Integrating JEDI and METplus for Evaluation of Atmospheric Composition Forecasts

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Project Background

- METplus, the verification/validation package for Unified Forecast System (UFS), has a limited capability for verifying atmospheric constituents (AOD, O_3, $PM_{2.5}$).
- Systematic evaluation of aerosol profiles and chemical species using satellite observations, critical for refining the UFS constituent models, is not available.
- This project aims to enhance METplus constituent verification capability by exploiting JPSS atmospheric constituent observations and other satellite observations.

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What is the application?

- A cross-cutting verification framework for trace gases/aerosols across UFS applications, including sub-seasonal-to-seasonal (S2S) and air quality (AQ) applications

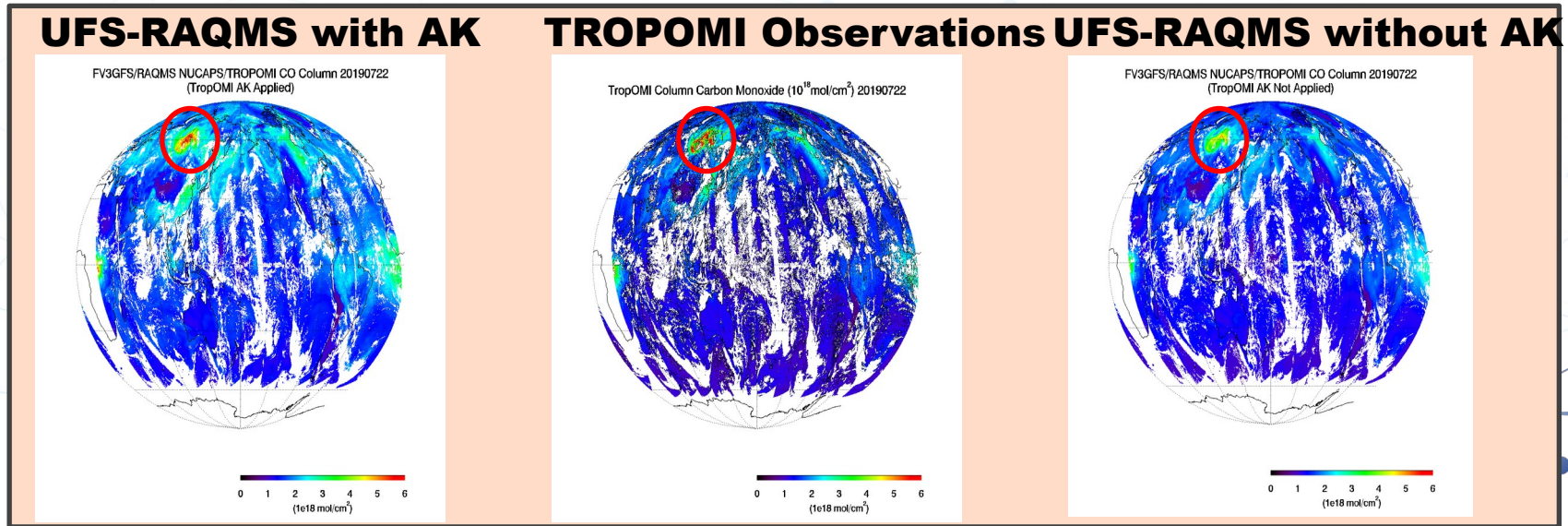# Why is the application important?

- The development ensures that model products and satellite observations are spatially and temporally compatible, which maximizes the benefits of satellite products to downstream UFS operational and research users

