Air Quality Prediction and Forecasting Improvement for Africa (PREFIA)

Ranjeet S Sokhi and PREFIA Members
Centre for Atmospheric and Climate Physics Research (CACP)
University of Hertfordshire, UK

PREFIA Workshop
7-8 October 2019
Institute for Meteorological Training and Research
World Meteorological Organization Regional Training Center (IMTR/WMO-RTC)
Kenya Meteorological Department Headquarters, Nairobi

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  Applications SAG (APP-SAG)
- **Monitoring, Analysis, and Prediction of Air Quality (MAP-AQ)**
- **Members of PREFIA**

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PREFIA Members

African countries

Non-African countries

UK
USA
Finland
The Netherlands
Norway
Spain
Sweden

More than 60 scientists participating

Modelling Groups

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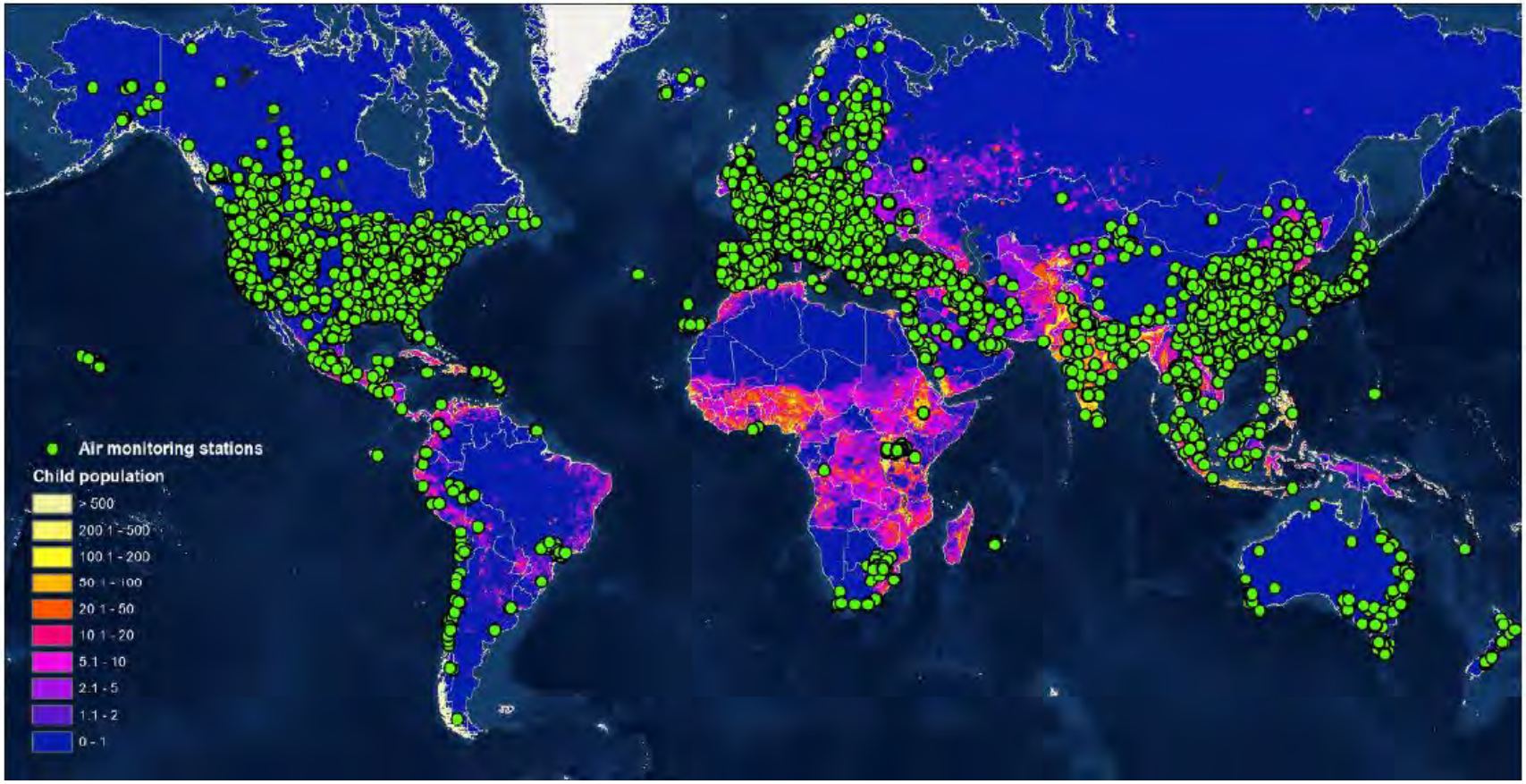
Global Partnership

