

Scientific Information Portal in the World Wide Web: The Global Soil Moisture Archive 1992- 2000 from ERS Scatterometer Data

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Abstract

Soil moisture is a key state variable of the global energy, water and carbon cycles and is such of crosscutting importance for a wide range of scientific applications. A method for soil moisture retrieval from space borne radar data, developed at the Institute of Photogrammetry and Remote Sensing of Vienna University of Technology, is opening new possibilities to provide soil moisture data for science and real-time applications. A recently established World Wide Web site makes the data available to the global community. The present paper discusses the Global Soil Moisture Archive and summarizes first experience with the information portal.

1. Introduction

Soil moisture is a key state variable of the global energy, water and carbon cycles and is such of crosscutting importance for a wide range of scientific applications. Through its dominant influence on key physical processes, soil moisture is a variable that has always been required in many interdisciplinary scientific and operational applications. These include agriculture, forest ecology, civil engineering, water resource management, climate research, weather forecast, ecosystem modelling and soil science. Although various scientific disciplines require soil moisture, access to reliable data is non-existing, hampering progress in related research disciplines (e.g. Jackson, 1999; Blöschl and Sivapalan 1995; Dirnmeyer 1995).

A main obstacle in providing reliable soil moisture data is the lack of a convincing approach to measure soil moisture operationally (Hollinger and Isard, 1994; Rombach and Mauser, 1997). Modern satellite based earth-observing systems offer means to overcome limitations imposed in traditional methods, opening new possibilities to provide soil moisture data for science and real-time applications. Since several years the Institute of Photogrammetry and Remote Sensing of Vienna Uni-

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iversity of Technology, is successfully working on a method to retrieve soil moisture information from low resolution active microwave data that has the potential to measure the soil water content directly, cost-effectively and homogenous in space and time (Wagner 1999). The method utilises data from the ERS scatterometer which was flown on the European Remote Sensing Satellites ERS-1 and ERS-2 (starting in 1991) and the Advanced Scatterometer which will be launched on board of the Meteorological Operational Satellite METOP in 2005. Only recently processing of global soil moisture data for the period 1992-00 has been finished.

To make the data public to a wide scientific community and in consequence motivate a thorough review, data of the Global Soil Moisture Archive is published in the World Wide Web. Soliciting researchers and users from various fields should trigger a broad discussion on the methodology used to retrieve soil moisture and such provide the basis for further developments and improvements.

2. The Information Portal

To reach a number of different scientific communities and make them aware of the global soil moisture archive, it was decided to use the World Wide Web, beside review journals, as a publishing platform and make data of the Global Soil Moisture Archive available under

<http://www.ipf.tuwien.ac.at/radar/ers-scat/home.htm>

The World Wide Web offers the unique possibility to be easily accessible and to provide room for a comprehensive presentation, complementing traditional publishing platforms like scientific journals. Accordingly, the established web portal informs interested users about the existence of a new source of information and offer possibilities to critical review derived soil moisture information. Focus of the web portal is hence on the visualisation of derived products.

2.1. Content

The Global Soil Moisture Archive comprises surface soil moisture and profile soil moisture (for the first meter) information at a spatial scale of 50x50 km². The core product of the retrieval method is a measure of surface soil moisture, the degree of saturation. The degree of saturation expresses the volume of water present in the soil relative to the volume of pores and is given in relative units ranging from 0-100 %. Depending on the location surface soil moisture measures are available 1-2 times per week. Profile soil moisture (Soil Water Index) is derived from surface soil moisture applying a simple infiltration model and is normally derived every decade. Similar to

the degree of saturation, the Soil Water Index is a relative measures ranging from 0 to unity (100%) or in physical quantities from Wilting Level to Field Capacity. If the respective values of wilting level and field capacity are known, the Soil Water Index can easily be transformed to the respective wetness value in volumetric units representing an absolute measure of soil moisture.

| Parameter | Symbol | Frequency | Resolution | Range | Comments |
|--------------------------|--------|---|-------------------------|---------------------------|---|
| Degree of Saturation | m_s | ~ 3-4 days ¹ | 50 x 50 km ² | 0 – 100 % | Relative measure of surface soil moisture |
| Soil Water Index | SWI | 7 days 10 days 1 month ² | 50 x 50 km ² | 0 – 100% | Relative measure of profile soil moisture |
| Volumetric Soil Moisture | VSM | 7 days 10 days 1 month ² | 50 x 50 km ² | 0 – 50 Vol % ³ | Absolute measure of profile soil moisture |

¹ The Frequency depends on the available satellite data over a respective region. 3-4 days is an average value.

² any timestep is possible but 7 days is recommended as minimum time step.

³ the upper limit is based on experience, higher values are possible.

Tab. 1: Meta Information of the soil moisture data available through the Global Soil Moisture Archive.

