Standard Diagnostic Requirement for the Aqua-planet Experiment Project (APE)

March 2003

Introduction

This document provides a list of standard diagnostics considered necessary for the adequate analysis and intercomparison of experiments from an aqua-planet intercomparison project. It is an amalgamation of requested diagnostics taken from the AMIP II standard model output, the WGNE standard diagnostics of mean climate and selected diagnostics which have proved useful in analysing the previous aqua-planet and dynamical core experiments.

This document should be read in conjunction with Neale and Hoskins (2000a) and Neale and Hoskins (2000b) which outline a recommended suite of 8 aqua-planet AGCM experiments. Five experiments use a zonally symmetric SST forcing and three experiments include SST variations in the tropics. Information regarding averaging, sampling and the domain for each diagnostic is provided in section 1. The standard compulsory diagnostics are given in section 2 and the extended optional diagnostics in section 3.

1. Notes

The following gives information aimed at standardising the processing of data and analyses from the experiments.

Time-Averaging and Domains

Analysis/Data	Names	Time averaging	Domain
GT	Global Time-Series	Daily	Global, Area Average
GA	Global Time-Averages	3-yearly	Global, Area Average
SZ	Single-Level Zonal Means	3-yearly	90°S-90°N
SH	Single-Level 2-D Means	3-yearly	0-360°, 90°S-90°N
TR	Transients	6-hourly (year 3)	0-360°, Variable Lat.
MZ	Multiple-Level Zonal Means	3-yearly	90°S-90°N, P17
MF	Multiple-Level Zonal Mean Fluxes	3-yearly	90°S-90°N, P17
ME	Multiple-Level Equatorial Slices	3-yearly	5°S-5°N, 0-360°, P17
ML	Multiple-Level 3-D Means	3-yearly	Global (P17)
PF	Parametrization Forcing	3-yearly	Global (MS)
TE	Transformed Eulerian Means	3-yearly	Global (P17)
VB	Vertically Integrated Budgets	3-yearly	90°S-90°N

Table 1: Summary of diagnostics.

Data for all the diagnostics should be taken from the final 3 years of each 3-year + 6-months integration. A 360 or 365 day calendar should be used. As a guide in each of the following tables the model data required for each analysis for submission to the project is also listed. Therefore, each table lists either an analysis with the necessary data source or simply data required to calculate analyses elsewhere. A blank space in the data column means the diagnostic is calculated from analyses elsewhere in the same table, whereas a blank space in the analysis column means no analysis is required for this diagnostic. It is hoped this will assist in the planning of raw model output and reduce duplication, with just the 'data' being collected for each set of experiments.

In creating daily, monthly and 3-yearly time-averages, data is accumulated at every time-step. the exception to this is for data marked with † which should be sampled from the instantaneous values four times a day at 00, 06, 12 and 18z. Data for the TR diagnostics should be taken from the final year of the 3 year period.

Vertical Coordinates/Levels

Diagnostics should be calculated on pressure surfaces (P17) or model surfaces (MS), as indicated in Table 1. All pressure level diagnostics should be on the standard 17 WMO pressure levels (P17) to enable comparison with reanalysis products and compatibility with the existing AMIP II set-up.

1000 hPa	600 hPa	250 hPa	70 hPa	10 hPa
925 hPa	500 hPa	200 hPa	50 hPa	
850 hPa	400 hPa	150 hPa	30 hPa	
700 hPa	300 hPa	100 hPa	20 hPa	

For the vertically integrated fields the trapezium method of integration should be used with the 1000 hPa and 10 hPa pressure levels taken as end points.

Analyses Volumes

Assuming a GCM climate resolution similar to T42, the standard compulsory diagnostics volumes are estimated to be 292 Mb for each experiment performed. For the extended optional diagnostics volumes are 0.1 Mb for each zonally symmetric experiment and 11 Mb for each zonally asymmetric experiment. For the complete set of 8 aqua-planet experiments, as recommended in Neale and Hoskins (2000a), the total volume for the standard compulsory diagnostics is therefore approximately 2.4 Gb and for the extended optional diagnostics 0.03 Gb. It is hoped that these relatively small diagnostic volumes will make the dissemination of diagnostics much easier. Sizes are calculated assuming 32-bit/4-byte packing of data in netCDF format.

Nomenclature and Abbreviations

TOA - Top of the atmosphere
SFC - Surface
R_e - Radius of the earth

[..] - zonal average
$(..)^*$ - local departure form zonal average
$[..]^*$ - transformed Eulerian mean
$(\overline{..})$ - time average
$(..)'$ - instantaneous departure from time average

2. Standard Compulsory Diagnostics

Global Time-Series (GT)

Required for all experiments to provide an assessment of model stability throughout the experiment period. Global time series of daily averages.

Analysis	Data	Name	Units	Diagnostic
GT01	GT01	TOA incident shortwave radiation (+ve downward) (SW_{TOAi})	Wm^{-2}	gt_sw_toai
GT02	GT02	TOA reflected shortwave radiation (+ve downward) (SW_{TOAr})	Wm^{-2}	gt_sw_toar
GT03		TOA net shortwave radiation (+ve downward) (SW_{TOA})	Wm^{-2}	gt_sw_toa
GT04	GT04	TOA net longwave radiation (+ve upward) (LW_{TOA})	Wm^{-2}	gt_lw_toa
GT05		TOA radiation residual (+ve upward) ($SW_{TOA} - LW_{TOA}$)	Wm^{-2}	gt_rflux_toa
GT06		TOA albedo (α) (SW_{TOAr}/SW_{TOAi})	$fraction$	gt_albedo
GT07	GT07	Cloud fraction (CLD_F)	$fraction$	gt_cld_frac
GT08	GT08	Vertically integrated cloud water (CLD_W)	$kg.m^{-2}$	gt_cldw
GT09	GT09	Vertically integrated cloud ice (CLD_I)	$kg.m^{-2}$	gt_cldi
GT10		Total precipitation rate (PPN_T)	$kg.m^{-2}s^{-1}$	gt_tppn
GT11	GT11	Convective precipitation rate (PPN_C)	$kg.m^{-2}s^{-1}$	gt_cppn
GT12	GT12	Dynamic/Large-scale precipitation rate (PPN_D)	$kg.m^{-2}s^{-1}$	gt_dppn
GT13	GT13	Evaporation rate ($EVAP$)	$kg.m^{-2}s^{-1}$	gt_evap
GT14		Evaporation rate minus total precipitation rate ($EVAP - PPN_T$)	$kg.m^{-2}s^{-1}$	gt_emp
GT15	GT15	Incident shortwave radiation at surface (+ve downward) (SW_{Si})	Wm^{-2}	gt_sswi
GT16	GT16	Reflected shortwave radiation at surface (+ve downward) (SW_{Sr})	Wm^{-2}	gt_sswr
GT17		Net shortwave radiation at surface (+ve downward) (SW_S)	Wm^{-2}	gt_ssw
GT18	GT18	Downwelling longwave radiation at surface (+ve upward) (LW_{Sd})	Wm^{-2}	gt_slwd
GT19	GT19	Upwelling longwave radiation at surface(+ve upward) (LW_{Su})	Wm^{-2}	gt_slwu
GT20		Net longwave radiation at surface (+ve upward) (LW_S)	Wm^{-2}	gt_slw
GT21	GT21	Surface latent heat flux (+ve upward) (LH)	Wm^{-2}	gt_slh
GT22	GT22	Surface sensible heat flux (+ve upward) (SH)	Wm^{-2}	gt_ssh
GT23		Residual ($SW_S - LW_S - LH - SH$)	Wm^{-2}	gt_rflux_sfce
GT24	†GT24	Surface air temperature (at 2 m) (T_{Sair})	K	gt_ts2m
GT25	†GT25	Surface pressure (P_s)	Pa	gt_ps

