Hi-Resolution Local Ecological Marine Units

A workflow for generating a three dimensional mapping of the ocean

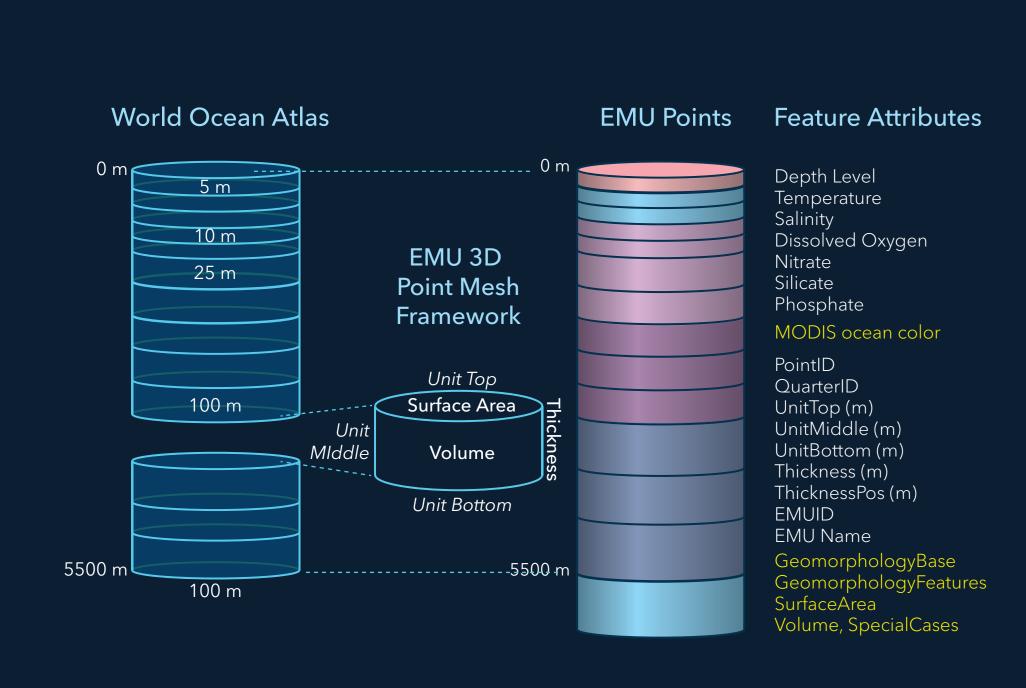


Sayre, R.G., Wright, D.J., Breyer, S.P., Butler, K.A, Van Graafeiland, K., et al., 2017. *Oceanography*, 30(1), doi:10.5670/oceanog.2017.116

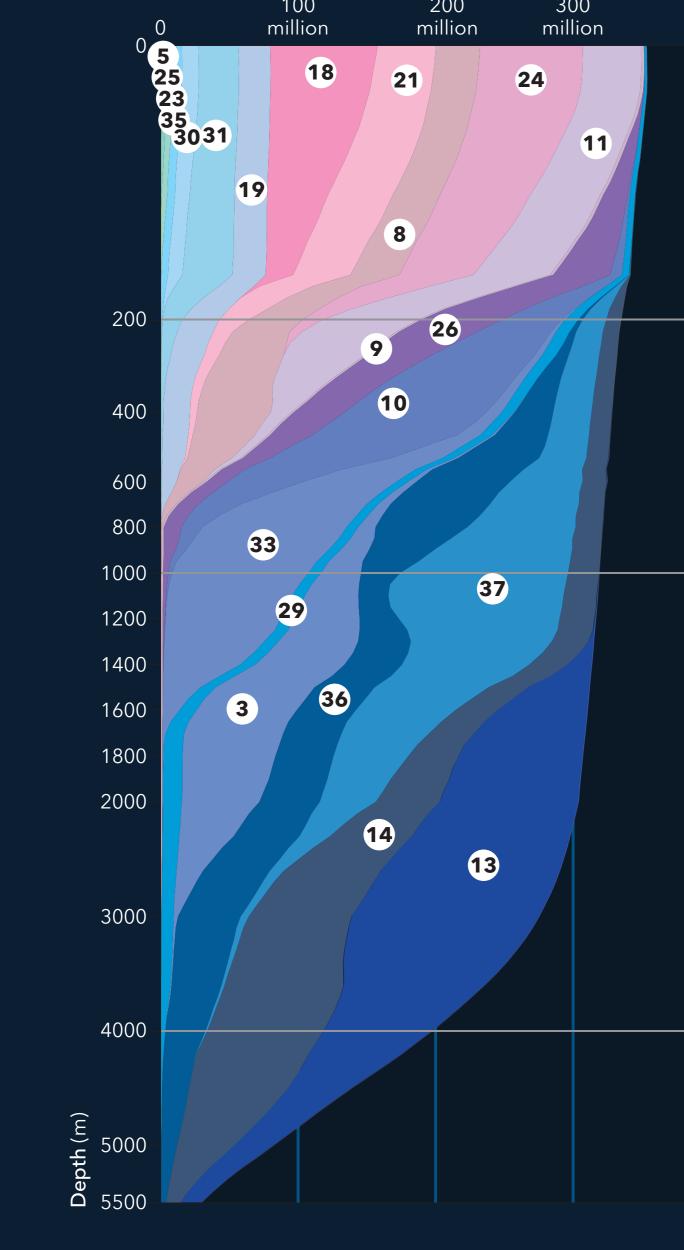
Why?

