



Combination at the
Observation Level
IERS Working Group



Objectives and workplan of the COL/IERS WG

Combination at the Observation Level

R. Biancale, D. Gambis

with contributions from GRGS, DGFI, AIUB, GSFC

Some milestones

2000 – *PhD of Ph. Yaya on combination of space techniques for EOP and reference system determination / GRGS*

2002 – creation of the IERS Combination Research Centres (11 CRCs)

2005 – *GRGS has organized routine operations of technique combination in the framework of the **IERS Combination Pilot Project (CPP)***

2007 – proposal of a new WG on “Combination at the Observation Level” within IERS at the UAW-2007

2009 – *GRGS submitted 2 years of combined solutions to ITRF2008*

2009 – kick-off meeting of the COL-WG (21-22 October, Warsaw)

Charter for a Working Group on Combination at the Observation Level

Consistency and homogeneity between techniques can be studied and clarified more directly if they are processed together in a same run or at least **with consistent software packages and a priori models**. Space geodetic techniques have different strengths and weaknesses for recovering geodetic parameters which makes their combination useful. But they may have also some systematic behaviour which can easier and more efficiently be detected and reduced at the observation level.

Its major task will be **to study methods and advantages of combining techniques at the observation level**, searching for an optimal strategy to solve for geodetic parameters. Demonstration should be based on weekly combined SINEX files (containing unconstrained normal equations of station coordinates, EOPs, nutation parameters and eventually quasar coordinates) from all space geodetic techniques together. The **new products** resulting from these combination procedures should be **compared to the current IERS products routinely produced**.

Declared COL participants

- AIUB: BERNESE
- DGFI: DOGS-OC/-CS + OCCAM
- GSFC: GEODYN/SOLVE
- GRGS: GINS/DYNAMO

Other potential COL participants

- JPL: GIPSY/OASIS
- ESOC: NAPEOS
- GFZ: EPOS
- ASI: GEODYN
- ...

Prerequisite

processing must be at the quality level of the Technique International Services

COL Strategy

$$\sum_{CC}^4 \left(\sum_{AC}^n \text{individual technique} \right) \Rightarrow \sum_{CC'}^{n'} \left(\sum_{COL}^{\geq 2} \text{multi-technique} \right)$$

$$\sum_{CC}^4 \left(\begin{array}{c} \text{IGS} \\ \text{IVS} \\ \text{International Laser Ranging Service} \\ \text{IDS} \end{array} \right) \Rightarrow \sum_{CC'}^{n'} \left(\begin{array}{c} \text{GINS} \\ \text{DOGS} \\ \text{BRISE} \\ \text{GEODYN} \end{array} \right)$$

Improving the combination approach by searching for homogeneity “at the level of observations” in terms of :

- precision (*considering systematisms and common parameters*)
- resolution (*considering observation densification*)
- consistency (*wrt modelling standard, software...*)

should increase accuracy

Mutual information from the different techniques should complement and improve global products taking advantage of strengths of each technique through an homogeneous processing

Combination at the NEq level vs. observation level

- with the same software handling several techniques
- with different software packages if they are well homogenized

$$\sum_i \frac{\partial Q_i^{calc}}{\partial p_k} \left(\sum_{j=1}^n \frac{\partial Q_i^{calc}}{\partial p_j} \Delta p_j - \Delta Q_i \right) = 0 \quad \forall k = 1, n$$

$$\Delta Q_i = Q_i^{obs} - Q_i^{calc} = \sum_{j=1}^n \frac{\partial Q_i}{\partial p_j} \Delta p_j$$

NEQ level

Observation level

Consistent processing of the data using the same models and parameterization

Appropriate **relative weighting** of the techniques

Corrections to the **original observations** are estimated

Outlier detection and **weighting** of observations technique-wise

Outlier detection and weighting of observations within the combination process

A priori **reduced parameter** cannot be handled anymore

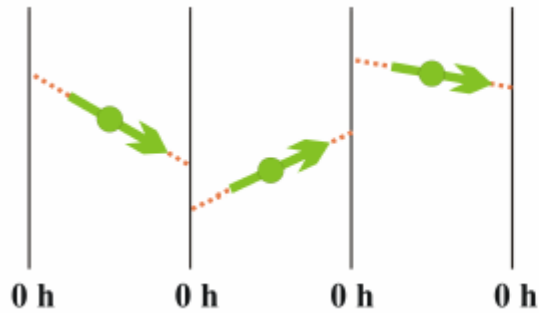
All parameters are available

Seitz, Thaller - Workshop on Combination on Observation Level, 21./22.10.09, Warsaw



