

The American Meteorological Society Committee on Radio Frequency Allocations

Jordan Gerth, AMS Committee Chair



@jjgerth

With contributions from the committee

NAS CORF Meeting, Washington, DC, 17 May 2019



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

AMS Committee on RF Allocations

- Organizes members to review and coordinate on all matters of radio frequency spectrum management pertinent to the enterprise
- Contains academic, government, and private sector professionals with expertise in remote sensing, radar meteorology, satellite meteorology, systems engineering, telecommunications, and policy
- Reviews and revises the policy statement on radio frequency allocations for the Society

Committee Goals

- Increase membership awareness of spectrum management matters and their potential impacts on the weather, water, and climate enterprise,
- Develop coalitions with other entities to inform the public and policymakers on radio frequency interference and its consequences, and
- Provide subject-matter expertise on how changes in spectrum policy and allocations could affect the collection or delivery of meteorological, hydrological, and oceanographical data

Committee Activities

Encouraging ex parte briefings at FCC

Filings in FCC dockets

Informational meetings with legislative staff

Op-eds and media interviews

Outreach to interested groups

AMS and member organizations have participated in relevant FCC proceedings on spectrum sharing



June 20, 2016

Ms. Marlene D.
Federal Comm.
445 12th Street,
Washington, DC

RE: AccuWeather
a Rulemaking

**American
Meteorological
Society**
45 Beacon St.
Boston, MA 02108

10 April 2017

Federal Communications
Ms. Marlene Dortch, Sec
445 12th Street, S.W.
Washington, DC 20554

RE: Written ex

**American
Geophysical Union**
2000 Florida Ave. NW #400
Washington, DC 20009

**University of
Wisconsin—Madison**
Space Science and
Engineering Center
1225 W. Dayton St.
Madison, WI 53706



The Weather Company, a
300 Interstate North Park
Atlanta, GA 30339
Mary Glackin, Senior VP,
June 17, 2016

Federal Communications
Ms. Marlene Dortch, Sec
445 12th Street, S.W.
Washington, DC 20554

Re: Letter in resp

American Meteorological Society
45 Beacon Street
Boston, MA 02108

1 March 2016

Federal Commu
Ms. Marlene Dor
445 12th Street,
Washington, DC

Re: Ex Pa

National Weather Association
3100 Monitor Avenue, Suite 123
Norman, OK 73072

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
المنظمة العالمية للأرصاد الجوية
世界气象组织



Our ref.:

8739-19/OBS/WIS/ITS/RF

Secrétariat
7 bis, avenue de la Paix – Case postale 2300
CH 1211 Genève 2 – Suisse
Tel.: +41 (0) 22 730 81 11
Fax: +41 (0) 22 730 81 81
wmo@wmo.int – www.wmo.int

Mrs Marlene Dortch, Secretary
Federal Communications Commission (FCC)
445 12th St., S.W.
WASHINGTON, D.C. 20554
USA

GENEVA, 21 June 2016

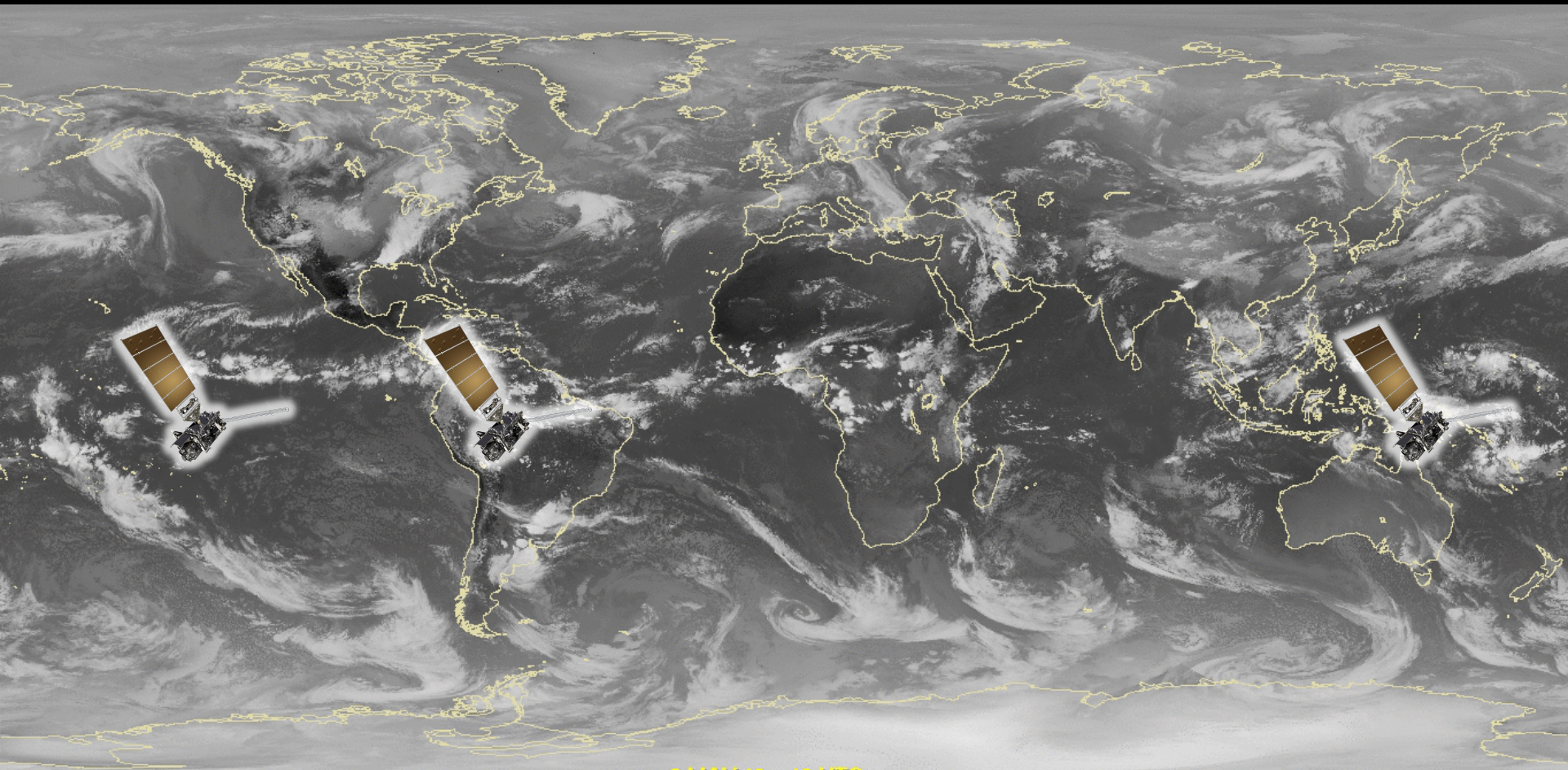
Subject: WMO comment in opposition to RM-11681: To update the record on
Ligado's request that the FCC initiate a rulemaking to allocate the 1675

Committee Priorities

- 1675-1680 MHz (L band)
 - GOES-R data relay and image rebroadcast (Delivery)
- 3.7-4.2 GHz (C band)
 - NOAAPort (Delivery)
- 23.8/24 GHz (K band)
 - Passive microwave water vapor sensing (Collection)

GOES-R data relay and
image rebroadcast
(Delivery)

