

TWCWG4

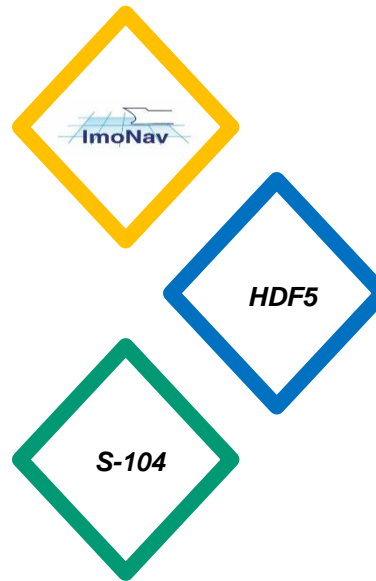
HDF5 encoding in ImoNav – first results



Agenda

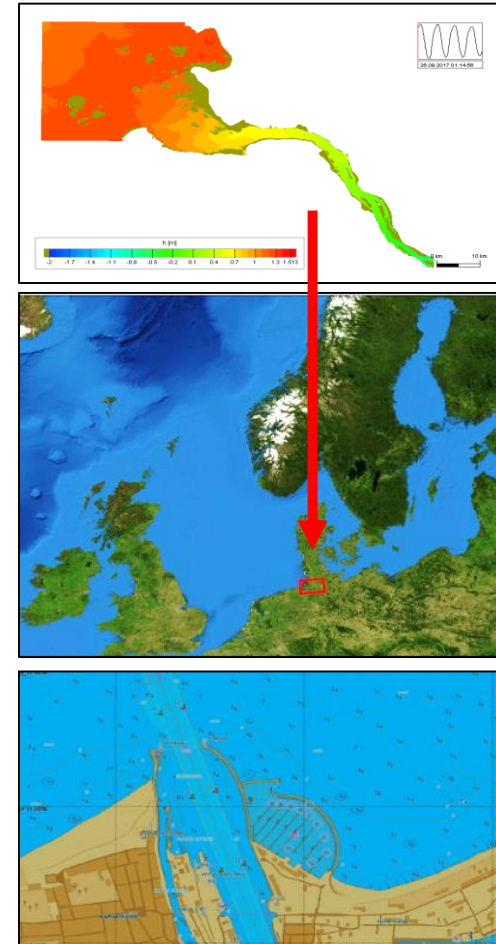
01 Introduction: ImoNav Project

03 Outlook: S-104 Encoding

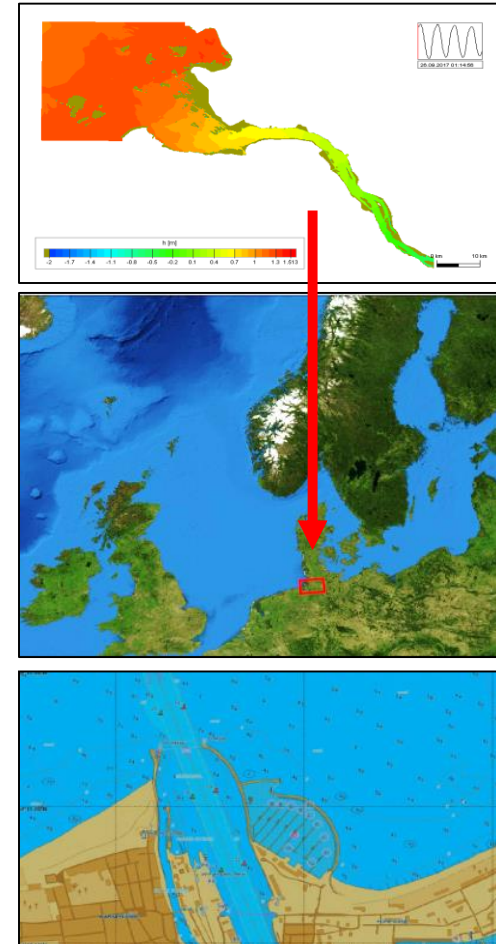


02 HDF5: S-111 Encoding & Viewer

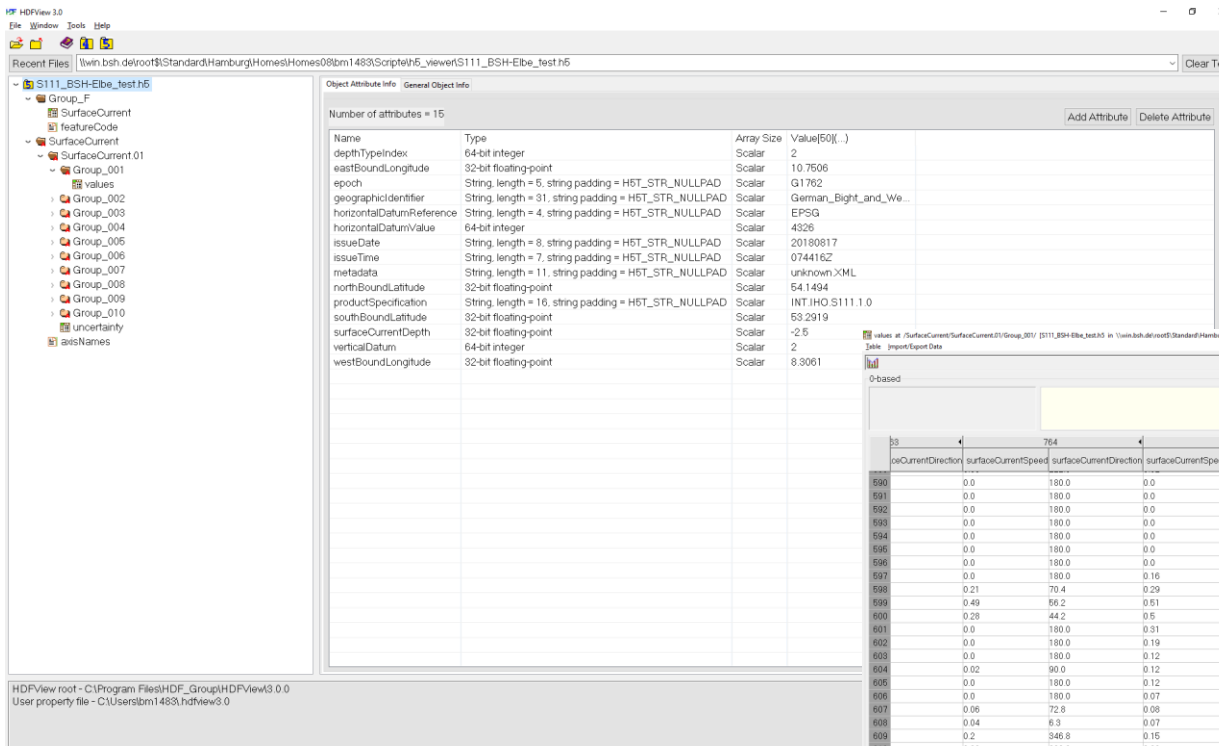
- Project ImoNav - **I**ntegration of high resolution **m**arine **g**eodata into electronic **n**avigation systems
- Develop an innovative high resolution navigation service for marine water ways (e.g. Elbe, German Bight)
 - Provide optimized water level forecast
 - Implement new method to combine numerical model forecast with model output statistics (MOS)
 - Provide high resolution bathymetry for test bed
 - Merge and harmonize data sets from different institutions
 - Combine bathymetric data and water level forecast



