MARINE DATA AND A GIS SYSTEM

Tracie Penman
MRJ Technology Solutions
10560 Arrowhead Drive
Fairfax, VA 22030

ABSTRACT: The purpose of this paper is to give an overview of how a consulting firm incorporates marine data into a GIS (Geographic Information System). The GIS used is ARC/INFO. The paper will provide a brief overview of how data get into the GIS and where the data come from. Examples (viewgraphs) of various types of data in final form will include: Shaded Bathymetry and Land Elevation (from ETOPO5); Contours (CMAP or GEBCO); Bottom Sediments (Digitized); Surface Currents (Scanned Data); Wrecks/Obstructions from NOAA from online; NIMA Broadcast Warnings (online download) Waves (Scanned, digitized data); Fishing (digitized and hand drawn from articles); Maritime Boundaries (digitized and generated from various sources).

GIS stands for Geographic Information System. A GIS will map (geo-locate) information about a feature with a set of coordinates - latitude/longitude. I work for MRJ Technology Solutions, an engineering and information technology company in Fairfax, VA. I am a GIS analyst using Arc/Info (a very popular GIS software system) and also the primary online researcher. The database for the project I work on is a global marine database. We are always looking for new information to put into the GIS database. We update our database after we find new data and decide they are better than what we have and time allows. In some cases, we will get data that sound like they would be useful, but then we have the problem of how to apply these data using Arc/Info or ARCVIEW. So many times the raw data just remain on disk, tape, CD or even a map. Sometimes it's not easy to extract the information from the CD/tape/disk. Most data are not in Arc/Info format, i.e., a coverage (vector).

One of the problems we have is: "Where do we get data?" We get data from US government agencies such as NOAA (National Oceanic and Atmospheric Administration), USGS (United States Geological Survey), NIMA (formerly DMA) (National Imagery and Mapping Agency), Naval Oceanographic Office, etc., and similar agencies in other countries like British Admiralty, BODC (British Oceanographic Data Center), etc. In some cases we will get data from State Agencies - Dept of Natural Resources, Geological Surveys, Port and Harbor administrations, etc. We also may get information from Academia - through contacts with faculty and researchers active in oceanographic work.

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Commercial vendors are another source. The newest place to find information about where to get data is on the Internet. The IAMSLIC Newsletter has many pointers for data that we check on. In the case of maritime boundaries, some of the data will come from the UN.

With so many different sources, you may wonder how do we exercise QA/QC? Many sources have their QA/QC before they release the data. In other cases (journals) data are peer-reviewed before publication. QA on data from foreign sources is tougher to find out about sometimes, but we always check. Internally at MRJ, we have procedures that we follow when processing data to use in our GIS. We have to digitize much of our data from charts and atlases.

MRJ is involved not only with environmental aspects of marine GIS, but also activity - fishing, oil and gas, commercial shipping, recreation, advisories (NOTOM’s - Notices to Mariners), and waste disposal. Clients are advised of other activities in the area(s) in which they are interested. This helps coordinate the use of “Ocean Space” and intends to avoid conflicts in the area of interest.

I put together a sample set of graphics that were generated from a GIS at MRJ Technology Solutions. The information in these graphics was generated from analysis and using appropriate software programs to the raw data. This was MRJ’s representation for this type of information.

1. Bathymetry - This 1st picture is shaded bathymetry (underwater topography) and shaded land elevation generated from ETOPO 5 (gridded point data of depths and elevations) - from NGDC (National Geophysical Data Center). The coastline is ARCWORLD III (scale 1:3 million ) from ESRI.

2. Sediments - This graphic is bottom sediments digitized from the Naval Oceanographic Publication-Pub 700 and bathymetric contours generated from the GEBCO data set, (an ASCII file downloaded from the GEBCO CD-ROM and reprocessed it into ARC format). In some instances, we will also add specific sediment data derived from oceanographic journals, reports, and atlases.

3. Maritime boundaries - General territorial sea limits are from NIMA but are updated by MRJ research based on literature. The other boundaries where generated using information from the State Department, the United Nations, and books we have on maritime information. A variety of open literature is used when putting together maritime boundaries.

4. Sea State - The sea state information was scanned from an oceanographic atlas from the US Navy, geo-rectified, and then traced over in ARC/INFO. Sea State is a numerical system used to describe the sea surface: higher numbers = rougher seas.
5. Water Transparency - The water clarity information was taken from NODC surface water transparency (World Secchi Disk Measurements) point data and then processed using Thiessen algorithm in ARCINFO. It gives an indication or underwater visibility: very important for cameras, TV and divers.

