

Ecole d'Eté 2012

Localisation précise par moyens spatiaux

Introduction au logiciel GINS (CNES/GRGS)

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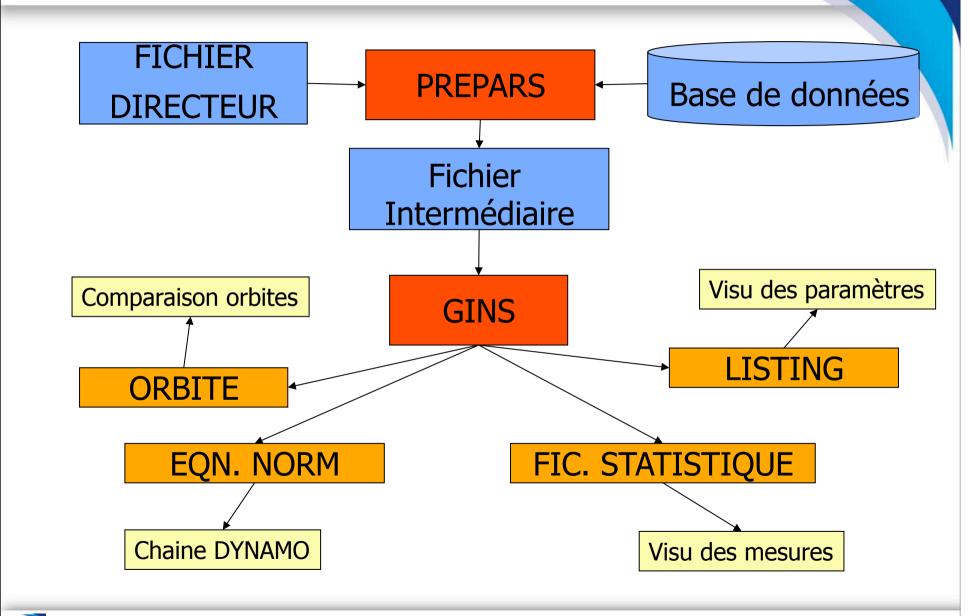
LE LOGICIEL GINS: Historique

- ~1970 Naissance
- 1994 Multi satellite (GPS)
- 1997 Portage en Fortran 90
- 1997 Gestion en configuration
- 1999 Élargissement au cas planétaire
- 2000 Portage sur différentes machines (Sun, Dec/Alpha ...)
- 2006 Portage sur PC-Linux
- 2007 GINS-PC
- 2009 Multi constellation
- 240000 lignes de Fortran 90

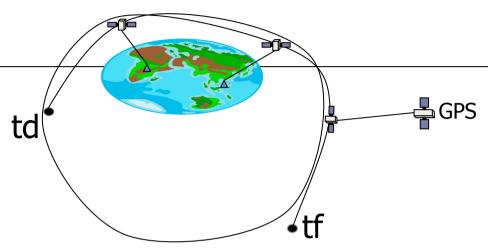
LE LOGICIEL GINS: fonctionnalités

- Calcul d'orbite autour d'un corps du système solaire
- Détermination de paramètres géophysiques:
 - Paramètres de rotation du corps: pole , TU1, nutations ...
 - position et vitesse des stations (géocentre)
 - coefficients du champ de gravité
 - coefficients des modèles de marée océanique
 - surface moyenne océanique
 - coefficients du modèle d'atmosphère (température, densité des gaz)
 - **–** ...
- Cas sans satellite: VLBI
- Cas planétaire
- Simulation de mesures

LE LOGICIEL GINS: Organigramme général



LE LOGICIEL GINS: Restitution d'orbite (1)



On fait une extrapolation d'orbite **ET**

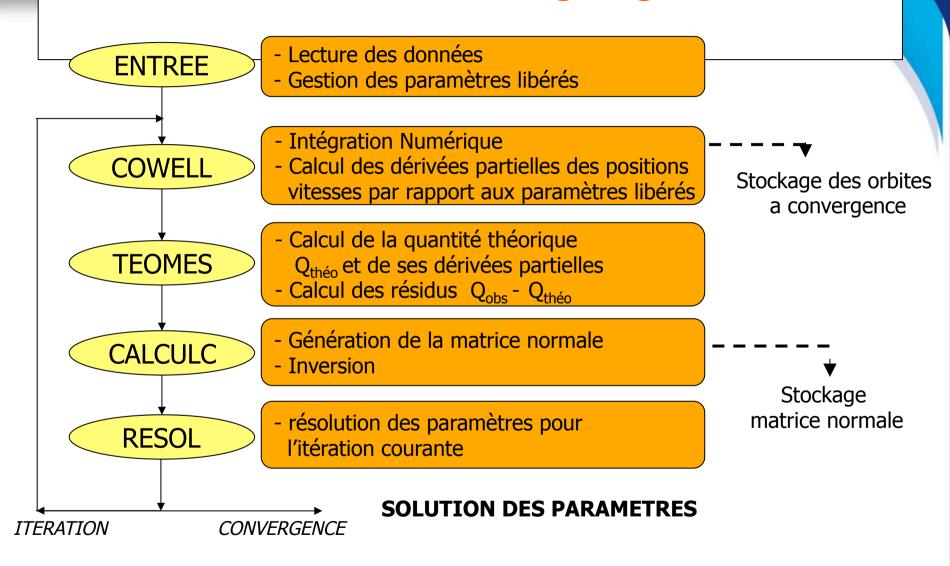
- on prend en compte des mesures à partir
 - de stations au sol(Laser, Doppler...)
 - d'autres satellites (GPS)

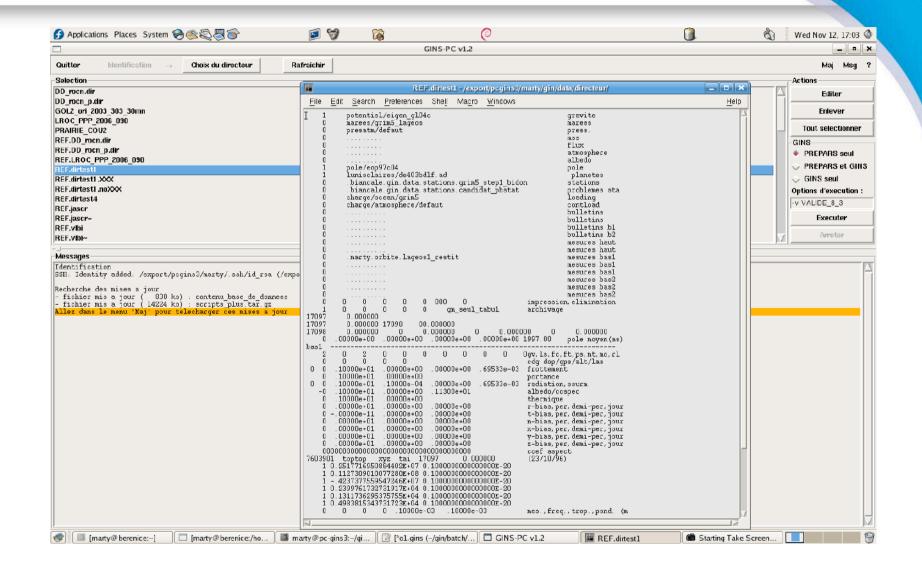




On cherche à minimiser les écarts entre les mesures et les mesures théoriques déduites l'orbite calculée et en ajustant des paramètres

