

Home Assistant For Indoor Climate Monitoring

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Agenda



- Home Assistant
- MQTT
- InfluxDB
- Grafana
- Climate Sensor v1, then v2
- Humidity
- Radon
- CO2





Previously ...



- Gave a KWLUG Talk (October 2018)
 - “IoT and Microcontrollers”
 - Emphasis on “Cloud Free”
 - ESP32 for microcontrollers
 - MicroPython
- Followup to Tim Laurence’s Excellent Talk
 - April 2024 Talk





ESP32



- WiFi 2.4GHz, and Bluetooth
- Full TCP/IP stack
- RISC CPU Dual/Single Core @ 160/240 MHz
- 520 KB RAM, 4 to 16MB Flash
- GPIO pins
- Modules: NodeMCU32S, Lolin32, ...etc.
- Lua firmware, Arduino IDE, MicroPython





MicroPython



- Python for microcontrollers
- REPL
 - Command prompt
 - Read Evaluate Print Loop
- No compiler needed!
- Runs on ESP32 microcontrollers
- Lots of libraries (MQTT, various sensors)
- Adafruit's ampy to send programs to microcontroller over USB





Home Assistant



- Home Automation platform
- Written in pure Python
- Runs on Linux
 - Raspberry Pi 4 or higher
 - N100 low power Intel
 - Pre-loaded devices (Yellow, Green)
- Docker images, Python venv





Home Assistant



- Written in pure Python
- Installation methods
 - Hassio (custom RaspberryPi distro)
 - Python venv (inside Raspian)
- Integrates to 2,950+ devices/services
- Many are 'cloud' services (which I avoid)





MQTT



- MQ Telemetry Transport
- Message Broker
- Publish and Subscribe paradigm
- Very useful for IoT devices
- Free implementation
 - Server: Mosquitto
 - Clients: Many, e.g. Paho MQTT





Recorder



- Instructs HA to stores sensor data
- Can store it in SQLite or MySQL/MariaDB
- configuration.yaml

```
recorder:
```

```
  db_url: !secret  
  mariadb_conn_str
```

```
  auto_purge: true
```

```
  purge_keep_days: 100
```





InfluxDB



- MySQL/MariaDB are inefficient for queries involving many months or years of sensor data
- InfluxDB solves this
- Time Series DB
- Can keep years of data
- Install via apt from repos.influxdata.com





InfluxDB



- Change certain config values

```
index-version = "tsi1"
```

```
level = "warn" # default is "info"
```

```
flux-log-enabled = false
```

```
access-log-status-filters = ["5xx", "4xx"]
```

```
suppress-write-log = true
```





- In Home Assistant

influxdb:

host: 127.0.0.1

database: ha

max_retries: 3

precision: ms

tags_attributes:

- entity_id
- friendly_name
- device_class





Grafana



- Data visualization platform
- Integrates with InfluxDB
 - (and many other data sources)
- Install .deb from apt.grafana.com





Climate Sensor v1



- BME280 sensor
- Connected to ESP32 (WiFi)
- Phone charger + microUSB cable
- Provides (every minute):
 - Ambient Temperature (Celsius)
 - Relative Humidity (%)
 - Atmospheric Pressure (hPa)





