Earth Observation Science

GEO/CEOS Cal/Val Harmonisation Workshop, Gaithersburg Md, May 6-8 2008

SST Validation, a possible Case Study for Harmonisation?

David Llewellyn-Jones

Space Research Centre
Department of Physics and Astronomy
University of Leicester, UK

Calibration & Validation – the SST Example

- **Generic Considerations**
- **SST Validation Needs**
- **The Coordination of SST Space Data**
- **A Way Forward for GEO/CEOS?**

Some Generic Principles

Level 1 observables need to use calibrated sensors

- **The Calibration procedures need to be:-**
  - **transferable**
  - **Repeatable**
  - **Traceable to recognised standards**
  - **Documented**

Level 2 Observations need to be validated

- **by *in situ* measurements, where possible**
- **Either directly**
- **or by consistency other measurements**
- ***In situ* measuring procedures should follow agreed protocols**

Specific SST Validation Needs

- **SST designated by GCOS as an Essential Climate Variable (ECV)**
- **SST observations now increasingly being used for Numerical Weather Prediction (NWP)**
- **This places high demands on accuracy (~0.2ºC or better), but also on coverage, consistency and long-term stability.**
- **This is problematical when data are collected on a mission-by-mission basis**

The Coordination of SST Space Data

- **Currently, thee are 11+ sensors generating usable SST products**
  - **2 AVHRRs (NOAA, EUMETSAT)**
  - **1 AATSR (ESA)**
  - **2 MODIS (NASA)**
  - **4 Geostationary:- GOES E,W; METEOSAT, NT-SAT: (NOAA, EUMETSAT, Japan)**
  - **2 Microwave:- TMI, AMSR-E (NASA, Japan)**
- **These sensors have different but complementary qualities, concerning accuracy, coverage, temporal sampling, cloud penetration etc**


The days of the
‘Shoot-out’ are over!!

The GODAE/GHRSST Pilot Project

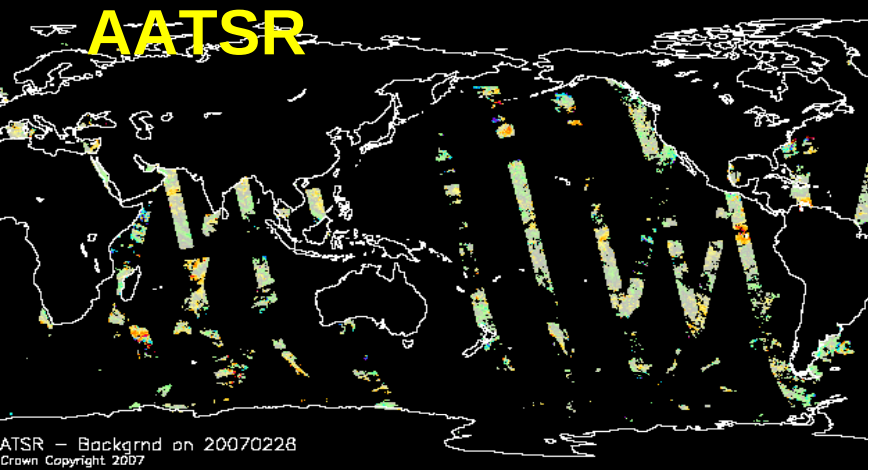
GODAE = Global Ocean Data Assimilation Experiment

GHRSST-PP = GODAE High-Resolution SST Pilot Project

- **International Consortium of providers, intermediaries and operational users**
- **Pilot Project - Funded by NASA, ESA, NOAA plus some contributions by others**
- **Long term funding still under negotiation**

What GHRSST achieves

- **Delivers multiple SST fields to operational users**
  - **in unified format (L2p – based on NETCDF)**
  - **and timely manner**
- **Sensor-specific Error Statistics (SSES) provided with all SST values, within the K2p product content**
- **For the end-users, this facilitates co-registration, data-merging and inter-changeabbility**
- **Example: UK Met Office's OSTIA**


