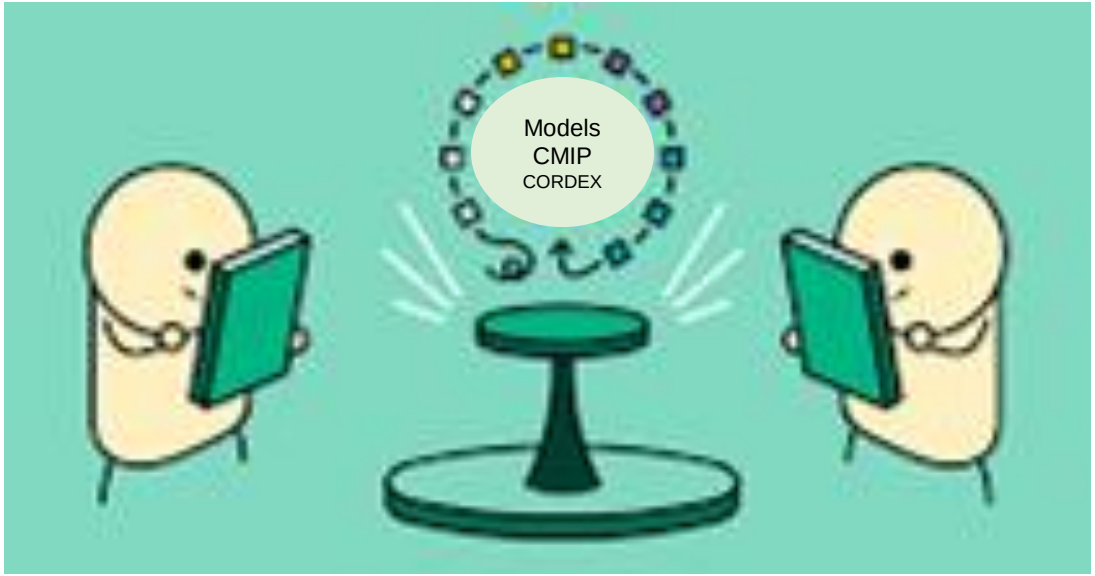
How can we download CMIP and CORDEX datasets?



Training Section

November, 2023

Dr Michelle Reboita

Dr Shaukat Ali

Outline

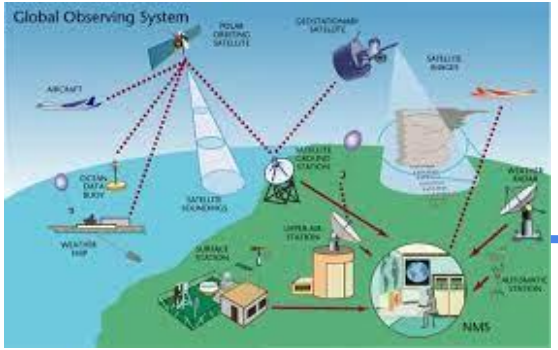
Introduction

- GCM and RCM
- IPCC, CMIP and CORDEX
- Forecast and Projection

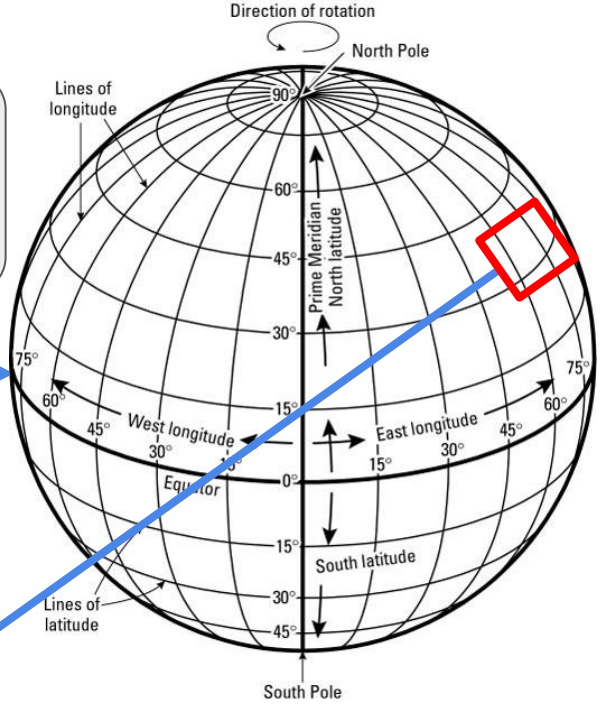
Tutorial

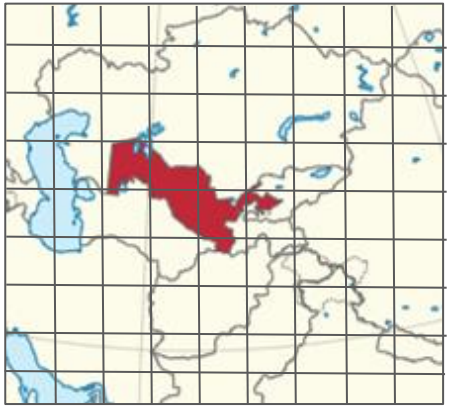
- **CMIP6** projections
- Downloading
  - Pre-Processing
- Plotting
- **CORDEX** projections
- Downloading
  - Pre-Processing
- Plotting

Introduction



Models need observed data to be initialized. These data are registered, processed and distributed in grid points (initial conditions) → reanalysis.



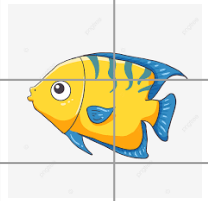


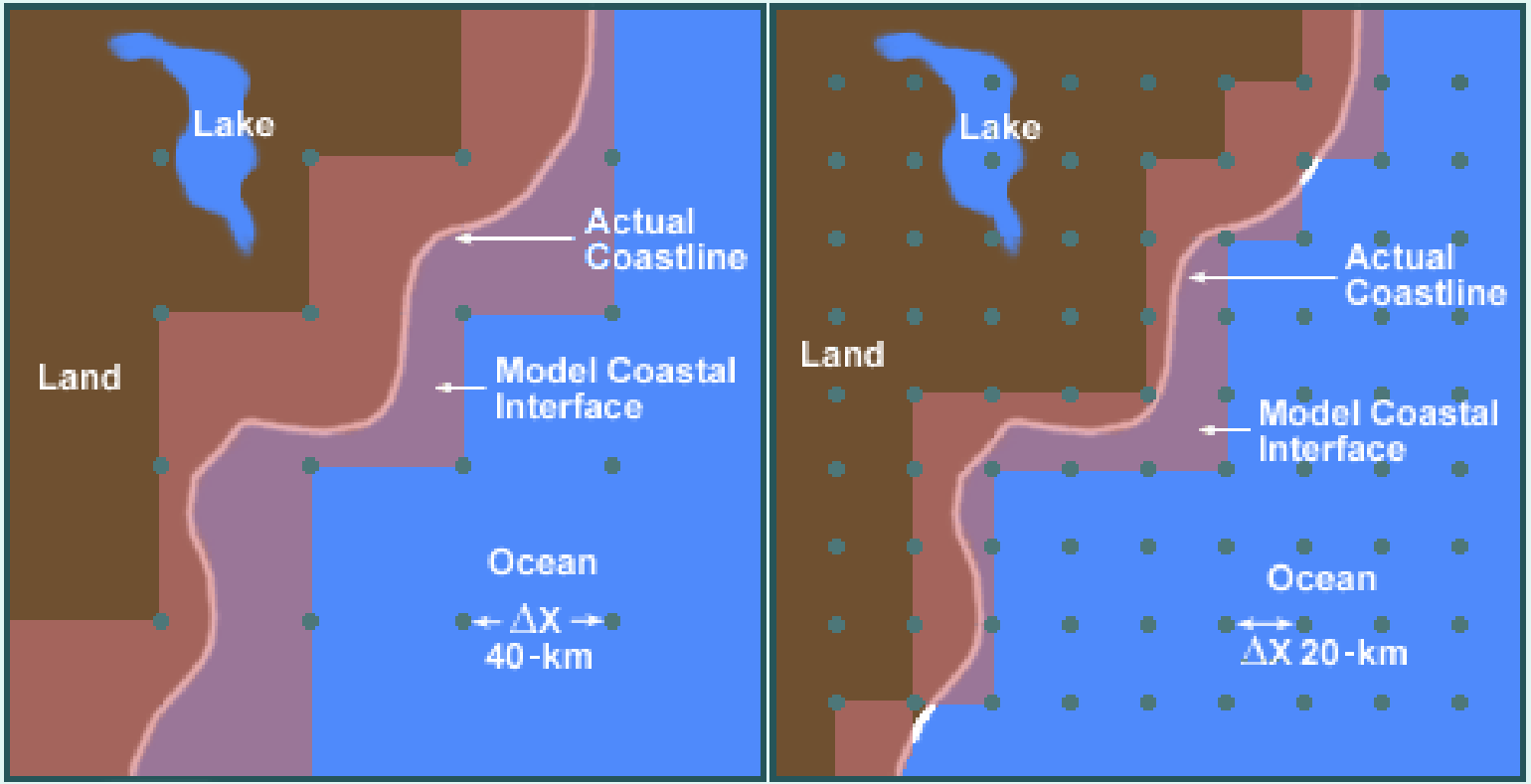
To simulate regional features of the climate, models need to have high resolution. It is expensive with GCMs but relatively cheaper with RCMs, which simulate a small part of the globe.

GCMs simulate the global atmosphere.
Coarse resolution.

Horizontal resolution of the models

High Resolution Low resolution





Model A: 40-km Resolution

Model B: 20-km Resolution

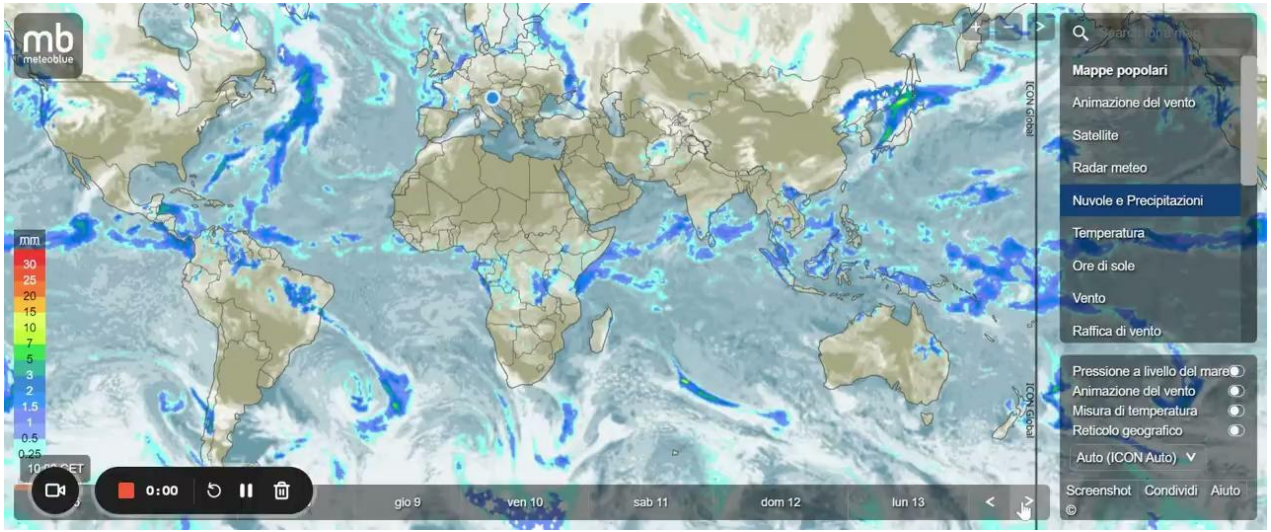
Coastal Region within the Models

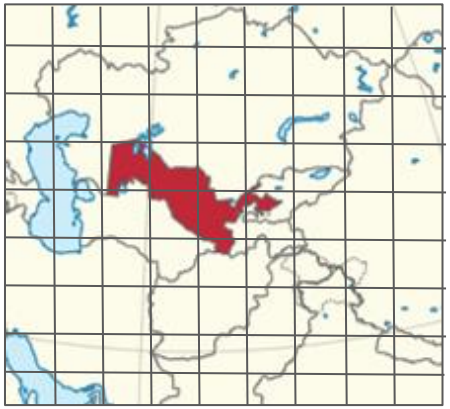
The COMET Program

Introduction

Note that the atmospheric systems are not stationary, traveling in the atmosphere

But how will RCMs know that the atmospheric systems are reaching or leaving a small domain?



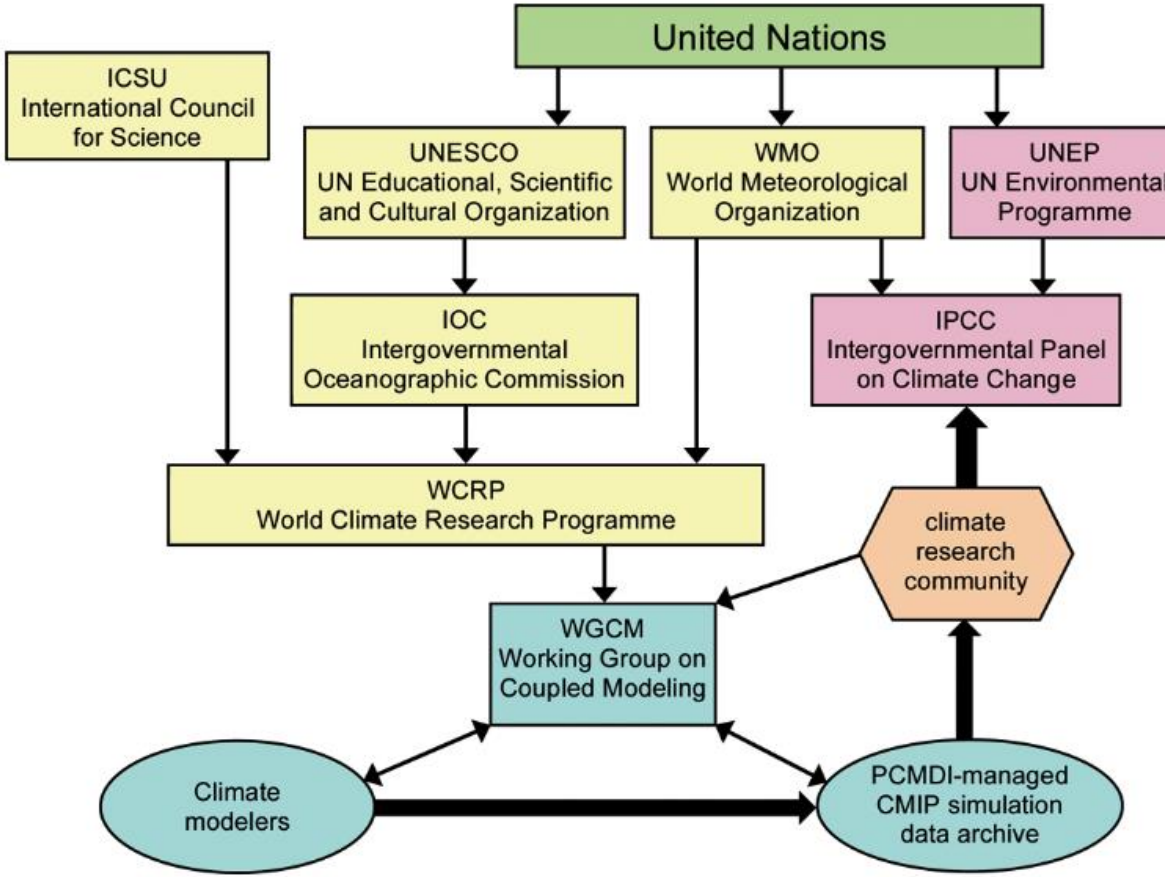


GCMs or reanalyses provide the initial and boundary conditions for RCMs

Introduction

Understanding why there are CMIP and CORDEX programmes

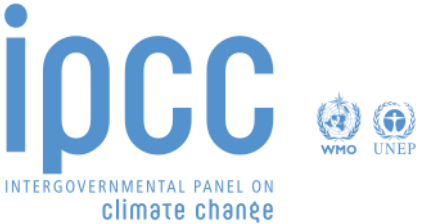
There are institutions that organize the protocols for the models' executions.



Organizational structure

Introduction

Understanding why there are CMIP and CORDEX programmes



- Created in 1988 by the United Nations Environment Programme (UN Environment) and the World Meteorological Organization (WMO);

- 195 Member countries;

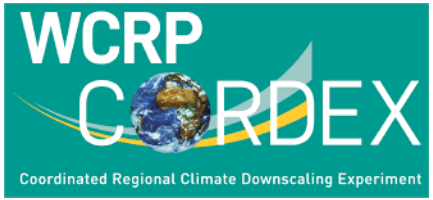
- Objective: systematic review of all relevant published literature to provide policymakers with regular scientific assessments on climate change

https://www.ipcc.ch/

- Created in 1995;

- Objectives: understand past, present and future climate changes; create protocols for numerical experiments and to make the multi-model output publically available in a standardized format

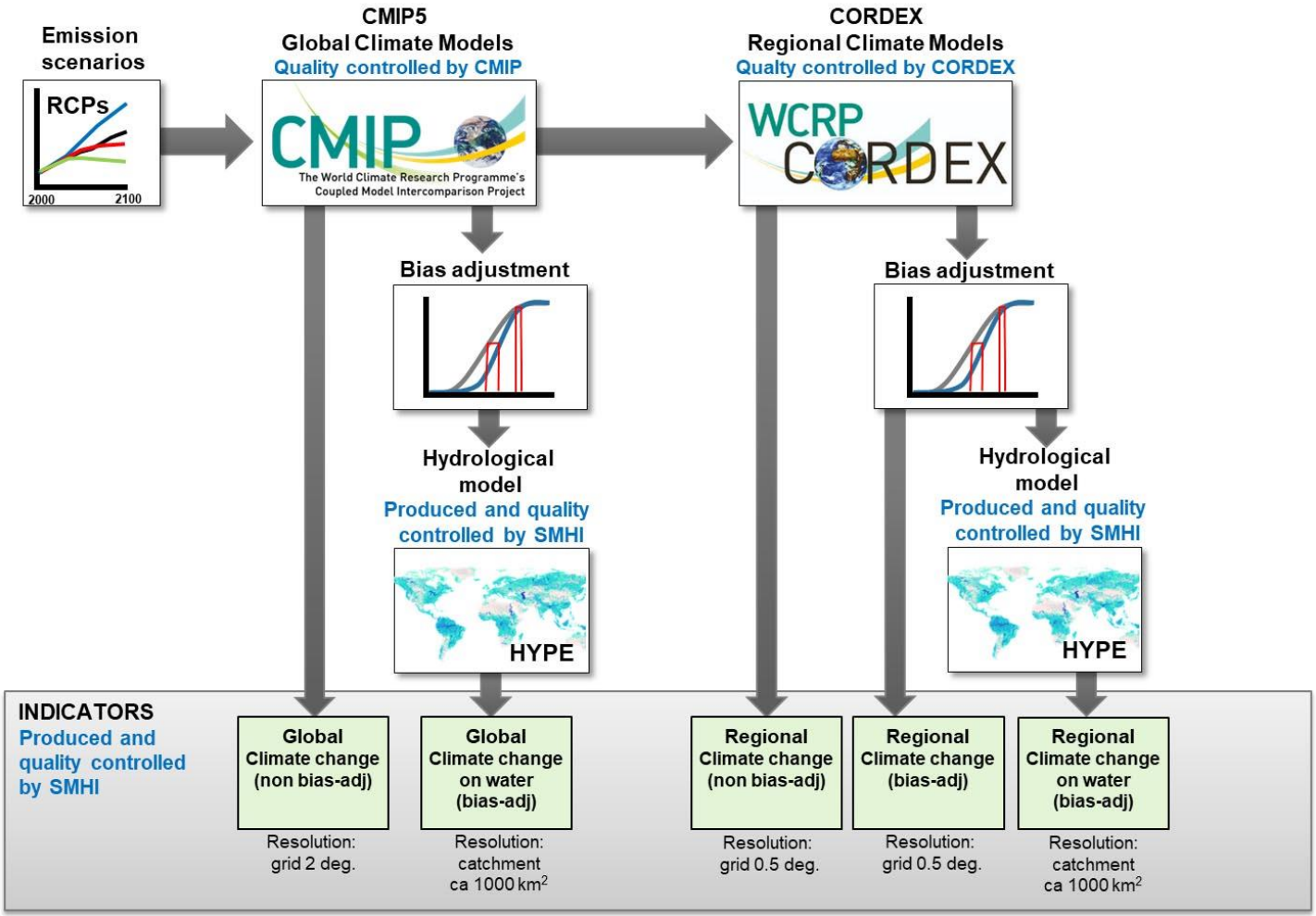
https://www.wcrp-climate.org/wgcm-cmip



- Created in 2009;

- Objective: a coordinated framework for evaluating and improving regional climate downscaling techniques and bridging the gap between the climate modelling community and end users of climate information across the globe.

https://www.icrc-cordex2016.org/index.php/about/what-is-cordex



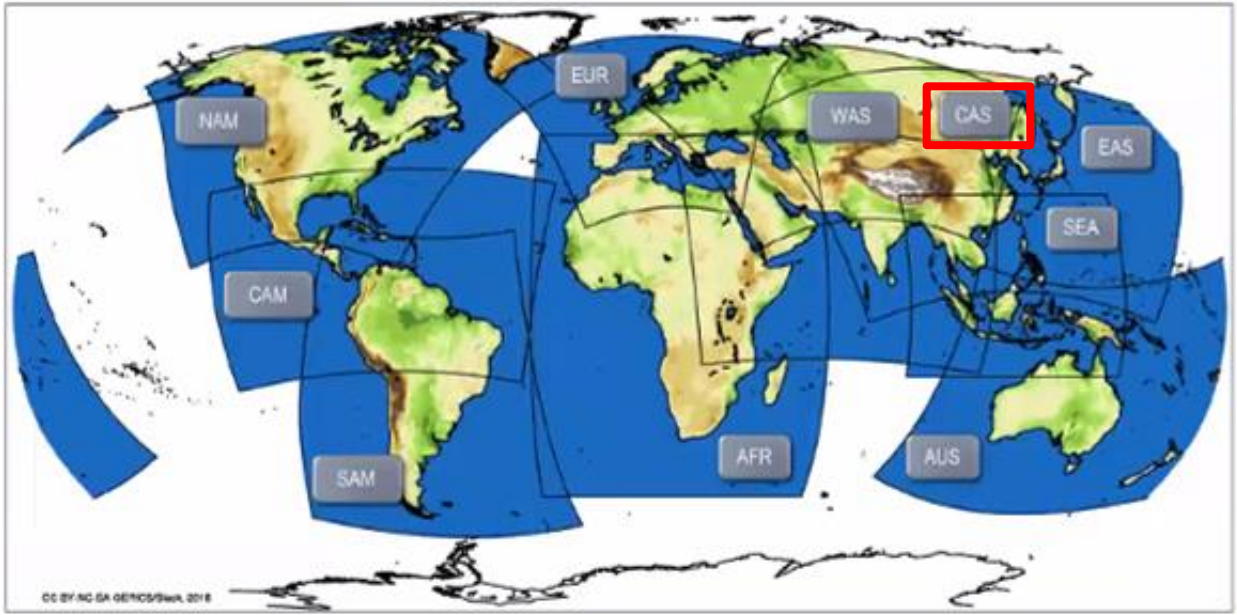
https://climateinformation.org/data-production-and-tailoring/production-of-climate-indicators/

Introduction

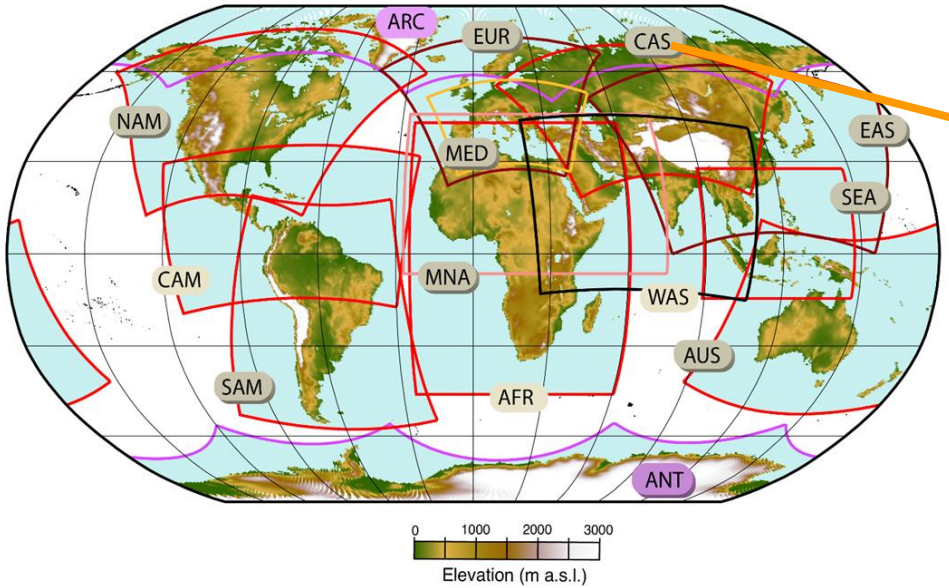
WCRP CMIP
World Climate Research Programme

WCRP CORDEX
Coordinated Regional Climate Downscaling Experiment

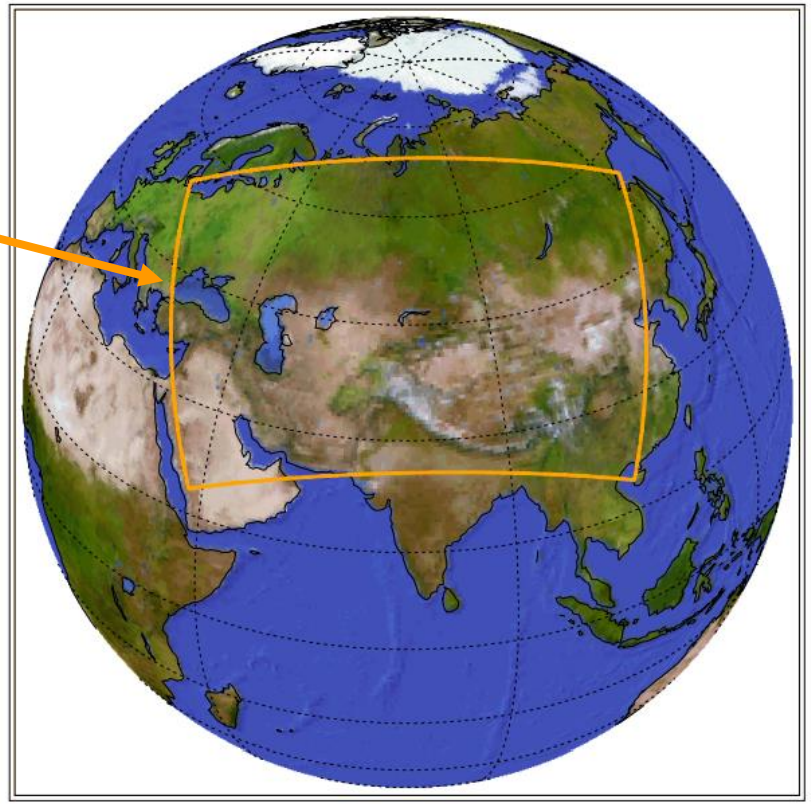
CORDEX domains



CORDEX
Central Asia domain



https://www.ipcc.ch/report/ar6/wg1/figures/atlas/figure-atlas-6



https://cordex.org/domains/region-8-central-asia/

Introduction

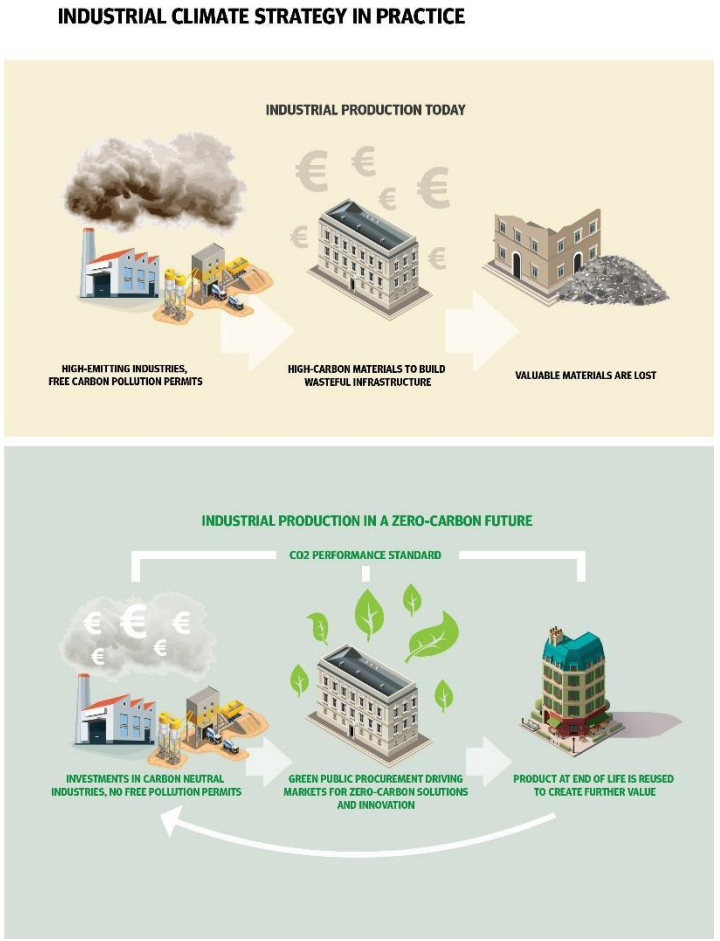
Definitions

Baseline/Reference: present-day conditions.

