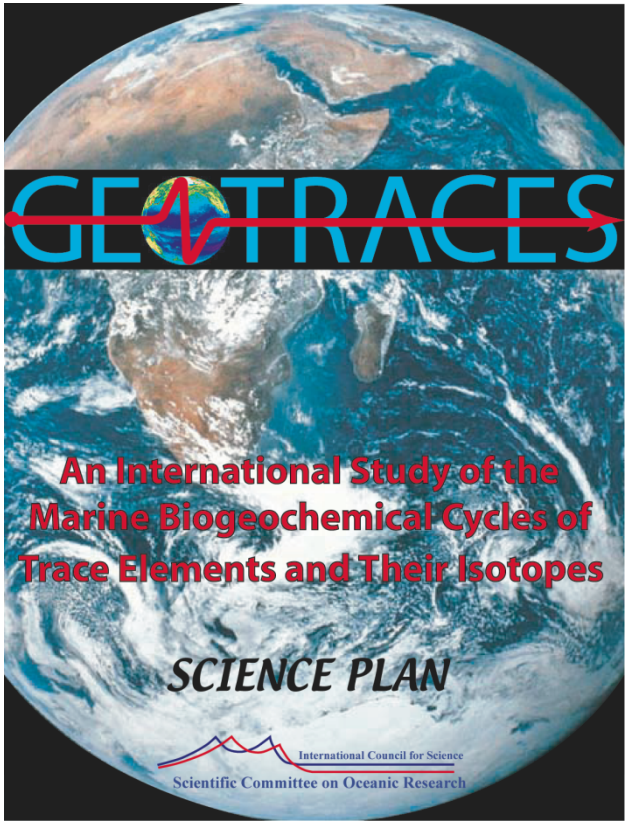
Introduction to GEOTRACES

Ken Buesseler, Lauren Kipp & Matt Charette

"To identify processes and quantify fluxes that control the distributions of key trace elements and isotopes (TEIs) in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions"



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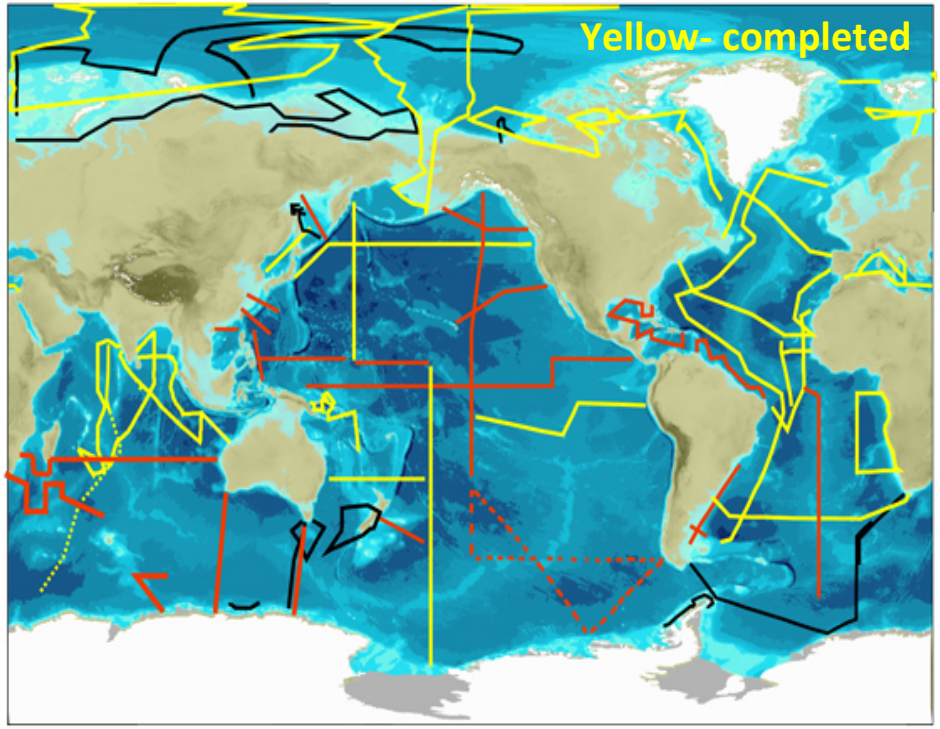
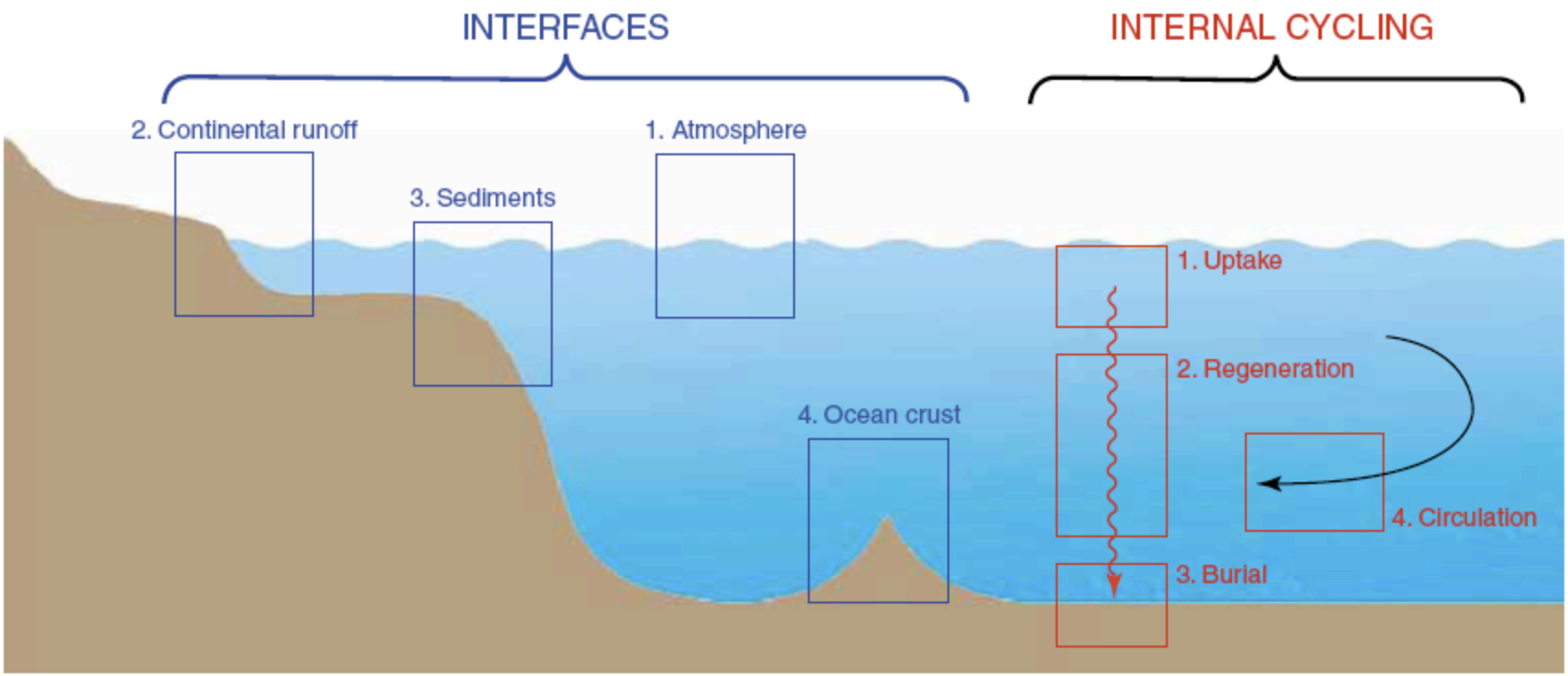


