



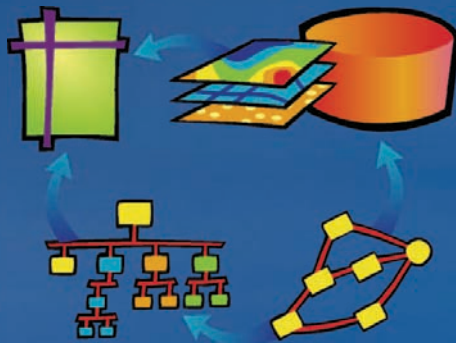
**2009 ESRI User Conference**  
**Technical Workshops**  
July 14–17, 2009

## **Arc Marine – Managing and Analyzing Ocean and Coastal Data in ArcGIS**

*Dawn Wright - Oregon State University*  
*Katsura Iizuka - ESRI*

# Topics

- **Overview of the Arc Marine data model**
  - Common marine data types
  - Feature & object classes; initial case studies
- **Introduction to the Arc Marine tutorial**
- **Arc Marine with other data models**

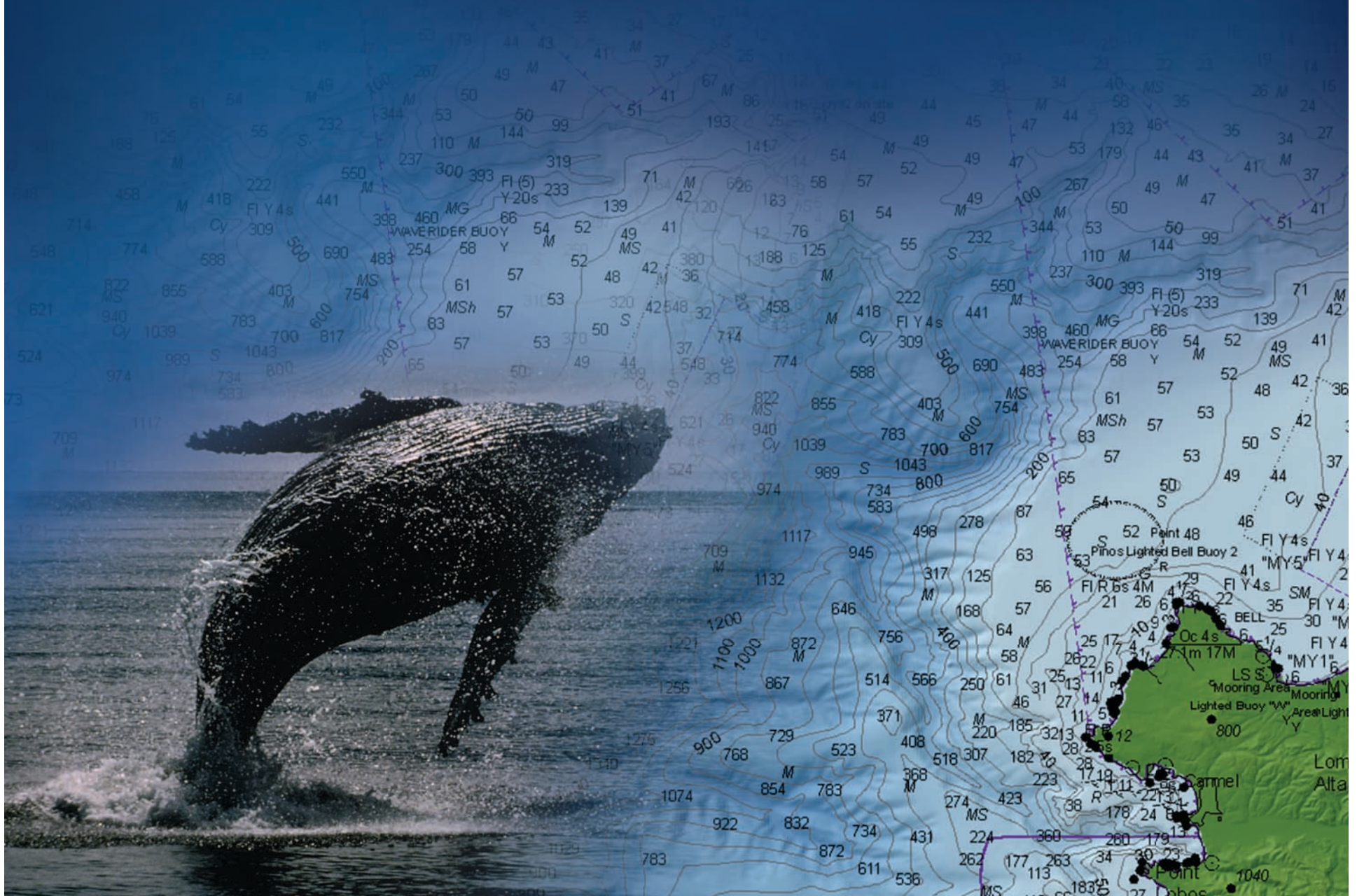


- **Discussion of tools, initiatives**
- **Open for questions**

Ranks among top models (Hydro, Water Utilities, GIS for the Nation, etc...) in terms of most downloads (more than 8200 times as of June 2009).

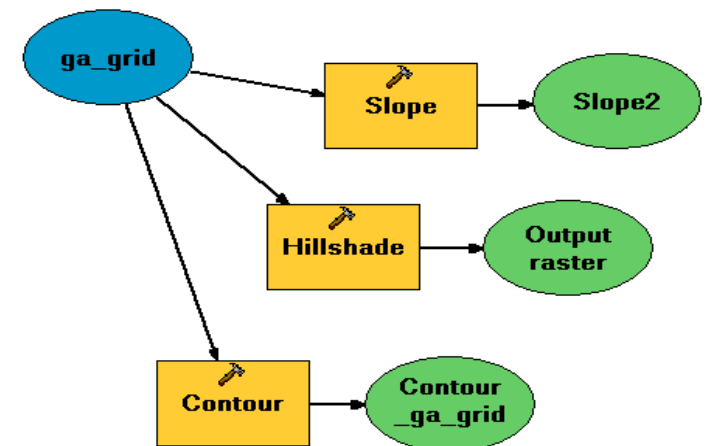


# Overview of the Arc Marine Data Model

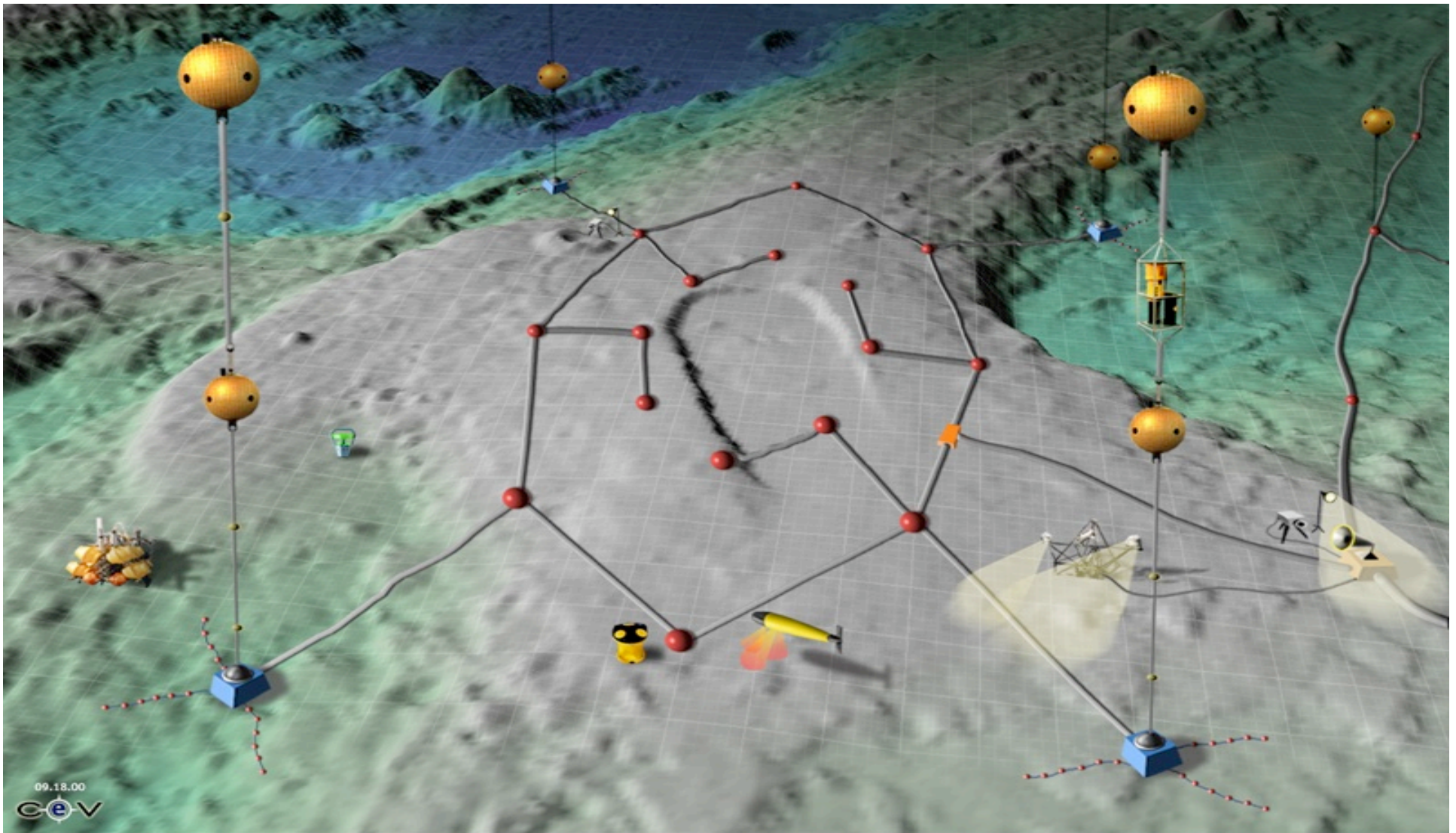


# Arc Marine Purpose

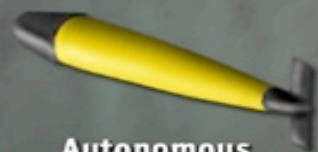
- **Your Geodatabase Template**
  - Data collection at sea/shore ... to final geoprocessing, analysis
    - Control of required data fields, common data structure
  - Simplify enterprise GIS project implementation
    - e.g., cruises, MPA networks, habitat mapping
- **Program Coding/Application Development**
  - Common/shared tool development
  - Rapid prototyping
  - Linkage to processing models
- **Data Sharing/Networking**
- **“Schooling” in the Gdb**
  - Arc Marine Tutorial in Advanced GIS courses







