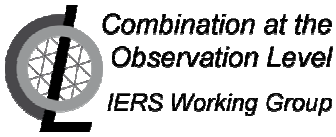
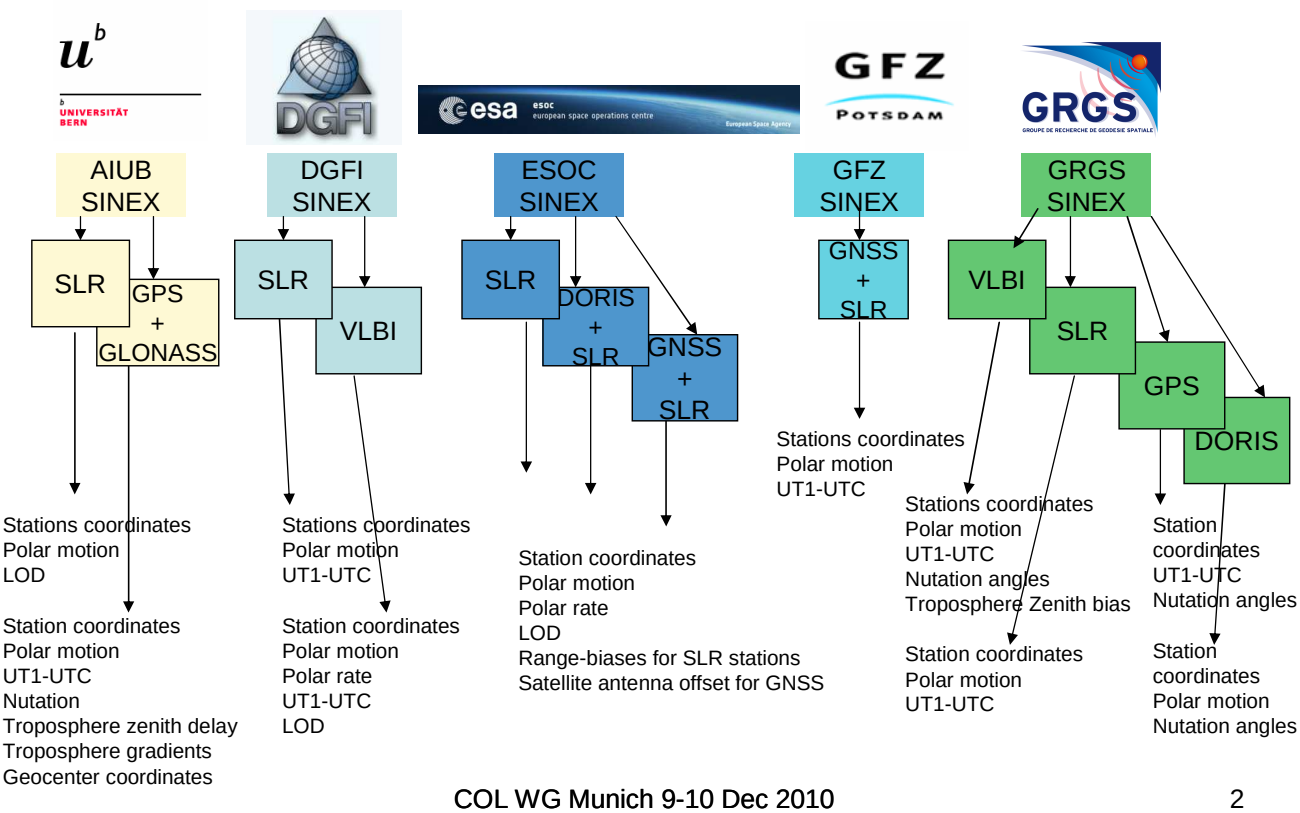


IERS COL-WG project
SINEX COMPATIBILITY
GRGS ANALYSES

J-Y. Richard, D. Gambis, R. Biancale, C. Bizouard

COL WG Munich 9-10 Dec 2010

Analysis Centers participating



AIUB

Analysis Strategy Summary for the International GNSS Service (IGS) available at:
ftp://ftp.unibe.ch/aiub/CODE/0000_CODE.ACN

SLR-only solution: arc length 7d
-Lageos-1/-2 data are included
-Derived from an SLR processing at AIUB together with BKG
-ILRS Analysis Working Group (AWG) specifications
Bernese GPS Software, SLR development version

Weekly **SLR** normals contain
-Station coordinates at epoch for **20 SLR Domes**
-Polar motion (24-hour resolution)
-LOD (24-hour resolution)
-Range biases for some stations (ILRS AWG specifications)

