Sentinel-3 Validation team – Temperature Special Session

GHRSST science team meeting,
20th June 2013

Craig Donlon and Anne O'Carroll
Co-chairs S3VT-T

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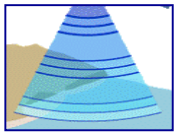
Agenda

- Welcome and overview of S3VT-T (10 min)
- Summary slides from team members (10 min)
- Questions / issues for discussion (10 min)

Sentinel-3 Validation Team (S3VT)

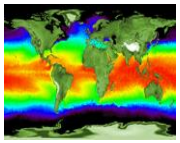
- The **aim** of the S3VT is:
  - **"**To engage world-class expertise and activities, through mutual benefit collaboration, that support the implementation of the Sentinel-3 validation activities and ensure the best possible outcomes for the Sentinel-3 mission**"**
- The **objective** is:
  - "To provide independent validation evidence, experimental data and recommendations"
- Open to relevant and interested groups and individuals worldwide
- Rolling call, first round of participants notified early 2013
- Invite further participation
- There is no ESA or EUMETSAT funding under this call

Four sub-groups of the S3-VT:



- S3VT- A: Altimetry

- S3VT-O: Ocean Colour



- S3VT-T: SST and IST

- S3VT-L: Land parameters

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S3VT Background

- Sentinel-3 Calibration and Validation Planning meeting 20-22nd March 2013, ESRIN
- Oct 2012 S3 OPT meeting http://www.sen3symposium.org/
- Cal/Val plan version 1 ready and reviewed (version 2 under preparation)
- S3VT rolling call
  - 80 submissions – 10 temperature
- Mission Performance Centre ITT (ESA) to be released end of summer
- First S3VT-T team meeting 20th June 2013, GHRSST science team meeting, Woods Hole
- First workshop currently planned for 26-29th November 2013, ESRIN

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Current team members

PI	Team name	Country	Leading institution
Nightingale Tim	Validation by In Situ Infrared Radiometry (VISIR)	UK	STFC Rutherford Appleton Laboratory
Barciela Rosa	Validation of Sentinel-3 Sea Surface Temperature data in Met Office products	UK	Met Office
Minnett Peter	Ship-board radiometric measurements of the ocean skin surface temperature to validate the SLSTR retrievals.	USA	University of Miami
Beggs Helen	Provide Australian Ship Sea Surface Temperature for SLSTR validation	AUSTRALIA	Bureau of Meteorology
Høyer Jacob	Arctic SLSTR Sea and Ice Surface Temperature validation group (ASSIST)	DENMARK	Center for Ocean and Ice, Danish Meteorological Institute
Mittaz Jonathan	Validation of SLSTR radiances using GSICS and low level calibration data	USA	CICS/ESSIC University of Maryland
Wimmer Werenfrid	ISAR-S3V - Infrared Shipborne Autonomous Radiometry for Sentinel-3 SLSTR Validation: Continuity of long-term Biscay validation data set bridging from AATSR	UK	University of Southampton
Eastwood Steinar	Validation of S-3 SLSTR SST and IST at High Latitudes from buoys by the EUMETSAT OSI SAF	NORWAY	Norwegian Meteorological Institute
Corlett Gary	Continuity of the ARC/SST_CCI SST CDR with SLSTR (CAST)	UK	University of Leicester
DiGiacomo Paul	STAR Validation Support for Sentinel-3: Ocean Color, Sea Surface Temperature and Land Surface Temperature	USA	NOAA/NESDIS

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Validation team rationale

- Sentinel-3 is a large, multi-instrument mission with operational NRT data delivery
- Data volumes are huge compared to many other missions
- It will be a demanding mission to validate
  - It is not unique in this aspect
- Validation is complex involving both operational and complementary activities:
  - **Operational:** e.g., inter-comparison of SST with drifting buoys, altimeter crossovers, diffuser degradation, USO monitoring, MWR tier-3 calibration, etc.
  - **Collaborative:** e.g., Independent validation using ships/aircraft, specific validation campaigns, experiments, analyses, in situ data, long term database, time series analyses, vicarious calibration support etc.
- **The scope of validation is too large for any single entity Collaboration is required for success**

