



The mission of the CEOS Land Product Validation (LPV) subgroup is to coordinate the quantitative validation of satellite-derived products. The focus lies on standardized intercomparison and validation across products from different satellites, algorithms, and agency sources.

The sub-group consists of 11 Focus Areas, with 2 co-leads responsible for each land surface variable (essential climate and biodiversity variables).



LAI-(Leaf Area Index)

Fapar-(fraction of absorbed photosynthetically active radiation)

Fire/Burn Area

Phenology

Vegetation Index

Land Cover

Snow Cover

BRDF/Albedo-(bidirectional reflectance distribution function)

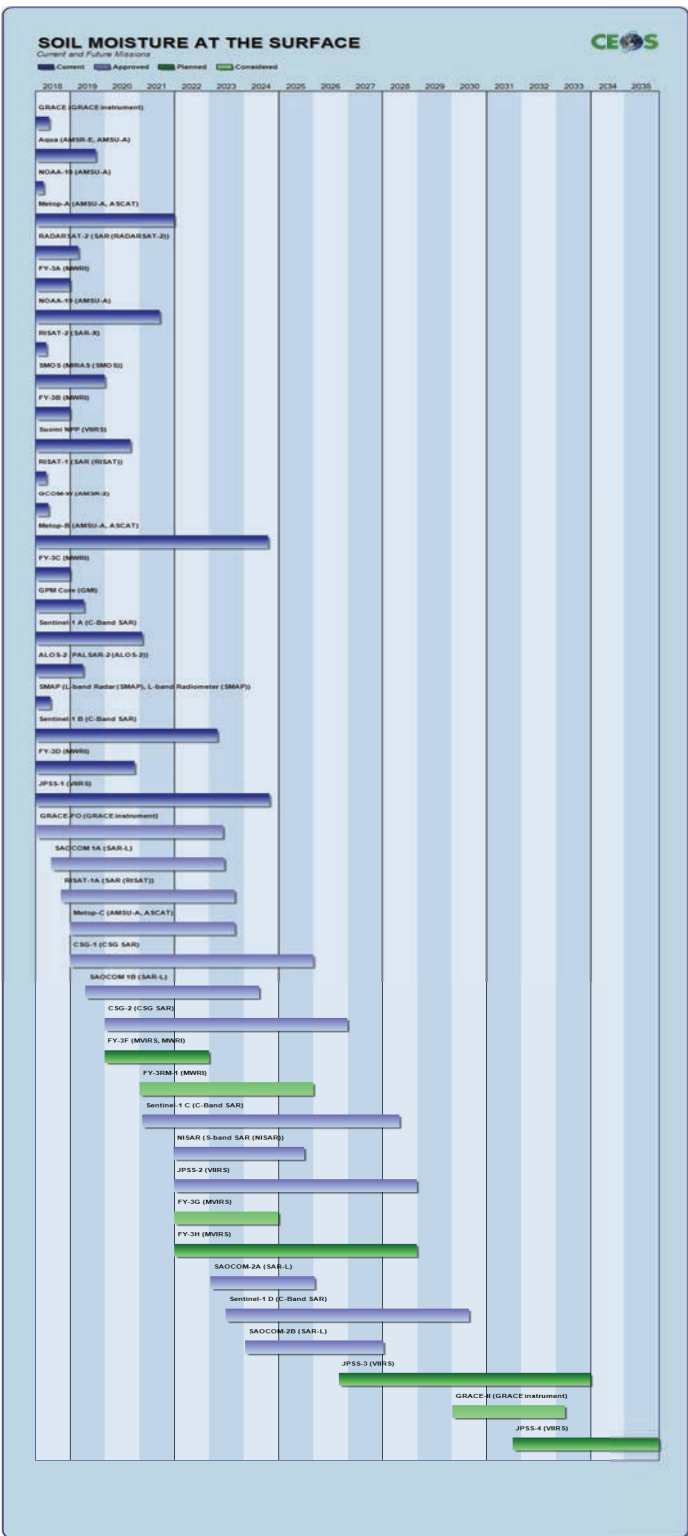
Soil Moisture

LST and Emissivity-(Land Surface Temperature)

