GEO/XO Hyperspectral IR Sounder (GXS)

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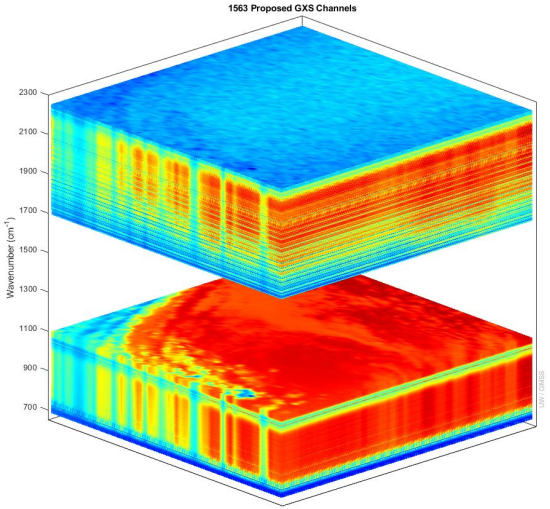
Overview

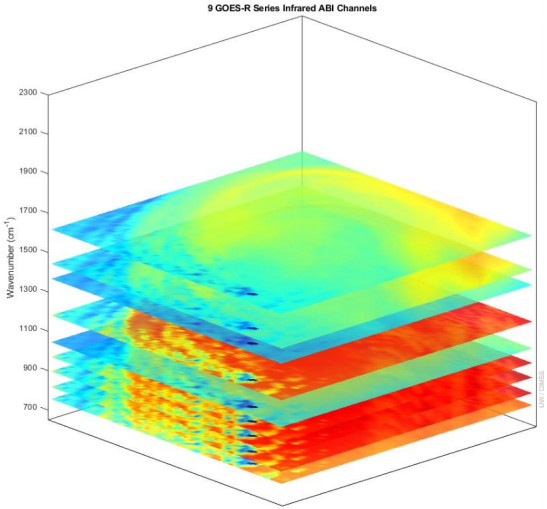
- GXS - What Is It?
  - What Are Its Capabilities?
- Where Does GXS fit into GEO/XO - and beyond?
- Why Is GXS Needed?
- How Will GXS Contribute to the Weather Enterprise?
- Who Is Doing What to Prepare to Exploit GXS?
- Your Questions?

Sounder in GEO - Horiz, Time Res ~ ABI; 100x Spectral bands yield vertical info for T, Q

GXS



ABI



IASI granule used to show the great improvement of the GXS over previous geostationary capabilities. Not shown are the improved temporal or spatial attributes of the GXS.

