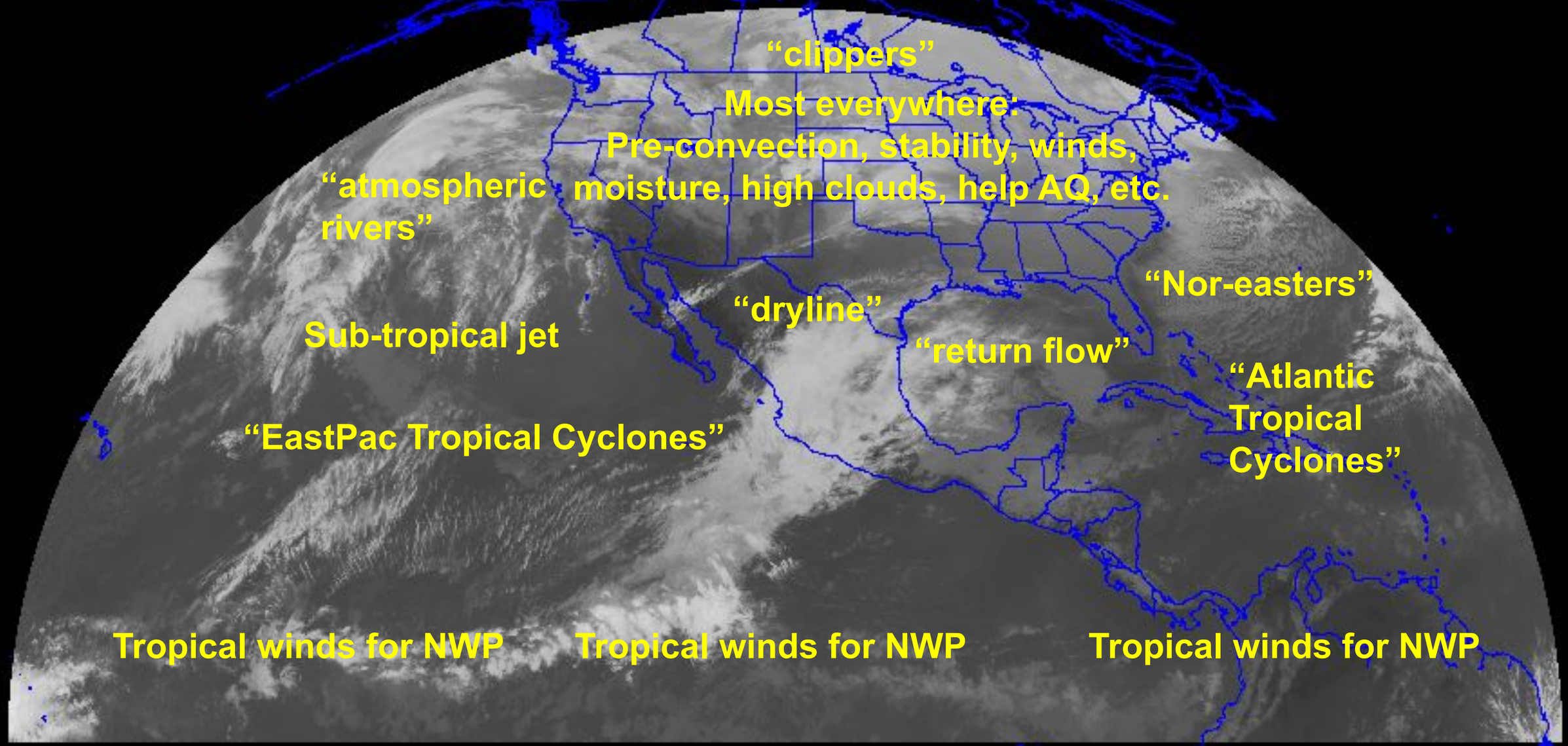
Public Sector Applications

Presented by E. L. McGrath-Spangler
But really the work of many others

Sample GeoXO Sounder Uses



Slide courtesy of Zhenglong Li

How does GXS improve the local WX Forecast?

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

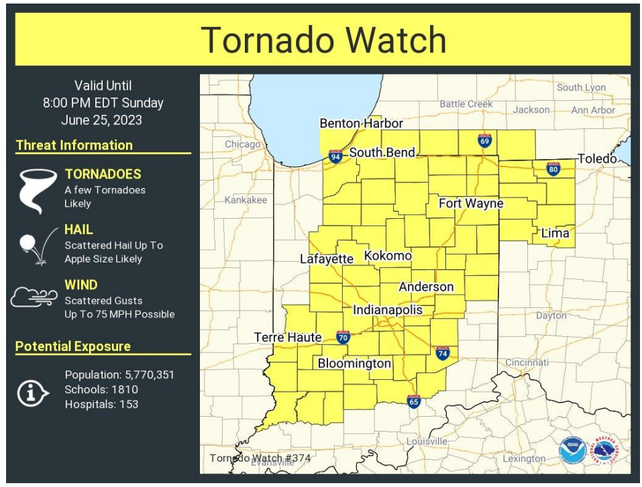
- Near-Storm Mesoscale Analysis (before and during an event; compare to model forecasts)
  - Convective
  - Winter
- Warn on Forecast (provides nearly constant updates to users, not just one warning)
- Precipitation Type (the improved temperature, moisture and wind profiles)
- Fire Weather/Spot Forecasts (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

WFO Indianapolis Mesoscale AFD 25 June 2023 1533z

… remains fluctuations in exactly where the initiation takes place but all signs point to somewhere in the Kokomo-Marion to Indy metro zone continuing S/SW towards Bloomington. Timing of initiation is critical. An earlier start closer to 18Z would support west of the zone mentioned above while a later start at 19-20Z would support in or just east of this zone. The atmosphere should start providing clues on this timing over the next 1-2 hours. […]

