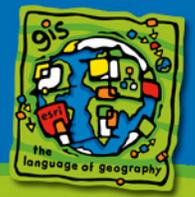


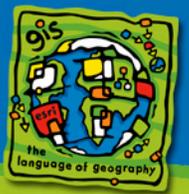
A Tutorial for New Users of the Marine Data Model

Alyssa Aaby, Dawn Wright
Oregon State University



Tutorial Purpose

- Assist in simple data entry into MDM
 - Starting point for project work or specific database design.
 - Personalize MDM to fit your needs
- Support for Case Studies
- Laboratory exercise or module
- General publicizing



Entry Point on Web dusk.geo.orst.edu/djl/arcgis

ArcGIS Marine Data Model Project

http://dusk.geo.orst.edu/djl/arcgis/

hosted by Davey Jones' Locker (Oregon State University)

The ArcGIS Marine Data Model

for the oceans, seas, and coastal regions of our planet...

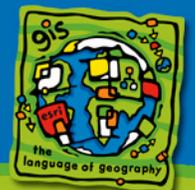


- [Project Info / Event Milestones](#)
- [People](#)
- [Conceptual Framework Documents inc. Poster](#)
- [Data Model Diagrams, Case Studies, & MDM Tutorial **New!!!**](#)
- [Supporting Documents / Meeting PPTs **Updated!**](#)
- [Links to Related Projects / Resources](#)
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• [Online Discussion Forum](#)

Search Here!

Last update: July 26, 2004



Using the Marine Data Model in ArcGIS 8.3/9.0

Links for this Tutorial

- [PowerPoint file of MDM Tutorial at ESRI UC 2004](#)
- [Marine Data Model Home Page](#)
- [Marine Data Model at ESRI](#)
- [More Samoa Source Data](#)

Basics:

- [Introduction to the ArcGIS Marine Data Model](#)
- [Tutorial Objectives](#)
- [Computer and Data Requirements](#)

Setting Up the Geodatabase:

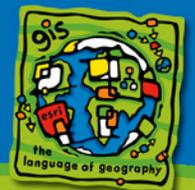
- Downloading the MDM Geodatabase
- Downloading the Data
- Applying the MDM Model Schema to the Geodatabase

Loading Data into the MDM Geodatabase

- Assess Your Data and Determine Your Database Setup
- Personalizing the MDM to Fit Your Data
- Loading Data into the MDM

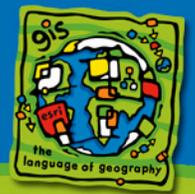
Adding the Geodatabase Features to your ArcMap Project

- How to add your data
- How to query the data



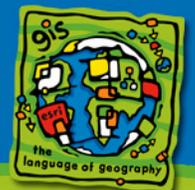
Tutorial Setup

- Tutorial divided into four sections
 - Basics
 - Setting Up the Geodatabase
 - Loading Data into the MDM Geodatabase
 - Adding the Geodatabase Features to your ArcMap Project

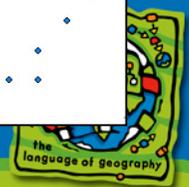
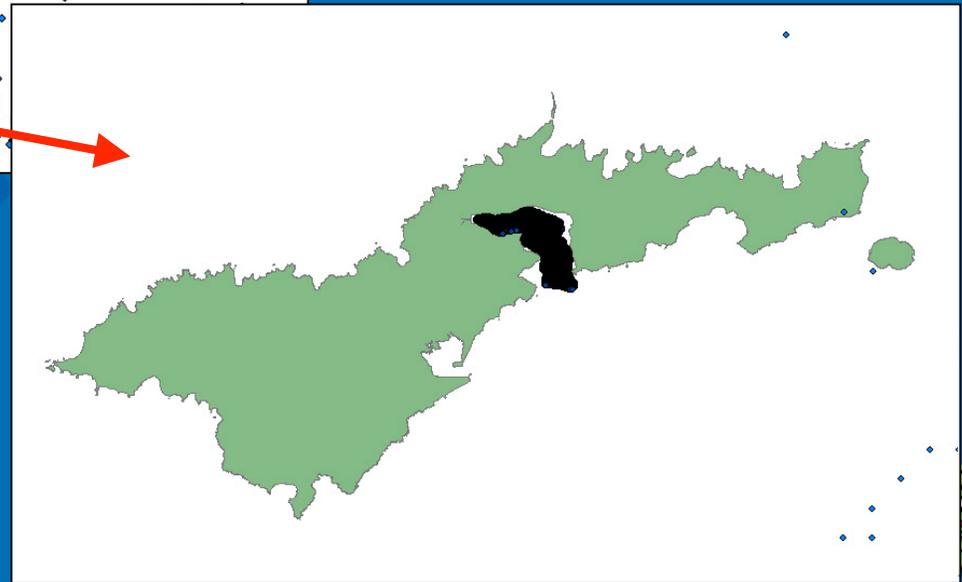
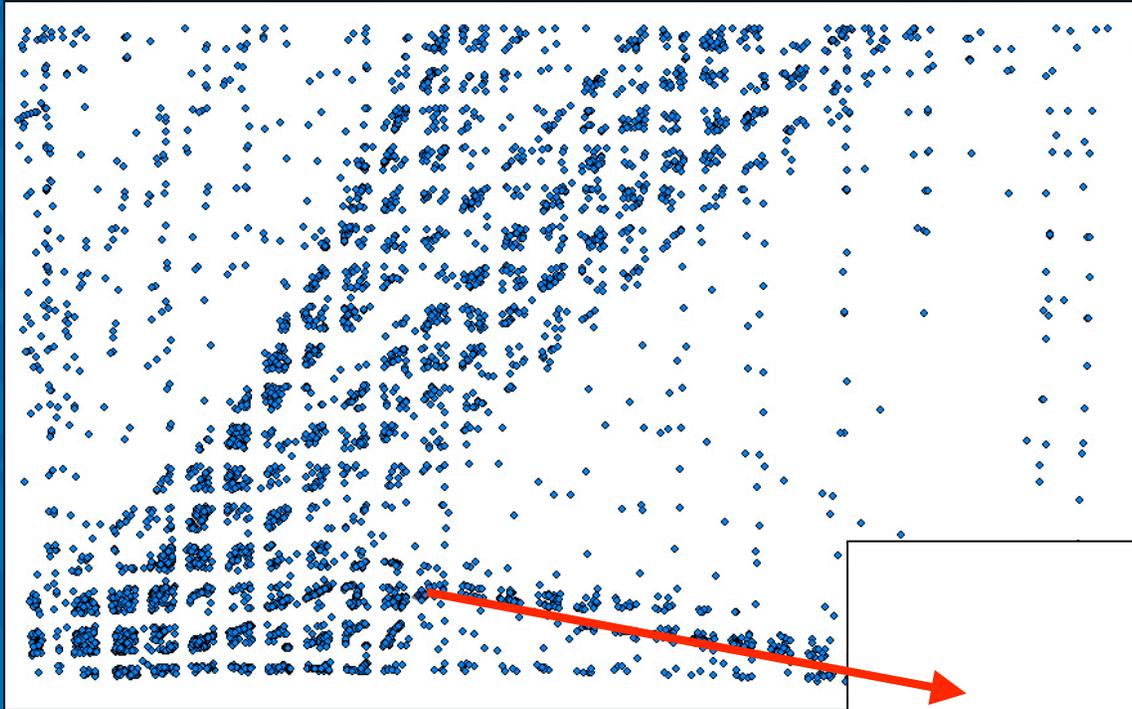


(1) Basics

- Introduction to the ArcGIS MDM
 - Why created
 - Intro to geodatabases
 - Helpful links
- Tutorial Objectives
 - Apply, prepare and load
- Computer and Data Requirements
 - Tested using ArcGIS 8.3 and 9.0
 - Need MDM schema, Tutuila Island and XYBottle shapefiles, Pago Pago 5m grid and XYBottle data tables.