Only technique dependent parameters can be reduced for an actual equivalence between NEq level and observation level

Problem of EOP interpolation

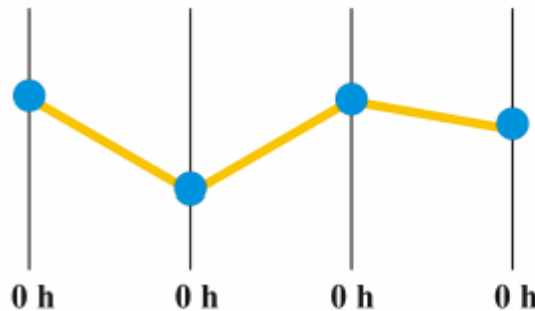


Piece-wise linear **Offset+Drift**

$2*n$ parameters

no continuity at boundaries

continuity constraints reduce #parameters to $n+1$



Piece-wise linear **Polygon**

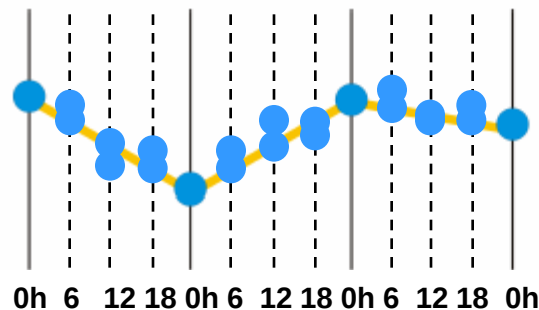
$n+1$ parameters

“real” continuity at boundaries

no continuity constraints needed

not distinguishable from “offset-only” in SINEX

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Densified piece-wise linear **Polygon**

$4n+1$ parameters

“real” continuity achieved

linearity conditions are integrated

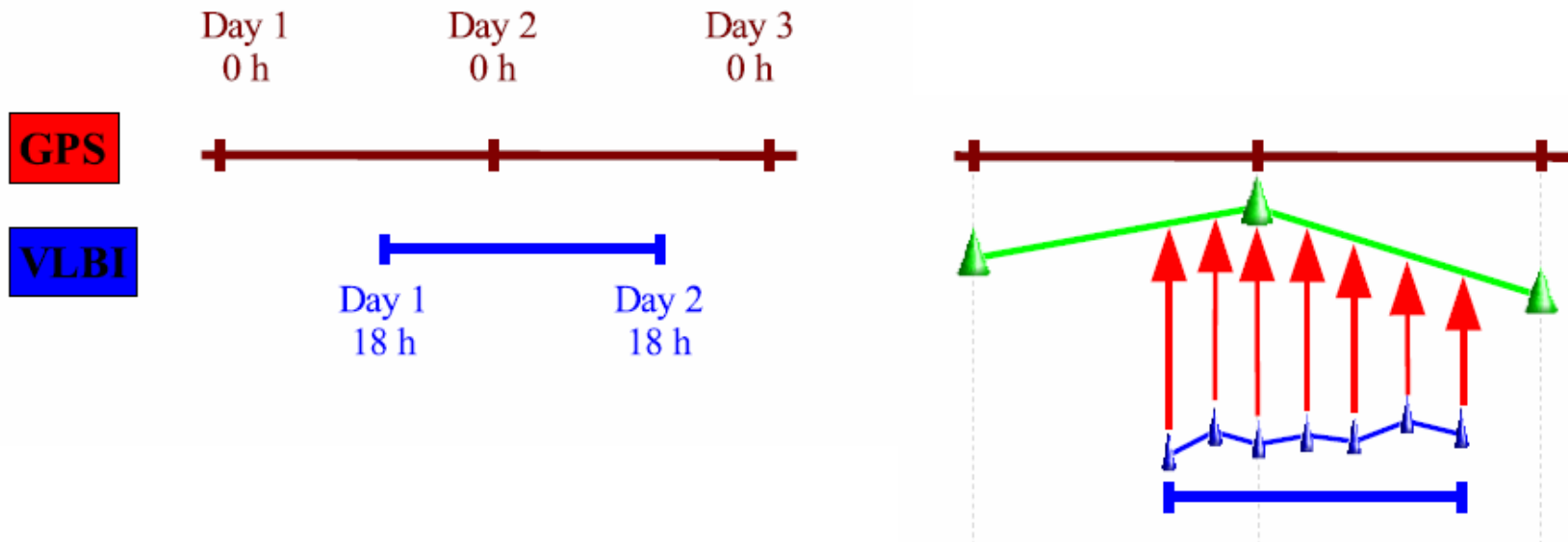
not distinguishable from “offset-only” in SINEX

