ASCAT services status
Post-EPS preparations

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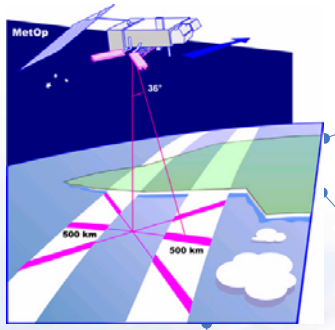
Outline

Overview
ASCAT L1b service
ASCAT L2 Soil Moisture
EARS (regional) ASCAT L2 Winds service
Post-EPS preparations

News and developments since Seattle 2008
Current areas of work and future plans

ASCAT services overview



L-BAND

Local processor

Single AHRPT station

L0: raw power echoes

LOCAL COVERAGE

REAL TIME

L-BAND

X-BAND

EARS network of AHRPT stations

EARS processing system (EUMETSAT and KNMI)

L2: Wind vectors on 25 and 12.5 km swath grid

REGIONAL COVERAGE

30 min

EUMETSAT POLAR SYSTEM (EPS) main acquisition station (Svalvard)

EPS Ground Segment (EUMETSAT and OSI SAF)

L1B: averaged normalised backscatter values (s0) on 25 km and 12.5 km swath grid

L1B: Full-resolution normalised backscatter values (s0)

L2: Soil Moisture product

L2: Wind vectors on 25 km and 12.5 km swath grid

GLOBAL COVERAGE

2-3 h ARCHIVE

ASCAT products overview

	Definition	Cov	Time	Source	Form	Diss. in NRT	Archive
L1B	Averaged s0 **values on a swath grid 25 km spacing, res. 50 km**	GLOB	2h	EUM	EPS	EUMETCast, NOAA	UMARF
					BUFR	EUMETCast, GTS	
	Averaged s0 **values on a swath grid 12.5 km spacing, res. 35 km**				EPS	EUMETCast, NOAA	
					BUFR	EUMETCast, GTS	
	'Full resolution' pre-averaging s0 **values: 256 s0 samples along beam for all 6 beams, res. 25x10 km**				EPS	To NOAA	
L2	Relative Soil Moisture **(top soil) on a swath grid 25 km spacing, res. 50 km**				BUFR	EUMETCast, GTS	
	Relative Soil Moisture **(top soil) on a swath grid 12.5 km spacing, res. 35 km**						
	Near surface wind vectors **on a swath grid25 km spacing, res. 50 km**			OSI SAF		EUMETCast, GTS, ftp	
	Near surface wind vectors **on a swath grid12.5 km spacing, res. 35 km**						
L2 EARS	Near surface wind vectors **on a swath grid 25 km spacing, res. 50 km**	REG	30min	EUM/ KNMI		EUMETCast, ftp	NO
	1 near surface wind vector **after ambiguity removal, for Nowcasting applications, res. 35 km**						

ASCAT products overview

	Definition	Cov	Time	Source	Form	Diss. in NRT	Archive
L1B	Averaged s0 **values on a swath grid 25 km spacing, res. 50 km**	GLOB	2h	EUM	EPS	EUMETCast, NOAA	UMARF
					BUFR	EUMETCast, GTS	
	Averaged s0 **values on a swath grid 12.5 km spacing, res. 35 km**				EPS	EUMETCast, NOAA	
					BUFR	EUMETCast, GTS	
	'Full resolution' pre-averaging s0 **values: 256 s0 samples along beam for all 6 beams, res. 25x10 km**				EPS	To NOAA	
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	Relative Soil Moisture **(top soil) on a swath grid 12.5 km spacing, res. 35 km**						
	Near surface wind vectors **on a swath grid25 km spacing, res. 50 km**			OSI SAF		EUMETCast, GTS, ftp	
	Near surface wind vectors **on a swath grid12.5 km spacing, res. 35 km**						
L2 EARS	Near surface wind vectors **on a swath grid 25 km spacing, res. 50 km**	REG	30min	EUM/ KNMI		EUMETCast, ftp, (GTS planned)	NO
	1 near surface wind vector **after ambiguity removal, for Nowcasting applications, res. 35 km**						

L1b - Status

Routine product generation and dissemination since February 2007 with provisional calibration

ASCAT L1b **products declared operational** 03/04/08, including full absolute calibration, as derived after processing instrument calibration measurements over the three ground transponders

Tuning of the calibration on 09/12/08 as a reference to start adapting the existing ERS-based Level 2 models (winds, soil moisture and ice) to ASCAT data

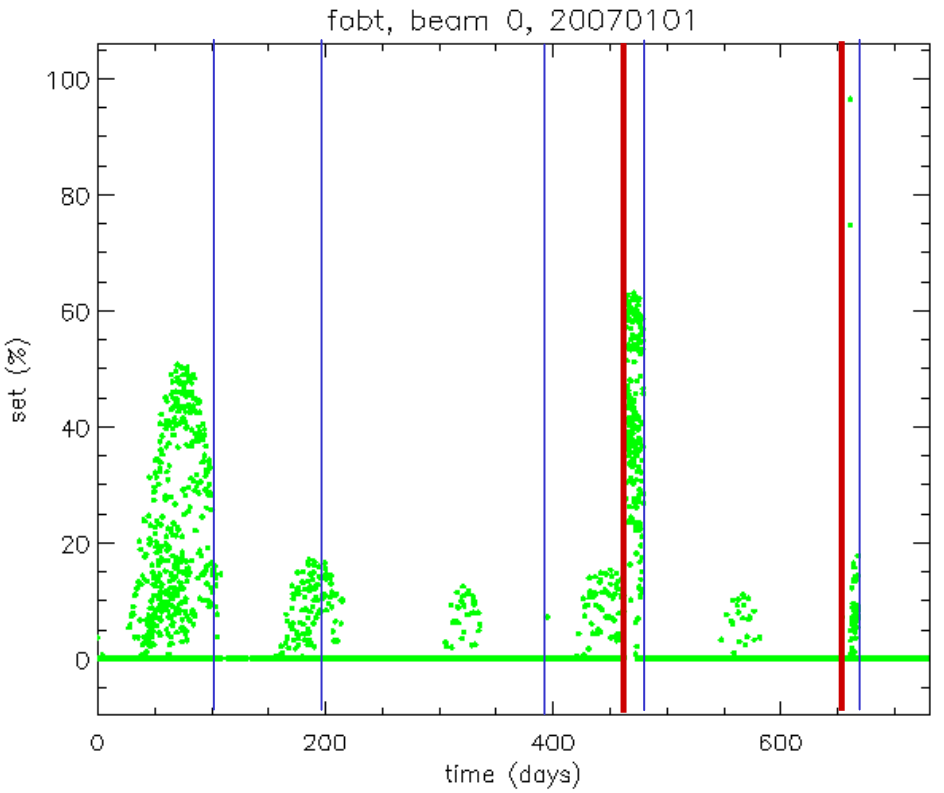
L1b – Current activities

Dynamic power-to-s0normalisation

Static implementation of Power-to-s0 normalisation by current ASCAT L1b processor introduces a requirement on orbit maintenance: eccentricity control

To simplify orbit strategy, spacecraft operations and save fuel: Implementation of orbit-based Power-to-s0 normalisation processing

Integration ongoing, validation during summer, implementation on the operational processor expected in August 2009



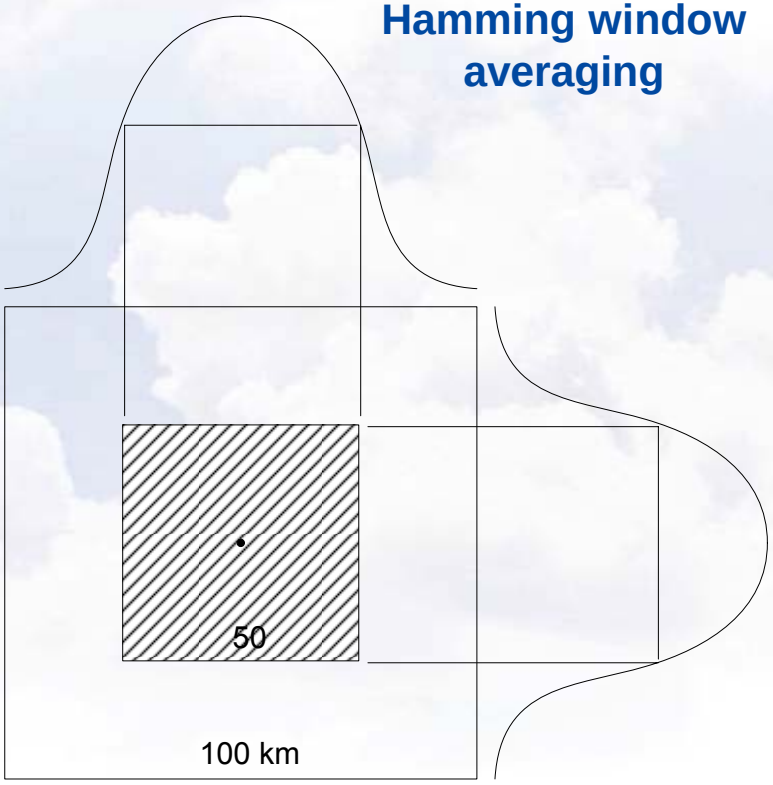
After the next OOP manoeuvre (September 17th), no specific eccentricity control manoeuvres for METOP-A are expected

