International Satellite Cloud Climatology Project

Calibration Monitoring
Build 5, Cal Add-on V1

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Table of Contents

1   Overview

This document is an expansion of the Build 5 Operations Guide Section 8, which documents the process by which NORM and ABS coefficients are derived for calibration of new satellites beyond the base period. This calibration process is needed in order to extend the data record.

1.1   Components of radiances, their QC and calibration

The ISCCP physical radiances (IR brightness temperature, VIS scaled radiance) are formed from two pieces of information: the raw image count values obtained from the satellite operator and the ISCCP-generated calibration tables that convert the counts into radiances. Either of these components can change with time from image-to-image, month-to-month, and satellite-to-satellite. Even with on-board calibration, the raw counts may not correspond to the same physical radiance values over time. Changes in the calibration tables try to correct for any changes in instrument (or telemetry errors) so that the image radiance statistics, when viewing Earth, are relatively constant over time.

The ISCCP calibration procedures employ several steps: quality checks of raw count statistics (GAC and B1U QC), monitoring of current polar orbiter calibration (VIS-IR MONITOR), adjustment of current polar orbiters to reference standard polar orbiter (NORM, ABS COEFS) based on output from VIS-IR MONITOR, normalization of geostationary calibrations to the current polar orbiter (VIS-IR NORM), final adjustment of geostationary calibrations to the reference standard based (NORM, ABS COEFFS) based on output from VIS-IR NORM and VIS-IR MONITOR, and a final check and possible adjustment during Cloud Product processing (CALCOR). Calibration is also monitored during Cloud Product processing by B4PLOTS, which may indicate an anomaly, and by D1STATS, which monitors monthly statistics against the whole time record. These plots can indicate unusual changes in the results that could be caused by erroneous calibration.

1.2   Expectations

Experience over ISCCP leads to the expectation that image-to-image and month-to-month calibrations for a satellite should not change dramatically, defined to be no more than a few Kelvins for brightness temperatures and no more than a few times 0.01 for VIS scaled radiances. This expectation is also consistent with the fact that radiance distributions over the whole Earth as a target are relatively constant over time, especially radiance distributions over oceans. Any instance where unusually large, short-term changes in the QC, MONITOR or NORM results are found should be investigated to ensure that an error either in raw counts (e.g., wrong spectral channel, dropped bits) or the procedures producing the calibration tables (e.g., truncated images, insufficient sample size or radiance range coverage) has not occurred. B4PLOTS can also indicate such errors by sudden spikes in image total cloud amount.

