

Air Quality Monitoring using satellites and reanalysis data

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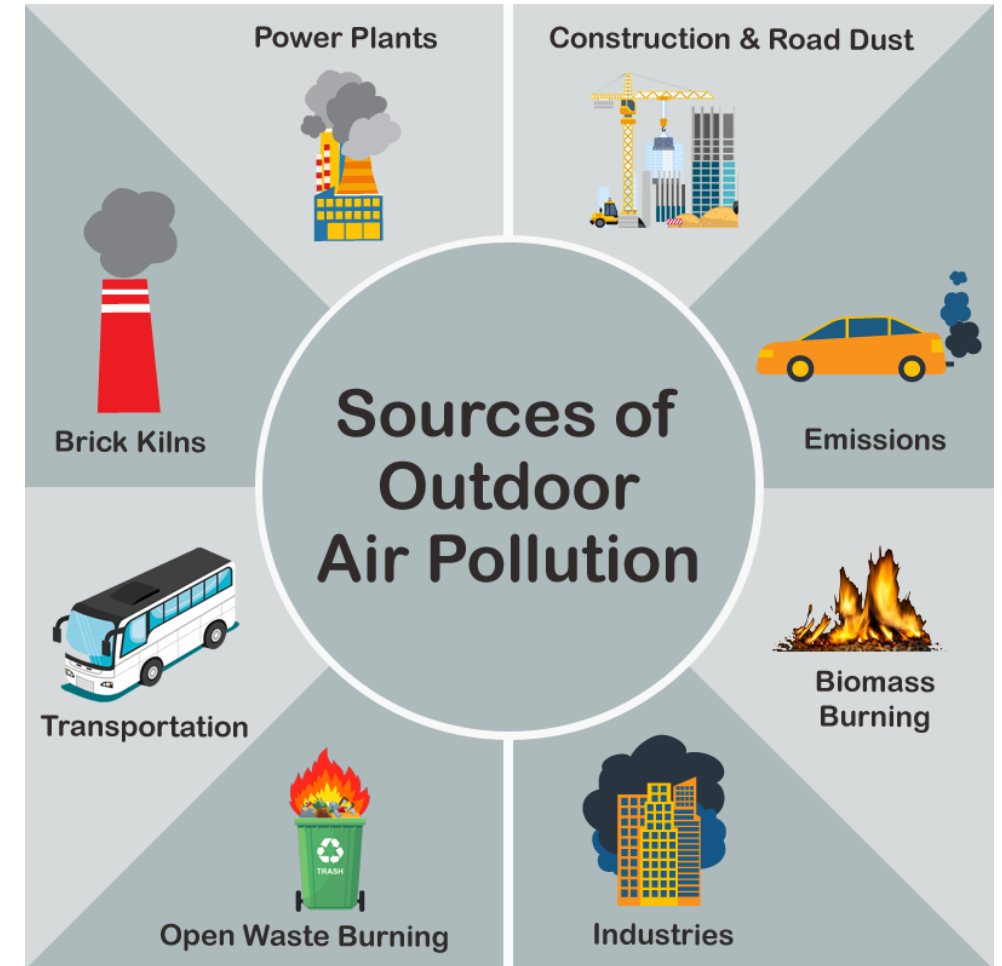
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Sources of Air Pollution

- **Air pollutants**
 - Airborne **particles** and **gases** that occur in concentrations that endanger the health and well-being of organisms.
- **Primary Pollutants**
 - **Emitted directly** from the identifiable source
 - Pollutes the air immediately after being emitted
- **Secondary Pollutants**
 - Are produced in the atmosphere by **chemical reactions** between primary pollutants (i.e. smog)



