Tracked wandering albatrosses depict no $\delta^{13}C$ gradients within their winter foraging areas in the Southwest Atlantic waters

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Aim

- 1) validate the marine $\delta^{13}C$ isoscape for top consumers in the southwest sector of the Atlantic Ocean during the austral winter;
- 2) assess monthly differences (from May to October) in $\delta^{13}C$ and $\delta^{15}N$ (i.e. temporal variation).

Conclusions

- The failure to distinguish a major biogeographic gradient in $\delta^{13}C$ values suggest that $\delta^{13}C$ values in the south Atlantic Ocean are fairly homogenous (Fig. 1).
- As birds did not show a significant change in diet composition or foraging areas during the study period, these results provide no evidence for major temporal variation in $\delta^{13}C$ and $\delta^{15}N$ in consumer tissues, or in the regional marine isoscape in the austral winter of 2009.

Introduction

- Stable isotope analyses (SIA) are a useful and powerful tool for tracing animal movements because they do not require initial marking of the organism.
- By analysing the appropriate tissues we can link isotopic information to specific geographic areas, and hence determine foraging areas of individuals
- The main limitation of isotopic tracking for inferring distribution is the lack of detailed reference maps of the isotopic landscape (i.e. isoscapes) in the marine environment.

Table 1. Comparison of foraging parameters , stable isotope values ($\delta^{13}C$ and $\delta^{15}N$) in blood cells and delipidated plasma, and diet composition (based on the stomach contents) of wandering albatrosses sampled at Bird Island, South Georgia, from May to October 2009.

2009	means ± SD						Kruskal-Wallis test	
	May (n=6)	June (n=3)	July (n=6)	August (n=6)	September (n=5)	October (n=3)	$H_{5,29}$	P
Trip duration (days)	3.2 ± 1.4	5.4 ± 2.3	5.7 ± 3.1	4.9 ± 4.6	10.7 ± 7.1	6.5 ± 5.1	5.8	0.33
Latitude in ° (of feeding attempts)	-53.6 ± 0.4ª	-49.1 ± 8.0	-50.2 ± 2.1	-49.7 ± 3.6	-44.8 ± 6.0ª	-50.2 ± 2.4	9.7	0.08
Longitude in ° (of feeding attempts)	-45.4 ± 5.3ª	-44.0 ± 8.8	-42.2 ± 5.7	-38.8 ± 1.1ª	-44.1 ± 4.3	-41.6 ± 5.4	10.0	0.07
SIA								
Plasma $\delta^{13}C$ (‰)	-19.9 ± 0.6	-20.4 ± 0.8	-20.5 ± 0.4	-19.8 ± 0.5	-19.8 ± 0.5	-20.1 ± 0.8	5.7	0.33
Plasma $\delta^{15}N$ (‰)	14.5 ± 0.5	14.4 ± 0.6	14.2 ± 0.5	14.4 ± 0.5	14.2 ± 0.3	14.2 ± 0.5	2.4	0.79
Blood cells $\delta^{13}C$ (‰)	-20.4 ± 0.6	-20.3 ± 0.4	-20.3 ± 0.3	-20.3 ± 0.1	-19.6 ± 0.5	-19.7 ± 0.9	5.5	0.36
Blood cells $\delta^{15}N$ (‰)	14.0 ± 0.2	14.0 ± 0.5	14.1 ± 0.3	14.0 ± 0.4	14.2 ± 0.2	14.3 ± 0.4	2.8	0.73
Diet								
Fish (% by mass)	63.0 ± 41.5	67.3 ± 56.7	63.5 ± 49.6	80.7 ± 26.3	34.9 ± 39.7	1.4 ± 2.3	8.0	0.16
Cephalopods (% by mass)	34.0 ± 42.4	32.7 ± 56.7	36.5 ± 49.6	15.4 ± 27.0	65.1 ± 39.7	90.1 ± 13.8	7.3	0.20
Crustaceans (% by mass)	0.3 ± 0.7	0	0	0	<0.1	0	3.4	0.64
Carrion (% by mass)	2.7 ± 6.6	0	0	3.9 ± 7.5	<0.1	8.5 ± 14.8	3.7	0.59

