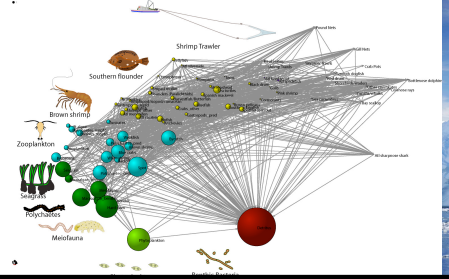
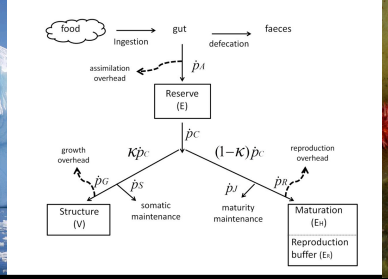
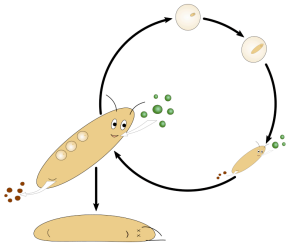



Inferring the responses of **Southern Ocean benthic species** to *environmental changes* using **Dynamic Energy Budget models**

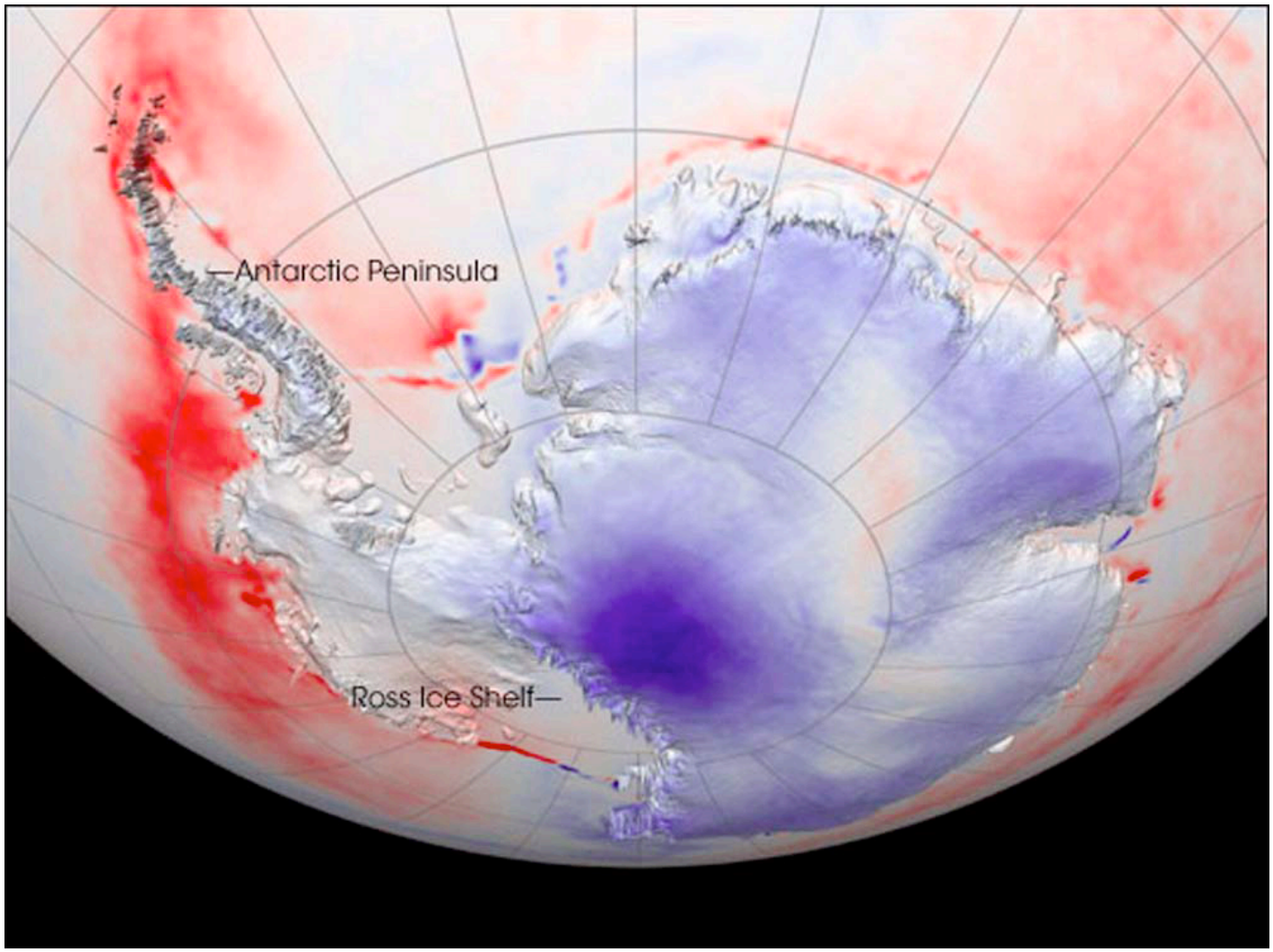
Charlène GUILLAUMOT
ULB, Bruxelles
Bruno Danis, Thomas Saucède