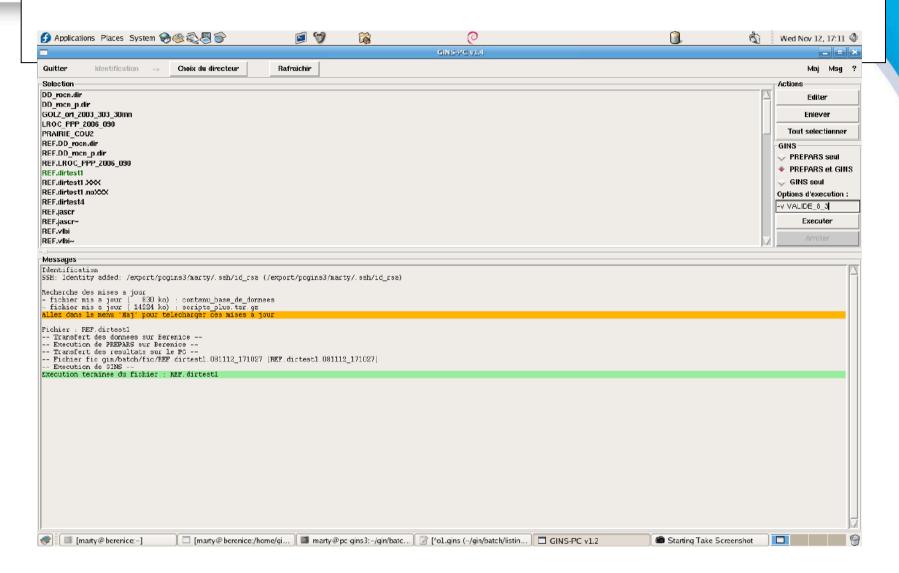
LE LOGICIEL GINS: Organigramme





GRGS Ecole d'Eté 2012

L'outil GINS-PC: IHM – Exécution de GINS

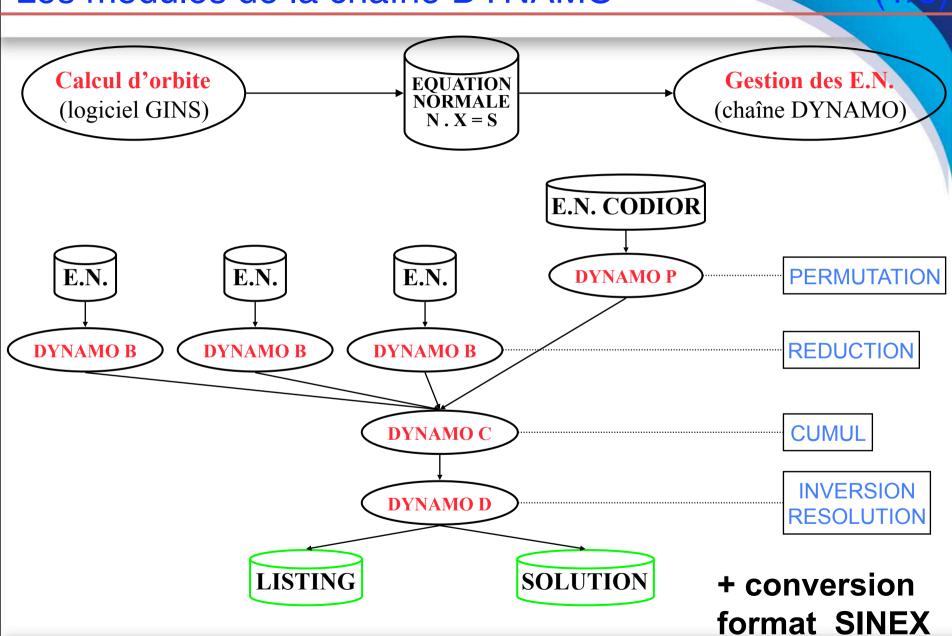


Boite à outils pour automatisation des traitements :

- Rapatriement des données IGS
- Renommer un RINEX suivant les standards
- Création du fichier station GINS (pour stations de campagne)
- CC2NONCC
- PRAIRIE (détection cycle slip, résolution WL,...)
- Création DIRECTEUR GINS
- Lance GINS
- Résolution des ambiguïtés (réduction EQNA, bootstrapping)
- Correction des mesures
- Extraction des paramètres pour interface graphique

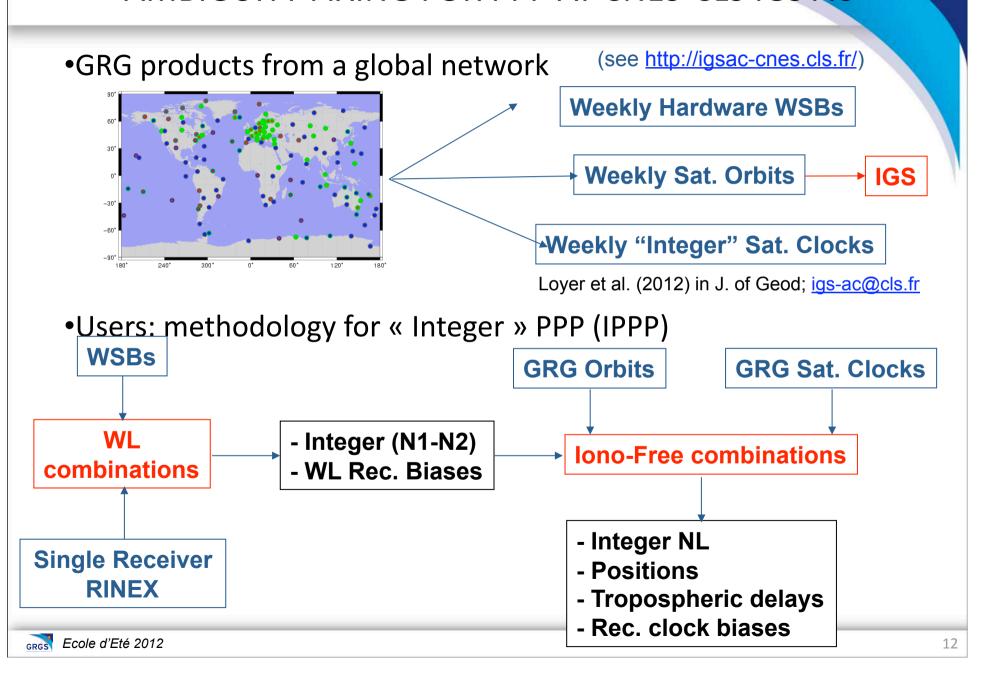
Les modules de la chaîne DYNAMO

(1/8)



