C3S: El Servicio de Cambio Climático de Copernicus

Climate Change

Joaquín Muñoz Sabater
European Centre for Medium-Range Weather Forecasts (ECMWF)

February 2022

Copernicus
Europe's eyes on Earth

European Commission | ECMWF

@j_munoz_sabater
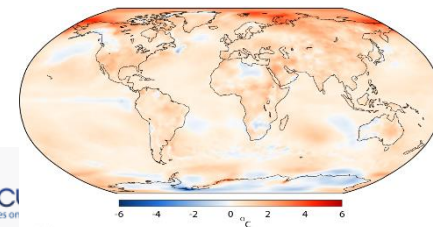
Climate Change

¿ Qué ofrece el Servicio Europeo de Cambio Climático (C3S) ?

¿ Cuáles son los productos más populares al servicio del usuario ?

¿Cómo acceder a los productos de C3S y qué herramientas de apoyo existen ?

¿ Para qué sirven los Sistemas de Información Sectorial (SIS) ?

¿ Algún otro componente en C3S ?

Abierto, completo, gratuito

Sentinels

In Situ

CLIMATE CHANGE

MARINE MONITORING.

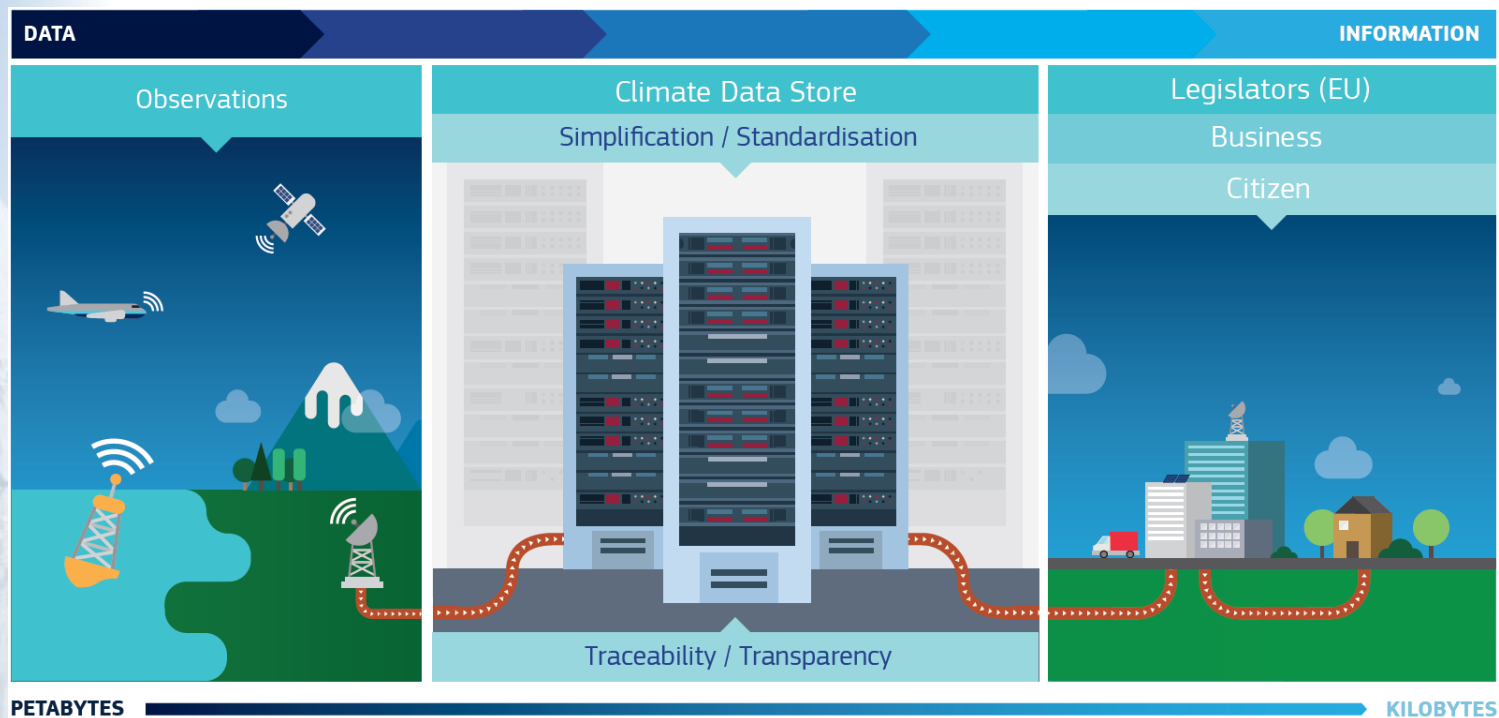ATMOSPHERE MONITORING

LAND MONITORING

SECURITY

EMERGENCY MANAGEMENT

1st MFF (2014-2020): ~ 4300 M€
2nd MFF (2021-2027): ~ 5420 M€

What is the Copernicus Climate Change Service (C3S)?

Climate Change

DATA		INFORMATION

Observations

Climate Data Store
Simplification / Standardisation
Traceability / Transparency

Legislators (EU)
Business
Citizen

PETABYTES — KILOBYTES

authoritative quality-controlled data and information based on Earth Observation about the past, present and future climate;

tools to inform climate change mitigation and adaptation strategies by policy makers and businesses;

examples of best practice in the use of climate information.

Copernicus
Europe's eyes on Earth

European Commission

ECMWF

Climate
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Temas tratados en el servicio:

- ❏ Cómo está cambiando el clima?
  - ❏ Observaciones de la Tierra
  - ❏ Reanálisis
- ❏ Continuará/se acelerará el cambio climático?
  - ❏ Predicciones
  - ❏ Proyecciones
- ❏ Cuáles son los impactos en la sociedad?
  - • Indicadores del clima
  - • Información sectorial

