Spectrum and the U.S. Weather Enterprise

Beau Backus

Spectrum Management

National Oceanic and Atmospheric Administration

May 23rd, 2017

Increase in Extreme Events

"Average" Year and Trends in the U.S.

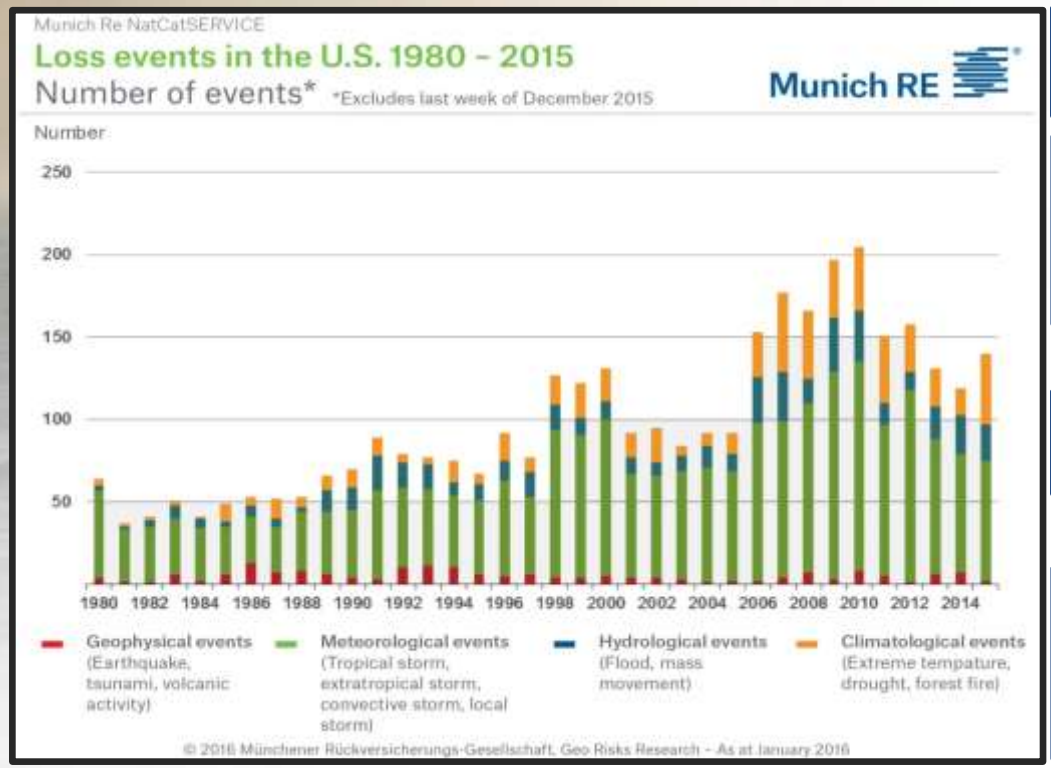
650 Deaths
$15B in Losses

26,000 Severe Thunderstorms

6 Atlantic Basin Hurricanes

1,300 Tornadoes

5,000 Floods



Increasing Vulnerability

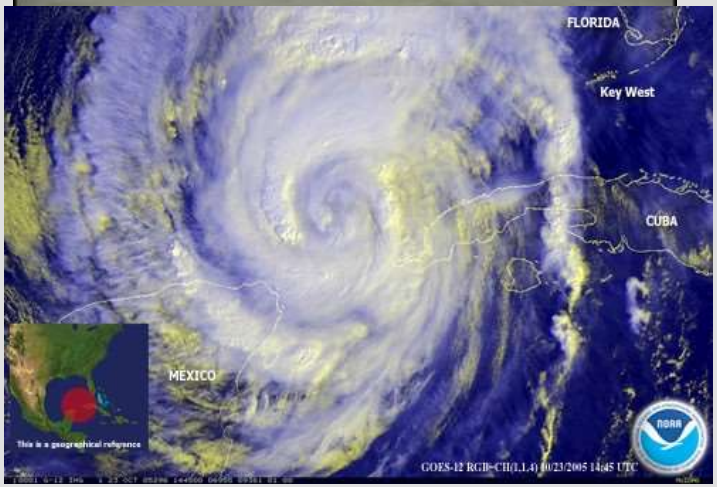
- Increasing population
- More infrastructure at risk
- Signs of sea level rise

- Improve forecasts of extreme events 4-8 days in advance

- Connecting forecasts to decision- makers is basis for building a Weather- Ready Nation

