

# Dynamical Diagnostics for SAGE III/ISS: Progress Report & Dynamical Coordinate Investigations

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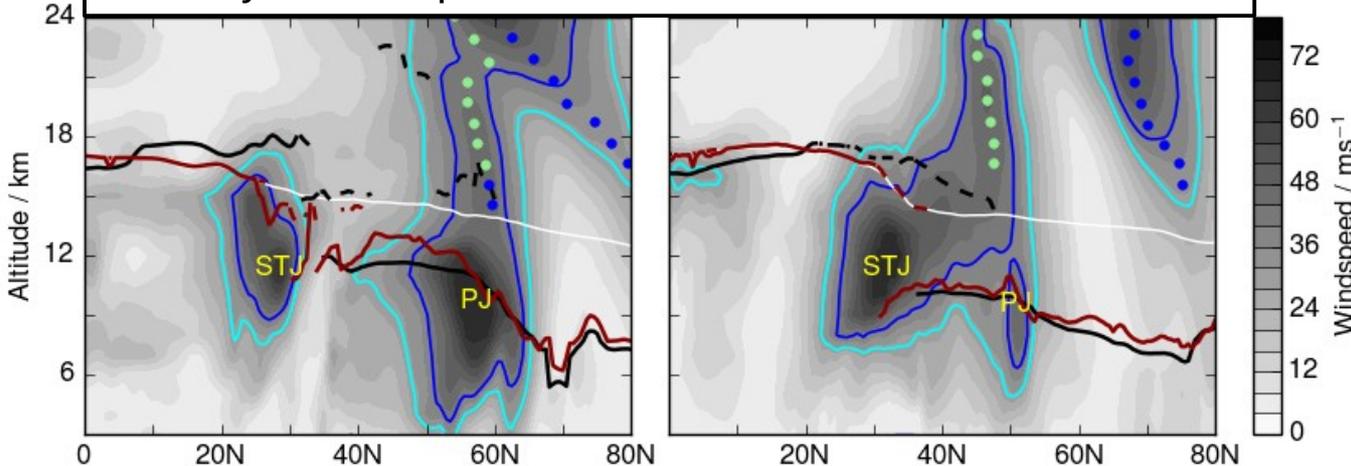


# Dynamical Diagnostics from JETPAC



## Jet and Tropopause Products for Analysis and Characterization

Reanalysis windspeeds at 117.5W and 105E on 20090129



JETPAC diagnostics have been calculated at multi-instrument measurement locations, including SAGE III/ISS (preliminary calculations have also been done for SAGE II)

**Jet Cores:** windspeed maxima  $>40\text{m/s}$

**Jet region edges:**  $30\text{m/s}$  windspeed

**Subtropical jet (STJ):** Lowest latitude westerly jet with tropopause altitude  $> 13\text{km}$  at its equatorward edge and a drop  $>2\text{km}$  between equatorward & poleward edge

**Polar Jet (PJ):** Strongest westerly jet poleward of STJ (or of  $40^\circ$  if no STJ)

Characterization of WMO (Temperature gradient) and **dynamical (PV-based)** tropopauses

Characterization of stratospheric subvortex (**blue** and **green** dots; two offspring from split SSW shown here)

# SAGE III/ISS JETPAC Diagnostics

**Microwave Limb Sounder**

Search

## EOS MICROWAVE LIMB SOUNDER DMPS

Please first select a version before selecting any other search criteria from the other pull-down menus. Note that all fields may not be available for every version.

Version:  Year:  Month:  Met Type:

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- [SAGE3ISS\\_02341520\\_v05-10\\_GEOS5MERRA2\\_DynEqL\\_jv301.nc4](#)
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- [SAGE3ISS\\_02341620\\_v05-10\\_GEOS5MERRA2\\_DynEqL\\_jv301.nc4](#)

**Data Documentation**

- [Derived Meteorological Products, Tropopause Characterization, and Jet Identification Data Fromat](#)

[https://mls.jpl.nasa.gov/dmp/data/dmp\\_locator.php](https://mls.jpl.nasa.gov/dmp/data/dmp_locator.php)

Contact Luis ([lmillan@jpl.nasa.gov](mailto:lmillan@jpl.nasa.gov)) if you want a zip file for full mission



# SAGE III/ISS Trajectory Diagnostics

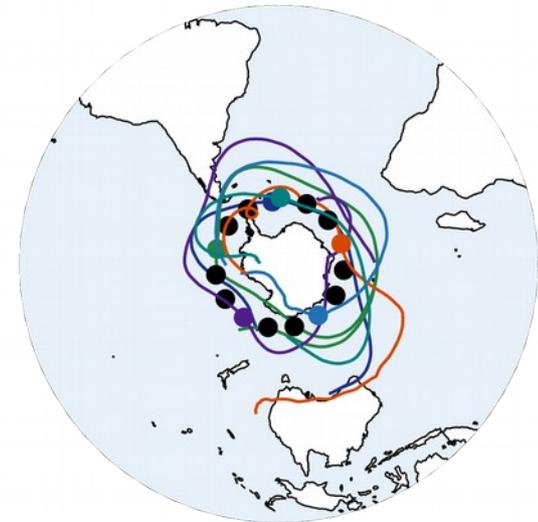
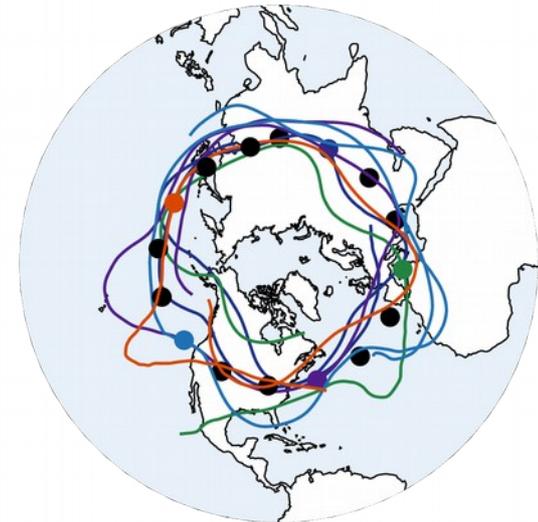
We have launched trajectories from the SAGEIII/ISS measurement locations (10 day forward/backward).

