

# ITU-R Study Group 7 Activities (Science Services)

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Chairman, ITU-R Study Group 7

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for Meteorology: Weather, Water and Climate  
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# Introduction

- “Science services” refer to the standard frequency and time signal, space research (SRS), space operation, Earth exploration-satellite (EESS), meteorological-satellite (MetSat), meteorological aids (MetAids) and radio astronomy (RAS) services.

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# Scope (1 of 3)

- The systems linked with Study Group 7 are used in activities that are a critical part of our everyday life such as:
  - global environment monitoring – atmosphere (including greenhouse gases emissions), oceans, land surface, biomass, etc.;
  - weather forecasting and climate change monitoring and prediction;
  - detection and tracking of many natural and man-made disasters (earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc);
  - providing alerting/warning information;
  - and, damage assessment and planning relief operations.

## Scope (2 of 3)

- SG 7 also encompasses systems for the study of outer space:
  - satellites for studying the sun, the magnetosphere and all the elements of our solar system;
  - spacecraft for human and robotic exploration of extraterrestrial bodies;
  - Earth and satellite-based radio astronomy to study the universe and its phenomena.

# Scope (3 of 3)

- Study Group 7 develops ITU-R Recommendations, Reports and Handbooks that are used for development and ensuring non-interference operation of:
  - space operation and space research systems;
  - Earth-exploration and meteorological systems (including the related use of links in the inter-satellite service);
  - radio astronomy and radar astronomy;
  - and, dissemination, reception and coordination of standard-frequency and time-signal services (including the application of satellite techniques) on a worldwide basis.

# Structure

- Four Working Parties (WPs) carry out studies on Questions assigned to Study Group (SG) 7:
  - WP 7A** Time signals and frequency standard emissions: Systems and applications, both terrestrial and satellite, for dissemination of standard time and frequency signals;
  - WP 7B** Space radiocommunication applications: Systems for transmission/reception of telecommand, tracking and telemetry data for space operations, space research, Earth exploration-satellite, and meteorological satellite services including the related use of links in the inter-satellite service;
  - WP 7C** Remote sensing systems: active and passive remote sensing applications in the Earth exploration-satellite service and systems of the MetAids service, as well as ground based passive sensors, space weather sensors and space research sensors, including planetary sensors;
  - WP 7D** Radio astronomy: radio astronomy and radar astronomy sensors, both Earth-based and space-based, including space very long baseline interferometry (VLBI).

- The work of WP 7A is of paramount importance to telecommunication administrations and industry. This work also has important consequences for other fields, such as:
  - radionavigation;
  - electric power generation;
  - space technology;
  - and, scientific and meteorological activities.

# Working Party 7B:

## Space radiocommunication applications

- The work of WP 7B assists administrations, national space agencies and industry in the planning of systems that share frequency allocations used by space radio systems.
- Extreme distances characterize deep space activities, with some current missions operating in excess of 11 billion km from the Earth.
- Near Earth space research missions often require constant communication with the Earth either directly from orbit or through geostationary data relay satellites.
- Manned space exploration introduces additional complexities related to protecting astronauts and cosmonauts working in space.
- Finally, It is crucial for understanding the Earth and its natural phenomena that active and passive sensor data obtained from Earth exploration-satellites is disseminated, while the transmission of weather-related observations from meteorological satellites provides global or regional coverage for weather models and weather event warnings.

# Working Party 7C:

## Remote sensing systems

- The Earth-exploration active sensors on-board satellites include systems to carry out scientific and meteorological measurements of soil moisture, forest biomass, precipitation, surface winds, ocean topography, clouds structure, etc.
- The Earth-exploration passive sensors are used for various terrestrial and atmospheric measurements, including important environmental data such as soil moisture, salinity, ocean surface temperature, water vapour profiles, temperature profiles, ocean ice, rain, snow, ice, winds, atmospheric chemicals, etc.
- MetAids are flown worldwide for the collection of upper atmosphere meteorological data for weather forecasts and severe storm prediction as well as other data.
- Space weather encompasses the conditions and processes occurring in space, including on the sun, in the magnetosphere, ionosphere and thermosphere, which have the potential to affect the near-Earth environment.