To maintain a healthy ocean and support sustainability, it is necessary to have a baseline for understanding the ocean's ecosystems and a framework for detecting change.

In support of that goal, Sayre et al. (2017) developed a three-dimensional mapping of the oceans based on physiochemical environmental data and created a database of over 52 million points that depict the global ocean in x, y, and z dimensions. These points were clustered into 37 distinct volumetric region units, called ecological marine units (EMUs).



The horizontal resolution of the EMU mesh is a $\frac{1}{4}$ ° x $\frac{1}{4}$ ° grid (~27 km2 at the equator). In the vertical dimension, mesh points are located at variable depth intervals, ranging from 5 m increments near the surface to 100 m increments at depth. A total of 102 depth zones extend to 5,500 m.



While the EMUs have proven useful in a variety of global scale analyses, Sayre et al. recognize their limitations at other spatial scales stating, "global analyses are useful for macroscale comparisons of ocean regions, local management strategies and policies will require appropriately scaled geographic assessment and accounting units" (p. 91).

This poster describes a workflow that addresses the scalability issues of the global EMU dataset. The workflow shows how to build, visualize, analyze and share highly localized EMUs using data from both NOAA's World Ocean Database and your local in situ observations.

How?

The EMU data set is an open-access resource available in both open data (e.g. an OGC geopackage) and standard commercial GIS formats (Esri file geodatabase).

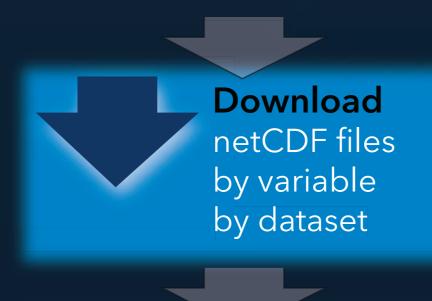
We present a set of preconfigured steps which encapsulate a GIS workflow, a form of guided data analysis, which yields local EMUs.

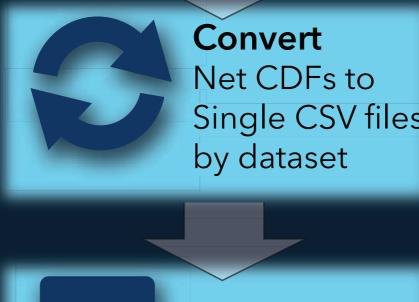
The guided data analysis is flexible and provides measures that promote quality assurance and customization along the way.

