NEW COURSE: Mathematics 1212

Climate, Sea Ice, and Life in Extreme Environments

An introduction to mathematical modeling of Earth's climate and ecosystems, focused on polar sea ice and the life it hosts, from algal communities to penguins and polar bears.

Spring 2025, MW 11:50 AM – 1:10 pm, 3 Units
Instructor: Ken Golden, Distinguished Professor of Mathematics
Prerequisite: "C" or better in Calculus I, or AP credit
General Education Life Science (LS) Designation

Course Description. Polar sea ice forms a critical component of the climate system, and is home to a rich array of life, from microbes living inside the ice to megafauna like penguins and polar bears. The rapid decline of sea ice impacts Earth's climate and its polar marine ecosystems, with cascading effects felt far beyond the polar regions. The course will cover the basic mathematics of climate and ecosystems, and then focus on modeling physical and biological processes in sea ice, and how life in extreme environments is responding to climate change. Some of the math that will be developed includes differential equations, random walks, fractal geometry, and percolation theory.
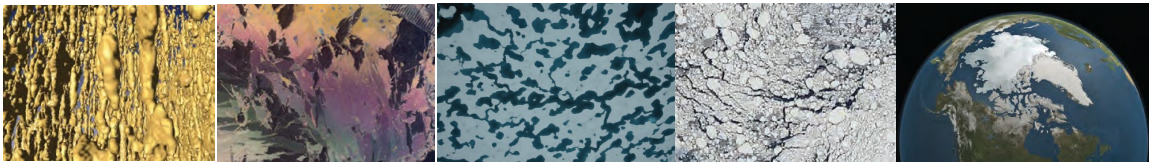

Figure 1. **From micro to macro in Earth's sea ice system** (left to right): X-ray CT of millimeter-scale brine inclusions (Golden et al., 2007); centimeter-scale polycrystalline structure (Arcone et al., 1986); melt ponds on Arctic sea ice (Perovich); sea ice pack as a granular composite (NASA); the Arctic Ocean viewed from space (NASA).

Figure 2. **From micro to macro in the sea ice ecosystem** (left to right): sea ice diatom in a brine inclusion, surrounded by extracellular polymeric gel (Krembs) that algae secrete to help them live in this extreme environment; illustration of a brine inclusion network, home to ice endemic organisms such as bacteria and nematodes in addition to algae; Assistant Professor of Math and Biological Sciences Jody Reimer studying a sedated polar bear on the Arctic Ocean; twin penguins off the coast of East Antarctica (Golden).