Betreff: [IGSMAIL-6356] Advice for coping with the change to IGS08+igs08.atx
Von: Jake Griffiths <Jake.Griffiths@noaa.gov>
Datum: Mon, 07 Mar 2011 09:24:21 -0500
An: igsmail@igscb.jpl.nasa.gov

As announced in IGS Mails #6354 and #6355, the IGS will switch from the (IGS05 +
igs05.atx) framework to (IGS08 + igs08.atx) in the coming weeks. Many users have
accumulated results expressed in the old framework, either based on the regular
IGS operational products since November 2006 or in concert with the IGS 1st
reprocessing campaign (acc.igs.org/reprocess.html). This note provides advice to
those users on transforming their old results to be consistent with the new
frame, to high accuracy.

The most direct method to establish consistency with the (IGS08 + igs08.atx)
system is to reprocess all old data in the new framework. The IGS will do that
over the next few years, in its 2nd reprocessing campaign. But many users may
not find this option to be timely or cost-efficient for the near term. An
alternative strategy is outlined below that does not require data reprocessing.

Jake Griffiths, Jim Ray, Paul Rebischung, Ralf Schmid

We assume that a user has a long time series of data reduced using igs05.atx
antenna calibrations and that the results have been stacked into a long-term
linear frame aligned to the IGS05 reference frame (RF), or possibly some other
well-defined RF. To generate an equivalent frame solution aligned to the IGS08
RF and consistent with igs08.atx antenna calibrations involves two main
steps--application of position corrections to account for antenna calibration
changes and a Helmert alignment to IGS08.SNX.

1. POSITION CORRECTIONS TO ACCOUNT FOR ATX CHANGES

A simple, direct Helmert transformation from the user igs05.atx-calibrated frame
to a set of the included IGS08 stations is **not** recommended. For one, the IGS08
positions have been derived from ITRF2008 values by directly applying
station-dependent corrections to account for the impact of changing from
igs05.atx antenna calibrations (which were used to realize IGS05 and ITRF2008)
to igs08.atx. Equivalent position corrections are needed for the user frame
before attempting any Helmert alignment.

1.1 Station-dependent corrections

For the IGS08 RF stations contained in the user frame, the same corrections as
used to create IGS08 can be applied, which are available at:

ftp://igs-rf.ensg.eu/pub/IGS08/ITRF2008_to_IGS08.txt
ftp://igs-rf.ign.fr/pub/IGS08/ITRF2008_to_IGS08.txt

For each antenna type with an antenna calibration update, sets of station
positions were estimated using the Bernese GPS Software 5.0. A static PPP
processing strategy was used with 24h of data every 30 days during the span for
which the particular antenna (plus radome) was deployed at the station. For each
span, one set of positions was estimated using the igs05.atx calibration of the
antenna, the other using the igs08.atx calibration. Then, the two sets of
positions were differenced (igs08 minus igs05) and the weighted-average taken
over the differences to provide the corrections found in the above table.

These station-dependent corrections are best to use. However, since additional
user corrections may also be needed for the non-IGS08 stations to ensure overall

self-consistency, the procedure in the next section can be applied for non-IGS08
stations, and, if more convenient, also for IGS08 stations.

1.2 Latitude-dependent correction models by antenna type

The station-dependent corrections above have been calculated for each individual
station separately, whereas antenna type correction models are fits over
latitude. Here, for each antenna type with an updated calibration, two sets of
station positions were estimated using the Bernese PPP engine and 24h of data
for 82 well-distributed global stations. For each updated calibration, it was
assumed that all 82 stations were equipped with the antenna of interest, which,
of course, is not true. However, both sets of positions were then differenced,
minimizing common errors, and latitude-dependent functions fitted to the global
ensemble of East, North and Up position differences.