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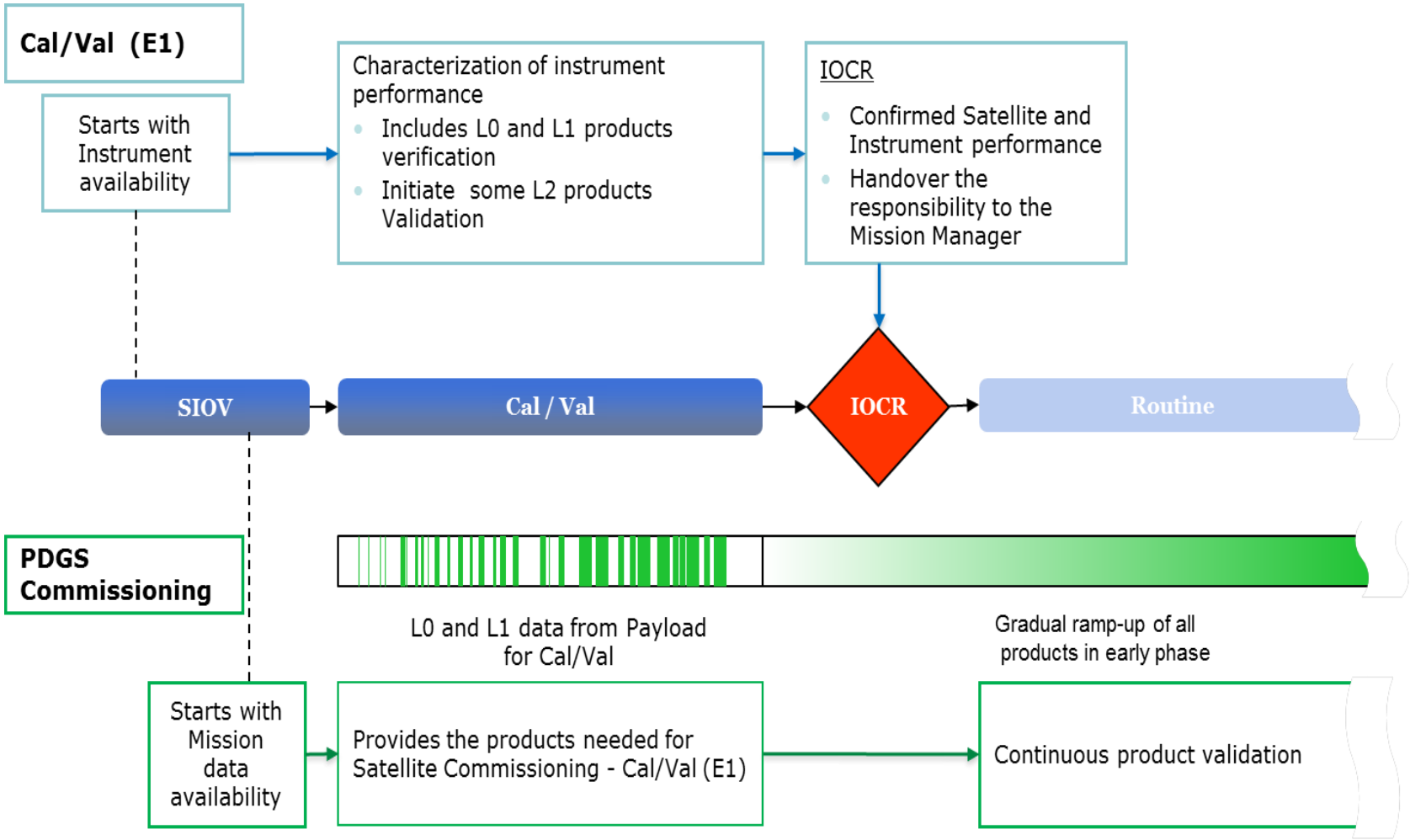
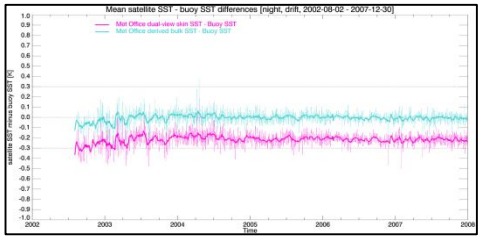
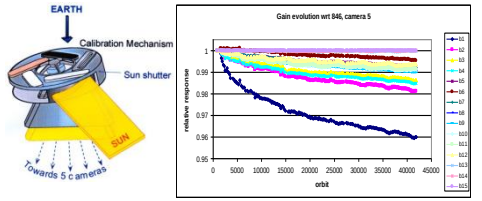
Early S3 Mission Timeline

