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

Gloria L Manney (NWRA, NMT) & Luis F Millán Valle (JPL/Caltech)
Dynamical Diagnostics from JETPAC

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

**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)

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

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

Reanalysis windspeeds at 117.5W and 105E on 20090129

JETPAC tropopause and UTLS jet analysis: Manney et al, 2011, 2014, 2017; Manney & Hegglin, 2018
SAGE III/ISS JETPAC Diagnostics

https://mls.jpl.nasa.gov/dmp/data/dmp locator.php

Contact Luis (lmillan@jpl.nasa.gov) if you want a zip file for full mission
We have launched trajectories from the SAGE III/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 4th 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 SAGE III/ISS versus other satellite instruments.

Please contact lmillan@jpl.nasa.gov if you want to get a hold of these trajectories.
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/θ 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

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

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

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

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