<https://shan.org.in/air-pollution.html>



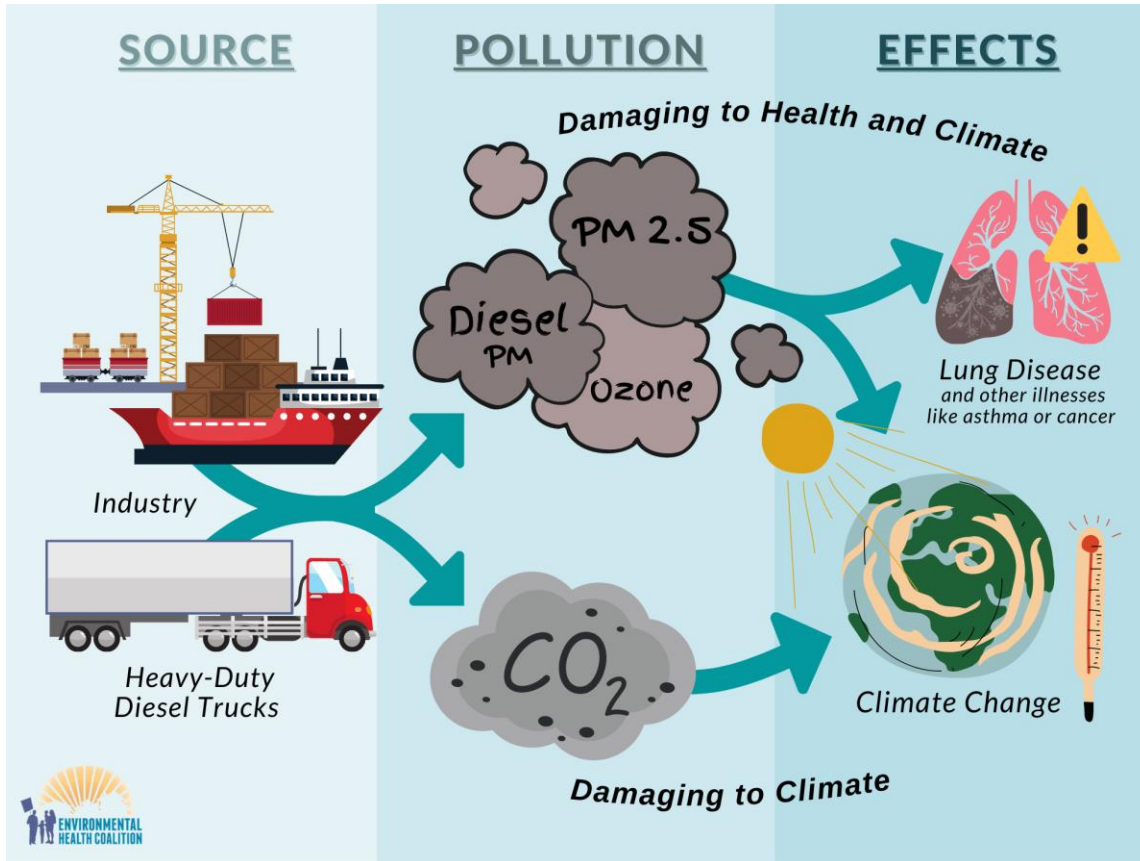
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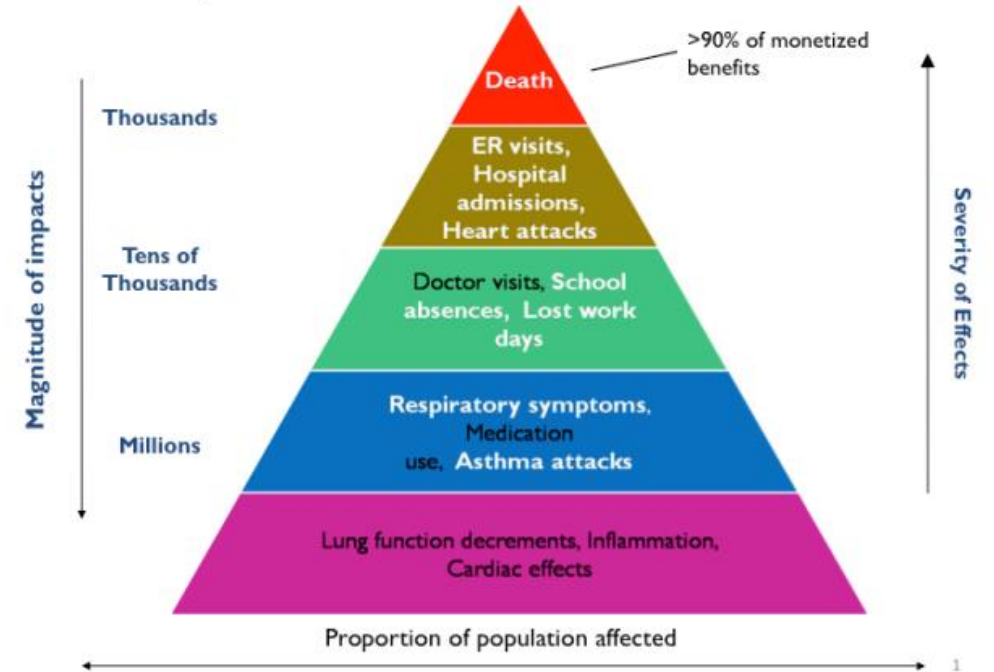


