

# IMPORTING GPS VECTORS

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## OPUS STATIONS

### About OPUS

The NGS hosts an online service called OPUS (Online Positioning User Service) which can be used for post processing your static GPS data to high-accuracy NSRS (National Spatial Reference System) coordinates. Reports generated by OPUS can be imported into STAR\*NET to easily obtain these post-processed coordinates, along with their full covariance matrix for more accurate processing within STAR\*NET.

Additional information is available on the NGS OPUS website at [www.ngs.noaa.gov/OPUS](http://www.ngs.noaa.gov/OPUS)

When uploading your GPS data to the NGS OPUS service for processing, you must request the "Extended Solution" format from within the Options section of the page.

Depending on the duration of your static collection, you can choose to upload to either the Static Processor (for between 2-48 hours of collected data) or the Rapid Static processor (for less than 2 hours of collected data). STAR\*NET 7.0 supports reports generated by the Static processor only, and the upcoming STAR\*NET 7.1 will also support reports generated by the Rapid Static processor.

### About OPUS Stations

Please note that only station data, no vectors, is imported from an OPUS reports.

OPUS stations are points that have a full covariance matrix. The NGS OPUS service was the instigator for this feature, but the concept is general purpose. Any source for points with full covariance information is acceptable, even Starnet (the "dump" file contains full station covariance as a result of adjustment).

OPUS station are entered in three line sets. The first line is a normal C, CH, P, or PH data record specifying the station's location. The second and third lines contain the covariance data. The form of these two lines is similar to the covariance data for GPS vectors: values are given as standard errors and correlations, or as variances and covariances. No other data types may interleave with the station set.

Whereas GPS distinguishes the type of covariance data by the inline option [.GPS WEIGHT COVARIANCE|STDERR|CORRELATION](#) with either type on G2 and G3 lines, the station covariance data is distinguished by different command codes pairs:

WS1 - standard errors  
WS2 - correlations

WV1 - variances  
WV2 - covariances

The order of value entry is dependent on the current coordinate order specified by the project options and the inline option [.ORDER](#).

Given north is Y and east is X, the possible sets are...

By Standard Error / Correlation:

C PNYXZ  
WS1 StdErr\_YStdErr\_XStdErr\_Z  
WS2 Correl\_YXCorrel\_YZCorrel\_XZ

```
C PXYZ
WS1 StdErr_XStdErr_YStdErr_Z
WS2 Correl_XYCorrel_XZCorrel_YZ
```

```
C PNYX
WS1 StdErr_YStdErr_X
WS2 Correl_YX
```

```
C PNXY
WS1 StdErr_XStdErr_Y
WS2 Correl_XY
```

By Variance / Covariance:

```
C PNYXZ
WV1 Var_YYVar_XXVar_ZZ
WV2 Covarl_YXCovarl_YZCovarl_XZ
```

```
C PXYZ
WV1 Var_XXVar_YYVar_ZZ
WV2 Covarl_XYCovarl_XZCovarl_YZ
```

```
C PNYX
WV1 Var_YYVar_XX
WV2 Covarl_YX
```

```
C PNXY
WV1 Var_XXVar_YY
WS2 Covarl_XY
```

The first line of the set (C, CH, P, PH) may have an optional descriptor, but it cannot have weight data as a normal coordinate data line.

StdErr/Correl and Var/Covar are equivalent. The relation between variance and correlation is:  $CoVar_{xy} = Correl_{xy} * StdErr_x * StdErr_y$

There is a missing feature in current OPUS support. The NGS OPUS service, being based on GPS observations, produces a highly optimistic covariance matrix for the rover station. Like Starnet GPS data, the OPUS station requires a multiplier factor to give reasonable weights.

## Inline Option .OPUS {FACTOR|CENTERING} [*value* [VERTICAL *value*]]

The OPUS importer provides a means to set weight factors similar to the [.GPS FACTOR](#) inline option . The dialog lets the user supply the factors and a .OPUS inline option is automatically inserted into the output Starnet data file.

The syntax for the inline option is a follows:

```
.OPUS {FACTOR|CENTERING} [value [VERTICAL value]]
```

OPUS, FACTOR, CENTERING, and VERTICAL can be abbreviated down to their least unique values.

Examples:

```
.OPUS FACTOR -- revert to that specified on the GPS options dialog
```

```
.OPUS FACTOR 100 -- Multiply X,Y,and Z standard errors by 100
```

.OPUS FACTOR 100 V 200 -- Multiply X, and Y standard errors by 100 and Z by 200

.OPUS CENTER -- revert to that specified on the GPS options dialog

.OPUS CENTER 0.001 -- Increase X, Y, and Z standard errors by propagating .001

.OPUS CENTER 0.001 V 0.002 -- Increase X and Y standard errors by propagating .001 and Z by 0.002

The opus factor is applied by multiplying the station standard errors by the factor. If both factoring and centering is applied, factoring is applied first.

Centering error is propagated by square root of the sum of squares:

Standard Error of X = SE (given)  
Horizontal Centering value = C (given)  
Adjusted Standard Error of X =  $\text{Sqrt}(SE * SE + C * C)$

If the opus station is stated in covariance terms, the covariance matrix is first converted to standard error / correlation form. Factors and centering is applied to the standard errors; correlation remains constant.

### Sample: OPUS Report

### Sample: Resulting STAR\*NET Data