WGCapD-Distance Education Course:
Webinar Series on SAR Data Processing and Applications
(April 17-June 9, 2017)
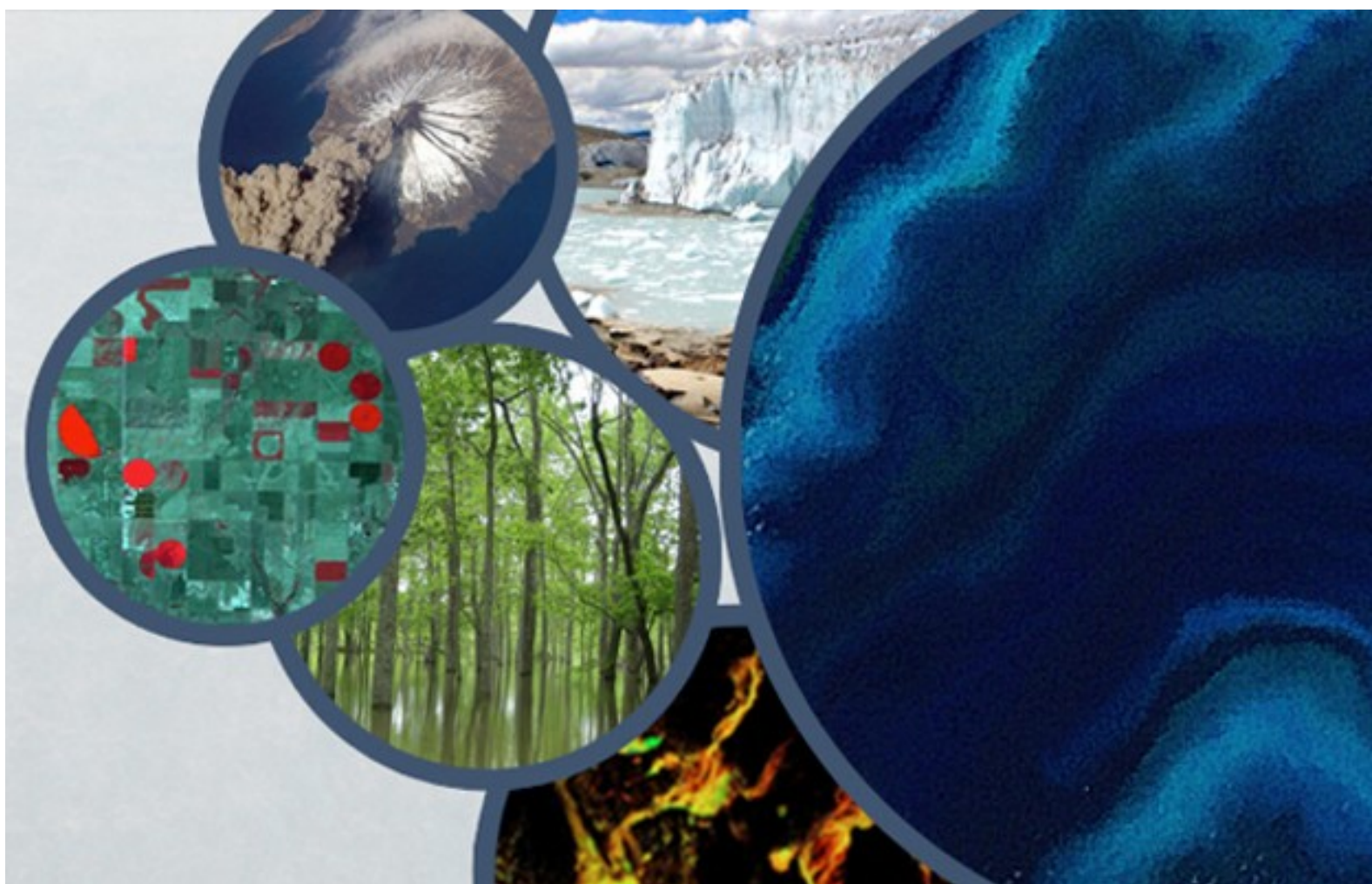
Working Group on Capacity Building and Data Democracy,
Committee on Earth Observation Satellites
Link to Register- http://elearning.iirs.gov.in/wgcapd/CEOS/
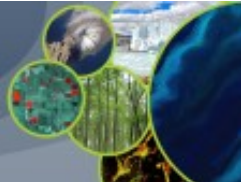
WGCapD-Distance Education Course
SAR Data Processing and Applications