Global Time-Averages (GA)

Required for all experiments.

Analysis	Data	Name	Units	Diagnostic
GA01	SH01	TOA incident shortwave radiation (+ve downward) (SW_{TOAi})	Wm^{-2}	ga_sw_toai
GA02	SH02	TOA reflected shortwave radiation (+ve downward) (SW_{TOAr})	Wm^{-2}	ga_sw_toar
GA03		TOA net shortwave radiation (+ve downward) (SW_{TOA})	Wm^{-2}	ga_sw_toa
GA04	SH04	TOA net longwave radiation (+ve upward) (LW_{TOA})	Wm^{-2}	ga_lw_toa
GA05		TOA radiation residual (+ve upward) ($SW_{TOA} - LW_{TOA}$)	Wm^{-2}	ga_rflux_toa
GA06		TOA albedo (α) (SW_{TOAr}/SW_{TOAi})	$fraction$	ga_albedo
GA07	SH07	Cloud fraction (CLD_F)	$fraction$	ga_cld_frac
GA08	SH08	Vertically integrated cloud water (CLD_W)	$kg.m^{-2}$	ga_cldw
GA09	SH09	Vertically integrated cloud ice (CLD_I)	$kg.m^{-2}$	ga_cldi
GA10		Total precipitation rate (PPN_T)	$kg.m^{-2}s^{-1}$	ga_tppn
GA11	SH11	Convective precipitation rate (PPN_C)	$kg.m^{-2}s^{-1}$	ga_cppn
GA12	SH12	Dynamic/Large-scale precipitation rate (PPN_D)	$kg.m^{-2}s^{-1}$	ga_dppn
GA13	SH13	Evaporation rate ($EVAP$)	$kg.m^{-2}s^{-1}$	ga_evap
GA14		Evaporation rate minus total precipitation rate ($EVAP - PPN_T$)	$kg.m^{-2}s^{-1}$	ga_emp
GA15	SH15	Incident shortwave radiation at surface (+ve downward) (SW_{Si})	Wm^{-2}	ga_sswi
GA16	SH16	Reflected shortwave radiation at surface (+ve downward) (SW_{Sr})	Wm^{-2}	ga_sswr
GA17		Net solar radiation at surface (+ve downward) (SW_S)	Wm^{-2}	ga_ssw
GA18	SH18	Downwelling longwave radiation at surface (+ve upward) (LW_{Sd})	Wm^{-2}	ga_slwd
GA19	SH19	Upwelling longwave radiation at surface(+ve upward) (LW_{Su})	Wm^{-2}	ga_slwu
GA20		Net longwave radiation at surface (+ve upward) (LW_S)	Wm^{-2}	ga_slw
GA21	SH21	Surface latent heat flux (+ve upward) (LH)	Wm^{-2}	ga_slh
GA22	SH22	Surface sensible heat flux (+ve upward) (SH)	Wm^{-2}	ga_ssh
GA23		Residual ($SW_S - LW_S - LH - SH$)	Wm^{-2}	ga_rflux_sfce
GA24	†SH24	Surface air temperature (at 2 m) (T_{Sair})	K	ga_ts2m
GA25	†SH30	Surface pressure (P_s)	Pa	ga_ps

Single-Level Fields

Single-level Zonal Means (SZ)

Required for all experiments.

Single-Level

Analysis	Data	Name	Units	Diagnostic
SZ01	SH01	TOA incident shortwave radiation (+ve downward) (SW_{TOAi})	Wm^{-2}	sz_sw_toai
SZ02	SH02	TOA reflected shortwave radiation (+ve downward) (SW_{TOAr})	Wm^{-2}	sz_sw_toar
SZ03		TOA net shortwave radiation (+ve downward) (SW_{TOA})	Wm^{-2}	sz_sw_toa
SZ04	SH04	TOA net longwave radiation (+ve upward) (LW_{TOA})	Wm^{-2}	sz_lw_toa
SZ05		TOA radiation residual (+ve upward) ($SW_{TOA} - LW_{TOA}$)	Wm^{-2}	sz_rflux_toa
SZ06		TOA albedo (α) (SW_{TOAr}/SW_{TOAi})	$fraction$	sz_albedo
SZ07	SH07	Cloud fraction (CLD_F)	$fraction$	sz_cld_frac
SZ08	SH08	Vertically integrated cloud water (CLD_W)	$kg.m^{-2}$	sz_cldw
SZ09	SH09	Vertically integrated cloud ice (CLD_I)	$kg.m^{-2}$	sz_cldi
SZ10		Total precipitation rate (PPN_T)	$kg.m^{-2}s^{-1}$	sz_tppn
SZ11	SH11	Convective precipitation rate (PPN_C)	$kg.m^{-2}s^{-1}$	sz_cppn
SZ12	SH12	Dynamic/Large-scale precipitation rate (PPN_D)	$kg.m^{-2}s^{-1}$	sz_dppn
SZ13	SH13	Evaporation rate ($EVAP$)	$kg.m^{-2}s^{-1}$	sz_evap
SZ14		Evaporation rate minus total precipitation rate ($EVAP - PPN_T$)	$kg.m^{-2}s^{-1}$	sz_emp
SZ15	SH15	Incident shortwave radiation at surface (+ve downward) (SW_{Si})	Wm^{-2}	sz_sswi
SZ16	SH16	Reflected shortwave radiation at surface (+ve downward) (SW_{Sr})	Wm^{-2}	sz_sswr
SZ17		Net shortwave radiation at surface (+ve downward) (SW_S)	Wm^{-2}	sz_ssw
SZ18	SH18	Downwelling longwave radiation at surface (+ve upward) (LW_{Sd})	Wm^{-2}	sz_slwd
SZ19	SH19	Upwelling longwave radiation at surface(+ve upward) (LW_{Su})	Wm^{-2}	sz_slwu
SZ20		Net longwave radiation at surface (+ve upward) (LW_S)	Wm^{-2}	sz_slw
SZ21	SH21	Surface latent heat flux (+ve upward) (LH)	Wm^{-2}	sz_slh
SZ22	SH22	Surface sensible heat flux (+ve upward) (SH)	Wm^{-2}	sz_ssh
SZ23		Residual ($SW_S - LW_S - LH - SH$)	Wm^{-2}	sz_rflux_sfce
SZ24	†SH24	Surface air temperature (at 2 m) (T_{Sair})	K	sz_ts2m
SZ25	†SH25	Surface specific humidity (at 2 m) (q_S)	$kg.kg^{-1}$	sz_q2m
SZ26	SH26	Zonal surface stress (+ve for eastward wind) (τ_{su})	Nm^{-2}	sz_tauu
SZ27	SH27	Meridional surface stress (+ve for northward wind) (τ_{sv})	Nm^{-2}	sz_tauv
SZ28	†SH28	Surface zonal wind (at 10 m)	ms^{-1}	sz_u10m
SZ29	†SH29	Surface meridional wind (at 10 m)	ms^{-1}	sz_v10m
SZ30	†SH30	Surface pressure(P_s)	Pa	sz_ps