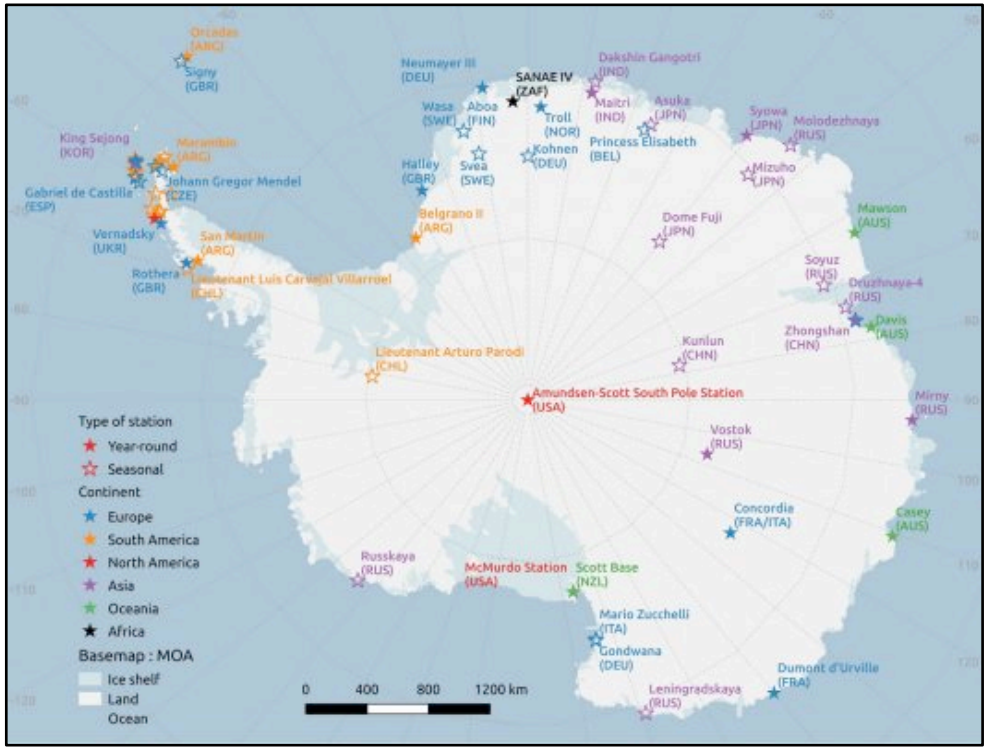
DEB2019
12th April 2019

INTRODUCTION

Mean changes in surface temperature per decade [1957-2004], NASA



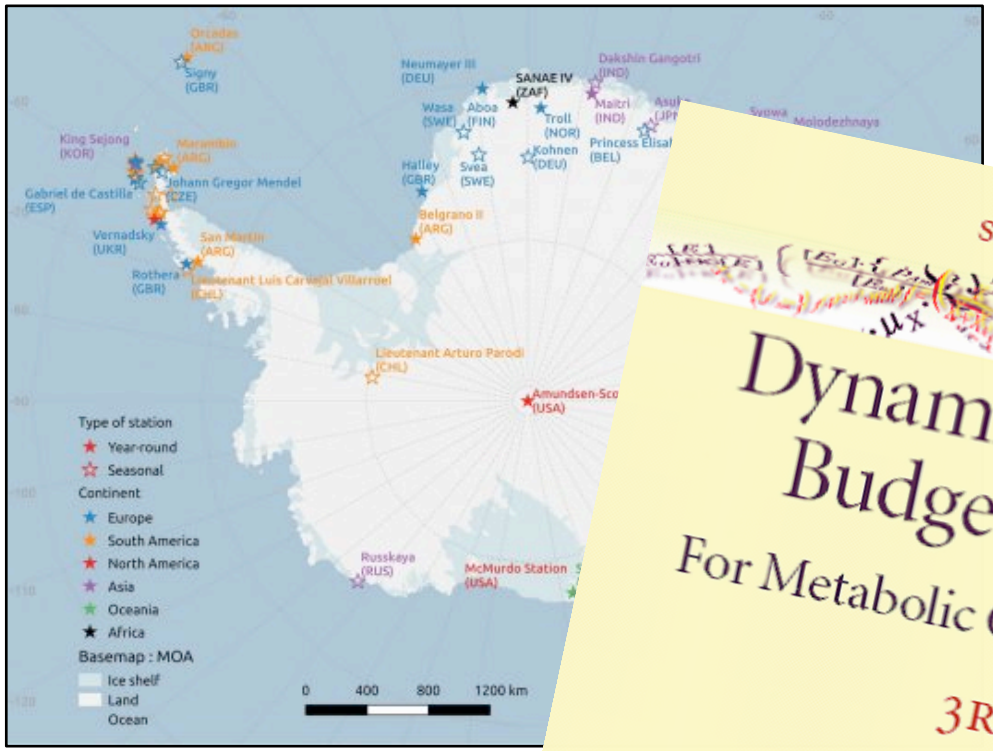
INTRODUCTION



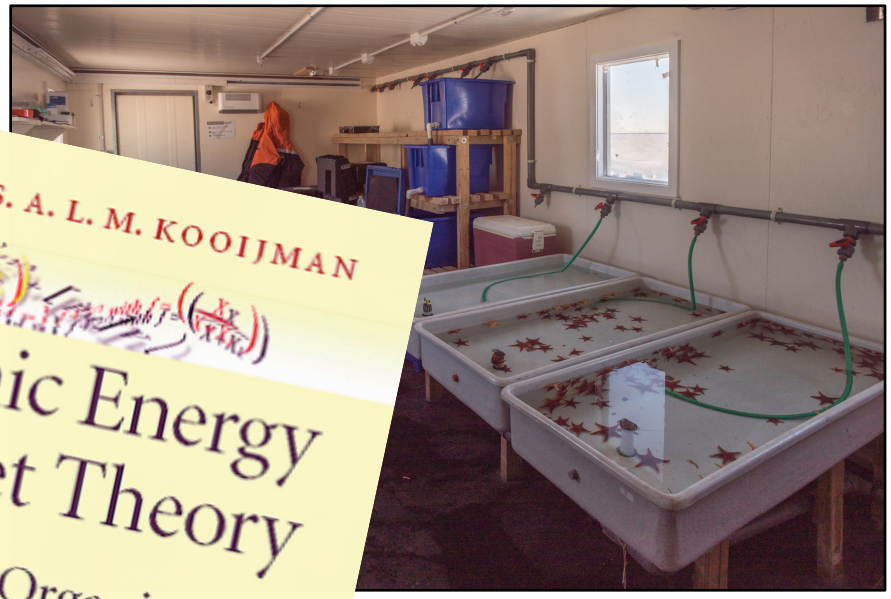
Rothera, Agüera et al. 2016

Research stations

INTRODUCTION



Research stations



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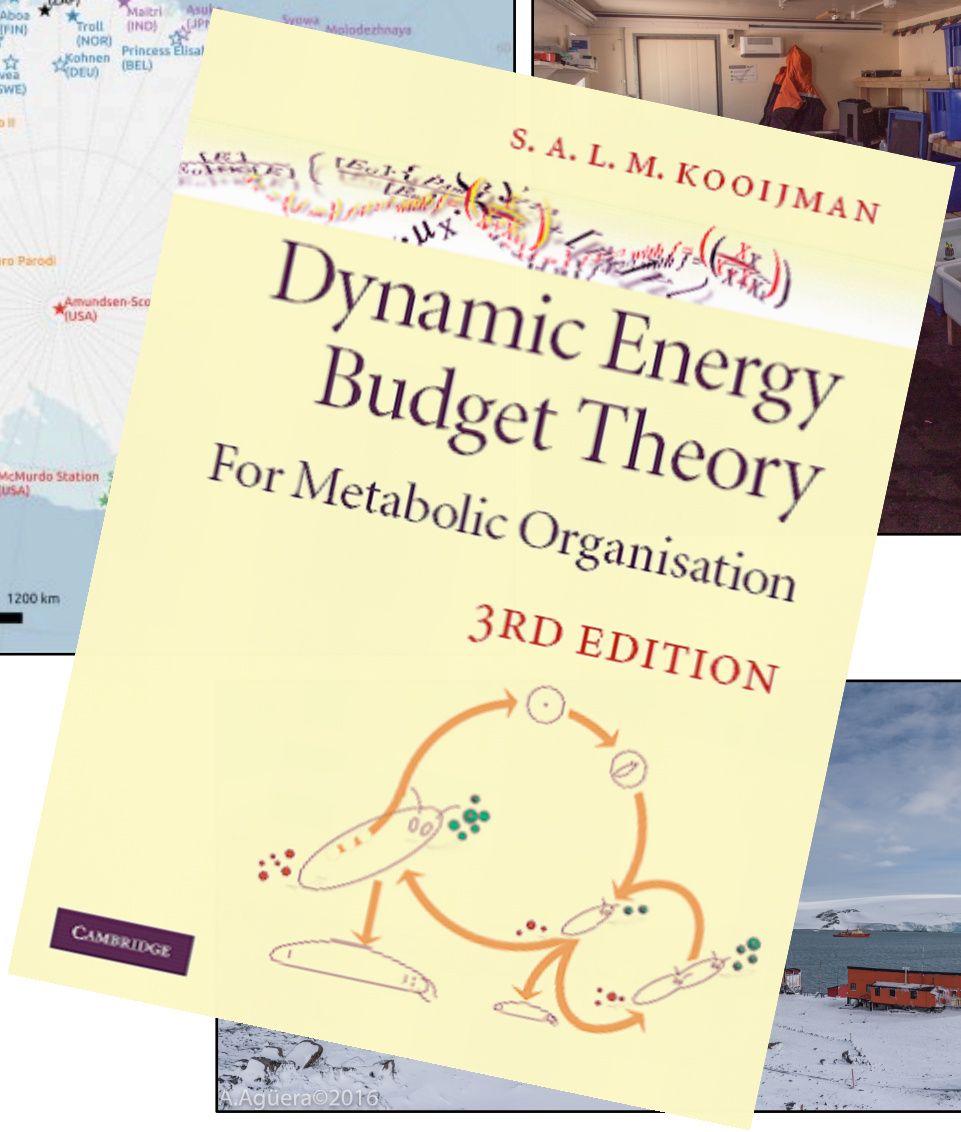
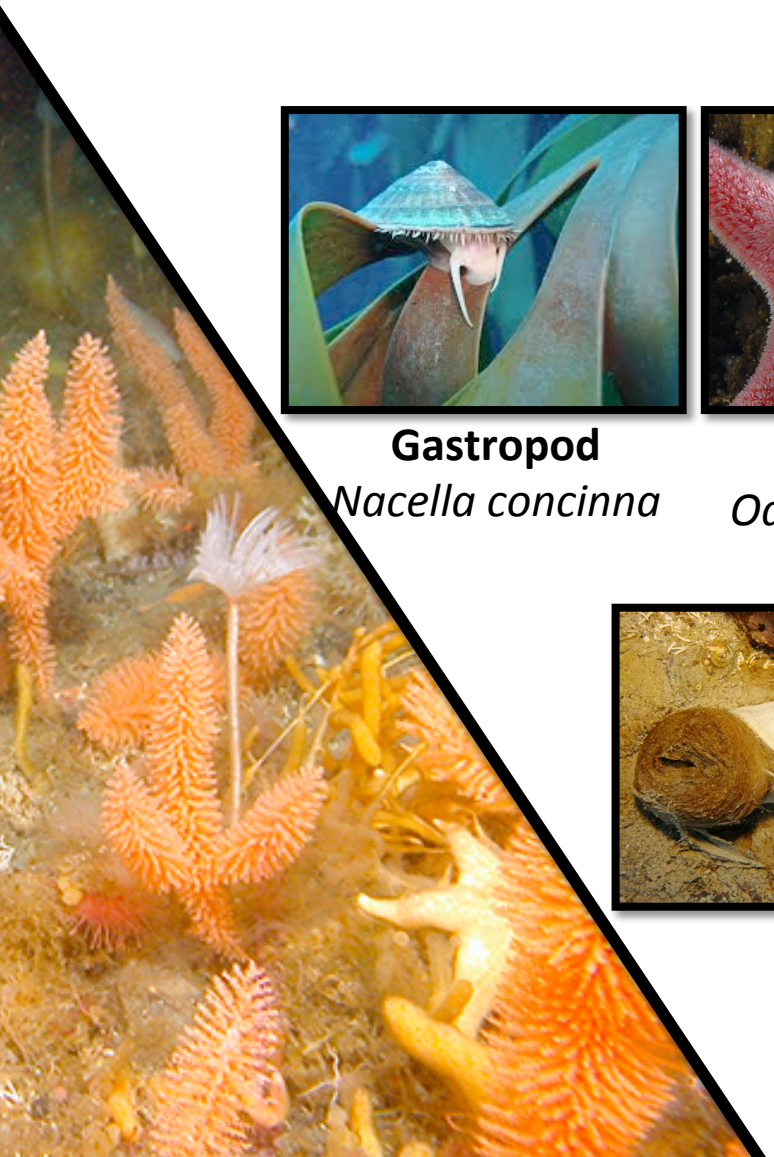


METHODS

Focus on some species…



Gastropod
Nacella concinna

Sea star
Odontaster validus

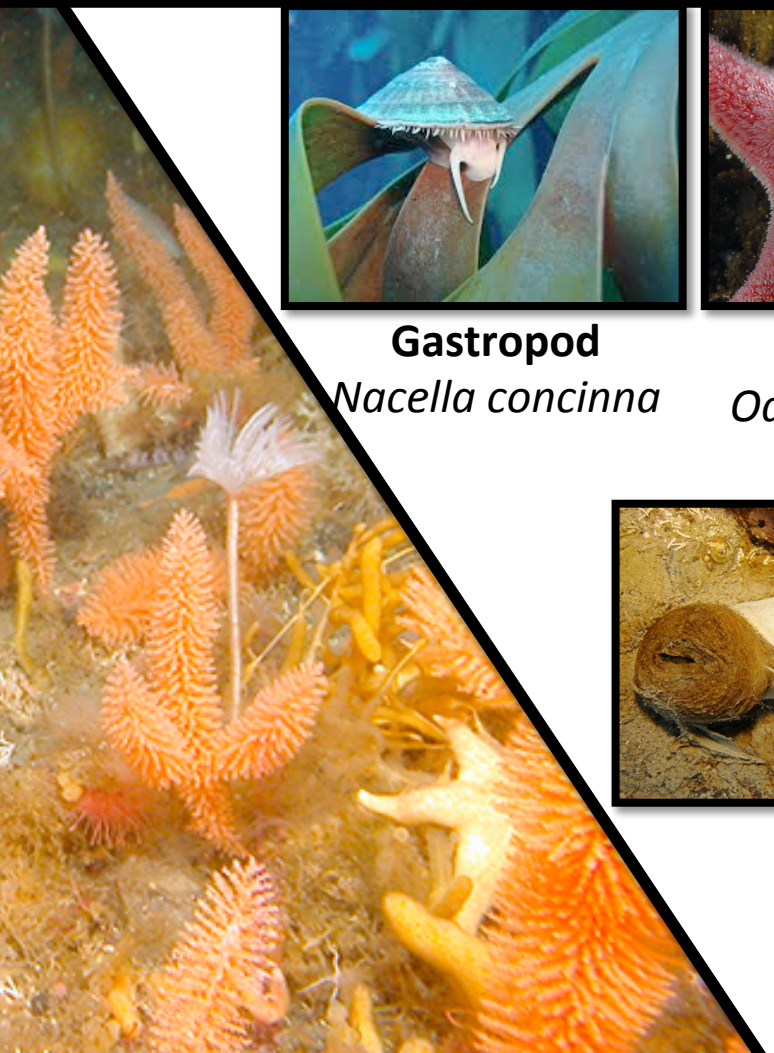
Sea urchins
Sterechinus neumayeri &
Abatus cordatus

Bivalves
Laternula elliptica &
Adamussium colbecki

Benthic fish
Trematomus bernacchii

METHODS

- Abundant in Southern Ocean benthic communities
- Contrasting physiological tolerances
- Contrasting feeding diets and reproductive strategies



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Sterechinus neumayeri &
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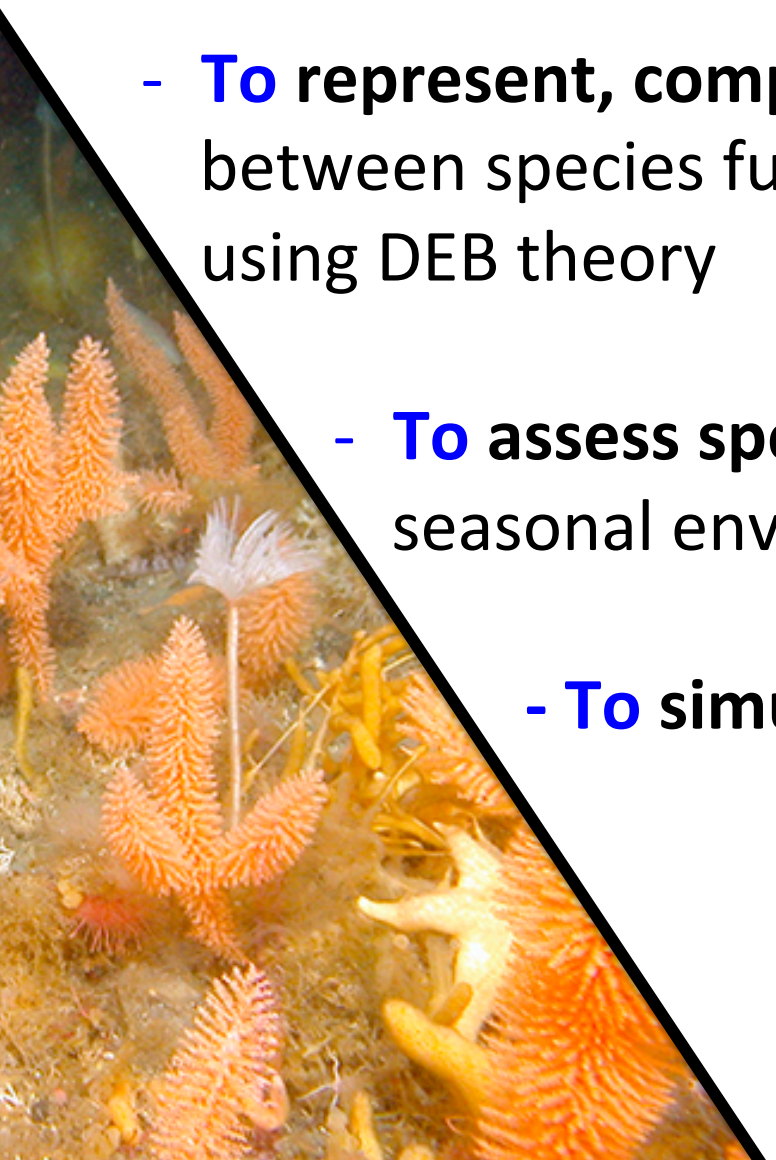
Bivalves
Laternula elliptica &
Adamussium colbecki

Benthic fish
Trematomus bernacchii

OBJECTIVES

Assess modelling potentials:

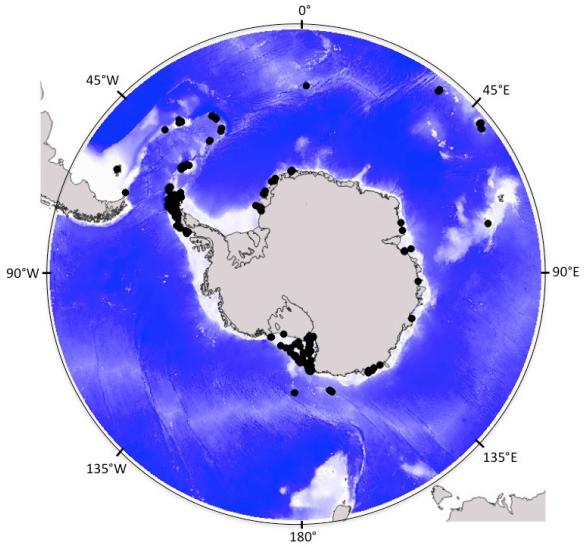


- **To represent, compare and highlight** the contrasts between species fundamental niches (Hutchinson, 1957) using DEB theory

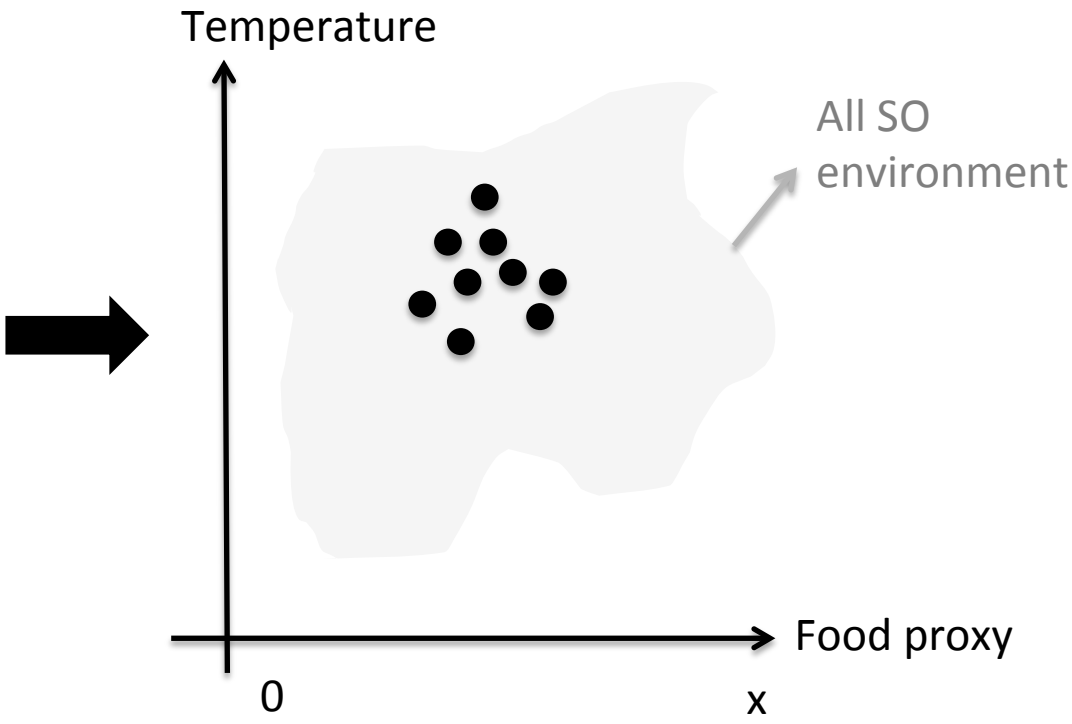
- **To assess species physiological sensitivity** to seasonal environmental changes

- **To simulate** global environmental changes?