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Effects of air pollution

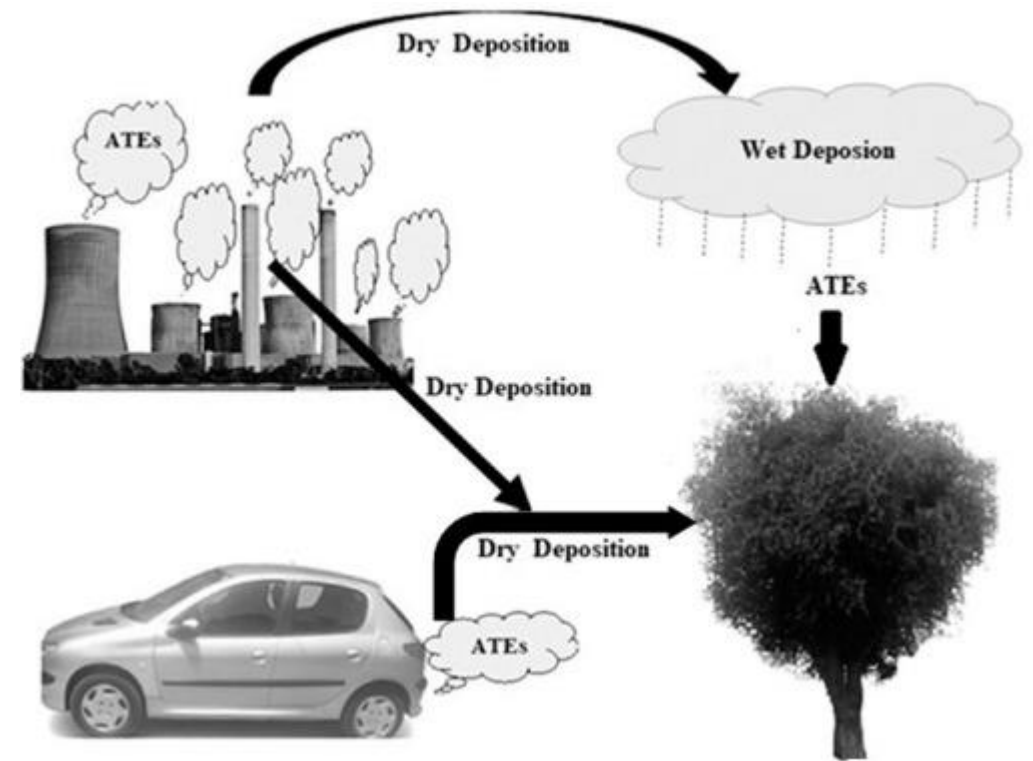
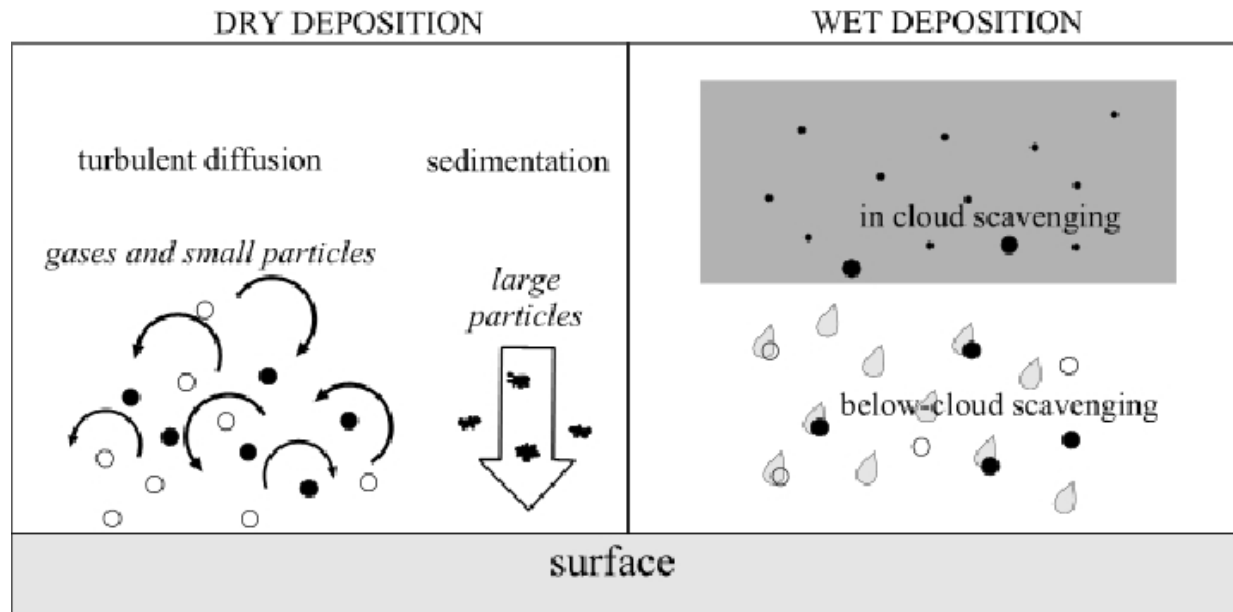


A "Pyramid of Effects" from Air Pollution



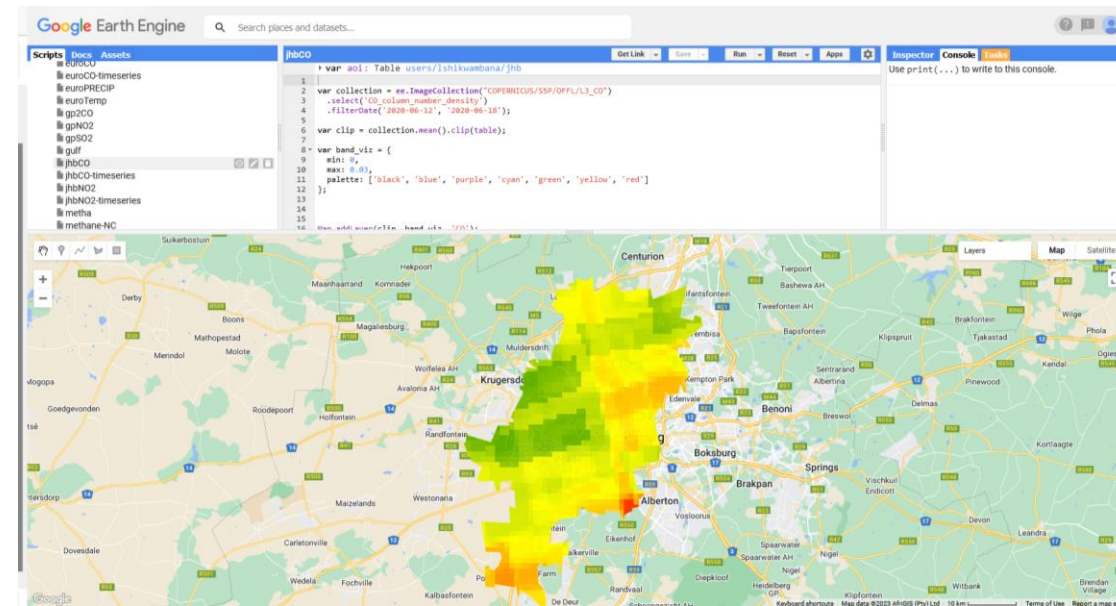
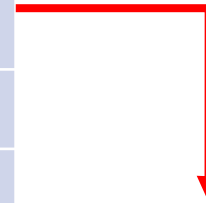
<https://www.epa.gov/benmap/how-benmap-ce-estimates-health-and-economic-effects-air-pollution>

