Arctic Earthtemp network meeting report

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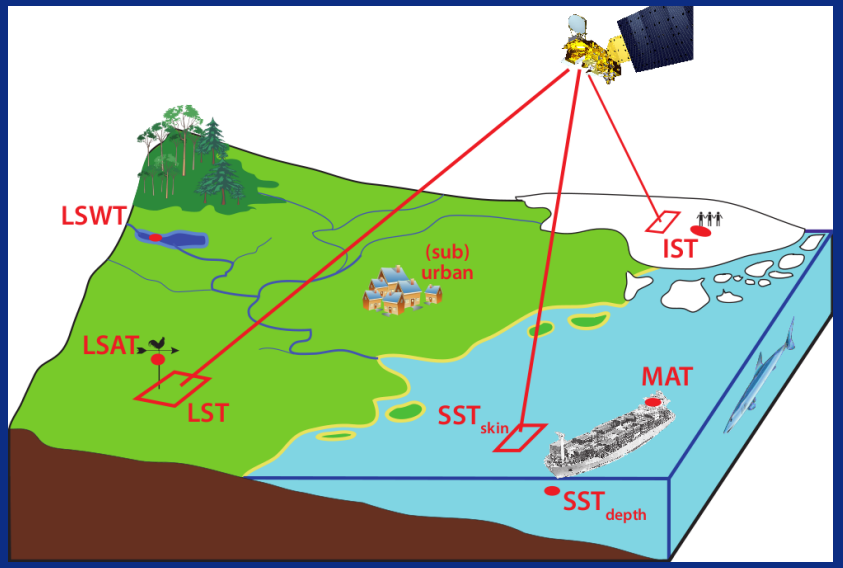
Earthtemp network

A UK-Funded network,
lead by Chris Merchant, Nick Rayner &
John Remedios

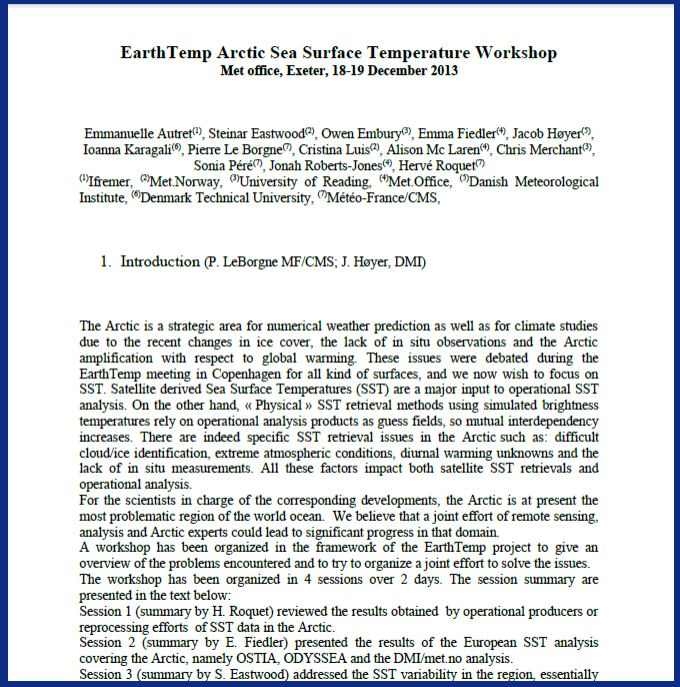


Objective:

To stimulate new international collaboration in measuring and understanding the surface temperatures of Earth. Participation will cross sub---disciplinary boundaries, linking experts in in situ and satellite observations, across all domains of Earth's surface.