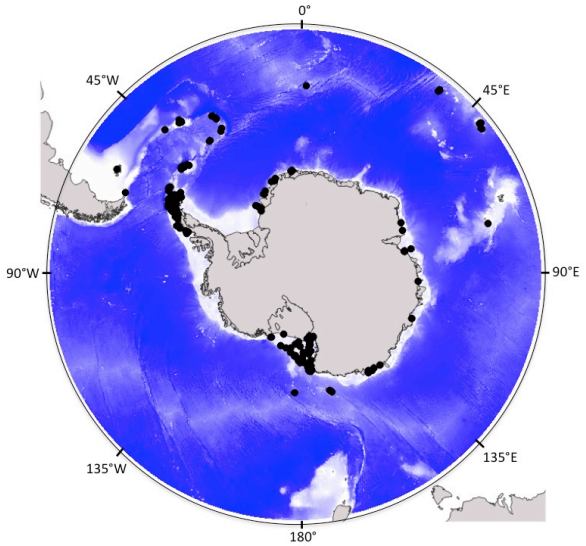
METHODS



Occurrences



METHODS



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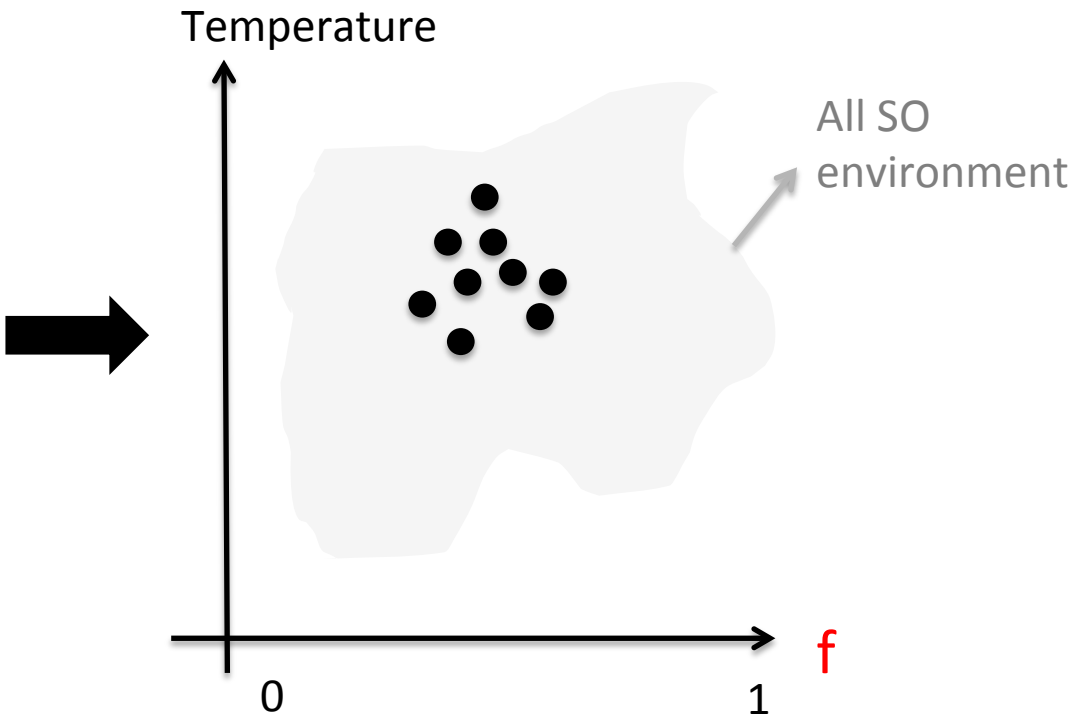
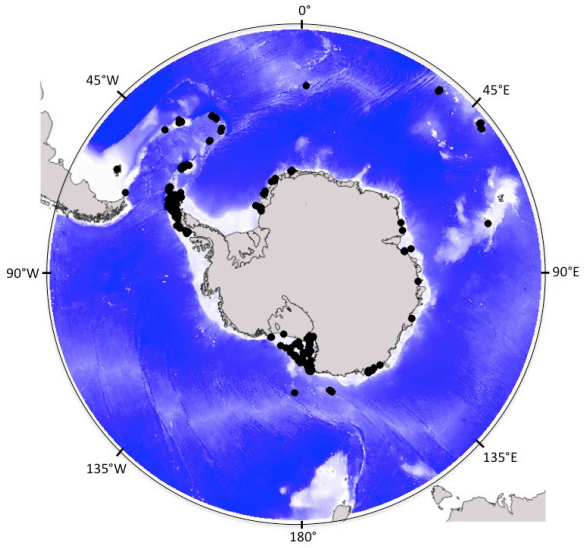
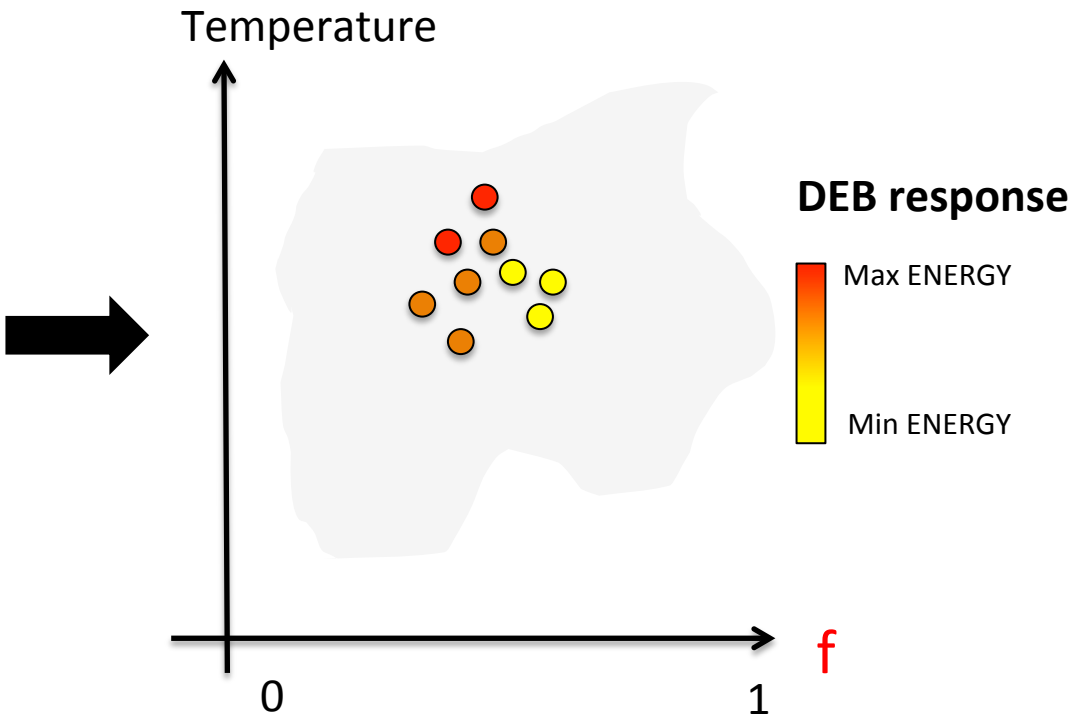


METHODS



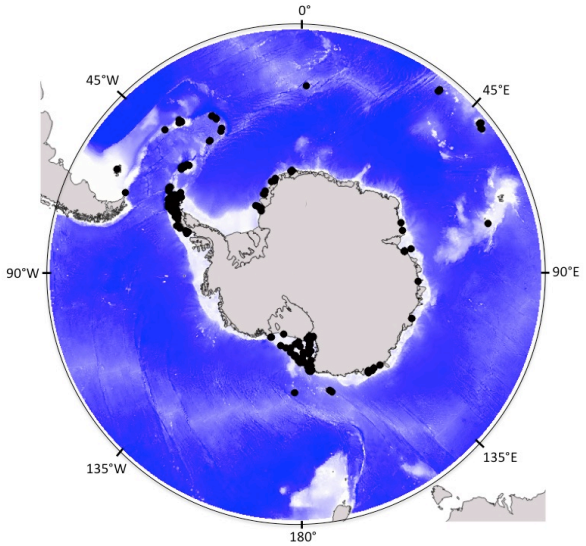
Occurrences



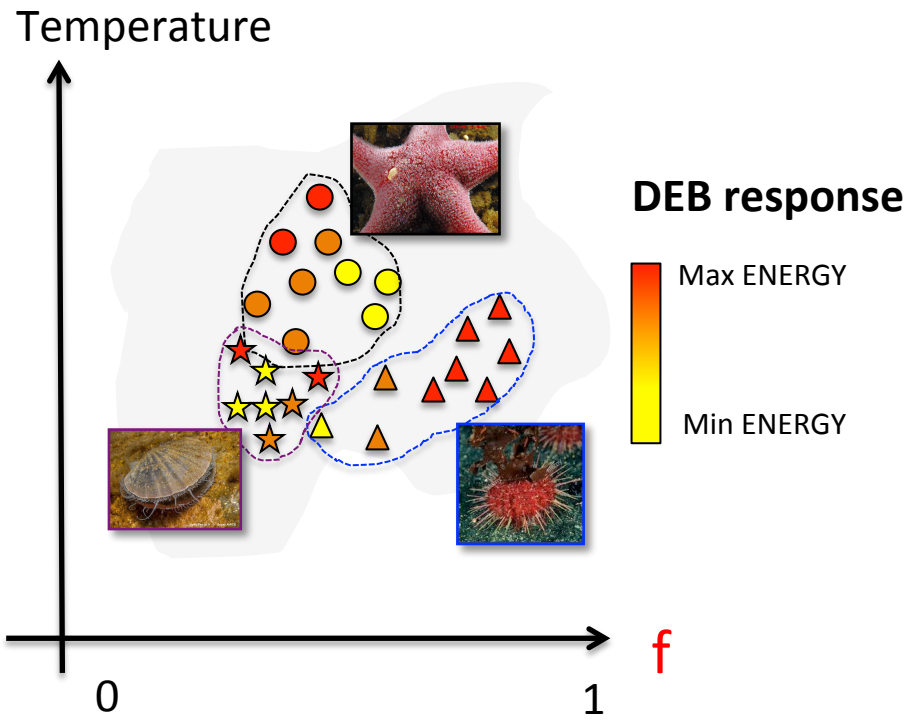
DEB responses

- Reserves dynamics
- Maintenance costs/energy stress
- Energy invested into reproduction
- Energy invested into growth

METHODS



Occurrences



COMPARISONS

- Between species
- Seasonal environmental changes

DEB responses

- Reserves dynamics
- Maintenance costs/energy stress
- Energy invested into reproduction
- Energy invested into growth