Single-Level 2-D (SH)

Required for all experiments.

Single-Level

Analysis	Data	Name	Units	Diagnostic
SH01	SH01	TOA incident shortwave radiation (+ve downward) (SW_{TOAi})	Wm^{-2}	sh_sw_toai
SH02	SH02	TOA reflected shortwave radiation (+ve downward) (SW_{TOAr})	Wm^{-2}	sh_sw_toar
SH03		TOA net shortwave radiation (+ve downward) (SW_{TOA})	Wm^{-2}	sh_sw_toa
SH04	SH04	TOA net longwave radiation (+ve upward) (LW_{TOA})	Wm^{-2}	sh_lw_toa
SH05		TOA radiation residual (+ve upward) ($SW_{TOA} - LW_{TOA}$)	Wm^{-2}	sh_rflux_toa
SH06		TOA albedo (α) (SW_{TOAr}/SW_{TOAi})	$fraction$	sh_albedo
SH07	SH07	Cloud fraction (CLD_F)	$fraction$	sh_cld_frac
SH08	SH08	Vertically integrated cloud water (CLD_W)	$kg.m^{-2}$	sh_cldw
SH09	SH09	Vertically integrated cloud ice (CLD_I)	$kg.m^{-2}$	sh_cldi
SH10		Total precipitation rate (PPN_T)	$kg.m^{-2}s^{-1}$	sh_tppn
SH11	SH11	Convective precipitation rate (PPN_C)	$kg.m^{-2}s^{-1}$	sh_cppn
SH12	SH12	Dynamic/Large-scale precipitation rate (PPN_D)	$kg.m^{-2}s^{-1}$	sh_dppn
SH13	SH13	Evaporation rate ($EVAP$)	$kg.m^{-2}s^{-1}$	sh_evap
SH14		Evaporation rate minus total precipitation rate ($EVAP - PPN_T$)	$kg.m^{-2}s^{-1}$	sh_emp
SH15	SH15	Incident shortwave radiation at surface (+ve downward) (SW_{Si})	Wm^{-2}	sh_sswi
SH16	SH16	Reflected shortwave radiation at surface (+ve downward) (SW_{Sr})	Wm^{-2}	sh_sswr
SH17		Net shortwave radiation at surface (+ve downward) (SW_S)	Wm^{-2}	sh_ssw
SH18	SH18	Downwelling longwave radiation at surface (+ve upward) (LW_{Sd})	Wm^{-2}	sh_slwd
SH19	SH19	Upwelling longwave radiation at surface(+ve upward) (LW_{Su})	Wm^{-2}	sh_slwu
SH20		Net longwave radiation at surface (+ve upward) (LW_S)	Wm^{-2}	sh_slw
SH21	SH21	Surface latent heat flux (+ve upward) (LH)	Wm^{-2}	sh_slh
SH22	SH22	Surface sensible heat flux (+ve upward) (SH)	Wm^{-2}	sh_ssh
SH23		Residual ($SW_S - LW_S - LH - SH$)	Wm^{-2}	sh_rflux_sfce
SH24	†SH24	Surface air temperature (at 2 m) (T_{Sair})	K	sh_t2m
SH25	†SH25	Surface specific humidity (at 2 m) (q_S)	$kg.kg^{-1}$	sh_q2m
SH26	SH26	Zonal surface stress (+ve for eastward wind) (τ_{su})	Nm^{-2}	sh_tauu
SH27	SH27	Meridional surface stress (+ve for northward wind) (τ_{sv})	Nm^{-2}	sh_tauv
SH28	†SH28	Surface zonal wind (at 10 m)	ms^{-1}	sh_u10m
SH29	†SH29	Surface meridional wind (at 10 m)	ms^{-1}	sh_v10m
SH30	†SH30	Surface pressure (P_s)	Pa	sh_ps

Latitude-Longitude Slice

Analysis	Data	Name	Units	Diagnostic
SH31	†ML01	Zonal wind at 200 hPa (u_{200})	ms^{-1}	sh_u200
SH32	†ML01	Zonal wind at 850 hPa (u_{850})	ms^{-1}	sh_u850
SH33	†ML02	Meridional wind at 200 hPa (v_{200})	ms^{-1}	sh_v200
SH34	†ML02	Meridional wind at 850 hPa (v_{850})	ms^{-1}	sh_v850
SH35	†ML04	Omega at 500 hPa (ω_{500})	$Pa.s^{-1}$	sh_om500
SH36	†ML05	Geopotential height at 500 hPa (Z_{500})	m	sh_z500
SH37	†ML03	Temperature at 700 hPa (T_{700})	K	sh_t700
SH38	†ML01,02	Divergence at 200 hPa (D_{200})	s^{-1}	sh_div200
SH39	†ML01,02	Divergence at 850 hPa (D_{850})	s^{-1}	sh_div850
SH40	†ML01,02	Relative Vorticity at 200 hPa (ξ_{200})	s^{-1}	sh_vort200
SH41	†ML01,02	Relative Vorticity at 850 hPa (ξ_{850})	s^{-1}	sh_vort850
SH42	†ML01,02	Streamfunction at 200 hPa (ψ_{200})	m^2s^{-1}	sh_psi200
SH43	†ML01,02	Streamfunction at 850 hPa (ψ_{850})	m^2s^{-1}	sh_psi850
SH44	†ML01,02	Velocity potential at 200 hPa (χ_{200})	m^2s^{-1}	sh_chi200
SH45	†ML01,02	Velocity potential at 850 hPa (χ_{850})	m^2s^{-1}	sh_chi850
SH46	†ML01,02	Zonal rotational velocity at 200 hPa ($u_{\psi200}$)	ms^{-1}	sh_upsi200
SH47	†ML01,02	Zonal rotational velocity at 850 hPa ($u_{\psi850}$)	ms^{-1}	sh_upsi850
SH48	†ML01,02	Meridional rotational velocity at 200 hPa ($v_{\psi200}$)	ms^{-1}	sh_vpsi200
SH49	†ML01,02	Meridional rotational velocity at 850 hPa ($v_{\psi850}$)	ms^{-1}	sh_vpsi850
SH50	†ML01,02	Zonal divergent velocity at 200 hPa ($u_{\chi200}$)	ms^{-1}	sh_uchi200
SH51	†ML01,02	Zonal divergent velocity at 850 hPa ($u_{\chi850}$)	ms^{-1}	sh_uchi850
SH52	†ML01,02	Meridional divergent velocity at 200 hPa ($v_{\chi200}$)	ms^{-1}	sh_vchi200
SH53	†ML01,02	Meridional divergent velocity at 850 hPa ($v_{\chi850}$)	ms^{-1}	sh_vchi850