- 96 cruises completed since 2006 by
- 17 countries
- >875 publications
- Public/shared data

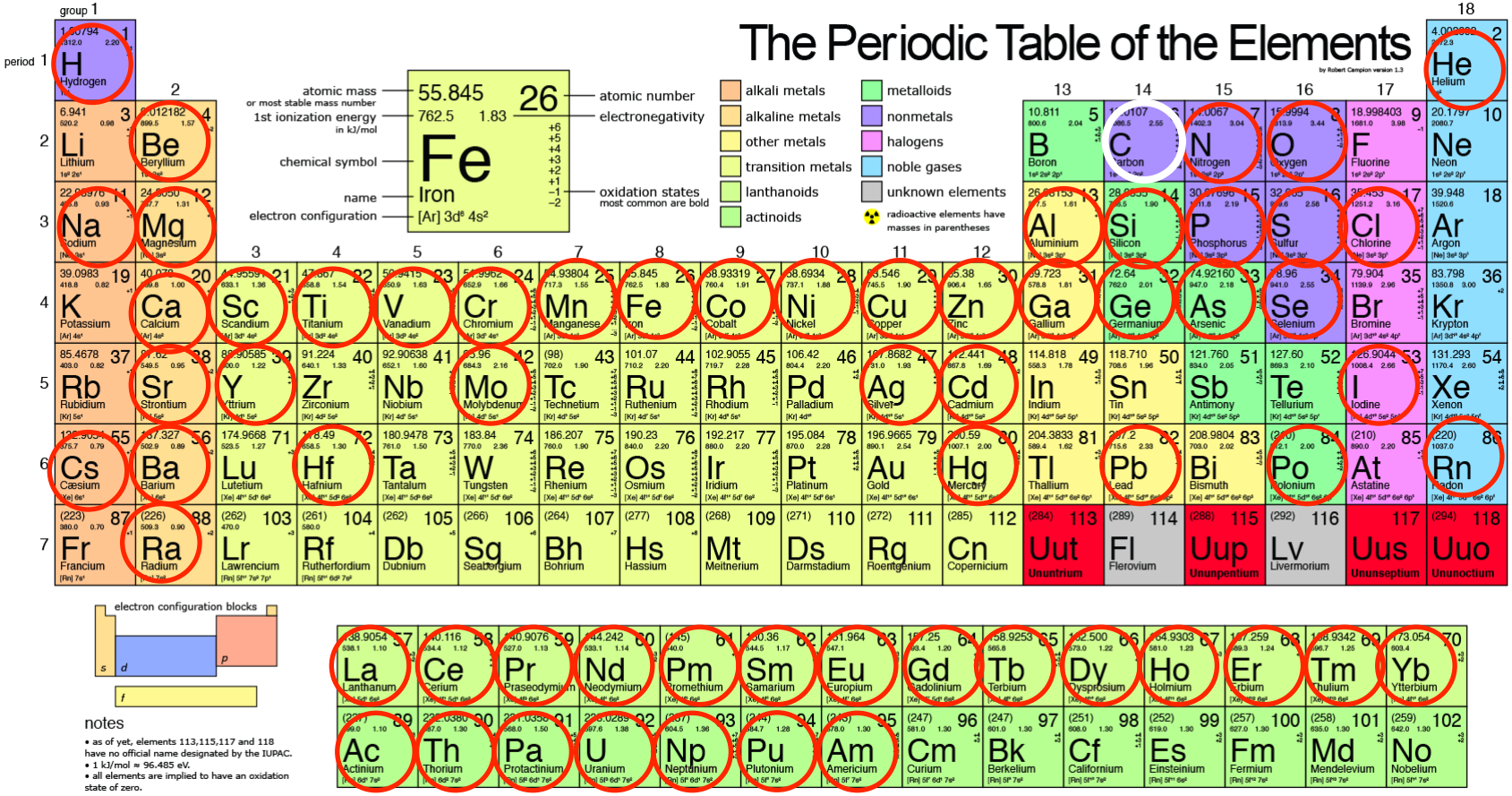
Goal- Identify processes and quantify fluxes