Link to Project and Workflow: http://esriurl.com/LocalEMU

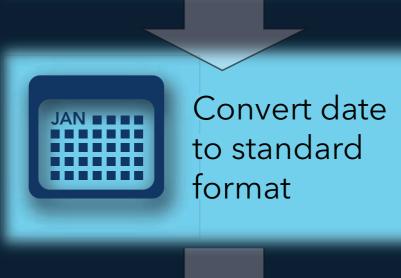
Workflow





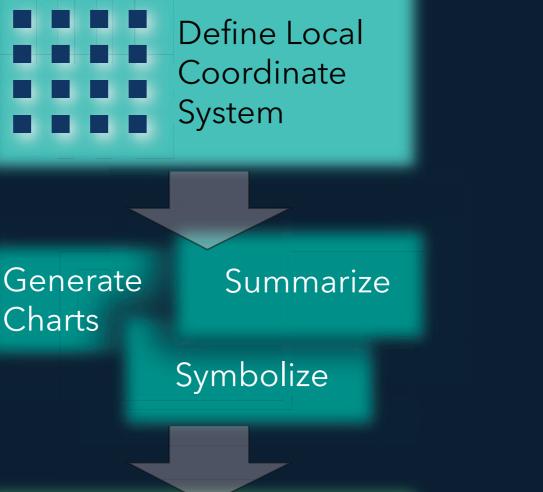






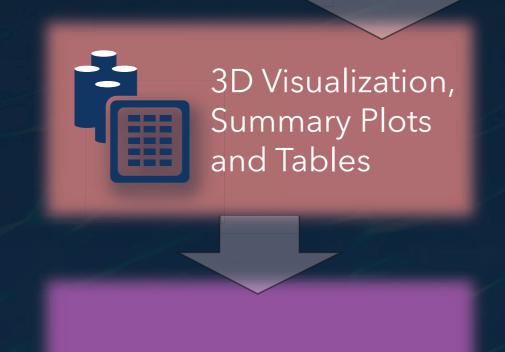












Local EMUs

Create charts for each one of the datasets

Moderate Oxyge

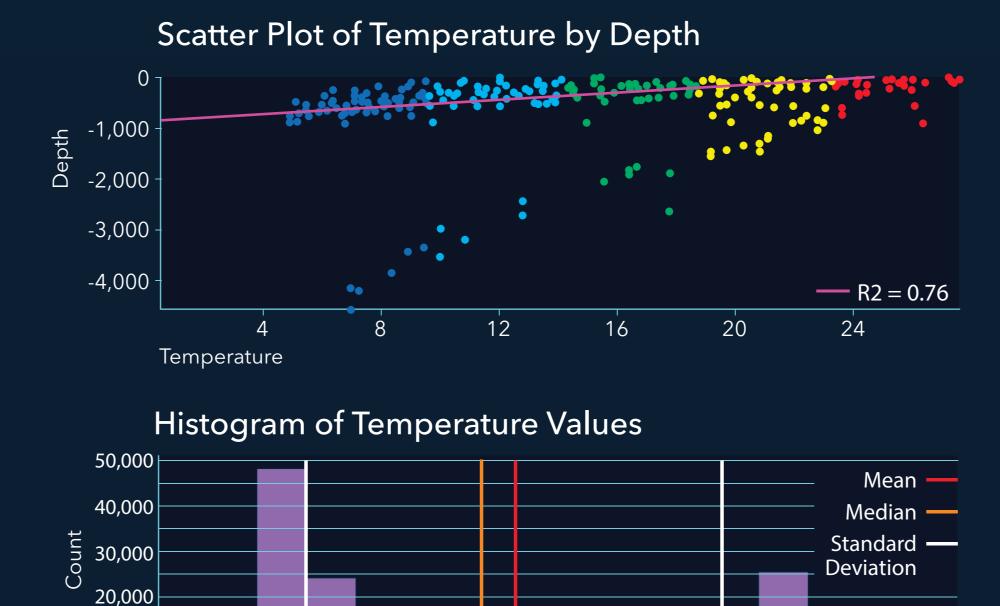


Very Low Oxyger

FINDINGS: Hawaii. 1 x 1 degree area off the west coast of Hawaii.