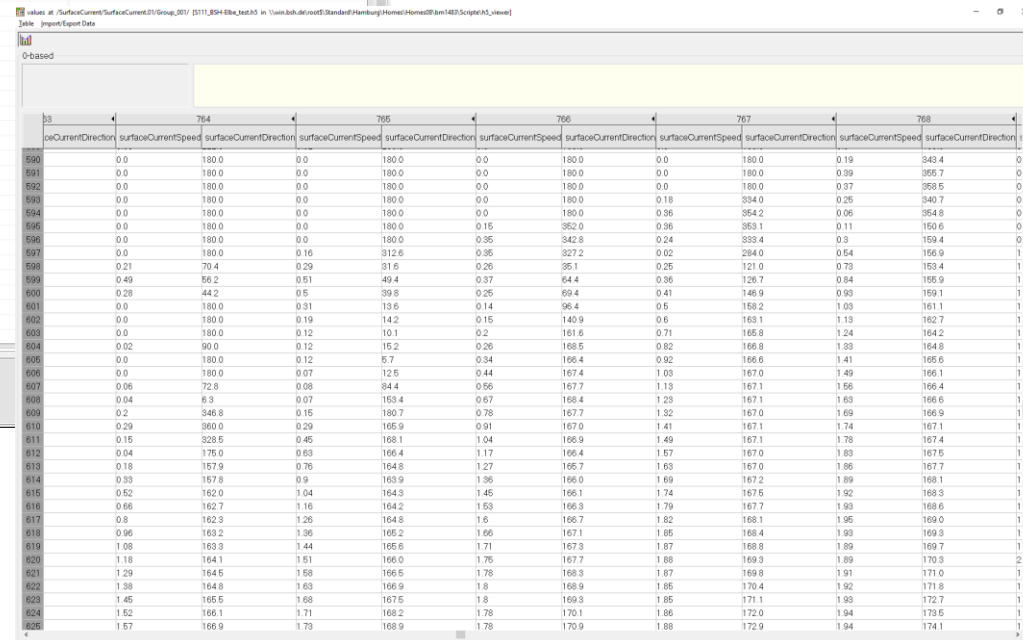
- Automate all processes for operational production
- Portray the data in ENC's and ECDIS
- Develop a communication concept for land - ship data transfer
- Deliver data according to IHO standards
 - Water level height (S-104)
 - Surface currents (S-111)
 - Total water depth (???)