Transients (TR)

Required for all experiments.

Requirements for this diagnostic will constitute the heaviest burden on data size but they are considered necessary for the adequate diagnosis of tropical wave activity. All longitudes are required and the latitudinal range is indicated. Ideally the diagnosis should follow that of Wheeler and Kiladis (1999) with analysis of the total, symmetric and antisymmetric components of tropical wave activity for data between 30°N and 30°S. Surface pressure and upper-tropospheric winds are required for diagnosis of extra-tropical storm-track activity.

Analysis	Data	Name	Units	Diagnostic	Latitudes
TR01	TR01	Total precipitation rate (PPN_{T_6hr})	$kg.m^{-2}s^{-1}$	tr_tppn	90°S-90°N
TR02	TR02	TOA net longwave radiation (+ve upward) (LW_{TOA_6hr})	Wm^{-2}	tr_lw_toa	90°S-90°N
TR03	†TR03	Vertical velocity at 500 hPa (ω_{500_6hr})	$Pa.s^{-1}$	tr_om500	90°S-90°N
TR04	†TR04	Zonal wind at 250 hPa (u_{250_6hr})	ms^{-1}	tr_u250	90°S-90°N
TR05	†TR05	Meridional wind at 250 hPa (v_{250_6hr})	ms^{-1}	tr_v250	90°S-90°N
TR06	†TR06	Surface pressure(P_{s_6hr})	Pa	tr_mslp	90°S-90°N

Multiple-Level Fields

Information regarding vertical levels is provided in section 1.

Multiple-Level Zonal Means (MZ)

Required for all experiments.

Upper-air Fields

Analysis	Data	Name	Units	Diagnostic
MZ01	†ML01	Zonal wind (u)	ms^{-1}	mz_u
MZ02	†ML02	Meridional wind (v)	ms^{-1}	mz_v
MZ03	†ML03	Temperature (T)	K	mz_t
MZ04	†ML04	Omega (ω)	$Pa.s^{-1}$	mz_om
MZ05	†ML05	Geopotential height (Z)	m	mz_z
MZ06	†ML06	Specific humidity (q)	$kg.kg^{-1}$	mz_q
MZ07	†ML07	Relative humidity (RH)	$\%$	mz_rh
MZ08	†ML02 or †ML04	Mean meridional circulation (Ψ_{MMC})	$kg.s^{-1}$	mz_mmc
MZ09	†ML03	Potential temperature (θ)	K	mz_th
MZ10	†ML03,06	Equivalent potential temperature (θ_e)	K	mz_the
MZ11	†ML03,06	Saturated equivalent potential temperature (θ_e^*)	K	mz_thes

Multiple Level Zonal Mean Fluxes (MF)

Required for all experiments.

To capture the contribution to the time averaged atmospheric flux of quantities by mid-latitude wave activity co-variance statistics are required. The budget equation for the total zonally averaged covariance of the quantities α and β is

$$[\overline{\alpha\beta}] = [\overline{\alpha}][\overline{\beta}] + [\overline{\alpha}^*\overline{\beta}^*] + \overline{[\alpha]'[\beta]'} + \overline{[\alpha'^*\beta'^*]}$$

$[\overline{\alpha\beta}]$ - Total.
$[\overline{\alpha}][\overline{\beta}]$ - Contribution from the stationary mean meridional circulation.
$[\overline{\alpha}^*\overline{\beta}^*]$ - Contribution from the stationary eddies.
$\overline{[\alpha]'[\beta]'}$ - Contribution from the transient mean meridional circulation.
$\overline{[\alpha'^*\beta'^*]}$ - Contribution from the transient eddies.

The transient terms can be calculated as residuals from the mean at each time period such that:

$$\overline{[\alpha]'[\beta]'} = \overline{[\alpha][\beta]} - [\overline{\alpha}][\overline{\beta}]$$
$$\overline{[\alpha'^*\beta'^*]} = \overline{[\alpha^*\beta^*]} - [\overline{\alpha}^*\overline{\beta}^*]$$

Total Fluxes

Analysis	Data	Name	Units	Diagnostic
MF01	†MF01	Zonal wind variance ($[\overline{u^2}]$)	m^2s^{-2}	mf_uu
MF02	†MF02	Meridional wind variance ($[\overline{v^2}]$)	m^2s^{-2}	mf_vv
MF03	†MF03	Temperature variance ($[\overline{T^2}]$)	K^2	mf_tt
MF04	†MF04	Omega variance ($[\overline{\omega^2}]$)	Pa^2s^{-2}	mf_omom
MF05	†MF05	Geopotential variance ($[\overline{\Phi^2}]$)	$(m^2s^{-2})^2$	mf_phiphi
MF06	†MF06	Specific humidity variance ($[\overline{q^2}]$)	$(kg.kg^{-1})^2$	mf_qq
MF07	†MF07	Poleward zonal momentum flux ($[\overline{uv}]$)	m^2s^{-2}	mf_uv
MF08	†MF08	Vertical zonal momentum flux ($[\overline{u\omega}]$)	$mPa.s^{-2}$	mf_uom
MF09	†MF09	Vertical meridional momentum flux ($[\overline{v\omega}]$)	$mPa.s^{-2}$	mf_vom
MF10	†MF10	Poleward temperature flux ($[\overline{vT}]$)	$ms^{-1}K$	mf_vt
MF11	†MF11	Vertical temperature flux ($[\overline{\omega T}]$)	$Pa.s^{-1}K$	mf_omt
MF12	†MF12	Poleward moisture flux ($[\overline{vq}]$)	$ms^{-1}kg.kg^{-1}$	mf_vq
MF13	†MF13	Vertical moisture flux ($[\overline{\omega q}]$)	$Pa.s^{-1}kg.kg^{-1}$	mf_omq
MF14	†MF14	Poleward geopotential flux ($[\overline{v\Phi}]$)	m^3s^{-3}	mf_vphi

