

Update on the SA Mercury Network (SAMNet) Human Capital Development Activities

13th APMMN Partners Meeting

Lynwill G Martin (Ph.D)

Lead Scientist



Global Atmosphere Watch (GAW)

- WMO GAW coordinates activities and data from 31 Global Stations, >400 Regional Stations, and around 100 Contributing stations operated by Contributing Networks
- CPT first measurements started 1978 with CO 1st measured
- Strategic position of CPT w.r.t. southern hemisphere



Why we are UNIQUE





CAPE OF GOOD HOPE
THE MOST SOUTH-WESTERN POINT
OF THE AFRICAN CONTINENT

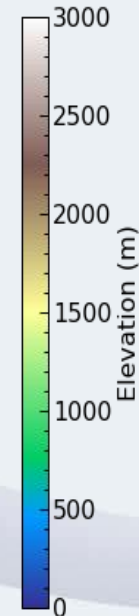
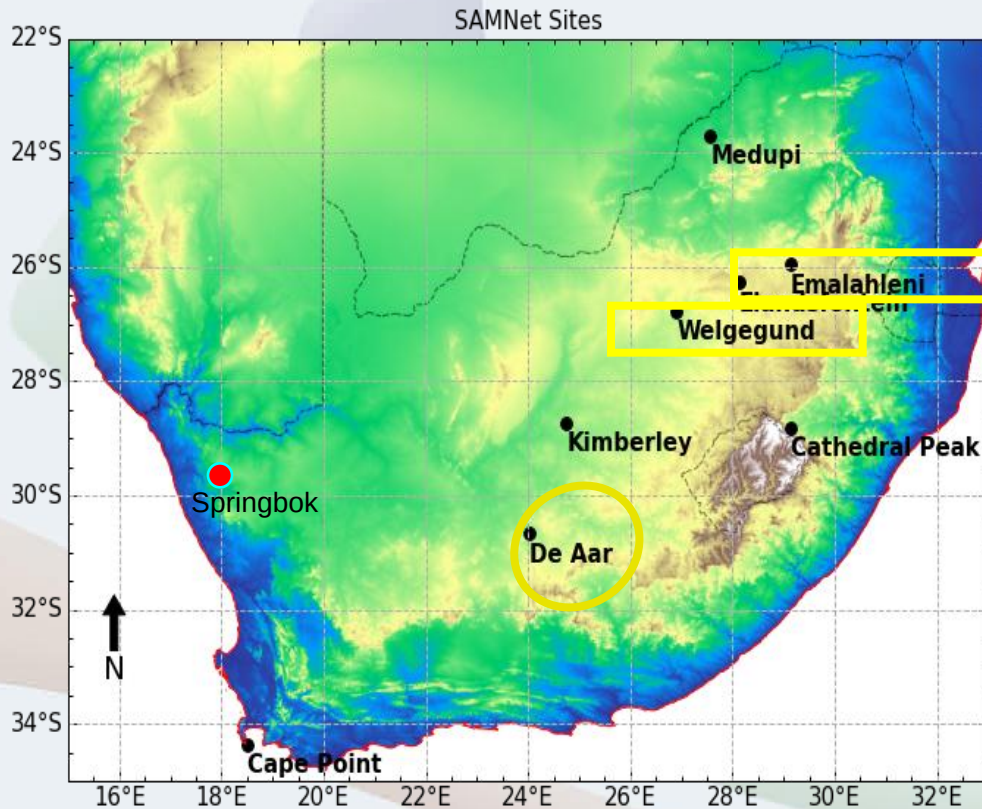
34° 21' 25" SOUTH
18° 28' 26" EAST

CAPE OF GOOD HOPE
THE MOST SOUTH-WESTERN POINT
OF THE AFRICAN CONTINENT



- . CPT 1st Hg Measurements were made in Sep 1995 via Manual Method
- . Started with Continuous measurement in 2007 with a Tekran 2537A
- . SAMNet started 1 April 2020 and the overall goal is to develop a **coordinated SA (later in Africa through Afri-GEO) observation network for mercury** to determine the status and trends in atmospheric mercury concentrations
- . Expand the monitoring stations in SA and start Speciation monitoring at CPT
- . Assist partners in developing their mercury monitoring capacity (training)
- . Give government and relevant stakeholders a firm basis for future policy developments in the implementation of the Minamata Convention

SA Mercury Network (SAMNet) Observations



- 3 x Tekran X (Cape Point, Welgegund) Ship
- 3 x Lumex , CPT, De Aar and Emalahleni
- 8 Passive Sampling Sites (across the country)
- 3 Passive sites collaborating with ECCC
- 4 Wet deposition sites

Speciation Monitoring started May 2022

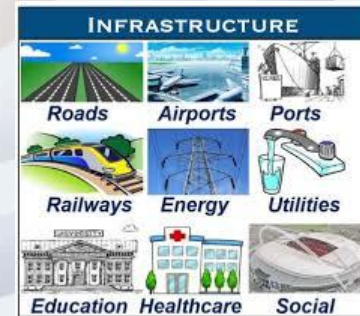
New Site:

Springbok started July 2022

Passives part of the Global Network EC

What are the BIGGEST CHALLENGES related to Capacity Development in Developing COUNTRIES