One View of Future Energy Consumption World Total
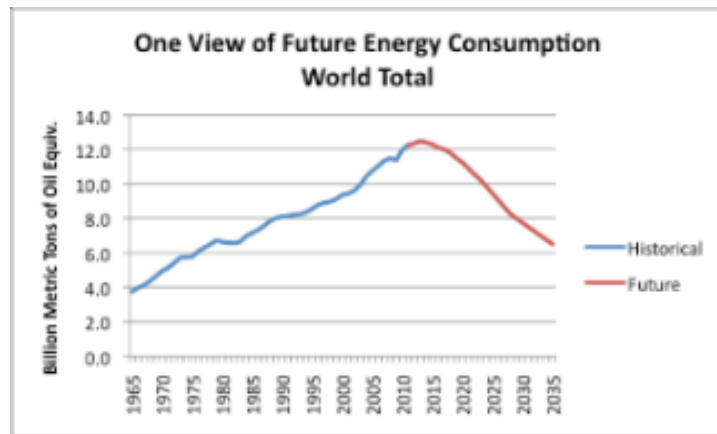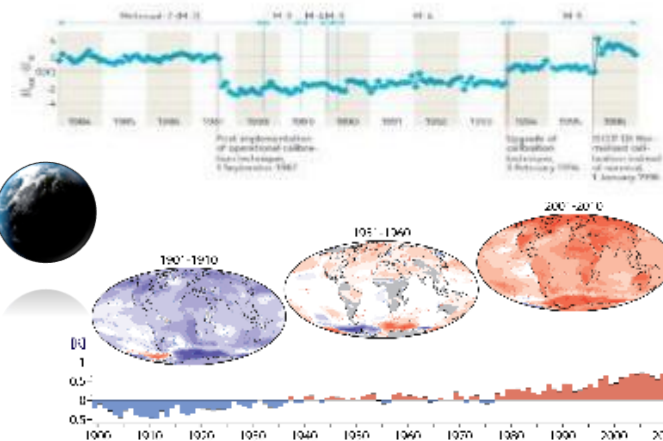
Climate Change

Evaluación & Control Calidad

Garantía de calidad
Integridad del Servicio
Necesidades de usuarios

European commission e.g.,FP7 Space call, H2020

EU estados miembros, ESA, EUMETSAT, EEA, WMO..

Divulgación & difusión

Climate Data Store

Sistemas de Información Sectorial
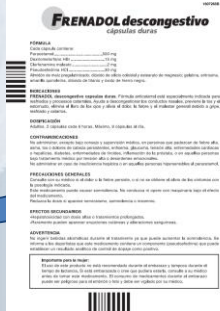
ENERGY WATER MANAGEMENT INSURANCE AGRICULTURE & FORESTRY INFRASTRUCTURE

Usuarios & stakeholders

Climate
Change

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IWF
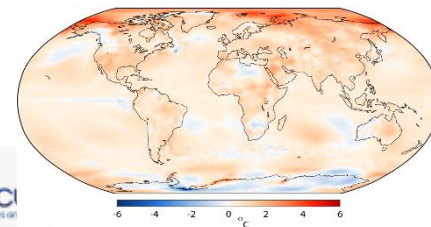
Climate
Change

Florence Thu 13 Sep 2018, 01 UTC for ERA-Interim

Florence Thu 13 Sep 2018, 01 UTC for ERA5

ERA5 HRES — Monthly mean anomalies wrt. 1981-2010 - Global — Temperature (K)

1950 – 1979
Preliminary (published end 2020)

1979 – present
Complete. NRT stream runs RT – 1 day
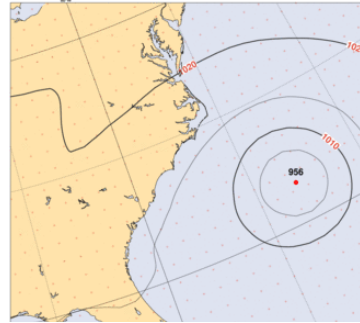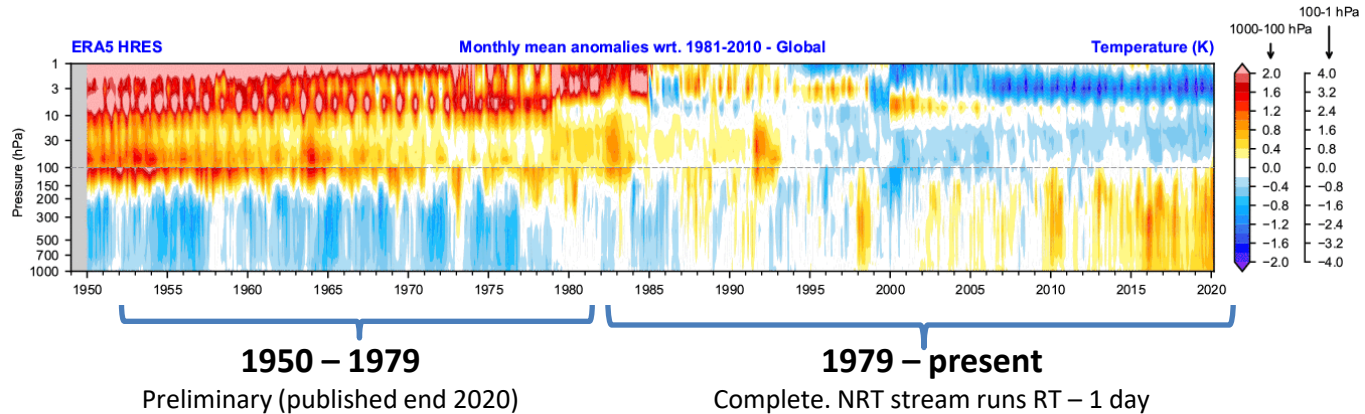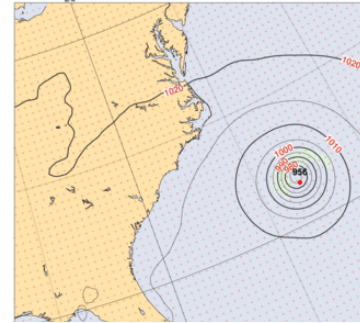
Hersbach et al., 2020 (Quart. J. Roy. Met. Soc.)

Climate
Change

orography
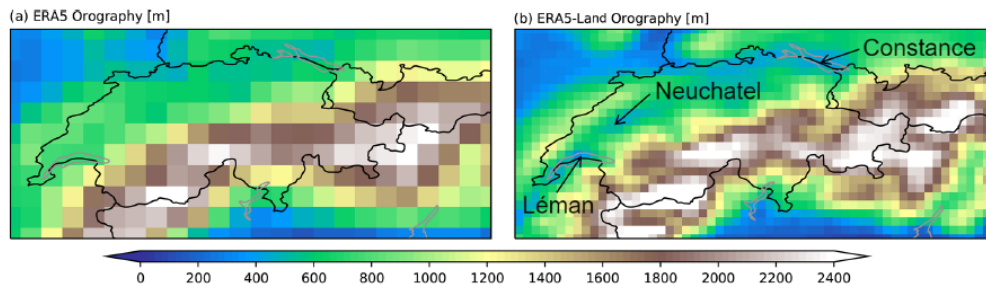
**Soil Temperature
(15 July 2018
06UTC)**

**Soil Temperature
(15 July 2018
15UTC)**

(a) ERA5 Orography [m]

(b) ERA5-Land Orography [m]

Constance

Neuchatel

Léman

(c) ERA5 LST 2018-07-15 06UTC [°C]

(d) ERA5-Land LST 2018-07-15 06UTC [°C]