Thematic workshops

- Earthtemp meeting in Copenhagen, 2012
  - "Surface temperatures in the high latitudes."
- Follow up meeting in Exeter, Focusing on high latitude SST, Challenges and solutions
  - Sponsored by **EarthTemp Network Visiting Scientist Scheme**



EarthTemp Arctic Sea Surface Temperature Workshop
Met office, Exeter, 18-19 December 2013

Emmanuelle Autret[1], Steinar Eastwood[2], Owen Embury[3], Emma Fiedler[4], Jacob Høyer[5], Ioanna Karagali[6], Pierre Le Borgne[7], Cristina Luis[2], Alison Mc Laren[4], Chris Merchant[3], Sonia Péré[7], Jonah Roberts-Jones[4], Hervé Roquet[7]
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1. Introduction (P. LeBorgne MF/CMS; J. Høyer, DMI)

The Arctic is a strategic area for numerical weather prediction as well as for climate studies due to the recent changes in ice cover, the lack of in situ observations and the Arctic amplification with respect to global warming. These issues were debated during the EarthTemp meeting in Copenhagen for all kind of surfaces, and we now wish to focus on SST. Satellite derived Sea Surface Temperatures (SST) are a major input to operational SST analysis. On the other hand, « Physical » SST retrieval methods using simulated brightness temperatures rely on operational analysis products as guess fields, so mutual interdependency increases. There are indeed specific SST retrieval issues in the Arctic such as: difficult cloud/ice identification, extreme atmospheric conditions, diurnal warming unknowns and the lack of in situ measurements. All these factors impact both satellite SST retrievals and operational analysis.
For the scientists in charge of the corresponding developments, the Arctic is at present the most problematic region of the world ocean. We believe that a joint effort of remote sensing, analysis and Arctic experts could lead to significant progress in that domain.
A workshop has been organized in the framework of the EarthTemp project to give an overview of the problems encountered and to try to organize a joint effort to solve the issues.
The workshop has been organized in 4 sessions over 2 days. The session summary are presented in the text below:
Session 1 (summary by H. Roquet) reviewed the results obtained by operational producers or reprocessing efforts of SST data in the Arctic.
Session 2 (summary by E. Fiedler) presented the results of the European SST analysis covering the Arctic, namely OSTIA, ODYSSEA and the DMI/met.no analysis.
Session 3 (summary by S. Eastwood) addressed the SST variability in the region, essentially

Workshop agenda

1. Algorithmic issues
2. SST Analysis problems
3. Diurnal variability
4. Solutions

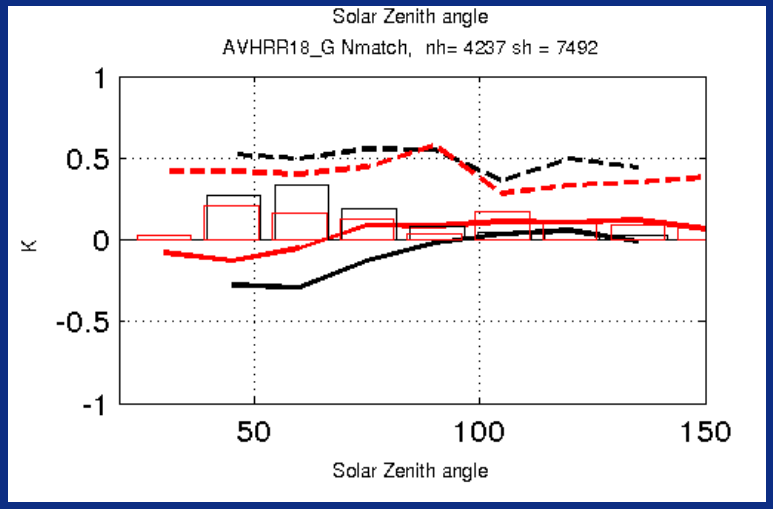
Session 1, SST Algorithms

• Cloud and ice detection in the Arctic	S. Eastwood
• NRT SST retrieval: multi-spectral algorithms in the Arctic	P. Le Borgne
• Arctic algorithms validation results from the CCI project	J. L. Høyer
• Experience from the CCI project in the Arctic	O. Embury
• Physics-based SST retrieval in the Arctic	C. Merchant

