

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, 8 May 2020



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 Dortch
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

Secrétaire
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) and related Ligado proceedings
 - GOES-R data relay and image rebroadcast (Delivery)
- 23.8/24 GHz (K band) and greater frequencies
 - Passive microwave water vapor sensing (Collection)
- Whatever comes next

GOES-R data relay and
image rebroadcast
(Delivery)

1675-1680 MHz



GRB (31 Mbps)
1686.6 MHz

HRIT/EMWIN
1694.1 MHz

DCP Report Relay
1679.9 MHz and 1680.2 MHz

Remote Automatic Weather Stations (RAWS)

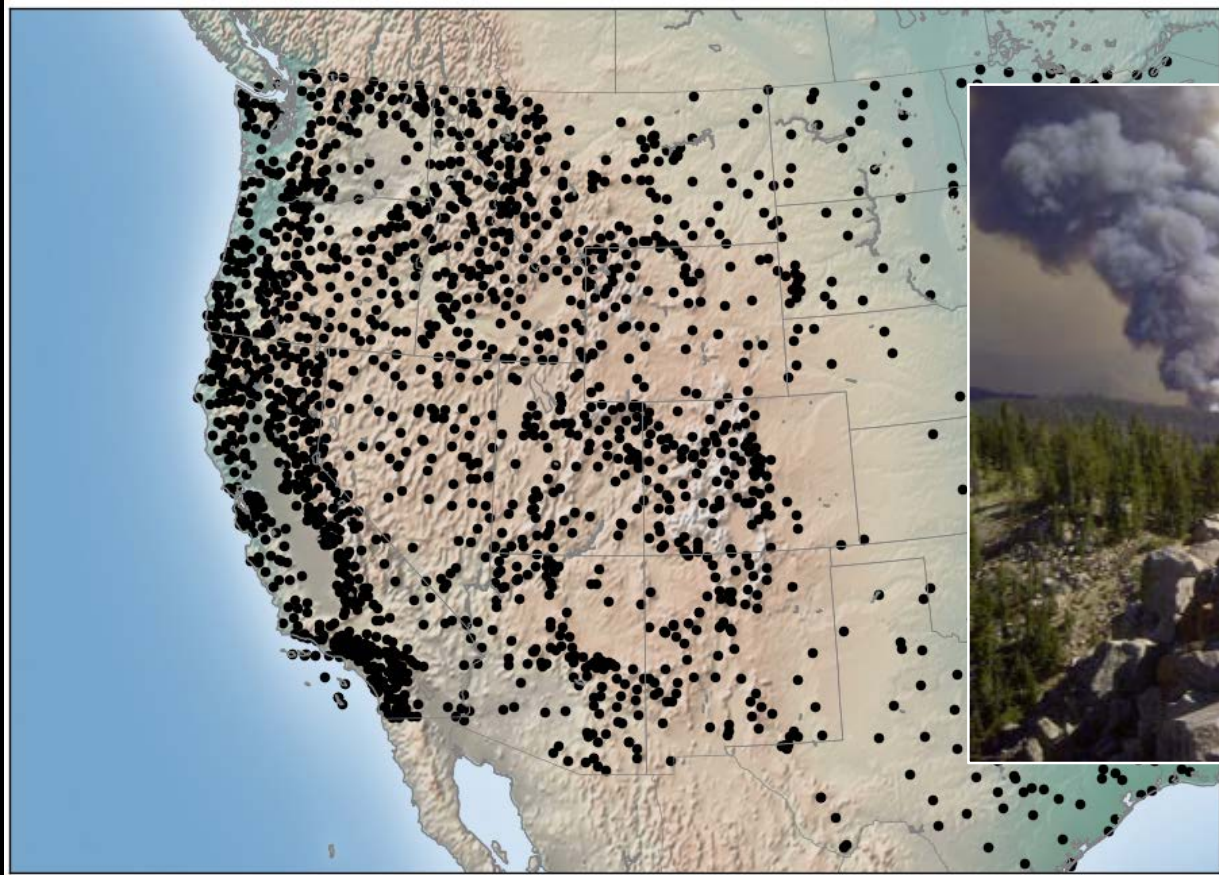
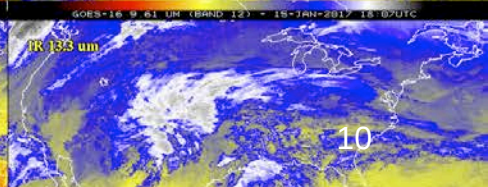
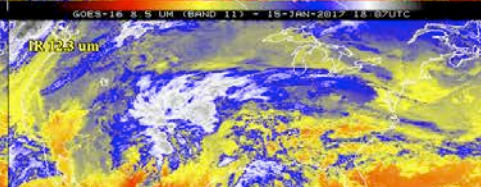
