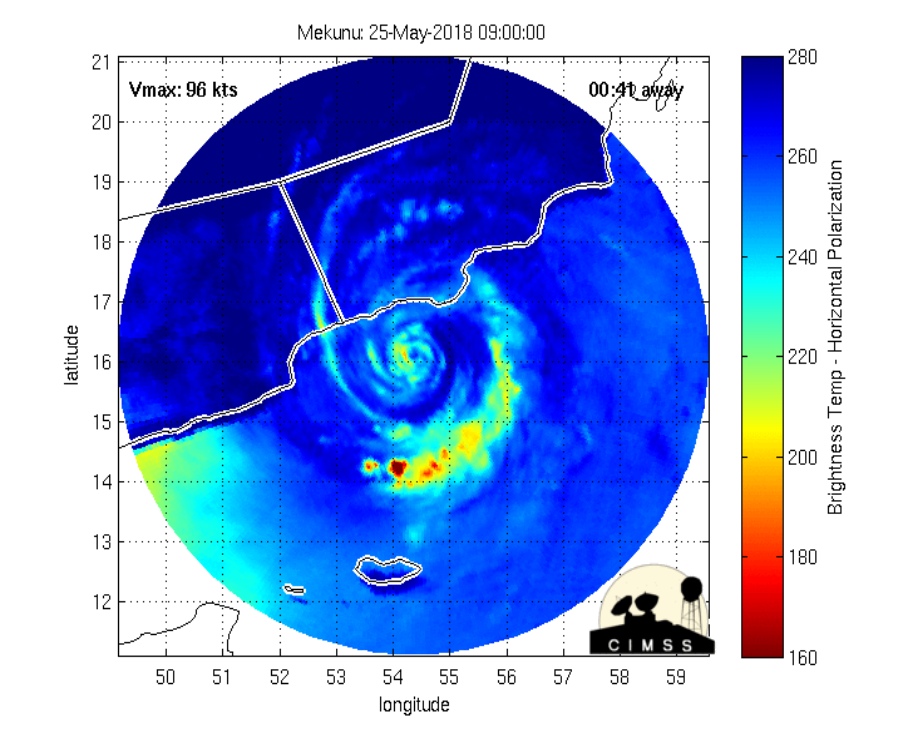
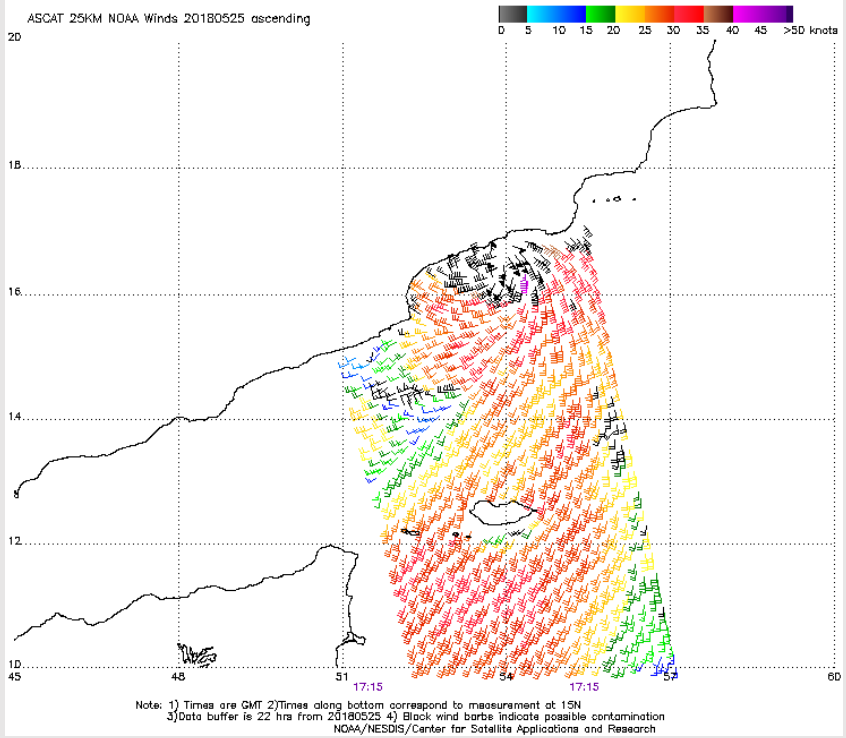
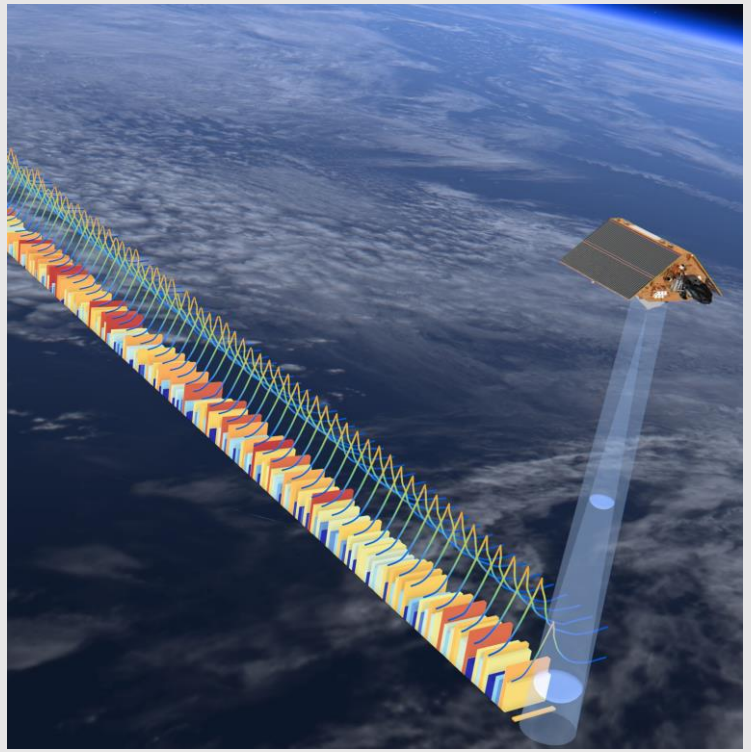
Short Introduction to:

Electromagnetic Spectrum and Microwave Remote Sensing





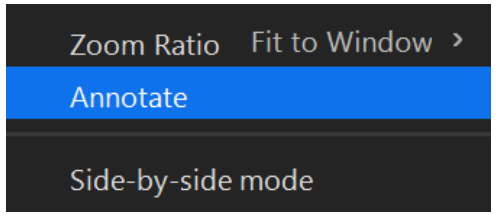


Ibrahim Al Abdulsalam
Meteorologist
Directorate General of Meteorology / Oman

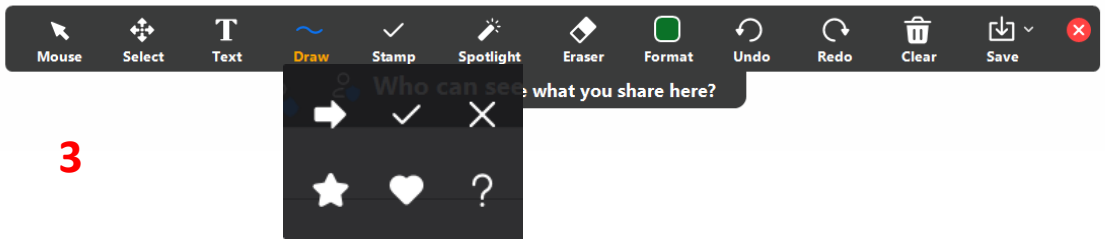
How to Annotate ! :

1

2



3



Having a problem!

Put it in the chat

Try it Here :

Attending by PC

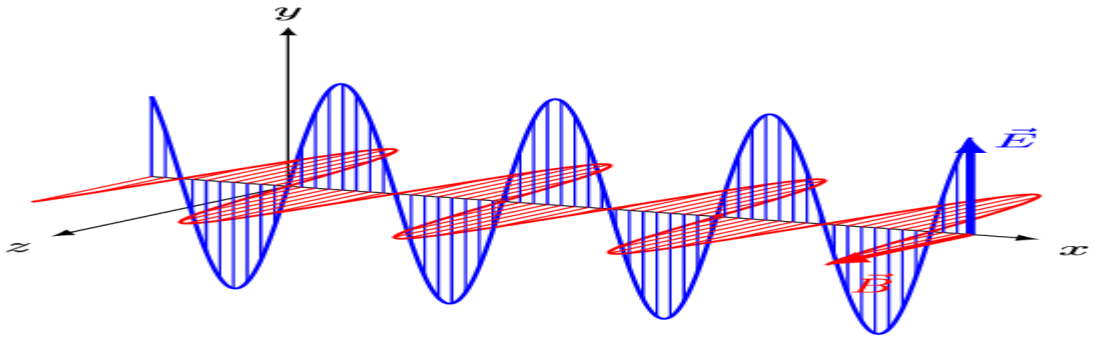
Where are you from ?

Your Field of Work

Weather Forecasting & Observation	Atmospheric and climate Research	Environment	Oceanography	Other

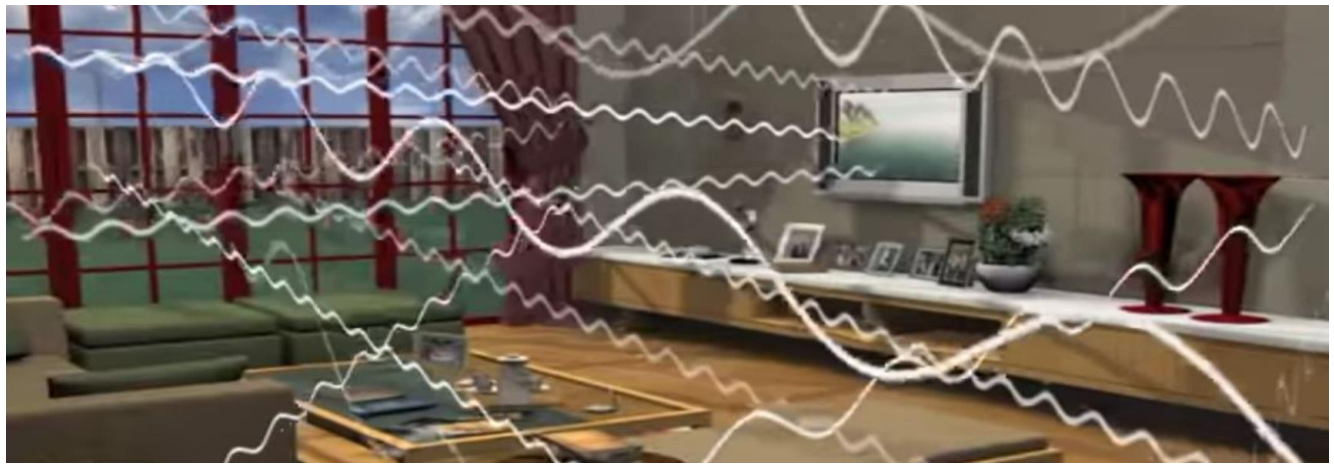
Electromagnetic waves:

Waves created as a result of vibrations between an electric field and a magnetic field



Electromagnetic spectrum:

The electromagnetic spectrum is a comprised of all frequencies/wavelength of electromagnetic radiation that propagate and travel through space in the form of waves.



