
INAR
INSTITUTE FOR ATMOSPHERIC AND EARTH SYSTEM RESEARCH
FOR THE ONLY PLANET WE HAVE

# CONTRIBUTION TO Solving GRAND CHALLENGES

We have natural greenhouse effect
Without it the mean surface T ca - 18 °C
Now ca 14 °C
Climate is changing but how?

**Climate change**

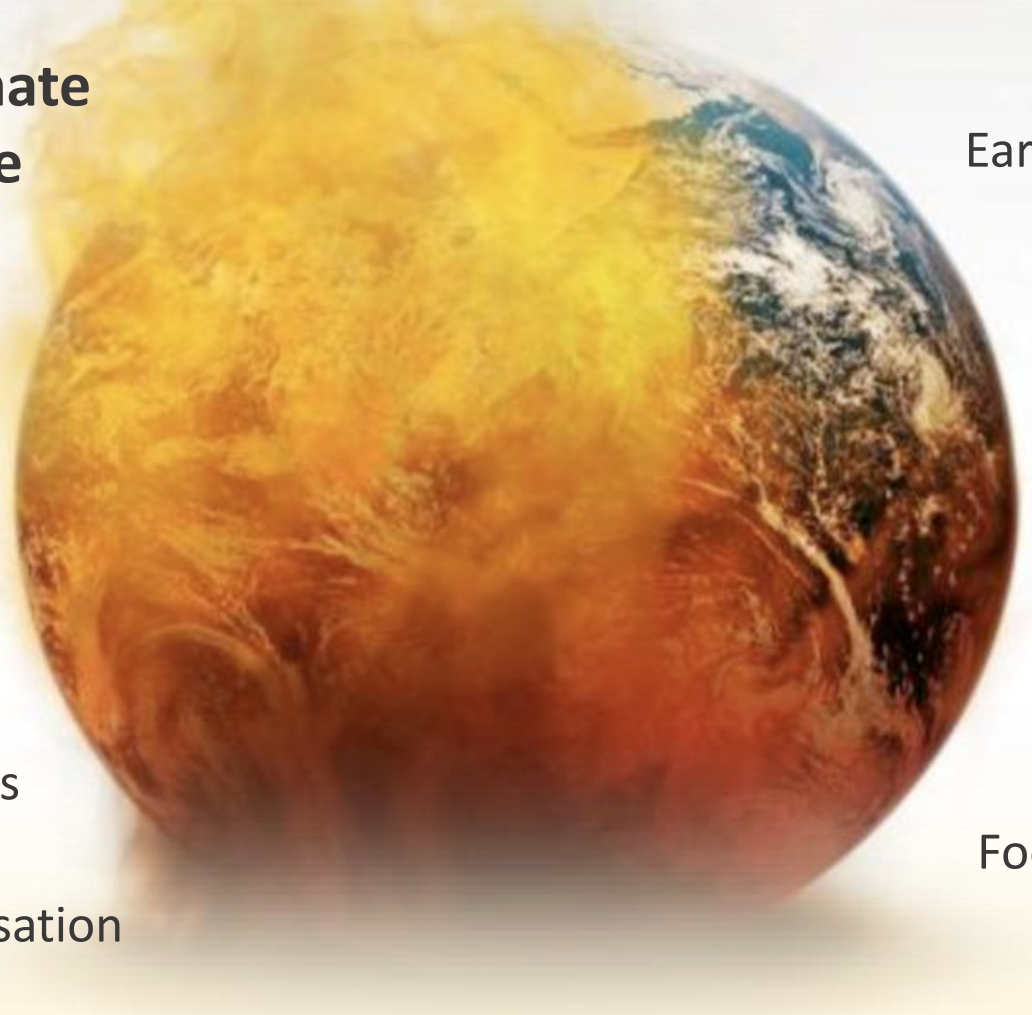
Volcanoes

Energy

**Biodiversity loss**

Epidemic diseases

Chemicalisation



Earthquakes

**Air quality**

**Fresh water**

Ocean acidification

**Deforestation**

Food supplies

**Demography / Population /Urbanization**

**DISCIPLINES**

Natural Sciences

Social Sciences

Medicine