(e) ERA5 LST 2018-07-15 15UTC [°C]
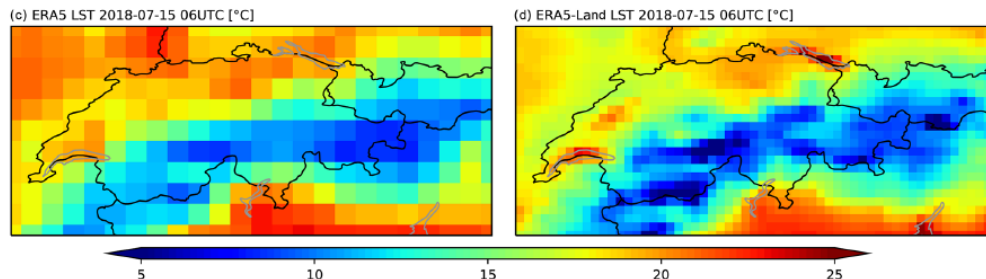
(f) ERA5-Land LST 2018-07-15 15UTC [°C]
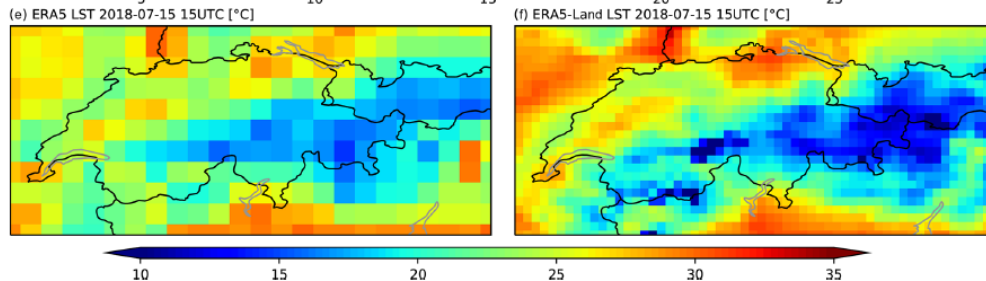
Muñoz-Sabater et al., 2021 (Earth Syst. Sc. Data)

Essential Climate Variables

We use historical observations from in-situ and satellite sensors to build **Climate Data Records of Essential Climate Variables (ECVs)**

Required to support the work of the UNFCCC and the IPCC

In total 54 ECVs

CO_2

Climate Change

	GCOS	2017	2018	2019	2020	2021	2022	2023	2024
		C3S_312a							
			C3S_312b						
							C3S2_312		
Atmospheric physics									
Precipitation	4.3.5								
Surface Radiation Budget	4.3.6			Lot 1			Atmospheric Physics		
Water Vapour	4.5.3								
Cloud Properties	4.5.4								
Earth Radiation Budget	4.5.5								
Atmospheric composition									
Carbon Dioxide	4.7.1	Lot 6					Atmospheric Composition		
Methane	4.7.2	Lot 6		Lot 2					
Ozone	4.7.4	Lot 4							
Aerosol	4.7.5	Lot 5							
Ocean									
Sea Surface Temperature	5.3.1	Lot 3					Ocean		
Sea Level	5.3.3	Lot 2		Lot 3					
Sea ice	5.3.5	Lot 1							
Ocean Colour	5.3.7								
Land hydrology & cryosphere									
Lakes	6.3.4								
Glaciers	6.3.6	Lot 8		Lot 4			Land Hydrology & Cryosphere		
Ice sheets and ice shelves	6.3.7								
Soil moisture	6.3.16	Lot 7							
Land biosphere									
Albedo	6.3.9	Lot 9							
Land Cover	6.3.10			Lot 5			Land Biosphere		
Fraction of Absorbed Photosynthe	6.3.11	Lot 9							
Leaf Area Index	6.3.12	Lot 9							
Fire	6.3.15								
		2019	2018	2019	2020	2021	2022	2023	2024

Table 1: From proof-of-concept phase (9 Lots) to operations (5 Lots) of C3S ECV services. The column labelled GCOS shows the relevant section in the GCOS Status Report (GCOS-SR 2015).

Coordination with CM-SAF / ROM SAF / ESA CCI / Uni. Maryland / NASA / NOAA

Coordination with ESA-CCI and other national projects

Coordination with ESA-CCI

Coordination with ESA-CCI, GloboLakes, Arc-Lake, HydroWeb
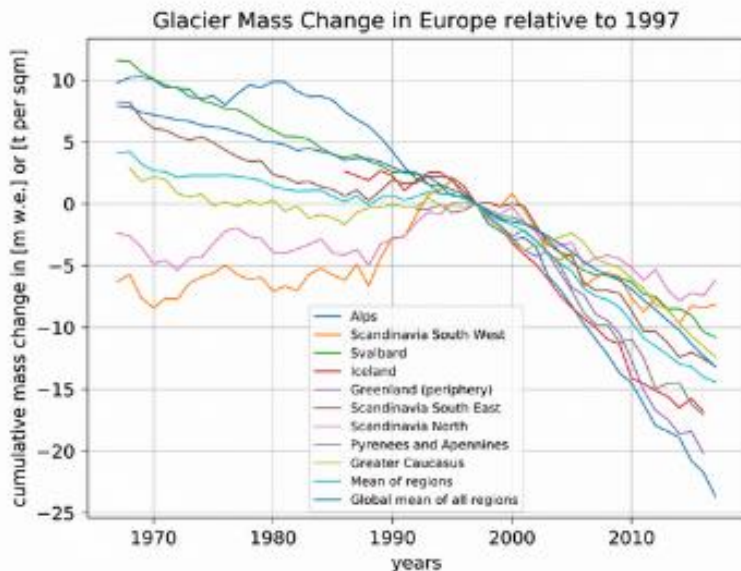
Coordination with ESA-CCI, CGL, QA4ECV, LSA-SAF

https://cds.climate.copernicus.eu/#!/search?text=satellite

European Commission

ECMWF

Glacier Mass Change in Europe relative to 1997

Cumulative glacier mass changes in Europe from 1967-2017 for glaciers with long-term records in nine different regions. Cumulative mass balance values are given in the unit 'metre water equivalent (m w.e.)' relative to 1997. Data source: WGMS (2017, updated), Credit: WGMS /Copernicus Climate Change Service

Media global:
- Más de 20m de pérdida del grosor de hielo desde 1960s

Europe:
- La pérdida de hielo de los glaciares basada en observaciones varía entre los 2m en el sudoeste de Escandinavia a 34m en los Alpes

C3S multi-system seasonal forecast
Mean forecast SST anomaly
Nominal forecast start: 01/01/22
Variance-standardized mean

ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCC
FMA 2022
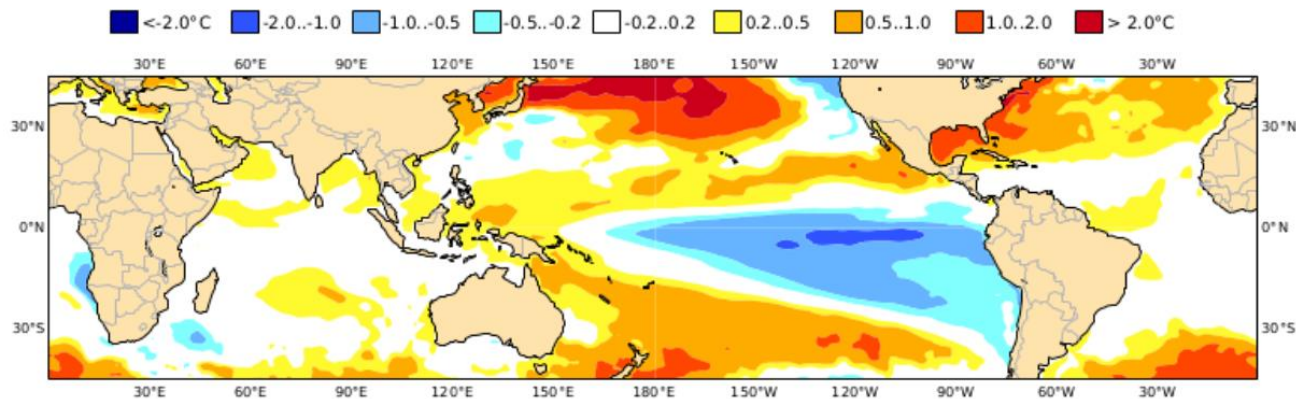
- Data – from world-leading producers
- Operational schedule – released monthly (12th of the month)
- Tools and computational environment

Free and open access to all these resources

Climate
Change

- **CMIP5 simulations:** in the Climate Data Store (CDS) since 2018

- **CMIP6 simulations:** published in CDS in March 2021
  - **New functionality** to improve handling of data **web-processing services**

- **World-wide CORDEX simulations:** European region in the CDS since 2019; continual update with data for other regions

Domain ⑦

At least one selection must be made

- ○ Africa
- ○ Australasia
- ○ East Asia
- ○ Middle East and North Africa
- ○ South-East Asia

- ○ Antarctic
- ○ Central America
- ○ Europe
- ○ North America
- ○ South Asia

- ○ Arctic
- ○ Central Asia
- ○ Mediterranean
- ○ South America
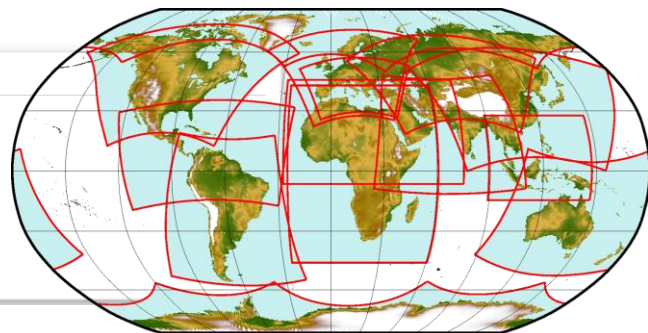
IMPLEMENTED BY

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¿ Qué ofrece el Servicio Europeo de Cambio Climático (C3S) ?

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IWF

Climate Change

116,000 + users

https://cds.climate.copernicus.eu

The **Climate Data Store** also called CDS, is **an online open and free service**.

It allows users to browse and access the wide range of climate datasets via a searchable catalogue…

… It allows users to build their own applications, maps and graphs

… a n d   a   c o n s i s t e n t   a n d   s i m p l e   m e t a (d a t a)   a c c e s s

Download form

Overview

EQC Information

*Coming very soon
(still under validation)*

Documentation

… and a consistent and simple meta(data) access

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Download form

Overview

EQC Information

Documentation

Climate Change

```
□ 07          □ 08          ☑ 09
□ 13          □ 14          □ 15
□ 19          □ 20          □ 21
□ 25          □ 26          □ 27
□ 31
```

Format ⑦

🔘 Zip file (.zip)

Terms of use

✔ GHG-CCI Licence   View terms

[Hide API request] [Show Toolbox request]

Please go to the documentation page for information as to how to use the search...

```python
import cdsapi

c = cdsapi.Client()

c.retrieve(
    'satellite-methane',
    {
        'format':'zip',
        'processing_level':'level_2',
        'variable':'xch4',
        'sensor_and_algorithm':'sciamachy_wfmd',
        'year':'2004',
        'month':'03',
        'day':'09'
    },
    'download.zip')
```

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import cdsapi

c = cdsapi.Client()