1 - Visible Light

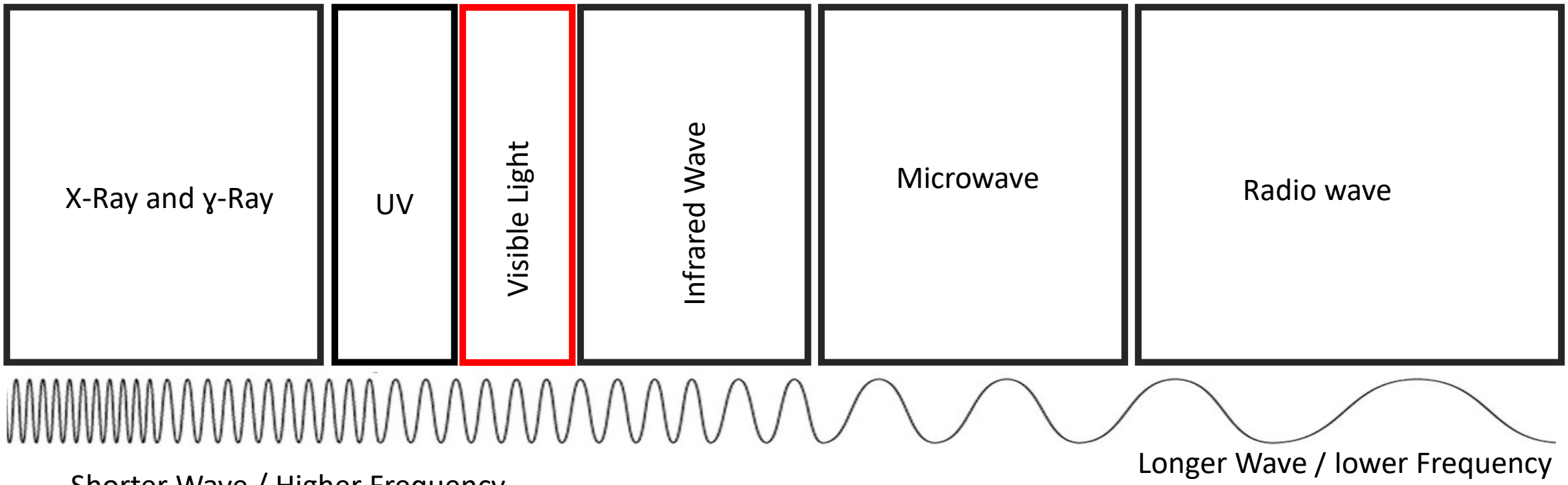
2 - UV

3 - Radio wave

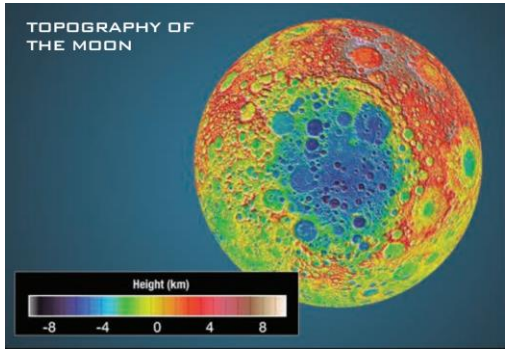
4 - Infrared Wave

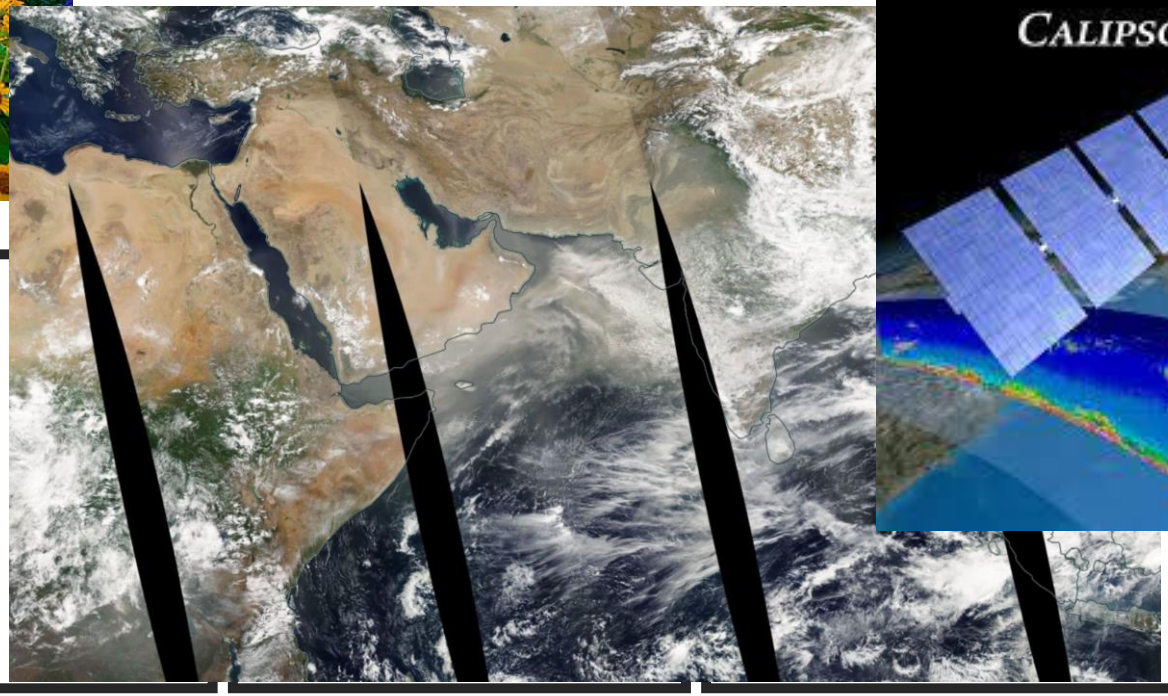
5- X-Ray and ɣ-Ray

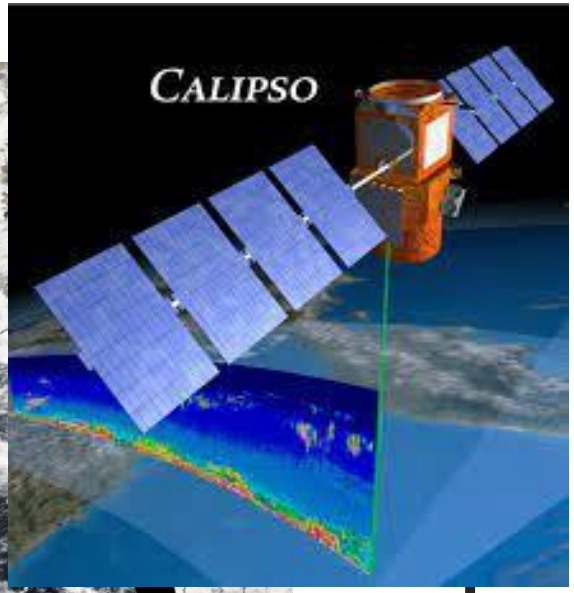
6 - Microwave



Applications

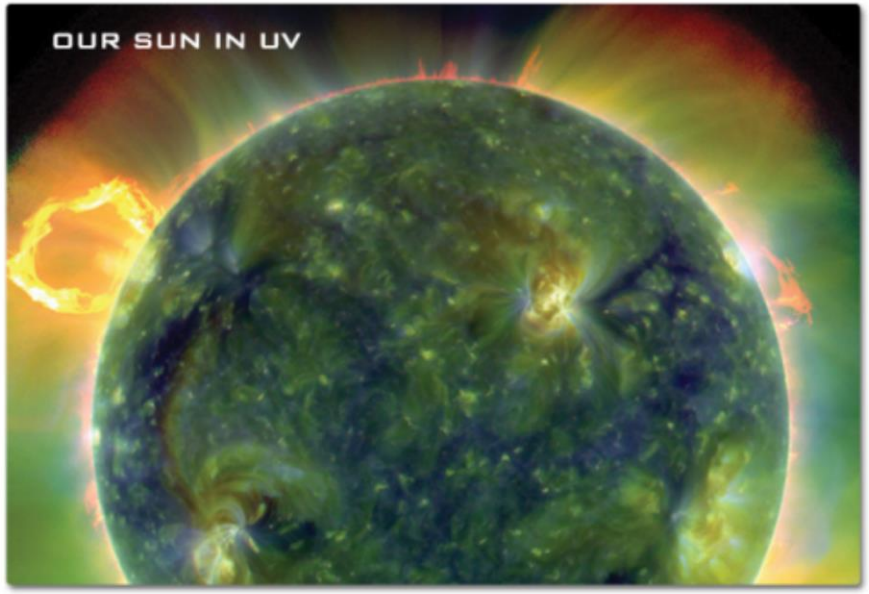




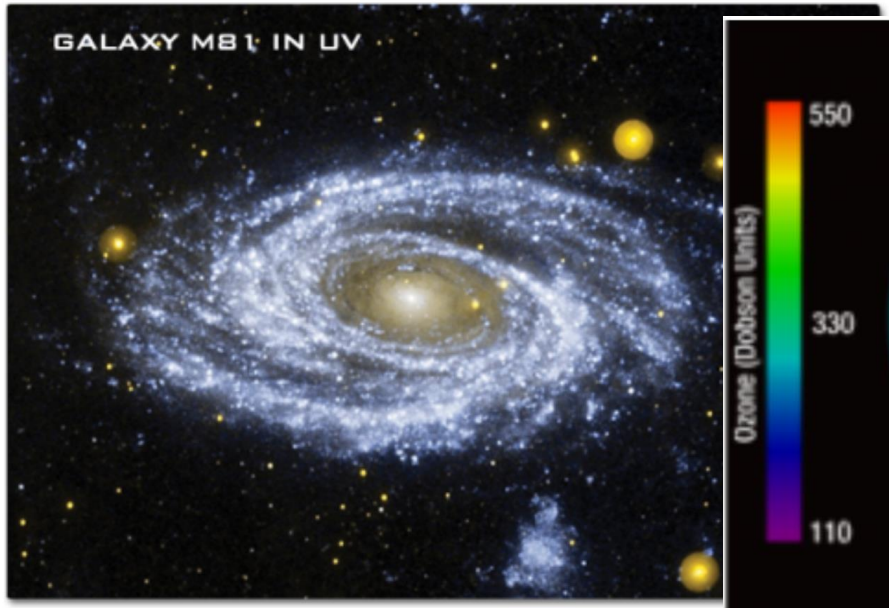


Shorter Wave / Higher Frequency

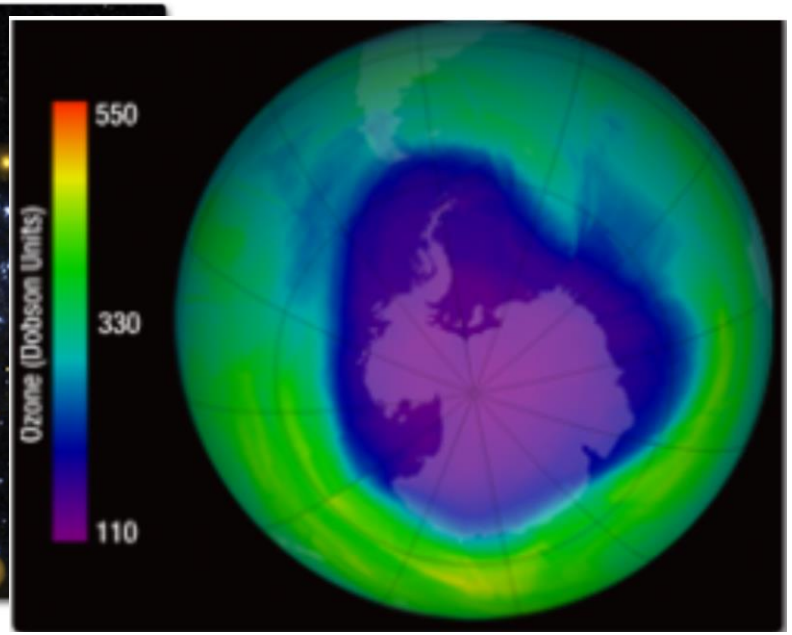
Longer Wave / lower Frequency

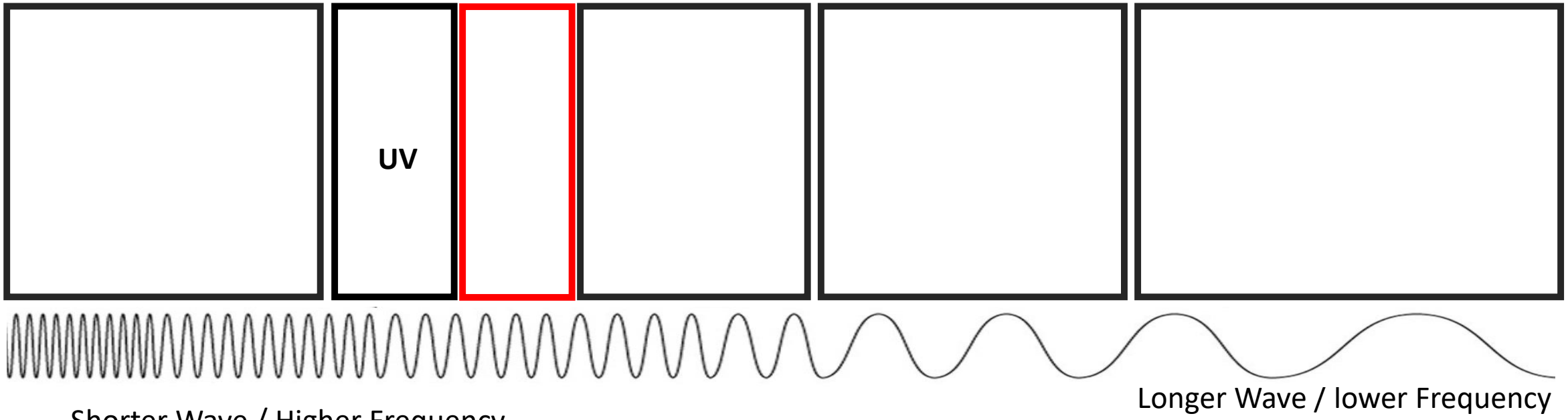


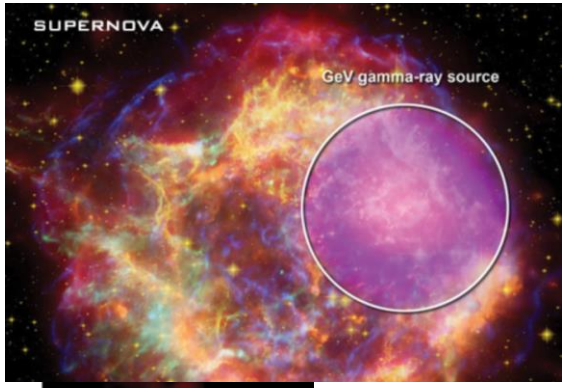
Credit: Image is courtesy of: NASA/SDO/AIA

