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# Climate Decision Support as a Service - Not Just Up and Coming, Up and Running

## The Advance Climate Analysis and Forecast Decision Support System (ACAF-DSS)

## Phase II.5

SBIR Topic **N142-121**

Office of Naval Research (ONR)

Presented by:
Bruce W. Ford, President
Clear Science, Inc.

# The DOD Challenge

***TOPIC OBJECTIVE:*** **Develop a software suite which would allow DoD mission planners to access, manipulate, display, and save extended range (intra-seasonal to inter-annual) probabilistic environmental prediction graphical products from a distributed Federal data service through a fast, flexible, and IA-compliant web service.**

***DESCRIPTION HIGHLIGHTS:***

**"Almost all mission analysis and planning tools in the DoD rely heavily on short range (0-7 days) explicit deterministic forecasts."**

**"…forecast and related product datasets are massive and provided in diverse formats that are not well suited for DoD use, especially for use in decision support tools applicable to DoD mission planning"**

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# Why the ACAF-DSS?

## Better decision = better outcomes

- Reason #1
  - Predict variability
- Reason #2
  - Extended lead times to support planning decisions
- Reason #3
  - A realized tactical/strategic advantage

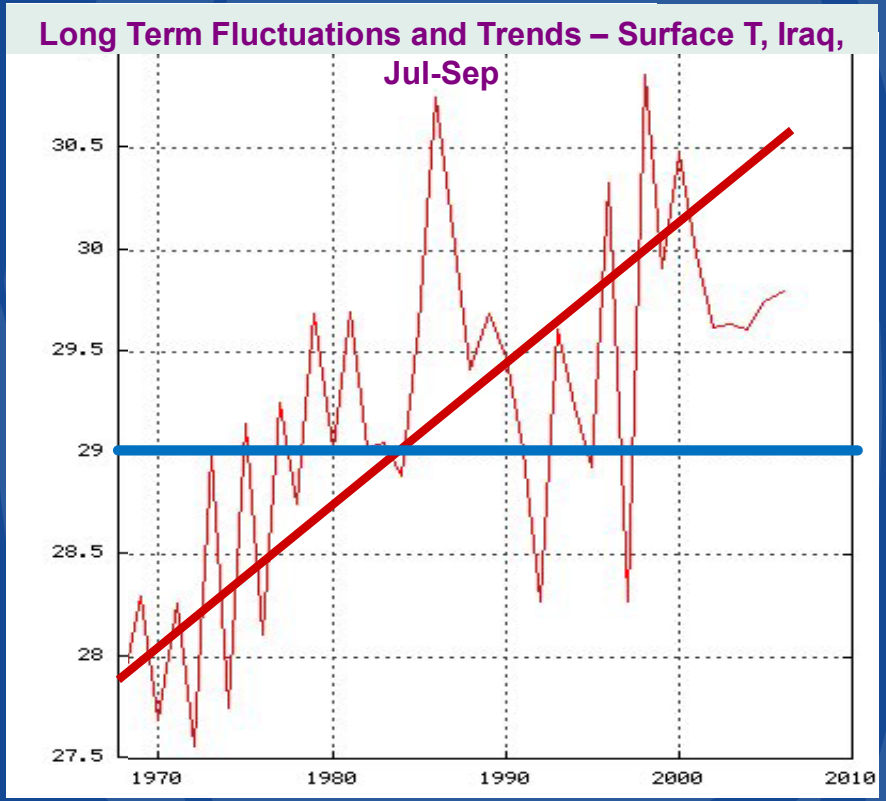


Image courtesy of Naval Postgraduate School

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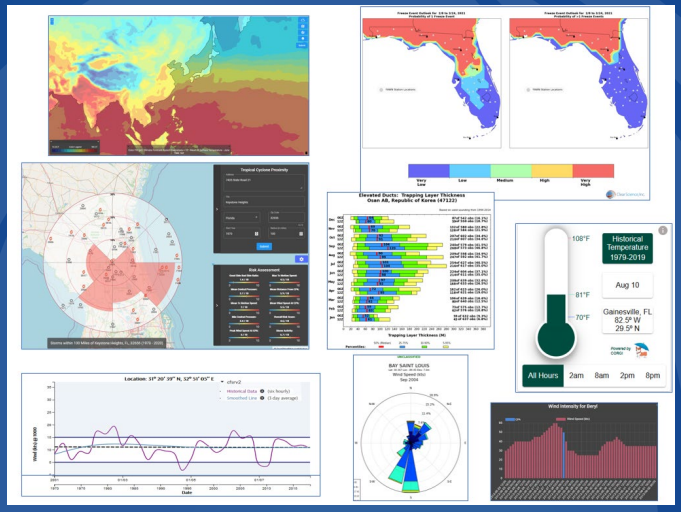
# What is the ACAF-DSS

- SBIR Phase II.5 – Prototype
- Full-featured Decision Support System (DSS) accessible via web, API call or OGC service
- Long-range forecasts (e.g., CFS, Subx)
- Access to 20+ historical datasets (1970-present) gridded, point observations, tabular (interchangeable)




**Time selection:**
- Hour
- Day(s)
- Month
- Conditional
  - COI
  - Parameter

**Calculations (native):**
- Mean
- Median
- Min/Max
- Percentile
- Standard deviation
- Long term:
  - Mean
  - Min/Max
  - Median
  - Percentile
  - Standard deviation

**Calculations (native):**
- Anomalies of:
  - Mean
  - Min/Max
  - Median
  - Percentile
  - Standard deviation
- Frequency of Occurrence
- Correlation
- Regression
- Special Parameters

**UI Outputs:**
- Image
- NetCDF
- CSV
- JSON

**Views:** Maps, time series', vertical profiles, cross sections

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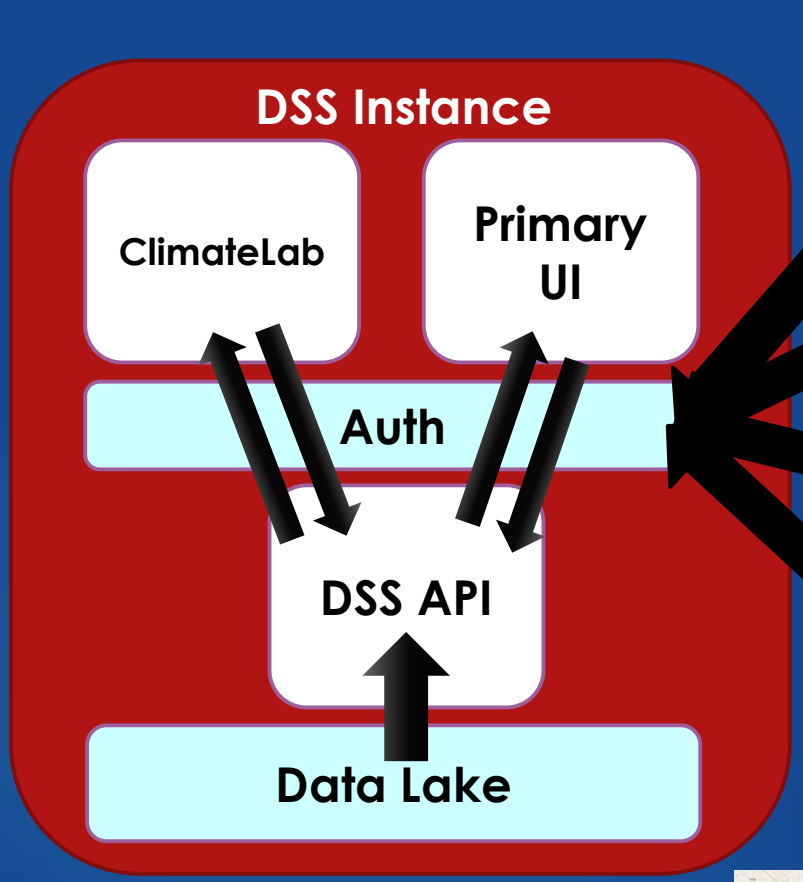
# Flexible Information Delivery




