EVALUATION OF SEA SURFACE TEMPERATURE FROM FY-3C VIRR DATA IN THE ARCTIC

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Introduction Sea Surface temperature (SST) is an essential indicator for climate change. High accuracy and stability of the satellite SST products are required for long-term climate data record of global SST. The Arctic warming is faster than the global average and has significant impact on the global climate. Satellite SST retrievals in the Arctic are more complicated than low-mid latitude due to persistent cloud, sea ice contamination and dry atmosphere. Fengyun-3 (FY-3) series satellites are the second-generation polar-orbiting meteorological satellites from China. FY-3C was launched as an operational satellite on September 23, 2013. FY-3C has an equator crossing time of 10:00AM in the descending node and a designed life-span of five years. The Visible and Infrared Scanning Radiometer (VIRR) onboard FY-3C has 10 spectral bands, ranging from 0.43 μm to 12.5 μm, with a resolution of 1.1 km at nadir and swath of 2800 km. The VIRR has infrared split-window channels (10.3-11.3 and 11.5-12.5 μm) for SST observations. The 5 km daily-composited daytime and nighttime FY-3C VIRR SST products are distributed by the National Satellite Meteorological Center (NSMC) of China Meteorological Administration (CMA). The nighttime FY-3C VIRR SST data are evaluated for latitudes greater than 60°N against in situ data from iQuam system and daily 4 km SST data from MODIS onboard the Terra satellite. The five-month data acquired during August to December 2014 are used for the study.

Comparisons of VIRR and MODIS SST with in situ data The in situ buoy and 4 km MODIS SST nighttime data are averaged and resampled at a spatial resolution of 5 km respectively, which is similar to that of the VIRR SST data. The 1032 matchups are mainly located in the Nordic Seas, Denmark Strait, Davis Strait, Baffin Bay, Bering Sea and Beaufort Sea (figure 1). The histograms of satellite and buoy SST difference are shown in figure 2. The VIRR and buoy statistics indicate a bias of -0.12°C with a standard deviation of 0.93°C, a median of -0.06°C, a robust standard deviation of 0.76°C. A 0.17K offset is added to the Terra/MODIS nighttime SSTs to adjust the MODIS skin to the bulk temperature, allowing for a comparison with buoy SSTs. The MODIS and buoy statistics indicate a bias of –0.61°C with a standard deviation of 0.55°C, a median of -0.56°C, a robust standard deviation of 0.48°C. The time series of the SST difference between the satellite and buoy SST are shown in figure 3. The SST difference between VIRR and buoy SST encompasses a warm bias after October, whereas a cool bias exists for the SST difference between MODIS and buoy SST.

