


Introduction to NorESM



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¹ NORCE Norwegian Research Centre

² Bjerknes Centre for Climate Research

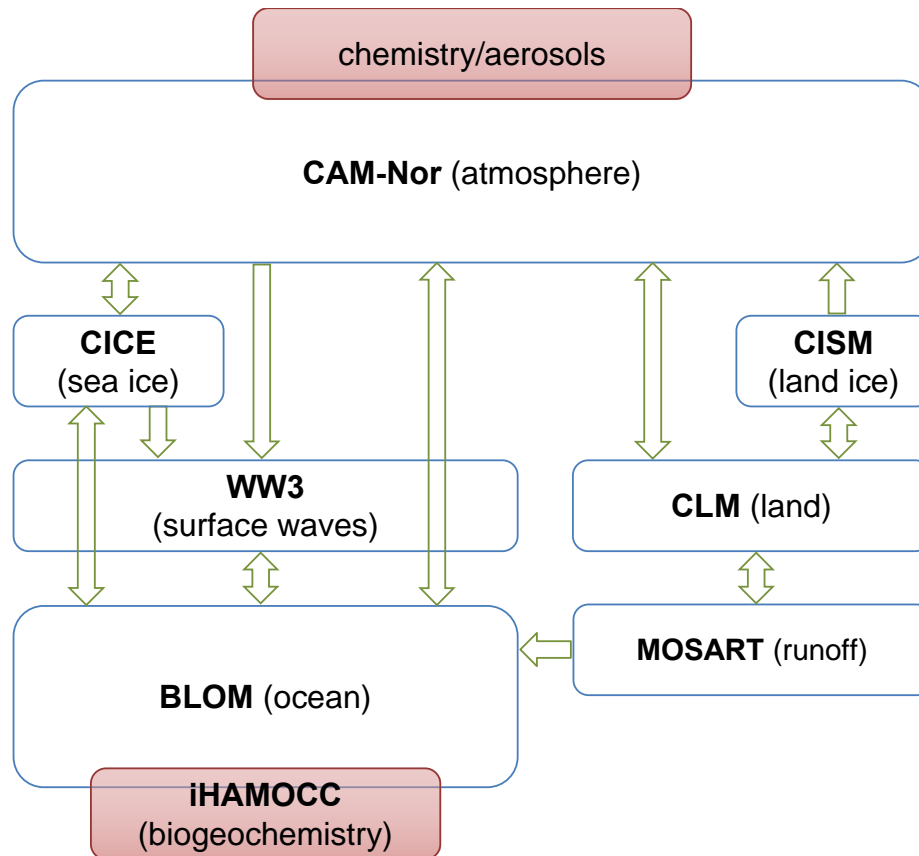
³ University of Bergen

Outline

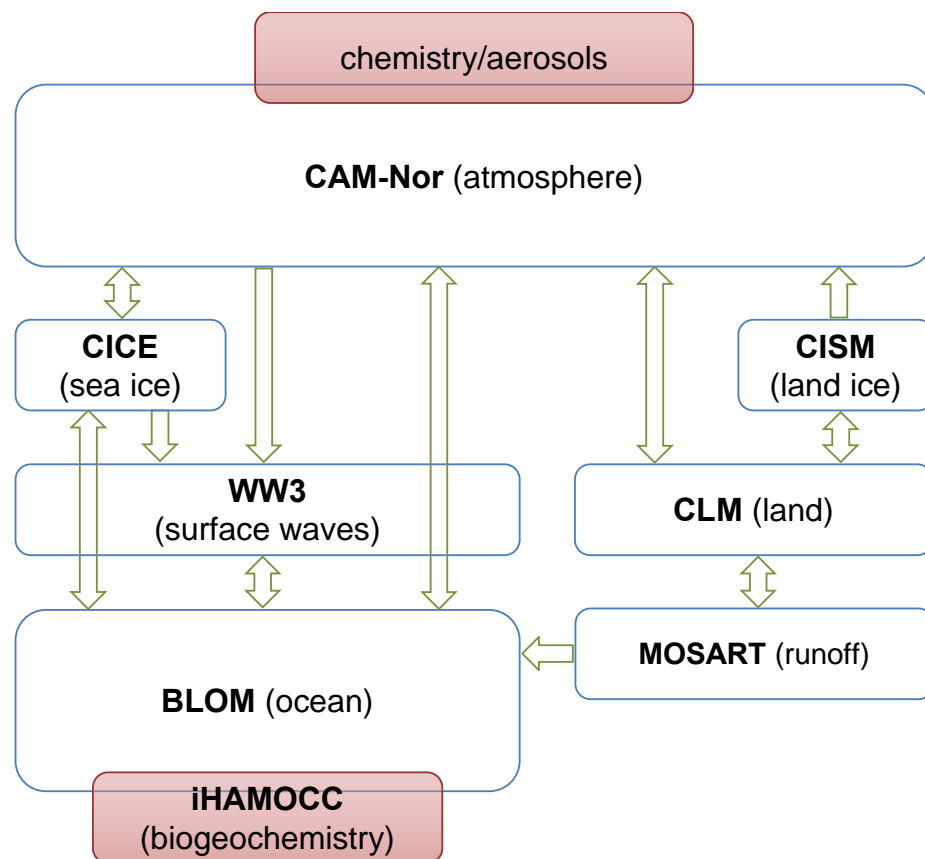
- NorESM overview and differences to CESM
- Some dynamical and physical characteristics
- Scientific updates in NorESM2 compared to NorESM1
- CMIP6 status
- NorESM infrastructure
- Plans for further NorESM development

Norwegian Earth System Model (NorESM)

Based on Community Earth System Model (CESM) of NCAR, Boulder, USA.



