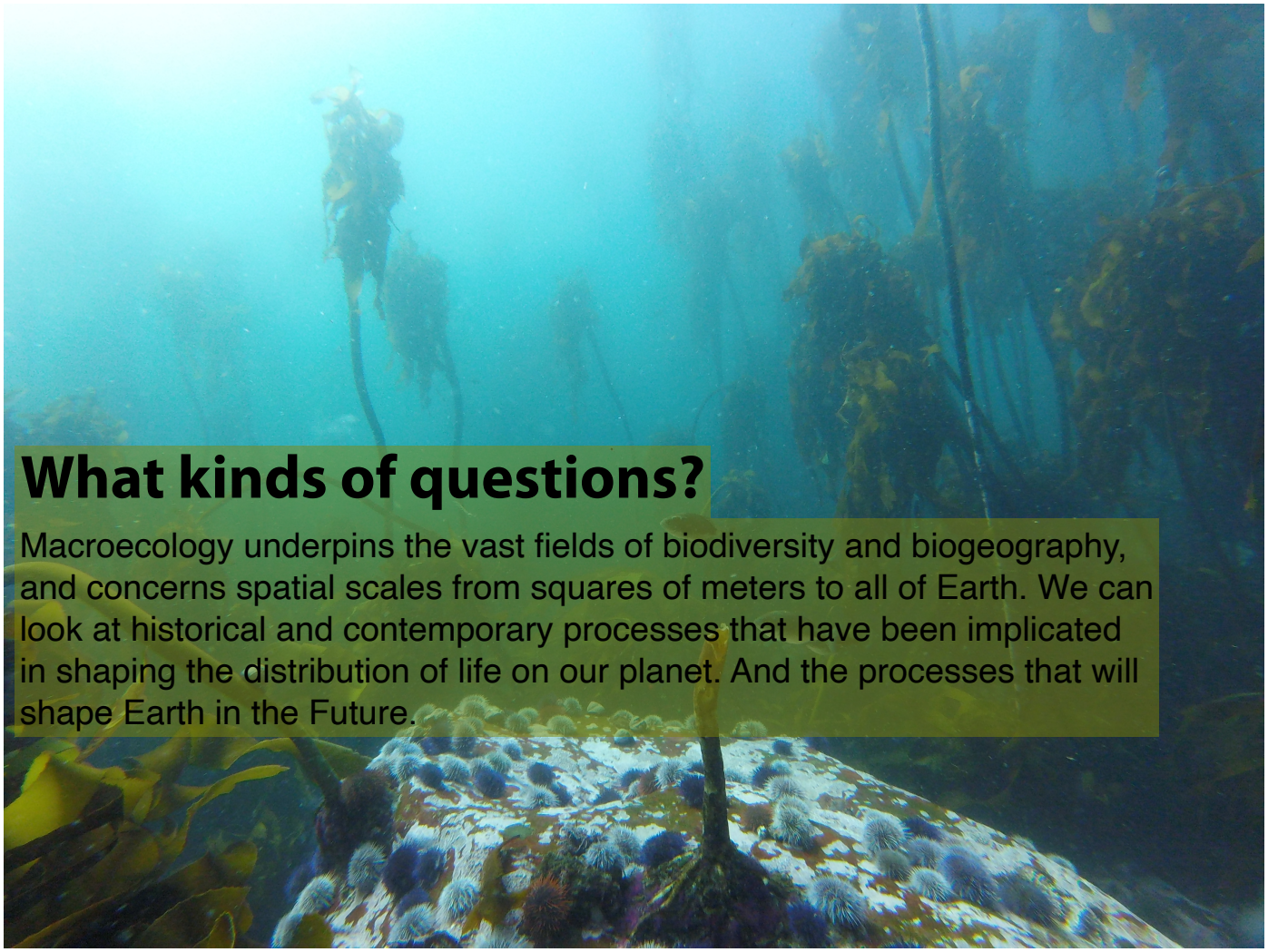
BDC334
Biogeography & Global Ecology

