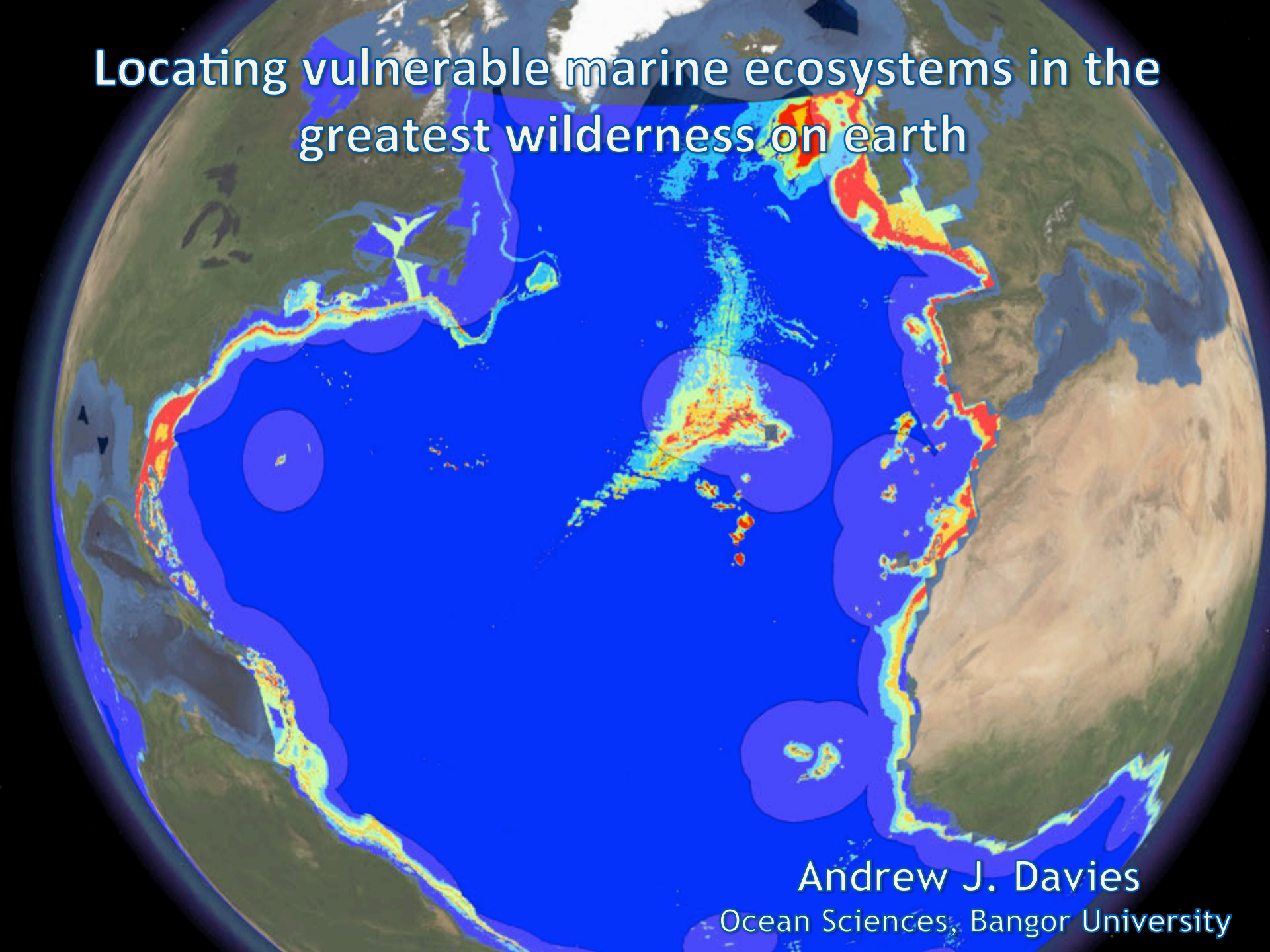


Locating vulnerable marine ecosystems in the greatest wilderness on earth



Andrew J. Davies

Ocean Sciences, Bangor University

Why do we call this planet Earth
when it is quite obviously Ocean?

Sir Arthur C. Clarke

The public perception - a featureless wasteland?



The public perception - contains vast exploitable resources?



The public perception - a playground for millionaires?



