Seabirds, fish and bivalves – French biomonitoring activities

GLOBAL OBSERVATION SYSTEM FOR MERCURY

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Seabirds, fish and bivalves – French biomonitoring activities

Different spatial and time scales of Hg biomonitoring:

- present period at large scale: tuna fish in the Atlantic, Pacific and Indian Oceans

- *lead by IRD*
- *linked to IMBER-CLIOTOP initiative on tuna trophic ecology*

- present and past periods at large scale: seabirds from the Poles and France, seabirds from Museums

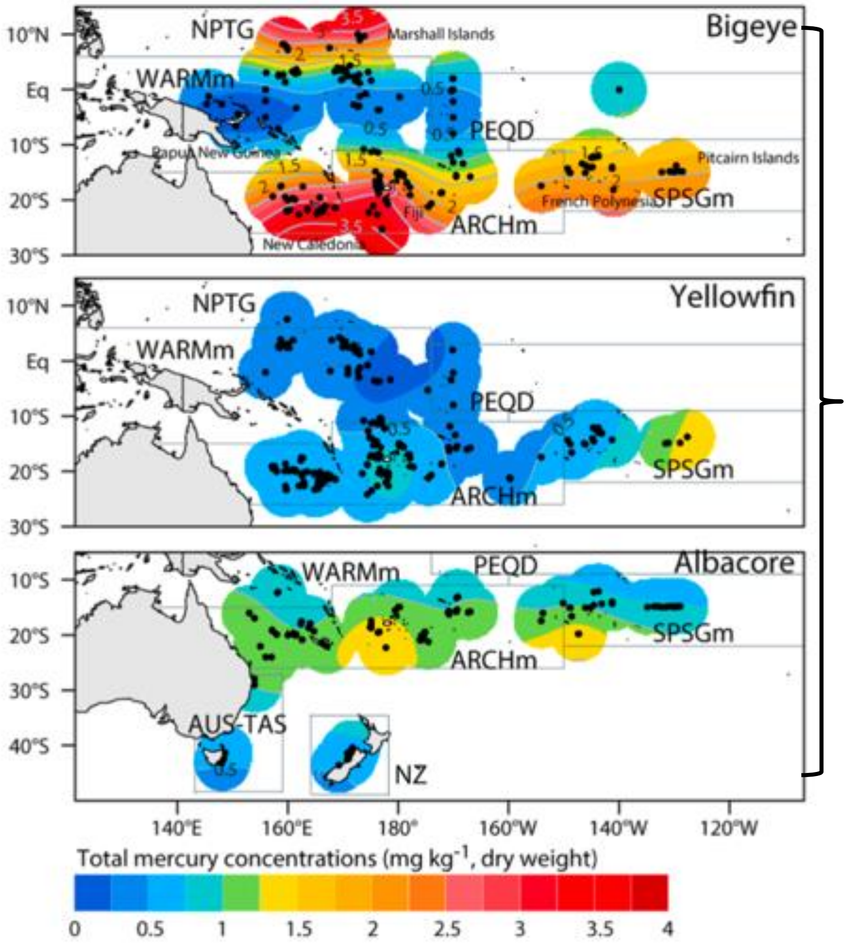
- *lead by La Rochelle University*
- *linked to AMAP*

- present and past periods at national scale (France): sediments and bivalves from the ROCCH ("French Mussel Watch") since 1979

- *lead by Ifremer*
- *linked to OSPAR*

MeHg levels, distribution and source origin in tuna at the global scale

➢ *Spatiotemporal distribution of MeHg in tuna from the SW Central Pacific Ocean*



Development of Generalized Additive Models (GAMs)

Exploratory variables:
δ13C
SST
TP (δ15N)
NPP
Etc…

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Houssard et al., 2019 ES&T: *A Model of Mercury Distribution in Tuna from the Western and Central Pacific Ocean: Influence of Physiology, Ecology and Environmental Factors*

