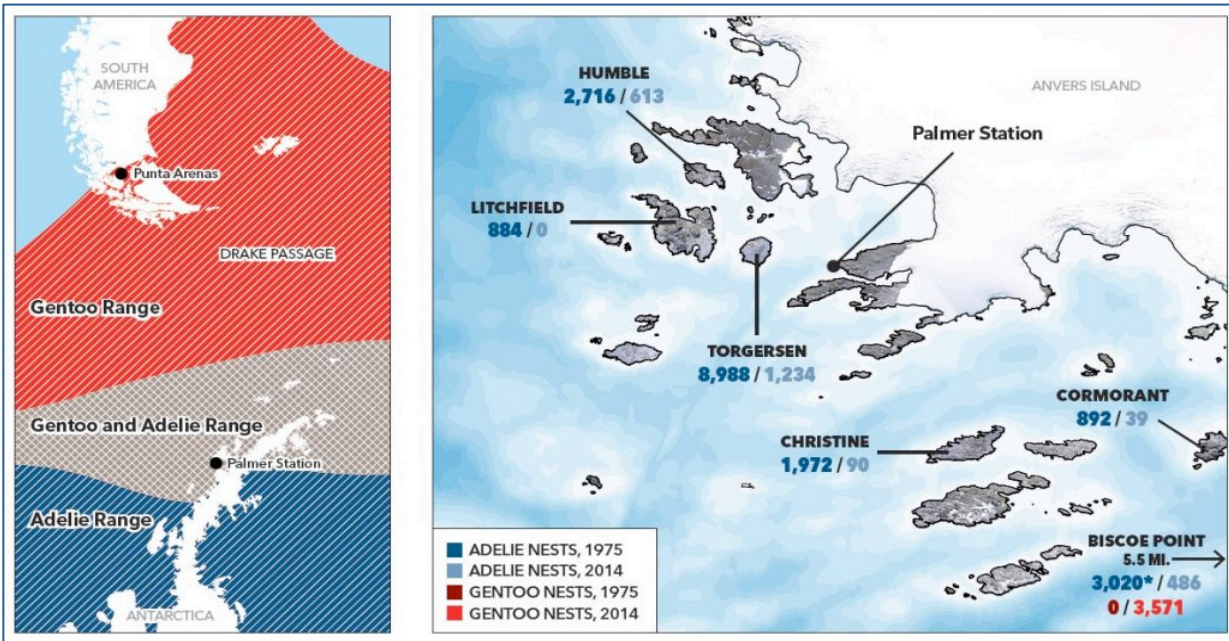


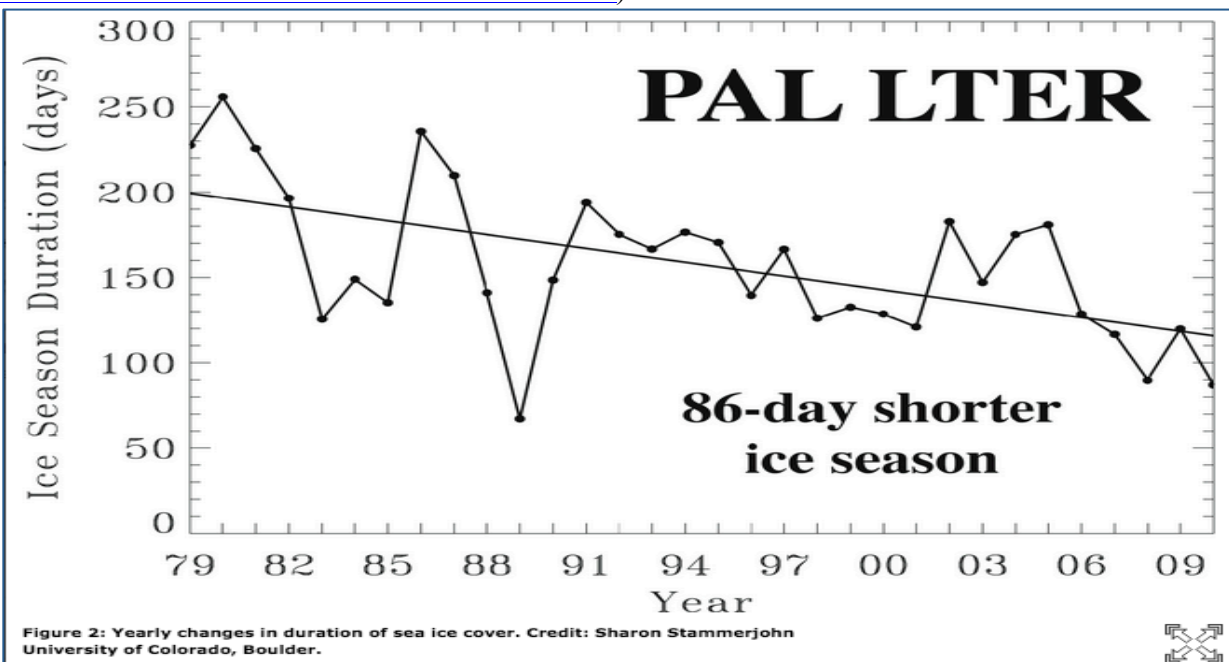


Education and Research: Testing Hypotheses

Graphic #1: Comparison of Adelie and Gentoo Ranges and Nests (Gentoo Penguins mostly occur farther north than Adelie Penguins (left), but those boundaries are changing as the climate warms. At Palmer Station (right), Adelie numbers have fallen drastically, and gentoos now outnumber them. *Maps: Drake Passage by Mea Cook using Generic Mapping Tools. Palmer area from U.S. Antarctic Program, NSF, and Environmental Research & Assessment. *Dark blue number for Adelie nests (Biscoe) is from 1971.* <https://www.allaboutbirds.org/on-the-antarctic-peninsula-scientists-witness-a-penguin-revolution/>)

