Development of a Low-Cost Air Quality Monitoring System

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Introduction

- 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
- Develop observation networks and applications

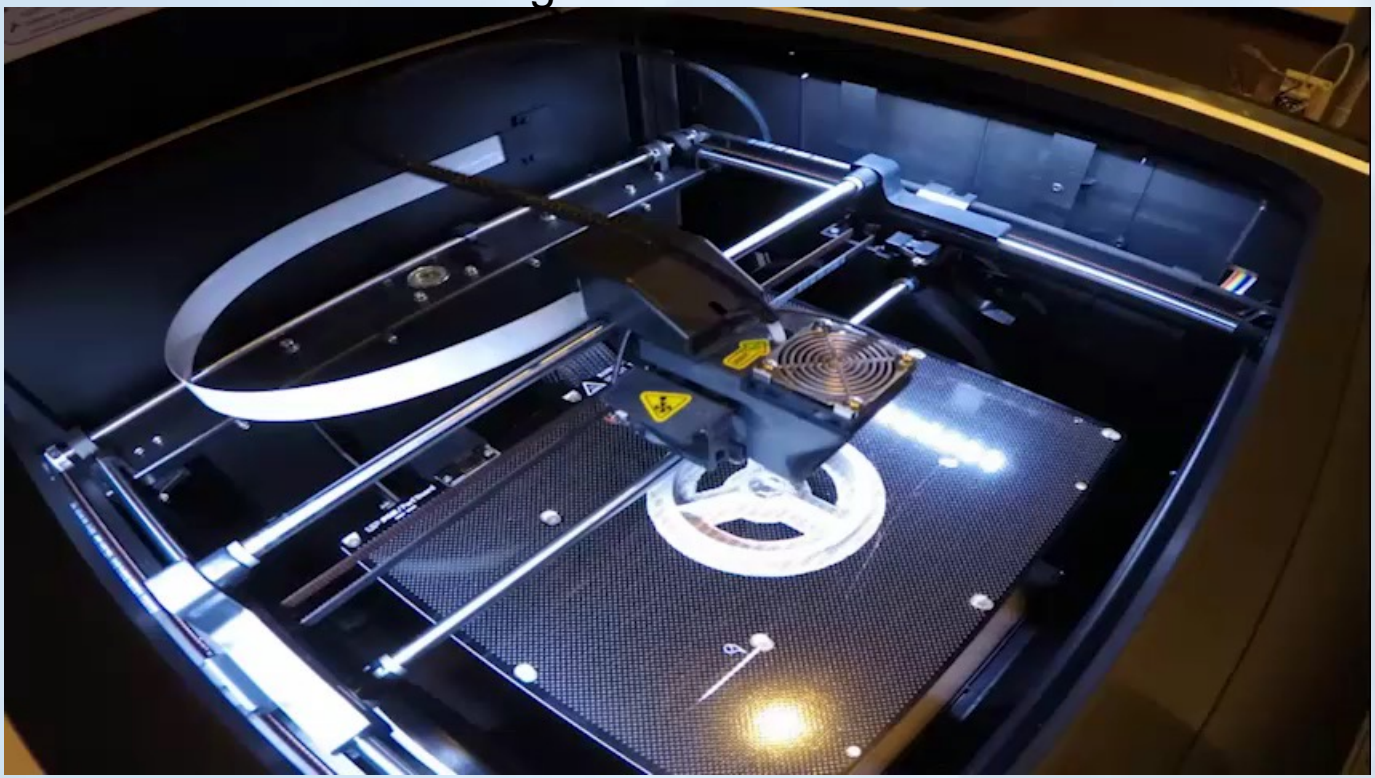
Low-Cost Observation Platform Development

- **Use 3D printers – inexpensive technology**
  - 1-2 weeks to fabricate
  - Cost ~$500 USD per station
- **Use low-cost, reliable micro-sensors**
- **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)