GNSS solution**:** arc length 3d
-Combined **GPS+GLONASS** analysis
Derived from a GLONASS reprocessing at CODE
Bernese GPS Software, version 5.1

Daily **GNSS** normals contain :
- Station coordinates at epoch for **252 GNSS Domes**
- Polar motion (24-hour resolution)
- UT1-UTC (24-hour resolution)
- Nutation (24-hour resolution)
- Troposphere zenith delays (2-hour resolution)
- Troposphere gradients (24-hour resolution)

DGFI

SLR-only solution: arc length 7d, step size 60s
-SLR data from Lageos-1 / -2, and Etalon-1 / -2

Weekly **SLR** normals contain:
Station coordinates at epoch for **23 SLR stations**
X-pole, Y-pole, UT1-UTC et the mid day epoch

VLBI-only solution is based on data of 52 telescopes

Daily **VLBI** normals contain:
-Station coordinates at epoch for **11 VLBI stations**
-X-pole, Y-pole, X-pole rate, Y-pole rate UT1-UTC and LOD at the mid-day epoch

AIUB

	GPS **daily**	SLR **weekly**
SINEX format Method 6c	+SOLUTION/STATISTICS +SITE/ID +SITE/RECEIVER +SITE/ANTENNA +SITE/GPS_PHASE_CENTER +SITE/ECCENTRICITY +SOLUTION/EPOCHS +SOLUTION/**NORMAL_EQUATION_VECTOR** +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**NORMAL_EQUATION_MATRIX L**	+SOLUTION/STATISTICS +SITE/ID +SITE/ECCENTRICITY +SOLUTION/EPOCHS +BIAS/EPOCHS +SOLUTION/**NORMAL_EQUATION_VECTOR** +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**NORMAL_EQUATION_MATRIX L**
Parameters	XPO, YPO, UT, 00h STAX, STAY, STAZ 12h **TGETOT** (00h 24h), troposphere gradient in east (wet + dry) m **TGNTOT** (00h, 24h), troposphere gradient in north (wet + dry) m **TROTOT** (2h) wet + dry Trop. delay, m NUT_OB (delta Psi) (00h, 24h), NUT_LN (delta Eps) (00h, 24h), **XGC, YGC, ZGC** at 11h59 (Geocenter)	XPO, YPO, **12h** XPOR, YPOR, LOD **12h** STAX, STAY, STAZ 12h mid epoch
GINS format	Normal Equations converted Troposphere & Center of Mass parameters are now converted	Normal Equations converted

DGFI

	VLBI **daily**	SLR **weekly**
SINEX format Method 6c	+SITE/ID +**NUTATION/DATA** +**PRECESSION/DATA** +SITE/ECCENTRICITY +SOLUTION/EPOCHS +SOLUTION/**APRIORI** +SOLUTION/STATISTICS +**SOLUTION/NORMAL_EQUATION_MATRIX U** +SOLUTION/**NORMAL_EQUATION_VECTOR** **ENDSNX of file are missing**	+SITE/ID +SOLUTION/EPOCHS +BIAS/EPOCHS +SITE/ECCENTRICITY +SOLUTION/STATISTICS +SOLUTION/**APRIORI** +**SOLUTION/NORMAL_EQUATION_MATRIX U** +SOLUTION/**NORMAL_EQUATION_VECTOR**
Parameters	XPO, YPO, UT, 1pt/d at 11h58 (**1pt at 11h & 1 pt at 06h**) XPOR, YPOR, LOD, 1pt/d at 11h58 **NUT_OB, NUT_LN** 1pt/d at 11h STAX, STAY, STAZ 1pt/d at 12h	XPO, YPO, UT, 00h STAX, STAY, STAZ 1pt at 12h mid epoch RBIAS 1 pt at 12h01 mid epoch
GINS format	Normal Equations converted	Normal Equations converted

ESOC

NAPEOS reference document DOPS-SYS-TN-0100-OPS-GN-MathModels.pdf is available at:
ftp://dgn6.esoc.esa.int/cool/

Combined DORIS/SLR solutions are based on:
-DORIS data from: SPOT-2, 4, 5, ENVISAT, and JASON-2.
-SLR data from: ENVISAT and JASON-2

Combined GNSS/SLR solutions are based on:
-IGS GNSS data from all GNSS satellites using **150 stations** of the IGS tracking network. - Note that the collocated GNSS sites were selected with high priority
-SLR data from the GPS36/PRN06, GLO723/R11, GLO716/R15, GLO713/R24

SLR-only solution is based on:
-SLR data from Lageos-1 and -2, and Etalon-1 and -2

