

# investigating the effect of depth on species connectivity and distribution in the deep sea

*Nils Piechaud, Nicola Foster, Rebecca Ross, Michelle Taylor, Alex Rogers, Kerry Howell*



**RESEARCH  
WITH  
PLYMOUTH  
UNIVERSITY**



Introduction:

The cruise

- Scientific Goal
- background

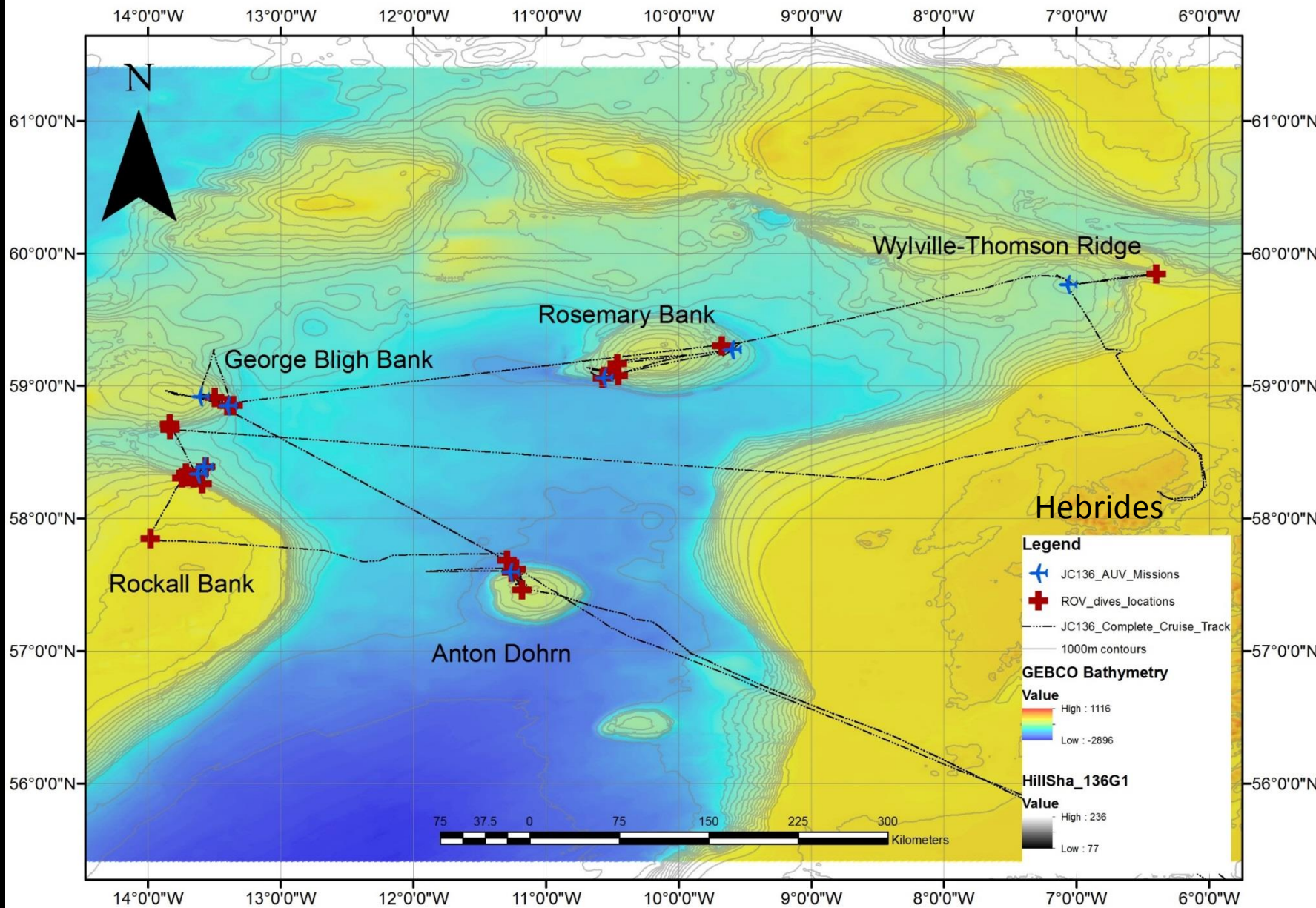
Results

Involvement of the MAS fleet

- Isis
- Autosub
- others

conclusion





40 days

2 legs

27 scientists

71 stations

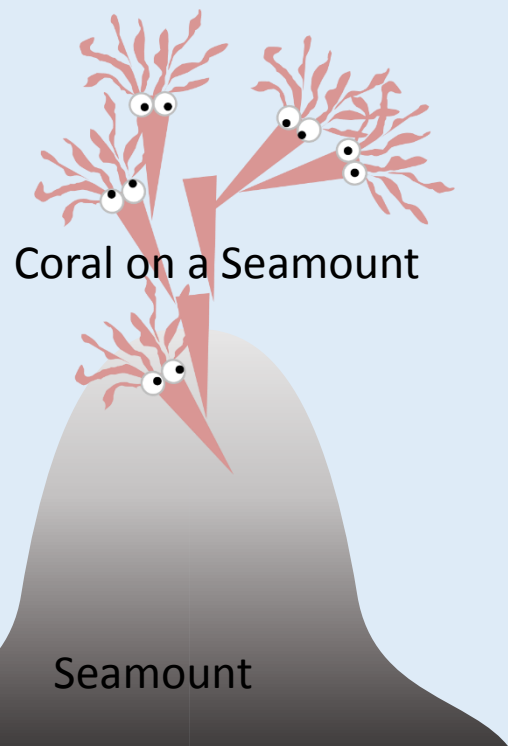


### The DeepLinks project Hypothesis are:

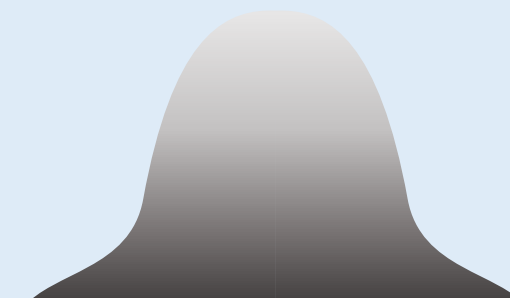
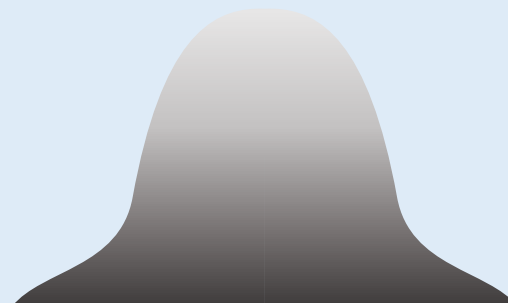
- **H1:** Population connectivity varies with depth
- **H2:** The decrease in connectivity is correlated to current flow, as predicted by hydrodynamic models.
- **H3:** Hydrodynamic model predictions can be used for conservation planning

connectivity: exchange of individuals among marine populations

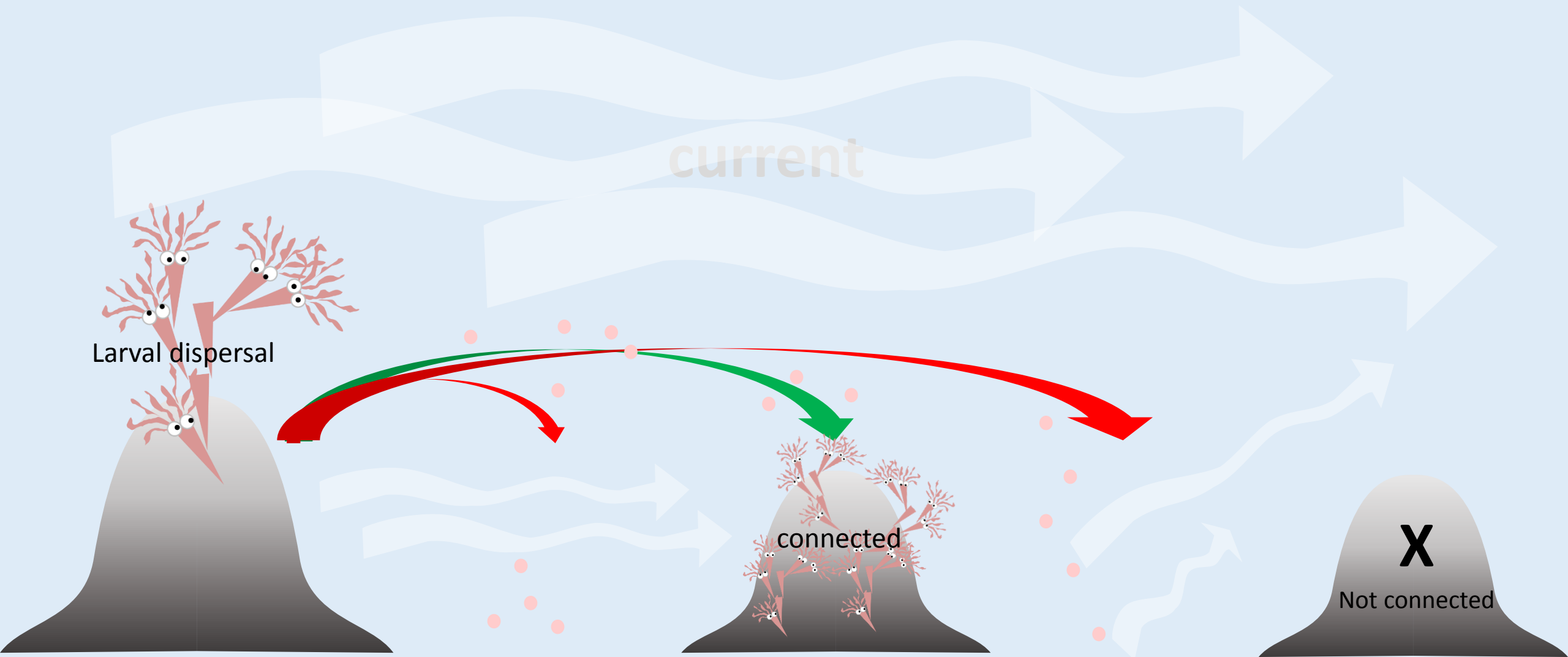
most of the deep sea animals are virtually unable to move over great distances