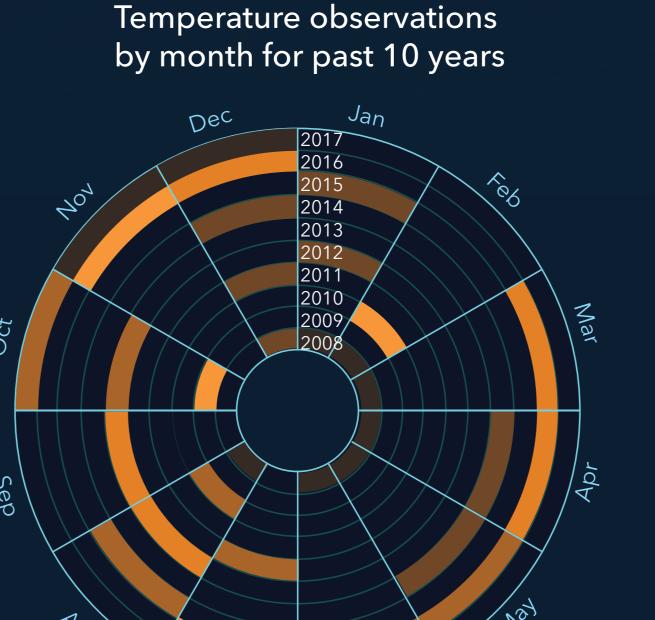
Data were obtained from the NOAA World Ocean Database through NOAA Select. In this workflow individual netCDF files are converted to a single feature class with attributes representing the sampled variable. Depth information is also translated to corresponding z values in the feature class.

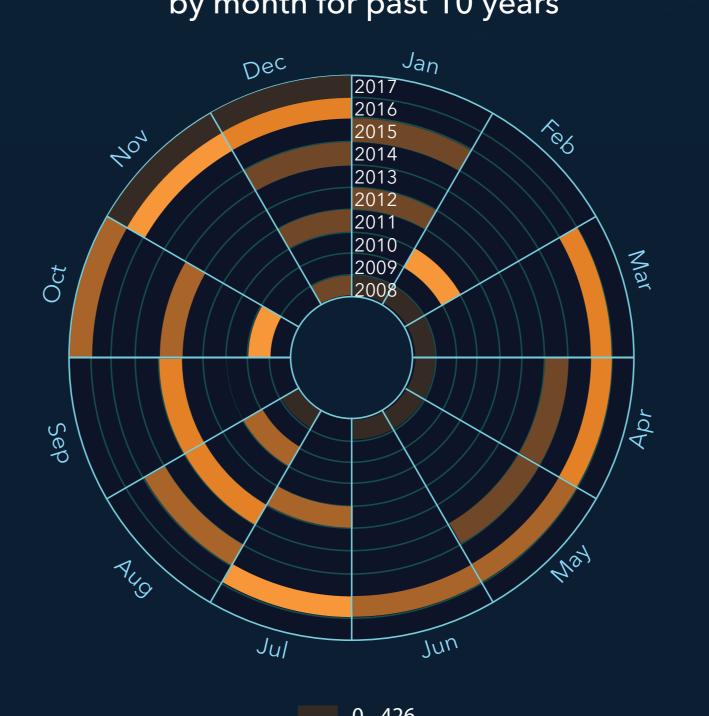
These observations were taken at depths ranging from the surface to 4,572 meters between the years of 1928 and 2017. Nearly a century of data!



Project coodinate system: UTM Zone 5N Number of global EMU's within the Study Area: **16**

