

Application of AQ sensors in low & middle income countries

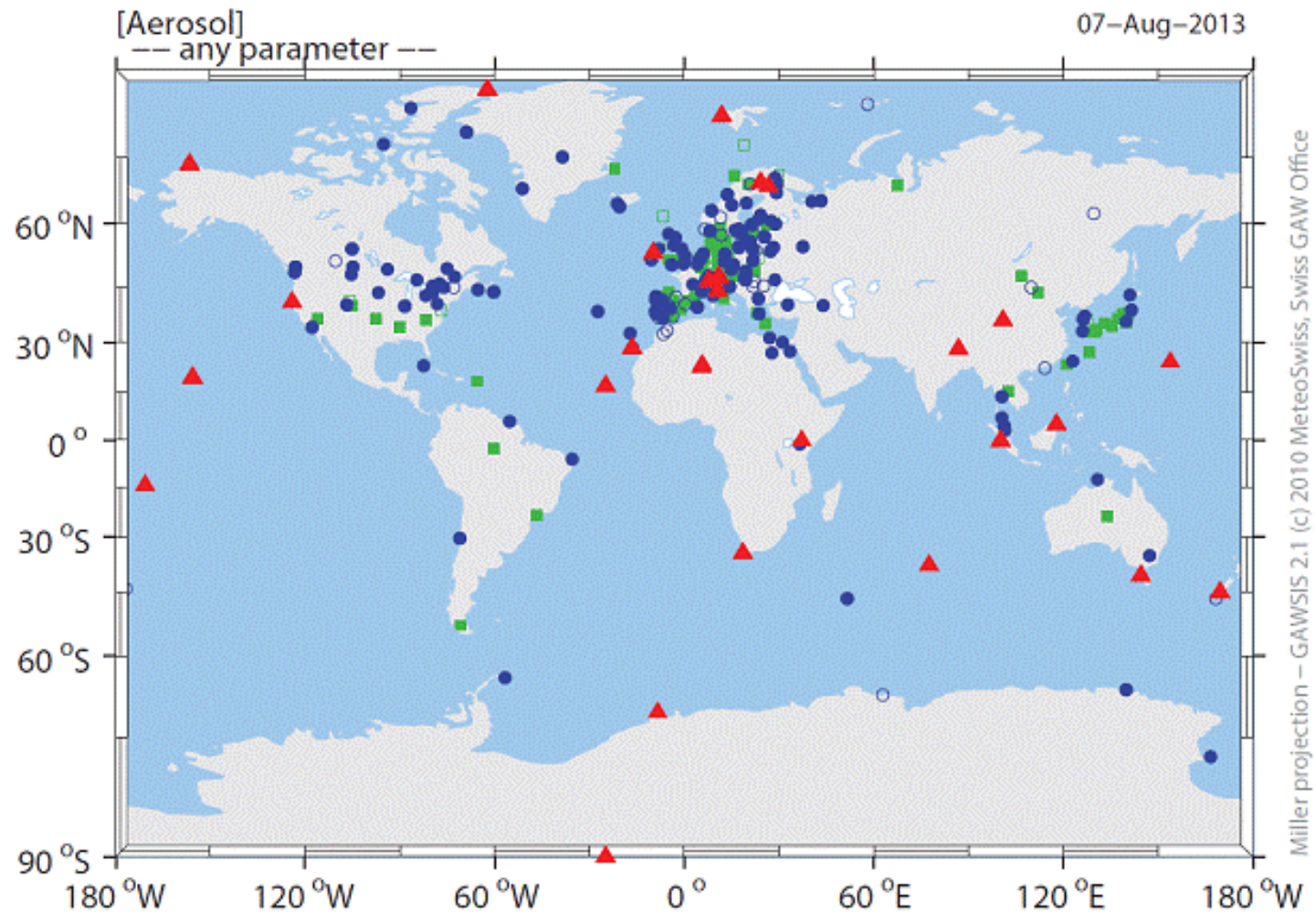
1st Air Sensors International Conference
Oakland CA, 12-14 September 2018

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Outline

- **Rationale**
- **Sensors 101 – our journey**
 - **Open Source sensor**
 - **Demonstrating utility in/to LMICs**
 - **Connecting public and policy**
- **Network management thingy**
- **Lessons learned**

Rationale –



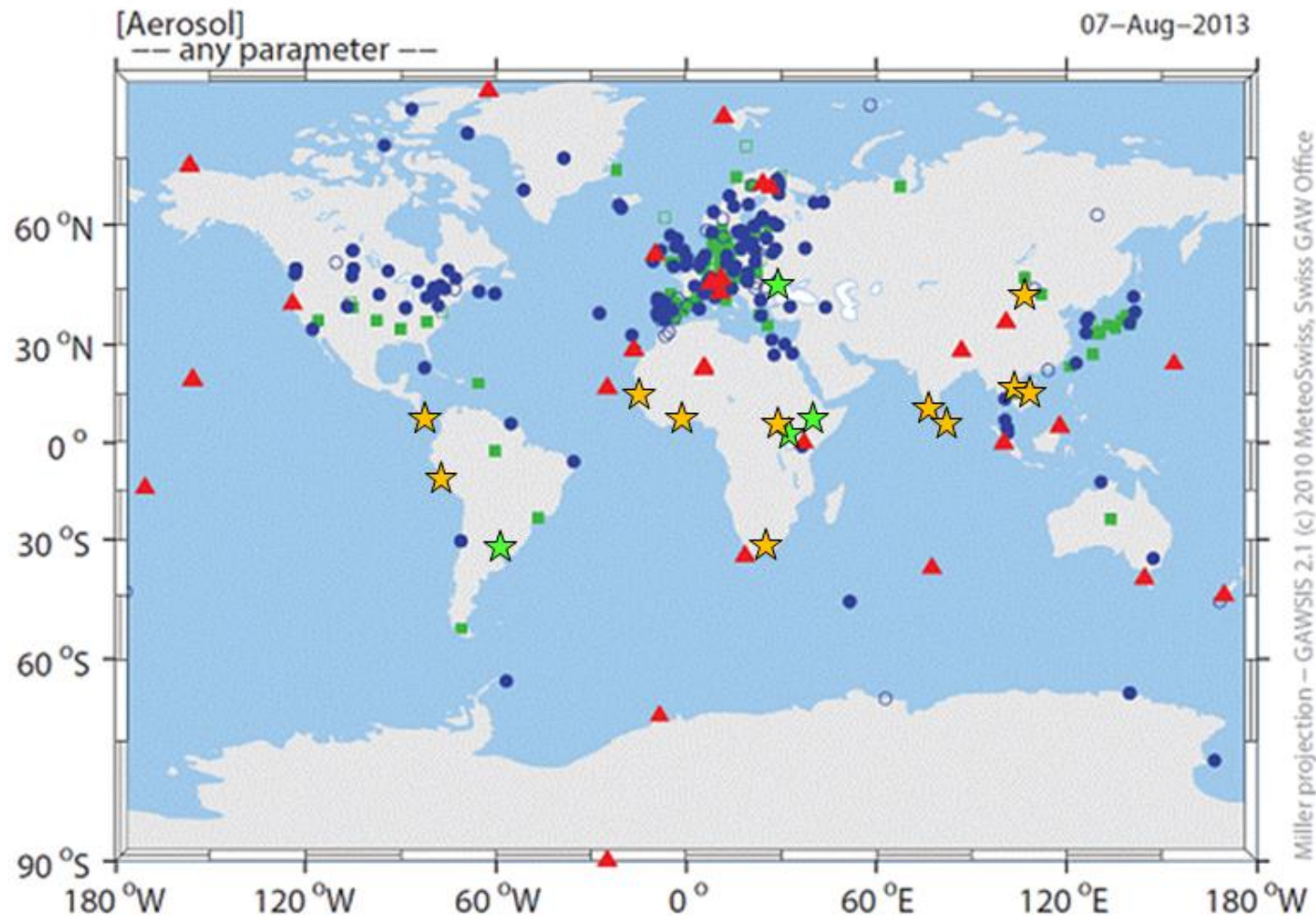
Miller projection – GAW/SIS 2.1 (c) 2010 MeteoSwiss, Swiss GAW Office



- ▲ GAW Global Station
- GAW Regional Station
- Contributing Station
- Open symbols denote closed or inactive stations.



Rationale –



★ Deployment in progress

★ Planned deployments 2018/19



▲ GAW Global Station

● GAW Regional Station

■ Contributing Station

Open symbols denote closed or inactive stations.



