



AOMSUC-12

11 - 18 November 2022

Online, Hosted by Japan Meteorological Agency



12th Asia - Oceania Meteorological Satellite Users' Conference

AOMSUC-12 Training Course

James F.W. Purdom, PhD

Chair, AOMSUC International Conference Steering Committee



Thank you to all involved in putting this two-day training course together. It required a lot of hard work and is truly appreciated.

Congratulations to JMA on the continued provision of meteorological satellite data and products across Asia/Oceania; of particular note is the Himawari-8 geostationary satellite

Today, meteorological satellites provide essential data for NMHSs in Asia/Oceania and across the globe. Their data are used for a variety of applications ranging from nowcasting to climate, land to oceans, and ecology to observing the sun.

This did not happen by accident. It required 4 necessary ingredients.

**This did not happen by accident. It required
4 necessary ingredients.**

Over 60 years of:

Leadership

Vision

Understanding

Utilization

**Those four attributes have been embodied
within satellite community from the very
beginning; from the top administrative
level to across the spectrum of workers
within those organizations and their User
Community**

**Here we will focus on two of those
necessary ingredients.**

**Understanding
Utilization**

**This training course focuses on
understanding and utilization of the
wonderful information that you have
available to you from the
meteorological satellites that provide
data over Asia/Oceania.**

APPLICATIONS

Some Basics in brief

- Satellites and their orbits
 - What we sense
- What we are observing

Orbits

- The mainstay orbits for meteorological and environmental applications
 - **Sun synchronous Polar orbits**
 - **Geostationary orbits**
- Other orbits and specialized applications
 - **Pro-grade orbits**
 - **Constellations and formation flying**

A Brief Reminder: Comparison of geostationary (Geo) and low earth orbiting (Leo) satellite capabilities

Geo

**observes process itself
(motion and targets of opportunity)**

**repeat coverage in minutes
($\Delta t \leq 15$ minutes)**

near full earth disk

best viewing of tropics & mid-latitudes

same viewing angle

differing solar illumination

multispectral imager

**IR only sounder
(8 km resolution)**

filter radiometer

diffraction more than leo

Leo

observes effects of process

**repeat coverage twice daily
($\Delta t = 12$ hours)**

global coverage

best viewing of poles

varying viewing angle

same solar illumination

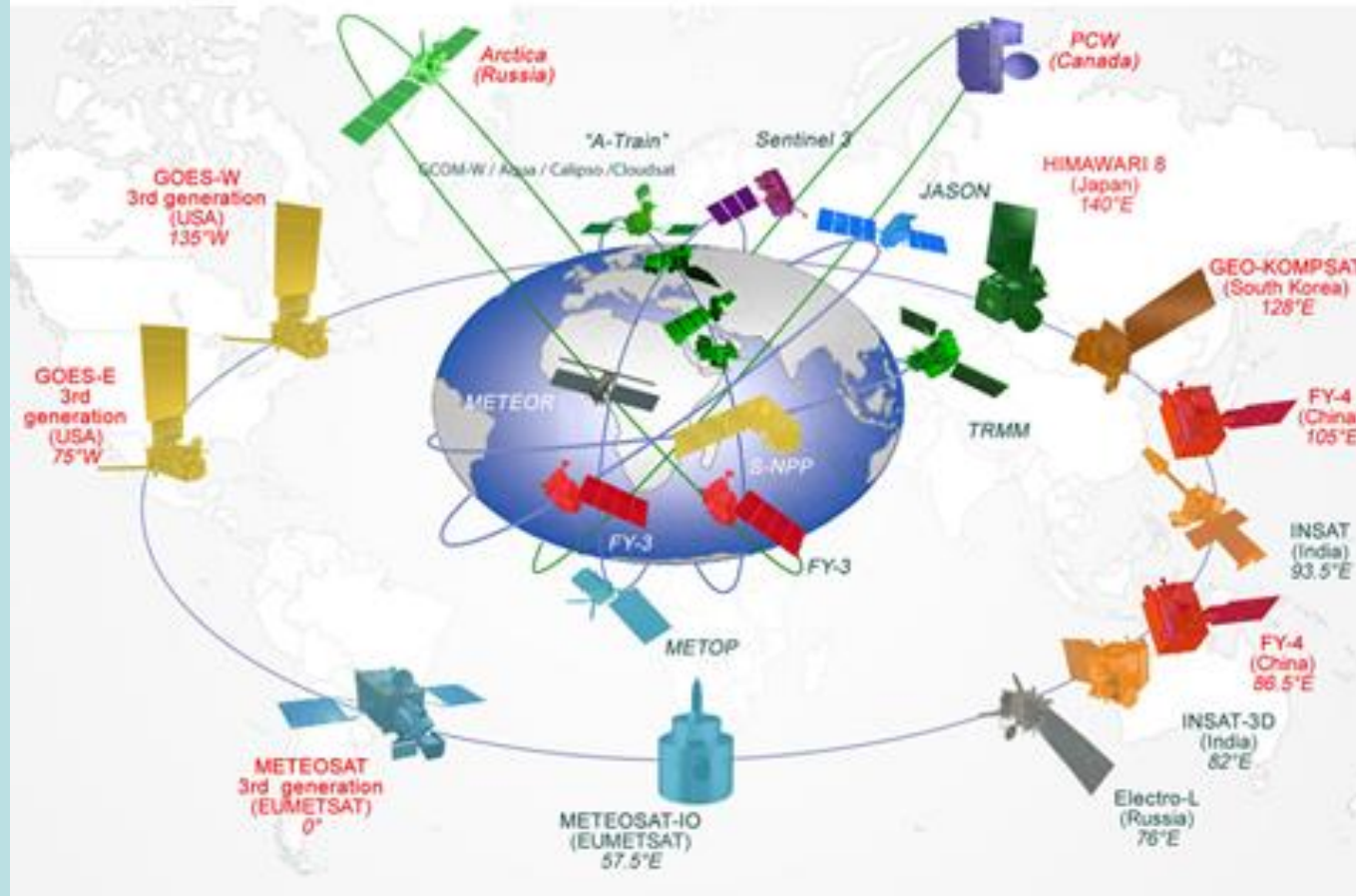
**multispectral imager
(generally higher resolution)**

**IR and microwave sounder
(1, 17, 50 km resolution)**

**filter radiometer,
interferometer, and
grating spectrometer**

diffraction less than geo

Vision for WIGOS 2020



The space agencies are meeting the challenge of providing a vibrant polar and geostationary satellite constellation

**2022-11-06
17:00:00 UTC**

(H)ide

Play (space) < >

(L)oop (R)ock Re(v)

Speed (↑/↓) [Slider]

Zoom (+) Zoom (-) Max (Z)oom

[Slider] 0° Slid(e)r

(S)atellite Himawari-8 (14...)

