# CSU – RAMS

## Comprehensive Analysis File Variable List

**This document contains the full list of output variables as they appear in the native HDF5 output analysis files. Included are the name, units, and description of the variables. Note that not all of the listed variables are available from every simulation. Variables are not output unless the physics schemes they are associated with are turned on in the simulations via user choices in the RAMSIN namelist.**

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| RAMS Variables (prior to REVU post-processing) | | | |
|---|---|---|---|
| ASCII Name | dimensions | units | Description |
| (4) GRID AND TOPOGRAPHY | | | |
| GLAT | nx,ny | deg | Latitude |
| GLON | nx,ny | deg | Longitude |
| TOPT | nx,ny | m | topography height |
| TOPZO | nx,ny | m | topographic roughness length |

| (15) DYNAMICS & THERMODYNAMICS | | | |
|---|---|---|---|
| PI | nx,ny,nz | J/(kg*K) | PI = Exner function * Cp, where (Cp=1004 J/kg/K in RAMS) Exner-function = T/Θ = (p/p00)^(Rd/Cp) |
| PI0 | nx,ny,nz | J/(kg*K) | (INPUT) reference state PI |
| UP | nx,ny,nz | m/s | Past U (zonal) wind component |
| VP | nx,ny,nz | m/s | Past V (meridional) wind component |
| WP | nx,ny,nz | m/s | Past W (vertical) wind component |
| PP | nx,ny,nz | J/(kg*K) | Past perturbation Exner function (PI-prime) |
| UC | nx,ny,nz | m/s | Current U wind component |
| VC | nx,ny,nz | m/s | Current V wind component |
| WC | nx,ny,nz | m/s | Current W wind component |
| PC | nx,ny,nz | J/(kg*K) | Current perturbation Exner function (PI-prime) |
| THP | nx,ny,nz | K | Theta-IL, ice-liquid potential temperature (prognostic variable) |
| RTP | nx,ny,nz | kg/kg | Total water mixing ratio (water vapor + condensate) (prognostic variable) |
| THETA | nx,ny,nz | K | Theta, potential temperature |
| RV | nx,ny,nz | kg/kg | Water vapor mixing ratio |
| DN0 | nx,ny,nz | kg/m^3 | reference state air density |

| (6) SURFACE FILE INPUT CHARACTERISTICS (Used by both LEAF & SIB) | | | |
|---|---|---|---|
| (LEAF always runs PATCH=1, which is water/ocean) | | | |
| SOIL_TEXT | nx,ny,nzg,np | # | dominant soil textural class |
| LEAF_CLASS | nx,ny,np | # | vegetation class |

| | | | |
|---|---|---|---|
| PATCH_AREA | nx,ny,np | fraction | patch fractional area |
| VEG_NDVIP | nx,ny,np | # | past NDVI (NDVI = Normalized Difference Vegetation Index) |
| VEG_NDVIC | nx,ny,np | # | current NDVI |
| VEG_NDVIF | nx,ny,np | # | future NDVI |

| (8) SURFACE CHARACTERISTICS (LEAF3 / SIB) (Diagnostic for both) | | | |
|---|---|---|---|
| PATCH_ROUGH | nx,ny,np | m | net roughness |
| SOIL_ROUGH | nx,ny,np | m | soil roughness |
| VEG_FRACAREA | nx,ny,np | fraction | vegetation fractional area |
| VEG_LAI | nx,ny,np | m^2/m^2 | green leaf area index |
| VEG_TAI | nx,ny,np | m^2/m^2 | total leaf area index |
| VEG_ROUGH | nx,ny,np | m | vegetation roughness length |
| VEG_HEIGHT | nx,ny,np | m | vegetation / canopy height |
| VEG_ALBEDO | nx,ny,np | fraction | vegetation albedo |

| (16) SURFACE CHARACTERISTICS (LEAF3 / SIB) (Prognostic for both) | | | |
|---|---|---|---|
| SOIL_WATER | nx,ny,nzg,np | m^3/m^3 | volumetric soil moisture |
| SOIL_ENERGY | nx,ny,nzg,np | J/kg | soil energy (used to compute soil temperature) |
| SFCWATER_NLEV | nx,ny,np | # | number of snow (or surface water) levels |
| SFCWATER_MASS | nx,ny,nzs,np | Kg/m^2 | surface water mass (snow + surface water) |
| SFCWATER_ENERGY | nx,ny,nzs,np | J/m^3 | surface water energy (used to compute surface water temperature) |
| SFCWATER_DEPTH | nx,ny,nzs,np | m | surface water depth |
| USTAR | nx,ny,np | m/s | ustar |
| TSTAR | nx,ny,np | K | tstar |
| RSTAR | nx,ny,np | kg/kg | rstar |
| STOM_RESIST | nx,ny,np | s/m | leaf stomatal resistance |
| VEG_WATER | nx,ny,np | kg/m^2 | vegetation moisture |
| VEG_TEMP | nx,ny,np | K | vegetation temperature |
| CAN_RVAP | nx,ny,np | kg/kg | canopy mixing ratio |
| CAN_TEMP | nx,ny,np | K | canopy temperature |
| GROUND_RSAT | nx,ny,np | kg/kg | saturation mixing ratio of the top soil/snow surface |
| GROUND_RVAP | nx,ny,np | kg/kg | Without snowcover, ground_rvap is the effective saturation mixing ratio of soil |