# Working Party 7D: Radio astronomy

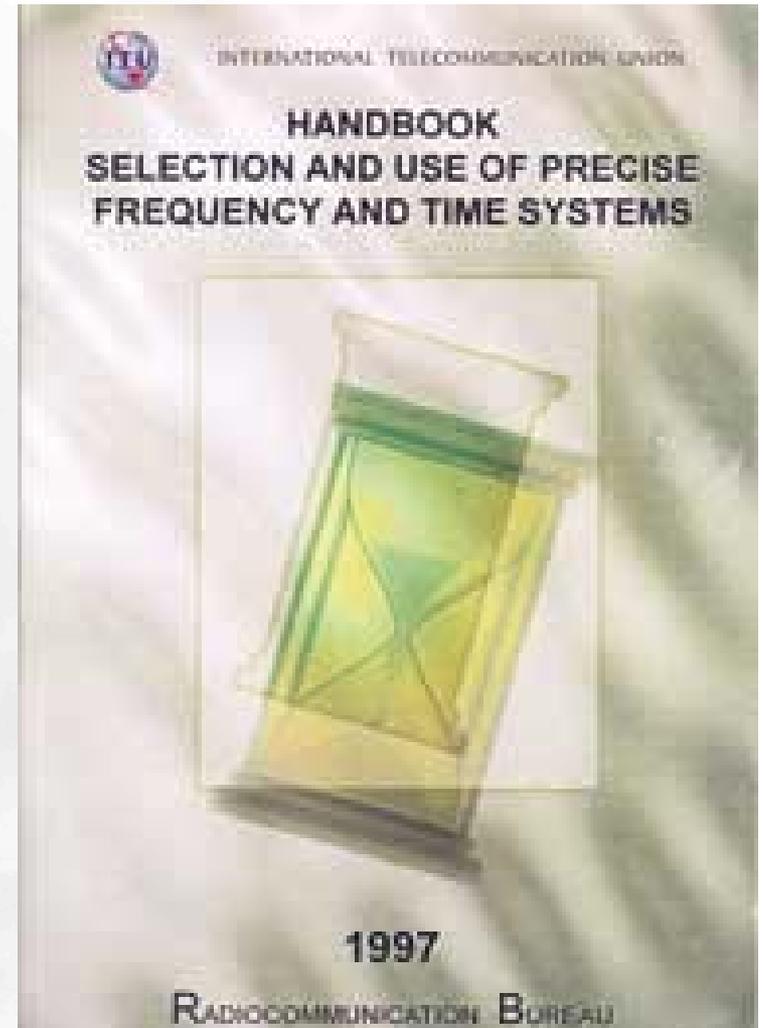
- Radio Astronomy observations involve the detection of extremely faint radio signals from the cosmos over the entire radio spectrum, and therefore require the most sensitive radio telescope systems.
- Such systems are very susceptible to radio frequency interference from other radio services and hence careful management of the radio spectrum is of extreme importance to radio astronomy.

# Handbook on Selection and Use of Precise Frequency and Time Systems

Published: **1997**

([www.itu.int/pub/R-HDB-31](http://www.itu.int/pub/R-HDB-31))

describes basic concepts, frequency and time sources, measurement techniques, characteristics of various frequency standards, operational experience, problems and future prospects.