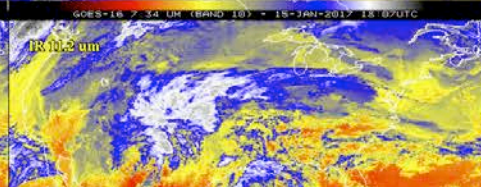
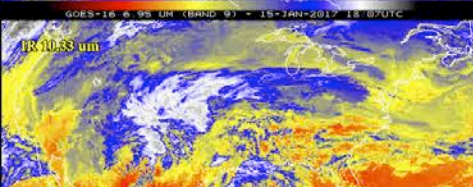
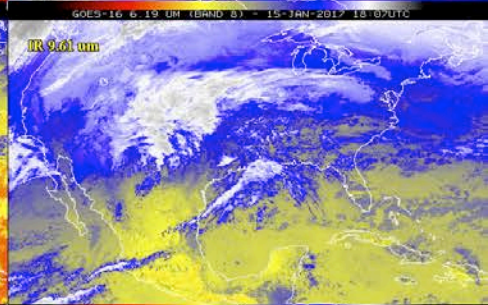
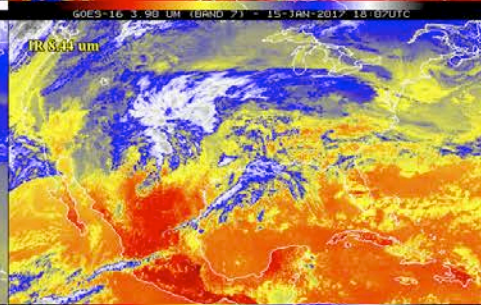
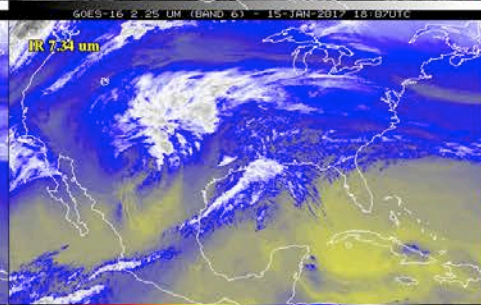
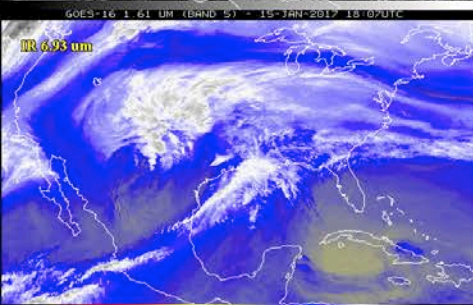
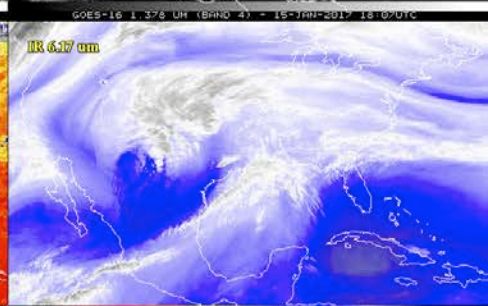
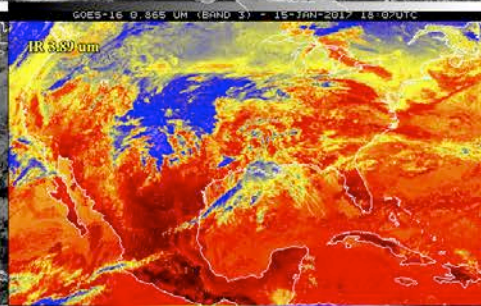
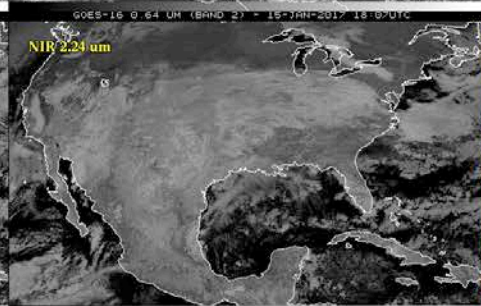
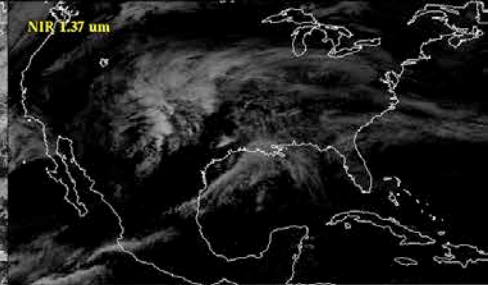
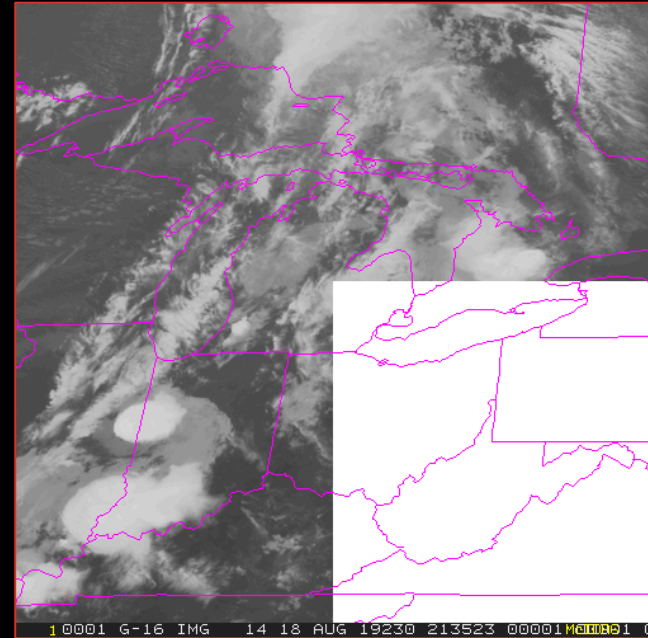
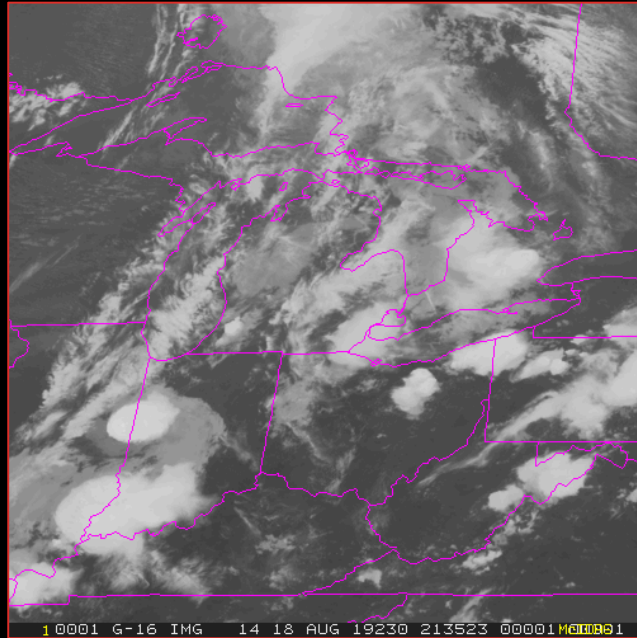


Photo Source: Rob Swofford (BLM)



18 AUGUST 2019 2135 UTC GOES-16 LOST DATA EXAMPLE



GOES REBROADCAST (GRB) USES

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

The delivery of satellite weather data must
always be
timely,
consistent, and
reliable.



