Appendix A. MERRA-2 (M2) variable definitions.*

M2T1NXSLV	**2D Atmospheric variables**
TS	Surface skin temperature (K) *– An approximation for the temperature of the Earth's tropopause, which lies about 17 km (11 miles) above the surface, expressed in degrees Kelvin. The tropopause is the boundary between the turbulent mixing-dominated troposphere and the more stable stratosphere.*
QV2M	2-meter specific humidity (kg/kg) *– The amount of water vapor contained in a unit amount of air, generally expressed as kg of water per kg of air.*
T2M	2-meter air temperature (K*)* *– The air temperature 2m above the ground, expressed in degrees Kelvin.*
M2T1NXFLX	**2D Surface fluxes**
EFLUX	Positive latent heat flux (W/m^2) *– The exchange of energy between the surface of the Earth and the atmosphere when water evaporates from or condenses onto the surface, expressed in Watts per square meter. Positive latent heat flux means that evaporation is occurring.*
HFLUX	Positive sensible heat flux (W/m^2) *– The exchange of energy between the surface of the Earth and the atmosphere when no state change is involved and energy is transferred by conduction, expressed in Watts per square meter. Positive sensible heat flux means heat is flowing from the surface to the atmosphere.*
SPEED	Surface wind speed (m/s) *– The speed of wind flow near the Earth's surface, expressed in meters per second.*

* These summaries were derived from definitions provided in: J. R. Holton, J. A. Curry, and J. A. Pyle, Eds., *Encyclopedia of atmospheric sciences*. Amsterdam; Boston: Academic Press, 2003. Details about the MERRA-2 collection and variable naming conventions can be found in in: Bosilovich, M.G., R. Lucchesi, and M. Suarez. 2016. "MERRA-2: File Specification." *GMAO Office Note* 9 (Version 1.1): 1–73.

PREVTOT — Total re-evaporation/sublimation of precipitation ([kg/m^2]/s)
– The amount of precipitation that evaporates (water to water vapor transition) or sublimates (snow or ice to water vapor transition) while falling through the atmosphere and fails to arrive at the land surface, expressed in mm per second. [1 kg of water spread over a square meter (kg/m^2) = 1 mm]

PRECTOTCORR — Total observation-corrected surface precipitation ([kg/m^2]/s)
– Total precipitation modeled from atmospheric physics corrected with satellite and/or gauge-based measurements, expressed in mm per second. [1 kg of water spread over a square meter (kg/m^2) = 1 mm]

M2T1NXRAD — 2D Surface and top-of-atmosphere radiation fluxes

ALBEDO — Surface albedo
– The amount of sunlight reflected by the Earth's surface, generally expressed as a decimal value with 1.0 being a perfect reflector and 0.0 absorbing all incoming light.

LWGNT — Surface net downward longwave flux (W/m^2)
– The rate of flow of radiant energy reaching the Earth's surface in the thermal infrared spectrum (4-100 μm), expressed in Watts per square meter. LWGNT is a result of atmospheric absorption, emission, and scattering within the entire atmospheric column.

SWGNT — Surface net downward shortwave flux (W/m^2)
– An estimate of the total amount of shortwave (0.3-4.0 μm) radiative energy that reaches the Earth's surface, expressed in Watts per square meter. SWGNT is an important source of energy and important influence on land-atmosphere and vegetation interactions, SWGNT has many applications in the general and applied sciences.

TAUTOT — Optical thickness of all clouds
– A measure of attenuation of the light passing through the atmosphere due to the scattering and absorption by cloud droplets. TAUTOT is a dimensionless, monotonically increasing function that approaches zero as cloud thickness approaches zero.

CLDTOT — Total cloud area fraction
– The proportion of the sky covered by all the visible clouds, an important influence on downward solar radiation.

M2T1NXLND 2D Land surface variables

LAI	Leaf area index *– A complex variable that relates the size of plant canopies to canopy density and the angle at which leaves are oriented to one another and to incident light. A dimensionless quality that is often used as an indicator of plant growth rate.*
GRN	Vegetation greenness fraction *– The proportion of ground covered by green vegetation. Values range from 0 to 1.*
GWETPROF	Average profile soil wetness *– The amount of water and water vapor present in the soil, generally expressed as the proportion of water present in a given volume of soil. Values range from 0 to 1.*
GWETROOT	Root zone soil wetness *– The amount of water and water vapor available to plants in the root zone, generally considered to be the upper 200 cm of soil, expressed as the proportion of water present in a given amount of soil. Values range from 0 to 1.*
TSURF	Mean land surface temperature (K) *– The radiative temperature of the Earth's land surface, expressed in degrees Kelvin.*
TSAT	Surface temperature of saturated zone (K) *– Surface temperature of soil in which all the interstices or voids are filled with groundwater, expressed in degrees Kelvin.*
FRWLT	Fractional wilting area *– Proportion of the land surface where the moisture content causes plants to wilt. Values range from 0 to 1.*
QINFIL	Soil water infiltration rate ([km/m^2]/s)) *– A measure of how fast water enters the soil, expressed in mm per second. [1 kg of water spread over a square meter (kg/m^2) = 1 mm]*
GHLAND	Downward heat flux into topsoil layer (W/m^2) *– The amount of thermal energy transferred to the soil, which can be affected by such factors as soil and air temperature, soil water content, canopy characteristics, and wind speed, expressed in Watts per square meter.*

WCHANGE Total land water change per unit time ([kg/m^2]/s)
– Total rate of movement of water to and from the Earth's surface, expressed in mm per second. [1 kg of water spread over a square meter (kg/m^2) = 1 mm].

ECHANGE Total land energy change per unit time (W/m^2)
– Total rate of energy transferred to and from the Earth's surface, expressed in Watts per square meter.

PRMC Total profile soil moisture content (m^3/m^3)
– The amount of water present in the soil, expressed as cubic meters of water per cubic meter of soil.

RZMC Root zone soil moisture content (m^3/m^3)
– The amount of water in the soil root zone, expressed as cubic meters of water per cubic meter of soil.

EVPSOIL Bare soil evaporation energy flux (W/m^2)
– The rate of radiant energy transfer when water evaporates from a saturated land surface, expressed in Watts per square meter.

EVPTRNS Transpiration energy flux (W/m^2)
– The amount of energy released as water evaporates at the plant leaf / atmosphere interface, expressed in Watts per square meter.

EVPINTR Interception loss energy flux (W/m^2)
– The portion of precipitation that is returned to the atmosphere through evaporation from plant surfaces or absorbed by plants and does not reach the ground, expressed in Watts per square meter.

EVLAND Evaporation from land ([kg/m^2]/s)
– The rate of moisture transfer from the land surface to the atmosphere, expressed in mm per second. [1 kg of water spread over a square meter (kg/m^2) = 1 mm]. Evapo-transpiration is the sum of all processes by which water moves from the land surface to the atmosphere via evaporation (EVLAND, EVPINTR, etc.) and transpiration (EVPTRNS).