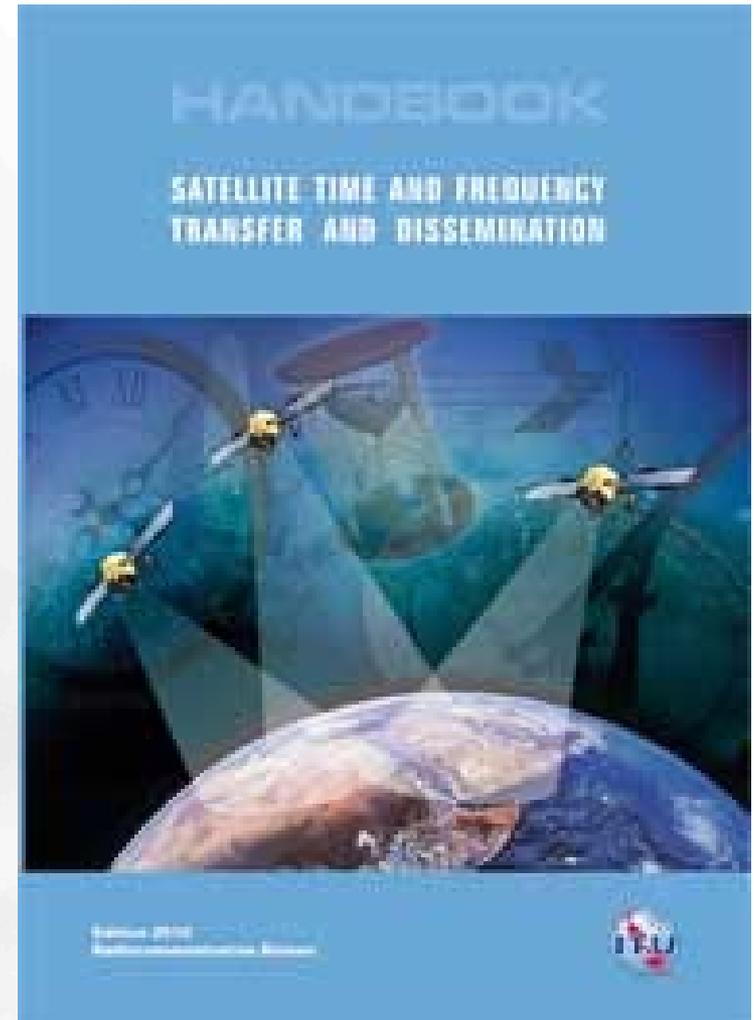


# Satellite Time and Frequency Transfer and Dissemination

Published: 2010

([www.itu.int/pub/R-HDB-55](http://www.itu.int/pub/R-HDB-55))

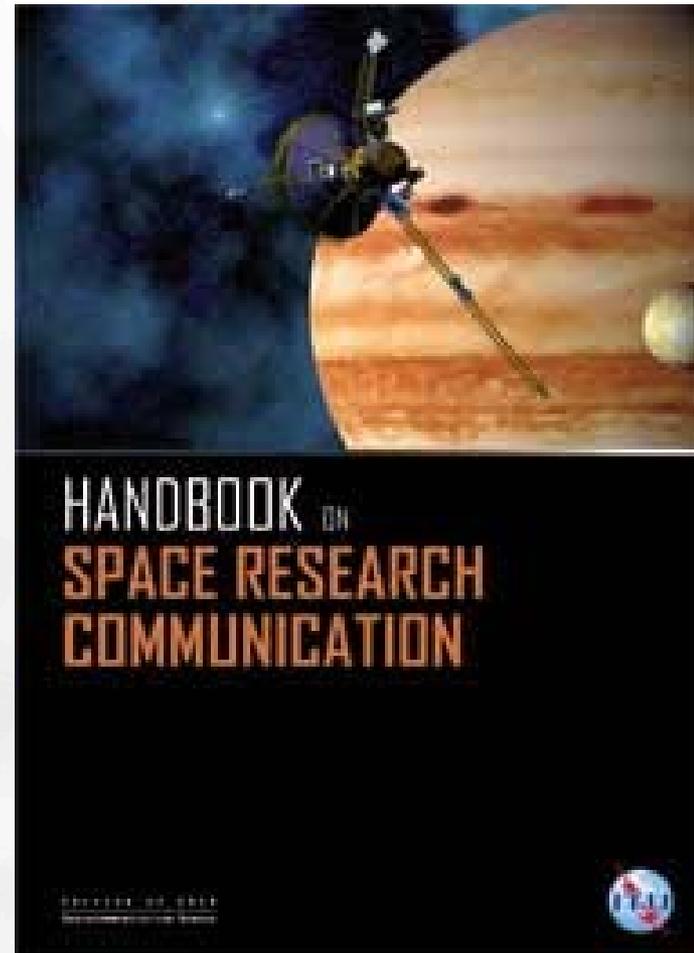
provides detailed information on the applied methods, technologies, algorithms, data structure and practical use of frequency and timing signals provided by satellite systems.



Published: 2014

([www.itu.int/pub/R-HDB-43](http://www.itu.int/pub/R-HDB-43))

presents the basic technical and spectrum requirements for the many different space research programmes, missions and activities. It discusses space research functions and technical implementations, factors that govern frequency selection for space research missions, and space research protection and sharing considerations.