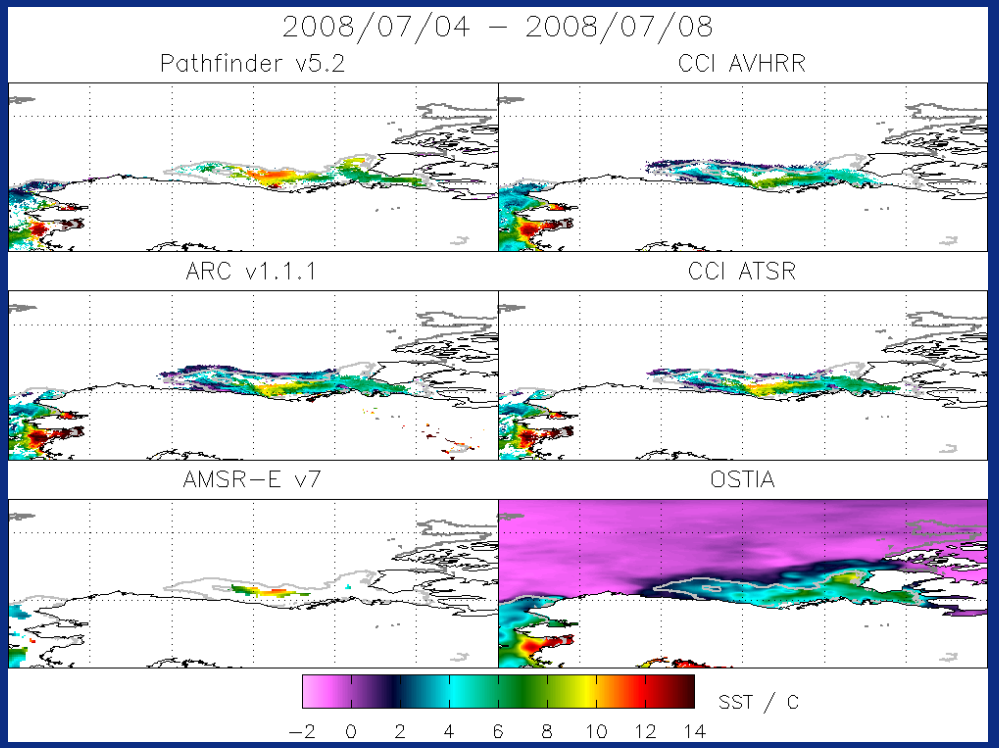
Session 1, SST Algorithms

SST algorithms in the CCI project (O Embury + J. L. Høyer)

- Improved performance compared to operational products
- Daytime negative bias
- Issues with masking out data in CCI AVHRRs, due to 4 deg C cold OSTIA



MacKenzie River outflow



Session 2, SST Analysis

• Arctic L4 analysis	J. L. Høyer
• OSTIA accuracy in the high latitudes	J. Roberts-Jones
• OSTIA analysis issues in the Arctic	E. Fiedler
• ODYSSEA	P. Le Borgne
• Discussions/Break?	

Reference sensors: stable bias

- No consensus about reference sensor in Arctic.
- Intercomparisons of biases may be way forward

- Monthly mean July difference: AATSR and Pathfinder (J. Høyer).

