

# → EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

## Climate Resilience

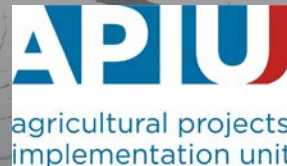
### Webinar Series for Kyrgyzstan:

Resilient Rural Communities: Managing climate risks  
using Earth Observation

*Identification of Land use/cover changes*



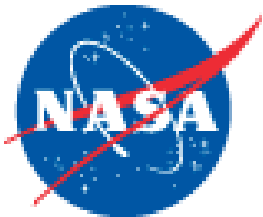
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COPERNICUS LAND MONITORING SERVICE  
State of Play on data requirements





COPERNICUS LAND MONITORING SERVICE  
State of Play on data requirements



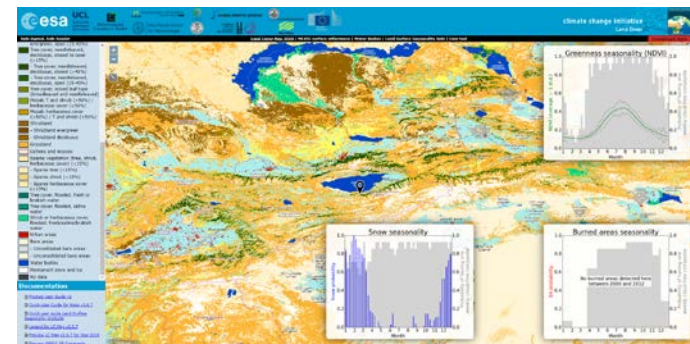
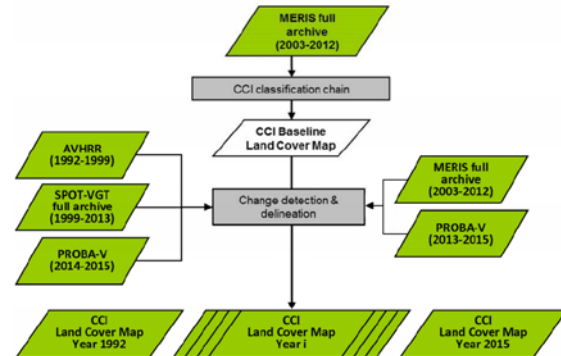


**Data sources:** MERIS (300m), Spot-Vegetation (1km), PROBA-V (1km), AVHRR (1km)

**Spatial Extent:** Global

**Spatial Resolution:** 300m

**Temporal Resolution:** Annual (from 1992-2019)





Data sources: MERIS (300m), Spot-Vegetation (1km), PROBA-V (1km), AVHRR (1km)

Spatial Extent: Global

Spatial Resolution: 300m

Temporal Resolution: Annual (from 1992-2019)

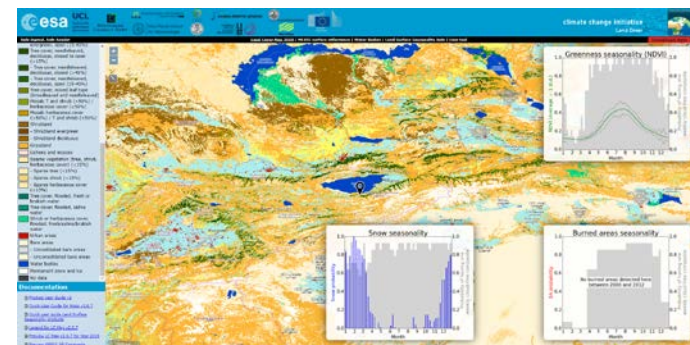
**To be continued...**

ESA CCI LAND COVER:

Sentinel-2 based prototype LAND COVER Map @20meter resolution of AFRICA (2016)

New AI technologies:

Random Forest & Machine Learning



## Global composites and land cover maps from ENVISAT



**Data sources:** ENVISAT (MERIS sensor)

**Spatial Extent:** Global

**Spatial Resolution:** 300m

**Temporal Resolution:** 2 periods (12/2004-6/2006 & 1/2009-12/2009-)

### Purpose:

Complement and update other existing comparable global products E.g. Global Land Cover Map (GLC 2000 1km)

### Products:

GlobCover MERIS FR composites  
&

GlobCover Land Cover Product V2

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## EO based system for global cropland monitoring

