A MARINE REFERENCE BASE FOR THE UK SDI

WHERE DOES MARINE DATA FIT INTO THE SCHEME FOR GENERIC NATIONAL SDIS?

The UK Location Strategy is published and work on the design for the UK Spatial Data Infrastructure (SDI) is progressing. The UK Marine and Coastal Access Bill and government Marine Policy Objectives underline the need for better understanding of our seas. Now is the right time to establish marine and coastal reference information as a core geographic dataset.

The INSPIRE Directive (Infrastructure for Spatial Information in the European Community) refers to several marine related data themes and many generic geographic features cross into the marine domain. Examples include geographic names, transport networks, elevation, geology and hydrography (or hydrology). UK Location Strategy aims are applicable to land, sea and air, and many marine and atmospheric practitioners are involved in its development. Yet there are challenges to overcome for the UK marine space to be properly represented - both technical and cultural.

The marine community suffers from a legacy of data collected for a particular purpose and not re-used, resulting in the silos of undiscoverable data that the UK Location Strategy is attempting address. Widely available data products are so strongly coupled to a particular application, e.g. safety of life at sea, that they are not suitable to support many other activities (see text box).

Perhaps the greatest benefit to the marine community will come not from the technical implementation of an SDI, but from adopting the principles of best practice data and information management that the SDI concept extols. Adapted from the UK Location Strategy, these principles are:

1. We know what data we have, and so avoid duplicating it.
2. We use common reference data so we know we are talking about

the same places and things and obtain consistent answers.

3. We can share information easily through common standards, technology and business relationships, e.g. licensing.
4. We have strong governance involving all relevant parties, a will to change and work towards common aims.
5. We have the appropriate knowledge and skills to understand the issues and use information effectively.

The first principle is solved through creation and publication of consistent (standardised) metadata which describes a dataset, its terms of use and its provenance, and willingness by providers and users of data to abide by this principle.

The third and fourth principles relate to having policies, standards, networks and services in place, with appropriate terms of reference, and a well coordinated structure to manage how data is created, maintained and disseminated. Principle five addresses being able to employ the right people, not only experts in geographic information but in numerous aspects of how different data is acquired, interpreted and used. Principle two addresses the need for content, i.e. the data and information of interest to users and which can be used as input to create a range of products and services.

Information Content

Arguably, the most important component of SDI is the information content available to users, expressed within a consistent coordinate reference system. At the core is reference information, i.e. the common datasets, themes or spatial data layers that most people use most of the time and which collectively make up a digital base map that can viewed and queried. The UK's Digital National Framework (dnf.org) defines reference information as any geographic feature that is used as a locational reference for application information, or can be used in geographic analysis. Application information provides the outer layer of information, which is generally business specific. It may contain no spatial reference(s) other than provided by the reference information and consist only of supplementary properties.

Reference information is often arbitrarily divided into base and associated reference information, where base information comprises fundamental topographic features (e.g. buildings, grassland) describing complete and detailed coverage of the Earth's surface. Associated reference information comprises supplementary datasets where this is also commonly used to support georeferencing or analysis (e.g. transport networks, land parcels). Interestingly, the INSPIRE Directive makes no such division and, although not explicit, the data themes identified in its annexes can all be considered as reference information although these are unlikely to be not exhaustive.

There is debate about the types of features (geographic or spatial objects) that should comprise reference information. The debate is subjective and dependent on the application(s) that the information is intended to support. Content will differ across SDI implementations (INSPIRE notwithstanding), because perspectives vary and there is no single specification.

The aim is to determine some standards for reference information and disseminate common rules for its creation and maintenance. Encouraging providers to migrate their data towards these standards is one of the challenges in creating SDI. Yet achieving this goal would result in the greatest benefits internally (by data providers) and externally (by users).

MARINE APPLICATION AREAS REQUIRING ACCESS TO FIT-FOR-PURPOSE SPATIAL DATA

Environment Protection - protection and conservation of rich biodiversity against pressures from human activity and development, marine spatial planning, licensing and regulation.
Economic Development - justification, planning, management and compliance of offshore and coastal development including oil and gas, aggregate extraction, renewable energy, tourism and recreation.
Risk Management - management and mitigation incidents at sea, coastal erosion, flooding, rising sea levels, shipping and navigation, emergency services, defence and security.

To make SDI attractive and support a range of applications and services, certain principles for reference information must be met. By adopting these principles, information providers (e.g. hydrographic offices) benefit though efficiency and use gains – and users benefit from better data, capable of supporting a wider range of applications. These principles form the foundations for interoperability and support primary third party data being re-used rather than replicated.