AATSR
ATSR – Backgrnd on 20070228
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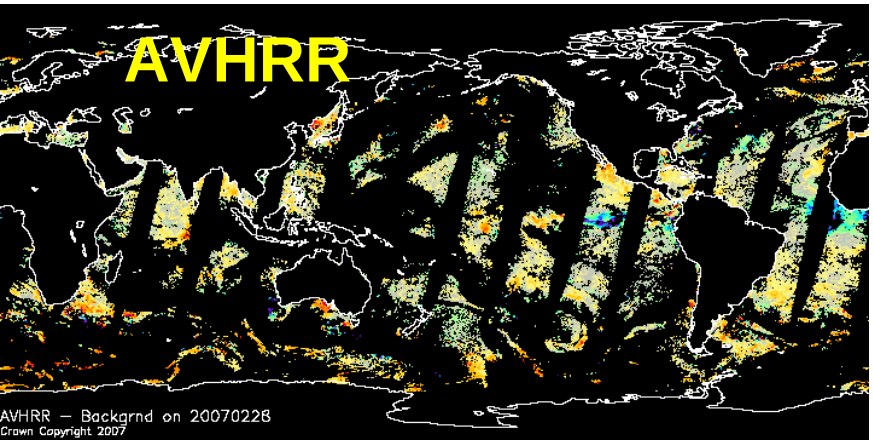
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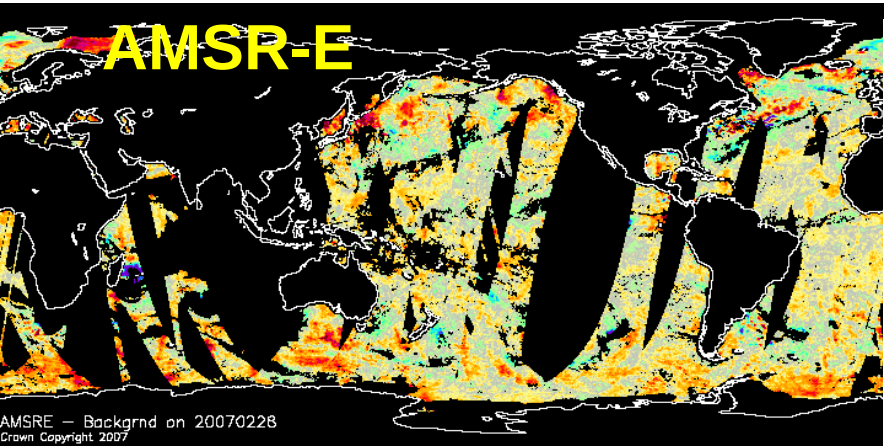
AMSR-E
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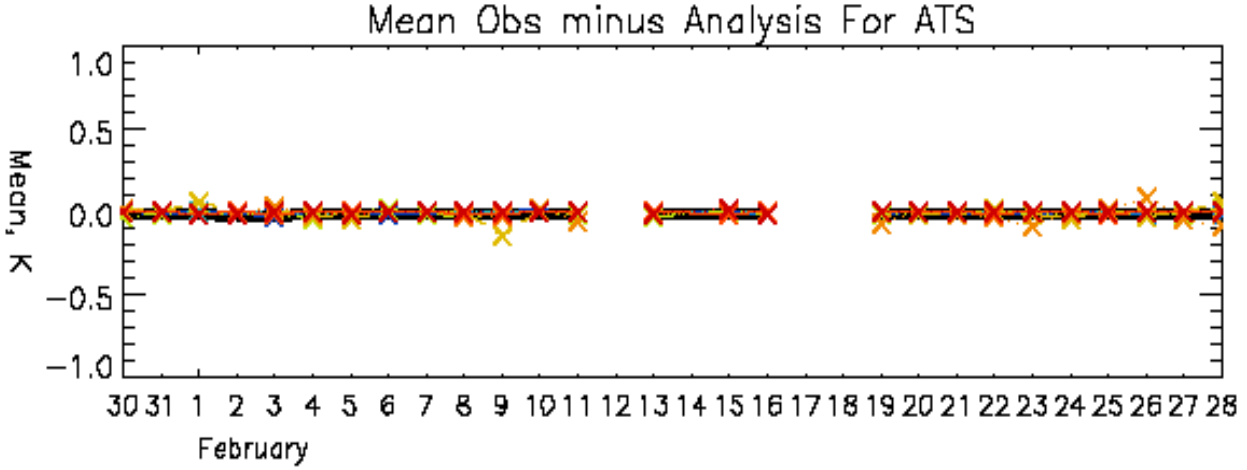
