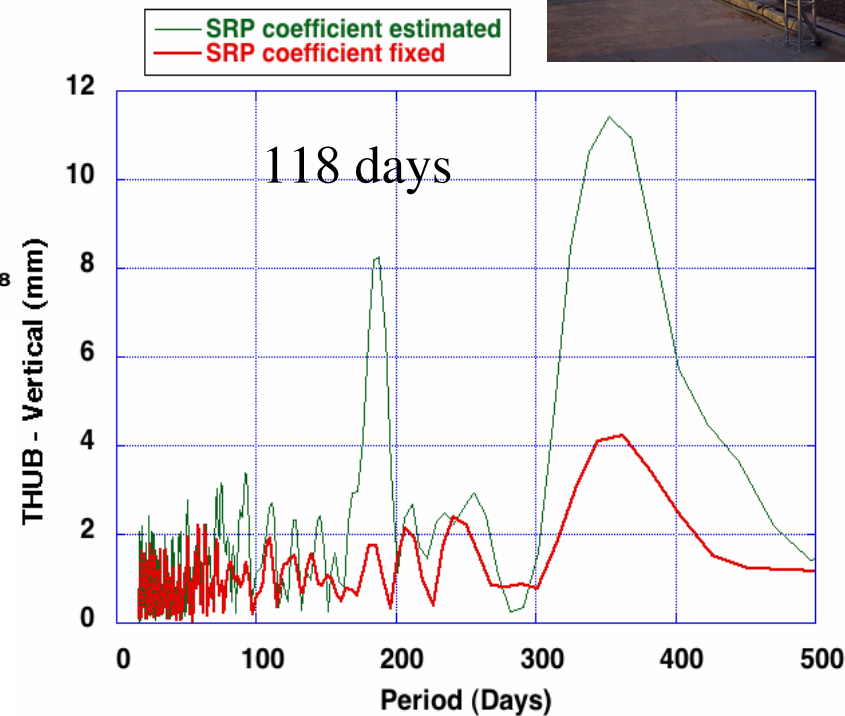
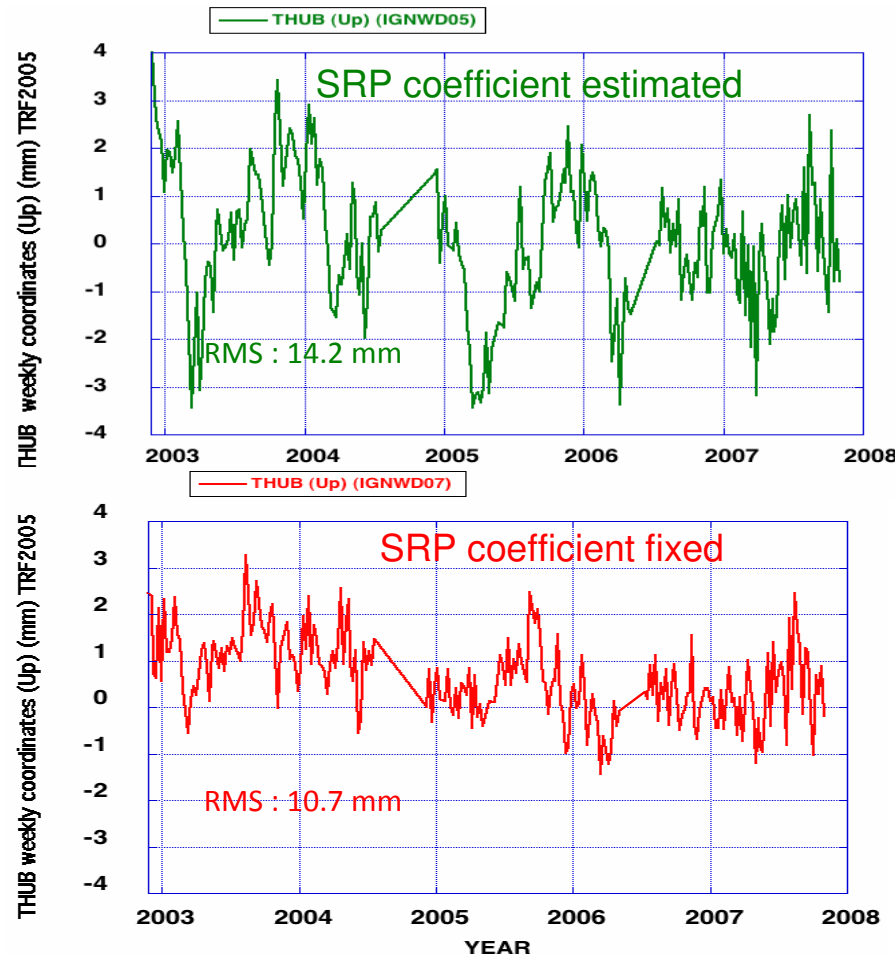


Gobinddass et al., J. Geod., 2009

DORIS Vertical time series THUB, (Greenland)

QuickTime™ and a
TIFF (Uncompressed) decompresso
are needed to see this picture.

