Formats for the geoid models

Content:

1. Format ".byn"
2. Format ".bin" (US National Geodetic Survey)
3. Format ".grd"
4. Format ".slv"

1. NRCan's ".BYN" Format

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	long	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	0: Undefined
						1: Ellipsoid-potential separation (m)
						2: Deflection NS (arcsec.)
						3: Deflection EW (arcsec.)

						4: Gravity (mGal)
						5: DEM (m)
						6: SSH (m)
						7: SST (m)
						8: Ocean current velocity (m/s)
						9: Others
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
						4: long integer
11		Spare		6	40	Always zero
12	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)
13	SubType	Sub-Type	short	2	44	See table 2 below
14	Datum	3-D Ref. Frame	short	2	46	0: ITRF / WGS84
						1: NAD83(CSRS)
15	Ellipsoid	Ellipsoid	short	2	48	0: GRS80
						1: WGS84
						2: Alt1
						3: Alt2
16	ByteOrder	Byte Order	short	2	50	0: Big-endian (e.g., HP Unix)
						1: Little-endian (e.g., PC, linux)
17	Scale	Scale Boundaries	short	2	52	0: No scale applied to boundaries and spacing
						1: Scale is applied (x1000)
18	Wo	Geopotential Wo	double	8	60	$m^2\ s^{-2}$ (e.g., W = 62636856.88)
19	GM	GM	double	8	68	$m^3\ s^{-2}$ (e.g., GM = 3.986 x 10^{14})
20	TideSystem	Tidal System	short	2	70	0: Tide free

						1: Mean tide
						2: Zero tide
21	RefRealization	Realization (3D)	short	2	72	Version number (e.g., 2005 for ITRF)
22	Epoch	Epoch	float	4	76	Decimal year (e.g., 2007.5)
23	PtType	Node	short	2	78	0: Point
						1: Mean
24		Spares		2	80	Always zero

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

Table 2: Sub-Type

#	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)
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

Data (Row x Column x byte size)

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 long (4 bytes) integers. The size of the bytes is defined in the header (item #10).

The total size of the file is 80 bytes + (Row x Column x (2 or 4) bytes)

where

  Row = (North – South)/DLat + 1 and
  Column = (East – West)/DLon + 1

Undefined values

  Long int (4-byte data): 9999.0*Factor
  Short int (2 byte data): 32767

Natural Resources Canada

2. Extension ".bin" (USA)

The information regarding the US ".bin" format was taken from the US National Geodetic Survey (NGS) Web site.
The text in red was added by GSD.

What do the filenames indicate about the type of data they contain?

A typical filename, **"tyyyyrnn.fff"**, would indicate:

- **t: The type of data contained in the file**
  - t = g means hybrid geoid model (i.e. GEOID96, GEOID99 , HTv1.01 , HTv2.0)
  - t = s means gravimetric geoid model (i.e. G99SSS, G96SSS , CGG2000, CGG2010)
  - t = x means Deflections of the vertical in the North/South direction (Xi)
  - t = e means Deflections of the vertical in the East/West direction (Eta)

- **yyyy: The year the data was created**

- **r: The main region where the data are located**
  - r = u means "Conterminous USA"
  - r = a means "Alaska"
  - r = h means "Hawaii"
  - r = p means "Puerto Rico and the American Virgin Islands"
  - r = c means "Canada"
  - r = m means "Mexico"

- **nn: The sub-region number of this file**
  - CONUS has 8 overlapping sub-regions (nn = 01 to 08)
  - Alaska has 4 overlapping sub-regions (nn = 01 to 04)
  - Hawaii has 1 region (nn = 01)
  - Puerto Rico and the American Virgin Islands have 1 region (nn = 01)

- - Canada has 4 overlapping sub-regions (nn = 00 to 03)
    - if nn = 00, it is whole Canada
    - if nn = 01, it is western Canada (not available)
    - if nn = 02, it is eastern Canada (not available)
    - if nn = 03, it is northern Canada (not available)

- **fff: The format of the data file**
  - fff = bin means binary file
  - fff = asc means ASCII file

For example, "g2000c00.bin" and "s2000c00.bin" are HTv2.0 and CGG2000 in the US NGS format, respectively.

US NGS format for the data files:

The file format for any sub-grid files (GEOID99, G99SSS or DEFLEC99 files) is identical:

- A 44-byte header followed by "nla" rows of data, each row being "nlo" elements long, each element being a 4-byte floating point number. The format chosen is known in FORTRAN lingo as "direct access binary". The exact ordering of the bytes is mapped below:

```
Bytes - Type – Name of the variable – Description of the data
     1- 8 real*8 glamn: Southern most Latitude of grid (decimal degrees)
     9-16 real*8 glomn: Western most Longitude of grid (decimal degrees)
    17-24 real*8 dla  : Latitude spacing of grid (decimal degrees)
    25-32 real*8 dlo  : Longitude spacing of grid (decimal degrees)
    33-36 int*4  nla  : Number of rows of grid
    37-40 int*4  nlo  : Number of columns of grid
    41-44 int*4  ikind: Set to "1", meaning the gridded data is "real*4"
    45-48 real*4 data(1,1): Gridded value at element 1,1 (Southwest corner)
     . . .
The rest of the file continues as 4-byte real values, filling in first the south row (data(1,nlo) being the
last variable in the south row), and then proceeding northward.

The total number of bytes in a "*.bin" file is: 44 + 4*nla*nlo
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3. Extension ".grd"

The files with the extension ".grd" are ASCII. The data are stored by rows from the north to the south. Each row is stored from the west to the east. Each record has one value with the exception of the first record, which is the header. The header is made of 6 values describing the area of the grid and its spacing.

The values of the header are in this following order: North latitude, South latitude, West Longitude, East Longitude, North-South spacing and East-West spacing. These 6 values are in decimal degrees.

4. Extension ".slv"

Important: This format is discontinued. GSD is not supporting this format anymore.

The "slv" format is made of two files: one file with the extension "slv" and a second file with the extension "bin". The former file is ASCII and contains information related to the data grid such as the boundaries of the grid, its spacing and reference frame. The latter file is the data and this file is binary.

The data are stored by rows starting from the north. Each row is stored from the west to the east. All data are stored as **short integer**. For the transformation from integer to float, the user must divide the integer value by the scale *Factor*, which is given in the "slv" file. The file may contain undefined values. The undefined values are expressed as a value of 32767.

The size of the file is the number of rows multiply by number of columns times 2.

- Size of file in bytes = (Rows*Columns*2 bytes)