Metrics for Improved Reanalyses in Polar Regions

Chelsea L. Parker^{1,2}, Richard I. Cullather^{2,3}, Lauren C. Andrews³, and Amal El Akkraoui³







Introduction

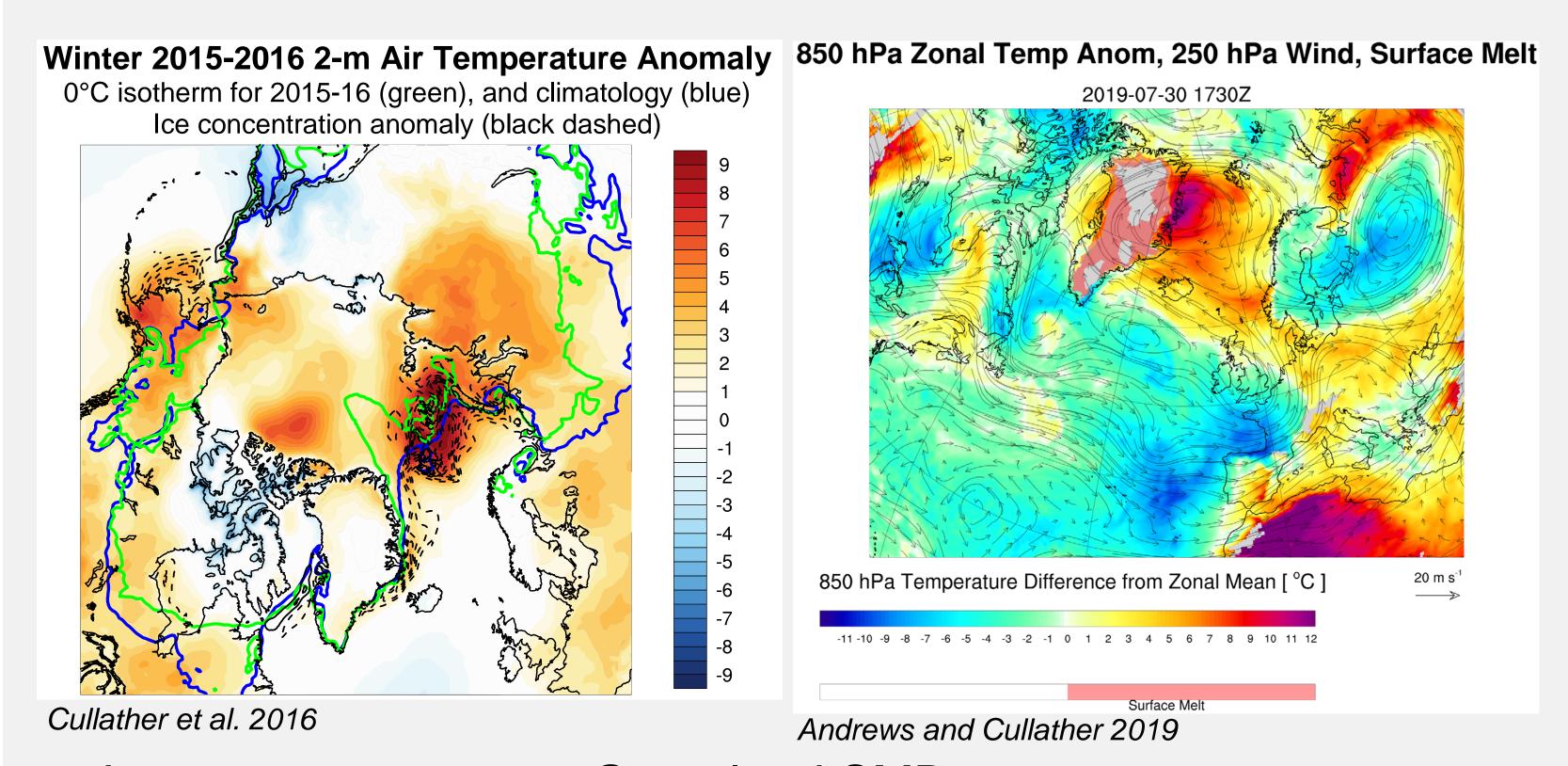
Reanalyses are retrospective, gridded depictions of the atmosphere widely used for boundary conditions, climate model validation, and diagnostic analyses.

However, reanalyses have difficulties representing polar processes. Here, we provide a preliminary assessment of a prototype system in comparison to recent products and seek community input for future reanalyses.