Problème à 118-jours : détection par Williams and Willis, 2006; Le Bail and al., 2006; Feissel-Vernier and al., 2007; Almavict and al., 2009



SRP fixé → 25% d'amélioration THUB
(en vertical)

Les erreurs à 118 jours et à 1 an diminuent de manière significative

Gobinddass et al., Adv. Space Res., 2009

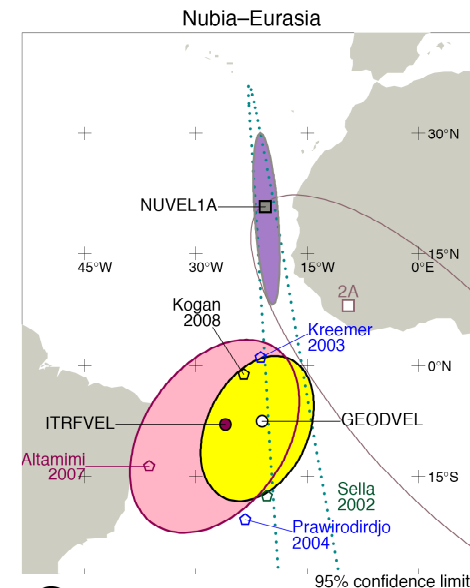
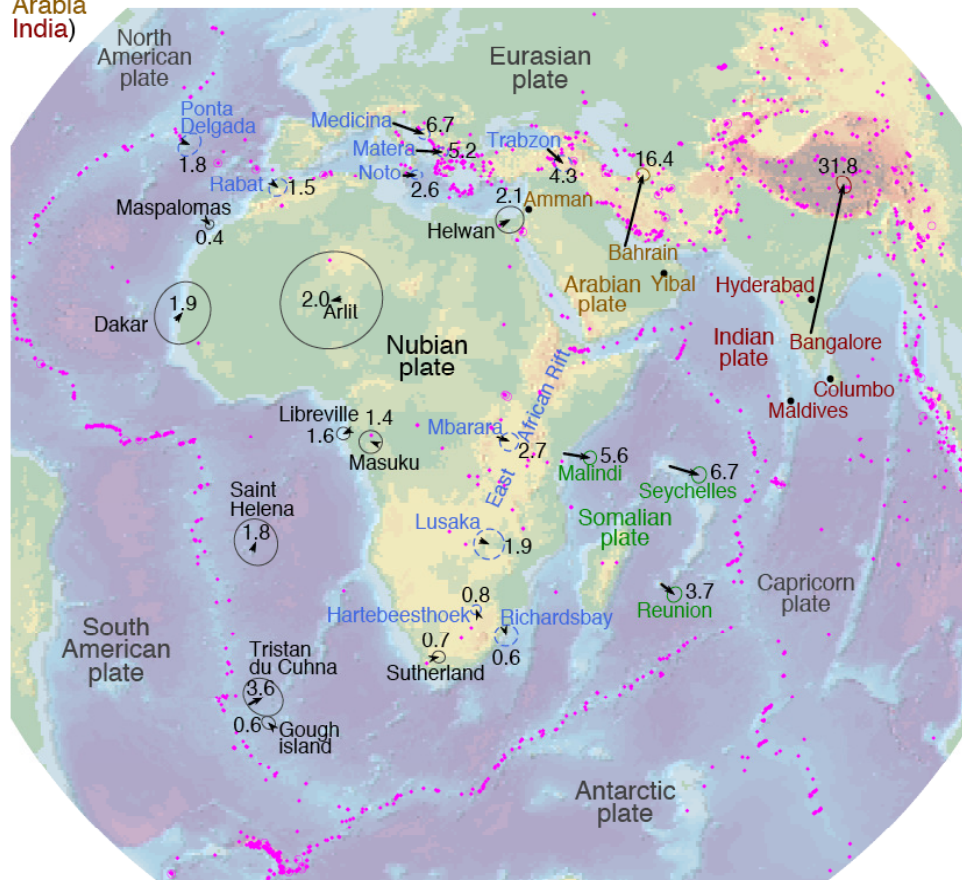
Applications géophysiques

- ➔ **Mouvements des plaques tectoniques**
- ➔ **Marégraphes et niveau des mers**
- ➔ **Station Socorro (volcan)**

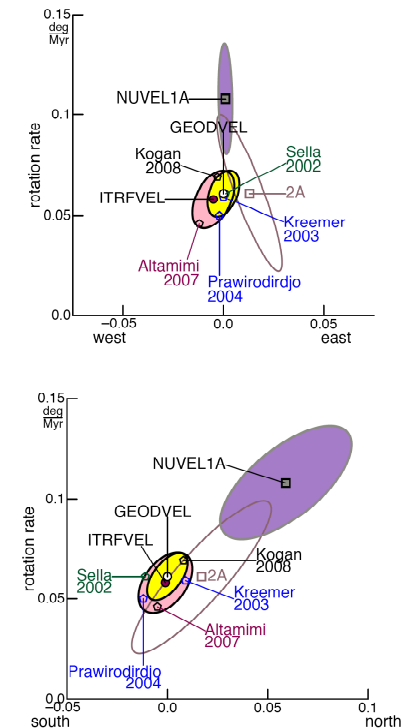
Mouvement des plaques tectoniques

g

Nubia
(Somalia
Arabia
India)