Nowcasting Challenges at the Local WFO



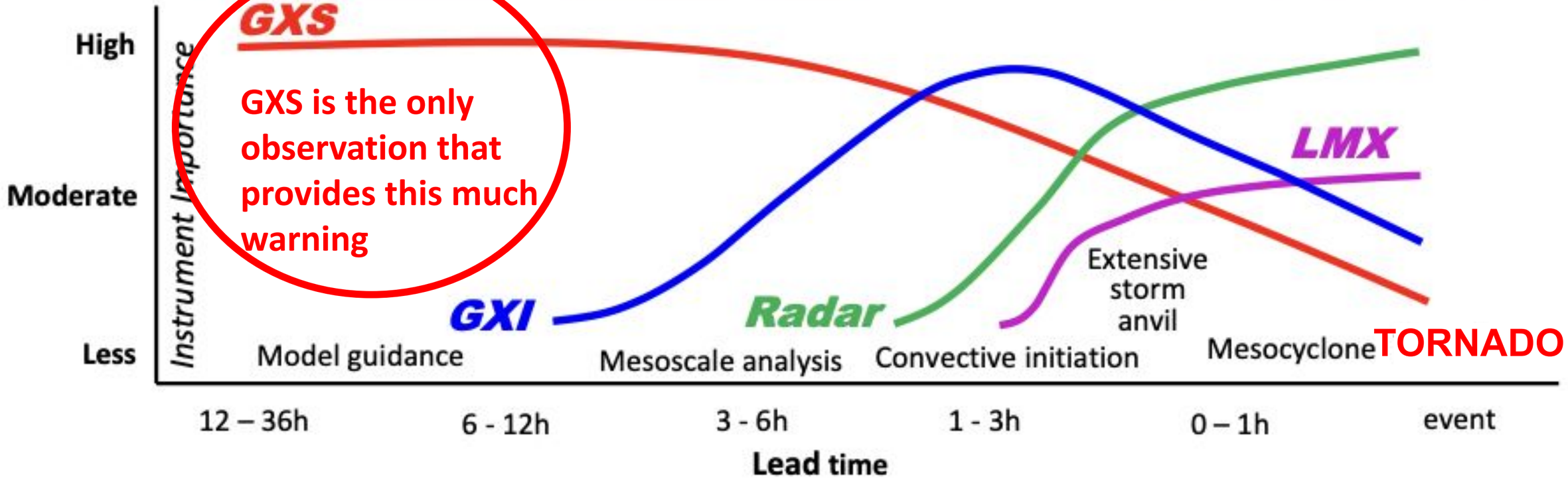
…errors can be identified through careful analysis of observational data

The most common are:

- PBL moisture characteristics
- Lower tropospheric boundary locations
- Position/timing of synoptic scale boundaries in closed/closing mid-latitude systems
- Unstable but weakly forced scenarios when cold pool characteristics are important
- Earlier or ongoing convection has overturned the environment and/or augmented boundary characteristics

From Randy Bowers (NWS Indianapolis)

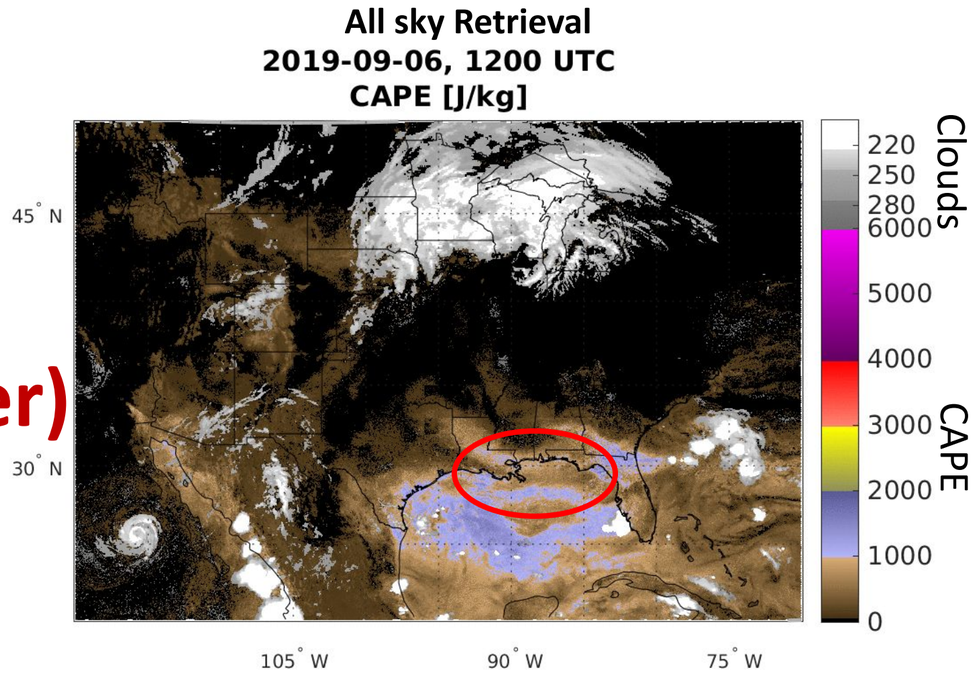
Contributions of GeoXO and Radar vs. Lead-time for Severe Storms



