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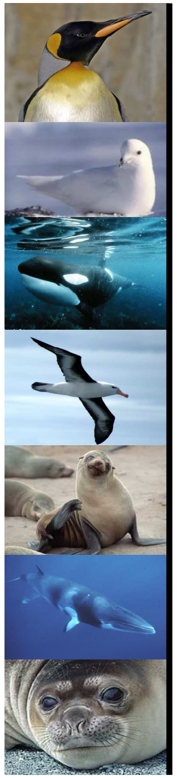
Equipe Prédateurs Marins



Extracting oceanographic data via R : An application to habitat modelling of marine species

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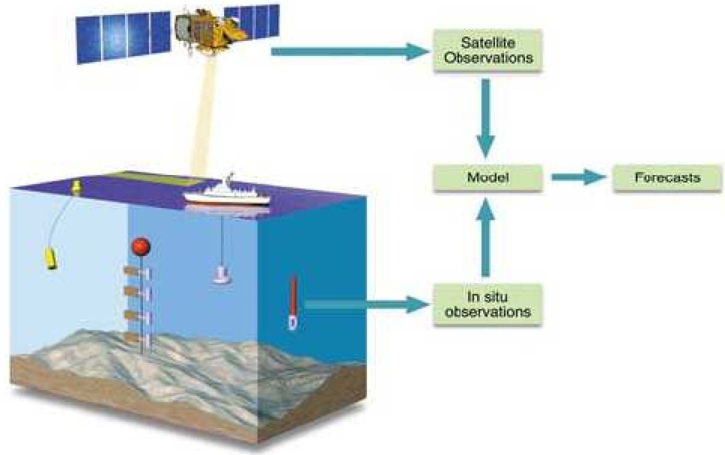
Framework

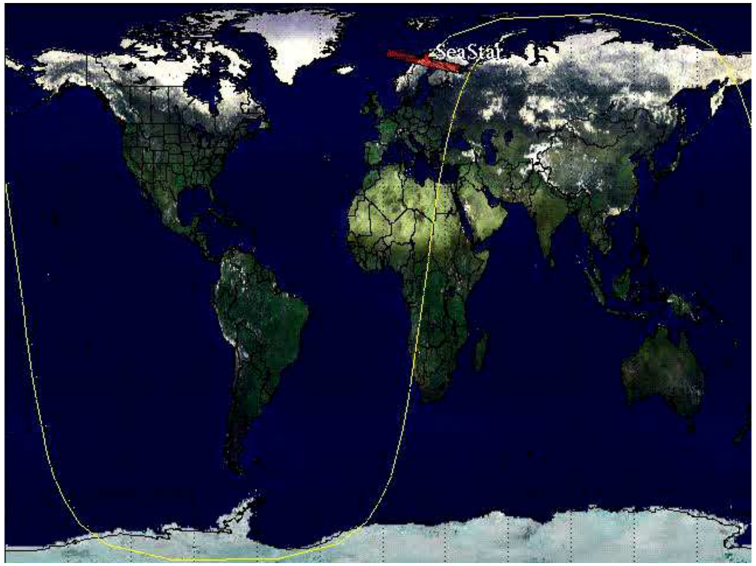
➢ Thanks to the rapid development of remote sensing technologies, the availability of oceanographic data has dramatically increased during the last years.

➢ Diverse oceanographic data availability depending on:
(1) sources (NOAA, ESA)
(2) format (netcdf, hdf)
(3) resolution (temporal and spatial)

➢ Oceanographic data extraction is time-consuming and difficult to handle within the same format.



http://earth.esa.int/workshops/venice06/participants/282/paper_282_blanc.pdf



1-day chlorophyll measurement

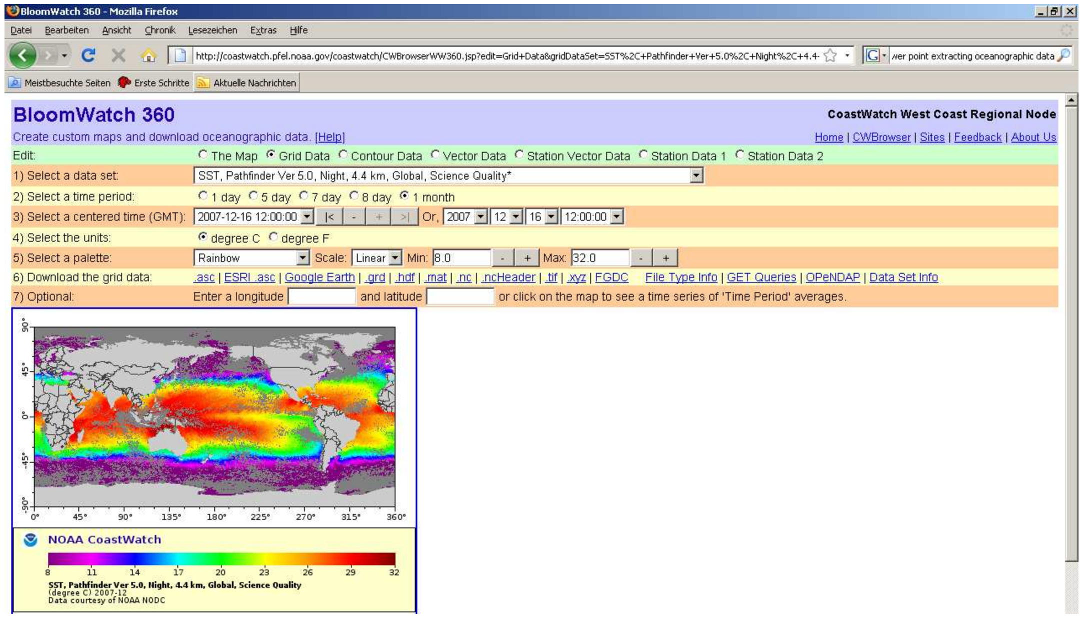
(http://oceancolor.gsfc.nasa.gov)