Climate Sensor v1

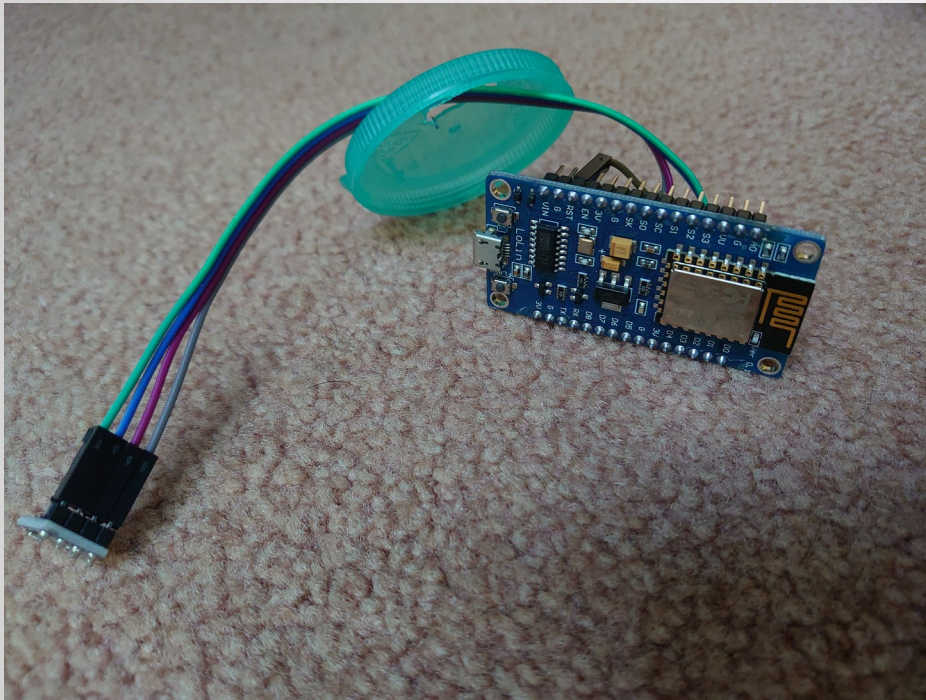


- Programmed in MicroPython
- BME280 library
- Paho MQTT
- Loop forever
 - Read sensor values
 - Format message (JSON in my case)
 - Connect to MQTT server (on RasPi)
 - Send message
 - Sleep for 60 seconds





Climate Sensor v1





Climate



- Dashboard

Current Temperature -- C



Current Humidity -- %





Humidity



- High relative humidity is uncomfortable
- Also bad for certain things
 - Furniture
 - Optics (binoculars, camera lenses, telescopes)
 - Can promote fungal growth
 - Musty, stale air smell
- Fluctuation is also bad (warping, ...)
- Dewpoint (when does vapour condense?)





Humidity - Summer



- Summer problem, specially in basement
- A/C alone can't keep up
- Dehumidifier in summer
 - Set to 45% target humidity
 - Connected to a drain
 - No tray to empty





Humidity - Winter



- Heating, specially with natural gas, causes low humidity
- Itchy skin, dry nose, ...etc.
- Humidifier
 - Centrally connected to furnace
 - But only manual control





Humidity



- Ideally, high no more than 55%
- Low depends on season
 - Dec, Jan, Feb, Mar: 39%
 - Rest of year: 43%
- Outside those ranges, I get alerts
 - (More in a future presentation)