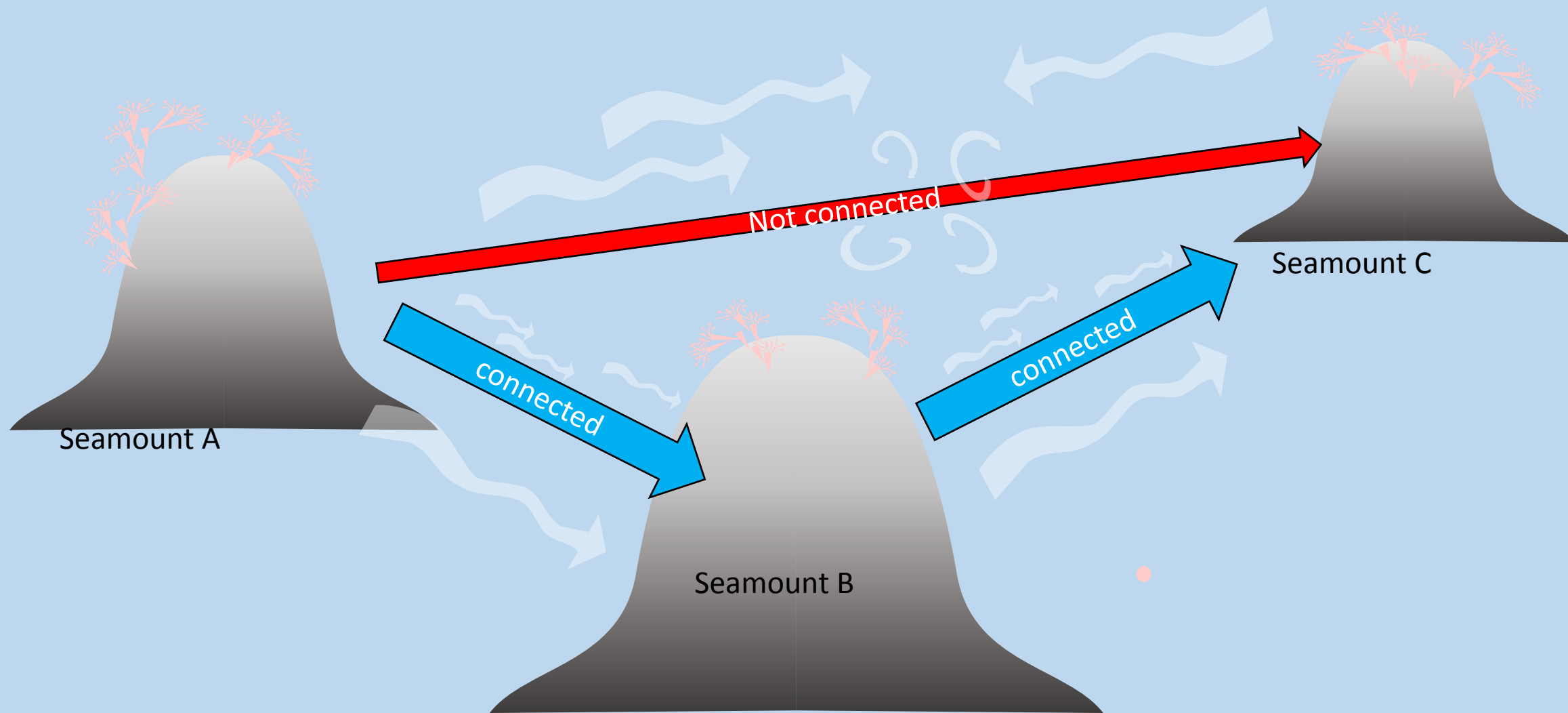


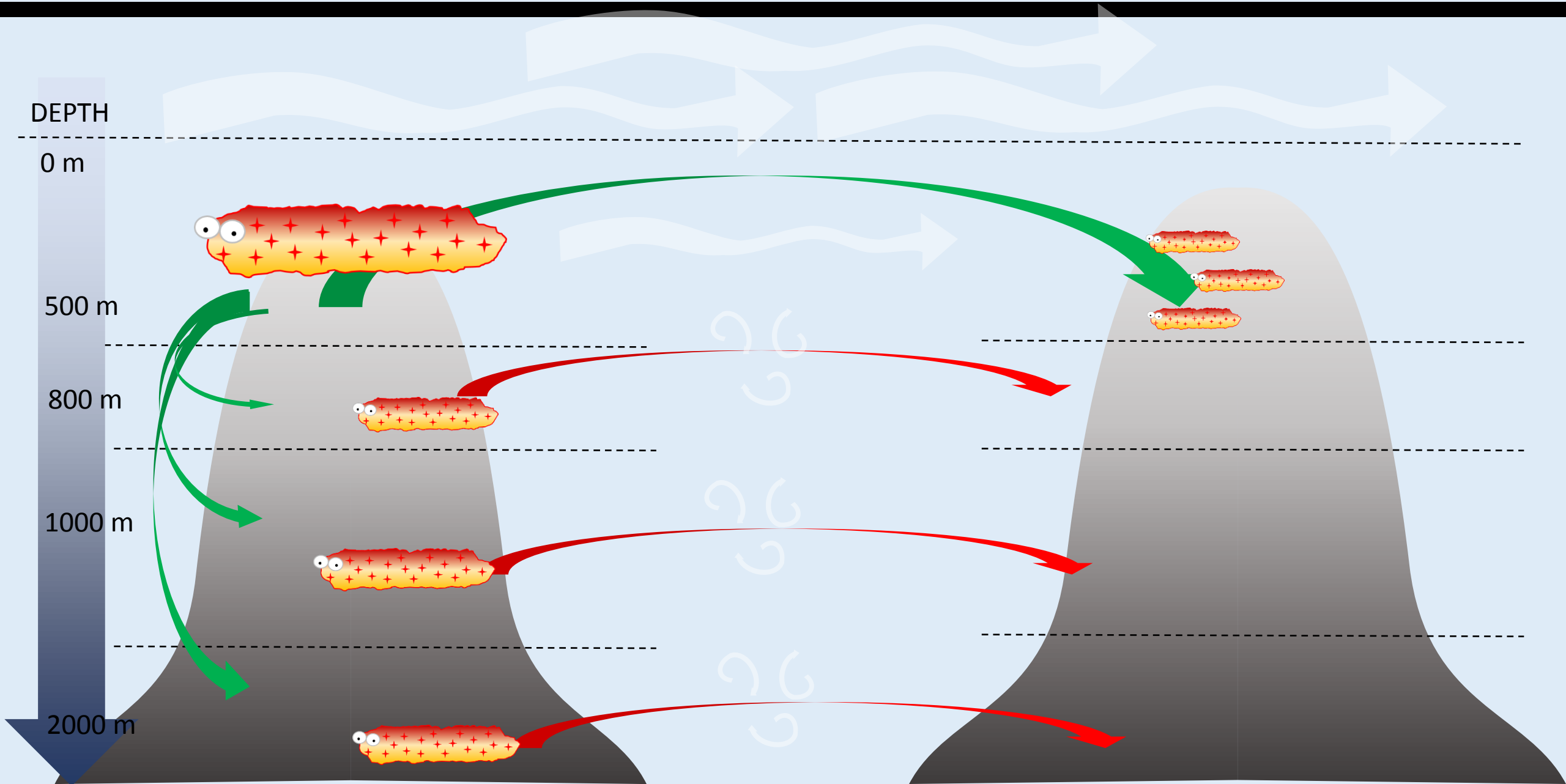
How to travel to new places?



the dispersal (the process by which offspring can settle away from their parents) is done at larval stages when currents can carry them away

