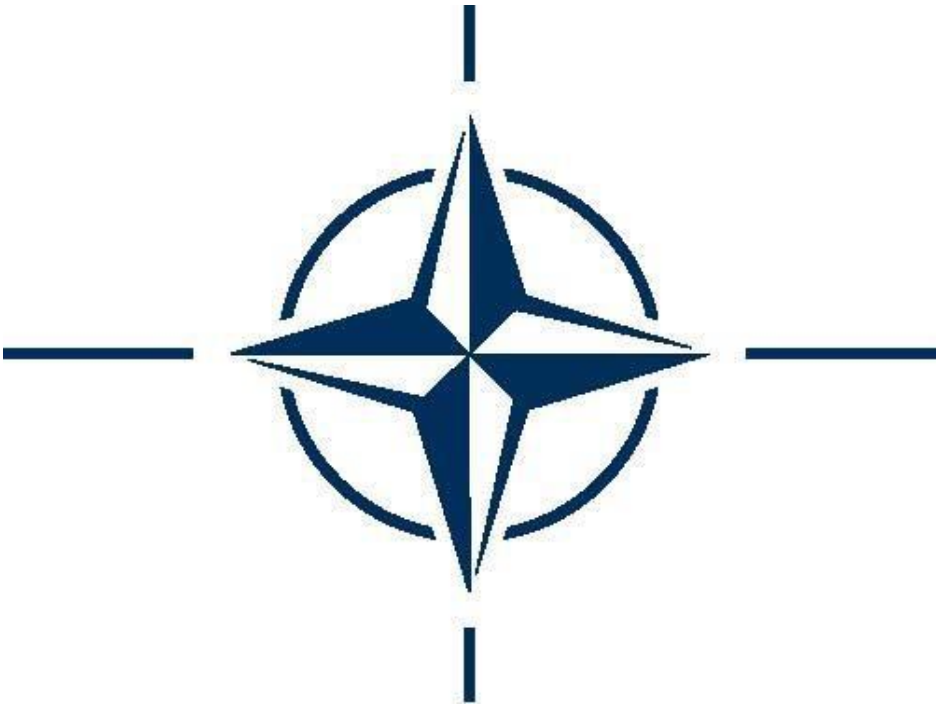
NATO STANDARD

AGeoP-19

ADDITIONAL MILITARY LAYERS (AML) – DIGITAL GEOSPATIAL DATA PRODUCTS

Edition B, version 1

FEBRUARY 2022



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NATO LETTER OF PROMULGATION

22 February 2022

1. The enclosed Allied Geographic Publication AGeoP-19, Edition B, version 1, ADDITIONAL MILITARY LAYERS (AML) - DIGITAL GEOSPATIAL DATA PRODUCTS, which has been approved by the nations in the Military Committee Joint Standardization Board, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 7170.

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Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
EST	WC, AMC and GS-ESB will not be produced. SBO, ESB and MFF production is planned to happen in the future 2025+ depending on data availability for the Estonian Defence Forces. Currently only the LBO, CLB and RAL products are available over the Estonian territorial waters.
LTU	The Lithuanian Navy uses only the developed AML, but the AML development capacity is not planned in the medium term.
ROU	Maritime Hydrographic Directorate has the technical equipment to compile AML (Additional Military Layer) products, S-57 vectorial format (software and hardware) as it follows: - Contour Line Bathymetry - Bathymetric Line (CLB); - Large Bottom Objects (LBO) - Underwater obstacles larger than 5 m; - Small Bottom Objects (SBO) - Underwater obstacles smaller than 5 m; - Environment, Seabed and Beach (ESB) - environment, sea bottom type and beaches; - Routes, Areas and Limits (RAL) - route, areas, and limits; - Maritime Foundation and Facilities (MFF) - maritime and harbour facilities. Romanian warships are not equipped with WECDIS (Warship Electronic Chart Display and Information Systems) for using this digital geospatial products.
USA	USA does not participate in AML co-production. USA is in the process of transitioning from legacy Digital Nautical Chart production to S57-based Electronic Navigation Chart production, which serves as the base layer for AML. Upon completion of this transition, USA will being immediate transition to S500-based production to align with United Kingdom Hydrographic Office (UKHO), and National Oceanic and Atmospheric Agency (NOAA).
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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CHAPTER 1 ADDITIONAL MILITARY LAYERS

1.1 INTRODUCTION

This chapter provides an overview of the concept and development of Additional Military Layers (AML).