09.18.00  
CEV



**Autonomous Underwater Vehicle**



**Current Meter**



**Rover**



**Camera & Lights**



**Acoustic Doppler**



**Nutrient Monitor**



**Wave Sensor**

# Common Marine Data Types

## Marine Points

### Instantaneous Points

### Time Series Point

## Marine Lines

<b>Feature Points</b> ID X,Y Z <b>Examples:</b> marker buoy, transponder, other fixed, geography	<b>Instant Subtype</b> ID X,Y Z or $\Delta Z$ $m_1...m_2$ t <b>Examples:</b> CTD, XBT, SVP casts at $\Delta Z$ , fish density, tide gauge, etc., at surface or a single Z	<b>Location Series Subtype</b> ID $\Delta X,Y$ $\Delta Z$ $m_1...m_2$ $t_1...t_2$ <b>Examples:</b> telemetry, bird/mammal sighting, ship mounted ADCP	<b>Time Series</b> ID X,Y Z or $\Delta Z$ $m_1...m_2$ $t_1...t_{infinity}$ <b>Examples:</b> current meter, moored ADCP at $\Delta Z$ , obs. buoy, hydrophone, OBS at single Z	<b>Profile Line</b> ID X,Y $M_1,M_2$ $Z_1, Z_2...$ <b>Examples:</b> for abstracting data from, building profile from, measuring change along... seismic reflection, bathy profile, cross section, sed. transport line	<b>Time Duration Line Track</b> ID $X_1,Y_1, X_2, Y_2...$ $M_1,M_2$ $Z_1, Z_2...$ $m_1, m_2...$ $t_1, t_2...$ <b>Examples:</b> transit ship track, ROV or sub track, algal bloom trawl, ADCP tracks, ARGO drifter	<b>Feature Line</b> ID $X_1,Y_1, X_2, Y_2...$ $M_1,M_2$ <b>Examples:</b> cable, pipeline, sea wall, ocean front, EEZ or legal boundaries NOT enclosing an area
<b>Survey Subtype</b> <b>Examples:</b> aerial coastal survey, lidar, SCUBA/free swim obs.	<b>Sounding Subtype</b> <b>Examples:</b> single beam bathy					<b>Shoreline</b> shoreline type, VDatum

## Marine Areas

## Marine Rasters/Grids/Meshes

## Derived or Placeholder

<b>Feature Area</b> ID $X_1,Y_1,X_2,Y_2...X_1,Y_1$ Z m <b>Examples:</b> Marine boundaries (e.g., sanctuary, MPA), habitats, lava flows, clipping, masking	<b>Time Duration Area</b> ID $X_1,Y_1,X_2,Y_2...X_1,Y_1$ Z m $t_1...t_n$ <b>Examples:</b> No-take zones, oil spills, harmful algal bloom	<b>Regularly Interpolated Surfaces</b> $row_1, col_1...row_n, col_n$ $Z_{r,c1}...Z_{r,cn}$ multipoint <b>Examples:</b> multibeam bathy, sidescan, lidar, SST, climatology, scientific mesh, "re-analyzed" products (images such as GeoTIFF, BIL, etc.)	<b>Irregularly Interpolated Surfaces</b> $row_1, col_1...row_n, col_n$ $Z_{r,c1}...Z_{r,cn}$ multipoint <b>Examples:</b> TINs, bathymetry, sidescan, lidar, scientific mesh for finite element model, etc.	<b>Mesh Volume</b> ID $X_1,Y_1,Z_1,X_2,Y_2,Z_2$ $...X_1,Y_1,Z_1$ m or $m_1...m_n$ t or $t_1...t_n$ ncols,nrows,nlayers in scientific mesh, multipatch <b>Examples:</b> model of plume, front, warm core, trawl abundance	<b>Animations, Movies, Video</b> $X_1,Y_1,Z_1,X_2,Y_2,Z_2$ $...X_1,Y_1,Z_1$ $t_1...t_n$ <b>Examples:</b> UW video footage, outputs from atm. or circulation models that are animated & georegistered so other data may be overlain
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### ACRONYMS—definitions

ADCP—acoustic doppler current profiler ARGO—array for real-time geostrophic oceanography BIL—band interleaved by line (for remotely sensed images or grids) CTD—conductivity, temperature, depth EEZ—exclusive economic zone	GeoTIFF—georeferenced tagged image file format LIDAR—light detection and ranging MPA—marine protected area OBS—ocean bottom seismometer	ROV—remotely-operated vehicle SCUBA—self-contained underwater breathing apparatus SST—sea surface temperature SVP—sound velocity profile	TIN—triangulated irregular network U/W—underwater (also often refers to "underway") VDatum—vertical datum XBT—expendable bathythermograph
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# *Arc Marine: GIS for a Blue Planet*

ESRI Press, 2007

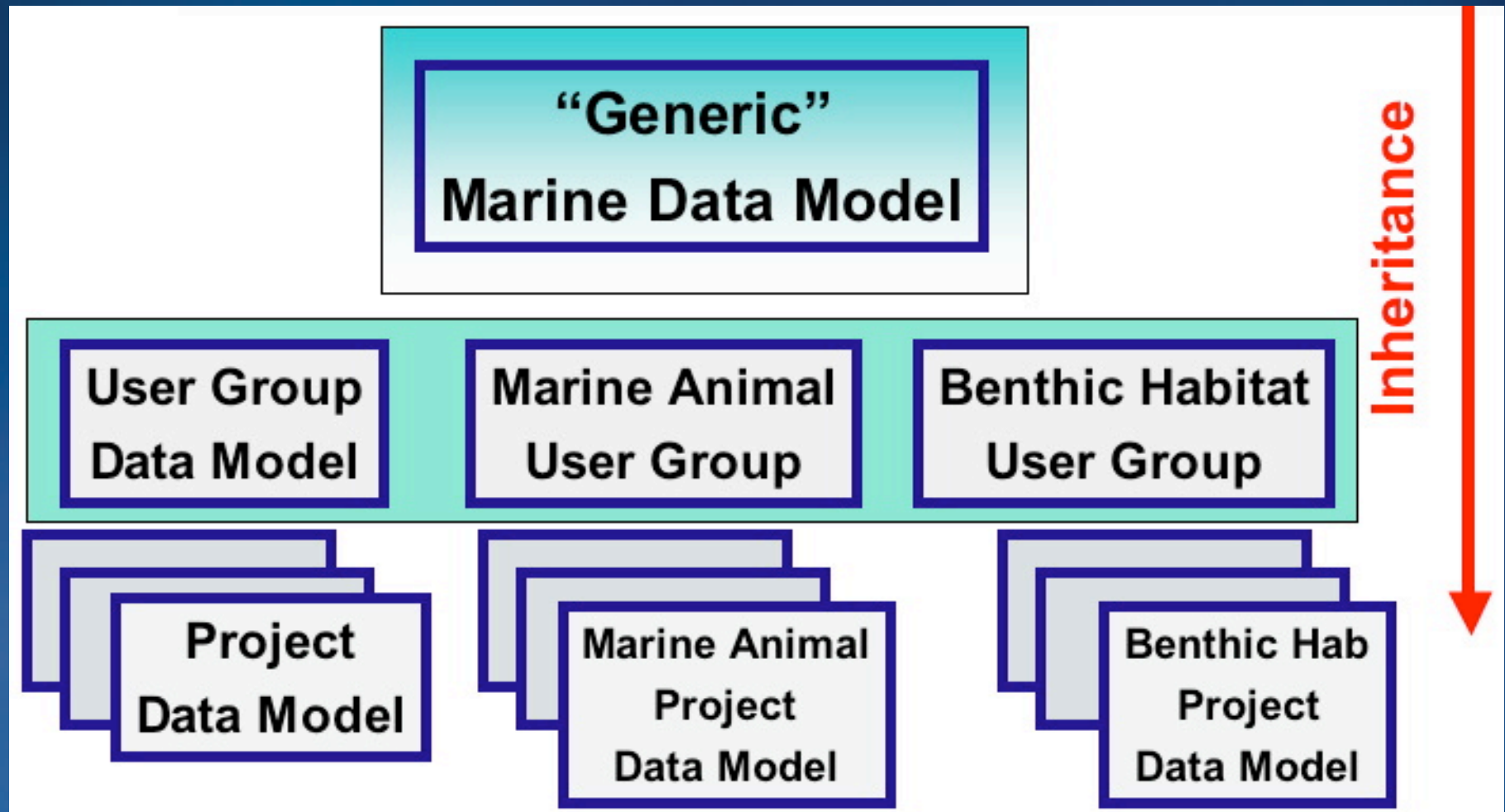
- By Dawn Wright, Michael Blongewicz, Pat Halpin, Joe Breman
  - Foreword by Jane Lubchenco, now NOAA Administrator
- Full background documentation with 13 case studies

- Ch 1 - Introduction
- Ch 2 - Common Marine Data Types
- Ch 3 - Marine Surveys
- Ch 4 - Marine Animal Data Applications
- Ch 5 - Implementing Time Series & Measurements
- Ch 6 - Nearshore and Coastal/Shoreline Analysis
- Ch 7 - Model Meshes
- Ch 8 - Multidimensional GIS
- Ch 9 - Epilogue

## Accompanying Web Site:

Arc Marine Poster, Tutorial, UML/XMI, Tool Suite, other goodies  
<http://dusk.geo.orst.edu/djl/arcgis>

