



# WMO Update on Space Weather Activities



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# WMO Inter-Programme Coordination Team on Space Weather (ICTSW)

Established in May, 2010

Joint leadership: Commission for Basic Systems & Commission for Aeronautical Meteorology



26 out of 185 WMO Member States; 7 International Organizations



# On-going Activities

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- WMO four-year plan in support of international coordination of operational space weather monitoring and forecasting
  - Space weather related terminology
  - Review of space weather observation needs and capabilities
  - Space-based observation planning and coordination
  - Space weather information services to ICAO
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## Four-year plan in support of international coordination of operational space weather monitoring and forecasting (1 of 4)

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- May 2015: WMO Congress agreed that WMO should undertake international coordination of operational space weather activities
  - Requested integration with relevant meteorological activities
  - Requested to review space weather terminology in consultation with ICSU
  - Requested the WMO Commission for Aeronautical Meteorology (CAeM) and Commission for Basic Systems (CBS) to submit the four-year plan to the Executive Council in June 2016 for approval
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## Four-year plan in support of international coordination of operational space weather monitoring and forecasting (2 of 4)

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High-level goals: Where can WMO best add value?

- Availability and interoperability of sustained observations (ground or space-based)
- Collection and delivery of space weather data in near-real time
- Identify requirements and develop best practices for services requiring international coordination, including international air navigation (with ICAO) and emergency warning (DRR)
- Training and capacity building
- Facilitate transfer of science to operations and promote synergy between space weather, and meteorology/climate activities



## Four-year plan in support of international coordination of operational space weather monitoring and forecasting (3 of 4)

### Strategic level

- Coordination/communication/advocacy
- Partnership

### Products & services

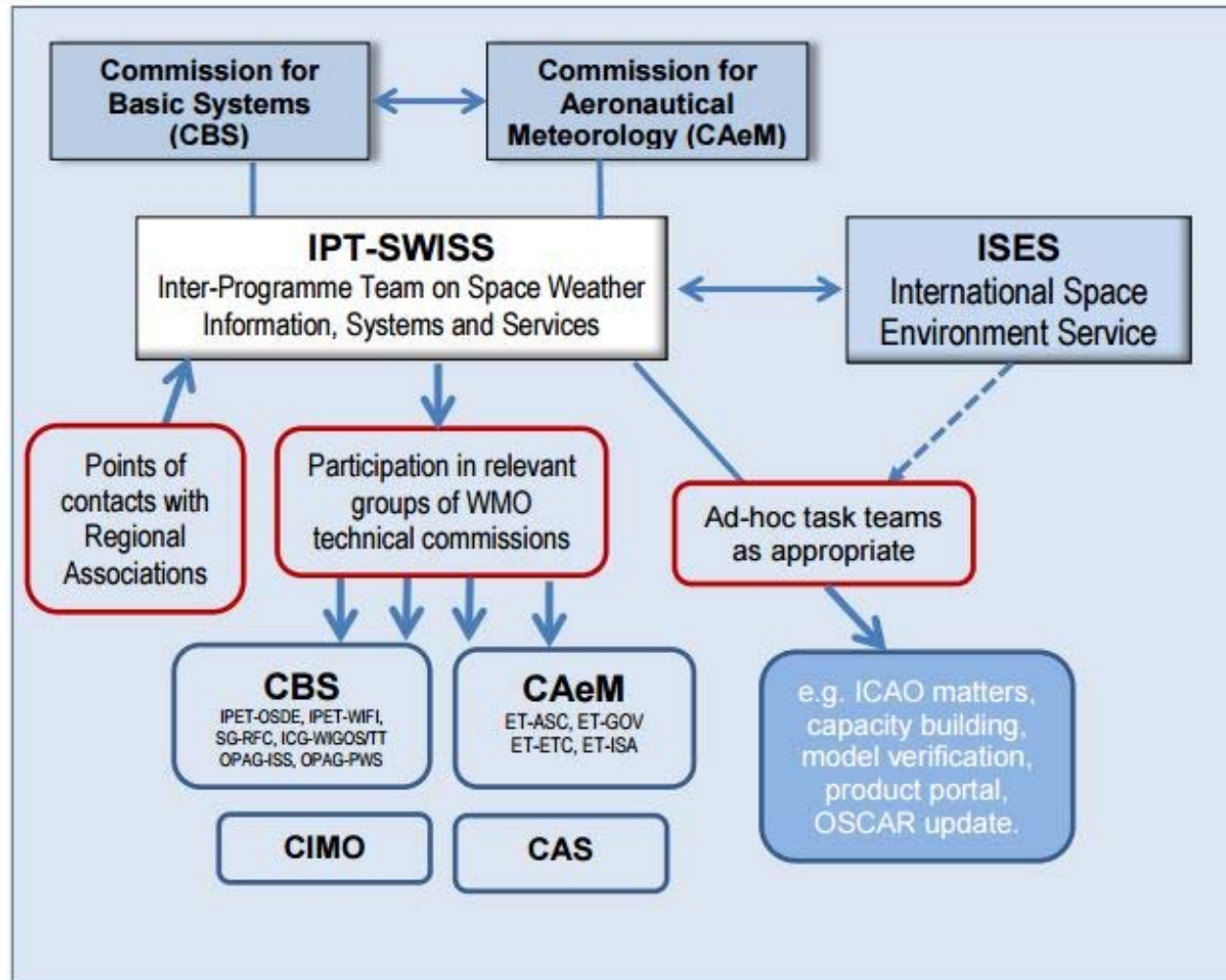
- User requirements for product and services
- Develop best practices in key areas: aviation, public safety, infrastructures
- Training, capacity building