Atmospheric deposition is an important transport process for gases and particles



Some data used for air pollution studies

Data	Spatial resolution	Temporal resolution	Products
Merra-2	0.5° × 0.625°	Daily	Black Carbon concentration
TROPOMI	0.01 × 0.01 arc degrees	1-day	Carbon Monoxide
CALIPSO	0.5° × 0.625°	Monthly	Smoke and Polluted dust AOD 532 nm
MODIS	1 km	Daily	AOD (550 nm)



MERRA-2 (Reanalysis data) (Hourly resolution)

Sulphate (SO₄) surface concentration

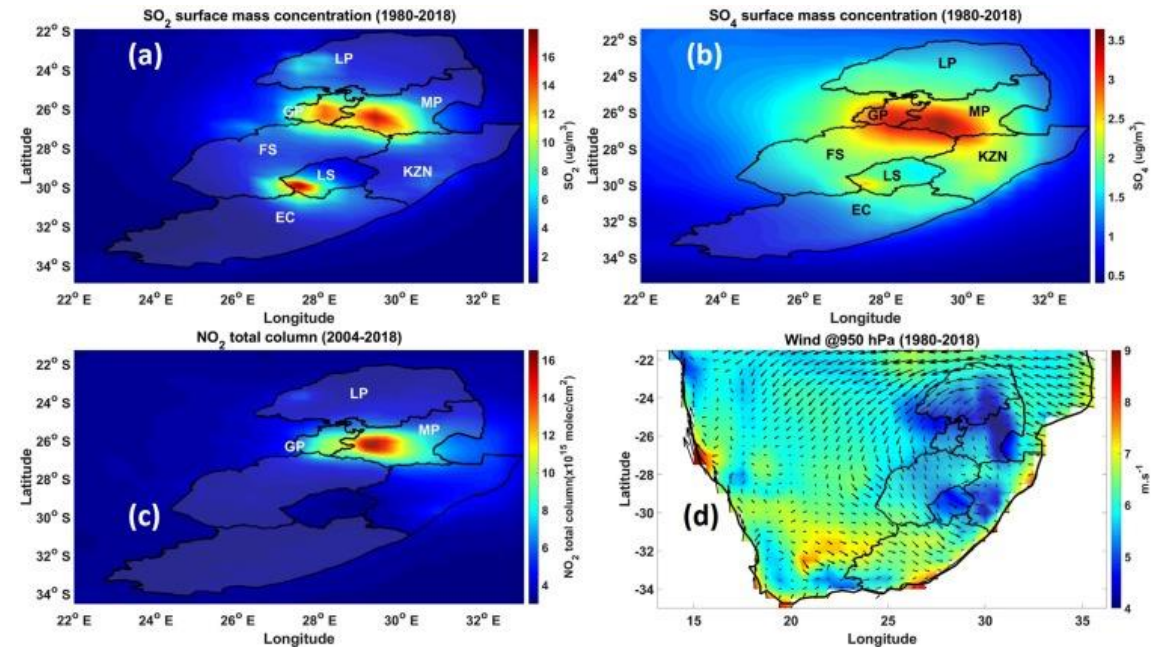
Sulphur dioxide (SO₂) surface concentration

Dust surface concentration – PM2.5

Spatial resolution 0.5 x 0.625°

***Each degree of latitude is approximately 111 km apart.*

Data availability 1980 to present



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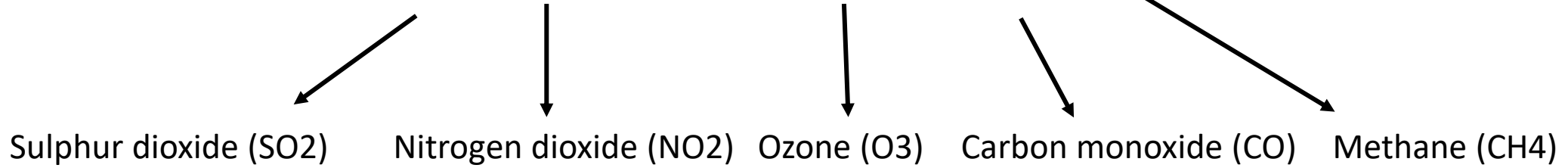
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SENTINEL-5P (TROPOMI)

- Sentinel-5 Precursor (S5P) is the first of the atmospheric composition Sentinels. It was launched on 13 October 2017
- Sentinel-5P satellite carries a single payload instrument: TROPOMI (TROPOspheric Monitoring Instrument)
- Sentinel-5 Precursor mission instrument collects data useful for assessing air quality.
- The TROPOMI instrument is a multispectral sensor that records reflectance of wavelengths important for measuring atmospheric concentrations of ozone, methane, formaldehyde, aerosol, carbon monoxide, nitrogen oxide, and sulphur dioxide, as well as cloud characteristics at a spatial resolution of 0.01 arc degrees (latitude 1 arc degree = ~ 111 km => 0.01 arc degree = ~1.11 km)

Sentinel-5P (TROPOMI)



Spatial resolution Up to 7.0* km x 3.5 km.

