Digital Earth AFRICA

Transformational Information for Africa

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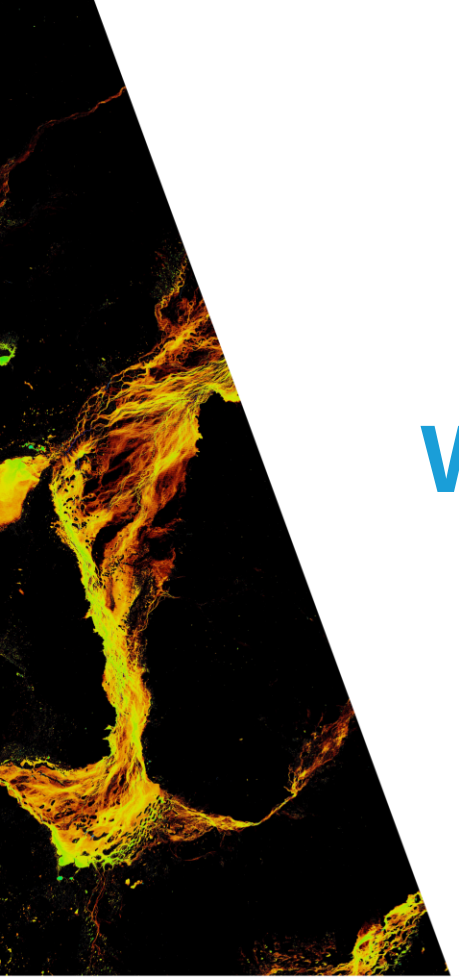
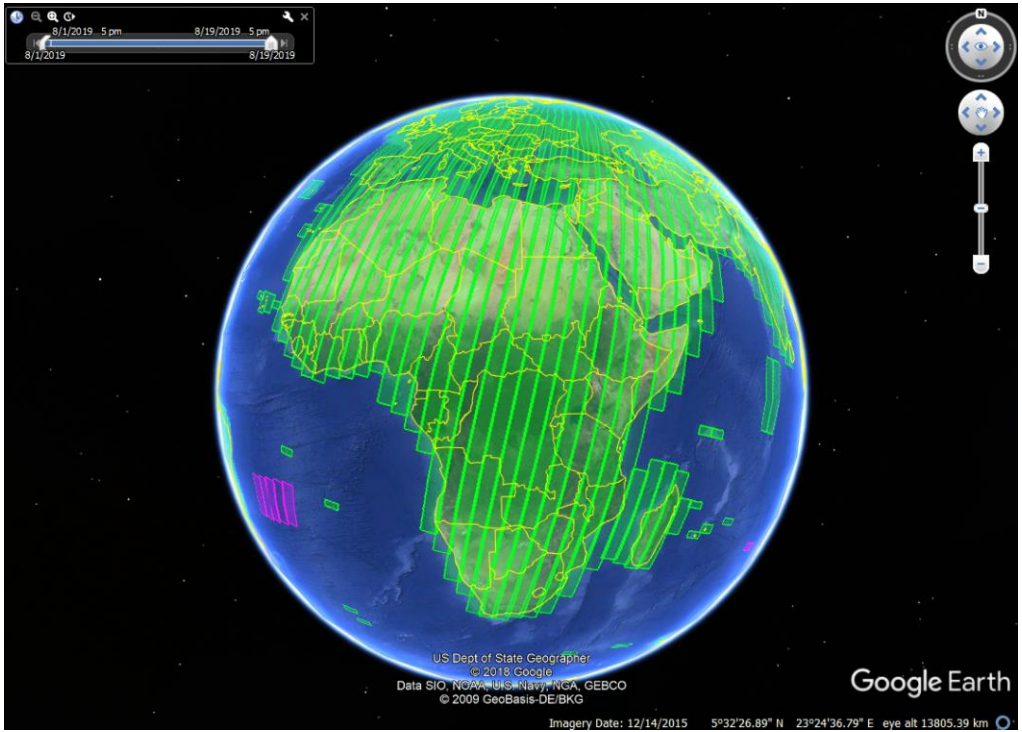
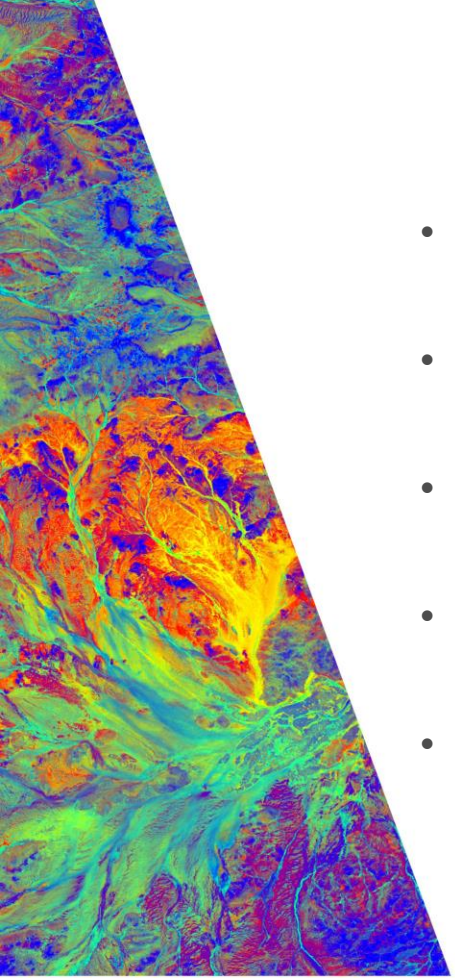


What is Digital Earth Africa?

Sentinel-2 Observation Plan August 2019

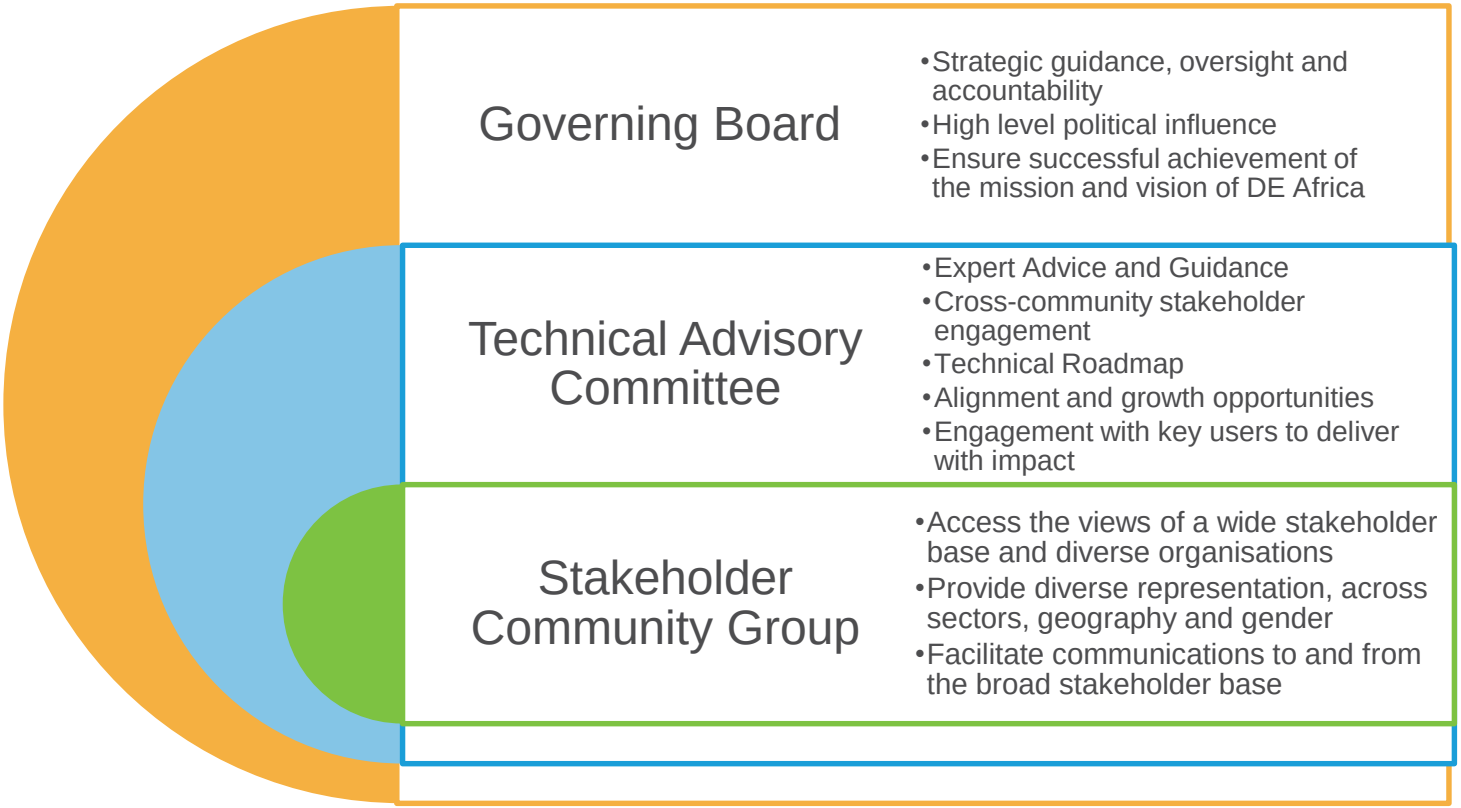


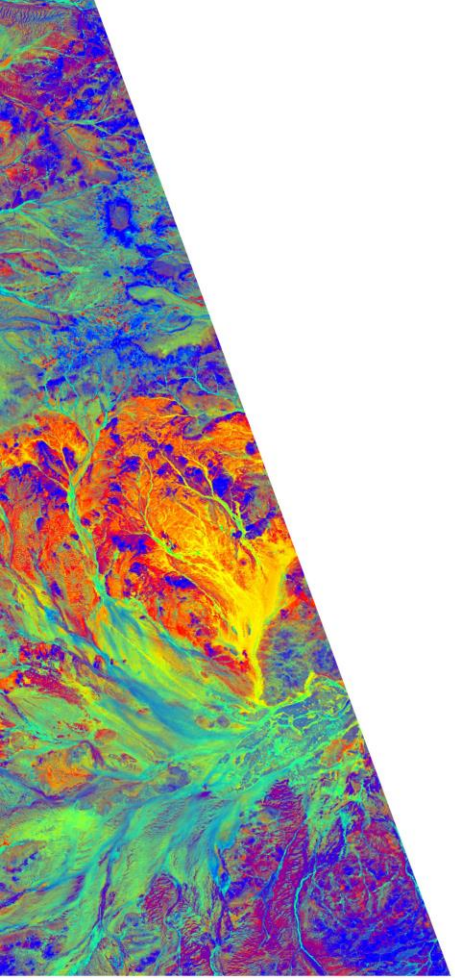


DE Africa - *Key inputs*

- Funding ($24m AUD), from The Helmsley Charitable Trust, and the Australian Government (2019-2021) – our Funding Partners
- Freely available satellite images from international space programs *Analysis Ready Data*
- Australian inventions, expertise and experience – Open Data Cube and Digital Earth Australia – which can be leveraged to Africa
- Preparation work of the Africa Regional Data Cube Project and the DE Africa Phase-I study
- Partnerships, Cooperation, Alignment of effort and positive discussions
    - UNECA, AUC, RCMRD, Agrymet, GEO (The Group on Earth Observations, including GEOGLAM, GFOI), ESRI, Amazon, the United States Geological Survey, GMES and Africa, ESA and others.
- Advances in cloud, storage & compute - affordability and availability`

Governance structure





Governance Principles

Open and free data

- Interoperability
- Privacy and Integrity

Operational service

- Continental-scale
- Sustainable
- Domain expertise

Accountability and transparency

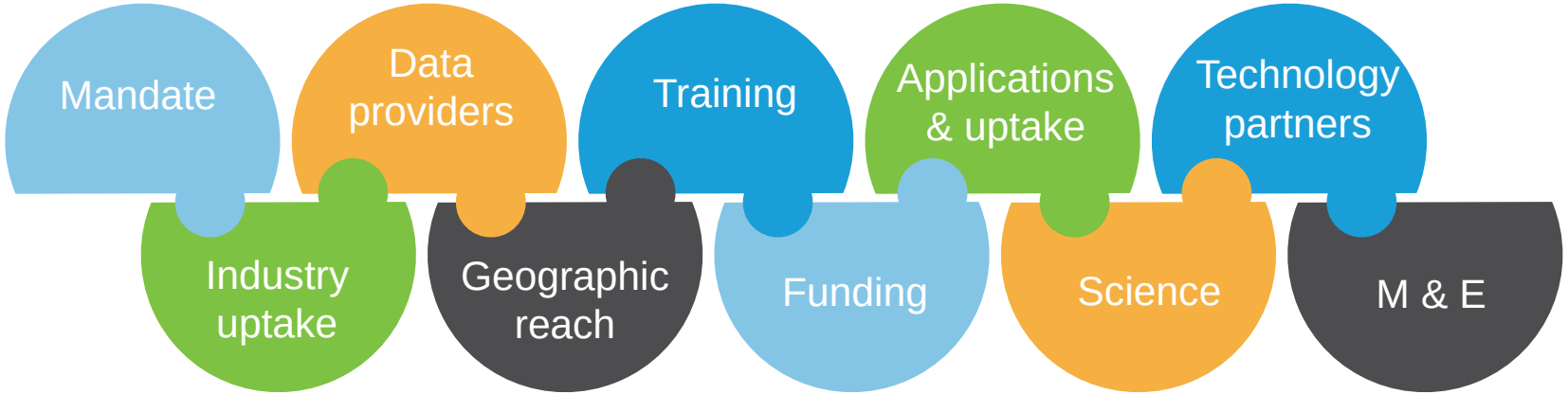
- Responsive to African priorities
- Agile, nimble and action oriented

Diversity and inclusion

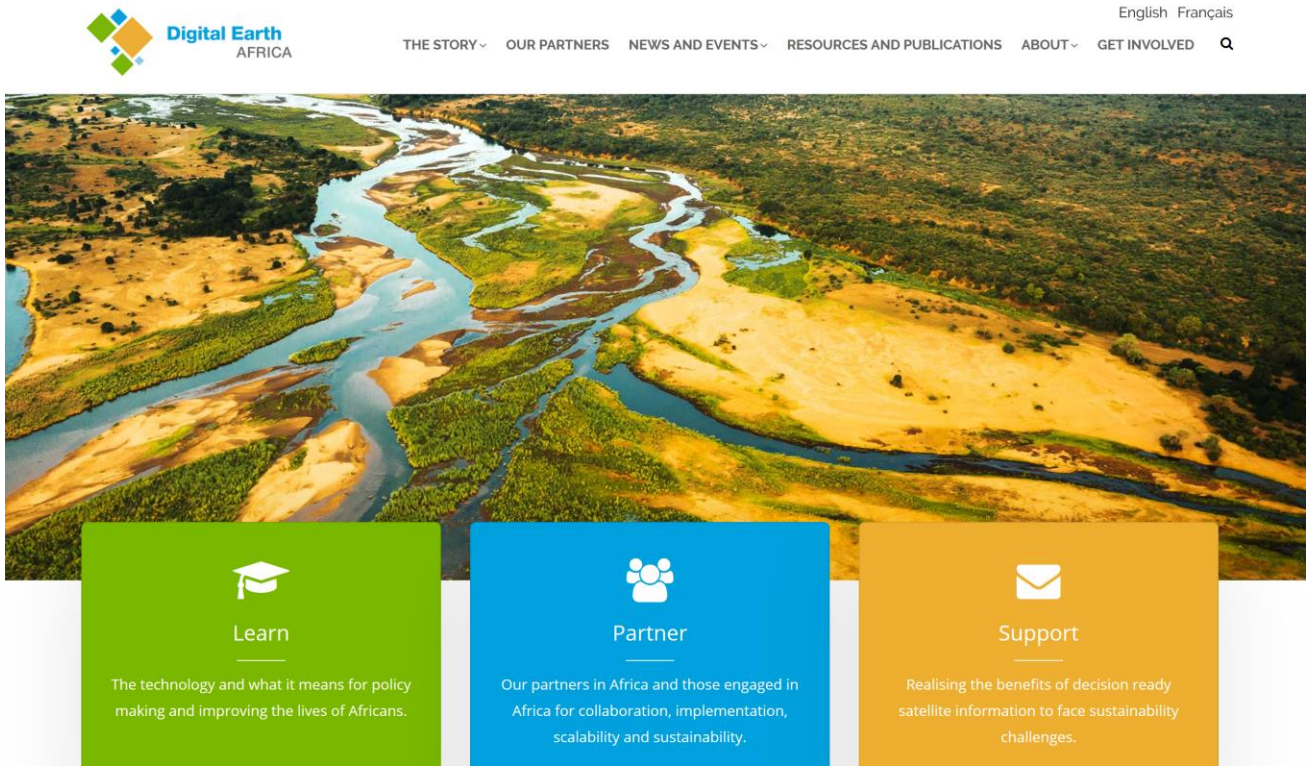
- Multi-sector perspectives
- Span data communities
- Foster collaboration

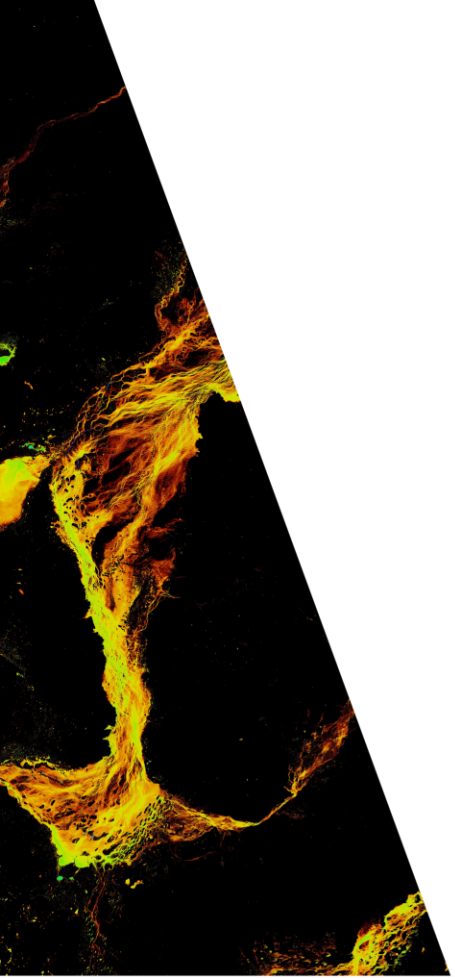
Built on partnerships

Partnerships to **deliver** Partnerships to **amplify** Partnerships to **sustain**



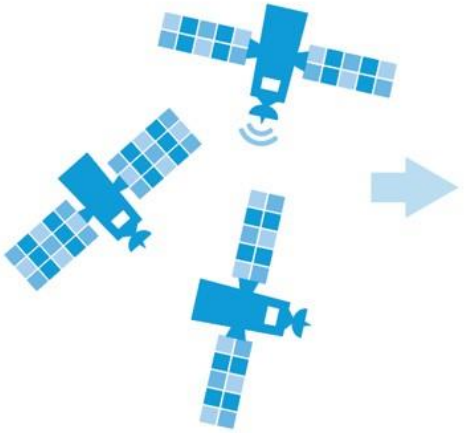
www.digitalearthafrica.org – please register your interest!