1.2 OVERVIEW

Additional Military Layers (AML) is a unified range of digital geospatial data products designed to satisfy the totality of NATO non-navigational maritime defence requirements.

It is designed to:

- Provide the defence maritime user with digital vector and gridded data to support situational awareness across the full range of warfare scenarios at every operating level from strategic planning to tactical operation.

- Be deployable within a wide range of systems including headquarters, planning, command and control, navigational (WECDIS) – in conjunction with maritime navigational products such as ENC – weapon systems and sensors (e.g. SONAR).

The terms “Additional Military Layers” and “AML” shall not be used except to describe the concept and products identified in this publication.

All AML products will be constructed using the WGS84 horizontal datum.

The Content Model developed for AML products will be designed for compatibility with the relevant elements of the content models of associated products such as ENC and DNC.

The AML concept allows for the use of different exchange standards (e.g. S-57). The product specification separates the generic definition of the content of each AML product (held in the main body of the specification), from exchange standards (defined in annexes of the specification). This approach ensures interoperability at the information (content model) level, while allowing flexibility in the format of the data.

Subject to design of user systems, AML products provided in different exchange standards can be combined in a single display. AML products also may be displayed with backdrop navigational chart data in raster or vector form.

A single product specification may result in a number of data products for the same geographic area. These data products may vary because of scale, security classification or be different subsets of the data content defined in the specification. The content and scale of these different products will be dictated by the intended use of that product.

This publication does not mandate the use of any particular symbolisation standard for AML Products. However, to support consistent display in WECDIS systems, portrayal guidance, through the preparation of an AML Portrayal Specification, has been developed using APP-06(C) and IHO S-52.

The AML Portrayal Specification defines symbols and rules for the display of vector AML datasets and supports AML 1.0, 2.1 and 3.0 vector products. It builds on the IHO S-52 Edition 6.1 standard and the Presentation library 4.0.

Additional symbols have been added where required, and additional viewing groups created to allow users to customize the display to meet their needs.

The current version of the AML Portrayal Specification is version 3.0.0, however, the GMWG should be contacted to obtain the latest information.

1.3 ORIGIN AND HISTORY

The AML initiative has defined maritime digital products for the defence user. The original concept paper[1] for AML was presented to the GeoRWG in 1996.

Version 1.0 of AML was published in November 2001. This consisted of six logical layers of information, the content of each being defined within their own product specification. These six layers defined digital vector information and covered the following areas:

- Contour Line Bathymetry (CLB)
- Large Bottom Objects (LBO)[2]
- Small Bottom Objects (SBO)[3]
- Environment, Seabed and Beach (ESB)
- Routes, Areas and Limits (RAL)
- Maritime Foundation and Facilities (MFF)

Version 2.1 of AML was published in November 2005. This version extended the features contained within the six vector product specifications, changed some features between product specifications and re-modelled some features within the SBO product specification. However, it retained the six separate vector specifications as defined in V1.0.

In addition, three gridded product specifications have been added to the AML concept:

- Integrated Water Column (IWC) – Version 2.2, Jun 2006.
- Atmospheric and Meteorological Climatology (AMC) – Version 1.0, Nov 2004
- Gridded Sediment – Environment Seabed and Beach (GS-ESB) – Version 1.0, Jul 05

[1] GeoRWG, London, April 1996: “Additional Information Layers for Military Hydrographic Use”, R. Carpenter, UKHO
[2] That is wrecks and items on the seabed of similar dimensions, which includes NSC information
[3] That is mine-like contacts and items on the seabed of similar dimensions.

Version 3.0 of AML was published in July 2008. This version has only affected the six vector specifications. The gridded specifications remain unchanged. Version 3.0 has combined the six vector product specifications into a single product specification. It has also extended the features described within AML.

The AML Large Bottom Object (LBO) layer caters for Non-Sub Contact (NSC) information requirements and supersedes former STANAG 3715. AML LBO is used for the exchange of NSC information.

Current AML product specifications are described at section 1.5 of this document.

1.4 GOVERNANCE OF AML

AML development is directed by the Geospatial Maritime Working Group (GMWG) and all versions of AML endorsed by them.

