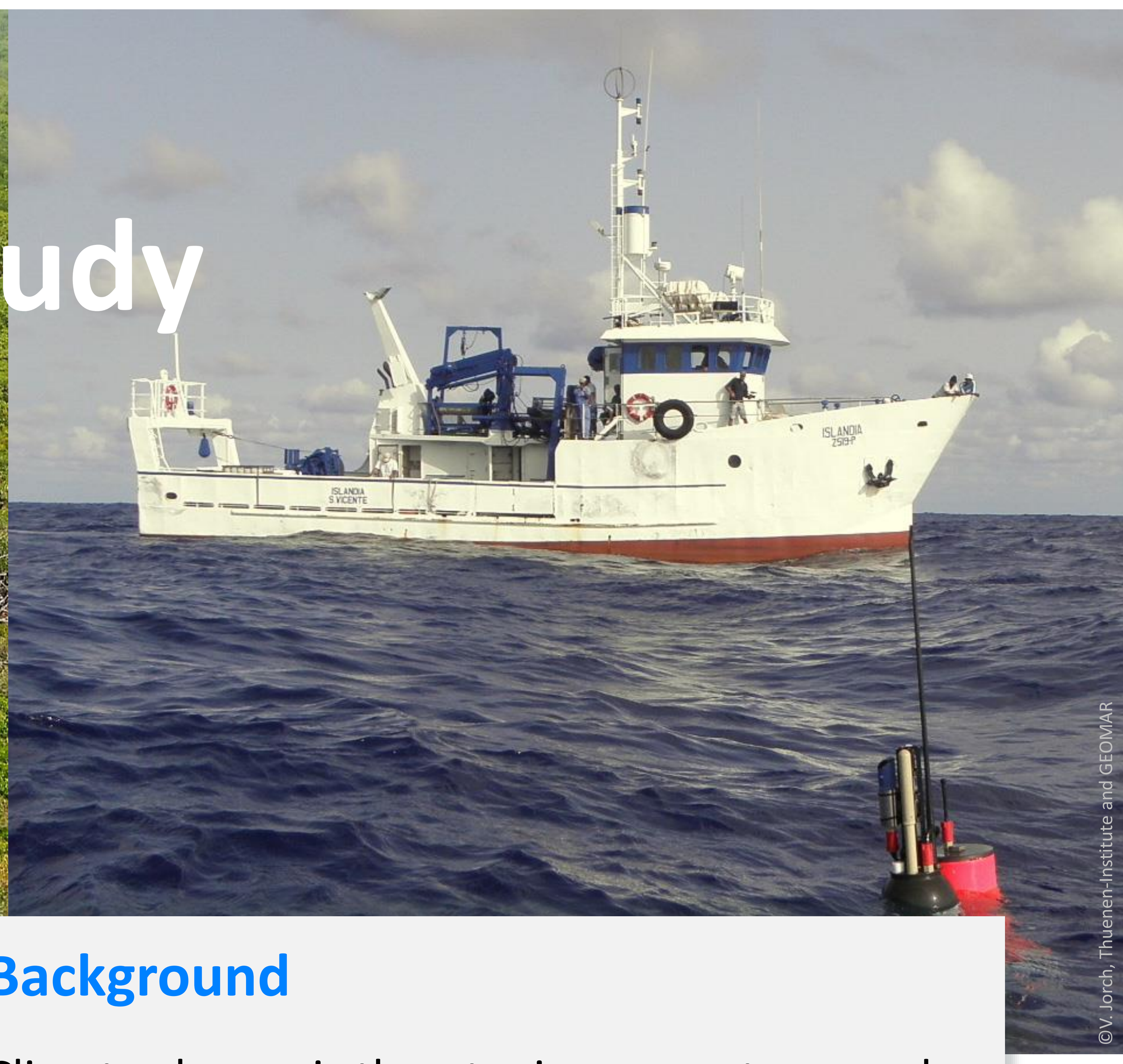
Greenhouse Gas Observation & Climate-Smart Agriculture

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730995

Gaps, needs and options - A design study for long-term greenhouse gas observation in Africa