From Virgin's Flickr page

But we know differently - cold-water coral reefs



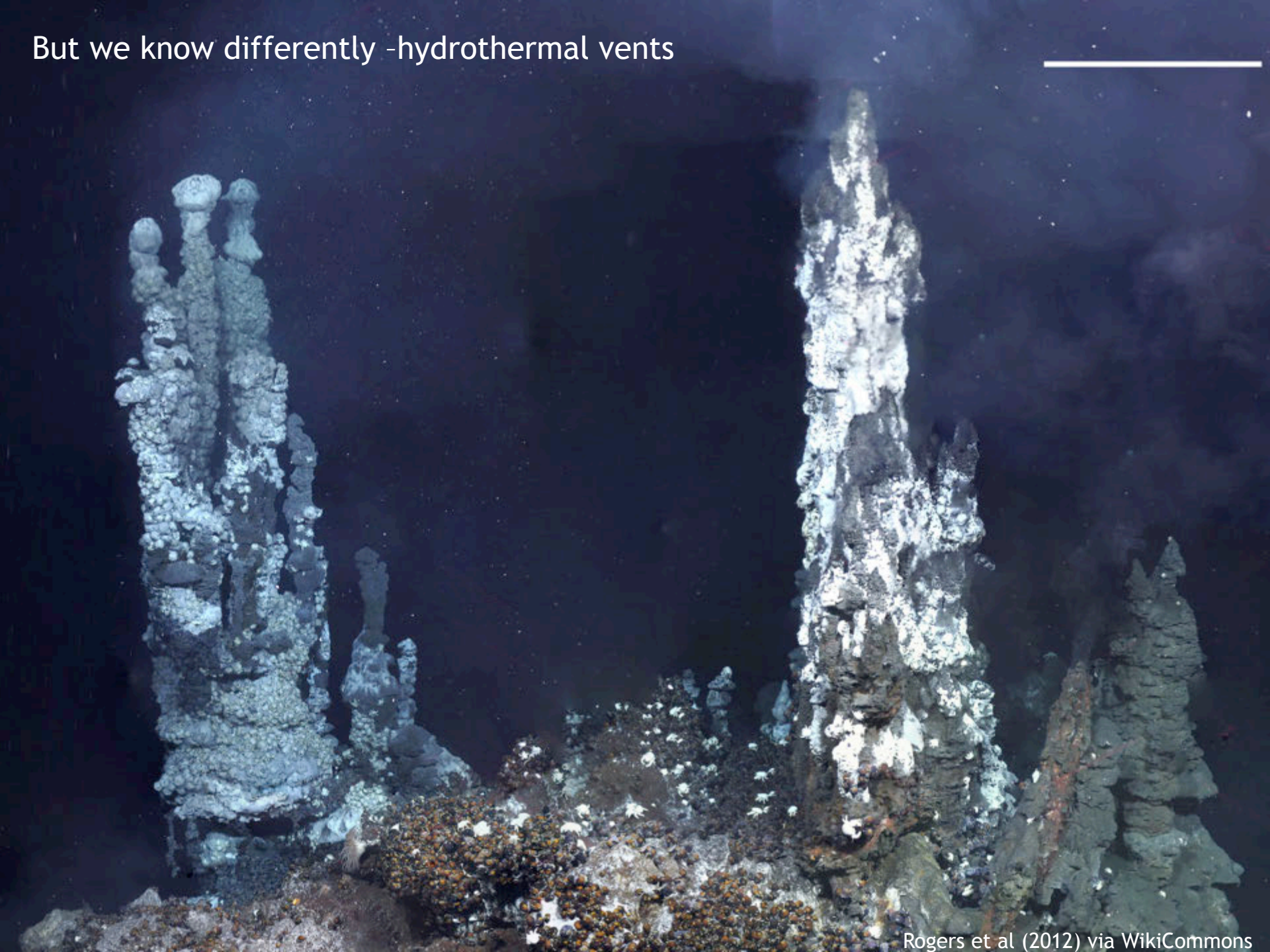
But we know differently - sponge reef



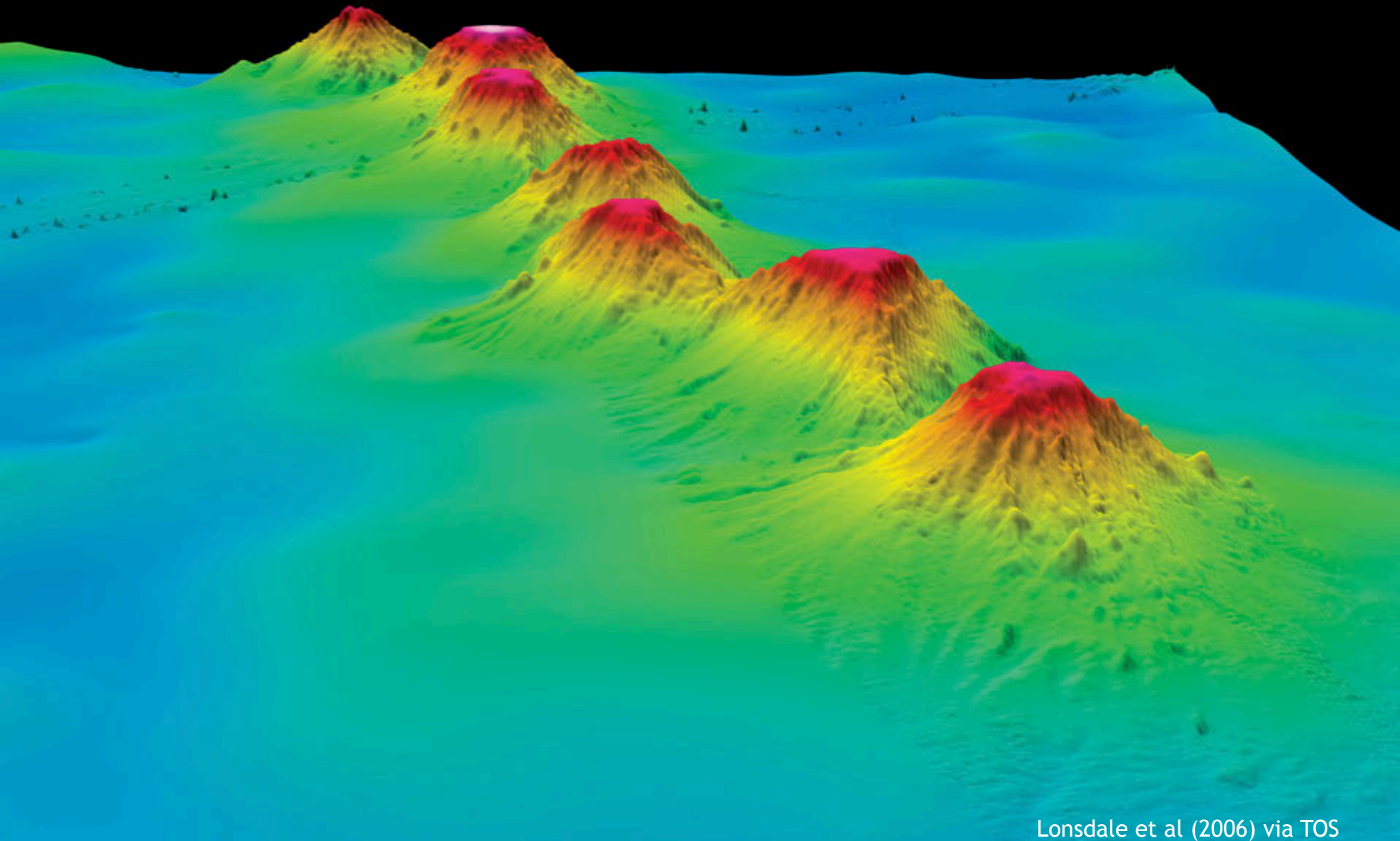
But we know differently - solitary corals



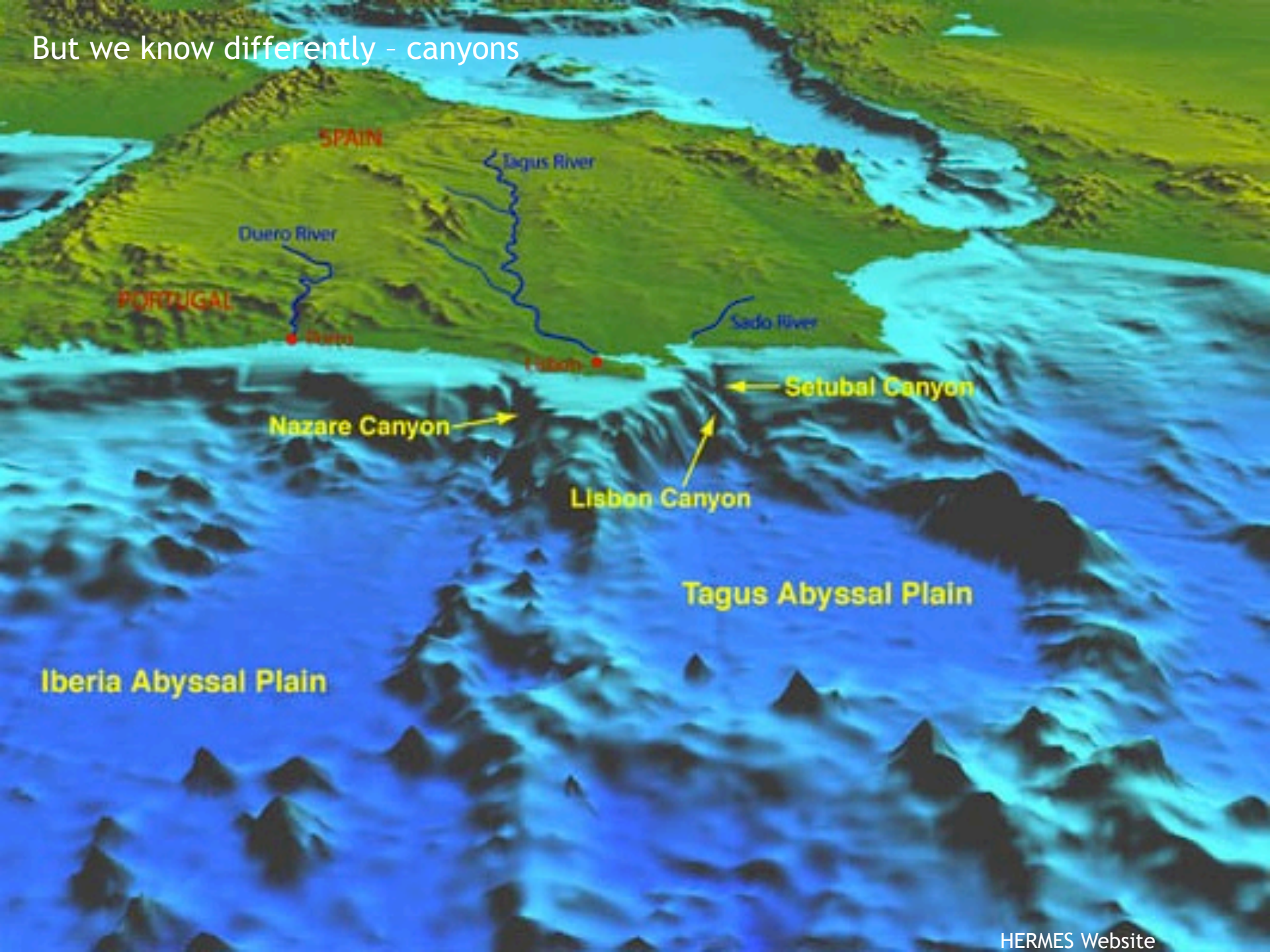
But we know differently -hydrothermal vents



But we know differently - seamounts



But we know differently - canyons



But what about predictive
modelling?



HEY, WALDO-WATCHERS!
SAW SOME TRULY TERRIFIC
SIGHTS TODAY—SOMEONE
BURNING TROUSERS WITH
AN IRON; A LONG THIN MAN
WITH A LONG THIN TIE;
A GLOVE ATTACKING A MAN.
PHEW! INCREDIBLE!

