



# Advances in METplus Verification Capabilities for Subseasonal to Seasonal Evaluation

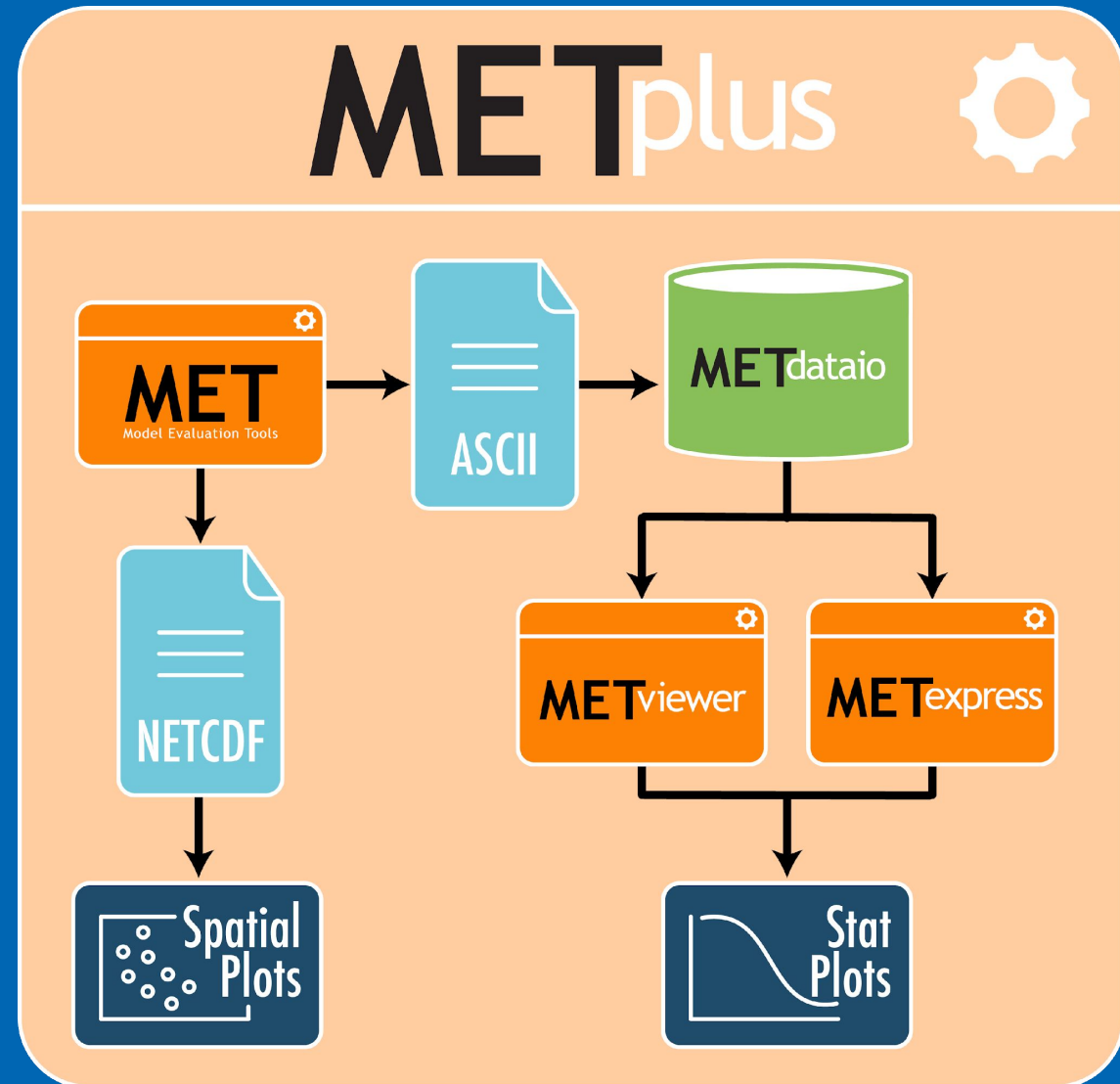
Christina Kalb<sup>1</sup>, Tara Jensen<sup>1</sup>, Minna Win-Gildenmeister<sup>1</sup>, George McCabe<sup>1</sup>, John Opatz<sup>1</sup>, Hank Fisher<sup>1</sup>, Zachary Lawrence<sup>2</sup>, Amy Butler<sup>2</sup>, Maria Gehne<sup>3</sup>, Douglas Miller<sup>4</sup>, Zhou Wang<sup>4</sup>, Cristiana Stan<sup>5</sup>, Weiwei Li<sup>1</sup>

<sup>1</sup>NCAR/RAL, <sup>2</sup>NOAA/CSL, <sup>3</sup>NOAA/PSL, <sup>4</sup>UIUC, <sup>5</sup>GMU