L1b – Current activities

Level 1b spatial averaging alternatives

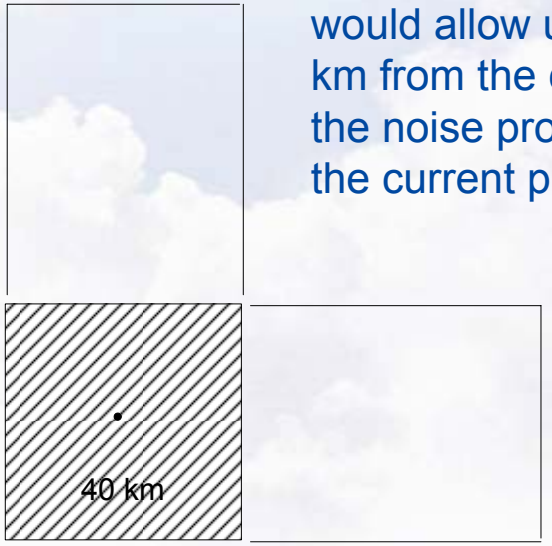
Current Hamming-window averaging provides land-free sigma0 averages as far as 50 km from the coast

Hamming window averaging



Box window averaging

would allow us to get about 20 km from the coast, yet keeping the noise properties very close to the current product



3 weeks of data available for testing effect on the L2 wind and soil moisture retrievals

L1b – Reprocessing status and plans

Phase 1: Long record of consistent ASCAT L1b product, 3-transponder calibration Dec08.

- Reprocessing took place over Dec08/Jan09
- 2007-2008 (10079 orbit products, 2 years of data) processed in 3 weeks.
- Approximate size of data set is 60GB (25 km swath grid) and 244GB (12.5 km)
- EPS Native format
- Corresponding Level 2 soil moisture has been re-processed as well
- Validation ongoing and ingestion into UMARF planned for June09

Tuning of models for L2 retrieval (winds and soil moisture)
Confirming the stability of the instrument and sigma0 over time

Phase 2: Long record of ASCAT L1b product derived with dynamic sigma0 normalisation (end of 2009, 3 years of data). As soon as ASCAT-based geophysical models for wind and soil moisture have been agreed, Level 2 will be re-processed from this data set

Additional requests for long record L1b – at least 6 months of soil moisture with sigma0 box averaging

Other?

L1b – Phase-1 reprocessing analysis

Rain Forest Monitoring

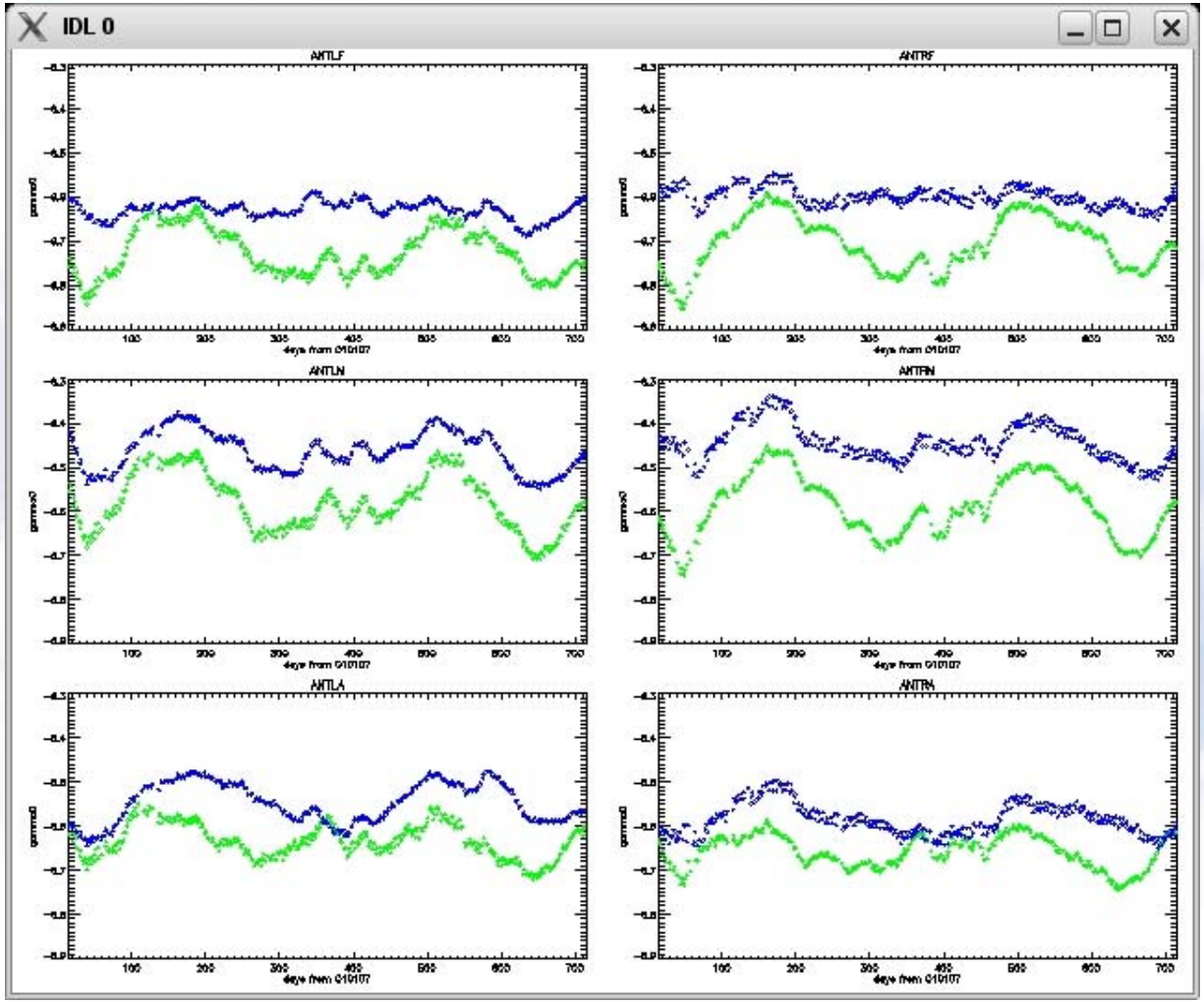
Time series of rainforest γ0 values

γ0 = σ0/cos(θ), θ = inc.angle

Original rainforest area used for ERS-SCAT calibration stability monitoring

Plots show stability of the instrument calibration,

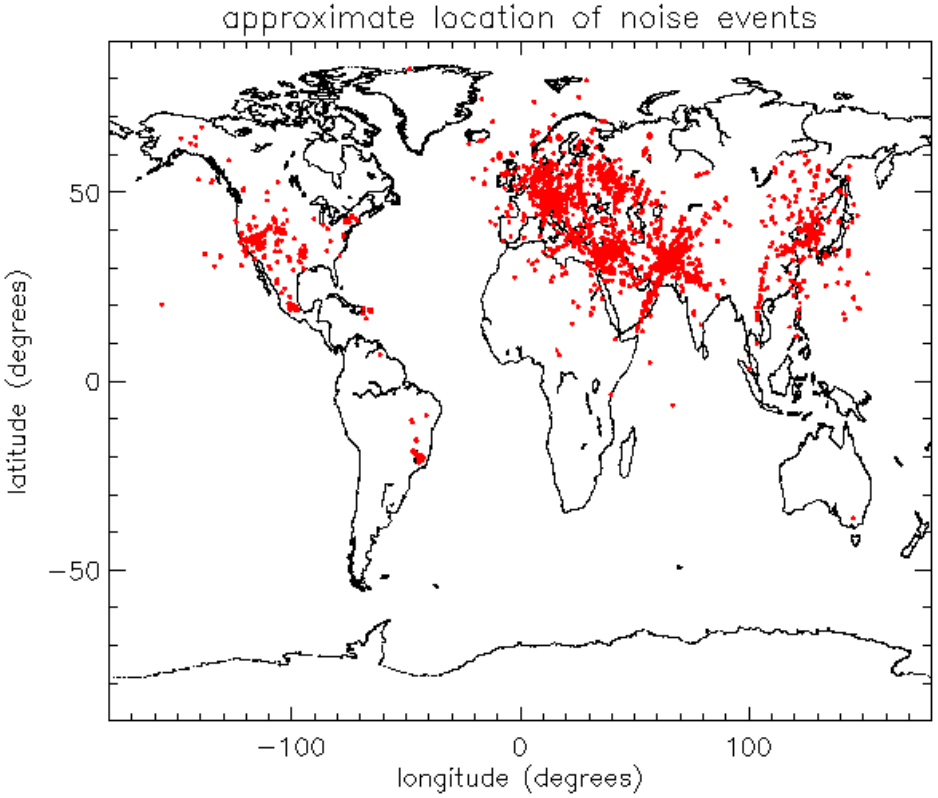
Seasonal cycle present and ascending/descending pass differences need to be better understood (mask out rivers)