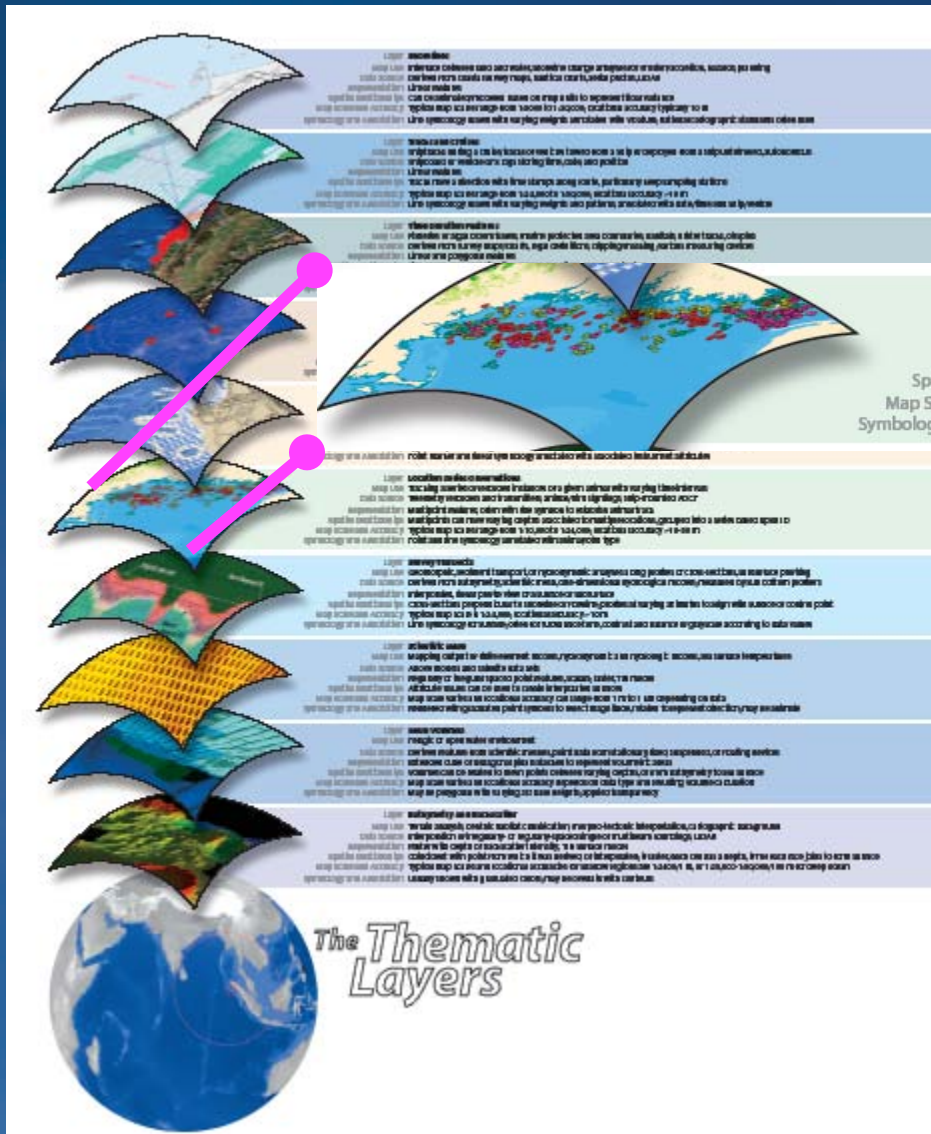
# Arc Marine Design Strategy





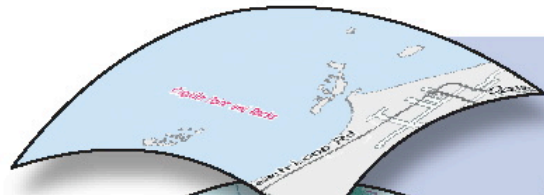
# Thematic Content (“Layer Stack”)

## Thematic groupings of oceanographic data sets

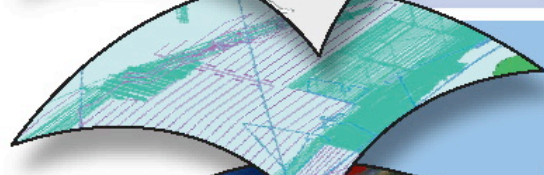


Layer	Location Series Observations
Map Use	Tracking a series of recorded instances of a given animal with varying time intervals
Data Source	Telemetry recorders and transmitters, animal/bird sightings, ship-mounted ADCP
Representation	Multipoint features, often with line symbols to establish animal track
Spatial Relationships	Multipoints can have varying depths associated to multiple locations, grouped into a series
Map Scale and Accuracy	Typical map scales range from 1:10,000 to 1:24,000; locational accuracy ~10-50 m
Symbology and Annotation	Point and line symbology annotated with animal/bird type

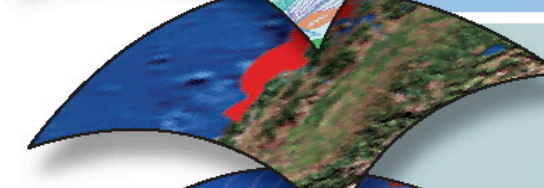
# Arc Marine Thematic Layers



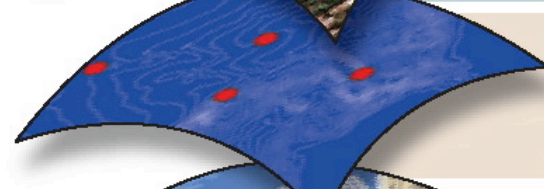
**Layer** Shorelines  
**Map Use** Interface between land and water, shoreline change analyses for erosion/accretion, hazards, planning  
**Data Source** Derived from coastal survey maps, nautical charts, aerial photos, LIDAR  
**Representation** Linear features  
**Spatial Relationships** Can be animated/ modeled based on map units to represent tidal variance  
**Map Scale and Accuracy** Typical map scales range from 1:5000 to 1:20,000; locational accuracy typically 10 m  
**Symbology and Annotation** Line symbology drawn with varying weights annotated with VDatum; national cartographic standards often used



**Layer** Tracks and Cruises  
**Map Use** Shiptacks during a cruise, tracks of vehicles towed from a ship or deployed from a ship untethered, autonomous  
**Data Source** Shipboard or vehicle GPS logs storing time, date, and position  
**Representation** Linear features  
**Spatial Relationships** Tracks have a direction with time stamps along route, particularly keep sampling stations  
**Map Scale and Accuracy** Typical map scales range from 1:24,000 to 1:50,000; locational accuracy ~10 m  
**Symbology and Annotation** Line symbology drawn with varying weights and patterns, annotated with date/time and ship/vehicle



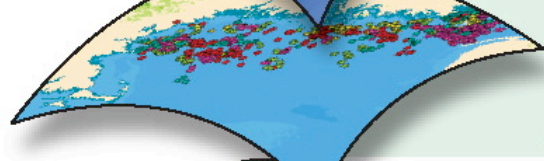
**Layer** Time Duration Features  
**Map Use** Fisheries or algal bloom trawls, marine protected area boundaries, habitats, drifter tracks, oil spills  
**Data Source** Derived from survey maps/charts, legal definitions, clipping/masking; various measuring devices  
**Representation** Linear and polygonal features  
**Spatial Relationships** Size, shape, area and direction change over time; may be animated  
**Map Scale and Accuracy** Typical map scale is 1:24,000; locational accuracy ~10 m  
**Symbology and Annotation** Line and polygon symbology with varying weights, patterns and fills



**Layer** TimeSeries Locations  
**Map Use** Variations in time of variables measured at fixed observations stations at sea and onshore  
**Data Source** Fixed or moored measuring devices such as hydrophones, acoustic doppler current profilers (ADCP), ocean bottom seismometers (OBS), tide gauges  
**Representation** Point features  
**Spatial Relationships** Points can be related to center of a grid cell or associated to a time series calculation or numerical model  
**Map Scale and Accuracy** Typical map scales range from 1:10,000 to 1:24,000; locational accuracy ~10 m  
**Symbology and Annotation** Point marker symbology with associated instrument attributes



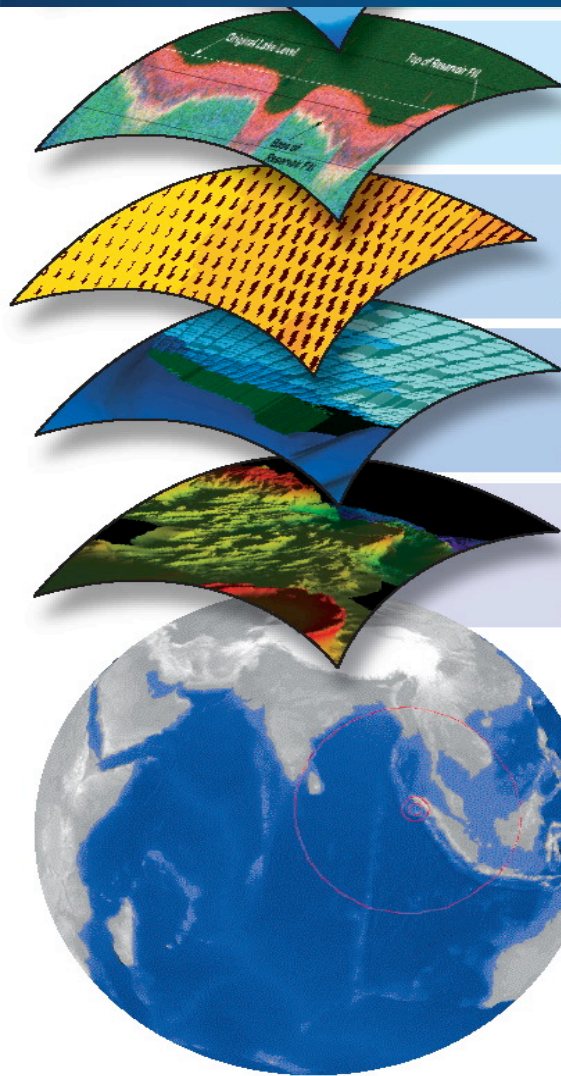
**Layer** Instantaneous Measured Points  
**Map Use** Variations in space of variables measured at a given moment in time through the water column  
**Data Source** Instrument casts such as conductivity-temp-depth (CTD), expandable bathythermograph (XBT), sound velocity profile (SVP), fish density, etc.  
**Representation** Point features, vertical profiles  
**Spatial Relationships** Points can have varying depths associated to a single location, as well as multiple measurements  
**Map Scale and Accuracy** Typical map scales range from 1:10,000 to 1:24,000; locational accuracy ~10-50 m  
**Symbology and Annotation** Point marker and linear symbology annotated with associated instrument attributes



**Layer** Location Series Observations  
**Map Use** Tracking a series of recorded instances of a given animal with varying time intervals  
**Data Source** Telemetry recorders and transmitters, animal/bird sightings, ship-mounted ADCP  
**Representation** Multipoint features, often with line symbols to establish animal track  
**Spatial Relationships** Multipoints can have varying depths associated to multiple locations, grouped into a series based upon ID  
**Map Scale and Accuracy** Typical map scales range from 1:10,000 to 1:24,000; locational accuracy ~10-50 m  
**Symbology and Annotation** Point and line symbology annotated with animal/bird type



# Arc Marine Thematic Layers



**Layer** **Survey Transects**  
**Map Use** Geomorphic, sediment transport, or hydrodynamic analyses along profiles or cross-sections, subsurface profiling  
**Data Source** Derived from bathymetry, scientific mesh, one-dimensional hydrological models; measured by sub bottom profilers  
**Representation** Interpolated, linear profile view of a surface or subsurface  
**Spatial Relationships** Cross-sections perpendicular to shoreline or flowline; profiles at varying azimuths to align with surface or control point  
**Map Scale and Accuracy** Typical map scale is 1:24,000; locational accuracy ~10 m  
**Symbology and Annotation** Line symbology for surface; often for subsurface tone, contrast and balance of grayscale according to data values