Forecast: predict the future based on initial conditions applied in the numerical models (it does not include scenarios).

Projection: term that can be regarded as any description of the future and the **pathway (scenario)** leading to it.

Scenario: description of a possible future state of the world.

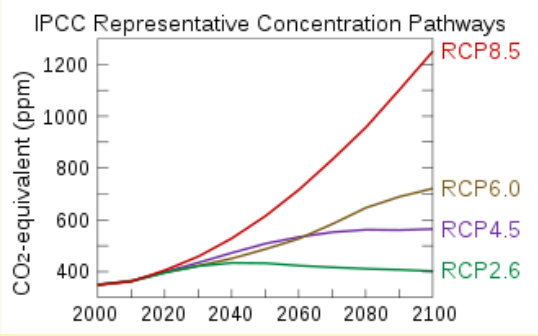


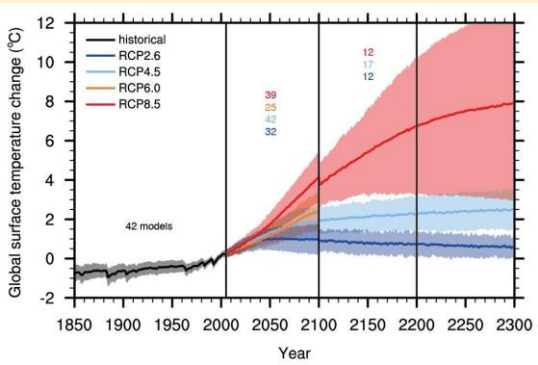
https://carbonmarketwatch.org/wp-content/uploads/2019/04/Industrial-Climate-strategy-in-practise-02-01.jpg

Introduction

Scenarios

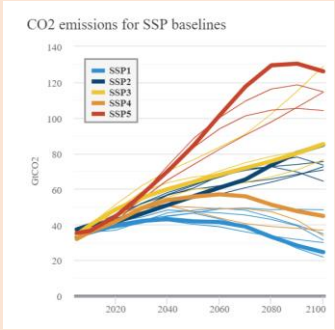
RCPs

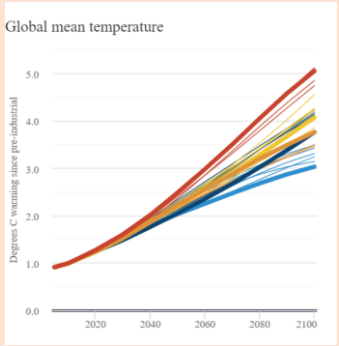




https://open.oregonstate.education/climatechange/chapter/impacts/

SSPs





https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

Representative Concentration Pathways (RCPs)

- describe different levels of greenhouse gases and other radiative forcings that might occur in the future
- 4 pathways, spanning a broad range of forcing in 2100 (2.6, 4.5, 6.0, and 8.5 W m^{-2})
- they do not include any socioeconomic "narratives" to go alongside them.

Shared Socioeconomic Pathways (SSPs)

- include socioeconomic factors (population, economic growth, education, urbanization and the rate of technological development)
- 5 socioeconomic development trajectories defined in terms of challenges to adaptation and mitigation

RCPs and SSPs are complementary

The RCPs set pathways for greenhouse gas concentrations and, effectively, the amount of warming that could occur by the end of the century. Whereas the SSPs set the stage on which reductions in emissions will – or will not – be achieved.

Introduction

SSP scenarios are described by Riahi et al. (2017).

ELSEVIER

Global Environmental Change

Volume 42, January 2017, Pages 153-168

The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview

Keywan Riahi [a], Detlef P. van Vuuren [b], Elmar Kriegler [c], Jae Edmonds [d], Brian C. O'Neill [e], Shinichiro Fujimori [f], Nico Bauer [c], Katherine Calvin [d], Rob Dellink [g], Oliver Fricko [a], Wolfgang Lutz [a], Alexander Popp [c], Jesus Crespo Cuaresma [a], Samir KC [a, h], Marian Leimbach [c], Leiwen Jiang [e], Tom Kram [b], Shilpa Rao [a] ... Massimo Tavoni [i, j, o]

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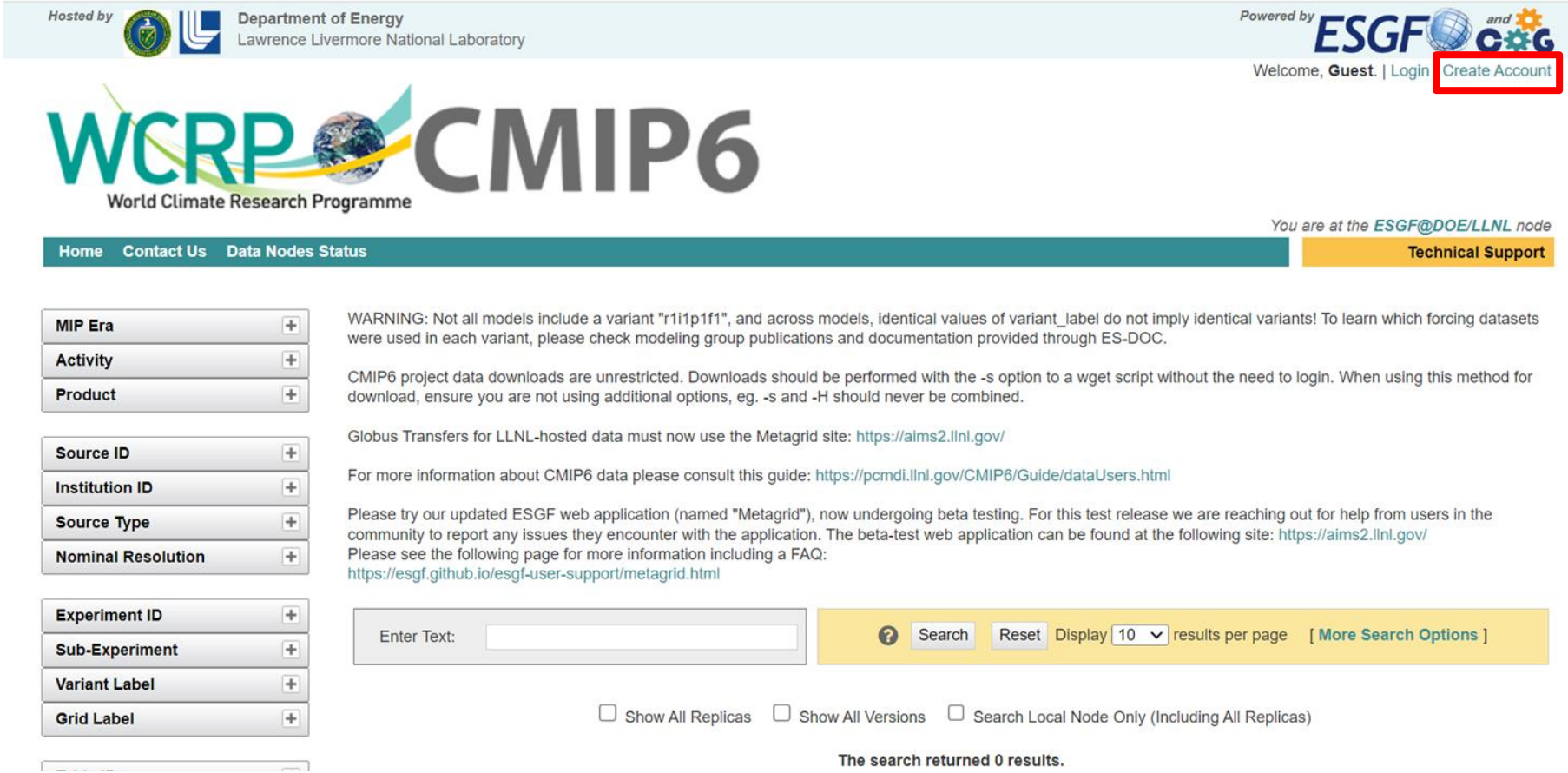
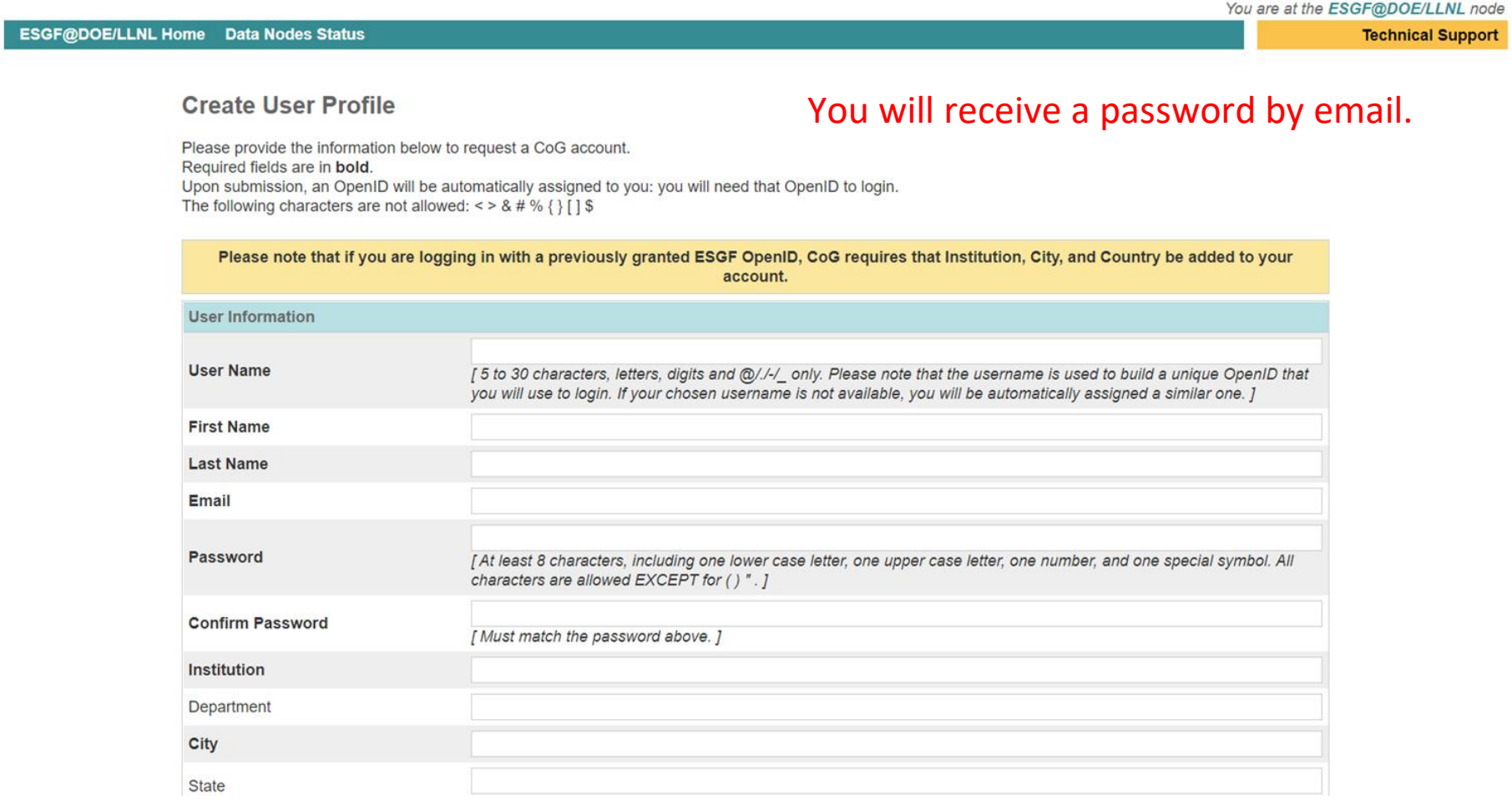
Tutorial

CMIP6: Download

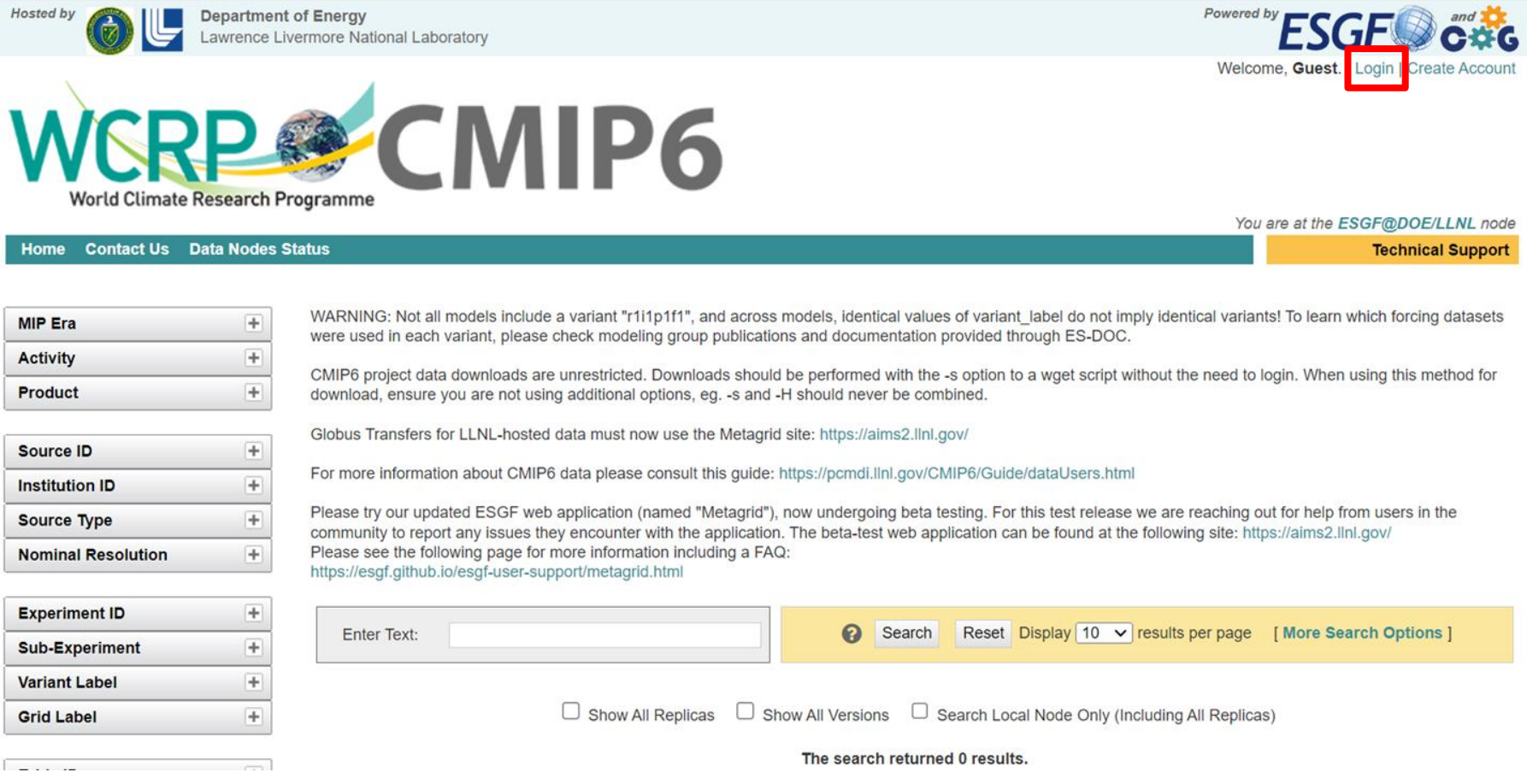
https://esgf-node.llnl.gov/search/cmip6/



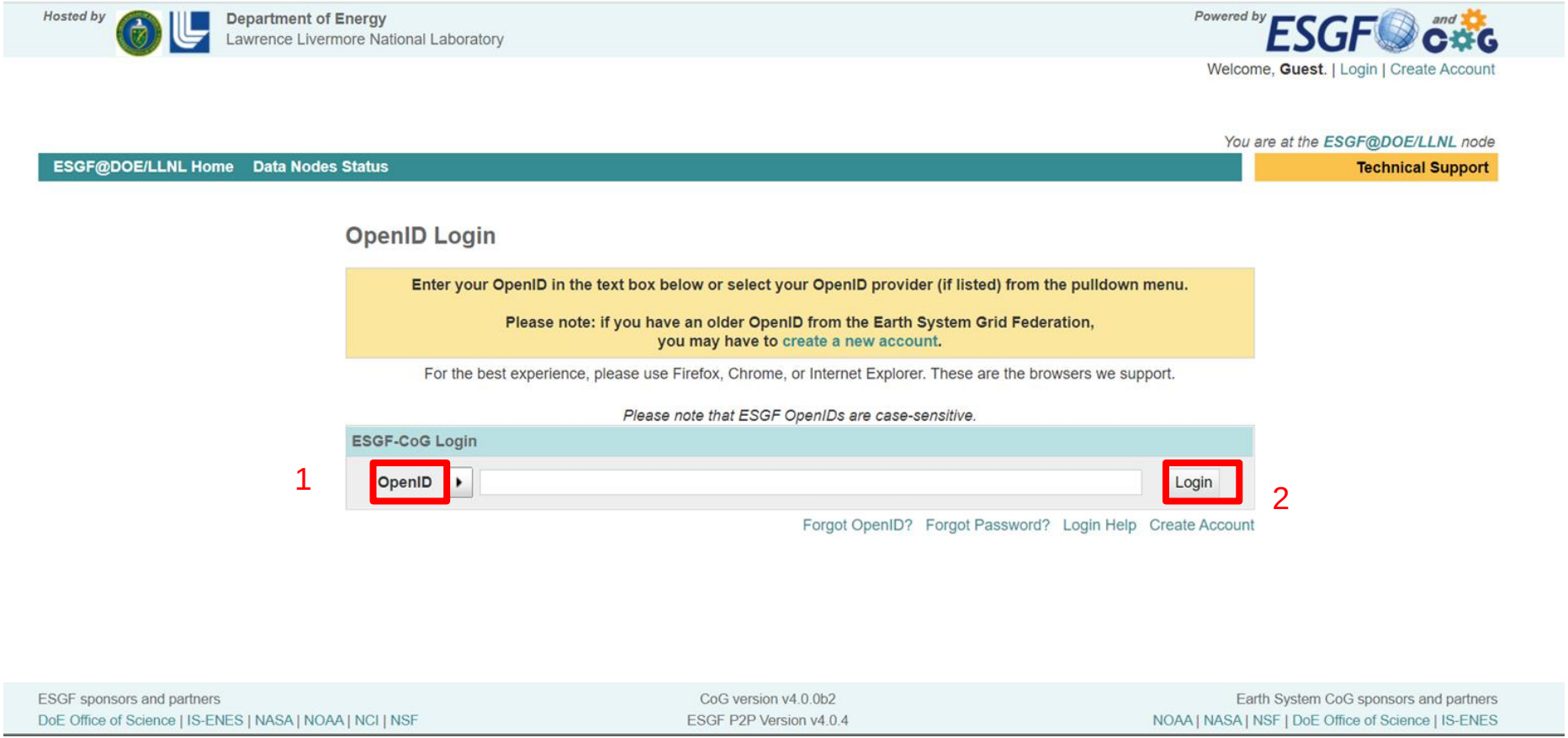
Fill in the form



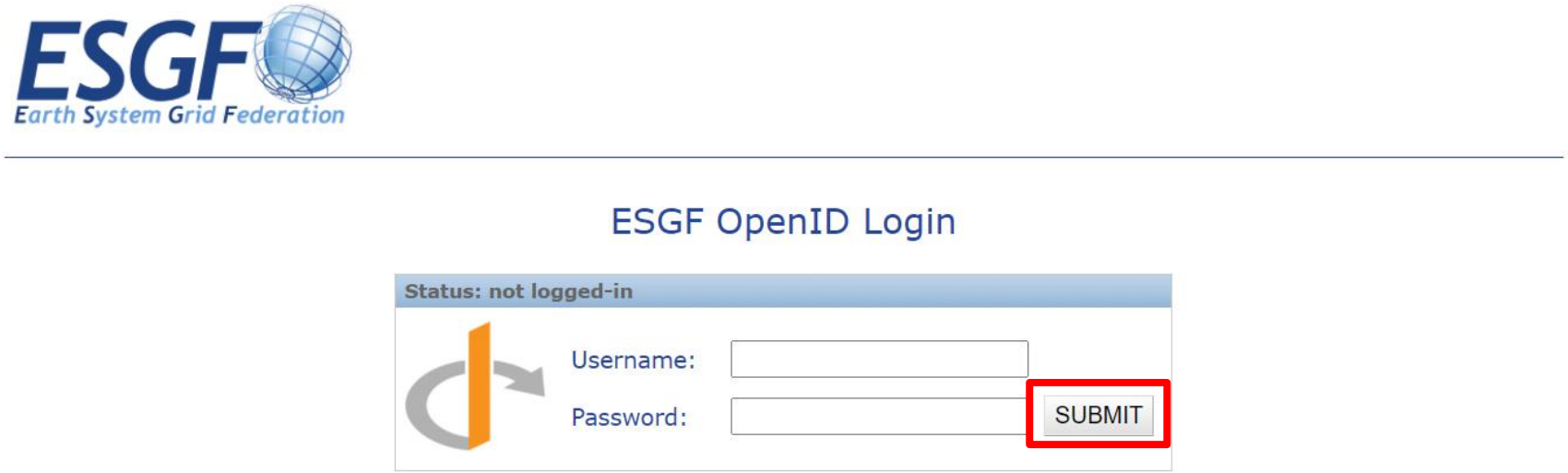
Click on login



Use the openID received by email



Fill in the username and password



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Lawrence Livermore National Laboratory

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WCRP CMIP6
World Climate Research Programme

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- MIP Era
- Activity
- Product
- Source ID
- Institution ID
- Source Type
- Nominal Resolution
- Experiment ID
- Sub-Experiment
- Variant Label
- Grid Label

WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.

CMIP6 project data downloads are unrestricted. Downloads should be performed with the -s option to a wget script without the need to login. When using this method for download, ensure you are not using additional options, eg. -s and -H should never be combined.

Globus Transfers for LLNL-hosted data must now use the Metagrid site: https://aims2.llnl.gov/

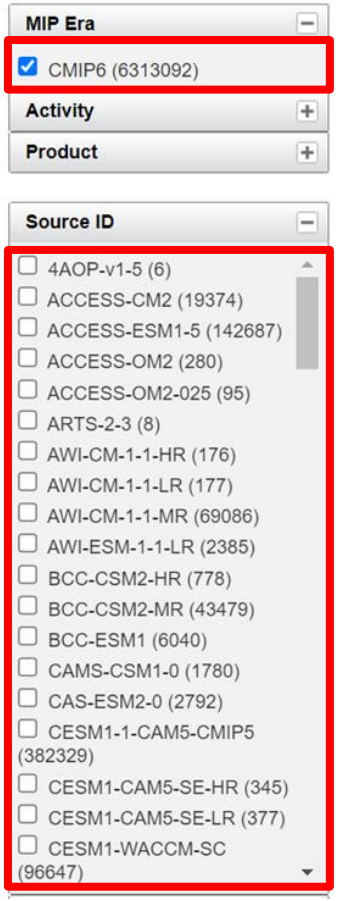
For more information about CMIP6 data please consult this guide: https://pcmdi.llnl.gov/CMIP6/Guide/dataUsers.html

Please try our updated ESGF web application (named "Metagrid"), now undergoing beta testing. For this test release we are reaching out for help from users in the community to report any issues they encounter with the application. The beta-test web application can be found at the following site: https://aims2.llnl.gov/
Please see the following page for more information including a FAQ:
https://esgf.github.io/esgf-user-support/metagrid.html

Enter Text: Search Reset Display 10 results per page [More Search Options]

Select the options

Show All Replicas Show All Versions Search Local Node Only (Including All Replicas)