Structure of S-111 – HDF5 Encoding: HDFView 3.0



- Example: **Dataset** for for German Bight



Code Structure (Python): Conversion of model output to S-111-HDF5-File

Input file: model output

- Read data
- Convert units
- Return arrays for speed, direction and time



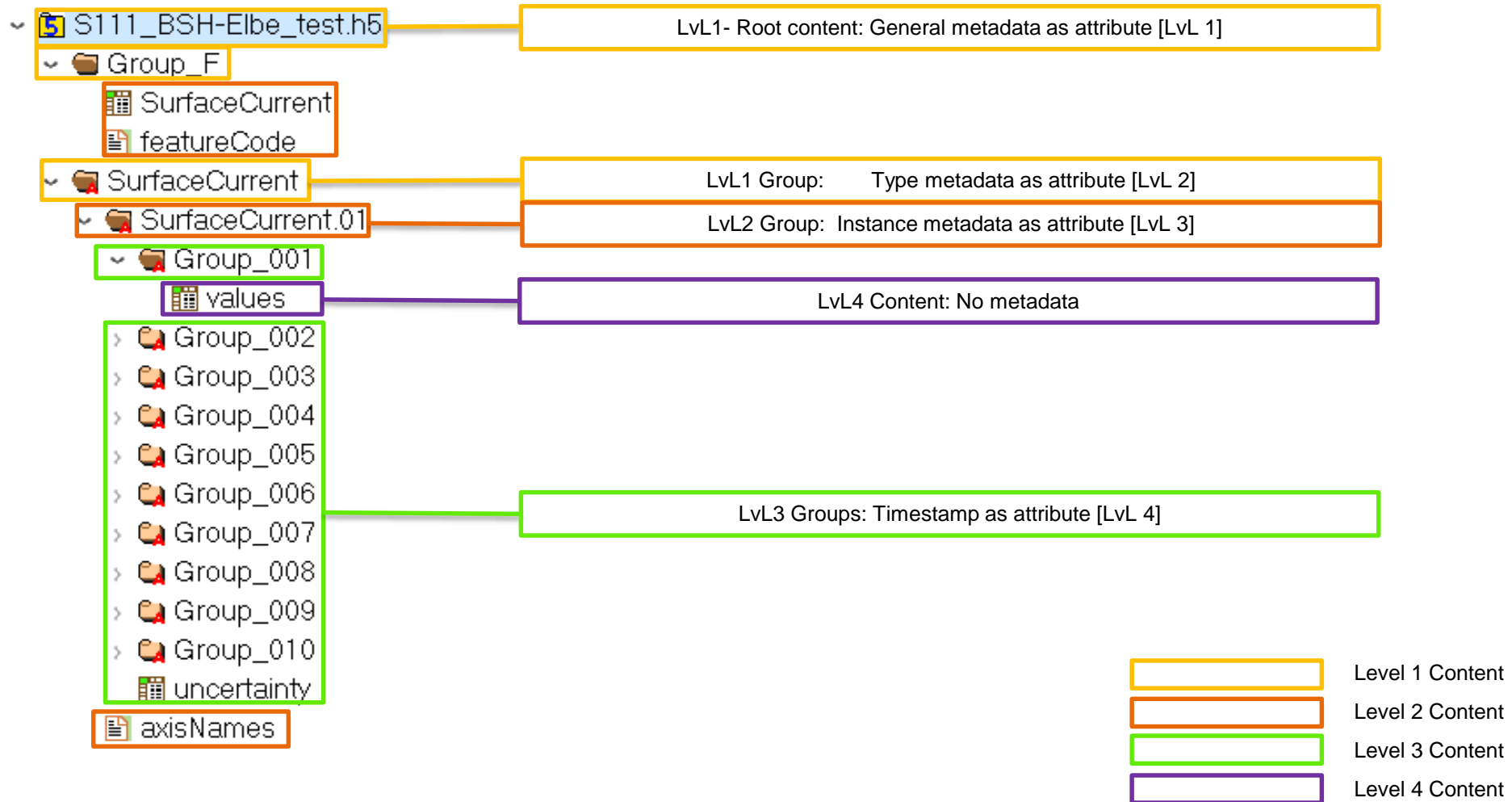
Create / read metadata

- Read in general metadata (for institution)
- Create metadata from input-arrays
- Return metadata dictionaries and according types



Write output: HDF5-File

- Create groups
- Create datasets and write data
- Write metadata as attributes to the correct hierarchy level



S111_BSH-Elbe_test.h5

Group_F

SurfaceCurrent

featureCode

SurfaceCurrent

SurfaceCurrent.01

Group_001

values

Group_002

Group_003

Group_004

Group_005

Group_006

Group_007

Group_008

Group_009

Group_010

uncertainty

axisNames

	0		1	
	surfaceCurrentSpeed	surfaceCurrentDirection	surfaceCurrentSpeed	surfaceCurrentDirection
18	-1.0	-1.0	-1.0	-1.0
19	-1.0	-1.0	-1.0	-1.0
20	-1.0	-1.0	-1.0	-1.0
21	0.34	275.9	0.33	273.3
22	0.36	284.9	0.34	279.6
23	0.37	288.6	0.34	283.4
24	0.37	288.4	0.33	283.9
25	0.37	284.7	0.33	280.6
26	0.34	276.2	0.3	274.5
27	-1.0	-1.0	-1.0	-1.0

- Compound array with two components (surfaceCurrentSpeed, surfaceCurrentDirection)
 - Under each index a tuple is stored
- Missing value, landmask is -1

S111_BSH-Elbe_test.h5

Group_F

SurfaceCurrent

featureCode

SurfaceCurrent

SurfaceCurrent.01

Group_001

values

Group_002

Group_003

Group_004

Group_005

Group_006

Group_007

Group_008

Group_009

Group_010

uncertainty

axisNames

0		
	name	value
0	surfaceCurrentDirectionUncertainty	-1.0
1	surfaceCurrentSpeedUncertainty	-1.0

“Uncertainty Dataset – The (optional) uncertainty data is contained in a compound HDF5 dataset. There is a name and a value for surface current speed and direction. The default, denoting a missing value, is -1.0. “

“For practical purposes, the confidence level is 95% and the uncertainty is defined herein as 1.96 times the standard deviation of the differences between observed and predicted values “

How to deal with uncertainty?

