WMO Structured Basic Satellite Skills Training Course

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WORLD METEOROLOGICAL ORGANIZATION

Overview

Rationale:

- Limited access to trusted sources to comprehensive, structured, accessible basic satellite training using a centralized and structured approach
- Organizations (RTCs, Vlab CoEs, Satellite Operators, international educational and training organizations) have great learning resources.

Aims:

- To create a self-paced structured learning course consists both existing and developing training materials that can meet the needs of the users, mainly in basic training
- to promote widely the learning resources that been created by the WMO partners for multi-use and development.

Content:

- Tutorials, lectures, training modules, conceptual models, and case studies, linked to Satellite Enabling Skills.
- Free-to-use materials, proper recognition to creators
- Will serve as a platform for sharing resources using WMO ETRP portal: www.etrp.wmo.int.
- WMO ETRO is upholding intellectual property rights while promoting knowledge sharing
- Support for trainers in different delivery approaches

Audiences

- **The primary audiences**:

  (1) **Trainers**, as support and guidance to their satellite training modules

  (2) **Junior forecasters** in Member Countries, especially the early career forecasters.

- **Secondary audiences**:

  (1) **Senior forecasters** who would like to revisit the materials to strengthen their knowledge in particular skills

  (2) **Non meteorologist audiences** to gain the insight and brief pictures about the weather satellite network and operation.

Organizational Needs

WMO has the responsibility to help the members meet their missions to operate weather forecasting effectively by:

(1) contributing to the **courses offered** by the RTCs and VLab CoE for competency development in weather operations,

(2) providing access to other weather forecasters who did not benefit from the opportunity to attend specialized training to improve their skills through the self-paced learning

The topic of remote sensing especially in satellite meteorology, based on in *WMO Documents Guidelines on Satellite Skills and Knowledge for Operational Meteorologist*, is one of the **most needed courses** in the Regions.

The aim to **promote existing learning resources and best practices** from RTCs, Vlab CoEs, and Satellite Operators while preventing duplication and addressing uncovered training needs.

Learning Outcomes

Participants will be able to:

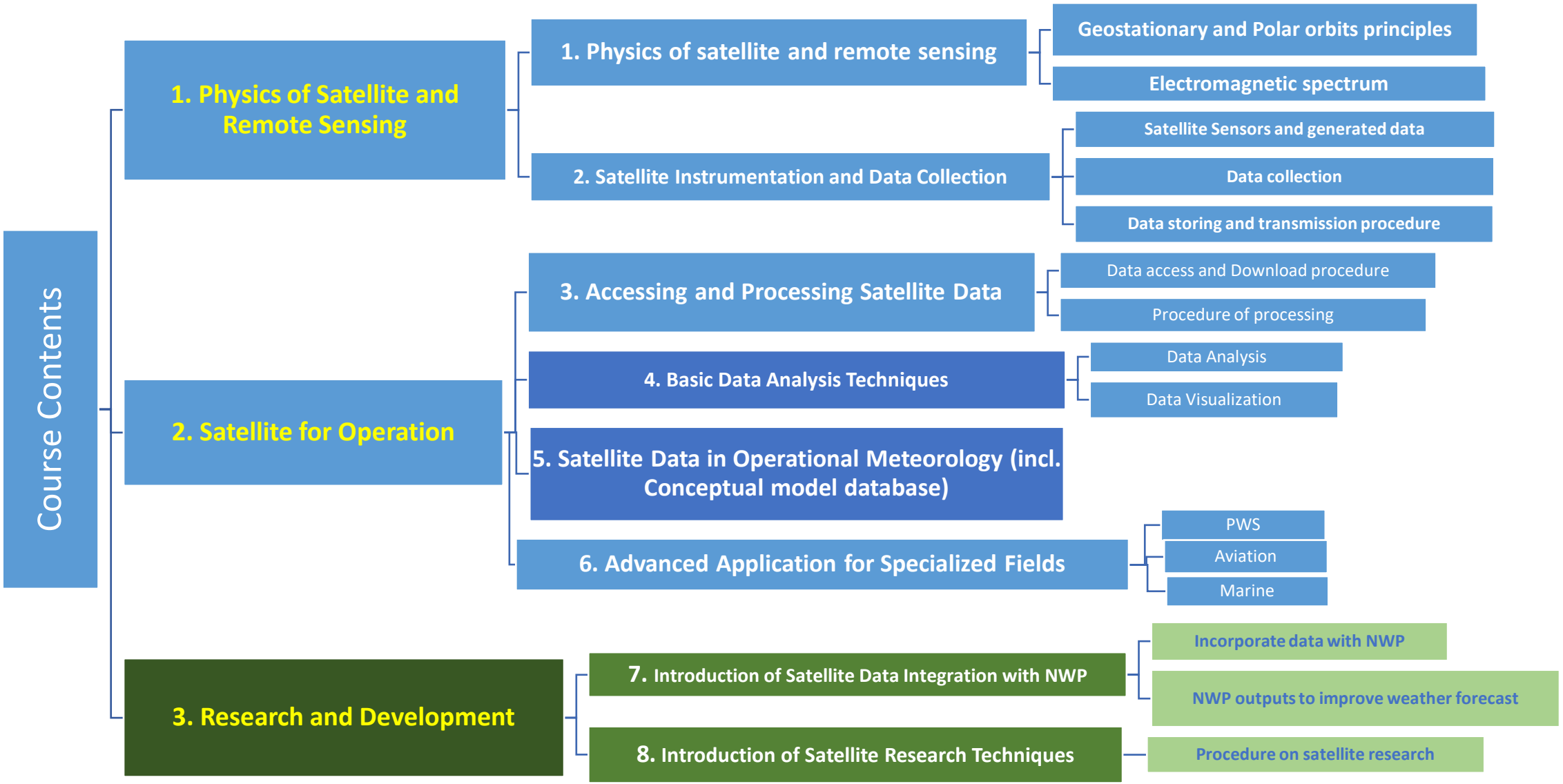
1. **Understand** the **fundamental physics and principles** underlying satellite orbits, remote sensing, and satellite instrumentation
2. **Understand** the **about satellite sensors**, their functions, and the processes involved in data collection and transmission.
3. **Access, select, display, process and manipulate the satellite data** using various tools and software, considering the characteristics, limitations, and possible errors in the satellite data.
4. **Apply** **basic data analysis techniques** for **interpreting satellite data**, including monospectral data and combinations of channels, including RGB (red/green/blue) displays and derived products.
5. **Using** **satellite data in daily weather forecasting and operational meteorology**, considering the systems, features, and phenomena of interest on the required forecasting tasks and location within the context of all other observations, guidance, and situational awareness.
6. **Using** **satellite data in specialized meteorological fields** such as marine, aviation, and agrometeorology.
7. **Understand** **satellite data incorporation** into numerical weather prediction models to enhance forecasting accuracy.
8. **Understand** **how to conduct research projects using satellite data** and stay updated with advancements in the field.

Learning Solution

Self Paced Learning in Moodle Platform:

- **Flexibility to complete courses** at their own pace and convenience, accommodating their individual schedules and learning paces
- encourages **greater responsibility and self-discipline**, as learners must manage their own time and progress through the course independently
- **Well-suited learning solution for online platforms of Moodle**,
- **Can be updated and improved** based on learner feedback and advancements in the field, ensuring that the content remains current and relevant
- **Flexible, accessible, and effective way** to gain essential knowledge and stay up to date with the latest developments in satellite meteorology.

Structure


Course Contents
1. Physics of Satellite and Remote Sensing
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Geostationary and Polar orbits principles
Electromagnetic spectrum
2. Satellite Instrumentation and Data Collection
Satellite Sensors and generated data
Data collection
Data storing and transmission procedure
2. Satellite for Operation
3. Accessing and Processing Satellite Data
Data access and Download procedure
Procedure of processing
4. Basic Data Analysis Techniques
Data Analysis
Data Visualization
5. Satellite Data in Operational Meteorology (incl. Conceptual model database)
6. Advanced Application for Specialized Fields
PWS
Aviation
Marine
3. Research and Development
7. Introduction of Satellite Data Integration with NWP
Incorporate data with NWP
NWP outputs to improve weather forecast
8. Introduction of Satellite Research Techniques
Procedure on satellite research

Constrains

Sustainability: We need to work using contributions from the WMO, the RTCs, CoEs, and the NMHSs. We are also encouraging the delivery of other WMO-language versions of this course in the near future and want to involve RTCs and CoEs, satellite operators, and **other satellite communities** in future course development.