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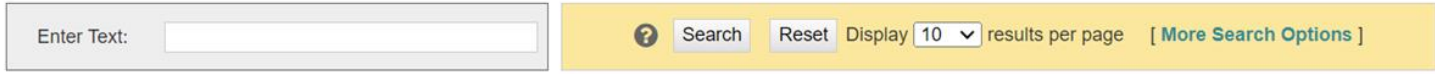
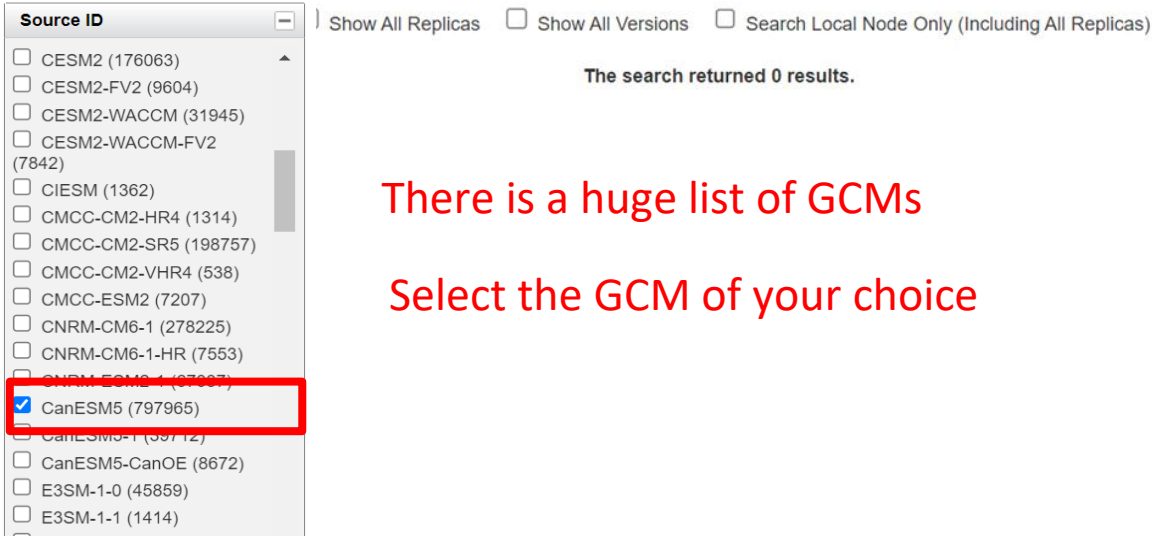
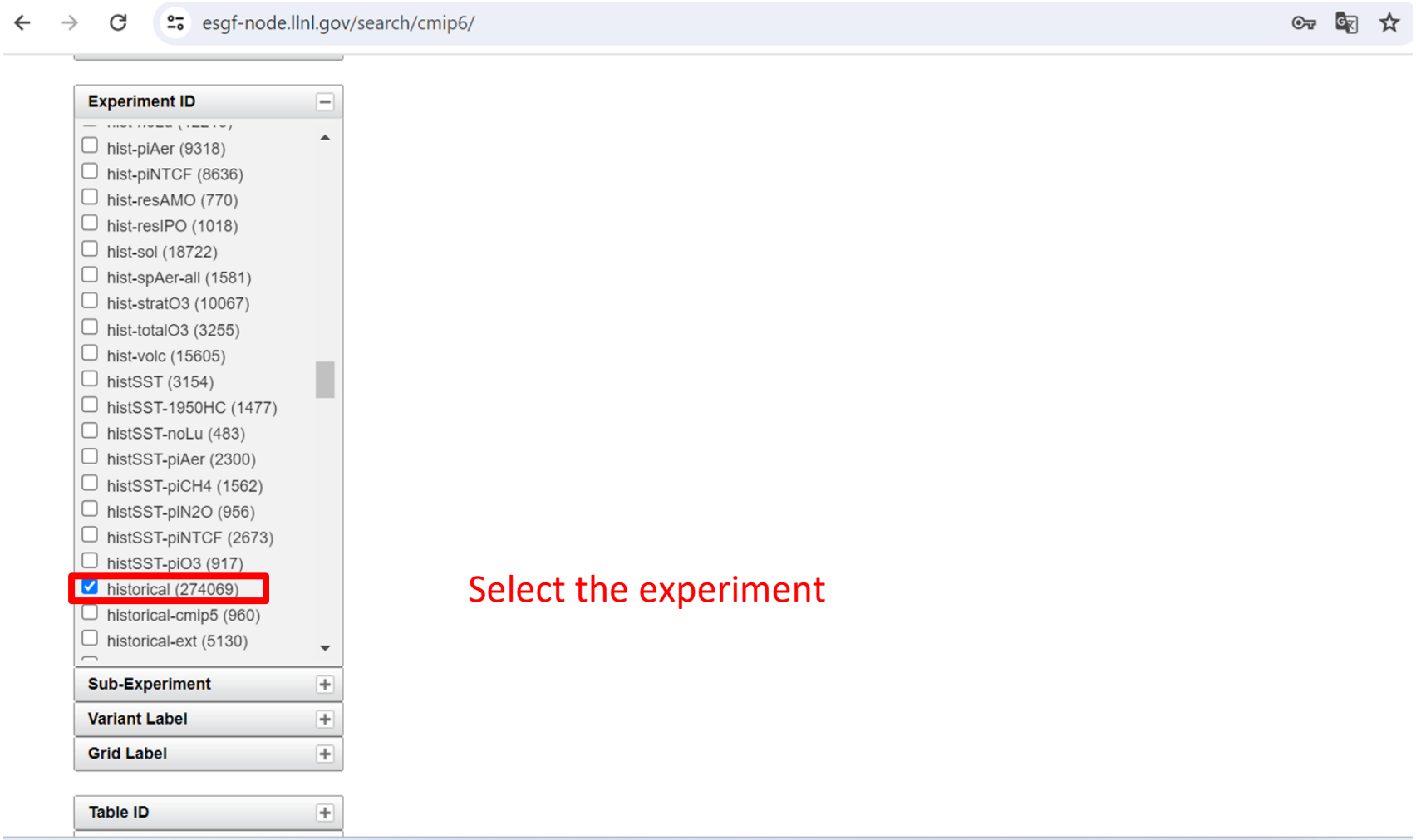
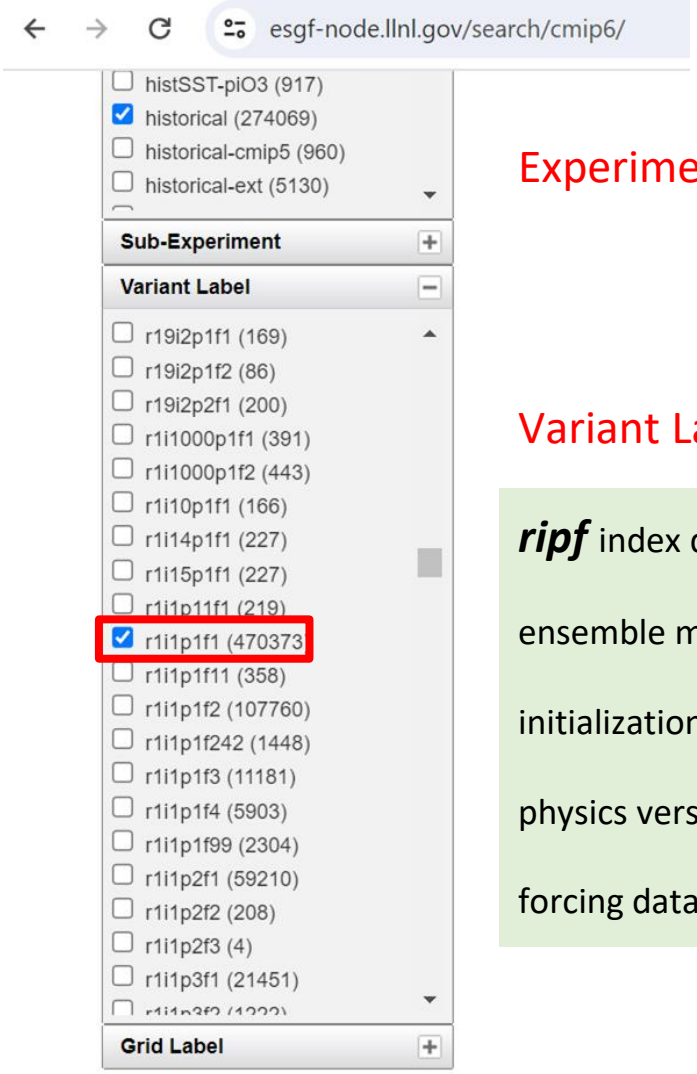




There is a huge list of GCMs

Select the GCM of your choice


esgf-node.llnl.gov/search/cmip6/
Experiment ID
hist-piAer (9318)
hist-piNTCF (8636)
hist-resAMO (770)
hist-resIPO (1018)
hist-sol (18722)
hist-spAer-all (1581)
hist-stratO3 (10067)
hist-totalO3 (3255)
hist-volc (15605)
histSST (3154)
histSST-1950HC (1477)
histSST-noLu (483)
histSST-piAer (2300)
histSST-piCH4 (1562)
histSST-piN2O (956)
histSST-piNTCF (2673)
histSST-piO3 (917)
historical (274069)
historical-cmip5 (960)
historical-ext (5130)
Sub-Experiment
Variant Label
Grid Label
Table ID
Select the experiment



Experiment Configuration

Variant Label

ripf index denotes the

ensemble member (realization ***r***),

initialization methods (***i***),

physics versions (***p***), and

forcing data set (***f***)

In each **model output file** the "**ripf**" identifier is used to uniquely distinguish each member of an ensemble, but the differences between members may not always be clearly (or correctly) recorded in the "variant_info" global attribute inside the netcdf file.

ES-DOC will therefore serve as the reference source for understanding differences between ensemble members.

Modeling groups will record in ES-DOC the key to interpreting the differences between simulations identified by different indices. In particular for each forcing index, the list of forcing data sets applied in the simulation will be recorded.

https://pcmdi.llnl.gov/CMIP6/Guide/dataUsers.html

Some details are provided in https://docs.google.com/document/d/1h0r8RZr_f3-8egBMMh7aqLwy3snpD6_MrDz1q8n5XUk/edit#

Initialization method is as follows:

1: Initial conditions taken from a prior simulation, as indicated by the branch-date attribute.

2: As 1, but with an additional random perturbation applied to the initial state of the atmosphere.

https://ukesm.ac.uk/cmip6/variant-id/

Forcing configuration (example for HadGEM3-GC3.1):

1: Input4MIPs version v6.1.1; no ozone remapping

2: Input4MIPs version v6.2.0; no ozone remapping

3: Input4MIPs version v6.2.0; with ozone remapping

ripf index denotes the

ensemble member (realization *r*),

initialization methods (*i*),

physics versions (*p*), and

forcing data set (*f*)

Frequency

Variable

Table ID +

Frequency −

- [ ] 1hr (1117)
- [ ] 1hrCM (40)
- [ ] 3hr (34109)
- [ ] 3hrPt (16648)
- [ ] 6hr (54652)
- [ ] 6hrPt (33441)
- [ ] day (1026728)
- [ ] dec (3199)
- [ ] fx (169082)
- [x] mon (4806984)
- [ ] monC (7763)
- [ ] monPt (10664)
- [ ] month (11)
- [ ] subhrPt (4930)
- [ ] yr (137914)
- [ ] yrPt (5810)

Realm +

Variable +

CF Standard Name +

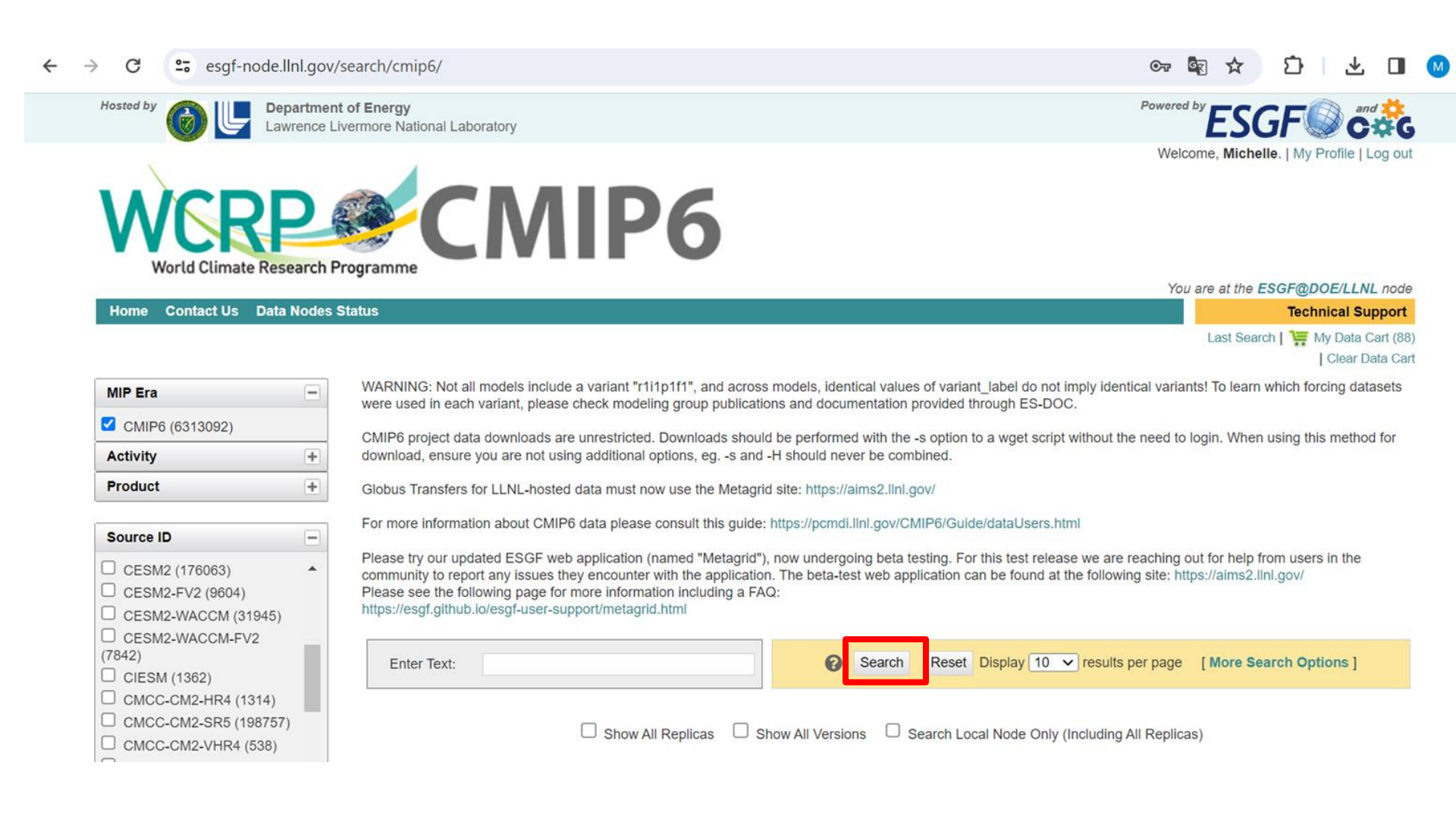
Realm +

Variable +

CF Standard Name −

- [ ] thickness at 550nm (227)
- [ ] age of sea ice (4928)
- [ ] age of stratospheric air (443)
- [ ] age of surface snow (3696)
- [ ] air pressure (12442)
- [ ] air pressure at cloud top (8384)
- [ ] air pressure at convective cloud base (7815)
- [ ] air pressure at convective cloud top (9386)
- [ ] air pressure at mean sea level (14025)
- [ ] air pressure at sea level (4135)
- [x] air temperature (309912)
- [ ] air temperature at cloud top (1092)
- [ ] all-sky surface longwave radiative flux due to dust (16)
- [ ] all-sky surface shortwave radiative flux due to dust (16)
- [ ] ambient aerosol absorption

Data Node +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Data Nodes Status
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| Clear Data Cart
MIP Era
CMIP6 (6313092)
Activity
Product
Source ID
CESM2 (176063)
CESM2-FV2 (9604)
CESM2-WACCM (31945)
CESM2-WACCM-FV2 (7842)
CIESM (1362)
CMCC-CM2-HR4 (1314)
CMCC-CM2-SR5 (198757)
CMCC-CM2-VHR4 (538)
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Please try our updated ESGF web application (named "Metagrid"), now undergoing beta testing. For this test release we are reaching out for help from users in the community to report any issues they encounter with the application. The beta-test web application can be found at the following site: https://aims2.llnl.gov/
Please see the following page for more information including a FAQ:
https://esgf.github.io/esgf-user-support/metagrid.html
Enter Text:
Search
Reset
Display 10 results per page
[More Search Options]
Show All Replicas
Show All Versions
Search Local Node Only (Including All Replicas)

esgf-node.llnl.gov/search/cmip6/

4 temperatures? Which is the mean air temperature at 2-m?

Experiment ID
- [x] historical (4)

Sub-Experiment

Variant Label
- [x] r1i1p1f1 (4)

Grid Label

Table ID

Frequency
- [x] mon (4)

Realm

Variable

CF Standard Name
- [x] air temperature (4)

Data Node

Show All Replicas Show All Versions Search Local

Search Constraints: CMIP6 | CanESM5 | historical | r1i1p1f1 | mon | air_temperature

Total Number of Results: 4

-1-

Add all displayed results to Data Cart Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.ta.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

2. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmin.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

3. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmax.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

4. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tas.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

4 temperatures? Which is the mean air temperature at 2-m?

Visit the tutorials to learn more about the variable names.

https://pcmdi.llnl.gov/CMIP6/Guide/dataUsers.html

https://pcmdi.llnl.gov/mips/cmip3/variableList.html

https://wcrp-cmip.org/cmip-model-and-experiment-documentation/

https://cfconventions.org/Data/cf-standard-names/current/build/cf-standard-name-table.html

CMIP6 paper: https://gmd.copernicus.org/preprints/gmd-2019-219/gmd-2019-219.pdf

esgf-node.llnl.gov/search/cmip6/

4 temperatures? Which is the mean air temperature at 2-m?

Answer: tas

Experiment ID
- historical (4)

Sub-Experiment

Variant Label
- r1i1p1f1 (4)

Grid Label

Table ID

Frequency
- mon (4)

Realm

Variable

CF Standard Name
- air temperature (4)

Data Node

Show All Replicas | Show All Versions | Search Local

Search Constraints: CMIP6 | CanESM5 | historical | r1i1p1f1 | mon | air_temperature

Total Number of Results: 4

-1-

Add all displayed results to Data Cart | Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.ta.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

2. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmin.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

3. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmax.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

4. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tas.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

esgf-node.llnl.gov/search/cmip6/

Table ID

Frequency

- [x] mon (4)

Realm

Variable

- [ ] ta (1)
- [ ] tas (1)
- [ ] tasmax (1)
- [ ] tasmin (1)

CF Standard Name

- [x] air temperature (4)

Data Node

Total Number of Files (for all variables): 1
Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
Add to Data Cart

2. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmin.gn**
Data Node: crd-esgf-drc.ec.gc.ca
Version: 20190429
Total Number of Files (for all variables): 1
Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
Add to Data Cart

3. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tasmax.gn**
Data Node: crd-esgf-drc.ec.gc.ca
Version: 20190429
Total Number of Files (for all variables): 1
Full Dataset Services: [Show Metadata] [List Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
Add to Data Cart

4. **CMIP6.CMIP.CCCma.CanESM5.historical.r1i1p1f1.Amon.tas.gn**
Data Node: crd-esgf-drc.ec.gc.ca
Version: 20190429
Total Number of Files (for all variables): 1
Full Dataset Services: [Show Metadata] [Hide Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]

Total Number of Files: 1

1 **tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc**
checksum: 1d4052b00baac5d9d383070effe6bb36d5194568706e4c6088ee65b6f7dcb52b
size: 52443019
tracking_id: hdl:21.14100/872062df-acae-499b-aa0f-9eaca7681abc
[More File Metadata]

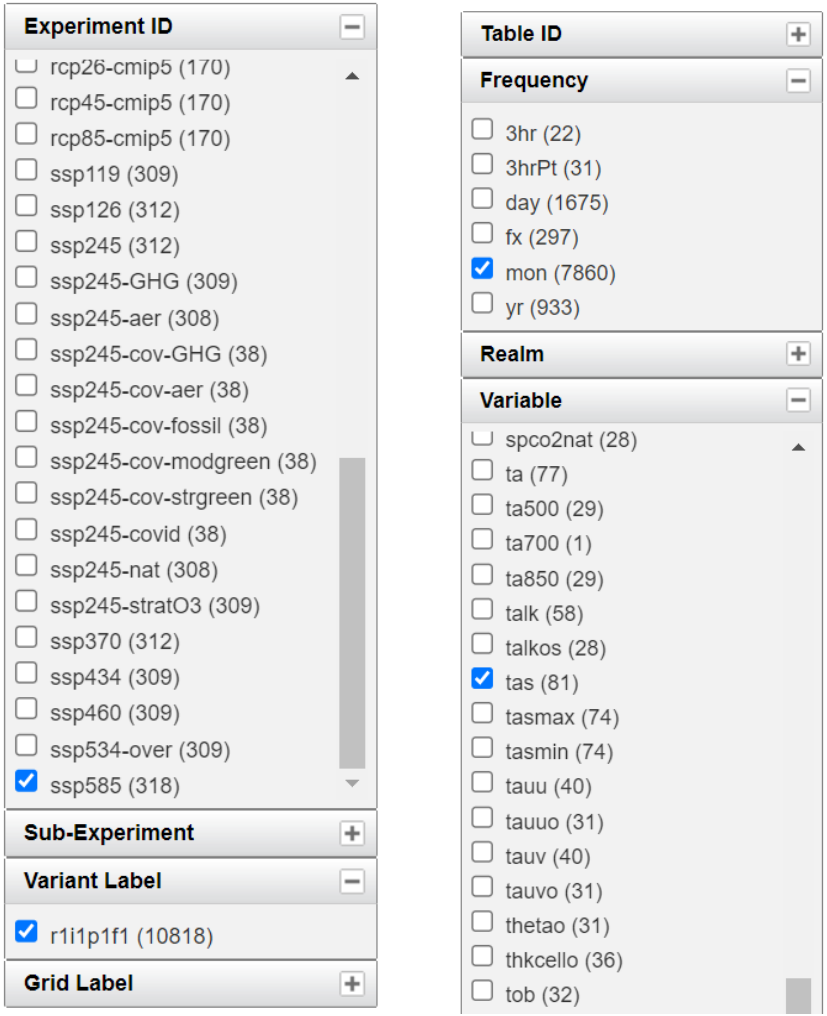
Single File Access:
HTTP Download
OpenDAP Download

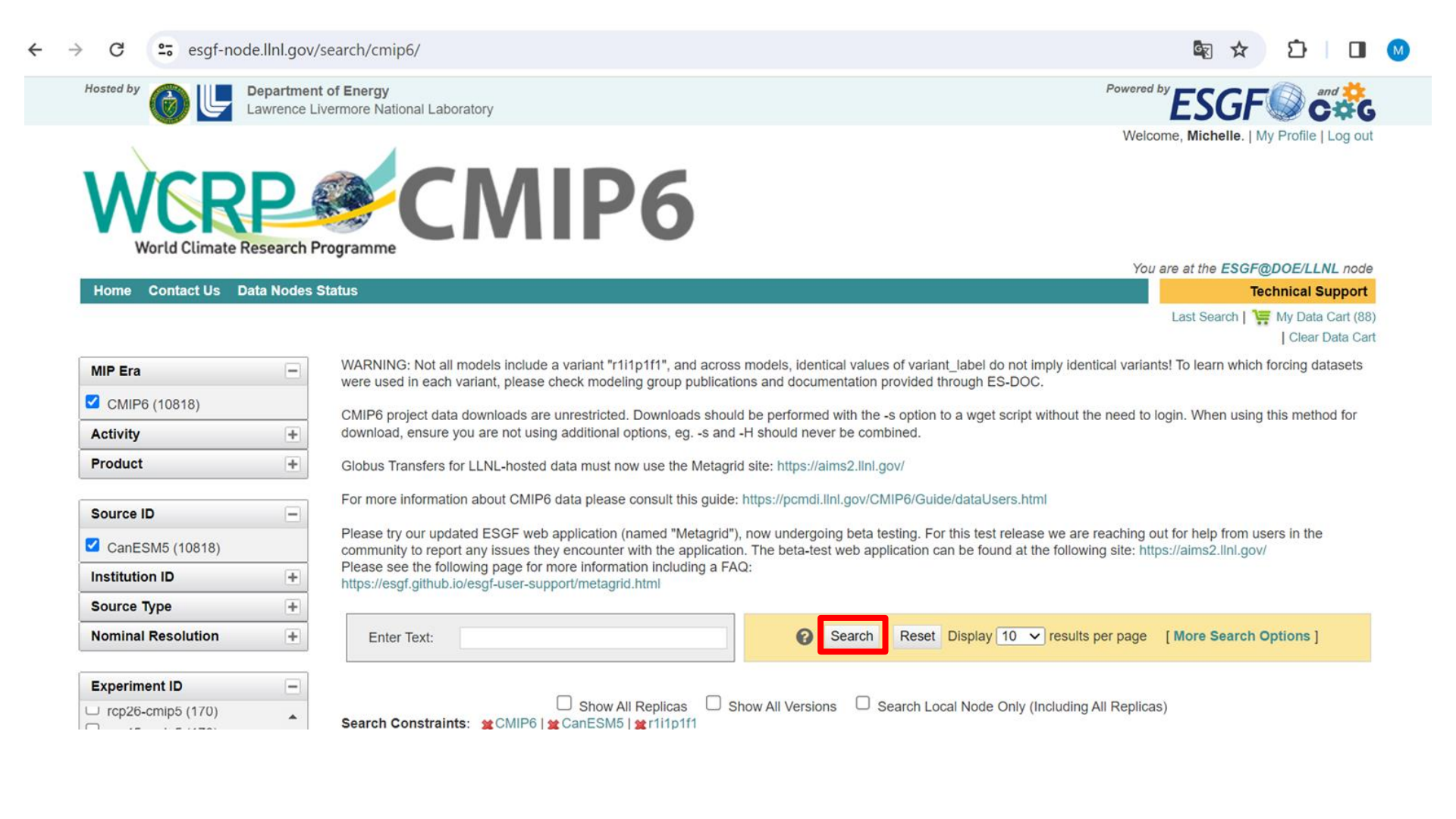
Add to Data Cart

right click and choose "**save as**"

Follow the previous steps and download the monthly mean of the air temperature at 2-m (variable tas)

Model: CanESM5
Experiment: SSP5-8.5 scenario
Variant: r1i1p1f1
Frequency: monthly
Variable: tas
Period: 2015-2100


Experiment ID
rcp26-cmip5 (170)
rcp45-cmip5 (170)
rcp85-cmip5 (170)
ssp119 (309)
ssp126 (312)
ssp245 (312)
ssp245-GHG (309)
ssp245-aer (308)
ssp245-cov-GHG (38)
ssp245-cov-aer (38)
ssp245-cov-fossil (38)
ssp245-cov-modgreen (38)
ssp245-cov-strgreen (38)
ssp245-covid (38)
ssp245-nat (308)
ssp245-stratO3 (309)
ssp370 (312)
ssp434 (309)
ssp460 (309)
ssp534-over (309)
ssp585 (318)
Sub-Experiment
Variant Label
r1i1p1f1 (10818)
Grid Label
Table ID
Frequency
3hr (22)
3hrPt (31)
day (1675)
fx (297)
mon (7860)
yr (933)
Realm
Variable
spco2nat (28)
ta (77)
ta500 (29)
ta700 (1)
ta850 (29)
talk (58)
talkos (28)
tas (81)
tasmax (74)
tasmin (74)
tauu (40)
tauuo (31)
tauv (40)
tauvo (31)
thetao (31)
thkcello (36)
tob (32)


esgf-node.llnl.gov/search/cmip6/
Hosted by
Department of Energy
Lawrence Livermore National Laboratory
Powered by ESGF and CoG
Welcome, Michelle. | My Profile | Log out
WCRP CMIP6
World Climate Research Programme
You are at the ESGF@DOE/LLNL node
Home
Contact Us
Data Nodes Status
Technical Support
Last Search | My Data Cart (88)
| Clear Data Cart
MIP Era
CMIP6 (10818)
Activity
Product
Source ID
CanESM5 (10818)
Institution ID
Source Type
Nominal Resolution
Experiment ID
rcp26-cmip5 (170)
WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.
CMIP6 project data downloads are unrestricted. Downloads should be performed with the -s option to a wget script without the need to login. When using this method for download, ensure you are not using additional options, eg. -s and -H should never be combined.
Globus Transfers for LLNL-hosted data must now use the Metagrid site: https://aims2.llnl.gov/
For more information about CMIP6 data please consult this guide: https://pcmdi.llnl.gov/CMIP6/Guide/dataUsers.html
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Please see the following page for more information including a FAQ:
https://esgf.github.io/esgf-user-support/metagrid.html
Enter Text:
Search
Reset
Display 10 results per page
[More Search Options]
Show All Replicas
Show All Versions
Search Local Node Only (Including All Replicas)
Search Constraints: CMIP6 | CanESM5 | r1i1p1f1

esgf-node.llnl.gov/search/cmip6/

| Clear Data Cart

MIP Era
- [x] CMIP6 (1)

Activity

Product

Source ID
- [x] CanESM5 (1)

Institution ID

Source Type

Nominal Resolution

Experiment ID
- [x] ssp585 (1)

Sub-Experiment

Variant Label
- [x] r1i1p1f1 (1)

Grid Label

Table ID

Frequency
- [x] mon (1)

WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.

