Sea Surface Temperature

Cara Wilson

NOAA Coastwatch Satellite Course

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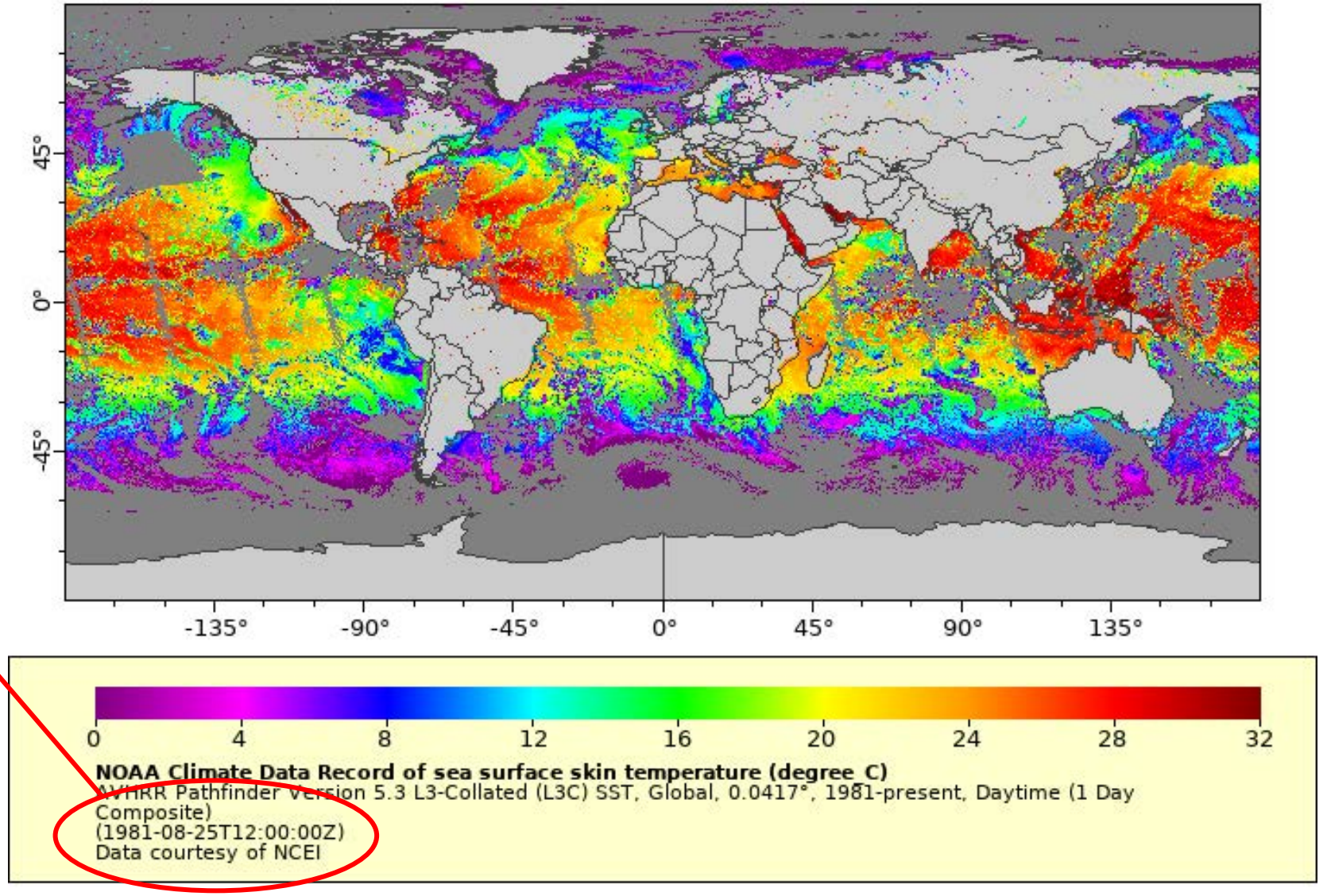
Versioning

-Wilson, 2017, WCN
-Tomlinson and Vogel, 2018, ECN
-Abecassis and Howell, 2018, PIN
-Wilson and Robinson, 2019, WCN

