OPUS Accumulator

Date: Friday, February 17, 2023 Build: 124
By: Mark Silver, ms@igage.com

Mail List

If you use the OPUS_Accumulator or any of the BORG tools it is highly recommended that you subscribe to this mail list: http://ymlp.com/xguqjwsugmguu to receive automatic update notifications.

Program Description

The OPUS Accumulator (OA) program reads every:

.txt, .eml and .msg

file in a path and generates a tab-delimited summary file named 'SUMMARY.prn'. The SUMMARY.prn file is intended to be opened in Excel or the Open Office Spreadsheet and contains a summary of all of the data contained in NGS OPUS reports (RS or STATIC.)

Most items are summarized with the Minimum, Maximum, Range, Average and 1-sigma Standard Deviation. Lat and Lon are tabulated in decimal-degrees with the average listed as both decimal-degrees and Deg-Min-Sec for easier use populating reference station positions.

An ECEF option checkbox enables tabulation of the ECEF positions in addition to Lat/Lon.

It is possible to also generate a plot file 'SUMMARY.png' that graphically shows the UTM position trends. Additional information on the plot follows later in this document.

It can take as long as 10 seconds to fully parse some email formats, so a cache file system is available to speed up repeated readings of files by storing intermediate output in a .oacf file extension. Check the 'Use Cache' checkbox. The cache files will have the same timestamp as the input file, so if a change is made to an input file OA will automatically recompute the cache file.

OA has been enhanced to recurse through directories (check the 'Recurse' checkbox.) In this way a group of folders with OPUS results from multiple stations can automatically be computed with one invocation.

IMPORTANT! OA skips folders that have an underscore '_' as the first character of the folder name.

General

OA is part of the OPUS-BORG project that Mark Silver uses to monitor CORS stations. Other components include:

OU Opus Uploader

OU automatically submits files to OPUS without web form interaction. In the simplest operation a single file is submitted. Folder recursion is also possible so it is also possible to submit multiple files by wildcard or explicit list.

OU now has the ability to recurse through a folder structure looking for observation files that do not have current OPUS solutions, only submitting new files.

iBase_Mail Mail reader

Downloads mail from a POP server. Detects OPUS output files (from NGS) and automatically files the OPUS result files into properly named station folders. Other mail is placed into a junk folder.

iBase Automation of hourly RINEX file generation

Automatically converts RT27 capture files into observation and navigation RINEX files for multiple stations at the top of every hour. Output files are placed in standard NGS compatible folder structures.

iB_Daily Automatically converts hourly files to daily files

Automatically takes 24 1-hour 1-second interval RINEX files (that are in ZIP format), decimates to 30-second interval and combines to daily 24-hour files.

DIP_Cap RCAPTURE replacement

DIP_Cap is a replacement for the Trimble RCAPTURE tool.

RT27 streams from an IP address / Port are downloaded and collected into properly named, hourly, data files which are then read by the iBase program and converted to compressed observation and navigation files.

DIP_Cap is more reliable than RCAPTURE and will run for indefinite periods, automatically figuring out the best way to recover internet connections. Files are appended, not overwritten when errors occur and streams are cached in memory to reduce write cycles on disks.

Command Line Options

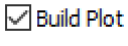
```
Command Line Arguments: ');
  -d  +d                disable / enable debug');
  -c  +c                disable / enable cache');
  --c                   clear cache prior to running');
  -e  +e                disable / enable ECEF summary');
  -p  +p                disable / enable plot file');
  -r  +r                disable / enable path recursion');
  -s  +s                summarize folder results in base folder');
  -n  +n                name output files by folder name');
  -u  +u                move duplicate/damaged source files to _dups and _e);
  -R  +R                do / don't Relax error checking (+Relax allows OPUS-RS
  "path to process"     path to process, enclosed in quotes if needed');
```

if a valid path is specified, OA will automatically run with the last settings.