R-based tool: Xtractomatic

➢ Recently developed a R-based tool: ***Xtractomatic***
(http://coastwatch.pfel.noaa.gov/xtracto/)

Environmental Research Division
Southwest Fisheries Science Center
US National Marine Fisheries Service

➢ Simply make available environmental data (SST, chlorophyll, wind) within the R environment.



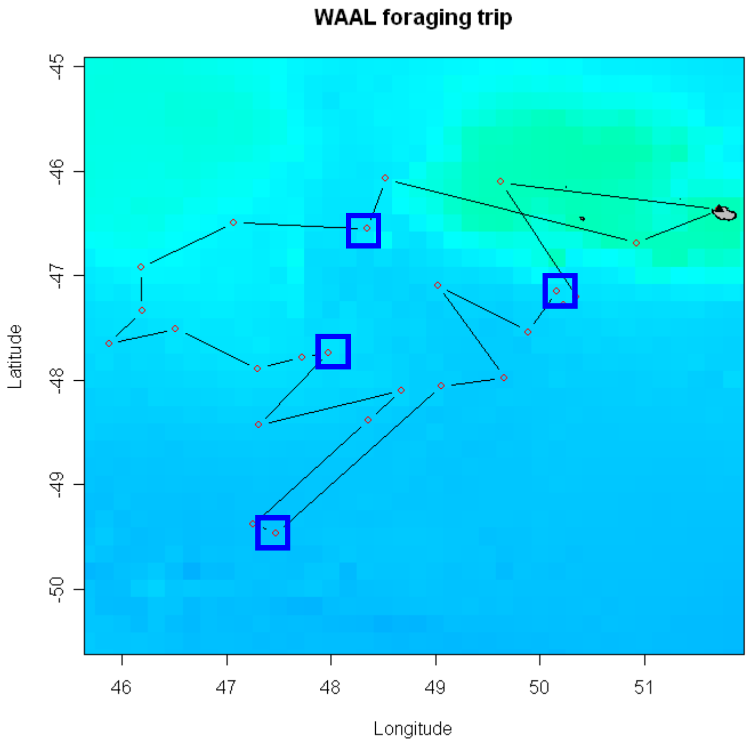
http://coastwatch.pfel.noaa.gov/coastwatch/CWBrowserWW360.jsp

