

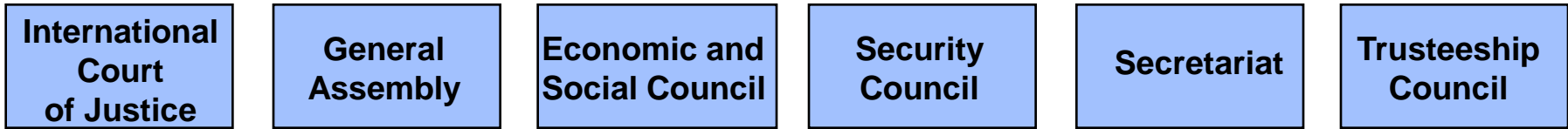
# WMO Four-year Plan for Space Weather Activities



WORLD  
METEOROLOGICAL  
ORGANIZATION

**Toshiyuki Kurino**  
**WMO Space Programme**

# WMO in the United Nations



WMO is a specialized agency of the United Nations (UN) with 191 Member States and Territories. WMO is dedicated to international cooperation and coordination on “Weather, Climate and Water”, namely the state and behaviour of the Earth’s atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources.

- Main and other sessions
- States and territories
- Other
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- ◆ UNU
- ◆ WFC

- COMMITTEES
- EXPERT, AD-HOC AND RELATED BODIES
- IFAD
- UNIDO
- WTO
- Specialized agencies and other autonomous organizations within the system
- Other commissions, committees and ad-hoc related bodies



# WMO Space Programme

The WMO Space Programme has 4 main components:

## The space-based Observing System



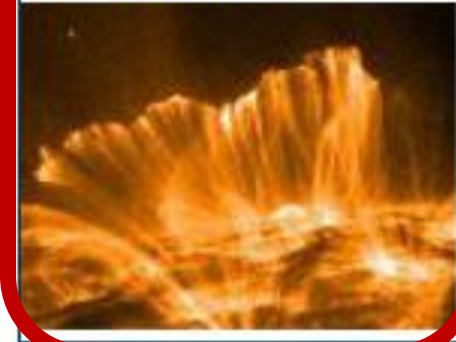
## Access to Satellite Data and Products



## Awareness and Training



## Space Weather Coordination



- [OSCAR/Requirements \(Observing Requirements Database\)](#)
- [OSCAR/Space \(Satellite & Instrument Database\)](#)
- [Satellite Status list](#)
- [Satellite User Readiness Navigator \(SATURN\)](#)
- [Product Access Guide \(PAG\)](#)
- [Virtual Laboratory for Education and Training in Satellite Meteorology \(VLAB\)](#)
- [Working Documents for Meetings](#)



[http://www.wmo.int/pages/prog/sat/index\\_en.php](http://www.wmo.int/pages/prog/sat/index_en.php)

# WMO's Involvement in Space Weather (1/5)

- In June 2008, the WMO Executive Council (EC-60) noted the considerable impact of Space Weather on meteorological infrastructure and important human activities. It acknowledged the potential synergy between meteorological and Space Weather services to operational users. The Council agreed that WMO should support international coordination of Space Weather activities and urged WMO Members to provide corresponding resources through Secondments and Trust Fund donations.



# WMO's Involvement in Space Weather (2/5)

- In **May 2010**, WMO established the **Interprogramme Coordination Team on Space Weather (ICTSW)** with a mandate to support Space Weather observation, data exchange, product and services delivery, and operational applications. As of May 2016, ICTSW involved experts from 26 WMO Member countries and 7 International organizations.



## WMO's Involvement in Space Weather (2/5)

- In **May 2011**, the **World Meteorological Congress (Cg-16)** acknowledged the need for a coordinated effort by WMO Members to address the **observing and service requirements** to **protect the society against the global hazards of Space Weather**.
- In **July 2014** the potential **space weather services to international air traffic navigation** were discussed at the conjoint session of the WMO Commission for Aeronautical Meteorology (CAeM) and the Meteorological Division of the International Civil Aviation Organization (ICAO).



# WMO's Involvement in Space Weather (4/5)

- In May 2015, the World Meteorological Congress (Cg-17) agreed that WMO should undertake international coordination of operational space weather monitoring and forecasting with a view to support the protection of life, property and critical infrastructures and the impacted economic activities in an optimized overall effort.