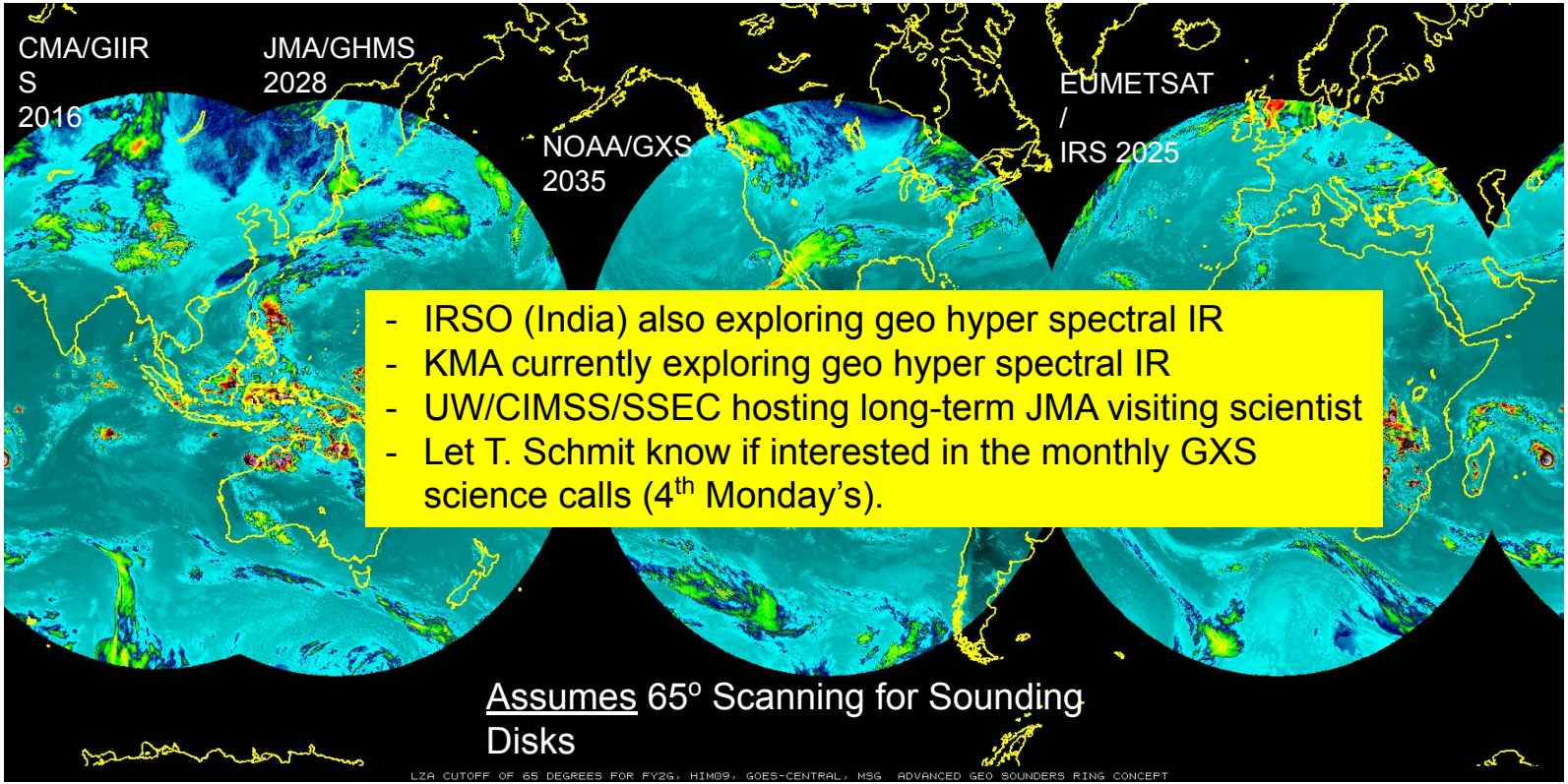
Number of Independent Pieces of Vertical Information		
Temperature	13	2
Moisture	11	2.5

There is more than six times (temperature) and four times (moisture) of number of independent pieces of vertical information compared to the ABI.

GXS Capabilities Summary (What and Why)