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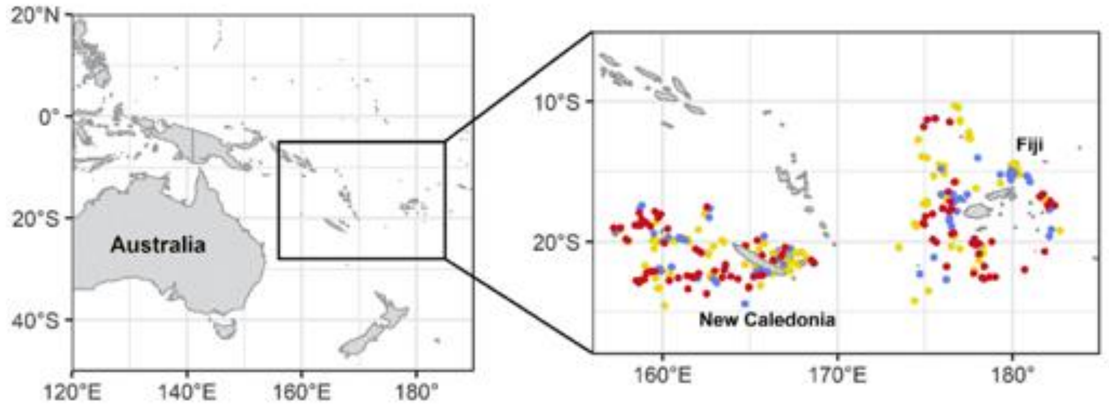
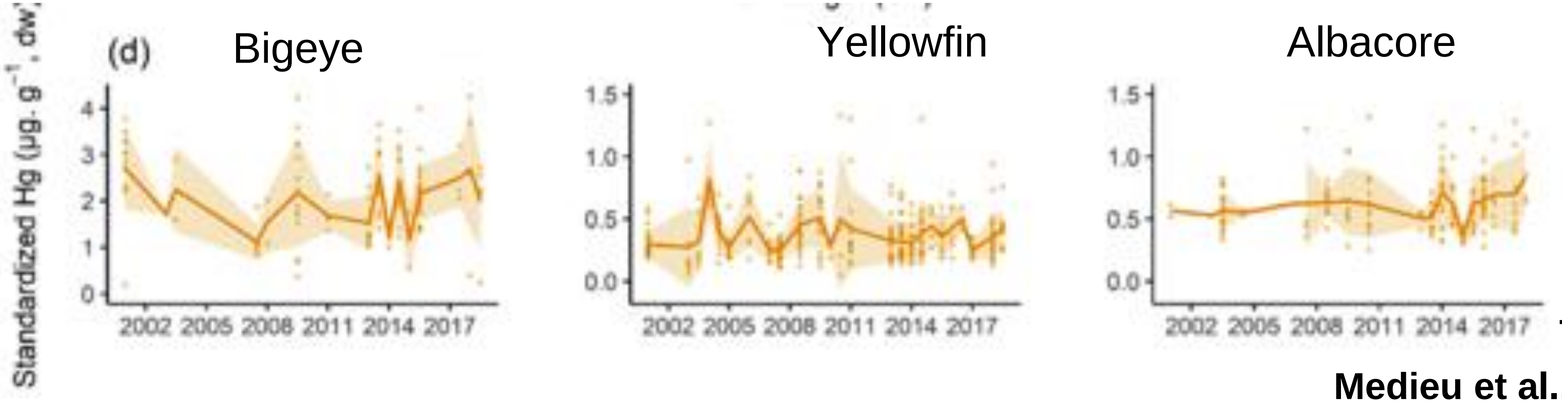
Temporal distribution (18 yr) of MeHg in tuna from the SWC Pacific Ocean

➢ *Investigate tuna MeHg trends and controlling factors at high resolution temporal scales*





Development of GAMs

Exploratory variables:
δ13C
SST
TP (δ15N)
NPP
Etc…

Medieu et al., 2021 Chemosphere: Stable mercury concentrations of tropical tuna in the SWC Pacific ocean: An 18-year monitoring study

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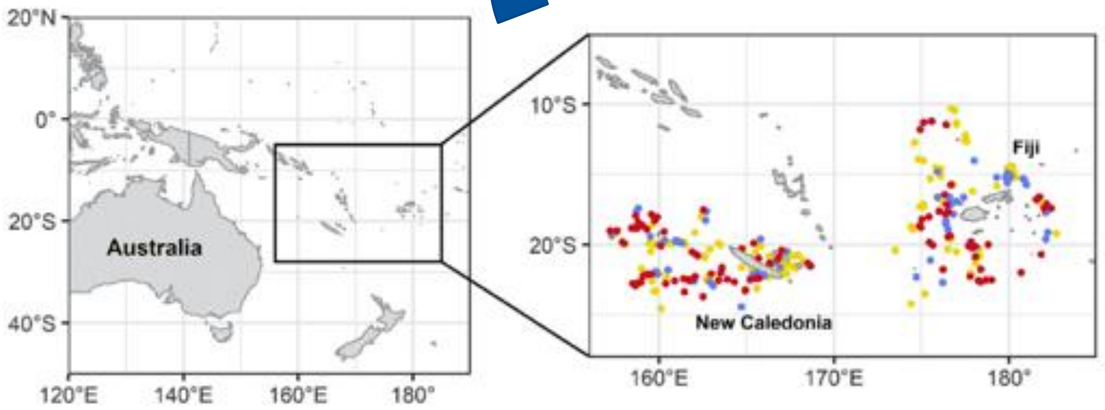
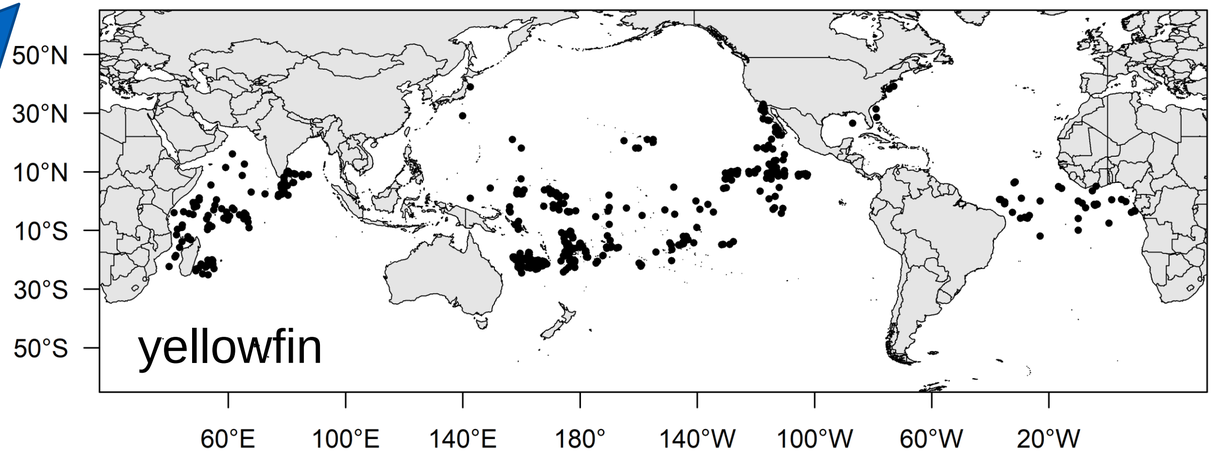
➢ *Distribution of MeHg at global scale: High spatial coverage in the tropical and intertropical regions*