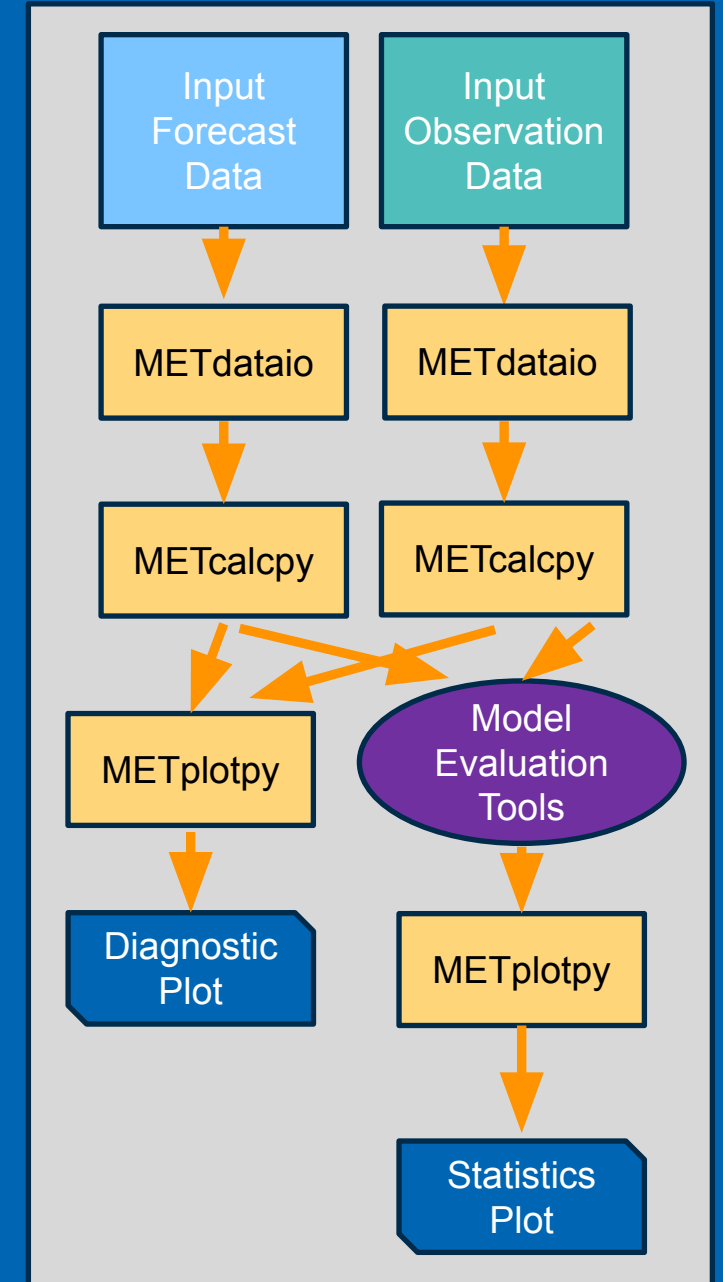
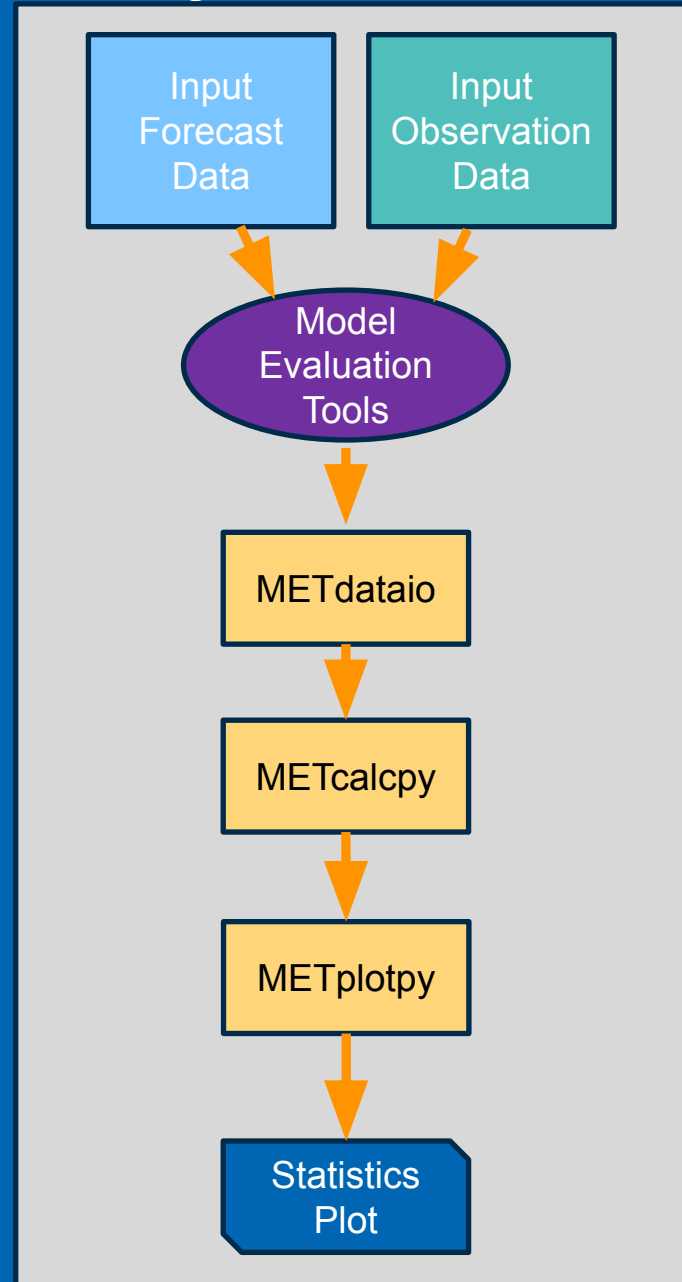
# What is METplus?

