ESA Climate Change Initiative Phase-II

Sea Surface Temperature (SST)

www.esa-sst-cci.org

SST CCI Phase 2

Merchant

esa
University of Reading
Met Office
Brockmann Consult
DMI
Norwegian Meteorological Institute
METEO FRANCE
Toujours un temps d'avance
University of Leicester
Space ConneXions

SST CCI Phase 2 Status

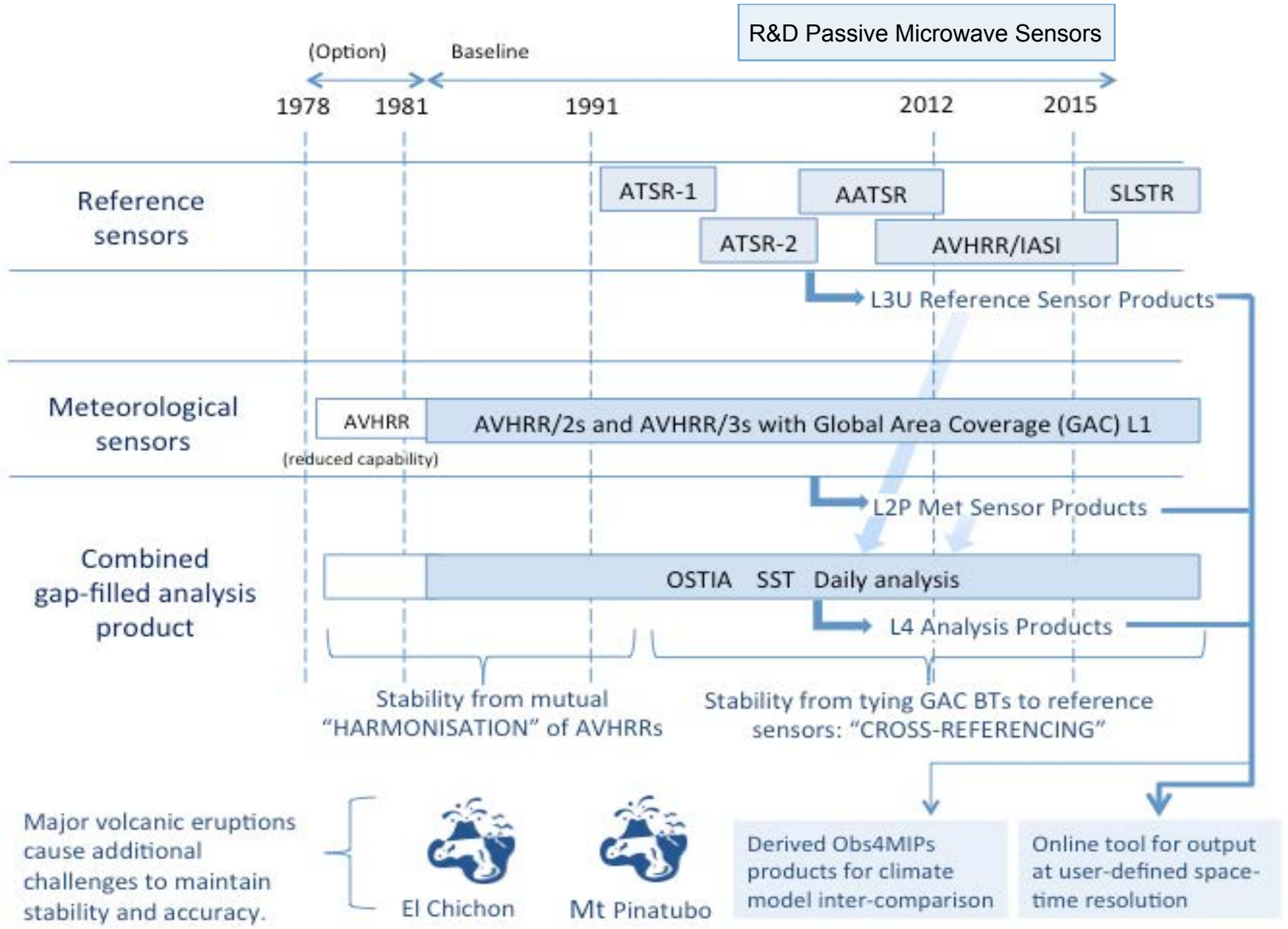
- Formal KO is 7th Feb
- 39 month project plan
- Work started January 2014
  - First demonstration of new system for ATSR processing at CEMS tested successfully
  - Multisensor Matchup System being rebuilt at CEMS – important datasets will be generated in first few months
  - Co-ordination with Cloud CCI on AVHRR GAC data for 1980s
  - Sampling uncertainty model developed