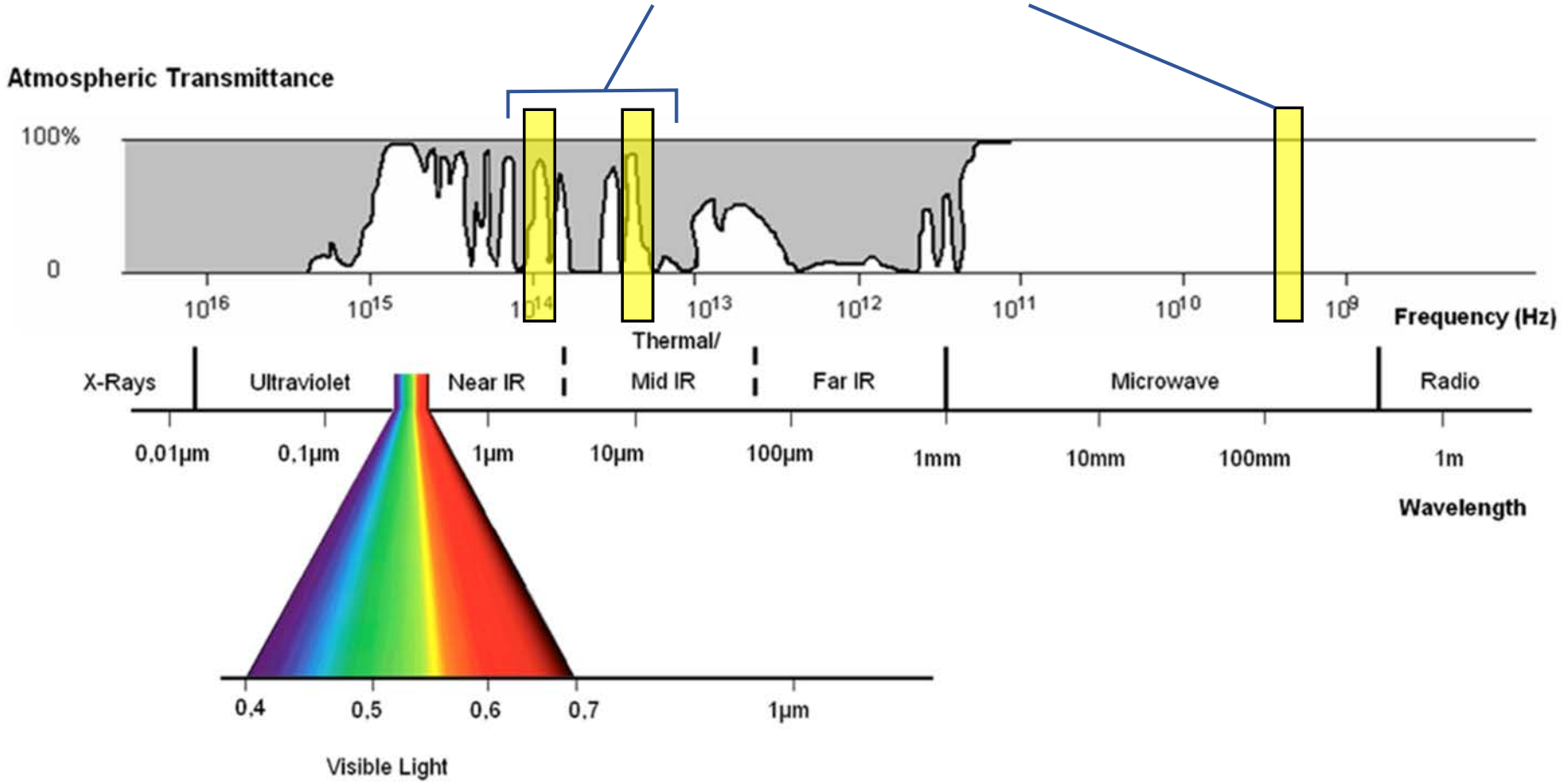
SST

Satellite SST records go back to 1981

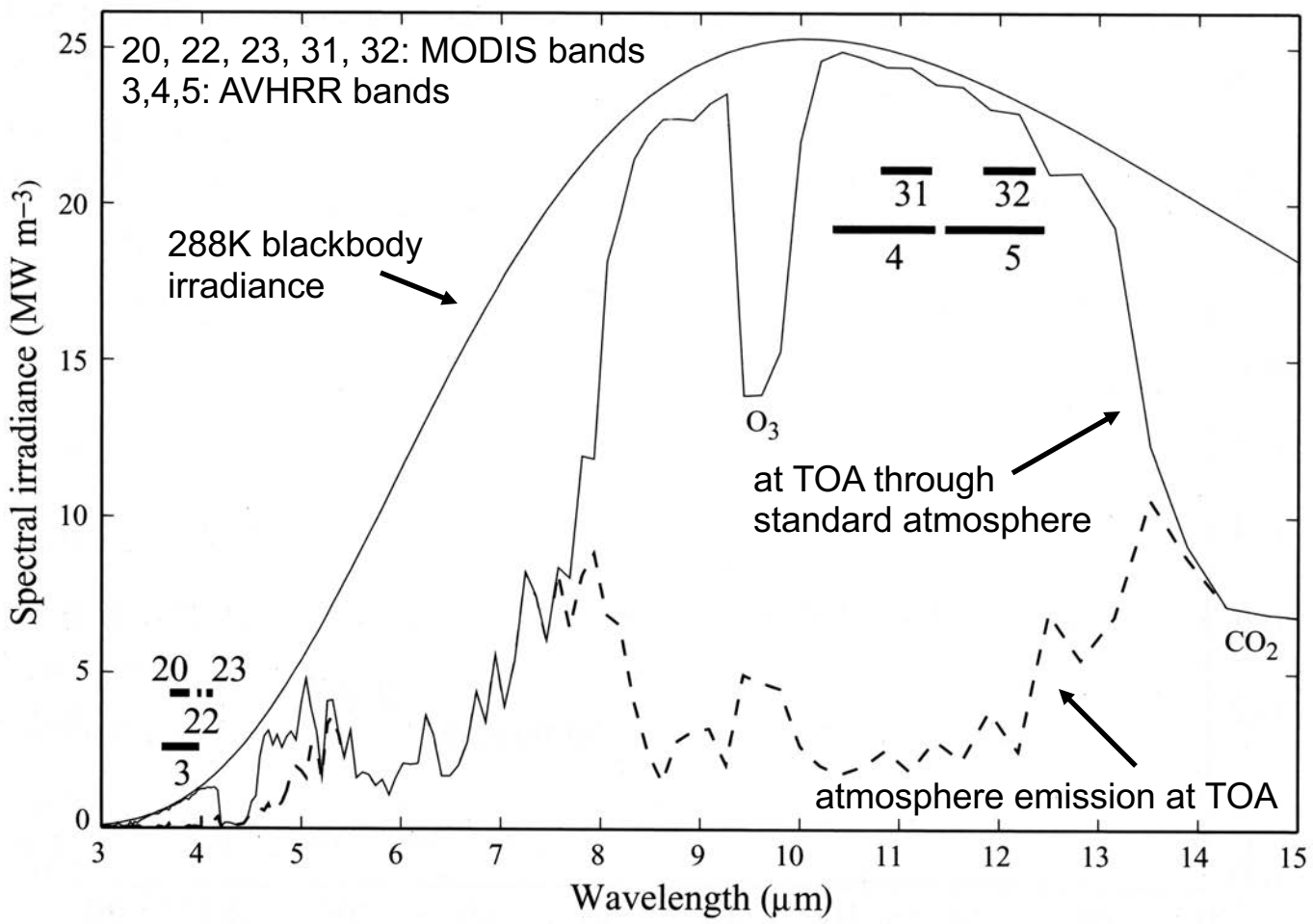


SST & Atmospheric Windows

SST measurements made in both the IR and the microwave

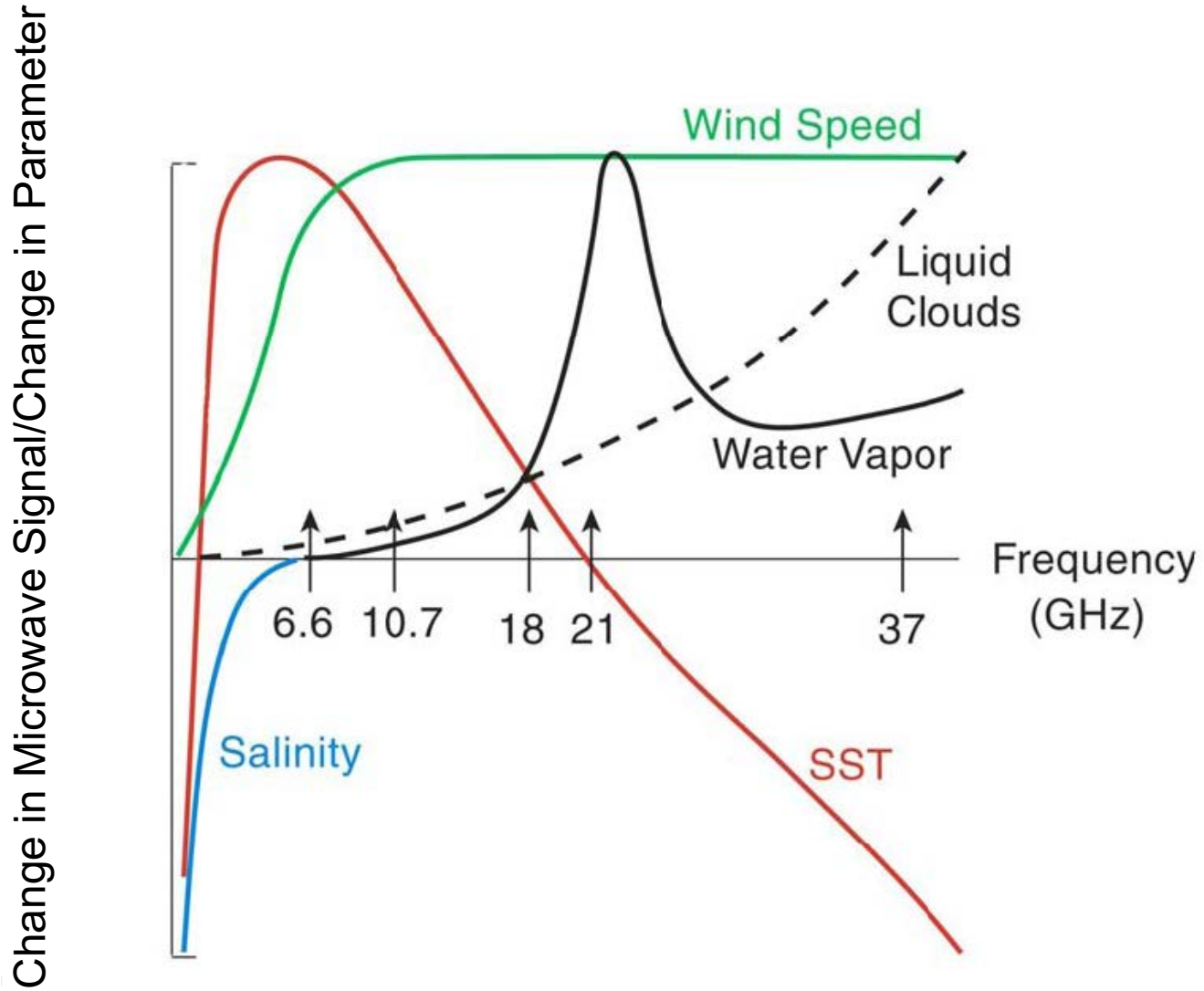


SST Band Selection



from Martin textbook

Microwave Ocean Surface Emissions

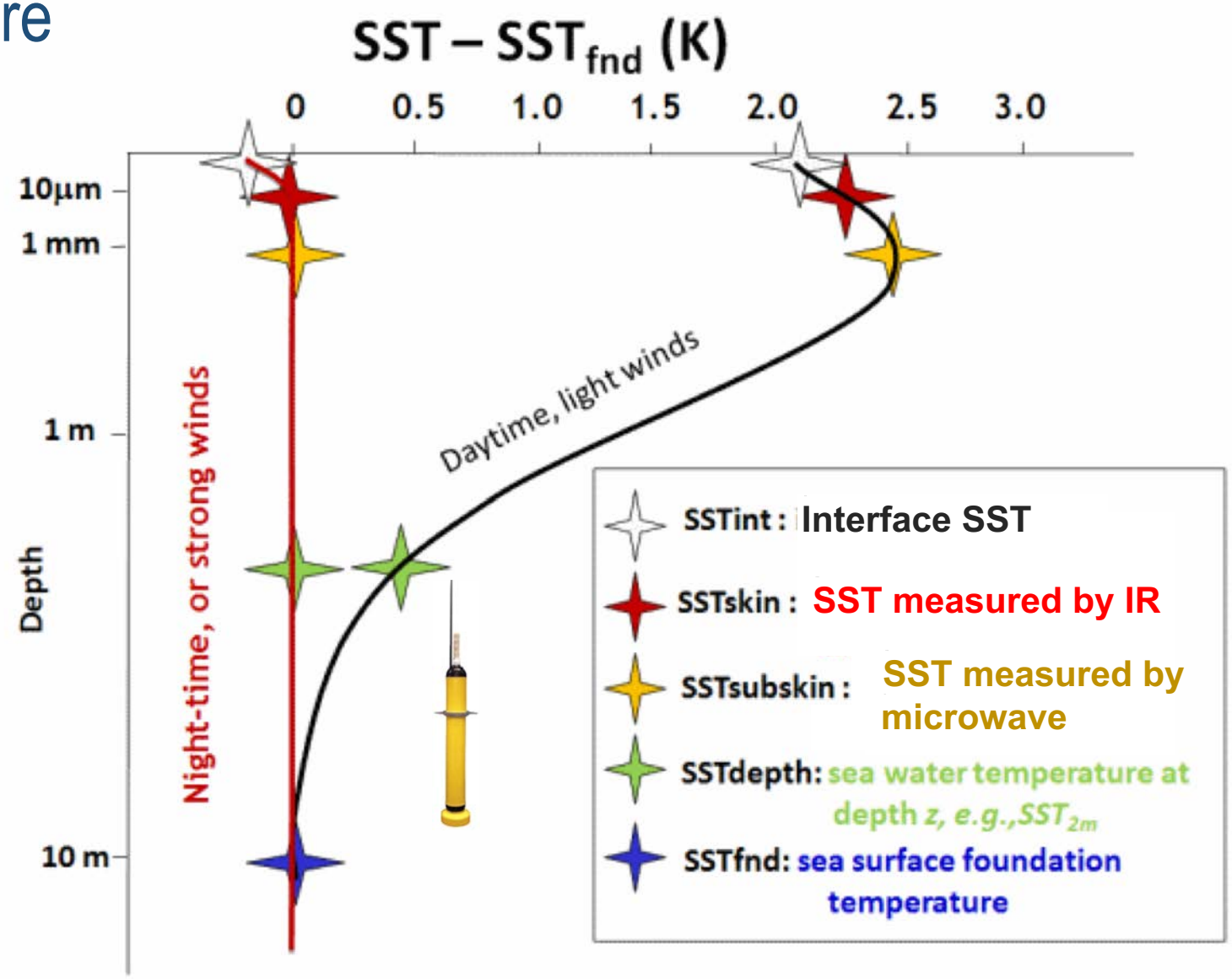


Microwave SST measurements of SST

