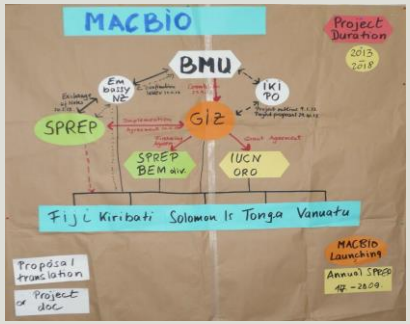
GIS @ MACBIO

Marine and Coastal Biodiversity Management
in Pacific Island Countries



SPREP Secretariat of the Pacific Regional Environment Programme

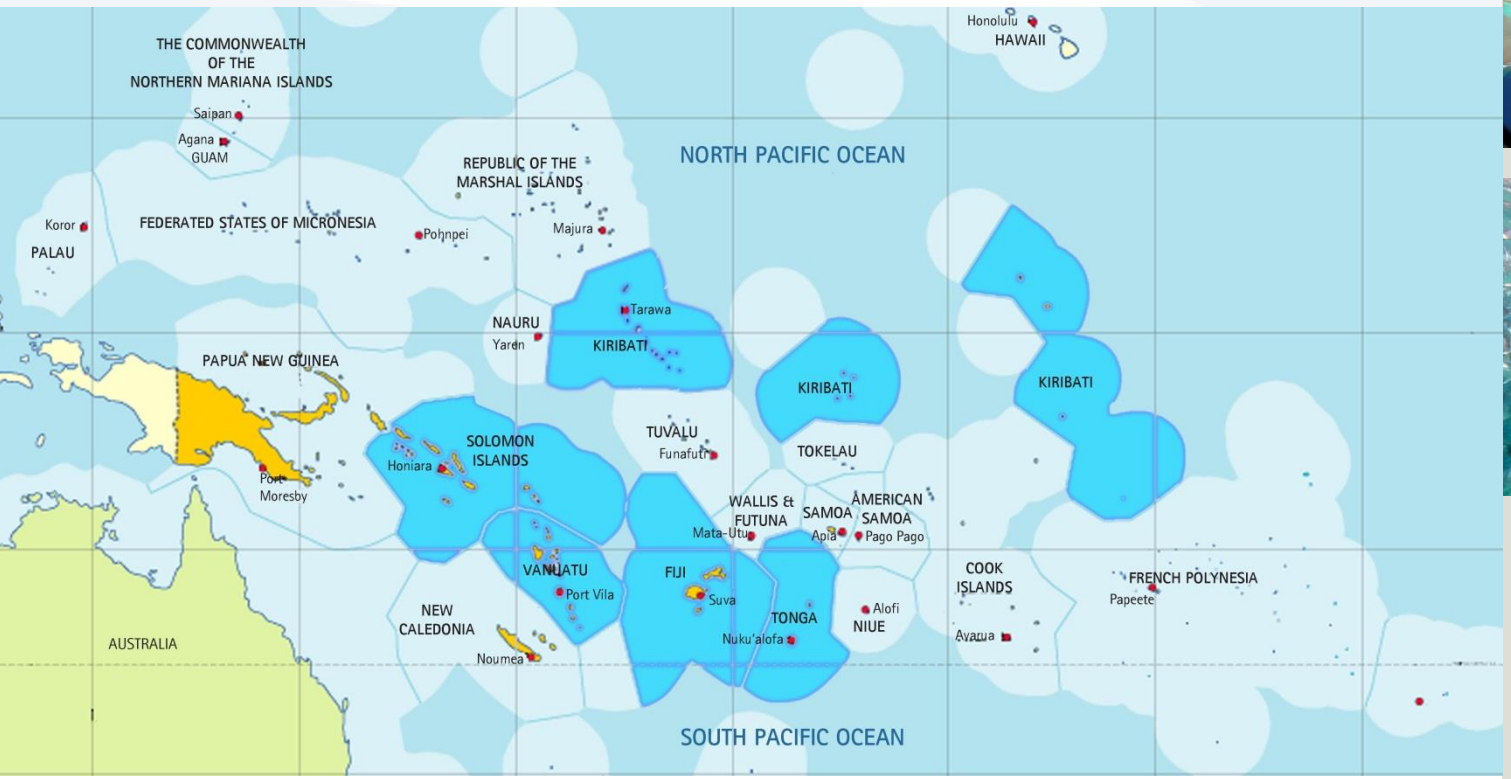
IUCN

giz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
of the Federal Republic of Germany

