

RadEst 3: Software to Estimate Daily Global Solar Radiation



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The RadEst program allows evaluating and estimating daily global solar radiation at a given latitude. Four models estimate atmospheric transmissivity of global solar radiation based on the difference between maximum and minimum air temperature. The estimated value of radiation is calculated as the product of the estimated transmissivity and the value of potential radiation outside the earth atmosphere.

Global Solar Radiation

$$Rad = tt \text{ PRad}$$

Rad = Daily global solar radiation (MJ m⁻² day⁻¹)
 tt = Atmosphere transmittance (0-0.8)
 PRad = Rad outside atmosphere (MJ m⁻² day⁻¹)

Models

Bristow and Campbell

$$tt = \tau \left[1 - \exp\left(\frac{-b \Delta T^2}{\Delta T_m}\right) \right]$$

Campbell and Donatelli

$$tt = \tau \left\{ 1 - \exp\left[-b f(T_{avg}) \Delta T^2 f_1(T_n)\right] \right\}$$

Donatelli and Bellocchi

$$tt = \tau \left[1 + c1 \sin\left(i \frac{\pi}{180} c2\right) \right] \left[1 - \exp\left(\frac{-b \Delta T^2}{\Delta T_w}\right) \right]$$

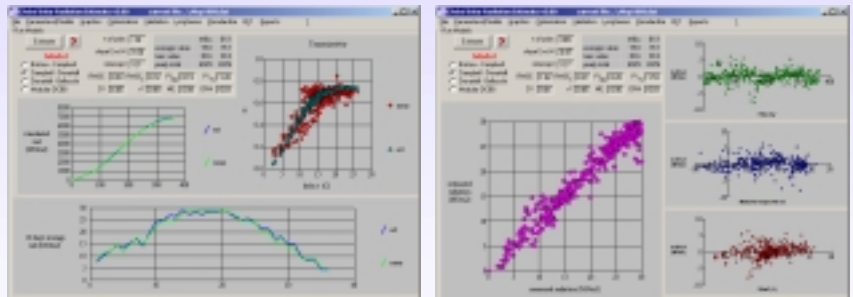
Modular DCBB

$$tt = \tau \left[1 + c1 \sin\left(i \frac{\pi}{180} c2\right) \right] \left\{ 1 - \exp\left[\frac{-b \Delta T^2 f_2(T_n)}{\Delta T_{avg}}\right] \right\}$$

τ = clear sky transmissivity
 i = day of the year
 ΔT = $(T_x - (T_n + T_{n+1}))/2$
 ΔT_w = mean ΔT weekly (mobile mean)
 ΔT_m = mean ΔT monthly
 ΔT_{avg} = either ΔT_w or ΔT_m
 $f(\Delta T_{avg}) = 0.017 \exp[\exp(-0.053 T_{avg})]$
 $T_{avg} = (T_x + T_n)/2$
 $f_1(T_n) = \exp(T_n/T_{nc})$
 $f_2(T_n) = \text{either } f_1(T_n) \text{ or } 1$

$b, c1, c2, T_{nc}$ are empirical parameters

Parameter Estimate and Statistical Indices



The performance of each model can be analyzed both as daily data and as ten day means. Model residuals are plotted vs. day of the year, minimum air temperature, and ΔT . When an estimate is made, to evaluate model performance the following statistical indices are computed:

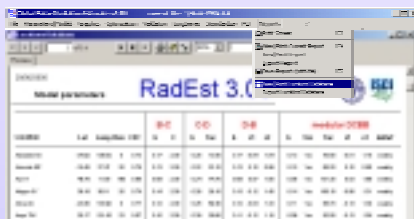
- number of pairs used for the computation
- slope of the regression estimated vs. measured
- intercept of the regression estimated vs. measured
- RMSE, root mean squared error
- RMSEs, systematic component
- CV, coefficient of variability
- ME, modelling efficiency
- CRM, coefficient of residual mass
- Pldoy, pattern index of residuals vs. day of the year
- PITn, pattern index of residuals vs. minimum temperature

The statistical indices are computed both for daily and ten day periods

Parameters

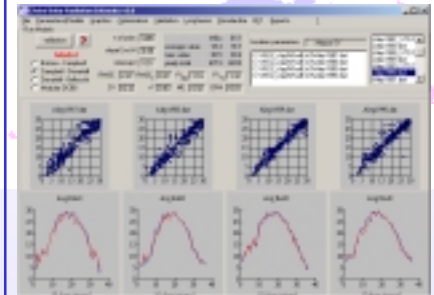


Parameters can be estimated via an optimization procedure for either the current year or at most five years of data.



Extensive report capabilities allow storing and exporting both estimates and the location dataset using various formats (XLS, HTML, CSV, etc.).

Validation



Validation of parameter estimates can be done against at most five years of data. The relevant statistic is computed.



RadEst 3.00 is available for downloading at:

Europe
www.inea.it/isci/mdon/software/radest/re300_beta/radest/re300_beta.htm
 USA
ftp://c100.bsvse.wsu.edu/pub/mdon/RadEst/RadEst300_inst.zip