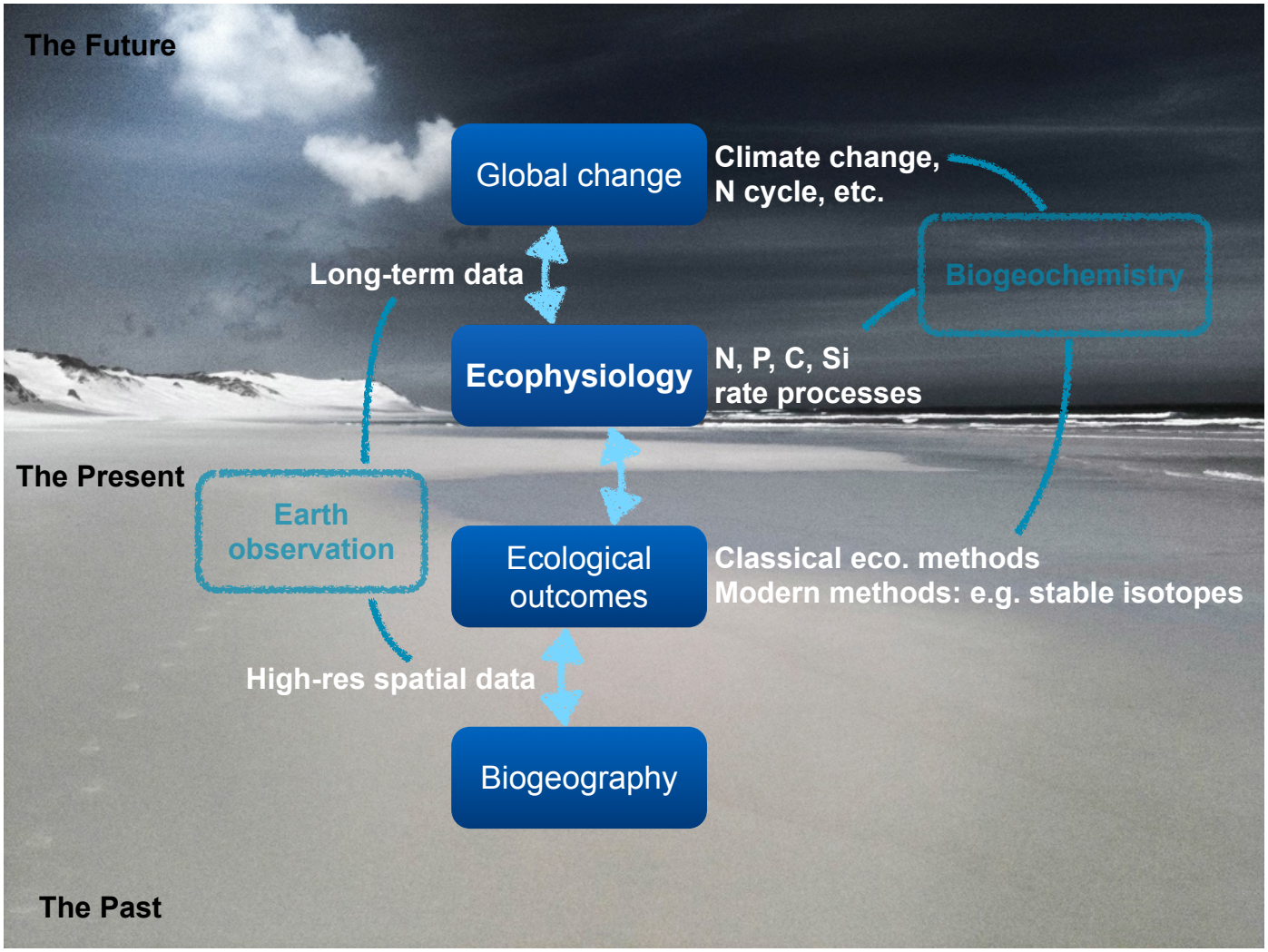
Topic 2
Gradients



What kinds of questions?

