LCS Applications: A Case for More Focused Quality Assurance

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A brief history of sensors

Source: PublicLab

LCS networks across the world

- Sensors.Africa – citizen science, mostly W and E Africa
- Luftdaten
- AfriqAir
- AirQo
- Purple Air
- UNEP/others & Clarity
- Breathe London/Accra/Warsaw

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Major Applications and Different QA Needs

- Health
- Regulatory
- Modelling
- Forecasting
- Climate
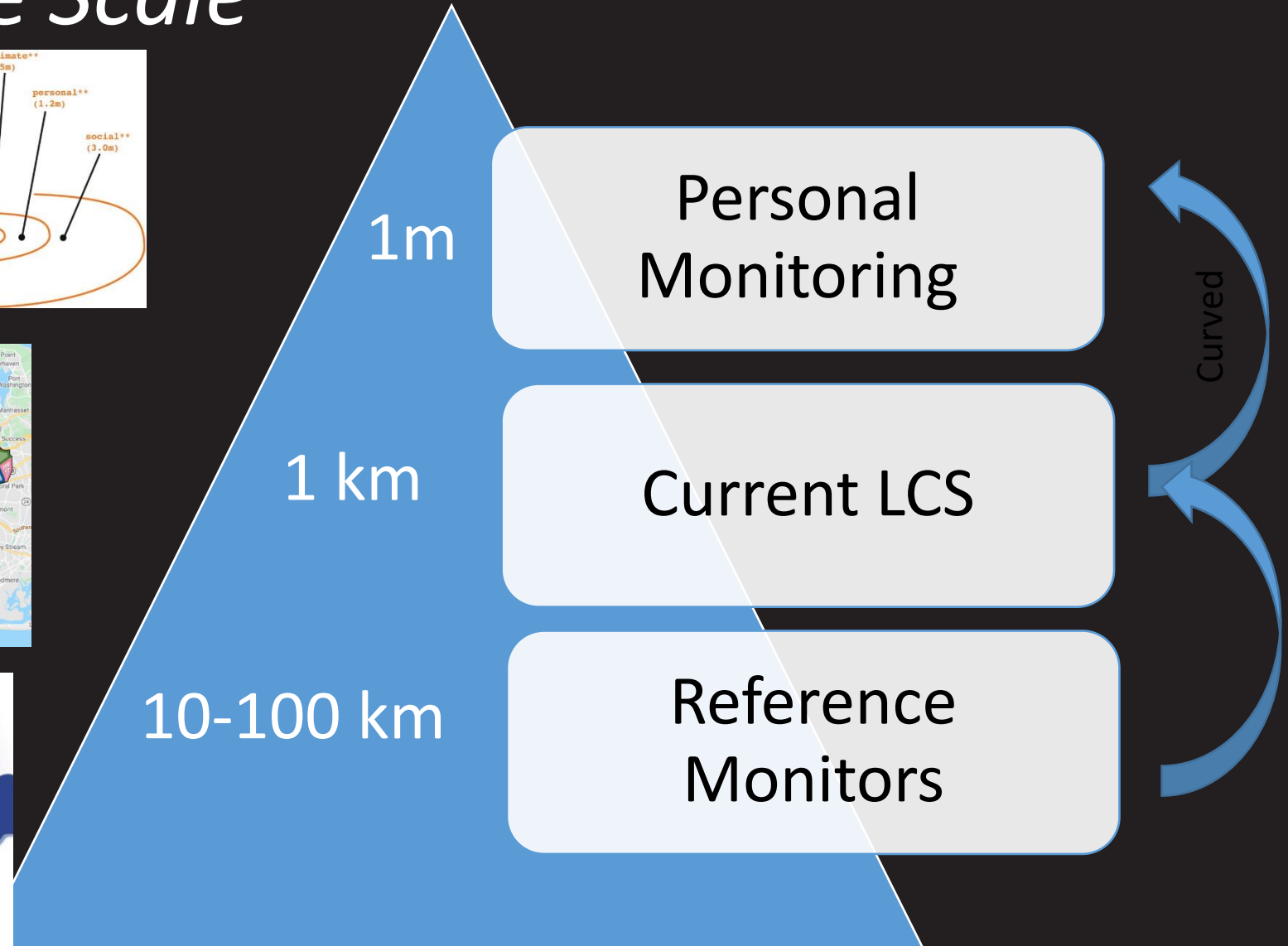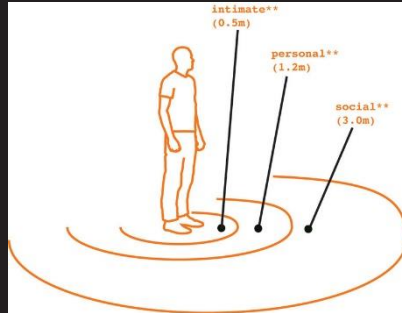- Citizen Science/Education
- Metadata intelligence