**Direct API Calls**

- Machine to machine
- Scripting
- TDAs

**OGC Service Calls**

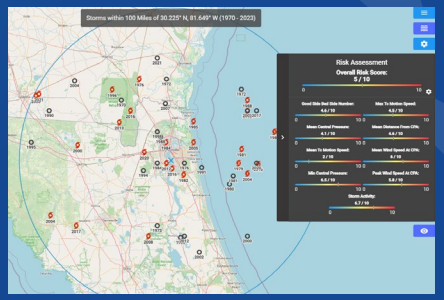
- WCS
- WFS

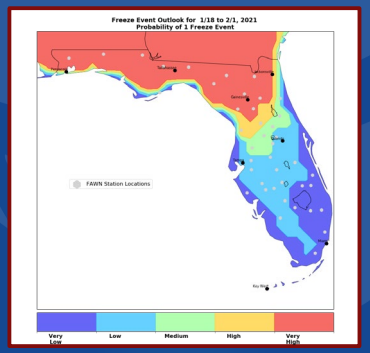
**Service Calls (Embedded Widget)**

- Surface Temperature Widget

**Special Use UIs**

- TERAS-TC
- Florida Freeze Probability Outlook



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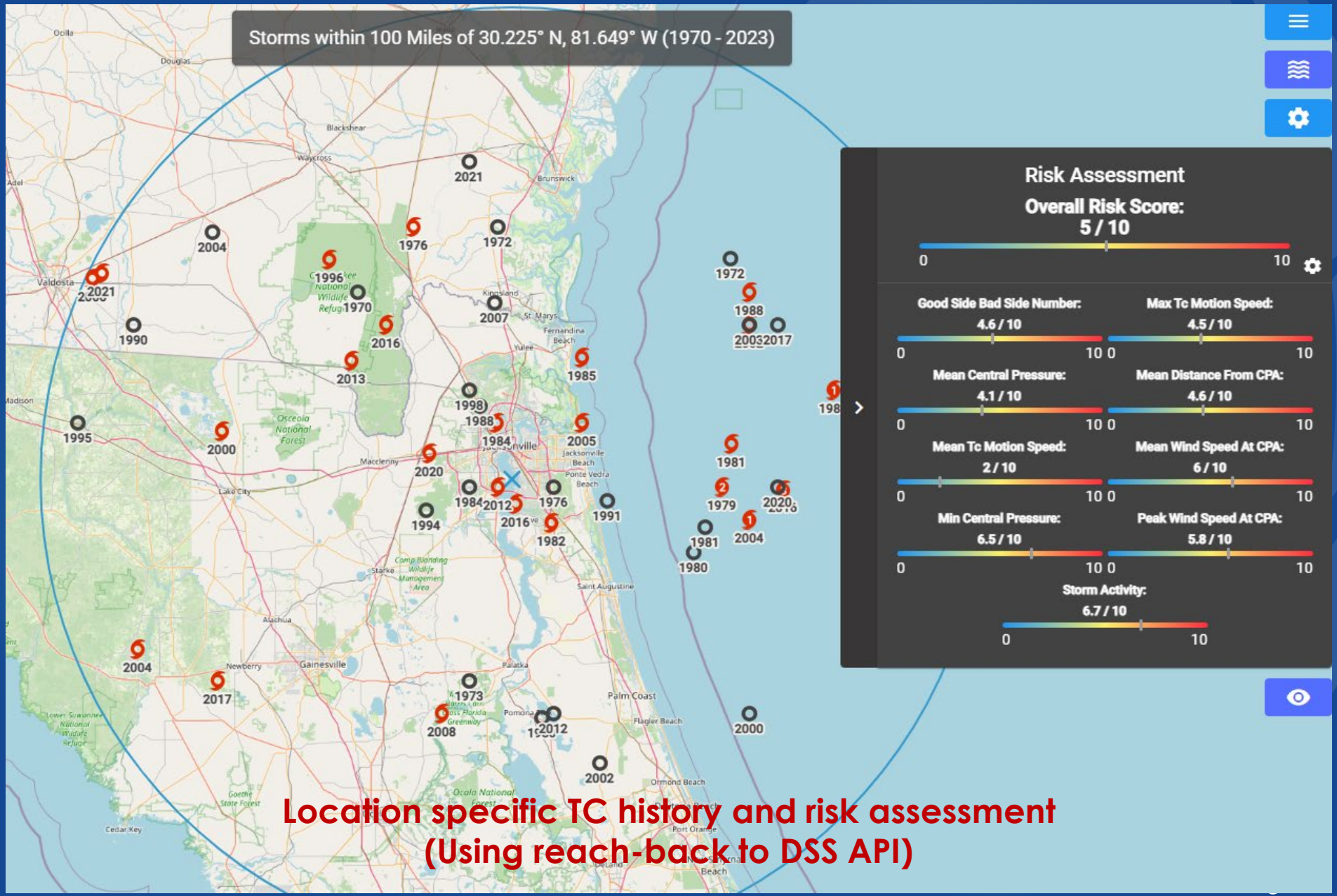
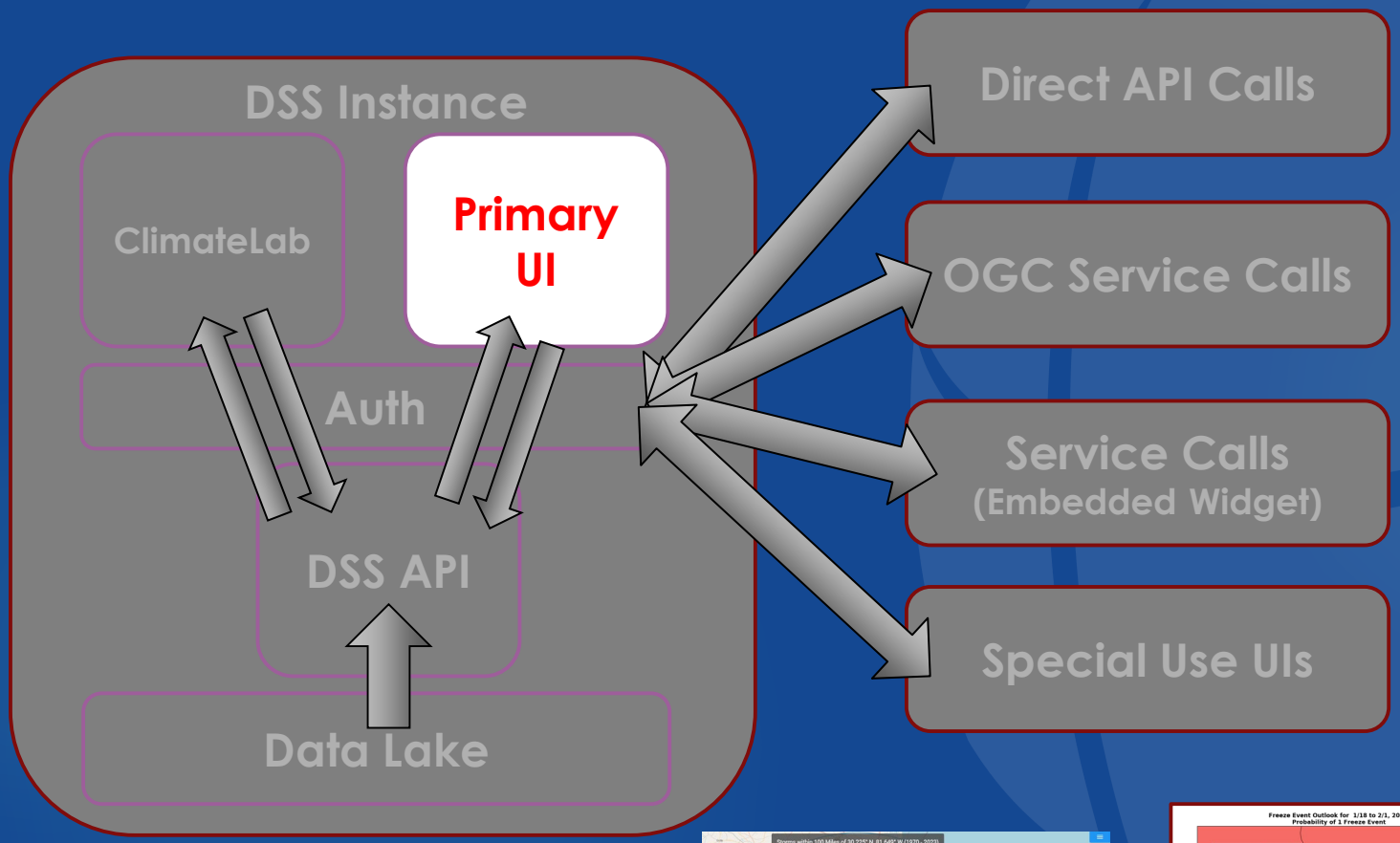
# Tropical Cyclone Risk Assessment UI




