



BIODIVERSITY.AQ



SDM outputs, assessment and interpretation



Tuesday 3rd, September
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Introduction

SDM -> many purposes

So many possible outputs !!

- ➔ You can use different tools, R... packages inside R to make nice plots (ggplot2)
- ➔ You can also export your data to other softwares (maps in Qgis) (e.g maps...)

** Feel free to ask instructors questions on our favourite mapping tools

PREDICTIVE MAPS

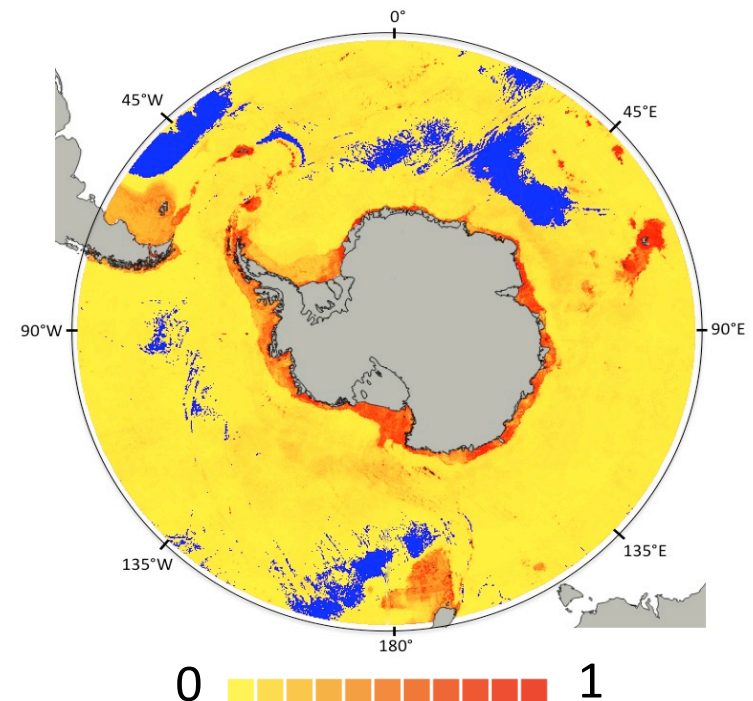
Probably the most famous output =)

In Presence/Absence models (response variable = 0 or 1):

Output is generally given as a probability* (between 0 and 1) that the species is present in each pixel given the environmental conditions present in that pixel

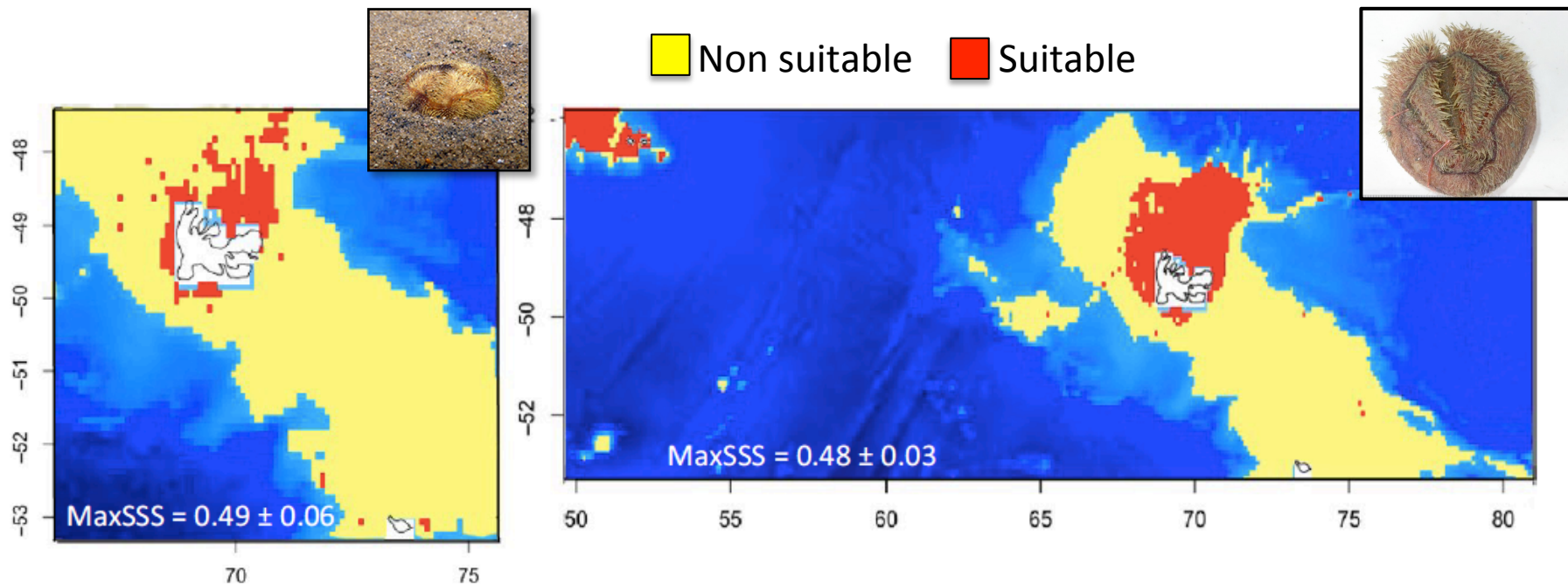
NB. Different algorithms can give different results (e.g., MaxEnt, Random Forests, BRT)

* Note: Probabilities are not always statistical probabilities. E.g., Random Forest calculates 'probability' differently than generalized additive models (GAM)



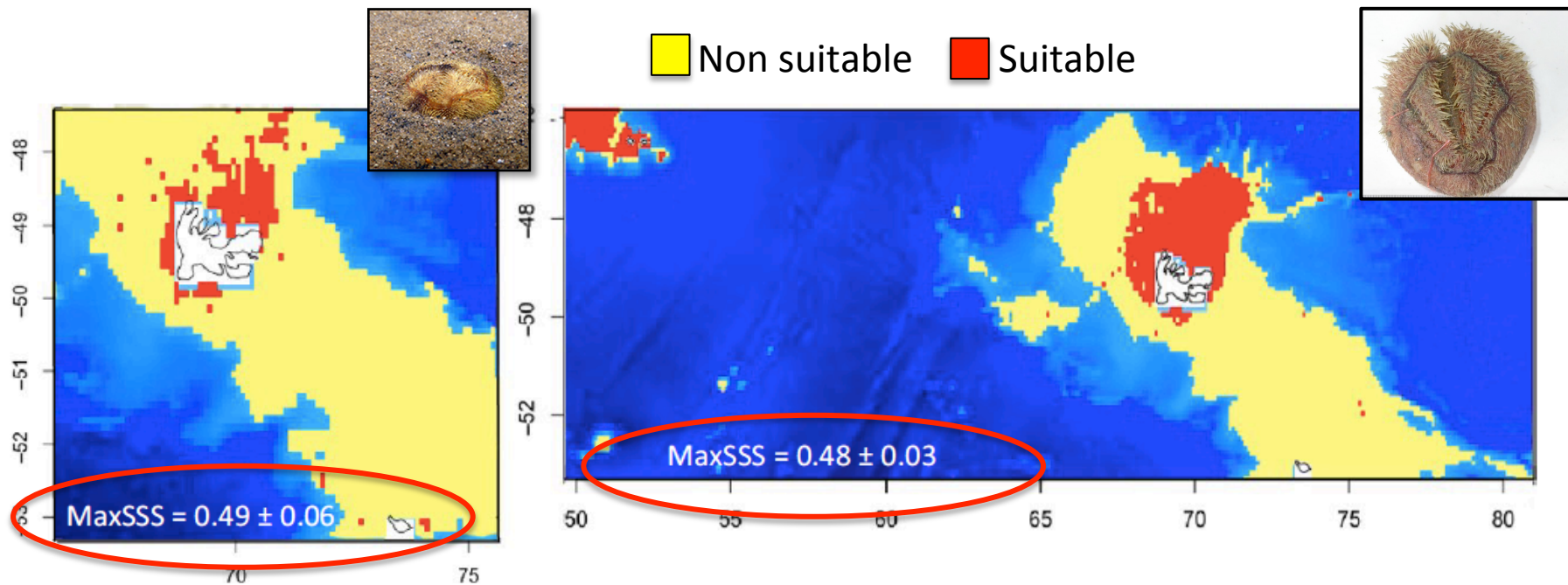
PREDICTIVE MAPS

You can threshold your results to provide a map with suitable / unsuitable predicted distribution