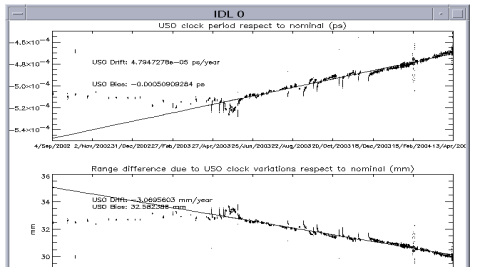


Validation across the mission

- Phase E2: Routine phase
  - Satellite and payload stable and functional
  - PDGS stable for lower level products but gradually “ramped-up” to full capacity.
- We need to take a long-term view of validation across the mission
- **This is the primary focus of the Validation team**







Data provision

- Access to a range of Sentinel-3 data products, according to a ramp-up scenario
- Access guaranteed to S3VT members through agreed mechanisms
- Focus on defined validation targets
- ESA and EUMETSAT third party data foreseen
- Members to define and possibly refine data requirements according to operational constraints

Summary

- The Sentinel 3-Validation team has a dedicated sub-group for Surface Temperature
- We are working for you to help arrange the best way to support you in your validation work
  - Collaborative G/S Collaboration agreements will be used to formalise the operational relationship with the Agencies
  - Establish a Dossier of activity (as done for other missions and now across all S3VT teams)
  - We need to organise ourselves to work together and target specific funding (EC Copernicus etc)
  - S3-VT workshop at ESRIN from 26 to 29th November 2013
- This output of this meeting is a critical input to the Sentinel-3 Cal/Val planning process now underway

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What we need from you (1/2)

- Together we need to develop a Dossier of field and other activities during E1 and E2 (Based on proposals)
  - Where/when/what will you operate?
  - What S3 and other data do you actually need in the early part of the mission (we may be able to plan data takes)
  - How do you want to get the data?
  - How will you/we report results?
  - What preparations are needed (Radiometer intercalibration?)
  - What protocols will be followed?
  - Do we need a MERMAID and ODESSA for S2VT-T?
  - Do we need standard processing code for radiometers (or a test data set)?
  - How will you report uncertainties?
  - tions exist for funding?

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What we need from you (2/2)

- We need to plan our session at the S3VT workshop
- Outline Agenda (To be added)
- Collaboration with other S3VT teams?
- What do they want from the Mission other than data (Cal info, info on ops etc)?
- EUM specific issues?
- ESA Specific Issues?
- Copernicus specific Issues (from the regulation?)

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Summary slides from current team members

- Thank you for your contributions!!

Validation by In Situ Infrared Radiometry (VISIR)

Tim Nightingale, Caroline Cox, Hugh Mortimer, Chris Mutlow, Caroline Poulsen, Dave Smith, Wayne Tubby

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VISIR
Tim Nightingale
RAL Space, STFC

Summary of activity

Permanent SISTeR installation on the Cunard Queen Mary 2 liner.

April – December: north Atlantic transects between Southampton and New York.

January – March: round-the-world cruise

One instrument currently, second ready soon.

In situ data to be collected

Upwelling and downwelling radiances at 10.8μm

Sea and sky state images

GPS geolocation and timestamp data

Data requirements

SLSTR L2 (or L1b) and L2P orbit or child products containing matchup points

Issues / questions

Funding. Currently "keep-alive" funding from the UK Government until the end of March 2013

L2 Data. Access to L2 single-algorithm SSTs as well as L2P SST

Subsetting/data ordering tool?

