Poster Number

A comparison of two proxy SST estimation methods in the Arctic

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Introduction

Temperature is a key indicator of climate change in the Arctic. But sea surface temperature (SST) observations in this region are limited especially at the ice margin. Therefore, sea ice concentrations are typically used to generate proxy temperatures. Ice-to-SST conversion methodologies differ. Here two commonly used ice-to-SST conversion methods are evaluated using high quality SST buoy data from the Measuring the Upper layer Temperature of the Polar Oceans (UpTemPO) project.

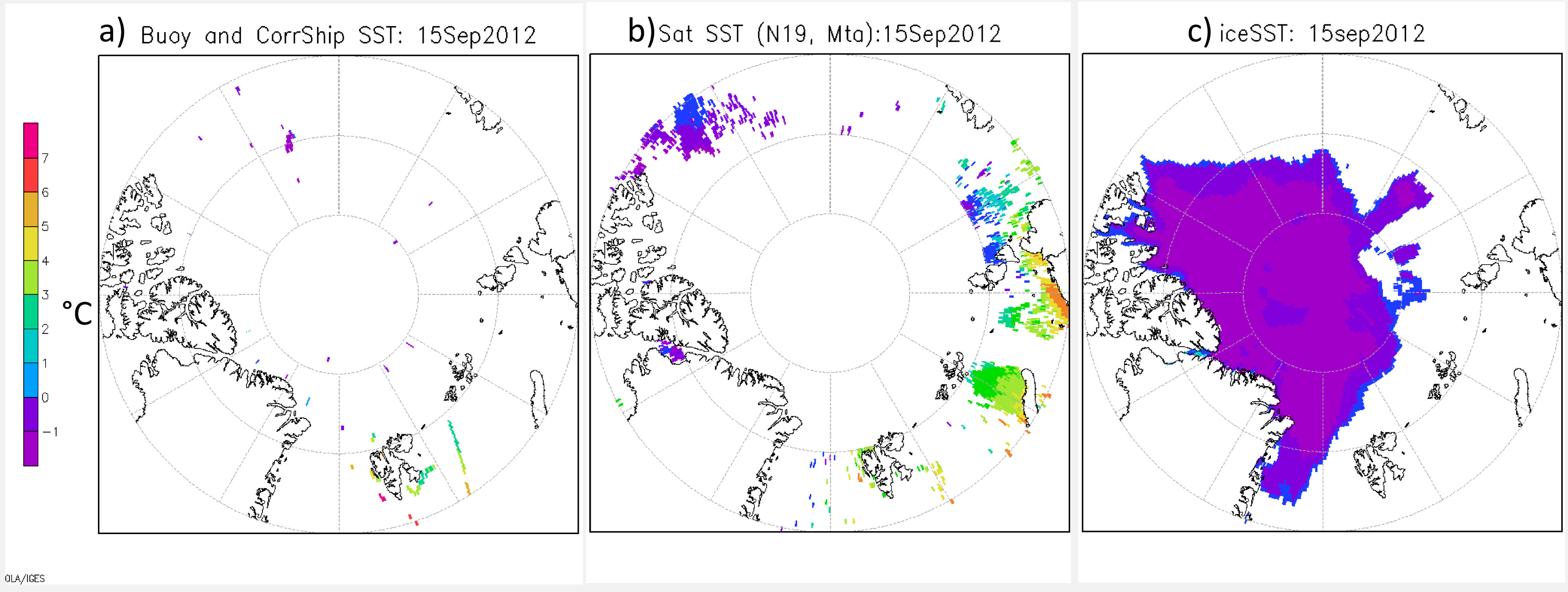


Fig. 1 Example of SST data in the Arctic Ocean for a single day: a) In situ observations and b) satellite (AVHRR) data have limited coverage compared to c) proxy SSTs generated from sea ice concentrations