- Inputs and outputs at the interfaces of the ocean
- Internal cycling within the ocean
- **Radionuclides** provide rates of TEI processes and fluxes

GEOTRACES TEI's (Trace Elements and Isotopes)

- Tracers; micronutrients; contaminants; paleoproxies
- Intercalibration essential

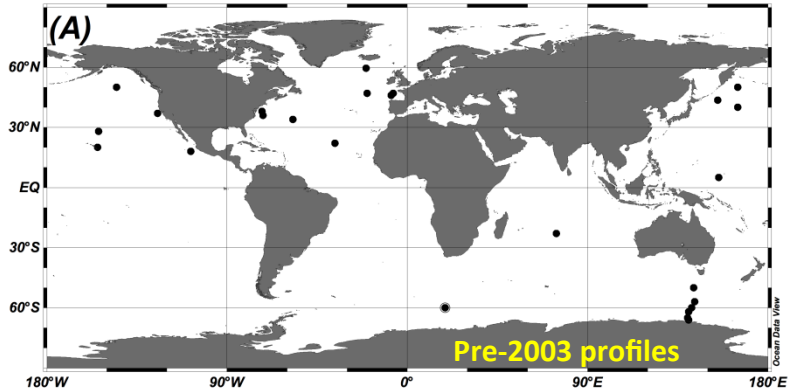


The sum is greater than the parts!

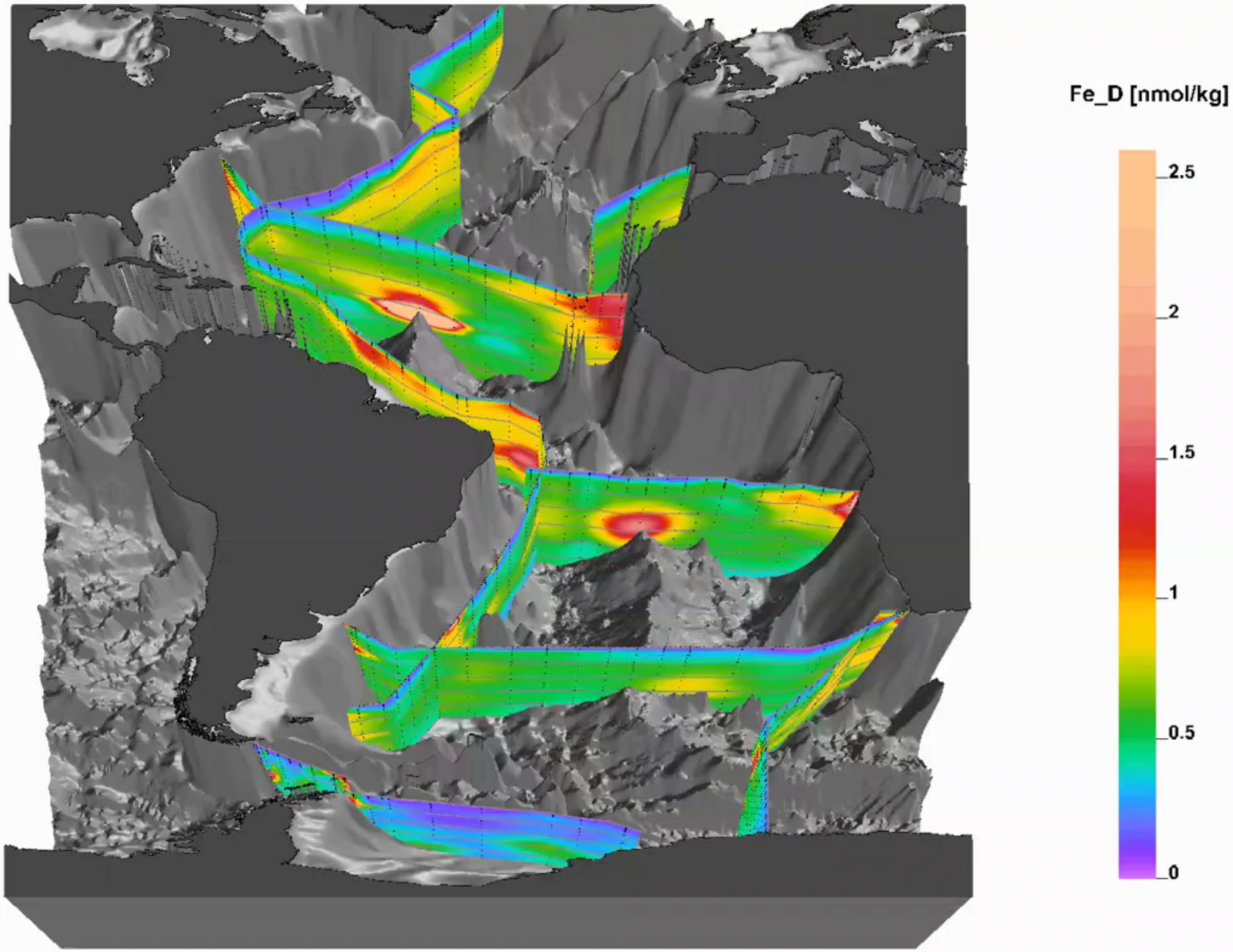
Example of Iron- key ocean micro-nutrient