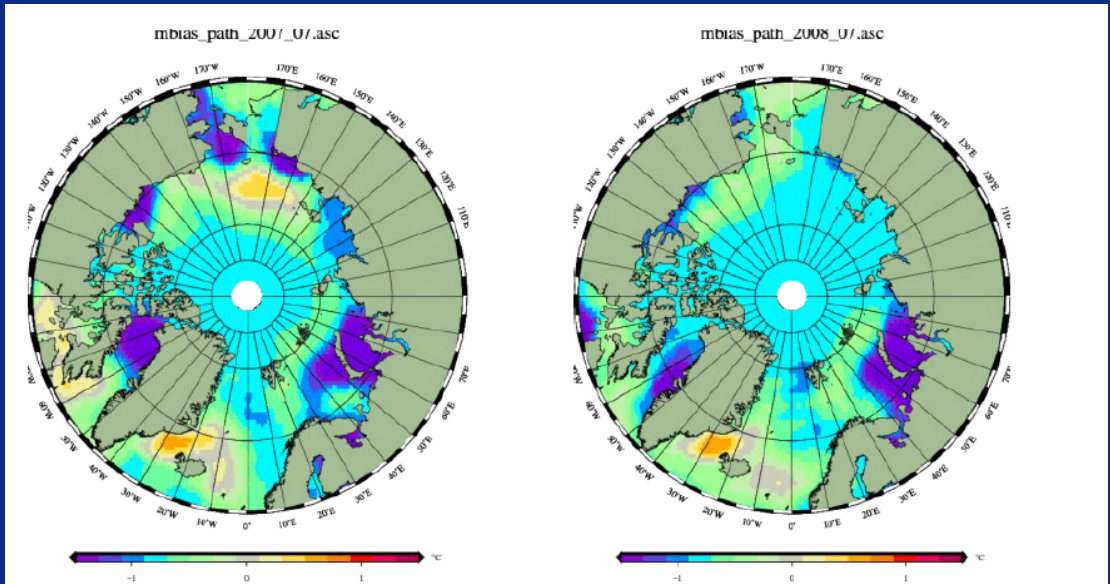


Figure 1: Mean monthly SST difference of Pathfinder vs AATSR for July 2007 (left) and July 2008 (right).

Performance near ice edge

- Challenging to get SST right here
- DMI method spreads cold observations too far into ocean
- OSTIA method too warm in the ice pack
- UK Metoffice: try and use anisotropic ice edge dependent statistics
- DMI will derive new SST/Sea Ice relationship with CCI data sets

Sea ice cover and SST freezing line in OSTIA (E. Fiedler).

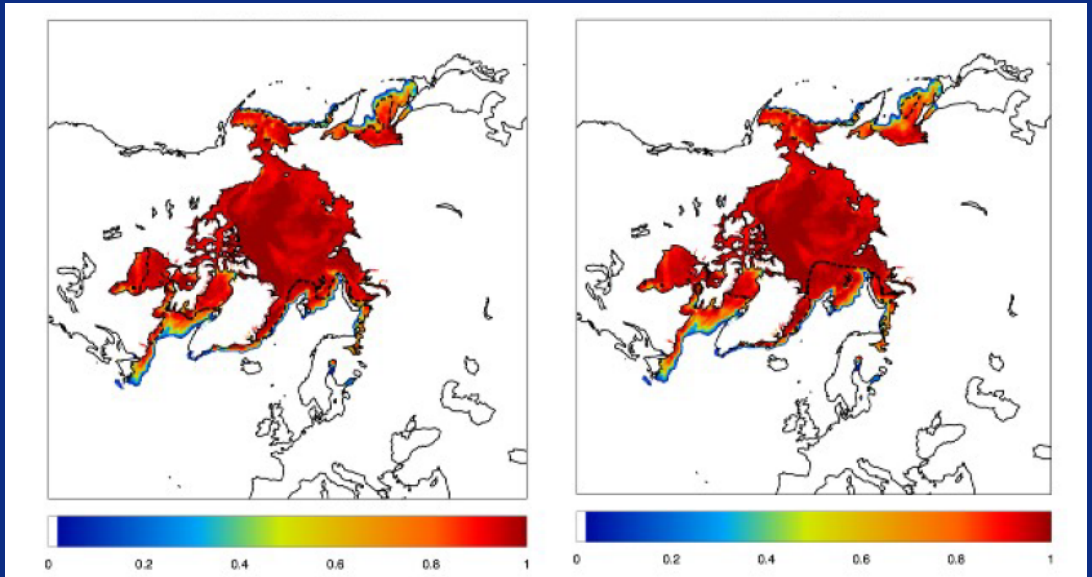


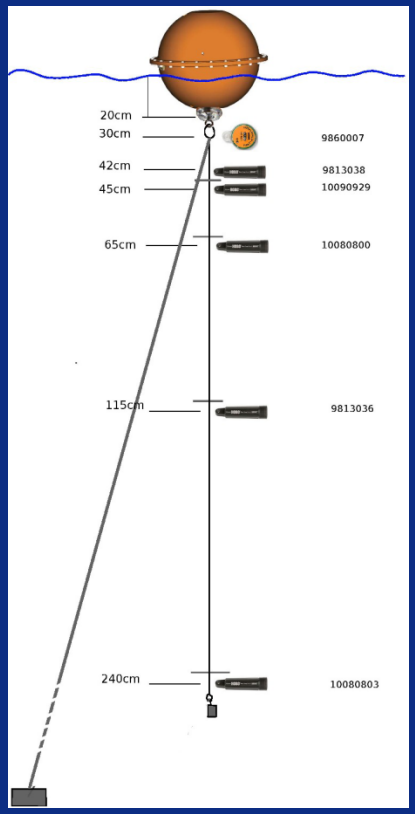
Figure 3: OSTIA sea ice fraction and freezing SST (dashed black line) using old background error covariances (left) and new (right) for the Arctic, on 26 March 2012.