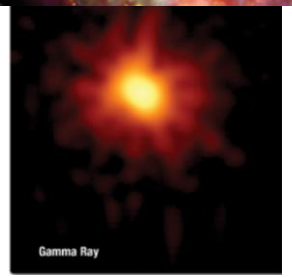


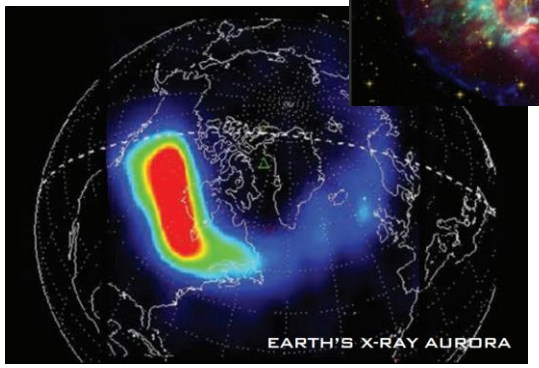
Credit: NASA/JPL-Caltech

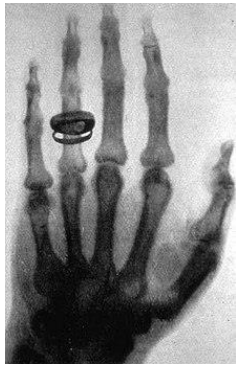








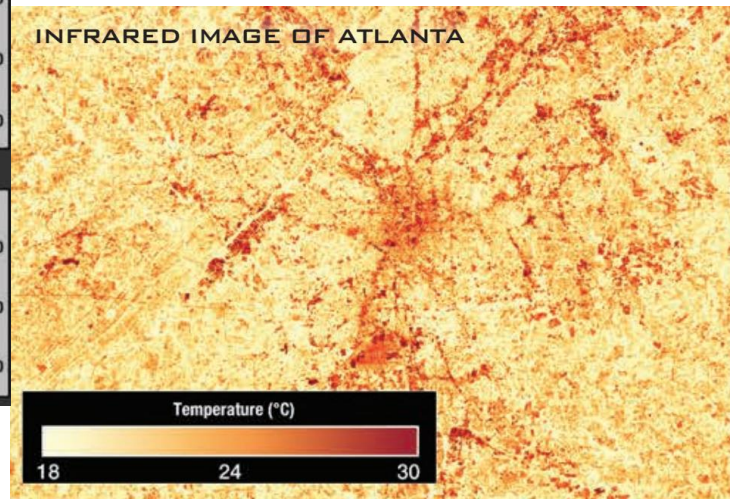


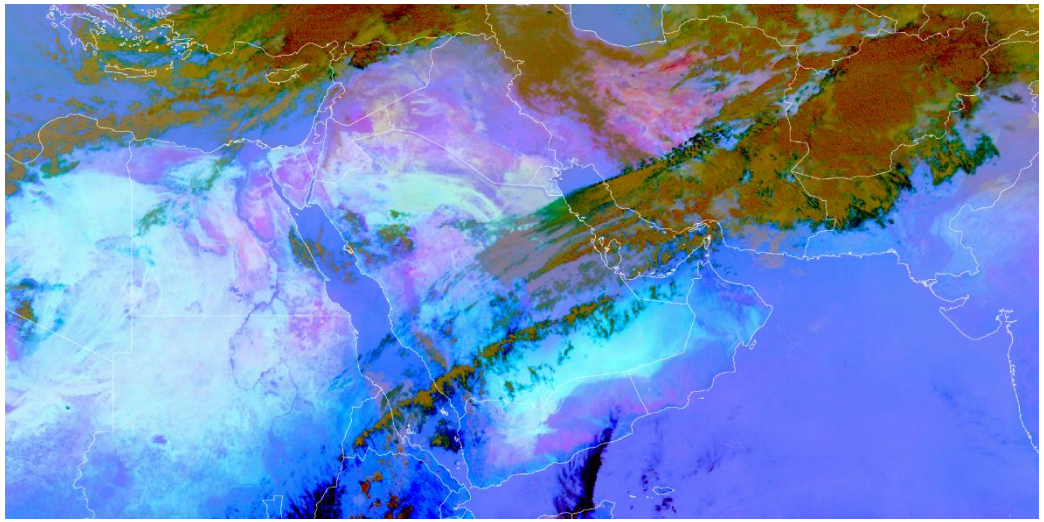


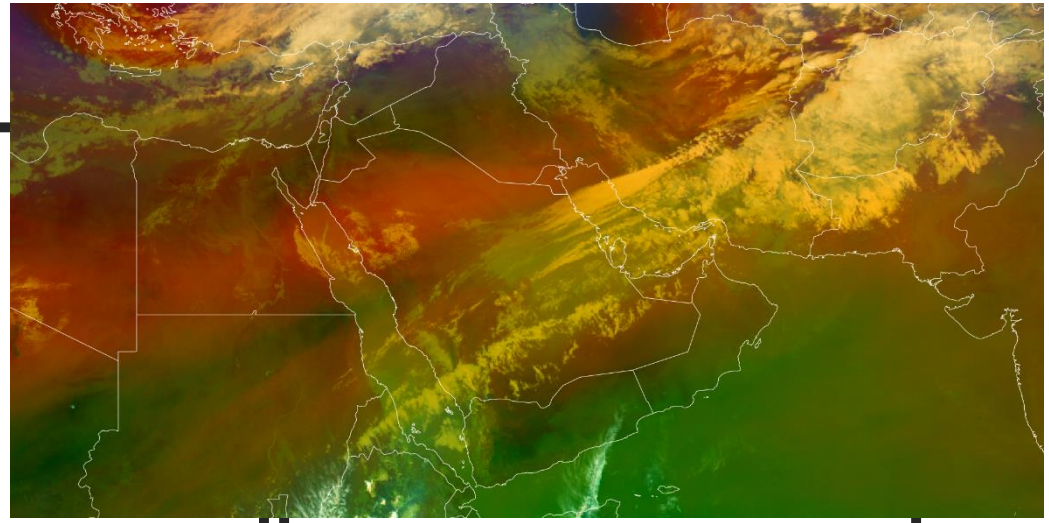
X-Ray and ɣ-Ray

Shorter Wave / Higher Frequency

Longer Wave / lower Frequency





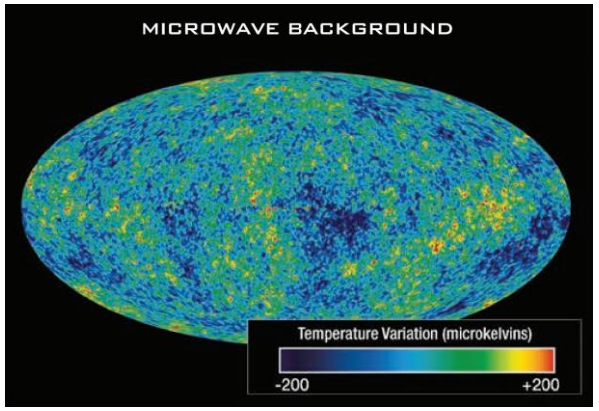


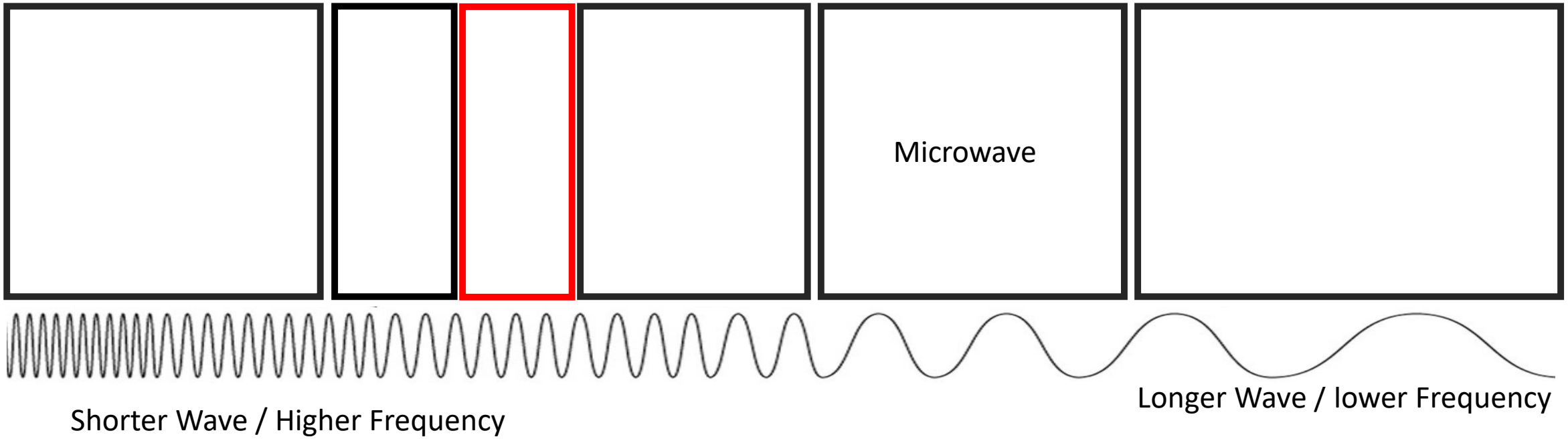
Shorter Wave / Higher Frequency

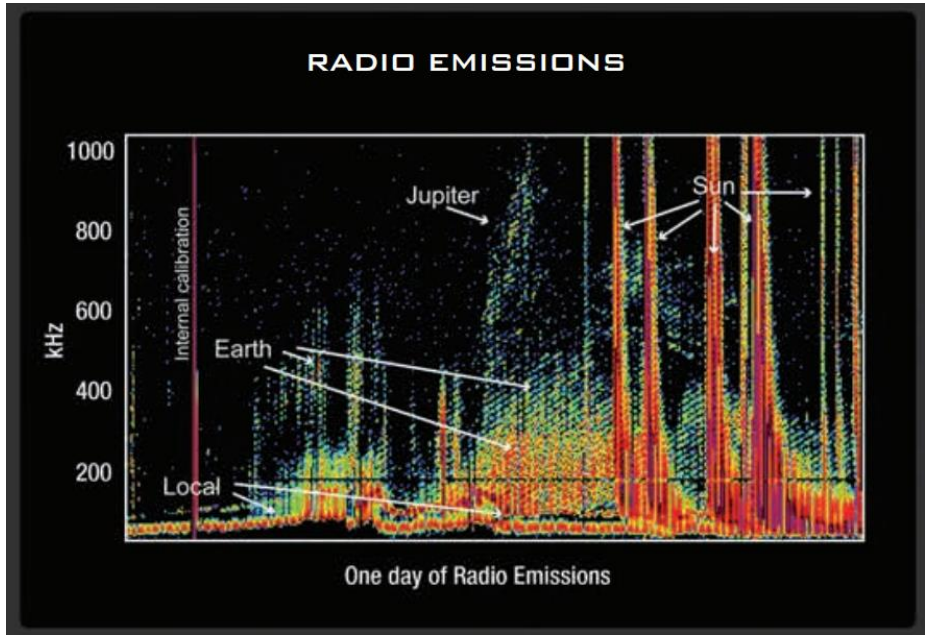
Longer Wave / lower Frequency

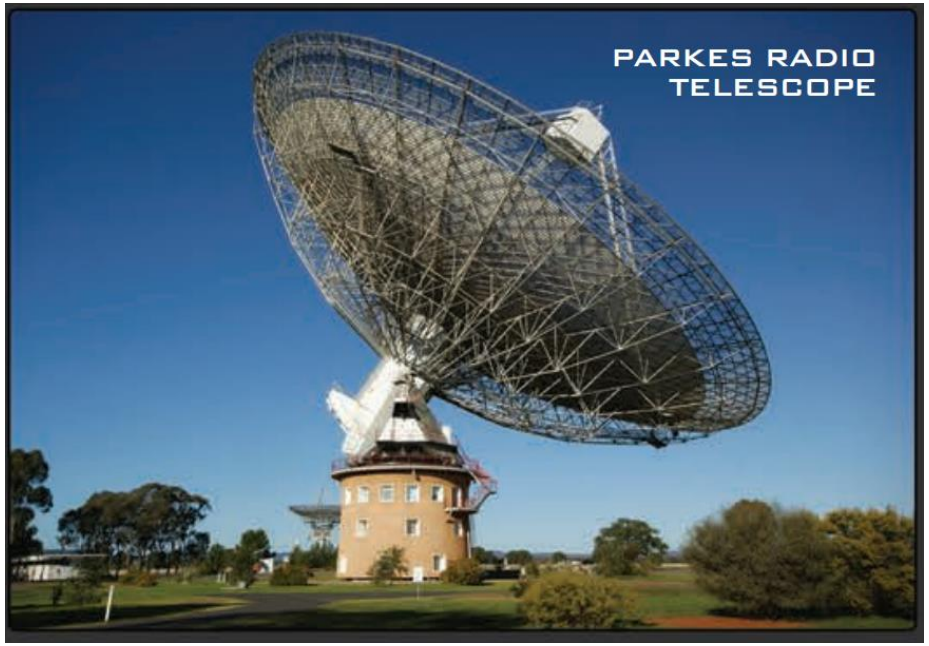
Telecommunication
GPS
Mobile phone
WiFi
Radars
Bluetooth
Traffic Radar

