Simulated and Derived Variables in RegCM Simulations[1]

Average anemometer temperature (TA, ^oC): 2-meter air temperature averaged over the model grid cell for the given time period.

Average maximum anemometer temperature (TAMAX, ^oC): 2-meter maximum air temperature averaged over the model grid cell for the given time period.

Average minimum anemometer temperature (TAMIN, ^oC): 2-meter minimum air temperature averaged over the given time period.

Absolute maximum anemometer temperature (TAMAXA, ^oC): Value of the maximum 2-meter air temperature that occurred during the given time period.

Absolute minimum anemometer temperature (TAMINA, ^oC): Value of the minimum 2-meter air temperature that occurred during the given time period.

Average ground temperature (TG, ^oC): Temperature of the surface averaged over the given time period.

Average maximum ground temperature (TGMAX, ^oC): Maximum temperature of the surface averaged over the given time period

Average minimum ground temperature (TGMIN, ^oC): Minimum temperature of the surface averaged over the given time period.

Average foliage temperature (TF, ^oC): Temperature of the foliage averaged over the given time period.

Number of days with TA < 0^oC (T0, count): For daily averages: total number of 3-hr periods in which the absolute air temperature was below 0^oC. For monthly averages: total number of days in which the absolute air temperature was below 0^oC.

Number of days with TA > 33^oC (T33, count): For daily averages: total number of 3-hr periods in which the absolute air temperature was above 33^oC. For monthly averages: total number of days in which the absolute air temperature was above 33^oC.

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[1] North America and Eastern North America data are averaged or counted from 3- and 6h (3h) model output. Western North America data are averaged or counted from 3-hr output.

Growing degree days, base 10°C (GDD10, count): Growing degree days based on a 10°C threshold. Calculated as (McMaster and Wilhelm (1997), Agricultural and Forest Meteorology, 87(4):291-300, doi:10.1016/S0168-1923(97)00027-0):

$$GDD_{10} = \frac{TA_{max} - TA_{min}}{2.0} - 10,$$

where TA_{max} and TA_{min} are respectively the daily maximum and minimum temperatures and growing degree days are accumulated only if the computed quantity is greater than zero.

Growing degree days base 5°C (GDD5, count): As above based on a threshold of 5°C.

Cooling degree days base 22°C (CDD, count): Cooling degree days (CDD) based on a 22°C threshold (T_{base}). CDDs are accumulated when the air temperature > 22°C. Calculated using the UK British Met Office definition (http://www.metoffice.gov.uk/climatechange/science/monitoring/ukcp09/faq.html#faq):

$$DD = 0 \text{ if } TA_{max} \leq T_{base}$$

$$DD = \frac{TA_{max} - T_{base}}{4.0} \text{ if } \frac{TA_{max} - TA_{min}}{2.0} < T_{base}$$

$$DD = \frac{TA_{max} - T_{base}}{2.0} - \frac{T_{base} - TA_{min}}{4.0} \text{ if } TA_{min} < T_{base}$$

$$DD = \frac{TA_{max} + TA_{min}}{2.0} - T_{base} \text{ if } TA_{min} > T_{base}$$

Heating degree days base 15.5°C (HDD, count): Heating degree days (HDD) based on a 15.5°C threshold (T_{base}). HDDs are accumulated when the air temperature < 15.5°C. Calculated as above.

Solar radiation incident at the surface (SWI, W m^{-2}): Incoming solar radiation at the surface. The value is determined by insolation at the top and processes and properties of the atmosphere such as scattering and reflection by clouds and aerosols

Net solar radiation absorbed (SWN, W m^{-2}): Incoming solar radiation absorbed at the surface. The value is determined by incident solar and the albedo or reflectivity (a) of the surface: $\Phi_n = (1-\alpha)\Phi_i$ specified in the model. Albedo varies by date to account for surface changes and the angle of the sun.

Downward longwave radiation (LWD, W m^{-2}): Atmospheric longwave radiation flux at the surface.

Net longwave radiation (LWN, W m^{-2}): Net longwave radiation at the surface determined as the algebraic sum of incoming longwave (defined above) minus outgoing longwave, which is determined by the surface temperature and emissivity, and is radiated upward by the surface.