Stationary Mean Meridional Circulation Fluxes

Analysis	Data	Name	Units	Diagnostic
MF15	†ML01	Zonal wind variance ($[\overline{u}]^2$)	m^2s^{-2}	mf_tm_uu
MF16	†ML02	Meridional wind variance ($[\overline{v}]^2$)	m^2s^{-2}	mf_tm_vv
MF17	†ML03	Temperature variance ($[\overline{T}]^2$)	K^2	mf_tm_tt
MF18	†ML04	Omega variance ($[\overline{\omega}]^2$)	Pa^2s^{-2}	mf_tm_omom
MF19	†ML05	Geopotential variance ($[\overline{\Phi}]^2$)	$(m^2s^{-2})^2$	mf_tm_phiphi
MF20	†ML06	Specific humidity variance ($[\overline{q}]^2$)	$(kg.kg^{-1})^2$	mf_tm_qq
MF21	†ML01,ML02	Poleward zonal momentum flux ($[\overline{u}][\overline{v}]$)	m^2s^{-2}	mf_tm_uv
MF22	†ML01,ML04	Vertical zonal momentum flux ($[\overline{u}][\overline{\omega}]$)	$mPa.s^{-2}$	mf_tm_uom
MF23	†ML02,ML04	Vertical meridional momentum flux ($[\overline{v}][\overline{\omega}]$)	$mPa.s^{-2}$	mf_tm_vom
MF24	†ML02,ML03	Poleward temperature flux ($[\overline{v}][\overline{T}]$)	$ms^{-1}K$	mf_tm_vt
MF25	†ML04,ML03	Vertical temperature flux ($[\overline{\omega}][\overline{T}]$)	$Pa.s^{-1}K$	mf_tm_omt
MF26	†ML02,ML06	Poleward moisture flux ($[\overline{v}][\overline{q}]$)	$ms^{-1}kg.kg^{-1}$	mf_tm_vq
MF27	†ML04,ML06	Vertical moisture flux ($[\overline{\omega}][\overline{q}]$)	$Pa.s^{-1}kg.kg^{-1}$	mf_tm_omq
MF28	†ML02,ML05	Poleward geopotential flux ($[\overline{v}][\overline{\Phi}]$)	m^3s^{-3}	mf_tm_vphi

Stationary Eddy Fluxes

Analysis	Data	Name	Units	Diagnostic
MF29	†MF29	Zonal wind variance($[\overline{u}^{*2}]$)	m^2s^{-2}	mf_se_uu
MF30	†MF30	Meridional wind variance ($[\overline{v}^{*2}]$)	m^2s^{-2}	mf_se_vv
MF31	†MF31	Temperature variance ($[\overline{T}^{*2}]$)	K^2	mf_se_tt
MF32	†MF32	Omega variance ($[\overline{\omega}^{*2}]$)	Pa^2s^{-2}	mf_se_omom
MF33	†MF33	Geopotential variance ($[\overline{\Phi}^{*2}]$)	$(m^2s^{-2})^2$	mf_se_phiphi
MF34	†MF34	Specific humidity variance ($[\overline{q}^{*2}]$)	$(kg.kg^{-1})^2$	mf_se_qq
MF35	†MF35	Poleward zonal momentum flux ($[\overline{u}^*\overline{v}^*]$)	m^2s^{-2}	mf_se_uv
MF36	†MF36	Vertical zonal momentum flux ($[\overline{u}^*\overline{\omega}^*]$)	$mPa.s^{-2}$	mf_se_uom
MF37	†MF37	Vertical meridional momentum flux ($[\overline{v}^*\overline{\omega}^*]$)	$mPa.s^{-2}$	mf_se_vom
MF38	†MF38	Poleward temperature flux ($[\overline{v}^*\overline{T}^*]$)	$ms^{-1}K$	mf_se_vt
MF39	†MF39	Vertical temperature flux ($[\overline{\omega}^*\overline{T}^*]$)	$Pa.s^{-1}K$	mf_se_omt
MF40	†MF40	Poleward moisture flux ($[\overline{v}^*\overline{q}^*]$)	$ms^{-1}kg.kg^{-1}$	mf_se_vq
MF41	†MF41	Vertical moisture flux ($[\overline{\omega}^*\overline{q}^*]$)	$Pa.s^{-1}kg.kg^{-1}$	mf_se_omq
MF42	†MF42	Poleward geopotential flux ($[\overline{v}^*\overline{\Phi}^*]$)	m^3s^{-3}	mf_se_vphi

Transient Mean Meridional Circulation Fluxes

Analysis	Data	Name	Units	Diagnostic
MF43	†MF43	Zonal wind variance($\overline{[u]'^2}$)	m^2s^{-2}	mf_tm_uu
MF44	†MF44	Meridional wind variance ($\overline{[v]'^2}$)	m^2s^{-2}	mf_tm_vv
MF45	†MF45	Temperature variance ($\overline{[T]'^2}$)	K^2	mf_tm_tt
MF46	†MF46	Omega variance ($\overline{[\omega]'^2}$)	Pa^2s^{-2}	mf_tm_omom
MF47	†MF47	Geopotential variance ($\overline{[\Phi]'^2}$)	$(m^2s^{-2})^2$	mf_tm_phiphi
MF48	†MF48	Specific humidity variance ($\overline{[q]'^2}$)	$(kg.kg^{-1})^2$	mf_tm_qq
MF49	†MF49	Poleward zonal momentum flux ($\overline{[u]'[v]'}$)	m^2s^{-2}	mf_tm_uv
MF50	†MF50	Vertical zonal momentum flux ($\overline{[u]'[\omega]'}$)	$mPa.s^{-2}$	mf_tm_uom
MF51	†MF51	Vertical meridional momentum flux ($\overline{[v]'[\omega]'}$)	$mPa.s^{-2}$	mf_tm_vom
MF52	†MF52	Poleward temperature flux ($\overline{[v]'[T]'}$)	$ms^{-1}K$	mf_tm_vt
MF53	†MF53	Vertical temperature flux ($\overline{[\omega]'[T]'}$)	$Pa.s^{-1}K$	mf_tm_omt
MF54	†MF54	Poleward moisture flux ($\overline{[v]'[q]'}$)	$ms^{-1}kg.kg^{-1}$	mf_tm_vq
MF55	†MF55	Vertical moisture flux ($\overline{[\omega]'[q]'}$)	$Pa.s^{-1}kg.kg^{-1}$	mf_tm_omq
MF56	†MF56	Poleward geopotential flux ($\overline{[v]'[\Phi]'}$)	m^3s^{-3}	mf_tm_vphi