PREDICTIVE MAPS

You can threshold your results to provide a map with suitable / unsuitable predicted distribution



Threshold: Max SSS -> maximum sensitivity + specificity threshold
See Liu et al. (2013)

Guillaumot et al. (2018b)

Several thresholding procedures

-> explore the literature to find the most appropriated one !

<i>Procedure</i>	
MTP	Minimum Training Presence : take the value of the lowest probability on which a presence record falls. Risk: outliers !!
10%TP	Tenth percentile training presence threshold : same, but instead of taking the minimal value, take the 10% lowest value (density distribution)
SSequality	Value for which sensitivity and specificity are equal
maxSSS	Maximum Sensibility plus Specificity The sum of specificity and sensitivity is maximal
Arbitrary value	Take 0.5, 0.7 or other !
...	

PREDICTIVE MAPS

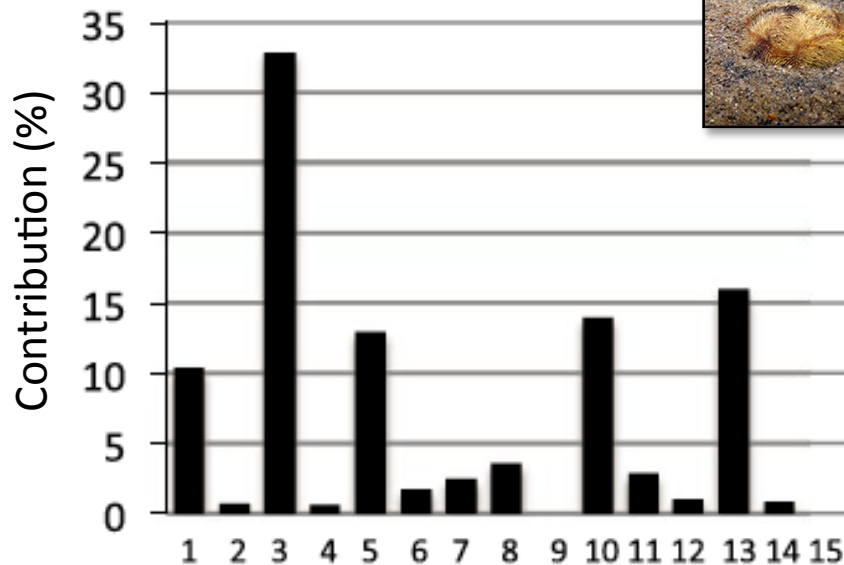
PRACTICE !

- Go into the code and plot your predictions
- Try to change the colors (color palette)
- Try to binarise your results into 2 colors (non suitable= yellow; suitable= red) with a threshold of 0.7

In which proportion does each environmental descriptor influence the model predictions ?

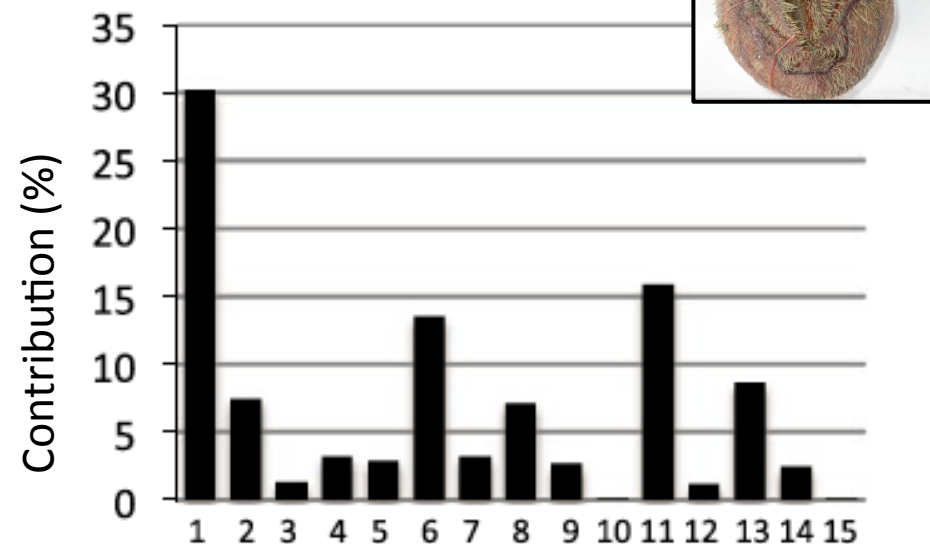
SDM outputs: Contribution of environmental descriptors

In which proportion does each environmental descriptor influence the model predictions ?



LEGEND

1. Seafloor T° mean
2. Sea surface T° amplitude
3. Seafloor T° amplitude
4. Sea surface salinity mean
5. Seafloor salinity mean
6. Sea surface salinity amplitude
7. Seafloor salinity amplitude
8. Depth
9. Sediments
10. Geomorphology
11. Chl a
12. POC
13. Seafloor oxygen
14. Slope
15. Ice cover