Se(c)tor Full Disk

(P)roduct Band 13: 10.4 μm...

Add (O)verlay Add (O)verlay

of (I)mages 12

(T)ime Step 10 min

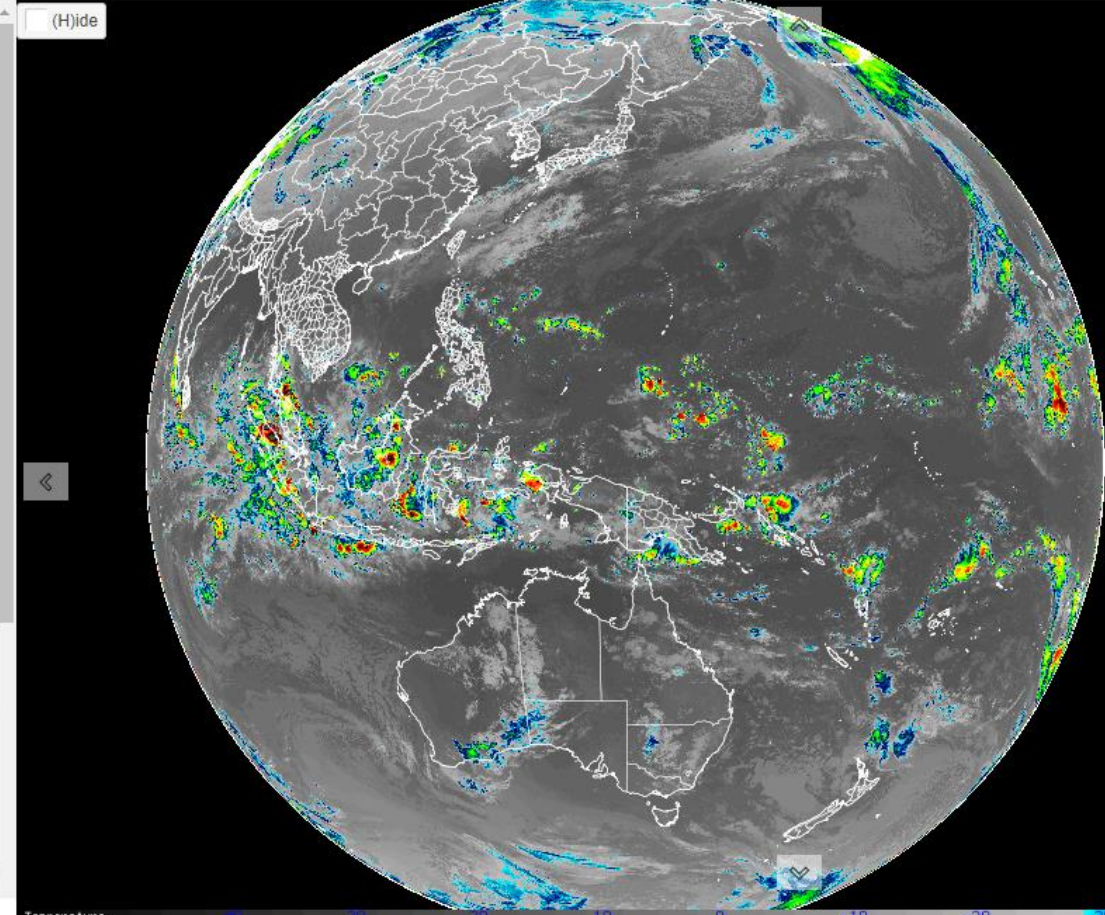
Band 13: 10.4 μm ("Clean" IR Longwave Window)

Hide [Slider] Info

Add (M)ap [Dropdown] Lat/Lo(n)

Default Borders

White [Dropdown] Hide [Slider]



Temperature [Color Scale]

CIRA
RAMMB

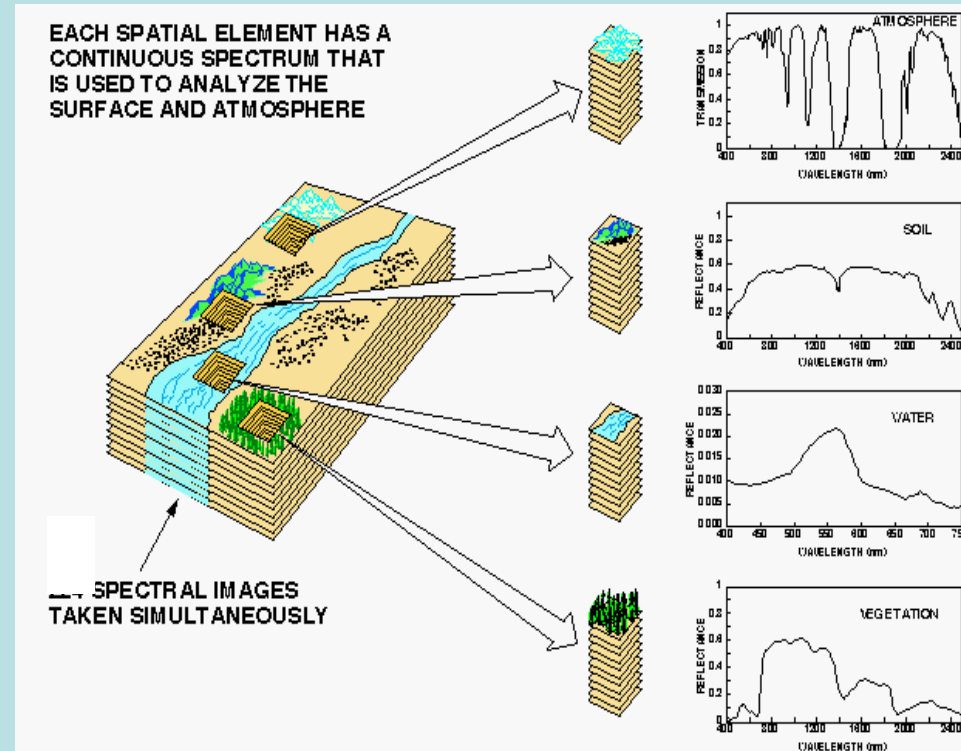
Some Basics in brief

- Satellites and their orbits
 - What we sense
- What we are observing

In satellite remote sensing, four basic parameters need to be addressed: all deal with resolution. The current generation satellites are a giant step forward in all four.

