**VIC output variable description**

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**1 Water Balance Terms - state variables**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| ASAT | Saturate Area Fraction (of exposed land, i.e. non-lake;  the total fraction of the grid cell that is completely full  of water would be ASAT plus LAKE\_AERA\_FRAC) | fraction |
| LAKE\_AREA\_FRACT | Lake surface area as fraction of grid cell area | fraction |
| LAKE\_DEPTH | Lake depth (distance between surface and deepest point) | m |
| LAKE\_ICE | Moisture stored as lake ice | mm over lake ice area |
| LAKE\_ICE\_FRACT | Fractional coverage of lake ice | fraction |
| LAKE\_ICE\_HEIGHT | Thickness of lake ice | cm |
| LAKE\_MOIST | Liquid water and ice stored in lake | mm over grid cell |
| LAKE\_SURF\_AREA | Lake surface area | m2 |
| LAKE\_SWE | Liquid water equivalent of snow on top of lake ice | m over lake ice area |
| LAKE\_SWE\_V | Volumetric liquid water equivalent of snow on top of lake ice | m3 |
| LAKE\_VOLUME | Lake volume | m3 |
| ROOTMOIST | Total soil moisture in layers that contain roots | mm |
| SMFROZFRAC | Fraction of soil moisture (by mass) that is ice, for each soil layer | fraction |
| SMLIQFRAC | Fraction of soil moisture (by mass) that is liquid, for each soil layer | fraction |
| SNOW\_CANOPY | Snow interception storage in canopy | mm |
| SNOW\_COVER | Fractional area of snow cover | fraction |
| SNOW\_DEPTH | Depth of snow pack | cm |
| SOIL\_ICE | Soil ice content for each soil layer | mm |
| SOIL\_LIQ | Soil liquid content for each soil layer | mm |
| SOIL\_MOIST | Total soil moisture content for each soil layer | mm |
| SOIL\_WET | Vertical average of (soil moisture - wilting point)/(maximum soil moisture - wilting point) | mm/mm |
| SURFSTOR | Storage of liquid water and ice (not snow) on surface (ponding) | mm |
| SURF\_FROST\_FRAC | Fraction of soil surface that is frozen | fraction |
| SWE | Snow water equivalent in snow pack (including vegetation-intercepted snow) | mm |
| WDEW | Total moisture interception storage in canopy | mm |
| ZWT | Water table position, using lowest unsaturated soil layer | cm (positive upwards, i.e. negative values indicate below soil surface; 0 = at soil surface) |
| ZWT\_LUMPED | Water table position, lumping all layers' moistures together | cm (positive upwards, i.e. negative values indicate below soil surface; 0 = at soil surface) |