c.retrieve(
    'satellite-methane',
    {
        'format': 'zip',
        'processing_level': 'level_2',
        'variable': 'xch4',
        'sensor_and_algorithm': 'sciamachy_wfmd',
        'year': '2004',
        'month': '03',
        'day': '09'
    },
    'download.zip')
```

pip install cdsapi

https://cds.climate.copernicus.eu/api-how-to

ECMWF

… with a workflow editor

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CDS Toolbox editor

Python based workflows

Climate Change

Fast Toolbox application development in the COVID-19 crisis context
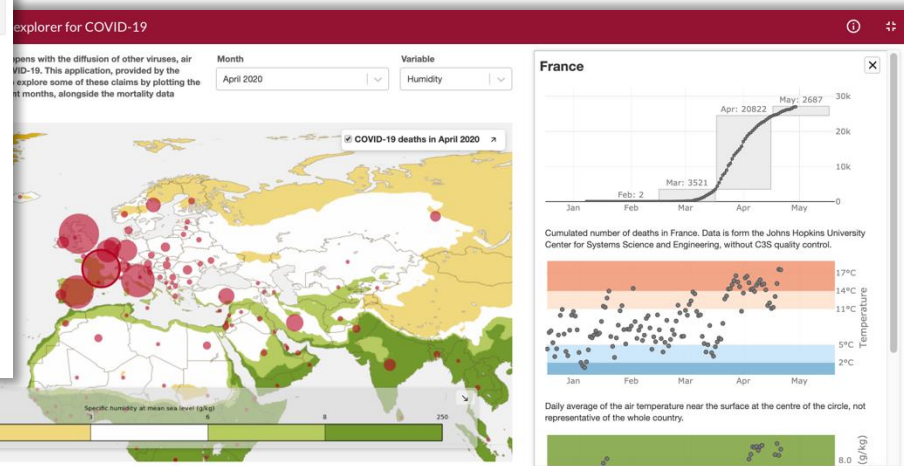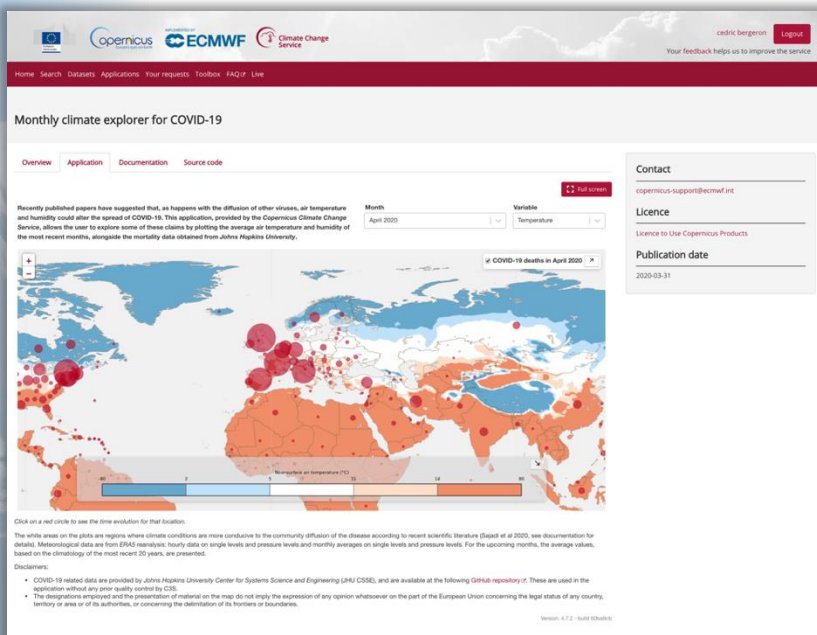
Improved visualisation tools and caching system
(for a very fast response time)

Climate Change

Home Search Datasets Applications Toolbox Support Live

Global temperature trend monitor

Overview Application Documentation Source code

How close are we to reaching a global warming of 1.5°C?

Reaching 1.5°C of global warming - a limit agreed under the Paris agreement - may feel like a very distant reality, but it might be closer than you think. Experts suggest it is likely to happen between 2030 and the early 2050s. See where we are now and how soon we would reach the limit if the warming continued at today's pace. **Use the slider to explore how the estimate changes in time.**

Global warming reached an estimated **1.20°C** in August 2021.
If the 30-year warming trend leading up to then continued,
global warming would reach **1.5°C** by **January 2034**.

January 2034

August 2021

2°C
1.5°C
1.20°C
1°C
0.5°C
0°C

1970   1980   1990   2000   2010   2020   2030   2040   2050   2060
Generated using Copernicus Climate Change Service information 2021.

2000   2003   2006   2009   2012   2015   2018   Sep 2020   Dec 2020   Mar 2021   Jun 2021

— Temperature trend   — Observed temperature change since pre-industrial times
— IPCC "likely" estimate   IPCC projections

In this application:

- "Global warming" at a point in time refers to the increase in a 30-year average, centred on the specified time, of Earth's global surface temperature relative to the pre-industrial period;
- "Reaching the limit" refers to the moment when the central time of the 30-year average temperature equals 1.5°C above pre-industrial values;
- "Pre-industrial values" refers to the approximation of the surface air temperature of this era from the IPCC 'Global warming of 1.5°C' report.

Datasets explorers

for a city to discover a range of local climate statistics for the period 1979-

on ECMWF atmospheric reanalysis of the global climate. Inspired by Lobelia's Past Climate Explorer.