Sensor based monitoring - 101

- Not a replacement for regulatory grade, reference monitors
- Quality assurance is critical (as with any data collection)
- Easy to deploy – sensor is the lesser of challenges faced



NO, SO₂, PM2.5,10
2014/15



4-5 gases* + PM2.5,10
2016



~ shoe box size
2017

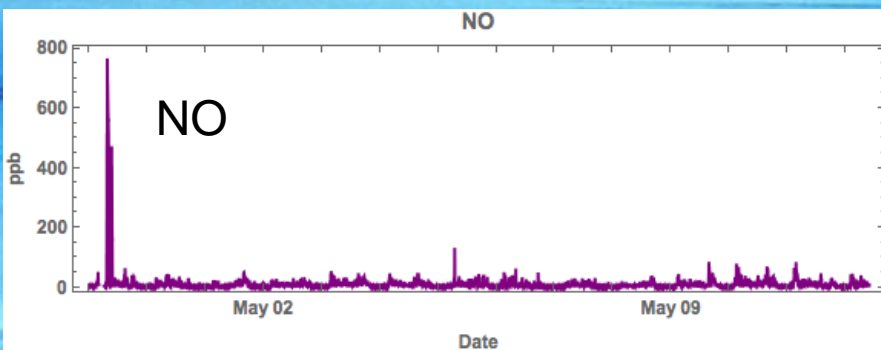
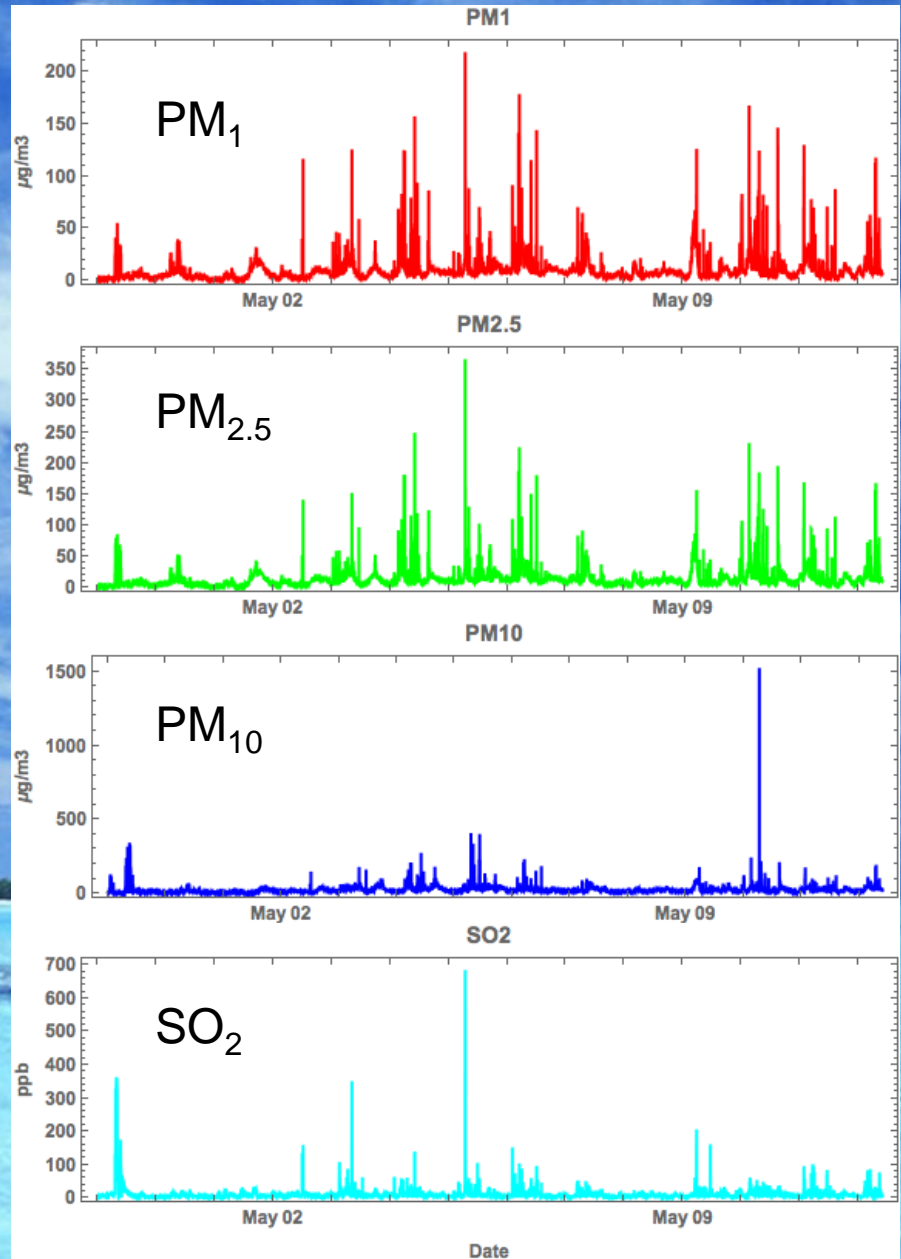
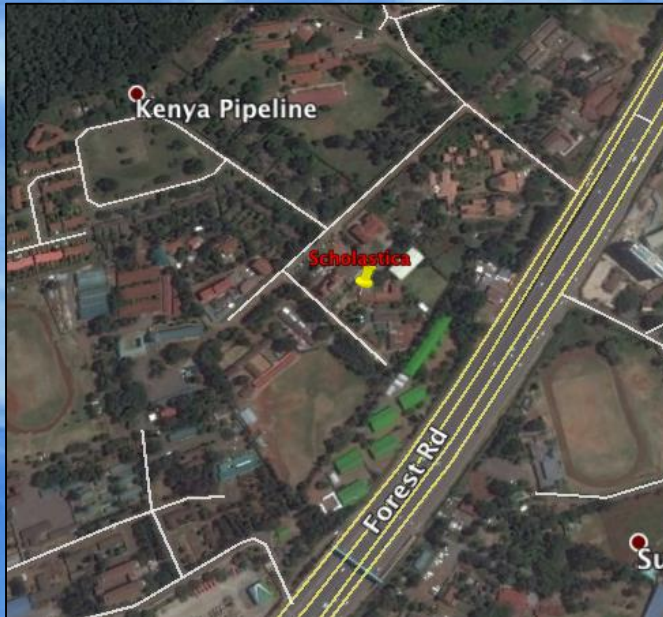
*NDIR (CO₂), VOCs

Nairobi case study April 2016

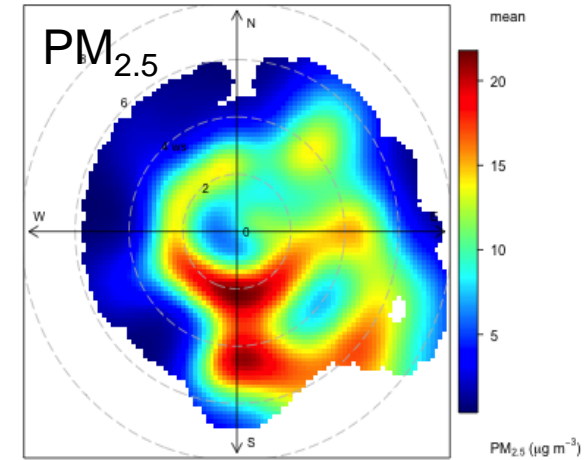
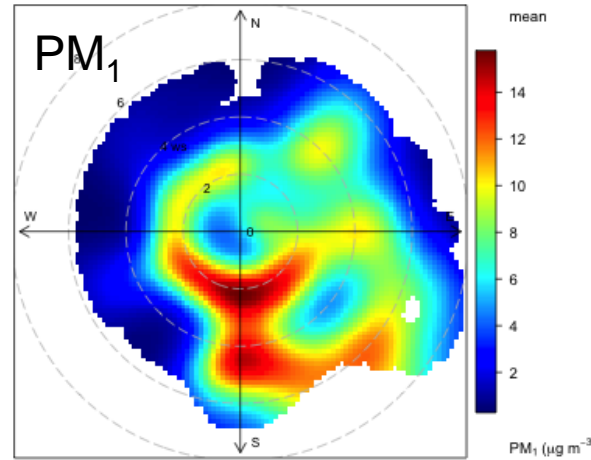
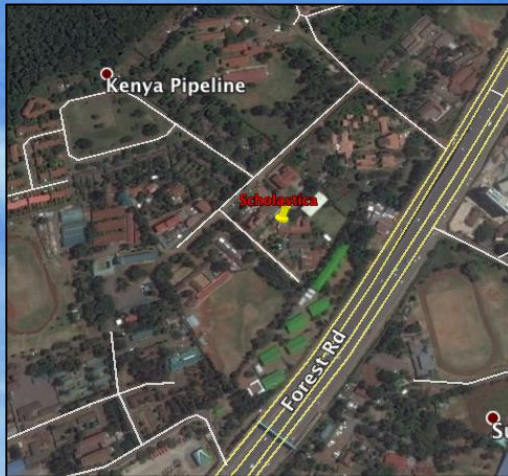