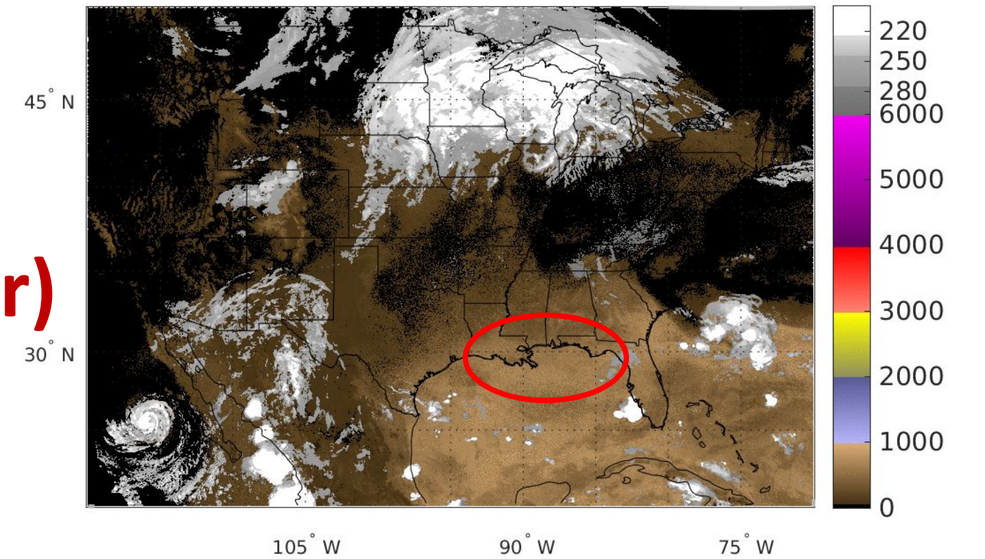
Application to nowcasting

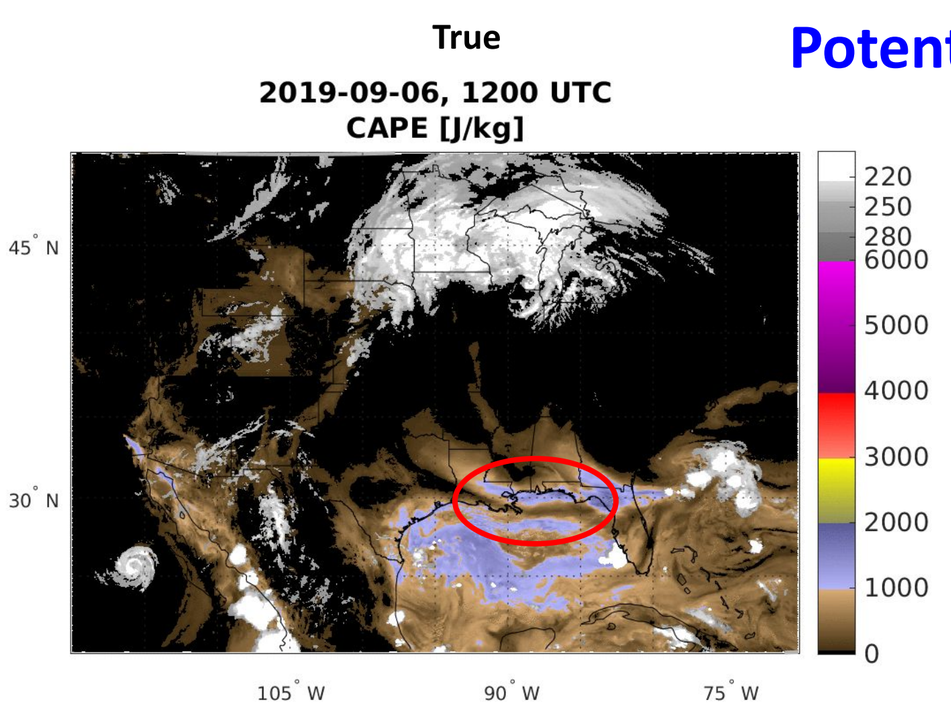
Convective Available Potential Energy

GXS (Sounder)



GXI (Imager)





True

GXS provides critical instability information in a pre-storm environment not possible from an imager

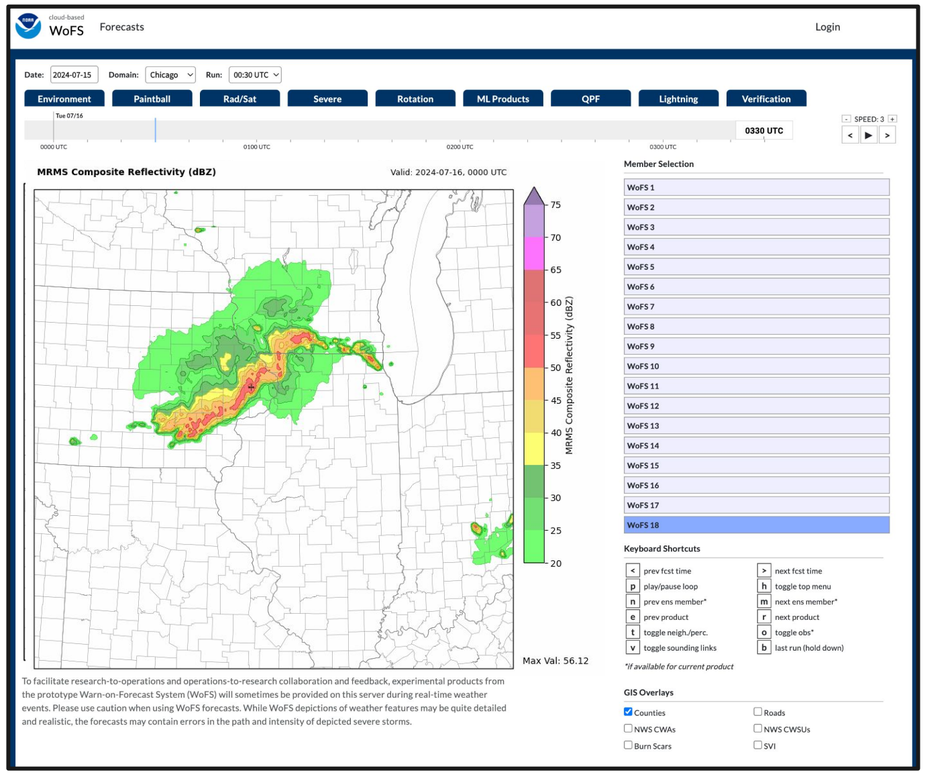
From Zhenglong Li (UW/CIMSS)

The Warn-on-Forecast System (WoFS)

Numerical guidance for thunderstorm hazards (e.g., flash flooding, tornadoes, large hail, etc.) for 0-6 h lead times (*"Watch-to-Warning"*) is **limited**.