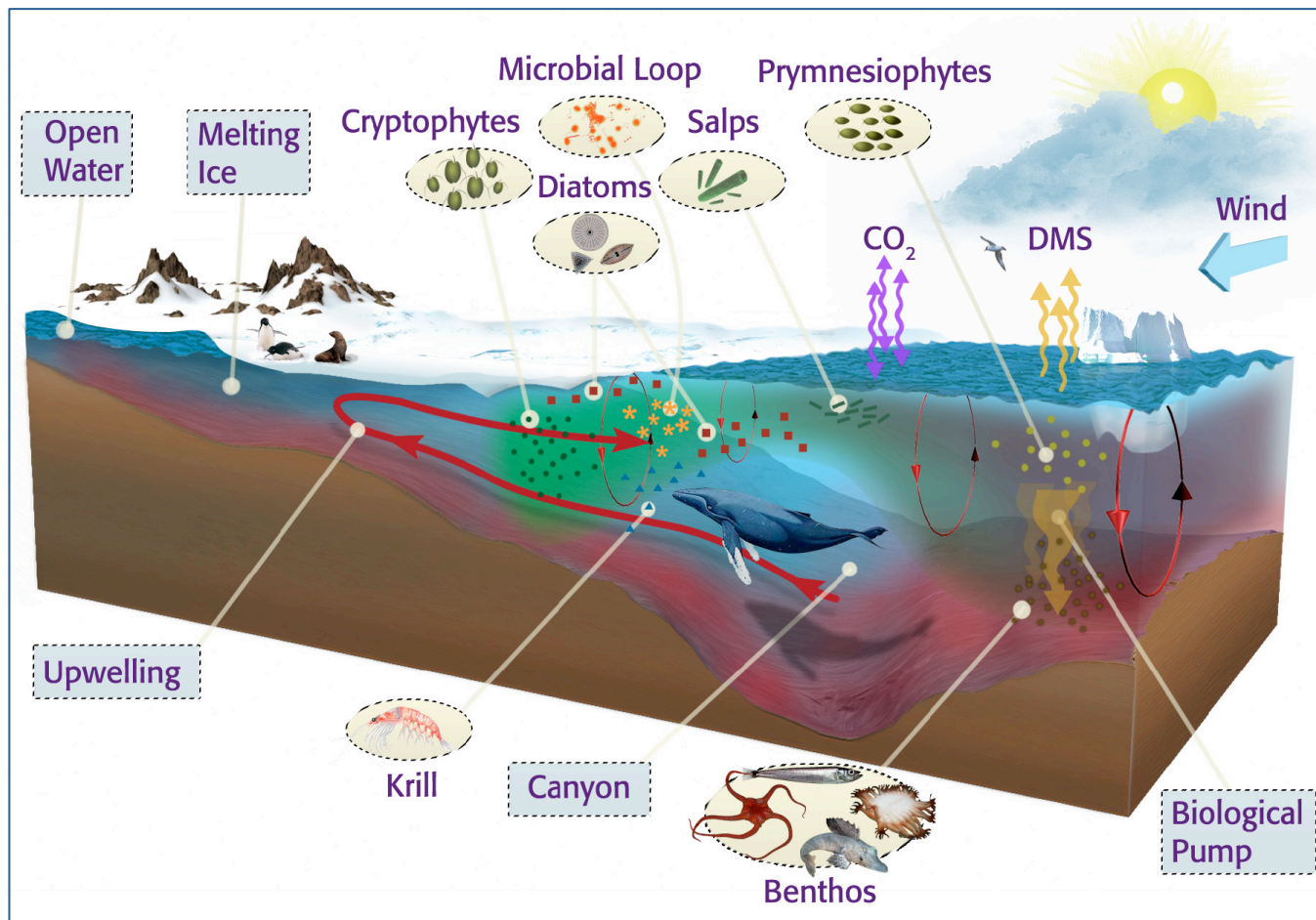


Graphic #2: West Antarctic Peninsula Sea Ice at Palmer Station (Yearly changes in duration of sea ice cover. Credit: Sharon Stammerjohn University of Colorado, Boulder. <http://pal.lternet.edu/research/transformational-science>)



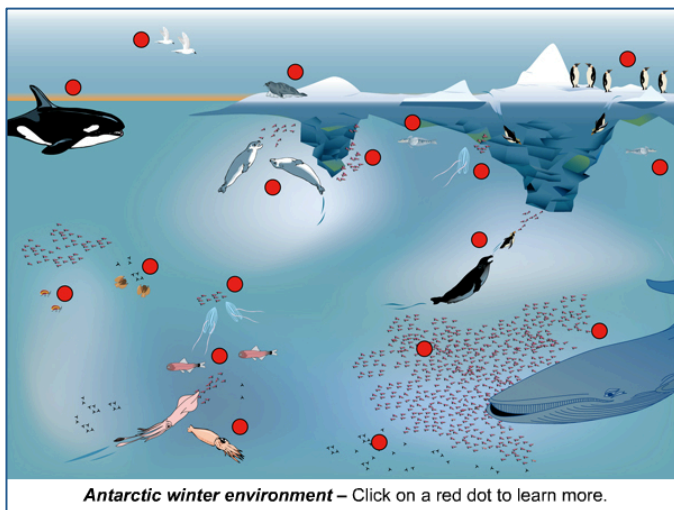
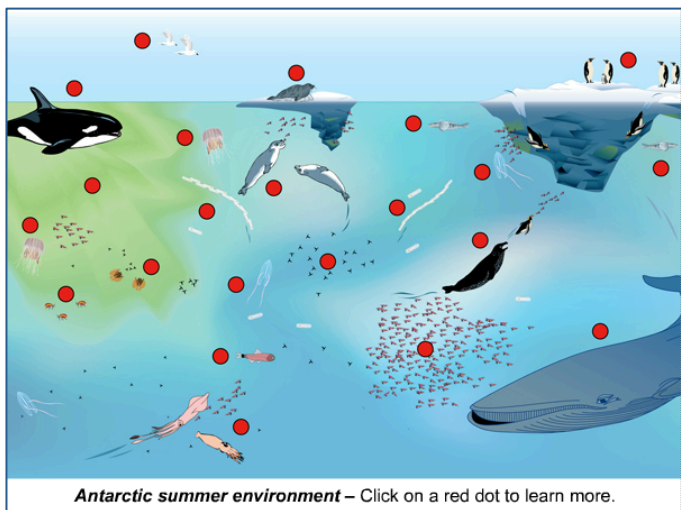
Graphic #3: Antarctic Food Web & Biological Pump (The marine foodweb of the west Antarctic Peninsula is characterized by large predators such as penguins, seals and whales sustained by upwelling that supports high productivity and large krill populations. Credit I. Heifetz, Rutgers University.

<http://pal.lternet.edu/research/transformational-science>)



Graphic #4: Antarctic Food Web Interactive:

<http://polardiscovery.whoi.edu/antarctica/summer.html>.