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Please see the following page for more information including a FAQ:
https://esgf.github.io/esgf-user-support/metagrid.html

Enter Text: Search Reset Display 10 results per page [More Search Options]

Show All Replicas Show All Versions Search Local Node Only (Including All Replicas)

Search Constraints: CMIP6 | CanESM5 | r1i1p1f1 | ssp585 | mon | tas

Total Number of Results: 1
-1-
Add all displayed results to Data Cart Remove all displayed results from Data Cart
Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **CMIP6.ScenarioMIP.CCCma.CanESM5.ssp585.r1i1p1f1.Amon.tas.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 3
   Full Dataset Services: [Show Metadata] List Files [WGET Script] [LAS] [Show Citation] [PID] [Further Info]
   Add to Data Cart

esgf-node.llnl.gov/search/cmip6/

Experiment ID
- [x] ssp585 (1)

Sub-Experiment

Variant Label
- [x] r1i1p1f1 (1)

Grid Label

Table ID

Frequency
- [x] mon (1)

Realm

Variable
- [x] tas (1)

CF Standard Name

Data Node

☐ Show All Replicas ☐ Show All Versions ☐ Search Local Node Only (Including All Replicas)

Search Constraints: ✖CMIP6 | ✖CanESM5 | ✖r1i1p1f1 | ✖ssp585 | ✖mon | ✖tas

Total Number of Results: 1

-1-

Add all displayed results to Data Cart Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **CMIP6.ScenarioMIP.CCCma.CanESM5.ssp585.r1i1p1f1.Amon.tas.gn**
   Data Node: crd-esgf-drc.ec.gc.ca
   Version: 20190429
   Total Number of Files (for all variables): 3
   Full Dataset Services: [Show Metadata] [Hide Files] [WGET Script] [LAS] [Show Citation] [PID] [Further Info]

Total Number of Files: 3

1	**tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc** checksum: 15e3747c7b4380b2431eac6c2c77ab91580bca02962bb45deac38be35e7cdf07 size: 27267498 tracking_id: hdl:21.14100/fd4cec7c-a59e-475b-9d4f-5c04ce24dab7 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download
2	**tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_210101-218012.nc** checksum: 45cb432cb45d87081a8f78da87cddf2aacba95ba083c70c128bb12c4be9ff73c size: 25232340 tracking_id: hdl:21.14100/0a8ed2c5-9bf6-4e21-8960-c20885f86791 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download
3	**tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_218101-230012.nc** checksum: 4cac1d5202c3b970995fd35369a8350d16e9713bde158b1446843a7049483e14 size: 37722355 tracking_id: hdl:21.14100/a65012ed-84d1-4998-9cb5-c3f3de826ed2 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download

save as

Add to Data Cart

Tutorial

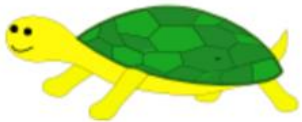
CMIP6: Pre-Processing

Softwares

Max-Planck-Institut für Meteorologie **CDO**

Climate Data Operators

Objective: Manipulate data



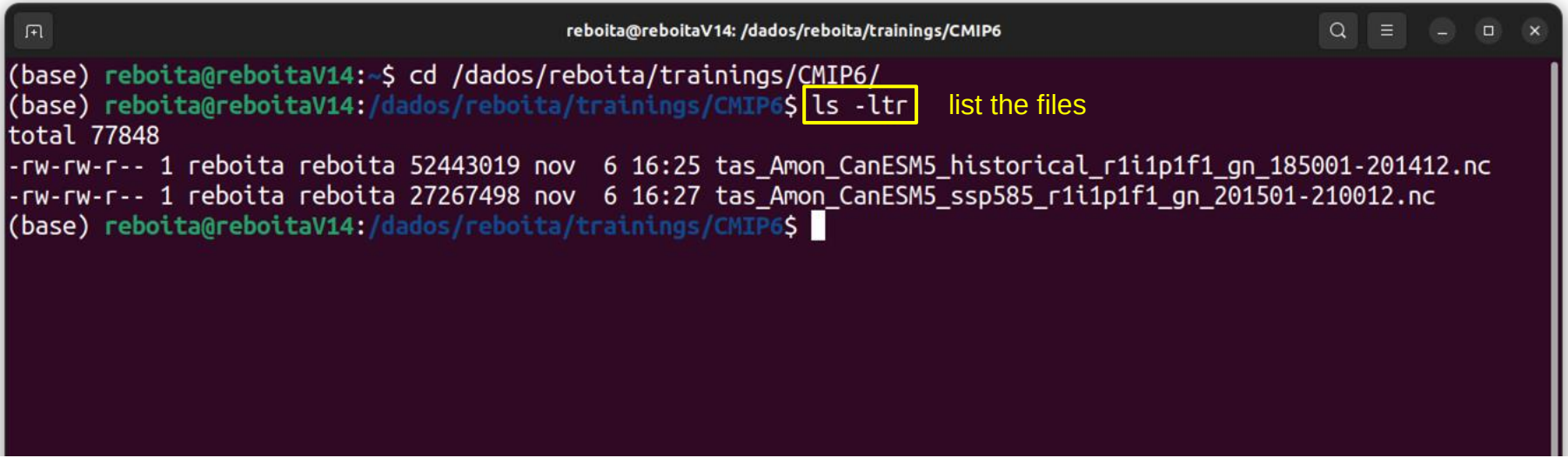
OpenGrADS

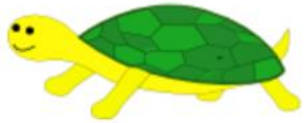
"Opening GrADS to a World of Extensions"

Grid Analysis and Display System

Objective: Visualization of data

Downloaded data were stored at /trainings/CMIP6





OpenGrADS

"Opening GrADS to a World of Extensions"

```
reboita@reboitaV14: /dados/reboita/trainings/CMIP6
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ ls
tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ grads

             Welcome to the OpenGrADS Bundle Distribution
             -------------------------------------------

For additional information enter "grads -h".

Starting "/opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/grads   " ...


Grid Analysis and Display System (GrADS) Version 2.0.2.oga.2
Copyright (c) 1988-2011 by Brian Doty and the
Institute for Global Environment and Society (IGES)
GrADS comes with ABSOLUTELY NO WARRANTY
See file COPYRIGHT for more information

Config: v2.0.2.oga.2 little-endian readline printim grib2 netcdf hdf4-sds hdf5 opendap-gri
ds,stn athena geotiff shapefile
Issue 'q config' command for more detailed configuration information
Loading User Defined Extensions table </opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/ge
x/udxt> ... ok.
Landscape mode? ('n' for portrait):
GX Package Initialization: Size = 11 8.5
ga->
```

enter

enter

```
reboita@reboitaV14: /dados/reboita/
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ g

             Welcome to the OpenGrADS Bundle Distribution
             --------------------------------------------

For additional information enter "grads -h".

Starting "/opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/grads   " ...


Grid Analysis and Display System (GrADS) Version 2.0.2.oga.2
Copyright (c) 1988-2011 by Brian Doty and the
Institute for Global Environment and Society (IGES)
GrADS comes with ABSOLUTELY NO WARRANTY
See file COPYRIGHT for more information

Config: v2.0.2.oga.2 little-endian readline printim grib2 netcdf hdf4-sds hdf5 opendap-grids,stn athena
 geotiff shapefile
Issue 'q config' command for more detailed configuration information
Loading User Defined Extensions table </opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/gex/udxt> ... o
k.
Landscape mode? ('n' for portrait):
GX Package Initialization: Size = 11 8.5
ga-> !ls
tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc
ga-> sdfopen tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
Scanning self-describing file:  tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
SDF Error: 365 day calendars are no longer supported by sdfopen.
  To open this file with GrADS, use a descriptor file with
  a complete TDEF entry and OPTIONS 365_day_calendar.
  Documentation is at http://iges.org/grads/gadoc/SDFdescriptorfile.html
ga->
```

Obs: the examples are in the Linux system. If you are using Windows, it is necessary to provide the **path** of the files sdfopen **C:\trainings\CMIP6\tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc**

Netcdf file was not opened!
Calendar problem???

Model outputs are a challenge because they have:

Netcdf file was not opened!
Calendar problem???

→ different calendars

- standard
- 360 days
- 365 days
- 366 days

→ grid type

- regular space
- non-regular space

→ horizontal resolution

We need to standardize the model data.

Examples of horizontal resolution

CMIP6 model name	Country	Horizontal resolution (lon. by lat. in degrees)	Variant label	Key references
ACCESS-CM2	Australia	1.9°×1.3°	r1i1p1f1	Bi et al. (2012)
ACCESS-ESM1-5	Australia	1.9°×1.2°	r1i1p1f1	Law et al. (2017)
BCC-CSM2-MR	China	1.1°×1.1°	r1i1p1f1	Wu et al. (2019)
CAMS-CSM1-0	China	1.1°×1.1°	r1i1p1f1	Rong et al. (2019)
CanESM5	Canada	2.8°×2.8°	r1i1p1f1	Swart et al. (2019)
CESM2	USA	1.3°×0.9°	r1i1p1f1	Lauritzen et al. (2018)
CESM2-WACCM	USA	1.3°×0.9°	r1i1p1f1	Li et al. (2019)
CNRM-CM6-1	France	1.4°×1.4°	r1i1p1f2	Voldoire et al. (2019)
CNRM-CM6-1-HR	France	0.5°×0.5°	r1i1p1f2	Voldoire et al. (2019)

Our example

Knowing the dataset

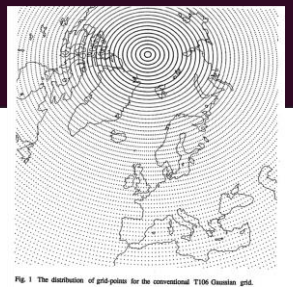
Max-Planck-Institut für Meteorologie CDO

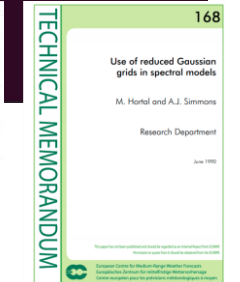
```
reboita@reboitaV14: /dados/reboita/trainings/CMIP6
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo sinfo tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
   File format : NetCDF4 classic zip
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  CanESM5  v instant       1   1      8192   1  F32z : -1
   Grid coordinates :
     1 : gaussian                : points=8192 (128x64)  F32
                               lon : 0 to 357.1875 by 2.8125 degrees_east  circular
                               lat : -87.8638 to 87.8638 degrees_north
                         available : cellbounds
   Vertical coordinates :
     1 : height                  : levels=1  scalar
                            height : 2 m
   Time coordinate :
                              time : 1980 steps
     RefTime =  1850-01-01 00:00:00  Units = days  Calendar = 365_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1850-01-16 12:00:00  1850-02-15 00:00:00  1850-03-16 12:00:00  1850-04-16 00:00:00
  1850-05-16 12:00:00  1850-06-16 00:00:00  1850-07-16 12:00:00  1850-08-16 12:00:00
  1850-09-16 00:00:00  1850-10-16 12:00:00  1850-11-16 00:00:00  1850-12-16 12:00:00
  1851-01-16 12:00:00  1851-02-15 00:00:00  1851-03-16 12:00:00  1851-04-16 00:00:00
  1851-05-16 12:00:00  1851-06-16 00:00:00  1851-07-16 12:00:00  1851-08-16 12:00:00
  1851-09-16 00:00:00  1851-10-16 12:00:00  1851-11-16 00:00:00  1851-12-16 12:00:00
  1852-01-16 12:00:00  1852-02-15 00:00:00  1852-03-16 12:00:00  1852-04-16 00:00:00
  1852-05-16 12:00:00  1852-06-16 00:00:00  1852-07-16 12:00:00  1852-08-16 12:00:00
```

GrADS does not understand **365 day calendar**.

Grid coordinate is **Gaussian** (regular in longitude and almost regular in latitude). GrADS understands this type of grid but as GCMs have different horizontal resolution, we can interpolate all of them to the same regular grid (equally spaced).

We will use **CDO** to adapt the file.





Grid coordinate

Max-Planck-Institut für Meteorologie CDO

Before executing the command

cdo remapbil,grid.txt infile.nc outfile.nc

it is necessary to construct a txt file with the grid information.

This information can be obtained using
cdo sinfo infile.nc

```
reboita@reboitaV14: /dados/reboita/trainings/CMIP6
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo sinfo tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
   File format : NetCDF4 classic zip
    -1 : Institut Source    T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  CanESM5   v instant       1   1      8192   1  F32z : -1
   Grid coordinates :
     1 : gaussian                 : points=8192 (128x64)  F32
                                  lon : 0 to 357.1875 by 2.8125 degrees_east  circular
                                  lat : -87.8638 to 87.8638 degrees_north
                        available : cellbounds
   Vertical coordinates :
     1 : height                   : levels=1  scalar
                                  height : 2 m
   Time coordi    :
                                  time : 1980 steps
     Re    me =  1850-01-01 00:00:00  Units = days  Ca   ndar = 365_day  Bounds = true
    -MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-   hh:mm:ss  YYYY-MM-DD hh:mm:ss
 1850-01-16 12:00:00  1850-02-15 00:00:00  1850-03-   12:00:00  1850-04-16 00:00:00
 1850-05-16 12:00:00  1850-06-16 00:00:00  1850-0   16 12:00:00  1850-08-16 12:00:00
 1850-09-16 00:00:00  1850-10-16 12:00:00  1850-   -16 00:00:00  1850-12-16 12:00:00
 1851-01-16 12:00:00  1851-02-15 00:00:00  1851    -16 12:00:00  1851-04-16 00:00:00
 1851-05-16 12:00:00  1851-06-16 00:00:00  185     7-16 12:00:00  1851-08-16 12:00:00
 1851-09-16 00:00:00  1851-10-16 12:00:00  185     11-16 00:00:00  1851-
 1852-01-16 12:00:00  1852-02-15 00:00:00  18      -03-16 12:00:00  1852-
 1852-05-16 12:00:00  1852-06-16 00:00:00  1       2-07-16 12:00:00  1852-
```

Defining 2.5º x 2.5º as horizontal resolution. So, the number of grid points is obtained as:
lon = 360º / **2.5º** = 144 + 1 = **145**
lat = 180º / **2.5º** = 72 + 1 = **73**

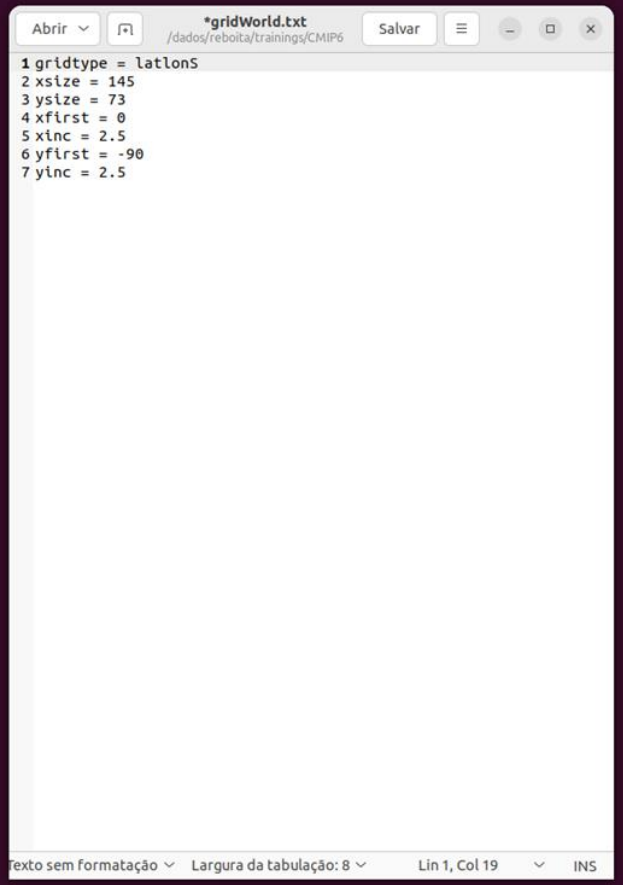
Open a text editor and type the grid information
gedit gridWorld.txt &

Suggesting of editor for Windows: notepad++

gridtype = latlon
xsize = **145**
ysize = **73**
xfirst = 0
xinc = **2.5**
yfirst = -90
yinc = **2.5**

reboita@reboitaV14: /dados/reboita/trainings/CMIP6

```
  1854-01-16 12:00:00  1854-02-15 00:00:00  1854-03-16 12:00:00  1854-04-16 00:00:00
  1854-05-16 12:00:00  1854-06-16 00:00:00  1854-07-16 12:00:00  1854-08-16 12:00:00
  1854-09-16 00:00:00  1854-10-16 12:00:00  1854-11-16 00:00:00  1854-12-16 12:00:00
   ...................................................................................
   ...................................................................................
   ..........
  2010-01-16 12:00:00  2010-02-15 00:00:00  2010-03-16 12:00:00  2010-04-16 00:00:00
  2010-05-16 12:00:00  2010-06-16 00:00:00  2010-07-16 12:00:00  2010-08-16 12:00:00
  2010-09-16 00:00:00  2010-10-16 12:00:00  2010-11-16 00:00:00  2010-12-16 12:00:00
  2011-01-16 12:00:00  2011-02-15 00:00:00  2011-03-16 12:00:00  2011-04-16 00:00:00
  2011-05-16 12:00:00  2011-06-16 00:00:00  2011-07-16 12:00:00  2011-08-16 12:00:00
  2011-09-16 00:00:00  2011-10-16 12:00:00  2011-11-16 00:00:00  2011-12-16 12:00:00
  2012-01-16 12:00:00  2012-02-15 00:00:00  2012-03-16 12:00:00  2012-04-16 00:00:00
  2012-05-16 12:00:00  2012-06-16 00:00:00  2012-07-16 12:00:00  2012-08-16 12:00:00
  2012-09-16 00:00:00  2012-10-16 12:00:00  2012-11-16 00:00:00  2012-12-16 12:00:00
  2013-01-16 12:00:00  2013-02-15 00:00:00  2013-03-16 12:00:00  2013-04-16 00:00:00
  2013-05-16 12:00:00  2013-06-16 00:00:00  2013-07-16 12:00:00  2013-08-16 12:00:00
  2013-09-16 00:00:00  2013-10-16 12:00:00  2013-11-16 00:00:00  2013-12-16 12:00:00
  2014-01-16 12:00:00  2014-02-15 00:00:00  2014-03-16 12:00:00  2014-04-16 00:00:00
  2014-05-16 12:00:00  2014-06-16 00:00:00  2014-07-16 12:00:00  2014-08-16 12:00:00
  2014-09-16 00:00:00  2014-10-16 12:00:00  2014-11-16 00:00:00  2014-12-16 12:00:00
cdo    sinfo: Processed 1 variable over 1980 timesteps [0.03s 50MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ gedit gridWorld.txt
```



gedit is a text editor of Linux

typing **gedit** and a **file name,** a window will be opened for you to write

reboita@reboitaV14: /dados/reboita/trainings/CMIP6

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ gedit gridWorld.txt &
[1] 3509
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo remapbil,gridWorld.txt tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap.nc
cdo    remapbil: Bilinear weights from gaussian (128x64) to lonlat (145x73) grid
cdo    remapbil: Processed 16220160 values from 1 variable over 1980 timesteps [0.76s 97MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo sinfo tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  CanESM5  v instant       1   1     10585   1  F32  : -1
   Grid coordinates :
     1 : lonlat                  : points=10585 (145x73)
                                 lon : 0 to 360 by 2.5 degrees_east
                                 lat : -90 to 90 by 2.5 degrees_north
   Vertical coordinates :
     1 : height                  : levels=1  scalar
                                 height : 2 m
   Time coordinate :
                                 time : 1980 steps
     RefTime =  1850-01-01 00:00:00  Units = days  Calendar = 365_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1850-01-16 12:00:00  1850-02-15 00:00:00  1850-03-16 12:00:00  1850-04-16 00:00:00
  1850-05-16 12:00:00  1850-06-16 00:00:00  1850-07-16 12:00:00  1850-08-16 12:00:00
  1850-09-16 00:00:00  1850-10-16 12:00:00  1850-11-16 00:00:00  1850-12-16 12:00:00
  1851-01-16 12:00:00  1851-02-15 00:00:00  1851-03-16 12:00:00  1851-04-16 00:00:00
  1851-05-16 12:00:00  1851-06-16 00:00:00  1851-07-16 12:00:00  1851-08-16 12:00:00
  1851-09-16 00:00:00  1851-10-16 12:00:00  1851-11-16 00:00:00  1851-12-16 12:00:00
  1852-01-16 12:00:00  1852-02-15 00:00:00  1852-03-16 12:00:00  1852-04-16 00:00:00
  1852-05-16 12:00:00  1852-06-16 00:00:00  1852-07-16 12:00:00  1852-08-16 12:00:00
  1852-09-16 00:00:00  1852-10-16 12:00:00  1852-11-16 00:00:00  1852-12-16 12:00:00
  1853-01-16 12:00:00  1853-02-15 00:00:00  1853-03-16 12:00:00  1853-04-16 00:00:00
  1853-05-16 12:00:00  1853-06-16 00:00:00  1853-07-16 12:00:00  1853-08-16 12:00:00
  1853-09-16 00:00:00  1853-10-16 12:00:00  1853-11-16 00:00:00  1853-12-16 12:00:00
  1854-01-16 12:00:00  1854-02-15 00:00:00  1854-03-16 12:00:00  1854-04-16 00:00:00
  1854-05-16 12:00:00  1854-06-16 00:00:00  1854-07-16 12:00:00  1854-08-16 12:00:00
  1854-09-16 00:00:00  1854-10-16 12:00:00  1854-11-16 00:00:00  1854-12-16 12:00:00
```

& does not block the terminal

Adjusting grid and coordinates

Knowing the new file

Max-Planck-Institut für Meteorologie CDO

```
                          time : 1980 steps
   RefTime =  1850-01-01 00:00:00  Units = days  Calendar = 365_day  Bounds = true
 YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
 1850-01-16 12:00:00  1850-02-15 00:00:00  1850-03-16 12:00:00  1850-04-16 00:00:00
 1850-05-16 12:00:00  1850-06-16 00:00:00  1850-07-16 12:00:00  1850-08-16 12:00:00
 1850-09-16 00:00:00  1850-10-16 12:00:00  1850-11-16 00:00:00  1850-12-16 12:00:00
 1851-01-16 12:00:00  1851-02-15 00:00:00  1851-03-16 12:00:00  1851-04-16 00:00:00
 1851-05-16 12:00:00  1851-06-16 00:00:00  1851-07-16 12:00:00  1851-08-16 12:00:00
 1851-09-16 00:00:00  1851-10-16 12:00:00  1851-11-16 00:00:00  1851-12-16 12:00:00
 1852-01-16 12:00:00  1852-02-15 00:00:00  1852-03-16 12:00:00  1852-04-16 00:00:00
 1852-05-16 12:00:00  1852-06-16 00:00:00  1852-07-16 12:00:00  1852-08-16 12:00:00
 1852-09-16 00:00:00  1852-10-16 12:00:00  1852-11-16 00:00:00  1852-12-16 12:00:00
 1853-01-16 12:00:00  1853-02-15 00:00:00  1853-03-16 12:00:00  1853-04-16 00:00:00
 1853-05-16 12:00:00  1853-06-16 00:00:00  1853-07-16 12:00:00  1853-08-16 12:00:00
 1853-09-16 00:00:00  1853-10-16 12:00:00  1853-11-16 00:00:00  1853-12-16 12:00:00
 1854-01-16 12:00:00  1854-02-15 00:00:00  1854-03-16 12:00:00  1854-04-16 00:00:00
 1854-05-16 12:00:00  1854-06-16 00:00:00  1854-07-16 12:00:00  1854-08-16 12:00:00
 1854-09-16 00:00:00  1854-10-16 12:00:00  1854-11-16 00:00:00  1854-12-16 12:00:00
  ........................................................................
  ........................................................................
  ..........
 2010-01-16 12:00:00  2010-02-15 00:00:00  2010-03-16 12:00:00  2010-04-16 00:00:00
 2010-05-16 12:00:00  2010-06-16 00:00:00  2010-07-16 12:00:00  2010-08-16 12:00:00
 2010-09-16 00:00:00  2010-10-16 12:00:00  2010-11-16 00:00:00  2010-12-16 12:00:00
 2011-01-16 12:00:00  2011-02-15 00:00:00  2011-03-16 12:00:00  2011-04-16 00:00:00
 2011-05-16 12:00:00  2011-06-16 00:00:00  2011-07-16 12:00:00  2011-08-16 12:00:00
 2011-09-16 00:00:00  2011-10-16 12:00:00  2011-11-16 00:00:00  2011-12-16 12:00:00
 2012-01-16 12:00:00  2012-02-15 00:00:00  2012-03-16 12:00:00  2012-04-16 00:00:00
 2012-05-16 12:00:00  2012-06-16 00:00:00  2012-07-16 12:00:00  2012-08-16 12:00:00
 2012-09-16 00:00:00  2012-10-16 12:00:00  2012-11-16 00:00:00  2012-12-16 12:00:00
 2013-01-16 12:00:00  2013-02-15 00:00:00  2013-03-16 12:00:00  2013-04-16 00:00:00
 2013-05-16 12:00:00  2013-06-16 00:00:00  2013-07-16 12:00:00  2013-08-16 12:00:00
 2013-09-16 00:00:00  2013-10-16 12:00:00  2013-11-16 00:00:00  2013-12-16 12:00:00
 2014-01-16 12:00:00  2014-02-15 00:00:00  2014-03-16 12:00:00  2014-04-16 00:00:00
 2014-05-16 12:00:00  2014-06-16 00:00:00  2014-07-16 12:00:00  2014-08-16 12:00:00
 2014-09-16 00:00:00  2014-10-16 12:00:00  2014-11-16 00:00:00  2014-12-16 12:00:00
cdo    sinfo: Processed 1 variable over 1980 timesteps [0.03s 48MB].
```