Plotting Enhancement

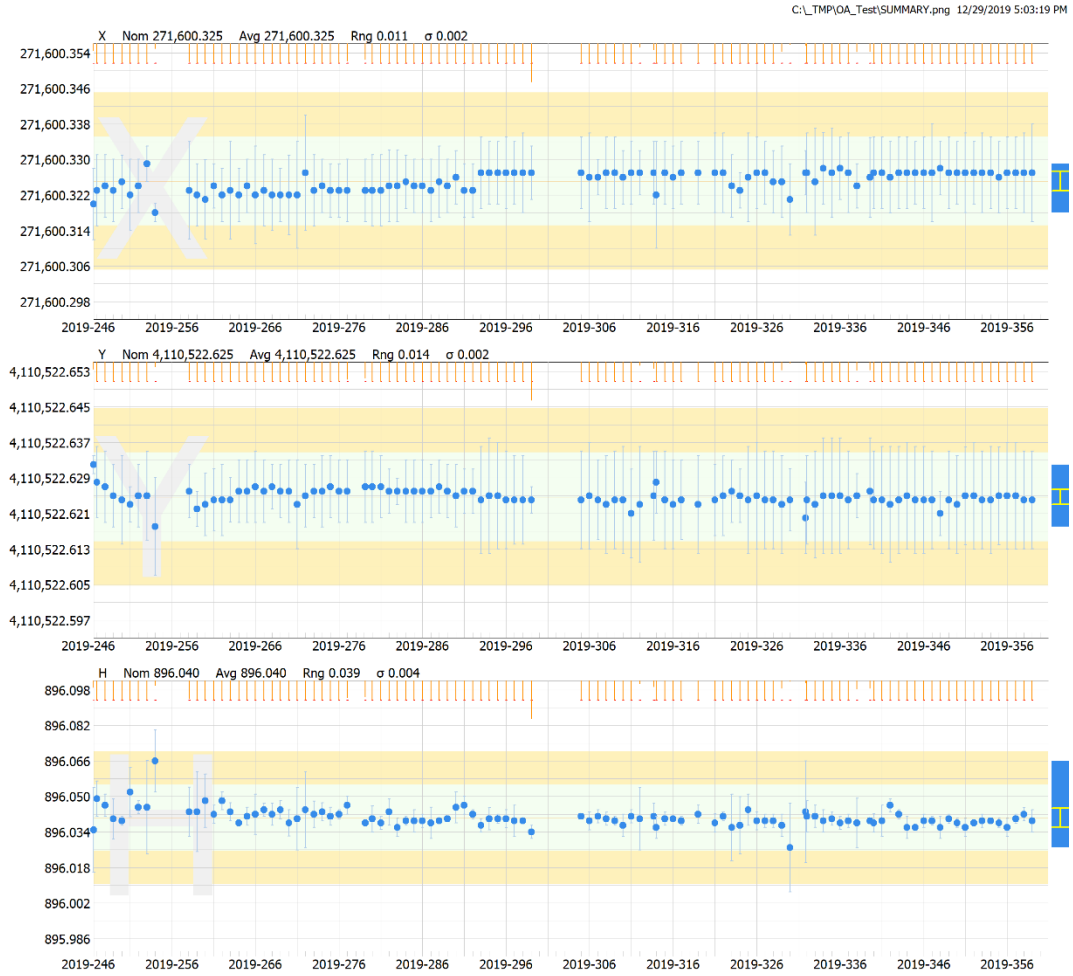
In Build 97 an optional plotting tool has been added to the OPUS Accumulator. This option graphically summarizes the compiled OPUS reports into a set of three graphs drawn into a single PNG file placed in the folder with the compiled messages.

The plot is enabled by checking the ‘Build Plot’ checkbox:



After the input folder is processed and the plot file has been generated, you can click the ‘Show Plot’ button to display the generated plot in whatever tool your machine evaluates .PNG files with.

The format of the plot:

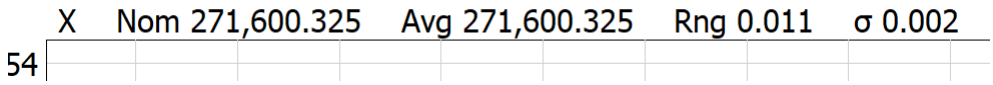


Includes a representation of UTM**X**, UTM**Y** and Ellipsoid **H**eight. All values are in meters.

