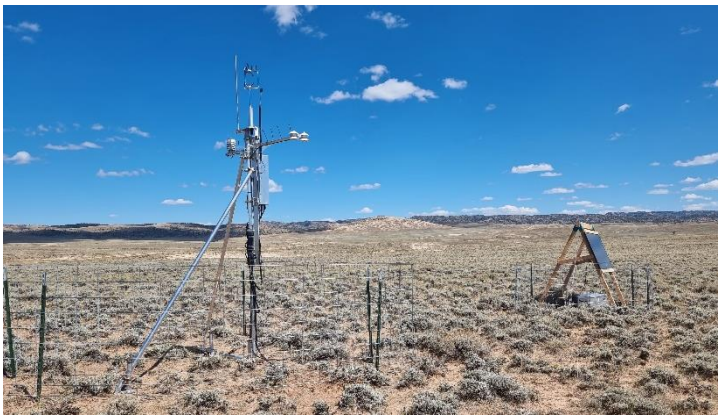
QUANTERRA

Measuring atmospheric fluxes

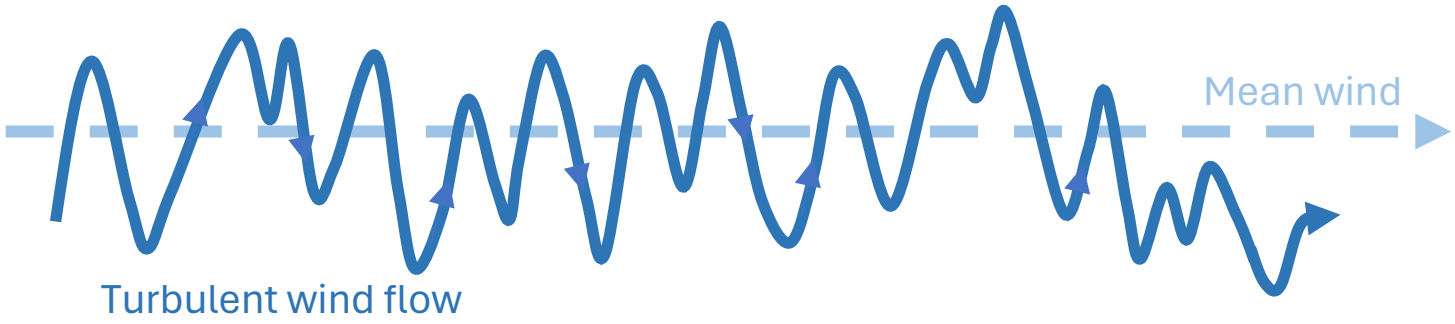
Near real-time measurement of flows of carbon, water and energy

We measure the carbon uptake of a field using 'micro-meteorology' techniques. An advanced weather station known as a 'flux tower' is used to measure atmospheric variables, these measurements are then coupled with understanding of atmospheric physics to calculate the flows of energy, water and CO_2 between the atmosphere and the ecosystem every 30 minutes.



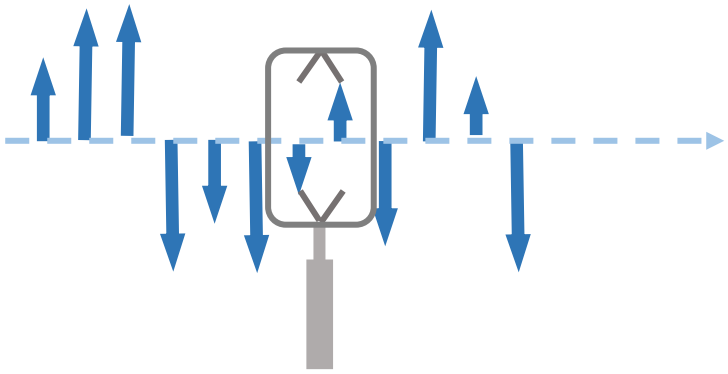
Turbulence & eddies

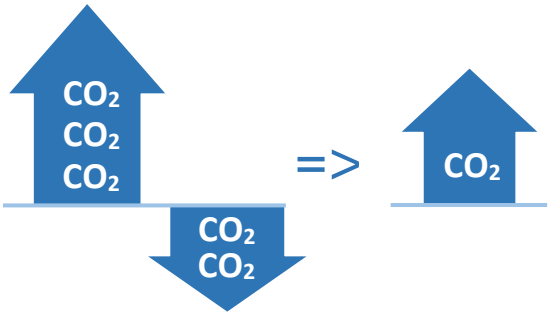
Wind and heating of the land surface relative to the air, results in disruption of the horizontal wind flow by adding upward and downward motions, called eddies, to the flow. This is referred to as turbulent wind flow. The eddies transport molecules, such as CO_2 and H_2O, and energy between the surface and the atmosphere.



Atmospheric measurement

As the wind passes through the measurement devices on the flux tower we measure the eddy vertical motion. At the same time we measure the constituents of the air, including concentration of CO_2, temperature, and humidity. We make these measurements 10 times every second.