```
reboita@reboitaV14: /dados/reboita/trainings/CMIP6
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ ls
figures        scripts                                                  tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap.nc
gridWorld.txt  tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc  tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo remapbil,gridWorld.txt tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc tas_Amon_CanES
M5_ssp585_r1i1p1f1_gn_201501-210012_remap.nc
cdo    remapbil: Bilinear weights from gaussian (128x64) to lonlat (145x73) grid
cdo    remapbil: Processed 8454144 values from 1 variable over 1032 timesteps [0.33s 93MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo sinfo tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012_remap.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  CanESM5  v instant       1   1     10585   1  F32  : -1
   Grid coordinates :
     1 : lonlat                : points=10585 (145x73)
                           lon : 0 to 360 by 2.5 degrees_east
                           lat : -90 to 90 by 2.5 degrees_north
   Vertical coordinates :
     1 : height                : levels=1  scalar
                        height : 2 m
   Time coordinate :
                          time : 1032 steps
     RefTime =  1850-01-01 00:00:00  Units = days  Calendar = 365_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  2015-01-16 12:00:00  2015-02-15 00:00:00  2015-03-16 12:00:00  2015-04-16 00:00:00
  2015-05-16 12:00:00  2015-06-16 00:00:00  2015-07-16 12:00:00  2015-08-16 12:00:00
  2015-09-16 00:00:00  2015-10-16 12:00:00  2015-11-16 00:00:00  2015-12-16 12:00:00
  2016-01-16 12:00:00  2016-02-15 00:00:00  2016-03-16 12:00:00  2016-04-16 00:00:00
  2016-05-16 12:00:00  2016-06-16 00:00:00  2016-07-16 12:00:00  2016-08-16 12:00:00
  2016-09-16 00:00:00  2016-10-16 12:00:00  2016-11-16 00:00:00  2016-12-16 12:00:00
  2017-01-16 12:00:00  2017-02-15 00:00:00  2017-03-16 12:00:00  2017-04-16 00:00:00
  2017-05-16 12:00:00  2017-06-16 00:00:00  2017-07-16 12:00:00  2017-08-16 12:00:00
  2017-09-16 00:00:00  2017-10-16 12:00:00  2017-11-16 00:00:00  2017-12-16 12:00:00
  2018-01-16 12:00:00  2018-02-15 00:00:00  2018-03-16 12:00:00  2018-04-16 00:00:00
  2018-05-16 12:00:00  2018-06-16 00:00:00  2018-07-16 12:00:00  2018-08-16 12:00:00
  2018-09-16 00:00:00  2018-10-16 12:00:00  2018-11-16 00:00:00  2018-12-16 12:00:00
  2019-01-16 12:00:00  2019-02-15 00:00:00  2019-03-16 12:00:00  2019-04-16 00:00:00
  2019-05-16 12:00:00  2019-06-16 00:00:00  2019-07-16 12:00:00  2019-08-16 12:00:00
  2019-09-16 00:00:00  2019-10-16 12:00:00  2019-11-16 00:00:00  2019-12-16 12:00:00
```

Repeating the previous procedure but with the file of future climate

reboita@reboitaV14: /dados/reboita/trainings/CMIP6

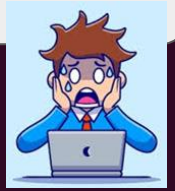
```
  2018-05-16 12:00:00  2018-06-16 00:00:00  2018-07-16 12:00:00  2018-08-16 12:00:00
  2018-09-16 00:00:00  2018-10-16 12:00:00  2018-11-16 00:00:00  2018-12-16 12:00:00
  2019-01-16 12:00:00  2019-02-15 00:00:00  2019-03-16 12:00:00  2019-04-16 00:00:00
  2019-05-16 12:00:00  2019-06-16 00:00:00  2019-07-16 12:00:00  2019-08-16 12:00:00
  2019-09-16 00:00:00  2019-10-16 12:00:00  2019-11-16 00:00:00  2019-12-16 12:00:00
   ...........................................................................
   ...........................................................................
   .
  2096-01-16 12:00:00  2096-02-15 00:00:00  2096-03-16 12:00:00  2096-04-16 00:00:00
  2096-05-16 12:00:00  2096-06-16 00:00:00  2096-07-16 12:00:00  2096-08-16 12:00:00
  2096-09-16 00:00:00  2096-10-16 12:00:00  2096-11-16 00:00:00  2096-12-16 12:00:00
  2097-01-16 12:00:00  2097-02-15 00:00:00  2097-03-16 12:00:00  2097-04-16 00:00:00
  2097-05-16 12:00:00  2097-06-16 00:00:00  2097-07-16 12:00:00  2097-08-16 12:00:00
  2097-09-16 00:00:00  2097-10-16 12:00:00  2097-11-16 00:00:00  2097-12-16 12:00:00
  2098-01-16 12:00:00  2098-02-15 00:00:00  2098-03-16 12:00:00  2098-04-16 00:00:00
  2098-05-16 12:00:00  2098-06-16 00:00:00  2098-07-16 12:00:00  2098-08-16 12:00:00
  2098-09-16 00:00:00  2098-10-16 12:00:00  2098-11-16 00:00:00  2098-12-16 12:00:00
  2099-01-16 12:00:00  2099-02-15 00:00:00  2099-03-16 12:00:00  2099-04-16 00:00:00
  2099-05-16 12:00:00  2099-06-16 00:00:00  2099-07-16 12:00:00  2099-08-16 12:00:00
  2099-09-16 00:00:00  2099-10-16 12:00:00  2099-11-16 00:00:00  2099-12-16 12:00:00
  2100-01-16 12:00:00  2100-02-15 00:00:00  2100-03-16 12:00:00  2100-04-16 00:00:00
  2100-05-16 12:00:00  2100-06-16 00:00:00  2100-07-16 12:00:00  2100-08-16 12:00:00
  2100-09-16 00:00:00  2100-10-16 12:00:00  2100-11-16 00:00:00  2100-12-16 12:00:00
cdo    sinfo: Processed 1 variable over 1032 timesteps [0.02s 47MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ ls
figures         tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc        tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012_remap.nc
gridWorld.txt   tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap.nc
scripts         tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ ls -ltr
total 202852
-rw-rw-r-- 1 reboita reboita 52443019 nov  6 16:25 tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412.nc
-rw-rw-r-- 1 reboita reboita 27267498 nov  6 16:27 tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012.nc
-rw-rw-r-- 1 reboita reboita       87 nov  7 03:54 gridWorld.txt
drwxrwxr-x 2 reboita reboita     4096 nov  7 03:55 figures
drwxrwxr-x 2 reboita reboita     4096 nov  7 03:56 scripts
-rw-rw-r-- 1 reboita reboita 84120526 nov  7 04:09 tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap.nc
-rw-rw-r-- 1 reboita reboita 43864669 nov  7 04:20 tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012_remap.nc
```

ls list files

ls -ltr list files and add information

New files

We still have the problem with the calendar if we want to work with GrADS software



Calendar

Data can have a

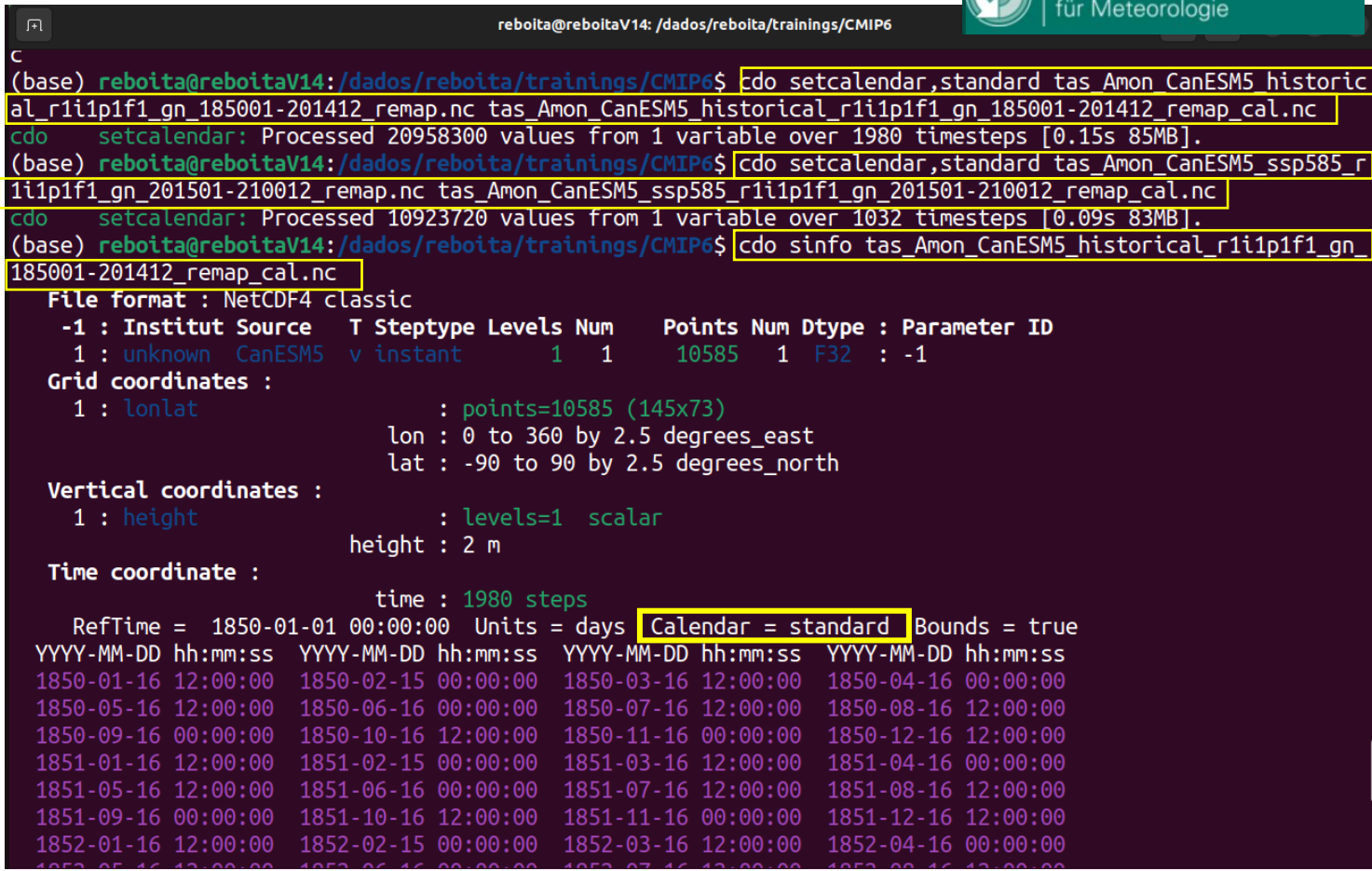
standard calendar (years with 365 and 366 days)
360 days (all years with 360 days – months with 30 days)
365 days (all years with 365 days – not include February 29)
366 days (all years with 366 days)

GrADS only supports standard calendar

We can perform a **trick with cdo** for loading and visualizing the data in GrADS, but **“the date the GrADS will show is not correct”** because it considers a standard calendar

Calendar

cdo setcalendar,standar infile.nc outfile.nc



Tutorial

CMIP6: Plotting

Open GrADS: type grads in the terminal

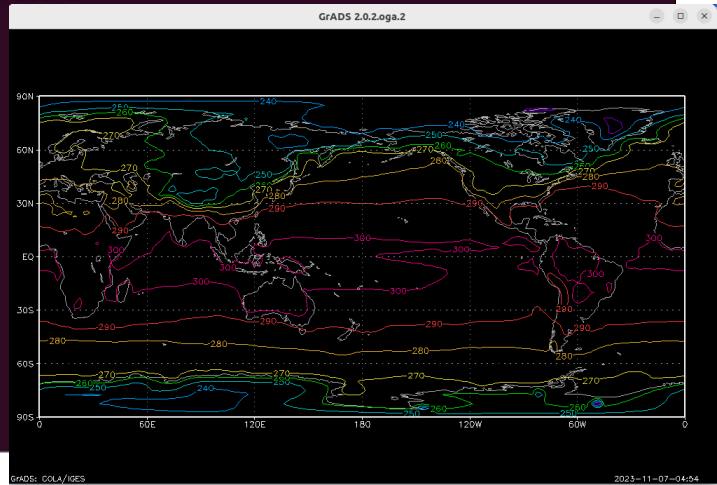
```
reboita@reboitaV14: /dados/reboita/trainings/CMIP6
Starting "/opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/grads    " ...


Grid Analysis and Display System (GrADS) Version 2.0.2.oga.2
Copyright (c) 1988-2011 by Brian Doty and the
Institute for Global Environment and Society (IGES)
GrADS comes with ABSOLUTELY NO WARRANTY
See file COPYRIGHT for more information

Config: v2.0.2.oga.2 little-endian readline printim grib2 netcdf hdf4-sds hdf5 opendap-grids,stn athena geotiff shapefile
Issue 'q config' command for more detailed configuration information
Loading User Defined Extensions table </opt/opengrads/Linux/Versions/2.0.2.oga.2/x86_64/gex/udxt> ... ok.
Landscape mode? ('n' for portrait):
GX Package Initialization: Size = 11 8.5
ga-> sdfopen tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
Scanning self-describing file: tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
SDF file tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc is open as file 1
LON set to 0 360
LAT set to -90 90
LEV set to 0 0
Time values set: 1850:1:16:12 1850:1:16:12
E set to 1 1
ga-> q file
File 1 : CanESM5 output prepared for CMIP6
  Descriptor: tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
  Binary: tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
  Type = Gridded
  Xsize = 145  Ysize = 73  Zsize = 1  Tsize = 1980  Esize = 1
  Number of Variables = 1
     tas  0  t,y,x  Near-Surface Air Temperature
ga-> d tas
Contouring: 220 to 300 interval 10
```

load the file

show file information

tas is the variable name

display a variable in a graphical window



Monthly means

```
Config: v2.2.1 little-endian readline grib2 netcdf hdf4-sds hdf5 opendap-grids,stn geotiff shapefile
Issue 'q config' and 'q gxconfig' commands for more detailed configuration information
Landscape mode? ('n' for portrait):
GX Package Initialization: Size = 11 8.5
ga-> sdfopen tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
Scanning self-describing file:  tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
SDF file tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc is open as file 1
LON set to 0 360
LAT set to -90 90
LEV set to 0 0
Time values set: 1850:1:16:12 1850:1:16:12
E set to 1 1
ga-> set t 1
Time values set: 1850:1:16:12 1850:1:16:12
ga-> set t 2
Time values set: 1850:2:16:12 1850:2:16:12
ga-> set t 13
Time values set: 1851:1:16:12 1851:1:16:12
ga-> q file
File 1 : CanESM5 output prepared for CMIP6
  Descriptor: tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
  Binary: tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc
  Type = Gridded
  Xsize = 145  Ysize = 73  Zsize = 1  Tsize = 1980  Esize = 1
  Number of Variables = 1
     tas  0  t,y,x  Near-Surface Air Temperature
ga-> define m01=ave(tas,t=1,t=1980,12)
Averaging.  dim = 3, start = 1, end = 1980
Define memory allocation size = 84680 bytes
ga-> define m02=ave(tas,t=2,t=1980,12)
Averaging.  dim = 3, start = 2, end = 1980
Define memory allocation size = 84680 bytes
ga-> define m03=ave(tas,t=3,t=1980,12)
Averaging.  dim = 3, start = 3, end = 1980
Define memory allocation size = 84680 bytes
ga->
```

Let's do it in a GrADS script?

OpenGrADS
"Opening GrADS to a World of Extensions"

*Script to compute the climatological means from **1950** to **2014** and plot 'reinit'

*Graphical window with white background
'set display color white'
'c'

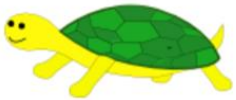
*Loading the file: sdfopen /path/file.nc Type all in the same line
'sdfopen /dados/reboita/trainings/CMIP6/tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc'

*Monthly means
'define m1=ave(tas,t=1,t=1980,12)'
'define m2=ave(tas,t=2,t=1980,12)'
'define m3=ave(tas,t=3,t=1980,12)'
'define m4=ave(tas,t=4,t=1980,12)'
'define m5=ave(tas,t=5,t=1980,12)'
'define m6=ave(tas,t=6,t=1980,12)'
'define m7=ave(tas,t=7,t=1980,12)'
'define m8=ave(tas,t=8,t=1980,12)'
'define m9=ave(tas,t=9,t=1980,12)'
'define m10=ave(tas,t=10,t=1980,12)'
'define m11=ave(tas,t=11,t=1980,12)'
'define m12=ave(tas,t=12,t=1980,12)'

OpenGrADS
"Opening GrADS to a World of Extensions"

Open a text editor
gedit → Linux
notepad++ → Windows

GrADS sintaxe:
Commands inside ' '
Comment *



OpenGrADS

"Opening GrADS to a World of Extensions"

```
*Seasonal means

'define djf=(m1+m2+m12)/3'
'define mam=(m3+m4+m5)/3'
'define jja=(m6+m7+m8)/3'
'define son=(m9+m10+m11)/3'

*Annual mean

*option 1
'define annual=(djf+mam+jja+son)/4'

*option 2
*'define annual=(tas,t=1,tas=1980)'
```

Part II

```
*Plotting

time=1
while(time<=12)
'set t 'time

'set gxout shaded'
'set clevs -20 -15 -10 -5 0 5 10 15 20'
'set ccols 9 14 4 11 5 10 7 12 8 2 6'

*Remove bottom grads information
'set grads off'

*Increase the font size
'set xlopts 1 1 0.16'
'set ylopts 1 1 0.14'

*Changing the TAS unit to Celsius
'd m'time'-273.15'
'draw title TAS ('time')'
'cbarn.gs'
*Defining the path to store the figures
'printim /dados/reboita/trainings/CMIP6/
figures/TAS_'time'.png'

*Click enter to see each image
pull n
'c'

time=time+1
endwhile
```

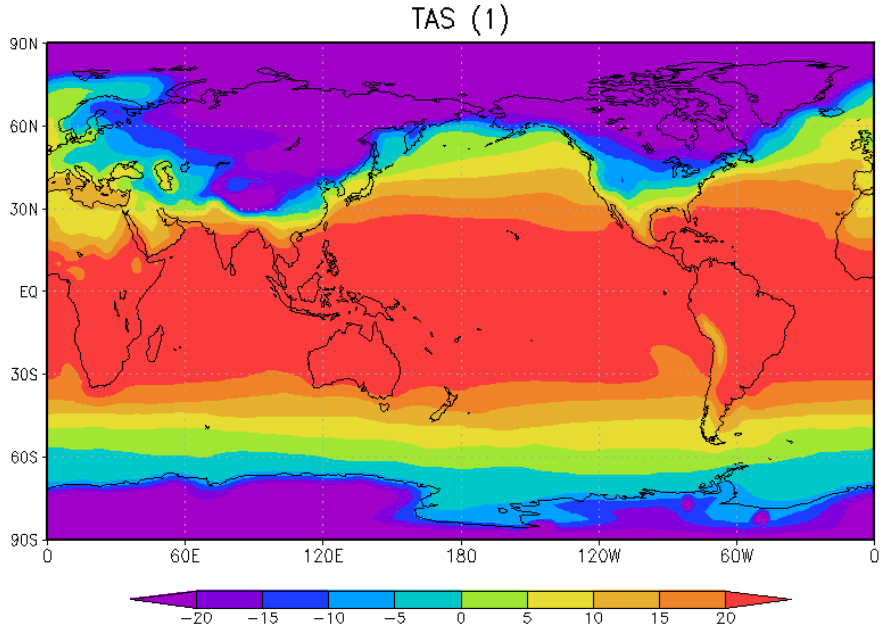
Part III

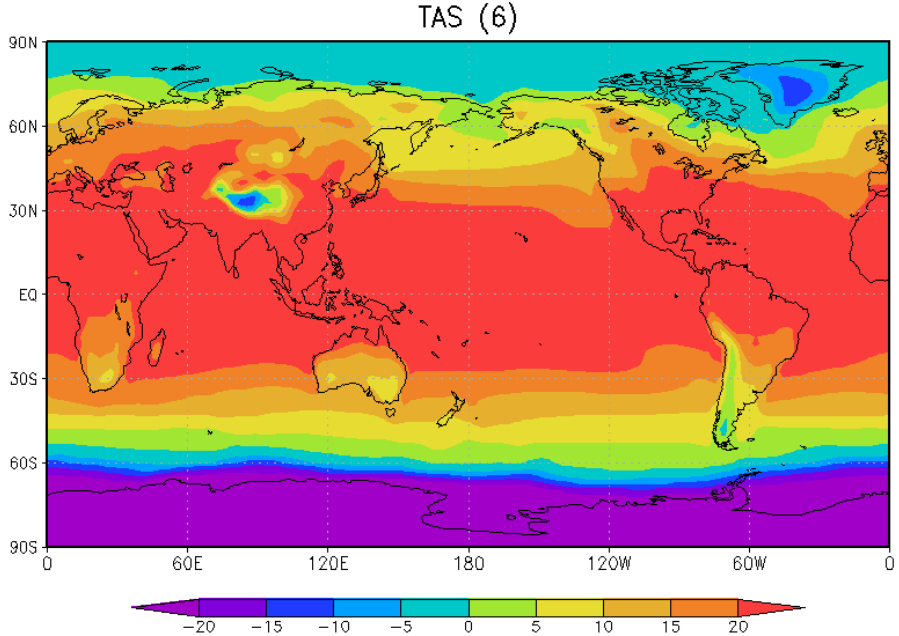
Air temperature 2-m (ºC)

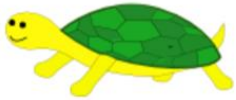
January and June (1850-2014)

OpenGrADS

"Opening GrADS to a World of Extensions"







OpenGrADS

"Opening GrADS to a World of Extensions"

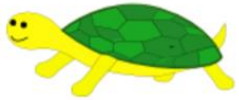
Save the previous script with the name do_difference.gs

In this script, load the historical file and future file and compute the monthly and seasonal means

Historical period: 1995-2014
Future period: 2080-2099

Plot the seasonal difference between future (2080-2099) and historical period (1995-2014).

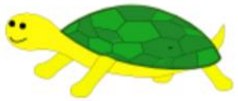
Abrir



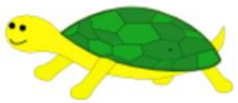
OpenGrADS

"Opening GrADS to a World of Extensions"

```
********** Compute the monthly and seasonal climatological means of *************
*****************   historical and future projections    ************************

'reinit'

*Graphical windown with white background
'set display color white'
'c'

######################## Historical Period ##################

*Loading the file
'sdfopen /dados/reboita/trainings/CMIP6/tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc'

*Monthly means

'define m1h=ave(tas,time=00Z01Jan1995,time=00Z31Dec2014,12)'
'define m2h=ave(tas,time=00Z01Feb1995,time=00Z31Dec2014,12)'
'define m3h=ave(tas,time=00Z01Mar1995,time=00Z31Dec2014,12)'
'define m4h=ave(tas,time=00Z01Apr1995,time=00Z31Dec2014,12)'
'define m5h=ave(tas,time=00Z01May1995,time=00Z31Dec2014,12)'
'define m6h=ave(tas,time=00Z01Jun1995,time=00Z31Dec2014,12)'
'define m7h=ave(tas,time=00Z01Jul1995,time=00Z31Dec2014,12)'
'define m8h=ave(tas,time=00Z01Aug1995,time=00Z31Dec2014,12)'
'define m9h=ave(tas,time=00Z01Sep1995,time=00Z31Dec2014,12)'
'define m10h=ave(tas,time=00Z01Oct1995,time=00Z31Dec2014,12)'
'define m11h=ave(tas,time=00Z01Nov1995,time=00Z31Dec2014,12)'
'define m12h=ave(tas,time=00Z01Dec1995,time=00Z31Dec2014,12)'

*Seasonal means

'define djfh=(m1h+m2h+m12h)/3'
'define mamh=(m3h+m4h+m5h)/3'
'define jjah=(m6h+m7h+m8h)/3'
'define sonh=(m9h+m10h+m11h)/3'

'close 1'

```




```
39
40
41 ######################## Future Period ##################
42
43 *Loading the file
44 'sdfopen /dados/reboita/trainings/CMIP6/tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012_remap_cal.nc'
45
46 *Monthly means
47
48 'define m1f=ave(tas,time=00Z01Jan2080,time=00Z31Dec2099,12)'
49 'define m2f=ave(tas,time=00Z01Feb2080,time=00Z31Dec2099,12)'
50 'define m3f=ave(tas,time=00Z01Mar2080,time=00Z31Dec2099,12)'
51 'define m4f=ave(tas,time=00Z01Apr2080,time=00Z31Dec2099,12)'
52 'define m5f=ave(tas,time=00Z01May2080,time=00Z31Dec2099,12)'
53 'define m6f=ave(tas,time=00Z01Jun2080,time=00Z31Dec2099,12)'
54 'define m7f=ave(tas,time=00Z01Jul2080,time=00Z31Dec2099,12)'
55 'define m8f=ave(tas,time=00Z01Aug2080,time=00Z31Dec2099,12)'
56 'define m9f=ave(tas,time=00Z01Sep2080,time=00Z31Dec2099,12)'
57 'define m10f=ave(tas,time=00Z01Oct2080,time=00Z31Dec2099,12)'
58 'define m11f=ave(tas,time=00Z01Nov2080,time=00Z31Dec2099,12)'
59 'define m12f=ave(tas,time=00Z01Dec2080,time=00Z31Dec2099,12)'
60
61 *Seasonal means
62
63 'define djff=(m1f+m2f+m12f)/3'
64 'define mamf=(m3f+m4f+m5f)/3'
65 'define jjaf=(m6f+m7f+m8f)/3'
66 'define sonf=(m9f+m10f+m11f)/3'
67
68
69
70 ######################## Future - Historical ##################
71
72 'define dif1=djff-djfh'
73 'define dif2=mamf-mamh'
74 'define dif3=jjaf-jjah'
75 'define dif4=sonf-sonh'
```



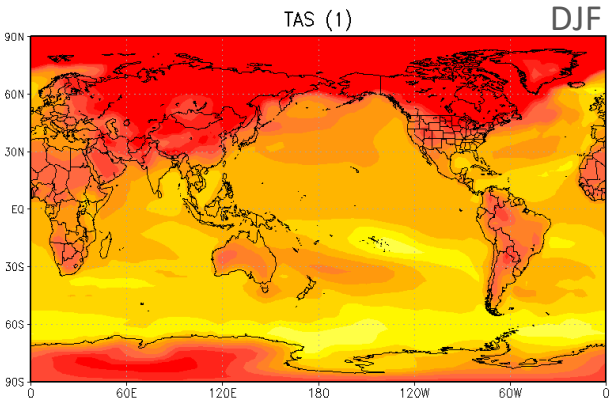
OpenGrADS

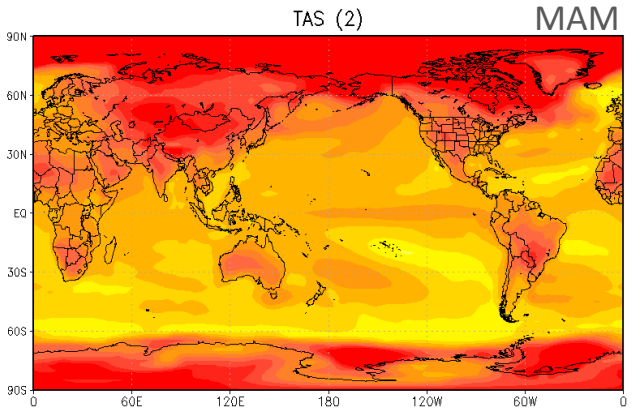
"Opening GrADS to a World of Extensions"

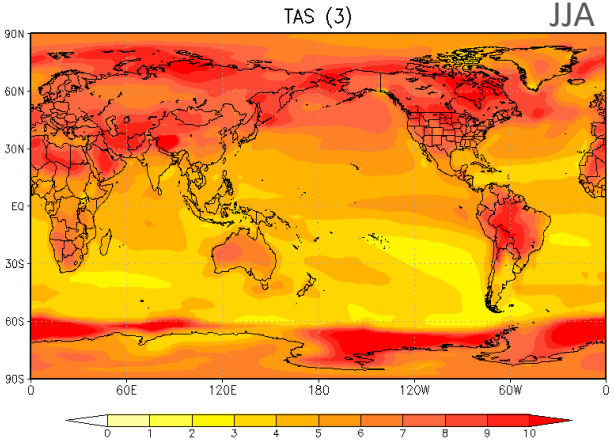
```
77 ############################ Plotting ########################
78
79 *Plotting
80
81 time=1
82 while(time<=4)
83
84 'set t 'time
85
86 'set gxout shaded'
87 *'set clevs 1 2 3 4 5 6 7 8 9'
88 *'set ccols 9 14 4 11 5 10 7 12 8 2 6'
89 'set mpdset mres'
90
91 *Remove bottom grads information
92 'set grads off'
93
94 *Increase the font size
95 'set xlopts 1 1 0.16'
96 'set ylopts 1 1 0.14'
97
98
99 *Changing the TAS unit to Celsius
100 'color 0 10 1 -kind white->yellow->orange->tomato->red'
101 'd dif'time''
102 'draw title TAS ('time')'
103 'cbarn.gs'
104 *Defining the path to store the figures
105 'printim /dados/reboita/trainings/CMIP6/figures/dif_TAS_'time'.png'
106
107 *Click enter to see each image
108 pull n
109 'c'
110
111 time=time+1
112 endwhile
113
```

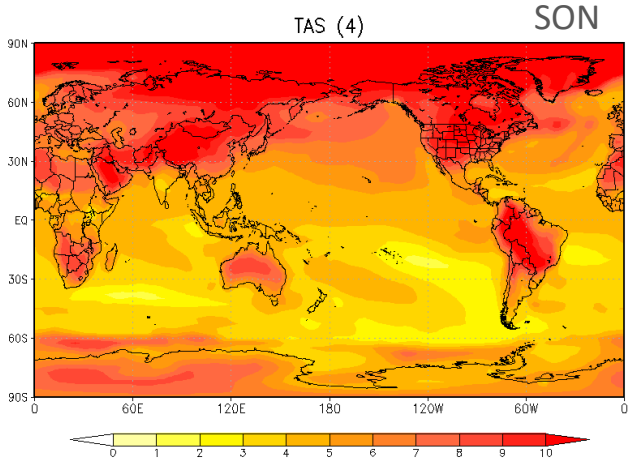
Air temperature 2-m (ºC)
Future (2080-2099) - Historical (1995-2014)

OpenGrADS
"Opening GrADS to a World of Extensions"









Extracting a time series

Using **CDO**: merge the files of historical and future periods

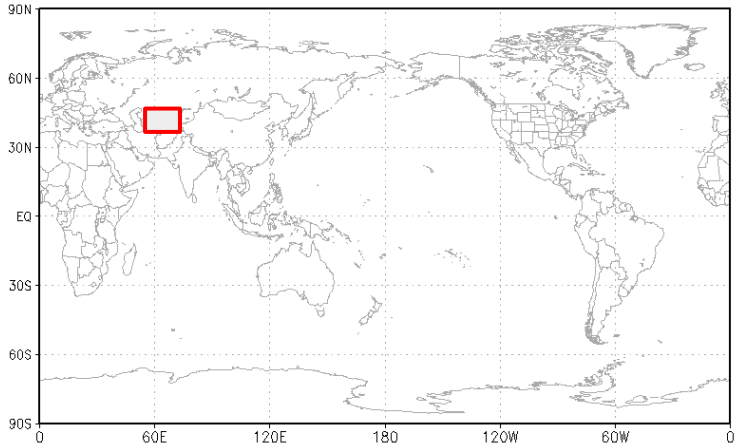
```
cdo mergetime in_01.nc in_02.nc out.nc
```

Using **GrADS**: compute the monthly mean of the air temperature for each time step for the whole globe and for an area covering Uzbekistan, convert the unit from K to ºC and save the results in a text file with the configuration:

Month Year Globe UZ

Using **Excel**: plot the monthly time series.
Compute the annual mean and make a new plot.

Uzbekistan coordinates
lon1 = 56
lon2 = 73
lat1 = 37
lat2 = 45.5

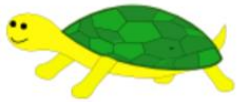


reboita@reboitaV14: /dados/reboita/trainings/CMIP6

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo mergetime tas_Amon_CanESM5_historical_r1i1p1f1_gn_185001-201412_remap_cal.nc tas_Amon_CanESM5_ssp585_r1i1p1f1_gn_201501-210012_remap_cal.nc tas_Amon_CanESM5_185001_210012.nc
cdo    mergetime: Processed 31882020 values from 2 variables over 3012 timesteps [0.28s 85MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CMIP6$ cdo sinfo tas_Amon_CanESM5_185001_210012.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  CanESM5  v instant       1   1     10585   1  F32  : -1
   Grid coordinates :
     1 : lonlat                    : points=10585 (145x73)
                           lon : 0 to 360 by 2.5 degrees_east
                           lat : -90 to 90 by 2.5 degrees_north
   Vertical coordinates :
     1 : height                    : levels=1  scalar
                         height : 2 m
   Time coordinate :
                           time : 3012 steps
     RefTime =  1850-01-01 00:00:00  Units = days  Calendar = standard  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1850-01-16 12:00:00  1850-02-15 00:00:00  1850-03-16 12:00:00  1850-04-16 00:00:00
  1850-05-16 12:00:00  1850-06-16 00:00:00  1850-07-16 12:00:00  1850-08-16 12:00:00
  1850-09-16 00:00:00  1850-10-16 12:00:00  1850-11-16 00:00:00  1850-12-16 12:00:00
  1851-01-16 12:00:00  1851-02-15 00:00:00  1851-03-16 12:00:00  1851-04-16 00:00:00
  1851-05-16 12:00:00  1851-06-16 00:00:00  1851-07-16 12:00:00  1851-08-16 12:00:00
  1851-09-16 00:00:00  1851-10-16 12:00:00  1851-11-16 00:00:00  1851-12-16 12:00:00
  1852-01-16 12:00:00  1852-02-15 00:00:00  1852-03-16 12:00:00  1852-04-16 00:00:00
  1852-05-16 12:00:00  1852-06-16 00:00:00  1852-07-16 12:00:00  1852-08-16 12:00:00
  1852-09-16 00:00:00  1852-10-16 12:00:00  1852-11-16 00:00:00  1852-12-16 12:00:00
  1853-01-16 12:00:00  1853-02-15 00:00:00  1853-03-16 12:00:00  1853-04-16 00:00:00
  1853-05-16 12:00:00  1853-06-16 00:00:00  1853-07-16 12:00:00  1853-08-16 12:00:00
```