Graphic #5: Effects of Changing Sea Ice on Food Web: SAM Cartoon. During negative episodes of the Southern Annular Mode along the Western Antarctic Peninsula (- SAM, left panel), heavy, persistent winter sea ice and calm winds in spring and summer encourage growth of phytoplankton and krill. During positive SAM episodes (+ SAM, right panel) conditions are generally reversed. Schematic courtesy Grace Saba/Rutgers. (https://www.vims.edu/newsandevents/topstories/archives/2014/saba_wap.php)

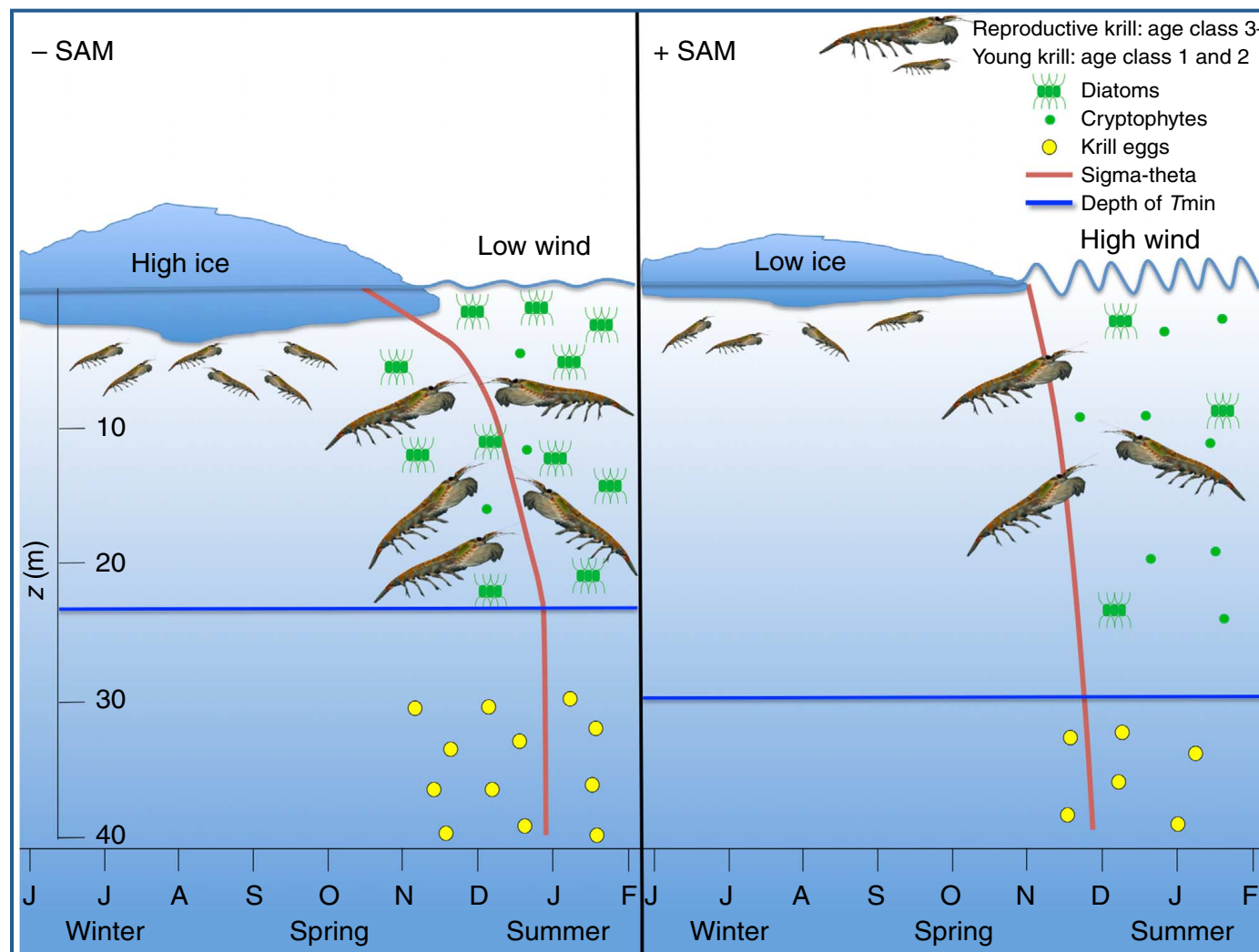


Figure 4 | Effects of large-scale climate and local physical forcing on biological processes in the coastal WAP. Generalized illustration summarizing how individual and combined winter and spring climate, weather and physical oceanographic processes (see months July–February on x axis) cascade from phytoplankton to krill recruitment in a negative Southern Annular Mode (– SAM) in July and spring (left panel) and a positive SAM (+ SAM) in July and spring (right panel). Depth of temperature minimum (T_{min}) in the remnant Winter Water layer in the region was estimated from Stations B and E November–December averages. All other properties (phytoplankton, krill, krill eggs and sigma-theta) are generalized for qualitative illustration (more versus less), and do not represent quantitative differences between negative and positive SAM. Note: female *E. superba* spawn over deeper water; this illustration is meant to depict relative egg production.