**Data sources:** Sentinel (1-2-3), Landsat 8,

**Spatial Extent:** Global

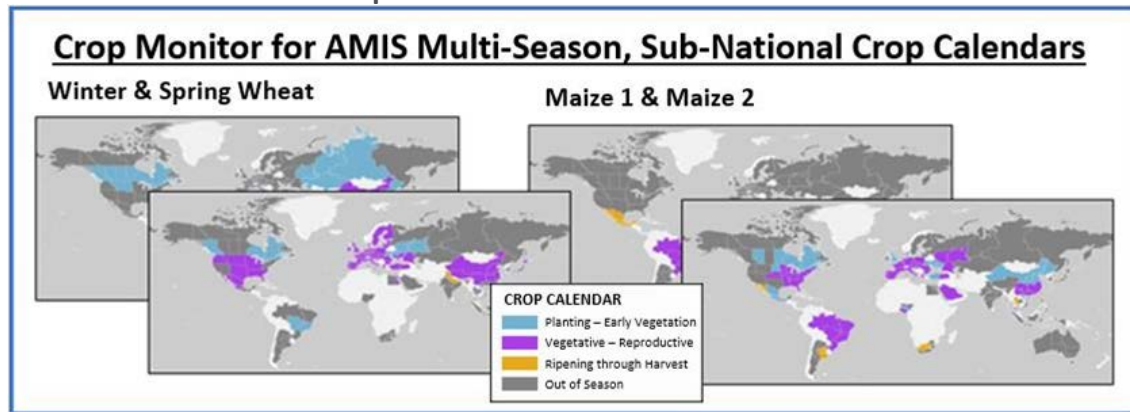
**Spatial Resolution:** 10m

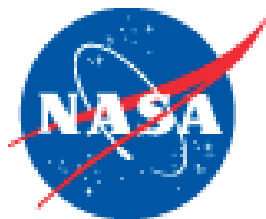
**Temporal Resolution:** Seasonally updated (From 2022 and onwards for wheat and maize crops)



### Other Initiatives:

An open-source, efficient, agile and robust EO based system to timely monitor the global cropland extent at field scale





# MODIS Land Cover Type Product- NASA



**Data sources:** Moderate Resolution Imaging Spectroradiometer (MODIS)

**Spatial Extent:** Global

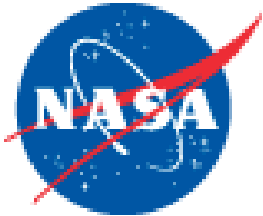
**Spatial Resolution:** 500km

**Temporal Resolution:** Yearly (2001-2019)

**13 Science Data Sets:** 5 LC Type, 3 LC Property, 3 LC Property Assessment, 1 LC Quality Control, 1 Land Water Mask

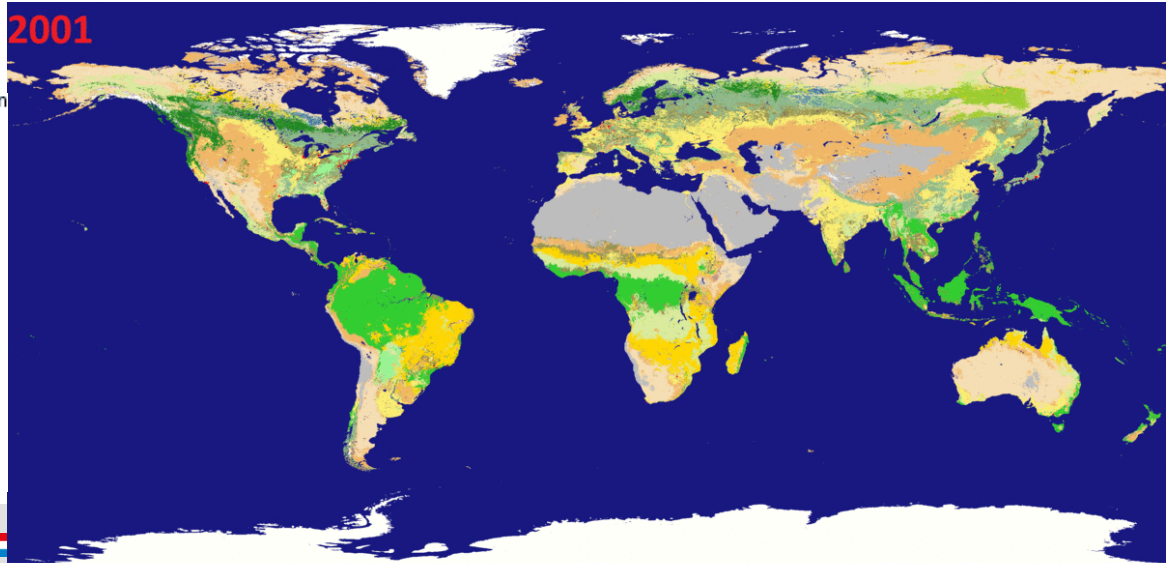


## Supervised classifications



Landcover Classification

Water
Evergreen Needleleaf Forest
Evergreen Broadleaf Forest
Deciduous Needleleaf Forest
Deciduous Broadleaf Forest
Mixed Forests
Closed Shrublands
Open Shrublands
Woody Savannas
Savannas
Grasslands
Permanent Wetlands
Croplands
Urban and Built-up
Cropland/Natural Vegetation
Permanent Snow and Ice
Barren or Sparsely Vegetated



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COPERNICUS LAND MONITORING SERVICE

State of Play on data requirements



## Copernicus Global Land Service

*Providing bio-geophysical products of global land surface*

[Home](#)[Products](#)[Use cases](#)[Product Access](#)[Viewing](#)[Library](#)[Get Support](#)[Vegetation](#)[Energy](#)[Water](#)[Cryosphere](#)[Hot Spots](#)[Groundbased](#)

# EC's Copernicus Global Land Service



# EC's Copernicus Global Land Service



**Data sources:** PROBA-V  
**Spatial Extent:** Global  
**Spatial Resolution:** 100m  
**Temporal Resolution:** Annual (2015-2019)