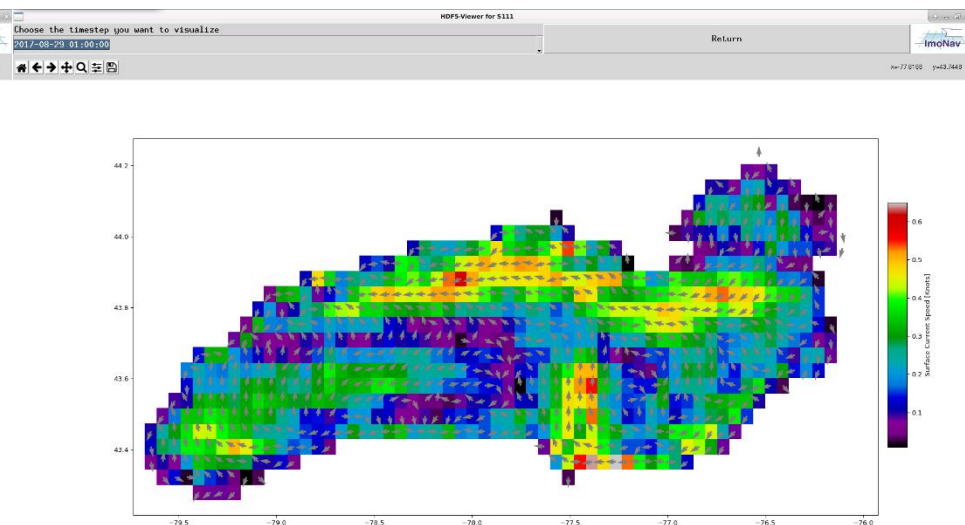
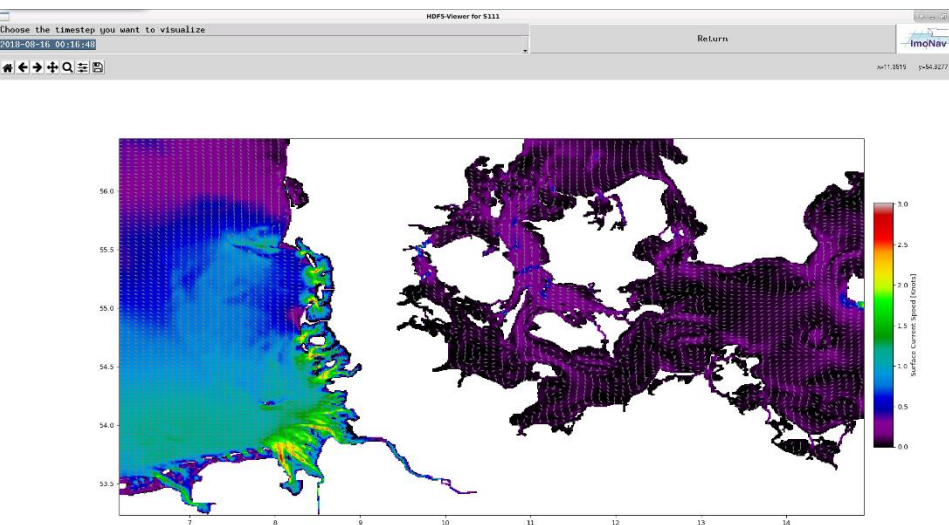
- One value for the entire grid and forecast interval?

S-111 – Visualization Tool

- Internal Tool: Basic approach for quick overview
- Python based application (Tkinter): GUI and some plotting functionality
- Currently able to plot DataCodingFormat 2 [Regular Grid] and DataCodingFormat 3 [Ungeorectified Grid]

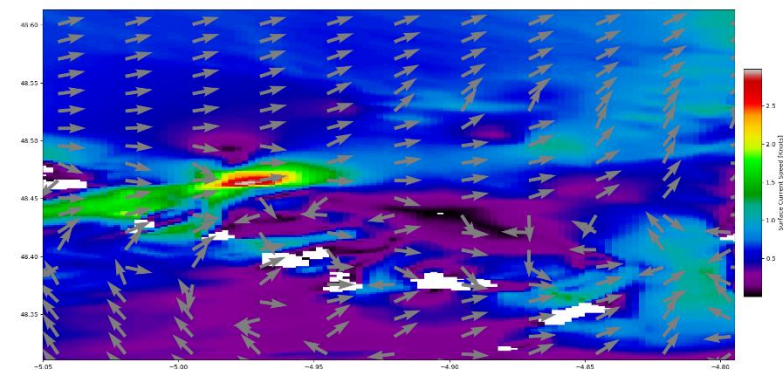
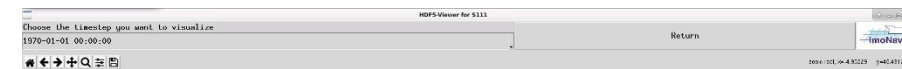
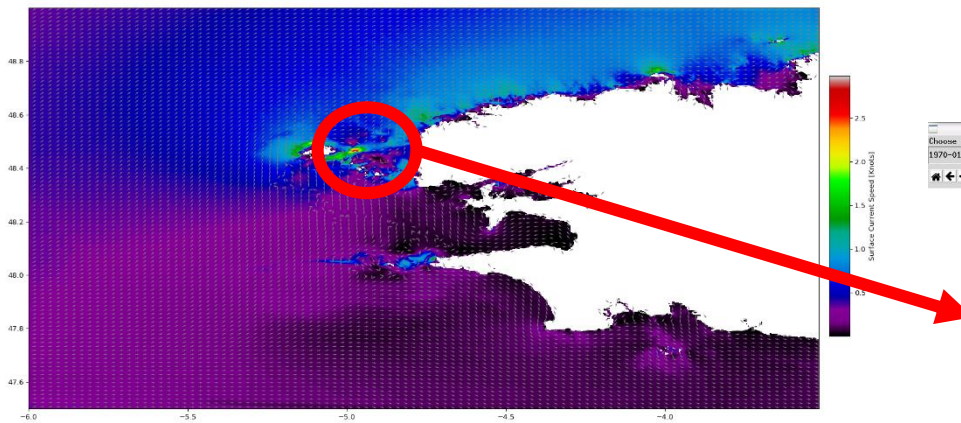
Testfile: Germany