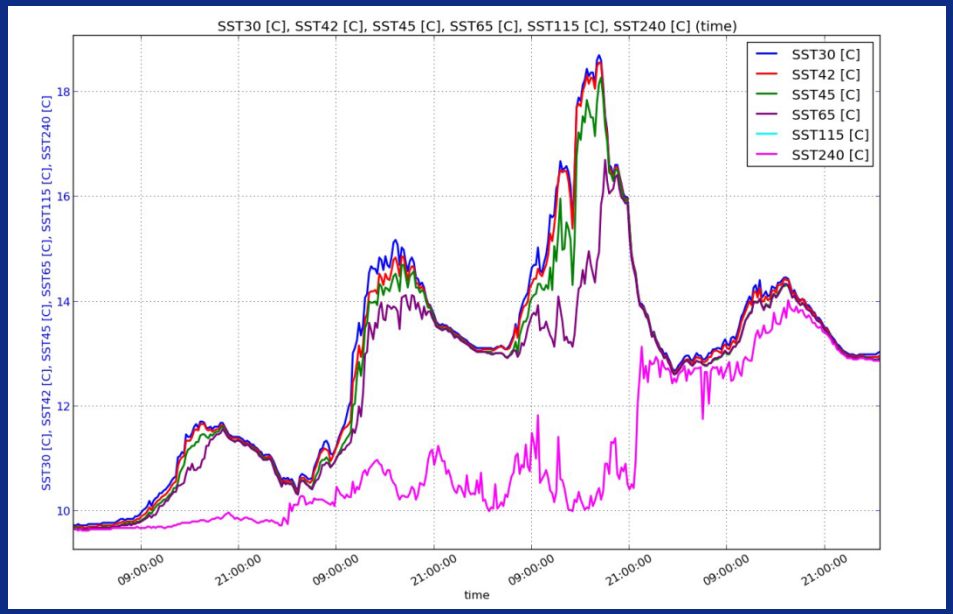
Session 3: SST variability in the Arctic

- Marginal Ice zones (J. Høyer)
- DW Observations in Lake Vaenern (S. Eastwood)
- DW Observations at Meteo-France (S. Pere)
- Vertical model results (I. Karagali)
- Vertical profiles observations (C. Luis)

Diurnal warming in Lake Vänern

- S. Eastwood
- Modified drifting bouy
- Validate SST lake products
- Stratification during day, collapse during night
- Residual warming trend