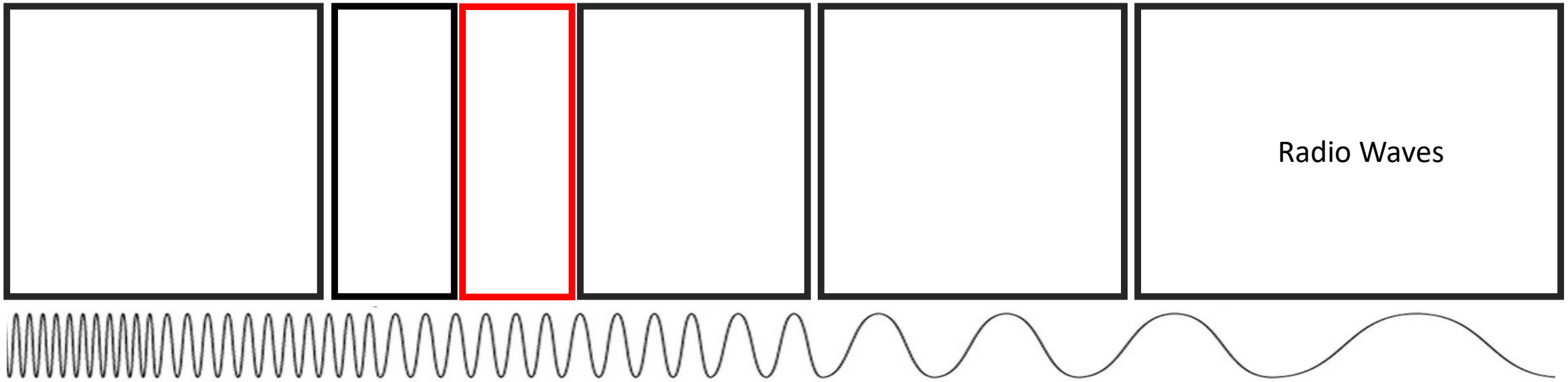
Weather Radar
Satellite Radar
Microwave imagery satellite
Scatterometer
Altimeters

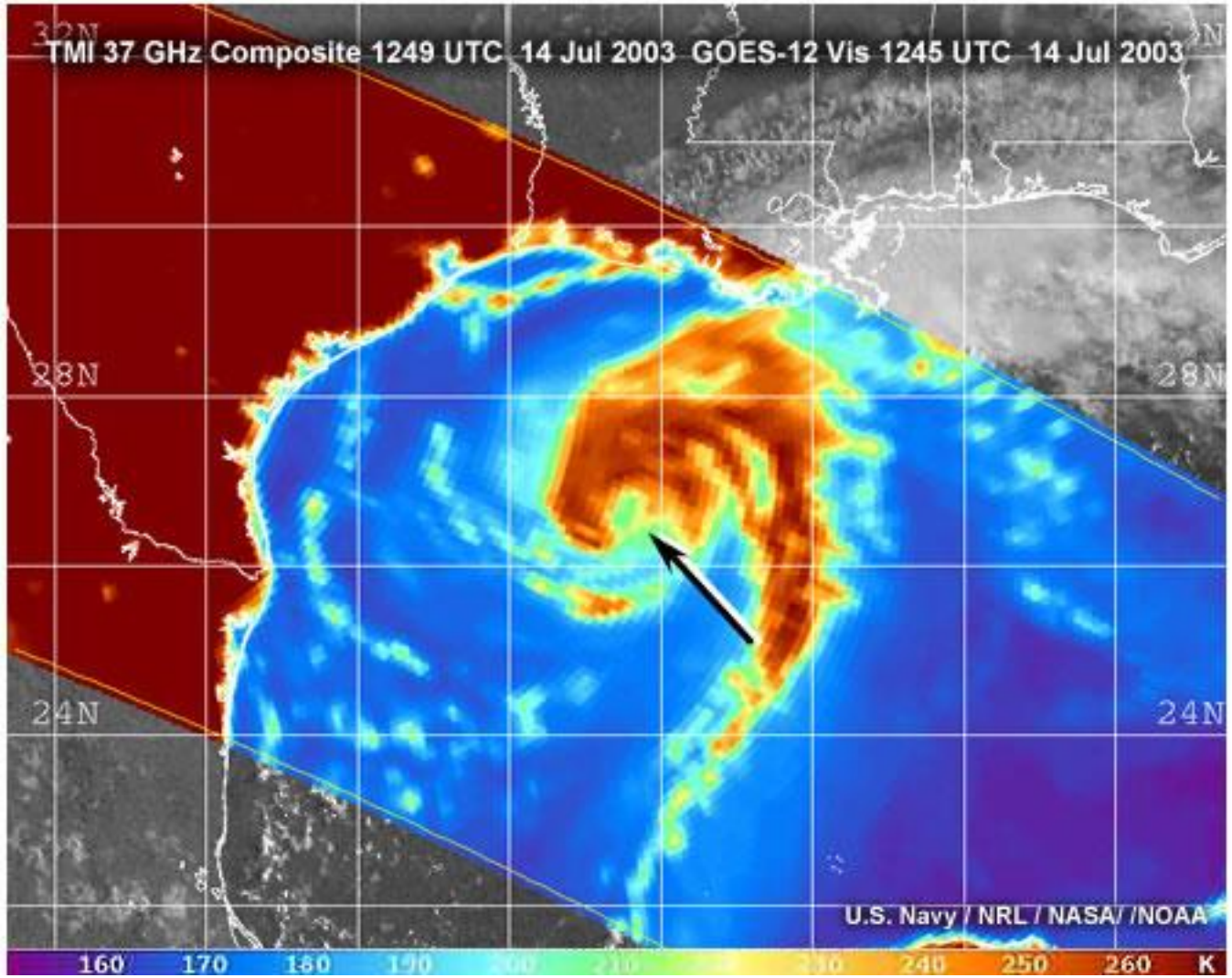





RADIO EMISSIONS
1000
800
600
400
200
kHz
Internal calibration
Jupiter
Sun
Earth
Local
One day of Radio Emissions


PARKES RADIO
TELESCOPE


Radio Waves
Shorter Wave / Higher Frequency
Longer Wave / lower Frequency


TMI 37 GHz Composite 1249 UTC 14 Jul 2003 GOES-12 Vis 1245 UTC 14 Jul 2003
32N
28N
24N
U.S. Navy / NRL / NASA/ /NOAA
160 170 180 190 240 250 260 K

Microwave Bands and Their Satellite Weather Applications

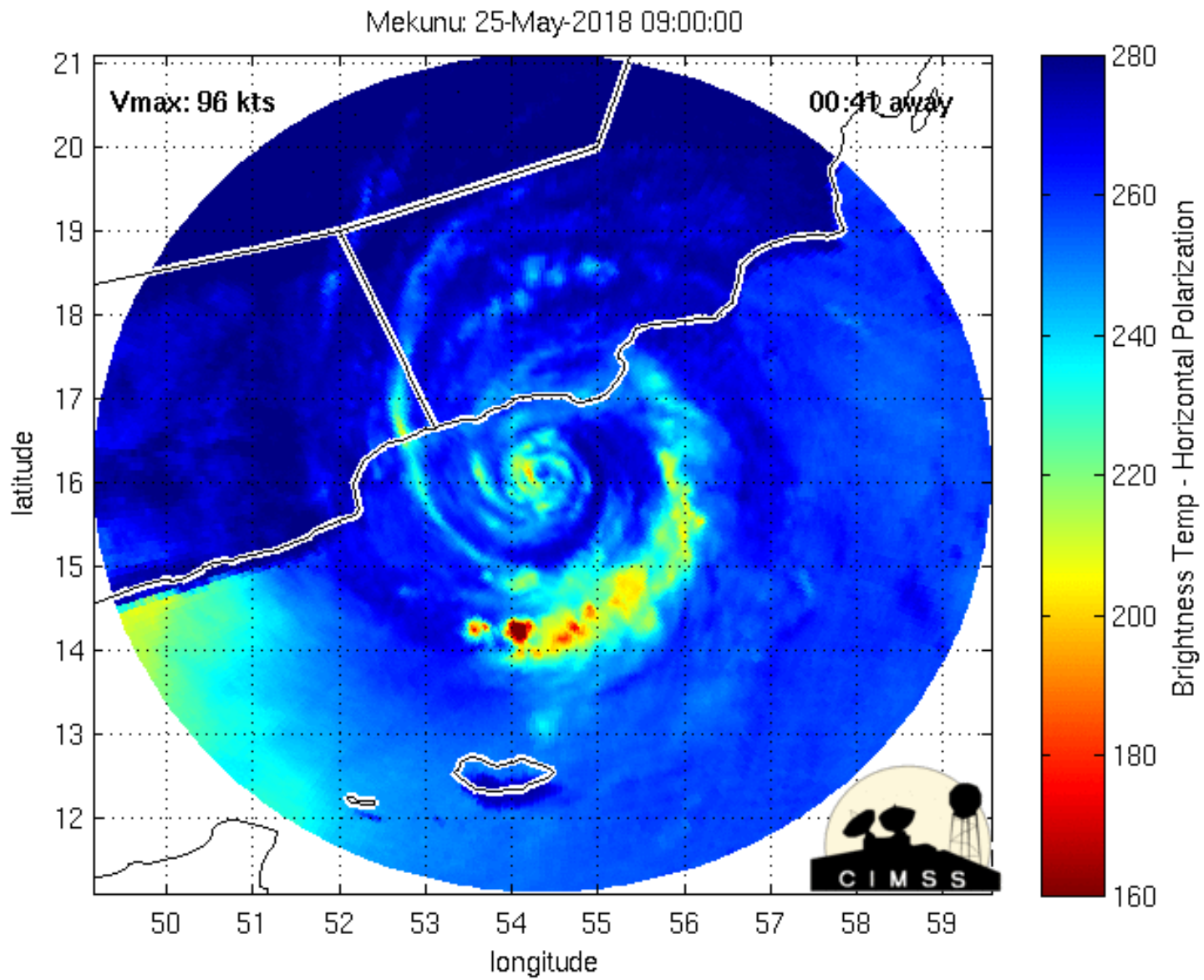
Band	Frequency range	Wavelength range
L	1 - 2 GHz	15 - 30 cm
S	2 - 4 GHz	7.5 - 15 cm
C	4 - 8 GHz	3.75 - 7.5 cm
X	8 - 12 GHz	25 - 37.5 mm
Ku	12 - 18 GHz	16.7 - 25 mm
K	18 - 26.5 GHz	11.3 - 16.7 mm
Ka	26.5 - 40 GHz	5.0 - 11.3 mm
Q	33 - 50 GHz	6.0 - 9.0 mm
U	40 - 60 GHz	5.0 - 7.5 mm
V	50 - 75 GHz	4.0 - 6.0 mm
W	75 - 110 GHz	2.7 - 4.0 mm
F	90 - 140 GHz	2.1 - 3.3 mm
D	110 - 170 GHz	1.8 - 2.7 mm