Technology etc

**PEEX / IEAS**

**Science Diplomacy/TWAS**

**WMO/GAW**

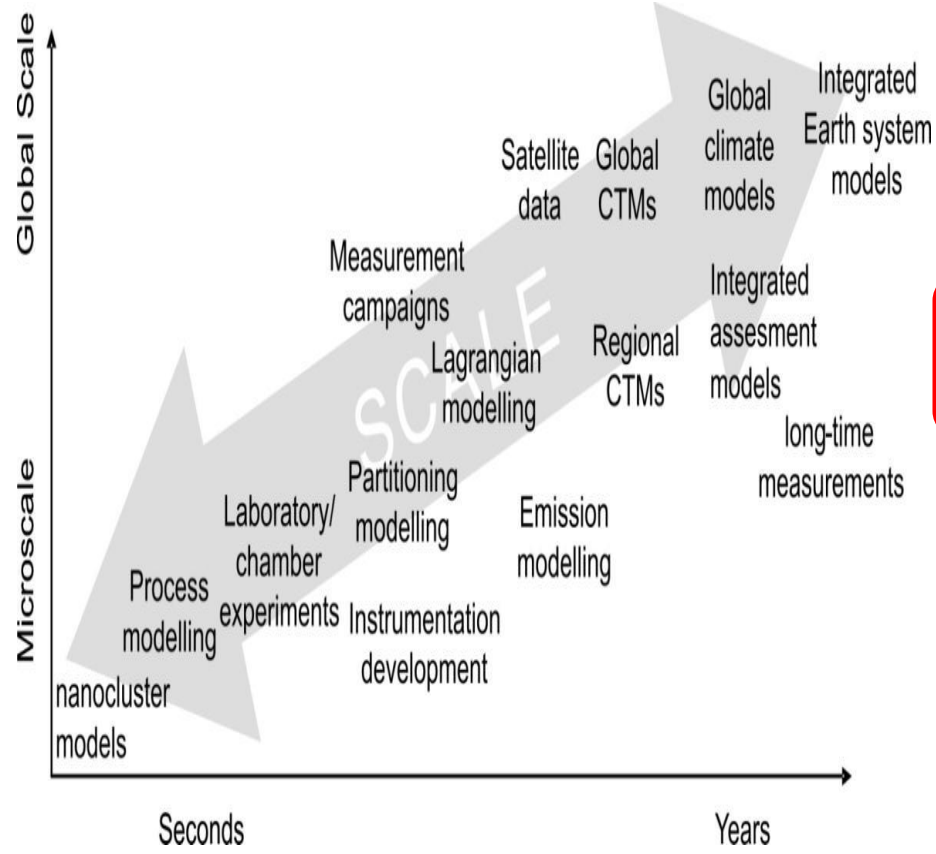
**Global SMEAR**

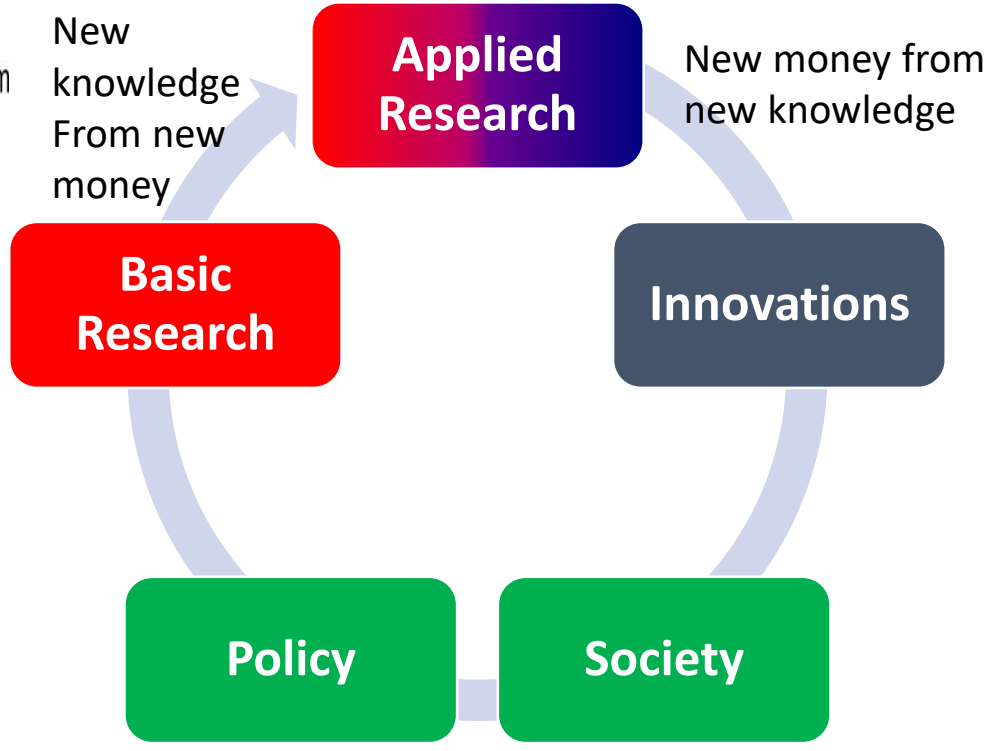
**ICOS, ACTRIS, eLTER**

**From ideas to implementation**

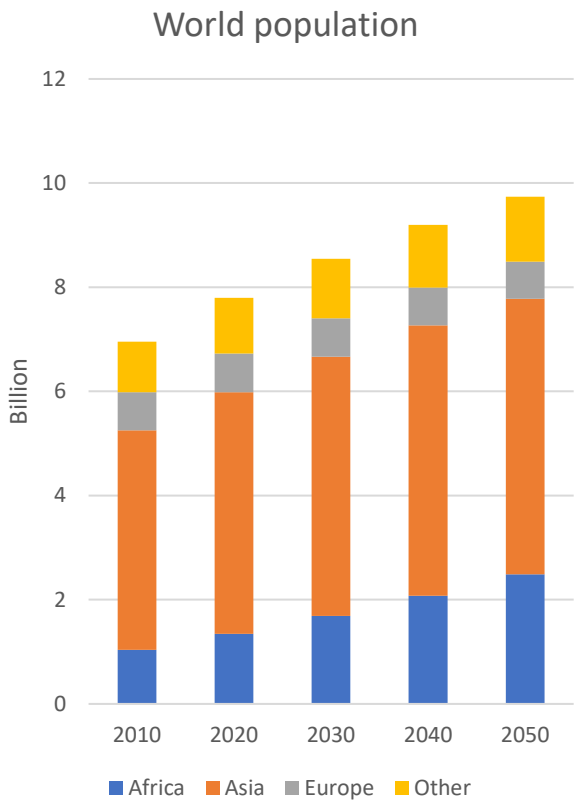
# Grand Challenges: How to answer

- ✓ clear and ambitious vision / from deep understanding to practical solutions
- ✓ empirical and experimental / modelling and new theories
- ✓ multidisciplinary (physics, chemistry, biology, meteorology, economy, social sciences etc)
- ✓ from research to innovations; new SMEs