Objective

To strengthen the sustainable management and conservation of marine and coastal biodiversity in five Pacific Island Countries (Fiji, Kiribati, Solomon Islands, Tonga, Vanuatu)



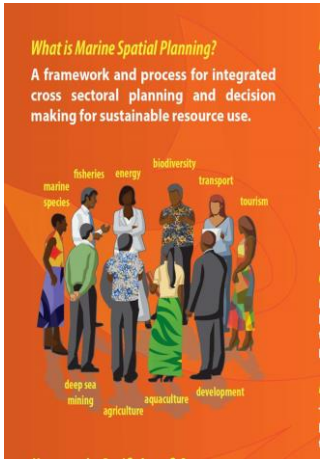
06/2013 – 05/2018

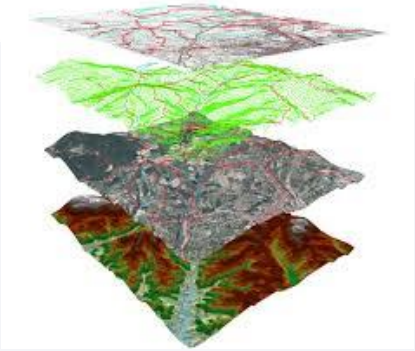
€ 8.1 Mio BMUB

Project component - Marine Spatial Planning

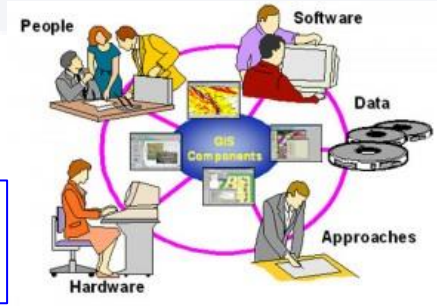
1. **Economic valuations** of marine + coastal ecosystem services
2. **Marine spatial planning**
3. **Effective** approaches to **site management** (MPAs and locally managed marine areas)

Marine Spatial Planning (MSP)





GIS



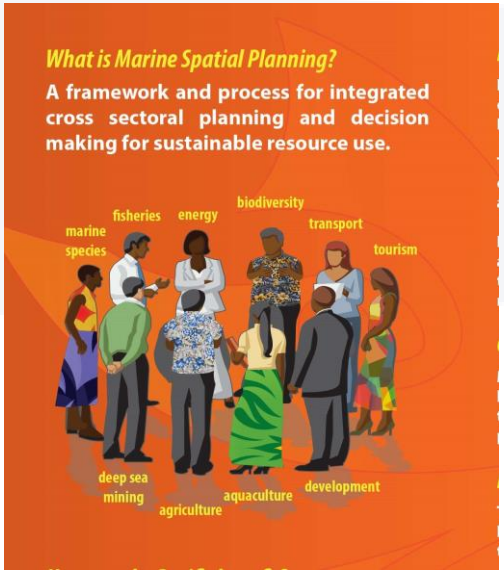
GIS Elements

- Support Governments with marine mapping and GIS needs
- Identify marine and coastal data
- Assist to compile and consolidate data.
- *Transform data into suitable spatial format for MSP*
- Provide hands-on training: in-country - capacity building (QGIS)
- Coordinate with other projects in-country

<u>Spatial data sources:</u>

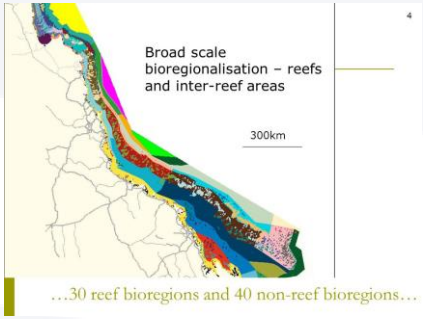
- <u>Government/NGOs (closed) and</u>
- <u>Regional/Global data sources (open)</u>

Marine and Coastal Data



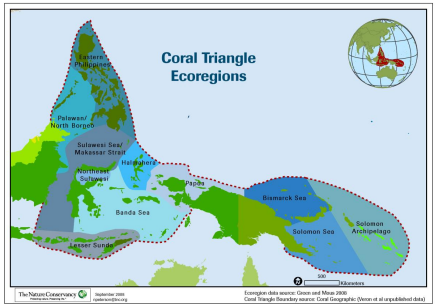
Current project – Marine Classification

- **Building marine zones or regions**
- **Classification: using best available biological and physical information**
    - *E.g Species and habitat diversity (comprehensive)*
    - *<u>Environmental conditions</u>: SST, depth, salinity, dis. oxygen, chlorophyll, etc.*
    -



Why?