Number of different EMU classifications: 9





426 - 1,494

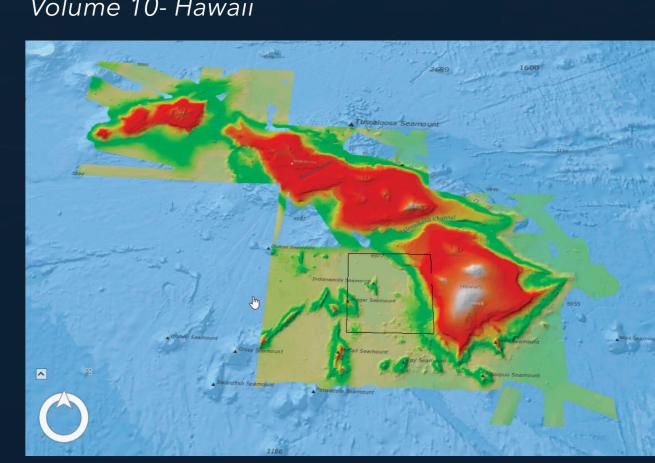
1,494 - 3,240

3,240 - 6,842

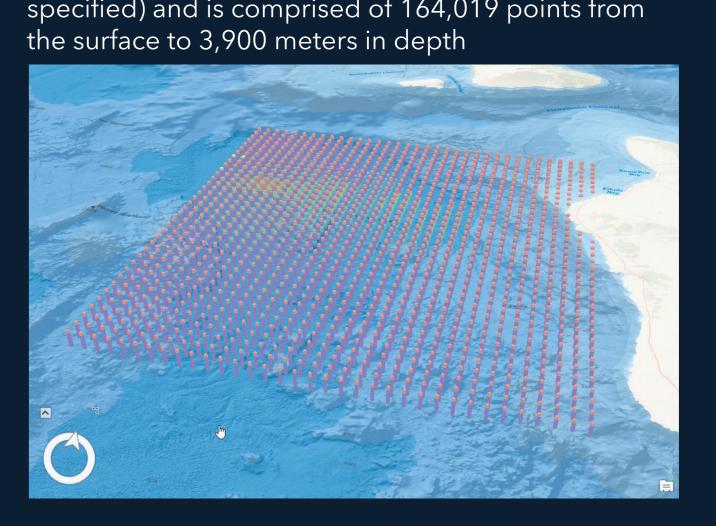
6,842 - 16,163

We were also able to incorporate elevation (depth) data from NOAA's Coastal relief modeling to help

https://www.ngdc.noaa.gov/mggcoastal/crm.html



This particular point mesh has a 25 square kilometer norizontal cell size (user specified) using the WOA specified) and is comprised of 164,019 points from

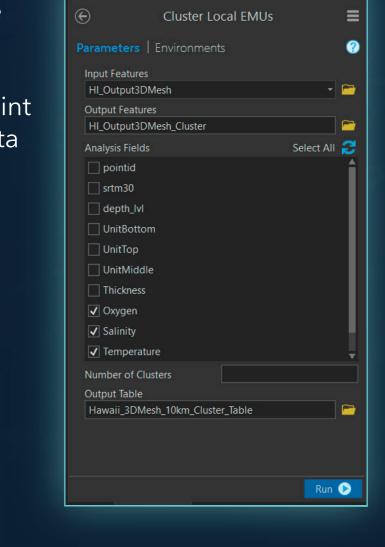


Now the temperature, salinity, and oxygen observations can be used to interpolate those values to the 3D point mesh.

Once the values are interpolated to the 3D Point Mesh, clustering can be used to group the data based on attribute values.

> In this scenario the software decides the appropriate number of clusters (after data valuation). From here a table and supporting graphics can be generated showing the

In this example we classified based on temperature, oxygen and salinity. 29 clusters were determined.



Data can be symbolized using Cluster ID

FINDINGS:

In this example we used the

Oxygen (203)

workflow to help understand

Temperature (228,475)

and **Salinity** (80,227)

Santa Barbara

In this example, the grid is not dense enough, and we want to cluster with

Project coodinate system: UTM Zone 10N

Number of global EMU's within the Study Area: Number of different EMU classifications:



Counts of EMUs within the Study Area

Top 3 Prominent

Southern California.