- Currently available until May 2019; will re-run and update to present with v5.2
- MERRA-2 winds and heating rates are used in a 4<sup>th</sup> order Runge-Kutta integration with 5 minute timesteps
- Parcel locations are saved every 20 minutes
- Flanking trajectories added to quantify dispersion / mixing
- Trajectories are stored in nc4 format

**Work in progress:** Use the trajectory hunting technique to validate SAGEIII/ISS versus other satellite instruments.

Please contact [lmillan@jpl.nasa.gov](mailto:lmillan@jpl.nasa.gov) if you want to get a hold of these trajectories

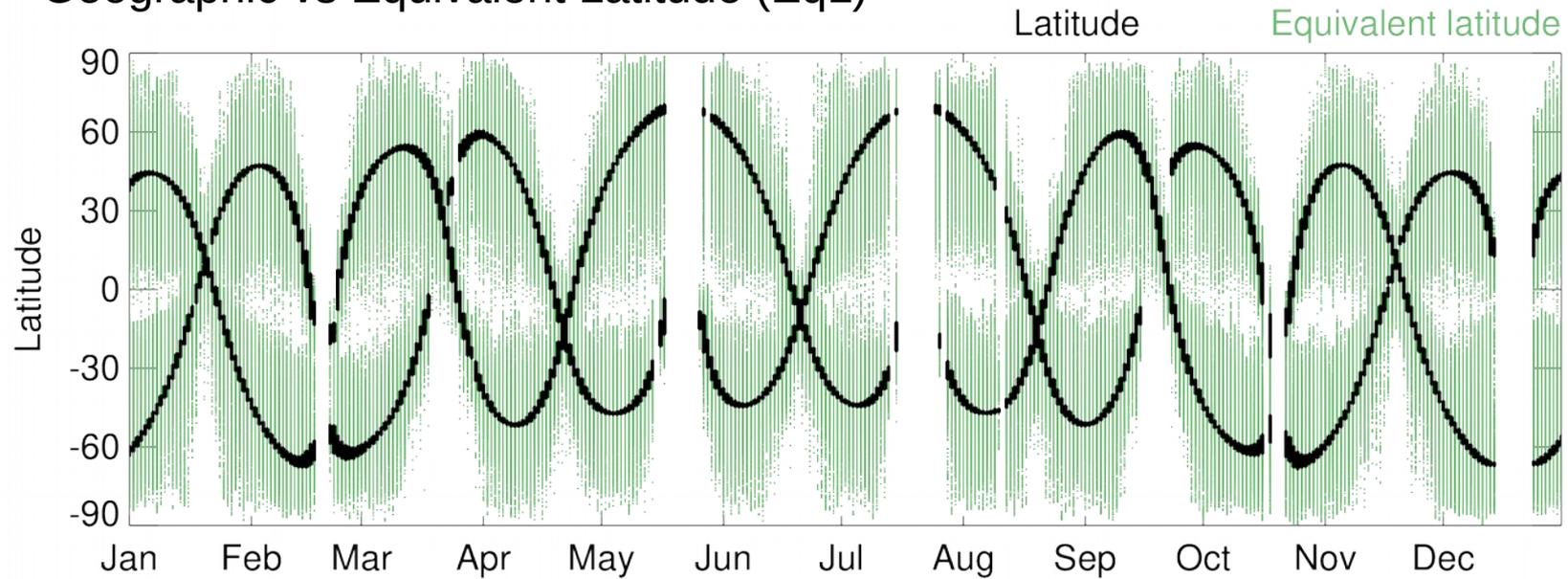
Jan 1st 2018



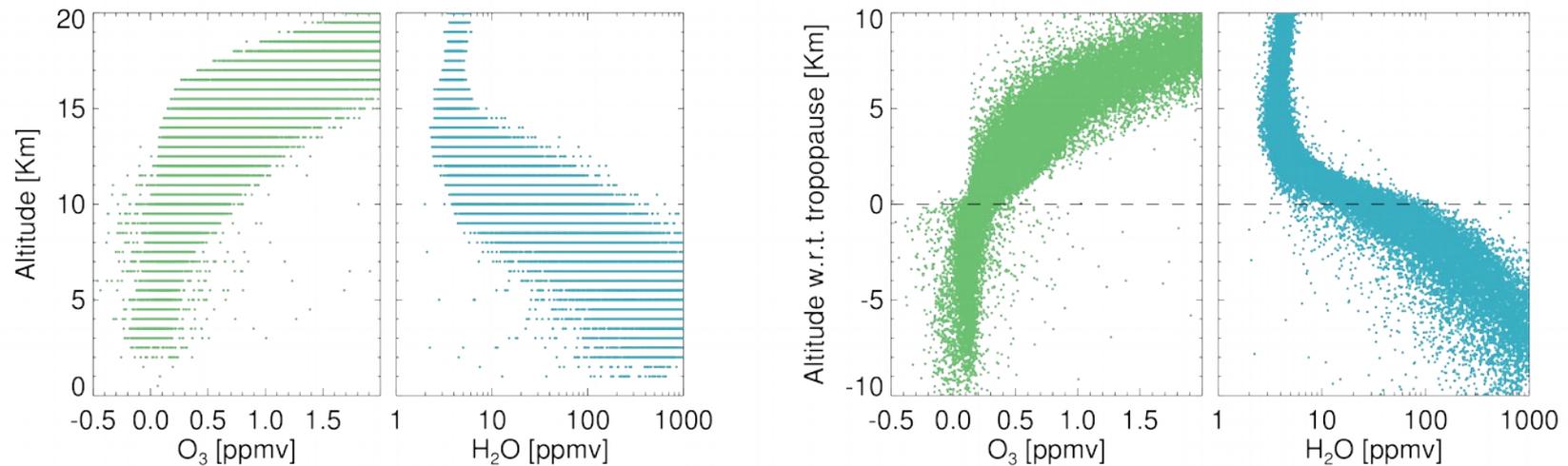
Parcels started at 15km

# Dynamical Coordinate Motivation

## Geographic vs Equivalent Latitude (EqL)

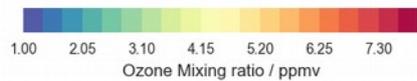
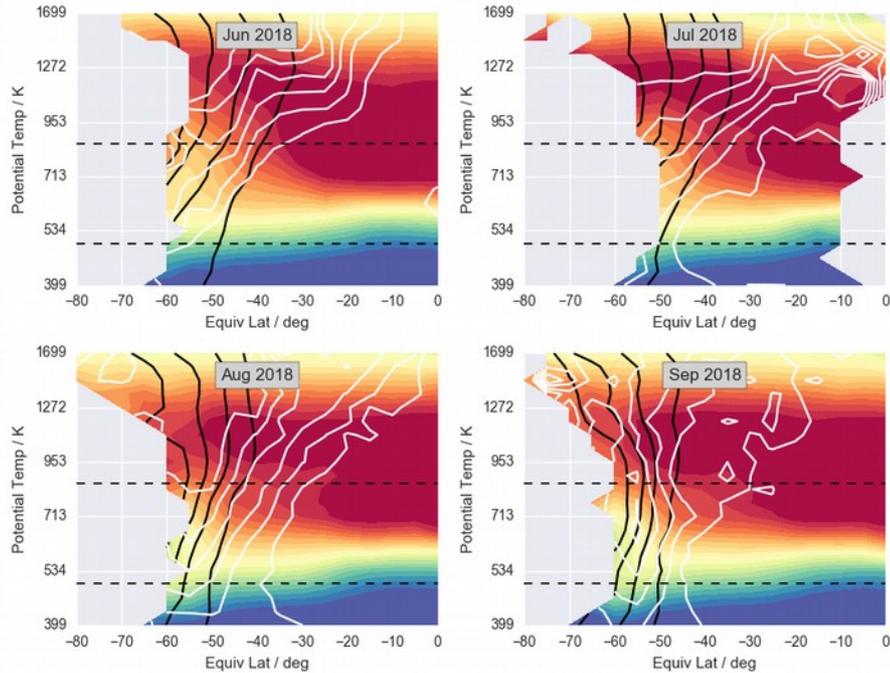


## Altitude vs Tropopause Relative Vertical Coordinate

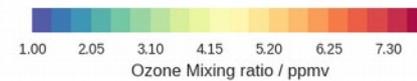
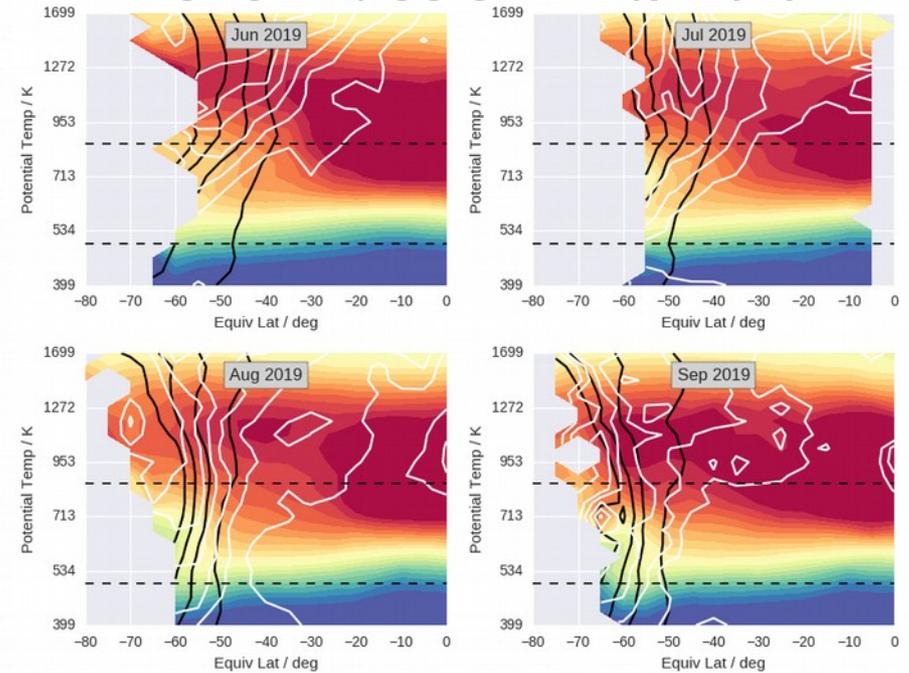


# EqL/θ SH Stratospheric Polar Ozone

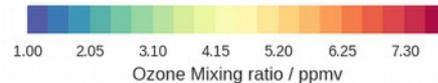
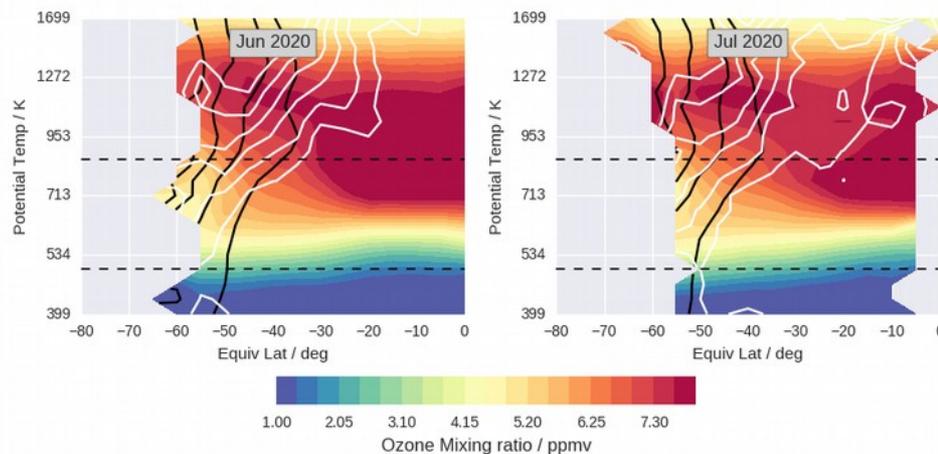
## SAGE III/ISS SH Winter 2018



