APERÇU DU PROJET

- **L'objectif du groupe de travail Afrique** est de renforcer les capacités en Afrique dans le secteur de l'Observation de la Terre depuis l'Espace, **en complément** d'autres efforts institutionnels tels que GMES & Afrique.
- Programme de formation des formateurs en **FR, EN et PT** :
  - Phase 1 : 10 modules de formation délivrée à 30 formateurs
  - Phase 2 : soutien aux formateurs pour la mise en œuvre d'une session de formation auprès de leurs communautés locales.
- **Webinaires** en FR, EN et PT pour **une diffusion et un engagement plus larges**.

Agenda pour aujourd'hui !

Webinaire 2 : Services et applications Copernicus - partie II

Webinar #3
Durée: 1h40
Objectif : Présenter les services Copernicus et leur utilisation dans des cas concrets
FOCUS: CAMS and C3S
Introduction générale et objectifs du webinaire (5 min) (Linda Tomasini, CNES)

Les Services Copernicus (partie II):
CAMS (Vincent-Henry Peuch, ECMWF), **20 min**
Q&R (10 min)

C3S (Vincent-Henry Peuch, ECMWF) - **20min**
Q&R (10 min)

Le projet du Consortium OSS dans GMES & Afrique (Evence Louis Zoungrana, Observatoire du Sahara et du Sahel) **10 min**
Q&R (5 min)

Le SCO ou Observatoire Spatial du Climat (Linda Tomasini, CNES) - **5 min**

Le projet GeoHaTACC du SCO (Jean-Philippe Malet, CNRS-EOST) - **10 min**
Q&R (5 min)

Le Service Copernicus de Surveillance de l'Atmosphère (CAMS)

Présentation du Service et de quelques applications

Vincent-Henri Peuch
Laurence Rouïl
Les équipes et les contractants CAMS

Mai 2024

Atmosphere Monitoring

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Copernicus
Europe's eyes on Earth

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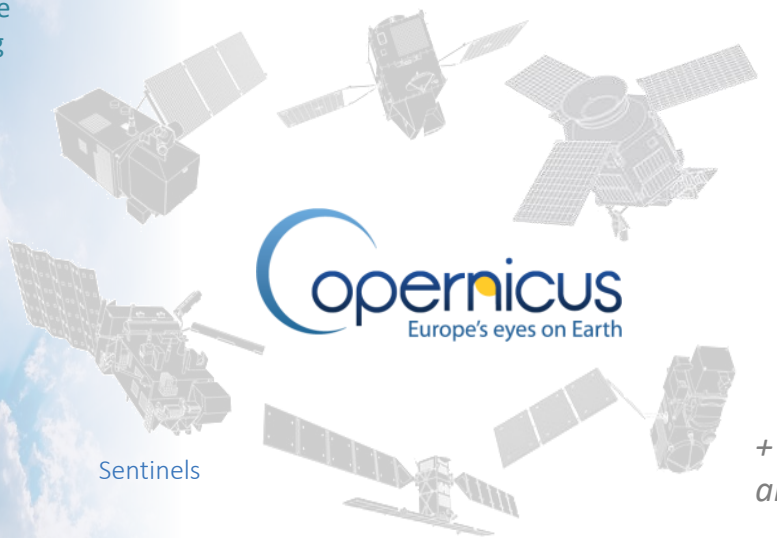
COPERNICUS

Atmosphere Monitoring



Sentinels

+ many other satellites and non-satellite data

Combiner observations et modèles numériques pour fournir des services d'information

- Atmosphère
- Climat
- Territoires
- Océans
- Urgences
- Sécurité

Copernicus est le programme **operationel** de l'UE pour l'Observation de la Terre et de surveillance de notre planète et de son environnement pour le bénéfice de tous: **données entièrement libres et gratuites**.

Service mis en oeuvre par ECMWF

ECWMF contribute au Service

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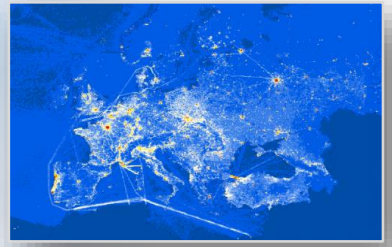
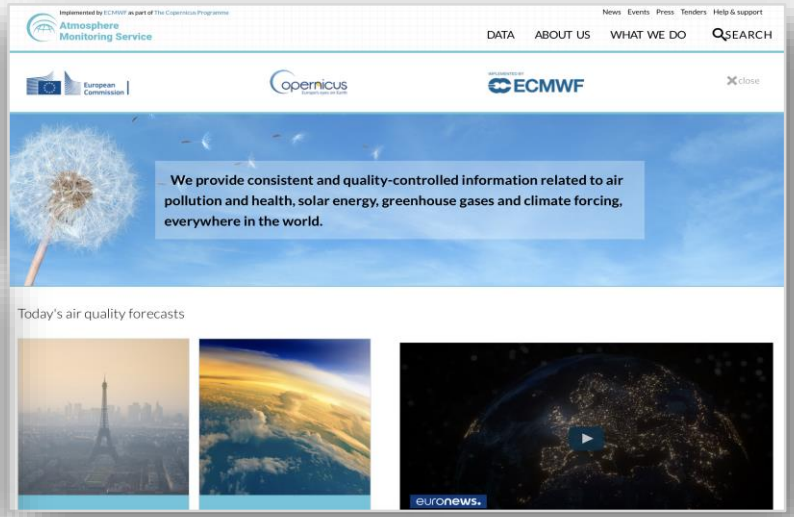
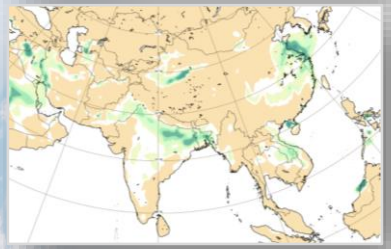
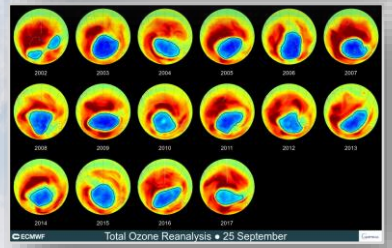
LE PORTEFEUILLE DE SERVICES CAMS

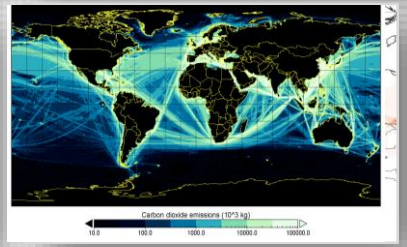
Atmosphere Monitoring

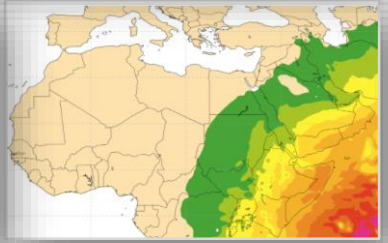












CAMS fournit des produits d'information libres & gratuits basés sur l'Observation de la Terre dans les domaines suivants:

- Composition chimique atmosphérique globale pour le passé, present et future (prévisions);
- Couche d'ozone;
- Qualité de l'Air en Europe;
- Emissions et flux de surface pour polluants et GES;
- rayonnement solaire;
- Forçages radiatifs sur le climat.

http://atmosphere.copernicus.eu
http://ads.atmosphere.copernicus.eu

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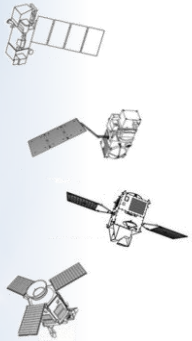
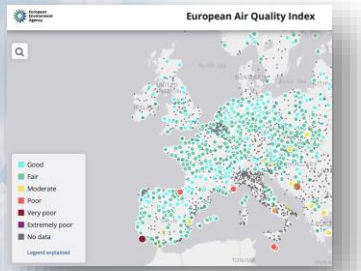
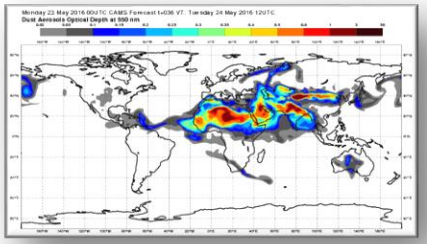
LA CHAINE D'INFORMATION DE CAMS

Atmosphere Monitoring



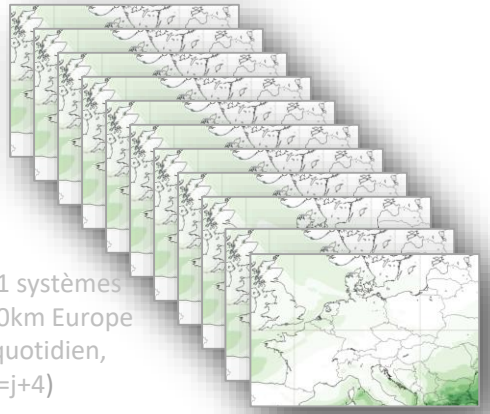
Observation de la Terre
(details ci-après)



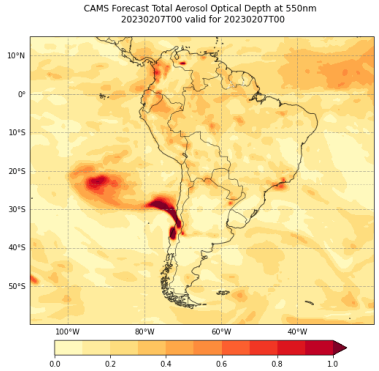


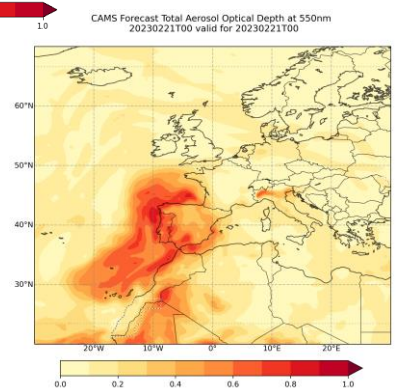
Chimie tropo. & strato. détaillée, 40km, globe (2x par jour, j+5)

Les principales chaines opérationelles de **modélisation et d'assimilation de données** de CAMS



11 systèmes 10km Europe (quotidien, d=j+4)





Les yeux de l'Europe sur la Terre

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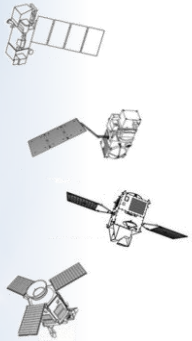
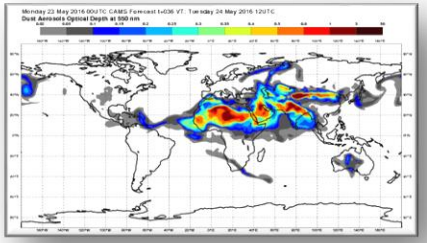
CAMS MAIN WORKFLOW… SERVING USERS WORLDWIDE

Atmosphere Monitoring

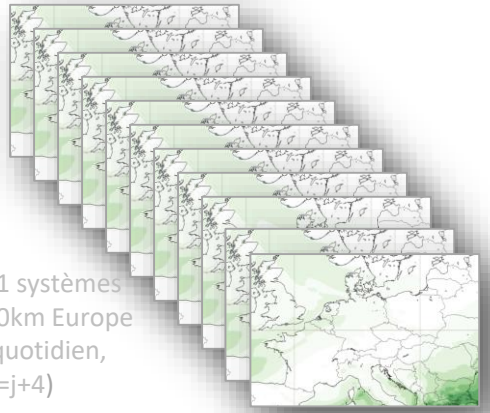


Observation de la Terre
(details ci-après)

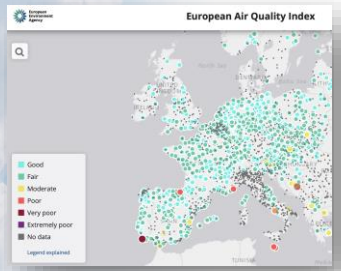


Chimie tropo. & strato. détaillée, 40km, globe (2x par jour, j+5)

Les principales chaines opérationelles de **modélisation et d'assimilation de données** de CAMS



11 systèmes 10km Europe (quotidien, d=j+4)



Utilisateurs CAMS >33500 (~3200 routine)

Effet multiplicateur (200Mil+)

Windy.com

Google Maps Platform

The Weather Channel

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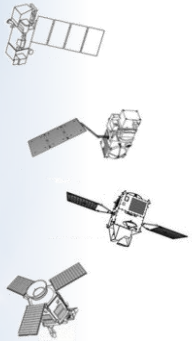
ECMWF

UTILISATION DES DONNÉES SATELLITAIRES PAR CAMS

Atmosphere Monitoring



Observation de la Terre satellites (>90 instruments) et non-satellites in-situ (sites officiels et recherche)

Instrument	Satellite	Space Agency	Provider	Species	Status
AATSR	ENVISAT	ESA	ESA	AOD	REA(A)
AHI	Himawari-8	JMA	JMA	FRP	GFAS(P)
GOME-2	METOP-B, -C/ METOP-B, -C/ METOP-A/ METOP-A, -B	EUMETSAT-ESA	AC-SAF	O_3, NO_2, SO_2/ HCHO/ O_3, NO_2, SO_2, HCHO/ O_3, NO_2	GRTF(A)/ GRTF(M)/ GRTF(M)/ REA(A)
IASI	METOP-B, -C/ METOP-A/ METOP-A, -B, -C/ METOP-A, -B/ METOP-A, -B/ METOP-A, -B	EUMETSAT-CNES/ -/-/-/-/EUMETSAT	AC-SAF/AC-SAF/ULB-LATMOS/LMD/LMD/ EUMETSAT	CO/CO/O_3, SO_2/ CH_4/CO_2/CH_4, CO_2	GRTF(A)/ GRTF(M)/ GRTF(P)/ GDM(A)/ GDM(P) / REA(A)
Imager	GOES-E, -W	NOAA	NOAA	FRP	GFAS(P)
MIPAS	ENVISAT	ESA	ESA	O_3 profile	REA(A)
MLS	EOS-Aura	NASA	NASA	O_3 profile	GRTF(A)/REA(A)
MODIS	EOS-Aqua, -Terra	NASA	NASA	AOD/AOD/FRP	GRTF(A)/ REA(A)/ GFAS(A)
MOPITT	EOS-Terra	NASA	NCAR	CO	GRTF(A)/ REA(A)
OCO-2	OCO-2	NASA	NASA	CO_2	GDM(P)/ GHGI(A)
OMI	EOS-Aura	NASA	KNMI	O_3, NO_2, SO_2/ O_3, NO_2	GRTF(A)/ REA(A)
OMPS	S-NPP, NOAA-20	NOAA	EUMETSAT	O_3	GRTF(A)
PMAp	METOP-A, -B/ METOP-C	EUMETSAT	EUMETSAT	AOD	GRTF(A)/ GRTF(M)
SBUV-2	NOAA-19/ NOAA-14, -16, -17, -18 and -19	NOAA	NOAA	O_3 profile	GRTF(M)/ REA(A)
SCIAMACHY	ENVISAT	ESA	KNMI	O_3, NO_2, CH_4, CO_2	REA(A)
SEVIRI	MSG	EUMETSAT	ICARE/ EUMETSAT	AOD/FRP	GRTF(P)/ GFAS(P)
SLSTR	Sentinel-3	ESA-EUMETSAT	EUMETSAT	AOD/FRP	GRTF(P)/ GFAS(P)
TANSO	GOSAT	JAXA	SRON/ Uni. Bremen/ SRON-Uni. Bremen/SRON	CH_4/ CO_2/ CH_4, CO_2/CH_4	GDM(A)/ GDM(A)/ REA(A) GHGI(A)
TROPOMI	Sentinel-5p	ESA-NSO	ESA-KNMI-DLR-/ ESA-KNMI-SRON-DLR	O_3, SO_2 /NO_2, CO, HCHO/ CH_4	GRTF(A)/ GRTF(M)/ GDM(P)
VIIRS	S-NPP, NOAA-20	NASA-NOAA	EUMETSAT	AOD	GRTF(P)

- Pour la composition chimique, seules les données satellitaires sont assimilées dans le système global CAMS (*in situ* utilisées pour la verification et assimilées dans les systems régionaux sur l'Europe).
- Toutes les autres données pour les variables Météo non décrites ici (~75 satelllites & in situ)

Statut (A: assimilé; M: monitoré; P: planifié / mode recherche) depends des différentes applications:

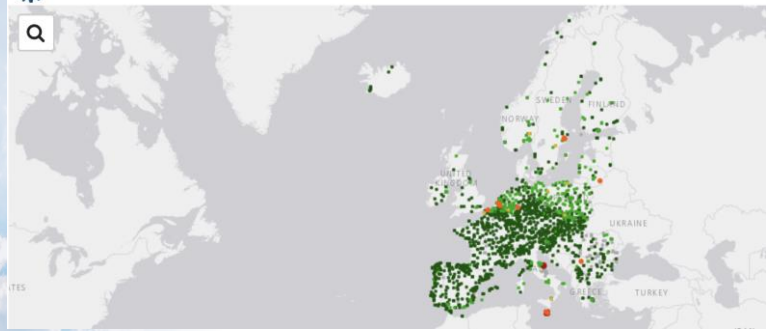
- Global real-time forecast (GRTF)
- Global delayed mode (GDM)
- Global reanalysis (REA)
- Global fire assimilation system (GFAS)
- Global surface net flux inversions of GHG (GHGI)

UTLISATIONS DES DONNÉES IN SITU PAR CAMS

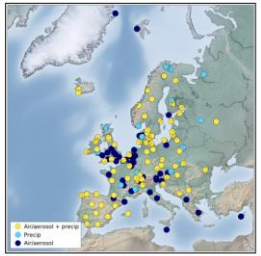
Atmosphere Monitoring

European Environment Agency

Up-to-date air quality data



emep



ACTRiS
Exploring the Atmosphere

NDACC
Network for the Detection of Atmospheric Composition Change

ICOS
Integrated Carbon Observation System

EAN
European Aeroallergen Network

GAW

IAGOS
IN-SERVICE AIRCRAFT FOR A GLOBAL OBSERVING SYSTEM

GLOBAL ATMOSPHERE WATCH

E EUROPEAN UNION

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Atmosphere Monitoring

LES PROCHAINS SATELLITES D'INTÉRÊT POUR CAMS

MetOp-SG-A

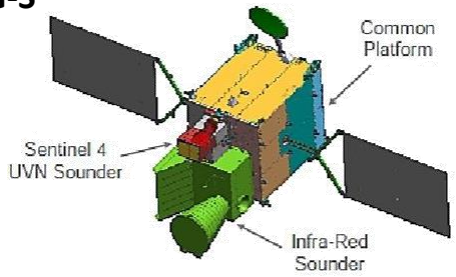
- Sentinel-5
- IASI-NG
- 3MI

Lancement fin 2025 ou 2026

EUMETSAT

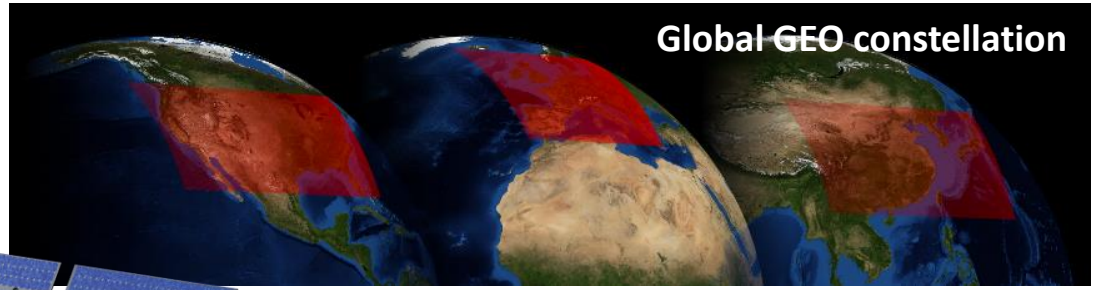
esa

MTG-S

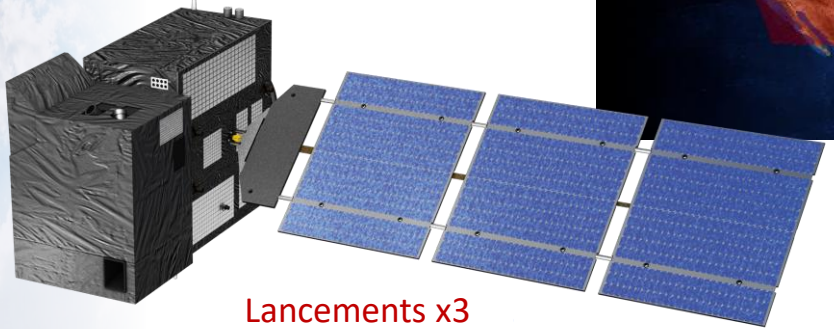


- Sentinel-4
- IRS

Lancement fin 2025 ou 2026



Utilisation de GEMS (Asie) & TEMPO (Amérique du Nord)