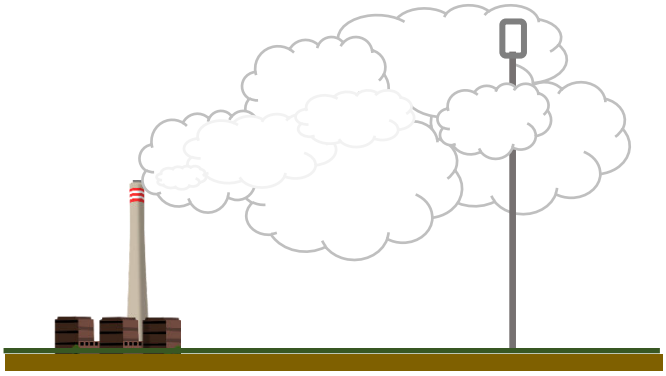


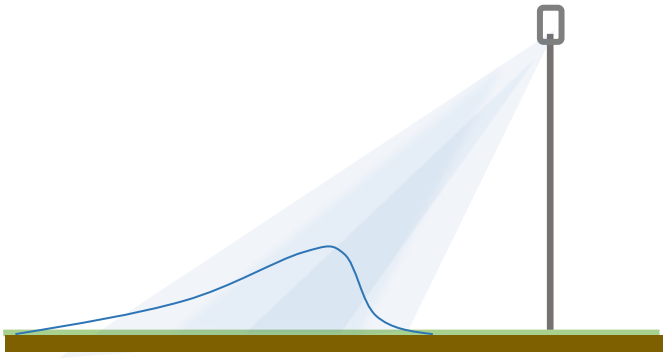


From these measurements we calculate the amount of CO_2, H_2O, and heat being carried away from or towards the surface by the vertical motions of the wind. This is referred to as flux. We typically average these flux measurements over longer time periods (30 minutes) to reduce uncertainty.

Field scale measurements

By placing our measurement devices high above the surface we can measure fluxes from a large area. Just like a chimney or smoke stack, every plant gives off a plume of gas that can be measured by a tower placed downwind. If the surface of a field is relative uniform we can determine the probability of where the flux originated from on the surface.

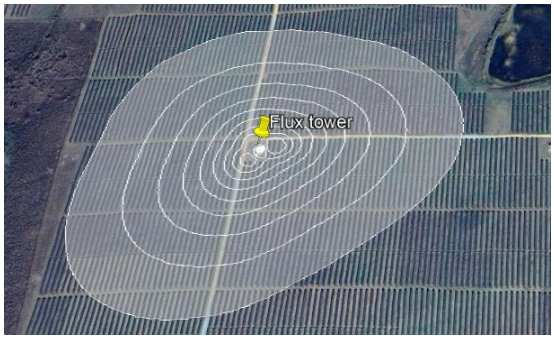




Flux footprint

Because the wind changes direction, over time the tower measures fluxes from different areas of ground surrounding it. The size and shape of the measurement area around the tower is dependent on the height of the tower above the surface, the dominant wind direction and other site characteristics, but the majority of the time a tower on a crop or grazing field would represent an area of about 4 hectares to 10 hectares.

We use historic wind data to calculate a likely annual measurement footprint, and install the towers so that they are usually measuring an area that is representative of the field we're interested in.

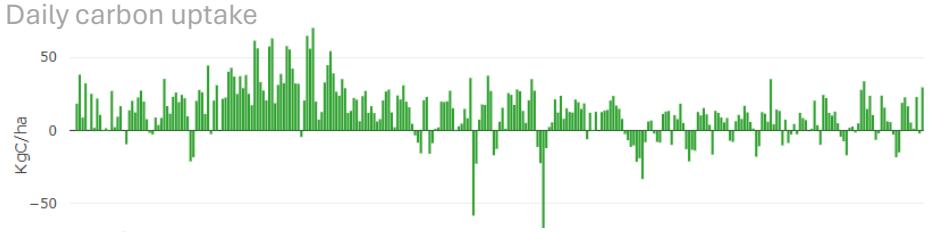


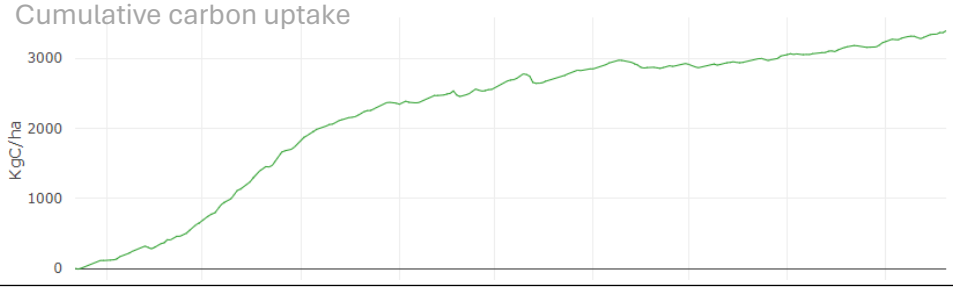
Other measurements

In addition to carbon, water and energy fluxes, the towers also measure a range of other variables such as solar irradiation, precipitation, soil moisture, soil temperature and soil heat flux. We can then use these measurements to help quality control our calculated fluxes, and to drive models that enable us to use the fluxes across larger landscapes.

Using the data

Fine timescale fluxes and supporting data can be used to determine information about the ecosystem, such as how it responds to weather or farm management events. They can also be aggregated over longer timescales to evidence how much carbon has been captured (or emitted) relative to a baseline or an alternative management practice.





This approach can also be used for other trace gases, such as methane, but sensors for monitoring these gases are usually prohibitively expensive. We are currently testing lower cost sensors with the goal to be able to integrate into our system for wider GHG monitoring.

Want to know more?
Contact us at info@Qtsys.com