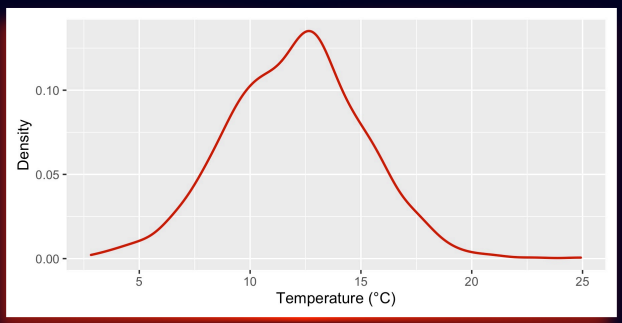
Macroecology underpins the vast fields of biodiversity and biogeography, and concerns spatial scales from squares of meters to all of Earth. We can look at historical and contemporary processes that have been implicated in shaping the distribution of life on our planet. And the processes that will shape Earth in the Future.

Processes


The Future
Global change
Climate change,
N cycle, etc.
Long-term data
Biogeochemistry
Ecophysiology
N, P, C, Si
rate processes
The Present
Earth
observation
Ecological
outcomes
Classical eco. methods
Modern methods: e.g. stable isotopes
High-res spatial data
Biogeography
The Past

Gradients

- it is easy to understand how species and/or samples come to be arranged (sorted) along gradients
- the **unimodal model** *sensu* Whittaker (1967, 1969):
  - the relationship between the abundance [*etc.*] of species *vs.* position along a gradient is a unimodal function
  - this implies that each species has a unique set of optimal conditions at which the species attains maximal abundance
  - the abundance decreases away from that 'sweet spot'
- multiple gradients co-exist, and communities (*i.e.* a collection of outcomes according to interacting unimodal species-environment models) are formed in this 'space' of gradients



http://ordination.okstate.edu/overview.htm

Coenoclines

- a coenocline is a visual representation of all species response functions combined along a single gradient
- given the large number of species and the high noise in most studies, coenoclines are usually only displayed in highly simplified form
- nevertheless, they are useful heuristic concepts
- coenoplanes (2 environmental gradients) and coenospaces (>2 gradients) are even more difficult to display
- however, specialised statistical approaches can produce abstracted depictions of coenospaces