Waldo
~~~~~



TO:  
WALDO-WATCHERS  
OVER THE MOON,  
THE WILD WEST,  
NOW



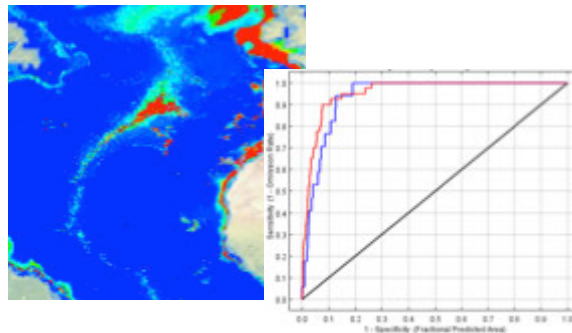
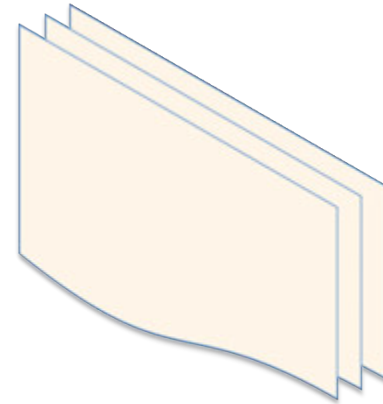
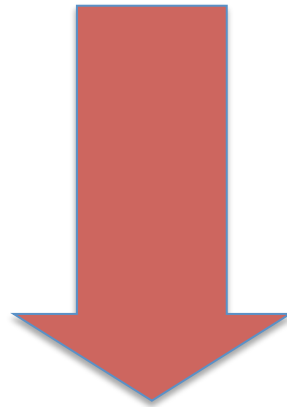


# How do models work?

Species locations

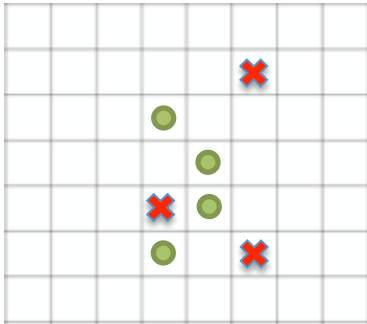


Environmental /  
geophysical data



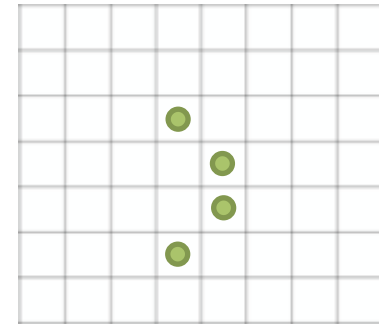
# Different models, different data

Presence / Absence



Generalised models  
Regression models  
Common in data-rich  
areas

Presence-only

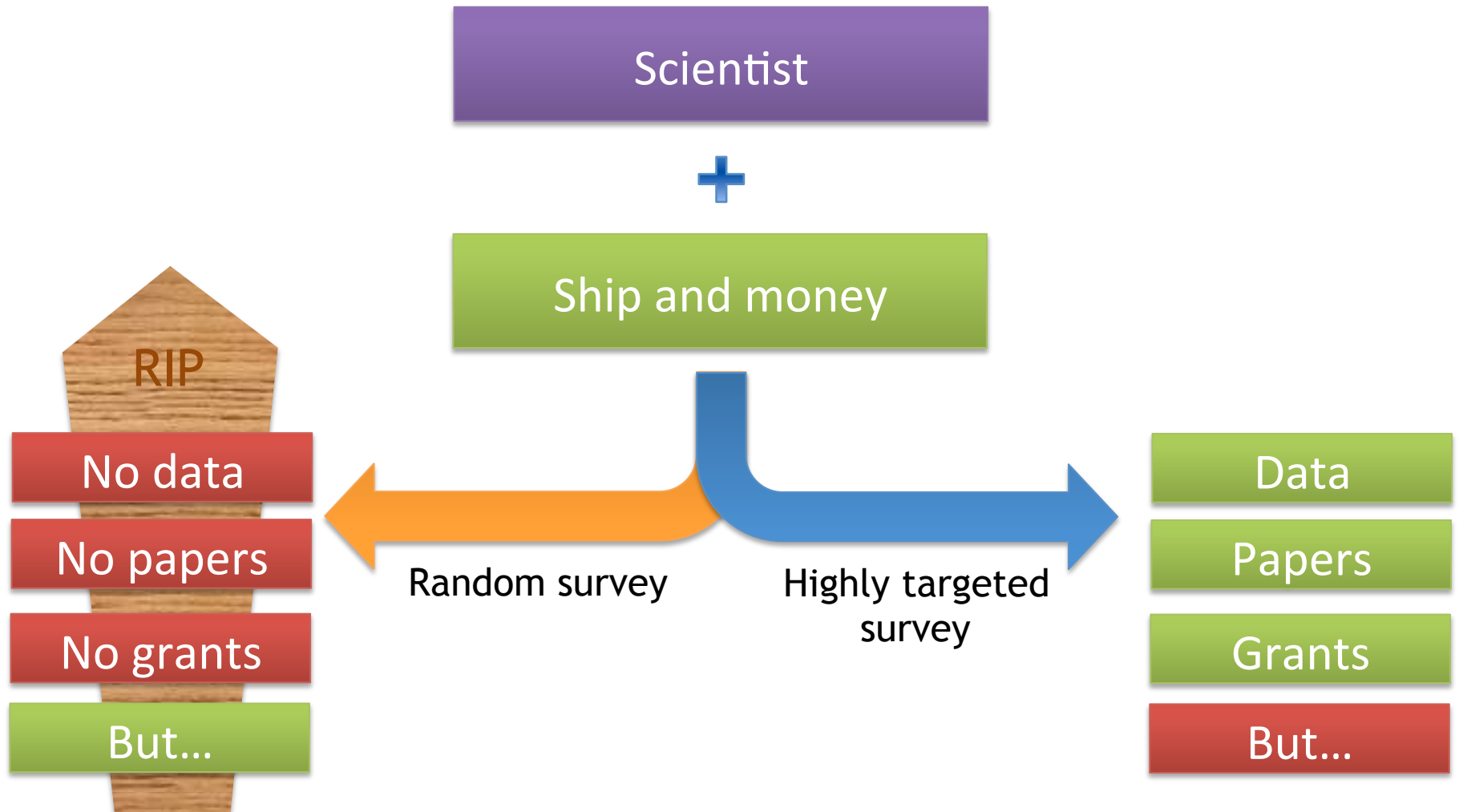


Envelope models  
Maxent / ENFA  
Mostly in data-poor  
areas

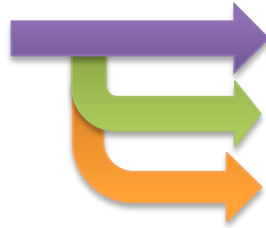


# “I couldn’t help but notice you..”

Or sampling bias



Species



Enigmatic  
Obvious  
Heavily researched

Depth



Mostly shallow  