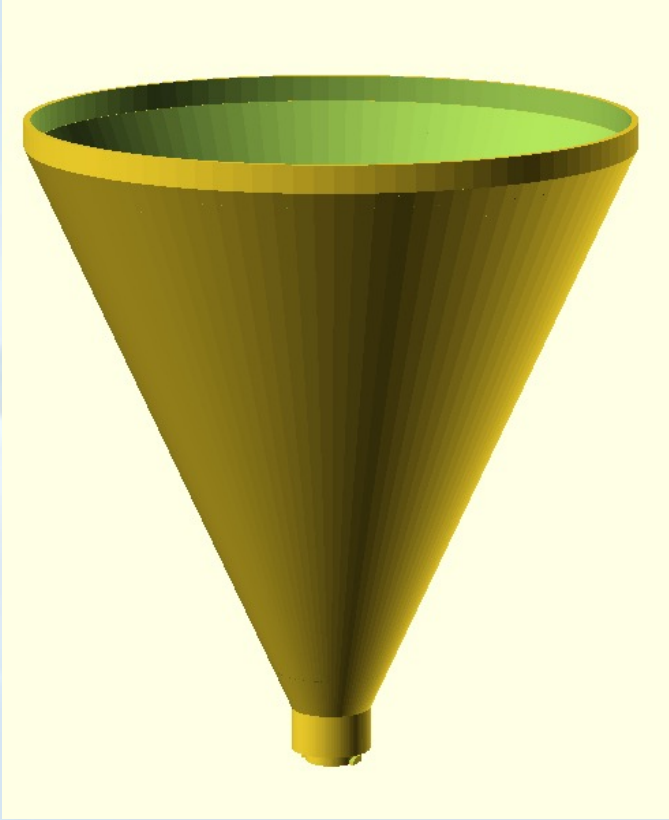
3D Printing Pros and Cons

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



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

Wind Speed

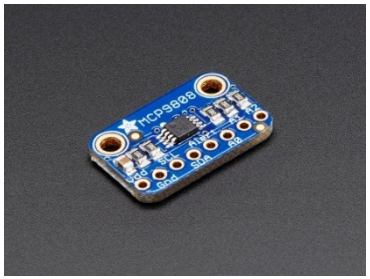
Wind Direction

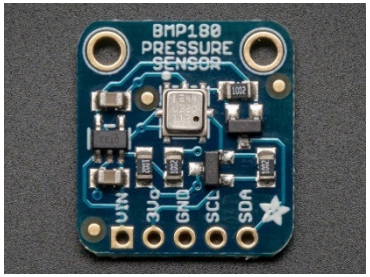
Light Sensor

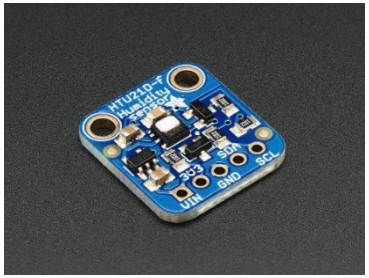
Precipitation Rate

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

Radiation Shield and State Variables:
Pressure, Temperature & Humidity







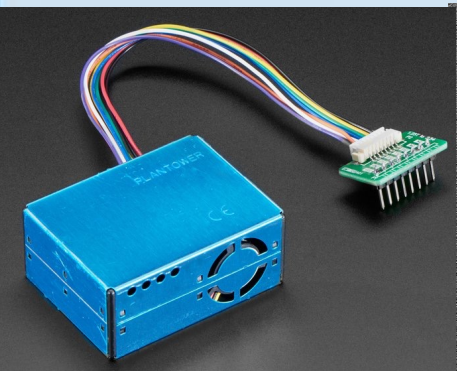
Power and Communications

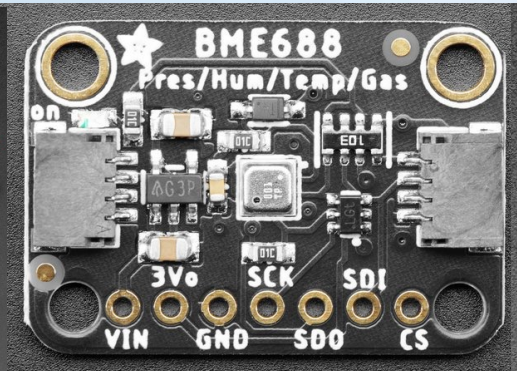
Commercial and solar power solutions

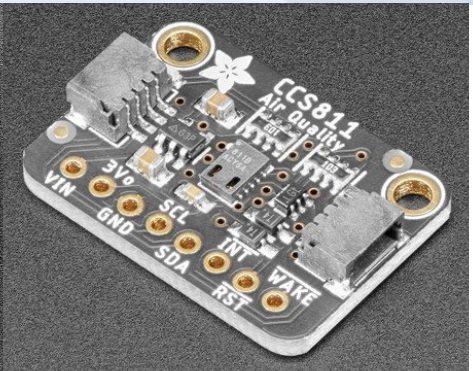
Direct network, wireless, cell modem, satellite communication (Iridium, GOES, METEOSAT), LoRa (Long Range) networks