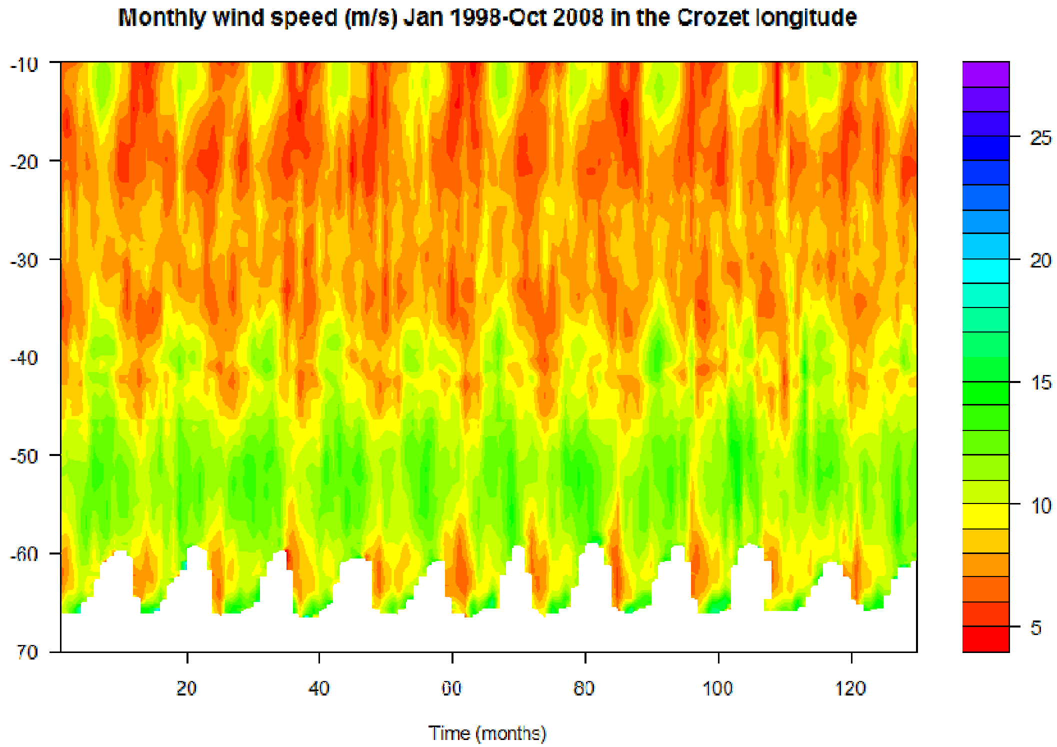
R-based tool: Xtractomatic

- Two types of oceanographic data extraction:

Series of longitude, latitude and time specifying an extraction box

3-D cube: longitude, latitude and time





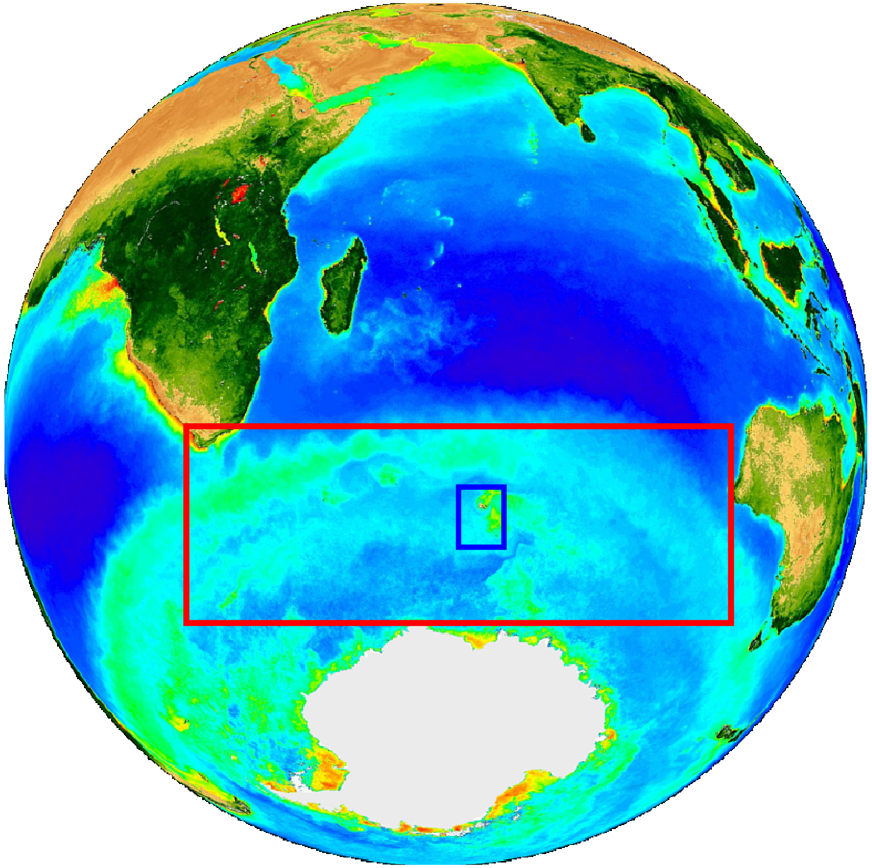
extract<-rxtractomatic(xpos=230°, ypos=40°, tpos='2006-01-01', dtype='18', xrad=0.1°, yrad=0.1°)

extract<-rxtractomatic_3D(xpos=230°:240°, ypos=40°: 45°, tpos=c('2006-05-05','2006-05-21'), dtype='18')

- Data storage: netcdf (20 years of daily wind data over a 0.25° cell size in only 4 GB).

Applying to marine species

➢Xtractomatic applied to the extraction of oceanographic data ⇒ habitat modelling of marine species (e.g. southern Indian Ocean).



Southern Indian Ocean

Wandering Albatross Diomedea exulans

Krefftichthys anderssoni

Habitat modelling (I): birds

Framework

- The identification of key marine areas (foraging / migration) is critical for the development of comprehensive approaches to the conservation of top predator populations.

- Top predators inhabit a heterogeneous environment and their distribution patterns reflects oceanographic variability.

