

Geothermal Heat and Arctic Sea Ice Variability

Continuing his series of intriguing articles on the effects of volcanic eruptions on regional weather, Wyss Yim (Geology, 1971-74) has been examining the effect on the extent of Arctic sea ice.

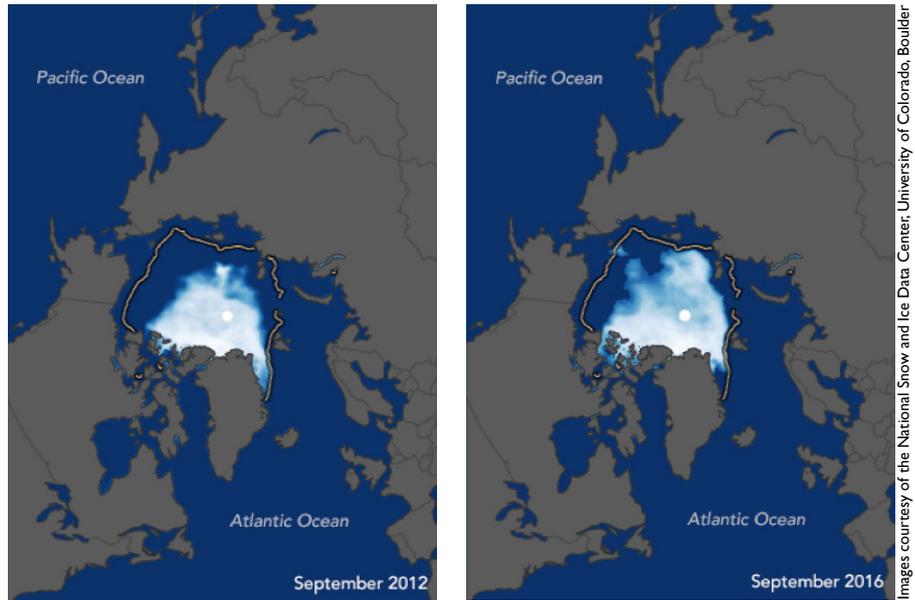
In previous issues of Imperial ENGINEER (Autumn 2013, Spring 2016, Autumn 2016, and Spring 2017), selected volcanic eruptions studied were found to have an important role in regional weather. Out of these, two eruptions releasing geothermal heat into oceans were particularly notable. The first eruption was entirely submarine, and the second eruption was initially submarine followed by both submarine and sub-aerial activities. Both these eruptions were also responsible for causing the Arctic sea ice to undergo major retreat. In this article, satellite observation records in support of the two retreats are presented, provided by the National Snow and Ice Data Centre, Boulder.

Satellite observation records of Arctic sea ice extent were first available in 1979. The Arctic Ocean is capped by layers of frozen seawater. Under normal conditions, Arctic sea ice grows dramatically each winter usually reaching its maximum in March. It melts just as dramatically each summer, reaching its minimum in September.

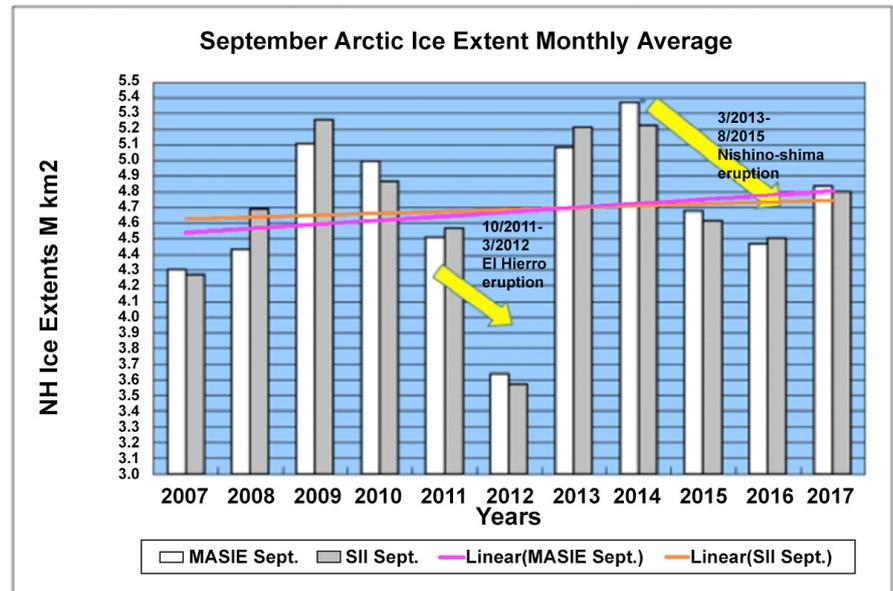
In the northern Atlantic Ocean from October 2011 to March 2012, an entirely submarine eruption occurred off El Hierro Island in the Canary archipelago. The eruption timing was between mid-autumn to early spring in the northern hemisphere generating warmer sea water than normal and causing the lowest Arctic sea ice on record in September 2012.

In the northern Pacific Ocean from March 2013, an initially submarine eruption occurred off Nishino-shima Island 940 km south of Tokyo. In November 2013, a new volcanic island was formed and both submarine and sub-aerial activities continued until August 2015. This 'long' lasting eruption provided an explanation for the northern Pacific Blob which puzzled many scientists who were unaware of the connection with submarine volcanism. The appearance of warmer seawater than normal on the surface of the north Pacific Ocean led to the development of strong El Niño conditions during 2014 to 2015 providing an explanation for the continuous and gradual Arctic sea ice retreat observed during September 2014, September 2015 and September 2016.

The natural release of geothermal heat into the northern hemisphere portions of the Atlantic Ocean and Pacific Ocean was therefore responsible for the two episodes of major Arctic sea ice retreat during the last decade. An improvement in the future monitoring of submarine volcanic activity is needed to provide a better understanding of polar sea ice variability.



Opaque white areas indicate the greatest concentration, and dark blue areas are open water. The yellow outline on each image shows the median sea ice extent for September and March as observed by satellites from 1979 through 2000.



NH – Northern Hemisphere
MASIE – Multisensor Analyzed Sea Ice Extent
SII – Sea Ice Index



Professor Wyss Yim DSc PhD DIC FGS was at Imperial College in the Department of Geology from 1971-1974. After that he spent 35 years until retirement at the University of Hong Kong where he taught civil engineering, geosciences and environmental management students, and, helped found the Department of Earth Sciences. He was awarded the DSc by the University of London in 1997. Wyss served as the Deputy Chairman of the Climate Change Science Implementation Team of UNESCO's International Year of Planet Earth 2007-2009.