AIR QUALITY AND CLIMATE IMPACT OF CHARCOAL USE IN AFRICA

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5-SECOND SUMMARY

- 208 Tg fuelwood burned to produce charcoal in 2014.
- Emissions of pollutants in 2014 are 15 Tg CO, 40 Gg BC, and 80 Gg OC, and 1.8 Tg CH_4.
- Charcoal production likely to double from 2014 to 2030 due to rapid urbanization

Introduction

Charcoal is a dominant energy source in Africa, growing at 7% per year due to urbanization and population growth (Arnold *et al.*, 2006), low electricity access (Sawe, 2014) and unaffordable alternatives (GIZ, 2014). Charcoal production, use (including plastic burning), and transport produce emissions of aerosols and trace gases (FAO, 2017) that impact air quality, human health and climate (Marais and Wiedinmyer, 2016).

Here we develop a substantially improved representation of air pollutant emissions from the charcoal supply chain in Africa for 2014 and use the GEOS-Chem model to determine the impact on local air quality and global climate.

The charcoal supply chain

Production in rural areas

Kilns combustion efficiency < 20%

Large source of CO, NMVOCs, OC, CH_4

Rural to urban transport

Unregulated and outdated diesel trucks.

Large source of NO_x and BC

Use in densely populated urban centres

Includes burning of plastic to initiate combustion. Prevalent in slums.

Source of HCl

Activities and Emission Factors

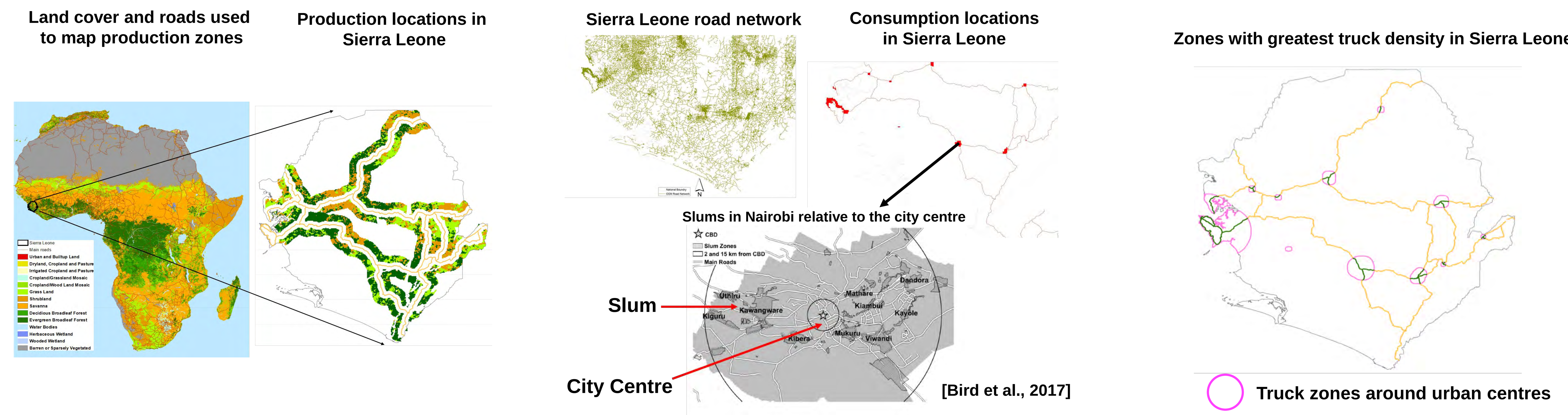
Amount of charcoal produced and used is from the United Nations Energy Statistics database.

Number of trucks obtained assuming each truck transports 15.8 tonnes of charcoal.

Our own estimate of plastic use in slums across Africa

Air pollutant emission factors from Akagi et al. (2011) for charcoal, Zavala et al. (2017) for trucks, and Jayarathne et al., (2018) for plastic.

Mapping Charcoal Production, Use, and Transport



Production:
mapped 5 to 15 km from primary roads (Campbell, 1996). We also account for vegetation distribution and protected areas

Consumption:
Urban extent determined as lines in the OpenStreetMap residential road network with cell size > 1 mm and radius > 25 mm

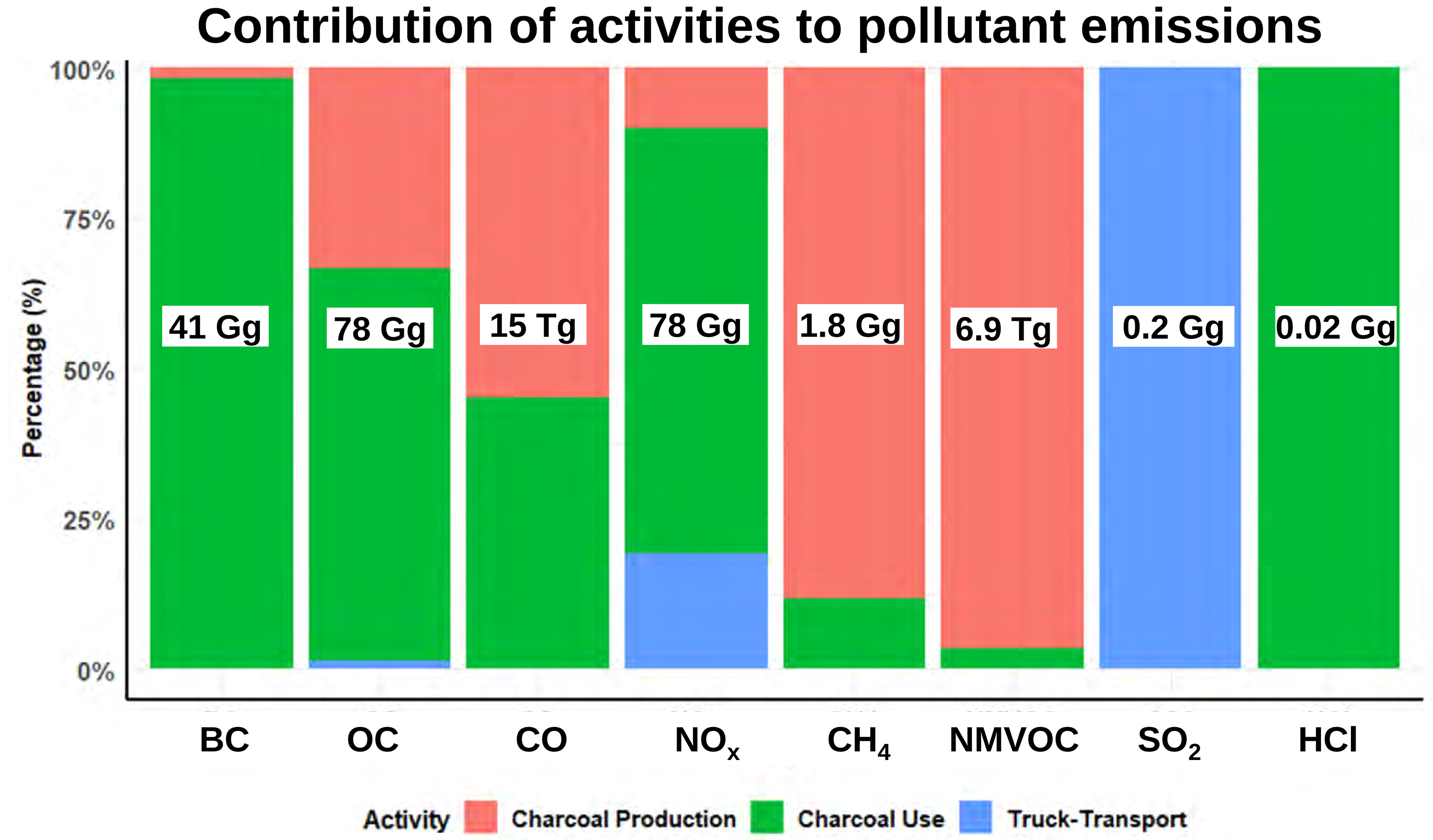
Plastic burning limited to slums mapped to 2-15 km around the centre of the city based on Bird et al., 2017.

Trucks:
Trucks mapped on OpenStreetMap roads around urban centres. Extent of trucks is assumed proportional to urban population

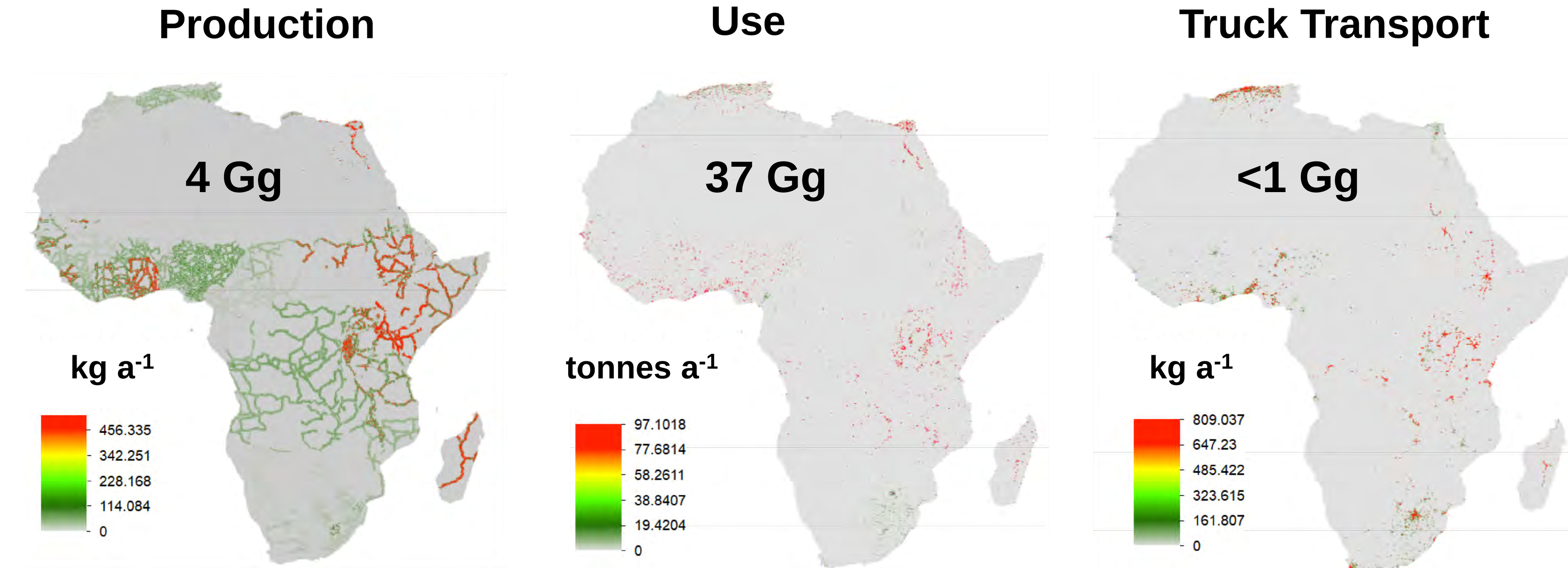
We estimate 208 Tg of fuelwood is used to produce charcoal in 2014. This is 24% of biomass consumed from open fires, the dominant source of pollution across Africa.

Charcoal Emissions of Dominant Air Pollutants

Contribution of activities to pollutant emissions



Spatial distribution of black carbon emissions [kg a^{-1}]



Emissions are highest in East and West Africa where the majority of charcoal is produced and consumed

Total annual air pollutant emissions are: 15 Tg CO, 41 Gg BC, 78 Gg OC, 78 Gg NO_x, 1.8 Tg CH_4, and 20 Mg HCl.

Urbanisation is a strong predictor of trends in charcoal emissions. Urban population increases by 77% from 2014 to 2030, so charcoal will make an increasing contribution to air pollution in Africa without viable energy alternatives.

Ongoing Work

GEOS-Chem

Embed the inventory in GEOS-Chem to estimate the impact of the charcoal supply chain in Africa in 2014 on local air quality and global climate.

References

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