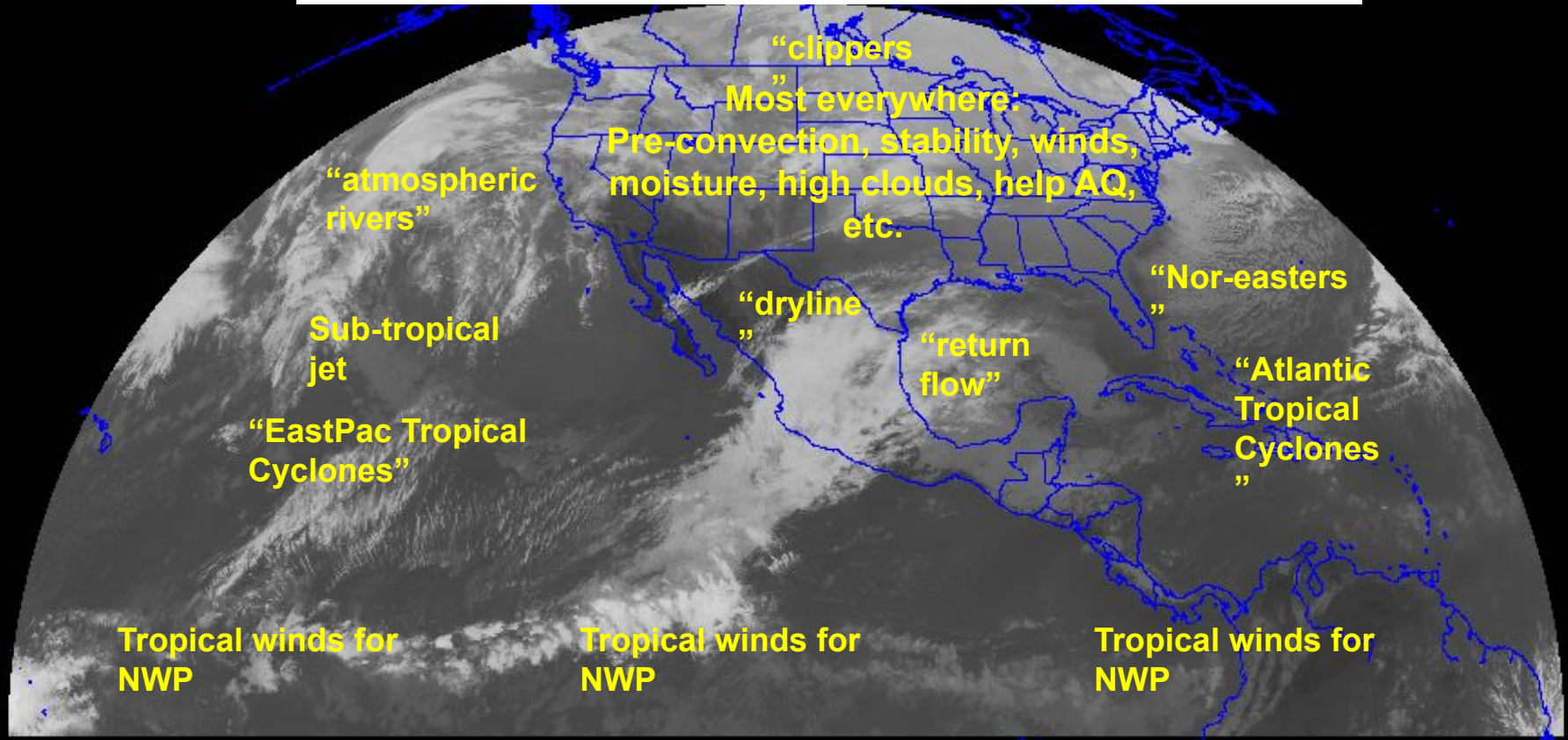
Attribute	What	Why
Coverage	Ideally: Sounding Disk as seen from both GOES-East and –West positions; Central satellite position currently planned	The Atlantic for **hurricane development** and **model initializations**, CONUS for the **pre-convective environment monitoring** and the Pacific for both **upstream weather and monitoring moisture (and winds)** over the huge area with little conventional data.
Spatial Resolution	4 km (at the satellite subpoint)	Doubling the clear-sky yields, compared to LEO, for a given time. Also for finer moisture gradients to be monitored.
Temporal Resolution	Sounding Disks (60 min), CONUS (~30 min) and mesoscale (5 min)	Sounding Disk upstream information and hurricane monitoring (**improved track and intensity**), CONUS for pre-convective monitoring and the targeted for regions of extremely active weather. Allows for clouds to move out and obtain more clear sky information.
Spectral Coverage / Resolution	680- 1095 cm-1 14.7 – 9.13 μm 1689 – 2250 cm-1 5.92 – 4.44 μm) @ ~0.6 cm-1	Spectral with information related to temperature, moisture and support select atmospheric compositions (ozone, NH3, isoprene, HNO3, N20 and CO). Need to resolve, not average out, the critical on/off spectral lines.
Other	Evolution of the radiances	Provides critical vertical information on atmospheric winds

Critical Component of the GEO-RING of IR Sounders



WMO WIGOS 2040 includes geostationary hyperspectral IR sounders

GXS Observation Applications



Where does GXS fit in to the local WX Forecast?

GXS data will fill in observational gaps to help with these and other operational issues:

- Near-Storm Mesoscale Analysis (before and during an event; compare to model forecasts)
  - Convective
  - Winter
- Warn on Forecast (provides nearly constant updates to users, not just one warning)
- Precipitation Type (the improved temperature, moisture and wind profiles)
- Fire Weather/Spot Forecasts (wind surges, low-mid level RH, etc.)
- Aviation Forecasts (Icing levels, convective turbulence)
- Air Quality (daily cycle and nighttime constraints)
- Physical Modeling (input to models, especially on the regional scale)
- Machine Learning (great opportunity to train with GXS for many critical parameters
- Flash Floods (Moisture transport; Low-mid level boundaries)

From NWS Briefing on "**Day in the Life at NWS Columbia**" by Frank Alsheimer

Science Team Preparing to Exploit GXS Observations

- Prioritize activities and assess what we can do with available resources
- Develop an integrated science activities plan.

