Numerical Reanalyses as a Gateway to Arctic Synthesis

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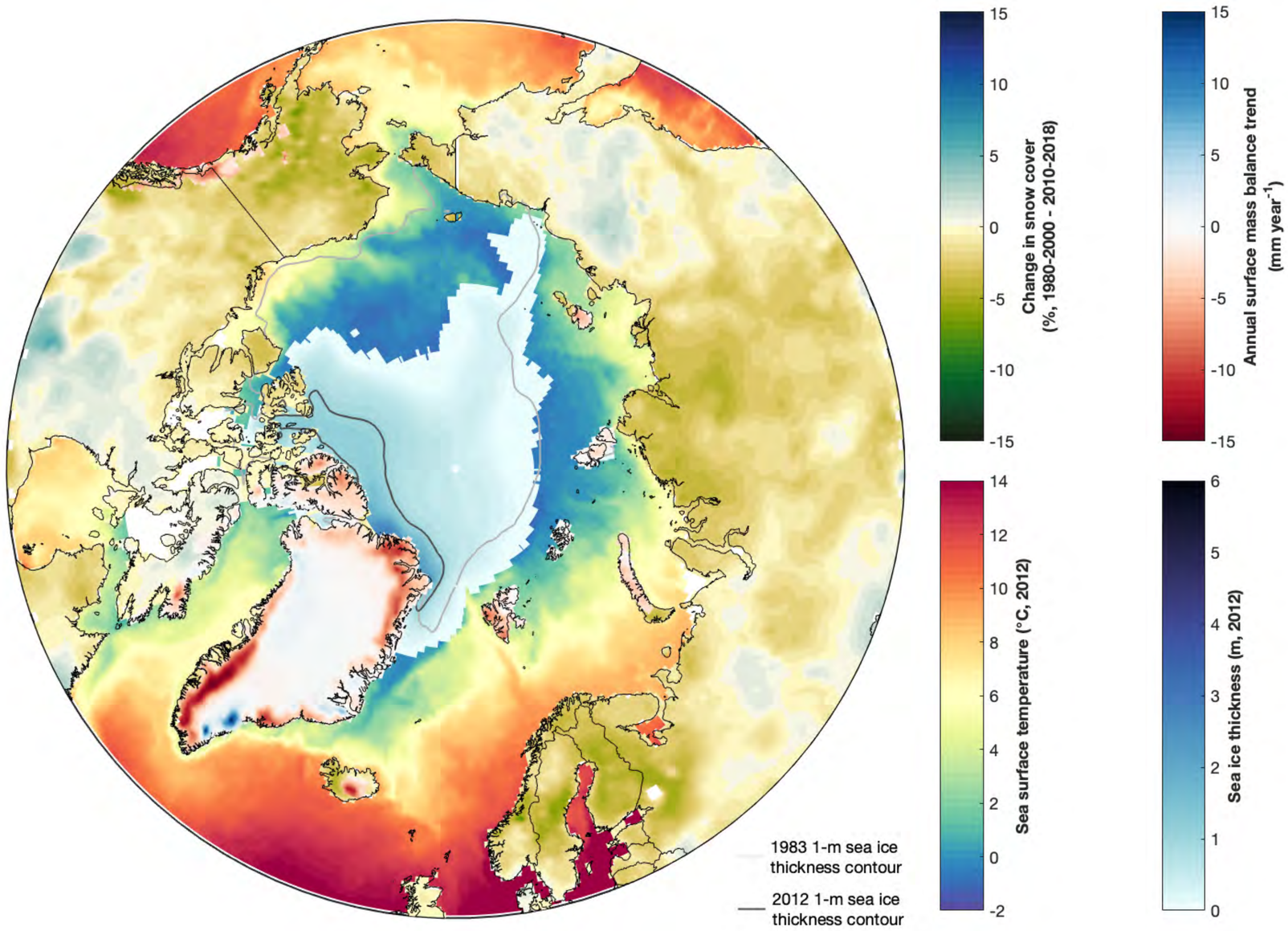
Arctic changes in context: Numerical reanalyses, like MERRA-2 and SODA3, provide insight into the scale, magnitude, and the uncertainty of recent Arctic changes and give context to future scenarios.

- MERRA-2 (Modern-Era Retrospective analysis for Research and Applications, Version 2) provides a wide range of atmospheric and land variables, permitting analysis of cryospheric trends, such as snow cover and SMB, and the global conditions associated with the observed changes.