**ACCESS**

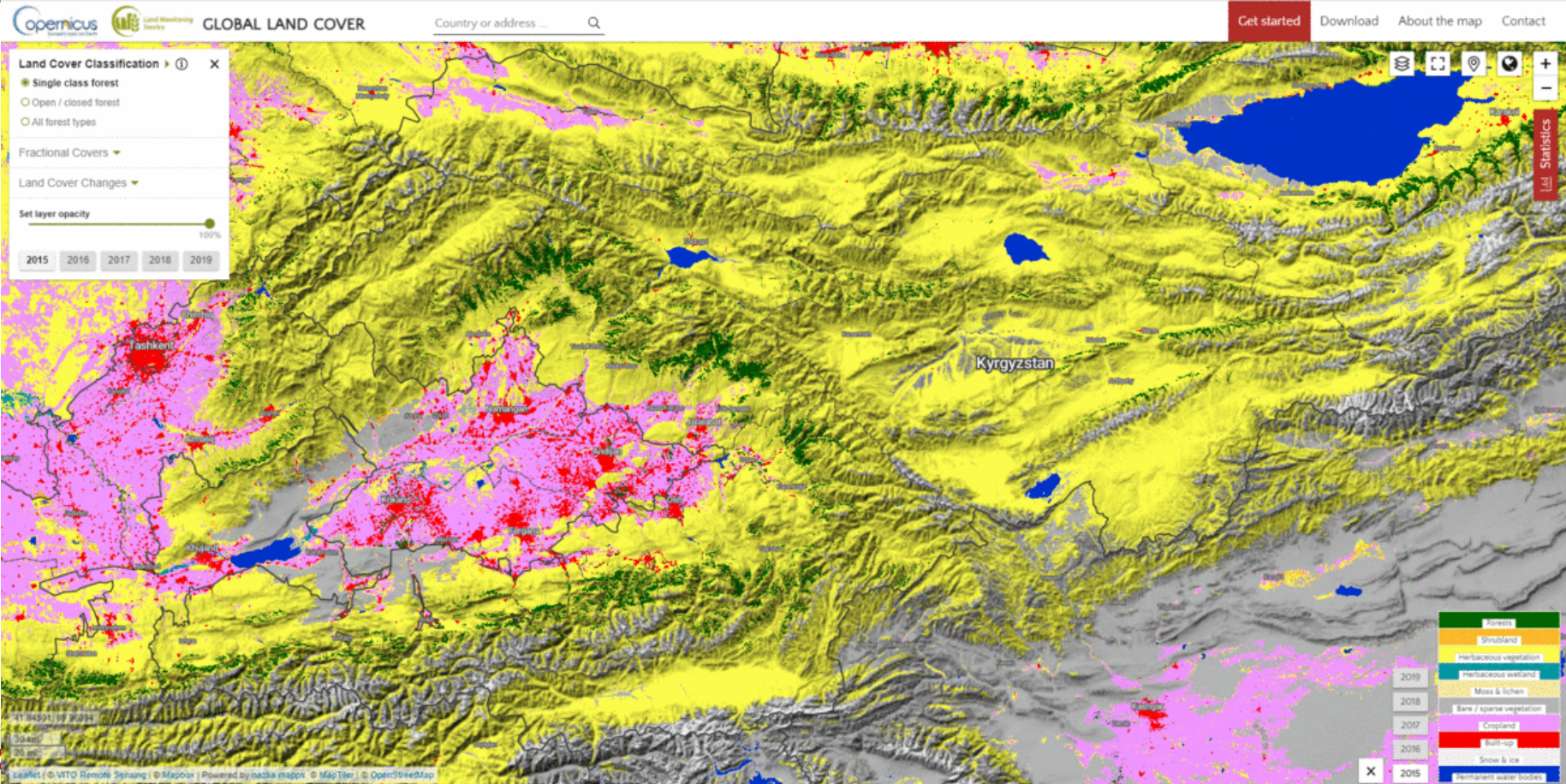
[Global Land Cover viewer for maps and area statistics](#)

[Google Earth Engine™ for analysis](#)

[Geo-WIKI for inter-comparison and validation](#)

[Zenodo Open Science data](#)

# EC's Copernicus Global Land Service





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*State of Play on data requirements*



