



Canadian Hydrographic Service (CHS) S-111 encoding experience

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TWCWG1

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Purpose

- Inform TWCWG members of CHS S-111 encoding experience
- Seek TWCWG members endorsement to recommend adoption of Currents standard to HSSC



Plan

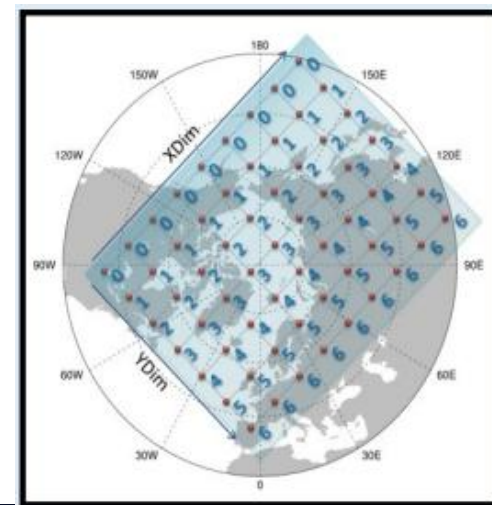
- Early tests
- Data sets
- Metadata
- Caris encoding tool
- Transformation needed
- Results
- Conclusion





Early tests

- Working with HDFView
 - Free software from HDFGroup
- Quite easy to encode time series and gridded info with HDFView for testing
- Impossible to encode metadata properly using existing HDF group scripts

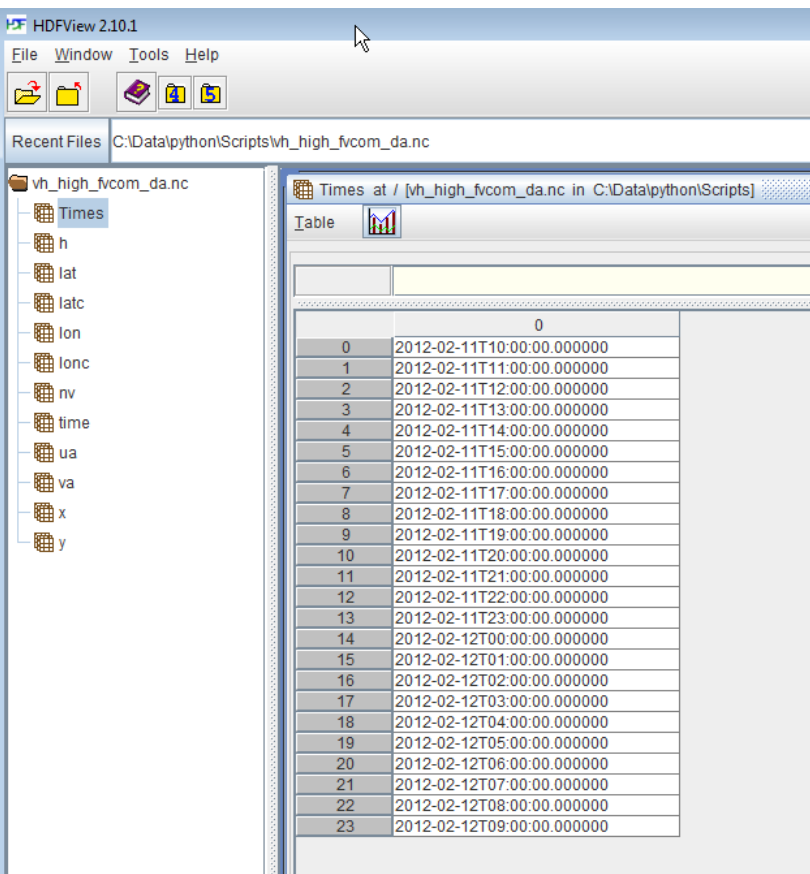




Datasets

- Time series Predictions, many stations in one file
- Model output result irregular grid