NO, NO₂, SO₂, PM₁, PM_{2.5}, PM₁₀

Sample results

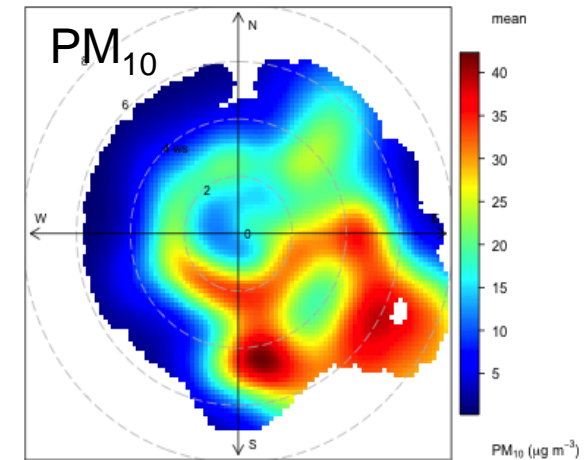
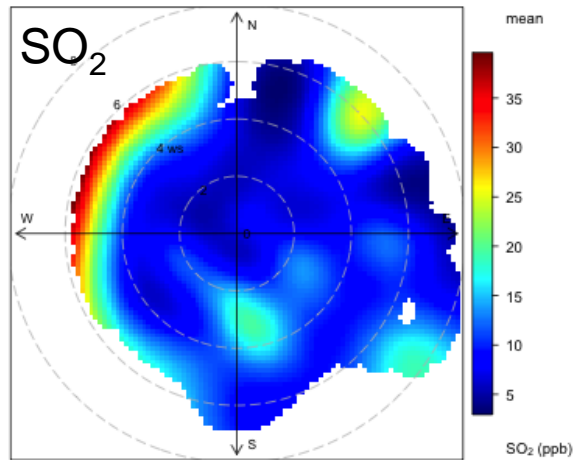


Sample results

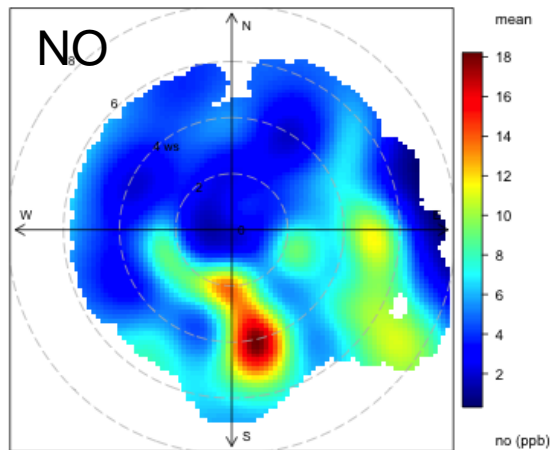


SO₂_(Scholastica)

PM₁₀_(Scholastica)

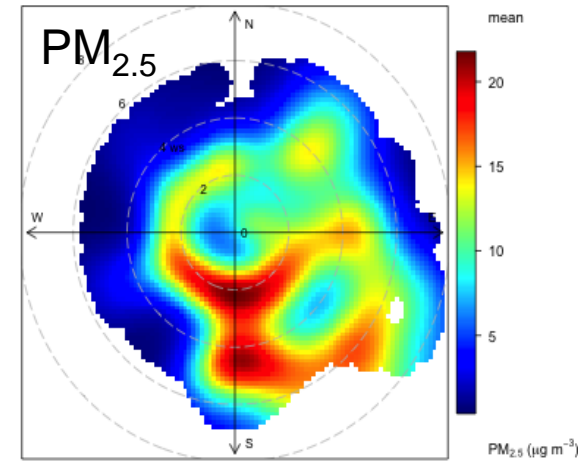
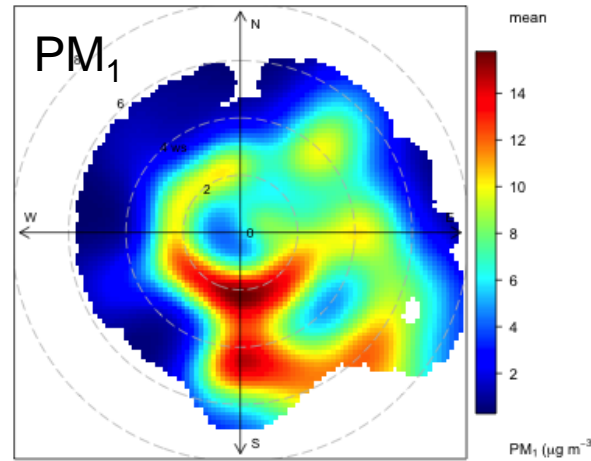
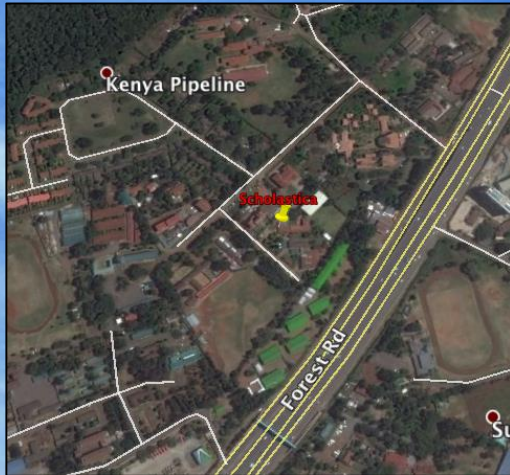


NO_(Scholastica)



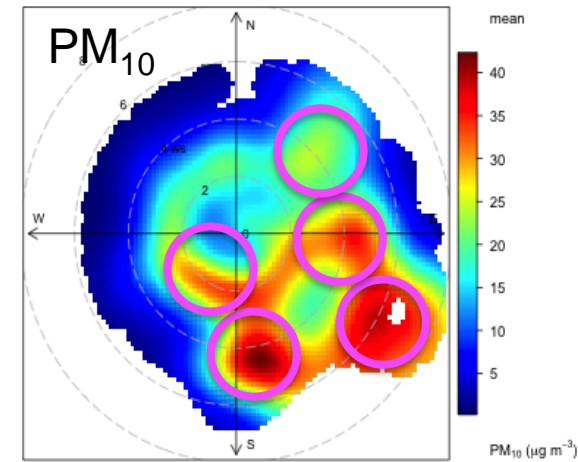
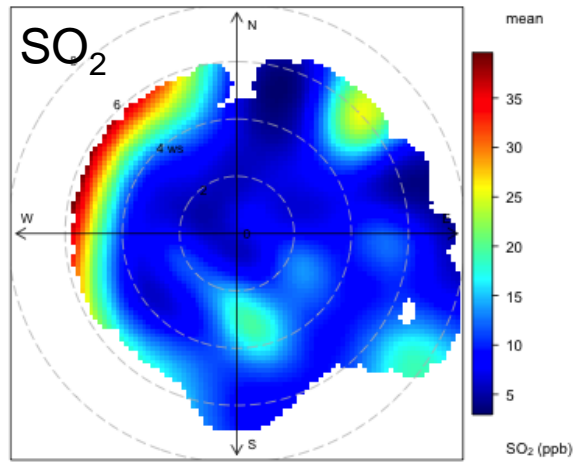
- Multiple sources
- Multiple *common* sources
- Road signatures in PM, NO, SO₂