Norwegian Earth System Model (NorESM)



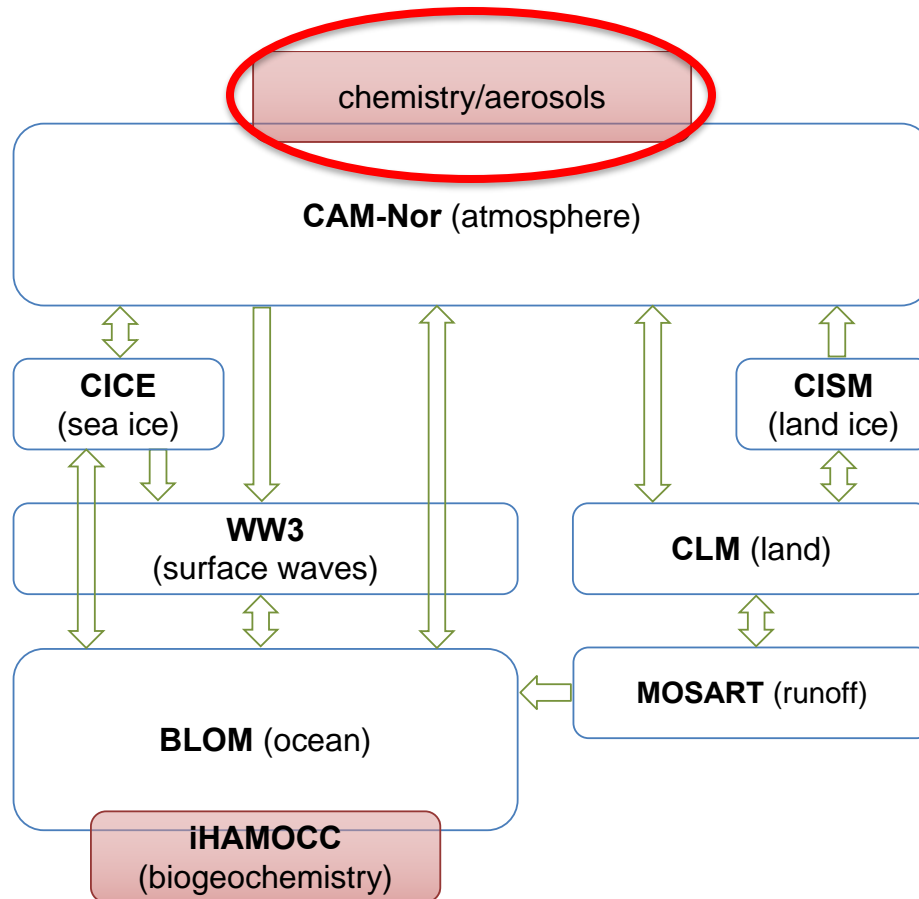
Consortium:



Norwegian Earth System Model (NorESM)

Specific NorESM additions to CESM:

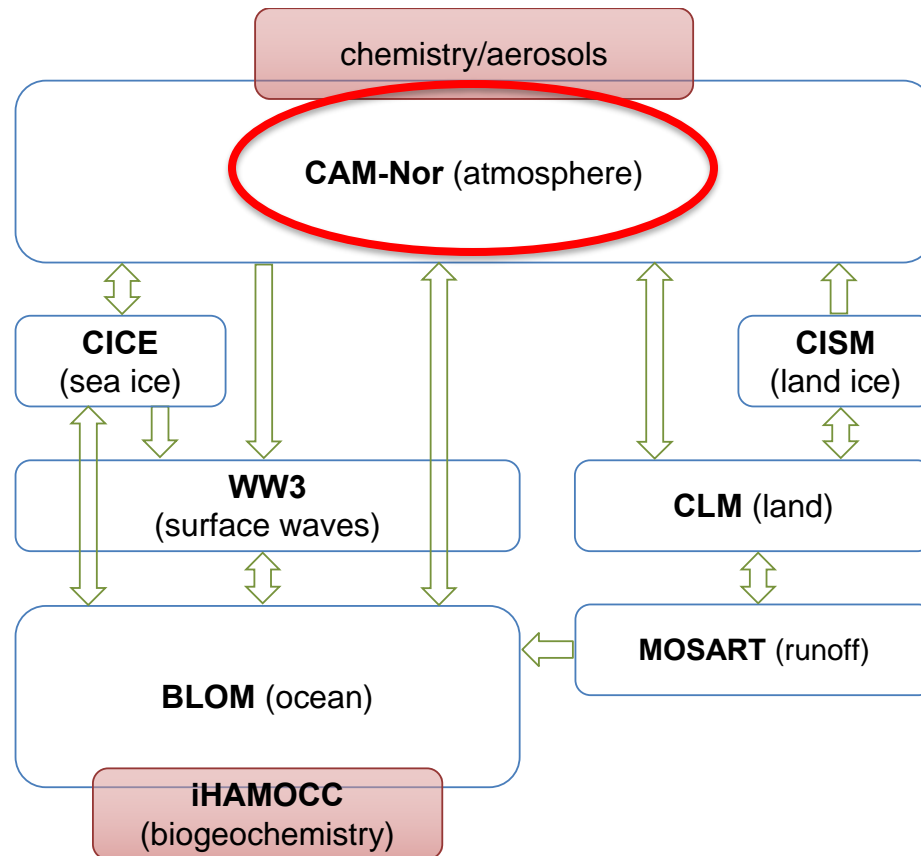
- Atmospheric chemistry/aerosol/cloud module



Oslo



Norwegian Earth System Model (NorESM)



Specific NorESM additions to CESM:

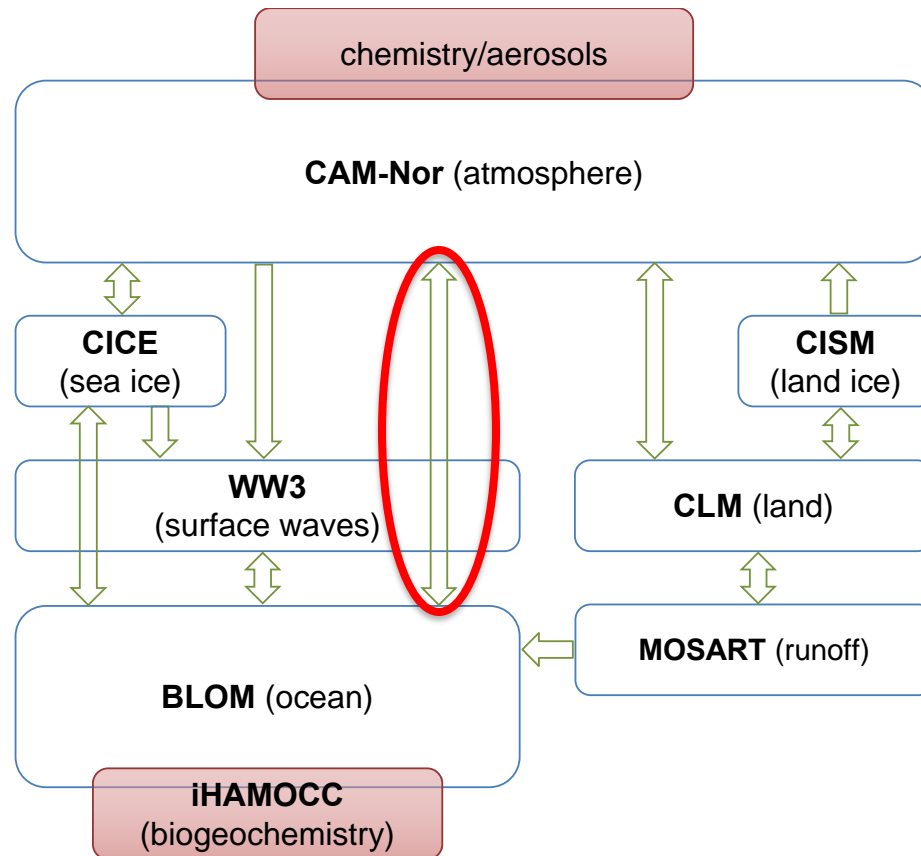
- Atmospheric chemistry/aerosol/cloud module
- Atmospheric dynamics/physics: Improved conservation of energy and angular momentum