- Phase 1 Final Presentation – Mercator Room 6th Feb (Thursday)

Principal challenges

- **To extend the SST CCI climate data record** (CDR) **before and after** the period of the Along-Track Scanning Radiometers (ATSRs);
- To evolve the SST CCI CDR throughout the data period…
- To evolve the existing prototype system into an implementation that is :
  - sustainable in the long term
  - able to harness the best scientific SST R&D
  - able to provide necessary performance:
    - a ‘nimble’ improvement cycle for reprocessing
    - high-performance capacity to store and process relevant data flows now and in the coming era of Sentinel missions

Requirement	GCOS (2011)	SST CCI URD L3/L4 breakthrough'	SST CCI Ph 1 result	SST CCI Ph2 target
Accuracy / demonstrated on scale	0.1 K / 100 km	0.02 K / 100 km	Generally ~0.2 K / regionally	0.1 K / 1000 km ATSR era, 0.2 K 1980s.
Precision	None	0.05 K / 100 km	Varies, quantify it	Varies, quantify it
Stability (retrospectively assessable against tropical moorings only, using current methods)	0.03 K / decade	0.02 K per decade; 0.05 K seasonally, diurnally	Mostly <0.05 K per decade for 1996 – 2010; seasonal stability generally ~0.2 K, locally greater	<0.05 K per decade for 1991 to present; ~0.1 K / decade overall
Spatial resolution	1 km	0.1 deg	0.05 deg	0.05 deg
Temporal resolution	Daily	Day/night (UTC)	Day/night on standardized local time (L2, L3); daily (L4)	Day/night standardized on local time; new adjustments (e.g., UTC daily mean)
Uncertainty information	None	Total uncertainty	Total and components	Total and components, corr. length scales
Type of SST	Blended	Skin & buoy-depth	Skin and buoy-depth	Skin and buoy-depth (R&D on sub-skin)
Period		~1980 - now	1991 - 2010	1981 - 2016


R&D Passive Microwave Sensors
(Option)
Baseline
1978
1981
1991
2012
2015
Reference sensors
ATSR-1
AATSR
SLSTR
ATSR-2
AVHRR/IASI
L3U Reference Sensor Products
Meteorological sensors
AVHRR
(reduced capability)
AVHRR/2s and AVHRR/3s with Global Area Coverage (GAC) L1
L2P Met Sensor Products
Combined gap-filled analysis product
OSTIA SST Daily analysis
L4 Analysis Products
Stability from mutual "HARMONISATION" of AVHRRs
Stability from tying GAC BTs to reference sensors: "CROSS-REFERENCING"
Major volcanic eruptions cause additional challenges to maintain stability and accuracy.
El Chichon
Mt Pinatubo
Derived Obs4MIPs products for climate model inter-comparison
Online tool for output at user-defined space-time resolution

New EO science

- Known techniques cannot deliver objectives
- New EO science required to
  - Harmonise and **stabilise** AVHRRs/ATSR1 pre-1996
    - Mutual bias correction across constellation
    - Instrument calibration modelling (essential work at L1b)
  - Link AATSR to SLSTR via AVHRR-A/IASI
  - Achieve IR SST targets
    - Smooth-atmosphere optimal estimation for AVHRRs
    - Coefficients / OE in presence of strat. aerosol
    - New cloud detection strat. aerosol
- Fundamental work on new MW subskin-SST
  - in context of IR-dominated CDR
  - driven by outcomes from Phase-I activity

New -- Passive Microwave research

- Recently supported by Phase 1 demo results
- SST CCI has responded to JAXA AO for AMSR2 science team
- Have started information content study (UoR funded)

