



From evaporating pans to transpiring plants (John Dalton Medal Lecture)

Michael Roderick

The Australian National University, Research School of Earth Sciences & Research School of Biology, Australia

The name of the original inventor of irrigated agriculture is lost to antiquity. Nevertheless, one can perhaps imagine an inquisitive desert inhabitant noting the greener vegetation along a watercourse and putting two and two together. Once water was being supplied and food was being produced it would be natural to ask a further question: how much water can we put on? No doubt much experience was gained down through the ages, but again, one can readily imagine someone inverting a rain gauge, filling it with water and measuring how fast the water evaporated. The inverted rain gauge measures the demand for water by the atmosphere. We call it the evaporative demand. I do not know if this is what actually happened but it sure makes an interesting start to a talk. Evaporation pans are basically inverted rain gauges. The rain gauge and evaporation pan measure the supply and demand respectively and these instruments are the workhorses of agricultural meteorology. Rain gauges are well known. Evaporation pans are lesser known but are in widespread use and are a key part of several national standardized meteorological networks. Many more pans are used for things like scheduling irrigation on farms or estimating evaporation from lakes. Analysis of the long records now available from standardized networks has revealed an interesting phenomenon, i.e. pan evaporation has increased in some places and decreased in other but when averaged over large numbers of pans there has been a steady decline. These independent reports from, for example, the US, Russia, China, India, Thailand, are replicated in the southern hemisphere in, for example, Australia, New Zealand and South Africa. One often hears the statement that because the earth is expected to warm with increasing greenhouse gas emissions then it follows that water will evaporate faster. The pan evaporation observations show that this widely held expectation is wrong. When expectations disagree with observations, it is the observations that win. That is the basis of science.

In this Dalton Medal lecture we first examine pan evaporation observations and show why pan evaporation has declined. Armed with that knowledge we then investigate the consequences for plant water use and how this is directly coupled to the catchment water balance.