- Suite of verification and diagnostic tools wrapped in Python
  - Make model evaluation easy, reproducible
- Components:
  - Wrappers:
    - low level workflow for running MET
    - Move data from one component to another
  - Model Evaluation Tools (MET)
    - Statistical engine, point and gridded data
    - Over 150 traditional statistics and diagnostic methods
    - 15 interpolation methods
    - Spatial and Object-based methods
  - Analysis Tools
    - METcalcpy, METplotpy, METdataio, METviewer, METexpress



# METplus Analysis and Data Flow

- METviewer
- METcalcpy
  - Used by METviewer to compute statistics
  - Contains contributed diagnostics and pre-processing
- METplotpy
  - Used by METviewer to generate plots
  - Contains contributed plots for use cases
- METdataio
  - Loads verification data into METviewer
  - Reads netCDF for METcalcpy use



# Subseasonal to Seasonal Use Cases

- Use Case:
  - Example METplus configurations illustrating how to run common metrics
- 4 Categories
  - S2S
  - S2S: Mid Latitude
  - S2S: Madden-Julian Oscillation
  - S2S: Stratosphere
- May create a single plot
- Many S2S use cases combine
  - Diagnostics or Indices computed in METcalcpy
  - Statistics computed in MET
  - Graphical output from METplotpy

METplus  
develop  
Search docs  
FOR USERS  
User's Guide  
1. Overview  
2. METplus Release Information  
3. Getting Started  
4. Installation  
5. Configuration  
6. Python Wrappers  
7. METplus Use Cases  
7.1. MET tools  
7.2. Model Applications  
7.2.1. Air Quality and Composition  
7.2.2. Climate  
7.2.3. Clouds  
7.2.4. Data Assimilation  
7.2.5. Land Surface  
7.2.6. Marine and Cryosphere  
7.2.7. Medium Range  
7.2.8. Planetary Boundary Layer  
7.2.9. Precipitation  
7.2.10. Subseasonal to Seasonal  
7.2.11. Subseasonal to Seasonal: Mid-Latitude  
7.2.12. Subseasonal to Seasonal: Madden-Julian Oscillation  
7.2.13. Subseasonal to Seasonal: Stratosphere  
7.2.14. Short Range  
7.2.15. Space Weather  
7.2.16. Tropical Cyclone and Extra-Tropical Cyclones

## 7.2.10. Subseasonal to Seasonal

Subseasonal-to-Seasonal model configurations; Lower resolution model configurations (>4km) usually producing forecasts out beyond 14 days and up 1 year

- UserScript: Compute Cross Spectra and Make a Plot
- Grid-Stat and Series-Analysis: BMKG APIK Seasonal Forecast
- TCGen: Genesis Density Function (GDF) and Track Density Function (TDF)
- UserScript: Make a Hovmoeller plot
- GridStat: Determine dominant ensemble members terciles and calculate categorical outputs
- SeriesAnalysis: Standardize ensemble members and calculate probabilistic outputs

