1675 - 1695 MHz Band

1. Band Introduction

The Geostationary Operational Environmental Satellites (GOES) series of satellites operate in this band transmitting weather and other meteorological data to earth station receivers for further processing and distribution. In addition, Federal agencies use the 1675-1683 MHz portion of this band to transmit meteorological data from radiosondes to ground stations for weather forecasting.

2. Allocations

2a. Allocation Table

The frequency allocation table shown below is extracted from NTIA's Manual of Regulations & Procedures for Federal Radio Frequency Management, Chapter 4 – Allocations, Allotments and Plans.

Table of Frequency Allocations (1675 –1695 MHz)

Table of Frequency Allocations

United States Table

Federal Table	Non-Federal Table	FCC Rule Part(s)
1675-1695 METEOROLOGICAL AIDS (radiosonde) METEOROLOGICAL-SATELLITE (space-to-Earth) US88 5.341 US211 US289		

2b. Additional Allocation Table Information

5.341 In the bands 1400-1727 MHz, 101-120 GHz and 197-220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extraterrestrial origin.

US88 In the bands 1675-1695 MHz and 1695-1710 MHz, the following provisions shall apply:

(a) Non-Federal use of the band 1695-1710 MHz by the fixed and mobile except aeronautical mobile services is restricted to stations in the Advanced Wireless Service (AWS). Base stations that enable AWS mobile and portable stations to operate in the band 1695-1710 MHz must be successfully coordinated prior to operation as follows: (i) all base stations within the 27 protection zones listed in paragraph (b) that enable mobiles to operate at a maximum e.i.r.p. of 20 dBm, and (ii) nationwide for base stations that enable mobiles to operate with a maximum e.i.r.p. greater than 20 dBm, up to a

maximum e.i.r.p. of 30 dBm, unless otherwise specified by Commission rule, order, or notice

(b) Forty-seven Federal earth stations located within the protection zones listed below operate on a co-equal, primary basis with AWS operations. All other Federal earth stations operate on a secondary basis.

(1) Protection zones for Federal earth stations receiving in the band 1695-1710 MHz:

State	Location	Latitude	Longitude	Radius (km)
AK	Barrow ……...	71° 19' 22"	156° 36' 41"	...…..….. 35
AK	Elmendorf AFB …….	61° 14' 08"	149° 55' 31"	….....….. 98
AK	Fairbanks ……...	64° 58' 22"	147° 30' 02"	…….. 20
AZ	Yuma …….	32° 39' 24"	114° 36' 22"	…….. 95
CA	Monterey ……...	36° 35' 34"	121° 51' 20"	…….. 76
CA	Twenty-Nine Palms...	34° 17' 46"	116° 09' 44"	…….. 80
FL	Miami ……	25° 44' 05"	080° 09' 45"	…….. 51
HI	Hickam AFB …….	21° 19' 18"	157° 57' 30"	…….. 28
MD	Suitland …….	38° 51' 07"	076° 56' 12"	…….. 98
MS	Stennis Space Center	30° 21' 23"	089° 36' 41"	…….. 57
SD	Sioux Falls ……	43° 44' 09"	096° 37' 33"	…….. 42
VA	Wallops Island ……..	37° 56' 45"	075° 27' 45"	…….. 30
GU	Andersen AFB ……..	13° 34' 52"	144° 55' 28"	…….. 42

(2) Protection zones for Federal earth stations receiving in the band 1675-1695 MHz:

State	Location	Latitude	Longitude	Radius (km)
CA	Sacramento ……	38° 35' 50"	121° 32' 34"	…….. 55
CO	Boulder ……..	39° 59' 26"	105° 15' 51"	…….. 02
ID	Boise …….	43° 35' 42"	116° 13' 49"	…….. 39

IL	Rock Island ……...	41° 31' 04"	090° 33' 46"	……. 19
MO	Kansas City ……...	39° 16' 40"	094° 39' 44"	……. 40
MO	St. Louis ……	38° 35' 26"	090° 12' 25"	……. 34
MS	Columbus Lake …….	33° 32' 04"	088° 30' 06"	……. 03
MS	Vicksburg ……...…..	32° 20' 47"	090° 50' 10"	……. 16
NE	Omaha ……..….....	41° 20' 56"	095° 57' 34"	……. 30
OH	Cincinnati …..……...	39° 06' 10"	084° 30' 35"	……. 32
OK	Norman …….	35° 10' 52"	097° 26' 21"	……. 03
TN	Knoxville ……...	35° 57' 58"	083° 55' 13"	……. 50
WV	Fairmont ……	39° 26' 02"	080° 11' 33"	……. 04
PR	Guaynabo ……..	18° 25' 26"	066° 06' 50"	……. 48

NOTE: The coordinates are specified in the conventional manner (North latitude, West longitude), except that the Guam (GU) entry is specified in terms of East longitude.

