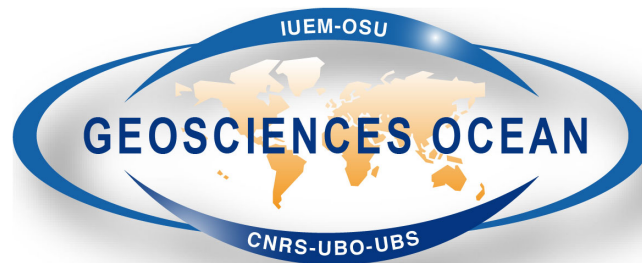


SEA ICE IN THE EARTH SYSTEM: A MULTIDISCIPLINARY PERSPECTIVE - June 4-6 2019, Brest, France

Evidence of interactions between icebergs and blue whales from a soundscape analysis in Sea Ice thermodynamics from small to large scale Southern Indian Ocean

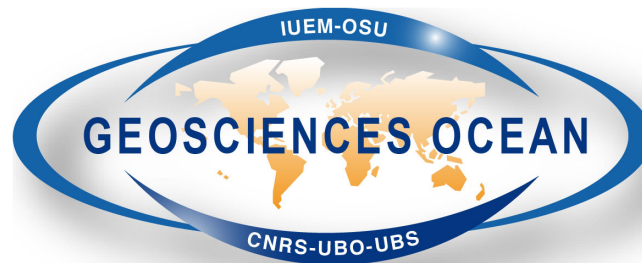
Jean-Yves Royer & Emmanuelle C. Leroy



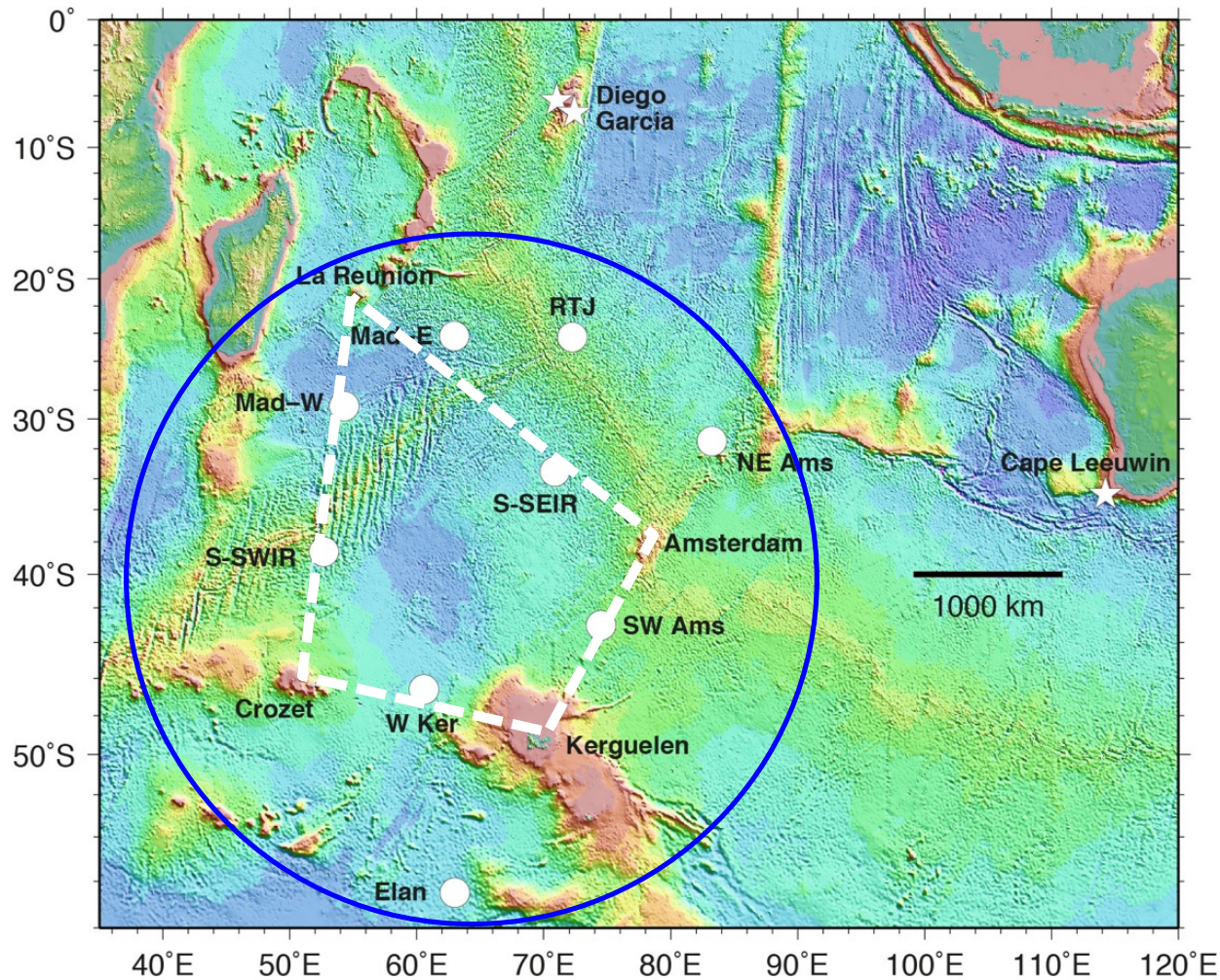
SEA ICE IN THE EARTH SYSTEM: A MULTIDISCIPLINARY PERSPECTIVE - June 4-6 2019, Brest, France