**Location specific TC history and risk assessment**
**(Using reach-back to DSS API)**

# Flexible Information Delivery



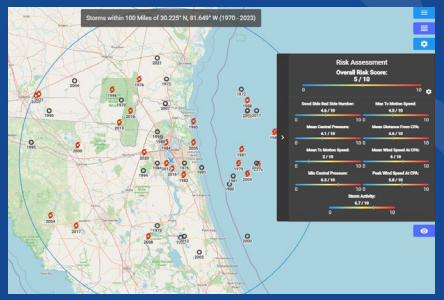

## *Actionable Information*

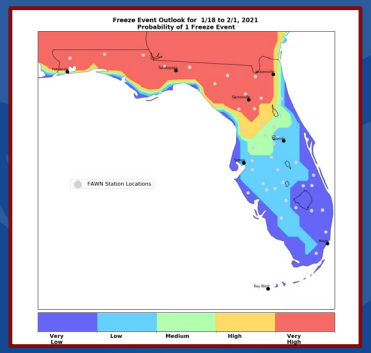
- Machine to machine
- Scripting
- TDAs

- WCS
- WFS

- Surface Temperature Widget

- TERAS-TC
- Florida Freeze Probability Outlook



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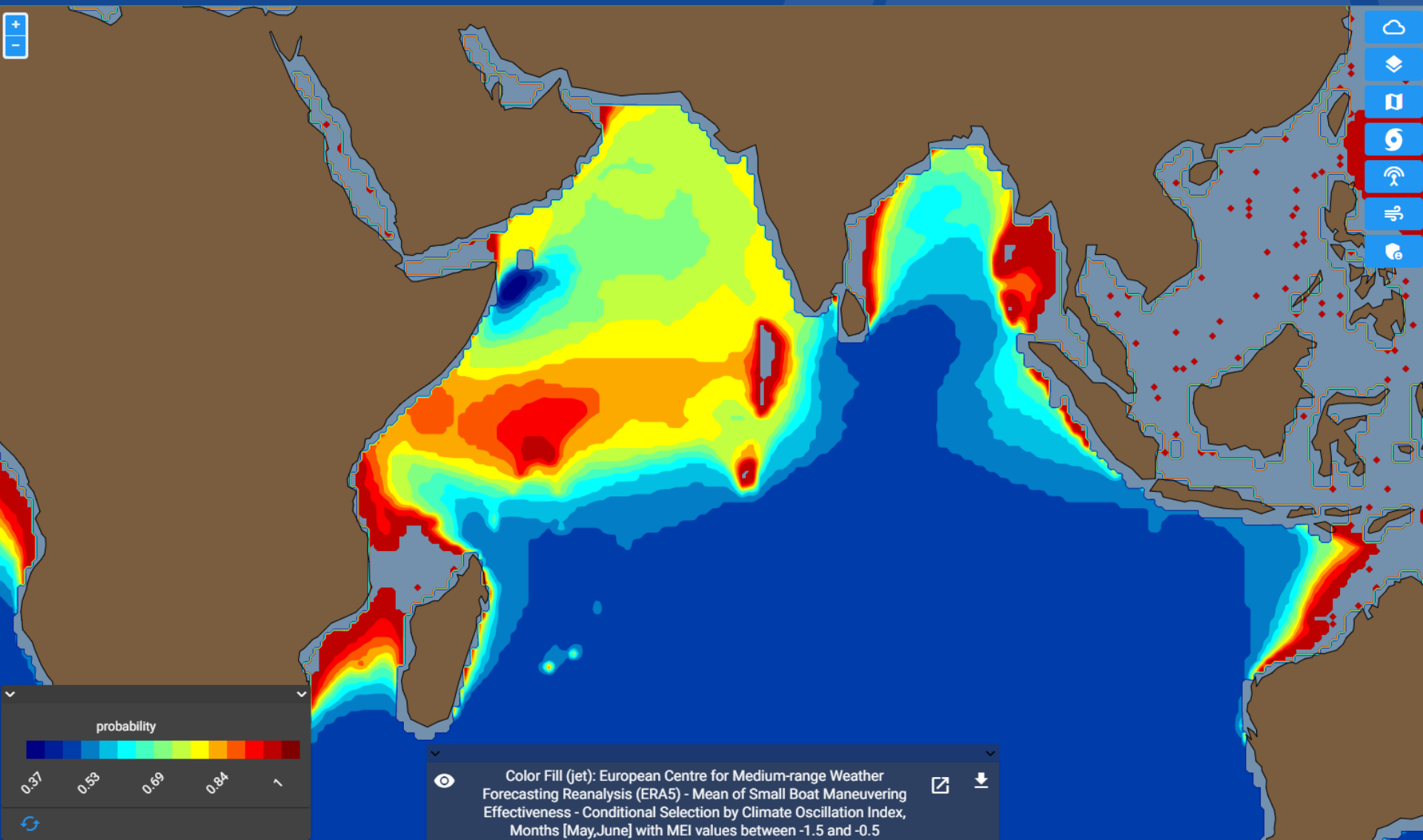
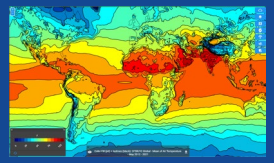
# Use Case: Small Boat Threat?