Time: Lack of time (the initiative begins the process in Q2 of 2024, TDP is developing, learning contents will be organized along the Q3 – Q4 of 2024, Q4 of 2024 for the expert review; open for trial project by the Q1 of 2025 at the latest.

Resources: This course will use training materials available from RTCs, VLab CoEs, Satellite Providers, or other entities like COMET/MetEd and Eumetrain. It will take advantage of the Global Campus initiative, which has a large collection of qualified learning materials.

Budget: The budget for course development is allocated under the WMO ETR budget. Similarly, the budget for developing or updating learning materials is managed by the resource owner, ensuring financial stability throughout the project.

Constrains *(Cont)*

Participants: There are four somewhat distinct audiences being targeted, that will create challenges of integrating content and finding ways to make the best transitions into and between the modules.

Facilitation: In addition to the ETR Office team, we invite additional Subject Matter Experts (SMEs) to enhance the team as reviewers and advisers, especially to take a comprehensive approach to the course. **The contributors are expected to come from satellite communities such as VLab CoEs, RTCs and international training organizations.**

Content expertise: The Subject Matters Experts (SMEs) have strong experiences in satellite and satellite training course, and most have good online learning delivery and self-paced course experience of various kinds and extents. However voluntary based contribution makes another challenge for dedicated time.

Project Risks: Shorter time to collecting and ensure the accuracy for the related resources for better represented materials from around the globe, by use the available content and activities. One of biggest challenges is to ensure that all resources have similar structures and approaches. Therefore, the strong communication with the RTCs, CoEs, satellite operators and international training organizations need to coordinate for harmonization while keep also in mind that the lessen additional effort the better. We need to resolve gaps and determine how to complete the course design before the end of 2024.

Learning Activities

Pre Course *Topic: Building Learning Commitment*	Overview of the training (Course Guidebook) Familiarization of the Moodle environment Participants self-reflection, motivation of attending the course. Reading: related documents and Satellite Communities (Satellite Enabling Skills, WMO-Competencies etc) Reading: the communities in satellite
Topic 1: Physics of Satellite and remote Sensing	**Activities**: Reading, watching videos, gamification etc **Assessment and Evaluation:** Quizzes of Multiple-choice questions, true/false questions, and short answer questions, matching the facts etc
Topic 2: Satellite Instrumentation and Data Collection	
Topic 3: Accessing and Processing Satellite Data	
Topic 4: Basic Data Analysis Techniques	
Topic 5: *Satellite Data in Operational Meteorology*	
Topic 6: *Advanced Application for Specialized Fields*	
Topic 7: *Introduction of Satellite Data Integration with NWP*	
Topic 8: *Introduction of Satellite Research Techniques*	

Evaluation and Assessment

- **Purpose**: To assess learners' understanding of key concepts and retention of knowledge at their own pace.
- **Frequency**: At the end of each module.
- **Format**: Multiple-choice questions, true/false questions, and short answer questions, matching the facts
- **Grading**: Automatic grading with immediate feedback provided.
- **Measured through**: Module quizzes and short answer questions (**knowledge and understanding)**

Continuous Feedback and Improvement

- **Progress Tracking**: Learners can monitor their own progress through the course dashboard, which shows completed modules, quiz scores, and upcoming assessments.
- **Course Evaluation**: End-of-course survey to gather learner feedback on course content, delivery, and assessment methods for continuous improvement. This Level 1 – 2 evaluations (Kirkpatrick) will be used and be embedded in the Moodle.

Self-Paced Adaptations

- **Flexible Deadlines**: suggested timelines and milestones will be provided to help learners stay on track.
- **Accessible Resources**: Comprehensive support materials, including FAQs, video tutorials, glossaries and access to the owner of the resources for questions and guidance.