Biomass



| <b>Validation Stage - Definition and Current State</b> |   | <b>Variable</b>   |
|--|---|---|
| <b>0</b>   | No validation. Product accuracy has not been assessed. Product considered beta.   |   |
| <b>1</b>   | Product accuracy is assessed from a small (typically < 30) set of locations and time periods by comparison with in-situ or other suitable reference data.   | <b>Snow<br/>Fire Radiative Power</b>  |
| <b>2</b>   | Product accuracy is estimated over a significant set of locations and time periods by comparison with reference in situ or other suitable reference data. Spatial and temporal consistency of the product and consistency with similar products has been evaluated over globally representative locations and time periods. Results are published in the peer-reviewed literature.  | <b>Fapar<br/>Phenology<br/>Burned Area<br/>Land Cover<br/>LAI</b>                             |
| <b>3</b>   | Uncertainties in the product and its associated structure are well quantified from comparison with reference in situ or other suitable reference data. Uncertainties are characterized in a statistically rigorous way over multiple locations and time periods representing global conditions. Spatial and temporal consistency of the product and with similar products has been evaluated over globally representative locations and periods. Results are published in the peer-reviewed literature. | <b>Vegetation Indices<br/>Albedo<br/>Soil Moisture<br/>LST &amp; Emissivity<br/>Phenology</b> |
| <b>4</b>   | Validation results for stage 3 are systematically updated when new product versions are released and as the time-series expands.  | <b>Active Fire</b>  |



## CEOS EO Database for Soil Moisture

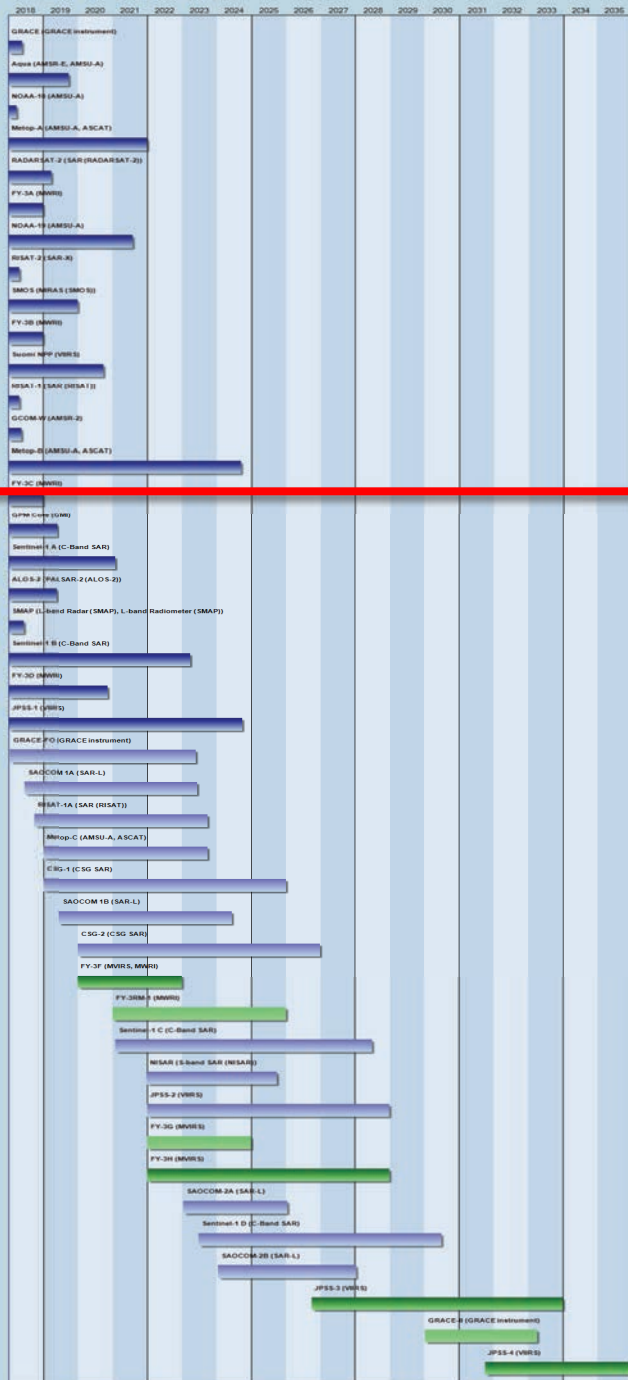
<http://database.eohandbook.com/timeline/timeline.aspx?measurementParameterID=171>