Sample results

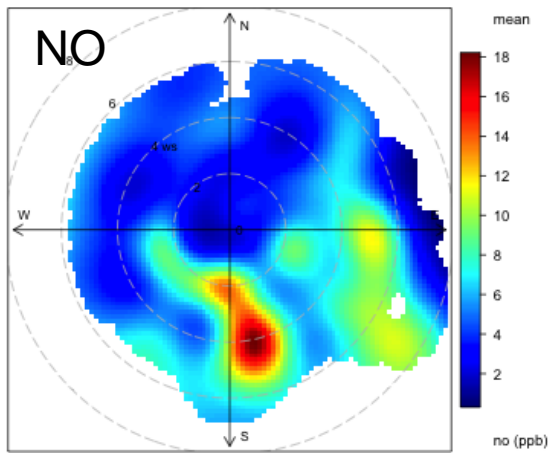


SO₂ (Scholastica)

PM₁₀ (Scholastica)

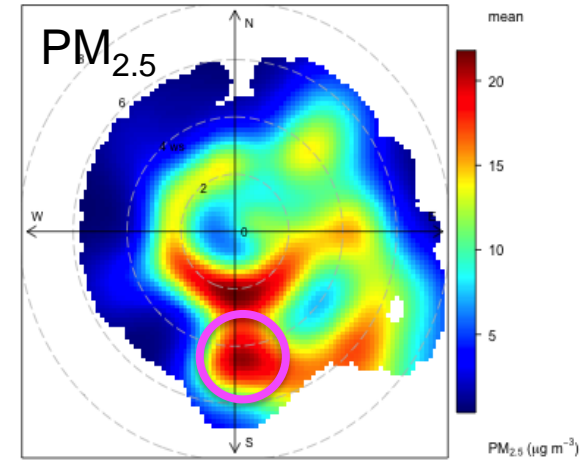
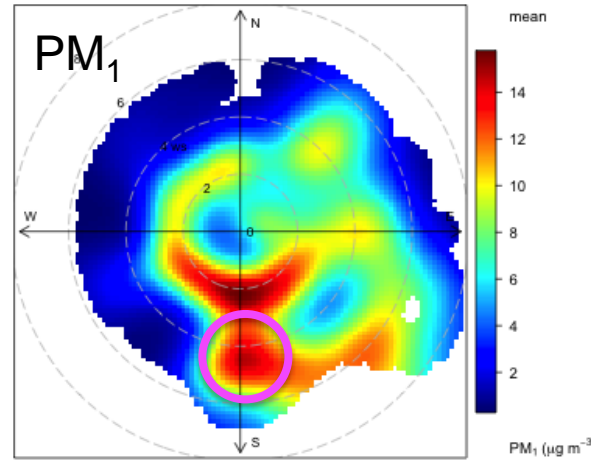
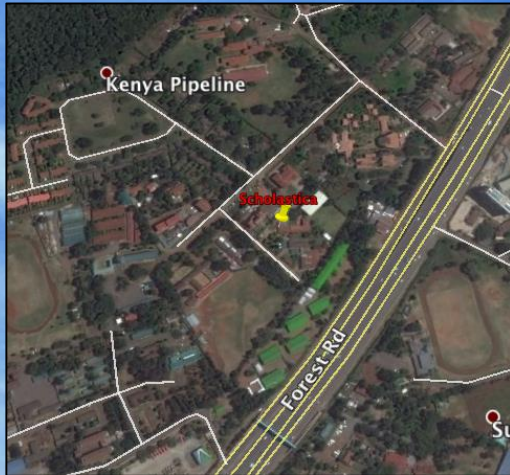


NO (Scholastica)



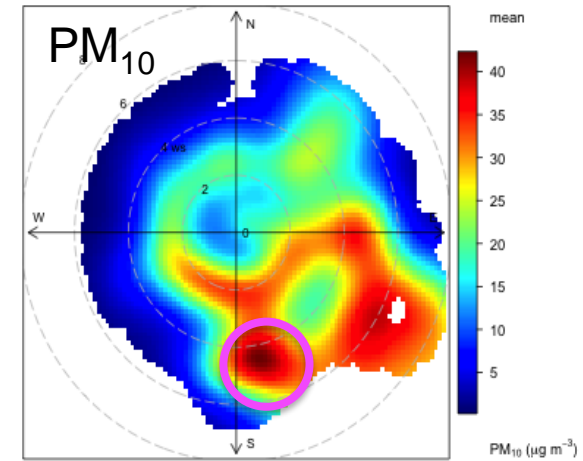
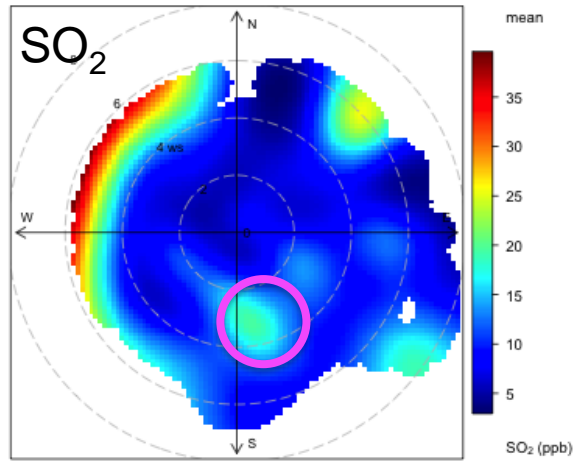
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Sample results

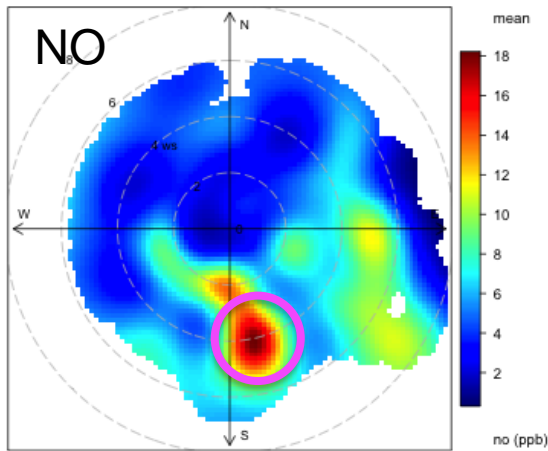


SO₂_(Scholastica)

PM₁₀_(Scholastica)

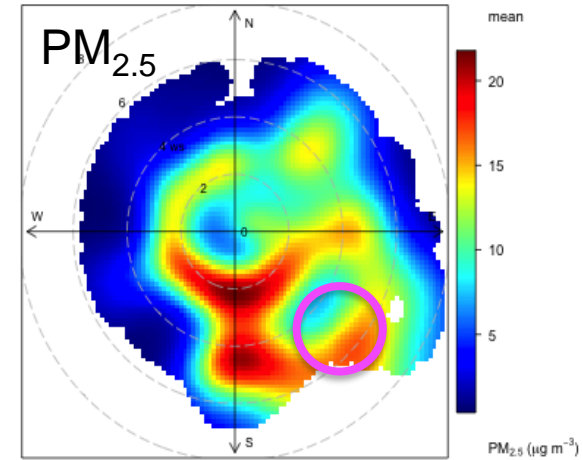
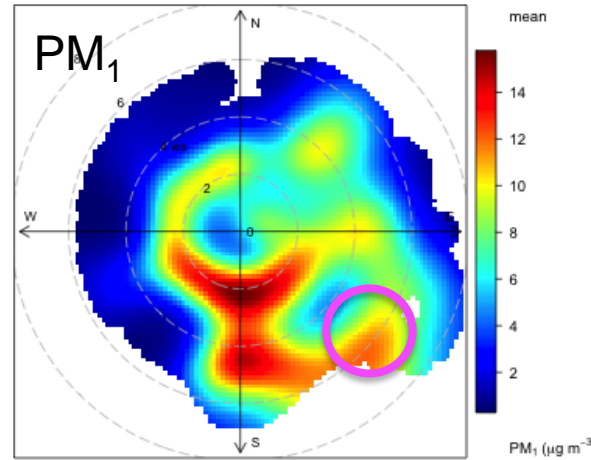
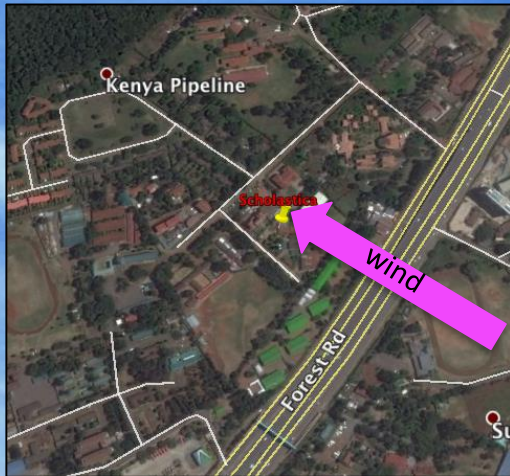


