Image Analysis and Spatial Statistics (IASS) - Spring 2016 ROBEX online course

Week 2 – Marine science

Marine Science Week 2: Generating numbers from marine images using 'Papara(ZZ)l'.

Commonly in news reports on the ocean we may be shown an image of a washed up whale dying on a beach, or perhaps a bird trapped in oil on a beach after an oil spill. Whilst these images convey an image to really understand what is going on we need to consider the images in context. The current reports of dead whales washed up on European beaches can be compared with historical records: photographs taken of the same beaches in the past. The numbers of birds trapped within oil after an accident can only be accurately estimated after many images of oil spill have been examined and the densities of birds across a coast gauged. Possibly, a high density of trapped birds in one area is not repeated elsewhere on the coast. These questions can have both scientific and legislative interest.

Some concepts for comparing 'counts'

Much marine research focuses on investigating areas of the seafloor (or water column) and quantifying, or counting, what fauna are there. Some areas of the deep sea seafloor visited by robots such as those under design within the ROBEX community, are 'extreme ecosystems' where chemical or hydrodynamic conditions can change on short spatial and temporal scales. A good example of these are the 'black smokers' – volcanic vents in the deep sea erupting a range of hot fluids. Some species, such as vestimentiferan tubeworms and some shrimp, can utilize the material (or the bacteria living on the material) erupting from these vents. Because of this adaptation, photographs showing areas of the seafloor close to a vent may have far more of these associate species present within it than a photograph of a comparably sized area of seafloor more distant from a vent.

Another current topic of interest within the applied marine sciences is how the impact of man may be felt on the deep sea seafloor (both spatially and temporally) following an anthropogenic event, such as the drilling of an oil well or the extraction from the seafloor of a surface resource, such as gravel or Manganese nodules. To gauge this, areas of the seafloor should be imaged before, during and after human activity, and fauna counts logged over time. The distance from the disturbance and the level of impacts can also be investigated by taking repeated samples (i.e. taking photographs) at intervals from the epicenter (i.e. middle of impact, such as point of oil well drilling).

For a general understanding of species' distribution, counts of individuals are needed, both spatially, and to capture behavioural changes (such as diurnal migrations), temporally.

How to turn image data into numerical data

Depending on the research question, you may want to determine areas of an image characterized by a particular feature or fauna, or you may simply want to count the number of individuals of each taxa present in an image. For this weeks task, we will start with this – we will work through two sets of images, and log all the individuals of each particular taxa in each. To do this, we will use the 'Papara(ZZ)l'

software installed last week (or follow the website link if you have not already downloaded this softward.

The DISturbance and reCOL (DISCOL) experiment

Today high-tech items such as mobile phones and laptops require a number of rare, 'high tech' metal elements for their construction. These elements can be limited in supply and many of the land based sources of these are producing progressively more expensive ores. In response to this, other sources have been sought, and potentially MANGANESE NODULE FIELDS (areas of deep sea seafloor >4km deep) are one such source. In these regions nodules are scattered across the muddy seafloor and given the correct (not yet fully realized!) technology, these nodules may be collected.

These nodule areas are poorly studied. They are interesting from a biological point of view as they are a mix of soft sediment (the deep sea mud) and hard ground (the nodules). This provides a mix of habitat niches unusual on the deep sea seafloor.

26 years ago the concept of potential nodule extraction was first raised, and in response to the this a 6 km diameter area of the Pacific seafloor in the Peruvian basin was ploughed 70+ times with an 8 m wide plough. This plough forced into the sediment the majority of these nodules, removing the hard substrate. During the following 7 years scientific cruises revisited the site and photographed the seafloor, to record how fauna recolonized the trawled areas. These analyses are outlined in 'Bluhm, 2001' – a paper available to download from this weeks webpage.

Last year, with advanced towed camera systems and a Remote Operated Vehicle (ROV) the location was revisited and areas of ploughed seafloor imaged, along with areas of unploughed seafloor. By comparing the numbers of each taxa in these ploughed areas and unploughed areas it is hoped that an idea of the length of seafloor recovery can be estimated, and conclusions made as to whether or not all fauna recover at the same rate following such exploitation.

By following the tasks below, you will have the chance to investigate these interesting questions!

Marine science tasks this week:

1. Download and install 'Papara(ZZ)I' if you have not done so, from https://github.com/PAPARA-ZZ-I/PAPARA-ZZ-I
2. ..The usermanual for 'Papara(ZZ)I' may also be downloaded from the above site.
3. Download and read 'Bluhm, 2001' – this paper gives an overview of the science being investigated in this work.
4. Download 'SO242-2-shortreport.pdf' for a brief overview of the research cruise.
5. Download 'Iass_week2_discolfaunaguide.pdf' – this .pdf shows all the main fauna from DISCOL, and you can use it in your analysis.
6. Download the 'iass_week2_discol_listofkeywords.txt' file.
7. Download and unzip 'track_-_35' and 'nontrack_-_35' files. These each contain 35 images from the ploughed and unploughed regions.

8. Run ‘Papara(ZZ)l’, select the ‘track_-_35’ or ‘nontrack_-_35’ folders.
9. Load the ‘iass_week2_discol_listofkeywords.txt’ file.
10. Go through each image, labelling whichever fauna or features you can (the guide may be useful here). Label anything you cannot identify as ‘indeterminate’. YOU CAN TURN THE PC OFF WHENEVER YOU WANT AND RETURN AGAIN TO WORK AT ANOTHER TIME, JUST REMEMBER TO SIGN IN AS THE SAME USER!
11. After you have gone through all the images – hit ‘Export Summary Results’.
12. Repeat the process with the other image set.

This is the main work for this week! We will analyse and compare our results next week!

Please email me on: autun.purser@awi.de if you have any problems!