Food and Agriculture Organization of the United Nations

Required input for simulations with AquaCrop

Input variable	Comments
Climate (conditions at the upper boundary):	
Daily, 10-daily or monthly maximum and minimum **air temperature**;	The required climatic data is for one or more years. Daily data will be generated by AquaCrop at run time, if the climate files contain 10-daily or monthly input data is given.
Daily, 10-day or monthly mean values of **Reference evapotranspiration** (ETo), or of climatic data to compute ETo. (AquaCrop contains a calculator in which data can be givens in a wide variety of units to estimate ETo). The required data to calculate ETo can consist of air humidity, wind speed, and radiation or sunshine data;	
Daily **rainfall data** (10-day or monthly mean not recommended although better than none);	
Mean annual **CO_2 concentrations**.	Historical data from Mauna Loa Observatory (Hawaii) and various sets (with different storylines) of expected [CO_2] for future years, are available in the database of AquaCrop.
Crop parameters likely to require adjustments for cultivar and local environment and management:	
Planting date;	AquaCrop can generate planting date from rainfall, air temperature data, or soil water content in top soil.
Plant density;	AquaCrop can estimate plant density from plant spacing, or from seeding rate and germination percentage.

Maximum canopy cover (CCx);	Depending on plant density and cultivar. Can be easily observed in the field.
Time to crop emergence, flowering, start of canopy senescence and to maturity (length of crop cycle);	Cultivar specific. Can be easily observed in the field.
The proportion of grain dry weight to above-ground biomass, i.e., harvest index (HI);	
Maximum effective rooting depth (Zr_x) and time to reach Z_x.	Depends on conditions in root zone.
Soil physical parameters of the distinctive (up to 5) soil horizons:	
- Soil water content (θ) at saturation, field capacity, and permanent wilting point; - Saturated hydraulic conductivity; - Depth of layer restricting/limiting root deepening.	A hydraulic properties calculator (Saxton and Rawls, 2006) is available to estimate θ's and Ksat from soil texture. From θ_{SAT}, θ_{FC}, θ_{PWP} and Ksat, AquaCrop derives other physical parameters governing soil evaporation, internal drainage, deep percolation, surface runoff and capillary rise
Groundwater table (Conditions at the lower boundary):	
Depth and salinity of the groundwater table (if less than 4 meter below root zone)	Can be constant or variable in time. Field data
Field management practices:	
Soil fertility: Indication of the maximum relative dry aboveground biomass (B_{rel}) that can be expected in the fertility-stressed environment compared to stress-free conditions;	B_{rel} is the maximum B that can be produced under the governing local conditions in a field only affected by soil fertility stress in a good rainy year or under irrigation when there is no water stress. It may be available from statistical reports, indigenous farmer knowledge, or from nearby experimental fields.
Practices affecting soil evaporation and/or surface runoff (mulches, tied ridges, soil bunds): - Cover and type of soil mulches; - Height of soil bunds; - Adjustment of surface runoff when affected by crop type and planting	Field data; Guidelines are available in the 'Field management menu' of AquaCrop.

Irrigation management practices:	
Irrigation method;	The method affects soil evaporation. Field data.
Application depth and time of irrigation events; Salinity of the irrigation water.	Field data.
Initial conditions at start of simulation period:	
Initial soil water content and soil salinity at various depths in the soil profile.	In the absence of measurements or sampling of the soil profile at the time of sowing/planting, measurements or samples collected earlier can be used to determine the initial soil water content. In this case the simulation should start before the sowing/planting day and the simulation period is no longer linked with the growing cycle. In the absence of any measurement or sampling, the initial soil water content needs to be estimated. For example: - Soil profile will be close to Field Capacity at the end of a winter period characterized by ample rainfall and a small to negligible evaporative demand of the atmosphere; - Soil profile will be close to Wilting Point at the end of a summer period characterized by the absence of rainfall/irrigation and a high evaporative demand of the atmosphere (with a reference evapotranspiration (ETo) of 5 mm/day or above).
Field data (for calibration/validation)	
- Maximum green leaf area index (LAI) or crop canopy cover at various times over the season; - Above ground biomass at various times over the season and at crop maturity; - Final yield at crop maturity.	With the help of the light interception function, LAI can be converted to CC: $CC = 1 - e^{-k\,LAI}$ where k is a crop specific growth coefficient (~ 0.7).

References:

- Raes, D., Steduto, P., Hsiao, T.C., and Fereres, E. 2015. AquaCrop Reference manual. http://www.fao.org/nr/water/aquacrop.html
- Saxton, K. E., Rawls, W. J. 2006. Soil Water Characteristic Estimates by Texture and Organic Matter for Hydrologic Solutions. Soil Sci. Soc. Am. J. 70, 1569–1578. URL web page (for downloading the hydraulic properties calculator): http://hydrolab.arsusda.gov/soilwater/Index.htm