Data from Satellites are Essential to *All Forecasts and Warnings*

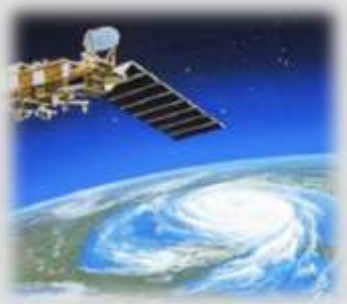
Hurricanes



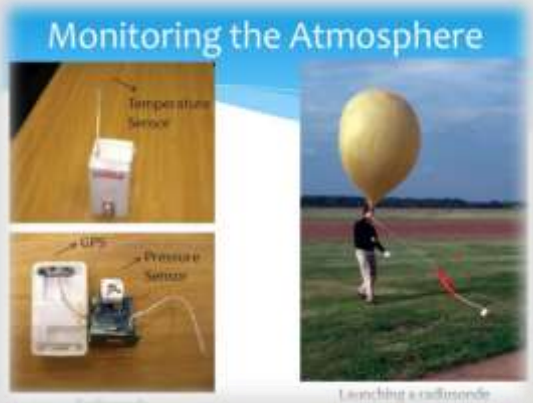
Flooding

Tornados

Access to Spectrum is Critical to NOAA Missions



Command and Control of NOAA satellites



Radiosondes

NOAA Aircraft

Stream Gage

Radar

Data critical from remote locations for input into weather forecasts, warnings and numerical weather prediction models

Seismic stations

Tracking endangered wildlife

EMWIN

Ships

Tsunami Buoy

GOES–R
Huge Strides in Capabilities

3X MORE CHANNELS

Improves every product from current GOES Imager and will offer new products for severe weather forecasting, fire and smoke monitoring, volcanic ash advisories, and more.

4X BETTER RESOLUTION

The GOES-R series of satellites will offer images with greater clarity and 4x better resolution than earlier GOES satellites.

5X FASTER SCANS

Faster scans every 30 seconds of severe weather events and can scan the entire full disk of the Earth 5x faster than before.

GOES-R Architecture

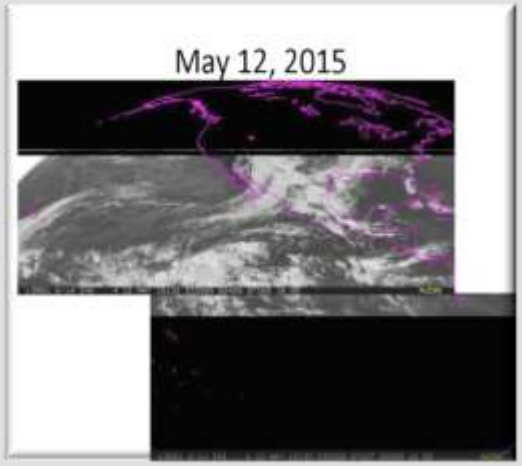
Potential Impacts of 1675-1680 MHz Sharing

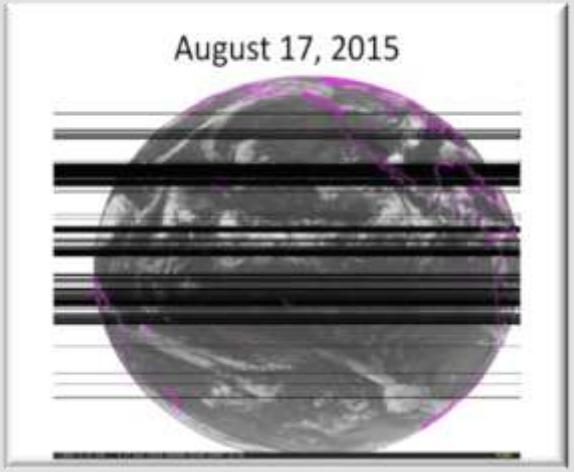
- GOES-NOP satellites deliver critical Sensor Data:
  - Sensor Data downlink contains the raw imagers and sounder data that are transmitted to NOAA data acquisition stations in the 1675-1680 MHz band
  - These data are the basis for many of the satellite products that NOAA provides to public and the weather enterprise
  - Loss of these data will result in the loss of images required to track hurricanes and monitor the rapid development of severe storms that may develop into destructive tornados

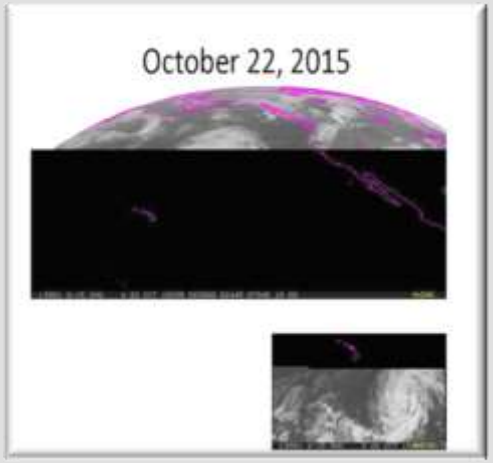
- Federal and non-federal users of Data Collection Platform rebroadcast (DCPR) outside protection zones will be subject to interference
  - Reception of hydrological data from sensors deployed nationwide required for flood prediction and warnings
  - Reception of sensor data required for wildfire management