**Plot Small Boat Effectiveness in May-June for LN between -0.5 and -1.5**

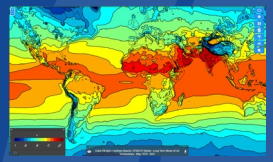


# Use Case: Recent Trends vs. LT? (magnitude and location)

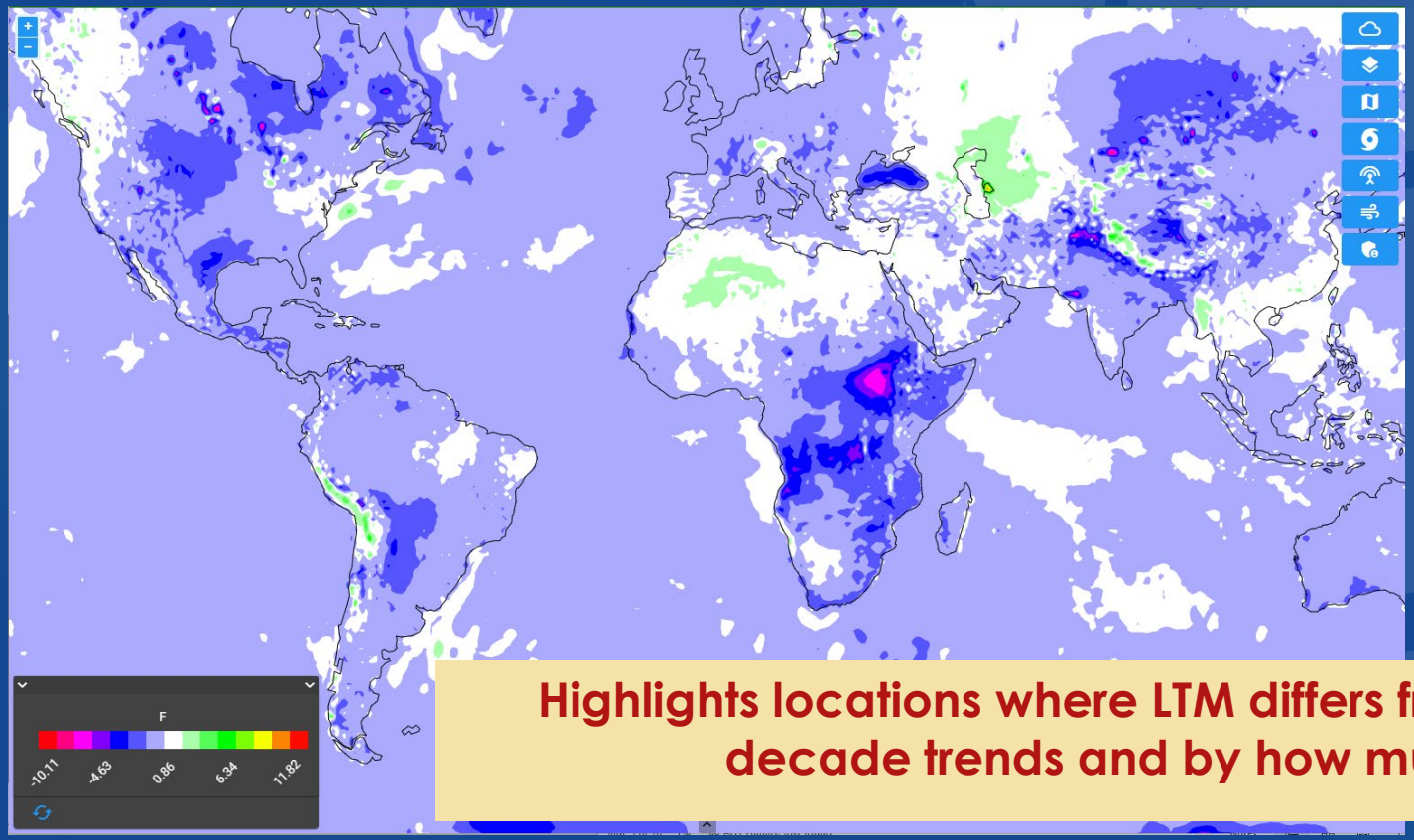
**Compare long term mean against an optimal climate normal (May Tsfc)**



Recent 10 years



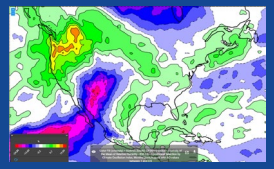
1979-2021 LTM



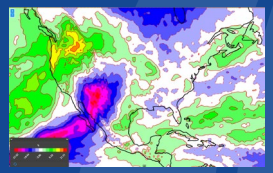

**Highlights locations where LTM differs from recent-decade trends and by how much**

# Use Case: What is your level of confidence

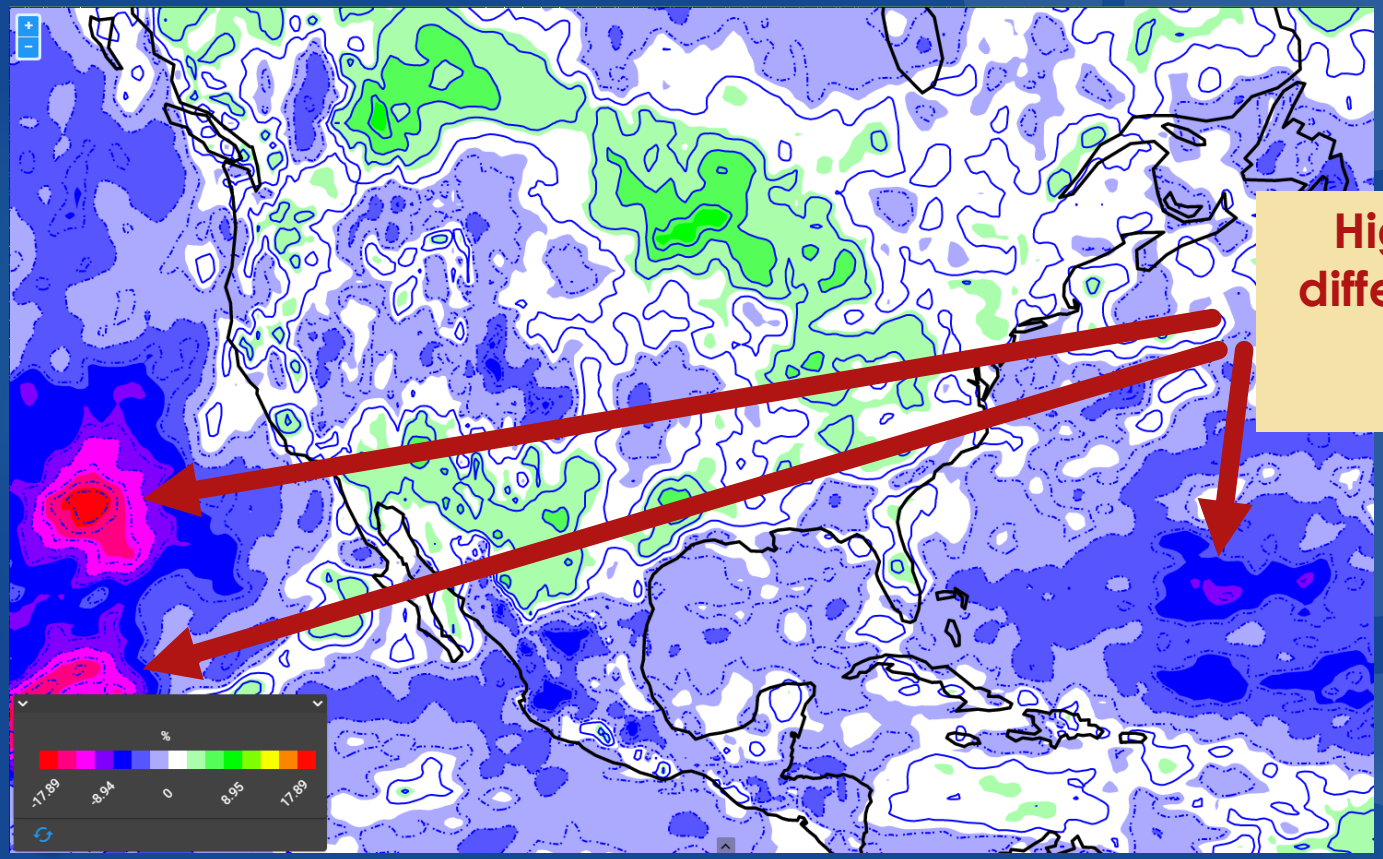
**Compare the same anomaly using different datasets (specific to a RH@850 in the summer [JJA] for AO >1)**