PREFIA is a catalyst for creating a wider network by collaborating with other groups and agencies including:

- World Meteorological Organisation (WMO) - GURME, APPs, MAP-AQ
- Working Group on Numerical Experimentation (WGNE)
- World Weather Research Programme (WWRP)
- World Climate Research Programme (WCRP)
- World Health Organisation (WHO)
- EUMETSAT
- Global Emissions Initiative (GEIA)
- International Nitrogen management System (INMS)
- International Global Atmospheric Chemistry (IGAC) Project
- International Commission on Atmospheric Chemistry and Global Pollution (iCACGP)
- Integrated Carbon Observation System (ICOS)

Real-time air pollution monitoring stations globally
Source: UNICEF (2019)



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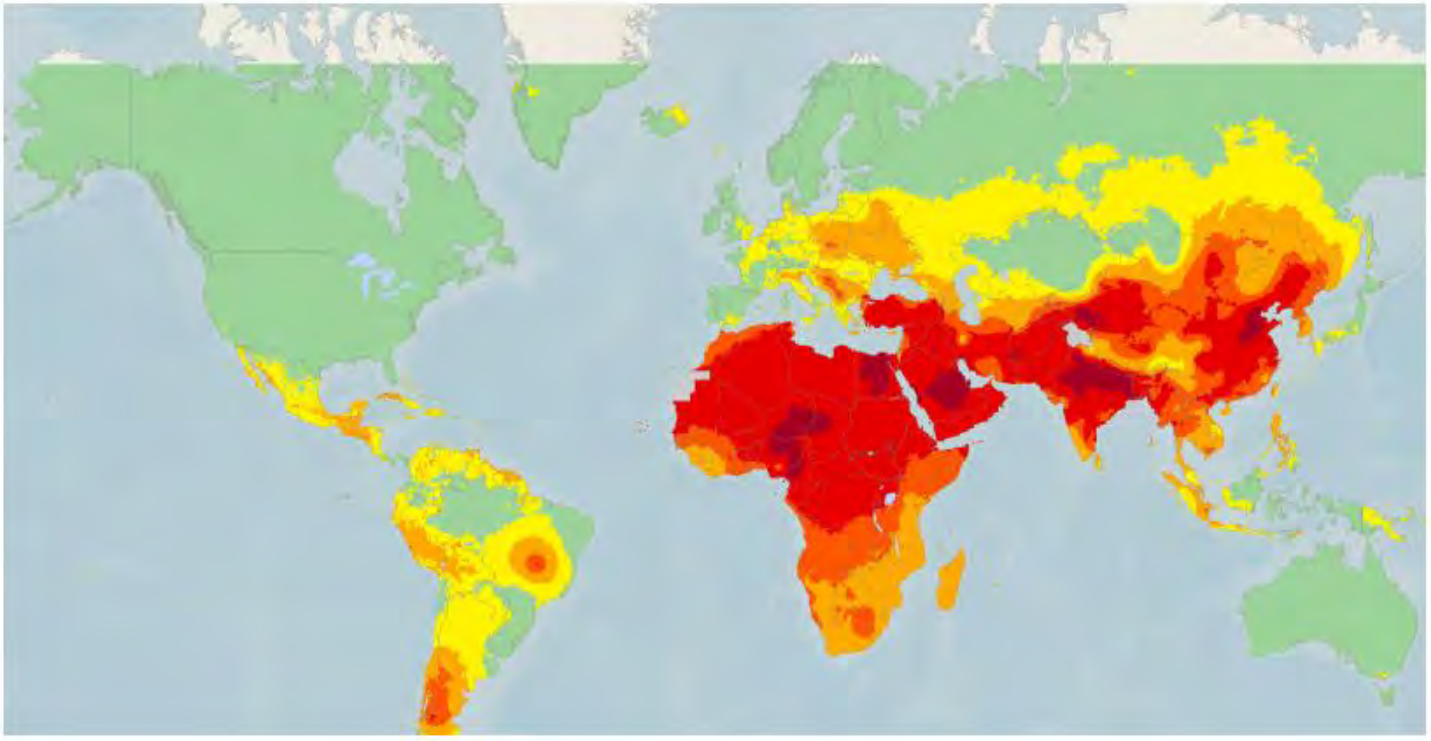
Global Outdoor Air Pollution (PM2.5)

Source: World Health Organization 2018



Modeled annual mean PM2.5 for the year 2016 (ug/m3)

raster:

< 10	< 16 - 25	< 36 - 69
< 11 - 15	< 26 - 35	> 70

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Aim of PREFIA

Aim:

To **develop and improve** air quality prediction and forecasting capabilities and related meteorological analysis for African applications through an international **science and training** effort.