- FUNDING
- INFRASTRUCTURE
- WILLINGNESS
- MAN POWER
- SKILLS & EXPERTISE
- There are more pressing matters than Chem & Waste
- Chemical Pollution low on the Agenda
- Competing interest (PFAS, microplastics GHG)



CAPACITY DEVELOPMENT in SOUTH AFRICA FOR MERCURY MONITORING

- SAMNet part of Global Observation System for Mercury (GOS4M) a GEO-Flagship Program
- Collaborate with other Networks (APMMN, NADP since 2018)
- 6x MSc and 2x PhD supported since 2020 (To date 3 MSc students completed their studies)
- Equip the Next Generation Early to make the Program Sustainable

Development of a novel graphene-based passive air sampler towards bridging mercury monitoring gaps in South Africa

Geyan Kempkes¹, Lynwill Martin² and Patricia Forbes¹

¹*Department of Chemistry, University of Pretoria, Pretoria, South Africa*

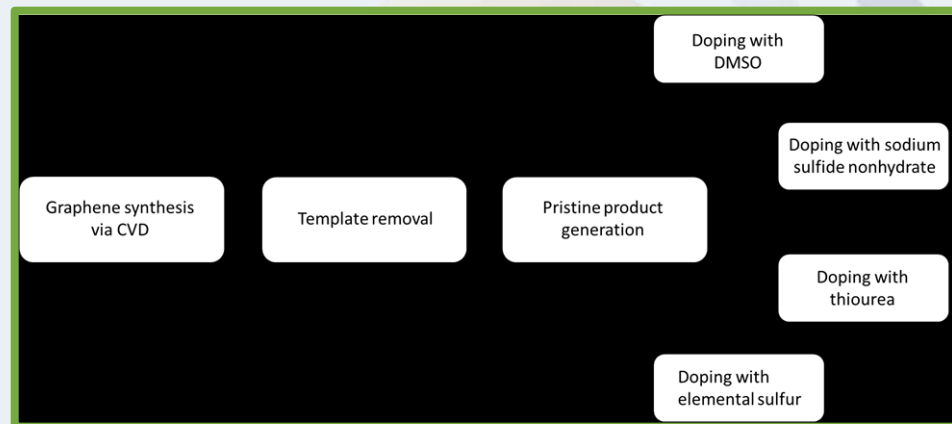
²*South African Weather Service*



A novel graphene foam passive air sampler (PAS)

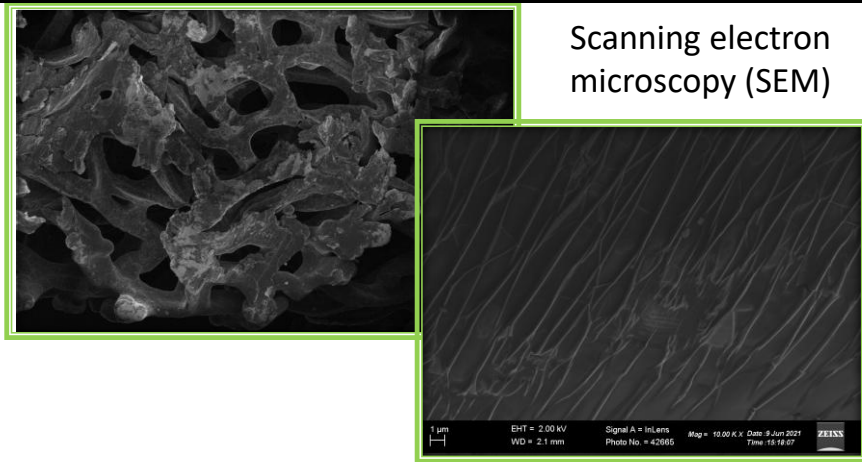
Sorbent preparation

- Pristine graphene foam is catalytically synthesised by chemical vapour deposition (CVD) on a metal support
- Further derivatized with various S sources and methods and then characterized
- S sources include: DMSO, Na_2S and thiourea and elemental sulfur
- Very low final mass ~17 - 36 mg per sampler
- Final product can fit into PAS design as a Radiello®-sized cartridge