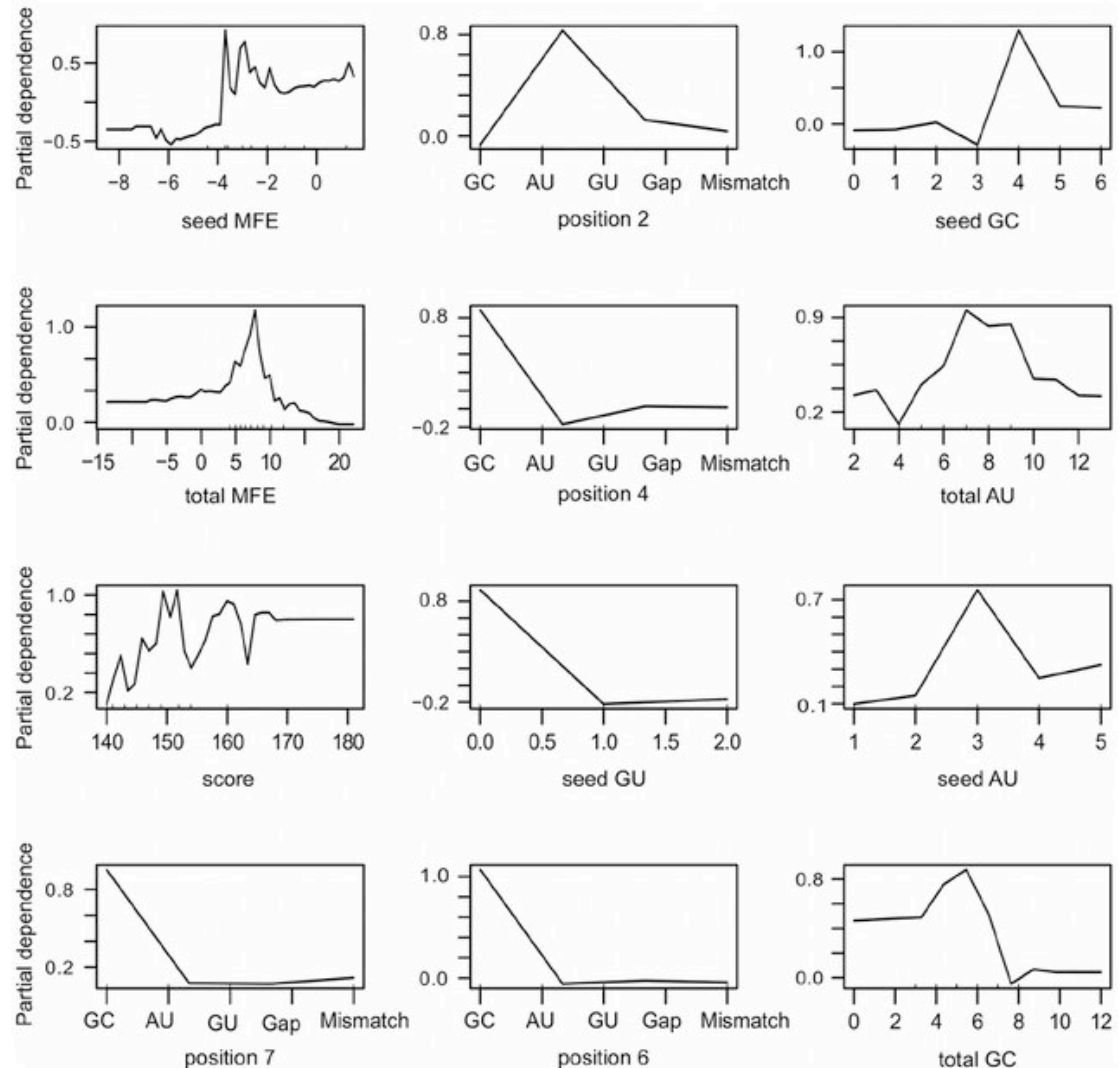
PRACTICE !

- Display the table of contributions

What is a partial dependence plot?