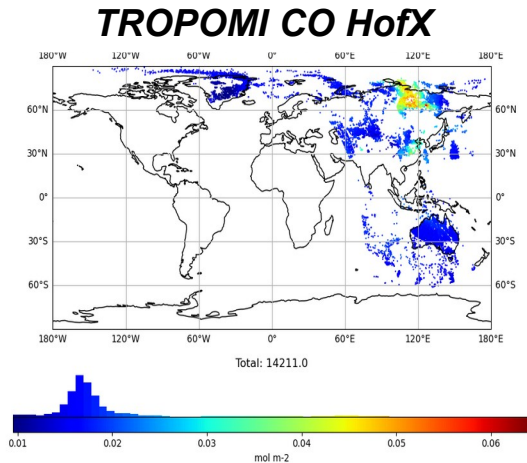# TROPOMI CO forward operator

UFS-RAQMS with AK   **TROPOMI Observations**   **UFS-RAQMS without AK**
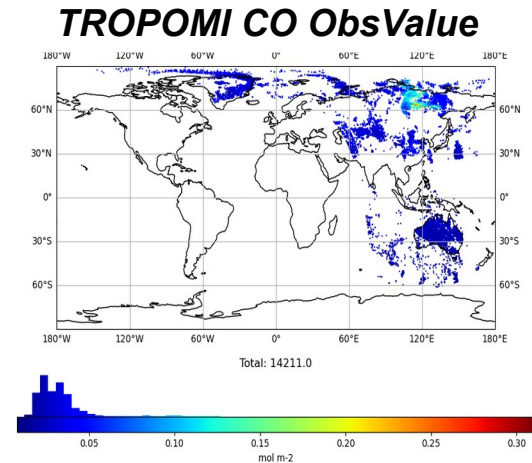
Application of TROPOMI forward operator accounts for altitude dependent sensitivity to CO

SkyLab Data Viewer

Simulated observation from model state using observation operator
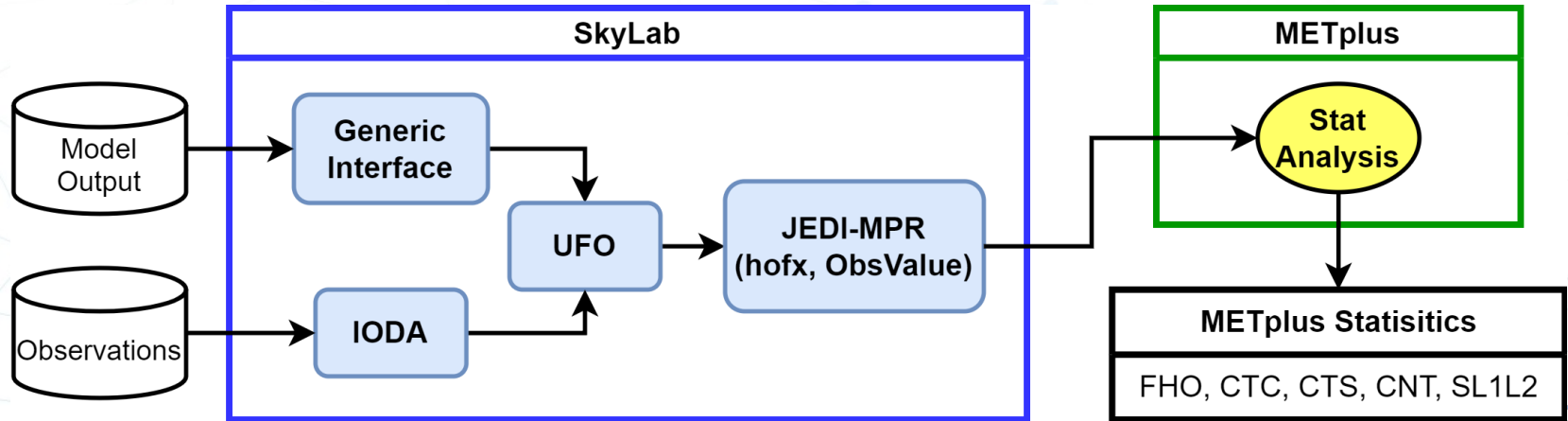
Observations