Abrir

write_timeseries_tas_globe_UZ.gs
/dados/reboita/trainings/CMIP6/scripts



OpenGrADS

"Opening GrADS to a World of Extensions"

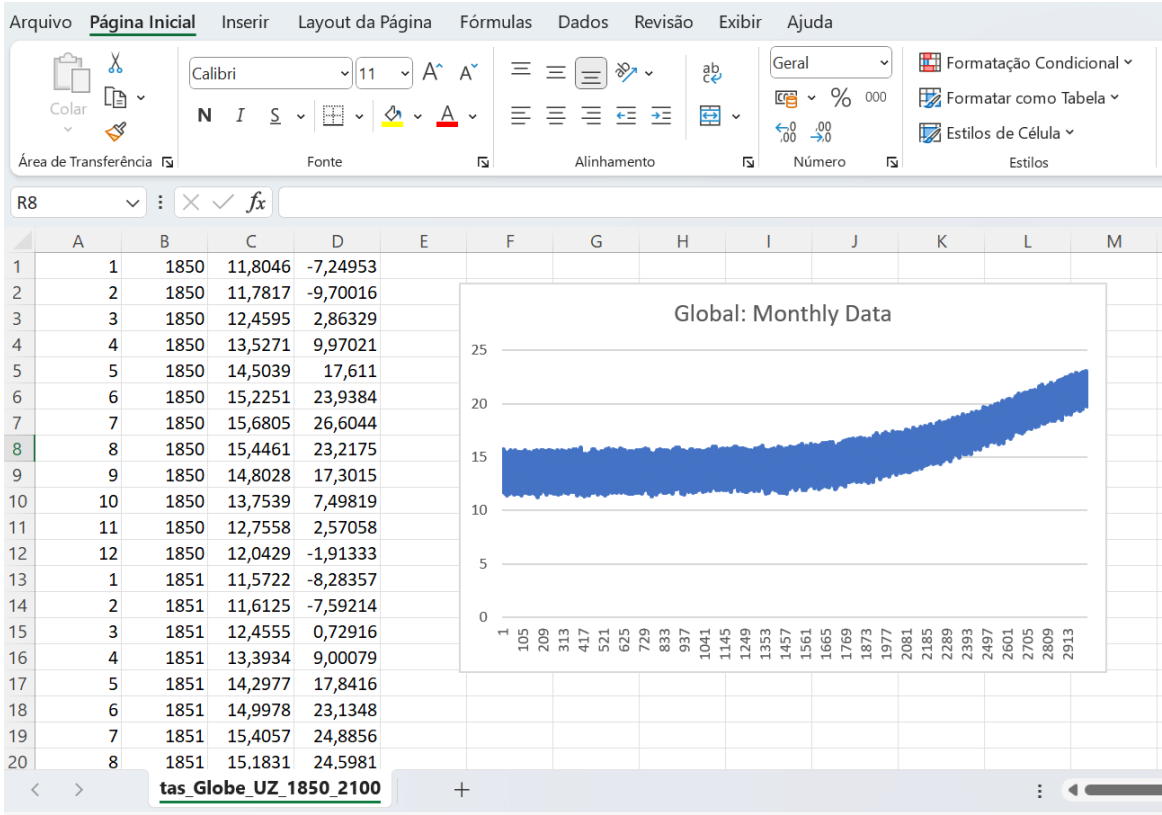
```
1
2  ********************************************************************************
3  *This program creates a time series of each selected region
4
5  'reinit'
6
7  ********************************************************************************
8  *** MODIFY HERE  (INCLUDING PATH)
9
10 'sdfopen /dados/reboita/trainings/CMIP6/tas_Amon_CanESM5_185001_210012.nc'
11
12 ********************************************************************************
13
14 ***Here we get the variable name automatically
15 'q file'
16 row=sublin(result,7)
17 var=subwrd(row,1)
18 say 'variavel name ='  var
19
20 ***Here we get the time stpes automatically
21 'q file'
22 row=sublin(result,5)
23 ntimonth=subwrd(row,12)
24 say 'ntimonth ='  ntimonth
25
26 *Looping time
27 tt=1
28 while(tt<=ntimonth)
29 'set t 'tt
30
31 'q dims'
32 row=sublin(result,5)
33 dd=subwrd(row,6)
34 month=substr(dd,6,3)
35 year=substr(dd,9,4)
36
37 say year
38
39
40 if (month = JAN) ; month1 = 01 ; endif
41 if (month = FEB) ; month1 = 02 ; endif
42 if (month = MAR) ; month1 = 03 ; endif
43 if (month = APR) ; month1 = 04 ; endif
44 if (month = MAY) ; month1 = 05 ; endif
45 if (month = JUN) ; month1 = 06 ; endif
46 if (month = JUL) ; month1 = 07 ; endif
47 if (month = AUG) ; month1 = 08 ; endif
48 if (month = SEP) ; month1 = 09 ; endif
49 if (month = OCT) ; month1 = 10 ; endif
50 if (month = NOV) ; month1 = 11 ; endif
51 if (month = DEC) ; month1 = 12 ; endif
52
53 say month1
54
55 'set gxout print'
56
57 *** MODIFY HERE (COORDINATES)
58
59 'define globe=aave('var',lon=0,lon=360,lat=-90,lat=90)'
60 *Changing the unit from Kelvin to Celsius
61 'd globe-273.15'
62 value1=sublin(result,2)
63 say value1
64
65 'define uz=aave('var',lon=56,lon=73,lat=37,lat=45.5)'
66
67 'd uz-273.15'
68 value2=sublin(result,2)
69 say value2
70
71
72 *** MODIFY HERE  (PATH AND NAME OF THE OUTFILE)
73
74 write('/dados/reboita/trainings/CMIP6/tas_Globe_UZ_1850_2100.txt', month1 ' ' year ' ' value1  ' ' value2)
75 tt=tt+1
76 endwhile
77
78
79 close('/dados/reboita/trainings/CMIP6/tas_Globe_UZ_1850_2100.txt', month1 ' ' year ' ' value1 ' ' value2)
80
81 'quit'
82
83
84
```

Month Year Globe UZ

write_timeseries_tas_globe_UZ.gs

```
 1 01 1850 11.8046  -7.24953
 2 02 1850 11.7817  -9.70016
 3 03 1850 12.4595  2.86329
 4 04 1850 13.5271  9.97021
 5 05 1850 14.5039  17.611
 6 06 1850 15.2251  23.9384
 7 07 1850 15.6805  26.6044
 8 08 1850 15.4461  23.2175
 9 09 1850 14.8028  17.3015
10 10 1850 13.7539  7.49819
11 11 1850 12.7558  2.57058
12 12 1850 12.0429  -1.91333
13 01 1851 11.5722  -8.28357
14 02 1851 11.6125  -7.59214
15 03 1851 12.4555  0.72916
16 04 1851 13.3934  9.00079
17 05 1851 14.2977  17.8416
18 06 1851 14.9978  23.1348
19 07 1851 15.4057  24.8856
20 08 1851 15.1831  24.5981
21 09 1851 14.2871  16.7393
22 10 1851 13.3619  9.03962
23 11 1851 12.4745  -3.0703
24 12 1851 11.6876  -9.1215
25 01 1852 11.4539  -11.5507
26 02 1852 11.5844  -8.30785
27 03 1852 12.3318  0.403973
28 04 1852 13.3007  6.77463
29 05 1852 14.4446  17.9846
30 06 1852 15.1435  22.8986
31 07 1852 15.4465  26.4004
32 08 1852 15.2506  24.6624
33 09 1852 14.4683  16.1689
34 10 1852 13.5744  10.7595
35 11 1852 12.6336  3.63298
36 12 1852 11.9406  -0.707756
37 01 1853 11.6266  0.658405
38 02 1853 11.5961  -2.53058
39 03 1853 12.4467  6.9339
40 04 1853 13.4692  11.2142
41 05 1853 14.5869  15.8867
42 06 1853 15.219  24.4159
43 07 1853 15.6425  26.4353
44 08 1853 15.409  23.8641
45 09 1853 14.6549  16.8877
46 10 1853 13.742  7.98781
47 11 1853 12.84  4.43057
48 12 1853 12.1913  -6.24431
49 01 1854 11.7131  -6.73157
50 02 1854 11.775  -4.40387
51 03 1854 12.4198  0.0287897
52 04 1854 13.5564  10.3253
```

Excel

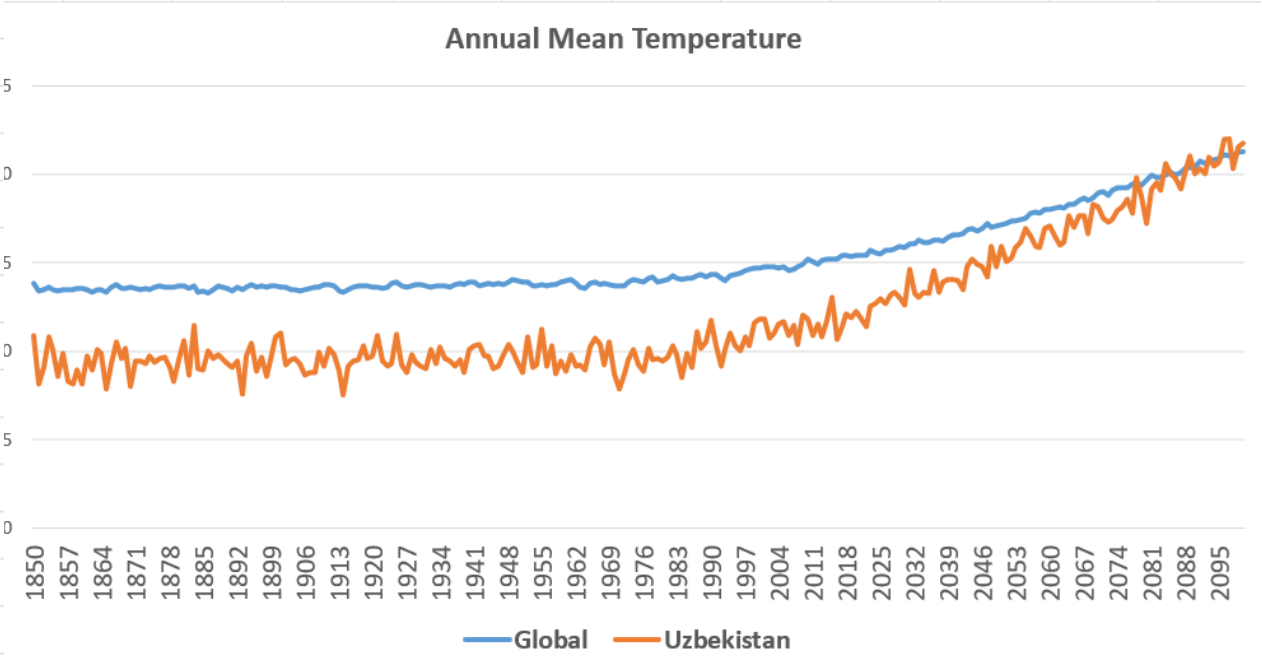


	A	B	C	D
1	1	1850	11,8046	-7,24953
2	2	1850	11,7817	-9,70016
3	3	1850	12,4595	2,86329
4	4	1850	13,5271	9,97021
5	5	1850	14,5039	17,611
6	6	1850	15,2251	23,9384
7	7	1850	15,6805	26,6044
8	8	1850	15,4461	23,2175
9	9	1850	14,8028	17,3015
10	10	1850	13,7539	7,49819
11	11	1850	12,7558	2,57058
12	12	1850	12,0429	-1,91333
13	1	1851	11,5722	-8,28357
14	2	1851	11,6125	-7,59214
15	3	1851	12,4555	0,72916
16	4	1851	13,3934	9,00079
17	5	1851	14,2977	17,8416
18	6	1851	14,9978	23,1348
19	7	1851	15,4057	24,8856
20	8	1851	15,1831	24,5981

	A	B	C
1		Global	Uzbekistan
2	1850	13,8163	10,90559818
3	1851	13,3941	8,158455
4	1852	13,4644	9,093306417
5	1853	13,6187	10,82830792
6	1854	13,4817	10,08572331
7	1855	13,4301	8,5883775
8	1856	13,4804	9,8877425
9	1857	13,4721	8,30967725
10	1858	13,4495	8,153013275
11	1859	13,576	8,932196167
12	1860	13,5384	8,147553333
13	1861	13,5038	9,726085275
14	1862	13,3523	8,954719333
15	1863	13,4913	10,07634833
16	1864	13,4783	9,861345833
17	1865	13,3559	7,8404775
18	1866	13,5938	9,318476767
19	1867	13,7386	10,55818
20	1868	13,5894	9,581425833
21	1869	13,5522	10,14803917

From the monthly data, get the annual mean.

You can compute it using **Excel**. See Dr. Ali's tutorial.



Tutorial

CORDEX: Download

CORDEX-CORE (Coordinated Regional Climate Downscaling Experiments - Coordinated Output for Regional Evaluations)

- set of simulations for most CORDEX domains

- scenarios **RCPs 2.6** and **8.5**, and

- 25 km of horizontal resolution

Coordination of Regional Downscaling

William Joseph Gutowski and Filippo Giorgi

https://doi.org/10.1093/acrefore/9780190228620.013.658
Published online: 28 February 2020

Summary

Regional climate downscaling has been motivated by the objective to understand how climate processes not resolved by global models can influence the evolution of a region's climate and by the need to provide climate change information to other sectors, such as water resources, agriculture, and human health, on scales poorly resolved by global models but where impacts are felt. There are four primary approaches to regional downscaling: regional climate models (RCMs), empirical statistical downscaling (ESD), variable resolution global models (VARGCM), and "time-slice" simulations with high-resolution global atmospheric models (HIRGCM). Downscaling using RCMs is often referred to as dynamical downscaling to contrast it with statistical downscaling. Although there have been efforts to coordinate each of these approaches, the predominant effort to coordinate regional downscaling activities has involved RCMs.

Climate Dynamics Journal has a special issue focusing on the CORDEX-CORE

link.springer.com/article/10.1007/s00382-021-05902-w

Springer Link

Editorial | Published: 04 August 2021

Editorial for the CORDEX-CORE Experiment I Special Issue

Filippo Giorgi ✉, Erika Coppola, Claas Teichmann & Daniela Jacob

Climate Dynamics **57**, 1265–1268 (2021) | Cite this article

1050 Accesses | **1** Altmetric | Metrics

The CORDEX-CORE initiative

The Coordinated Regional Downscaling Experiment (CORDEX, Giorgi et al. 2009; Jones et al. 2011a) is the main reference program for the climate downscaling community. During its first activities, CORDEX has resulted in the production of ensembles of projections over continental scale domains covering most land areas of the globe at an intermediate resolution of ~ 50 km (e.g. Giorgi and Gutowski 2015), with the exception of the EURO-CORDEX (Jacob et al. 2013; Jacob et al. 2020) and MED-CORDEX (Ruti et al. 2016) programs for which higher resolution projections have been completed. However, one of the weaknesses of this first set of CORDEX

WCRP CORDEX
Coordinated Regional Climate Downscaling Experiment

WEBPAGE

RCMs currently contributing to the CORDEX CORE framework simulate at least nine domains (Figure 1) with horizontal resolution of 0.22° (about 25 km, see Figure 1a and 1b):

- REMO model (contribution by GERICS)
- RegCM model (, Italy, with the participation of Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP/CAS), Oak Ridge National Laboratory, Tennessee, National Center for Atmospheric Research, NCAR, The Hong Kong University of Science and Technology)
-

Experiments:

- evaluation: reanalysis, 1979 to 2017
- historical, RCP2.6 and RCP8.5: GCMs, 1950 (1970) to 2100

Forcings: ERA-Interim re-analysis, GCMs representing the range of low, medium, and high global equilibrium climate sensitivity (ECS) (in addition, there are three backup GCMs, as alternative forcing). The driving GCMs selected for the CORDEX-CORE ensemble offer a broad spread of ECS and were based on the suitability for the dynamical downscaling (McSweeney et al, 2015):

- NCC-NORESM (low ECS, backup: GFDL-ESM2M)
- MPI-ESM-LR/MPI-ESM-MR (medium ECS, backup: EC-Earth)
- HadGEM-ES (high ECS, backup: MIROC-MIROC5)

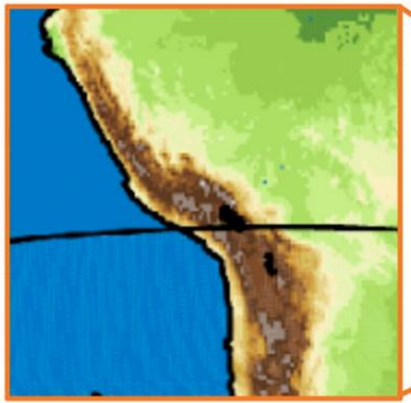


Figure 1b: Orographically structured area at CORDEX-CORE resolution of 0.22°.

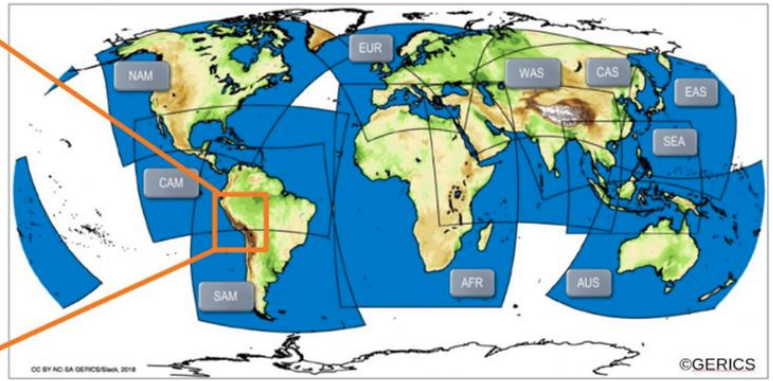
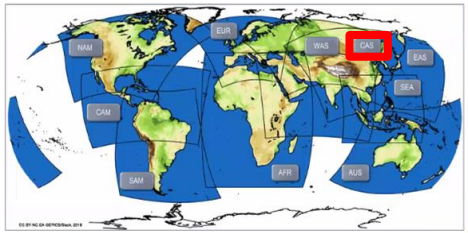


Figure 1a: CORDEX-CORE model domains used in the simulations. From top-left to bottom right: North America (**NAM**), Central America (**CAM**), South America (**SAM**), Europe (**EUR**), Africa (**AFR**), South Asia (**WAS**), East Asia (**EAS**), Southeast Asia (**SEA**), and Australasia (**AUS**). The domain

https://cordex.org/experiment-guidelines/cordex-core/cordex-core-simulations/

WCRP CORDEX
Coordinated Regional Climate Downscaling Experiment

WEBPAGE



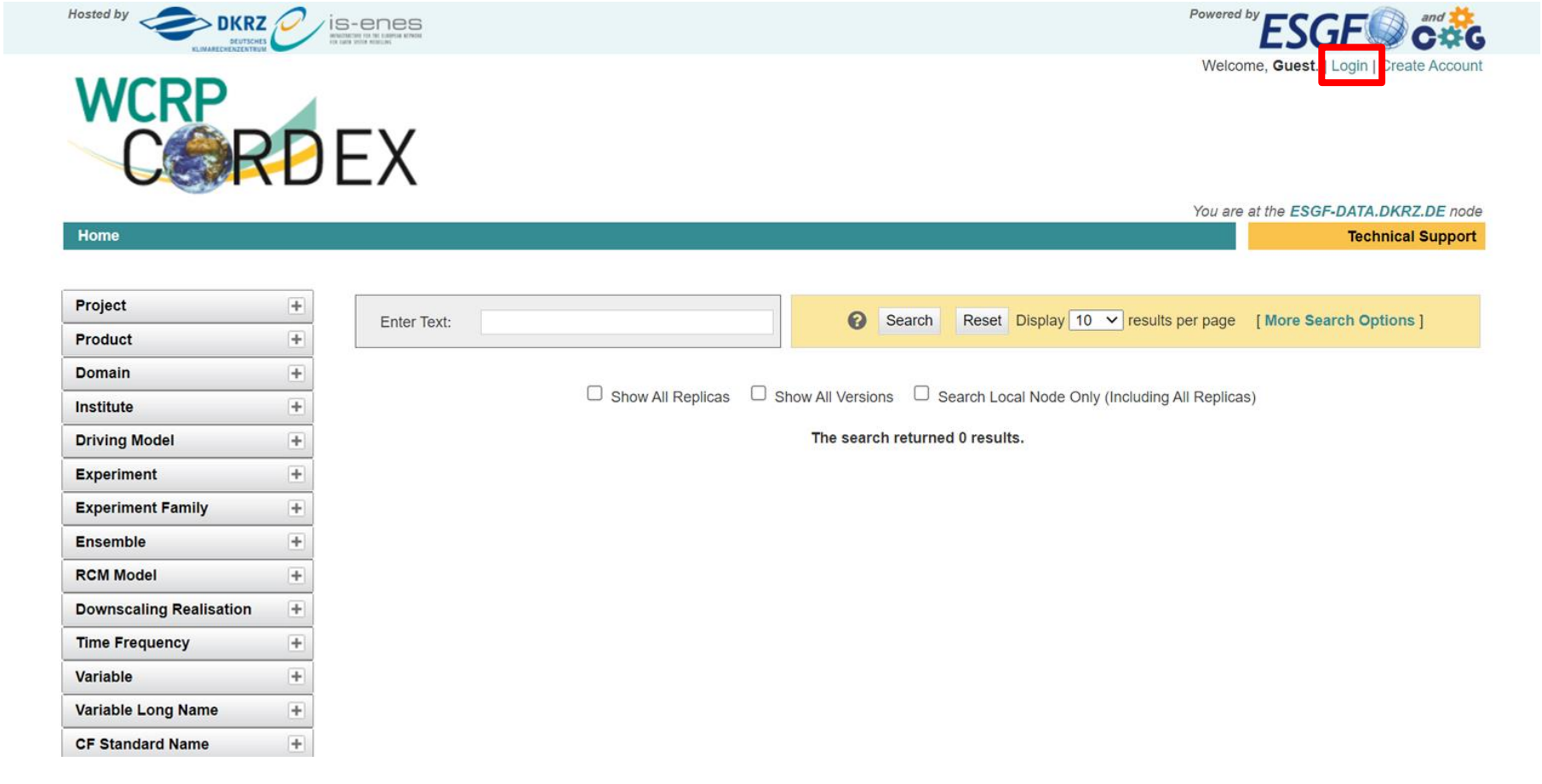
CORDEX-CORE available projections

Domains	ERA-Interim	NCC-NORESM	GFDL-ESM2M	MPI-ESM-LR	MPI-ESM-MR	HadGEM-ES	MIROC-MIROC5
CAS-22		●		●		●	
EUR-11/22	● ICTP	● ICTP		● ICTP		● ICTP	
AFR-22	● ICTP	● ICTP		●	ICTP	● ICTP	
CAM-22	● ICTP	●	ICTP	●	ICTP	● ICTP	
SAM-22	● ICTP	● ICTP		●	ICTP	● ICTP	
WAS-22	● ICTP	● ICTP		●	ICTP	●	ICTP
EAS-22	● ICTP	● ICTP		●	ICTP	● ICTP	
SEA-22	● ICTP	● ICTP		●	ICTP	● ICTP	
AUS-22	● ICTP	● ICTP		●	ICTP	● ICTP	
NAM-22	● ICTP	●	ICTP	●	ICTP	● ICTP	©GERICS

Figure 2: CORDEX-CORE simulation matrix. Orange GERICS-logo represents simulations performed using REMO, ICTP-logo represents simulations using RegCM.

Projections are performed by volunteers (no financial support).
WCRP needs more researchers to collaborate with the work.

https://esgf-data.dkrz.de/search/cordex-dkrz/



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Please note: if you have an older OpenID from the Earth System Grid Federation, you may have to create a new account.

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esgf-node.llnl.gov/esgf-idp/idp/login_ids.htm

ESGF OpenID Login

Status: not logged-in

Username:

Password:

SUBMIT

esgf-data.dkrz.de/search/cordex-dkrz/

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- Driving Model
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- Experiment Family
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- Downscaling Realisation
- Time Frequency
- Variable
- Variable Long Name
- CF Standard Name
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Project

- [x] CORDEX (179856)
- [ ] CORDEX-Adjust (1218)
- [ ] CORDEX-ESD (1370)
- [ ] CORDEX-FPSCONV (245)
- [ ] CORDEX-Reklies (6849)

Product

Domain

Institute

Driving Model

Experiment

Experiment Family

Ensemble

RCM Model

Downscaling Realisation

Time Frequency

Variable

Variable Long Name

CF Standard Name

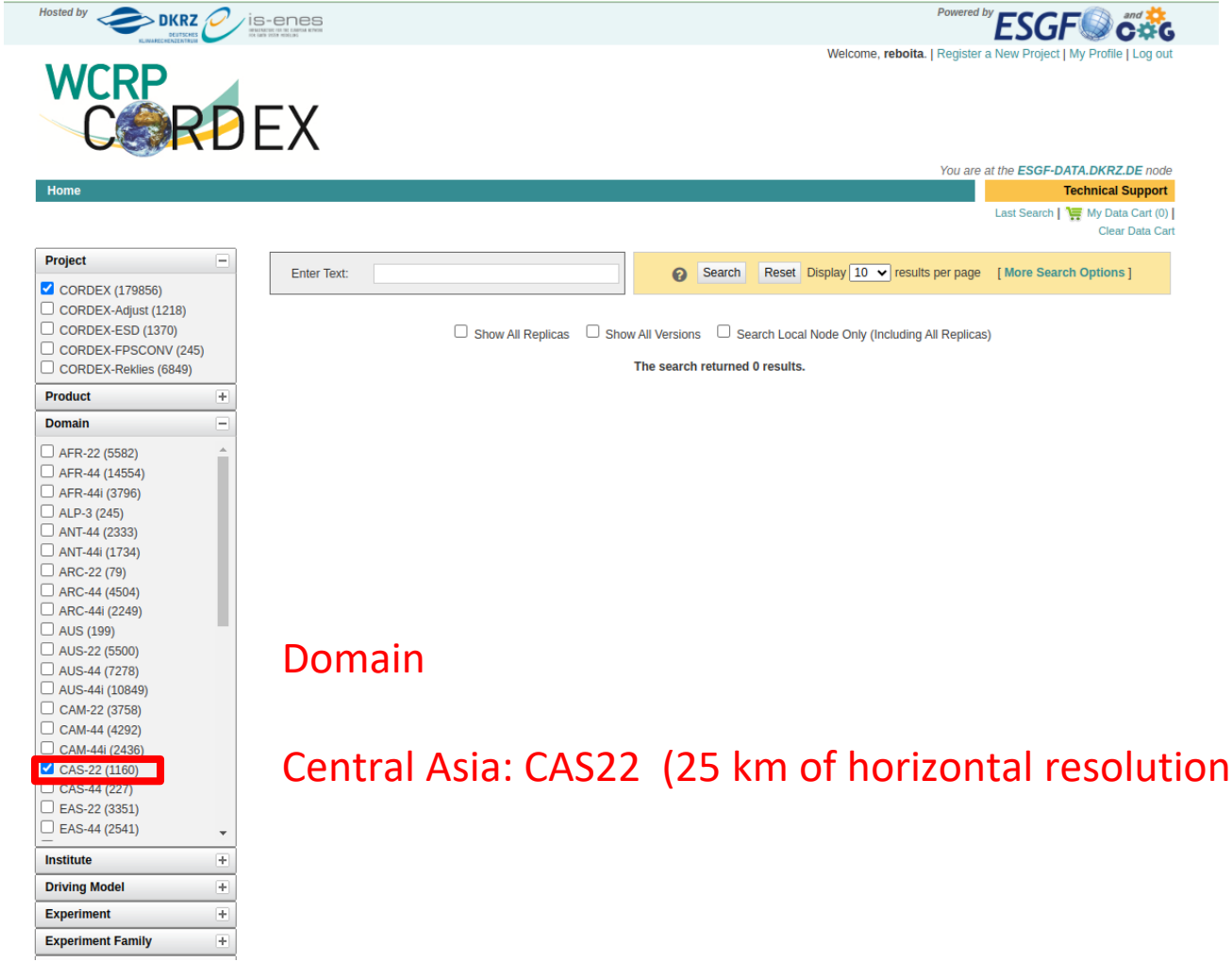
Datanode

Enter Text:

Search | Reset | Display 10 results per page | [More Search Options]

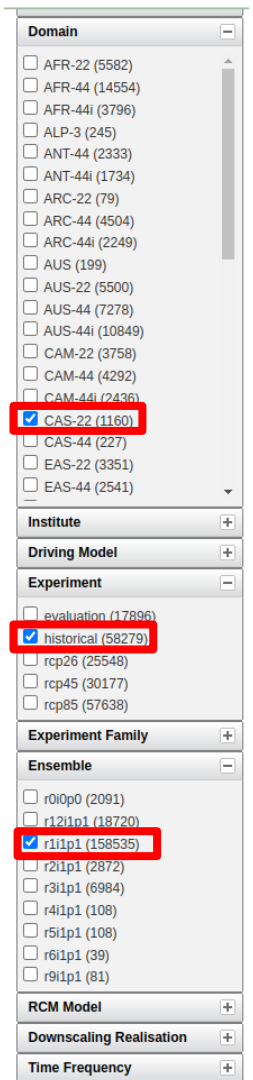
Show All Replicas | Show All Versions | Search Local Node Only (Including All Replicas)

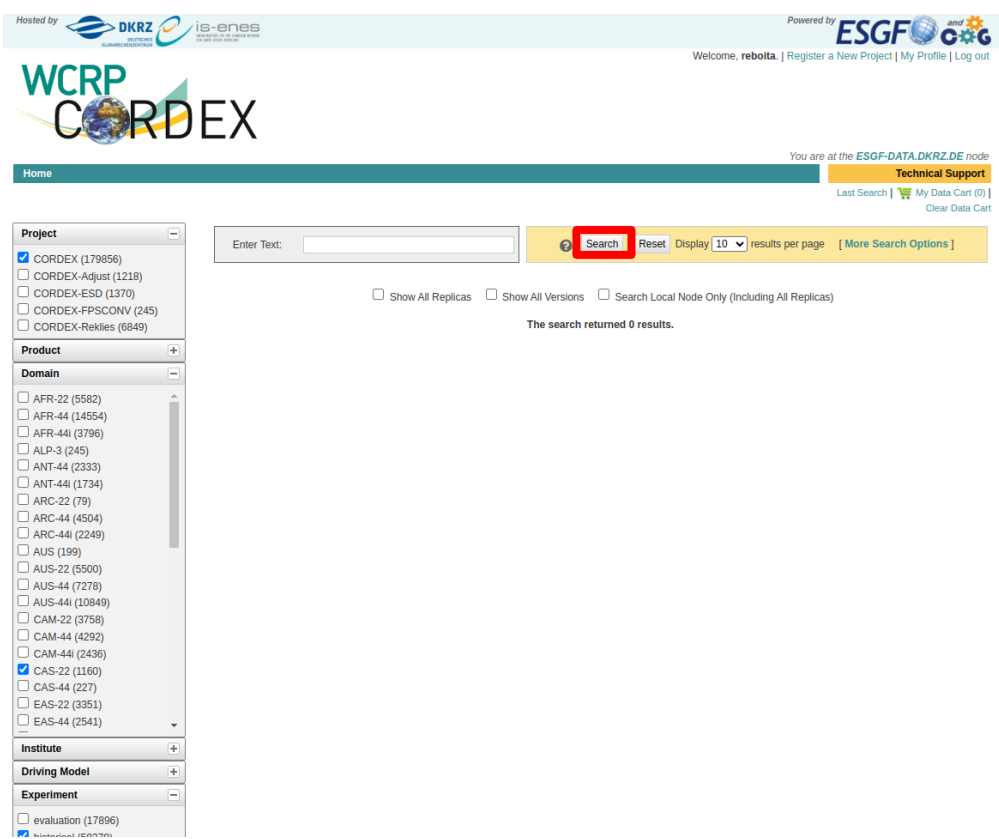
The search returned 0 results.