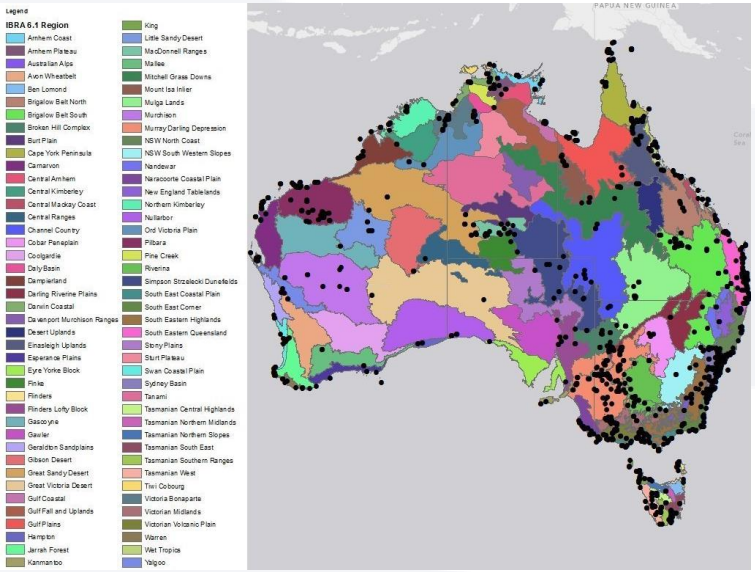
- Current efforts to prioritize new marine conservation areas have been hampered by:
    - Lack of detailed, comprehensive biogeographic systems to classify oceans
    - Conservation is opportunistic and where there is data



Example

1. IBRA - Interim Biogeographic Regionalization for Australia

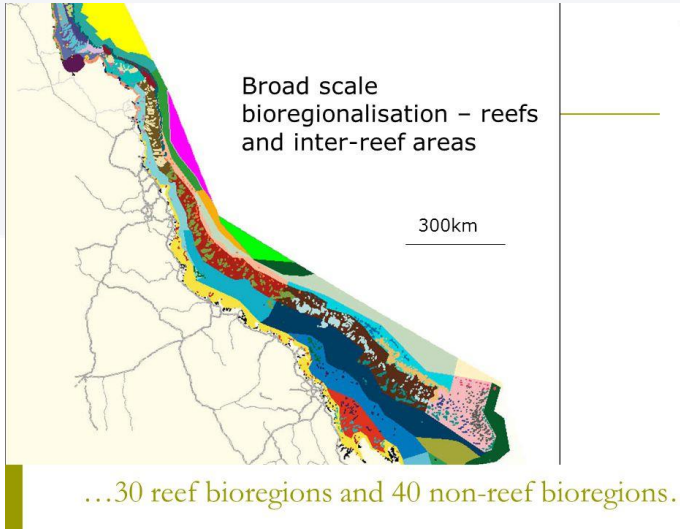
- used land-based approach to classify land surface, incl. attributes of climate, geomorphology, and flora/fauna information.
- Endorsed by Australian government as a key tool for identifying land for conservation under *Australia's Strategy for the National Reserve System 2009-2030*.



https://www.environment.gov.au/land/nrs/science/ibra

2. Rezoning the Great Barrier Reef Marine Park

- There were 30 reef and 40 non-reef classes
- Process led to the protection of representative habitats - > 30% protection of GBR
- Involved participatory planning – recognized as “world best practice”