The top right corner of the graph includes the full path and filename of the plot:

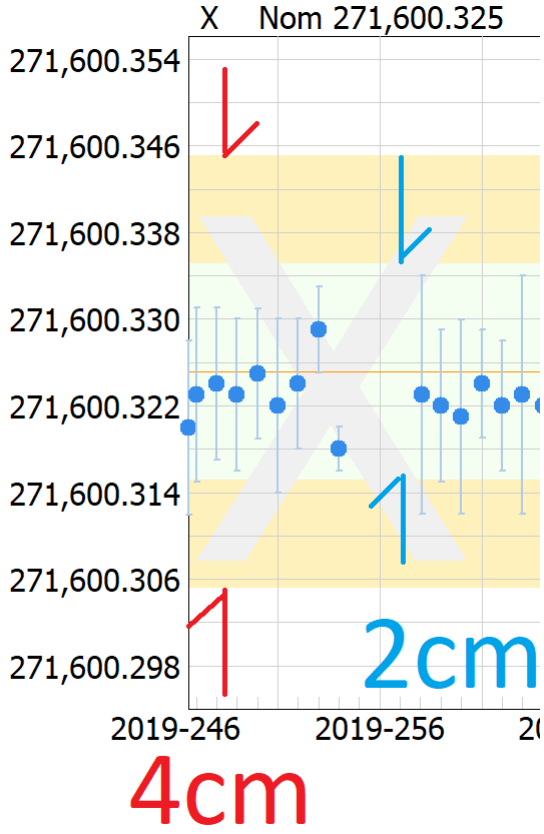
C:_TMP\OA_Test\SUMMARY.png 12/27/2019 9:08:54 PM

The remainder of the plot includes three similar sections. Each graph includes the plotted variable, the nominal and Average values (currently the same), the Range and the Standard Deviation:



The Y-axis of each graph includes text markers for the range. The amber background denotes a 4cm band (+/- 2cm) about the nominal value. The light-green band denotes a 2cm band (+/- 1cm) about the nominal value. The scale of the X, Y and Z graphs are independent and will adjust to include all

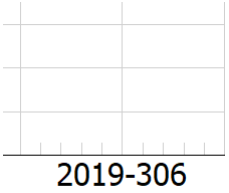
data points. The nominal ranges are +/-3cm for X and Y; +/- 6cm for the Height.



The graphed range is expanded such that all points and the top and bottom of the error bars are fully plotted.

Each OPUS report's results are plotted as blue dots. The RMS/Peak-to-Peak values are shown as extended error bars about the dot:

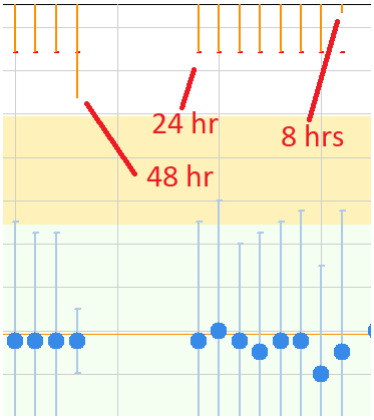
The horizontal axis includes tick mark for each 24-hour period. Days are annotated with the year and Julian date:



In this example, the primary bar above the '9' is the 306th Julian day of 2019. Remember that January 1st is Julian day 1. Every day has a tick, every 5th day (1, 6, 11, 16…) has a major graph line.

((V98 Addtion:)) Observation File Length Indication

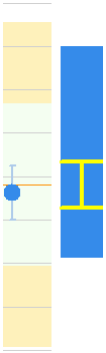
Orange bars at the top of each graph indicate the length of the observation file. A red horizontal tick marks 24-hours. This example:



Shows several 24-hour files, a 48-hour file and a short 8-hour file.

Because all files are weighted equally in the average computations, you may want to get rid of observation files that are significantly shorter than others.

The right-hand side of each graph includes an indication of Range and Standard Deviation:



The blue bar includes the range of all results. The yellow 'I-bar' shows +/- 1 Sigma about the Average value. This provides a quick visual representation of range, probable value, skewness and kurtosis.

Version Notes

2013.04.06:

Worked around issues with mailers that split report lines and strip whitespace.

2013.04.14:

Added 'Ephemeris' column to reported data.

2013.06.11:

Added tabulation of Min,Max,Rng,Avg,StdDev to numeric columns

2013.06.17:

Changed icon. The NGS complained that the icon was too close to their agency trademark.

Changed the names of header lines.

Detect missing values on read, provide message.

2013.07.26:

Trap <tel:xxx.xxxx.xx.xxx> strings from email containers.

2014.09.28:

Accumulate state plane and UTM coordinates, with statistics.