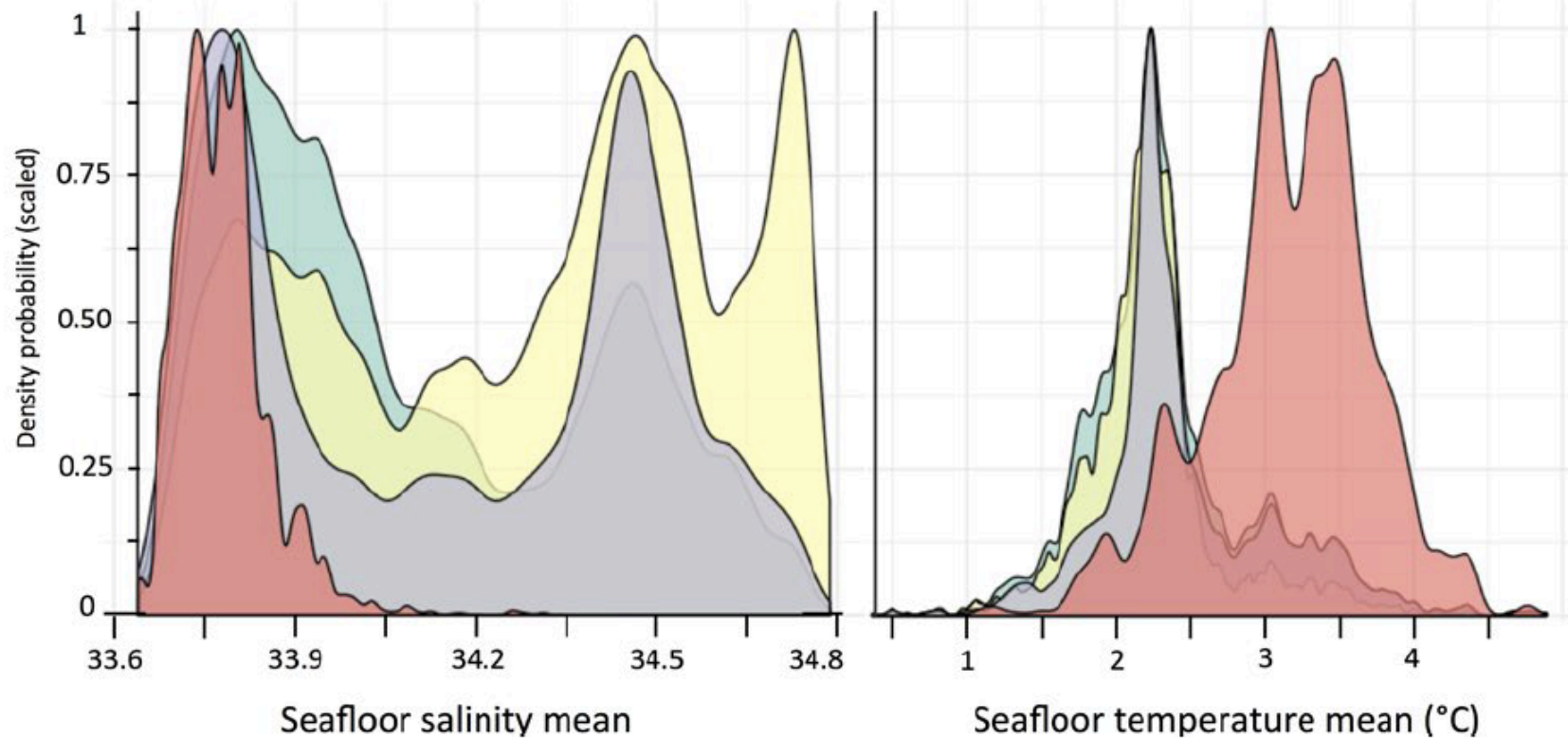
Y axis: distribution probability

X axis: environmental value



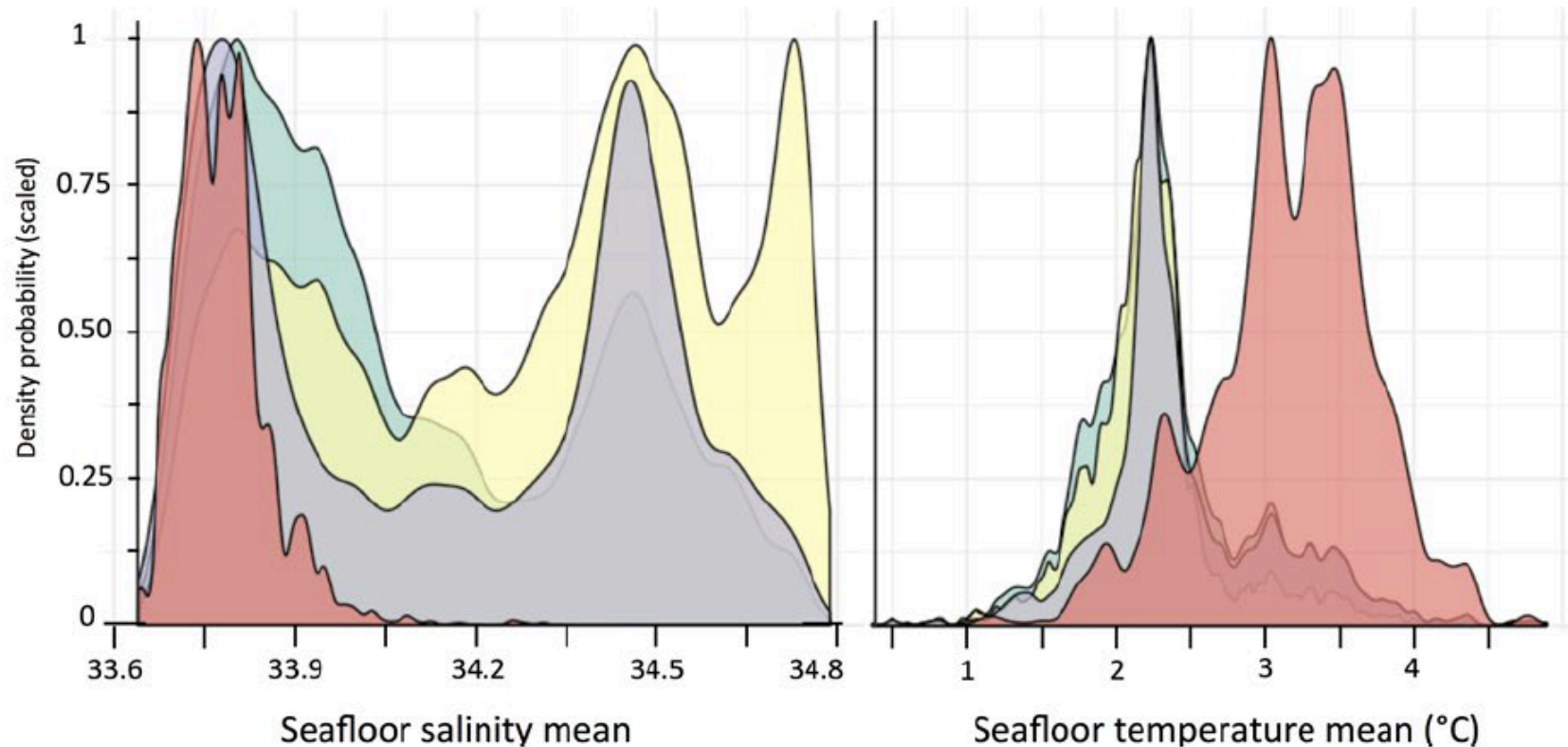
Partial dependance plot -> What is the value of the distribution probability associated to each environmental value ?

Comparison between 4 species (4 colors)



Partial dependance plot -> What is the value of the distribution probability associated to each environmental value ?

Comparison between 4 species (4 colors)



How do you interpret/use these results ?

**TEAM
PLAY!**

PRACTICE !

- One volunteer to the board!
 - As a group, write out the code to extract X/Y data and plot the above

MODEL EVALUATION METRICS

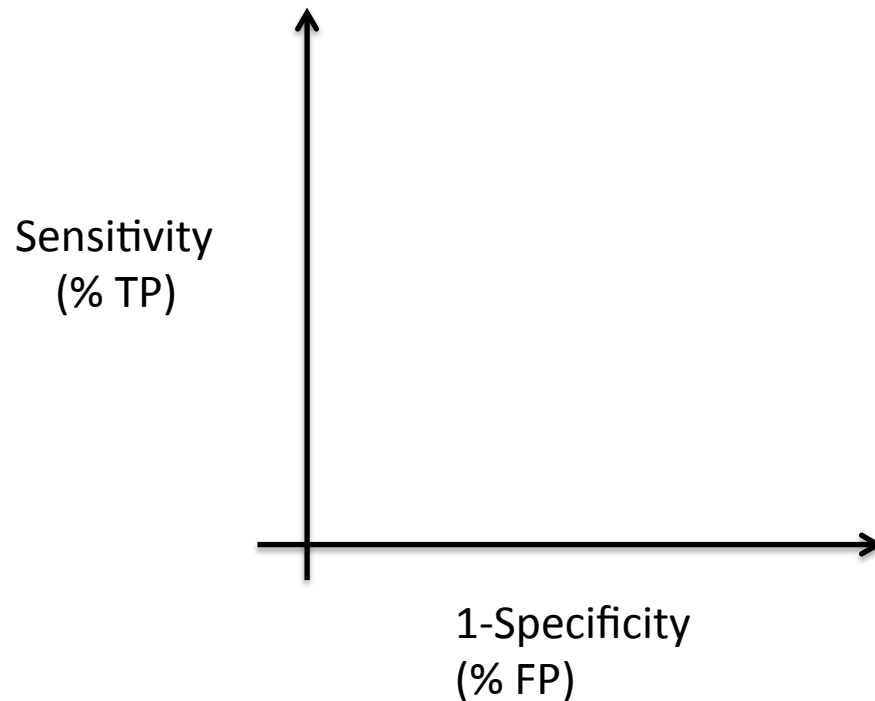
Several metrics to evaluate your models !

More or less appropriated according to your dataset (presence-absence/ presence only data): need to be careful with interpretation

AREA UNDER THE RECEIVER OPERATED CURVE (AUC)

Evaluates the proportion of True/False positives and True/False negatives in the predictions

AREA UNDER THE RECEIVER OPERATED CURVE (AUC)



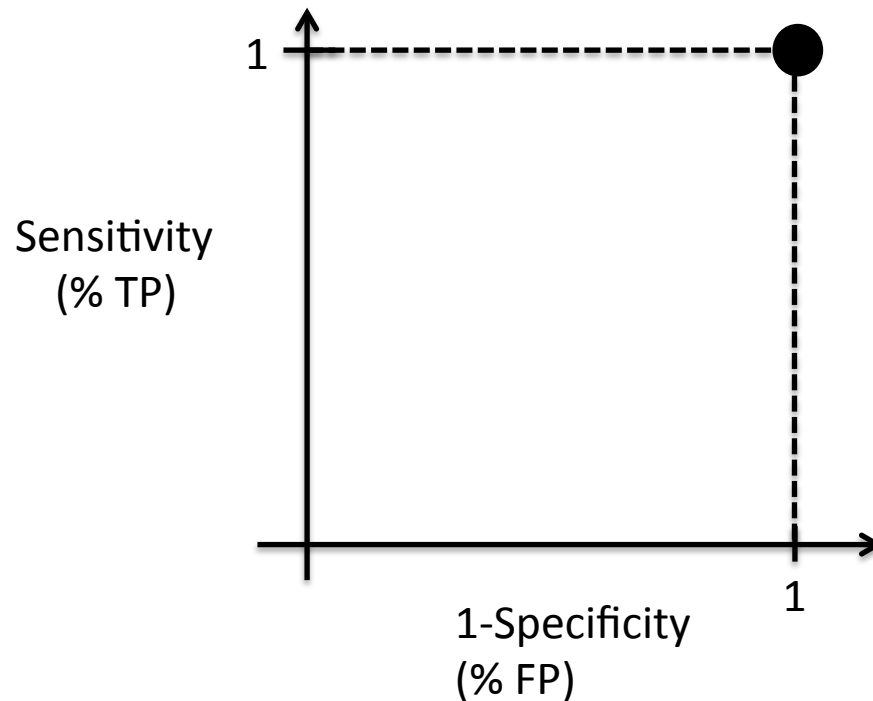
CONFUSION MATRIX

		Predicted class	
		<i>P</i>	<i>N</i>
Actual Class	<i>P</i>	True Positives (TP)	False Negatives (FN)
	<i>N</i>	False Positives (FP)	True Negatives (TN)

Sensitivity: $(TP)/(TP+FN)$ -> presence records **correctly** predicted

1-Specificity: $(FP)/(FP+TN)$ -> presence records **incorrectly** predicted

AREA UNDER THE RECEIVER OPERATED CURVE (AUC)