A prototype for new reanalyses

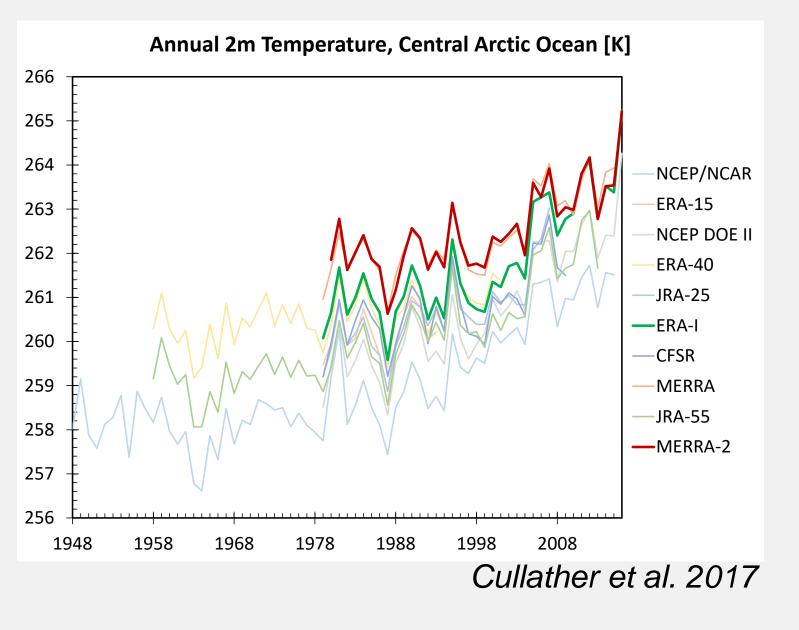
The new system (*reana_C360*) incorporates: hybrid 4Densemble Var. assimilation, updated radiation modeling (RRTMG) and convective parameterization, diurnal cycle SST modeling, improved topography, 1/4° resolution.

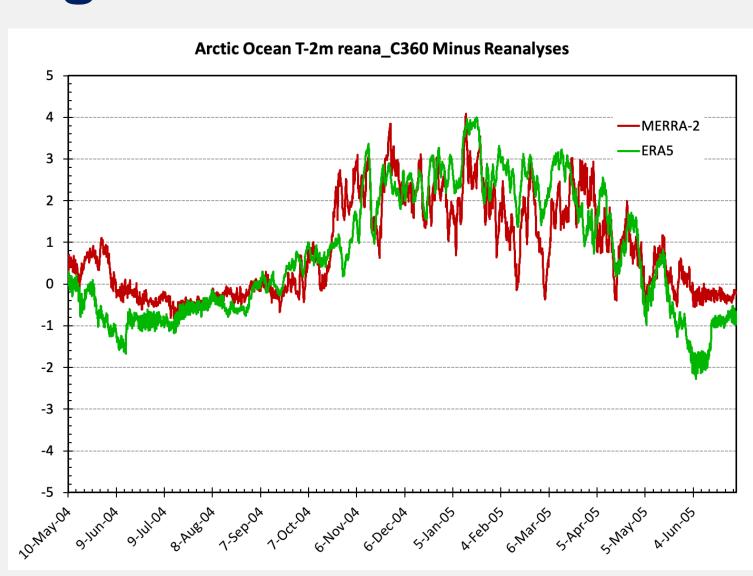
What can reanalyses do well?



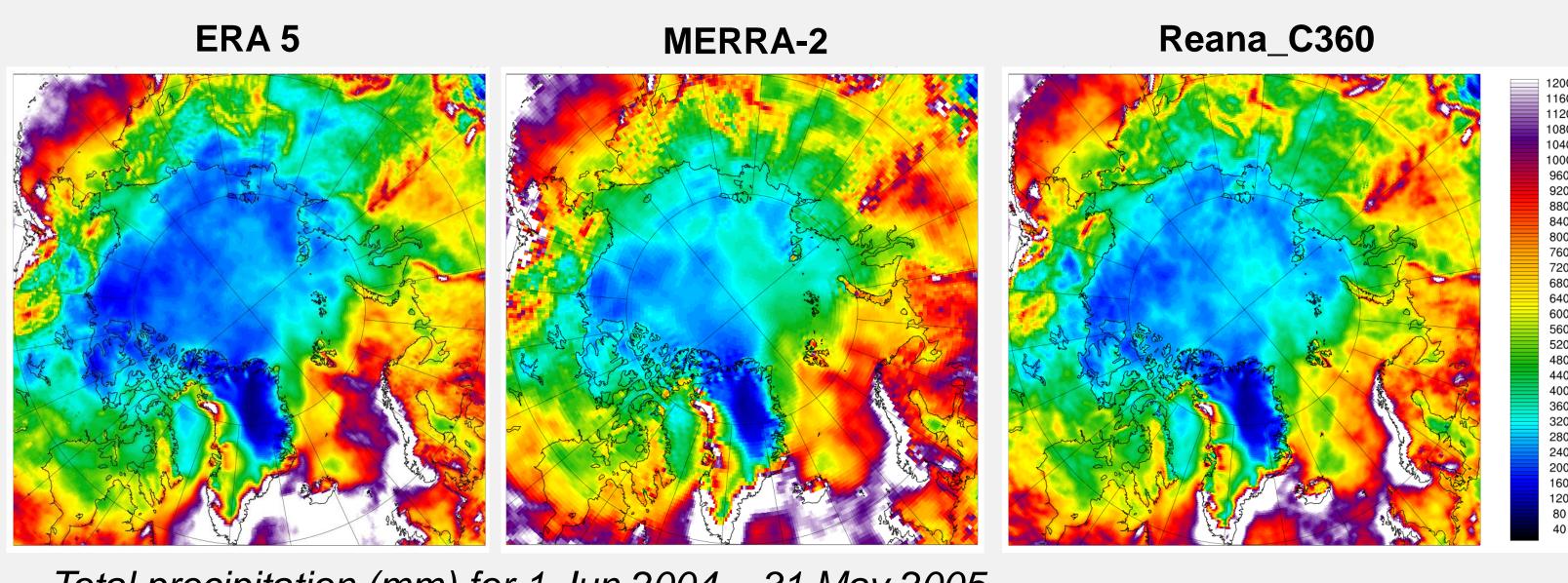
- Long-term states e.g. Greenland SMB
- Provide global perspectives with teleconnections to lower latitudes.
- Represent significant climatic events in the context of the historical record, e.g. the extreme Arctic winter of 2015-16 and the Greenland melt event of 2019.