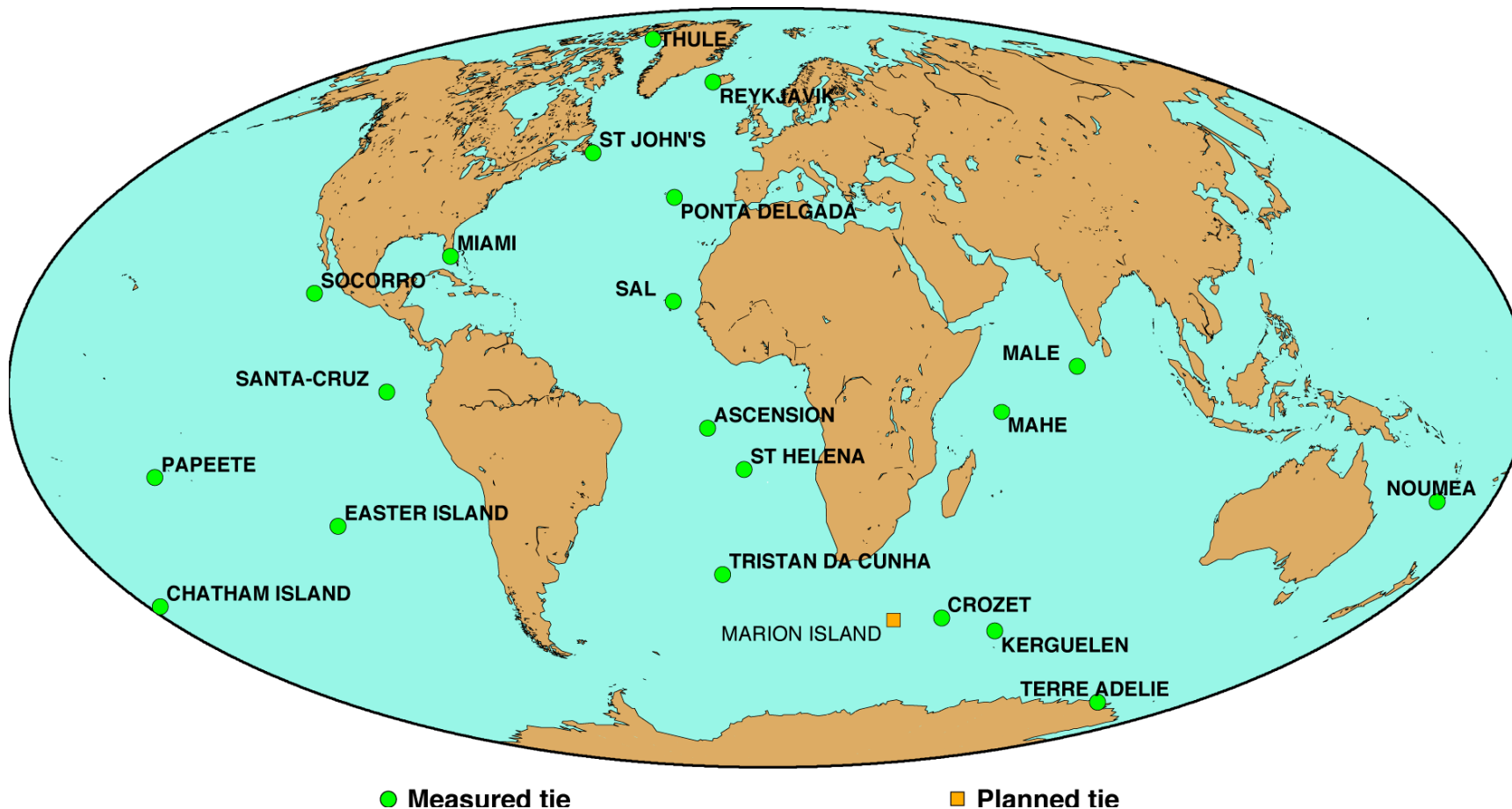
C



Modèle GEODVEL

Argus et al., 2010

DORIS et les marégraphes

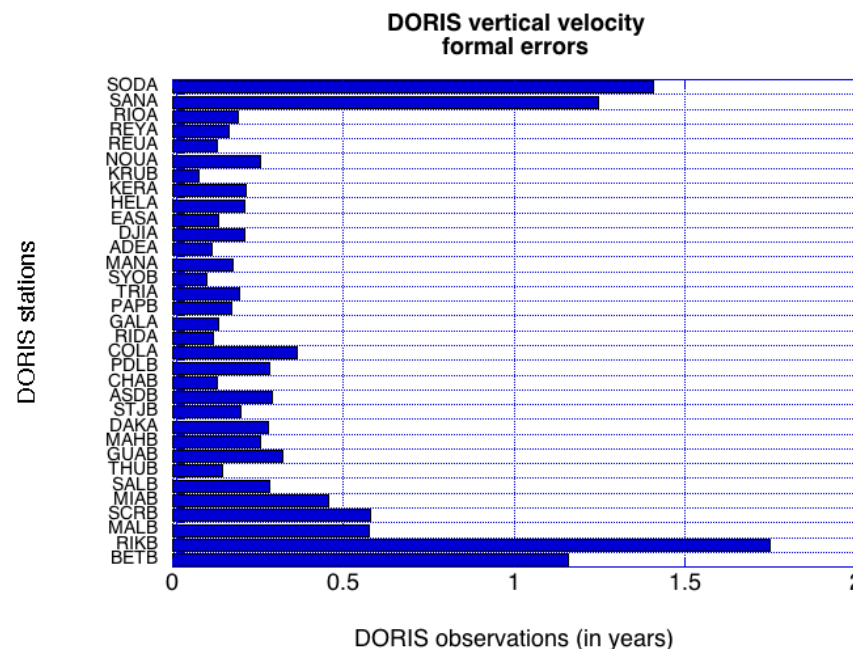
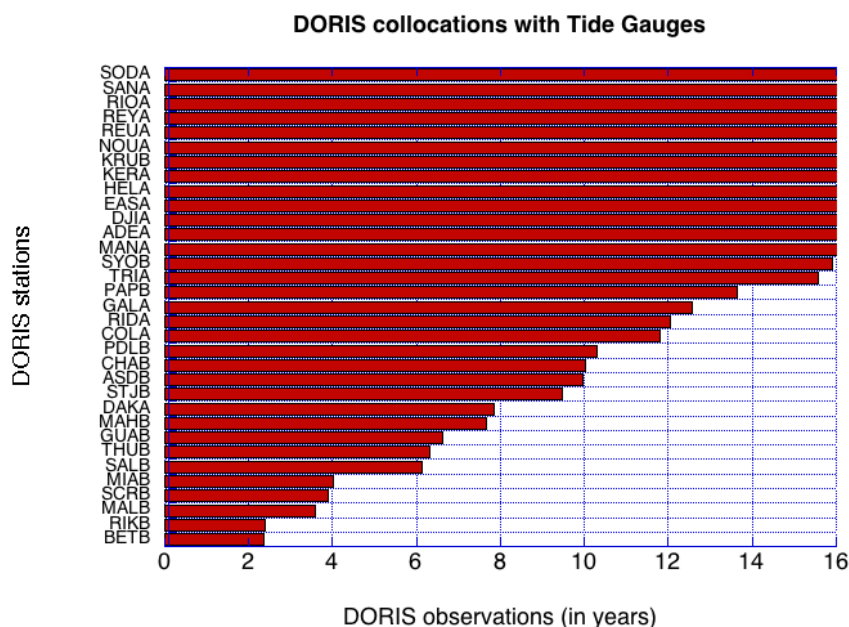


33 in 2009

(as 2006)

Fagard, J. Geod., 2006

DORIS et les marégraphes (erreurs formelles)