For NATO Operational Geospatial Requirements, the GMWG is directed and supported by the Geospatial Requirements Working Group (GRWG). For NATO Geospatial Standardization, the GMWG is directed and supported by the Joint Geospatial Standards Working Group (JGSWG). GMWG also reports annually to the NATO Geospatial Board (NGB). For oceanographic and meteorological contents, GMWG will liaise with the Military Committee Meteorology and Oceanography Group (MC METOC Group).

1.5 PRODUCT SPECIFICATIONS (GENERAL)

The NATO endorsed Product Specifications for the three concurrent versions of AML are the authority for AML products.

The Product Specifications define the data content, format and structure of all AML products.

These specifications must be referred and adhered to by any AML production or receiving system.

The endorsed AML Product Specifications may be accessed via the AML web page hosted on the United Kingdom Hydrographic Office website (https://www.admiralty.co.uk/ukho/defence).

1.6 PRODUCT DESCRIPTIONS (AML VERSIONS 1.0 AND 2.1)

Contour Line Bathymetry – CLB:

CLB is a vector scaled product. It includes spot soundings, depth areas and more depth contours than those shown on standard navigational charts.

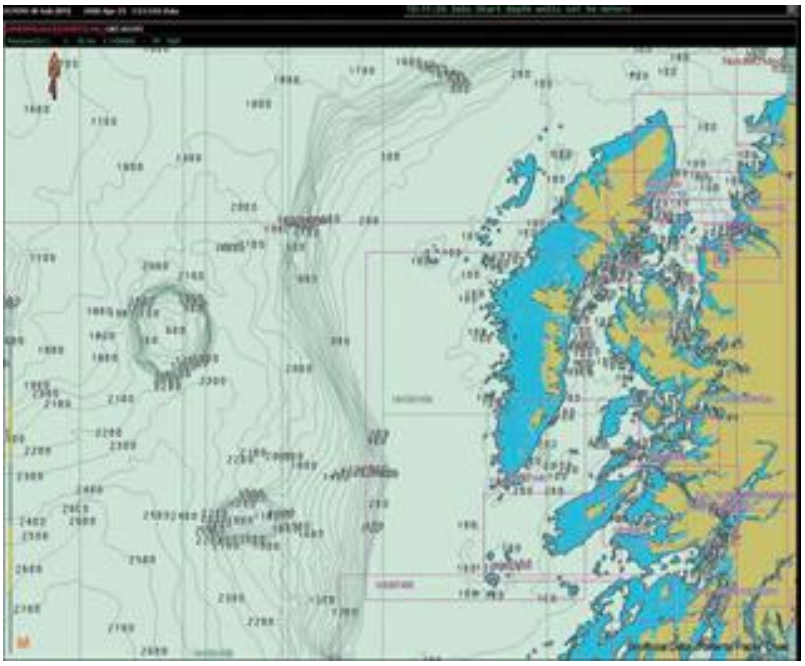


Fig 1
Scale band 4 (1:1,000,000) Contour Line Bathymetry west of Scotland. Useful for planning (Viewer - OSI ECPINS v5.0.3)

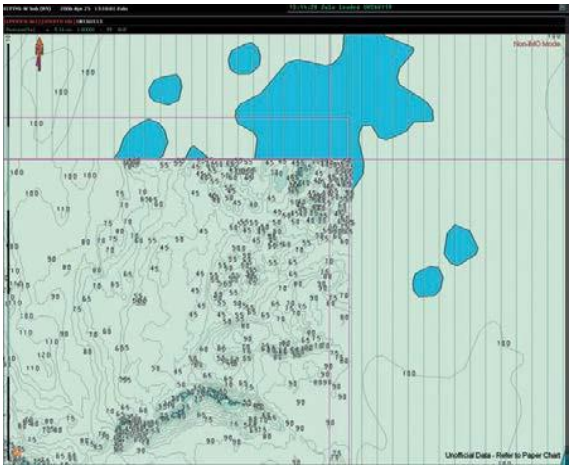


Fig 2
Lower left - detailed bathymetry in the Minch at Scale Band 6 (1:50,000), compiled at survey scale for tactical use. Compare with the Scale Band 4 data to the north and east. (Viewer - OSI ECPINS v5.0.3)

Environment, Seabed and Beach – ESB:

Designed to provide the user with information about the seabed and beach areas, ESB is of particular value in support of mine counter-measure activities and amphibious operations. It is a vector scaled product including:

- Composition and thickness of multiple sediment layers including bedrock
- Acoustic/physical properties
- Slope

- Mine Counter Measures (MCM) areas
- Sand waves
- Trawl scours
- Vegetation
- Beach – full map/chart at very large scale, or as an overlay to standard mapping/charting
- Low resolution seabed information to support Anti-Submarine Warfare (ASW)

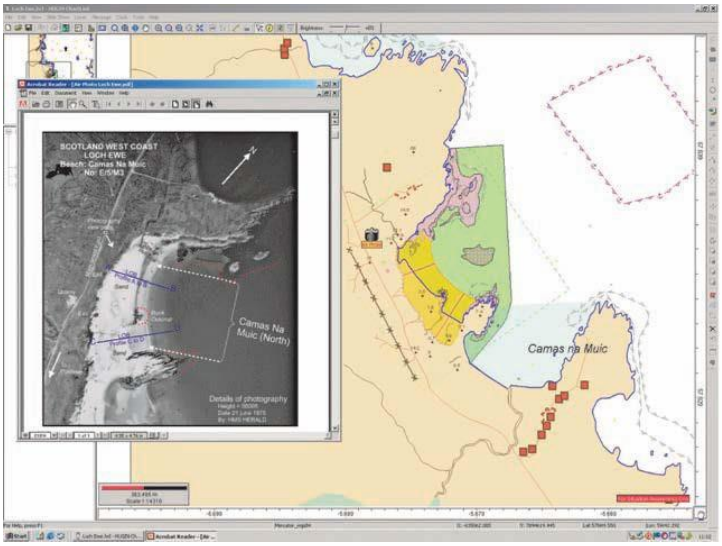


Fig 3
Beach information from ESB displayed with MFF. Aerial photography from a linked external file is also displayed. (Viewer – Tenet HUGIN Chartlink)

Large Bottom Objects – LBO:

LBO is an un-scaled vector product showing all objects on the seabed larger than 5m in any dimension. LBO includes:

- Wrecks (charted and uncharted)
- Rocks
- Obstructions
- Seabed installations

Each bottom object includes full attribution beyond that shown on a standard chart making the data useful for submarine and anti-submarine operations and for mine warfare applications.