Transient Eddy Fluxes

Analysis	Data	Name	Units	Diagnostic
MF57	†MF57	Zonal wind variance($\overline{[u'^{*2}]}$)	m^2s^{-2}	mf_te_uu
MF58	†MF58	Meridional wind variance ($\overline{[v'^{*2}]}$)	m^2s^{-2}	mf_te_vv
MF59	†MF59	Temperature variance ($\overline{[T'^{*2}]}$)	K^2	mf_te_tt
MF60	†MF60	Omega variance ($\overline{[\omega'^{*2}]}$)	Pa^2s^{-2}	mf_te_omom
MF61	†MF61	Geopotential variance ($\overline{[\Phi'^{*2}]}$)	$(m^2s^{-2})^2$	mf_te_phiphi
MF62	†MF62	Specific humidity variance ($\overline{[q'^{*2}]}$)	$(kg.kg^{-1})^2$	mf_te_qq
MF63	†MF63	Poleward zonal momentum flux ($\overline{[u'^*v'^*]}$)	m^2s^{-2}	mf_te_uv
MF64	†MF64	Vertical zonal momentum flux ($\overline{[u'^*\omega'^*]}$)	$mPa.s^{-2}$	mf_te_uom
MF65	†MF65	Vertical meridional momentum flux($\overline{[v'^*\omega'^*]}$)	$mPa.s^{-2}$	mf_te_vom
MF66	†MF66	Poleward temperature flux ($\overline{[v'^*T'^*]}$)	$ms^{-1}K$	mf_te_vt
MF67	†MF67	Vertical temperature flux ($\overline{[\omega'^*T'^*]}$)	$Pa.s^{-1}K$	mf_te_omt
MF68	†MF68	Poleward moisture flux ($\overline{[v'^*q'^*]}$)	$ms^{-1}kg.kg^{-1}$	mf_te_vq
MF69	†MF69	Vertical moisture flux ($\overline{[\omega'^*q'^*]}$)	$Pa.s^{-1}kg.kg^{-1}$	mf_te_omq
MF70	†MF70	Poleward geopotential flux ($\overline{[v'^*\Phi'^*]}$)	m^3s^{-3}	mf_te_vphi

Multiple-Level Equatorial Slices (ME)

Required for all experiments. Equatorial averaging performed between 5°S-5°N.

Analysis	Data	Name	Units	Diagnostic
ME01	†ML01	Zonal wind (u)	ms^{-1}	me_u
ME02	†ML04	Omega (ω)	$Pa.s^{-1}$	me_om
ME03	†ML06	Specific humidity (q)	$kg.kg^{-1}$	me_q
ME04	†ML07	Relative humidity (RH)	$\%$	me_rh
ME05	†ML03	Potential temperature (θ)	K	me_th
ME06	†ML03,06	Equivalent potential temperature (θ_e)	K	me_the
ME07	†ML03,06	Saturated equivalent potential temperature (θ_e^*)	K	me_thes

Multiple-Level 3-D Means (ML)

Required for all experiments.

Analysis	Data	Name	Units	Diagnostic
	†ML01	Zonal wind (u)	ms^{-1}	ml_u
	†ML02	Meridional wind (v)	ms^{-1}	ml_v
	†ML03	Temperature (T)	K	ml_t
	†ML04	Omega (ω)	$Pa.s^{-1}$	ml_om
	†ML05	Geopotential (Φ)	m^2s^{-2}	ml_phi
	†ML06	Specific humidity (q)	$kg.kg^{-1}$	ml_q
	†ML07	Relative humidity (RH)	$\%$	ml_rh

3. Extended Optional Diagnostics

The production of the following diagnostics are not considered vital for the adequate comparison of aqua-planet models but would provide a greater insight into the balance and interactions within each model and how models compare.

Parametrization Forcing (PF)

Zonal means for zonally symmetric experiments and three-dimensional fields for zonally asymmetric experiments.

Temperature

- Total $\left(\frac{\partial T}{\partial t}\right)$
- Shortwave radiation $\left(\frac{\partial T}{\partial t}\right)_{SW}$
- Longwave radiation $\left(\frac{\partial T}{\partial t}\right)_{LW}$
- Turbulence $\left(\frac{\partial T}{\partial t}\right)_{TURB}$
- Convection $\left(\frac{\partial T}{\partial t}\right)_{CONV}$
- Cloud scheme $\left(\frac{\partial T}{\partial t}\right)_{LSCLD}$
- Dissipation $\left(\frac{\partial T}{\partial t}\right)_{DISP}$

Absolute humidity

- Total $\left(\frac{\partial q}{\partial t}\right)$
- Turbulence $\left(\frac{\partial q}{\partial t}\right)_{TURB}$
- Convection $\left(\frac{\partial q}{\partial t}\right)_{CONV}$
- Cloud scheme $\left(\frac{\partial q}{\partial t}\right)_{LSCLD}$
- Negative q fix $\left(\frac{\partial q}{\partial t}\right)_{NEGQ}$

Zonal velocity

- Total $\left(\frac{\partial u}{\partial t}\right)$
- Turbulence $\left(\frac{\partial u}{\partial t}\right)_{TURB}$
- Convection $\left(\frac{\partial u}{\partial t}\right)_{CONV}$
- Gravity-wave drag $\left(\frac{\partial u}{\partial t}\right)_{GWD}$

Meridional velocity

- Total $\left(\frac{\partial v}{\partial t}\right)$
- Turbulence $\left(\frac{\partial v}{\partial t}\right)_{TURB}$
- Convection $\left(\frac{\partial v}{\partial t}\right)_{CONV}$
- Gravity-wave drag $\left(\frac{\partial v}{\partial t}\right)_{GWD}$

