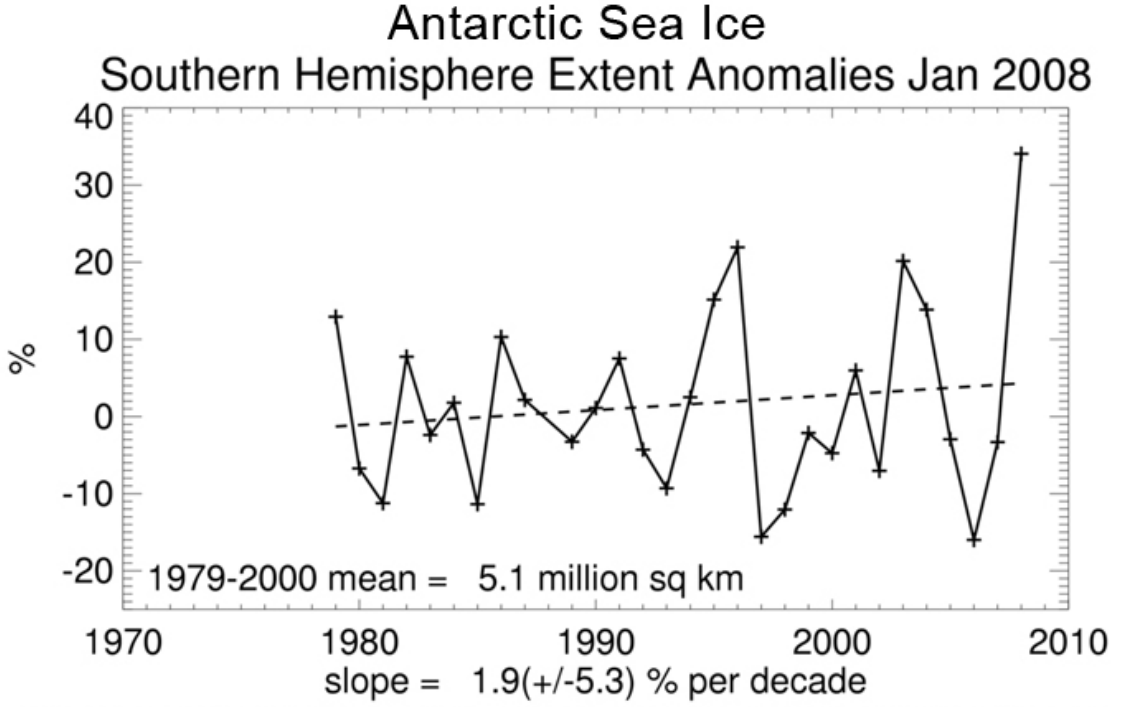
Why is Antarctic Sea Ice increasing?

In light of recent confirmation of regional heating across Antarctica since the turn of the century, the increasing amount of Antarctic Sea ice documented since the 1990s is perplexing.



Fetterer, F., K. Knowles, W. Meier, and M. Savoie. 2002, updated 2007. Sea ice index. Boulder, CO: National Snow and Ice Data Center. Digital media.

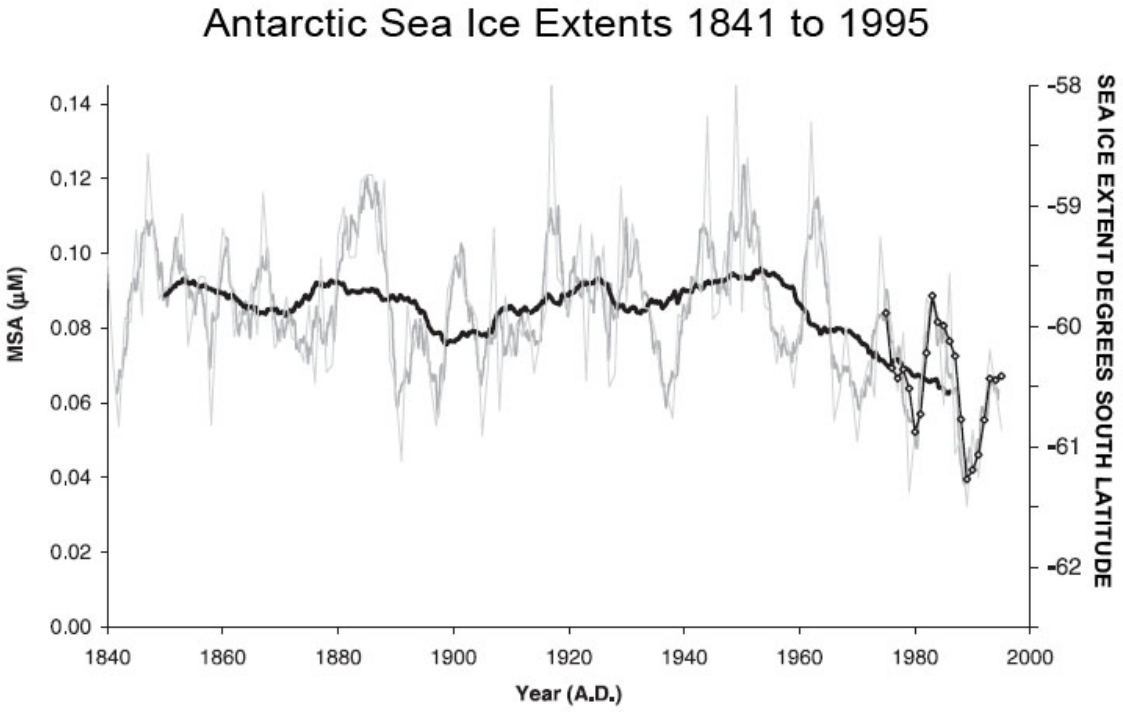
My favorite explanation is the increased melt is decreasing ocean salinity which allows greater sea ice formation. This relationship may be playing a role, but I have found no references for support. I have found two interesting articles. The first shows that today's sea ice extent is a part of a long term cycle and is not particularly record breaking. The second shows how Antarctic warming is increasing the sea ice because of decreased brine production and decreased shallow surface convection.