**2 Water Balance Terms – fluxes**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| BASEFLOW | Baseflow out of the bottom layer | mm (ALMA\_OUTPUT: mm/s) |
| DELINTERCEPT | Change in canopy interception storage | mm |
| DELSOILMOIST | Change in soil water content | mm |
| DELSURFSTOR | Change in surface liquid water storage | mm |
| DELSWE | Change in snow water equivalent | mm |
| DELSWE | Change in snow water equivalent | mm |
| EVAP | Total net evaporation | mm (ALMA\_OUTPUT: mm/s) |
| EVAP\_BARE | Net evaporation from bare soil | mm (ALMA\_OUTPUT: mm/s) |
| EVAP\_CANOP | Net evaporation from canopy interception | mm (ALMA\_OUTPUT: mm/s) |
| INFLOW | Moisture that reaches top of soil column | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_BF\_IN | Incoming baseflow from lake catchment | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_BF\_IN\_V | Incoming volumetric baseflow from lake catchment | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_BF\_OUT | Outgoing baseflow from lake to channel network | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_BF\_V | Outgoing volumetric baseflow from lake to channel network | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_CHANNEL\_IN | Channel inflow from upstream | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_CHANNEL\_IN\_V | Volumetric channel inflow from upstream | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_CHANNEL\_OUT | Channel outflow from lake to channel network | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_CHANNEL\_V | Volumetric channel outflow from lake to channel network | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_DSTOR | Change in lake moisture storage (liquid plus ice cover) | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_DSTOR\_V | Volumetric change in lake moisture storage (liquid plus ice cover) | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_DSWE | Change in swe on top of lake ice | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_DSWE\_V | Volumetric change in swe on top of lake ice | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_EVAP | Net evaporation from lake surface | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_EVAP\_V | Net volumetric evaporation from lake surface | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_PREC\_V | Volumetric precipitation over lake surface | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_RCHRG | Recharge from lake to surrounding wetland | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_RCHRG\_V | Volumetric recharge from lake to surrounding wetland | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_RO\_IN | Incoming runoff from lake catchment | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_RO\_IN\_V | Incoming volumetric runoff from lake catchment | m3  (ALMA\_OUTPUT: m3/s) |
| LAKE\_VAPFLX | Outgoing sublimation from snow on top of lake ice | mm (ALMA\_OUTPUT: mm/s) |
| LAKE\_VAPFLX\_V | Outgoing volumetric sublimation from snow on top of lake ice | m3  (ALMA\_OUTPUT: m3/s) |
| PET\_SATSOIL | Potential evap from saturated bare soil | mm (ALMA\_OUTPUT: mm/s) |
| PET\_H2OSURF | Potential evap from open water | mm (ALMA\_OUTPUT: mm/s) |
| PET\_SHORT | Potential evap (transpiration only) from short reference crop (grass) | mm (ALMA\_OUTPUT: mm/s) |
| PET\_TALL | Potential evap (transpiration only) from tall reference crop (alfalfa) | mm (ALMA\_OUTPUT: mm/s) |
| PET\_NATVEG | Potential evap (transpiration only) from current vegetation and current canopy resistance | mm (ALMA\_OUTPUT: mm/s) |
| PET\_VEGNOCR | Potential evap (transpiration only) from current vegetation and 0 canopy resistance | mm (ALMA\_OUTPUT: mm/s) |
| PREC | Incoming precipitation | mm (ALMA\_OUTPUT: mm/s) |
| RAINF | Rainfall | mm (ALMA\_OUTPUT: mm/s) |
| REFREEZE | Refreezing of water in the snow | mm (ALMA\_OUTPUT: mm/s) |
| RUNOFF | Surface runoff | mm (ALMA\_OUTPUT: mm/s) |
| SNOW\_MELT | Snow melt | mm (ALMA\_OUTPUT: mm/s) |
| SNOWF | Snowfall | mm (ALMA\_OUTPUT: mm/s) |
| SUB\_BLOWING | Net sublimation of blowing snow | mm (ALMA\_OUTPUT: mm/s) |
| SUB\_CANOP | Net sublimation from snow stored in canopy | mm (ALMA\_OUTPUT: mm/s) |
| SUB\_SNOW | Total net sublimation from snow pack (surface and blowing) | mm (ALMA\_OUTPUT: mm/s) |
| SUB\_SURFACE | Net sublimation from snow pack surface | mm (ALMA\_OUTPUT: mm/s) |
| TRANSP\_VEG | Net transpiration from vegetation | mm (ALMA\_OUTPUT: mm/s) |
| WATER\_ERROR | Water budget error | mm |

**3 Energy Balance Terms – state variables**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| ALBEDO | Average surface albedo | fraction |
| BARESOILT | Bare soil surface temperature | C (ALMA\_OUTPUT: K) |
| FDEPTH | Depth of freezing fronts for each freezing front | cm (ALMA\_OUTPUT: m) |
| LAKE\_ICE\_TEMP | Temperature of lake ice | K |
| LAKE\_SURF\_TEMP | Lake surface temperature | K |
| RAD\_TEMP | Average radiative surface temperature | K |
| SALBEDO | Snow pack albedo | fraction |
| SNOW\_PACK\_TEMP | Snow pack temperature | C (ALMA\_OUTPUT: K) |
| SNOW\_SURF\_TEMP | Snow surface temperature | C (ALMA\_OUTPUT: K) |
| SNOWT\_FBFLAG | Snow surface temperature fallback flag | 0 or 1 |
| SOIL\_TEMP | Soil temperature for each soil layer | C (ALMA\_OUTPUT: K) |
| SOIL\_TNODE | Soil temperature for each soil thermal node | C (ALMA\_OUTPUT: K) |
| SOIL\_TNODE\_WL | Soil temperature for each soil thermal node in the wetland | C (ALMA\_OUTPUT: K) |
| SOILT\_FBFLAG | Soil temperature flag for each soil thermal node | 0 or 1 |
| SURF\_TEMP | Average surface temperature | C (ALMA\_OUTPUT: K) |
| SURFT\_FBFLAG | Surface temperature fallback flag | 0 or 1 |
| TCAN\_FBFLAG | Tcanopy fallback flag | 0 or 1 |
| TDEPTH | Depth of thawing fronts for each thawing front | cm (ALMA\_OUTPUT: m) |
| TFOL\_FBFLAG | Tfoliage fallback flag | 0 or 1 |
| VEGT | Average vegetation canopy temperature | C (ALMA\_OUTPUT: K) |