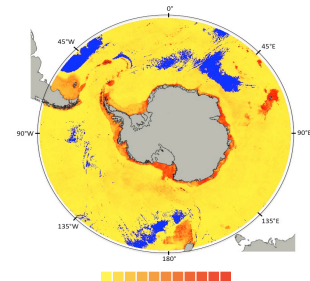


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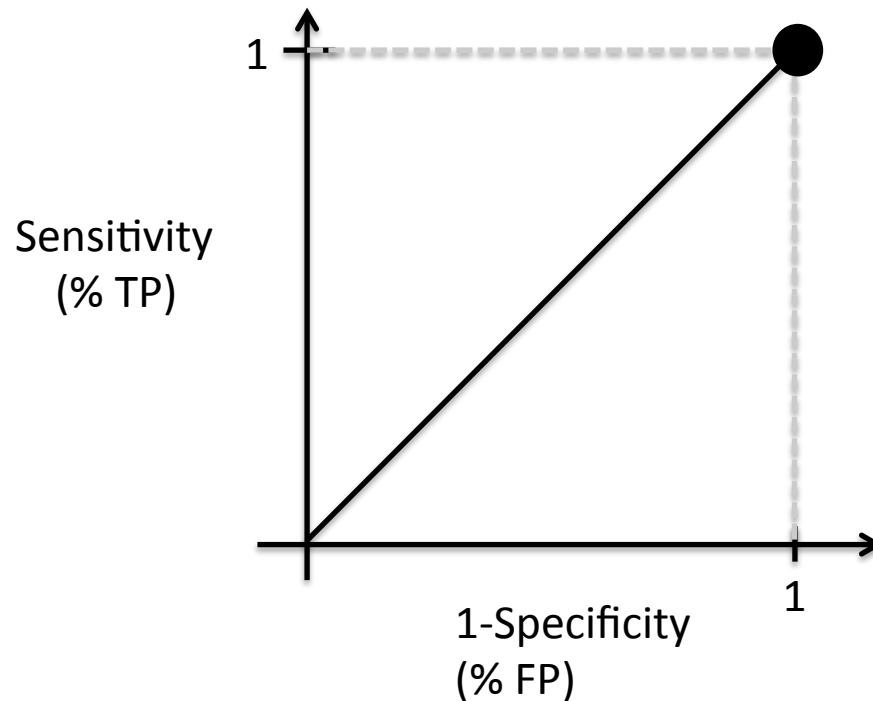
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FOR A CONSIDERED THRESHOLD...

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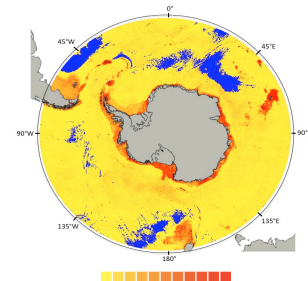


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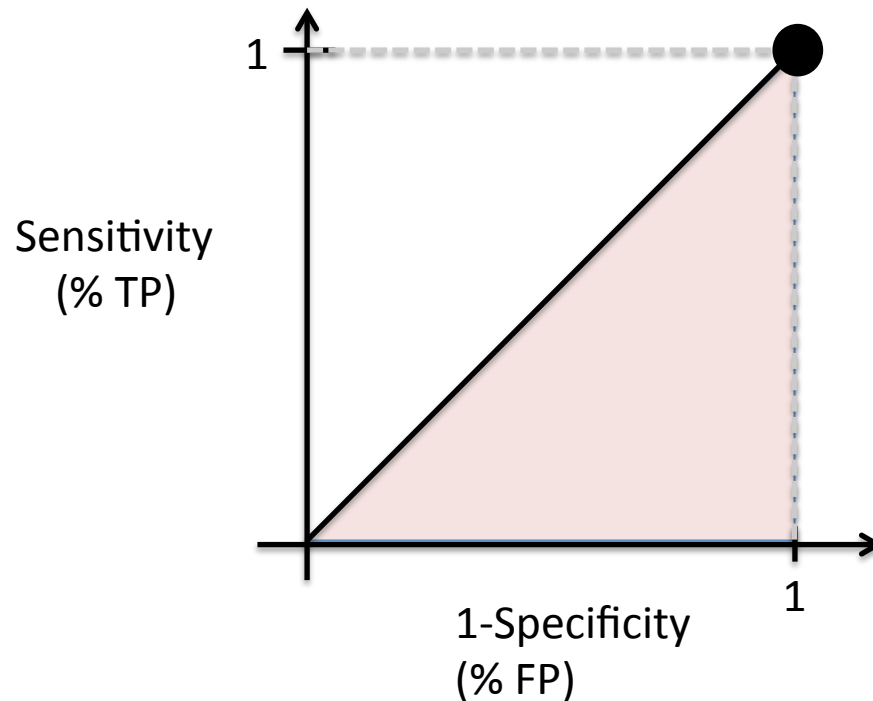
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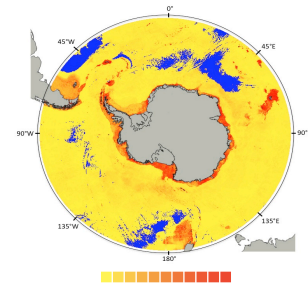