$$\begin{cases} P_j(6h) = \frac{3}{4}P_j(0h) + \frac{1}{4}P_{j+1}(0h) \\ P_j(12h) = \frac{1}{2}P_j(0h) + \frac{1}{2}P_{j+1}(0h) \\ P_j(18h) = \frac{1}{4}P_j(0h) + \frac{3}{4}P_{j+1}(0h) \end{cases}$$

Problem of epoch reference

No clear correspondence between validity intervals of *daily EOPs* derived for instance from GPS/SLR and from VLBI 24-h sessions

=> **Can be avoided if higher temporal resolutions are used in the individual contributions**

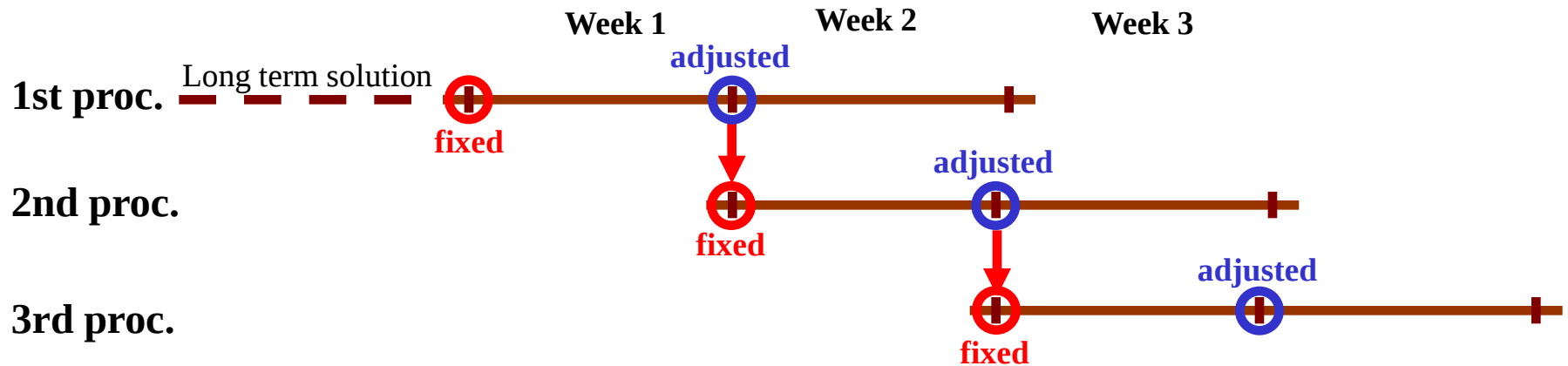


Possibility of stabilizing the adjusted series by continuity constraints:

$$x(t_{i+1}) - x(t_i) = 0 \quad \sigma$$

Problem of weekly continuity

working by fortnight periods:



- parameters of the 1st and 2nd weeks are adjusted together
- parameters of the 1st week become definitive
- parameters adjusted in the middle of the period (with the less noise) become the starting point of the 2nd week processing
- parameters of the 2nd and 3rd weeks are adjusted together
- parameters of the 2nd week become definitive
- parameters adjusted in the middle of the period become the starting point of the 3rd week processing
- and so on ...

