Betreff: [IGSMAIL-6355] Upcoming switch to IGS08/igs08.atx - Details on igs08.atx
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Dear colleagues!

As announced in [IGSMAIL-6354], the IGS will adopt a new reference frame called IGS08 that should be used together with igs08.atx, an updated set of receiver and satellite antenna phase center corrections, in the near future. Those will replace the absolute phase center correction model igs05.atx adopted in November 2006 (GPS week 1400) together with the IGS reference frame IGS05.

Since then, it was only possible to add correction values for new satellite or receiver antennas. In general, updates of existing values were not possible in order not to jeopardize the consistency of IGS products. So, for a lot of IGS stations converted field calibrations were still applied, although azimuthal phase center corrections down to the horizon from robot calibrations would have been available.

Due to a strong correlation between the satellite antenna phase center offsets in the Earth radial direction (z-PCOs) and the scale of the terrestrial reference frame, the scale difference between ITRF2005 and ITRF2008 is also relevant for the antenna model. If satellite z-PCOs were not adapted before the switch to IGS08, the scales of the terrestrial frame solutions of the IGS analysis centers (ACs) would no longer be close to the ITRF scale.

Due to these reasons a general update of the IGS antenna phase center correction model became necessary. As coordinate jumps are unavoidable when adopting a new reference frame, receiver antenna calibrations are ideally updated at the same time. So, besides replacing converted field calibrations, more or less all type-specific correction values were updated with results from recent calibrations of further individual antennas.

All these changes will have an impact on the users. However, this impact will be much smaller than was the case with the switch from relative to absolute phase center corrections in 2006 (see [IGSMAIL-5189]). Details on the various model improvements will be given in the following. If you have any further comments or questions, please send those to schmid@bv.tum.de.

A preliminary version of the antenna model without GLONASS satellite antenna corrections is currently available at
ftp://igs-rf.ign.fr/pub/IGS08/igs08_1604_woGLO_final.atx
As soon as the GLONASS satellite antenna corrections are finalized, the final model will be posted at ftp://igs.org/igscb/station/general/ and announced via IGSMAIL.

Many thanks to
- all ACs providing sat. PCO estimates within their reprocessed SINEX files
- Xavier Collilieux (IGN) for analyzing those SINEX files
- CODE and ESA for providing GLONASS satellite antenna corrections
- Martin Schmitz (Geo++ GmbH) for providing updated robot calibrations
- Paul Rebischung (IGN) for analyzing the impact on station coordinates

With best regards,

Ralf Schmid

on behalf of the IGS Antenna Working Group

Major changes of igs08.atx w.r.t. igs05.atx
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* Satellite antenna phase center corrections (GLONASS still tbd.!)

+ The satellite z-PCOs from igs08.atx are consistent with the new IGS reference frame IGS08, whereas those from igs05.atx were approximately consistent with IGS05.

+ The z-PCO estimates are based on the results of more ACs. The GPS values in igs08.atx were derived from the weekly SINEX files of five ACs (CODE, ESA, GFZ, MIT, NRCan), whereas igs05.atx was based on two ACs only. The GLONASS corrections (still tbd.) were estimated by CODE and ESA, whereas igs05.atx contained a CODE-only solution.

+ All preliminary z-PCOs for satellites launched in recent years could be replaced by actual estimates. It is the intention for igs08.atx that preliminary values should be replaced within few months after the launch.

+ Due to an improved quality of the ITRF vertical rates (ITRF2008 compared to ITRF2000), the z-PCOs are no longer trend-corrected.

+ igs08.atx also contains information on historical satellites. All GPS Block I satellites were added with block mean values. The same is true for all GLONASS satellites back to the IGEX-98 campaign (still tbd.).

* Receiver antenna calibrations

+ Robot calibrations for 15 additional antenna types could be added. For those types, converted field calibrations or copied values were applied so far or they were not contained in the file:

ASH701941.B	SCIS
ASH701945C_M	NONE
ASH701945C_M	OLGA
ASH701945E_M	NONE
ASH701945E_M	SNOW
ASH701945G_M	SNOW
LEIAX1202GG	NONE
NOV503+CR	SPKE
NOV600	NONE
TPSCR3_GGD	NONE
TPSCR3_GGD	CONE
TRM29659.00	SCIS
TRM29659.00	SCIT
TRM39105.00	NONE
TRM41249.00	TZGD

+ For 9 additional antenna types, robot calibration results were copied from antenna types that should be identical in construction. For those types, converted field calibrations were applied so far or they were not contained in the file:

ASH700228B	NONE
ASH700228E	NONE
ASH700718A	NONE
ASH700936A_M	SNOW
ASH700936E_C	SNOW
ASH701945B_M	SNOW
ASH701945D_M	SNOW
LEIAS05	NONE