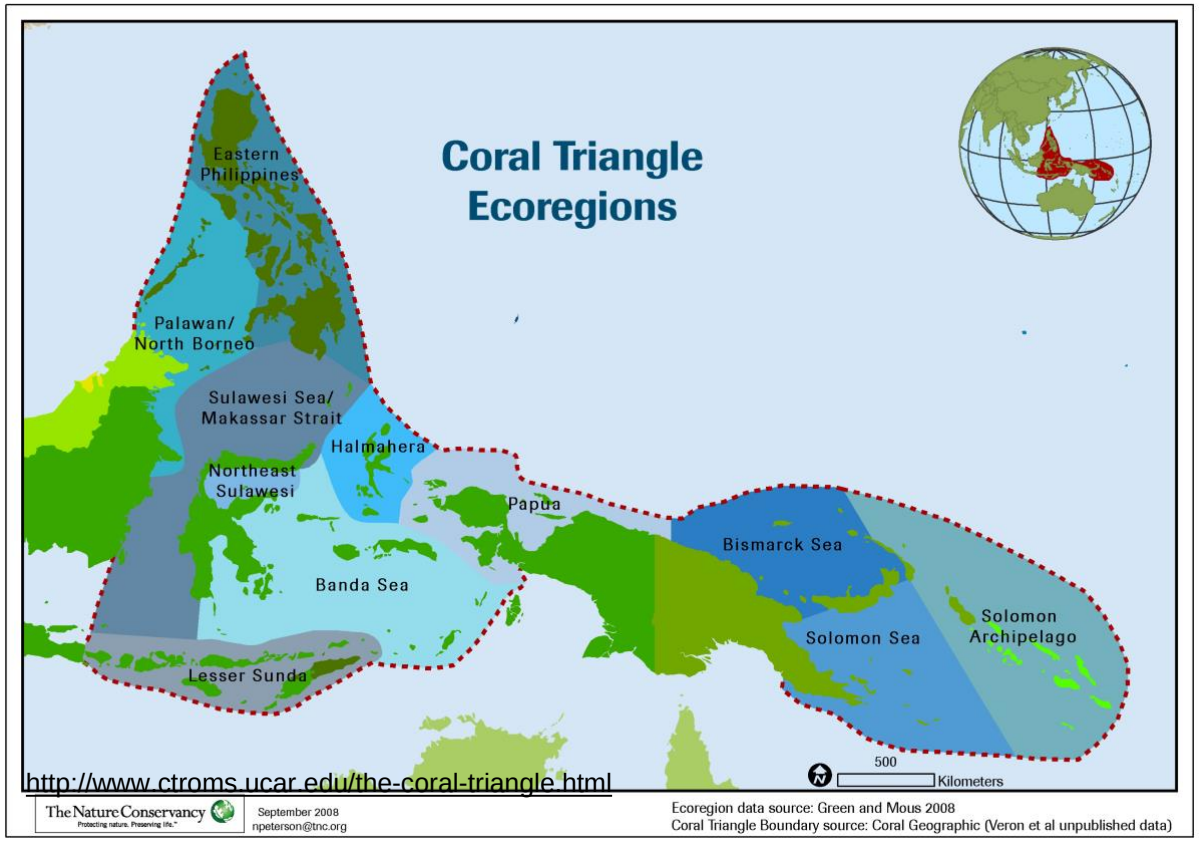


http://www.gbrmpa.gov.au/

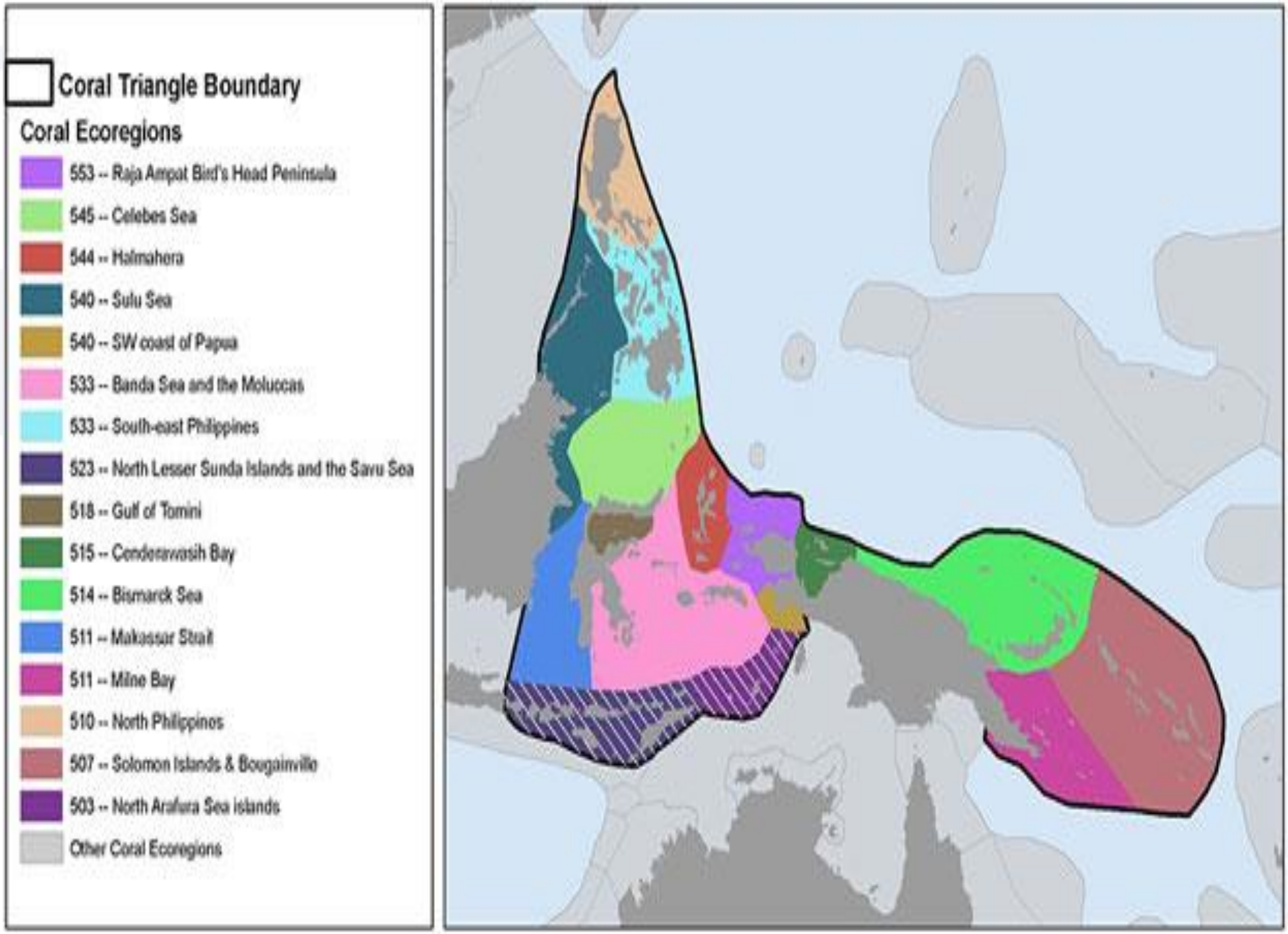
Example

3. Coral Triangle Initiative – Ecoregions

- define "geographically distinct assemblages of species, natural communities, and environmental conditions".
- There were eleven defined ecoregions.



http://www.ctroms.ucar.edu/the-coral-triangle.html

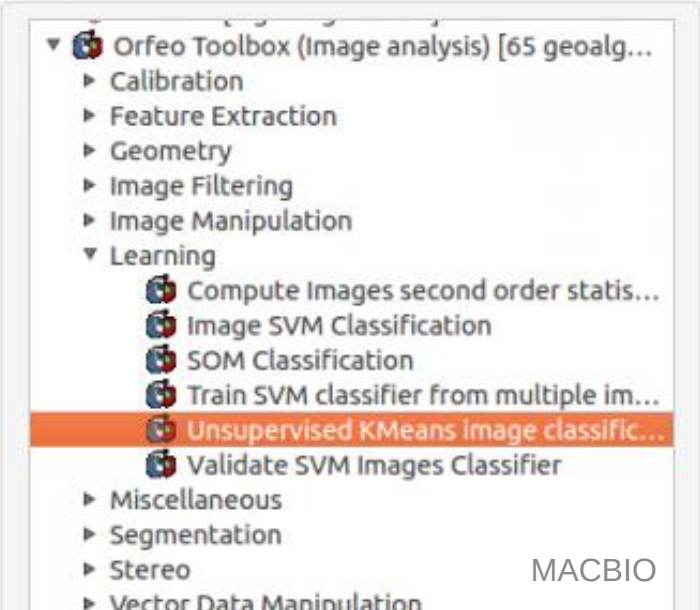

Coral Triangle Boundary
Coral Ecoregions
553 -- Raja Ampat Bird's Head Peninsula
545 -- Celebes Sea
544 -- Halmahera
540 -- Sulu Sea
540 -- SW coast of Papua
533 -- Banda Sea and the Moluccas
533 -- South-east Philippines
523 -- North Lesser Sunda Islands and the Savu Sea
518 -- Gulf of Tomini
515 -- Cenderawasih Bay
514 -- Bismarck Sea
511 -- Makassar Strait
511 -- Milne Bay
510 -- North Philippines
507 -- Solomon Islands & Bougainville
503 -- North Arafura Sea islands
Other Coral Ecoregions

HOW??