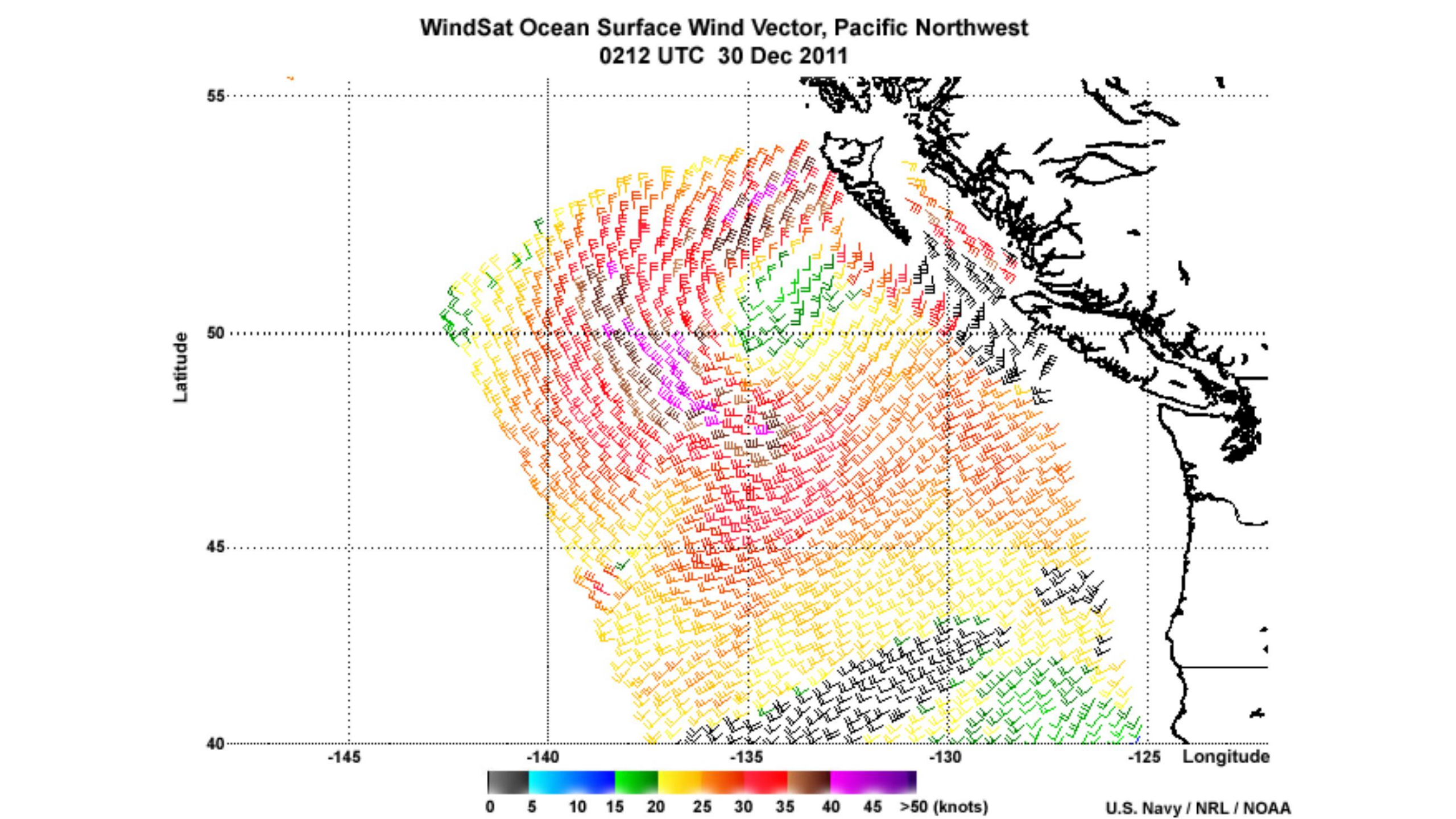
Satellite Instruments

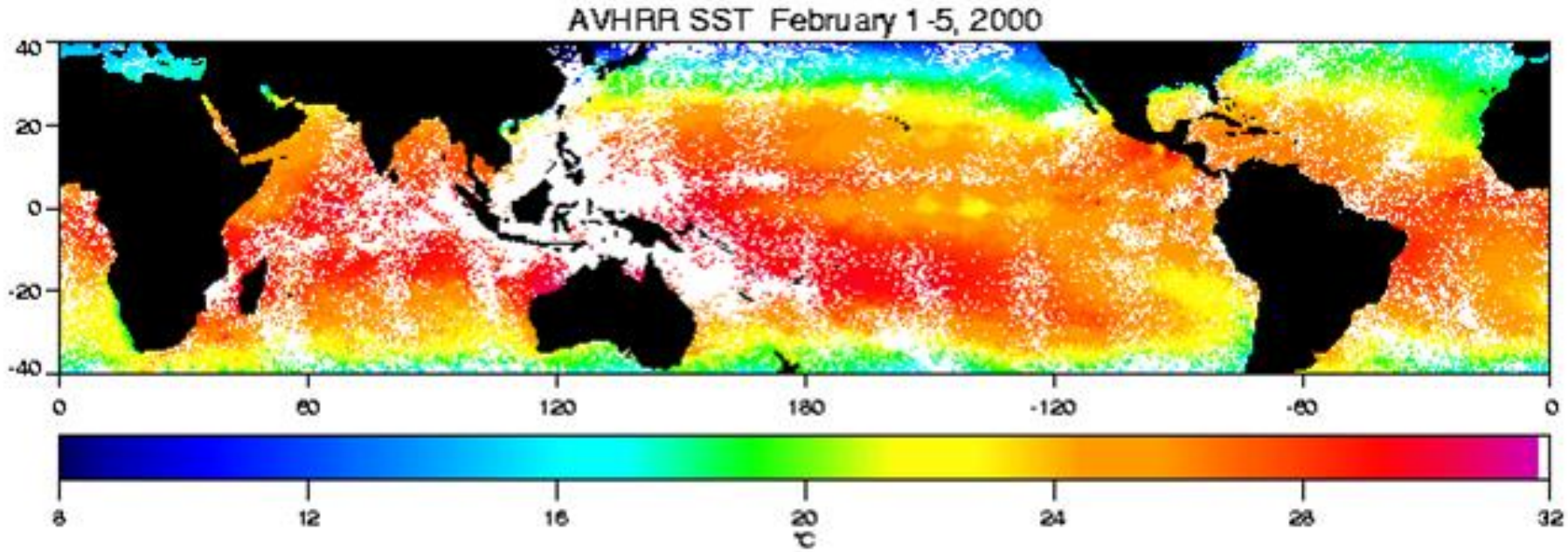
-WindSat
-ASCAT
-Jason
-CloudSat
-TRMM and GPM
-AMSU
-AMSR
-SSMIS
-Sentenal
-ATMS
CryoSat
QuikSCAT
MetOp
-
-
-

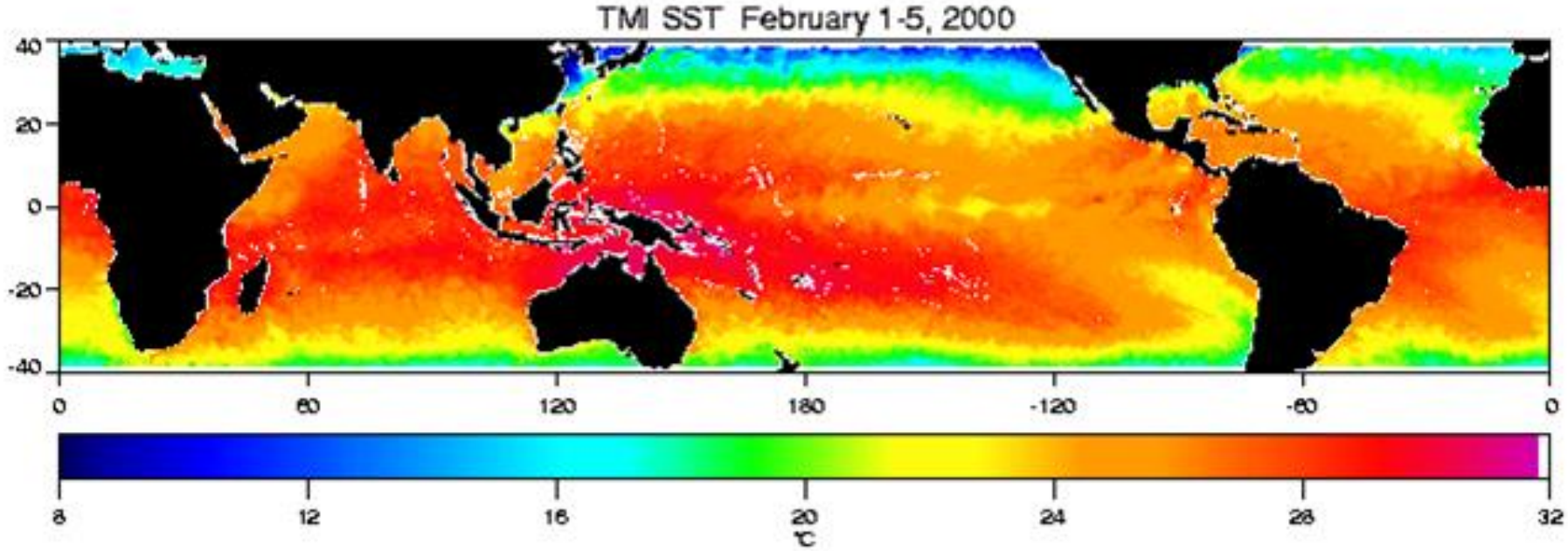
Measurement Capabilities:

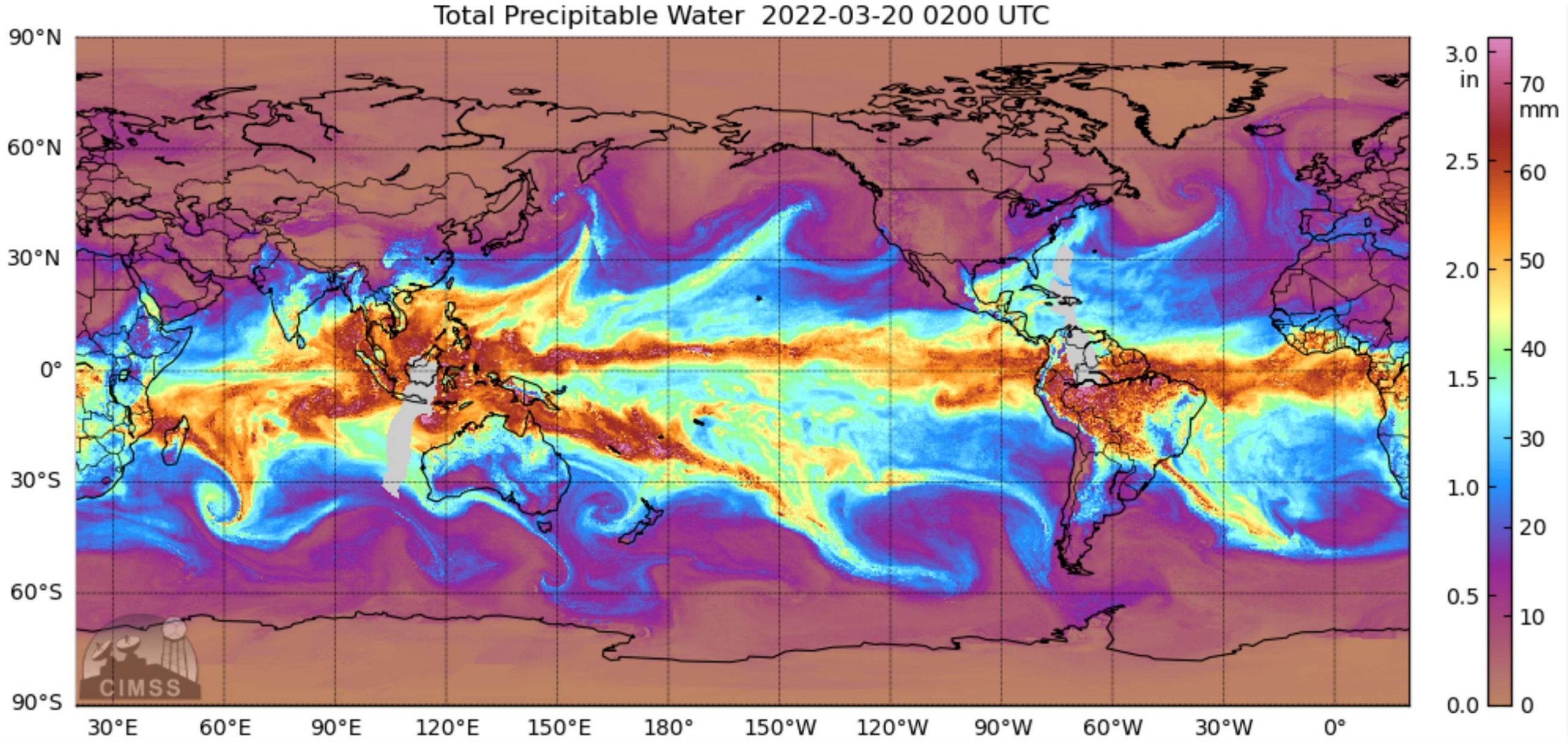
-Cloud and Precipitation information
-Sea Surface Wind
-Atmospheric Sounding
-Snow and Sea Ice
-Soil moisture
- Sea Surface Temperature
-Sea surface height and Sea state
-Land and Oceanic topography and Geology
-Vegetation
-Land use
-
-
-
-
-
-

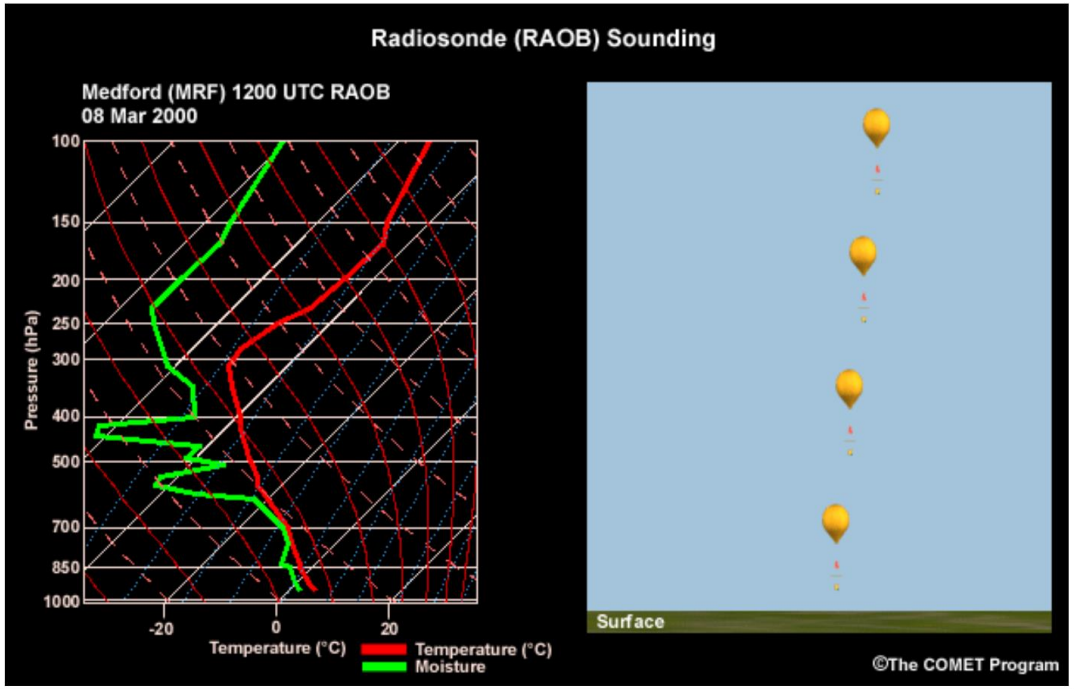

Mekunu: 25-May-2018 09:00:00
Vmax: 96 kts
00:41 away
latitude
longitude
21
20
19
18
17
16
15
14
13
12
50
51
52
53
54
55
56
57
58
59
CIMSS
280
260
240
220
200
180
160
Brightness Temp - Horizontal Polarization