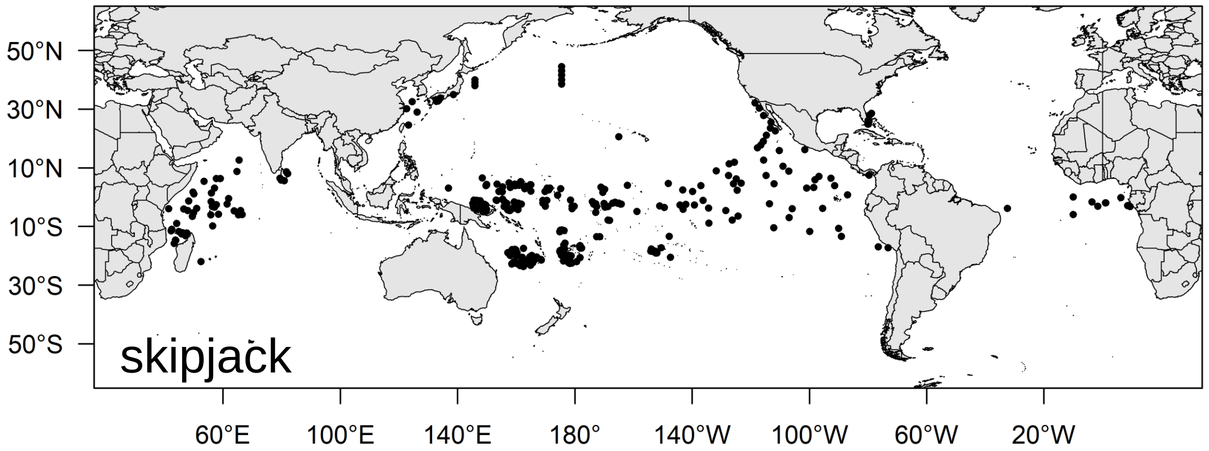
MERTOX
Understanding MeHg Origin
Hg C H H H
δ202 δ13 δD
2017 - 2022

On-going

SWC Pacific Ocean







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Establishing a Global Tuna Hg database (on going, ANR funding)

- By the community, for the community
- Database in R: Incorporation of **all existing data** (literature review, QAQC checks) + **> 5100 new samples** analyzed for Hg to be included

- On-going collaborations with > 12 countries => to be extended to cover more areas

- **HgT analysis, Hg isotopes** (→**iGOS⁴M),** coupling with other ecological tracers ($\delta^{13}C$, $\delta^{15}N$) and oceanic variables (ROM-PISCES model)
- Data policy: free access, cite original studies

Deliverables

- **High spatial resolution maps (regional/global)**
- **Spatial modelling, providing code and monitoring tools to the community**

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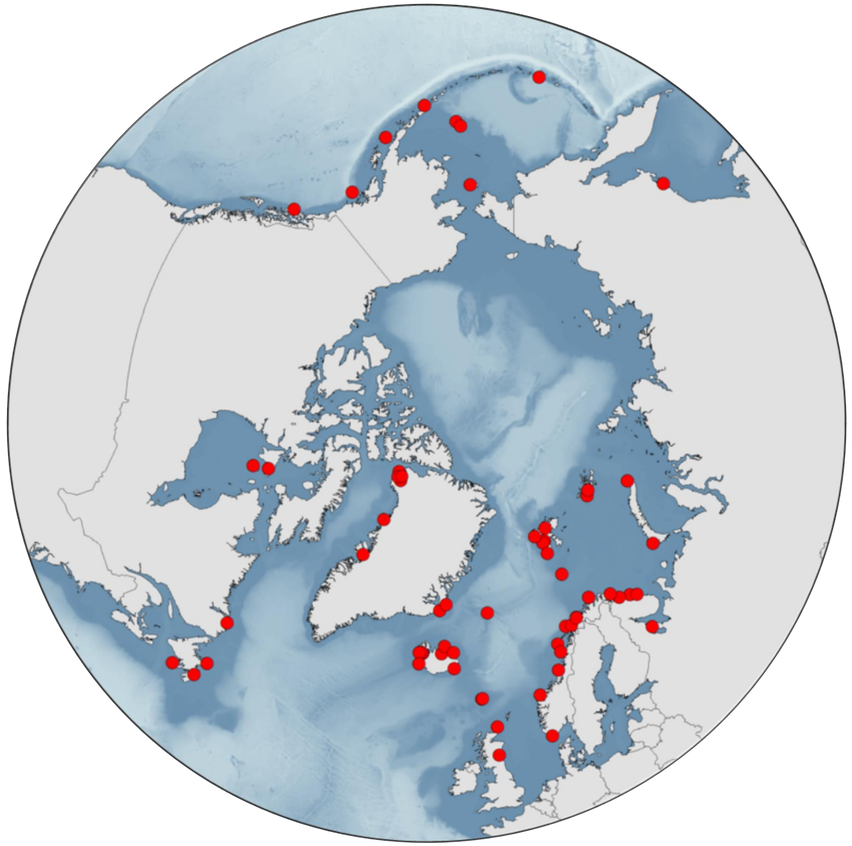
Seabirds: *International pan-Arctic sampling network to map and monitor the contamination of Arctic marine ecosystems (ARCTOX)*



