







Essential variables for long-term observation of climate change and related dynamics in Africa Johannes Beck¹, Ana López-Ballesteros², Matthew Saunders², Jörg Helmschrot^{1,3}

Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) Department of Botany, School of Natural Sciences, Trinity College Dublin, Ireland Department of Soil Science, Faculty of AgriSciences, Stellenbosch University, South Africa

Climate and environmental change observation in Africa

• Closing the Earth's energy balance and the carbon and water cycles through observations remain outstanding scientific issues that require high quality records of key variables [1]

The SEACRIFOG Project

LUND UNIVERSITY

THÜNEN



"Supporting EU-African Cooperation on Research Infrastructures for Food Security and GHG Observations"



uni Research

UNIVERSITY OF THE WITWATERSRAND,

IOHANNESBURG

TROPOS

Leibniz Institute for

- Objective: Develop a roadmap towards a a network of research infrastructures for the long-term observation of climate change and related environmental dynamics on the African continent. This network is to be tailored to the African context by ensuring that continent-specific ecosystems and anthropic developments as well as their interactions with the local and global climate system be captured with sufficient accuracy. At the same time, the network is to be fully interoperable with global initiatives such as the GCOS.
- Duration: 3 years (March 2017 February 2020)

ILRI

CzechGlobe

This rating is the

South African

Environmental

Existing

• Implementation: Consortium of 16 European and African organizations, combining expertise in atmospheric, terrestrial and oceanic observation

NRF

AEON

INDP

SASSCAL

- In the case of the African continent, there are still large observational gaps, resulting in major uncertainties for most of the key variables related to climate change, above all the greenhouse gas (GHG) balance [2]
- At the same time, Africa is one of the most dynamic regions in the world, having the highest population growth rate of all continents, which is coupled with factors like increasing energy demand, exploitation of natural resources and associated land-use related emissions [2]

The concept of essential variables for the African

- In order to characterize the Earth's climate through systematic observation of a limited set of critical variables, GCOS the developed the 'essential climate variables' (ECVs) [3]. Similar initiatives developed the EOVs [4] and EBVs [5] for the maritime and biosphere.
- Identify an essential set of • Objective: variables appropriate to observe (and attribute) changes in Africa
- Method: Consider all possibly relevant variables and assess them against their relevance, feasibility and costeffectiveness in the African context

SEACRIFOG Collaborative Inventory Tool

• Web-tool developed by SASSCAL (based on the Shiny package for R) to facilitate a comprehensive consultative process capturing interdisciplinary



I/we consider ourselves experts in the following

• Funding: European Commission under the Horizon 2020 Work Programme

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

GEOMAR

expertise from relevant researchers

• Integrates the various steps towards defining the essential variables for investigating climate change on the African continent and thoroughly assessing the availability of corresponding

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	Ser Contraction		V2.7.4, 19 March 2018, StationControl SESSEACRIFOG Collaborative Inventory Tool Logged in as user johannes.beck@sasscal.org (Close or reload tab to log off)
About	Variable Classes	Variable Rating	Observation Networks/Infrastructure Sub-Variables/Data Products
	The table Variables Methane Products products	e below contains all variable s variable classes can compresent of the second compresent of th	classes of potential relevance to SEACRIFOG. Note that, in analogy with the Essential Climate ise various sub-variables and corresponding data products (e.g. variable class 31 'Carbon Dioxide, es' comprises various different gases). The latter will then be captured via the tab 'Sub-Variables/Data table, detailed information for the respective variable class as well as associated sub-variables and data side of the screen. Contributors are requested to
Varia Listi	ble • Ad bd ng bd	Id variable classes of potenti ottom of the table lit variable classes in case yo ottom of the table	al relevance to SEACRIFOG which are still missing in the list, using the button 'Add Variable' at the but have additional/more accurate information available, using the button 'Edit Selected Variable' at the
Varia 1 Above 2 Albed	able.Name -ground biomass 0	th: Domain Type Terrestrial ECV Terrestrial ECV	Variable Class Detail Variable Name: Anthropogenic Greenhouse Gas Fluxes Variable Domain: Terrestrial

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1	Above-ground biomass	Terrestrial	ECV
2	Albedo	Terrestrial	ECV
3	Anthropogenic Greenhouse Gas Fluxes	Terrestrial	ECV
4	Anthropogenic Water Use	Terrestrial	ECV
5	Fire	Terrestrial	ECV
6	Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)	Terrestrial	ECV
7	Glaciers	Terrestrial	ECV
8	Groundwater	Terrestrial	ECV
9	Ice Sheets and ice shelves	Terrestrial	ECV
10	Lakes	Terrestrial	ECV

Variable Type: ECV

Current Variable Availability:

Description of Variable:

Anthropogenic emissions and removals from the Land Use, Land-use Change and Forestry sector are the net result of two fluxes: an emission term due to deforestation and forest degradation (mainly in the tropics) and an uptake term due to vegetation growth, for example forest regrowth and re-planting. The land sink is mainly driven by vegetation growth not directly linked to managed land such as recovery from deforestation events in the distant past or increased growth through CO2 fertilisation (both of which may have natural and human components). This sink has increased roughly in proportion to the emissions in response to human interventions on the carbon cycle, and improved knowledge about this land sink would improve future projections and the efficacy of mitigation efforts in achieving climate goals.

Further Information on Variable: Click Here

Varia Rat	able ing	consultatio entered on that group	n and behalf of	 domain(s): Terrestrial Dom Atmospheric Do Oceanic Domain 	ain omain in	conducted work in/or	d extensive A Africa				
	Subm	nit rating									
		Va	riable.Name		Domain	Туре	Further.Info	Relevance	Feasibility	Cost	Comment
	Above-grou	nd biomass			Terrestrial	ECV	Click Here	High	v		
	Albedo				Terrestrial	ECV	Click Here		V		
	Anthropoge	nic Greenhouse Gas Flu	IXes		Terrestrial	ECV	Click Here	Low	V		
	Anthropoge	nic Water Use			Terrestrial	ECV	Click Here	Medium	V		
	Fire				Terrestrial	ECV	Click Here	High	V		
	Fraction of /	Absorbed Photosynthetic	cally Active Radia	tion (FAPAR)	Terrestrial	ECV	Click Here		V		
	Glaciers				Terrestrial	ECV	Click Here	▼	V		
	Groundwate	PL			Terrestrial	ECV	Click Here	▼	V		
	Ice Sheets a	and ice shelves			Terrestrial	ECV	Click Here	V	V		
L	Lakes				Terrestrial	ECV	Click Here	V	V		
		Network.Name 1 Global Climate Observing System 2 SASSCAL ObservationNet 3 SASSCAL Weathernet 4 FLUXNET 5 Copernicus	Network.Status Existing Existing Existing Existing Existing Existing Planned	Network.Type Various Ground-based Ground-based Ground-based Ground-based Ground-based Space-borne Ground-based Space-borne	Ma	+ - 3000 km 2000 mi	Stations (Click a	a station marker	for further stati	IO.Region : A IO.Region : A Intry : France tion : La Réun tude : -21.079 gitude : 55.38 vation : 2160 IO.Index : 0-2 W.station.desi erating.status tus2 : Operati	information)
		 Global Atmosphere Watch South African Weather Service 	Existing Existing	Ground-based Ground-based							•

				:	Search:			
			Sub.Var.or.Product.Name 🔶	Variable.Class 🔶	Source.Network	Requirements.Met 🍦	Sub-Variable/Data Product Det	
		1	ESA CCI S2 Prototype Land Cover 20m Map of Africa 2016	Land cover	Copernicus	Yes	Global 10-daily Directional Albedo 1km: T Parent Variable/Variable Class:	
		Da	ata 🏻	Above-ground biomass	African Tropical Rainforest Observation Network	No	Albedo Captured/Provided by Network: Copernicus	
			ux	Inorganic Carbon	Global Ocean	Yes	Product Type: Orthoimagery	
	Ava		ability	River Discharge	Global Terrestrial Network for River Discharge	No	Description of Sub-Variable/Data Product: The surface albedo quantifies the fraction of irradianc on the temperature and water balance. The directiona as the integration of the bi-directional reflectance ove sun and is computed for the local solar noon.	
		5	Global 10-daily Directional Albedo 1km; Tiles	Albedo	Copernicus	No	Data/Product Provider: Copernicus Global Land Sevice	
		6	Land Surface Temperature -	Land Surface	Copernicus	Vec	Data Access: Click Here	
		Ŭ	Temperature (LST) V1	Temperature	oopernieus	103	Data Available Since (Year): 1998	
Global 10-daily Burnt Area 1km - 2014 onward		Global 10-daily Burnt Area 1km - 2014 onward	Fire	Copernicus	No	Data Available Until (Year): 2014		
		8	Global 10-daily Burnt Area 1km - 1999-2014	Fire	Copernicus	No	Measurement/Product Requirement Specs (URL): https://www.ncdc.noaa.gov/gosic/gcos-essential-clime	
		9	Global 10-daily Dry Matter Productivity 1km	Above-ground biomass	Copernicus	No	Measurement Frequency (Required): Daily	
		10	GHSL - Global Human Settlement Layer	Human Population	Copernicus	No	Measurement Frequency (Currently Available): 10 days	
		11	Gridded Livestock of the World (GLW)	Livestock Population		No	Spatial Resolution (Required): 50m	
		Showi	ing 1 to 11 of 11 entries		Previous	1 Next	Spatial Resolution (Currently Available): 1000m	
		Ad	d Sub-Variable/Data Product	Edit Selected	Item		Maximal Uncertainty (Required): Max (5 %; 0.0025)	

Ground-based

tion)



- Once the consultative process is concluded, the tool may be developed into a public resource on observation infrastructures and corresponding data products for the African continent
- Currently not open to the public, but interested researchers in the field of environmental observation are encouraged to register and contribute!

For further information and tool registration contact johannes.beck@sasscal.org

Next Steps

- Capture input from as many researchers as possible (*your* input to the tool may be valuable!)
- Define set of essential variables for observing (climate) change on the African continent
- For this set, thoroughly assess existing and planned research infrastructures, identify available data products and develop appropriate measurement protocols
- Identify gaps and needs in terms of research infrastructures
- Develop roadmap (including costing) towards a pan-African observation network which is both regionally appropriate and fully interoperable with global initiatives

nd water balance. The directional albedo or directional-hemispherical reflectance (also called black-sky albedo) is defin ne bi-directional reflectance over the viewing hemisphere. It assumes all energy is coming from a direct radiation from t

	No	Copernicus Global Land Sevice
		Data Access: Click Here
Yes	Yes	Data Available Since (Year): 1998
	No	Data Available Until (Year): 2014
	No	Measurement/Product Requirement Specs (URL): https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix/gcos-land-ecv-albedo
	No	Measurement Frequency (Required): Daily
	No	Measurement Frequency (Currently Available): 10 days
	No	Spatial Resolution (Required): 50m
1	1 Next	Spatial Resolution (Currently Available): 1000m
		Maximal Uncertainty (Required): Max (5 %; 0.0025)

References:

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