NOAA STAR SST S3VT

Sasha Ignatov

Prasanjit Dash (SQUAM)
Xingming Liang (MICROS)
Feng Xu (*iQuam*)
Yury Kihai (match-ups of S3 SST with *i*Quam)

NOAA STAR SST S3VT
Sasha Ignatov
NOAA STAR

Summary of Activities

- Access S3 L2 SST on STAR Central Data Repository (SCDR), in NRT, Match-up with L4 fields and *i*Quam *in situ* data, display ΔSST in SQUAM
- Access S3 L1b on SCDR in NRT, select clear-sky ocean pixels, run CRTM, display ΔBT in MICROS

In situ data to be collected

- *i*Quam in situ QCed data: drifters, moored buoys, and ARGO Floats
- L4 SST fields (GMPE, CMC, OSTIA)
- Community Radiative Transfer Model (CRTM) runs in conjunction with first guess SST and upper air fields

Data Requirements

- S3 L2 SST product
- L1b files (preferably, with clear-sky mask and land/sea mask appended)
- We expect that L1b and L2 SST data will be pulled by SCDR, and made available to our team for analyses

Issues/Questions

- Add ARC data in SQUAM (underway)
- Establish proxy data flow from ESA to SCDR prior to launch: Check throughput, Learn data formats, Test system end-to-end

Ignatov, and Team, NOAA

Met Office

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Met Office Satellite Applications
Roger Saunders

Compare SLSTR SSTs with drifting buoys, OSTIA analyses and HadSST3 **Compare SLSTR radiances with IASI radiances in NRT**	**Buoy data from GTS network**
SLSTR Level 1 and 2 data	**Will aim to demonstrate that SLSTR is of at least the same quality as AATSR**

Australian Ship SST IMOS Team

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Atiur Siddique

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  - http://imos.org.au/sst.html

IMOS

Australian Government
Bureau of Meteorology

BLUElink
Ocean Forecasting Australia

Australian Ship SST IMOS Team

Helen Beggs
CAWCR, Bureau of Meteorology

Summary of activity

Validation quality, sustained observations of both bulk and skin SST from research vessels and ships of opportunity (SOOP) will be provided over the Australian region to the S3VT Data will be used at BoM to validate SLSTR SST

In situ data to be collected

Near real-time, quality assured SSTdepth from at least 10 vessels

Near real-time, QA'd, SSTskin from RV Investigator

Data requirements

SLSTR SSTskin in GHRSST GDS2 L3U format

Issues / questions

When will SLSTR L3U data be available?

Who will collect the in situ SST data for S3VT activities?

“CAST”

Continuity of the ARC/SST_CCI SST CDR with SLSTR

Gary Corlett, David Berry, Owen Embury, Christopher Merchant, Nick Rayner, John Remedios, Roger Saunders

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University of Leicester

University of Southampton

University of Reading

Met Office

CAST

Gary Corlett

UoL, UoS, UoR, MOHC

Summary of activity

The ATSR Reprocessing for Climate (ARC) project has created an SST CDR from the ATSR series that over the period 1994 to 2010 is stable, with better than 95% confidence, to within 0.005 K yr-1 (demonstrated for tropical regions), and with regional biases less than 0.1 K globally. The ARC record has been extended to the end of the AATSR mission through the ESA SST_CCI project.

The minimum 6 month overlap periods between successive ATSRs was critical in harmonising the time series to account for spectral and radiometric uncertainties between instruments.

No such overlap will exist between AATSR and the first SLSTR so this project will make an initial assessment of the accuracy and stability of the combined ARC/SLSTR SST record, and highlight further areas for improvement

In situ data to be collected

None

Project will use all available drifter, mooring, float & radiometer data, with additional QC

Data requirements

We require access to all SLSTR Level 1b and Level 2 data sets to extract match-ups to the various in situ and surface datasets.

We will also require co-located METOP A and B AVHRR and IASI BTs and SSTs, as well as ECMWF ERA Interim model fields.