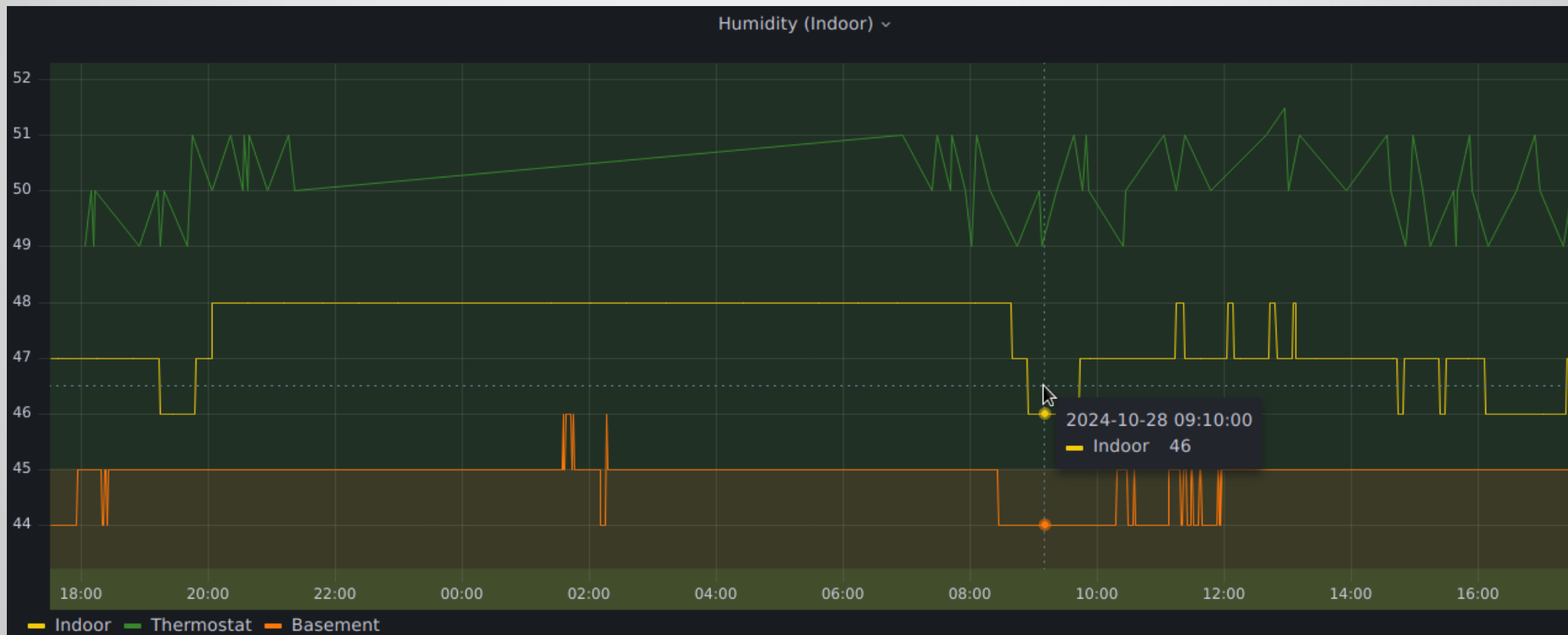




Humidity



- Thermostat, basement, return air





Humidity



- Home Assistant provides alerts when:
 - Below a certain threshold
 - Above a certain threshold
 - Thresholds vary by season





Radon



- Natural radio active gas from earth's crust
- Odorless
- Causes 16% of lung cancer cases
- Seeps into building via foundation cracks, sump pumps, ...
- Seasonal (higher in autumn)
- Low atmospheric pressure “pulls” it from underground





Radon Levels



- Long term readings is what matters
- Limit varies by organization
 - WHO 100 Becquerel / cubic meter
 - USA 150 bq/m³
 - Canada 200 bq/m³
- Sensors resolution is day average





Radon Mitigation



- HRV (Heat Recovery Ventilator)