## 7.2.11. Subseasonal to Seasonal: Mid-Latitude

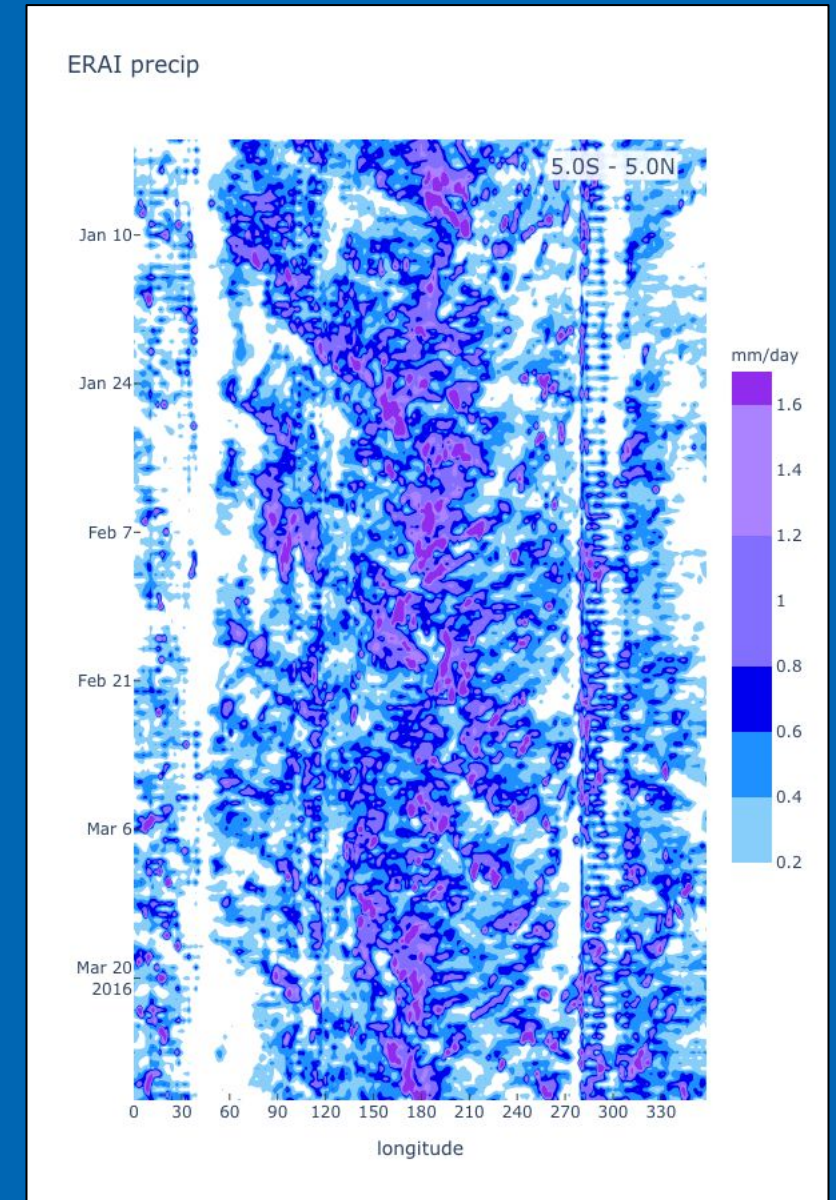
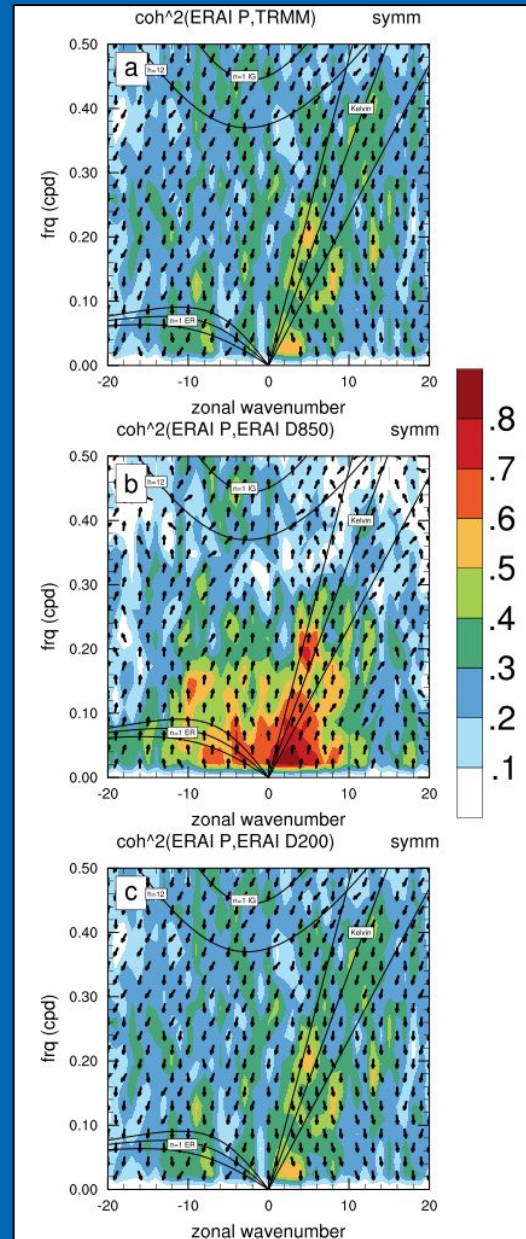
Subseasonal-to-Seasonal model configurations relating to middle latitudes

- Blocking Calculation: ERA RegridDataPlane, PcpCombine, and Blocking python code
- WeatherRegime Calculation: ERA RegridDataPlane, PcpCombine, and WeatherRegime python code
- Blocking Calculation: GFS and ERA RegridDataPlane, PcpCombine, and Blocking python code
- WeatherRegime Calculation: GFS and ERA RegridDataPlane, PcpCombine, and WeatherRegime python code