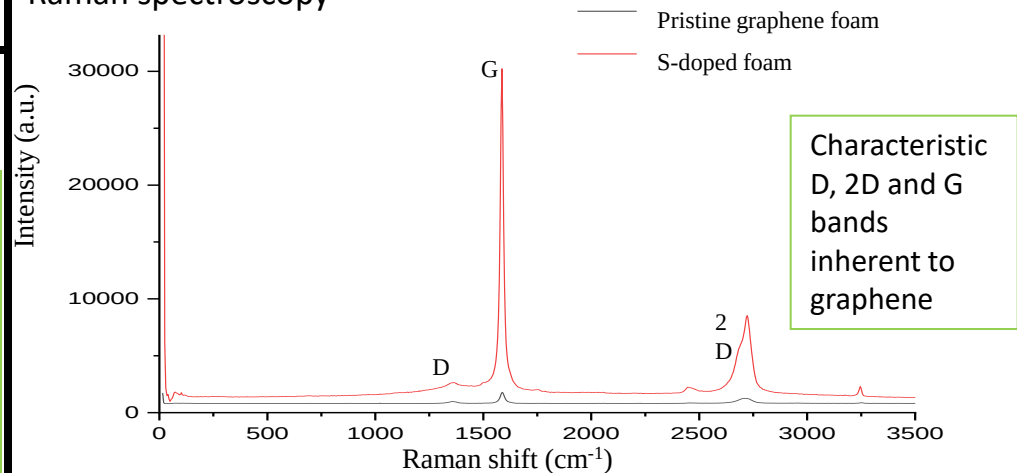


Sorbent Characterization

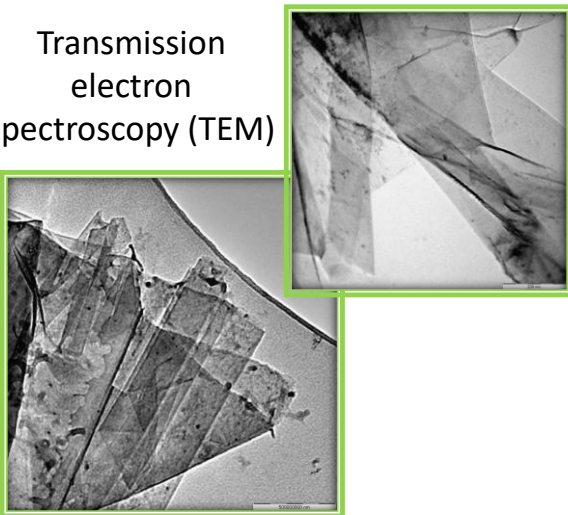
Scanning electron microscopy (SEM)



Raman spectroscopy



Transmission electron spectroscopy (TEM)



Surface area by Brunauer-Emmett-Teller (BET)

Specific surface areas for sorbents used in sampling

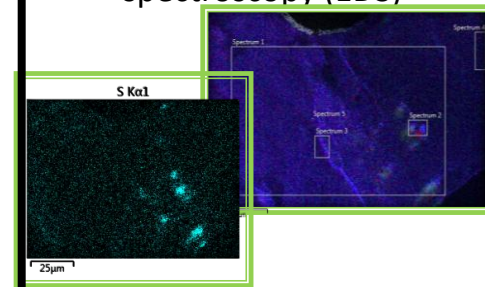
- Mean of pristine foam ~2,03 m².g⁻¹
- Mean of derivatized foams ~5,53 m².g⁻¹

Thermogravimetric analysis (TGA)

Relative mass losses upon analysis were consistent with the losses observed by TGA

- Pristine foam ~12,7% over 2 to 4 cycles
- Doped foam variants ~12,6% over 2 to 4 cycles

Energy-dispersive X-ray spectroscopy (EDS)



Other characterization includes X-ray photoelectron spectroscopy (XPS) and Fourier Transform Infrared Spectroscopy (FTIR)

Conclusions

- There has been a gradual increase in Hg monitoring data in South Africa
- The novel graphene foam sorbent shows potential for TGM capture from air
- Cost of using MerPAS® is higher, ~R1800 (\$85) per single MerPAS® vs ~R300 (\$15) for our novel sampler
- The low mass of the sorbent and long deployment times required infer best use at impacted sites
- The sorbent foam can be adapted to suit different applications such as badge samplers for occupational sampling
- A journal publication on this study has been submitted for review





ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Atmospheric Hg Along a Southern Ocean Transect

Victor Mugabe

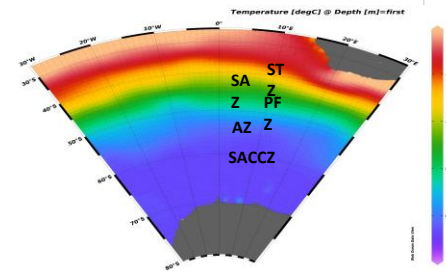
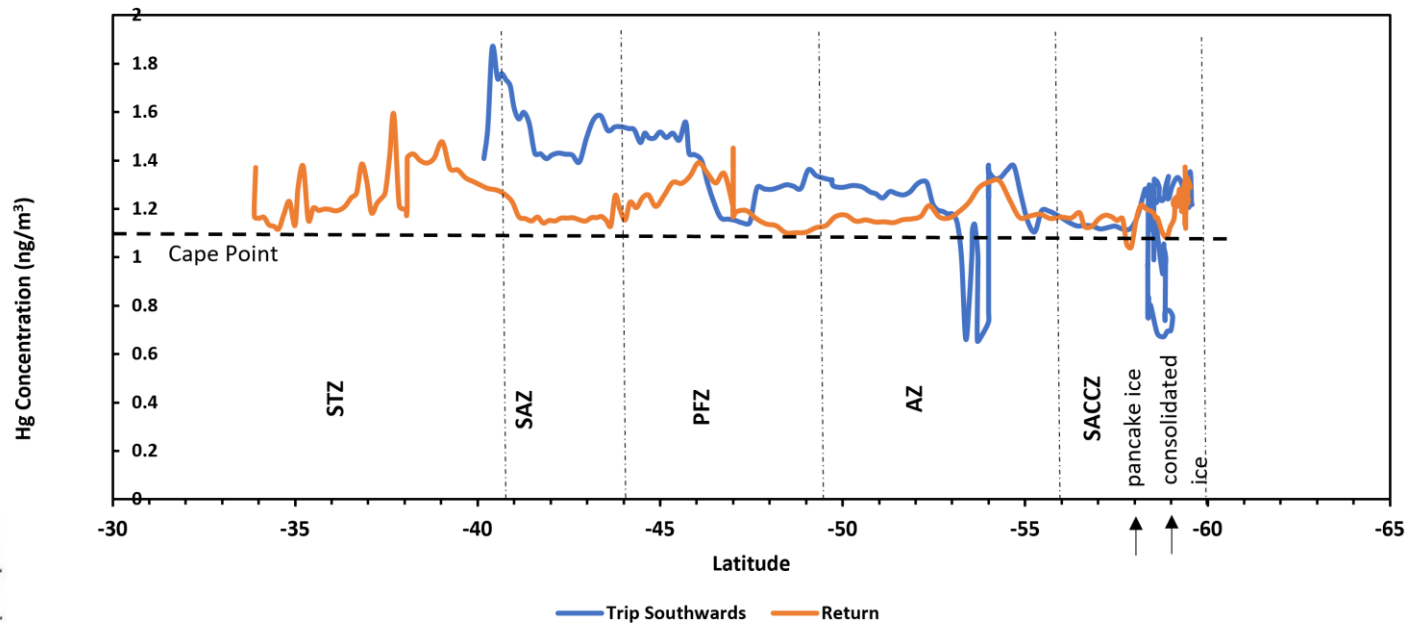
Susanne Fietz, Lynwill Martin, Helene Angot
Casper Labuschagne