# SOIL MOISTURE AT THE SURFACE



Current and Future Missions

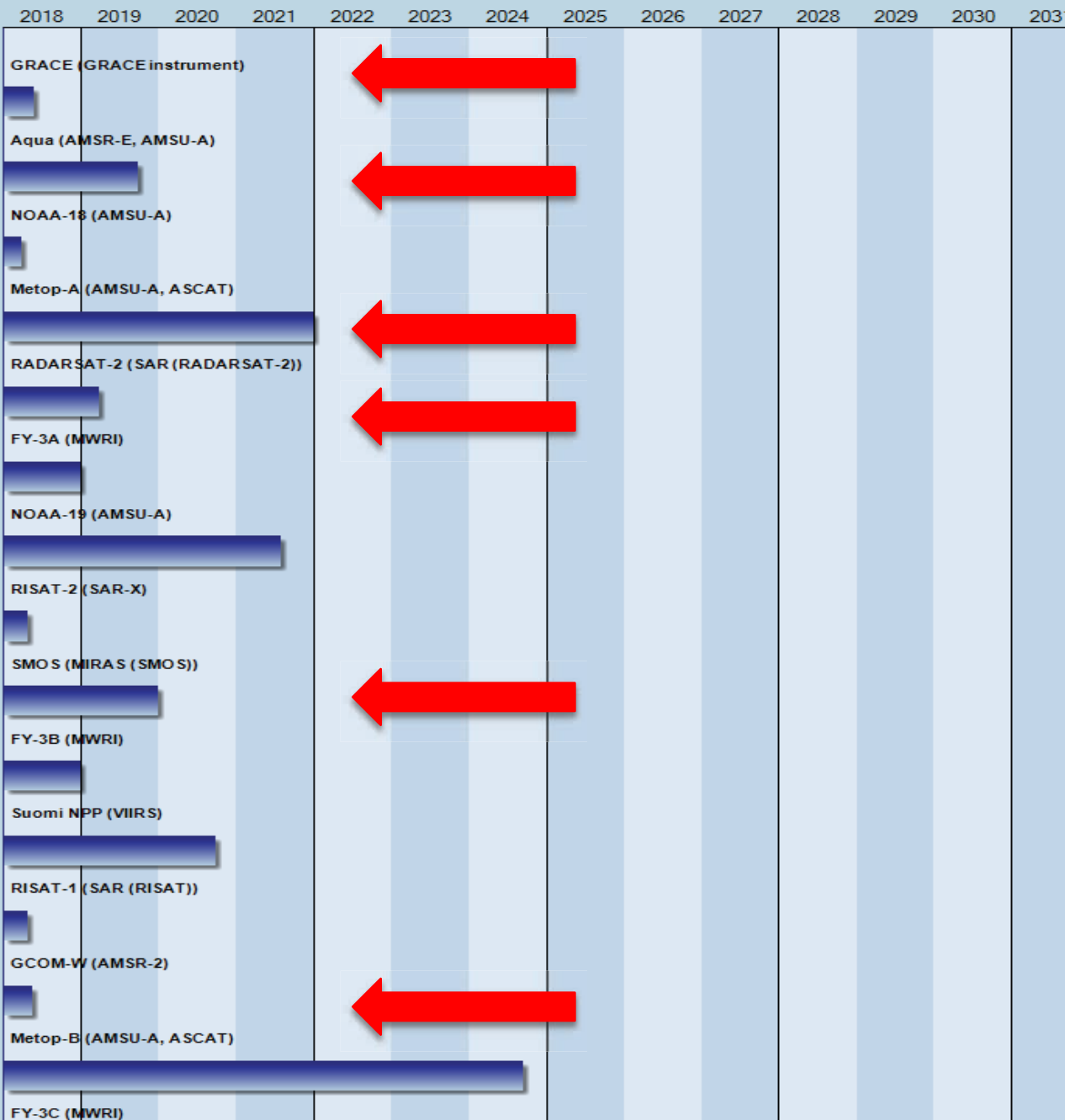
Current Approved Planned Considered



# SOIL MOISTURE AT THE SURFACE

Current and Future Missions

Current Approved Planned Considered



**SOIL MOISTURE AT THE SURFACE**



Current Approved Planned Considered



FY-3C (MWRI)