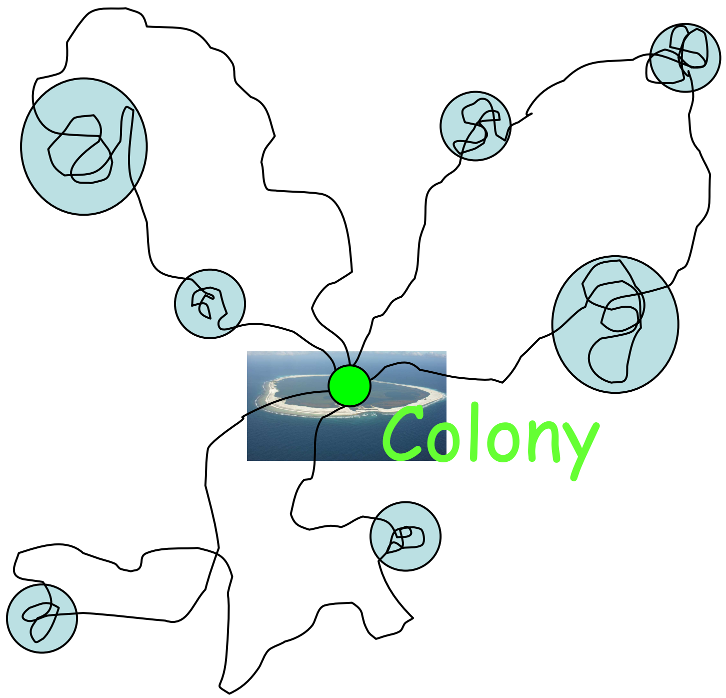
- Susceptibility to anthropogenic impacts depends on:
  - (1) Habitat association.
  - (2) Degree of aggregation.

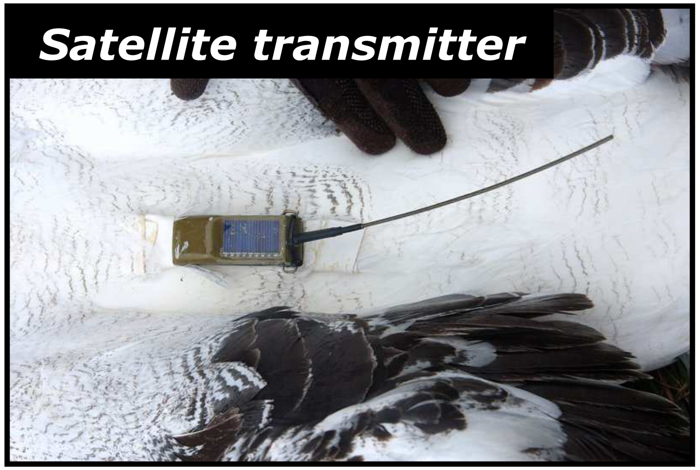
- Southern Ocean: bycatch is the main conservation problem of seabirds.

- Important to assess the distribution and oceanographic habitats of top predators for identifying key marine areas for their conservation.

Wandering Albatross

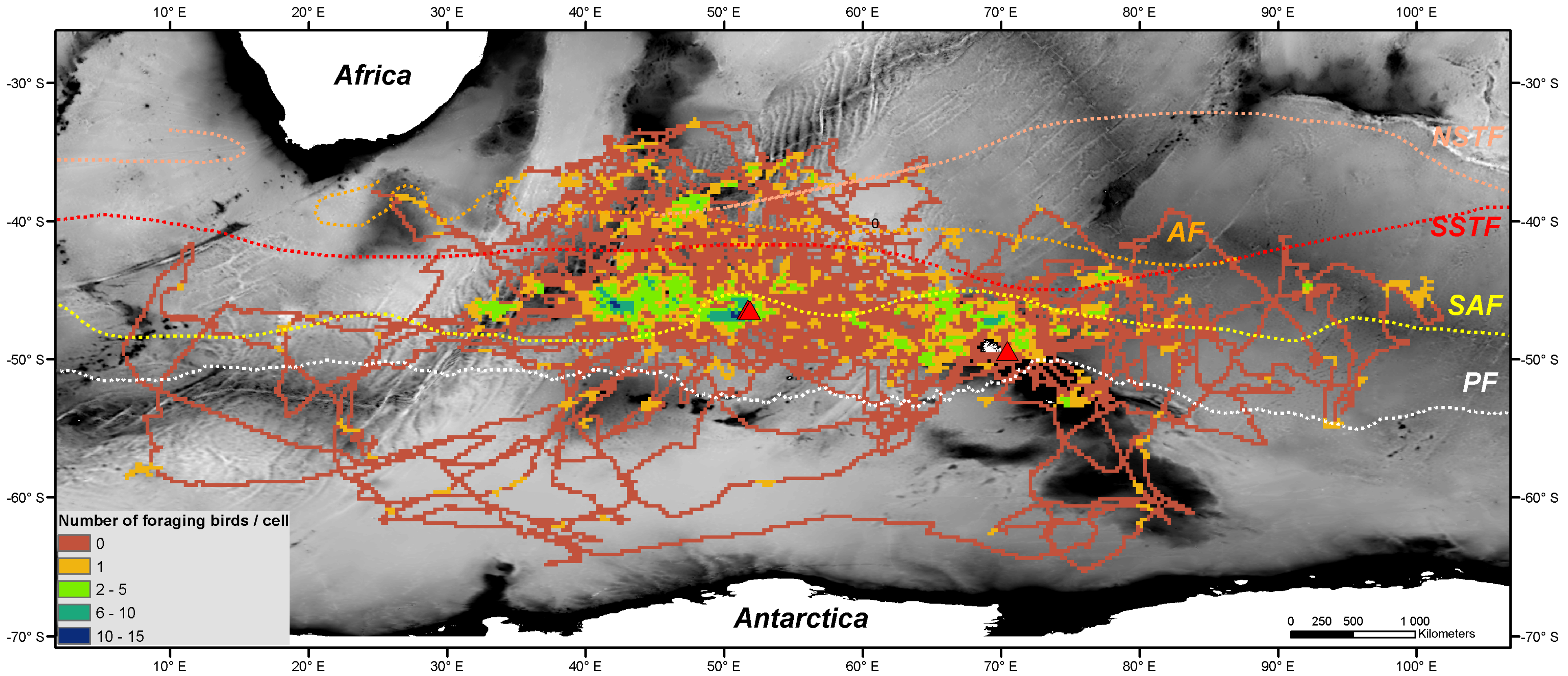
- ➢Conservation status: vulnerable
- ➢122 individual tracks (1998-2005) over a standard grid 0.25°
- ➢Animal movement analysis for identifying foraging zones ⇒ foraging/not foraging.





