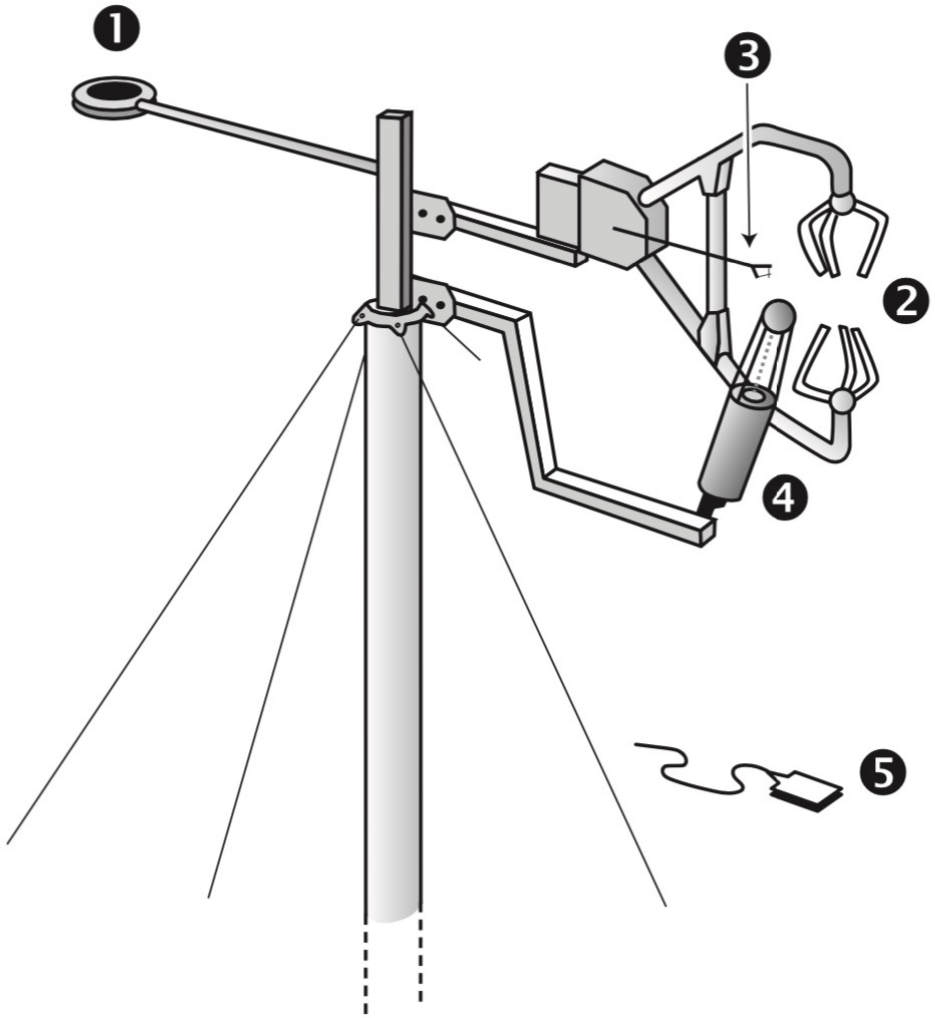
25 Eddy covariance systems

Surface Energy Balance Station

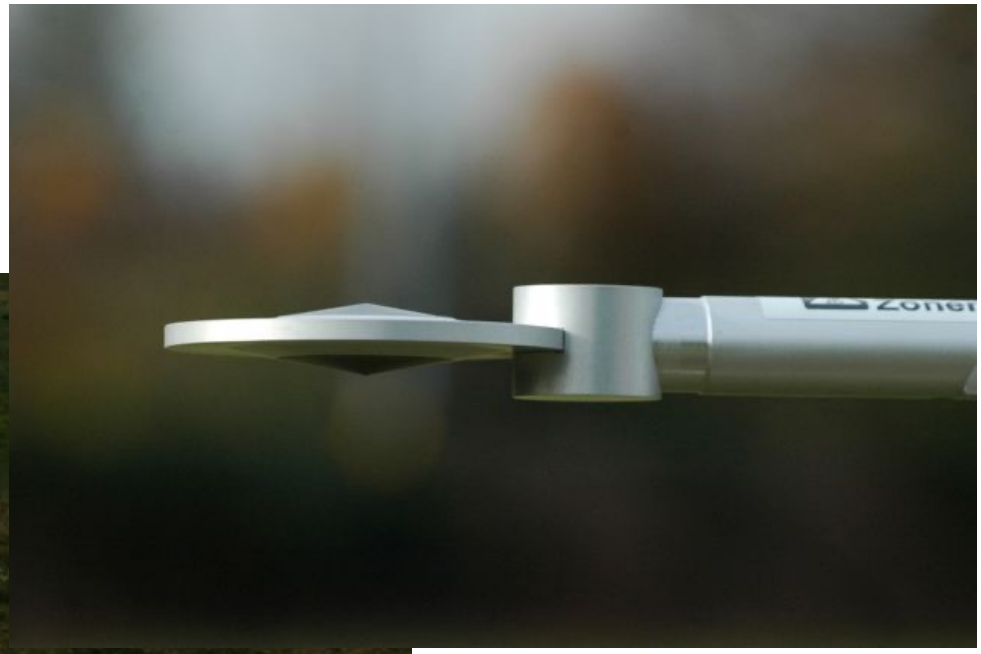


This set-up measures all terms of the surface energy balance (SEB):