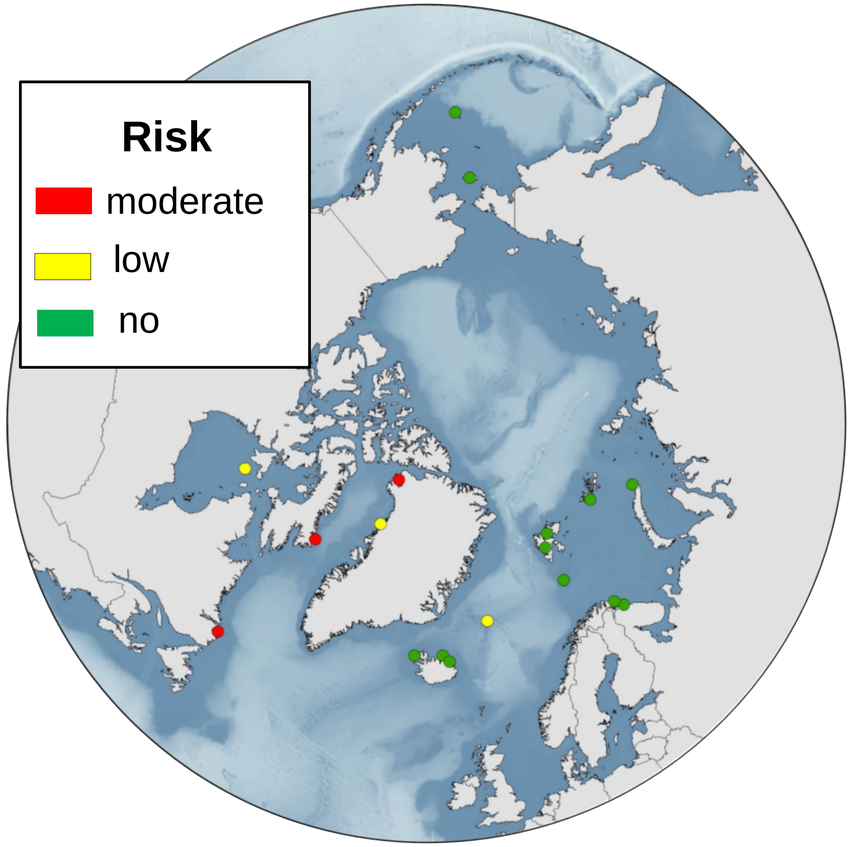
ARCTOX network: 64 sampling sites since 2015

25 seabird species

Levels of Hg in blood and feathers

Contact: jfort@univ-lr.fr

ARCTOX: evaluation of the toxicological risk



1) Monitor Hg contamination of Arctic seabirds and spatial variations in a risk assessment and conservation context

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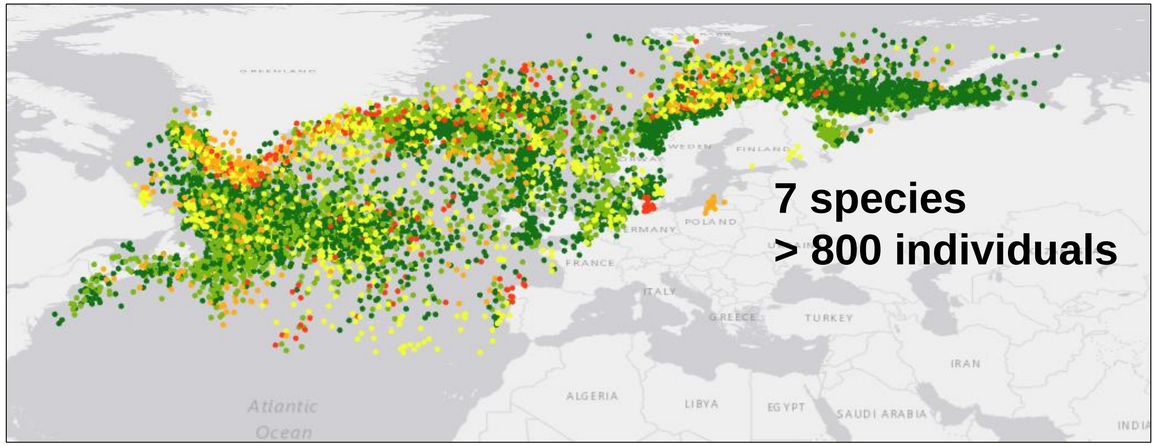
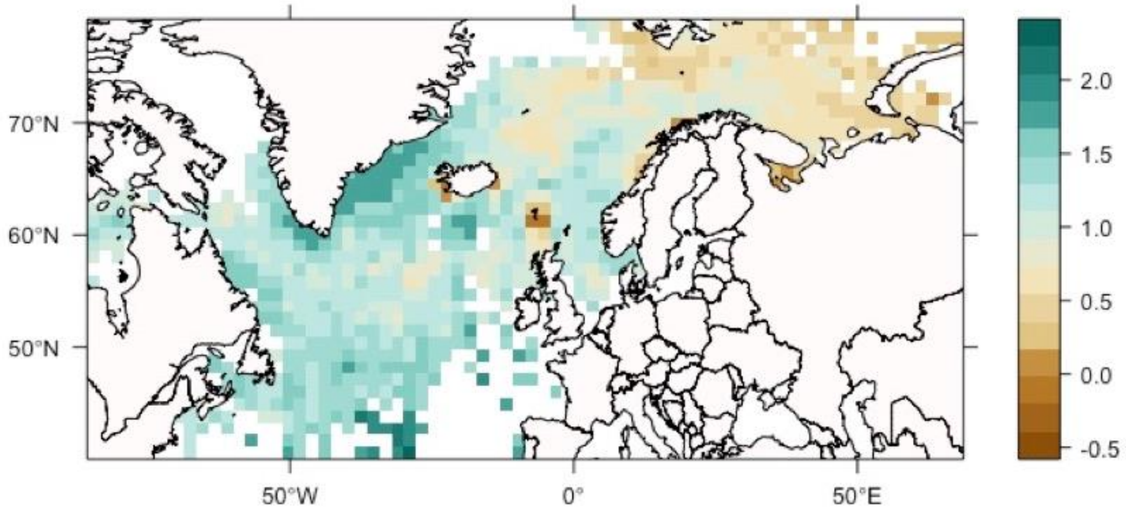
ARCTOX: tracking Hg in and out the Arctic