	OSTIA CCI		OSTIA CCI demo	
Region	STD	Mean Error	STD	Mean Error
Global	0.44	0.00	0.41	0.02
N Atlantic	0.57	0.04	0.52	0.07
Tr Atlantic	0.23	0.10	0.22	0.10
S Atlantic	0.33	-0.02	0.32	0.00
N Pacific	0.49	-0.07	0.44	-0.04
Tr Pacific	0.38	-0.03	0.34	-0.02
S Pacific	0.34	0.01	0.33	0.02
Indian Ocean	0.32	0.05	0.31	0.06
Southern Ocean	0.40	-0.07	0.41	-0.09

- **Significant EO science challenges** to benefit from PMW SST (since late 1990s) without undermining stability / temporal consistency
  - Initial R&D work within baseline on AMSR-2
  - Assuming success, Option is proposed for first implementation (AMSR-E/2)

L2P / L3U products timeline

Multi-sensor series	1st production (KO + 13)	2nd production^ (KO + 22)	Final production (KO + 33)	Options
AVHRR GAC*	1991 - 2013	1981 - 1996	1981 - 2016	1978 - 1981
ATSR**	1991 - 2012	1991 - 1996	1991 – 2012	-
AVHRR Full Res	-	-	2007 – 2016	-
AMSR-E/2	-	-	-	2002 - 2016

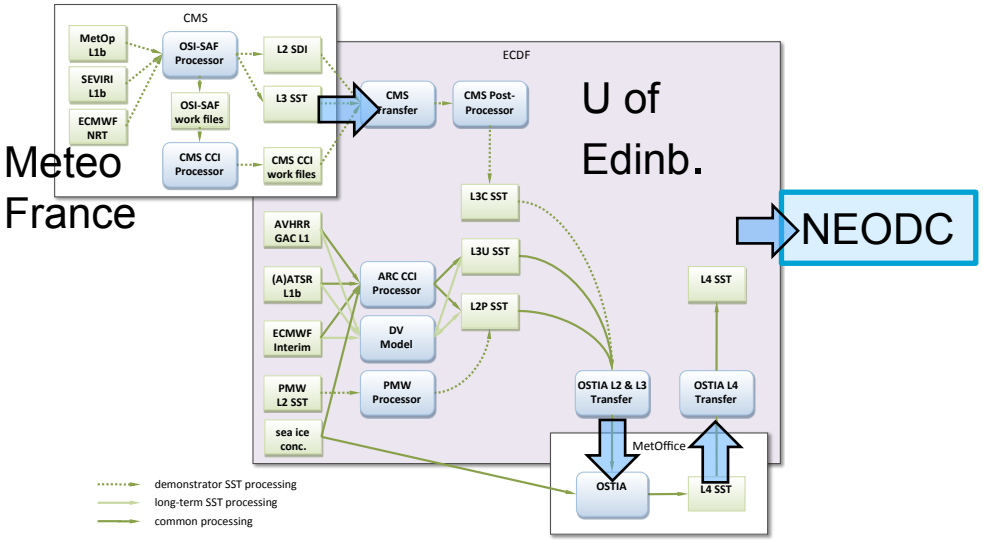
* AVHRR GAC data cover 1981 to the present using the AVHRR/2 and AVHRR/3 instruments. AVHRR/1 data exist from 1978 onwards, which have potential for SST, although with reduced capability due to absence of the "split window".

** The new L1b archive (v2.1) for ATSRs will be used in Phase-II.

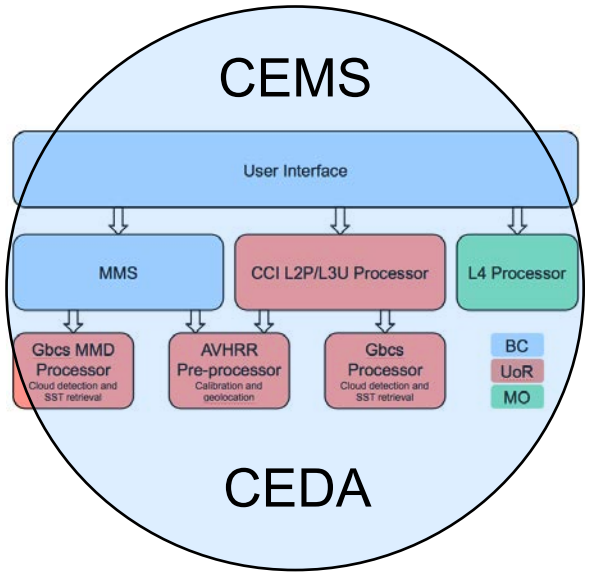
^ This corresponds to the 'interim processing' required in the Annex G. It will give first experience on pre-ATSR AVHRRs, and will not yield publicly disseminated products.