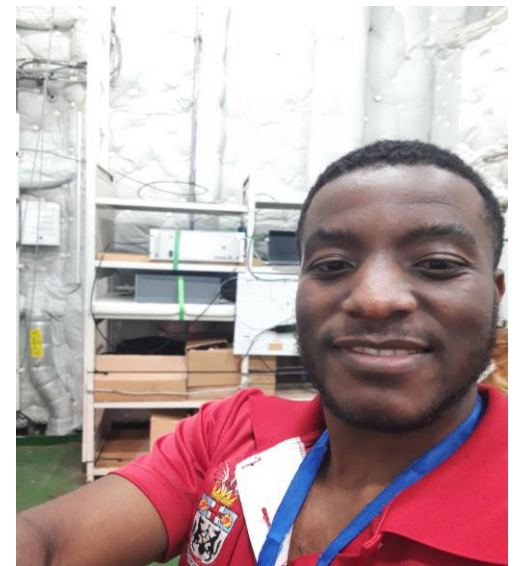
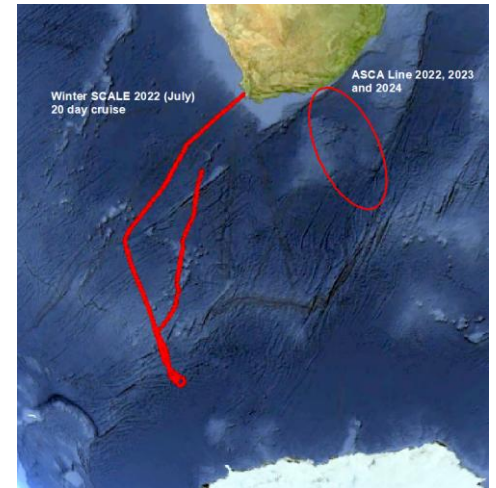
SCALE 2022 Results

Research Aim: Explaining Hg observations in SO in winter.

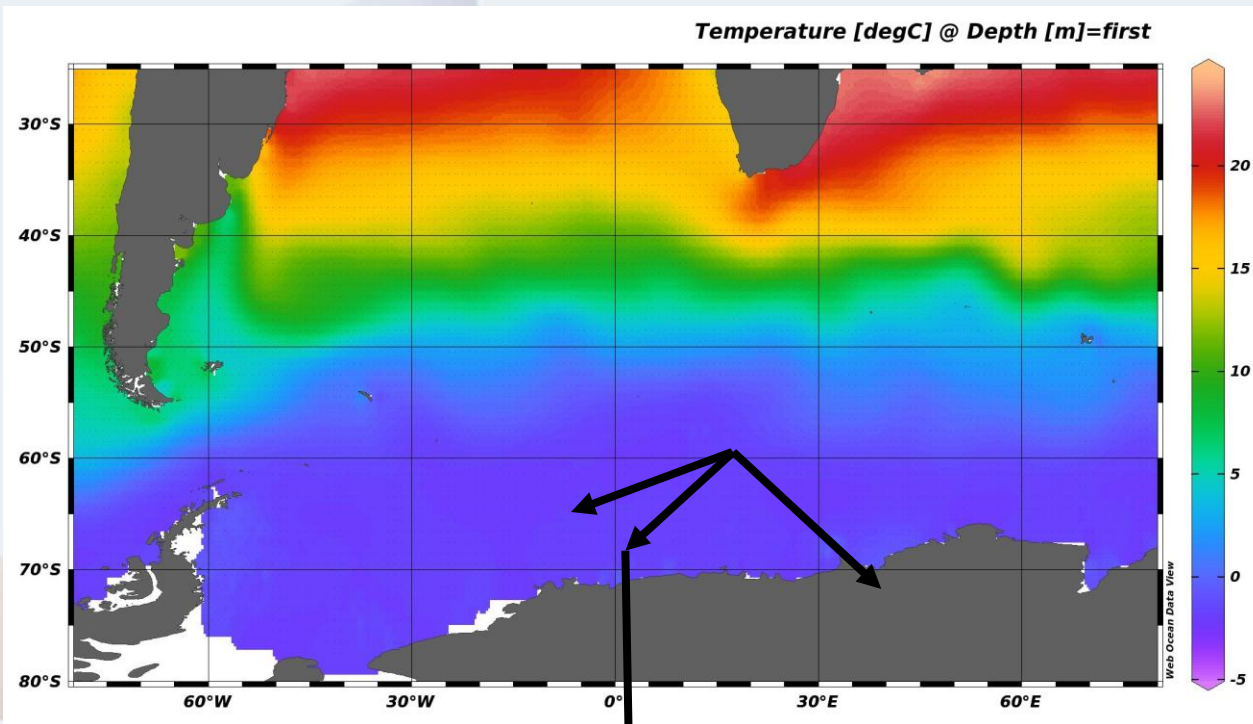
Winter (July 2022)