GPM Core (GMI)

Sentinel-1 A (C-Band SAR)

ALOS-2 (PAL SAR-2 (ALOS-2))

SMAP (L-band Radar (SMAP), L-band Radiometer (SMAP))

Sentinel-1 B (C-Band SAR)

FY-3D (MWRI)

JPSS-1 (VIIRS)

GRACE-FO (GRACE instrument)

SACCOM 1A (SAR-L)

RISAT-1A (SAR (RISAT))

Metop-C (AMSU-A, ASCAT)

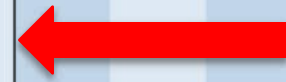
CSG-1 (CSG SAR)

SACCOM 1B (SAR-L)

CSG-2 (CSG SAR)

FY-3F (MWRS, MWRI)

FY-3RM-1 (MWRI)





**SOIL MOISTURE AT THE SURFACE**



Current and Future Missions

Current Approved Planned Considered



CSG-2 (CSG SAR)

FY-3F (MWIRS, MWRI)

FY-3RM-1 (MWRI)

Sentinel-1 C (C-Band SAR)

NISAR (S-band SAR (NISAR))

JPSS-2 (VIIRS)

FY-3G (MWIRS)

FY-3H (MWIRS)

SAOCOM-2A (SAR-L)

Sentinel-1 D (C-Band SAR)

SAOCOM-2B (SAR-L)

JPSS-3 (VIIRS)

GRACE-2





## **Soil Moisture Definition**

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**Soil moisture** is expressed as soil water content (mass or volume of water in the soil) or soil water potential (soil water energy status). The volumetric soil water content is defined as the volume of the water divided by the total volume (volume of dry soil, air, and water) of a soil sample. Conversion is possible if soil properties are known. ([WMO, 2008](#), updated 2012.)

**Units:** Volumetric soil water content is expressed in units of  $\text{m}^3\text{m}^{-3}$ . Additionally, degree of saturation and gravimetric are used for some products, expressed as percent and  $\text{g cm}^{-3}$ , respectively.

## **Highest Validation Stage Currently Reached for Satellite-Derived Soil Moisture Products**

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**Validation stage 3** (LPV validation stage hierarchy) - The highest LPV validation stage reached for satellite-derived Soil Moisture products. Limitations to reach higher validation stage include gaps in spatial distribution of reference data and limited representativeness of point measurements at the satellite pixel resolution.





## GCOS

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GCOS target requirements for soil moisture were set as follows (GCOS-200):

| Variable/Parameter      | Horizontal Resolution | Vertical Resolution | Temporal Resolution | Accuracy                            | Stability                               |
|-------------------------|-----------------------|---------------------|---------------------|-------------------------------------|---|
| Surface Soil Moisture   | 1-25 km               | 0-5 cm*             | Daily               | 0.04 m <sup>3</sup> /m <sup>3</sup> | 0.01 m <sup>3</sup> /m <sup>3</sup> /yr |
| Root Zone Soil Moisture | 1-25 km               | 0-1 m*              | Daily               | 0.04 m <sup>3</sup> /m <sup>3</sup> | 0.01 m <sup>3</sup> /m <sup>3</sup> /yr |

\* Vertical resolutions are not standardized, but these are community practices.

LPV Soil Moisture contributions towards action items T15, T16, T17, T18 (IP 2016/GCOS-200).



Welcome to the Data Hosting Facility of the

## International Soil Moisture Network

The International Soil Moisture Network is an international cooperation to establish and maintain a global in-situ soil moisture database. This database is an essential means of the geoscientific community for validating and improving global satellite observations and land surface models.

Soil moisture, which is the water stored in the upper soil layer, is a crucial parameter for a large number of applications, including numerical weather prediction, flood forecasting, agricultural drought assessment, water resources management, greenhouse gas accounting, civil protection, and epidemiological modeling of water borne diseases. Therefore, the societal benefits of the International Soil Moisture Network are expected to be large.