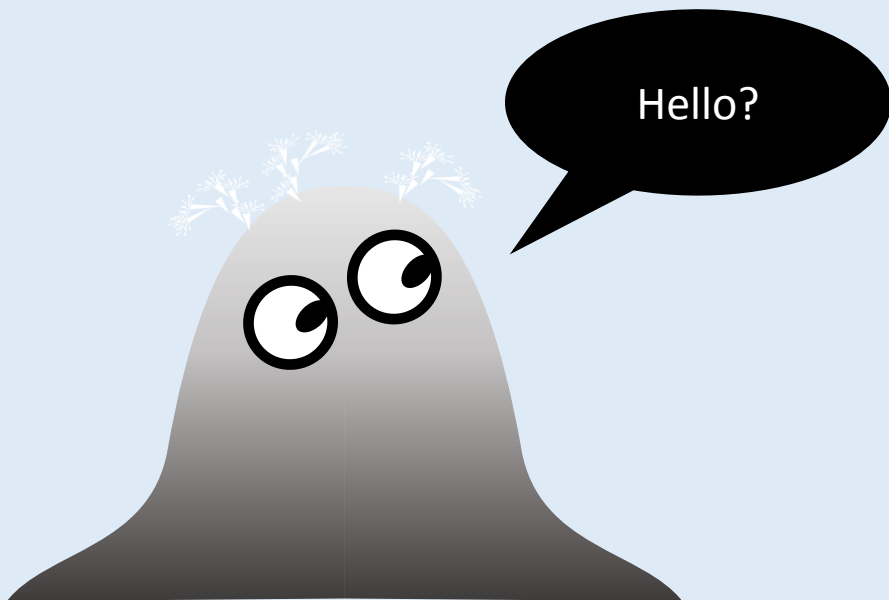




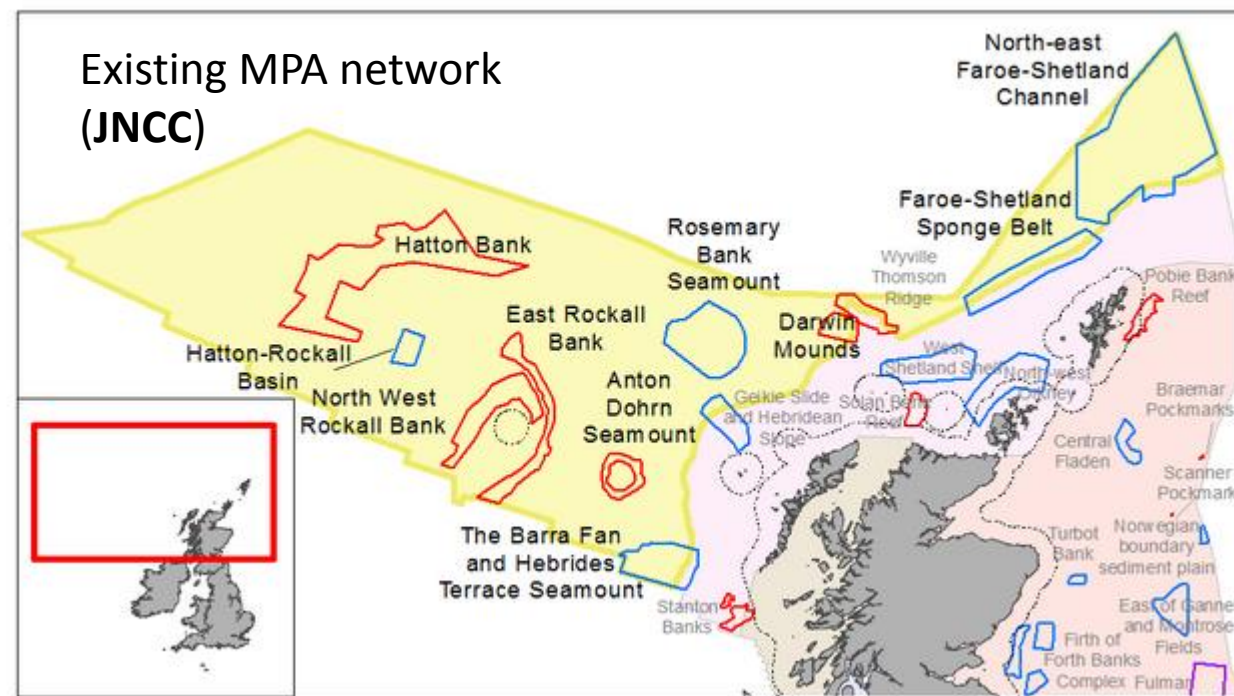




- Isolated seamount faces



- On short term:
  - Loss of genetic diversity
  - Loss of resilience
- On longer term:
  - Isolated populations may evolve into new species



Studying connectivity answers many questions and is capital to the understanding of deep sea habitat



### The DeepLinks project Hypothesis are:

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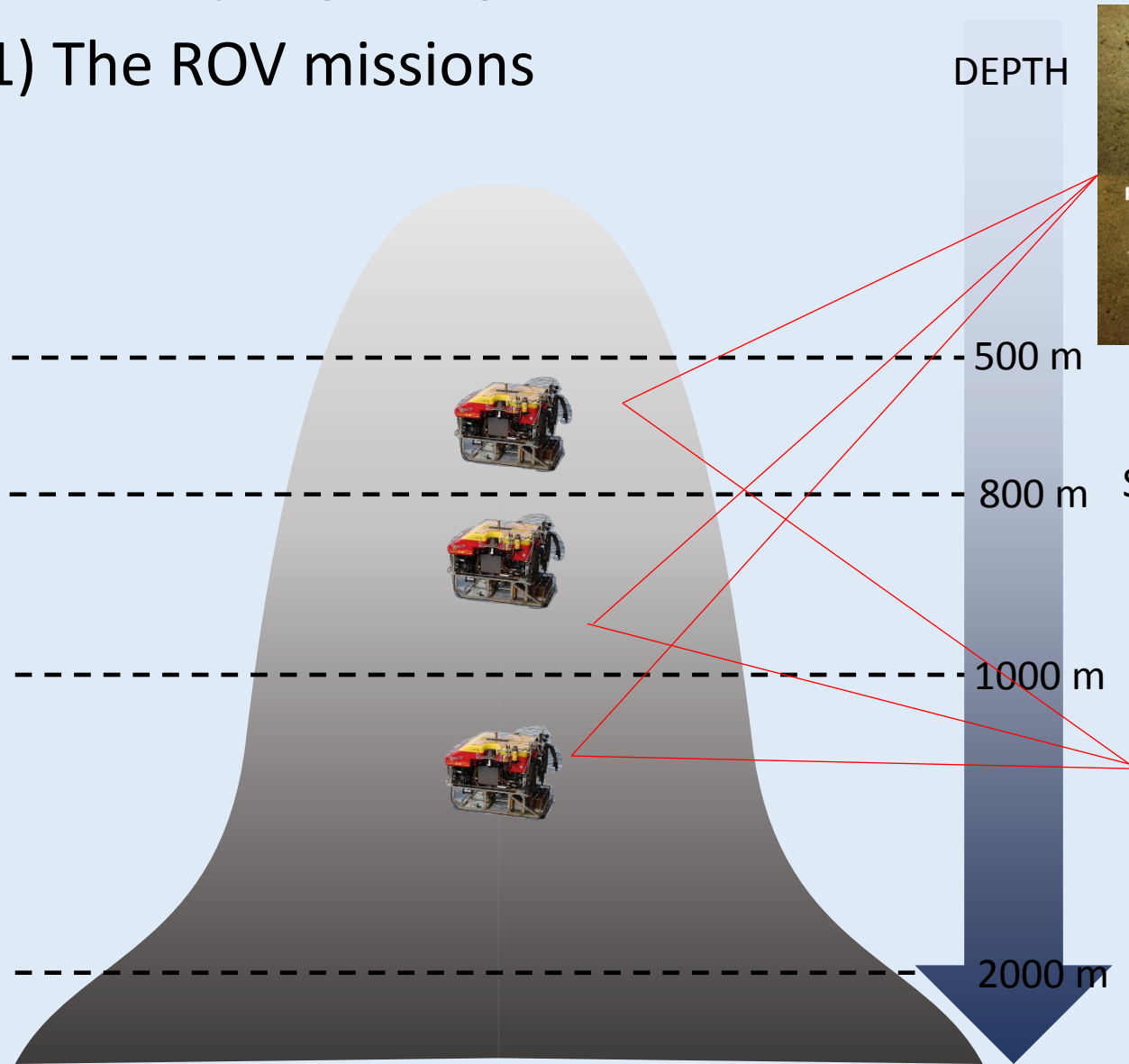
### The aims of this research cruise are to sample a range of sites and depth bands to:

1. obtain physical samples of 4 model organisms for **genetic** analysis,
2. gather benthic biological survey **video** data for **diversity patterns** analysis
3. collect **oceanographic data** to validate high resolution oceanographic models with which we will model **larval dispersal**.