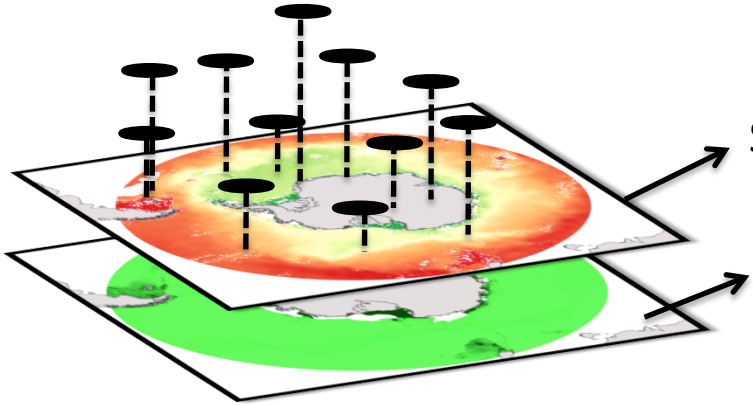
METHODS

Sea urchin
Sterechinus neumayeri

Sea star
Odontaster validus

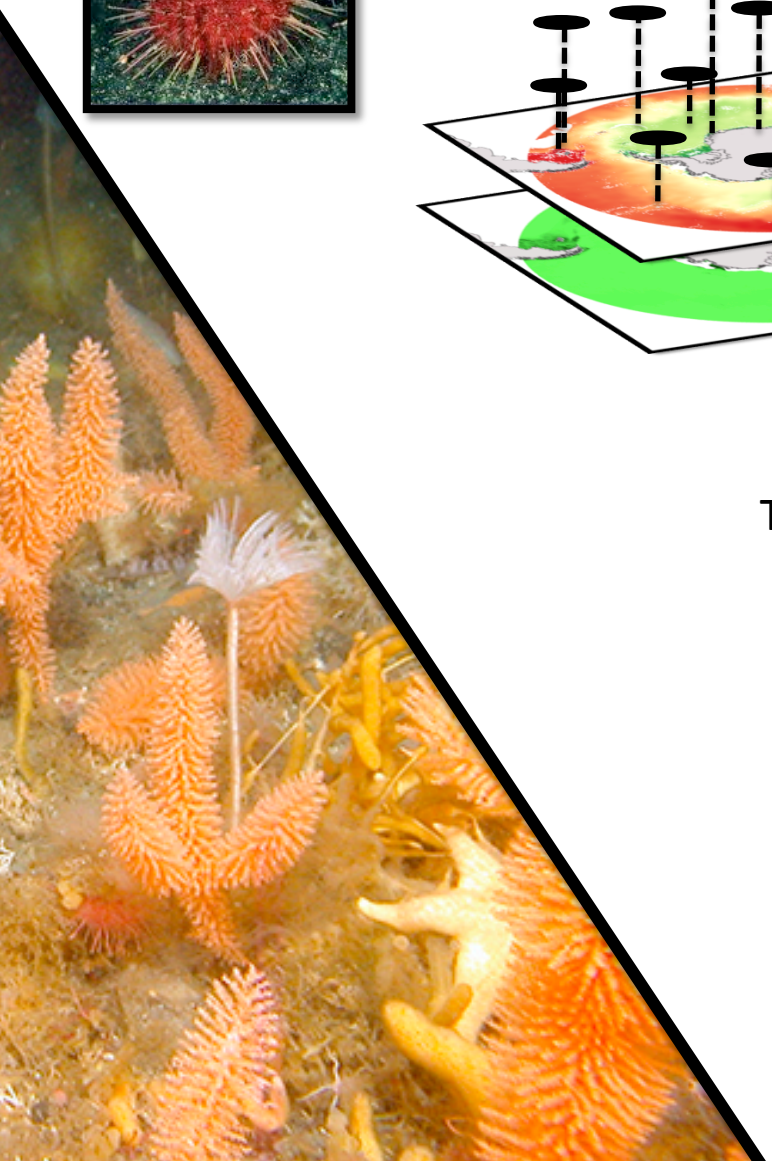
METHODS

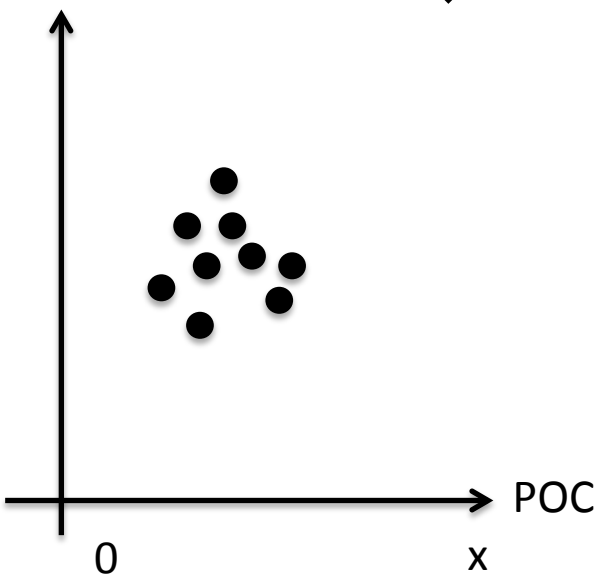
Average summers [2005-2012]



Seafloor temperature

Particulate Organic Carbon
(POC exported, $gC.m^{-2}.d^{-1}$)





METHODS

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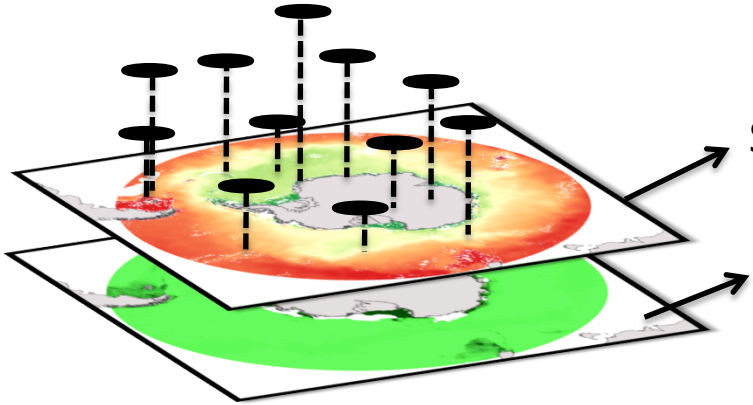

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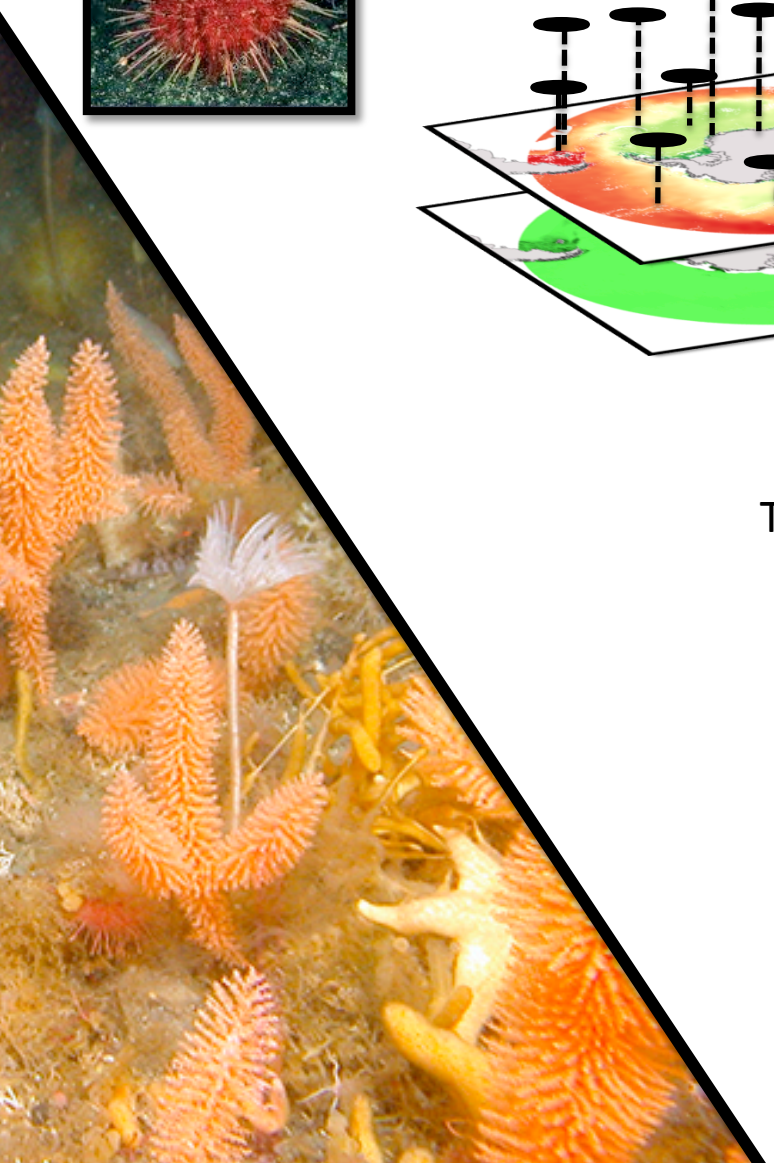
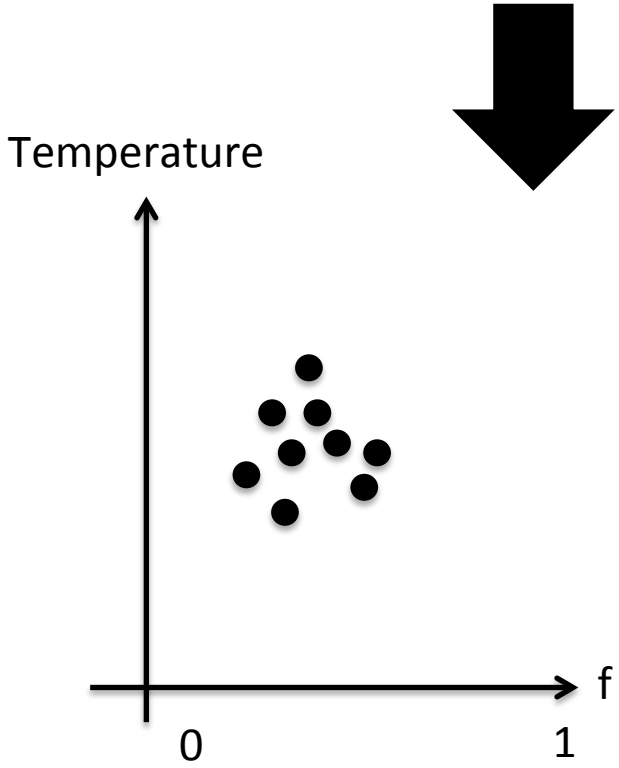
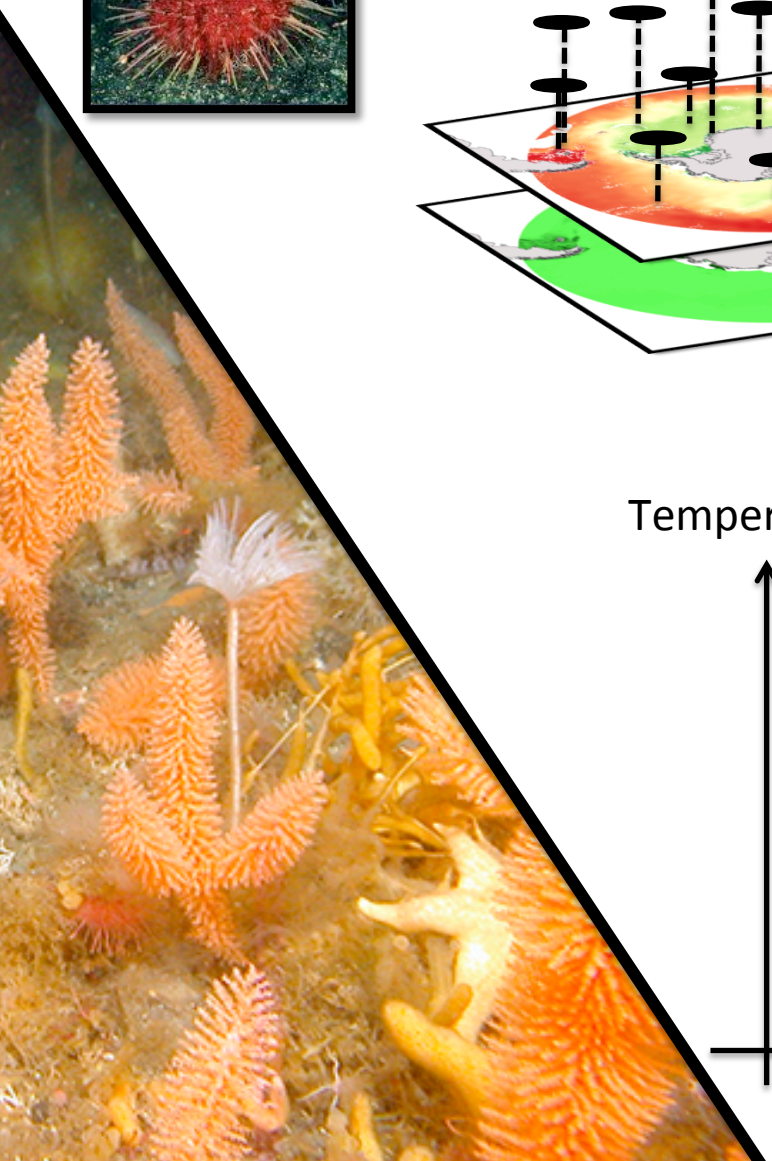