 - Needs a properly sealed house
 - No chimney vented water heater
 - No fireplaces
 - Therefore, not practical for older houses
- Negative slab pressure
 - Specialized 24/7 fans vented to side of house





Testing for Radon



- Test kits
 - Detector placed in basement for months
 - Then sent to lab
 - Not always accurate (inconclusive)
- AirThings Corentium
 - Standalone sensor with LCD display





Climate Sensor v2



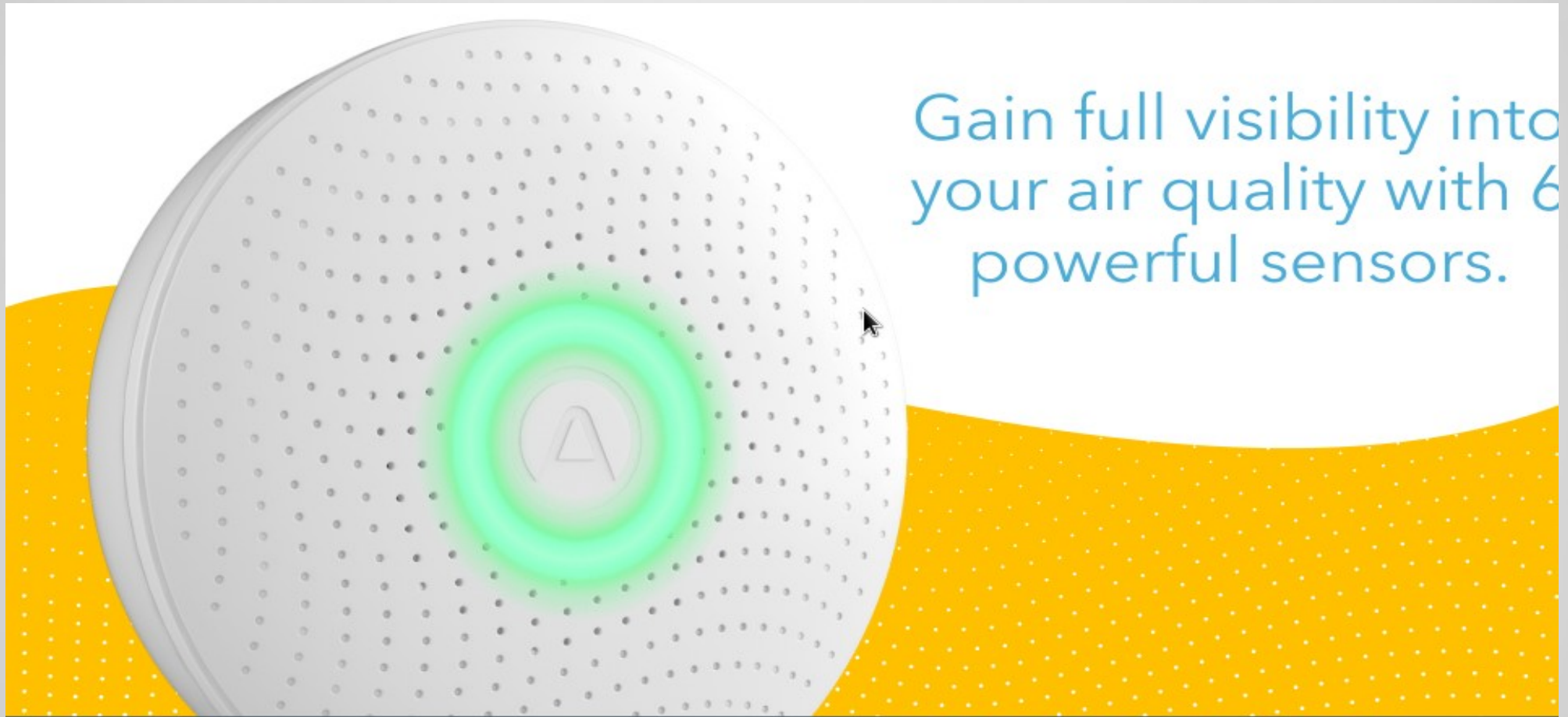
- AirThings Wave Plus
- Only Cloud Free Radon sensor
- Battery operated (2 x AA, lasts ~ 1 year)
- Not cheap, wait for a sale
- Provides (interval configurable):
 - Temp/humidity/pressure
 - Radon (bq/m³)
 - Volatile Organic Compounds (VOCs)
 - Luminance (lux)