- Using GIS? ***QGIS, ArcGIS***
- Unsupervised classification – *(groupings of pixels with common characteristics)*

  - QGIS - Processing algorithm under the Orfeo Toolbox.

Start up QGIS and add your layer stack to the project. We will need this later on to interpret the classes afterwards. Now open up the SEXTANTE toolbox and go the *Learning* section of the Orfeo Toolbox and double click on *Unsupervised KMeans image classification*:



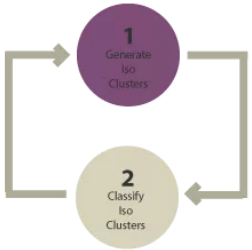
ArcGIS - Calculate the clusters, then assign classes

Unsupervised Classification in ArcGIS (iso-clusters)

Unsupervised classification remote sensing does not provide sample classes. The user identifies how many classes to generate and which bands to use. The software then clusters pixels into the set number of classes. The user then identifies the land cover classes.

Unsupervised Classification Steps:

- Generate clusters
- Assign classes



Unsupervised Classification Diagram

Step 1: Activate Spatial Analyst Extension

The first step is to activate the spatial analyst extension in ArcGIS (customize>extensions>spatial analyst).

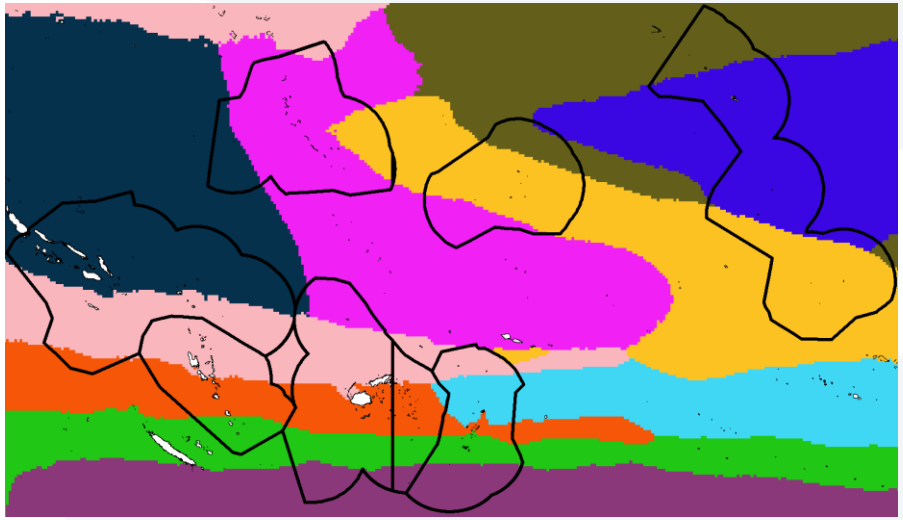
Step 2: Generate clusters

This unsupervised classification example uses the iso-clusters unsupervised classification method (spatial analysis tools>multivariate>iso clusters).

Input: The image you want to be classified.
Number of classes: The number of classes generated during unsupervised classification should be about 10 times the number of bands in your image. For example, if you are working with multispectral red, green, blue and NIR bands, then the number here will be 40 (4 classes x 10).
Minimum class size: This is the number of pixels to make a unique class.

When you click OK, classes will be formed based on your input parameters. But they still need to be identified which land cover classes they are.

