An EarthTemp Matchup Database for the Arctic Region

Darren Ghent[1], Stephan Matthiesen[2], Jacob Hoyer[3], Gorm Dybkjaer[3], Karen Veal[1], Christopher Whyte[1], and John Remedios[1]

(1) *Department of Physics and Astronomy, University of Leicester, Leicester, UK, djg20@le.ac.uk*;

(2) *School of Geosciences, University of Edinburgh, Edinburgh, UK*

(3) *Danish Meteorological Institute, Copenhagen, Denmark*

Introduction

We present here work carried out under an initiative of the EarthTemp community in preparation for the second meeting of the network focussing on high latitude regions. The initiative was to create a first matchup database for land surface temperature (LST) / ice surface temperature (IST) between satellite-retrieved observations and ground-based measurements.

The EarthTemp Arctic Matchup Database (ETA_MDB) is an open source dataset which will become available through the EarthTemp website to all network participants. Data is stored in netCDF-4 format with climate and forecasting (CF) convention compliant metadata. Updates to the dataset will be released to the community when new ground-based sites or LST products are added.

The baseline for the design and development of the ETA_MDB is the LST MDB created by the University of Leicester under the ESA Project - Long Term Land Surface Temperature Validation [see Ghent (2012) for more details].

Site description

The Barrow site in Alaska is part of the Atmospheric Radiation Measurement (ARM) network of stations measuring various meteorological and surface parameters worldwide. The network consists of several permanent stations supplemented with additional mobile sites. The Barrow site is one of the permanent sites having provided continuous measurements of surface temperature since October 2003. The site is categorised as A-4 In the ESA initiated LST Validation Protocol (Schneider et al., 2012) which is an open-source set of guidelines. In this first version of the ETA_MDB we chose a 3-month period in winter when the landscape is more homogeneous, 1st January 2012 to 31st March 2012, and when several key satellites are in orbit. In contrast, in the summer months the site is relatively heterogeneous being a mix of water, bare

Measurements obtained from this site and stored in the ETA_MDB include the following:

- Land surface temperature
- Land surface air temperature (LSAT)
- Down-welling radiation
- Up-welling radiation
- Cloud presence

Satellite observations

AATSR:

The following two LST products are retrieved with matchups extracted and stored in the ETA_MDB:

- **ESA_V2** - standard ESA LST product with standard cloud screening.
- **UOL_V3** - enhanced offline LST product developed at the University of Leicester with improved Auxiliary Data Files (ADFs), retrieval coefficients and simulation-based cloud screening (Ghent et al. In preparation)

MODIS:

Matchups for the MODIS level-2 LST products: **MOD11_L2** (Terra) and **MYD11_L2** (Aqua) are extracted and stored in the ETA_MDB. Standard MODIS operational cloud screening is applied.

AVHRR:

Matchups are extracted from the Danish Meteorological Institute's split-window IST algorithm for Metop-AVHRR. The cloud screening is taken from the SAFNWC/ PPS cloud mask product.

Matchup Methodology

The general methodology adopted for comparing the satellite-derived LST with the corresponding in situ data is as follows:

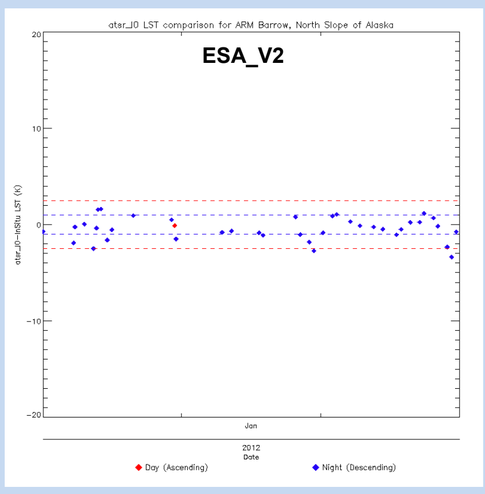
- If required the in situ radiometric temperatures are corrected for surface emissivity effects and an estimate of skin temperature is derived.
- For each satellite overpass the nominal 1 km pixel containing the location of the in situ observation is extracted.
- The satellite LST for this pixel and the in situ observation that is temporally closest to the exact time of the satellite overpass are recorded as a matchup. The threshold for the temporal offset between the time of the satellite overpass and the in situ observation is set as ±5 minutes.
- Any matchups flagged cloudy from the LST products accompanying Quality Control flags are rejected. Indeed, only the highest quality observations are eligible for matching up with the ground-based measurements.