US211 In the bands 1670-1690, 5000-5250 MHz and 10.7-11.7, 15.1365-15.35, 15.4-15.7, 22.5-22.55, 24-24.05, 31.0-31.3, 31.8-32.0, 40.5-42.5, 116-122.25, 123-130, 158.5-164, 167-168, 191.8-200, and 252-265 GHz, applicants for airborne or space station assignments are urged to take all practicable steps to protect radio astronomy observations in the adjacent bands from harmful interference; however, US74 applies.

US289 Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1690-1695 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table of Frequency Allocations.

3. Federal Agency Use

3a. Federal Agency Frequency Assignment Table

The following table identifies the frequency band, types of allocations, types of applications, and the number of frequency assignments by agency.

Federal Agency Frequency Assignment Table

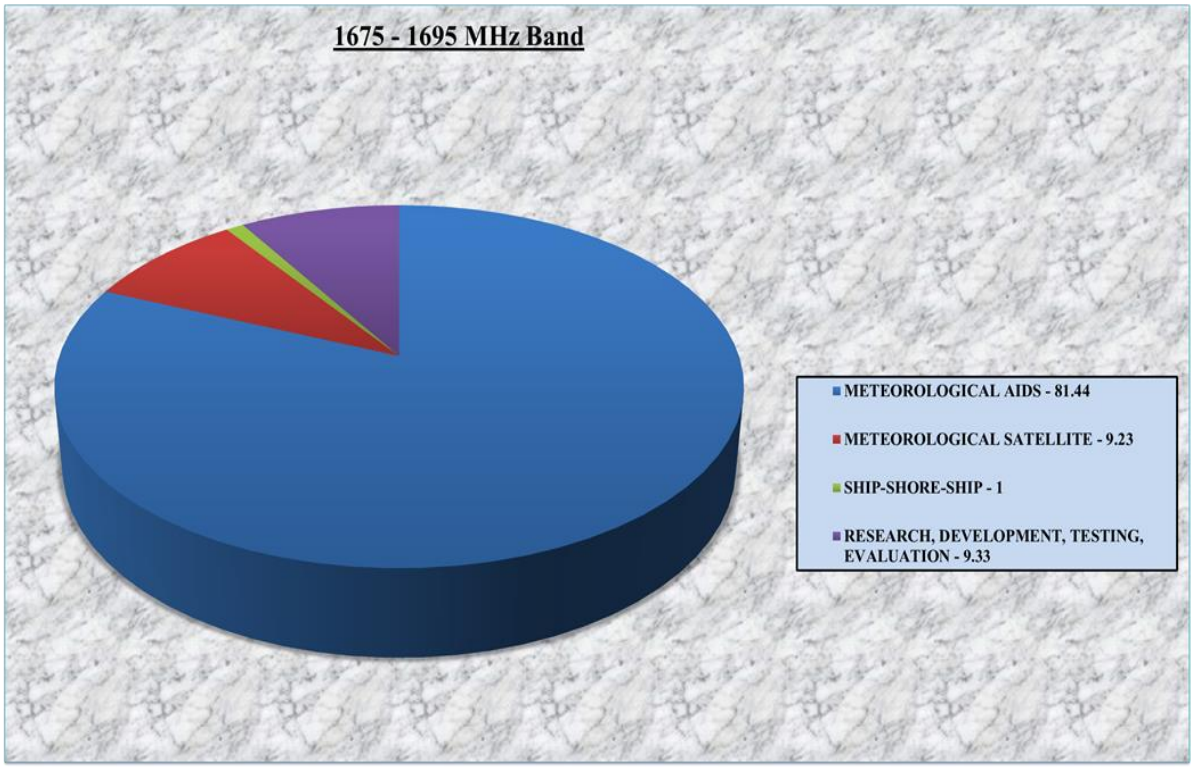
1675-1695 MHz					
SHARED BAND					
	METEOROLOGICAL AIDS (radiosonde) METEOROLOGICAL-SATELLITE (space-to-Earth)				
	TYPE OF APPLICATION				
AGENCY	METEOROLOGICAL AIDS	METEOROLOGICAL SATELLITE	SHIP-SHORE-SHIP	REESEARCH DEVELOPMENT TESTING EVALUATION	TOTAL
AF	1				1
AR	2				2
DOC	424	48		44	516
DOE	2				2
N	1		5		6
NASA		1			1
TOTAL	430	49	5	44	528

The number of actual systems, or number of equipments, may exceed and sometimes far exceed, the number of frequency assignments in a band. Also, a frequency assignment may represent a local, state, regional or nationwide authorization. Therefore, care must be taken in evaluating bands strictly on the basis of assignment counts or percentages of assignments.

