Session C14
T47A

Sea Surface Temperature: Upper ocean temperature variability from Argo and AMSR–E

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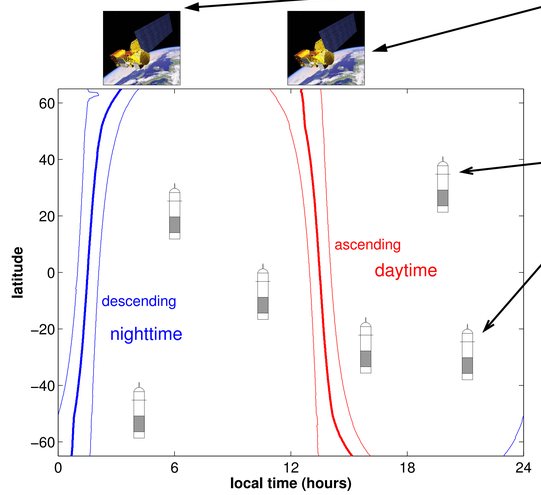
1. Introduction



AMSR-E, like the majority of Earth observing satellite, flies on a sun-synchronous orbit, which means that measurements are made at roughly the same local time everywhere: 1:30 am and 1:30 pm.

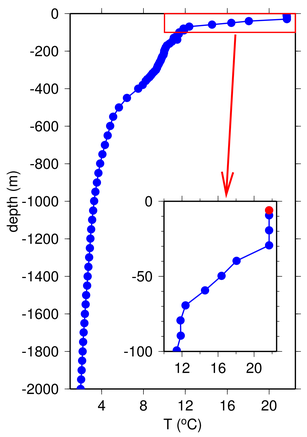
Argo floats rise to the surface throughout the day more or less randomly positioned in space and time.

The objective of this work is to evaluate AMSR-E surface microwave sea surface temperatures compared with Argo near-surface temperature measurements. The study asks two questions:

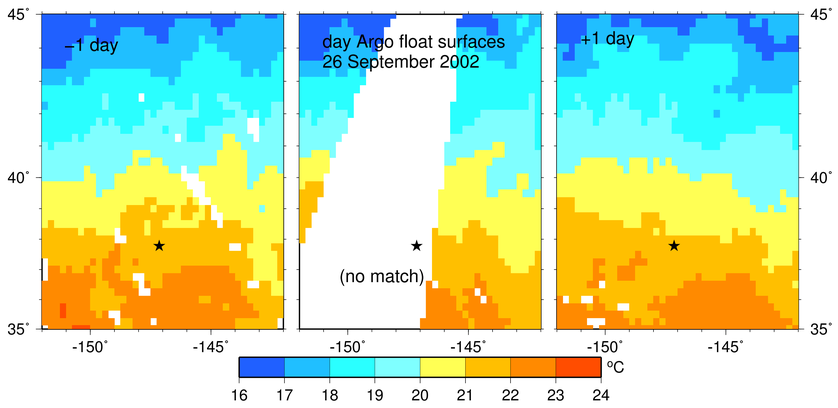
- Do Argo and AMSR-E measure upper ocean temperature consistently?
- What can we learn about diurnal variability from the relative timing of their measurements?

2. Methods

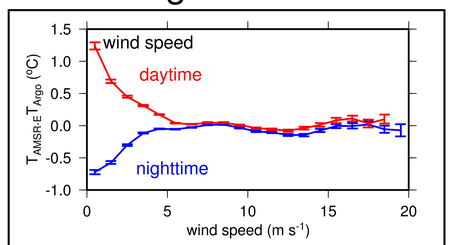
Argo data from the top 25 meters of the ocean are extracted for analysis. Only delayed mode Argo data are used, and these are quality controlled to check for extreme outliers (but there are few enough outliers, that results are unaffected by them.)



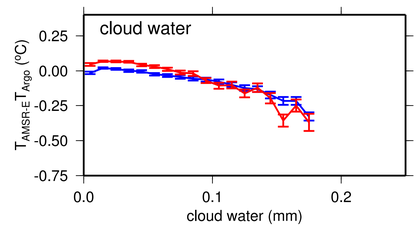
Each Argo profile is paired with co-located AMSR-E measurements over a 3 day period. Over 550,000 Argo float/AMSR-E data pairs (from 2002-2011) are used for this study. Of these pairs, 104,710 are within ± 3 hours.