1.   Overview - Background

The Committee on Earth Observation Satellites (CEOS) mission is to ensure international coordination of civil space-based Earth observations programs and promote exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind. CEOS supports effective societal decision-making in the areas of climate monitoring and research; carbon observations, including observations to support the effective monitoring and management of the world's forested regions; food security; disaster risk management; biodiversity; capacity building; data availability and access, and more.

The CEOS Working Group on Capacity Building & Data Democracy (WGCapD) (formed at the 25ᵗʰ CEOS Plenary in 2011) undertakes a variety of activities based on the <u>four pillars of the Data Democracy Initiative</u>, as depicted below:
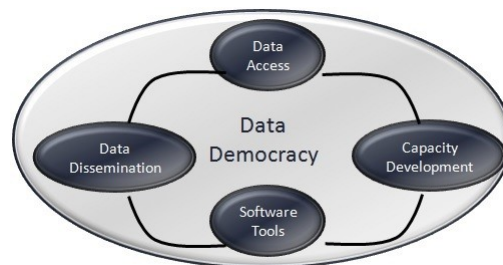

Figure 1 - Data Democracy Pilars

The WGCapD builds upon this Initiative in an effort to increase the capacity of institutions in less developed countries for effective use of Earth Observation data for the benefit of society and to achieve sustainable development.

The overall objective of the WGCapD is building capacity for the effective use of Earth Observation data as well as providing wider and easier access to those data. It aims to unify CEOS efforts toward:

- Providing wider and easier access to Earth Observation data
- Increasing the sharing of software tools such as the use of open source software and open systems interface
- Increasing data dissemination capabilities and transferring relevant technologies to end users
- Providing intensive capacity building, education, and training (including awareness and outreach) for enabling end users to gather the information they need and for increasing communication on achieved results
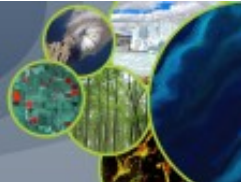
Synthetic Aperture Radar (SAR) remote sensing provides a new dimension for measuring various bio-geophysical parameters of the features on Earth surface. SAR sensors are advantageous in comparison to optical remote sensing because of their day night capabilities and penetration to even dense cloud cover. SAR polarimetry (PolSAR) and Polarimetric SAR Interferometry (PolInSAR) are widely used techniques, which exploit polarimetric and interferometric properties of various man-made and natural scatterers in order to extract the qualitative and quantitative physical information about land, ocean and snow. The growing interest of SAR remote sensing community in retrieval of 3-dimensional information Earth objects makes both polarimetric SAR interferometry and SAR tomography hot topics in recent years. It is expected that combining these two techniques (PolTomSAR) would provide much better discriminating ability for scatterers lying in the same pixel. Generally, this is about reconstruction of scattering profiles from limited and irregular polarimetric measurements. Scientific community is making untiring efforts to resolve the problem of complexity in advance processing of SAR data for different applications through training, education and research. Current research works on SAR remote sensing involve PolSAR, PolInSAR, Differential SAR Interferometry (DInSAR) and PolTomSAR for the manmade and natural objects appearing on Earth surface

2. Course Team

| NAME	INSTITUTION	ROLE	EMAIL
Dr. S. P. Aggarwal	**ISRO**	**Coordinator**	**spa@iirs.gov.in**
Dr. Hilcéa Ferreira	**INPE**	**Contributor**	**hilcea@dpi.inpe.br**
Dr. Harish Karnatak	**ISRO**	**Course Management**	**harish@iirs.gov.in**
Shashi Kumar	**ISRO**	Instructor	**shashi@iirs.gov.in**
Dr. Magdalena Fitrzyk	**ESA**	Instructor	**Magdalena.Fitrzyk@esa.int**
Chris Stewart	**ESA**	Instructor	**Chris.Stewart@esa.int**
Dr. R.S. Chatterjee	**ISRO**	Instructor	**rschatterjee@iirs.gov.in**
TBD	**DLR**	Instructor	
Dr. Heather McNairn	**Agriculture and Agri-Food, Canada**	Instructor	**heather.mcnairn@agr.gc.ca**
Dr. Hitendra Padalia	**ISRO**	Instructor	**hitendra@iirs.gov.in**
Dr. Praveen K. Thakur	**ISRO**	Instructor	**praveen@iirs.gov.in**
Erika Podest	**ARSET (NASA)**	Instructor	**Erika.Podest@jpl.nasa.gov**