Climate Sensor v2

abits



Waveplus



RADON



TVOC



CO₂



HUMIDITY



TEMP



PRESSURE





Integration with HA



- Several ways to integrate with HA
 - Cloud account at AirThings (!!!)
 - Bluetooth Low Energy (BLE)
- Chose an MQTT to BLE gateway
 - `https://github.com/mjmccans/airthings-mqtt-ha`
- Written in Python
- Requires paho-mqtt and bleak
- Needs a systemd unit file, so that gateway starts on boot

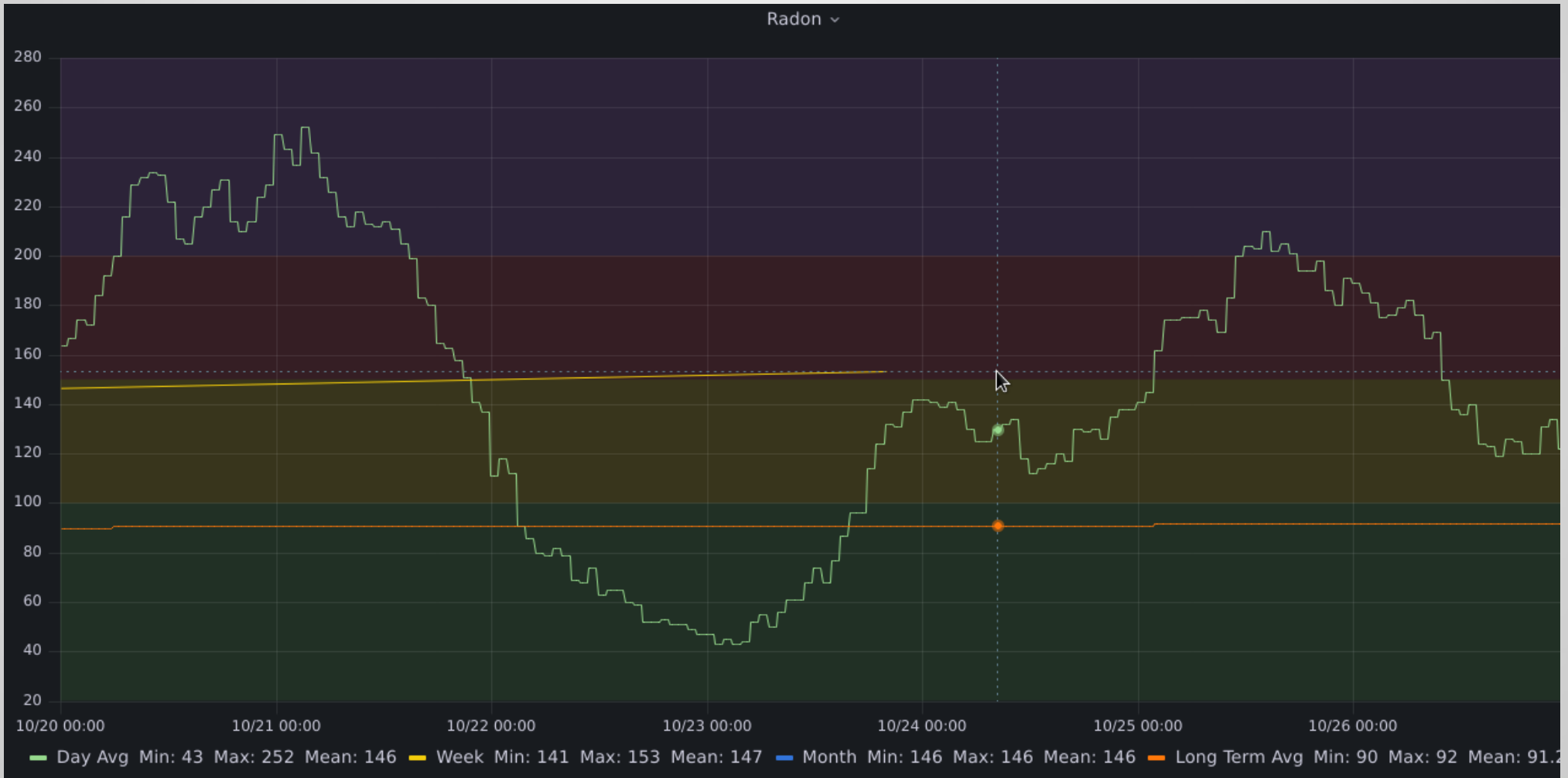




Radon



- Long term is what matters





VOCs



- Volatile Organic Compounds
- Occasionally get high, but subside on their own
- Related to cooking
- Some cosmetics/perfumes
- Not a concern in my case, long term





CO2



- Depends on:
 - How many people are in the house
 - Air circulation in the house
- Ultimate solution is an HRV
 - Not practical for older leaky houses
- High levels can make one sleepy