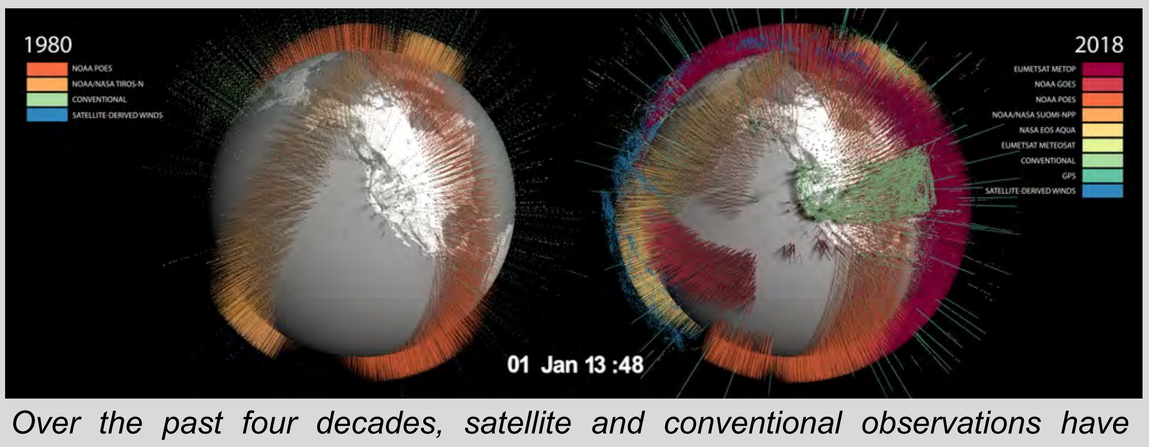
- SODA3 (Simple Ocean Data Assimilation 3) provides ocean state information, including temperature, salinity, velocity, and sea ice conditions.



Reanalyses in action

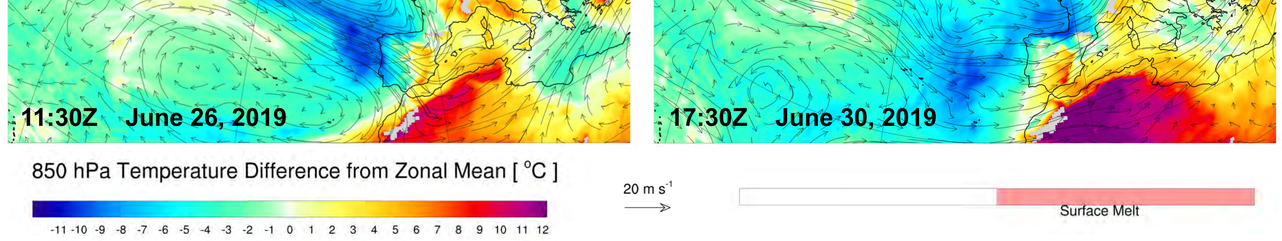
MERRA-2 incorporates a wide range of satellite and conventional observations within the Goddard Earth Observing System (GEOS) modeling and data assimilation system to produce an optimal estimate of the atmospheric state over time.

The image below demonstrates the critical role of increasing satellite observations in enhancing reanalysis results. But, it also demonstrates the challenge of seamlessly integrating rapidly changing observations.



Over the past four decades, satellite and conventional observations have increased in both quality and quantity. MERRA-2 leverages a vast array of observations to produce the best estimate of atmospheric state. In 1980, the median number of observations assimilated MERRA-2 over a six hour period was 175,000. In 2018, this number approached 5 million.

Conditions leading to the recent Greenland melt event



The atmospheric conditions leading to the large melt event across Greenland between June 30 and August 1, 2019 were unusual. As high-pressure strengthened over Europe, a low-pressure trough to the west deepened and became negatively tilted, folding the jet stream back northwestward and pulling the warm air mass toward the ice sheet. The warming triggered extensive melting across the ice sheet, adding to the already large flux of runoff occurring on the ice sheet this melt season. Initial results from the MERRA-2 reanalysis indicate that this melt season is likely to place behind only 2012 for mass loss.

GMAO atmospheric and land products
gmao.gsfc.nasa.gov

SODA3 ocean products
soda.umd.edu

National Aeronautics and Space Administration