# Remote Sensing of Soil Moisture and its Geophysical Applications

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## Overview

Soil moisture is an important hydrologic state variable critical to successful hydroclimatic and environmental predictions. Soil moisture varies both in space and time because of spatio-temporal variations in precipitation, soil properties, topographic features, and vegetation characteristics. Spatio-temporal distributions of soil moisture status in the root zone across large land areas provide important inputs for many agricultural, hydrological, and meteorological applications. Also, estimation of root zone soil moisture at various temporal and spatial scales is key to strategic management of water resources. Root zone soil moisture is a critical storage parameter, which controls partitioning of energy and mass related to evapotranspiration and runoff. Precipitation, soil texture, topography, land use, and a variety of meteorological variables influence the spatial distribution and temporal evolution of root zone soil moisture.

In recent years, air- and space-borne remote sensing campaigns have successfully demonstrated the use of passive microwave remote sensing to map soil moisture status near the soil surface at various spatial scales. Microwave remote sensing has also been proven successful for estimating the dielectric properties of soil based on land surface emissivity, which in turn helps in the estimation of soil moisture. Sensors mound over various satellites have found reliable in measuring the global surface wetness. Space-borne platforms/satellites such as SMOS (launched by the European Space Agency in 2009) and SMAP (launched by NASA in 2015) instruments were placed in orbit for the global monitoring of near-surface soil moisture. The SMOS and SMAP passive radiometers are currently providing 35- to 60-km-resolution soil moisture data globally on 2- to 3-d intervals, while SMAP active radar have failed and are out of service. Although coarse, SMAP and SMOS radiometer products are providing their first-of-the-kind brightness temperature and soil moisture data for various earth science applications at a global scale.

This course will give an exposure to all these advancements, considering the fact that such applications/research are little over India. This course will introduce microwave remote sensing of the Earth surface, in general. Specifically, how microwave remote sensing is used to measure a critical geophysical variable i.e., soil moisture? The course will also discuss the advantages and disadvantages of microwave remote sensing of soil moisture, and the retrieval algorithms. It will also cover the current space-borne platforms/satellites such as SMAP and SMOS that are dedicated for soil moisture measurement. Finally, the course will introduce the participants to important geophysical applications that need soil moisture observations for societal benefits.

# Course Outline

This course is scheduled from February 12 (Monday) to February 16 (Friday) 2018. Course objectives will be covered in five days, with lectures spanning for total 14 hours and tutorials spanning for total 8 hours. The primary objectives of the course are as follows:

- To understand how microwave rem0ote sensing is used to measure a critical geophysical variable i.e., soil moisture and realize the advantages and disadvantages of microwave remote sensing of soil moisture, and the retrieval algorithms.
- To provide the participant with the optimal information about microwave remote sensing of the Earth surface and its usage for further research pertaining to microwave remote sensing of soil moisture
- To expose the participants to the state-of-the-art space-borne platforms/satellites such as SMAP and SMOS that are dedicated for soil moisture measurement.

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| **Modules** | **Remote Sensing of Soil Moisture and its Geophysical Applications: February 12 – February 16, 2018 at Indian Institute of Technology (IIT) Delhi**<br><br>**Contents:**<br>• Introduction to microwave remote sensing<br>• SMAP Active – Passive Algorithm<br>• Error structure/ characterization<br>• Application of triple collocation method<br>• Applications in geophysical applications<br>• Data assimilation – Ensemble Kalman Filter<br>• Performance of soil moisture products<br>• State of the science<br><br>**Number of participants for the course will be limited to fourty.** |
| **Who can attend** | ▪ Practicing engineer/scientist/researcher from government organizations/ research laboratories/consulting groups/industries working in areas related to water resources/remote sensing fields.<br>▪ Students (Bachelors/Masters/PhD) and faculty from academic institutions interested in the fields of hydrology or geo-informatics or remote-sensing or atmospheric science or environmental science.<br>▪ Hydrologists or meteorologists interested in microwave remote sensing and soil moisture satellite products. |
| **Registration Procedure** | **Step 1: GIAN Web Portal Registration:** Register in the GIAN portal http://www.gian.iitkgp.ac.in/GREGN/index., by paying Rs. 500/- online. Registration to this portal is one time affair and will be valid for lifetime of GIAN. Please note that Course fee is separate.<br><br>**Step 2: Course Registration:** Login to the GIAN portal with the registered User ID and Password. Choose for the Course registration option. Select the course titled "Remote Sensing of Soil Moisture and its Geophysical Applications" from the list and click the "Save" option. Confirm your registration by clicking the suitable option.<br>**Last date for the registration of this course is 5th January 2018.** |

**Step 3: Course Shortlisting:** Candidates will be intimated through email regarding their selection.

**Step 4: Course Fee Remittance:** Once you receive the intimation from the Course Coordinator, the fee (as applicable) need to be paid. The participation fees for taking the course is as follows:

**Students from other Academic Institutes: Rs. 5,000**
**Faculty from other Academic Institute: Rs. 10,000**
**Professionals from Industry/ Research Organizations: Rs. 15,000**
**Participants from abroad: US $250**

The above fee includes all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges. The participants will be provided with accommodation on payment basis.

The details of fee payment by Electronic Clearing Service/ RTGS in the name of "IITD CEP ACCOUNT":

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| Bank Name | State Bank of India |
| Branch Name & Address | IIT Delhi, Hauz Khas, New Delhi – 110016 |
| IFS Code | SBIN0001077 |
| MICR Code | 110002156 |
| Type of Account | Saving Account |
| Bank Account No. | 36819334799 |
| SWIFT Code | SBININBB547 |
| IITD PAN No. | AAATI0393L |

**Step 5: Send Registration Form to Course Coordinator:** Fill up the registration form (Given in Page 5 of this brochure), by providing details of the bank transaction. Send the registration form to the Course coordinator at dhanyact@gmail.com/ hdanya@civil.iitd.ac.in **on or before 15th January 2018.**

# The Faculty

**Dr. Narendra N Das** is a Research Scientist at Jet Propulsion Laboratory (NASA), California Institute of Technology. Dr. Das is actively involved in the Soil Moisture Active Passive (SMAP) mission of NASA as a core member of the Algorithm Development Team (ADT) and has authored NASA SMAP mission documents. Dr. Das also conducts research on soil hydrology and crop modeling. More details in https://science.jpl.nasa.gov/people/Das/

**Prof. Dhanya C.T.** is an Assistant Professor at the Indian Institute of Technology (IIT) Delhi. Her research is primarily focused in unveiling different aspects of hydro-climatology, a multidisciplinary field integrating hydrology and climate science. She has published more than thirty research articles in international and national peer reviewed journals. She is the recipient of numerous awards such as "NASI Young Scientist Award", "IEI Young Engineers Award", Young Associate of Indian Academy of Sciences (IASc) etc. More details in http://web.iitd.ac.in/~dhanya/

Course Coordinator

**Prof. Dhanya C.T.**
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dhanyact@gmail.com

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http://web.iitd.ac.in/~dhanya/gian.html

## REGISTRATION FORM

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**GIAN Course**
**on**
**REMOTE SENSING OF SOIL MOISTURE AND ITS GEOPHYSICAL APPLICATIONS**

**(12th – 16th February 2018)**

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*Name*: _____

*Designation*: _____

*Organization*: _____

*Address*: _____

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*E-Mail*: _____

*Phone*:_____

*Mobile*: _____

*Fax*: _____

**Fees Payable to "IITD CEP ACCOUNT", SBI, IIT DELHI**

Transaction No.: _____

Dated: _____

Bank Name: _____

Rs. _____

Signature of Applicant