This international initiative is coordinated by the Global Energy and Water Exchanges Project (GEWEX) in cooperation with the **Group of Earth Observation (GEO)** and the **Committee on Earth Observation Satellites (CEOS)**. The International Soil Moisture Network has been made possible through the **voluntary contributions** of scientists and networks from around the world. The International Soil Moisture Network is operated in cooperation with the **Global Soil Moisture Databank** of the Rutgers University.



**Citation:**

Fernandes, R., Plummer, S., Nightingale, J., Baret, F., Camacho, F., Fang, H., Garrigues, S., Gobron, N., Lang, M., Lacaze, R., LeBlanc, S., Meroni, M., Martinez, B., Nilson, T., Pinty, B., Pisek, J., Sonnentag, O., Verger, A., Welles, J., Weiss, M., & Widłowski, J.L. (2014). Global Leaf Area Index Product Validation Good Practices. Version 2.0. In G. Schaepman-Strub, M. Román, & J. Nickeson (Eds.), Best Practice for Satellite-Derived Land Product Validation (p. 76): Land Product Validation Subgroup (WGCV/CEOS), doi:10.5067/doc/ceoswgcvlpv/lai.002



Committee on Earth Observation Satellites  
Working Group on Calibration and Validation

Land Product Validation Sub-Group

## Soil Moisture Product Validation Good Practices



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## **1. INTRODUCTION**

- 1.1 Importance of Soil Moisture
- 1.2 The UNFCCC and the Global Climate Observing System
- 1.3 The Role of CEOS WGCV
- 1.4 GCOS IP Action Items
- 1.5 Soil Moisture Requirements
- 1.6 Goal of this Documents

## **2. DEFINITIONS**

- 2.1 Definition of Soil Moisture
- 2.2 Definitions of Associated Physical Parameters
  - 2.2.1 Soil Texture
  - 2.2.2 Soil Temperature
  - ...
- 2.3 Definition of Other Key Term

## **3. GENERAL CONSIDERATIONS FOR SATELLITE-DERIVED SOIL MOISTURE VALIDATION**

- 3.1 CEOS Validation Stages
- 3.2 Reference Soil Moisture Estimates

## **4. GENERAL STRATEGY FOR VALIDATION OF SOIL MOISTURE PRODUCTS**

- 4.1 Current Products
- 4.2 Status of Current Validation Capacity
- 4.3 Validation Requirements

## **5. RECOMMENDED APPROACH FOR SOIL MOISTURE PRODUCTS**

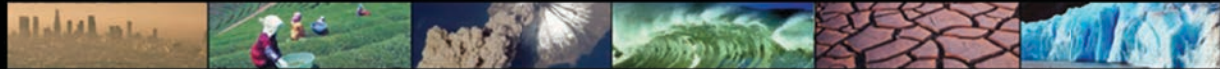


## CEOS WGCV LPV Soil Moisture



National Aeronautics and Space Administration  
Goddard Space Flight Center

## CEOS Working Group on Calibration and Validation



# Land Product Validation Subgroup

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## CEOS WGCV LPV Soil Moisture

## WORLD METEOROLOGICAL ORGANIZATION

### Commission for Agricultural Meteorology (CAgM)

**Proposed Structure for CAgM-17 (2018-2022)  
(as recommended by CAgM Management Group)**

#### **Focus Area 2: Research and Technology Development in Agrometeorology**

##### **Expert Team on Soil Moisture Monitoring and Applications**

- *Topics: Standards for soil moisture measurements; Applications on integrating ground-based and remotely sensed observations.*

##### **Expert Team on Agricultural Flux Measurements (Atmosphere and Soils)**

- *Topics: Standards on agricultural flux measurements; Liaise with various UN organizations on soil flux measurements; Liaise with IG3IS activities.*

##### **Expert Team on Weather and Climate Modeling for Sustainable Agriculture**

- *Topics: Use of climate scenarios for plant breeding and agricultural planning; Integration of weather / climate models with crop models.*

##### **Task Team on Operational Data Issues in Agricultural Meteorology**

##### **Task Team on World Agrometeorological Information Service (WAMIS)**





## CEOS WGCV LPV Soil Moisture