**Layer** **Scientific Mesh**  
**Map Use** Mapping output of finite element models, hydrodynamic and hydrologic models, sea surface temperatures  
**Data Source** Above models and satellite data sets  
**Representation** Regularly or irregular spaced point features, scalars; raster, TIN model  
**Spatial Relationships** Attribute values can be used to create interpolated surfaces  
**Map Scale and Accuracy** Map scale varies and locational accuracy can range from 1 m to 1 km depending on data  
**Symbology and Annotation** Rendered with graduated point symbols to reflect magnitude, rotated to represent direction; may be animate

**Layer** **Mesh Volumes**  
**Map Use** Pelagic or open water environment  
**Data Source** Derived features from scientific meshes, point data from stationary, fixed, suspended, or floating devices  
**Representation** Extended cube or hexagonal pillars stacked to represent volumetric areas  
**Spatial Relationships** Volumes can be related to mesh points between varying depths, or from bathymetry to sea surface  
**Map Scale and Accuracy** Map scale varies and locational accuracy depends on data type and resulting volume calculation  
**Symbology and Annotation** May be polygonal with varying 3D base heights; applied transparency

**Layer** **Bathymetry and Backscatter**  
**Map Use** Terrain analysis, benthic habitat classification, morpho-tectonic interpretation, cartographic background  
**Data Source** Interpolation of irregularly- or regularly-spaced single or multibeam soundings, LIDAR  
**Representation** Raster with depth or backscatter intensity, TIN surface model  
**Spatial Relationships** Coincident with point from which it was derived, or interpolated; if raster, each cell has a depth, if TIN each face joins to form surface  
**Map Scale and Accuracy** Typical map scales and locational accuracies for shallow regions are 1:2400/1 m, or 1:20,000-1:50,000/100 m for deep ocean  
**Symbology and Annotation** Usually shown with graduated colors; may be overlain with contours

*The Thematic Layers*

# Common Marine Data Types

## Marine Points

### Instantaneous Points

### Time Series Point

## Marine Lines

<b>Feature Points</b> ID X,Y Z <b>Examples:</b> marker buoy, transponder, other fixed, geography	<b>Instant Subtype</b> ID X,Y Z or $\Delta Z$ $m_1...m_2$ t <b>Examples:</b> CTD, XBT, SVP casts at $\Delta Z$ , fish density, tide gauge, etc., at surface or a single Z	<b>Location Series Subtype</b> ID $\Delta X,Y$ $\Delta Z$ $m_1...m_2$ $t_1...t_2$ <b>Examples:</b> telemetry, bird/ mammal sighting, ship mounted ADCP	<b>Time Series</b> ID X,Y Z or $\Delta Z$ $m_1...m_2$ $t_1...t_{infinity}$ <b>Examples:</b> current meter, moored ADCP at $\Delta Z$ , obs. buoy, hydrophone, OBS at single Z	<b>Profile Line</b> ID X,Y $M_1,M_2$ $Z_1, Z_2...$ <b>Examples:</b> for abstracting data from, building profile from, measuring change along... seismic reflection, bathy profile, cross section, sed. transport line	<b>Time Duration Line Track</b> ID $X_1,Y_1, X_2, Y_2...$ $M_1,M_2$ $Z_1, Z_2...$ $m_1, m_2...$ $t_1, t_2...$ <b>Examples:</b> transit ship track, ROV or sub track, algal bloom trawl, ADCP tracks, ARGO drifter	<b>Feature Line</b> ID $X_1,Y_1, X_2, Y_2...$ $M_1,M_2$ <b>Examples:</b> cable, pipeline, sea wall, ocean front, EEZ or legal boundaries NOT enclosing an area
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## Marine Areas

## Marine Rasters/Grids/Meshes

## Derived or Placeholder

<b>Feature Area</b> ID $X_1,Y_1,X_2,Y_2...X_1,Y_1$ Z m <b>Examples:</b> Marine boundaries (e.g., sanctuary, MPA), habitats, patches, lava flows, clipping, masking	<b>Time Duration Area</b> ID $X_1,Y_1,X_2,Y_2...X_1,Y_1$ Z m $t_1...t_n$ <b>Examples:</b> No-take zones, oil spills, harmful algal bloom	<b>Regularly Interpolated Surfaces</b> $row_1, col_1...row_n, col_n$ $Z_{r,c1}...Z_{r,cn}$ multipoint <b>Examples:</b> multibeam bathy, sidescan, lidar, SST, climatology, scientific mesh, "re-analyzed" products (images such as GeoTIFF, BIL, etc.)	<b>Irregularly Interpolated Surfaces</b> $row_1, col_1...row_n, col_n$ $Z_{r,c1}...Z_{r,cn}$ multipoint <b>Examples:</b> TINs, bathymetry, sidescan, lidar, scientific mesh for finite element model, etc.	<b>Mesh Volume</b> ID $X_1,Y_1,Z_1,X_2,Y_2,Z_2$ $...X_1,Y_1,Z_1$ m or $m_1...m_n$ t or $t_1...t_n$ ncols,nrows,nlayers in scientific mesh, multipatch <b>Examples:</b> model of plume, front, warm core, trawl abundance	<b>Animations, Movies, Video</b> $X_1,Y_1,Z_1,X_2,Y_2,Z_2$ $...X_1,Y_1,Z_1$ $t_1...t_n$ <b>Examples:</b> UW video footage, outputs from atm. or circulation models that are animated & georegistered so other data may be overlain
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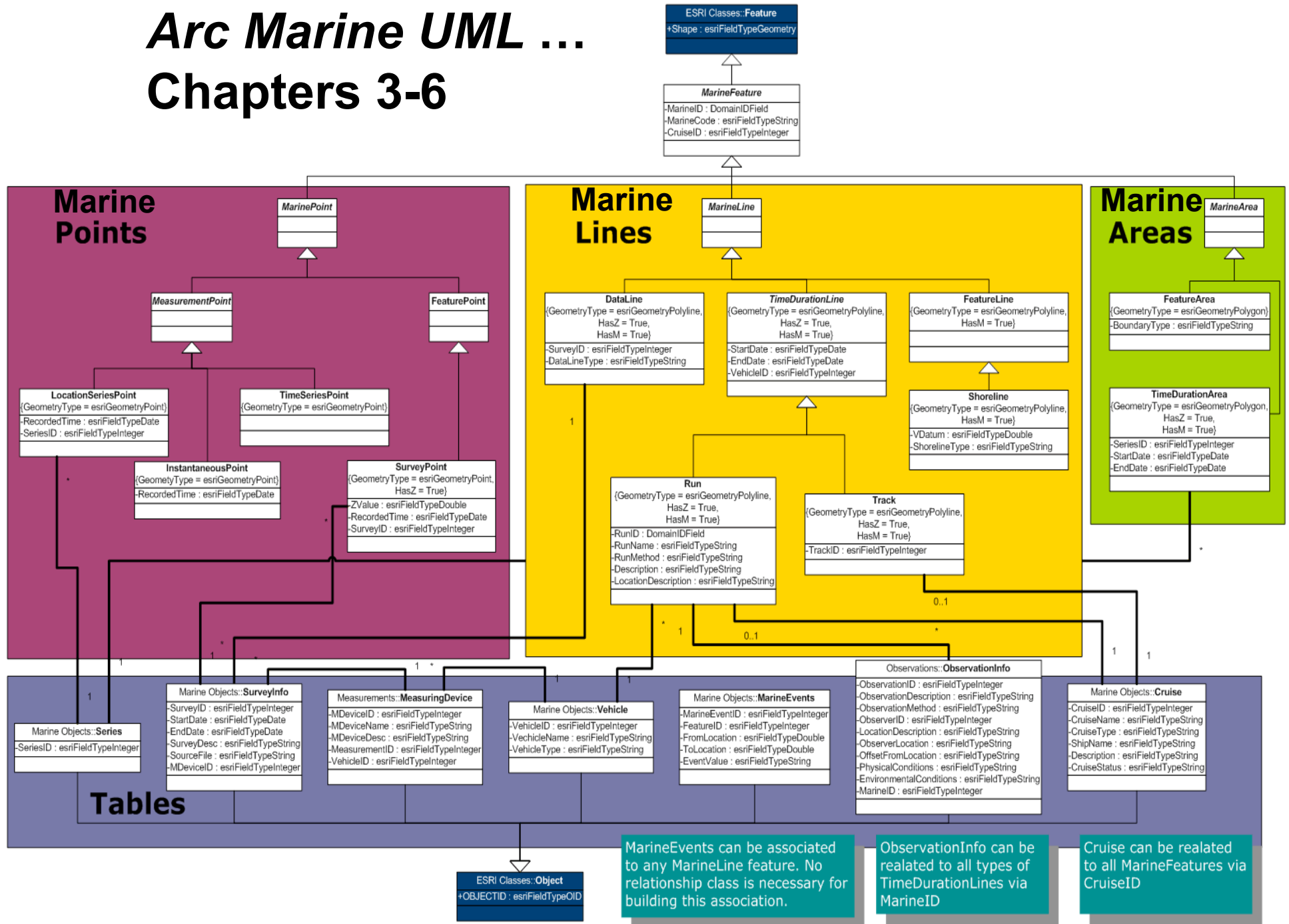
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# Arc Marine UML ...

## Chapters 3-6



# ARC MARINE: THE ARCGIS MARINE DATA MODEL



**ARC MARINE**  
 The ArcGIS Marine Data Model is a comprehensive framework for organizing and managing marine data. It provides a structured approach to data collection, storage, and analysis, ensuring consistency and interoperability across different marine datasets and applications.

The ArcGIS Marine Data Model



- 01. Overview
- 02. Data Model
- 03. Data Collection
- 04. Data Storage
- 05. Data Analysis
- 06. Data Visualization
- 07. Data Integration
- 08. Data Maintenance
- 09. Data Security
- 10. Data Archiving
- 11. Data Backup
- 12. Data Recovery
- 13. Data Migration
- 14. Data Conversion
- 15. Data Compression
- 16. Data Encryption
- 17. Data Decryption
- 18. Data Validation
- 19. Data Auditing
- 20. Data Monitoring
- 21. Data Reporting
- 22. Data Alerting
- 23. Data Archiving
- 24. Data Backup
- 25. Data Recovery
- 26. Data Migration
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- 29. Data Encryption
- 30. Data Decryption
- 31. Data Validation
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- 34. Data Reporting
- 35. Data Alerting

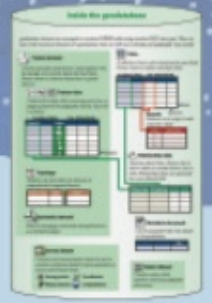
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- 32. Data Auditing
- 33. Data Monitoring
- 34. Data Reporting
- 35. Data Alerting



The diagram illustrates the data model structure, showing the relationships between various data layers and their components. It provides a clear overview of the data organization and how different datasets are integrated into the overall system.