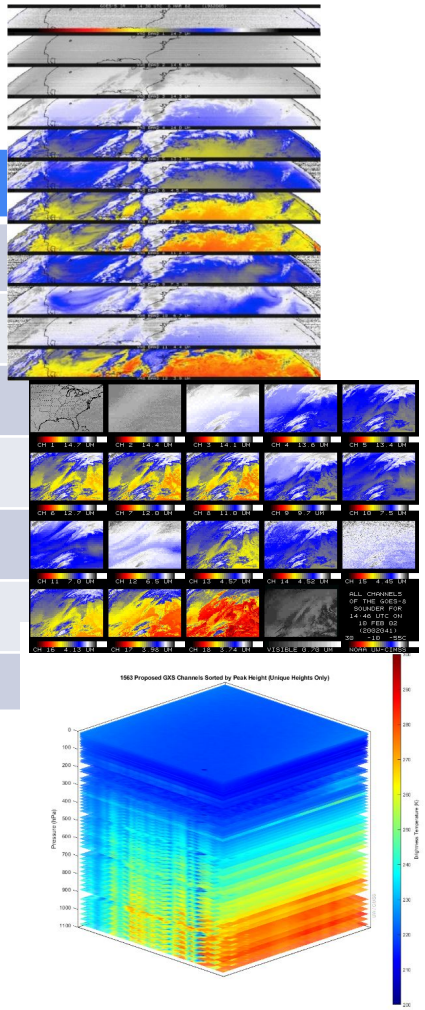
- Sub-teams for
  - Proxy
  - Advocacy
  - Retrievals
  - Data Assimilation
  - Nowcasting
  - Innovation
    - Cloud
    - AI/ML

Thank You!

Questions?

GXS: NOAA's 1st HIR Sounder in GEO

Item	# IR bands	Sounding
First Experimental	12	GOES-4 VAS (1980)
First Operational	18	GOES-8 (1994)
100x improved	~1500	High-spectral IR (*203X*)



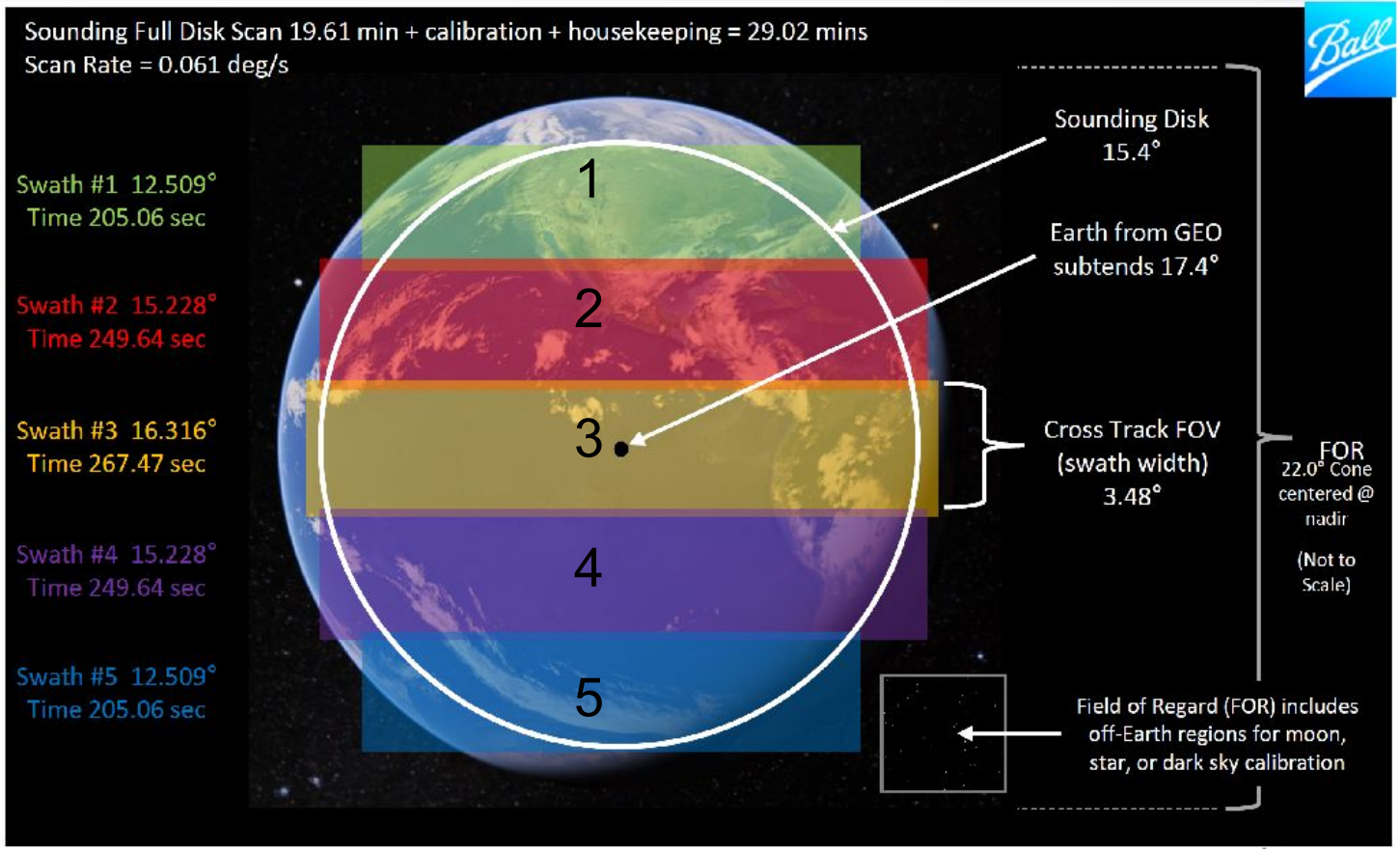
Consider NASA's GIFTS (2000); built and ground-tested and shown to provide high quality high resolution spectra, but was not launched.