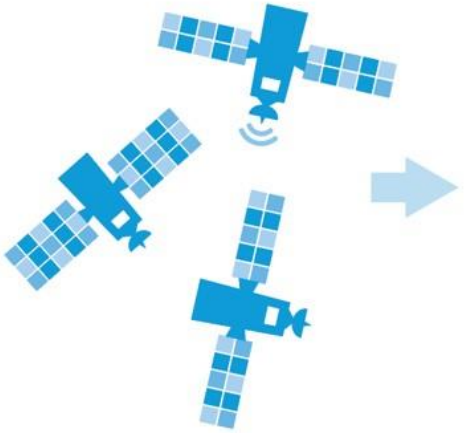
The Earth Observation Supply Chain

Connecting *observations* to *decisions*



Observations

Connecting *observations* to *decisions*



Observations

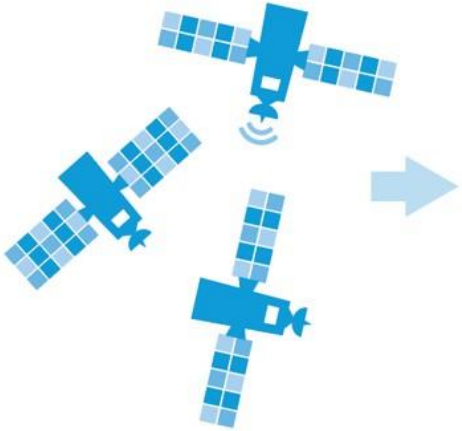
Reporting

Web services

Write code

Information
for decisions

Connecting *observations* to *decisions*



Observations

Analysis
Ready Data

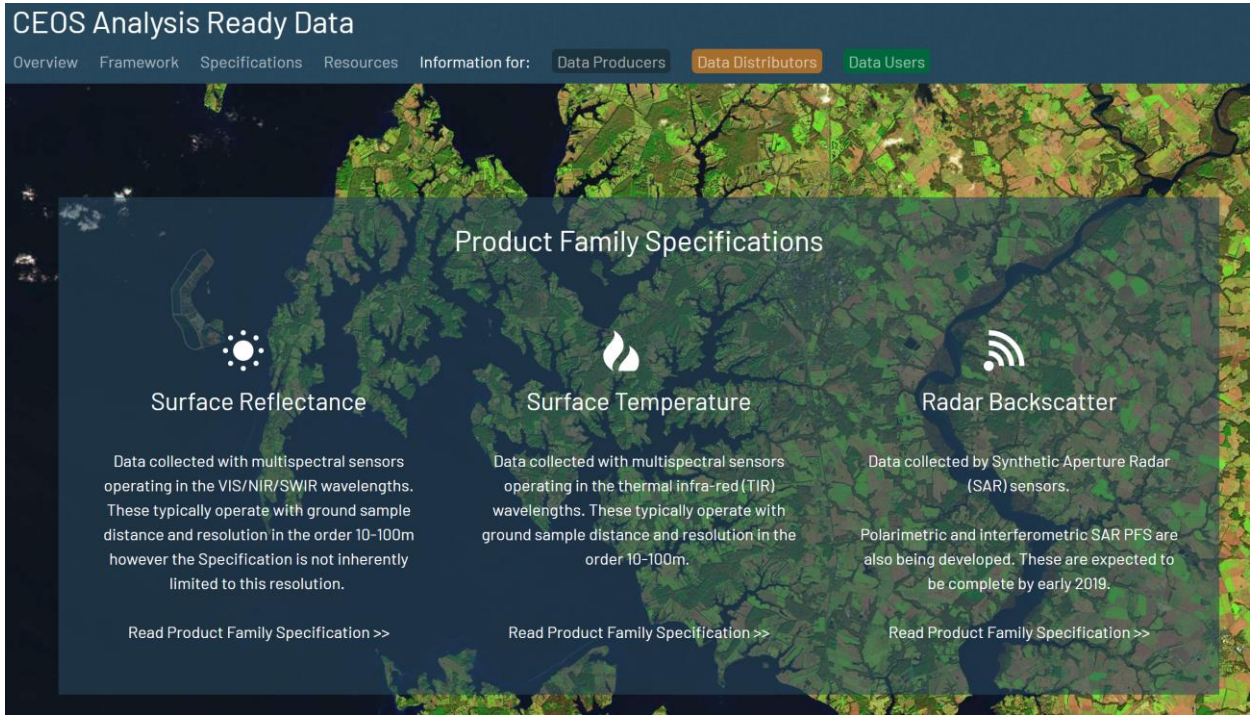
Reporting

Web services

Write code

Information
for decisions

Analysis Ready Data - specifications

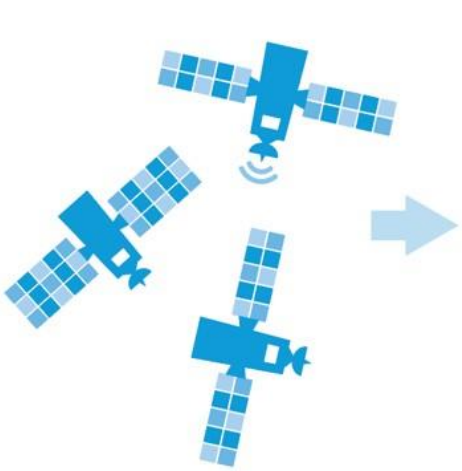


Analysis Ready Data - provision

Landsat global Collection-2 March 2020

USGS ‘Collection 2 Surface Reflectance and Land Temperature

Connecting *observations* to *decisions*

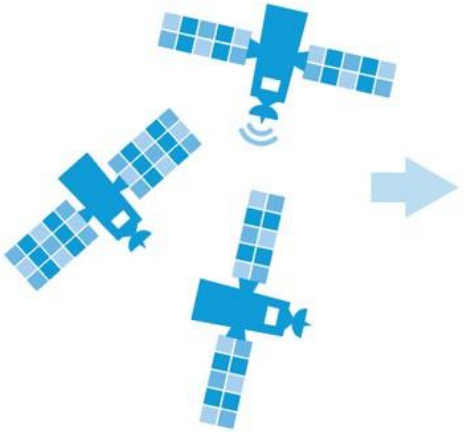


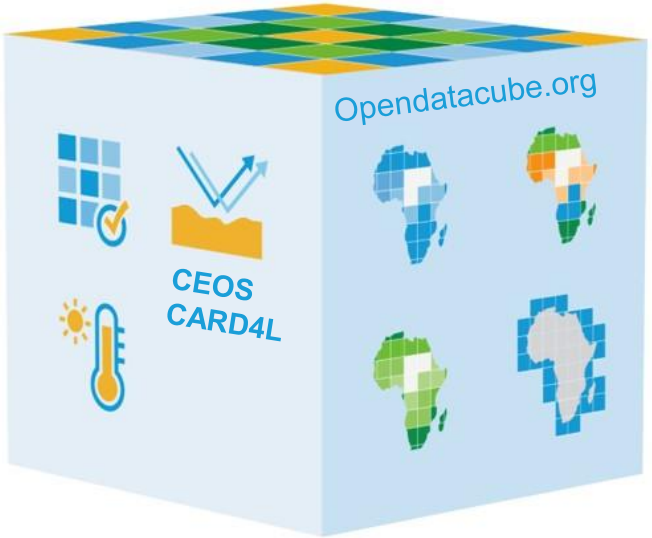
Observations

Analysis Ready Data

Information for decisions

Connecting *observations* to *decisions*





Observations

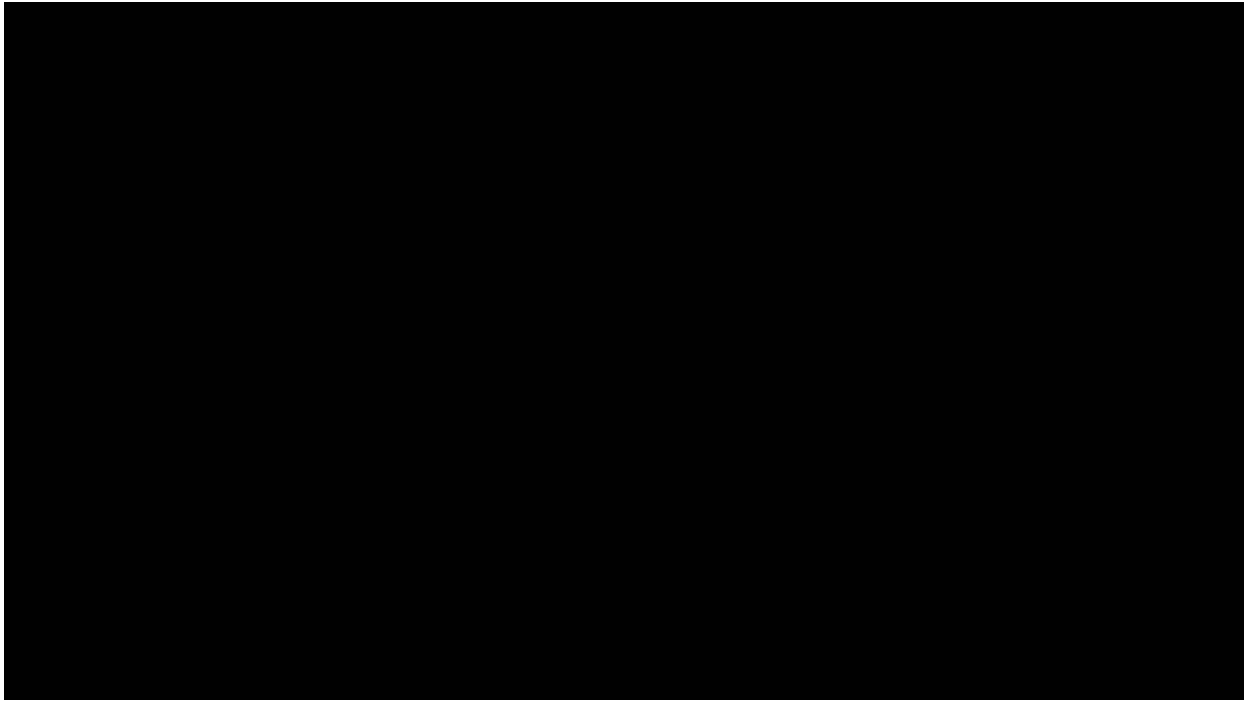
Analysis Ready Data

Products

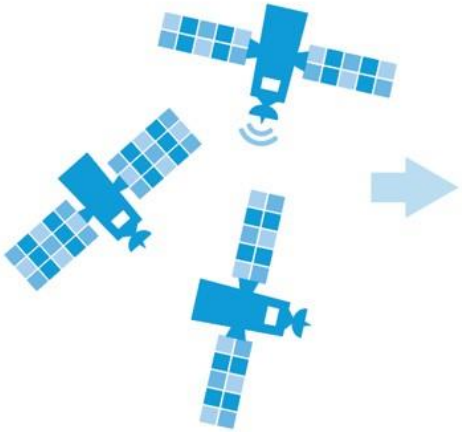
Information for decisions

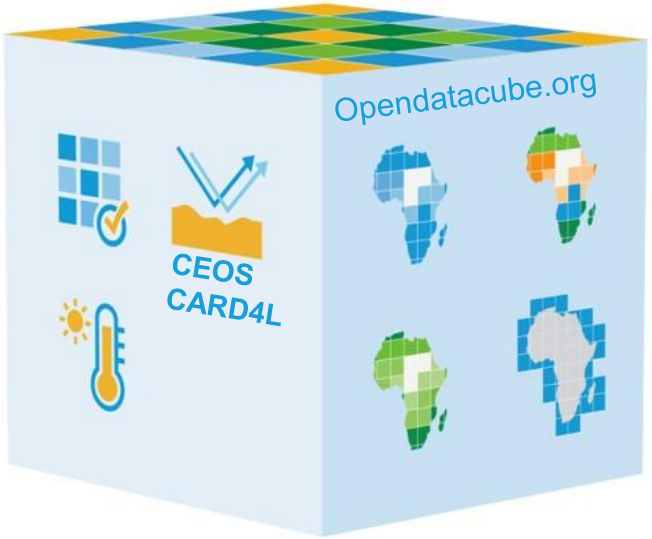
Data cube and the cloud – processing Big EO Data

Producing *continental* products



Connecting *observations* to *decisions*





Observations

Analysis Ready Data

Products

Information for decisions

Connecting *observations* to *decisions*

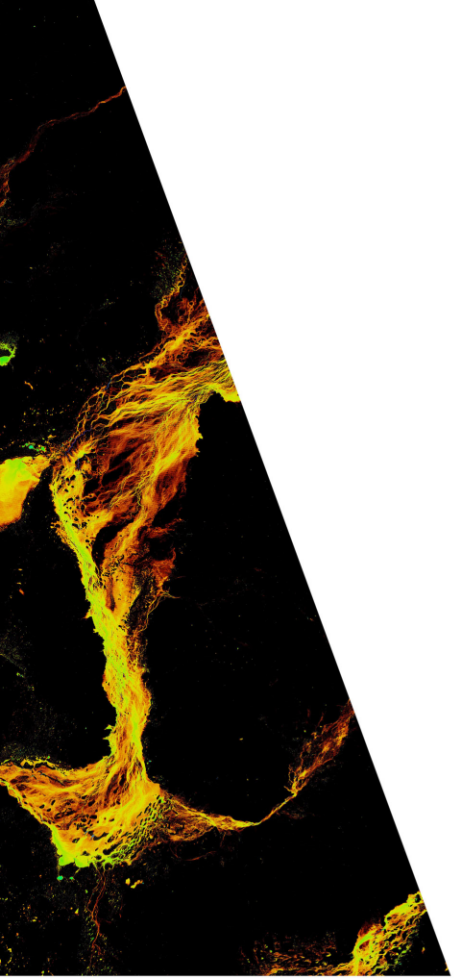
Observations

Analysis Ready Data

Products

Information for decisions

Connecting with users – from Hackathon to Operations

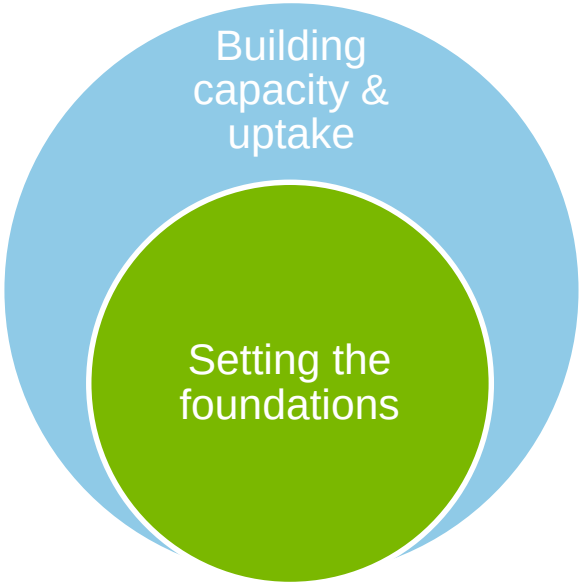


High Level Approach

Foundations

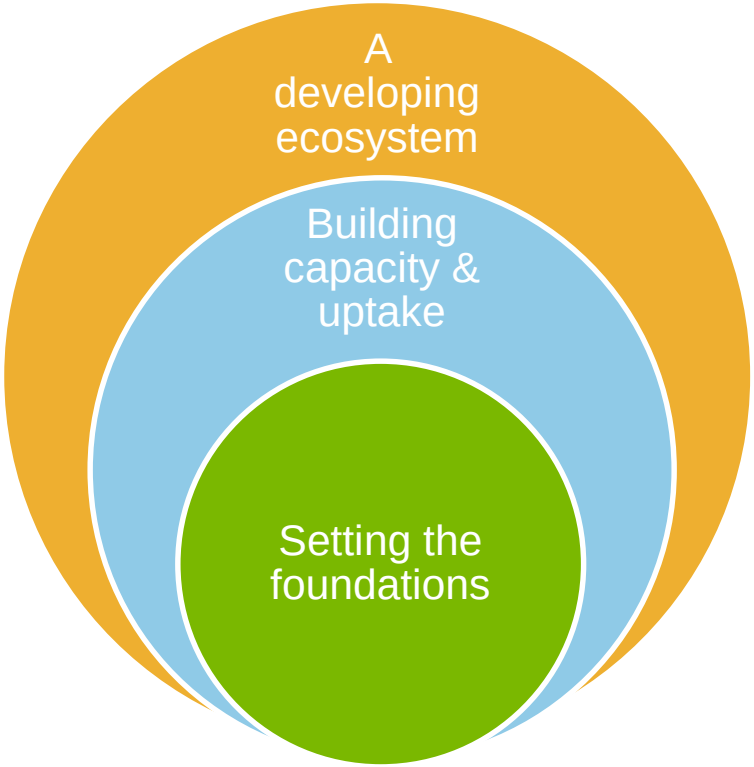
- Funding ☺ ☺
- Undertake Australian Government Investment Design process ☺
- Governance framework, mission and vision ☺ ☺
- Implement the governance framework ☺
- Hosting arrangements and DE Africa Office (and staffing)
- Build momentum and support - Deliver DE Africa Day and key events ☺
- Develop key strategies:
  - Communications and stakeholder engagement, ☺
  - Partnerships, ☺ and
  - Capacity building ☺
- Establish key partnerships with in-country enablers and others ☺
- Ensure alignment with relevant initiatives, programs and institutions ☺
- Build the DE Africa data and ODC infrastructure ☺
- Deliver continental-wide beta water observations from space product ☺
- Develop technical roadmap ☺

Capacity building and uptake

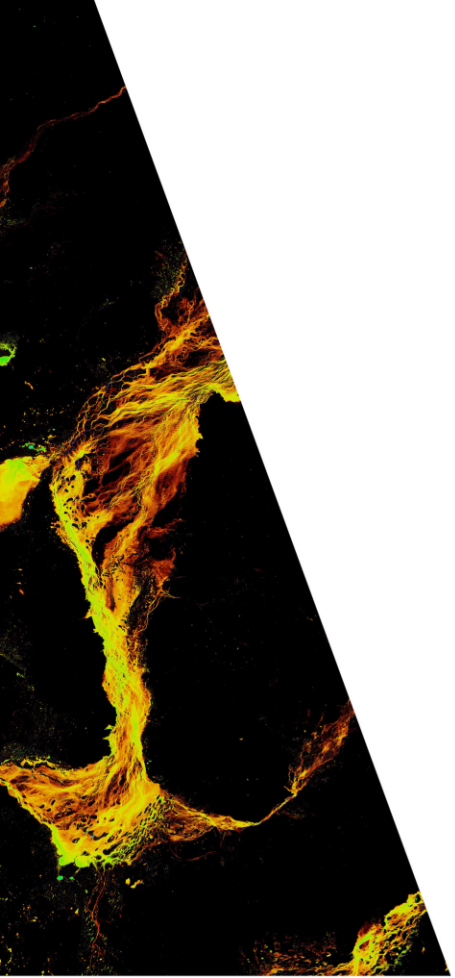


- First DE Africa Annual Users Meeting
- Implement technical roadmap
- Deliver 3 continental-wide products
- DE Africa Office operating and fully staffed
- Regular training and capacity building program in place
- Engage at the country level on uptake of DE Africa products
- Increase the ability for African countries to exploit DE Africa products and services
- Produce a study on the economic value of EO data for Africa
- Increase comprehensive stakeholder engagement
- Secure co-investment from additional philanthropic/aid agencies