CFSV2



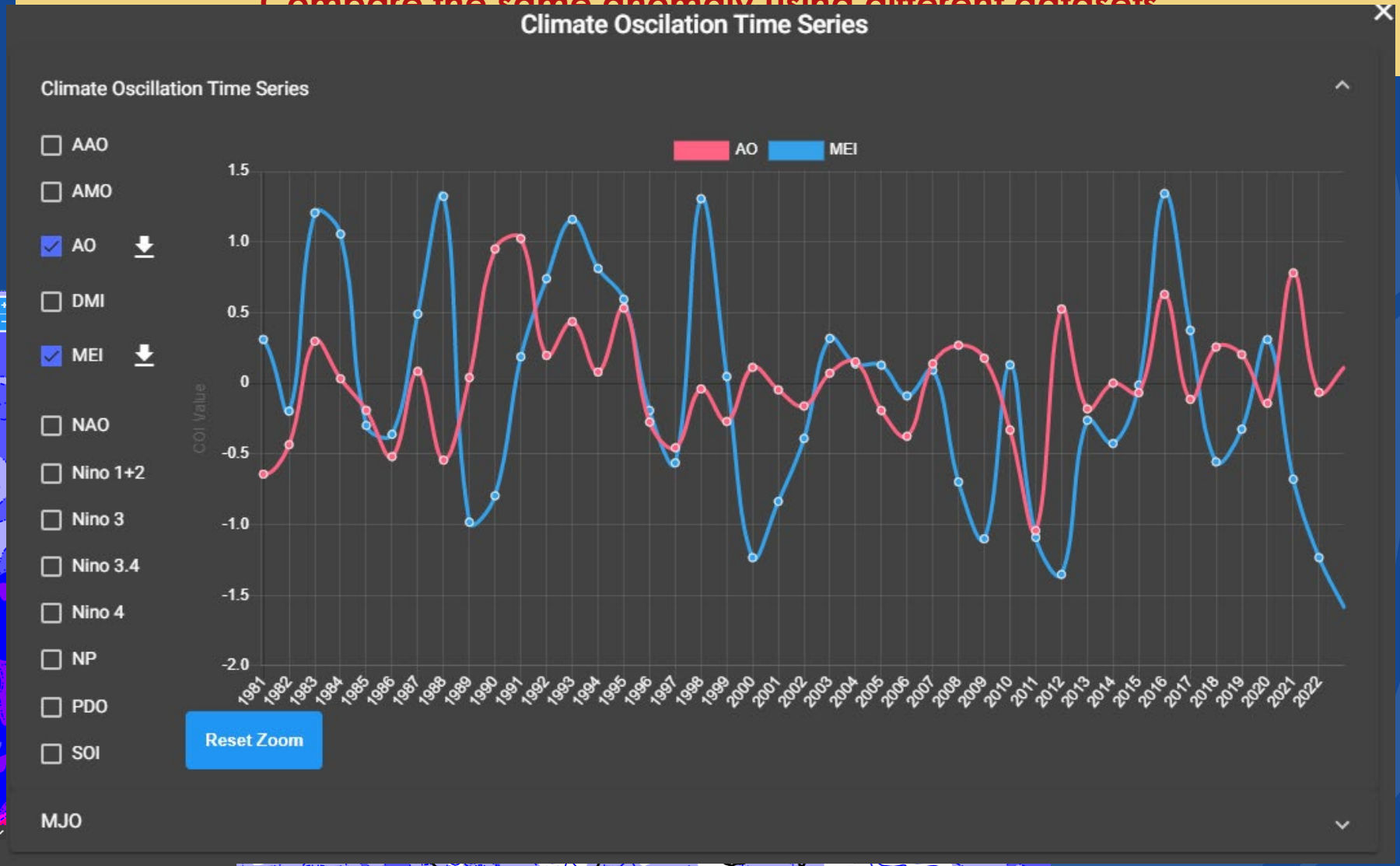
ERA5




**Highlights 18% RH differences between models.**

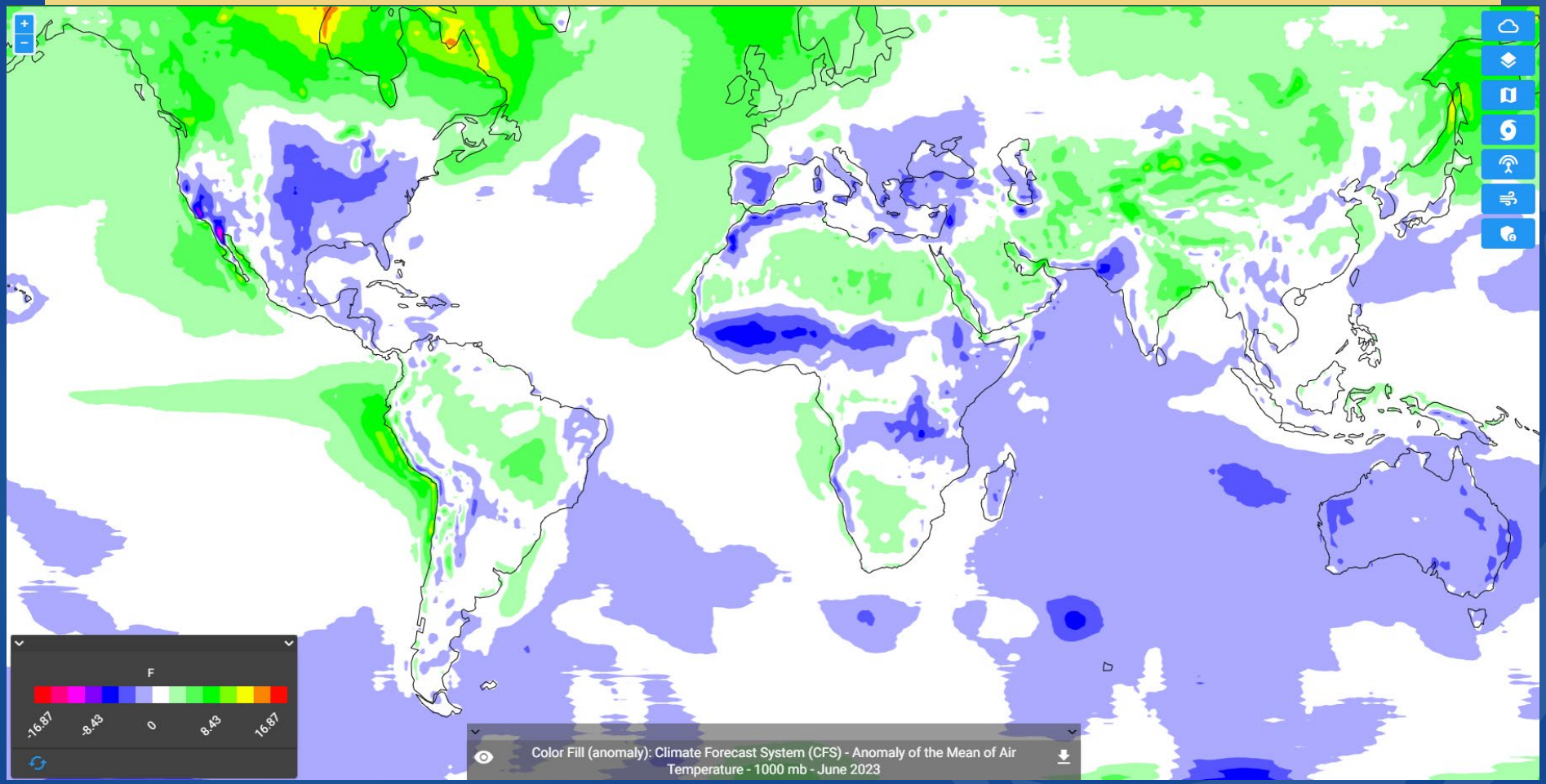
# Use Case: What is your level of confidence