1 675-1 680 MHZ



9 MAY 19 - 18 UTC

UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

ACTIVITY CODE

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NON-FEDERAL EXCLUSIVE

ALLOCATION USAGE DESIGNATION

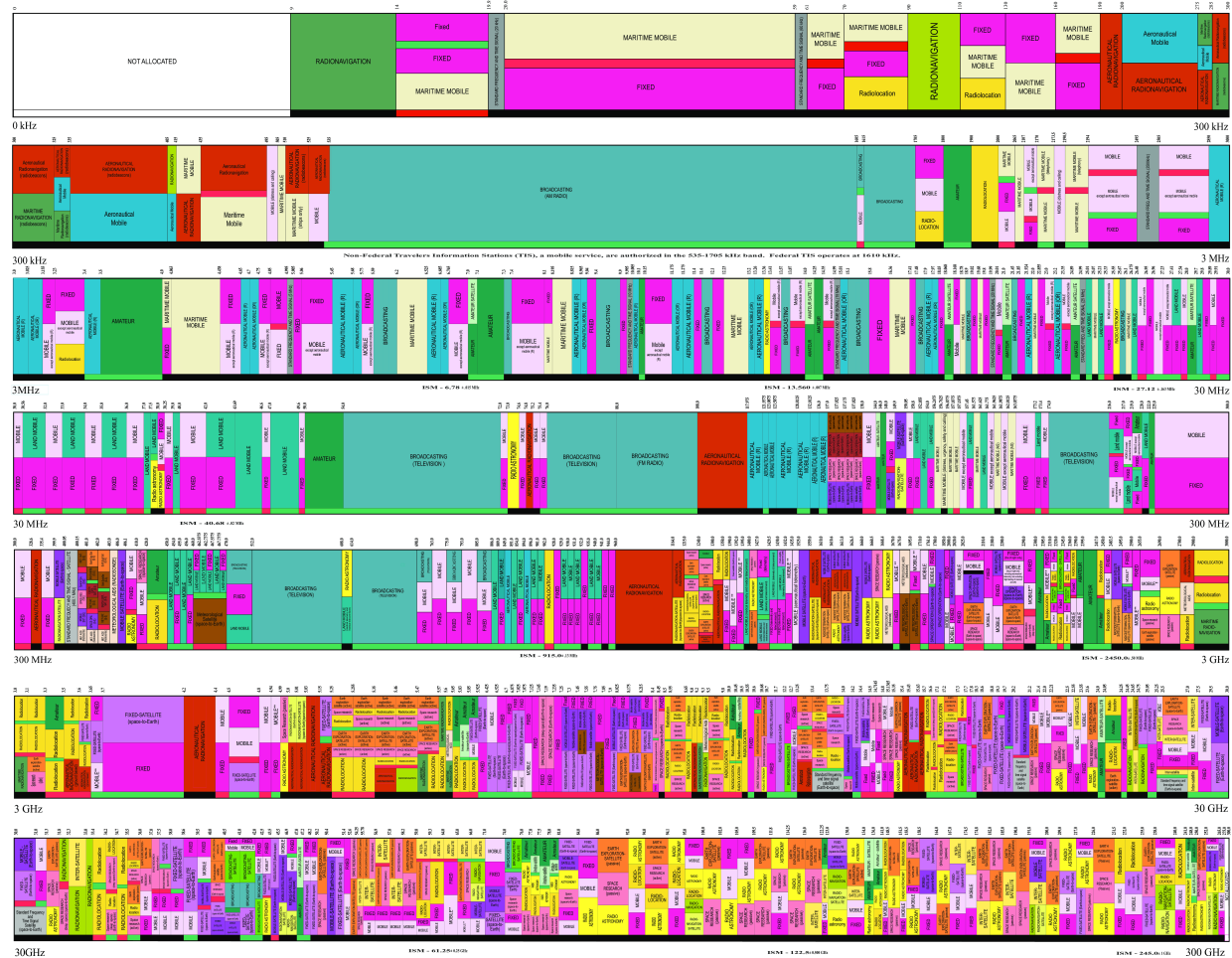
SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	MOBILE	1st Capital with Lower case letters

The chart is a graphic representation of the Table of Frequency Allocations and the FCC and NRC. It is not a legal document. It is a reference tool. It is not a legal document. It is a reference tool.

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management

JANUARY 2016

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
1400 K Street, NW
Washington, DC 20540-4201
Phone: (202) 418-0200 Fax: (202) 418-0201



U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
1400 K Street, NW
Washington, DC 20540-4201
Phone: (202) 418-0200 Fax: (202) 418-0201

HRIT/EMWIN
1694.1 MHz



GRB (31 Mbps)
1686.6 MHz

DCP Report Relay
1679.9 MHz and 1680.2 MHz

Remote Automatic Weather Stations (RAWS)

