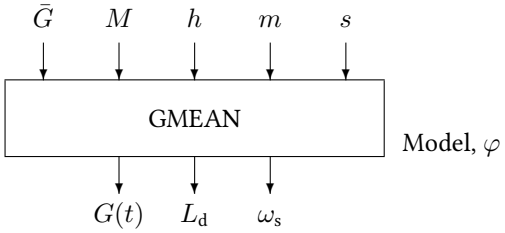
Block GMEAN

The GMEAN block returns the global radiation at a given real solar time for a mean monthly or daily radiation value based on statistical correlations.





Name	GMEAN
Function	em0013
Inputs	3 . . . [5]
Outputs	3
Parameters	2
Strings	0
Group	S

Inputs

1 Monthly or daily mean value $\bar{G}$ of global radiation / W m^{-2}
2 Month M
3 Hour h
4 Minute m
5 Second s

Outputs

1 Mean global radiation $G(t)$ / W m^{-2}
2 Mean daylength L_d / h
3 Mean sunrise hour angle ω_s / °

Parameters

1 Model
  0 Liu Jordan Collares-Pereira Rabl correlation
  1 World Bank Standard Solar Day
2 Latitude φ / °

Strings

None

Collares-Pereira Rabl correlation

The Collares-Pereira Rabl correlation which describes the ratio r between hourly and daily global irradiance for a given hour angle ω is given by

$$r = \frac{\pi}{24} \frac{\cos\omega - \cos\omega_{ss}}{\sin\omega_{sr} - \omega_{ss}\cos\omega_{ss}}(a + b\cos\omega)$$

with the coefficients

$$a = 0.4090 + 0.5016\sin(\omega_{ss} - 60)$$
$$b = 0.6609 - 0.4767\sin(\omega_{ss} - 60)$$

The relation between sunset hour angle ω_{ss} and day length (in hours) is $\omega_{ss} = 7.5(L_d - 12) + 90$.

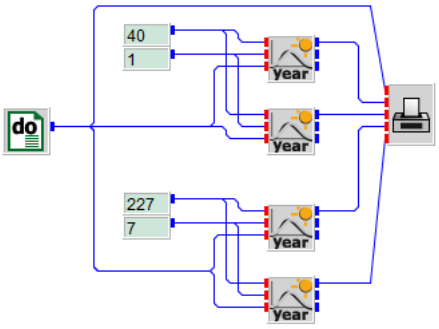
Standard solar day

The standard solar day has been introduced by the World Bank and is defined through the equation

$$G(t) = G_{max}\sin\left(\frac{\pi t}{L_d}\right) \qquad t = 0, 1, \ldots 11\ \text{h}$$

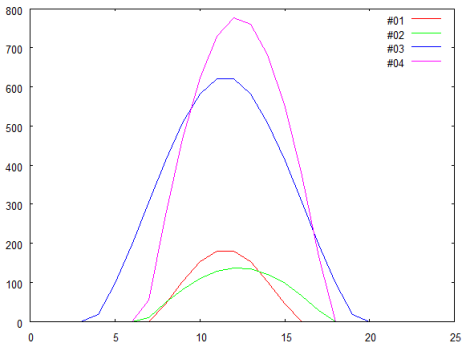
G_{max} denotes the daily maximum of the global radiation on a horizontal surface. L_d stands for the day length and is assumed constant with 11 hours. Both, hour angle and sunset hour angle are measured from true solar noon in this case.

gmean.vseit



A DO block counts the daily hours from zero to 23 in steps of one. Four CONST blocks provide the months January and July and their mean irradiances of 40 and 227 W/m^2, respectively. Four GMEAN blocks calculate the hourly mean irradiances from the Collarea-Pereira Rabl (upper GMEAN block) and Standard Solar Days (lower GMEAN block) correlations.

A PLOT block displays the four resulting curves on screen.



Remark Please observe, that the Standard Solar Day assumes a constant day length of eleven hours, which is automatically centered around true solar noon by the GMEAN block. The Collares-Pereira Rabl block adds thirty minutes to the hour input as suggested by the Collares-Pereira Rabl approach.