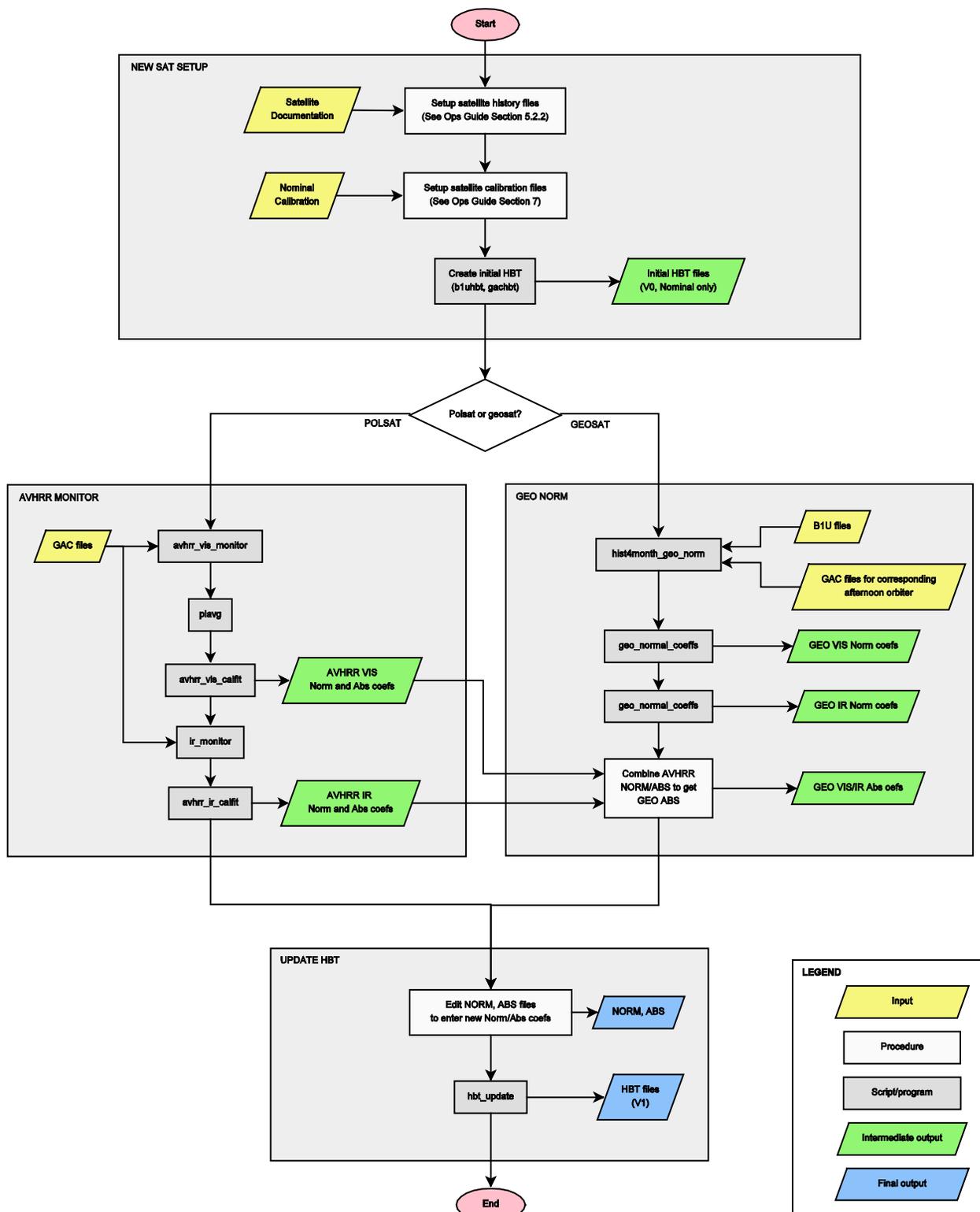## 1.3   Things to watch for and consistency checks

When examining the results of the QC, MONITOR and NORM programs, if there are large changes in the statistics or derived coefficients, then some additional things should be checked, especially by comparison to adjacent-in-time images and/or months of data from the same satellite. These include whether the pixel sample population has changed or whether the

extreme values in the counts **or** radiance distributions have changed (in particular if the lower/higher extremes have increased/decreased). These changes should be evaluated by application of the calibration coefficients to very low and very high count values to see if the changes in IR brightness temperature or VIS scaled radiances are actually significant in magnitude. In addition during Cloud Product processing, B4PLOTS should be checked for sudden spikes of cloud amount (to 0 or 100%), usually indicating an incorrect spectral channel, bad raw image counts or bad calibration tables. After Cloud Product processing the response of CALCOR should also be checked (did it ask for unusually large corrections?) and D1STATS should be checked to see if the Cloud Product statistics are similar to the rest of the time record. All of these checks are to determine where the problem lies: (1) raw image counts are bad – fix if possible or quarantine the image, (2) calibration coefficients from MONIITOR and NORM are bad – investigate cause but possibly replace them by interpolation between adjacent months, or (3) HBT is bad – redo and replace.

2   Calibration process flowchart

ISCCP Procedures for NEW-Satellite Calibration

```
                                    ┌───────┐
                                    │ Start │
                                    └───┬───┘
┌─ NEW SAT SETUP ──────────────────────┼────────────────────────────┐
│                                       ▼                            │
│  ┌──────────────┐      ┌──────────────────────────────┐           │
│  │  Satellite   │─────▶│  Setup satellite history files│           │
│  │ Documentation│      │  (See Ops Guide Section 5.2.2)│           │
│  └──────────────┘      └──────────────┬───────────────┘           │
│                                        ▼                           │
│  ┌──────────────┐      ┌──────────────────────────────┐           │
│  │   Nominal    │─────▶│ Setup satellite calibration   │           │
│  │ Calibration  │      │ files (See Ops Guide Section 7)│          │
│  └──────────────┘      └──────────────┬───────────────┘           │
│                                        ▼                           │
│                        ┌──────────────────┐   ┌──────────────────┐ │
│                        │ Create initial HBT│──▶│ Initial HBT files│ │
│                        │ (b1uhbt, gachbt)  │   │ (V0, Nominal only)│ │
│                        └──────────────────┘   └──────────────────┘ │
└────────────────────────────────────────────────────────────────────┘
```