- The biggest advantage of making microwave measurements of SST is that microwaves can penetrate through non-precipitating clouds.
- The intensity of microwave radiation is low at the top of the atmosphere so microwave sensors need large antennas.
- The spatial resolution of microwave sensors is limited to 25-50 km, because of diffraction effects arising from the longer wavelengths.
- The microwave emissivity of land and ice is significantly higher than the ocean, preventing accurate SST retrievals close to land or ice (within ~50 km).

Sea “Surface” Temperature

Temperature more stable during night-time, or in periods of strong winds



Types of SST Measurements

Infrared Measurements

Polar orbiting

- VIIRS on SNPP, NOAA-20 satellites (NOAA)
- MODIS on Aqua & Terra satellites (NASA)
- AVHRR sensors on NOAA & MetOp satellites

Geostationary

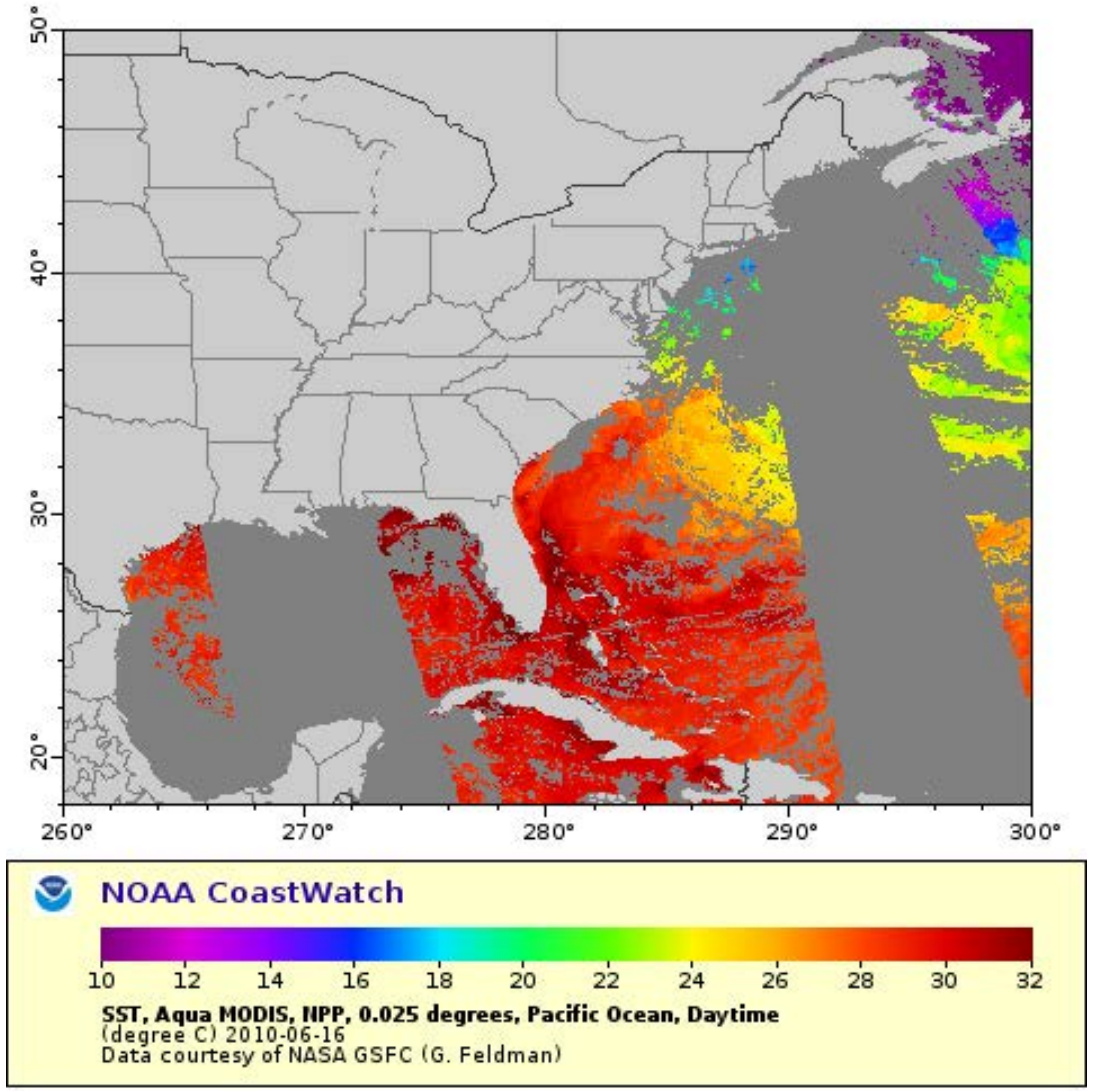
- ABI on GOES-16,17 (NOAA)
- AHI on Himawari-8 (Japan)
- SEVIRI on Meteosat (Europe)