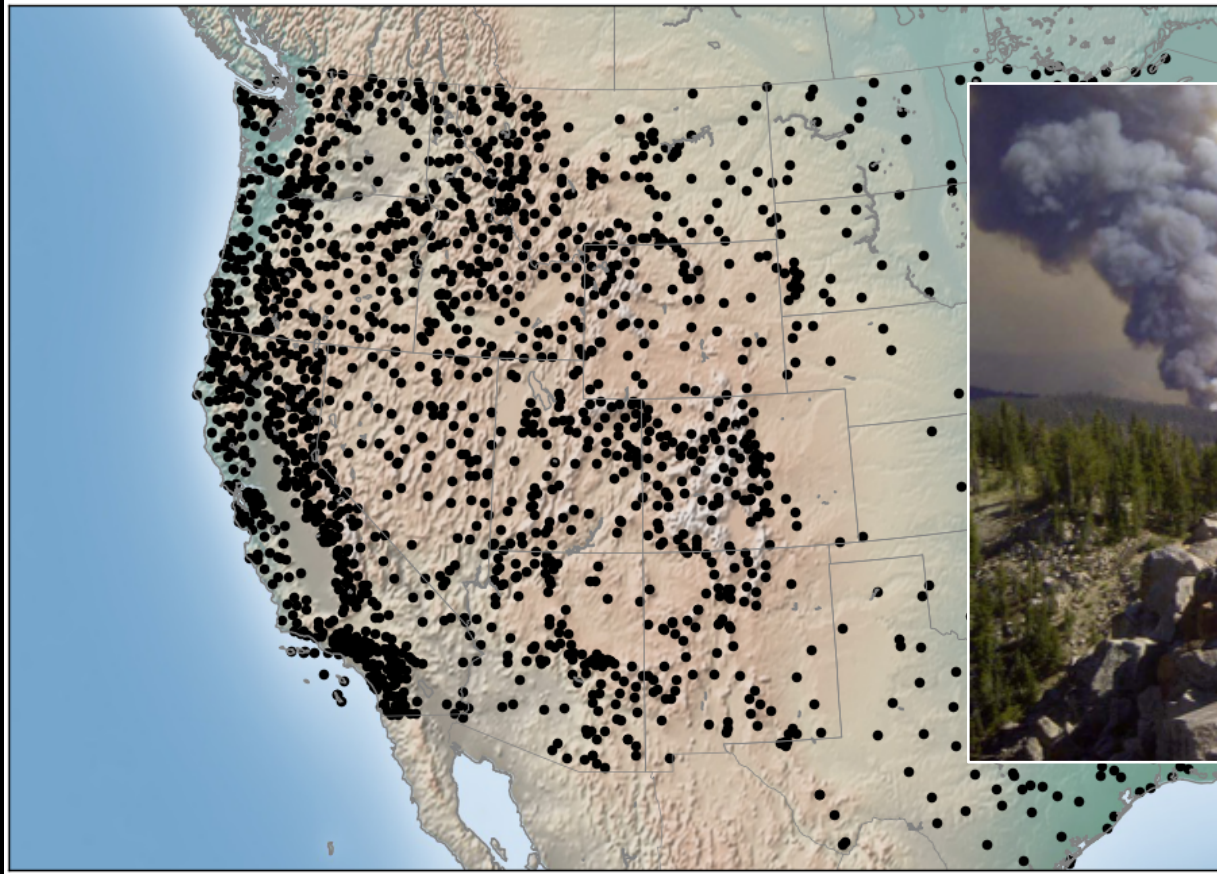
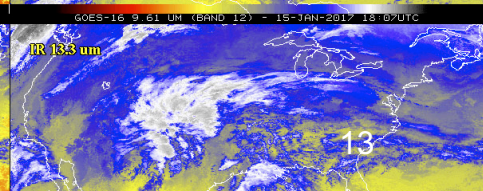
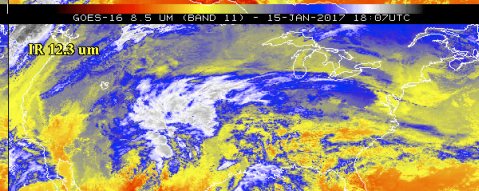
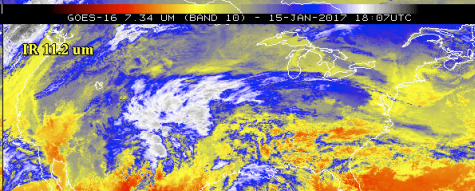
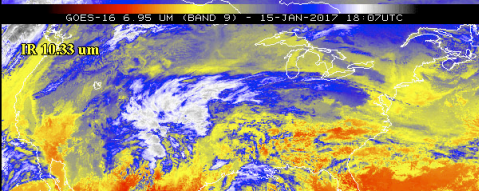
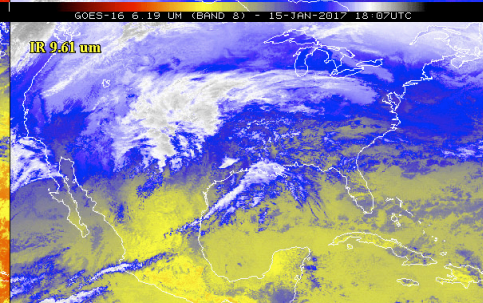
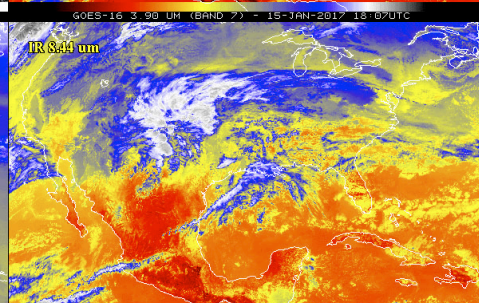
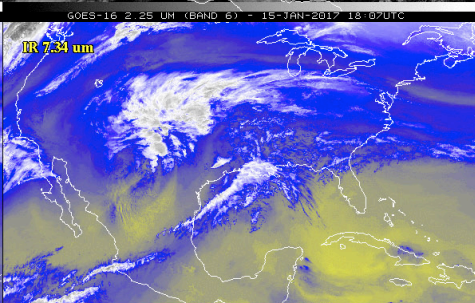
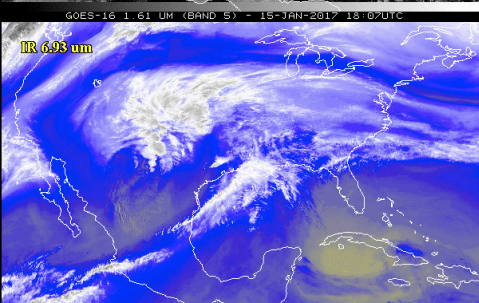
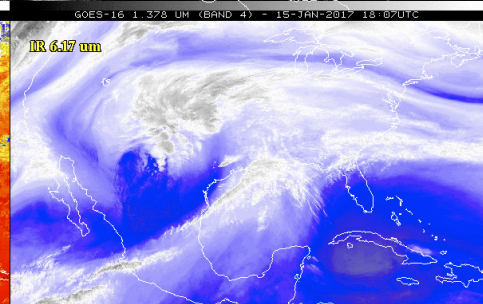
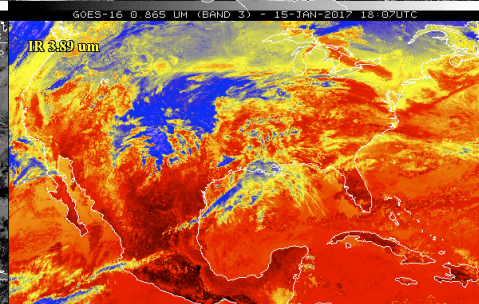
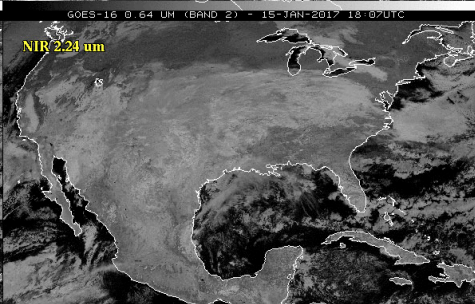
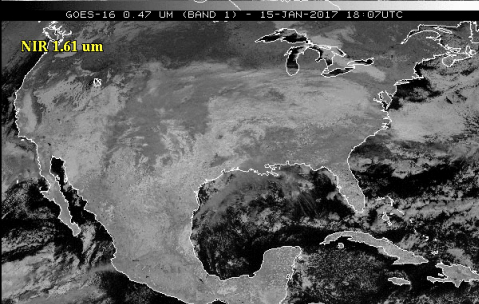
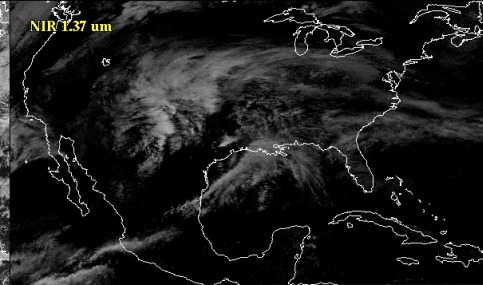
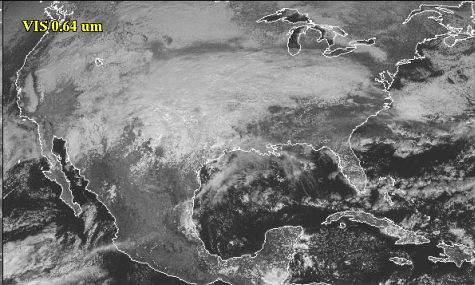
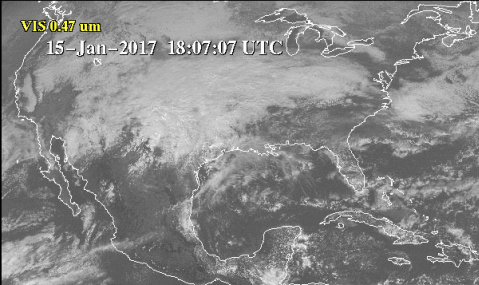