Issues / questions

None

Ship-board radiometric measurements of the ocean skin surface temperature to validate the SLSTR retrievals

Peter Minnett, Goshka Szczodrak, Miguel Izaguirre

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Chairman, Science Team of the Group for High Resolution Sea-Surface Temperature (GHRSST)
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ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE

Ship-board radiometry

Peter Minnett
RSMAS, University of Miami

Summary of activity:

- **Assess uncertainties in SLSTR skin SST retrievals by comparisons with ship-based measurements.**
- **Determine the characteristics of the SLSTR SST retrievals.**
- **Ship measurements will be made from a mix of commercial and research vessels.**

Data requirements:

- **Relative Spectral Response Functions of SLSTR IR bands**
- **Geo-located brightness temperatures co-located and coincident (within preset limits) with in situ measurements.**
- **Ancillary data (e.g. instrument parameters, including satellite scan angles; cloud mask; atmospheric parameters.**

In situ data to be collected:

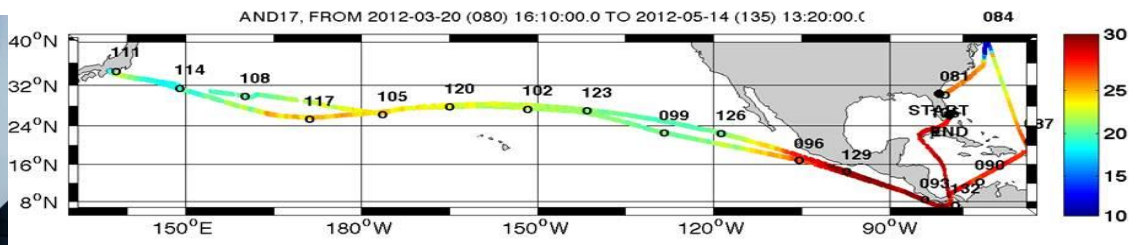
- **Spectra of infrared radiation emitted by the ocean and atmosphere, from which skin SST can be derived (M-AERI).**
- **Skin SST measurements from self-calibrating radiometers (ISAR).**
- **Ancillary surface meteorological variables.**
- **Episodic radiosonde profiles of temperature and humidity.**

Issues / questions:

- **Assumes continued support of ship-based measurements by NASA.**
- **Can Felyx be used to generate the match-ups between satellite and ship data?**

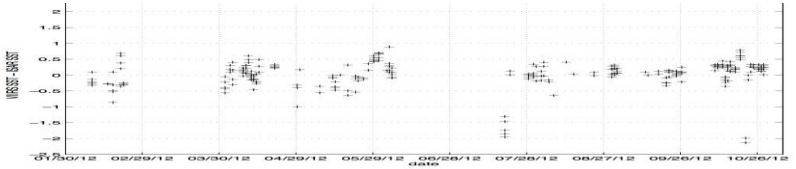
Examples of ISAR and M-AERI measurement's for the validation of MODIS and VIIRS SSTs

M/V *Andromeda Leader*

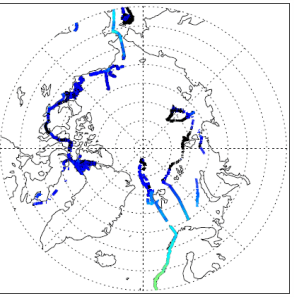


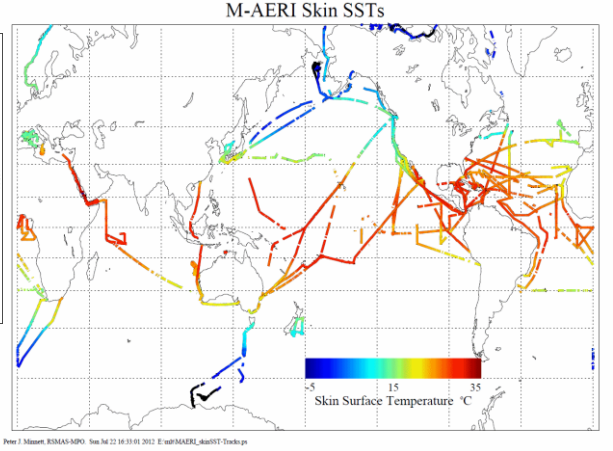
+2.0 K

VIIRS night – 3 band SST. Ship data from ISARs.



Mean 0.029K, st dev = 0.416K, n = 267 (Feb-Nov 2012)





M-AERI cruises for MODIS validation.

-2.0 K

M-AERI (left) and M-AERI Mk2 (right) mounted side-by side on the R/V *Knorr.*

Validation of SLSTR IR Radiances

Jonathan Mittaz
Tim Hewison

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Validation of SLSTR IR Radiances

Jonathan Mittaz
University of Maryland/NOAA & EUMETSAT

Summary of activity

We will take EUMETSAT generated SLSTR collocations and compare the radiances with the SLSTR generated ones. We will compare any biases (if any) with instrument parameters (counts/temperatures etc) as well as validate the SLSTR SRFs. If problems exist we will use the data to suggest improvements to the instrument calibration.