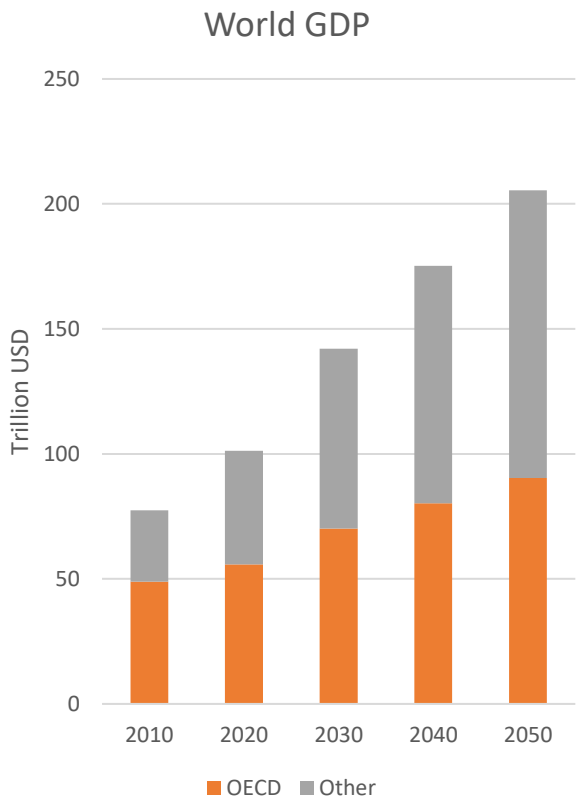


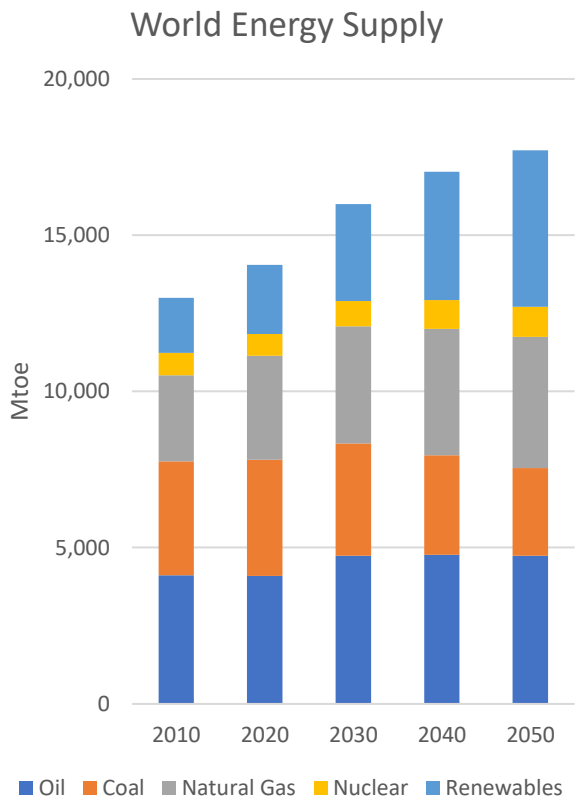
# The Global Energy Challenge



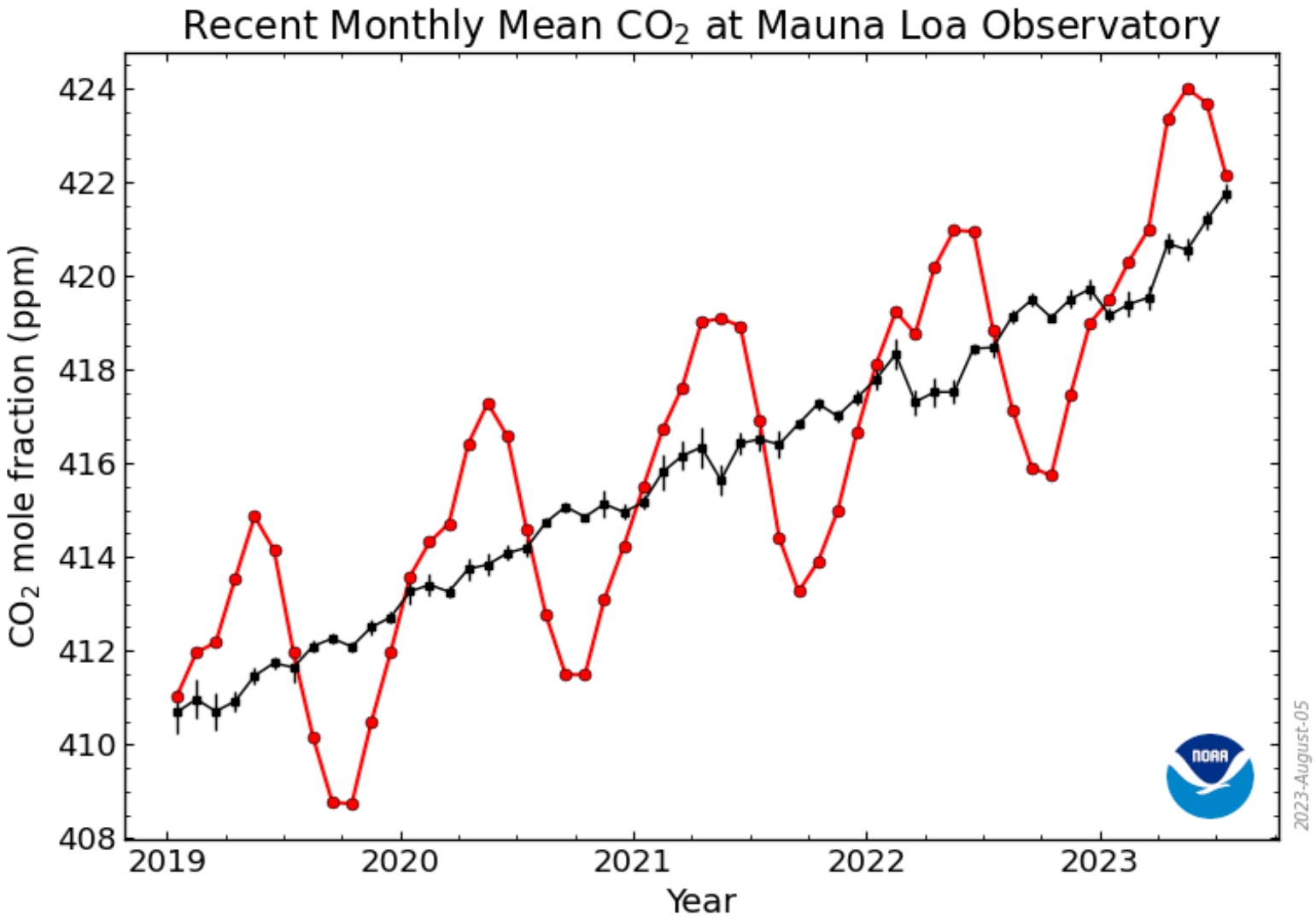

United Nations, World Population Prospects 2019, Medium variant