CO2M

Lancements x3 mi-2026 à fin 2027

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IMPACT DES DONNÉES SATELLITAIRE: EX. SENTINEL-5P CO

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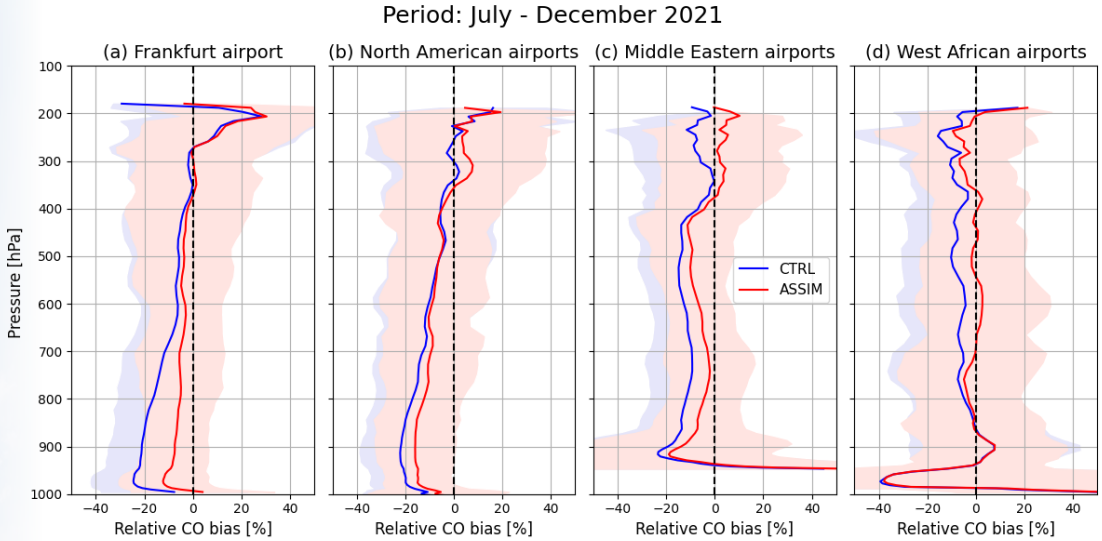
Comparaison aves les données aéroportées



Sans Sentinel-5p CO

Avec Sentinel-5p CO

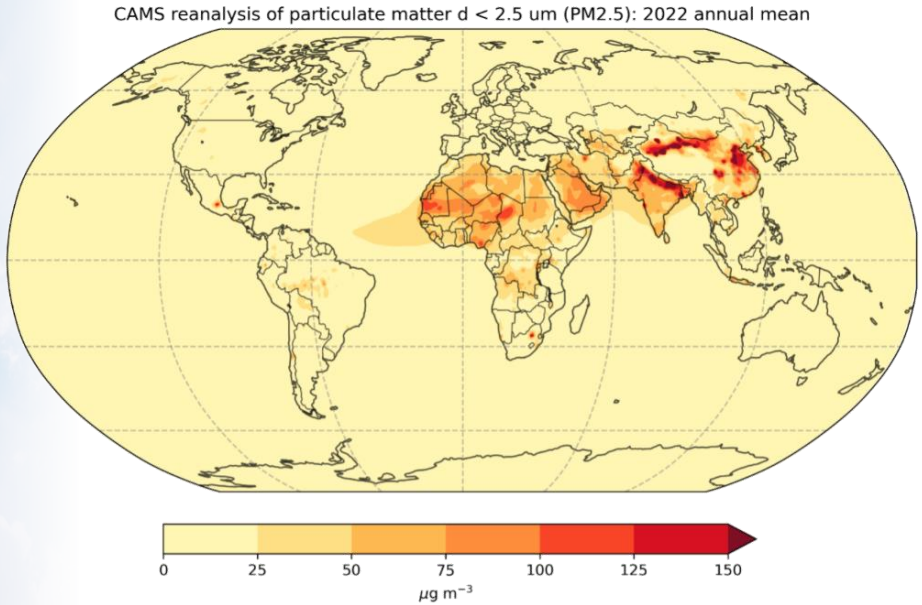
L'ajout de nouvelles données pour CAMS est un effort continu. Ici, l'exemple est pour les données de monoxyde de carbone (CO) déduites des mesures de Sentinel-5P. Elles améliorent les performances du système CAMS qui assimile déjà les données de CO des instruments MOPITT et IASI. Ces données sont assimilées en opérationel depuis Juin 2023.

Atmosphere Monitoring

LA REANALYSE CAMS (EAC4)

The Copernicus Atmosphere Monitoring Service (*CAMS) reanalysis dataset of atmospheric composition has been updated to the end of 2022 in the Atmosphere Data Store (ADS), which means that the ADS now contains a full 20-year global EAC4 reanalysis dataset.

The CAMS reanalysis dataset (EAC4) consists of three-dimensional time-consistent atmospheric composition fields, including aerosols and chemical species. A separate reanalysis dataset for greenhouse gases is published as EGG4. The dataset builds on the experience gained during the production of the earlier Monitoring Atmospheric Composition and Climate (MACC) reanalysis and CAMS interim reanalysis.



REFERENCED CONTENT

- CAMS reanalysis dataset
- Monitoring Atmospheric Composition and Climate
- CAMS interim reanalysis
- CAMS global forecasts
- AeroVal website
- Atmosphere Data Store

FURTHER READING

CAMS releases Interim Assessment Report on air quality in Europe

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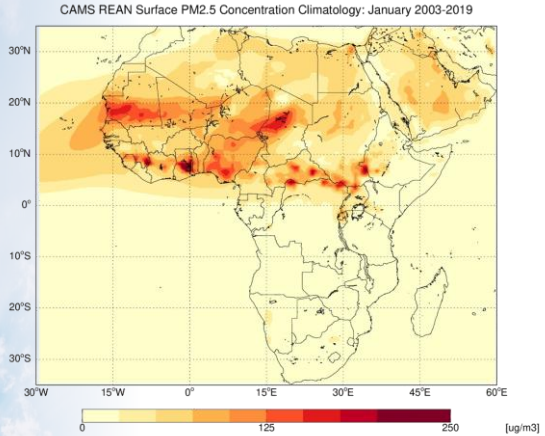
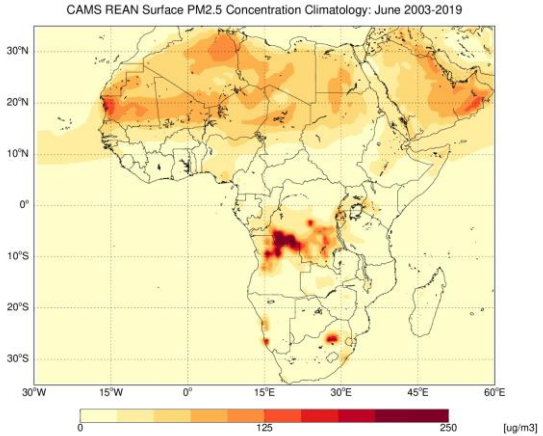
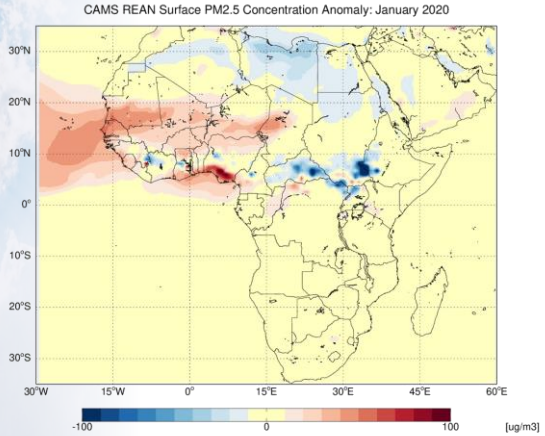
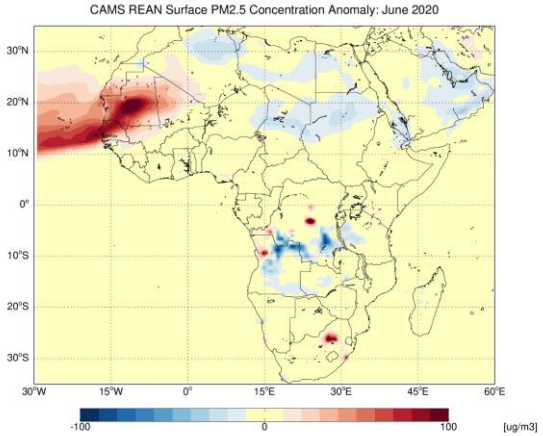
Atmosphere Monitoring

LA REANALYSE CAMS: PUTTING EPISODES IN CONTEXT





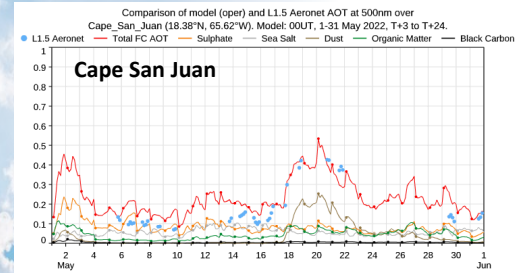


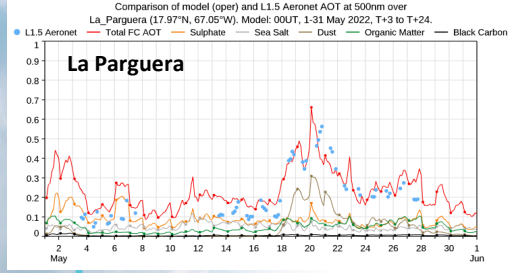


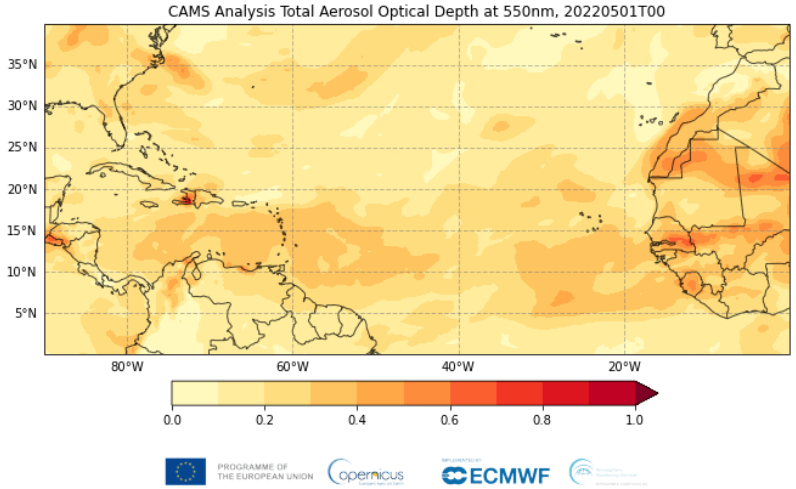
- La réanalyse CAMS fournit un ensemble de données cohérent pour comprendre les changements à long terme dans la composition atmosphérique à l'echelle mondiale et la qualité de l'air.
- Cet exemple montre la climatologie mensuelle de janvier et de juin pour la concentration de PM2.5 en surface, en moyenne pour 2003 à 2019.
- Les cartes des anomalies pour janvier et juin 2020 mettent en évidence des valeurs plus fortes pour les poussières désertiques et plus faibles pour les émissions dues aux feux.
- CAMS contribue aux bulletins annuels OMM/GAW et BAMS.

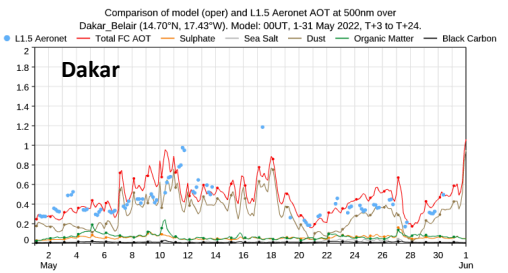
EXEMPLE: ÉPISODES DE POUSSIÈRES DÉSERTIQUES (MAI 2022)

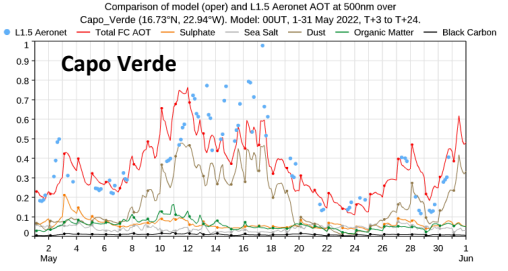
Atmosphere Monitoring











Prévisions opérationnelles du CAMS et leur évaluation dans le cas d'un transport de poussières sur l'Atlantique. Ces informations sont partagées avec les utilisateurs via le site CAMS, les réseaux sociaux et les médias.

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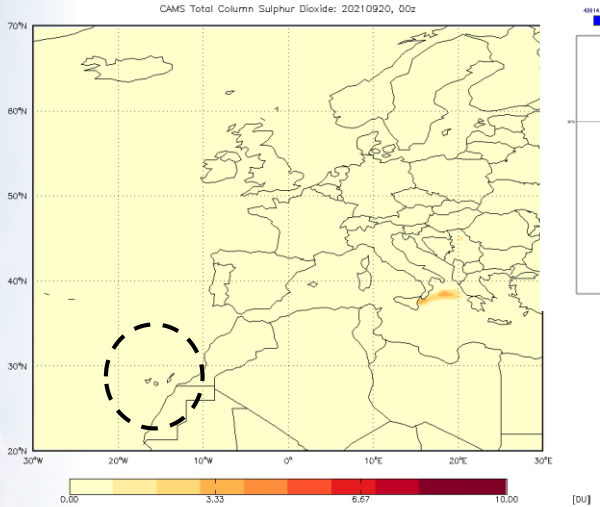
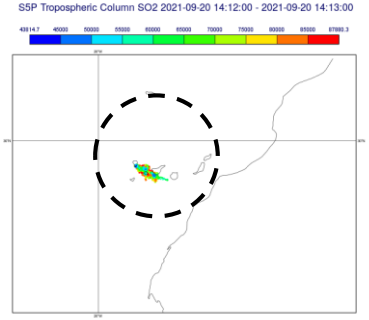
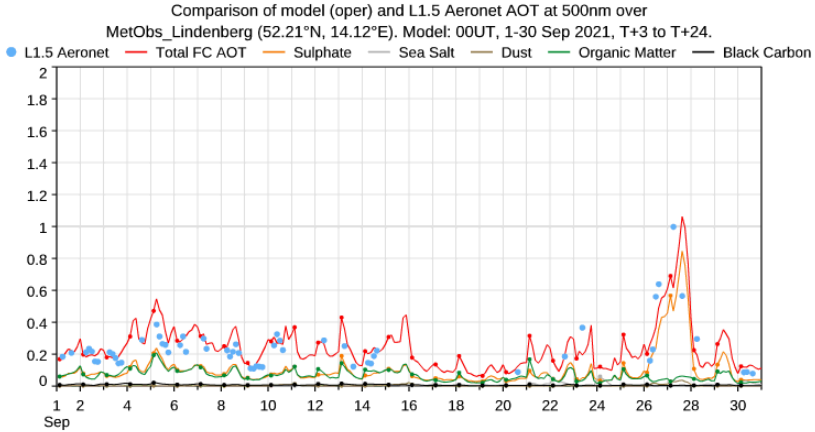
Atmosphere Monitoring

EXEMPLE: ÉRUPTIONS VOLCANIQUES (SEPTEMBRE 2021)







- Cumbre Vieja volcano on La Palma erupted on 19 September 2021 for first time since 1971
- First SO_2 detections from **GOME-2** & **S-5P** assimilated in IFS at 06z on 20 September (layer height ~550 hPa)
- Initial transport to the NW across N Africa, Europe and Mediterranean

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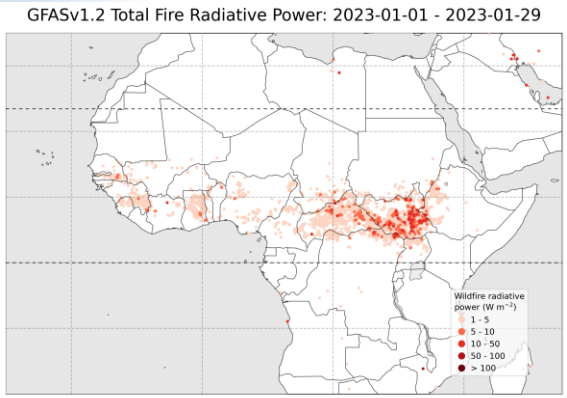
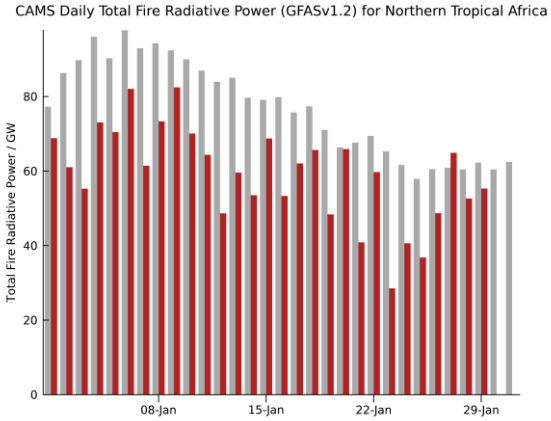
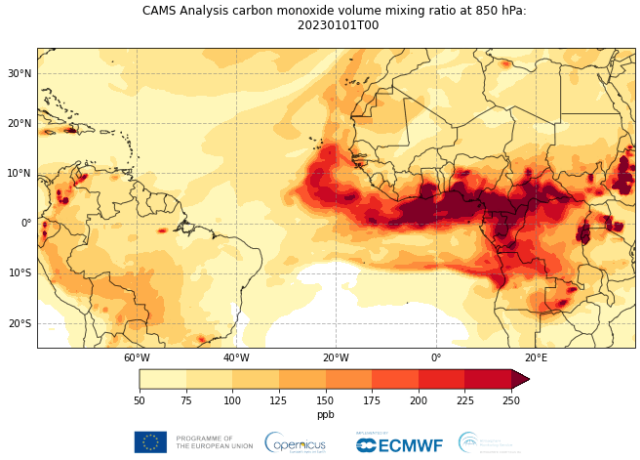
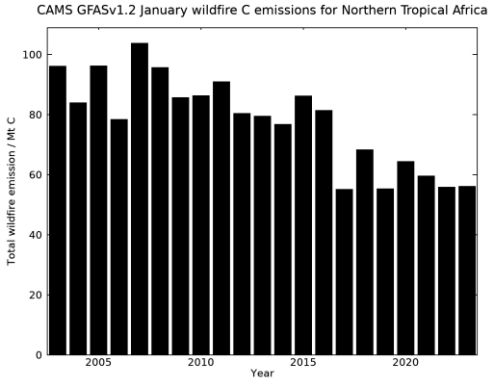
EXEMPLE: FEUX DE BIOMASSE EN AFRIQUE (JANVIER 2023)