May 6, 2020

Senator Jim Inhofe
Chairman
U.S. Senate Committee on Armed Services
228 Russell Office Building
Washington, DC 20510

Senator Jack Reed
Ranking Member
U.S. Senate Committee on Armed Services
228 Russell Office Building
Washington, DC 20510

Dear Chairman Inhofe and Ranking Member Reed,

We are pleased to file this statement for the record in re-
commence hearing, "Department of Defense Spectrum
Communications Commission's (FCC) Ligado Decision."
Committee for holding this important hearing and for
national security, public safety, and the future of our

Our coalition, made up of industries dependent upon
Positioning Systems (GPS) and satellite communica-
tions that approved the Ligado Networks L-Band applica-

Furthermore, the hurried nature of the circulation
during a declared national emergency – left little time
for government stakeholders like the Department of
Transportation. Each of these government agencies
about the FCC evaluation process, the information
potential impacts. The FCC decision risks the operation
thus threatening the safety and security of military operations
agriculture, transportation, construction, maritime and weather

Like these government agencies, the undersigned organizations share many of the same
and procedural concerns about the FCC's process and decisions, including:

Ignores National Security – The FCC dismissed the national security and safety concerns of the
Executive Branch – as personally reinforced by the Secretary of Defense, Deputy Secretary of
Defense, and numerous other very senior officials – virtually without explanation. Additionally,
rather than compare its analysis with that of the Executive branch, the commission said, in
essence, "they are wrong" and decided against national security experts without further comment
or engagement.

Our coalition, made up of industries
dependent upon and dedicated to
protecting Global Positioning Systems
(GPS) and satellite communications,
strongly opposes the recent FCC Order
that approved the Ligado Networks L-
Band application.

For these reasons and many more, we are strongly urging the FCC to stay and reconsider its
decisions on Ligado. It is in the interest of both national security and public safety to fully
address all the overwhelming technical and safety concerns raised by public and private sector
stakeholders. We thank the Committee for holding this hearing and appreciate your leadership on
this topic.

Geospatial Equipment & Technology
Institute
Helicopter Association International
International Air Transport Association
Iridium
JetBlue
L3Harris
Lockheed Martin
Masters, Mates & Pilots Union
Microcom Environmental
Narayan Strategy
National Agricultural Aviation Association
National Air Transportation Association
National Defense Industries Association
National Society of Professional Surveyors
NENA: The 9-1-1 Association
PlanetIQ
Solar Air Cargo Worldwide, Inc.
Regional Airline Association
Resilient Navigation and Timing Foundation
Satelles
Seafarers International Union
Semaphore Group
Skytrac
Southwest Airlines
Space Science and Engineering Center at
University of Wisconsin-Madison
Spire Global
Subsurface Utility Engineering Association
The Vertical Flight Society
Trimble
U.S. Contract Tower Association
U.S. Geospatial Executives Organization
United Airlines
UPS

14 of 68 organizations were part of the weather and water enterprise, including:

American Geophysical Union

American Meteorological Society

American Weather and Climate Industry Association

Space Science and Engineering Center at University of Wisconsin-Madison

For these reasons and many more, we are strongly urging the FCC to stay and reconsider its decisions on Ligado. It is in the interest of both national security and public safety to fully address all the overwhelming technical and safety concerns raised by public and private sector stakeholders. We thank the Committee for holding this hearing and appreciate your leadership on this topic.

Sincerely,

AccuWeather, Inc.	Geospatial Equipment & Technology Institute
Aerospace Industries Association	Helicopter Association International
Air Line Pilots Association International	International Air Transport Association
Aircraft Owners and Pilots Association	Iridium
Aireon	JetBlue
Airlines for America	L3Harris
Alaska Airlines	Lockheed Martin
Alert Users Group	Masters, Mates & Pilots Union
Alliance for Automotive Innovation	Microcom Environmental
American Airlines	Narayan Strategy
American Association of Airport Executives	National Agricultural Aviation Association
American Association of Port Authorities	National Air Transportation Association
American Farm Bureau Federation	National Defense Industries Association
American Geophysical Union	National Society of Professional Surveyors
American Meteorological Society	National Weather Association
American Road & Transportation Builders Association	NENA: The 9-1-1 Association
American Trucking Associations	PlanetIQ
American Weather and Climate Industry Association	Polar Air Cargo Worldwide, Inc.
Associated Equipment Distributors International	Regional Airline Association
Association of Equipment Manufacturers	Resilient Navigation and Timing Foundation
Atlas Air Worldwide	Satelles
Aviation Spectrum Resources Inc.	Seafarers International Union
BoatU.S.	Semaphore Group
Cargo Airline Association	Skytrac
Center for Sportfishing Policy	Southwest Airlines
Coalition of Airline Pilots Associations	Space Science and Engineering Center at University of Wisconsin-Madison
CoBank	Spire Global
Delta Air Lines	Subsurface Utility Engineering Association
DTN Weather	The Vertical Flight Society
FedEx Corporation	Trimble
Frontier Airlines	U.S. Contract Tower Association
General Aviation Manufacturers Association	U.S. Geospatial Executives Organization
GeoOptics, Inc.	United Airlines
	UPS