| (40) SURFACE CHARACTERISTICS (SIB only) | | | |
|---|---|---|---|
| (CAS = Canopy Air Space) | | | |
| RCO2P | nz,nx,ny | mass fraction | CO2 concentration (divide by 1.51724e-6 to get CO2 in ppm) (1.51e-6 = 44(g/mol) / (29g/mol) / 1.e6) where CO2 molar mass = 44 g/mol and Air molar mass = 29g/mol |
| SNOW1 | nx,ny,np | kg/m^2 | vegetation snow |
| SNOW2 | nx,ny,np | kg/m^2 | ground surface snow |
| CAPAC1 | nx,ny,np | kg/m^2 | vegetation liquid store |
| CAPAC2 | nx,ny,np | kg/m^2 | ground surface liquid store |
| PCO2AP | nx,ny,np | Pa | canopy air space CO2 concentration |
| CO2FLX | nx,ny,np | mol/m^2/s | surface CO2 flux (CAS to first atmospheric level) a.k.a. Net Ecosystem Exchange (NEE) |
| SFCSWA | nx,ny,np | fraction | surface albedo |
| UPLWRF | nx,ny,np | W/m^2 | surface longwave upward radiation |
| ASSIMN | nx,ny,np | umol/m^2/s | uptake of CO2 by canopy plants |
| RESPG | nx,ny,np | umol/m^2/s | ground respiration flux |
| RSTFAC1 | nx,ny,np | # (0->1) | leaf-surface humidity resistance stress |
| RSTFAC2 | nx,ny,np | # (0->1) | soil moisture resistance stress |
| RSTFAC3 | nx,ny,np | # (0->1) | temperature resistance stress |
| ECT | nx,ny,np | W/m^2 | transpiration flux |
| ECI | nx,ny,np | W/m^2 | canopy interception flux |
| EGI | nx,ny,np | W/m^2 | ground interception flux |
| EGS | nx,ny,np | W/m^2 | ground surface layer evaporation |
| HC | nx,ny,np | W/m^2 | canopy (veg) sensible heat flux |
| HG | nx,ny,np | W/m^2 | ground surface sensible heat flux |
| RA | nx,ny,np | s/m | CAS to lowest atmos layer aerodynamic resistance |
| RB | nx,ny,np | s/m | leaf surface to CAS aerodynamic resistance |
| RC | nx,ny,np | s/m | total canopy resistance |
| RD | nx,ny,np | s/m | ground to CAS aerodynamic resistance |
| ROFF | nx,ny,np | mm | water runoff (surface and subsurface) |

| | | | |
|---|---|---|---|
| GREEN | nx,ny,np | fraction | greenness fraction |
| APAR | nx,ny,np | fraction | absorbed fraction of photosynthetically active radiation |
| VENTMF | nx,ny,np | kg/m^2/s | ventilation mass flux |
| PCO2C | nx,ny,np | Pa | leaf chloroplast CO2 concentration |
| PCO2I | nx,ny,np | Pa | leaf internal CO2 concentration |
| PCO2S | nx,ny,np | Pa | leaf surface CO2 concentration |
| PCO2M | nx,ny,np | Pa | lowest atmospheric level CO2 concentration |
| EA | nx,ny,np | hPa | canopy water vapor pressure |
| EM | nx,ny,np | hPa | reference level vapor pressure |
| RHA | nx,ny,np | fraction | CAS relative humidity |
| RADVBC | nx,ny,np | W/m^2 | visible direct radiation |
| RADVDC | nx,ny,np | W/m^2 | visible diffuse radiation |
| RADNBC | nx,ny,np | W/m^2 | near infrared direct radiation |
| RADNDC | nx,ny,np | W/m^2 | near infrared diffuse radiation |
| PSY | nx,ny,np | hPa/deg | psychrometric constant |

| (32) HYDROMETEOR MIXING RATIOS, NUMBER CONCENTRATION, ENERGY | | | |
|---|---|---|---|
| SBM = Spectral Bin Model, mixr = mixing ratio | | | |
| RCP | nx,ny,nz | kg/kg | cloud mixing ratio |
| RDP | nx,ny,nz | kg/kg | drizzle mixing ratio |
| RRP | nx,ny,nz | kg/kg | rain mixing ratio |
| RPP | nx,ny,nz | kg/kg | pristine ice mixing ratio |
| RSP | nx,ny,nz | kg/kg | snow mixing ratio |
| RAP | nx,ny,nz | kg/kg | aggregates mixing ratio |
| RGP | nx,ny,nz | kg/kg | graupel mixing ratio |
| RHP | nx,ny,nz | kg/kg | hail mixing ratio |
| RIPP | nx,ny,nz | kg/kg | plates mixing ratio (SBM only) |
| RICP | nx,ny,nz | kg/kg | columns mixing ratio (SBM only) |
| RIDP | nx,ny,nz | kg/kg | dendrite mixing ratio (SBM only) |
| CCP | nx,ny,nz | #/kg | cloud droplet number concentration |
| CDP | nx,ny,nz | #/kg | drizzle droplet number concentration |
| CRP | nx,ny,nz | #/kg | rain drop number concentration |
| CPP | nx,ny,nz | #/kg | pristine ice particle number concentration |

| | | | |
|---|---|---|---|
| **CSP** | **nx,ny,nz** | **#/kg** | **snow particle number concentration** |
| **CAP** | **nx,ny,nz** | **#/kg** | **aggregates number concentration** |
| **CGP** | **nx,ny,nz** | **#/kg** | **graupel particle number concentration** |
| **CHP** | **nx,ny,nz** | **#/kg** | **hailstone number concentration** |
| **CIPP** | **nx,ny,nz** | **#/kg** | **plates number concentration (SBM only)** |
| **CICP** | **nx,ny,nz** | **#/kg** | **columns number concentration (SBM only)** |
| **CIDP** | **nx,ny,nz** | **#/kg** | **dendrites number concentration (SBM only)** |
| **Q2** | **nx,ny,nz** | **J/kg** | **rain internal energy** |
| **Q6** | **nx,ny,nz** | **J/kg** | **graupel internal energy** |
| **Q7** | **nx,ny,nz** | **J/kg** | **hail internal energy** |
| **FFCD** | **nx,ny,nz,nkr** | **kg/kg** | **cloud mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFIP** | **nx,ny,nz,nkr** | **kg/kg** | **plates mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFIC** | **nx,ny,nz,nkr** | **kg/kg** | **columns mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFID** | **nx,ny,nz,nkr** | **kg/kg** | **dendrites mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFSN** | **nx,ny,nz,nkr** | **kg/kg** | **aggregates mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFGL** | **nx,ny,nz,nkr** | **kg/kg** | **graupel mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |
| **FFHL** | **nx,ny,nz,nkr** | **kg/kg** | **hail mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |

| **(27) AEROSOLS MASS MIXING RATIOS AND NUMBER CONCENTRATION** | | | |
|---|---|---|---|
| **CN1NP** | **nx,ny,nz** | **#/kg** | **CCN mode-1 number concentration** |
| **CN2NP** | **nx,ny,nz** | **#/kg** | **CCN mode-2 number concentration** |
| **DUSTFRAC** | **nx,ny** | **fraction** | **Grid cell dust erodible fraction** |
| **MD1NP** | **nx,ny,nz** | **#/kg** | **sub-micron dust number** |

| | | | |
|---|---|---|---|
| | | | concentration |
| MD2NP | nx,ny,nz | #/kg | super-micron dust number concentration |
| ABC1NP | nx,ny,nz | #/kg | Absorbing carbon (1% BC, 99% OC) number concentration |
| ABC2NP | nx,ny,nz | #/kg | Absorbing carbon (2% BC, 98% OC) number concentration |
| SALT_FILM_NP | nx,ny,nz | #/kg | sea-salt film drop number concentration |
| SALT_JET_NP | nx,ny,nz | #/kg | sea-salt jet drop number concentration |
| SALT_SPUM_NP | nx,ny,nz | #/kg | sea-salt spume drop number concentration |
| REGEN_AERO1_NP | nx,ny,nz | #/kg | sub-micron regenerated aerosol number concentration |
| REGEN_AERO2_NP | nx,ny,nz | #/kg | super-micron regenerated aerosol number concentration |
| CN1MP | nx,ny,nz | kg/kg | CCN mode-1 mass mixing ratio |
| CN2MP | nx,ny,nz | kg/kg | CCN mode-2 mass mixing ratio |
| MD1MP | nx,ny,nz | kg/kg | sub-micron dust mass mixing ratio |
| MD2MP | nx,ny,nz | kg/kg | super-micron dust mass mixing ratio |
| ABC1MP | nx,ny,nz | #/kg | Absorbing carbon (1% BC, 99% OC) mass mixing ratio |
| ABC2MP | nx,ny,nz | #/kg | Absorbing carbon (2% BC, 98% OC) mass mixing ratio |
| SALT_FILM_MP | nx,ny,nz | kg/kg | sea-salt film drop mass mixing ratio |
| SALT_JET_MP | nx,ny,nz | kg/kg | sea-salt jet drop mass mixing ratio |
| SALT_SPUM_MP | nx,ny,nz | kg/kg | sea-salt spume drop mass mixing ratio |
| REGEN_AERO1_MP | nx,ny,nz | kg/kg | sub-micron regenerated aerosol mass mixing ratio |
| REGEN_AERO2_MP | nx,ny,nz | kg/kg | super-micron regenerated aerosol mass mixing ratio |
| CIFNP | nx,ny,nz | #/kg | ice nuclei number concentration (Meyers/DeMott-limited schemes) |
| RIFNP | nx,ny,nz | kg/kg | ice nuclei mass concentration (SBM CNT scheme) |

| | | | |
|---|---|---|---|
| **FNCN** | **nx,ny,nz,nkr** | **kg/kg** | **ccn mass mixing ratio distribution (SBM-only) (d(mixr)/dln(r))** |
| **FFIN** | **nx,ny,nz,nkr** | **kg/kg** | **ccn mass mixing ratio distribution (SBM only) (d(mixr)/dln(r))** |

| **(38) AEROSOLS TRACKING** | | | |
|---|---|---|---|
| **IFNNUCP** | **nx,ny,nz** | **#/kg** | **ice nuclei already nucleated** |
| **IMMERCP** | **nx,ny,nz** | **#/kg** | **ice nuclei within cloud droplets** |
| **IMMERDP** | **nx,ny,nz** | **#/kg** | **ice nuclei within drizzle droplets** |
| **IMMERRP** | **nx,ny,nz** | **#/kg** | **ice nuclei within rain droplets** |
| **CNMCP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within cloud droplets** |
| **CNMDP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within drizzle** |
| **CNMRP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within rain** |
| **CNMPP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within pristine ice** |
| **CNMSP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within snow** |
| **CNMAP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within aggregates** |
| **CNMGP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within graupel** |
| **CNMHP** | **nx,ny,nz** | **kg/kg** | **total aerosol mass within hail** |
| **DNMCP** | **nx,ny,nz** | **kg/kg** | **total dust mass within cloud droplets** |
| **DNMDP** | **nx,ny,nz** | **kg/kg** | **total dust mass within drizzle** |
| **DNMRP** | **nx,ny,nz** | **kg/kg** | **total dust mass within rain** |
| **DNMPP** | **nx,ny,nz** | **kg/kg** | **total dust mass within pristine ice** |
| **DNMSP** | **nx,ny,nz** | **kg/kg** | **total dust mass within snow** |
| **DNMAP** | **nx,ny,nz** | **kg/kg** | **total dust mass within aggregates** |
| **DNMGP** | **nx,ny,nz** | **kg/kg** | **total dust mass within graupel** |
| **DNMHP** | **nx,ny,nz** | **kg/kg** | **total dust mass within hail** |
| **DINCP** | **nx,ny,nz** | **kg/kg** | **dust mass within cloud droplets via ice nucleation** |
| **DINDP** | **nx,ny,nz** | **kg/kg** | **dust mass within drizzle via ice nucleation** |
| **DINRP** | **nx,ny,nz** | **kg/kg** | **dust mass within rain via ice nucleation** |