In situ data to be collected

None, but Top-of-Atmosphere radiances will be collected via collocation

Data requirements

Level 1a (raw counts + instrument parameters/temperatures + geolocation)

AIRS/IASI Collocations with SLSTR

Issues / questions

Availability of Level 1a data

ISAR-S3V

Infrared Shipborne Autonomous Radiometry for Sentinel-3 SLSTR Validation: Continuity of long-term Biscay validation data set bridging from AATSR

Werenfrid Wimmer

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UNIVERSITY OF Southampton

ISAR-S3V

Werenfrid Wimmer
UoS

Summary of activity

1. Maintain continuity of the existing ship radiometer measurement programme, established since 2004 in the Biscay / English Channel, to provide independent validation for the stability of the SST climate record bridging the gap from AATSR to SLSTR.
2. From the launch of S-3, continue the Biscay / English Channel ship radiometry programme in order to populate a growing match-up database of coincident SLSTR and ship radiometer observations throughout the lifetime of each SLSTR sensor.
3. Regularly verify the accuracy, compared with NPL and NISST references. of the radiometers and black body calibration sources used for ship radiometry, in order to deliver traceability for the SLSTR SST validation programme.
4. Facilitate the development of an international network of partners contributing additional ship radiometry routes for SLSTR validation, including the co-ordination of regular intercalibration workshops between ship radiometers and traceable references.

In situ data to be collected

SST skin measurements from ISAR

Data requirements

SLSTR Level 2 data for matching with ISAR data

SLSTR Level 1b data for anomaly analysis

Issues / questions

ISAR funding only guaranteed until March 2014

Arctic SLSTR Sea and Ice Surface Temperature validation group (ASSIST)

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DMI
Vejr, klima og hav

ASSIST
Jacob L. Høyer
Danish Meteorological Institute

Summary of activity

- Use ISAR Infrared Radiometer observations to validate the S3 product in high latitudes with reference to traceable standards
- Validate the SST products using drifting buoy observations in the high latitudes
- Assess the performance of the satellite SST and IST product with respect to ice edge, ice concentration, and solar elevation angle

In situ data to be collected

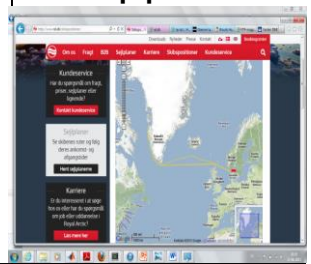
- Ship based Infrared radiometer observations from Royal Arctic Line, vessels Denmark – Greenland
- Weather balloon data from ships
- IST from field campaigns: ISAR + Ice mass balance buoys + AWS

Data requirements

SLSTR Level 2 SST	ESA	1 km
SLSTR level 1b	ESA	1km
ISAR observations	DMI	Single point, 1 minute
Radio-sonde /ISAR collocated	DMI	2-4 times daily
Drifting buoy observations	GTS	Single point, hourly
Sea ice concentration	OSI-SAF	10 km
Ice charts	DMI	1 km

Issues / questions

- No dedicated money for operational mounting of the ISAR instrument on a repeated track
- ISAR Deployment depending upon opportunities in other projects.



OSI SAF

Gorm Dybkjær
Steinar Eastwood, Herve Roquet,
Jean-Francois Piolle

OSI SAF
Gorm Dybkjaer
DMI, MET.NO, CMS/MF, IFREMER

Summary of activity

- Build a Match-up Data Base for S3A/SLSTR SST products validation using Felyx
- Exploitation of this MDB for validation at low/mid latitudes (CMS/MF) and high latitudes (MET.NO)
- Dedicated activity on IR radiometer (ISAR) in high latitudes

In situ data to be collected

- all available in situ data from Coriolis/Ifremer
- IR radiometer data from ISAR mounted on ship between Denmark and Greenland

Data requirements

- S3A/SLSTR level 1 and level 2 SST

Issues / questions

Questions and discussion