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







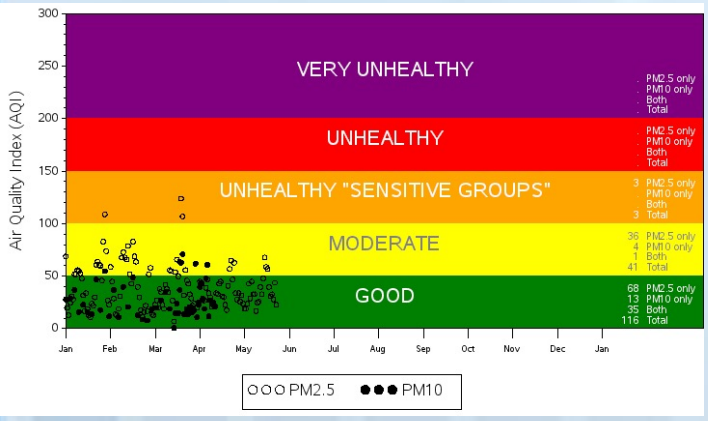
Air Quality Applications

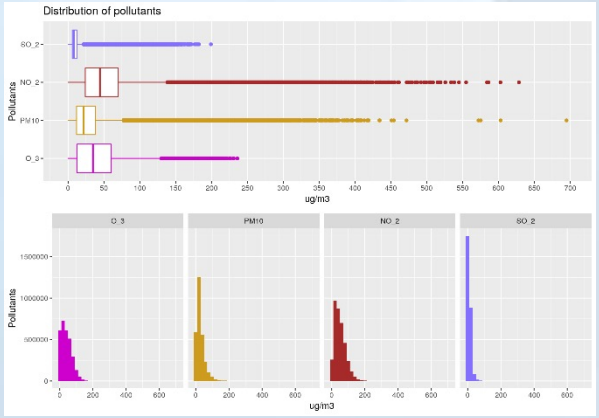
Smart City Applications

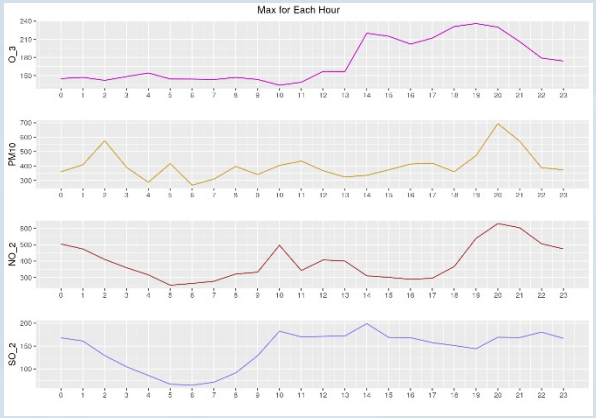
- Monitoring and warning for vulnerable residents (impact-based communications)
- Low-cost networks to monitor spatial distributions

