BYN Grid Format Description

The Canadian Geodetic Survey, Natural Resources Canada provides geoid heights and height system conversion files in **BYN** format. These are binary files and have the extension ".**byn**". The **BYN** format includes two sections, which are the Header (see Table 1) and the Data. The data are stored by rows starting from the north. Each row is stored from the west to the east. The data are either short (2 bytes) or standard (4 bytes) integers. The size of the bytes is defined in the header (see item #10 in Table 1).

The total size of the file is 80 bytes + (Row x Column x (2 or 4) bytes) where Row is the number of rows in the grid and Column is the number of columns in the grid. Row and Column can be calculated by these two equations:

Row = (North Boundary – South Boundary) / (NS Spacing) + 1
Column = (East Boundary – West Boundary) / (EW Spacing) + 1

The **BYN** files may contain **undefined data**. Depending if the data are stored as 2-byte or 4-byte integers, the undefined data are expressed the following way:

   a. 4-byte data (Standard integer): **9999.0*Factor**, the Factor is given in the header (see item #9 in Table 1)
   b. 2-byte data (Short integer): **32767**

Most of the parameters in the **BYN** header can be read by clicking the "Information" icon in the desktop version of **GPS-H** (see Figure 1). In addition, the GPS-H model information window allows extraction of a subset of a grid. The subset grid can be saved in either **BYN** or **ASCII** format.
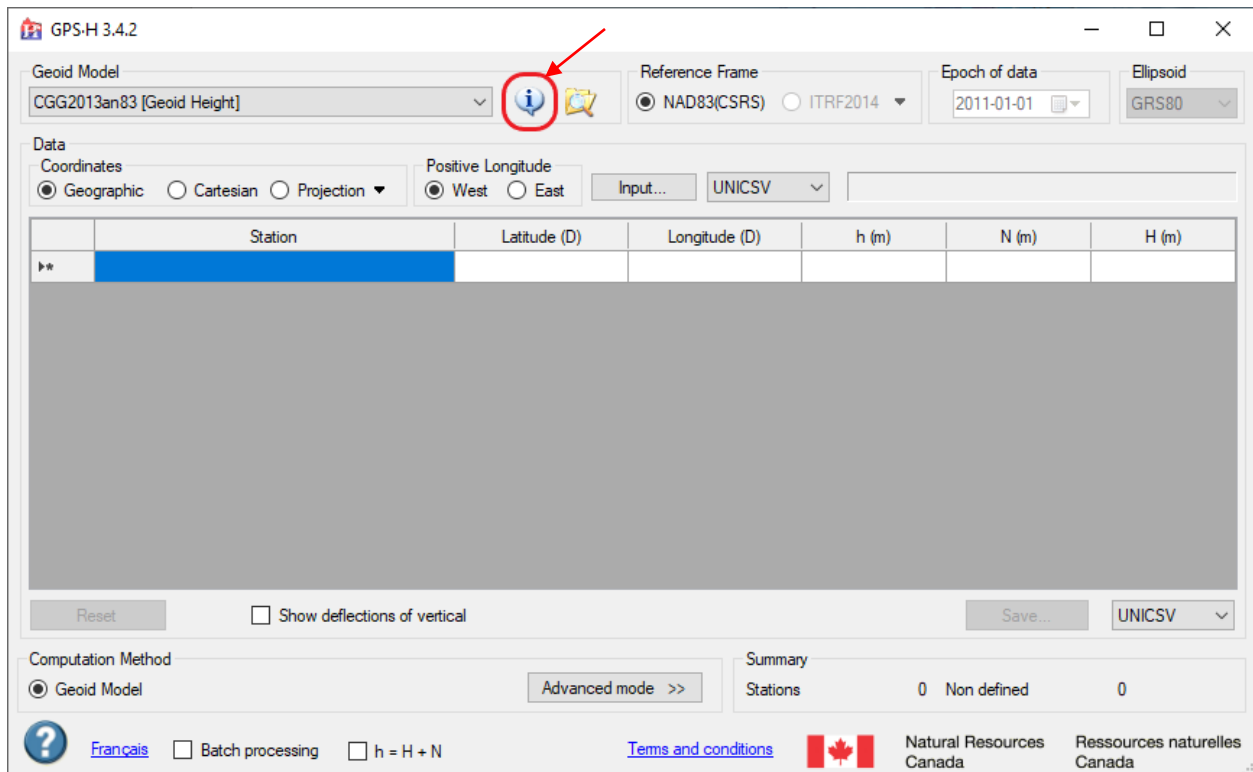
Figure 1: Desktop version of GPS-H highlighting the model information icon

NOTE: Files with extension "**.err**" are also in the **BYN** format. An "**.err**" file usually contains the error estimates of the **BYN** file of the same name (e.g., CGG2013n83.byn and CGG2013n83.err). The "**.err**" file will have variable Data (item #13 in Table 1) equal to 1 or 3.

