HISTORICAL REVIEW OF STUDIES ON AIR QUALITY AND CARBON SCIENCE IN SUB-SAHARIAN AFRICA

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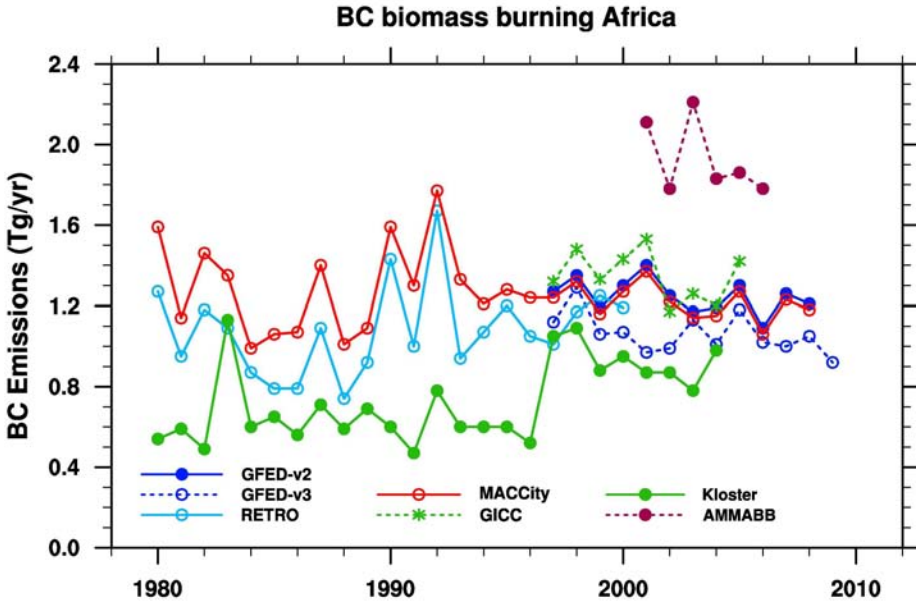
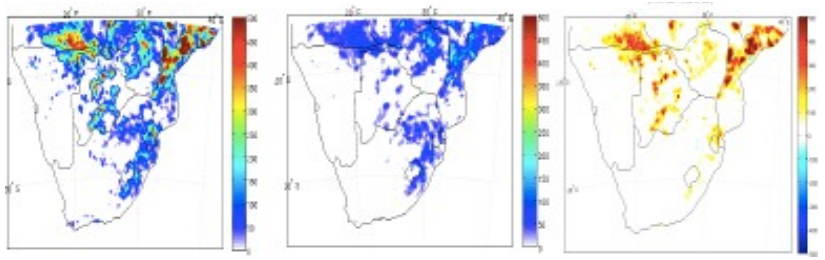
ONCE UPON A TIME :

- **1990** : FOS-DECAFE on biomass burning in Cote d'Ivoire : emissions, atmospheric composition.
- **1992** : SAFARI on biomass burning in South Africa : emissions, atmospheric composition, climate, ecology (at the same time TRACE-A experiment on transport, chemical composition of the atmosphere over the tropical South Atlantic Ocean)
- **1996** : EXPRESSO on biomass burning in Central Africa : emissions, atmospheric composition
- **From 1994** : IDAF (now INDAAF) long-term network of observations on atmospheric composition and deposition (8 rural sites in West and Central Africa (Niger, Mali, Senegal, Benin, Côte d'Ivoire, Cameroon and Congo); still active : see https://indaaf.obs-mip.fr/network/ with link to DEBITS in South Africa (4 sites); in 2020, the INSA project on Integrated Nitrogen Studies.
- **2006** : AMMA project in West Africa on Monsoon, Climate, Weather predictions : this includes important works on biomass burning and dust emissions, aerosol measurements in rural areas, regional modeling on aerosol radiative impact.
- **From 2012** : WASCAL project on climate change studies and climate services (https://wascal.org/projects/)

Laurent et al. 2008, Liousse et al., 2010, Tummon et al., 2010, Malavelle et al., 2011, Ndatchoh et al. 2015, Ouafo et al. 2018 etc..

BIOMASS BURNING EMISSIONS





AMMABB *GFED-GFAS* *AMMABB - GFED*

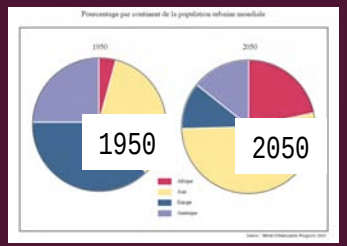
After having tested the role of emission factor and burnt area data, lack of knowledge on vegetation parametrization seems to be responsible for such differences

Liousse et al., 2010, Granier et al., 2011, Stroppiana et al. 2011, N'Datchoh et al., in prep.

BIOMASS BURNING AND DUST SOURCES ARE NOT THE ONLY CAUSES OF POLLUTION IN AFRICA

Intense photochemistry

Large increase of urban population



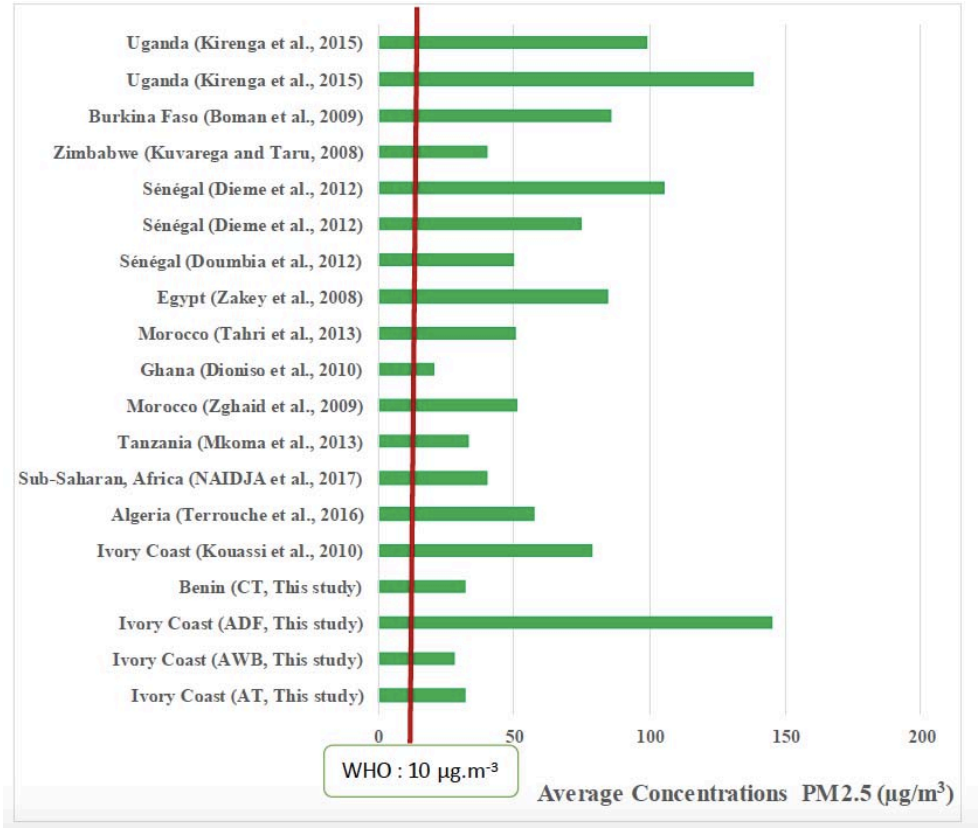
A cocktail of pollutants

Few regulations

ONCE UPON A TIME : *STUDIES ON AIR QUALITY*

- **2005** : first experiments on air pollution in Cotonou (Benin) during the **AMMA** project
- **2008** : **POLCA** on Air pollution and Health in Bamako (Mali), Dakar (Senegal) and Yaoundé (Cameroon)
- **2014** : Anthropogenic emission inventories in Africa for 2005 and 2030
- **2016** : **DICE** anthropogenic emission inventory in Africa by Marais and Wiedinmeyer
- **2014-2018** : **DACCIWA** on Air pollution and Health in Abidjan (Cote d'Ivoire) and Cotonou (Benin), emission inventory studies and health impact
- **2015-2018** : **CHAIREPOL** on Air Pollution and Health in Abidjan, Ouagadougou, Cotonou and Dakar (indoor and outdoor pollution)
- **2018-2022** : **PASMU** on Air pollution and Health in Abidjan and Korhogo
- **From 2015** : **GDRI-ARSAIO** on Air pollution and Health in South Africa
- A few other studies conducted in Dakar, Cotonou, Accra by local universities with international collaborations

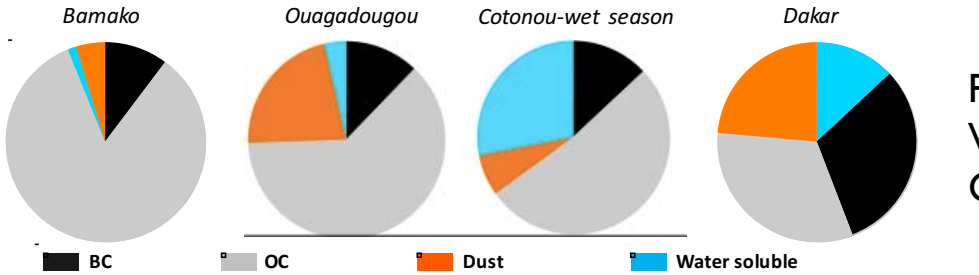
PARTICULATE MATTER CONCENTRATIONS ARE ALWAYS HIGHER THAN THE WHO NORMS



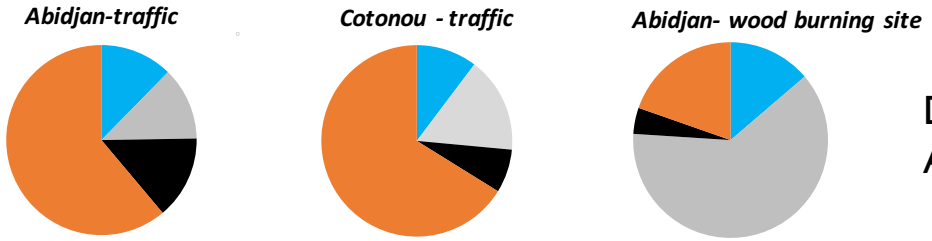
From Djossou et al., 2018 (DACCIWA results)
Confirmed by recent papers
(e.g. Adon et al., 2020, Gnamien et al. 2020)

ORGANIC CARBON AND DUST PARTICLES ARE THE MOST IMPORTANT AEROSOL COMPONENTS WITH STRONG SEASONAL VARIATIONS

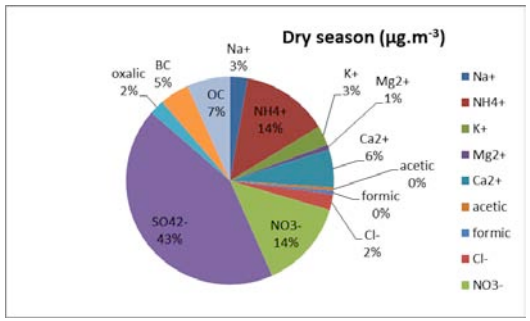
Fine aerosol chemical speciation



POLCA and AMMA campaigns
Val et al., 2013 (Doumbia phD)
Cachier, pers. com.

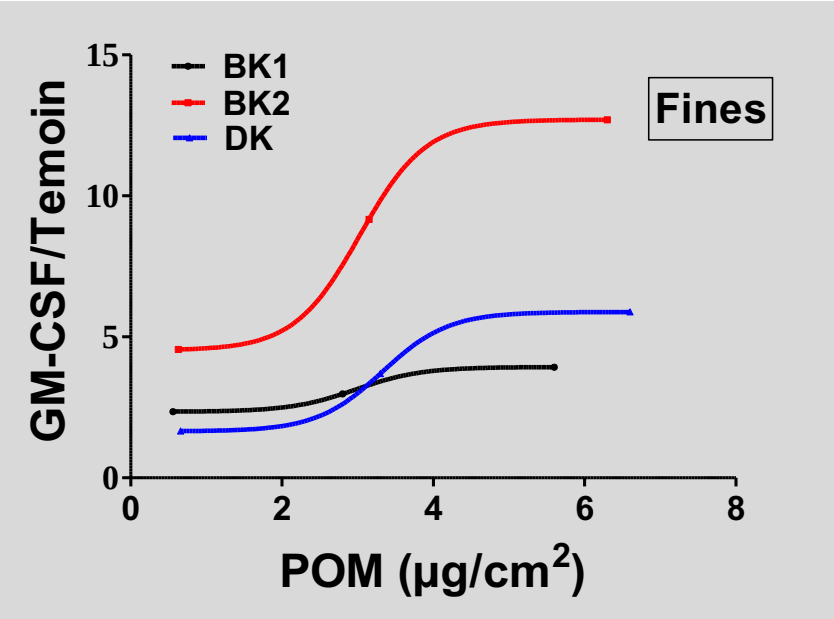


DACCIWA dry season
Adon et al., 2020

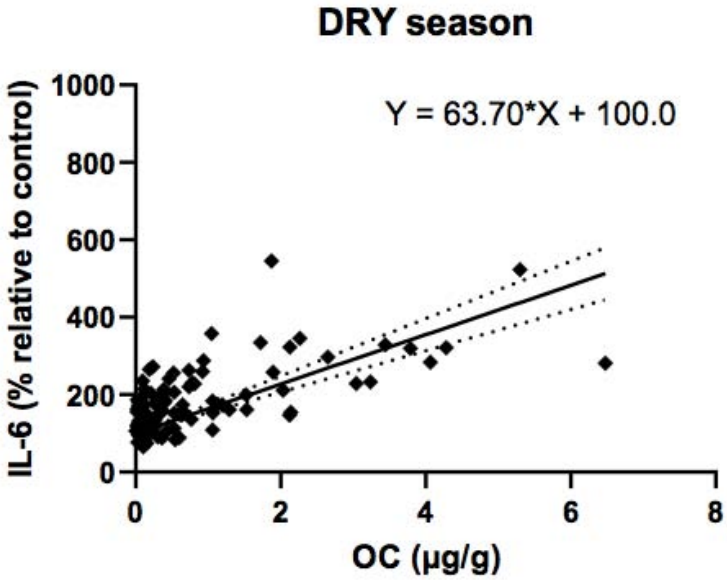


South Africa :Vaal triangle
Josipovic et al., 2018

THE AEROSOL PRO-INFLAMMATORY RESPONSE HIGHLY CORRELATED WITH CARBONACEOUS AEROSOL (BC, OC, WSOC)

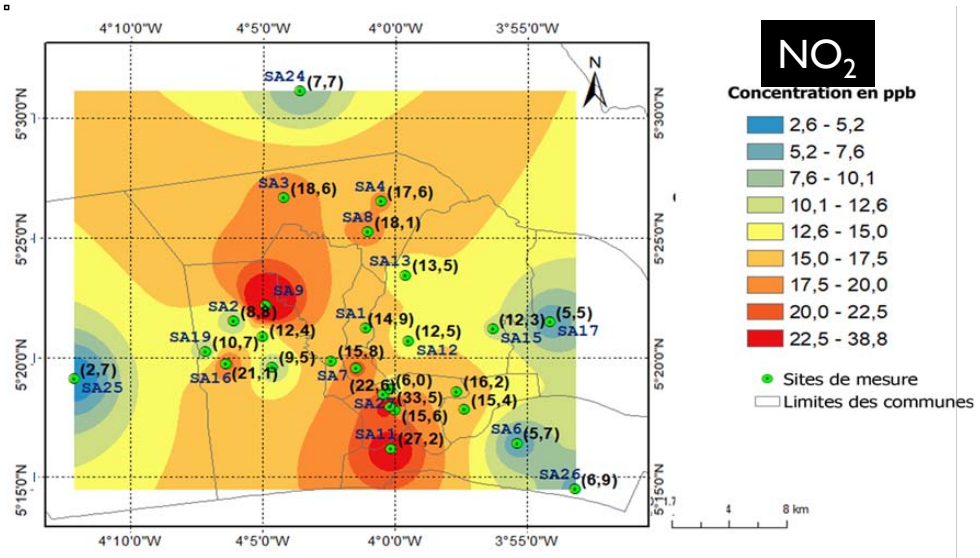


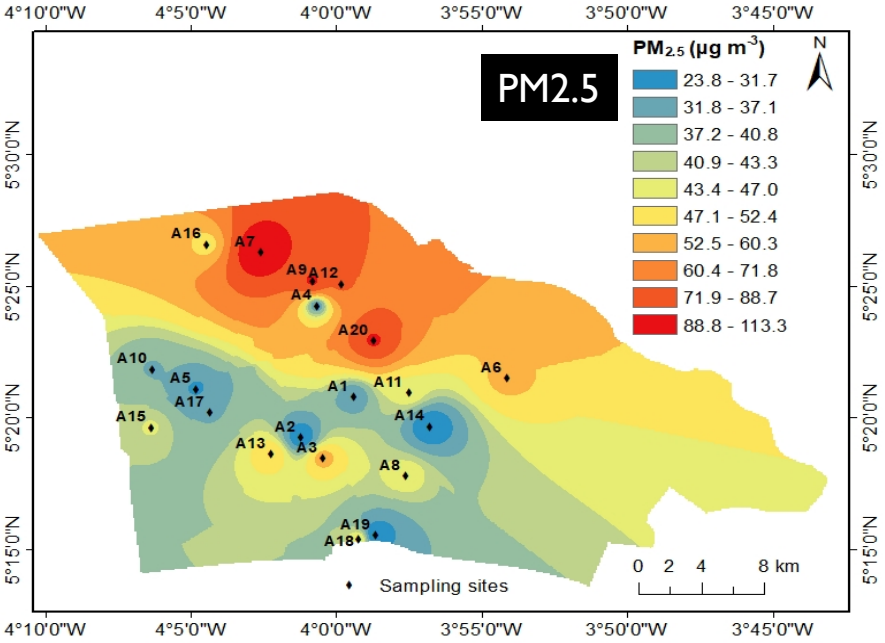
POLCA campaign : Val et al., 2013



DACCIWA campaign : Tran et al., in prep.

HIGH SPATIAL VARIABILITY OF POLLUTANT CONCENTRATIONS AT A CITY SCALE (E.G. ABIDJAN)

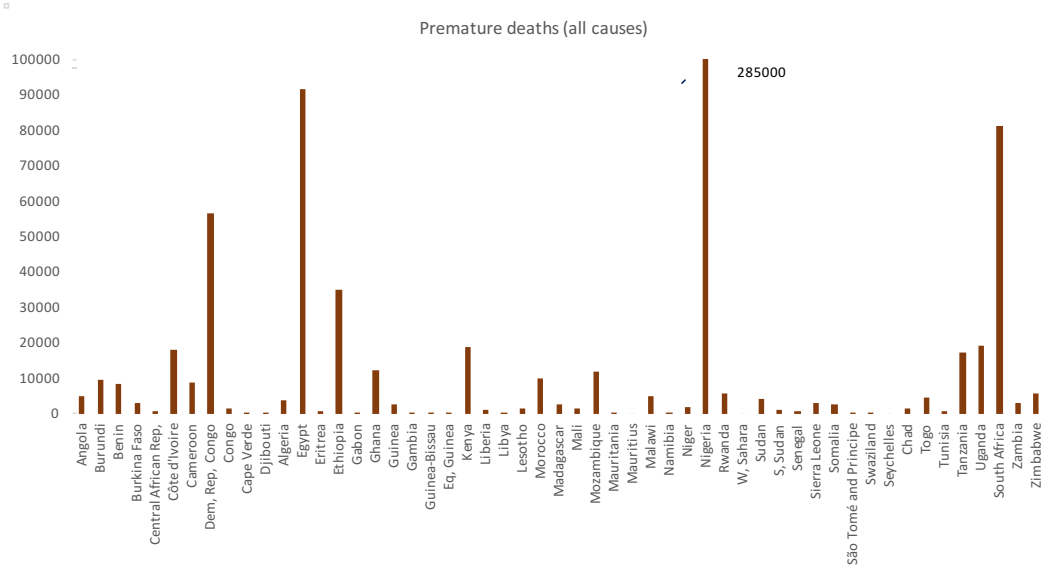


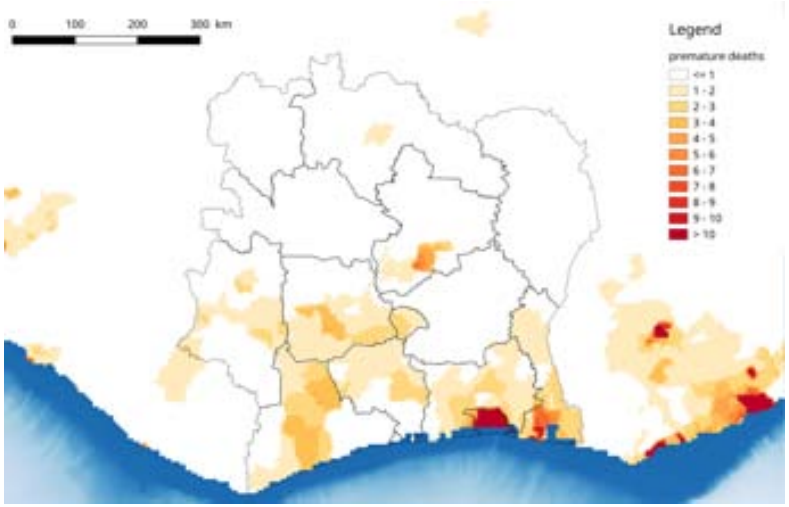


DACCIWA program : Bahino et al., 2018

PASMU program : Gnamien et al., 2020

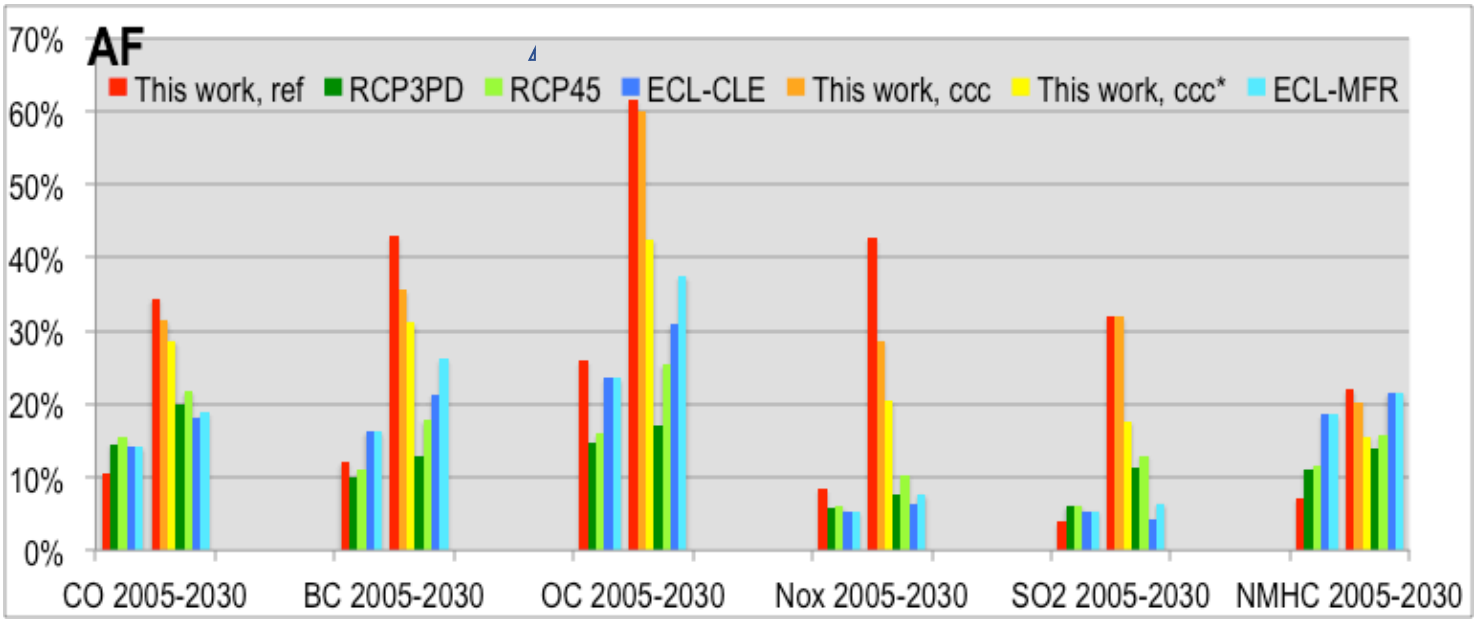
NEARLY ONE MILLION OF PEOPLE PER YEAR DIED FROM AIR POLLUTION IN AFRICA





DACCIWA results : N'Datchoh et al., in prep., from RegCM anthropogenic PM2.5 modeling.
In agreement with data given by Lelieveld et al., 2020 and by WHO.

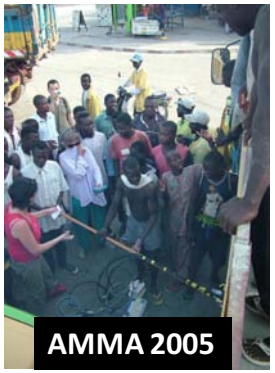
EXPLOSIVE EMISSIONS AND IMPACTS IF NO MITIGATIONS ARE PLANIFIED



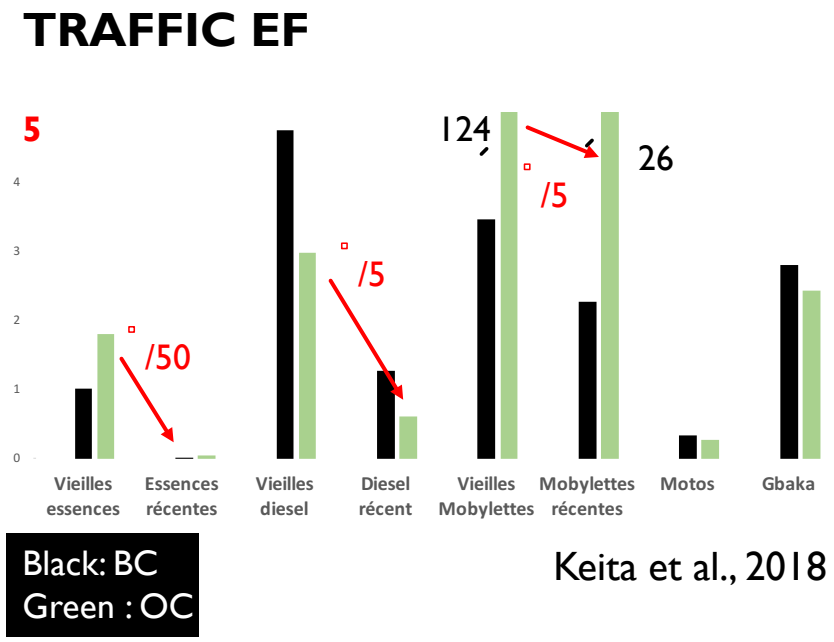
African anthropogenic emissions of organic particles could lead the world (25% in 2005 => 60% in 2030)
Emissions x 4 => OC x 4 in urban areas and x 2.5 in rural areas (RegCM modeling)

Liousse et al., 2014

EMISSION FACTOR MEASUREMENTS : A TOOL TO TEST MITIGATION EFFORT



Needs to focus on residential, waste burning, and traffic sectors



TAKE-HOME MESSAGES

- **Long-term measurements of air pollution in african megacities are urgently needed**
- **Emissions : need local observations and international intercomparisons**
- **New proxys for health such as aerosol oxydant capacity are really important to study air pollution and health effects**
- **Reconciling epidemiological studies with biological studies : need more cohort studies with personal exposure measurements (exposology) : a way to act on source mitigation.**
- **Need to integrate sociological factors to take into account the people vulnerability to air pollution**
- **Do not separe urban studies on health and climate (we need win-win results).**

Thanks for your attention