Bergen



Norwegian Earth System Model (NorESM)



Specific NorESM additions to CESM:

- Atmospheric chemistry/aerosol/cloud module
- Atmospheric dynamics/physics: Improved conservation of energy and angular momentum
- Parameterization of turbulent air-sea fluxes



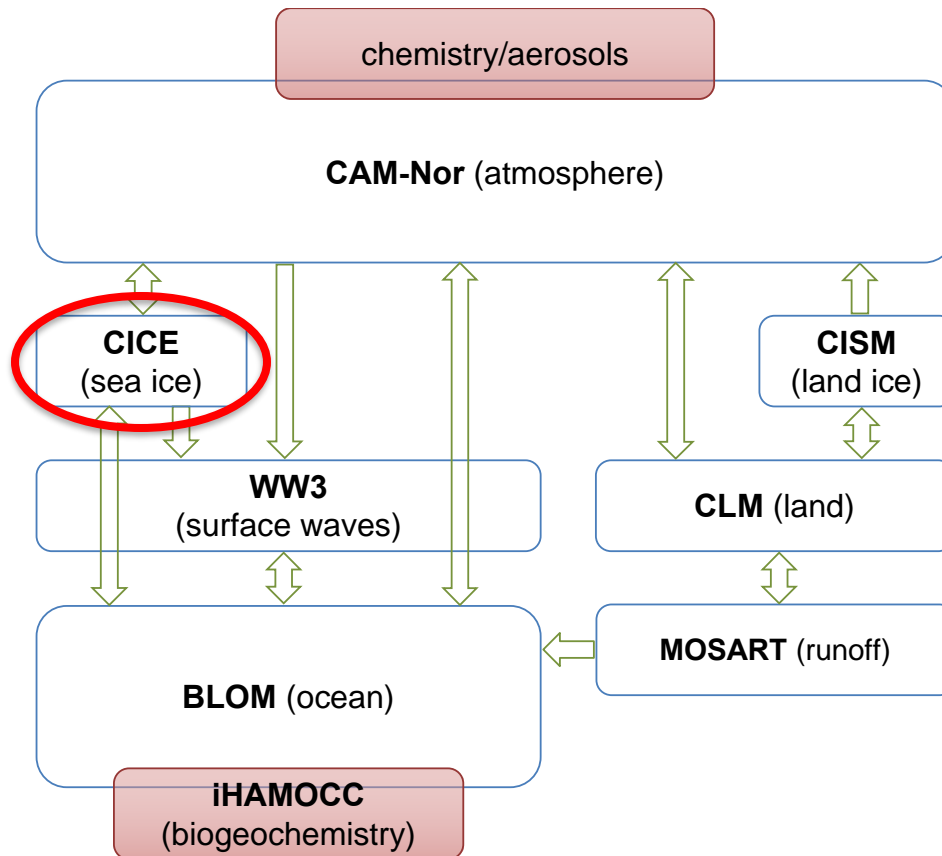
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Norwegian Earth System Model (NorESM)

Specific NorESM additions to CESM:

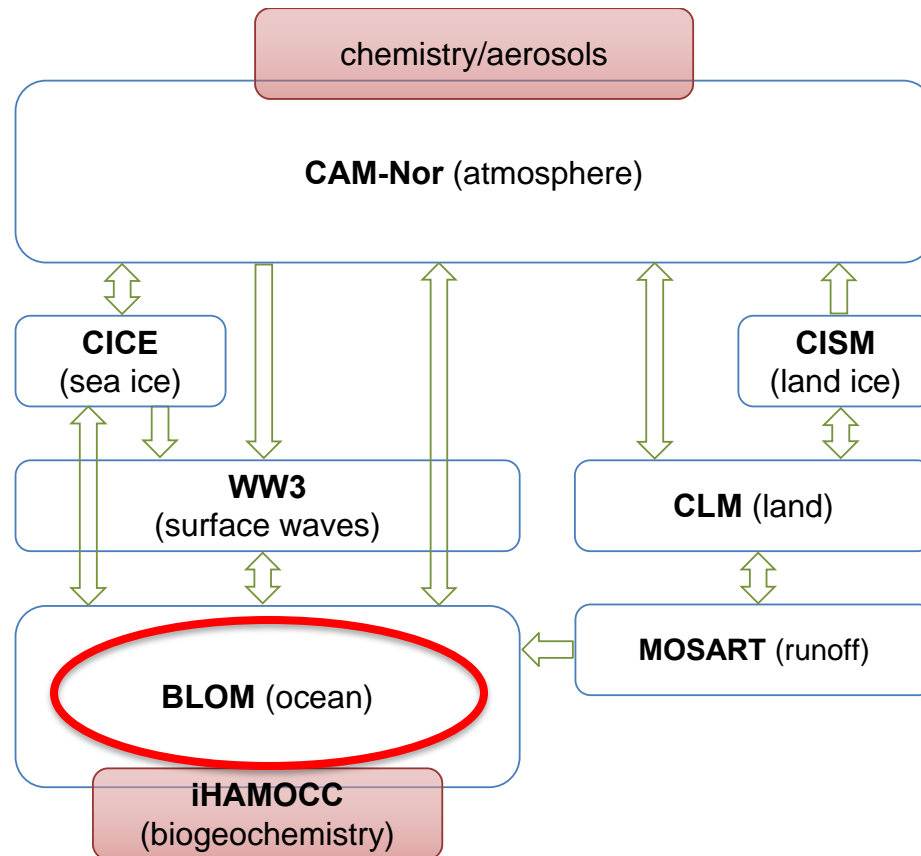
- Atmospheric chemistry/aerosol/cloud module
- Atmospheric dynamics/physics: Improved conservation of energy and angular momentum
- Parameterization of turbulent air-sea fluxes
- Wind drift of snow