- Satellite Documentation → Setup satellite history files (See Ops Guide Section 5.2.2)
- Nominal Calibration → Setup satellite calibration files (See Ops Guide Section 7)
- Create initial HBT (b1uhbt, gachbt) → Initial HBT files (V0, Nominal only)

Polsat or geosat?
- POLSAT
- GEOSAT

AVHRR MONITOR
- GAC files → avhrr_vis_monitor
- avhrr_vis_monitor → piavg
- piavg → avhrr_vis_calfit
- avhrr_vis_calfit → AVHRR VIS Norm and Abs coefs
- avhrr_vis_monitor → ir_monitor
- ir_monitor → avhrr_ir_calfit
- avhrr_ir_calfit → AVHRR IR Norm and Abs coefs

GEO NORM
- B1U files → hist4month_geo_norm
- GAC files for corresponding afternoon orbiter → hist4month_geo_norm
- hist4month_geo_norm → geo_normal_coefs
- geo_normal_coefs → GEO VIS Norm coefs
- geo_normal_coefs → GEO IR Norm coefs
- Combine AVHRR NORM/ABS to get GEO ABS → GEO VIS/IR Abs oefs

UPDATE HBT
- Edit NORM, ABS files to enter new Norm/Abs coefs → NORM, ABS
- hbt_update → HBT files (V1)
- End

LEGEND
- Input
- Procedure
- Script/program
- Intermediate output
- Final output

3   Contents of CAL Add-on V1 Package

The CAL Add-on V1 Package is a tar file that is to be unpacked in the location of
<ISCCP_ROOT>. It adds sub-directories to the <ISCCP_ROOT>/calibration directory as
follows:

```
calibration/bin        (Perl run scripts)

     initial_hbt.run            Run script for b1uhbt.f90

     avhrr_vis_monitor.run      Run script for avhrr_vis_monitor.f90

     ir_monitor.run             Run script for avhrr_ir_monitor.f90

     hist4month_geo_norm.run    Run script for hist4month_geo_norm.f90

     hbt_update.run             Run script for hbt_update.f90

     idl/  (IDL programs)

          read_clb.vegmap.pro    Sample program to plot contents of vegmap

          solbandw.pro           Compute solar constant and bandwidth

          plavg.pro              Compute means for avhrr_vis_calfit

          avhrr_vis_calfit.pro   Compute AVHRR VIS NORM, ABS coefs

          avhrr_ir_calfit.pro    Compute AVHRR IR NORM coefs

          geo_normal_coeffs.pro  Compute geosat VIS, IR NORM coefs

          solar_irrad_spectrum_0p3_4p0.sav   Solar spectral irradiance
                                             spectrum used by solbandw.pro

          savemulti.pro, closemulti.pro    3rd party IDL utils

          getcolor.pro, colour_ps.pro      3rd party IDL utils

          limage_plot.pro, tvscale.pro     3rd party IDL utils

calibration/doc

     ISCCP_Calibration_Addon.pdf   This document

calibration/src      (Fortran programs)

     Makefile                   Compiles f90 and installs in ../bin

     avhrr_vis_monitor.f90      AVHRR VIS monitor

     ir_monitor.f90             AVHRR IR monitor

     monitor_module.f90         Used by AVHRR monitor

     calcheck_module.f90        Used by AVHRR monitor

     gacdata_module.f90         Modified copy of production gacread to
                                return scan times

     hist4month_geo_norm.f90    Geosat VIS, IR NORM procedure
```

Page 6

```
    hbt_update.f90                  Update HBT using new NORM, ABS coefs

    add2sattab_radtmp.f90           Update SATTABLE for new satellite

    read_sattable.f90               Check contents of SATTABLE

    b1uhbt.f90                      Create initial HBT for geosats (updated
                                    from Build 5 version to include
                                    satellites beyond the base period)

calibration/tables      (static table data files)

    clb.vegmap              Used by avhrr_vis_monitor.f90

    inten.merge             Used by avhrr_vis_monitor.f90

    spc.osptrans_new        Used by avhrr_vis_monitor.f90

    spc.solarcon            Used by avhrr_vis_monitor.f90

    SATTABLE.ALL            Updated thermal RAD,TMP tables for new sats

calibration/sat_response_functions

    response.sss-nn         Updated response functions, new sats added

calibration/prdenv.cal      Script to set environment variables

calibration/README_cal.txt  Compiling instructions
```

The programs in this add-on package also use production modules. Paths are set in the "prdenv.cal" shell script which should be run to set the environment before using the Makefile in the calibration/src directory. Build this add-on by running "make; make install" from the calibration/src directory. Similarly, use "prdenv.cal" shell script to set the environment in any working directory in order to access the codes in this package from that directory.