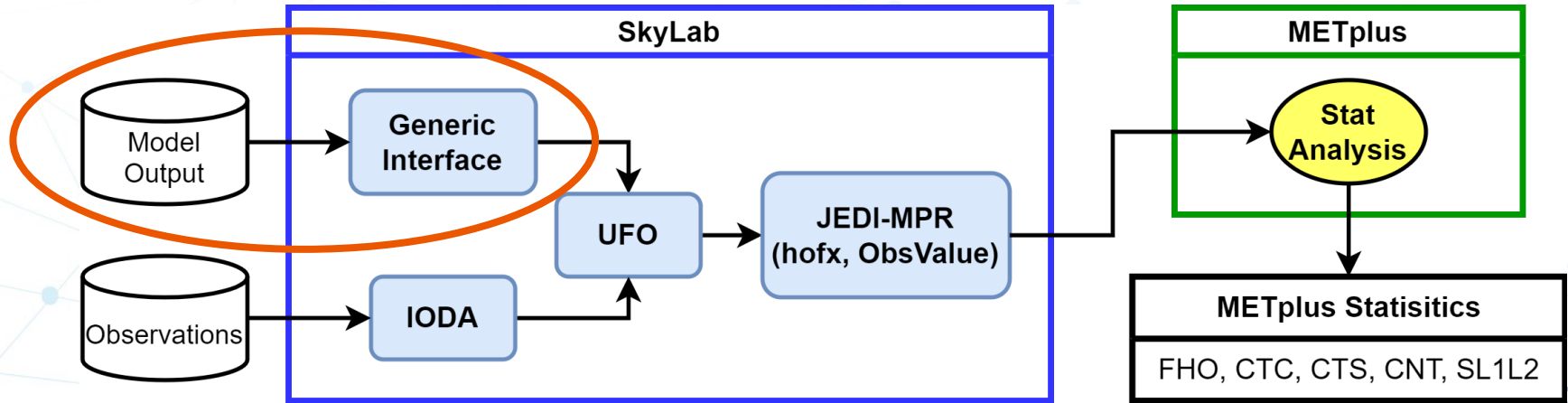Exp id: 27755c, background from GEOS-CF, 2021-08-01

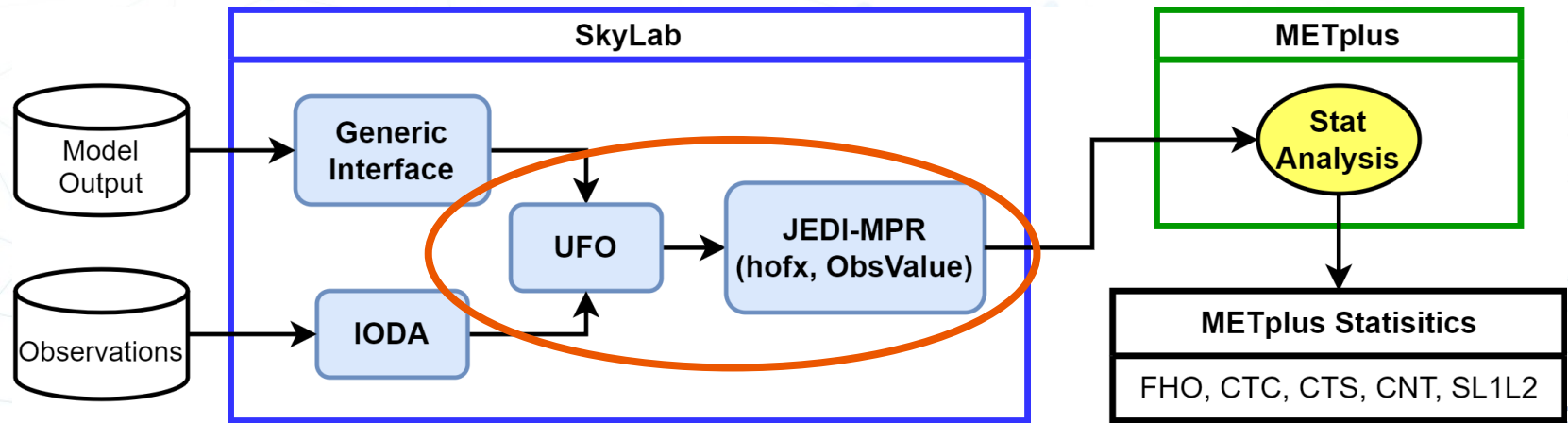# METplus enabled Skylab model evaluation workflow