### Common Marine Data Types

Feature Type	Measurement Points	Point in Time	Point in Space	Point in Time and Space
Point	Point	Point	Point	Point
Line	Line	Line	Line	Line
Polygon	Polygon	Polygon	Polygon	Polygon
Surface	Surface	Surface	Surface	Surface
Volume	Volume	Volume	Volume	Volume
Flow	Flow	Flow	Flow	Flow
Force	Force	Force	Force	Force
Energy	Energy	Energy	Energy	Energy
Mass	Mass	Mass	Mass	Mass
Temperature	Temperature	Temperature	Temperature	Temperature
Salinity	Salinity	Salinity	Salinity	Salinity
Density	Density	Density	Density	Density
Velocity	Velocity	Velocity	Velocity	Velocity
Acceleration	Acceleration	Acceleration	Acceleration	Acceleration
Pressure	Pressure	Pressure	Pressure	Pressure
Depth	Depth	Depth	Depth	Depth
Height	Height	Height	Height	Height
Distance	Distance	Distance	Distance	Distance
Area	Area	Area	Area	Area
Volume	Volume	Volume	Volume	Volume
Mass	Mass	Mass	Mass	Mass
Energy	Energy	Energy	Energy	Energy
Force	Force	Force	Force	Force
Power	Power	Power	Power	Power
Work	Work	Work	Work	Work
Heat	Heat	Heat	Heat	Heat
Temperature	Temperature	Temperature	Temperature	Temperature
Salinity	Salinity	Salinity	Salinity	Salinity
Density	Density	Density	Density	Density
Velocity	Velocity	Velocity	Velocity	Velocity
Acceleration	Acceleration	Acceleration	Acceleration	Acceleration
Pressure	Pressure	Pressure	Pressure	Pressure
Depth	Depth	Depth	Depth	Depth
Height	Height	Height	Height	Height
Distance	Distance	Distance	Distance	Distance
Area	Area	Area	Area	Area
Volume	Volume	Volume	Volume	Volume
Mass	Mass	Mass	Mass	Mass
Energy	Energy	Energy	Energy	Energy
Force	Force	Force	Force	Force
Power	Power	Power	Power	Power
Work	Work	Work	Work	Work
Heat	Heat	Heat	Heat	Heat



The diagram illustrates the data model structure, showing the relationships between various data layers and their components. It provides a clear overview of the data organization and how different datasets are integrated into the overall system.



# Using a Design Template

*Schema Wizard reads repository or template to create a geodatabase*

The image shows a screenshot of the 'Schema Wizard' dialog box in a software application. The dialog box is titled 'Schema Wizard' and contains the following elements:

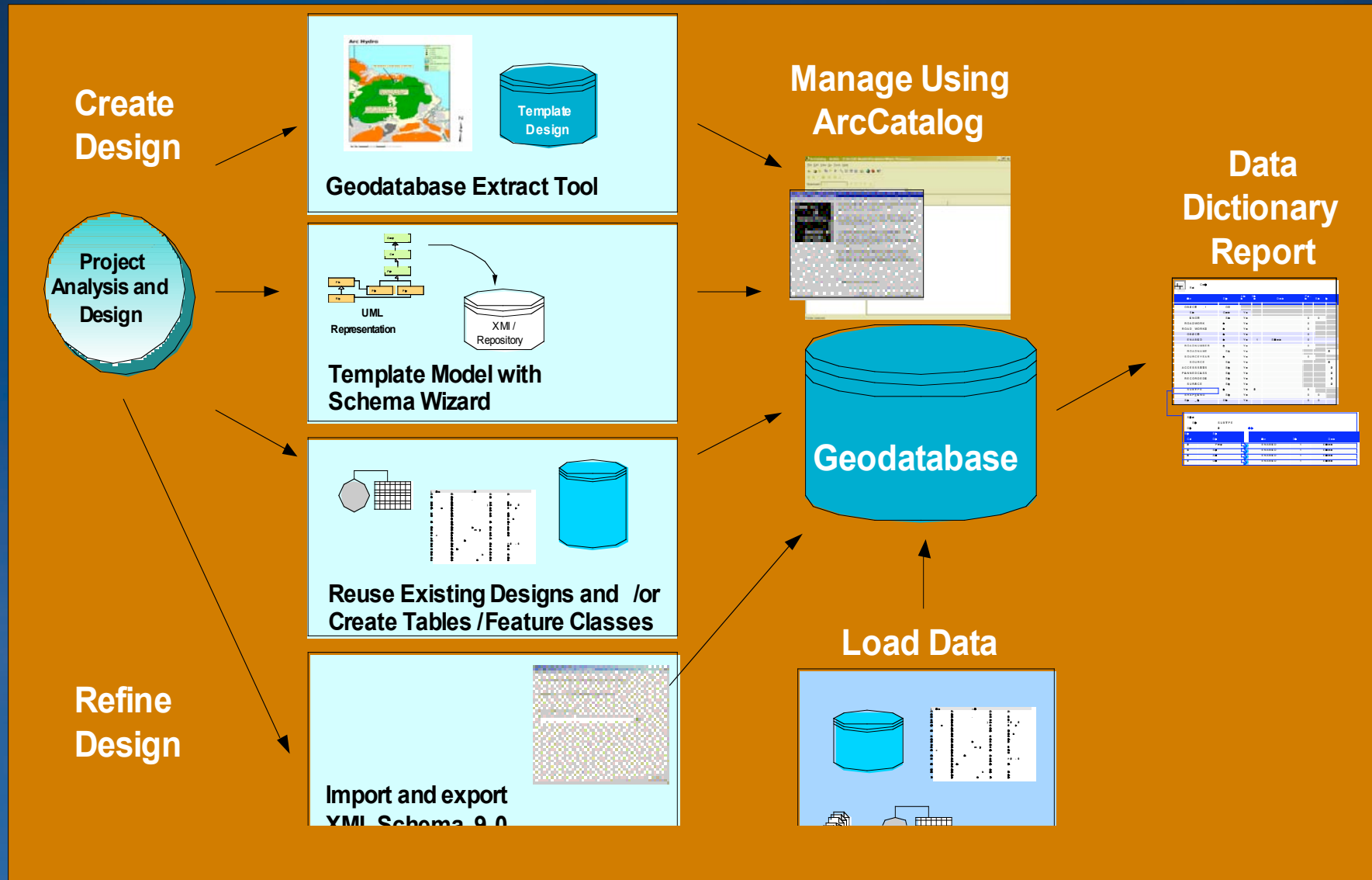
- Diagram:** A diagram showing a 'Case' box with an arrow pointing to 'XMI or Repository', which then points to 'GeoDB & Schema'.
- Text:** 'Connect to the Repository database. Repositories are stored in DBMS databases (Microsoft Access or SQL Server). Please provide the Repository.'
- Radio Buttons:** Two radio buttons are present: 'Model stored in XMI file.' (unselected) and 'Model stored in Repository database.' (selected).
- Database Path or Connection String:** A text box containing 'X:\Disciplines\Geology\DraftModel\repo812.mdb' and a 'Browse...' button.
- User Name:** A text box.
- Password:** A text box.
- Navigation Buttons:** '< Back', 'Next >', and 'Cancel' buttons.

Two yellow arrows point from the left and right sides of the dialog box to the 'Model stored in Repository database.' radio button and the 'Database Path or Connection String' text box, respectively.

On the left side, a tree view shows a folder named 'Hydro' containing a sub-folder 'ArcHydroFrameworkSchema.MDE' with several sub-items: RTblClassDefs, RTblDatabaseVersion, RTblInterfaceDefs, RTblInterfaceMem, RTblNamedObj, RTblObjColTemp, RTblPropDefs, RTblProps, RTblRelColDefs, RTblRelshipProps, RTblRelships, RTblRoot, RTblSites, and RTblSumInfo.

On the right side, a tree view shows a folder named 'MyDataModel.mdb' containing several sub-items: MyFeatureDataset, MyLines, MyPoints, MyPolygons, MyRelationship, MyTable, and NewRasterDataset.

# Project Design Methodology





# Marine Surveys (Ch. 3 in Arc Marine Book)

e.g., Instantaneous Points, Time Duration Line, Survey & Cruise object tables

Cape Cod Marine Geological Survey

Brian Andrews, USGS-Woods Hole, MA

Louisiana Subsidence

Global Warming, sea level rise  
Photogrammetry, FL

The screenshot displays the ArcMap interface with several key components:

- Top Left:** A satellite-style aerial photograph of a coastal area.
- Center:** A bathymetric map showing depth contours in various colors (red, yellow, green, blue). A yellow line indicates a survey track across the map.
- Bottom Left:** A legend window for the bathymetry data, showing a color scale from -1.5 meters (red) to -55.6 meters (blue). It lists layers such as 'esset02\_bs.tif', 'RTK 5m', 'RTK 2m', and 'Depth'.
- Bottom Center:** A 'MegaPEG' logo overlaid on a map showing a survey track with red dots representing data points. The text '16:38:41 05/08/04 34' is visible above the logo, and coordinates '42 29.453 -70 49.560' are at the bottom.
- Right Side:** A metadata window for a feature class named 'GS.LA\_SOUTH\_TM'. It displays the following information:

Property	Value
CTID	4
Responsibility	Mark Kulp
Organization	Geophysicist
Organization/ID	University of New Orleans
Author/ID	mkulp
- Bottom:** The Windows taskbar shows the 'start' button, 'ArcCatalog - ArcInfo ...', and 'Untitled - ArcMap - Ar...'. The system tray on the right shows the time as 5:35 PM.