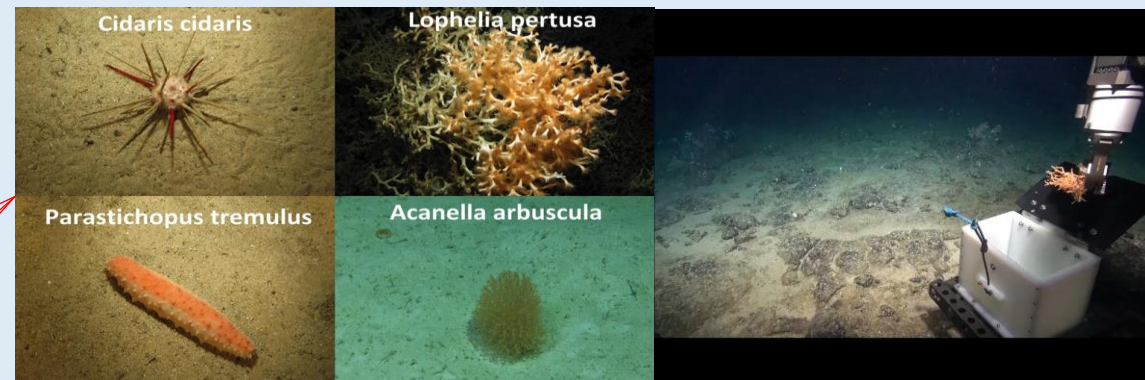
**See if hypothesis are true**

The sampling design:

1) The ROV missions



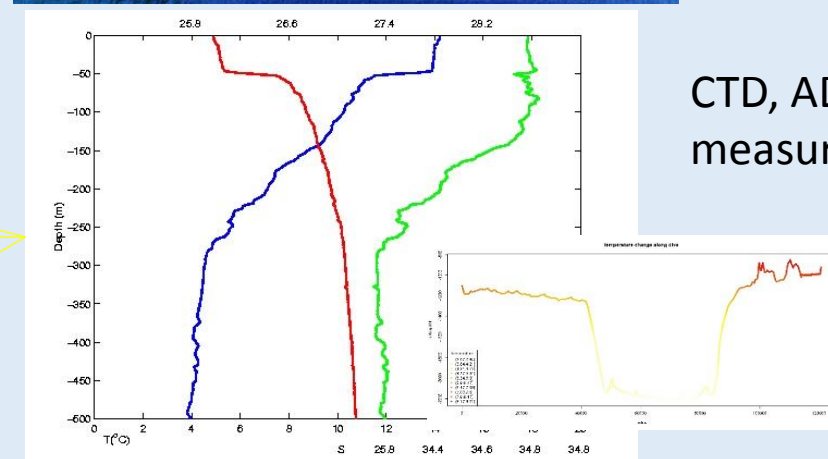
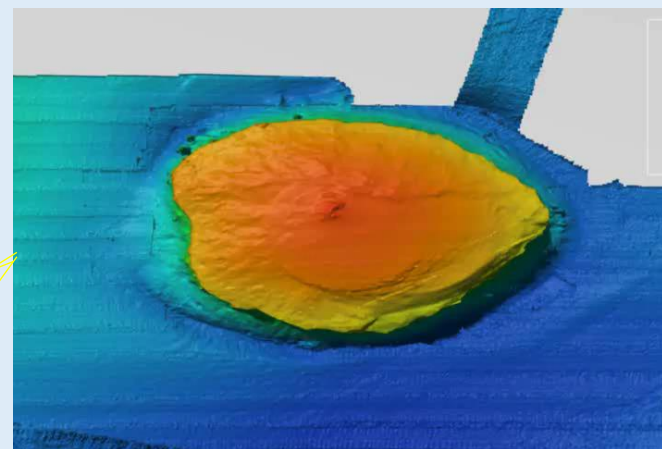
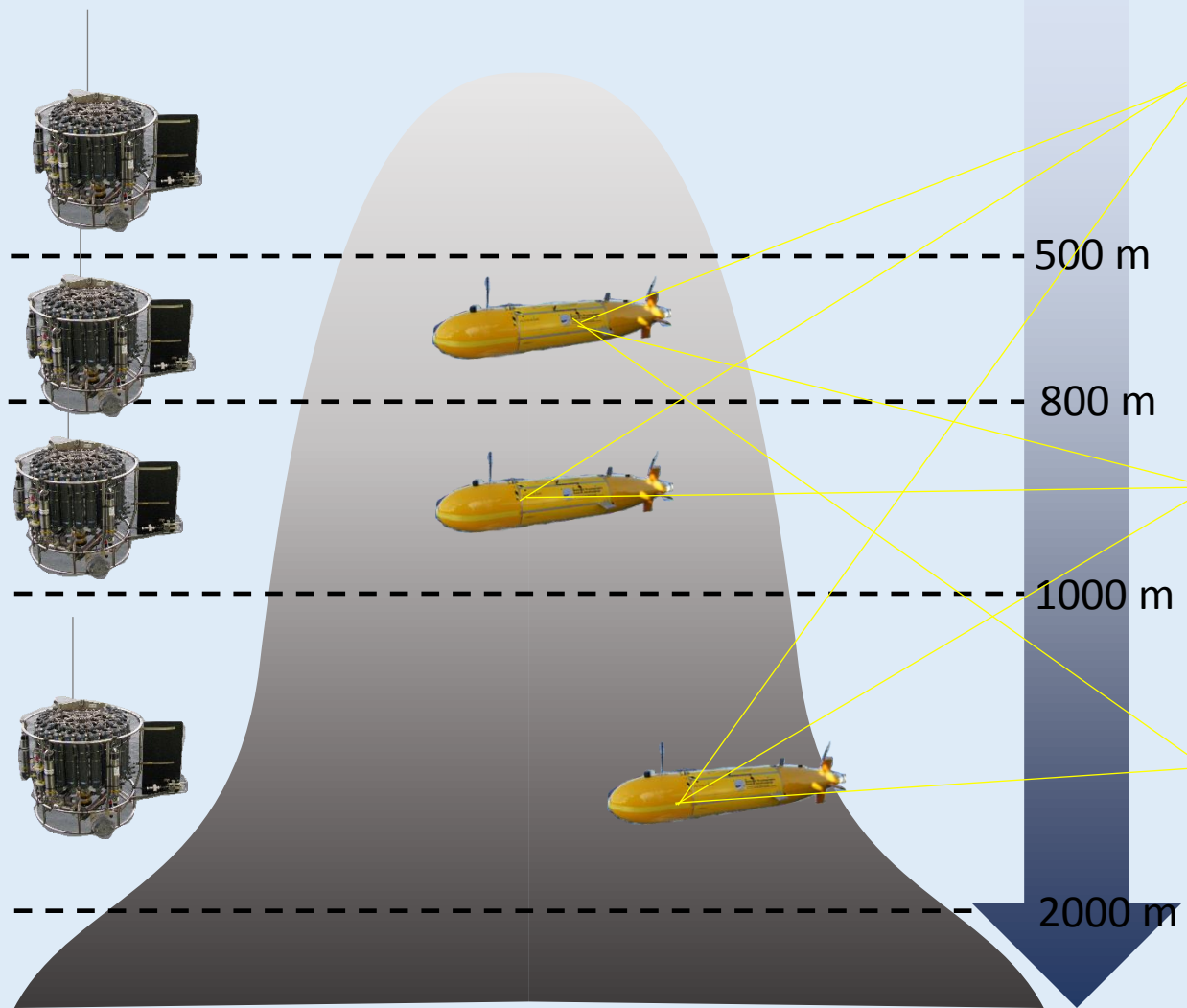
Benthic fauna sampling