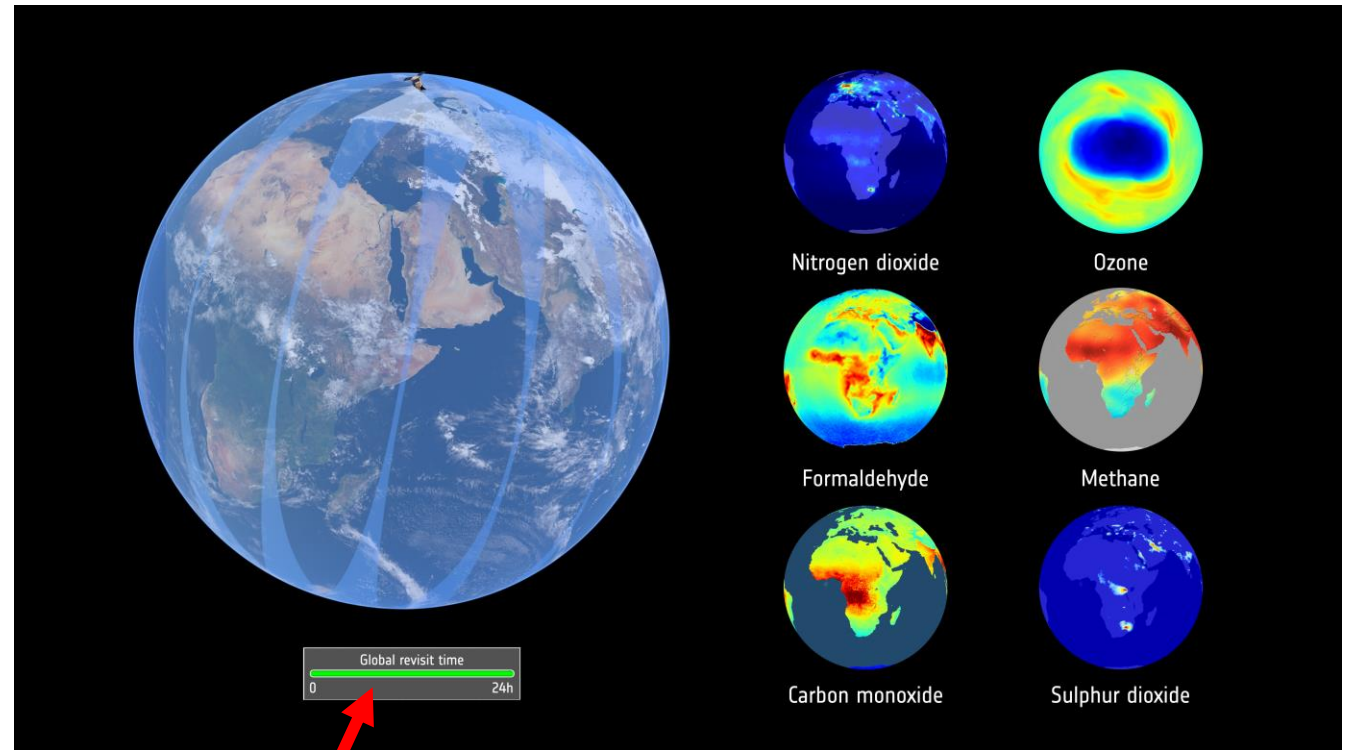
Revisit time Less than one day.

Data availability Since April 2018.

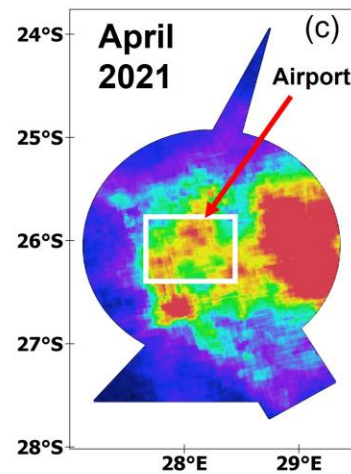
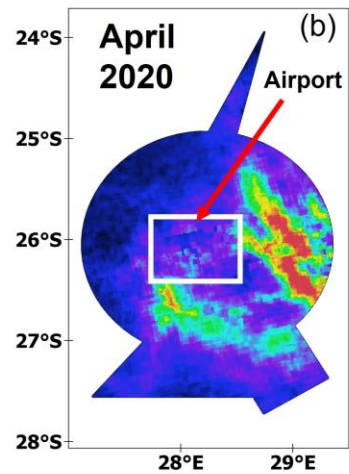
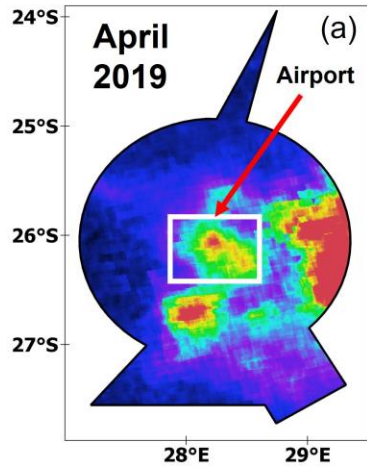
NRTI-for near real-time