# Marine Animal Tracking (Ch. 4 in Arc Marine Book)

e.g., Location Series Points, Time Duration Lines and Areas, object tables and rasters

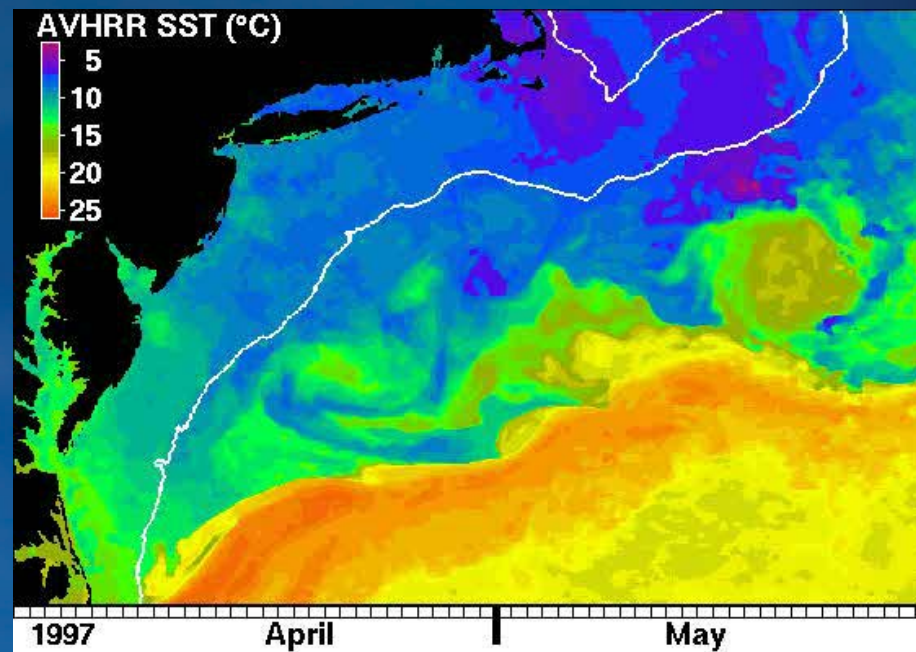
Ocean Biogeographic Information System,  
Pat Halpin et al., Duke U.

## Sea Turtle Tracks (*Caretta caretta*)



Source: <http://obis.env.duke.edu/datasets/> (Read & McClellan2004)

## Sea Surface Temperature (warm core rings)



Source: <http://www.po.gso.uri.edu/SST/>



# Advances in GIScience Session, Paper UC1896

## *Customizing the Arc Marine Model to Support Whale Tracking*

Lord-Castillo, B., Wright, D.J., Mate, B., and Follett, T., 2009.

A customization of the Arc Marine data model to support whale tracking via satellite altimetry, *Transactions in GIS*, 13(s1): 63-83.



# Time Series & Measurements (Ch. 5 in Arc Marine Book)

e.g., TimeSeriesPoints, ProfileLine, Time Series/Measurement object tables

*Marine Institute's Marine Data Repository*

*North Sea / Irish Sea*

*Martina Hennesey et al., Marine Institute, Galway, IRELAND*

*Eamonn Doyle et al., ESRI-IRELAND*

“90% of Ireland is undeveloped, undiscovered, and ... underwater.”

The screenshot shows the homepage of the Marine Institute website. At the top, there is a navigation bar with links for Home, About the Marine Institute, Contact, FOI, Privacy, and Site Map. The main header features the text 'marine.ie' and 'Research & Development' over a blue and green background. A left-hand navigation menu lists various services and opportunities. The main content area includes several news items with accompanying images and 'Read more...' links. A search bar is located on the right side of the page.


Home | About the Marine Institute | Contact | FOI | Privacy | Site Map


marine.ie


Research & Development

**> Industry Services**  
**> Scientific Services**  
**> Partnerships**  
**> R & D Projects**  
**> R & D Facilities**  
**> Media Centre**  
**> Funding**

**> Online Services**  
**> Statutory Services**  
**> Job Opportunities**  
**> Corporate Governance**  
**> Publications & Library**

**Marine Institute's new Headquarters build is on target**  
  
The construction of the Marine Institute's new Headquarters in Oranmore, Co. Galway is on target. Visit the build microsite [here...](#)

**Tracking the Marine Institute research vessels**  
  
The Marine Institute provides information about the locations, surveys and routes of the RV Celtic Voyager and RV Celtic Explorer, via the vessel tracking system. [Read more...](#)

**New Chairman Appointed**  
  
Mr Kevin Bonner has been appointed Chairman of the Board of the Marine Institute by Marine Minister, Pat the Cope Gallagher, TD. [Read more...](#)

**Keyword Search**

**Latest News**

**Marine Research Community Meets to Unlock Ireland's Ocean Potential**  
Opportunities for Ireland to develop its share of the €3,850 billion worldwide global maritime sector through a co-ordinated [Read more...](#)

**World's Longest Running Total Salmon Trapping Facility Celebrates 50th Anniversary**  
The Marine Institute, Newport is celebrating 50 years of research and innovation, since it was first established as the [Read more...](#)

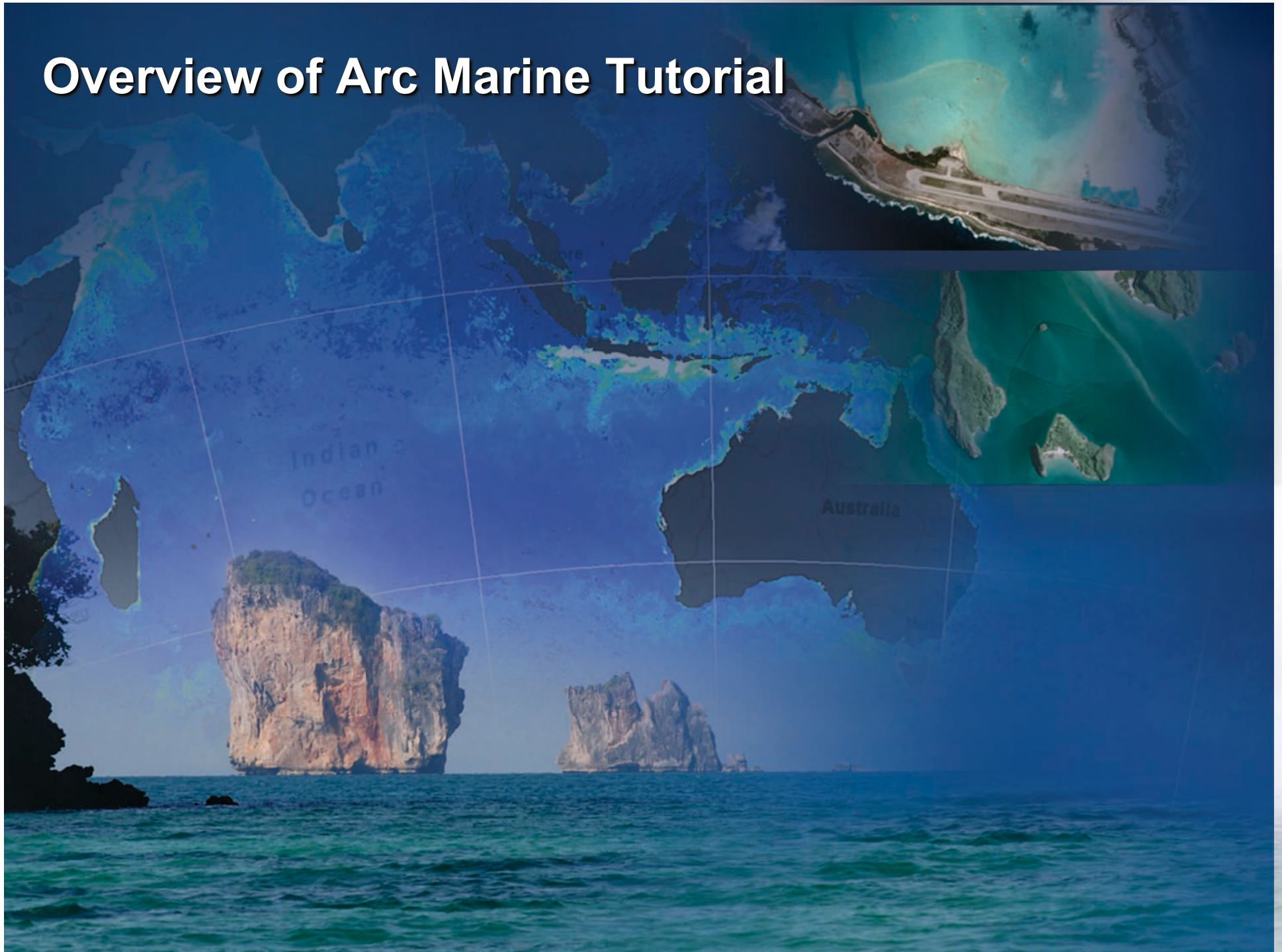
**New Research to Improve Seafood Safety**  
The Marine Institute is hosting a meeting in Galway today of scientists, seafood producers and industry regulators from [Read more...](#)

**Popular pages**

- > databuoy**
- > shellfish safety**
- > NDP-Marine RTDI Funding**
- > Estore**



# Overview of Arc Marine Tutorial



# Tutorial Purpose

- **Assist in simple data entry into Arc Marine**
  - Starting point for project work or specific database design
  - Do-it-yourself exercise in geodatabase building
  - Personalize Arc Marine to fit your needs
- **Support for case studies**
- **Classroom laboratory exercise or workshop module**



Entry Point on Web

dusk.geo.orst.edu/djl/arccgis

hosted by Davey Jones' Locker (Oregon State University)

# Arc Marine

(The ArcGIS Marine Data Model)  
for the oceans, seas, and coastal regions of our planet...



[Podcast from 2007 ESRI UC](#)  
(13 min.)

[Arc Marine Book  
and Poster](#)

"Rt-Click, Save As" for poster link (31 Mb PDF)

[Data Model Diagrams & Case  
Studies](#)

[Arc Marine Tutorial & Tools](#)

[Project Background / People](#)

[Links to Related Projects /  
Resources](#)

[Archive of Documents, Meeting  
PPTs](#)

Search Here!



# Learning Outcomes

- List the basic elements of a geodatabase
- Import an existing schema into an empty Arc Marine geodatabase
- Compare your data structure to that of an existing geodatabase schema
- Load data
- Create new relationships between tables
- Import tables with data already in them
- Create and load a raster catalog
- Display your data using dynamic segmentation
- Query data linked through relationships in ArcMap



# Monterey Bay Species Observations, Habitats



The screenshot shows the ArcMap interface with the following components:

- Layers Panel:** Contains 'SpeciesObservation Events', 'HabitatSegments Events' (with sub-layers for Boulder, Rock, Sand), 'Track', 'Shoreline', 'HabitClass' (with sub-layers for hard, mixed, soft), and 'Bathymetry'.
- ArcToolbox:** Lists various GIS tools such as 3D Analyst Tools, Analysis Tools, Cartography Tools, Conversion Tools, Data Management Tools, Database, Disconnected Eds, Domains, Feature class, Features, Fields, General, Append, Copy, Delete, Rename, Select Data, Generalization, Indexes, Joins, Layers and Table, Projection and Tr, Raster, Relationship Class, Subtypes, Table, Topology, Versions, Workspace, Geocoding Tools, Geostatistical Analyst, Linear Referencing To, Spatial Analyst Tools, and Spatial Statistics Tools.
- Main Map:** Displays a bathymetric map of Monterey Bay with several colored tracks overlaid on the terrain.
- Identity Results Window:** Shows a table of data for the selected track.