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Mean, K
1.0
0.5
0.0
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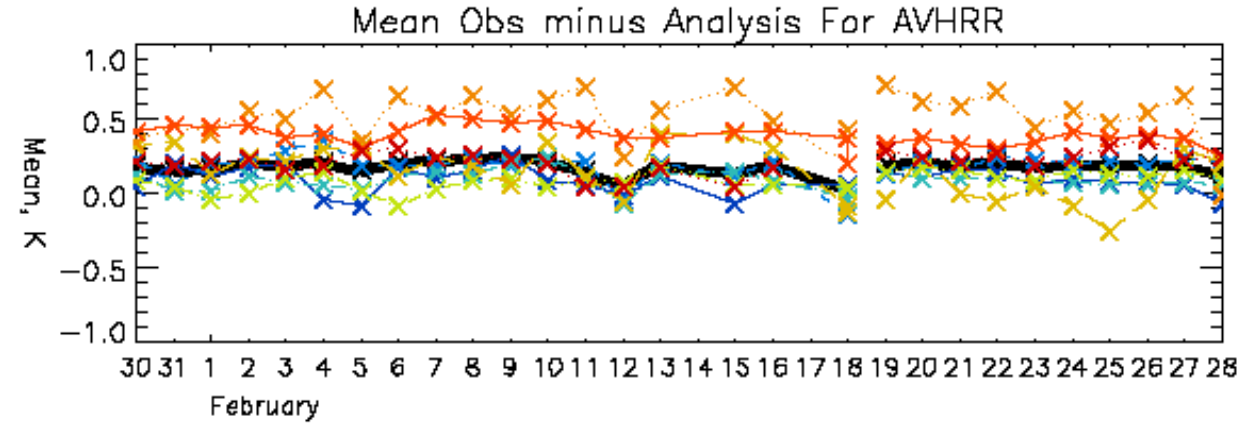
February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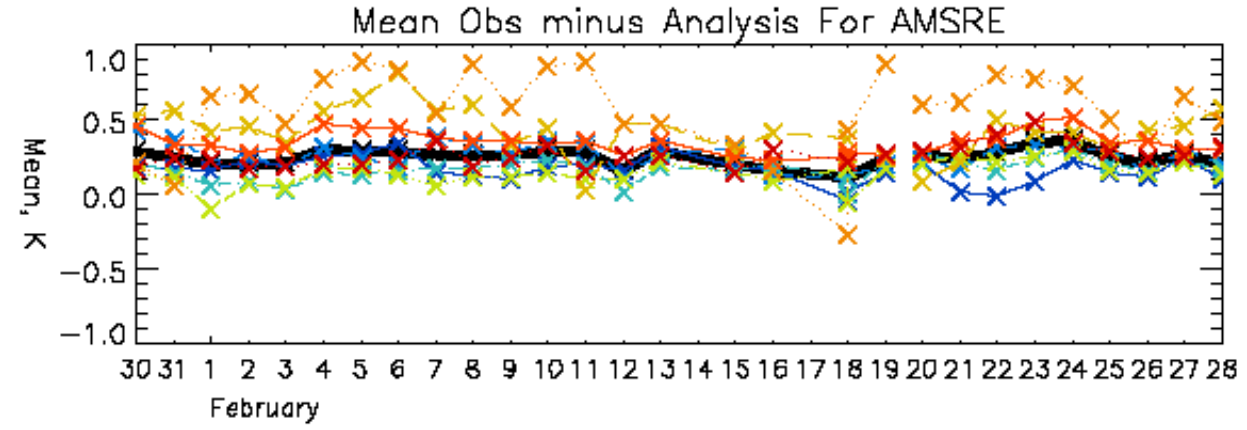
February