"Give me half a tanker full of iron,
and I'll give you an ice age"

John Martin, 1988 (WHOI talk)



Iron-
Challenge to measure
Key micronutrient
Ocean C cycle and climate controls

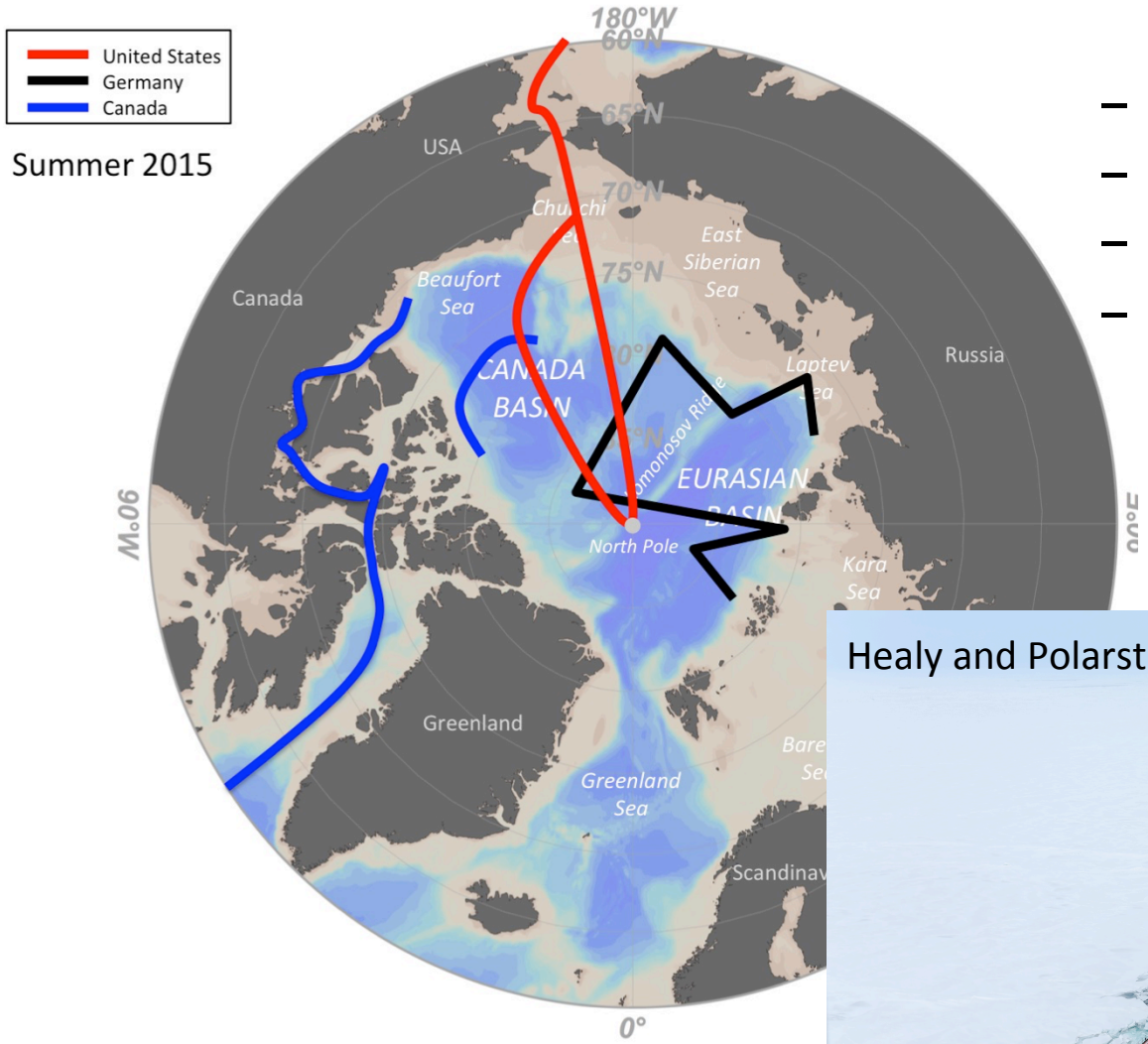


eGEOTRACES

Data: Cyril Abadie, Eric P Achterberg, Hein J de Baar, Andrew Bowie, Kenneth W Bruland, Kristen N Buck, Fanny Chever, Tim Conway, Gideon M Henderson, Seth John, Maarten Klunder, Patrick Laan, Francois Lacan, Christopher Measures, Rob Middag, Abigail Noble, Micha J A Rijkenberg, Mak A Saito, Christian Schlosser, Peter N Sedwick, Charles-Edouard Thuroczy, Jingfeng Wu