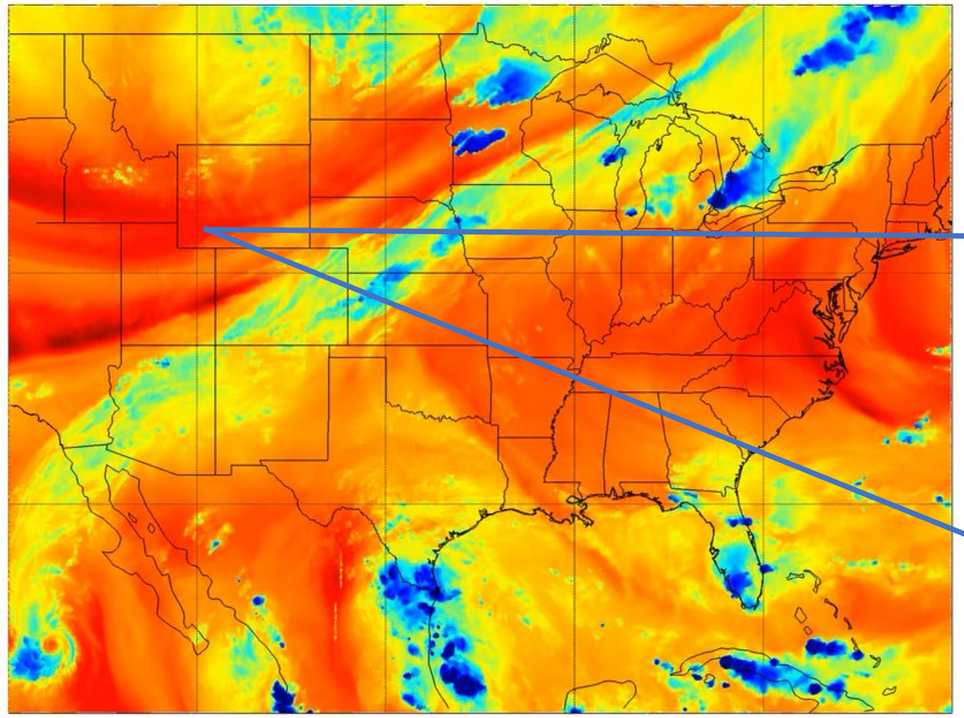
Using a convection-allowing ensemble, WoFS provides rapidly-updating probabilistic guidance for individual thunderstorm hazards in the 0-6 h range