Search...

○ Average wind speed (ms⁻¹)
● Average annual precipitation tot...
○ Average temperature (°C)
☑ States and provinces*
☑ Country boundaries*

Castello

Valencia

Average annual precipitation total (mm)
1000   1250   1500   1750   2000   2250   2500   2750   > 3000

Alicante
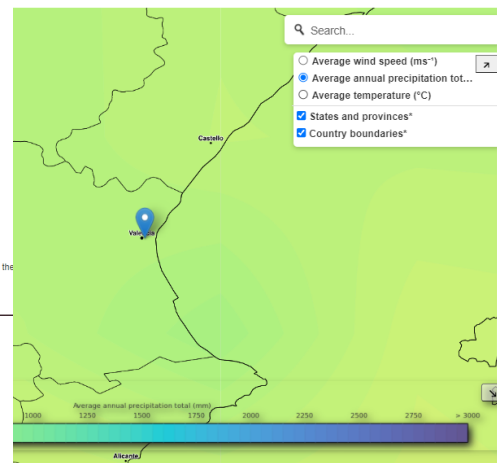
aterial on the map do not imply the expression of any opinion whatsoever on the part of the European Union area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Position: 39.48°N, 0.39°W   ✕

Temporal aggregation   Variable
Annual   ▼   Temperature anomaly   ▼

Warming stripes provide an at-a-glance view of yearly temperature trends in Valencia for the period 1979-2020.
The colour of each stripe represents the **temperature anomaly** for a given year, or how much warmer (red) or colder (blue) that year was relative to the **long-term reference** period of 1981-2010.
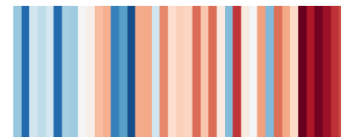
Warming stripes inspired by #ShowYourStripes

Version: 4.30.0 - build bcc7983

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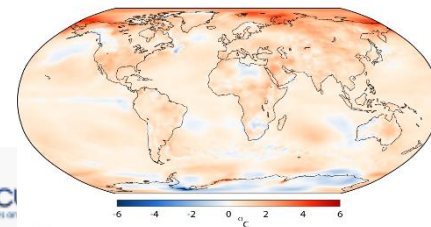
Climate
Change

Agriculture

Insurance

Biodiversity

Shipping

Coastal areas

Storm surges

Energy

Tourism

Health

Water management

Infrastructure

USERS

CLIMATE
DATA STORE

Benchmarks of
good practice

Quality
assured
data
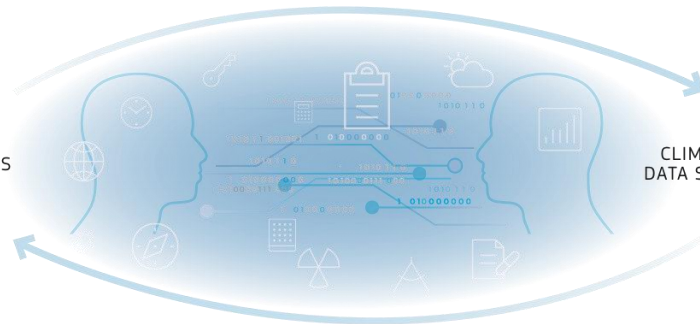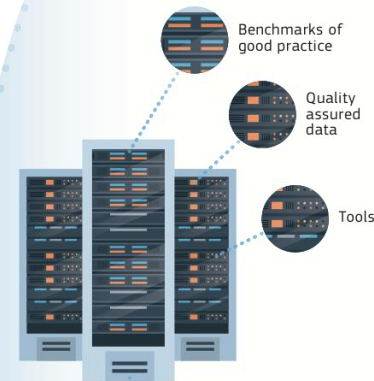
Tools

PRACTICAL EXAMPLES

Documentation

Tools and
applications

Case studies

Sector
relevant
data

ECMWF Copernicus
Europe's eyes on Earth

European
Commission

Climate
Change

The service chain produces climate knowledge relevant for supporting adaptation strategies in different sectors

Infrastructure, Transport and Associated Standards

Biodiversity

Energy

Disaster risk reduction

Health

Water management

Insurance

Coastal areas

Agriculture and forestry

Tourism

https://climate.copernicus.eu/sectoral-specific-challenges

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Climate change impacts on the biodiversity of Tropical Ecosystems

- Los objetivos de desarrollo de Costa Rica están muy ligados a la biodiversidad, energías alternativas y agua.
- Información climática de calidad es escasa y por tanto el apoyo a politicas futuras de adaptación al cambio climático es un desafío.
- ¿Se puede proporcionar información climática adaptada al territorio e indicadores de biodiversidad relevantes proyectados en el futuro para la protección de los habitats naturales?