typ. 0.1-0.2 mm/an pour 16 ans d'observation

Cas particuliers

Socorro (activité volcanique, Briole et al., 2009)

Santiago (balises DORIS à 20 km)



IDS

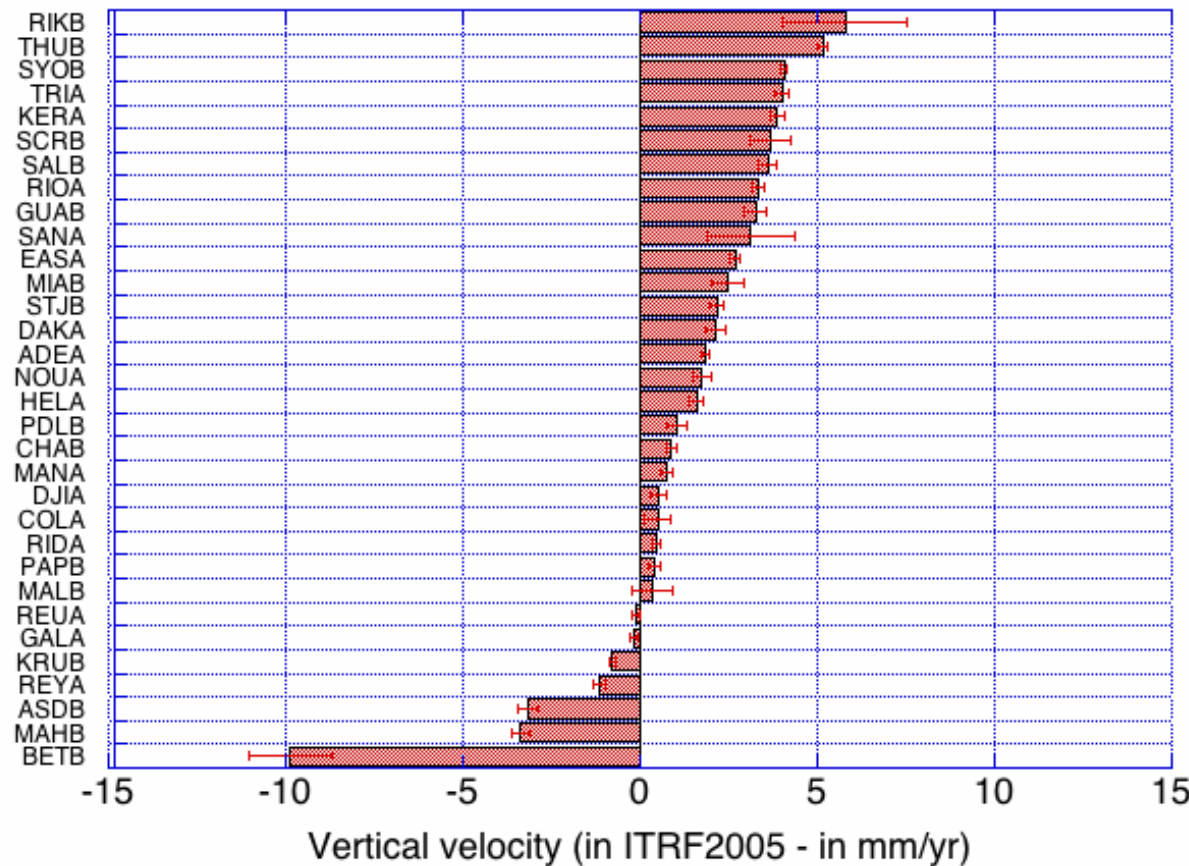
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Vitesse verticales DORIS (ign09d02) et marégraphes