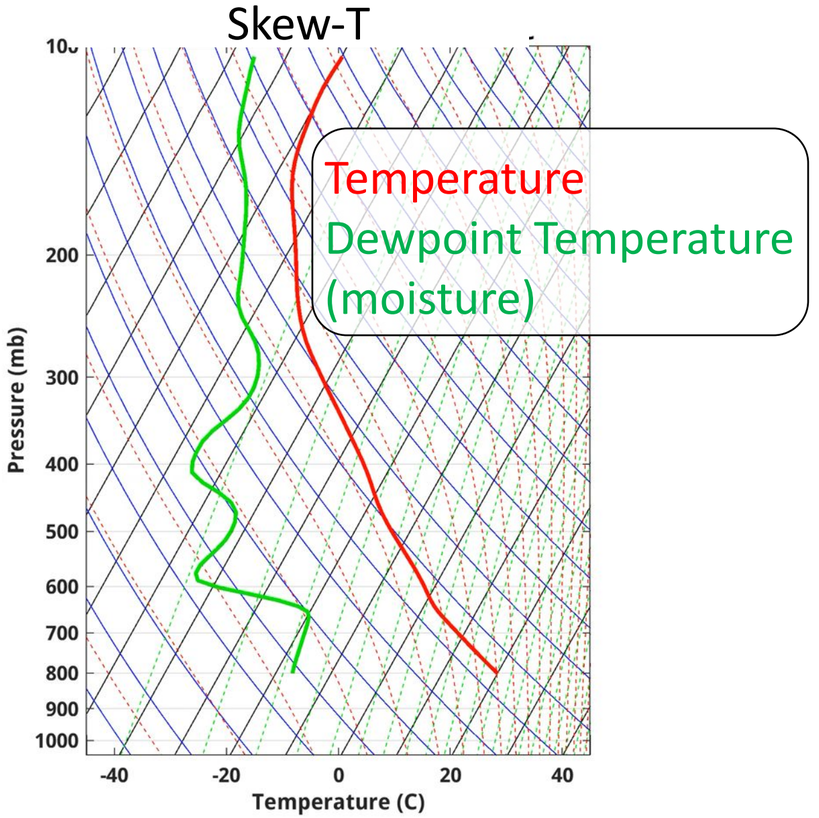
Cloud-Based WoFS Web Viewer

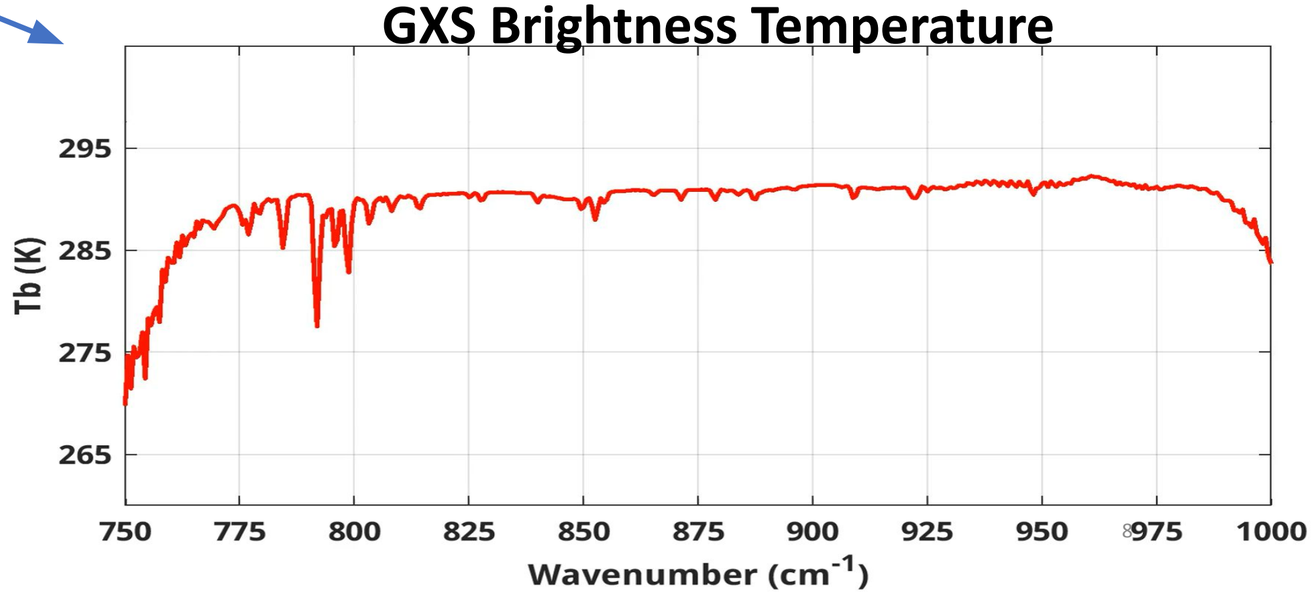


Slide Courtesy of Monte Flora

Wyoming Temperature inversion







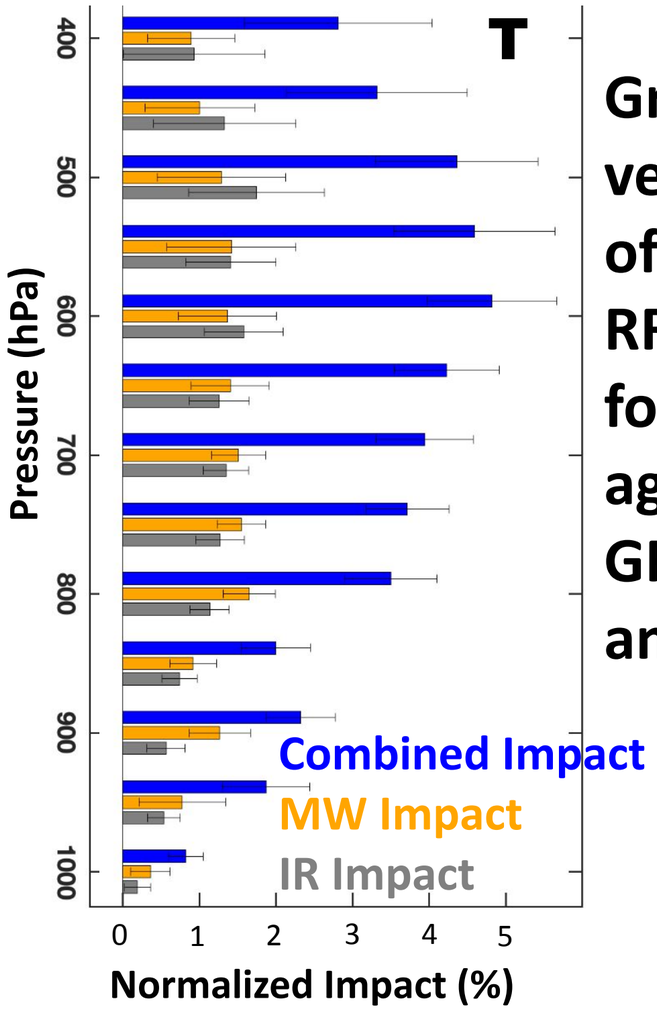
Fingers up: Temperature inversion

Fingers (way) down: No temperature inversion

From Zhenglong Li (UW/CIMSS)

Rapid-Update Regional Numerical Weather Prediction Applications for GeoXO Hyperspectral Sounder Observations

LEO satellite obs impact study shows importance of hyperspectral IR data



Gridded verification of 18-h RRFS forecasts against GFS analyses

We are very excited about the prospect of having high resolution hyperspectral sounder data covering the U.S. and adjacent regions.