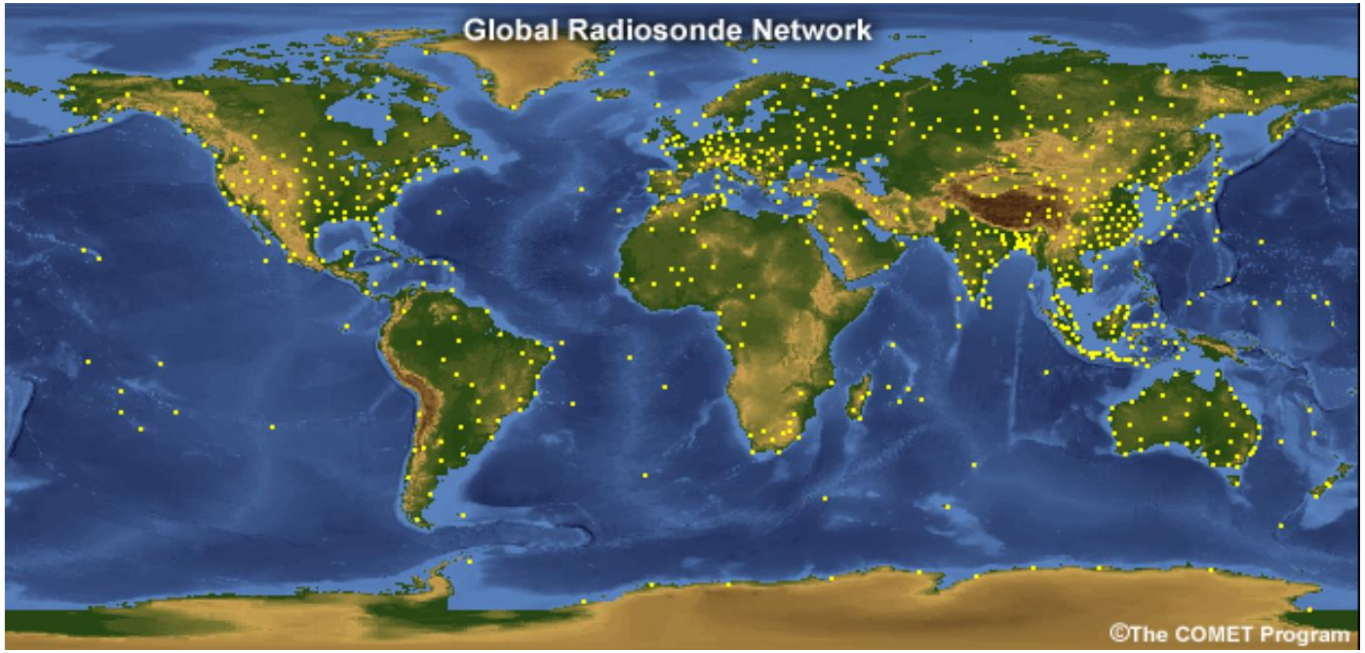

WindSat Ocean Surface Wind Vector, Pacific Northwest
0212 UTC 30 Dec 2011
55
50
45
40
Latitude
-145
-140
-135
-130
-125
Longitude
0 5 10 15 20 25 30 35 40 45 >50 (knots)
U.S. Navy / NRL / NOAA

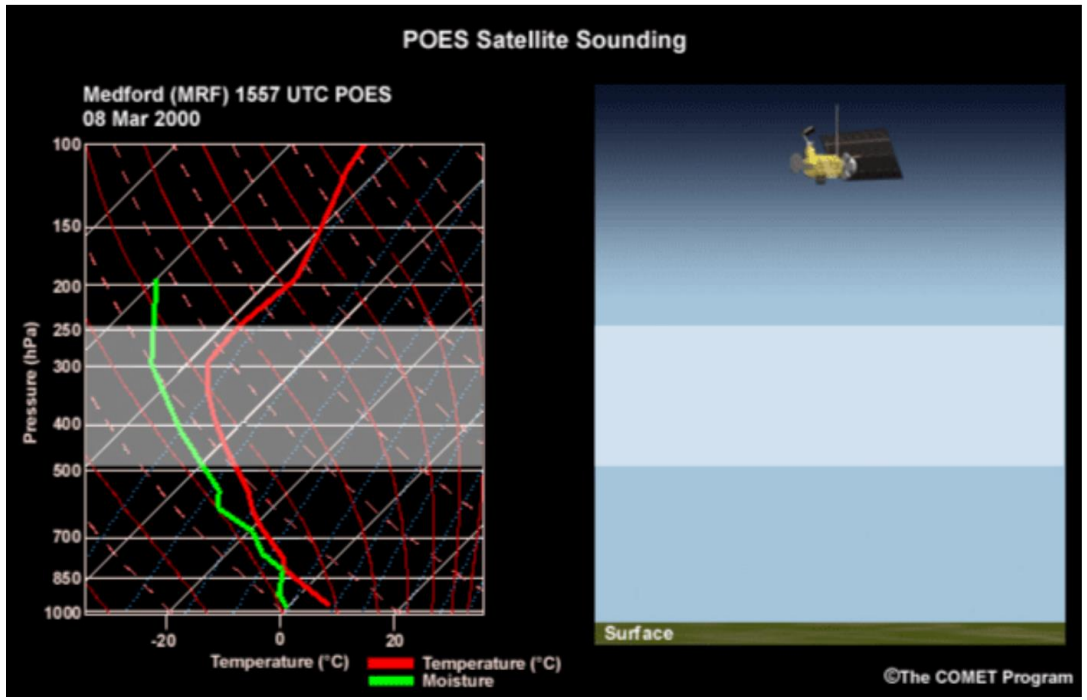

AVHRR SST February 1-5, 2000
40
20
0
-20
-40
0
60
120
180
-120
-60
0
8
12
16
20
24
28
32
°C

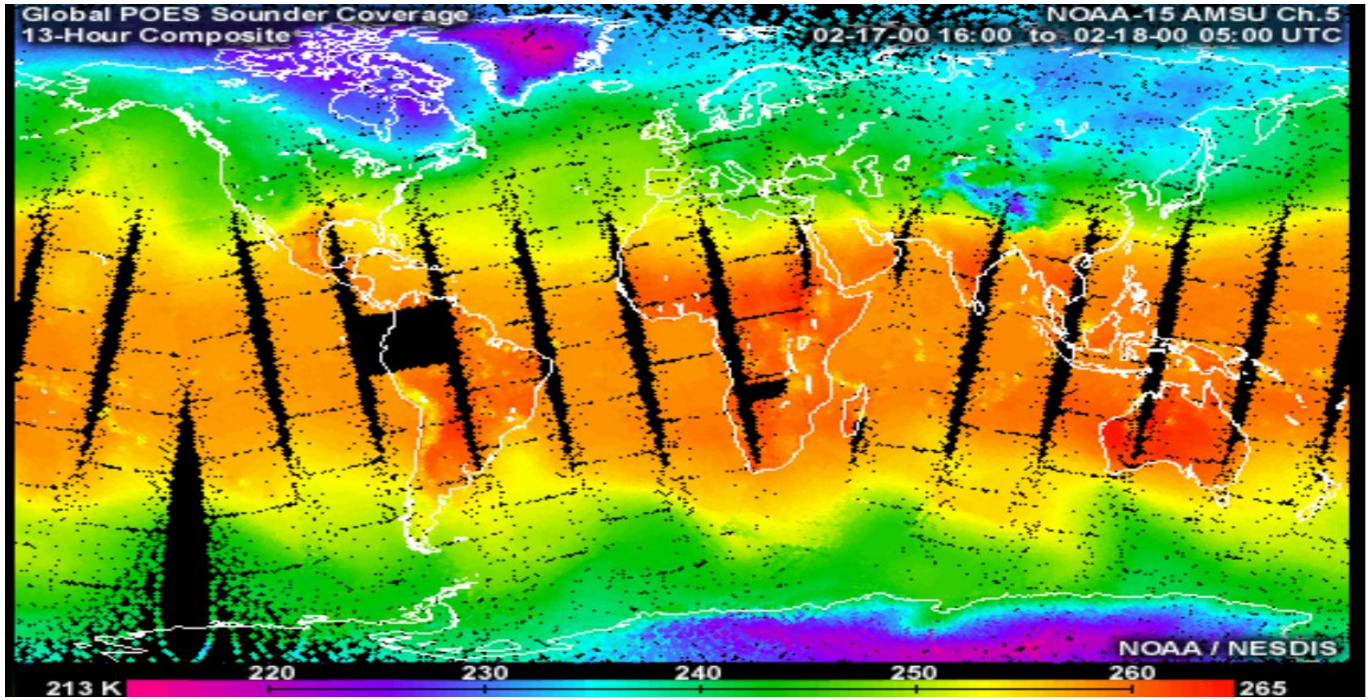

TMI SST February 1-5, 2000
40
20
0
-20
-40
0
60
120
180
-120
-60
0
8
12
16
20
24
28
32
°C


Total Precipitable Water 2022-03-20 0200 UTC
90°N
60°N
30°N
0°
30°S
60°S
90°S
30°E
60°E
90°E
120°E
150°E
180°
150°W
120°W
90°W
60°W
30°W
0°
3.0 in
2.5
2.0
1.5
1.0
0.5
0.0
70 mm
60
50
40
30
20
10
0
CIMSS


Radiosonde (RAOB) Sounding
Medford (MRF) 1200 UTC RAOB
08 Mar 2000
Pressure (hPa)
100
150
200
250
300
400
500
700
850
1000
-20
0
20
Temperature (°C)
Temperature (°C)
Moisture
Surface
©The COMET Program


Global Radiosonde Network
©The COMET Program


POES Satellite Sounding
Medford (MRF) 1557 UTC POES
08 Mar 2000
Pressure (hPa)
100
150
200
250
300
400
500
700
850
1000
-20
0
20
Temperature (°C)
Temperature (°C)
Moisture
Surface
©The COMET Program

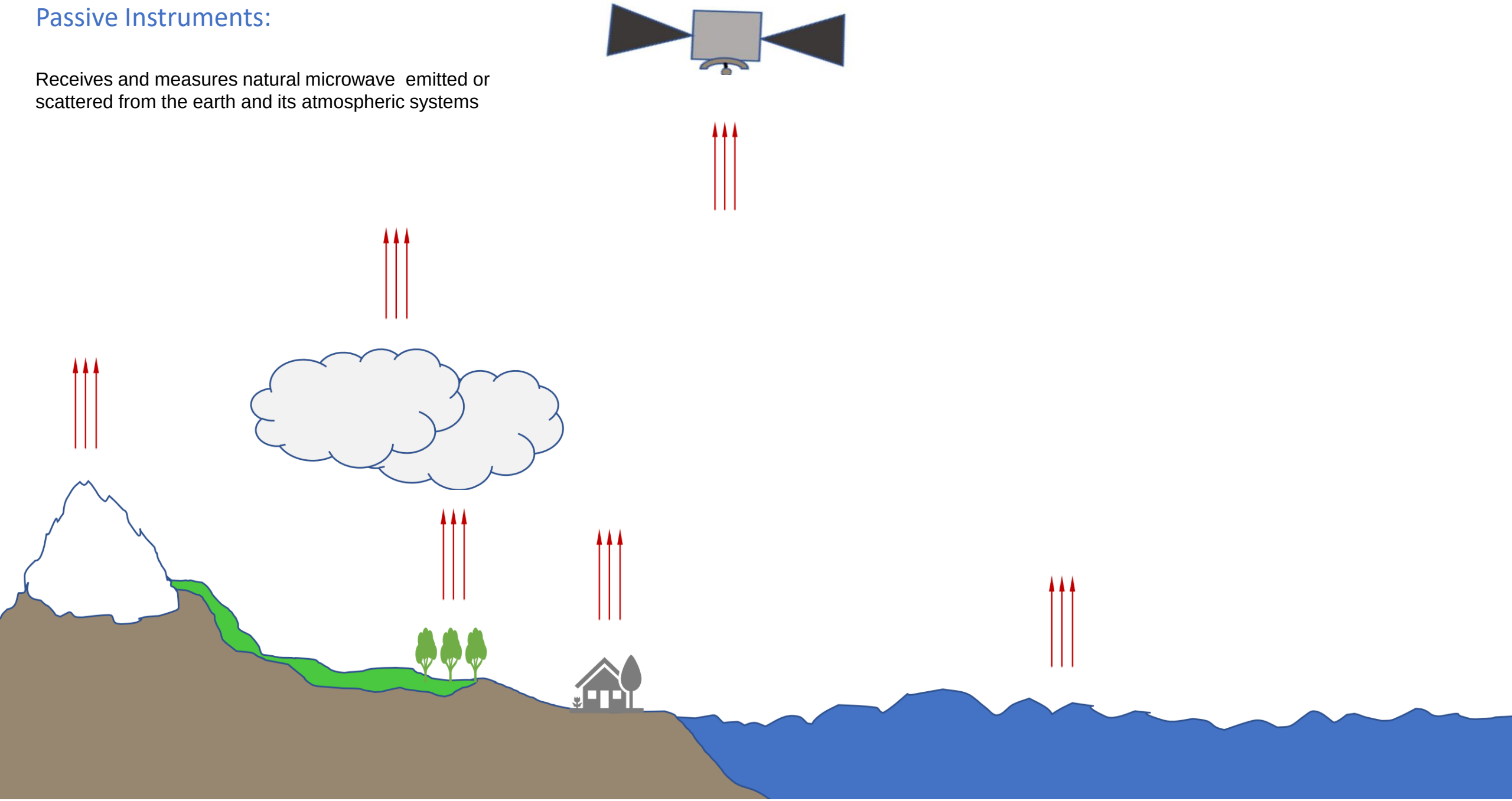

Global POES Sounder Coverage
13-Hour Composite
NOAA-15 AMSU Ch.5
02-17-00 16:00 to 02-18-00 05:00 UTC
NOAA / NESDIS
213 K
220
230
240
250
260
265

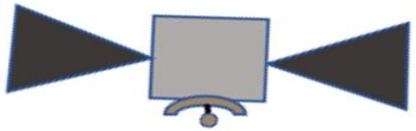
How That is Done?