Table 1: Header description (80 bytes)

#	Variable	Description	Type	Byte	Sum	Comments/(Units)
1	South	South Boundary	long	4	4	(arcsec.)
2	North	North Boundary	long	4	8	(arcsec.)
3	West	West Boundary	long	4	12	(arcsec.)
4	East	East Boundary	long	4	16	(arcsec.)
5	DLat	NS Spacing	short	2	18	(arcsec.)
6	DLon	EW Spacing	short	2	20	(arcsec.)
7	Global	Global	short	2	22	0: Local/Regional/National grid
						1: Global grid
8	Type	Type	short	2	24	**See Table 2**
9	Factor	Data factor	double	8	32	Transform data from integer to real
10	SizeOf	Data size in bytes	short	2	34	2: short integer (2 bytes)
						4: standard integer (4 bytes)
11	VDatum	Vertical Datum	short	2	36	0: Unspecified

#	Name	Description	Type	Bytes	Pos	Value
						1: CGVD28
						2: CGVD2013
						3: NAVD 88
						4: NAPGD2022
12		Spare		4	40	Always zero
13	Data	Data description	short	2	42	0: Data (e.g., N)
						1: Data error estimates (e.g., σN)
						2: Data velocity (e.g., N-dot)
						3: Velocity error estimates (e.g., σN-dot)
14	SubType	Sub-Type	short	2	44	**See Table 2**
15	Datum	3-D Ref. Frame	short	2	46	0: ITRF / WGS84
						1: NAD83(CSRS)
16	Ellipsoid	Ellipsoid	short	2	48	**See Table 3**
17	ByteOrder	Byte Order	short	2	50	0: Big-endian (e.g., HP Unix)
						1: Little-endian (e.g., PC, Linux)
18	Scale	Scale Boundaries	short	2	52	0: No scale applied to boundaries and spacing
						1: Scale is applied (x1000)
19	Wo	Geopotential Wo	double	8	60	$m^2\ s^{-2}$ (e.g., W = 62636856.88)
20	GM	GM	double	8	68	$m^3\ s^{-2}$ (e.g., GM = 3.986 x 10^{14})
21	TideSystem	Tidal System	short	2	70	0: Tide free
						1: Mean tide
						2: Zero tide
22	RefRealization	Realization (3D)	short	2	72	Version number (e.g., 2005 for ITRF)
23	Epoch	Epoch	float	4	76	Decimal year (e.g., 2007.5)
24	PtType	Node	short	2	78	0: Point
						1: Mean
25		Spares		2	80	Always zero

Items #18 to 22 must be defined if the grid is a geoid model.

Table 2: Types and Sub-Types

#	Type (item #8)	#	Sub-Type (item #13)
0	Undefined	0	NULL
1	Ellipsoid-Potential separation	0	Geoid Height
		1	Height Anomaly
		2	Height Transformation (Hybrid)
		3	Datum conversion using a single file
		4	Datum conversion on the fly using two files
2	Deflections of the vertical NS	0	NULL
3	Deflections of the vertical EW	0	NULL
4	Gravity	0	Undefined
		1	Absolute (m s^{-2} instead of mGal)
		2	Free-Air
		3	Bouguer

		4	Complete Bouguer
		5	Helmert
		6	Isostatic
5	DEM	0	MSL (General)
		1	Orthometric
		2	Normal
		3	Dynamic
		4	Ellipsoidal
6	Sea Surface Height (SSH)	0	NULL
7	Sea Surface Topography (SST)	0	NULL
8	Ocean current velocity	0	NULL
9	Others	0	NULL

Table 3: Ellipsoids

#	Name	Semi-major axis (m)	Inverse flattening	GM (m^3 s^{-2})	Angular velocity (rad s^{-1})
0	GRS80	6378137.0	298.257222101	3986005.0×10^8	7292115×10^{-11}
1	WGS84	6378137.0	298.257223564	3986004.418×10^8	7292115×10^{-11}
2	ALT1	6378136.3	298.256415099	3986004.415×10^8	7292115×10^{-11}
3	GRS67	6378160.0	298.247167427	3986030.0×10^8	$7292115.1467 \times 10^{-11}$
4	ELLIP1	6378136.46	298.256415099	3986004.415×10^8	7292115×10^{-11}
5	ALT2	6378136.3	298.257	3986004.415×10^8	7292115×10^{-11}
6	ELLIP2	6378136.0	298.257	3986004.4×10^8	7292115×10^{-11}
7	CLARKE 1866	6378206.4	294.9786982	3986004.4×10^8	7292115×10^{-11}