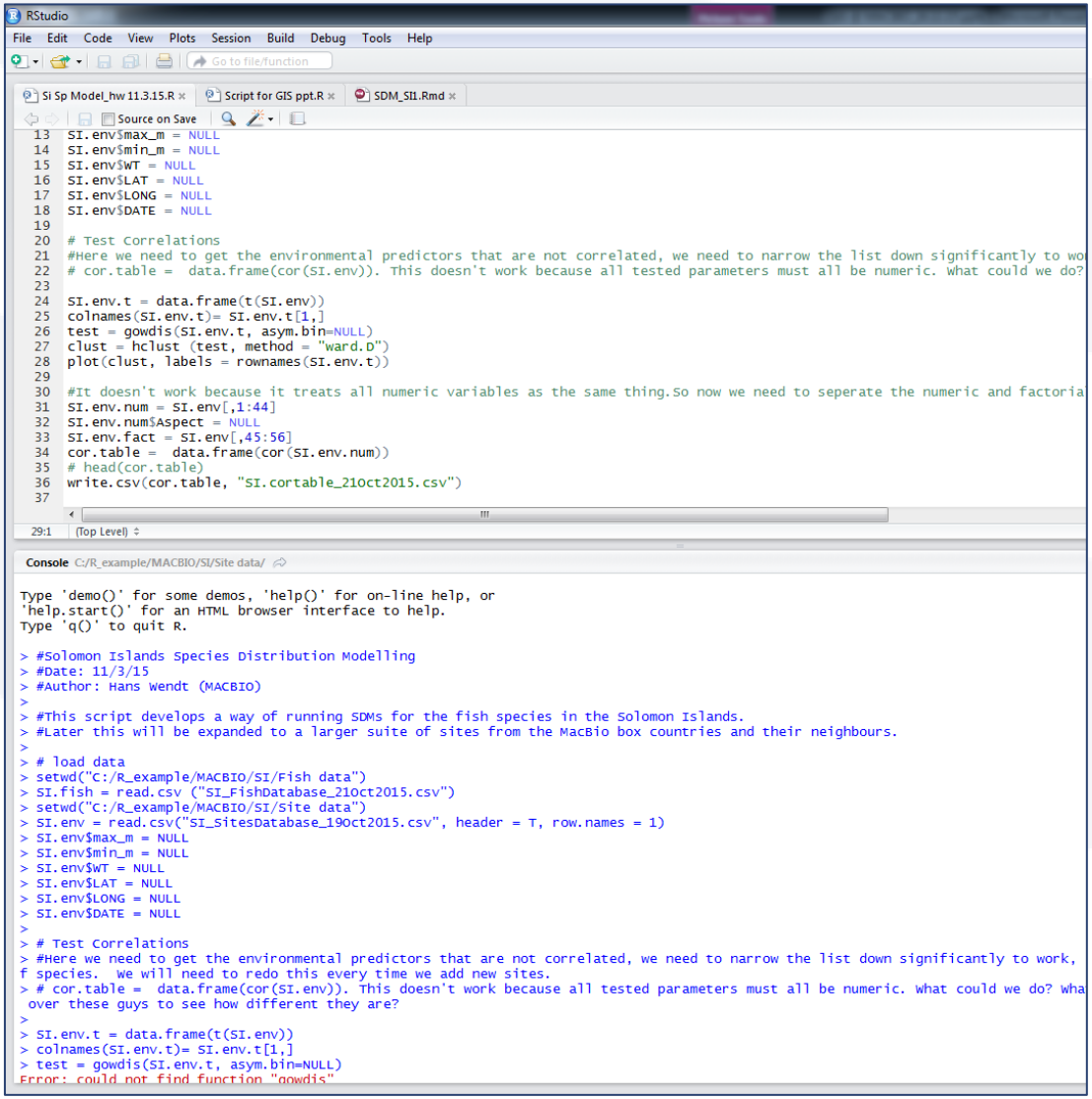
ArcGIS



Issue in GIS – it crashes with big data

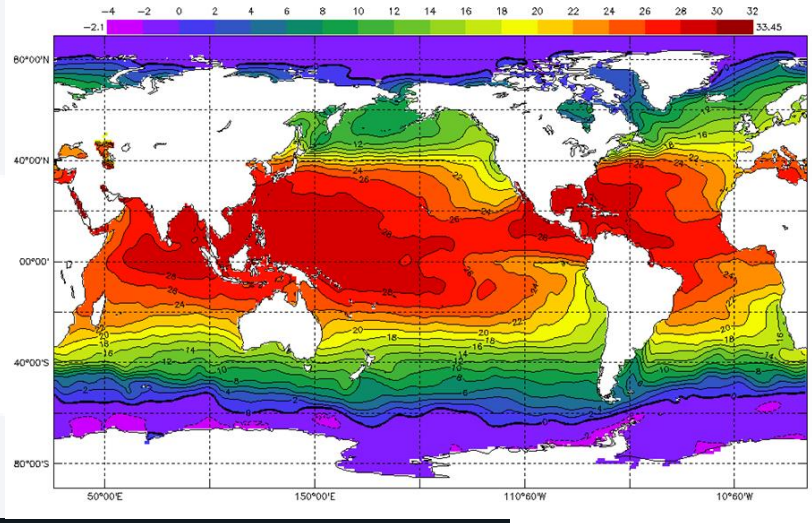
MACBIO - We use “R” Software

- Why R?
  - Open-source
  - Specialised stats software for statistical analysis and modelling
  - Handles large data size
  - Customization



Example scenario – open sourced data

- Data processing in QGIS/ArcGIS
- Input data into “R”
  - Environmental variables.csv
  - Species and modelling



RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Si Sp Model_hw 11.3.15.R | Script for GIS ppt.R | SDM_SI1.Rmd

Source on Save

```
#Script for 20km Grid of environmental data

#A)set a working directory and load data
setwd("C:/R_example/20kmgrid")