What are reanalyses missing?



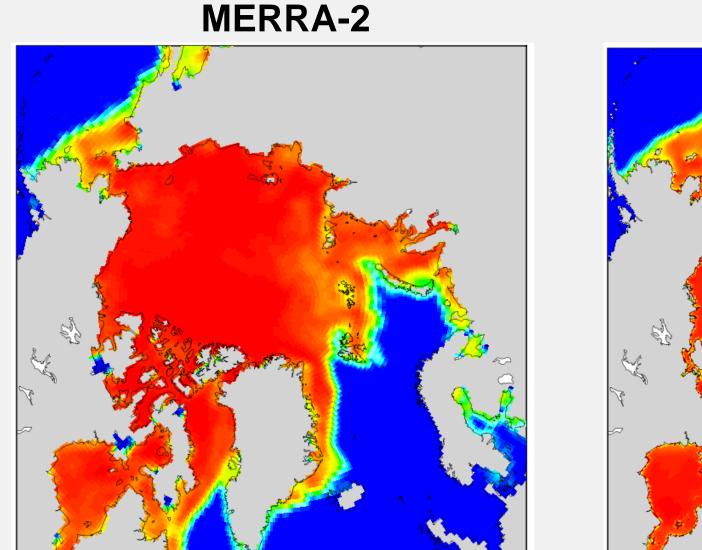


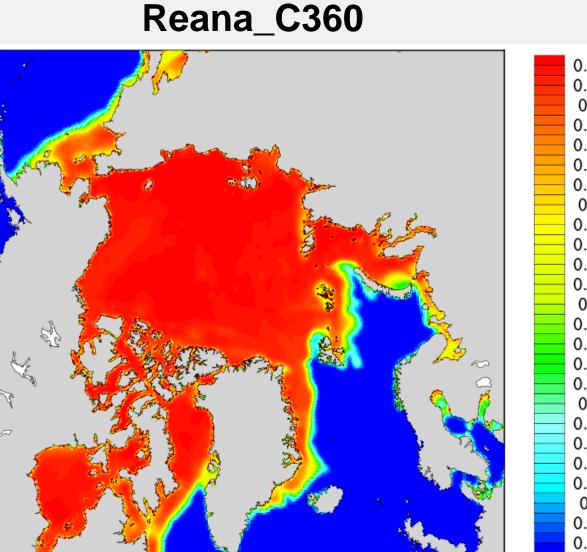
Air temperature trends. Products have a large spread due to different treatments of sea ice and ocean fluxes. New reanalyses, including the prototype, demonstrate a warm bias.



Total precipitation (mm) for 1 Jun 2004 – 31 May 2005

Precipitation and moist processes. Models have difficulty representing mixed-phase clouds. Arctic precipitation in MERRA-2 was ~1½ times observation. The prototype shows improvement but still overestimates precipitation.





February 2005 ice fraction / ocean area

Ice representation and processes. There have been some improvements in sea ice concentration, but snow, ice, and hydrology processes remain simplistic.

Current Work

Ongoing testing for a GMAO reanalysis of the 21st Century (MERRA-R21C).

PolarMERRA is a new initiative to examine and improve the representation of polar atmospheric processes in the GEOS model.

Your thoughts!

- Where are current reanalyses most lacking for your work?
- What physical processes should be incorporated in new reanalyses?
- What are important performance factors to consider in evaluating new reanalyses?