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LES PRODUITS D'INFORMATION CAMS SUR LES GES

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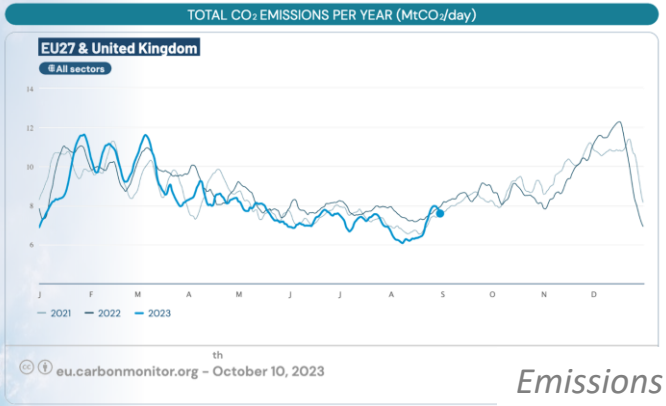
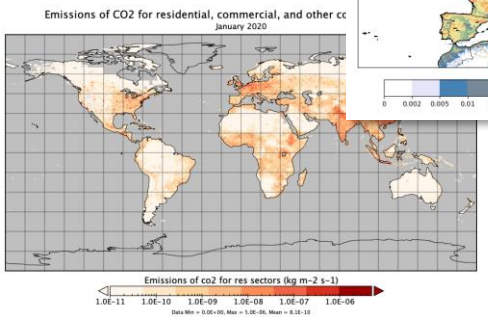
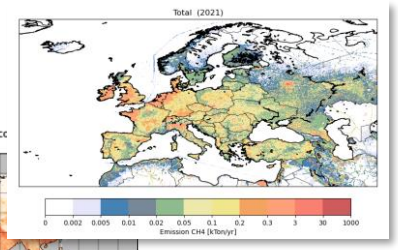


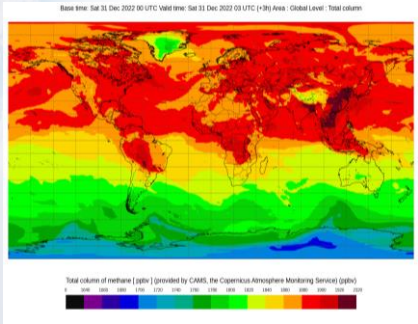
Inventaires d'emissions

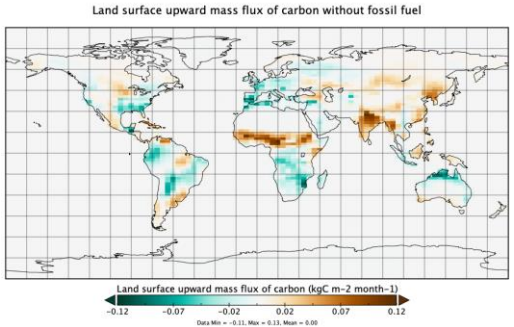




Emissions basées sur les activités

Prévisions mondiales quotidiennes des concentrations atmosphériques de CO2 et de CH4 à haute résolution





Inversions de flux mises à jour annuellement (mensuellement) pour CO_2, CH_4, et N_2O

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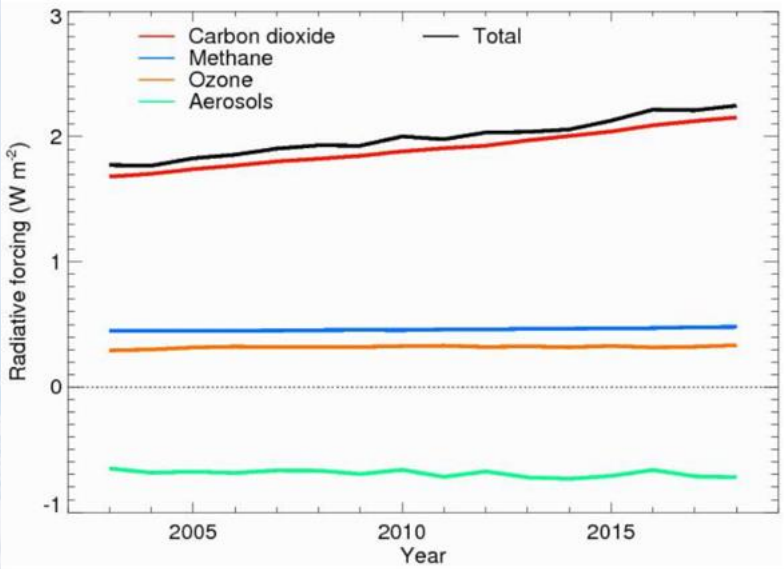
FORÇAGES CLIMATIQUES RADIATIFS DE CAMS



Carbon dioxide	+2.2 ± 0.3 W m^{-2}	+1.4% in a year	
Methane	+0.5 ± 0.1 W m^{-2}	+0.5% in a year	
Ozone	+0.3 ± 0.1 W m^{-2}	+3.8% in a year	Tropospheric ozone +0.3 ± 0.1 W m^{-2} Stratospheric ozone −0.01 ± 0.1 W m^{-2}
Aerosols	−0.7 ± 0.5 W m^{-2}	-1% in a year (became more negative)	Aerosol-radiation interactions −0.2 ± 0.1 W m^{-2} Aerosol-cloud interactions −0.5 ± 0.2 W m^{-2}
Total	+2.2 ± 1.3 W m^{-2}	+1.7% in a year	

To slow down climate change, net radiative forcing needs to decrease towards zero. To reverse climate change, net radiative forcing would need to become negative. Over the past 16 years, the opposite has happened: net radiative forcing has become more positive, fuelling further climate changes.

Carbon dioxide	+28% over the past 16 years
Methane	+7% over the past 16 years
Ozone	+14% over the past 16 years
Aerosols	-11% over the past 16 years (becoming more negative)
Net radiative forcing	+27% over the past 16 years

Calculés à l'aide de la réanalyse CAMS et d'une simulation préindustrielle CAMS. A été pris en compote par le GIEC (AR6).

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LA “NOUVELLE FRONTIÈRE” POUR CAMS: ÉMISSIONS

La cible principale concerne les émissions de CO_2 par les activités humaines, mais des produits seront aussi developpés pour le méthane et différents pollutants.

Une contribution européenne aux efforts de CEOS, de GCOS, de GEO et de l’OMM en soutien à l’Accord de Paris.

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LA MISE EN PLACE DU SERVICE CAMS POUR LES ÉMISSIONS

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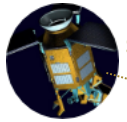
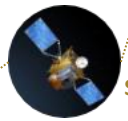
Depuis les groupes d'experts et les projets de recherche vers les services opérationnels

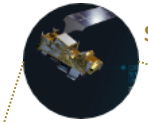
ECMWF esa EUMETSAT



Sentinel 5p



Sentinel 4



Sentinel 5

CO_2 Mission

Emissions Qualité de l'Air 2025/26

SATELLITE MISSIONS

Operational ramp-up in CAMS

SERVICE COMPONENTS

CO2 TASK FORCE GUIDANCE DOCUMENTS

2015

2017

2019

2017

2018

VERIFY

2021

CoCO2 Prototype system for a Copernicus CO_2 service

ICOS Cities

2022

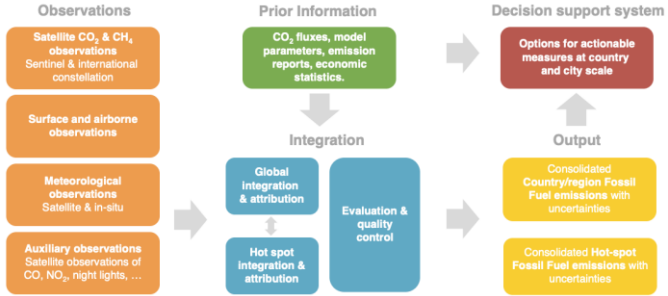
horizon europe

2026/27

CO_2 Monitoring & Verification Support (CO_2MVS)

RECHERCHE ET PROJETS PREPARATOIRES

CO_2 Human Emissions



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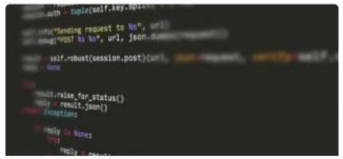
POLITIQUE D'ACCÈS AUX DONNÉES (LIBRE)

Atmosphere Monitoring

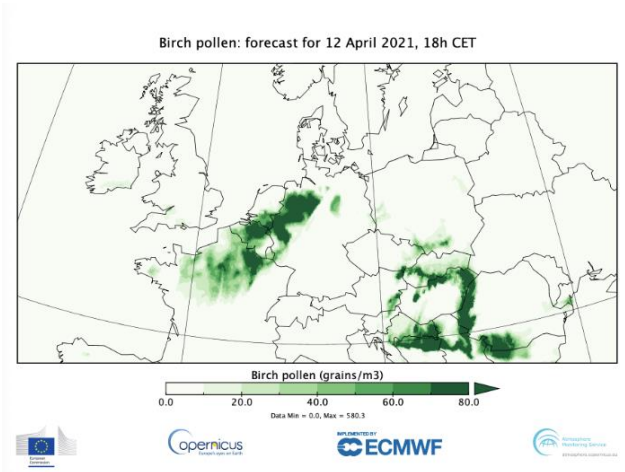
- **Data available and easily accessible** on the atmosphere/climate data store : ads.atmosphere.copernicus.eu and cds.climate.Copernicus.eu



Atmosphere Data Store **API**

Access the ECMWF Support Portal

- Collaboration/contribution to the European Climate and Health Observatory https://climate-adapt.eea.europa.eu/en/observatory



CAMS forecast of birch pollen for 12 April 2021. Credit: Copernicus Atmosphere Monitoring Service/ECMWF.

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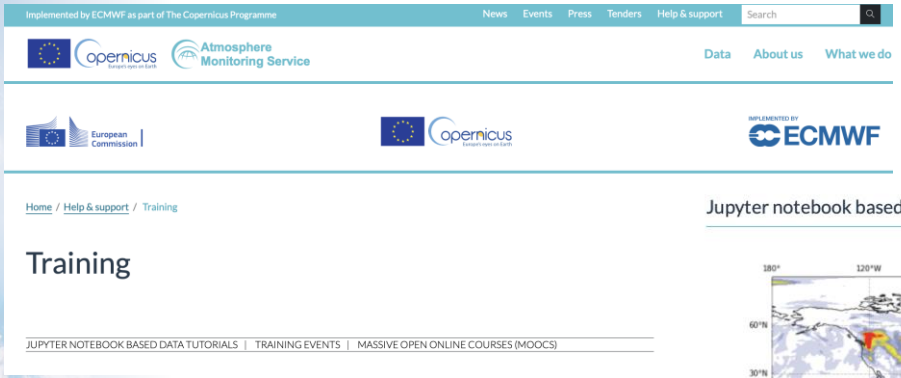
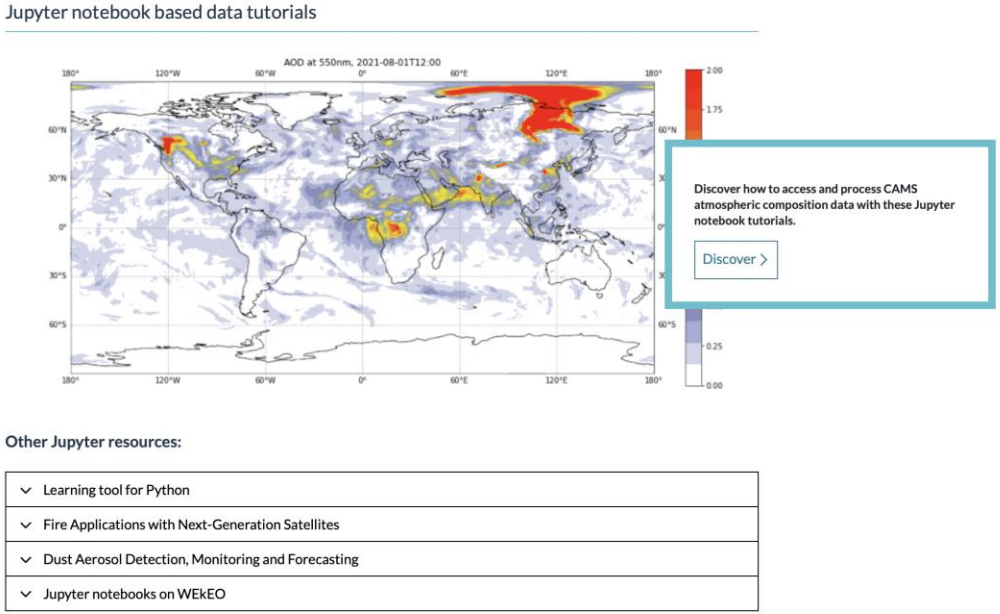
FORMATION ET UTILISATION DES DONNEES CAMS

https://atmosphere.copernicus.eu/training





De nombreuses ressources sont disponibles, le plus souvent développées en collaboration entre ECMWF, Eumetsat et l'ESA.

ACCÉDER AUX DONNÉES CAMS: ATMOSPHERE DATA STORE

Atmosphere Monitoring

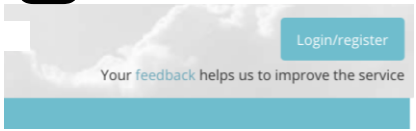
http://ads.atmosphere.copernicus.eu

Basé sur le CDS

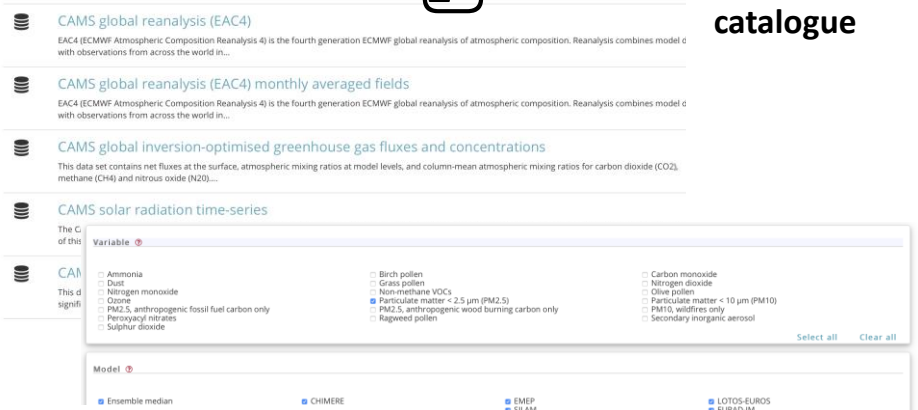
Cl… Change Service

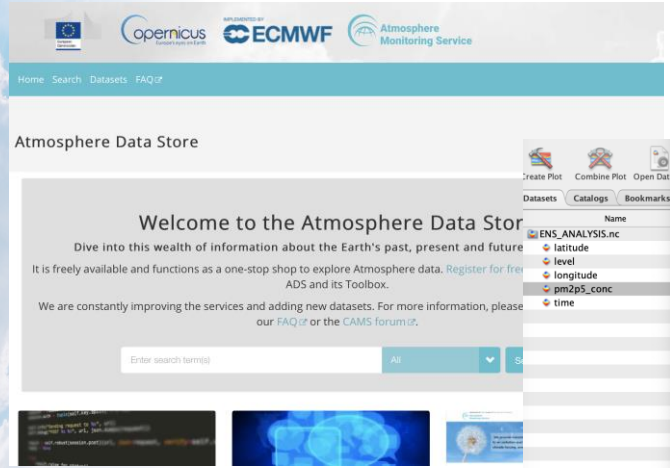
climate.copernicus.eu

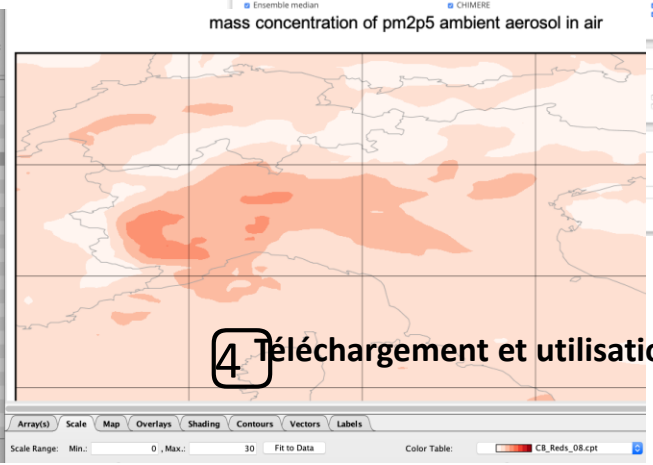
1 Inscription (1ère fois)