Data Collection



Next SA cruises into the Southern Ocean with planned Hg measurements



Research Aim: Comparing seasonal variability of atmospheric Hg along a SO transect

South Atlantic/Southern Ocean:
Cape Town - Gough Island

Spring:
5 Sept-11 Oct 2024

Southern Ocean:
Cape Town – Antarctica
Summer: Dec-Feb 2025

Western South Indian/Southern Ocean:
South Africa – Marion Island
Autumn: April 2024

Southern Ocean:
Cape Town – Antarctica
Winter: July 2025



**South African
Weather Service**



ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY



Liezl Bredenkamp

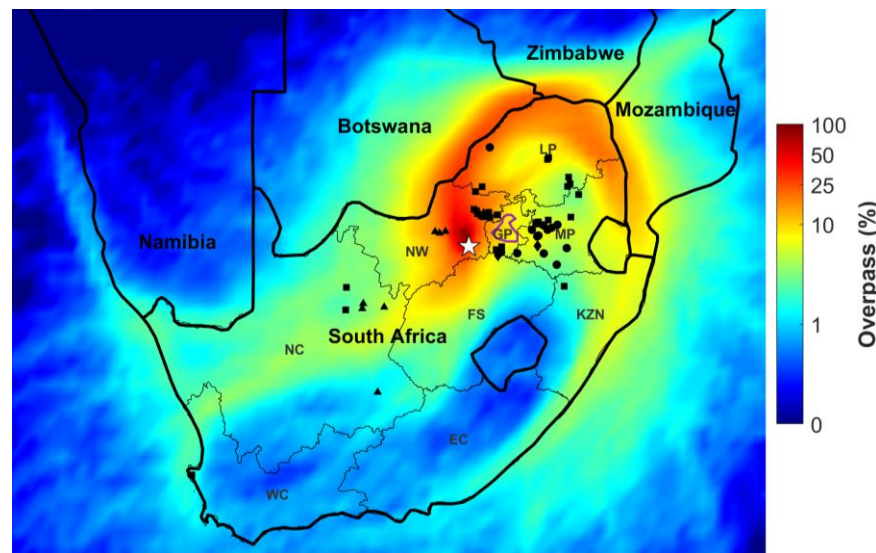


Pieter G van Zyl, Kerneels Jaars, Lynwill G Martin, Miroslav Josipovic

**A multi-year record of atmospheric mercury concentrations
at a regional site in the South African interior**



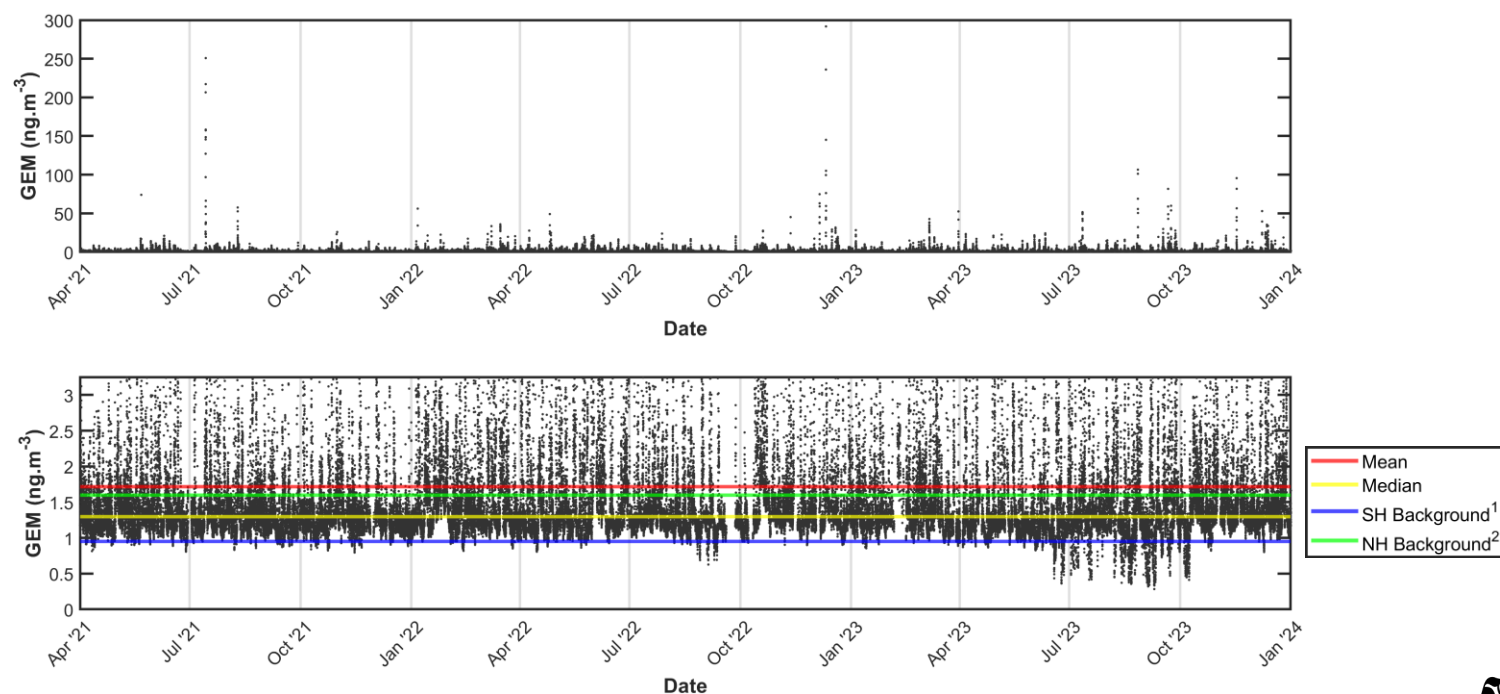
Welgegund monitoring site



<https://en.ilmatieteenlaitos.fi/welgegund-research-station>



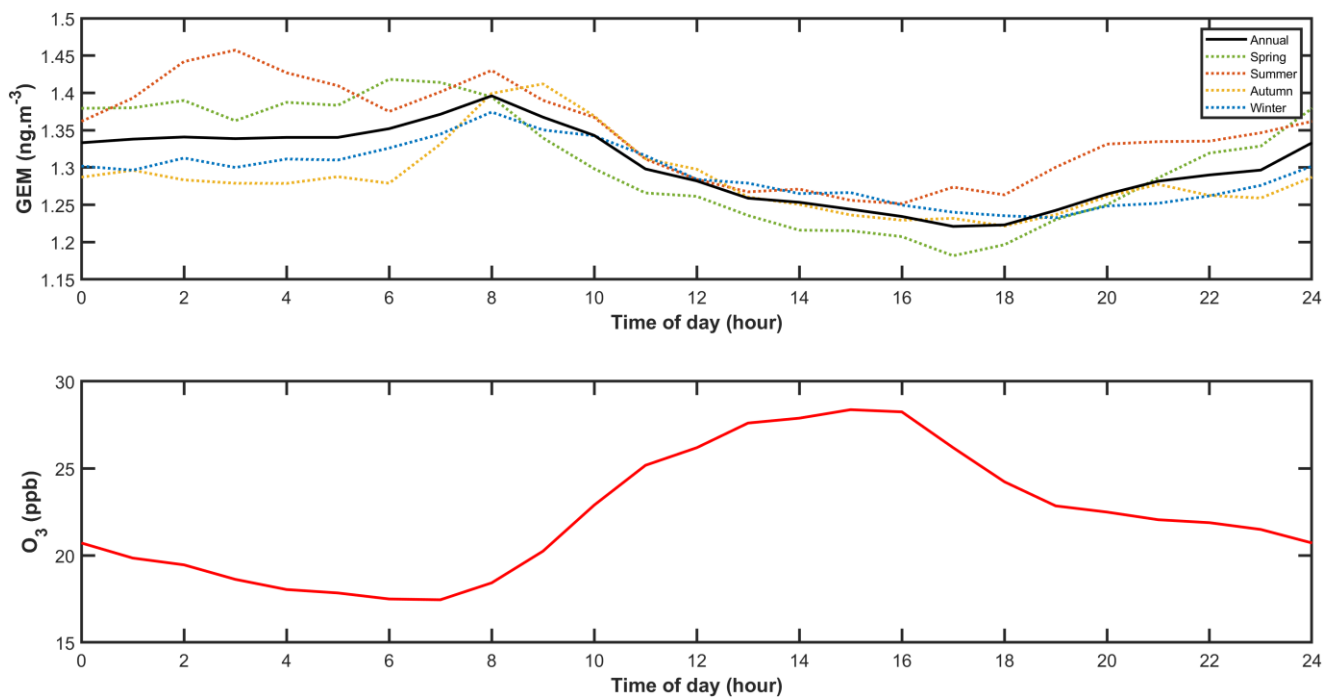
GEM at Welgegund within the global context



