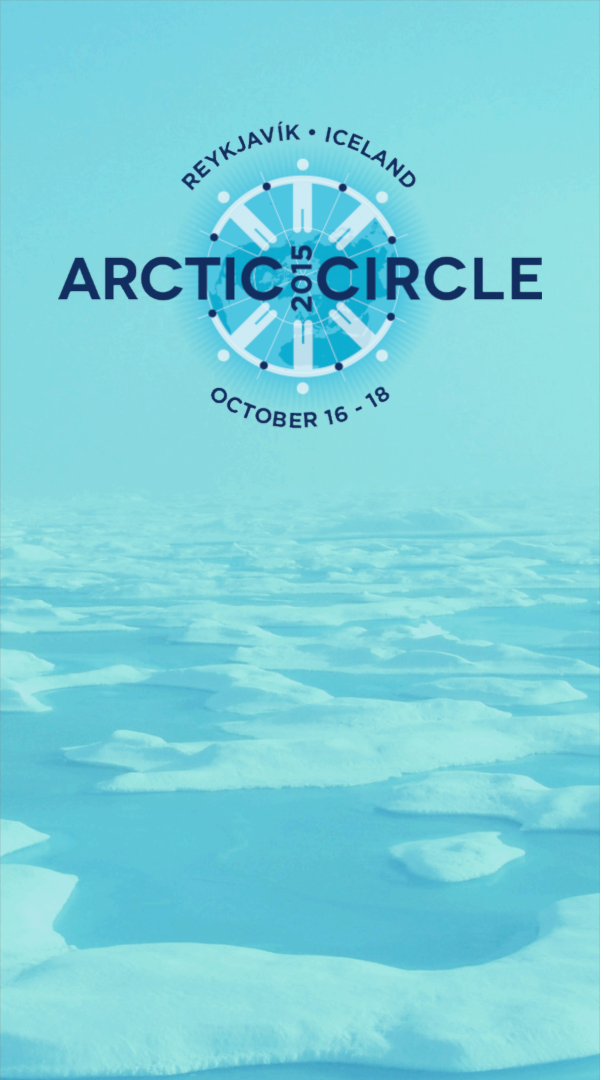


Biogeochemistry of Global Contaminants

Harvard School of Engineering and Applied Sciences

HARVARD
JOHN A. PAULSON
SCHOOL OF ENGINEERING
AND APPLIED SCIENCES

ENVIRONMENTAL CONTAMINANTS IN THE ARCTIC

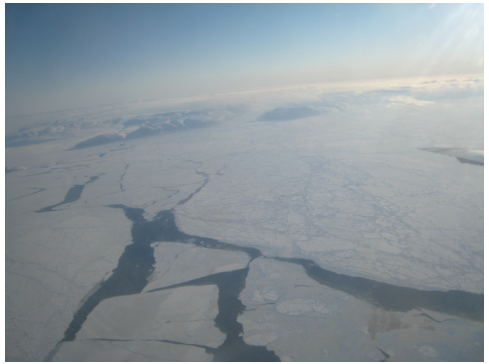
Elsie M. Sunderland

HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH
Department of Environmental Health

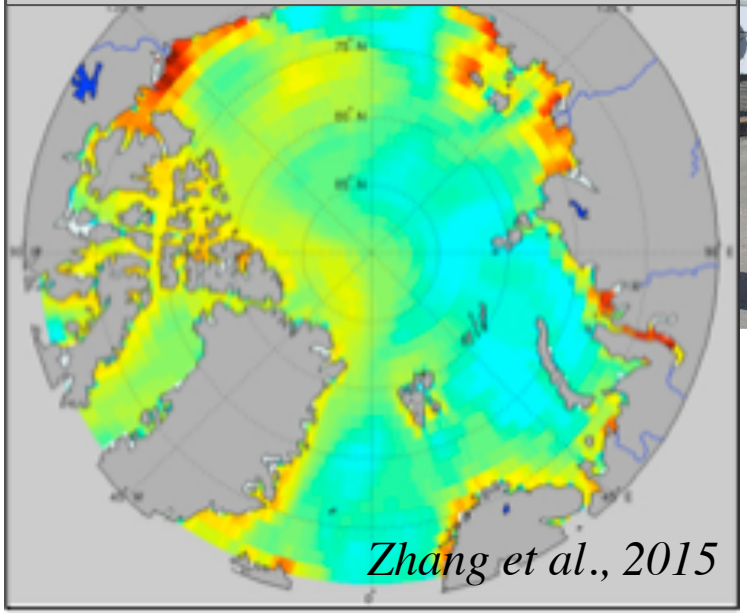
EFFECTS OF CLIMATE CHANGE ARE MOST SEVERE IN POLAR REGIONS