Envdata = read.csv("20kmGrid_Data.csv", header = TRUE)
```

R-Stats analysis

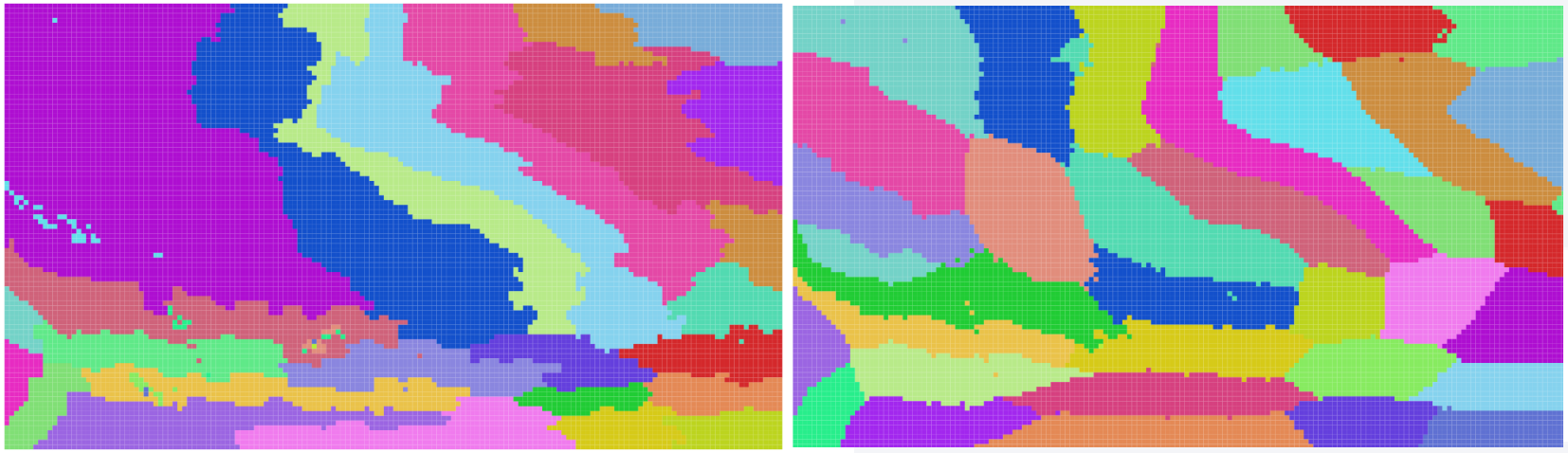
- Correlation test
  - correlation matrix for all pairs of parameters
  - Model testing

- Similarity and Cluster analysis
  - run a cluster analysis and similarity check
  - similarity = dist(newdata,method = "euclidean")
  - compare = hclust(similarity)

- Grouping of similar features
  - E.g. 10 or 30 classes
  - Main difference in scale of data

Output

- E.g. Marine zone classes for 20km



<u>Concluding remarks</u>

- Data input drives the degree of certainty of classification
- Output from marine classification provides biophysical basis – 1 of many layers for MSP process

Vinaka!

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