



**Information Day on EO Exploitation Activities of ESA's
Strategic Initiative: Soil Moisture**

**Norwegian Space Centre
Oslo, Norway
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ESA CLIMATE CHANGE INITIATIVE

ESA DATA USER ELEMENT

ESA VALUE ADDING ELEMENT



- The role of soil moisture in controlling energy fluxes and water exchange is incontestable: its long-term characterisation is required for **assessing the impacts of global warming on land surfaces**
- **Soil moisture has been declared an Essential Climate Variable (ECV)**
- Despite the emergence of several useful remotely-sensed soil moisture products, still many open issues:
 - Non-microwave methods affected by e.g. **cloud cover/atmospheric effects**
 - Microwave methods affected by e.g. **vegetation/surface roughness/surface temperature/RFI**
 - In-situ validation poses challenging problems, due to the **high spatial and temporal variability** of soil moisture
 - Error characterisation of existing products often **unsatisfactory**
 - Uncertainties about **what is actually retrieved** and **how soil moisture should be measured** in the field

GCOS Requirements for Soil Moisture



**2006
September**

GCOS-107
("satellite supplement")

2010 August

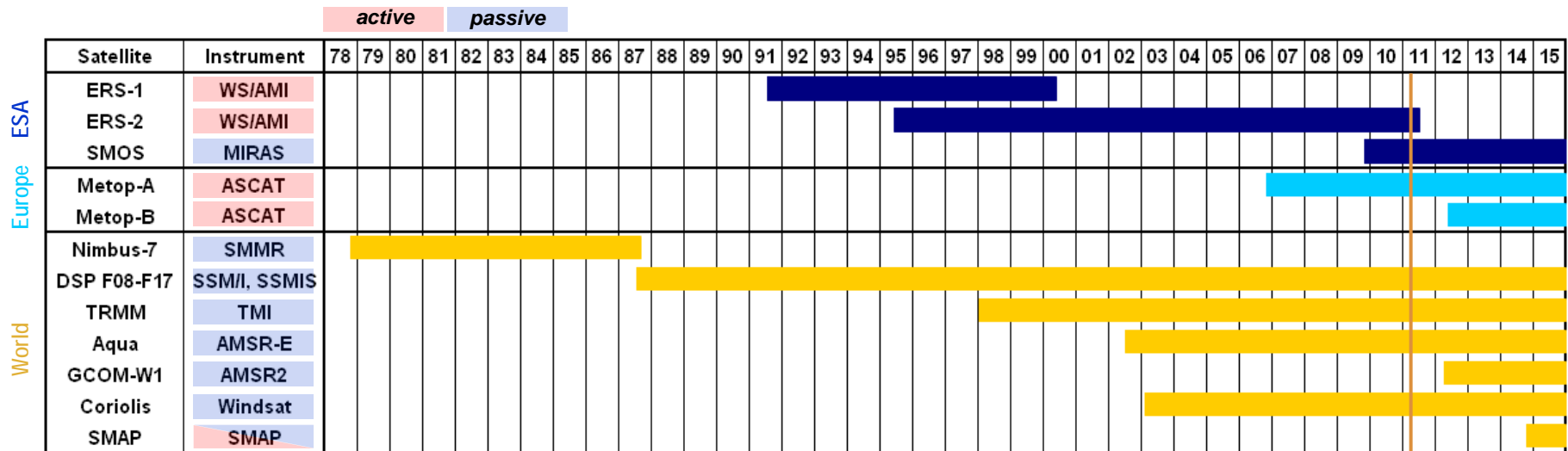
GCOS-138
(implementation
plan update)

Current Status

Status	Emerging		"Full"	
Requirements	Accuracy	5%		
	Resolution	Spatial	50 km	>4-5 vol% for some products, unknown for others
		Temporal	daily	>1-2 days
Stability	5%		Unknown for most products	
Needs	<p>T.10: Research towards global near-surface soil moisture (up to 10 cm soil depth).</p> <p>FCDR needed: active and passive microwave data</p>		<p>Scientific output steadily increasing.</p> <p>Recently launched or planned sensors (SMOS, SMAP, etc) too recent.</p> <p>Good potential for long time series from well-established passive (SMMR, SSM/I, TMI, AMSR-E) and active (ERS-1/2 Scatterometers, ASCAT) sensors.</p>	
Actions	N/A		<p>T13: Develop a record of validated globally-gridded near-surface soil moisture from satellites.</p> <p>Some already piecewise available, but validation and error characterisation still require substantial effort.</p> <p>Still potential for improvement in retrieval algorithms and hydrological modelling.</p> <p>Time series merging strategies need to be developed and evaluated.</p>	
			<p>T14: Develop Global Terrestrial Network for Soil Moisture (GTN-SM)</p> <p>A number of dedicated soil moisture validation sites are established but more are needed.</p> <p>International cooperation in gathering and streamlining existing historical in-situ data has started and needs to continue.</p>	

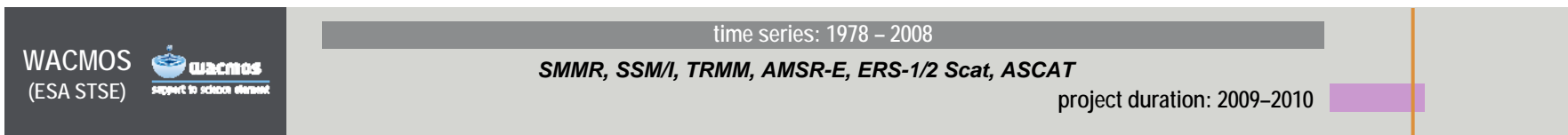
Data

Primary: coarse-resolution microwave



Secondary: high-resolution microwave, optical, visible/thermal IR

Related Projects



- These three ESA CCI high-level requirements apply to all ECVs:
 - **Maximise consistency**
 - **Maximise time series extent**
 - **Minimise uncertainties**

Algorithms

- Consistent product merging
- Retrieval validity
 - FCDR
 - Individual Level 2 Soil Moisture
 - Final CCI output
- Not sufficient understanding of influences of:
 - Variable surface (soil types, roughness)
 - Topography
 - Vegetation
 - Litter, interception, dew
 - Extent of standing water
 - Sensing time of day
 - RFI

Validation

- In-situ soil moisture data
 - No standard collecting protocol
 - No real approach for scaling from point to footprint
 - Incomplete geographical coverage
 - Uncertainty not always known
- Modelled soil moisture
 - Validity
 - “Data incest”
- Overlap and extension by recent (SMOS) and future (SMAP, Aquarius) missions

Uncertainties

- No complete instrument Level 1 uncertainties
 - For individual instruments
 - Between instrument generations
 - Between instrument types
- No consistent uncertainty estimation methodology of Level 2 Soil Moisture
- Retrieval differences between active/passive and between different wavelengths not sufficiently understood
- Not clear which soil depth is measured
- Unconsolidated definition of truth