Gear type  
Species

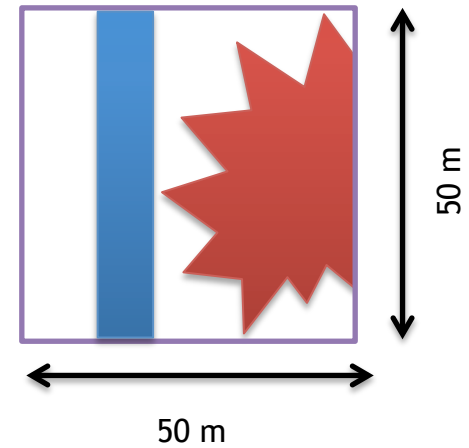
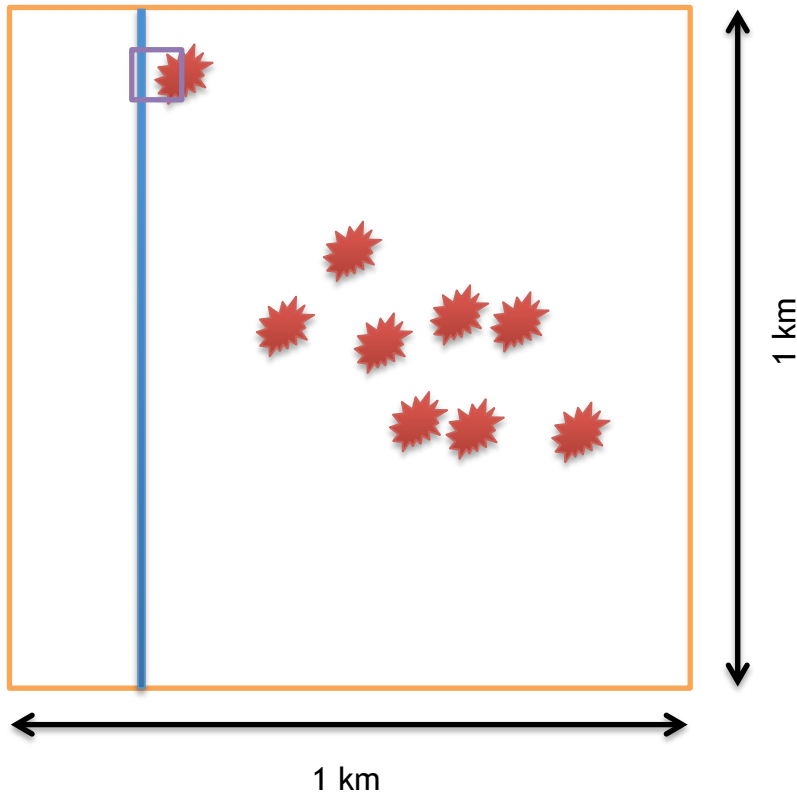
Geographic region



Country wealth  
Ships availability  
Capability



# Mis-matches in scale

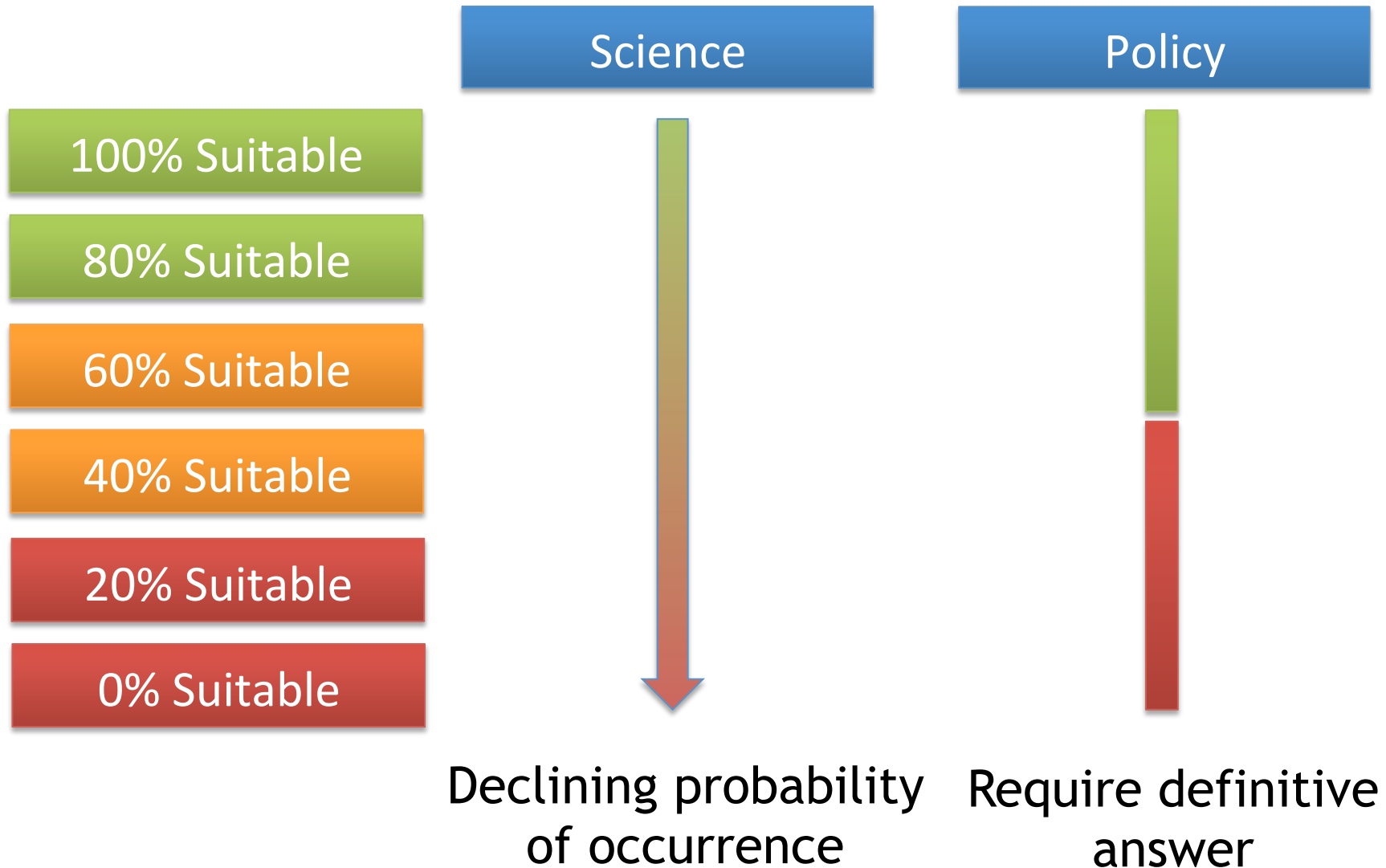


Environmental data

Survey methodology

Size of your target

# “What is the meaning of this?”





# Flawed yes, but what potential?

Models will never replace ship-based surveys,  
it is a complimentary technique



# Two main approaches..

Global / regional

Satellite bathymetry

Less species accuracy



Spatially (i.e. trawl)  
Sometimes inconsistent ID

More exploratory



More likely to locate  
new areas

Local

Multibeam

More accurate species



Spatially (often ROV)  
Reliable species ID

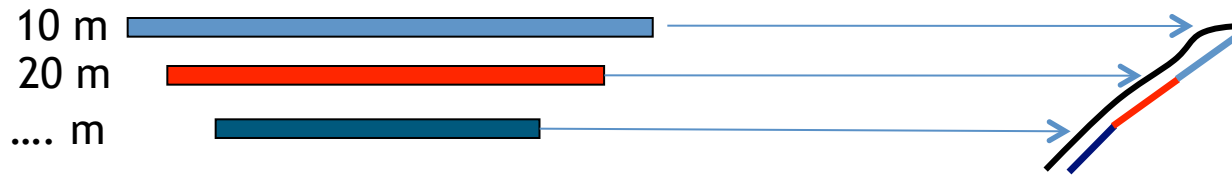