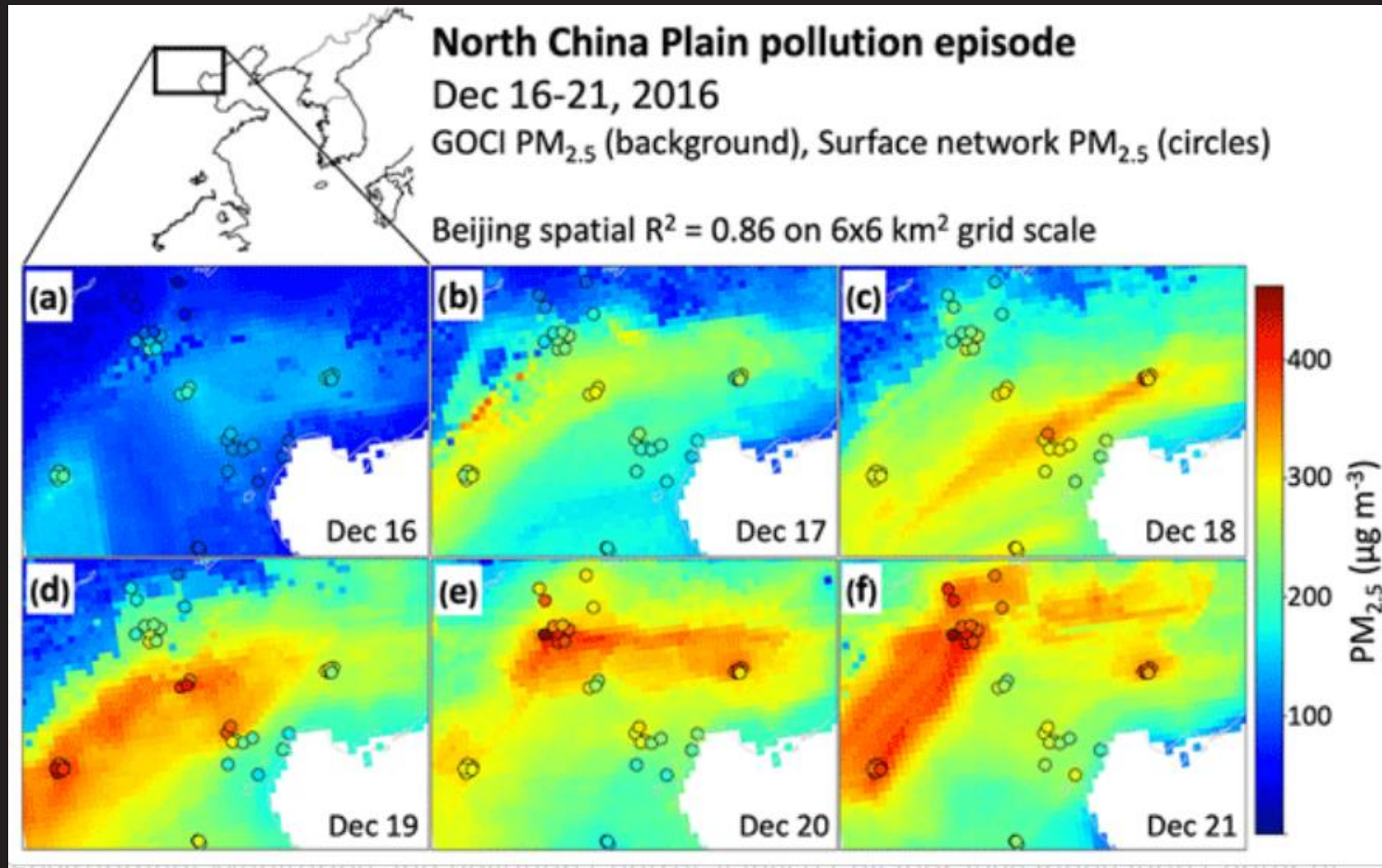# World Meteorological Organization Perspective