| | | | |
|---|---|---|---|
| **DINPP** | **nx,ny,nz** | **kg/kg** | **dust mass within pristine ice via ice nucleation** |
| **DINSP** | **nx,ny,nz** | **kg/kg** | **dust mass within snow via ice nucleation** |
| **DINAP** | **nx,ny,nz** | **kg/kg** | **dust mass within aggregates via ice nucleation** |
| **DINGP** | **nx,ny,nz** | **kg/kg** | **dust mass within graupel via ice nucleation** |
| **DINHP** | **nx,ny,nz** | **kg/kg** | **dust mass within hail via ice nucleation** |
| **SNMCP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within cloud droplets** |
| **SNMDP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within drizzle** |
| **SNMRP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within rain** |
| **SNMPP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within pristine ice** |
| **SNMSP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within snow** |
| **SNMAP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within aggregates** |
| **SNMGP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within graupel** |
| **SNMHP** | **nx,ny,nz** | **kg/kg** | **total soluble aerosol mass within hail** |
| **RESOL_AERO1_MP** | **nx,ny,nz** | **kg/kg** | **sub-micron regenerated aerosol soluble mass mixing ratio** |
| **RESOL_AERO2_MP** | **nx,ny,nz** | **kg/kg** | **super-micron regenerated aerosol soluble mass mixing ratio** |

| **(37) PRECIPITATION** | | | |
|---|---|---|---|
| **PCPVR** | **nx,ny,nz** | **kg/m^2/s** | **rain precipitation rate (3D)** |
| **PCPVP** | **nx,ny,nz** | **kg/m^2/s** | **pristine ice precipitation rate (3D)** |
| **PCPVS** | **nx,ny,nz** | **kg/m^2/s** | **snow precipitation rate (3D)** |
| **PCPVA** | **nx,ny,nz** | **kg/m^2/s** | **aggregates precipitation rate (3D)** |
| **PCPVG** | **nx,ny,nz** | **kg/m^2/s** | **graupel precipitation rate (3D)** |
| **PCPVH** | **nx,ny,nz** | **kg/m^2/s** | **hail precipitation rate (3D)** |
| **PCPVD** | **nx,ny,nz** | **kg/m^2/s** | **drizzle precipitation rate (3D)** |
| **PCPVIP** | **nx,ny,nz** | **kg/m^2/s** | **plates precipitation rate (3D;** |

| | | | |
|---|---|---|---|
| | | | SBM only) |
| **PCPVIC** | **nx,ny,nz** | **kg/m^2/s** | **columns precipitation rate (3D; SBM only)** |
| **PCPVID** | **nx,ny,nz** | **kg/m^2/s** | **dendrites precipitation rate (3D; SBM only)** |
| **PCPRR** | **nx,ny** | **kg/m^2/s** | **surface rain precipitation rate** |
| **PCPRP** | **nx,ny** | **kg/m^2/s** | **surface pristine ice precipitation rate** |
| **PCPRS** | **nx,ny** | **kg/m^2/s** | **surface snow precipitation rate** |
| **PCPRA** | **nx,ny** | **kg/m^2/s** | **surface aggregates precipitation rate** |
| **PCPRG** | **nx,ny** | **kg/m^2/s** | **surface graupel precipitation rate** |
| **PCPRH** | **nx,ny** | **kg/m^2/s** | **surface hail precipitation rate** |
| **PCPRD** | **nx,ny** | **kg/m^2/s** | **surface drizzle precipitation rate** |
| **PCPRIP** | **nx,ny** | **kg/m^2/s** | **surface plates precipitation rate (SBM only)** |
| **PCPRIC** | **nx,ny** | **kg/m^2/s** | **surface columns precipitation rate (SBM only)** |
| **PCPRID** | **nx,ny** | **kg/m^2/s** | **surface dendrites precipitation rate (SBM only)** |
| **ACCPR** | **nx,ny** | **kg/m^2** | **accumulated rain over the course of the simulation** |
| **ACCPP** | **nx,ny** | **kg/m^2** | **accumulated pristine ice over the course of the simulation** |
| **ACCPS** | **nx,ny** | **kg/m^2** | **accumulated snow over the course of the simulation** |
| **ACCPA** | **nx,ny** | **kg/m^2** | **accumulated aggregates over the course of the simulation** |
| **ACCPG** | **nx,ny** | **kg/m^2** | **accumulated graupel over the course of the simulation** |
| **ACCPH** | **nx,ny** | **kg/m^2** | **accumulated hail over the course of the simulation** |
| **ACCPD** | **nx,ny** | **kg/m^2** | **accumulated drizzle over the course of the simulation** |
| **ACCPIP** | **nx,ny** | **kg/m^2** | **accumulated plates over the course of the simulation (SBM only)** |
| **ACCPIC** | **nx,ny** | **kg/m^2** | **accumulated columns over the course of the simulation (SBM only)** |
| **ACCPID** | **nx,ny** | **kg/m^2** | **accumulated dendrites over the course of the simulation (SBM only)** |

| | | | |
|---|---|---|---|
| **PCPG** | **nx,ny** | **kg/m^2** | **microphysics precipitation per timestep (for water, kg/m^2 = mm), Used by LEAF/SIB surface models** |
| **QPCPG** | **nx,ny** | **J/m^2** | **microphysics precipitation energy per timestep, Used by LEAF surface model** |
| **DPCPG** | **nx,ny** | **m** | **microphysics precipitation depth per timestep, Used by LEAF surface model** |
| **ACCPDUST** | **nx,ny** | **kg/m^2** | **surface accumulated mass of aerosols identified as dust** |
| **ACCPAERO** | **nx,ny** | **kg/m^2** | **Total surface accumulated mass of aerosols** |
| **PCPRDUST** | **nx,ny** | **kg/m^2/s** | **surface accumulation rate of aerosols identified as dust** |
| **PCPRAERO** | **nx,ny** | **kg/m^2/s** | **Total surface accumulation rate of aerosols** |