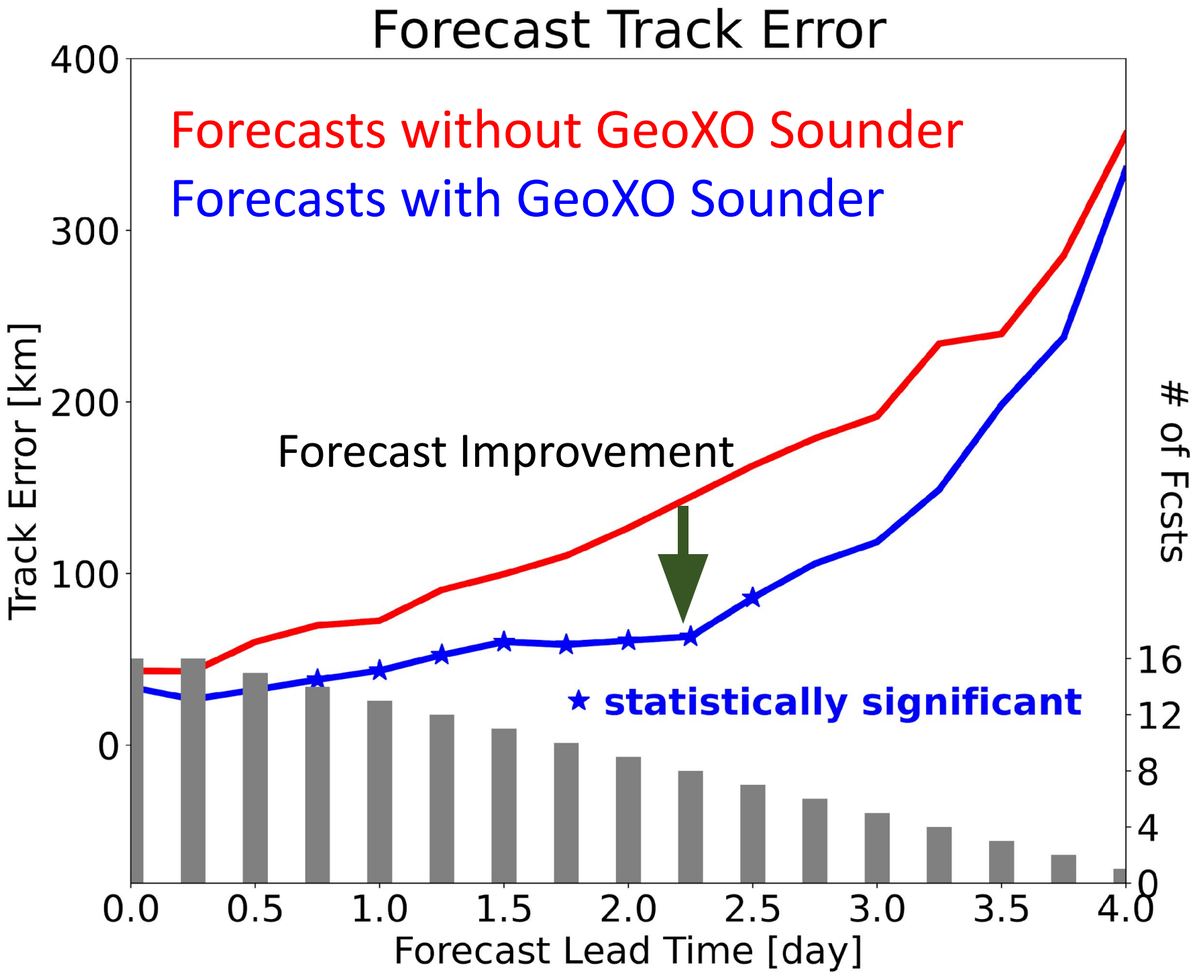
GXS data will be a game changer for improving forecasts of high impact weather from rapidly-updating high-resolution models

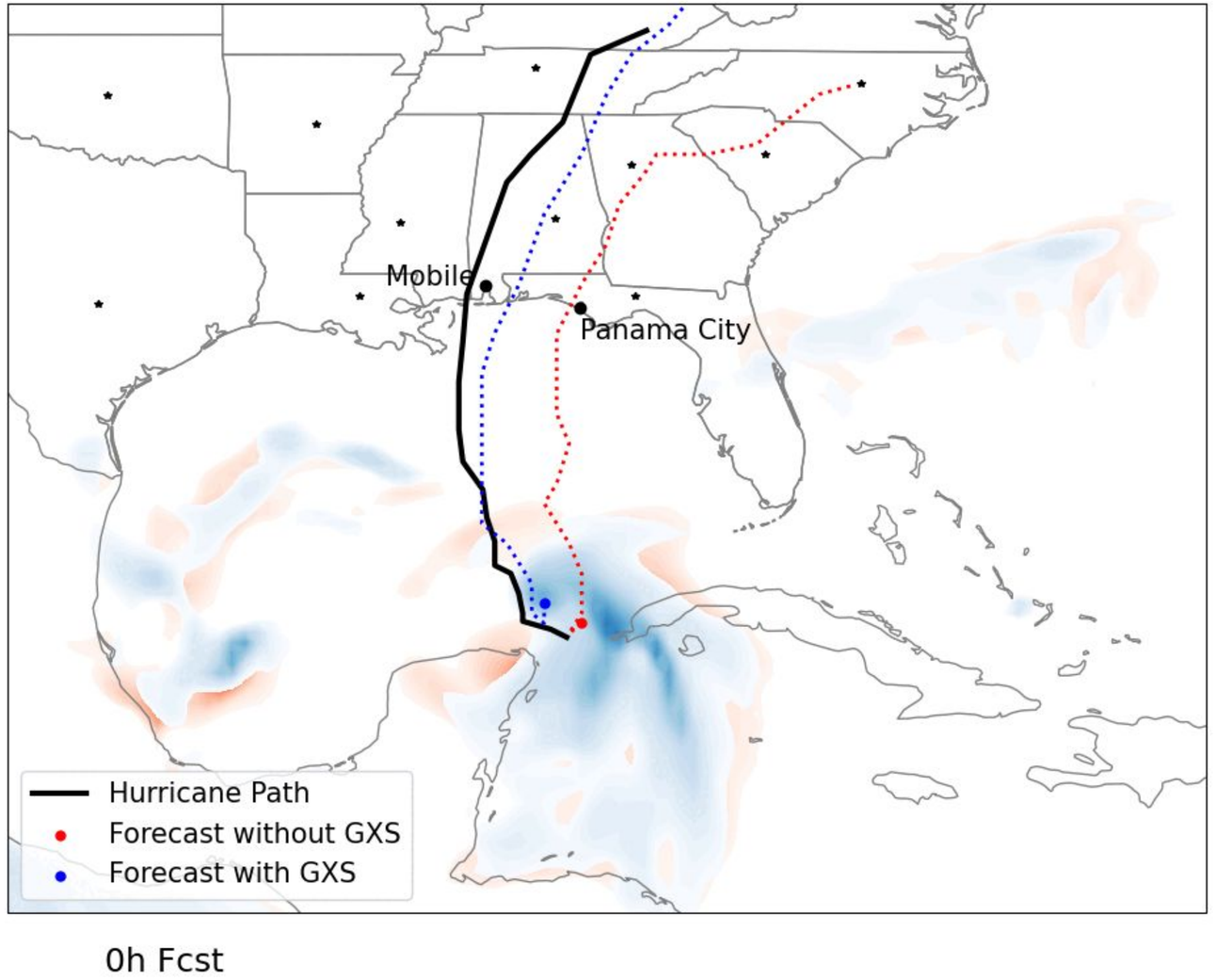
Regional model domain designed to take full advantage of GXS observations