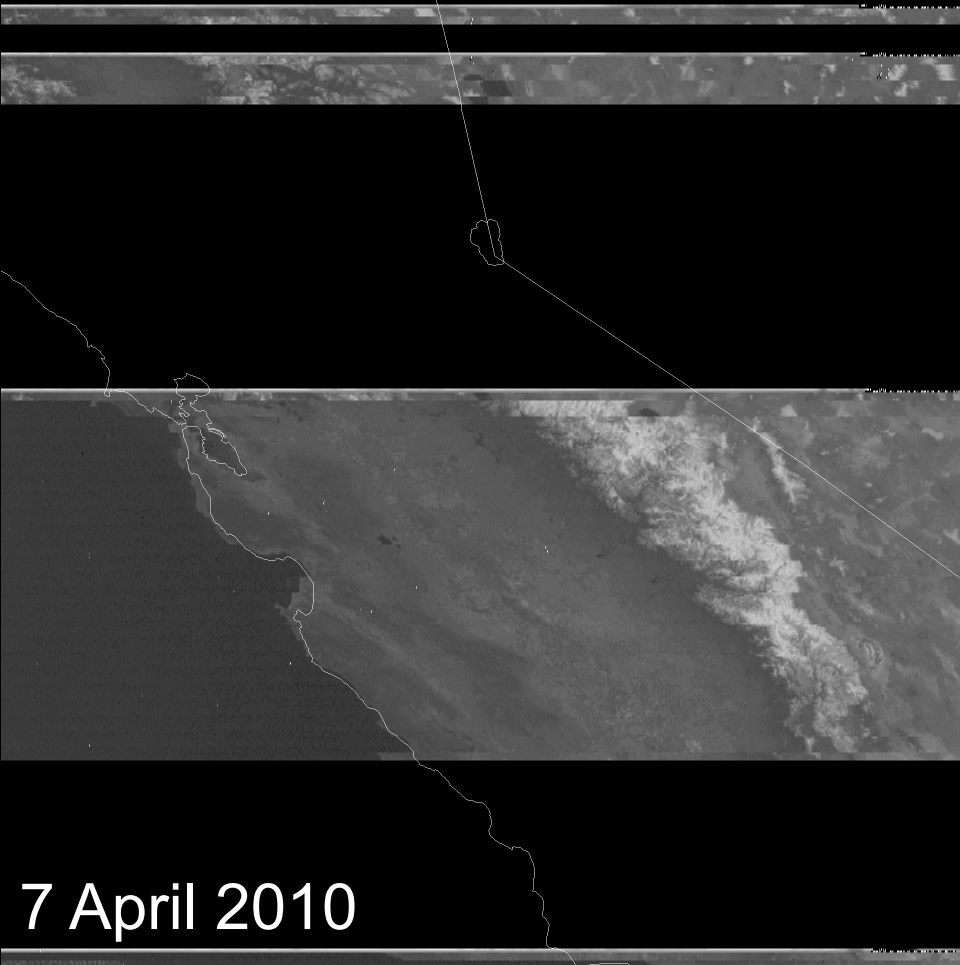
Photo Source: Rob Swofford (BLM)



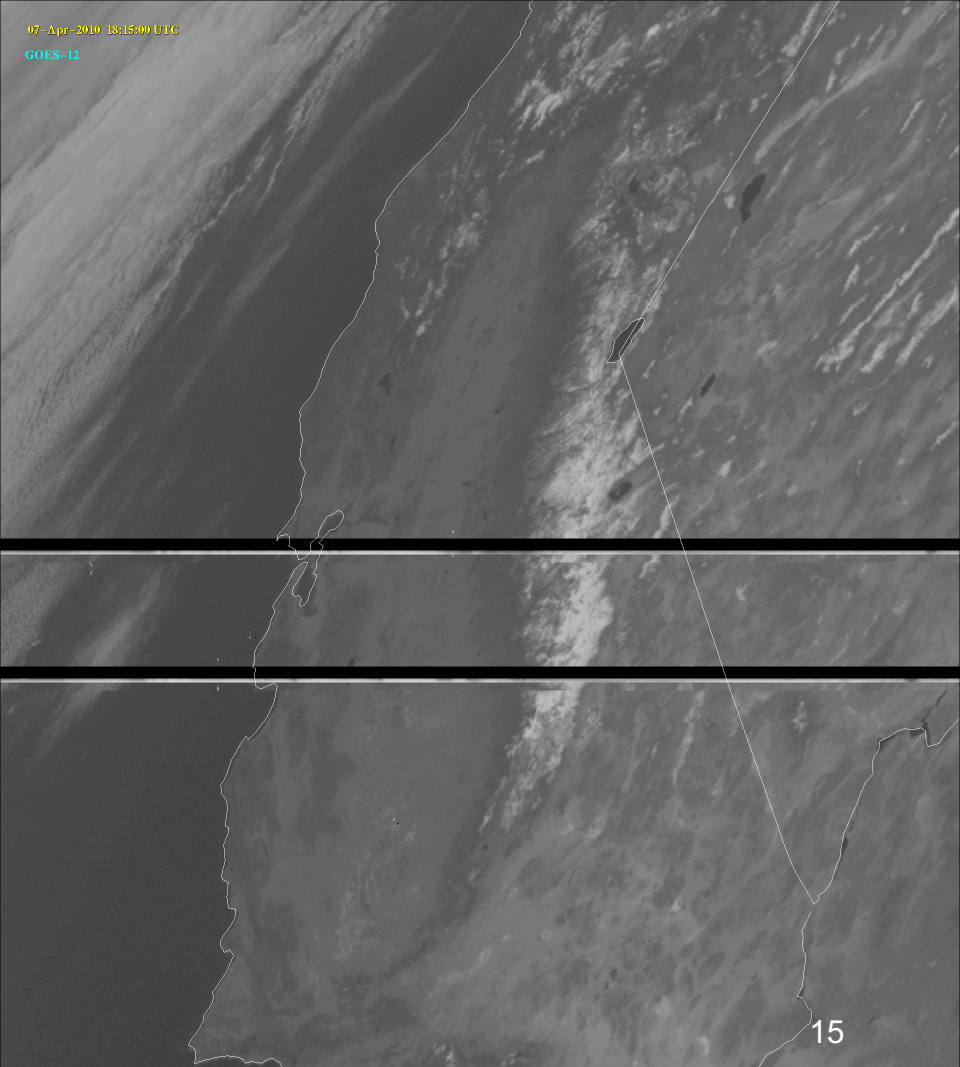
GOES ReBroadcast (GRB) Uses

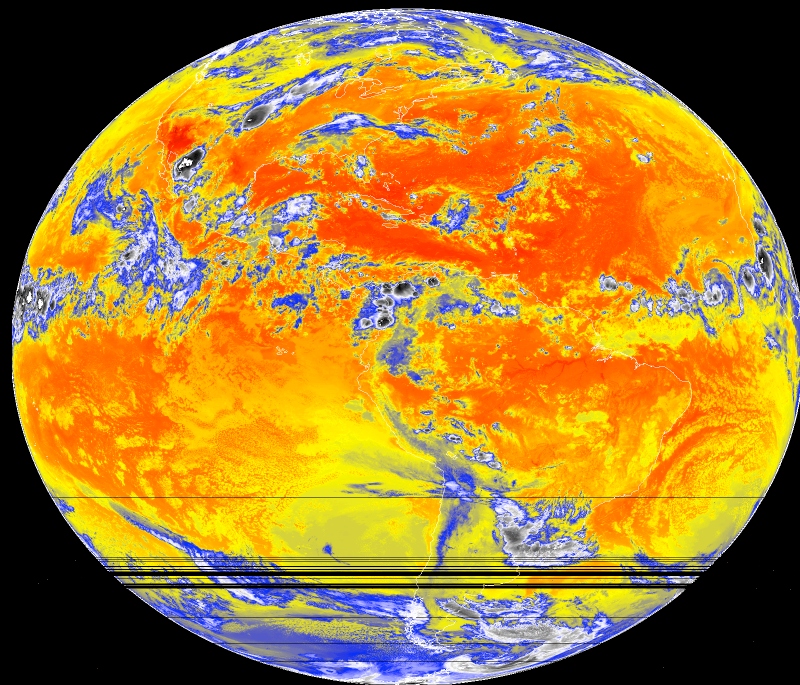
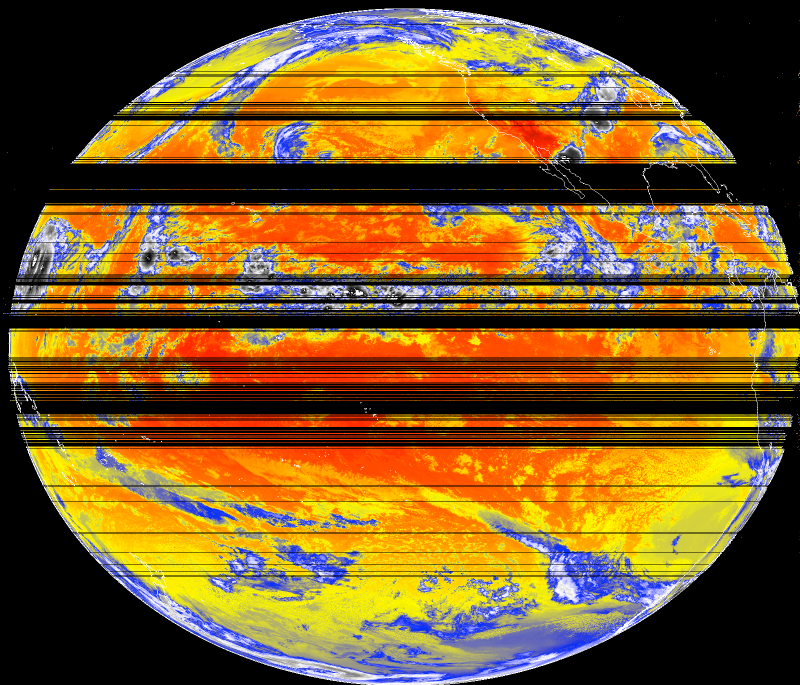
- Primary data feed for many National Weather Service (NWS) “National” centers (e.g., National Hurricane Center and Storm Prediction Center)
- Important source of full-resolution imagery outside of the contiguous United States
- Supports television broadcasts and aviation, energy, ground transportation, and other weather-sensitive industry sectors
- Most timely and reliable source of satellite cloud/moisture imagery and lightning products