# WMO's Involvement in Space Weather (5/5)

- In **June 2016**, the **Executive Council (EC-68)** approved the **Four-year Plan** for WMO activities related to space weather in 2016-2019, and requested CAeM and CBS **to establish Inter-Programme Team on Space Weather Information, System and Services (IPT-SWeISS)** who will pursue **the work and achievement of ICTSW**





# WMO Space Weather Services (Four-year Plan: 2016 - 2019)

to be implemented to improve capabilities of WMO Members to deliver space weather services;

As a result of this planned effort, space-based and ground-based space weather observing systems will be better coordinated;

-Consistent, quality-assured space weather products will be available to all WMO Members through WMO Information System (WIS);

-Space weather services, in particular, for civil aviation will be addressed as required by the International Civil Aviation Organization (ICAO)

-IPT-SWeISS is expected to facilitate the effective coordination with initiatives external to WMO and to enable the long-term improvement of space weather service capabilities.



# **IPT-SWeISS Membership (as of July 2017)**

(20 WMO Members, and 6 UNs and Intergovernmental Organizations)

## **WMO Members**

### **Co-chairs**

CMA, China (endorsed by CAeM), NOAA, USA (endorsed by CBS)

Argentina, Australia, Belgium, Brazil, Canada, France, Germany, Indonesia, Italy, Japan, Korea, Netherland, New Zealand, Poland, Russia, South Africa, Switzerland, UK

## **UN and Intergovernmental Organization**

CGMS, ESA, ICAO, ISES, ITU, UNOOSA



# An Urgent Need for Accelerated Action in Four-year Plan

- **Implementation of a Space Weather Basic System**, including issues related to observation techniques and networks, data management and exchange, data centers, and space climatology
- **Promoting of Space Weather Science**, including issues related to modelling, model evaluation and verification, interaction with climate, and transition from research to operations
- **Development of Space Weather Application**, including requirements evaluation, the delivery of services, capacity building and user interaction



# WMO's Initiative for Promoting Space Weather in collaboration with

- Service providers (**ISES**)
- Space-based observations providers (e.g., **CGMS**)
- Scientific organizations (e.g., **COSPAR**)
- UN and Intergovernmental organizations (e.g., **ICAO and ITU**)

**ICAO:** operational, global space weather information service for aviation

**ITU:** Radio Frequency Coordination

- Overall UN space policy framework (**COPUOS**)
- Emphasize synergy with core WMO operational frameworks; **WIGOS, WIS, GDPFS**