3b. Percentage of Frequency Assignment Chart:

The following chart displays the percentage of frequency assignments for the systems operating in the frequency band 1675-1695 MHz.

1675-1695 MHz Band By Service



4. Frequency Band Analysis By Application

The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) operates the GOES system in the band 1675-1695 MHz. The Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and various Federal/non-Federal entities operate earth stations to receive environmental research and weather data transmitted from GOES satellites. GOES satellites transmit raw data in the band 1675-1695 MHz to four primary receiving NOAA earth stations located at Fairbanks, AK, Wallops Island, VA, Suitland, MD, and Greenbelt, MD for processing. The earth stations transmit processed data back to the satellites using the band 2025-2110 MHz. The satellites then broadcast the processed data to Federal/non-Federal receiving earth stations in the 1675-1695 MHz band. Television and radio stations throughout the United States and parts of the world

use the processed data to generate daily weather reports for broadcast over television and radio stations. Various Federal/non-Federal earth stations also receive raw data from the NOAA meteorological
satellites and process this data for their own weather-related uses. One of the major uses of the broadcast data is the Emergency Managers Weather Information Newwork (EMWIN). EMWIN is a service that allows thousands of users to obtain up-to-date weather forecasts, warnings, and other information directly from the GOES. The general public as well as emergency managers and public safety officials, who need timely weather information, use the EMWIN service to make critical decisions. The following section describe detailed operations regarding GOES in the 1675-1695 MHz band.

4a. GOES Meteorological-Satellites

The goals of the GOES system program are to:

- maintain continuous, reliable operational, environmental, and storm warning systems to protect life and property;
- introduce improved atmospheric and oceanic observations and data dissemination capabilities;
- develop and provide new and improved applications and products for a wide range of Federal agencies, state and local governments, and the public.

To address these goals, NOAA's National Weather Service (NWS) and National Environmental Satellite, Data, and Information Service (NESDIS) established mission requirements that are the basis for the design of the GOES system and its capabilities. The GOES system thus functions to accomplish an environmental mission serving the needs of operational meteorological, space environmental, and research users. The NOAA GOES weather satellites provide enhanced coverage of the eastern and western hemisphere. The spacecraft design enables the primary sensors to focus at Earth and collect important weather related data such as cloud cover, surface temperature, and water vapor distribution. The satellites can track atmospheric phenomena, ensuring real-time coverage of short-lived dynamic events, such as severe local storms, tropical hurricanes and cyclones, volcanic ash, and wildfires, four types of meteorological events that directly affect public safety, and property. A data collection system on GOES receives environmental data from a network of widely dispersed data collection platforms (DCPs) such as river and rain gauges, seismometers, tide gauges, buoys, ships, and automatic weather stations and relays that data to earth stations at the frequencies 1694.5 and 1694.8 MHz. DCPs transmit sensor data to the GOES satellites in both the 402-403 MHz and 2025-2110 MHz bands.

The primary measurement sensors, referred to as the Imager and the Sounder, carry out the main mission of the GOES satellites. The GOES Imager and Sounder sensors execute environmental remote sensing function. The Imager is a multichannel instrument that senses radiant energy and reflected solar energy from the Earth's surface and atmosphere and produces visible and infrared images of the Earth's surface, oceans, cloud cover, and severe storm developments, providing the familiar weather pictures seen on television newscasts every day. The Sounder provides data for vertical atmospheric temperature and moisture profiles, surface and cloud top temperature, as well as ozone distribution. Sounder data also play a role in computer models to produce short-to-long-range weather forecasts. The Imager and Sounder sensors feature flexible scans for small-scale area viewing in regions of the visible and infrared spectrum allowing meteorologists to improve short-term weather forecasts.

GOES provides nearly continuous Imager and Sounder data, which allow forecasters to better measure changes in atmospheric temperature and moisture distributions, increasing the accuracy of weather forecasts. Applications related to weather, ocean, climate, cryosphere, land, and environmental hazards use GOES information. The Solar X-ray Imager (SXI) on GOES monitors the sun's X-rays for the early detection of coronal mass ejections and solar flares. This early warning is important because these solar flares affect not only the safety of humans in high-altitude missions, such as the International Space Station, but also military and commercial satellite communications, and commercial aviation flights. The GOES satellites also carry space environment monitoring instruments which monitor X-rays, extreme ultraviolet and particle emissions including solar protons, alpha particles, and electrons. These space environment-monitoring instruments also include a magnetometer that samples the Earth's magnetosphere.[1]

The Space Environment Monitor (SEM) covering an extensive range of solar energies performs space environment sensing. The SEM senses and obtains data remotely over a wide range of areas of the western hemisphere using the frequency band 1673.4-1678.6 MHz. Area coverage also includes the ability needed to relay signals and data from ground transmitters and platforms to central stations and end users. Figure 2 shows the GOES space and ground segments that operate using various frequencies.