NO_(Scholastica)



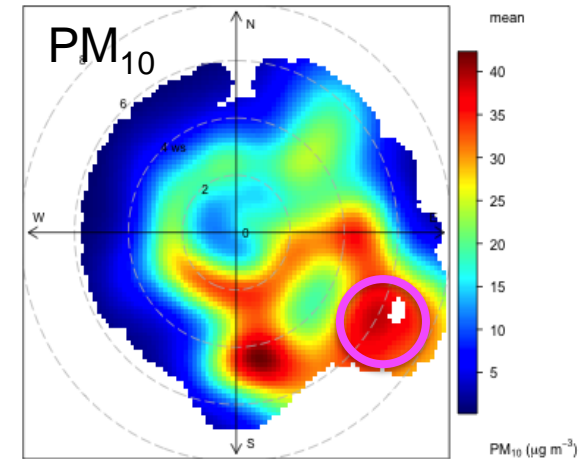
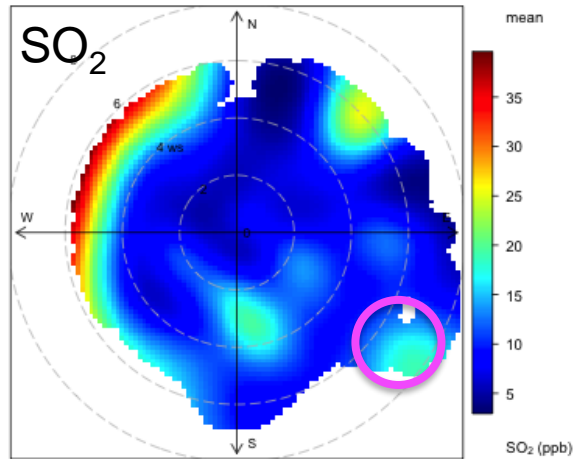
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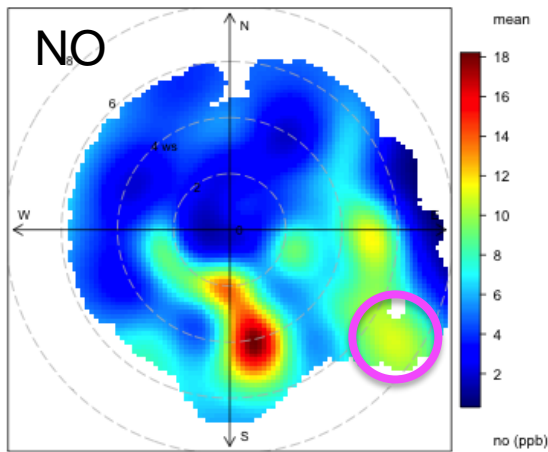


SO₂_(Scholastica)

PM₁₀_(Scholastica)

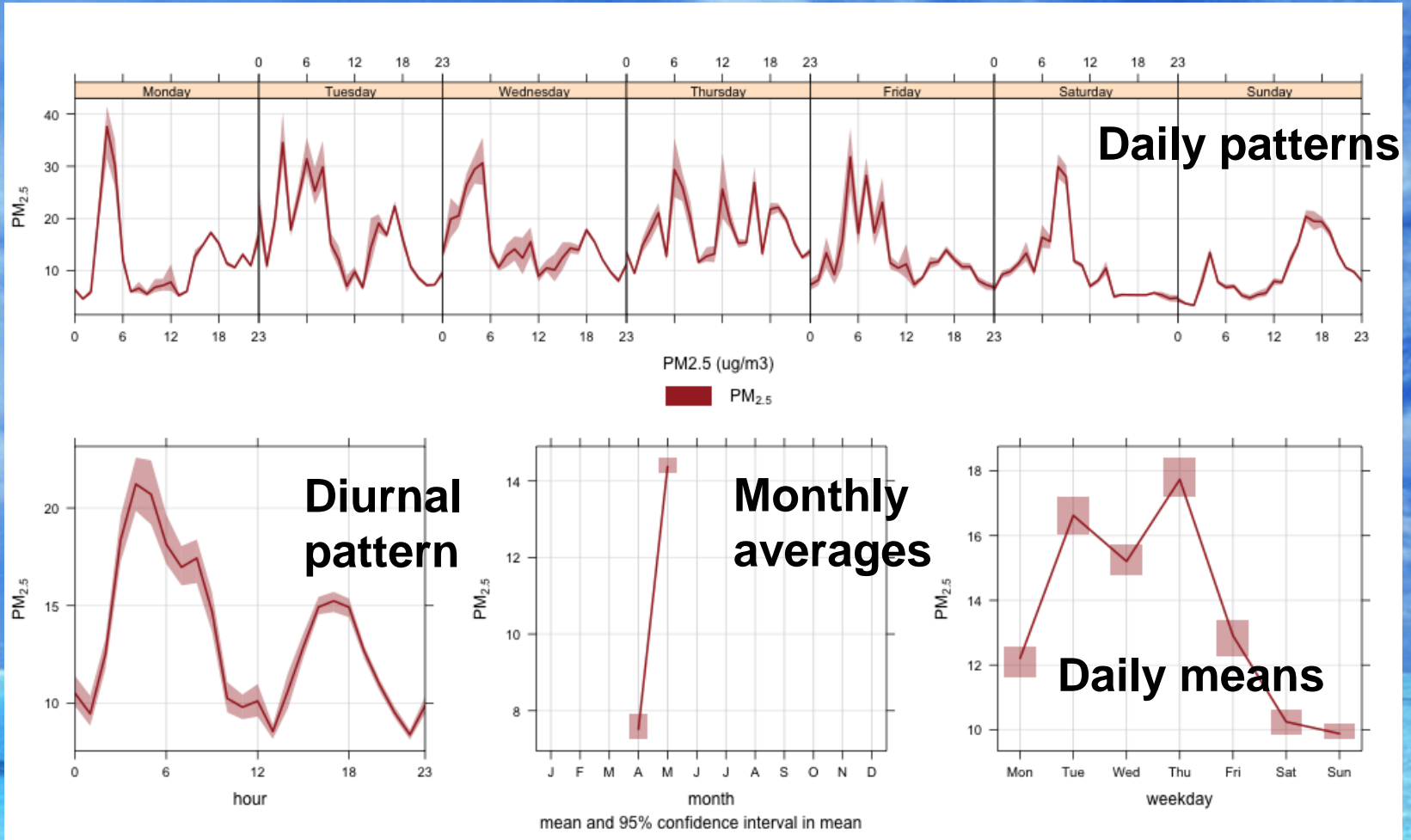


NO_(Scholastica)