FVCOM output



National prediction software

```
CurrentMeter 05000 SEYMOUR NARROWS 00000m 2013/12/29
!Predicted 50 08.0 N 125 21.0 W +08 0000:00
106849 0371days 100.0% R 0005:00 04
Huggett,WS Current Surveys 0m
Reference 070 NORM 0
01 Date YYYY/MM/DD 0 TD
02 HourMinute hhmm 0 TD
03 Direction deg T 0 TD
04 Speed m/s 0 TD

Tides & Currents, IOS
05000const.curr 050000000p20131229a.log 050000000cyyddda.vol6
Old constituent set from unknown source - probably British, using graphical
analysis technique. M.J.W. June '92.
Doodson numbers as defined by Godin's The Analysis of Tides. pp 25-27
4.....
5.....
6.....
7.....
8.....
9.....
**Constants used for the official predictions in Vol 6 of the Current Tables.
2013/12/29 00:00 180 5.502
2013/12/29 00:05 180 5.427
2013/12/29 00:10 180 5.344
2013/12/29 00:15 180 5.253
2013/12/29 00:20 180 5.155
2013/12/29 00:25 180 5.051
2013/12/29 00:30 180 4.940
2013/12/29 00:35 180 4.822
2013/12/29 00:40 180 4.698
2013/12/29 00:45 180 4.568
2013/12/29 00:50 180 4.433
```



Metadata table 10.3

1	Country of Origin	nationalOriginator	Character	CA	Country code for producer (ISO 3166-1)
2	Producing agency	producingAgency	Character	DFO	Agency responsible for producing the data.
3	Product Spec and version	productSpecification	Character	S-111_version_1.0.0	This must be encoded as 'S-111.X.X.X', with the Xs representing the version number
4	Date of product issue	dateOfIssuance	Character	20160224	Date
5	Number of this edition	editionNumber	Integer	1	
6	Date of update	updateApplicationDate	Character	20160224	Date
7	Update number of this product	updateNumber	Integer	0	Update number is assigned to each new dataset
8	Name of Data Product file	Filename	Character	Caxxxxxxxxx.h5	File name. e.g.: CAXXXXXXXXXXXXXXXXXX.hdf5
9	Data file format	Datatype	Character	IHO_HDF5	ISO HDF5
10	Name of geographic region	nameRegion	Character	Pacific	
11	Name of geographic sub-region	nameSubregion	Character	Seymour Narows	
12	Horizontal datum	horizontalDatumReference	Character	EPSG	EPSG
13	Horizontal datum number	horizontalDatumValue	Integer	4326	4326 (for WGS84)
14	Westmost longitude	westBoundLongitude	Float	50.133333	Arc Degrees
15	Eastmost longitude	eastBoundLongitude	Float	50.133333	Arc Degrees
16	Southmost latitude	southBoundLatitude	Float	125.35	Arc Degrees
17	Northmost latitude	northBoundLatitude	Float	125.35	Arc Degrees
18	Valid Time of Earliest Value	dateTimeOfFirstRecord	Character	20131229T000000Z	Date-time
19	Valid Time of Latest Value	dateTimeOfLastRecord	Character	20150104T000000Z	Date-time
20	Time interval	timeRecordInterval	Integer	300	Seconds
21	Number of time records	numberOfTimes	Integer	106849	
22	Type of current data	typeOfCurrentData	Enumeration	3	1: Historical observation 2: Real-time observation 3: Astronomical prediction 4: Analysis



Metadata table 10.3

23	Data organization index	dataCodingFormat	Enumeration	1	1: Time series at one or more fixed stations with same starting date-time, ending date-time, and number of points 2: Regularly-gridded arrays 3: Irregularly-gridded arrays
24	Number of stations with time series data	numberOfStations	Integer	1	Used only if dataCodingFormat = 1 or 4
25	Methodology, instrument, or model	methodOrSource	Character	Harm_pred	Instrument or model type
26	Vertical reference	depthTypeIndex	Enumeration	1	1: Layer average 2: Depth below sea surface 3: Depth below vertical datum 4: Height above bottom
27	Depth value	surfaceCurrentDepth	Float	0	Layer thickness, depth or height (m)
28		verticalDatum	Enumeration	27	1: Mean low water springs 2: Mean lower low water springs 3: Mean sea level 4: Lowest low water 5: Mean low water 6: Lowest low water springs 7: Approximate mean low water springs 8: Indian spring low water 9: Low water springs 10: Approximate lowest astronomical tide 11: Nearly lowest low water 12: Mean lower low water 13: Low water 14: Approximate mean low water 15: Approximate mean lower low water 16: Mean high water 17: Mean high water springs 18: High water 19: Approximate mean sea level 20: High water springs 21: Mean higher high water 22: Equinoctial spring low water 23: Lowest astronomical tide 24: Local datum