A developing ecosystem with compelling benefits

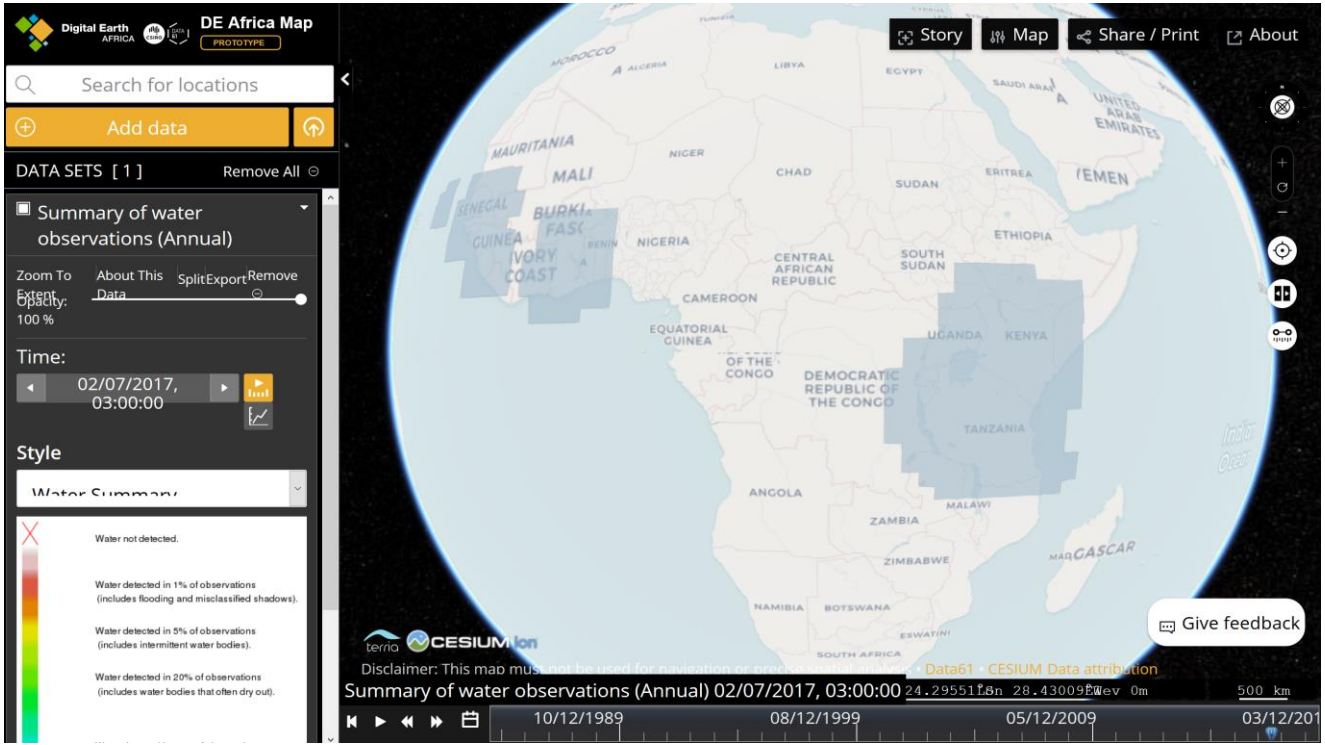


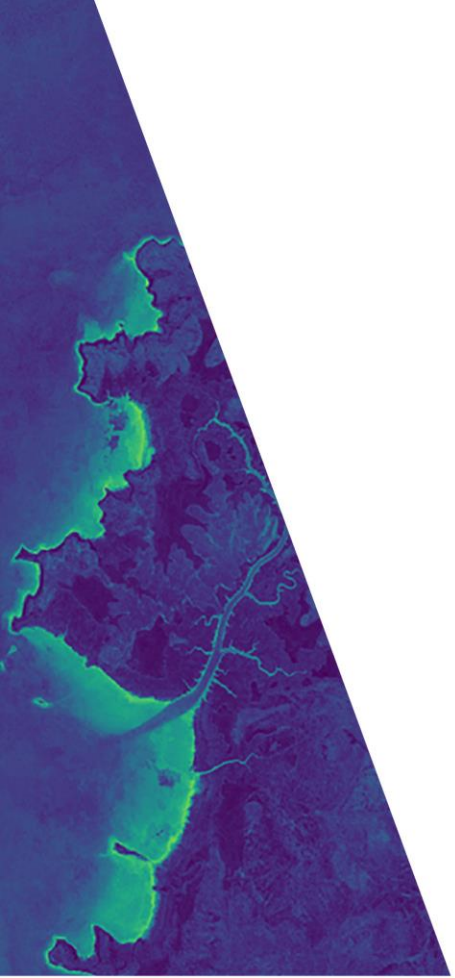
- Deliver 5 continental-wide products
- Deliver case studies on the impact of EO data on decision making in Africa
- Demonstrate a developing business case for direct country-level investment based on delivered value
- Demonstrate cases of products and services from DE Africa being independently ingested into new, innovative applications
- Develop a sustainability plan for the continued operations of DE Africa



Progress

DE Africa ‘cube’: maps.digitalearth.africa

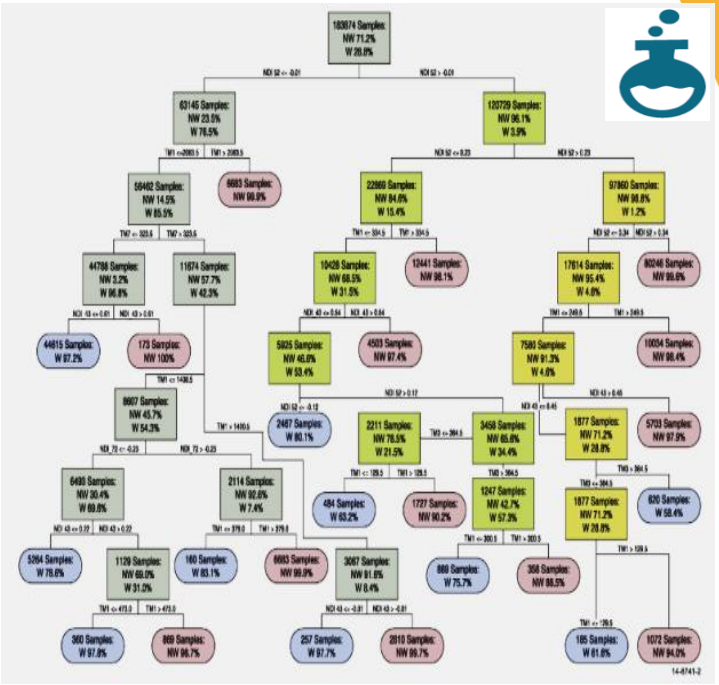




DEAfrica Platform – August 2019

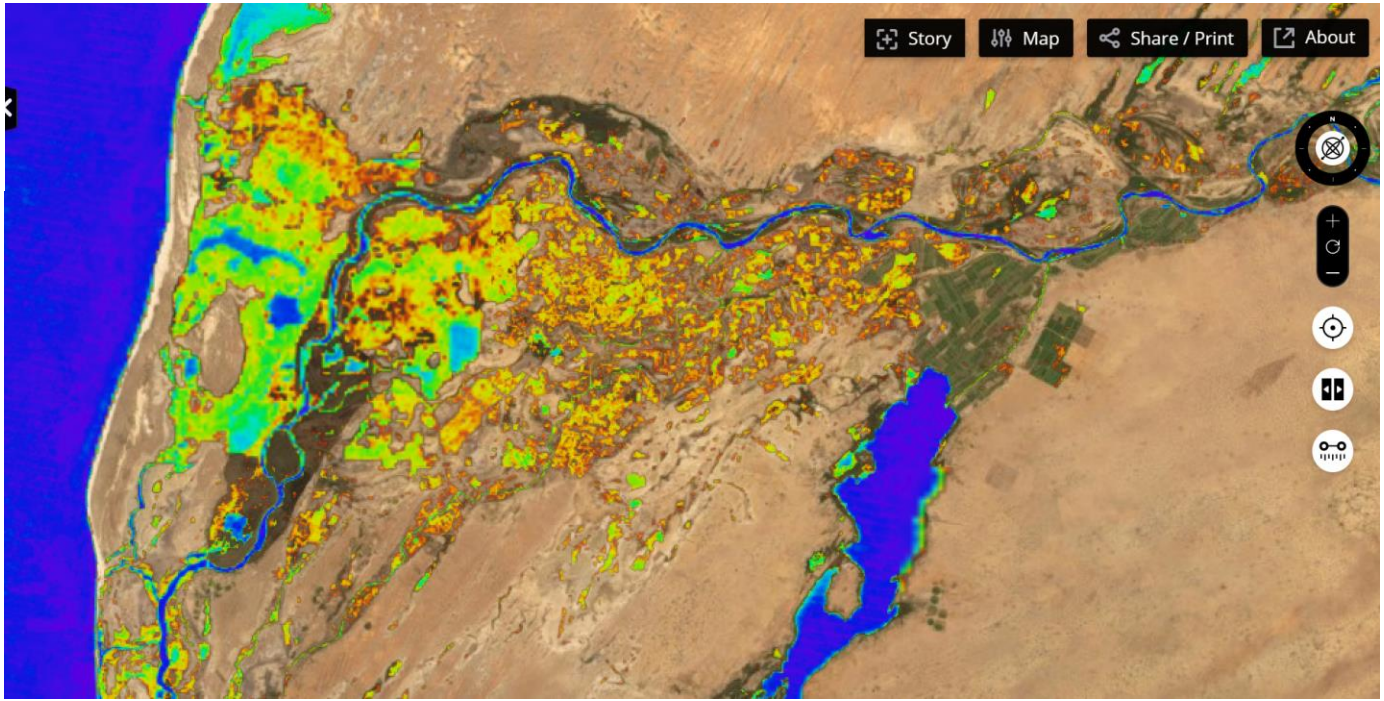
- DE Africa Map - http://maps.digitalearth.africa/
- OGC Web Services - https://ows.digitalearth.africa/
- Explorer - http://explorer.digitalearth.africa/
- Public Data bucket - https://data.digitalearth.africa/
- Jupyter Hub - https://sandbox.digitalearth.africa/
- GitHub - https://github.com/digitalearthafrica
- Slack channel - #de-Africa https://opendatacube.slack.com/
- Esri Africa GeoPortal http://www.africageoportal.com/

Water observations from space (WOfS)

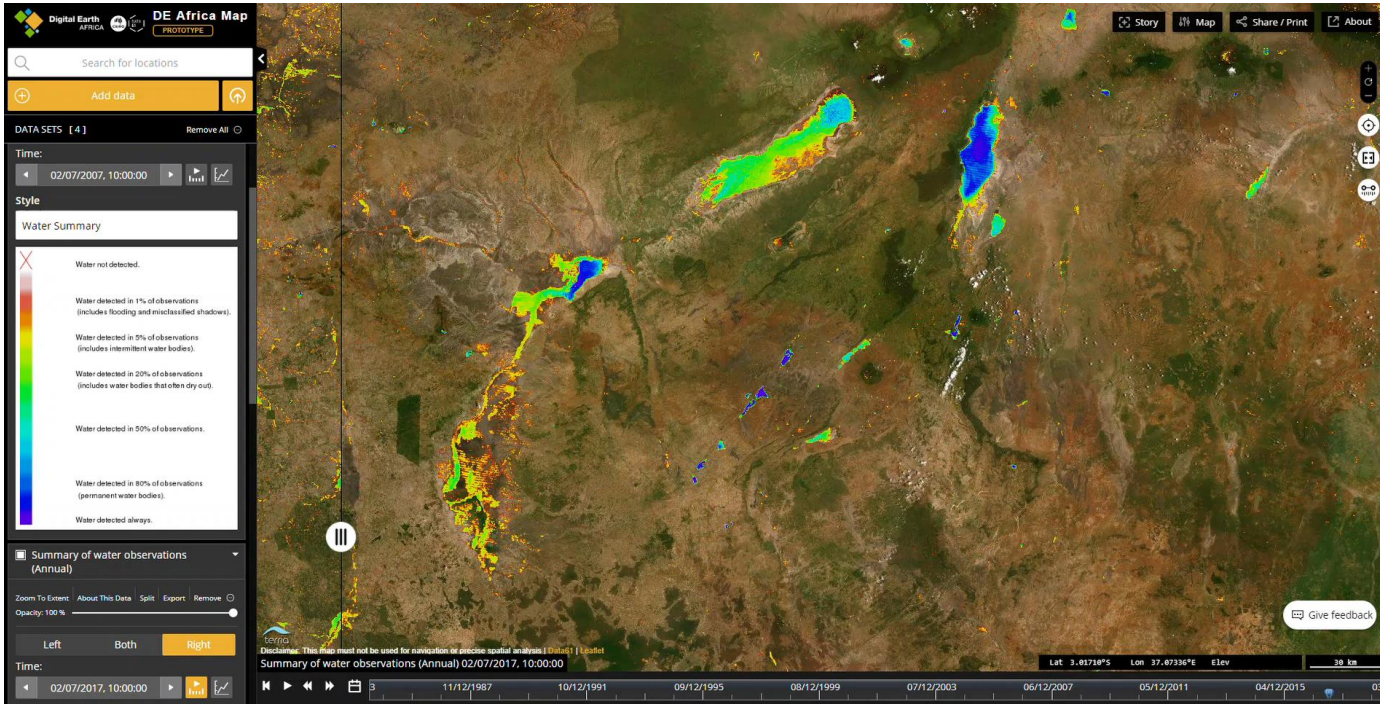


Mueller et al., 2016, Water Observations from Space. *Remote Sensing of Environment* **147** *341-352*

Surface Water (WOfS) Saint-Louis, Senegal (2016)

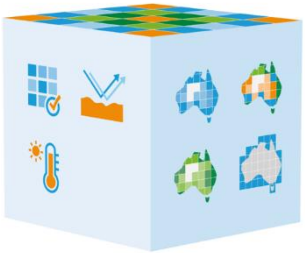


Surface Water (WOfS), Tanzania (2007/2017)

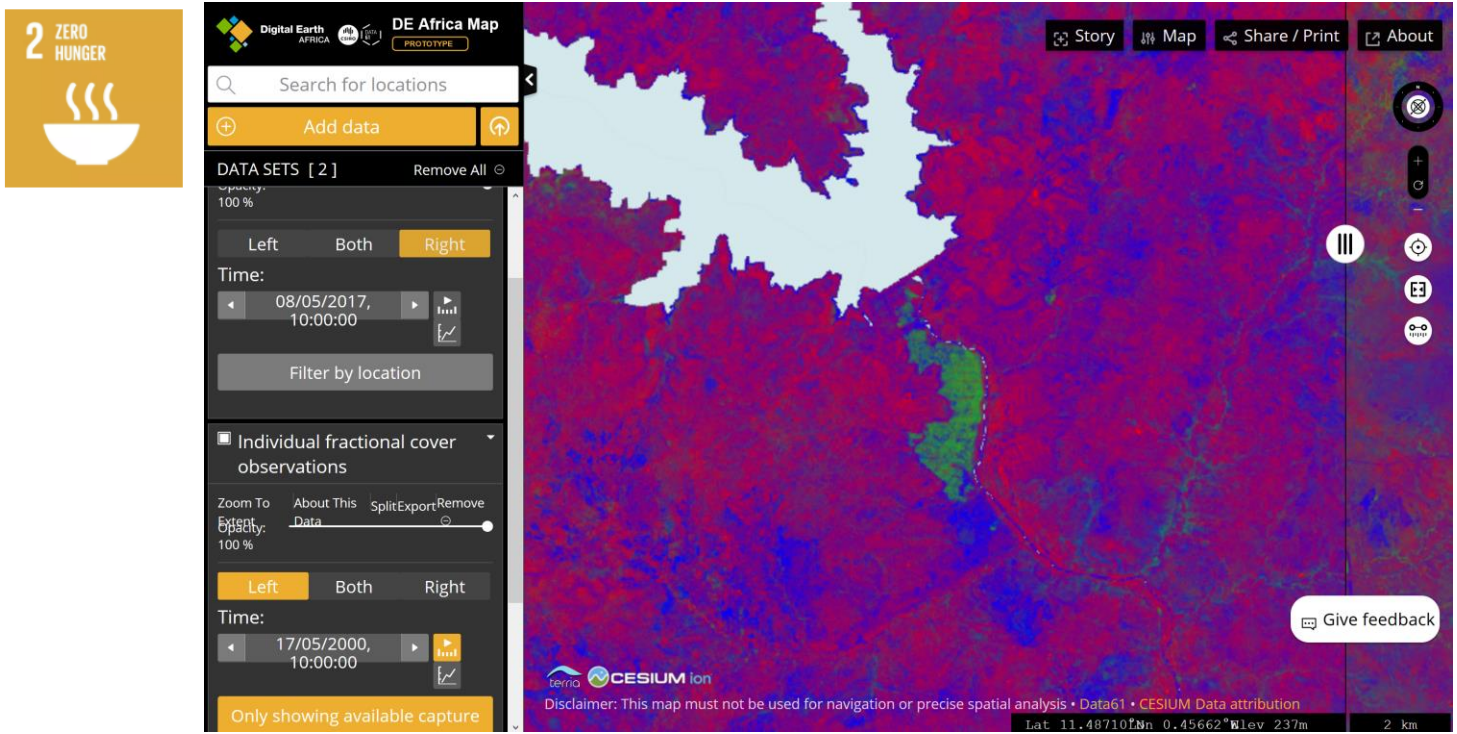


Drought resilience in Tanzania

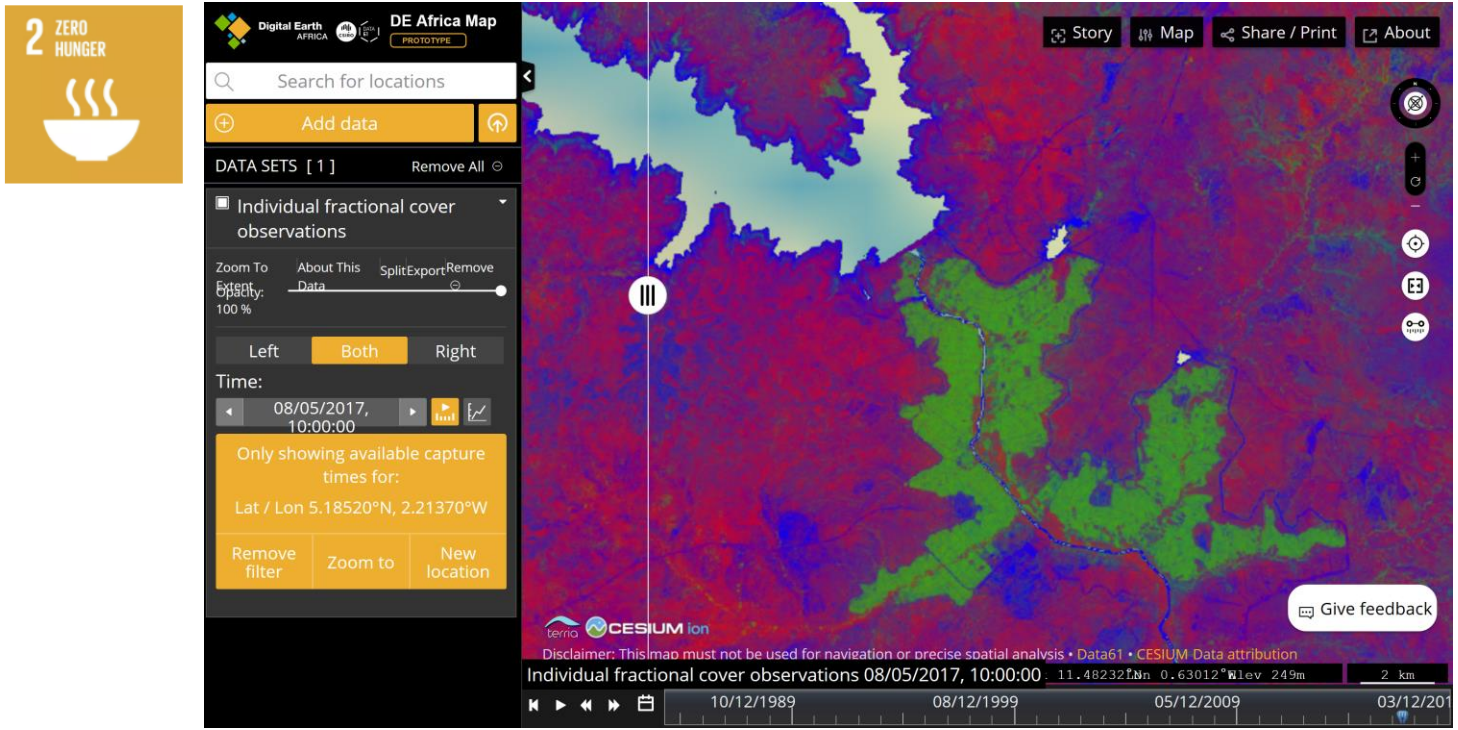
Monitoring cropping - ‘fractional cover’