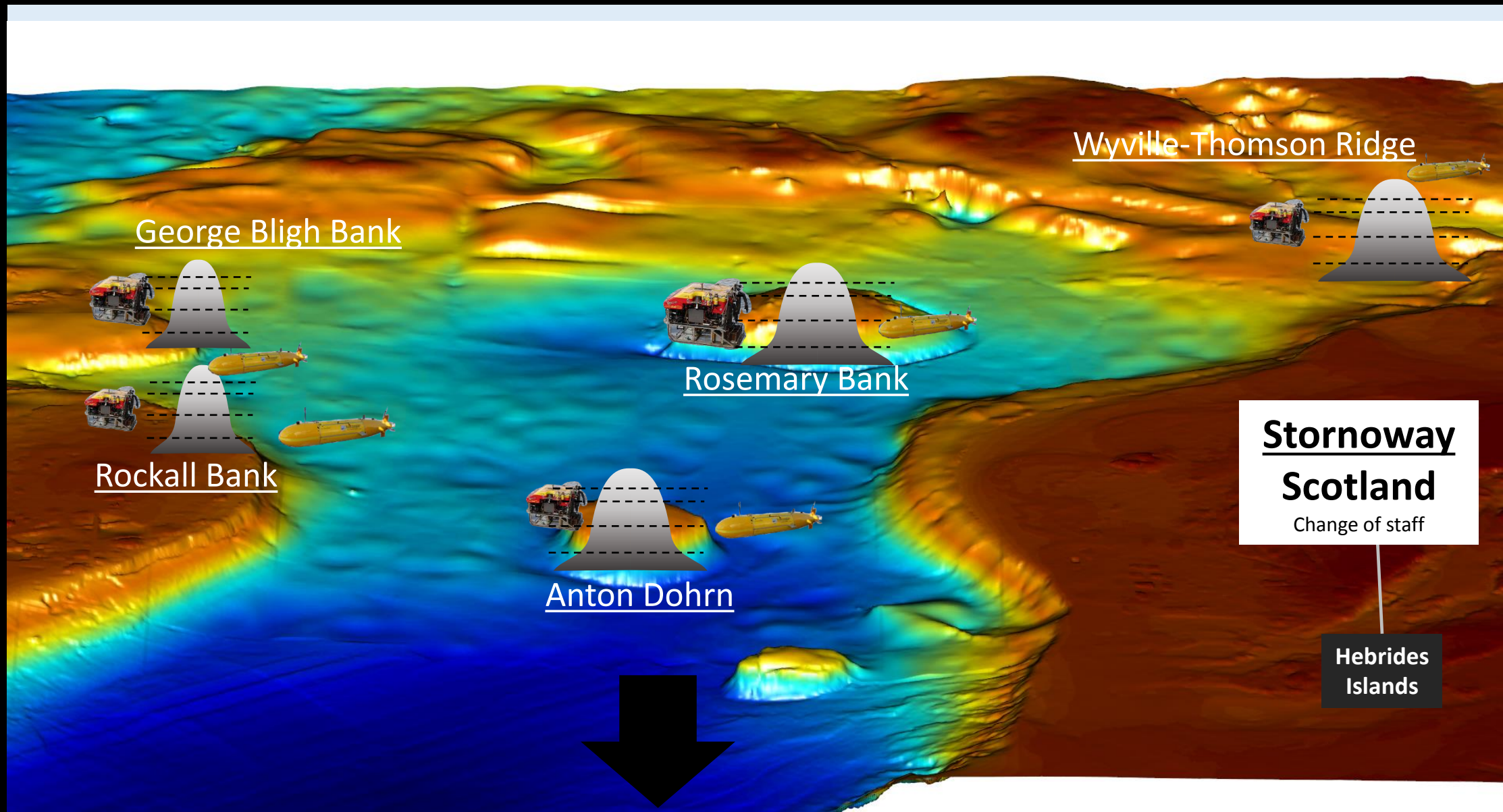


Seabed video samples to study diversity and distribution



### The sampling design: AUV and CTD missions







### RESULTS: **All cruise aims were broadly met.**



We **visited 5 sites** in the NE Atlantic (Rockall Bank, George Bligh Bank, Anton Dohrn Seamount, Wyville-Thomson Ridge, and Rosemary Bank)



**28 ROV dives**, **11 AUV missions**, **43 CTD casts**, 2 mooring deployments and equipment trials.



We obtained **3630** biological samples, including sufficient depth and site coverage for molecular analysis of **3** target species (but many more were collected).



We obtained **video transect** data with sufficient replication and depth stratification from **3 sites** and near complete sampling from a 4<sup>th</sup>. (58 TB of video in total)



We obtained **sufficient oceanographic data** to validate our models.



In addition, we gathered **5811.66 km<sup>2</sup> of seafloor multibeam**

### ISIS R.O.V.



- Exploration (28 dives - **362** hours on the Seabed)
- Video surveys with 3 cameras (Mainly Scorpio)
- Sampling
  - Claws
  - Slurp gun
  - Scoop
- Extras attachment were mounted on the vehicle
  - SNAPS, Photogrammetry set and corers

### ISIS R.O.V.



- Sampling
  - Collecting
    - Claws
    - Slurp gun
    - Scoop
  - Storage
    - tubes
    - bioboxes
- Videos (3 cameras)
  - Scorio
  - Science
  - Pilot





- ROV sampling

Physical samples brought to the surface  
unloaded



- Samples processing  
and processed in the JC cold room.

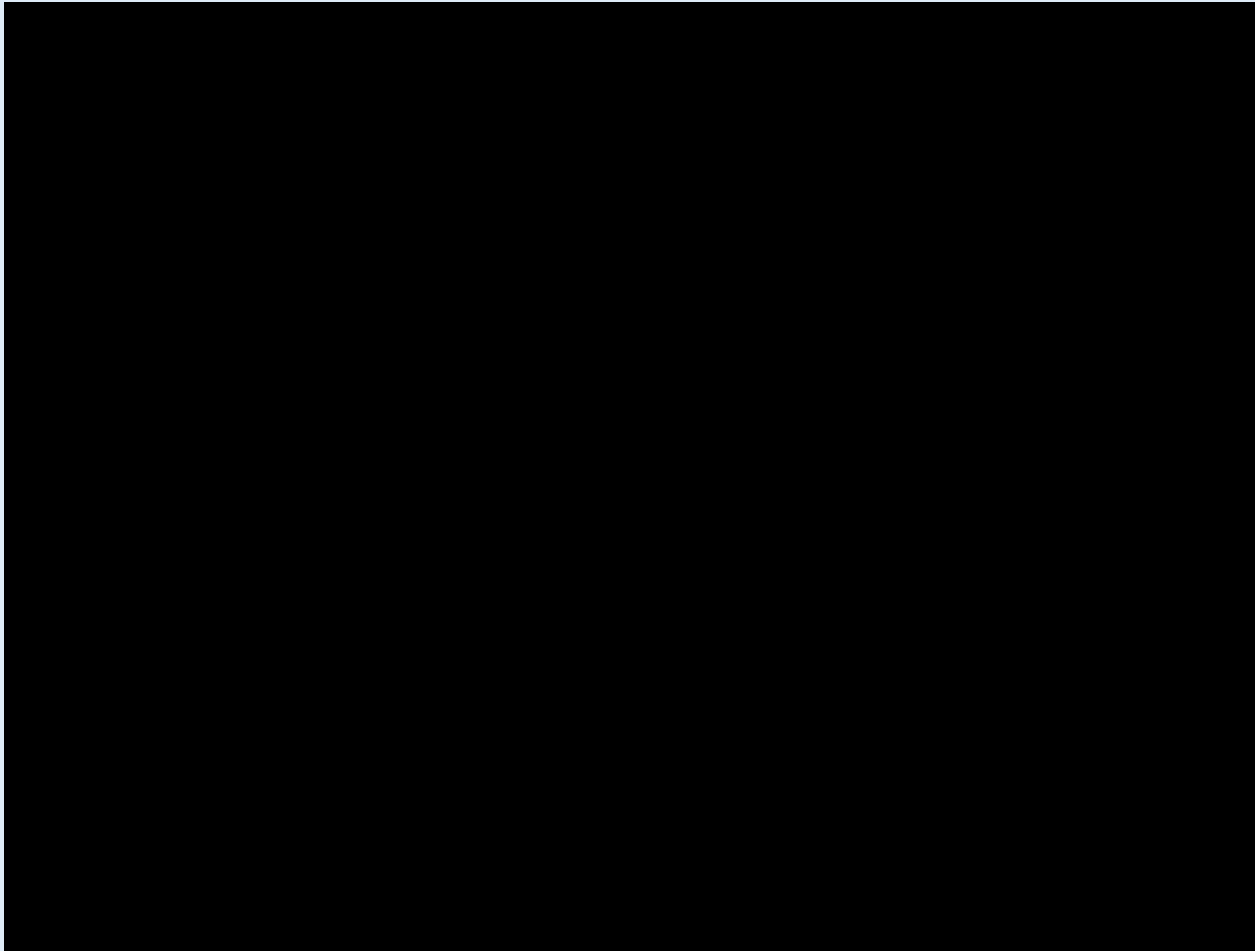


Thousands were collected

ISIS R.O.V.



- Reliable and adaptable
- Many different things can be mounted on it
- Various sampling equipment allows to take most things.
- Enthusiastic and helpful pilots team

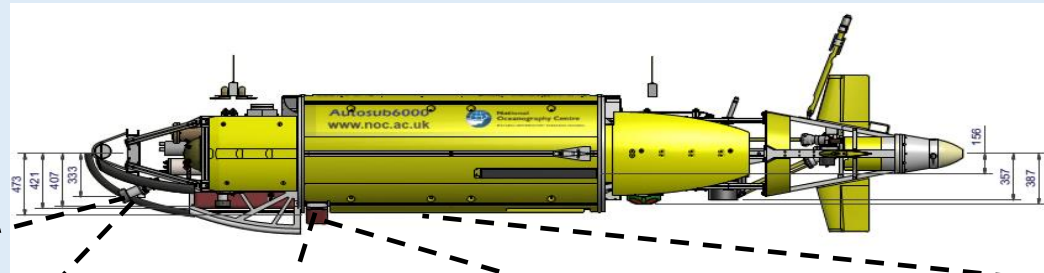


- Lack thrust in strong current
- Cannot be deployed or retrieved at any time
- Data requires processing after each dive

### Autosub

- 11 missions (4 photographic missions)
- For all dives
  - Multibeam and backscatter (usually about 3m resolution)
  - CTDs/ADCP/ others
- On some mission:
  - Images (120,000)
  - Very fine scale multibeam (~0.5m)