Microwave Measurements

- AMSR-2, 5/12 – present, on GCOM-W1 (Japan)
- AMSR-E, 5/02 - 10/11, on Aqua (NASA)
- AMSR, 12/02 - 10/03, on ADEOS-2 (Japan)

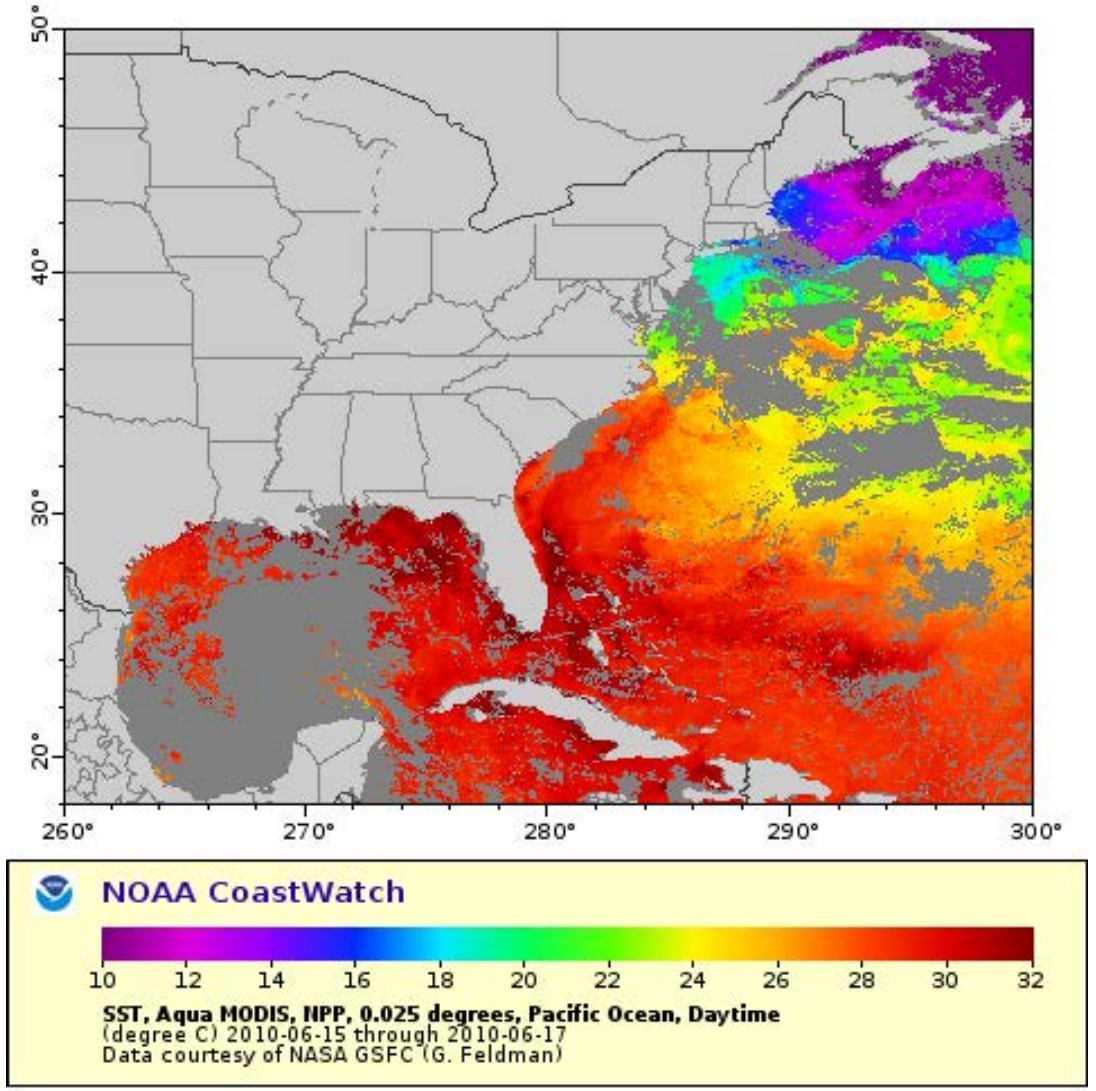
The Cloud Issue…

MODIS SST
1 day



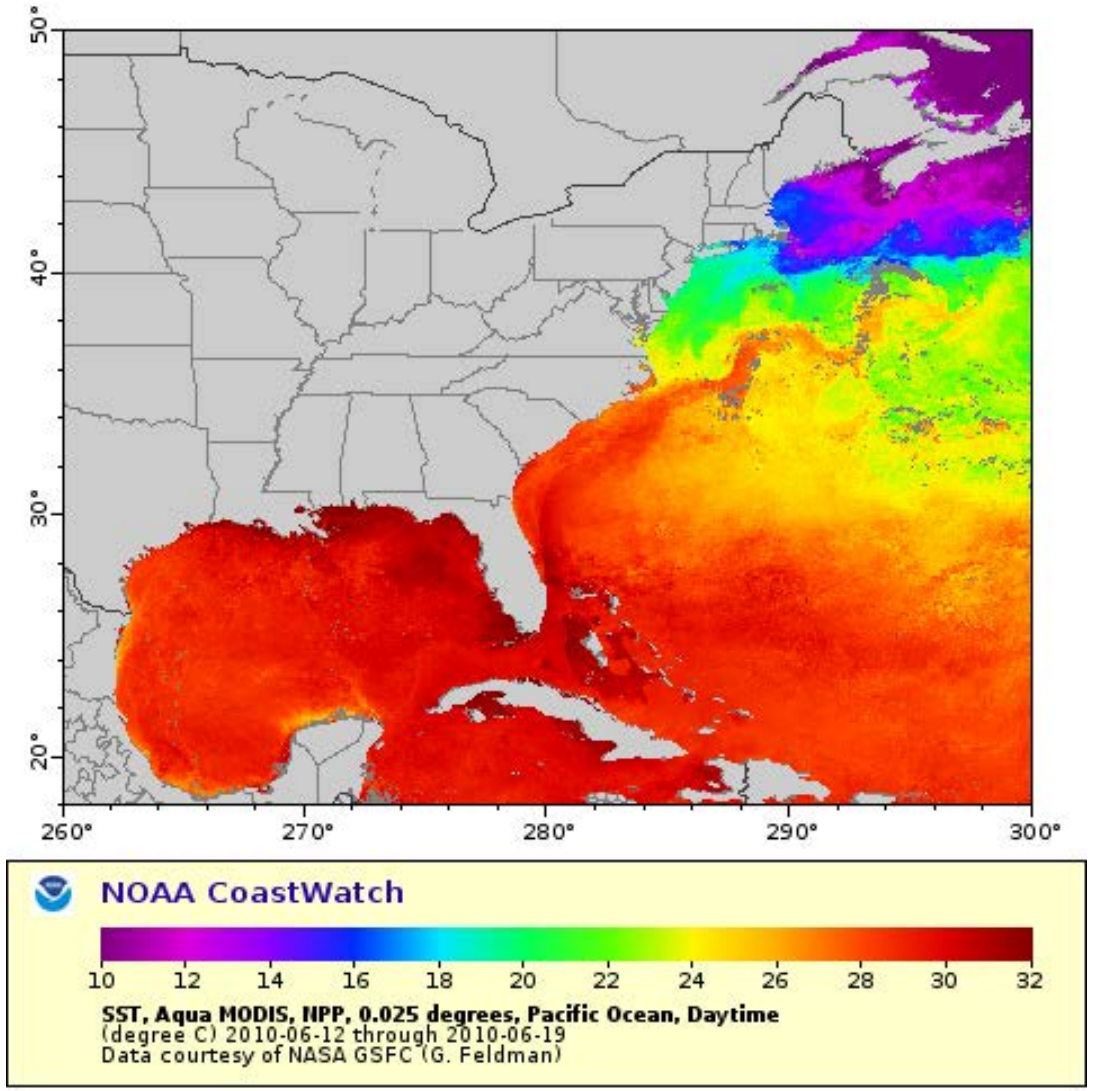
The Cloud Issue…

MODIS SST
3 day



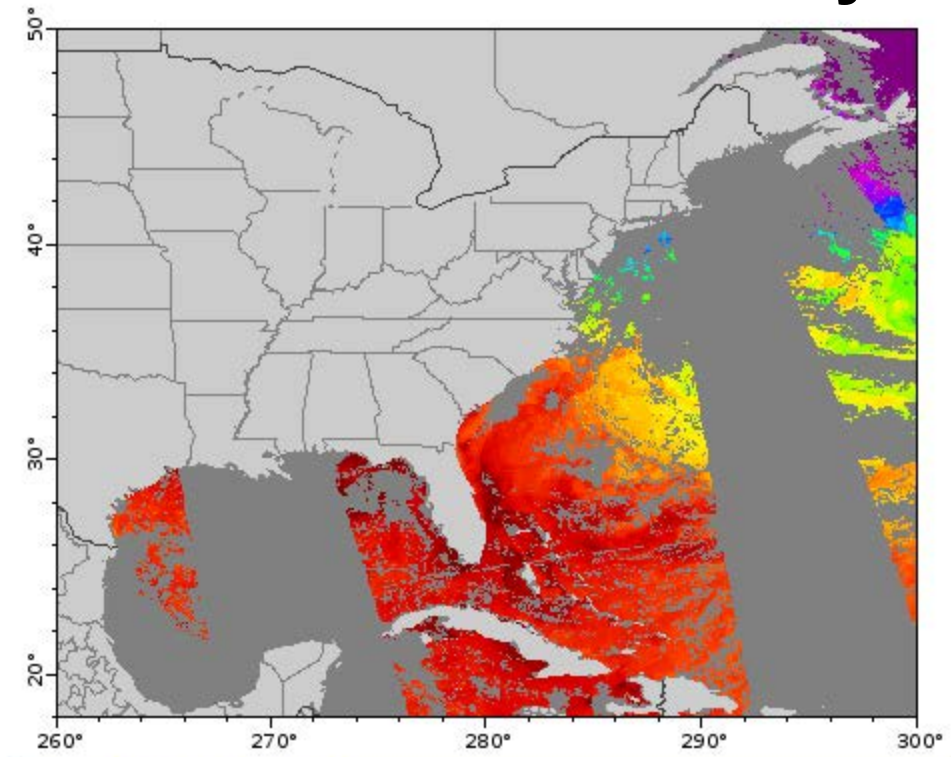