2014.10.12:

Added DMS coordinates for geographic averages

2014.12.30:

Fixed heading for LAT1_RMS.

Added EndTime and DeltaTime columns...

2015.03.02:

Added a sorted list of CORS stations used in the solution as the last column (BaseStations) in the output grid.

2016.08.12:

Check and covert multi-byte characters.

2016.08.31:

Previous version blew up station name capture-fixed. Added support for email with spurious quotation marks (?).

2017.01.22:

Add option to include ECEF.

2017.02.04:

Fixed tab stop error introduced on DMS.s column when ECEF enabled. Added .oacf generation, speeds up repeat processing 10x. Added Velocity for X,Y,Z, UTMx, UTMy, UTMz, SPCx, SPCy, Ellip Heights and Ortho Heights.

Moved settings file to standard Windows program settings location to allow OA to be run from folder with limited write rights.

2017.02.11:

Modified accuracy '(m)' trapping to work with possible updated reports proposed by NGS.

2017.05.17:

Added Command Line directives.

Fixed Start/Stop decode on RS reports.

2019.12.23 B97:

Added trend plotting to .PNG file.

Found and fixed an uninitialized summing array which may have resulted in higher-than-expected UTM and SPC computations.

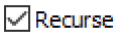
2019.12.29 B98:

Changed .INI file to iBase borg compliant location and format. Depending on your user name the location will be something like this:

```
Settings stored in C:\Users\ms\AppData\Local\iGage\iBase\iBase.ini
```


Added a red color scaled bar at the top of the graph to indicate length of the file in hours:

2020.01.04 B99:



Added path recursion. Added a Title to the graph.

2020.01.25.100:

Added Auto Run at 01:00

2020.04.26.112:

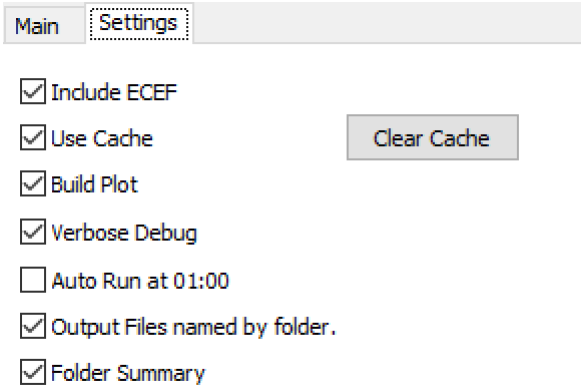
Input files are opened in Read (only) mode. X axis ticks above labels darker on plots.

Build 114; December 22, 2020

Build 115; May 24, 2021

Settings Tab

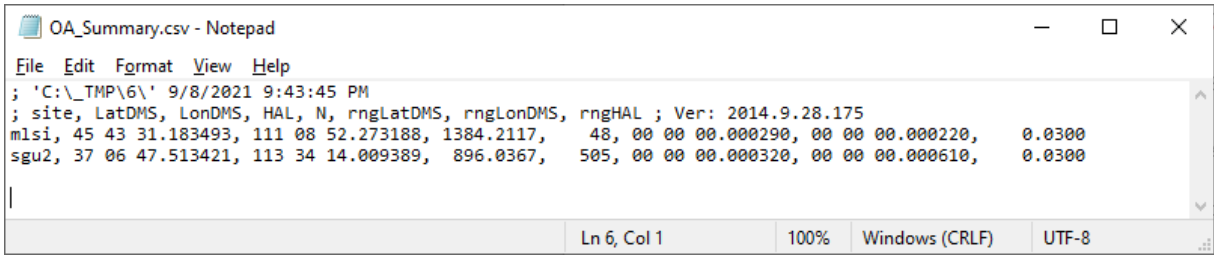
Most of the program settings have been moved to a new tab called ‘Settings’.



Summary of Summaries

☑ Folder Summary

Added option to build a summary of summaries. If enabled, a file named 'OA_Summary.csv' will be created in the base path.