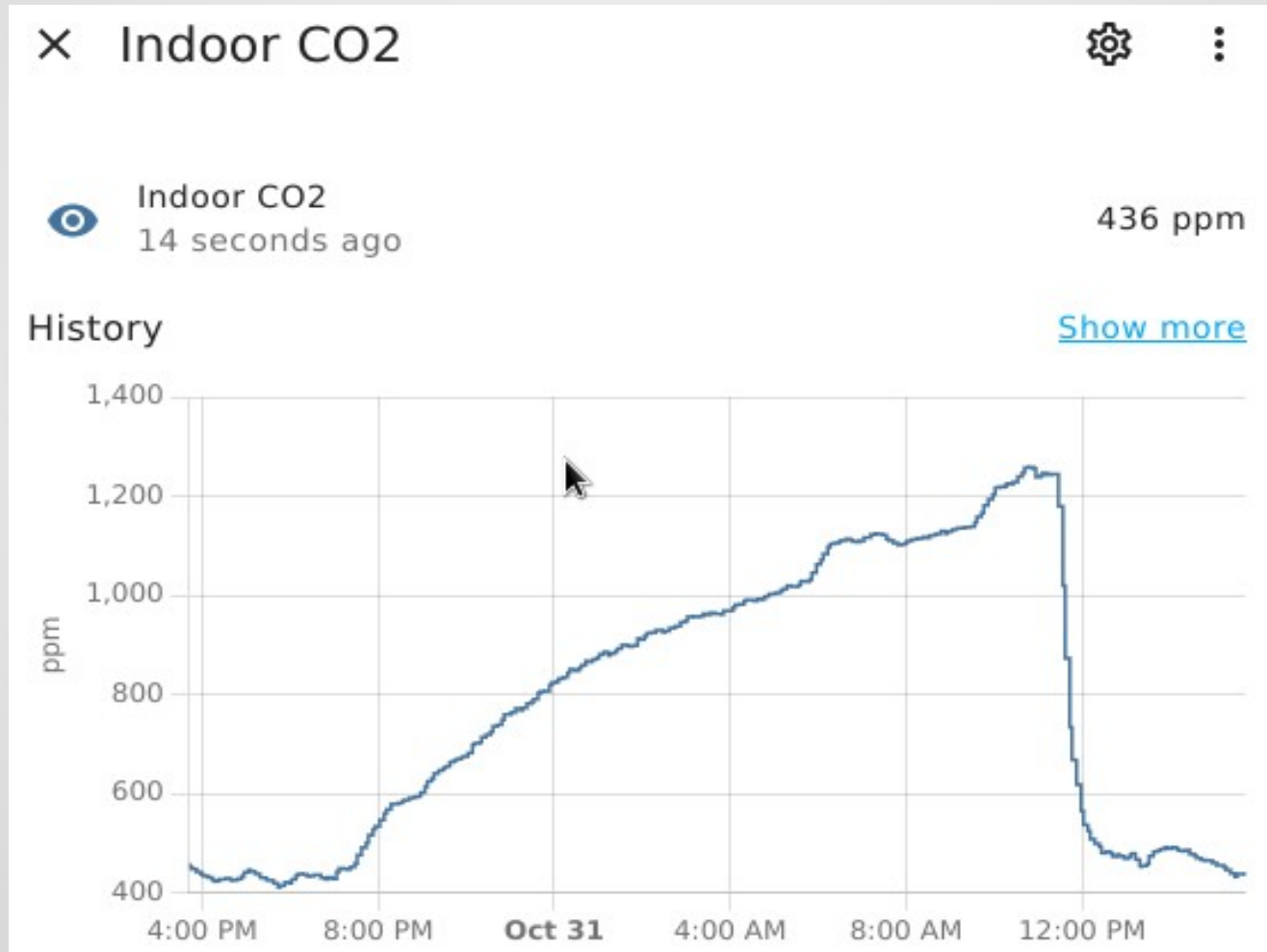




CO2



- From HA: window open

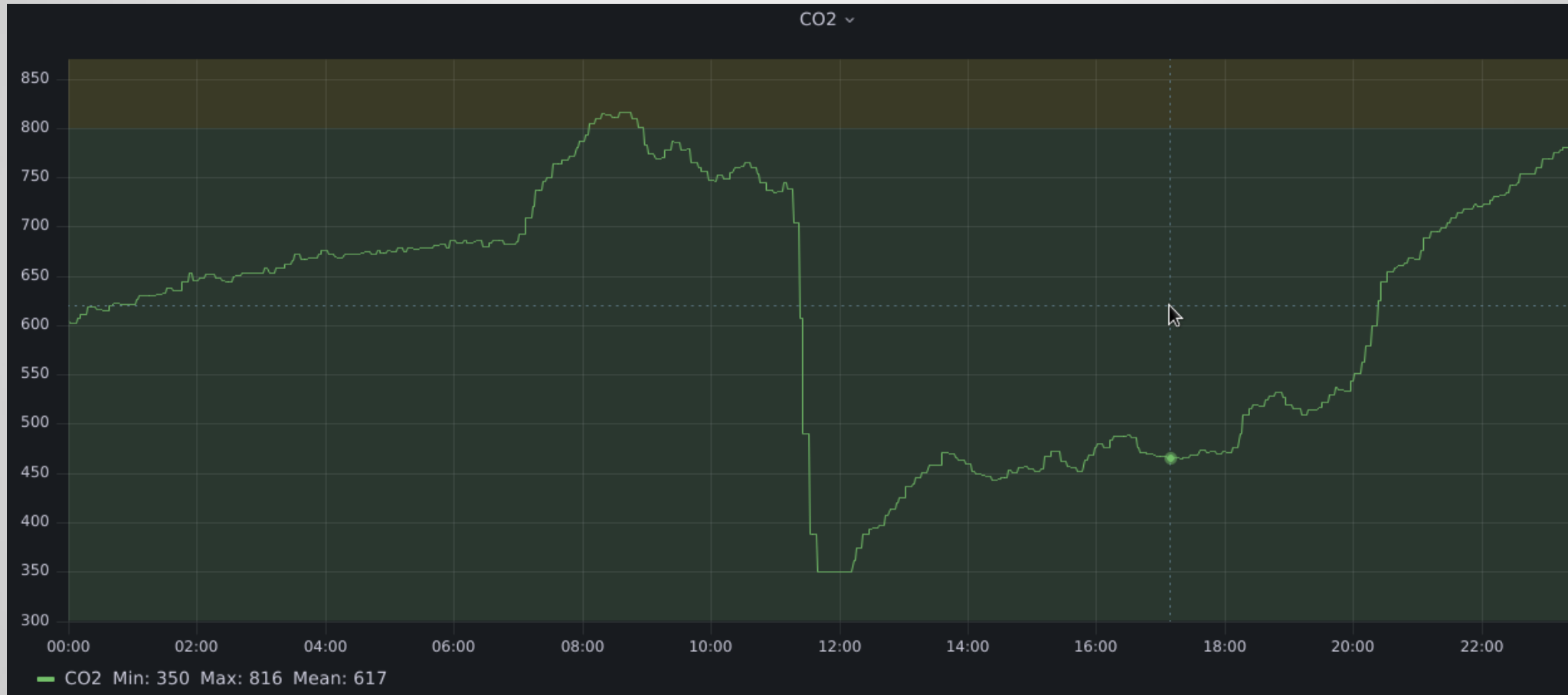




CO2



- When windows opened

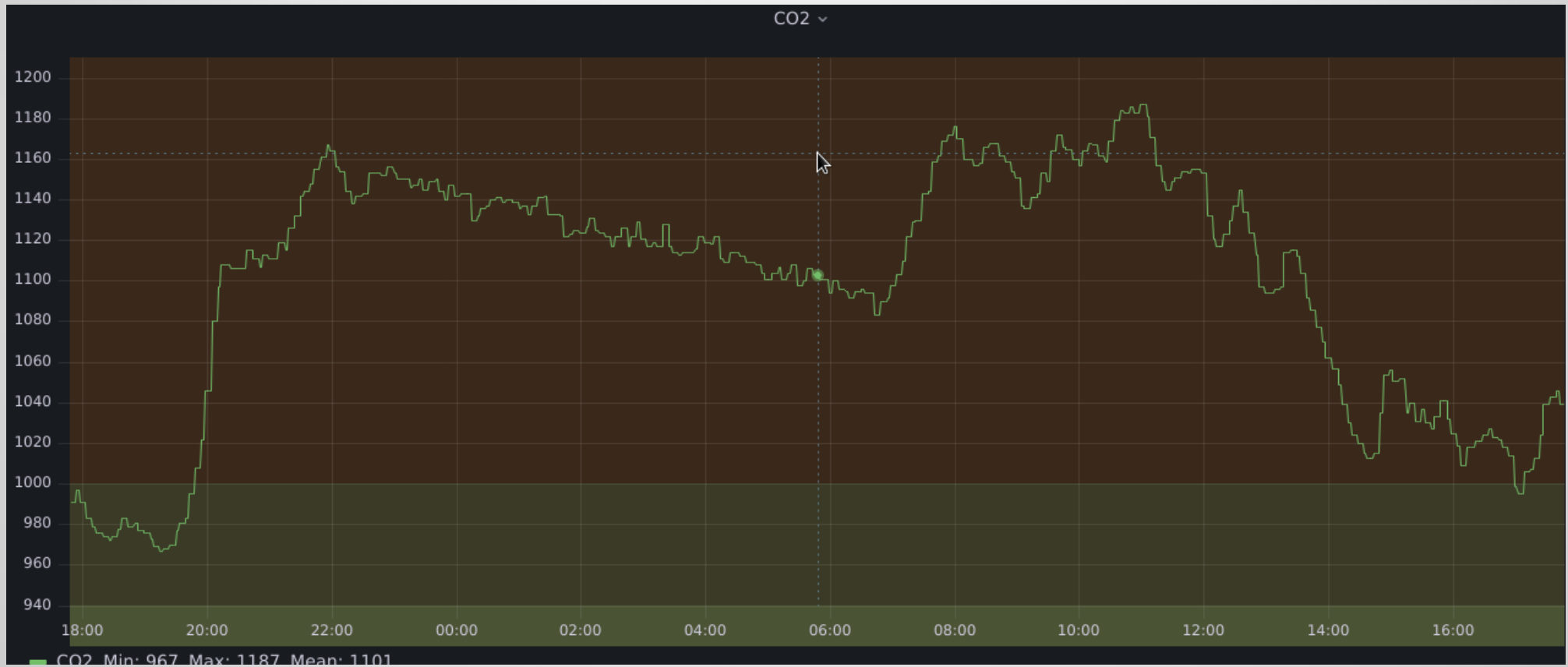




CO2

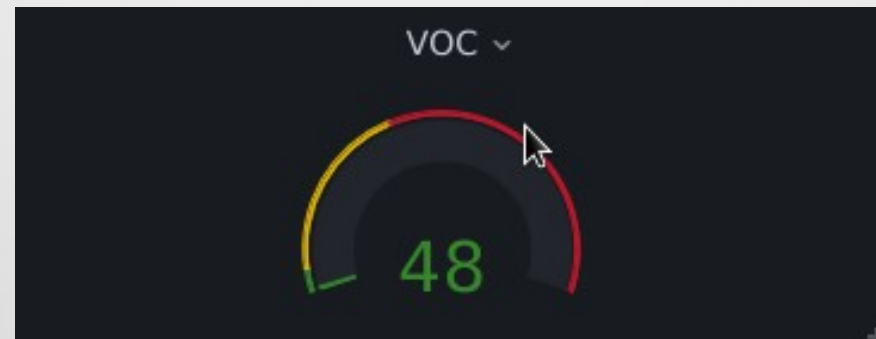