## 7.2.12. Subseasonal to Seasonal: Madden-Julian Oscillation

# Subseasonal to Seasonal Examples

- Two Plotting use cases
  - Cross Spectra plot
  - Hovmoeller plot ERAI precipitation
- CFSv2 Verification
  - Ensemble members Normalized by 29 year climatology
  - Traditional probabilistic statistics (ex. Brier, Reliability)
- Tercile Verification
  - Uses general trends seasonal to interannual
  - Multicategory contingency table statistics

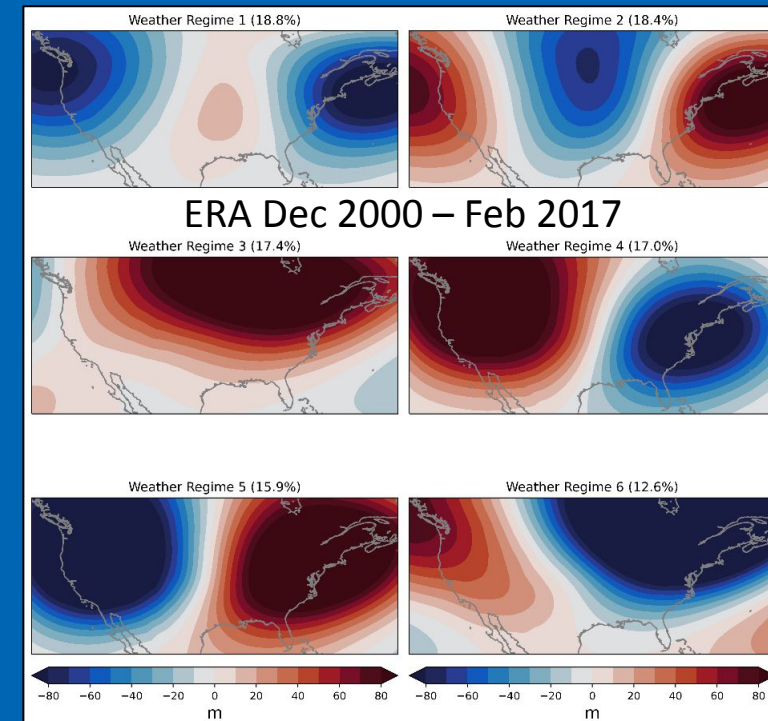
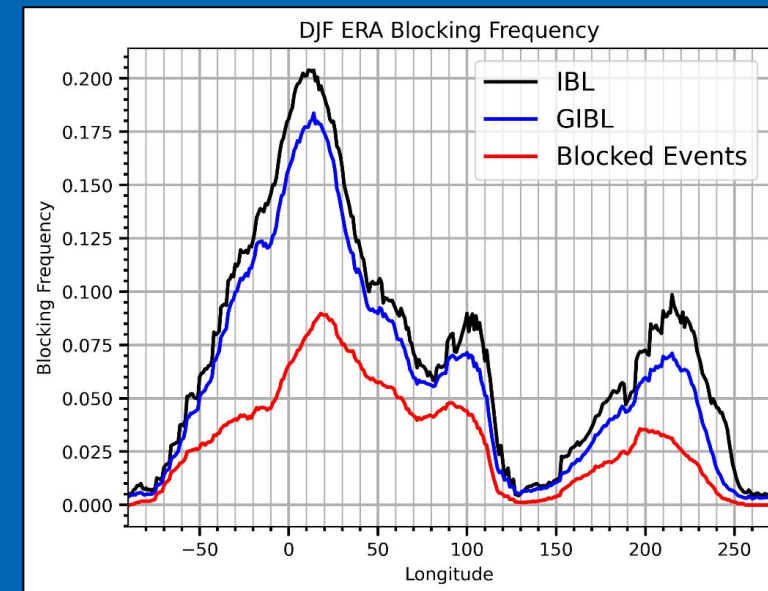


# Mid Latitude Examples

- UIUC
- Atmospheric Blocking
  - Most closely resembles Pelly Hoskins, 500 mb height
  - Reversals in geopotential height for blocked latitudes
  - Applies spatial and temporal characteristics
- Weather Regime Analysis
  - K-means clustering on 500 mb height, orders based on frequency
  - Optional step to perform EOF analysis and use reconstructed EOFs
  - Computes weekly frequency of each Weather Regime

