1. **Outflow Rossby Radius of Deformation .** The Rossby Radius defined as:

$$L_R \approx \frac{c_g}{\left(f+\zeta\right)}$$

where c_g is the phase speed of the 1st internal mode calculated from the local environment temperature and humidity between the surface and 20 km MSL, is computed on height surfaces and interpolated to the 356K isentropic surface. The relative vorticity $\left(\zeta + f\right)$ is used to represent inertial stability which is slightly different than its form in an axi-symmetric framework (Frank, 1982).

2. **Cold Point Tropopause Temperature.** This is the minimum temperature (C) above the 500 hPa pressure level.

3. **3 km Brunt Väisälä Frequency.** The Brunt-Väisälä frequency squared $\left(N^2 = \frac{g}{\theta}\frac{\partial\theta}{\partial z}\right)$ at 3 km MSL (Moist lapse rate used where saturated). Calculated at 3km MSL, a low value of this B-V f is indicative of an Elevated Mixed Layer (EML).
4. **Precipitable Water.** This is the column-integrated water mass expressed in mm of liquid water. This is indicative of the total column moisture.
5. **JAPE/MAPE/Speed.** The color-shaded field is the Jet Available Potential energy (JAPE, J/kg) defined on the 356K isentropic surface. JAPE is defined as:

$$\text{JAPE}=\frac{\left(\rho-\rho_s(z)\right)gz}{\rho}$$

where ρ is the total air density, and $\rho_S(z)$ is the air density at height z of a standard mid-latitude sounding. JAPE then represents the geopotential energy anomaly resulting from elevating anomalous air mass compared to a standard atmosphere. It effectively shows the stored energy in the tropical upper troposphere.

MAPE is the Montgomery stream function $\left(MAPE = gz + c_pT\right)$ defined on the 356 K isentopic surface contoured. The gradient of MAPE is indicative of the available energy for conversion to kinetic energy on an isentropic surface if velocity mvoes at an angle to the gradient (ageostrophic).

SPEED is a 3D rendering of the 42 m/s speed surface. Yellow coloring of the surface is where the zonal component is positive or zero and magenta coloring is where the zonal component is negative.

This plot provides an overview the relationship between the tropical JAPE storage and where the JAPE is being consumed (or created) as a result of jet stream interaction.

6. **Surface Based CAPE (J/kg) is** the Convective available potential energy computed at the surface. Ice processes are considered for temperatures colder than -20C.
7. **Surface Temperature (F).** This is the predicted 2 m surface temperature.
8. **850 hPa Temperature (C).** The predicted 850 hPa temperature.
9. **Vertically Integrated Work performed on Environment by Ageostrophic Acceleration (W/m2).** This is the work performed on the environment by the pressure velocity term on an isentropic surface, given by:

$$W = \int_{340}^{410} -\mathbf{V} \cdot \nabla \mathbf{M} \frac{\partial P}{\partial \theta} d\theta$$

10. **Net energy gained from meridional displacement (J/kg).** This is the sum of the effects of energy gained (lost) by inertial instability (stability) due to poleward displacement of 1 degree latitude and the energy gained (lost) to kinetic energy gradient acceleration:

$$W = \frac{u\Delta\left[\left(R\Omega\cos\phi + u\right)R\Omega\cos\phi\right]}{R\Omega\cos\phi} - \mathbf{V} \cdot \nabla M$$

where ϕ is the latitude angle, Ω is the Earth's angular velocity, M is the Montgomery stream function, R is the Earth's radius, and u is the zonal wind component. It is implicitly assumed that a displax=ced parcel will accelerate to a balance with the meridional geostrophic environmental pressure gradient.

11. **Velocity Potential $\left(\chi\right)$ (CHITH)** . This is the velocity potential on the 356 K isentropic surface $\left(10^6 \frac{m^2}{s}\right)$. Velocity potential is defined:

$$\nabla \cdot \mathbf{V} = \nabla^2 \chi$$

12. **(JAPEJETCHI)**) Jet streams (speed surface 42 m/s), JAPE bubble (2500 J/kg 3D surface shaded with velocity potential $\left(\chi\right)$ at 356K isentropic surface. Shows location and movement of global divergent circulations in UTLS.

13. **(JAPEJETGPM)** JAPE bubble (2500 J/kg 3D surface shaded with elevation in geopotential meters). 42 m/s jet stream 3D surface, shaded with strongest jet speed in vertical column.

14. **(JAPEJETWORK1)** JAPE bubble (2500 J/kg 3D surface shaded with integrated ageostrophic work performed by Montgomery stream function on 356K isentropic surface (J/kg/day). 42 m/s jet stream 3D surface, shaded with strongest jet speed in vertical column. This demonstrates regions of transfer between JAPE bubble and jet streams. MSLP (hPa) contoured for reference.

15. **(PZLTH1)** Log10 of potential vorticity (PVU).

16. **(LNDCVR/SST)** Land Cover (Snow, frozen ground, soil moisture, water (SST (C))

17. **(RHiJAPE)** JAPE bubble depicted by 40% relative humidity (over ice) 3D surface colored with temperature. 42 m/s jet stream 3D surface, shaded with strongest jet speed in vertical column. This column depicts tropical UTLS JAPE bubble seen in RH field. This display captures movement of air from the JAPE bubble into the extra tropics via conduits associated with tropical plumes driven by work term.