## SAGE III/ISS SH Winter 2019

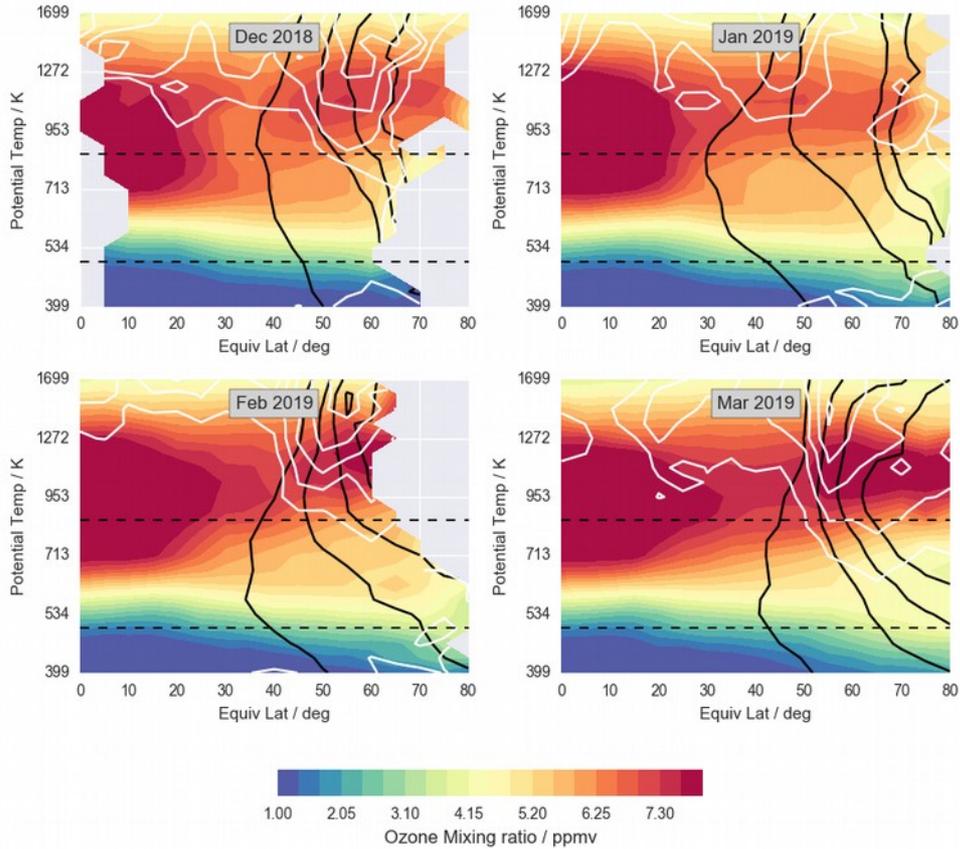


## SAGE III/ISS SH Winter 2020

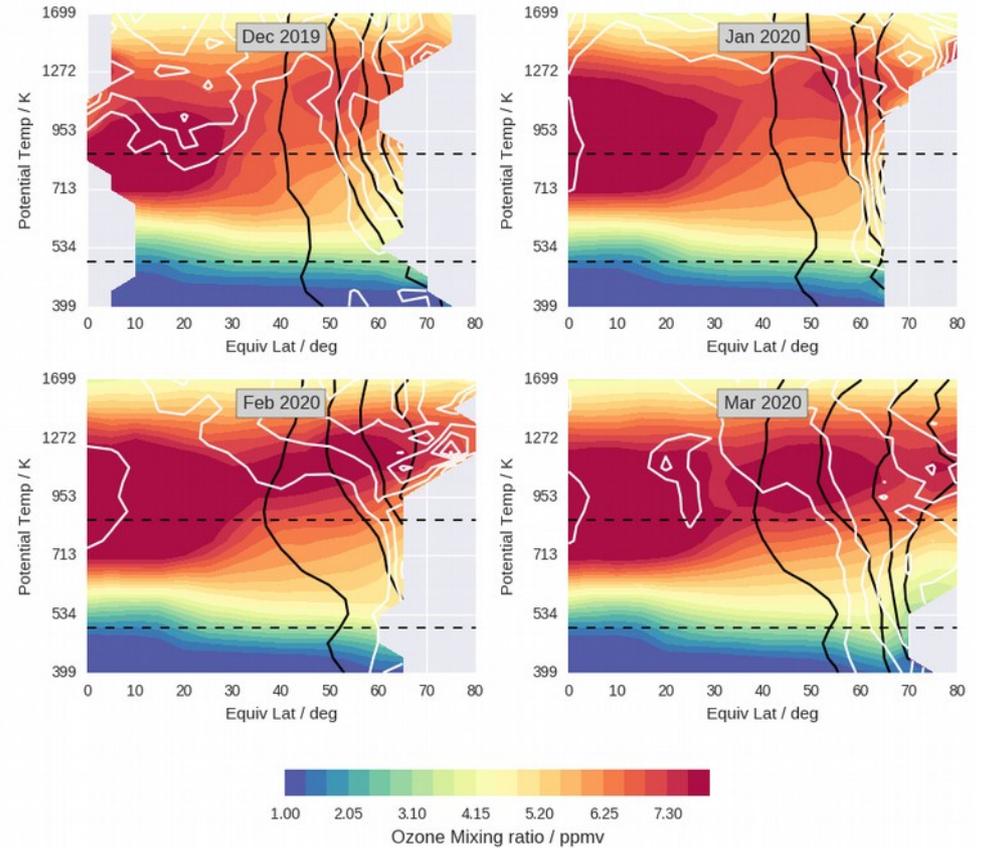


# EqL/ $\theta$ NH Stratospheric Polar Ozone

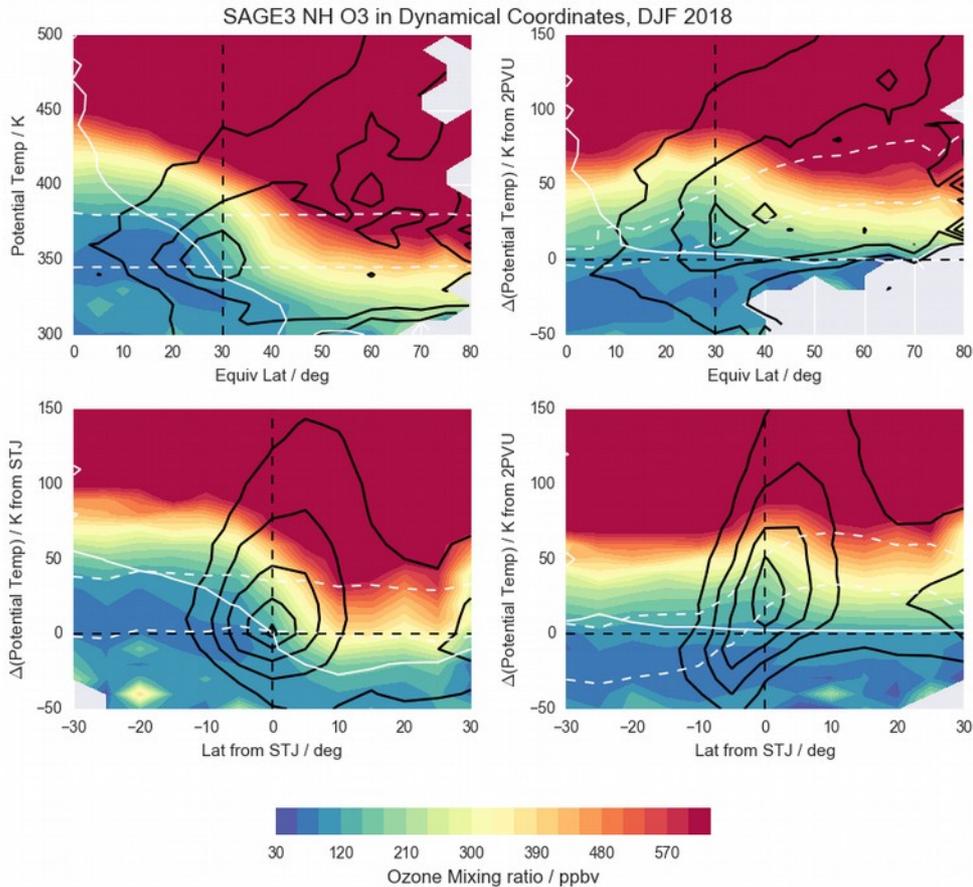
## SAGE III/ISS NH Winter 2018/2019



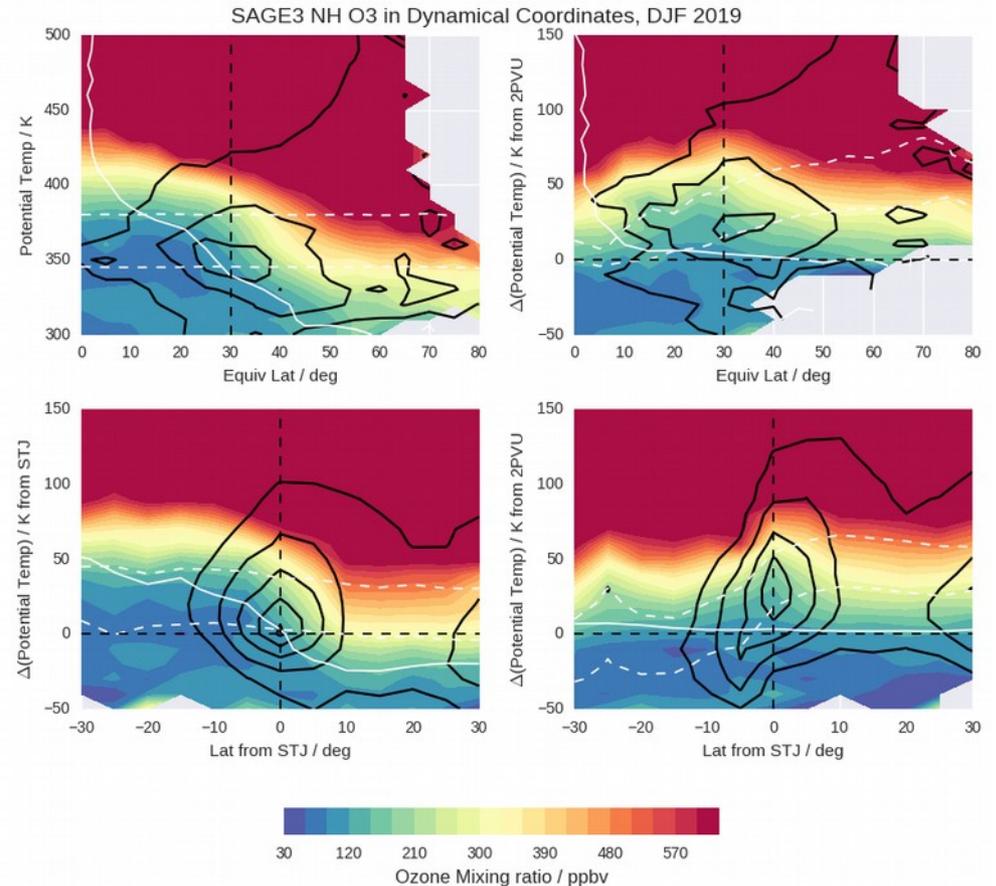