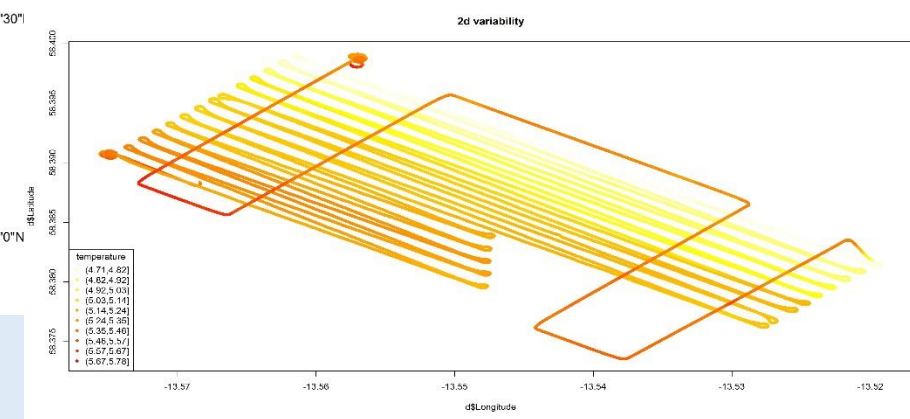
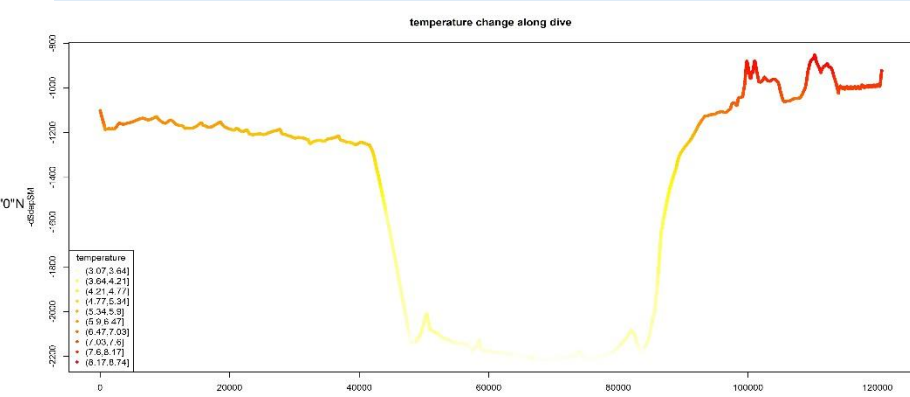
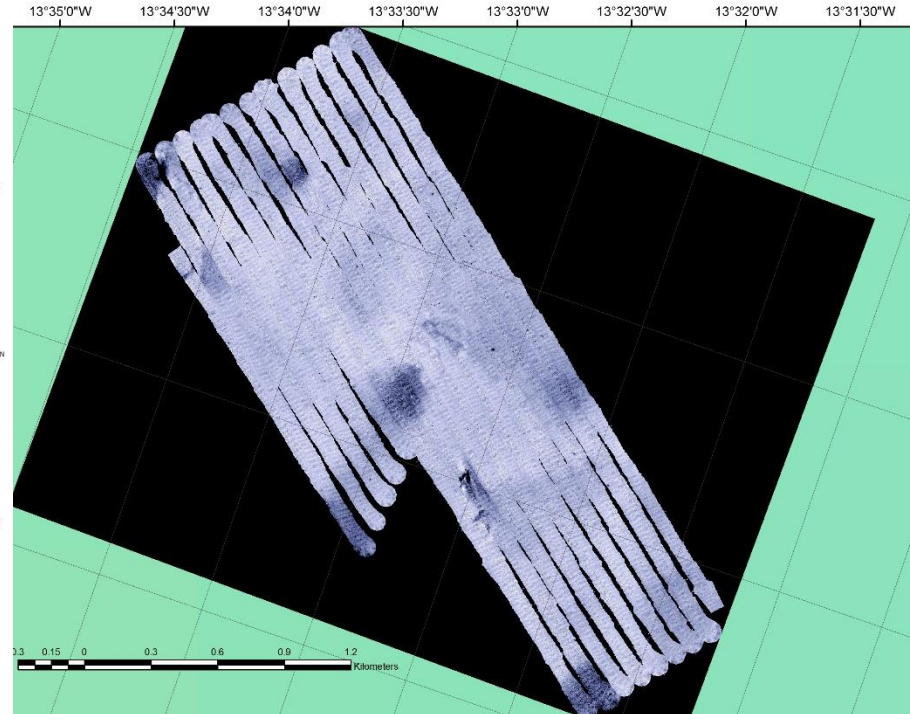
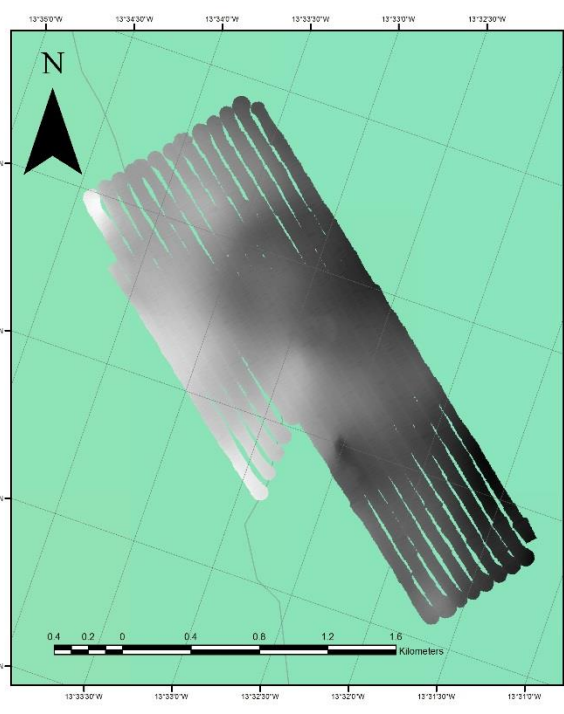


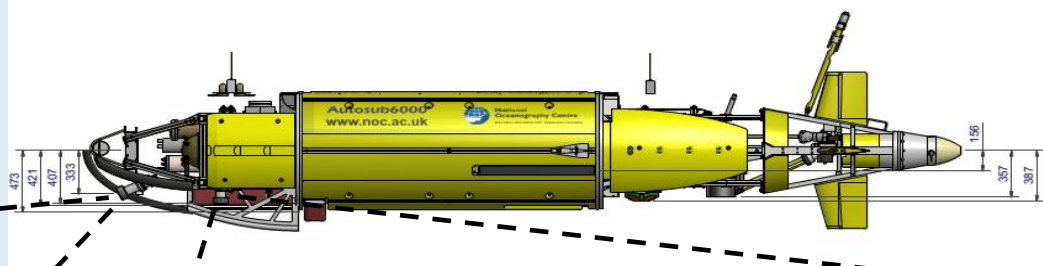


Multi beam

backscatter

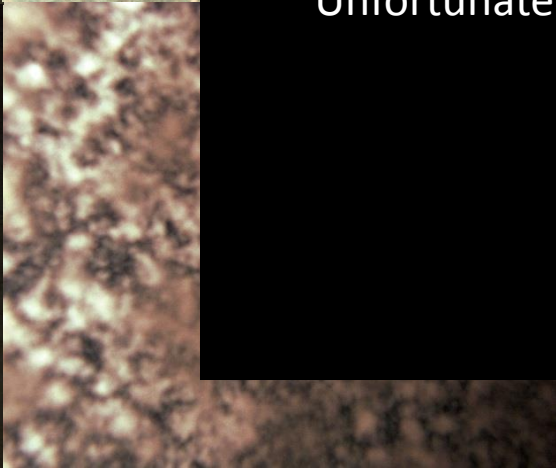
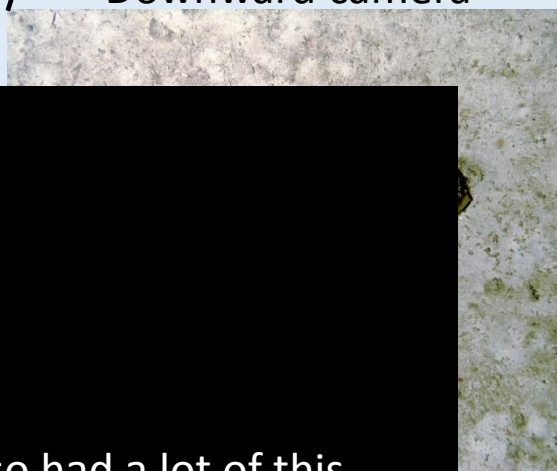
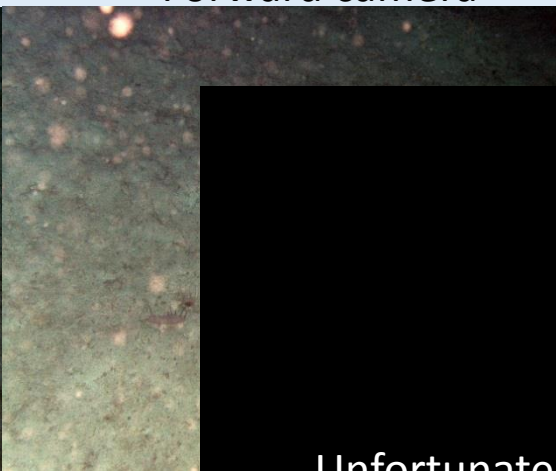
CTD/ ADCP