Compare the same anomaly using different datasets



# Use Case: Comparison of Outlook Approaches

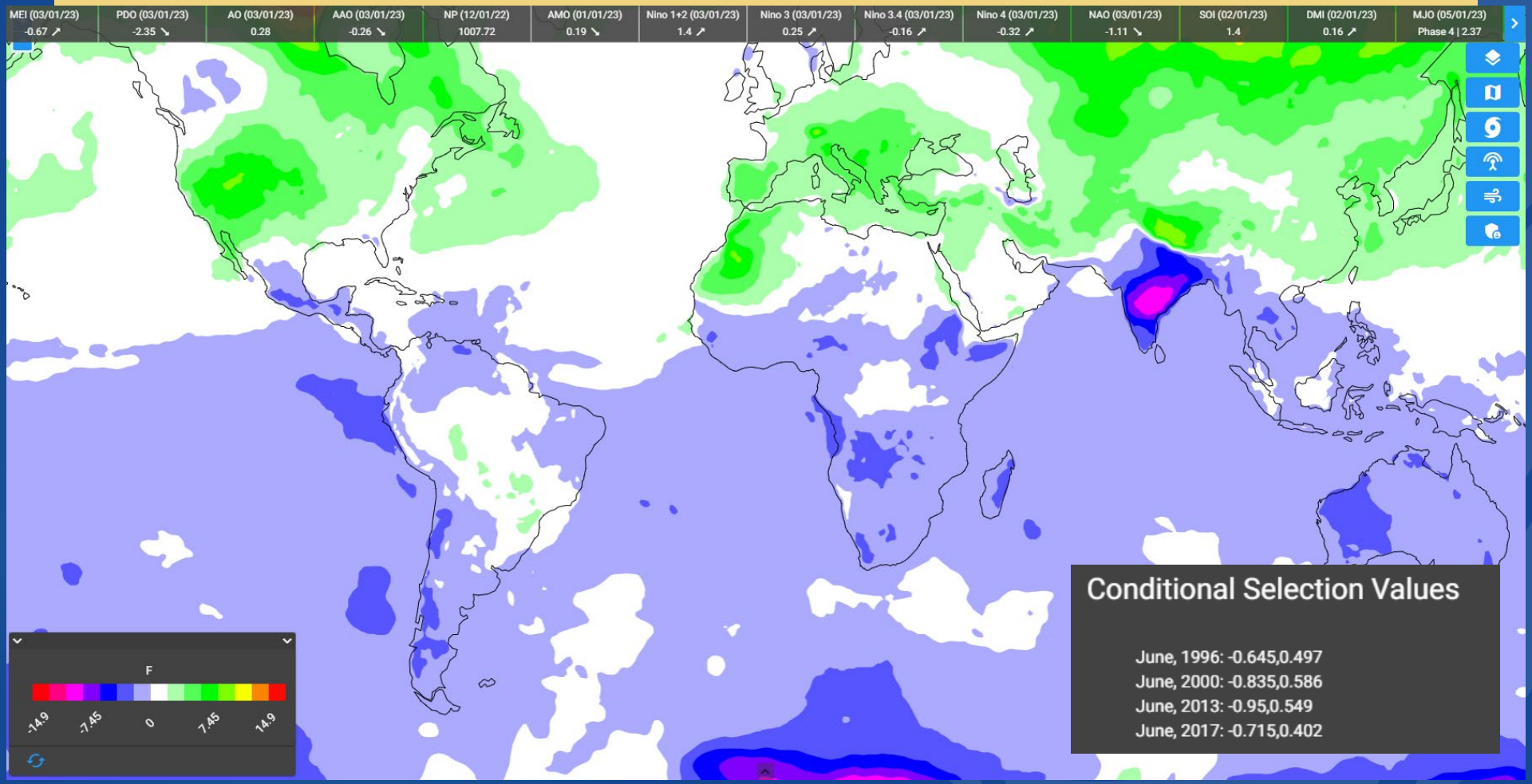
**Compare dynamic LR forecast to 'Climate situation' approach (June 2023 T1000 between CFS and MEI/AO predicted values/model months)**




**Step1: CFS T1000A for June of 2023**

# Use Case: Comparison of Outlook Approaches

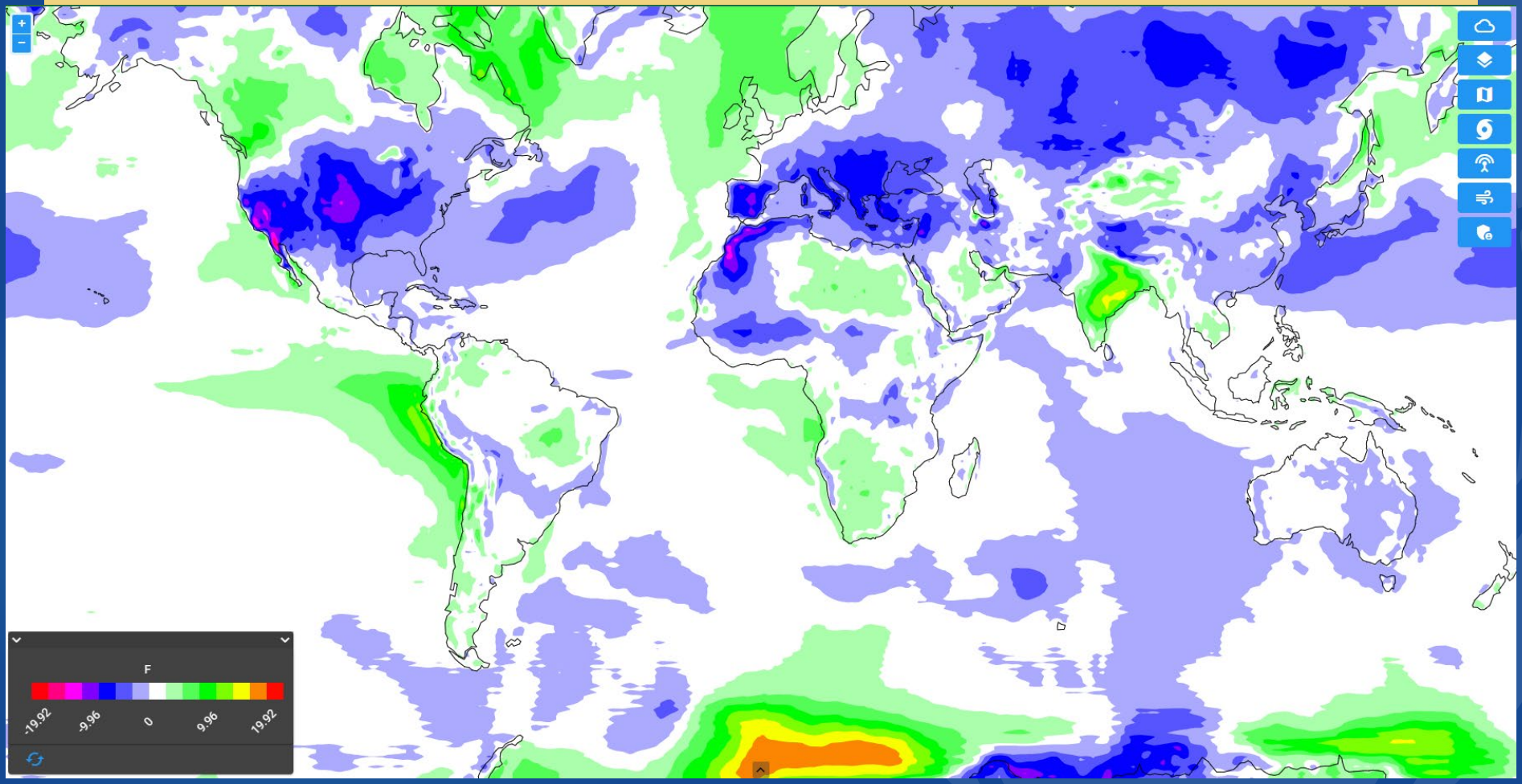
**Compare dynamic LR forecast to 'Climate situation' approach (June 2023 T1000 between CFS and MEI/AO predicted values/model months)**




