Information about Level 3 – MSE variance diagnostics

At this level the code calculates terms of MSE variance/covariance diagnostics.

To select this level set the parameter ENSO_MSE_VAR = 1 in
~/diagnostics/ENSO_MSE/settings.jsonc file.

The necessary input data are already estimated in **Level 2** and **Level 1.**

Level 3 diagnostics are estimated as:

$$s_x = \frac{\left\| x \cdot \langle h \rangle \right\|}{\left\| \langle h \rangle^2 \right\|}$$

Where x can be any one of the following MSE budget term:

moist advection: $x = -\langle V \cdot \nabla q \rangle$

MSE vertical advection: $x = -\left\langle \omega \frac{\partial h}{\partial p} \right\rangle$

net shortwave flux: $x = \langle SW \rangle$

net longwave flux: $x = \langle LW \rangle$

sensible heat flux: $x = \langle SHF \rangle$

latent heat flux: $x = \langle LHF \rangle$

The column MSE is, $h = C_p T + gz + L q$ where C_p is specific heat at constant pressure, T is temperature, g is the gravitational acceleration, z is geopotential height, L is latent heat of vaporization, and q is specific humidity. $\|\|\|$ represents area averages.

There are two default and one custom selected areas for averaging the MSE variances:

a) Equatorial Central Pacific (180º–200ºE; 10ºS – 5ºN)
b) Equatorial Eastern Pacific (220º–280ºE; 5ºS – 5ºN)
c) user prescribed area defined by environmental variables **slon1, slon2 , slat1** and **slat2** (longitudes, latitudes) in ~/diagnostics/ENSO_MSE/settings.jsonc file.

<u>Final output directories:</u>

The output data are saved in
~/diagnostics/wkdir/MDTF_$model_$first_year_$last_year/ENSO_MSE/
$diag_name/model/netCDF .

Graphical output is in :
~/diagnostics/wkdir/MDTF_$model_$first_year_$last_year/ENSO_MSE/model

(e.g., $model = CESM1, $fist_year= 1950, $last_year = 2005, $diag_name = MSE_VAR)

The calculated co-variances are scaled by MSE variance and plotted as a bar chart.