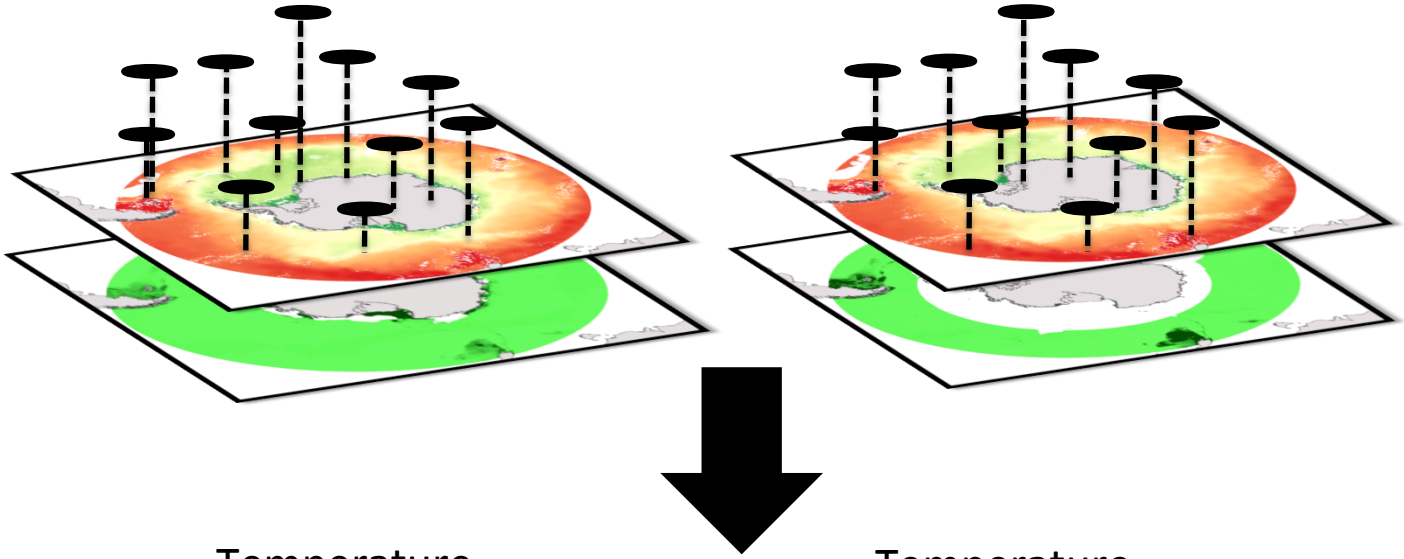


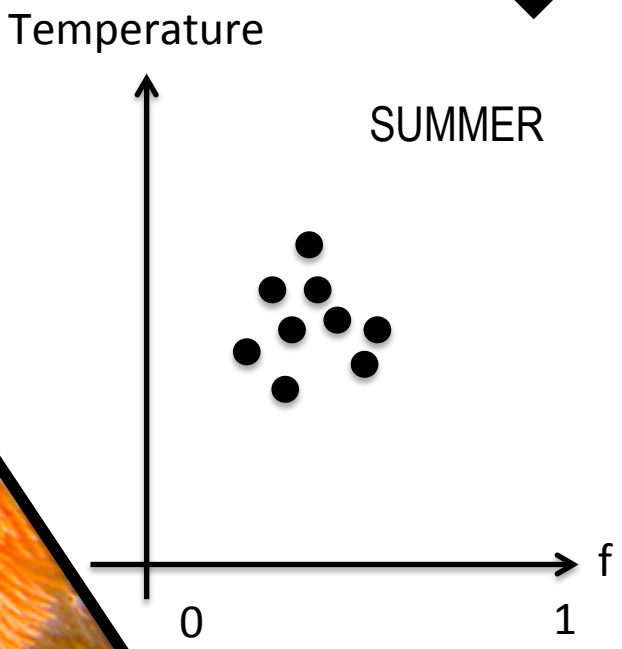
METHODS

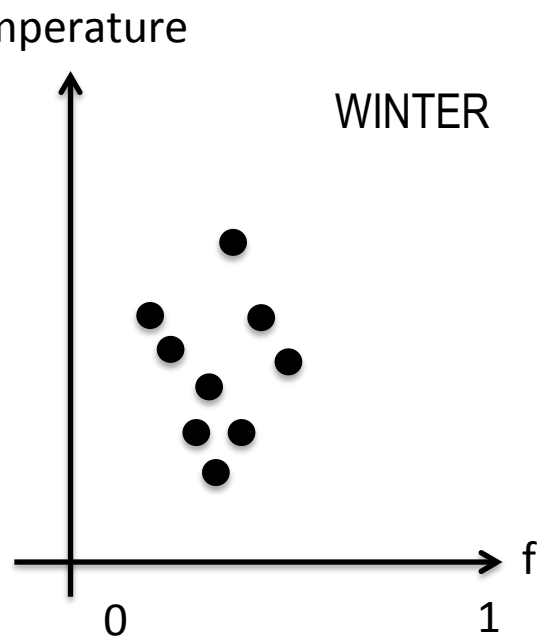


Average summers

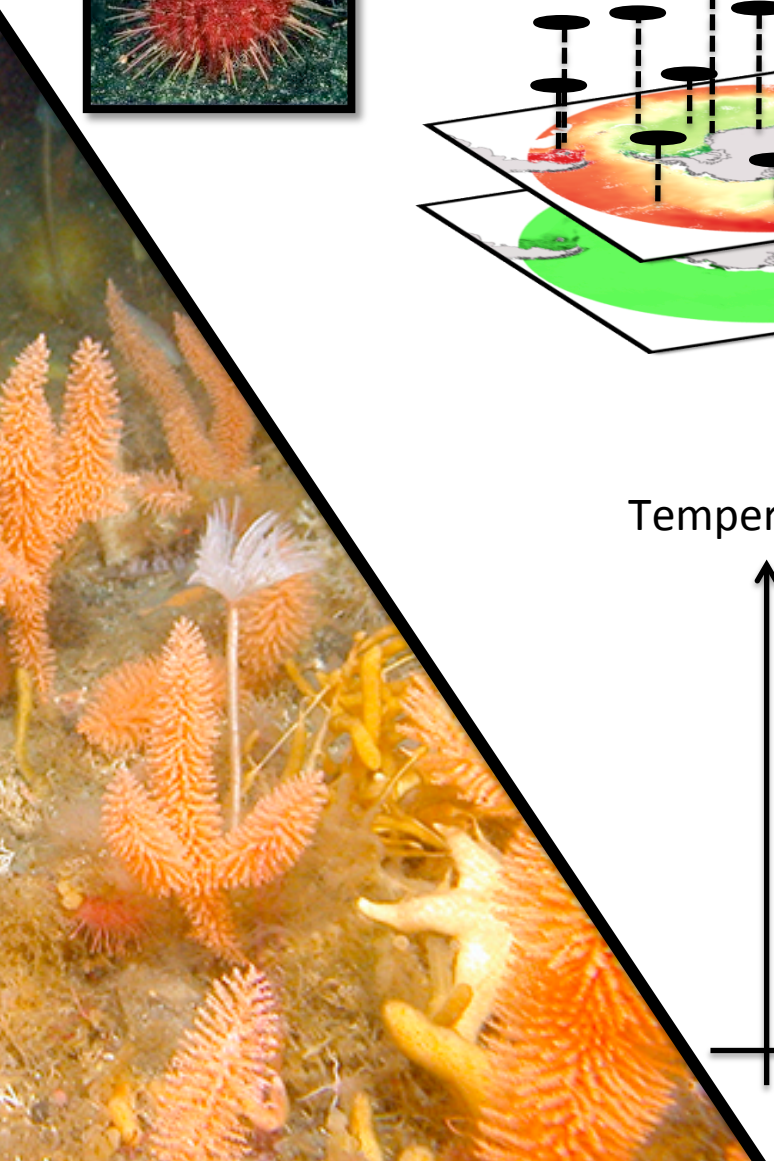
Average winters [2005-2012]







METHODS



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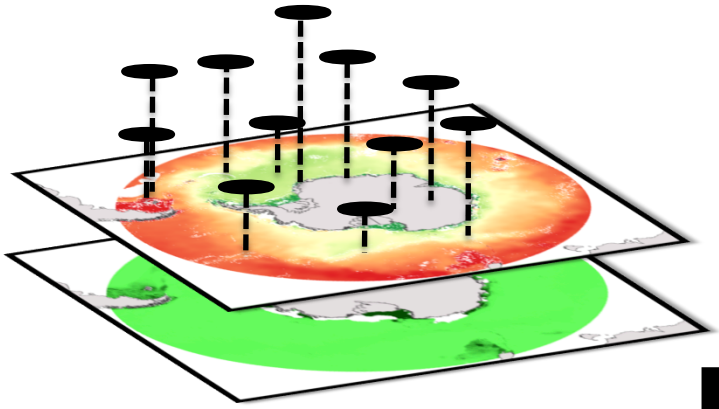

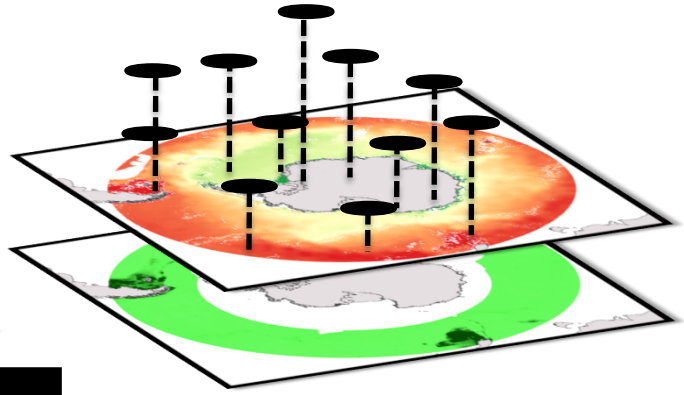

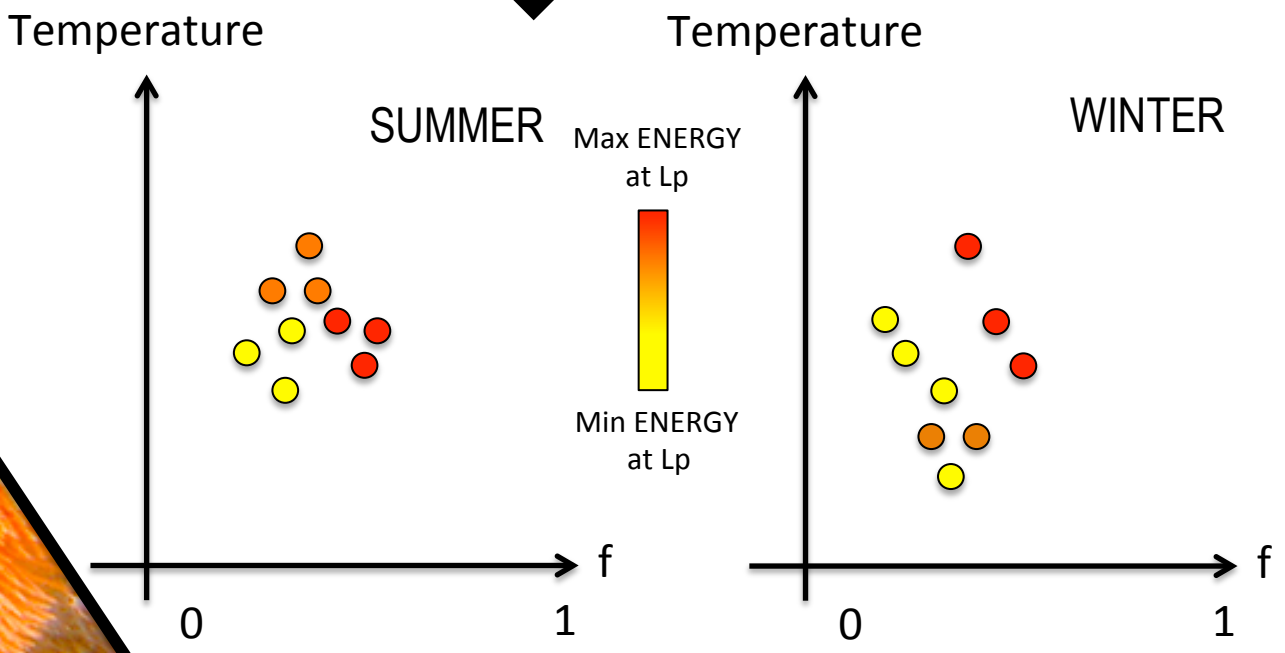

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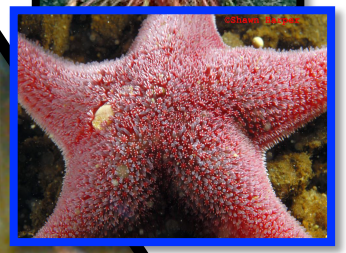

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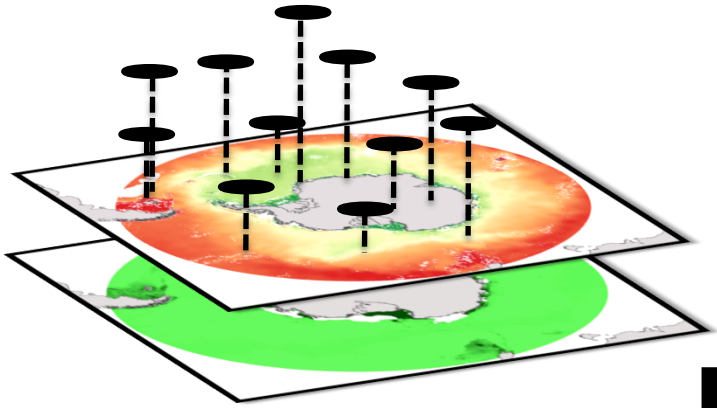
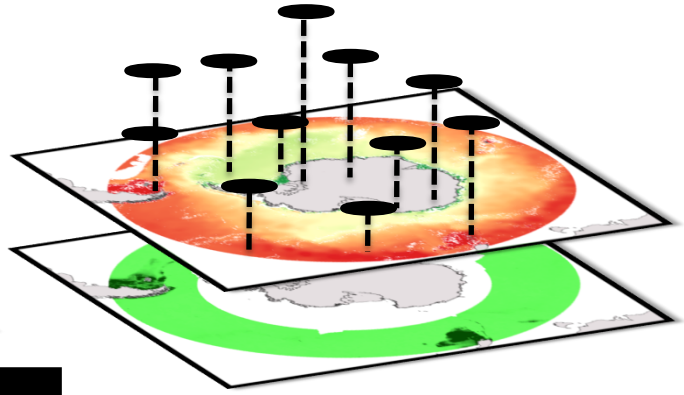
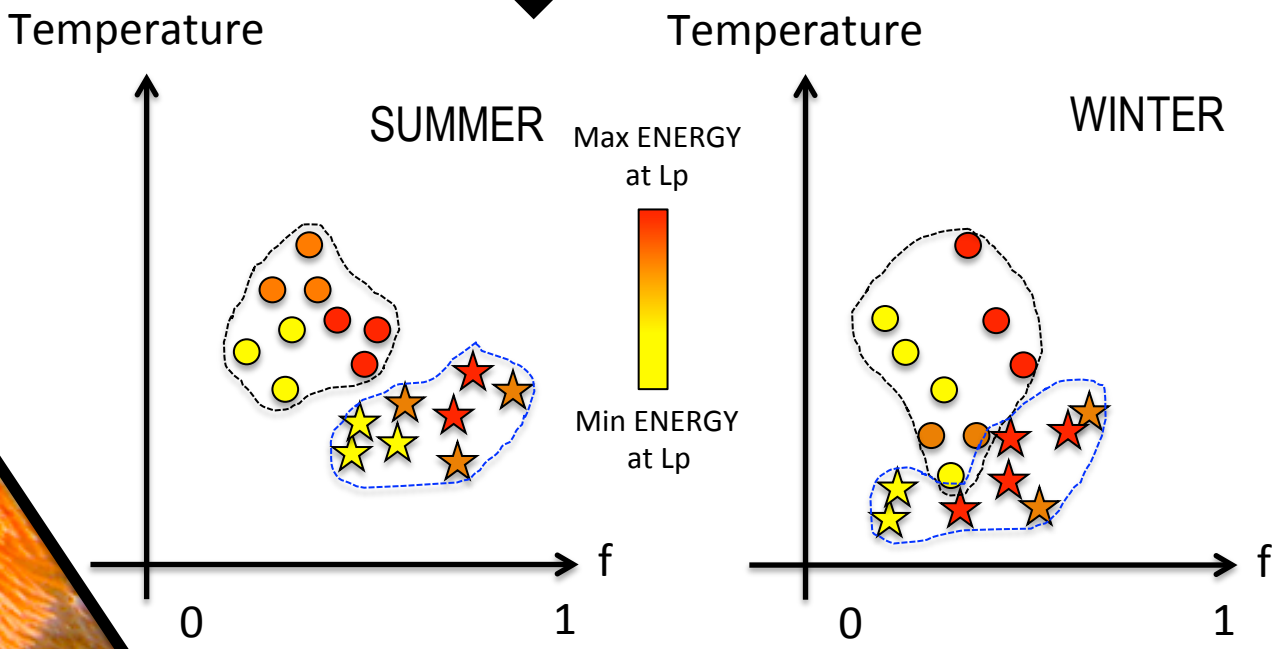