07-Apr-2010 18:30:00 UTC
GOES-11

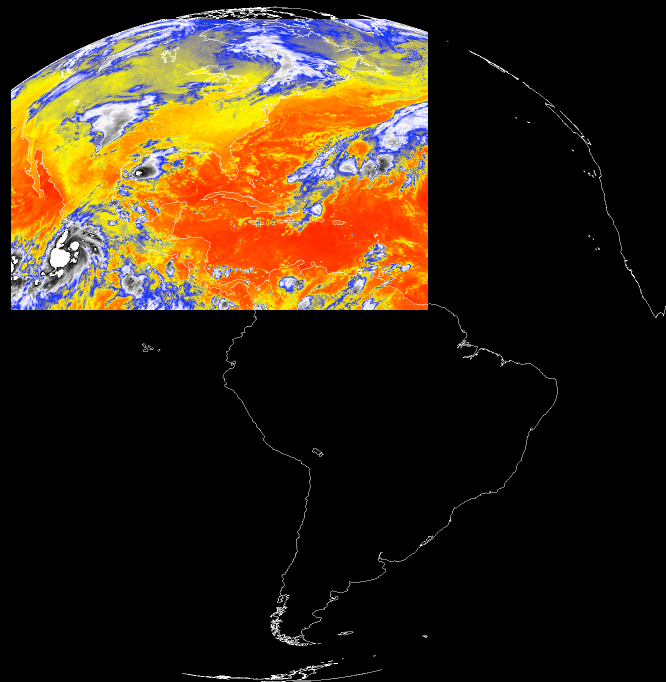
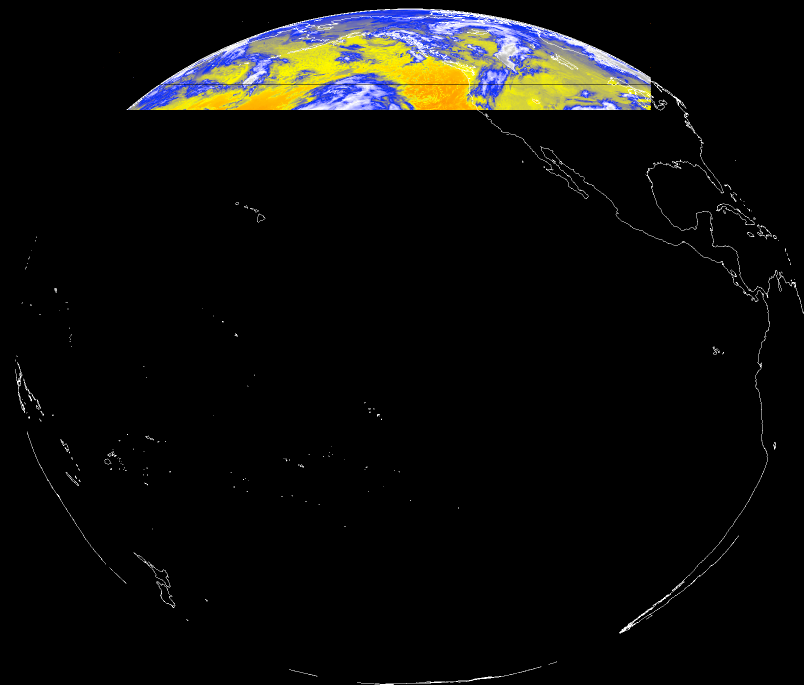


07-Apr-2010 18:15:00 UTC
GOES-12

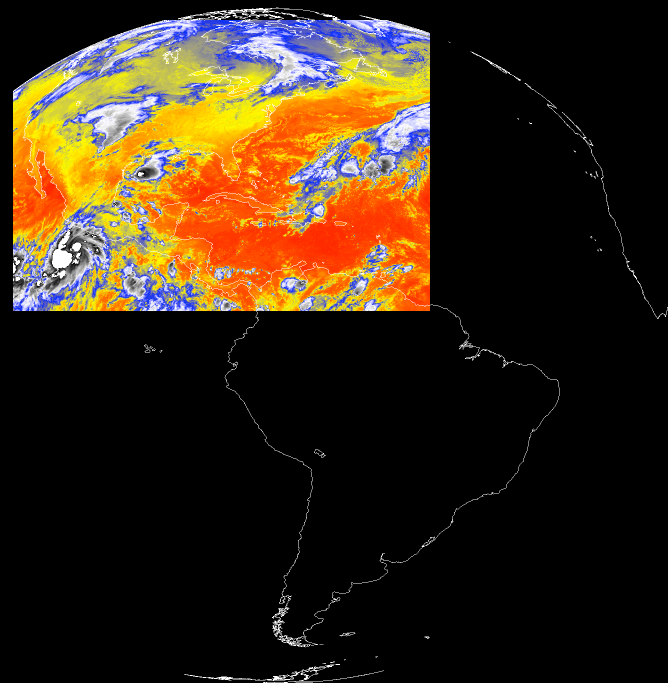
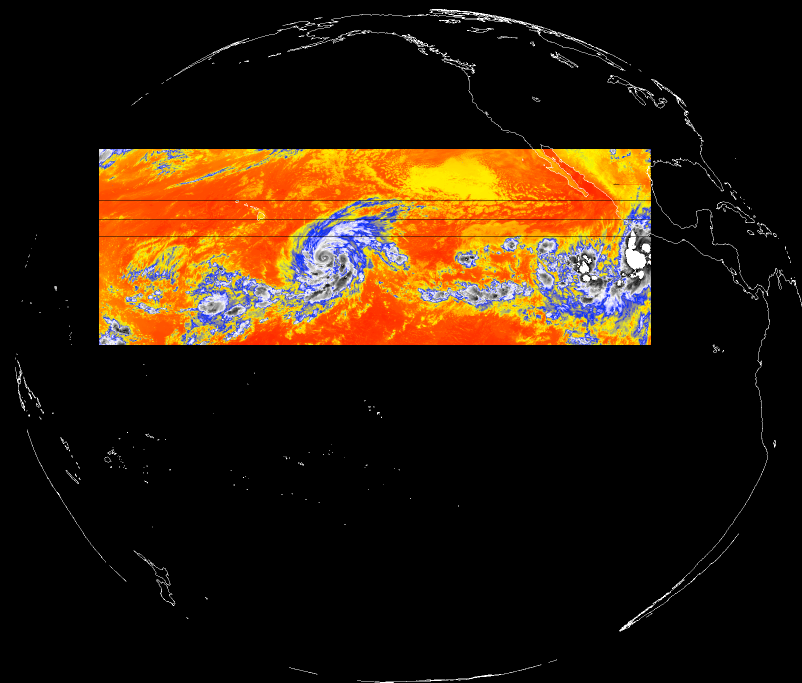