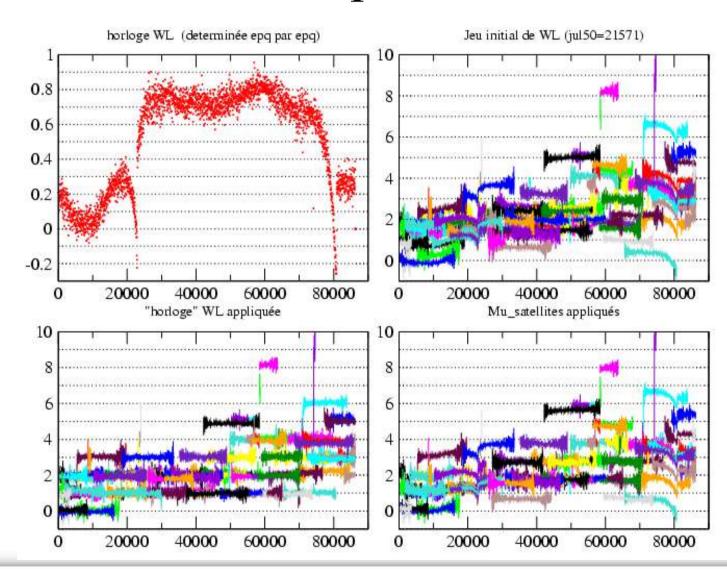
applications

AMBIGUITY FIXING FOR PPP AT CNES-CLS IGS AC



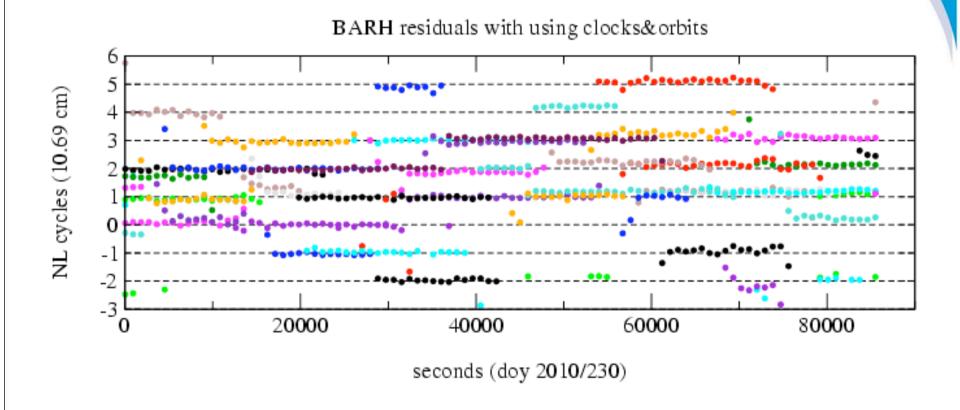
PPP : fixation entière des ambiguïtés

Wide Lane: Exemple station MCM4

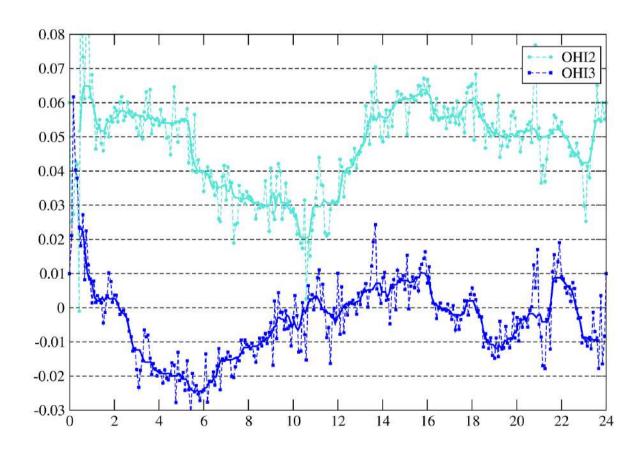


PPP : fixation entière des ambiguïtés

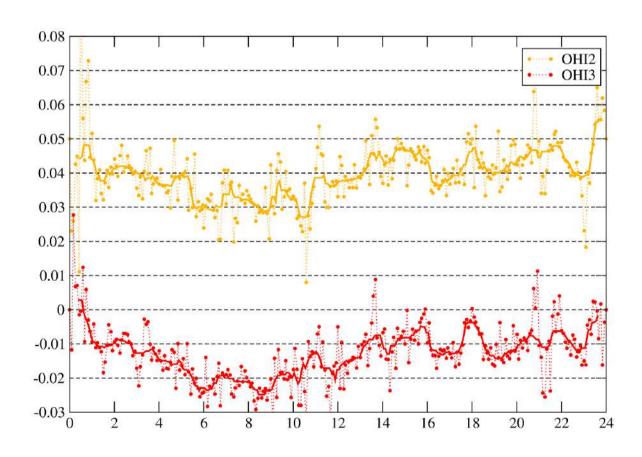
Exemple de résidus sur les phases avant le blocage Narrow-Lane