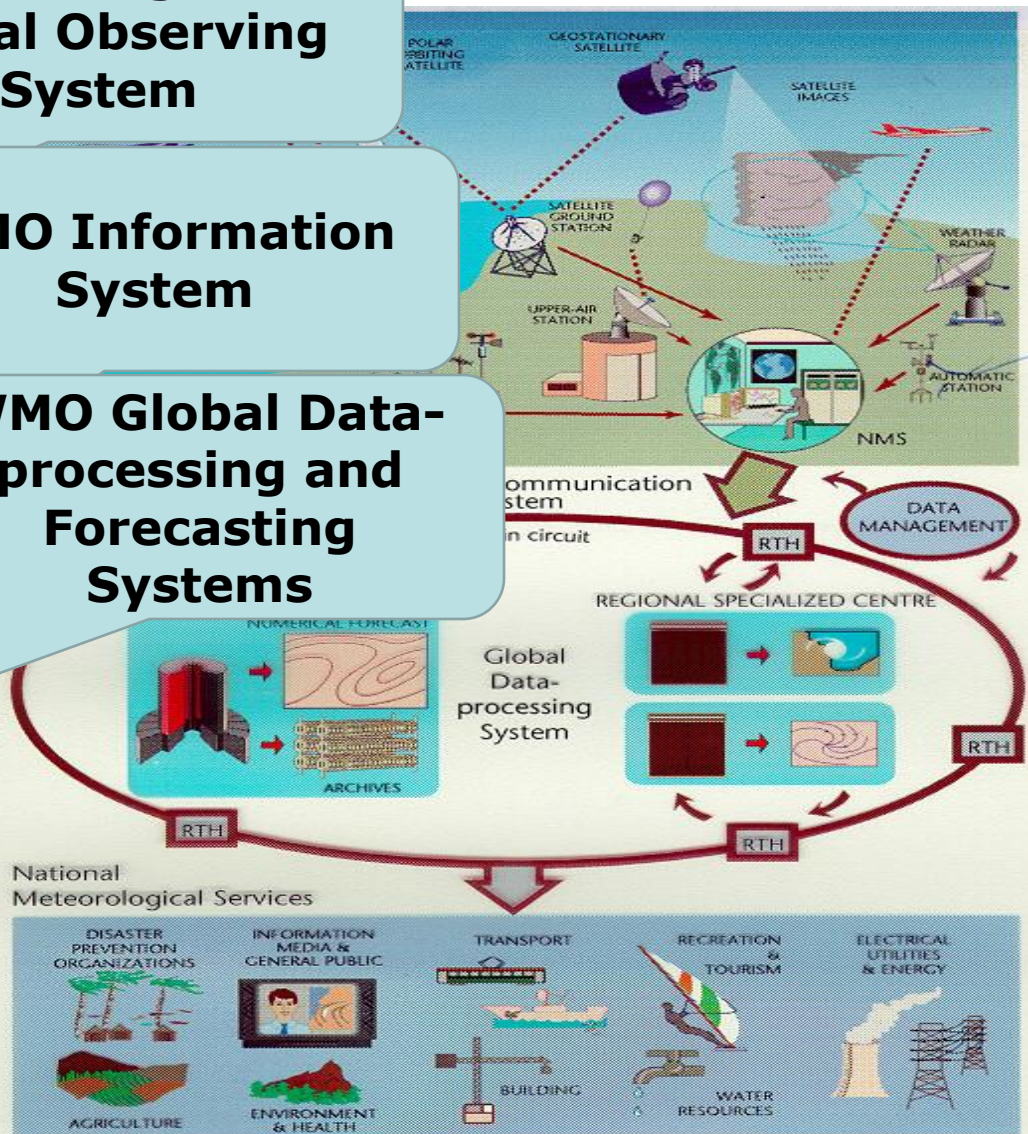
# WMO operational frameworks

**WMO Integrated Global Observing System**

**WMO Information System**

**WMO Global Data-processing and Forecasting Systems**

**GDPFS**



191 NMHSs: satellites, land, ships, buoys, and aircraft contribute to Global Observing every day

Global Telecom with Regional Hubs – becoming the WMO Information System

The GDPFS: Global, Regional Specialized Met. Centres (RSMC, RCC), and National Centres