Warming 2 x Global Average

Melting Permafrost
Loss of Sea Ice



Riverine Mercury Inputs to the Arctic Ocean



Increasing Freshwater Discharges to the Oceans

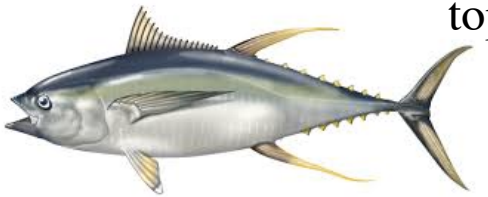
Vulnerable Human Populations

BIOACCUMULATIVE CONTAMINANTS IN MARINE FOOD WEBS EXACERBATE CLIMATE THREAT

Concentrations are x10^6-10^7 water

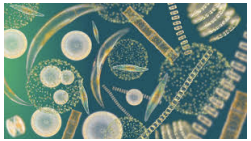
- Neurocognitive deficits
- Endocrine disruption
- Impaired immune function

top predators



big fish

small fish



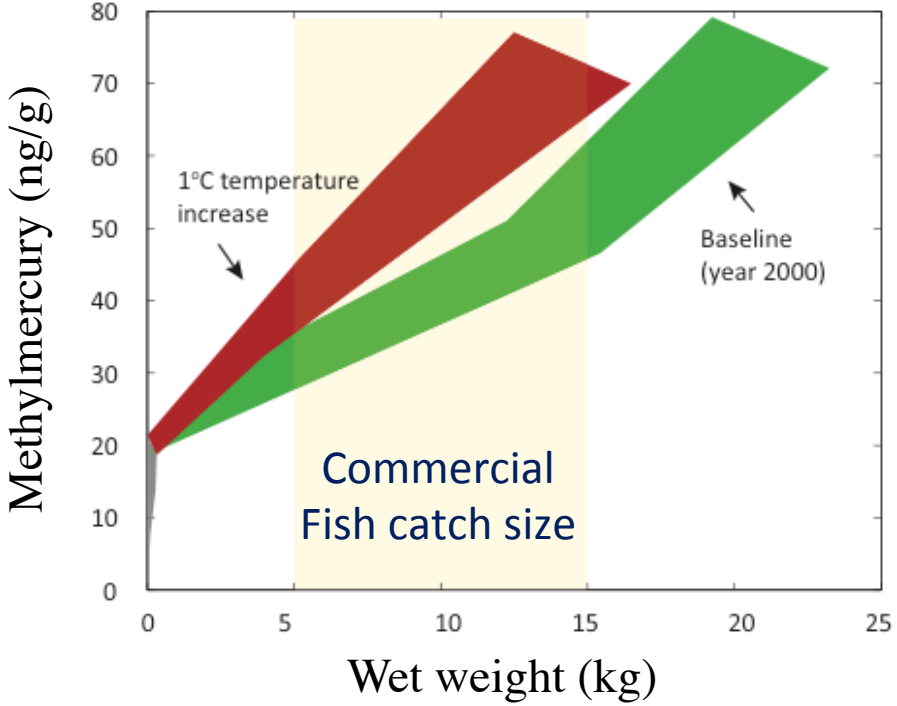
plankton

water

chemical concentration
(i.e., methylmercury)

