Parameter calibration of the Penman-Monteith eq. for Indonesian peatland conditions

# Data

* General data

|  |  |
| --- | --- |
| Latitude (Palangkaraya, where Hirano (2005) had the forests) | -2.216105 |
| elevation asl | 2.0 m (estimation) |

* Historic weather data from [here](https://www.worldweatheronline.com/palangkaraya-weather-averages/kalimantan-tengah/id.aspx)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month (from year 2009) | Tmax (C) | Tmean (C) | Tmin (C) | windspeed (m/s) | rel. hum. |
| Jan | 31 | 26 | 23 | 4,1 | 86 |
| Feb | 31 | 26 | 23 | 4,2 | 84 |
| Mar | 30 | 26 | 23 | 3,2 | 90 |
| Apr | 31 | 26 | 23 | 3,1 | 88 |
| May | 32 | 27 | 23 | 3,1 | 84 |
| June | 32 | 27 | 23 | 3,7 | 82 |
| July | 31 | 26 | 22 | 4,4 | 82 |
| Aug | 32 | 27 | 23 | 5,2 | 75 |
| Sept | 33 | 28 | 23 | 6,1 | 73 |
| Oct | 31 | 26 | 23 | 4,0 | 84 |
| Nov | 30 | 26 | 23 | 3,7 | 87 |
| Dec | 30 | 26 | 23 | 3,2 | 90 |

**NOTE**

* + **Windspeed data is the most suspicious of all: mean and max windspeed appear to be equivalent. Something might be wrong there!**
  + **Weather data from 2009 (no previous data available), but ET and radiation data from years (2004-2007)**
* Calibrated against (Hirano, 2015):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| year | Rn [GJ m-2 yr-1] | | | ET [mm yr-1] | | | |
| UF | DF | DB | UF | | DF | DB |
| 2004 | 4,78 | 4,71 | 4,53 | 1634 | 1529 | | 1359 |
| 2005 | 4,77 | 4,79 | 4,46 | 1648 | 1611 | | 1404 |
| 2006 (El Niño) | 4,58 | 4,41 | 4,25 | 1566 | 1401 | | 1277 |
| 2007 | 4,92 | 4,87 | 4,68 | 1695 | 1671 | | 1454 |
| mean | 4,76 | 4,7 | 4,48 | 1636 | 1553 | | 1374 |

UF=Undrained forest, DF=Drained forest, DB= Drained burnt forest

# Method

There are 2 parameters to obtain:

* Kc, the fraction of potential evapotranspiration that is realized (Kc = Eta/ETo)
* krs is an empirical parameter that ranges 0.16…0.19 according to FAO: [link here](http://www.fao.org/3/X0490E/x0490e07.htm)

krs influences net radiation; Kc influences ET. Hirano (2015) has measurements of both radiation and ET. Since radiation is required to compute ET, I first fit krs to the measured radiation and then fit Kc to ET.

**Fitting krs**

The albedo affects the net radiation Rn. I take the albedo (eyeballing average) to be 0.09 from Hirano (2015). I get the values:

|  |  |  |
| --- | --- | --- |
| krs | modelled Rn [GJ m-2 y-1] | measured Rn [GJ m-2 y-1] |
| 0.16 | 3.97 | 4.25…4.92 (mean 4.70-4.76) |
| 0.19 | 4.51 |

I choose krs=0.19, because even if higher krs values get closer to the measured Rn, the FAO documentation suggests the range krs=0.16…0.19 (and quite mysteriously so: [link here](http://www.fao.org/3/X0490E/x0490e07.htm)).

**Fitting Kc**

First of all, we set the albedo back to 0.23, since this is by definition the albedo for the FAO’s reference crop.

Next, I play around with the Kc values until I find the ones that look the best:

|  |  |  |
| --- | --- | --- |
| Kc | ETa modeled [mm yr-1] | ETa measured [mm yr-1] |
| 0.95 | 1640 | UF:1636; DF: 1553 |
| 0.90 | 1554 |

So the value of Kc should be between 0.95 and 0.90 depending on the type of forest (only drained and undrained forests considered, not burnt drained)

# Results

krs = 0.19

Kc=0.90…0.95

Parameter calibration results:

Sample plot of annual variation of modelled Rn and ETa for krs=0.19, kc=0.9A close up of a map

Description automatically generated

# References

Hirano et al. (2015). Evapotranspiration of tropical peat swamp forests. *Global Change Biology*.