





Development of a Low-Cost Air Quality Monitoring System

Paul Kucera, Ph.D. UCAR/COMET Boulder, CO USA 10 June 2021











- Low-cost sensor development to support international capacity development
- Build capacity to monitor for high impact weather, air quality, and hydrological events
- Observe and communicate warnings to local communities

alvation.

Develop observation networks and applications

Low-Cost Observation Platform Development

- Use 3D printers inexpensive technology
 - 1-2 weeks to fabricate
 - Cost ~\$500 USD per station
- Use low-cost, reliable microsensors
- Design a system that that can be assembled locally
- "Print and replace" components
 when systems fail
- Enable local agencies to take ownership in building and maintaining observation networks



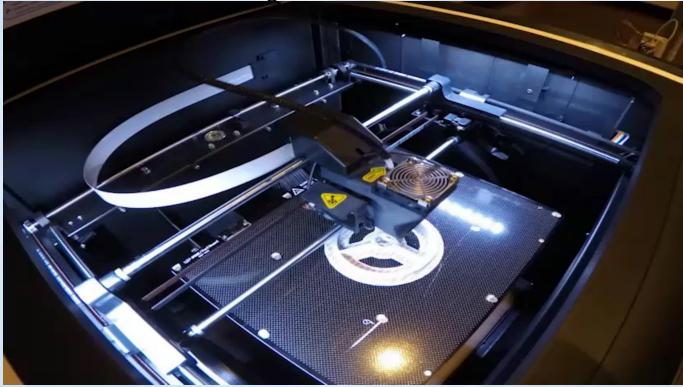
Weather Station Sensor Platform



3D-Printing



3D-Printing of the Radiation Shield



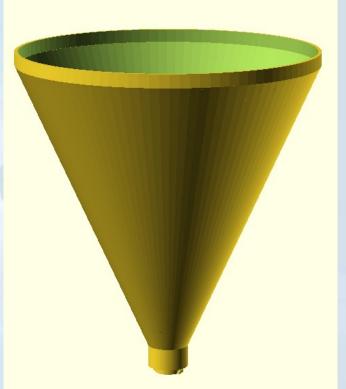
3D-Printed Automated Weather Station (**3D-PAWS**) **3D Printing Pros and Cons**

Pros

- Inexpensive technology
- Capable of making complex components
- Flexible "change on the fly" design
- Fast for prototyping

Cons

- Slow fabrication
- Limited range of plastic materials that are resistant to environmental conditions





3D-PAWS: Expanding the global weather observation data collection "footprint"

Initial Low-Cost Station: 3D-Printed Automated Weather Station (3D-PAWS)

Data acquisition and communication using Raspberry Pi or Arduino single board computers





Data Logger Housing

Precipitation Rate



Wind Direction

Light Sensor

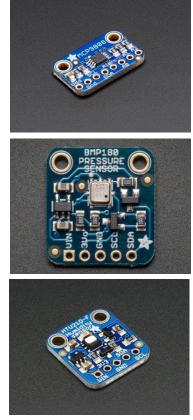




Initial Low-Cost Station: 3D-Printed Automated Weather Station (3D-PAWS)

Radiation Shield and State Variables: Pressure, Temperature & Humidity





Power and Communications

Commercial and solar power solutions



Direct network, wireless, cell modem, satellite communication (Iridium, GOES, METEOSAT), LoRa (Long Range) networks



New Sensor Development – Air Quality

- Low-cost air quality sensors are being evaluated with reference sensor to test sensitivity and reliability
- Integrated into 3D-PAWS system or as stand alone module
- New air quality sensor development in evaluation
 - Particulate Matter (PM): PM2.5, PM10
 - Ozone
 - $-SO_2$
 - $-NO_2$
 - VOC

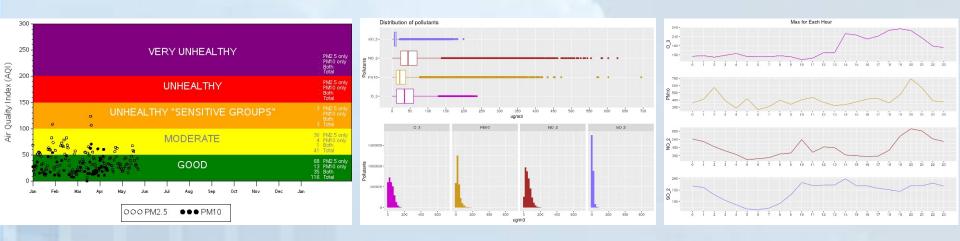




Air Quality Applications

Smart City Applications

- Monitoring and warning for vulnerable residents (impactbased communications)
- Low-cost networks to monitor spatial distributions
- **Research** applications
- Develop a database of pollutants
- Evaluate daily to seasonal impacts on pollutant variability



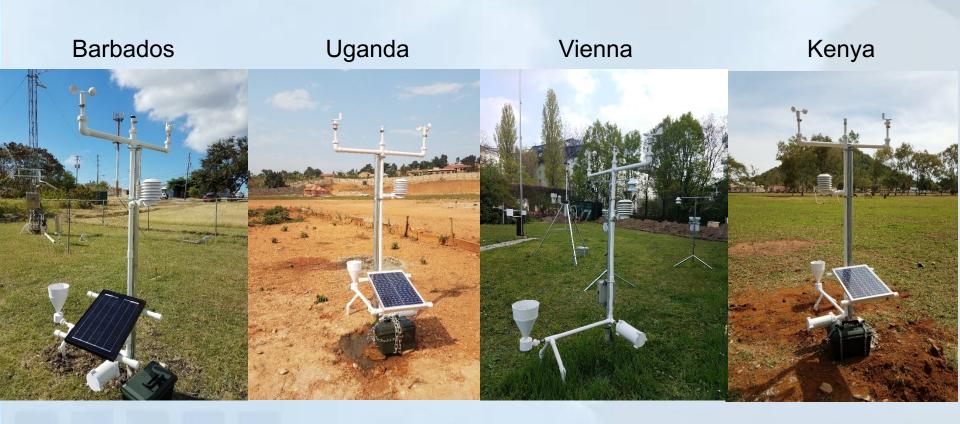
International Deployments

3D-PAWS Installations

- Zambia
- Kenya
- Uganda
- Curacao
- Barbados
- US
- Austria
- Germany
- Senegal
- El Salvador
- Turkey
- Canada



Current Design Setup



Open Data Access

Data access:

Long-term local data storage on station

Real-time Access:

- Web-data services (CHORDS)
- Local NMHS's
- **GLOBE** data services

NSF EarthCube Initiative: CHORDS (Cloud-Hosted Real-time Data Services for Geosciences) data-portal

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3D-PAWS Project Data Portal: http://3d.chordsrt.com

Hands-On Training







Thank You – Questions?



More Information: International Capacity Development Program: https://www.icdp.ucar.edu/ Contact: Paul Kucera (pkucera@ucar.edu), Martin Steinson (steinson@ucar.edu)