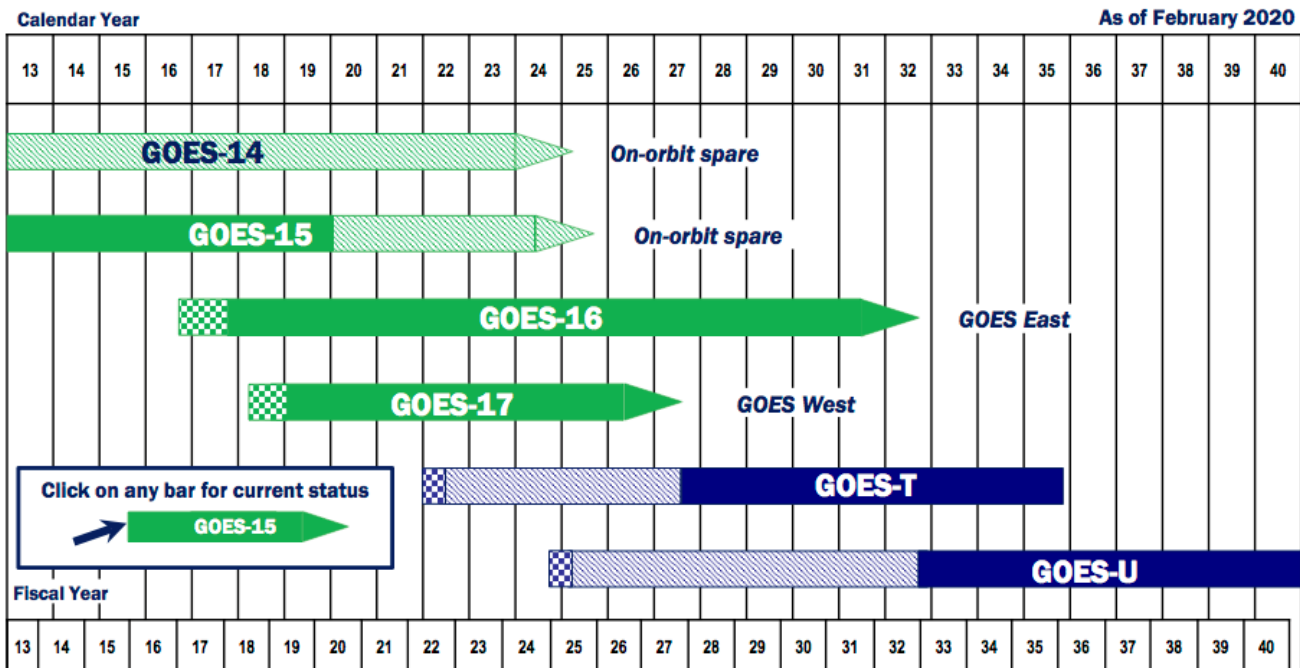
SUMMARY OF CONCERN

- There will be interference if Ligado's proposal moves forward.
- This is a unique method for delivering weather satellite data.
- Non-federal users need to be protected from interference.
- A cloud-based content delivery network is not viable since it relies on terrestrial connectivity, which can be compromised during/after storms.
- There are costly solutions to shift to a different satellite downlink prior to the next-generation of weather satellites.



NOAA Geostationary Satellite Programs

Continuity of Weather Observations



Approved:

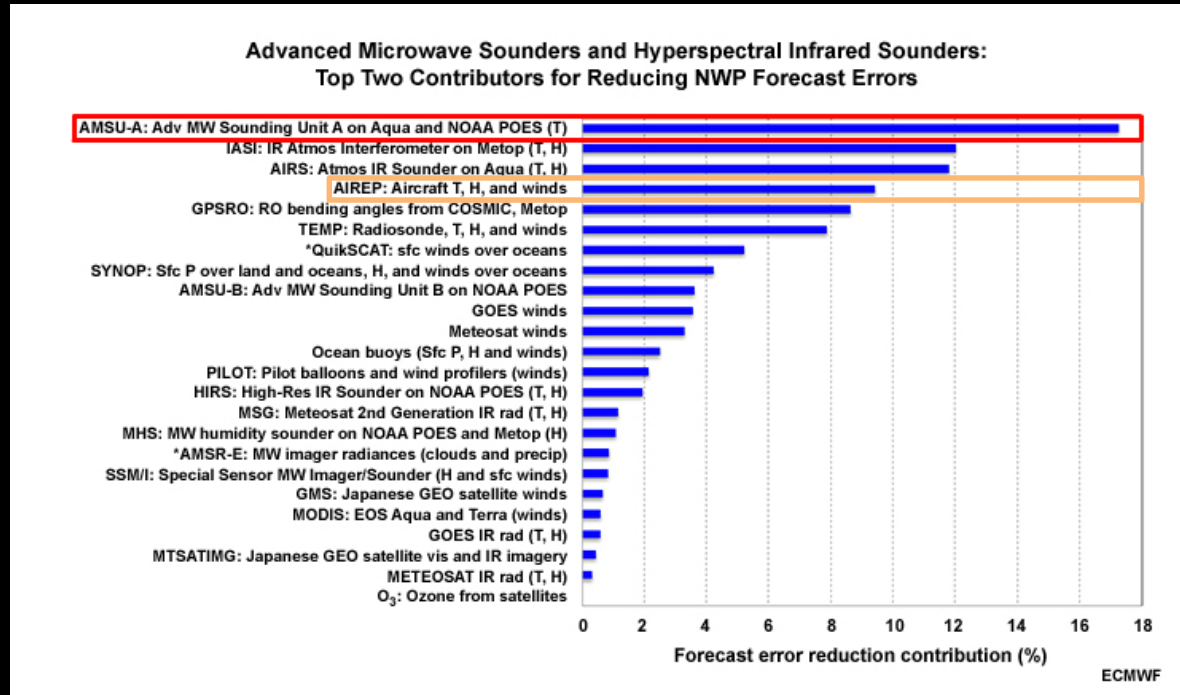
Assistant Administrator for Satellite and Information Services

- In orbit, operational
- In orbit, storage
- In orbit, checkout
- Planned in-orbit Storage
- Planned in-orbit Checkout
- Planned Mission Life
- Reliability analysis-based extended weather observation life estimate (60% confidence) for satellites on orbit for a minimum of one year – Most recent analysis: March 1, 2019

Passive microwave
water vapor sensing
(Collection)