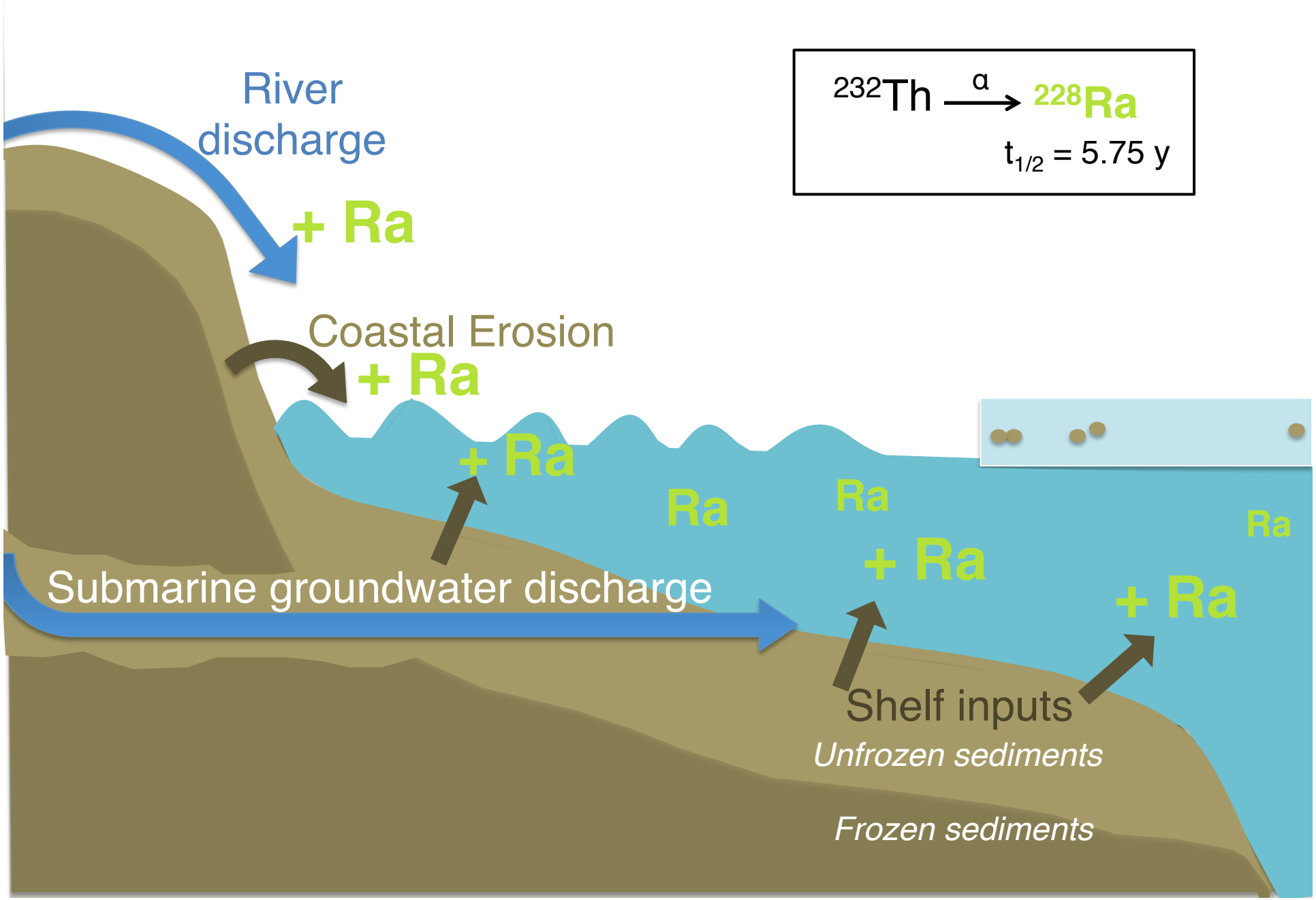
Graphics: Reiner Schlitzer

Example from the Arctic

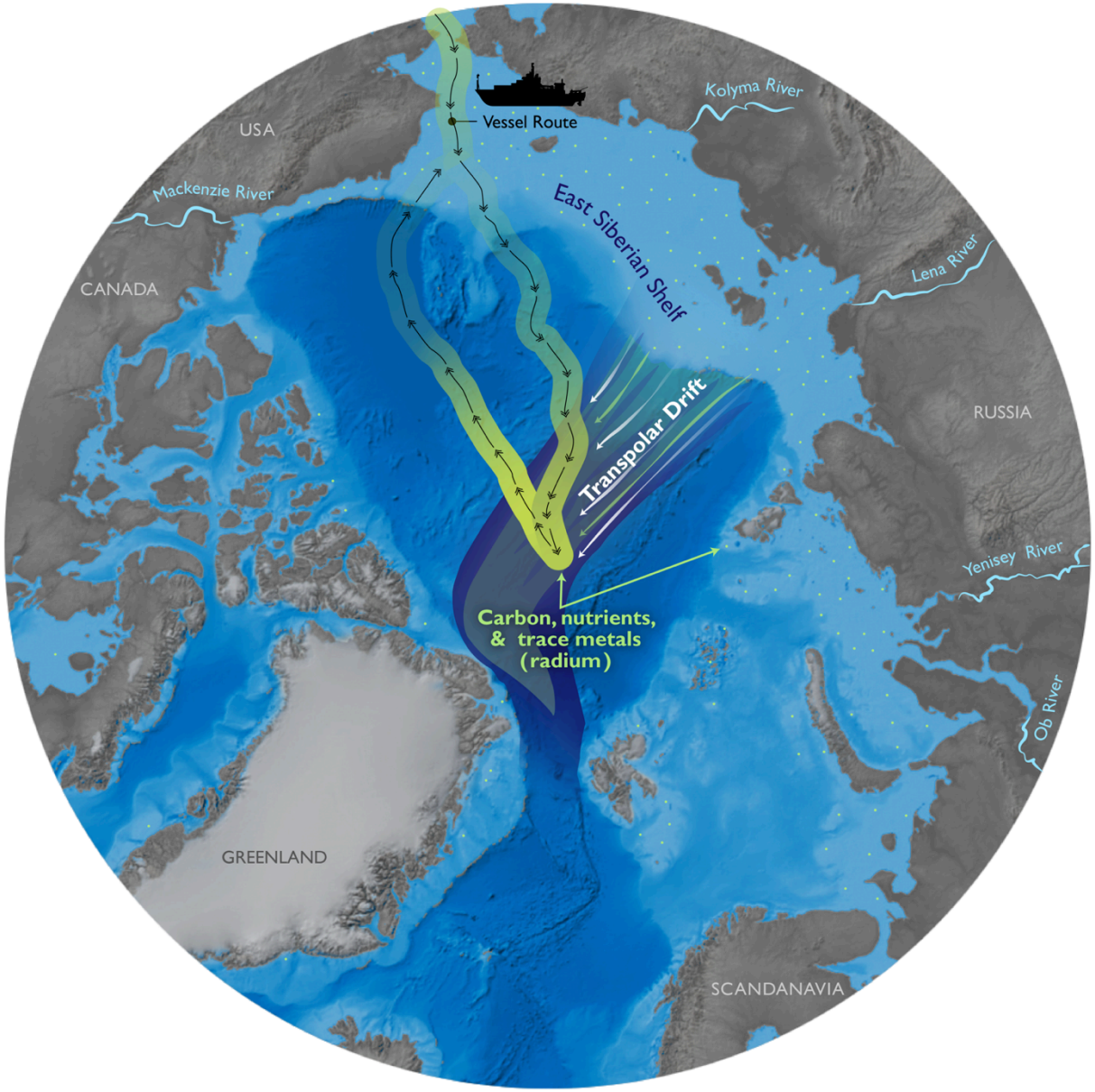


- 48 US Principal Investigators
- 29 US Institutions
- $ OCE and Polar Programs
- Another project launching student & post-doc careers

Radium isotopes are tracers of margin inputs to the ocean



