

Remote Sensing and GIS of the Marine Environment

Overview and goals

This course provides an overview of all fundamental Remote Sensing science concepts, including notions about the electromagnetic spectrum and the interaction of the electromagnetic radiation with the atmosphere, water and different targets. It also gives an insight on the different type of sensors, satellites and current applications of remote sensing. It then goes into the aspect of image acquisition, processing and analysis with particular attention to image visual interpretation and supervised and unsupervised classification methodologies. Accuracy assessment concepts and methods are also presented as an essential aspect. The final part will focus on the application of Remote Sensing and GIS to marine science topics including habitat identification and fauna and flora abundance assessment and mapping. Each section is followed by practical exercises, part of a complete real case study during which the students will put into practice the concepts learned to create maps of marine habitats from visual interpretation of aerial images of the Marine Protected Area, to investigate the interaction with flora and fauna diversity and abundance distribution assessed during the field surveys and to estimate the accuracy of the final product using ground truth data collected on the field.

Detailed contents

Lesson 1 - Introduction to remote sensing

- Definition
- Electromagnetic radiation
- Visible spectrum
- The infrared
- The microwave region
- Interactions with the atmosphere
- Radiation-target interactions
- Reflection
- Spectral response

Passive and active sensors
Digital images
Image bands
Spatial resolution
Spectral resolution
Radiometric resolution
Across-track scanning
Along-track scanning
Light in water
Sensors and satellites
Weather satellites
Land Observation Satellites
Ocean/marine applications
Coastal Zone Colour Scanner
SeaWiFS
MERIS
Synthetic Aperture Radar (SAR)
MODIS
Oil spill detection
Sea Surface Temperature
WorldView-2

Exercise 1 Georeferencing an aerial image of the Marine Protected Area

Lesson 2 – Image processing and visual interpretation

Introduction
Pre-processing
Image enhancement
Sun-glint removal
Image transformations
Principal component analysis
Normalized Difference Vegetation Index
Visual Interpretation
Shape, size, Pattern, Tone, Texture, Shadows, Association
Tone example
Pattern Example
Texture example
Image interpretation process

Exercise 2a Pre-processing of the aerial image of the Marine Protected Area

Exercise 2b Visual interpretation of habitat types

A guide to the habitats of Capo Rizzuto Marine Protected Area

Lesson 3 – Image classification

Objective

Methods: supervised and unsupervised classification

Signatures in the supervised classification: training areas

Signatures in the unsupervised classification: clustering

Maximum Likelihood classifier

Classification in ArcGIS

Generalization

Exercise 3 Classification of an aerial image of the Marine Protected Area

Lesson 4 – Accuracy assessment

Introduction

Sampling design

Data collection on site

The confusion matrix

Producer and user's accuracy

The Kappa coefficient

Habitat mapping along the coast of Mallorca (balearic Islands) using Ikonos images

Coral Reef Ecosystems mapping in the Pacific Ocean

Benthic vegetation mapping in Wallis lake Australia using Landsat images

Exercise 4 Accuracy assessment of habitat identification with field surveys

Lesson 5 – Habitat Suitability

Habitat definition

Habitat parameters
Bathymetry
Slope
Aspect
Rugosity
Bathymetric Position Index
Substrate type
Suitability modelling
Binary models with multiplication
Ranking models with additions
Rating models
Weighted rating models
Map algebra
Map algebra operations: Scalar, Transform, Overlay, Combine

Exercise 5 Habitat suitability

Lesson 6 – Benthic cover, marine fauna and flora mapping

Species abundance
Quadrats
Transects
Photographic methods
Visual census
Biodiversity
Species richness and evenness
Biodiversity index
Simpson Index

Exercise 6a Mapping of the benthic cover along a transect

Exercise 6b Mapping the distribution and abundance of marine fauna and flora

Further Information

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