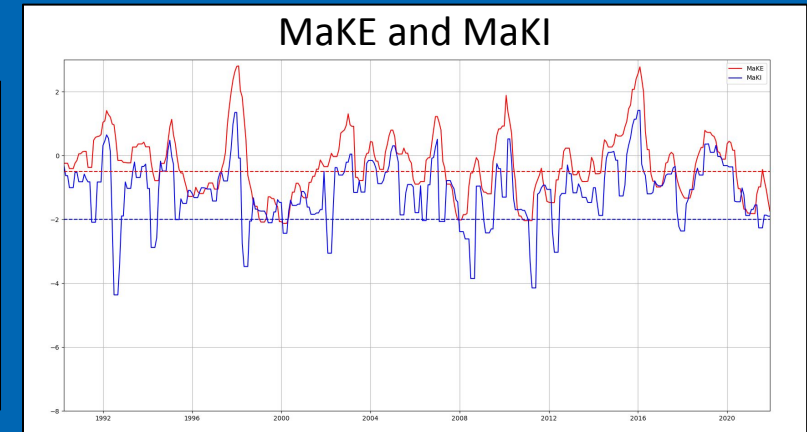
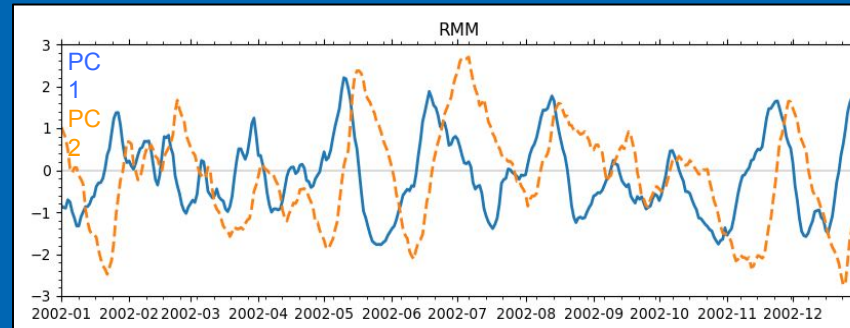
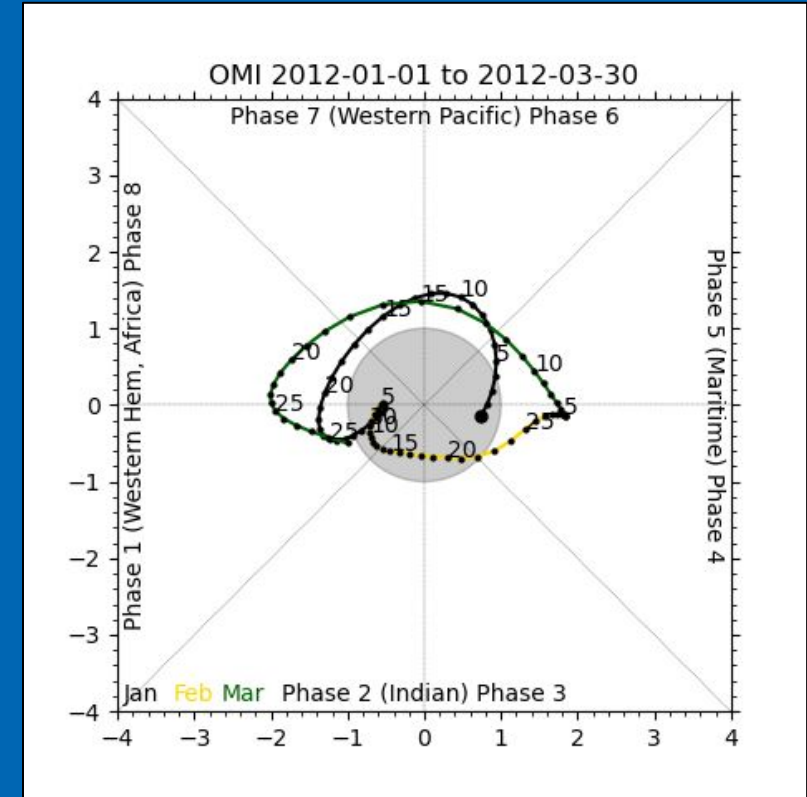
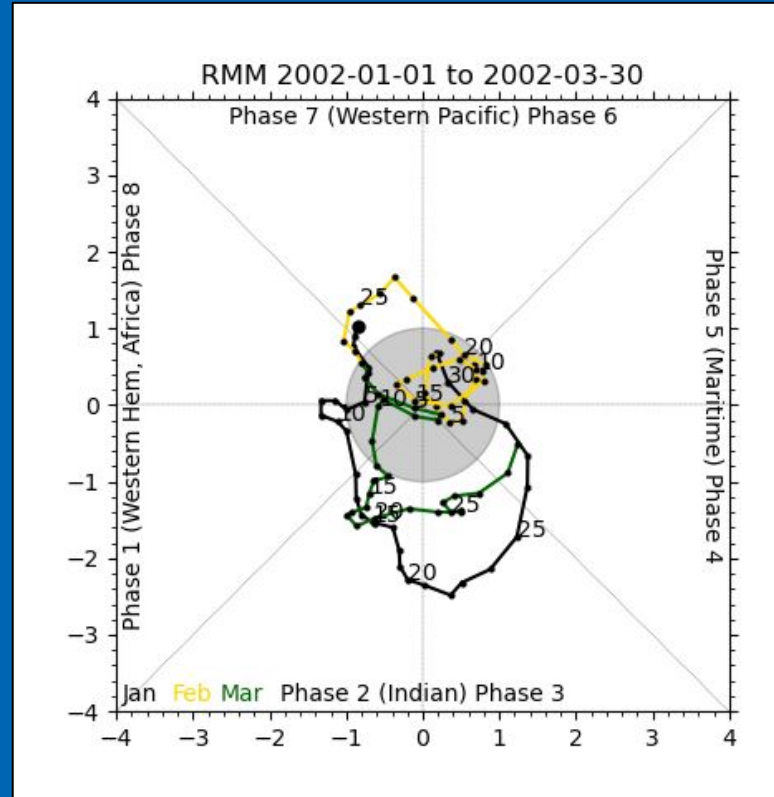
Statistic	IBL	Blocks
CSI	0.558	0.559
FBIAS	1.01	1.01
PODY	0.717	0.721
FAR	0.285	0.288

