WGCapD-Distance Education Course:
Webinar Series on Hyperspectral Remote Sensing and its Applications
7th November – 6th December 2019
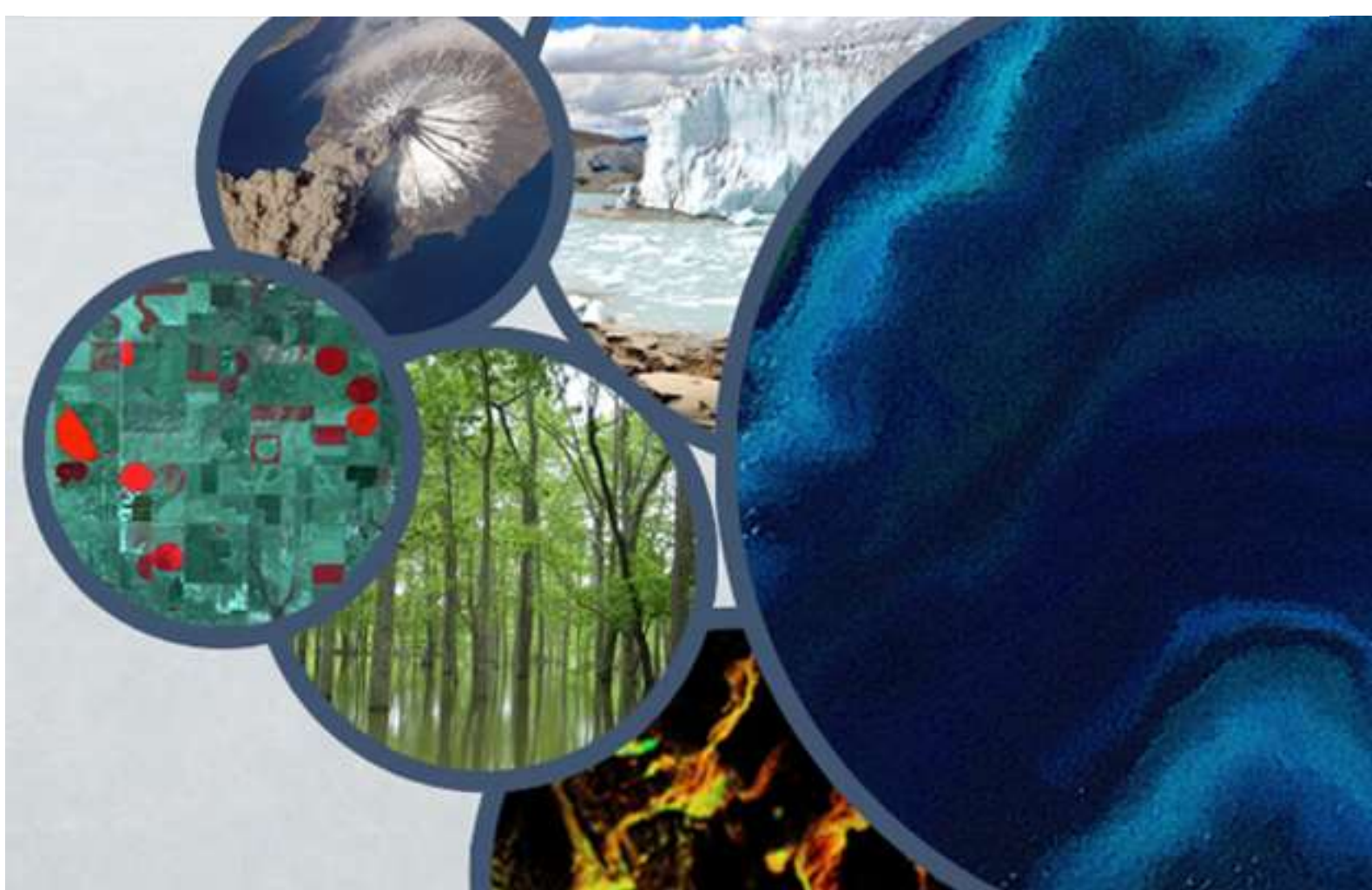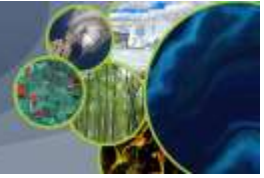

Working Group on Capacity Building and Data Democracy,
Committee on Earth Observation Satellites

WGCapD-Distance Education Course
Hyperspectral Remote Sensing and its Applications

1- Overview

1.1. 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 four pillars of the Data Democracy Initiative, 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
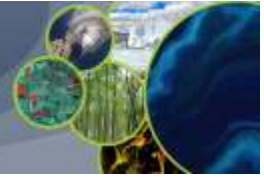
Hyperspectral Remote sensing also known as imaging spectrometry emerged as a promising technology for detection and identification of minerals, terrestrial vegetation, man-made materials and backgrounds. Hyperspectral remote sensing deals with measurements in a large number of narrow spectral bands over a contiguous spectral range. Because of its ability to detect narrow absorption features hyperspectral data has significantly found usage in different applications, especially the capability to extract quantitative information. This technology has been used for mineral exploration, identification and mapping of abundances of specific minerals, ecosystem monitoring, monitoring of coastal and inland waters, mapping the variability of soil properties, insect damage etc.