Weekly **DORIS/SLR, GNSS/SLR, SLR** normals contain:
Station coordinates for all stations used in the solution weekly at epoch
DORIS/SLR: **23 SLR** Domes + **48 DORIS** Domes numbers
GNSS/SLR: **197 GNSS** Domes - **11 SLR** Domes numbers
X-pole, Y-pole, X-pole rate, Y-pole rate and LOD at the mid-day epoch
Range-biases for all SLR stations
Satellite antenna offset (X, Y, and Z) for the GNSS satellites

GFZ

Combined GNSS/SLR solutions are based on:
-IGS GNSS data from all GNSS satellites using **68 stations** of the IGS tracking network.
-SLR data from GRACE-A and GRACE-B
-arc length 1 day

Daily **GNSS/SLR** normals contain:
Station coordinates for all stations used in the solution at mid-day epoch
X-pole, Y-pole and UTC at the mid-day epoch
Eccentricity
Constraints 1m for stations and 1m for EOP

ESOC

	DORIS+SLR weekly	GNSS+SLR weekly	SLR weekly
SINEX format Method 6b	+SITE/ID +SITE/RECEIVER +SITE/ANTENNA +SITE/ECCENTRICITY +SOLUTION/EPOCHS +BIAS/EPOCHS +SOLUTION/STATISTICS +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**MATRIX_APRIORI L INFO** +SOLUTION/**NORMAL_EQUATION_MATRIX L INFO** +SOLUTION/**NORMAL_EQUATION_VECTOR**	+SITE/ID +SITE/RECEIVER +SITE/ANTENNA +SITE/GPS_PHASE_CENTER +SITE/ECCENTRICITY +SATELLITE/ID +SATELLITE/PHASE_CENTER +SOLUTION/EPOCHS +BIAS/EPOCHS +SOLUTION/STATISTICS +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**MATRIX_APRIORI L INFO** **+**SOLUTION/**NORMAL_EQUATION_MATRIX L INFO** +SOLUTION/**NORMAL_EQUATION_VECTOR**	+SITE/ID +SITE/ECCENTRICITY +SOLUTION/EPOCHS +BIAS/EPOCHS +SOLUTION/STATISTICS +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**MATRIX_APRIORI L INFO** +SOLUTION/**NORMAL_EQUATION_MATRIX L INFO** +SOLUTION/**NORMAL_EQUATION_VECTOR**
Parameters	XPO, YPO 1pt/d at 12h XPOR, YPOR, LOD 1pt/d at 12h STAX, STAY, STAZ 1pt 12h mid epoch RBIAS 1pt 12h mid epoch	XPO, YPO 1pt/d à 12h XPOR, YPOR, LOD 1pt/d at 12h STAX, STAY, STAZ 1pt mid of epoch RBIAS 1pt at mid epoch **SATA_X, SATA_Y SATA_Z** 1pt/d mid epoch 11h59	XPO, YPO 1pt/d at 12h XPOR, YPOR, LOD 1pt/d at 12h STAX, STAY, STAZ 1pt mid epoch RBIAS 1pt mid epoch
GINS format	Normal Equations converted with white parameters due to the 1st line in SINEX with a wrong number of parameters estimated in the header line Normal Equations converted	Normal Equations converted	Normal Equations converted

GFZ

	GNSS+SLR daily
SINEX format Method 6a	+SITE/ID +SITE/ECCENTRICITY +SATELLITE/ID +SATELLITE/PHASE_CENTER +SOLUTION/EPOCHS +SOLUTION/STATISTICS **WEIGHTED SQUARE SUM O-C missing = f * dof** +SOLUTION/ESTIMATE +SOLUTION/**APRIORI** +SOLUTION/**NORMAL_EQUATION_VECTOR** +SOLUTION/**MATRIX_ESTIMATE L INFO L => matrice N = Ntotal – Nconstraint**
Parameters	XPO, YPO, **UT-UTC** 2pt/d at 00h and 24h STAX, STAY, STAZ 1pt/d at 12h
GINS format	Normal Equations converted with adding the **WEIGHTED SQUARE SUM O-C = Variance Factor * Degree of Freedom**

GRGS

GPS

GPS-only normals are based on the IGS GPS data from all GPS satellites using **121 stations of the IGS** tracking network. 57 stations of them are collocated with DORIS, VLBI and/or SLR

Weekly GPS normals contain:
Series n3:
- Station coordinates for all stations: weekly at epoch Wednesday 12:00
X-pole, Y-pole, UT1UTC: 6h-parameters at 00:00, 06:00, 12:00, 18:00 (piece-wise linear polygon)
Nutation, precession: 12h-paramters at 00:00 and 12:00