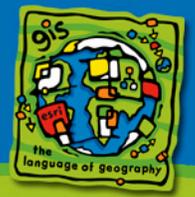


(1a) Views of Data



(2) Setting up the Geodatabase

- Downloading the MDM Geodatabase
- Downloading the Data
- Applying the MDM Model Schema to the Geodatabase



(2a) Downloading the MDM Geodatabase



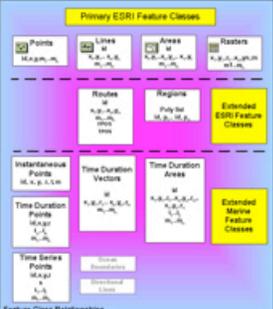
The ArcGIS Marine Data Model

Analysis/UML Diagrams

Case Studies



[Home](#) | [About](#) | [People](#) | [Framework](#) | [Diagrams & Data](#) | [Docs](#) | [Links](#)



Levels in data modeling include:
reality --> conceptual model --> logical model --> physical model, increasing in abstraction as one goes from human-orientation to computer-orientation.

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Analysis Diagram
[GIF Image](#), 642K (7/19/02)

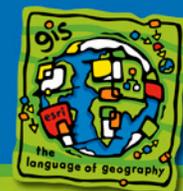
UML Diagram and Repository
[Visio and .mdb](#), 2.2 Mb zip file (9/07/03)

Common Marine Data Types Diagram
[GIF Image](#), 204K (6/29/03)
[PPT file, explaining fragment of UML](#), 164K (5/30/03)

Scientific Information Model Diagram (1997)
(May help w/ understanding semantics in Analysis and UML Diagrams)
[GIF Image](#), 168K (7/20/02)

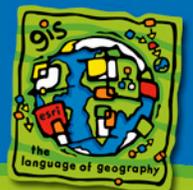
Marine Feature Classes Document
Zip file, 507K (9/07/03)





(2a) Downloading the MDM Geodatabase

- **Tip #1:** ArcCatalog does not always refresh automatically. If you do not see the *ArcGISMarineReposit.mdb* file in the *Samoa* folder after you extract it, refresh ArcCatalog by going to *View-->Refresh*.



(2b) Downloading the Data (if additional test data sets needed)

NetSite: <http://dusk.geo.orst.edu/dji/samoa/>



Fagatele Bay National Marine Sanctuary (FBNMS) GIS Data Archive

Last update: June 7, 2001

Where is American Samoa?
 About FBNMS
 FBNMS Main Site
 Photo Gallery
 GIS Tools
 Book Chapter (PDF document)
 Related Links
 Contact the Web Goddess

This site provides GIS data from recent shallow-water multibeam bathymetric surveys conducted April-May, 2001 in support of the Fagatele Bay National Marine Sanctuary, **American Samoa** in the SW Pacific Ocean. Also included are a recent compilation of GIS data layers obtained originally from the National Park Service, the USGS, the Digital Chart of the World, and other sources, as well as GMT grids, maps, and various photographic images and graphics. All GIS data are provided as ArcInfo export interchange files (ie. *.e00 files) which may be **IMPORTED** into ArcInfo, ArcView, or ArcExplorer. **Please note that bathymetric grids have not yet been completely cleaned of bad data points or undergone corrections for differential GPS.**

To download a file, PC or Unix users should hold down the **RIGHT** mouse button and then choose "Save this Link As" (Netscape) or "Download Link to Disk" (Internet Explorer). Mac users should hold down the mouse button and then choose "Save Link this As" (Netscape) or "Download Link to Disk" (Internet Explorer). In the table below, "NA" means "not available."

GIS Data Layers

Bathymetric and Topographic Grids

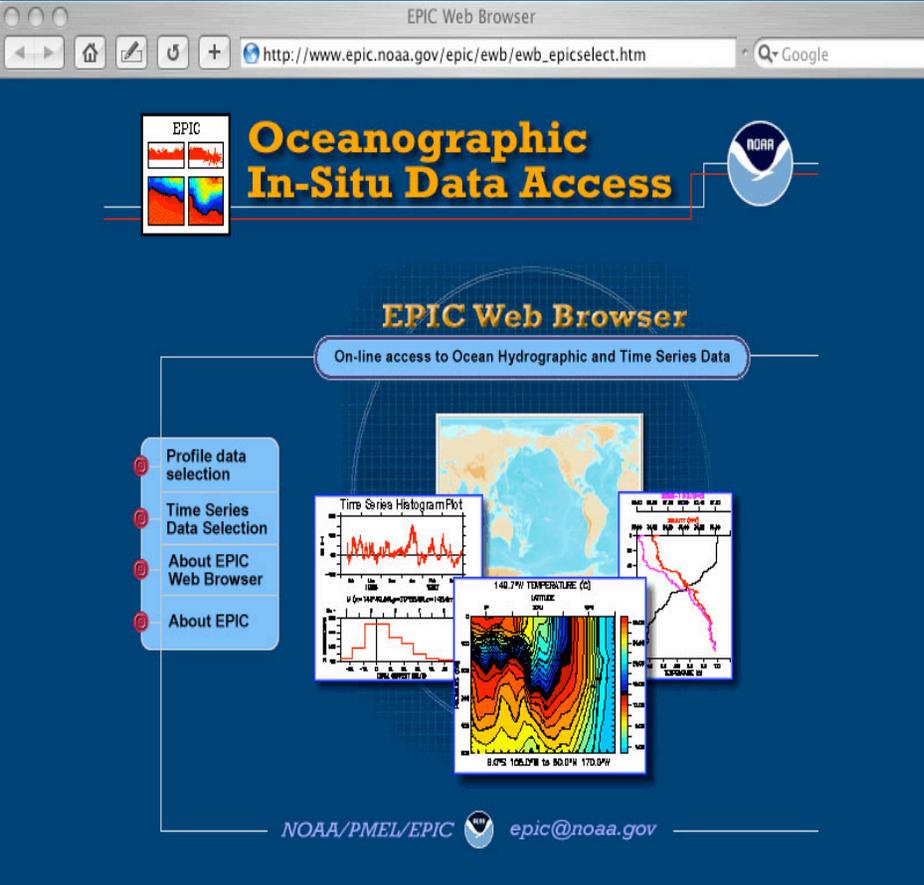
DATA SET	THUMBNAIL GRAPHIC	FGDC METADATA	DOWNLOAD FILE
FBNMS Bathymetry, 1-m grid (unshifted)	fb_sml.gif	fb_fm.htm	fbnms_fm.e00 (48 Mb)
FBNMS Bathymetry, 10-m grid (shifted to match USGS DEM)	trans_sml.gif	fb_shift.htm	fb_shift.e00 (494K)
Pago Pago Harbor Bathymetry, 1-m grid (shifted to match USGS DEM)	pago_sml.gif	pago_shift.htm	pago_shift.e00 (78 Mb)
Pago Pago Harbor Shipwreck Bathymetry, 1-m grid	wreck_sml.gif	wreck_fm.htm	wreck_fm.e00 (19 Mb)
Samoa Regional Bathymetry, Smith & Sandwell, 1-ka grid	samoa_sml.gif	samoa_bathy.htm	samoa_bathy.e00 (2.4 Mb)
Tutuila 10-m DEM, Lat/Long Decimal Degrees	tut_sml.gif	tutuila_geo.htm	tutuila_geo.e00 (162 Mb)
Tutuila 10-m DEM, UTM	tut_sml.gif	tutuila_den.htm	tutuila_den.e00 (162 Mb)