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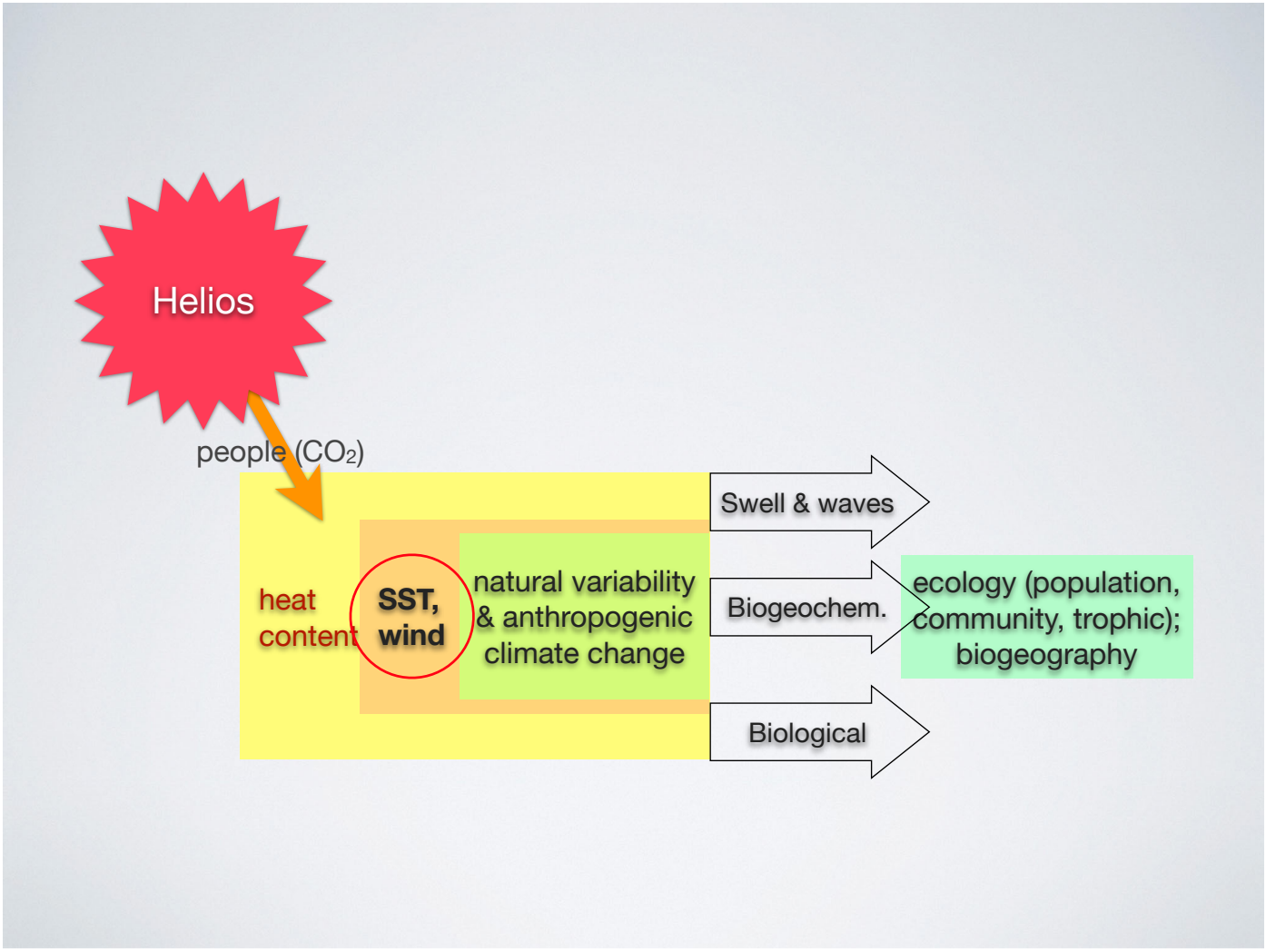