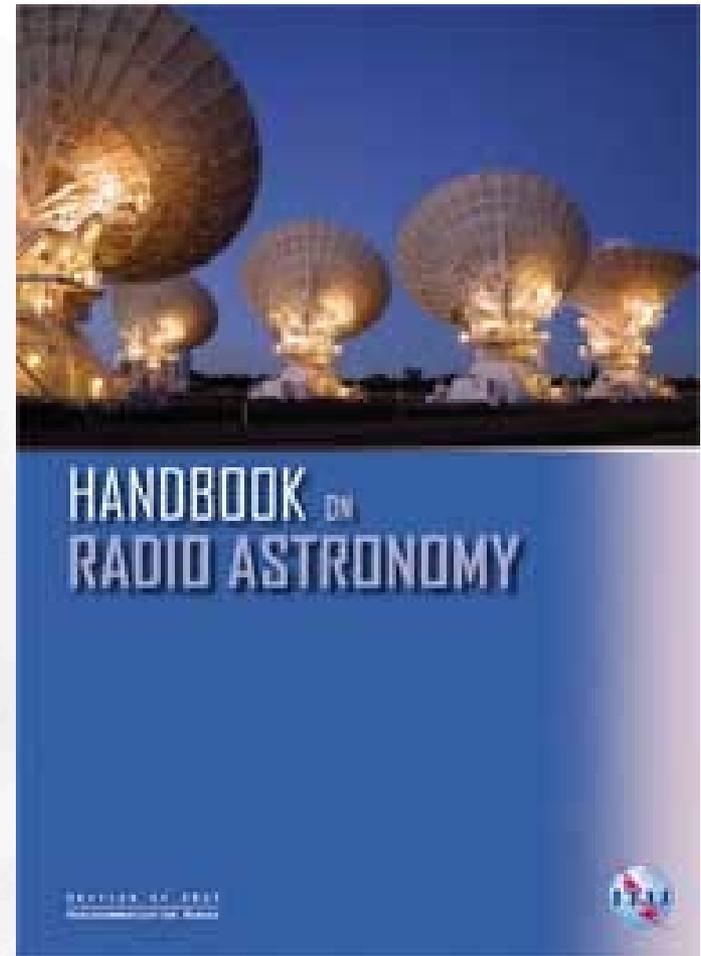


# Radio Astronomy

Published: 2013

([www.itu.int/pub/R-HDB-22](http://www.itu.int/pub/R-HDB-22))

is concerned with aspects of radio astronomy relevant to frequency coordination, i.e. the management of radio spectrum usage in order to minimize interference between radiocommunication services. It covers areas such as radio astronomy characteristics, preferred frequency bands, special radio astronomy applications, vulnerability to interference from other services, as well as issues associated with the sharing of radio spectrum with other services. The search for extraterrestrial intelligence and ground-based radar astronomy are also considered in the Handbook.

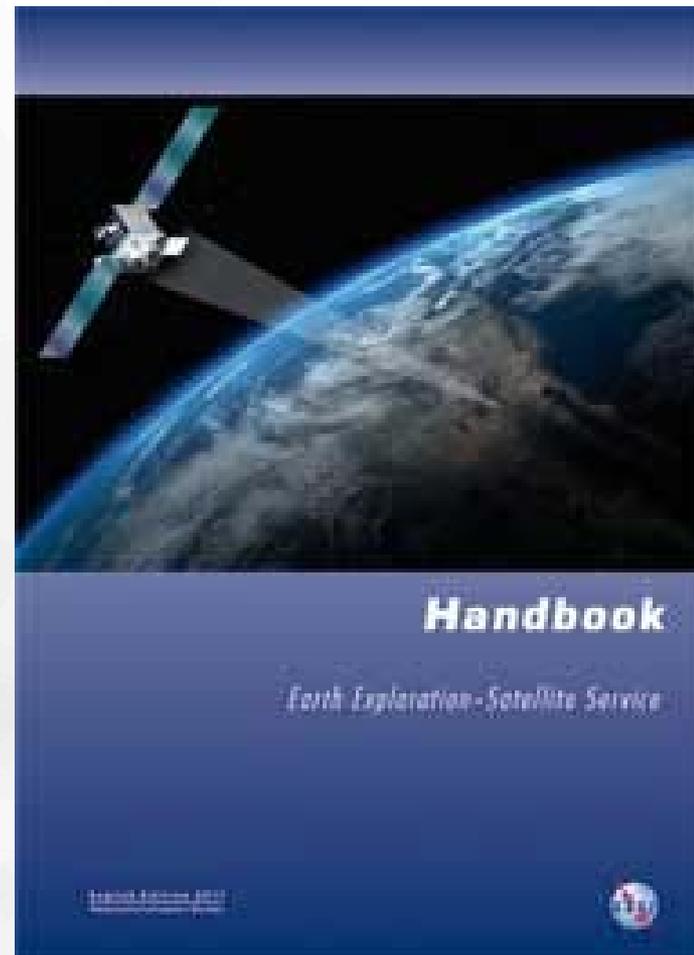


# Earth Exploration-Satellite Service

Published: 2011

([www.itu.int/pub/R-HDB-56](http://www.itu.int/pub/R-HDB-56))

describes the Earth exploration-satellite service (EESS), its technical characteristics, its applications, its spectrum requirements, as well as its benefits and provides full and comprehensive information on the development of EESS systems. Specifically, it provides basic definitions, sheds light on the technical principles underlying the operation of systems and presents their main applications to assist administrations in the spectrum planning, engineering and deployment aspects of these systems.