**4 Energy Balance Terms – fluxes**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| ADV\_SENS | Net sensible flux advected to snow pack | W/m2 |
| ADVECTION | Advected energy | W/m2 |
| DELTACC | Rate of change in cold content in snow pack | W/m2 (ALMA\_OUTPUT: J/m2) |
| DELTAH | Rate of change in heat storage | W/m2 (ALMA\_OUTPUT: J/m2) |
| ENERGY\_ERROR | Energy budget error | W/m2 |
| FUSION | Net energy used to melt/freeze soil moisture | W/m2 |
| GRND\_FLUX | Net heat flux into ground | W/m2 |
| IN\_LONG | Incoming longwave at ground surface (under veg) | W/m2 |
| LATENT | Net upward latent heat flux | W/m2 |
| LATENT\_SUB | Net upward latent heat flux from sublimation | W/m2 |
| MELT\_ENERGY | Energy of fusion (melting) in snowpack | W/m2 |
| NET\_LONG | Net downward longwave flux | W/m2 |
| NET\_SHORT | Net downward shortwave flux | W/m2 |
| R\_NET | Net downward radiation flux | W/m2 |
| RFRZ\_ENERGY | Net energy used to refreeze liquid water in snowpack | W/m2 |
| SENSIBLE | Net upward sensible heat flux | W/m2 |
| SNOW\_FLUX | Energy flux through snow pack | W/m2 |

**5 Miscellaneous Terms**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| AERO\_COND | Scene aerodynamic conductance (tiles with overstory contribute overstory conductance; others contribute surface conductance) | m/s |
| AERO\_COND1 | Surface aerodynamic conductance | m/s |
| AERO\_COND2 | Overstory aerodynamic conductance | m/s |
| AERO\_RESIST | Scenecanopy aerodynamic resistance (tiles with overstory contribute over story resistance; others contribute surface resistance) | s/m |
| AERO\_RESIST1 | Surface aerodynamic resistance | s/m |
| AERO\_RESIST2 | Overstory aerodynamic resistance | s/m |
| AIR\_TEMP | Air temperature | C  (ALMA\_OUTPUT: K) |
| DENSITY | Near-surface atmospheric density | kg/m3 |
| FDIR | fraction of incoming shortwave that is direct | fraction |
| LAI | Leaf Area Index | fraction |
| LONGWAVE | Incoming longwave | W/m2 |
| PRESSURE | Near surface atmospheric pressure | kPa  (ALMA\_OUTPUT: Pa) |
| QAIR | Specific humidity | kg/kg |
| REL\_HUMID | Relative humidity | fraction |
| SHORTWAVE | Incoming shortwave | W/m2 |
| SURF\_COND | Surface conductance | m/s |
| TSKC | (release 4.1.2 and later) Cloud fraction | fraction |
| VEGCOVER | Partial vegetation cover fraction | fraction |
| VP | Near surface vapor pressure | kPa  (ALMA\_OUTPUT: Pa) |
| VPD | Near surface vapor pressure deficit | kPa  (ALMA\_OUTPUT: Pa) |
| WIND | Near surface wind speed | m/s |

**6 Band-specific Quantities**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| ADV\_SENS\_BAND | Net sensible heat flux advected to snow pack | W/m2 |
| ADVECTION\_BAND | Advected energy | W/m2 |
| ALBEDO\_BAND | Average surface albedo | fraction |
| DELTACC\_BAND | Change in cold content in snow pack | W/m2 |
| GRND\_FLUX\_BAND | Net heat flux into ground | W/m2 |
| IN\_LONG\_BAND | Incoming longwave at ground surface (under veg) | W/m2 |
| LATENT\_BAND | Net upward latent heat flux | W/m2 |
| LATENT\_SUB\_BAND | Net upward latent heat flux due to sublimation | W/m2 |
| MELT\_ENERGY\_BAND | Energy of fusion (melting) in snowpack | W/m2 |
| NET\_LONG\_BAND | Net downward longwave flux | W/m2 |
| NET\_SHORT\_BAND | Net downward shortwave flux | W/m2 |
| RFRZ\_ENERGY\_BAND | Net energy used to refreeze liquid water in snowpack | W/m2 |
| SENSIBLE\_BAND | Net upward sensible heat flux | W/m2 |
| SNOW\_CANOPY\_BAND | Snow interception storage in canopy | mm |
| SNOW\_COVER\_BAND | Fractional area of snow cover | fraction |
| SNOW\_DEPTH\_BAND | Depth of snow pack | cm |
| SNOW\_FLUX\_BAND | Energy flux through snow pack | W/m2 |
| SNOW\_MELT\_BAND | Snow melt | mm |
| SNOW\_PACKT\_BAND | Snow pack temperature | C  (ALMA\_OUTPUT: K) |
| SNOW\_SURFT\_BAND | Snow surface temperature | C  (ALMA\_OUTPUT: K) |
| SWE\_BAND | Snow water equivalent in snow pack | mm |

**7 Carbon Cycle Terms**

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| APAR | absorbed PAR | W/m2 |
| GPP | gross primary productivity | g C/m2d |
| RAUT | autotrophic respiration | g C/m2d |
| NPP | net primary productivity | g C/m2d |
| LITTERFALL | flux of carbon from living biomass into soil | g C/m2d |
| RHET | soil (heterotrophic) respiration | g C/m2d |
| NEE | net ecosystem exchange (=NPP-RHET) | g C/m2d |
| CLITTER | carbon density in litter pool | g C/m2 |
| CINTER | carbon density in intermediate pool | g C/m2 |
| CSLOW | carbon density in slow pool | g C/m2 |