## A Global land cover characterization (GLCC) database

**Data sources:** AVHRR (1Km)

**Spatial Extent:** Global

**Spatial Resolution:** 1km

**Temporal Resolution:** Once (1992-1993)



**10-day NDVI (Normalized  
Difference Vegetation Index )  
composites**



**Land cover  
classifications**

### Data Provision

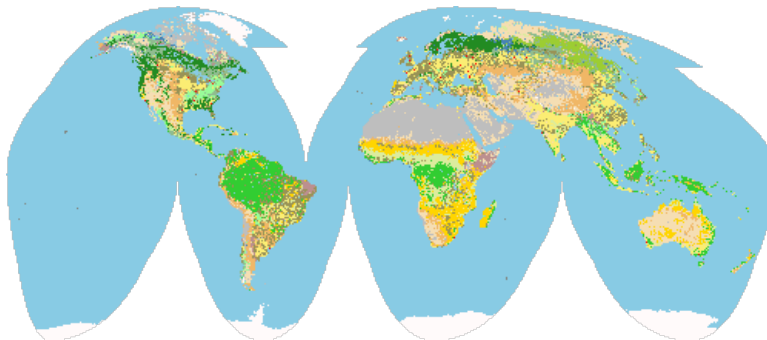


#### By Continent

GLCC classifications,  
& monthly NDVI  
composites,

#### Global

Global GLCC  
composites



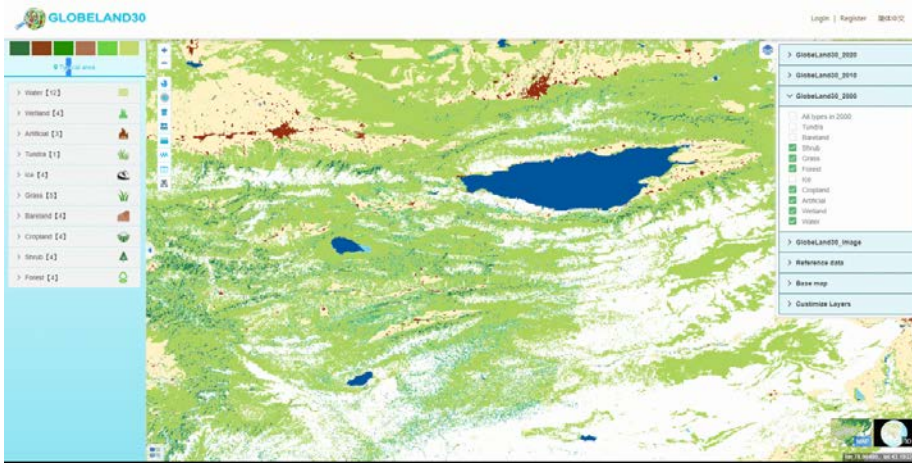


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State of Play on data requirements



## First Global land cover dataset at High-Resolution

perennial snow water bodies wetland tundra bare land  
**Freely available & comprise ten types of land cover**  
ice artificial surface  
cultivated land forests shrubland grassland



**Data sources:** Landsat & Chinese HJ-1

**Spatial Extent:** Global

**Spatial Resolution:** 30m

**Temporal Resolution:** 10year (2000, 2010 & 2020)



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State of Play on data requirements



Geo-Wiki is a global network of volunteers

Integrated Global Cover data

Land Cover

**Global**

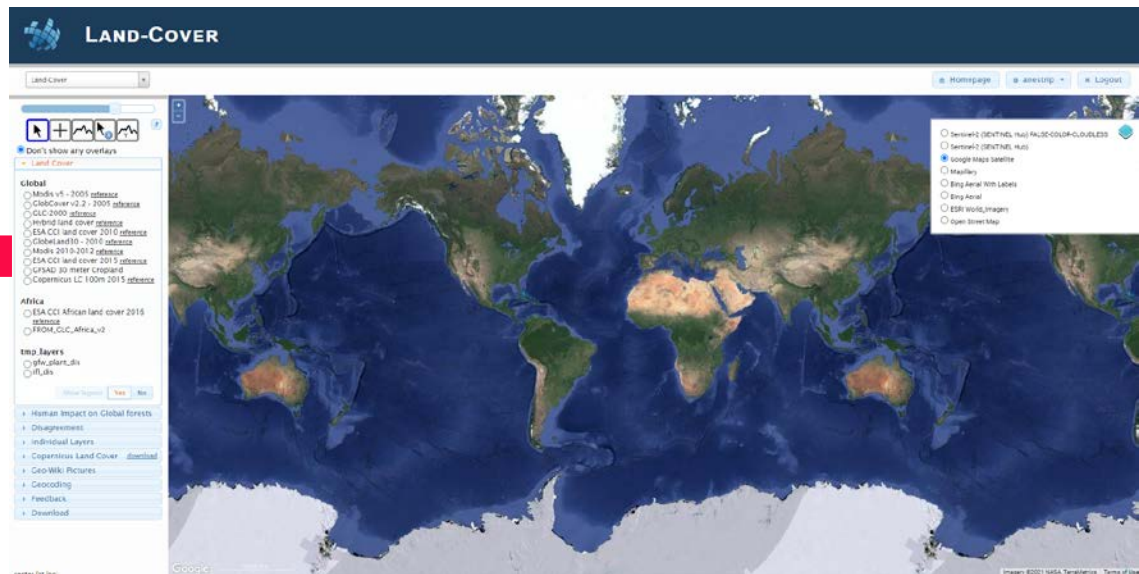
- ☐ Modis v5 - 2005 [reference](#)
- ☐ GlobCover v2.2 - 2005 [reference](#)
- ☐ GLC-2000 [reference](#)
- ☐ Hybrid land cover [reference](#)
- ☐ ESA CCI land cover 2010 [reference](#)
- ☐ Globeland30 - 2010 [reference](#)
- ☐ Modis 2010-2012 [reference](#)
- ☐ ESA CCI land cover 2015 [reference](#)
- ☐ GFSAD 30 meter Cropland
- ☐ Copernicus LC 100m 2015 [reference](#)