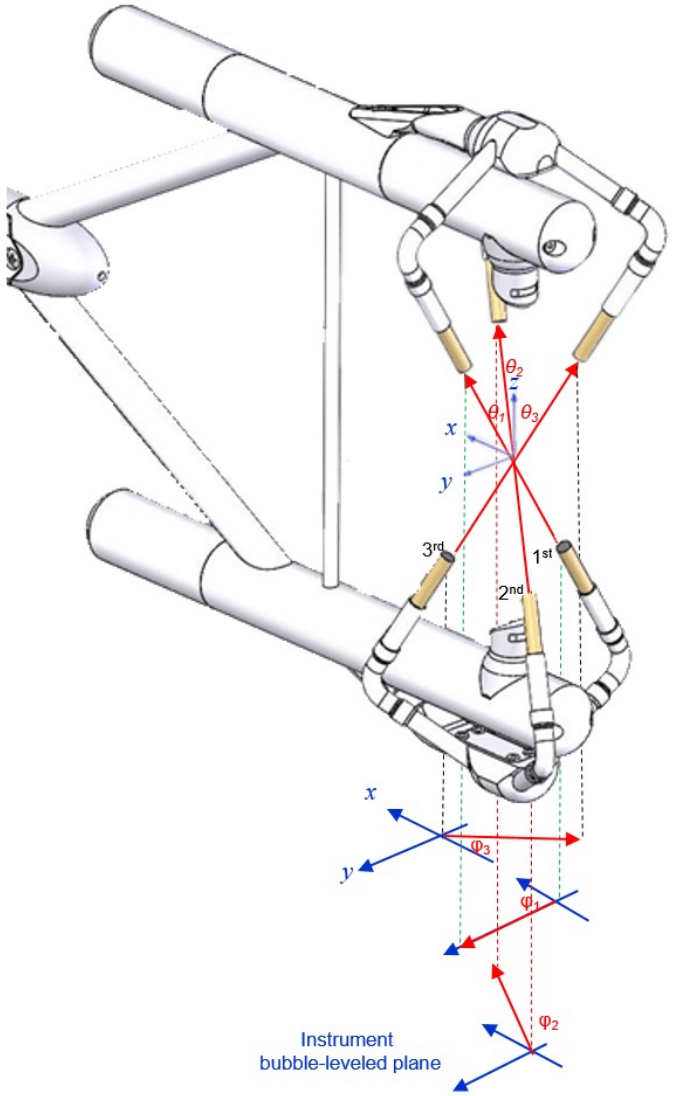
$$Q^* = Q_H + Q_E + Q_G$$

More info on theory of operation here:
https://www.azosensors.com/article.aspx?ArticleID=362