OECD (2022) Real GDP long-term forecast



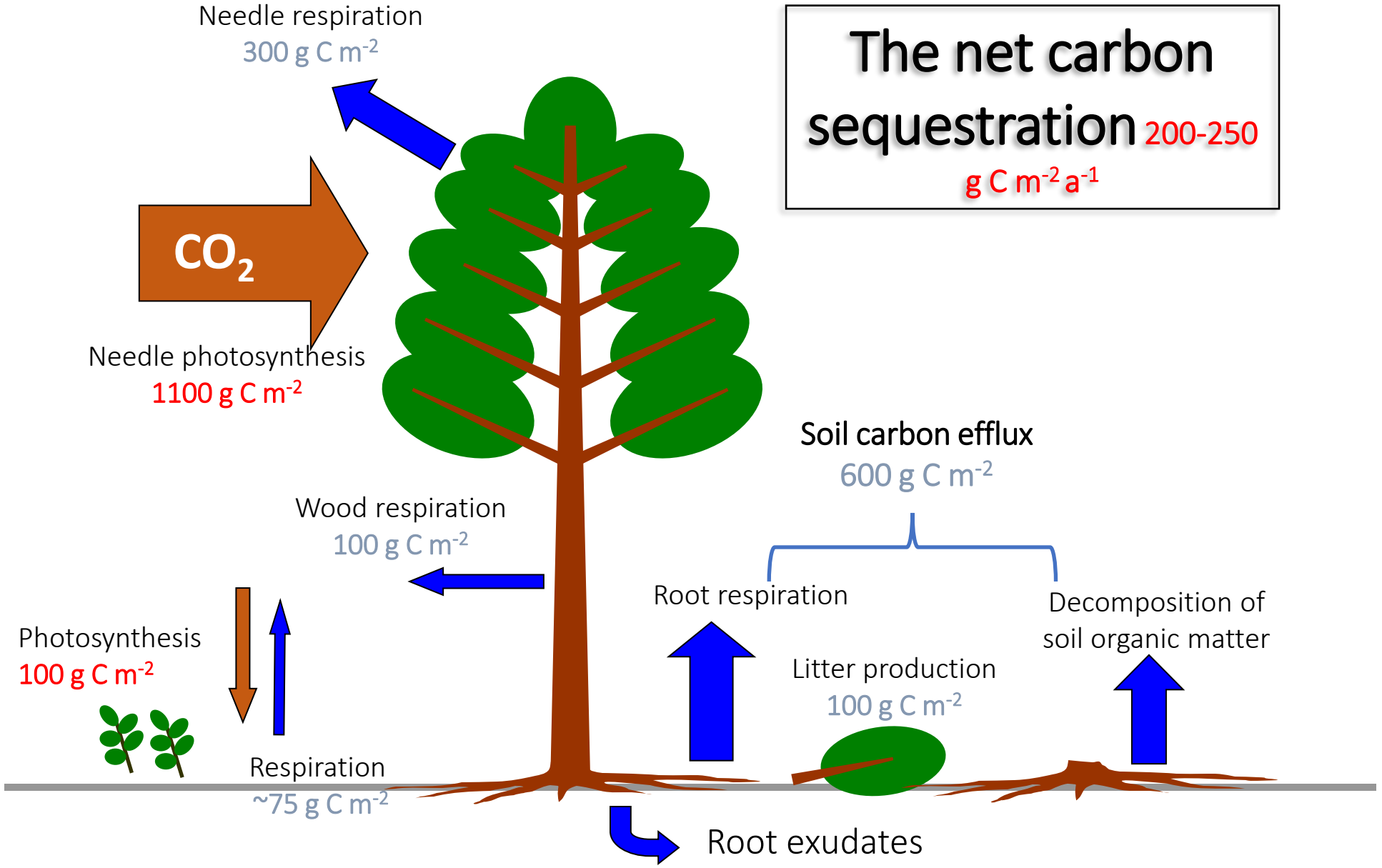

IEA (2021), World Energy Outlook 2021, IEA, Paris, Stated policies scenario (STEPS)