OFFL -for offline

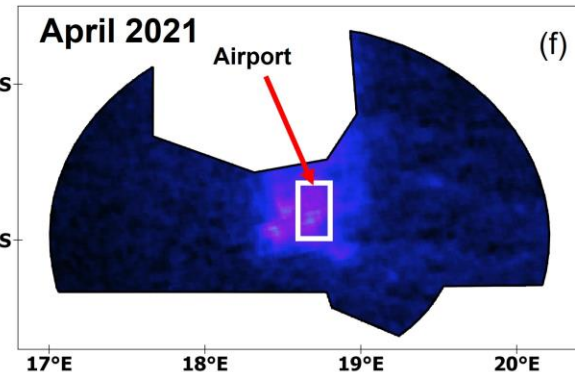
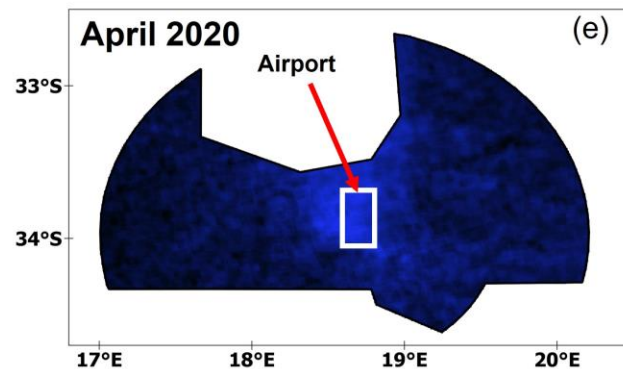
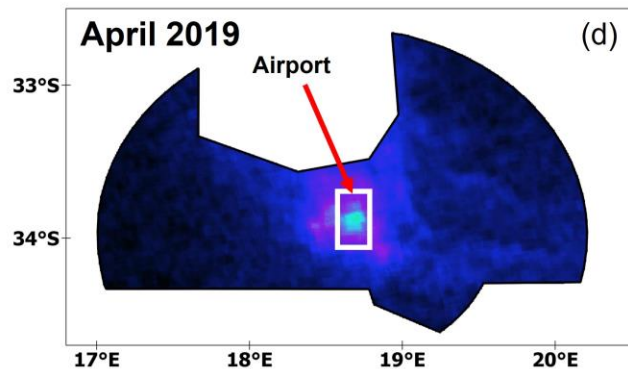
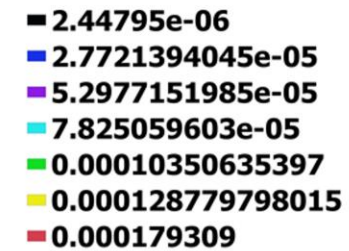
RPRO-for reprocessing



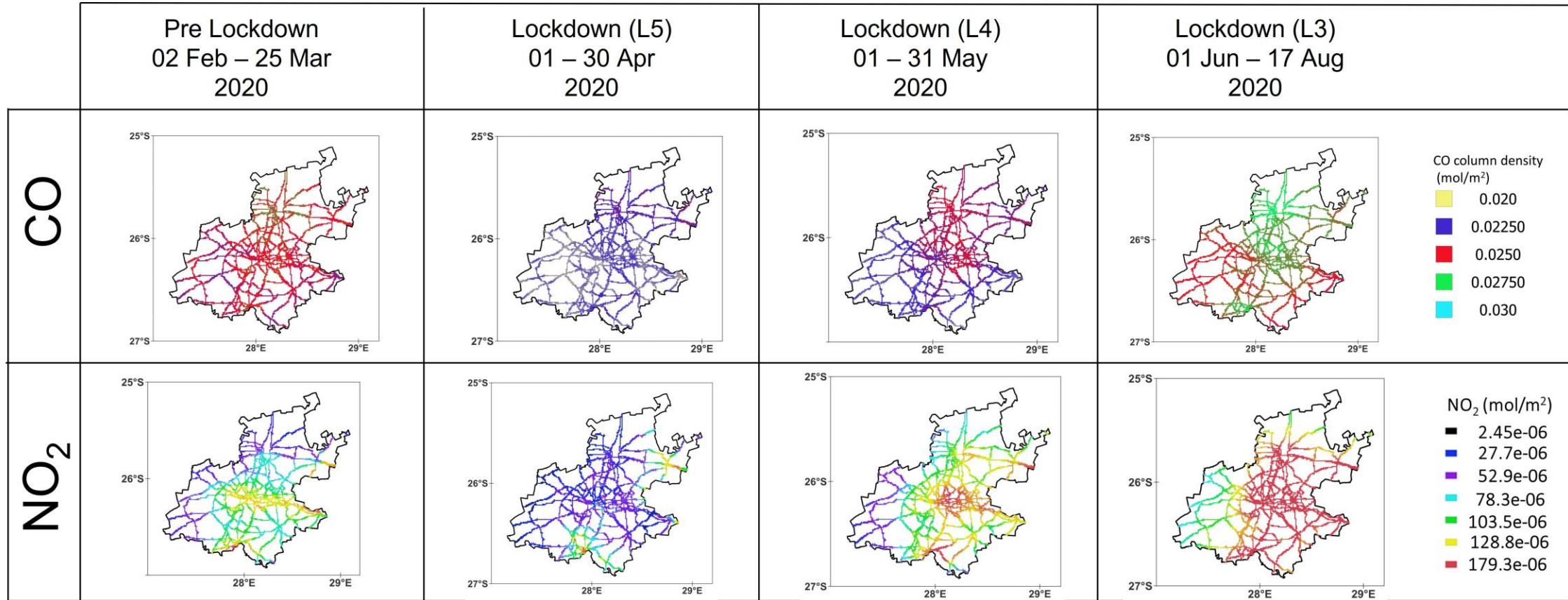
Example data from GEE: NO₂ emissions from aircrafts at ORTIA and CPIA



NO₂ (mol/m²)



Example data from GEE: Measurements of emissions from major highways in Gauteng Province, South Africa



Shikwambana, L., Kganyago, M., Mhangara, P. (2023). TROPOMI Utilized for the Monitoring of Emissions on Major Road Networks: A Case Study in South Africa During the COVID-19 Lockdown. In: Li, P., Elumalai, V. (eds) Recent Advances in Environmental Sustainability. EESIWC 2021. Environmental Earth Sciences. Springer.