Vector (Point, Line, Polygon) GIS Layers

DATA SET	THUMBNAIL GRAPHIC	FGDC METADATA	DOWNLOAD FILE
Birkeland Reef Observation Points	pts_sml.gif	birkppt.htm	birkppt.e00
Birkeland Reef Transects	trans_sml.gif	transectsl.htm	transects.e00
Outer Boundary of Tutuila Island	NA	boundariesp.htm	boundaries.e00

EPIC Web Browser

http://www.epic.noaa.gov/epic/ewb/ewb_epicselect.htm



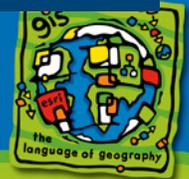
Oceanographic In-Situ Data Access

EPIC Web Browser

On-line access to Ocean Hydrographic and Time Series Data

- Profile data selection
- Time Series Data Selection
- About EPIC Web Browser
- About EPIC

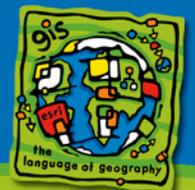
NOAA/PMEL/EPIC epic@noaa.gov



The MDM Repository and Test Data

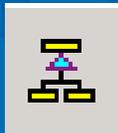


- All data contained in a feature dataset must have the same coordinate system and fit within the set spatial extent
- Tutorial used: WGS 1984 UTM Zone 2S

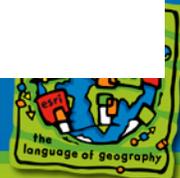
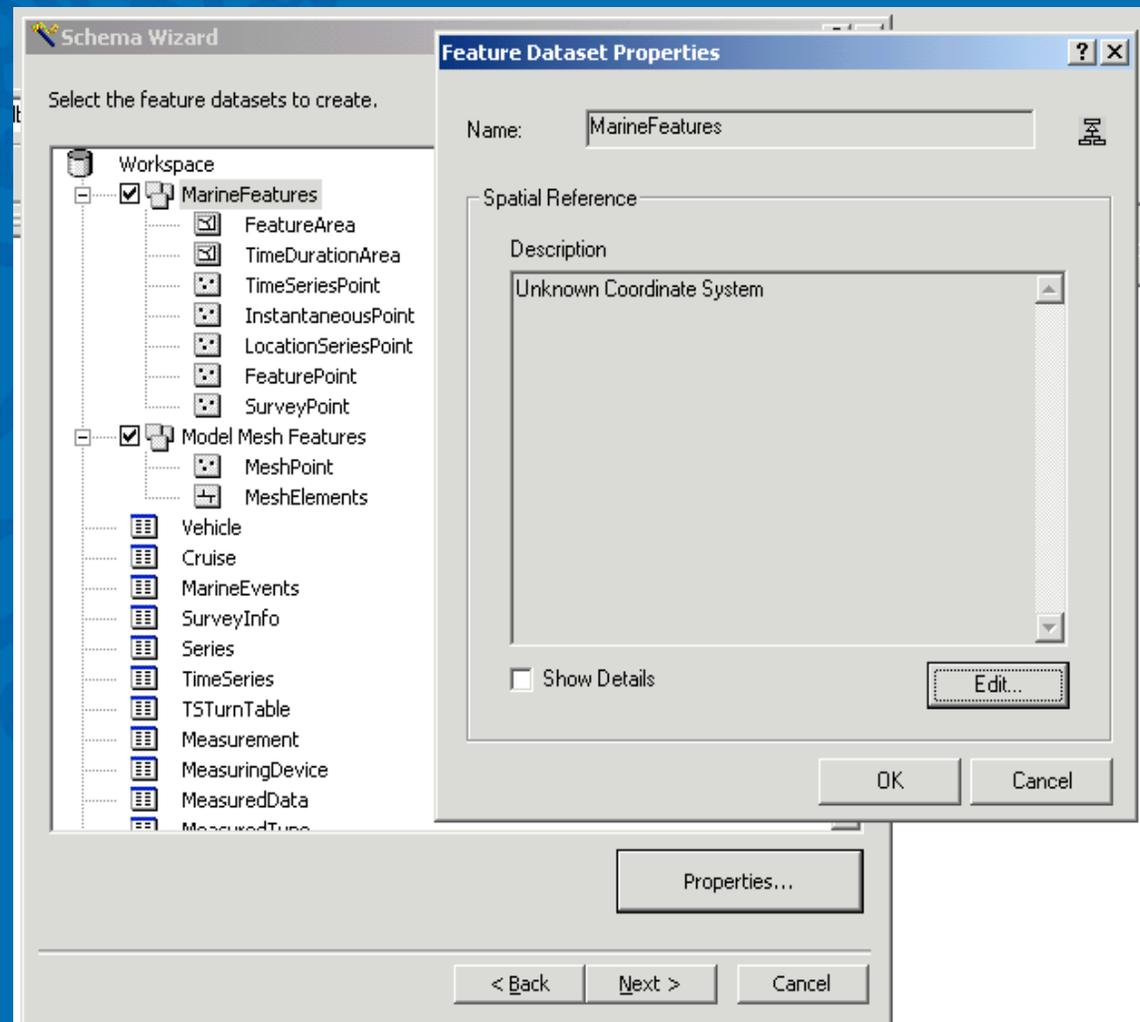


(2c) Applying the MDM Model Schema to the Geodatabase

- Use Schema Tool in ArcCatalog

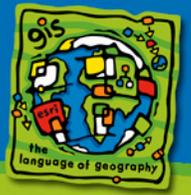


- Select coordinate system and spatial extent
- Tutorial used XYBottle Data



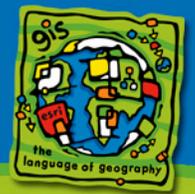
(2c) Applying the MDM Model Schema to the Geodatabase

- **Tip #2:** Use *Import* option and select a shapefile/coverage with the largest extent needed and desired coordinate system
- **Tip #3:** Make sure that the schema and your data match exactly



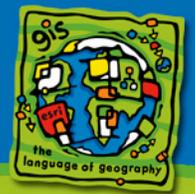
(3) Loading Data into the MDM Geodatabase

- Assess Your Data and Determine Your Database Setup
- Personalizing the MDM to Fit the Data
- Loading Vector Data into the MDM
- Creating a Relationship
- Loading Raster Data into the MDM