Observed foraging patterns

Number of birds foraging within each 0.25°-size cell

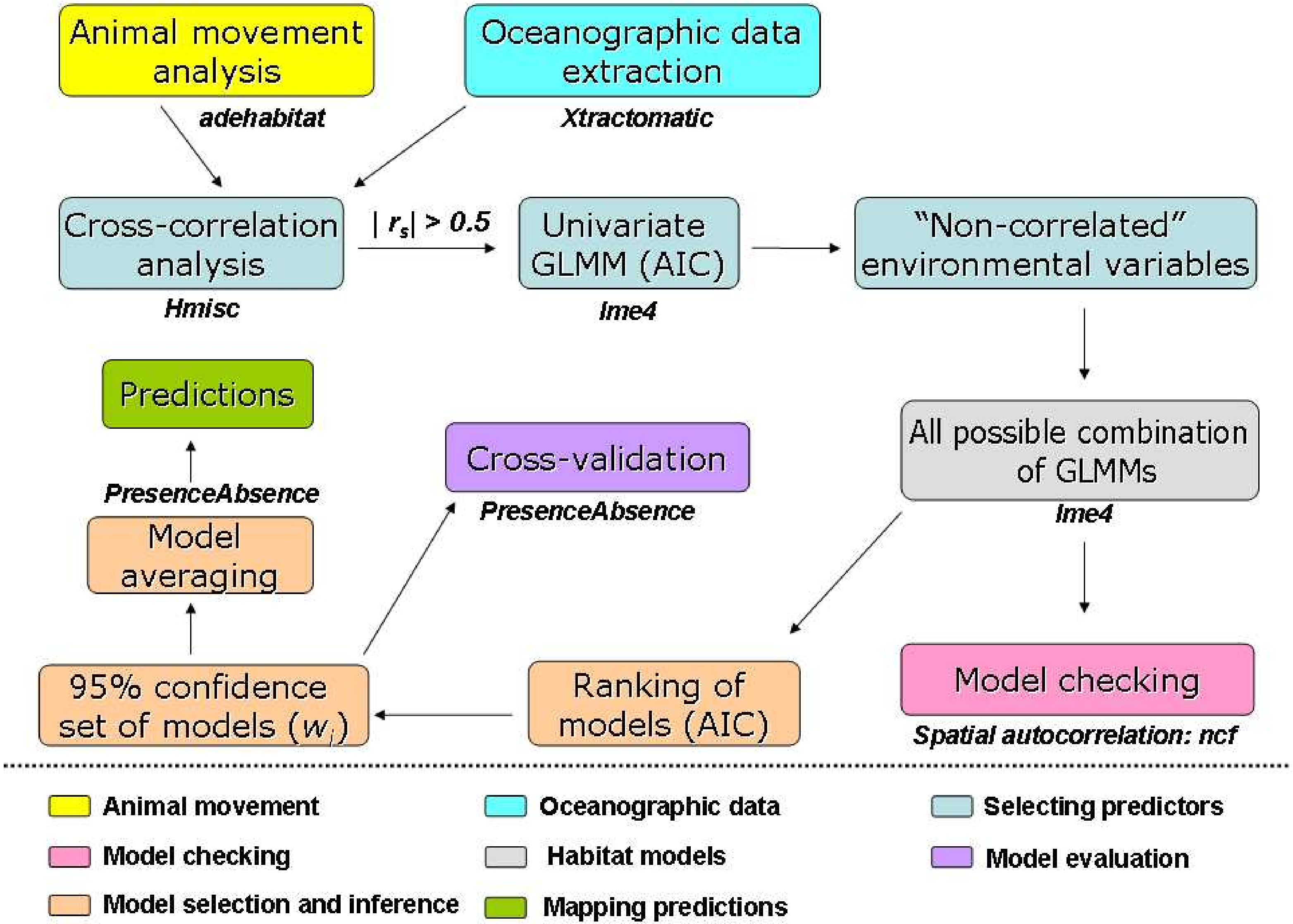


Explanatory variables

Explanatory Variables	*Satellite*	*Spatial resolution*	*Range (min – max)*	*Oceanographic process*
Chlorophyll *a* (CHL, mg m-3)	SEAWIFS	0.1°	0.051 - 1.657	Ocean productivity domains
CHL gradient (CHLG)	SEAWIFS	0.1°	0.000 - 99.487	Frontal systems
Sea Surface Temperature (SST, °C)	PATHFINDER	0.04°	0.45 - 24.60	Water mass distribution
SST gradient (SSTG)	PATHFINDER	0.04°	2.00 - 82.33	Frontal systems