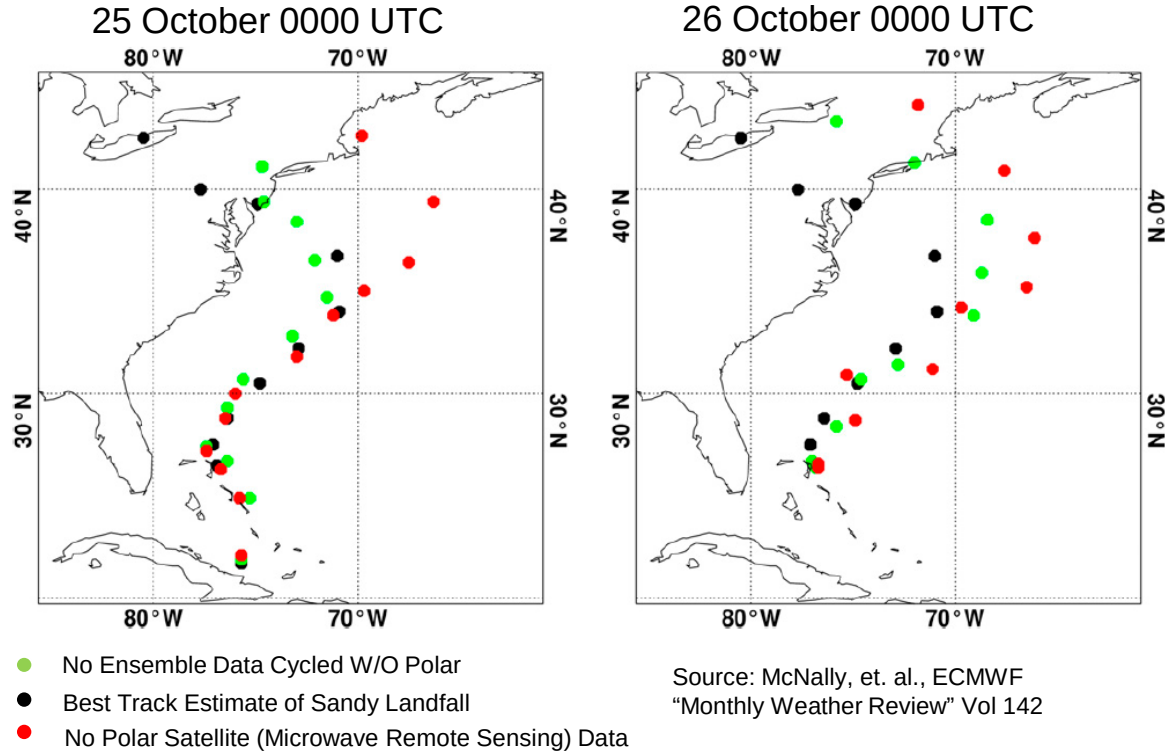
23.8/24 GHz

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)



ATMS

Advanced Technology Microwave Sounder
Joint Polar Satellite System (JPSS)

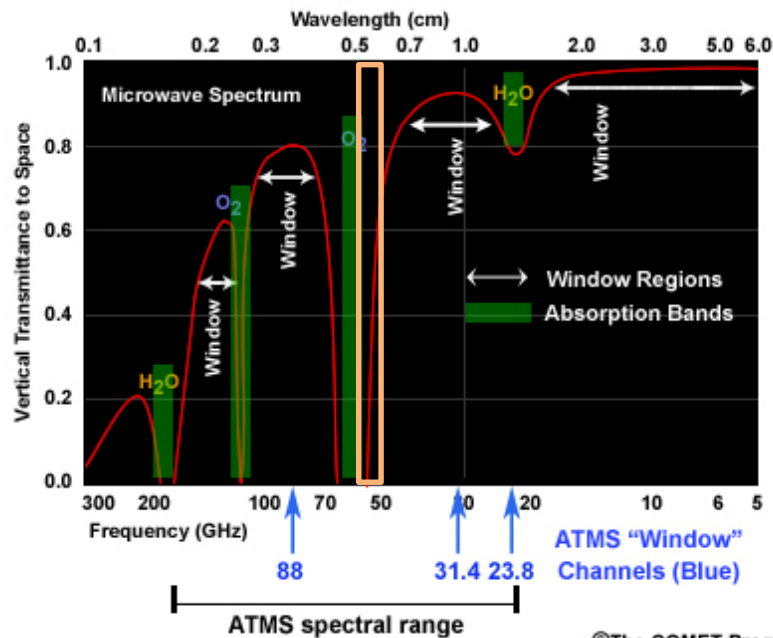
ATMS Channel Characteristics and Applications

Central Frequency (GHz)	Application	Footprint Size: Nadir View (km)	Footprint Size: Edge of Scan (km, Δy by Δx) Δy: Satellite's orbiting direction Δx: Perpendicular to satellite's orbiting direction
23.8 31.4	- Total precipitable water vapor - Precipitation - Integrated cloud liquid water - Integrated cloud ice water - Snow and ice cover characteristics (ice concentration, snow water equivalent) - Land surface temperature	75 x 75	142 x 323
50.3 51.76 52.8 88.2		32 x 32	60 x 137
53.6 – 57.29 (10 channels)	Atmospheric temperature sounding	32 x 32	60 x 137
165.5 183.31 +/- 1 to 183.31 +/- 7 (5 channels)	Atmospheric moisture sounding	16 x 16	30 x 68

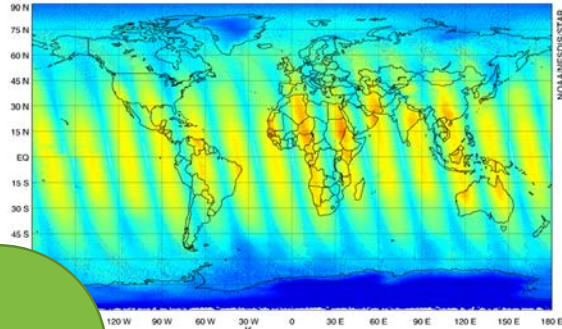
Electromagnetic Spectrum

Window Regions (for Cloud and Surface Products)

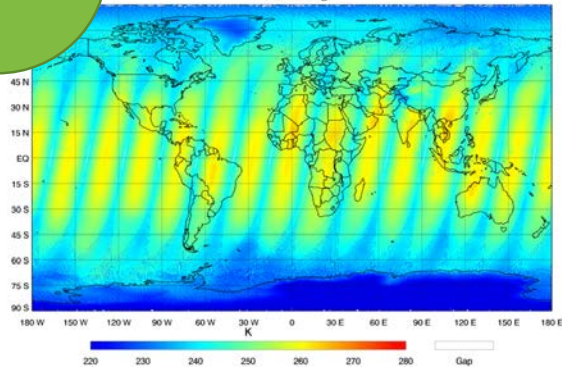
Absorption Regions (for Sounding Products)