To provide the user a comprehensive overview on the retrieved information examples of the different parameters are present on the information portal. The user has the possibility to view monthly SWI maps for each continent and sub regions and complete time series of surface soil moisture and volumetric soil moisture for selected points (Fig. 1). To guide the user in the interpretation of data and to allow a critical review, scatterometer derived soil moisture information is complemented by comparable information such as gridded precipitation data (GPCC 1998), synoptic weather records and insitu soil moisture data (Robock et al., 2000).

2.2. Implementation

Two basic requirements directed the design of the homepage. It should be simple but informative and easy accessible. It was therefore decided to rely on basic HTML and JAVA scripts. Using basic HTML and JAVA scripts guaranteed to be largely independent of web browser technology with the advantage of being compatible to the most common web browsers. Care was taken that the data is easily browsable using a simple intuitive menu. To allow straightforward evaluation of retrieved soil moisture

information, soil moisture information is directly compared to complementing data such as precipitation or insitu soil moisture data.

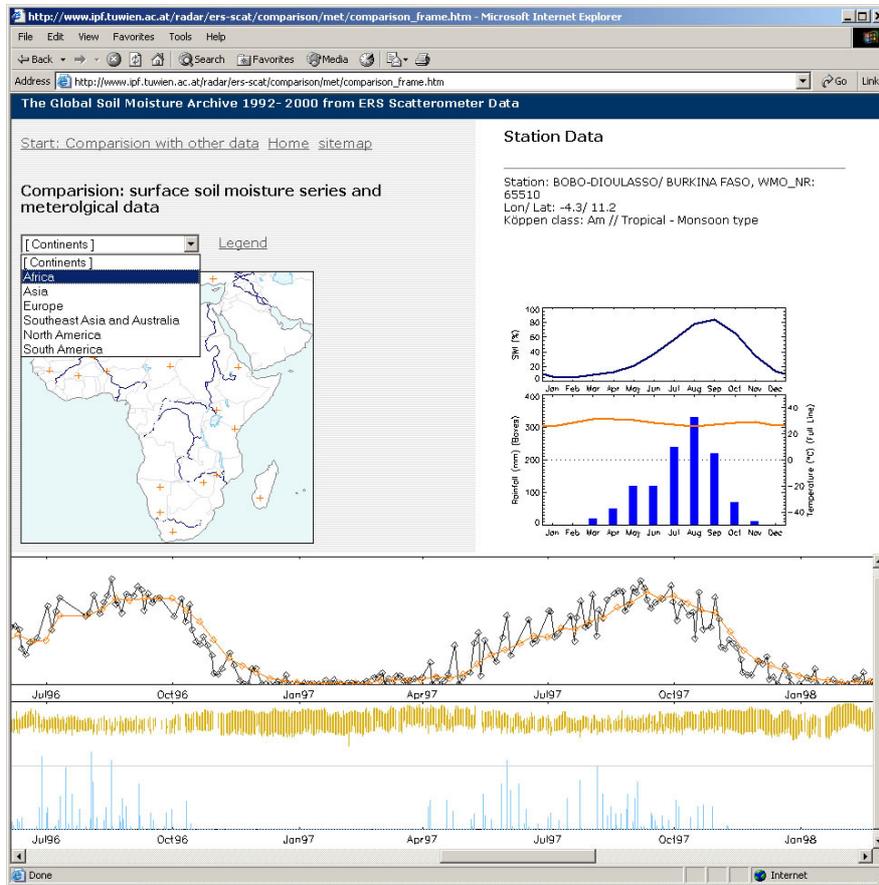


Fig. 1: Visualisation of soil moisture for a selected point in Africa. Surface Soil Moisture is compared to basic meteorological parameters.

2.2. Data Distribution

Principally derived soil moisture products are made publicly available on a non-cost basis for scientific applications. Providing open access to soil moisture information should relieve data distribution and hence guarantee diverse application of the data. Applying the derived soil moisture data in various scientific fields is an essential as-

pect of the validation process, giving insight into the data from different perspectives.

Data is distributed to scientific institutions in ASCII coded lists. Each list contains the coordinates of the grid points of an area of interest and soil moisture information for the respective region for a specific measurement date. Depending on the requests, data can be derived on a weekly, decade or monthly basis and is delivered via FTP.

3. Conclusions and Future Directions

Modern satellite based earth observation by the ERS scatterometer allows the first time to provide a global, reliable measure of soil moisture with adequate temporal and spatial resolution. Based on scatterometer a comprehensive Soil Moisture Archive for the period 1992-00 was set up containing information about surface and profile soil moisture. Recent research and pilot projects indicate that the obtained data can open new possibilities for science and real-time applications in various fields. Data of the Global Soil Moisture Archive is made available in the World Wide Web under <http://www.ipf.tuwien.ac.at/radar/ers-scat/home.htm> to reach the various scientific communities and to allow a critical review.

First experience with the Information portal show that the aim, to attract people from different scientific communities and potential users is eased by using the World Wide Web as publishing platform. Although the method and first results have been published in the most reputable remote sensing journals and on various conferences, a significant number of potential users responds only after visiting the project web page. Using the World Wide Web therefore seems to become an indispensable publishing tool complementing traditional means.

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