Analysis	Data	Name	Units	Diagnostic
PF01	PF01	Temperature tendency - Total $\left(\frac{\partial T}{\partial t}\right)$	Ks^{-1}	pf_t
PF02	PF02	Temperature tendency - Short wave $\left(\frac{\partial T}{\partial t}\right)_{SW}$	Ks^{-1}	pf_t_sw
PF03	PF03	Temperature tendency - Long wave $\left(\frac{\partial T}{\partial t}\right)_{LW}$	Ks^{-1}	pf_t_lw
PF04	PF04	Temperature tendency - Turbulence $\left(\frac{\partial T}{\partial t}\right)_{TURB}$	Ks^{-1}	pf_t_turb
PF05	PF05	Temperature tendency - Convection $\left(\frac{\partial T}{\partial t}\right)_{CONV}$	Ks^{-1}	pf_t_conv
PF06	PF06	Temperature tendency - Cloud $\left(\frac{\partial T}{\partial t}\right)_{LSCLD}$	Ks^{-1}	pf_t_cld
PF07	PF07	Temperature tendency - Dissipation $\left(\frac{\partial T}{\partial t}\right)_{DISP}$	Ks^{-1}	pf_t_disp
PF08	PF08	Absolute humidity tendency - Total $\left(\frac{\partial q}{\partial t}\right)$	$kg.kg^{-1}s^{-1}$	pf_q
PF09	PF09	Absolute humidity tendency - Turbulence $\left(\frac{\partial q}{\partial t}\right)_{TURB}$	$kg.kg^{-1}s^{-1}$	pf_q_turb
PF10	PF10	Absolute humidity tendency - Convection $\left(\frac{\partial q}{\partial t}\right)_{CONV}$	$kg.kg^{-1}s^{-1}$	pf_q_conv
PF11	PF11	Absolute humidity tendency - Cloud $\left(\frac{\partial q}{\partial t}\right)_{LSCLD}$	$kg.kg^{-1}s^{-1}$	pf_q_cld
PF12	PF12	Absolute humidity tendency - Negative q fix $\left(\frac{\partial q}{\partial t}\right)_{NEGQ}$	$kg.kg^{-1}s^{-1}$	pf_q_negq
PF13	PF13	Zonal velocity tendency - Total $\left(\frac{\partial u}{\partial t}\right)$	ms^{-2}	pf_u
PF14	PF14	Zonal velocity tendency - Turbulence $\left(\frac{\partial u}{\partial t}\right)_{TURB}$	ms^{-2}	pf_u_turb
PF15	PF15	Zonal velocity tendency - Convection $\left(\frac{\partial u}{\partial t}\right)_{CONV}$	ms^{-2}	pf_u_conv
PF16	PF16	Zonal velocity tendency - Gravity-wave drag $\left(\frac{\partial u}{\partial t}\right)_{GWD}$	ms^{-2}	pf_u_gwd
PF17	PF17	Meridional velocity tendency - Total $\left(\frac{\partial v}{\partial t}\right)$	ms^{-2}	pf_v
PF18	PF18	Meridional velocity tendency - Turbulence $\left(\frac{\partial v}{\partial t}\right)_{TURB}$	ms^{-2}	pf_v_turb
PF19	PF19	Meridional velocity tendency - Convection $\left(\frac{\partial v}{\partial t}\right)_{CONV}$	ms^{-2}	pf_v_conv
PF20	PF20	Meridional velocity tendency - Gravity-wave drag $\left(\frac{\partial v}{\partial t}\right)_{GWD}$	ms^{-2}	pf_v_gwd

Transformed Eulerian Mean TEM (TE)

The TEM momentum balance is the clearest way to analyse forcing of the zonally averaged flow by the zonally asymmetric (transient plus stationary) eddies. Calculations are performed on pressure levels.

Meridional wind $\left([v]^* = [\overline{v}] - \frac{\partial}{\partial p}\left(\frac{[\overline{v^*\theta^*}]}{\frac{\partial[\overline{\theta}]}{\partial p}}\right)\right)$

Omega $\left([\omega]^* = [\overline{\omega}] + \frac{1}{R_e \cos\phi}\frac{\partial}{\partial \phi}\left(\cos\phi \frac{[\overline{v^*\theta^*}]}{\frac{\partial[\overline{\theta}]}{\partial p}}\right)\right)$

Mean-meridional circulation $\left([\Psi]^* = \frac{2\pi R_e \cos\phi}{g}\int_0^p [v]^* dp\right)$

Eliassen-Palm Fluxes ($\mathbf{F} = (F_\phi, F_p)$)
Northward: $F_\phi = R_e \cos\phi \left(\frac{[\overline{v^*\theta^*}]}{\frac{\partial[\overline{\theta}]}{\partial p}}[\frac{\partial \overline{u}}{\partial p}] - [\overline{u^*v^*}]\right)$
Downward: $F_p = R_e \cos\phi \left(\frac{[\overline{v^*\theta^*}]}{\frac{\partial[\overline{\theta}]}{\partial p}}\left(f - \frac{1}{R_e \cos\phi}\frac{\partial}{\partial\phi}([\overline{u}]\cos\phi)\right) - [\overline{u^*\omega^*}]\right)$

Zonal mean Div $\mathbf{F}$ $\left([\nabla.\mathbf{F}] = \left(\frac{1}{R_e \cos\phi}\frac{\partial}{\partial\phi}(F_\phi \cos\phi), \frac{\partial F_p}{\partial p}\right)\right)$

Analysis	Data	Name	Units	Diagnostic
TE01	†ML02,03,†MF38,66	TEM Meridional wind ($[v]^*$)	ms^{-1}	te_v
TE02	†ML03,04,†MF38,66	TEM Omega ($[\omega]^*$)	$Pa.s^{-1}$	te_om
TE03		TEM Mean meridional circulation ($[\Psi]^*$)	$kg.s^{-1}$	te_mmc
TE04	†ML01,03,MF35,38,63,66	Northward Eliassen-Palm FLux (F_ϕ)	m^3s^{-2}	te_fphi
TE05	†ML01,03,MF36,38,64,66	Downward Eliassen-Palm Flux (F_p)	$Pa.m^2s^{-2}$	te_fp
TE06		TEM Zonal mean Div F ($[\nabla.\mathbf{F}]$)	m^2s^{-2}	te_divf

Vertically Integrated Budgets (VB)

This section follows closely the proposal for AMIP II subproject number 33 entitled *Atmospheric Transports and Energetics* put forward by G. J. Boer and S. J. Lambert. The time and zonally averaged, vertically integrated transport equation for a quantity χ takes, to good approximation and ignoring some minor source/sink terms, the following form

$$\frac{1}{R_e \cos\phi}\frac{\partial}{\partial\phi}F_\phi \cos\phi = [\overline{S}_{TOA}] + [\overline{S}_{SFC}] = \mathbf{S}$$

where

$$F_\phi = F_{sz} + F_{se} + F_{tz} + F_{te} = \int_0^{P_0} [\overline{\chi v}]\frac{dp}{g} = \int_0^{P_0} [\overline{\chi}][\overline{v}]\frac{dp}{g} + \int_0^{P_0} [\overline{\chi}^* \overline{v}^*]\frac{dp}{g} + \int_0^{P_0} \overline{[\chi'][v']}\frac{dp}{g} + \int_0^{P_0} [\overline{\chi'^* v'^*}]\frac{dp}{g}$$

