The Power of Community: Collaborative Development and Deployment of Low-Cost CO_2 Sensors at Scale

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Ribbit Network is a nonprofit organization with a vision to deploy a global network of low cost CO_2 sensors that can be used by communities for climate science education and advance our understanding of climate change.

Ground-based monitoring stations have by nature a limited geographical coverage. They are mostly deployed by university and research organizations around urban centers or colocated with industrial facilities. Some of these measurements can be recouped with satellite observations to validate findings.

CO_2 monitoring technology uses optical laser (NDIR or Non Dispersive InfraRed) and spectroscopy to measure the CO_2 concentration, measuring % of CO_2 in air, or part per million (ppm). Typical CO_2 levels currently observed are around 400ppm (0.04% CO_2).

Stations are usually connected to a WiFi or Cellular network that provides connectivity to the cloud for data upload and OTA (Over the Air) software updates.

Most ground monitoring stations are using commercial products. They are typically deployed in and around large urban areas. These systems are highly accurate (precision under 1ppm), but also very costly ($10,000 to $100,000 range). As a result, their deployment scope is limited.

Ribbit Network has taken a different approach: The Ribbit “Frog” sensors can be deployed at relatively low cost and scale overtime. They use a laser technology (IR) sensor to measure the CO_2 concentration. They are deployed by volunteer citizen scientists.

They are useful for detecting unknown sources of GHG, providing a micro-level assessment of greenhouse gas (GHG) emissions and offer a high sampling frequency (near real time monitoring). These networks also have an educational purpose, since students can be exposed early on to climate science.

Ribbit Network takes a modular, open source approach to sensor development. As such, the sensor can be extended and improved over time by the community, with minimum amount of funding. As more sensors are being deployed, additional use cases are uncovered. For example, adding support of additional GHG such as CH_4 as low cost sensors become available.

In this presentation, we will also touch on the limitations of this approach, including precision, calibration, and operations.

Figure 1. A Frog sensor deployed in the field.

Figure 2. Many Frog sensors built for the workshop.