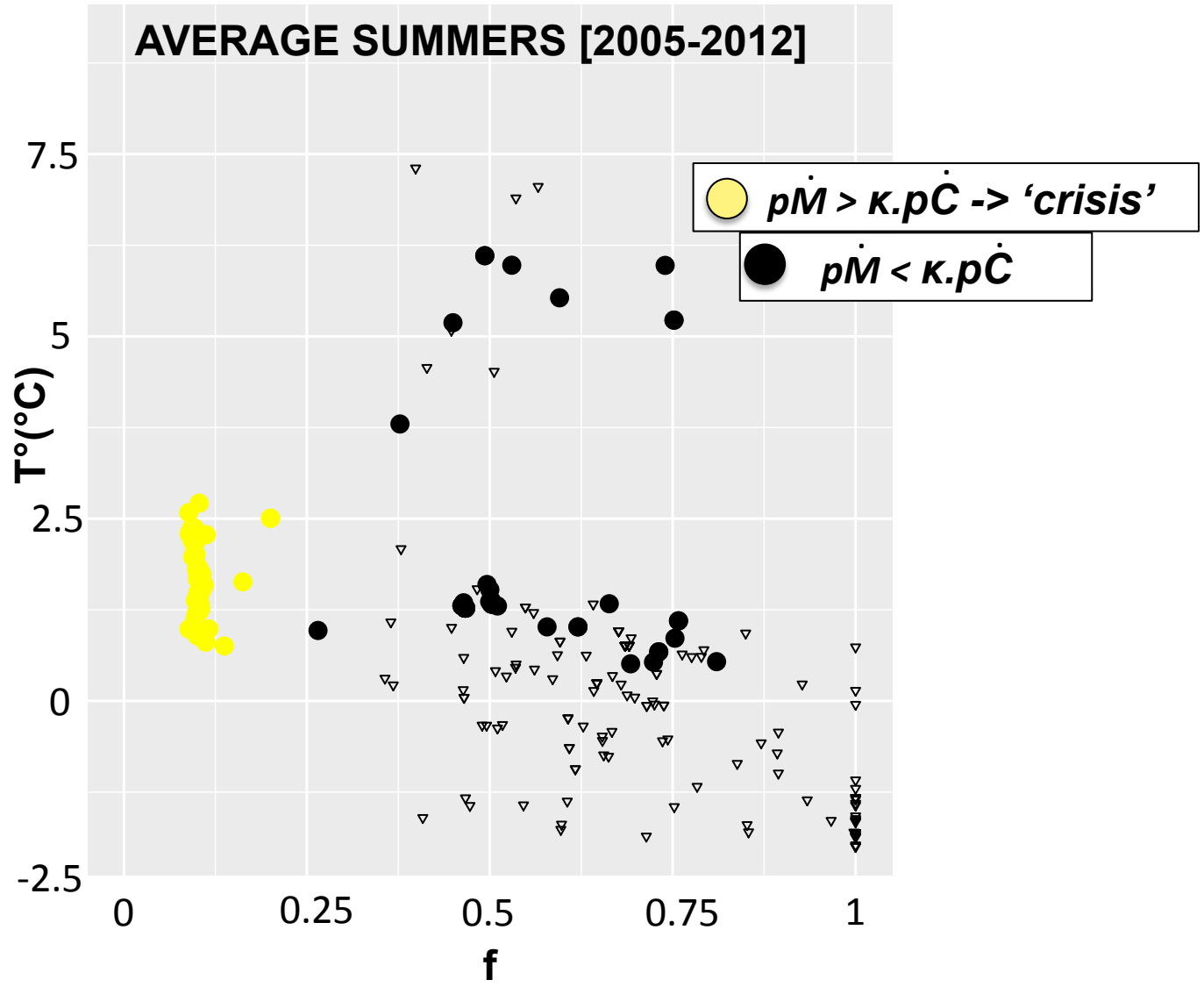


RESULTS

ENERGY STRESS
$\dot{p}M > \kappa.p\dot{C}$??

S.neumayeri

O.validus



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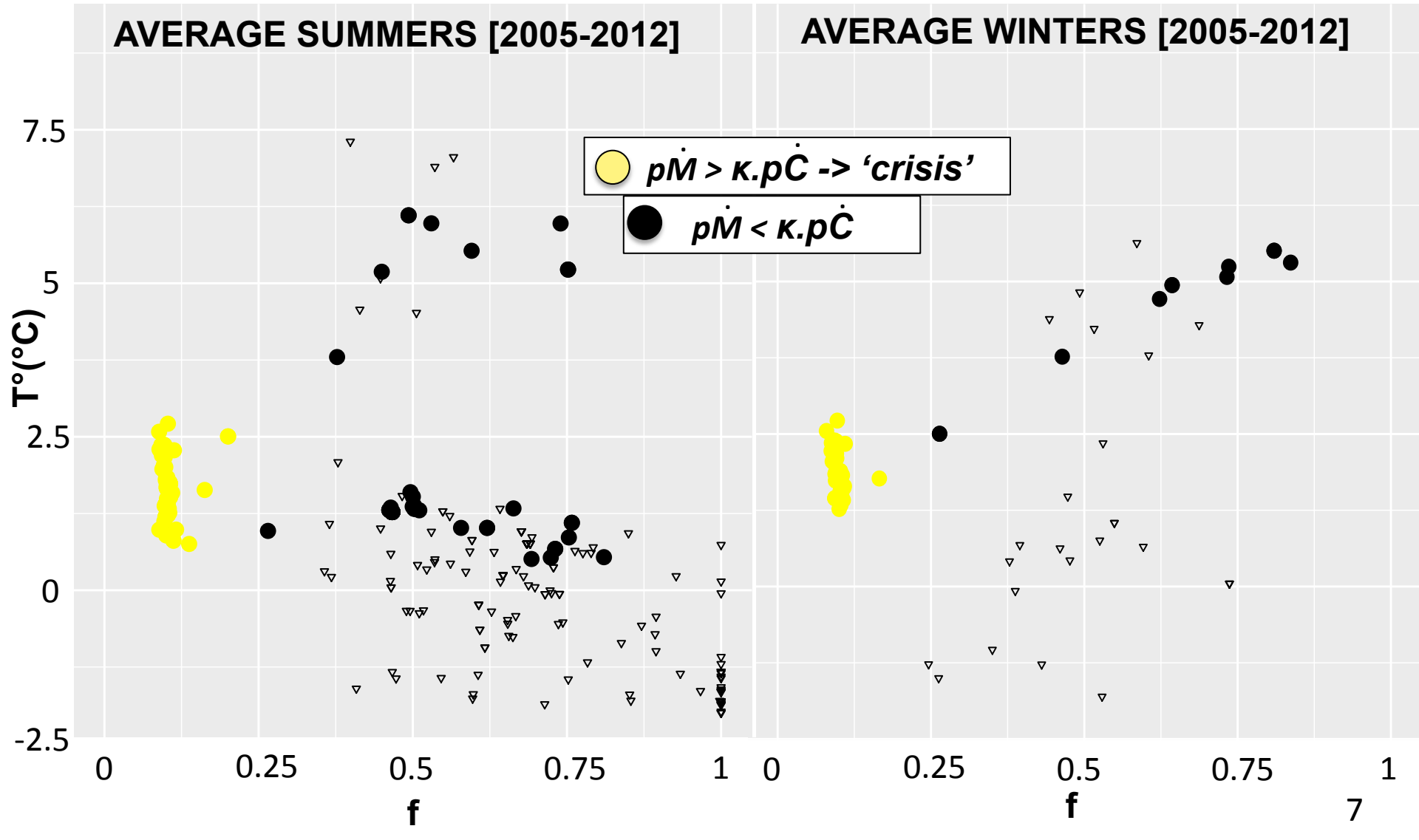
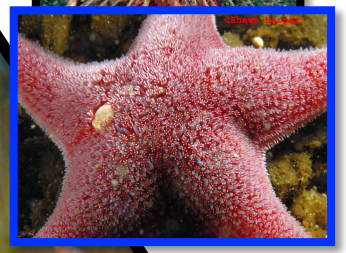


Quickly go back to methods…



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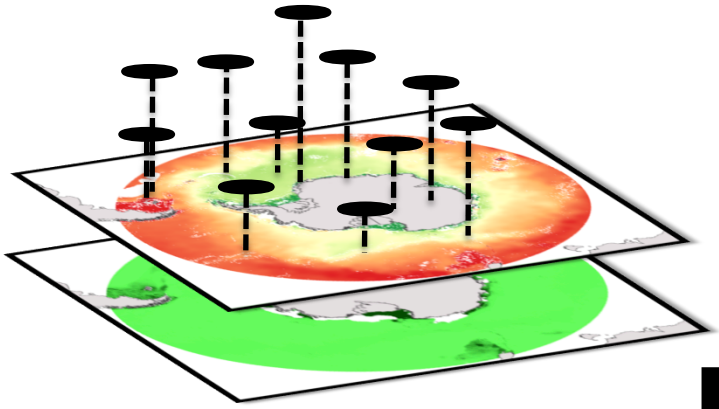

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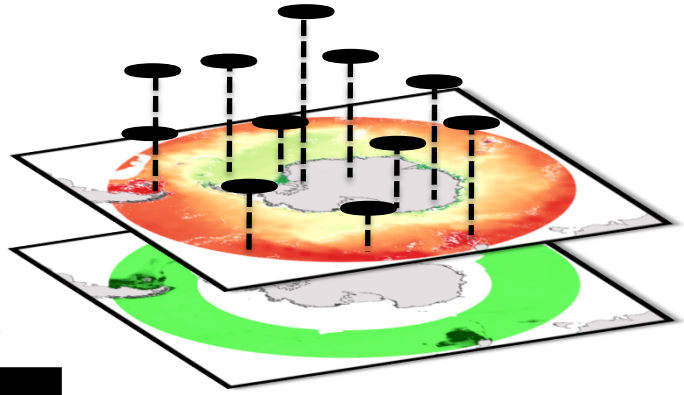

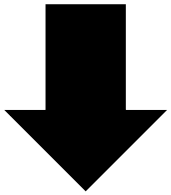

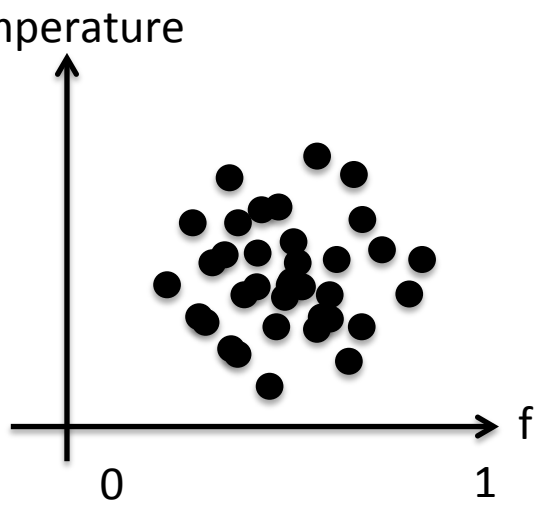

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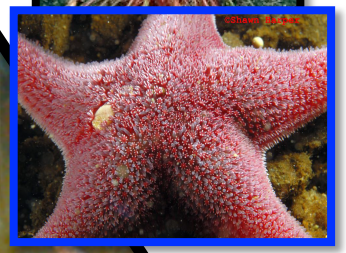

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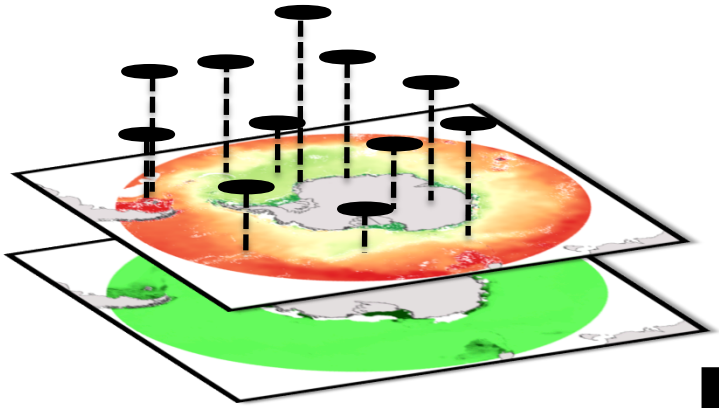

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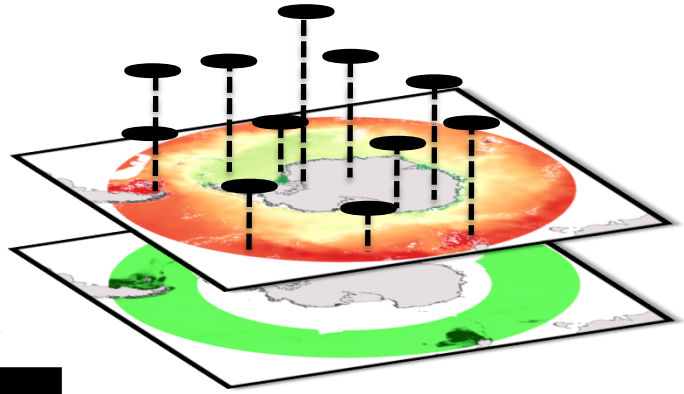
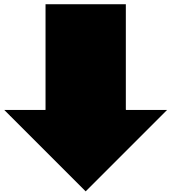
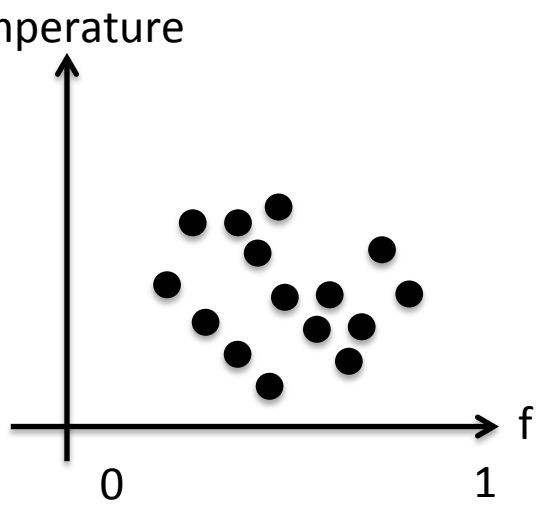