Collected data is processed and distributed in the 1683.5-1687.9 MHz band to users in real-time to meet observation time and timeliness requirements, including revisit cycles (rapid scan operations).

[1] A magnetometer is an electric device that senses changes in magnetic fields.

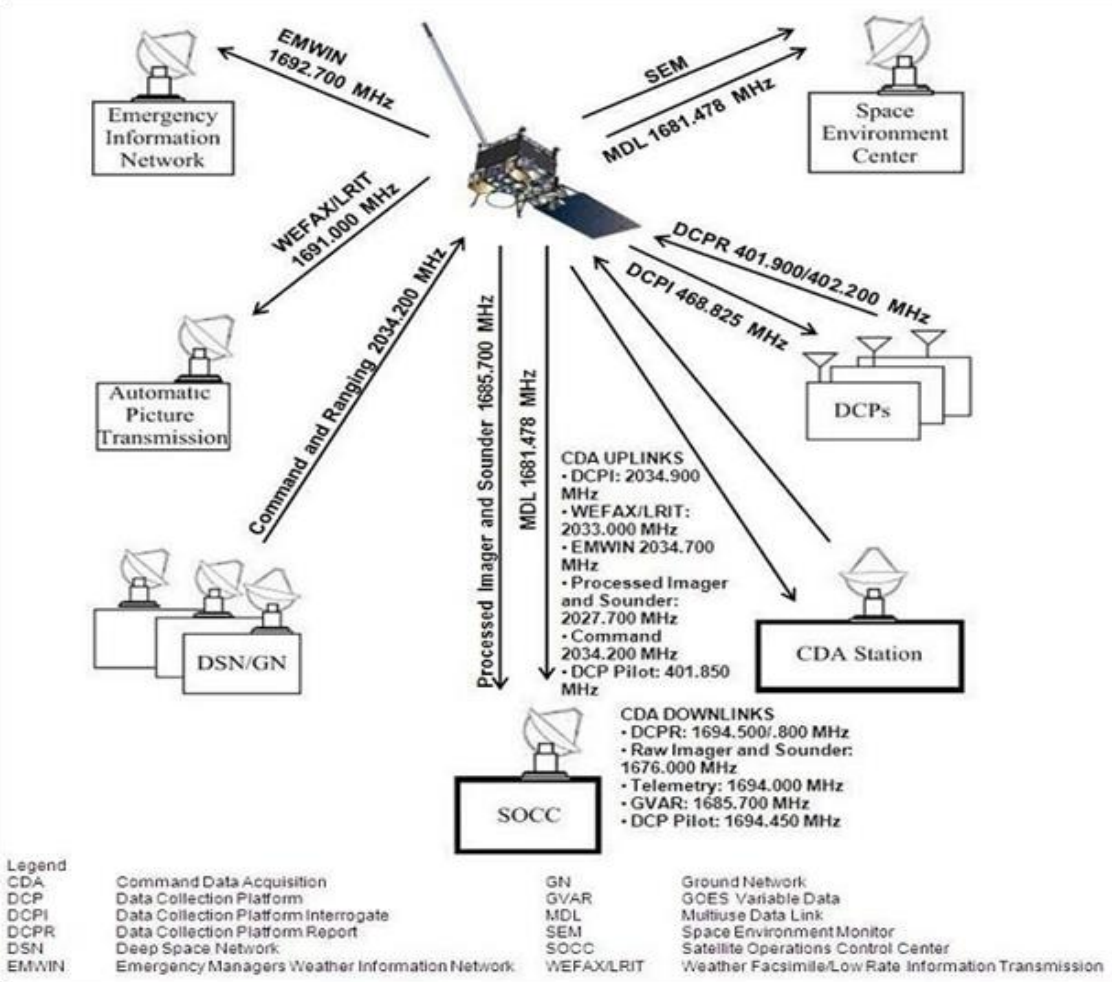


Figure 2. GOES System Space and Ground Segments

4b. GOES Meteorological Transmission Downlink Signals

Federal and non-Federal entities use GOES downlink signals for meteorological data. Table 1 shows an overview of NOAA's GOES Meteorological-Satellite Operations in the 1675-1695 MHz band and the various downlink signals.