Metadata table 10.3

					19 : Approximate mean sea level
					20 : High water springs
					21 : Mean higher high water
					22 : Equinoctial spring low water
					23 : Lowest astronomical tide
					24 : Local datum
					25 : International Great Lakes Datum 1985
					26 : Mean water level
					27 : Lower low water large tide
					28 : Higher high water large tide
					29 : Nearly highest high water
					30 : Highest astronomical tide (HAT)
29	Longitude of grid origin	gridOriginLongitude	Float		Arc Degrees (if dataCodingFormat=2)
30	Latitude of grid origin	gridOriginLatitude	Float		Arc Degrees (if dataCodingFormat=2)
31	Grid spacing, long.	gridSpacingLongitudinal	Float		Arc Degrees (if dataCodingFormat=2)
32	Grid spacing, lat.	gridSpacingLatitudinal	Float		Arc Degrees (if dataCodingFormat=2)
33	Number of points, long.	numberPointsLong	Integer		iMax (if dataCodingFormat=2)
34	Number of points, lat.	numberPointsLat	Integer		jMax (if dataCodingFormat=2)
35	First grid point num., long.	minimumGridPointLongitudinal	Integer		1 (if dataCodingFormat=2)
36	First grid point num., lat.	minimumGridPointLatitudinal	Integer		1 (if dataCodingFormat=2)
37	Nodes in irregular grid	numberOfNodes	Integer		Used if dataCodingFormat=3
38	Land mask	gridLandMaskValue	Float	-1.0	-1.0 or -99.999
39	Speed uncertainty	uncertaintyOfSpeed	Float	-1.0	kn. Negative value indicates unknown
40	Direction uncertainty	uncertaintyOfDirection	Float	-1.0	Arc Deg. Negative value indicates unknown
41	Horizontal position uncertainty	uncertaintyOfHorizontalPosition	Float	-1.0	m. Negative value indicates unknown
42	Vertical position	uncertaintyOfVerticalPosition	Float	-1.0	m. Negative value indicates unknown

General **Attributes** User Block

Number of attributes = 34

Add

Delete

Name	Value	Type	Array Size
Datatype	IHO_HDF5	String, length = 8	Scalar
Filename	out1.h5	String, length = 7	Scalar
dataCodingFormat	1	64-bit integer	Scalar
dateOfIssue	20160224	String, length = 8	Scalar
dateTimeOfFirstRecord	20131229T080000Z	String, length = 16	Scalar
dateTimeOfLastRecord	20150104T080000Z	String, length = 16	Scalar
depthTypeIndex	1	64-bit integer	Scalar
eastBoundLongitude	-125.084	64-bit floating-point	Scalar
editionNumber	1	64-bit integer	Scalar
gridOriginLatitude	-1.0	64-bit floating-point	Scalar
gridOriginLongitude	-1.0	64-bit floating-point	Scalar
gridSpacingLatitudinal	-1.0	64-bit floating-point	Scalar
gridSpacingLongitudinal	-1.0	64-bit floating-point	Scalar
horizontalDatumReference	EPSG	String, length = 4	Scalar
horizontalDatumValue	4326	64-bit integer	Scalar
methodOrSource	Harm_pred	String, length = 9	Scalar
nameRegion	Pacific	String, length = 7	Scalar
nameSubregion	Volume 6	String, length = 8	Scalar
nationalOriginator	CA	String, length = 2	Scalar
northBoundLatitude	51.058	64-bit floating-point	Scalar
numberOfStations	10	64-bit integer	Scalar
numberOfTimes	106849	64-bit integer	Scalar
numberPointsLat	-1	64-bit integer	Scalar
numberPointsLong	-1	64-bit integer	Scalar
producingAgency	DFO	String, length = 3	Scalar
productSpecification	S-111_version_1.0.0	String, length = 19	Scalar
southBoundLatitude	50.08	64-bit floating-point	Scalar
surfaceCurrentDepth	0.0	64-bit floating-point	Scalar
timeRecordInterval	300	64-bit integer	Scalar
typeOfCurrentData	3	64-bit integer	Scalar
updateApplicationDate	20160224	String, length = 8	Scalar
updateNumber	0	64-bit integer	Scalar
verticalDatum	27	64-bit integer	Scalar
westBoundLongitude	-128.3122	64-bit floating-point	Scalar