Highest radium concentrations were found in the central Arctic, transported by the Transpolar Drift

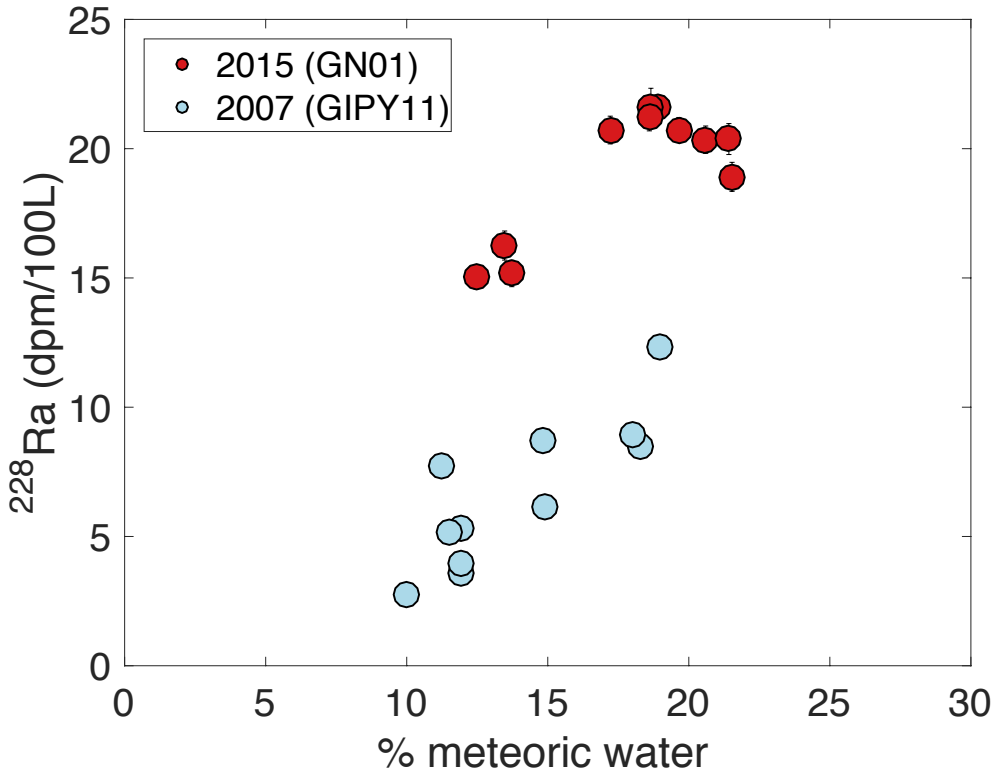


Radium in Arctic surface waters is not in steady state

- ^{228}Ra activities observed in the central Arctic in 2015 were approximately double what they were in 2007; ^{226}Ra activities were also higher in 2015