Mean Obs minus Analysis For AMSRE
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February

Implications for Cal/Val Programmes

- **Emphasis now on product rather than sensor**
- **Operational and climate users need continuity and consistency of performance**
- **Hence, continuity and consistency of validation**
- **How might this be achieved?**

Validation of SST – the AATSR example

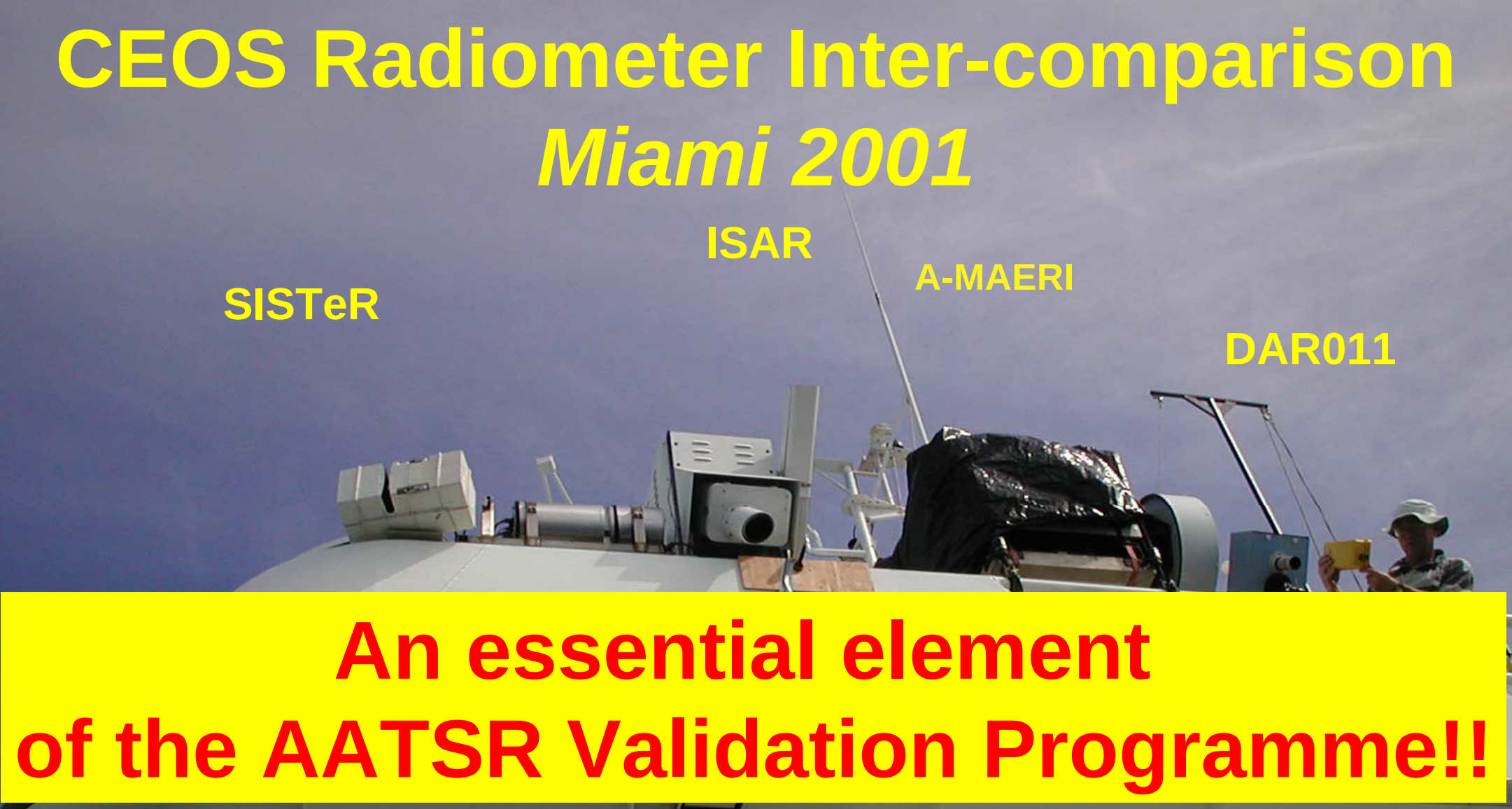
Three levels:

1) **Basic monitoring and checking against Global Buoy network – to check for gross errors and drift etc**
2) **Higher-accuracy autonomous sensors on ships of opportunity**
3) **High-precision special campaigns**

Measurement protocol in AATSR Validation plan

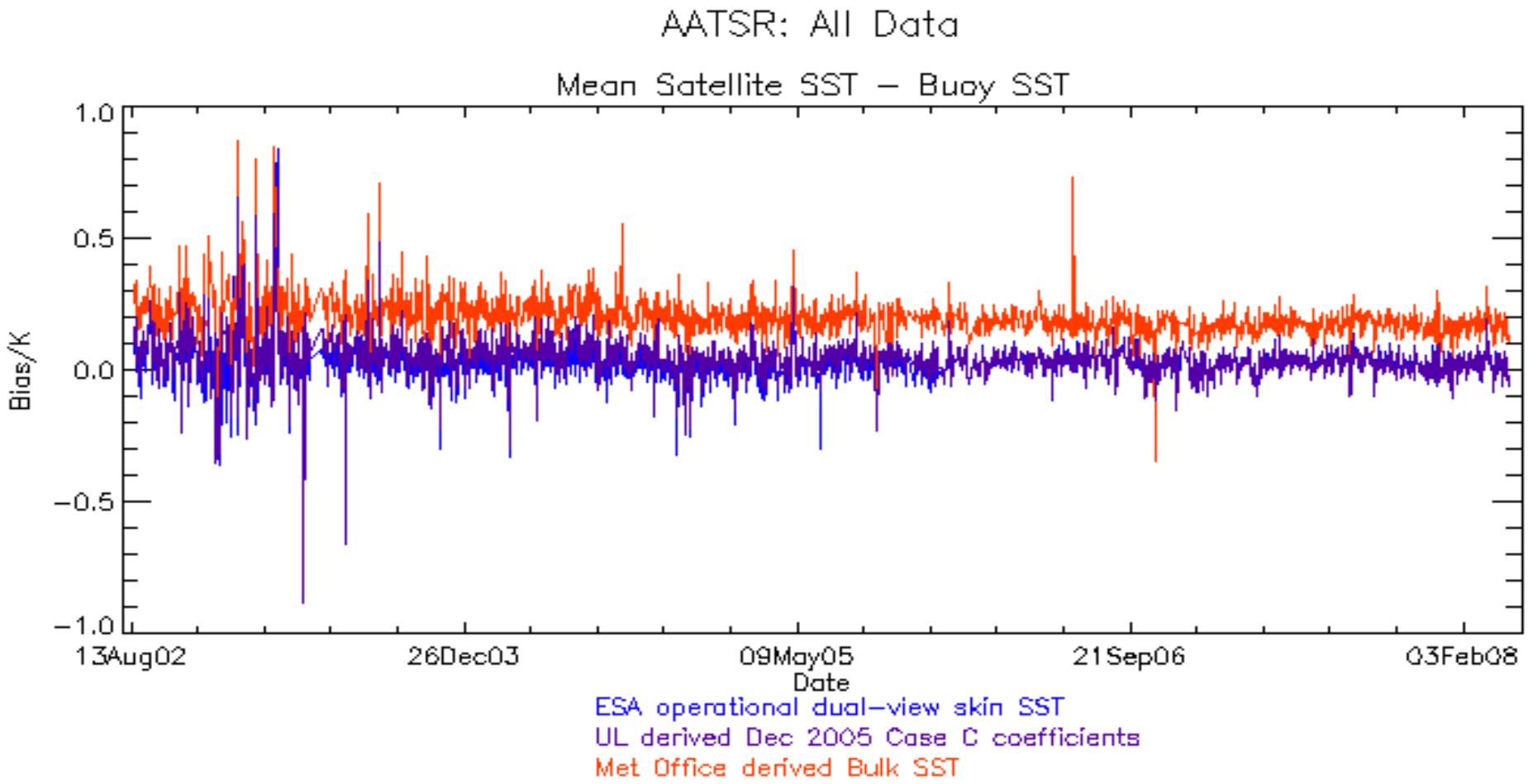
CEOS Radiometer Inter-comparison

Miami 2001



An essential element
of the AATSR Validation Programme!!

Long-term Stability of AATSR



Match-up data from Met Office

ATSR ERS-2

AATSR

University of Leicester

defra
Department for Environment Food and Rural Affairs

Buoy (Bulk) versus $AATSR_{Skin}$ & $AATR_{Bulk}$

	AATSR Skin				AATSR Bulk			
Match-ups	N	Bias	St. Dev.	% ±0.3	N	Bias	St. Dev.	% ±0.3
Day D2 PL	65028	-0.02	0.33	N/A	59498	+0.14	0.33	65.17
Night D2 PL	70074	-0.10	0.33	N/A	64641	+0.05	0.32	69.32
Night D3 PL	70117	+0.04	0.26	N/A	64674	+0.20	0.25	66.94
Day D2 UC	65020	+0.08	0.33	N/A	59489	+0.23	0.33	56.02
Night D2 UC	70088	-0.01	0.33	N/A	64652	+0.14	0.32	63.89
Night D3 UC	**70118**	**0.00**	**0.26**	**N/A**	**64668**	**+0.15**	**0.24**	**72.64**

PL: Pre-launch SST coefficients; UC: December 2005 Case C coefficients

Match-up data from Met Office

Validation of multi-sensor products

- **An operational data product requires an operational validation programme**
- **Need for maintained “validation networks”**