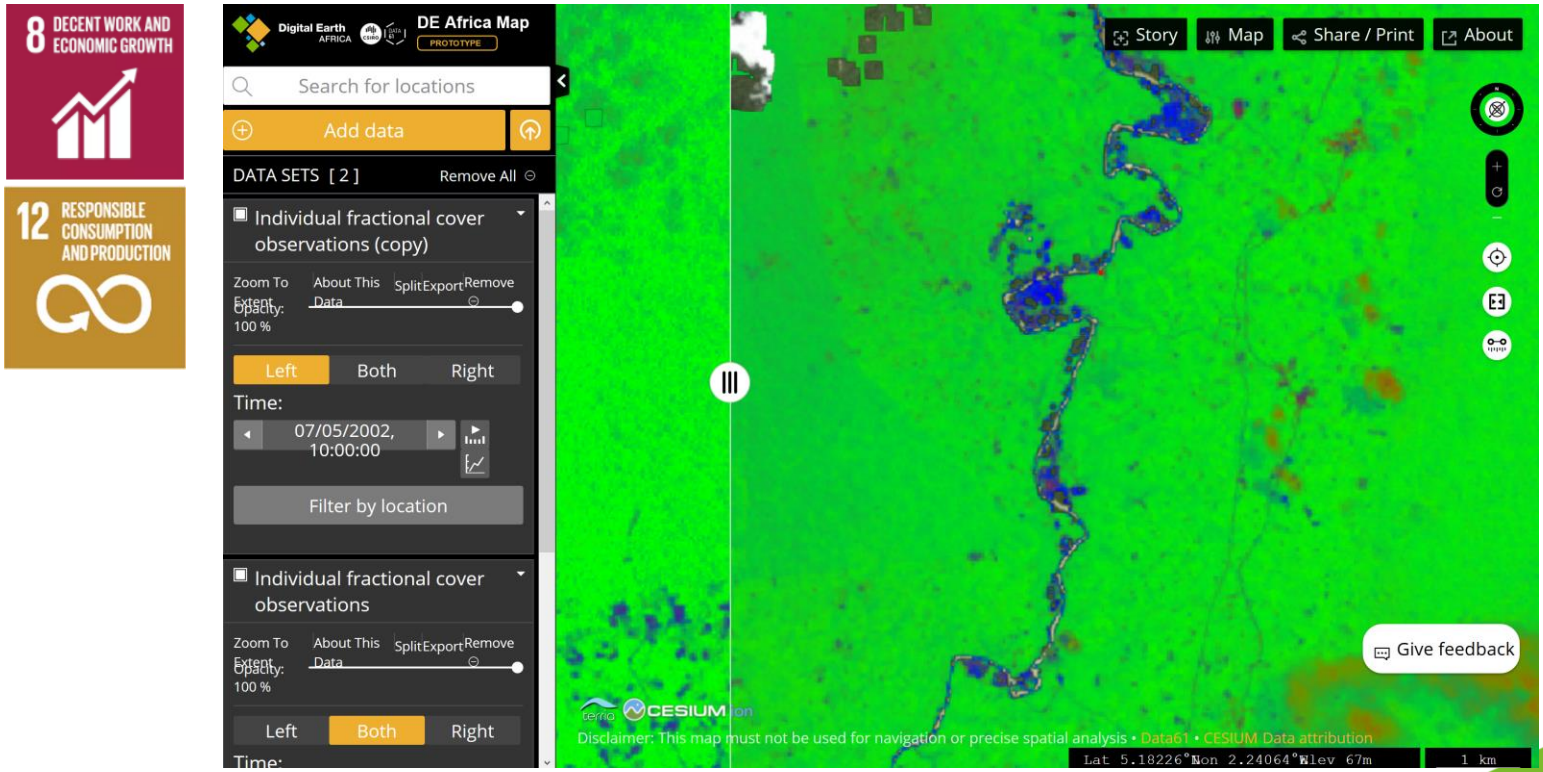
Fractional Cover, Burkina Fasso (2000)



Fractional Cover, Burkina Fasso (2017)



Extracting mining insights in Ghana



June 17, 2019, 2:01 PM GMT+10

The NASA Veteran Cracking Down on Illegal Gold Miners

● Satellite-imaging software helps government officials identify unlicensed mining sites.

By Tim McDonnell

▲ A small-scale mining operation in Kibi, Ghana. PHOTOGRAPHER: RUTH MCDOWALL FOR BLOOMBERG BUSINESSWEEK

LISTEN TO ARTICLE

▶ 4:52

SHARE THIS ARTICLE

Share

The illegal gold mine is hidden just past a thick grove of cocoa trees, a little ways off the two-lane road through Sagyimase, Ghana, a rural town a couple hours' drive north of the West African nation's capital, Accra. It sits on a torn-up patch of ground the size of a

Ghana uses Earth observations to stop illegal mining

- Ghanaian Environmental Protection Agency has revoked licenses of 47 companies
- Has begun two more criminal prosecutions

Digital Earth Africa Landsat 5/7/8 Change Detection

About

About this sample App

This compilation accesses the Landsat data of the Digital Earth Africa announced on DE Africa day (12th of August 2019) in Nairobi.

Based on the 3 'evolutionary generations' of Landsat you can select 2 images you regard appropriate (choose cloudless images where available) and then apply some simple change detection algorithms to it.

Use the swipe tool to compare

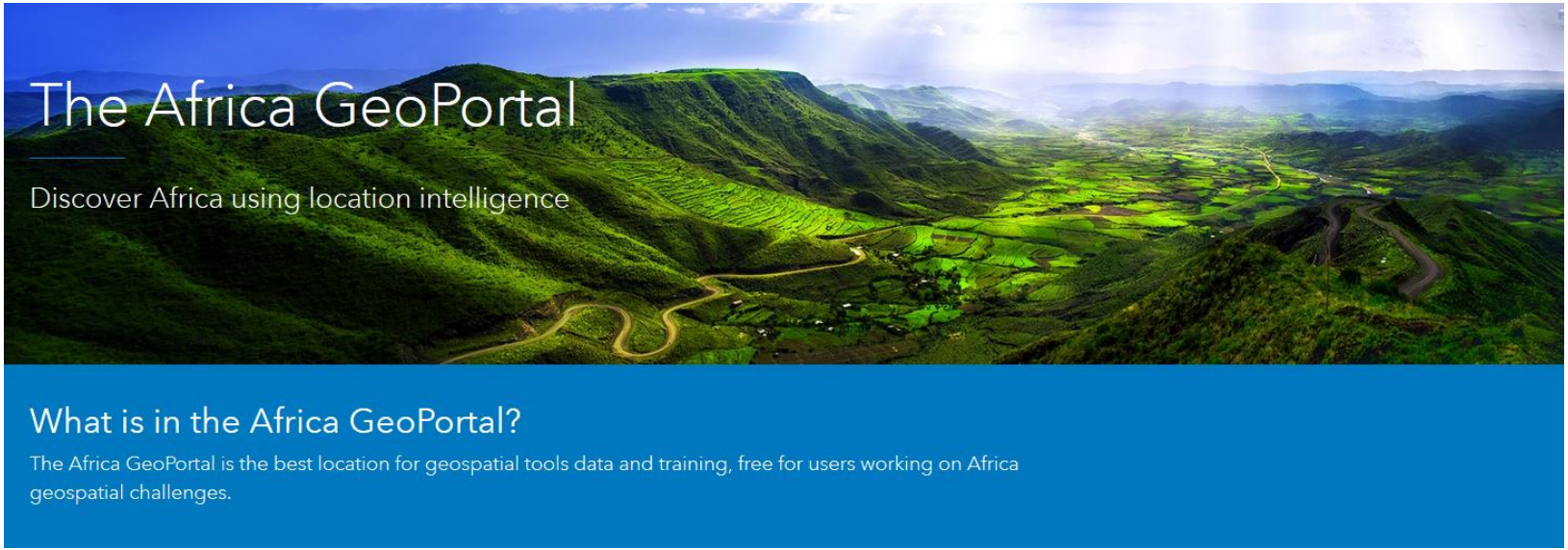
Here a hint for a nicely working combination:
Use the bookmark tool and go to Nairobi (Detail)
Open the ChangeDetection Tool
Select the Landsat 8 collection
Set Date 1 to be December 28, 2017
Set Date 2 to be February 3, 2014
Select the "Built up index" option (this will work with Landsat 8 only because of the bands used for it!)
Select the 'Difference Mask" Option
APPLY

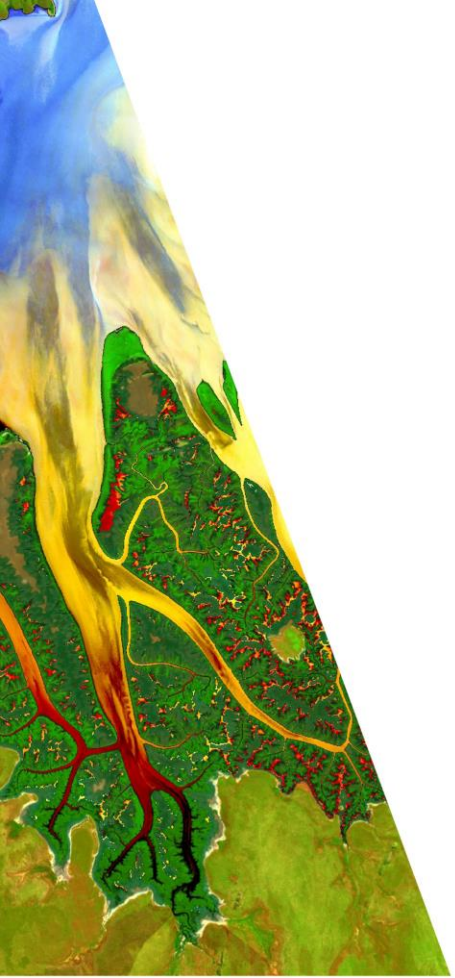
The areas in GREEN will show increase in Built-Up areas clearly

Credits to Digital Earth Africa

Africa Geoportal – ESRI partnership

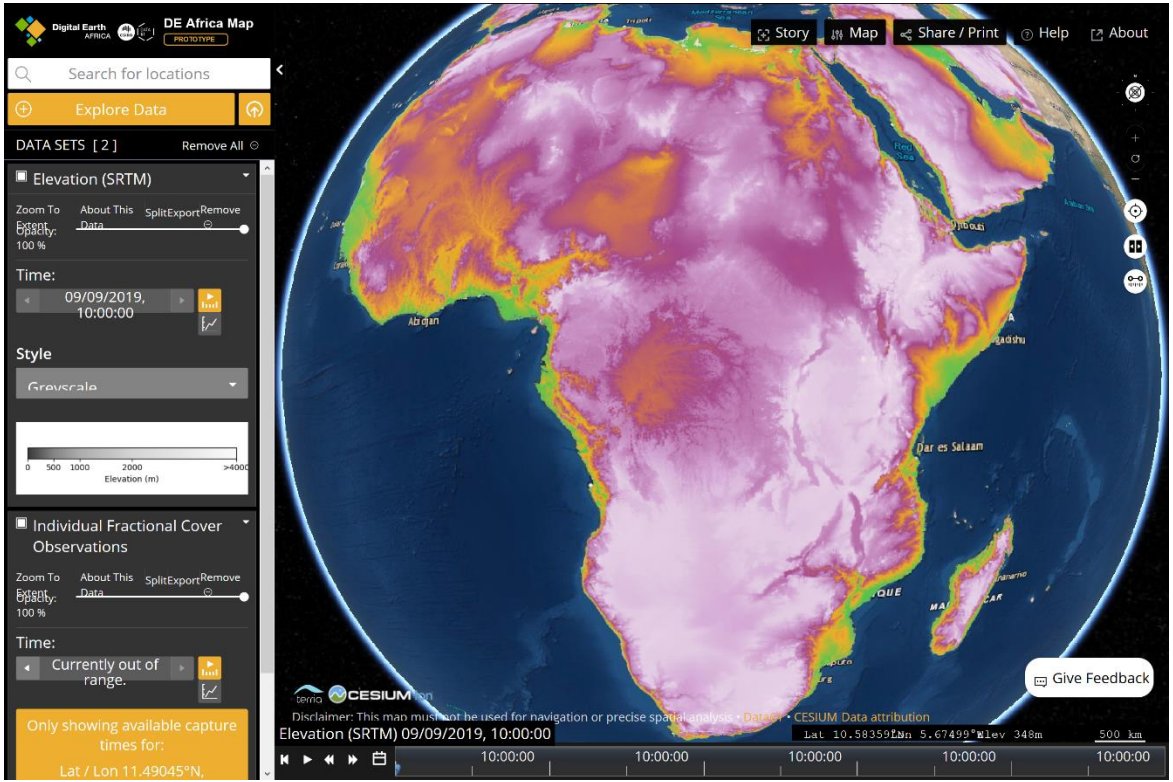
http://www.africageoportal.com/





Continental data!

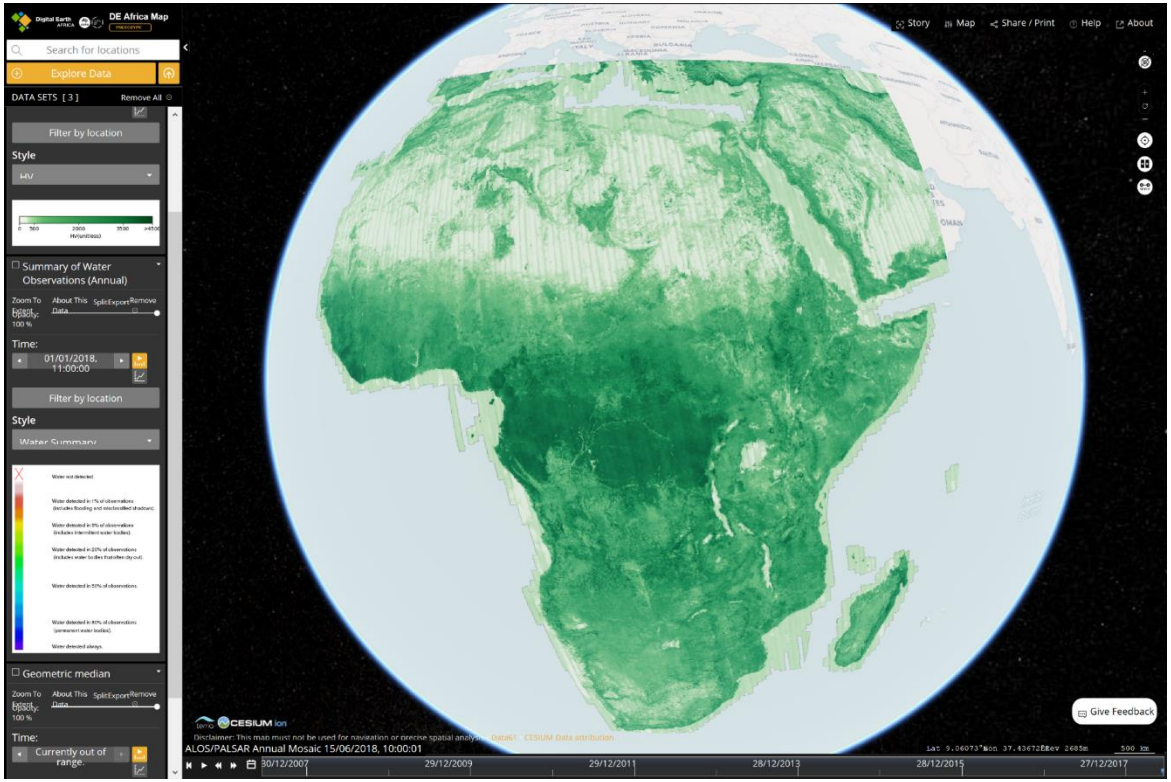
Digital Elevation Model



Continental Digital Elevation Model (DEM) – SRTM

Note:
A more accurate, high resolution DEM should be a priority for the continent. This should be coordinated with the major space agencies

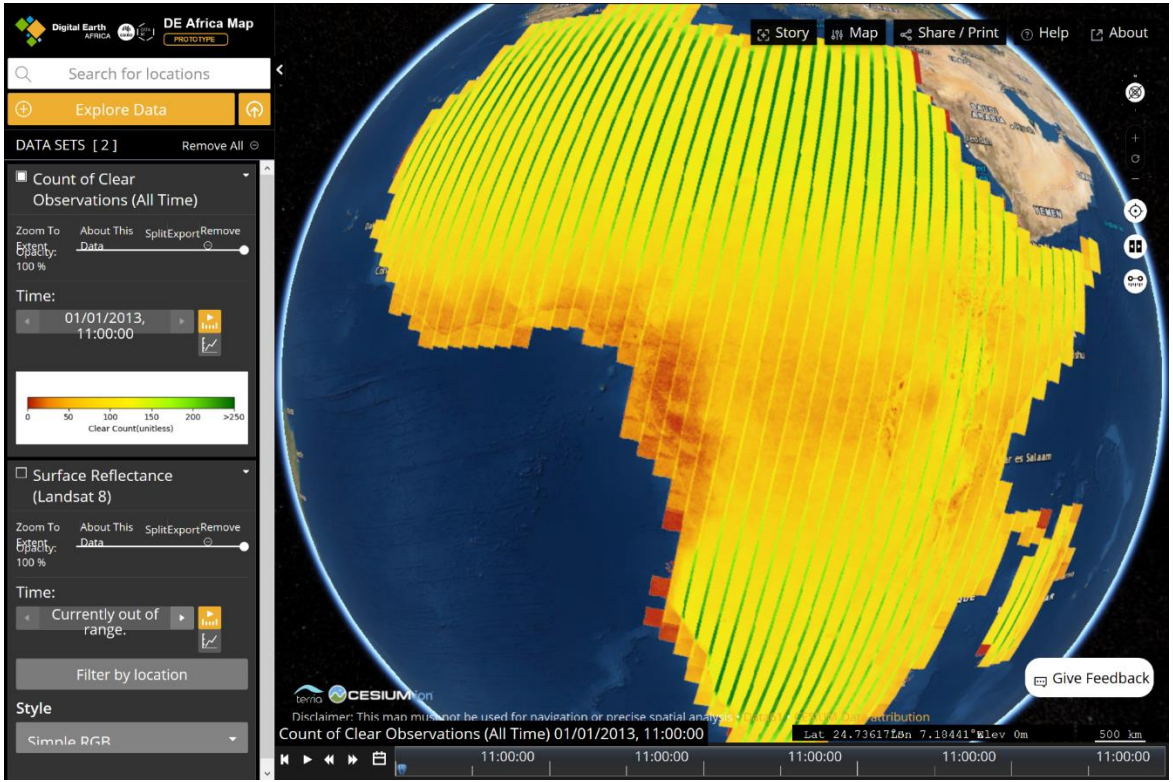
Radar mosaic images from JAXA – ALOS



Continental Radar data coverages from Japan's Advanced Land Observing Satellite (ALOS), provided by JAXA.

Years
2007, 2008, 2009, 2015, 2016, 2017

Continental Data from Landsat

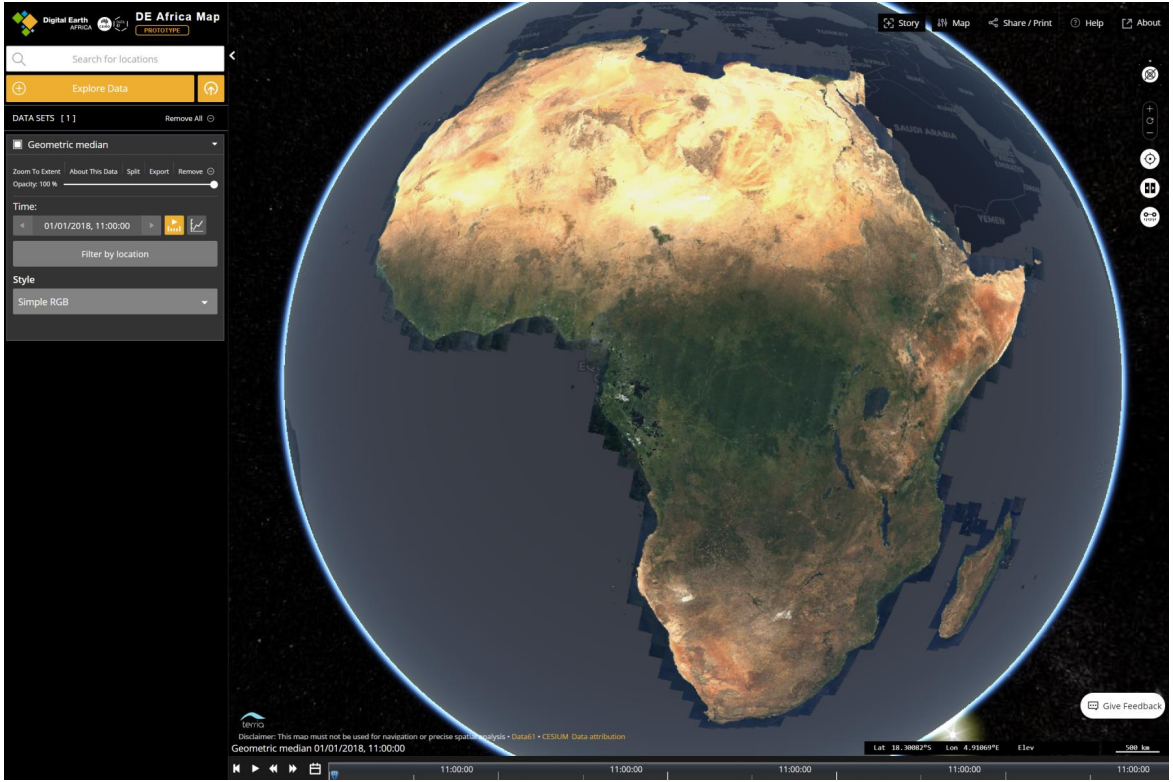


Continental Analysis Ready Data (ARD)
Landsat-8
2013 to 2018
Provisional data for DE Africa

Colours indicate how many cloud-free pixels during this time

Full Landsat (4,5,7,8) ARD early 2020.