Sea Level Anomaly (SLA, m)	AVISO	0.25°	-0.619 - 1.052	Presence of eddies
SLA gradient (SLAG)	AVISO	0.25°	0.214 - 58.912	Frontal systems
Wind speed (WIND, m s-1)	BLENDED	0.25°	5.822 - 12.746	Wind patterns
Bathymetry (BAT, m)	ETOPO	0.03°	80.735 - 5847.816	Coastal vs. pelagic domains
BAT gradient (BATG)	ETOPO	0.03°	0.187 - 96.522	Presence of topographic features (shelf-break, seamount)
Distance to colony (COLONY, km)	---	---	12.256 - 3354.582	Breeding colony influence on central-place-foragers

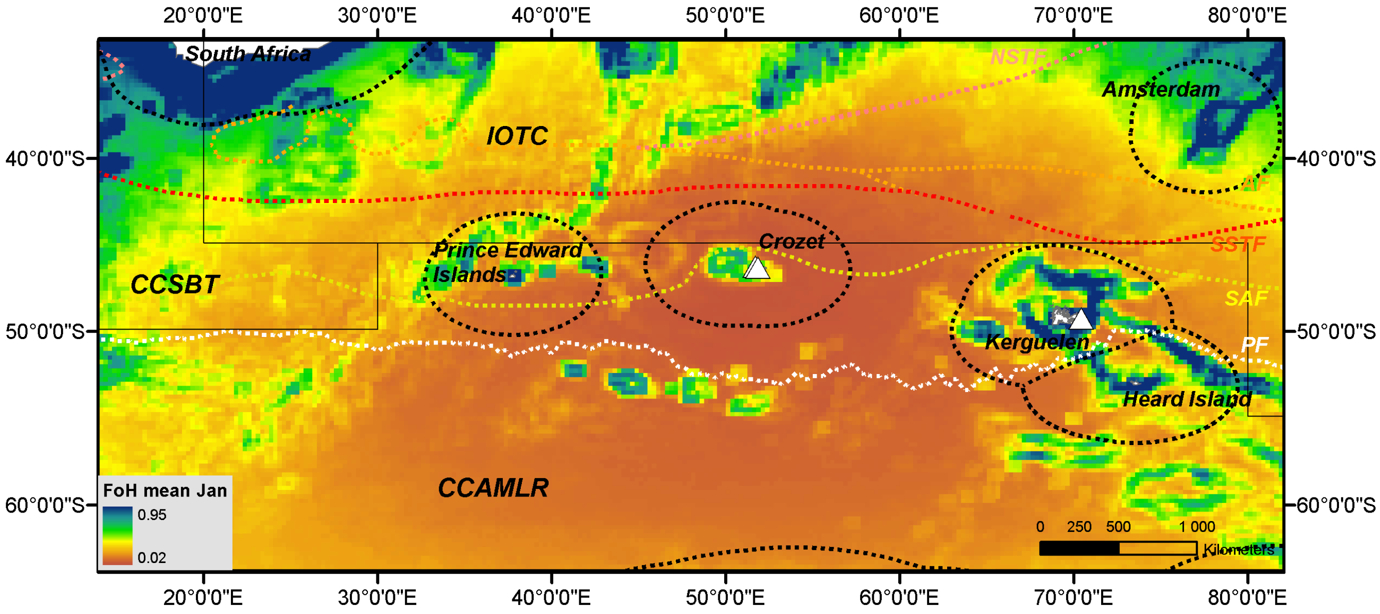
http://coastwatch.pfel.noaa.gov/coastwatch/CWBrowserWW360.jsp