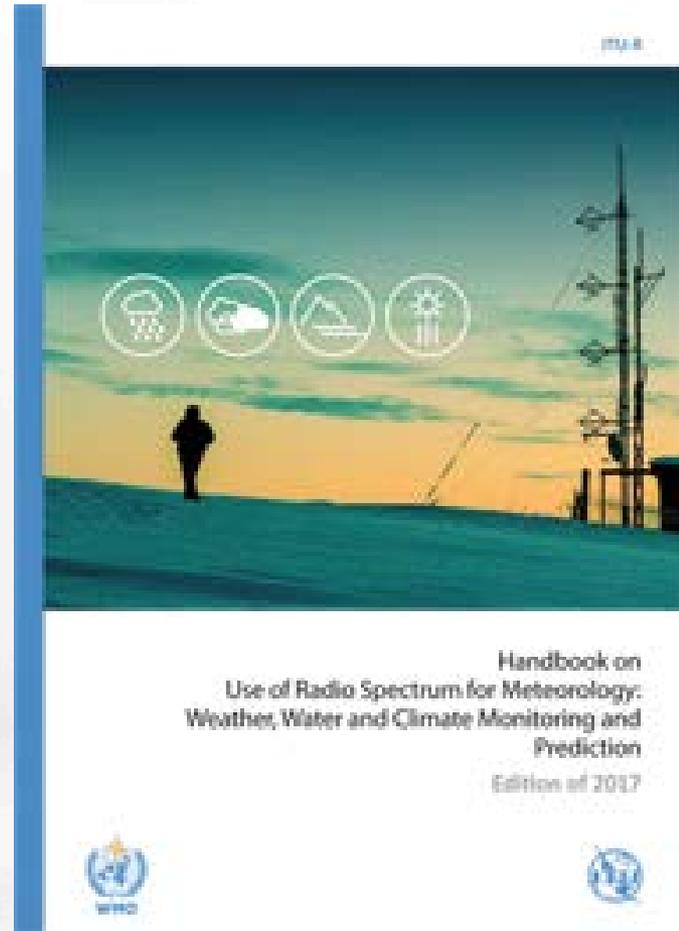


# Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction

Published: 2017

([www.itu.int/pub/R-HDB-45](http://www.itu.int/pub/R-HDB-45))

was developed in cooperation with the Steering Group on Radio Frequency Coordination of the World Meteorological Organization (WMO) and provides comprehensive technical information on the use of radio-based devices and systems, including meteorological and Earth exploration-satellites, radiosondes, weather radars, wind profiler radars, spaceborne remote sensing for weather and climate monitoring and forecasting.



# Questions assigned to SG 7 pertaining to Meteorological Services

Question ITU-R	Title	WP
<a href="#">129-3/7</a>	Unwanted emissions radiated from and received by stations of the science services	7B/7C/7D
<a href="#">139-4/7</a>	Data transmission for Earth exploration-satellite systems	7B
<a href="#">141-4/7</a>	Data transmission for meteorological satellite systems	7B
<a href="#">231/7</a>	Earth exploration-satellite service (active) and space research service (active) operating above 100 GHz	7C
<a href="#">234/7</a>	Frequency sharing between active sensor systems in the Earth exploration-satellite service and systems operating in other services in the 1 215-1 300 MHz band	7C
<a href="#">255/7</a>	Detection and resolution of radio frequency interference to Earth exploration-satellite service (passive) sensors	7C
<a href="#">256/7</a>	Space weather observations	7C