Identity Results		
Layers: Track		
Location: [-173423.200545 -161998.273115]		
Track		
13		
SpeciesObser	OBJECTID	1576
	segmentID	20918
	dive	209
	TC	4:37:07 PM
	TCdist	16:37:07
	sec	59827
	facial	399990
	count_1	1
	length	0
Cruise	devCode	juvenile
	note_1	crub
	ETC	crub
	ETCdist	crub
	sex	U
	vsTL	10
	COMNAME	VDY

-173505.30 -162186.55 Meters

## Important Things to Consider

- **Coordinate system and spatial extent**
- **Identifying any possible differences between the schema and your data**
- **Which feature classes should the data go into?**
- **What are the attributes of each data set?**
- **Do you want to relate any of your data? If so, through what key fields?**

**TIP: Remember to use Parameters table**

**- table and the associated relationships allow access to features from parameter of interest (S, T, DOC, etc.)**

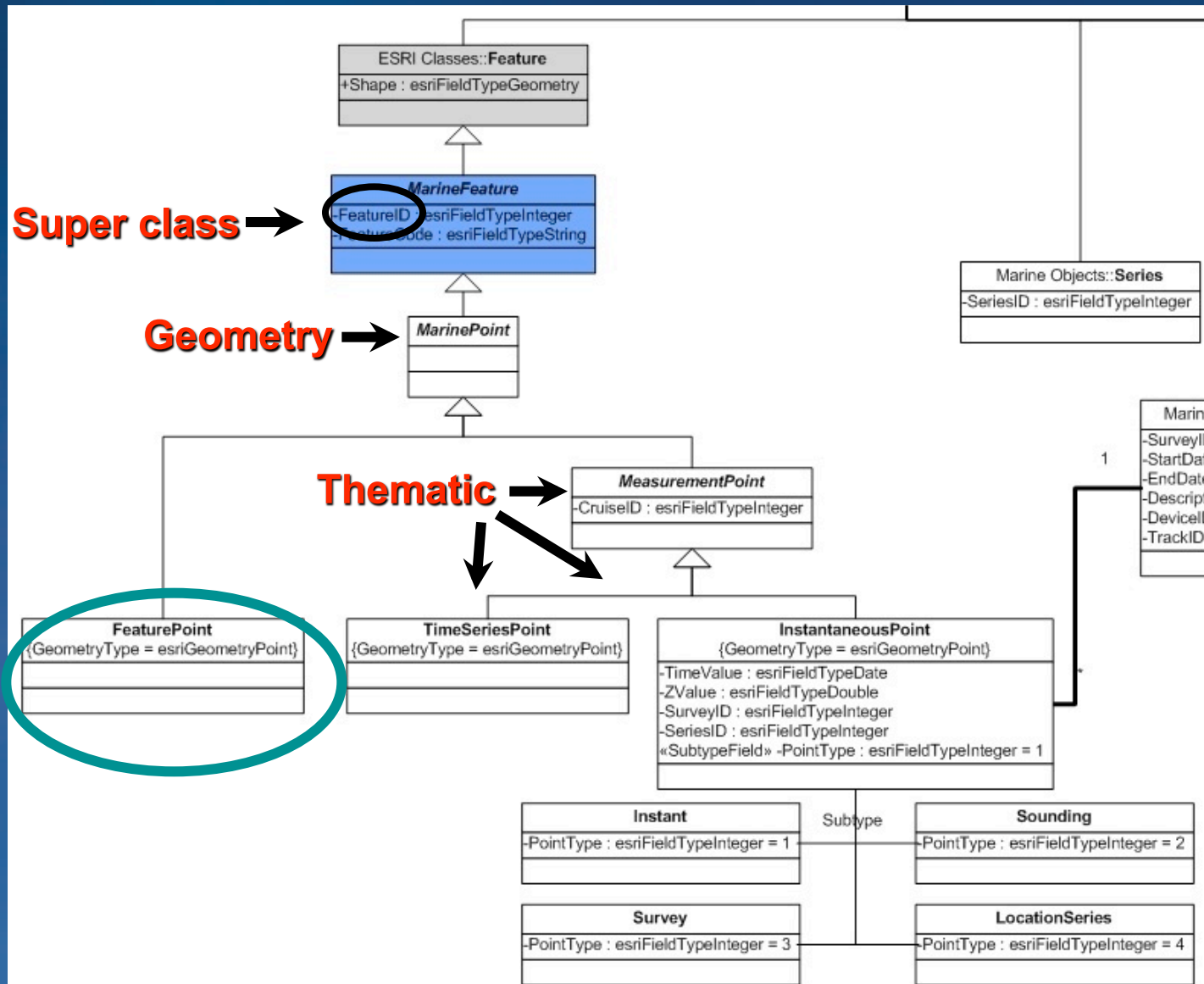


# Arc Marine with Other Data Models



# Arc Marine with Other Data Models?

Arc Hydro, IHO-S57, Weather & Climate, etc.





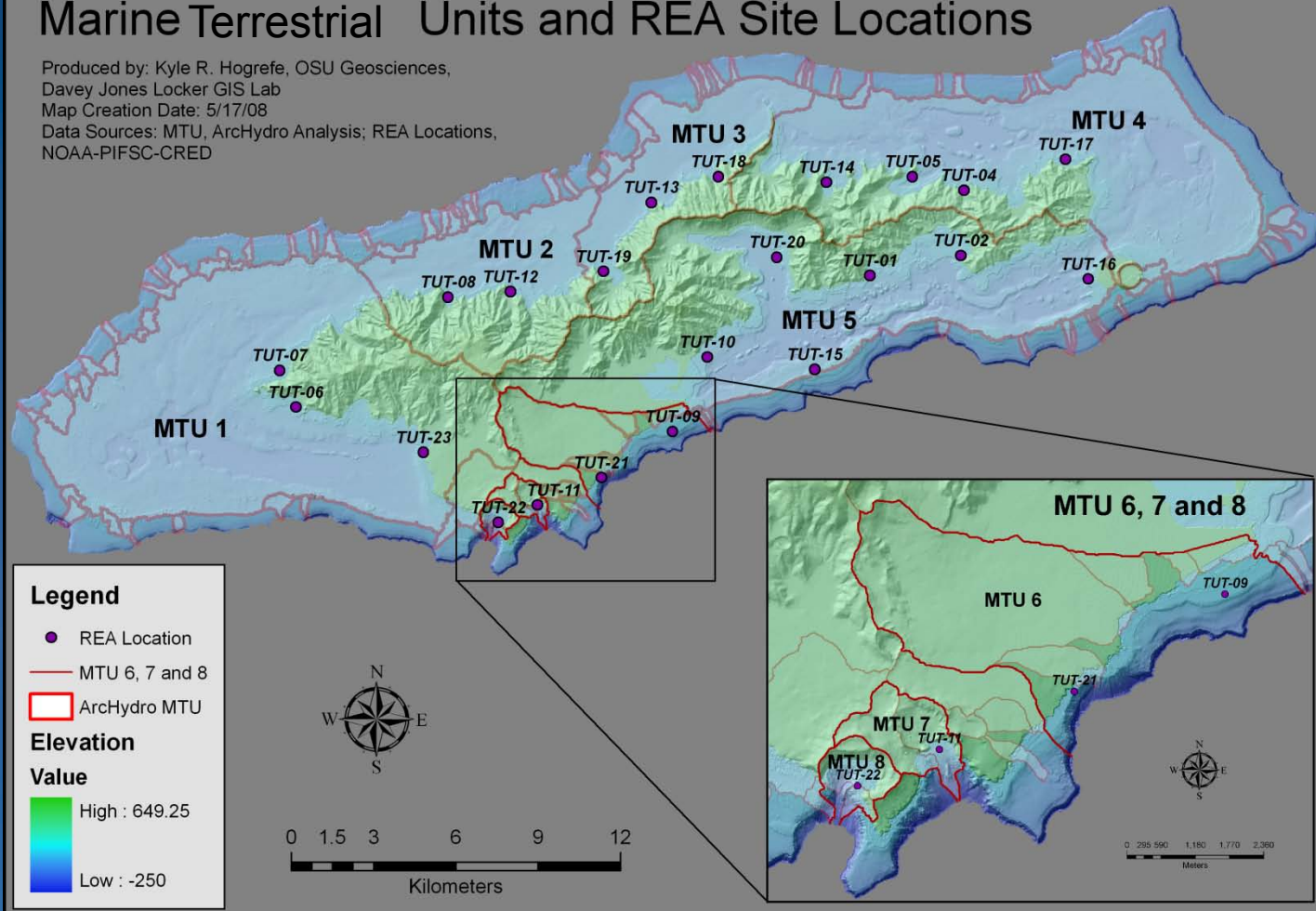
# Arc Marine with Other Data Models?

## Arc Hydro, Arc Marine

### Tutuila Coastal Terrain Model

#### Marine Terrestrial Units and REA Site Locations

Produced by: Kyle R. Hogrefe, OSU Geosciences,  
Davey Jones Locker GIS Lab  
Map Creation Date: 5/17/08  
Data Sources: MTU, ArcHydro Analysis; REA Locations,  
NOAA-PIFSC-CRED



## **Arc Marine with Other Data Models?**

**See also Nyerges et al., Coastal Zone '07 Paper**

**Constructing a Coastal Data Model for Puget Sound: A Classroom Experience:**

<http://dusk.geo.orst.edu/djl/arccgis/3470.Nyerges.pdf>



# ArcGIS Resource Centers

<http://resources.esri.com>



- Made for user communities.
- An expanded data models site.
- Provide a single location for your ArcGIS project.
- No needs to collect bits and pieces of information elsewhere.





## Build Rich Internet Applications

The new ArcGIS API for Flex allows you to create Rich Internet Applications with the power of ArcGIS Server.

[Learn More](#)



1 2 3

### Products

- ArcGIS Desktop
- ArcGIS Server
- ArcGIS Engine
- ArcGIS Explorer
- ArcGIS Mobile
- ArcIMS

### Functions

- ArcGIS Online
- Geoprocessing
- Geodatabase & ArcSDE
- Image Management
- CAD Integration
- Mapping & Visualization 
- Map Templates

### User Communities

- Water Utilities
- Java
- Public Safety

### Solutions

- Business Analyst Suite





### About ArcGIS for Water Utilities

This Web site provides application templates that will help you

- [Manage your water networks and other assets](#)
- [Plan](#) for your short-term operations and long-term needs
- Effectively share information with and manage your [mobile workforce](#)
- [Maintain operational awareness](#) and foster communication across your organization

### Helpful Resources

- Read the [Water Utilities Blog](#)
- Participate in the [Water, Wastewater & Stormwater Community Forums](#)
- View materials from the 2008 ESRI [Water Utilities Seminar](#)
- Read the [Water Writes](#) newsletter
- See [News and Events](#) for water utilities
- View [Case Studies](#) for water utilities

### Welcome to the Resource Center for Water Utilities Management



This Web site is for the ArcGIS water, wastewater, and stormwater utility community. It provides useful templates and best practice information enabling you to implement ArcGIS to manage your water utility information, perform your daily operations, and support your long term planning.