3. Language

- The entire distance education course is delivered in English.

4. Target Region

- The course is open to participants from all countries.
- All course materials will be provided in English.

5. Target Participants

- Academician, Scientists, Researchers and Professionals interested in SAR Remote Sensing, data processing and applications.
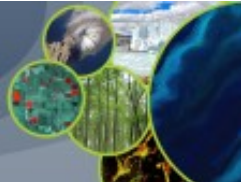
6. Methodolgy

- This course is an online distance education program that allows participants to fully engage with program content, their peers, and their instructors via live lectures, through discussion forums, online chat, question/answer session and feedback mechanisms.

- The Learning Platform Moodle (acronym for modular object-oriented dynamic learning environment) will be used for the course administration, documentation, tracking, reporting and delivery system. It will be hosted at the Indian Space Research Organisation – ISRO LMS Platform

- Citrix GoToWebinar or Aview will be used for synchronous communication among teachers and students and live sessions. . Participants are welcome to participate in all live sessions. However, if for any reason they cannot attend them, all of them will be recorded and available in Moodle for consultation.

7. System Requirements

- **For Moodle:**
    - Recommended Browsers: most browsers will handle the Moodle pages without problem. Some individual modules may require special software or plugins. Minimum recommended browser: Google Chrome 11, Firefox 4, Safari 5, Internet Explorer 8
    - Recommended Settings
        - Make sure that the browser is set to accept cookies
        - Javascript must be enabled
- **For GoTowebinar:**
    - Please check the following website for [GTM System Requirements](#)

8. Number of Participants:

- 100-200 participants

9. Instructors

- CEOS Members: ISRO, NASA, ESA, DLR, USGS, INPE & other space agencies and institutions.

10. Commitment by Instructors

- Preparation of 1-hour presentation using CEOS template
- Preparation of questions for quiz
- Preparation of instructional material or links of interest to be sent to participants
- Availability to participate live on the correspondent webinar session
- Answer possible questions and doubts from participants via discussion forum inside Moodle platform
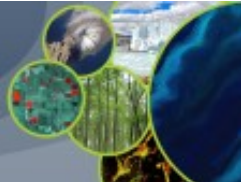
11. Announcement

- CEOS website;
- List provided by ISRO, INPE and CEOS-WGCapD;
- Virtual Laboratory for Training and Education in Satellite Meteorology (VLab website and newsletter);
- Regional Centers for Space Science and Technology Education (affiliated with United Nations);
- Other Regional Centers
  - Regional Centre for Mapping Resource for Development (RCMRD) in Nairobi, Kenya;
  - Regional Centre for Training in Aerospace Surveys (RECTAS) located within the campus of Obafemi Awolowo University, Ile-Ife, Nigeria.

12. Registration:

ISRO LMS (http://elearning.iirs.gov.in/wgcapd/CEOS/)

- Deadline for registration: 14th April 2017

13. Certificate of participation

- Designed and distributed by CEOS SEO

14. Instructional Material

- Presentation given via Power Point
- Recorded online sessions
- Data sources and reading material links
- Frequently Asked Questions (FAQ)

All materials will be made available inside Moodle during the course

15. Copyrights

- WGCapD, CEOS

16. Course Evaluation

- Through Feedback submitted by participants

17. Schedule

- April 17-June 09, 2017. Each monday from 17th April onwards at 13:00 UTC. The duration of each webinar will be of 1 hour and will be followed by 30 minutes Question-Answer session
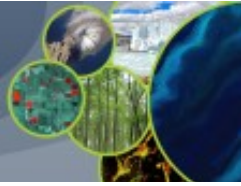
18. Pre requisite

- Elementary knowledge about Remote Sensing and Digital Image Processing

19. Webinar Objectives:

By the end of this webinar series, students will be able to:
- Understand the concept of SAR Remote Sensing and its utility for different applications

- Understand the complex processing steps of SAR data and availability of freely available software to process it
- Know about advantages of PolSAR, InSAR, PolInSAR and PolSAR Tomography
- Select suitable SAR data and appropriate methodology to get an output for specific applications

20.   Themes of Webinar

The themes of the eight webinars are listed next.