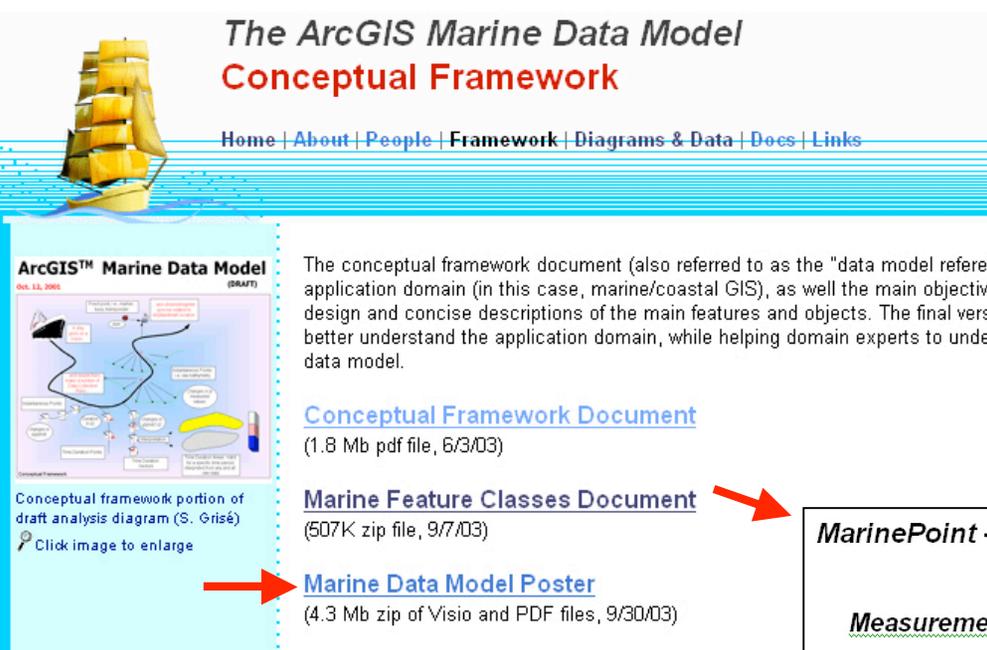
(3a) Assess Your Data and Determine Your Database Setup

- Most important, but also most time consuming step
- Important things to consider:
 - 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?



(3a.1) Matching Data with Feature Classes

Feature Classes Document and MDM Poster



The ArcGIS Marine Data Model
Conceptual Framework

Home | About | People | Framework | Diagrams & Data | Docs | Links

ArcGIS™ Marine Data Model
04.11.2003 (DRAFT)

The conceptual framework document (also referred to as the "data model reference application domain" (in this case, marine/coastal GIS), as well the main objective design and concise descriptions of the main features and objects. The final version better understand the application domain, while helping domain experts to understand the data model.

[Conceptual Framework Document](#)
(1.8 Mb pdf file, 6/3/03)

[Marine Feature Classes Document](#)
(507K zip file, 9/7/03)

[Marine Data Model Poster](#)
(4.3 Mb zip of Visio and PDF files, 9/30/03)

Conceptual framework portion of draft analysis diagram (S. Grisé)
Click image to enlarge

MarinePoint – an abstract class defining subclasses of point features.

MeasurementPoint – an abstract subclasses of MarinePoint used for categorizing points that are associated with Time or Measurements.

InstantaneousPoint – An instantiable subclass of MeasurementPoint for representing features that are a single observation in time and space. Meaning the X, Y coordinates plus a timestamp create the unique point feature. An InstantaneousPoint can have multiple Z depths via implementing the Measurement object class.

Properties: None

Attributes: RecordedTime – the time step for identifying the point

Examples: CTD (conductivity/temperature/depth), XBT (eXpendable BathyThermograph), SVP (Sound Velocity Profile) casts below the water surface, all with multiple Measurements.

Instantaneous Point = CTD or measurement package
Measurement Table – Measure ID of 1st CTD measure stop at depth z
MDevice Table = bottle, or could be same device but calibrated different way
MType = reading is of type dissolved O₂ (could be salinity, temp, photosynthetically available radiation (PAR), etc.)
MData = that actual numerical value of dissolved O₂

(3a.1) Matching Data with Feature Classes

Common Marine Data Types Diagram



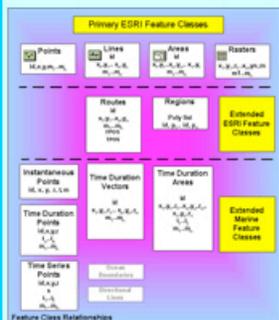
The ArcGIS Marine Data Model

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Draft diagram of primary ESRI marine feature classes (P. Halpin)

[Click image to enlarge](#)

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[GIF Image](#), 642K (7/19/02)

UML Diagram and Repository

[Visio and .mdb](#), 2.2 Mb zip file (9/07/03)

Common Marine Data Types Diagram

[GIF Image](#), 204K (6/29/03)

[PPT file, explaining fragment of UML](#), 164K (5/30/03)

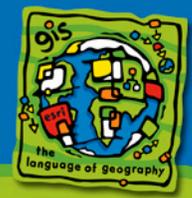
Scientific Information Model Diagram (1997)

(May help w/ understanding semantics in Analysis and UML Diagrams)

[GIF Image](#), 168K (7/20/02)

Marine Feature Classes Document

[Zip file](#), 507K (9/07/03)



MDM Common Marine Data Types

Draft 6/28/03 by Pat/Dawn

Common Marine Data Types

Feature Points

Previously "Fixed Points"

Survey Point

ID
X,Y
Z

Examples:
marker buoy,
transponder,
other fixed
geography

Measurement Points

Instantaneous Point

ID
X,Y,
Z or Z
t,
m₁...m₂

Examples:
CTD, XBT, SVP
casts at Z, fish
density, tide
gauge, etc. at
surface or a single
Z

Location Series Point

ID
X,Y,
Z
m₁...m₂
t₁...t₂

Examples:
telemetry,
bird/mammal
sighting, ship
mounted
ADCP

Time Series Point

ID
fixed X,Y,
Z or Z
m₁...m₂
t₁...t_{infinity}

Examples:
current meter,
moored ADCP at
Z, obs. buoy,
hydrophone,
OBSat single Z

Feature Lines

Data Line

ID
X, Y
M₁M₂
Z₁Z₂...

Examples:
for abstracting data from,
building profile from,
measuring change along...
cross-section,
bathy profile,
sed transport line
where "M" is GIS geometry
measure, rather than a
"measurement" from an
instrument in the field ("m")

Time Duration Line

ID
X₁Y₁X₂Y₂...
M₁M₂...
Z₁Z₂...
m₁m₂...
t₁t₂...

Examples:
algal bloom trawl,
ADCP tracks,
ARGO drifter

Run Track

Feature Line

ID
X₁Y₁X₂Y₂...
M₁M₂...

Examples:
sea wall, ocean front,
EEZ or
legal boundaries NOT
enclosing an area

Shoreline

shoreline type,
VDatum

Marine Areas

Feature Area

ID
X₁Y₁X₂Y₂...X_nY_n
Z
m

Examples:
Marine boundaries
(e.g.,sanctuary, MPA) ,
habitats,
patches, lava
flows, clipping,
masking

Time Duration Area

ID
X₁Y₁X₂Y₂...X_nY_n
Z
m
t₁...t_n

Examples:
No-take
zones,
oil spills,
harmful algal
bloom

Regularly Interpolated Surface

row₁,col₁...row_n,col_n
Z_{r,c1}...Z_{r,cn}

Examples:
bathymetry,
sidescan,
SST, climatology,
"re-analyzed"
products
(placeholder for
IMAGES such as
GeoTIFF, BIL, etc.)