Table 1. NOAA Meteorological-Satellite (GOES) Operations in the 1675-1695 MHz

Center Frequency (MHz)	Emission Bandwidth (MHz)	Function	Receive Locations
NOAA GOES N-P Meteorological Satellite Downlinks			
1676	5.200**	Sensor Data Link (SD)	Wallops Island, VA Greenbelt, MD Omaha, NE Fairbanks, AK
1681.478	0.400	Multi-Use Data Link (MDL)	Wallops Island, VA Greenbelt, MD Boulder, CO Omaha, NE
1685.7	4.220	Processed Data Relay (PDR)/GOES Variable (GVAR) (Broadcast)	US&P/Worldwide
1691.0	0.586	Low Rate Information Transmission (LRIT) (Broadcast)	
1692.7	0.027	Emergency Managers Weather Information Network (EMWIN) (Broadcast)	
1694.0	0.016	Command Data Acquisition (CDA)Telemetry	Fairbanks, AK Wallops Island, VA Greenbelt, MD Direct Readout Ground Stations (DRGS)
1694.5 1694.8	0.400 0.400	Data Collection Platform Report (DCPR)	
NOAA GOES-R* Meteorological Satellite Downlinks			
1690	12.000***	GOES-Re-Broadcast Data (GRB)	Western Hemisphere Suitland, MD
1683.3-1683.6	0.400	Data Collection Platform Report (DCP REPORT)	Worldwide Not including US&P

* The GOES-R program is under development and some center frequencies of the functions may change after the development and launch of the new GOES in the future.

** The emission of this link overlaps the 1670-1675 MHz band.

*** The emission of this link overlaps the 1695-1710 MHz band.

Emergency Managers Weather Information Network (1692.7MHz)

The EMWIN provides vital data to the emergency management community. The NWS provides a broadcast of live weather and civil emergency information to computers across the United States, the Caribbean, South America, and over most of the Pacific and Atlantic Oceans. The NWS in cooperation with NESDIS has been providing the EMWIN service since 1995. Since then, the emergency management community has had immediate access to information pertaining to threats from powerful weather events and the threat of serious civil disasters. Emergency information is broadcast using the center frequency of 1692.7 MHz via the GOES East and West satellites extending the coverage to the eastern edge of Australia.[2]

The EMWIN system's primary use is warning the public and distributing warning products and other processed data (graphics and imagery) emergency managers need. Its flexibility and low cost of operations is suitable for use even for small emergency management units anywhere in the United States. EMWIN's data regarding warning and weather information is in digital form in order to meet the needs of emergency managers. Emergency managers and the public can receive the data, demodulate, and display it on a computer. The system triggers sirens, pager networks, cell phones and other means of communications. Many users of these systems are mobile in nature (i.e., Red Cross response trucks) and are able to make use of the EMWIN signal.[3]

In addition to very fast broadcast of priority-driven weather-warning products, EMWIN also provides rapid dissemination of forecasts, graphics, and imagery to aid in increasing lead times for emergency managers. EMWIN not only provides this data but does so in a manner that can continue to work during and following disaster conditions when non-satellite forms of communication are unavailable.

The NWS gathers live weather and emergency information from forecast offices via the Telecommunications Gateway, which is a message-switching center, linked via redundant fiber optic channels to other major network nodes that provide the EMWIN system and other sources across the globe with weather watches, warnings, and forecasts.[4] The EMWIN system then broadcasts selected and prioritized data.

Low Rate Information Transmission (1691.0 MHz)

The European Organization for the Exploration of Meteorological Satellites (EUMETSAT), Japan Meteorological Agency (JMA), and NOAA support the global signal Low Rate Information Transmission (LRIT). The U.S. LRIT service provides visible and infrared sectors as well as full disk imagery to support users from 70ºN-70ºS and 15º W to 170º E. The service also includes selected meteorological and oceanographic charts, in-situ observations, and emergency warning information. The NOAA LRIT system provides digital data, via a broadcast service, on the GOES-East and GOES-West satellites. On the GOES-R series of satellites, LRIT service will merge with the EMWIN service.

---

[2] GOES East is located at 75º West and GOES West is located at 135º W.

[3] The EMWIN receive antenna dishes do not require stowing during high winds, allowing the system to be used during severe weather events, including hurricanes.

[4] The NWS operates and ensures continuous acquisition and dissemination of NWS and other global meteorological data and products. This central switching system (Telecommunications Gateway) of the NWS controls the exchange of data with remote locations.

GOES-Rebroadcast (1690 MHz)

The GOES-Rebroadcast (GRB) will begin on GOES-R, replacing the current GVAR (GOES Variable) service. The GRB service provides users with a variety of enhanced data and products at a much higher data rate approximately 20 megabytes per second as compared to the current data rate of 2.11 megabytes per second.

Multi-use Data Link (1681.478 MHz)

The Spacecraft Operations Control Center is an independent data link that receives the Multi-use Data Link (MDL). The Spacecraft Support Ground System (SSGS) processes this data and uses it for diagnosing dynamic interactions among the instruments and the spacecraft.[5]

Sensor Data (1676 MHz)

Sensors onboard the GOES spacecraft collect the raw Imager and Sounder data using the Sensor Data (SD) downlink signal. This data creates the images to track hurricanes or monitor the rapid development of severe storms that may develop into destructive tornados and is the basis of many of the satellite products produced continuously and available for public use.