■ DORIS Vertical velocities (ign09d02)

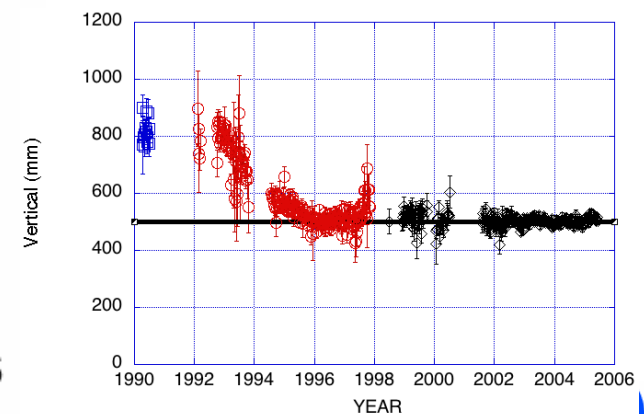
Velocities + formal errors

DORIS Station



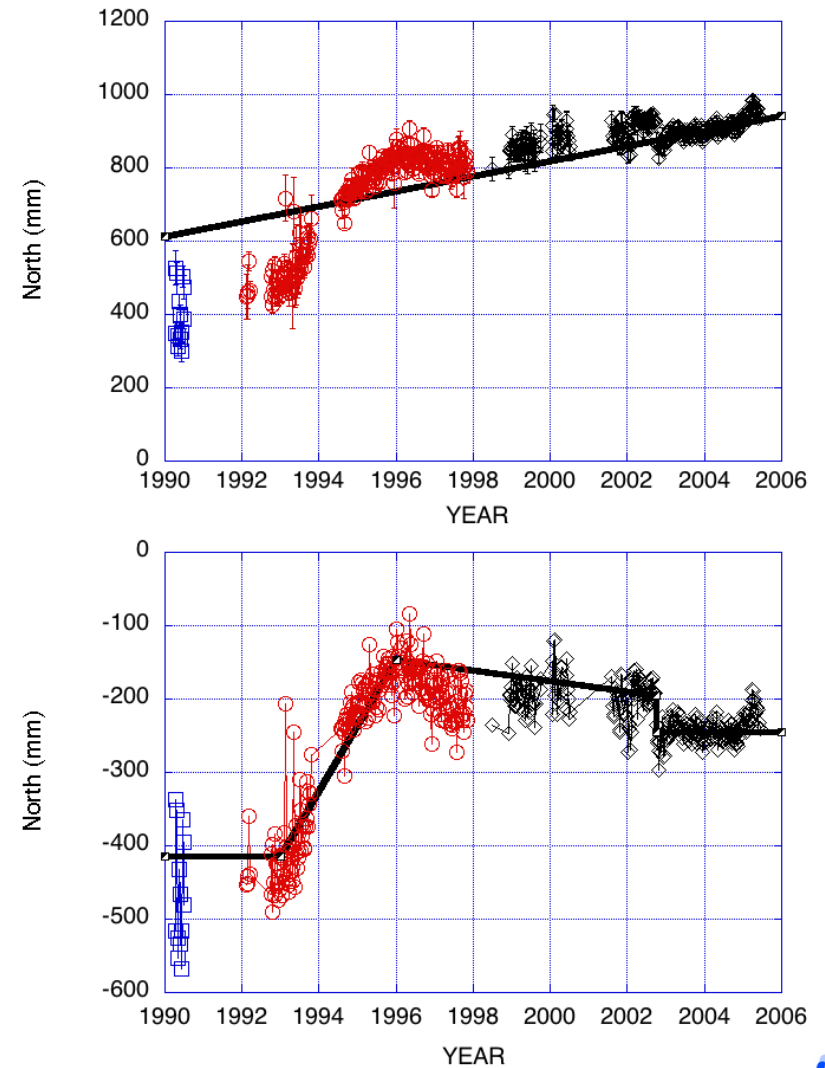
Sauf SODA
= Socorro Island
Cazenave et al., GRL, 1999

Activité volcanique,
cf Briole et al., *GJI*, 2009
-85.8 mm/yr +/- 1.4 mm/yr



Exemple: Socorro Island (1)