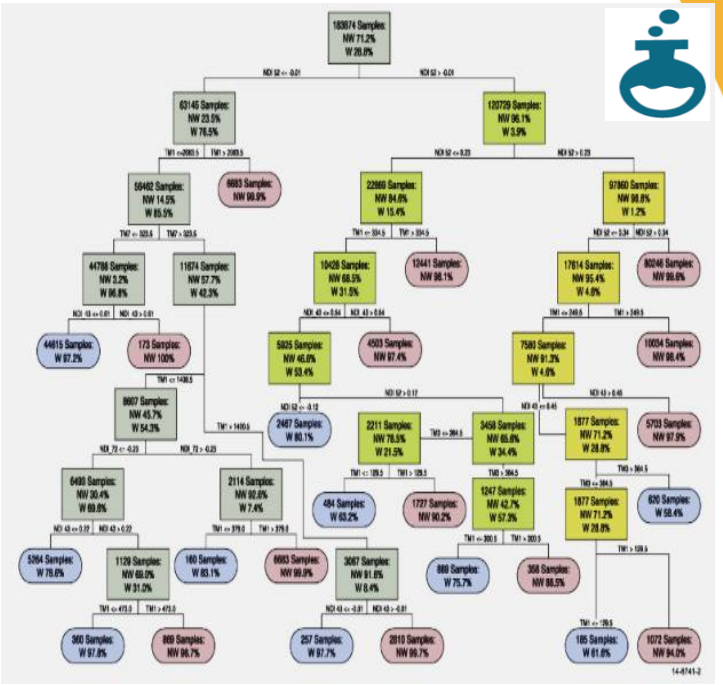
Geomedian Landsat Image for 2018



Geomedian 2018: the ‘average’ image for Africa from all available Landsat-8 images in 2018

~ 30,000 scenes
~ 18 TB data
Overnight processing on Amazon
< $200 US

Continental water observations from space (WOfS)



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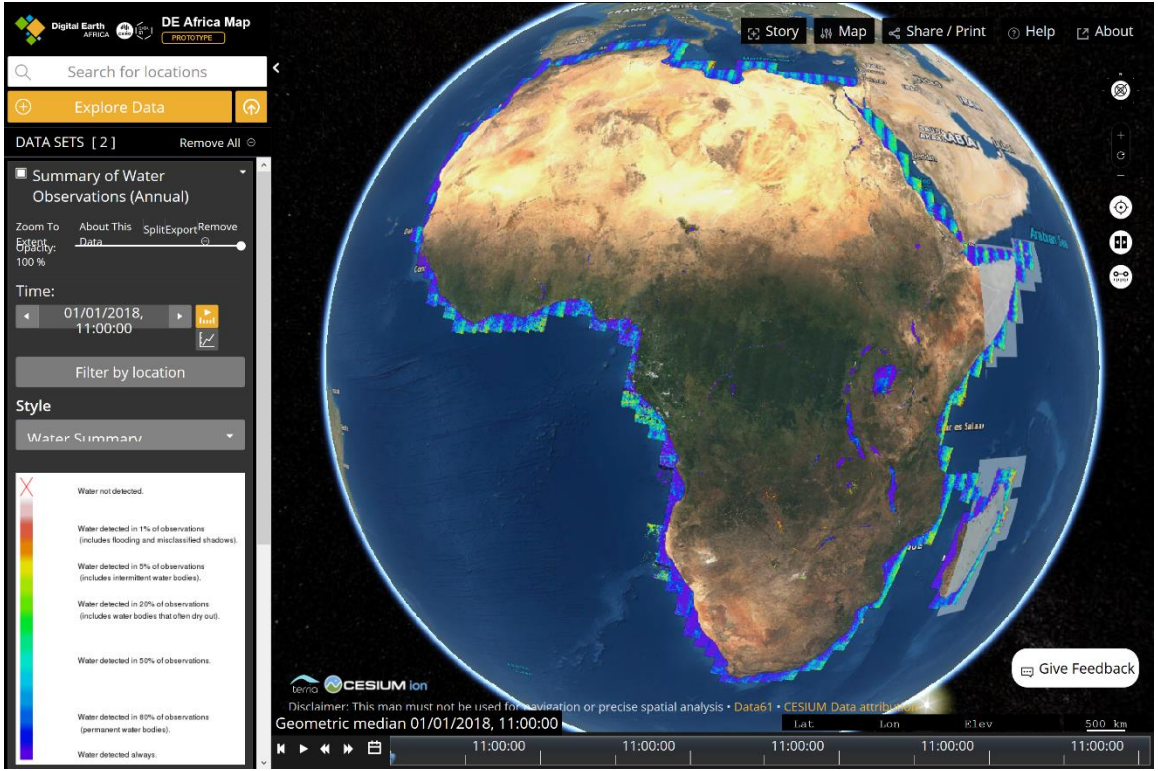
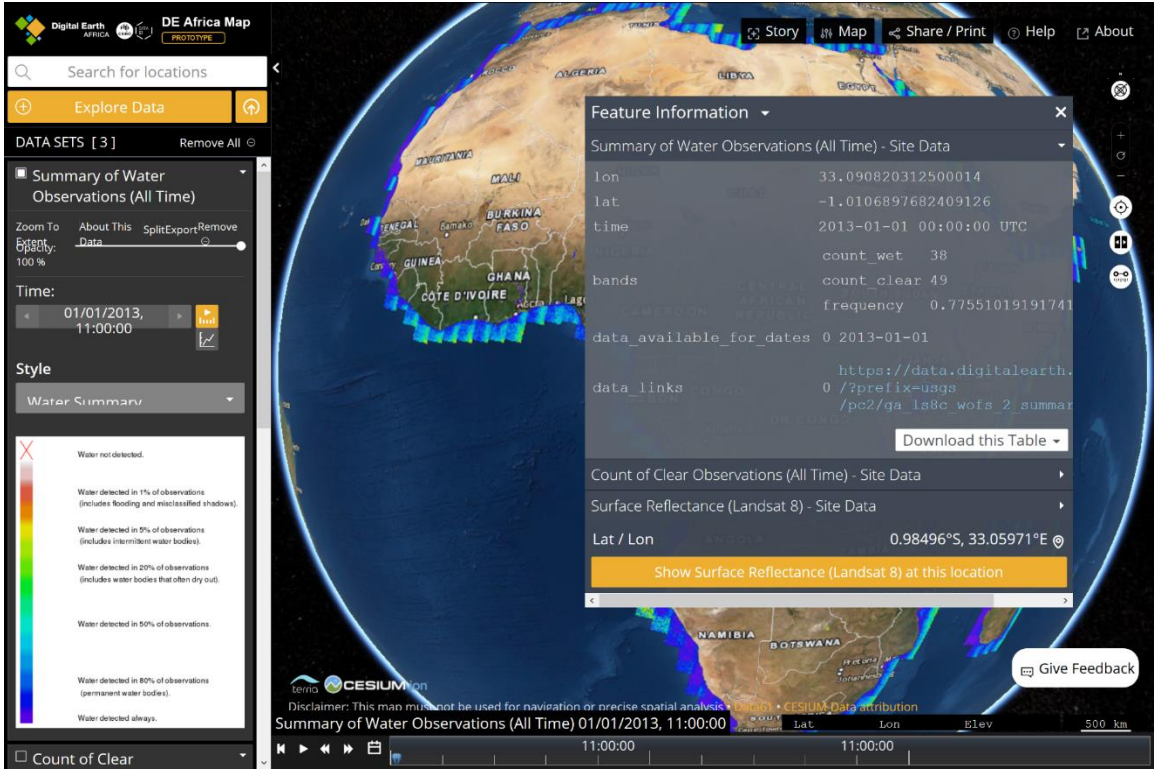


Applying the WOfS algorithm produces information on surface water for each year

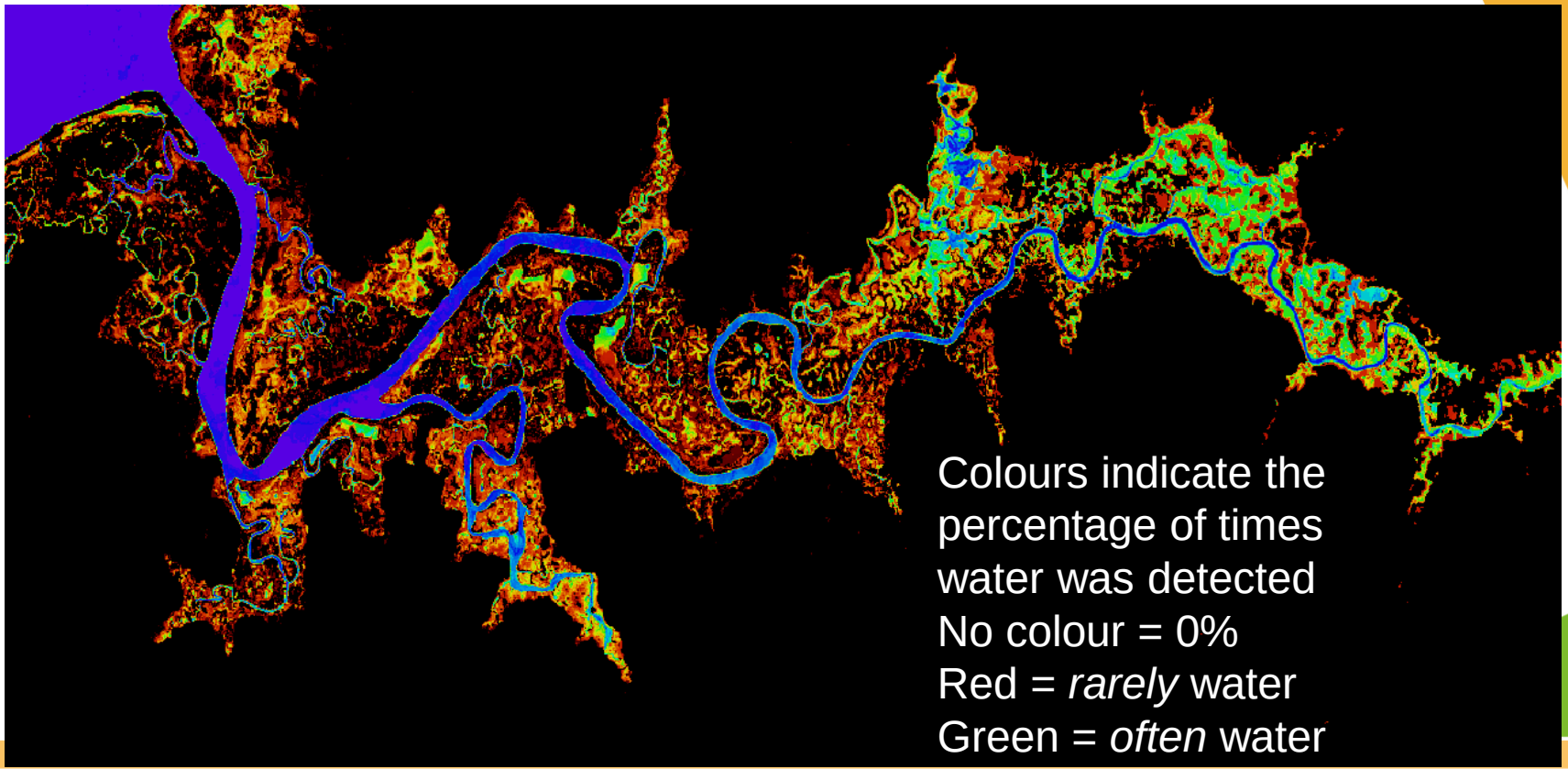
Processing on Amazon
< $200 US for each year of processing

Continental water observations from space (WOfS)



Any place can be explored to see how often and when water was seen by the satellites.

Continental water observations from space (WOfS)



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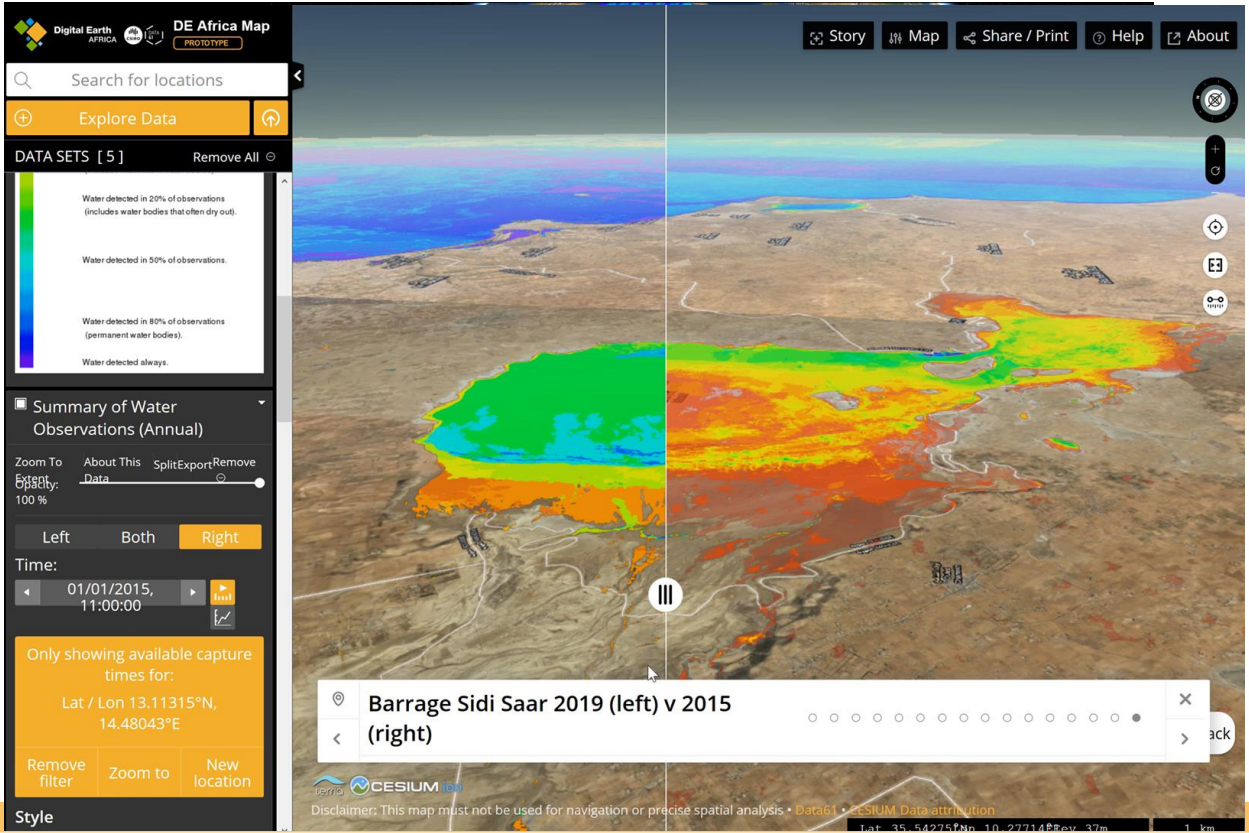
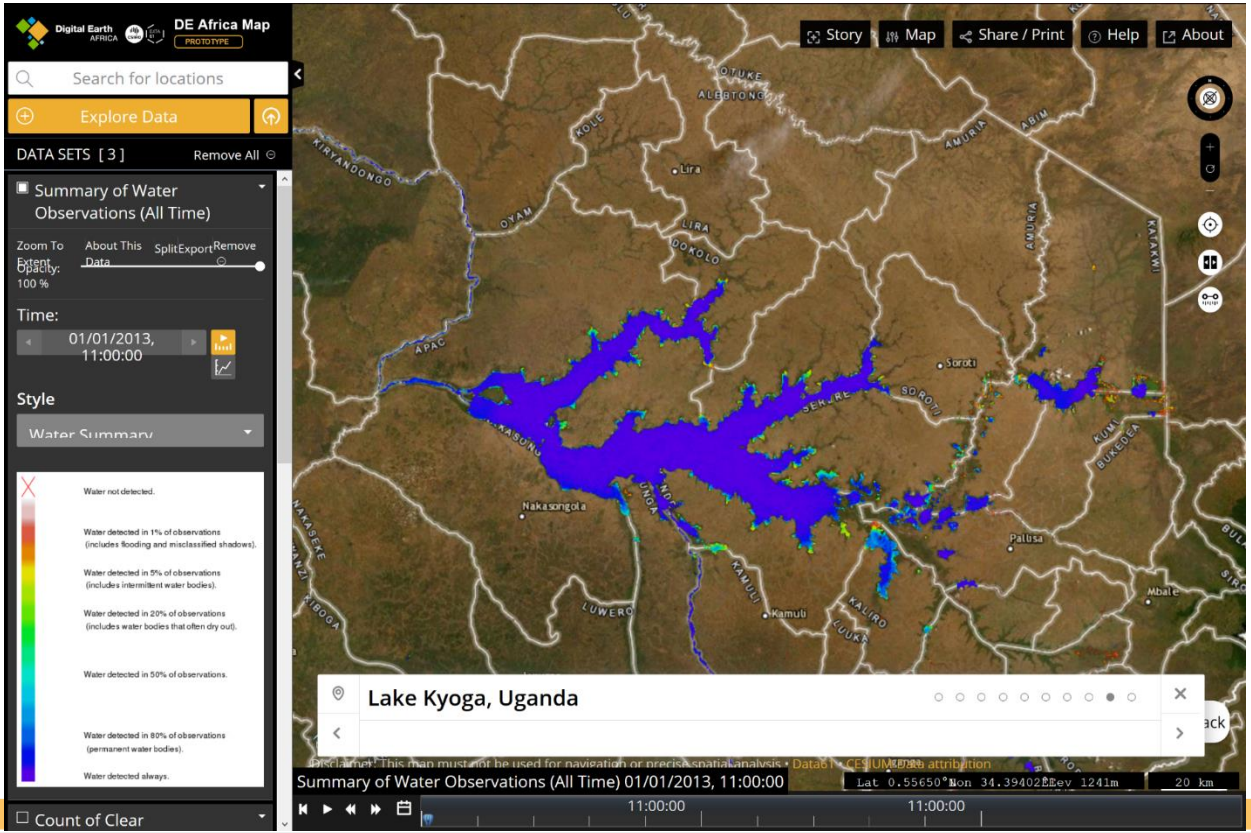


Colours indicate the percentage of times water was detected (in that year)

No colour = 0%
Red = *rarely* water
Green = *often* water
Blue = *always* water

Continental water observations from space (WOfS)