Derived or Placeholders

Irregularly Interpolated Surface

row₁,col₁...row_n,col_n
Z_{r,c1}...Z_{r,cn}

Examples:
TINs
bathymetry

Volume

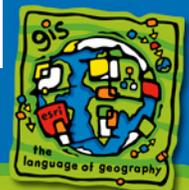
ID
X₁Y₁Z₁X₂Y₂Z₂
...X_nY_nZ_n
m or m₁...m_n
t or t₁...t_n

ncols,nrows,nlayers
Examples:
plume, front,
warm core, trawl
abundance

Animations, Movies, Video

X₁Y₁Z₁X₂Y₂Z₂
...X_nY_nZ_n
t₁...t_n

Examples:
U/W video footage,
outputs from atm. or
circulation models
that are animated &
georegistered so
other data may be
overlain



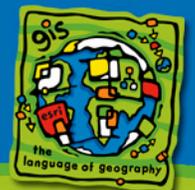
(3a.2) Matching Spatial with Non-Spatial

XYBottle Spatial Data

- Feature class:
InstantaneousPt
- Attributes:
 - *RefID* (Long Integer)
 - Cast (Text, 50 Characters)
 - Lat (Double)
 - Long (Double)
 - MaxDepth (Double)
- Will create a 1-to-1 relationship class between the *RefID*

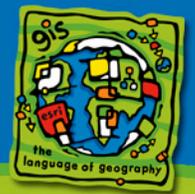
XYBottle Non-Spatial Data

- Table: create new
- Attributes:
 - *RefID* (Long Integer)
 - Cast (Text, 50 Characters)
 - MMDDYYYY (Date)
 - Temperature (Double)
 - Oxygen (Double)
 - Salinity (Double)
 - Phosphate (Double)

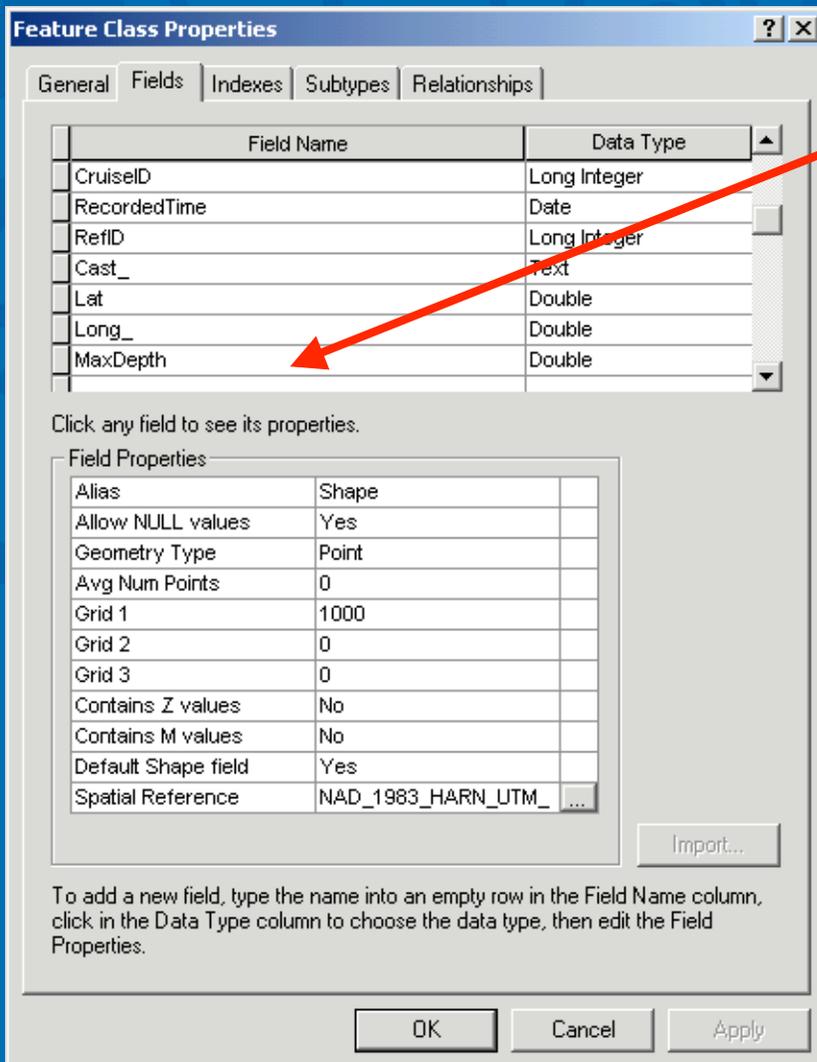


(3a) Determine the Database Setup

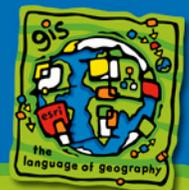
- **Tip #4:** Relationships between data columns can only be established if attribute data type is Long Integer



(3b) Personalizing the MDM to Fit the Data

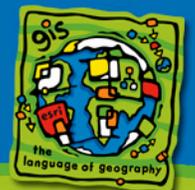


- Feature class personalized to fit XYBottle Data
- Field names were added to the InstantaneousPT feature class
- Can add additional field names later, but cannot modify once data have been added to those fields



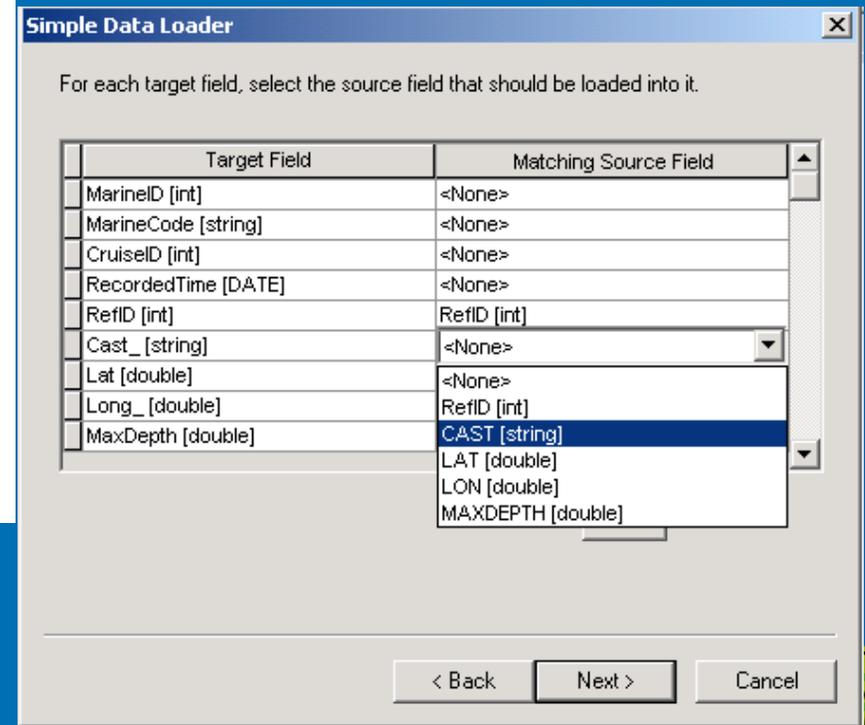
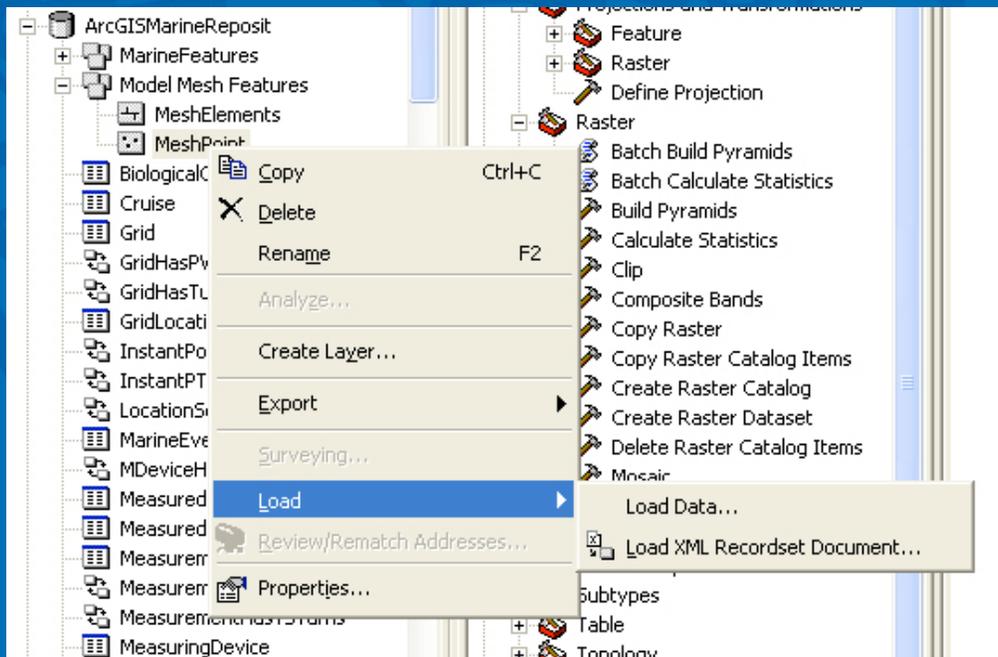
(3b) Personalizing the MDM to Fit Your Data