CLIMATE DRIVEN SHIFTS IN ECOSYSTEMS CAN INCREASE CONTAMINANT EXPOSURES

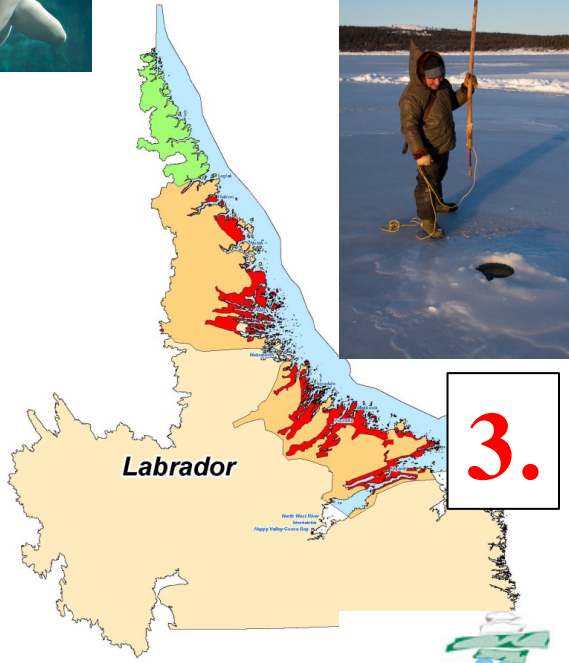
Modeled effect of seawater temperature increase on Methylmercury in Atlantic Cod (*Gadus morhua*)



Qureshi et al., 2013

IMPACTS ON THREE COMMUNITIES:

1. Faroe Islands
2. Nuuk, Greenland
3. Labrador, Canada



NIEHS
National Institute of Environmental Health Sciences

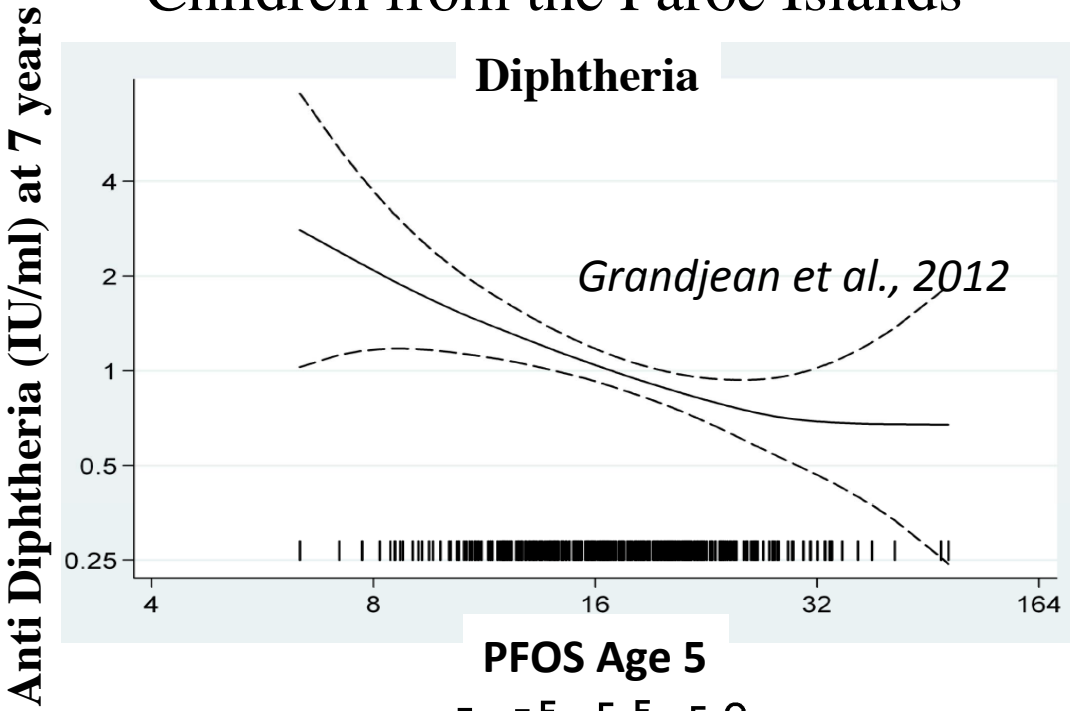
NSF

PI: Philippe Grandjean

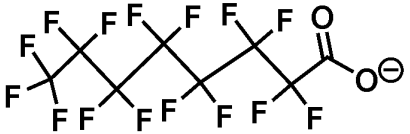
NUNATSIAVUT
kavamanga Government

IMMUNOTOXICITY DUE TO LIFETIME EXPOSURE TO OCEAN POLLUTANTS

Children from the Faroe Islands



PFOS Age 5



50% Reduction in antibody concentrations for each doubling of PFASs

NUUK, GREENLAND

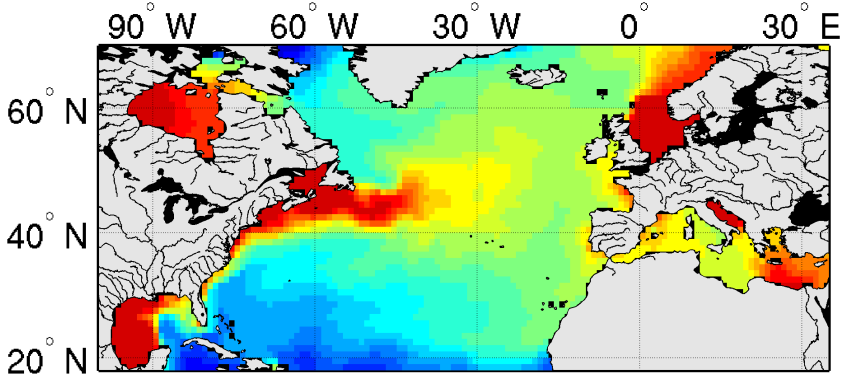
Blood sample for exposure biomarkers and vaccine antibodies

First sample shipment

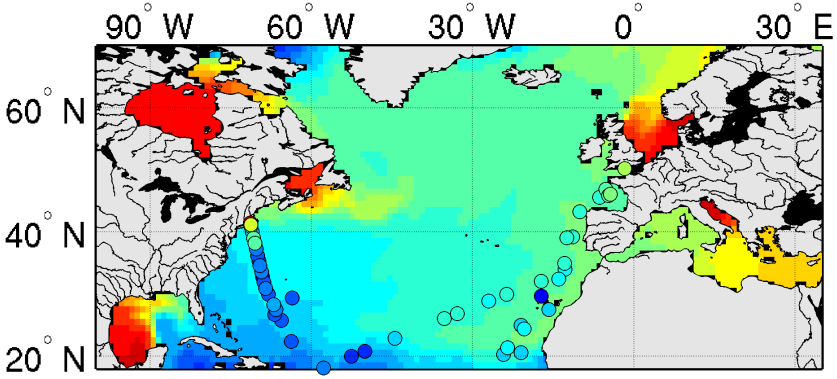
FAROE ISLANDS

Modeled North Atlantic seawater PFOS (pg/L)

Year 2000



Year 2010

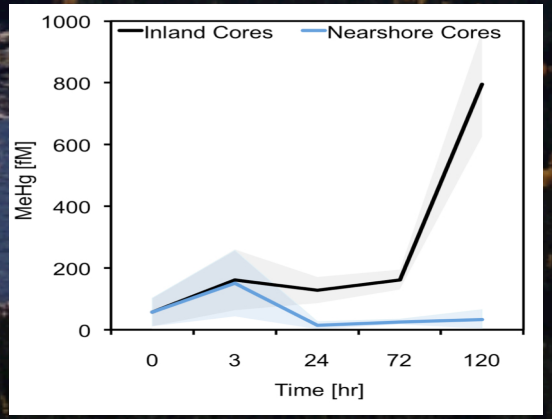


Zhang et al., 2015

LABRADOR, CANADA

Hydroelectric Development throughout the Canadian North

Flooding causes a pulse in methylmercury, methane and carbon.



Schartup et al., PNAS, 2015

GLOBAL ACTIONS HAVE RESULTED IN PRESENT LEVELS OF ENVIRONMENTAL CONTAMINANTS IN THE ARCTIC