NMHSs deliver analyses, forecast and early warning services

**Service delivery**



# Cooperation with International Civil Aviation Organization (ICAO)

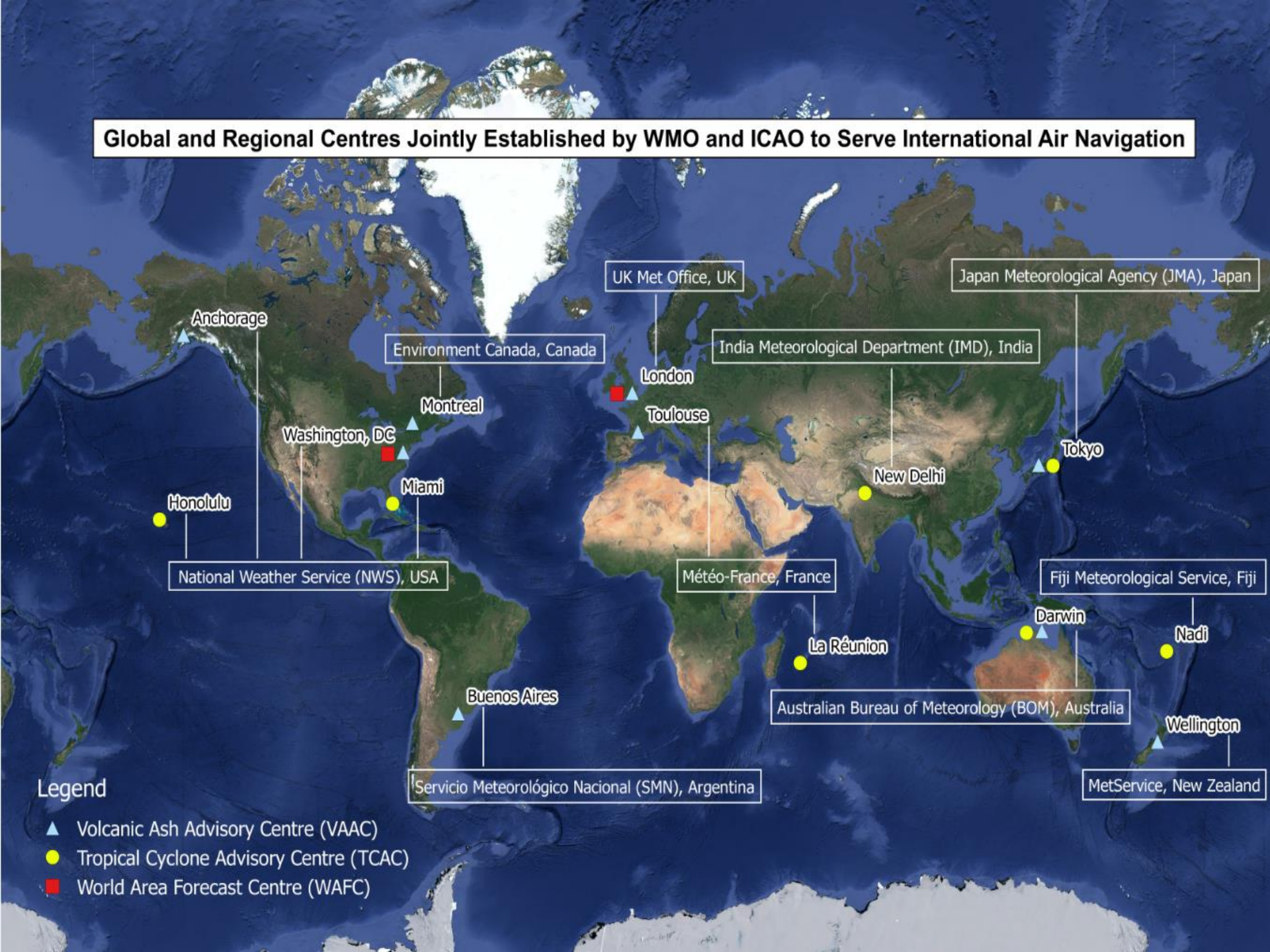
As part of the long-established close working relationship between WMO and ICAO, World Area Forecast Centre (WAFC), Tropical Cyclone Advisory Centre (TCAC), and Volcanic Ash Advisory Centre (VAAC). These centres provide specialized warning services for the aviation community.

The ICAO Meteorology Panel (METP) noted an update to a concept of operations for space weather, revisions to functional and performance requirement that would enable an operational global space weather information service for aviation in the 2018 timeframe, and guidance on the space weather information provider designation process.

One of the key components in the realization of an operational, global space weather information service for aviation before the end of 2018 is the conducting, by WMO at ICAO's request, of site assessments and audits of prospective space weather information providers.