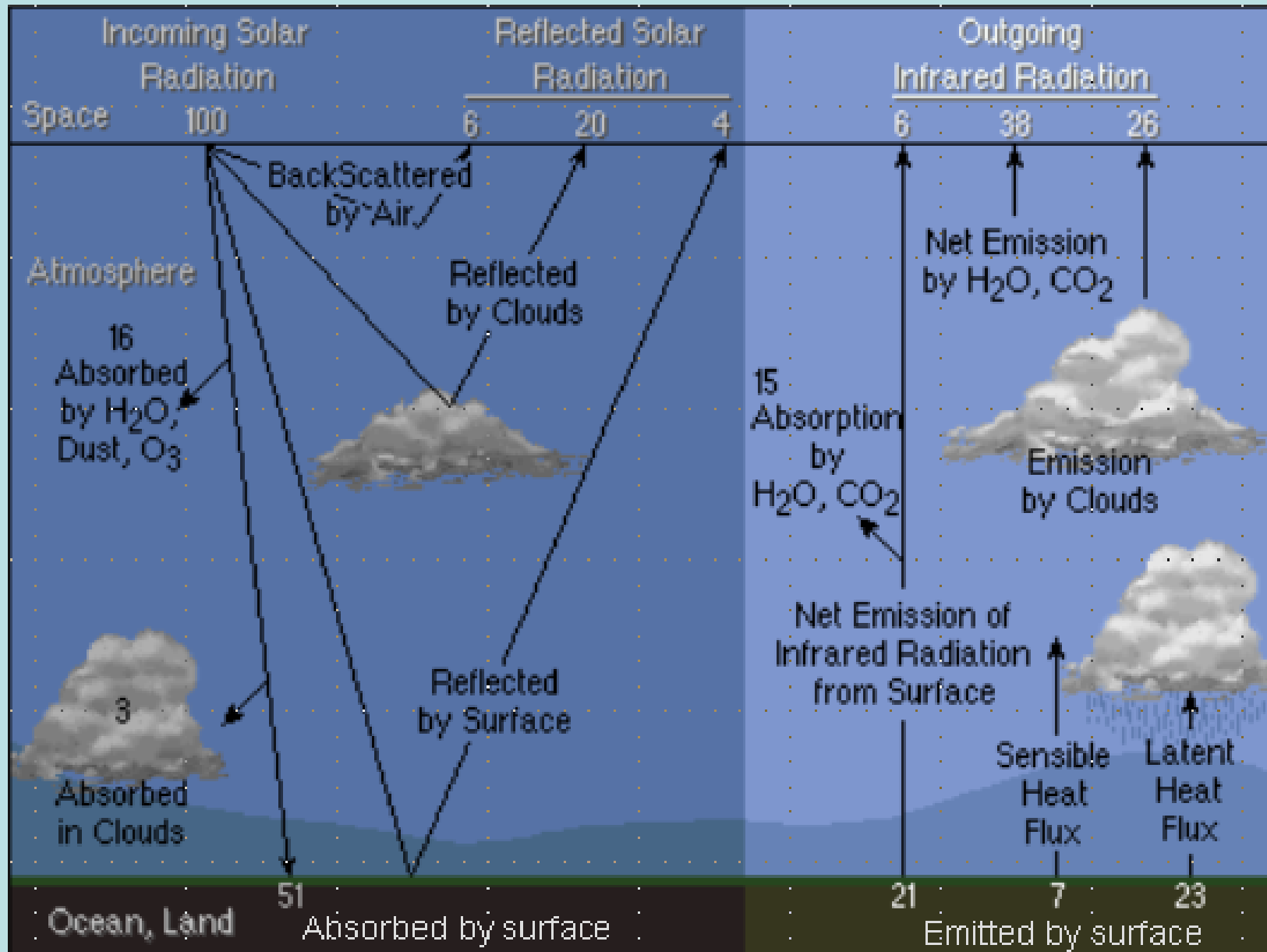
- temporal (how often)
- spatial (what size)
- spectral (what wavelengths and their width)
- radiometric (signal-to-noise)

The spatial and temporal domains of the phenomena being observed drive the satellite systems' spectral needs as a function of space, time, and signal to noise.