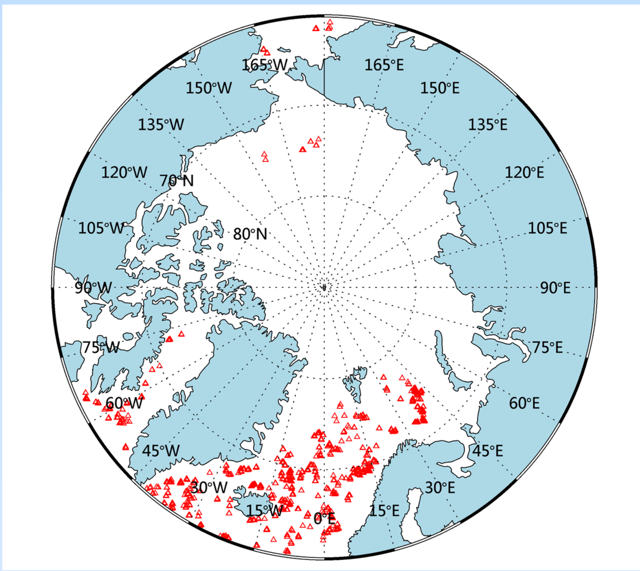

Fig.1 Matchup Locations

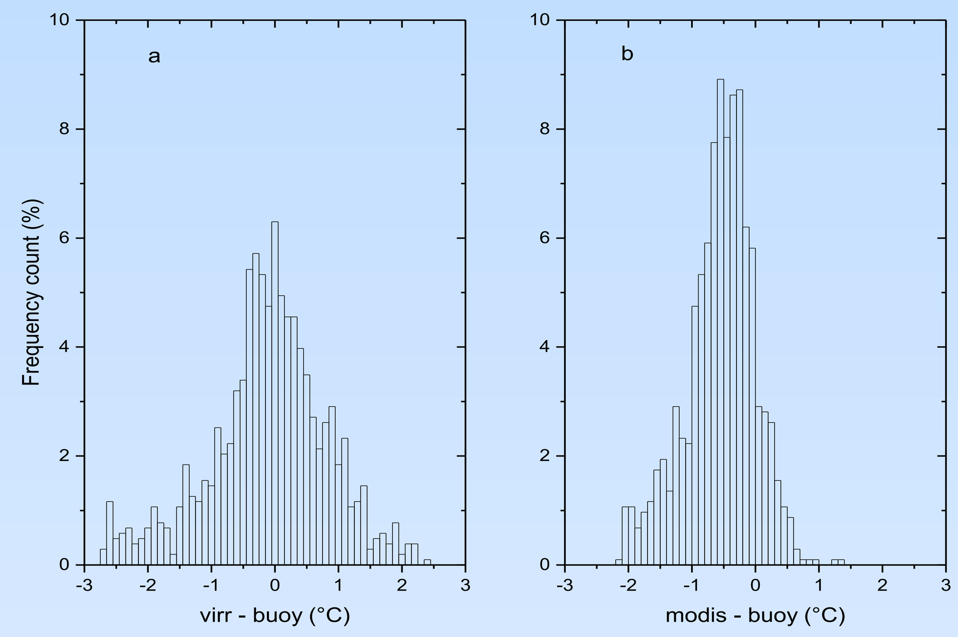

Fig. 2 Histograms of SST difference

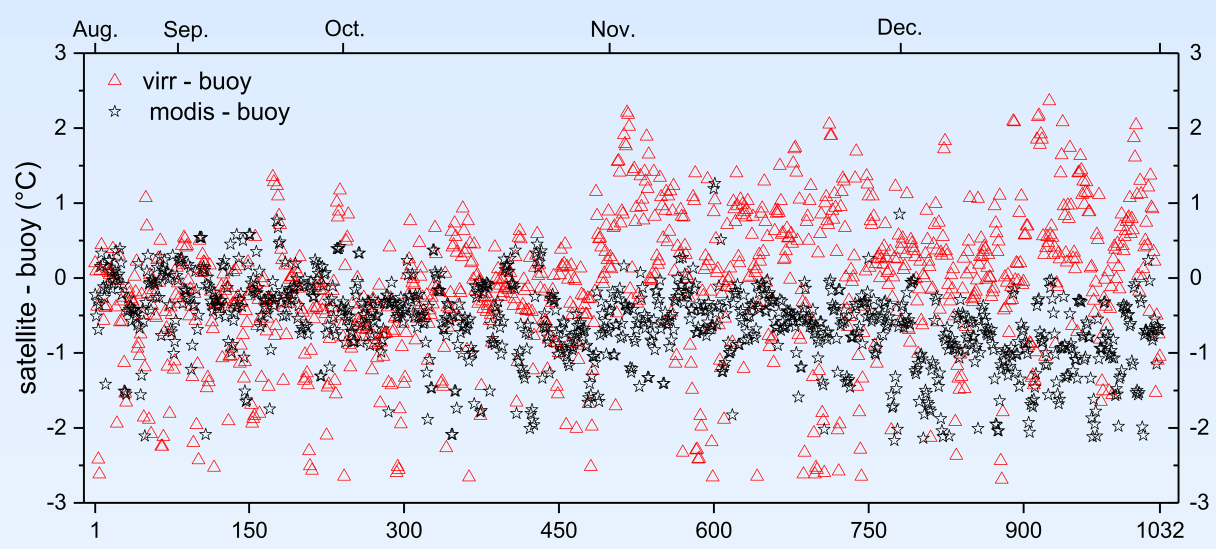

Fig. 3 Time series of SST difference between satellite and buoy data

The three-way error analysis is performed to estimate the standard deviation of the error for different observation types. The error variance expressions for three different observation types are given by O'Carroll et al. (2008):

$$\sigma_1^2=\frac{1}{2}(V_{12}+V_{31}-V_{23})$$

$$\sigma_2^2=\frac{1}{2}(V_{23}+V_{12}-V_{31})$$

$$\sigma_3^2=\frac{1}{2}(V_{31}+V_{23}-V_{12})$$

where *1*, *2* and *3* indicate the three different observation types, V_{ij} is the variance of the difference between observation types *i* and *j*, and σ_i^2 is the estimated error variance for observation type *i*. In this study, the subscript 1 refers to VIRR data, 2 to in situ buoy data and 3 to MODIS data. The results indicate standard deviations of error of 0.91°C for VIRR, 0.20°C for buoy and 0.51°C for MODIS SST (table 1).

Sensor	STD (°C)
VIRR	0.91
Buoy	0.20
MODIS	0.51

Table 1 Derived standard deviations for different observations

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