1.   **Overview of SAR Remote Sensing**
   Principles of Microwave Remote Sensing (Imaging and Non imaging), Microwave Bands, Imaging Radar Geometry, Basic Concept of Mono-, Bi-static & Multi-static SAR Sensors, Synthetic Aperture Radar (SAR), SAR versus other Earth Observation Instruments, SAR Polarisation, SAR Resolution Cell, Azimuth Resolution, Range Resolution, Complex SAR Image, Application of SAR Remote Sensing
   April 17, 201 7 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructors: Shashi Kumar, ISRO

2.   **SAR Data Format, SAR Missions and data access**
   Different types of SAR system, Imaging platforms and wavelength used in SAR remote sensing, Active and Passive Microwave Sensors, Imaging Modes, Spot-, Strip- & Scan-Mode, SAR data format RAW SLC Multilook, Geocoded: Terrain Corrected Geo Coded Products, Polarimatric Data, recent and historical SAR missions, SAR data access
   April 24, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructor: Dr. Magdalena Fitrzyk and Chris Stewart, ESA

3.   **SAR Data Processing**
   Different Levels of SAR Data, SAR Focusing- RAW Data Processing, Single Look Complex (SLC) Data, Intensity Image Generation, Slant Range Ambiguity & Slant to Ground Range Conversion, Multilook SAR Data, Speckle Filtering, Normalized Backscatter Cross Section
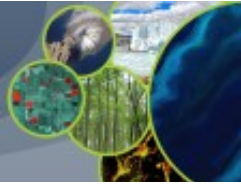   **May 01, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session**
   Instructor: Shashi Kumar, ISRO

4.   **Basics of SAR Polarimetry and Interferometry**
   Polarimetric SAR Remote Sensing, Requirement and need of PolSAR data, Stokes Vector, Polarimetric Scattering, Scattering Matrix and decomposition modeling. Concept of Interference, Phase Information, SAR Interferometry, Baseline, Altitude of Ambiguity, Interferogram Generation, Coherence Generation, Phase Unwrapping, Interpretation of SAR Backscatter, Coherence & Interferogram, Height of the Effective Scattering Centre.
   May 08, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructor: Shashi Kumar, ISRO

5. <u>**SAR Remote Sensing for Geological Applications**</u>
   Terrain Mapping and Analysis, Differential Interferometry for Landslide and Land Subsidence Monitoring
   May 15, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructors: Dr. R. S. Chatterjee, ISRO and Instructor, DLR

6. <u>**SAR Remote Sensing for Forest, Crop and Soil Moisture**</u>
   Need & Requirement of SAR for Forest Biophysical Parameter Assessment, Crop mapping and monitoring and soil moisture estimation
   May 22, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructor: Dr. Heather McNairn (Agriculture and Agrifood, Canada) and Dr. Hitendra Padalia, ISRO

7. <u>**PoISAR and InSAR Applications in Snow and Glacier Studies**</u>
   Retrieval of Snow Cover Area (SCA),Snow Physical Parameters, Glacier Dynamics, Ice Sheet and Sea ice Dynamics
   May 29, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructor: Dr. Praveen Thakur, ISRO, Instructor, DLR

8. <u>**SAR Data for Flood Mapping**</u>
   SAR Remote Sensing for flood inundation mapping and monitoring
   June 05, 2017 Start at 13:00 UTC, 1 h lecture and 30 minutes Q&A session
   Instructor: Chris Stewart, ESA and Erika Podest , ARSET (NASA)

21.   Student Assessment

- Through assignments and quizzes, participation in online sessions.