### Systems level

- Observations
- Data exchange
- Analysis and forecasting



# Four-year plan in support of international coordination of operational space weather monitoring and forecasting (4 of 4)





# Space Weather Related Terminology

*in consultation with IAU, IAGA, URSI, COSPAR, ICTSW, CBS*

- ***Space weather***  
رصد طقس الفضاء (طقس الفضاء) 空间天气 météorologie de l'espace  
космическая погода tiempo espacial (meteorología del espacio)
  - [*Space environment*] The physical and phenomenological state of the natural space environment, including the Sun and the interplanetary and planetary environments.
  - [*Meteorology of space*] The discipline which aims at observing, understanding and predicting the state of the Sun, of the interplanetary and planetary environments, their disturbances, and the potential impacts of these disturbances on biological and technological systems.
- ***Climate of space, space climate***  
مناخ الفضاء 空间气候 climat de l'espace климат космоса clima del espacio
  - The statistical properties and long-term variations of the physical and phenomenological state of the space environment.
- ***Climatology of space, space climatology***
  - The study of the statistical properties of the physical and phenomenological state of the space environment, its long-term variations and their impacts on the Earth environment.
- ***Geospace***
  - The region of space near the Earth, including the upper atmosphere and the area of influence of the Earth's magnetic field





# Review of observation needs and capabilities

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- Observation requirements to support operational SW monitoring, warning, forecasting (OSCAR/Requirements)
  - “Statement of Guidance” identifying gaps and priorities in space and surface observations to meet these requirements (*being updated*)
    - Ionosphere
    - Geomagnetic field
    - Thermosphere
    - Solar wind
    - Energetic particles
    - Solar monitoring
  - OSCAR/Space ([www.wmo.int/oscar/space](http://www.wmo.int/oscar/space))
    - online inventory of space-based observing capabilities and analysis of their specifications and planned availability
    - new version (*in development*) will include  $\approx$  300 space weather instruments
    - Planned to be ready for beta-testing in March 2016
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## New Vision for Space-based Observation in 2040 (in progress)

### Tier I, Operational fixed

- Solar coronagraph and radio-spectrograph, at L1
- In situ plasma, energetic particles, magnetic field (at L1 in solar wind, and GEO)
- In situ plasma, energetic particles at LEO
- GNSS radio-occultation for temperature, humidity and electron density

### Tier II, Operational flexible

- Solar EUV/X-ray imager, magnetograph, EUV/X-ray irradiance, on the Earth-Sun line (e.g. L1, GEO) and off the Earth-Sun line (e.g. L5, L4)
- Solar coronagraph and heliospheric imager off the Earth-Sun line (e.g. L4, L5)
- Solar wind plasma, energetic particles & magnetic field off Earth-Sun line (e.g. L5)
- Magnetospheric energetic particles (e.g. GEO, HEO, MEO, LEO)
- Enhanced RO constellation for atmospheric/ionospheric soundings

### Tier III, Pathfinders technology demo

- Solar coronal magnetic field imager, solar wind beyond L1
- Ionosphere/thermosphere spectral imager (e.g. GEO, HEO, MEO, LEO)
- Ionospheric electron and major ion density,
- Thermospheric neutral density and constituents



## Coordination Group for Meteorological Satellites

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- Focus on operational spacecraft and instrument issues
- Host space weather instruments
- Routinely report on satellite anomalies
- Can facilitate integration of observing capabilities



### Near-term Actions:

1. Develop actions from Terms of Reference
2. Work with WMO space weather team to develop procedures for collection and use of anomaly information

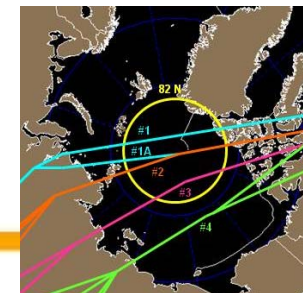




# Coordination of Major Application Areas: Aeronautical Meteorology

ICAO recognizes the ICTSW (as a technical body supporting the WMO CAeM) to provide advice on space weather matters

- Reviewed the ICAO Concept of Operation for International Space Weather Information (*continuing in 2016*)
- Reviewed draft Standards and Recommended Practices on space weather (*continuing in 2016 with review of operational requirements*)
- Provided guidance on future organization of operational space weather service delivery (*continuing in 2016-2017*)



# Summary

- There is a growing, global need for improved services and for consistent, coordinated observations and operational information
- The WMO is now actively engaged in defining observing requirements, observing gaps, and service needs and in coordinating efforts
- The four-year plan for space weather:
  - Builds on prior accomplishments and current efforts
  - Promotes synergy with WMO core programs in meteorology and climate
  - Fosters coordination with service, research, and policy organizations
  - Identifies specific actions to achieve the identified goals
- Interagency and international participation is encouraged in all aspects of this effort