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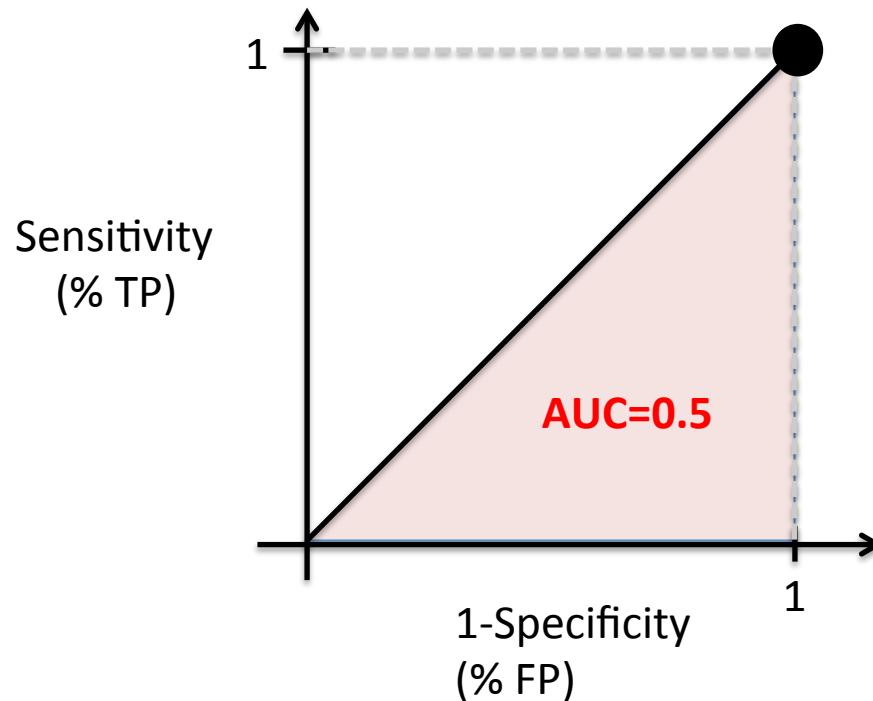
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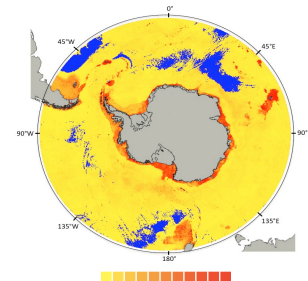
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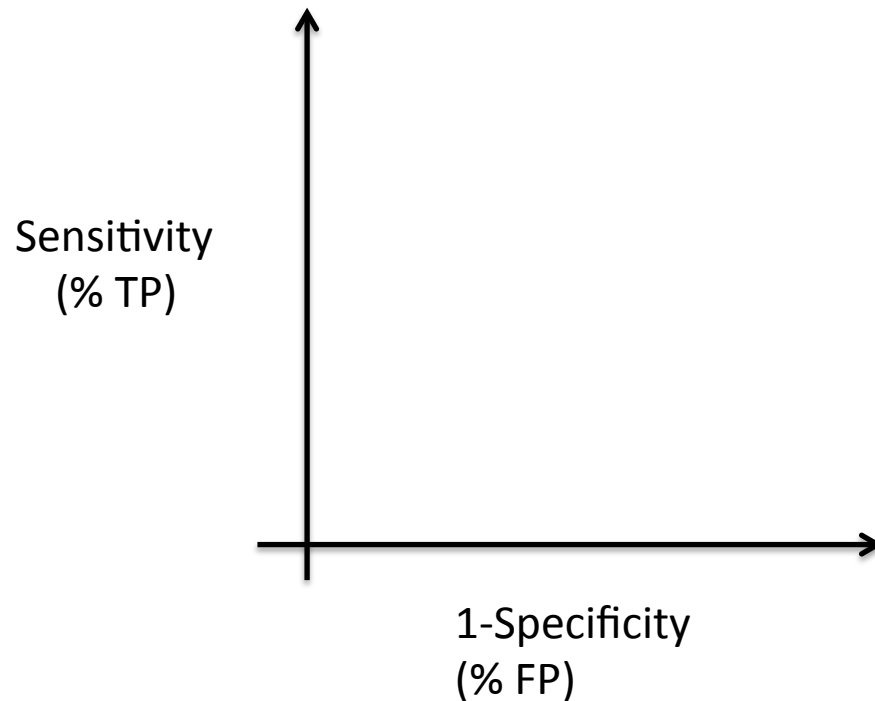
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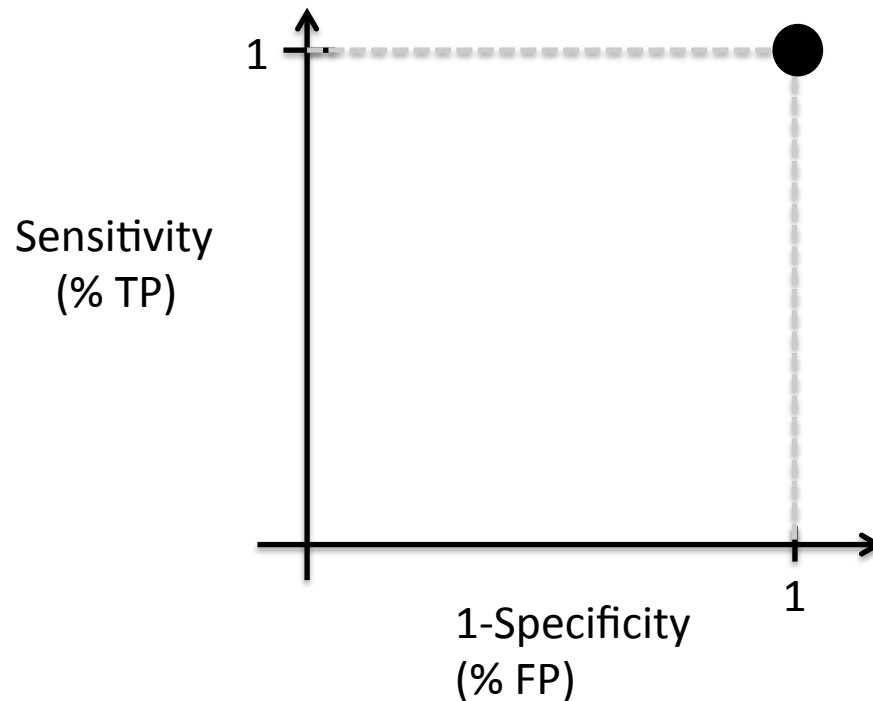
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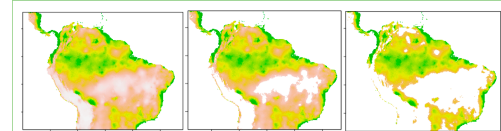


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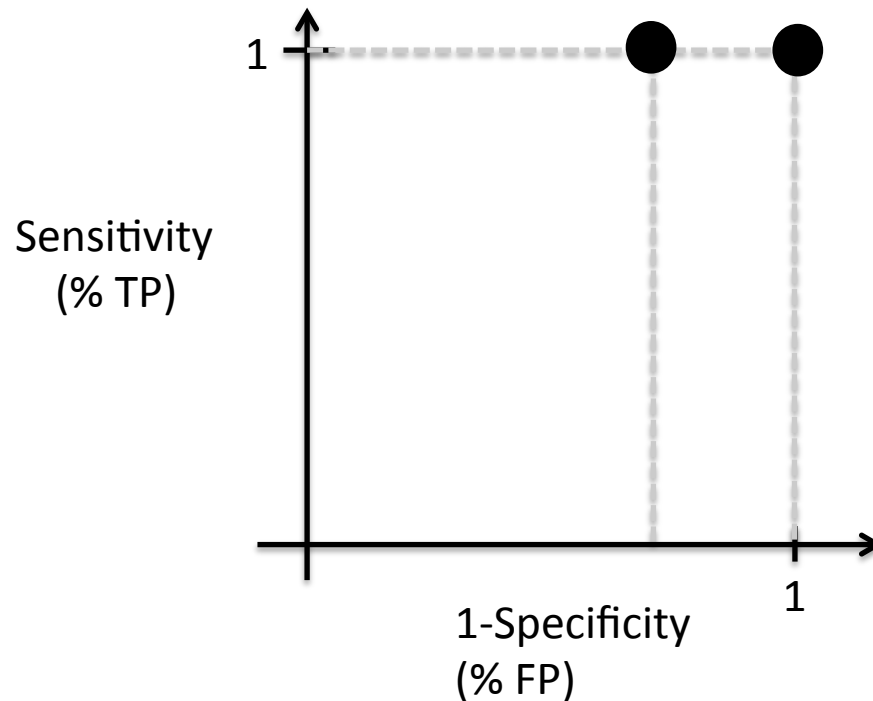
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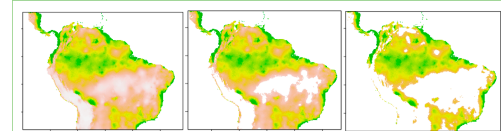
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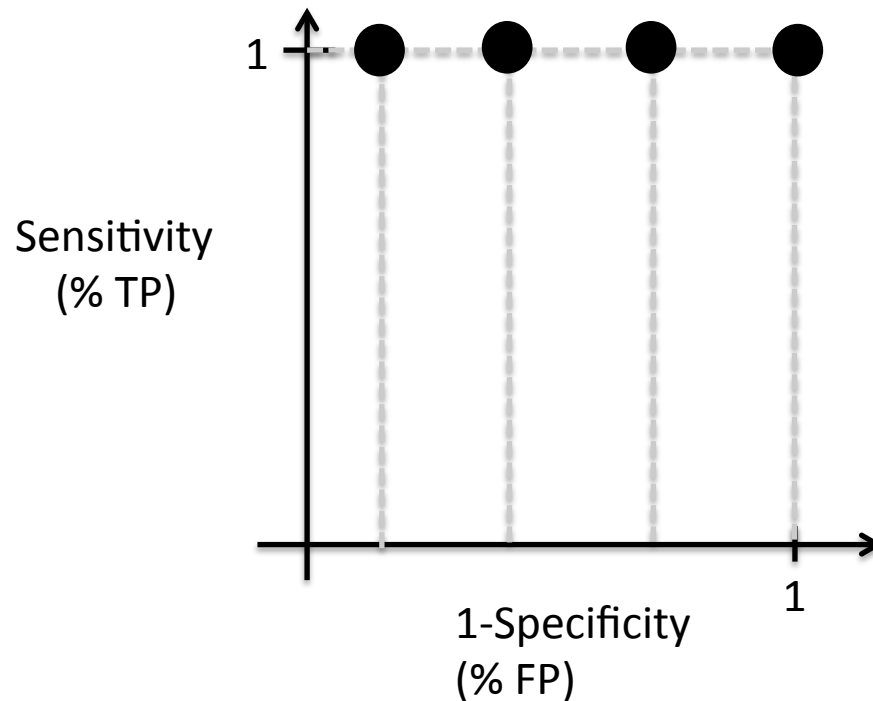