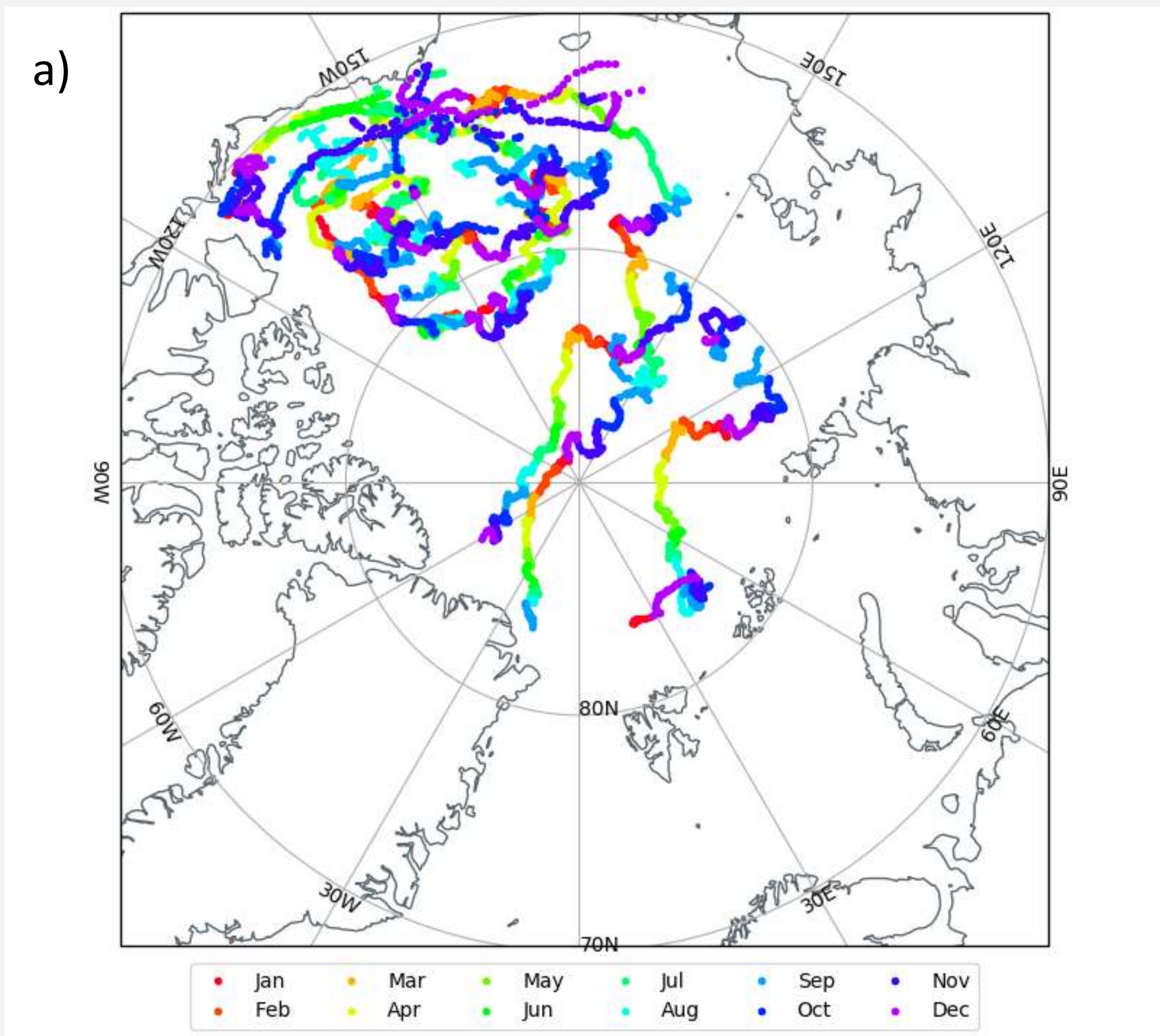
Data and Methods

NASA team sea ice concentrations (Cavalieri et al. 1996) from 2012 to 2016 were smoothed using a 7-day median filter and converted to SSTs using two methods:

1. Linear ice-to-SST equation for each month in multiple regions, applied where sea ice > 50% (Reynolds et al. 2007)
2. SST set to the daily freezing point (computed from salinity climatology; Zweng et al. 2013)
    A. applied where sea ice > 50%
    B. applied where sea ice > 0%
    C. Same as B plus an ice-dependent adjustment factor

For the initial comparisons, proxy SSTs were computed only where ice was above 50% after Reynolds et al (2007). Due to promising results for the second method, additional modifications were tested in the entire area containing sea ice.

Together with AVHRR data and in situ data, an SST analysis was generated for each of the proxy SSTs above using a modified version of the NOAA 1/4° Daily Optimum Interpolation SST (DOISST) code. This study is focused in water covered by sea ice, and excludes ice-free areas.