## SAGE III/ISS NH Winter 2019/2020



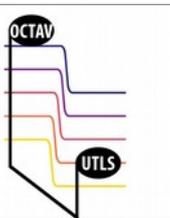
# SAGE III/ISS NH UTLS Ozone in Dynamical Coordinates



SAGE III/ISS NH DJF 2018/2019 (left) & 2019/2020 (below) in various dynamical coordinates

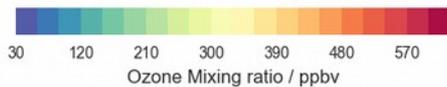
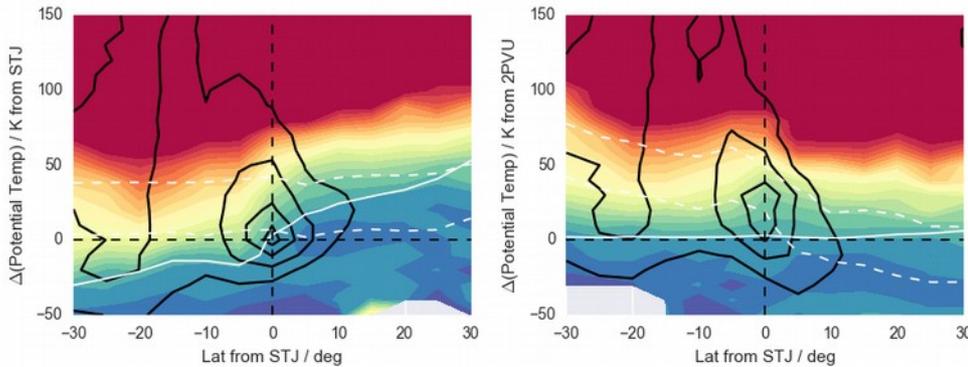
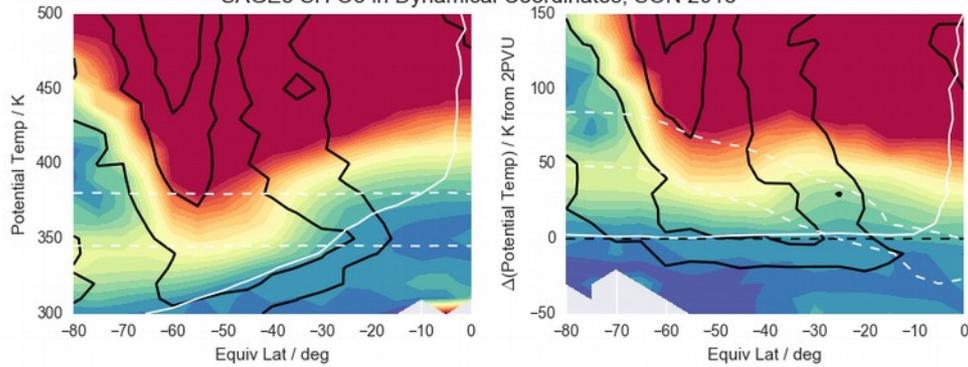