**Africa**

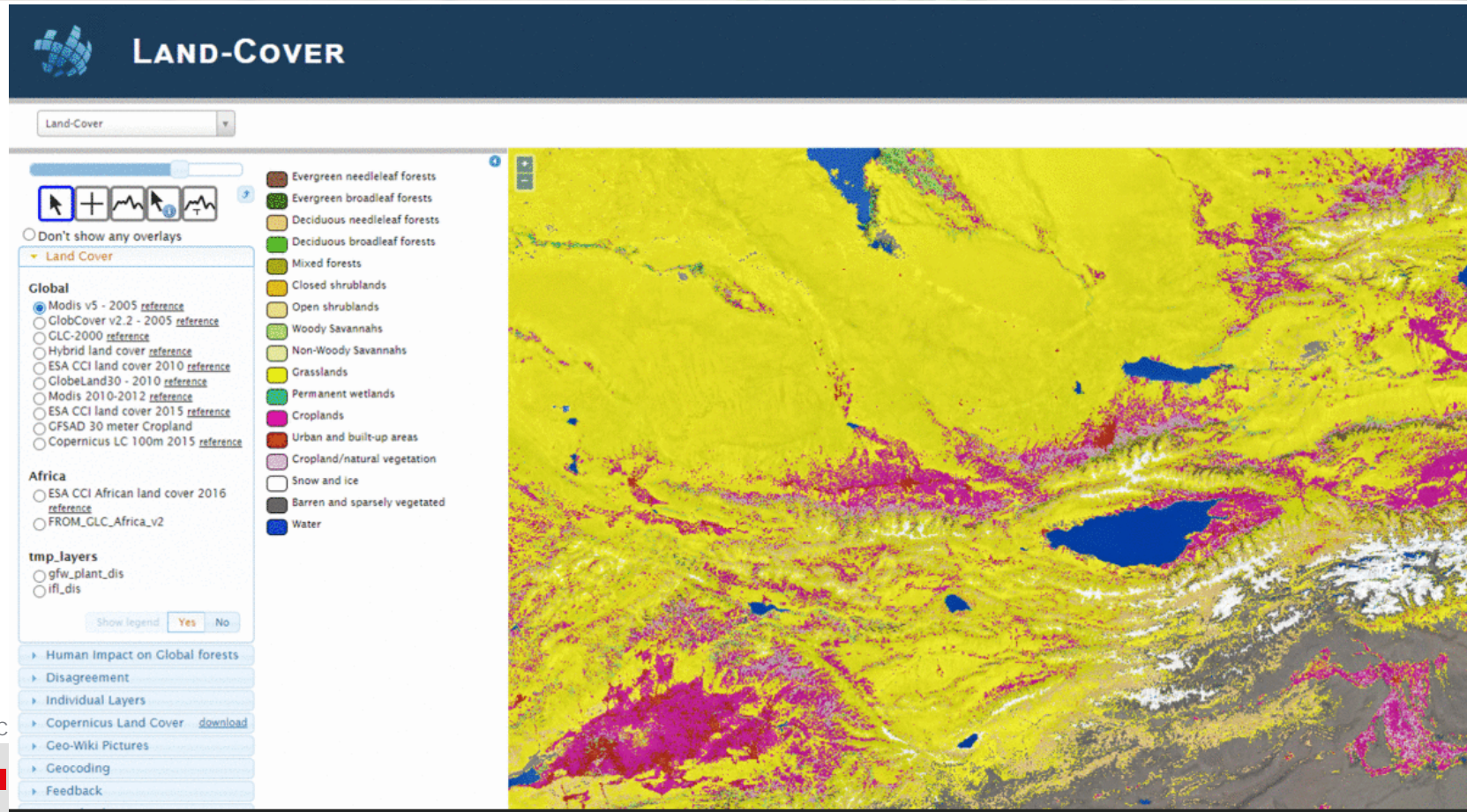
- ☐ ESA CCI African land cover 2016 [reference](#)
- ☐ FROM\_GLC\_Africa\_v2

**tmp\_layers**

- ☐ gfw\_plant\_dis
- ☐ ifl\_dis



# Geo-Wiki Global Land Cover platform



- Need to always be cautious about accuracy of products;
- Medium analysis products might be suitable for National or regional analysis but not for local scale cases;
- Global Land products are available for free but need to keep up with the classification categories and how to handle the volume of data;

# → EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

## Climate Resilience

### Webinar Series for Kyrgyzstan:

Resilient Rural Communities: Managing climate risks  
using Earth Observation

*Monitoring of Essential Climate Variables*



- Defined by the Global Climate Observing System (GCOS) of the United Nations Framework Convention on Climate Change
- 54 variables
- Physical, chemical, and biological variables
- Understand the Earth's climate
- Predict future climate change
- Used in a range of applications:
  - Modelling
  - Climate mitigation
  - Climate adaptation
  - Attribution
  - Risk monitoring and management



[https://www.esa.int/ESA\\_Multimedia/Images/2019/11/Sentinel-6\\_for\\_monitoring\\_sea\\_level](https://www.esa.int/ESA_Multimedia/Images/2019/11/Sentinel-6_for_monitoring_sea_level)