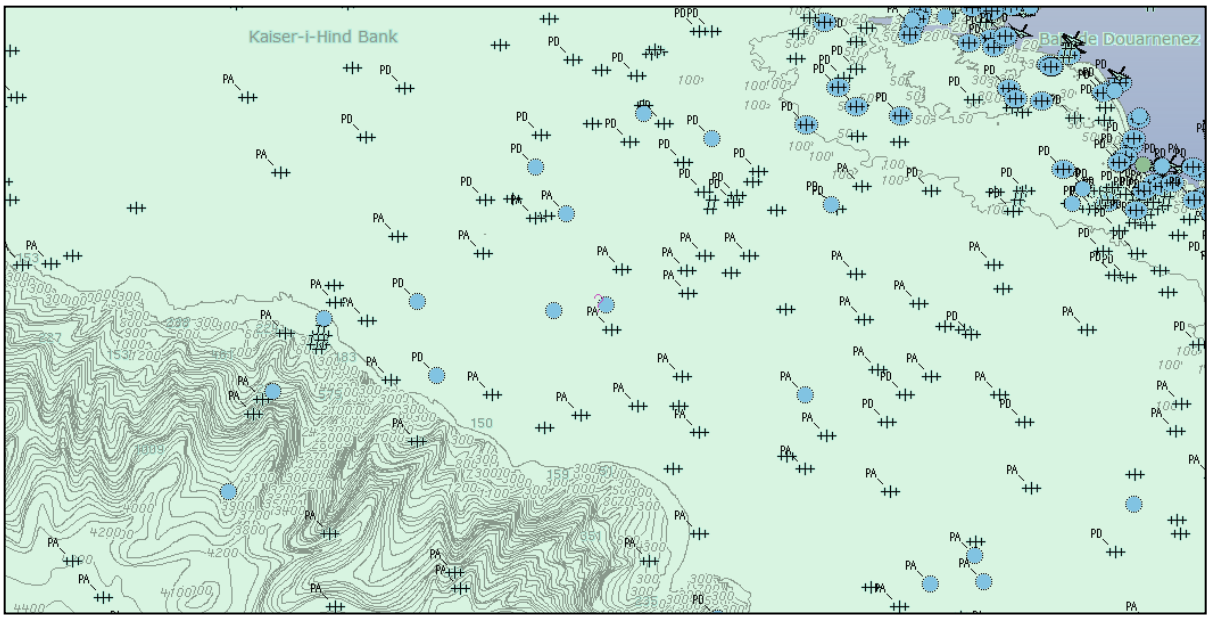


Fig 4
Features from LBO displayed alongside CLB
(Viewer – SevenCs SeeMyENC)

Maritime Foundation and Facilities – MFF:

MFF is a vector scaled product designed to provide a suitable reference background and context similar to that provided by raster nautical charts. Features included in MFF are:

- Coastline
- National land boundaries and major cities
- Main ports, harbour locations and facilities
- Major lights and buoyage
- Magnetic information
- Tidal information

Tactical Information included in MFF is:

- Radar reflective entities such as offshore platforms, buoys, beacons
- Communication facilities and coverage
- Pipeline and cable information
- Fishing activity
- Oil, gas and mineral production information
- Ice limits
- Search and rescue information
- Miscellaneous seabed obstructions that cover a significant area

Although in some instances ENC may be used to provide this background content, MFF has a number of specific advantages;

- MFF can be schemed as a regular grid and therefore covers the entire area of interest

instead of areas only of navigational interest

- AML is not encrypted using the S-63 encryption scheme and therefore can easily be loaded into a range of C2 systems
- AML may not be subject to the same copyright constraint as ENC data

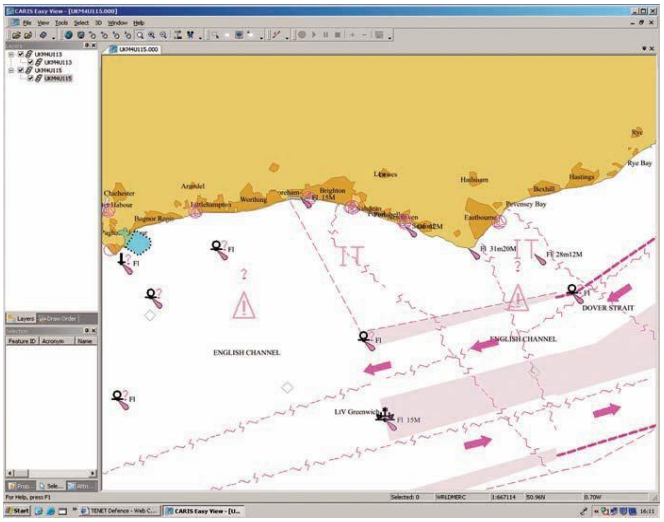


Fig 5
Scale band 4 MFF (Viewer - CARIS Easy View)

Small Bottom Objects – SBO:

The SBO vector dataset is useful for Mine Counter-Measures, Amphibious and route lead-through operations. It is un-scaled and includes all known bottom contacts that are smaller than 5 metres, i.e. mines and mine-like contacts.

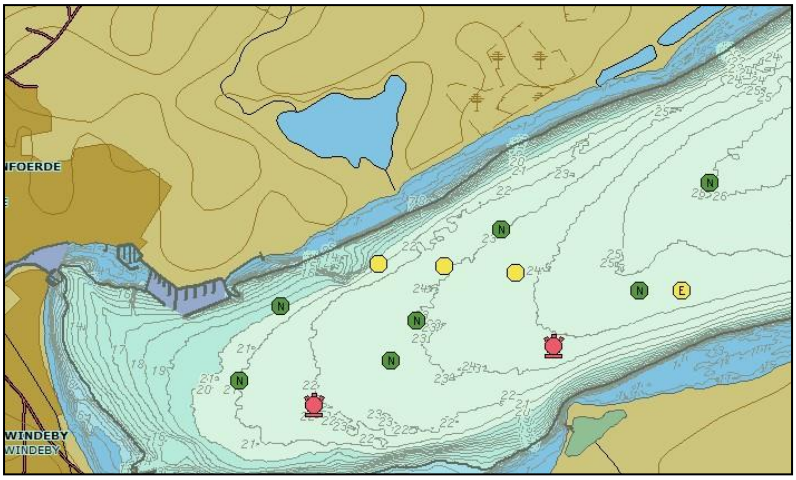


Fig 6
Fictitious sample Small Bottom Objects displayed alongside LND AML data displayed according to the draft AML Portrayal Specification.
(Viewer – SevenCs SeeMyENC)