**Step2: CFSV2 T1000A for Junes where MEI between -1.0 and -0.05 AND AO between 0 and 2**

# Use Case: Comparison of Outlook Approaches

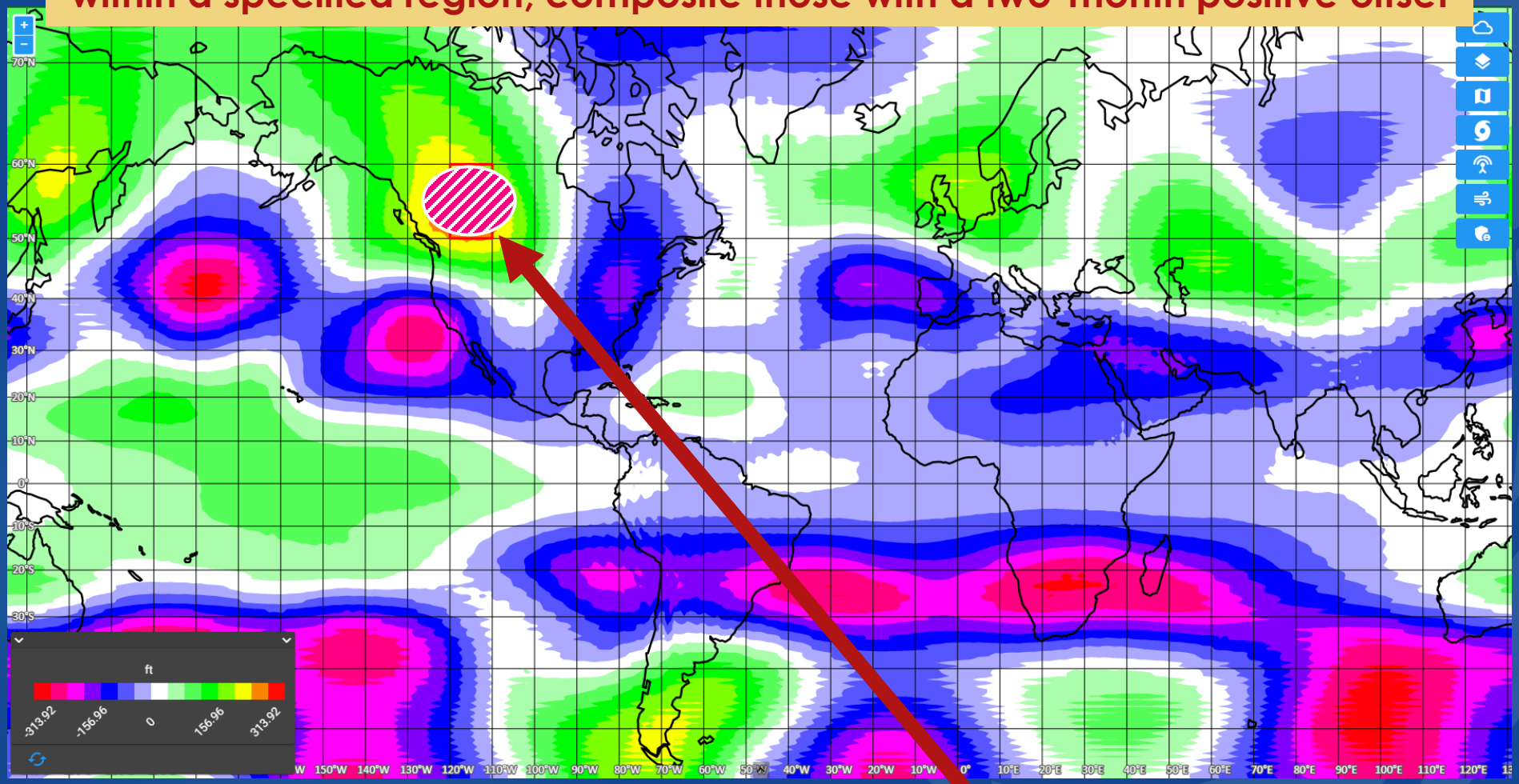
**Compare dynamic LR forecast to 'Climate situation' approach (June 2023 T1000 between CFS and MEI/AO predicted values/model months)**




**Step 3: Compare for a quick determination of how different the two methods are**

# Use Case: Teleconnective Impacts Analysis

**Conditionally select timeframes (Junes) that contain similar anomalies within a specified region, composite those with a two-month positive offset**




**CFS predicts a major anomaly here in June 2023!**

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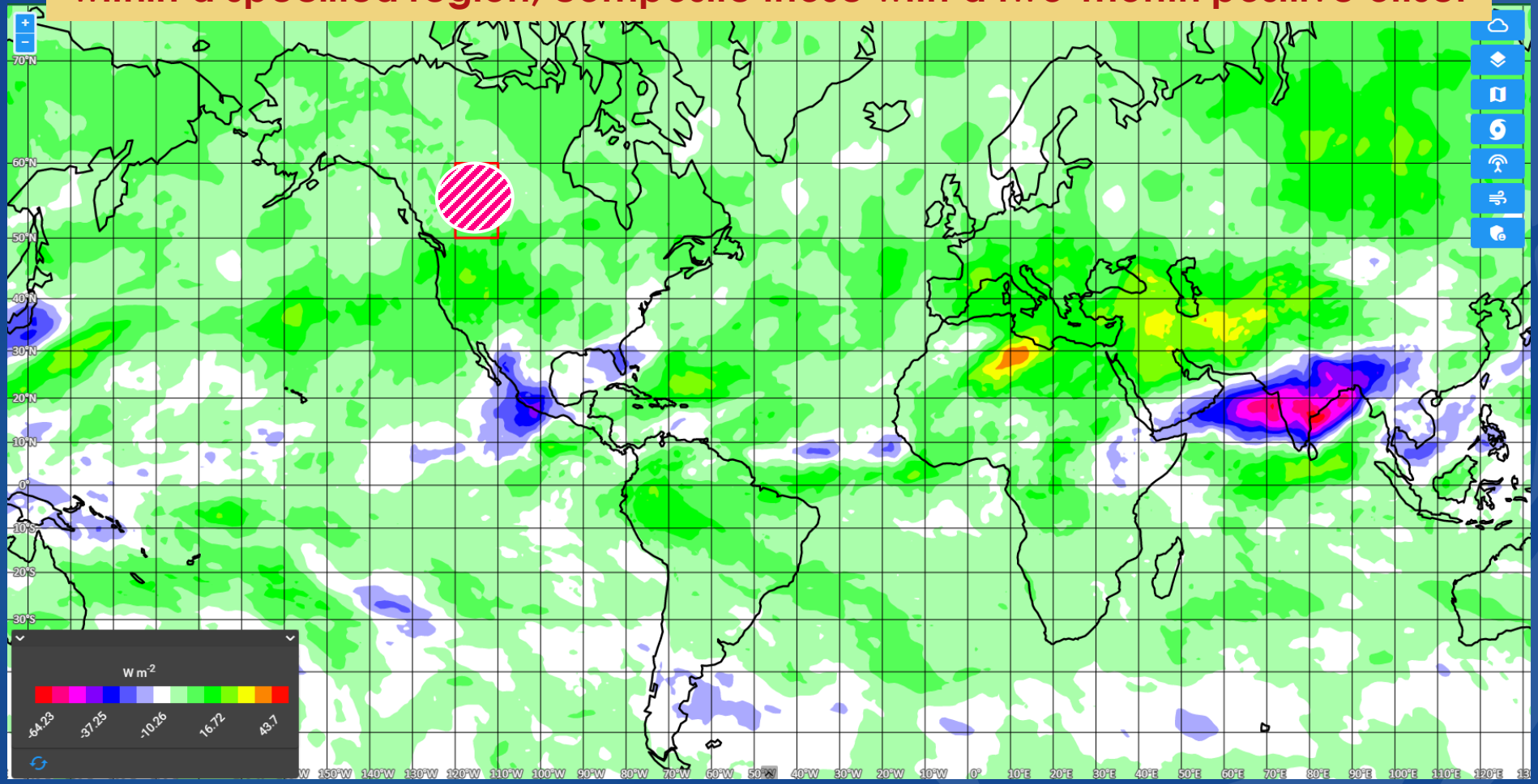
# Use Case: Teleconnective Impacts Analysis