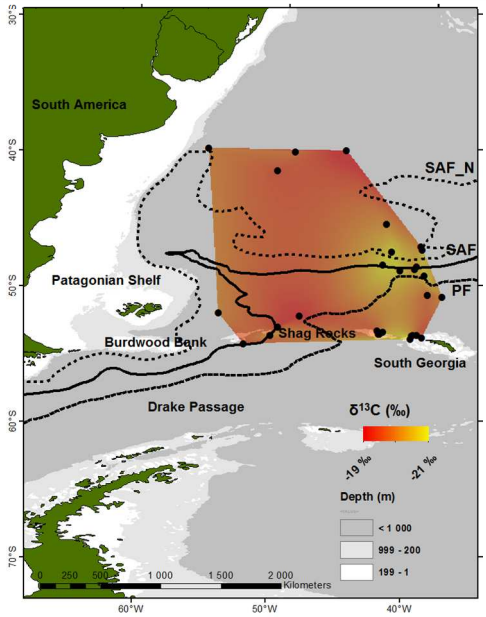

Figure 1. Estimated isoscape after natural neighbour interpolation from $\delta^{13}C$ values of delipidated plasma of the 29 wandering albatrosses tracked with both GPS and activity loggers (AR). Points represent the mean latitude and longitude of feeding attempts calculated for each bird from immersion data . The main oceanic fronts as described in Sallée et al. (2008) are indicated as follows: PF - Antarctic Polar Front, SAF - Subantarctic Front and SAF_N - northern extension of the Subantarctic Front.

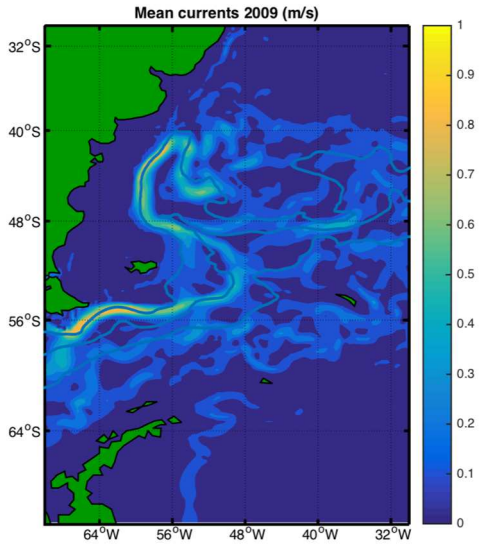

Figure 2. Annual mean currents derived from five-day mean currents for the year 2009. Current data from the 2005-2010 period of the Southern Ocean State Estimate (Mazloff et al., 2010). Solid lines are the mean positions of the Antarctic Polar Front, Subantarctic Front, and the northern extension of the Subantarctic Front, from Sallée et al. (2008).

Results

- The tracked birds foraged in waters to the north or northwest of South Georgia, including the Patagonian shelf-break, as far as 2000 km from the colony (Fig. 1).
- The foraging region encompassed the two main fronts in the Southern Ocean (Polar and Subantarctic fronts) (Fig. 2).
- $\delta^{13}C$ values varied by only 2.1 ‰ in plasma and 2.5 ‰ in blood cells, and no relationships were found between $\delta^{13}C$ values in plasma, and mean latitude or longitude of landings or feeding events of each individual.
- There was no substantial variation among months either in $\delta^{13}C$ or $\delta^{15}N$ values of plasma or blood cells of tracked birds (Table 1).

Methods

- The Wandering albatross (*Diomedea exulans*) was chosen as a top predator model species because it is a large species that forage over vast areas of the Atlantic Southern Ocean.
- Tracking data and blood and diet samples were collected monthly during the austral winter between May and October 2009.
- $\delta^{13}C$ and $\delta^{15}N$ values were measured in plasma and blood cells, and related to highly accurate data on individual movements and feeding activity obtained using three types of device: GPS, activity (immersion) loggers (AR) and stomach temperature probes.

References

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