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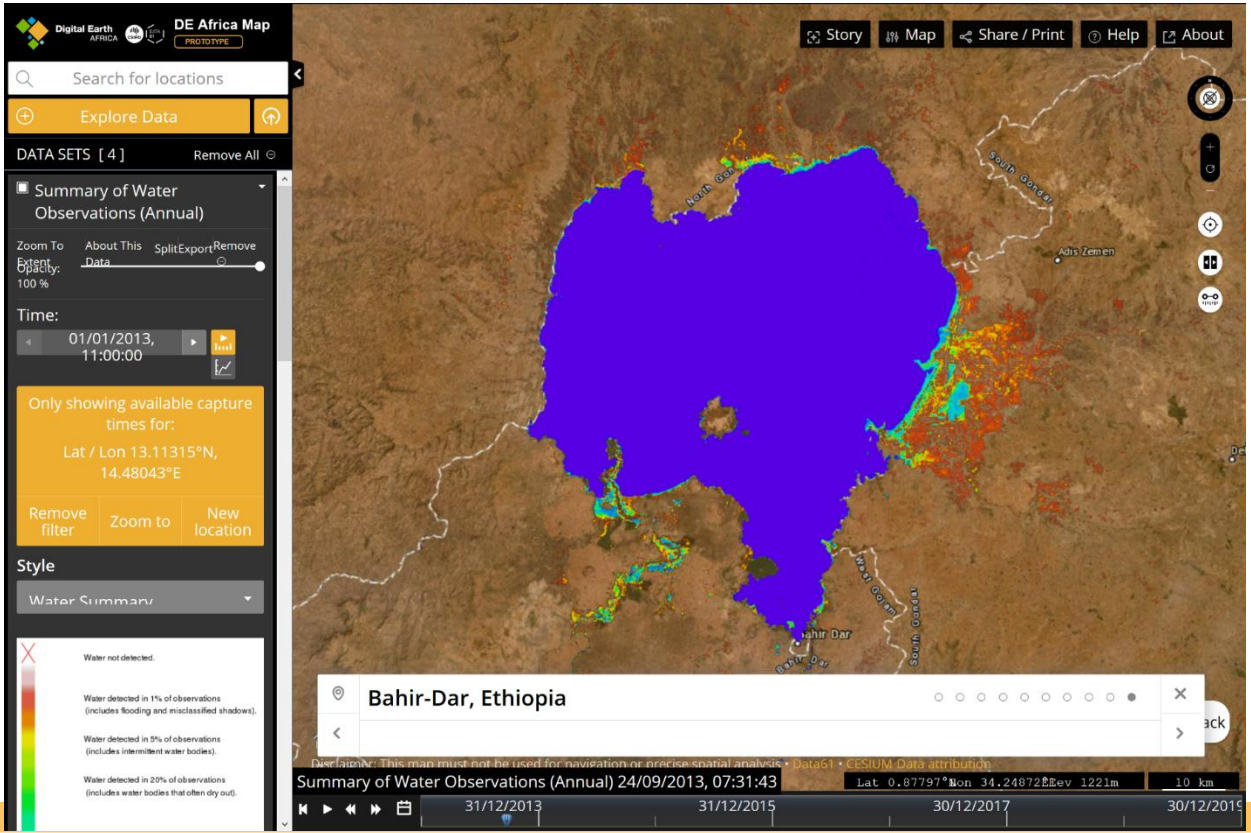
Blue = *always* water

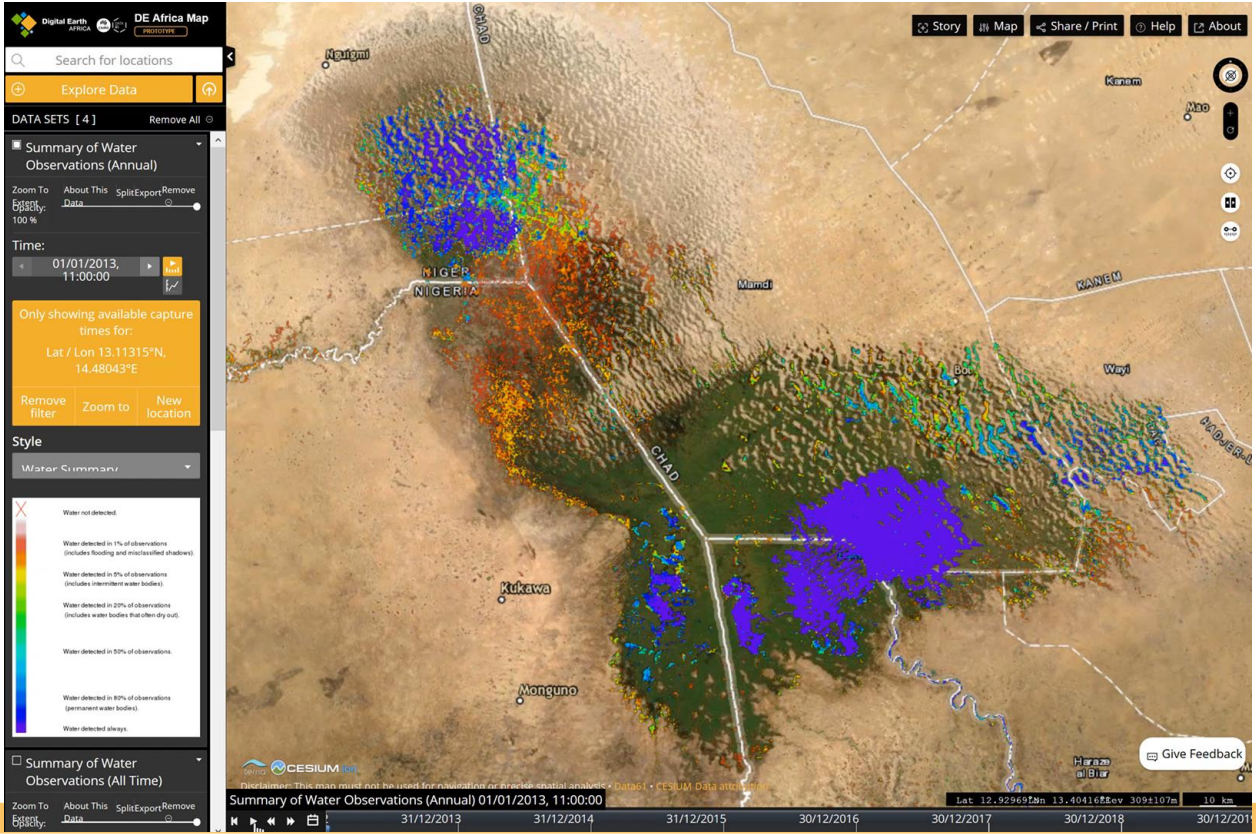
Continental water observations from space (WOfS)



Colours indicate the percentage of times water was detected (in that year)

No colour = 0%
Red = *rarely* water
Green = *often* water
Blue = *always* water

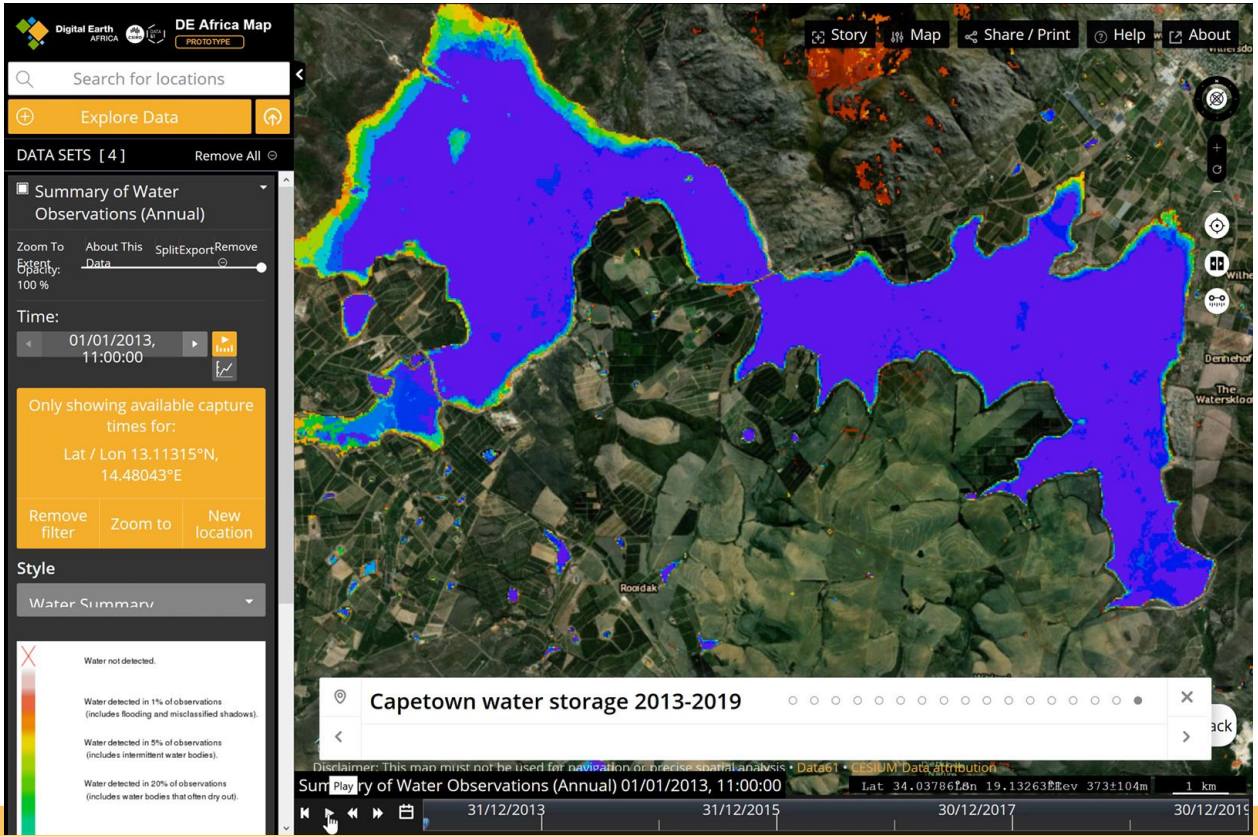
Continental water observations from space (WOfS)



Lake Chad from 2013 to 2019

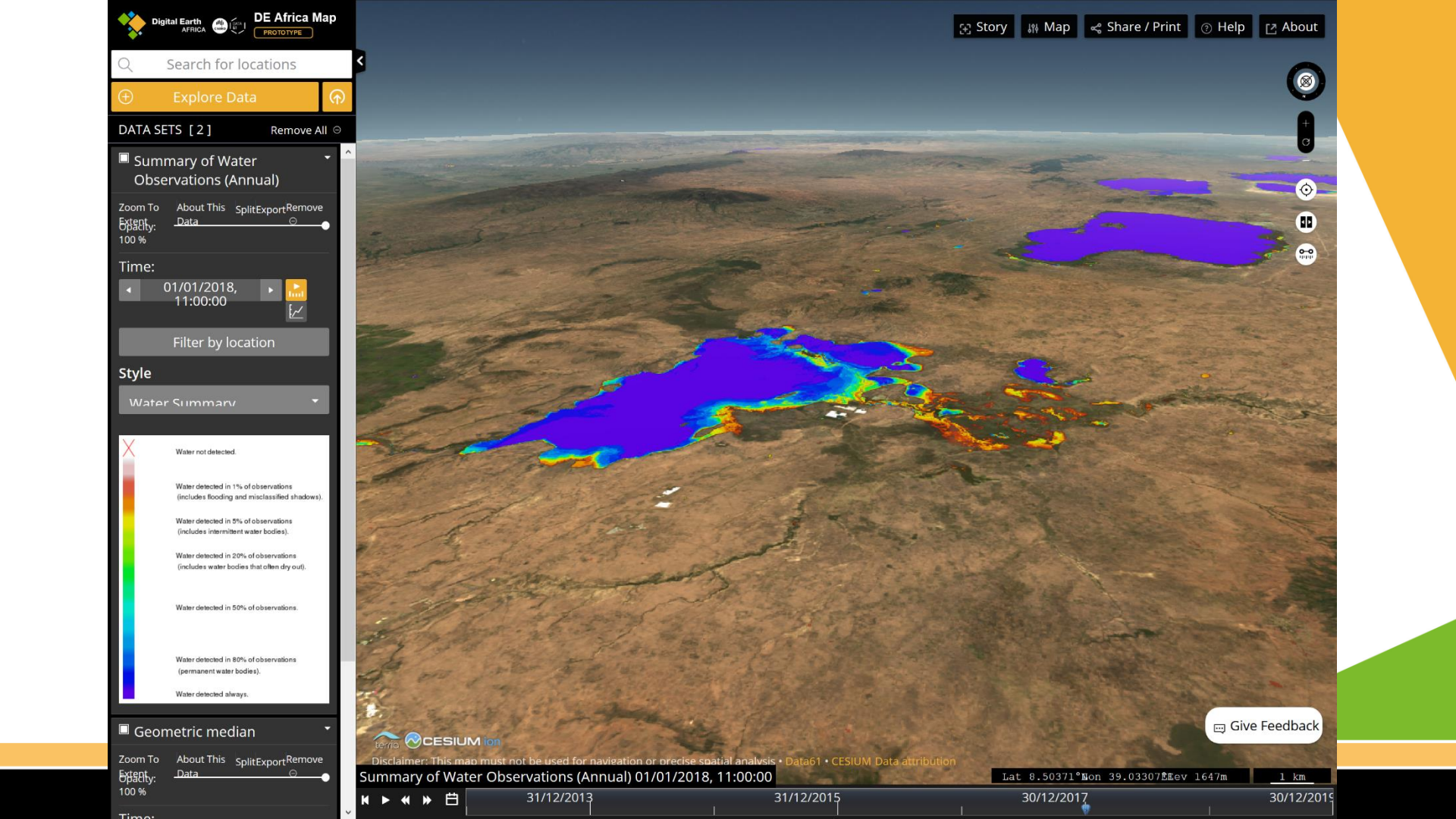
Colours:
No colour = 0%
Red = *rarely* water
Green = *often* water
Blue = *always* water

Continental water observations from space (WOfS)



Capetown water storage
2013 to 2019

Colours:
No colour = 0%
Red = *rarely* water
Green = *often* water
Blue = *always* water


Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [2]
Remove All
Summary of Water Observations (Annual)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
01/01/2018, 11:00:00
Filter by location
Style
Water Summary
Water not detected.
Water detected in 1% of observations (includes flooding and misclassified shadows).
Water detected in 5% of observations (includes intermittent water bodies).
Water detected in 20% of observations (includes water bodies that often dry out).
Water detected in 50% of observations.
Water detected in 80% of observations (permanent water bodies).
Water detected always.
Geometric median
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Story
Map
Share / Print
Help
About
Give Feedback
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Summary of Water Observations (Annual) 01/01/2018, 11:00:00
Lat 8.50371° Lon 39.03307° Elev 1647m
1 km
31/12/2013
31/12/2015
30/12/2017
30/12/2019

Digital Earth AFRICA | DE Africa Map PROTOTYPE

Search for locations

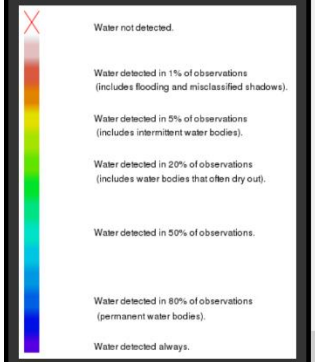
Explore Data

DATA SETS [3] Remove All

Filter by location

Style

Water Summary



Geometric median

Zoom To Extent | About This Data | Split | Export | Remove

Opacity: 100 %

Time:

01/01/2018, 11:00:00

Filter by location

Style

Simple RGB

Story | Map | Share / Print | Help | About

Give Feedback

terria CESIUM ion

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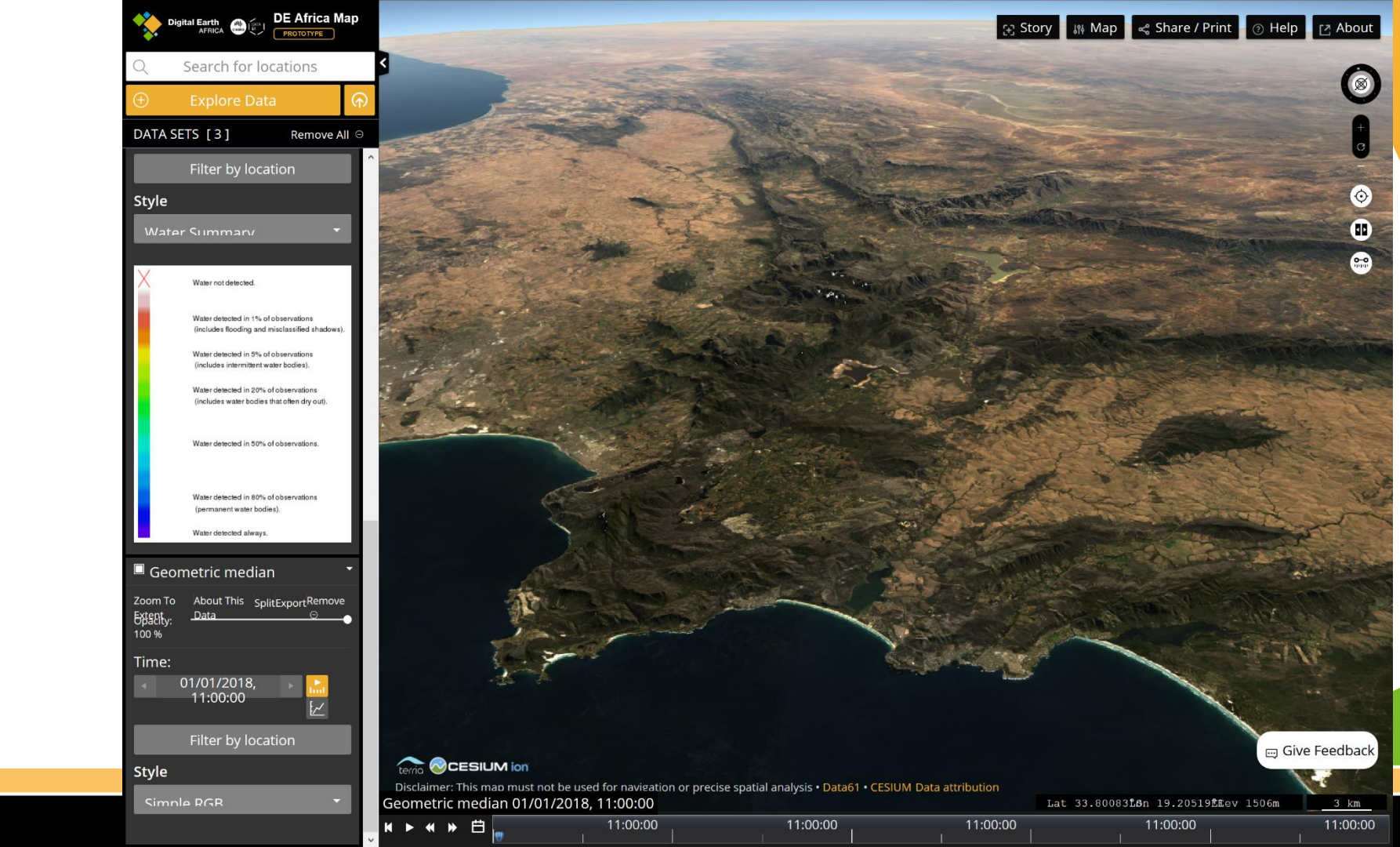
Geometric median 01/01/2018, 11:00:00