Category	Frequency Correlation
WR 1	0.906
WR 2	0.859
WR 3	0.951
WR 4	0.923
WR 5	0.952



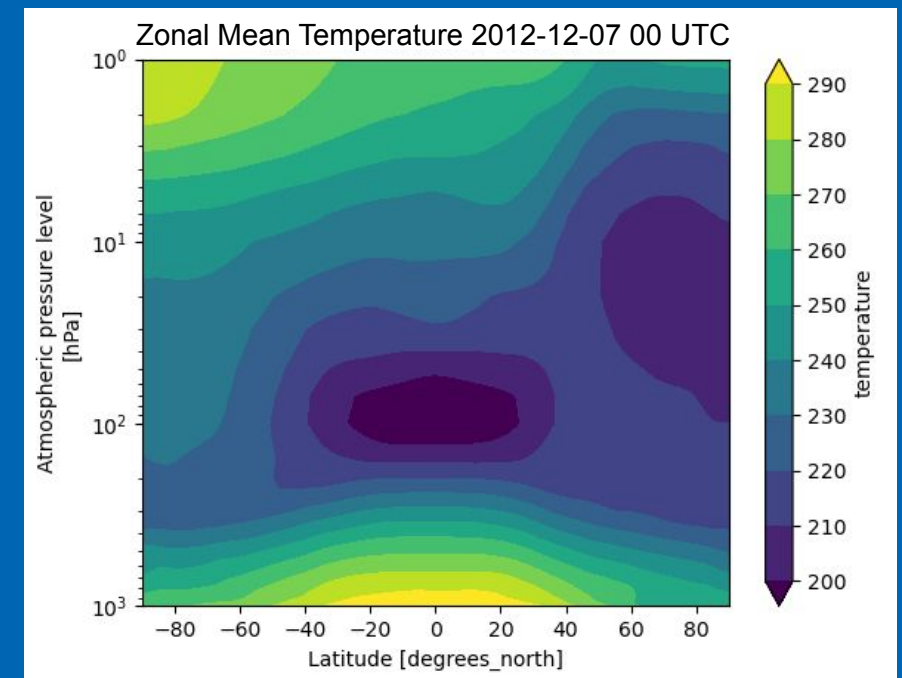
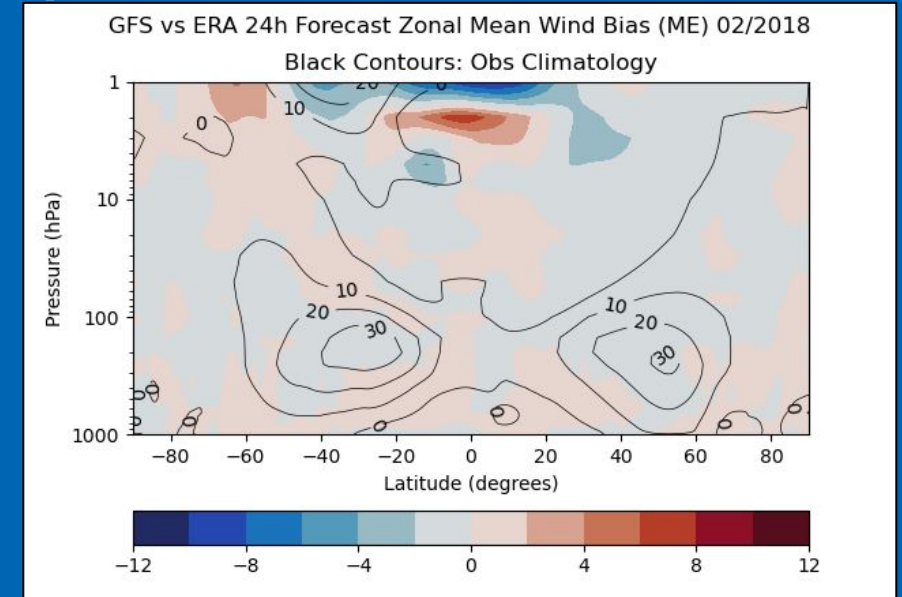
# Madden-Julian Oscillation Examples