This package is provided as an add-on that is separate from the production src directory because these codes are subject to change. When finalized, the contents of the calibration add-on directories of bin, src and tables could be merged with production directories.

4 New-Satellite Set-up

The calibration process requires that the following new satellite setup procedures first be completed:

4.1 Creation of Sat.pm entry

The new satellite must be added to Sat.pm by creating a new entry in the hash structure which specifies the satellite characteristics. See Ops Guide Section 5.2.2 for details.

4.2 Initial calibration setup (NOMINAL)

4.2.1 Response functions

The instrument response functions are obtained from the satellite operator and stored in a text file that is edited by hand. See Ops Guide Section 7.2.1 for details.

4.2.2 Solar constant (SOLCON) and IR bandwidth

The solar constant is computed manually for the VIS channel and entered into Sat.pm. See Ops Guide Section 7.2.2 for details.

An IDL procedure is provided (calibration/bin/idl/solbandw.pro) which calculates the solar constant and also the IR bandwidth. The bandwidth is entered into the nominal calibration file (SATINFO) which is used to create the thermal channel lookup tables in SATTABLE if it is necessary to convert radiance units: $W/m^2*sr*cm^{-1} \times$ bandwidth $= W/m^2*sr$.
To run:

> $. prdenv.cal
> $ idl
>   IDL> solbandw, 'response_filename', nchans, ispolar
>
>   response_filename= name of response function file
>   nchans= number of channels in the response function file
>   ispolr=1 for NOAA-10 and later orbiters, or 0 for all other satellites

Output:

>   satid_SRF_bandw.ps   Plot for each channel
>   satid_solbandw.txt   Text file containing solar constant and bandwidth values

4.2.3 Polar orbiter nominal calibration (SATINFO)

The information required for nominal calibration of polar orbiters must be obtained and entered by hand into a text file. See Ops Guide Section 7.2.3 for details. Although the operational nominal VIS calibration may change over time, the ISCCP procedure fixes the nominal VIS calibration to a constant value from the first month of data.

4.2.4 Thermal channel lookup tables (SATTABLE)

The SATTABLE.ALL file contains lookup tables for converting radiances to brightness temperatures, brightness temperatures to radiances, or counts to radiances. See Ops Guide Section 7.2.4 for details.

For new satellites beyond 2009 the prd/tables/SATTABLE.ALL file must be updated by adding the RAD(TMP) and TMP(RAD) lookup tables for the satellite. The program to generate these new tables is provided in calibration/src/add2sattab_radtmp.f90. This program must be modified by hand for each new satellite. The sections to be modified are identified by EDIT and END EDIT comments inside the code. Make sure the order of the channels is as expected, with two tables for each channel (first RAD(TMP) and then TMP(RAD)).

Historically, the order of the tables was dependent on the B2 format which varied by satellite and SPC. For newer satellites the first channel is always IR 10.5 µm and all other channels follow in increasing wavelength order. The index of the table to be used in production is specified in prd/src/sattable_module.f90. For new satellites beyond the base period this index will be 1. For older satellites it varies. The spectral identity of the IR channel should be verified; it should have a central wavelength of approximately 10.5 microns.

To run, first edit the program in sections marked EDIT and compile using "make install":

        $ add2sattab_radtmp

To check results use the program read_sattable.f90. Edit the path to the new SATTABLE file in the program and "make install" before running.

        $ read_sattable

When results have been verified, copy the new table to the production location in prd/tables/SATTABLE.ALL.

4.3 Initial cofficient files (NORM, ABS)

The NORM and ABS coefficients are stored as tables in text files. Initially these files are created with coefficients of 1.0 and 0.0 for slope and intercept (no correction). See Ops Guide Section 7.3 for details.

4.4 Initial HBT V0 files

The V0 HT files are created using the NOMINAL calibration obtained from the input data headers and/or the SPC. See Ops Guide Section 7.4 for details. For geosats beyond the base period, an updated version of b1uhbt.f90 is included in this package with a revised initial_hbt.run script.