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

Barbados

Uganda

Vienna

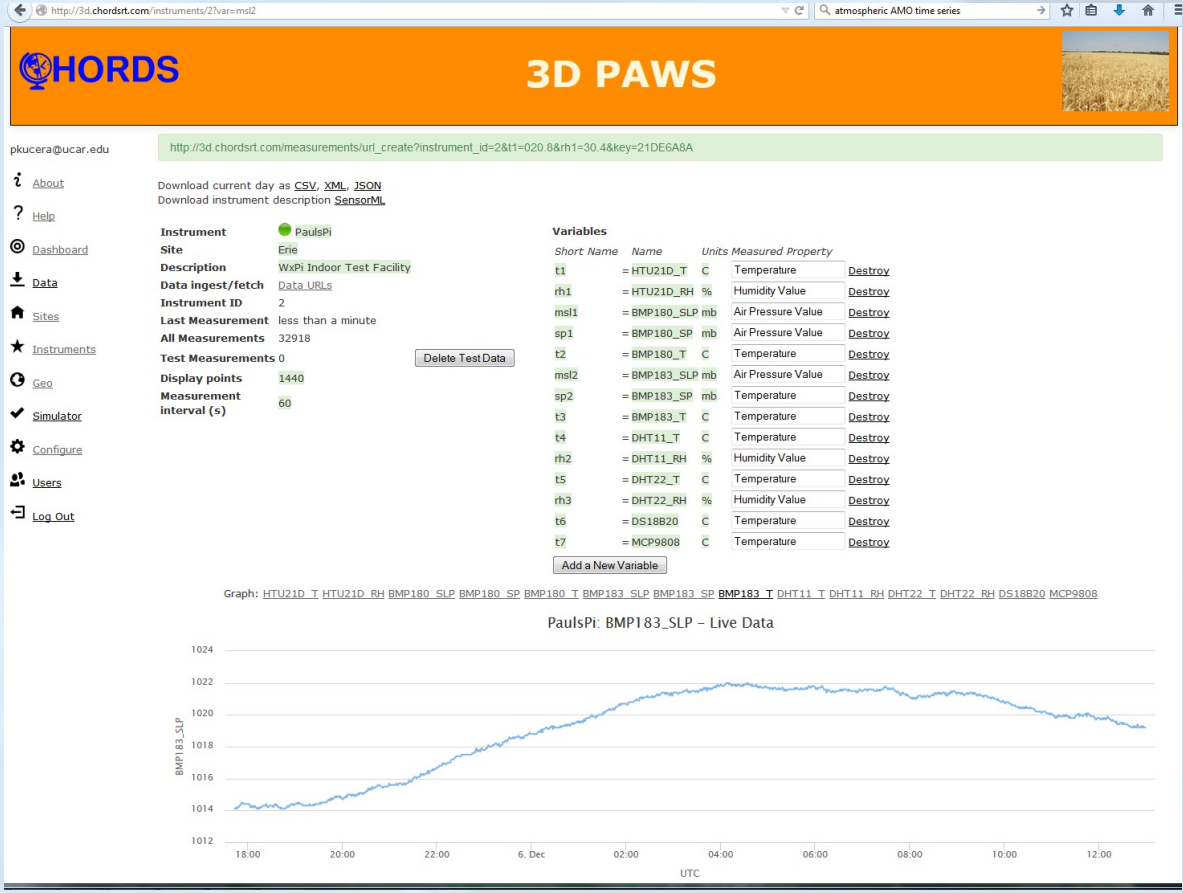
Kenya

Open Data Access

Data access:
- Long-term local data storage on station

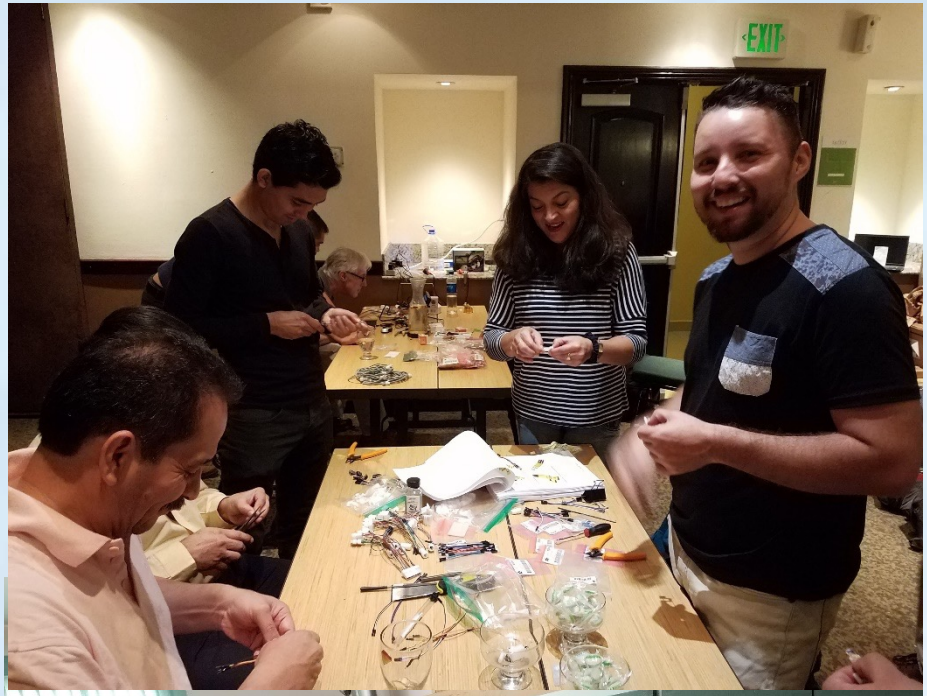
Real-time Access:
- Web-data services (CHORDS)
- Local NMHS's
- GLOBE data services

NSF EarthCube Initiative: CHORDS (**C**loud-**Ho**sted **R**eal-time **D**ata **S**ervices for Geosciences) data-portal



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/

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