2 Recherche dans le catalogue







3 Formulaire

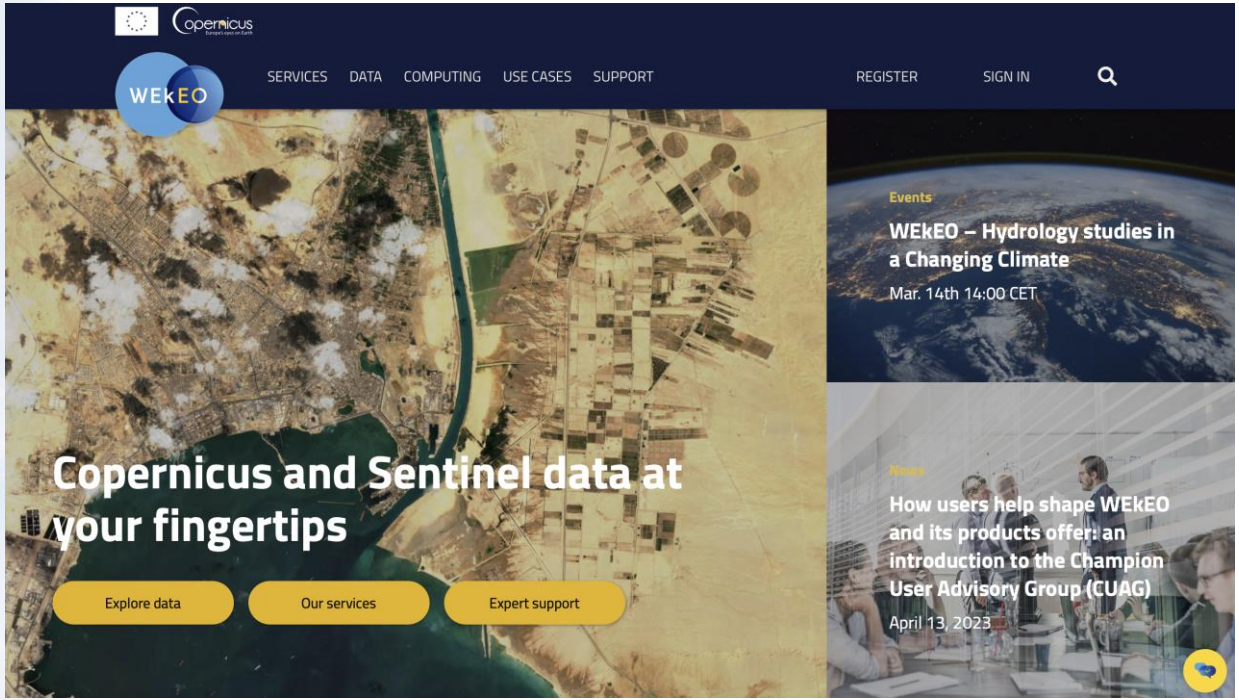
4 Téléchargement et utilisation

5 Script réutilisables (API)

Atmosphere Monitoring

SI VOUS AVEZ BESOIN DE MACHINES VIRTUELLES… IL Y A WEkEO

https://www.wekeo.eu



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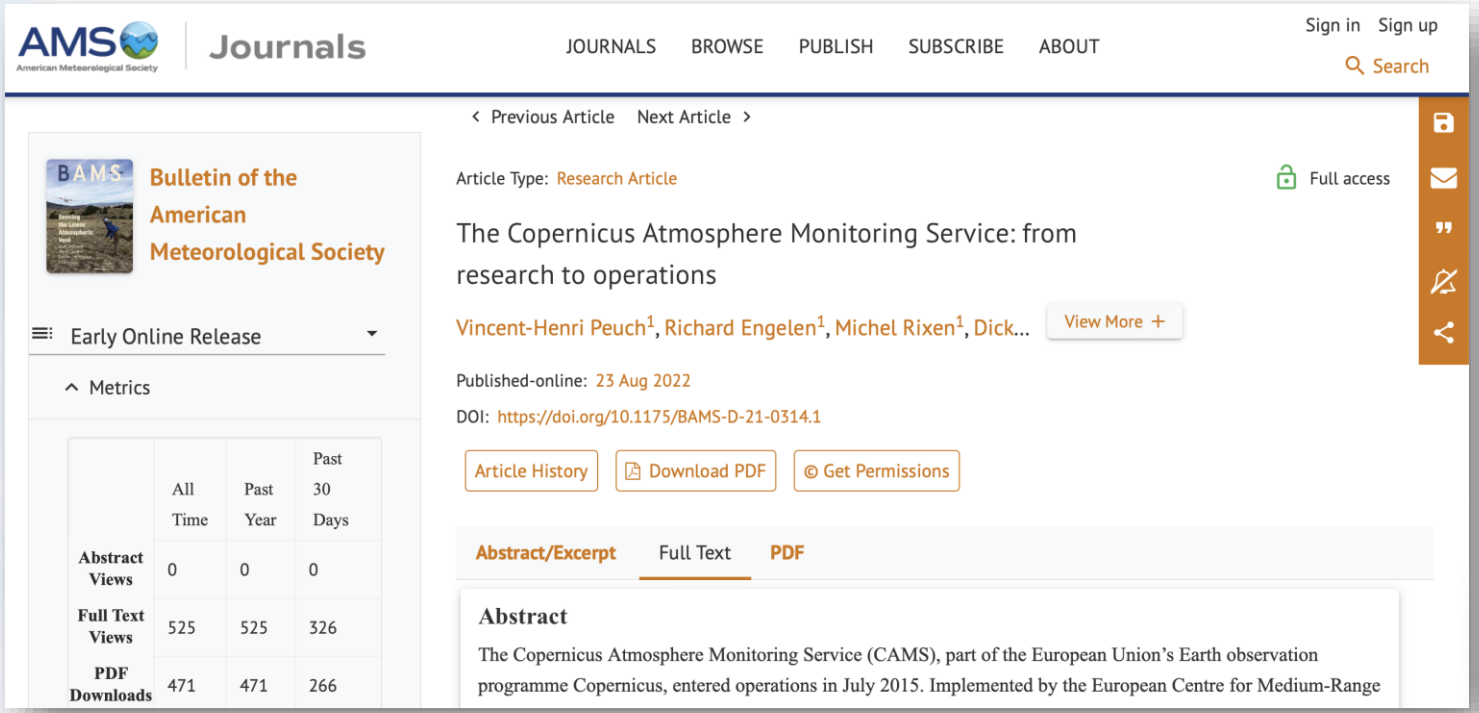
ARTICLE DE PRESENTATION GENERALE DE CAMS



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Article Type: Research Article

Full access

The Copernicus Atmosphere Monitoring Service: from research to operations

Vincent-Henri Peuch[1], Richard Engelen[1], Michel Rixen[1], Dick... View More +

Published-online: 23 Aug 2022

DOI: https://doi.org/10.1175/BAMS-D-21-0314.1

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Abstract/Excerpt | Full Text | PDF

Abstract

The Copernicus Atmosphere Monitoring Service (CAMS), part of the European Union's Earth observation programme Copernicus, entered operations in July 2015. Implemented by the European Centre for Medium-Range

https://doi.org/10.1175/BAMS-D-21-0314.1

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CONCLUSIONS

- Dans le cadre du programme Copernicus de l'Union Européenne, CAMS fournit des informations opérationnelles sur la qualité de l'air et la composition chimique de l'atmosphere (analyses, prévisions à j+5, réanalyses) et celles-ci sont disponibles librement et gratuitement.
- De nombreuses façons d'interagir avec les données, en fonction des besoins et des capacités.
- Il n'y a jamais assez de validation/verification! CAMS est très ouvert aux collaborations (expertise/retour d'expérience, comparaisons avec des observations locales, campagnes de terrain, descente en echelle, exploitation des données en général…)
- Approche conjointe avec EUMETSAT et ESA, notamment pour la formation et les interactions avec les utilisateurs (comment utiliser au mieux les données et informations disponibles?)

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...

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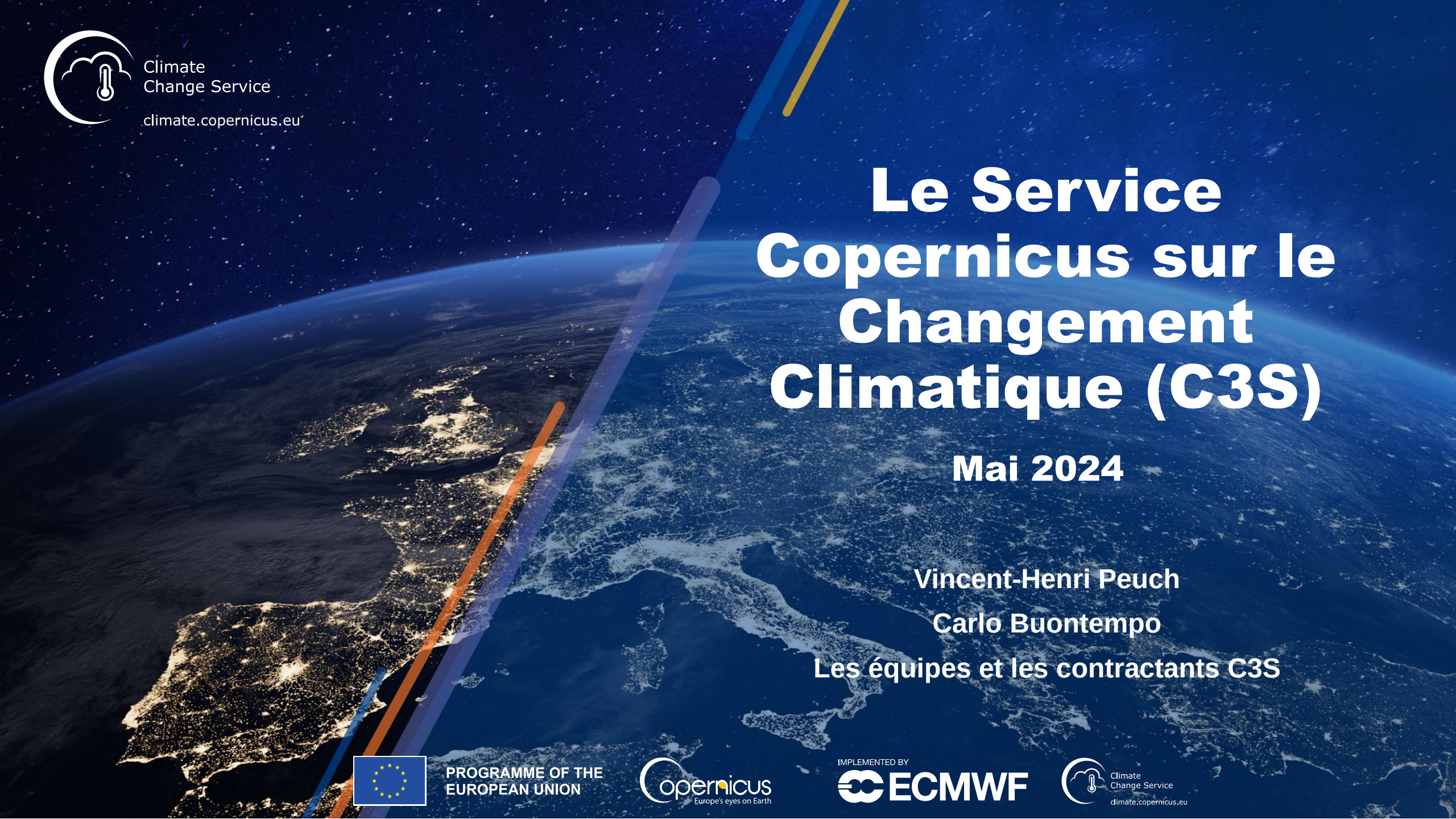

Climate
Change Service

climate.copernicus.eu

Le Service Copernicus sur le Changement Climatique (C3S)

Mai 2024

Vincent-Henri Peuch

Carlo Buontempo

Les équipes et les contractants C3S

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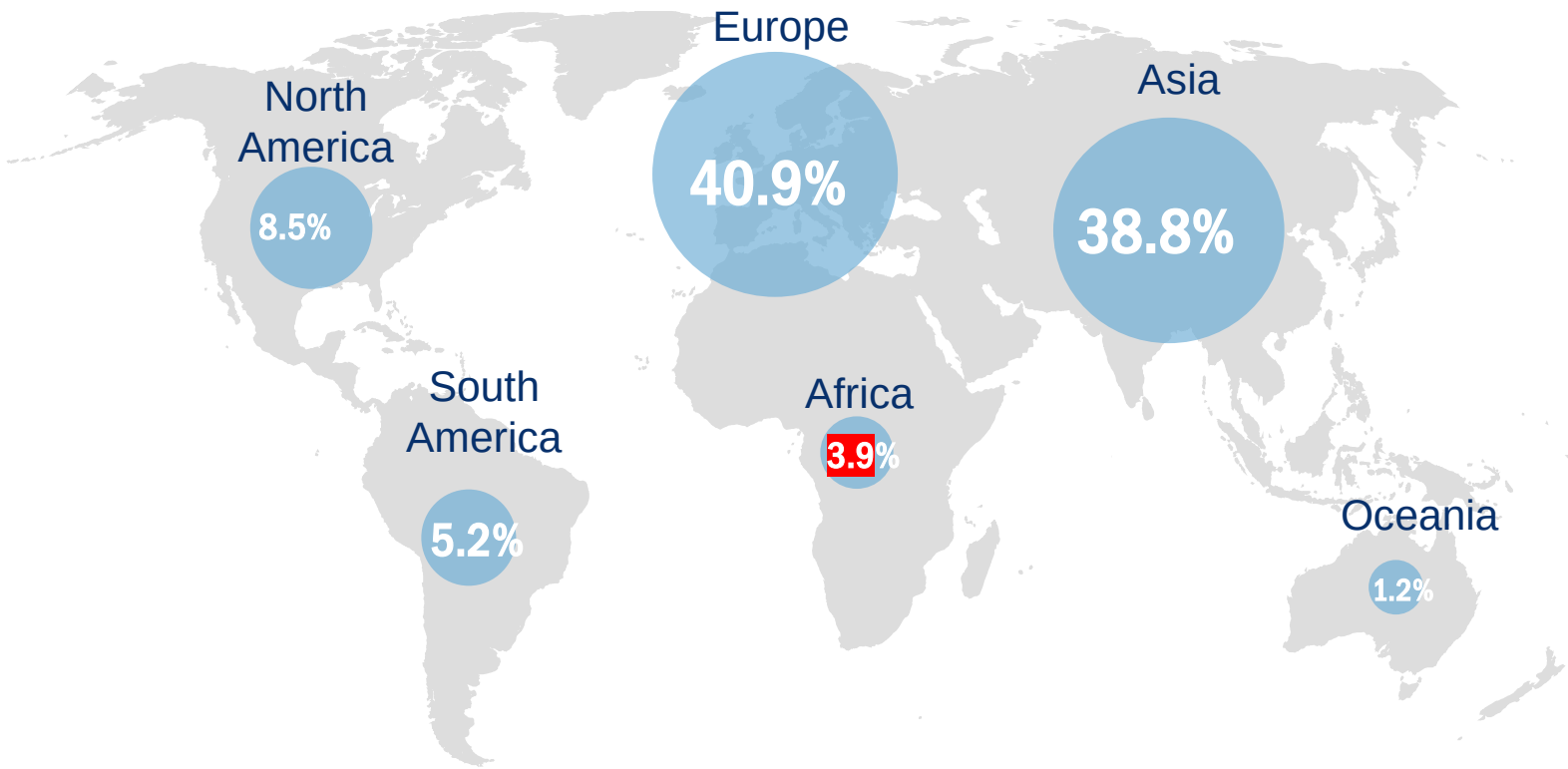
Politique d’accès aux données Copernicus: complet, libre et gratuit

C3S: les chiffres

Utilisateurs dans le monde

Les données climatiques ouvertes n'ont jamais eu autant d'importance



Utilisateur inscrits
>300,000

Utilisateurs finaux
Several millions

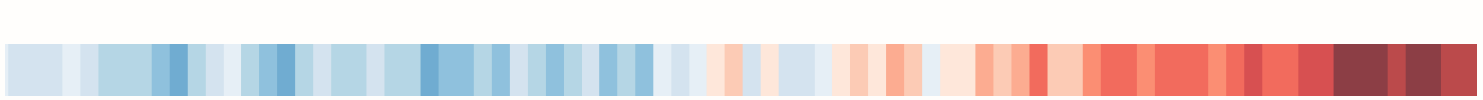
Requêtes
800 million

Volume téléchargé
>170 PB

Top 5 jeux de données
ERA5, ERA5 land, seasonal forecast, CORDEX, CARRA, CERRA, ORAS5, ECVs