The Cloud Issue…

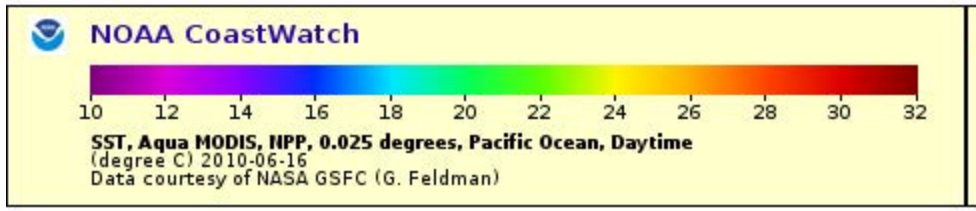
MODIS SST
8 day



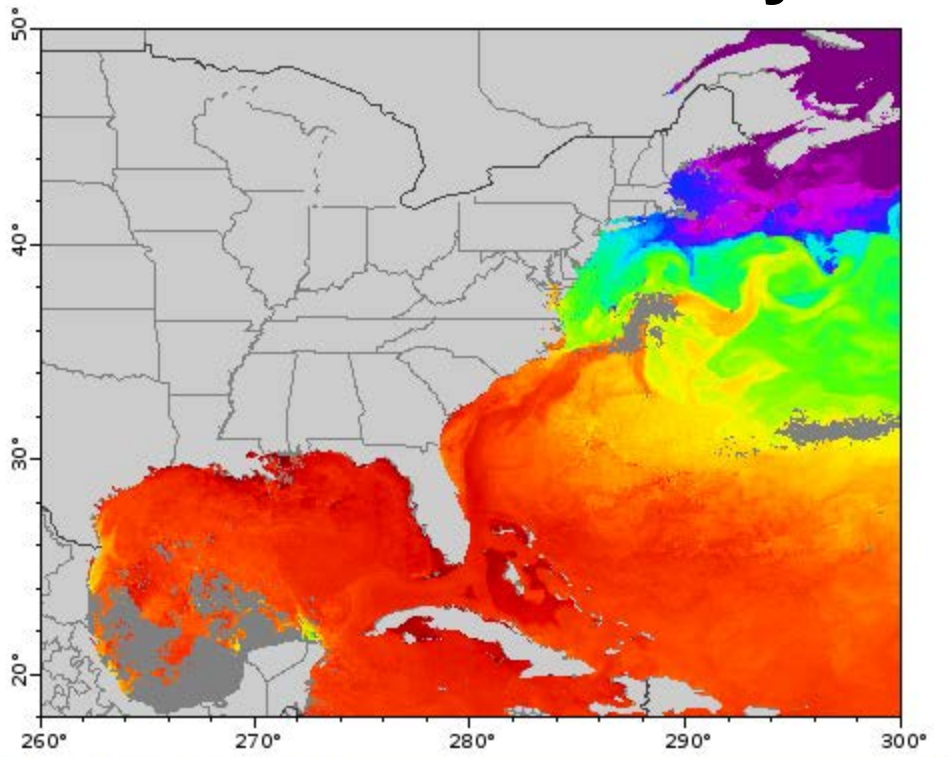
Polar vs. Geo

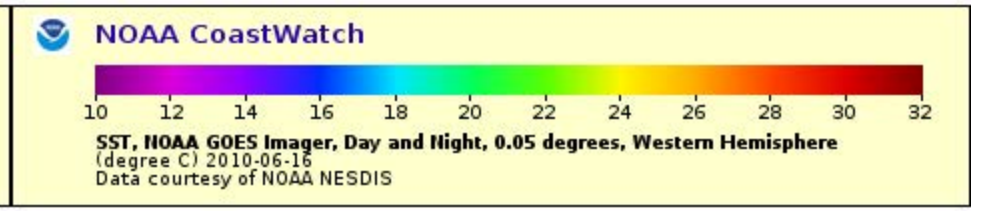
MODIS SST- 1 day





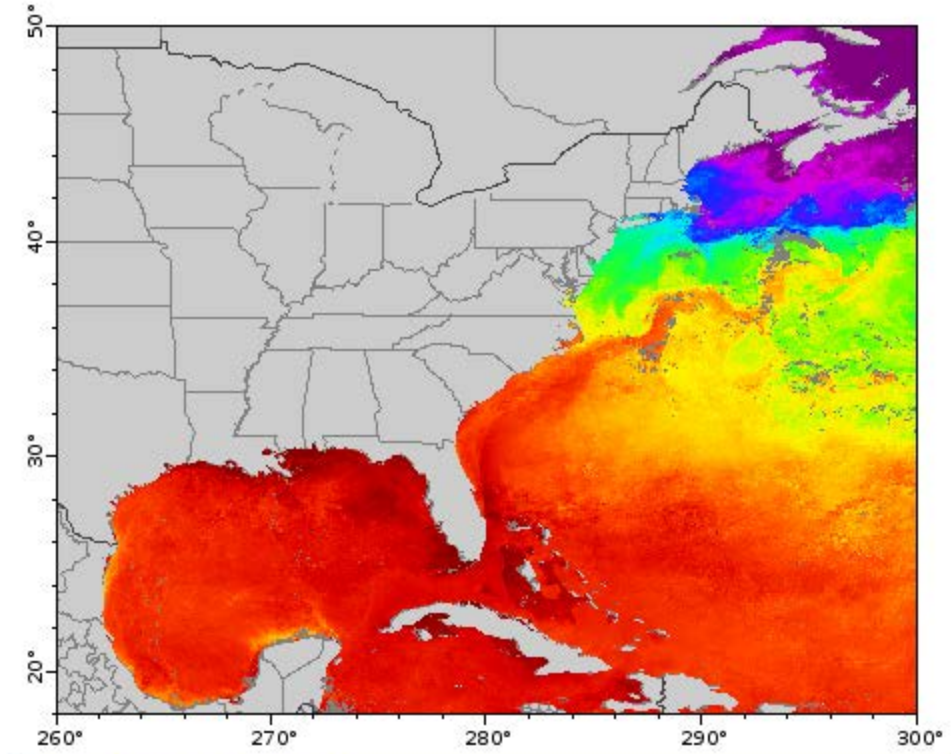
GOES SST- 1 day

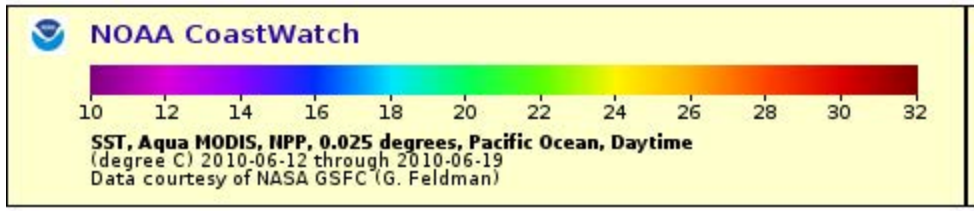




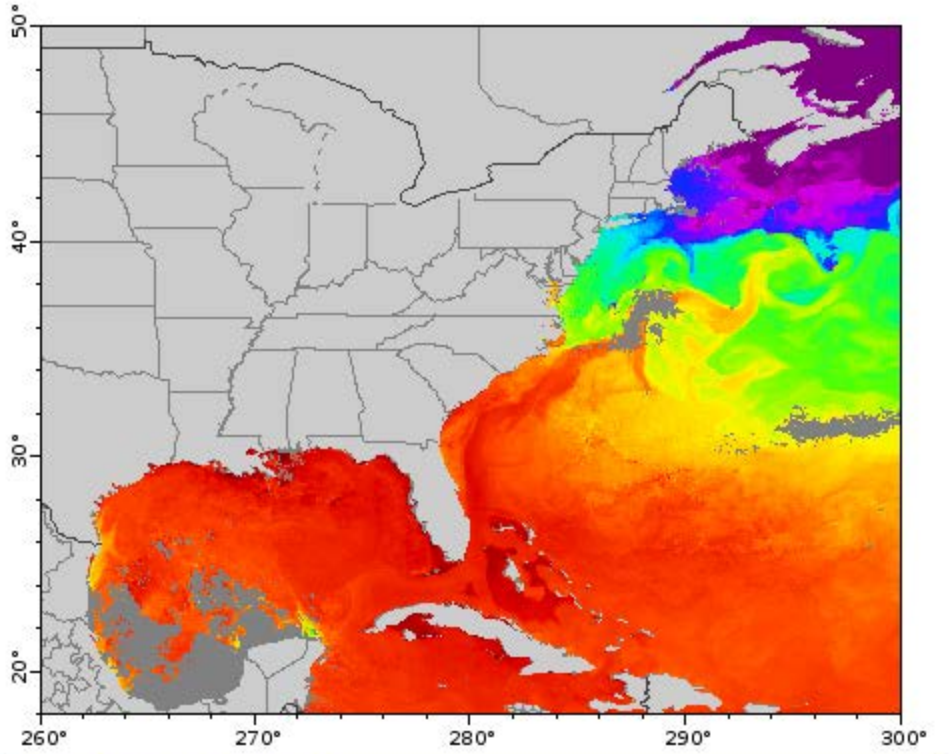