- Shelf inputs are the major source of ^{228}Ra in surface waters, suggesting that increased shelf-basin exchange is driving the Ra increase

- This suggests increased inputs of other shelf-derived species to the Arctic

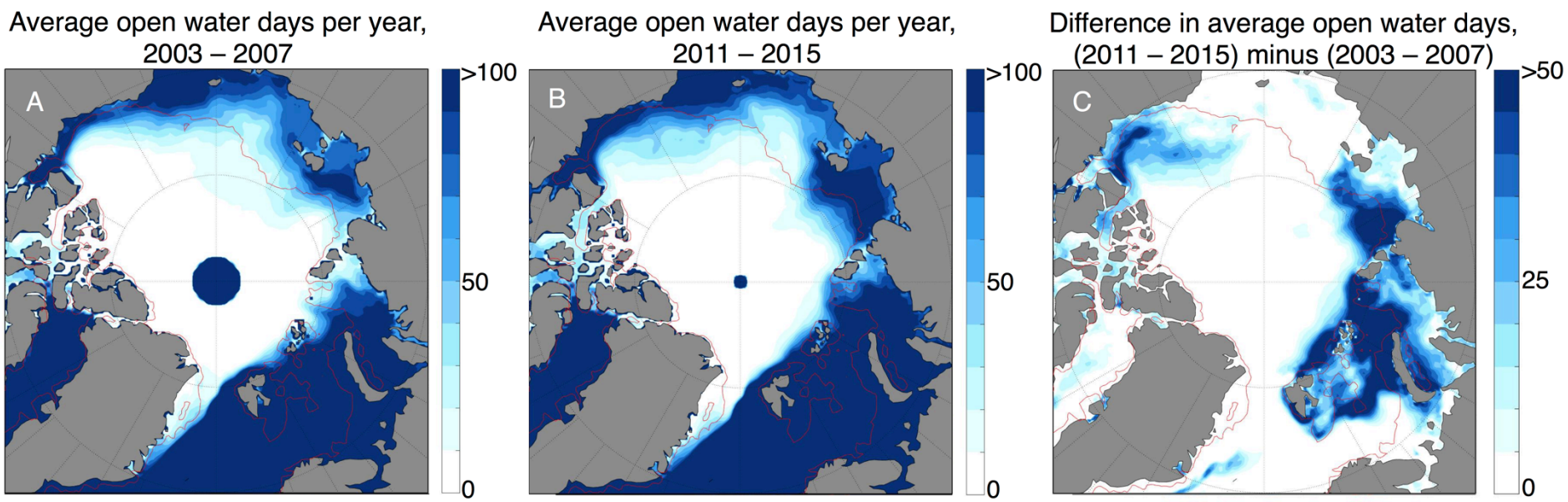


Meteoric water fraction provided by Peter Schlosser, Angelica Pasqualini, Bob Newton, Toby Koffman

Solute fluxes to Arctic shelves are being affected by climate change

Increased ^{228}Ra activities over the shelf could be driven by:

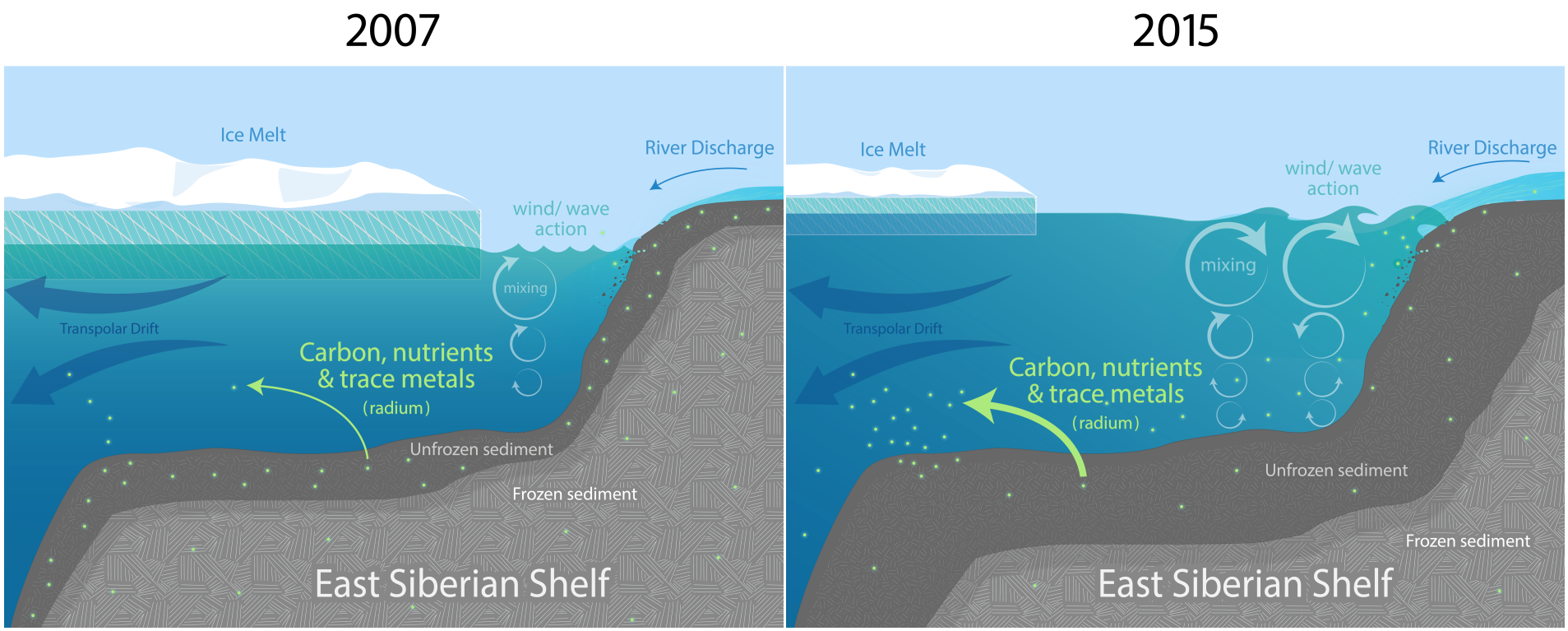
- Increased coastal erosion
- Permafrost thaw
- **Increased wind-driven vertical mixing**



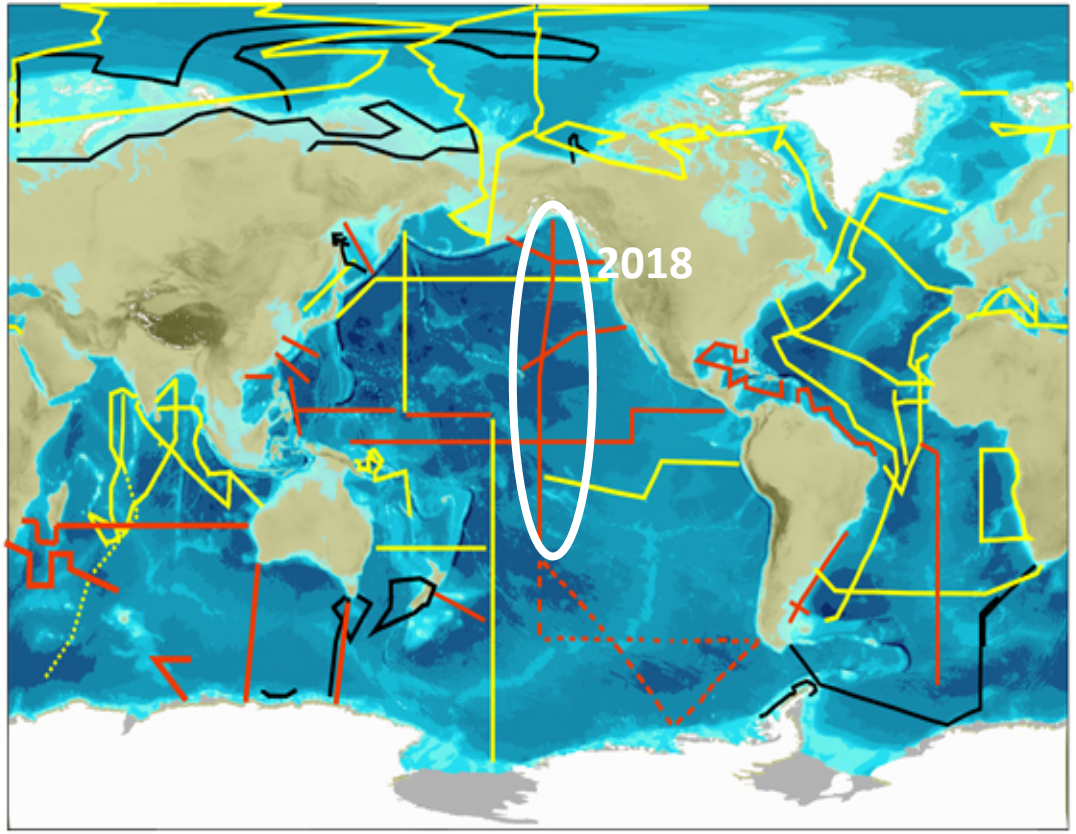
The loss of sea ice over Arctic shelves allows for more wind-driven mixing, resulting in more solutes mixed in to the overlying water column

- The increase in radium activities in the central Arctic suggests that the concentrations of other shelf-derived materials, such as nutrients, carbon, and trace metals, are also increasing

- Changes in nutrient delivery to surface waters may be particularly important when combined with decreasing light limitations



Next GETORACES expedition: Pacific Meridional Transect



- Alaska to Tahiti
- Sept. – Nov. 2018

- Second **intermediate data product** released in 2017: downloadable datasets, 3D electronic atlas

GEOTRACES
INTERMEDIATE DATA PRODUCT 2017

- Future US cruises
  - So. Pacific? So Ocean?