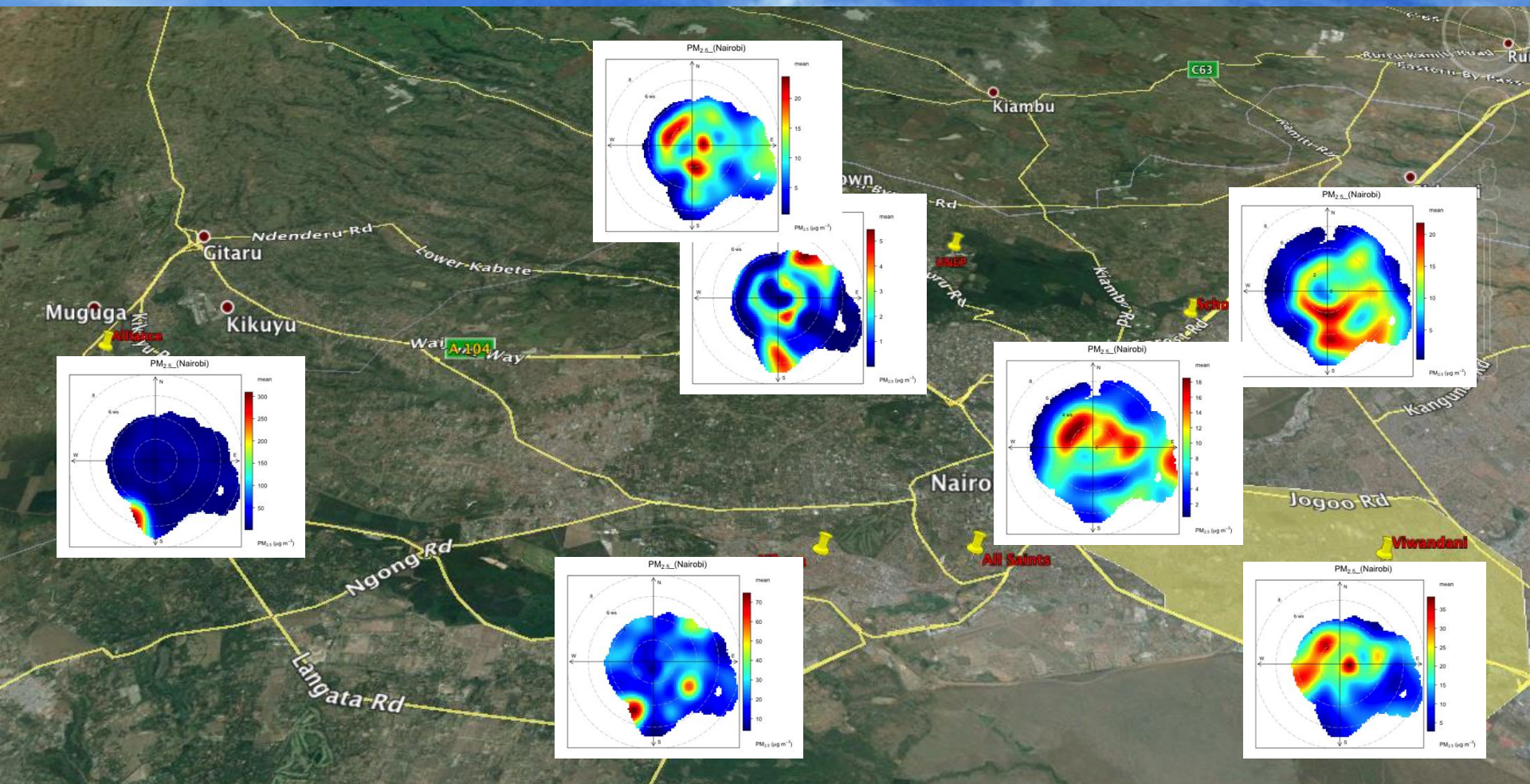
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Sample results



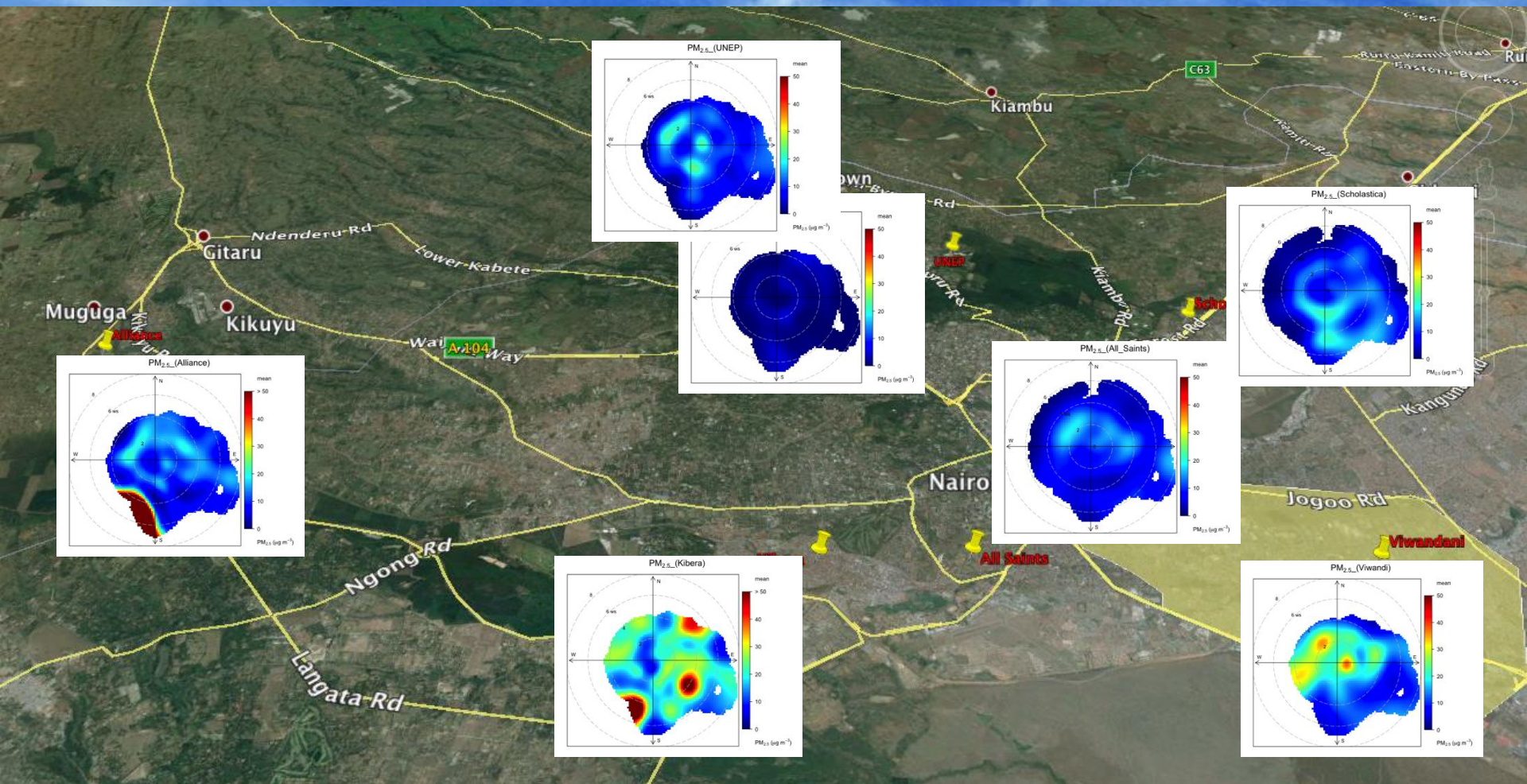
Full statistical analysis.....

Nairobi PM_{2.5} - scaled individually



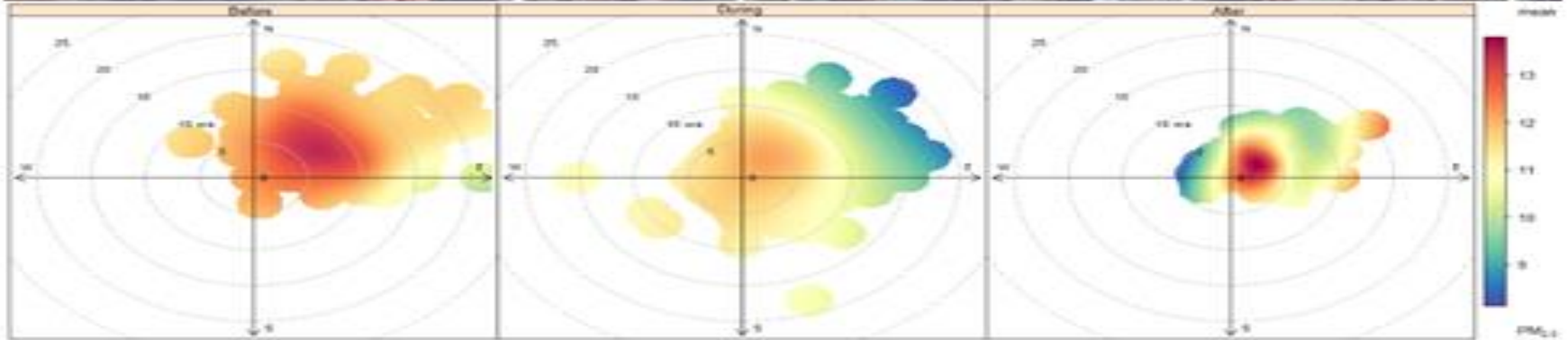
Distinct local emission features evident across Nairobi
(PM_{2.5})

Nairobi PM_{2.5} normalized to same scale



Citywide mapping of composition gradients/emissions
(PM_{2.5})