Routes, Areas and Limits – RAL:

RAL, an un-scaled vector product, contains features useful for a wide variety of planning and operational purposes. It includes the following type of features:

- Territorial Waters Limits – EEZ (Exclusive Economic Zone), fishery limits, contiguous zone, continental shelf areas, straight territorial baselines and territorial sea areas
- Military Practice Areas – danger areas, PEXA (Practice and Exercise Area), safe bottoming areas, testing and evaluation ranges
- Q routes
- Restricted areas e.g. historic wrecks, minefields, safety zones
- Submarine transit lanes
- Swept areas
- Waypoints/reporting/calling-in points - NAVAIDS, helicopter reporting points, rendezvous locations, reporting/radio calling-in point

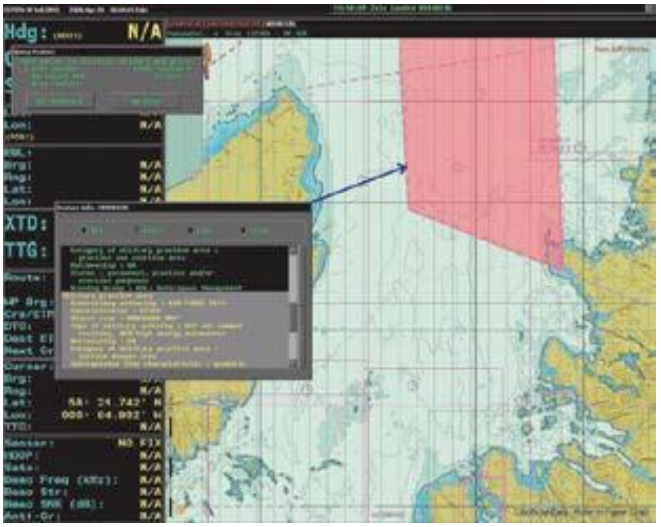
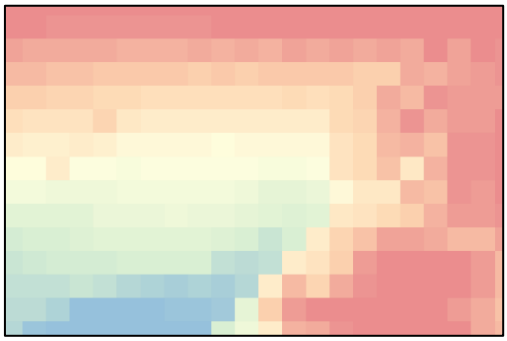


Fig 7
RAL with a military practice area highlighted and its attributes displayed.
(Viewer – OSI ECPINS).

Integrated Water Column – IWC:

The purpose of IWC, a gridded dataset, is to provide marine climatological data to describe the likely conditions found within the water column. Information includes:

- Temperature and salinity
- Ocean Current distribution
- Marine mammal distribution IWC is delivered in the netCDF format.



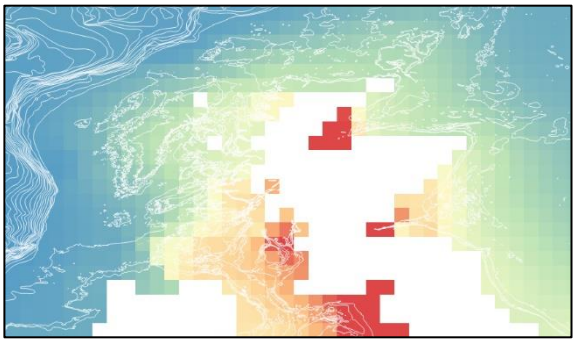


Fig 8 IWC Marine Mammal distribution *Fig 9 IWC Salinity including CLB for context (Viewer - QGIS (formerly Quantum GIS))*

Atmospheric and Meteorological Climatology – AMC:

AMC data describes the meteorological and climatological conditions to assist with operational planning. It is a gridded dataset including the following historical information:

- Wind speed, direction and frequency
- Air temperature
- Relative humidity
- Dew point
- Pressure
- Cloud cover
- Visibility
- Probability of meteorological phenomena

AMC is delivered in the GRIdded Binary (GRIB) format.