More intensive



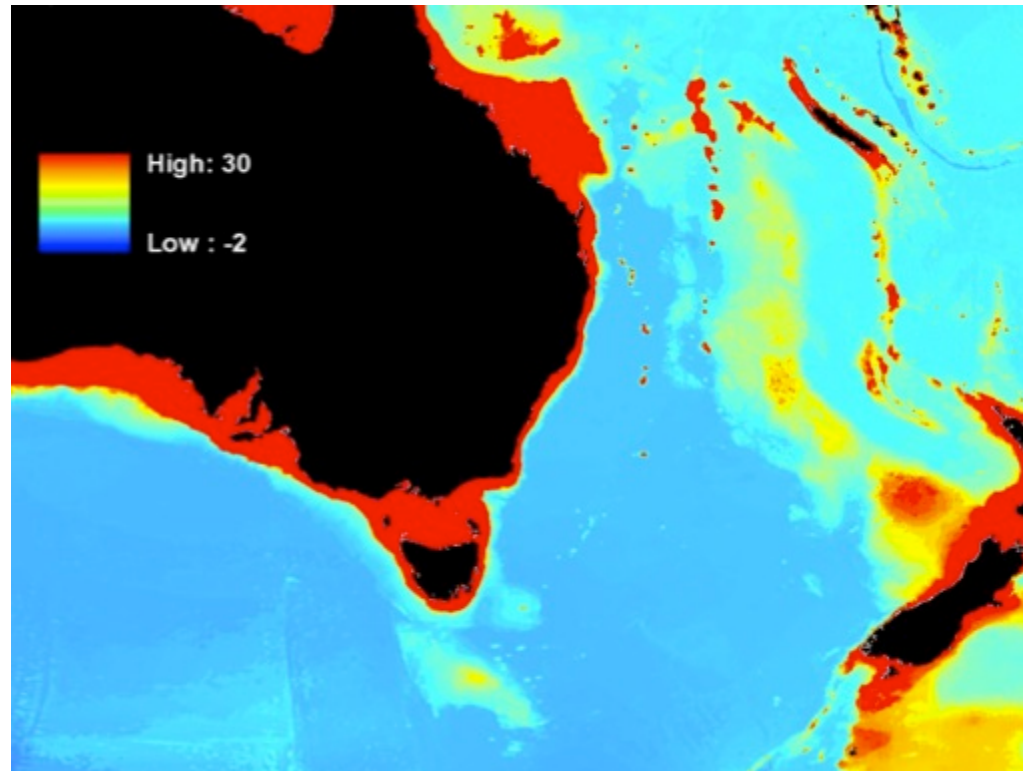
Time and money

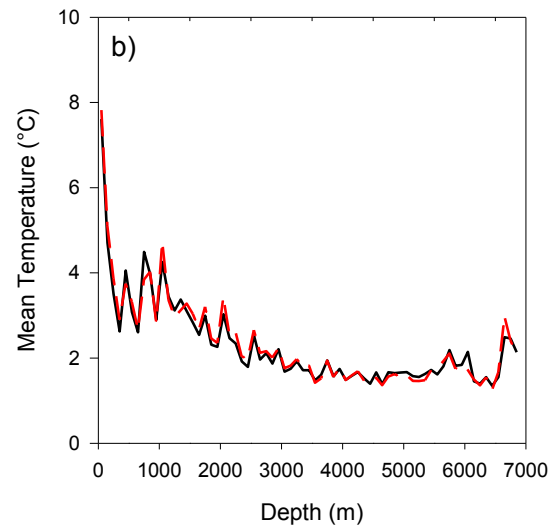
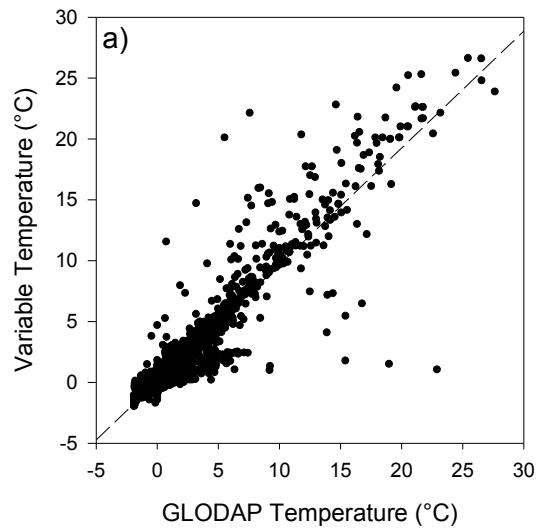


# Make the most of what you have..

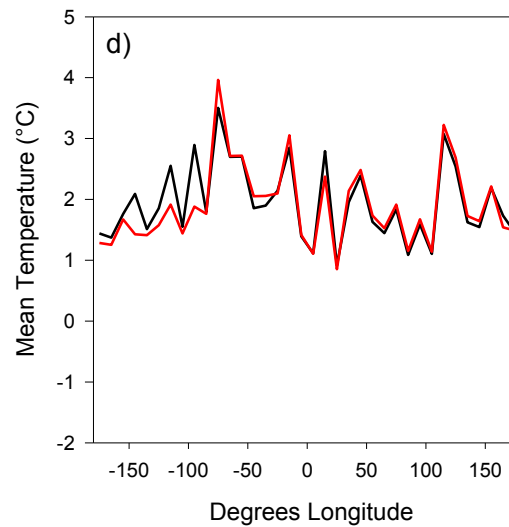
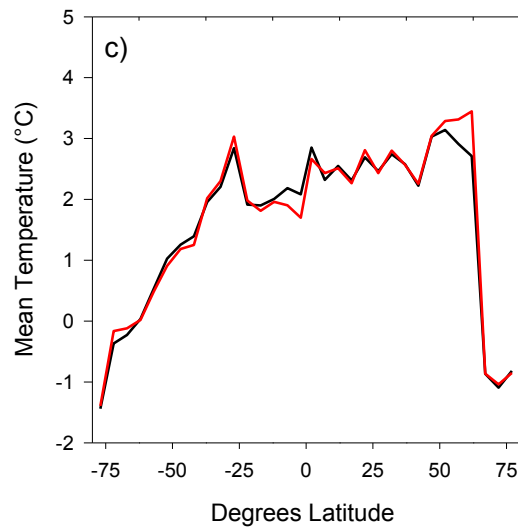


- Uses any resolution bathymetry.
- Extracts existing gridded data products and drapes the gridded product over the corresponding area of bathymetry.
- Essentially a model of environmental conditions.





**Must always validate your  
“modelled” environmental  
data...**



### **Correlations ( $R^2$ )**

Temperature = 0.924 ( $n = 6972$ )

Salinity = 0.914 ( $n = 6891$ )

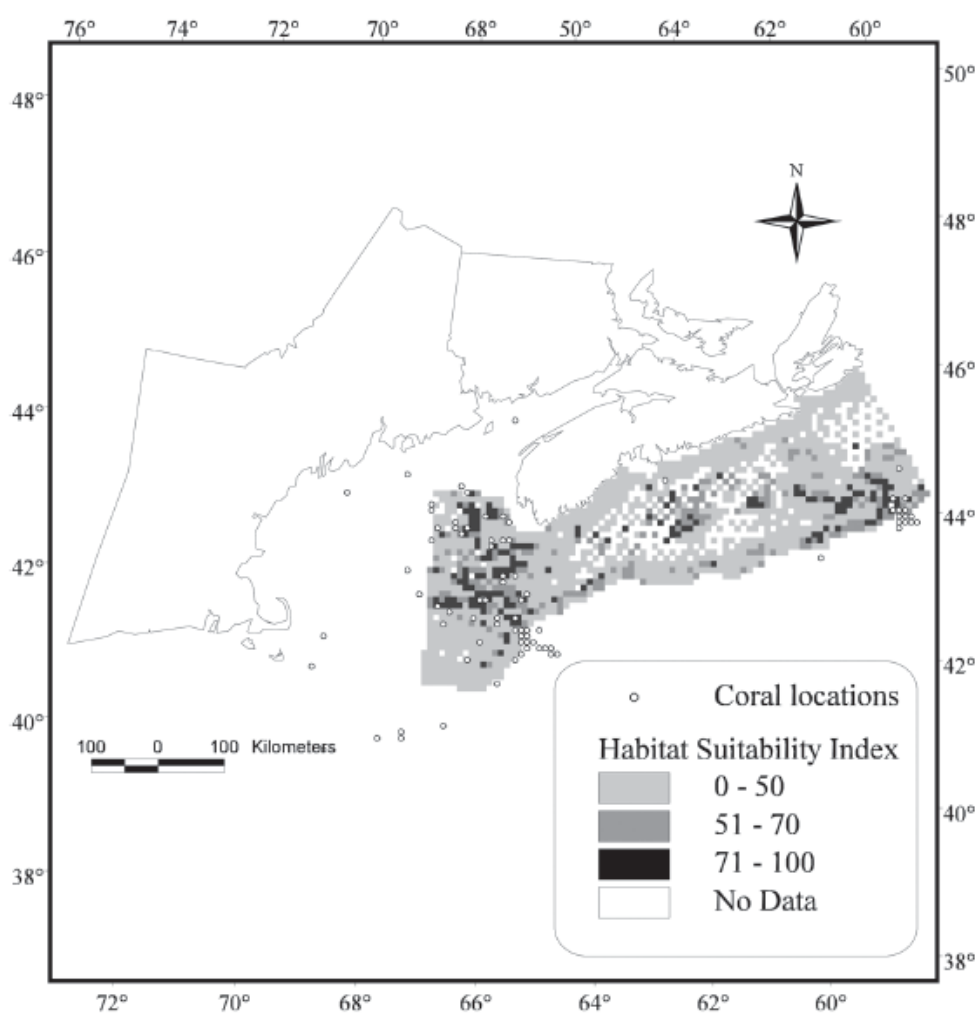
Nitrate = 0.913 ( $n = 6598$ )

Phosphate = 0.923 ( $n = 6386$ )

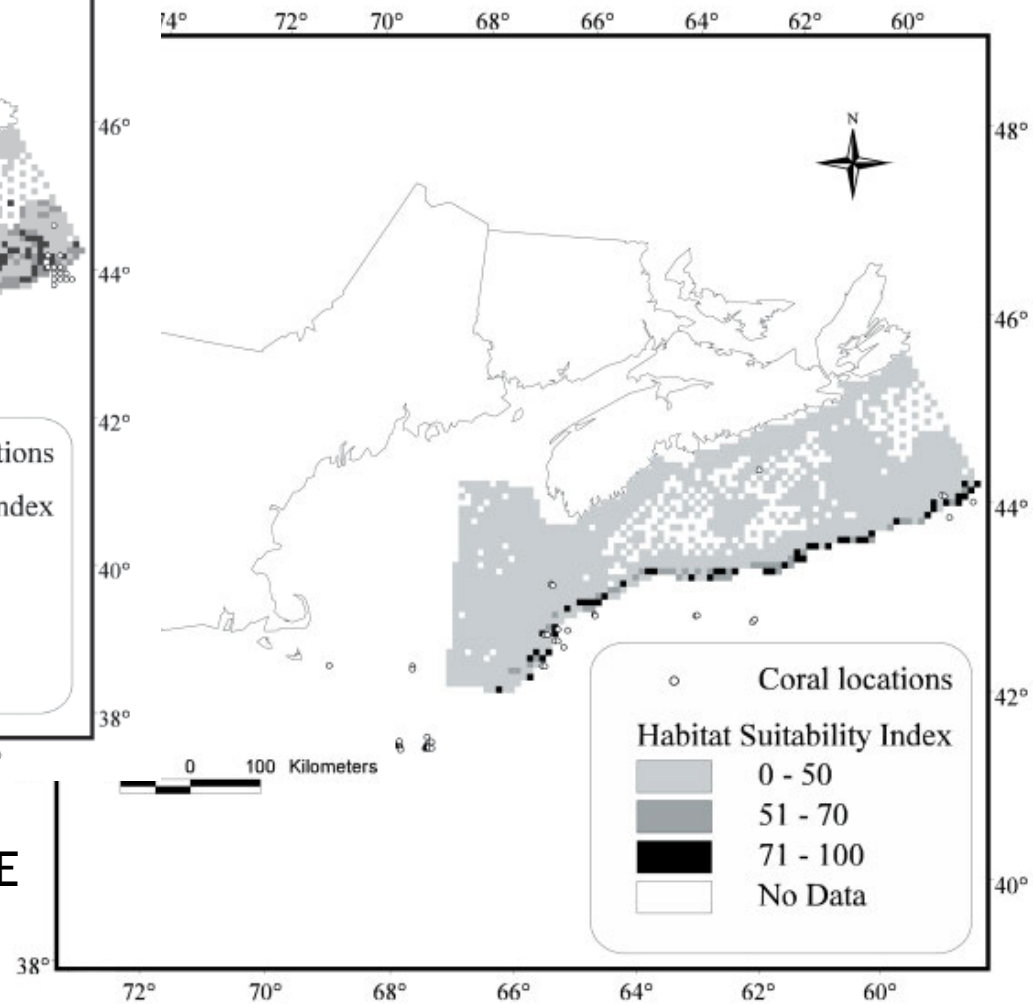