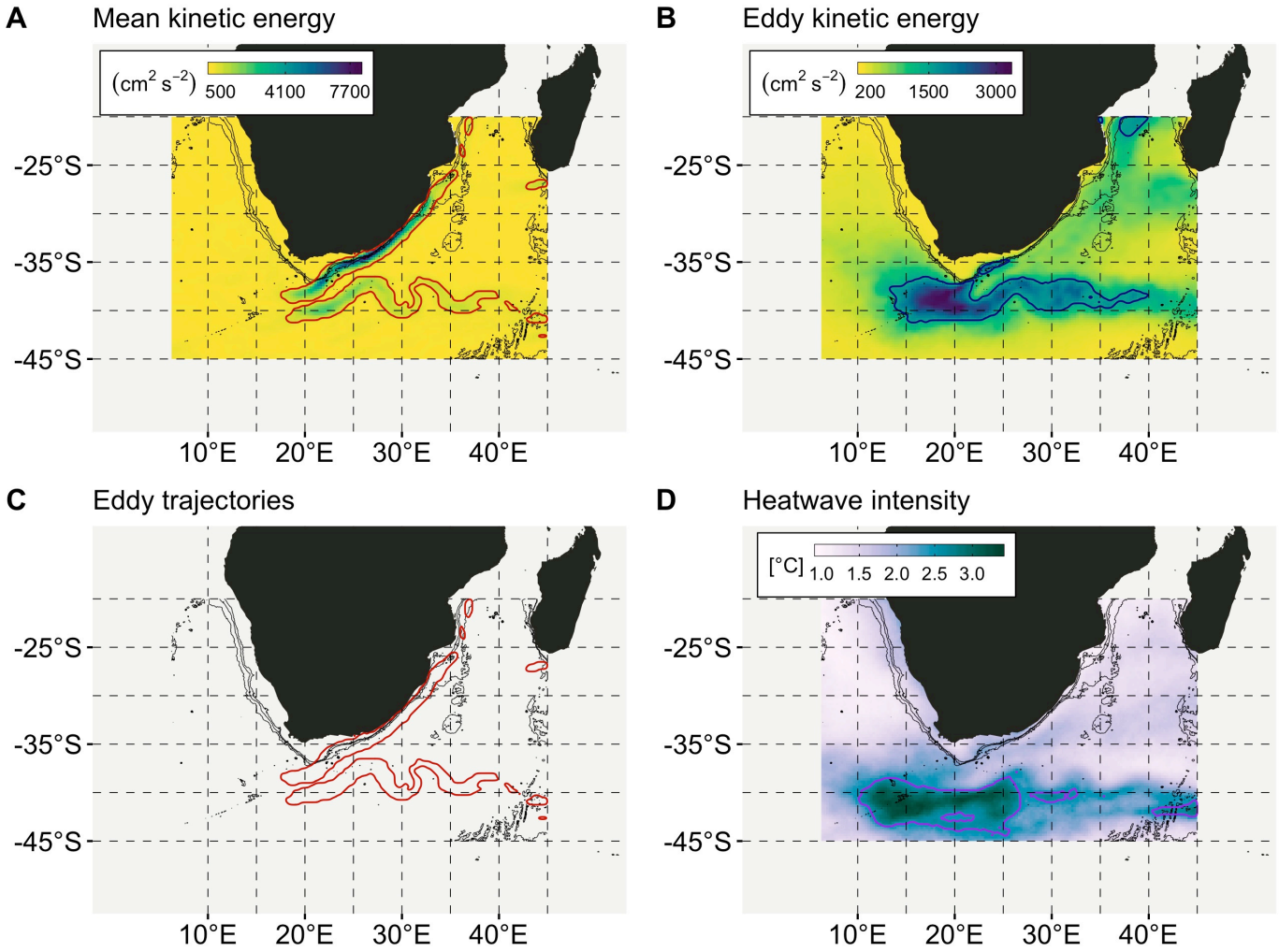
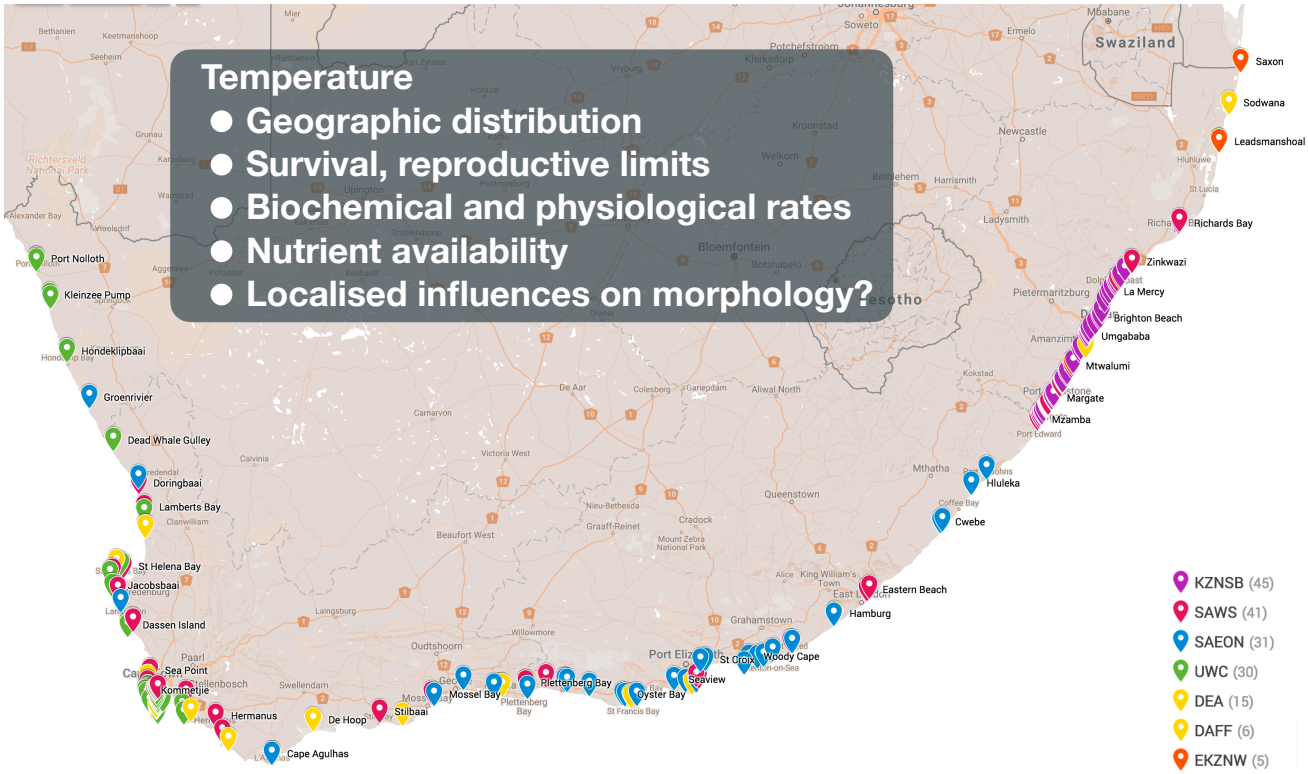