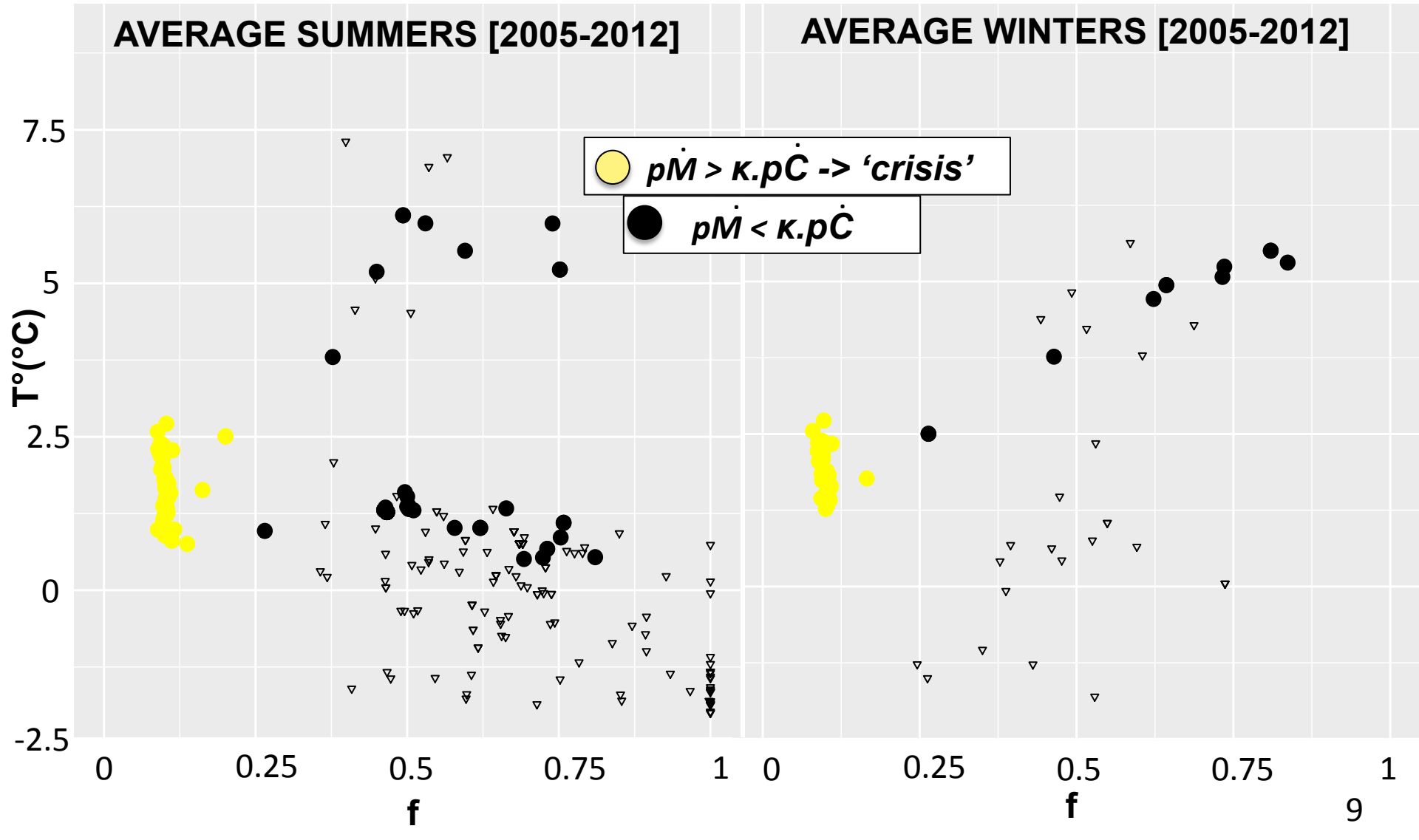


RESULTS

ENERGY STRESS
pṀ > κ.pĊ ??

S.neumayeri

O.validus

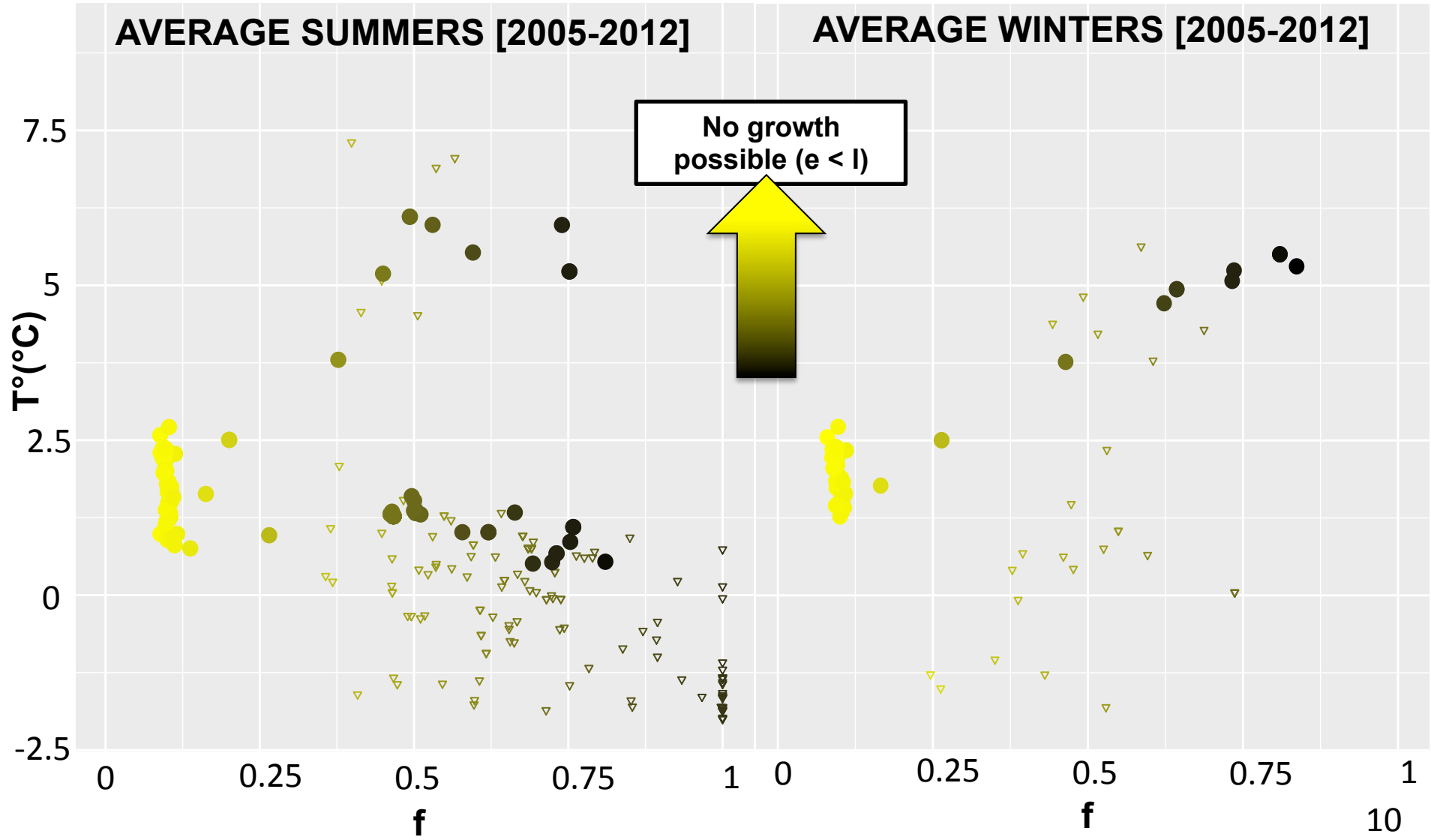


RESULTS

ENERGY STRESS
e < I ?

● *S.neumayeri*

▽ *O.validus*



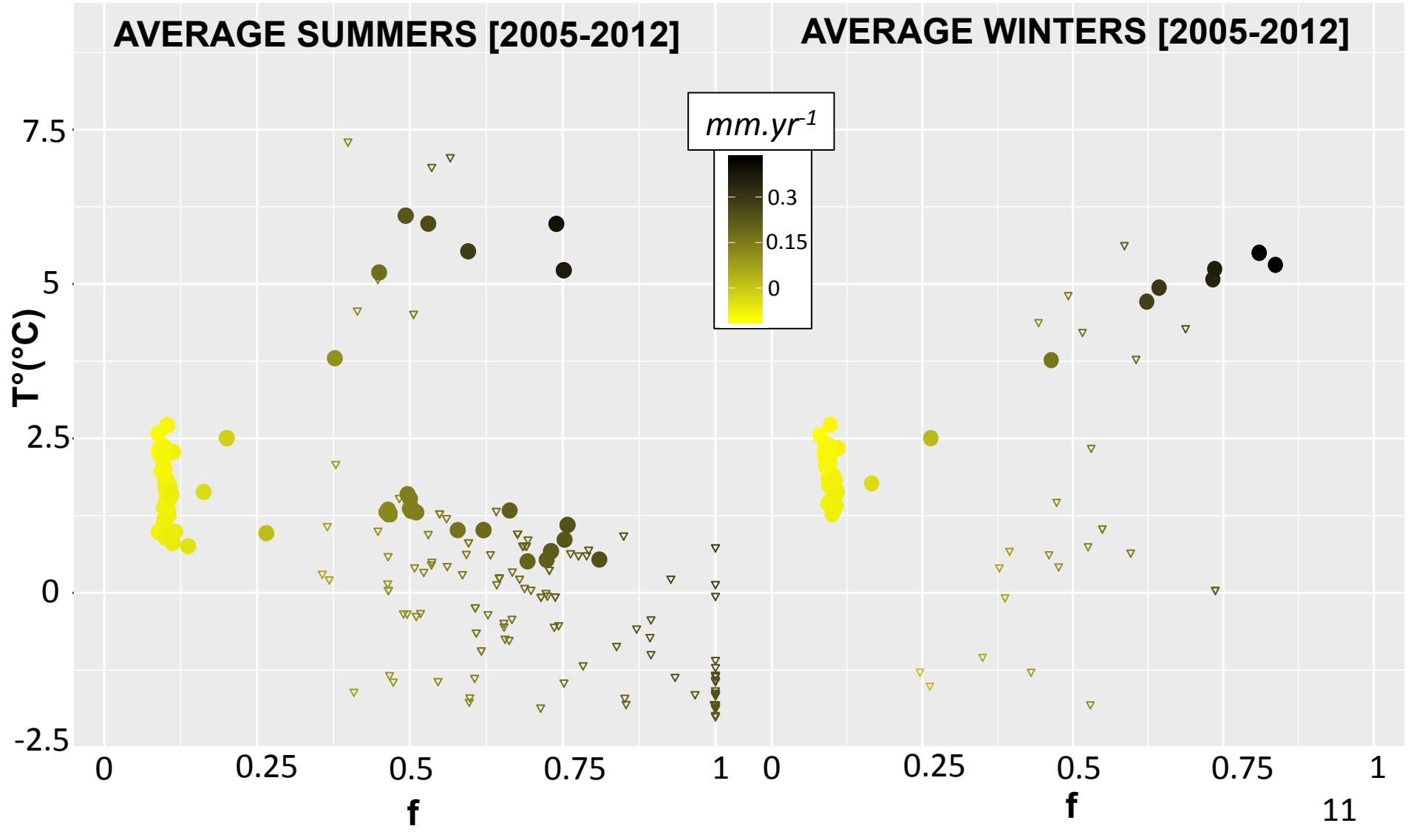
RESULTS

GROWTH LENGTH DYN.

$$\frac{dL}{dt} = \frac{\kappa.p\dot{C}-p\dot{M}}{[E_G]} \cdot \frac{1}{3.\delta.L_w^2}$$