# Global and Regional Centres Jointly Established by WMO and ICAO to Serve International Air Navigation

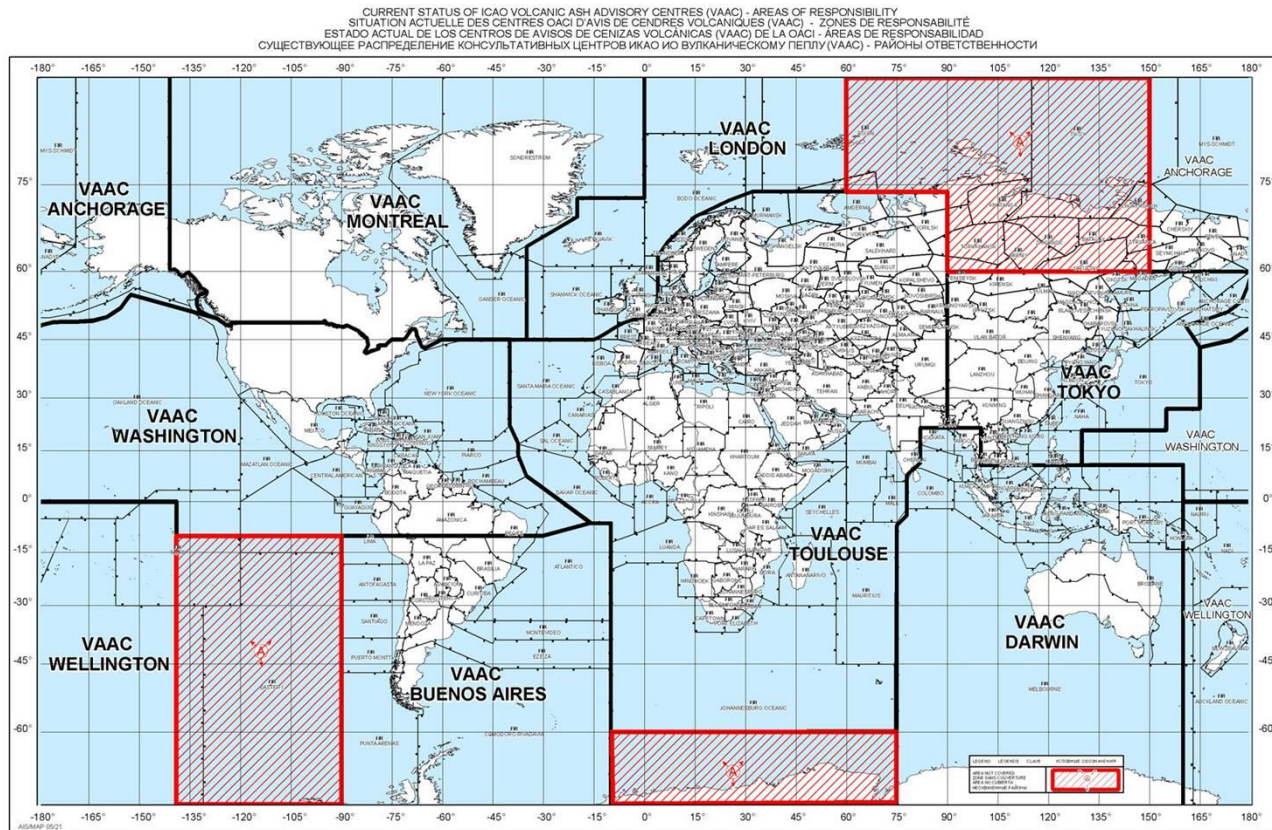


## Legend

- ▲ Volcanic Ash Advisory Centre (VAAC)
- Tropical Cyclone Advisory Centre (TCAC)
- World Area Forecast Centre (WAFC)

# Volcanic Ash Advisory Centers (VAACs)

ICAO in cooperation with WMO established a framework for the International Airways Volcano Watch (IAVW) in 1993. Within this framework, nine Volcanic Ash Advisory Centers (VAACs) monitor volcanic eruptions and **provide information on the locations and movement of volcanic ash in their areas of responsibility, as soon as volcanic ash is reported or detected** (volcano observatory, pilot report, satellite imagery, etc.)





# Summary

- Space weather is still an area of emerging importance in WMO.
- As an emerging area, the level of maturity of space weather capabilities varies considerably among WMO Members.
- Whereas some Members have established operational service capabilities, others may have an interest only in exploring how or if they may initiate some activity.
- To date, one highly successful aspect of the current IPT-SWeISS is that it allows a forum for all WMO Members with any level of interest or maturity to participate in and contribute to space weather-related activities and discussions.
- It is important that WMO Members with an exploratory or emerging interest will continue to have a means to participate.