Roadmap

- 1) review the approach of the various groups
and their capability to process two or more techniques.
- 2) establishing common processing standards
for all techniques in order to guarantee homogeneity and consistency.
- 3) optimizing and unifying parameterization
for instance for tropospheric parameters in order to minimize globally the degree of freedom of the whole inverse system.
- 4) studying the appropriate weighting between techniques
and the use of local ties or identical satellites tracked by several techniques.
- 5) elaborating benchmarks
to intercompare results between groups from the same data set.
- 6) insuring SINEX compatibility
between techniques and with the international technique services and IERS.
- 7) studying stabilization methods
and looking for high temporal resolution of parameters.
- 8) evaluating and comparing results
to search for compatibility between groups.
- 9) organizing routine operations
for a new TRF realization, either in the framework of the next ITRF or as ITRF assessment.

Actions and schedule

Benchmarks: the period chosen for establishing benchmarks is **from August 10 to August 30, 2008**. It includes the intensive **CONT08 VLBI period** (from 12 to 26/08/08). Combined SINEX will be delivered per week. They could be separated per technique.

Parameters estimated: the non reduced parameter set should include EOP (pole, UT1, nutation parameters per day and possibly drifts), station coordinates (per week), troposphere zenith delay ZTD (per hour). In order to reduce the size of SINEX files, troposphere parameters of non collocated GPS stations can be previously reduced.

Schedule deadline:

30 November: list of participants to be registered on the COL forum

31 December: discussion on a priori models and parameters

28 February: delivery of SINEX

30 April: results of comparisons

Next meeting: the second COL meeting will be held during EGU meeting in May 2010

FORUM COMBINATION at the Observation Level

<http://grgs.obspm.fr/forum/>

Discussion for GRGS processing

GINs/DYNAMO, Software, Formats...

NEWTOPIC*

Rechercher dans ce

Rechercher

Marquer les sujets comme lus • 11 sujets • Page 1 sur 1



SUJET	Publier un nouveau sujet	RÉPONSES	VUS	DERNIER MESSAGE
Réduction EQN	0 par jyr » 09 Mars 2009, 16:59	7	18	par jyr » 04 Juin 2009, 10:31
NNR conditions	par jyr » 28 Mai 2009, 17:01	1	3	par Isoudarin » 29 Mai 2009, 10:46
Sinex Tool	par jyr » 28 Mai 2009, 16:11	0	3	par jyr » 28 Mai 2009, 16:11
Modèles dans GINS	par jyr » 28 Mai 2009, 09:32	0	5	par jyr » 28 Mai 2009, 09:32
Rattachements	0 par jyr » 04 Mai 2009, 16:13	1	15	par Jean-Michel Lemoine » 25 Mai 2009, 15:59
Contraintes minimales	0 par jyr » 25 Mars 2009, 16:21	4	15	par jyr » 08 Avril 2009, 10:42
Paramètres de transformation	0 par jyr » 31 Mars 2009, 16:10	0	7	par jyr » 31 Mars 2009, 16:10
Parametres des QUASARS	par jyr » 27 Mars 2009, 17:06	1	5	par gbourda » 31 Mars 2009, 08:58
inversion des matrices	par jyr » 25 Mars 2009, 13:27	0	9	par jyr » 25 Mars 2009, 13:27
Combinaison de UT	par jyr » 13 Mars 2009, 15:05	0	6	par jyr » 13 Mars 2009, 15:05
Date en Journée CNES	par jyr » 06 Mars 2009, 10:55	1	15	par gbourda » 06 Mars 2009, 11:47



Exchanges with DGFI, ORB,
Ukrainian Observatory MAO ...
For SINEX Matrix

Combinations Series available at
<ftp://hpiers.obspm.fr/iers/eop/grgs/>

Forum Multi-technique Combinations
Hosted by Observatoire de Paris

Rechercher... Rechercher

Recherche avancée

Index du forum

Panneau de contrôle de l'utilisateur (0 nouveau message) • Voir vos messages • FAQ • Membres • Déconnexion [jyr]

Nous sommes actuellement le 05 Juin 2009, 15:36
[Panneau de contrôle du modérateur]