(black = windspeeds, solid white 2PVU, dashed white 345 and 380 K potential temperature)



# SAGE III/ISS SH UTLS Ozone in Dynamical Coordinates

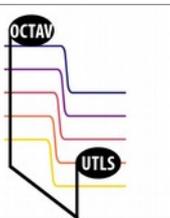
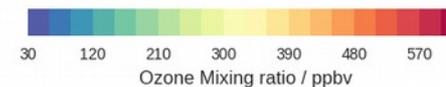
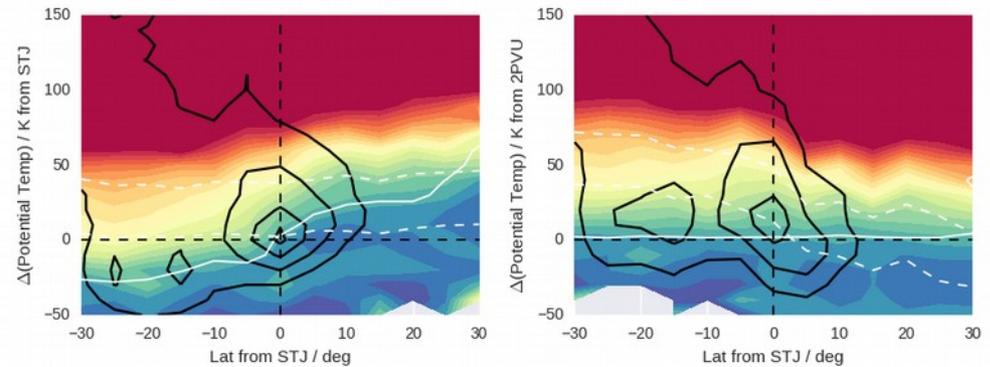
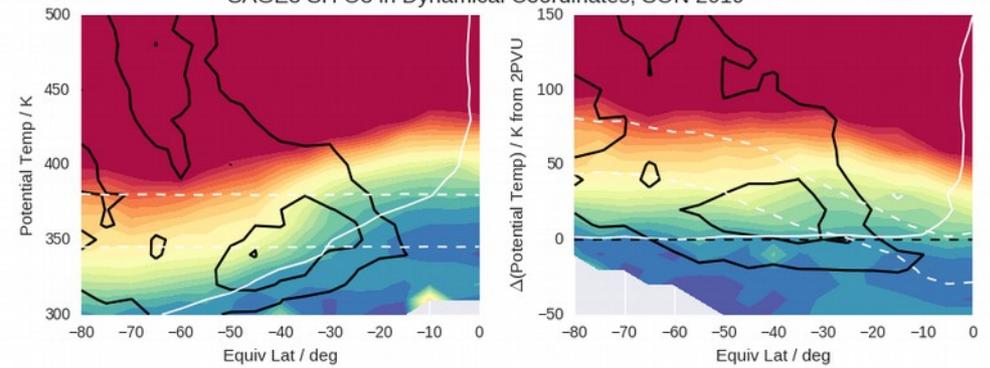
SAGE3 SH O3 in Dynamical Coordinates, SON 2018



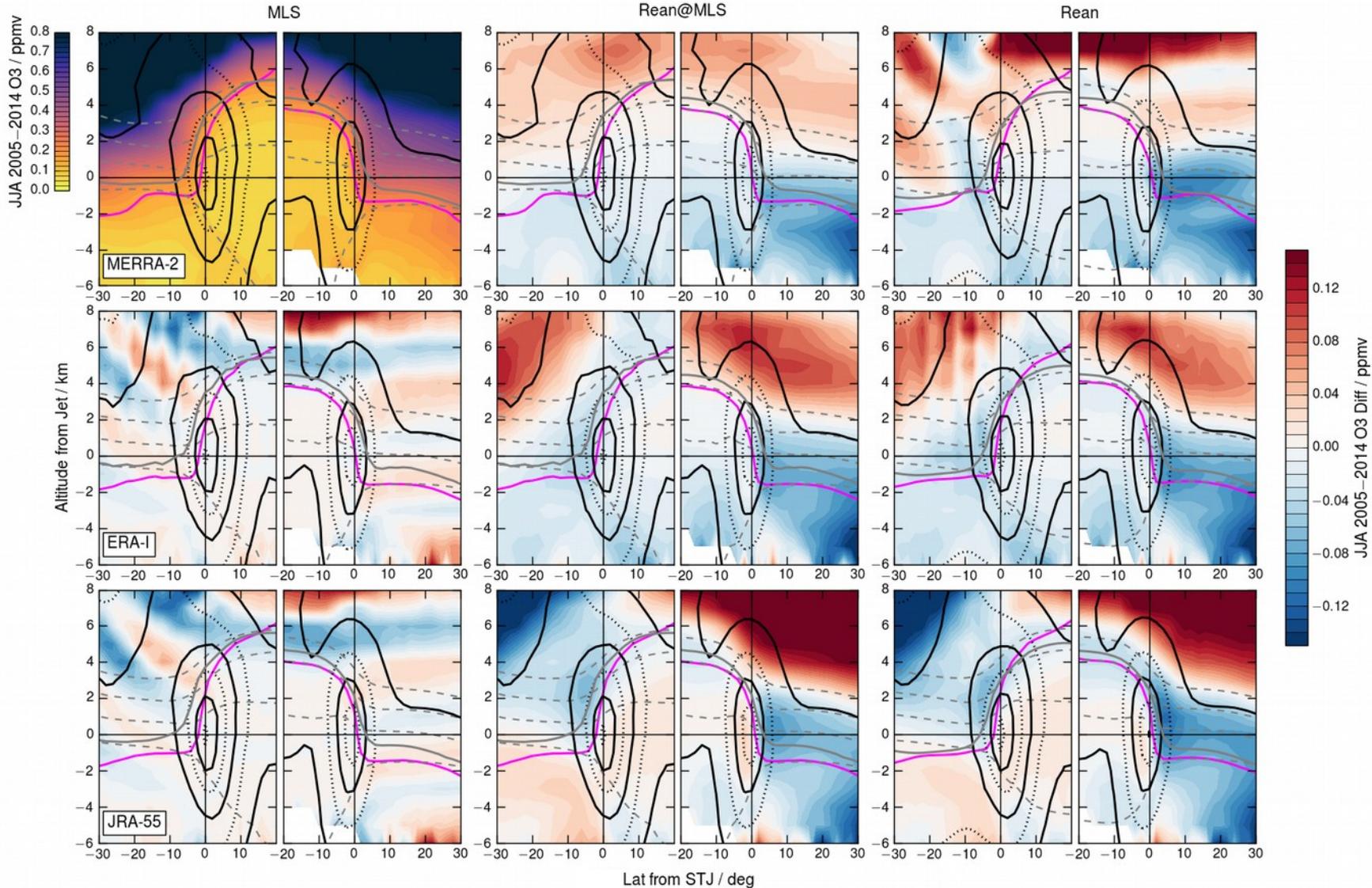
(black = windspeeds, solid white 2PVU, dashed white 345 and 380 K potential temperature)

