Using Rasters to Measure Impact of Weather on Military Maritime Operations

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Agenda

- Applying METOC data
- Multidimensional Data
- Using Geoprocessing to Analyze Oceanography Data
- Predictive Analysis Tools
- Raster Functions on Multidimensional Data
- Questions
Communicating Weather to Decision Makers

“Winds in the Area of Interest will be sustained at 20kts with gusts to 35kts.”

“What does that mean???”

“Will my mission be a success?”

“What platform can I use?”

“Waves in the Area of Interest will between 2.5 m and 3 m.”

“You can conduct X operation at these locations, but not at these locations.”
Multidimensional Model
Raster Data
Multidimensional Data

- Oceanographic data
  - Sea temperature
  - Salinity
  - Ocean current

- Meteorological data
  - Temperature
  - Humidity
  - Wind

- Land
  - Soil moisture
  - NDVI
  - Land cover
Scientific formats in ArcGIS 10.3

- **GRIB** (General Regularly-distributed Information in Binary form)
  - A gridded format used operationally worldwide by most meteorological centers.

- **netCDF** (Network Common Data Form)
  - A self-describing, machine-independent data format that support the creation, access, and sharing of array-oriented scientific data.

- **HDF** (Hierarchical Data Format)
  - A scientific format that supports a proliferation of different data models, including multidimensional arrays, raster images, and tables.

Variable / Dimension

- **Temperature / Time**
- **Salinity / Depth**
- **Pressure / Altitude**
Anti-Submarine Warfare

*Using Geoprocessing on Oceanography data to find Thermocline*
Predictive Analysis Tools
Predictive Analysis Tools – ArcGIS for Desktop
• Solutions Page
• Quick raster analysis
• Create Speed Models
• Query Analysis

Possible Use Cases:
• Query Analysis of Weather and Terrain Data
• Create Speed Models Based Off of Conditions
• Find Quickest Route

Predictive Analysis Tools – Web App Builder Widget
• GitHub
• Web App Builder Developer Edition
• Query Analysis

Possible Use Cases:
• Query Analysis of Weather and Terrain Data
• Create Weighted Overlays Between Raster Data
Predictive Analysis Add-In


**Overview**

The ArcGIS Predictive Analysis Tools Add-In is an Add-In to Esri's ArcMap desktop application. The tools contained in this Add-In allow you to build models to predict the location of moving or stationary targets or events. You can build models based on shared tradecraft or doctrine, or you can derive the models from a set of observations. The Add-In includes several tools that you use together to make predictions. The ArcGIS Predictive Analysis Tools Add-In allows you to:

- Build, save, and load queries to find locations where a set of conditions is true.
- Take a set of observations and use the characteristics of their locations to find what other areas have similar qualities.
Maritime Interdiction

Using Oceanography data to create a speed model
Raster Functions
ArcGIS Supports Native Model Data

Collection

Model Creation

Native METOC Data Formats
- netCDF
- GRIB
- HDF

Mosaic Data Set
Processing on-the-fly Raster Functions

fx

Server

Portal

Visualization

Dissemination

Exploitation

ArcGIS Desktop
Raster Function

- Geometric or Radiometric function applied pixel-by-pixel
- Hyper-efficient “on-the-fly” processing
- Chained together to create “processing chains”
Data Processing

- **Desktop Geoprocessing**
  - 1 area (RFS)
  - 1 person / machine
  - 1 tau (time)
  - Up to **5 days** (production)

- **Server**
  - 1 area (RFS)
  - 1 machine
  - 1 tau (time)
  - Up to **5 min**

- **Mosaic Dataset Functions**
  - All areas (model extents)
  - 1 machine/ many machines
  - All times/ on the fly processing
  - Up to **5 sec**
Military Aspects of Weather Version 2.0

- Utilize scheduled tasks to download data using batch files.
- Identify the anticipated effects of current conditions and forecast weather on potential operational activities.
- Military Aspects of Weather is supported on ArcGIS 10.1 – 10.4.x

http://solutions.arcgis.com/defense/templates/maow/
Underway Replenishment

Using METOC Data to See Effects on Operations
Resources

• Model Access – grib, netCDF
  - NOAA - NOAA Operational Model Archive and Distribution System
    - http://nomads.ncep.noaa.gov/

• Supplemental multidimensional tools
  - www.arcgis.com

• Multi-dimensional applications and tools
  - Github – WMS Multidimensional Esri Viewer
  - Github - ArcPy NetCDF Web Charting Tools
  - Dimension Explorer for ArcMap - http://blogs.esri.com/esri/apl/?s=multidimensional

• Military Aspects of Weather Template – http://Solutions.arcgis.com
Resources
solutions.arcgis.com/defense/templates/geoprocessing-tools

Overview
The Solutions Geoprocessing Toolbox contains specialized geoprocessing models and scripts to support defense and intelligence workflows including:

- Tools for visibility and range analysis
- Tools for analyzing the operational environment
- Tools for data management and coordinate conversion
- Tools for analyzing incidents to find patterns and trends
- Tools for creating operational graphics

Developers interested in contributing can use the solution-geoprocessing-toolbox repository in GitHub. The repository contains the most up-to-date tools built on the most recent version of the ArcGIS Platform. See the README.md for more details.

Requirements
Geoprocessing tool requirements can vary by toolbox. Minimum system requirements for the ArcGIS Platform can be found on the Support website.