Data Collection Platform Report (1694.5/1694.8 MHz)

The Data Collection Platform Report (DCPR) transponder receives signals from the DCPs in the 401.7-402.4 MHz band, amplifies the signal, and then re-transmits the signals using the 1694.5 and 1694.8 MHz frequencies. There is no processing of the DCP data on the satellite.

Command and Data Acquisition Telemetry (1694 MHz)

The GOES telemetry and command (T&C) subsystem provides the functional interface between the spacecraft and ground command and control. The spacecraft downlinks telemetry parameters describing the status, configuration, and health of the spacecraft payload and subsystems to the Command and Data Acquisition (CDA) station. The CDA

[5] GOES SSGS equipment resides at NOAA facilities at the following locations: Satellite Operations Control Center (SOCC) in Suitland, MD, Wallops Command and Data Acquisition Station (CDAS) in Wallops, VA, and Space Environmental Center (SEC) in Boulder, CO.

sends this data to the Satellite Operations Control Center (SOCC).[6] The spacecraft receives commands for mission control operations and managing expendable resources.

4c. Federal Meteorological Earth Stations

Various Federal agencies operate earth stations that receive real-time data directly from the NOAA satellites. Along with these earth stations, there are other Federal agencies using NOAA satellite data including DOD, Department of Homeland Security (DHS), Department of Interior (DOI), NASA, Department of Transportation (DOT) / Federal Aviation Administration (FAA), U.S. Department of Agriculture (USDA), and Department of Energy (DOE). All operations in the 1675-1695 MHz band are earth station receivers. The GOES-R system will have its primary location and function at Wallops, VA with backup capabilities at a new facility in Fairmont, WV. Figures 3-4 show Federal meteorological-satellite receiving earth stations operating in the 1675-1695 MHz band with corresponding exclusion zones.

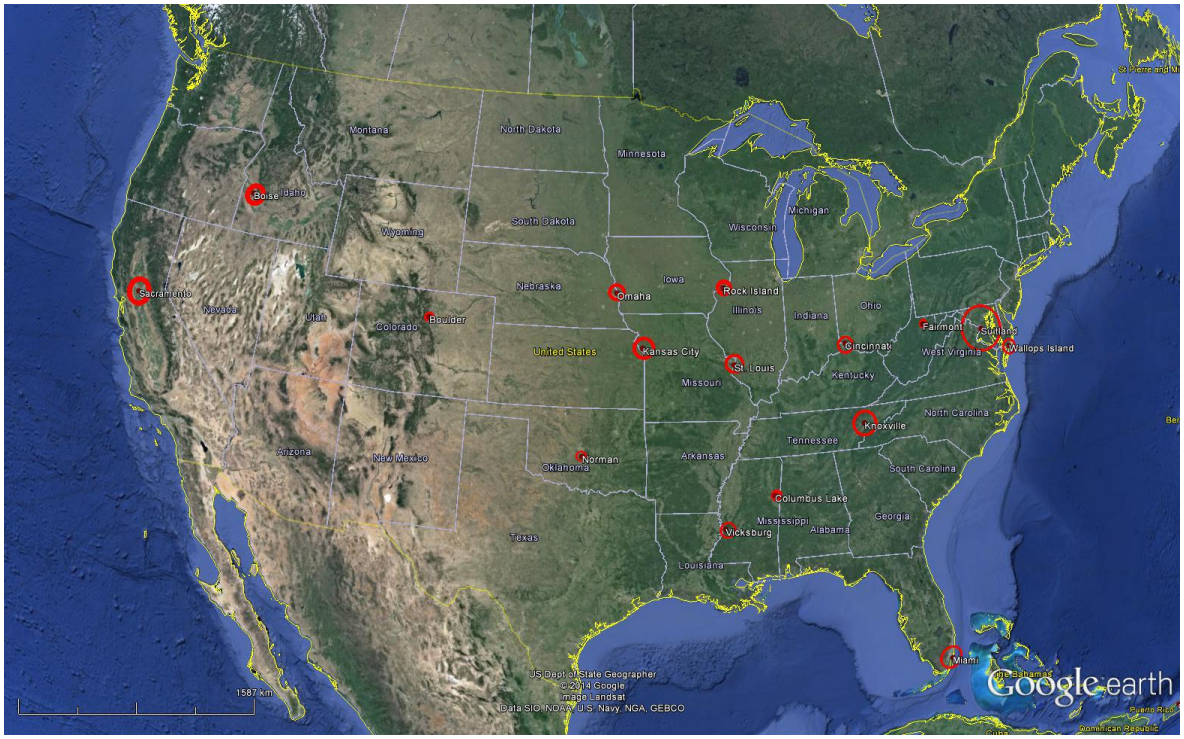


Figure 3. Federal Meteorological-Satellite Receiving Earth Stations, With Protection Zones in the Continental United States

[6] The CDA stations transmit commands to the satellites, acquire, and record environmental and engineering data from the satellites. The SOCC, which is located in Suitland, Maryland, is responsible for operational control of the entire ground system.