● *S.neumayeri*

▽ *O.validus*



PERSPECTIVES

- Improve or develop the remaining species DEB models

PERSPECTIVES

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- Improve food proxies

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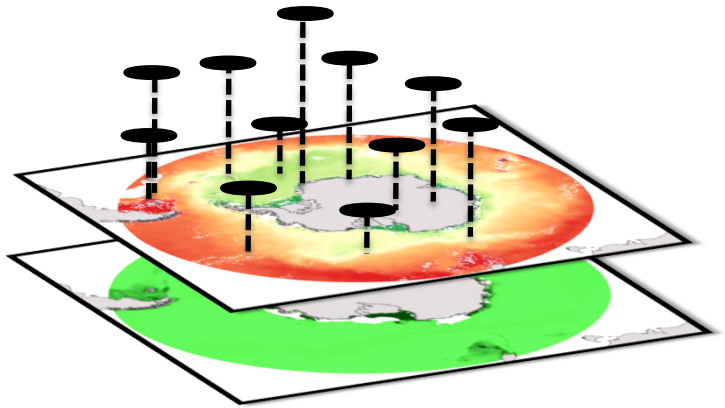
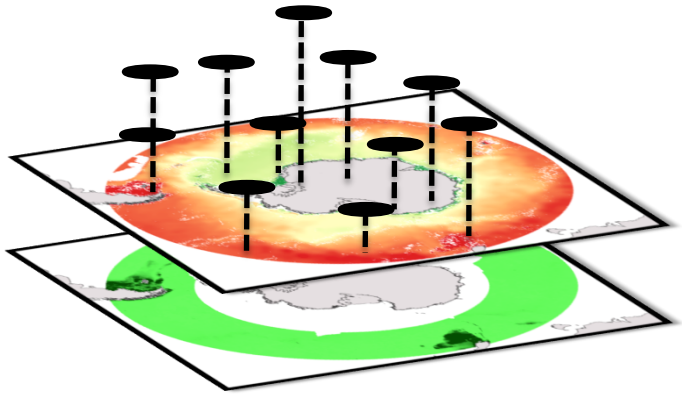
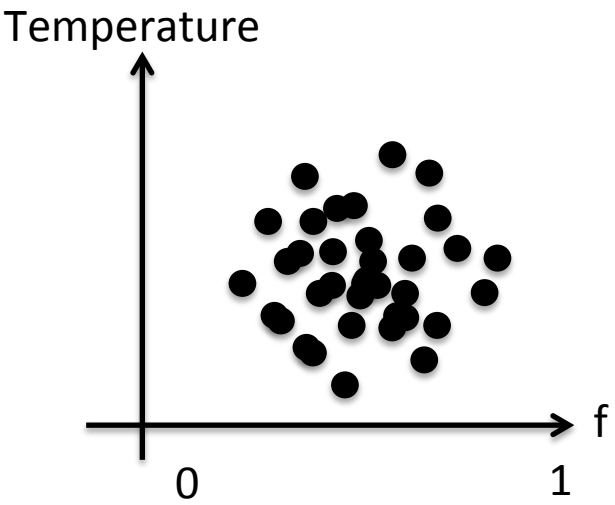
SUMMER



WINTER

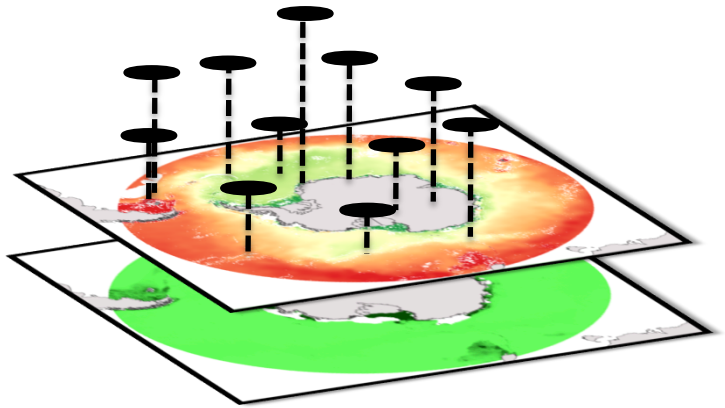




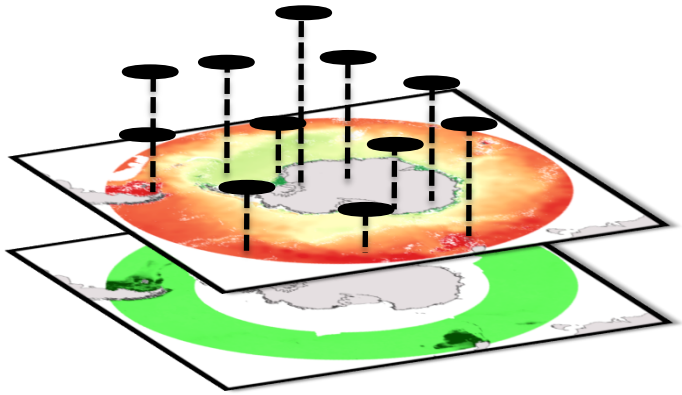
PERSPECTIVES

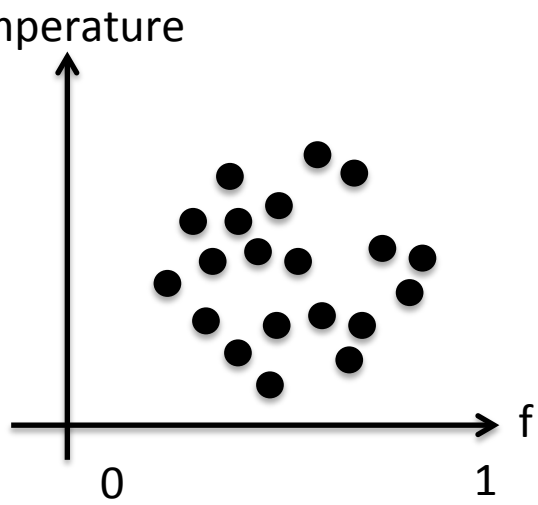
- Improve or develop the remaining species DEB models
- Improve food proxies

SUMMER



WINTER





PERSPECTIVES

- Improve or develop the remaining species DEB models
- Improve food proxies
- Consider temperature limits

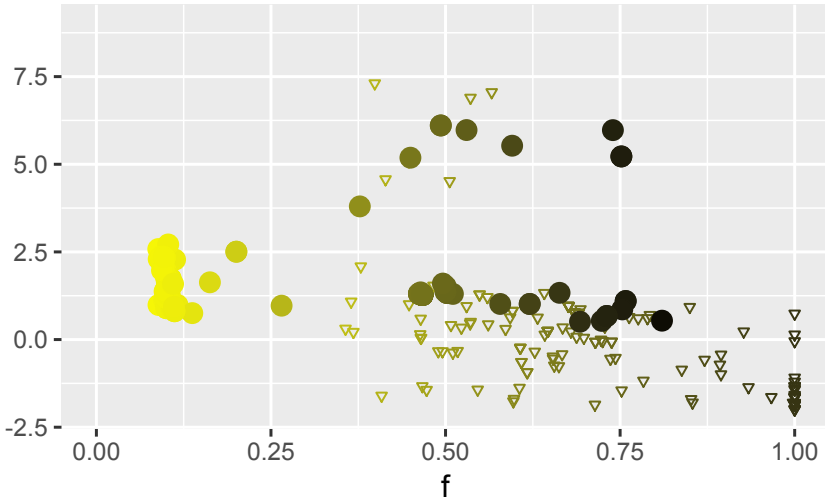
PERSPECTIVES

ENERGY STRESS
e < I ?

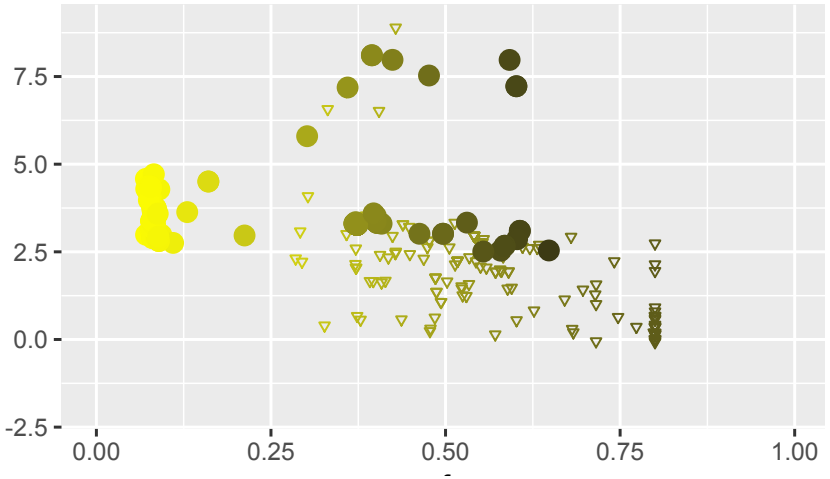
● *S.neumayeri*

▽ *O.validus*

Average summer (2002-2015)



Simulation : +2°C increase and -20% food



T°(°C)

No growth possible (e < I)

f

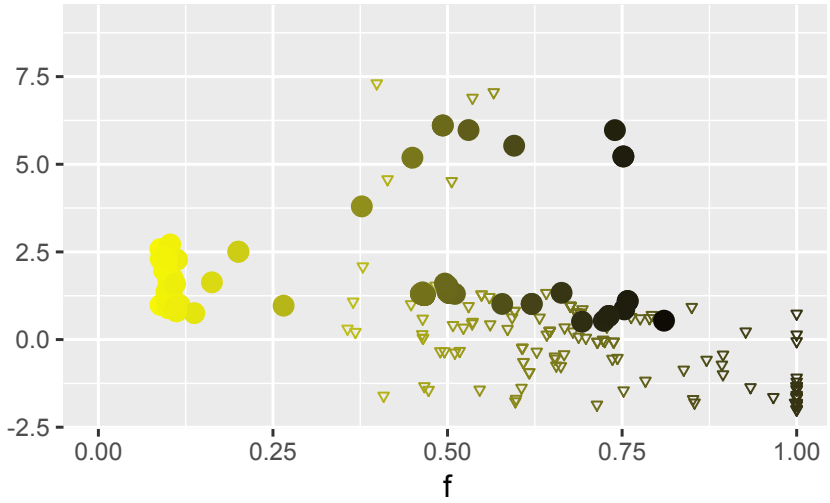
PERSPECTIVES

ENERGY STRESS
e < I ?

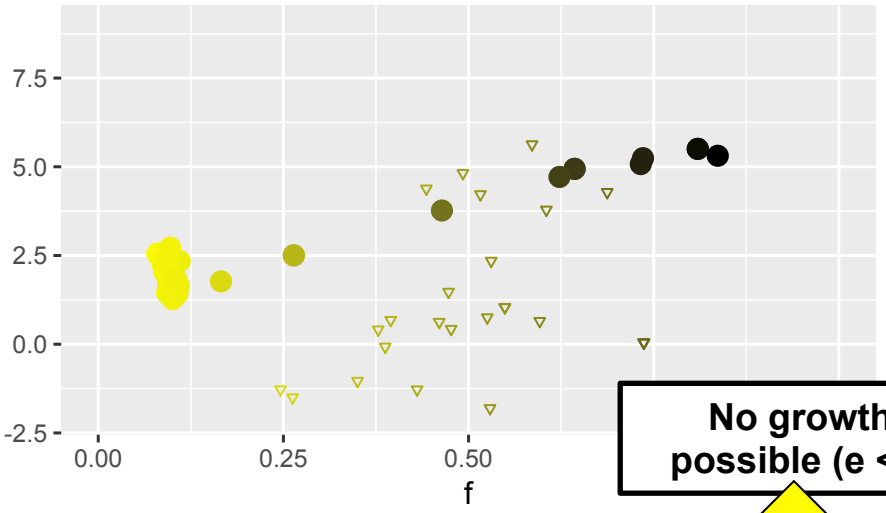
● *S.neumayeri*

▽ *O.validus*

Average summer (2002-2015)

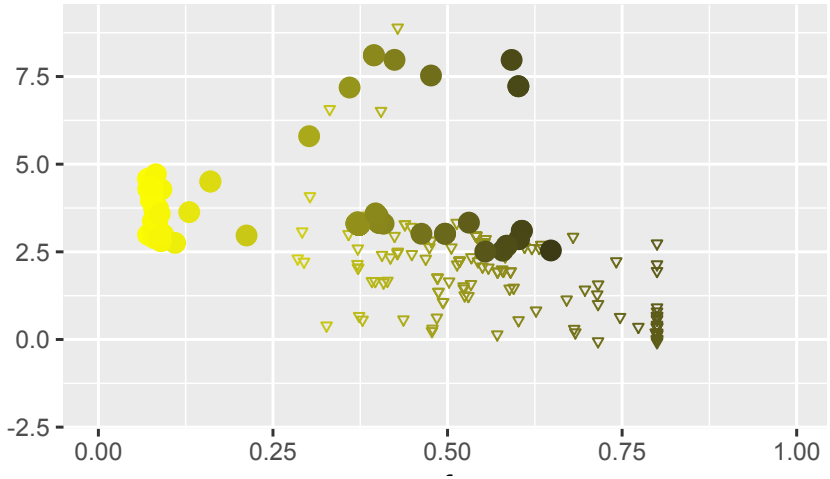


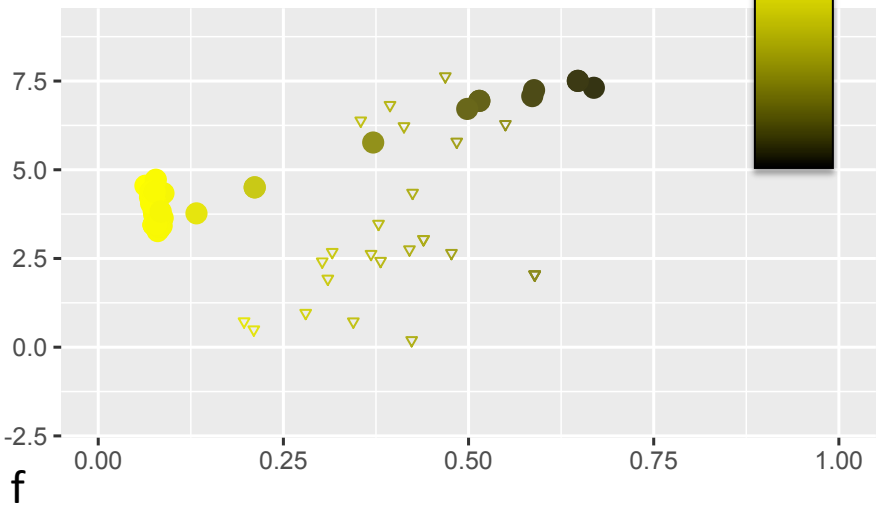
Average winter (2002-2015)



No growth possible (e < I)

Simulation : +2°C increase and -20% food





T°(°C)

PERSPECTIVES

- Improve or develop the remaining species DEB models
- Improve food proxies
- Consider temperature limits

PERSPECTIVES

- Improve or develop the remaining species DEB models
- Improve food proxies
- Consider temperature limits
- Compare the seven species & assess modelling potential


Thanks for your attention