- **Tip #5:** Make sure data types match up exactly, or your data will not load

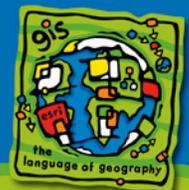
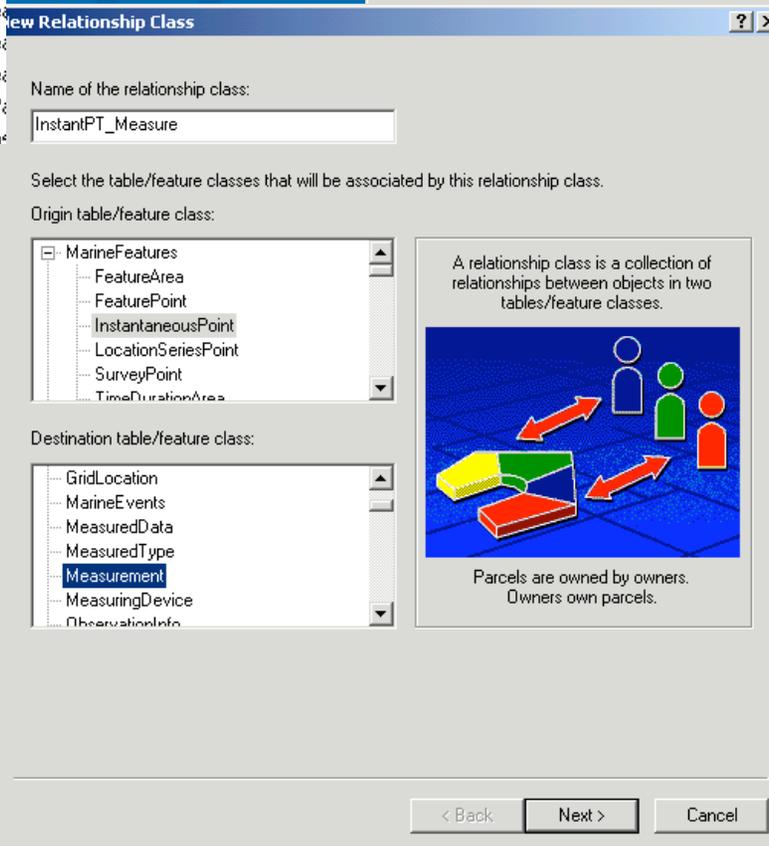
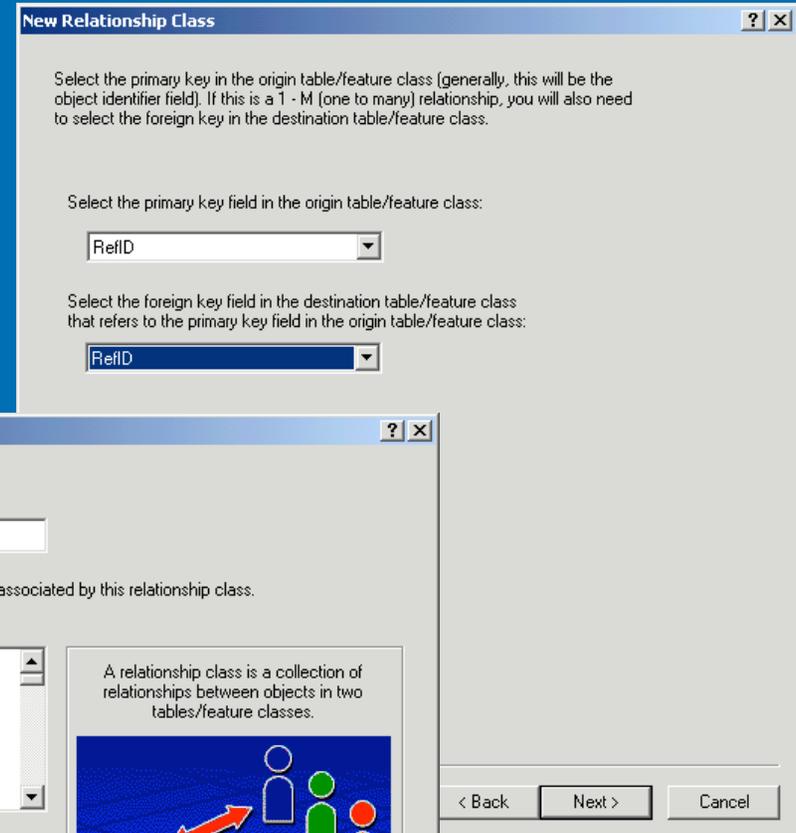
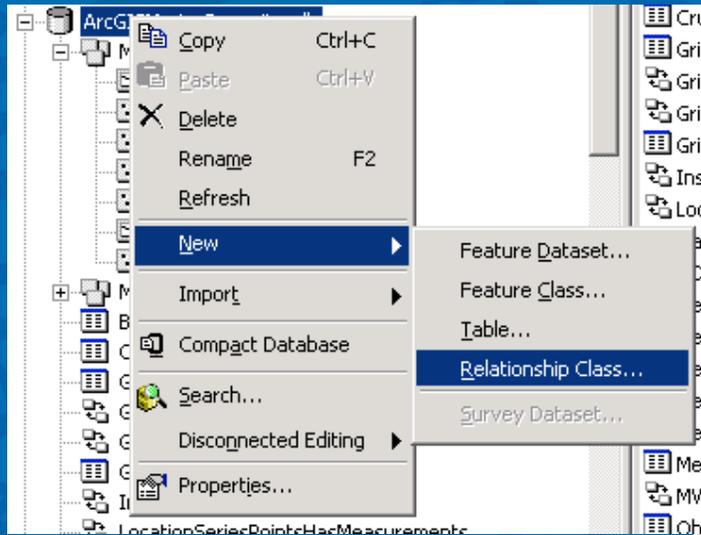