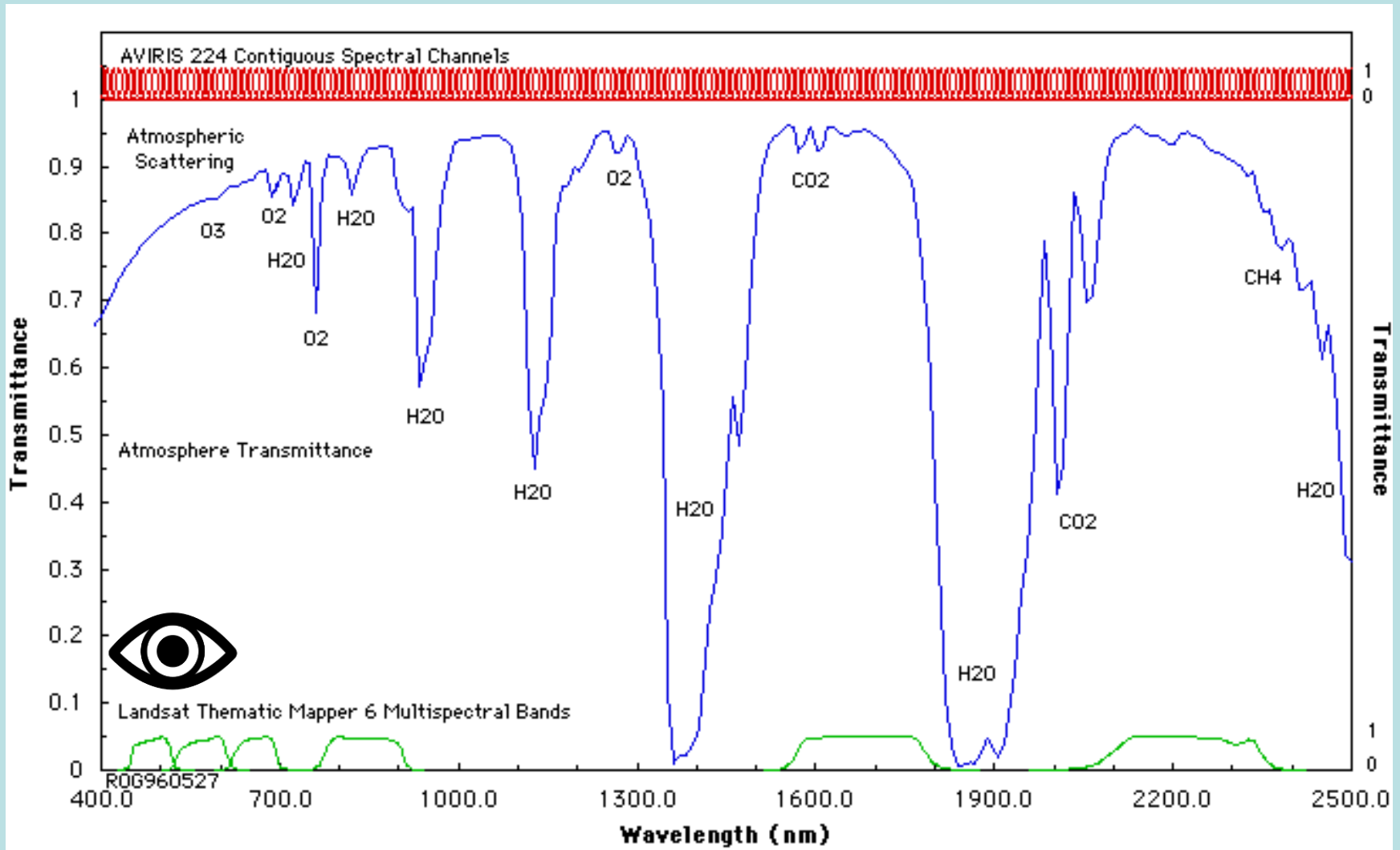


Each spatial element has a continuous spectrum (vis and IR) that may be used to analyze the surface and atmosphere

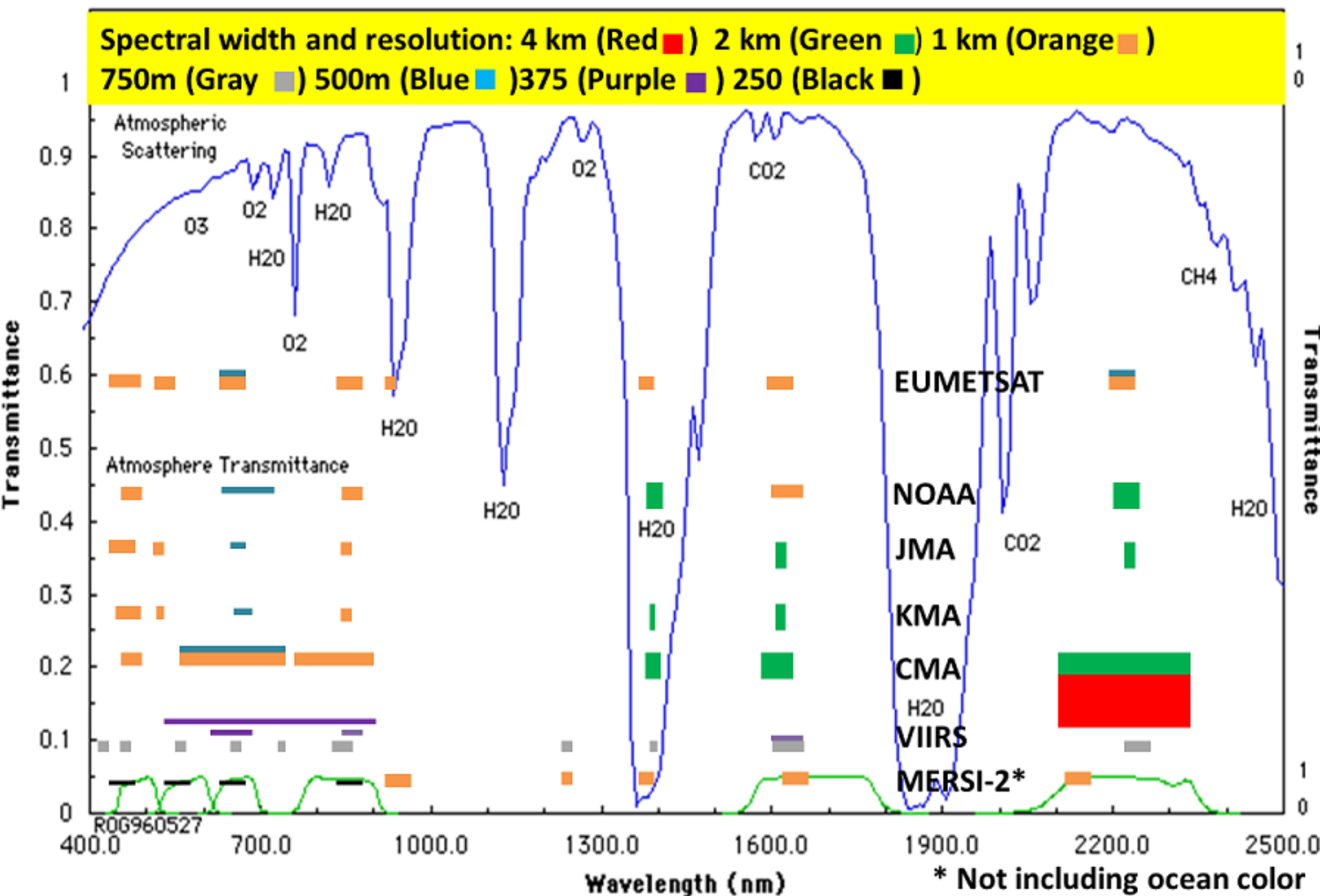
Surface and atmospheric properties effect what we view with a satellite sensor (solar left, emitted IR right)