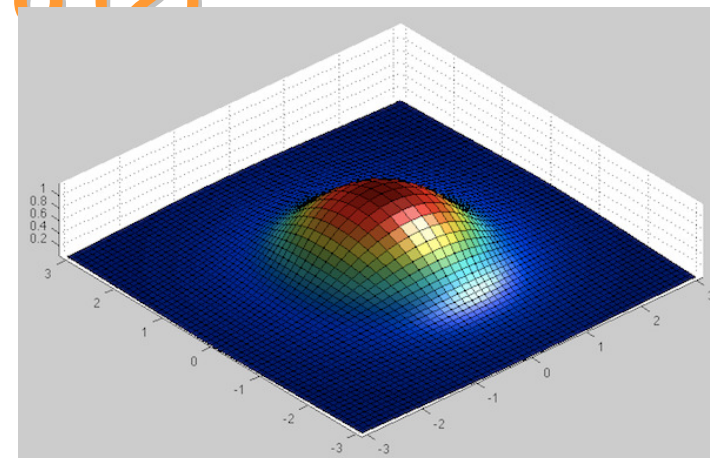
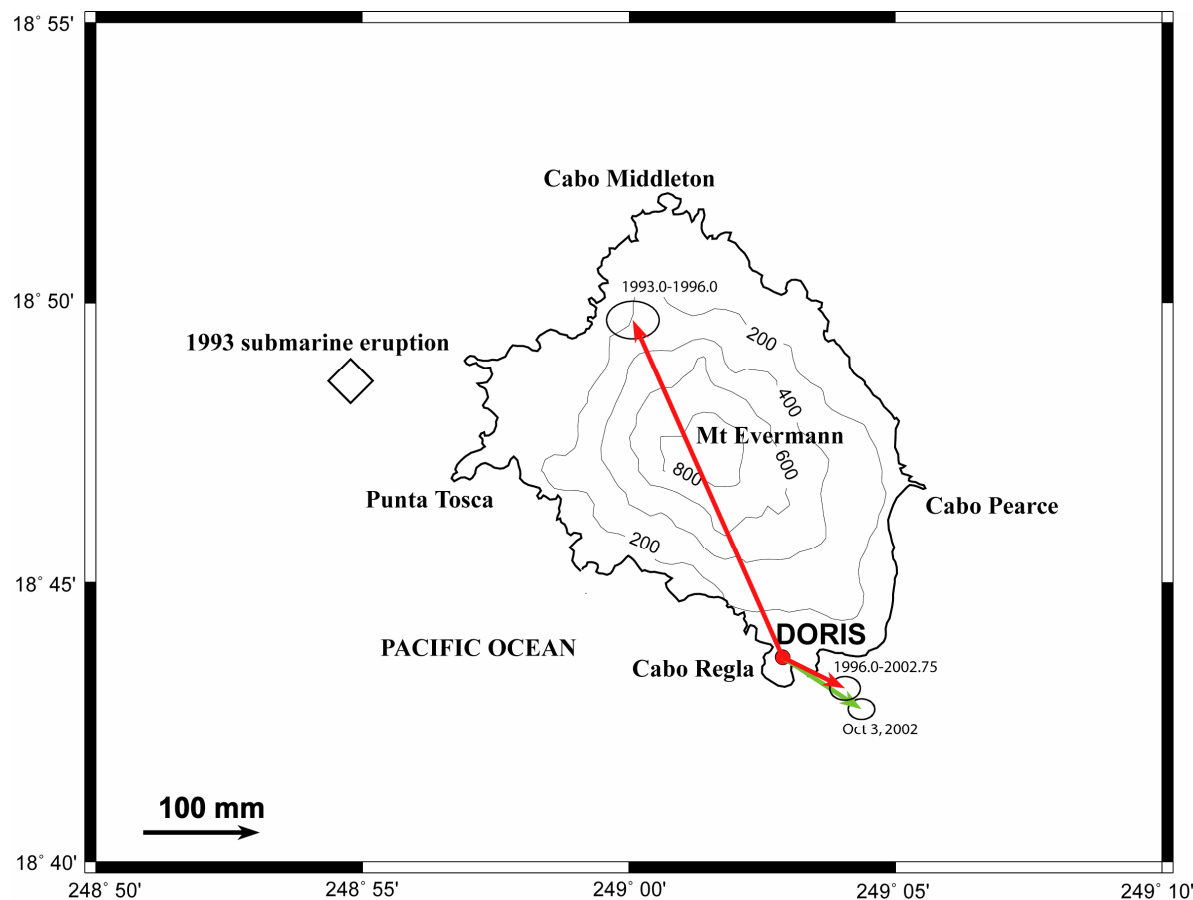
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.



Séries temporelles disponibles sur:

<http://ids-doris.org/html/doris/ids-station-series.php3>

Exemple: Socorro (2)



Modèle de Mogi

Conclusions:

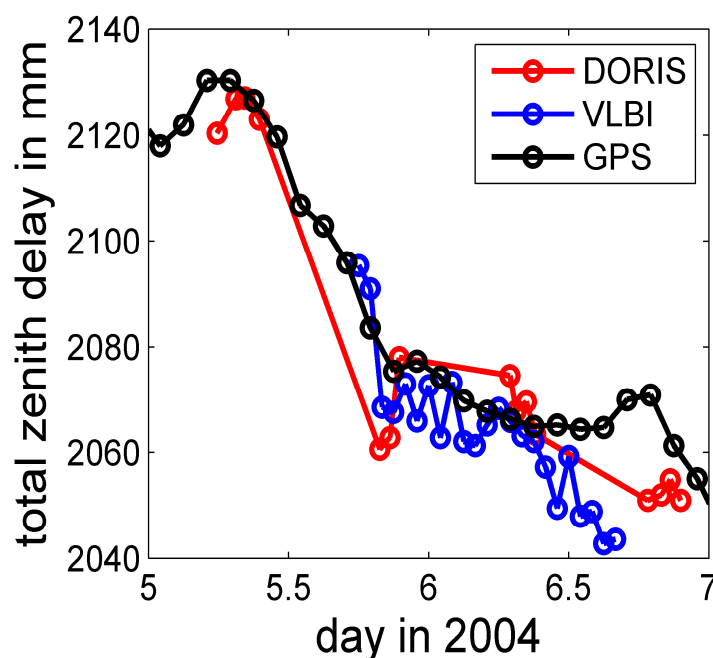
- quantité de lave
(1.8 m³/s sur 3 ans)
- Profondeur de la chambre
Magnétique (6.2 km)