1) Monitor Hg contamination of Arctic seabirds and spatial variations in a risk assessment and conservation context

2) Monitor Hg levels in marine ecosystems and identify hotspots using seabirds as bioindicators (inside and outside the Arctic by the use of tracking devices)

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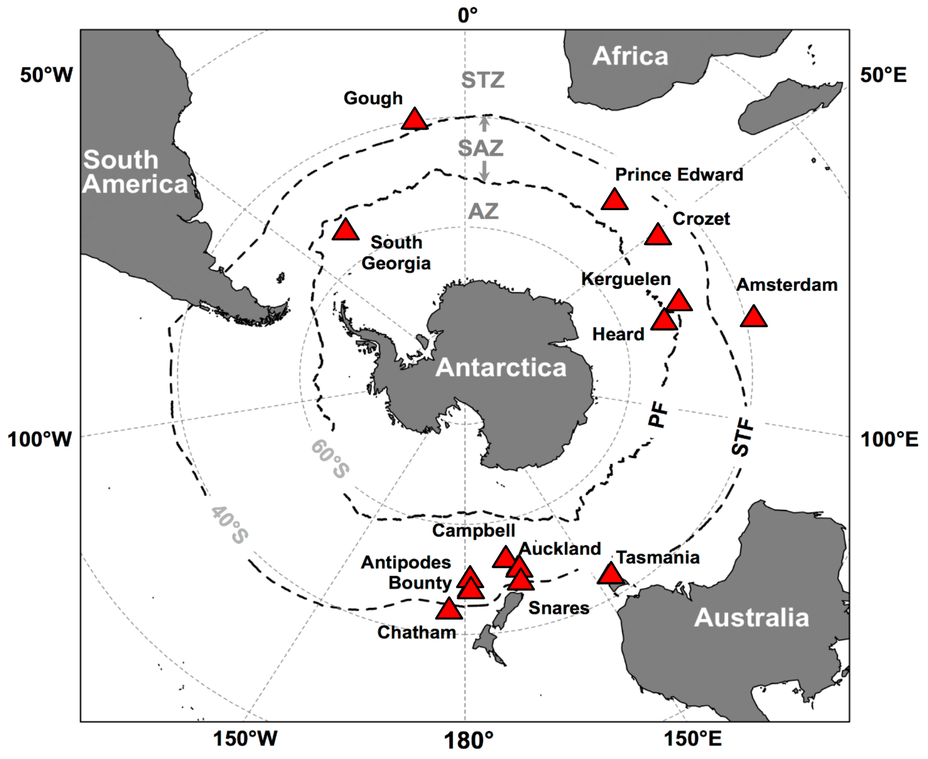
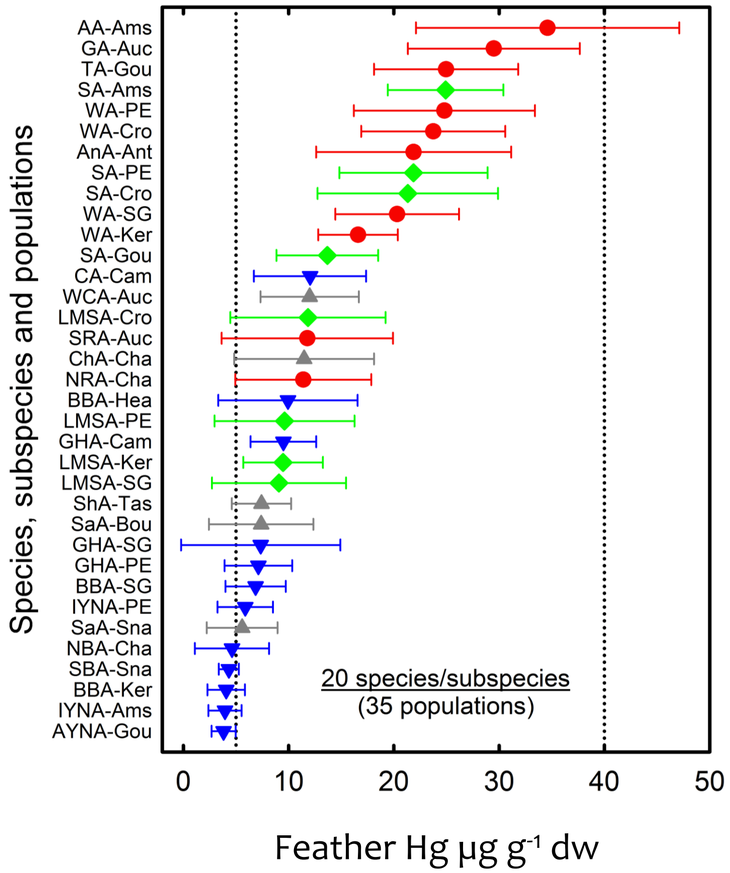
Monitoring the Southern Ocean