V. Jorch[1], M. Acosta[2], J. Beck[3], A. Bombelli[4], C. Brümmer[1], K. Butterbach-Bahl[5], B. Fiedler[6], E. Grieco[4], J. Helmschrot[3], W. Hugo[7], T. Johannessen[8], A. Körtzinger[6], W. Kutsch[9], A. López-Ballesteros[10], L. Merbold[11], E. Salmon[9], M. Saunders[10], B. Scholes[12]

1 Thünen Institute of Climate Smart Agriculture, 2 Global Change Research Institute, CAS (CZG), 3 Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), 4 Foundation Euro-Mediterranean Centre on Climate Change (CMCC), 5 Karlsruhe Institute of Technology, 6 Geomar Helmholtz Centre for Ocean Research Kiel (GEOMAR), 7 South African Environmental Observation Network (SAEON), 8 University of Bergen, Integrated Carbon Observation System (ICOS ERIC), 10 Trinity College of Dublin (TCD), 11 International Livestock Research Institute (ILRI), 12 University of the Witwatersrand Johannesburg (WITS)



Background

Climate change is threatening ecosystems and societies in Africa. At the same time, population growth causing land-use change, increased energy demand and the development of industry and transport infrastructure contributes to increasing greenhouse gas (GHG) emissions.

In global comparison carbon (C) emissions of Africa from fossil fuel and cement production are still very low (3.6% in 2014; Boden et al 2017). Regarding the African continent emissions from land use change and forestry account for more than one thierd of the total emissions (Valentini et al 2014).

Scientific advice on GHG emissions with regard to agricultural production is important for Africa to improve the environmental reporting and policies, by also considering food security demands. For scientific analysis and advice, sufficient qualitative and quantitative data about GHG sources and sinks are essential.

The essential Set of Variables to be monitored

For the design of an efficient observation system for Africa the interoperability with other networks, but also the specific continental context need to be considered. As one of the first steps we identified the essential set of variables which need to be monitored in Africa. We defined the 'ideal' set of variables, including all climatic, oceanic and biodiversity variables listed by WMO, GOOS and GEOBON. Those were listed in an online tool. 210 experts were consulted to rate the variables on their 'relevance', 'feasibility' and 'costs', in the African context. We received 40 answers, which were used to compute a score for each variable. 42 variables were identified as 'essential'.

Figure 1-4 taken from Lopéz-Ballesteros et al (2018)

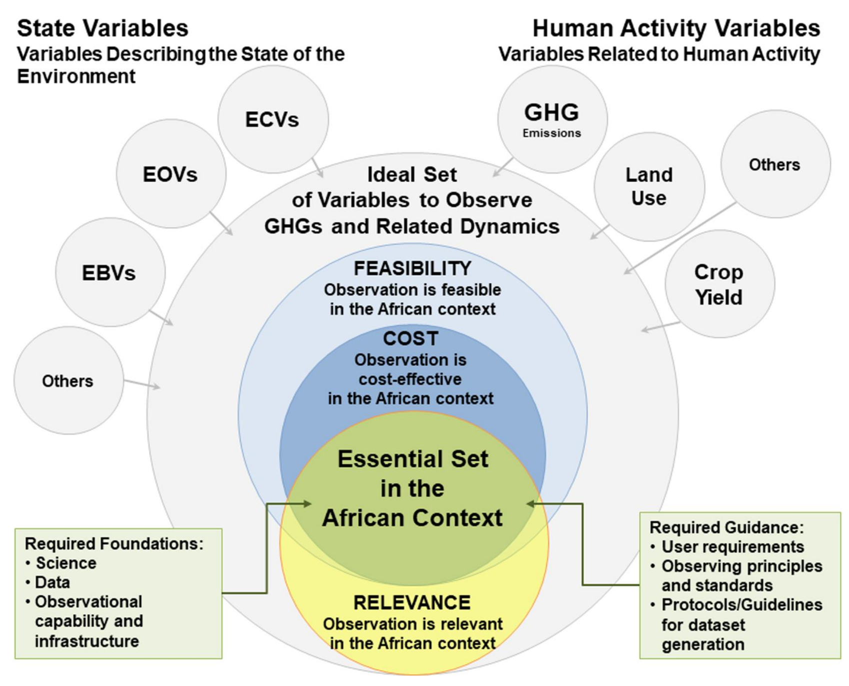


Figure 1: Conceptual framework describing the approach used to define the set of the 'essential variables'. ©American Meteorological Society. Used with permission from Bojinski et al (2014).