Des données libres pour des decisions pertinents

Passé — Présent — Futurs possibles



NOS CHOIX

PRODUITS C3S

Observations

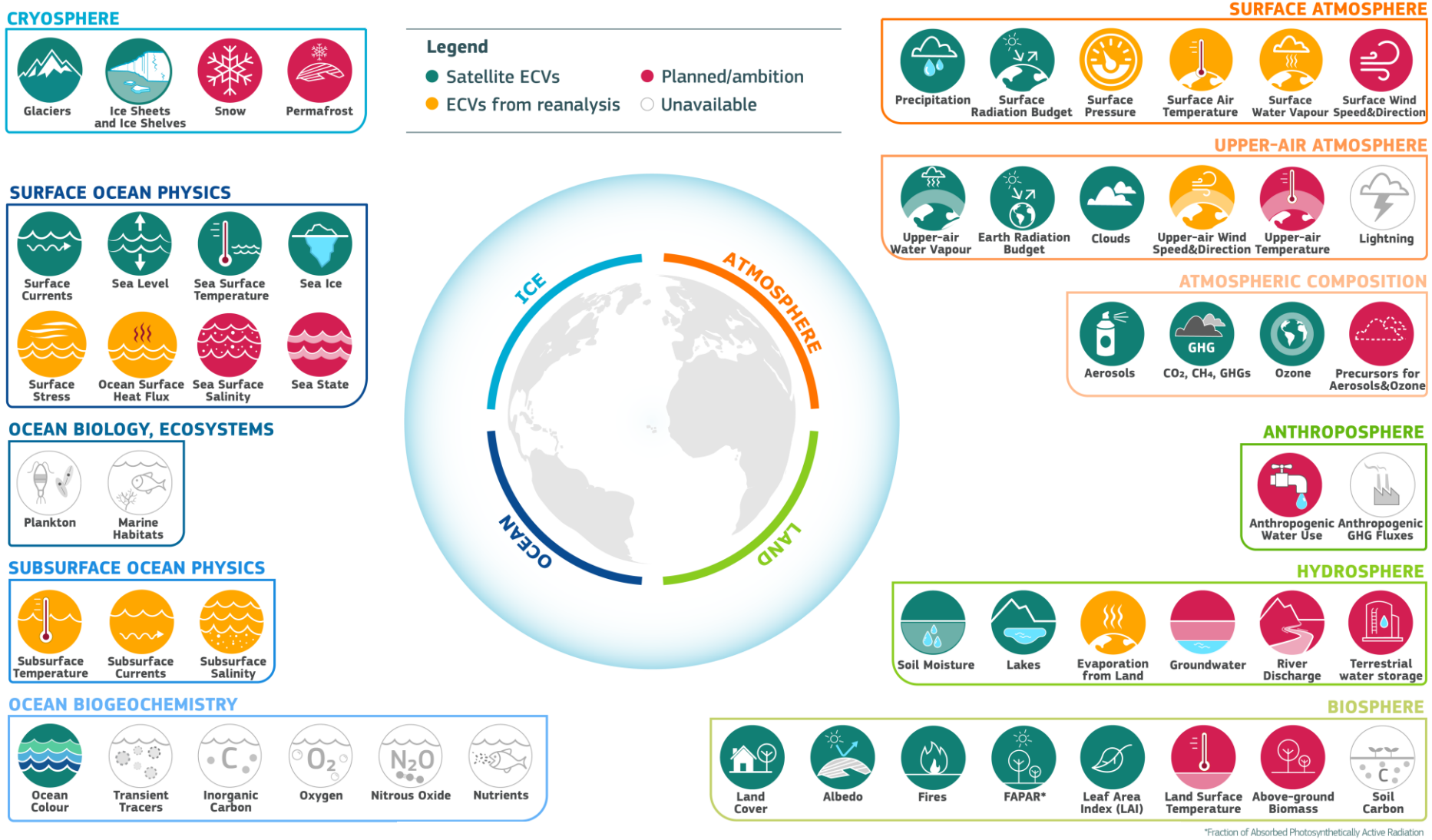
Reanalyse

Prévisions saisonnières à décennales

Projections climatiques

Observations

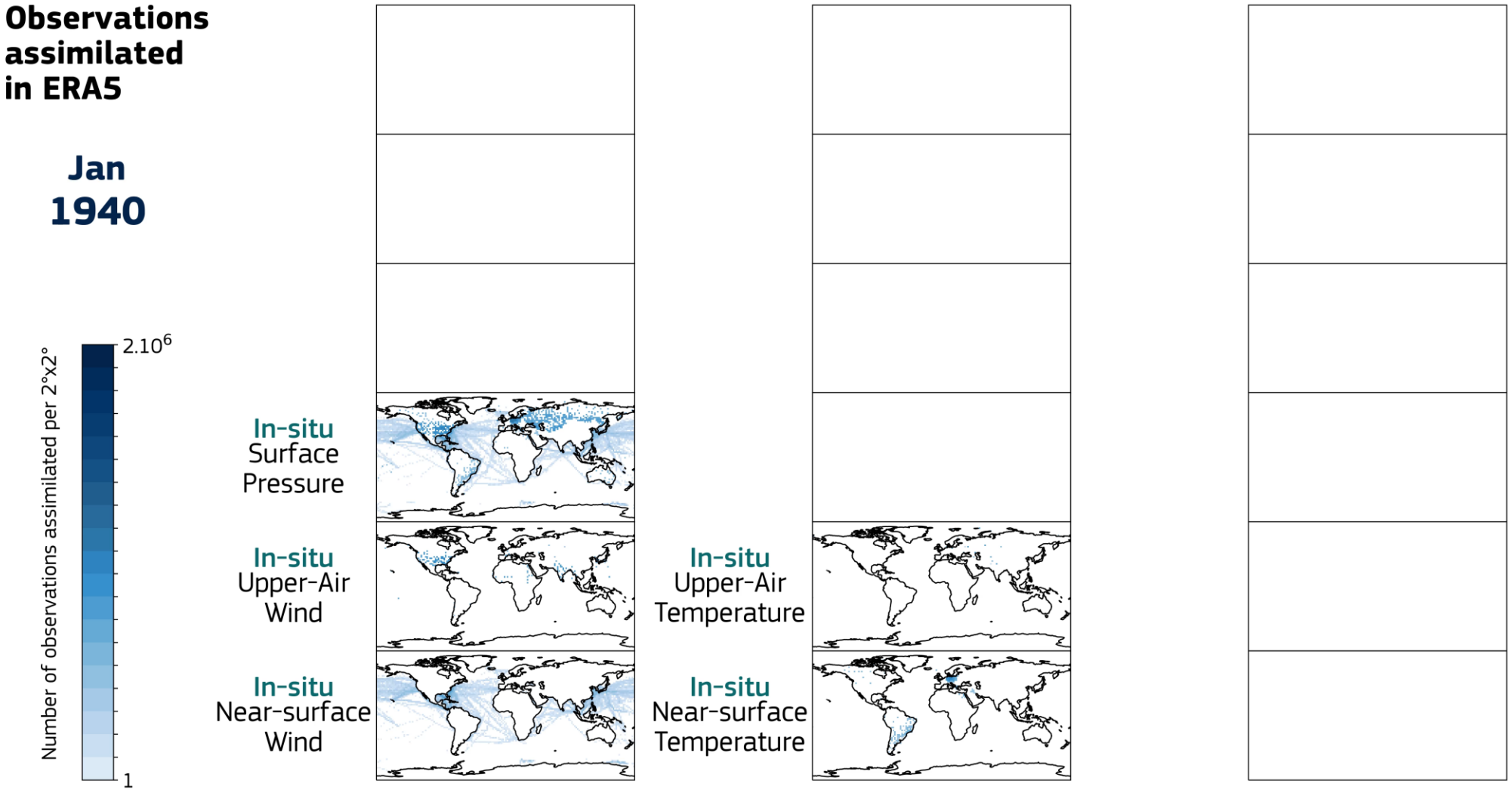
Variables Climatiques Essentielles (ECV)



Crucial pour comprendre les changements du climat.

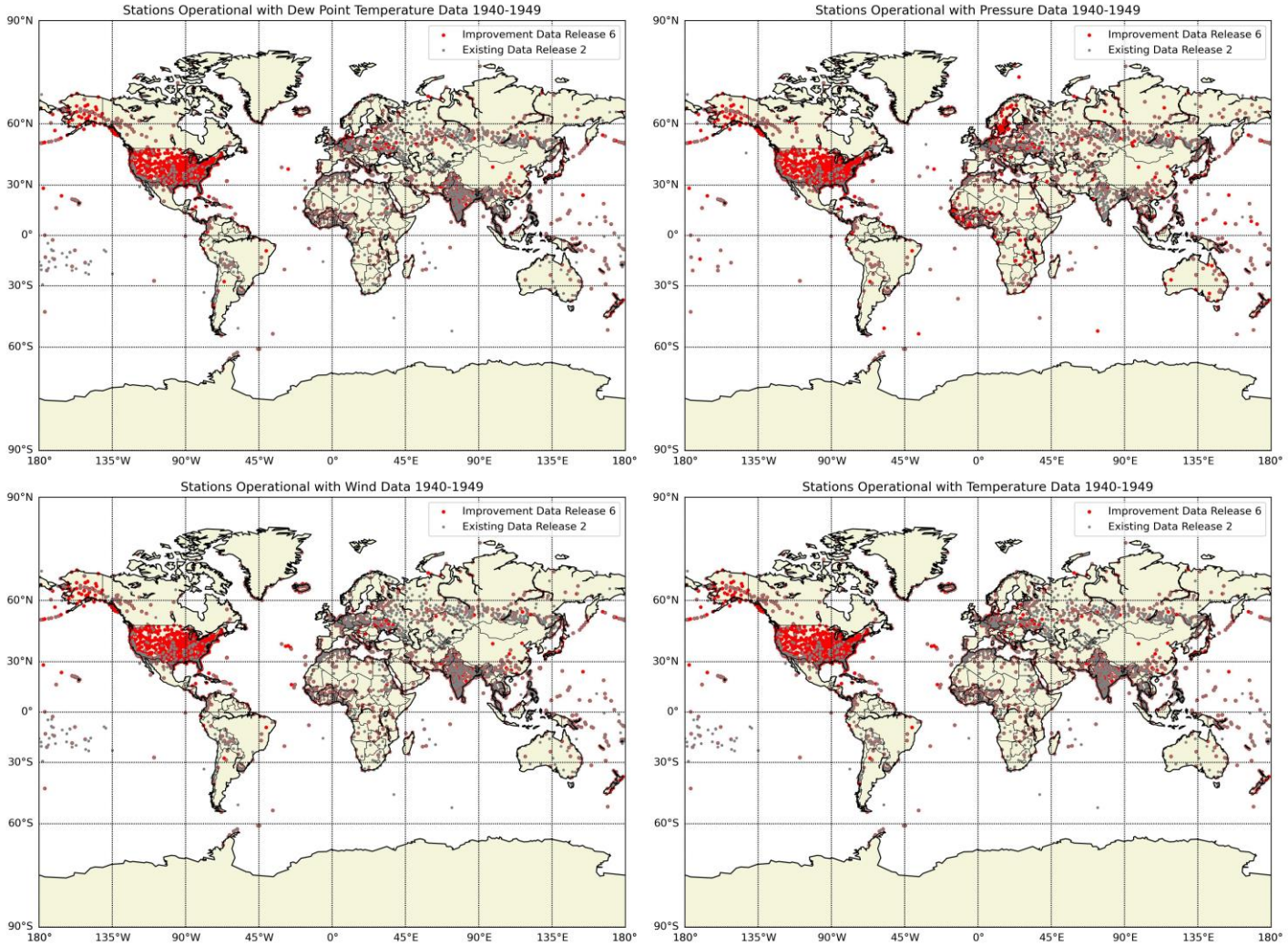
C3S répond aux besoins de mise en œuvre du GCOS et de la CCNUCC/UNFCCC.

Observations in situ: fondements des archives climatiques



C3S étend les jeux d'observations disponibles librement/gratuitement

C3S aide à la collecte et la recuperation des observations anciennes



Ces observations seront utilisées dans ERA6, pour augmenter la couverture d'observation par rapport à ERA5

Avec Maynooth University, NOAA …

https://cds.climate.copernicus.eu/cdsapp#!/dataset/insitu-observations-surface-land?tab=overview

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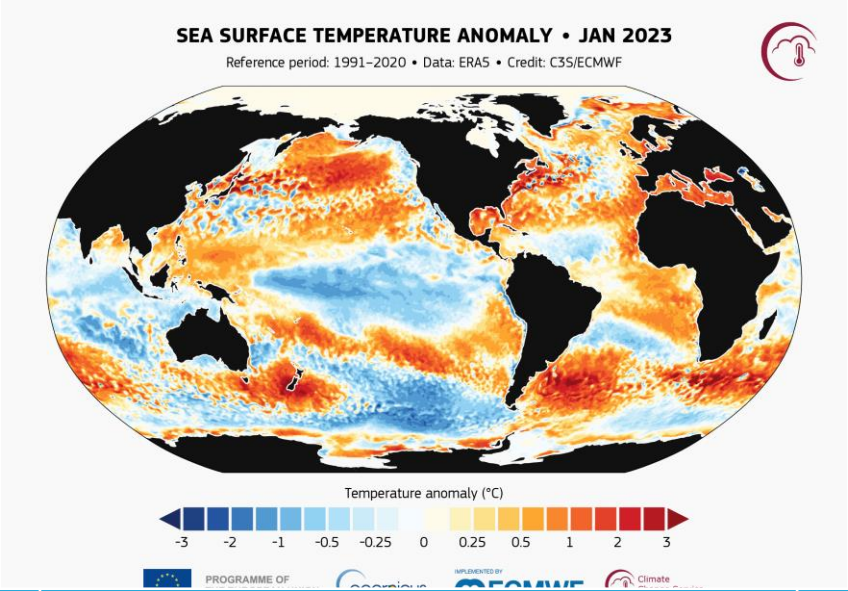
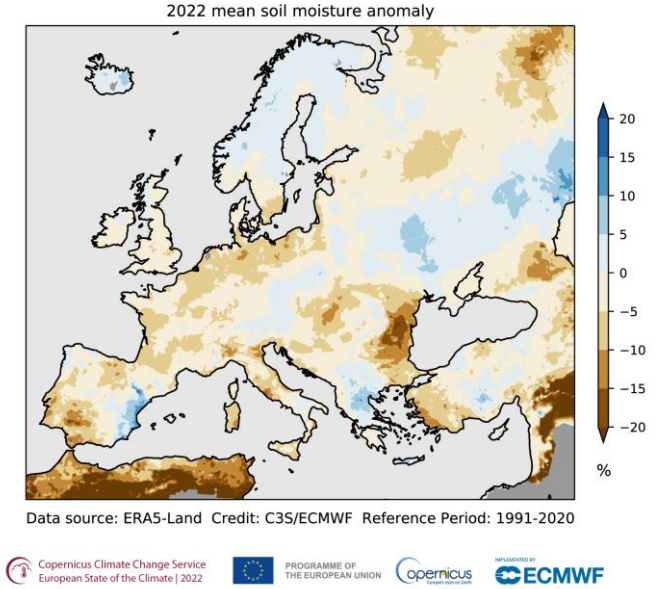
Réanalyses globales et régionales

Les données de réanalyse

ERA5





ERA5-Land

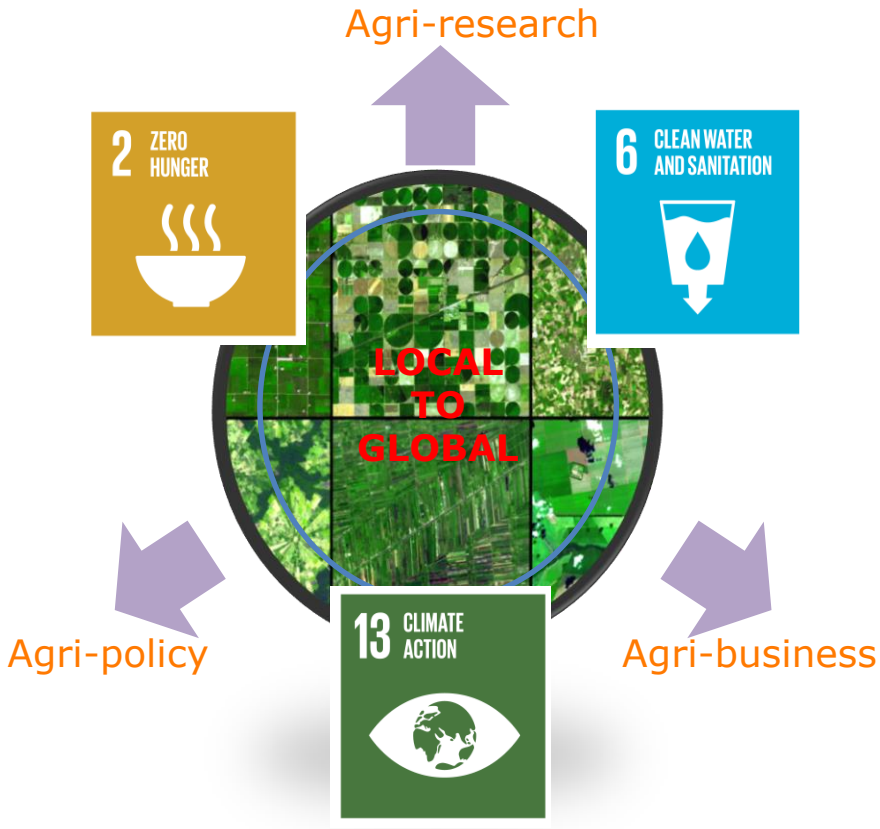
Product	Purpose	Time availability	Temporal resolution	Spatial resolution
ERA5	Global reanalysis for atmosphere, land and ocean waves	1940 onwards, up to 5 days behind real time	Hourly	30 km
ERA5 land	Global reanalysis for land-surface variables	1950 onwards, up to 5 days behind real time	Hourly	9 km
CERRA	European regional reanalysis	1984-2021	Hourly	5 km
CARRA	Arctic regional reanalysis	1990 onwards, up to 3 months behind real time	3-hourly analyses, hourly short-term forecasts	2.5 km

Des données pour agriculture & sécurité alimentaire basées sur ERA5

Données libres: AgERA5

- Produit global basé sur la réanalyse ECMWF ERA5
- Correction de Biais à l'aide des prévisions oper. ECMWF
- 0.1x0.1 degré (~10 km)
- De 1979 à au temps présent avec un délai de ~1 semaine
- 22 variables pour les applications agricoles:
  - Température (avg, min, max, etc.)
  - Précipitation et type de précipitations
  - Rayonnement global
  - Moyennes quotidiennes vapeur d'eau et vent
  - Humidité relative à différent moments du jour

https://doi.org/10.24381/cds.6c68c9bb

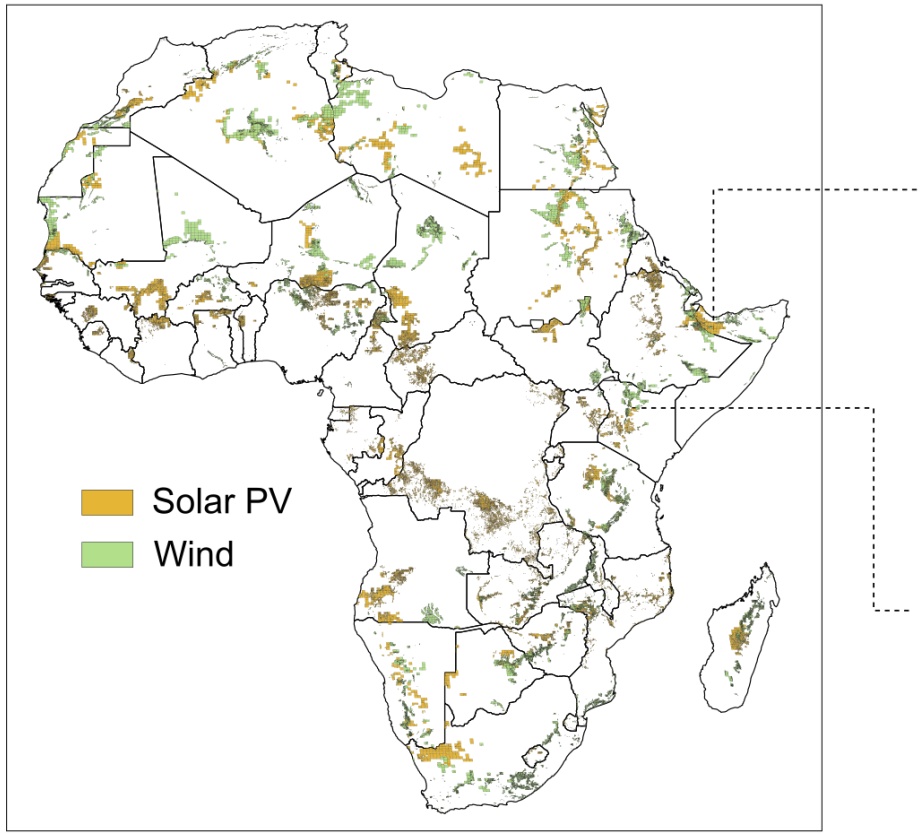


Quelques utilisations deAgERA5
FAO: https://data.apps.fao.org
WorldCereal: https://ceos.org/gst/agriculture.html
openEO Hub: https://hub.openeo.org/

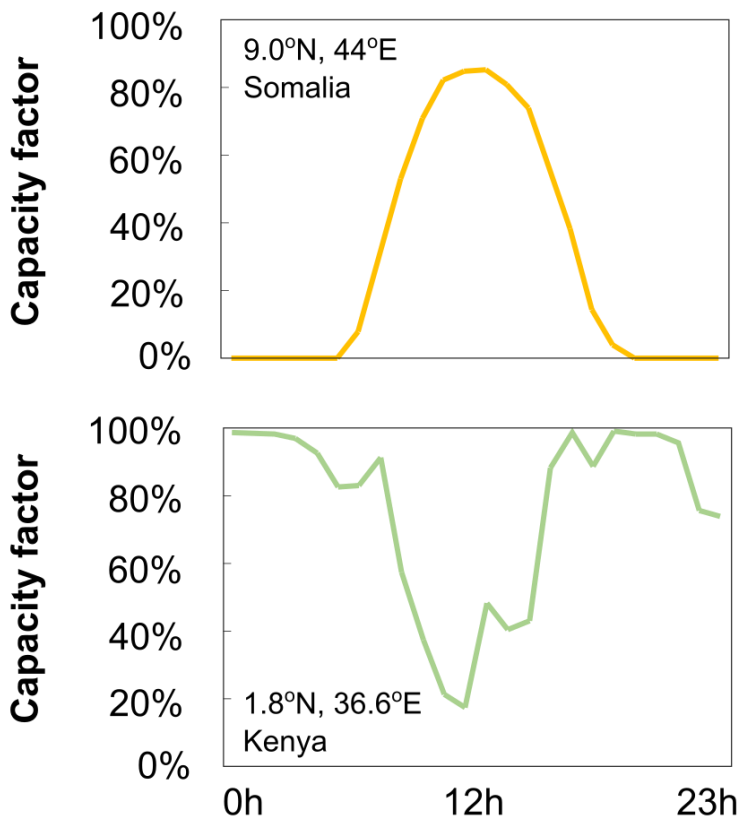
WAGENINGEN UNIVERSITY & RESEARCH

Analyse des potentiels solaire et éolien en Afrique

a Solar PV and wind MSRs

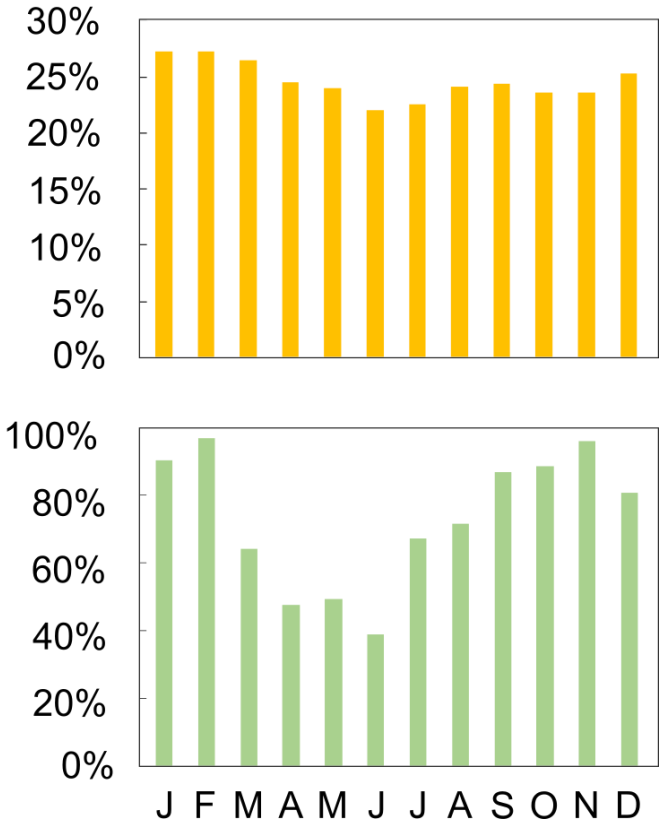


b Diurnal profiles



(12th of March of met year 2018)