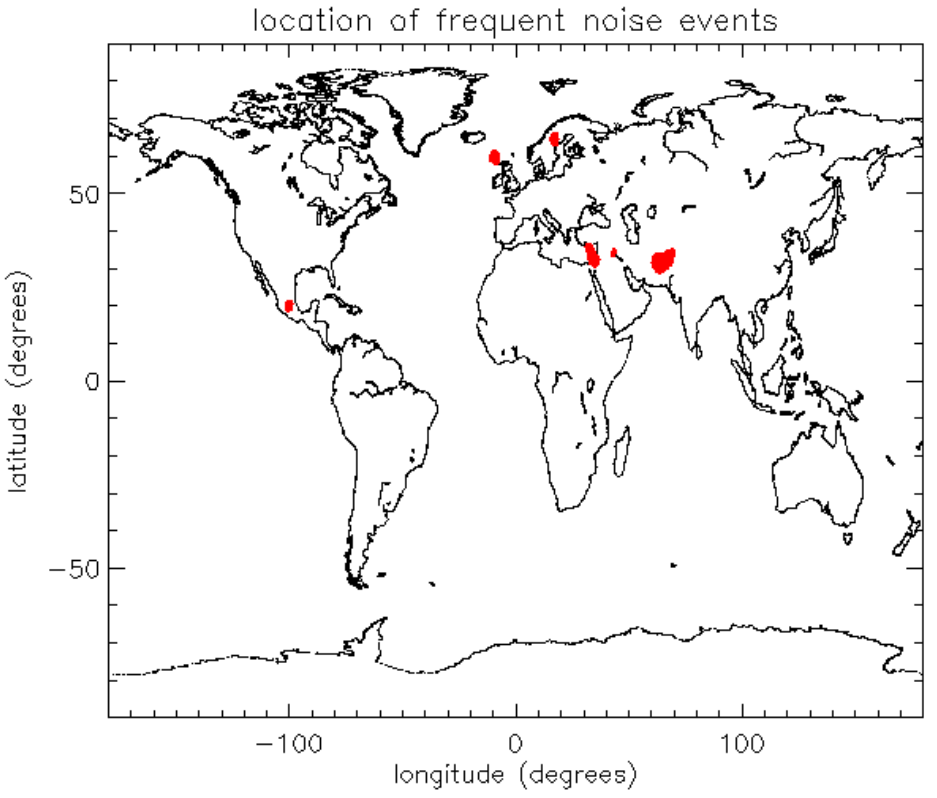


L1b – Phase-1 reprocessing analysis

Noise Power monitoring

Time series show occasionally unusual values of noise power, particularly between April-Sept 08





L2 Soil moisture – status

Product definition

Level 2: Surface soil moisture index (%) in orbit geometry, tailored for NWP assimilation

(Level 3 value-added products are also planned in partnership with the H-SAF)

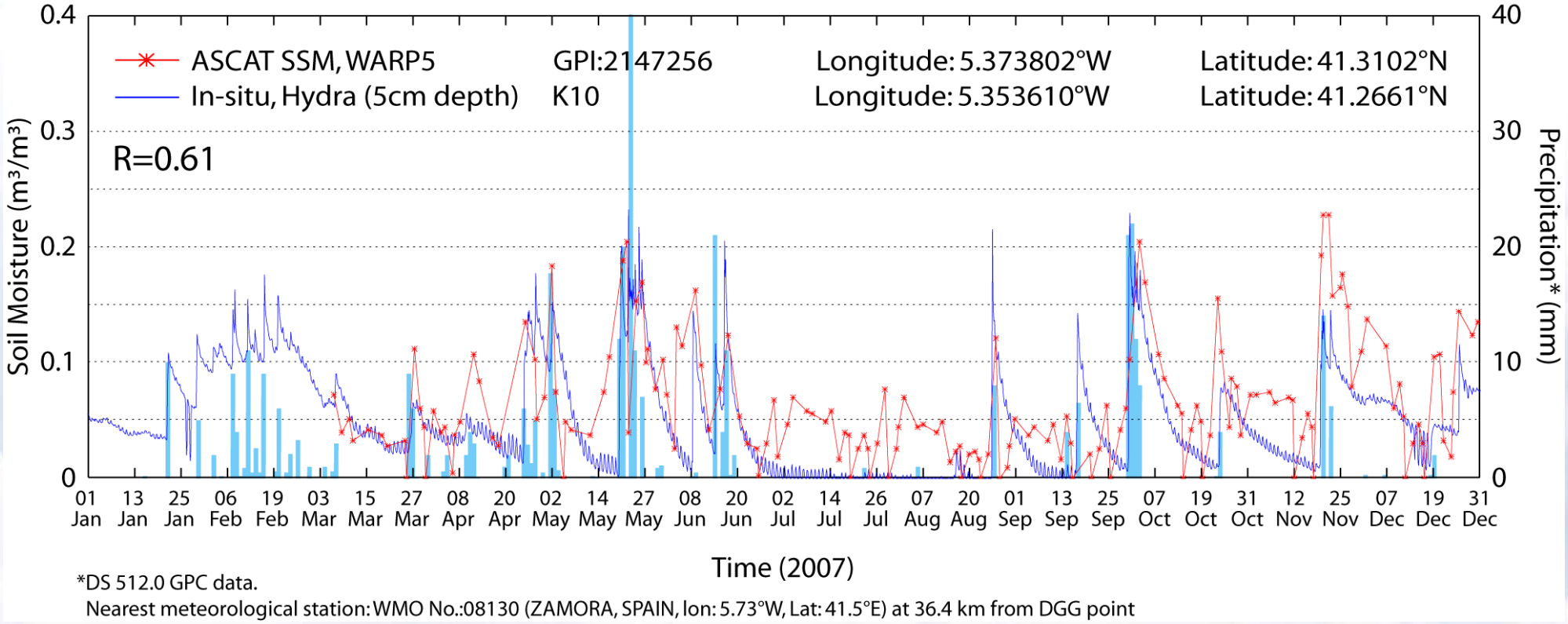
Service status

Operational since 10/12/08, a tuning of the retrieval for the left beam was introduced at the end of 04/09 Reprocessed data set available covering 2007-2008 available

Next steps

Cross-calibration with ERS scatterometer and removal of s0 bias corrections will be addressed

L2 Soil moisture – validation example



Courtesy of Vienna University of Technology, using in-situ data from University of Salamanca, Geography Department (Dr. Jose Martinez-Fernandez)

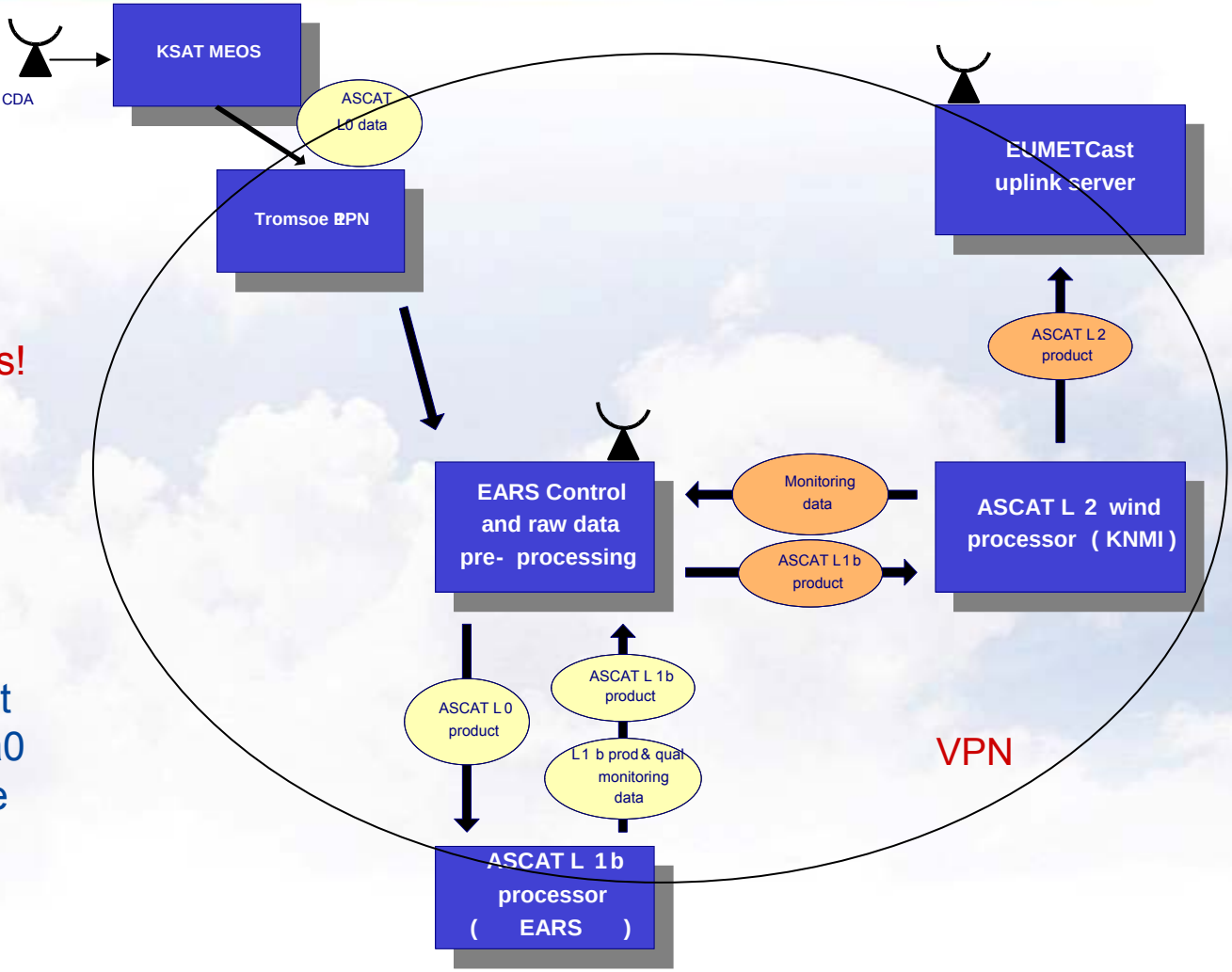
EARS ASCAT L2 winds – overview and status

Data feed from global data dump: 14 Metop dumps/day. Last 30 minutes of ASCAT extracted for further L1b + L2 processing

Timeliness: 40-45 min for data over equator, 15 minutes from sensing for data over high latitudes!