Powered By GSL

Slide Courtesy of Steve Weygandt (NOAA GSL)

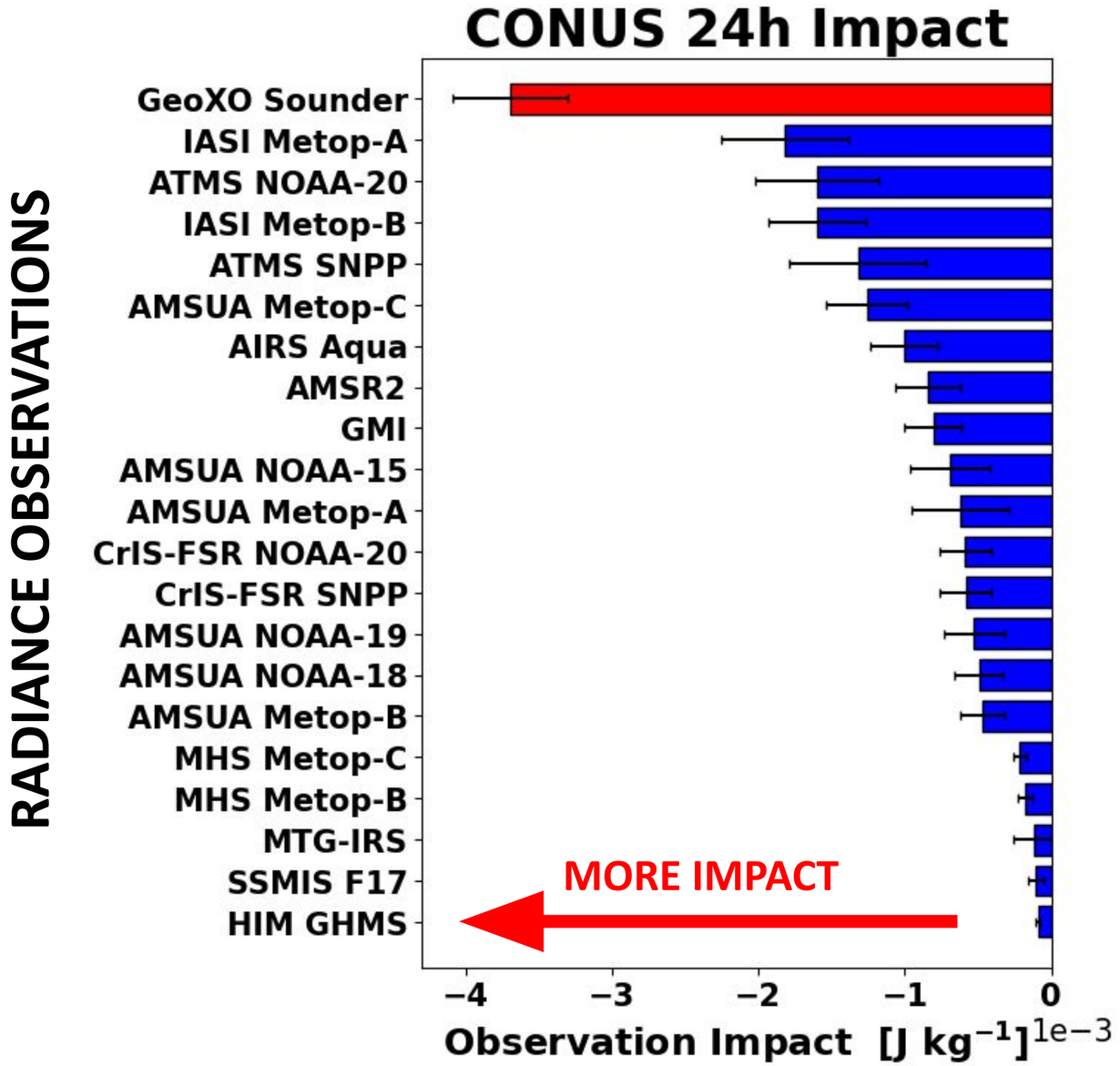
Hurricane Forecast Improvements





McGrath-Spangler et al. (2024)

Forecast Impact over CONUS



GeoXO OSSE Impacts

- Largest radiance impact over CONUS
- High temporal frequency
- Constant spatial coverage

McGrath-Spangler et al. (2025)

International GEO Sounders

CMA has 2 GEO IR sounders in operation
- Improved typhoon and warm anomaly forecasting

Europe will launch IRS this summer
- Expected to provide detailed atmospheric profiling leading to improved NWP, earlier detection of convective storms, and air quality applications

Japan expected to launch GHMS in JFY 2028
- Expected improvements to NWP and typhoon forecasting

Korea and India too!