Silicate = 0.823 ( $n = 6994$ )

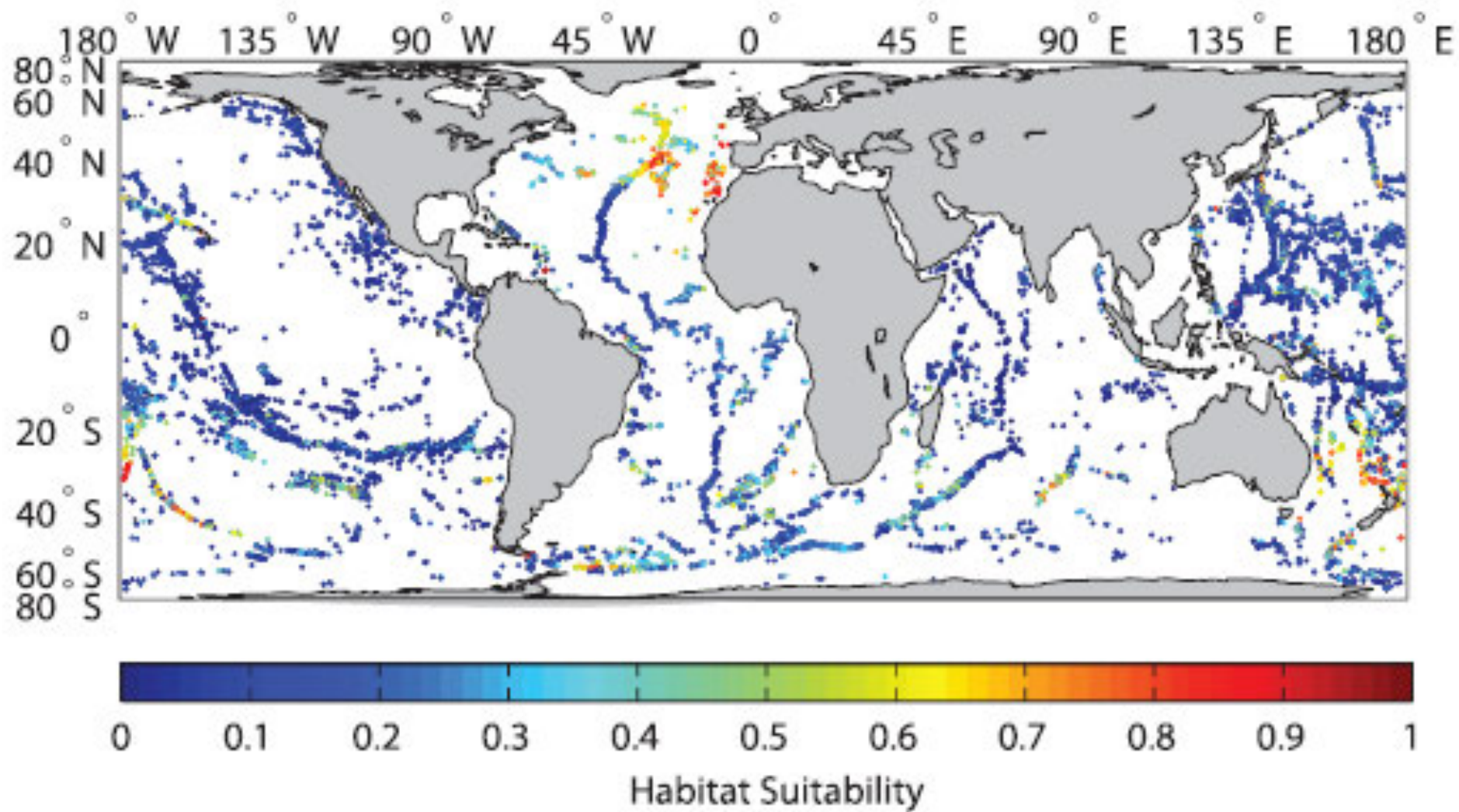
Red = variable, black = test set





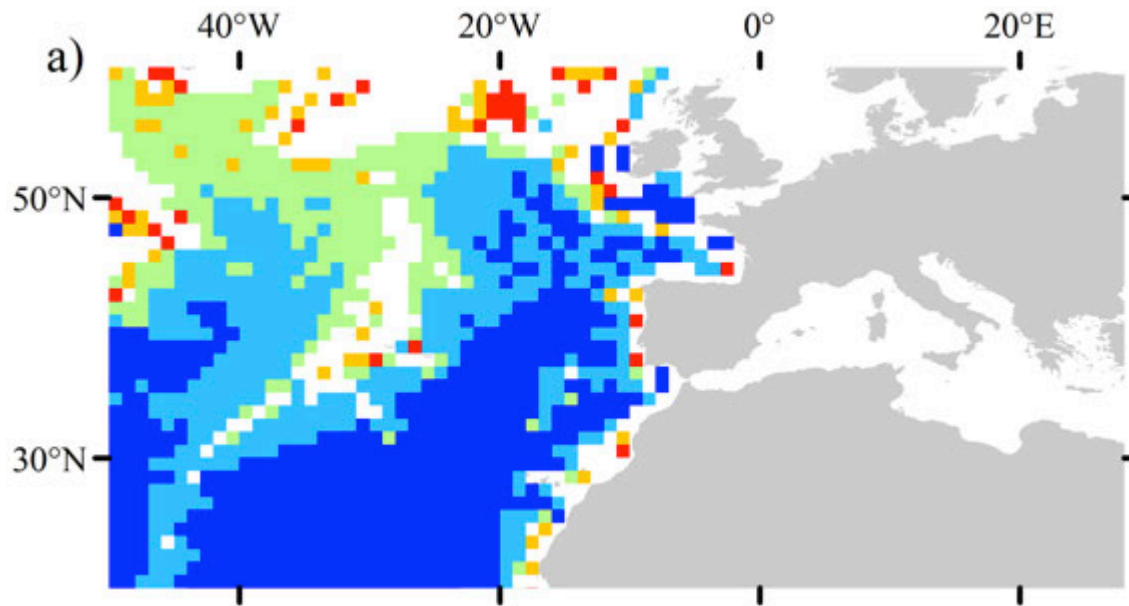
- Leverette and Metaxas (2005) CWCE
- Octocorals.



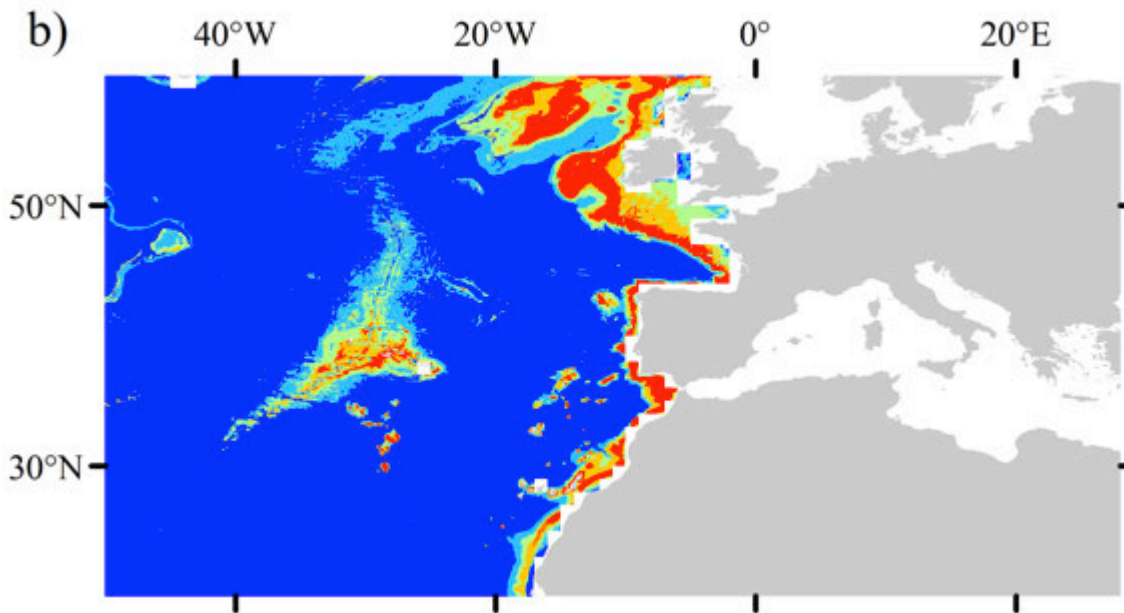


- Tittensor et al. (2009) J. Biogeog.
- Seamounts and coarse resolution





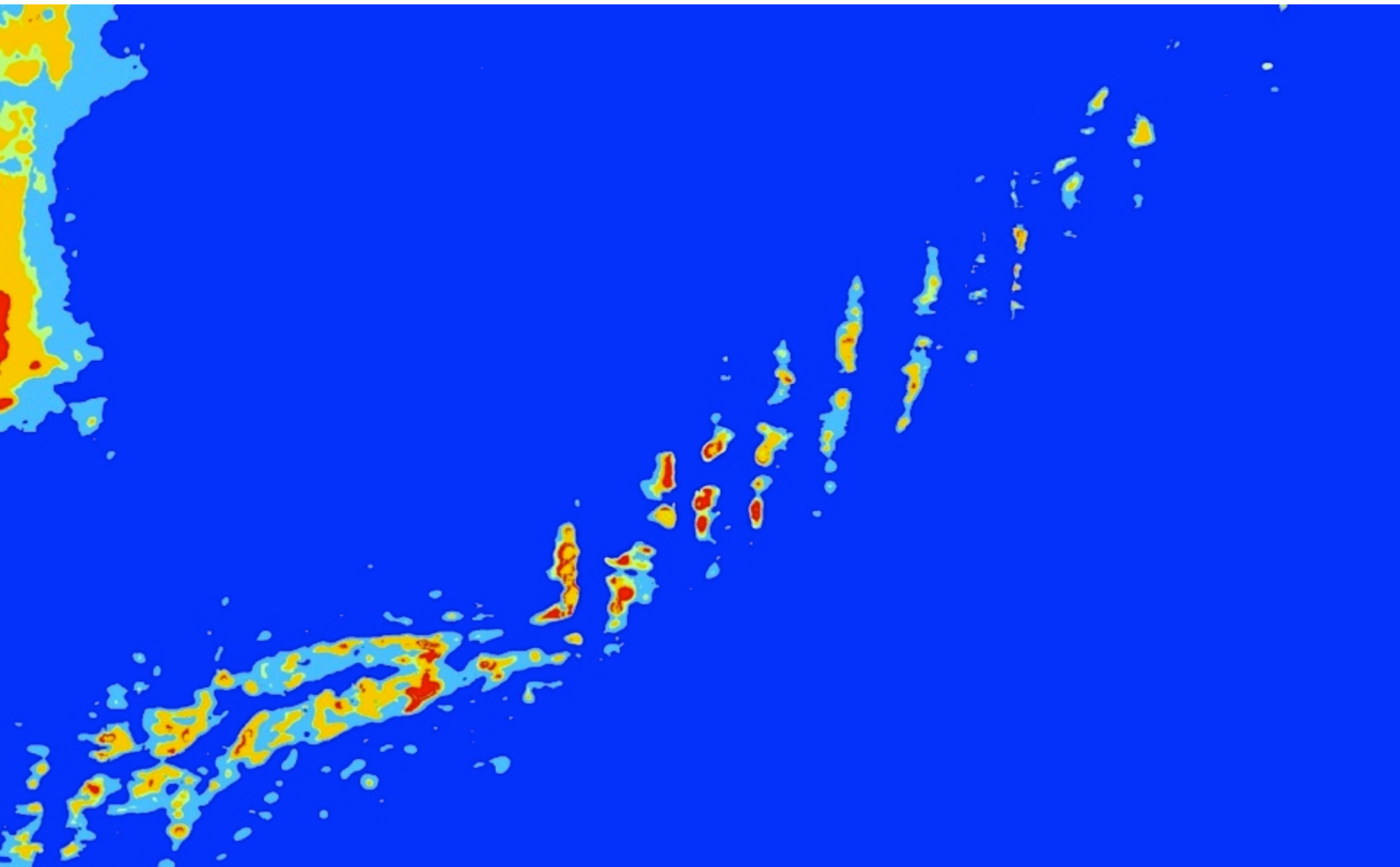
- Davies et al. (2008) DSR.
- Note low resolution of 1°



- Davies & Guinotte (2011) PLoS ONE.
- Significant improvement over earlier predictions.
- 30 arc second resolution (1 km)

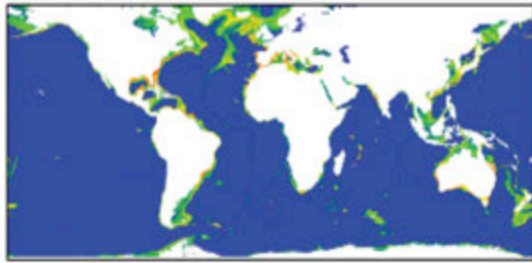
Prediction for *Lophelia pertusa*

## Prediction for *Solenosmilia*

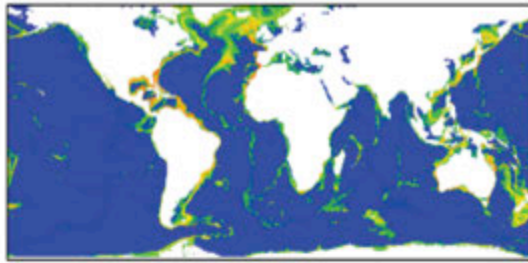




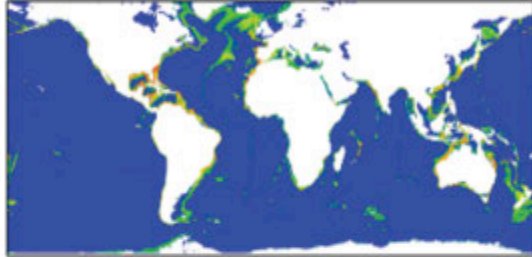
Alcyoniina



Calcaxonia