**Conditionally select timeframes (Junes) that contain similar anomalies within a specified region, composite those with a two-month positive offset**




**Composite of June OLR where anomaly region has high Z200A values (94, 00, 03, 05, 06, 15, 17, 18, 21)**

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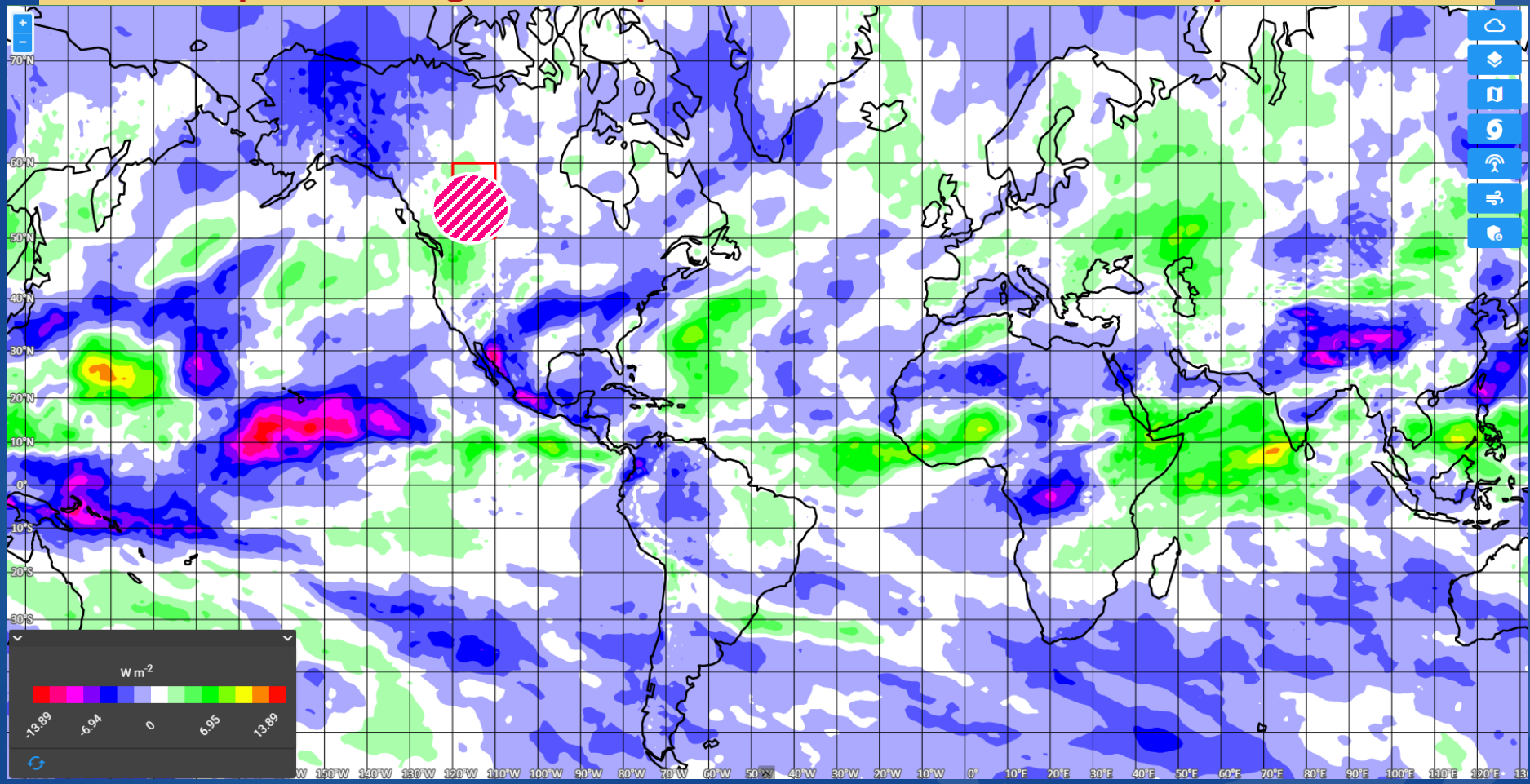
# Use Case: Teleconnective Impacts Analysis

**Conditionally select timeframes (Junes) that contain similar anomalies within a specified region, composite those with a two-month positive offset**




**Composite of AUGUST OLR where anomaly region has high Z200A values in June (94, 00, 03, 05, 06, 15, 17, 18, 21)**

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# ACAF-DSS Innovations/Benefits

| Innovation/Feature | Benefit to Decision-maker |
|---|---|
| Probabilistic environmental predictions within seconds (weeks to months lead time) | Enhanced planning, extend TDAs, better resource selection, risk reduction |
| System is available 24/7/365 | All planning cycle decisions can be enhanced with high-quality environmental information |
| > 20 historic and predictive datasets available and counting | Global/regional coverage to address any use case |
| Flexible output methods (UI, API, common formats, custom output) | Ensures decision-enhancing information is available across platforms |
| User interface (UI) with built-in data analysis tools (trends, bracketing, vertical/time/space cross sections, correlation/regression, time series) | Planners can customize information for specific purposes such as an operational constraint or timeframe |
| Extendibility – system built to facilitate custom-use out-growths | Reoccurring needs for information can be addressed in actionable, improved ways |

# DSS Potential Markets

- Departments of Government
- Insurance/Reinsurance (property, crop, health, liability)
- Finance/investment (world-wide commodities, capital allotment, investment timing)
- Agriculture (growth, infestation, timing, nutrient leeching)
- Energy (planning, timing energy purchases)
- Logistics (routing, staging, energy purchasing, expense forecasting)
  - Shipping (port selection, fuel conservation)
- Retail (pattern-of-life, shopper sentiment, shipping, sales space optimization)
- Healthcare (catastrophic event planning, staging)
- Tourism (early/late season onset, project planning)

# ACAF-DSS is a Force Multiplier!

- Add the benefit of improved environmental awareness to ALL of your organization's planning (e.g., the cumulative improvement effect of incrementally better information throughout the cycle).
- Let CSI apply this technology for your organization's benefit delivered exactly how your decision-makers need it, delivered constantly.
- Prime contractors – could your Government partners benefit by an extended weather/oceanography horizon? Mission-planning, TDAs, simulation creators, we can integrate with our platform.
- Industry – ACAF-DSS technology adaptable and expandable to a plethora of commercial applications. Advanced information about the emerging atmosphere can increase profits.

# ACAF-DSS What's next

- Contact us!


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**Video Link: https://youtu.be/sJJueXlYbCs**