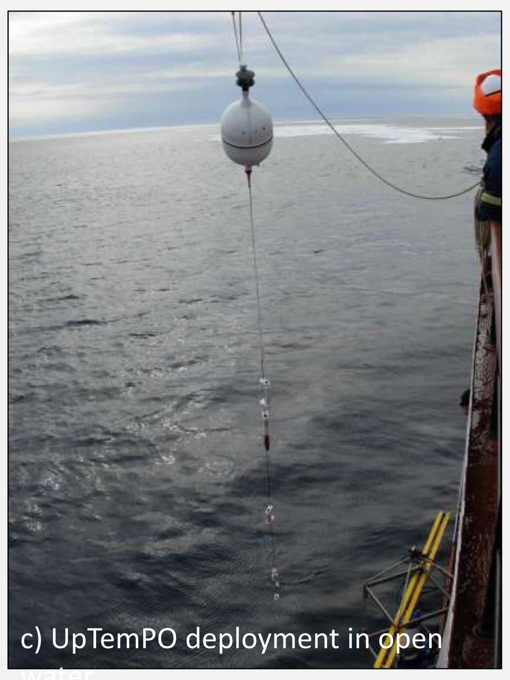


Fig. 2 a) UpTemPO buoy locations for 2012-2016 used in matchups with experimental DOISST. Colors indicate month. Photos of buoy deployments: b) in ice and c) in open water.

Results

The freezing point method yielded better results than the linear fit approach. For all methods smaller, the mean bias and RMSE was lower at higher ice concentrations. When the freezing point method was applied to ice concentrations below 50%, the resulting DOISST had a negative bias. This bias was minimized when an ice-dependent adjustment factor was added.

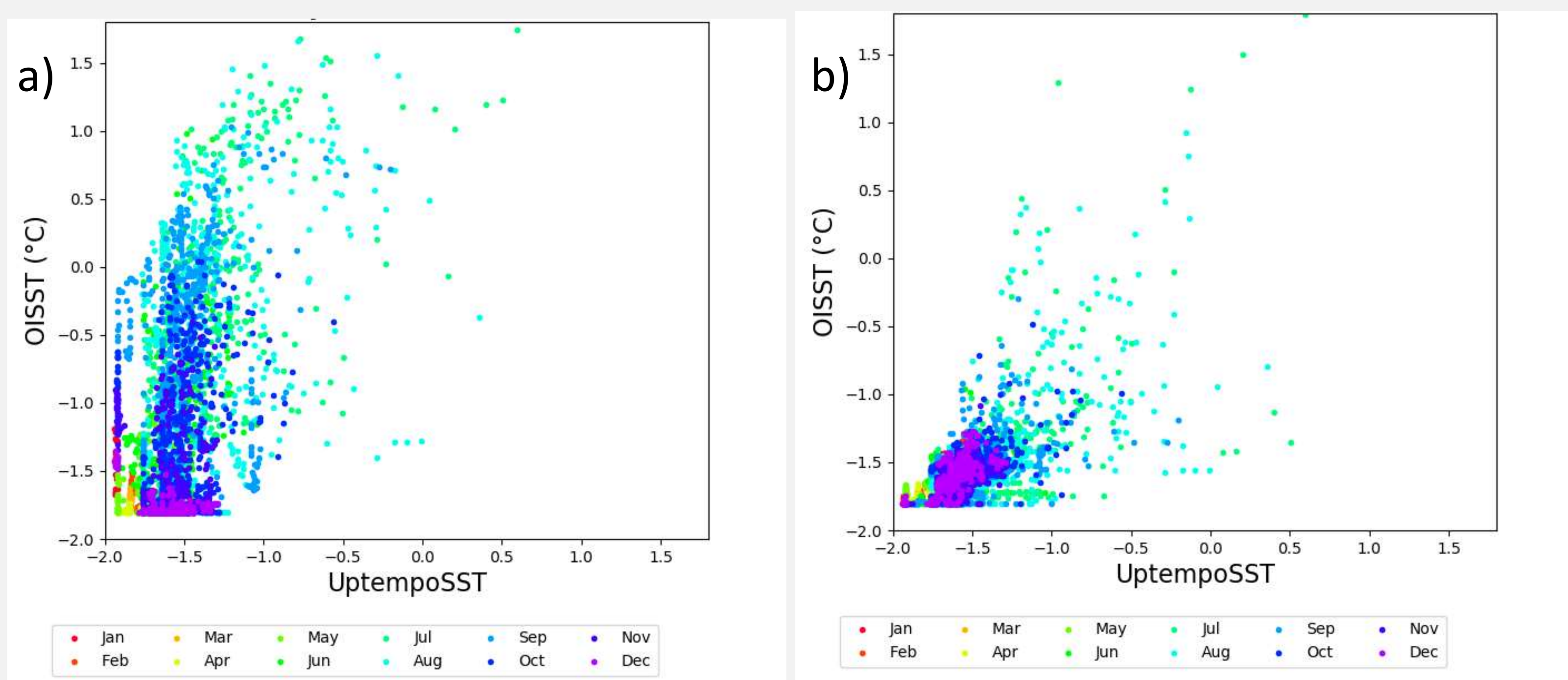


Fig. 3. Comparison between UpTemPO buoy SSTs and the daily OISST produced using proxy SSTs generated by: a) linear fit equations, and b) freezing point method applied where ice > 0%.