Number of Observations

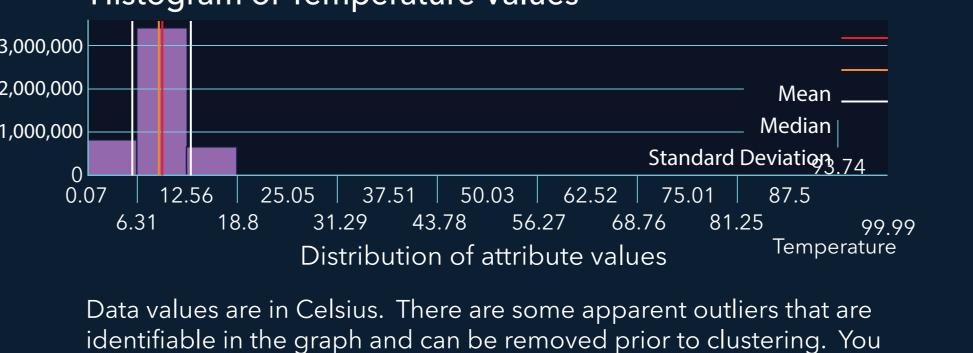
Temperature: **4,983,203**

Salinity: 2,953,802

Moderate Depth Normal Salinity, Very Low Oxygen High Nitrate, Low Phosphate

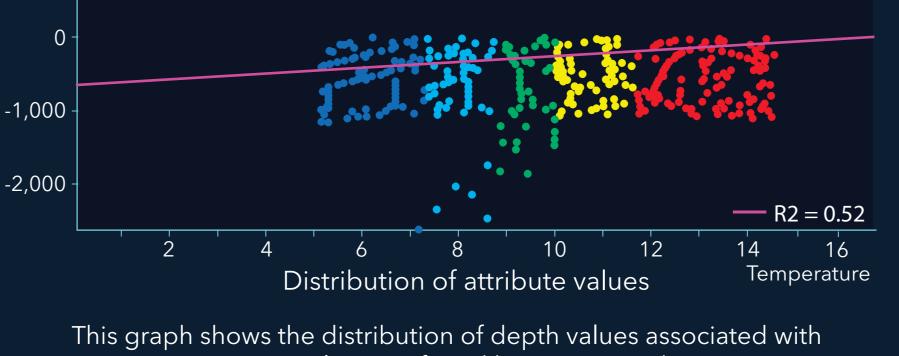
Use charts to help identify

Histogram of Temperature Values

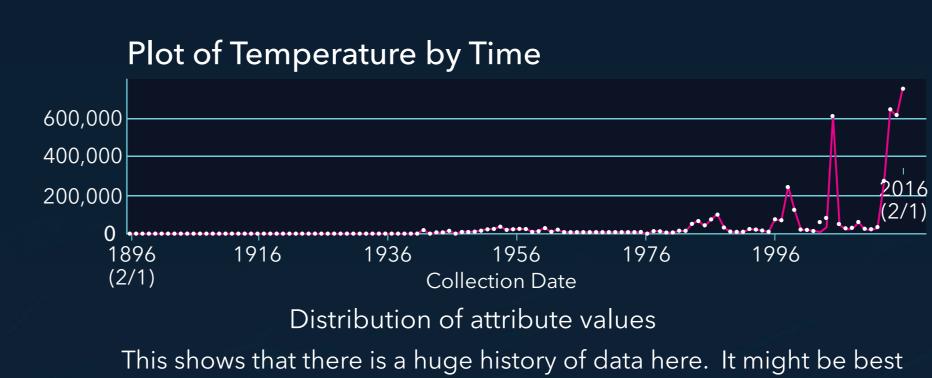


have the ability to trace these outliers back to the source dataset.

Scatter Plot of Temperature by Depth



temperature. Most values are found between 0 and 1,400 meters. You have the ability to interact with the data and identify which values in the graph correspond with the spatial locations in the map



to focus or work with the most recent data, collected within the last 30

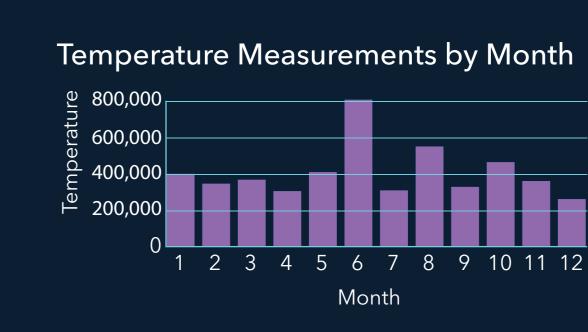
Use convert time field to add months as an attribute to the table (converted from Date)