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Norwegian Earth System Model (NorESM)



Specific NorESM additions to CESM:

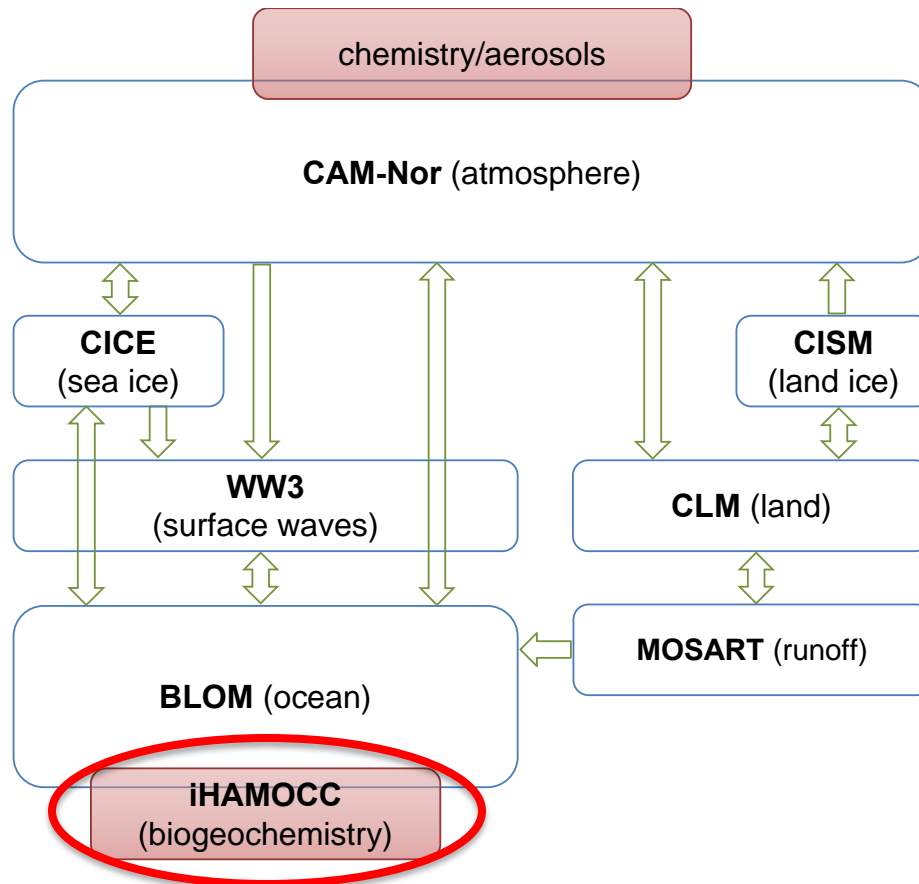
- Atmospheric chemistry/aerosol/cloud module
- Atmospheric dynamics/physics: Improved conservation of energy and angular momentum
- Parameterization of turbulent air-sea fluxes
- Wind drift of snow
- Ocean component with isopycnic vertical coordinate



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Norwegian Earth System Model (NorESM)



Specific NorESM additions to CESM:

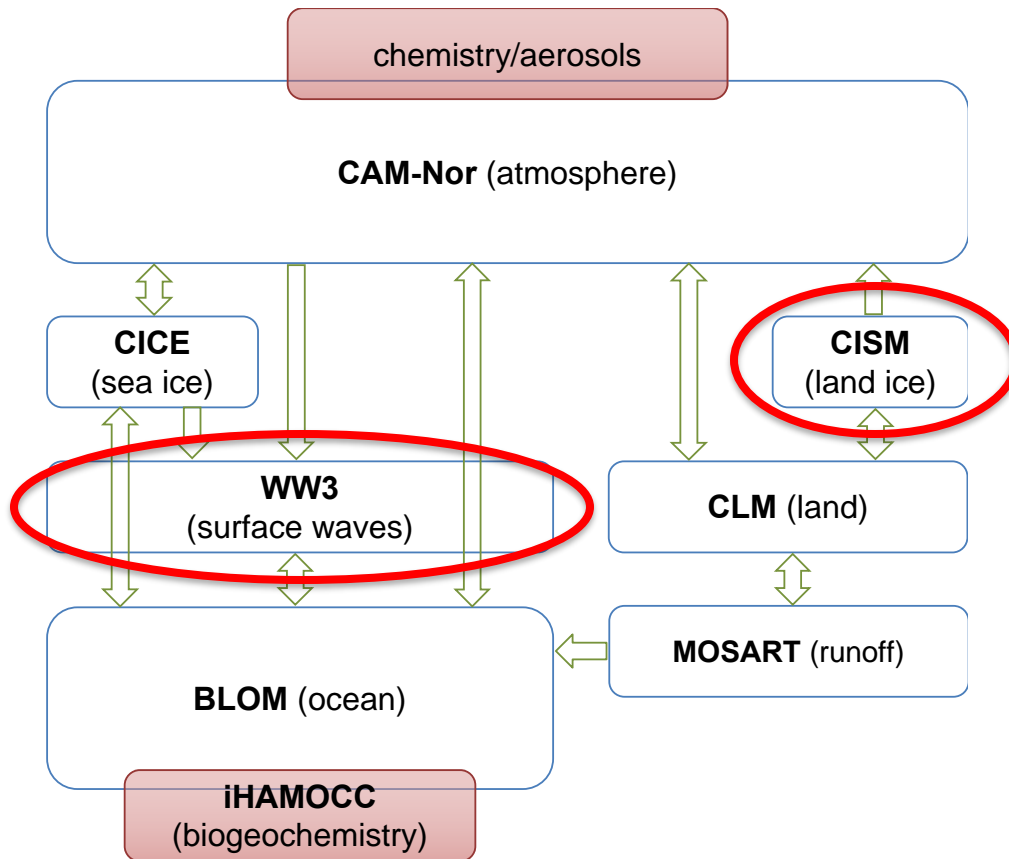
- Atmospheric chemistry/aerosol/cloud module
- Atmospheric dynamics/physics: Improved conservation of energy and angular momentum
- Parameterization of turbulent air-sea fluxes
- Wind drift of snow
- Ocean component with isopycnic vertical coordinate
- Hamburg Model of Ocean Carbon Cycle (HAMOCC) adopted for use with isopycnic ocean model and further developed