Brïole et al., GJI, 2009

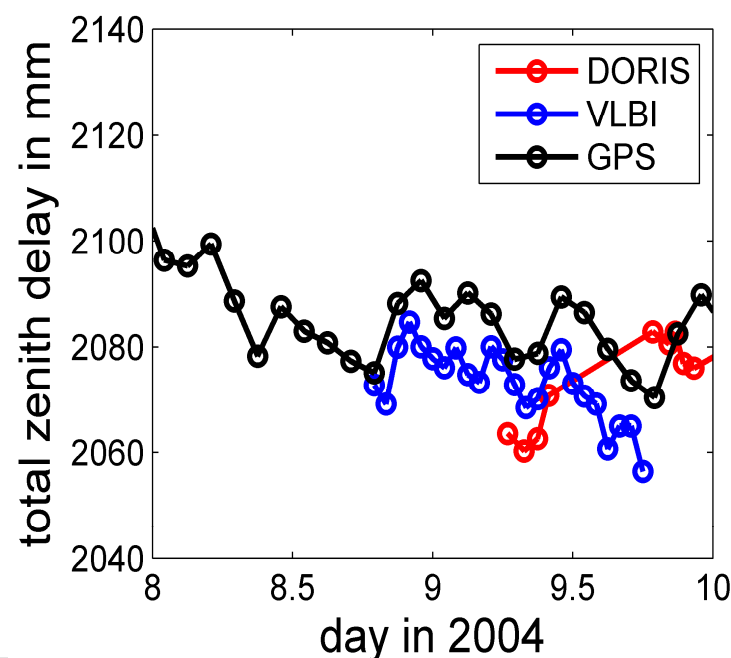
Troposphere comparisons

- DORIS, like VLBI & GPS must estimate troposphere corrections.
- Corrections are estimated pass-by-pass (typically 10-15 min, ~2X per satellite & DORIS station, and per day).

Hartebeesthoek

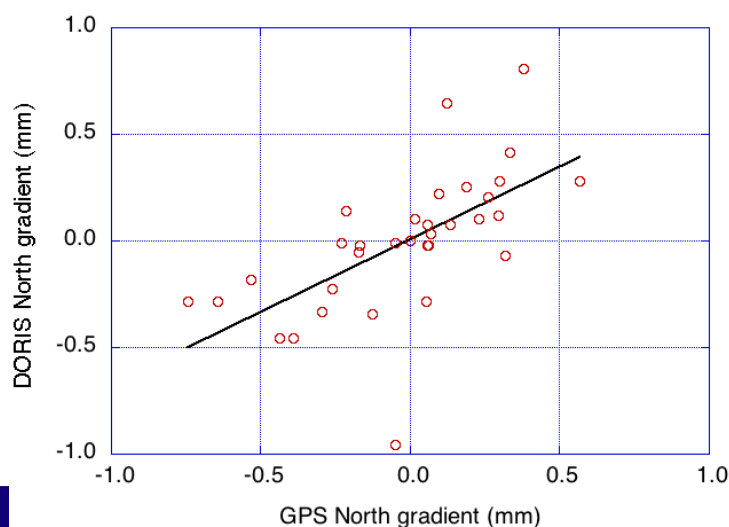
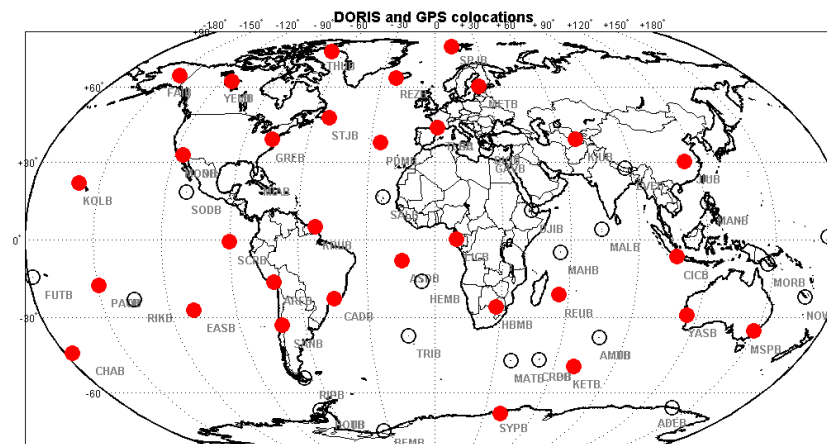
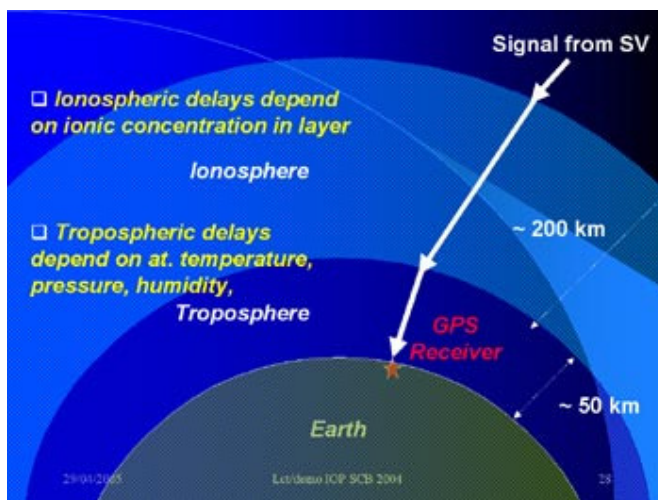