The visible to near infrared portion of the spectrum



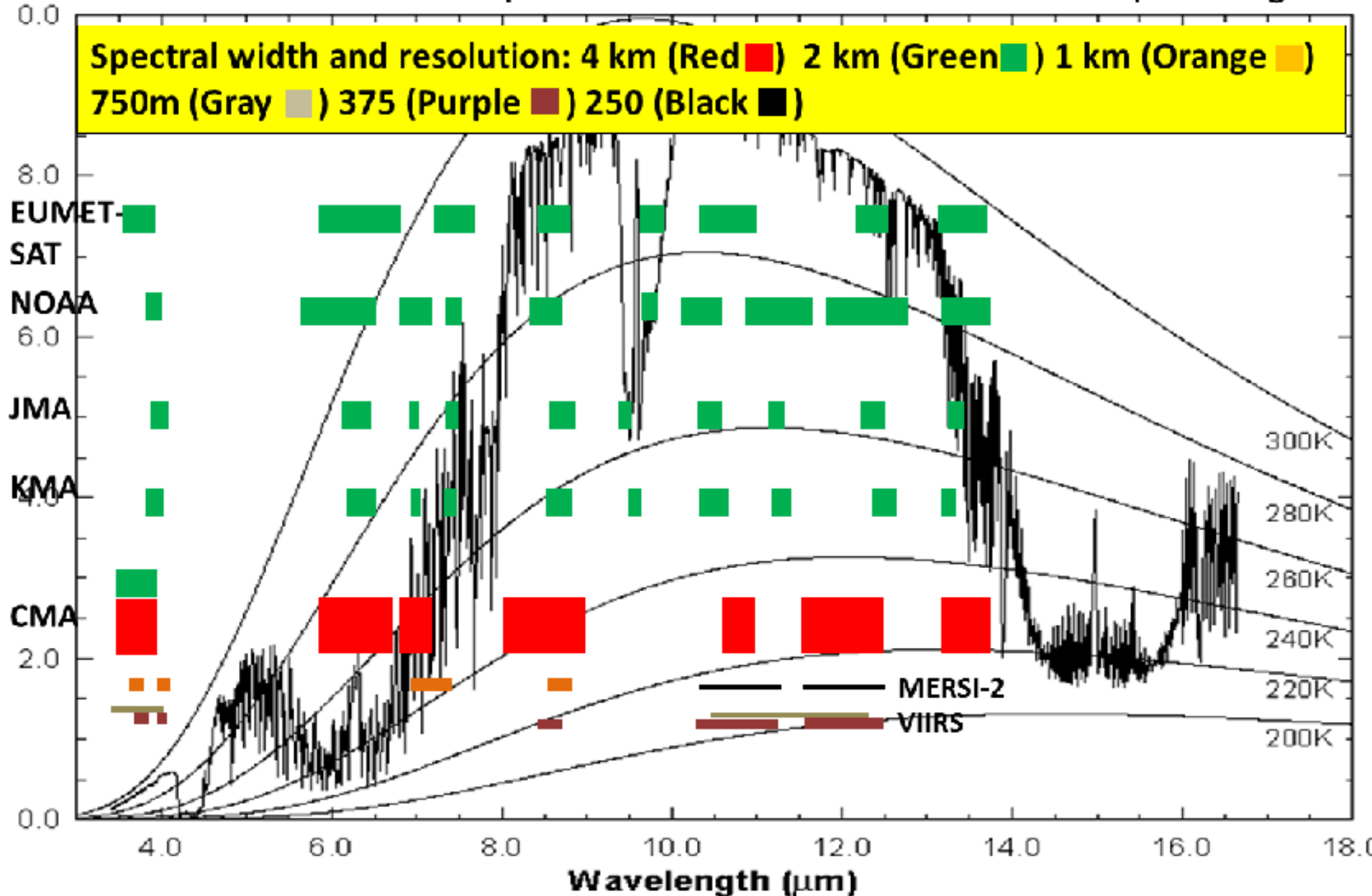
Geosats 2020 timeframe and spectral widths and resolutions and selected polar imagers



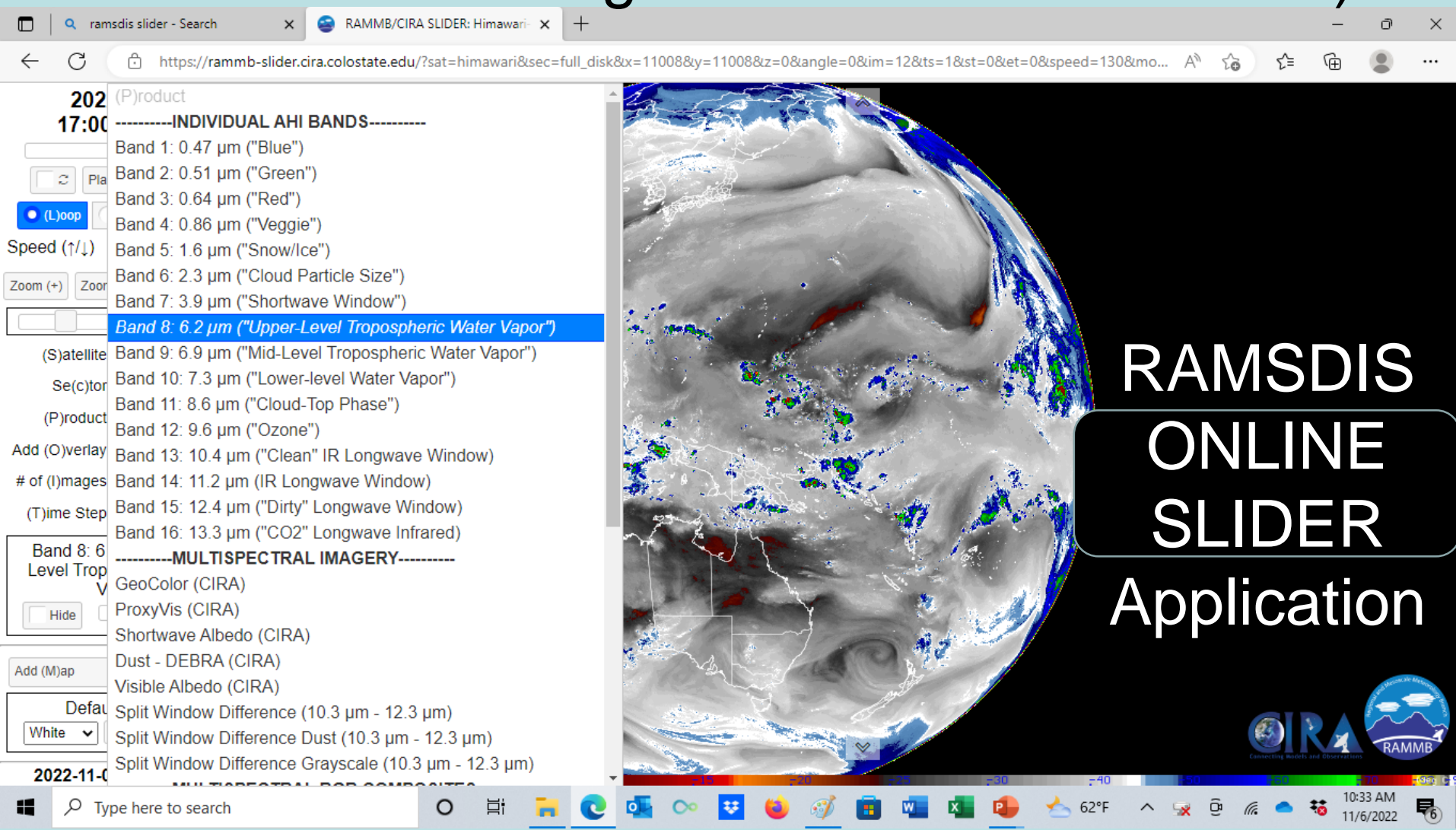
Infrared

High resolution atmospheric absorption spectrum and comparative blackbody curves.