Passive and Active Satellite Instruments

Passive Instruments:

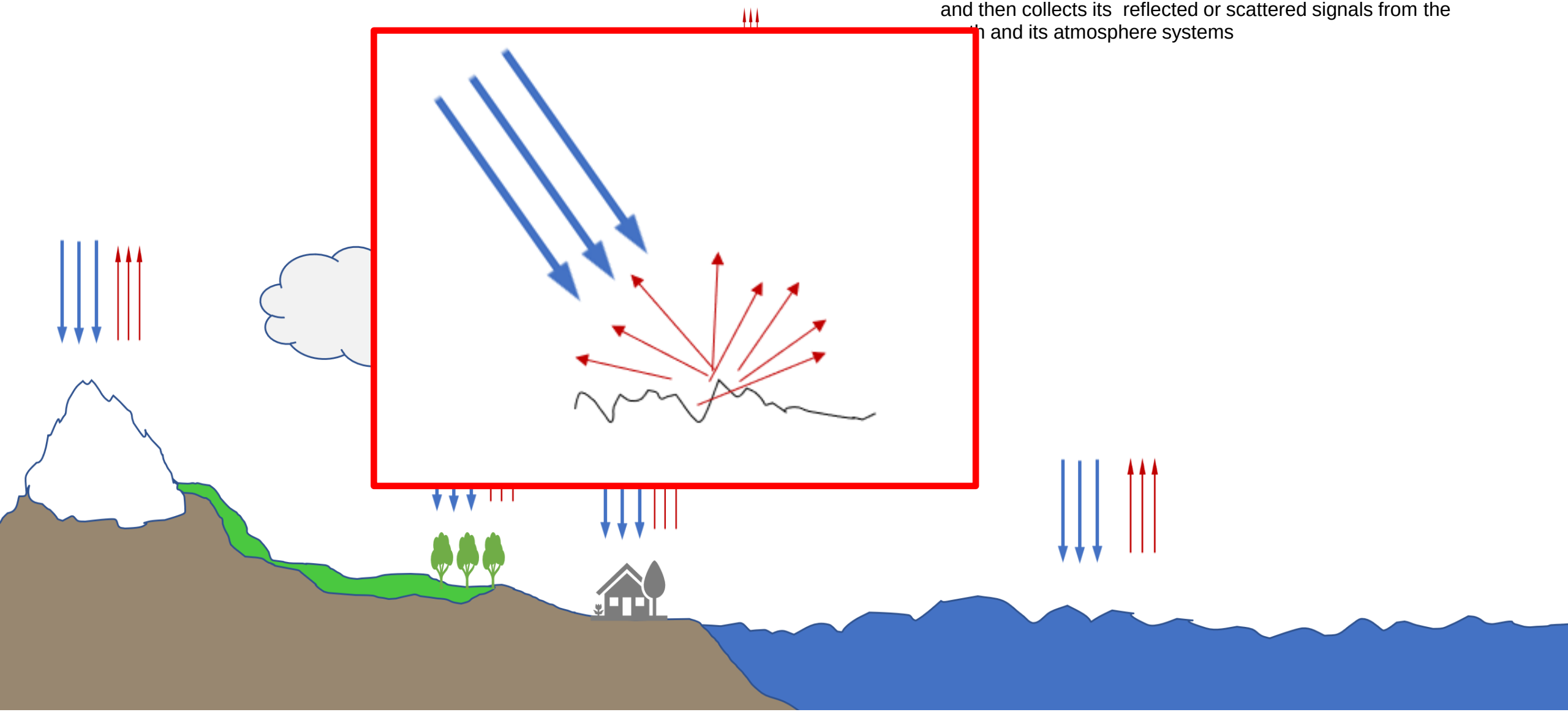
Receives and measures natural microwave emitted or scattered from the earth and its atmospheric systems





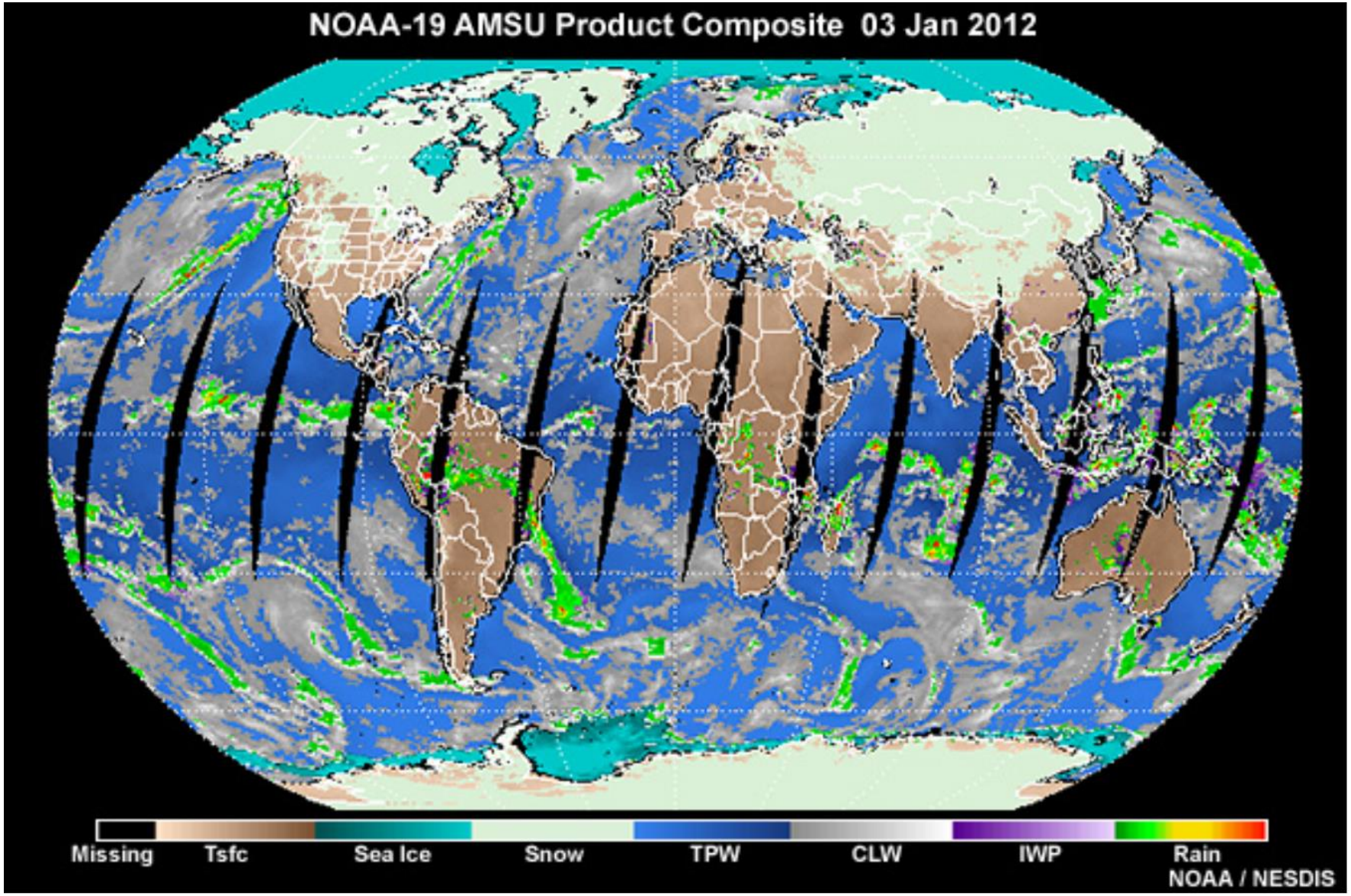
Active Instruments:

Radar instrument transmits its own microwave radiation and then collects its reflected or scattered signals from the earth and its atmosphere systems

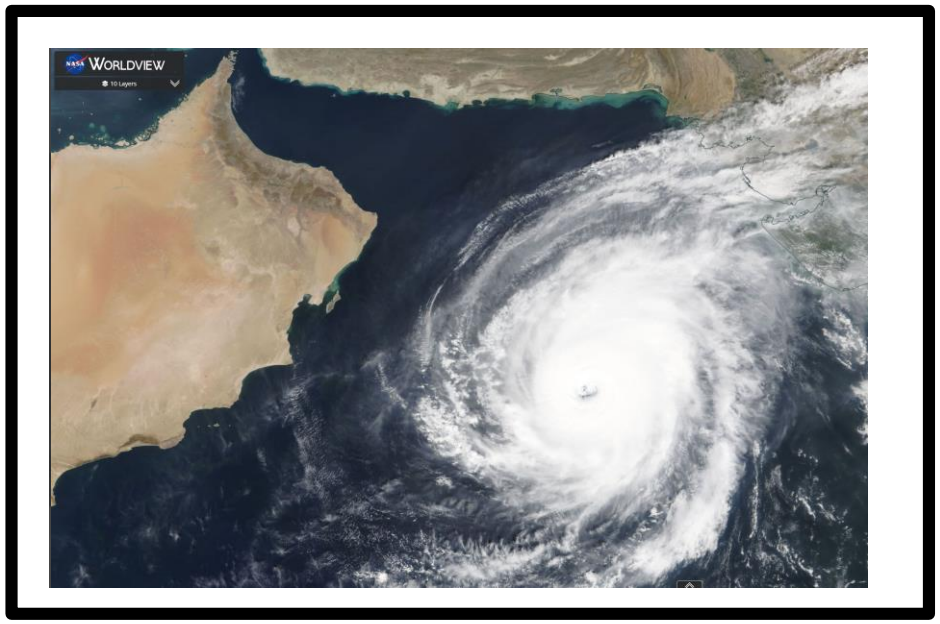


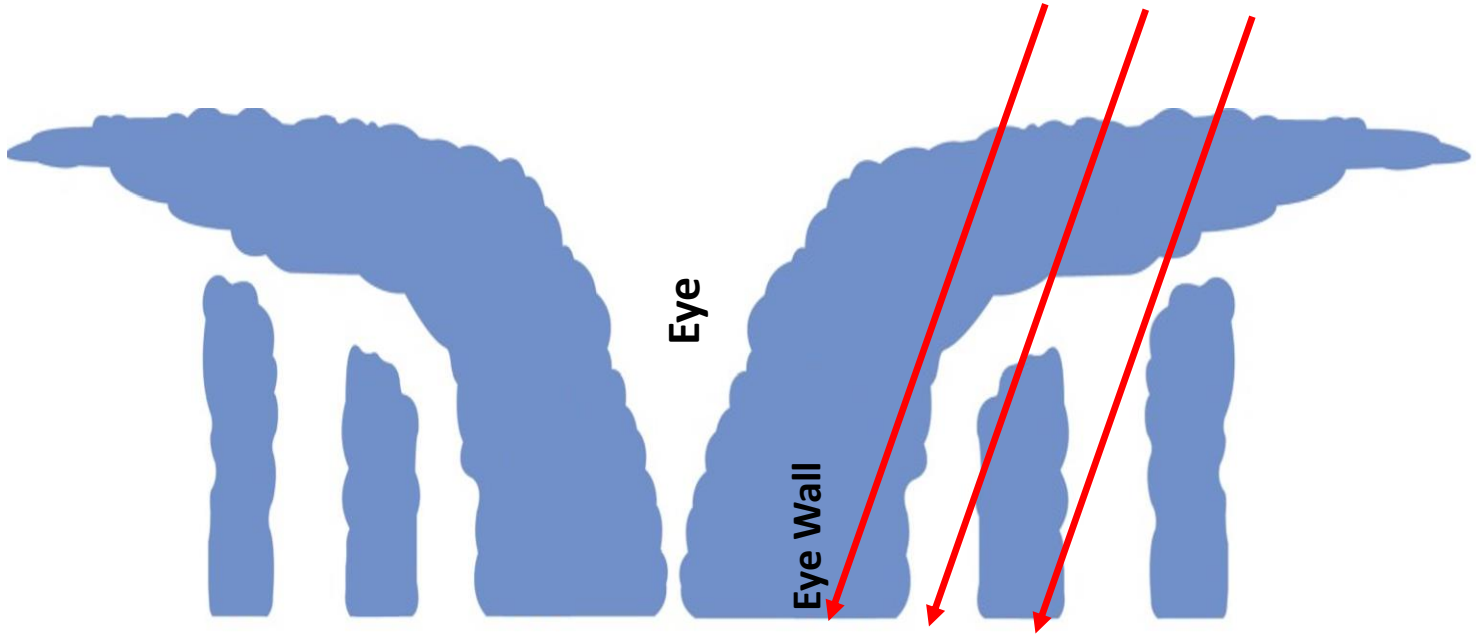
Why Microwave!