c Seasonal profiles

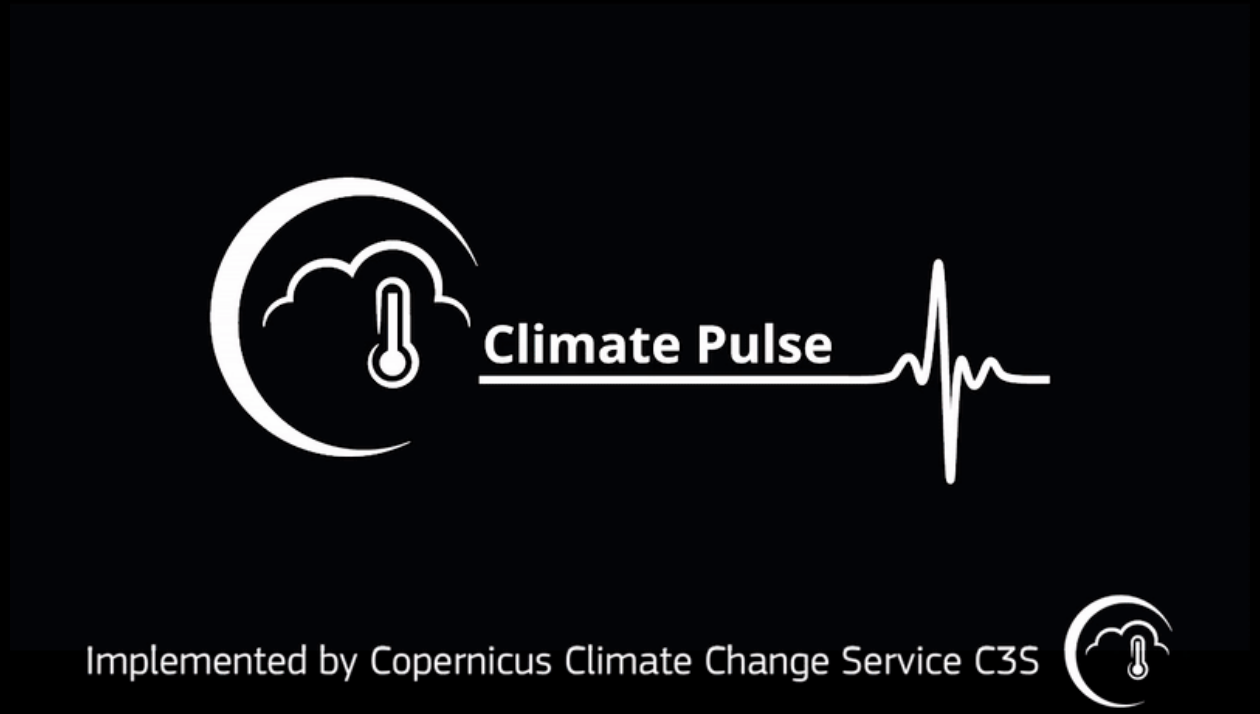


S. Sterl, B. Hussain, A. Miketa, Y. Li, B. Merven, M. Bassam Ben Ticha, M.A. Eltahir Elabbas, W. Thiery, and D. Russo. *An all-Africa dataset of energy model "supply regions" for solar PV and wind power*. Submitted to Scientific Data (2022).

IRENA
International Renewable Energy Agency

Climate
Change Service
climate.copernicus.eu

Connaissance du Climat


Climate Pulse
Implemented by Copernicus Climate Change Service C3S

Prévisions et projections

Composantes des prévisions saisonnières C3S

DONNÉES NUMÉRIQUES

cds.climate.copernicus.eu

- Climate Data Store
  - Atmosphere
    - daily and subdaily data (6h, 12h, 24h)
    - monthly statistics (mean, max, min, standard deviation)
    - bias corrected data (monthly anomalies)
  - Ocean monthly means
- Multi-system retrospective forecasts and real-time forecasts, the latter published on 6th (ECMWF) and 10th day of month (the rest)

CDS API

```
import cdsapi

c = cdsapi.Client()

c.retrieve(
    'seasonal-monthly-single-levels',
    {   'format':'grib',
        'originating_centre':'meteo_france',
        'variable':'total_precipitation',
        'product_type':[
            'ensemble_mean','hindcast_climate_mean'
        ],
        'year':'2018',
        'month':'09',
        'leadtime_month':['1','2','3','4','5','6'] },
    'cds_seasonal_output.grib')
```

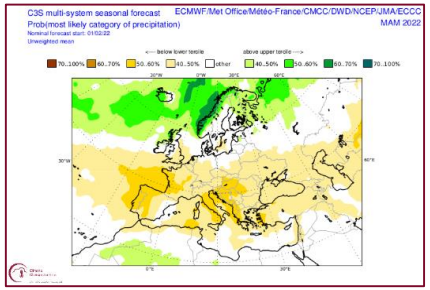
Python workflows

jupyter

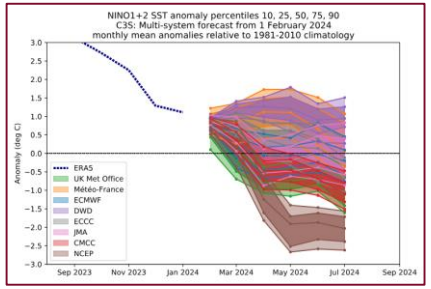
PRODUITS GRAPHIQUES

climate.copernicus.eu/charts/packages/c3s_seasonal/

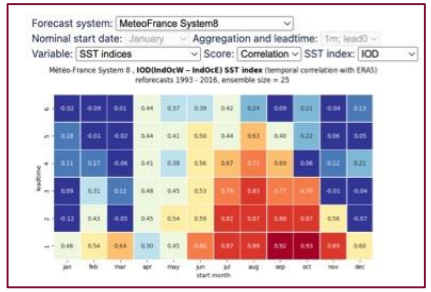
Products for individual contributing systems and multi-system combination



Total precipitation
Near-surface temperature and wind
Mean sea-level pressure
Sea surface temperature
Sea ice concentration
Geopotential height at 500 hPa
Temperature at 850 hPa

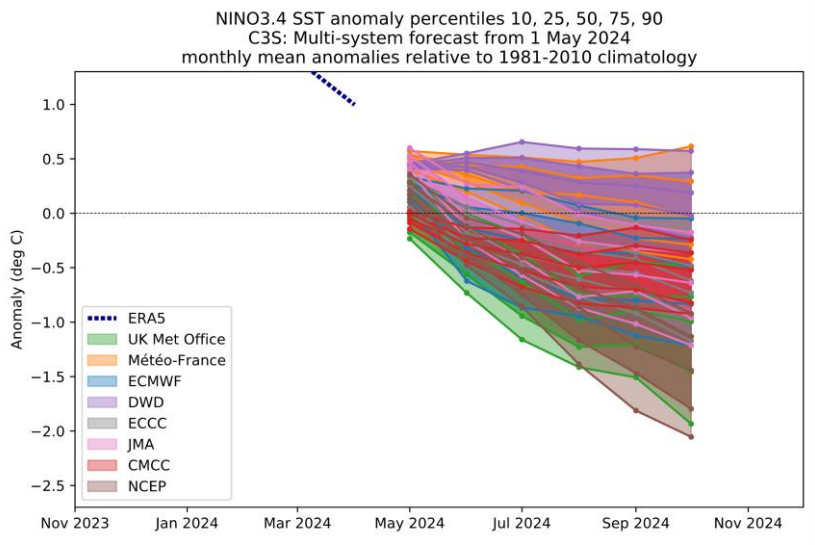


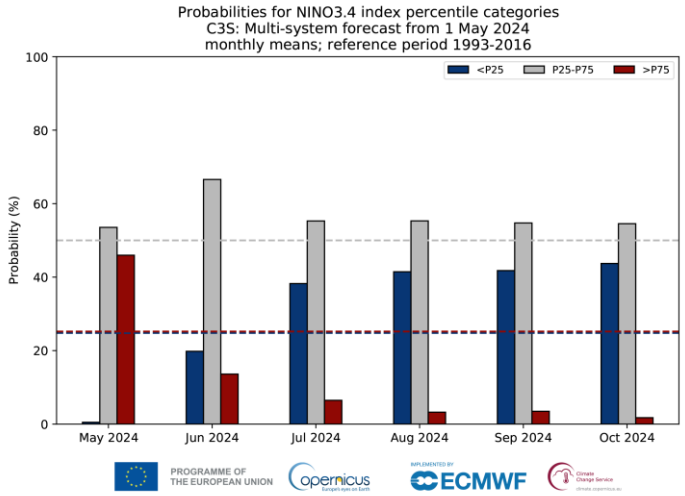
Sea surface temperature NINO regions
Sea surface temperature Indian Ocean
Zonal mean wind at 10hPa



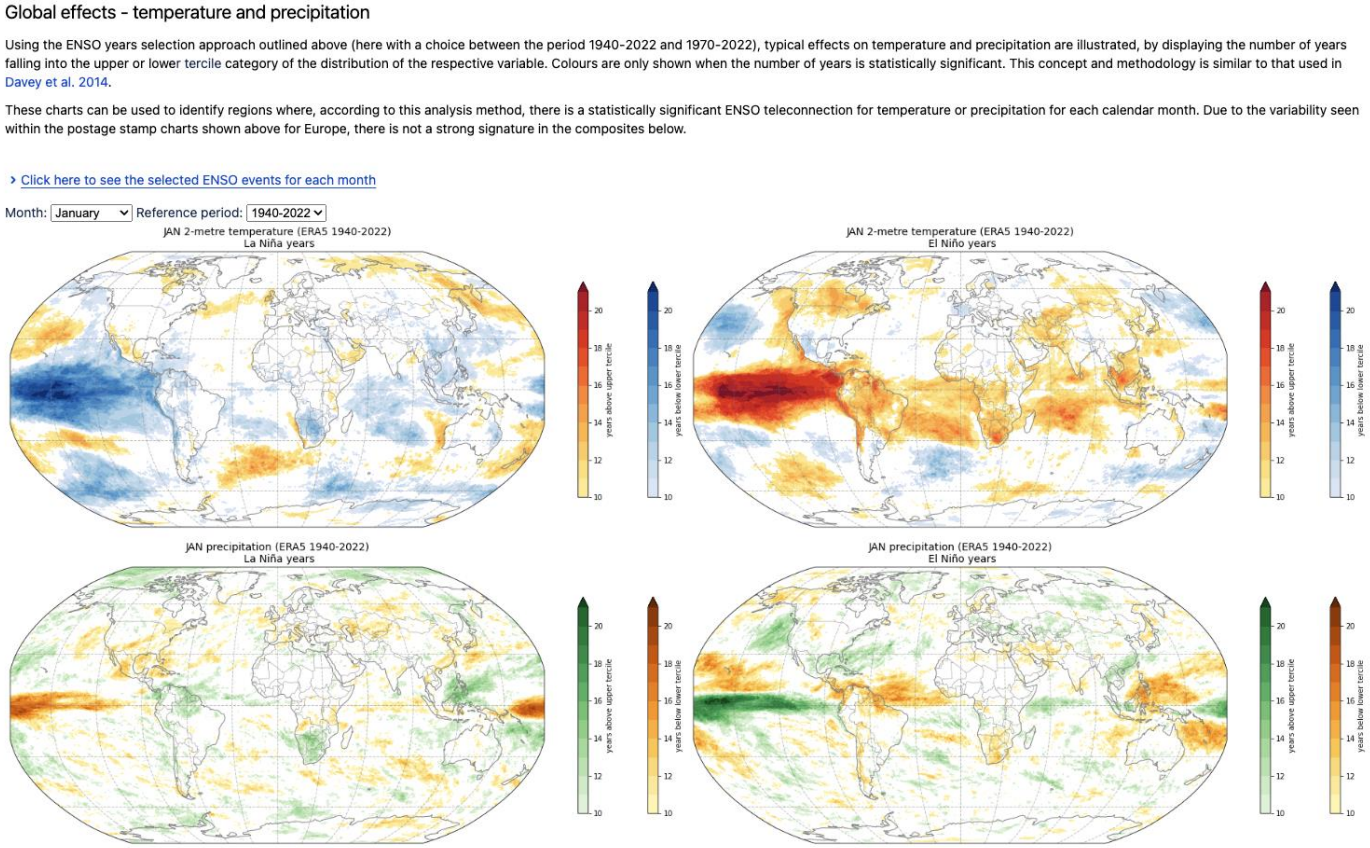
Temporal correlation
Relative Operating Characteristic (ROC) score
Ranked Probability Score (RPS)

NINO 3.4 Mai 2024





Prévision C3S multi-systèmes



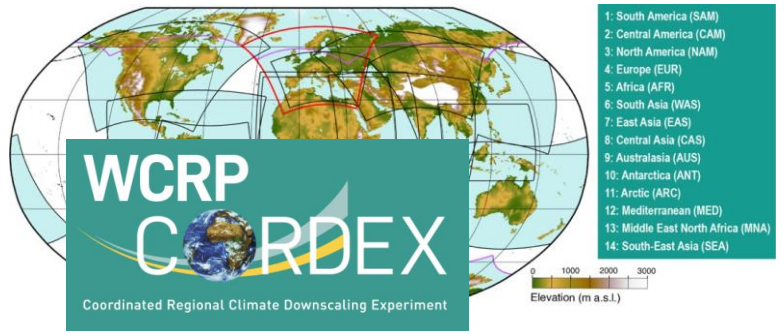
Etude des téléconnection ENSO

https://confluence.ecmwf.int/display/COPSRV/ENSO+impacts+on+Europe

C3S projections décennales et à long terme

WCRP CMIP5 World Climate Research Programme

WCRP CMIP6 World Climate Research Programme



Prévi. climatiques globales

Climate Change Service
climate.copernicus.eu

- Accès aux données operationel
- Contrôle qualité
- tutoriaux

Prévi. climatiques régionales

Prévi. décennales

CMIP5 daily data on single levels

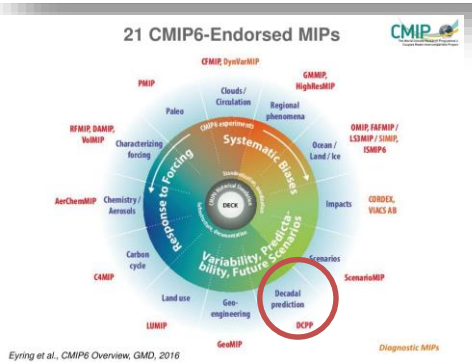
Dataset | Global | Atmosphere (surface) | Atmosphere (upper air) | Climate projections

This catalogue entry provides daily climate projections on single levels from a large number of experiments, models, members and time periods computed in the framework of the fifth phase of the Coupled Model Intercompa... one vertical...

CMIP6 climate projections

Dataset | Global | Atmosphere (surface) | Atmosphere (upper air) | Climate projections

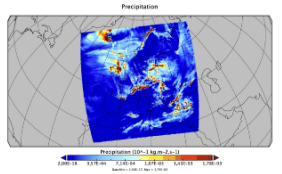
This catalogue entry provides daily and monthly global climate projections data from a large number of experiments, models and time periods computed in the framework of the sixth phase of the Coupled Model Intercomparison Project (CMIP6). CMIP6 data underpins the Intergovernmental Panel on Climate Change 6th Assessment Report. The use of these data is mostly aimed at: addressing outstanding scien...



CORDEX regional climate model data on single levels

Dataset | Europe | Atmosphere (surface) | Atmosphere (upper air) | Climate projections

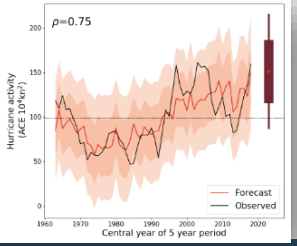
This catalogue entry provides Regional Climate Model (RCM) data on single levels from a number of experiments, models, domains, resolutions, ensemble members, time frequencies and periods computed over several regional domains all over the World in the framework of the Coordinated Regional Climate Downscaling Experiment (CORDEX). The term "single levels" is used to express that the variables are 2...



CMIP6 predictions underpinning the C3S decadal prediction prototypes

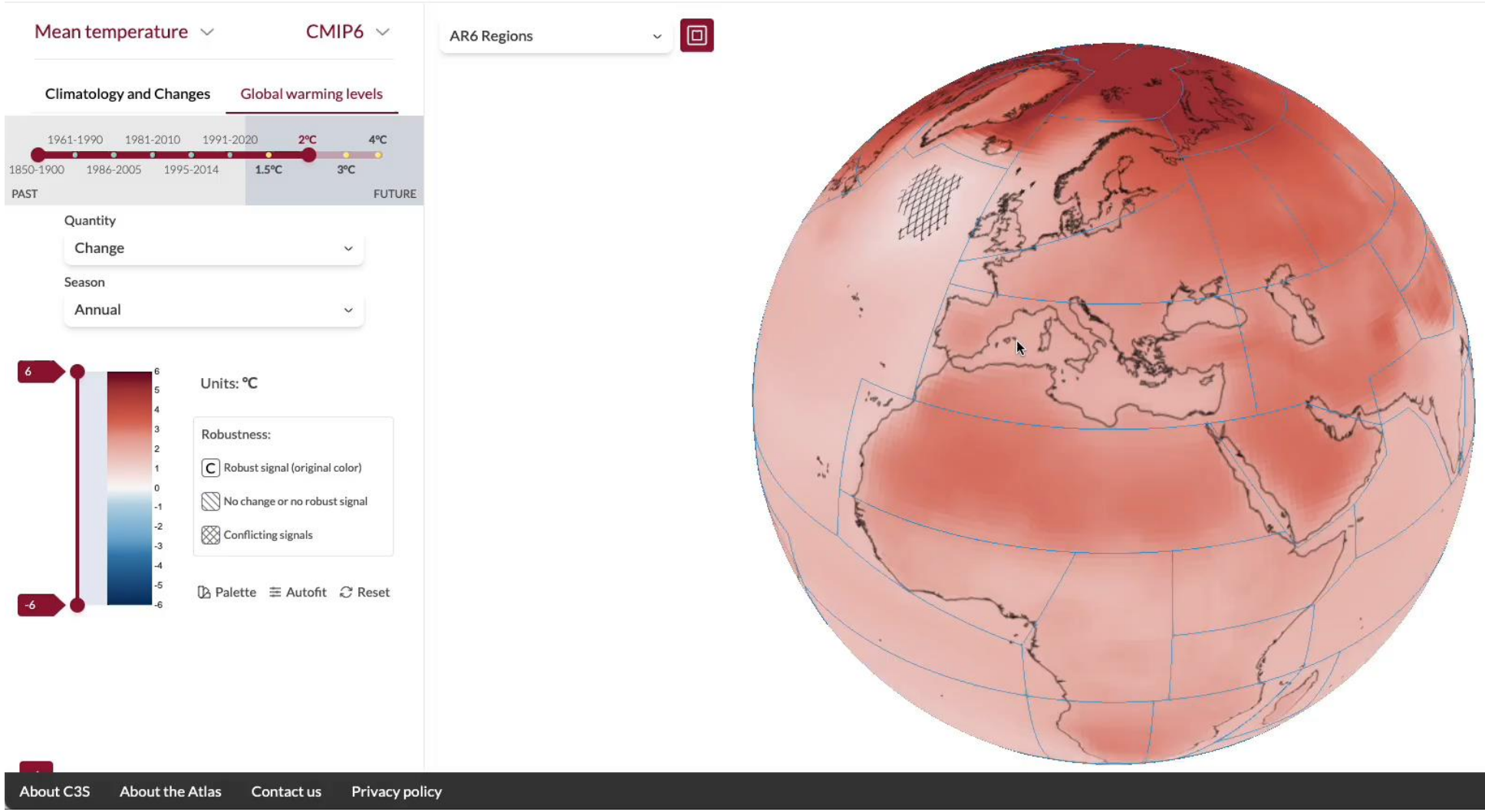
Dataset | Global | Atmosphere (surface) | Atmosphere (upper air) | Climate projections

This catalogue entry provides daily and monthly global climate model data from Decadal Climate Predictions Project (DCPP) experiments, part of the sixth phase of the Coupled Model Intercomparison Project (CMIP6). The decadal data in the Climate Data Store (CDS) are a quality-controlled subset of the full DCPP. CMIP6-DCPP data addresses the ability of the climate system to be predicted on annual, m...