Current RF Interference Challenges
GOES Satellite

Recent Examples of Satellite Data Loss Due to Interference







Loss of any one of these images will impact the entire suite of products and users

Potential operational impacts include:

- Weather forecasting nation-wide
- Tornado warnings – flash flood warnings
- Shipping industry
- Airlines, including domestic and international routes
- Satellite dropout affects US & foreign weather and aviation services
- Tropical cyclone forecasting in the Atlantic and Pacific oceans

NOAA Satellite Spectrum in Consideration for Repurposing

1695-1710 MHz: Recently repurposed for sharing with AWS-3 (Advanced Wireless Services -3) licensees for use as LTE uplink band. Affects 27 critical federal sites and numerous other federal and nonfederal sites. Operations by AWS-3 has not begun so no validation of mitigation steps.

1675-1680 MHz: In consideration for repurposing for use by commercial fix and mobile operations and continued shared use as a METSAT downlink band. Consideration primarily due to commercial party petition to US FCC in Proceeding RM-11681. Significant concern by NOAA on DCP downlink interference risk to GOES-R series.

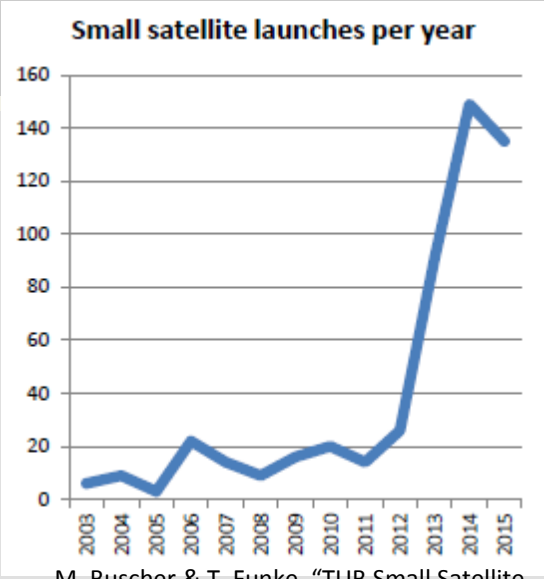
400.15-420 and 150.05-174 MHz: WRC-19 agenda item 1.7, resolution 659, assessment of the suitability of using existing SOS allocations below 1 GHz to accommodate the TT&C requirements for NGSO satellites with short duration missions.

5150-5925 MHz: WRC-19 agenda item 1.16, to consider issues related to wireless access systems, including radio local area networks. May include additional spectrum allocations to the mobile service.

24.5-27.5 GHz: WRC-19 agenda item 1.13, to consider identification of frequency bands for the future development of IMT, including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 238.

Above 24 GHz: FCC Notice of Proposed Rulemaking, “Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14-177”: Solicitation of comments on mobile use in the following bands – 27.5-28.35 GHz, 37-38.6 GHz, 38.6-40 GHz, 64-71 GHz

Other Space Spectrum Issues



M. Buscher & T. Funke, "TUB Small Satellite Database," SFCG-36 SF36-52/I, June 2016.

Small Sat: Extremely large growth in small sat deployments are being projected and observed. Spectrum use is increasing and placing pressure on established systems for coordination in UHF, S, and X bands as well as other space allocated bands.

Passive Bands: Various international mobile telecommunications (IMT) groups are examining spectrum above 6 GHz as part of 5G growth. Several bands in consideration are adjacent to critical passive bands used for remote sensing. Degradation in ability to use passive bands is a growing concern.

Space Weather: In accordance with ITU Resolution 657 (WRC-15), review the results of studies, conducted for WRC-2019, relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors, with a view to providing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services.

Summary

- NOAA's National Weather Service relies on accurate, timely and reliable satellite observations to provide better information to save lives and property -- as it builds a Weather-Ready Nation
- NOAA satellite operations have experienced interference in the 1670-1675 MHz for the past several years
- Federal and non-federal users of Data Collection Platform outside protection zones cannot be protected and will be subject to interference
  - Potential impacts to emergency management, weather warnings, aviation, and wildfire management capability
- These data are the basis for satellite products provided by NOAA to the public and other government agencies, and further used by the weather enterprise
- Additional studies required prior to any auction of NOAA frequencies


Thank You!
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
NASA