Albatrosses around the Antarctic



35 albatross populations, 20 species



AA: Amsterdam albatross
AnA: Antipodean albatross
GA: Gibson's albatross
NRA: Northern royal albatross
SRA: Southern royal albatross
TA: Tristan albatross
WA: Wandering albatross
LMSA: Light-mantled sooty albatross
SA: Dark-mantled sooty albatross
SaA: Salvin's albatross
ShA: Shy albatross
WCA: White-capped albatross
AYNA: Atlantic yellow-nosed albatross
BBA: Black-browed albatross
CA: Campbell albatross
ChA: Chatham albatross
GHA: Grey-headed albatross
IYNA: Indian yellow-nosed albatross
NBA: Northern Buller's albatross
SBA: Southern Buller's albatross

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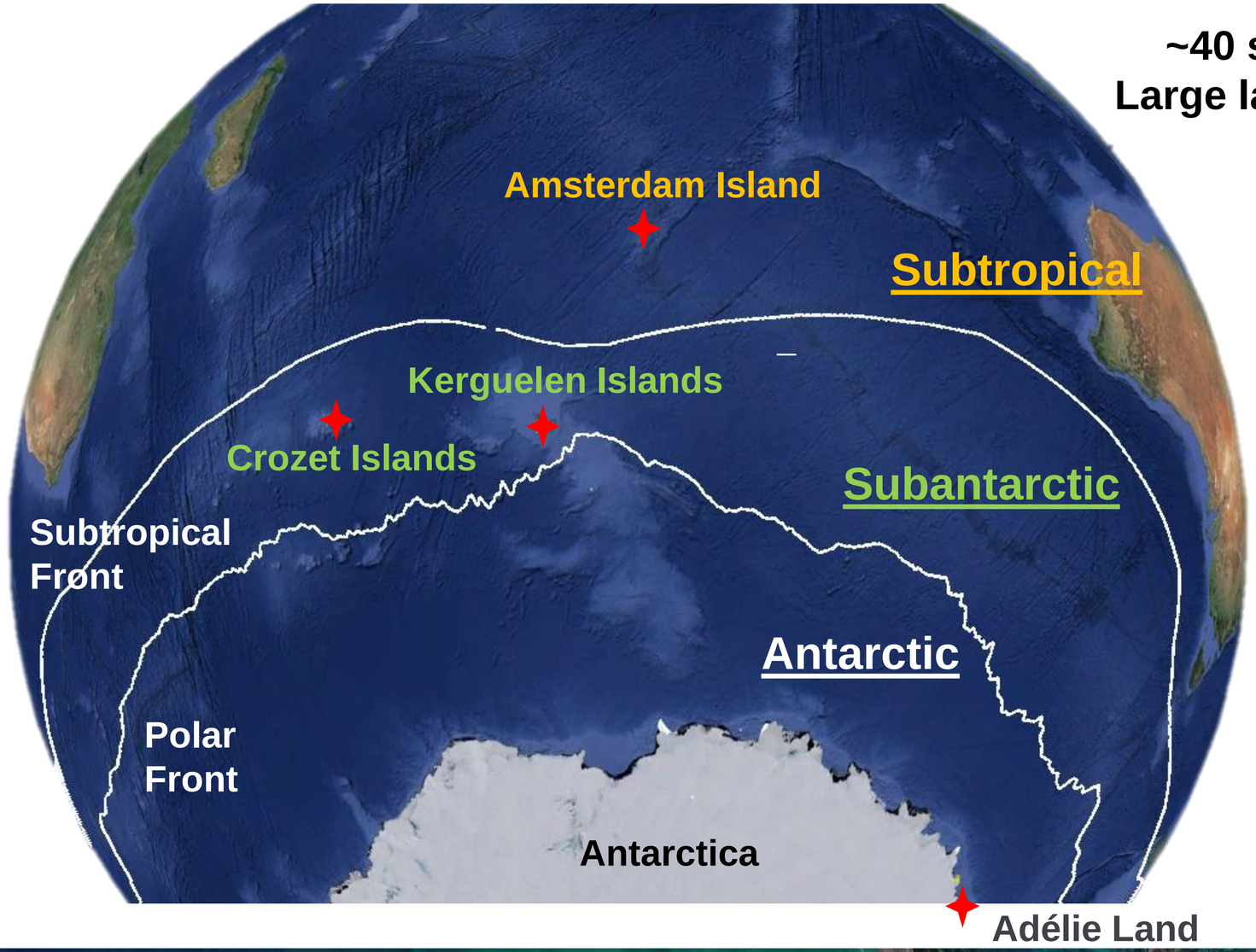
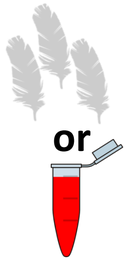
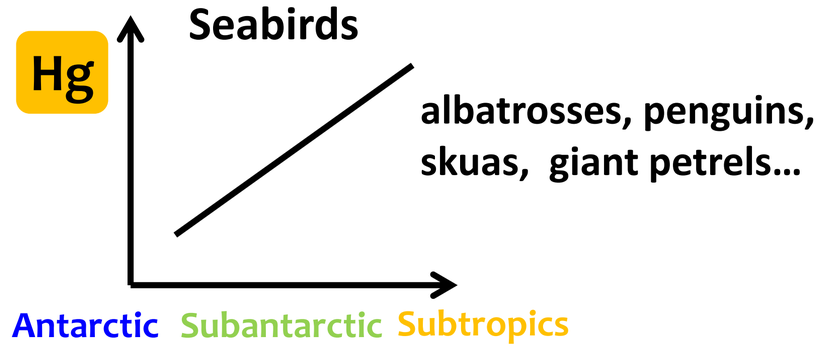
Monitoring the Southern Ocean: TAAF (Terres Australes et Antarctiques Françaises)