- NOAA PSL and GMU
- OMI
  - Project filtered OLR onto spatial EOFs
  - Phase diagram
- RMM
  - First 2 PC normalized by standard deviation
  - Phase diagram, time series, EOF plot
- MaKE/MaKI
  - Zonal and meridional components of wind stress and surface ocean currents and SST
  - Computes MaKE and MaKI



# Stratosphere Examples

- NOAA CSL
- Zonal Mean Bias
  - Computes zonal mean temperature and U, 100 – 1 hPa
  - Runs Series-Analysis to compute ME, RMSE, etc.
    - MET now handles data on semi-structured grids through python embedding (ex: zonal or meridional mean)
  - Bias Plots
- Polar Cap Temperature
  - Average zonal mean Temperature 60 – 90 latitude
  - Computes ME, RMSE from 100 – 1 hPa with lead time
- QBO in progress
  - Phase diagram





# Training Resources

**METPLUS TRAINING SERIES | AGENDA AND RECORDINGS**

NOV 30 2021 - MAY 1 2022

This page include recordings for all 20 of the METplus Training Series session. **The page will remain available until the next Basic Training Series occurs** (likely in fall 2023).

The [Resources and Support](#) tab contains resources and support with links to the online tutorial, instructions on obtaining tutorial data, the METplus training videos, and the METplus Discussion support forum.

The [METplus Training - External Drive](#) contains presentations, recordings, and chat history for each session.

**ABOUT**

- Agenda And Recordings
- Sign Up For Updates
- Resources And Support

Session 1 - November 30, 2021 9am MST / 11am EST / 1600 UTC +

**Prerequisite:** Install METplus v4.0.0 / MET v10.0.0 if not using a supported platform


**Presentation:** What is METplus?

**Presentation:** Online tutorial basics

**Hands-On:** Getting set-up

**Homework:** Complete METplus Setup section of the online tutorial through METplus: How to Run

**Recordings and Chats:** Main Session Chat, Hera/Jet Chat, Cheyenne Chat, AWS Chat



METplus Training Series 2021 - 2022

Presented by the METplus Team

NCAR/RAL, NOAA/GSL, and Developmental Testbed Center

**METPLUS ADVANCED TRAINING SERIES | SPRING 2023: AGENDA AND RECORDINGS**

NOV 1 2023 - APR 3 2024 | VIRTUAL-LINK FOR THE MEETING PROVIDED TO REGISTERED PARTICIPANTS

The [Resources and Support](#) tab contains resources and support with links to the online tutorial, instructions on obtaining tutorial data, the METplus training videos, and the METplus Discussion support forum.

The "METplus Training - External Drive" contains presentations, recordings, and chat history for each session.

**Spring 2023: Agenda And Recordings**

Session 1 - Prototypes in the Cloud - April 19 9am MST / 11am EST / 1600 UTC

Session 2 - S2S Diagnostics - May 3 9am MST / 11am EST / 1600 UTC

**ABOUT**

- Fall 2023, Spring 2024: Agendas And Recordings
- Spring 2023: Agenda And Recordings
- Registration
- Resources And Support

## Links:

- [METplus Advanced Training Series](#)
- [METplus Online Tutorial](#)

\*S2S  
Sections in  
both  
trainings

# Getting Help

## METplus User Support Discussion Forum

# METplus

Contacts:

Tara Jensen:  
jensen@ucar.edu

Christina Kalb:  
kalb@ucar.edu

The screenshot shows the GitHub Discussions page for the METplus repository. The page title is "dtcenter / METplus" and the current view is "Discussions". The repository has 150 issues, 2 pull requests, 6 projects, and 6 wikis. The main content area displays a list of discussions, sorted by latest activity, with filters for "is:open" and "Filter: Open".

**Categories:**

- View all discussions
- Announcements
- Configuration
- Existing Builds
- File I/O
- Incoming
- Installation
- Plot Generation
- Polls
- Release Acceptance Testing
- Statistical Computation
- Tips/Tricks
- Training
- Use Cases

**Discussions:**

- Trouble running TCPairs basic use case** (1 reply)
  - component: documentation
  - component: input data
  - asked 2 days ago in Use Cases - Unanswered
- pb2nc results not consistently reproducible** (1 reply)
  - MET: PreProcessing Tools (Point)
  - asked last week in Existing Builds - Unanswered
- Output within Pointstat mpr files** (5 replies)
  - MET: Grid-to-Point Verification
  - asked on Jan 26 in File I/O - Answered
- MODE 11.1.0 Unevenly Spaced Lat/Lon Error** (1 reply)
  - MET: Feature Verification
  - asked on Sep 28, 2023 in File I/O - Unanswered
- WARNING: Set the "wind\_thresh" and "wind\_logic" configuration options to exclude zero vectors** (10 replies)
  - MET: Wind Verification
  - asked 2 weeks ago in Statistical Computation - Answered
- Read Multilocatonal temporal Netcdf File** (18 replies)
  - METplus: Configuration
  - METplus: Precipitation
  - asked last month in Configuration - Unanswered

**Most helpful** (Last 30 days): jprestop (2 votes)