# RS Series of Recommendations (1 of 3)

Recommendation	Title
<a href="#"><u>RS.515</u></a>	Frequency bands and bandwidths used for satellite passive remote sensing
<a href="#"><u>RS.577</u></a>	Frequency bands and required bandwidths used for spaceborne active sensors operating in the Earth exploration-satellite (active) and space research (active) services
<a href="#"><u>RS.1165</u></a>	Technical characteristics and performance criteria for systems in the meteorological aids service in the 403 MHz and 1 680 MHz bands
<a href="#"><u>RS.1166</u></a>	Performance and interference criteria for active spaceborne sensors
<a href="#"><u>RS.1259</u></a>	Feasibility of sharing between spaceborne passive sensors and the fixed service from 50 to 60 GHz
<a href="#"><u>RS.1260</u></a>	Feasibility of sharing between active spaceborne sensors and other services in the range 420-470 MHz
<a href="#"><u>RS.1261</u></a>	Feasibility of sharing between spaceborne cloud radars and other services in the range of 92-95 GHz
<a href="#"><u>RS.1263</u></a>	Interference criteria for meteorological aids operated in the 400.15-406 MHz and 1 668.4-1 700 MHz bands
<a href="#"><u>RS.1264</u></a>	Feasibility of frequency sharing between the meteorological aids service and the mobile-satellite service (Earth-to-space) in the 1 668.4-1 700 MHz band
<a href="#"><u>RS.1279</u></a>	Spectrum sharing between spaceborne passive sensors and inter-satellite links in the range 50.2-59.3 GHz
<a href="#"><u>RS.1280</u></a>	Selection of active spaceborne sensor emission characteristics to mitigate the potential for interference to terrestrial radars operating in frequency bands 1-10 GHz
<a href="#"><u>RS.1281</u></a>	Protection of stations in the radiolocation service from emissions from active spaceborne sensors in the band 13.4-13.75 GHz
<a href="#"><u>RS.1282</u></a>	Feasibility of sharing between wind profiler radars and active spaceborne sensors in the vicinity of 1 260 MHz
<a href="#"><u>RS.1346</u></a>	Sharing between the meteorological aids service and medical implant communication systems (MICS) operating in the mobile service in the frequency band 401-406 MHz

# RS Series of Recommendations (2 of 3)

Recommendation	Title
<a href="#"><u>RS.1347</u></a>	Feasibility of sharing between radionavigation-satellite service receivers and the Earth exploration-satellite (active) and space research (active) services in the 1 215-1 260 MHz band
<a href="#"><u>RS.1416</u></a>	Sharing between spaceborne passive sensors and the inter-satellite service operating near 118 and 183 GHz
<a href="#"><u>RS.1449</u></a>	Feasibility of sharing between the FSS (space-to-Earth) and the Earth exploration-satellite (passive) and space research (passive) services in the band 18.6-18.8 GHz
<a href="#"><u>RS.1624</u></a>	Sharing between the Earth exploration satellite (passive) and airborne altimeters in the aeronautical radionavigation service in the band 4 200-4 400 MHz
<a href="#"><u>RS.1628</u></a>	Feasibility of sharing in the band 35.5-36 GHz between the Earth exploration-satellite service (active) and space research service (active), and other services allocated in this band
<a href="#"><u>RS.1632</u></a>	Sharing in the band 5 250-5 350 MHz between the Earth exploration-satellite service (active) and wireless access systems (including radio local area networks) in the mobile service
<a href="#"><u>RS.1744</u></a>	Technical and operational characteristics of ground-based meteorological aids systems operating in the frequency range 272-750 THz
<a href="#"><u>RS.1745</u></a>	Use of the band 1 668.4 1 710 MHz by the meteorological aids service and meteorological-satellite service (space-to-Earth)
<a href="#"><u>RS.1749</u></a>	Mitigation technique to facilitate the use of the 1 215-1 300 MHz band by the Earth exploration-satellite service (active) and the space research service (active)
<a href="#"><u>RS.1803</u></a>	Technical and operational characteristics for passive sensors in the Earth exploration-satellite (passive) service to facilitate sharing of the 10.6-10.68 GHz and 36-37 GHz bands with the fixed and mobile services
<a href="#"><u>RS.1804</u></a>	Technical and operational characteristics of Earth exploration-satellite service (EESS) systems operating above 3 000 GHz
<a href="#"><u>RS.1813</u></a>	Reference antenna pattern for passive sensors operating in the Earth exploration-satellite service (passive) to be used in compatibility analyses in the frequency range 1.4-100 GHz