METplus enabled Skylab model evaluation workflow

A generic interface is developed to ingest model data in any grid format (regular lat/lon, Lambert projection, Gaussian grid)
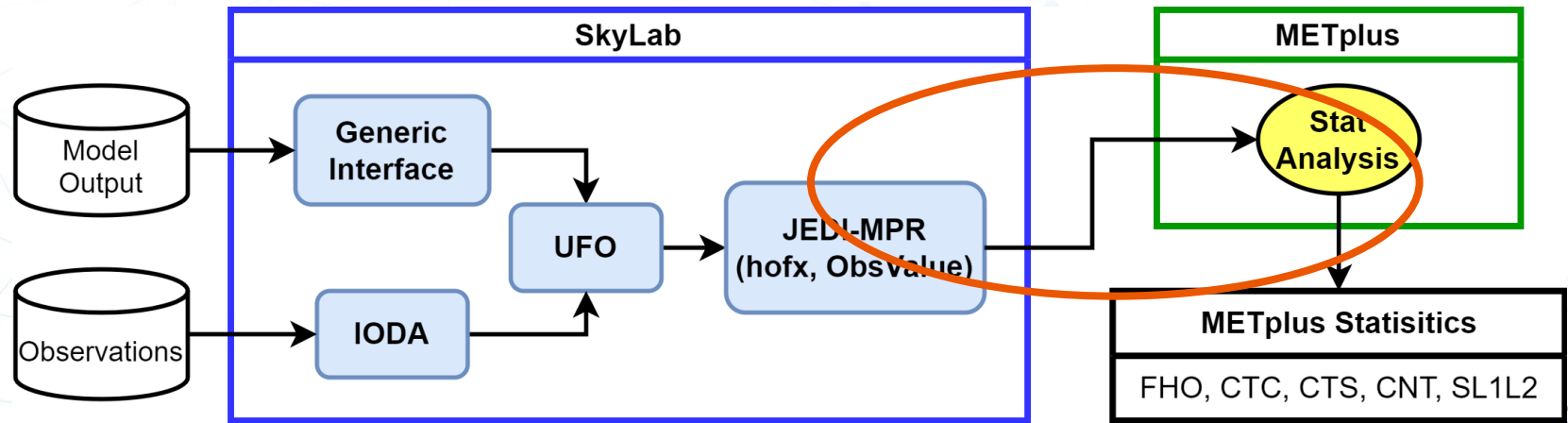
METplus enabled Skylab model evaluation workflow

UFO produces paired model and observation in IODA format (hofx and ObsValue)

IODA: the Interface for Observation Data Access; UFO: the Unified Forward Operator
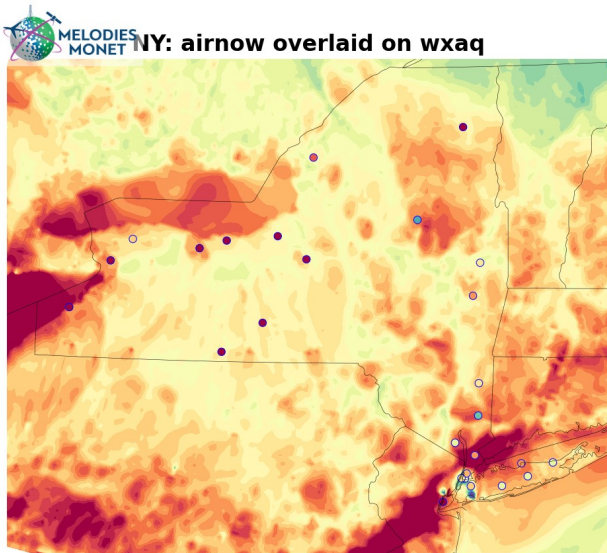
METplus enabled Skylab model evaluation workflow

Using METplus python embedded script, the matched pair (MPR) data can be passed to StatAnalysis tool

METplus interfaced with MELODIES-MONET

MELODIES-MONET

Evaluate WRF-Chem 24-h O_3 forecast, initialized from 00Z June 2, 2023, against AIRNOW observations

NY: airnow overlaid on wxaq

METplus StatAnalysis

20- 30 ppbv

	O_Y	O_N
F_Y	20	11
F_N	9	173

>30 ppbv

	O_Y	O_N
F_Y	169	12
F_N	11	21

Paired in MELODIES-MONET and calculate the contingency table counts (CTC) in METplus StatAnalysis

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Conclusions

- The JCSDA-UW-RAL team, funded by JPSS PGRR program, develops atmospheric composition evaluation package via interfacing JEDI with METplus
- The team is also connecting METplus with Melodies-Monet for broad composition community, which enables the option to use observation operators implemented in Melodies-Monet such as OMPS Nadir Mapper O_3
- An atmospheric composition verification framework: a cross cutting framework across and beyond UFS applications

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