Paper for Consideration by HSSC11

Surface Current Production at NOAA using IHO's S-111 Format

Submitted by:	United States (NOAA)
Executive Summary:	The United States submits the following information paper to summarize the progress that is being made with respect to S-111 and the production of surface current data that are produced by NOAA
Related Documents:	S-100 Edition 4.0.0 S-111 Edition 1.0.0
Related Projects:	S-100, S-104

Introduction / Background

The International Hydrographic Organisation's (IHO) S-1xx standards are designed to support a greater variety of hydrographic digital data sources, products, and customers. The S-100 framework allows for easier use of hydrographic data beyond Hydrographic Offices and Electronic Chart Display and Information Systems (ECDIS). The United States and the National Oceanic and Atmospheric Administration (NOAA) are actively engaged in developing new products and services that use the S-100 suite of standards and specifications under development.

Surface current data in the IHO's S-111 format are being produced from NOAA's Operational Forecast Systems for Electronic Navigation Systems (ENCs) and Portable Pilot Units, and are designed to be interoperable with products that conform to the IHO's S-100 framework. The latest surface current specifications, currently being used to produce S-111 datasets by NOAA, were adopted by the IHO in December, 2018.

Analysis/Discussion

NOAA's Coast Survey Development Laboratory (CSDL) is providing a service for disseminating Operational Forecast System (OFS) surface current information in the International Hydrographic Organization (IHO) S-111 product specification that outlines formats for storing and sending water current data and metadata. S-111 is designed for interoperability with Electronic Navigational Charts and other IHO S-100 product specifications and aims to standardize surface currents for use in navigation systems in order to improve Navigation Decision Support for mariners.

The S-100/S-111 complaint HDF5 datasets produced by CSDL have been converted to a regular grid and sub-setted to provide an easily digestible size and format for consumption by Electronic Chart Systems such as Electronic Chart Display and Information Systems (ECDIS), portable pilot units (PPU), and electronic charting systems (ECS). Subsequent development efforts will include conversion to IHO S-104 standard format for water level data. Currently, S-111 HDF5 datasets are being produced for the Chesapeake Bay Operational Forecast System (CBOFS), Delaware Bay Operational Forecast System (DBOFS), the Port of New York and New Jersey Operational Forecast System (NYOFS) and for most of the Atlantic Ocean. The S-111 HDF5 datasets for the other OFS' across the United States are under development and will be posted as they become available.

HDF5 Files are produced every 6 hours following each CBOFS, DBOFS, NYOFS and RTOFS model run cycle. The full forecast period is downloaded in its native ROMS and POM NetCDF format, interpolated to a regular grid, and

appended to a single S-111 HD5 file (for a default grid) or a set of Band 2/4 S-111 HDF5 files, one HDF5 file per ENC cell with OFS coverage. Each S-111 HDF5 file contains 48-72 hour forecast projections for each forecast cycle. Currents are interpolated to a depth of 4.5m below the sea surface, and half the depth of the water column for areas shallower than 9m. See Table 1. For additional parameters that are used during surface current dataset production.