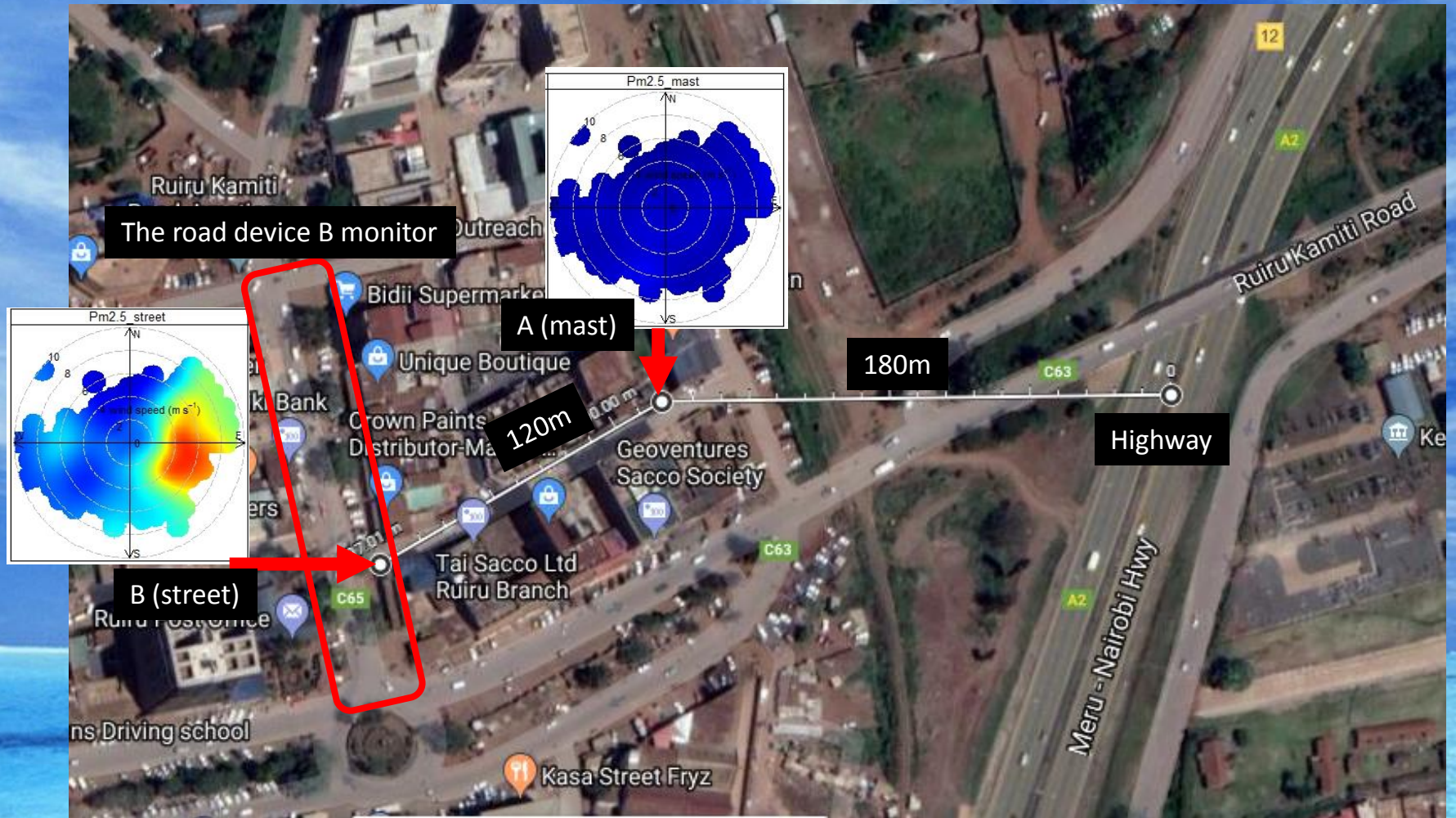
Public & Policy - Street closure Nairobi CBD 11/ 2016



Source: (UN Environment Report, 2018)