System highlights

- Integrated implementation at CEMS
  - Fully functional (re-runable) Multi-Sensor Match-up System
  - Updated NEMOVAR-based OSTIA implemented as stand-alone (better connection to assimilation systems)
  - Fast: Able to process ATSR-series in <3 days
- CEMS will be integrated in UK Collab. Ground Segment, therefore "future proof" wrt. Copernicus missions



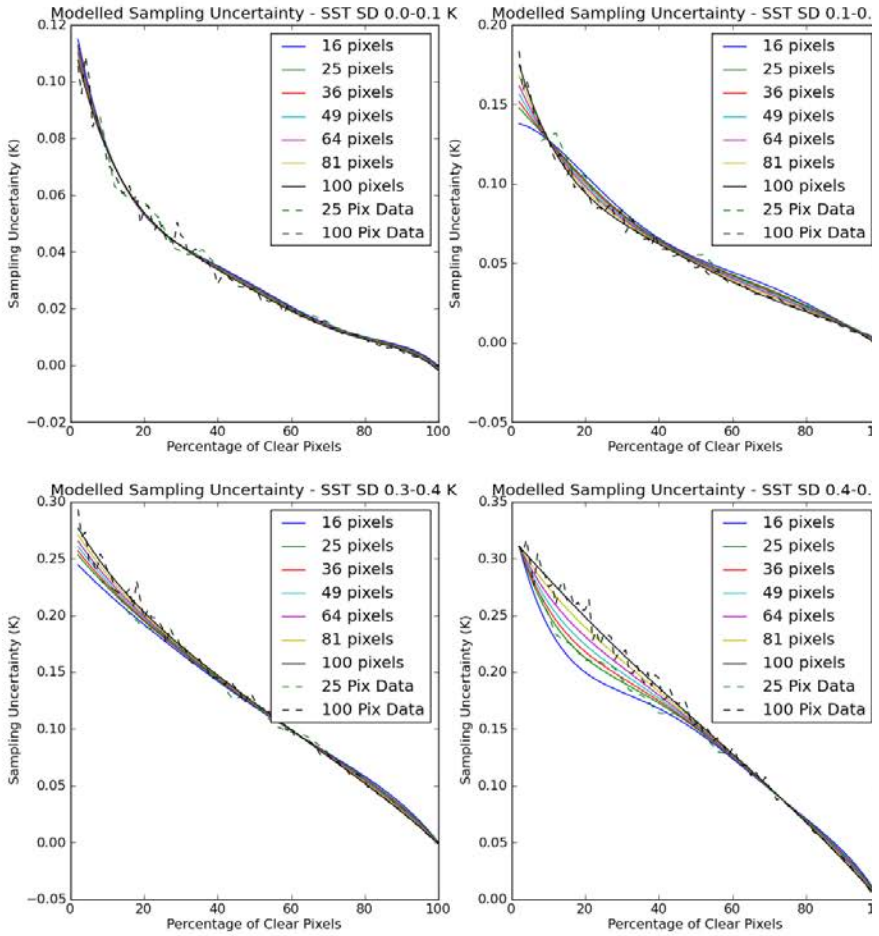
Phase 1 -- distributed



Phase 2 -- integrated

Uncertainty aspects

- Phase 1 Climate Assessment demonstrated utility of SST estimates for data assimilation
- Scientific development of uncertainty estimates in Phase 2 0.05 deg products includes improved sampling effects (already well advanced)
- New work on use of L2/L3 uncertainty components in L4, including observation error correlation length scales
- Major user consultation meeting both to understand users' requirements, and inform users about new possibilities



‘Sustainable’ – ‘sustained’

- Phase 2 funds building of a *sustainable* system
  - operations AND science part of one system == CCI
  - CDR generation underpinned by the best scientific R&D
- Want to see a system that *is in fact* sustained beyond CCI Phase 2
  - Many SST datasets, why sustain this one?
  - SST CCI dataset needs to be demonstrably unique in aspects of quality relevant to climate applications
  - Phase 2 has sharper focus on the outcome in terms of climate quality through scientific work-packages
  - Aim: become as fundamental to climate applications of SST as ICOADS