SEA - SURFACE  
TEMPERATURE,  
OCEAN COLOUR

TEMPERATURE,  
WATER VAPOUR,

CLOUD PROPERTIES,  
PRECIPITATION

EARTH RADIATION  
BUDGET

### Upper-air Atmosphere



### Surface Atmosphere



### Atmospheric Composition



### Cryosphere



### Anthroposphere



### Surface Ocean Physics



### Ocean Biology/Ecosystems



### Ocean Biogeochemistry



### Subsurface Ocean Physics



### Biosphere



### Hydrosphere



SEA LEVEL, SEA STATE,  
SURFACE CURRENT

CARBON DIOXIDE PARTIAL  
PRESSURE, OCEAN ACIDITY

SEA - SURFACE SALINITY,  
PHYTOPLANKTON

NUTRIENTS, TRACERS,  
OCEAN ACIDITY,  
CARBON DIOXIDE  
PARTIAL PRESSURE

OCEAN CURRENT,  
OXYGEN

SOIL MOISTURE

GROUND WATER

FIRE DISTURBANCE,  
LAND COVER

GROUND BIOMASS,  
AREA INDEX

RIVER DISCHARGE,  
WATER USE

 **GCOS**



European Space Agency

# Essential Climate Variables (ECVs)



## Atmosphere

### Surface

- [Precipitation](#)
- [Pressure](#)
- [Radiation budget](#)
- [Temperature](#)
- [Water vapour](#)
- [Wind speed and direction](#)

### Upper-air

- [Earth radiation budget](#)
- [Lightning](#)
- [Temperature](#)
- [Water vapor](#)
- [Wind speed and direction](#)

### Atmospheric Composition

- [Aerosols](#)
- [Carbon dioxide, methane and other greenhouse gases](#)
- [Clouds](#)
- [Ozone](#)
- [Precursors for aerosols and ozone](#)

## Land

### Hydrosphere

- [Groundwater](#)
- [Lakes](#)
- [River discharge](#)

### Cryosphere

- [Glaciers](#)
- [Ice sheets and ice shelves](#)
- [Permafrost](#)
- [Snow](#)

### Biosphere

- [Above-ground biomass](#)
- [Albedo](#)
- [Evaporation from land](#)
- [Fire](#)
- [Fraction of absorbed photosynthetically active radiation \(FAPAR\)](#)
- [Land cover](#)
- [Land surface temperature](#)
- [Leaf area index](#)
- [Soil carbon](#)
- [Soil moisture](#)

### Anthroposphere

- [Anthropogenic Greenhouse gas fluxes](#)
- [Anthropogenic water use](#)

## Ocean

### Physical

- [Ocean surface heat flux](#)
- [Sea ice](#)
- [Sea level](#)
- [Sea state](#)
- [Sea surface currents](#)
- [Sea surface salinity](#)
- [Sea surface stress](#)
- [Sea surface temperature](#)
- [Subsurface currents](#)
- [Subsurface salinity](#)
- [Subsurface temperature](#)

### Biogeochemical

- [Inorganic carbon](#)
- [Nitrous oxide](#)
- [Nutrients](#)
- [Ocean colour](#)
- [Oxygen](#)
- [Transient tracers](#)

### Biological/ecosystems

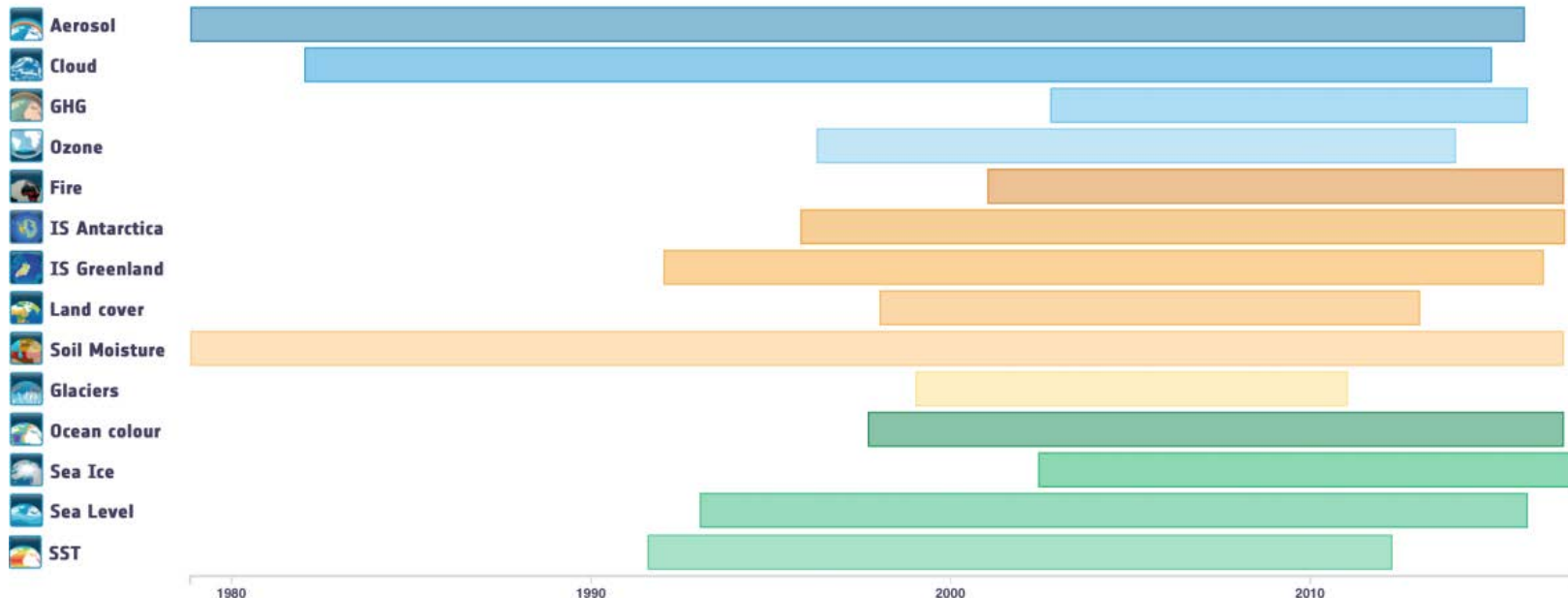
- [Marine habitats](#)
- [Plankton](#)