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Norwegian Earth System Model (NorESM)



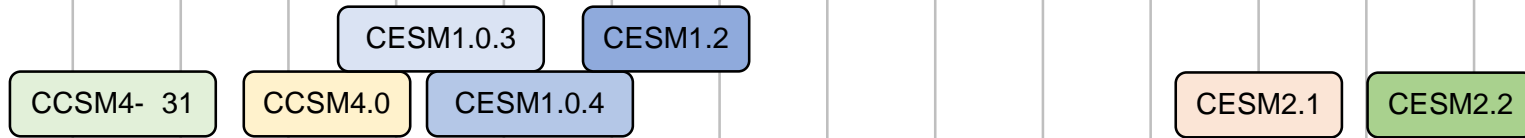
NorESM2.X / NorESM3

CISM – land ice is available in experimental versions of NorESM2

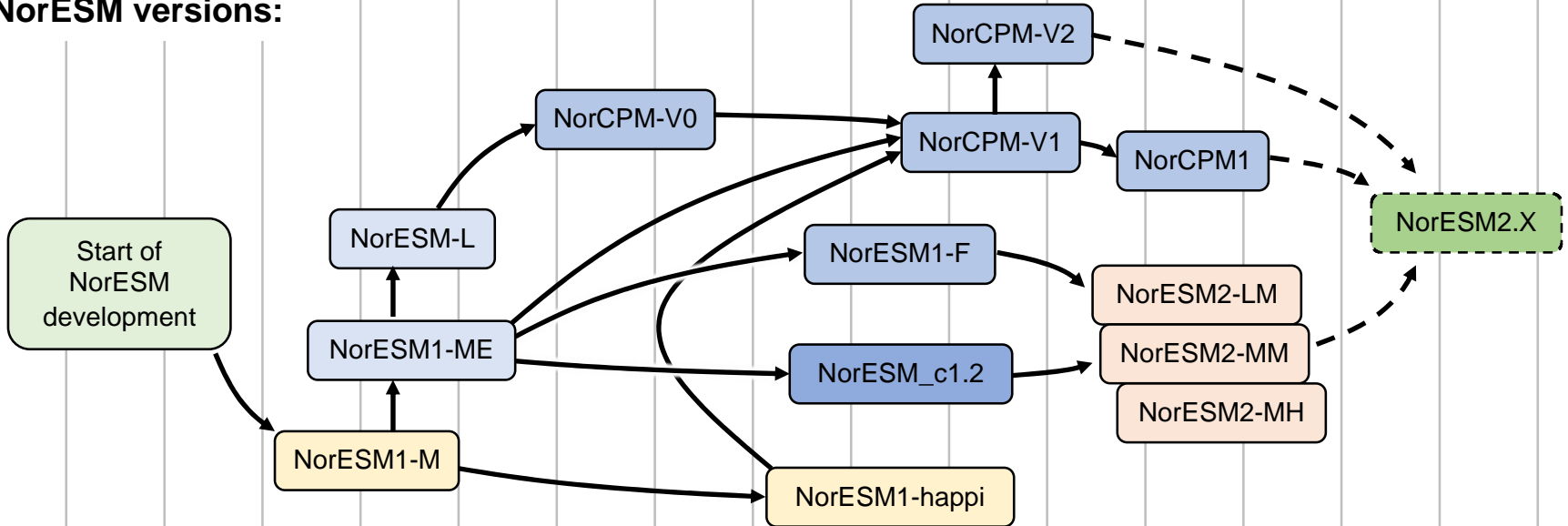
WW3 – ongoing work to include surface waves as a model component

NorESM genealogy

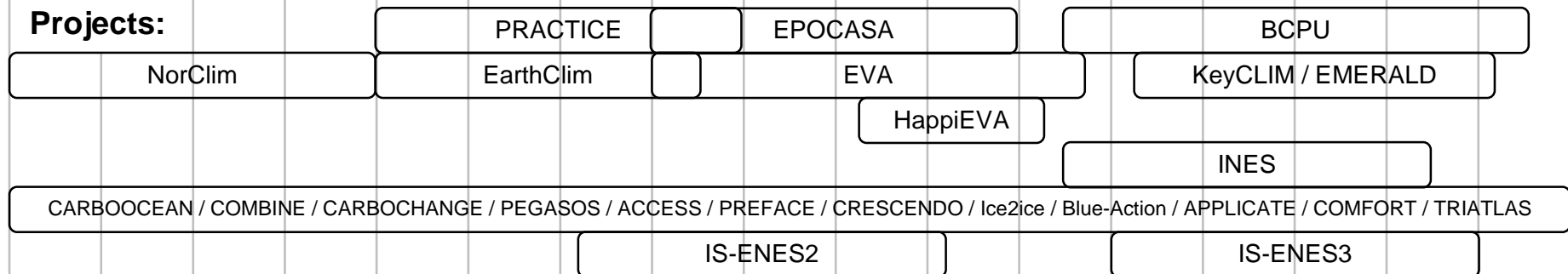
CCSM/CESM versions:



NorESM versions:



Projects:



2007

2009

2011

2013

2015

2017

2019

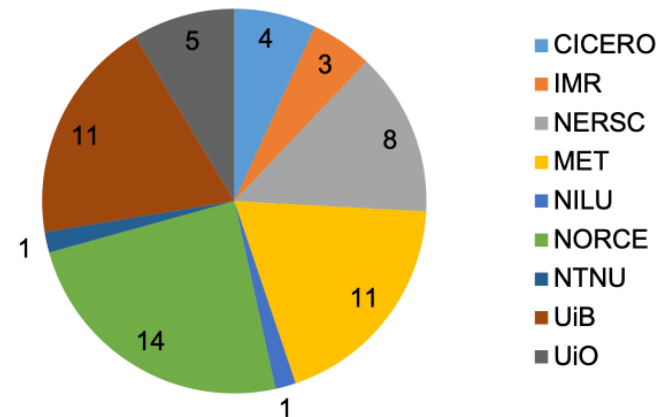
2021

2023

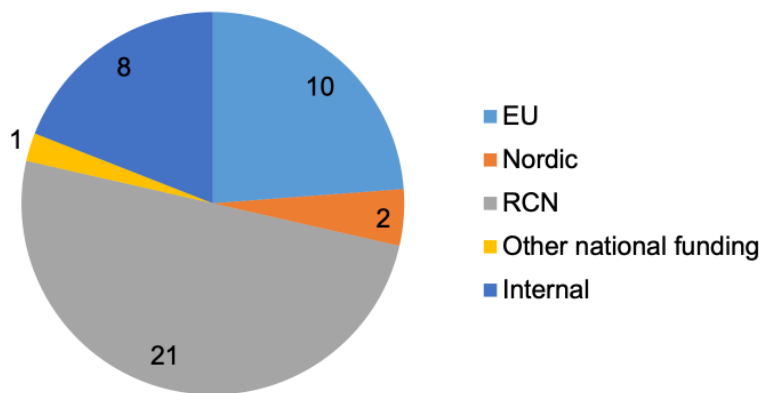
Users and developers of NorESM

- Based on a survey from February 2021.
- In total 58 national users and developers of NorESM in 2020.

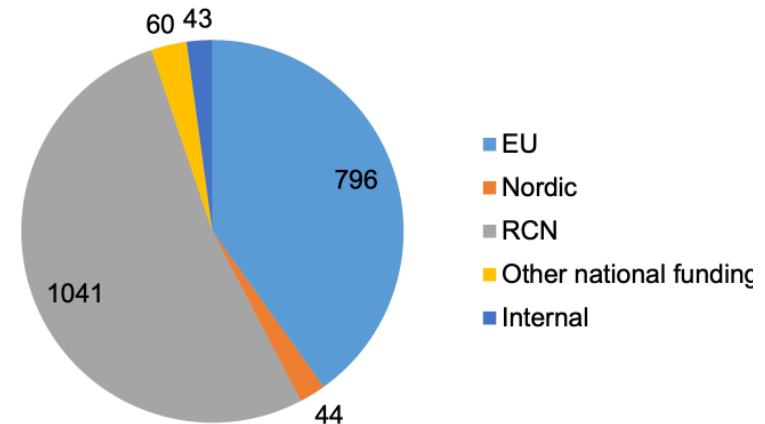
National users



Number of projects



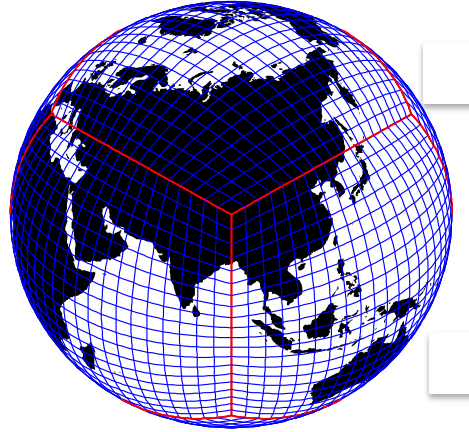
Total grant size (MNOK)