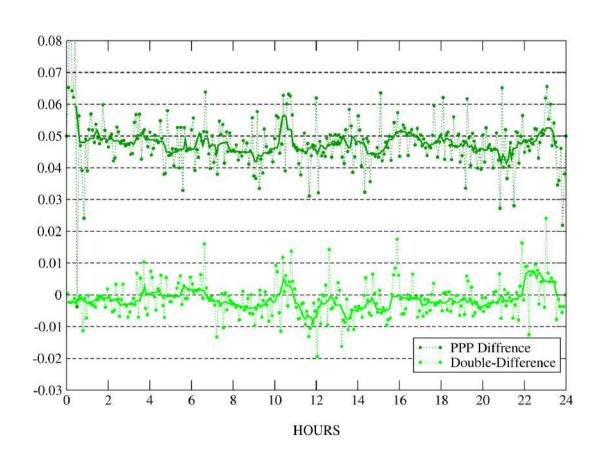
E-W Float



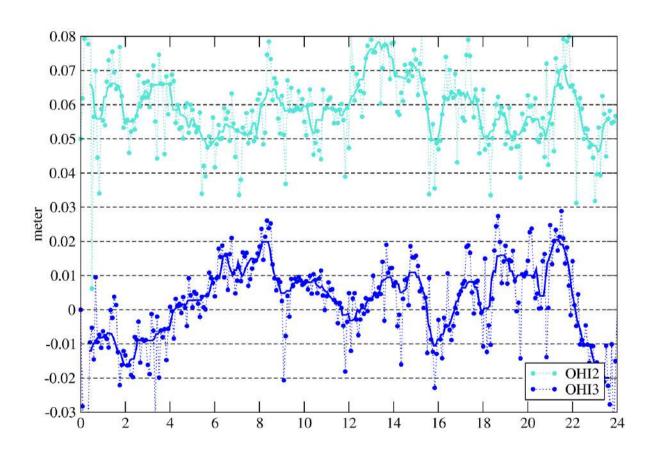
E-W Fixed



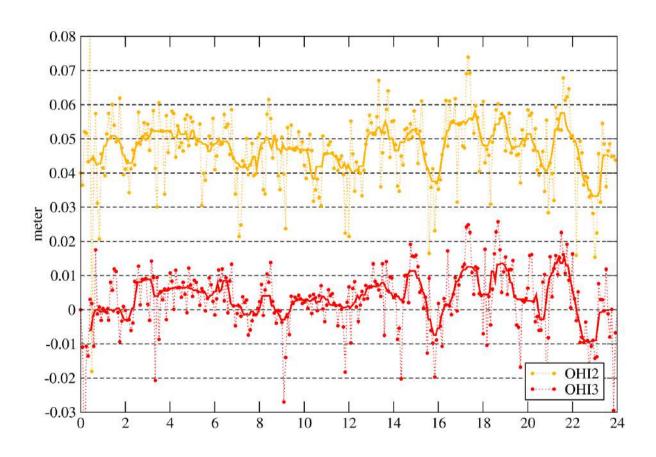
E-W IPPP vs DD



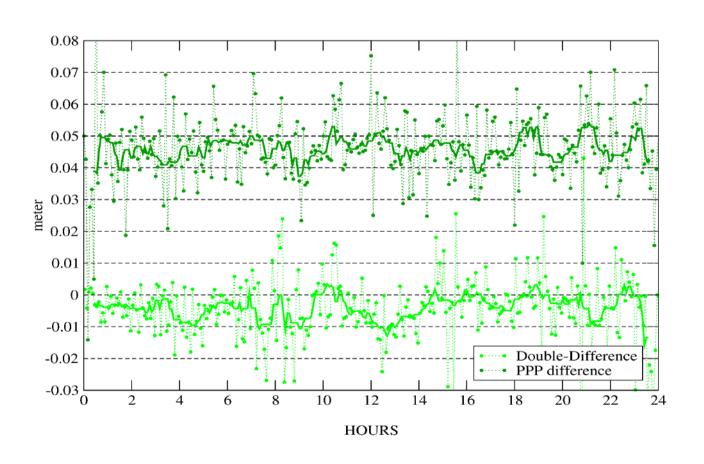
N-S Float



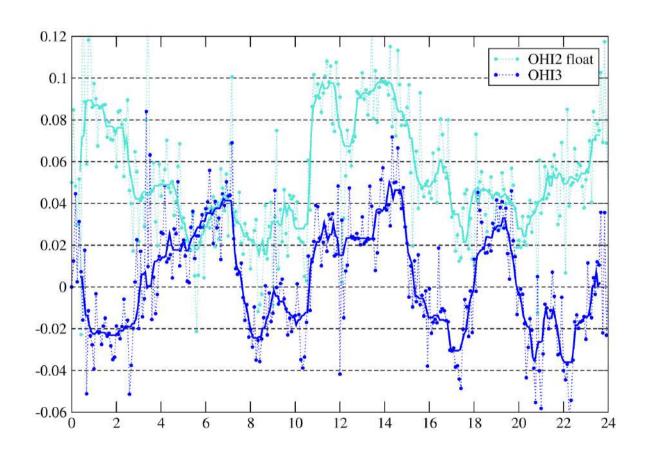
N-S Fixed



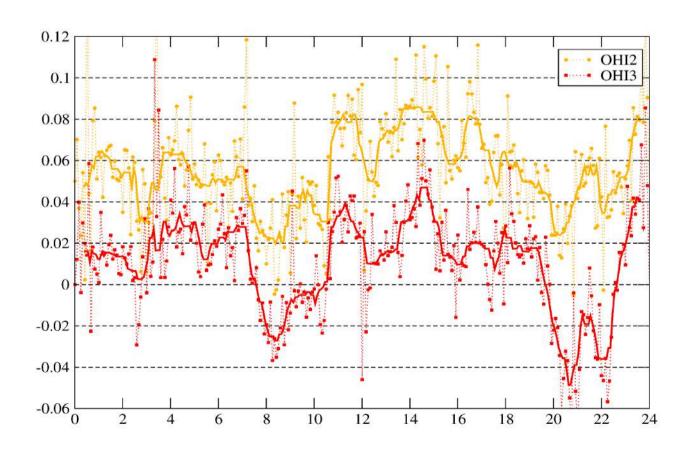
N-S IPPP vs DD



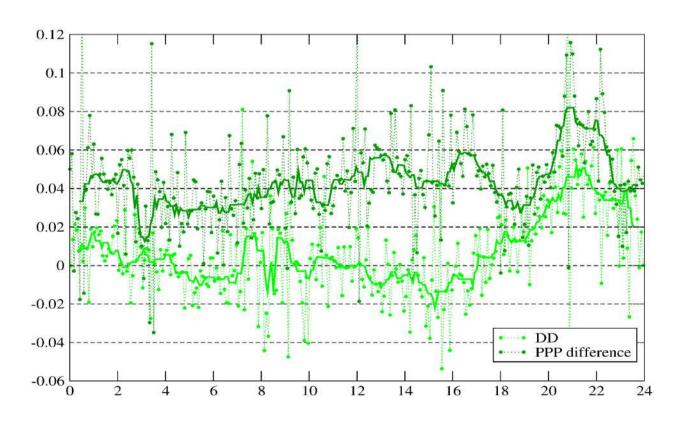
H Float



H Fixed

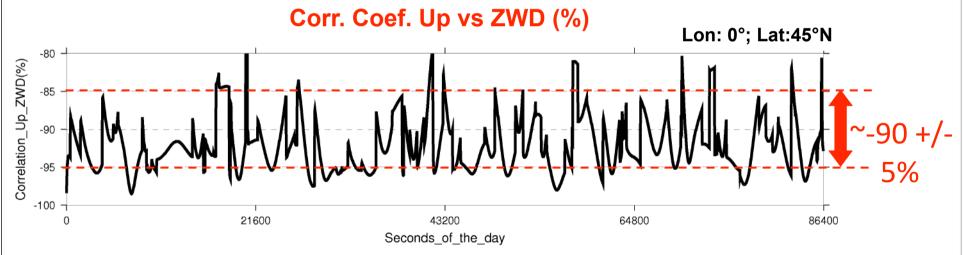


H IPPP vs DD



CORRELATION TIME VARIATIONS

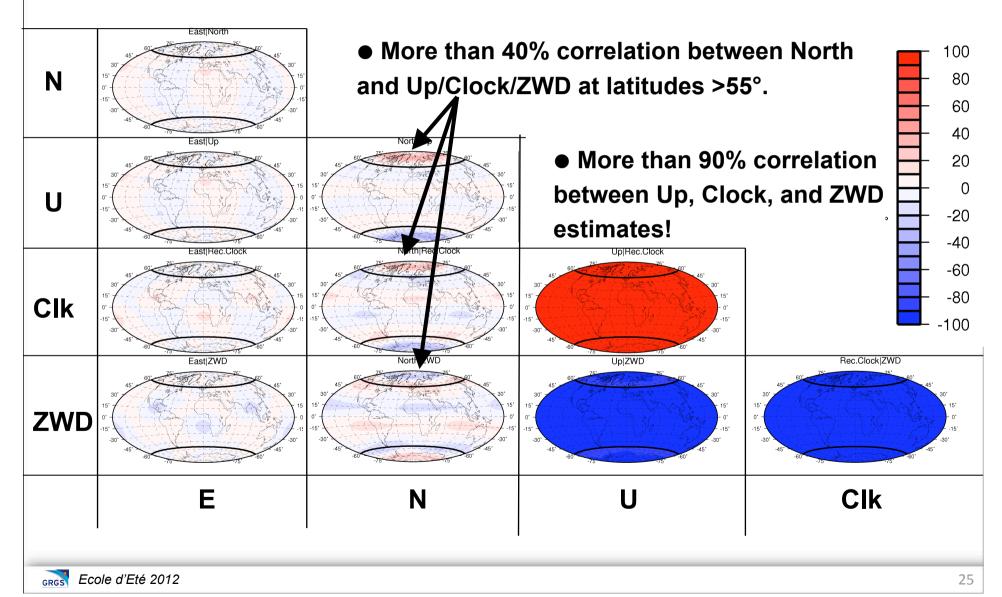
- How the correlations between parameters change over time?
- We computed the correlation matrix derived from a 24h Kalman Filter using an SP3 orbit file.