Resultados potenciales: Los resultados finales podrian ayudar las autoridades nacionales a la mejor gestion de areas protegidas y el establecimiento de corredores biológicos (areas sensibles al clima)

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Methodology

- global data (GCM and GCM-CMIP5 ensemble bias-corrected to Hydro-GFD at 50km)
- Local station data

Land-use based biodiversity indicators were calculated for the national bio-corridor program

Land-use based biodiversity indicators were calculated for the national bio-corridor program

STEP1
Data download

STEP2
Production of climatologies

STEP3
Calculation of land-use based indicators

STEP4
Calculation of biodiversity indicators

STEP5
Merging of indicators and projection

Ongoing (every 2-3 months):
Quality control and client meetings

Precipitation & temperature based on local interpolated station data

National Holdridge Life Zone (HLZ) ecosystem classification as a biodiversity indicator

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ECMWF
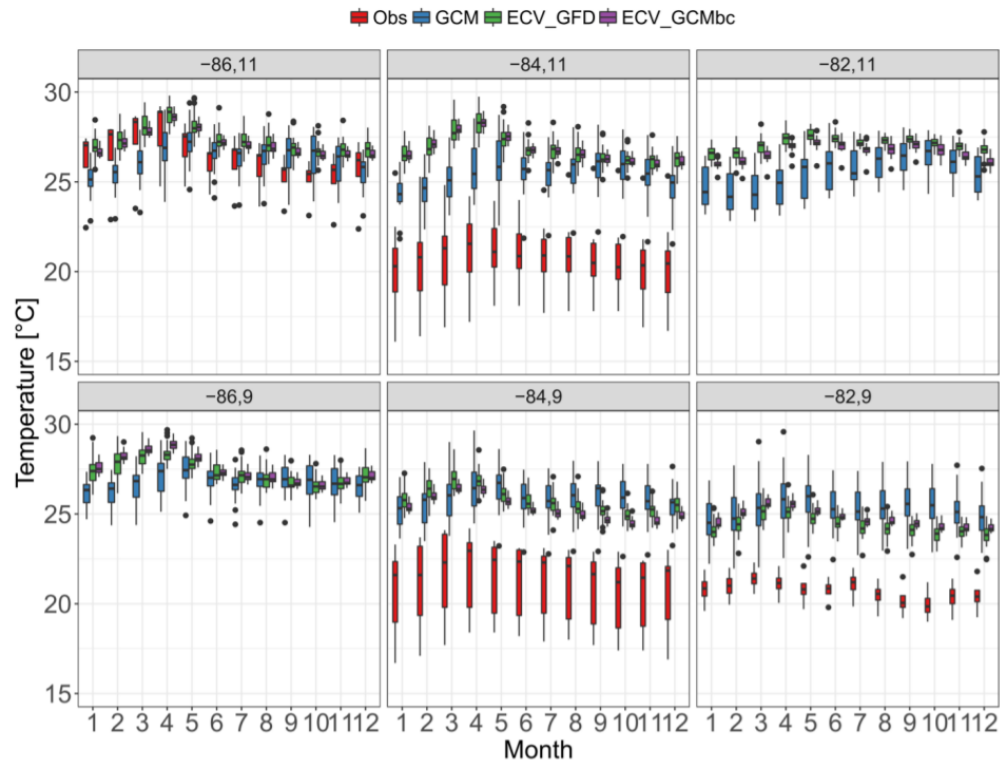
Climate
Change

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Climate
Change

Methodology

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Data download

STEP2
Production of
climatologies

Precipitation &
temperature based
on local interpolated
station data

Mean annual temperature (°C)

	<= 8		16 - 18
	8 - 10		18 - 20
	10 - 12		20 - 22
	12 - 14		22 - 24
	14 - 16		> 24

Mean annual precipitation (mm)

	<= 2000		5000 - 6000
	2000 - 3000		6000 - 7000
	3000 - 4000		> 7000
	4000 - 5000		

25 0 25 50 75 100 km

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Commission

ECMWF
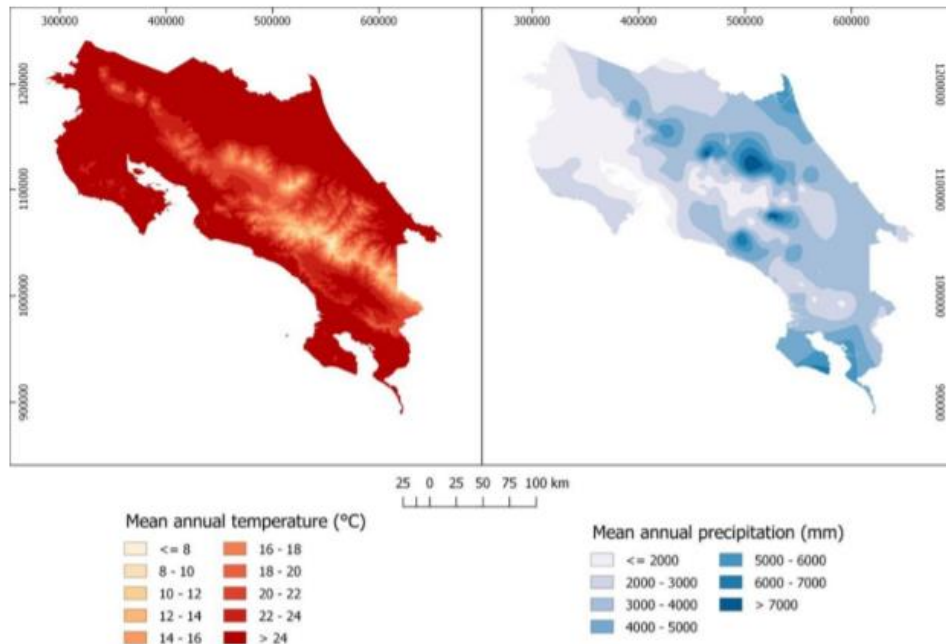
Climate
Change

Methodology

Land-use based biodiversity indicators were calculated for the national bio-corridor program

STEP3
Calculation of land-use based indicators

STEP4
Calculation of biodiversity indicators

STEP5
Merging of indicators and projection

Ongoing (every 2-3 months):
quality control and client meetings

Biodiversity Index
0.09 - 0.25
0.25 - 0.40
0.40 - 0.55
0.55 - 0.70
0.70 - 0.85

Fragmentation Index
0.70 - 1.45
1.45 - 2.20
2.20 - 3.00
3.00 - 3.70
3.70 - 4.50

Natural Cover Index
0.31 - 0.44
0.44 - 0.57
0.57 - 0.70
0.70 - 0.83
0.83 - 0.96

Resistance Index
9.3 - 24.0
24.0 - 38.6
38.6 - 53.3
53.3 - 67.9
67.9 - 82.6

Methodology

Symbology
- Subtropical montane wet forest [13%]
- Subtropical montane rain forest [67,47%]
- Subtropical lower montane moist forest [41,05%]
- Subtropical lower montane wet forest [69,31%]
- Subtropical lower montane rain forest [71,92%]