Service operational since 14/12/08 and **EARS SCAT demonstration** service runs in parallel

On going work to adapt the current system to dynamic poser-to-sigma0 normalisation, to process available AHRPT data, and to produce L2 soil moisture as well



Concluding remarks

L1b

Calibration settled, pending dynamic implementation of normalisation.

Issues being addressed in the context of oceanographic and climate applications: Lb averaging

2 years of reprocessed L1b data are expected to be available from our archive in June09, this data set should open the door for Level2 product retrieval tuning

Preliminary results on reprocessed data analysis shows a very stable instrument

L2 soil moisture

Operational dissemination started on 10/12/08, product tailored for NWP assimilation, good validation results with high accuracy in-situ data

2 years of reprocessed L2 soil moisture data are expected to be available from our archive in June09

EARS ASCAT L2 ocean winds

Operational dissemination started on 14/12/08, product tailored for regional Forecasting and Nowcasting, timeliness is 15 minutes for high latitudes

Post EPS programmatic preparations

Post-EPS: the follow-on of the EUMETSAT Polar System (EPS), that will provide continuity of observations and respond to the needs of the users in the 2020 time frame.

Planning:

Phase 0	- Mission Analysis 2005 – 2009
Phase A	- Feasibility2009 – 2011
Phase B	- Preliminary Definition2011 – 2013
Phase C, D	- Detailed Definition, Production2014 – 2018
Phase E	- Utilisation from 2018

WEBSITE: http://www.eumetsat.int/Home/Main/What_We_Do/Satellites/Future_Satellites/Post-EPS/?l=en

Position papers,programmatic assumptions, Support studies, Requirement Document

3-4 February 2009: EUMETSAT 2nd Post-EPS User Consultation Workshop

Nineteen observation missions have been identified => Scatterometry mission (SCA);

Satellite scenarios considered:

Single satellite scenario: like EPS a satellite in a sun-synchronous orbit (SSO) with local time of ascending node (LTAN) of 09:30 and altitude of 817 km.

Dual satellite scenario: Imaging and sounding instruments at 817km, Mainly microwave and other instruments (SCA) at 700 km.

ASCAT follow-on.The mission requirements identify ASCAT as heritage instrument.

POST EPS Scatterometer Mission Requirements (1)

MRD_SCA.006: The SCA measures the target scattering coefficient under at least three azimuth angles, ideally separated by 45° each (heritage ERS/ASCAT instruments).

MRD_SCA.010: The radar carrier frequency shall operate in C-band.

MRD_SCA.190: The SCA shall operate, fulfilling the radiometric requirements, in VV polarisation as threshold and in VV and HH polarisations as objective.

MRD_SCA.001: L In any trade-off between horizontal resolution and spatial coverage the former shall have higher priority.

MRD_SCA.100: The SCA incidence angle shall be ≥ 20°.

POST EPS Scatterometer Mission Requirements (2)

MRD_SCA.110: The SCA shall maximise the useful viewing angle range provide at least:
50% coverage within 12 hours and 97% coverage within 48 hours (threshold)
82% coverage within 12 hours (breakthrough).

MRD_SCA.120: The horizontal resolution shall be ≤ 25 km (breakthrough), ≤ 50 km (threshold).

MRD_SCA.130: The horizontal sampling interval shall be ≤ 12.5 km.

MRD_SCA.140: The geo-localisation accuracy (knowledge) shall be <1 km (Objective), < 2 km (Threshold).

MRD_SCA.150: The measured wind speed covers the range between 4 and 25 m/s with the full specified performance. Measurements with reduced performance below 4 m/s and above 25 m/s up to 40 m/s are desirable. […]

MRD_SCA.160: The radiometric accuracy (bias error) shall be ≤ 0.35 dB peak to peak per beam.

MRD_SCA.170: The radiometric resolution Kp(i) shall be:
Threshold (Breaktrough) – 50 (25) km x 50(25) km Horizontal spatial resolution;
At 4 m/s cross-wind: Kp(i) = (0.175 i - 1.375) %
At 25 m/s up-wind: Kp(i) = 3 %

MRD_SCA.180: The overall radiometric stability shall be ≤ 0.1 dB over an orbit and over the mission lifetime.

POST EPS Phase 0 => Phase A

Instrument concepts are being elaborated in the ESA Phase industrial studies.

- **Both rotating and fixed (ASCAT-type) fan beam concepts are considered**
- **KNMI conducts an ESA study to look at wind performance aspects of the concepts.**

Autumn 2009:

- **The Phase 0 studies Final Reviews**
- **System level Mission Definition Review**

End 2010: Draft of the (EUMETSAT NOAA) Joint Polar System Agreement.

Useful links

ASCAT Products guide

http://www.eumetsat.int/Home/Main/Publications/Technical_and_Scientific_Documentation/EPS_Product_Guides/index.htm

EUMETSAT User Services

www.eumetsat.int

Contact directly the ASCAT team

ascat_calval@eumetsat.int

Ocean and Sea Ice SAF page

www.osi-saf.org

The scatterometer page at KNMI

www.knmi.nl/scatterometer

The scatterometer soil moisture at TUWien

http://www.ipf.tuwien.ac.at/radar/

Back-up slides

ASCAT L1b ad L2 Products format

L1b: EPS Native format

Binary, uncompressed, MRD (Measurement Data Record) based

– Readers available from EUMETSAT in fortran, idl, c, c++

L1b and L2: BUFR

Binary, compressed, common template for all L1B and L2 products, which can be filled with all or a selection of them

– Reader available from the KNMI scatterometer page

L2 surface winds: NetDCF

Currently under definition

Product access

Near real time

EUMETCast (all products)

GTS (global products, planned for regional fast products as well BUFR format)

ftp server at KNMI (all L2 wind products)

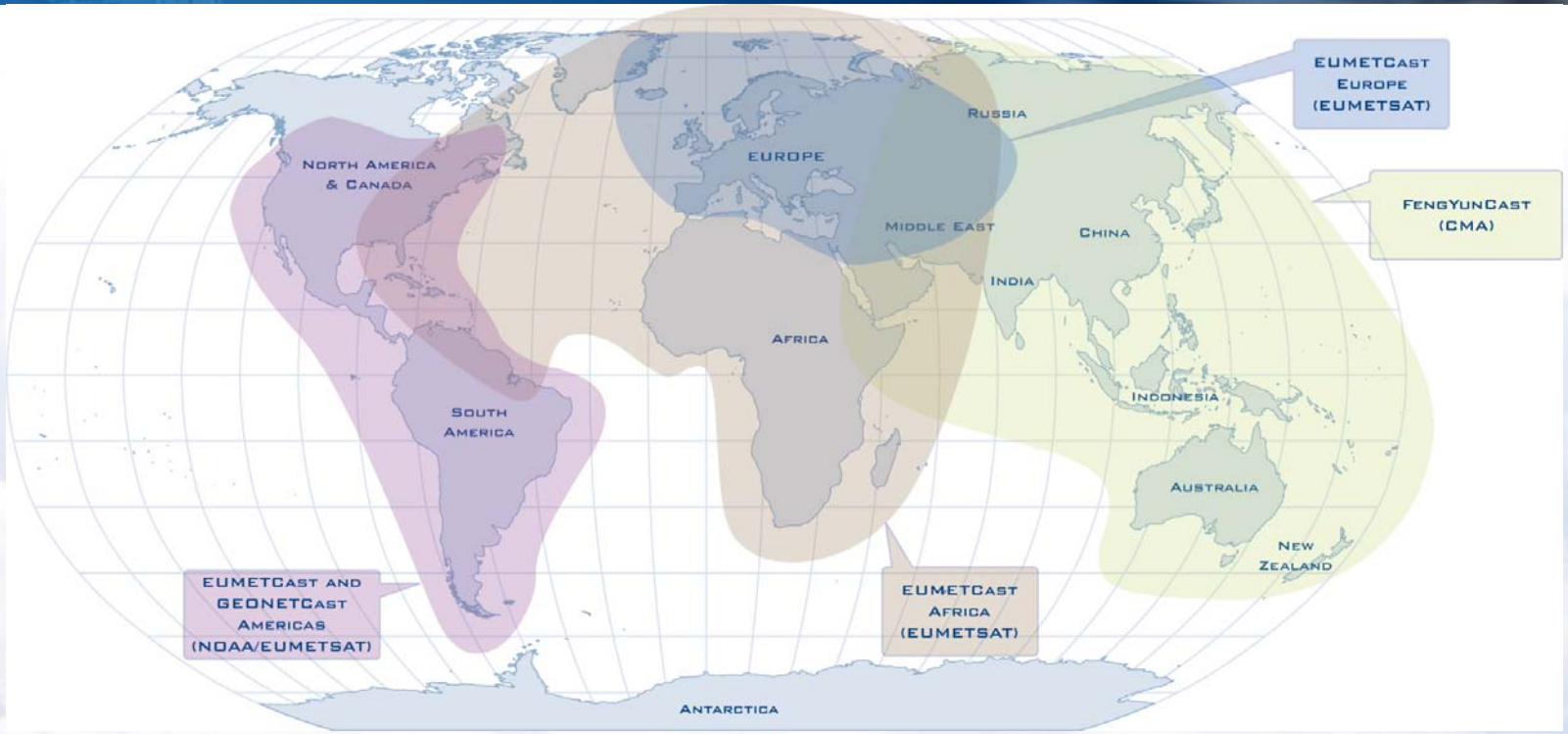
NOAA gets all L1b ASCAT products via the **transatlantic link** (3 min granularity)