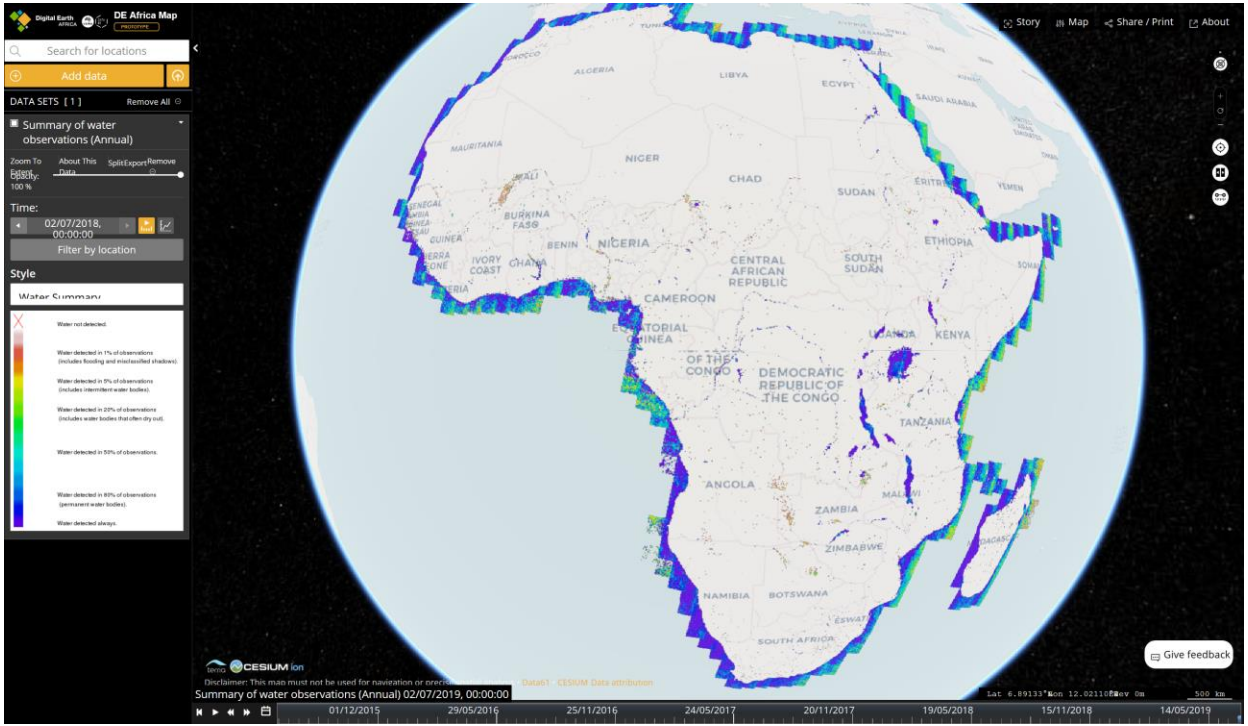
Lat 34.03398° Lon 20.36631° Elev 108m

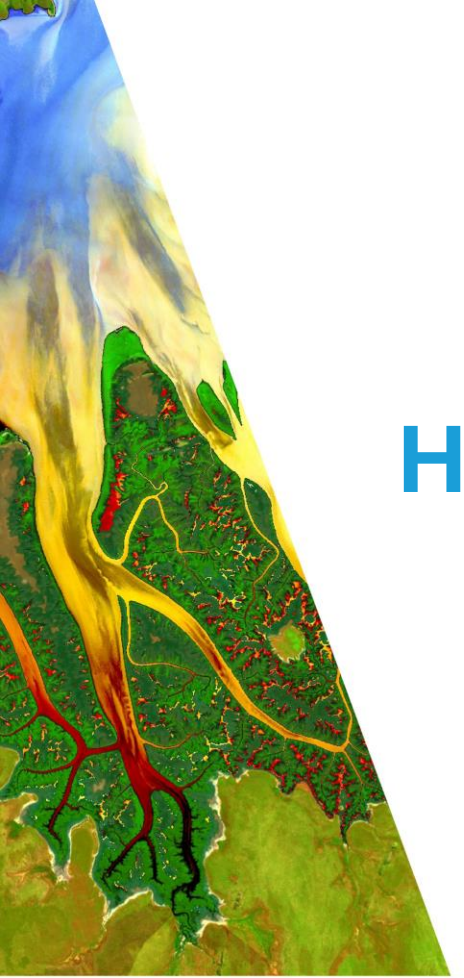
1 km

11:00:00 | 11:00:00 | 11:00:00 | 11:00:00 | 11:00:00

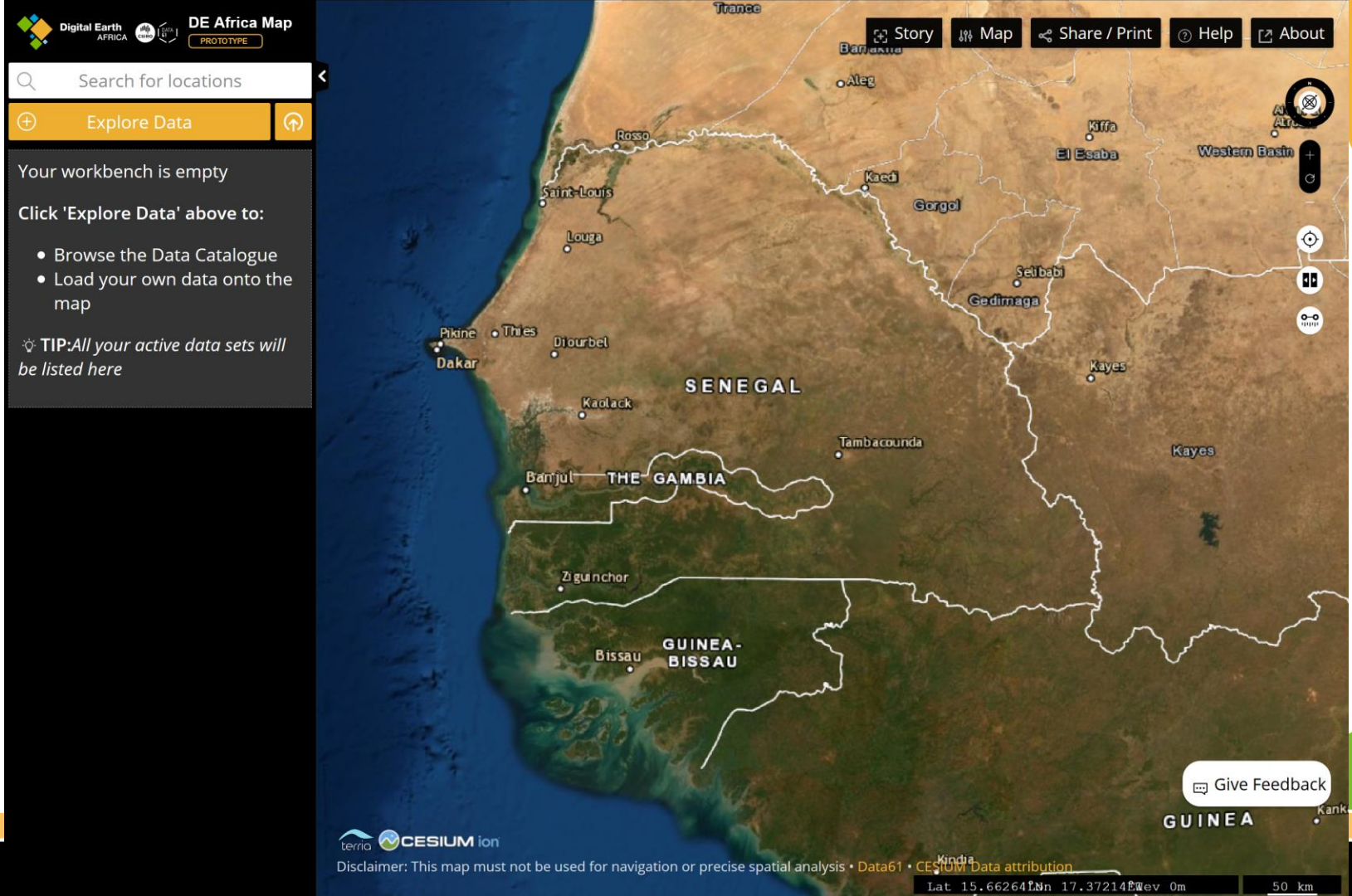

Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [3]
Remove All
Filter by location
Style
Water Summary
Water not detected.
Water detected in 1% of observations (includes flooding and misclassified shadows).
Water detected in 5% of observations (includes intermittent water bodies).
Water detected in 20% of observations (includes water bodies that often dry out).
Water detected in 50% of observations.
Water detected in 80% of observations (permanent water bodies).
Water detected always.
Geometric median
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
01/01/2018, 11:00:00
Filter by location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Geometric median 01/01/2018, 11:00:00
3 km
11:00:00
11:00:00
11:00:00
11:00:00
11:00:00

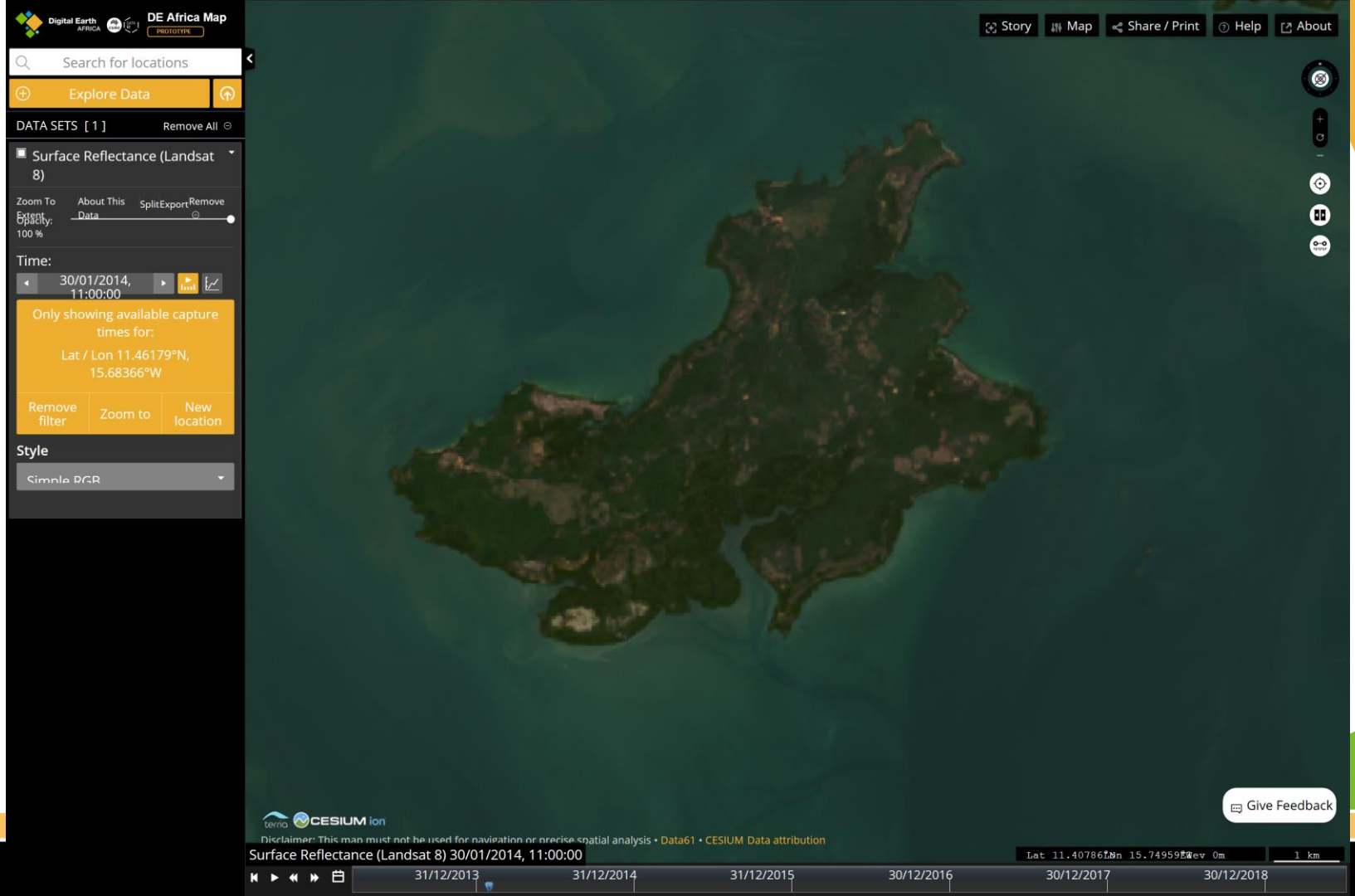
That’s a continental product!

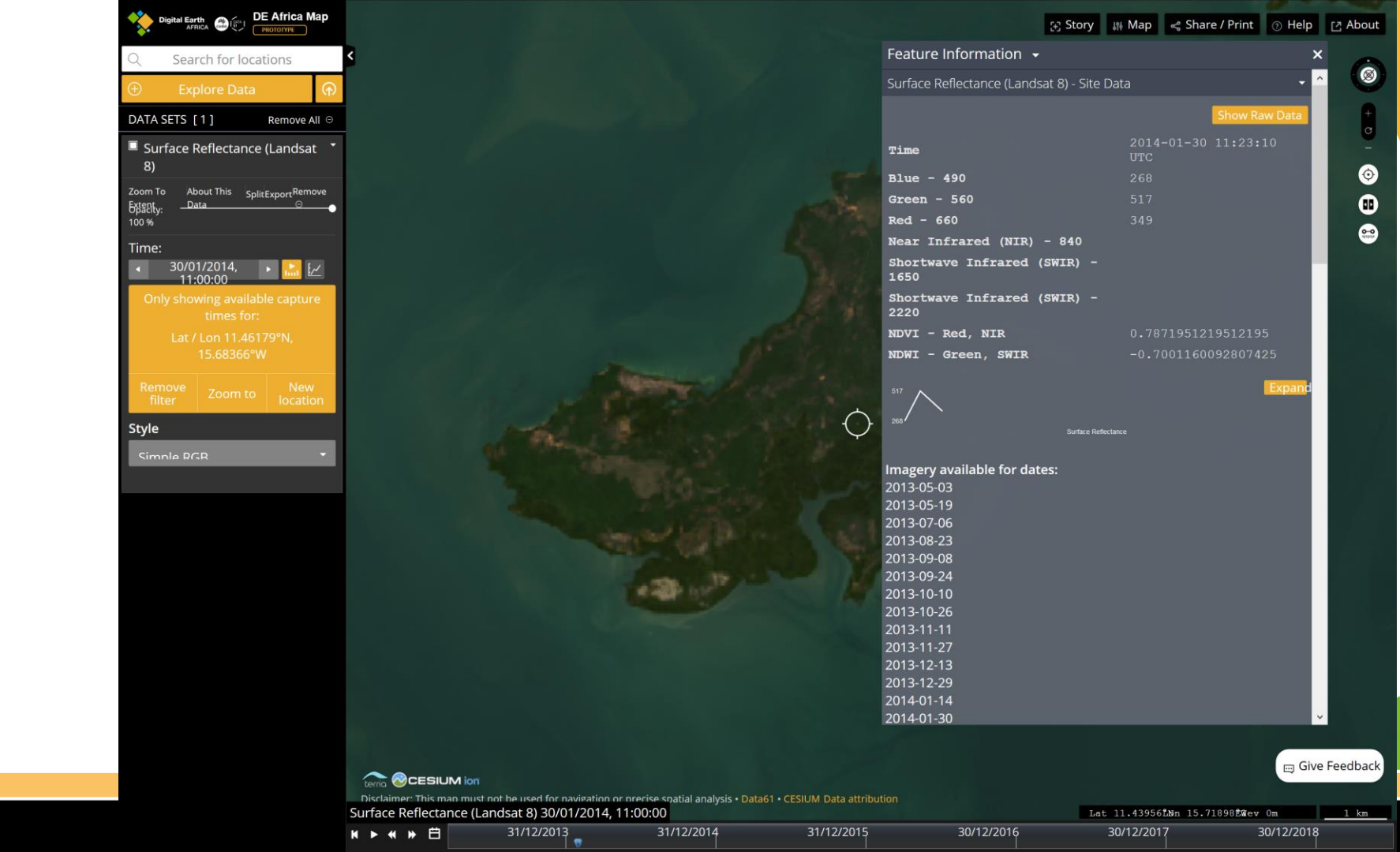


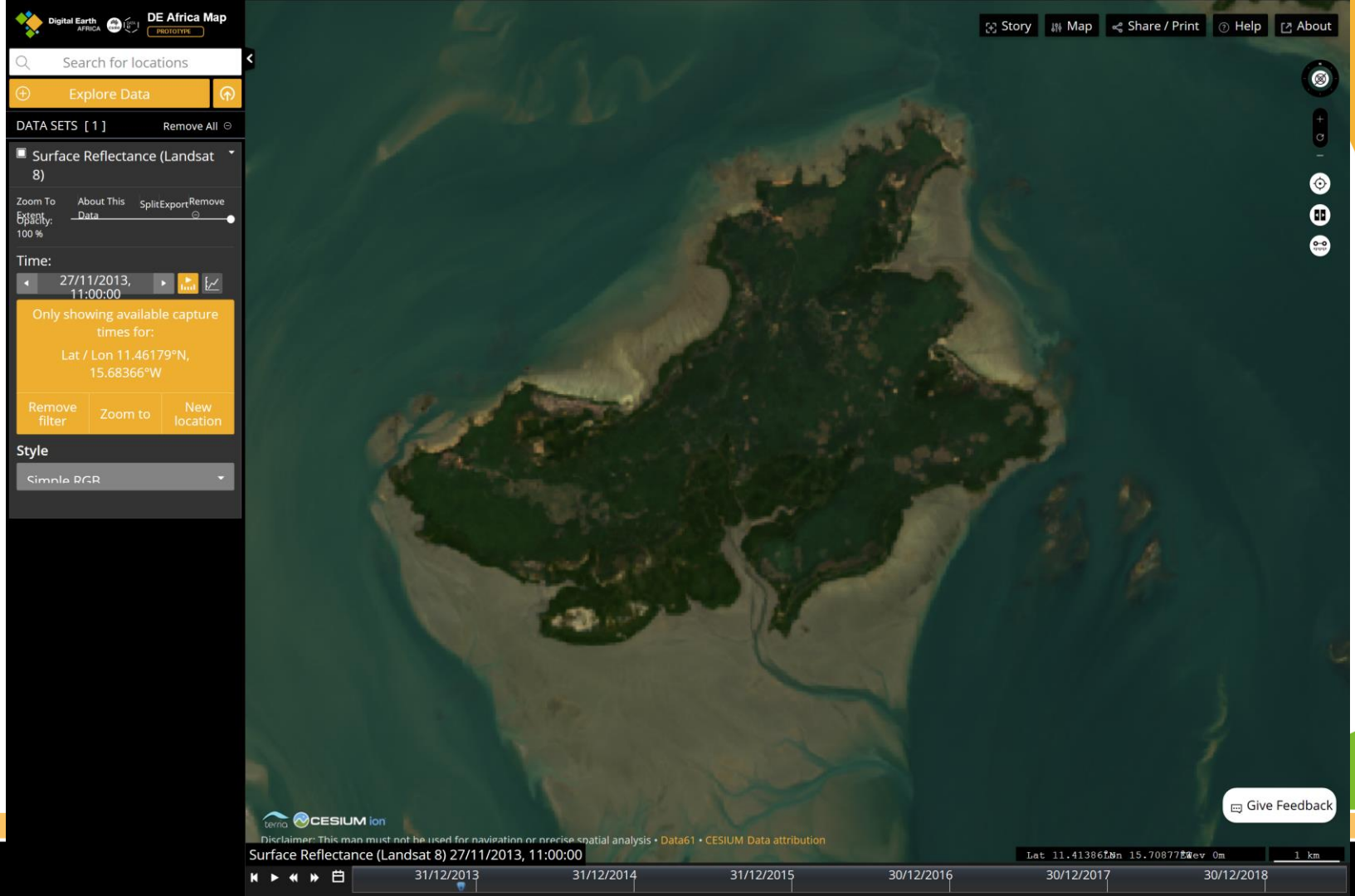


How the time-series builds information

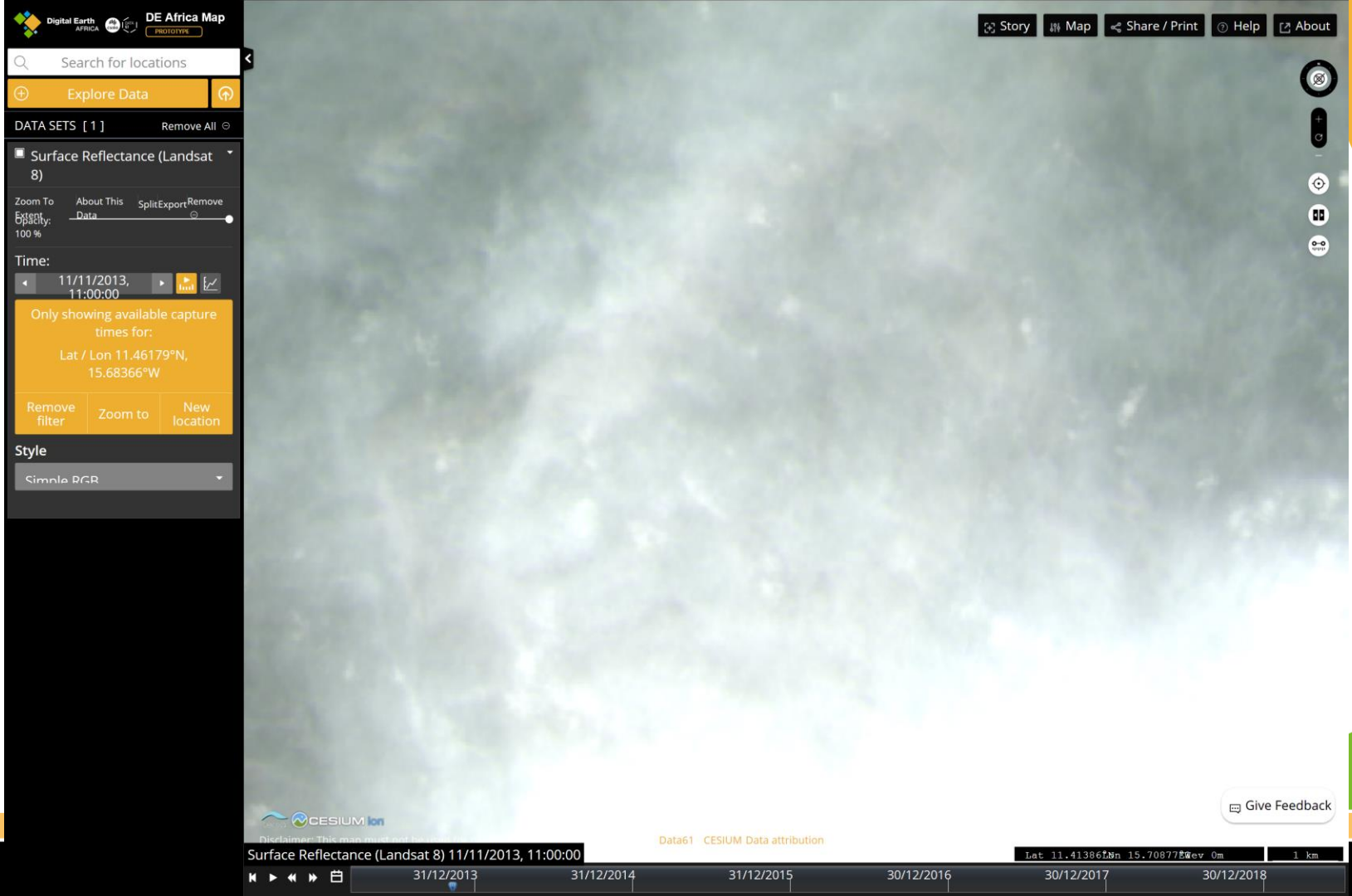

Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
Your workbench is empty
Click 'Explore Data' above to:
Browse the Data Catalogue
Load your own data onto the map
TIP:All your active data sets will be listed here
Story
Map
Share / Print
Help
About
Trance
Aleg
Rosso
Kiffa
El Esaba
Western Basin
Kaedi
Saint-Louis
Gorgol
Louga
Selibabi
Gedimaga
Pikine
Thies
Diourbel
Dakar
SENEGAL
Kaolack
Kayes
Tambacounda
Kayes
Banjul
THE GAMBIA
Ziguinchor
Bissau
GUINEA-BISSAU
Give Feedback
GUINEA
Kindia
terria
CESIUM ion
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Lat 15.66264°N 17.37214°W ev 0m
50 km