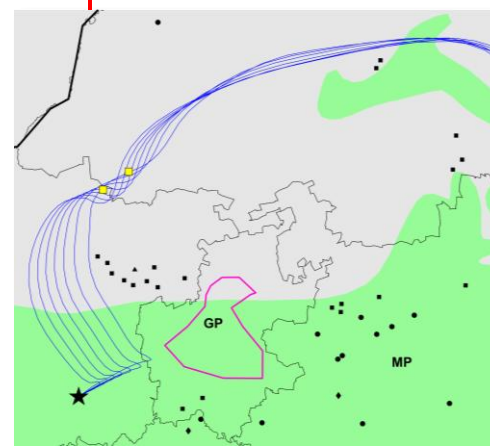
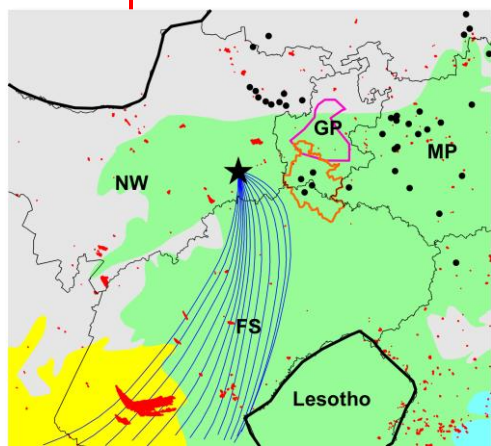
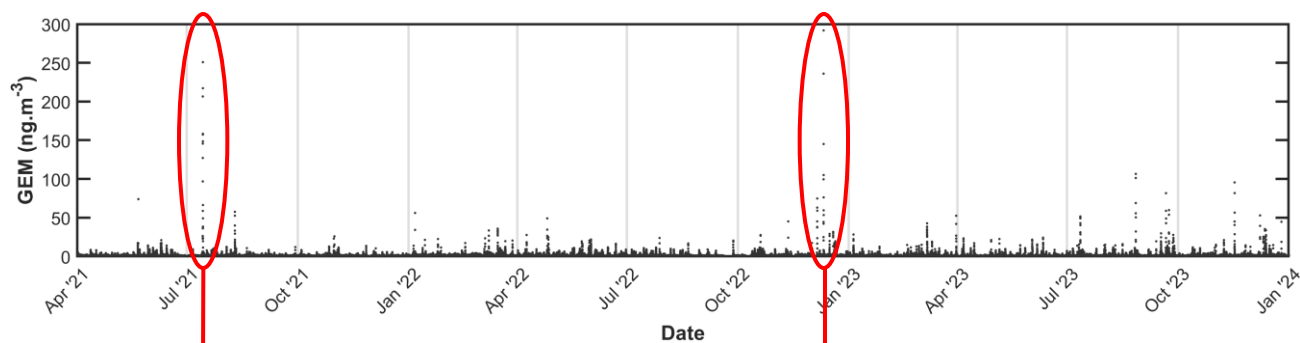
[1] Slemr *et al.*, 2015, [2]. Sprovieri *et al.*, 2016