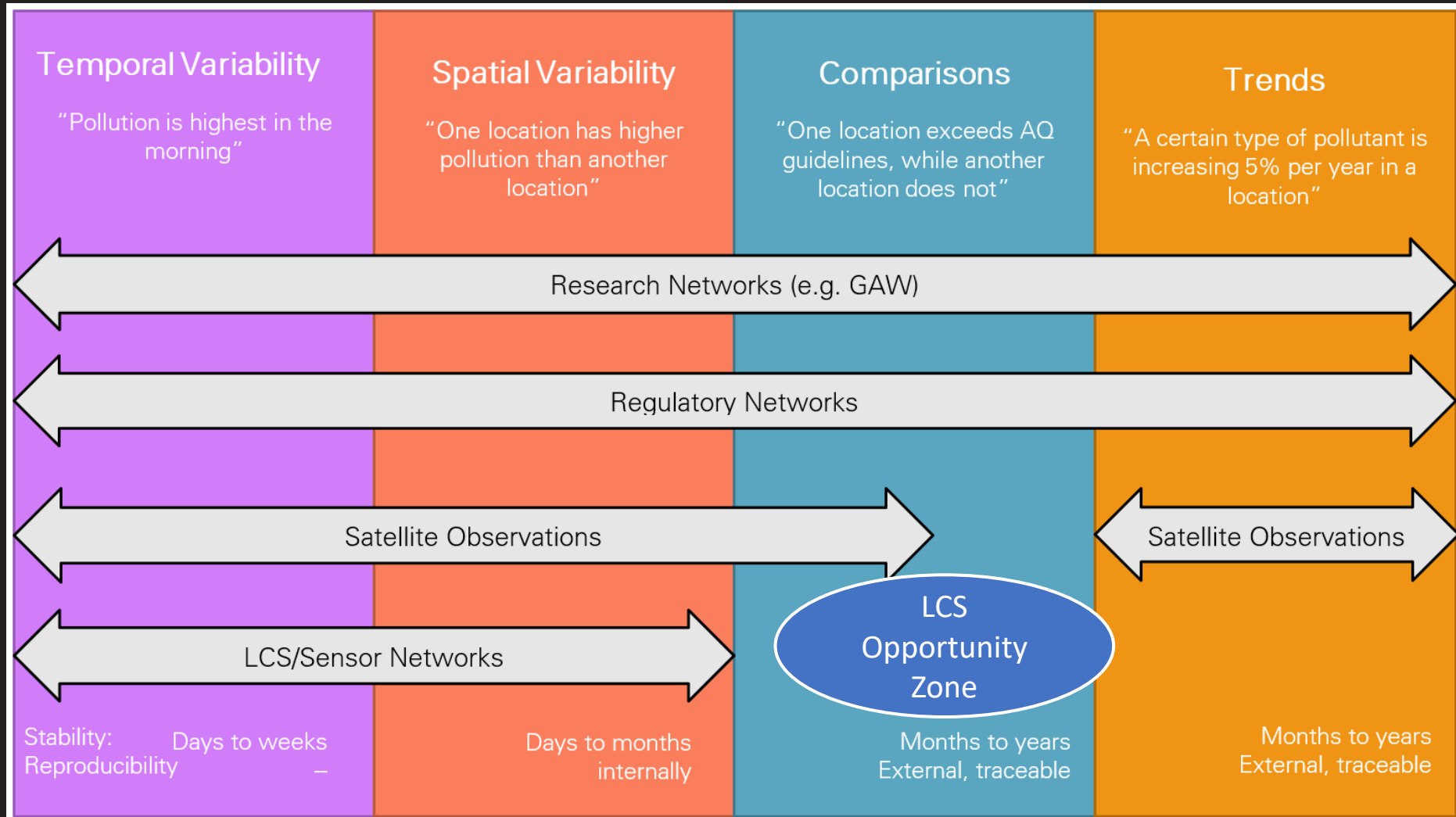
Questions must drive what QA is required