Resources

Human Resources

- WMO: Education and Training Office; WMO Space Program; WMO Vlab Working Group
- Organization/Members: CoE, Satellite Operators, Eumetrain...**others are welcome**

Learning Resources and Tools;

- WMO ETR Moodle site and other online tools and resources, including content resources

Milestones and Schedule

Task	Completion Date
Training Development Plan completed	Q2 2024
Training Development Plan reviewed and revised	Q3 2024
Organizing the resources	Q3 – Q4 2024
Review by the Experts	Q4 - 2024
Training delivered (begin date/end date)	Q1 - 2025
Training evaluation complete (1st round – to be conducted once every year)	Q3 - 2025

Discussion

- A broad content scope: *To what extent this course could be expanded? What will be the best scope?*
- Learning resources compilation: *How will be the best approach? (considering many numbers of satellite operators)*
- Lack of time and resources (including the human resources, ID and SME, developer and reviewer)
- Community information: *Is it needed? How will be the best approach?*

In which part of this initiative, you think you would contribute the best?

Thank You

WORLD METEOROLOGICAL ORGANIZATION

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Skill 3: Identify and Diagnose broadscale, synoptic, and mesoscale systems

Description
Identify, locate, and interpret broadscale, synoptic and mesoscale atmospheric systems, their characteristics, strength and stage of evolution, and deduce atmospheric dynamic and thermodynamic properties.

Performance components
For each system, select an appropriate conceptual model to characterize the system, its orientation, strength and stage of evolution, including precursor signatures. Recognize departures from climatological or idealized models and that some features relate to more than one category.

Background knowledge and skills

- Compare satellite imagery, RGB products, and derived temperature, moisture, and wind fields with conceptual models to identify atmospheric systems in various stages of evolution.

- Utilize the Dvorak and other techniques to deduce tropical system development, intensity, and decay.

- Utilize satellite lightning products to track convective system evolution and identify intensity changes.

Skill 3: Identify and DIAGNOSE broadscale, synoptic, and mesoscale systems

3.1 Identify and locate the following broadscale systems and features:

3.1.1	Intertropical convergence zones, monsoon, and trade wind regimes.
3.1.2	Westerly regimes with embedded cyclones and anticyclones.
3.1.3	Polar and tropical easterlies and systems.
3.1.4	Broadscale waves.
3.1.5	Zonal, meridional flows, mobile and blocking systems.
3.1.6	Upper- and low-level circulations.
3.1.7	Low-level moisture boundaries.

3.2 Identify and locate the following synoptic-scale systems and features:

3.2.1	Anticyclones.
3.2.2	Cyclones, tropical cyclones and lows, extratropical and polar lows, at upper and lower levels.
3.2.3	Jet streams, convergence and frontal zones, conveyor belts, and dry slots.
3.2.4	Troughs, ridges and cols, deformation axes, waves.
3.2.5	Cloud regions – stratiform, stratocumulus, cumulus (cold outbreaks, trade cumulus), cloud bands, cloud streets, and cloud shields.
3.2.6	Cold pools and thermal shear.

3.3 Identify and locate the following mesoscale systems and features:

3.3.1	Local thermal and topographic circulations, including land and sea breezes, katabatic and anabatic winds, foehn winds, mountain waves, banner clouds, island and peninsula effects (including Kármán vortices and V-shaped wave clouds), heat lows and troughs, and lake effect snow.
3.3.2	Convective environments and areas of instability, convective initiation, inhibition and the breakdown of inhibition.
3.3.3	Convective cells and cloud systems (including pulse convection, multicells, supercells, squall lines, mesoscale convective complexes and systems) and associated mesoscale features, including outflow boundaries and storm-top features.
3.3.4	Convergence lines (mesoscale boundaries and interactions, dry lines, cloud streets).
3.3.5	Low-level jets.
3.3.6	Gravity waves and bores.

Structure

The course will have **eight modules**:

A. **Six main modules** to prepare participants ***for the weather forecasting and operational meteorology:***

Module 1: *Physics of Satellite and Remote Sensing*
Module 2: *Satellite Instrumentation and Data Collection*
Module 3: *Accessing and Processing Satellite Data*
Module 4: *Basic Data Analysis Techniques*
Module 5: *Satellite Data in Operational Meteorology*
Module 6: *Advanced Application for Specialized Fields*

B. **Two additional modules** that prepare the participants for the advanced level of the learning on research and development in the satellite field:

Module 7: *Introduction of Satellite Data Integration with NWP*
Module 8: *Introduction of Satellite Research Techniques*.