# RS Series of Recommendations (3 of 3)

Recommendation	Title
<a href="#"><u>RS.1858</u></a>	Characterization and assessment of aggregate interference to the Earth exploration-satellite service (passive) sensor operations from multiple sources of man made emissions
<a href="#"><u>RS.1859</u></a>	Use of remote sensing systems for data collection to be used in the event of natural disasters and similar emergencies
<a href="#"><u>RS.1861</u></a>	Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz
<a href="#"><u>RS.1881</u></a>	Protection criteria for arrival time difference receivers operating in the meteorological aids service in the frequency band 9-11.3 kHz
<a href="#"><u>RS.1883</u></a>	Use of remote sensing systems in the study of climate change and the effects thereof
<a href="#"><u>RS.1884</u></a>	Methodology for determining terrestrial and space-to-Earth sharing and coordination criteria for meteorological aids in the 400.15-406 MHz and 1 668 1 700 MHz bands
<a href="#"><u>RS.2017</u></a>	Performance and interference criteria for satellite passive remote sensing
<a href="#"><u>RS.2042</u></a>	Typical technical and operating characteristics for spaceborne radar sounder systems using the 40-50 MHz band
<a href="#"><u>RS.2043</u></a>	Characteristics of SARS operating in the Earth exploration-satellite service (active) around 9 600 MHz
<a href="#"><u>RS.2064</u></a>	Typical technical and operating characteristics and frequency bands used by space research service (passive) systems
<a href="#"><u>RS.2065</u></a>	Protection of space research service (SRS) space-to-Earth links in the 8 400-8 450 MHz and 8 450-8 500 MHz bands from unwanted emissions of synthetic aperture radars operating in the Earth exploration-satellite service (active) around 9 600 MHz
<a href="#"><u>RS.2066</u></a>	Protection of the radio astronomy service in the frequency band 10.6-10.7 GHz from unwanted emissions of synthetic aperture radars operating in the Earth exploration-satellite service (active) around 9 600 MHz
<a href="#"><u>RS.2105</u></a>	Typical technical and operational characteristics of Earth exploration-satellite service (active) systems using allocations between 432 MHz and 238 GHz
<a href="#"><u>RS.2106</u></a>	Detection and resolution of radio frequency interference to Earth exploration-satellite service (passive) sensors

# SA Series of Recommendations (1 of 2) pertaining to Meteorological Services

Recommendation	Title
<a href="#"><u>SA.514</u></a>	Interference criteria for command and data transmission systems operating in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1020</u></a>	Hypothetical reference system for the Earth exploration-satellite and meteorological satellite services
<a href="#"><u>SA.1021</u></a>	Methodology for determining performance objectives for systems in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1022</u></a>	Methodology for determining interference criteria for systems in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1023</u></a>	Methodology for determining sharing and coordination criteria for systems in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1024</u></a>	Necessary bandwidths and preferred frequency bands for data transmission from Earth exploration satellites (not including meteorological satellites)
<a href="#"><u>SA.1025</u></a>	Performance criteria for space-to-Earth data transmission systems operating in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit
<a href="#"><u>SA.1026</u></a>	Aggregate interference criteria for space-to-Earth data transmission systems operating in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit
<a href="#"><u>SA.1027</u></a>	Sharing criteria for space-to-Earth data transmission systems in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit
<a href="#"><u>SA.1154</u></a>	Provisions to protect the space research (SR), space operations (SO) and Earth exploration-satellite services (EESS) and to facilitate sharing with the mobile service in the 2 025-2 110 MHz and 2 200-2 290 MHz bands
<a href="#"><u>SA.1158</u></a>	Feasibility of frequency sharing in the 1 670-1 710 MHz band between the meteorological-satellite service (space-to-Earth) and the mobile-satellite service (Earth-to-space)
<a href="#"><u>SA.1159</u></a>	Performance criteria for data dissemination, data collection and direct data readout systems in the Earth exploration-satellite service and meteorological-satellite service

# SA Series of Recommendations (2 of 2) pertaining to Meteorological Services

Recommendation	Title
<a href="#"><u>SA.1160</u></a>	Interference criteria for data dissemination and direct data readout systems in the Earth exploration-satellite and meteorological-satellite services using satellites in the geostationary orbit
<a href="#"><u>SA.1161</u></a>	Sharing and coordination criteria for data dissemination and direct data readout systems in the Earth exploration-satellite and meteorological-satellite services using satellites in geostationary orbit
<a href="#"><u>SA.1162</u></a>	Performance criteria for service links in data collection and platform location systems in the Earth exploration- and meteorological-satellite services
<a href="#"><u>SA.1163</u></a>	Interference criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1164</u></a>	Sharing and coordination criteria for service links in data collection systems in the Earth exploration-satellite and meteorological-satellite services
<a href="#"><u>SA.1258</u></a>	Sharing of the frequency band 401-403 MHz between the meteorological-satellite service, Earth exploration-satellite service and meteorological Aids service
<a href="#"><u>SA.1277</u></a>	Sharing in the 8 025-8 400 MHz frequency band between the Earth exploration-satellite service and the fixed, fixed-satellite, meteorological-satellite and mobile services in Regions 1, 2 and 3
<a href="#"><u>SA.1627</u></a>	Telecommunication requirements and characteristics of EESS and MetSat service systems for data collection and platform location
<a href="#"><u>SA.1807</u></a>	System characteristics and interference criteria for meteorological satellite systems operating around 18 GHz
<a href="#"><u>SA.1810</u></a>	System design guidelines for Earth exploration-satellites operating in the band 8 025-8 400 MHz
<a href="#"><u>SA.1862</u></a>	Guidelines for efficient use of the band 25.5-27.0 GHz by the Earth exploration-satellite service (space-to-Earth) and space research service (space-to-Earth)
<a href="#"><u>SA.2044</u></a>	Protection criteria for non-GSO data collection platforms in the band 401-403 MHz
<a href="#"><u>SA.2045</u></a>	Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary METSAT and EESS systems