| **(12) RADIATION** | | | |
|---|---|---|---|
| **FTHRD** | **nx,ny,nz** | **K/s** | **radiative heating rate** |
| **BEXT** | **nx,ny,nz** | **km** | **visibility** |
| **SWUP** | **nx,ny,nz** | **W/m^2** | **upwelling shortwave radiation** |
| **SWDN** | **nx,ny,nz** | **W/m^2** | **downwelling shortwave radiation** |
| **LWUP** | **nx,ny,nz** | **W/m^2** | **upwelling longwave radiation** |
| **LWDN** | **nx,ny,nz** | **W/m^2** | **downwelling longwave radiation** |
| **RSHORT** | **nx,ny** | **W/m^2** | **surface downwelling shortwave radiation** |
| **RLONG** | **nx,ny** | **W/m^2** | **surface downwelling longwave radiation** |
| **RLONGUP** | **nx,ny** | **W/m^2** | **surface upwelling longwave radiation** |
| **AODT** | **nx,ny** | **unitless** | **Aerosol optical depth in visible radiation band-3** |
| **ALBEDT** | **nx,ny** | **fraction** | **surface albedo** |
| **COSZ** | **nx,ny** | **unitless** | **cosine of the solar zenith angle** |

| **(11) TURBULENCE AND FLUXES** | | | |
|---|---|---|---|
| **TKEP** | **nx,ny,nz** | **m^2/s^2** | **turbulent kinetic energy (from Mellor-Yamada and Deardorf schemes only)** |

| | | | |
|---|---|---|---|
| HKH | nx,ny,nz | m^2/s | horizontal eddy diffusivity coefficient for heat for scalar quantities (un-density weighted) |
| VKH | nx,ny,nz | m^2/s | vertical eddy diffusivity coefficient for heat for scalar quantities (un-density weighted) |
| RHKM | nx,ny,nz | m^2/s | horizontal eddy diffusivity coefficient for momentum |
| RVKM | nx,ny,nz | m^2/s | vertical eddy diffusivity coefficient for momentum |
| RVKH | nx,ny,nz | m^2/s | vertical eddy diffusivity coefficient for heat for scalar quantities |
| SFLUX_U | nx,ny | Pascals | surface U-momentum flux |
| SFLUX_V | nx,ny | Pascals | surface V-momentum flux |
| SFLUX_W | nx,ny | Pascals | surface W-momentum flux |
| SFLUX_T | nx,ny | (K*kg) / (m^2*s) | surface temperature flux (multiply by Cp [~1004 J/(kg*K)] to get surface sensible heat flux in W/m^2) |
| SFLUX_R | nx,ny | kg / (m^2*s) | surface moisture flux (multiply by Lv [~2.5e6 J/kg] to get surface latent heat flux in W/m^2) |

| (12) CUMULUS PARAMETERIZATION FIELDS | | | |
|---|---|---|---|
| THSRC | nx,ny,nz | K/sec | convective parameterization heating rate |
| RTSRC | nx,ny,nz | kg/kg/sec | convective parameterization moistening rate |
| ACONPR | nx,ny | kg/m^2 | convective parameterization total accumulated precipitation |
| CONPRR | nx,ny | kg/m^2/sec | convective parameterization precipitation rate |
| RCSRC | nx,ny,nz | kg/kg/sec | convective cloud water mixing ratio tendency (KF scheme only) |
| RRSRC | nx,ny,nz | kg/kg/sec | convective rain mixing ratio tendency (KF scheme only) |
| RPSRC | nx,ny,nz | kg/kg/sec | convective pristine ice mixing ratio tendency (KF scheme only) |

| | | | |
|---|---|---|---|
| **RSSRC** | **nx,ny,nz** | **kg/kg/sec** | **convective snow mixing ratio tendency (KF scheme only)** |
| **W0AVG** | **nx,ny,nz** | **m/s** | **a running mean average of vertical velocity (KF scheme only)** |
| **W0AVGLT** | **nx,ny,nz** | **m/s** | **a running mean average of the horizontal components of the contravariant vertical velocity (KF scheme only)** |
| **NCA** | **nx,ny** | **m/s** | **integer counter keeping track of number of time steps that convective tendencies maintained (KF scheme only)** |
| **CONVGO** | **nx,ny** | **m/s** | **integer which keeps track if pre-convection checks satisfied (KF scheme only)** |

| **(36) BUDGET VARIABLES for IMBUDGET >=1** | | | |
|---|---|---|---|
| **All budgets are accumulated (Total) values unless otherwise noted as being instantaneous values. Accumulated budgets are summed each timestep between analysis (A) output file writes and then reset. They are not reset for LITE or MEAN file outputs. "Total" budgets end with a "T". Instantaneous budgets have the same name but without the "T".** | | | |
| **WP_BUOY_THETA** | **nx,ny,nz** | **m/s** | **instantaneous vertical velocity contribution from Theta-V buoyancy computation** |
| **WP_BUOY_COND** | **nx,ny,nz** | **m/s** | **instantaneous vertical velocity contribution from condensate loading** |
| **WP_ADVDIF** | **nx,ny,nz** | **m/s** | **instantaneous vertical velocity contribution by the combination of both advection and diffusion** |
| **LATHEATVAP** | **nx,ny,nz** | **dΘ or dT** | **instantaneous / single timestep (T or Θ) due to vapor diffusion and cloud & ice nucleation** |
| **LATHEATFRZ** | **nx,ny,nz** | **dΘ or dT** | **instantaneous / single timestep (T or Θ) due to collision-coalescence and melting routines** |
| **LATHEATVAPT** | **nx,ny,nz** | **dΘ or dT** | **change in (T or Θ) due to vapor diffusion and cloud & ice nucleation** |
| **LATHEATFRZT** | **nx,ny,nz** | **dΘ or dT** | **change in (T or Θ) due to** |