Discrepancies (de, dn, du) derived by subtracting the latitude-modeled from the
directly calculated position corrections have been computed. Most de and dn
discrepancies are smaller than 0.5 mm in magnitude, and most in du are smaller
than 1 mm in magnitude. Though there are several that are larger (units below
are mm):

```
#CODE_PT_SOLN__ANTENNA_____DOME__de_____dn_____du____
   CONZ  A   2  TPSCR3_GGD       CONE    0.52   0.17  -0.75
   CONZ  A   3  TPSCR3_GGD       CONE    0.52   0.17  -0.75
   JAB1  A   6  LEIAT504         NONE   -0.65  -0.04  -1.73
   EISL  A   2  ASH701945C_M     NONE   -0.76   0.21  -1.57
   NKLG  A   1  TRM29659.00      NONE    0.03  -0.02   1.09
   KERG  A   3  ASH701945E_M     SNOW   -0.03  -0.25  -1.04
   PIMO  A   4  ASH701945C_M     NONE    0.28   0.16  -1.53
   EISL  A   2  ASH701945C_M     NONE   -0.76   0.21  -1.57
   JAB1  A   6  LEIAT504         NONE   -0.65  -0.04  -1.73
   HOFN  A   4  TPSCR3_GGD       CONE    0.19   0.01  -2.65
   SCOR  A   1  ASH701941.B      SCIS   -0.16  -0.38  -3.38
```

The overall average ENU discrepancies and standard deviations are:

```
  avg. de = -0.02 (+/- 0.19) mm
  avg. dn = -0.02 (+/- 0.13) mm
  avg. du = -0.13 (+/- 0.67) mm
```

Thus, on aggregate, the deficiencies of the modeled corrections are negligible
compared to the sigmas in IGS08. This is confirmed by rigorously comparing the
IGS08.SNX file and a pseudo SINEX file derived from applying the modeled
corrections (see Table 1).

Table 1. Helmert parameters from a comparison of IGS08.snx and a pseudo IGS08.
The parameters were derived using the 91 primary IGS08 core sites. Note that the
sigmas were **not** rescaled to force chi2=1, though, they were reduced by a
factor of sqrt(2).

	TX(mm)	TY(mm)	TZ(mm)	S(ppb)	RX(mas)	RY(mas)	RZ(mas)
offsets	0.00	0.00	0.00	0.000	0.000	0.000	0.000
±	0.06	0.06	0.06	0.010	0.002	0.002	0.002
rates	0.00	0.00	0.00	0.000	0.000	0.000	0.000
±	0.00	0.00	0.00	0.001	0.000	0.000	0.000

Although the comparisons made for IGS08.SNX are promising, actual changes due to
the igs05.atx->igs08.atx calibration updates may differ from those obtained by
the latitude-dependent models, especially for non-IGS08 stations, for reasons
such as:
  • the models were obtained from simulations using data from stations not
    actually equipped with the antennas of interest and only 24h of data
  • the precise impact of antenna calibration changes on station positions is a

```
        function of latitude *and* perhaps other parameters, such as station
        environment (observation masks and multipath) and elevation cut-off angle
```

1.3 Utilities

A few Perl utilities, designed for applying position corrections with some level
of modularity in mind, are available at:

ftp://igs-rf.ign.fr/pub/IGS08/scripts
ftp://igs-rf.ensg.eu/pub/IGS08/scripts

where,

```
    snx2ant.pl      - builds antenna information table from igs05.atx-calibrated
                        SINEX
    comp_corr.pl    - evaluates latitude-dependent models for each
                        antenna(+radome) in antenna information table to obtain
                        position corrections
    cmp2disc.pl     - matches position corrections to solution numbers given in a
                        table of discontinuities for the user's igs05.atx-calibrated
                        SINEX
    apply_shifts.pl - applies position corrections to solutions in igs05.atx-
                        calibrated SINEX
    date_conv.pm    - Perl module called by the above scripts
```

Running the scripts without command-line arguments will provide usage
information and other information about the input files.