Copernicus Interactive Climate Atlas

Mean temperature (°C) - CMIP6 - Change - Warming 2°C - Annual - rel. to 1850-1900

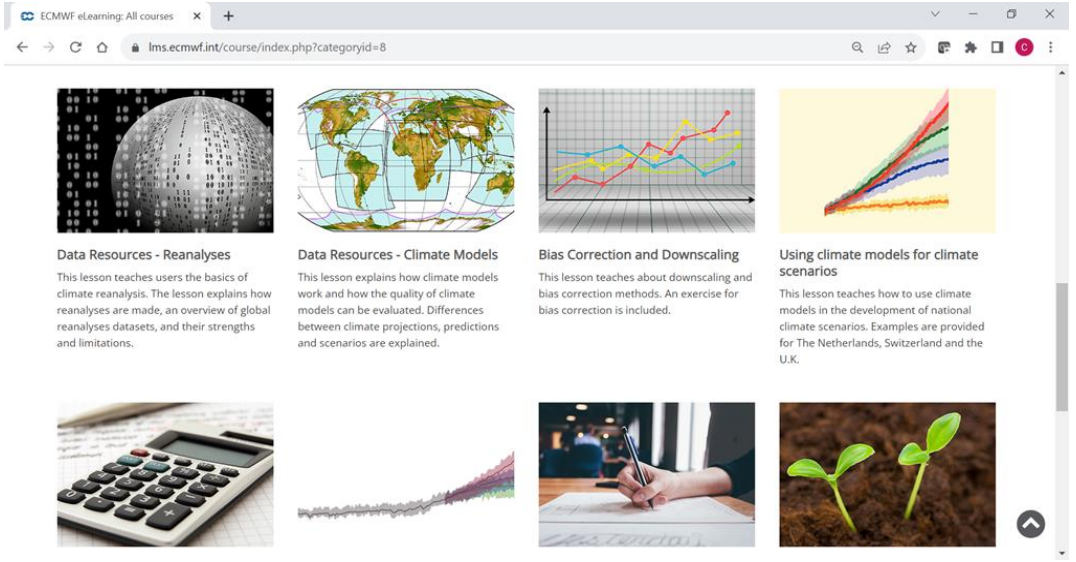


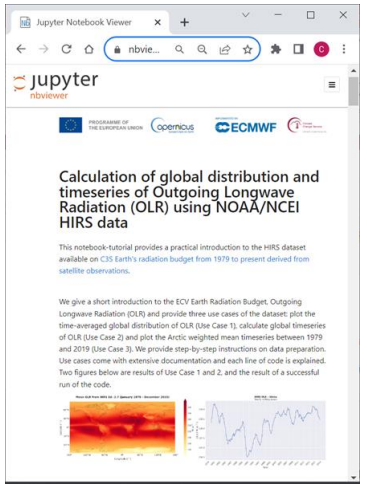
Climate
Change Service
climate.copernicus.eu

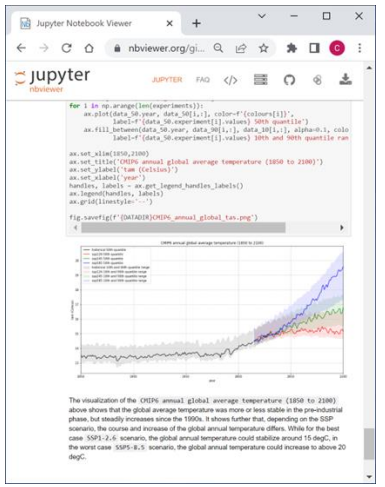
Interactions avec les utilisateurs et activités de formation

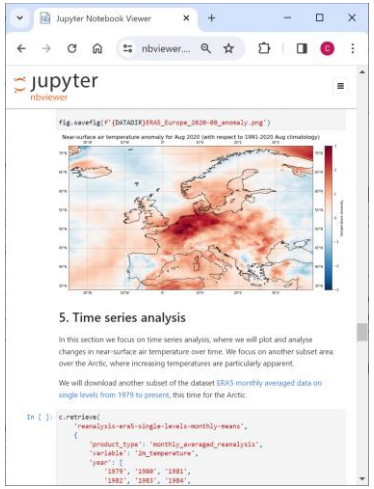
Activités de formation

- Contrat sur la formation (sessions, matériel)
  - Contract started Q1 2024
  - Training events (also in context of partnerships, NCP, core & other users)
  - Curation & development of learning resources (Jupyter, elearning)
- Appel à des formateurs avec des expertises spéciques
  - Launched Q3 2023
  - Trainer
  - Content Creator
  - Instructional Designer
- C3S Mini-MOOCs
  - RFP due for launch in Q1 2024
  - Series of short online courses on C3S relevant topics
  - Targeted to wider audience



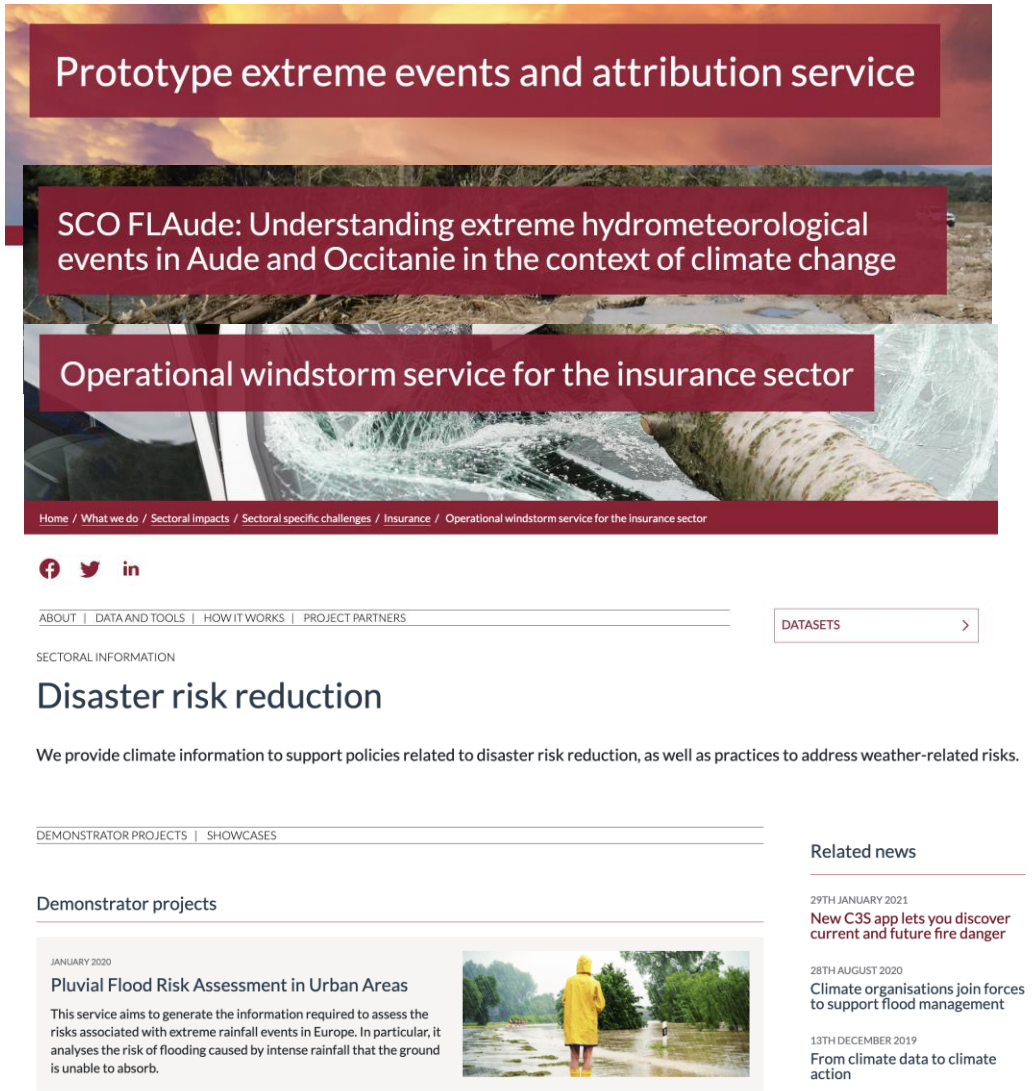






Conclusion et perspectives

Attribution: accès modulaire à l'information sur les évènements extrêmes



Accès opérationnel aux informations sur les événements extrêmes, notamment :

- Changements observés à long terme dans les évènements extrêmes et leur attribution
- Informations détaillées sur les types d'événements dans un climat en changement(par exemple, fiches d'information ou similaires)
- Augmenter le nombre d'outils dédiés pour l'analyse des événements extrêmes
- Etude de la cohérence avec les projections climatiques
- Suite quotidienne NRT similaire à la suite de bulletins mensuels (étendue/évoluée) C3S
- Mécanisme de déclenchement via l'Extreme Forecast Index (ou similaire)
- Adéquation des ensembles de données pour l'analyse des évènements extrêmes
- Renforcement des outils basés sur l'IA

Climate Change

Merci!

Vincent-Henri.Peuch@ecmwf.int
Carlo.Buontempo@ecmwf.int

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SAHARA AND SAHEL OBSERVATORY

GMES North Africa Consortium

GMES AND AFRICA

Earth Observation for the Sustainable Management of Water and Natural Resources in North Africa

Products and Services

Use cases on Copernicus data in Tunisia

28 mai, 2024

Evence Zoungrana

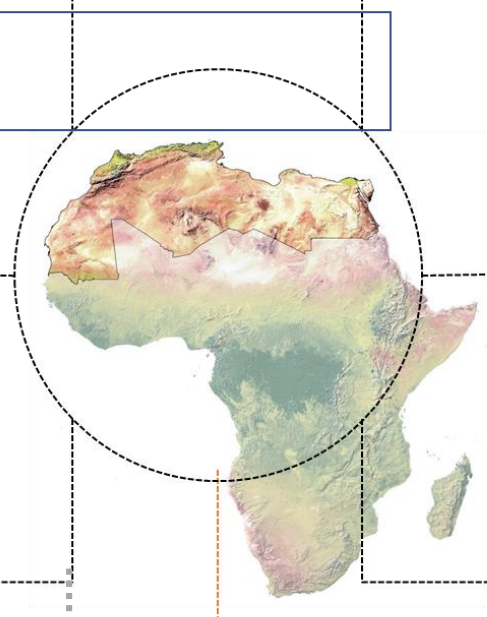
GMES Afrique du Nord : 1 Consortium & 1 projet régional

ONG Tenmiya

CRASTE-LF

Centre National de Cartographie et Télédétection

Observatoire du Sahara et du Sahel



Desert Research Center

Libyan Center for Remote Sensing and Space Sciences

Université de Nouakchott

CRTEAN

Earth Observation for the Sustainable Management of Water and Natural Resources in North Africa

GMES AND AFRICA

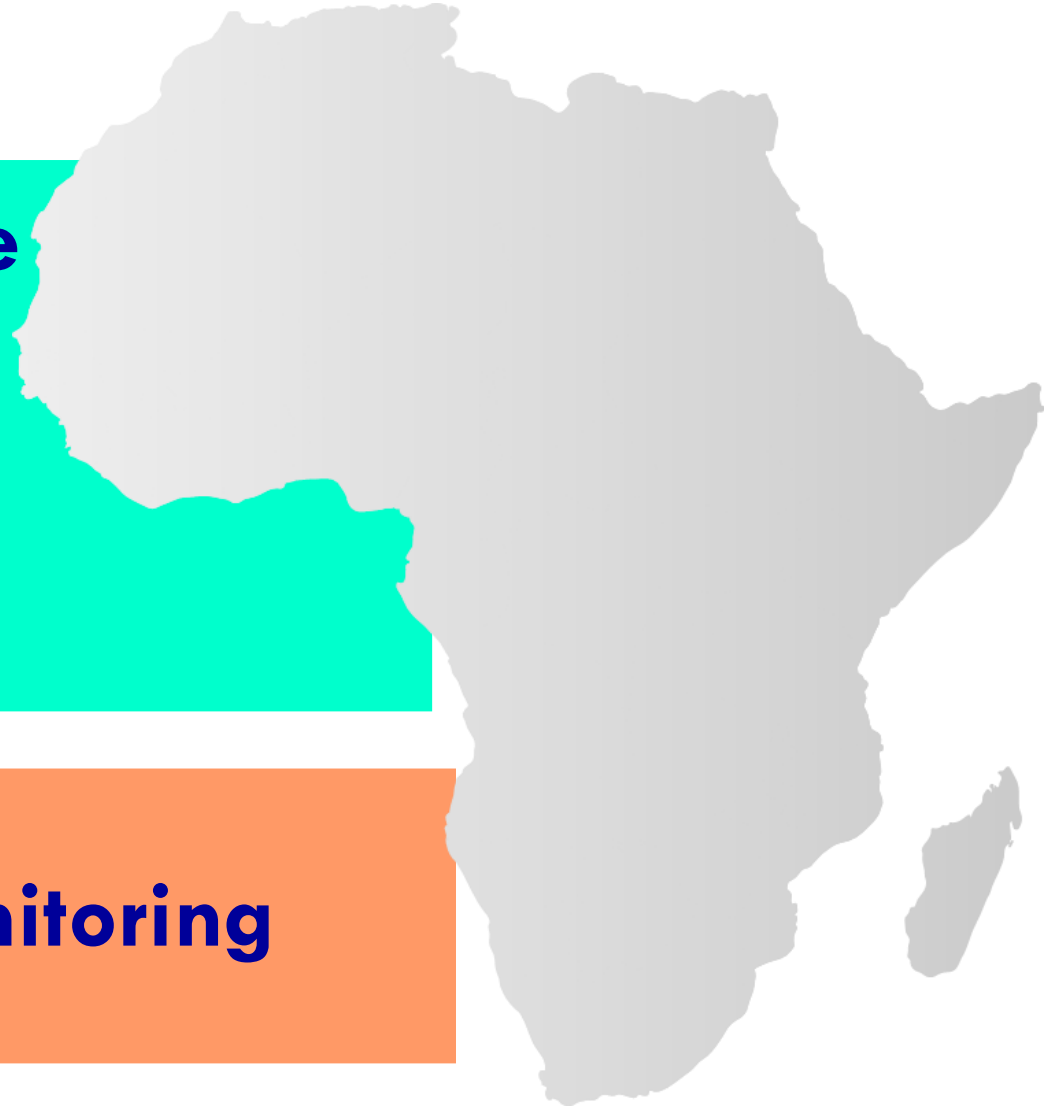
African Union

Sahara and Sahel Observatory

➔ 2 Services

Seasonal agriculture monitoring

Water abstraction assessment



Land degradation monitoring

Consolidation - Better operationalization - Appropriation & Uptake

Objectives of GMES & Africa

Contribute to a **more sustainable management** of **WNR** and tackling **climate change** based on **space science and technology** applications, mainly under **COPERNICUS**

Developing a framework fro promoting intra-African and Africa-Europe collaborating on open access data	Supporting the of WNR services and CMS operationalization to adequately provide information to policy makers, scientists, businesses and the public on real time basis	Strengthening regional and national capacities to generate and apply EO-based information	Raising public awareness on the critical role of EO systems and geospatial information in sustainable development