Dernière visite le : 04 Juin 2009, 10:31

Voir les messages sans réponses • Voir les nouveaux messages • Voir les sujets actifs

Marquer les forums comme lus

WELCOME	SUJETS	MESSAGES	DERNIER MESSAGE
Readme First Read First before posting	1	1	par admingr » 18 Février 2009, 14:09

COMBINAISONS GRGS	SUJETS	MESSAGES	DERNIER MESSAGE
GINS/DYNAMO, Software, Formats... Ici on parle des logiciels en general, m.a.j., problemes, etc...	11	26	par jyr » 04 Juin 2009, 10:31
ITRF2008 Ici on parle de tout ce qui concerne l'ITRF2008	5	18	par jyr » 17 Avril 2009, 15:22
Autres Analyses Ici on parle des analyses	2	4	par loyer » 06 Mars 2009, 10:26
Troposphere	1	1	par loyer » 04 Mars 2009, 11:29

WORKING GROUP IERS ON MULTI-TECHNIQUE COMBINATIONS	SUJETS	MESSAGES	DERNIER MESSAGE
DATA All about DATA	1	1	par jyr » 04 Mai 2009, 14:07
ANALYSES All about Analyses	0	0	Aucun message

QUI EST EN LIGNE ?

Au total, il y a 2 utilisateurs en ligne :: 1 inscrit, 0 invisible et 1 invité (basé sur les utilisateurs actifs des 5 dernières minutes)
Le nombre maximum d'utilisateurs en ligne simultanément a été de 5 le 16 Février 2009, 16:12

Utilisateurs inscrits : jyr

Légende: **Administrateurs**, **Modérateurs globaux**

STATISTIQUES

51 messages au total • 21 sujets au total • 18 membres au total • Notre membre le plus récent est **mariaik**

Index du forum

L'équipe • Supprimer tous les cookies du forum • Heures au format UTC + 1 heure

Software description form

GRGS	
Combination Center	
Name	Observatoire de Paris
Contact	jean-yves.richard@obspm.fr
CONT08 COL campaign	
2008/08/10-2008/08/30	
DORIS	
Weight	
Analysis Center	
Name	CNES/CLS
Contact	laurent.soudarin@cls.fr
Software	
Name and version	GIN5 v9.2
Satellite	
satellites included in weekly SINEX	Spot-2,-4,-5, Envisat, Jason-2
Arc cut	
Arc lengths	3.5 days nominally (minimum 1 day)
Handle of Manoeuvres	half day containing manoeuvre not taken into account
Handle of Data lacks	half day containing data lacks higher than 3hrs not taken into account
Additional margins	3h

Reference System	
Polar motion and UT1 a priori	IERS bulletin C04 consistent with ITRF 2005, with IERS 1996 sub-daily corrections
Polar motion and UT1 approach	piece wise linear polygon
Station coordinates and velocities	DPOD2005 v1.4
Displacement of reference	
Earth tides	Wahr model (IERS Conventions 2003)
Atmospheric loading	ECMWF-derived 3D pressure field at 6 hr interval
Ocean loading	FES 2004 (all principal constituents, with admittance)
Hydrology loading	none
Pole tides	Solid Earth Pole tide from IERS2003
Satellite reference	
Mass and center of gravity	Post-Launch values + variations generated by Control Center
Satellite center of mass - antenna phase center correction	applied from CDDIS data files
Attitude Model	Nominal law for Jason2 and ENVISAT; SPOT satellites orientation is geocentric
Gravity	
Gravity field (static)	EIGEN-GL04S up to degree 99
Gravity field (time varying)	Drit+Annual+Semiannual 50x50 from EIGEN-GL04S-ANNUAL
Earth tides	IERS 2003 Solid Earth tides

Concluding remarks

- the COL-WG is starting activity, presently with 4 groups (AIUB, DGFI, GRGS, GSFC), still any other group is welcome
- it will focus mainly on:
 - homogeneizing technique processing
 - mutualizing physical parameters between techniques (troposphere...)
 - studying technique systematizations
 - progressing in combination methods and strategies (weighting...)
- it will organize test processing on benchmarks
- its goal is to demonstrate the gain of this COL approach vs. actual realizations (C04, ITRF...)