**May 2018: 411.44 ppm**
**May 2019: 414.86 ppm**
**May 2020: 417.31 ppm**
**May 2021: 419.31 ppm**
**May 2022: 420.99 ppm**
**May 2023: 424.00 ppm**

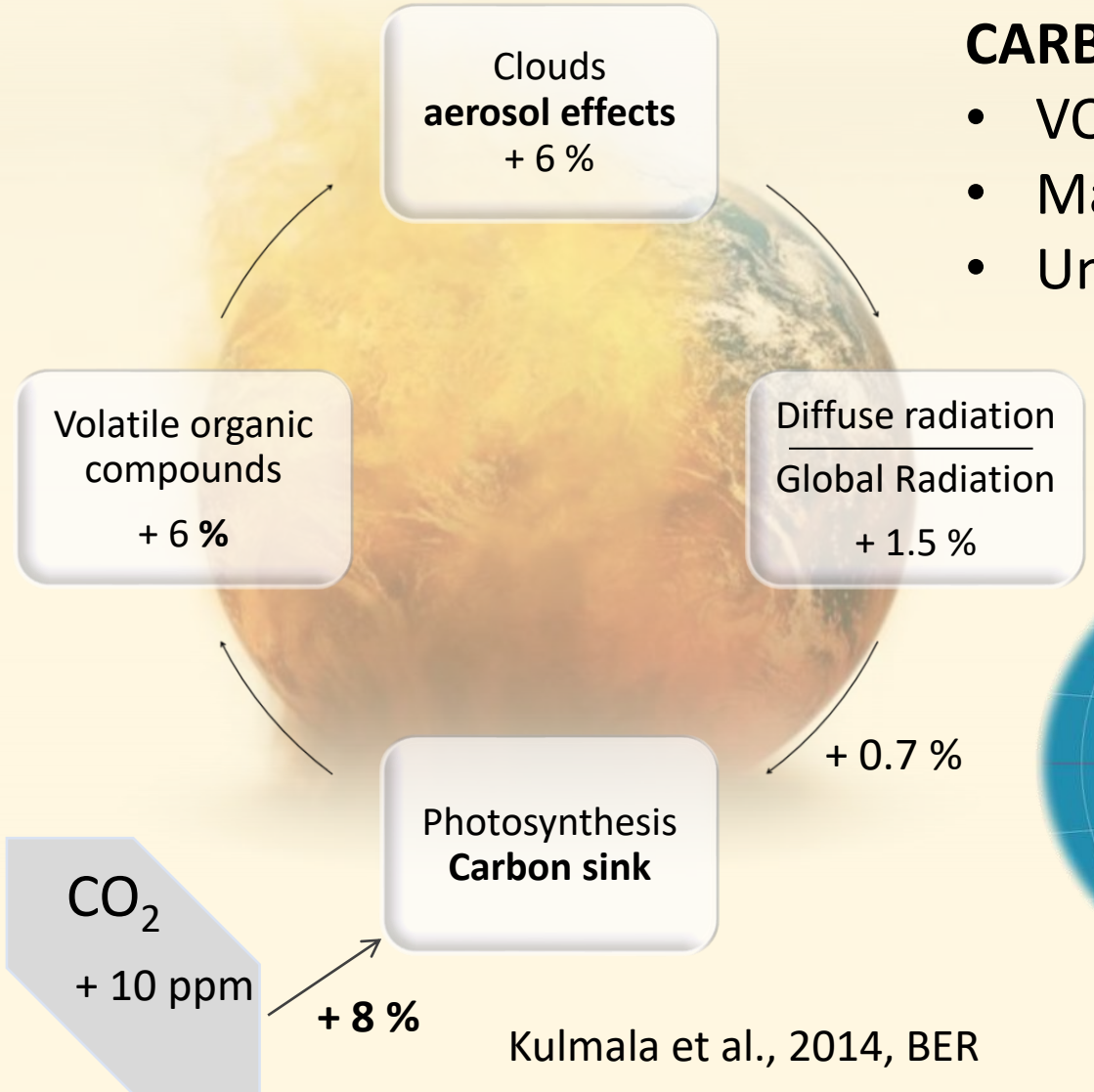
# SMEAR II-station (boreal forest, country side)