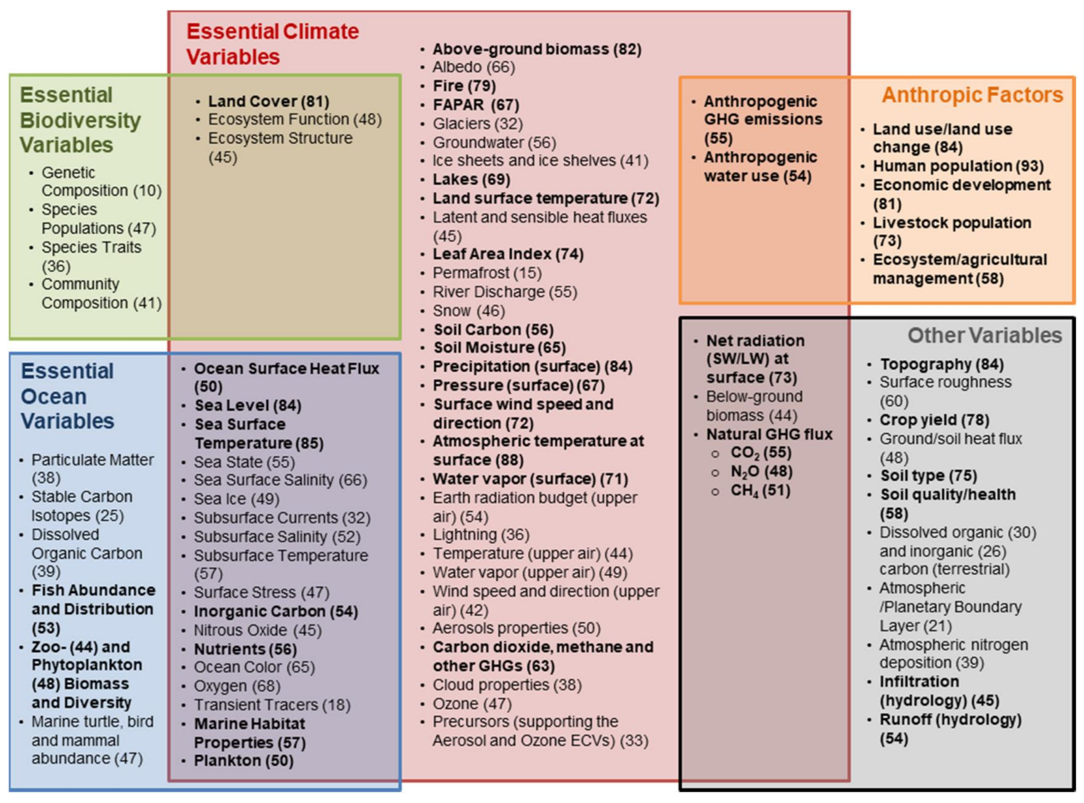


Figure 2: Indicative list of all candidate variables proposed and their assessment score (in parentheses) resulting from the consultative rating process. The preliminary set of 'essential variables' is highlighted in bold font.

Inventory of RIs across Africa

We compiled an inventory of the environmental observation stations, measuring any of the identified variables, through literature search and consulting relevant projects and experts. 47 observation infrastructures were identified. For the ground- based and sea-born observation sites, we captured the location and operation status (as far as available). Observation stations are heterogeneously distributed, especially those for atmospheric and GHG observations. The density of stations is relatively high in parts of Northern, Western and Southern Africa, but still does not reach the level of other continents. For the sea-born station, the pattern is similar. We further plotted the stations to biomes and the main anthromes. We show that smaller biomes, such as mangroves are underrepresented. Moreover a significant correlation of population and station density was found.

Contact Veronika Jorch (Coordinator), Thünen Institute of Climate-Smart Agriculture, Bundesallee 68, 38116 Braunschweig, Germany
Email veronika.jorch@thuenen.de
Web www.seacrifog.eu
@SEACRIFOG

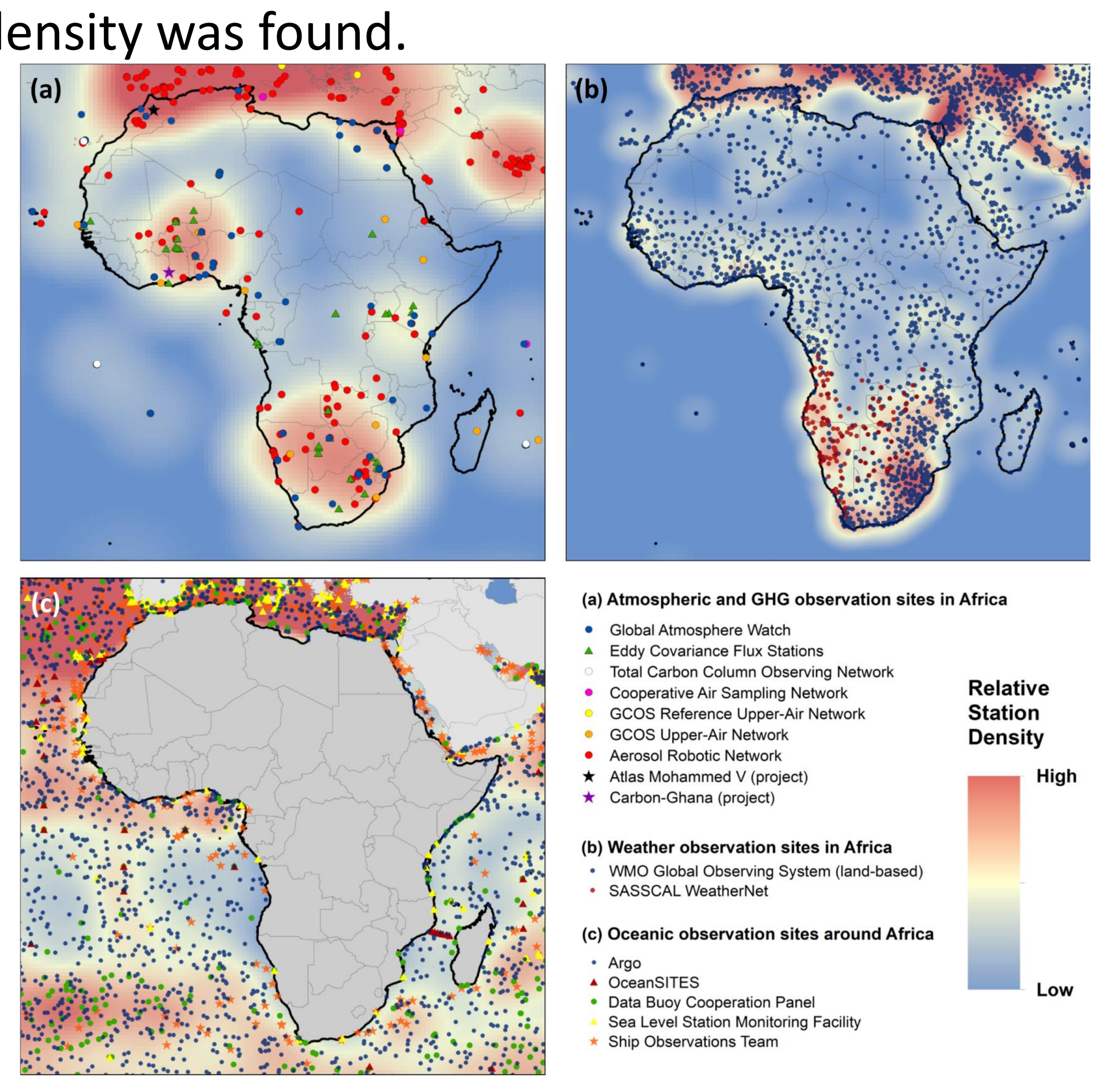


Figure 3: Observation stations and density of selected networks.

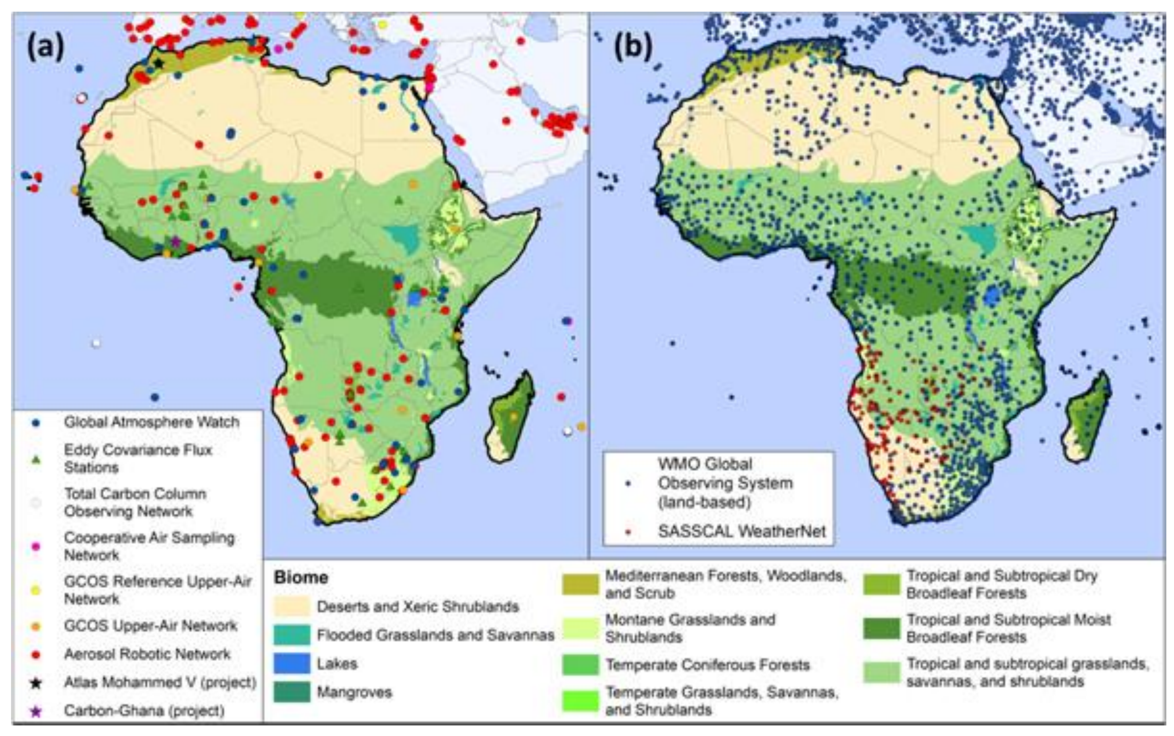


Figure 4: Observing stations of selected networks for (a) GHG and aerosols and (b) weather observation against the major biomes (Olson et al 2001) of the African continent.

Literature:
Boden T A, Marland G and Andres R J 2017 Global, Regional, and National Fossil-Fuel CO2 Emissions (Carbon Dioxide Information Analysis Centre (CDIAC), Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, Tenn., USA) (http://cdiac.ess-dive.lbl.gov/trends/emis/meth_reg.html)(Accessed: 28th August 2018)
Bojinski S et al 2014 The concept of essential climate variables in support of climate research, applications, and policy Bull. Am. Meteorol. Soc. 95 1431–43
Lopéz-Ballesteros et al 2018 Towards a feasible and representative pan-African research infrastructure network for GHG observations Environmental Research Letters 13 8
Olson D M et al 2001 Terrestrial ecoregions of the world: a new map of life on Earth
Valentini R et al 2014 A full greenhouse gases budget of Africa: synthesis, uncertainties, and vulnerabilities Biogeosciences 11 381–407