Sensible heat flux (SH, Wm^{-2}): Turbulent heat flux that occurs when the temperature of the surface differs from the overlying air. It is a function of temperature, atmospheric stability, wind speed and properties of the surface.

Evapotranspiration (ET, mm d^{-1}): Total evaporation from open water, land and vegetation. Can be converted to latent heat flux (the heat that is stored in water vapor) LE = lE where l is the latent heat of vaporization.

Total precipitation (RT, mm d^{-1}): Total liquid water precipitation determined as the combined total of convective (associated, for example, with localized thunderstorms) and dynamic (associated with fronts).

Total convective precipitation in RT (RC, mm d^{-1}): The convective component of RT above.

Number of precipitation events < 2 mm per 6h (3h) period (P2, count): Count of events having total precipitation less than 2 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Number of precipitation events 2 ≤ P < 10 mm per 6h (3h) period (P2_P10, count): Count of events having total precipitation greater than or equal to 2 mm and less than 10 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Number of precipitation events 10 ≤ P < 25 mm per 6h (3h) period (P10_P25, count): Count of events having total precipitation greater than or equal to 10 mm and less than 25 mm. The 6-hr (3-hr) (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Number of precipitation events 25 ≤ P < 50 mm per 6h (3h) period (P25_P50, count): Count of events having total precipitation greater than or equal to 25 mm and less than 50 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Number of precipitation events 50 $\leq$ P < 100 mm per 6h (3h) period (P50_P100, count): Count of events having total precipitation greater than or equal to 50 mm and less than 100 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Number of precipitation events P $\geq$ 100 mm per 6h (3h) period (P100, count): Count of events having total precipitation greater than 100 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess frequency of events in various categories.

Convection Precipitation < 1 mm per 6h (3h) period (CA1, count): Count of convective events having total precipitation less than 1 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess dry versus wet convective storms.

Convection Precipitation $\geq$ 1 mm per 6h (3h) period (CA2, count): Count of convective events having total precipitation less than 1 mm. The 6-hr (3-hr) period is the time step at which the data are written out by the model. This variable is part of a binning process that can be used to assess dry versus wet convective storms.

Snow water equivalent (SNOW, mm): Total liquid water equivalent in snowpack.

Anemometer specific humidity (QA, kg kg^{-1}): Specific humidity at 2 meters. Expressed as m_w/m_t where m_w is the mass of water vapor (kg) and m_t is the total mass of air (kg).

Anemometer relative humidity (RHA, fraction): Relative humidity at 2 meters.

Surface runoff from soil model (RNFS, mm d^{-1}): Surface runoff computed by the soil model in BATS.

Base flow from soil model, (RB, mm d^{-1}): Net flow out of the lowest soil level (3 m thick) in BATS.

Top layer soil model moisture (RMT, mm): Liquid water content in the top soil layer (10 cm thick) in BATS.

Root Layer soil model moisture (SMR, mm): Liquid water content in the root soil layer (vegetation dependant, 1.0, 1.5 or 2.0 m thick) in BATS.

Total runoff (pseudo hydrograph) (TOTRNF, m^3 s^{-1}): Total runoff rate from a model grid square computed as the sum of surface runoff and base flow.

Anemometer eastward wind (U, m s^{-1}): Eastward vector wind component at 2 meters.

Anemometer northward wind (V, m s^{-1}): Northward vector wind component at 2 meters.

Number of 3-hr wind velocity events > 6ms^{-1} (UMAG6, count): Count of the number of wind events that exceed 6 ms^{-1} at a 3-hr interval. This derived variable is used to assess dune mobility.

Maximum 10 m wind speed (W10MX, m s^{-1}): Maximum simulated wind speed at 10 m over the averaging period.

Planetary boundary layer height (ZPBL, m): The height or thickness of the planetary boundary layer, the lowest level of the atmosphere that interacts with and is influenced by the land/ocean surface.

Surface drag stress (DRAG, N m^{-2}): The shear stress over the land/ocean surface associated with wind. It is determined by properties of the surface (e.g., roughness, displacement height).

Surface pressure (PSRF, hPa): Atmospheric pressure on the model surface. Surface pressure varies with elevation of the model surface.

Minimum surface pressure (PSMIN, hPa): Minimum surface pressure over the averaging period.

Sea level pressure: Atmospheric pressure at sea level. SLP is a primary control of surface wind patterns.