Regional gradients





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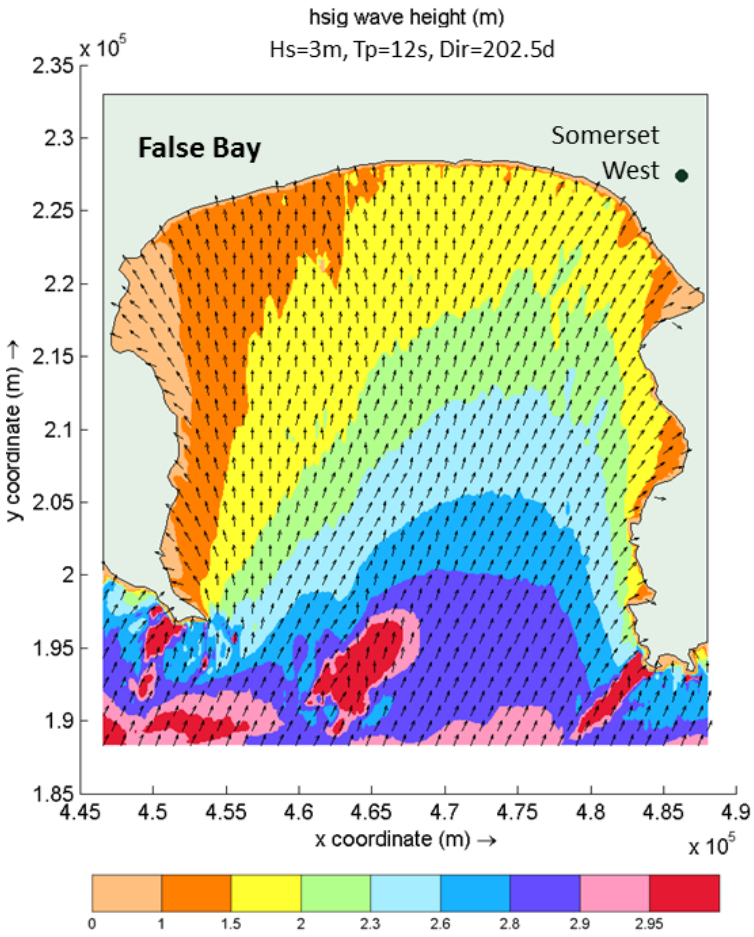
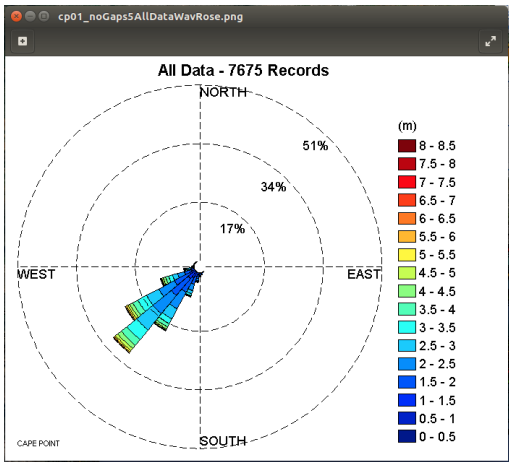




Numerical wave model

- Wave Watch III forced by NCEP winds at 3hr resolution, hindcast from 1994-2013
- Wave parameters modelled using SWAN
- 200m alongshore resolution