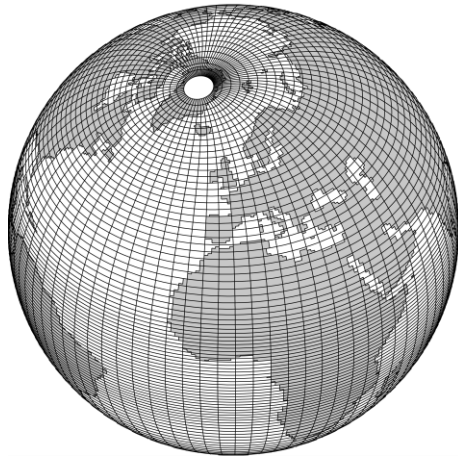
Component discretization



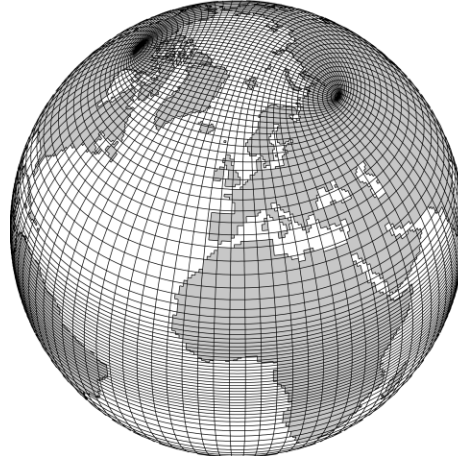
CAM finite volume



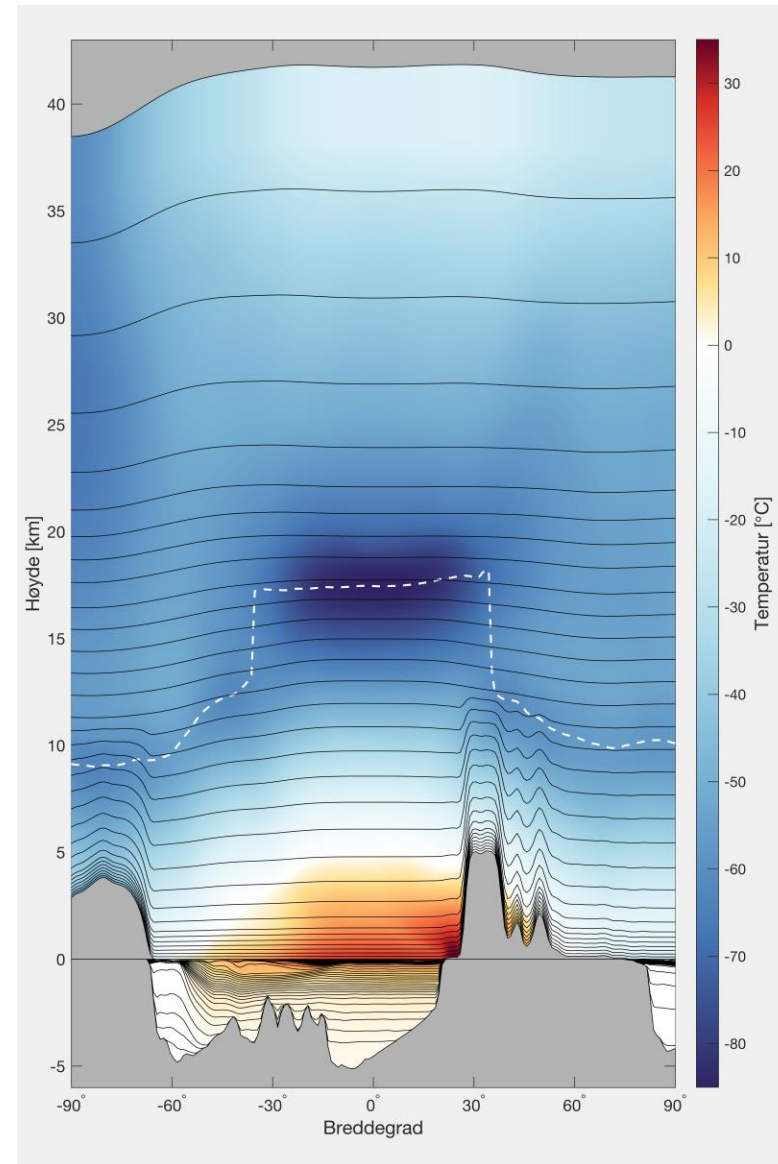
CAM spectral element



BLOM/CICE bipolar

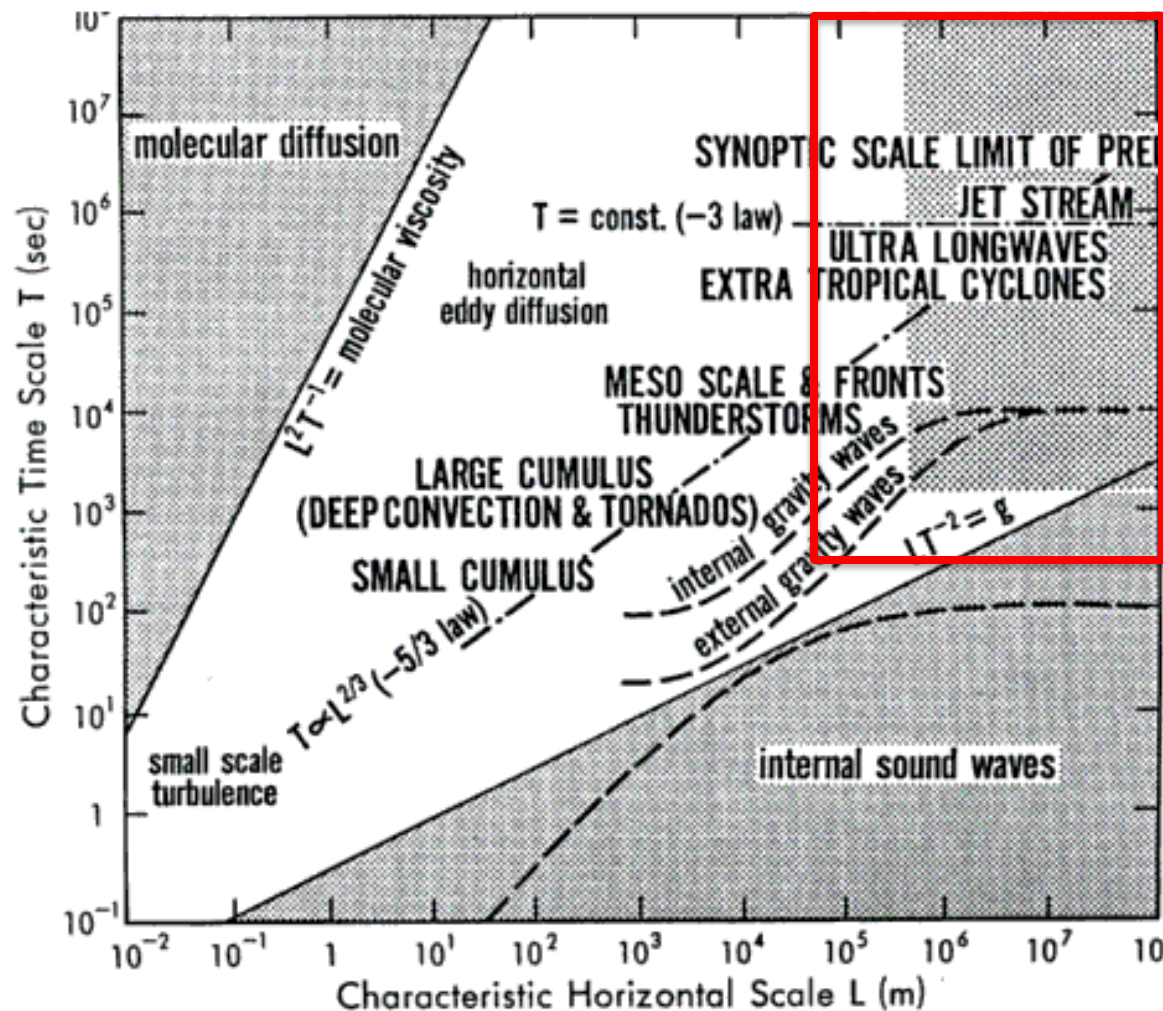


BLOM/CICE tripolar