6. Surface Currents - This information is very general and was hand drawn based on environmental studies (POEM Studies) that were done in the Mediterranean. In other parts of the world we have scanned currents from British Admiralty pilots. But in the Mediterranean Sea, this was the latest/best information from reports, so I drew the currents. Current speed is in knots where 1 knot is about 1/2 meter per second.

7. Activity - This information was generated from downloaded data from NIMA (National Imagery and Mapping Agency) through the online Navinfonet system (NIMA’s Automated Notice to Mariners). NIMA broadcasts messages they get from ships working throughout the world so other mariners will stay clear from certain areas and notify mariners when the work will be completed or when an area is clear. Mobile offshore drilling units came from NIMA - where oil companies will notify NIMA where they area working and a list is updated daily although you don’t know how often some oil companies will report this information.

8. Fishing - This information came from an FAO atlas and other open source analysis from reports, journals, and newspapers. Someone digitized from the atlas and then the 200 meter contour was used as general limit for trawling although some trawlers now pull nets as deep as 1000 meters.

9. Wrecks/Obstructions - This information is from CMAP (a PC-based raster product of nautical charts). With CMAP it looks like you’re looking at a paper map on the computer screen. We are able, because of a negotiated agreement, to get this chart information into ARC/INFO format. The cables, some wrecks, and obstructions are from CMAP. We also got wrecks from NIMA.

10. Slope - These data were generated with ARC/INFO and ETOPO 5 sounding data.

11. Water Temperature - This is generated using PV-Wave (another software program), where we will extract data from NODC temperatures off of the temperature/salinity CD-ROM (Global Ocean Temperatures CD-ROM) by giving an area and then plot these data. We found this was the best way to present temperature vs. depth.

12. Climate - generated using Corel Draw from Climatic Tables from various sources.

13. Sea State Histogram generated from sea state tables
14. Wind information - we normally present this information using wind roses by month. These data are pulled from a table in a Navy Climatic atlas and then are put into Corel Draw.

With Arc/Info we can overlay the data however we may need to depending on what we want to show. Since we have a global marine database, our information comes from many different sources and references. It is rare to find one source that would cover the world and it’s almost impossible to find marine data on a global scale, even on a sea by sea basis. There are always new studies, new research, new datasets, and new regulations. So we try to keep up with what is happening in the oceans. Many times this information is not mappable -- at least for us because it is too small scale and also there is no geo-referencing (tying to real world coordination - latitude/longitude) information. But it’s my job to keep looking for more/new/better data.
WATER CLARITY

WINTER

SPRING

SUMMER

FALL

Water Transparency

- < 5 meters
- 5 < 10 meters
- 10 < 15 meters
- 15 < 20 meters
- 20 < 25 meters
- >= 25 meters

* Secchi Disk Location
BATHYMETRY AND ELEVATION

DEPTH
- > 3000 Meters
- 2500 - 3000 M
- 2000 - 2500 M
- 1500 - 2000 M
- 1000 - 1500 M
- 500 - 1000 M
- 100 - 500 M
- 0 - 100 M
- > 2000 Meters
- 0 - 200 M

ELEVATION

40°N
39°N
38°N
37°N
36°N
35°N
34°N
33°N
32°N
31°N
30°N
17°E
19°E
21°E
23°E
25°E
27°E
29°E
31°E
33°E
35°E
37°E

GREECE
AEGEAN
TURKEY
CYPRUS
MEDITERRANEAN
LIBYA
EGYPT
ISRAEL
JORDAN
FISHING

LEGEND

- NO TO LOW DEWERSAL/PELAGIC FISHING
- MODERATE TO HIGH DEWERSAL/PELAGIC FISHING
- KNOWN TRAWLING GROUNDS
- POSSIBLY TRAWLABLE SLOPE WATERS

MAP OF THE MEDITERRANEAN SEA WITH FISHING AREAS MARKED.
MARITIME BOUNDARIES

LEGEND
- - - TERRITORIAL SEA LIMITS (TSL)
- - MEDIAN LINE
- AGREED BOUNDARY
- CONTIGUOUS ZONE
- - - HIGH SEAS

GREECE

MEDITERRANEAN SEA

TURKEY

LIBYA

EGYPT

GULF OF SIDRA
WRECKS AND OBSTRUCTIONS

LEGEND
- WRECK/OBSTRACTION
- ROCK
- SUBMARINE CABLE

GREECE   TURKEY
39°N
GREECE    TURKEY
38°N
37°N
36°N
35°N
34°N
33°N
32°N
31°N
30°N

MEDITERRANEAN SEA
GENERAL SURFACE CURRENTS

SURFACE CURRENTS
(SPEED IN KNOTS)

AVERAGE ANNUAL