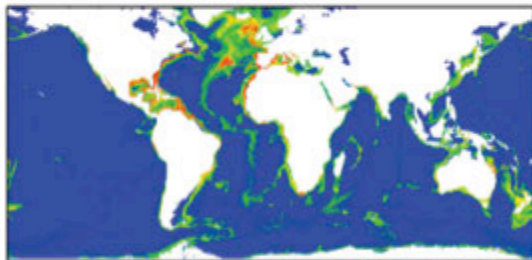
Holaxonia



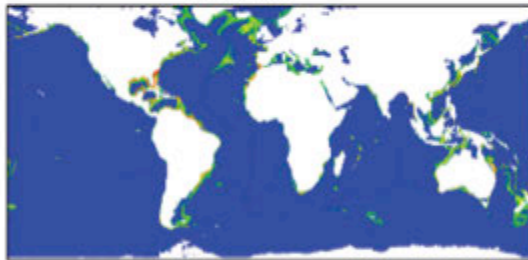
Scleraxonia



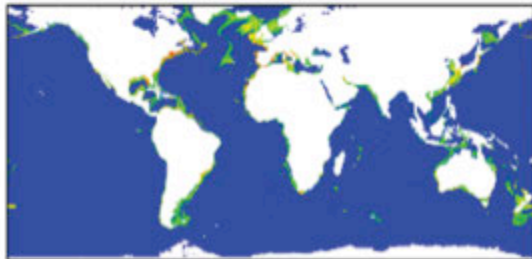
Sessiliflorae



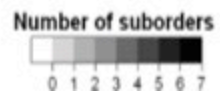
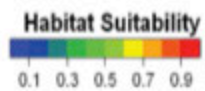
Stolonifera



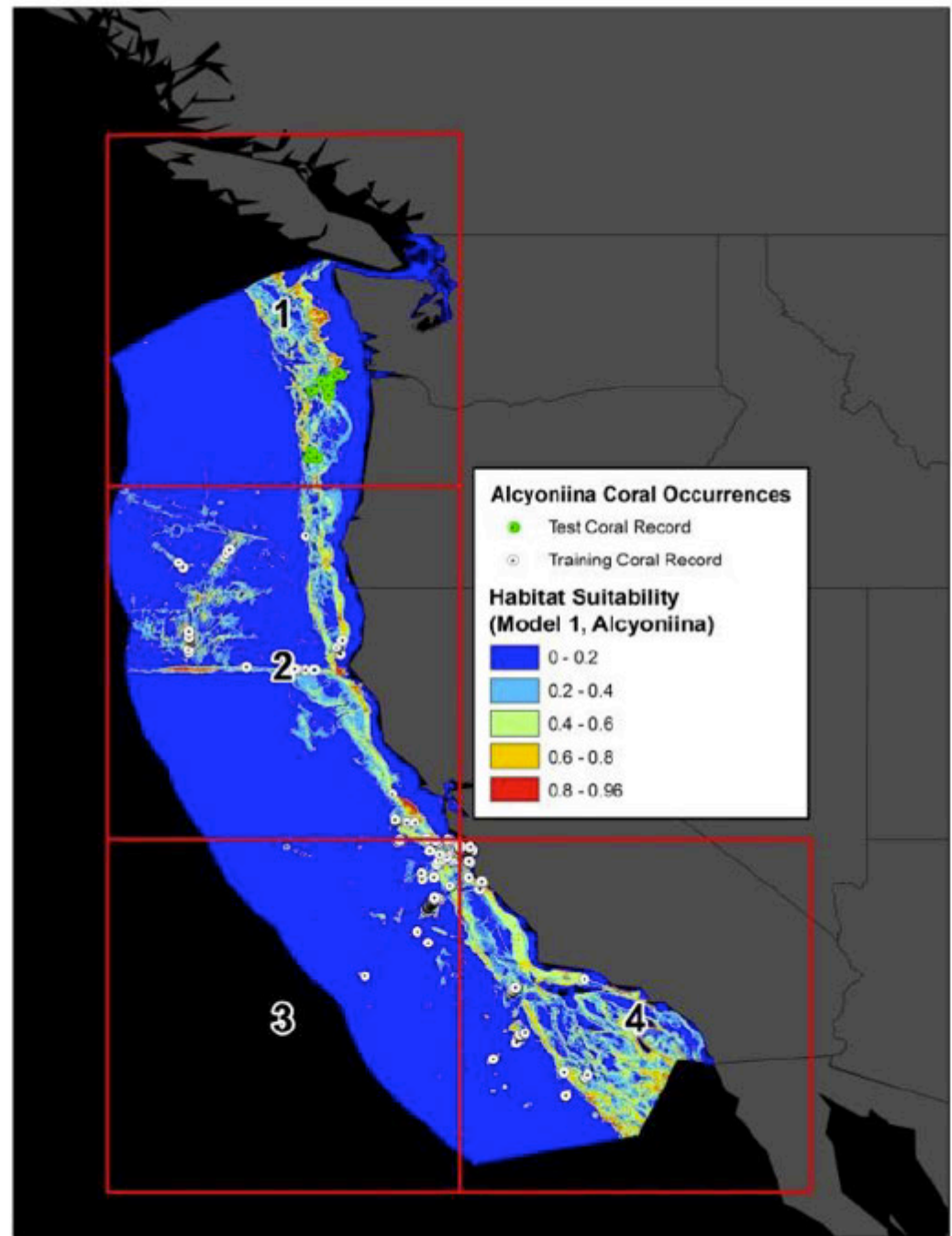
Subselliflorae



Octocoral consensus



Regional model for US West coast, developing spatial cross-validation approach.



20°0'0"W

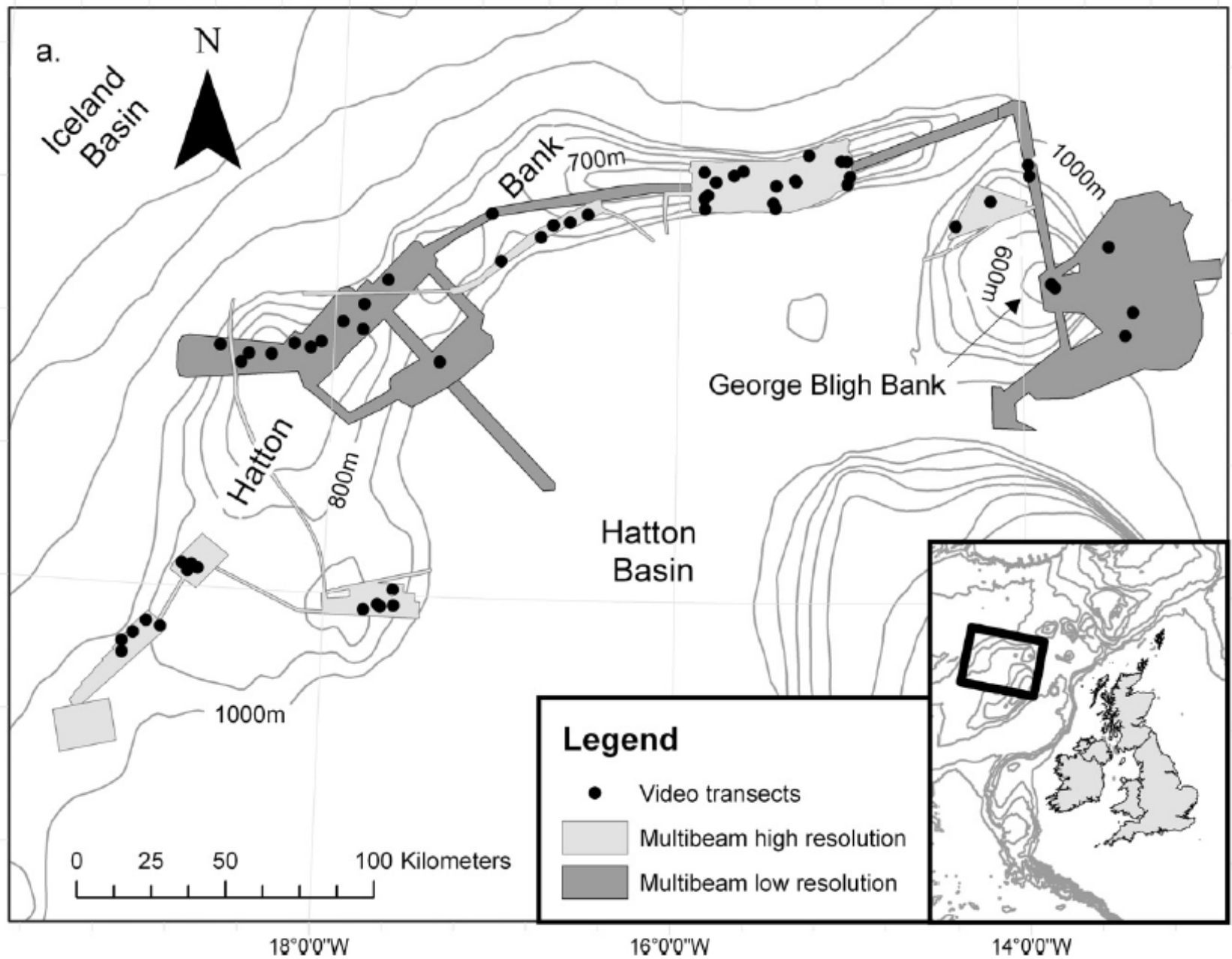
18°0'0"W

16°0'0"W

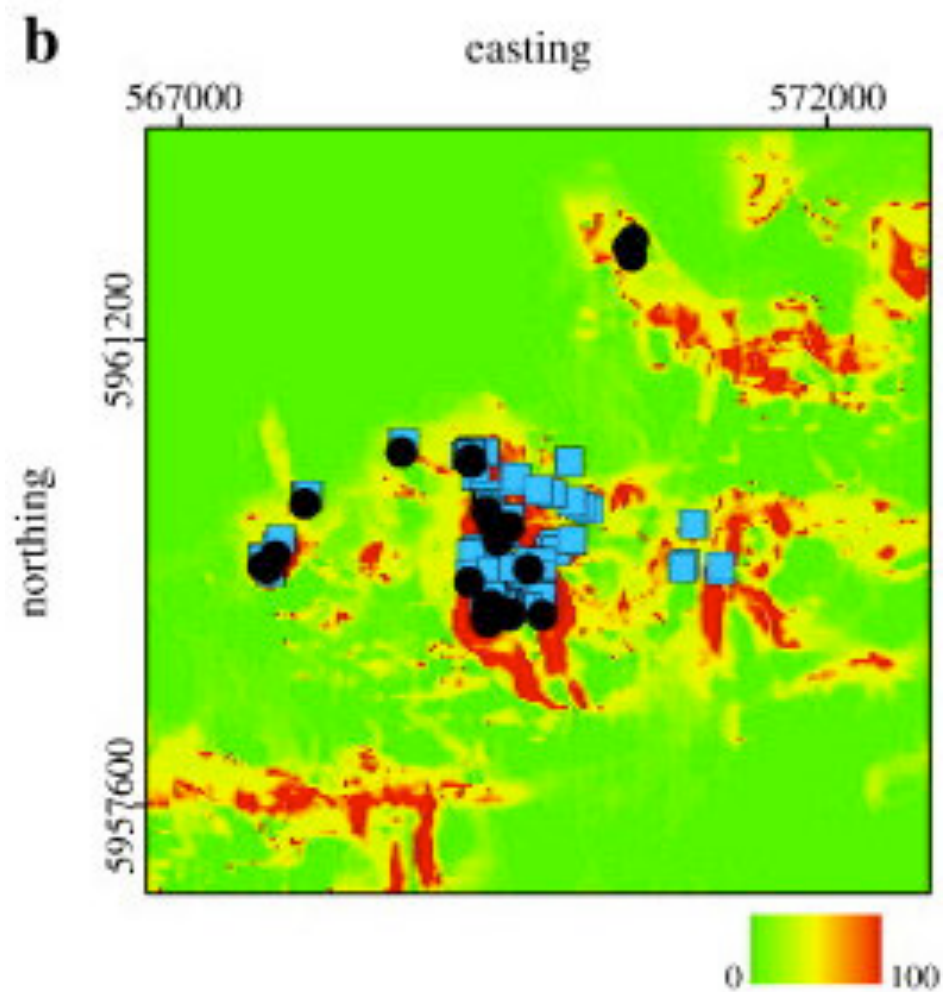
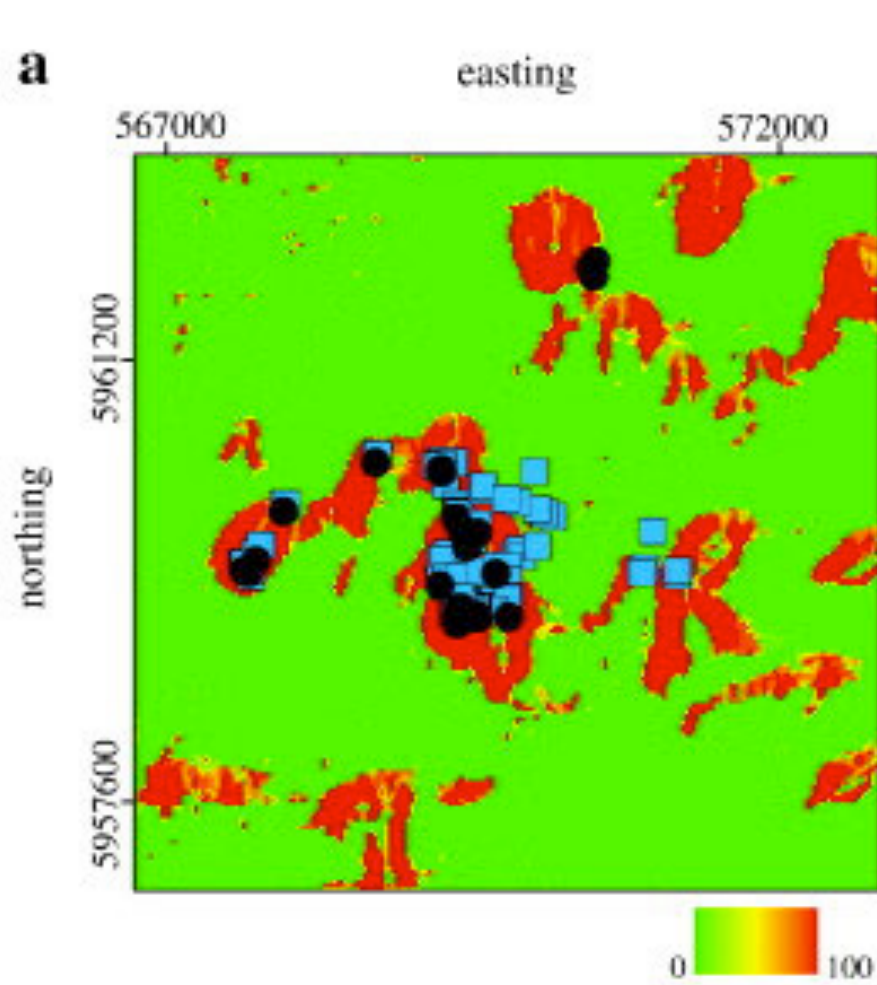
14°0'0"W

58°0'0"N

58°0'0"N







Guinan et al (2009) Eco Infor.

# General shift towards local scale

- Produces good maps, direct conservation/management relevance
- Easily verifiable
  - But...
    - The true power of predictive modelling lies in discovering the undiscovered. Those coral areas out there where there has been no survey effort.
- Also much greater adoption at this scale.

# Future direction

- Better environmental data:
  - High resolution environmental datasets, but more variables as ecological information improves
- Bigger species location datasets and more species:
  - 12,000 records of octocoral in Yesson et al. (in press), several thousand in Davies and Guinotte (2011).
  - But better quality data is needed.
- Integration with impact data and policy integration:
  - VMS records, impact assessments, climate change modelling.
- Higher quality, regional and local scale models:
  - Combination of multibeam and visual surveys (i.e. Guinan et al. 2009 & Howell et al. 2011).