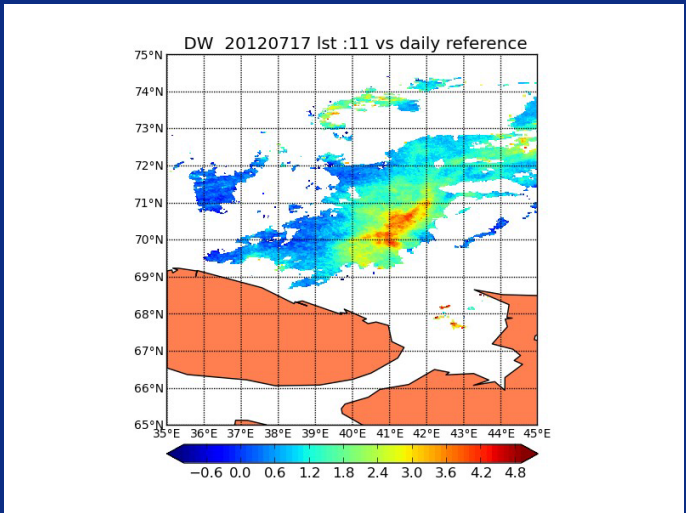


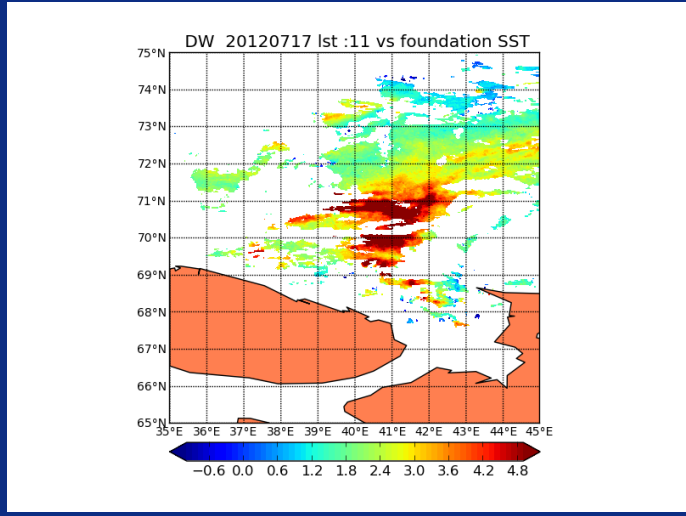


SST Foundation temperature in the Arctic (Sonia)

- What to use as reference field for DV events where no nighttime exists
- Very few nighttime observations >7 m/s wind speed in Arctic summer

2012. Figure 8: METOP-A derived warming amplitude at 11 LST using as reference: a) the previous night SST ; b) the foundation SST.





Solutions

Consensus that increased cooperation is the way forward, and that we should try to facilitate collaboration, both within the group and with external projects.

Collaboration within the group

- Publish the workshop results, either as a report or in the journal: *Geoscientific Instrumentation, Method and Data Systems.* (Jacob and Pierre)
- Small projects, 2-4 partners,
    - Atmospheric profile data set (Jacob, Herve, Steinar, Cristina)
    - SST and ice concentration relationships (Jacob, Emma)
    - Wiki set up (Steinar)
- Include information + reader code on in situ obs in Wiki (All)
- GOTM preliminary studies (Ioanna, Pierre, Sonia, Chris, Herve)
- Skin effects in Arctic, using FOAM (Alison, Chris)
- Student projects involving several institutions (Chris)
- Visiting scientists within Earthtemp and OSI-SAF
- Larger projects: (Part of Horizon 2020)
- Focused meetings can be envisaged for the smaller projects, within the Earthtemp visiting scientists or OSI-SAF VS

Collaboration with external projects

- **NACLIM (Jacob)** (EU FP7, 2012-2017, 18 partners): Assess the quality and skill of climate predictions
- **ICE-ARC** (**Jacob**)(EU FP7, 2014-2018): Focus is on the rapid retreat and collapse of the Arctic sea ice cover and to assess the climatic (ice, ocean, atmosphere and ecosystem) changes
- **IAOOS (Pierre):** Monitoring Arctic climate change, up to 40 platforms, Ocean and Ice
- **Arctic ROOS** (**Jacob**): Operational monitoring and forecasting of ocean circulation, water masses, ocean surface conditions, sea ice and biological/chemical constituents
- **HadISST (Nick Rayner):** Monthly fields of SST and sea ice concentration from 1870 to date
- **ACCESS (Pierre):** Monitoring and modeling Arctic climate change in ocean, atm and sea ice
- **OSI SAF (Pierre+Herve):** algorithm development, operational processing AVHRR and VIIRS
- **OSI SAF (Herve)** S3-FA: federated activity on High Latitude validation of SLSTR SST
- **NAACOS** (**Jacob**)**:** Ice obs + ocean modelling, setting out Ice mass balance buoys set out
- **NORMAP (Steinar)**: reprocessing of AVHRR GAC for SST And IST
- **SST CCI 2 (Chris)**: SST retrievals, cloud/ice masking
- **MyOcean2** Arctic SST(Cristina) + IST level 4analysis(Jacob) + Diurnal analysis (Alison)
- **MERCATOR Blanc (Herve):** High resolution model re analysis from 2007 till 2014 over the Arctic

More information

- See presentations at Wiki: https://wiki.met.no/arctic-sst/start
- Come to HL-TAG breakout: Tuesday 13.30-15.30
- See Earthtemp web site: http://www.earthtemp.net/
- Meeting report at Wiki