| | | | |
|---|---|---|---|
| | | | **collision-coalescence and melting routines** |
| **NUCCLDRT** | **nx,ny,nz** | **kg/kg** | **nucleation mass of cloud and drizzle** |
| **NUCCLDCT** | **nx,ny,nz** | **#/g** | **nucleation number of cloud and drizzle** |
| **NUCICERT** | **nx,ny,nz** | **kg/kg** | **total nucleation mass of pristine ice** |
| **NUCICECT** | **nx,ny,nz** | **#/g** | **total nucleation number of pristine ice** |
| **VAPLIQT** | **nx,ny,nz** | **kg/kg** | **vapor condensation summed for all liquid hydromet species** |
| **VAPICET** | **nx,ny,nz** | **kg/kg** | **vapor deposition summed for all ice hydromet species** |
| **EVAPLIQT** | **nx,ny,nz** | **kg/kg** | **evaporation summed for all liquid hydrometeor species** |
| **EVAPICET** | **nx,ny,nz** | **kg/kg** | **sublimation summed for all ice hydrometeor species** |
| **MELT2LIQTHERMT** | **nx,ny,nz** | **kg/kg** | **thermodynamic melting of ice species in melting routine that lead to mass transfers to liquid only species** |
| **MELT2RAINCOLT** | **nx,ny,nz** | **kg/kg** | **ice melting to rain due to collection of rain (rcy values; not "colxfers" adjusted; see mic_coll.f90)** |
| **MELTVAPT** | **nx,ny,nz** | **kg/kg** | **net melting computed from latent heating routines due to vapor and heat diffusion. Includes partial melting.** |
| **MELTCOLMELTT** | **nx,ny,nz** | **kg/kg** | **net melting computed from latent heating routines due to collision and melting schemes. Includes partial melting.** |
| **FREEZVAPT** | **nx,ny,nz** | **kg/kg** | **net freezing computed from latent heating routines due to vapor and heat diffusion. Includes partial freezing.** |
| **FREEZCOLMELTT** | **nx,ny,nz** | **kg/kg** | **net freezing computed from latent heating routines due to collision and melting schemes. Includes partial freezing.** |
| **FREEZICENUCT** | **nx,ny,nz** | **kg/kg** | **net freezing computed from latent heating routines due to ice nucleation.** |

| | | | |
|---|---|---|---|
| **CLD2RAINT** | **nx,ny,nz** | **kg/kg** | **cloud water transferred to rain via autoconversion + accretion** |
| **CLD2DRIZT** | **nx,ny,nz** | **kg/kg** | **cloud water transferred to drizzle via autoconversion + accretion** |
| **DRZ2RAINT** | **nx,ny,nz** | **kg/kg** | **drizzle water transferred to rain via autoconversion + accretion** |
| **RIMECLDT** | **nx,ny,nz** | **kg/kg** | **cloud water collected by all ice species (rcx values; see mic_coll.f90) (mass transfer from cloud)** |
| **RIMEDRZT** | **nx,ny,nz** | **kg/kg** | **drizzle water collected by all ice species (rcx values; see mic_coll.f90) (mass transfer from drizzle)** |
| **RIMERAINT** | **nx,ny,nz** | **kg/kg** | **rain water collected by ice species (rcx values; see mic_coll.f90) (mass transfer from rain)** |
| **AGGRSELFPRIST** | **nx,ny,nz** | **kg/kg** | **mass transfer pristine ice to aggregates due to pristine ice self-collection** |
| **AGGRSELFSNOWT** | **nx,ny,nz** | **kg/kg** | **mass transfer snow to aggregates due to snow self-collection** |
| **AGGRPSPRIST** | **nx,ny,nz** | **kg/kg** | **mass transfer of pristine ice to aggregates due to pristine ice / snow collisions** |
| **AGGRPSSNOWT** | **nx,ny,nz** | **kg/kg** | **mass transfer of snow to aggregates due to pristine ice / snow collisions** |
| **RAINBREAKUPT** | **nx,ny,nz** | **#/g** | **Raindrop number created by breakup from self-collection** |
| **CLDSIPHMT** | **nx,ny,nz** | **#/g** | **Pristine ice number created by Hallett-Mossop SIP with cloud drops** |
| **DRZSIPHMT** | **nx,ny,nz** | **#/g** | **Pristine ice number created by Hallett-Mossop SIP with drizzle drops** |

| | | | |
|---|---|---|---|
| **RAINSHEDT** | **nx,ny,nz** | **#/g** | **Raindrop number created by shedding of water from hail** |