(3c) Loading Vector Data into the MDM

- Load data into feature class/table
- Match field names and data types

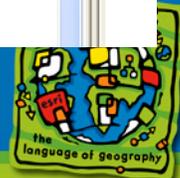
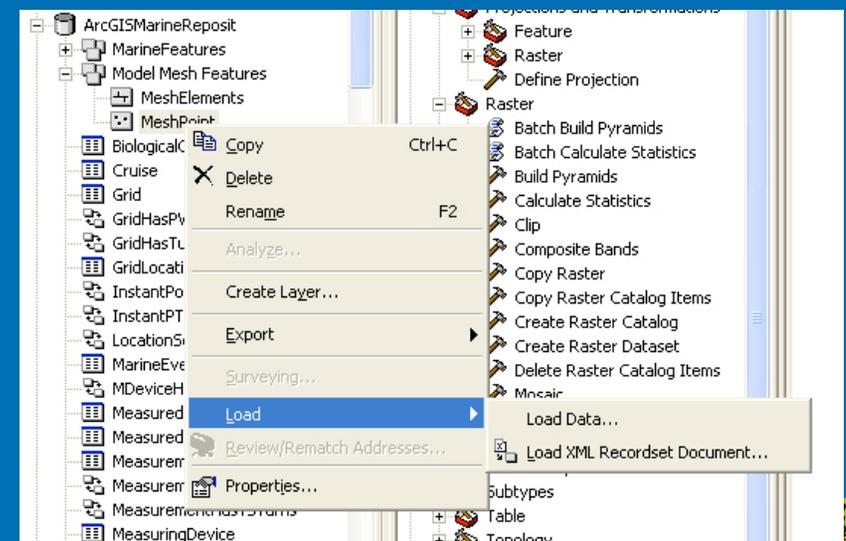
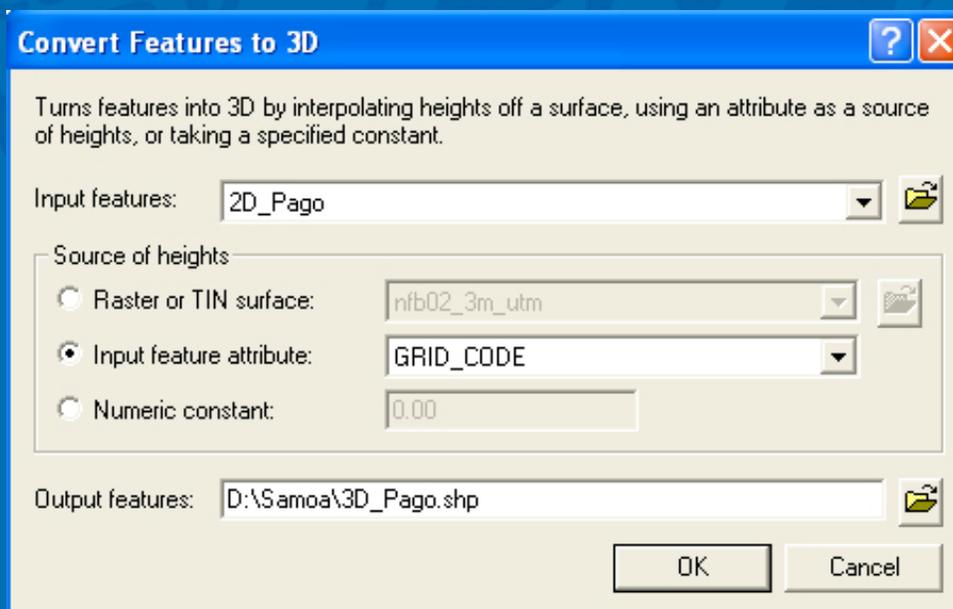


(3d) Creating a Relationship



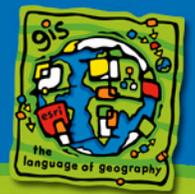
(3e) Loading Raster Data into the MDM (ArcGIS 8.3 only)

- To add raster data (without ArcSDE):
 - Can add standalone grid
 - Or can convert grid to shapefile
- Convert Pago 5m grid to 3D shapefile
- Loaded data into MeshPoint feature class



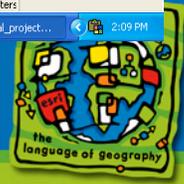
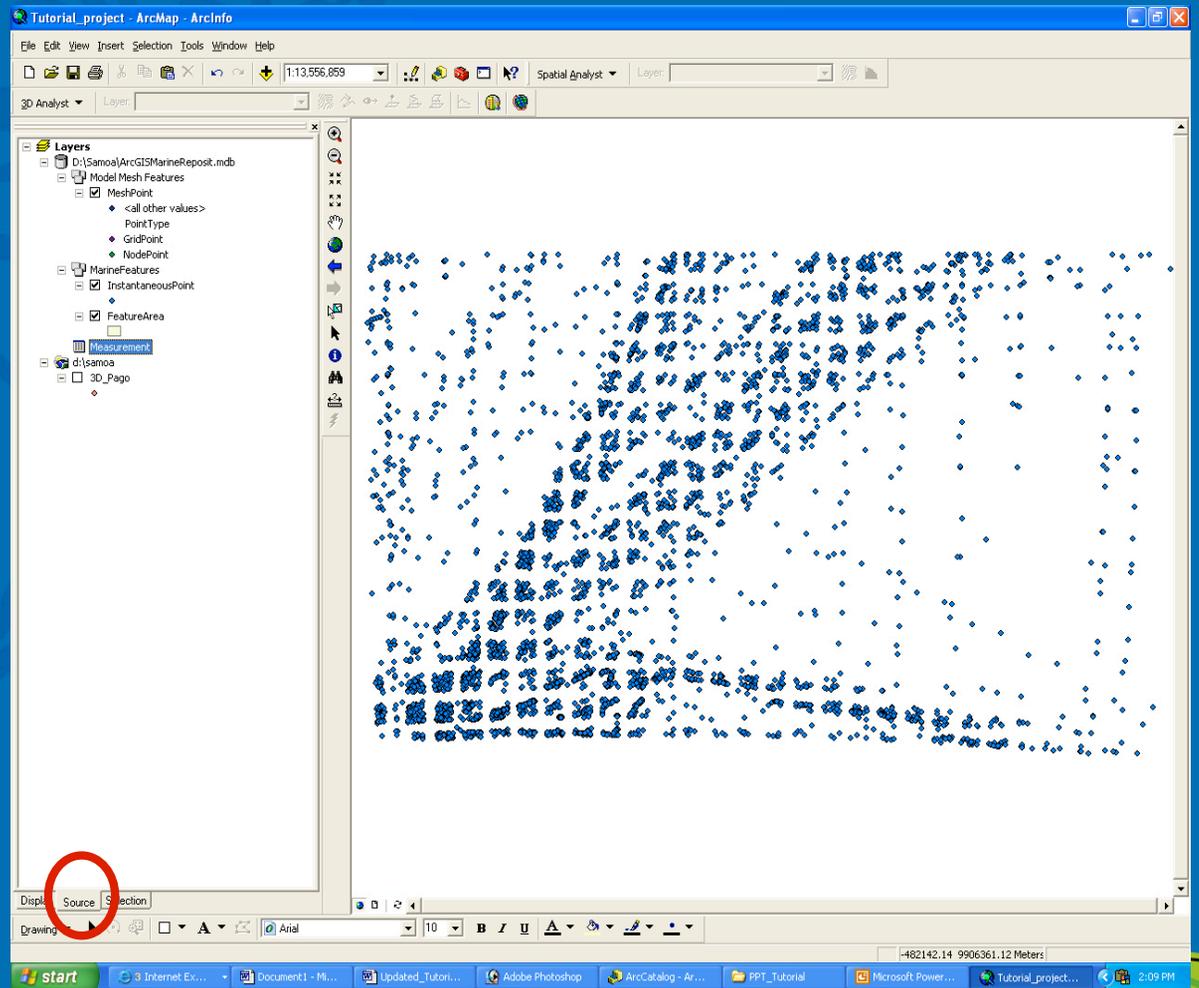
(4) Adding the Geodatabase Features to your ArcMap Project

- How to add the data in ArcMap
- How to query the data in ArcMap



(4a) How to add the data

1. Add the three feature classes: FeatureArea, InstantaneousPoint and MeshPoint, from the geodatabase.
2. Add the Measurement table.
3. Now you are ready to query for information through the tables.