Total cloud fraction (TOTCLD, fraction): Total cloud cover in the model. The RegCM uses random overlap to determine cloud cover from types present in the vertical levels. Total cloud cover is determined as:

$C_T = 1 - \prod_{l=1}^{nlevels} \left(1 - f_l\right)$, where f_l is the cloud fraction of model level l and *nlevels* is the number of vertical levels (23). See Weare, BC, (2001) *Climate Dynamics* 17:143-150.

3-Dimensional Variables on Atmospheric Pressure Levels

Cloud water mixing ratio (QC_p, kg kg^{-1}): Water mixing ratio in clouds. Determined by m_w / m_d where m_w is the mass of water vapor (kg) and m_d is the mass of dry air (kg).

Atmospheric mixing ratio (QC_p, kg kg^{-1}): As above, but for the total atmosphere.

Relative humidity (RH_p, fraction): As defined above.

Dew point temperature (TD_p, ^{o}C): The temperature to which moist air (as determined by air temperature and mixing ratio) must be cooled to change the phase of water vapor to liquid water.

Horizontal divergence (DIV_p, m s^{-1}): An area in the atmosphere where air mass is decreasing through time. Determined by wind flow and associated with cyclonic development and activity in the atmosphere: upper level divergence is accompanied by lower level convergence and upward motion leading to potential precipitation events. http://amsglossary.allenpress.com/glossary/search?p=1&query=horizontal+divergence&submit=Search,http://en.wikipedia.org/wiki/Divergence

Geopotential height (HGT_p, m): The height of constant pressure levels in the atmosphere. Commonly levels at 950, 850, 700, 500 and 300 hPa are used to diagnose and predict atmospheric circulation patterns at regional and hemispheric scales.

Potential temperature (TH_p, ^{o}C): The temperature that an unsaturated parcel of dry air at a given pressure would attain if the parcel was brought adiabatically to a standard pressure (typically 1000 hPa). Potential temperature is associated with vertical static stability and thus convection in the atmosphere.
http://amsglossary.allenpress.com/glossary/search?p=1&query=potential+temperature&submit=Search

Atmospheric temperature (T_p, ^{o}C): Temperature on model pressure levels.

Eastward wind (U_p, m s^{-1}): Eastward wind vector on model pressure levels.

Northward wind (V_p, m s^{-1}): Northward wind vector on model pressure levels.

Horizontal vorticity (VOR_p, m s^{-1}): Rotation of air masses around a vertical axis. In the Northern Hemisphere, clockwise rotation is (positive vorticity) associated with anticyclonic flow and counter clockwise (negative vorticity) with cyclonic flow. Associated with vertical motions and development of convective activity.
http://amsglossary.allenpress.com/glossary/search?id=potential-vorticity1,
http://en.wikipedia.org/wiki/Vorticity

Moist static energy (MSE_p, m^2 s^{-2}): A measure of the total potential and kinetic energy and latent heat derived from water vapor content of an air parcel. Also associated with convective development.
http://amsglossary.allenpress.com/glossary/search?p=1&query=moist+static&submit=Search

Omega (OMEGA_p, Pa s^{-1}): Vertical rising rate of air parcels. Associated with vorticty. Provides a measure of large scale rising and sinking motions in the atmosphere. Negative values indicate rising and a tendency for convection and positive values indicate sinking motions associated with adiabitc warming and high pressure. http://amsglossary.allenpress.com/glossary/search?p=1&query=omega+equation&submit=Search, http://en.wikipedia.org/wiki/Omega_equation

Terrain Ht, Vegetation codes, Axes and Projection Information

Terrain ht (ht, m): Elevation of model grid squares.

Pressure-coordinate: Pressure levels (hPa) in the processed output: 100., 200., 300., 400., 500., 600, 700., 750., 800., 850., 900., 950., 1000.

Time-coordinate: Time step of data. The axis has an unlimited dimension and the units are in the standard format of days since 1900-01-01.

BATS surface type codes: See below.

x-coordinate: Horizontal distance coordinates of the grid centers.

y-coordinate: Vertical distance coordinates of the grid centers.

Latitude: Latitude of the grid centers.

Longitude: Longitude of the grid centers.

Lambert_Conformal: Projection type used in the model.