Evidence of iceberg effects on blue whales from a soundscape analysis in the Southern Indian Ocean

Jean-Yves Royer & Emmanuelle C. Leroy



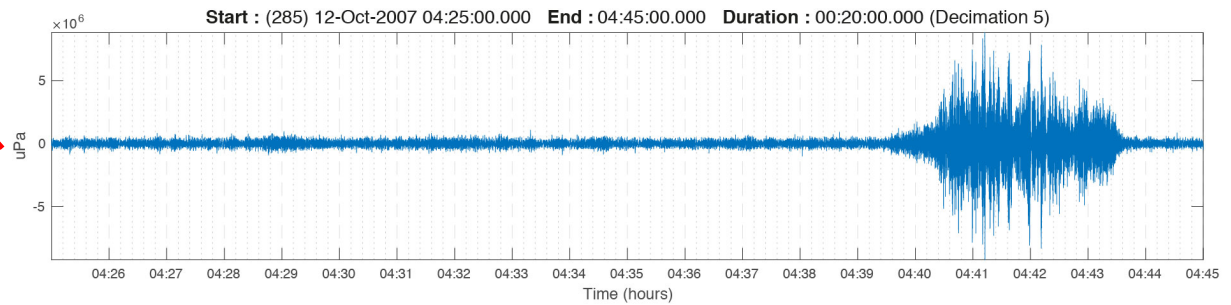
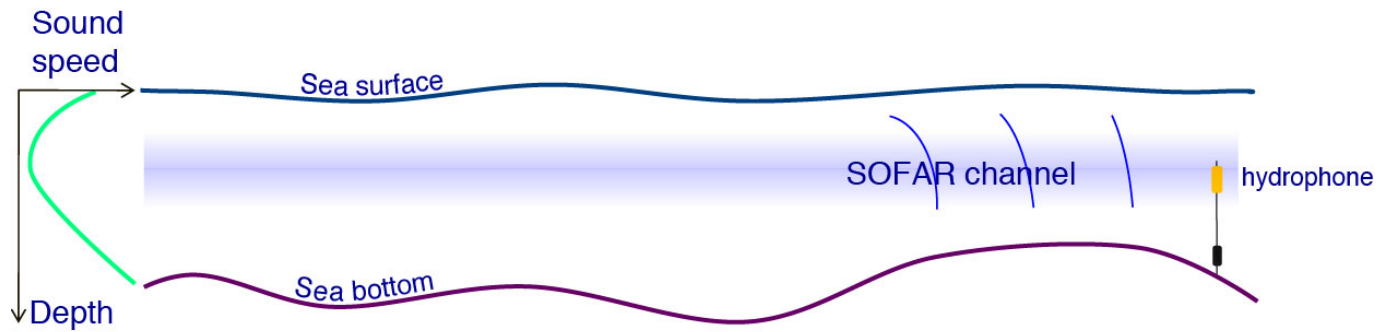
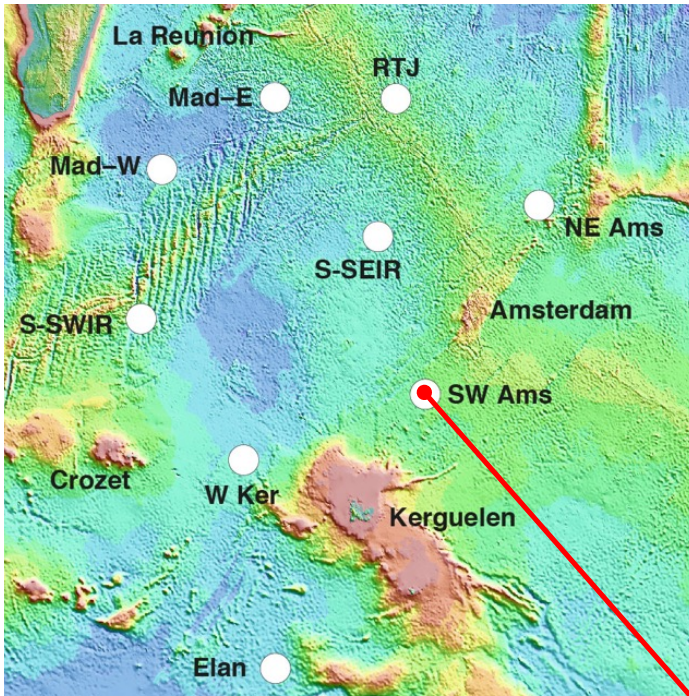
10 years of acoustic monitoring in the Southern Indian Ocean: The OHASISBIO network



- Continuous recording @ 240Hz
=> low frequencies 0-120 Hz
- 9 sites, 10 instruments
covered area ~ 3000 x 3000 km²
- Initiated in 2010,
after a test experiment in 2007
- Redeployed every year since then