1. Net all-wave radiometer



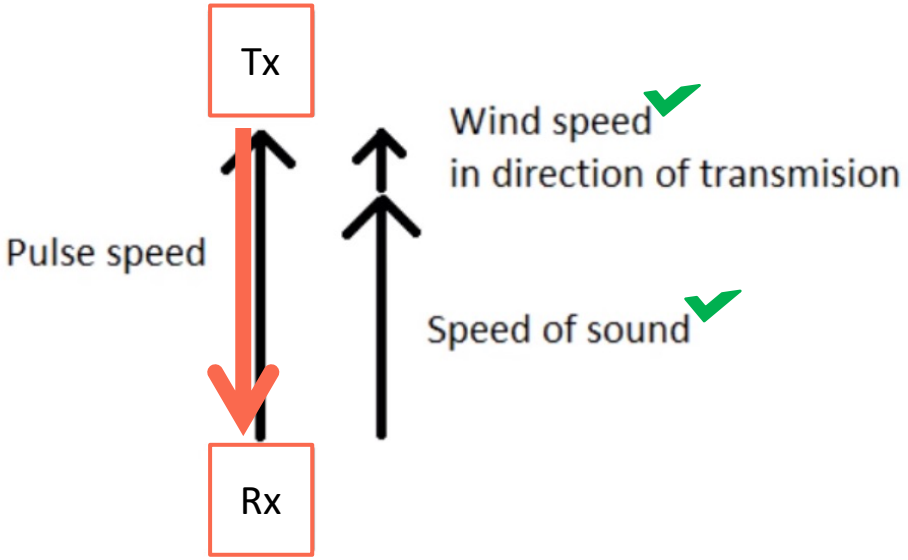
2. 3-D Sonic Anemometer



More info on theory of operation here (see measuring principle): https://www.biral.com/product/ultrasonic-anemometer-3d-4-3830-20-340/#product-overview