The GOES-R series included advanced imagers, the first geostationary lightning mapper and space weather instruments; high temporal and horizontal resolution, but NOT spectral resolution needed for sounding

Sample Scan Pattern

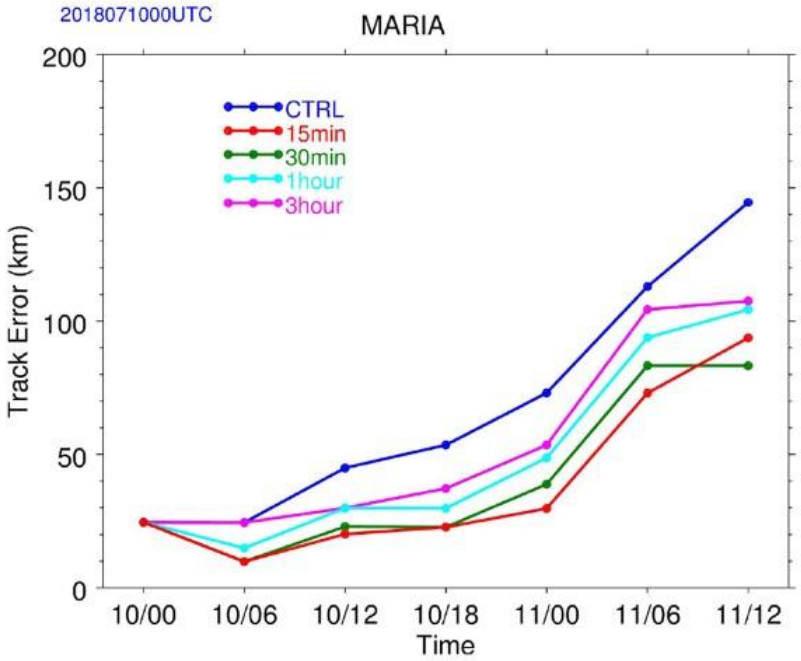
Consider more frequent Northern Hemisphere scan

- Swaths 1,2 and 3, then alternative for 4 and 5
  - Hence 20 min repeat over CONUS
- Swaths 1 and 2 and then alternative for 3, 4 and 5
- Meso-scale scans as well
  - Currently they are ABI-sized
  - 1000 km x 1000



*"For weather surveillance **a geostationary hyperspectral infrared sounder** would **dramatically increase confidence in forecasts of hurricanes and other storms** that originate over the ocean and head towards U.S. interests."*
- Ken Graham, NWS Director (former NHC Director)

GWX Impact to Improve track and intensity forecasts



Improved Typhoon Maria track forecasts (2018), based on observed geostationary high-spectral resolution infrared data. The red line indicate with 15 min data.
https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL093672

Improving tropical cyclone forecasts with high temporal/spectral IR observations.

Track & intensity forecasts for Typhoon Maria are most improved with 15 min data, the track (> 40%) and the intensity (18%).

Precipitation forecasts also improved.