- Positions, Rec. clocks and ZWDs estimated every 30s. Constraint of 5mm/ h^0.5 applied on ZWD estimates.



- Strong correlation between Up and ZWD estimates.
- But, no significant variations despite evolutions of sat. geometry.

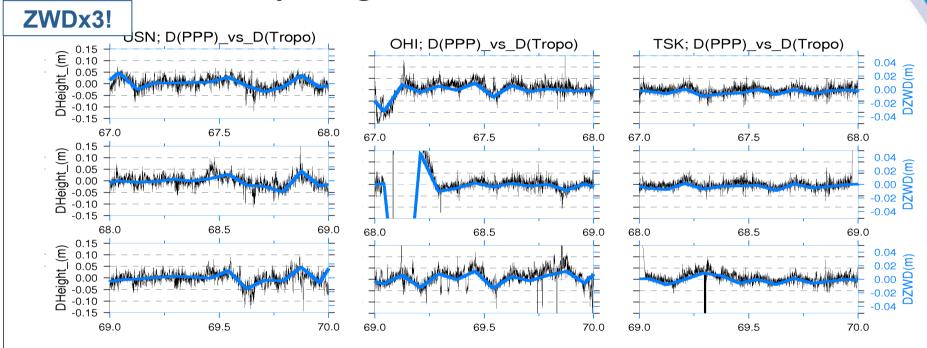
CORRELATION SPATIAL VARIATIONS

East not significantly correlated.

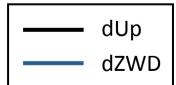


HOW ERRORS PROPAGATES AT CLOSE STATIONS?

Idea: comparing their PPP series

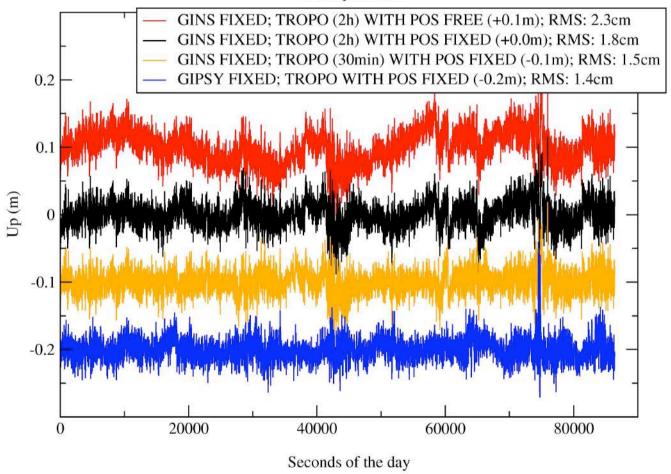


- Horizontal errors are dominated by satellite geometry
- DPPP vs Double differences present similar performances for horizontal components
- Up/Clocks errors suffer from:
 - Differences in tropospheric estimates
 - The correlation between Up/Clocks and ZWDs