Polar vs. Geo

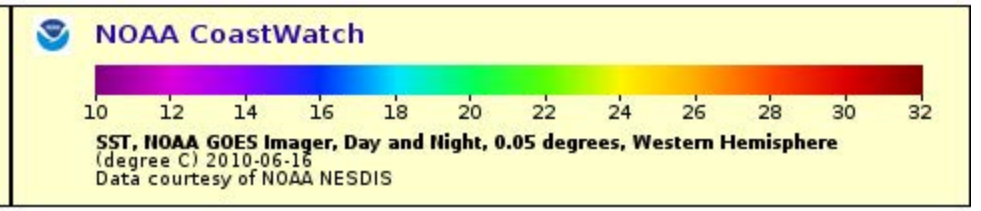
MODIS SST- 8 day





GOES SST- 1 day

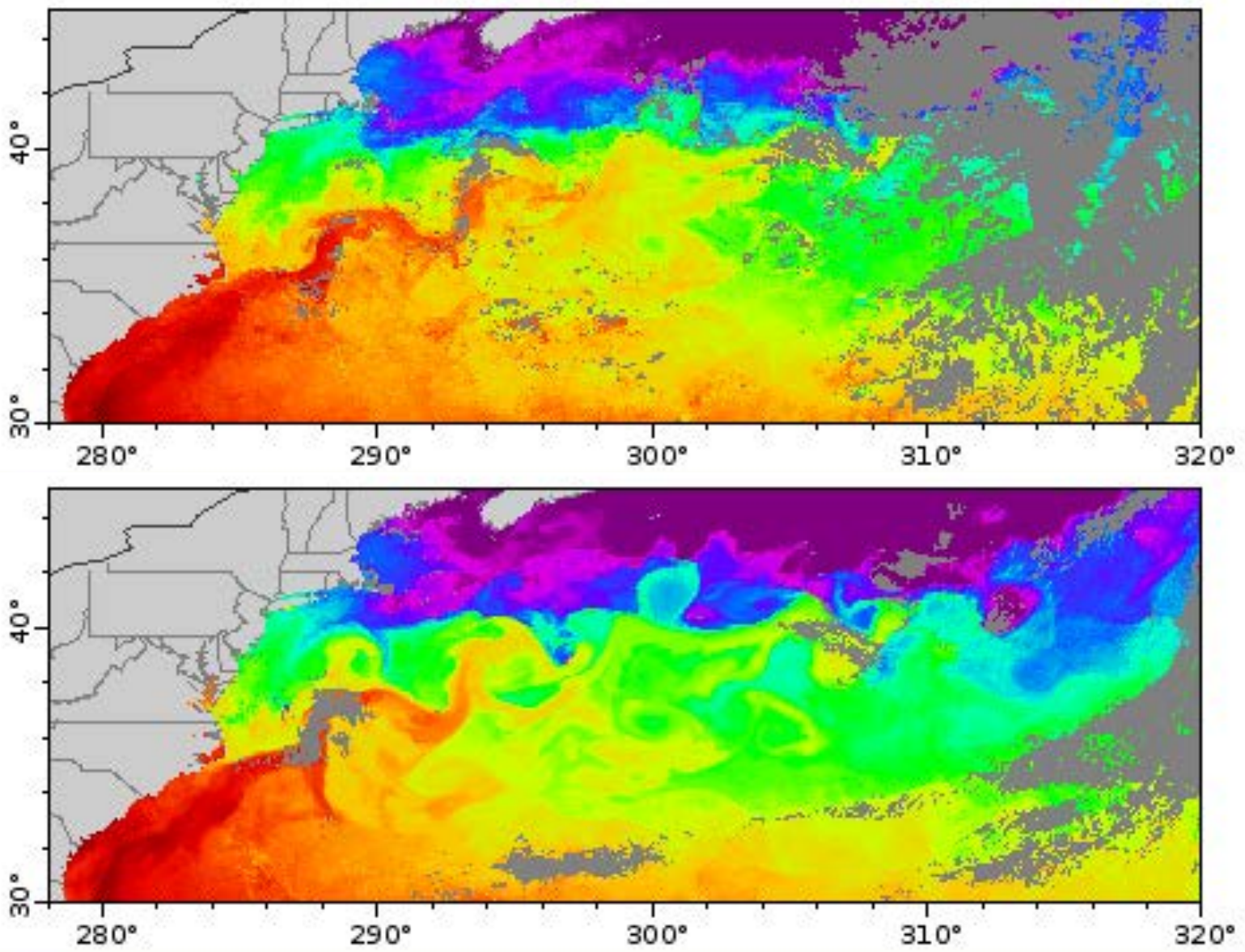




Polar vs Geo

MODIS, 8 day
Higher spatial resolution

GOES, 1 day
Lower spatial resolution

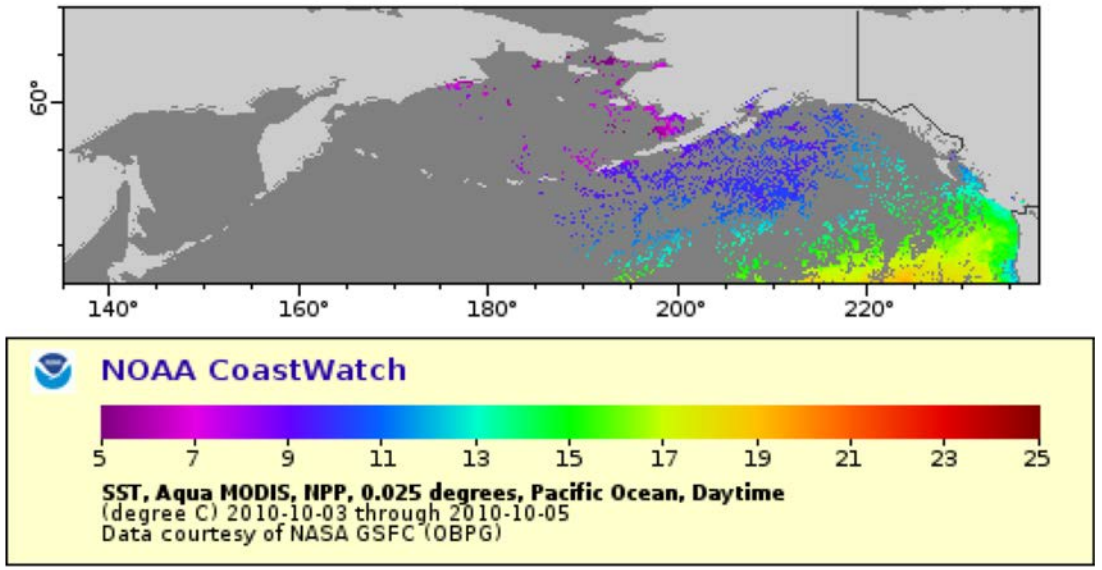


IR vs. Microwave

IR: MODIS

3 day, 0.025 degree res.