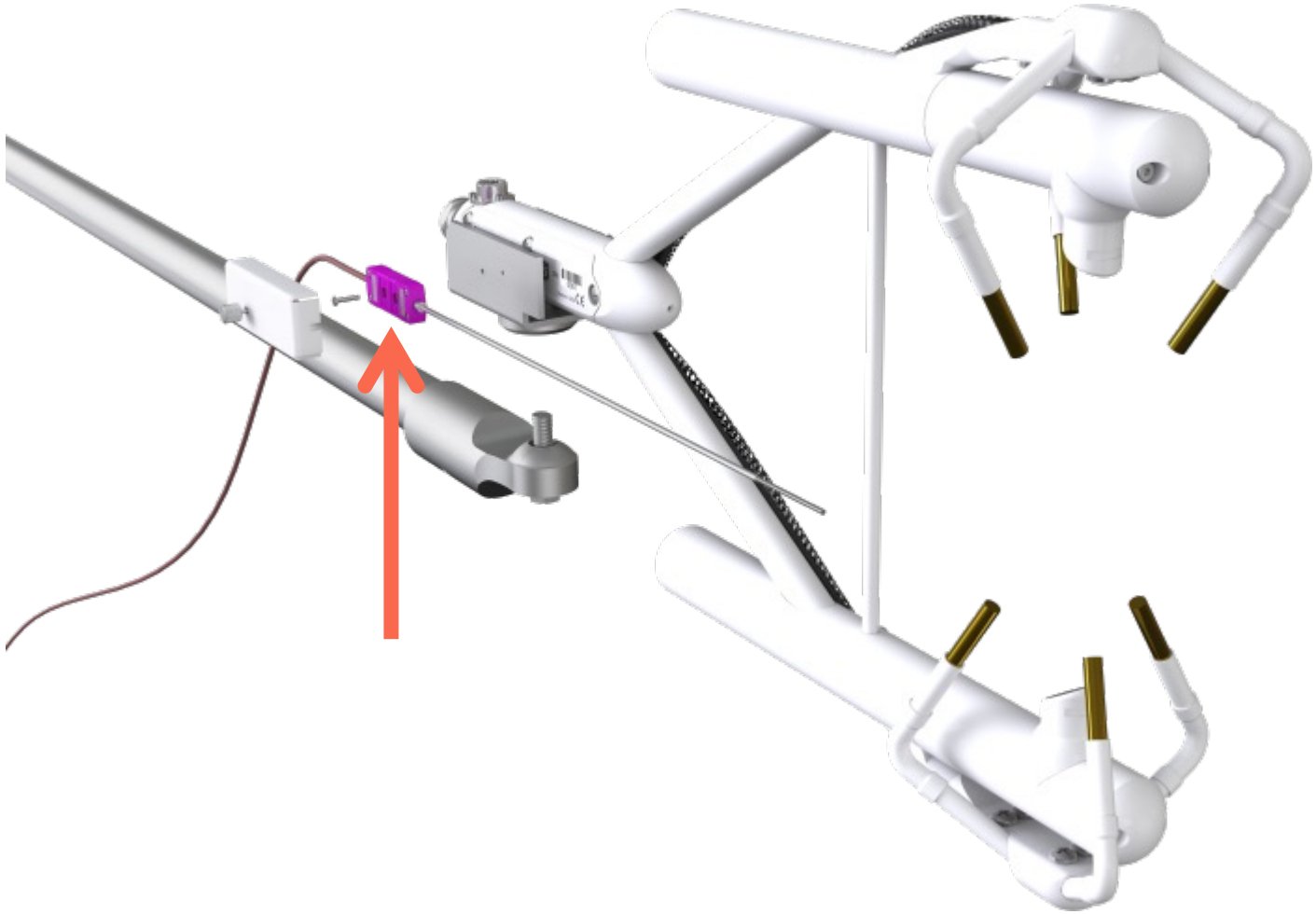
2. 3-D Sonic Anemometer

- Time of flight model
- Convert measured time to velocity, and account for the speed of sound



$$c\left(\frac{m}{s}\right) = 331.3\sqrt{1+\frac{T(^{\circ}C)}{273.15}}$$

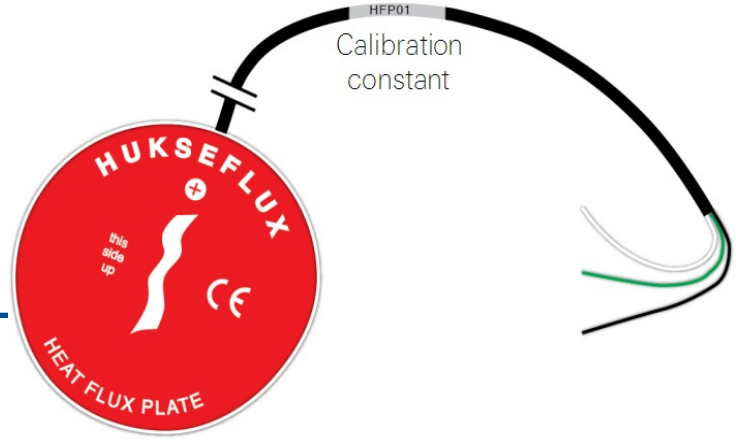
3. Fine-Wire Thermocouple



4. Infrared CO_2/H_2O gas analyzer

The gas analyzer operates by measuring the absorption of infrared radiation at different wavelengths.

5. Soil heat flux plate



A heat flux plate is the most common sensor to measure soil heat flux. Heat flux sensors are typically small, rigid, disc-shape sensors that are inserted horizontally into the soil at the reference depth (Ochsner et al., 2006). An encapsulated thermopile in the sensor produces a voltage proportional to the temperature gradient perpendicular (e.g., vertical) across the sensor body (Ochsner et al., 2006). The material of the heat flux sensor mimics the bulk density and thermal heat diffusivities of a common loam soil. Assuming that the actual soil heat flux is at steady state, i.e., the thermal conductivity of the body is constant and that the sensor has negligible influence on the thermal flow pattern, the output voltage is directly proportional to the local/measured heat flux, see **Figure 1**.