Access to EUMETSAT Archive (UMARF)

All reconstructed global products (1 dump)

On retrieval, EPS format and conversion to HDF5 and BUFR is possible

Where can you receive EUMETCast data today?



Multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology. It uses commercial telecommunication geostationary satellites to multicast files (data and products) to a wide user community.

Part of a bigger picture: **GEONETCast**

http://www.eumetsat.int/Home/Main/What_We_Do/Technical_Cooperations/GEONETCast/index.htm

Need for dynamic implementation of s0 normalisation

ASCAT processor uses a static representation of power-to-s0 normalisation factors for a reference Metop orbit –> it is implicitly assumed that orbit height and satellite attitude are invariant from orbit to orbit and from cycle to cycle.

But orbit height and attitude do vary from orbit to orbit, up to about 500 m, which brings on a s0 error of +/-0.05 dB

Plans for dynamic generation of normalisation factors are underway, in order to make the best of the orbit information available on time, without significantly affecting the timeliness of the products. Implementation planned for April 2009

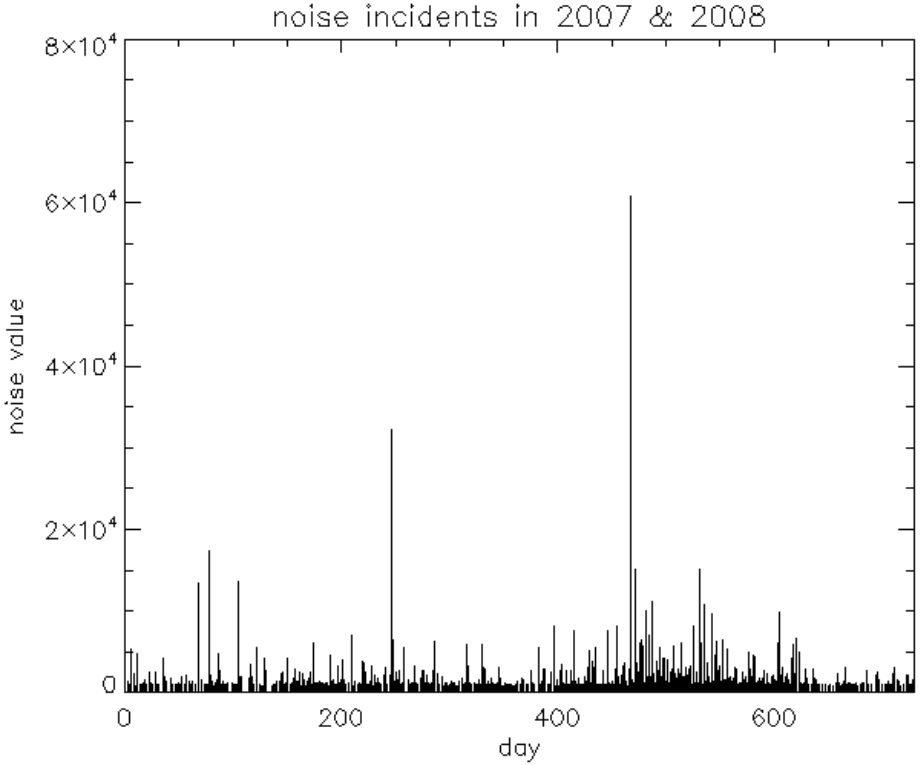
METOP-A Manouvre history

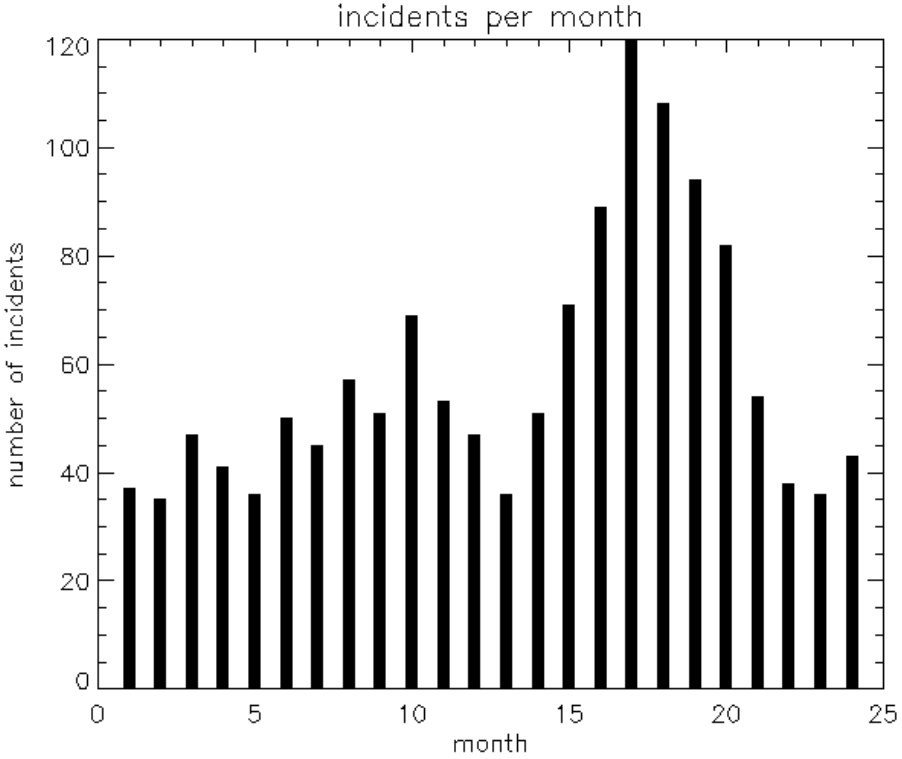
2006/10/21 18:58:08.261	OOP	GEO	performed by ESOC
2006/10/22 06:30:43.020	IP	GEO	double IP, performed by ESOC
2006/10/22 07:20:35.005	IP	GEO	double IP, performed by ESOC
2006/11/02 15:06:32.444	IP	YSM	single IP
2007/04/19 14:05:56.690	IP	YSM	double IP
2007/04/19 14:56:40.524	IP	YSM	double IP
2007/07/12 14:48:18.525	IP	YSM	
2008/01/31 14:38:03.501	IP	YSM	
2008/04/08 13:26:21.358	OOP	GEO	
2008/04/09 03:48:39.881	OOP	GEO	
2008/04/24 14:46:31.392	IP	YSM	double IP
2008/04/09 03:48:39.881	IP	YSM	double IP
2008/10/23 14:30:02.148	OOP	GEO	
2008/10/30 14:11:05.163	IP	YSM	double IP
2008/10/30 15:01:42.255	IP	YSM	double IP
2009/01/22 14:11:17.812	IP	YSM	
2009/09/17		**OOP + IP (planned)**	

L1b – Phase-1 reprocessing analysis

Noise Power monitoring

Time series show occasionally unusual values of noise power, particularly between April-Sept 08