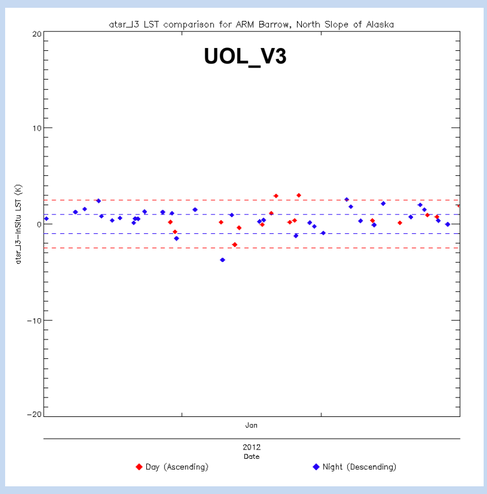
Results

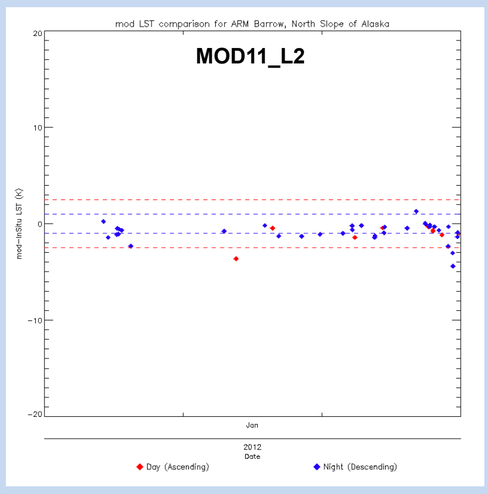
All five LST/IST product produce matchups with low medians and robust standard deviations indicating the retrieval algorithms are operating optimally for the surface and atmospheric conditions experienced within the matchup period. There are however some features of the matchup process which warrant closer inspection:

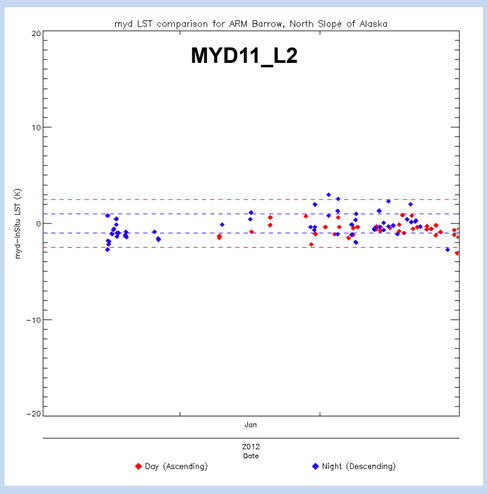
- The ESA_V2 product has only a single daytime matchup compared with sixteen for UOL_V3 - this is due to more matchups being screened out by the operational cloud detection tests - the implication being that these tests are over-masking during the day.
- The AVHRR product has larger biases (in a negative direction) and robust standard deviations than the other products - this though would appear most likely to be due to greater under-masking of clouds.

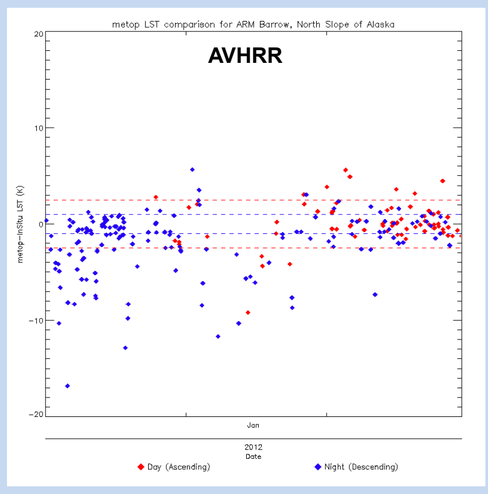
LST product	Day				Night			
	N	Median bias (K)	Med. Abs. Dev. (K)	RMSE (K)	N	Median bias (K)	Med. Abs. Dev. (K)	RMSE (K)
AATSR ESA_V2	1	-	-	-	39	-0.470	0.690	0.835
AATSR UOL_V3	16	0.350	0.585	0.682	34	0.550	0.645	0.719
MOD11_L2	10	-0.785	0.335	0.853	35	-0.680	0.470	0.827
MYD11_L2	39	-0.590	0.380	0.702	58	-0.475	0.730	0.759
Metop-AVHRR	69	-0.090	1.040	1.044	155	-1.050	1.380	1.734











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