# M-Series Recommendations (SG-5) pertaining to Meteorological Systems

Recommendation	Title
<a href="#"><u>M.1085</u></a>	Technical and operational characteristics of wind profiler radars for bands in the vicinity of 400 MHz
<a href="#"><u>M.1226</u></a>	Technical and operational characteristics of wind profiler radars in bands in the vicinity of 50 MHz
<a href="#"><u>M.1227</u></a>	Technical and operational characteristics of wind profiler radars in bands in the vicinity of 1 000 MHz
<a href="#"><u>M.1464</u></a>	Characteristics of radiolocation radars, and characteristics and protection criteria for sharing studies for aeronautical radionavigation and meteorological radars in the radiodetermination service operating in the frequency band 2 700-2 900 MHz
<a href="#"><u>M.1849</u></a>	Technical and operational aspects of ground-based meteorological radars
<a href="#"><u>M.1874</u></a>	Technical and operational characteristics of oceanographic radars operating in sub-bands within the frequency range 3-50 MHz

# ITU-R Resolutions for SG 7

Resolution ITU-R	Title
<a href="#">28-2</a>	Standard-frequency and time-signal emissions
<a href="#">55-2</a>	ITU studies of disaster prediction, detection, mitigation and relief

# WRC-19 Agenda Items where SG 7 is Responsible Group

- **1.2** to consider in-band power limits for earth stations operating in the mobile-satellite service, meteorological-satellite service and Earth exploration-satellite service in the frequency bands 401-403 MHz and 399.9-400.05 MHz, in accordance with Resolution 765 (WRC 15);
- **1.3** to consider possible upgrading of the secondary allocation to the meteorological-satellite service (space-to-Earth) to primary status and a possible primary allocation to the Earth exploration-satellite service (space-to-Earth) in the frequency band 460-470 MHz, in accordance with Resolution 766 (WRC 15);
- **1.7** to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC 15);

# WRC-19 Agenda Items where WPs in SG 7 are Concerned Groups (1 of 2)

AI	Description	Group
1.5	to consider the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion communicating with geostationary space stations in the fixed-satellite service and take appropriate action, in accordance with Resolution 158 (WRC 15);	WP 7B, WP 7C
1.6	to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC 15);	WP 7B, WP 7C, WP 7D
1.8	to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution 359 (Rev. WRC 15);	WP 7D
1.10	to consider spectrum needs and regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System (GADSS), in accordance with Resolution 426 (WRC 15);	WP 7B, WP 7C, WP 7D
1.11	to take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands to support railway radiocommunication systems between train and trackside within existing mobile service allocations, in accordance with Resolution 236 (WRC 15);	WP 7B, WP 7C, WP 7D
1.12	to consider possible global or regional harmonized frequency bands, to the maximum extent possible, for the implementation of evolving Intelligent Transport Systems (ITS) under existing mobile-service allocations, in accordance with Resolution 237 (WRC 15);	WP 7B, WP 7C, WP 7D

# WRC-19 Agenda Items where WPs in SG 7 are Concerned Groups (2 of 2)

AI	Description	Group
1.13	to consider identification of frequency bands for the future development of International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238 (WRC 15);	WP 7B, WP 7C, WP 7D
1.14	to consider, on the basis of ITU R studies in accordance with Resolution 160 (WRC 15), appropriate regulatory actions for high-altitude platform stations (HAPS), within existing fixed-service allocations;	WP 7B, WP 7C, [WP 7D]
1.15	to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC 15);	WP 7C, WP 7D
1.16	to consider issues related to wireless access systems, including radio local area networks (WAS/RLAN), in the frequency bands between 5 150 MHz and 5 925 MHz, and take the appropriate regulatory actions, including additional spectrum allocations to the mobile service, in accordance with Resolution 239 (WRC 15);	WP 7C
9.1.4	Resolution 763 (WRC 15): Stations on board sub-orbital vehicles	WP 7B
9.1.9	Resolution 162 (WRC 15): Studies relating to spectrum needs and possible allocation of the frequency band 51.4-52.4 GHz to the fixed-satellite service (Earth-to-space)	WP 7C, WP 7D