Thank You

Challenges to SST Analysis

- The SST analysis in the Arctic face many of the same challenges
- Lack of stable reference sensor
- Overall, L4 analyses in the Arctic are good
- For improvements, need quality satellite reference dataset and more in situ for
- reference and/or validation
- Arctic observations don't always agree with each other
- Largest differences between global NRT L4 SST analyses are in the high latitudes
- Persistent cloud cover in Arctic means use of microwave data is important
- Improvement of analysis performance and ice/SST consistency near the ice edge is a
- priority
- Adjustment of correlation length scales dependent on position of ice edge useful
- Freezing SST/ice concentration relationships should be investigated, for statistical or
- ice assimilation methods
- Diurnal warming events in the Arctic could be investigated using L4 analyses

Modeling of diurnal warming (I. Karagali)

- Models could be used
- Efforts underway to model Arctic DV events

2012. Figure 8: METOP-A derived warming amplitude at 11 LST using as reference: a) the previous night SST ; b) the foundation SST.

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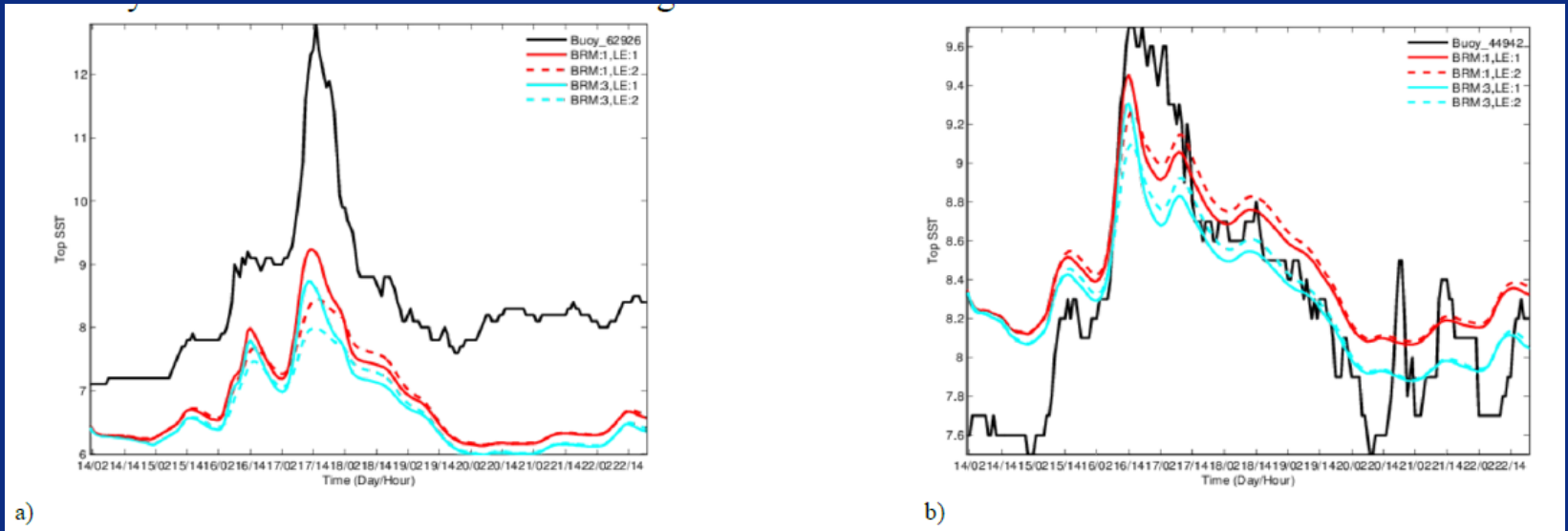

Figure 12: GOTM runs versus drifting buoy measurements (black solid) for two WMO buoys, a) 62926 and b) 44942.

Session 1, SST Algorithms

NRT SST retrieval : multi-spectral algorithm limitations and use of NWP outputs in the Arctic (P. Le Borgne)

Problem: Radiative transfer simulations based on OSTIA “foundation” SSTs are very difficult to compare with observations, since “foundation” SST is very scarcely observed from space in low/ medium wind and permanent solar illumination conditions.

Solution: Use a drastic wind filtering and further test with regional high latitude algorithms which require the building of an atmospheric profile data set adapted to Arctic conditions.