5 Monitoring Polar Orbiter Calibration (MONITOR)

This process requires 2.0 whole years of GAC input data at a minimum, but a longer period is preferred. It requires that all satellite set-up procedures have been run including initialization of the HBT calibration tables with the nominal calibrations for the polar orbiter. The results of this process are NORM and ABS coefficients for the polar orbiter VIS and IR channels.

5.1 VIS channel monitor

The VIS monitor step reads GAC files (run for polar orbiter satellites only, single satellite at a time), applies HBT nominal calibration table 4, (but the code can use any table which can be used for later checking), retrieves the reflectance for each pixel after correcting for absorption through ozone and makes two maps, one for clear sky reflectance and one for total reflectance including clouds, using surface types with limits to define a set of targets on Earth. This information is used to investigate the VIS calibration if later results indicate a problem of consistency in the data record. The resulting map for clear sky reflectances is averaged over the globe for each month. When sufficient data are available (2 whole years or more), the global monthly mean reflectances are differenced with the NOAA-9 climatology. A linear fit is made to the time series of the reflectance differences. The reflectance differences are multiplied by a variable factor (K) until the offset of the linear fit is a minimum. The K-factor becomes the NORM coefficient for the current afternoon polar orbiter satellite. The slope (S) of the linear fit to the reflectance differences without the K-factor determines the ABS coefficient, which equals $1.0 + S/K$. The trend is removed by applying an exponential correction, $(ABS)**(month-1)$.

Program:	avhrr_vis_monitor.f90
Input:	GAC, HBT
Output:	sssnn.yyyymm.t.REGMONF Clear-sky surface reflectance for targets
	sssnn.yyyymm.t.TOTMONF Total surface reflectance, includes clouds

      where "t" is N, R, A depending on table selection (N=4 nom, R=5 norm, A=6 abs)

When running the VIS monitor to develop NORM and ABS coefficients for the polar orbiters, HBT Table 4 (NOM) calibration is used. However, there may occasions when the effect of the NORM and ABS needs to be checked, especially to see if long-term trends have been removed. This can be done by choosing either Table 5 (NORM) or Table 6 (ABS) but only after those coefficients have been applied to generate an updated HBT.

To run from the wrkdir, set the environment and start the run script with args:

      $ . ./prdenv.cal

      $ avhrr_vis_monitor.run wrkdir yyyy mm ddbeg ddend satpos tablenumber

For example, to run July 2007 NOA using NOMINAL calibration (table 4):

      $ cd wrkdirs/2007_07

```
$ . ./prdenv.cal
$ avhrr_vis_monitor.run . 2007 7 1 31 noa 4
```

This creates two output files:

NOA18.200707. N.REGMONF
NOA18.200707.N.TOTMONF

5.2 Deriving NORM coefficients and ABS coefficients for VIS AVHRR

When enough data (*.N.REGMONF) files are available(at least 1.5 to 2.0 years) generate monthly means using the IDL procedure plavg.pro.

Create a text file that lists all of the output files from the VIS monitor that will be input to the IDL program plavg.pro.

IDL> plavg,'input_file_list"

Where "input_file_list" lists all output files for the satellite. The IDL routine will write out a text file input_file_list_plavg.txt which will contain monthly means.

Example output: input_file_list_plavg.txt

```
200701  glb_clrskysrf_mmean=    10.4852
200702  glb_clrskysrf_mmean=    10.3517
200703  glb_clrskysrf_mmean=    10.5507
200704  glb_clrskysrf_mmean=    9.66581
200705  glb_clrskysrf_mmean=    7.80806
…
```

Enter these values into the "n18nom" array in the IDL routine avhrr_vis_calfit.pro. Make sure you fill in the NOAA-9 corresponding month climatology (yymm) in the "n9clim" array. Edit the prefix for the output file name, and then run the script.

IDL> avhrr_vis_calfit

The output will be prefix_avhrr_vis_calfit.ps, which will contain the fit plots and the AVHRR NORM and ABS calibration coefficients.

Results can be checked by re-running the monitor with Table 5 (NORM) or Table 6 (ABS) selected from updated (using the above coefficients) HBT files. As the record grows, the monitor can be used to check for revised trend corrections.

5.3 IR channel monitor

The IR monitor manual step reads GAC data and applies HBT nominal (Table 4) calibration and generates statistics.