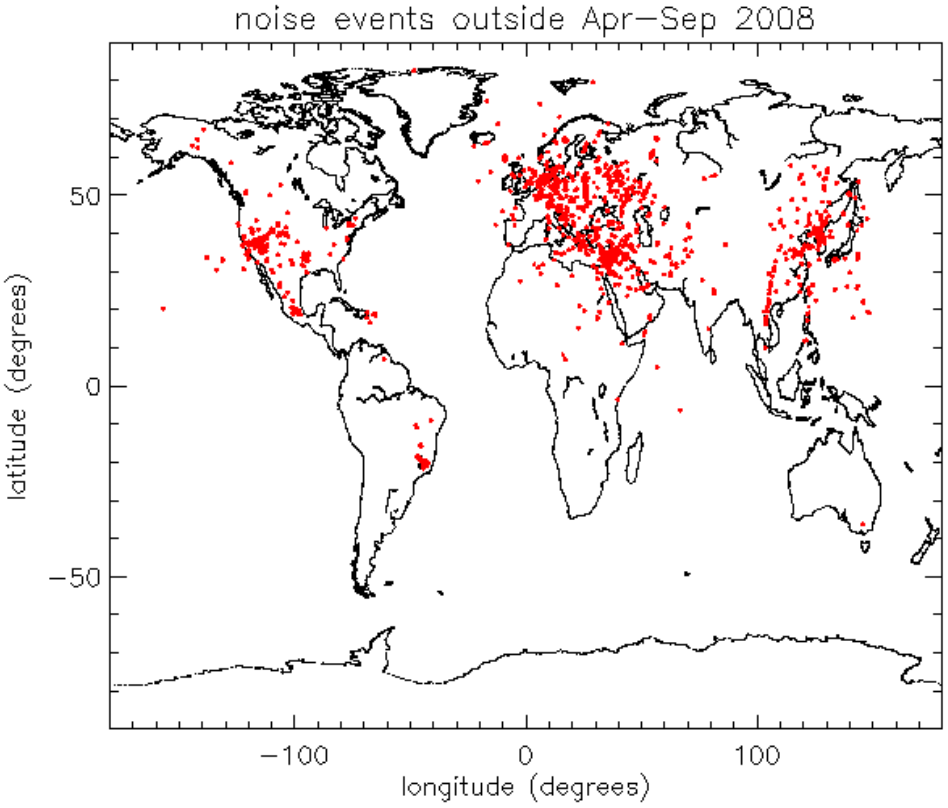


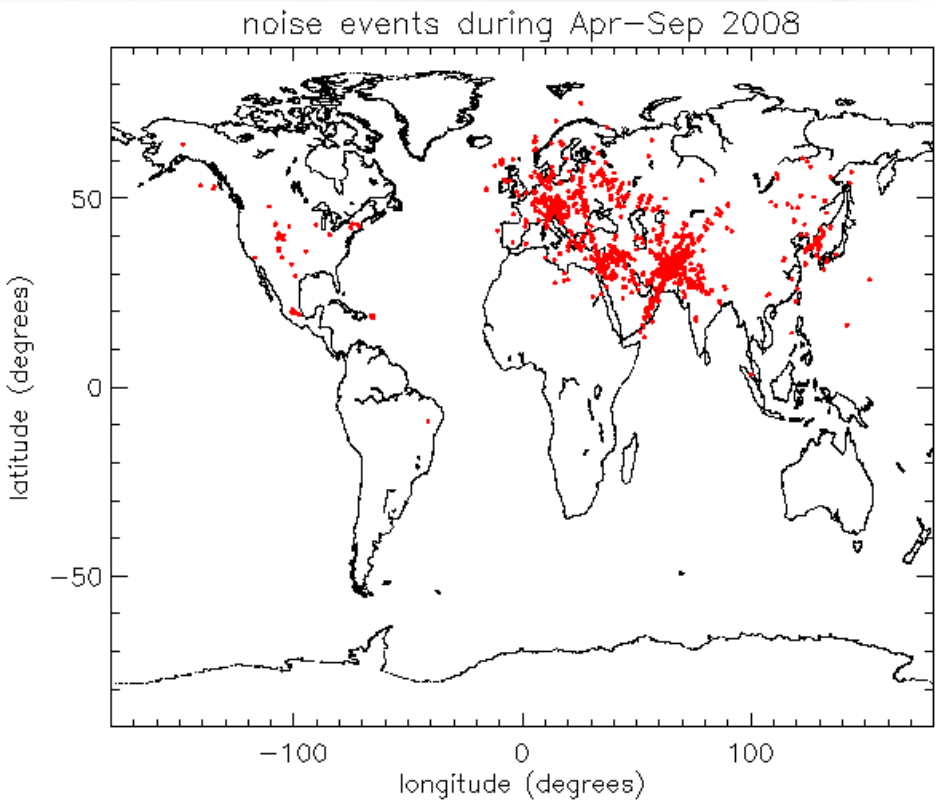


L1b – Phase-1 reprocessing analysis

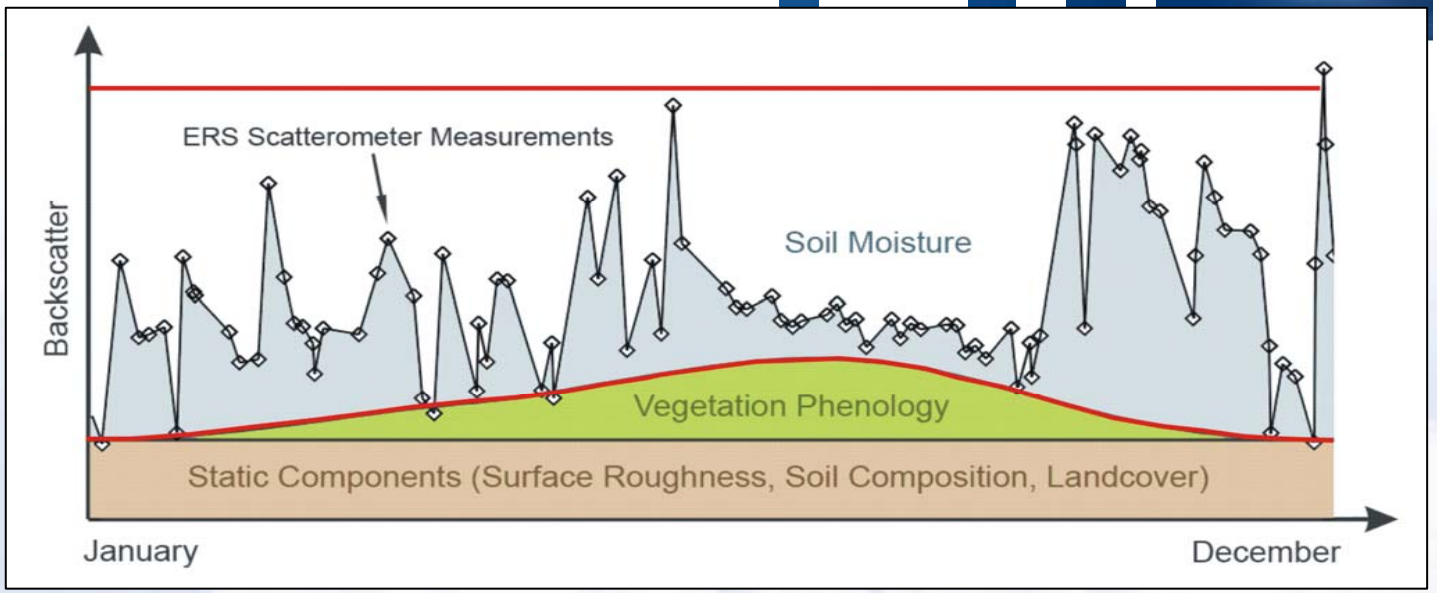
Noise Power monitoring

Location of occasionally unusual values of noise power, particularly between April-Sept 08