➔ Services : participatory approach

Past experiences of the partners

End-users needs assessment

North-Africa specific context

Data and kit of indicators on interested themes

Decision supports systems

Geo-services

End users involvement

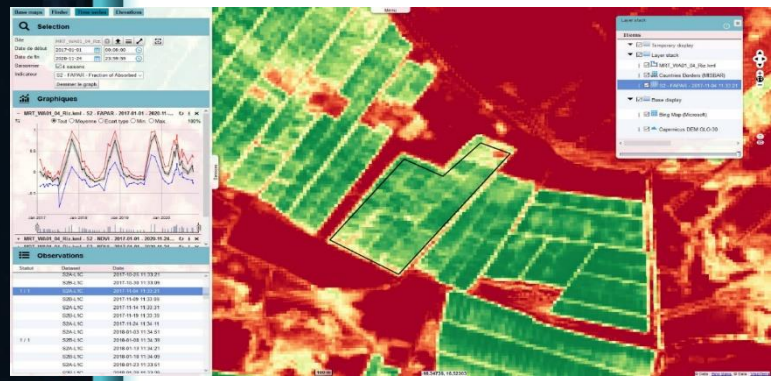
National partners

Information, indicators & data
to plan appropriate response

6 Plateformes + 1

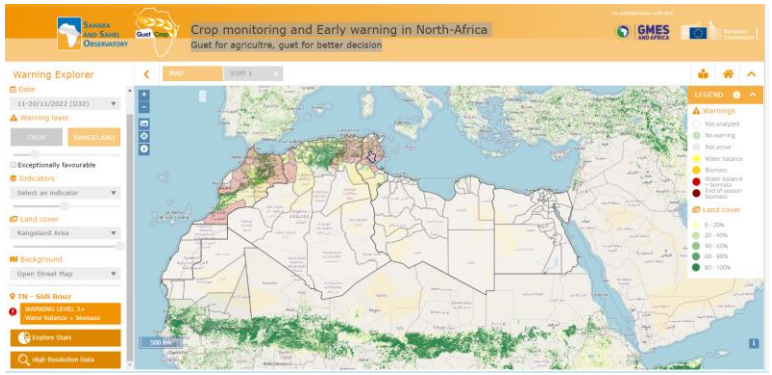
MISBAR

www.misbar.oss-online.org



GuetCrop

http://guetcrop.oss-online.org

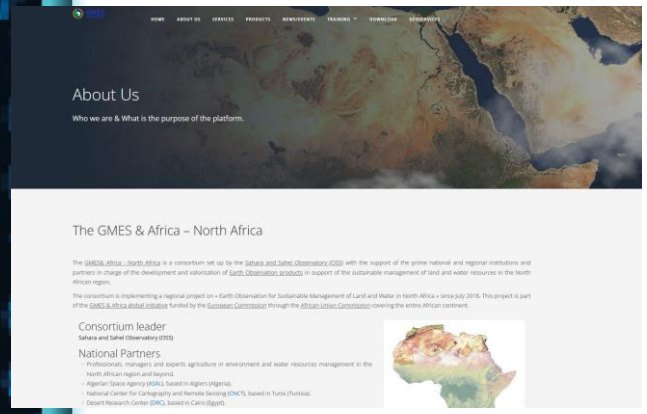


MISLAND

www.misland.oss-online.org

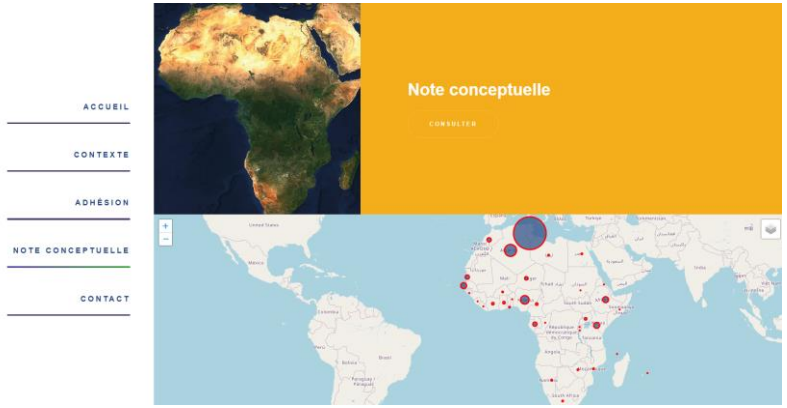
Dissemination platform

http://projet.oss-online.org/GMES-Africa



JIN platform

http://projet.oss-online.org/GMES-Africa/jin/



eLearning platform

https://www.crastelf-eacademie.com

Use cases

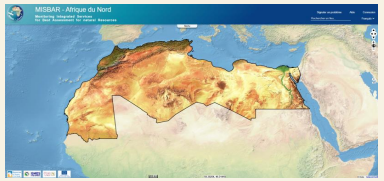
Tunisia

Use cases

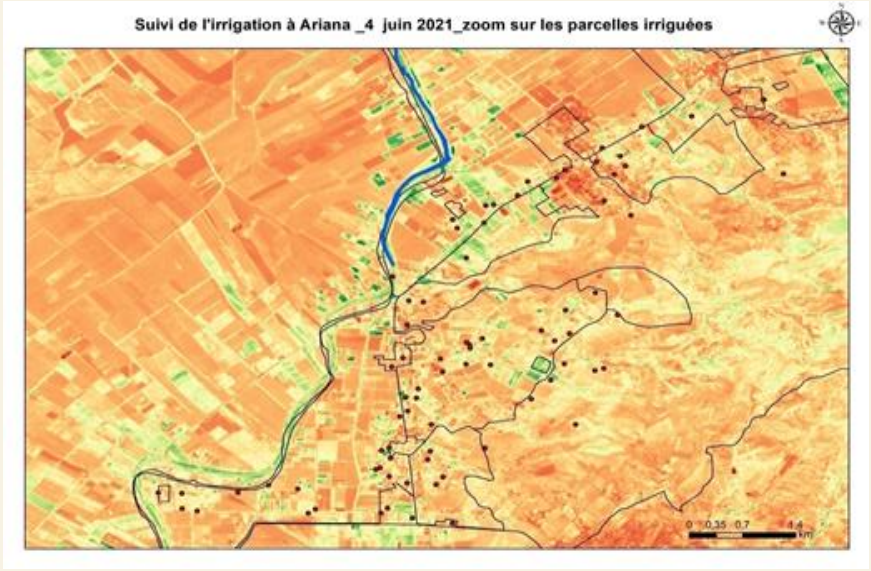
Use cases in Tunisia

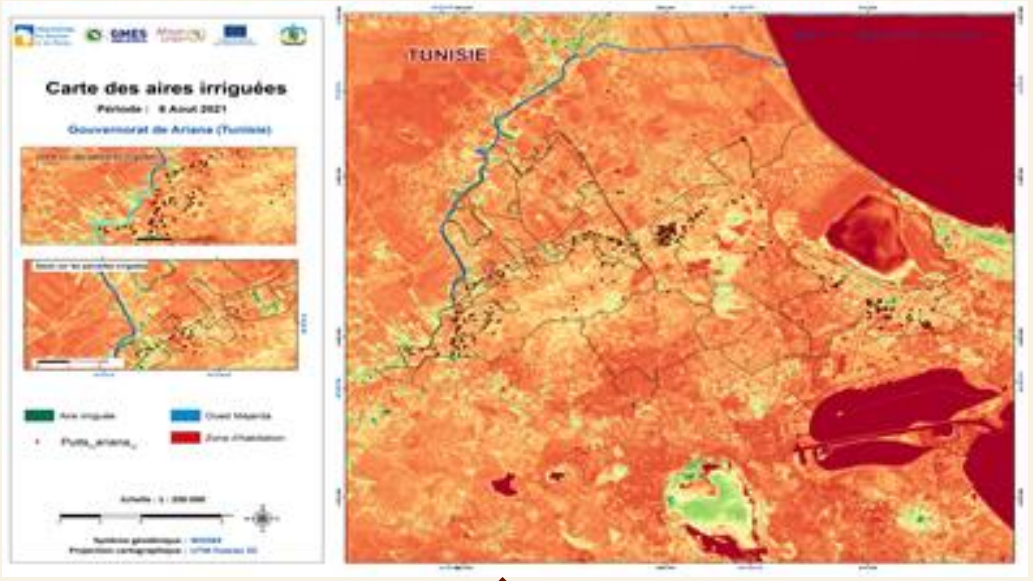
1. Monitoring of non-inventoried water pumping crops in Ariana

➔ Farmers are pumping water without any information regarding the volumes of water that are used ➔ Need to identify pumping site non-inventilated.



NDVI from **Sentinel-2** in MISBAR + authorized well location





Identification of the plots and people affected by unauthorized pumping

Next step

1. Identification of water leaks in the irrigation network
2. Estimated cultivated area
3. Hydromorphy and salinization of irrigated perimeters

Use cases

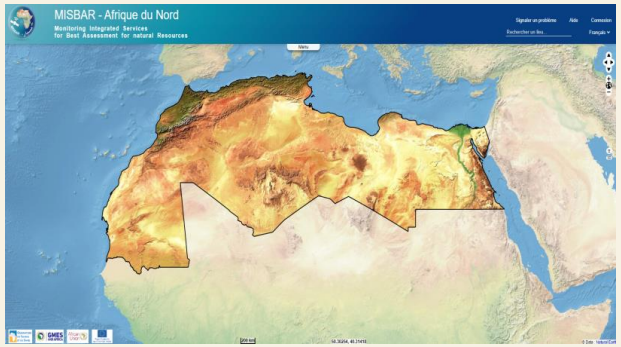
Use cases in Tunisia

2. Monitoring burned areas in Bizerte and Jendouba

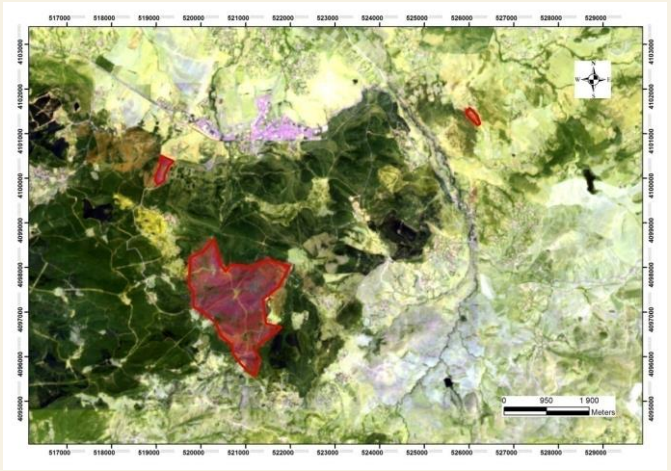
➔In the north African region, there are often a lot of forest fires in summer.

➔ Need to identify determining exactly how much forest area has been burnt.

Identification and estimation of the burned area



Sentinel-2 data preparation + selection burned area style



Burned area in Bizerte

Burned area in Jendouba

GMES AND AFRICA

SAHARA AND SAHEL OBSERVATORY

African Union

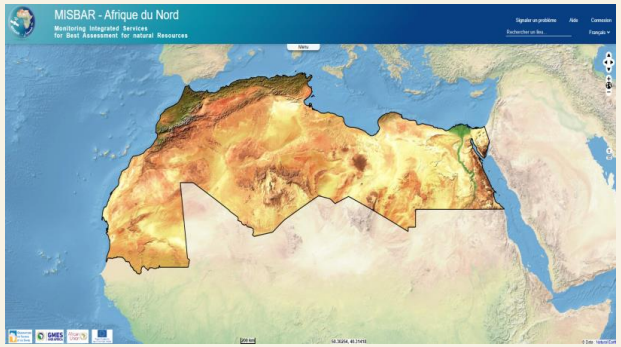
Use cases

Use cases in Tunisia

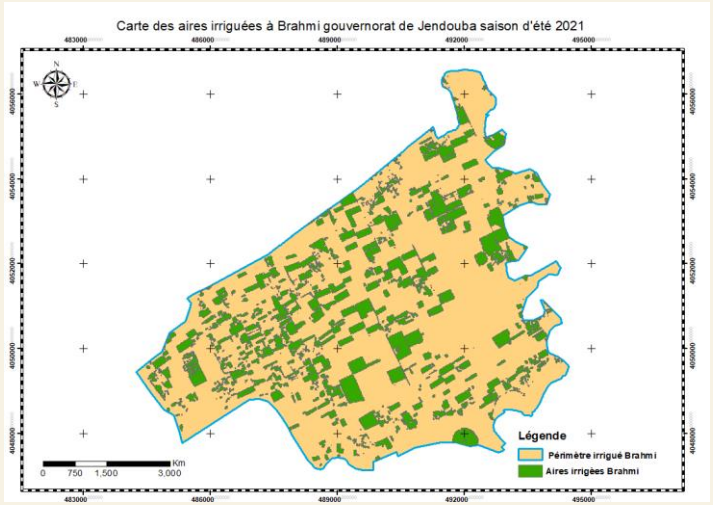
3. Monitoring the crop intensification rate in the irrigated areas : Jendouba and Nabeul

➔ Technicians responsible for monitoring irrigated areas want to know the rate of crop intensification in irrigated areas.

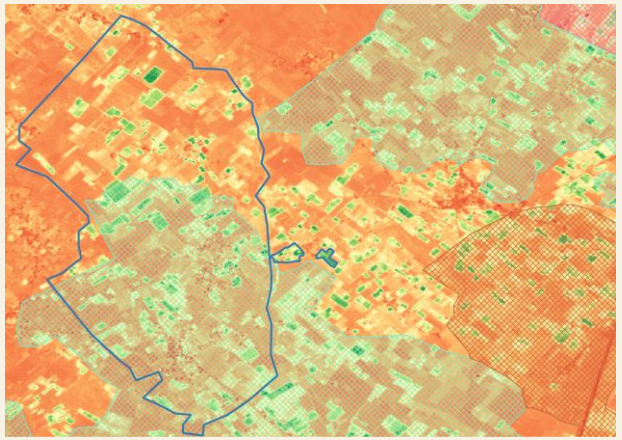
Determination of crop intensification rates in the irrigated areas



NDVI from **Sentinel-2** MISBAR + delimitation of irrigated area



Brahmi irrigated area in Jendouba



Irrigated area in Nabeul

GMES AND AFRICA

SAHARA AND SAHEL OBSERVATORY

African Union

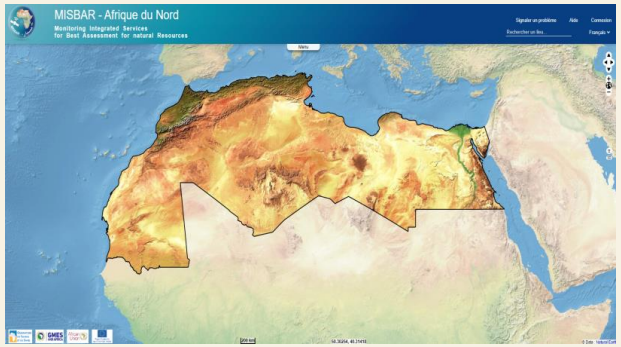
Use cases

Use cases in Tunisia

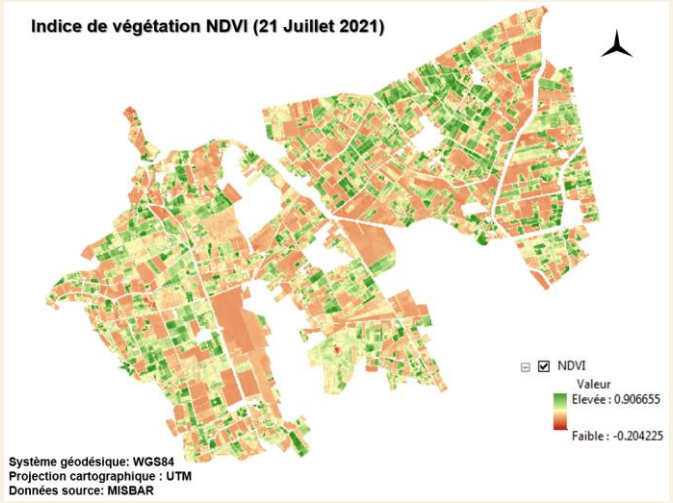
4. The assessment of plants' theoretical water requirements : Manouba

➔ Need to identify the theoretical water requirement at the level of a region ➔ Technicians want to assess the potential of spatial remote sensing for irrigation management.

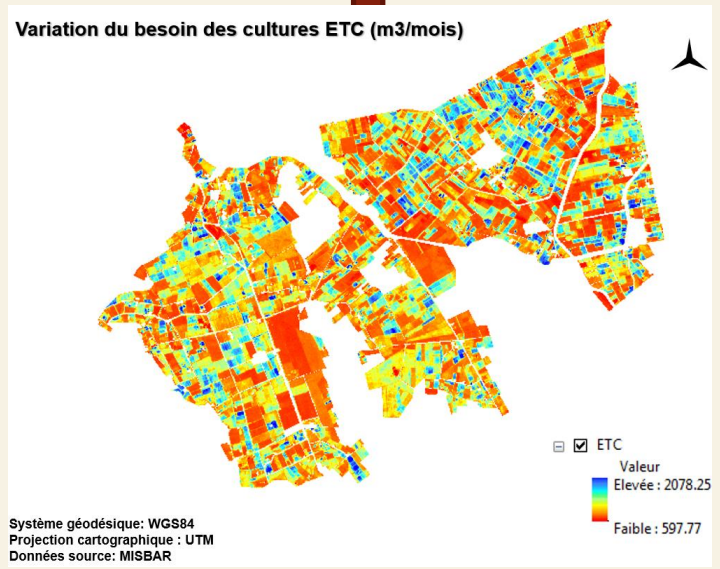
Theoretical water consumption maps enable the irrigation manager to provide the right dose at the right time for the various crops irrigated.



Sentinel-2 NDVI from MISBAR + delimitation of irrigated area



NDVI of the irrigated area



Plants' theoritical water requirements

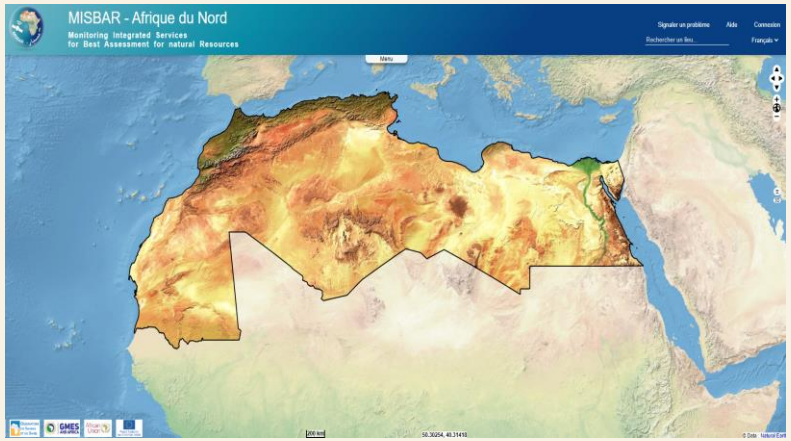
Use cases

Use cases in Tunisia

4. Mapping and estimation of wheat crop areas in Jendouba and Kairouan

➔There is a need to identify the wheat crop areas, monitor crop growth condition and its Phenology, and get input data for in support to yield estimate.

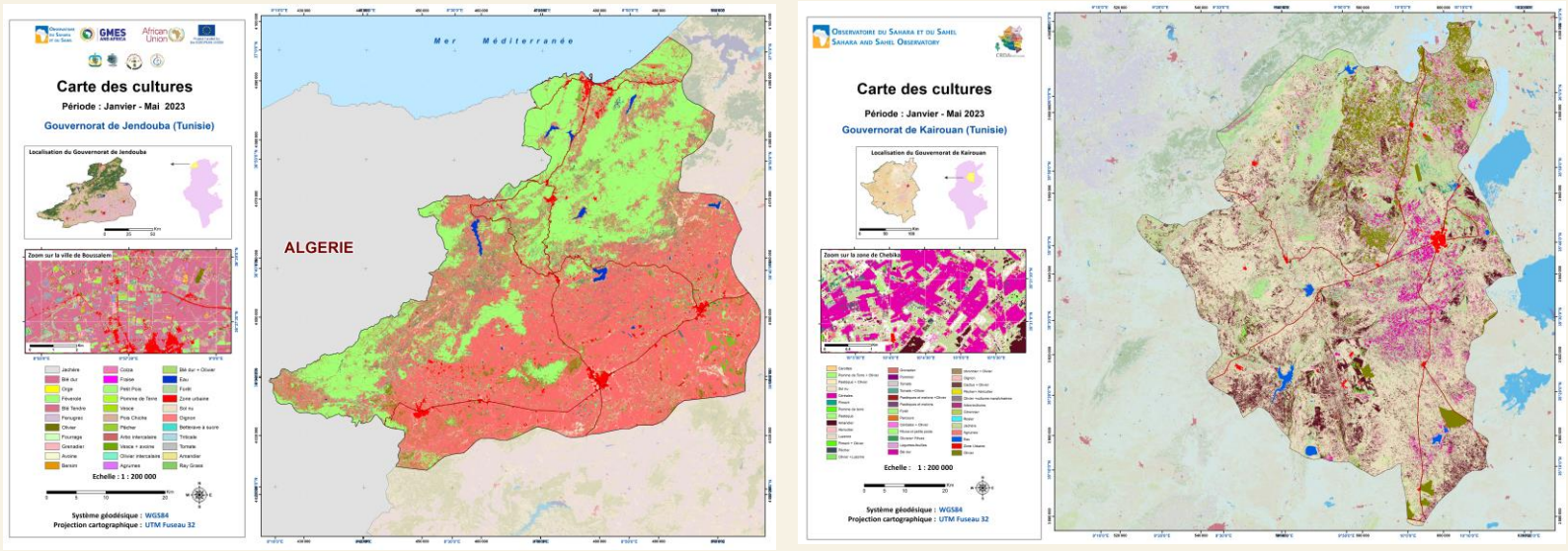
Requests from the 2 CRDA
Field data provided based on the campaigns done by the two CRDA



MISBAR for satellite data acquisition (**Sentinel-2**)

Jendouba

Kairouan



Spatial distribution of crops grown during the period January 2023 - May 2023

Thanks
for your attention

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