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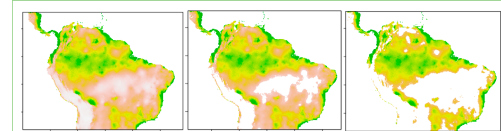
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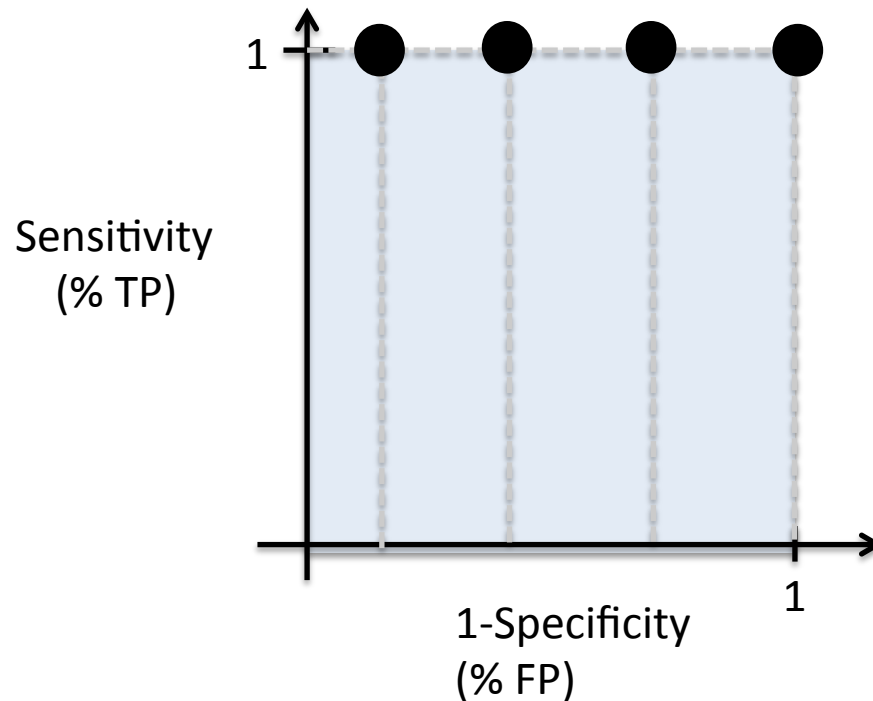


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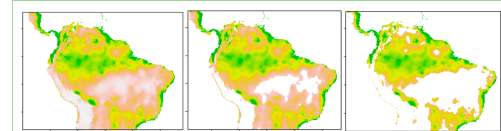
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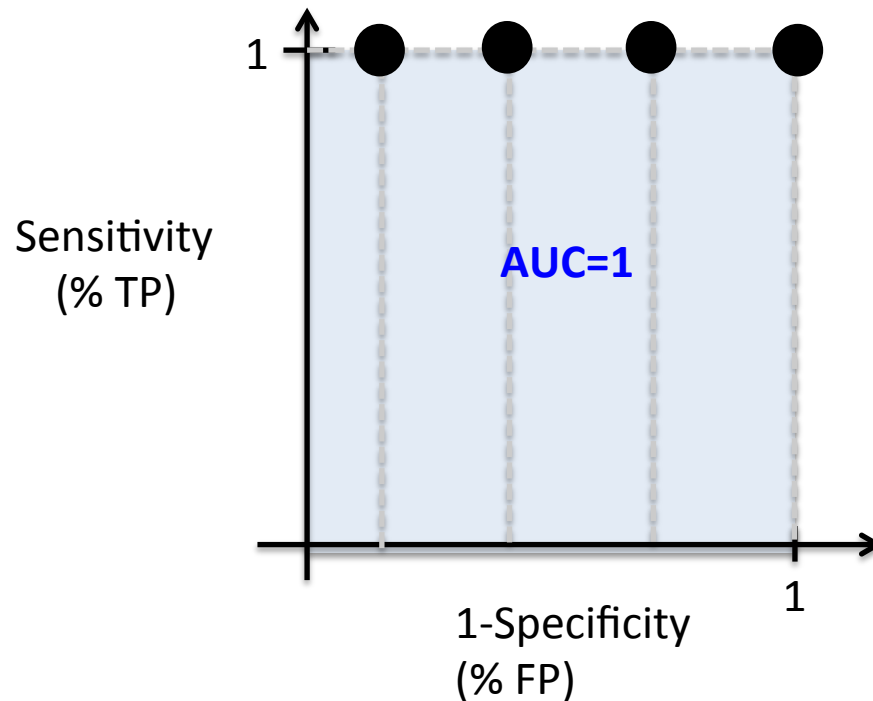


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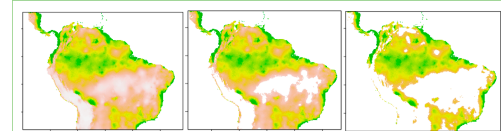
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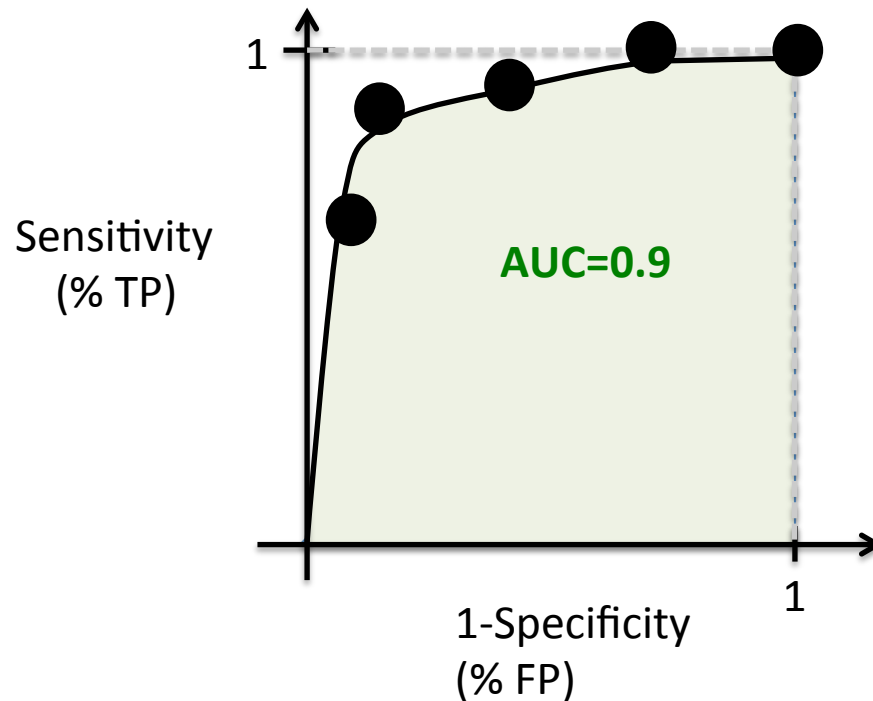