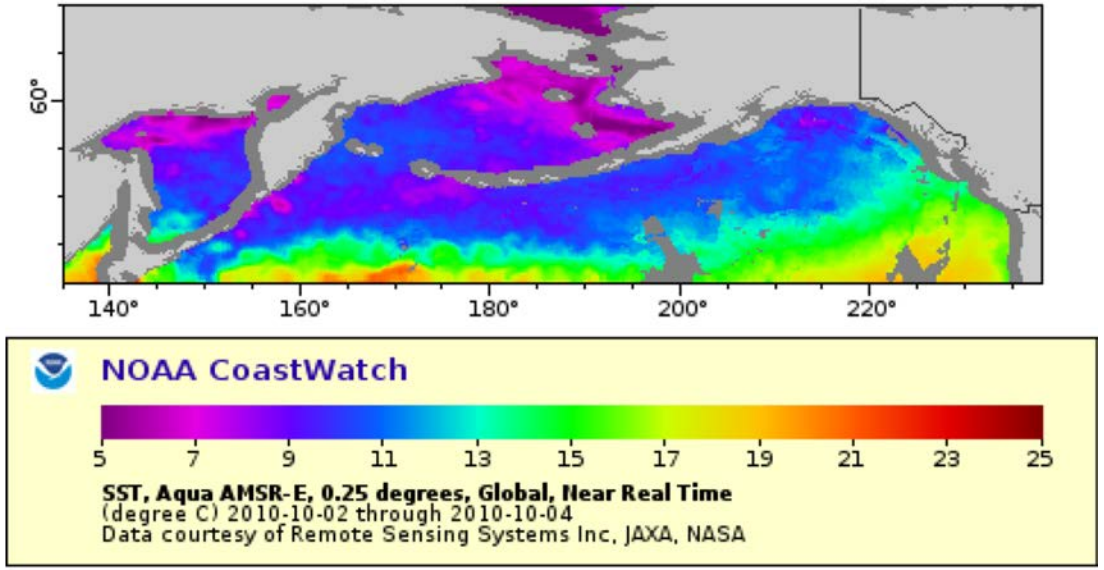
Clouds are an issue



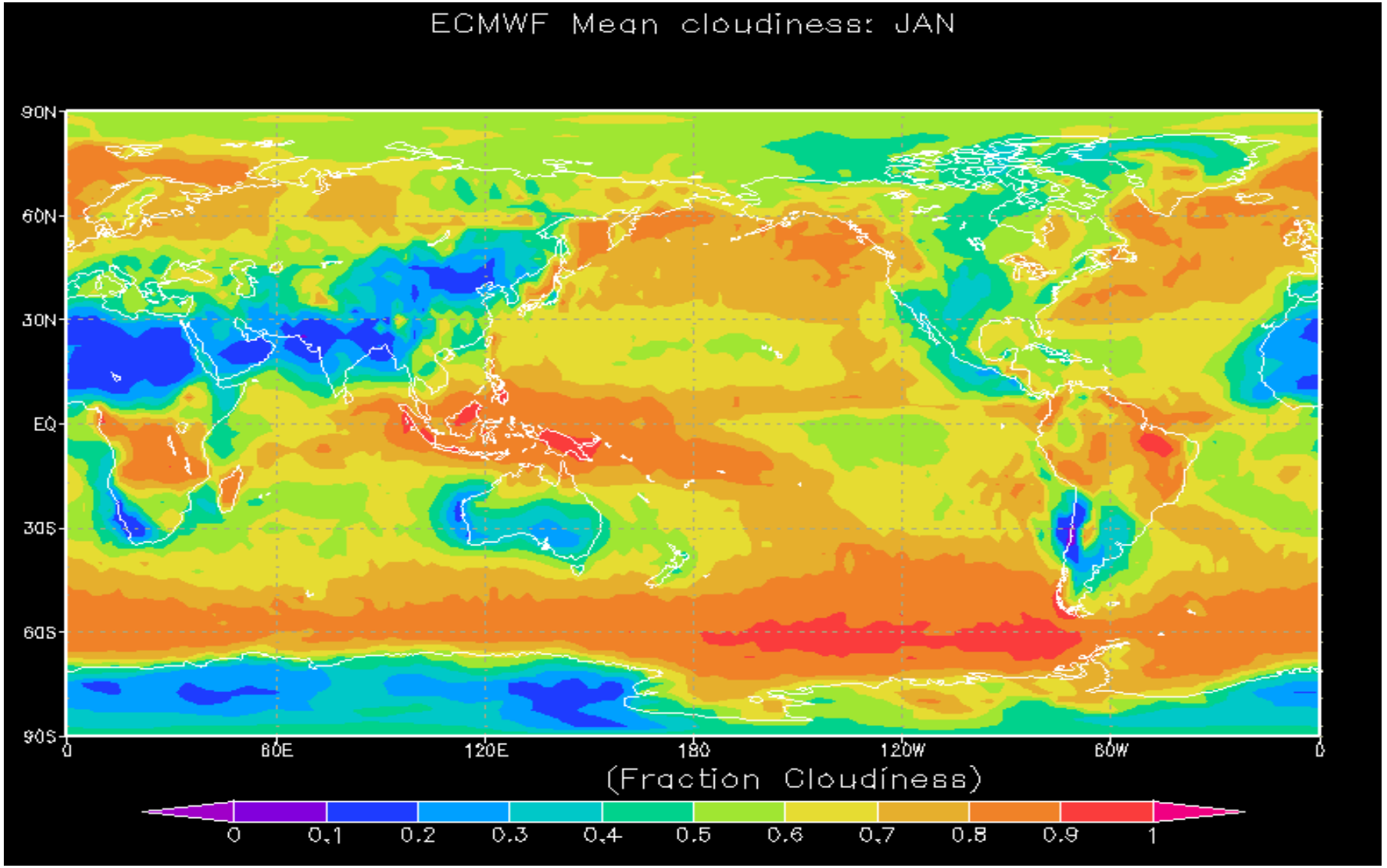
Microwave: AMSR-E

3 day, 0.25 degree res.

Clouds not an issue,
but trade-off is in spatial res



Global Cloudiness



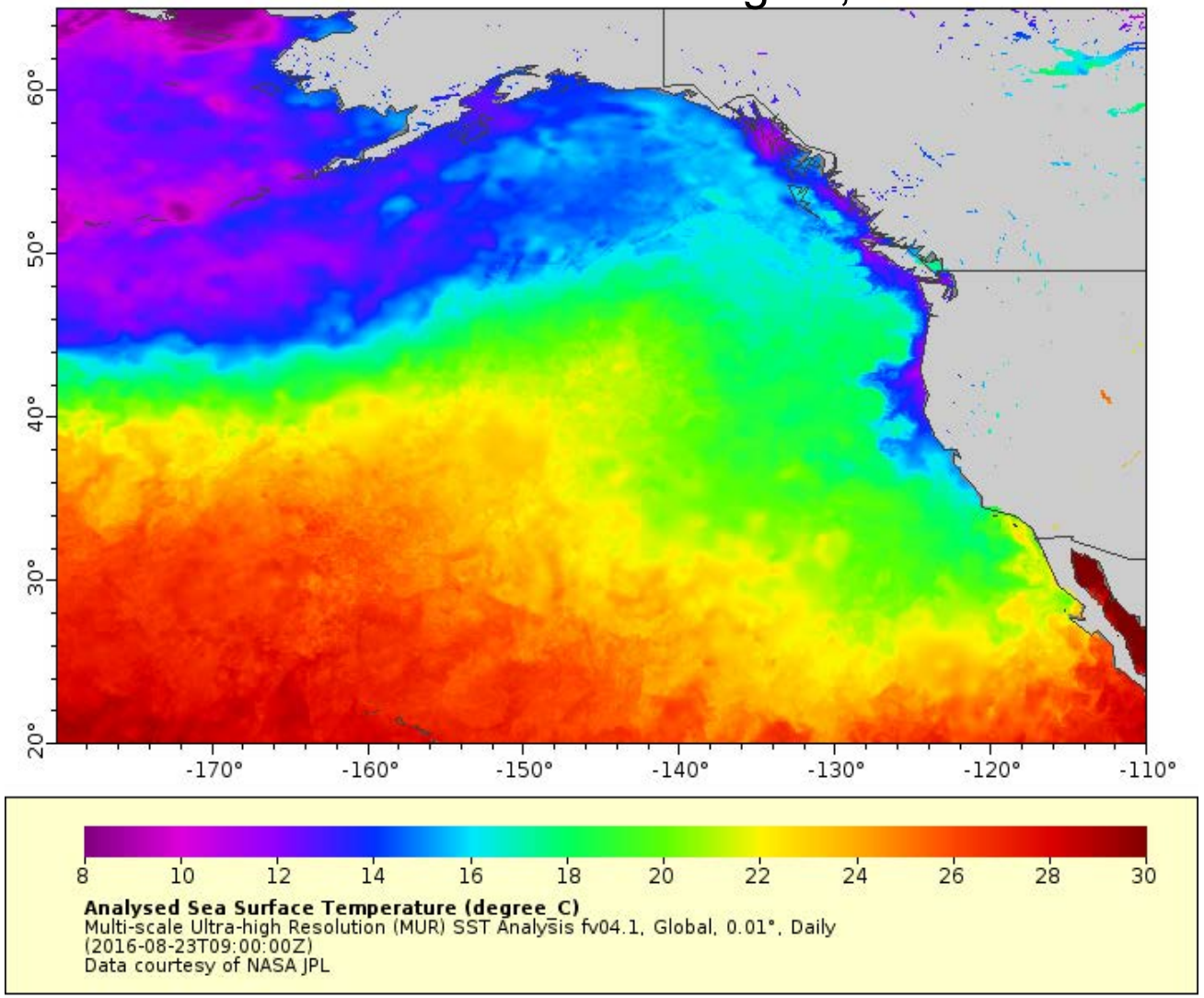
MUR SST Dataset

GHRSST produces global high-resolution (<10km) SST products from merging a variety of different satellite SST datasets

MUR:
Multi-scale Ultra–high Resolution (1 km) on ERDDAP.

Product goes back to June 1 2002

1 km MUR SST Aug 23, 2016



Recommended SST Products on WCN ERDDAP

Name	Time Coverage	Spatial Resolution	Temporal Composites	Gap-Free?	Anomaly?
MUR	6/01/02 – now	1 km	Daily, Monthly	Yes	Yes
Pathfinder	8/25/81 – 12/31/19	4 km	Daily, Weekly, Monthly	No	No
NOAA Coral Reef	1/15/85 – now	5 km	Daily, Monthly	Yes	Yes
MODIS	01/01/03 – now	4 km	Daily, Weekly, Monthly	No	No
VIIRS	11/2/14 – now	750 m, west coast only	3-day	No	No
GeoPolar Blend	06/02/14/02 - now	5 km	Daily	Yes	No

SST Summary

- SST can be measured a variety of ways from satellites :
  - **IR** measurements made on **polar orbiting** satellites (ie MODIS, AVHRR, VIIRS) make 2 measurements per day (daytime & nighttime)
  - **IR** measurements on **geostationary** satellites make hourly, or sub-hourly, measurements
  - **microwave** measurements (AMSR) which can “see” through clouds, but at lower spatial resolution than IR measurements
- Using composite products an almost complete daily image can be obtained
- Cloud-masking, determining and eliminating what is a cloud, is not yet a perfect science.
- SST is accurate to < 0.3°C