Geosats 2020 timeframe and spectral widths and resolutions and selected polar imagers



Himawari-8 full disc 6.2 micron channel taken 11/06/2022 (with side bar showing 16 channels available including a comment on their use)



The screenshot displays the RAMSDIS online slider application interface. The main window shows a satellite image of Earth, with a control sidebar on the left. The sidebar is titled "2022-11-06 17:00" and lists 16 individual AHI bands, with Band 8 (6.2 μm) selected. Below the bands, there is a section for "MULTISPECTRAL IMAGERY" with options like GeoColor, ProxyVis, and Shortwave Albedo. The application is running in a web browser, and the RAMMB logo is visible in the bottom right corner.

2022-11-06 17:00 (P)roduct

-----INDIVIDUAL AHI BANDS-----

- Band 1: 0.47 μm ("Blue")
- Band 2: 0.51 μm ("Green")
- Band 3: 0.64 μm ("Red")
- Band 4: 0.86 μm ("Veggie")
- Band 5: 1.6 μm ("Snow/Ice")
- Band 6: 2.3 μm ("Cloud Particle Size")
- Band 7: 3.9 μm ("Shortwave Window")
- Band 8: 6.2 μm ("Upper-Level Tropospheric Water Vapor")**
- Band 9: 6.9 μm ("Mid-Level Tropospheric Water Vapor")
- Band 10: 7.3 μm ("Lower-level Water Vapor")
- Band 11: 8.6 μm ("Cloud-Top Phase")
- Band 12: 9.6 μm ("Ozone")
- Band 13: 10.4 μm ("Clean" IR Longwave Window)
- Band 14: 11.2 μm (IR Longwave Window)
- Band 15: 12.4 μm ("Dirty" Longwave Window)
- Band 16: 13.3 μm ("CO2" Longwave Infrared)

-----MULTISPECTRAL IMAGERY-----

- GeoColor (CIRA)
- ProxyVis (CIRA)
- Shortwave Albedo (CIRA)
- Dust - DEBRA (CIRA)
- Visible Albedo (CIRA)
- Split Window Difference (10.3 μm - 12.3 μm)
- Split Window Difference Dust (10.3 μm - 12.3 μm)
- Split Window Difference Grayscale (10.3 μm - 12.3 μm)

RAMSDIS ONLINE SLIDER Application

CIRA RAMMB

10:33 AM 11/6/2022

H-8 images
to illustrate
difference
between the
same scene
at 0.51 (top)
0.86 (bottom)

RAMMB/CIRA SLIDER: Himawari-8

2018-08-27 05:20:00 UTC

Play (space) < >

(L)oop (R)ock Re(v)

Speed

Zoom (+) Zoom (-) Max (Z)oom

(M)aps Lat/Lo(n) Slide(r)

Mouse (D)raw Clear Drawin(g)s

(S)atellite Himawari-8

Se(c)tor Full Disk

(P)roduct Band 2: 0.51 μm ...

Add (O)verlay Add (O)verlay

of (I)mages 60

(T)ime Step 10 min

Band 2: 0.51 μm ("Green" Band)

Hide

(A)rchived Imagery

2018-08-27 00:00:00:000

2018-08-27 07:07:50:000

Transferring data from rambmb-slider.cira.colostate.edu...

Windows taskbar: Type here to search, 12:02 PM 8/27/2018

RAMMB/CIRA SLIDER: Himawari-8

2018-08-27 05:20:00 UTC

Play (space) < >

(L)oop (R)ock Re(v)

Speed

Zoom (+) Zoom (-) Max (Z)oom

(M)aps Lat/Lo(n) Slide(r)

Mouse (D)raw Clear Drawin(g)s

(S)atellite Himawari-8

Se(c)tor Full Disk

(P)roduct Band 4: 0.86 μm ...

Add (O)verlay Add (O)verlay

of (I)mages 60

(T)ime Step 10 min

Band 4: 0.86 μm ("Veggie" Band)

Hide

(A)rchived Imagery

2018-08-27 00:00:00:000

2018-08-27 07:07:50:000

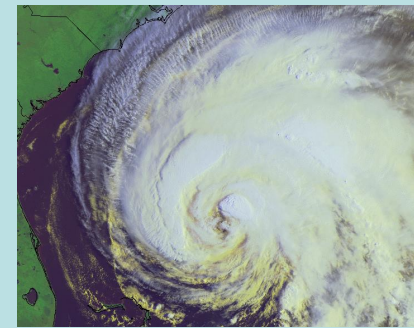
2018-08-27 05:20:00 UTC

Windows taskbar: Type here to search, 12:00 PM 8/27/2018

Some Basics in brief

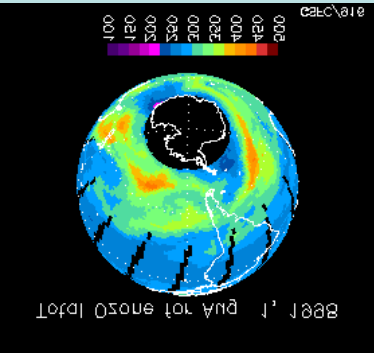
- Satellites and their orbits
 - What we sense
- What we are observing

Meteorological

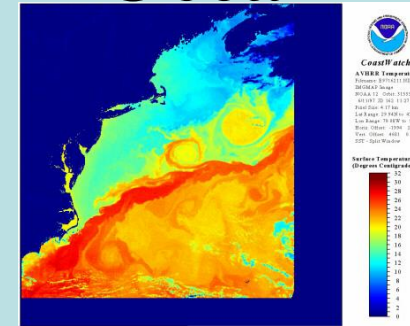


Climate

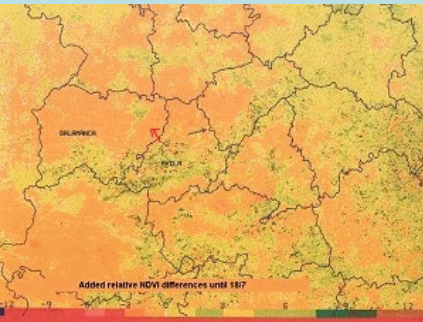
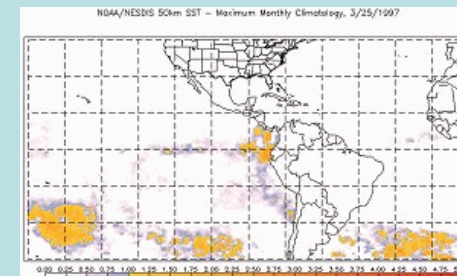
The spatial and temporal domains of the phenomena being investigated drive the satellite's observing requirements as a function of space, time, spectra, and signal to noise: and here the trade off begins.