- **Project specific funding can be unsatisfactory if multi-sensor data are used**

Summary so far

- **SST from Space is now treated as a multi-sensor product, exploiting complementary qualities of sensors**
- **Climate and operational applications require Consistency in conduct and coverage of validation activities**
- **AATSR provides an example of a validation programme that could be applied o other parameters**

What is needed for SST?

- **Continue Buoy network**
  - **Major enhancements not likely**
- **Enlargement of autonomous radiometer coverage –**
  - **set up an 'Autonomous Radiometer Network' (ARN)**
  - **To be operated according to agreed protocols**
- **High-precision campaigns continue on *ad hoc* basis?**
- **Funding Issue is key**
  - **Some Project-specific verification activities, provider-funded**
  - **Networks need a different funding approach, perhaps user-driven**

ATSR ERS-1 ATSR ERS-2 AATSR University of Leicester defra Department for Environment Food and Rural Affairs

Generic Considerations

- **GHRSST is an example to be noted and, hopefully, followed by other satellite-observed ECV's**
- **For each parameter, there needs to be a network of 'sites', e.g. the ARN, maintained to agreed standards**

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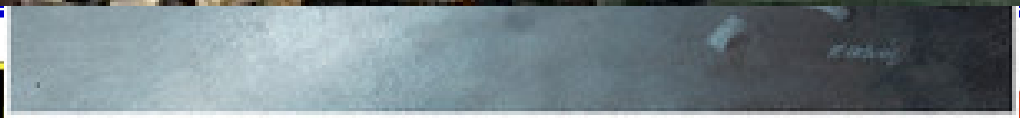
Top-down?

or Bottom-up?