Angular Momentum
Absolute angular momentum is $M = R_e \cos\phi(\Omega R_e \cos\phi + u)$ and, to a good approximation, the equation for the relative angular momentum budget is given by

$$F_{AM} = R_e \cos\phi \int_0^{P_0} [\overline{uv}]\frac{dp}{g} \qquad S_{AM} = R_e \cos\phi[\overline{\tau}_{su}]$$

Hydrology
The moisture q budget, given by

$$F_q = R_e \cos\phi \int_0^{P_0} [\overline{qv}]\frac{dp}{g} \qquad S_q = [\overline{EVAP}] - [\overline{PPN}_T]$$

Energy
Dry static energy ($H_d = C_pT + \Phi$) and moist latent energy ($H_m = Lq$) budgets are given by

$$F_{H_d} = \int_0^{P_0} [\overline{H_d v}]\frac{dp}{g} \qquad S_{H_d} = [\overline{SW}_{TOA}] - [\overline{LW}_{TOA}] - [\overline{SW}_{SFC}] + [\overline{LW}_{SFC}] + [\overline{SH}]$$

$$F_{H_m} = \int_0^{P_0} [\overline{H_m v}]\frac{dp}{g} \qquad S_{H_m} = [\overline{LH}]$$

Mass Budget Check
As a check of the error in the above calculations due to net mass fluxes, the vertically integrated mass flux is also calculated, given by

$$F_v = \int_0^{P_0} [\overline{v}]\frac{dp}{g}$$

Note that some diagnostics involve repeated calculations from previous diagnostics and the moist energy fluxes simply require multiplication of the moisture fluxes by a constant latent heat of vapourization (L) value. However, the diagnostics are included for completeness. The flux quantities are requested as diagnostics, in order that associated total transports ($T = 2\pi R_e F_\phi \cos\phi$) may also be obtained.

Analysis	Data	Name	Units	Diagnostic
VB01	†MF21	F_{AM} - Stationary Zonal Fluxes $\left(R_e \cos\phi \int_0^{P_0} [\overline{u}][\overline{v}] \frac{dp}{g}\right)$	$kg.ms^{-2}$	vb_am_sz
VB02	†MF35	F_{AM} - Stationary Eddy Fluxes $\left(R_e \cos\phi \int_0^{P_0} [\overline{u}^*\overline{v}^*] \frac{dp}{g}\right)$	$kg.ms^{-2}$	vb_am_se
VB04	†MF49	F_{AM} - Transient Zonal Fluxes $\left(R_e \cos\phi \int_0^{P_0} \overline{[u]'[v]'} \frac{dp}{g}\right)$	$kg.ms^{-2}$	vb_am_tz
VB03	†MF63	F_{AM} - Transient Eddy Fluxes $\left(R_e \cos\phi \int_0^{P_0} [\overline{u'^*v'^*}] \frac{dp}{g}\right)$	$kg.ms^{-2}$	vb_am_te
VB05	SH26	F_{AM} - Surface Turbulent Stress ($[\overline{\tau}_{su}] R_e \cos\phi$)	$kg.ms^{-2}$	vb_am_tau
VB06	†MF26	F_q - Stationary Zonal Fluxes $\left(\int_0^{P_0} [\overline{v}][\overline{q}] \frac{dp}{g}\right)$	$kg.m^{-1}s^{-1}$	vb_q_sz
VB07	†MF40	F_q - Stationary Eddy Fluxes $\left(\int_0^{P_0} [\overline{v}^*\overline{q}^*] \frac{dp}{g}\right)$	$kg.m^{-1}s^{-1}$	vb_q_se
VB08	†MF54	F_q - Transient Zonal Fluxes $\left(\int_0^{P_0} \overline{[v]'[q]'} \frac{dp}{g}\right)$	$kg.m^{-1}s^{-1}$	vb_q_tz
VB09	†MF68	F_q - Transient Eddy Fluxes $\left(\int_0^{P_0} [\overline{v'^*q'^*}] \frac{dp}{g}\right)$	$kg.m^{-1}s^{-1}$	vb_q_te
VB10	SH13	F_q - Evaporation $\left([\overline{EVAP}]\right)$	$kg.m^{-1}s^{-1}$	vb_q_evap
VB11	SH11,12	F_q - Total Precipitation $\left([\overline{PPN_T}]\right)$	$kg.m^{-1}s^{-1}$	vb_q_tppn
VB12	†MF24,28	F_{H_d} - Dry Stationary Zonal Fluxes $\left(\int_0^{P_0} [\overline{v}][\overline{h}_d] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hd_sz
VB13	†MF38,42	F_{H_d} - Dry Stationary Eddy Fluxes $\left(\int_0^{P_0} [\overline{v}^*\overline{h}_d^*] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hd_se
VB14	†MF52,56	F_{H_d} - Dry Transient Zonal Fluxes $\left(\int_0^{P_0} \overline{[v]'[h_d]'} \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hd_tz
VB15	†MF66,70	F_{H_d} - Dry Transient Eddy Fluxes $\left(\int_0^{P_0} [\overline{v'^*h_d'^*}] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hd_te
VB16	SH01,02,04	F_{H_d} - Dry $[S]$, TOA $\left([\overline{SW}_{TOA}] + [\overline{LW}_{TOA}]\right)$	$Jm^{-1}s^{-1}$	vb_hd_toa
VB17	SH15,16,18,19,22	F_{H_d} - Dry $[S]$, Surface $\left([\overline{SW}_S] + [\overline{LW}_S] + [\overline{SH}]\right)$	$Jm^{-1}s^{-1}$	vb_hd_surf
VB18	†MF26	F_{H_m} - Moist Stationary Zonal Fluxes $\left(\int_0^{P_0} [\overline{v}][\overline{h}_m] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hm_sz
VB19	†MF40	F_{H_m} - Moist Stationary Eddy Fluxes $\left(\int_0^{P_0} [\overline{v}^*\overline{h}_m^*] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hm_se
VB20	†MF54	F_{H_m} - Moist Transient Zonal Fluxes $\left(\int_0^{P_0} \overline{[v]'[h_m]'} \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hm_tz
VB21	†MF68	F_{H_m} - Moist Transient Eddy Fluxes $\left(\int_0^{P_0} [\overline{v'^*h_m'^*}] \frac{dp}{g}\right)$	$Jm^{-1}s^{-1}$	vb_hm_te
VB22	SH21	F_{H_m} - Moist $[S]$, Surface $\left(S_m = [\overline{LH}]\right)$	$Jm^{-1}s^{-1}$	vb_hm_surf
VB23	†ML02	F_v - Mass Budget $\left(\int_0^{P_0} [\overline{v}] \frac{dp}{g}\right)$	$kg.m^{-1}s^{-1}$	vb_m

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