SAGE III/ISS SH SON 2018 (left) & 2019 (below) in various dynamical coordinates

SAGE3 SH O3 in Dynamical Coordinates, SON 2019



# Future work: Sampling Matters!



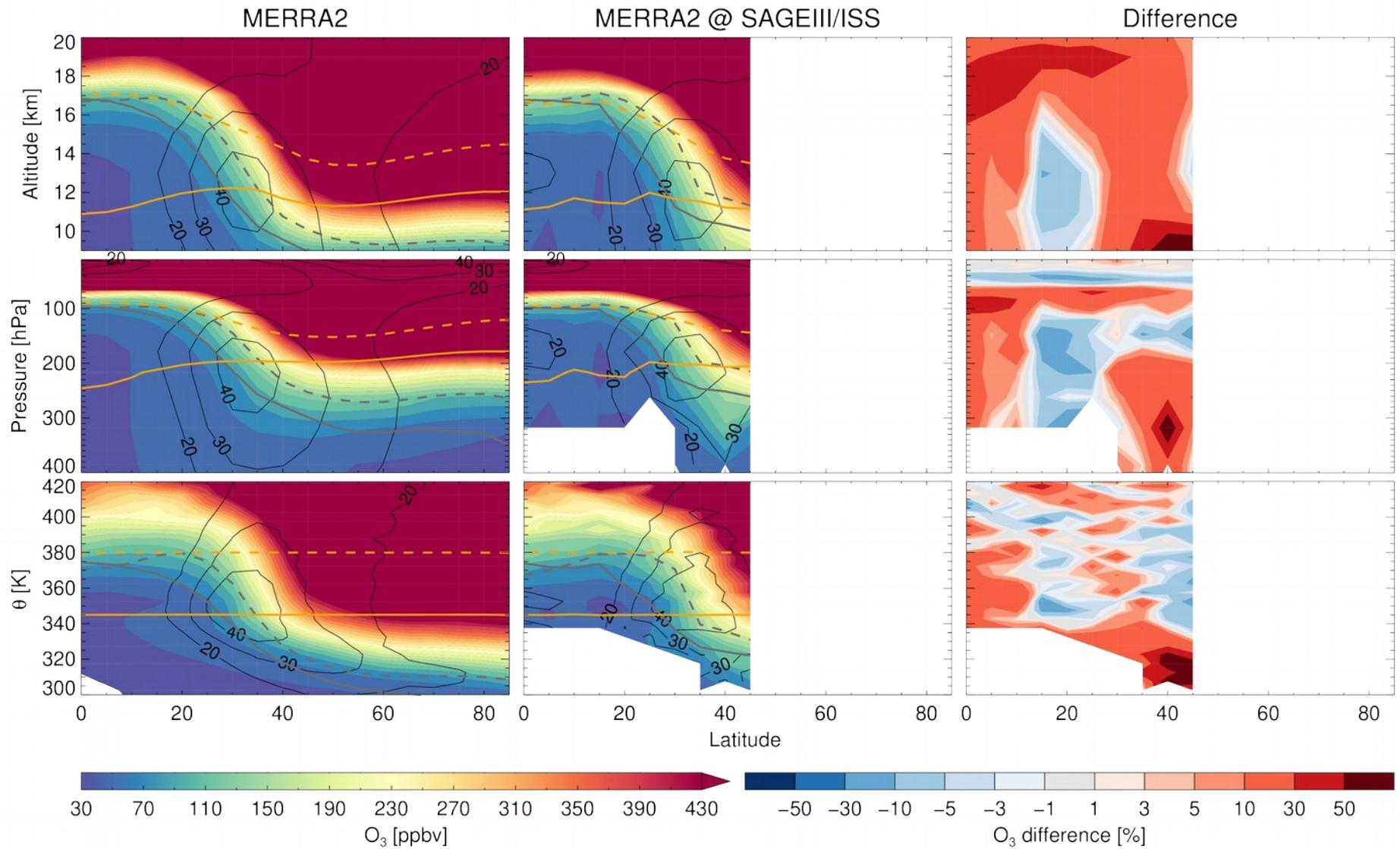
MLS O3 mapped with each reanalyses' dynamical fields