AIR QUALITY

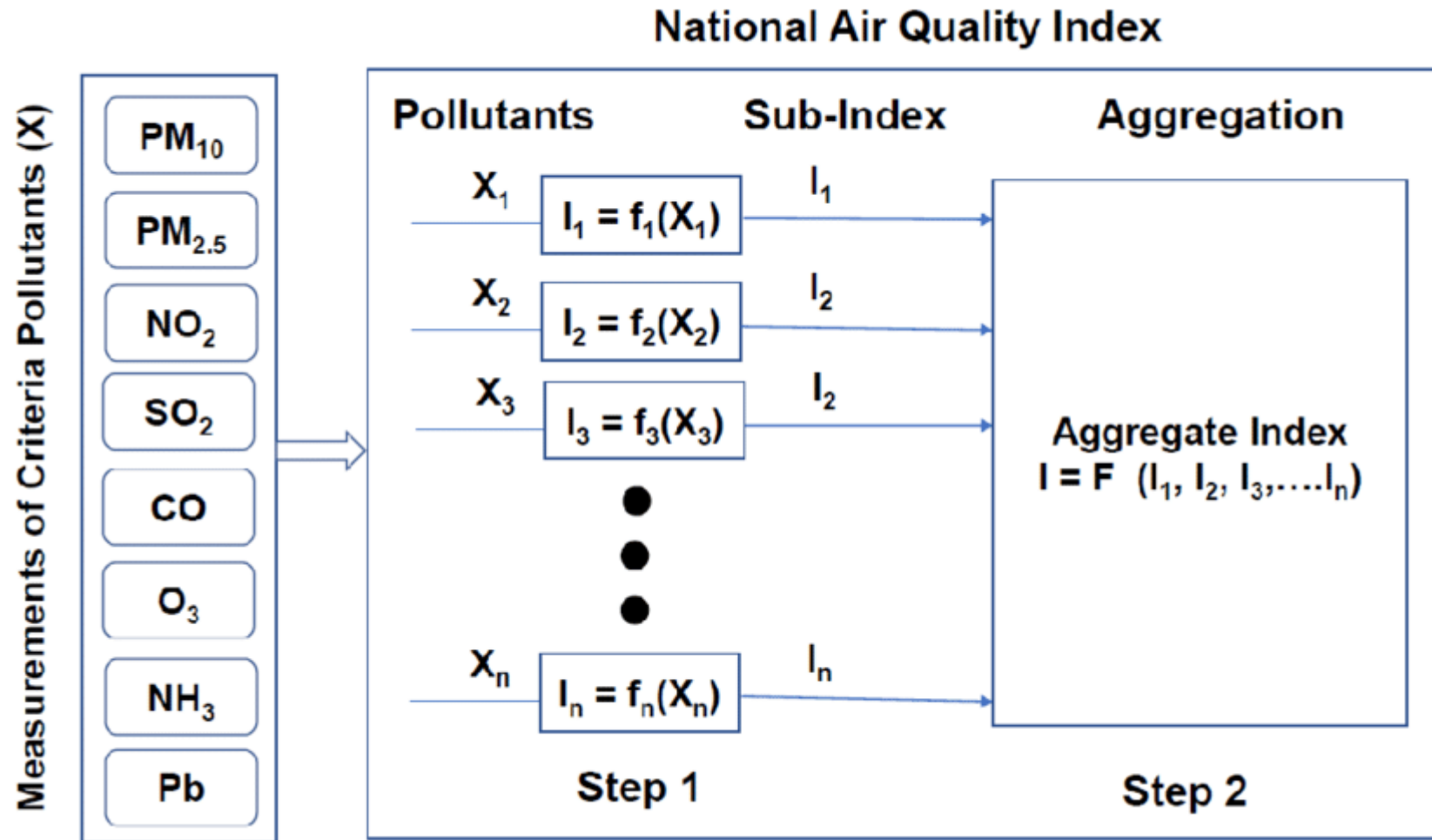


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AQI calculation

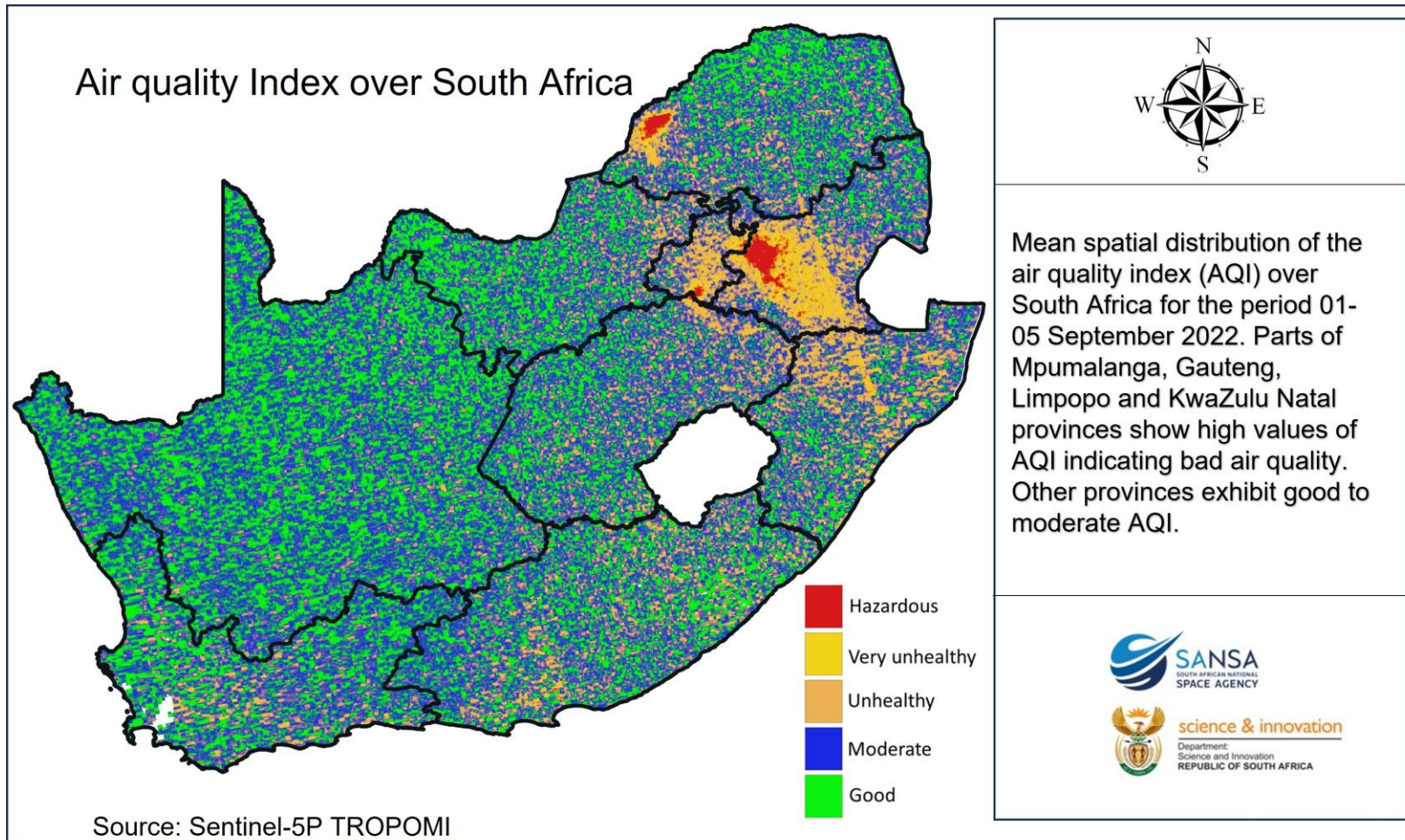


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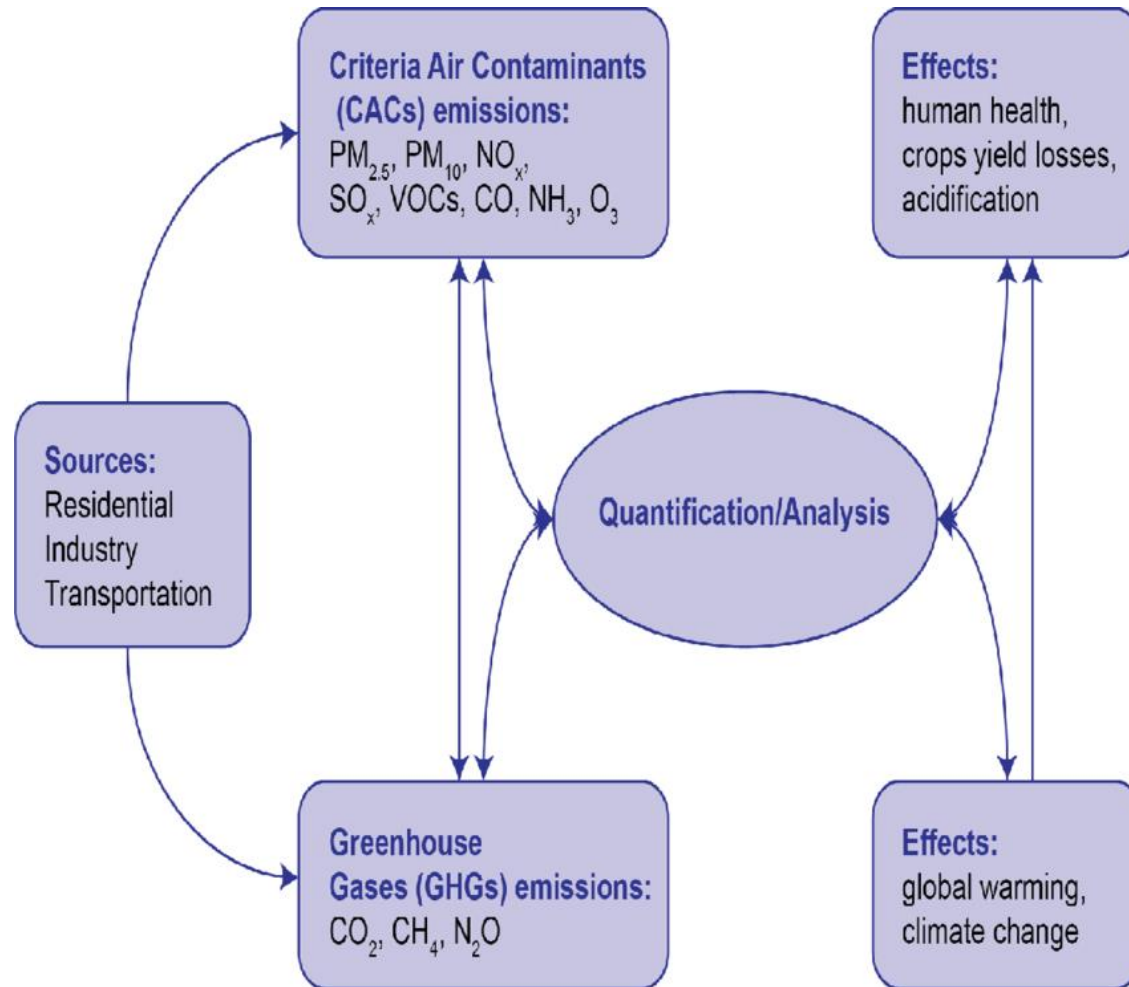
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Calculated Air Quality Index over South Africa using GEE



Conclusion



Laskar, Imranul. (2019). Literature Review and Quantitative Analysis of Community Impacts on Local Air Quality



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