< Modification of the AMWG scripts related to Taylor diagrams >

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*** Problems and modifications**

A script for Taylor diagrams in the AMWG diagnostics package uses the pressure data for vertical interpolation for 300-mb zonal wind, and vertical weighted average of relative humidity and temperature. In the current script, "*lev*", *lev* = p_o**(hyam+hybm)*, is used for pressure, but *lev* is not the actual pressure at each grid point.

Thus, pressure should be computed using the NCL function, *pres_hybrid_ccm*, which calculates pressure at hybrid levels [*pres*(i,j)=p_o**hyam*+p_s(i,j)**hybm*]. Also, a variable at a specific pressure level should be calculated by a vertical interpolation function (*vinth2p*) and should not be a value at a closest pressure level.

*** Modifications in $DIAG_HOME/code/taylor_utils.ncl**

Original	Modified

function getPresAvg
xNew = **wgt_vert_avg_beta(x&lev**, x, PS_MONTH, ipunit, opt)
	function getPresAvg
	if (isfilevar(f0,"hyam")) then
	hyam = f0->hyam
	hybm = f0->hybm
	pres = pres_hybrid_ccm(PS_MONTH,1000.,**hyam,hybm)**
	else
	pres = x&lev
	end if
	xNew = **wgt_vert_avg_beta(pres**, x, PS_MONTH, ipunit, opt)

function extractPresLvl
if (x@class.eq."scalar") then
; x_P is chosen from x for an index where "lev" is closest to levP(nv,0)
x_P = x(:,{levP(nv,0)},:,:) ; (time,lat,lon)
else ; must be vector
x_P = x(:,:,{levP(nv,0)},:,:) ; (xy,time,lat,lon)
end if
	function extractPresLvl_vintp (added)
	if (x@class.eq."scalar") then
	x_tmp = **vinth2p**(x,hyam,hybm,**levP(nv,0)**,ps,2,1000.,1,False)
	x_P = x(:,0,:,:)
	x_P = 1.e20
	x_P = (/x_tmp(:,0,:,:)/)
	else ; must be vector
	xdims = dimsizes(x)
	x_P = x(:,:,0,:,:)
	x_P = 1.e20
	do vv = 0,xdims(0)-1
	x_tmp = **vinth2p**(x(vv,:,:,:,:),hyam,hybm,**levP(nv,0)**,ps,2,1000.,1,False)
	x_P(vv,:,:,:) = (/x_tmp(:,0,:,:)/)
	end do
	end if

*** Results**

- Experiment: f19_g16_FC5

- Model: CAM-FV
- Resolution: f19_g16 (ATM grid: 1.9x2.5, OCN grid: gx1 v6)
- Compset: F_2000_CAM5 (Stand-alone cam default, prescribed ocn/ice, cam5 physics)

- Re-computed variables in the Taylor diagram

- **7**: 300-mb zonal wind (zonal wind interpolated vertically to 300 mb)
- **8**: Relative Humidity (weighted vertical average)
- **9**: Temperature (weighted vertical average)
- The variables from 0 to 6 are not changed, because the vertical interpolation or weighted vertical average are not needed for them.

The f19_g16_FC5 simulation is compared to the CCSM 3.5 simulation (cam3_5_fv1.9x2.5). The metrics for temperature show largest difference between the original and modified diagrams for both simulations (Fig. 1).