Day and Night

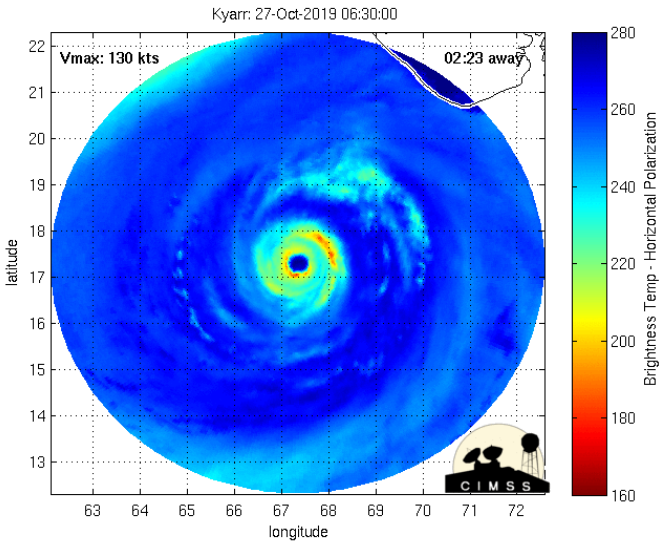


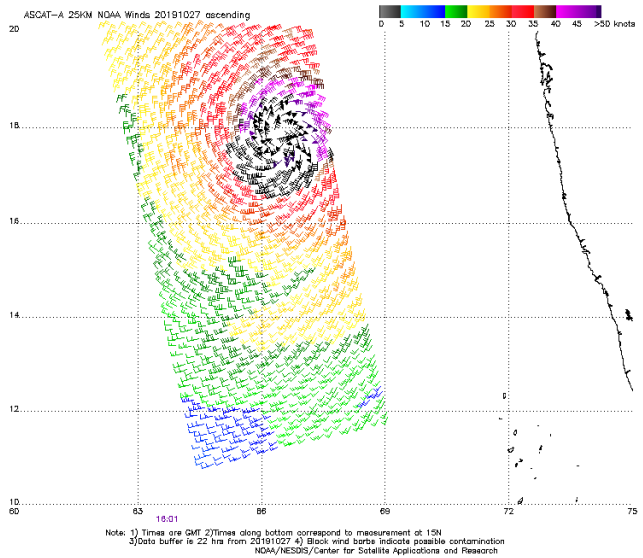
Excellent Capabilities to go through different atmospheric composition including cloud with very heavy precipitation

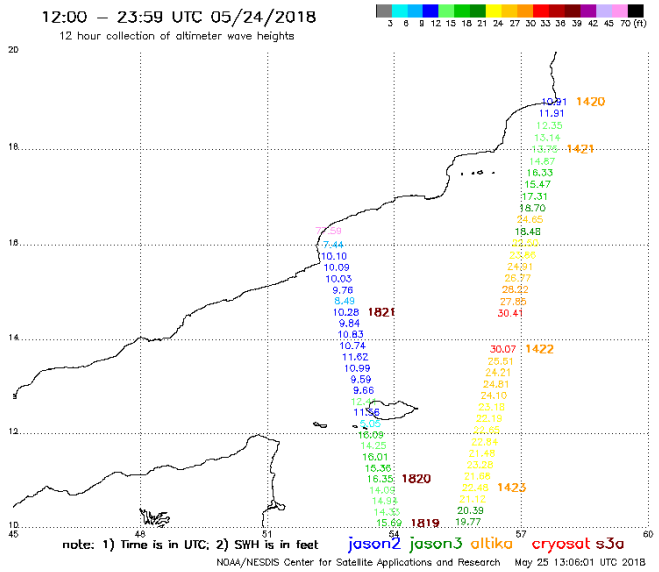


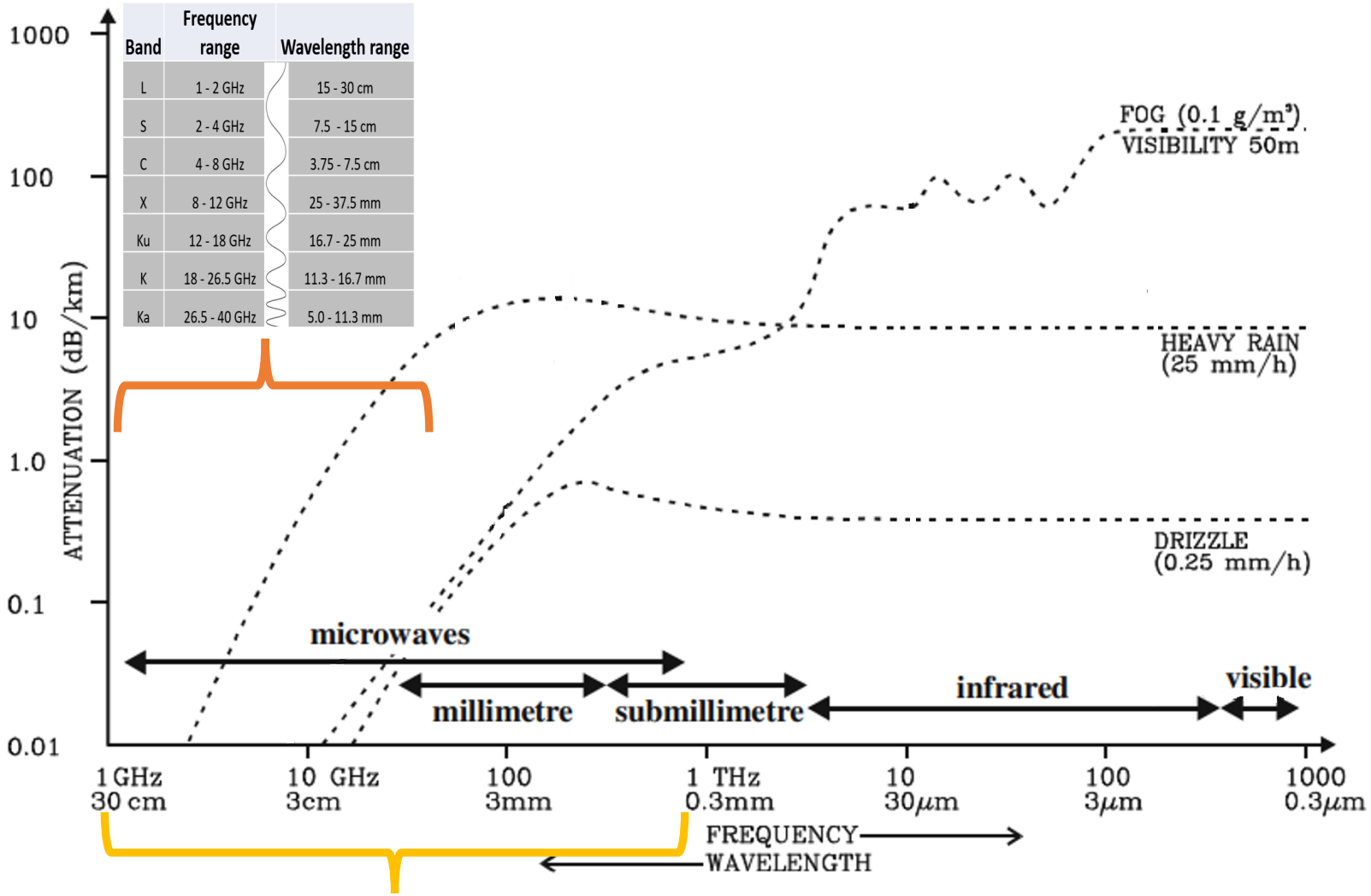


Microwave

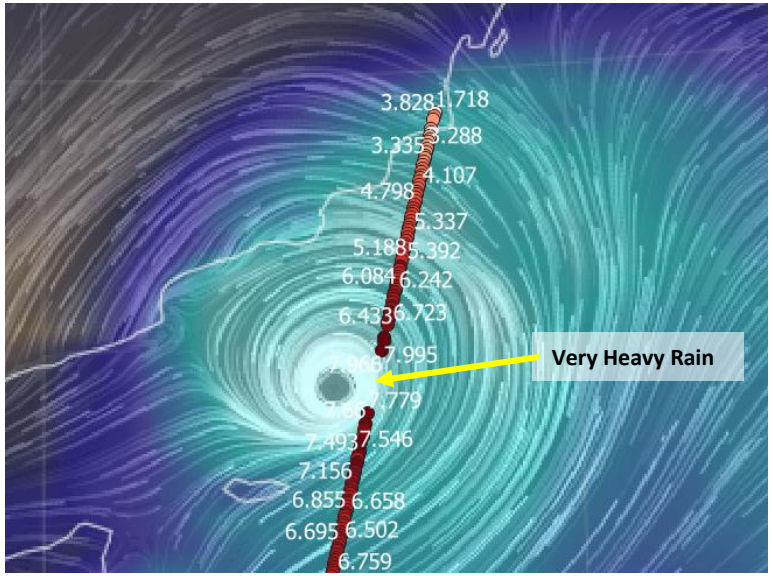




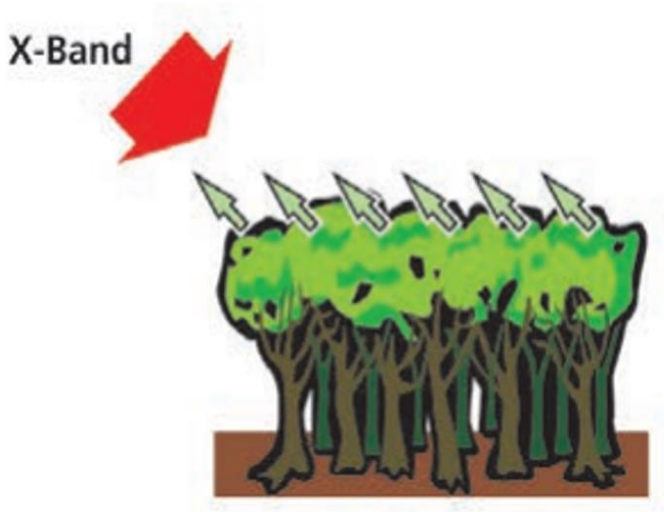


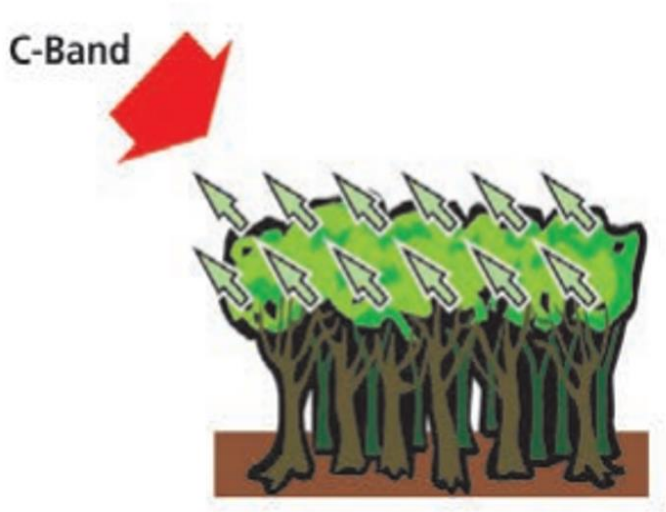


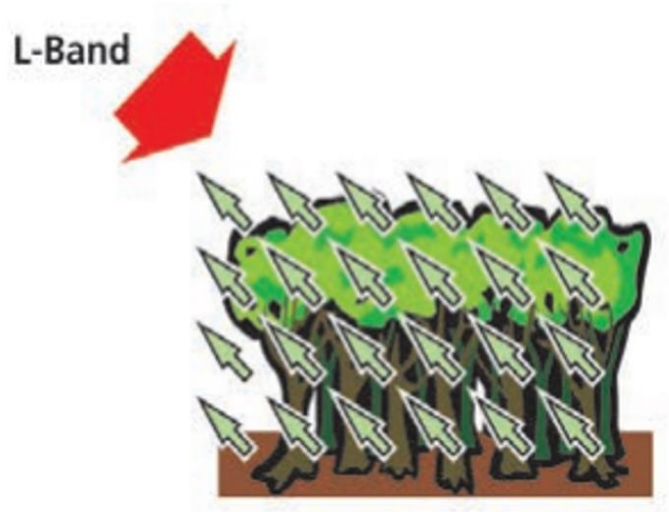
Ka Band Altimetry



Band	Frequency range	Wavelength range
L	1 - 2 GHz	15 - 30 cm
S	2 - 4 GHz	7.5 - 15 cm
C	4 - 8 GHz	3.75 - 7.5 cm
X	8 - 12 GHz	25 - 37.5 mm
Ku	12 - 18 GHz	16.7 - 25 mm
K	18 - 26.5 GHz	11.3 - 16.7 mm
Ka	26.5 - 40 GHz	5.0 - 11.3 mm







Questions

Thank You