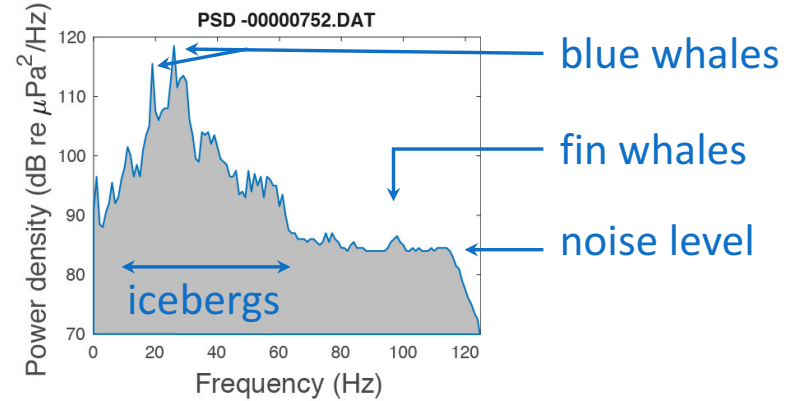
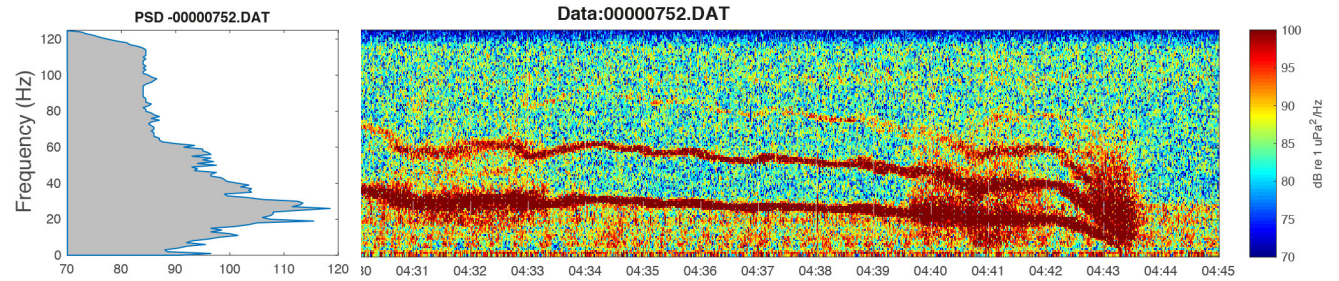
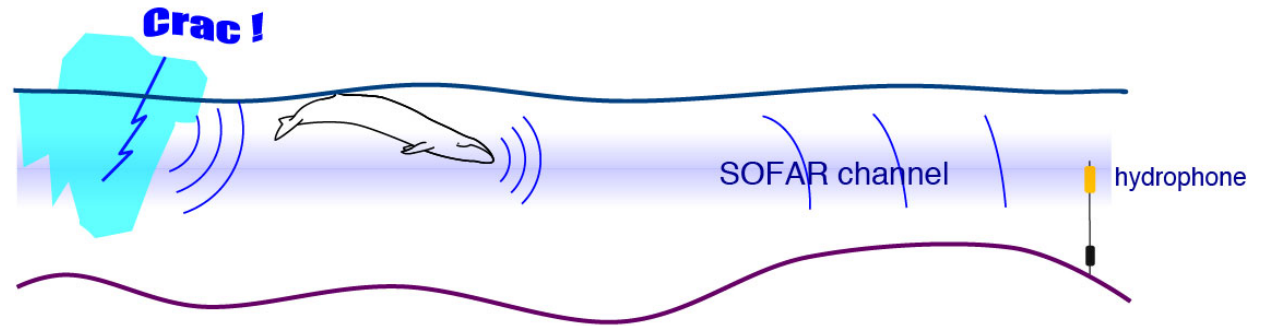
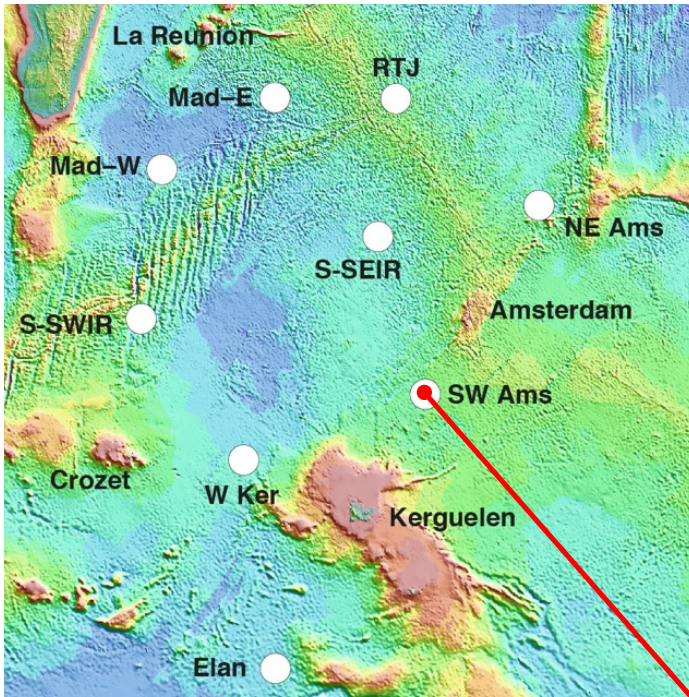
- Taking advantage of the yearly voyages
of **RV Marion Dufresne** to the French
Southern islands