(a) Original **(b) Modified**

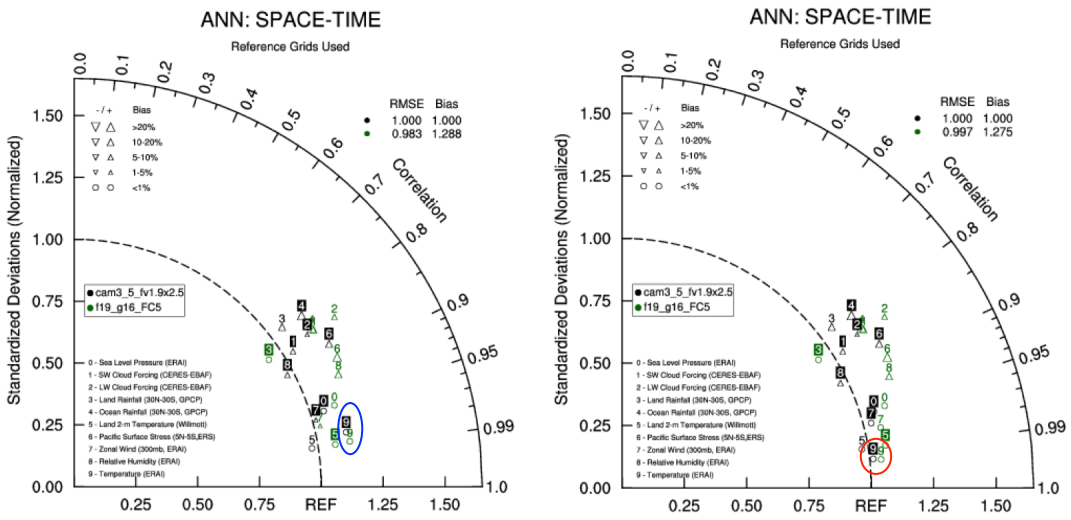

Fig. 1. A space-time Taylor diagram showing the global performance of f19_g16_FC5 run relative to cam3_5_fv1.9x2.5 (reference) run with (a) original and (b) modified AMWG diagnostics scripts.

Overall, the metrics for each variable compared with the ERA-Interim reanalysis are improved (Tables 1 and 2). It is found that the f19_g16_FC5 result shows better correlation and larger biases in the original diagnostics, but not in the modified ones for some periods.

Table 1. Correlation coefficient with the ERA-Interim reanalysis for each variable (**green: better**, **red: worse**)

(a) Original

CAM METRICS	cam3_5_fv1.9x2.5					f19_g16_FC5				
	ANN	DJF	MAM	JJA	SON	ANN	DJF	MAM	JJA	SON
Zonal Wind (300mb, ERAI)	0.977	0.966	0.962	0.977	0.974	0.986	0.976	0.977	0.981	0.983
Relative Humidity (ERAI)	0.907	0.892	0.898	0.903	0.889	0.943	0.931	0.923	0.932	0.942
Temperature (ERAI)	0.980	0.983	0.980	0.980	0.982	0.987	0.986	0.986	0.988	0.988

(b) Modified

CAM METRICS	cam3_5_fv1.9x2.5					f19_g16_FC5				
	ANN	DJF	MAM	JJA	SON	ANN	DJF	MAM	JJA	SON
Zonal Wind (300mb, ERAI)	0.981	0.971	0.970	0.978	0.977	0.989	0.981	0.980	0.982	0.986
Relative Humidity (ERAI)	0.929	0.915	0.919	0.912	0.906	0.945	0.933	0.925	0.935	0.943
Temperature (ERAI)	0.994	0.994	0.994	0.994	0.995	0.995	0.994	0.994	0.995	0.995

Table 2. Bias from the ERA-Interim reanalysis (**green: better**, **red: worse**)

(a) Original

CAM METRICS	cam3_5_fv1.9x2.5					f19_g16_FC5				
	ANN	DJF	MAM	JJA	SON	ANN	DJF	MAM	JJA	SON
Zonal Wind (300mb, ERAI)	3.256	5.951	1.689	3.141	2.109	5.008	6.141	4.601	5.180	4.062
Relative Humidity (ERAI)	6.376	6.050	6.802	6.579	6.065	16.063	16.076	16.400	15.545	16.233
Temperature (ERAI)	0.455	0.392	0.537	0.453	0.435	0.739	0.766	0.801	0.660	0.729

(b) Modified

CAM METRICS	cam3_5_fv1.9x2.5					f19_g16_FC5				
	ANN	DJF	MAM	JJA	SON	ANN	DJF	MAM	JJA	SON
Zonal Wind (300mb, ERAI)	0.372	3.232	1.177	0.017	0.744	0.815	0.652	1.460	0.728	1.794
Relative Humidity (ERAI)	6.661	6.627	7.081	6.596	6.337	15.878	16.177	16.147	15.193	16.001
Temperature (ERAI)	0.280	0.240	0.365	0.257	0.255	0.594	0.635	0.654	0.507	0.581