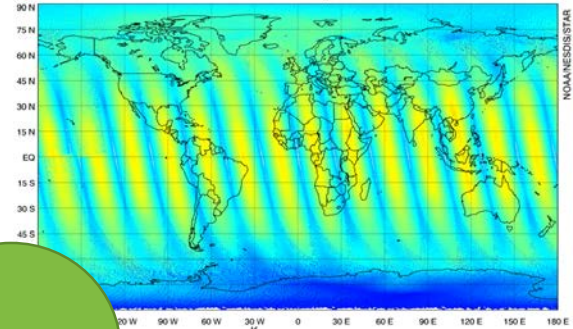
Suomi NPP ATMS TDR Ch.6 53.596±0.115 GHz QH-POL
2020-05-06
Ascending



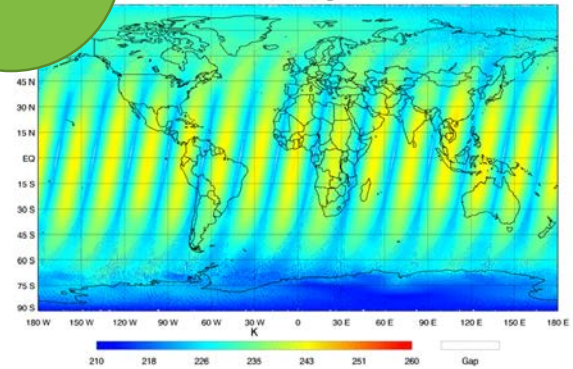
0.9%



Suomi NPP ATMS TDR Ch.7 54.4 GHz QH-POL
2020-05-06
Ascending

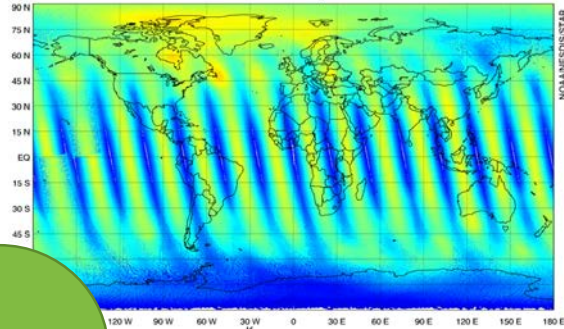


1.1%

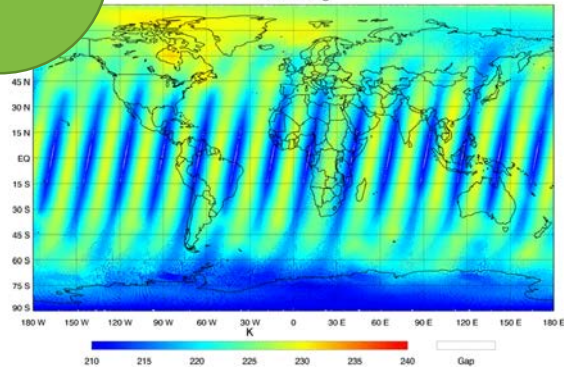


NASA GMAO GEOS 24h Observation Impact Per Channel, 6 February through 6 May 2020 00 UTC

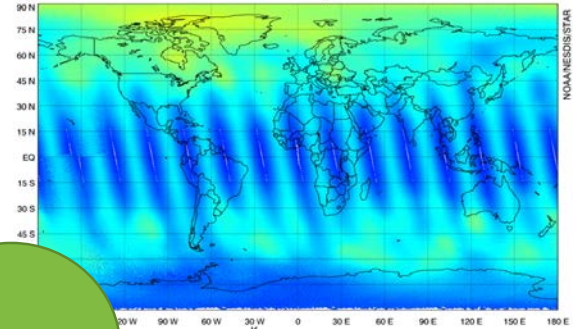
Suomi NPP ATMS TDR Ch.8 54.94 GHz QH-POL
2020-05-06
Ascending



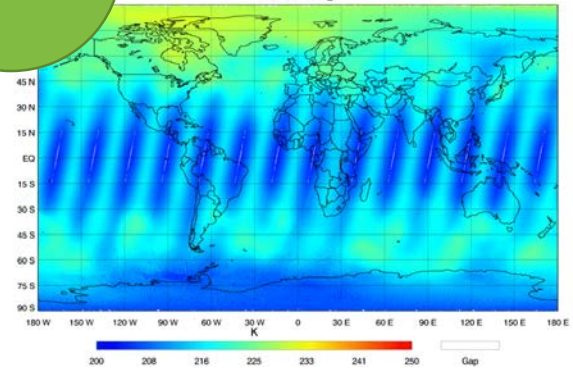
1.3%



Suomi NPP ATMS TDR Ch.9 55.5 GHz QH-POL
2020-05-06
Ascending



1.2%



NASA GMAO GEOS 24h Observation Impact Per Channel, 6 February through 6 May 2020 00 UTC