L2 Soil moisture – product definition and retrieval method

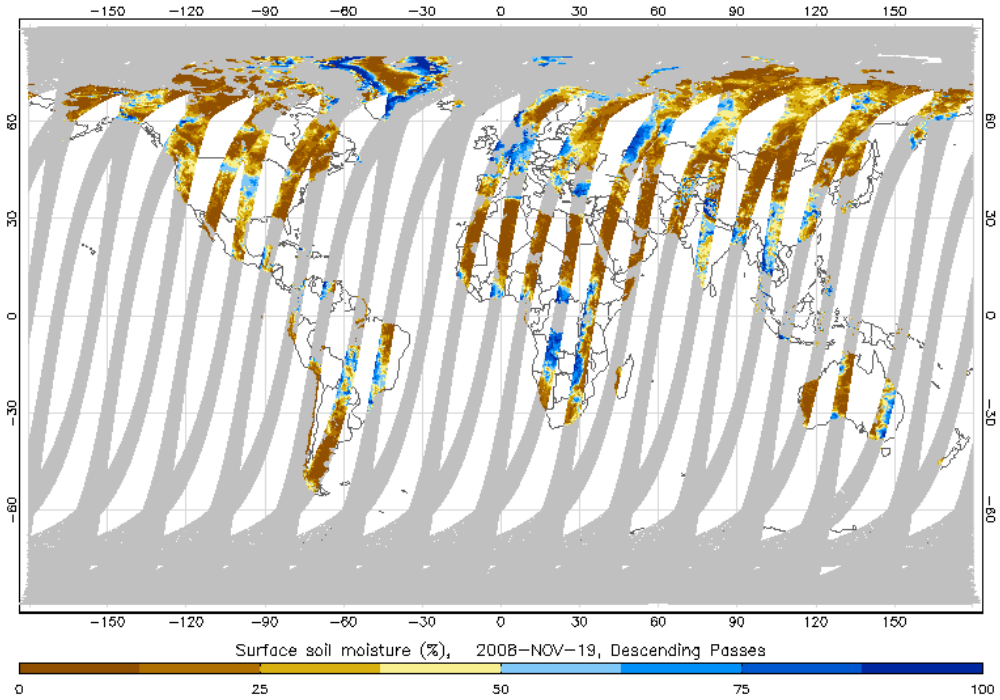


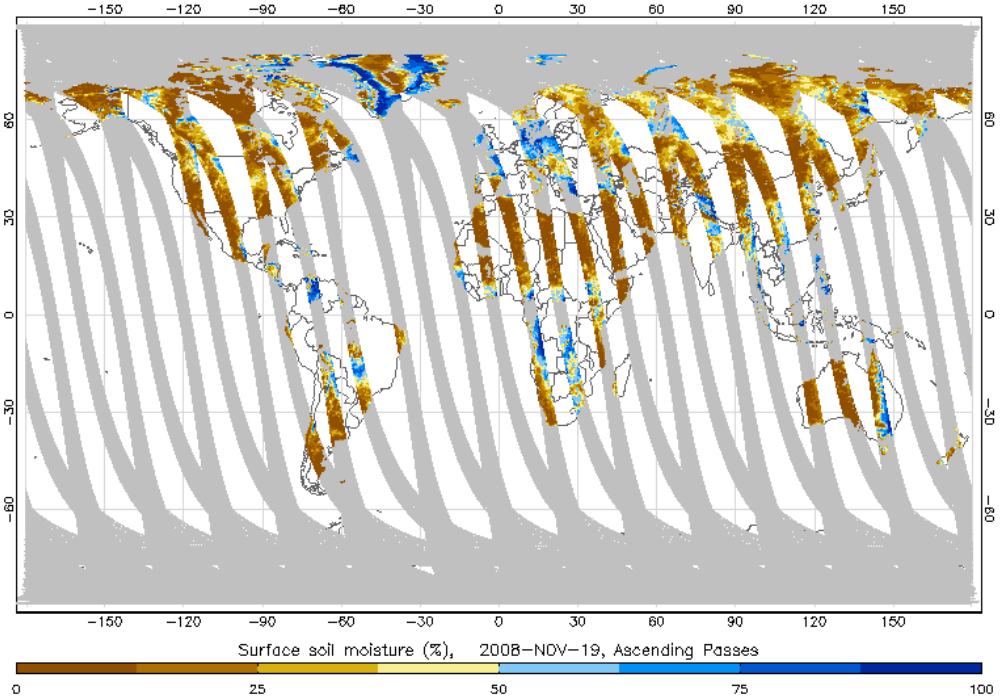
Top 5cm of soil moisture in relative units between 0 and total water capacity [%]

Change-detection, data history-based approach, ERS-1/2 scatterometer data long-term data series starting 1992 (s0 bias corrections necessary), removal of vegetation , land cover patterns and “roughness” at 50 km scale

Linear relationship of soil moisture and backscatter in dB (availability of measurements over several incidence angles is very important)

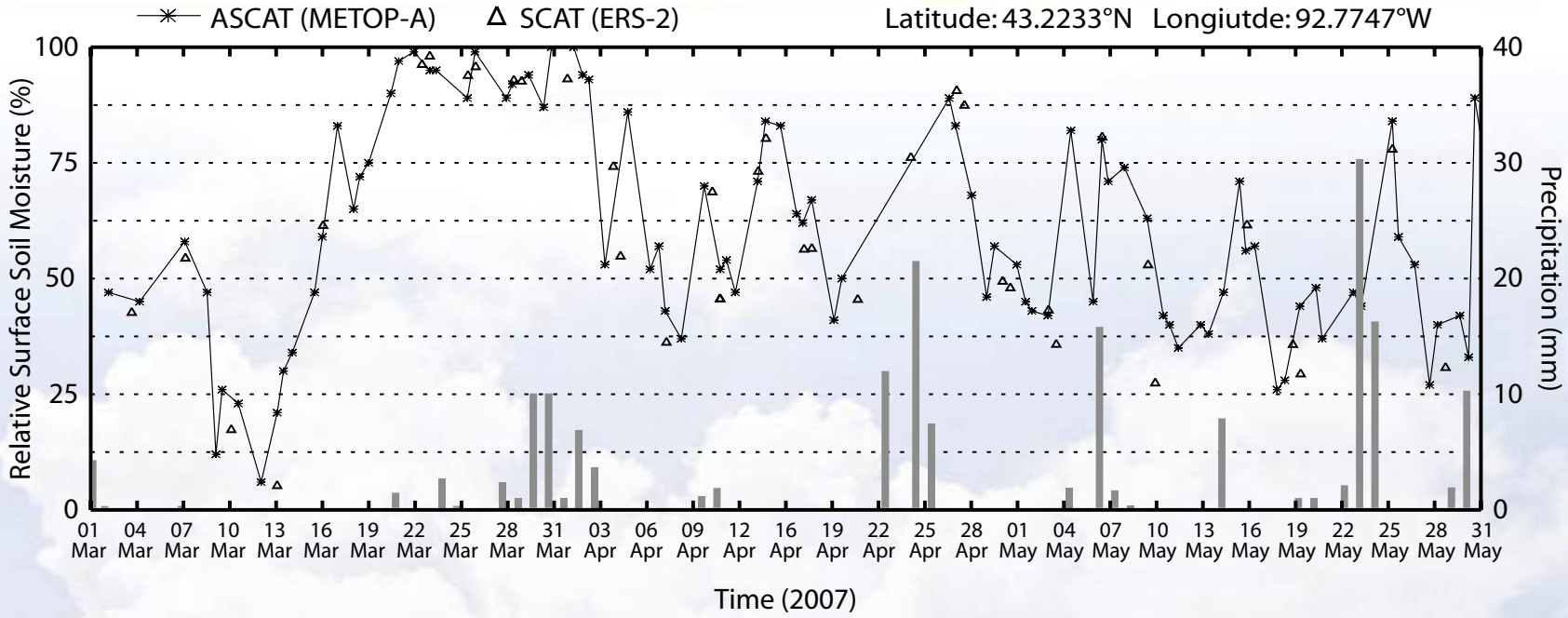
L2 Soil moisture – daily coverage





ftp://adsp_01:12qwas@cvfftp.eumetsat.org/../ASCAT_SOMO/output/html/index.html

L2 Soil moisture – validation



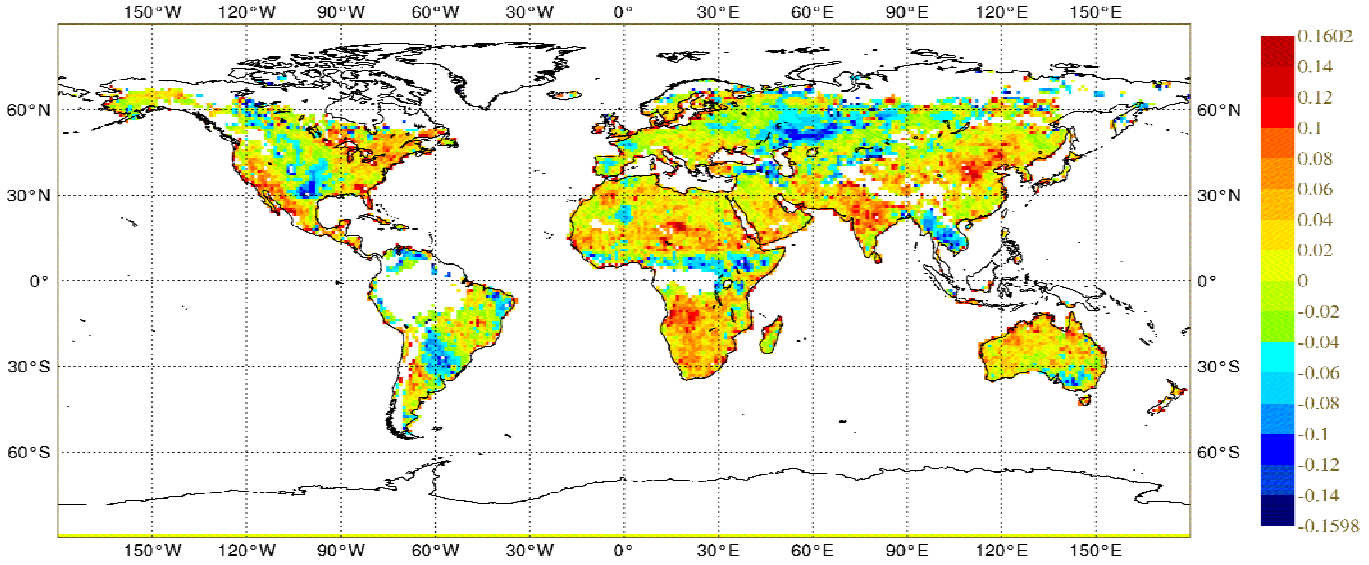
Correlation with rainfall events

Northern Iowa, USA, precipitation data indicated as grey bars.