| **(47) BUDGET VARIABLES for IMBUDGET >=2** | | | |
|---|---|---|---|
| **All budgets are accumulated (Total) values unless otherwise noted as being instantaneous values. Accumulated budgets are summed each timestep between analysis (A) output file writes and then reset. They are not reset for LITE or MEAN file outputs. "Total" budgets end with a "T". "Instantaneous" budgets for this set do not currently exist.** | | | |
| **INUCHOMRT** | **nx,ny,nz** | **kg/kg** | **homogeneous droplet freezing ice nucleation mass** |
| **INUCHOMCT** | **nx,ny,nz** | **#/g** | **homogeneous droplet freezing ice nucleation number** |
| **INUCCONTRT** | **nx,ny,nz** | **Kg/kg** | **contact freezing ice nucleation mass** |
| **INUCCONTCT** | **nx,ny,nz** | **#/g** | **contact freezing ice nucleation number** |
| **INUCIFNRT** | **nx,ny,nz** | **kg/kg** | **condensation & immersion freezing ice nucleation mass from ice nuclei** |
| **INUCIFNCT** | **nx,ny,nz** | **#/g** | **condensation & immersion freezing ice nucleation number from ice nuclei** |
| **INUCHAZRT** | **nx,ny,nz** | **kg/kg** | **haze droplet nucleation mass tied to aerosol concentration** |
| **INUCHAZCT** | **nx,ny,nz** | **#/g** | **haze droplet nucleation number tied to aerosol concentration** |
| **VAPCLDT** | **nx,ny,nz** | **kg/kg** | **vapor condensation on cloud** |
| **VAPRAINT** | **nx,ny,nz** | **kg/kg** | **vapor condensation on rain** |
| **VAPPRIST** | **nx,ny,nz** | **kg/kg** | **vapor deposition on pristine ice** |
| **VAPSNOWT** | **nx,ny,nz** | **kg/kg** | **vapor deposition on snow** |
| **VAPAGGRT** | **nx,ny,nz** | **kg/kg** | **vapor deposition on aggregates** |
| **VAPGRAUT** | **nx,ny,nz** | **kg/kg** | **vapor deposition on graupel** |
| **VAPHAILT** | **nx,ny,nz** | **kg/kg** | **vapor deposition on hail** |
| **VAPDRIZT** | **nx,ny,nz** | **kg/kg** | **vapor condensation on drizzle** |
| **EVAPCLDT** | **nx,ny,nz** | **kg/kg** | **evaporation of cloud droplets** |
| **EVAPRAINT** | **nx,ny,nz** | **kg/kg** | **evaporation of rain** |
| **EVAPPRIST** | **nx,ny,nz** | **kg/kg** | **sublimation of pristine ice** |
| **EVAPSNOWT** | **nx,ny,nz** | **kg/kg** | **sublimation of snow** |

| | | | |
|---|---|---|---|
| **EVAPAGGRT** | **nx,ny,nz** | **kg/kg** | **sublimation of aggregates** |
| **EVAPGRAUT** | **nx,ny,nz** | **kg/kg** | **sublimation of graupel** |
| **EVAPHAILT** | **nx,ny,nz** | **kg/kg** | **sublimation of hail** |
| **EVAPDRIST** | **nx,ny,nz** | **kg/kg** | **evaporation of drizzle** |
| **MELTPRISTHMT** | **nx,ny,nz** | **kg/kg** | **mass transfer from pristine ice due to thermodynamic melting** |
| **MELTSNOWTHMT** | **nx,ny,nz** | **kg/kg** | **mass transfer from snow due to thermodynamic melting** |
| **MELTAGGRTHMT** | **nx,ny,nz** | **kg/kg** | **mass transfer from aggregates due to thermodynamic melting** |
| **MELTGRAUTHMT** | **nx,ny,nz** | **kg/kg** | **mass transfer from graupel due to thermodynamic melting** |
| **MELTHAILTHMT** | **nx,ny,nz** | **kg/kg** | **mass transfer from hail due to thermodynamic melting** |
| **MELTPRISCOLT** | **nx,ny,nz** | **kg/kg** | **mass transfer from pristine ice due to collisional melting** |
| **MELTSNOWCOLT** | **nx,ny,nz** | **kg/kg** | **mass transfer from snow due to collisional melting** |
| **MELTAGGRCOLT** | **nx,ny,nz** | **kg/kg** | **mass transfer from aggregates due to collisional melting** |
| **MELTGRAUCOLT** | **nx,ny,nz** | **kg/kg** | **mass transfer from graupel due to collisional melting** |
| **MELTHAILCOLT** | **nx,ny,nz** | **kg/kg** | **mass transfer from hail due to collisional melting** |
| **RIMECLDSNOWT** | **nx,ny,nz** | **kg/kg** | **mass transfer from cloud due to riming by snow** |
| **RIMECLDAGGRT** | **nx,ny,nz** | **kg/kg** | **mass transfer from cloud due to riming by aggregates** |
| **RIMECLDGRAUT** | **nx,ny,nz** | **kg/kg** | **mass transfer from cloud due to riming by graupel** |
| **RIMECLDHAILT** | **nx,ny,nz** | **kg/kg** | **mass transfer from cloud due to riming by hail** |
| **RIMEDRZSNOWT** | **nx,ny,nz** | **kg/kg** | **mass transfer from drizzle due to riming by snow** |
| **RIMEDRZAGGRT** | **nx,ny,nz** | **kg/kg** | **mass transfer from drizzle due to riming by aggregates** |
| **RIMEDRZGRAUT** | **nx,ny,nz** | **kg/kg** | **mass transfer from drizzle due to riming by graupel** |
| **RIMEDRZHAILT** | **nx,ny,nz** | **kg/kg** | **mass transfer from drizzle due to riming by hail** |
| **RIMERAINPRIST** | **nx,ny,nz** | **kg/kg** | **mass transfer from rain due to collisions with pristine ice** |
| **RIMERAINSNOWT** | **nx,ny,nz** | **kg/kg** | **mass transfer from rain due to collisions with snow** |

| | | | |
|---|---|---|---|
| **RIMERAINAGGRT** | **nx,ny,nz** | **kg/kg** | **mass transfer from rain due to collisions with aggregates** |
| **RIMERAINGRAUT** | **nx,ny,nz** | **kg/kg** | **mass transfer from rain due to collisions with graupel** |
| **RIMERAINHAILT** | **nx,ny,nz** | **kg/kg** | **mass transfer from rain due to collisions with hail** |