Output:

The scientific development of a multiscale prediction and forecasting framework will be a key instrument to support air pollution management strategies for Africa e.g.

- Local, short term measures
- A regional response for longer term improvements in air quality;
- Contributions from long range transport;
- Quantifying health outcomes resulting from exposure to air pollution

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Specific Objectives

Specific objectives:

1. To undertake a ***comprehensive science based model intercomparison*** for Africa over local to regional scales;

2. To collate appropriate **observational datasets** and ***develop a database to support this initiative*** in terms of model evaluation and improvement;

3. To identify, recommend and implement ***model improvements to reduce uncertainties*** in prediction and forecasting on local to regional scales for African applications;

4. To support ***training of local scientists and users*** in the area of prediction and forecasting of air quality and related meteorological analysis for Africa;

5. To initiate a ***global science dissemination and outreach strategy to transfer knowledge*** to meteorological services, scientists, users and local communities

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PREFIA Work Programme

- **Phase 1 focus on regional and country/subregional scales**
- Model intercomparison exercise with 2015 (?) as the base year (with other groups)
- Individual model and ensemble approach
- Workshop during 7-12 Oct 2019

- **Phase 2 Science case studies to include subregions and urban scales**
- Develop downscaling approaches

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PREFIA Modelling Protocols – Phase 1

- Computed period: baseline year 2017
- No data assimilation is expected.
- Input meteorology and physiography: up to the model

- **Regional domain:**
  - Emission input: CAMS-global inventory preferable
  - Participating models: SILAM, WRF-CMAQ, WRF-Chem, Reg-CM, ECMWF, LOTUS-EURO, MATCH and others….

- **Sub-regional domain:**
  - Next phase

- IC/BC – up to model or common?
  - Copernicus global archives, SILAM archive and others…

- Output file format: NetCDF, CF convention 1.3

- **Observations - critical**

PREFIA Modelling Protocols – Phase 1

- **Output:**
- Output vertical levels: for concentrations, screen level 2m above the ground; for optical thickness, vertically-integrated column
- Output temporal resolution: 1 hour
- **Output variables:**
- 2D 2m concentrations of SO2, SO4, NO, NO2, NO3, HNO3, O3, NH3, HCHO, CO, NH4, OH, HO2. Unit: μg <substance> m-3
- 2D concentrations of dry PM2.5, PM10, PPM2.5 (Primary PM2.5), PPM10 (Primary PM10), EC (Elemental carbon), SOA (secondary organic carbon), SS (Sea salt), D (wind-blown Dust). Unit: μg PM m-3
- 2D dry and wet deposition of the above species. Unit: mg <subst/PM> m-2 hr-1
- 2D column-integrated of AOD at 550nm wavelength, sum of all aerosols, relative unit.
- 2D boundary layer height. Unit: m
- 2D precipitation rate. Unit mm hr-1
- 2D cloud cover fraction. Relative unit [0..1]
- 2D surface temperature. Unit: K
- 2D emission maps for all species used from input inventory or computed by the model. Unit kg <species> m-2 hr-1 cell-1.

PREFIA Modelling Protocols – Phase 1

Decisions:

- Refinement of protocols ✓
- Participants ✓
- Which models ✓
- Analysis of model outputs – ongoing ✓
- Observation datasets – limited ??
- Documentation, report, publication – next phase
- Presentation of first results – Workshop Oct 2019 ✓

PREFIA workshop and Training

7-12 Oct 2019, Nairobi - Indicative plan

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
PREFIA Science Workshop	PREFIA Science Workshop - am Stakeholder event – pm	TRAINING			

Models (to be decided):
Training models - WRF and CMAQ
Share experience e.g. WRF-Chem, SILAM
Case studies for training – to be defined
Post training – trainees to be part of PREFIA activities, establish local AQF systems, science support via PREFIA partners

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PREFIA workshop and Training

7-12 Oct 2019, Nairobi - Plan

Model inter-comparison exercise

Finalise protocols – 15 June 2019

Model run outputs – 15 August

Inter-comparison analysis – On going

Submit paper for journal – 2020

WMO report – 2020

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Final remarks

THANK YOU TO EVERYONE!!!

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