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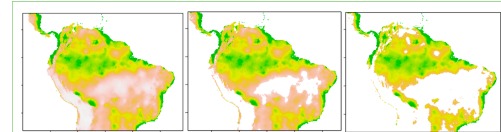
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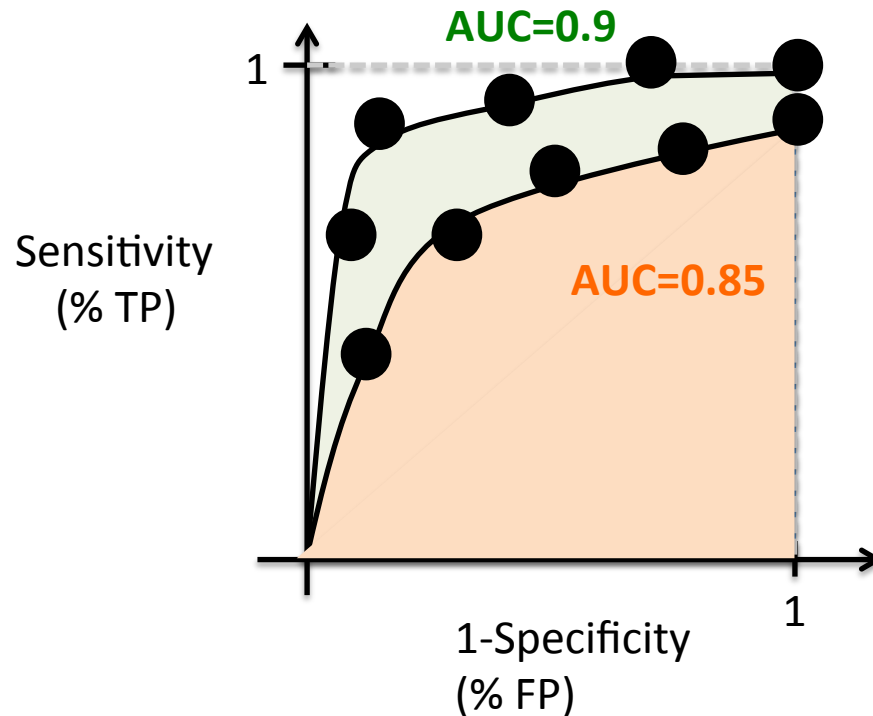


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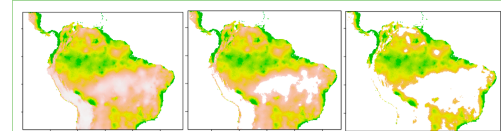
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AUC tests several thresholds...

Nice explanation at

<https://www.youtube.com/watch?v=4jRBRDbJemM>

OTHER STATISTICS....

- **True Skill Statistics:** evaluation of sensitivity + specificity -1
- **Point biserial correlation:** correlation between the occurrence observations & the predictions
- **Correctly classified test data:** % of presence test data that correctly fall into predicted suitable areas
-> Test data : independent from training data??
- **R Pearson:** for models generated with abundance records

OTHER STATISTICS....

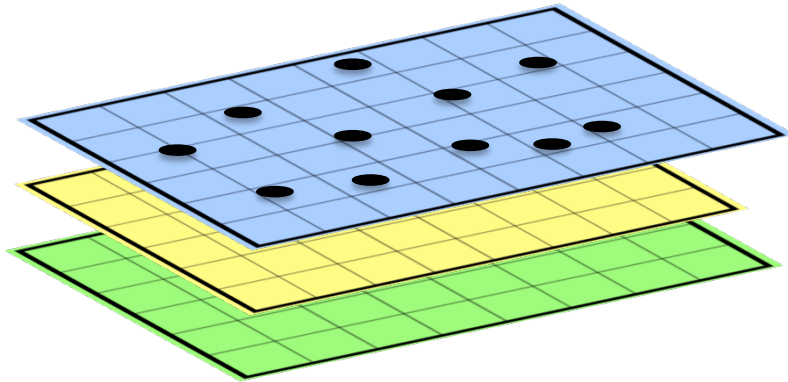
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-> Test data : independent from training data??
- **R Pearson:** for models generated with abundance records
 - ➔ Relevance of presence-only models ?
 - ➔ Strong sensitivity to the chosen threshold

PRACTICE !

- Get the results of AUC, TSS, COR... OF YOUR MODEL
- In the binarisation exercise, replace the threshold 0.7 by the value of the MaxSSS. Are your results strongly different?

EXTRAPOLATION...

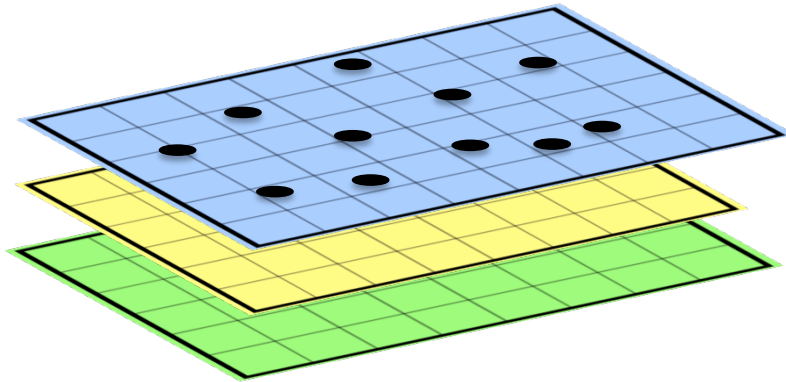
Presence records

Descriptor A interval $[a1, a2]$ Descriptor B interval $[b1, b2]$ Descriptor C interval $[c1, c2]$

...

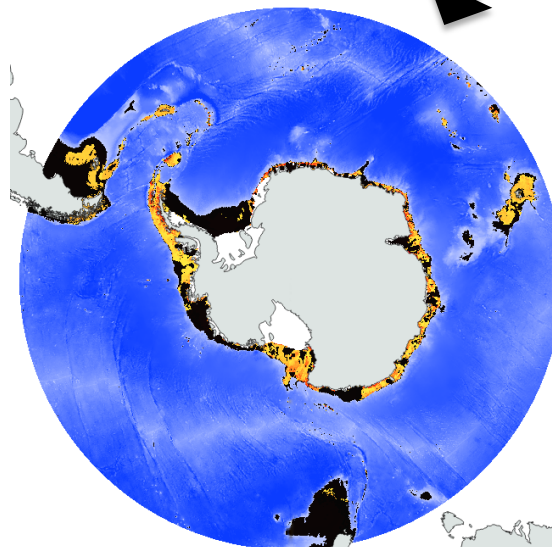
EXTRAPOLATION...

Presence records

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...

MESS: Multivariate
Environmental Similarity
Surface
(Elith et al. 2010)



More than 60% of the
area: extrapolation !
➔ To take into
consideration

Guillaumot *et al.* (*in prep.*)

See also Torres et al. (2015)

PRACTICE !

In the script, you have a section in which the code defines the area where environmental conditions are outside the range of the calibration

- Run the code and produce an extrapolated map
- Write a code to assess the proportion of the projected area that is actually extrapolation

QUESTIONS ???