- When windows closed





Another Dashboard

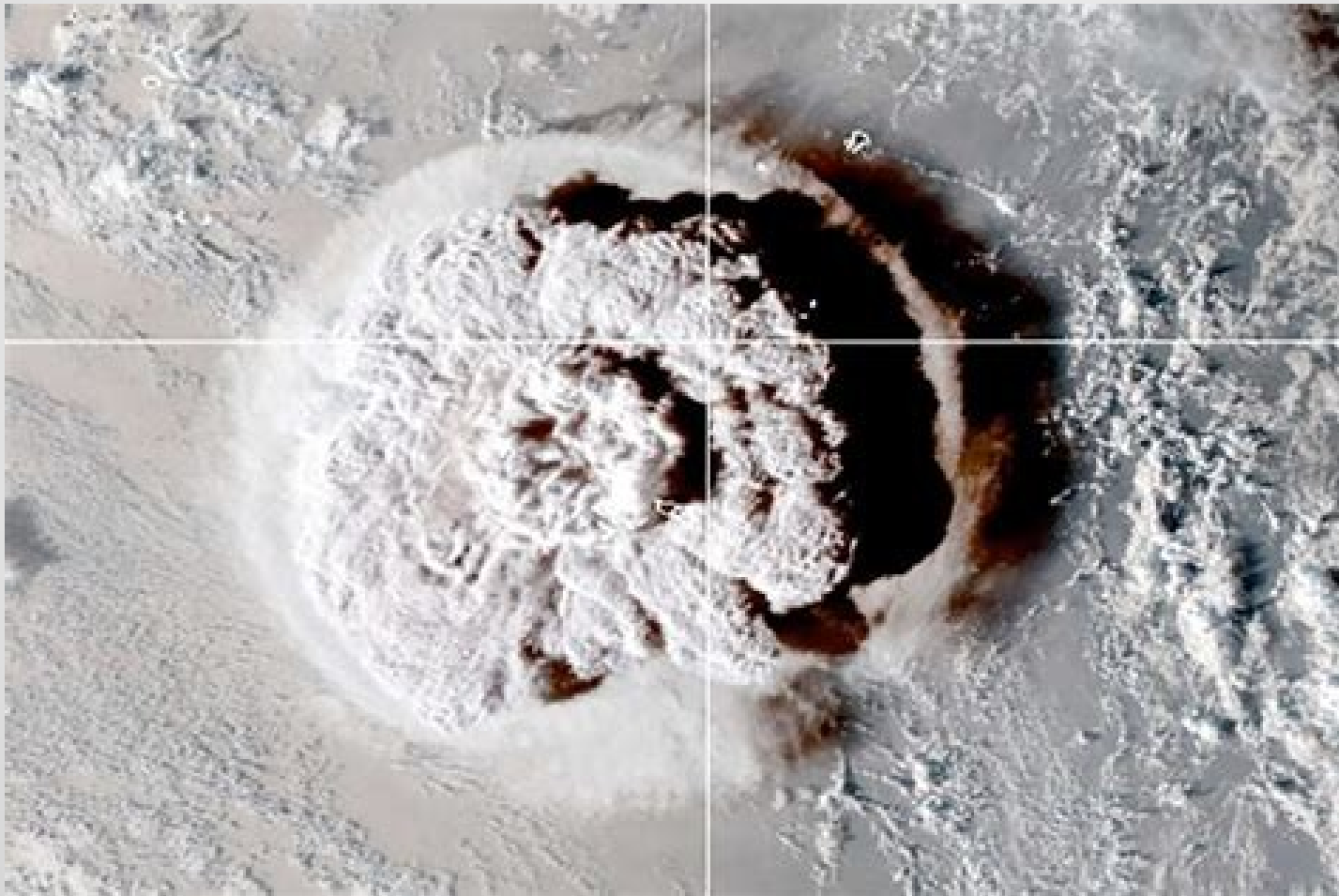




Pressure



- Hunga Tonga eruption 16 Jan 2022





Pressure



- Hunga Tonga 16 Jan 2022, pressure wave
- On BME280 sensor





Future?



- PM2.5
 - Ready made sensor
 - Cloud free
- ESPHome instead of MicroPython
 - Garage Door Sensor
- Zigbee devices
 - Mesh protocol





More To Come ...



One or Two More Presentations?





Conclusion



Questions?

Comments?