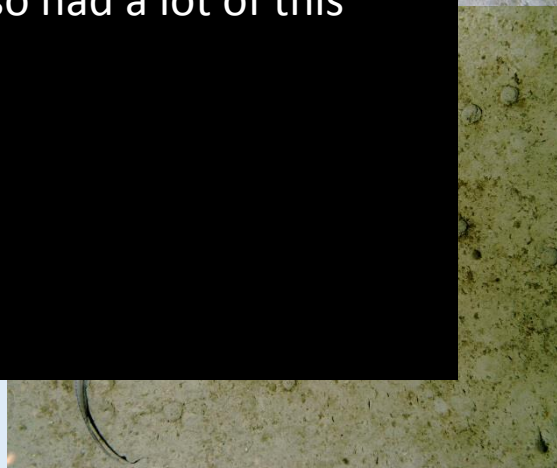


Forward camera

Downward camera



Unfortunately, we also had a lot of this



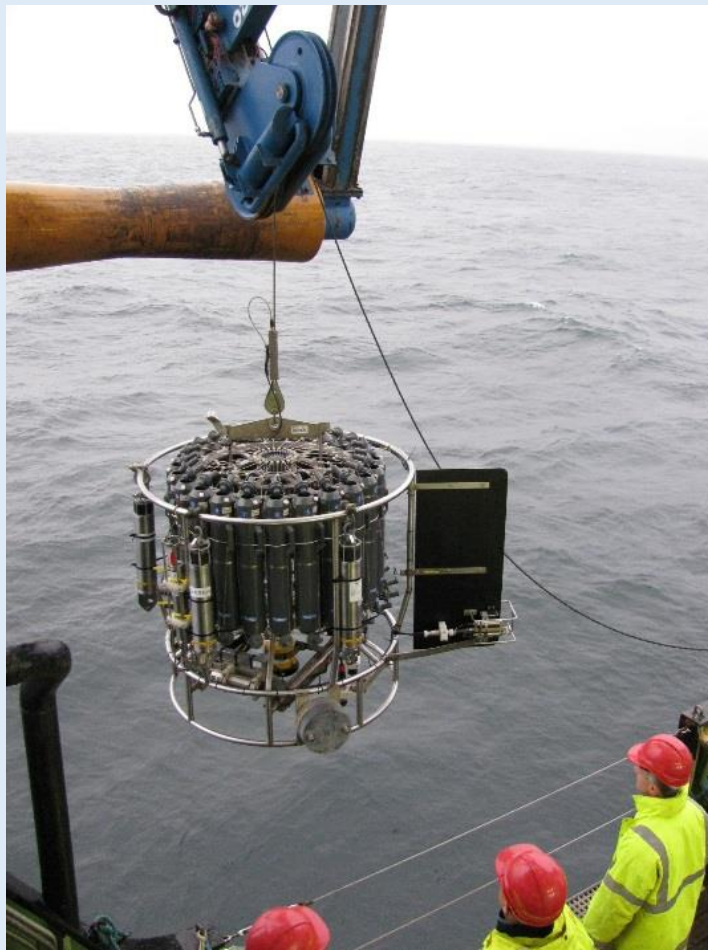
### Autosub

- Is autonomous. Can work while ship and ROV do other things
- Can make its way to a rendezvous point after its mission. Saves a lot of travel time
- Results come in a processed format and the data is directly usable for plotting and analysis
- Collects a lot of data (120,000 images per dive; 750GB)
- Autosub team always trying their best to ensure optimal functioning
  
- Was originally meant to do all the seabed video sampling while the ROV was doing the physical sampling
  - The ROV had to do both to ensure consistency in imaging gear
  - Autosub was used to test other sampling methods
  - We are still exploring the results



### Additional:

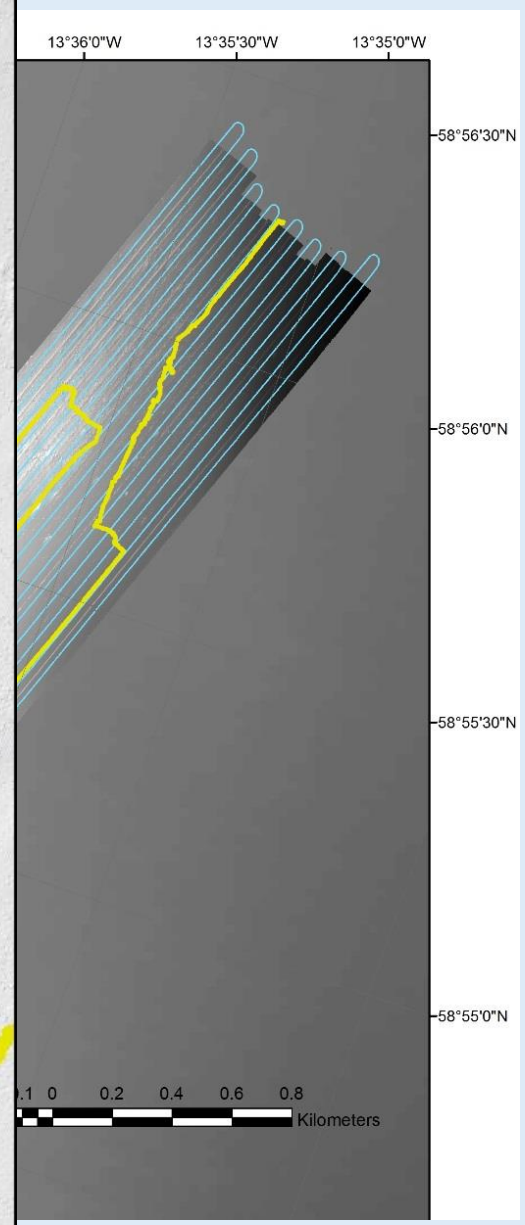
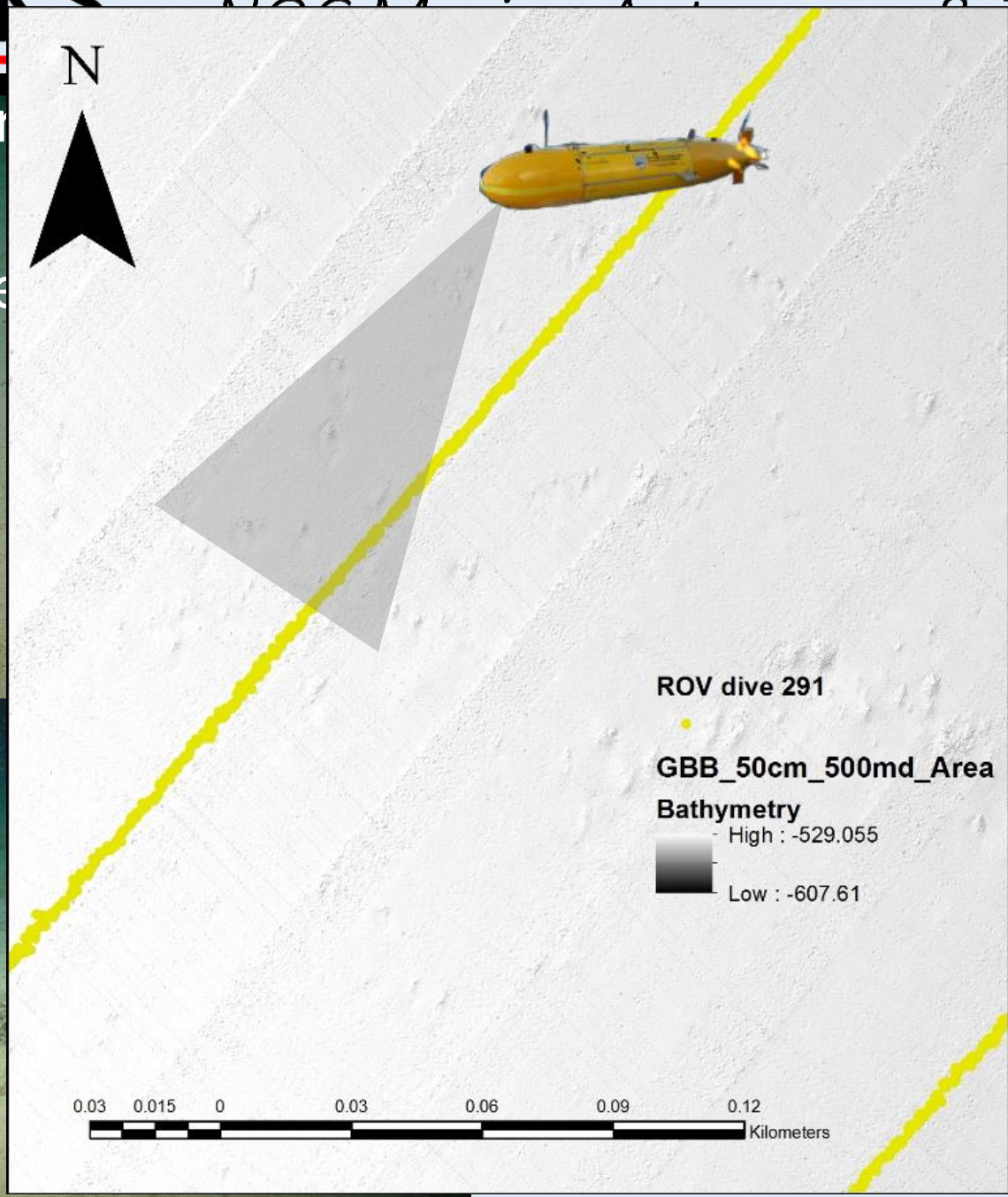
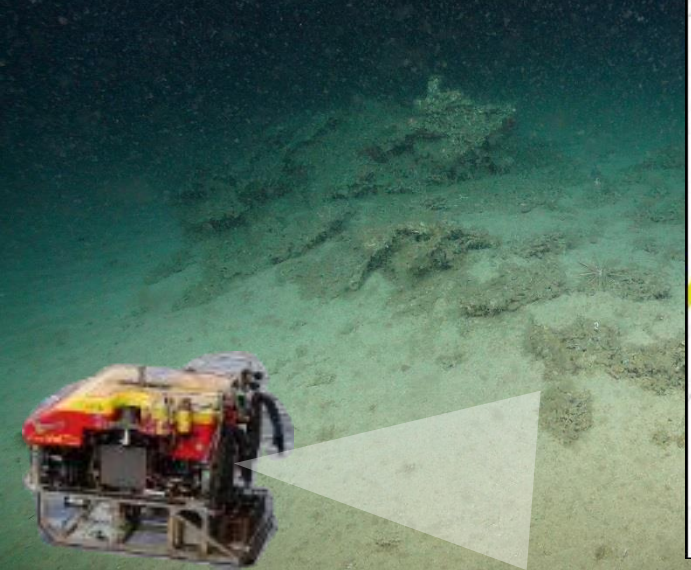
- CTD
- Moorings (LADCP)
- DS2 sled