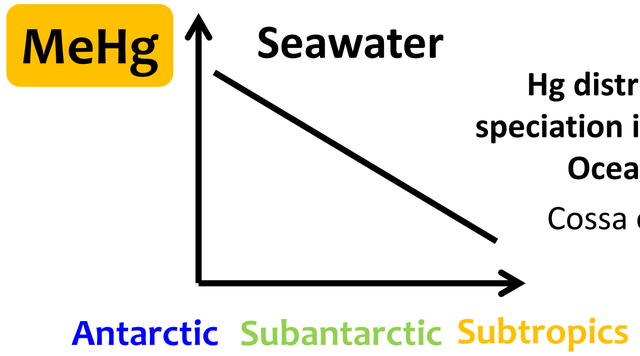


~40 seabird species
Large latitudinal gradient





Carravieri et al. 2014, 2016, 2017, 2020
Brasso et 2015, Cherel et al. 2018



Hg distribution and speciation in the Southern Ocean waters

Cossa et al. 2011

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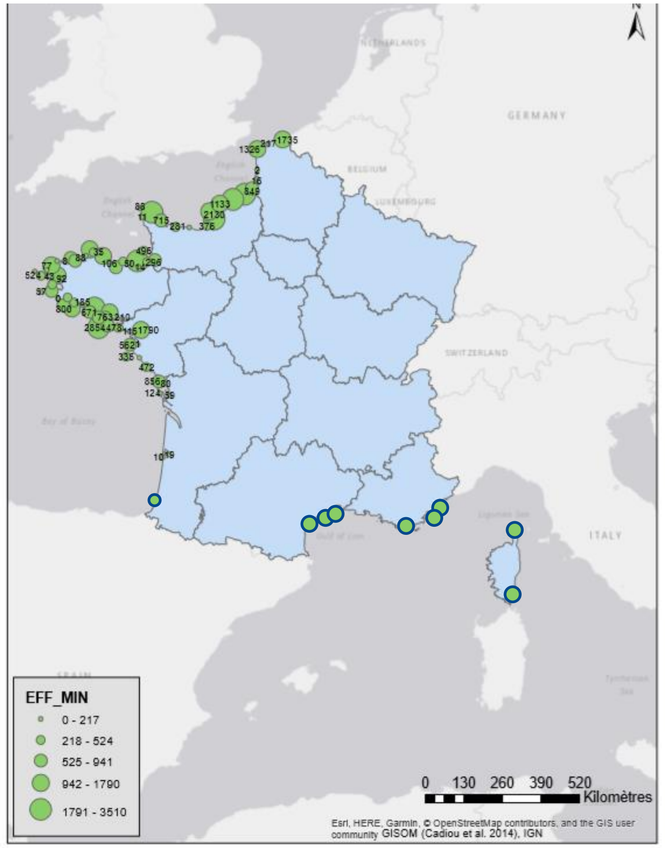
Seabirds: Monitoring contaminant levels and associated risk for the Marine Strategy Framework Directive



> 30 sampling sites since 2019

Spatial monitoring

10 seabird species

Levels of Hg in blood and feathers

Temporal monitoring (on-going)

Seabirds from Museums

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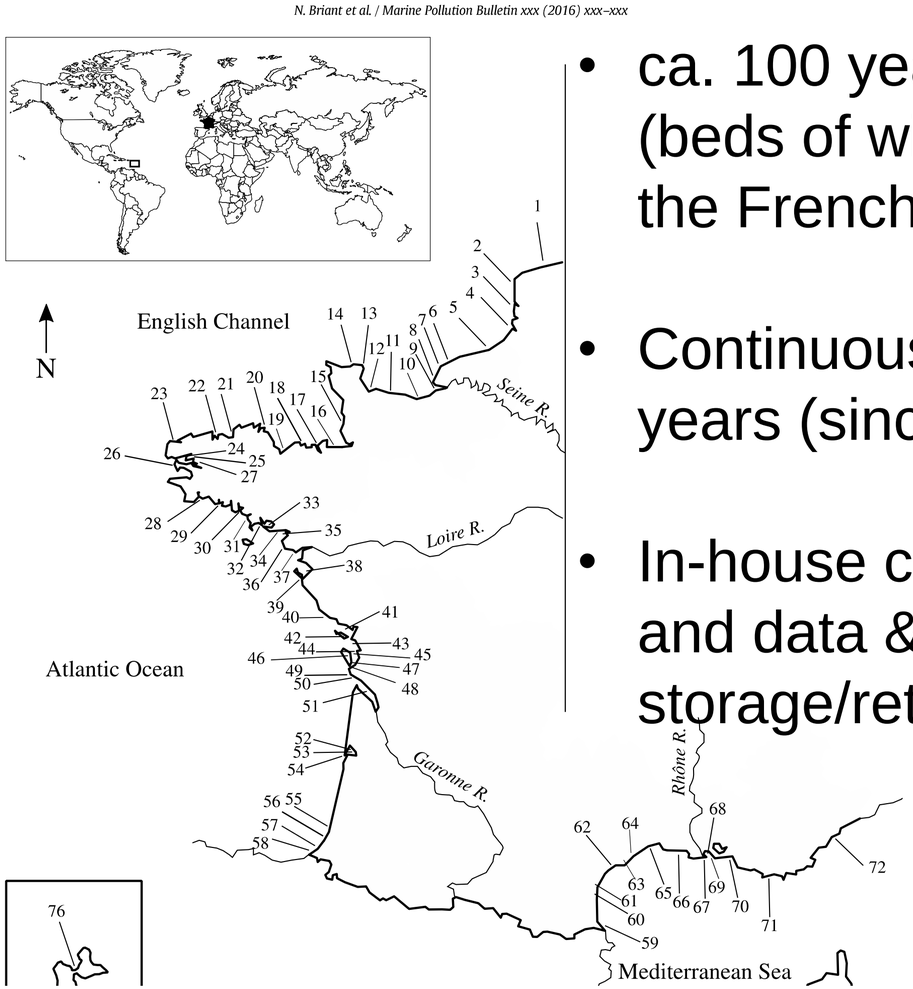
ROCCH: a marine monitoring programme designed to monitor the (chemical) health of the marine environment, operated by Ifremer