ERS-1 ERS-2

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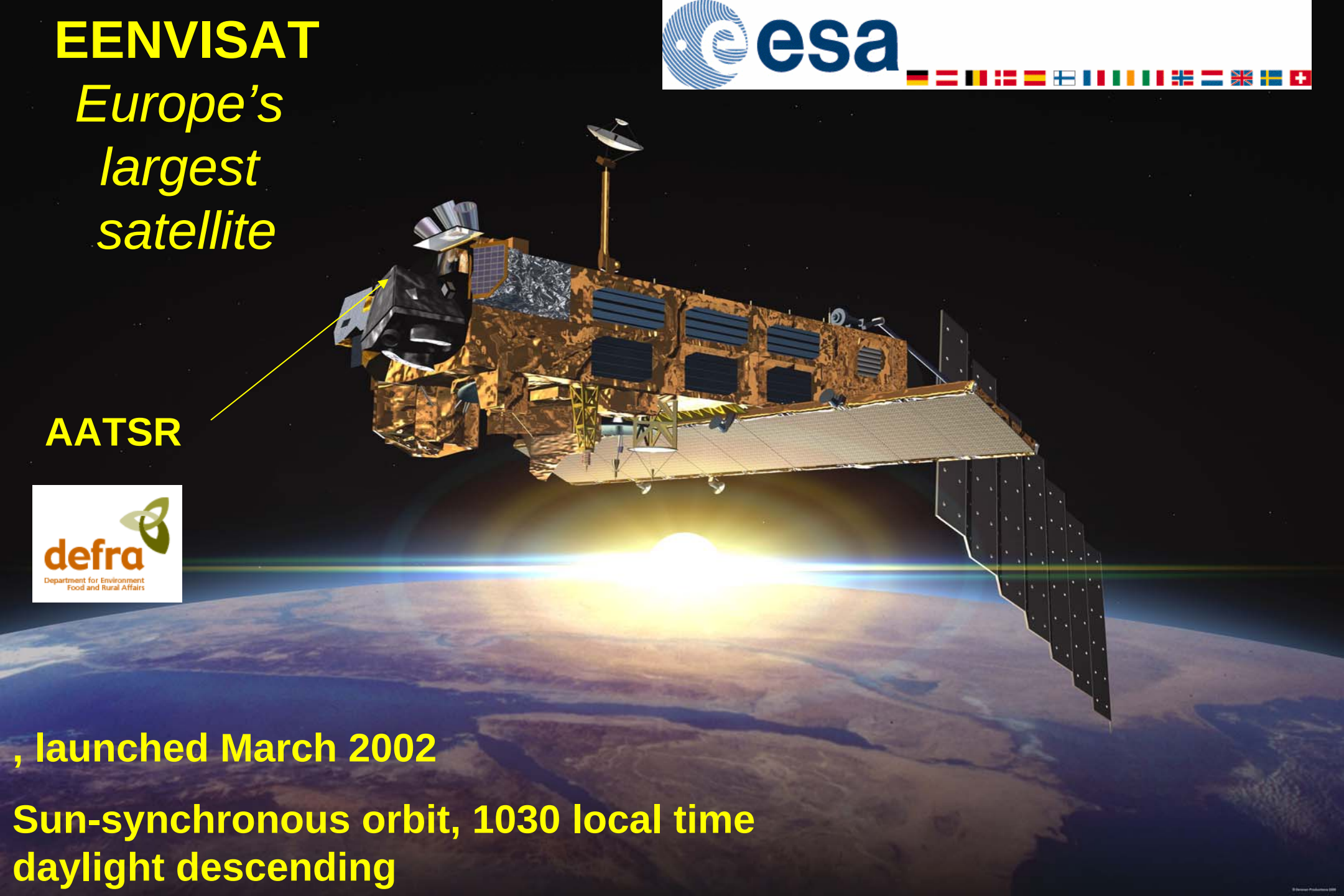
EENVISAT

Europe's largest satellite



AATSR

, launched March 2002

Sun-synchronous orbit, 1030 local time daylight descending