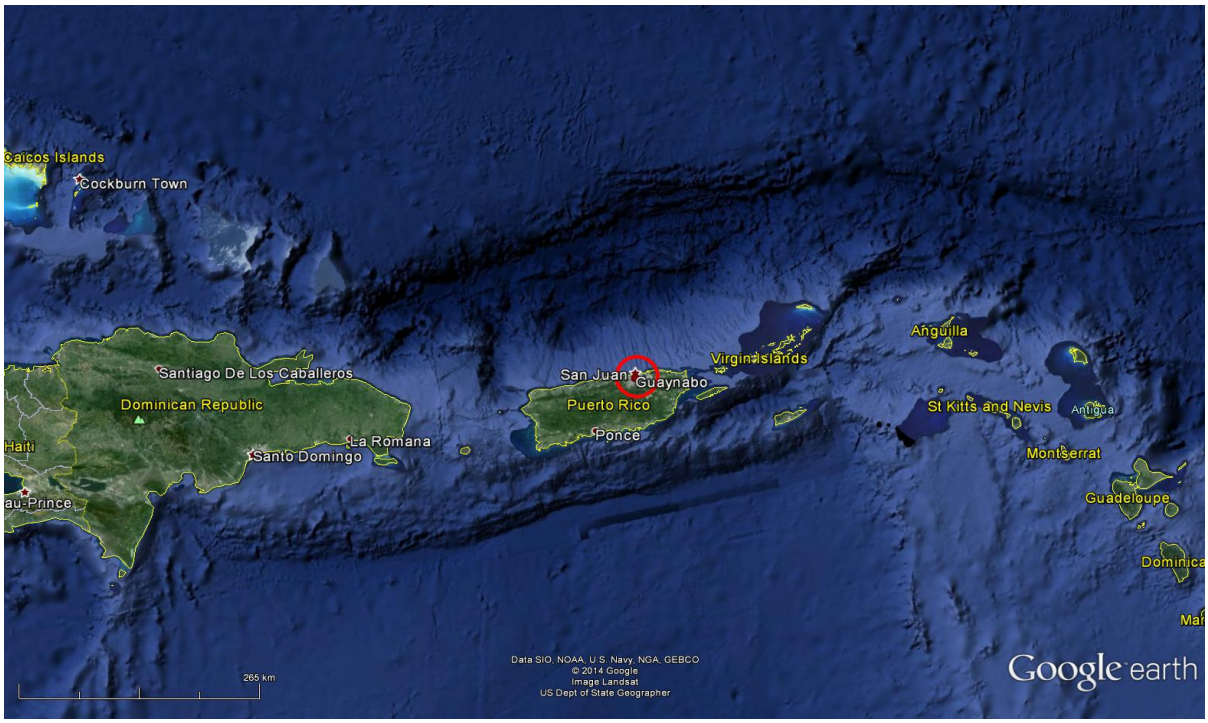


Figure 4. Federal Meteorological-Satellite Receiving Earth Station, With Protection Zone in Puerto Rico