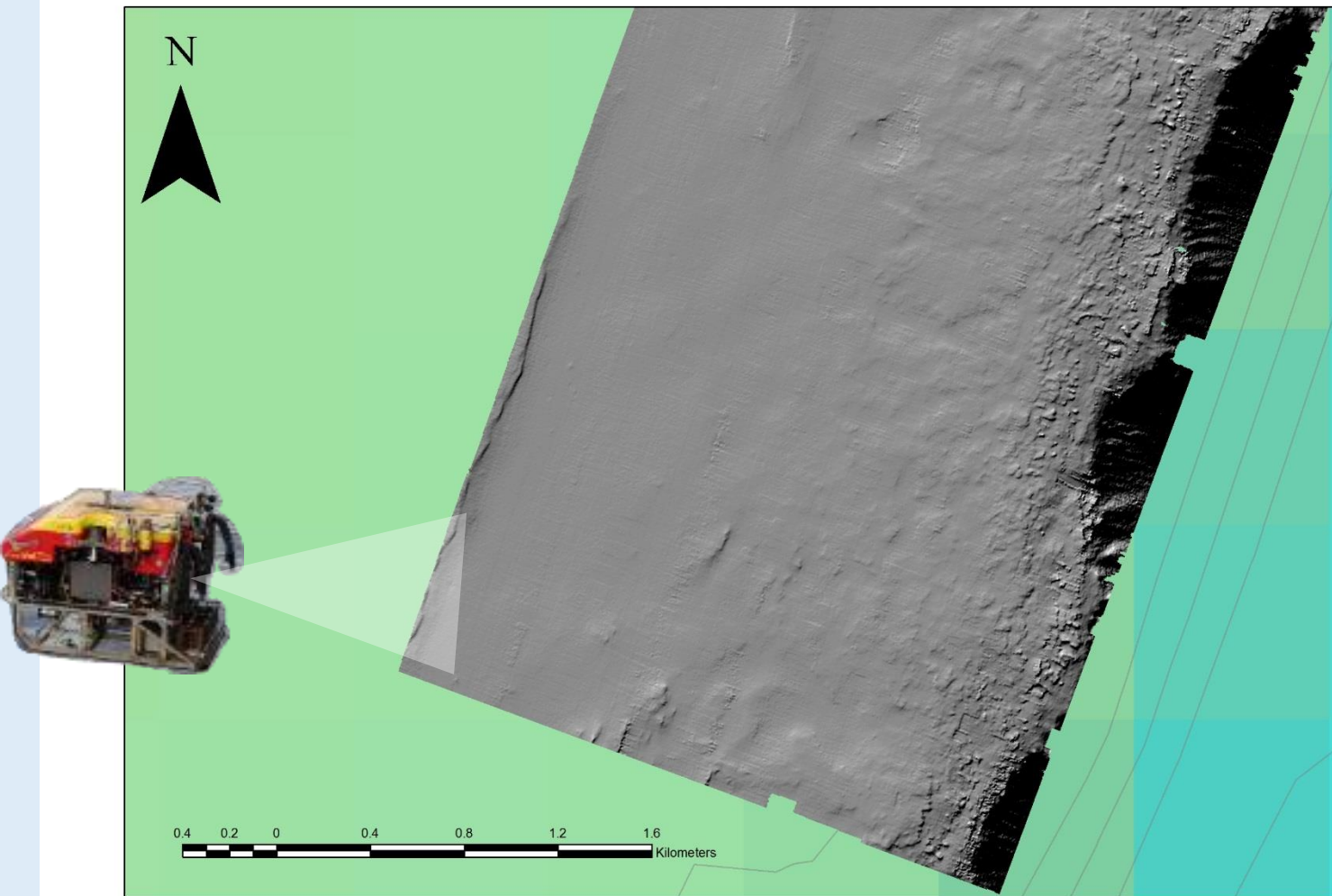




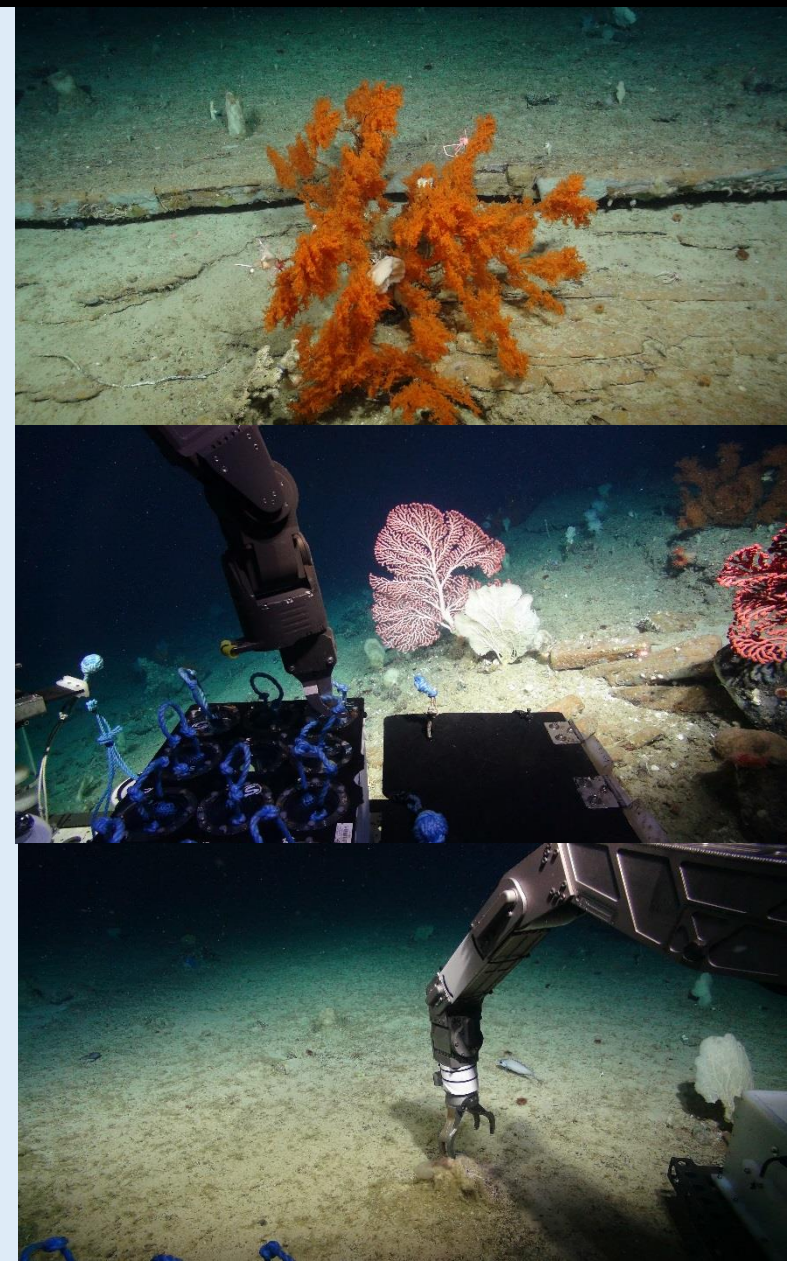
# DEEP LINKS

# Technology Showcase





Fine scale multibeam was used to plan Isis sampling dives



### Suggestions : How autonomous vehicles could be improved for benthic Ecological surveys



change location of the **flash light on Autosub** so images are less blurry



Flying only over flat terrain is no use for biologists: it excludes most of the sea-bed  
**Fly closer to the ground** or need Higher images resolution



Image processing could be standardized (for all images and all cruises)



**Automated identification of species** is necessary to use the large amount images collected by autonomous vehicles



**BODC** needs to be able to **store all that data and metadata** and be able to archive it and make it **easily accessible** (browse by geography, or search the meta-data to know where to find data)



**Better internet** on the ship to enable live video capacities or data exchange



# DEEP LINKS

Thank you