Gridded Sediment - Environment Seabed and Beach - GS-ESB:

The GS-ESB product contains geo-acoustic properties of the sediment layer in a gridded form. It is currently a draft product specification only implemented within UK systems.
It is a draft specification which is not endorsed by NATO however it is used by some nations.

GS-ESB is delivered in the NetCDF format.

1.7 PRODUCT DESCRIPTIONS (AML VERSION 3.0)

This version combines the 6 vector specifications into a single product specification. Version 3.0 also extends the content of AML in the following areas:

- Additional land features and attributes from Vector Map VMAP
- Ice features and attributes from World Meteorological Organization (WMO) ECDIS Ice Objects v4.0
- Additional air features and attributes
- Incorporates changes made to IHO S-57 3.1.1
- Generic attributes SCAMIN and SCAMAX
- Extra attribution on Marine Management Areas

AML v3.0 identifies certain layers or data themes that represent logical groupings of data types but these are not explicitly defined in the Product Specification. The identified layers are:

- AML Additional Military Layers – Generic
- TSB Territorial Sea Boundaries
- FAI Flight Aeronautical Information. This can be broken down into:
- CFI Civil Flight Information
- MFI Military Flight Information
- PEA Practice and Exercise Areas
- MMA Marine Management Areas
- QRT Q-Routes
- SBO Small Bottom objects for MCM Mine Counter Measure
- LBO Large Bottom Objects for ASW and MCM
- CLB Contour Line Bathymetry for different users/warfare scenarios
- AMP Amphibious Warfare Data
- ICE Ice Data
- MTD Mine Tactical Data
- SED Sediment
- LND Land Background Data
- NCD Nautical Chart Background Data
- MNI Military Nautical Information of relevance to navigation scenario

1.8 PRODUCT FORMAT

The AML product specification has been written in two parts. The main part of the product specification describes the content of the product without specifying any particular format. Annexes to the product specification describe how that content should be encoded in a particular format. (e.g. Annex A of the vector product specification describes the S-57 format encoding.)

Currently the only NATO endorsed format for the vector product specifications is S-57.

The format for the gridded IWC and GS-ESB products is net-CDF. The format for the gridded AMC product is GRIB.

1.9 IMPLEMENTATION

As described above, there are currently three concurrent versions of the AML vector product specifications.

As of the date of this document, all three versions are current. This is because of the need to support legacy systems still requiring earlier versions of the specification.

The version of AML a NATO nation chooses to adopt will be dictated by the capability of their AML receiving systems and the requirements for interoperability across warfare disciplines and between NATO nations and NATO commands.

Further information should be sought from the GMWG with respect to the implementation of AML.

1.10 STATUS WITHIN NATO

AML as defined in this standard is a mandated product for WECDIS as defined in STANAG 4564.

AML is recognised as a core requirement for NATO maritime geospatial requirements[4]. Such an example is the use of AML in the NATO AML Co-Production Programme (NACPP), which is a collaborative initiative among NATO nations to support NATO maritime operations and NATO priority operational requirements.

1.11 ENCRYPTION

In the interests of international interoperability, AML products will not be encrypted.

1.12 NETWORK MODEL BATHYMETRY

It was previously intended to develop a Network Model Bathymetry specification; although this has not been completed, the IHO S-102 Product Specification has been published and should be used to meet the requirement for detailed bathymetric information.

1.13 FUTURE DEVELOPMENTS

Currently work is in progress to develop a new generation of AML product specifications.
This reflects wider developments and the limitations of the current specifications. Importantly the new standards being developed should be more flexible and aligned to COTS software and delivery via Web Services. This work is conducted by the GMWG Technical Panel within the GMWG and in liaison with DGIWG, the IHO and other bodies.

Reflecting developments in geospatial technologies such as Web Services various activities within civil and military standards bodies are underway to develop contemporary standards for geospatial information largely building on the ISO TC211 19100 series of standards. These follow the shift from traditional products towards vector data and delivery via web services.