1.2. Course Coordinator

NAME	INSTITUTION	ROLE
Shefali Agrawal	**ISRO**	**Coordinator**

1.3. Language

- The entire distance education course is delivered in English.

1.4. Target Region

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

1.5. Target Participants

- Academician, Scientists, Researchers and Professionals interested in Hyperspectral Remote Sensing and its applications.

1.6. 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 Organization – ISRO LMS Platform

- GoToMeeting (GTM) will be used for synchronous communication among teachers and students and live sessions.

1.7. System Requirements

- 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
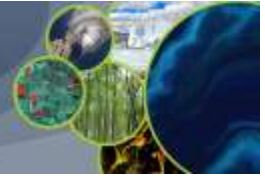
    o   Javascript must be enabled

1.8. Number of Participants:

- 100-200 participants

1.9. Instructors

- CEOS Members: ISRO, NASA, ESA, DLR, USGS, INPE & other agencies

1.10. 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

1.11. Certificate for Instructors

- Since instructors are volunteers, they will be rewarded in some way: certificates of participation, proposing to write a joint paper etc.
- Certificates will be issued by CEOS SEO

1.12. Announcement

- CEOS website
- List of practitioners provided by ISRO and CEOS
- Virtual Laboratory for Training and Education
- Regional Centers for Space Science and Technology Education (affiliated with United Nations)
    - Latin America and the Caribbean (Mexico and Brazil): CRECTEALC (Regional Center for Space Science and Technology Education for Latin America and the Caribbean)
    - Asia and the Pacific (India): CSSTEAP (Centre for Space Science and Technology Education in Asia and the Pacific)
    - Africa (Morocco): CRASTE-LF (African Regional Centre for Space Science and Technology Education in French Language)
    - Africa (Nigeria): ARCSSTE-E (African Regional Centre for Space Science and Technology Education in English Language)
    - Western Asia (Jordan): Regional Centre for Space Science and Technology Education for Western Asia

- 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.

1.13. Registration

- ISRO LMS (http://elearning.iirs.gov.in/wgcapd/CEOS/)
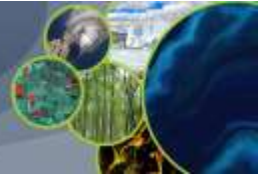
1.14. Certificate of participation
- Designed and distributed by CEOS SEO

1.15. Instructional Material
- Presentation given via Power Point
- Recorded online sessions
- Data source and reading material links
- Frequently Asked Questions (FAQ)
- All materials will be made available inside Moodle

1.16. Copyrights
- WGCapD, CEOS

1.17. Feedback
- Through Feedback submitted by candidates

1.18. Schedule
- 7th November –06th December 2019 at **1300 UTC**
  Repeat Telecast on next day at 0600 UTC

1.19. Prerequisite
- Elementary knowledge about Remote Sensing and Digital Image Processing

1.20. Webinar Objectives

By the end of this webinar series, students should:
- Understand the concept of Hyperspectral Remote Sensing and appreciate why calibration is critical and knowledge of approaches taken for the atmospheric correction of hyperspectral data. Know about advantages of hyperspectral over optical remote sensing
- Be able to understand the processing steps of hyperspectral data and availability of software's.
- Application of Hyperspectral remote sensing for Vegetation, Water resources and geological studies

1.21. Themes of Webinar

The themes of the five webinars are listed

1. **Overview of Hyperspectral Remote sensing (7th November 2019)**
   Hyperspectral remote sensing- concept, Physics, principles-imaging spectroscopy Multispectral vs hyperspectral, Imaging platforms and Modes (airborne, ground based and space based), Historical and recent Hyperspectral airborne and space borne Mission, Ground based sensors, hyperspectral data preprocessing, Radiometric calibration

   Instructor: NASA/JPL/CNES/INPE/DLR
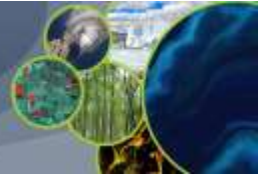
2. **Information Extraction from Hyperspectral data/Hyperspectral data processing Algorithms (14th November 2019)**

   Data Dimensionality reduction techniques, endmember selection, spectral libraries, Hyperspectral Indices, overview of hyperspectral data classification approaches- Sam, SVM, Spectral un-mixing, spectral matching methods

   Instructor: ISRO

3. **Hyperspectral Remote Sensing for vegetation Studies (21st November 2019)**

   Spectra of vegetation/ crop, spectral libraries of crop and vegetation, Hyperspectral vegetation Indices, species/community level detection and discrimination, Canopy chlorophyll estimation, Foliar nitrogen content estimation, vegetation stress detection- Case examples

   Instructor: ISRO

4. **Hyperspectral Remote Sensing for Geological Applications (28th November 2019)**

   Mineral spectra and their characteristic absorptions, mineral mapping, lithological mapping, hydro carbon exploration

   Instructors: ISRO

5. **Hyperspectral Remote Sensing for Water resources (5th December 2019)**

   Spectra of Water, snow. Water quality, snow physical parameter retrieval, soil moisture

   Instructor: ISRO

1.22. Student Assessment
  - Through assignments and quizzes