Domain

Central Asia: CAS22 (25 km of horizontal resolution)





The next selection is **RCM model**
But not all models in the list are available for CAS
To know the models available for CAS click on search
and come back to RCM option

WCRP CORDEX

Project −
- [x] CORDEX (333)

Product +

Domain −
- [x] CAS-22 (333)

Institute +

Driving Model +

Experiment −
- [x] historical (333)

Experiment Family +

Ensemble −
- [x] r1i1p1 (333)

RCM Model +

Downscaling Realisation +

Time Frequency +

Variable +

Variable Long Name +

CF Standard Name +

Datanode +

Enter Text: Search Reset Display 10 results per page [More Search Options]

☐ Show All Replicas ☐ Show All Versions ☐ Search Local Node Only (Including All Replicas)

Search Constraints: ✖CORDEX | ✖CAS-22 | ✖historical | ✖r1i1p1

Total Number of Results: 333

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1. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.3hr.tas**
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   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
2. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.hus850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
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   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
3. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua850**
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   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
4. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua200**
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   Add to Data Cart
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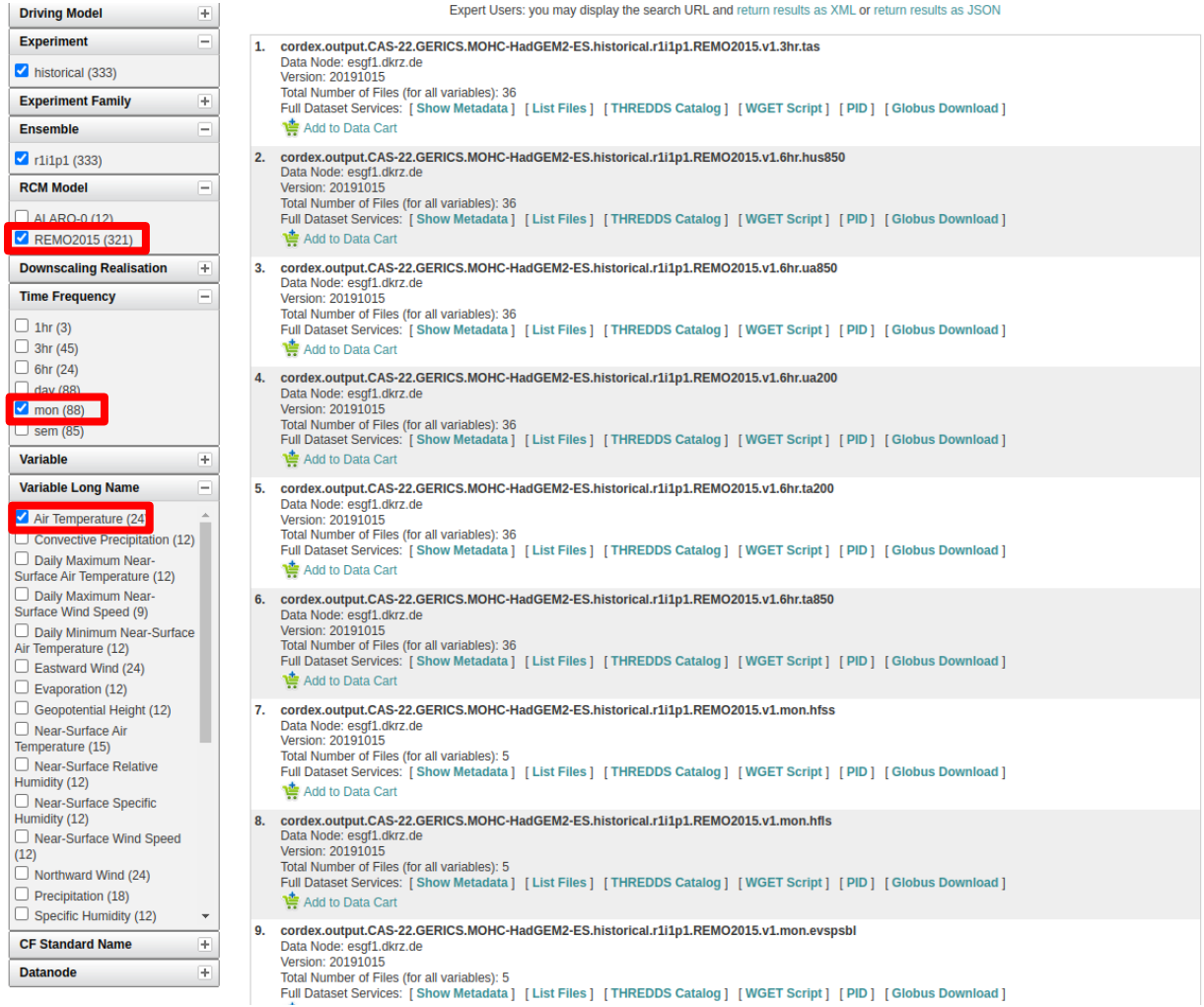
   Add to Data Cart


Driving Model
Experiment
historical (333)
Experiment Family
Ensemble
r1i1p1 (333)
RCM Model
ALARO-0 (12)
REMO2015 (321)
Downscaling Realisation
Time Frequency
1hr (3)
3hr (45)
6hr (24)
day (88)
mon (88)
sem (85)
Variable
Variable Long Name
Air Temperature (24
Convective Precipitation (12)
Daily Maximum Near-Surface Air Temperature (12)
Daily Maximum Near-Surface Wind Speed (9)
Daily Minimum Near-Surface Air Temperature (12)
Eastward Wind (24)
Evaporation (12)
Geopotential Height (12)
Near-Surface Air Temperature (15)
Near-Surface Relative Humidity (12)
Near-Surface Specific Humidity (12)
Near-Surface Wind Speed (12)
Northward Wind (24)
Precipitation (18)
Specific Humidity (12)
CF Standard Name
Datanode
Expert Users: you may display the search URL and return results as XML or return results as JSON
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Total Number of Files (for all variables): 36
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
2. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.hus850
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 36
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
3. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua850
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 36
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
4. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua200
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Version: 20191015
Total Number of Files (for all variables): 36
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Add to Data Cart
5. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ta200
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 36
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
6. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ta850
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 36
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
7. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.hfss
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 5
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
8. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.hfls
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 5
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
Add to Data Cart
9. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.evspsbl
Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 5
Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]

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Last Search | My Data Cart (0) | Clear Data Cart

Project
- [x] CORDEX (333)

Product

Domain
- [x] CAS-22 (333)

Institute

Driving Model

Experiment
- [x] historical (333)

Experiment Family

Ensemble
- [x] r1i1p1 (333)

RCM Model
- [ ] ALARO-0 (12)
- [x] REMO2015 (321)

Downscaling Realisation

Time Frequency
- [ ] 1hr (3)
- [ ] 3hr (45)
- [ ] 6hr (24)
- [ ] day (88)
- [x] mon (88)
- [ ] sem (85)

Variable

Variable Long Name
- [x] Air Temperature (24)
- [ ] Convective Precipitation (12)
- [ ] Daily Maximum Near-

Enter Text: | Search | Reset | Display 10 results per page | [More Search Options]

[ ] Show All Replicas [ ] Show All Versions [ ] Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | historical | r1i1p1

Total Number of Results: 333

-1- 2 3 4 5 6 Next >>

Add all displayed results to Data Cart Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

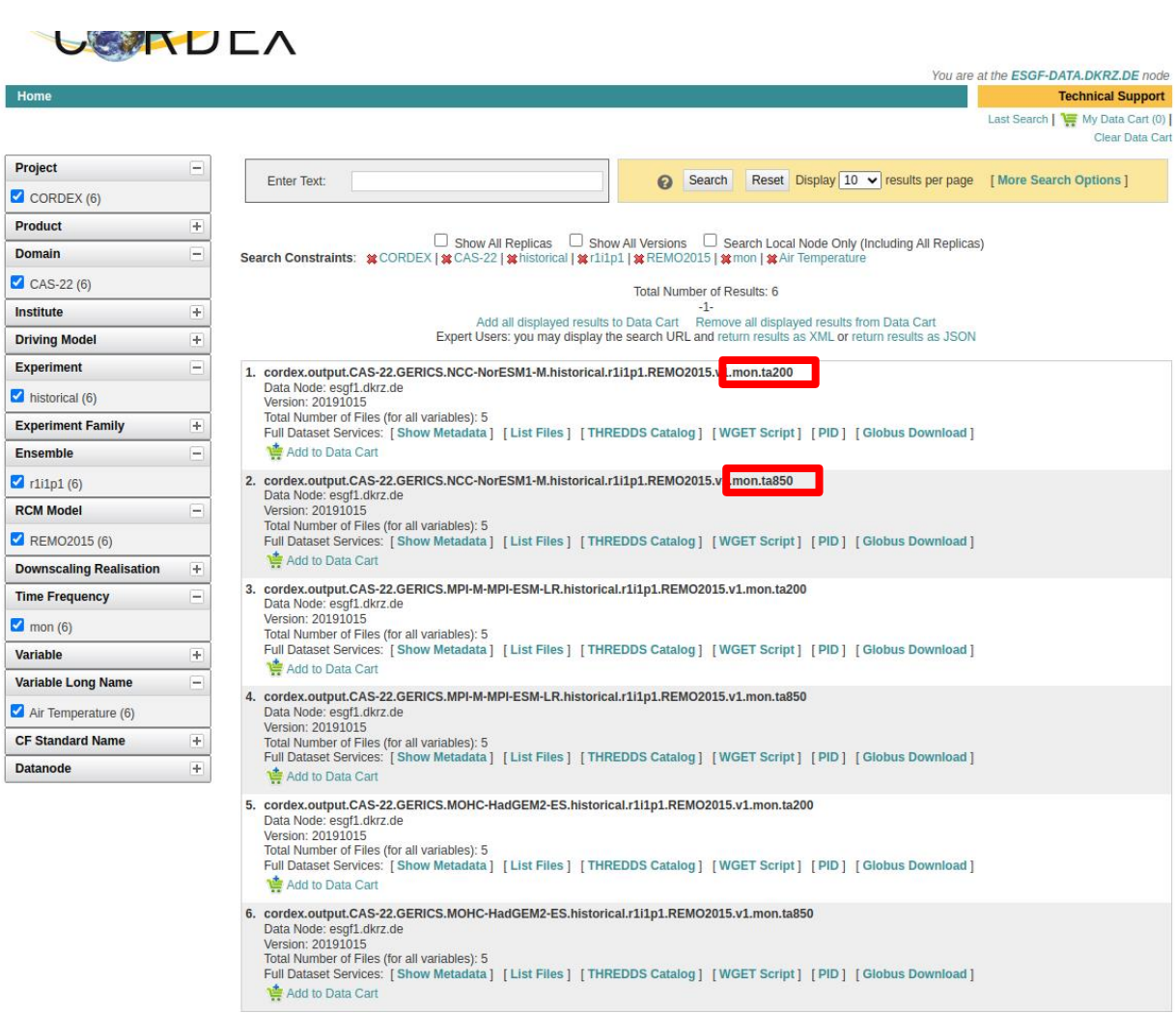
1. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.3hr.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

2. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.hus850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

3. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

4. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ua200**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

5. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.6hr.ta200**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 36
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart



In this selection we obtained the air temperature at 200 and 850 hPa.
But we are interested in near-surface air temperature.
Let's do a new selection.

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Project [−]
- CORDEX (6)

Product [+]

Domain [−]
- CAS-22 (6)

Institute [+]

Driving Model [+]

Experiment [−]
- historical (6)

Experiment Family [+]

Ensemble [−]
- r1i1p1 (6)

RCM Model [−]
- REMO2015 (6)

Downscaling Realisation [+]

Time Frequency [−]
- mon (6)

Variable [+]

Variable Long Name [−]
- Air Temperature (6)

CF Standard Name [+]

Datanode [+]

Enter Text: | Search | Reset | Display 10 results per page | [More Search Options]

Show All Replicas | Show All Versions | Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | historical | r1i1p1 | REMO2015 | mon | Air Temperature

Total Number of Results: 6

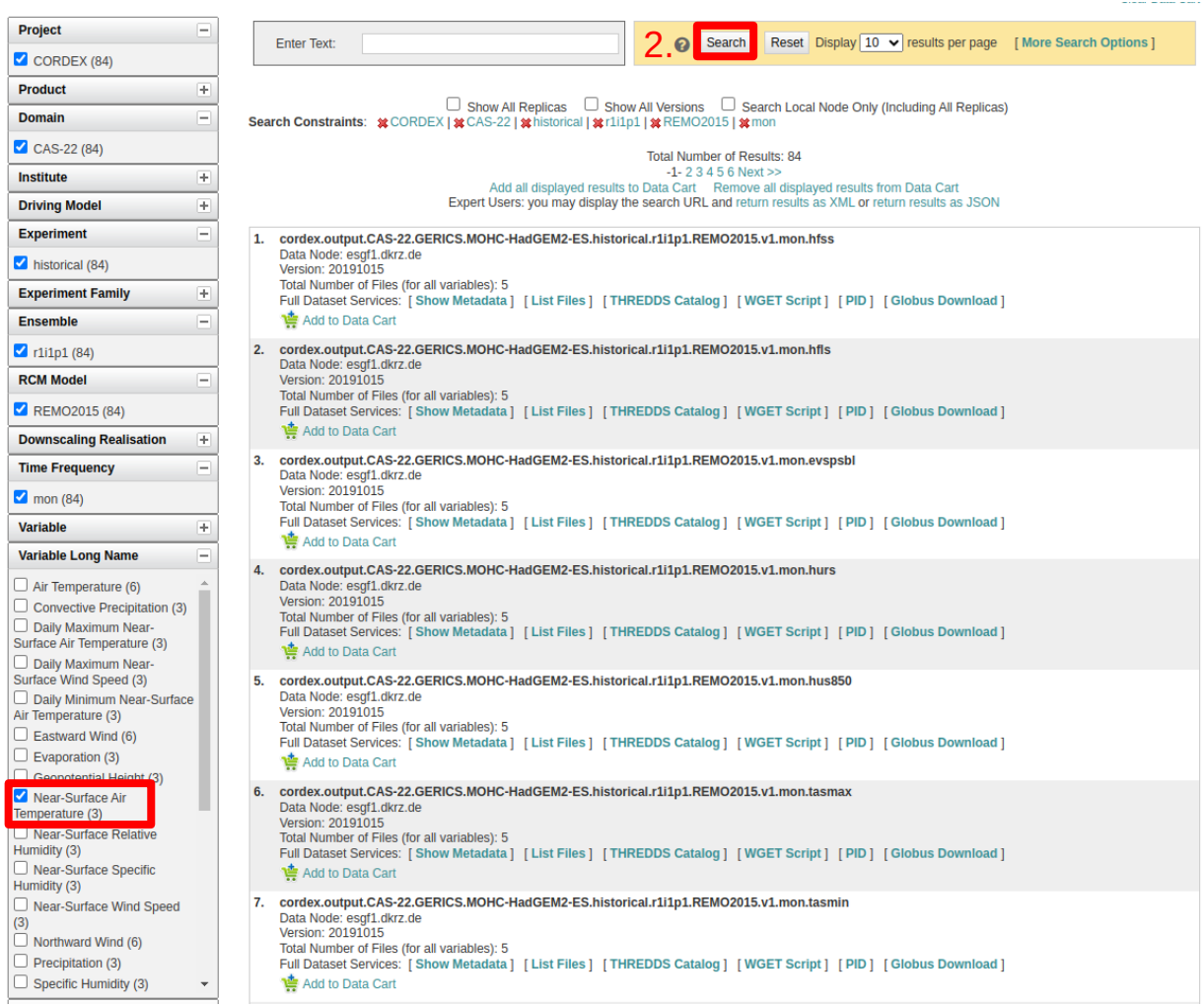
-1-

Add all displayed results to Data Cart | Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **cordex.output.CAS-22.GERICS.NCC-NorESM1-M.historical.r1i1p1.REMO2015.v1.mon.ta200**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
2. **cordex.output.CAS-22.GERICS.NCC-NorESM1-M.historical.r1i1p1.REMO2015.v1.mon.ta850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
3. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.historical.r1i1p1.REMO2015.v1.mon.ta200**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
4. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.historical.r1i1p1.REMO2015.v1.mon.ta850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
5. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.ta200**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
6. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.ta850**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

First, remove the air temperature selected by clicking on x



Select the variable and click on search

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Last Search | My Data Cart (0) | Clear Data Cart

Project (−)
- CORDEX (3)

Product (+)

Domain (−)
- CAS-22 (3)

Institute (+)

Driving Model (+)

Experiment (−)
- historical (3)

Experiment Family (+)

Ensemble (−)
- r1i1p1 (3)

RCM Model (−)
- REMO2015 (3)

Downscaling Realisation (+)

Time Frequency (−)
- mon (3)

Variable (+)

Variable Long Name (−)
- Near-Surface Air Temperature (3)

CF Standard Name (+)

Datanode (+)

Enter Text:

Search | Reset | Display 10 results per page | [More Search Options]

Show All Replicas | Show All Versions | Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | historical | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature

Total Number of Results: 3

-1-

Add all displayed results to Data Cart | Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

2. **cordex.output.CAS-22.GERICS.NCC-NorESM1-M.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

3. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

Ok!

Click on List Files

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Last Search | My Data Cart (0) | Clear Data Cart

Project
- CORDEX (3)

Product

Domain
- CAS-22 (3)

Institute

Driving Model

Experiment
- historical (3)

Experiment Family

Ensemble
- r1i1p1 (3)

RCM Model
- REMO2015 (3)

Downscaling Realisation

Time Frequency
- mon (3)

Variable

Variable Long Name
- Near-Surface Air Temperature (3)

CF Standard Name

Datanode

Enter Text: | Search | Reset | Display 10 results per page | [More Search Options]

Show All Replicas | Show All Versions | Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | historical | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature

Total Number of Results: 3

-1-

Add all displayed results to Data Cart | Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.tas

Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 5
Full Dataset Services: [**Show Metadata**] [**Hide Files**] [**THREDDS Catalog**] [**WGET Script**] [**PID**] [**Globus Download**]

Total Number of Files: 5

1	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_197001-197012.nc** checksum: c975390895ed508a1a91f0f4dcedb4e3f69de7d09cf493f9b7be45b06b6cde43 size: 2863519 tracking_id: hdl:21.14103/2bb4bceb-15dc-4a19-8cbc-89df7e6fc4f6 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
2	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_197101-198012.nc** checksum: 0b944c6415275f0cf92699e45d0874237a1dca2279e447f1e6690a7ad1b7cdca size: 18750029 tracking_id: hdl:21.14103/33d14c93-cbcc-4cbf-9959-9857d4a24a4f [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
3	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_198101-199012.nc** checksum: d73345e9ae4180516a1f22cc0cb4f1a651499e5ba200d8f43c155a4f3fc009bb size: 18740840 tracking_id: hdl:21.14103/4678f320-8430-4397-bfbd-188b991efb14 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
4	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc** checksum: e6f2ee420be64ef60dfbbaa6a8452b88ed2cc61dc93ad5646a2a186442f684e size: 18733160 tracking_id: hdl:21.14103/d31a8ec7-bbd6-4112-8d6d-08d145ec07b6 [More File Metadata]	HTTP Download Globus Download
5	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc** checksum: fe55d2c235f72642234e2e5b4c331019001b0a8e0d80281f284bb4ed59b74f2 size: 9914779 tracking_id: hdl:21.14103/d44dd83c-7836-4471-beb4-4dc622ae962c [More File Metadata]	HTTP Download Globus Download

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Note that the files are separated by periods

Click on this and “save as”

Follow the previous steps, download:

Variable: near-surface air temperature (tas)
Frequency: monthly
Experiment: RCP8.5 scenario
Period: 2050-2060
Model: HadGEM2-ES

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Last Search | My Data Cart (0) | Clear Data Cart

Project −
- CORDEX (3)

Product +

Domain −
- CAS-22 (3)

Institute +

Driving Model +

Experiment −
- historical (3)

Experiment Family +

Ensemble −
- r1i1p1 (3)

RCM Model −
- REMO2015 (3)

Downscaling Realisation +

Time Frequency −
- mon (3)

Variable +

Variable Long Name −
- Near-Surface Air Temperature (3)

CF Standard Name +

Datanode +

Enter Text: Search Reset Display 10 results per page [More Search Options]

Show All Replicas Show All Versions Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | historical | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature

Remove this option

Total Number of Results: 3

-1-

Add all displayed results to Data Cart Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.tas

Data Node: esgf1.dkrz.de
Version: 20191015
Total Number of Files (for all variables): 5
Full Dataset Services: [Show Metadata] [Hide Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]

Total Number of Files: 5

1	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_197001-197012.nc** checksum: c975390895ed508a1a91f0f4dcedb4e3f69de7d09cf493f9b7be45b06b6cde43 size: 2863519 tracking_id: hdl:21.14103/2bb4bceb-15dc-4a19-8cbc-89df7e6fc4f6 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
2	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_197101-198012.nc** checksum: 0b944c6415275f0cf92699e45d0874237a1dca2279e447f1e6690a7ad1b7cdca size: 18750029 tracking_id: hdl:21.14103/33d14c93-cbcc-4cbf-9959-9857d4a24a4f [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
3	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_198101-199012.nc** checksum: d73345e9ae4180516a1f22cc0cb4f1a651499e5ba200d8f43c155a4f3fc009bb size: 18740840 tracking_id: hdl:21.14103/4678f320-8430-4397-bfbd-188b991efb14 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
4	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc** checksum: e6f2ee420be64ef60dfbbaa6a8452b88ed2cc61dc93ad5646a2a1864427f684e size: 18733160 tracking_id: hdl:21.14103/d31a8ec7-bbd6-4112-8d6d-08d145ec07b6 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
5	**tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc** checksum: fe55d2c235f72642234e2e5b4c331019001b0a8e0d80281f284bb4edf59b74f2 size: 9914779 tracking_id: hdl:21.14103/d44dd83c-7836-4471-beb4-4dc622ae962c [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download

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Last Search | My Data Cart (0) | Clear Data Cart

Project
- [x] CORDEX (10)

Product

Domain
- [x] CAS-22 (10)

Institute

Driving Model

Experiment
- [ ] evaluation (1)
- [ ] historical (3)
- [ ] rcp26 (3)
- [x] rcp85 (3)

1.