| **BUDGET VARIABLES for IMBUDGET >=3** | | | |
|---|---|---|---|
| **All budgets are accumulated (Total) values unless otherwise noted as being instantaneous values. Accumulated budgets are summed each timestep between analysis (A) output file writes and then reset. They are not reset for LITE or MEAN file outputs. "Total" budgets end with a "T". "Instantaneous" budgets for this set do not currently exist.** | | | |
| **DUST1CLDRT** | **nx,ny,nz** | **kg/kg** | **nucleation of cloud droplet mixing ratio from dust mode 1** |
| **DUST2CLDRT** | **nx,ny,nz** | **kg/kg** | **nucleation of cloud droplet mixing ratio from dust mode 2** |
| **DUST1DRZRT** | **nx,ny,nz** | **kg/kg** | **nucleation of drizzle droplet mixing ratio from dust mode 1** |
| **DUST2DRZRT** | **nx,ny,nz** | **kg/kg** | **nucleation of drizzle droplet mixing ratio from dust mode 2** |

| **(44) KPP Ocean Mixed Layer Model Variables** | | | |
|---|---|---|---|
| **Some of these KPP variables are required for history restart and must be output. Others are simply diagnostics. See RAMSIN flags and KPP code to control how many optional output variables are written to file.** | | | |
| **KPP_OLD** | **nx,ny** | **index** | **Index to ID past value of Us,Vs** |
| **KPP_NEW** | **nx,ny** | **Index** | **Index to ID new value of Us,Vs** |
| **KPP_JERLOV** | **nx,ny** | **jerlov cat** | **Ocean optical clarity category** |
| **KPP_OCDEPTH** | **nx,ny** | **m** | **Ocean depth** |
| **KPP_HMIX** | **nx,ny** | **m** | **Mixed-layer depth** |
| **KPP_BOTTOMT** | **nx,ny** | **Celsius** | **Ocean bottom temperature** |
| **KPP_SREF** | **nx,ny** | **o/oo** | **Reference salinity** |
| **KPP_FREEZ_FLAG** | **nx,ny** | **fraction** | **Fraction of levels prevented from freezing** |
| **KPP_RESET_FLAG** | **nx,ny** | **Index** | **Flag to indicate isothermal column, reset T/S to climo** |
| **KPP_FLX_UST** | **nx,ny** | **N/m2** | **Sflux(1) zonal surface wind stress** |
| **KPP_FLX_VST** | **nx,ny** | **N/m2** | **Sflux(2) meridional surface wind stress** |
| **KPP_FLX_NSW** | **nx,ny** | **W/m2** | **Sflux(3) Net surface shortwave radiation** |
| **KPP_FLX_NLW** | **nx,ny** | **W/m2** | **Sflux(4) non-shortwave** |

| | | | |
|---|---|---|---|
| | | | radiation (lwdn-lwup-sensible-latent) |
| KPP_FLX_ICE | nx,ny | Not used | Sflux(5) melting of sea ice |
| KPP_FLX_PCP | nx,ny | mm/sec | Sflux(6) net freshwater (precip-evaporation) |
| KPP_SWDK_OPT | nx,ny,nkppz | fraction | Solar shortwave flux fraction on DM depths |
| KPP_wB | nx,ny,nkppz | m2/s3 | w'B' total kinematic buoyancy flux |
| KPP_wU | nx,ny,nkppz | m2/s2 | w'U' turbulent zonal velocity flux |
| KPP_wV | nx,ny,nkppz | m2/s2 | w'V' turbulent meridional velocity flux |
| KPP_wXt | nx,ny,nkppz | C * m/s | w'T' turbulent temperature flux |
| KPP_wXs | nx,ny,nkppz | o/oo * 1/s | w'S' turbulent salinity flux |
| KPP_wXNTt | nx,ny,nkppz | C * m/s | w'T'(NT) non-turbulent temperature flux |
| KPP_SWFRAC | nx,ny,nkppz | fraction | Solar shortwave flux fraction on ZM depths |
| KPP_TINC_FCORR | nx,ny,nkppz | K | Temperature increment from flux correction with depth |
| KPP_SINC_CORR | nx,ny,nkppz | o/oo | Salinity increment from flux correction with depth |
| KPP_SAL_CLIM | nx,ny,nkppz | o/oo | 3D salinity climatology (can be time updated) |
| KPP_OCNT_CLIM | nx,ny,nkppz | Celsius | 3D temperature climatology (can be time updated) |
| KPP_BUOY | nx,ny,nkppz | m/s2 | buoyancy |
| KPP_RHO | nx,ny,nkppz | kg/m3 | Ocean density |
| KPP_CP | nx,ny,nkppz | J/kg/K | Ocean specific heat capacity |
| KPP_U | nx,ny,nkppz | m/s | Latest value of ocean U current |
| KPP_V | nx,ny,nkppz | m/s | Latest value of ocean V current |
| KPP_U_init | nx,ny,nkppz | m/s | Initial value of ocean U current |
| KPP_V_init | nx,ny,nkppz | m/s | Initial value of ocean V current |
| KPP_US0 | nx,ny,nkppz | m/s | Contains old/new U current |
| KPP_VS0 | nx,ny,nkppz | m/s | Contains old/new V current |
| KPP_US1 | nx,ny,nkppz | m/s | Contains old/new U current |
| KPP_VS1 | nx,ny,nkppz | m/s | Contains old/new V current |
| KPP_X_T | nx,ny,nkppz | Celsius | Latest ocean temperature |
| KPP_X_S | nx,ny,nkppz | o/oo | Latest ocean salinity (+sref) |

| | | | |
|---|---|---|---|
| **KPP_XS_T0** | **nx,ny,nkppz** | **Celsius** | **Contains old/new temperature** |
| **KPP_XS_T1** | **nx,ny,nkppz** | **Celsius** | **Contains old/new temperature** |
| **KPP_XS_S0** | **nx,ny,nkppz** | **o/oo** | **Contains old/new salinity** |
| **KPP_XS_S1** | **nx,ny,nkppz** | **o/oo** | **Contains old/new salinity** |

| **CUSTOM TRACER VARIABLES** | | | |
|---|---|---|---|
| **TRACERP001** | **nx,ny,nz** | **mixing ratio units needed** | **customizable by the user** |
| **TRACERP002, etc…** | | | |