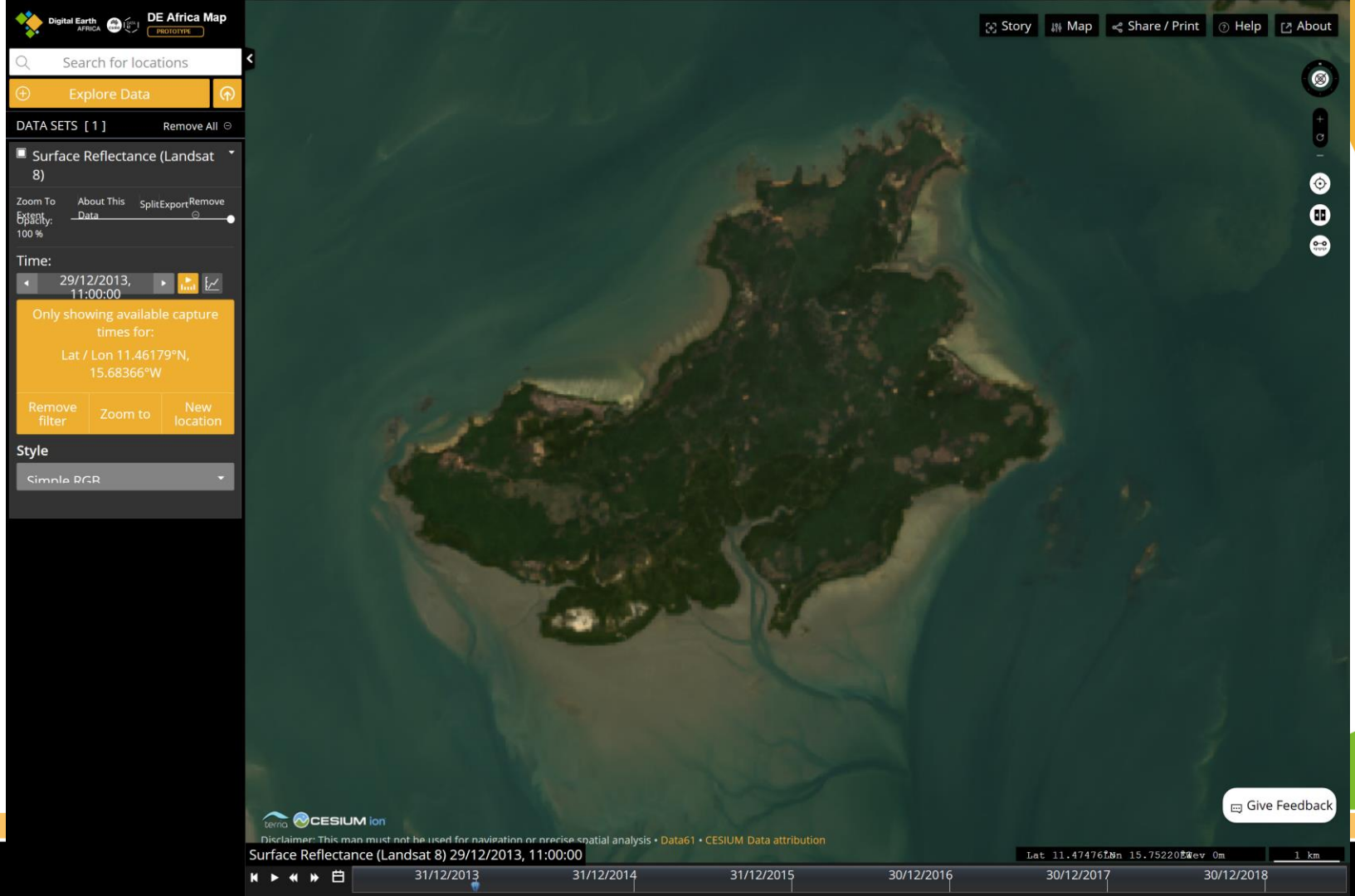

Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
30/01/2014, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
CESIUM ion
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Surface Reflectance (Landsat 8) 30/01/2014, 11:00:00
1 km
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018


Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
30/01/2014, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Feature Information
Surface Reflectance (Landsat 8) - Site Data
Show Raw Data
Time 2014-01-30 11:23:10 UTC
Blue - 490 268
Green - 560 517
Red - 660 349
Near Infrared (NIR) - 840
Shortwave Infrared (SWIR) - 1650
Shortwave Infrared (SWIR) - 2220
NDVI - Red, NIR 0.7871951219512195
NDWI - Green, SWIR -0.7001160092807425
Expand
517
268
Surface Reflectance
Imagery available for dates:
2013-05-03
2013-05-19
2013-07-06
2013-08-23
2013-09-08
2013-09-24
2013-10-10
2013-10-26
2013-11-11
2013-11-27
2013-12-13
2013-12-29
2014-01-14
2014-01-30
Give Feedback
CESIUM ion
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Surface Reflectance (Landsat 8) 30/01/2014, 11:00:00
1 km
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018

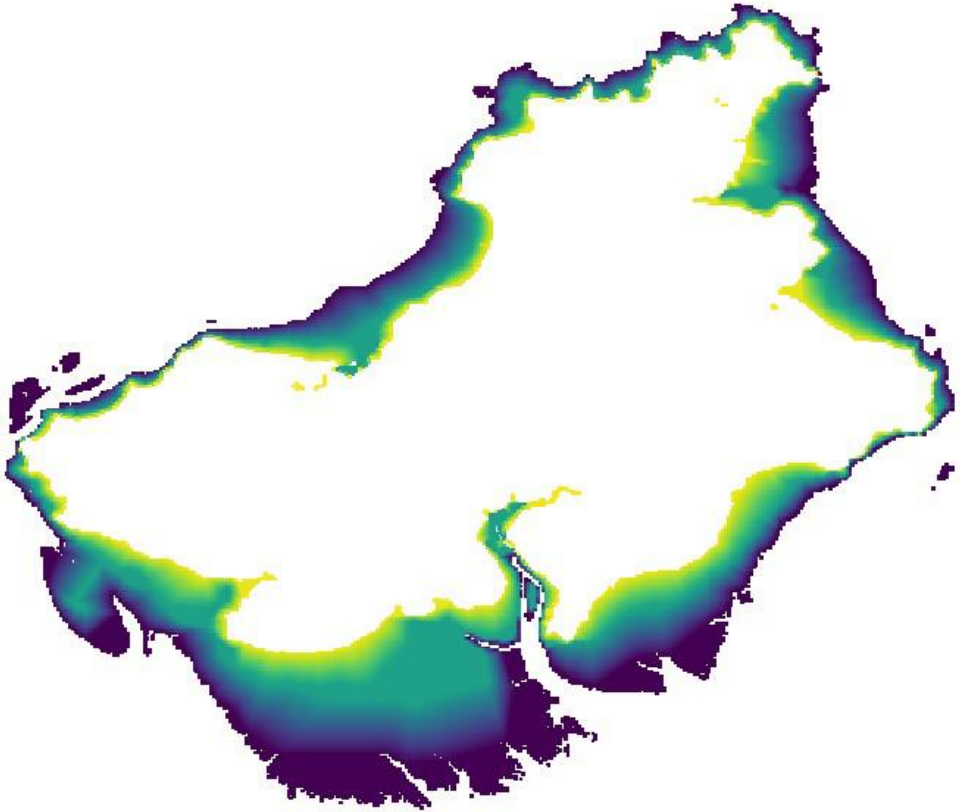

Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
27/11/2013, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
CESIUM ion
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Surface Reflectance (Landsat 8) 27/11/2013, 11:00:00
1 km
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018


Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
26/10/2013, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
Surface Reflectance (Landsat 8) 26/10/2013, 11:00:00
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018
1 km

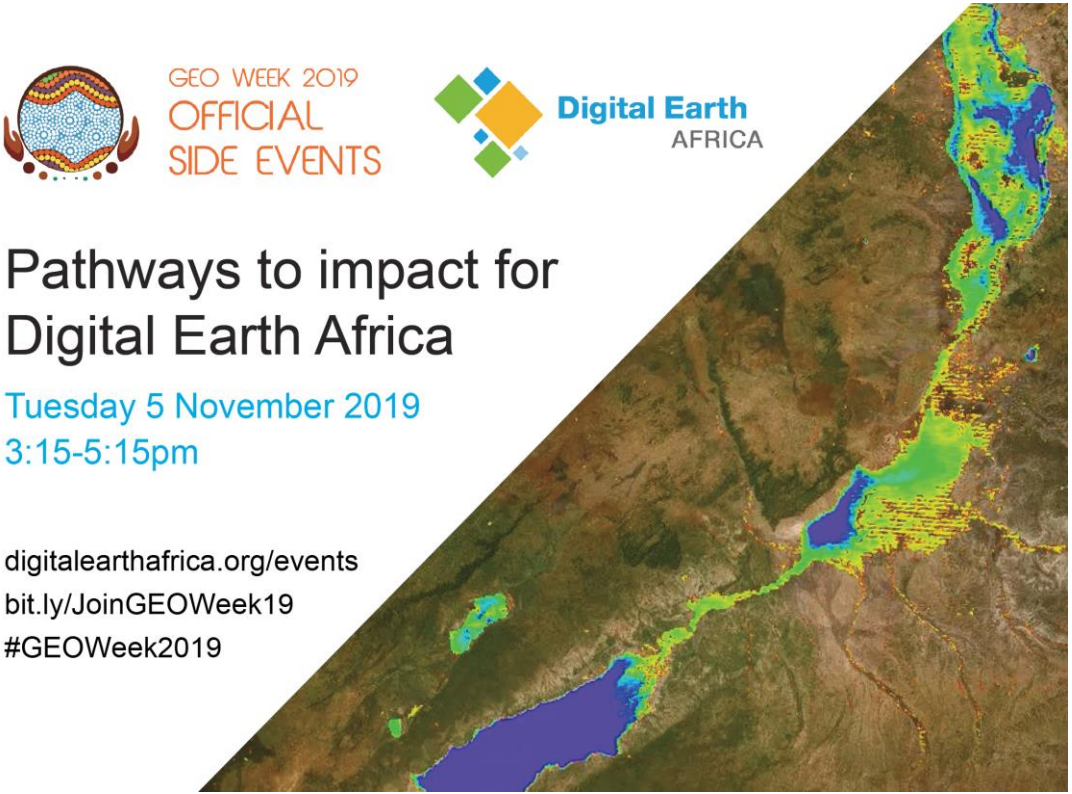

Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
11/11/2013, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
CESIUM ion
Data61 CESIUM Data attribution
Surface Reflectance (Landsat 8) 11/11/2013, 11:00:00
1 km
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018


Digital Earth AFRICA
DE Africa Map
PROTOTYPE
Search for locations
Explore Data
DATA SETS [1]
Remove All
Surface Reflectance (Landsat 8)
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
29/12/2013, 11:00:00
Only showing available capture times for:
Lat / Lon 11.46179°N, 15.68366°W
Remove filter
Zoom to
New location
Style
Simple RGB
Story
Map
Share / Print
Help
About
Give Feedback
CESIUM ion
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Surface Reflectance (Landsat 8) 29/12/2013, 11:00:00
1 km
31/12/2013
31/12/2014
31/12/2015
30/12/2016
30/12/2017
30/12/2018

Mapping the inter-tidal zone from the image series



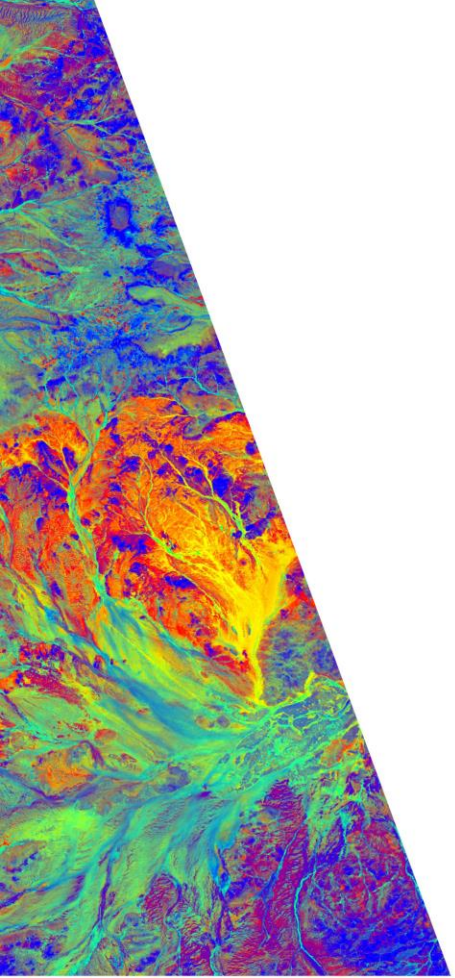

Search for locations
Explore Data
DATA SETS [1]
Remove All
Geometric median
Zoom To Extent
About This Data
Split
Export
Remove
Opacity: 100 %
Time:
01/01/2018, 11:00:00
Filter by location
Style
Simple RGB
SAUDI ARABIA
YEMEN
Give Feedback
Disclaimer: This map must not be used for navigation or precise spatial analysis • Data61 • CESIUM Data attribution
Geometric median 01/01/2018, 11:00:00
Lat 18.30082°S
Lon 4.91069°E
Elev
500 km



- Announce partnerships and co-contributions
- Launch the first continental-scale product – WOfS for Africa
- Interactive convener and panel discussing the pathways to impact.

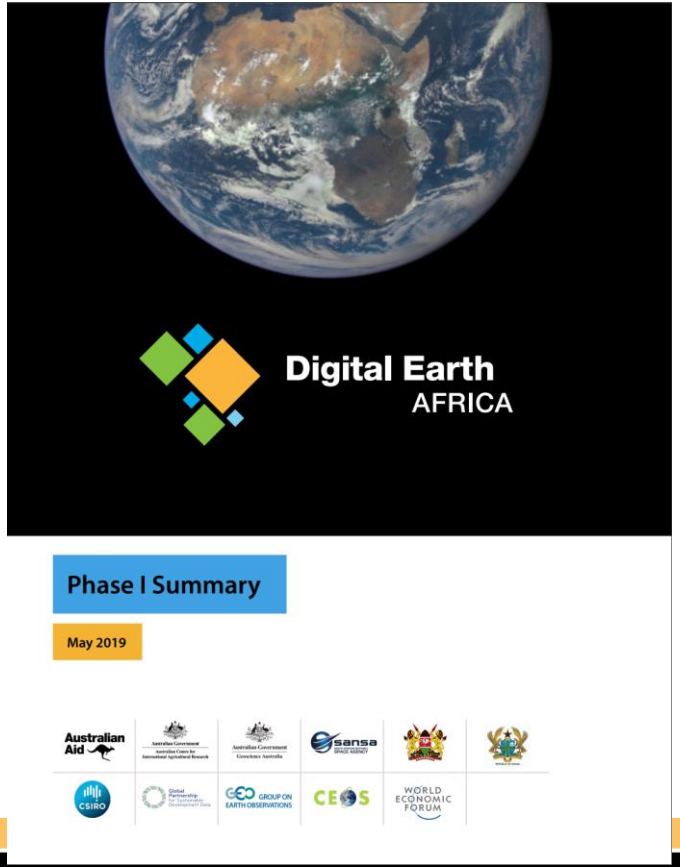
Q&A

www.digitalearthafrica.org



More material

Digital Earth Africa Phase I



DIGITAL EARTH AFRICA PHASE I STEERING COMMITTEE MEMBERS

Stuart Minchin (Chair), Chief - Environmental Geosciences Division, Geoscience Australia

Aditya Agrawal, Founder, D4DInsights
Andiswa Mlisa, Managing Director, Earth Observations, South African National Space Agency
Anne Marie Engtoft Larsen, Knowledge Lead - 4th Industrial Revolution, World Economic Forum
Brian Killough, CEOS Systems Engineering Office, NASA
Claire Melamed, CEO, Global Partnership for Sustainable Development Data
Davis Adieno, Regional Director for Africa, Global Partnership for Sustainable Development Data
Imraan Saloojee, Manager, Earth Observations, South African National Space Agency
Nicholas Davis, Head of Society and Innovation, World Economic Forum
Omar Seidu, Head, Demographic Statistics and SDG Coordinator, Ghana Statistical Service
Philip Thigo, Senior Advisor on Data and Innovation, Kenya Office of the Deputy President
Sives Govender, Research Group Leader, Council for Scientific and Industrial Research, South Africa
Steven Ramage, Head of External Relations, Group on Earth Observations
Trevor Dhu, Program Director - Digital Earth Australia, Geoscience Australia

Many thanks to the Australian Centre for International Agricultural Research (ACIAR) for their generous support and funding of Phase I of Digital Earth Africa.

Digital Earth Africa Demo - Crop Growing Trend

This notebook gives an example of using DEAfrica products to identify likely irrigated crops and plot growth trend over multiple years.

Two products derived from Landsat Surface Reflectance data are used:

1. NDVI derived from Landsat Surface Reflectance.
2. Fractional Cover.

Following steps are demonstrated:

1. Find a clear Landsat 8 image during the dry season and visualize
2. Segement the clear image using NDVI values
3. Select a segement and retrieve the fractional cover time series

1. Find a clear Landsat 8 image during the dry season and visualize

In [ ]:

```
%pylab notebook

from matplotlib import pyplot as plt
import xarray as xr

# import datacube modules
import datacube
```