MONITORING HOW MICROWAVE OBSERVATIONS IMPROVE NUMERICAL MODEL SKILL

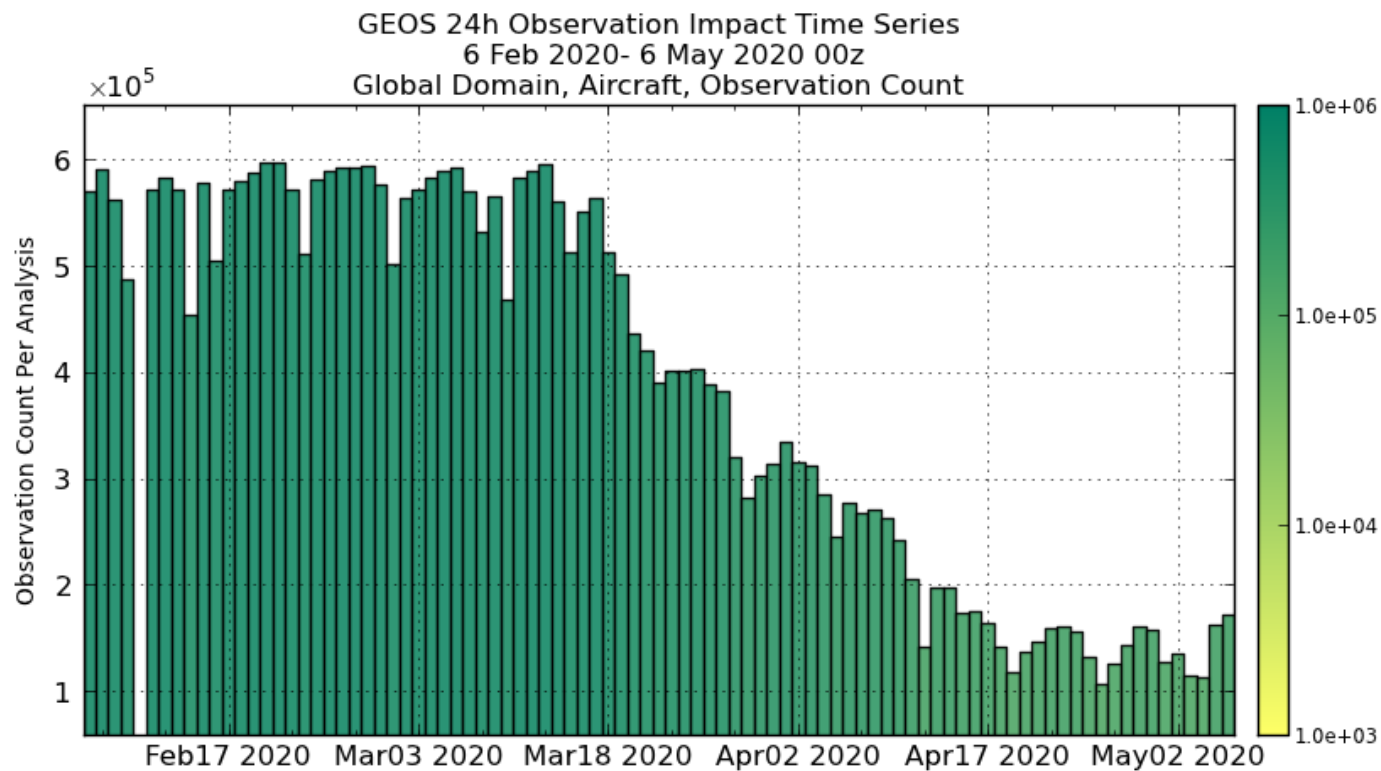
In numerical forecast model data assimilation, some of the observations are largely complementary (many individual platforms have small impacts).

Removing one observation platform (one satellite) may not notably affect the skill of the model solution in any given run, but it may lower the skill floor over time.

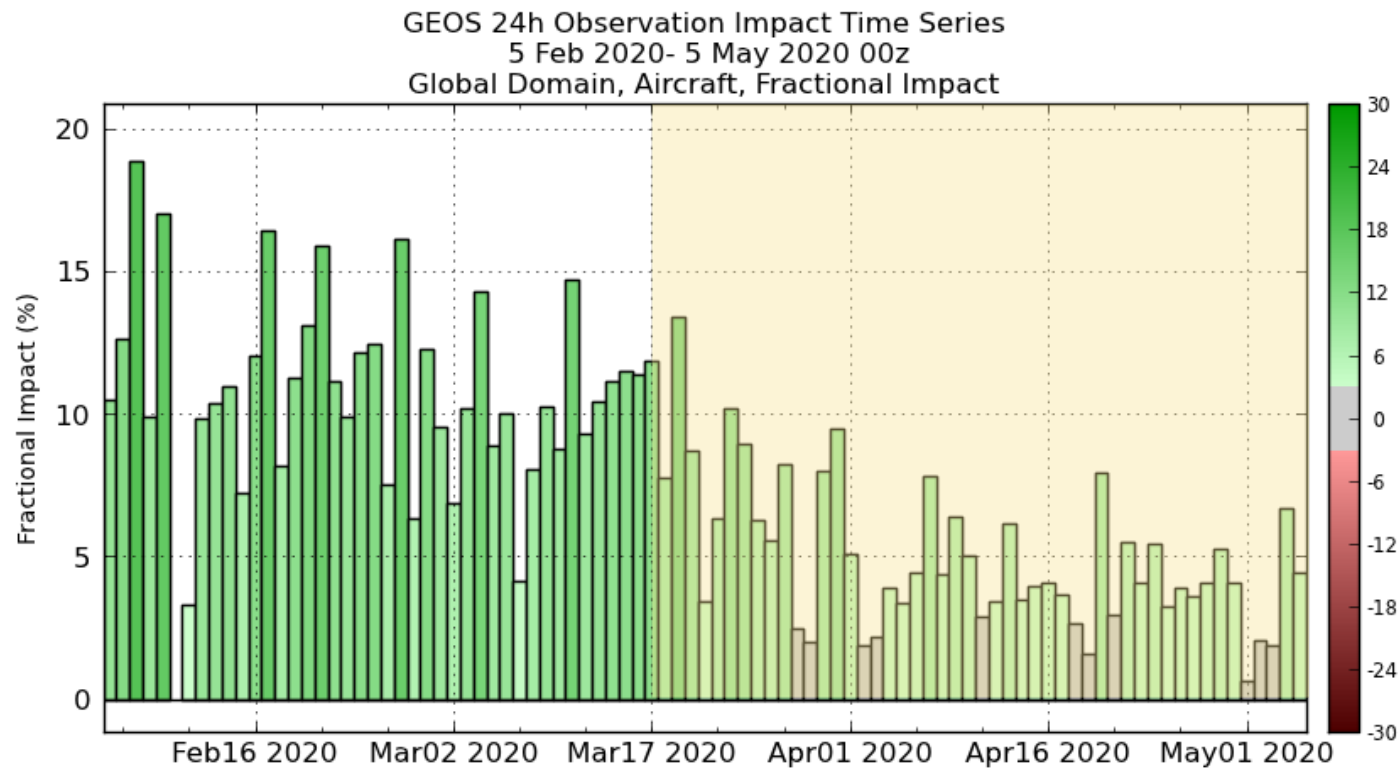
The most likely consequence of microwave interference on numerical weather predictions is a general/gradual lowering of the skill floor.