The scripts for computing, matching and applying the modeled position
corrections assume that three files are provided by the user. Those files are:
  • a table of antenna information for sites in the igs05.atx-calibrated
    solution in a particular format (see usage info in comp_corr.pl)--if
    the SITE/ID and SITE/ANTENNA blocks in the SINEX file of the stacked
    frame are accurate, then snx2ant.pl can be used to create the ant.info table
  • a list of sites and solution numbers appearing in the stacked frame, also in
    a particular format (see usage info in cmp2disc.pl)
  • a definitive, SINEX-formatted discontinuity table (named soln.snx below)
    containing a record for each site in the igs05.atx-calibrated SINEX
    file--if a site has no discontinuities, we recommend inserting a record
    that corresponds to the solution number and data span

A fourth file containing a table of coefficients for the latitude-dependent
models is also required. As stated in IGS Mail #6354, such a table is available
containing models for each antenna type with *.atx calibrations. The file can be
found in two places:

  ftp://igs-rf.ign.fr/pub/IGS08/new_calib/lat_models.txt
  ftp://igs-rf.ensg.eu/pub/IGS08/new_calib/lat_models.txt

All antenna types appearing in both igs05.atx and igs08.atx have
latitude-dependent models in the lat_models.txt table. The models for
antenna/radome combinations with unchanged calibration values have zeros for
their coefficients, so a zero position correction is applied when the model is
evaluated. In the special cases where the user's stacked frame solution contains
sites with uncalibrated equipment, no correction is available to make its
position consistent with IGS05 or IGS08. Users should take care in how such
stations are used in order to avoid introducing frame inconsistencies in
downstream processing.

The sequence of Korn shell commands using the above scripts and tables could
look something like:

  snx2ant.pl igs08.atx igs05-atx.SNX > ant.info 2> log

```
comp_corr.pl ant.info lat_models.txt > ant.info_corr 2>> log

cmp2disc.pl pts.dat ant.info_corr soln.snx > shifts.dat 2>> log

apply_shifts.pl shifts.dat igs05-atx.SNX > igs08-atx.SNX 2>> log
```

where the igs05-atx.SNX and igs08-atx.SNX frames are consistent with usage of
igs05.atx and igs08.atx antenna calibrations, respectively. The user should also
note that the scripts provide diagnostic information to the log file that we
hope can be helpful in computing, matching and applying position corrections to
the data intervals in the user's regional solution. Of course, one can imagine
the case where a discontinuity due to an antenna change was omitted because no
position jump was detected. Such cases leave the user to decide whether
additional discontinuities are to be inserted, and the matching process be
repeated, or to simply omit that particular station/solution from the final
SINEX file.

It is important to note that the SOLUTION/EPOCHS block from the user's SINEX
file is not used to match latitude-dependent models to SINEX solution numbers.
By definition, the SOLUTION/EPOCHS block contains information about the span of
data used in the estimation of the position and velocity. The span of data may
not coincide with the discontinuity interval. Thus, the definitive beginning and
ending epochs used for matching are assumed to be in the user's soln.snx
discontinuity file.

2 - HELMERT ALIGNMENT TO IGS08.SNX

Once station-dependent corrections are computed and applied, then a Helmert
alignment to IGS08 should be performed. However, one must take care to match
discontinuity intervals between sites in IGS08 and the user's solution.

Note that within the entire IGS contribution to ITRF2008 of about 558 station
time series, which span up to about 12.5 yr, there is an overall average of 0.9
position discontinuities per station. The continuous span of data without any
break averages about 8.7 yr with a standard deviation of 3.2 yr. Consequently,
it is only practical to realize long-term GNSS RFs these days by including
position discontinuities, which is the case with the IGS08 RF. Aligning a user
frame to IGS08 requires that the same set of discontinuities applied in IGS08 be
used in the user frame for the stations used in the alignment. The set of IGS08
discontinuities is available at:

  ftp://igs-rf.ensg.eu/pub/IGS08/soln_IGS08.snx
  ftp://igs-rf.ign.fr/pub/IGS08/soln_IGS08.snx

We recommend that, once all station-specific corrections have been applied to
the user frame coordinates, the solution be aligned to IGS08. The set of sites
used for the Helmert alignment should be based on the IGS08 core network (e.g.,
ftp://igs-rf.ensg.eu/pub/IGS08/IGS08_core.txt), while also taking care to match
IGS08 discontinuities. Of course, the user can adopt their own set of
discontinuities, but it may be most convenient to use the same as those used by
the IGS for any common IGS08 stations.

_____
IGSMail mailing list
IGSMail@igscb.jpl.nasa.gov
http://igscb.jpl.nasa.gov/mailman/listinfo/igsmail