Kokee Park



**Preliminary (example) comparisons
from VLBI & GPS (Johannes Boehm)
and DORIS (Pascal Willis).**

Gradients troposphériques horizontaux



Objectifs: prendre en compte
L'anisotropie de l'atmosphère

Validation: comparaison avec GPS

Willis et al., soumis

Bureau des longitudes
Paris, 6 janvier 2010

International DORIS Service

IDS - International DORIS Service 04/01/10 16:22

International DORIS Service

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- Data & Products
- Meetings
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- DORIS system
- Official web site
- Network
- System monitoring
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- Documents
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[IDS Activity report for 2006-2008](#)

[Spot-2 end of activity](#)

[IDS contribution to ITRF2008](#)

DORIS is a Doppler satellite tracking system developed for precise orbit determination and precise ground location. It is onboard the Jason-1 and ENVISAT altimetric satellites and the remote sensing satellites SPOT-2, SPOT-4 and SPOT-5. It also flew with SPOT-3 and TOPEX/POSEIDON.

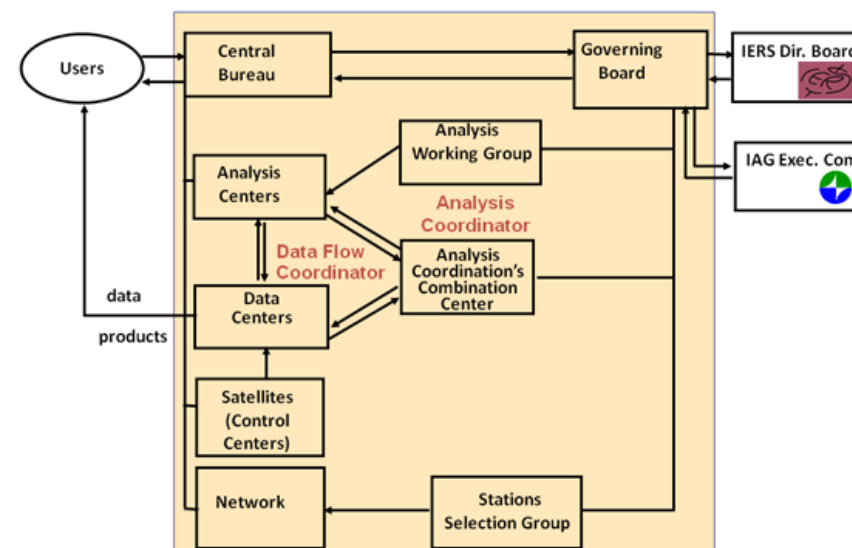
IDS is an international service which provides a support, through DORIS data and products, to geodesic, geophysical, and other research and operational activities. New proposals for Analysis Centers and temporary or permanent DORIS stations are welcome. See the [call for participation](#).

This site is composed of three parts:

- "IDS" describes the organization of the service and includes documents, access to the data and products, event announcements, contacts and links.
- "DORIS" allows to access general description of the system, and gives information about the system events and the tracking network.
- "Analysis Coordination" provides information and discussion areas about the analysis strategies and models used in the IDS products. It is maintained by the [Analysis Coordinator](#) with the support of the Central Bureau.

You may come back at any time to the Home Page by clicking on the IDS logo at the left upper top.

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Service scientifique de
l'Association Internationale de Géodésie

<http://ids-doris.org/>

Centres d'analyse IDS

Contributed to ITRF2005 & ITRF2008

IGN: Pascal Willis (GIPSY/OASIS)

LCA: Laurent Soudarin (GINS)

INA: Sergei Kuzin (GIPSY/OASIS)

Contributed to ITRF2008 (New Analysis Centers)

GOP: Geodetic Observatory Pecny, Petr Stepanek, (Bernese)

ESA: ESOC, Michiel Otten (NAPEOS)

GAU: Geoscience Australia, Ramesh Govind, (GEODYN)

GSC: NASA GSFC, Karine Le Bail/Frank Lemoine (GEODYN)

Candidate Analysis Centers

NCL: University of Newcastle, Phil. Moore (FAUST)

- DORIS: système français
opérationnel depuis 1990 (SPOT-2)
- Réseau dense et homogène
- Applications scientifiques
 - Orbitographie précise (temps réel / DIODE)
 - Géodésie : positionnement terrestre, géocentre
 - Géophysique: tectonique, niveau des mers, mouvements locaux
- Futur:
 - amélioration (7 centres d'analyses: International DORIS Service)
 - Nouvelles mesures (phase vs. Doppler)
 - Nouveaux satellites