Program: ir_monitor.f90
Inputs: GAC, HBT
Outputs: monitorsssnn.yyyymm

To run from the wrkdir, set the environment and start the run script with args:

    $ . ./prdenv.cal
    $ ir_monitor.run wrkdir yyyy mm ddbeg ddend satpos

For example, to run July 2007 NOA

    $ cd wrkdirs/2007_07
    $ . ./prdenv.cal
    $ ir_monitor.run . 2007 7 1 31 noa

This creates an output file ir_monitor.NOA-18.YYYYMM which is used to derive calibration coefficients in an IDL process.

5.4 Deriving NORM coefficients and ABS coefficients for IR AVHRR

The AVHRR NORM coefficients are derived using the output from ir_monitor.f90. Create a text file that lists the output files from the IR monitor that will be input to the IDL script avhrr_ir_calfit, and then run the script.

    IDL> avhrr_ir_calfit, 'input_file_list'

This will read all input files and calculate the record mean for 25th and 90th water percentile for current AVHRR and fit a line through the regression plot against NOAA-9 record values already calculated. The printed output is the slope and intercept of the fitted line and these are the NORM calibration coefficients for IR AVHRR.

The AVHRR ABS IR calibration coefficients are slope and intercept, 1.0 and 0.0 K, respectively, for all AVHRRs on satellites before NOAA-15 and 0.9767 and +5.667 K, respectively, afterwards.

6 Geostationary Calibration (NORM)

This process requires one month of B1U input data plus the contemporaneous month of afternoon orbiter GAC data. It requires that all satellite set-up procedures have been run including initialization of the HBT calibration tables with the nominal calibrations for both the polar orbiter and the geostationary satellites. The results of this process are the NORM coefficients for the geostationary satellite VIS and IR channels. Combining the NORM and ABS coefficients from the reference polar orbiter makes the ABS coefficients for geostationary satellites.

 The procedure consists of finding the matching pixels of both satellites, matching being conditioned by limits on the cosine of the satellite zenith angles (MUE $\geq$ 0.5) and the difference of observation times ($<$ 1.25 hr), as well as the minimum number of matched pixels ($\geq$ 2500). The number of matches found will vary and there may not be matches found every day. Only the GAC images whose starting time is within 30 minutes of the geosat nominal time are searched. For each set of matching pixels, a histogram is made for nominally calibrated reflectance (VIS channel) and brightness temperature (IR channel). Nine percentiles are calculated 1st, 5th, 10th, 25th, 50th, 75th, 90th, 95th and 99th. A linear fit is done using the two extreme percentile values for each set of polar and geostationary histograms. The resulting gain and offset are used as NORM calibration coefficients for the geostationary satellites.

To run, set the production environment by sourcing prdenv.cal. In a working directory run the hist4month_geo_norm.run script:

```
$ . ../prdenv.cal
$ hist4month_geo_norm.run wrkdir yyyy mm start_day end_day satpos min_mue
equator_cross_time_polar  time_dif_fractional_hour
```

Where:
wrkdir	is the working directory (usually .)
yyyy mm start_day end_day	is the time period to run
satpos	is the 3-char satellite position
min_mue	is the minimum mue value to be used
equator_cross_time_polar	is the equator crossing time of the afternoon orbiter
time_dif_fractional_hour	is the maximum time difference between the orbiter scan time and the geostationary middle scan time.

Example:

```
$ hist4month_geo_norm.run . 2007 07 1 31 met 50 1500 1.25
```

The script creates a list of filenames of GAC and B1U pairs of images for the UTC timeslot corresponding to the equator crossing time of the afternoon orbiter and also for the adjacent UTC timeslots and includes both ascending and descending polar orbits. Then it calls hist4month_geo_norm.f90 that will read each pair of images and match the 0.1 degree grid box

that has values for both satellites, taking in account the limiting conditions, and writes out the matched grid and the histogram percentiles for the pair

>   (array[2=geo/pol,13perc&stat,2=ch1/ch2,2=water/land])

The output files are:
>   geo_norm.muelim.hourdif.fractionhourdif.eq_cross_time.satid.yyyymm
>   (example: geo_norm.50.1.25.1500.MET-9.200707) Contains percentile data.

>   geo_norm.muelim.hourdif.fractionhourdif.eq_cross_time.satid.yyyymm.match_grid .
>   Used for IDL plot of the matching region.