# YES: we can measure the sink / CARBON partitioning




Courtesy: Pasi Kolari

# THE POTENTIAL OF SMEAR CONCEPT: GLOBAL COMPREHENSIVE FEEDBACK ANALYSIS

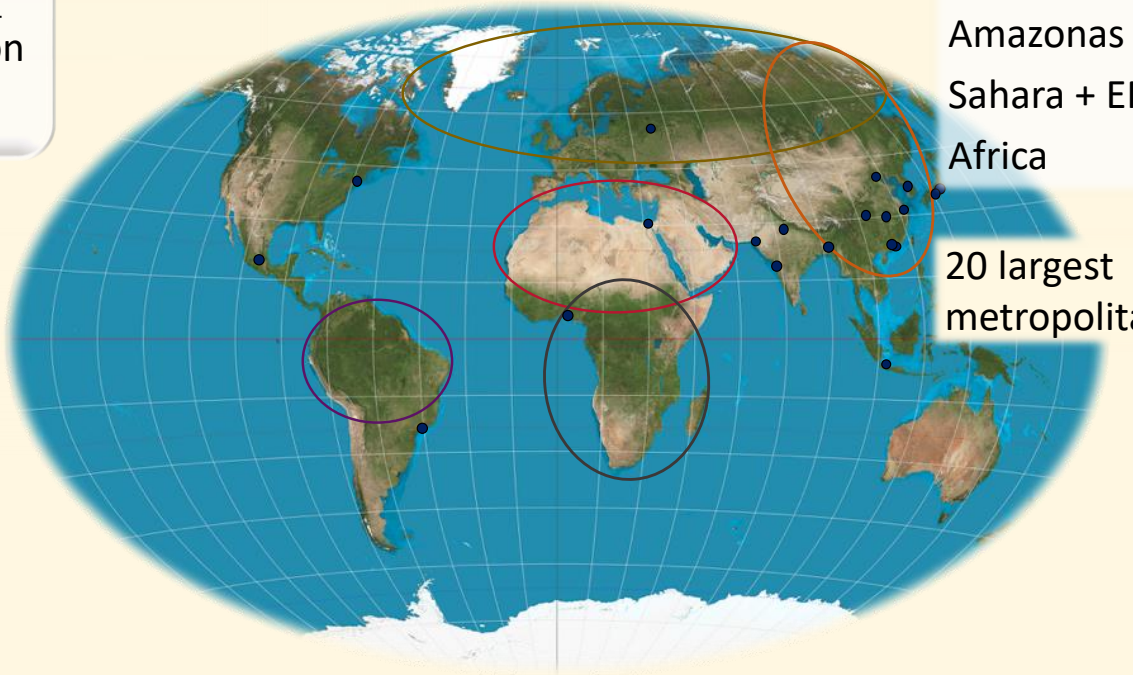



Kulmala et al., 2014, BER

**CARBON SINK PLUS**

- VOCs, Aerosols, clouds, precipitation
- Max 1.8 x carbon sink (Hyytiälä / SMEAR II results)
- Uncertainties