The Water Facilities Resource Center is the place for you to:

- Learn how to implement ArcGIS for managing water utilities
- Download and configure ArcGIS templates that can help you get started
- Communicate with:
  - Other Water utilities users like you
  - The ESRI Water Utilities team



Login

Blog

Template Gallery

Media Gallery

Share your work and download examples published by other users in the ArcGIS community.

## Template Gallery

Add An Entry

1

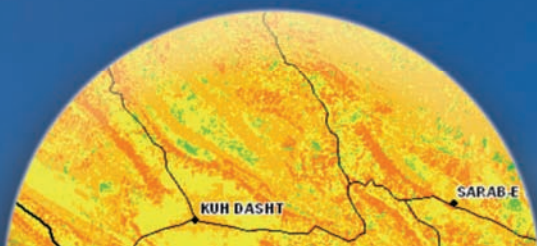
name	rating	date added	product version	author	downloads
<b>Water Distribution Model for use with ArcGIS for AutoCAD</b>	0 Ratings	Jun 03 2009 <small>Updated: Jun 03 2009</small>	9.3	donk	68
<p>These sample AutoCAD drawings were created with the ArcGIS EXPORT TO CAD tool using the sample geodatabase included in the Water Distribution Network Editing template found here:  <a href="http://resources.esri.com/waterutilities/index.cfm?fa=codeGalleryDetails&amp;scriptID=16039">http://resources.esri.com/waterutilities/index.cfm?fa=codeGalleryDetails&amp;scriptID=16039</a> Included in the download is the data dictionary from the Water Distribution Network Editing Template. To use these template drawings you will need to use a version of AutoCAD has been enhanced...</p>					
<b>Water Distribution Operations Dashboard</b>	5 Ratings	Feb 13 2009 <small>Updated: Mar 19 2009</small>	9.3	ArcGISTeamWater	947
<p>The Water Distribution Operations Dashboard Template is an industry-specific configuration of ArcGIS Server and ESRI's Sample Flex Viewer that provides a high-level view into the health and operations of a water utility. It provides relevant basemaps and operational layers from several sources, and provides a series of information popups and reports so concise map-centric content can be visualized and used...</p>					
<b>Water Distribution Network Editing</b>	4 Ratings	Feb 13 2009 <small>Updated: Apr 20 2009</small>	9.3	ArcGISTeamWater	1248
<p>The Water Distribution Network Editing Template is an industry-specific...</p>					



# Tools and Initiatives to Advance Arc Marine



- **BIDI and GeoDI projects in Ireland**
- **Ecosystem-Based Management (EBM) Tools Network**



# Additional Arc Marine Projects

[cmrc.ucc.ie](http://cmrc.ucc.ie)

[workshop1.science.oregonstate.edu/fri07](http://workshop1.science.oregonstate.edu/fri07)

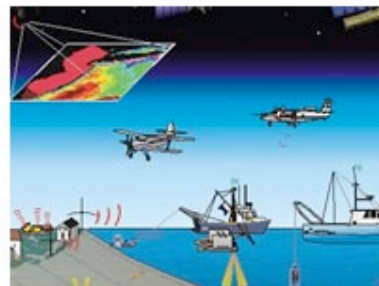


Coastal and Marine Resources Centre

Ionad Acmhanní Cóna is Mara

Wednesday, July 30th, 2008 09:21 pm

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Rutgers marine field station

## BIDI: Biological Data Integration

Project Status - active  
Start Year: 2005  
End Year: 2007  
Funding Body: [Marine Institute](#) . .

Geographic Area: Irish coastline  
Local Study Area:

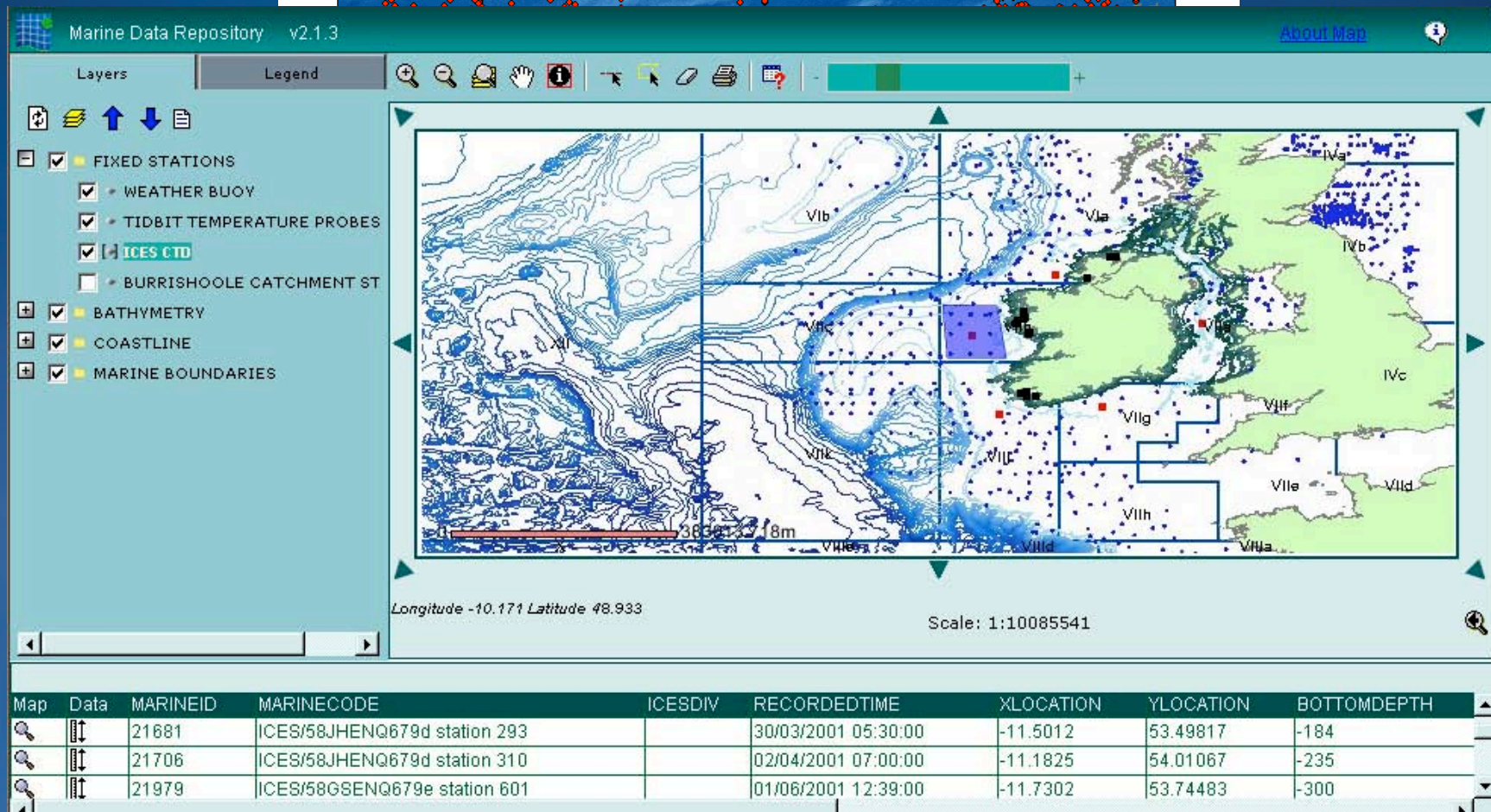
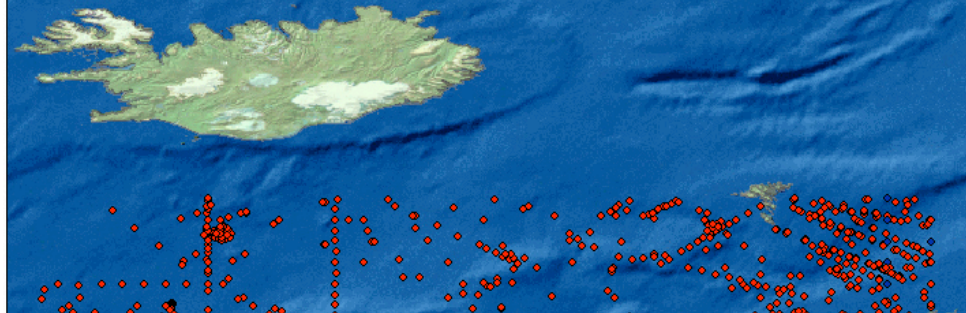
Project Co-Ordinator: Valerie Cummins  
CMRC Contact: Yassine Lassoued

### Abstract

The project aims to review existing biological datasets within the Marine Institute, analyse them with respect to integration with the Arc Marine Data Model and assess the scientific value of undertaking this process.



# The spatial extent of Marine Institute datasets



# Additional Arc Marine Projects

[geodi.ucc.ie](http://geodi.ucc.ie)



Geological & Geophysical Data Integration

Home

Welcome to GeoDI



## Navigation

- Home
- Context
- Objectives
- ▷ Partnership
- Work Plan
- ▷ Resources
- Stories

GeoDI (*Geological & Geophysical Data Integration*) is a three-year project funded by NDP under the Sea Change programme.

The objective of the GeoDI project is to derive maximum value from the national data acquisition effort to date and to allow future data to be integrated easily. This can be achieved by integrating datasets and advancing the data management methods to derive a holistic and more sophisticated view of change in the status of the marine environment. The GeoDI project aims to address this challenge by examining the critical issues involved in the integration of Irish marine geoscientific datasets and assessing tools and services for enhanced analyses of geoscientific data.





# Ecosystem Based Management Tools Network

[www.ebmtools.org](http://www.ebmtools.org)



- [Home](#)
- [About EBM](#)
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dusk.geo.orst.edu/djl/arccgis  
support.esri.com/datamodels

hosted by Davey Jones' Locker (Oregon State University)

## Arc Marine (The ArcGIS Marine Data Model) for the oceans, seas, and coastal regions of our planet...



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(13 min.)

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and Poster](#)

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# Open Discussion

**Session Evaluations Reminder:**  
*Please turn in your session evaluations.*  
... Thank you!

**Thanks for participating!**

*Dawn Wright* [dawn@dusk.geo.orst.edu](mailto:dawn@dusk.geo.orst.edu)

*Katsura Iizuka* [kiizuka@esri.com](mailto:kiizuka@esri.com)