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   LEIAT202-GP     NONE

+ Existing type-specific phase center corrections from robot
calibrations were updated with results from recent individual antenna
calibrations, if available. Therefore, 46 robot calibrations changed:
   AOAD/M_T        NONE
   AOAD/M_TA_NGS   NONE
   ASH700228A      NONE
   ASH700936A_M    NONE
   ASH700936B_M    NONE
   ASH700936C_M    NONE
   ASH700936D_M    NONE
   ASH700936D_M    SNOW
   ASH700936E      NONE
   ASH700936E      SNOW
   ASH700936E_C    NONE
   ASH700936F_C    NONE
   ASH701073.1     NONE
   ASH701073.3     NONE
   ASH701945B_M    NONE
   ASH701945D_M    NONE
   ASH701945G_M    NONE
   ASH701946.2     NONE
   ASH701946.3     NONE
   LEIAS10         NONE
   LEIAT504        NONE
   LEIAT504        LEIS
   LEIAT504GG      NONE
   LEIAT504GG      LEIS
   LEIATX1230+GNSS NONE
   LEIAX1202       NONE
   LEIAX1203+GNSS  NONE
   LEIGS09         NONE
   LEIMNA950GG     NONE
   TPSCR.G3        NONE
   TPSCR.G3        TPSH
   TPSCR4          NONE
   TRM14177.00     NONE
   TRM14532.00     NONE
   TRM22020.00+GP  NONE
   TRM29659.00     NONE
   TRM29659.00     TCWD
   TRM33429.00+GP  NONE
   TRM33429.20+GP  NONE
   TRM41249.00     NONE
   TRM55971.00     NONE
   TRM57971.00     NONE
   TRM59800.00     NONE
   TRM59800.00     SCIS
   TRM59800.80     NONE
   TRM59800.80     SCIS
However, the correction values for 41 antenna types with robot-based
values remained unchanged:
   ASH700228D      NONE
   ASH700718B      NONE
   ASH700936B_M    SNOW
   ASH700936C_M    SNOW
   ASH701945C_M    PFAN
   ASH701945C_M    SNOW
   ASH701946.3     SNOW
   JAV_GRANT-G3T   NONE
   JAV_RINGANT_G3T NONE
   JAVRINGANT_DM   NONE
   LEIAR10         NONE
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   LEIAR25         NONE
   LEIAR25         LEIT
   LEIAR25.R3      NONE
   LEIAR25.R3      LEIT
   LEIAR25.R4      NONE
   LEIAR25.R4      LEIT
   LEIAR25.R4      SCIT
   LEIAT302-GP     NONE
   LEIAT303        NONE
   LEIAT303        LEIC
   LEIAT504        OLGA
   LEIAT504        SCIS
   LEIGS15         NONE
   NOV702          NONE
   NOV702GG        NONE
   NOV750.R4       NONE
   NOV750.R4       NOVS
   TPSCR.G3        SCIS
   TPSCR3_GGD      OLGA
   TPSCR3_GGD      PFAN
   TRM23903.00     NONE
   TRM29659.00     OLGA
   TRM29659.00     SNOW
   TRM33429.20+GP  TCWD
   TRM55971.00     TZGD
   TRM57970.00     NONE
   TRM59800.00     SCIT
   TRM59800.80     SCIT
   TRMR8_GNSS      NONE
   TRMR8_GNSS3     NONE

+ GLONASS-specific corrections from robot calibrations were added, if
available. Those will be used to generate the GLONASS products of the
IGS. In case that GLONASS-specific values are not available for a
certain antenna type, the correction values for the GPS frequencies will
be used instead.

+ As the correction values of the IGS reference antenna AOAD/M_T got
updated, all converted calibrations slightly changed. This concerns 87
antenna calibrations converted from NGS field results and 14 types
converted from igs_01.pcv.

+ To improve internal consistency the correction values of 3 antenna
types are now converted from NGS field calibrations, rather than from
igs_01.pcv:
   ASH700228C      NONE
   LEISR299_INT    NONE
   LEISR399_INT    NONE

+ The calibrations of 2 antenna types were removed due to naming
inconsistencies between IGS and NGS:
   SPP571908273    NONE
   SPP571908273    SPKE

+ The calibrations of 2 antenna types remained untouched due to problems
with unmodeled subtypes having the same name. The Antenna Working Group
will try to approach this problem in the near future:
   JPSREGANT_DD_E  NONE
   JPSREGANT_SD_E  NONE


Some remarks on the magnitude and impact of the changes
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"AOAD/M_T NONE" as an example

Although the Dorne Margolin antenna AOAD/M_T of Allen Osborne Associates, Inc. was the reference antenna of the IGS, as long as relative phase center corrections were used, its "type mean values" contained in igs05.atx were based on the calibration of one single antenna only, namely SN 404 (serial number). However, the igs05.atx correction values were a mean of 42 individual calibration runs. For igs08.atx, additional 20 calibration runs of a second antenna (SN 393) were considered.