- ca. 100 yearly sampling points (beds of wild bivalves) along the French coastline
- Continuous monitoring for 40 years (since 1979) by Ifremer
- In-house chemical analyses, and data & metadata storage/retrieval

>8000 preserved bivalve samples

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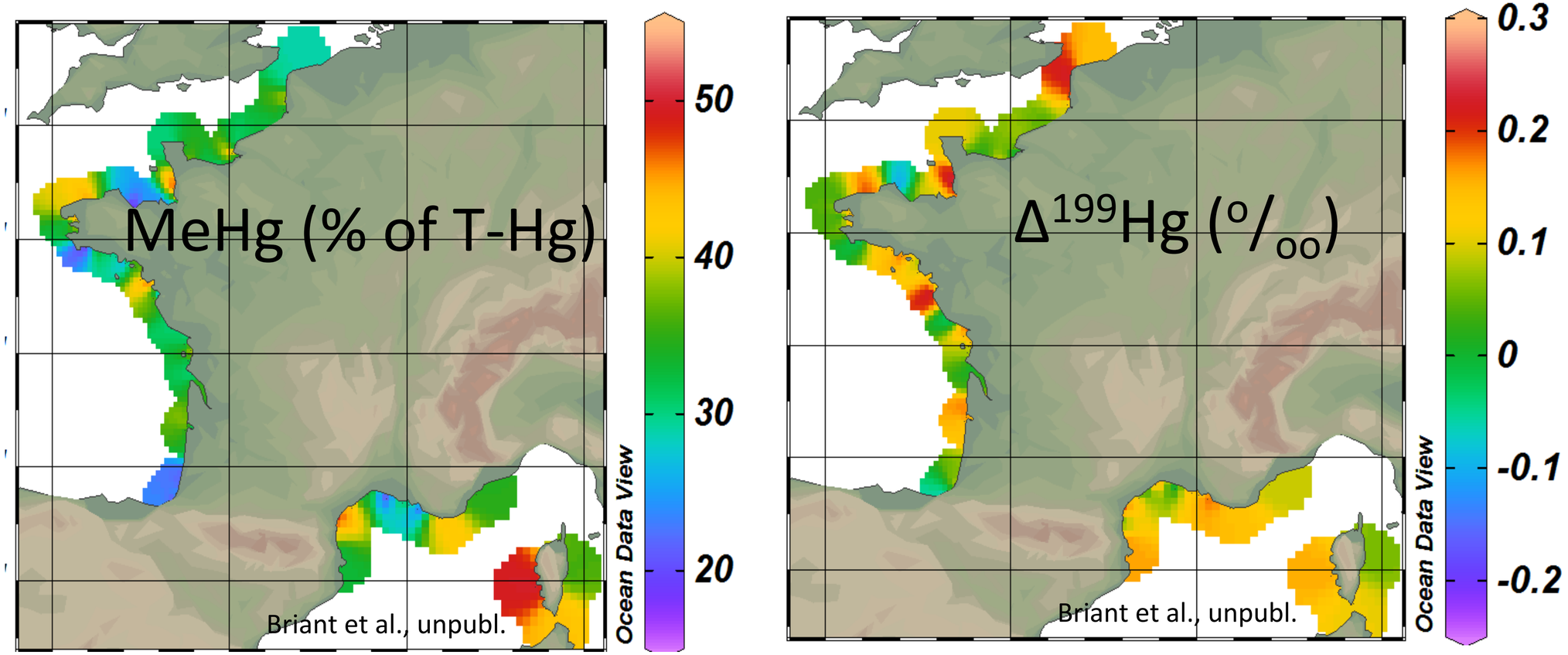

Data transmitted annually to OSPAR regional seas

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Proposed Hg GOS4M biomonitoring priorities

1- On-going collaborative Hg global database initiative -> Tuna Hg GOS4M prog.

2- Organize Tuna Hg GOS4M as a dedicated Hg initiative (task team) within IMBERCLIOTOP prog. to understand the influence of a changing ocean on predator ecology on Hg levels in tuna

3- Expand collaborations to improve spatial coverage (unpublished data, new samples) with increased presence in international tuna fisheries observatories (=Local Hg representative)

4- Organize regional initiatives to start and consolidate annual and consistent sample collection for temporal analysis at reference locations

5- Link Seabird and Tuna Hg GOS4M to ocean and atmospheric Hg databases

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Thank you!

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