The first line of the file is:

; c:\fullpathprocessed date_time_completed

The second line of the file is:

; site, LatDMS, LonDMS, HAL, N, rngLatDMS, rngLonDMS, rngHAL

Each subsequent line will be of this format:

ssss, 42 31 53.123456, 109 21 42.123456, 1231.4231, 24, 00 00 00.01, 00 00 00.02, 0.0173

where:

ssss the site name which is assumed to be the first four characters of the processed folder

N the number of occupations processed for this folder

NOTE: Version 116: May 24 2021

Lat and Lon min and sec values are zero padded to 2 characters:

42 1 3.123456 new:-> 42 01 03.123456

Single Populations Statistics

The Min, Max and RNG will now be set to the single value of single populations runs. Additional error checking has been added to facilitate this condition.

Plots will NOT be generated for populations with single observations.

Summary Filenames

☑ Output Files named by folder.

In the past, the summary files have ALWAYS been called summary.prn and summary.png.

This has made looking at BORG produced data very difficult to compile and hard to share multiple stations with other by email.

A new option exists to extract the first four characters of the folder that contains occupations as the site name and name the files appropriately. If the folder has less than 4 characters, the folder name is front padded with underscores. For example, if the containing folder is called 'sg1' the reports will be named '_sg1'.

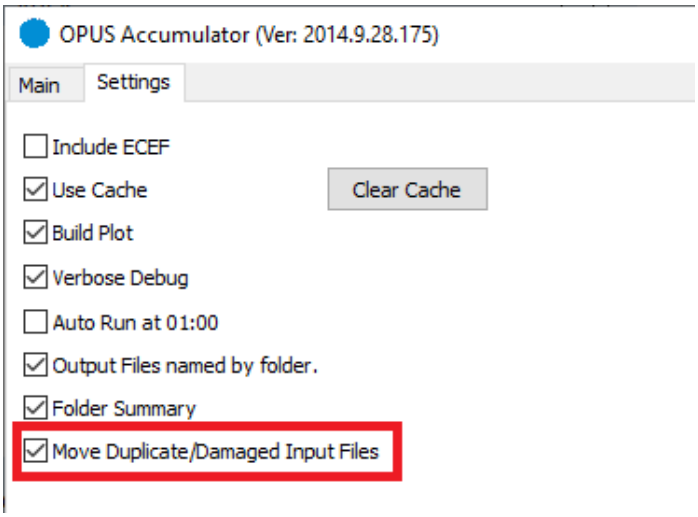
NOTE: Version 116: May 24 2021

The generated filename is now ssss_opus.prn and ssss_opus.png. There have been too many filenames that are just the station name and it has been impossible to lump netstat and opus summaries into the same folder.

Graphing Bug

The most recent OPUS result was not being plotted on the graph. It is now included on the right-most pixel of the graph image.

Build 120; September 8, 2021



Overlapping Files

OA now compares the start and end observation times and if observation files overlap only the best file OPUS solution file for the time period is accumulated and plotted. Files that start within five-minutes of each other and end within five-minutes of each other are treated as overlapping. Only one file will be accumulated.

This enhancement solves an issue where multiple OPUS solutions, based on the same observation file, with precise, rapid and ultra-rapid ephemeris or multiple OPUS solutions processed on multiple dates are all available in the same folder.

	StartTime	EndTime	DeltaTime	RINEX_FN	OverAll_RMS	OBS_Used	FIXED_AMB	ARP_HT	ANT_
2	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
3	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
4	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
5	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
6	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
7	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
8	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
9	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
10	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
11	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
12	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
13	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
14	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
15	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
16	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
17	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
18	6/21/2021 0:00	6/21/2021 23:59	23:59:00	mlsi1720.21o	0.014	96%	91%	0	CHCC
19	6/22/2021 0:00	6/22/2021 23:59	23:59:00	mlsi1730.21o	0.014	96%	92%	0	CHCC

In this extreme case 17 identical solutions, processed on the same input file have been placed in the input folder. Previous OA versions accumulated all 17 files and weighted them equally in the average, compared with a single file on other days.