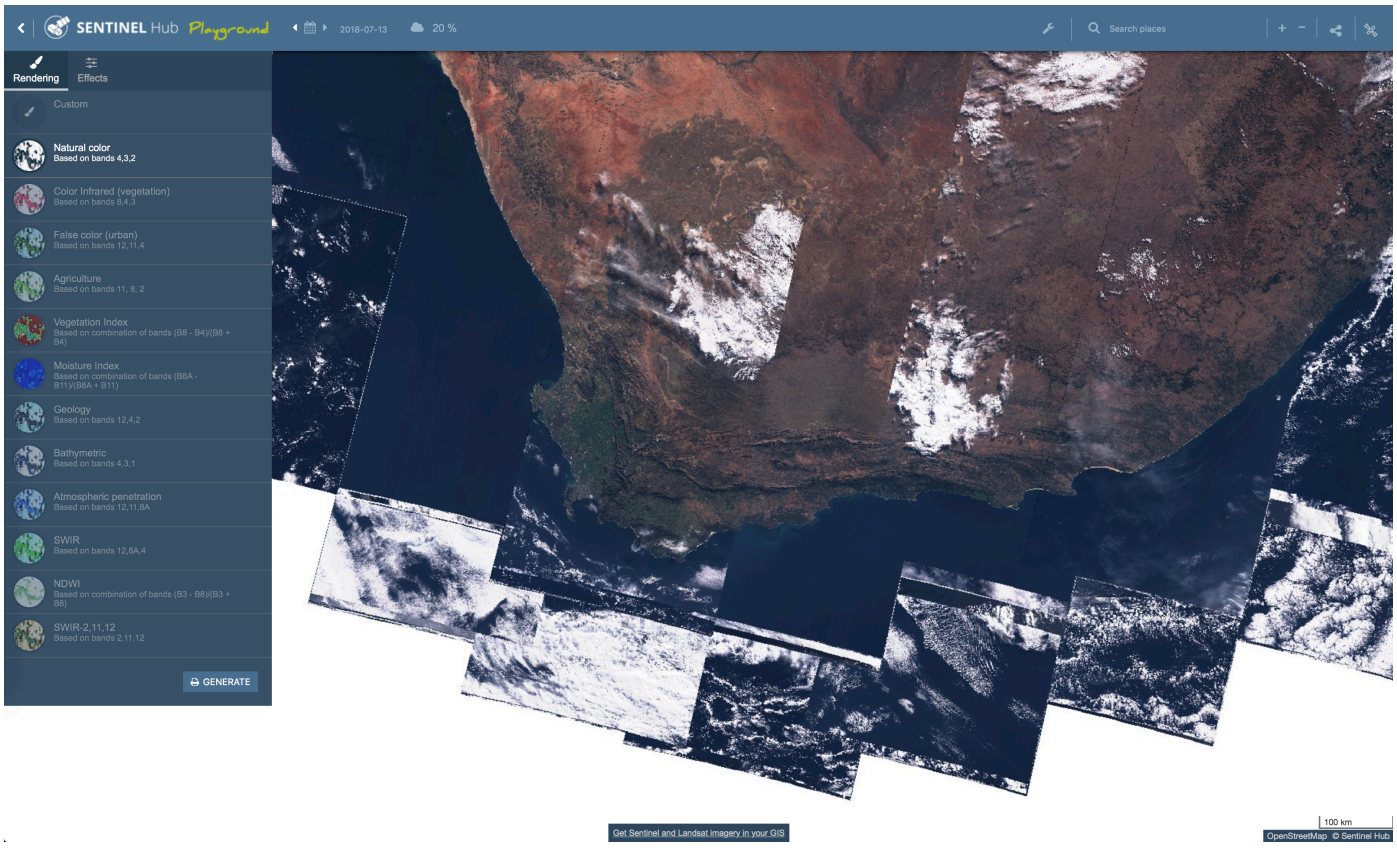
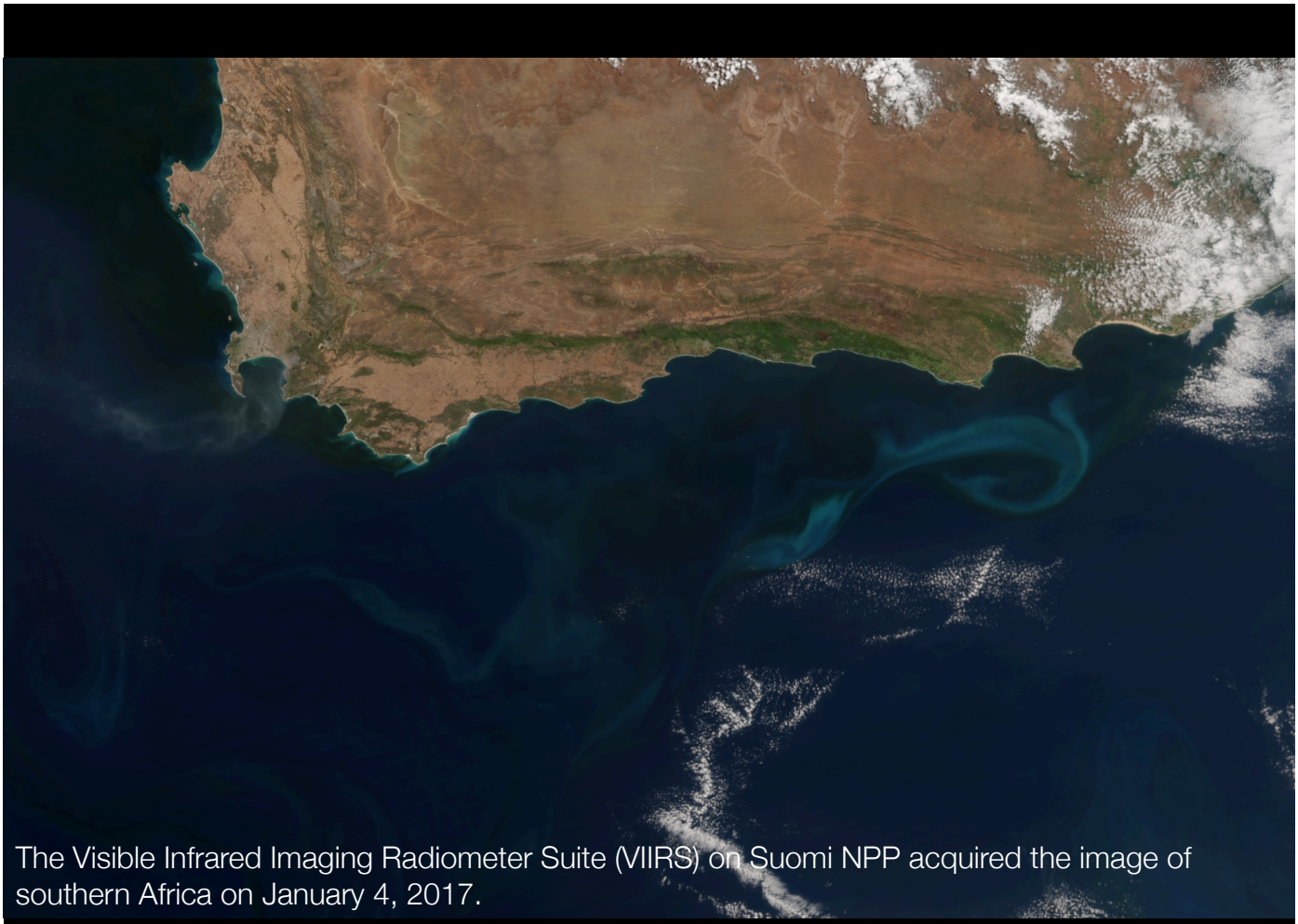


Image of Cape Agulhas was acquired by the Operational Land Imager (OLI) on Landsat 8 on May 25, 2016.



The Visible Infrared Imaging Radiometer Suite (VIIRS) on Suomi NPP acquired the image of southern Africa on January 4, 2017.

Global gradients

Self study

- think of several
- think about how biodiversity is affected by them