Each reanalyses' O3 interpolated to MLS locations before mapping

Each reanalyses' O3 mapped from its native grid

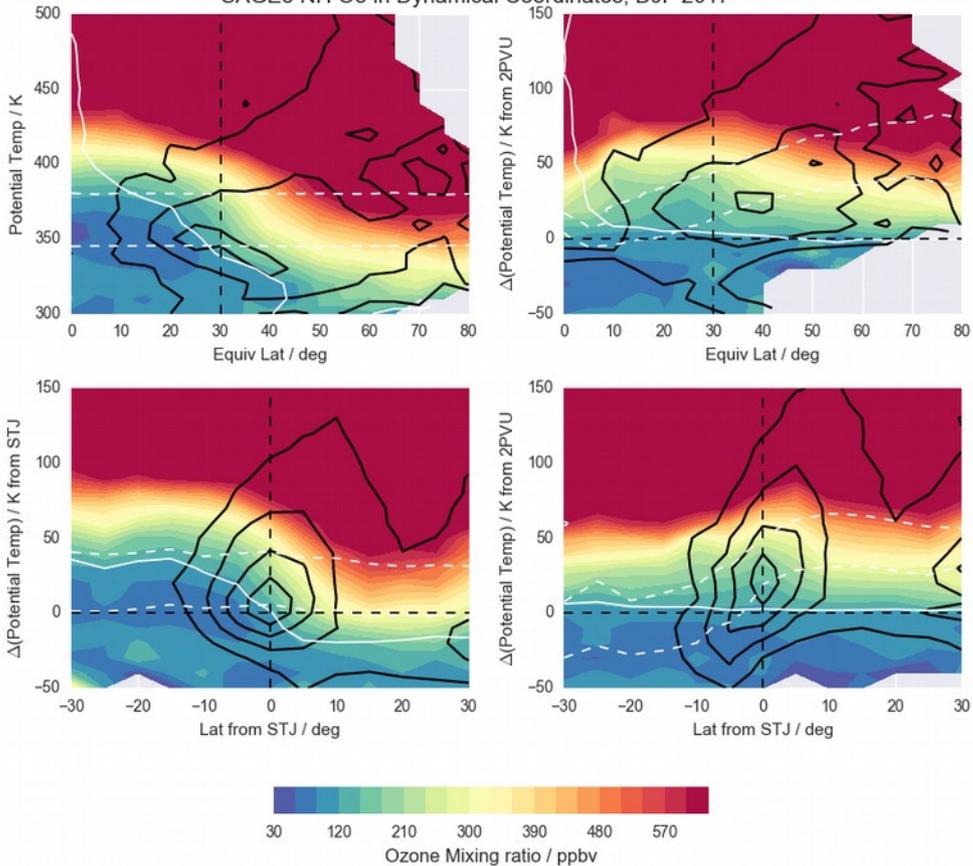
Chapter 7

# Future work: SAGE III Sampling Assessment



# Future work: SAGE & MLS Comparison / Bias Assessment

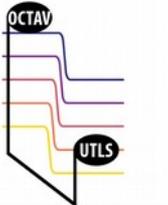
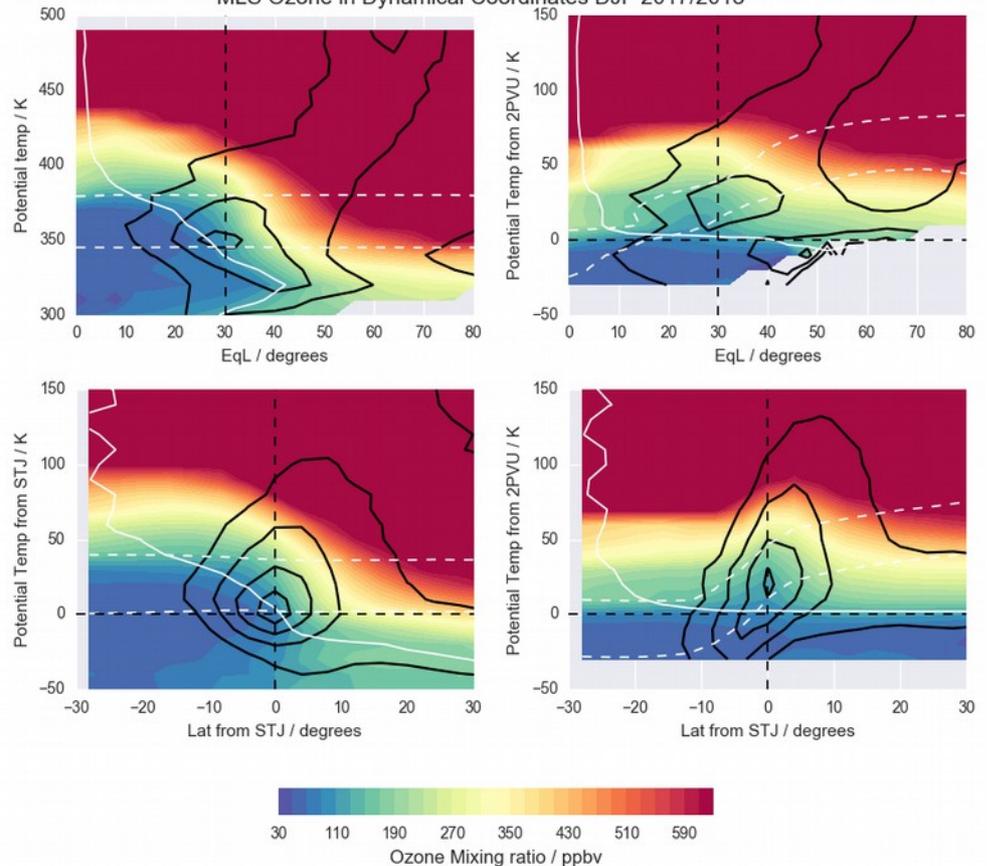
SAGE3 NH O3 in Dynamical Coordinates, DJF 2017



(black = windspeeds, solid white 2PVU, dashed white 345 and 380 K potential temperature)

SAGE III/ISS (left) and MLS (below) Ozone in dynamical coordinates for DJF 2017/2018

MLS Ozone in Dynamical Coordinates DJF 2017/2018



## Future work: Immediate Plans

- Continue to update and provide dynamical diagnostics for SAGE-III/ISS
- Eagerly awaiting v5.2, and will promptly reprocess dynamical diagnostics (including trajectory analysis)
- With v5.2, will do non-coincident validation of SAGE-III/ISS ozone with ACE-FTS, OSIRIS, and Aura MLS, using a variety of dynamical coordinates as per the above examples, as well as with MLS using trajectory-hunting methods
- With v5.2, will apply the tools we have been developing to assess sampling and instrument biases
- Description of SAGE-III/ISS dynamical diagnostics, and results of initial non-coincident validation in dynamical coordinates will be part of a planned paper for ESSD on dynamical diagnostics / coordinate mapping developed using JETPAC for the SPARC OCTAV-UTLS Activity
- Submit a proposal to the current SAGE-III/ISS call to continue this work and extend it to analysis of UTLS ozone variability and trends in dynamical coordinates