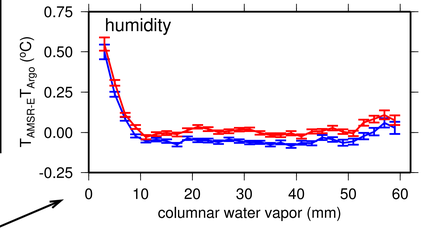


3. Do Argo and AMSR–E agree?

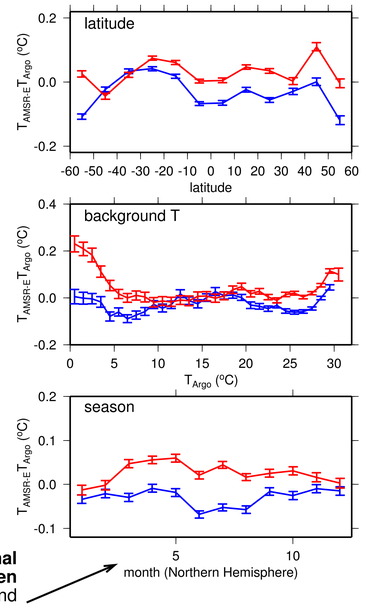


The biggest biases between Argo and AMSR-E occur in low wind conditions as a result of diurnal warming and cooling of the upper most millimeters of the ocean. Here Argo data are from ~5 m depth, and are within ±3 hours of AMSR-E overpasses.



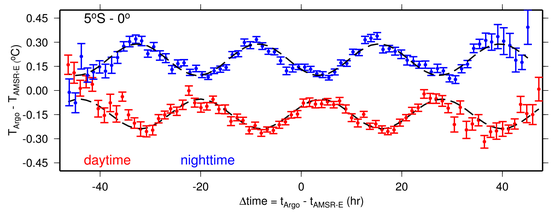


Water vapor and humidity also bias AMSR-E relative to Argo, even after correcting for the bias in low wind conditions. (Here are comparisons only for winds exceeding 5 m s^{-1}.)

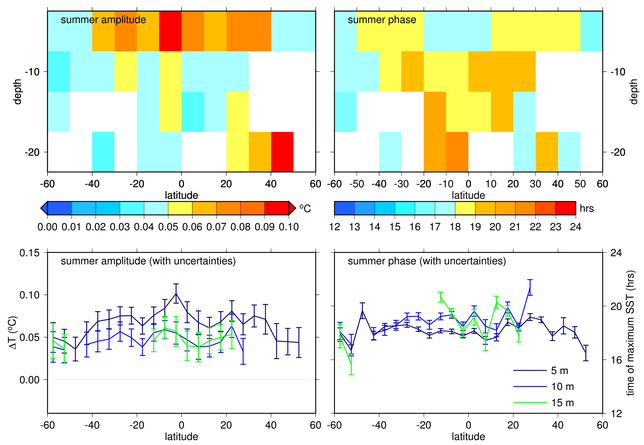


Latitude, upper ocean temperature, and seasonal effects also appear to result in differences between AMSR-E and Argo temperatures, even after low wind speed events are excluded.

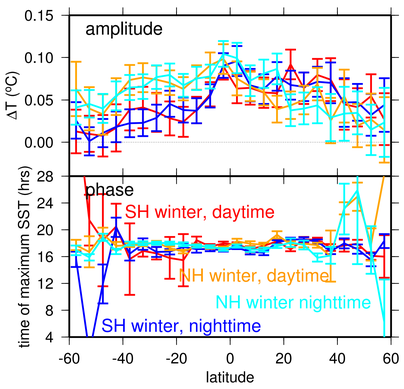
4. How does upper ocean temperature change diurnally?



In order to determine the diurnal temperature cycle at 5-m depth, AMSR-E is used as a reference, and Argo data are sorted by time difference relative to the satellite overpass. Even at zero-lag there is a difference between Argo and AMSR-E. Diurnal cycles relative to daytime and nighttime passes have the same amplitude.



The summertime diurnal amplitude decreases with depth and the time of maximum increases with depth, as temperature propagates downward over the course of a few hours.



Diurnal cycles vary as a function of latitude with stronger diurnal amplitudes near the tropics and in the summertime mid-latitudes. The time of maximum temperature is nearly constant at all latitudes. The seasonal effect is most noticeable at high latitudes.

5. Implications

Summary

- Upper ocean temperatures undergo a diurnal cycle that is detectable to depths of 15-20 m, and diurnal T_{max} propagates downward with time.
- Upper ocean processes (including wind speed and radiative effects in the upper ocean) as well as possible atmospheric biases contribute to differences between Argo and AMSR-E.

What do these results mean for climate research?

- Assessment of satellite SST relative to "bulk" mixed-layer temperatures (e.g. for climate studies) need to account for diurnal variability in the reference temperatures.
- Assessments of upper ocean heat content from profile data should take into consideration the local time of measurement.
- Diurnal variability in upper ocean stratification is likely to couple with diurnal winds and radiative forcing to have a net impact on upper ocean properties.

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