As the number of individually calibrated antennas is small, the phase center corrections change significantly, if additional calibrations are taken into account. The differences between calibration results for antennas of the same type contain the errors of the calibration procedure, but also the effect of deviations of the individual antenna from the ideally manufactured one. The latter effect could only be compensated by using individual rather than type mean calibrations. However, individual calibrations are not considered within the IGS so far.

If the number of individual calibrations to derive the type mean values was bigger, the transition from one phase center model to the next would be smoother. On the one hand, this would have advantages for the maintenance of the reference frame, but on the other hand, the stability of the phase center corrections would somehow be illusive, as actual deviations from the type mean hardly showed up anymore.

In the case of AOAD/M_T, the phase center correction changes due to the update from igs05.atx to igs08.atx are on the sub-mm level. The biggest effect shows up in the up component of the L1 PCO (0.6 mm) as well as in the phase center variations (PCVs) for L1 (up to 0.6 mm below an elevation of 10°). If these corrections are applied to derive the ionosphere-free linear combination, the effect is amplified. Thus, IGN could find coordinate changes for stations equipped with AOAD/M_T of about 2-3 mm (see coefficient "a" of the model for up position shifts) that were too small to be considered for IGS08:
ftp://igs-rf.ensg.eu/pub/IGS08/new_calib/lat_models.txt

As the AOAD/M_T antenna is used to convert relative field calibrations, also all those correction values change in the same manner. In the future, coordinate changes due to calibration updates will get smaller and smaller, whereas the problem of individual antenna deviations persists. Unfortunately, their impact on station coordinates could easily reach the 1 mm level.

Biggest phase center correction changes

By checking the coefficients "a" of IGN's latitude-dependent correction models (ftp://igs-rf.ensg.eu/pub/IGS08/new_calib/lat_models.txt), one can easily detect those antenna types that suffer the biggest changes (differences of more than 1 cm in the station coordinates):

+ ASH700228C NONE
Whereas the former relative IGS model igs_01.pcv only contained one set of phase center corrections for all antennas of the type ASH700228x, NGS provides three different sets (ASH700228A/B, ASH700228C, ASH700228D/E). Therefore, igs08.atx contains values converted from relative NGS field calibrations that differ significantly from those converted from igs_01.pcv (contained in igs05.atx).

+ ASH700718A NONE
Both NGS and igs_01.pcv provide identical correction values for

ASH700718A and ASH700718B. Therefore, the robot-based values for ASH700718B were copied. The big offset component in North direction only shows up in the igs_01.pcv values (used for igs05.atx), but not in the NGS or Geo++ results.

+ ASH701941.B SCIS
For that antenna/radome combination no calibration results were available so far. Therefore, the correction values for the antenna without radome (NONE) were applied within the IGS. So, the dramatic coordinate change in vertical direction demonstrates the effect of ignoring the radome.

+ LEIAT202-GP NONE
As both NGS and igs_01.pcv provide identical correction values for LEIAT202-GP and LEIAT302-GP, robot-based values were copied from LEIAT302-GP. The values contained in igs05.atx were converted from igs_01.pcv.

+ LEISR299_INT NONE
According to NGS, LEISR299_INT should be identical to LEISR399_INTA, but not to LEISR399_INT as was the case in igs_01.pcv. This might be related to the confusion as regards these antenna names within rcvr_ant.tab.

+ TRM39105.00 NONE
In this case, converted field calibrations could be replaced by robot-based values.

Biggest impact of robot-to-robot updates

In most cases the coordinate changes caused by robot calibration updates are small. The "a" coefficients from ftp://igs-rf.ensg.eu/pub/IGS08/new_calib/lat_models.txt are below 2 mm for most antenna types that already had robot-based correction values in igs05.atx. The calibration differences are smaller, but amplified by the ionosphere-free linear combination.

The biggest coordinate changes can mainly be explained by significant changes in the number of individually calibrated antennas. Detailed information on the number of individual antennas and calibration runs is given in the antenna-specific comments contained in igs08.atx:

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+ ASH700936E      NONE (up component)     1 ->  2 individual antennas
+ TRM29659.00     NONE (east component)  12 -> 18 individual antennas
+ ASH700936D_M    NONE (up component)     1 ->  4 individual antennas
+ LEIAT504GG      NONE (up component)     5 -> 25 individual antennas
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