« Looking at » an acoustic record



20 minutes

« Looking at » an acoustic record

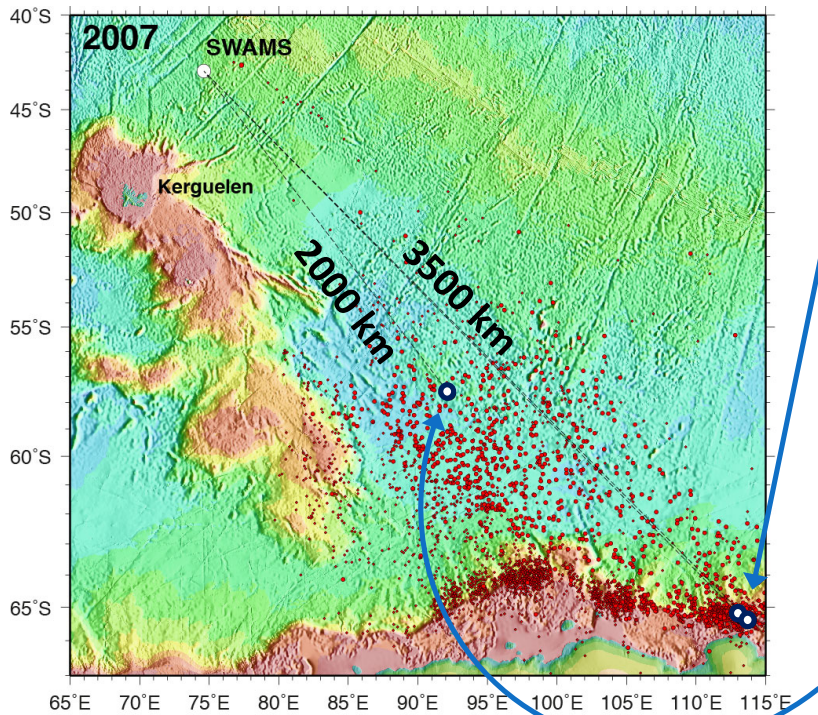


Sounds
accelerated
20 times

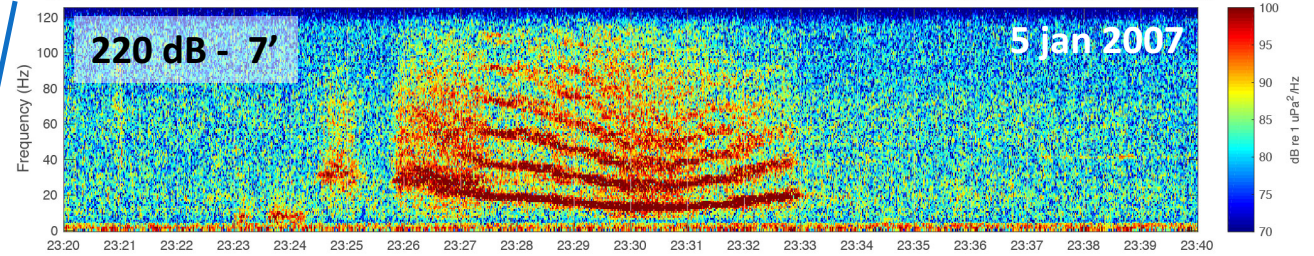
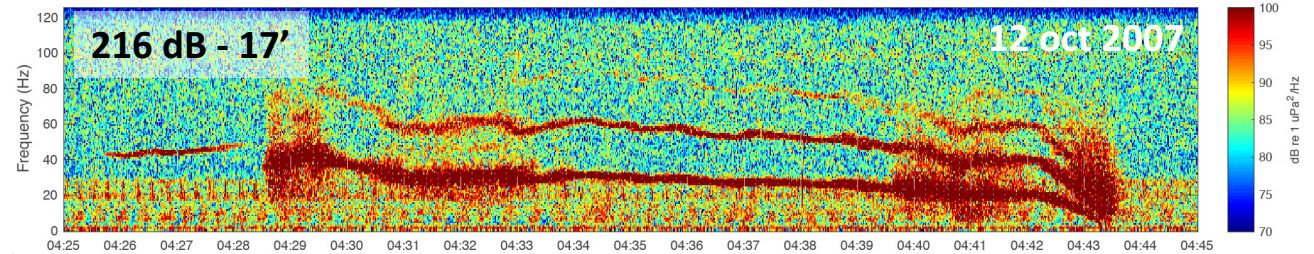