Courtesy of TUWien from the paper “ASCAT Soil Moisture: An Assessment of the Data Quality and Consistency with the ERS Scatterometer Heritage” by Naeimi V., Bartalis Z., Wagner W., accepted by JHM, 2008

L2 Soil moisture – validation

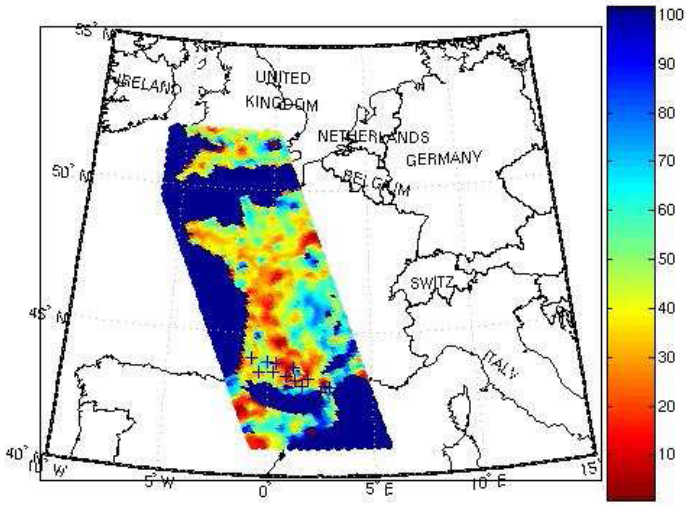
ASCAT SOIL MOISTURE
MEAN ANALYSIS DEPARTURE (OBS-ANA)
DATA PERIOD = 2007050100 - 2007052000
EXP = ez49
Min: -0.480544 Max: 0.521605 Mean: 0.012312



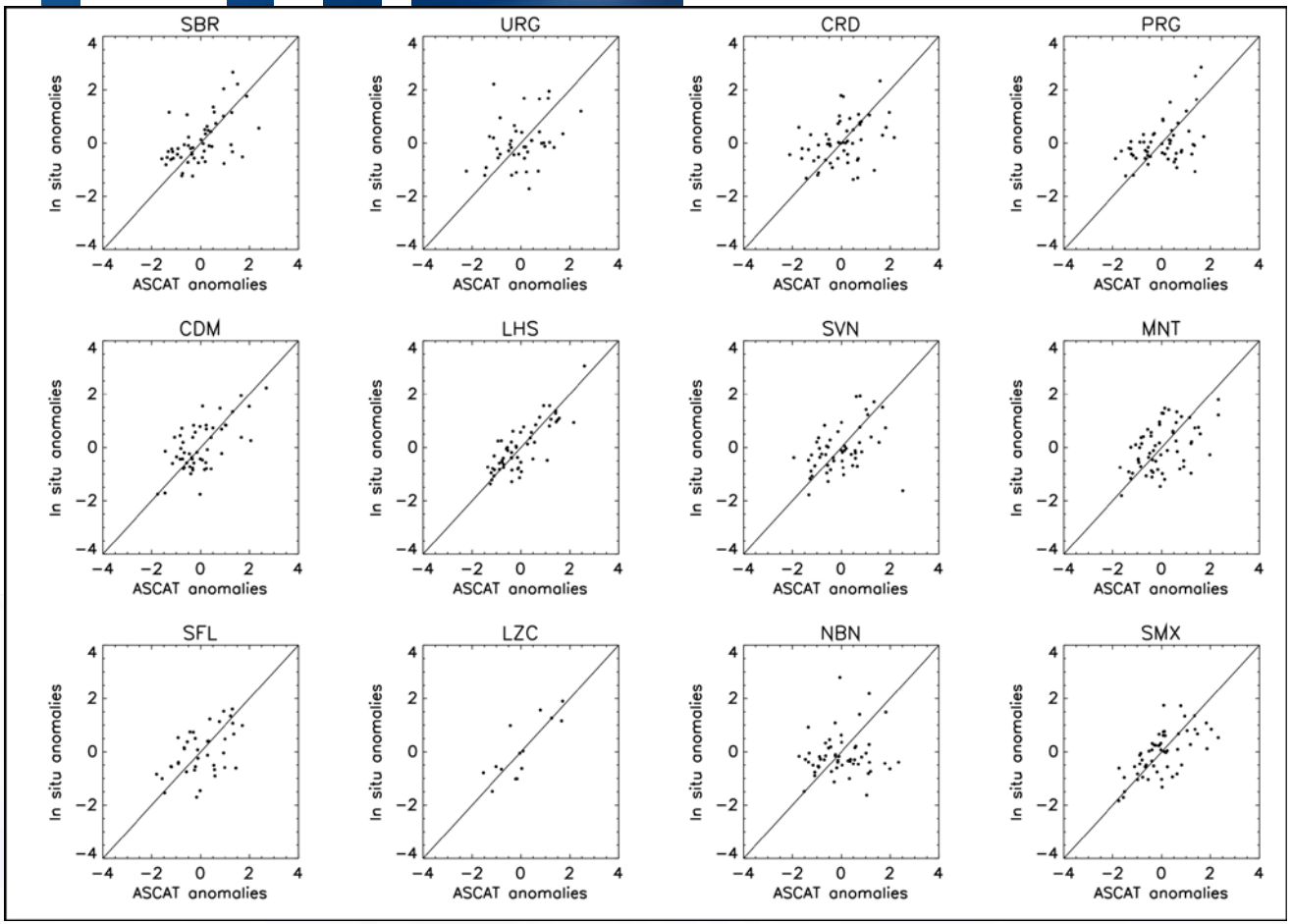
Comparisons with ECMWF mode surface soil moisture

Provided by ECMWF

L2 Soil moisture – validation

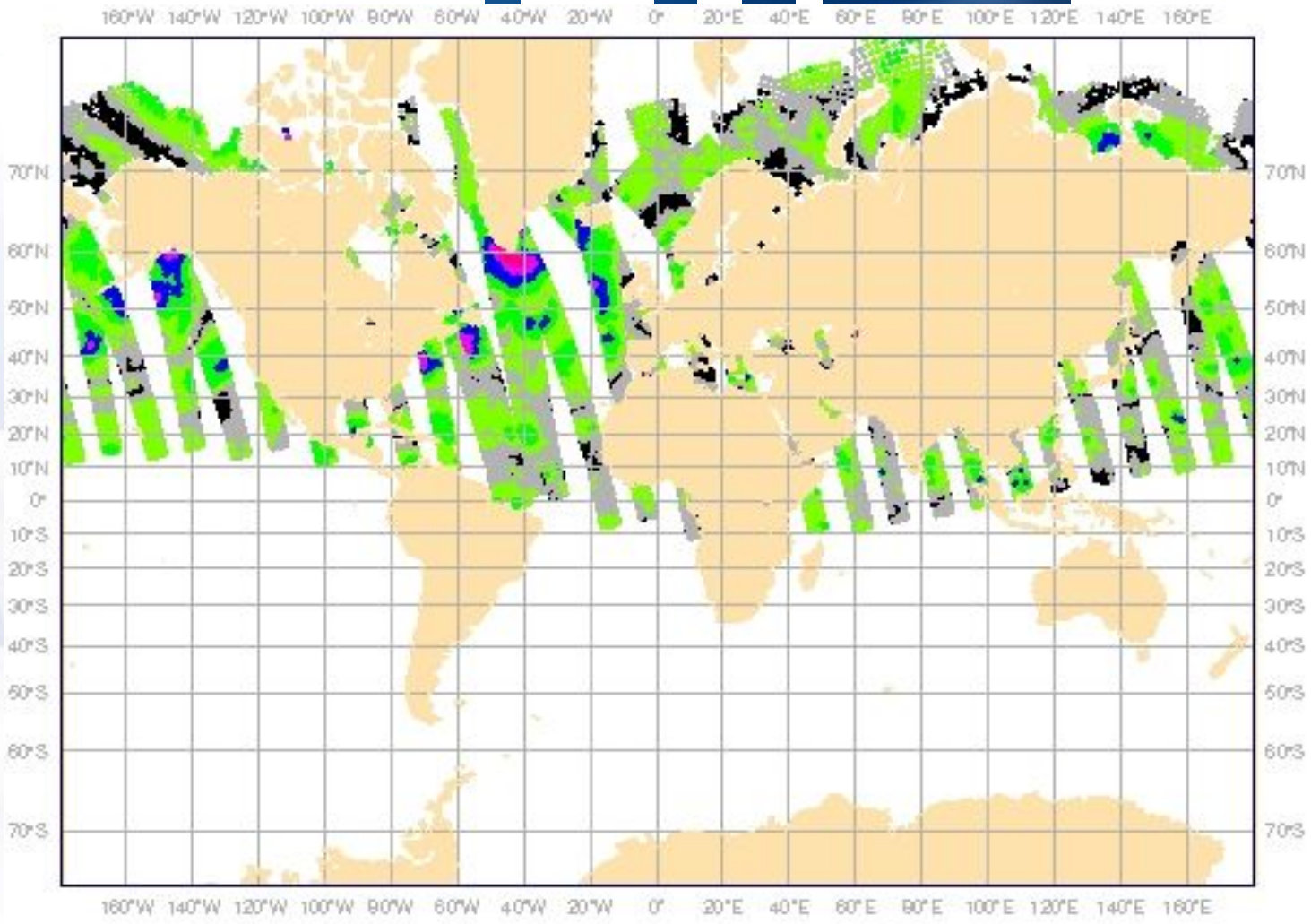


ASCAT surface soil moisture swath over France: “+” symbol are for the twelve stations of the SMOSMANIA network and SMOSREX



In-situ anomalies as a function of ASCAT anomalies for descending orbits between 1 April and 30 September 2007
Provided by Meteo-France

EARS ASCAT L2 winds - coverage



Picture provided by KNMI