Testfile: USA



Testfile: France (Ungeorectified Grid)

- Binned data representation (1000x1000 points)
- Integration of Matplotlib – Toolbox for zoom & save functionality etc.



- S-104 Encoding analogous to S-111 (?)
 - Structure for DataCodingFormat 2 (regular grid) could be the same
 - Metadata and attributes have to be changed

s104_BSH-GBWB_test.h5
Group_F
Waterlevel
featureCode
Waterlevel
Waterlevel.01
Group_001
values
Group_002
uncertainty
axisNames

Type Metadata

Feature Name Dataset

Object Attribute Info
General Object Info

Number of attributes = 14

Name	Type	Array Size	Value[50](...)
commonPointRule	64-bit integer	Scalar	4
dataCodingFormat	64-bit integer	Scalar	2
dimension	64-bit integer	Scalar	2
horizontalPositionUncertainty	32-bit floating-point	Scalar	-1.0
interpolationType	64-bit integer	Scalar	10
maxDatasetwaterLevelHeight	32-bit floating-point	Scalar	2.35987
methodWaterlevelProduct	String, length = 24, string padding = H5T_STR_NULLPAD	Scalar	BSH_3D_Circulation_M...
minDatasetwaterLevelHeight	32-bit floating-point	Scalar	-0.943935
numInstances	64-bit integer	Scalar	1
sequencingRule.scanDirection	String, length = 18, string padding = H5T_STR_NULLPAD	Scalar	latitude,longitude
sequencingRule.type	64-bit integer	Scalar	1
timeUncertainty	32-bit floating-point	Scalar	-1.0
typeOfWaterlevelData	64-bit integer	Scalar	6
verticalUncertainty	32-bit floating-point	Scalar	-1.0

0								
	code	name	uom.name	fillValue	datatype	lower	upper	closure
0	waterLevelHeight	Waterlevel Height	meters	-9999.0	H5T_FLOAT			openInterval

~ s104_BSH-GBWB_test.h5

~ Group_F

Waterlevel

featureCode

~ Waterlevel

~ Waterlevel.01

~ Group_001

values

> Group_002

uncertainty

axisNames

	0	1	2	3	4	5	6	
	waterLevelHeight	waterLevelHeight	waterLevelHeight	waterLevelHeight	waterLevelHeight	waterLevelHeight	waterLevelHeight	w
109	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.
110	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	-0.
111	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	-0.
112	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.
113	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.38	-0.
114	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.
115	-0.37	-0.37	-0.37	-0.37	-0.36	-0.37	-0.36	-0.
116	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.
117	-0.36	-0.36	-0.35	-0.36	-0.35	-0.35	-0.35	-0.
118	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.
119	-0.35	-0.35	-0.34	-0.34	-0.34	-0.34	-0.34	-0.
120	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.
121	-0.34	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.
122	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.
123	-0.33	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.
124	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.
125	-0.32	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.

- Most striking result in ImoNav so far:
 - MOS-surface correction method is suitable to optimize water level forecast operationally
- Experience with HDF5-Encoding :
 - Python has useful packages to write HDF5-Files (H5py)
 - Metadata has to be placed carefully

Thank you!



BUNDESAMT FÜR
SEESCHIFFFAHRT
UND
HYDROGRAPHIE



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