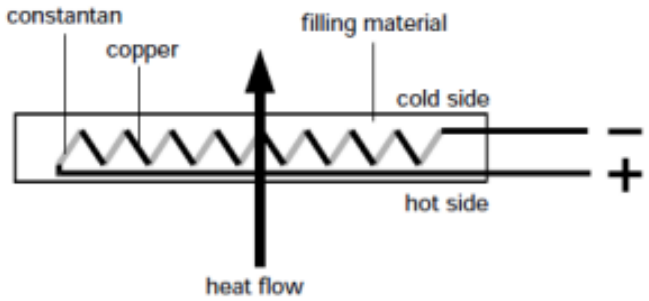
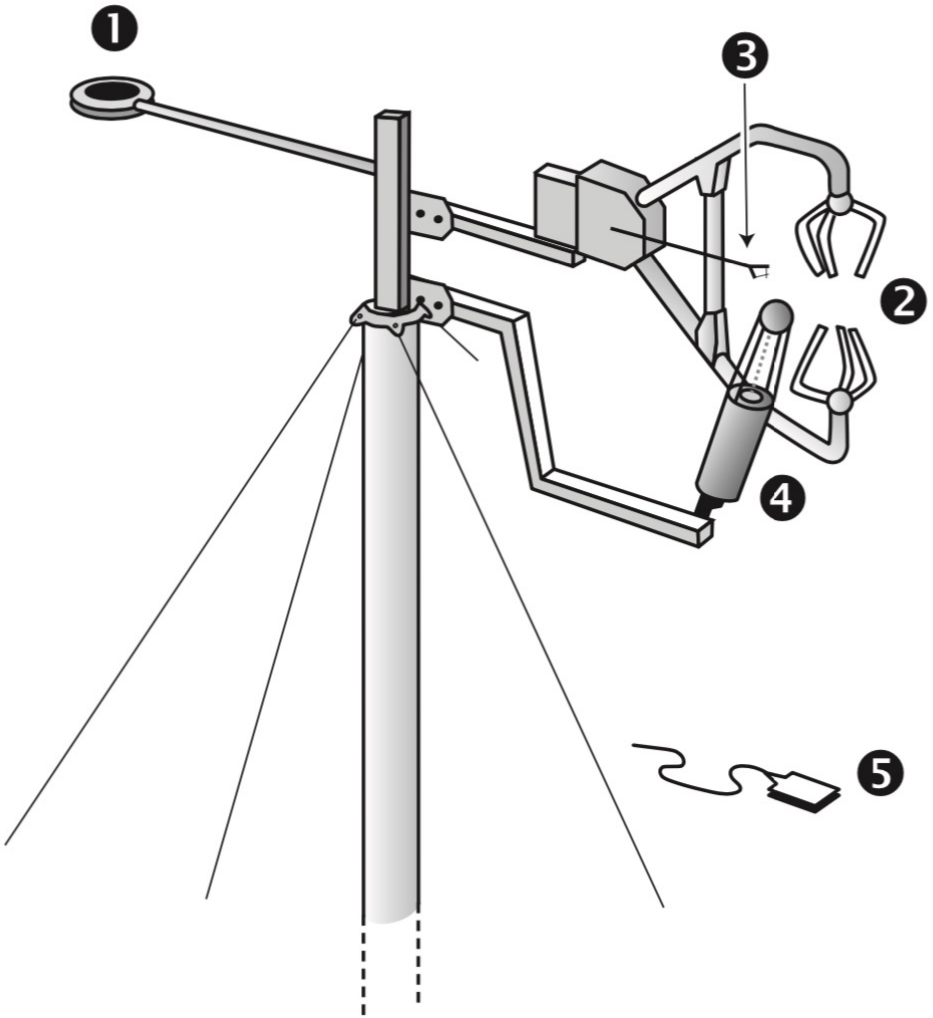


Figure 1. Conceptual schematic of a heat flux sensor (source: RD [04]).

https://data.neonscience.org/documents/10179/11204/NEON.DOC.000814vC/2f7b16d7-7e22-f4be-33c3-336e65bd8171?version=1.0

Surface Energy Balance Station



	Name of instrument	Term of SEB measured	Principle of operation
❶			
❷			
❸			
❹			
❺			

This set-up measures all terms of the surface energy balance (SEB):

$$Q^* = Q_H + Q_E + Q_G$$