Modelling procedure

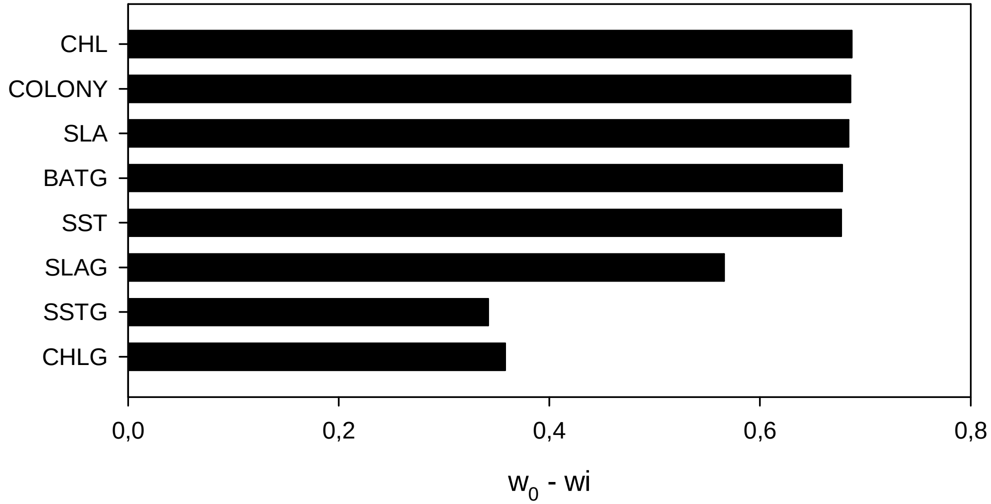


Predicting foraging habitat

Predicted foraging habitat for the Wandering Albatross



Importance of the environmental variables



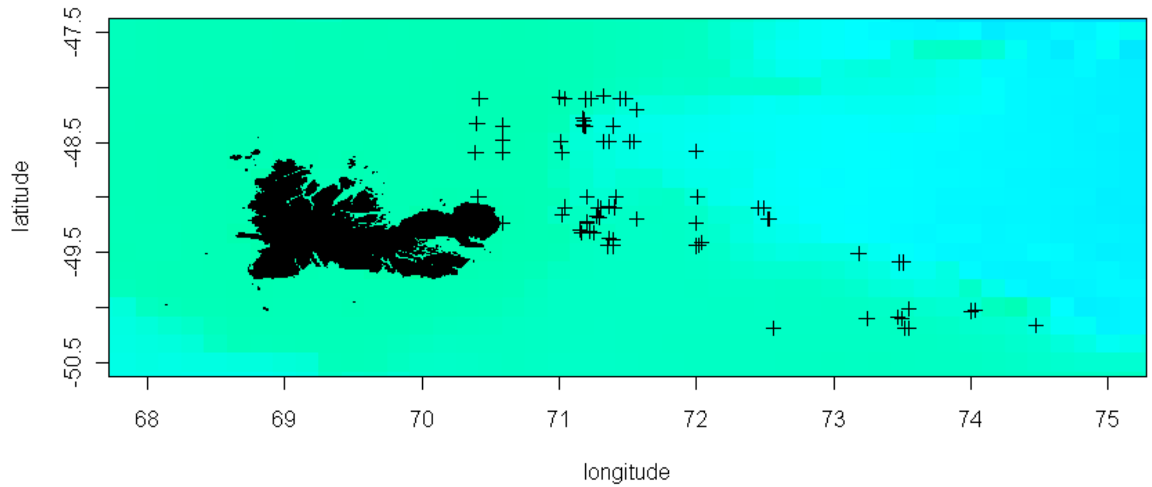
Habitat modelling (II): fishes

Framework

- Mesopelagic fishes are the most important biomass in the Southern Ocean after krill.
- They are a key food resources for top predator such as seabirds and mammals.
- Fish are studied using oceanographic cruises and sampled in certain locations. How to extrapolate their distribution to unsampled areas?
- The same work-flow as bird habitat modelling was followed except the use of generalized additive models (GAM, *gam* package).
- Map of fish habitat predictions could be used as input variables for top predators habitat modelling.