Iceberg sounds

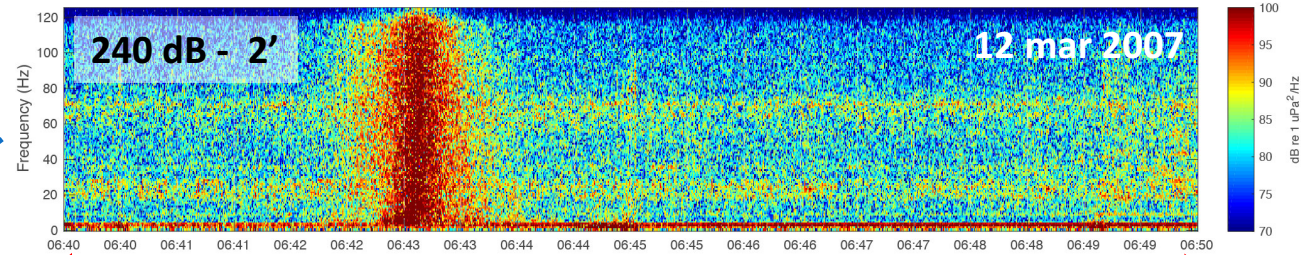
- Long tremors  rubbing icebergs



Locations based on acoustic triangulation



- Short bursts  cracks in drifting icebergs



20 minutes

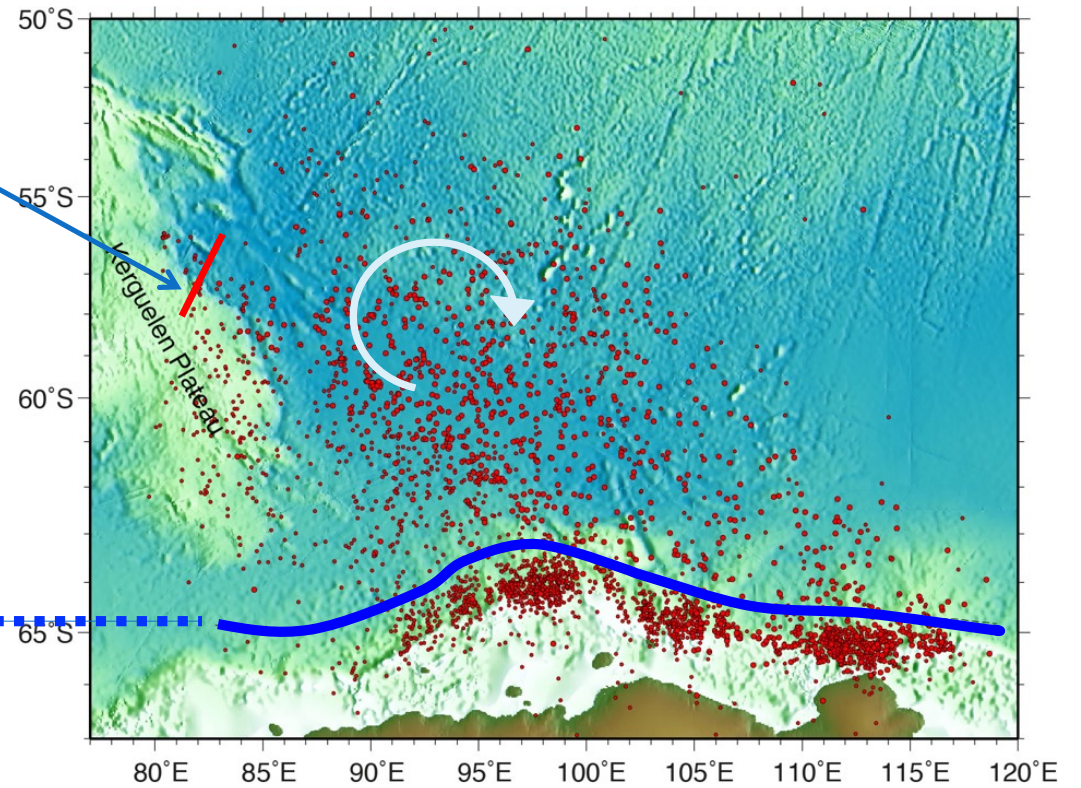
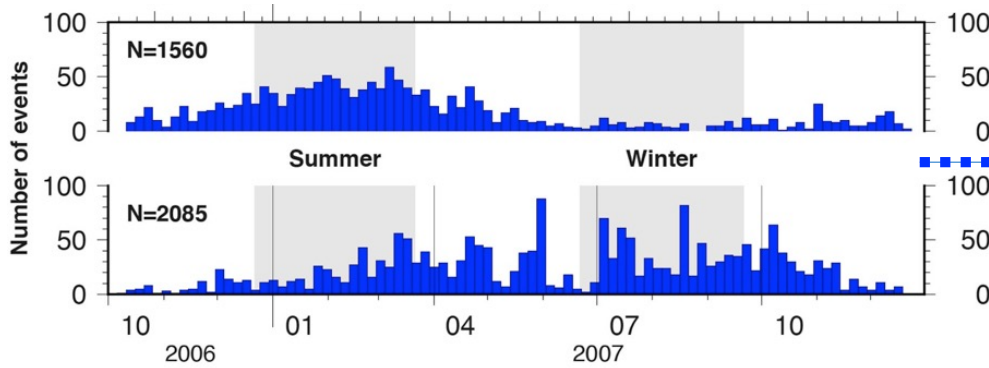
Iceberg sounds



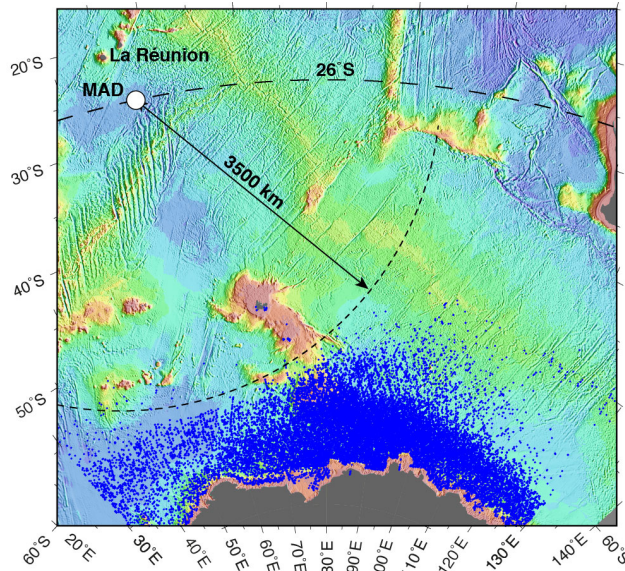
Icebergs east of Kerguelen Plateau (Jan 2010)



Locating icebergs from their sounds (by triangulation)
~3600 events in 15 months (Oct 2006 – Dec 2007)