Many opportunities to refine applications!

GODDARD EARTH SCIENCES

Thanks!

Any Questions?

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GeoXO

GODDARD EARTH SCIENCES

Met Office

EUMETSAT Research Fellowship:

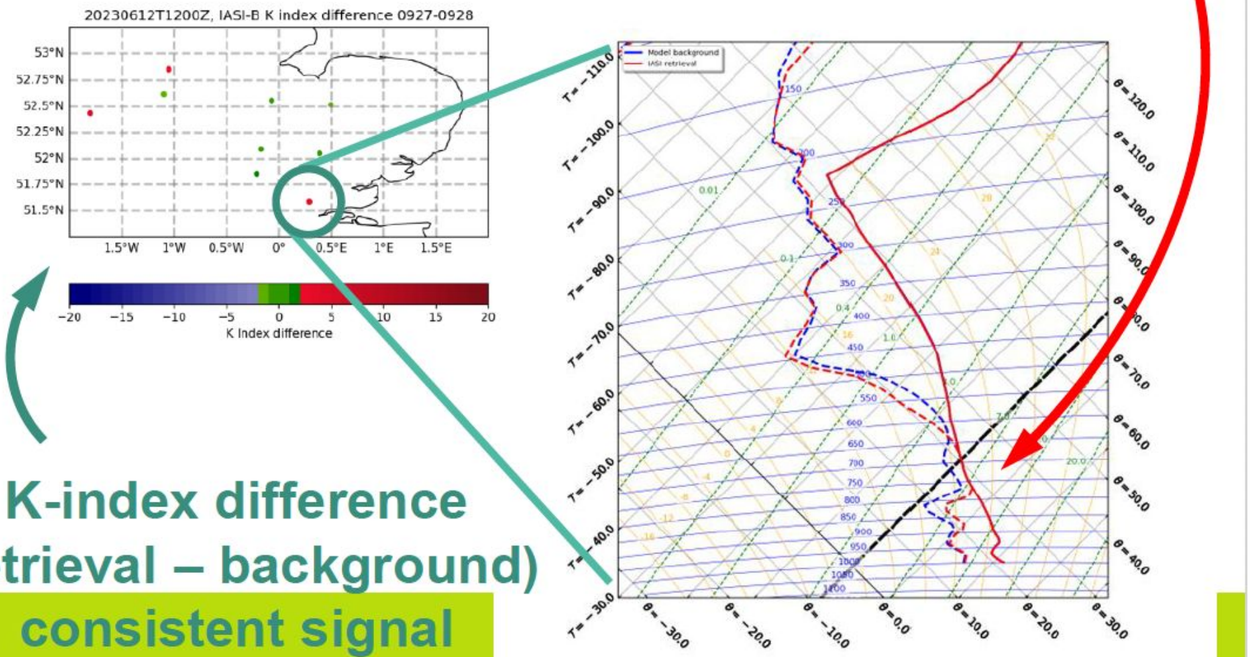
Using MTG-IRS to diagnose convective instability for nowcasting

October 2023 – October 2026

- 1d-Var/OE retrievals of T and q:
  - update model information using timely satellite observations → nowcasting tool
- Enhancing existing SEVIRI-based products:
  - what extra information does hyperspectral coverage give us?
  - how to optimise the retrieval?
  - how best to summarise added value for an operational forecaster?
- Currently using morning IASI overpasses as a proxy: MTG-IRS will give better temporal resolution and continuity

SEE POSTER SESSION
Ruth Taylor, Poster 3.16

IASI retrieval indicates moister profile at lower levels than **model background**
→ **greater likelihood of convection**



K-index difference (retrieval – background) consistent signal

From Blackmore (EUMETSAT 2024)

Received: 15 December 2021 | Revised: 17 March 2022 | Accepted: 1 April 2022 | Published o
DOI: 10.1002/qj.4282

RESEARCH ARTICLE

Analysis of MTG-IRS observations ... selection

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Atmos. Meas. Tech., 17, 5279–5299, 2024
https://doi.org/10.5194/amt-17-5279-2024

Atmospheric Measurement Techniques
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Assessment of the contribution of the Meteosat Third Generation Infrared Sounder (MTG-IRS) for the characterisation of ozone over Europe

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Received: 17 February 2024 – Discussion started: 12 March 2024
Revised: 4 July 2024 – Accepted: 17 July 2024 – Published: 12 September 2024

Received: 16 December 2022 | Revised: 15 May 2023 | Accepted: 25 July 2023
DOI: 10.1002/qj.4548

Quarterly Journal of the Royal Meteorological Society RMetS

RESEARCH ARTICLE

...e future MTG-IRS sounder ...eather prediction

...Vidot | P. Brousseau | M. Martet |

...S) instrument is an infrared Fourier-transform spec-...oard the Meteosat Third Generation series of the future ...for the Exploitation of Meteorological Satellite's geo-...ill measure the radiance emitted by the Earth at the ...ing 1,960 channels. The IRS will provide high spatial-...four-dimensional information on atmospheric temper-...ds, clouds, and surfaces, as well as on the chemical

...9AX, UK

January 2020