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# Thank you



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Questions:  
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# Key Elements for an Operational Real-Time Warning System

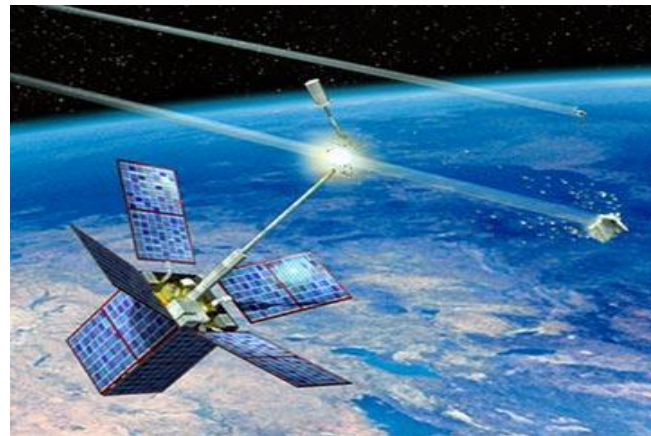
- Clear and Well Defined Procedures and Operations
- 24/7 Real-Time Operational Response System
- Equally Important: Operational Efficiency / Timeliness and Accuracy of Products
- Respect of the International and National Roles / Authority of Agencies and States
- Redundancy and Backup Systems and Centres
- Robust and Rapid Global Distribution Communication Systems
- Regular Testing
- Documentation and Training
- Ongoing Review of Procedures, Issues and Requirements for Future Work and Developments



# WMO Space Weather

There is an increasing societal demand for space weather services as a result of growing dependence on technologies impacted by space weather:

- air navigation on polar routes exposed to space weather events
- fleet of satellites used operationally for telecommunication, broadcasting, observation or positioning
- use of satellite-based navigation and timing signals that are affected by ionospheric disturbances
- electric power grids that are exposed to geomagnetically induced currents



# Definition of space weather

- Space Weather is defined here as the physical and phenomenological state of the natural space environment including the sun and the interplanetary and planetary environments.
- The associated discipline, “Meteorology of space” also commonly named “Space weather”, 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



# Coordination Group for Meteorological Satellites (CGMS)

- WMO Space Programme's objectives are to be achieved through strong partnership with CGMS and co-sponsoring international science groups: ITWG, IWWG, IPWG, **IROWG** and ICWG
- CGMS is a technical coordination body of satellite operators including space agencies focusing primarily on weather and climate satellite programmes in response to WMO requirements.



The baseline for holding a CGMS Membership covers: ([http://www.cgms-info.org/index\\_.php/cgms/members\\_observers](http://www.cgms-info.org/index_.php/cgms/members_observers))

- Current and prospective developers and operators of meteorological satellites;
- WMO, because of its unique role as representative of the world meteorological data user community, and other programmes jointly supported by WMO and other international agencies;
- Space agencies operating R&D satellites contributing to WMO programmes.

Organisation	Website	Accession
Centre National d'Etudes Spatiales	<a href="#">CNES</a>	2004
China Meteorological Administration	<a href="#">CMA</a>	1989
China National Space Administration	<a href="#">CNSA</a>	2006
EUMETSAT	<a href="#">EUMETSAT</a>	1987
India Meteorological Department	<a href="#">IMD</a>	1979
Indian Space Research Organisation	<a href="#">ISRO</a>	2015
Intergovernmental Oceanographic Commission / UNESCO	<a href="#">IOC/Unesco</a>	2001
Japan Aerospace Exploration Agency	<a href="#">JAXA</a>	2003
Japan Meteorological Agency	<a href="#">JMA</a>	1972
Korea Meteorological Administration	<a href="#">KMA</a>	2005
National Aeronautics and Space Administration	<a href="#">NASA</a>	2003
National Oceanic and Atmospheric Administration	<a href="#">NOAA</a>	1972
Russian Federal Service for Hydrometeorology and Environmental Monitoring	<a href="#">ROSHYDROMET</a>	1973
Russian Federal Space Agency	<a href="#">ROSCOSMOS</a>	2003
The European Space Agency	<a href="#">ESA</a>	2003
World Meteorological Organization	<a href="#">WMO</a>	1973



- In 2014, CGMS decided to include objectives related to space weather monitoring into its multi-year High-Level Priority Plan (HLPP) and agreed on Terms of Reference for CGMS Space Weather Activities.
- It is anticipated that CGMS will soon extend the scope of its activity towards space-based observation of space weather variables.
- Space Weather Task Team (SWTT) was organized to define the methodology for the implementation of space weather into CGMS

