SEBCS Documentation

Release 2.1.1

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INTRODUCTION

The SEBCS for QGIS is software enabling calculation of energy balance and crop water stress features (heat fluxes, evaporative fraction, Bowen ratio, Omega factor, CWSI etc.) from Landsat satellite data (L5 TM, L7 ETM+, L8 OLI/TIRS, L9 OLI/TIRS) and also from other devices (e.g. UAV). The calculation procedure uses an approach based on Penman-Monteith method, SEBAL method and gradient approach of the energy balance characteristics calculation.

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ABBREVIATION

4.1 Abbreviation list

Table 4.1.1: Abbreviations used within the SEBCS documentation

Feature	Unit	Description
a_w	$^\circ$	Aspect
B	rel.	Spectral bands, spectral reflectance
C	const.	Constant
c_p	$J.kg^{-1}.K^{-1}$	Thermal heat capacity of dry air (cp = 1012 $J.kg^{-1}.K^{-1}$)
d	m	Effective height of the canopy
DMT	m	Digital model of terrain
$d\epsilon$	unitless	Effect of natural surfaces geometry distribution and their internal reflection
E_a	kPa	Water vapour pressure of saturated air
e_a	kPa	Water vapour pressure
E_s	kPa	Water vapour pressure of saturated air at the surface
e_s	kPa	Water vapour pressure at the surface
F_L	unitless	Factor of Monin-Obukhov length
g	$m.s^{-2}$	Gravitational forcing
G	$W.m^{-2}$	Ground heat flux
h	m	Canopy height
H	$W.m^{-2}$	Sensible heat flux
H_s	$^\circ$	Hour angle
h_{st}	m	Mean height of canopy around the meteo-station
I_s	$W.m^{-2}$	Incident shortwave solar radiation perpendicular to beam
L	m	Monin-Obukhov length
L_{dry}	m	Monin-Obukhow length for dry air
Lat	$^\circ$	Latitude
$Long$	$^\circ$	Longitude
N	unitless	No. of day in year
$MSAVI$	unitless	Modified Soil Adjusted Vegetation Index
$NDMI$	unitless	Normalized Difference Moisture Index
$NDVI$	unitless	Normalized Difference Vegetation Index
P	kPa	Atmospheric pressure
Pv	unitless	Fractional vegetation index
r_a	$s.m^{-1}$	Surface aerodynamic resistance for heat and momentum transfer
r_c	$s.m^{-1}$	Surface resistance for water vapour transfer

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Feature	Unit	Description
r_{cp}	$s.m^{-1}$	Surface aerodynamic resistance for water vapour transfer in case of potential evapotranspiration
Rh	%	Relative humidity of air
$Rl_{\uparrow}$	$W.m^{-2}$	Upward longwave radiation flux
$Rl_{\downarrow}$	$W.m^{-2}$	Downward longwave radiation flux
Rn	$W.m^{-2}$	Total net radiation
R_{blue}	$rel.$	Spectral reflectance in blue spectral area (BLUE band)
R_{green}	$rel.$	Spectral reflectance in green spectral area (GREEN band)
R_{red}	$rel.$	Spectral reflectance in red spectral area (RED band)
R_{nir}	$rel.$	Spectral reflectance in NIR spectral area (NIR band)
R_{swir1}	$rel.$	Spectral reflectance in SWIR spectral area at approx. 1.6 μm (SWIR1 band)
R_{swir2}	$rel.$	Spectral reflectance in NIR spectral area at approx. 2.2 μm (SWIR2 band)
$Rs_{\uparrow}$	$W.m^{-2}$	Reflected shortwave radiation flux
$Rs_{\downarrow}$	$W.m^{-2}$	Incomming shortwave radiation flux
$Rs_{\downarrow const}$	$W.m^{-2}$	Incomming shortwave radiation flux at the horizontal surface
S_t		Solar time
T^*	K	Scaling parameter of temperature in the boundary layer
T_a	C	Air temperature in height z
T_{a_K}	K	Air temperature in height z
T_B	K	Surface brightness temperature ($\varepsilon = 1.0$)
T_{max}	C	Max. surface temperature in the image
T_s	C	Surface temperature
T_{s_K}	K	Surface temperature
T_{st}	°C	Air temperature measured at meteostation in height z_{st}
T_{s_dry}	K	Calculated maximal surface temperature
T_{s_wet}	K	Calculated minimal surface temperature
U	$m.s^{-1}$	Wind speed in height z
u^*	$m.s^{-1}$	Friction velocity of the wind
U_{st}	$m.s^{-1}$	Wind speed measured at meteostation in height z_{st}
VPD	kPa	Water vapour pressure deficit
W	mm	Amount of water for rain in atmosphere
w_b	const.	Constants for spectral bands
x	unitless	Constant
z	m	Height of the mixing layer ($z = 200$)
z_{0h}	m	Aerodynamic roughness for heat and water vapour transfer
:math:`z_{0m}	m	Aerodynamic roughness for momentum transfer
z_{st}	m	Height of measurement at the meteostation
α	rel.	Albedo
α_{PT}	unitless	Priestley-Taylor alpha ($\alpha_{PT} = 1.26$)
α_z	°	Solar height angle
β	unitless	Bowen ratio
β_s	°	Slope gradient
Γ	$C.m^{-1}$	Adiabatic lapse rate ($\Gamma = 0.0065\ C.m^{-1}$)
γ	$kPa.C^{-1}$	Psychrometric constant
γ^*	$kPa.C^{-1}$	Modified psychrometric constant according to Jackson et al. (1981)
δ_s	°	Solar declination
δT	K	Temperature gradient calculated according to Bastiaanssen et al. (1998)

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Feature	Unit	Description
δT_{dry}	K	Temperature gradient for the dry areas
Δ	$kPa.C^{-1}$	The slope of the saturated water vapour pressure\ to temperature gradient
ε	rel.	Surface emissivity
ε_a	rel.	Atmospheric emissivity
ε_s	rel.	Soil emissivity
ε_v	rel.	Vegetation emissivity
κ	unitless	Kármán constant ($\kappa = 0.41$)
λ	$J.g^{-1}$	Latent heat of evaporation
λE	$W.m^{-2}$	Latent heat flux
λE_{max}	$W.m^{-2}$	Latent heat flux equal to $Rn - G$
λE_p	$W.m^{-2}$	Potential latent heat flux
λE_{PT}	$W.m^{-2}$	Priestley-Taylor potential latent heat flux
π	unitless	Ludolf number
ρ	$kg.m^{-3}$	Dry air density
ρ_{s_b}	rel.	Surface spectral reflectance for optical bands
ρ_{t_b}	rel.	TOA spectral reflectance for optical bands
ς	unitless	Monin-Obukhov stability parameter
σ	$W.m^{-2}.K^{-4}$	Stefan-Boltzmann constant ($\sigma = 5.6703 \cdot 10^{-8}\ W.m^{-2}.K^{-4}$)
$\Psi_h(\varsigma)$	unitless	Stability parameter for heat transfer
$\Psi_m(\varsigma)$	unitless	Stability parameter for momentum transfer
Ω	rel.	Decoupling coefficient (Omega factor)
η	$^\circ$	Satellite inclination angle to nadir
θ	$^\circ$	Solar zenith angle
τ_{in_b}	rel.	Atmospheric transmittance for spectral bands for direct radiation
τ_{out_b}	rel.	Atmospheric transmittance for spectral bands for diffuse radiation