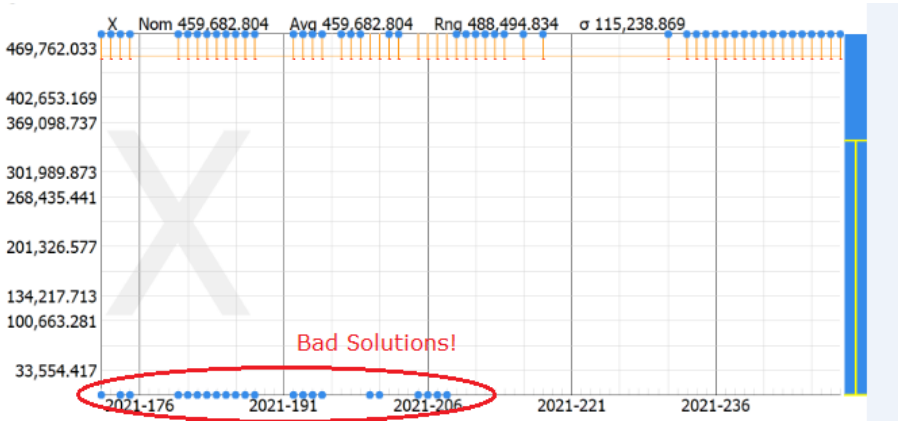
The 'Best' OPUS Solution for the time period is selected based on:

- better ephemeris
- lower overall RMS
- later OPUS execution time

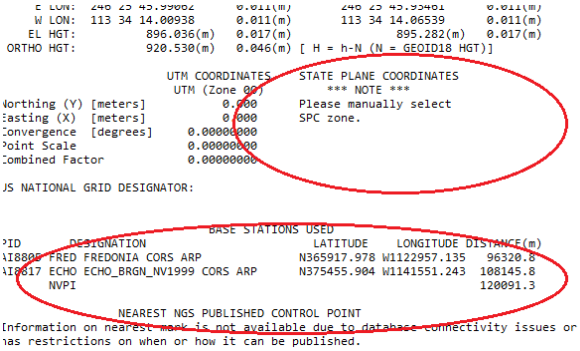
If the 'Move Duplicate/Damaged Input Files' box is checked then the inferior duplicate files are moved to a '_duplicates' subfolder and any matching cache file is deleted.

Enhanced Error Checking

Extensive error checking has been added to detect ill formed OPUS reports. These errant OPUS reports started being randomly generated by the NGS system in June 2021 and resulted in 0.0 X,Y and Z UTM coordinates being plotted which destroyed the plotting range:



These zero readings are caused by missing data in the OPUS solution:



OA now detects any missing value and does not use the file in the .PRN file or the .PNG plotfile.

If the 'Move Duplicate/Damaged Input Files' box is checked then the damaged OPUS solution files are moved to a '_invalid' subfolder and any matching cache file is deleted.

New Columns in Output PRN file

The User's email address returned in the OPUS report is now included in a new right-hand column.

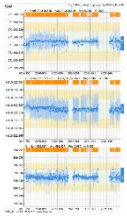
The ProcessDateTime is now included in a new right-hand column. This facilitates ordering multiple solutions for the same file into process order.

Note: Starting with this version, no overlapping files will be accumulated. Only the 'Best' file is kept and used.

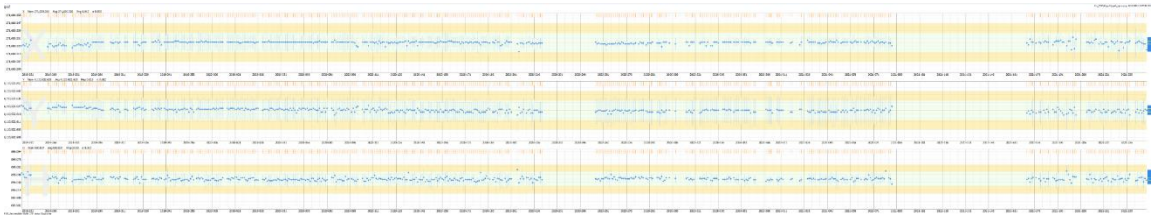
Build 121; September 12, 2021

Updated plotting tool, now correctly calculates the graph width for multi-year data sets with and without missing days.

Previous Builds:



Build 175:



Build 122; March 4, 2022

Added +R / -R option to Relax error checking to allow OPUS-RS files to process. This relaxes a few error checking methods and should have no effect on OPUS-STATIC jobs. I personally depend on the STATIC error checking to move jobs that accidently process as Rapid Static out of the processing folder.

Fixed the spelling of 'Arguments' in the command line arguments list shown in the logging memo at startup. (Embarrassed = Yes!)

Build 123; May 20, 2022

Updated parse for Stop time to fix issue with updated OPUS output format.

Lengthened log memo to 50,000 lines from 300.

Build 124; January 5, 2023

Minor changes to a minor report.