Experiment Family

Ensemble
- [x] r1i1p1 (10)

RCM Model
- [x] REMO2015 (10)

Downscaling Realisation

Time Frequency
- [x] mon (10)

Variable

Variable Long Name
- [x] Near-Surface Air Temperature (10)

CF Standard Name

Datanode

Enter Text:

2. Search | Reset | Display 10 results per page | [More Search Options]

[ ] Show All Replicas [ ] Show All Versions [ ] Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature

Total Number of Results: 10

-1-

Add all displayed results to Data Cart Remove all displayed results from Data Cart

Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **cordex.output.CAS-22.GERICS.ECMWF-ERAINT.evaluation.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191030
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

2. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

3. **cordex.output.CAS-22.GERICS.NCC-NorESM1-M.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

4. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.historical.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191015
   Total Number of Files (for all variables): 5
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

5. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.rcp26.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191025
   Total Number of Files (for all variables): 10
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

WCRP CORDEX

Project
- [x] CORDEX (3)

Product

Domain
- [x] CAS-22 (3)

Institute

Driving Model

Experiment
- [x] rcp85 (3)

Experiment Family

Ensemble
- [x] r1i1p1 (3)

RCM Model
- [x] REMO2015 (3)

Downscaling Realisation

Time Frequency
- [x] mon (3)

Variable

Variable Long Name
- [x] Near-Surface Air Temperature (3)

CF Standard Name

Datanode

Enter Text:

Search | Reset | Display 10 results per page | [More Search Options]

☐ Show All Replicas ☐ Show All Versions ☐ Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature | rcp85

Total Number of Results: 3
-1-
Add all displayed results to Data Cart Remove all displayed results from Data Cart
Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.rcp85.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191029
   Total Number of Files (for all variables): 10
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
2. **cordex.output.CAS-22.GERICS.MPI-M-MPI-ESM-LR.rcp85.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191029
   Total Number of Files (for all variables): 10
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart
3. **cordex.output.CAS-22.GERICS.NCC-NorESM1-M.rcp85.r1i1p1.REMO2015.v1.mon.tas**
   Data Node: esgf1.dkrz.de
   Version: 20191029
   Total Number of Files (for all variables): 10
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]
   Add to Data Cart

Product +

Domain −
- [x] CAS-22 (3)

Institute +

Driving Model +

Experiment −
- [x] rcp85 (3)

Experiment Family +

Ensemble −
- [x] r1i1p1 (3)

RCM Model −
- [x] REMO2015 (3)

Downscaling Realisation +

Time Frequency −
- [x] mon (3)

Variable +

Variable Long Name −
- [x] Near-Surface Air Temperature (3)

CF Standard Name +

Datanode +

☐ Show All Replicas ☐ Show All Versions ☐ Search Local Node Only (Including All Replicas)

Search Constraints: CORDEX | CAS-22 | r1i1p1 | REMO2015 | mon | Near-Surface Air Temperature | rcp85

Total Number of Results: 3
-1-
Add all displayed results to Data Cart Remove all displayed results from Data Cart
Expert Users: you may display the search URL and return results as XML or return results as JSON

1. cordex.output.CAS-22.GERICS.MOHC-HadGEM2-ES.rcp85.r1i1p1.REMO2015.v1.mon.tas
Data Node: esgf1.dkrz.de
Version: 20191029
Total Number of Files (for all variables): 10
Full Dataset Services: [Show Metadata] [Hide Files] [THREDDS Catalog] [WGET Script] [PID] [Globus Download]

Total Number of Files: 10

1	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_200601-201012.nc** checksum: 48c6107e100264834c03a25a77321f7b1b172f2a80855755db90d806f4ff6902 size: 9907223 tracking_id: hdl:21.14103/56922197-6835-4b7a-9331-b095682c9dca [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
2	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_201101-202012.nc** checksum: 645b31e004ac4ad1a5bd90646619e13dfbf95303c2a55c86c9af7f3d01ea4c40 size: 18712555 tracking_id: hdl:21.14103/e309bf0f-598a-41a7-bb5e-4afdaa4ddfdd [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
3	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_202101-203012.nc** checksum: 3181e2ce74e67945379a1bfa4dd05d5140e840aa247b8ae1f489b1d116e979fa size: 18712868 tracking_id: hdl:21.14103/3cb6d0df-f900-4f32-9a19-0b527bf85b14 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
4	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_203101-204012.nc** checksum: aa4536a8cd8eaa165618321b56b2ab4807919a8ba64e8518c8ace28defa8478e size: 18706495 tracking_id: hdl:21.14103/fdcc1f60-8142-4011-b6e9-98637196a714 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
5	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_204101-205012.nc** checksum: 25bcda3f3d62054f8cc55a1908d376441398034ea523eecbf4c717ea3c69df79 size: 18692374 tracking_id: hdl:21.14103/35d7f877-466c-4f4e-9d9a-71439576161a [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
6	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_205101-206012.nc** checksum: 8b7d2468f6747886304baf54795c82c5a9561ddead6b9f37572cc7c6ede28086 size: 18667740 tracking_id: hdl:21.14103/b319e949-2f16-4e55-b798-b7dc0e067b32 [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
7	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012.nc** checksum: 275c857ed26b1ae1d2d349d95ced8eb40ad63c0899d58236aae5c9db[illegible] size: 18655304 tracking_id: hdl:21.14103/8ca1a023-7a91-49d3-b0bb-aa64a5a26b3b [More File Metadata]	HTTP Download Globus Download
8	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_207101-208012.nc** checksum: 7af5d1f256b7381f9345507a651b43b09588cbab3c4969a3b1960c9307435588 size: 18654109 tracking_id: hdl:21.14103/36f191e9-6055-4519-b358-7ca1c13009dd [More File Metadata]	Single File Access: HTTP Download OpenDAP Download Globus Download
9	**tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_208101-209012.nc** checksum: 9c6c9a3a8b4d06c6b0a5048bc655a1f32c30274224c6dc1299fae58f33846798 size: 18648688 tracking_id: hdl:21.14103/bbde4f13-3176-4fc6-b131-488143f70912	Single File Access: HTTP Download OpenDAP Download

Click on this and “save as”

Knowing the dataset

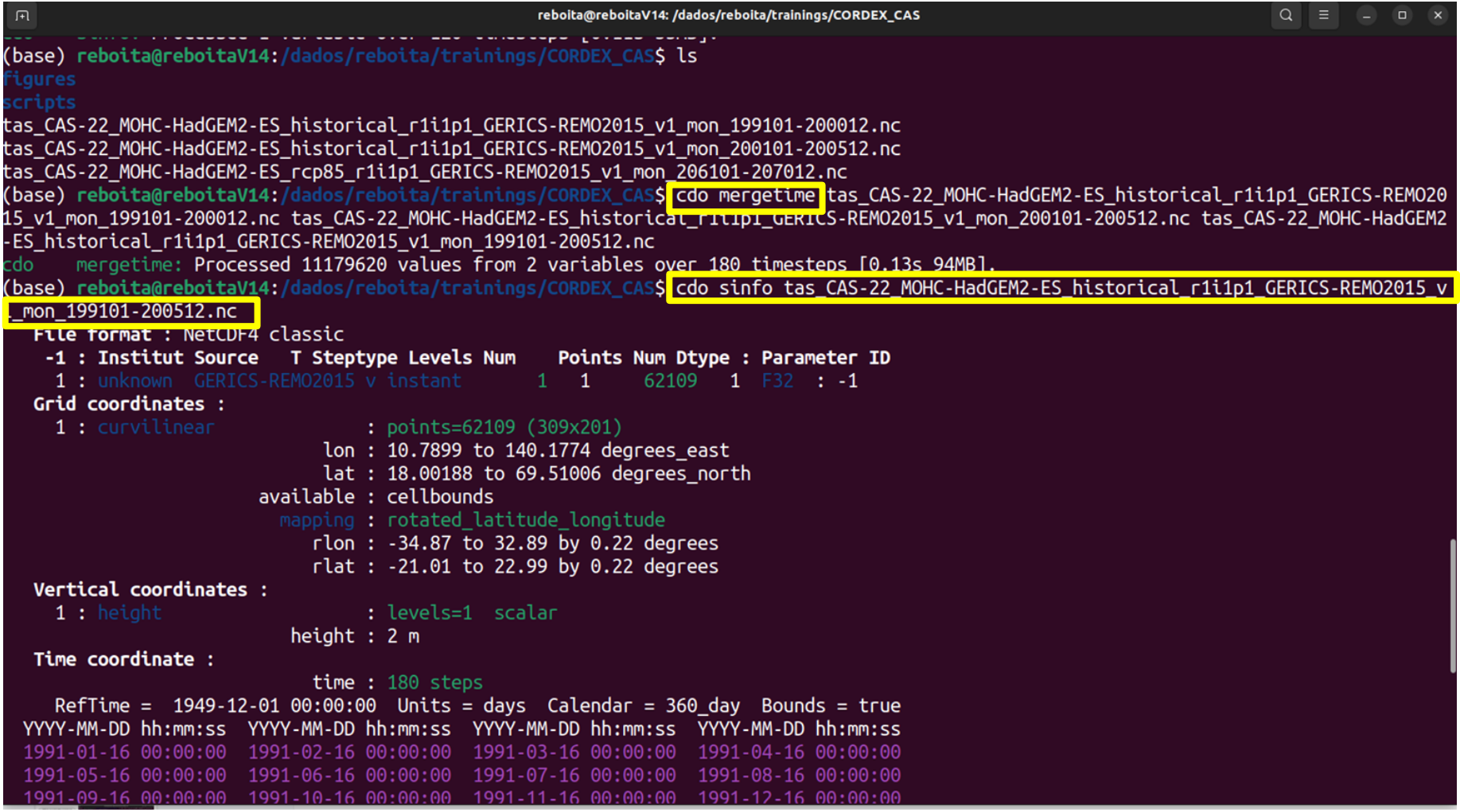
```
reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS
(base) reboita@reboitaV14:/dados/reboita/trainings$ cd CORDEX_CAS/
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ ls
figures
scripts
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo sinfo tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-2000
12.nc
   File format : NetCDF4 classic zip
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  GERICS-REMO2015 v instant       1   1     62109   1  F32z : -1
  Grid coordinates :
     1 : curvilinear                : points=62109 (309x201)
                              lon : 10.7899 to 140.1774 degrees_east
                              lat : 18.00188 to 69.51006 degrees_north
                        available : cellbounds
                          mapping : rotated_latitude_longitude
                             rlon : -34.87 to 32.89 by 0.22 degrees
                             rlat : -21.01 to 22.99 by 0.22 degrees
  Vertical coordinates :
     1 : height                   : levels=1  scalar
                           height : 2 m
  Time coordinate :
                             time : 120 steps
    RefTime =  1949-12-01 00:00:00  Units = days  Calendar = 360_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1991-01-16 00:00:00  1991-02-16 00:00:00  1991-03-16 00:00:00  1991-04-16 00:00:00
  1991-05-16 00:00:00  1991-06-16 00:00:00  1991-07-16 00:00:00  1991-08-16 00:00:00
  1991-09-16 00:00:00  1991-10-16 00:00:00  1991-11-16 00:00:00  1991-12-16 00:00:00
  1992-01-16 00:00:00  1992-02-16 00:00:00  1992-03-16 00:00:00  1992-04-16 00:00:00
  1992-05-16 00:00:00  1992-06-16 00:00:00  1992-07-16 00:00:00  1992-08-16 00:00:00
  1992-09-16 00:00:00  1992-10-16 00:00:00  1992-11-16 00:00:00  1992-12-16 00:00:00
  1993-01-16 00:00:00  1993-02-16 00:00:00  1993-03-16 00:00:00  1993-04-16 00:00:00
  1993-05-16 00:00:00  1993-06-16 00:00:00  1993-07-16 00:00:00  1993-08-16 00:00:00
  1993-09-16 00:00:00  1993-10-16 00:00:00  1993-11-16 00:00:00  1993-12-16 00:00:00
  1994-01-16 00:00:00  1994-02-16 00:00:00  1994-03-16 00:00:00  1994-04-16 00:00:00
  1994-05-16 00:00:00  1994-06-16 00:00:00  1994-07-16 00:00:00  1994-08-16 00:00:00
```

GrADS does not understand a **360 day calendar**.

Grid coordinate is **curvilinear**.

We will use **CDO** to adapt the file.

But before, we will merge the historical files.



reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ ls
figures
scripts
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo mergetime tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO20
15_v1_mon_199101-200012.nc tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc tas_CAS-22_MOHC-HadGEM2
-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512.nc
cdo    mergetime: Processed 11179620 values from 2 variables over 180 timesteps [0.13s 94MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo sinfo tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v
1_mon_199101-200512.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  GERICS-REMO2015 v instant       1   1     62109   1  F32  : -1
   Grid coordinates :
     1 : curvilinear              : points=62109 (309x201)
                             lon : 10.7899 to 140.1774 degrees_east
                             lat : 18.00188 to 69.51006 degrees_north
                       available : cellbounds
                         mapping : rotated_latitude_longitude
                            rlon : -34.87 to 32.89 by 0.22 degrees
                            rlat : -21.01 to 22.99 by 0.22 degrees
   Vertical coordinates :
     1 : height                  : levels=1  scalar
                          height : 2 m
   Time coordinate :
                            time : 180 steps
     RefTime =  1949-12-01 00:00:00  Units = days  Calendar = 360_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1991-01-16 00:00:00  1991-02-16 00:00:00  1991-03-16 00:00:00  1991-04-16 00:00:00
  1991-05-16 00:00:00  1991-06-16 00:00:00  1991-07-16 00:00:00  1991-08-16 00:00:00
  1991-09-16 00:00:00  1991-10-16 00:00:00  1991-11-16 00:00:00  1991-12-16 00:00:00
```

Grid coordinate

Max-Planck-Institut für Meteorologie CDO

Before executing the command

cdo remapbil,grid.txt infile.nc outfile.nc

it is necessary to construct a txt file with the grid information.

This information can be obtained using
cdo sinfo infile.nc

```
reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo sinfo tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  GERICS-REMO2015 v instant       1   1     62109   1  F32  : -1
   Grid coordinates :
     1 : curvilinear                : points=62109 (309x201)
                                lon : 10.7899 to 140.1774 degrees_east
                                lat : 18.00188 to 69.51006 degrees_north
                          available : cellbounds
                            mapping : rotated_latitude_longitude
                               rlon : -34.87 to 32.89 by 0.22 degrees
                               rlat : -21.01 to 22.99 by 0.22 degrees
   Vertical coordinates :
     1 : height                     : levels=1  scalar
                             height : 2 m
   Time coordinate :
                               time : 180 steps
     RefTime =  1949-12-01 00:00:00  Units = days  Calendar = 360_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1991-01-16 00:00:00  1991-02-16 00:00:00  1991-03-16 00:00:00  1991-04-16 00:00:00
  1991-05-16 00:00:00  1991-06-16 00:00:00  1991-07-16 00:00:00  1991-08-16 00:00:00
  1991-09-16 00:00:00  1991-10-16 00:00:00  1991-11-16 00:00:00  1991-12-16 00:00:00
  1992-01-16 00:00:00  1992-02-16 00:00:00  1992-03-16 00:00:00  1992-04-16 00:00:00
  1992-05-16 00:00:00  1992-06-16 00:00:00  1992-07-16 00:00:00  1992-08-16 00:00:00
  1992-09-16 00:00:00  1992-10-16 00:00:00  1992-11-16 00:00:00  1992-12-16 00:00:00
  1993-01-16 00:00:00  1993-02-16 00:00:00  1993-03-16 00:00:00  1993-04-16 00:00:00
  1993-05-16 00:00:00  1993-06-16 00:00:00  1993-07-16 00:00:00  1993-08-16 00:
  1993-09-16 00:00:00  1993-10-16 00:00:00  1993-11-16 00:00:00  1993-12-16 00:
  1994-01-16 00:00:00  1994-02-16 00:00:00  1994-03-16 00:00:00  1994-04-16 00:
  1994-05-16 00:00:00  1994-06-16 00:00:00  1994-07-16 00:00:00  1994-08-16 00:
  1994-09-16 00:00:00  1994-10-16 00:00:00  1994-11-16 00:00:00  1994-12-16 00:
                                                                  1995-04-16 00:
```

140º-10º=130º
69º-18º=51º

Defining 0.25º x 0.25º as horizontal resolution. So, the number of grid points is obtained as:
lon = 130º / **0.25º** = 520 + 1 = **521**
lat = 51º / **0.25º** = 204 + 1 = **205**

Open a text editor and type the grid information
gedit gridCAS.txt &

Suggesting of editor for Windows: notepad++

gridtype = latlon
xsize = **521**
ysize = **205**
xfirst = 10.8
xinc = **0.25**
yfirst = 18.0
yinc = **0.25**

gedit is a text editor of Linux

Max-Planck-Institut für Meteorologie **CDO**

```
reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ ls
figures
gridCAS.txt
scripts
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012.nc
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo remapbil,gridCAS.txt tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_
mon_199101-200512.nc tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512_remap.nc
cdo    remapbil: Bilinear weights from curvilinear (309x201) to lonlat (521x205) grid
cdo    remapbil: Processed 11179620 values from 1 variable over 180 timesteps [0.43s 99MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo remapbil,gridCAS.txt tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_2
06101-207012.nc tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012_remap.nc
cdo    remapbil: Bilinear weights from curvilinear (309x201) to lonlat (521x205) grid
cdo    remapbil: Processed 7453080 values from 1 variable over 120 timesteps [0.24s 103MB].
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo sinfo tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-2005
12_remap.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  GERICS-REMO2015 v instant       1   1    106805   1  F32  : -1
   Grid coordinates :
     1 : lonlat                     : points=106805 (521x205)
                                    lon : 10.8 to 140.8 by 0.25 degrees_east
                                    lat : 18 to 69 by 0.25 degrees_north
   Vertical coordinates :
     1 : height                     : levels=1  scalar
                                    height : 2 m
   Time coordinate :
                                    time : 180 steps
     RefTime =  1949-12-01 00:00:00  Units = days  Calendar = 360_day  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1991-01-16 00:00:00  1991-02-16 00:00:00  1991-03-16 00:00:00  1991-04-16 00:00:00
  1991-05-16 00:00:00  1991-06-16 00:00:00  1991-07-16 00:00:00  1991-08-16 00:00:00
  1991-09-16 00:00:00  1991-10-16 00:00:00  1991-11-16 00:00:00  1991-12-16 00:00:00
  1992-01-16 00:00:00  1992-02-16 00:00:00  1992-03-16 00:00:00  1992-04-16 00:00:00
  1992-05-16 00:00:00  1992-06-16 00:00:00  1992-07-16 00:00:00  1992-08-16 00:00:00
  1992-09-16 00:00:00  1992-10-16 00:00:00  1992-11-16 00:00:00  1992-12-16 00:00:00
```

Listing files

Adjusting grid and coordinates: historical period

Adjusting grid and coordinates: future

Knowing the new historical file

We still have the problem with the calendar if we want to work with GrADS software

reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS

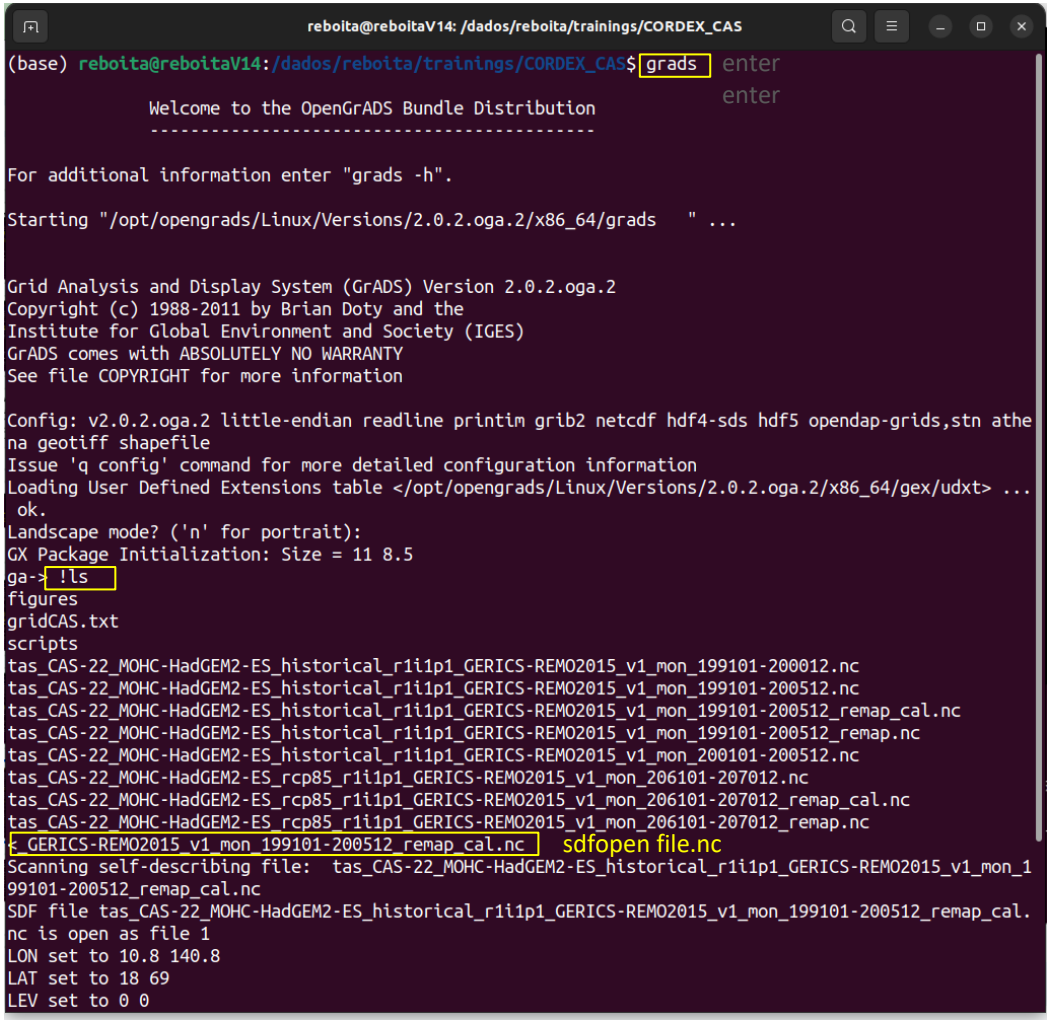
```
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ ls
```
Listing files

```
figures
gridCAS.txt
scripts
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200012.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512_remap.nc
tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_200101-200512.nc
tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012.nc
tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012_remap.nc
```
Adjusting calendar: historical period

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo setcalendar,standard tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1
mon_199101-200512_remap.nc tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-200512_remap_cal.nc
cdo    setcalendar: Processed 19224900 values from 1 variable over 180 timesteps [0.08s 81MB].
```
Adjusting calendar: future

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo setcalendar,standard tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_2
06101-207012_remap.nc tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012_remap_cal.nc
cdo    setcalendar: Processed 12816600 values from 1 variable over 120 timesteps [0.06s 80MB].
```
Knowing the new historical file

```
(base) reboita@reboitaV14:/dados/reboita/trainings/CORDEX_CAS$ cdo sinfo tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v1_mon_199101-2005
12_remap_cal.nc
   File format : NetCDF4 classic
    -1 : Institut Source   T Steptype Levels Num    Points Num Dtype : Parameter ID
     1 : unknown  GERICS-REMO2015 v instant       1   1    106805   1  F32  : -1
   Grid coordinates :
     1 : lonlat                     : points=106805 (521x205)
                           lon : 10.8 to 140.8 by 0.25 degrees_east
                           lat : 18 to 69 by 0.25 degrees_north
   Vertical coordinates :
     1 : height                     : levels=1  scalar
                         height : 2 m
   Time coordinate :
                          time : 180 steps
     RefTime =  1949-12-01 00:00:00  Units = days  Calendar = standard  Bounds = true
  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss  YYYY-MM-DD hh:mm:ss
  1991-01-16 00:00:00  1991-02-16 00:00:00  1991-03-16 00:00:00  1991-04-16 00:00:00
  1991-05-16 00:00:00  1991-06-16 00:00:00  1991-07-16 00:00:00  1991-08-16 00:00:00
  1991-09-16 00:00:00  1991-10-16 00:00:00  1991-11-16 00:00:00  1991-12-16 00:00:00
  1992-01-16 00:00:00  1992-02-16 00:00:00  1992-03-16 00:00:00  1992-04-16 00:00:00
  1992-05-16 00:00:00  1992-06-16 00:00:00  1992-07-16 00:00:00  1992-08-16 00:00:00
  1992-09-16 00:00:00  1992-10-16 00:00:00  1992-11-16 00:00:00  1992-12-16 00:00:00
```



Load the files in GrADS

Compute the mean air temperature for
historical period 1995-2005
future: 2061-2070

Plot a map FUTURE - HISTORICAL

sdfopen tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_ GERICS-REMO2015_v1_mon_199101-200512_remap_cal.nc

sdfopen tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012_remap_cal.nc

OpenGrADS
"Opening GrADS to a World of Extensions"

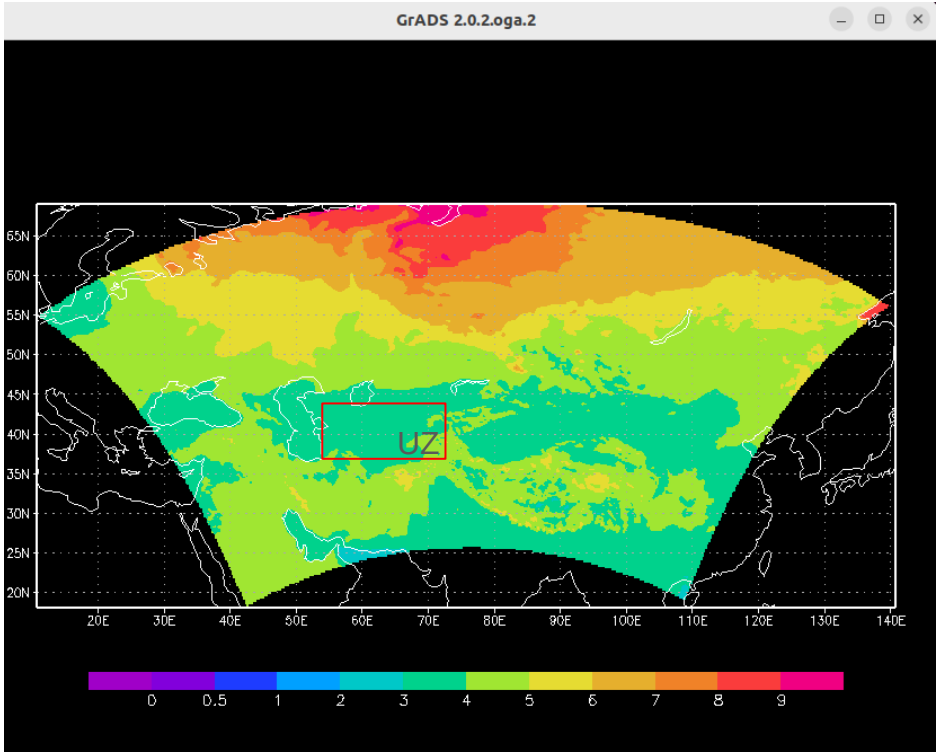
```
reboita@reboitaV14: /dados/reboita/trainings/CORDEX_CAS
LEV set to 0 0
Time values set: 1991:1:16:0 1991:1:16:0
E set to 1 1
<S_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_206101-207012_remap_cal.nc

Scanning self-describing file:  tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_
GERICS-REMO2015_v1_mon_206101-207012_remap_cal.nc
SDF file tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon_
206101-207012_remap_cal.nc is open as file 2


ga-> q file 1
File 1 : GERICS-REMO2015 model output prepared for CORDEX historical
  Descriptor: tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO20
15_v1_mon_199101-200512_remap_cal.nc
  Binary: tas_CAS-22_MOHC-HadGEM2-ES_historical_r1i1p1_GERICS-REMO2015_v
1_mon_199101-200512_remap_cal.nc
  Type = Gridded
  Xsize = 521  Ysize = 205  Zsize = 1  Tsize = 180  Esize = 1
  Number of Variables = 1
    tas    0  t,y,x  Near-Surface Air Temperature
ga-> q file 2
File 2 : GERICS-REMO2015 model output prepared for CORDEX RCP8.5
  Descriptor: tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1
_mon_206101-207012_remap_cal.nc
  Binary: tas_CAS-22_MOHC-HadGEM2-ES_rcp85_r1i1p1_GERICS-REMO2015_v1_mon
_206101-207012_remap_cal.nc
  Type = Gridded
  Xsize = 521  Ysize = 205  Zsize = 1  Tsize = 120  Esize = 1
  Number of Variables = 1
    tas    0  t,y,x  Near-Surface Air Temperature
ga-> define mh=ave(tas.1,time=00Z01Jan1995,time=00Z12Dec2005)
Averaging.  dim = 3, start = 49, end = 180
Define memory allocation size = 854440 bytes
ga-> define mf=ave(tas.2,time=00Z01Jan2061,time=00Z12Dec2070)
Averaging.  dim = 3, start = 841, end = 960
Define memory allocation size = 854440 bytes
ga-> define dif=mf-mh
Define memory allocation size = 854440 bytes
ga-> set gxout shaded
ga-> set clevs 0 0.5 1 2 3 4 5 6 7 8 9
Number of clevs = 11
ga-> d dif
```

Attention: both files have a variable with the same name

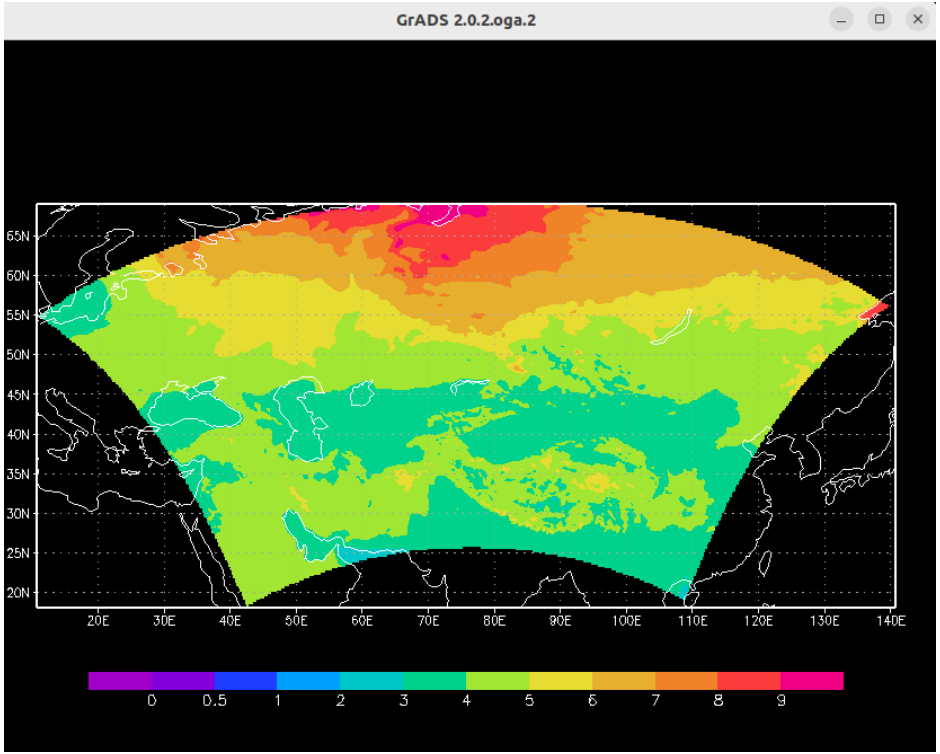
Numbers are attributed to the variables to identify them following the order of the sdfopen



Task completed

Future - Historical

Air temperature



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https://code.mpimet.mpg.de/projects/cdo/wiki/Tutorial
https://gianni.geosci.monash.edu/tools/climate-data-analysis-tutorial/

GrADS

http://cola.gmu.edu/grads/gadoc/tutorial.html
https://www2.atmos.umd.edu/~dkuhl/documents/GRADSmanual.pdf
https://gradsaddict.blogspot.com/p/tutorials.html

RCMs

https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.13932

Reference

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