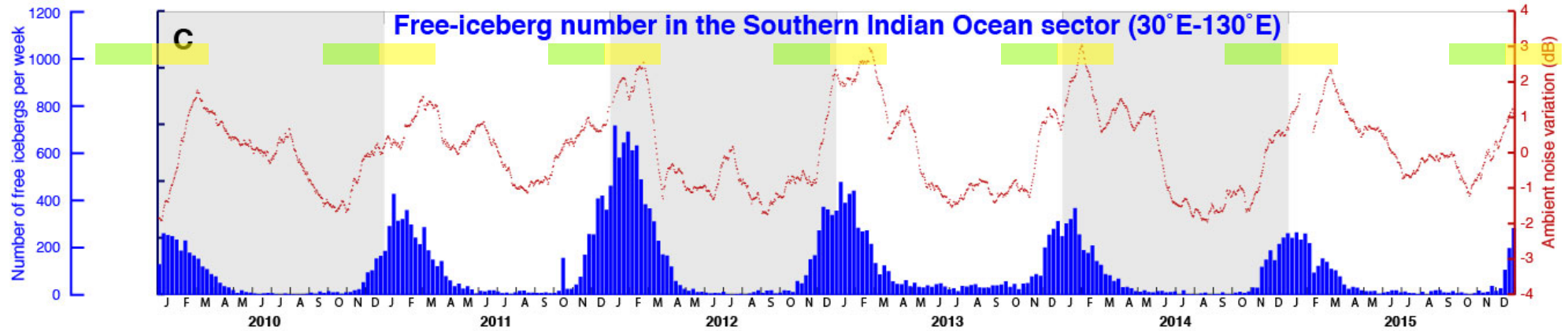
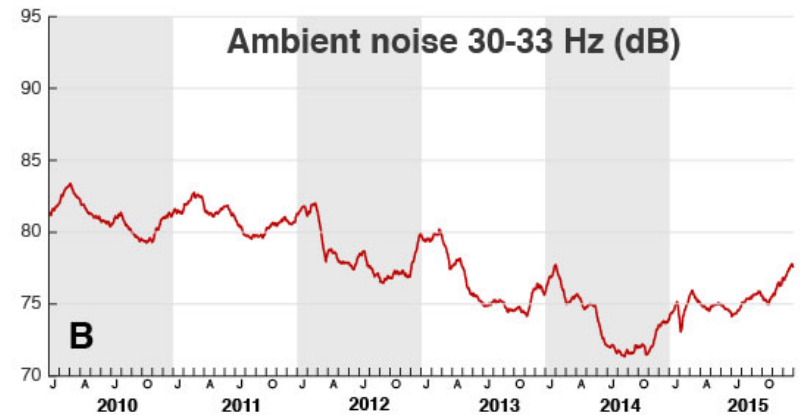


Iceberg sounds



2010-2015
 Altiberg database
 (satellite altimetry)
 Tournadre et al., JGR 2016

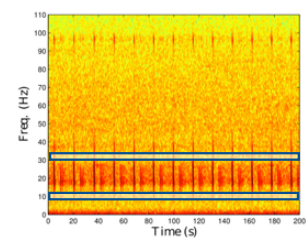
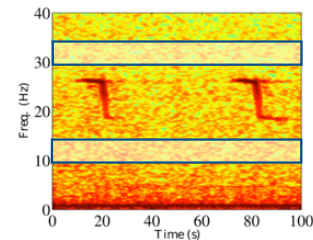
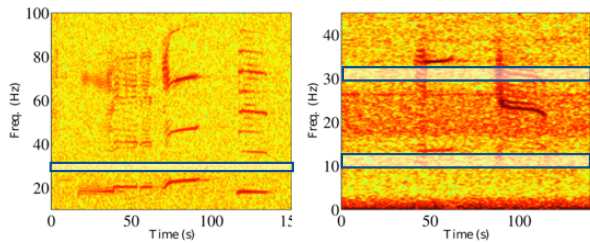
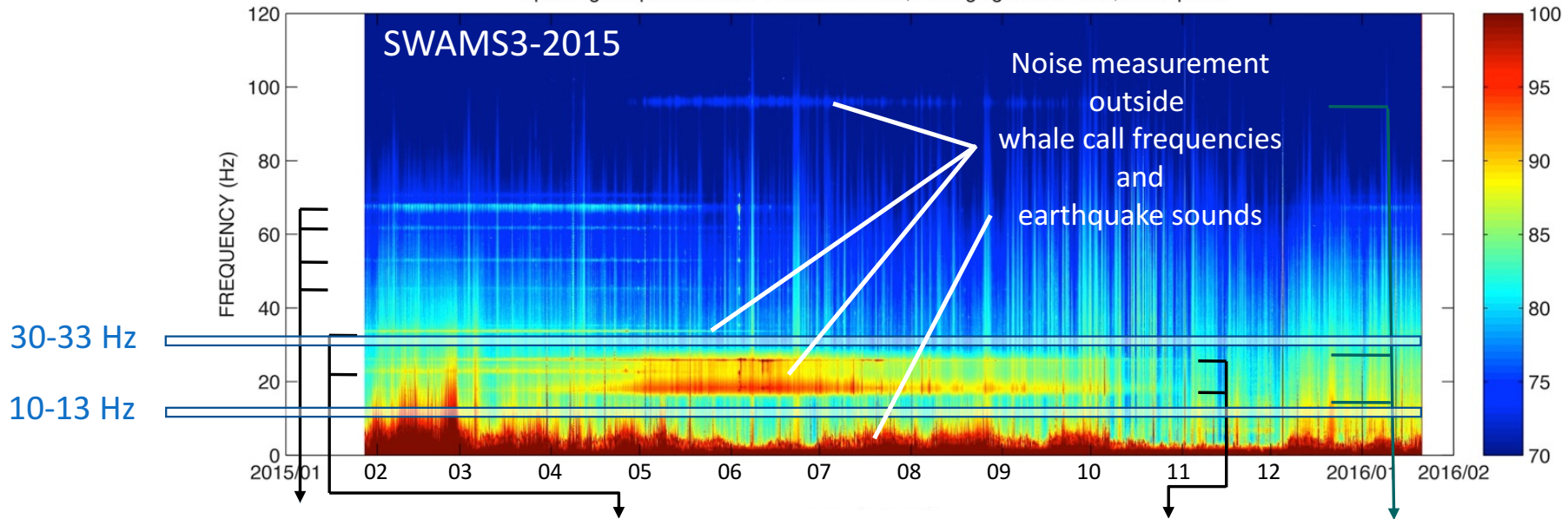
Spring Summer