There are various methods to assess the model forecast sensitivity to certain observations over time.

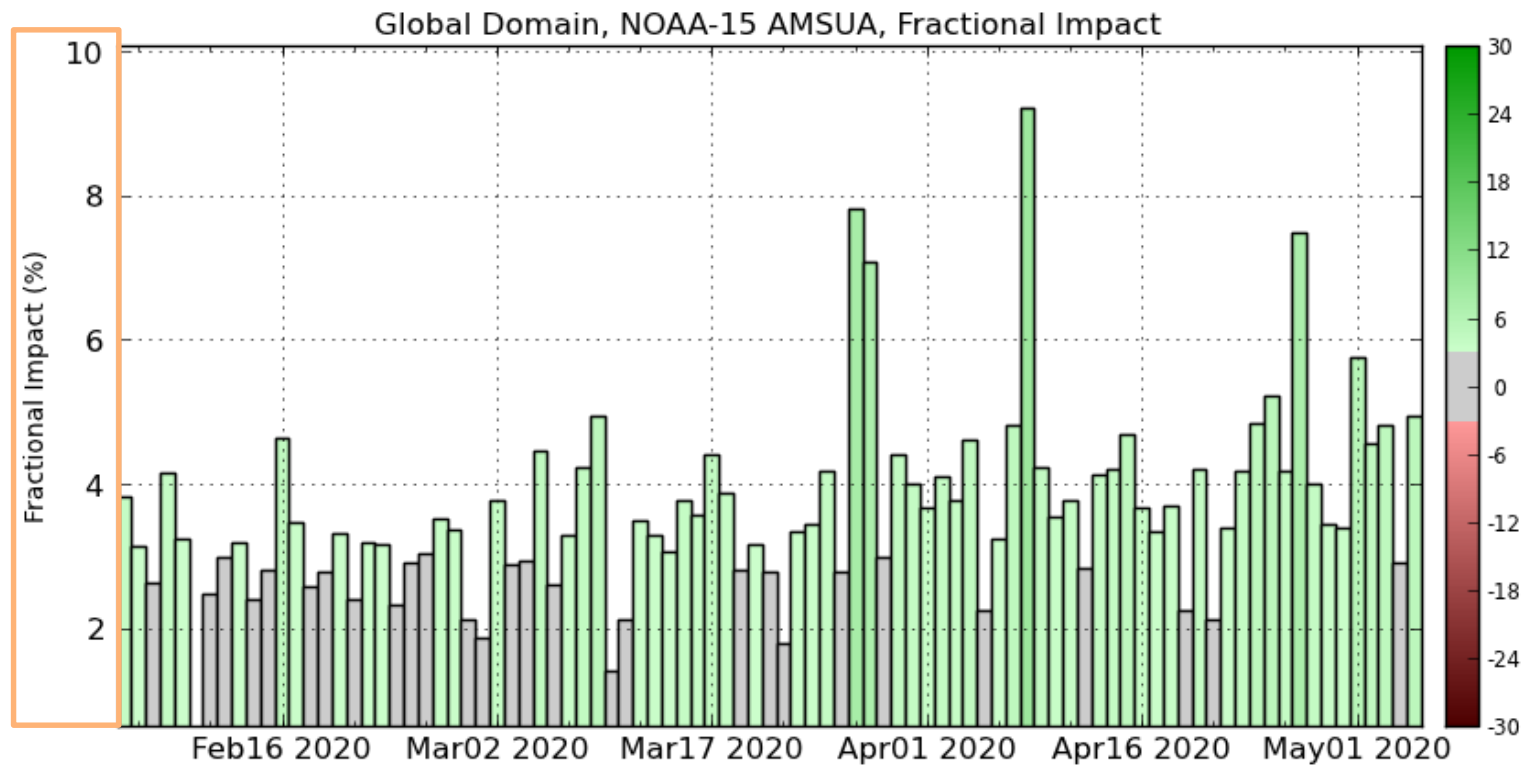
One type of observation has decreased 80% since February... Let's investigate what observations compensated for that.



Source: NASA/GMAO/GEOS



Source: NASA/GMAO/GEOS



Source: NASA/GMAO/GEOS

ECMWF FORECAST SENSITIVITY TO ALL OBSERVATIONS (JULY/AUG 2016)

Geer, A. J., Baordo, F. , Bormann, N.
 , Chambon, P. , English, S. J.,
Kazumori, M. , Lawrence, H. , Lean,
P. , Lonitz, K. And Iupu, C. (2017),
The growing impact of satellite
observations sensitive to humidity,
cloud and precipitation. Q.J.R.
Meteorol. Soc., 143: 3189-3206.
doi:[10.1002/qj.3172](https://doi.org/10.1002/qj.3172)



Southern hemisphere middle
latitudes



Central contiguous United
States



Equatorial Africa



Eastern Asia and the Tropical
Western North Pacific Ocean

ECMWF FORECAST SENSITIVITY OBSERVATION IMPACT (FSOI)

2006

Microwave water vapor observations
for the entire world

6%

2016

Microwave water vapor observations
for the entire world

20%

ECMWF FORECAST SENSITIVITY OBSERVATION IMPACT (FSOI)

2016

Microwave water vapor observations for
the entire world

20%

2016

Microwave water vapor observations
over Canada, Siberia, South America,
and Africa

25%+

Over oceans

25 to 45%

Geer, A. J., Baordo, F. , Bormann, N. , Chambon, P. , English, S. J., Kazumori, M. , Lawrence, H. , Lean, P. , Lonitz, K. and lupu, C. (2017), The growing impact of satellite observations sensitive to humidity, cloud and precipitation. Q.J.R. Meteorol. Soc., 143: 3189-3206. doi:[10.1002/qj.3172](https://doi.org/10.1002/qj.3172)

IMPACTS SUMMARY

- Value of microwave water vapor observations is not easily achievable through other means
 - Unique observations based on physical properties of water vapor and oxygen
 - Maintains high data rate and assures high reliability over vast area of globe
- Continuing important observing capabilities maintains the value of our satellite constellations and quality of local and global weather forecasts.

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



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