17 August 2015



22 October 2015



22 October 2015

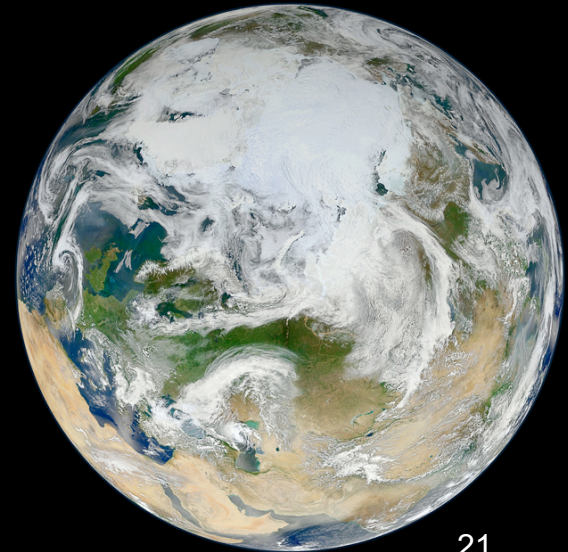
Proposed Sharing at 1675-1680 MHz

- A commercial provider has petitioned the FCC to share spectrum in 1675-1680 MHz with GOES-R downlinks
- Signal levels could be over ten million times stronger than those coming from satellite
- The FCC approved a Notice of Proposed Rulemaking (NPRM) at their 9 May 2019 meeting
- Past public comment periods (RM-11681) received objections from multiple members of the weather enterprise
 - New docket is 19-116
 - 30 days for comments, 30 days for reply comments after posted in Federal Register

As it is today, the delivery of satellite weather
imagery must always be
timely,
consistent, and
reliable.



Full resolution Himawari-8 satellite imagery is currently provisioned via a cloud service, but technical access issues and insufficient bandwidth have compromised the required “around the clock” availability for United States interests.



Comparison of GRB to Cloud Services

Service	Outage Allowed based on cloud service (30 days)	Service Availability Target (%)	Combined Availability with Terrestrial “Last Mile” Internet Delivery (%)
GOES-R GRB Broadcast	5 minutes	99.988%	N/A
Amazon EC2 Service	20 minutes	99.95%	99.93%
Amazon Simple Storage	40 minutes	99.9%	99.88%

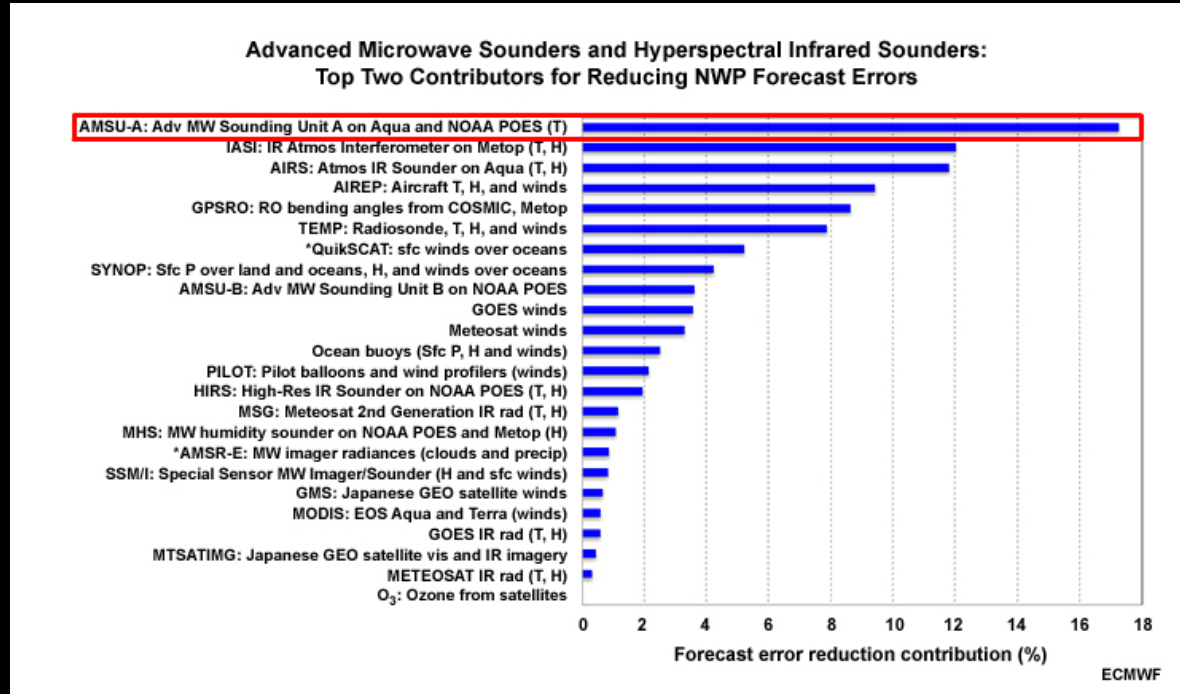
Passive microwave
water vapor sensing
(Collection)

23.8/24 GHZ

Auction and Advocacy

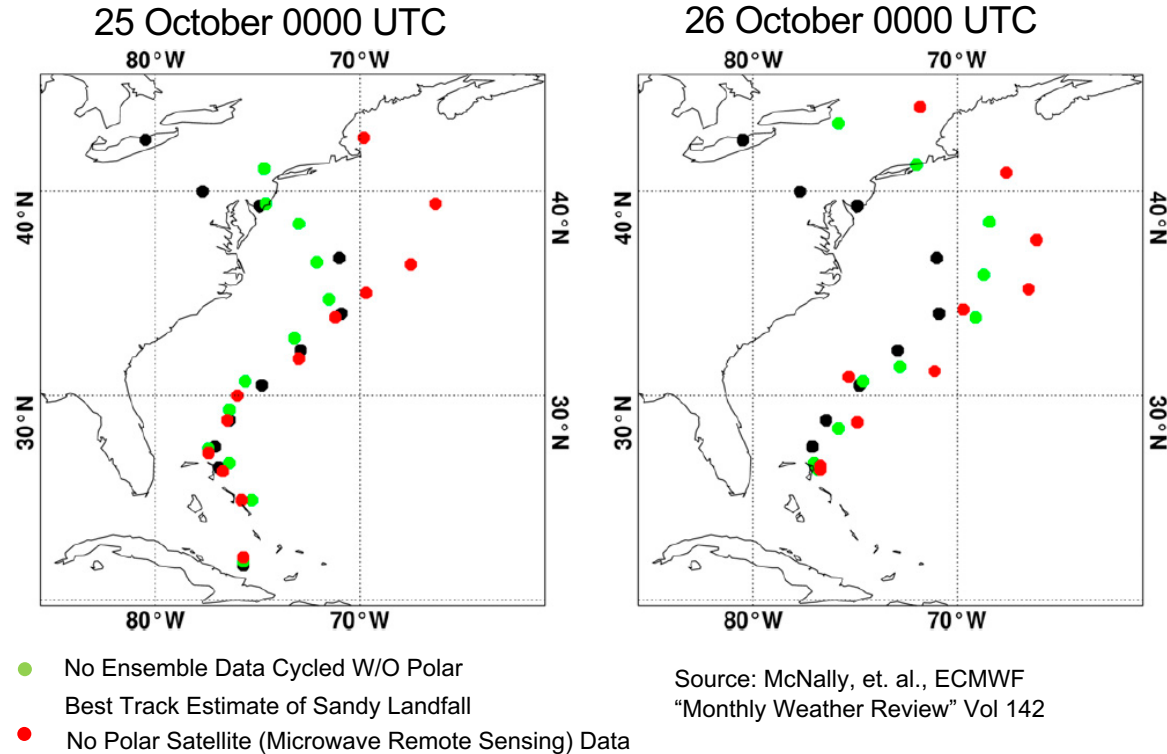
- Recent U.S. 24 GHz auction
 - -20 dBW/200 MHz limit is too high for EESS applications
 - Disagreements between NOAA/NASA and FCC
 - More stringent limits proposed by other nations
- Limited peer-reviewed research on data assimilation and forecast skill impacts of individual passive microwave bands
 - High priority to examine impact per satellite (including orbit time), per band, per spatial extent, and per model configuration
- Advocating for lower emission limit and sensitivity studies
 - Informing WRC-19 and international limits
- Concern about three additional U.S. auctions in 37-47 GHz