Series n4: (similar to the equations inverted for our contribution to IGS)
- Station coordinates for all stations: weekly at epoch Wednesday 12:00
X-pole, Y-pole, X-pole rate, Y-pole rate, UT1UTC and LOD: daily values at 12:00
Serie n5: series n3 reduced
Station coordinates for all stations: weekly parameters
X-pole, Y-pole, UT1UTC: daily at 12:00 (daily piece-wise linear polygon)

DORIS

DORIS-only normals are based on the DORIS data from: SPOT-2, 4, 5, ENVISAT, and JASON-2

Weekly DORIS normals contain:
Serie n1, n2:
- Station coordinates for all stations: weekly parameters, Wednesday 12:00
- X-pole, Y-pole, UT1UTC: 6h-parameters at 00:00, 06:00, 12:00, 18:00 (piece-wise linear polygon)
- Nutation, precession: 12h-paramters at 00:00 and 12:00
-Tropospheric zenithal bias per station and per satellite pass.

Serie n3:
- Station coordinates for all stations: weekly parameters, Wednesday 12:00
- X-pole, Y-pole, UT1UTC: 6h-parameters at 00:00, 06:00, 12:00, 18:00 (piece-wise linear polygon)
-Nutation, precession: 12h-paramters at 00:00 and 12:00

Serie n4:
- Station coordinates for all stations: weekly parameters, Wednesday 12:00
- X-pole, Y-pole, UT1UTC: daily-parameters at 12:00 (daily piece-wise linear polygon)
- Nutation, precession: daily-parameters at 12:00

GRGS

VLBI

VLBI-only Clocks and tropospheric zenith delays are modelled using piecewise continuous linear functions with breaks every hour. The a priori terrestrial reference frame used is ITRF2005. The celestial frame is fixed to the ICRF.

Weekly VLBI normals contain:
-Station coordinates at epoch for **11 VLBI stations**
-X-pole, Y-pole, UT1-UTC, 6h interval per day (series n1) & daily (series n2)
-Nutation angle ψsin(ε0) and ε, 12h interval per day (series n1) & daily (series n2)
-Troposphere Zenith bias hourly

SLR

SLR-only solution is based on SLR data from Lageos-1 and -2,
weekly orbital arcs: RMSLA1=1.06cm
RMSLA2=0.99cm
orbital modeling:
- following ILRS recommendations for SLR data
- accounting for atmospheric loading (gravity field and station coordinates), and albedo grids

Adjusted parameters:
- 5 empirical coefficients (non gravitational forces)
- no range bias (following ILRS recommendations)

Weekly SLR normals contain:
Station coordinates at epoch for **14 SLR stations**
X-pole, Y-pole, UT1-UTC 6h interval per day (series n1) & daily (series n2)

GRGS

	VLBI weekly	GPS weekly	DORIS weekly	SLR weekly
SINEX format 6c	+SITE/ID +NUTATION/DATA (mandatory) +PRECESSION/DATA (mandatory) +SOLUTION/STATISTICS +SOLUTION/EPOCHS +SOLUTION/APRIORI +SOLUTION/NORMAL_EQUATION_VECTOR +SOLUTION/NORMAL_EQUATION_MATRIX L	+SITE/ID +SITE/RECEIVER +SITE/ANTENNA +SITE/GPS_PHASE_CENTER +SITE/ECCENTRICITY +SOLUTION/STATISTICS +SOLUTION/EPOCHS +SOLUTION/APRIORI +SOLUTION/NORMAL_EQUATION_VECTOR +SOLUTION/NORMAL_EQUATION_MATRIX L	+SITE/ID +SOLUTION/STATISTICS +SOLUTION/EPOCHS +SOLUTION/APRIORI +SOLUTION/NORMAL_EQUATION_VECTOR +SOLUTION/NORMAL_EQUATION_MATRIX L	
Parameters	XPO, YPO, **UT-TAI** 4 pt/d, 00h,06h,12h,18h NUT_OB, NUT_LN 2 pt/d 00h,12h STAX, STAY, STAZ 1 pt/d 12h ZBIAS Station names missing	XPO, YPO, **UT-TAI** 4 pt/d, 00h,06h,12h,18h NUT_OB, NUT_LN 2 pt/d 00h,12h STAX, STAY, STAZ 1 pt/d 12h	XPO, YPO, **UT-TAI** 4 pt/d, 00h,06h,12h,18h NUT_OB, NUT_LN 2 pt/d 00h,12h STAX, STAY, STAZ 1 pt/d 12h	XPO, YPO, **UT-TAI** 4 pt/d, 00h,06h,12h,18h STAX, STAY, STAZ 1 pt/d 12h