(4) How to query the data

- **Sample query:** How many points have a temperature of 30 °C ? (Larger issue: Effect of global warming on coral reefs)

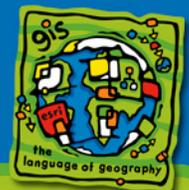
Attributes of Measurement

OBJECTID*	MeasurementID*	FeatureID*	ZLocation	XLocation
1	<Null>	<Null>	<Null>	<Null>
2	<Null>	<Null>	<Null>	<Null>
3	<Null>	<Null>	<Null>	<Null>
4	<Null>	<Null>	<Null>	<Null>
5	<Null>	<Null>	<Null>	<Null>
6	<Null>	<Null>	<Null>	<Null>
7	<Null>	<Null>	<Null>	<Null>
8	<Null>	<Null>	<Null>	<Null>

Record: 14 | 1 | Show: All Selected | Records (423 out of *2000 Selected.)

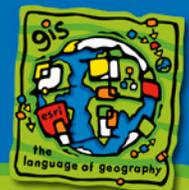
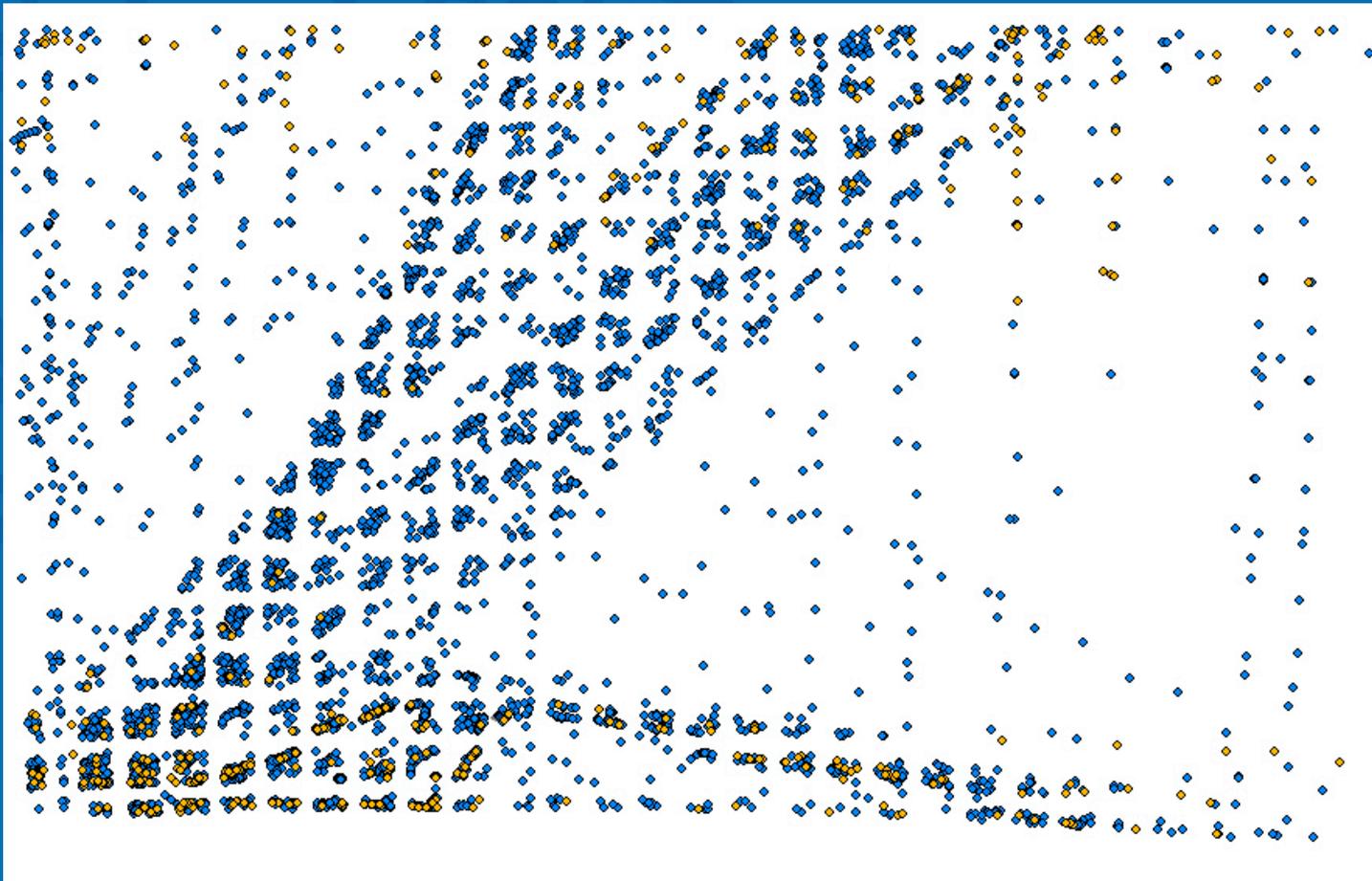
Related Tables

- MeasurementHasSTurns : TSTurn
- MeasurementHasDevice : MeasureDevice
- TimeSeriesPointHasMeasurements : TimeSeriesPoint
- InstantPointHasMeasurements : InstantPoint
- LocationSeriesPointHasMeasurements : LocationSeriesPoint
- InstantPT_Measure : InstantaneousPoint



Sample Result of query

- 423 (in orange) out of 4780



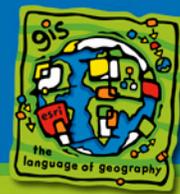
Summary: Important Things to Consider

- 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?



Summary of “Tips and Tricks”

- **Tip #1:** ArcCatalog does not always refresh automatically. If you do not see the *ArcGISMarineReposit.mdb* file in the *Samoa* folder after you extract it, refresh ArcCatalog
- **Tip #2:** Use *Import* option and select a shapefile/coverage with the largest extent needed and desired coordinate system
- **Tip #3:** Make sure that the schema and your data match exactly
 - Ex: M value for MeshGrid feature class
- **Tip #4:** Relationships between data columns can only be established if attribute data type is Long Integer
- **Tip #5:** Make sure data types match up exactly, otherwise, your data will not load



dusk.geo.orst.edu/djl/arctgis

ArcGIS Marine Data Model Project

http://dusk.geo.orst.edu/djl/arctgis/

hosted by Davey Jones' Locker (Oregon State University)

The ArcGIS Marine Data Model

for the oceans, seas, and coastal regions of our planet...

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