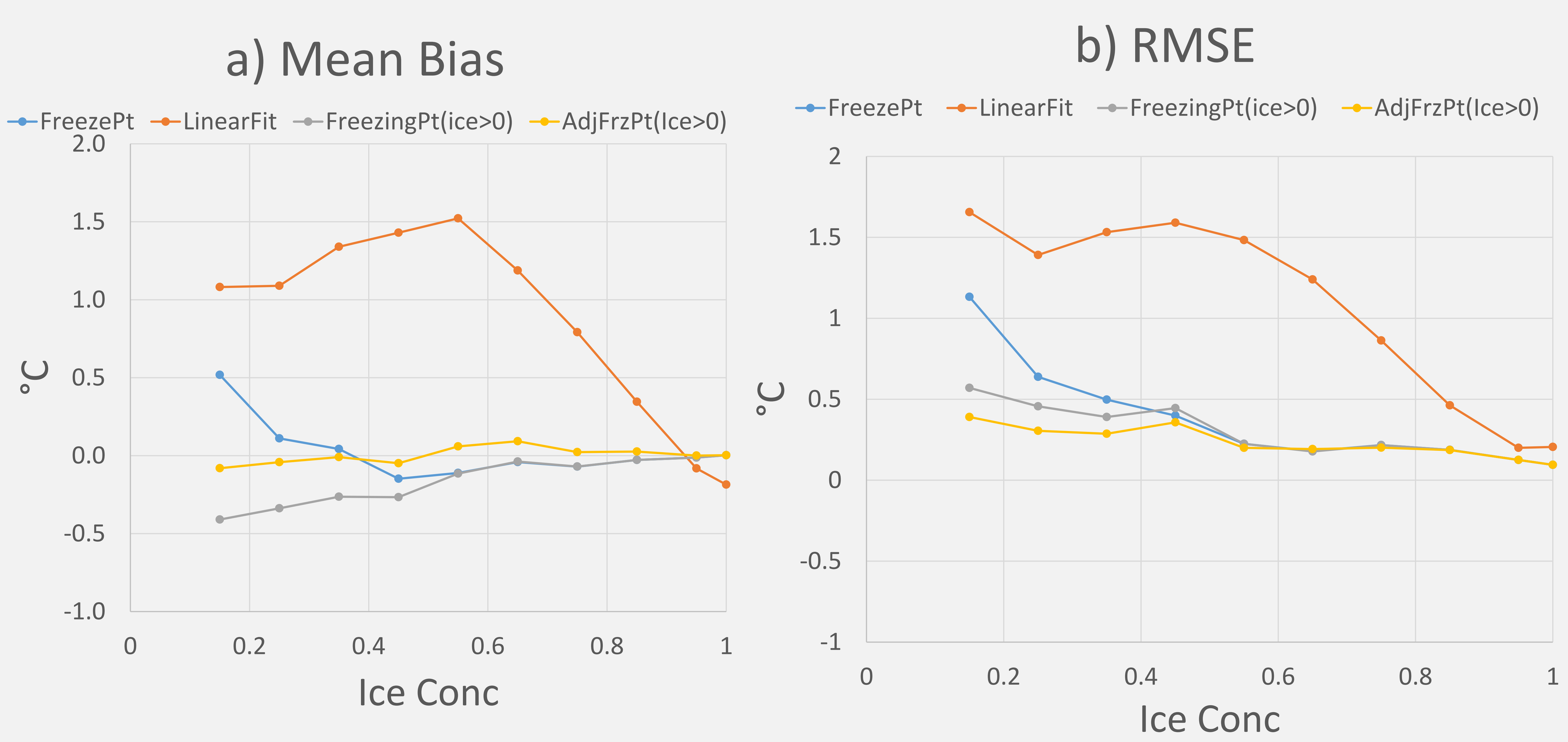


Fig. 4. Mean bias and RMSE of DOISST produced using different proxy SSTs described in methods

The comparison was repeated using a different ice dataset. The results (not shown) were somewhat different, but the freezing point method still performed better.

Note that the limited amount of buoy data precluded the development of a new ice-to-SST equation that could be independently validated, but that is a possibility for the future, as more data become available.

References

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