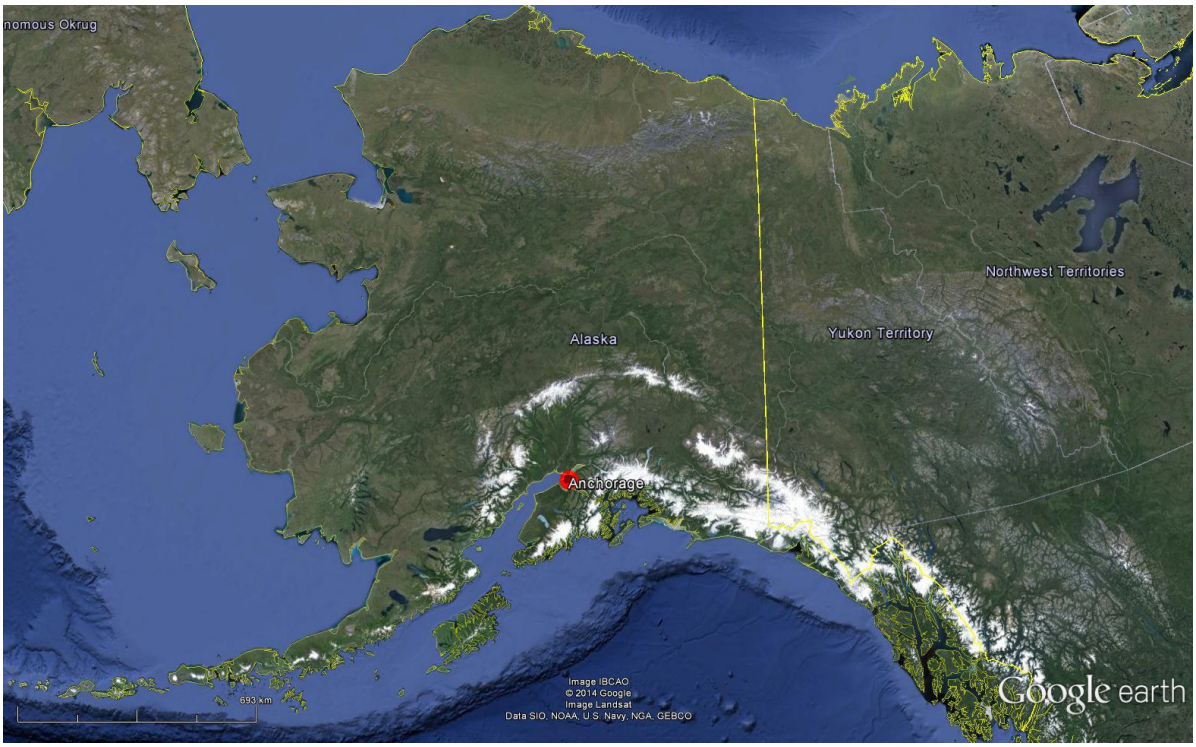


Figure 4. Federal Meteorological-Satellite Receiving Earth Station, With Protection Zone in Anchorage, AK

4d. International Use

NOAA supports several international programs that use the 1675-1695 MHz band. These programs allow users in the western hemisphere to acquire data from foreign spacecraft to support their operations. NOAA works with other non-Federal environmental satellite operators EUMETSAT, JMA, China Meteorological Administration, Russia's Federal Service for Hydrometeorology and Environmental Monitoring, India Meteorological Department, Korean Meteorological Administration and the World Meteorological Organization (WMO) to coordinate the frequencies and equator crossing times for all meteorological spacecraft.[7] The most critical of these sites is the earth station in Hawaii collecting meteorological data from a Japanese geostationary satellite. The Japanese satellite provides critical up-stream weather information that greatly improves forecast models for the United States and local forecast for the NWS Pacific Region.

4e. Meteorological Aids (MetAids) (Radiosonde)

In the 1675-1683 portion of the 1675-1695 MHz band, NOAA, DOD, DOE, and NASA operate radiosonde systems in the meteorological aids service. Radiosondes are expendable free-floating balloons, equipped with transmitters and antennas that provide near real-time environmental data. The radiosonde systems perform measurements of the atmospheric pressure, temperature, and relative humidity. The azimuth and elevation angle of the radiosonde with respect to the receiving antenna determines its wind speed and direction. The meteorological data from these radiosondes provide warnings and forecasts of weather events such as tornados and tropical cyclones. Radiosondes are launched twice a day from 87 sites located throughout the United States and its possessions.[8] Transmission of data from a radiosonde typically lasts for duration of two to three hours.

Table 2 describes the meteorological aids (radiosondes) operations in the 1675-1683 MHz band. Figure 6 shows the radiosonde launch sites in the United States and Canada.

Table 2. MetAids (Radiosondes) operations in the 1675-1683 MHz band.

Frequency Band (MHz)	Emission Bandwidth (kHz)	Function
1675 – 1677		

[7] WMO is a specialized agency of the United Nations and has a membership of 189 member states and territories. It originated from the International Meteorological Organization (IMO), which was formed in 1873. Established in 1950, WMO became the specialized agency of the United Nations in 1951 for meteorology (weather and climate), operational hydrology and related geophysical sciences.

[8] Radiosonde launches take place twice per day, at approximately 00:00 and 12:00 Coordinated Universal Time.

Frequency Band (MHz)	Emission Bandwidth (kHz)	Function
1677 – 1679 1679 – 1681 1681 – 1683	130	Transmission of Weather data

Figure 6. Radiosonde Launch Sites

4f. The DOD operates coastal station transmitters at a limited number of locations for testing and calibrating equipment onboard U.S. Navy ships.

5. Planned Use

NOAA will continue to operate the GOES meteorological-satellite system in the 1675-1695 MHz band for the foreseeable future. Federal/non-Federal entities will continue to perform operations of fixed and portable meteorological earth station receivers in the 1675-1695 MHz band. Federal agencies will continue to operate radiosonde (airborne transmitters and earth station receivers) in the 1675-1683 MHz portion of the band for some time. However, Federal agencies are considering relocating radiosonde operations to the 401.15-406 MHz band in the future.[9]

[9] See Transition Plans and Transition Data for the 1695 –1710 MHz Band. http://www.ntia.doc.gov/other-publication/2014/transition-plans-and-transition-data-1695-1710-mhz-band