Top Two Contributors for Reducing NWP Forecast Errors



ECMWF Hurricane Sandy Predictions

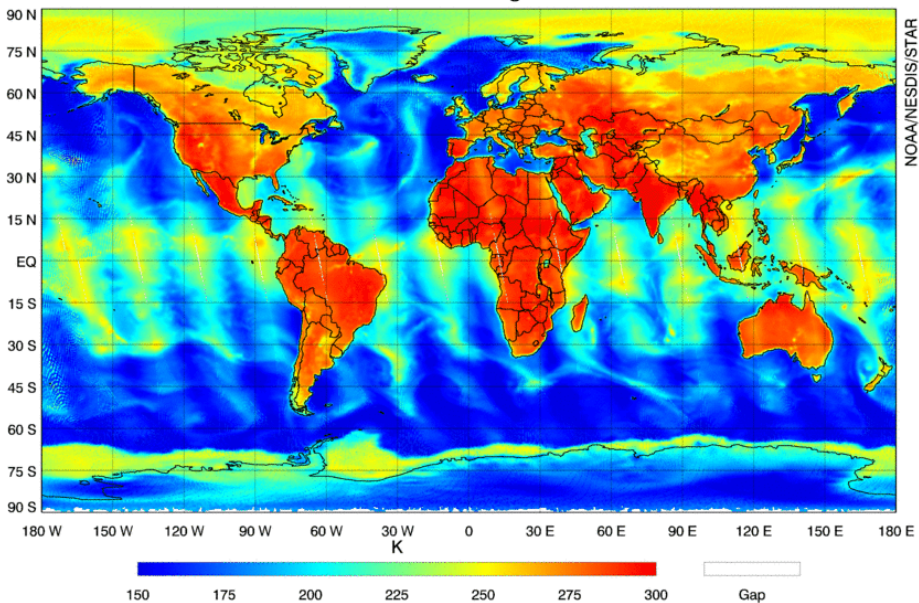
Location of landfall with and without satellite microwave observations



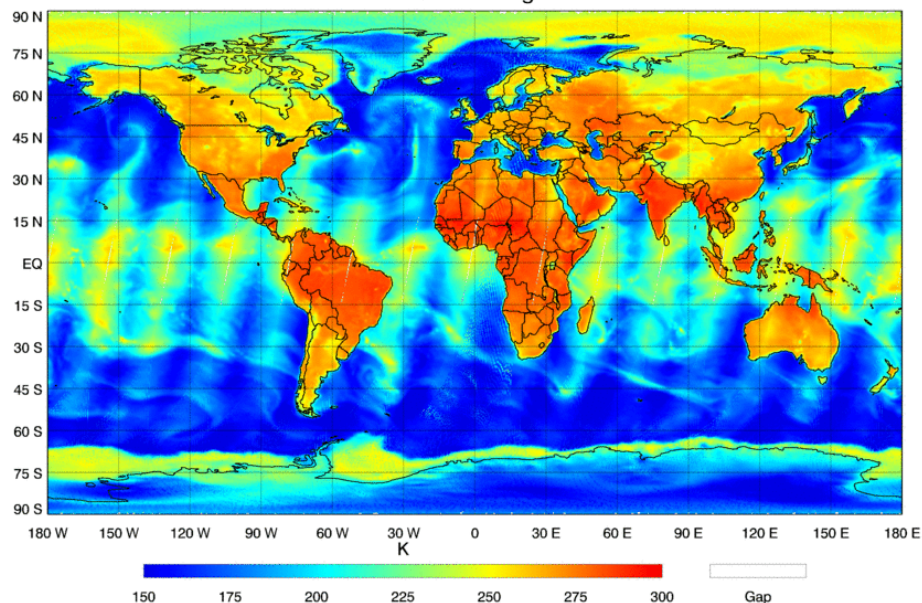
Without microwave obs (red), Sandy predicted for landfall in Maine 24 hours later instead of New Jersey (black)

Passive Sensor Acronym	Instrument full name	Space Agency	Type of scanning	Satellites	EESS(passive) bands (GHz)					
					23.6-24.0	31.3-31.8	36-37	50.2-50.4	52.6-54.25	86-92
ALTIKA	AltiKa Dual Band Radiometer	CNES	Along track	SARAL	X		X			
AMR	Advanced Microwave Radiometer	NOAA; EUMETSAT	Cross-track	JASON-2 & 3	X					
AMR-C	Advanced Microwave Radiometer-C	NOAA; EUMETSAT	Cross-track	JASON-CS-A & B (Sentinel-6A & 6B)	X					
AMSR	Advanced Microwave Scanning Radiometer	JAXA	Conical	ADEOS-2	X		X	X	X	X
AMSR-2	Advanced Microwave Scanning Radiometer-2	JAXA	Conical	GCOM-W1 to W3	X		X			X
AMSR-E	Advanced Microwave Scanning Radiometer for EOS	JAXA	Conical	Aqua	X		X			X
AMSU-A	Advanced Microwave Sounding Unit - A	NOAA; NASA; EUMETSAT	Cross-track	NOAA-15, 18 & 19; AQUA; MetOp-A/ B/ C	X	X		X	X	X
AMSU-B	Advanced Microwave Sounding Unit - B	NOAA	Cross-track	NOAA-15						X
ATMS	Advanced Technology Microwave Sounder	NOAA	Cross-track	SNPP; JPSS-1 to 4	X	X		X	X	X
CIMR	Copernicus Imaging Microwave Radiometer	ESA	Conical	CIMR			X			
DREAM	Dual-channel Radiometers for Earth and Atmosphere Monitoring	KARI	Cross-track	STSat-2	X					
GMI	GPM Microwave Imager	NASA	Conical	GPM Core Observatory	X		X			X
JMR	JASON Microwave Radiometer	NASA	Cross-track	JASON-1	X					
MADRAS	Microwave Analysis & Detection of Rain & Atmospheric Structures	ISRO	Conical	Megha-Tropiques	X		X			X