Impact de la paramétrisation

1s-sampled data

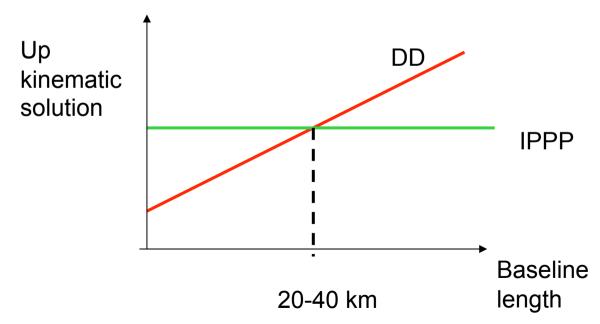


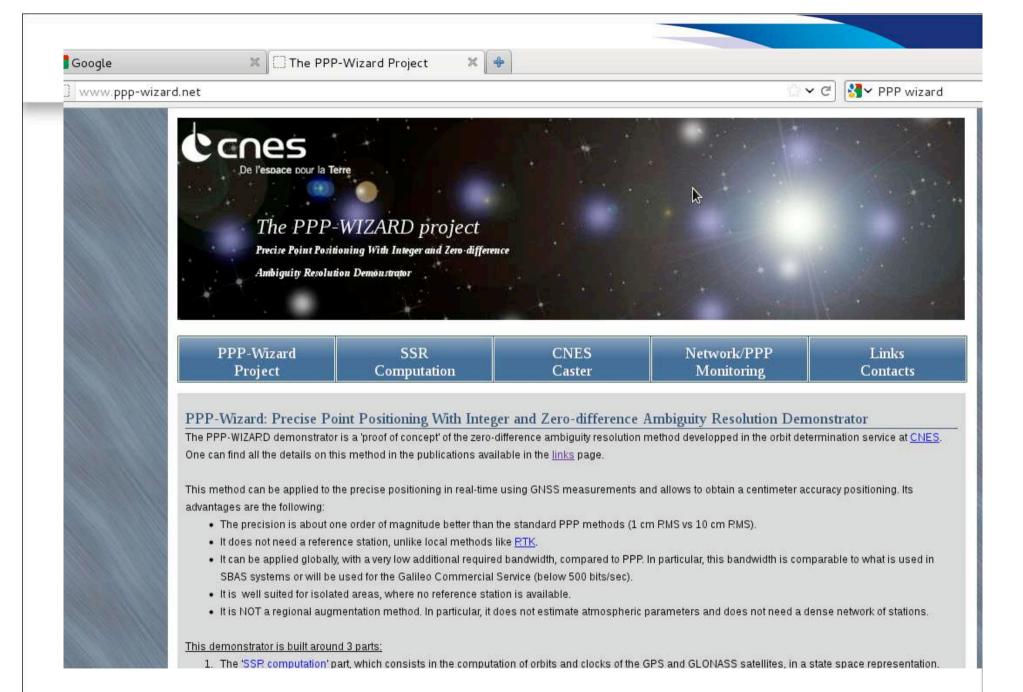
IPPP vs DD

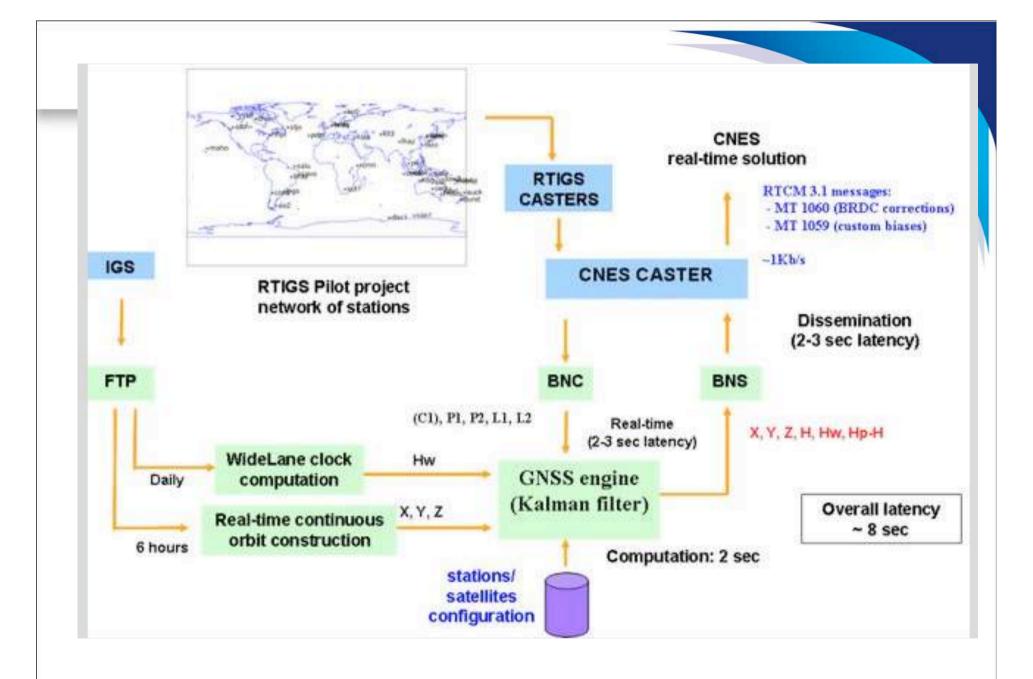
Comparing IPPP and DD on short baselines:

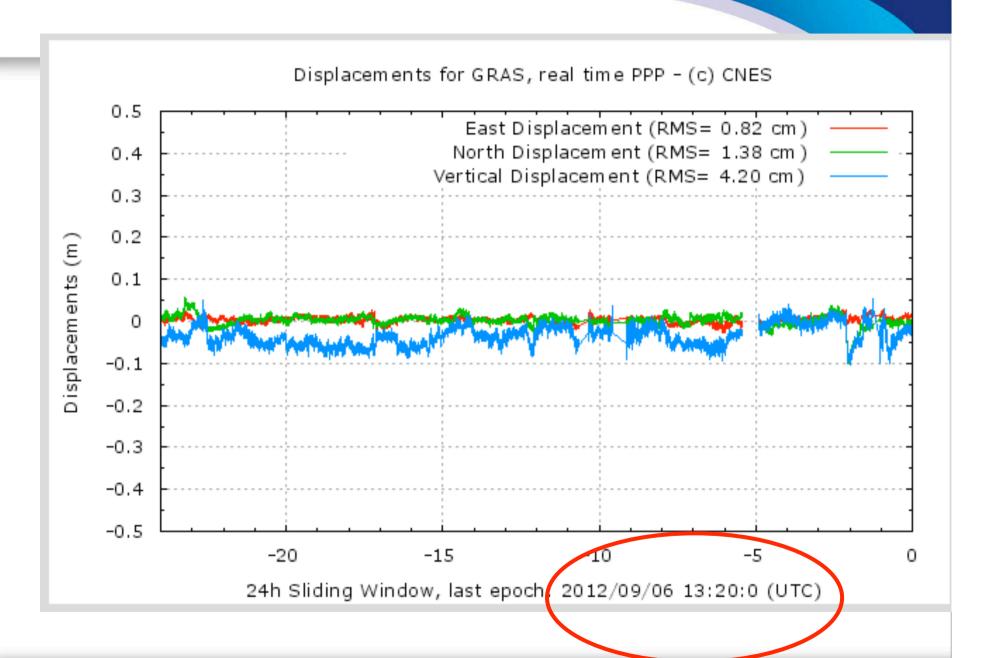
- IPPP kinematic height time series errors at the level of 4-5cm
- DD remains the most powerful technique on short baselines (when a reference technique is availale)

Using [5mm+1ppm] as the DD Up baseline error:



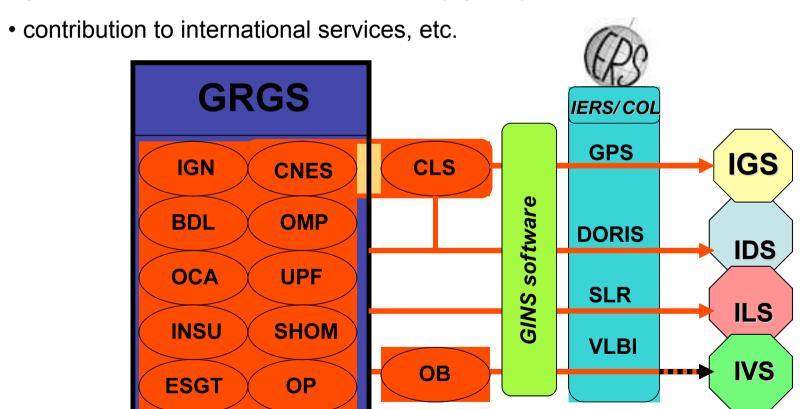






GINS et les Centres d'Analyses

- Centre National d'Etudes Spatiales / Groupe de Recherches de Géodésie
 Spatiale develop the GINS scientific software for more than 40 years
- muti-technique tool
- global static/variable earth and planetary gravity field models (i.e. GRACE)