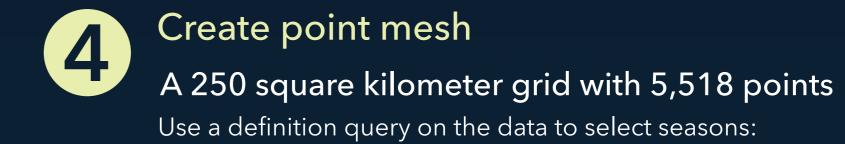


Salinity Measurements by Month







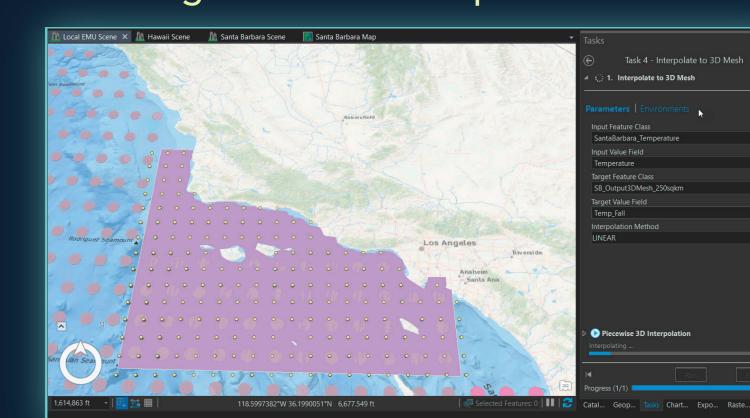


https://www.timeanddate.com/calendar/aboutseasons.html SQL Query = Sample Month IN (3, 4, 5) for SpringSQL Query = Sample_Month IN (6, 7, 8) for Summer SQL Query = Sample_Month IN (9, 10, 11) for Fall

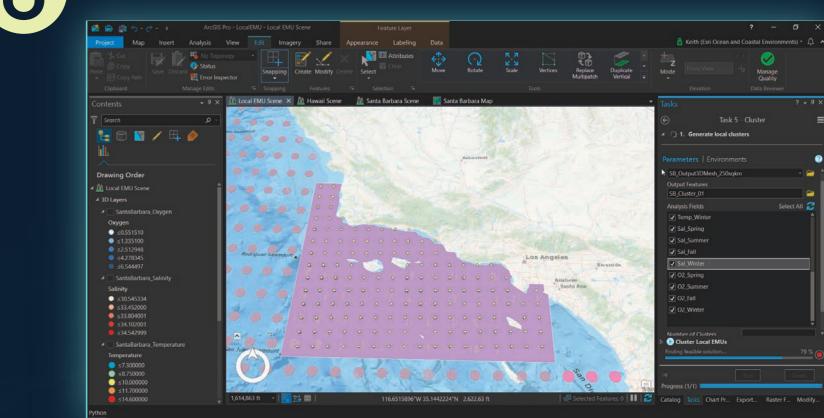
SQL Query = Sample_Month IN (12, 1, 2) for Winter

3 values: Temperature, Salinity, Oxygen, by 4 Seasons

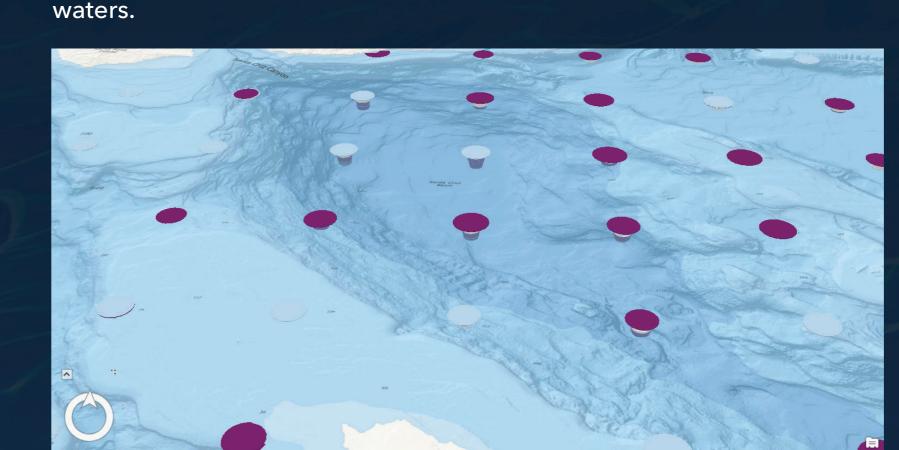




Cluster using the 12 attributes







The distinct surficial water masses are merging around Point Conception, and this is noticeable. The cooler water from the north is colliding with the southern waters and mixing in this region.