# Global Initiatives on Climate Change



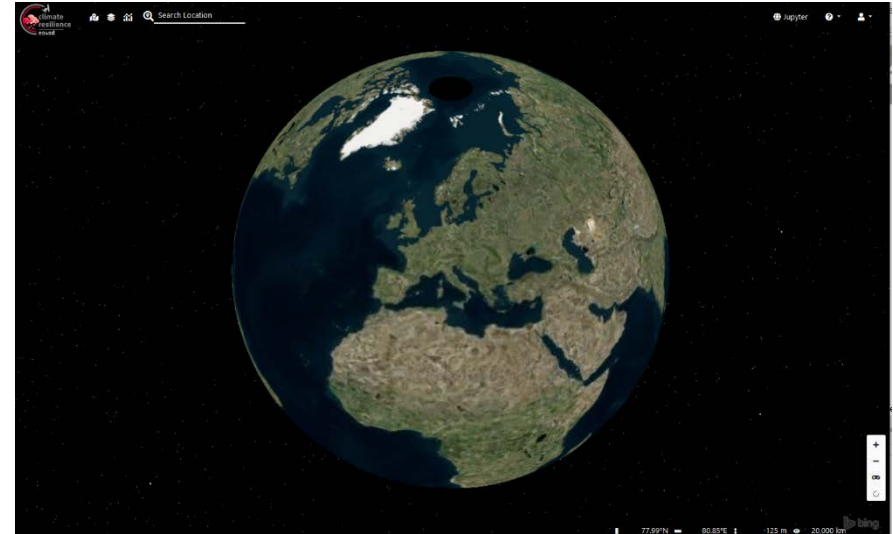
## → CCI DASHBOARD

Climate data dashboard of the ESA Climate Change Initiative



# ECVs on the EO4SD Platform

- An online platform to access earth observation data
- Atmosphere, oceans, hydrosphere, biosphere
- Global, open, free-to-use
- Access, visualise, and download data
- Spatial patterns and historical trends



<https://explorer-eo4sdcr.adamplatform.eu/>

## ➤ Precipitation

Indicator	Source data
Daily accumulated precipitation	ERA5, ERA5 Land, GPCP, GPM IMERG, NOAA Hydroestimator, SM2RAIN-ASCAT, NEX-GDDP
Dry spell days	ERA5, ERA5-Land
Heavy precipitation days (>20mm)	ERA5, Era5-Land
Max number of consecutive dry days	ERA5, ERA5-Land
Max number of consecutive wet days	ERA5, ERA5-Land
Max 30-day rainfall (10-, 20-, 50, 100-year return level)	ERA5, ERA5-Land
Max 5-day rainfall (10-, 20-, 50, 100-year return level)	ERA5, ERA5-Land
Max 1-day rainfall (10-, 20-, 50, 100-year return level)	ERA5, ERA5-Land

## ➤ Temperature

Indicator	Source data
Daily average temperature at 2m	ERA5, ERA5-Land, NEX-GDDP
Growing season length	ERA5, ERA5-Land
Daily minimum / maximum air temperature	NEX-GDDP
Number days >25 °C	ERA5, ERA5-Land
Number days >35 °C	ERA5, ERA5-Land
Number tropical nights (min temperature >20 °C	ERA5, ERA5-Land
Warm spell duration index	ERA5, ERA5-Land

## ➤ Water vapour

Indicator	Source data
Daily relative humidity	ERA5, ERA5-Land

## ➤ River Discharge

Indicator	Source data
Daily runoff	ERA5, ERA5-Land

## ➤ Evaporation from land surface

Indicator	Source data
Potential Evaporation	ERA5, ERA5-Land

## ➤ Lakes

Indicator	Source data
Normalised Difference Water Index (NDWI)	ESA CCI
Maximum / minimum water body extent	
Wetness and water frequency	

## ➤ Soil moisture

Indicator	Source data
ESA CCI Soil Moisture	ESA CCI

## ➤ Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)

Indicator	Source data
Normalised Difference Vegetation Index (NDVI)	MODIS

➤ Ocean colour

Indicator	Source data
Chlorophyll-A concentration	ESA CCI

➤ Sea level rise

Indicator	Source data
Sea level anomalies	ESA CCI

➤ Sea surface temperature

Indicator	Source data
Sea surface temperature (daily, monthly average)	ESA CCI

# How are EO-powered ECVs used to manage climate risks to agriculture?

# 1) Hazard exposure assessment: Multi-hazard index and map

## The solution

Index integrating climate-related hazard and vegetation indicators to describe locations' exposure to climate-related hazards (e.g. flood, soil erosion, landslides, vegetation degradation etc.).

## How this solution helps build climate resilience

Identify communities exposed to most severe climate hazard and the types of climate hazards that present the greatest levels of threat in each location. Helps evidence and prioritise resilience interventions.

## How EO-driven ECVs add value

High-resolution, comparable climate-related hazard data across an area of interest.