These developments include those within the IHO, developing the S-100 standard to provide a contemporary and flexible framework for hydrographic information. The Open Geospatial Consortium (OGC) develops and drives standards which geo enable the web. Within NATO the NATO Geospatial Information Framework (NGIF) has been published and is being further developed to realise NATO geospatial policy using these new standards.

[4] Geospatial Maritime Information Requirements in Support to NATO, version1.2, Mar 2008

The Defence Maritime Exchange Model (DMGEM) is a framework developed by the GMWG to address the need for a contemporary set of standards and specifications aligned with IHO and NATO NGIF. STANAG 6503 outlines the DMGEM and subordinate product specifications that support situational awareness within maritime navigation and C2 systems, but also leverages NGIF support to wider C2 systems including delivery via web services.

AML+ (IHO S-500 series) is the name given to a new generation of AML product specifications within the DMGEM Framework and is defined as 'a unified range of digital geospatial data products designed to satisfy NATO non-navigational maritime defence requirements, which is an evolution of AML, and that is aligned with contemporary geospatial standards, including the NGIF'. These define the detailed content, structure and display of maritime geospatial information. Initial work on a S-500 specification has begun based on IHO work and AML 3.0 content. The GMWG Technical Panel for Standards is taking this work forward.

NGIF is a major piece of work being led strategically by NATO's Joint Geospatial Standards Working Group (JGSWG) and technically through the Defence Geospatial Information Working Group (DGIWG) (which is working in support of NATO) to deliver a set of common geospatial information standards across NATO.

NGIF is intended to realize the principle of 'operating off the same map' by developing a common data model from which digital and hardcopy products can be created. It will ensure that products can be delivered across the NATO Networked Enabled Capability (NNEC) utilising a Service Oriented Architecture (SOA) approach. NGIF provides an opportunity to exploit maritime geospatial data alongside other domains (i.e. air and land) to present one unified view to the NATO Warfighter.

Further details can be found in the DMGEM STANAG 6503 which, in due course, will supersede STANAG 7170.

ANNEX A LEXICON

SECTION I – TERMS AND DEFINITIONS

TERM	DEFINITION
Additional Military Layers (AML)	A unified range of digital geospatial data products designed to satisfy the totality of NATO non-navigational maritime defence requirements.
Additional Military Layers Plus (AML+)	A unified range of digital geospatial data products designed to satisfy NATO non-navigational maritime defence requirements, which is an evolution of AML, and that is aligned with contemporary geospatial standards, including the NGIF.
Non-Sub Contact (NSC)	Any feature, wreck, or other object on the sea floor that could be mistakenly identified as an operable submarine when detected with acoustic or magnetic sensors.

SECTION II – ACRONYMS AND ABBREVIATIONS

ABBREVIATION	FULL FORM
AMC	Atmospheric and Meteorological Climatology
AML	Additional Military Layers
AML+	Additional Military Layers Plus
C2	Command and Control
CLB	Contour Line Bathymetry
DMGEM	Defence Maritime Geospatial Exchange Model
DNC	Digital Nautical Chart (US vector chart in VPF format)
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
ESB	Environment, Seabed and Beach
GMWG	Geospatial Maritime Working Group
GRIB	GrIdded Binary (WMO bit-oriented data exchange format)
GRWG	Geospatial Requirements Working Group
IHO	International Hydrographic Organization
IWC	Integrated Water Column
JGSWG	Joint Geospatial Standards Working Group
LBO	Large Bottom Objects
MC METOC Group	Military Committee Meteorology and Oceanography Group
METOC	Meteorological Oceanographic
MFF	Maritime Foundation and Facilities
MILOC	Military Oceanography
MILMET	Military Meteorology
Net-CDF	Network Common Data Format
NACPP	NATO AML Co-Production Programme
NGB	NATO Geospatial Board
NGP	NATO Geospatial Policy
NSC	Non-Sub Contact
RAL	Routes, Areas and Limits
S-52	IHO Display of ENC and Symbology
S-57	IHO Transfer Standard for Digital Hydrographic Data
S-100	IHO Universal Hydrographic Data Model
S-102	Bathymetric Surface Product Specification
S-500	IHO Additional Military Layers (Next generation)
SBO	Small Bottom Objects

SONAR	SOund Navigation And Ranging
VPF	Vector Product Format
WECDIS	Warship Electronic Chart Display and Information System (NATO STANAG 4564)
WMO	World Meteorological Organisation

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