Number of attributes = 43

Add

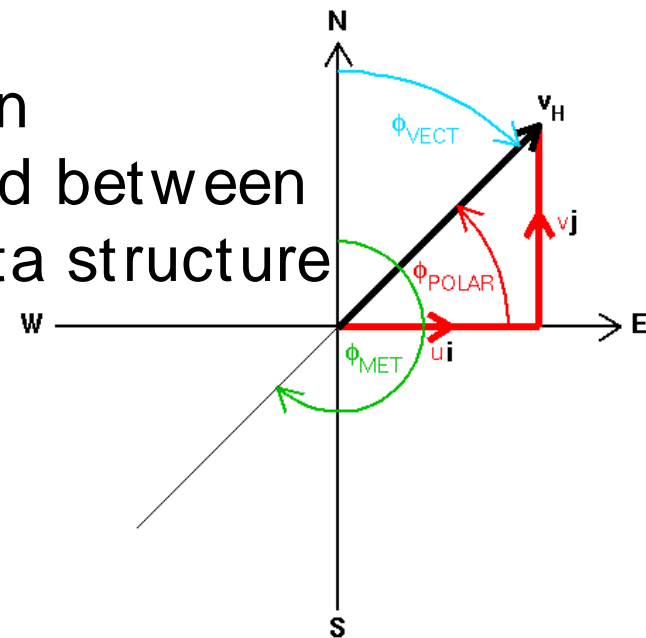
Delete

Name	Value	Type	Array Size
Datatype	IHO_HDF5	String, length = 8	Scalar
Filename	out5.h5	String, length = 7	Scalar
dataCodingFormat	3	64-bit integer	Scalar
dateOfIssue	20160308	String, length = 8	Scalar
dateTimeOfFirstRecord	20120211T100000Z	String, length = 16	Scalar
dateTimeOfLastRecord	20120212T090000Z	String, length = 16	Scalar
depthTypeIndex	1	64-bit integer	Scalar
eastBoundLongitude	-122.00048566666668	64-bit floating-point	Scalar
editionNumber	1	64-bit integer	Scalar
gridLandMaskValue	-1.0	64-bit floating-point	Scalar
gridOriginLatitude	0.0	64-bit floating-point	Scalar
gridOriginLongitude	0.0	64-bit floating-point	Scalar
gridSpacingLatitudinal	0.0	64-bit floating-point	Scalar
gridSpacingLongitudinal	0.0	64-bit floating-point	Scalar
horizontalDatumReference	EPSG	String, length = 4	Scalar
horizontalDatumValue	4326	64-bit integer	Scalar
methodOrSource	FVCOM	String, length = 5	Scalar
minimumGridPointLatitudinal	0	64-bit integer	Scalar
minimumGridPointLongitudinal	0	64-bit integer	Scalar
nameRegion	Pacific	String, length = 7	Scalar
nameSubregion	Vancouver	String, length = 9	Scalar
nationalOriginator	CA	String, length = 2	Scalar
northBoundLatitude	49.695590333333335	64-bit floating-point	Scalar
numberOfNodes	72963	64-bit integer	Scalar
numberOfStations	0	64-bit integer	Scalar
numberOfTimes	24	64-bit integer	Scalar
numberPointsLat	0	64-bit integer	Scalar
numberPointsLong	0	64-bit integer	Scalar
producingAgency	DFO	String, length = 3	Scalar
productSpecification	S-111_version_1.0.0	String, length = 19	Scalar
southBoundLatitude	48.80277266666667	64-bit floating-point	Scalar
surfaceCurrentDepth	0.0	64-bit floating-point	Scalar
timeRecordInterval	3600	64-bit integer	Scalar
typeOfCurrentData	5	64-bit integer	Scalar
uncertaintyOfDirection	-1.0	64-bit floating-point	Scalar
uncertaintyOfHorizontalPosition	-1.0	64-bit floating-point	Scalar
uncertaintyOfSpeed	-1.0	64-bit floating-point	Scalar
uncertaintyOfTime	-1.0	64-bit floating-point	Scalar
uncertaintyOfVerticalPosition	-1.0	64-bit floating-point	Scalar
updateApplicationDate	20160308	String, length = 8	Scalar
updateNumber	0	64-bit integer	Scalar
verticalDatum	27	64-bit integer	Scalar
westBoundLongitude	-123.95338500000001	64-bit floating-point	Scalar