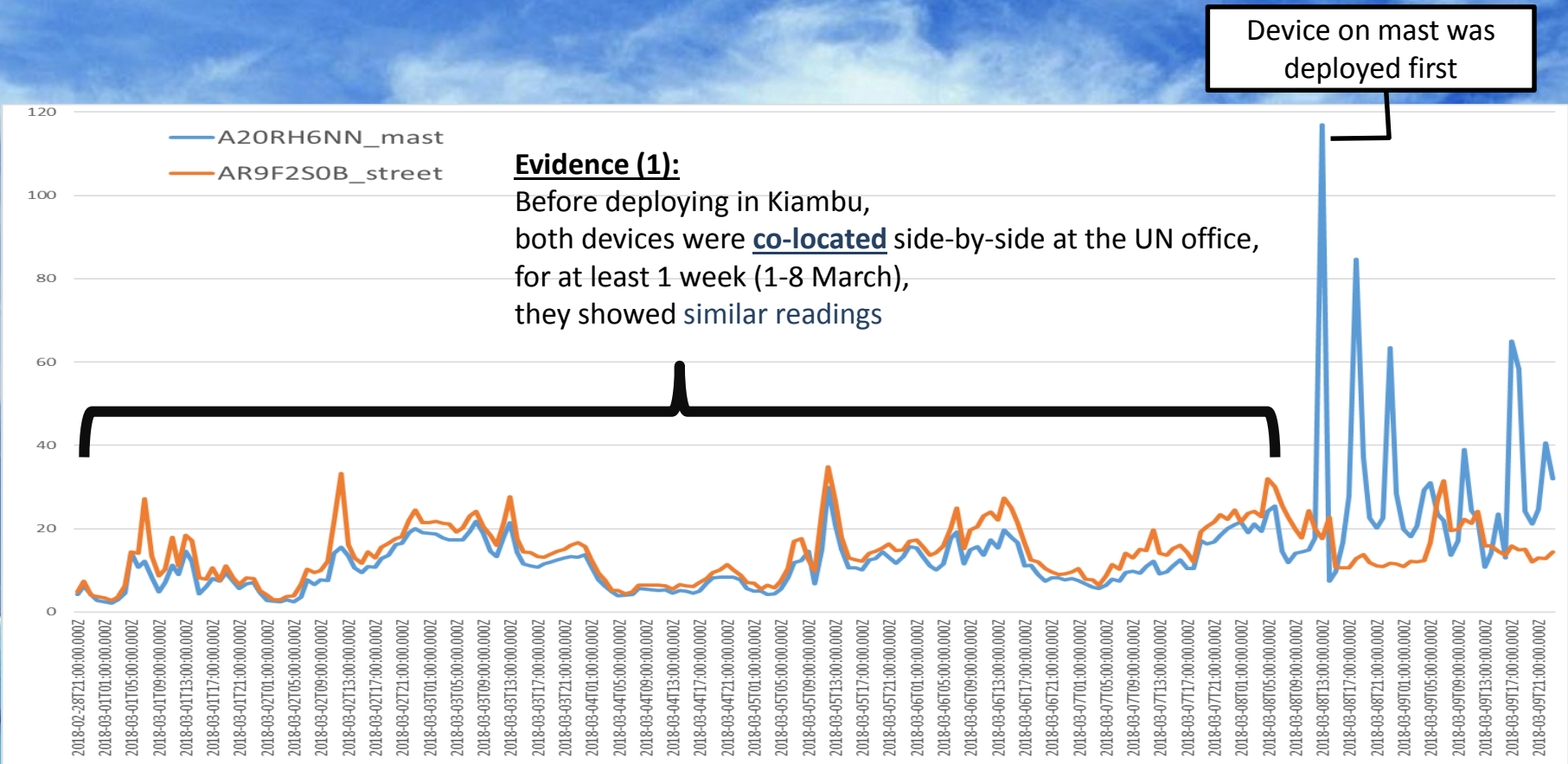


Kiambu county street closure – May 2018





Pre-deployment colocation

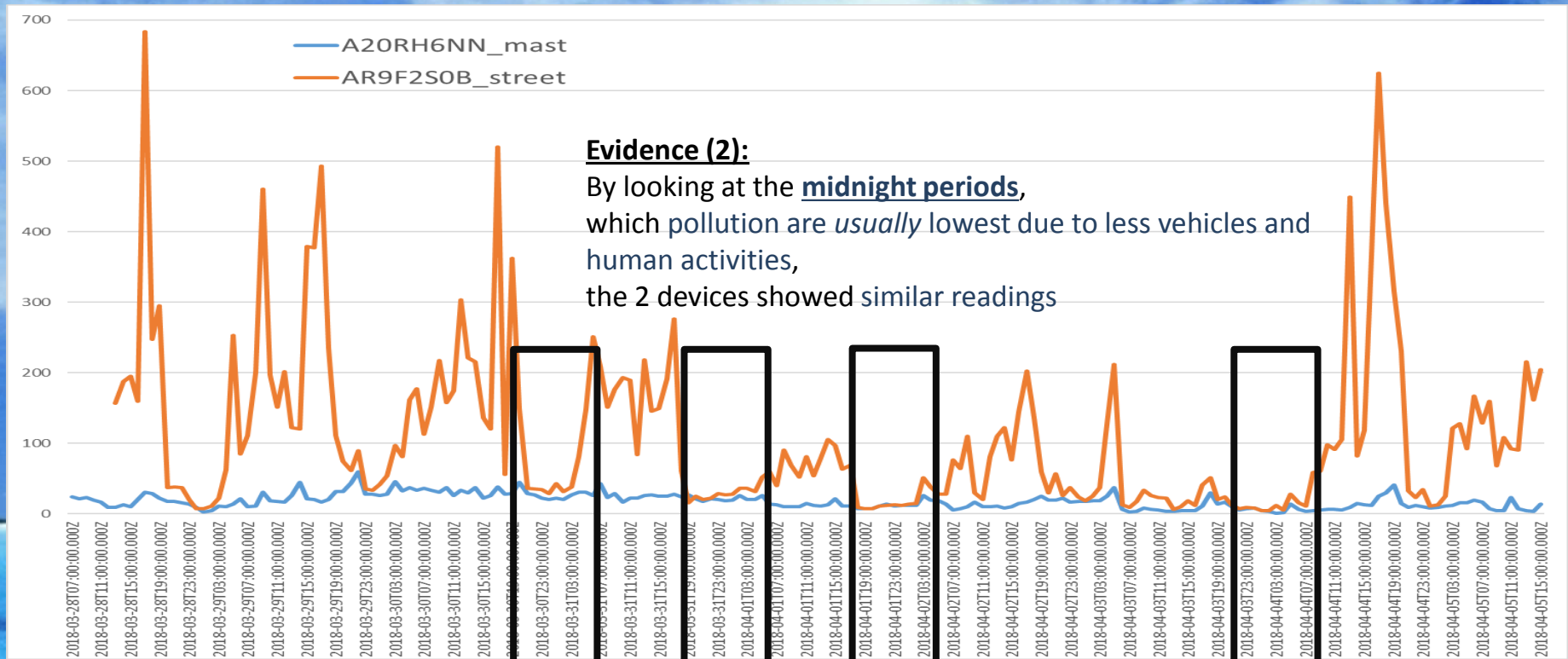


Evidence (1):
Before deploying in Kiambu, both devices were co-located side-by-side at the UN office, for at least 1 week (1-8 March), they showed similar readings

Device on mast was deployed first

This graph shows the period 1 Mar to 9 Mar.

Off-peak comparison

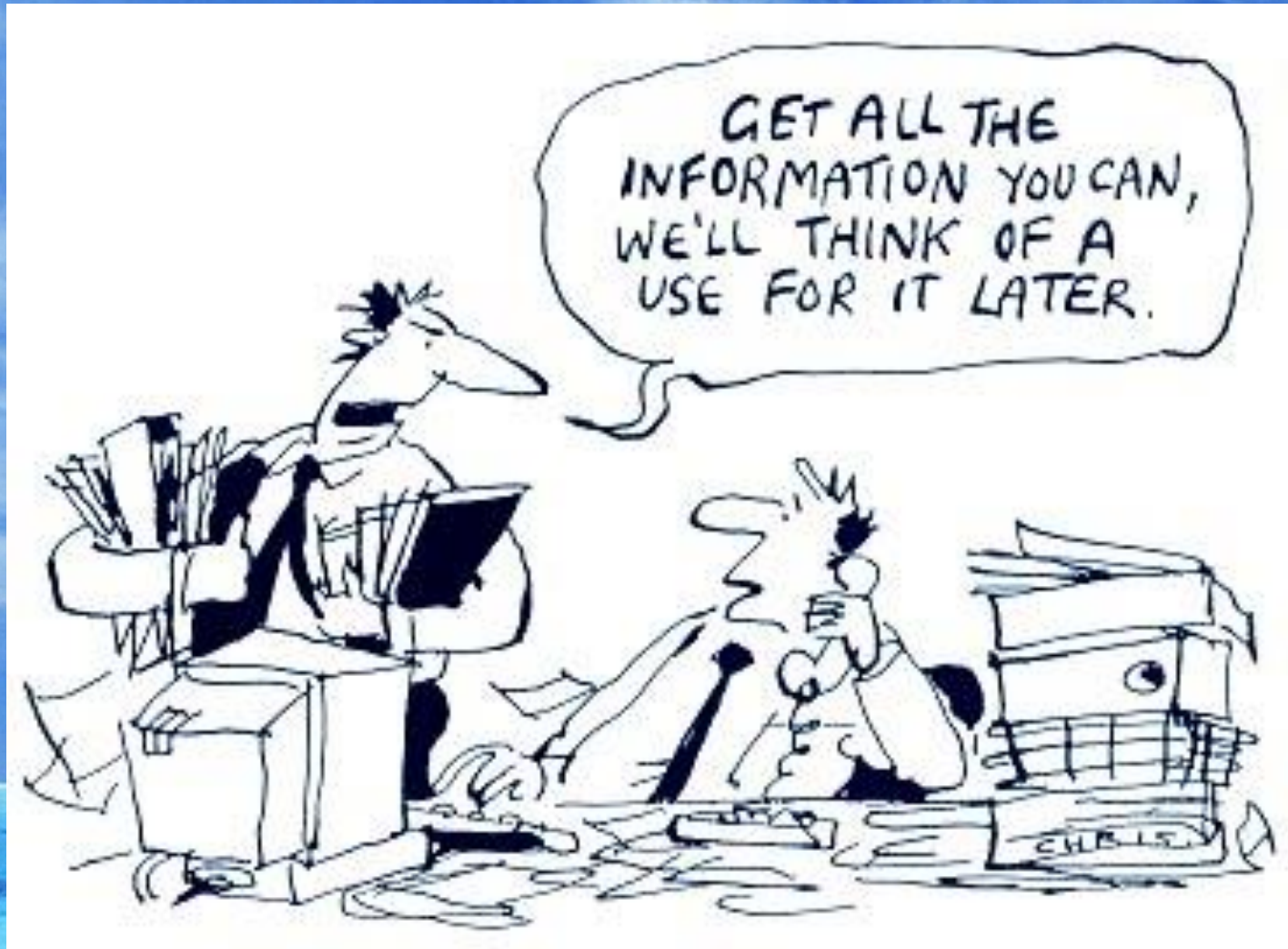


Evidence (2):

By looking at the midnight periods, which pollution are *usually* lowest due to less vehicles and human activities, the 2 devices showed similar readings

This graph shows the period 28 Mar to 5 Apr as an example.

Sensor based monitoring – 1000's?



Approve

909069473 - Longtan (PM2.5-88502 1 Hr POC 1) ▾

Next

Valid

Invalid

Approve & Save



Invalid Data

Show



LST	Value	QC	Op	Check
2018-05-24 00:00:00	10	0	0	
2018-05-24 01:00:00	20	9	0	Sticking
2018-05-24 02:00:00	20	9	0	Sticking
2018-05-24 03:00:00	20	9	0	Sticking
2018-05-24 04:00:00	20	9	0	Sticking
2018-05-24 05:00:00	20	9	0	Sticking
2018-05-24 06:00:00	27	0	0	
2018-05-24 07:00:00	14	0	0	
2018-05-24 08:00:00	7	0	0	
2018-05-24 09:00:00	9	0	0	
2018-05-24 10:00:00	20	0	0	
2018-05-24 11:00:00	29	0	0	
2018-05-24 12:00:00	30	0	0	
2018-05-24 13:00:00	21	0	0	
2018-05-24 16:00:00	17	0	0	
2018-05-24 17:00:00	20	0	0	
2018-05-24 18:00:00	23	0	0	

Lessons learned

- Sensors are able to generate useful information to support policy actions
- Data collected is sufficiently accurate to determine the state of air quality, pollution hot spots and pollution sources*
- The units are deployable in cities with limited infrastructure and difficult operating conditions
- A cloud based management platform could make capacity building and support a collective effort

*maintaining reliability of the data and increasing accuracy would require a calibration protocol (e.g. reference station)

Thank you



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