Implement recently multi-GNSS capabilities

Traitements GNSS pour l'IGS

CNES et CLS

• GPS: 2 mai 2010

• GLONASS (+GPS): 2 janvier 2011

« GINS Engine » 4 opérateurs

Contribution aux produits finaux (J+11)

	GPS seul (lib.)	GPS seul (fixe)	GPS (fix.) + Glonass
Mesures	~260 000	~150 000	~260 000
Dynamique	~380	~380	~700
Troposphère	~2550	~2550	~2550
Ambigüités	~8400	~1300	~5500
ISB	0	0	~1200
Horloges	~20500	~20500	~24000
Total (param.)	~32000	~25000	~34400



Presentation

Since 2007, CNES/GS and CLS teams have been processing regularly GPS data from a worklowide network of IGS permanent stations.

We compute precise GPS orbits together with Earth rotation parameters and stations coordinates at the sub centimetre level.

Our solutions have been submitted since January 2004 to the International Earth Rotation Service in the Immework of the Combination Research Center experiment.

Main events

2012.08 Switch to daily Sinex products (GPS week 1702)

2012.05 30' grg clock files available on IGS products archive centers

2011.06 Contribution to the IGS GLONASS final products

2011.04 Switch to IGS08/ANTEX08 (GPS week 1632)

2010.05 Contribution to the IGS GPS final products

2009.11 New analysis strategy; zero-difference ambiguity fixing

2009.03 Increasing number of stations in the processing up to 110

2009.01 Start of routine delivery of clock files (5')

2008.03 Increasing number of stations in the processing up to 90

2007.09 Start of weekly SINEX routine delivery to IGS

Doc!

www.igsac-cnes.cls.fr

WSB!

ftp site direct acces (weekly updated Wide-Lane Satellite biases and 30s clk).



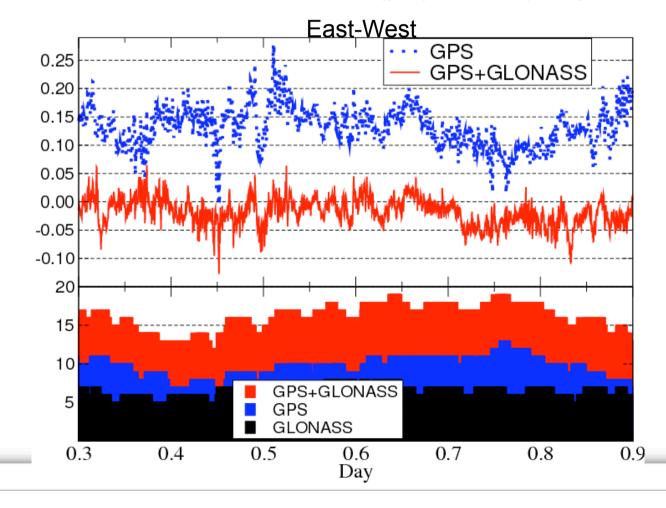
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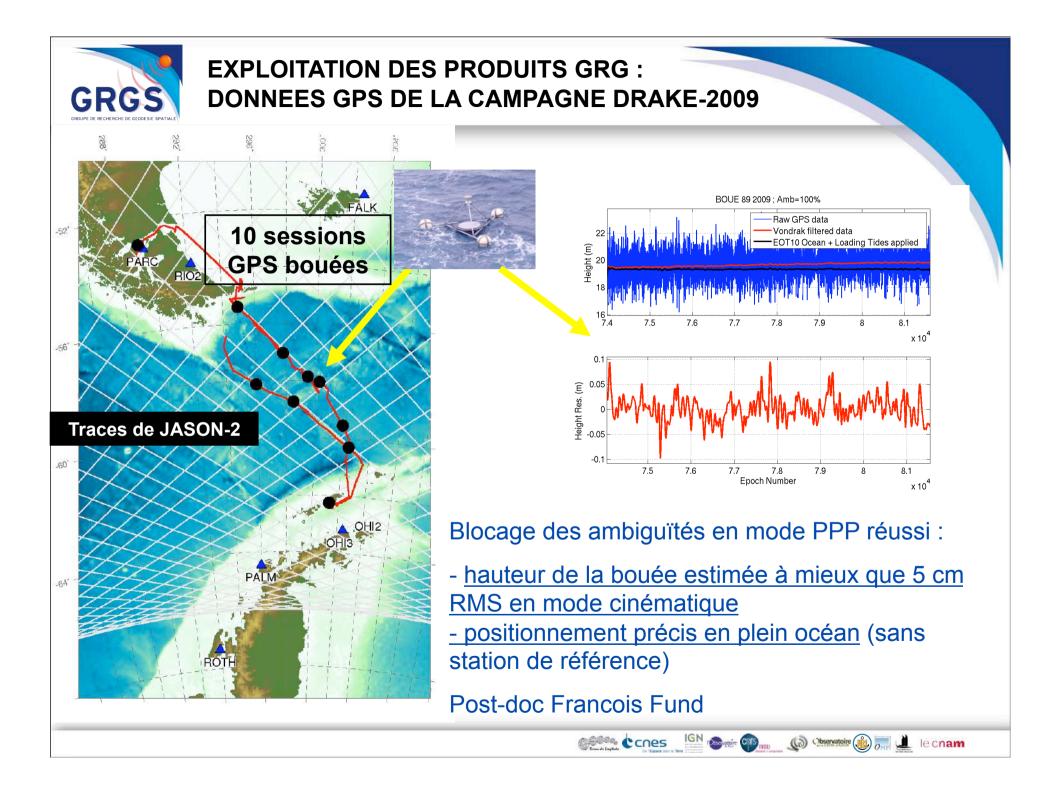
Kinematic (30s) PPP tracking of a mobile in Antarctica

- •example of solution when the mobile was stopped to check the repeatability
- •using IGS-ESA GLONASS orbit/clock products

•because GRG GLONASS clocks are not (yet) correctly aligned to GPS

time





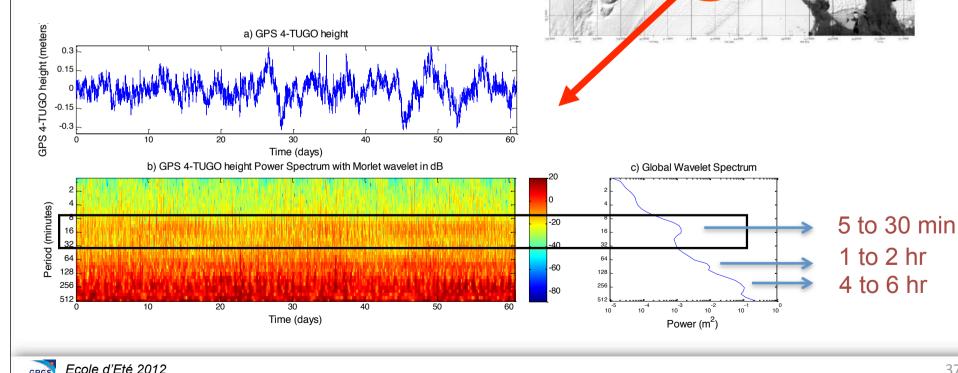
ETUDE DES MODES PROPRES DE VIBRATION DU GLACIER MERTZ

Projet CRAC-ICE (LEGOS)