Ocean

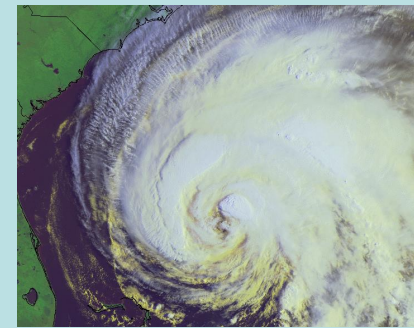


Ecological



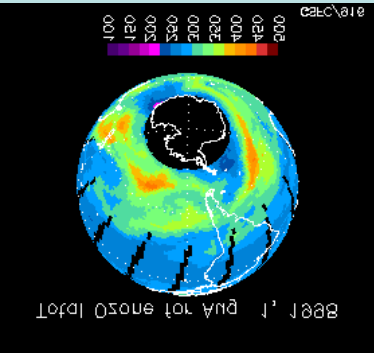
Land

Meteorological

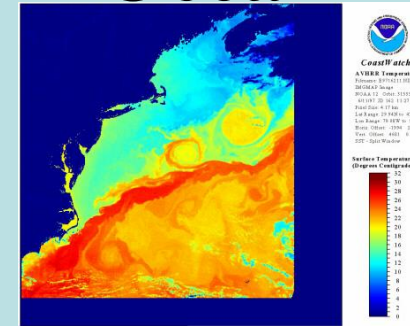


Climate

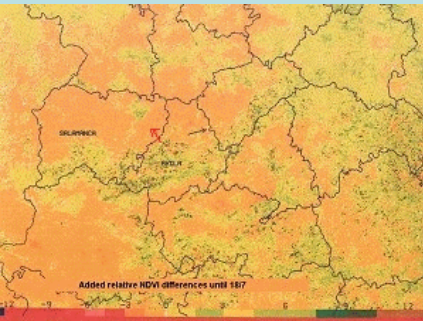
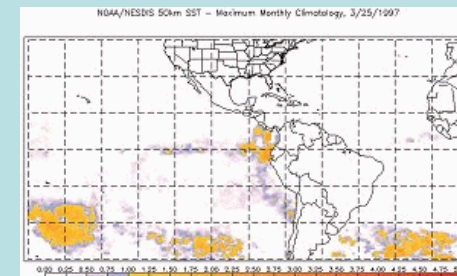
The clouds and cloud patterns in satellite imagery represent the ongoing effects of dynamic and thermodynamic processes in the atmosphere. We need to understand those processes, across scale, and use them in our various applications.



Ocean



Ecological



Land

Two things to note in this animation (at least two things)

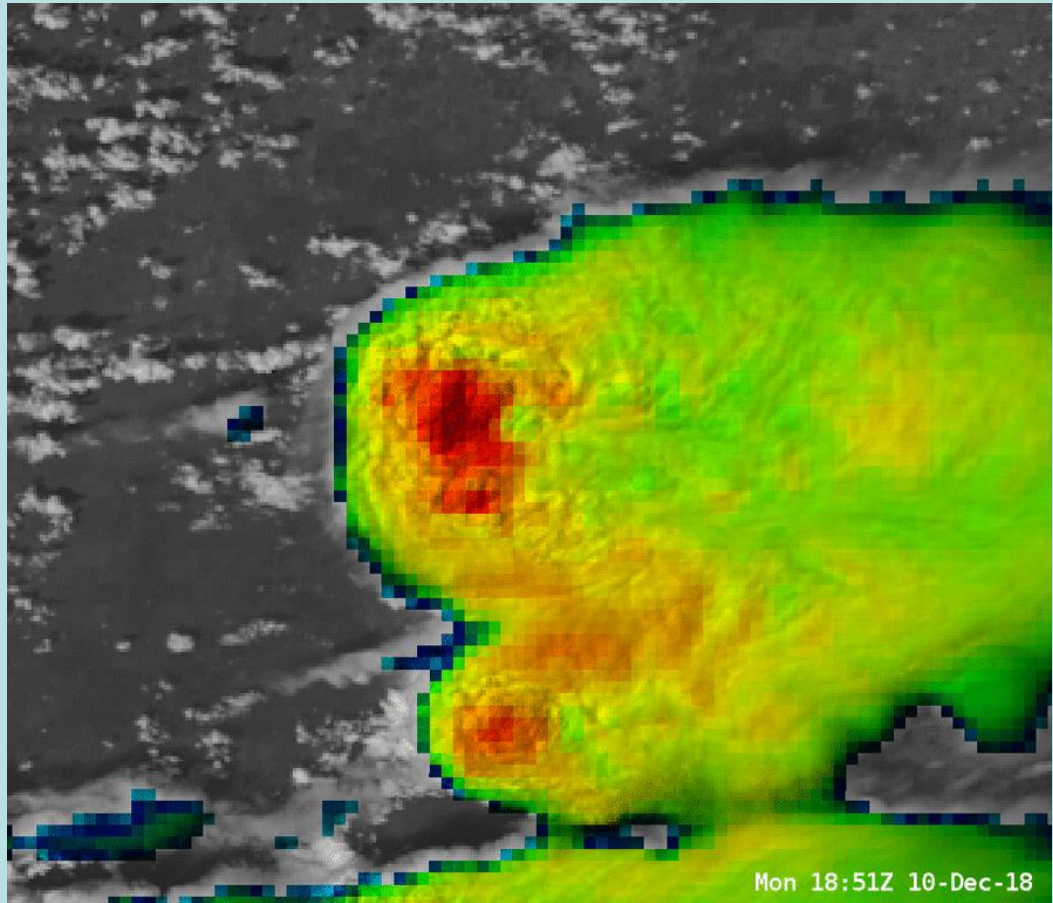
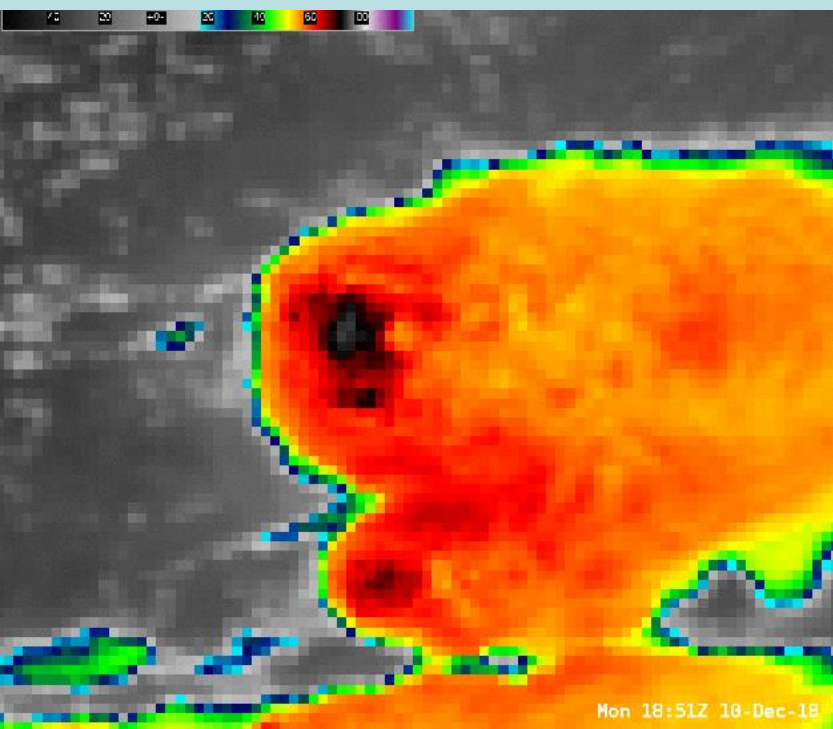
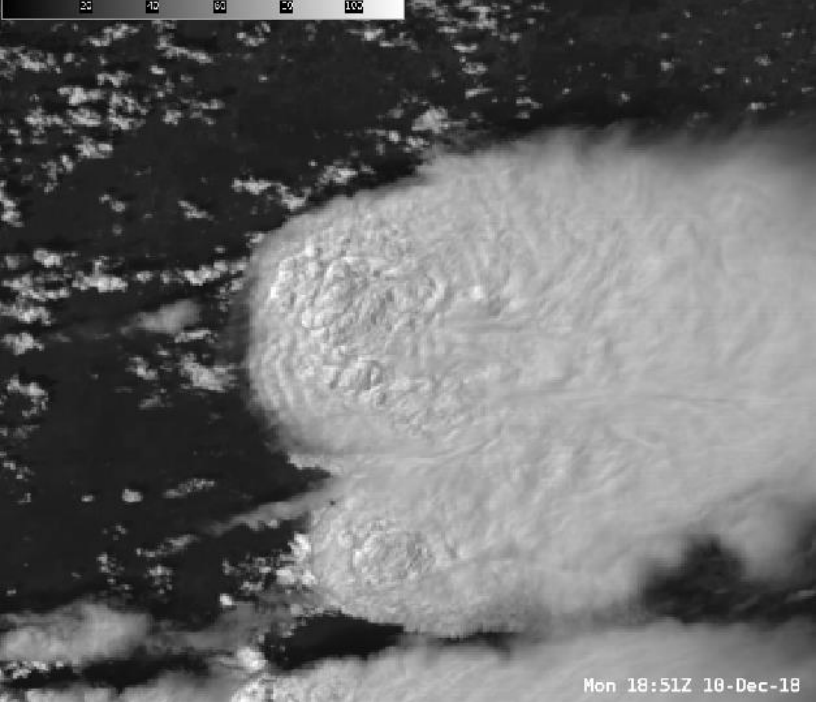