6.1 Deriving NORM coefficients

The output from the NORM procedure has the statistics for both VIS and IR channels. Use the IDL procedures for VIS and IR separately to derive the NORM coefficients by fitting a line through the two extreme percentile pair of points, in this case 1st and 99th.

6.1.1 VIS channel

Run the IDL script geo_normal_coeffs.pro to compute the VIS NORM coefficients.

>   IDL> geo_normal_coeffs, file_name, low_percentile, high_percentile, 'vis'

>   Optional named arguments are:
>   grid_plot_flag=1   to plot match region on second plot page
>   text_print=1   to create output text file with results

Example:

>   IDL> geo_normal_coeffs, 'geo_norm.50.1.25.1500.MET-9.200707', '1st', '99th', 'vis'

>   The output will be :
>   visgeo_norm.50.1.25.1500.MET-9.200707.1st99th.ps
>   Contains fit plots for water, land and test results, and match region if grid_plot_flag=1

>   if text_print=1, visgeo_norm.50.1.25.1500.MET-9.200707.1st99th.txt file contains result

>   The red line in the plot is the 2-point fit line, the black line is the all-points fit line. When the test of the coefficients on the extreme values modifies the value by more than 10% the result is printed in red.

>   The slope and intercept are added to NORMCOEF.EUM.0707 or used to create new file.

6.1.2 IR channel

Run the IDL sript geo_norm_coeffs to compute the IR NORM coefs.

>   IDL> geo_normal_coeffs, file_name, low_percentile, high_percentile, 'ir'

Page 14

Optional named arguments are:

    grid_plot_flag=1   to plot match region on second plot page
    text_print=1   to create output text file with results

Example:

    IDL> geo_normal_coeffs, 'geo_norm.50.1.25.1500.MET-9.200707', '1st', '99th', 'ir'

The output will be :

    irgeo_norm.50.1.25.1500.MET-9.200707.1st99th.ps
    Contains fit plots for water, land and test results, and match region if grid_plot_flag=1

    if text_print=1, irgeo_norm.50.1.25.1500.MET-9.200707.1st99th.txt file contains result

    The red line in the plot is the 2-point fit line, the black is the all-points fit line. When the test of the coefficients on the extreme values modifies the value by more than 10% the result is printed in red.

    The slope and intercept are added to NORMCOEF.EUM.0707 or used to create new file.

6.2 Deriving ABS coefficients

The geostationary satellites ABS coefficients are a combination of the AVHRR NORM and ABS coefficients derived in 2.1 and 2.2.

6.2.1 VIS channel

Using the AVHRR coefficients derived in Section   5.2 above, calculate for each month the ABS correction for geostationary satellites:

ABS slope = (AVHRR NORM slope) * (AVHRR ABS slope)
ABS intercept = (AVHRR ABS intercept) + (AVHRR ABS slope)*(AVHRR NORM intercept)

The above coefficients are used to create new ABSCOEFS.SPC.YYMM for the geostationary satellite.

6.2.2 IR channel

For each month use the AVHRR IR NORM coefficients derived in Section 5.4 above to create (or add to) to the ABSCOEFS.SPC.YYMM channel 2 (IR). The coefficients are constant for all months for the life of the current AVHRR.

7   Updating HBT with new coefficients (hbt_update)

The results of the above MONITOR and NORM processes are the NORM and ABS coefficients. These coefficients are entered manually into the NORM and ABS files (created blank as part of initial satellite setup) and an updated version of HBT is created for use in production by running the hbt_update program. During production, the ABS coefs may be updated further, based on the overlap statistics generated by CALCOR during the merge step (RECAL process)

The NORM and ABS files are updated using a text editor. These files should be kept in a version control system, such as svn, to track which version of the coefficients are used for production of each version of HBT.

To run:
After creating the wrkdir and sourcing prdenv.cal :

        $ hbt_update.run wrkdir yyyy mm satpos actual_hbt_version

This script will read the updated ABSCOEFS and NORMCOEF files from ../calibration/H_coefficients/ call hbt_update.f90 , read the current HBT version and create a new version of HBT = actual_hbt_version+1 in the wrkdir.

The results may be checked by re-running the monitor programs (polar orbiter VIS and IR, geostationary IR) using Table 5 (NORM) or Table 6 (ABS).

After checking the new HBT move it to ~prd/data/bt/satpos/, it is now ready for production.

END OF DOCUMENT