Climate Analysis with Galaxy

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Overview

• Starting point
• Objectives
• Approach
• Status
• Lesson learnt
• Future plans
Infrastructure for Norwegian Earth System modelling

• Upgrade/maintain/optimize Earth System Models (ESM) suitable for the national climate community & participation in Climate Model Model Intercomparison Projects (CMIP)

• Provide an e-infrastructure for simulations, storage, analysis and validation

• Connects to international data grids and ensures that model data complies with established standards of the climate community.

AND...
A long term goal: Open and reproducible Climate Science by default
FAIR and Open: of course we do...

There is a wealth of data\textsuperscript{1} and information available about the past, current and future climate.

• Is this information easily accessible, discoverable or reusable?

• Can we trust everything we find? Which information to use when and how?

• What about local and regional impacts of global change?

• Should we better support education and innovation?

\textsuperscript{1} Climate models, model outputs, diagnostic tools, etc.
From exclusive to inclusive

- Cover needs from students, researchers, decision makers, businesses, media, artists, citizen, etc.

- Cater for cross-disciplinary aspects

- Cater for different expectations and different level of expertise in climate Science, data & visualization analysis, programming, etc.

Our choice: Galaxy Community Hub
Galaxy ecosystem for Climate Analysis

Manage source codes

Create containers for tools

Compute & Storage

Manage packages

Share and publish tools & workflows
Example: Community Earth System Model

A one-time effort

CESM package and containers for all

Command Line Interface
Status: Community Earth System Model

bioconda / packages / cesm 2.1.1

The Community Earth System Model (CESM) is a coupled climate model for simulating Earth's climate system.

- Easy deployment on cloud computing resources
- Speed-up prototyping (ex: testing new variable resolution grid over Europe)
- Single column

Conda

License: BSD 3-Clause
Home: https://github.com/ESCOMP/cesm
Documentation: http://www.cesm.ucar.edu/
294 total downloads
Last upload: 15 days and 7 hours ago

Installers
conda install

To install this package with conda run:
conda install -c bioconda cesm
Example: Coupling climate and economic models
Status: https://climate.usegalaxy.eu

- 4 tools published and many more in preparation!
- Climate tools deployed on climate.usegalaxy.eu
- Galaxy tutorial “Getting your hands on climate data” in preparation
An ECV is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterization of Earth’s climate.

https://gcos.wmo.int/en/essential-climate-variables
Get and Plot with different views/projections

Copernicus Essential Climate Variables for assessing climate variability (Galaxy Version 0.1.4)

Variable(s)
- Select/Unselect all
- Surface air temperature
- Surface relative humidity
- 0-7cm volumetric soil moisture
- Precipitation
- Sea-ice cover

Select type of data
- Monthly mean

Select year(s)
- Select/Unselect all
- 2019

Select month(s)
- Select/Unselect all
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

Advanced Options

Execute
Monthly surface air temperature anomalies relative to 1981-2010

Temperature anomalies (celcius)

https://climate.copernicus.eu/surface-air-temperature-may-2019
Visualization with OpenLayers

Volcanic eruptions since 1960

https://volcano.si.edu/database/webservices.cfm
Lessons learnt

• Choose a community rather than a standalone technical solution
• Mentoring is very valuable for onboarding new communities
• Training is paramount
Way forward: from local to global

INES - *Infrastructure for Norwegian Earth System modelling* (NRC grant 270061)

Nordic Infrastructure Collaboration on Earth System Tools (NICEST)

[https://nordicesmhub.github.io/](https://nordicesmhub.github.io/)


Mozilla Open Leaders Program
What’s next?

• **New tools** will be included in the Galaxy Toolshed
  - Full access to Copernicus re-analysis (ERA-5) and not only ECVs
  - Full access to past and future Climate projections (CMIP5, CMIP6)
  - Improve visualization
  - Include Earth System Models (CESM, CLM, etc.) and FLEXible PARTicle dispersion model (FLEXPART)

• **Training:**
  - Galaxy tutorial “Getting your hands on climate data”
  - Galaxy tutorial “Earth System Models”
FEEDBACK IS WELCOME!

THANK YOU

climate.usegalaxy.eu

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