- LCS application driven by question(s) which vary in spatiotemporal variability, averaging time, density, and/or precision and accuracy requirements.
  - Is the purpose regulatory, research, educational, or just descriptive?
- Generally speaking, users of LCS can be myopic to their discipline; manufacturers generally interested in one-size-fits-most approach.
- "Black box" sensors/data should warrant caution since measurement provenance unclear.
- Regulatory and health applications require higher levels of QA; others may require less.

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LCS to Improve *Scale*

1m — Personal Monitoring

1 km — Current LCS

10-100 km — Reference Monitors

Curved

LCS and *Satellites*

North China Plain pollution episode
Dec 16-21, 2016
GOCI PM$_{2.5}$ (background), Surface network PM$_{2.5}$ (circles)

Beijing spatial R^2 = 0.86 on 6x6 km^2 grid scale

(a) Dec 16 (b) Dec 17 (c) Dec 18 (d) Dec 19 (e) Dec 20 (f) Dec 21

PM$_{2.5}$ (µg m^{-3})

Pendergrass, et al 2022, AMT

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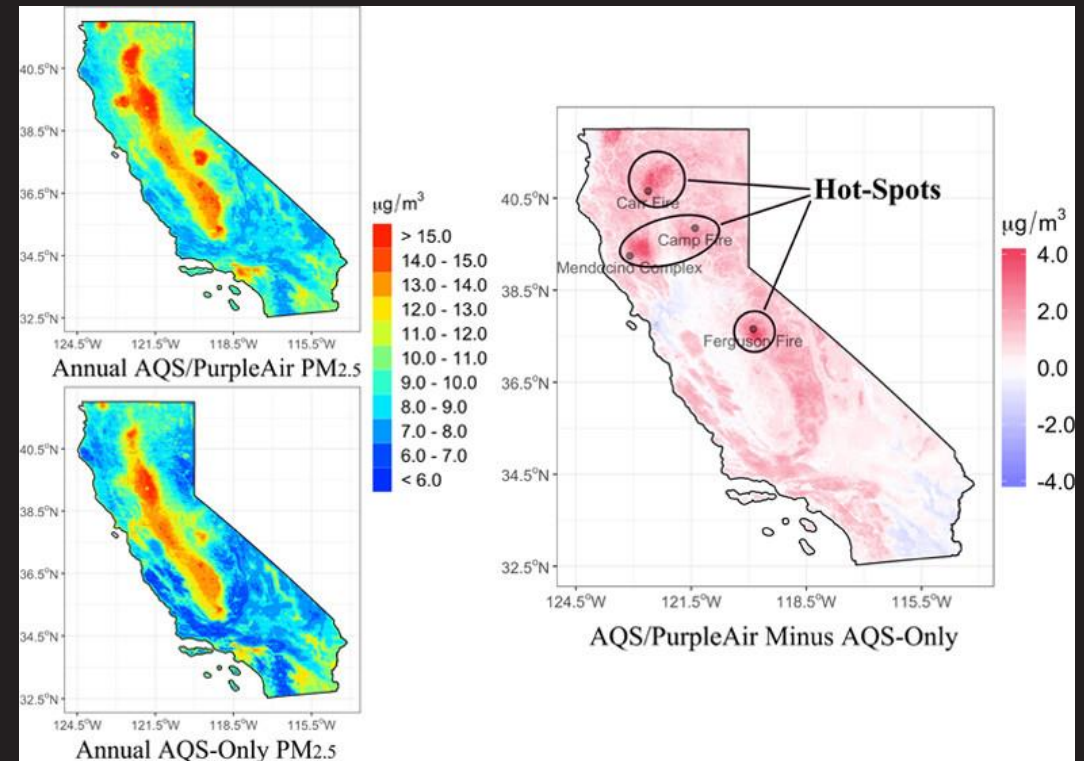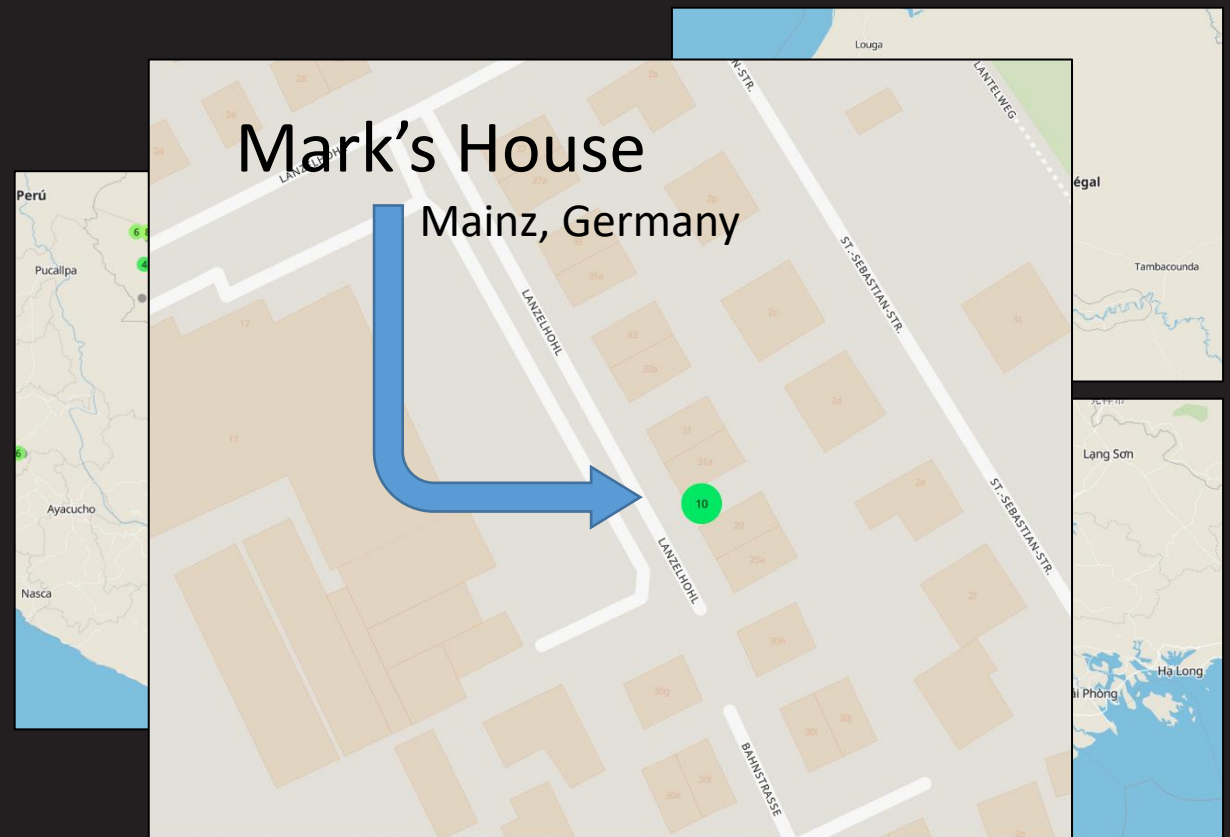
Forecasting and Model Refinement

- QA requirements of LCS data for forecasting and models (e.g. CTM) still undefined.

- Not yet a one-measurement-fits-all solution

- Despite inherent LCS measurement uncertainty, results often on par with model uncertainties.

Environ. Sci. Technol. 2020, 54, 4, 2152-2162

LCS successes (not a QA issue, but be careful of ethics)

- Purple Air, Clarity, Acclima, Aircube, CityLab, Luftdaten, Village Green, CairClip, and on and on…

From Purple Air, 26 June 2023

Mark's House
Mainz, Germany

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Conclusions

- LCS hold promise to answer challenging questions, but only if they report data that is statistically meaningful.

- Applications are varied, and require similarly varied quality assurance.

- Sensors need not be absolutely certain. But we must be absolute about their uncertainty.

Acknowledgements

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QR Code to WMO
report 1215