37

- Positionnement cinématique de 2 récepteurs GPS (« isolés ») en mode IPPP
- Mise en évidence de modes propres de vibrations du glacier

Thèse Lydie Lescarmontier (2012)



EXPLOITATION DES PRODUITS GRG:TRANSFERT DE TEMPS PAR IPPP

La technique IPPP assure la continuité des solutions d'arc en arc ce qui présente un grand intérêt pour l'observation du comportement d'horloges atomiques (connectées à des récepteurs GNSS) à long terme.

Exemple: comparaison d'horloge Two-Way (TW) et PPP entre les stations NIST et PTB

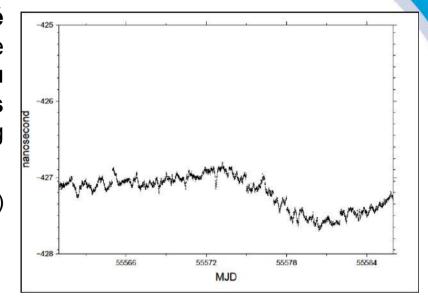


TABLE II. RMS OF DIFFERENT COMPARISONS FOR THE LINK NIST-PTB OVER JANUARY 2011

Comparison	RMS / ns
GPSPPP (2011) – (2007)	0.129
GPSPPP (2011) – IPPP	0.221
GPSPPP (2007) – TW	0.539
GPSPPP (2011) – TW	0.534
IPPP - TW	0.518

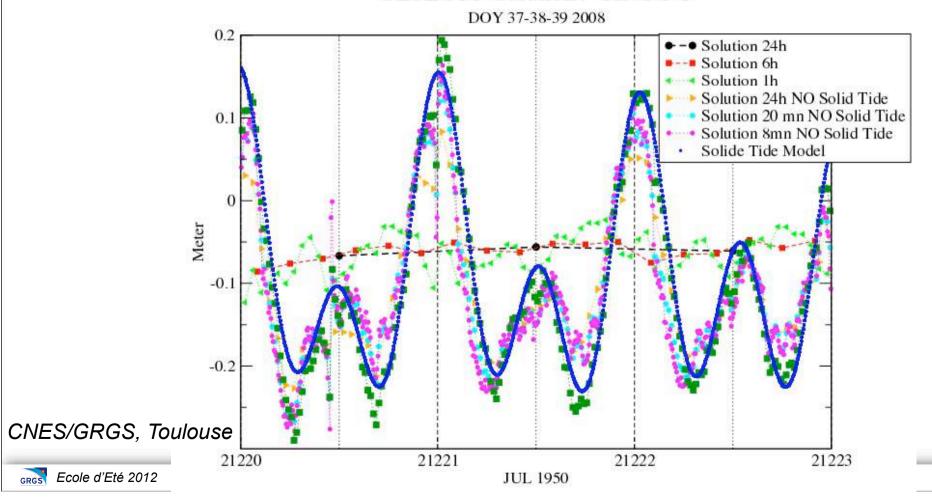
Figure 4. Difference between the IPPP solution and the GPSPPP(2011) "standard" solution for the link nist-ptbb over January 2011 (RMS is 221 ps).

Coopération avec Gérard Petit (BIPM) et Jérôme Delporte (CNES/RF/HT)

Déformation de marée solide

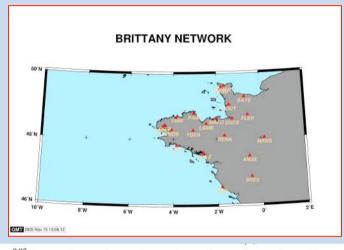
- Déformation de la croute terrestre a Toulouse sous l'effet de l'attraction de la lune et du soleil
- Calcul d'un point GPS toutes les 8 minutes

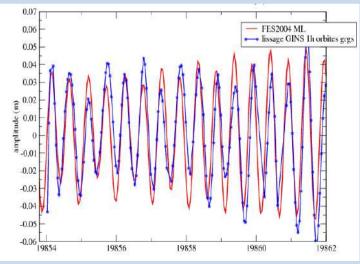
TLSE PPP Solution / GINS-PC



Déformation crustale de charge

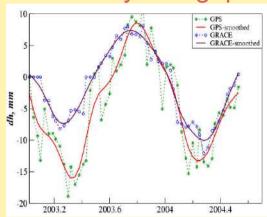
Effet des marées océaniques





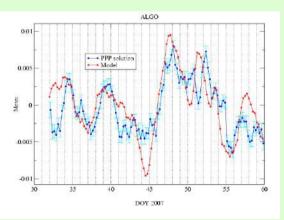
S. Melachroinos, CNES, Toulouse

Effet hydrologique

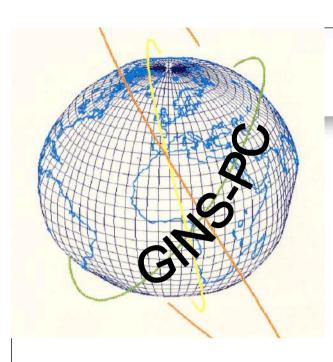


D. Fazhilova, LEGOS, Toulouse

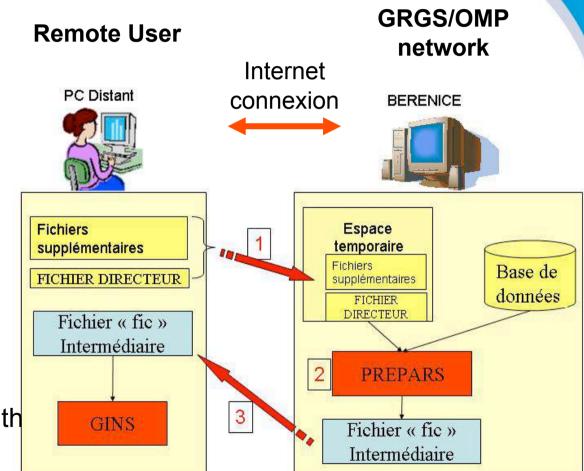
Effet atmosphérique



F. Perosanz CNES, Toulouse



Distribution de GINS



- GINS software for science applications
- convention to be signed with CNES
- contact : jean-charles.marty@cnes.fr