Suomi NPP ATMS TDR Ch.1 23.8 GHz QV-POL
2019-05-12
Ascending



Descending



Passive Sensor Acronym	Instrument full name	Space Agency	Type of scanning	Satellites	EESS(passive) bands (GHz)					
					23.6-24.0	31.3-31.8	36-37	50.2-50.4	52.6-54.25	86-92
MHS	Microwave Humidity Sounding	EUMETSAT; NOAA	Cross-track	MetOp-A/B/C; NOAA-18 & 19						X
MIVZA	Microwave humidity sounder	Roscosmos	Conical	Meteor-3M	X					
MSMR	Multi-frequency Scanning Microwave Radiometer	ISRO	Conical	OceanSat-1 (IRS-P4)	X					
MTVZA	Imaging/Sounding Microwave Radiometer	Roscosmos	Conical	Meteor-3M	X					
MTVZA-GY	Imaging/Sounding Microwave Radiometer - improved	Roscosmos	Conical	Meteor-M N1; Meteor-M N2-1 to -5	X	X	X		X	X
MTVZAGY-MP	Imaging/Sounding Microwave Radiometer for Meteor-MP	Roscosmos	Conical	Meteor-MP N1 & N2	X	X	X	X	X	X
MTVZA-OK (MW)	Combined Microwave-Optical Imaging/ Sounding Radiometer (MW component)	NSAU	Conical	SICH-1M	X					
MW radiometer	Microwave radiometer {NOTE: similar to AMR, AMR-C}	NASA	Cross-track	SWOT	X					
MWHS-II	Micro-Wave Humidity Sounder -2	CMA	Cross-track	FY-3C to -3H						X
MWI	Microwave Radiometer	NSOAS	Conical	HY-2A &-2B	X		X			
MWI	MicroWave Imager	EUMETSAT/ ESA	Conical	Metop-SG-B1/2/3	X	X		X	X	X
MWR	Microwave Radiometer	Roscosmos	Cross-track	Okean-O1-1 to 7; SICH-1	X					
MWR	Micro-Wave Radiometer	ESA	Cross-track	ERS-2; Envisat	X					
MWR	Micro-Wave Radiometer	ESA	Cross-track	Sentinel-3A & 3B	X		X			
MWR	Micro-Wave Radiometer	CONAE	Cross-track	SAC-D	X					
MWRI-I	Micro-Wave Radiation Imager	CMA	Conical	FY-3A/B/C/D	X		X			X
MWRI-II	Micro-Wave Radiation Imager	CMA	Conical	FY-3F/G	X		X	X	X	X

Passive Sensor Acronym	Instrument full name	Space Agency	Type of scanning	Satellites	EESS(passive) bands (GHz)					
					23.6-24.0	31.3-31.8	36-37	50.2-50.4	52.6-54.25	86-92
MWRI -III	Micro-Wave Radiation Imager	CMA	Conical	FY-3RM-1 & 2	X		X	X	X	X
MWS	Micro-Wave Sounder	EUMETSAT/ESA	Cross-track	Metop-SG-A1/2/3	X	X		X	X	X
MWTS-I	Micro-Wave Temperature Sounder - 1	CMA	Cross-track	FY-3A & -3B				X	X	
MWTS-II	Micro-Wave Temperature Sounder - 2	CMA	Cross-track	FY-3C & -3D				X	X	
MWTS-III	Micro-Wave Temperature Sounder - 3	CMA	Cross-track	FY-3E/F/G/H	X	X		X	X	
SSM/I	Special Sensor Microwave - Imager	DoD	Conical	DMSP-F08, F10 to F15			X			X
SSM/T	Special Sensor Microwave - Temperature	DoD	Cross-track	DMSP-F04, F07 to F15				X	X	
SSMIS	Special Sensor Microwave - Imager/Sounder	DoD	Conical	DMSP-F16 to F20			X	X	X	X
TMI	TRMM Microwave Imager	NASA	Conical	TRMM	X					
TMR	TOPEX Microwave Radiometer	NASA	Cross-track	TOPEX-Poseidon	X					
WindSat	WindSat	DoD	Conical	Coriolis	X		X			
WVR	Water Vapor Radiometer	NASA	Cross-track	GFO	X					

Impacts Summary

- Most meteorological community use of spectrum not easily replaceable through other means
 - Unique observations based on physical properties of water vapor and other atmospheric molecules
 - Maintains high data rate and assures high reliability
- Continuing important observing capabilities through spectrum allocations maintains the value of our satellite constellations and quality of local and global weather forecasts
- More conflicts with 5G/IoT for the foreseeable future

The number of
users and
customers
of weather satellite imagery is not
known, or
fixed, or
characterized.



The weather enterprise must better
capture and
communicate to regulators and legislators
the relative value
of disparate observation sets to
meteorologists for
prediction and
warning purposes.



United States Senate
WASHINGTON, DC 20510

May 13, 2019

The Honorable Ajit Pai
Chairman
Federal Communications Commission
445 12th Street, NE
Washington, DC 20541

Dear Chairman:

We write you regarding the FCC's proposed rule on 24 GHz band. The FCC is currently considering a rule that could lead to dangerous impacts to the American people. We urge the Federal Communications Commission to winnow down the number of any final licenses to winning bidders for future commercial use of the 24 GHz band until the FCC approves the passive band spectrum until the FCC approves the passive band and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) determine are necessary to protect critical weather forecasting operations. NOAA determine are necessary to protect critical weather forecasting operations. NOAA determine are necessary to protect critical weather forecasting operations.

In March 2019, the FCC began auctioning spectrum for future commercial broadband use in the 24 GHz band. NOAA, and members of the American Meteorological Society, are concerned that out-of-band emissions from future commercial use would disrupt the ability to collect weather data (23.6 to 24 GHz) that meteorologists rely on for weather forecasting operations in the U.S. and

Leadership in 5G networks and devices is undoubtedly critical to our economic and national security. However, it does not enhance America's place in this global race for 5G leadership to advocate for standards that do not pass scientific scrutiny in international forums (such as at the International Telecommunications Union's World Radiocommunication Conference 2019) as the FCC has proposed.

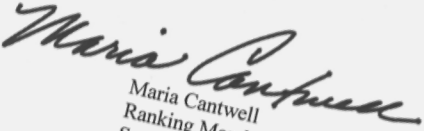
In addition, we ask that you provide us with the following information by June 11, 2019:

1. Provide any computer models, assumptions, and analysis that support the FCC's rule on emission limits from future commercial broadband transmissions in the 24 GHz band and show that it will not impact applications in adjacent frequency bands, particularly satellite measurements of water vapor in the 23.8 GHz band that is so important to weather forecasting.
2. Explain what the FCC intends to do if the International Telecommunications Union refuses to accept the current FCC advocated level for the 24 GHz band.
3. Explain the reconciliation of the FCC's rule with the International Telecommunications Union's World Radiocommunication Conference 2019.

"We write with a straight-forward request: Don't allow wireless companies to operate in a 24 GHz band until vital weather forecasting operations are protected."


Ron Wyden
Ranking Member
Senate Committee on Finance

Sincerely,


Maria Cantwell
Ranking Member
Senate Committee on Commerce, Science
and Transportation

FCC.gov

19-116
RM-11681
GOES-R
1675-1680 MHz



17-183
NOAAPort
3.7-4.2 GHz

<http://tinyurl.com/1675-1680-GOES>

<http://tinyurl.com/NOAAPort-spectrum>

Community Challenges

- Explaining that weather forecasts improve annually, largely due to satellite observations
- Explaining that the atmosphere is emitting microwaves that are useful to sense
- Finding compelling examples of microwave passive remote sensing interference in imagery
- The speed of science and peer review is slower than current spectrum auctions
- Building consensus and coalitions

Questions?

Jordan Gerth

jordan.gerth@ssec.wisc.edu
ametsoc.org/radio



@jjgerth

Special thanks to...

Dave Lubar
Renee Leduc Clarke



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON