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Towards an integrated pan-African research infrastructure network for long-term climate change monitoring

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Introduction

Global observation of climate-relevant variables:

Major gaps in Africa→ Large uncertainty regarding GHG balance, exact understanding of processes, human role, ...



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ASSCAL Southern African Science Service Centre for Climate Change and Adaptive Land Management



www.seacrifog.eu

SEACRIFOG

Supporting EU-African Cooperation on Research Infrastructures for Food Security and GHG Observations (2017-2020)

SASSCAL's Role:

What needs to and can be observed across the African continent?

 \rightarrow Ideal and mandatory set of observational variables

What are the gaps and needs regarding observation infrastructure?

ightarrow Inventory of existing and planned infrastructures

What are the gaps and needs regarding data? → Assessment of available data (Spatial and temporal coverage, quality)



SEACRIFOG Objective:

Design of continental observation network tailored to African requirements

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Approach

Southern African Science Service Centre for Climate Change and Adaptive Land Management

SEACRIFOG Collaborative and Interactive Inventory

Tool: http://seacrifog-tool.sasscal.org/



- Written (R/Shiny) and hosted by SASSCAL
- Integrate the implementation and outcomes of tasks
- Facilitate participatory process to gather expertise from environmental observation community
- Interactive platform for data collection, collaboration and sharing

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Infrastructure Inventory

For mandatory variable set: Identify existing and planned observation infrastructures in Africa

- ightarrow Spatial analysis of coverage of ecosystems and anthropogenic biomes
- → Inversion of a spatially-explicit GHG emission, transport and chemistry model to determine the number and optimal location of observations of the main GHGs in Africa

Show	20 v entries	Search:	
	Network.Name	Network.Status 🛉	Network.Type 👇
1	Global Climate Observing System	Existing	Various
2	SASSCAL ObservationNet	Existing	Ground-based
3	SASSCAL Weathernet	Existing	Ground-based
4	FLUXNET	Existing	Ground-based
5	Copernicus	Existing	Space-borne
6	Baseline Surface Radiation Network	Existing	Ground-based
7	China-Brazil Earth Resources Satellite Program for Africa	Planned	Space-borne
8	Global Atmosphere Watch	Existing	Ground-based
9	South African Weather Service	Existing	Ground-based
10	South African Environmental Observation	Existing	Ground-based



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Infrastructure Assessment

For mandatory variable set: Assessing existing and planned observation infrastructures in Africa

ightarrow Spatial assessment of coverage of ecosystems and anthropogenic biomes

→ number of density maps to show gaps in coverage of observation structures of the main GHGs in Africa



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State Variables

Environment

Variables Describing the State of the

Identification of Observation Variables



- Human Activity Variables Variables Related to Human Activity
 - Concept based on ECV framework
 - Variable ratings from 40 experts collected
 - Variable score computed from these ratings
 - Essential set determined based on score

Illustration adapted from: Bojinski et al., "The Concept of Essential Climate Variables in Support of Climate Research, Applications, and Policy," *Bulletin of the American Meteorological Society,* vol. 95, no. 9, p. 1431–1443, 2014.





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Identification of Observation Variables

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Essential Biodiversity Variables • Genetic Composition (1 • Species Populations (4 • Species Traits (36) • Community Composition (4	Essential Climate Variables • Land Cover (81) • Ecosystem Function (48) • Ecosystem Structure (45) • In the second	 Above-ground biomass (82) Albedo (66) Fire (79) FAPAR (67) Glaciers (32) Groundwater (56) Ice sheets and ice shelves (41) Lakes (69) Land surface temperature (72) Latent and sensible heat fluxes (45) Leaf Area Index (74) Permafrost (15) River Discharge (55) Snow (46) Soil Carbon (56) Soil Moisture (65) Precipitation (surface) (84) Pressure (surface) (67) Surface wind speed and direction (72) Atmospheric temperature at surface (88) Water vapor (surface) (71) Earth radiation budget (upper air) (54) Lightning (36) Temperature (upper air) (44) Water vapor (upper air) (49) Wind speed and direction (upper air) (42) Aerosols properties (50) Carbon dioxide, methane and other GHGs (63) Ozone (47) Precursors (supporting the Aerosol and Ozone ECVs) (33) 	 Anthropogenic GHG emissions (55) Anthropogenic water use (54) 	Anthropic Factors Land use/land use change (84) Human population (93) Economic development (81) Livestock population (73) Ecosystem/agricultural management (58)	 Preliminary results: Ideal set: 89 variables/variable groups Mandatory set
Essential Ocean Variables - Particulate Matter (38) - Stable Carbon Isotopes (25) - Dissolved Organic Carbon (39) - Fish Abundance and Distributio (53) - Zoo- (44) and Phytoplankton (48) Biomass and Diversity - Marine turtle, bir and mammal abundance (47)	 Ocean Surface Heat Flux (50) Sea Level (84) Sea Surface Temperature (85) Sea Surface Salinity (66) Sea lce (49) Subsurface Currents (32) Subsurface Salinity (52) Subsurface Temperature (57) Surface Stress (47) Inorganic Carbon (54) Nitrous Oxide (45) Nutrients (56) Ocean Color (65) Oxygen (68) Transient Tracers (18) Marine Habitat Properties (57) Plankton (50) 		 Net radiation (SW/LW) at surface (73) Below-ground biomass (44) Natural GHG flux CO₂ (55) N₂O (48) CH₄ (51) 	Other Variables Topography (84) Surface roughness (60) Ground/soil heat flux (48) Soil type (75) Soil quality/health (58) Dissolved organic (30) and inorganic (26) carbon (terrestrial) Atmospheric /Planetary Boundary Layer (21) Atmospheric nitrogen deposition (39) Infiltration (hydrology) (45) Runoff (hydrology) (54)	 (bold font): 42 variables/variable groups Focus on GHG and food security + anthropic factors Interoperable with global initiatives

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Data Availability

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For mandatory variable set: Assess data availability, data quality, spatial and temporal coverage

At	out Variable Classe	es Variable	Rating Obse	ervation Networks/	Infrastructure	Sub-Variables/Data Products			
The table below contains all sub-variables and corresponding data products associated with variable classes relevant to SEACRIFOG . Capturing these will allow for systematic identification of data gaps and needs. If you select an entry in the table, detailed information for the respective sub-variable/data product will be provided on the right side of the screen. Contributors are requested to • Add sub-variables/data products associated with variable classes of relevance to SEACRIFOG, using the button 'Add Sub-Variable/Data Product' at the bottom of the table • Edit entries in case you have additional/more accurate information available, using the button 'Edit Selected Item' at the bottom of the table									
	Search:								
	Sub.Var.or.Product.Name 🔶	Variable.Class 🔶	Source.Network	Requirements.Met 🔶	Sub-Varia	able/Data Product Detail			
1	ESA CCI S2 Prototype Land Cover 20m Map of Africa 2016	Land cover	Copernicus	Yes	ESA CCI S2	Prototype Land Cover 20m Map	of Africa 2016		
2	Above-ground biomass and structure of 260 African tropical forests	Above-ground biomass	African Tropical Rainforest Observation Network	No	Parent Variable/Variable Class: Land cover Captured/Provided by Network: Copernicus Product Type: Raster (20m) Description of Sub-Variable/Data Product: Prototype high resolution LC map at 20m over Africa based on 1 year of Sentinel-2A observations from December 2015 to December 2016. The Coordinate Reference System used for the global land cover database is a geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid. The legend of the S2 prototype LC 20m map of Africa 2016 was built after reviewing various existing typologies (e.g. LCCS, LCML), global (e.g. GLC-share, GlobeLand30) and national experiences (Africover, SERVIR-RMCD). The legend includes 10 generic classes that appropriately describe the land surface at 20m: "trees cover areas", "shrubs cover areas", "grassland", "cropland", "vegetation aquatic or regularly flooded", "lichen and mosses / sparse vegetation", "bare areas", "built up areas", "snow and/or ice" and "open water" Among the Land Cover classes, two of them were largely identified thanks to external dataset: the "open water" class was based on the Global Surface Water product from JRC/EC and the "urban areas" relied both on the Global Human Settlement Layer from JRC/EC and on the Global Urban Footprint from DLR. Data/Product Provider: European Space Agency				
3	pCO2 (to provide Air-sea flux of CO2)	Inorganic Carbon	Global Ocean Observing System	Yes					
4	River Discharge	River Discharge	Global Terrestrial Network for River Discharge	No					
5	Global 10-daily Directional Albedo 1km: Tiles	Albedo	Copernicus	No					
6	Land Surface Temperature - Hourly Land Surface Temperature (LST) V1	Land Surface Temperature	Copernicus	Yes					
7	Global 10-daily Burnt Area 1km - 2014 onward	Fire	Copernicus	No	Data Access: Click Here Data Available Since (Year): 2016 Data Available Until (Year):				
8	Global 10-daily Burnt Area 1km - 1999-2014	Fire	Copernicus	No					
9	Global 10-daily Dry Matter Productivity 1km	Above-ground biomass	Copernicus	No	Measurement/ Click Here	Product Requirement Specs (URL):			

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Outlook

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The web-based **SEACRIFOG Collaborative Inventory Tool** will further serve to capture and share relevant information and will be turned into a **public resource**

Next steps:

- Complete inventories of infrastructure and data available
- Development of standardized measurement protocols for identified variable set
- Optimal observation network design based on spatial optimization through inverse modelling
- Costing of required technology and input

→ By 2020: Roadmap (incl. funding recommendations) regarding the development of a continental network of RIs for the systematic long-term observation of climatic and environmental changes related to GHG emissions and food security

Ideally, this will result in the subsequent establishment of this network (with support from EU and others) over the following 10-20 years

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Thank you for your attention!

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