- Tropical montane wet forest [23,29%]
- Tropical montane rain forest [1,78%]
- Tropical lower montane moist forest [37,57%]
- Tropical lower montane wet forest [76,21%]
- Tropical lower montane rain forest [83,45%]
- Tropical premontane moist forest [17,72%]
- Tropical premontane wet forest [28,33%]
- Tropical premontane rain forest [31,02%]
- Tropical wet forest [48,63%]
- Tropical moist forest [41,89%]
- Tropical dry forest [50,99%]

STEP3
Calculation of land-use based indicators

STEP4
Calculation of biodiversity indicators

STEP5
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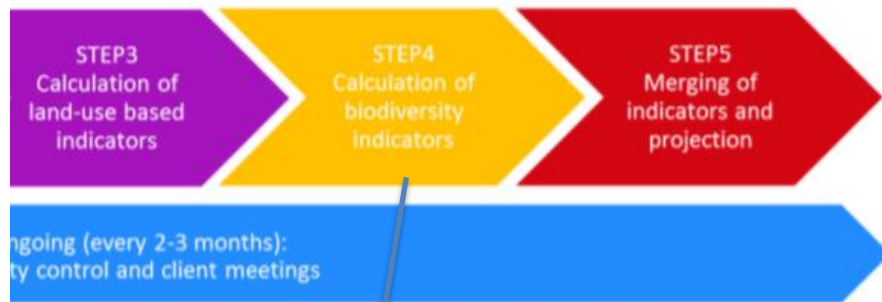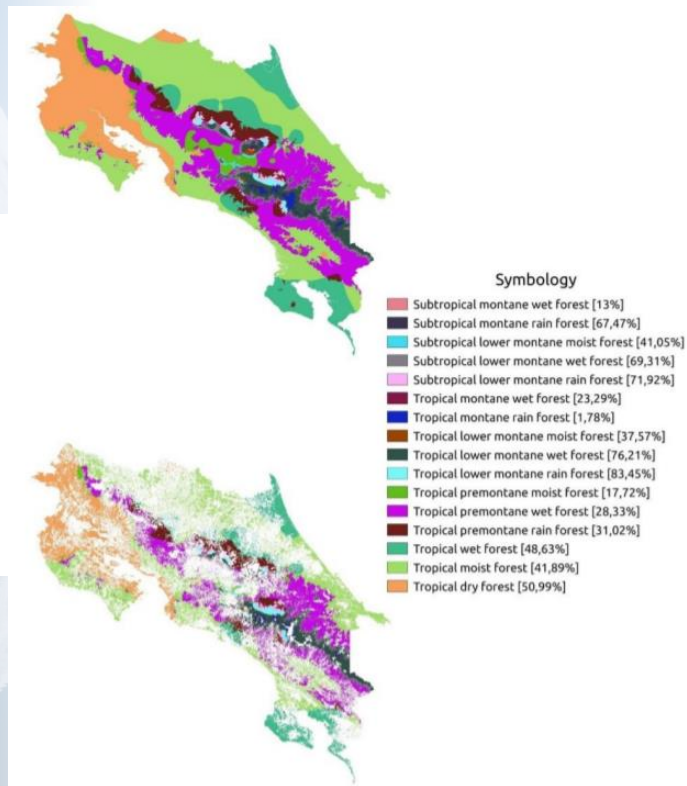National Holdridge Life Zone (HLZ) ecosystem classification as a biodiversity indicator

Climate
Change
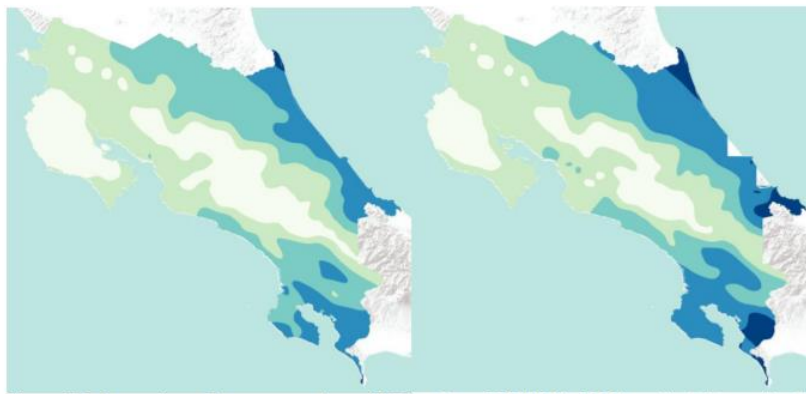
Methodol

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STEP1
Data dov

STEP2

STEP3
Calculation of
biodiversity
indicators

STEP4
Calculation of
biodiversity
indicators

STEP5
Merging of
indicators and
projection
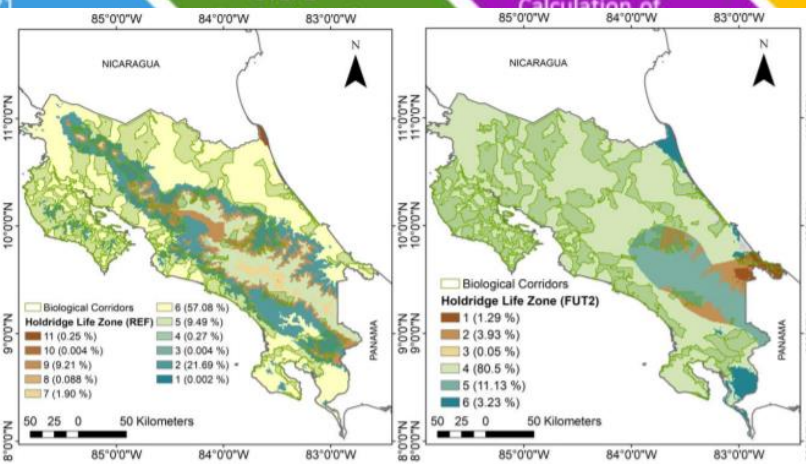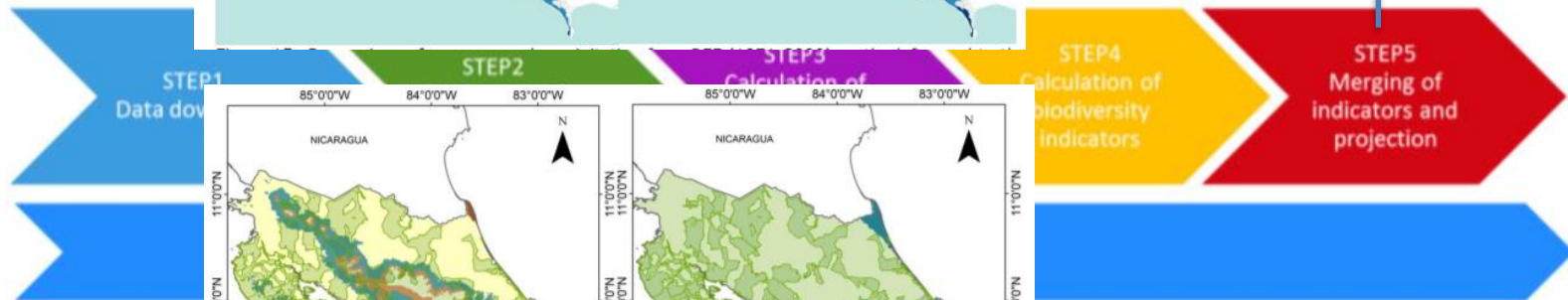
Climate Change

Conclusiones

- Probable tendencia de incremento de la temperature media de Costa Roca alrededor de 1.5 °C hasta 2040.

- La tendencia de la precipitation muestra, en general, condiciones más húmedas y más prominentes en el Caribe y Pacífico Sur, aunque no se observa una sequedad en el norte de Costa Rica para el 2040.

- Cambios en los patrones actuales are mayoritariamente debidos a la tendencia de incremento de temperaturas en el país, independientemente de la altitud.

- Los cambios tienen más probabilidad de ocurrir a las alturas más elevadas, contrastando con los ecosistemas más resistentes a bajas altitudes.

→ **Estos resultados pueden utilizarse para incrementar la resiliencia de los ecosistemas a través de medidas de adaptación para proteger los ecosistemas con mayor biodiversidad y más sensibles a cambios climáticos.**
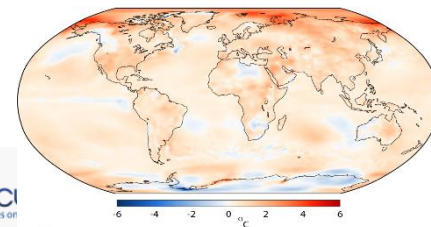
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¿ Qué ofrece el Servicio Europeo de Cambio Climático (C3S) ?

¿ Cuáles son los productos más populares al servicio del usuario ?

¿Cómo acceder a los productos de C3S y qué herramientas de apoyo existen ?

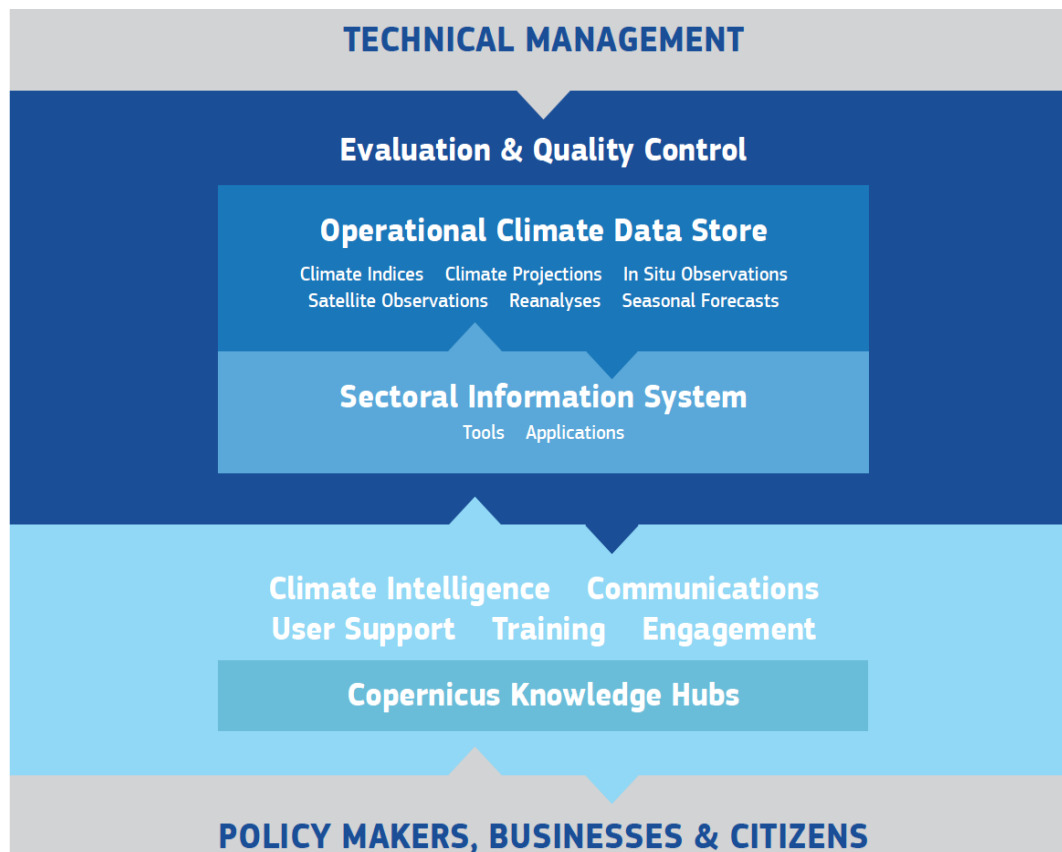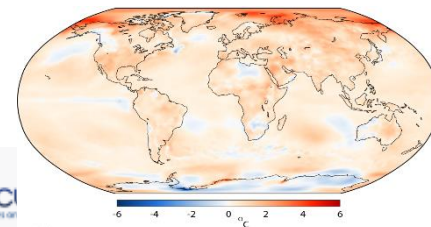¿ Para qué sirven los Sistemas de Información Sectorial (SIS) ?

¿ Algún otro componente en C3S ?

Climate
Change

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IWF

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