- Seasonal variations of the ambient noise
- Match with seasonal variations of the free-iceberg number in the SIO sector

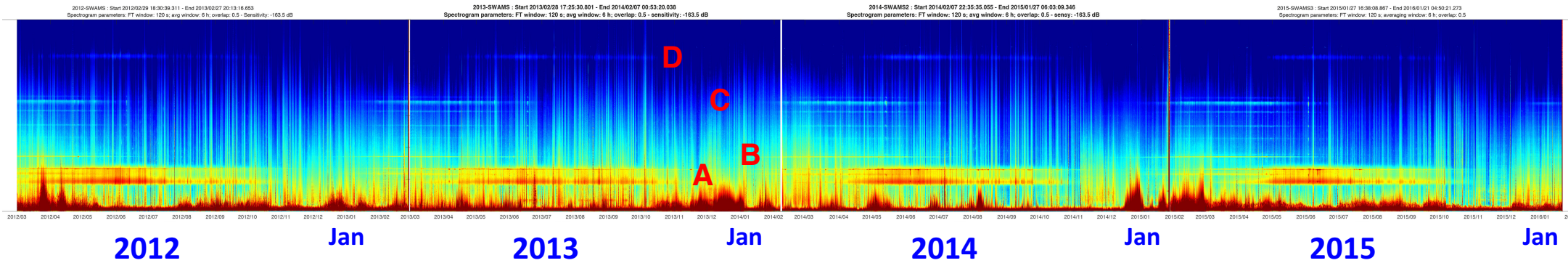
Whale “noise”

2015–SWAMS3 : Start 2015/01/27 16:38:08.867 – End 2016/01/21 04:50:21.273
 Spectrogram parameters: FT window: 120 s; averaging window: 6 h; overlap: 0.5



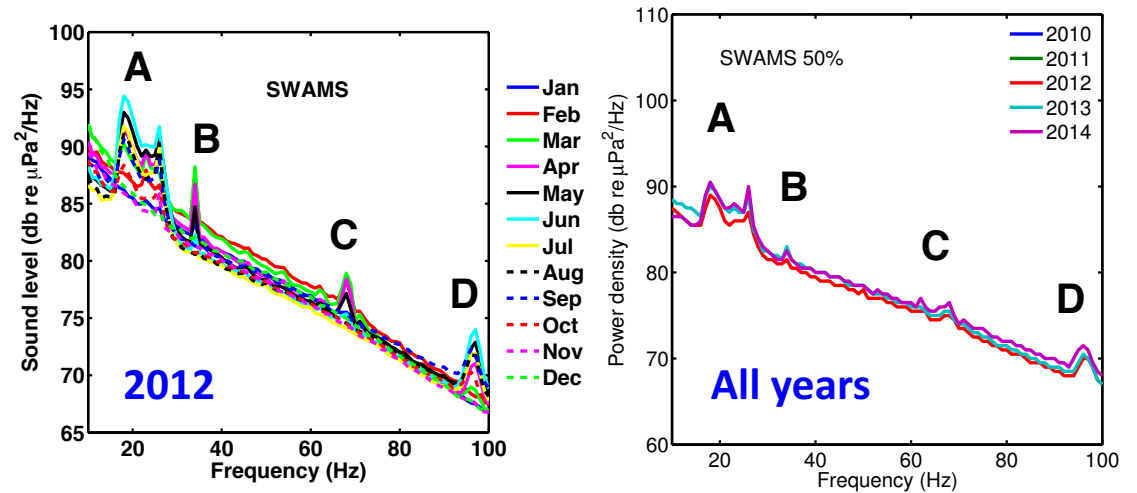
Whale “noise”

SWAMS site (between Kerguelen & Amsterdam islands)

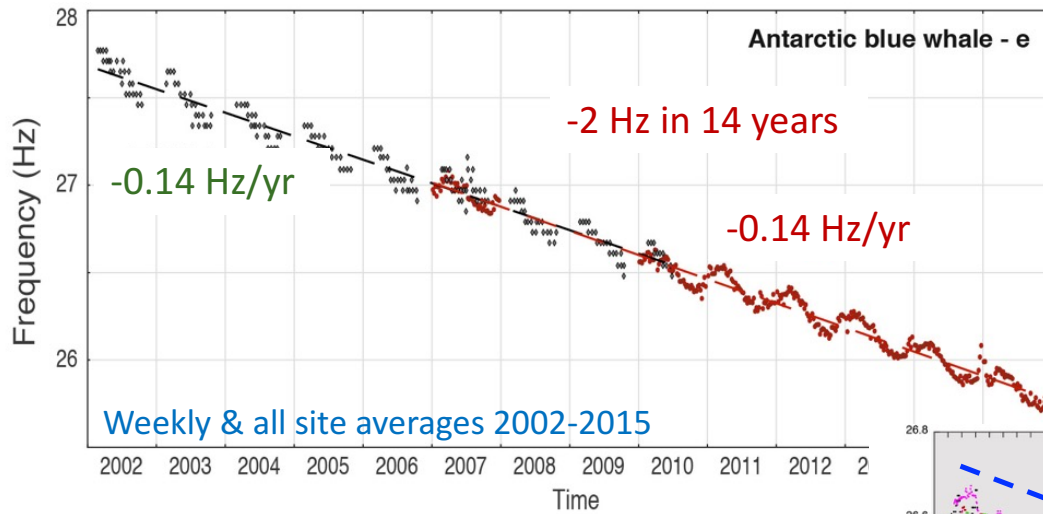


Whale calls are highly seasonal

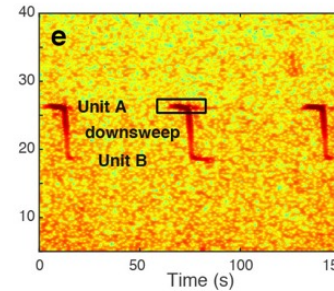
- A. Antarctic b.w. March – November
- B. C. Pygmy b.w. February - June
- D. Fin whale May - October