The cloud streets moving Northward in the loop appear to be almost rolling, which actually is a reflection of shear across that stably capped cloud street layer (water clouds).

Inspection of the two prominent storms as they evolve: the cloud streets can be seen being “tilted” upward into the storm due to increasing vertical motion and buoyancy.

A visual representation of the “tilting term” in the vorticity equation

$$\left(\frac{\partial w}{\partial y} \frac{\partial u}{\partial z} - \frac{\partial w}{\partial x} \frac{\partial v}{\partial z} \right)$$



The spatial and temporal domains of the phenomena being investigated drive the satellite's observing requirements as a function of space, time, spectra, and signal to noise

Spectral Bands And Their Applications

James F.W. Purdom

Understanding Utilization

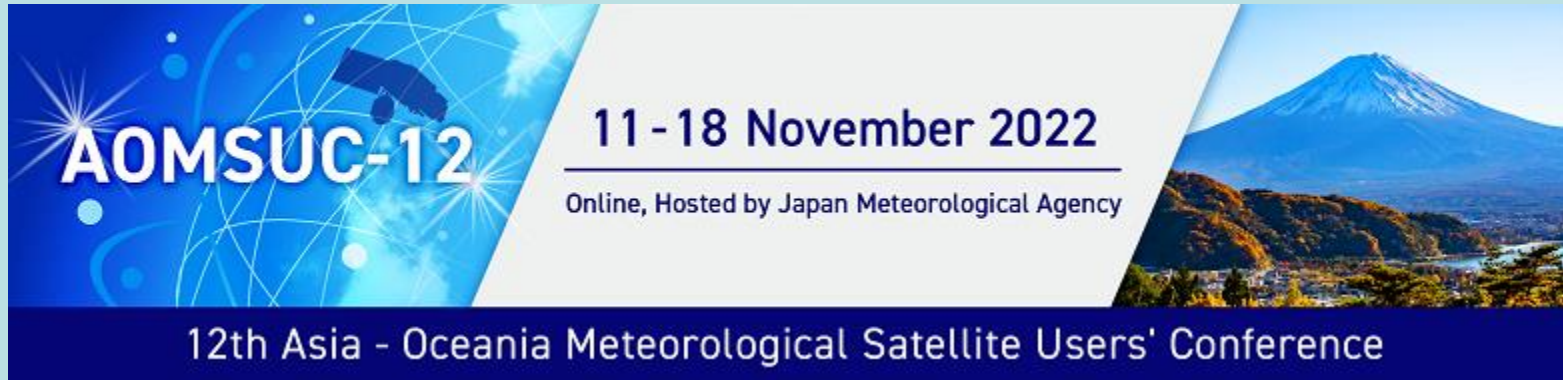
You have a very well-planned training course over the next two days. Relax, enjoy and learn. It's followed by the AOMSUC Conference



Three days of wonderful presentations. Most sessions begin with Key-Note Presentations that are “State of the Art” from a User’s Perspective. Register and look at the Program yourself. Don’t miss it, it’s going to be great!

**Let the training portion of AOMSUC-12
Begin!!!**

Relax, enjoy and learn.



AND ONCE AGAIN

**THANK YOU TO ALL INVOLVED
IN PUTTING THESE EVENTS
TOGETHER**