Methods

Modelling presence probability



R.V. La Curieuse

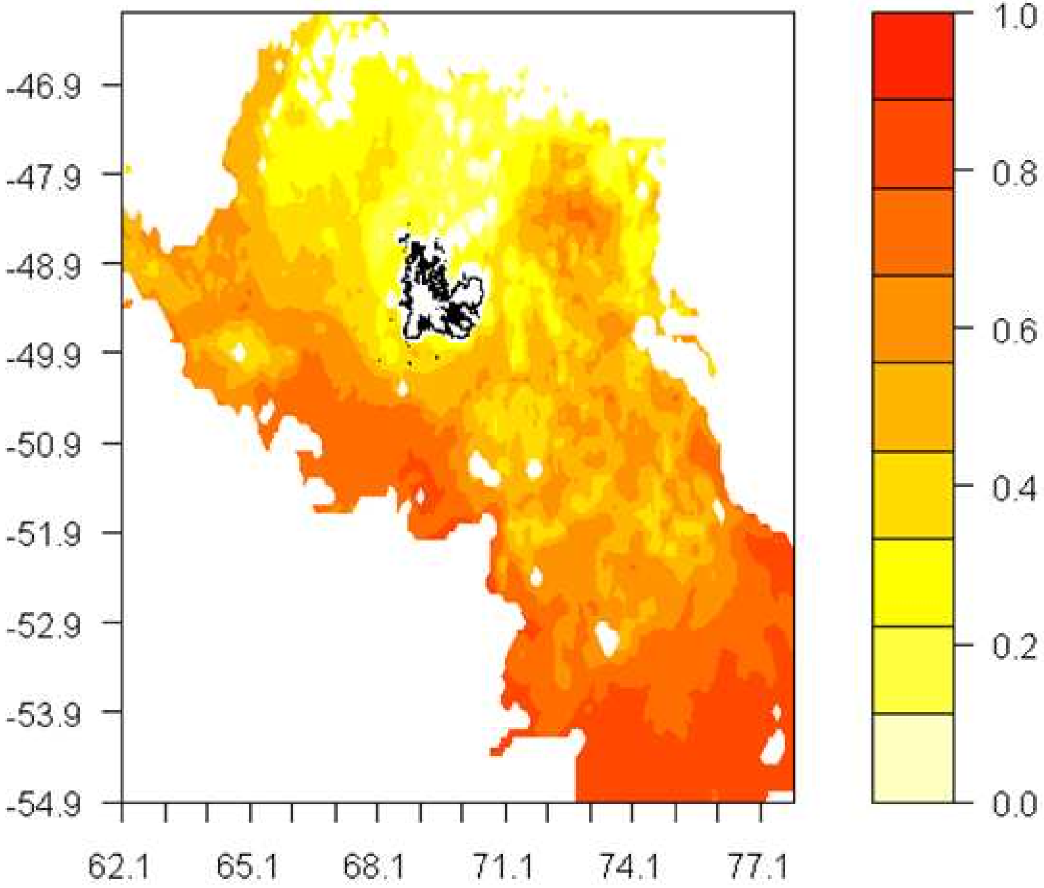
Positions of the sampling stations from 1998 to 2000 (December to March)

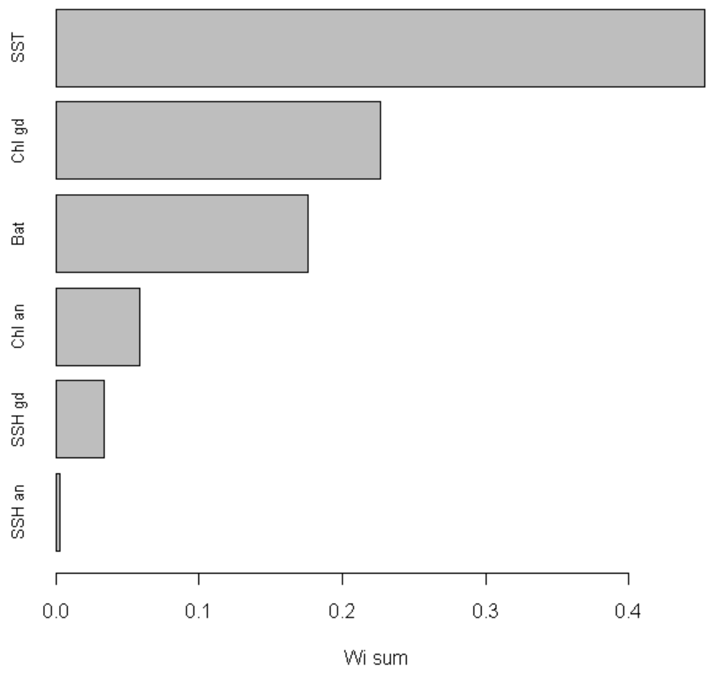
- Oceanographic data extract using the Xtractomatic function :

Data	Source	Spatial resolution
Chlorophyll	Seawifs	0.1°
Sea surface temperature	Pathfinder V5	4 km
Sea surface height	Aviso	0.25°

Predicting occurrence patterns

Predicted presence probability of
Krefftichthys anderssoni





Importance of the environmental variables

Discussion & Perspective

➢ Given the high conservation concern of marine top predators and current major environmental changes, the standardization of the whole habitat modelling process makes much easier and faster the investigation of the oceanographic processes influencing marine species distribution patterns.

Identify unsampled areas that could be of importance for top predators

➢Our results highlight the importance of dynamic features for defining the distribution patterns of marine species (e.g. SST, CHL).

➢ Logistic regressions (GLMMs and GAMs) are robust tools for modelling species distributions and they allow generating statistical functions that allow predictions of potentially suitable habitat distribution.

➢ Thanks to the increasing availability of environmental data and automatic procedures for their acquisition, habitat predictions could then be made in 'real time'.

MLA2

Acknowledgements

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- The Ethic Committee of IPEV approved the field procedure.

- The oceanographic data were extracted thanks to the Environmental Research Division, Southwest Fisheries Science Center and US National Marine Fisheries Service.

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Diapositive 16

MLA2 Here you should introduce your funding... and maybe people who have helped during the fieldwork...
I have already included the GLIDES project...
Maite Louzao Arsuaga; 15/06/2009


GRACIAS