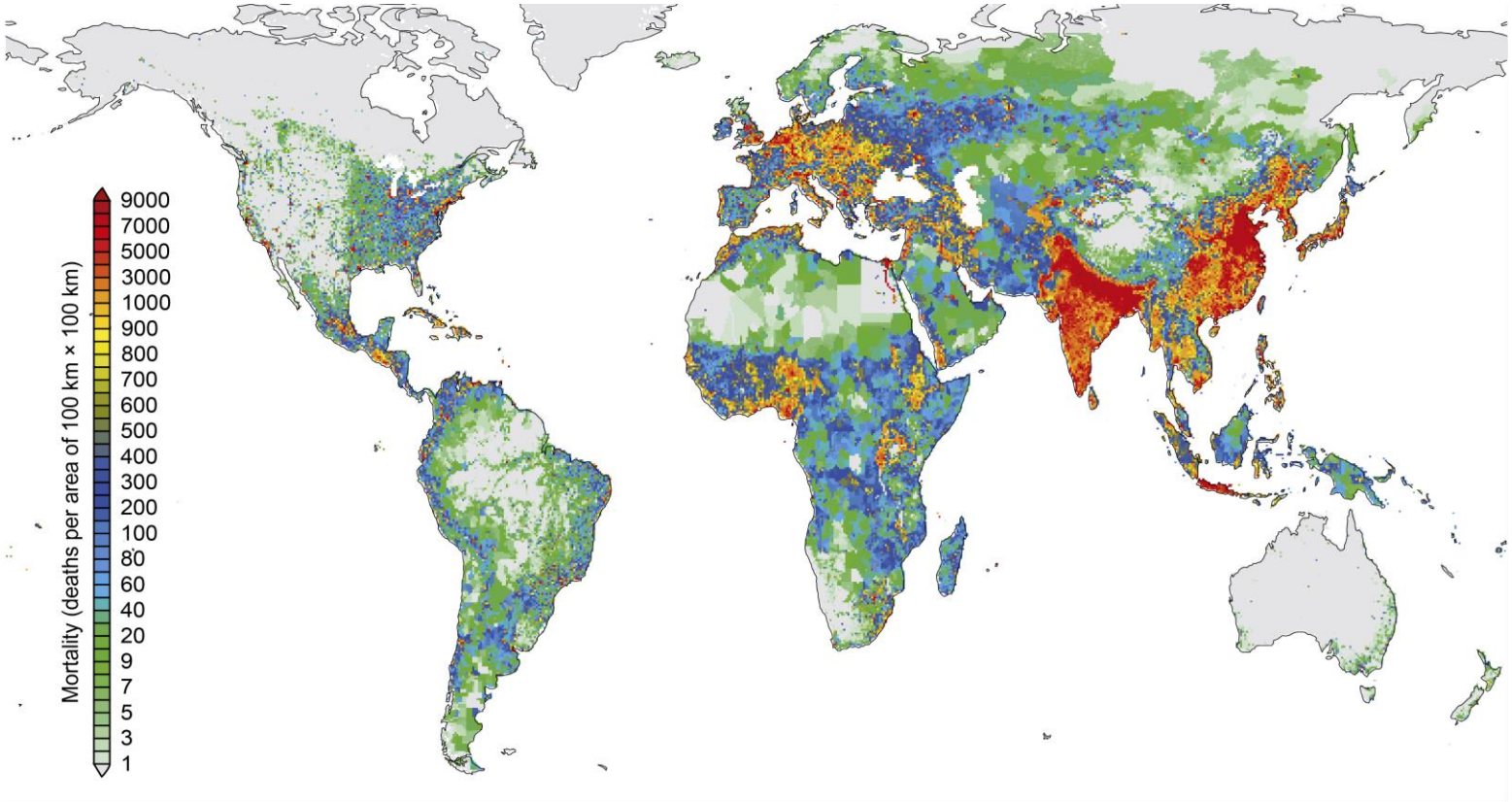
  => observations / models



# Haze - Air Pollution “Cocktails”

## Atmospheric aerosol particles with strong health and climate impact

**Up to 9 million pre-mature deaths caused by aerosol pollution in 2019**

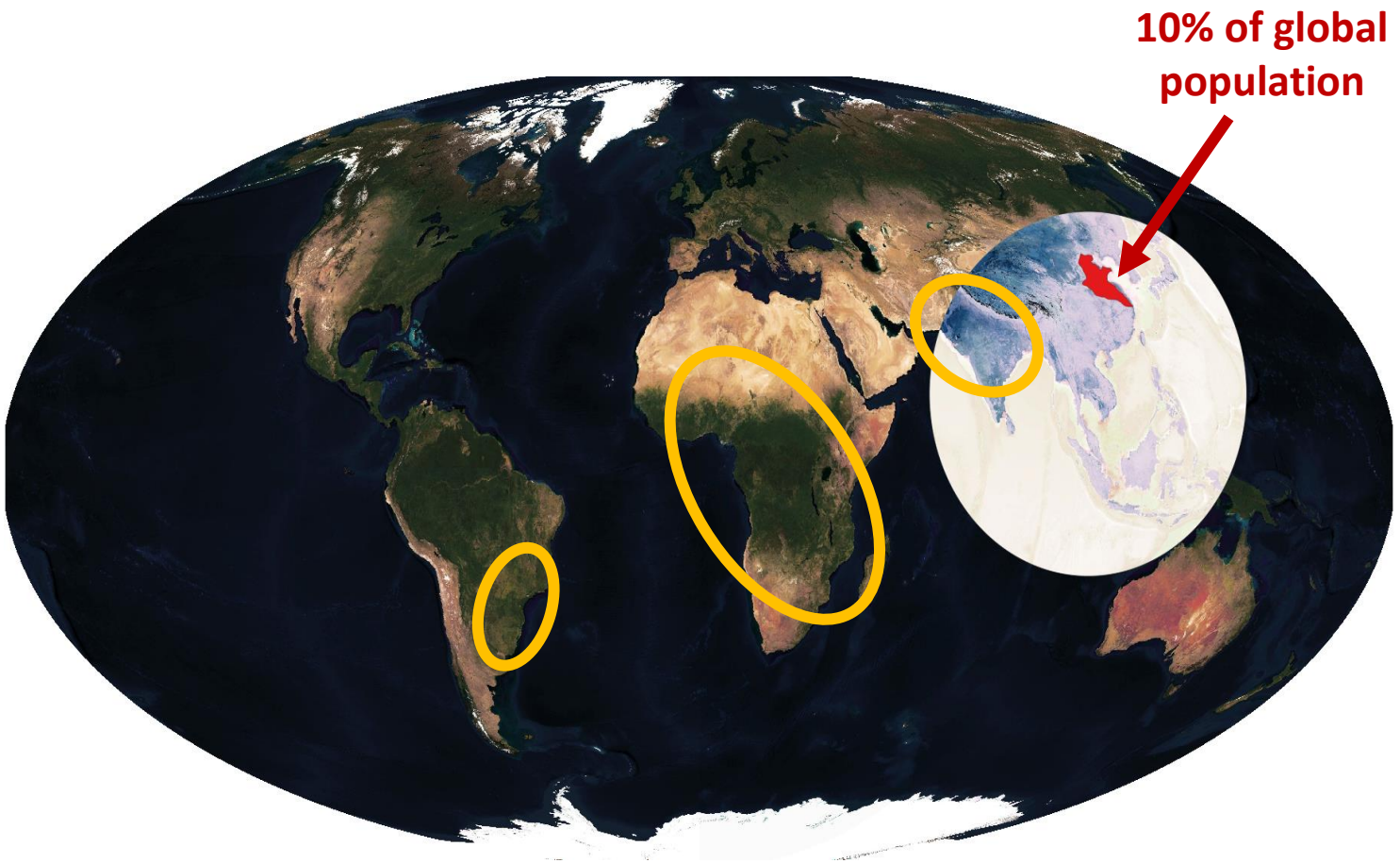


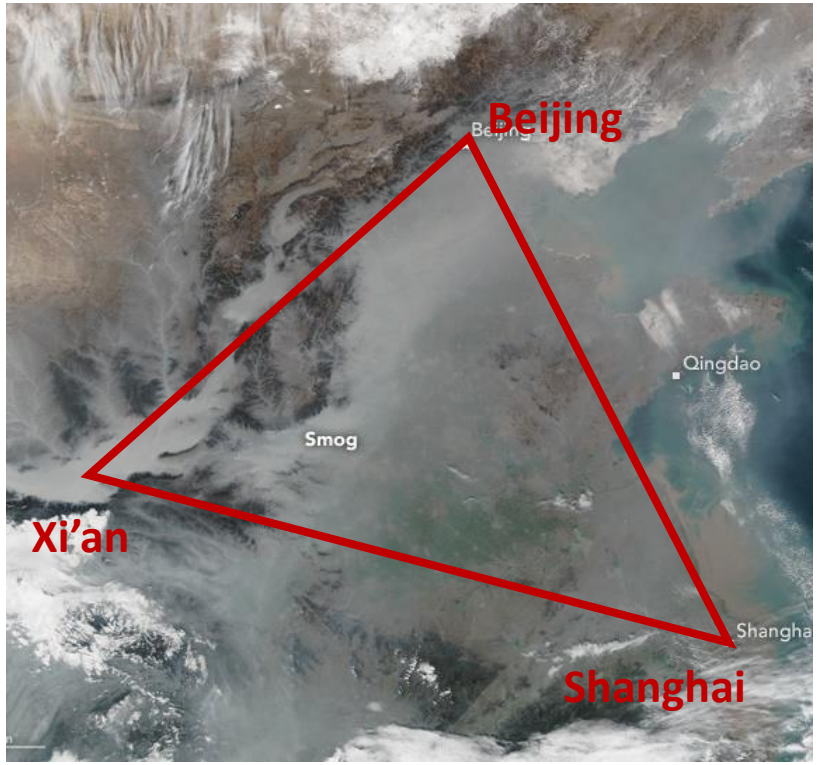

**Haze** vs. **clear blue sky**


**Aerosols remain the largest uncertainty in climate assessment (IPCC, 2021)**

Ni & Cheng 2023; Burnett PNAS 2018; GBD Lancet 2020

# China Gigacity - A living lab for haze study



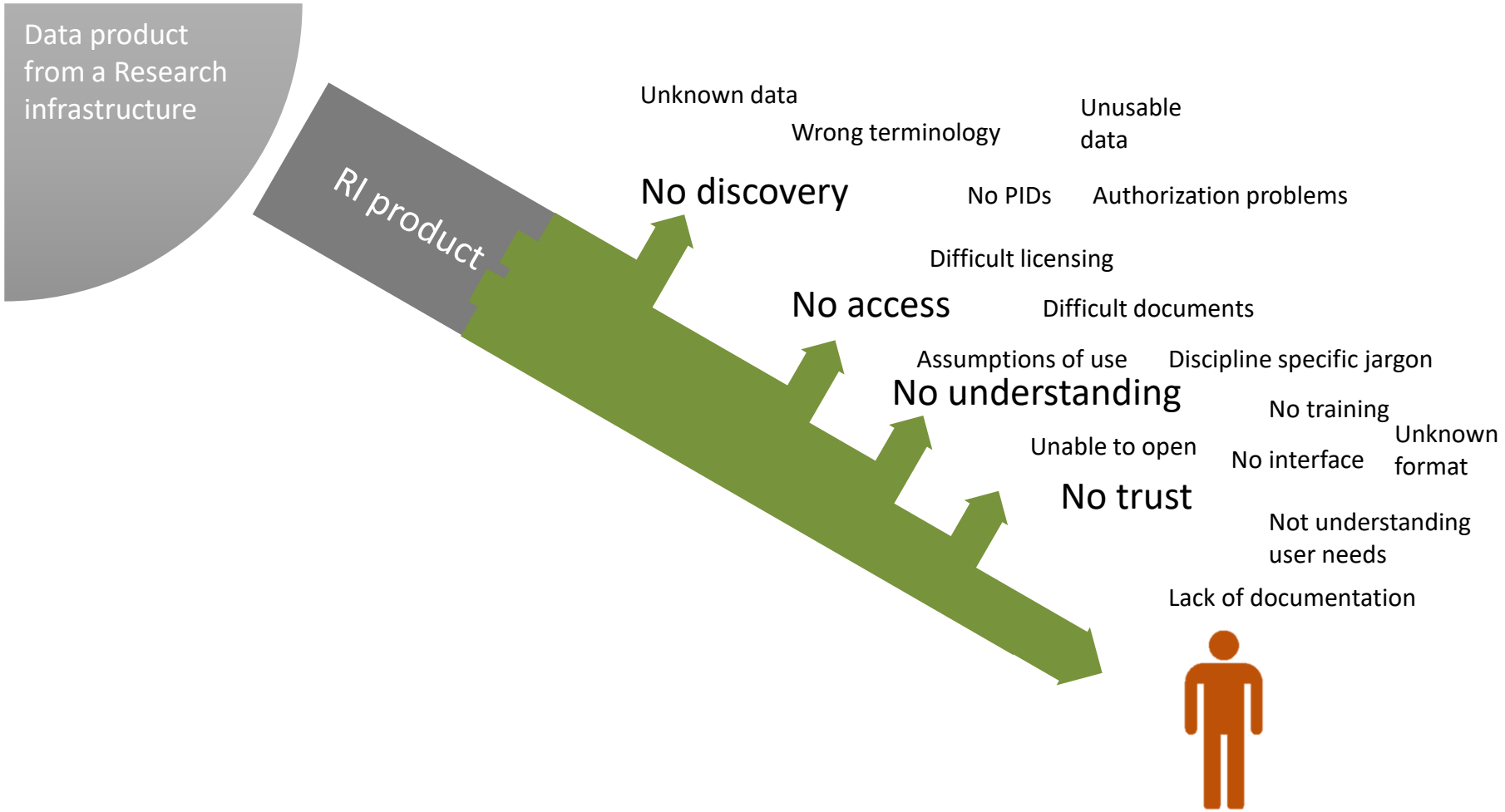

**Knowledge for global development, especially global south**

Kulmala & Ding et al., 2021, ACP; MODIS

# Open access, open data, open science

- Access to research infrastructures
- Access to data
- Data today is heterogeneous and challenging to manage:
- we need to organise:
  - an easy access to the data
  - plan harmonised and standardised ways to analyse it

# Barriers of information



# Science Diplomacy helps to answer global grand challenges

- We need open science, open data to meet global grand challenges
  - Without comprehensive data we are not able to meet the challenges
  - Present and future questions
- Geopolitics
  - Barriers, problems
  - To achieve open data is not easy or it is even impossible
  - Science diplomacy could help
- Science Diplomacy
  - important tool to ensure open science, open data
  - long-term, persistent networking
  - Present and future questions/challenges
- Trust – networks
- High scientific level open doors