LI-COR Automated Evapotranspiration Station - North Platte, Nebraska

A Case Study Demonstrating FluxSuite™ Software

EC-107

The LI-COR Automated Evapotranspiration Station installed in North Platte, Nebraska, provides water managers and producers with information that can aide in decision making processes throughout the growing season.

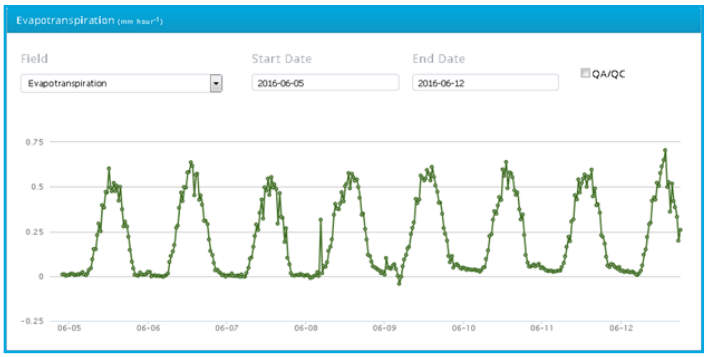
The LI-COR Automated Evapotranspiration Station is located just south of West State Farm Road in North Platte, Nebraska, on the north end of the cornfield being monitored. This location was chosen because the prevailing summer winds are from the south. The analytical equipment is mounted approximately 12 feet above the ground, allowing it to measure crop activity within about 1000 feet of the station

An overview of the available station outputs from the LI-COR FluxSuite™ Software 'dashboard' is provided below.

Evapotranspiration (Actual)

The chart to the right displays the amount of water – in air – moving through the measurement path of the LI-7500RS analyzer. The source of this water is evaporation from the surface (ground), as well as from crop transpiration. During the growing season, we should see spikes in evapotranspiration during periods of plant growth. The chart indicates that water was being "added" to the atmosphere around sunrise. This increase continues until late morning, and we see a plateau for a 2-4-hour time period. The water being returned to the air begins to decrease in early to mid-afternoon, and falls to zero around sunset. During the growing season, we expect to see healthy crops delivering water to the atmosphere. If this is not the case, the crop could be stressed – lacking available water or insect damaged – and should be visibly evaluated.

This chart also shows that between 0.5-0.75 mm/hour (0.02-0.03 inches) of water is being "lost" to the atmosphere during peak activity periods. If you hover over the individual points (generated every 30 minutes), the total daily water loss can be calculated. This information could potentially be used for irrigation planning.



Carbon Dioxide Flux

What we see on this chart is the change in crop level carbon dioxide (CO_2) concentrations. CO_2 is used by the crop during periods of growth, so we would expect to see negative values during daylight hours, as CO_2 is taken up by the growing corn.

In the nighttime hours, we should see positive CO_2 values as the plants are not photosynthesizing. Note that this is the opposite of what we see with evapotranspiration!

As the summer progresses, the increased biomass of the crop will continue to take in more and more CO_2 until senescence. If a decreasing uptake of CO_2 is observed as the growing season progresses, the plants could be stressed. The chart below shows CO_2 being absorbed, starting around sunrise and continuing for approximately 8 hours. We then see CO_2 fluxes increase until around sunset. They stay relatively flat until the sun rises, indicating the start of another day of growing.

Note that by looking at both the ET and CO_2 flux graphs, we can see two instances where the equipment might have been disturbed. One in the early morning of June 8th, and the other the early morning of June 9th. See the spikes that appear on both

charts? This data point should probably be discarded, as it is seen in multiple measurements and is an isolated occurrence.

Ambient Air Temperature

This simply displays the air temperature at the Automated ET Station.

Ambient Air Pressure

Ambient air pressure changes can be indicative of upcoming weather events.

Rising pressures typically indicate movement toward less humid (drier) and more calm air conditions. Clear skies are also common as pressure rises.

When atmospheric pressure is falling, as seen below, it often indicates that windy, cloudy, and/or wet conditions are on the way. After two days of steadily falling air pressure, ¾" of rain fell on the station location on the afternoon of July 11, 2016. Over these 2+ days, average wind speed steadily increased from about 5 mph to over 30 mph.

Ambient Air Relative Humidity

Ambient air humidity is the amount of water vapor in the air. As humidity approaches 100%, the likelihood of water droplets (rain) forming increases.

Humidity can also impact crop growth. The following description of Humidity and Plants is courtesy of the NOAA Air Resources Lab (http://www.arl.noaa.gov/faq_c1.php)

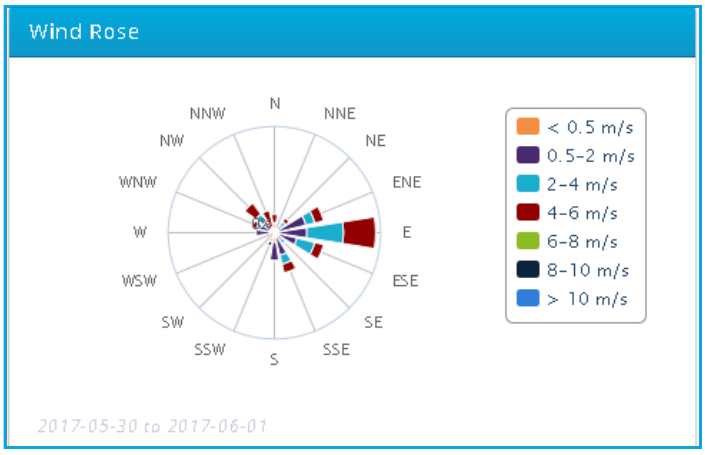
Humidity and Plants

Plants also respond to changes in humidity. Transpiration of water vapor through leaf stomata depends on the gradient of moisture between the leaf interior (which is saturated) and the overlying air, as well as the availability of moisture in the soil. The lower the atmospheric humidity, the greater the transpiration rate. The transpiration rate is determined by a balance between the amount of energy available to convert water from the liquid to vapor phase and the moisture gradient.

Transpiration rates also depend on the resistance to water movement between the leaf and the air. By analogy with the flow of electricity through a circuit, with elements of different electrical resistance, the flow of water is modeled by considering the resistance of the leaf stomata, the leaf cuticle, and the air in the boundary layer adjacent to the leaf. Extension of this leaf model to crop fields or to natural plant ecosystems can be problematic, and more sophisticated micrometeorological methods are used.

Wind Rose

This chart shows the direction the wind is blowing ***from***, as well as average speeds. It is important to consult this chart, as one should confirm that air movement over the field of interest is being measured by the LI-COR station. Note too, that the wind measurements cover the last three days. On the chart below, we can see that the primary wind direction over the past three days has been from the east, at relatively mild speeds. Note that this image represents the wind speed and direction, not the fetch or area measured.



More Information

This note is intended to provide a quick overview of the information a LI-COR Automated ET system can provide. If you have other questions, please feel free to email us at envsales@licor.com and we will respond in a timely manner.

LI-COR

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