Transformations needed

- Convert from meters per second to knots(output always in knots)
- Transform u , v in speed and direction
- For model results, restructure needed between Fvcom Netcdf output and S-111 data structure





Caris encoding tools

2 step approach

- First you create the container with metadata
- Second you add data

[s111_add_irregular_grid.py](#)

[s111_add_timeseries.py](#)

[s111_create_file.py](#)

Create File This script will generate the HDF5 S-111 file. Only the metadata provided from the input metadata file in the correct format will be encoded.

usage: s111_c

METADATA_F

for example S

example: C:\Pr

"D:\Sample_D

"D:\Sample_D

Add Time Series This script will add data to an existing HDF5 S-111 file. Only data provided from an input data file in the correct format will be encoded.

usage: s111

TIME_SERI

name of the

SingleStatio

example: C:

"D:\Sample_

"D:\Sample_

Add Irregular Grid This script will add data to an existing HDF5 S-111 file. Only data provided from an input data file in the correct format will be encoded.

usage: s111_add_irregular_grid.py [-h] -t IRREGULAR_GRID_FILE inOutFile

IRREGULAR_GRID_FILE: NetCDF (which flavour exactly?). See sample data. inOutFile: file path and name of the existing HDF5 S-111 file created with s111_create_file.py script, for example IrregularGridExample.h5

example: C:\Program Files\Python35>python.exe .\Scripts\s111_add_irregular_grid.py -t "D:\Sample_Data\irregular grid example\vh_high_fvcom_da.nc" "D:\Sample_Data\Created_Test\irregulargrid.h5"



Results

- Time series
- 10 stations, one year, 5 minutes > 16 M

- Compressed **Volume 6 - Discovery Passage & West Coast of Vancouver Island**

- [Arran Rapids \(current\) \(5600\)](#)
- [Beazley Passage \(current\) \(5200\)](#)
- [Gillard Passage \(current\) \(5500\)](#)
- [Hole In The Wall \(current\) \(5100\)](#)
- [Johnstone Str. Cen. \(current\) \(6000\)](#)
- [Nakwakto Rapids \(current\) \(6700\)](#)
- [Quatsino Narrows \(current\) \(9200\)](#)
- [Scott Channel \(current\) \(8500\)](#)
- [Seymour Narrows \(current\) \(5000\)](#)
- [Weynton Passage \(current\) \(6500\)](#)



Results

- Fvcom modelling output
- West coast model, 72963 points, 1 hour intervall for 24 hours > 28 M
- Compressed > 21 M



Conclusion and Recommendations

- Tool is license free, anybody can request access for encoding trials.
- Easily adaptable to new specifications versions.
- Can be adapted to other inputs or datatypes.
- Next step is to add regular grid encoding capacity.
- CHS' experience demonstrated feasibility
- Ensure that Metadata will meet Marine Spatial Data Infrastructure (MSDI) Standards
- Canada seeks TWCWG members to support the concept and ask TWCWG to recommend HSSC to adopt S-111 encoding process as a preliminary Standard