### Essential Climate Variables (ECVs)

### Source

#### *Biosphere ECVs*

Normalised Difference Vegetation Index (NDVI)

MODIS Vegetation Index Products

Land cover

ESA CCI

Leaf Area Index

Sentinel-3 (Copernicus Land)

#### *Surface atmosphere ECVs*

Rainfall

ERA5, ERA5 Land, GPCP, GPM IMERG, NOAA Hydroestimator, SM2RAIN-ASCAT

#### *Other*

Precipitation-triggered landslide

Global Landslide Hazard Assessment for Situational Awareness (LHASA)

River flood (1-in-100 return period)

EU-JRC, WRI Aqueduct

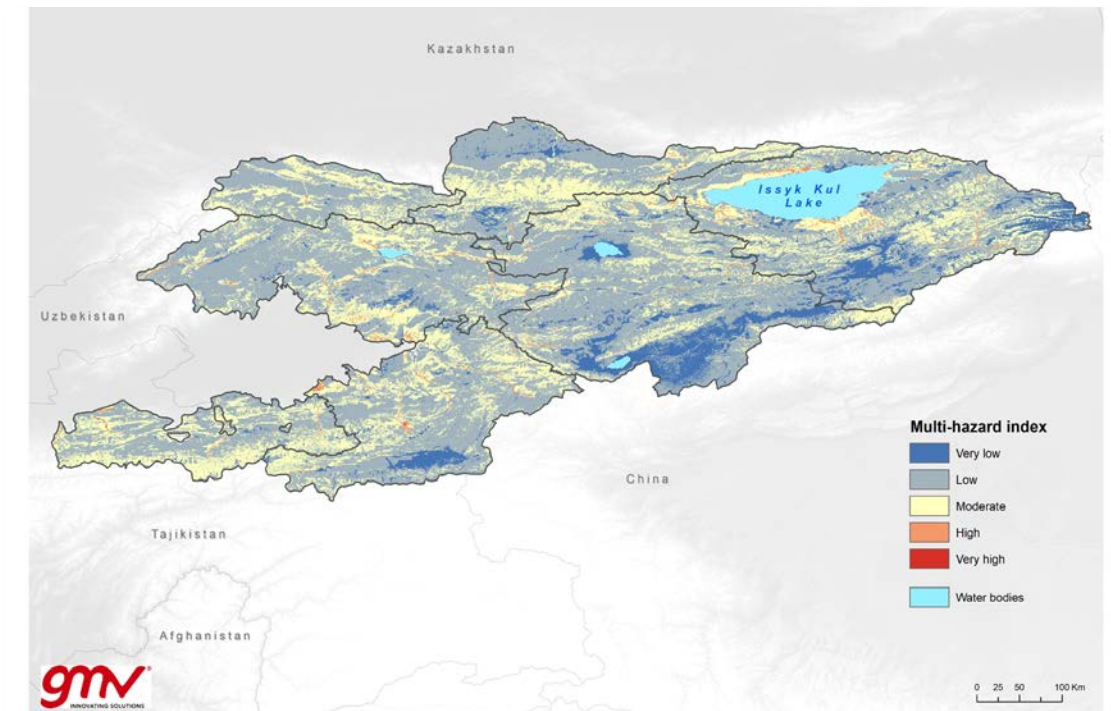
Soil characteristics

SoilGrids

Topography

Shuttle Radar Topography Mission Digital Elevation Mission

# 1) Multi-hazard index and map



<http://eo4sd-climate.gmv.com/publications/brochure/earth-observation-data-environmental-management>

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# 2) Index-based parametric insurance: Drought

## The solution

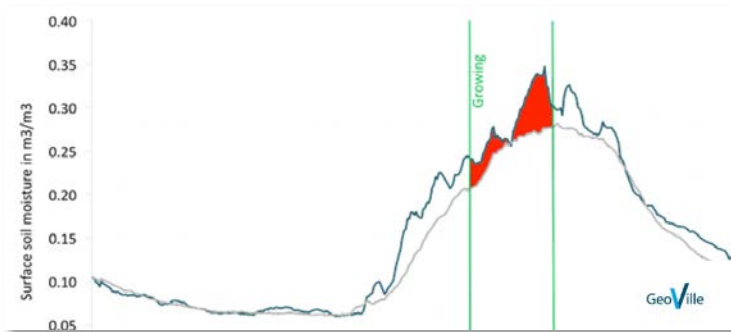
Insurance solution that compensates farmers for economic losses resulting due to the impacts of drought.

## How this solution helps build climate resilience

Provides robust and consistent evidence that enables triggering of timely and predictable payments to farmers, mitigating constraints on cashflow and debt servicing.

## How EO-driven ECVs add value

Provide robust, near real-time observations of soil water availability at high-resolution across an area of interest.



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### Essential Climate Variables (ECVs)

### Source

#### Biosphere ECVs

Soil Water Index	Sentinel-1, ASCAT
Soil Moisture	ESA Sentinel-1, ESA CCI
Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)	ESA CCI

#### Surface atmosphere ECVs

Rainfall	ERA5, ERA5 Land, GPCP, GPM IMERG, NOAA Hydroestimator, SM2RAIN-ASCAT
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#### Other

Crop yield	e.g. Ministry of Agriculture
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<http://eo4sd-climate.gmv.com/portfolio/product/sectoral-climate-services-agriculture>

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# Thank you!