The following key principles have adapted from the Digital National Framework and state that reference information:

- is maintained to a published specification, is clear and unambiguous and reflects a consistent approach to feature classification, such that its recognition and representation is assured;
- provides complete coverage of the Earth's surface of the area in scope by features or their representations (instances may overlap each other, e.g. roads under bridges);
- uses vector geometry, where only one geometry type, i.e. point, line or area, is used to represent a particular feature type;
- is available to all users and has wide applicability,
- is discernible, i.e. generally visible and identified or perceived as geographic features in the real world, i.e. things with a physical presence;
- has as fine a granularity as practicable – more atomic units should be favoured over the less atomic;
- is complete and comprehensive – where an object type is defined as being present in a dataset, then all object instances within scope should be present and complete;
- has a defined life-cycle which should be documented, maintained and communicated; and
- is identified and versioned, i.e. feature instances should carry an identifier and a version number and include the ability to add or remove features.

Application information is business oriented information that requires connectivity through a geographic reference of some kind (e.g. a building, field, road or user defined feature such as a property parcel) to enable the end user to analyse and interpret the integrated information from different sources. Application information may comprise

properties of a given feature which are linked in some way to a reference feature. In either case, standards for linking datasets should be present (e.g. the Digital National Framework Association Model) and application information comply with the above principles.

The consensus in Great Britain is that a subset of Ordnance Survey MasterMap Topography Layer is the most likely candidate for reference information on land. Work undertaken by the Marine Data and Information Network (www.oceannet.org) has identified a number of 'core' datasets that might form the reference information of interest to most users and provide a MasterMap Topography Layer equivalent for our seas (see text box).

Data Themes forming Marine Reference Information

Coastlines (Mean High and Low Water (Spring Tides in Scotland), Lowest Astronomical Tide)
Elevation (bathymetry based on actual surveys if available, not that derived from nautical charts)
Tidal Surfaces (e.g. mean sea level) relative to a geodetic datum as input to integrating land and sea
Coastal / Sea Bed Geology and Geomorphology (i.e. marine landscapes as input to habitat mapping)
Offshore Infrastructure (e.g. oil and gas installations, submarine cables, aids to navigation)
Other Structures, Shipwrecks and other 'Debris'
Shoreline Constructions (e.g. pontoons, piers, outfalls, intakes to power stations)
National Limits and Boundaries (e.g. Territorial Sea and Fisheries Limits)
Licensed Development and Activity Areas (e.g. shipping, aggregate extraction, military exercise)
Named Sea Areas (as input to a marine gazetteer)

As stated above, a number of themes clearly overlap with, or are offshore extensions, of comparable land data.

SeaZone HydroSpatial

SeaZone's off the shelf digital mapping product, SeaZone HydroSpatial, includes data themes identified as forming marine reference information and has an established user base across the public and private sectors in the UK and overseas. As with MasterMap Topography Layer, SeaZone has to overcome a number of legacy and other issues with regard to HydroSpatial complying with the principles for reference information.

Elevation is a basic requirement for marine reference information in SDI and should be as accurate and up to date as possible. SeaZone is developing a new version of HydroSpatial using survey data as input to creating a surface model and to derive contiguous contours. Data derived from nautical charts is not suitable, as contours are broken and inconsistent, particularly at chart boundaries, and made deliberately conservative (i.e. elevation shown is shallower than it actually is) for safety reasons. In areas where there is no existing digital survey data, SeaZone is either capturing data from paper survey sheets where available or promoting the need for new data acquisition. As last resort, chart derived data is used as input. Metadata accompanying surveys allows for their de-confliction and provides end users with details of inputs.

Knowledge of the height of chart datum to which most hydrographic surveys are referenced to a geodetic datum allows offshore and land datums to be integrated. Knowledge of the nature of the coastline and sea bed is also a basic requirement for marine reference information and supports higher level data creation, e.g. as input to habitat mapping. Data sources are many and varied and how features (e.g. sand waves) are classified varies between organisations. SeaZone is working with British Geological Survey (BGS) to update existing data sets and create higher resolution sea bed geological data using new sources of information. BGS, in collaboration with other geological surveys, is addressing the need for consistent classification and joining of data across the coastal zone and national boundaries.

For other data themes comprising marine reference information, the sources of information vary considerably. Ideally, the competent authority for individual datasets will be known and the authority will make its most accurate and up to date data available. However, often this is not the case, intelligence is gathered by (for example) by the UK Hydrographic Office for the production of nautical charts and other publications, and it is the charted data that provides the only available input. The ability of the UK Hydrographic Office to acquire and maintain source data is under consideration. In the meantime, SeaZone is encouraging aforementioned competent authorities to collaborate and is undertaking rework of chart derived data to increase its suitability as reference information.

Article by Dr Mike Osborne, founder of SeaZone Solutions, who maintains his longstanding vision to provide off shelf digital mapping and related services to support data infrastructure development offshore. He is a member of the DNF expert group, a MEDIN partner, and an expert contributor the International Hydrographic Organisation's Working Group on Marine Spatial Data Infrastructure.