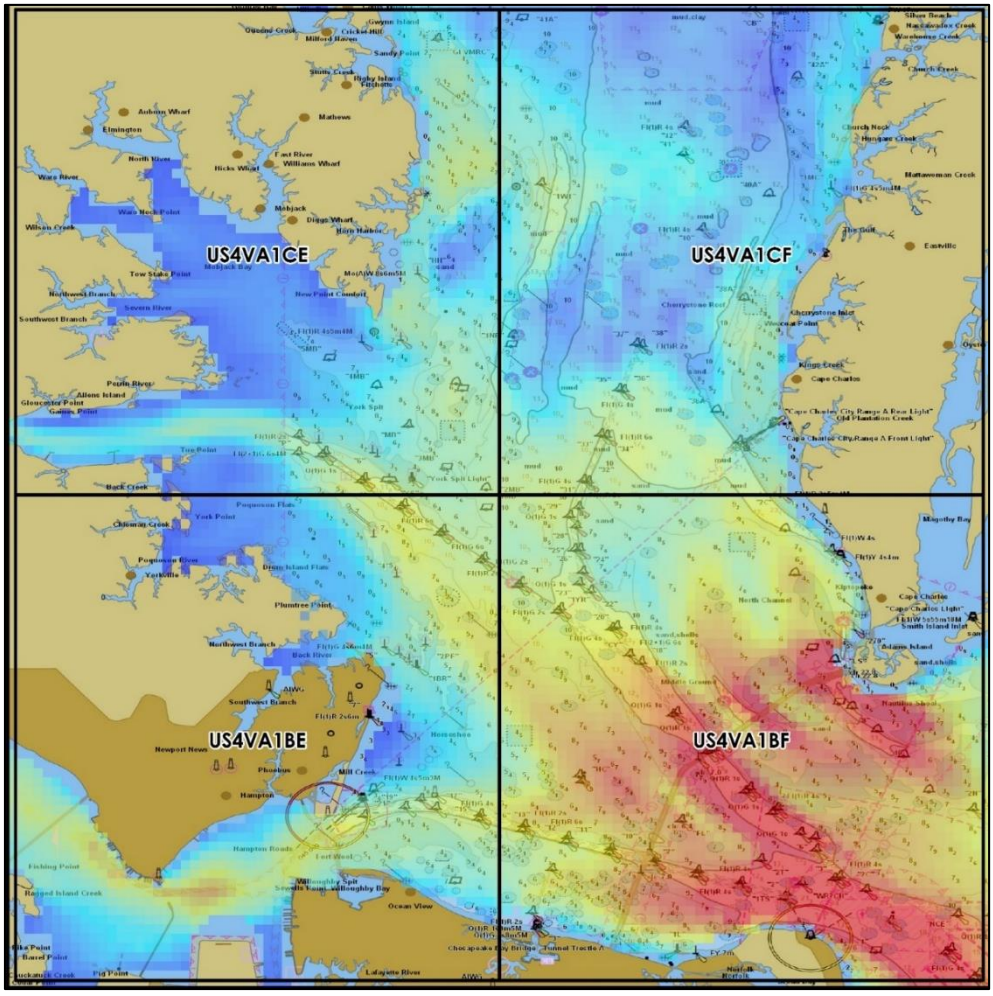
Table 1. Specifications used to produce surface current data by NOAA.

Variable	Value
IHO Specifications	S-100 Edition 4.0.0 S-111 Edition 1.0.0
Format	Hierarchical Data Format 5 (HDF5)
Operational Forecast System Parameter(s)	Surface Currents
Coordinate System	WGS 84 (G1762)
Frequency	Every 6 hours
Time Resolution	Hourly out to 72 hours
Time Zone	UTC
Spatial Resolution	500 meters
Observation Depth	-4.5 meters
Data Coverage	Atlantic Coast, Atlantic Ocean, Gulf of Mexico
Hydrodynamic Models	Regional Ocean Modelling System Princeton Ocean Model Hybrid Coordinate Ocean Model

Justification and Impacts

NOAA is defining a process to integrate surface currents and other data types by improving navigational products and services to aid in timely and accurate decision making by the mariner. The concept known as Precision Navigation will provide data and chart information using IHO standards and specifications (S-100, S-104, S-111, S-412, etc.) to professional mariners for viewing on Portable Pilot Units, iPads, and through future cloud applications.

Figure 1. Surface current data for the lower Chesapeake Bay, Virginia using IHO's S-111 standard.



Concluding Remarks

NOAA is prepared to offer technical assistance and make the source code and scripts for our tools available to those who wish to investigate the prospects of producing their own S-111 compliant datasets.

Action Required of HSSC11

The HSSC is invited to review the technical brief and take the opportunity to ask questions on NOAA's implementation of S-111.