Curran, et. al., says in *Ice Core Evidence for Antarctic Sea Ice Decline Since the 1950s,* that there is a tracer, produced in ocean waters that is deposited in the Antarctic ice that is a proxy to ocean ice extent. When more of this proxy is found in ice cores, it means that there is a greater amount of open water downwind. Curran calibrated his model with known sea ice extents records from 1980 to present so that he could project historic sea ice extents into the past back to 1841.

The study represents an area of sea ice along the eastern coast of Antarctica of approximately 15% of Antartica's total sea ice.

The proxy used, methanesulphonic acid (MSA), is produced by marine phytoplankton and makes it's way into the winds by the same methods that salts and other organic and inorganic material from the ocean moves into the atmosphere from open surface waters of the sea.

What Curran found was there is an eleven-year cycle of sea ice volume, since 1950, Artic Sea ice has declined significantly, by about 20%.



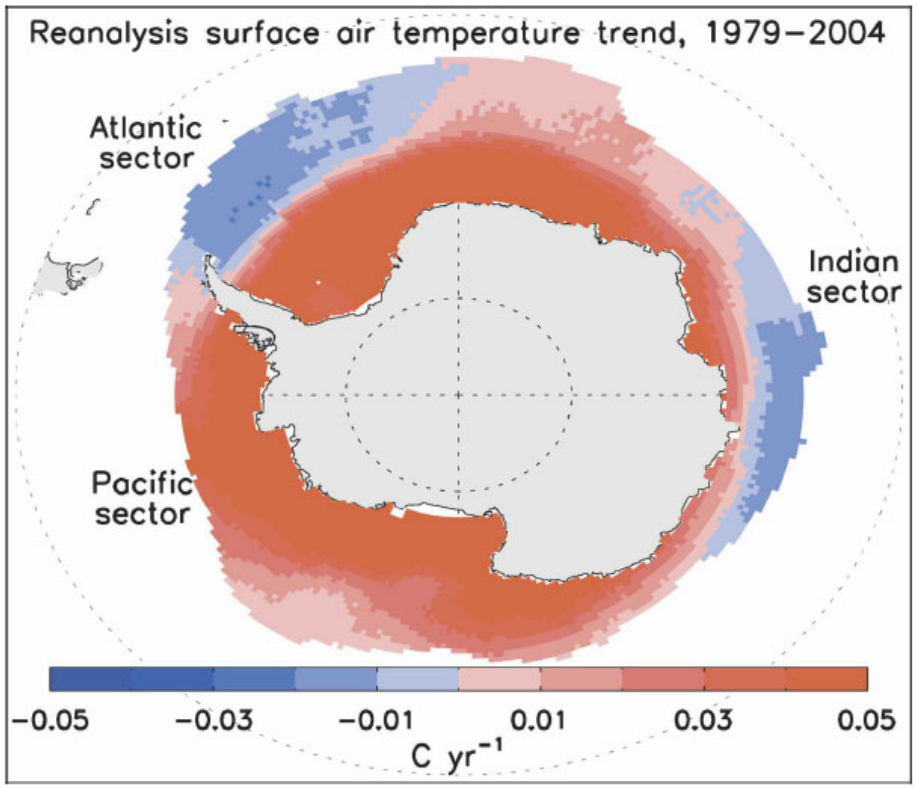
The light colored erratic line is MSA concentration from the Law Dome ice core. The bold dark line is the 20 year running average of MSA concentration. The thin black line with circles is the satellite record of sea ice extent.

Reference: Curran et, al., Ice Core Evidence for Antarctic Sea Ice Decline Since the 1950s, Science, November, 2003

So why is Antarctic Sea Ice increasing right now? This is the riddle as Jinlun Zhang puts it in his paper published in the Journal of Climate in June *Increasing Antarctic Sea Ice under Warming Atmospheric and Oceanic Conditions.* Zhang comes up with a pretty good description of what may be happening. It's complicated, but it fits.

Observations around the continent show increased air and water temperatures from 1979 to 2004. (NCEP–NCAR reanalysis 1979 to 2004) Zhang uses a sea ice model coupled to an ocean model to explore why this is happening. The model confirms that increasing air temperatures increase infrared radiation capture (the greenhouse effect) and then warms upper ocean waters. This increase in upper ocean temperature decreases sea ice growth, which leads to a decrease in brine rejection by forming and aging sea ice (this is a normal process as salt is naturally forced from sea ice over time until the ice becomes completely fresh after a couple of years).

The reduced sea ice volume producing less brine makes the upper ocean less salty and less dense. This leads to less convection of deeper warmer waters as the less dense waters sink less. This means the upper ocean waters are cooler and the cooler less saline waters then allow more sea ice to form. Simple really. About as simple as learning French - but still an adequate description of a plausible explanation that is backed up by confirmation with computer modeling.



NCEP–NCAR reanalysis surface air temperature over the ice-covered areas of the Southern Ocean defined as the 1979–2004 mean satellite-observed sea ice extent.

References:

Curran, et. al., Ice Core Evidence for Antarctic Sea Ice Decline Since the 1950s, Science November, 2003

Zhang, Increasing Antarctic Sea Ice under Warming Atmospheric and Oceanic Conditions, Journal of Climate, June, 2007