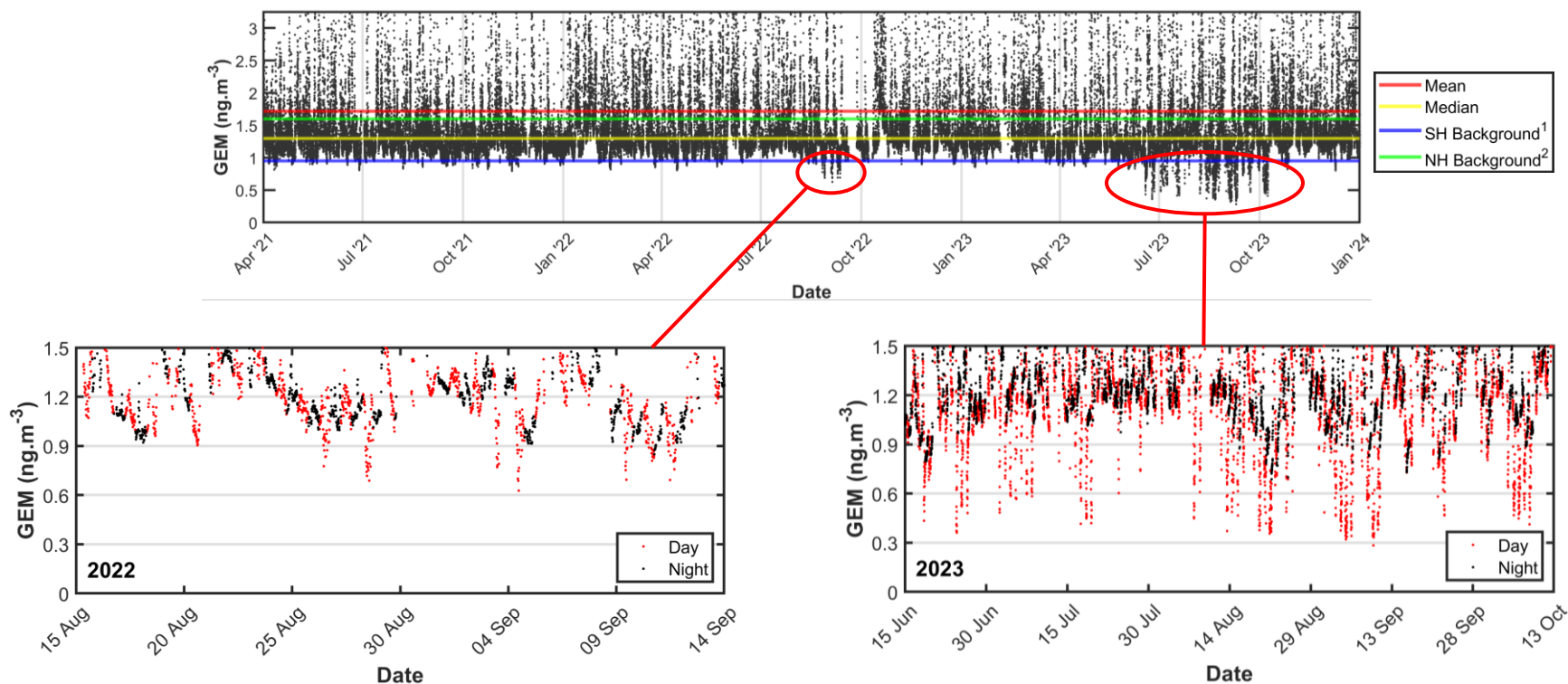
Diurnal variation in GEM



Case study 1: Pollution events



Case study 2: Depletion events



[1] Slemr et al., 2015, [2]. Sprovieri et al., 2016

Conclusions

- **Welgegund** GEM correlates well with other sites.
- GEM **diurnal** pattern shows anti-correlation with ozone.
- **Seasonality** of GEM is influenced by chemistry and meteorology.
- **Spatial distribution** of GEM is influenced by air mass history and ozone.
- **Pollution events** had natural and anthropogenic origin.
- Cause of **depletion events** still unknown.



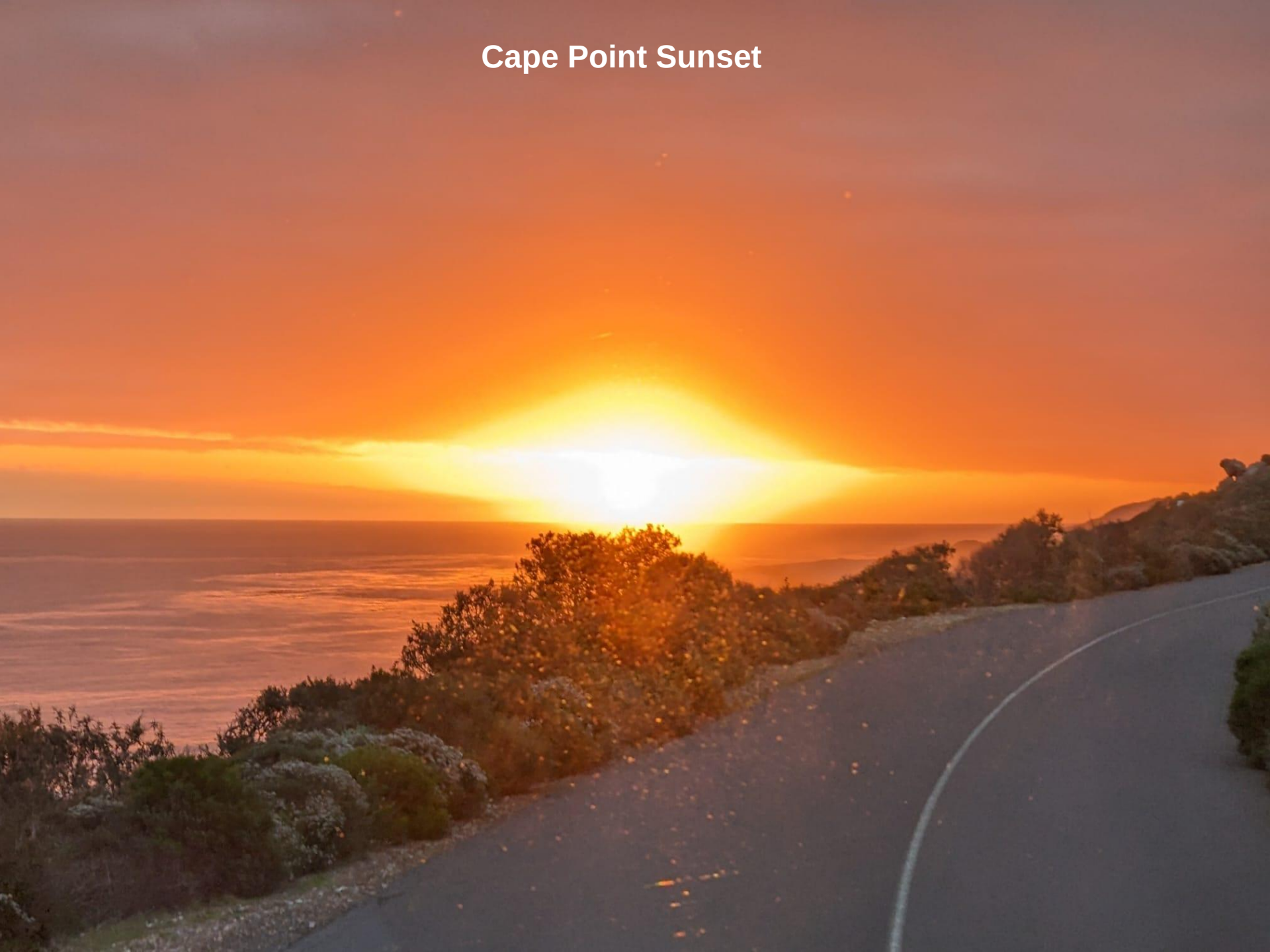
New Case Study at Cape Point Aug 2024



Very Good Agreement



Cape Point Sunset



GAW & SAMNet Stakeholders



sasol



South African
Weather Service