Whale call-pitch changes



Analysis based on > 1 000 000 detected calls



Two observations:

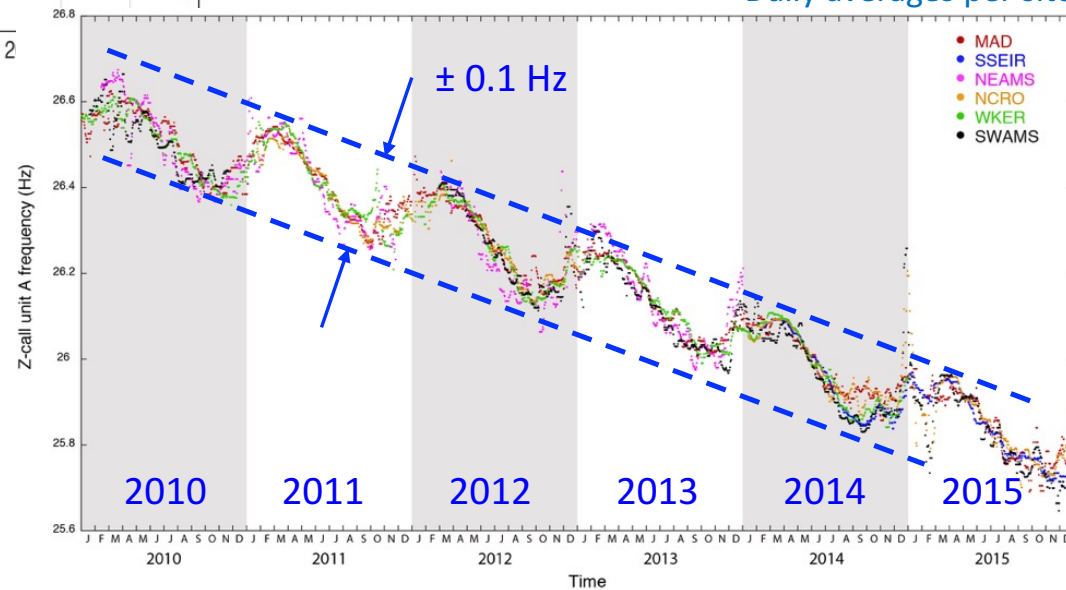
- Long-term linear decrease
- Seasonal variations
- Both are synchronous at all sites

Weekly & all site averages 2002-2015

Daily averages per site

How call-pitch change ?

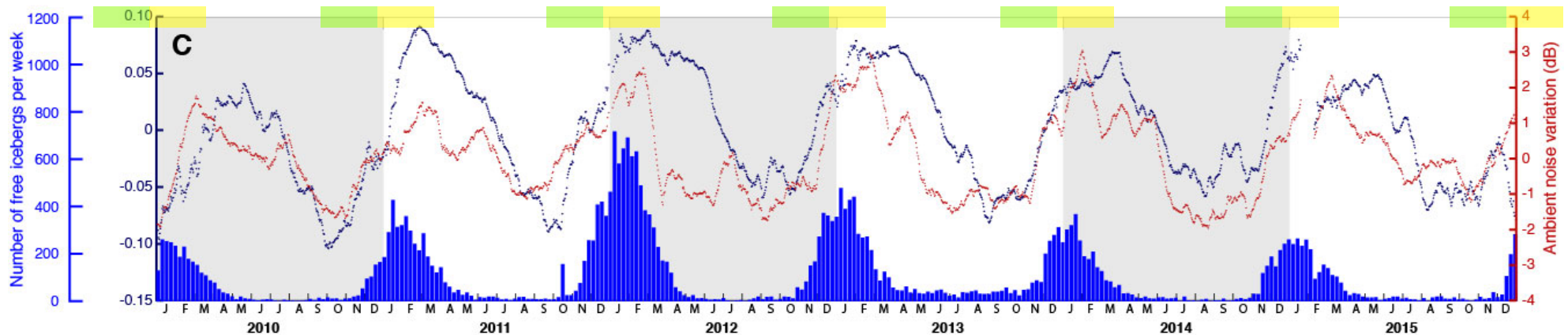
- Louder calls produce higher frequency
- Lower calls produce lower frequency



Whale-call pitch vs Noise vs Icebergs

- **Free icebergs** generate **loud noises** that ensonify the whole Southern Ocean up to tropical latitudes
- **Changes in the noise level** make the whales **change** their **call intensity**, which, in turn, induces a **change** in their **call frequency** (up to 0.2 Hz)

Spring
Summer



Leroy et al. JGR 2018

So, on an **annual scale**, iceberg sounds affect the vocal behavior of blue whales
... but, apparently, whales do not hold any grudge against them

Picture taken from RV Marion Dufresne, January 2010 @ 58°S