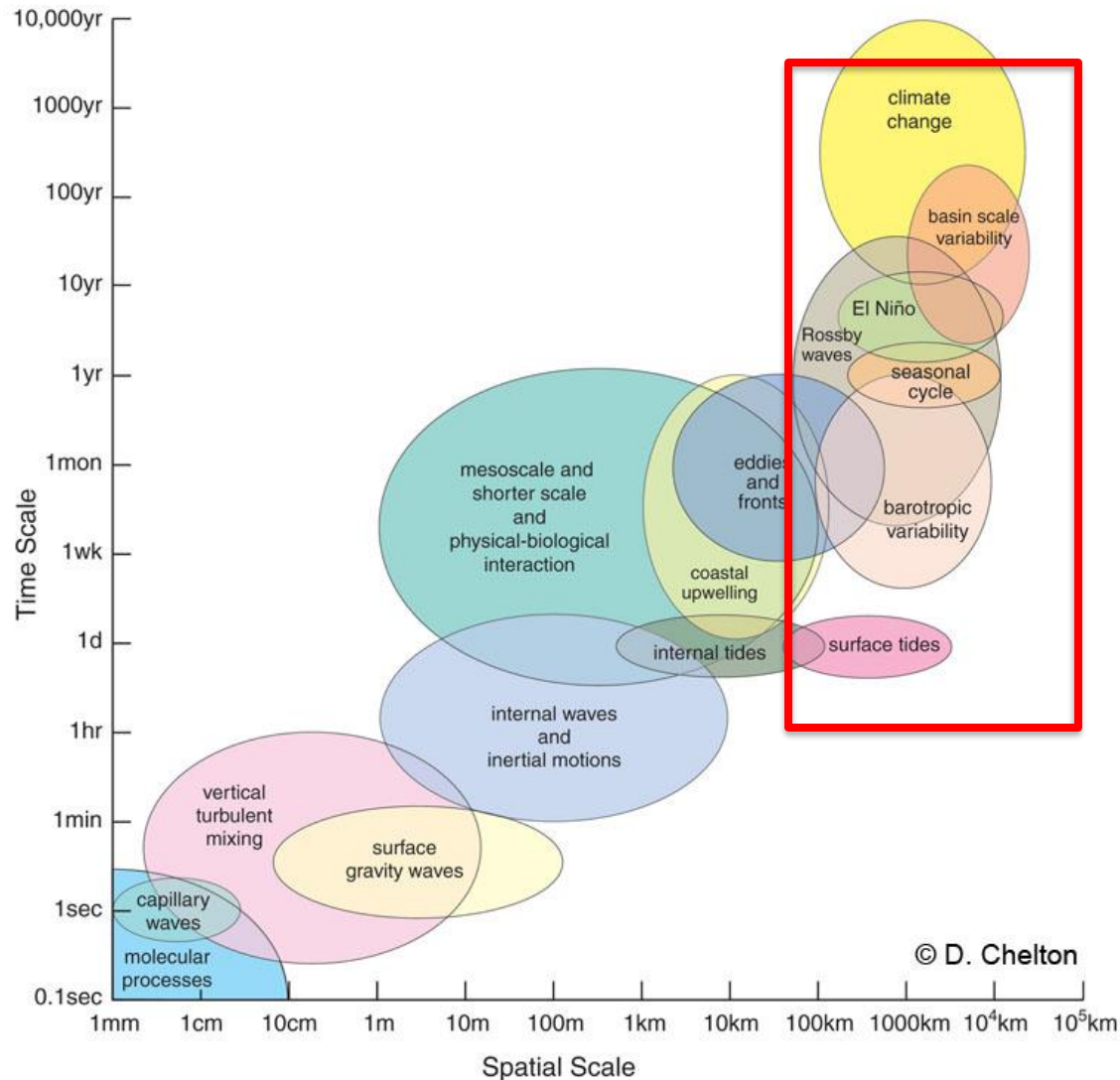
April temperature of
NorESM2 along 87.5°E

Spatial and temporal scales of the atmosphere

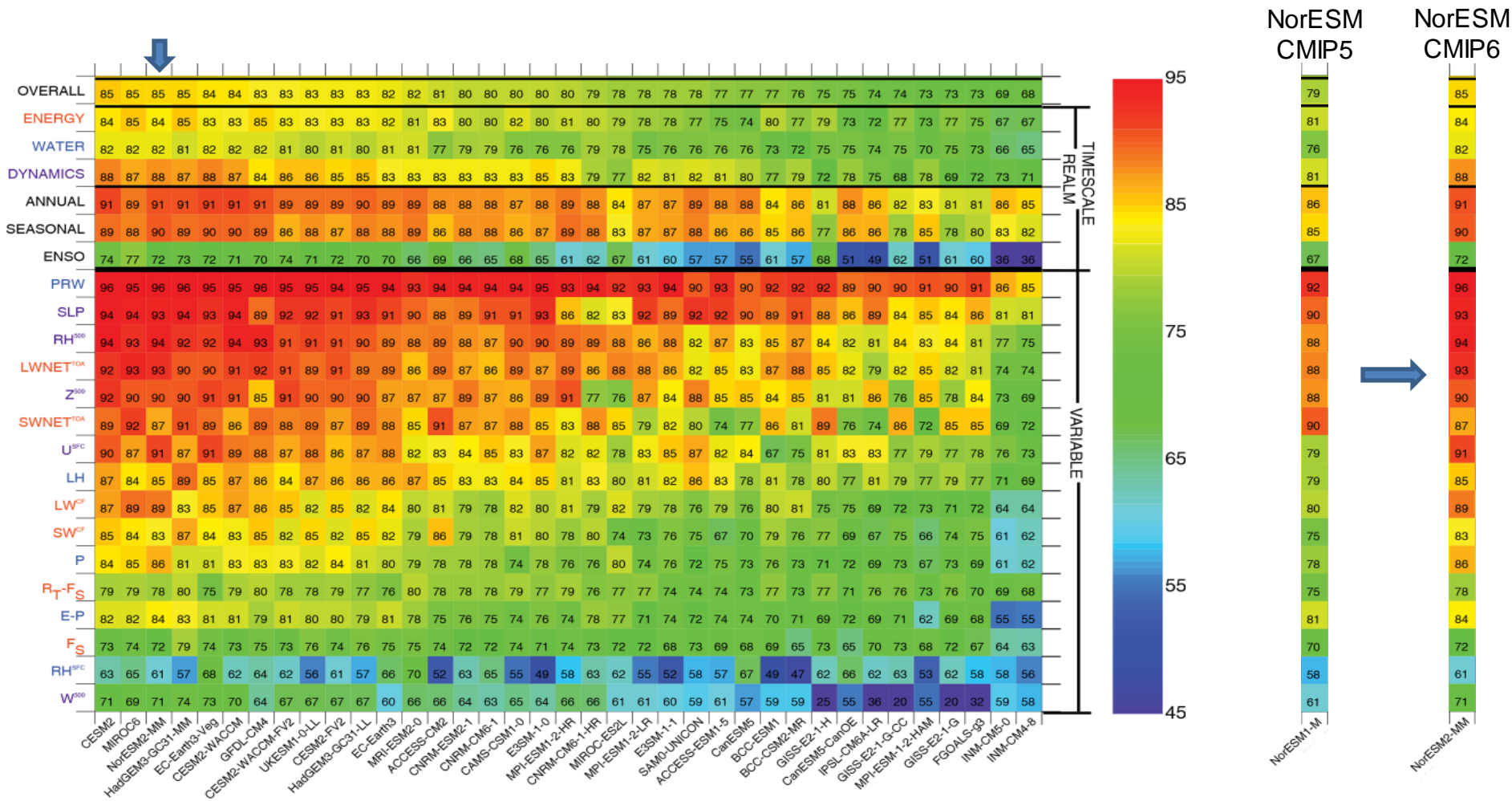


Courtesy: Smagorinsky (1974).

Spatial and temporal scales of the ocean



CESM2/NorESM2 developments



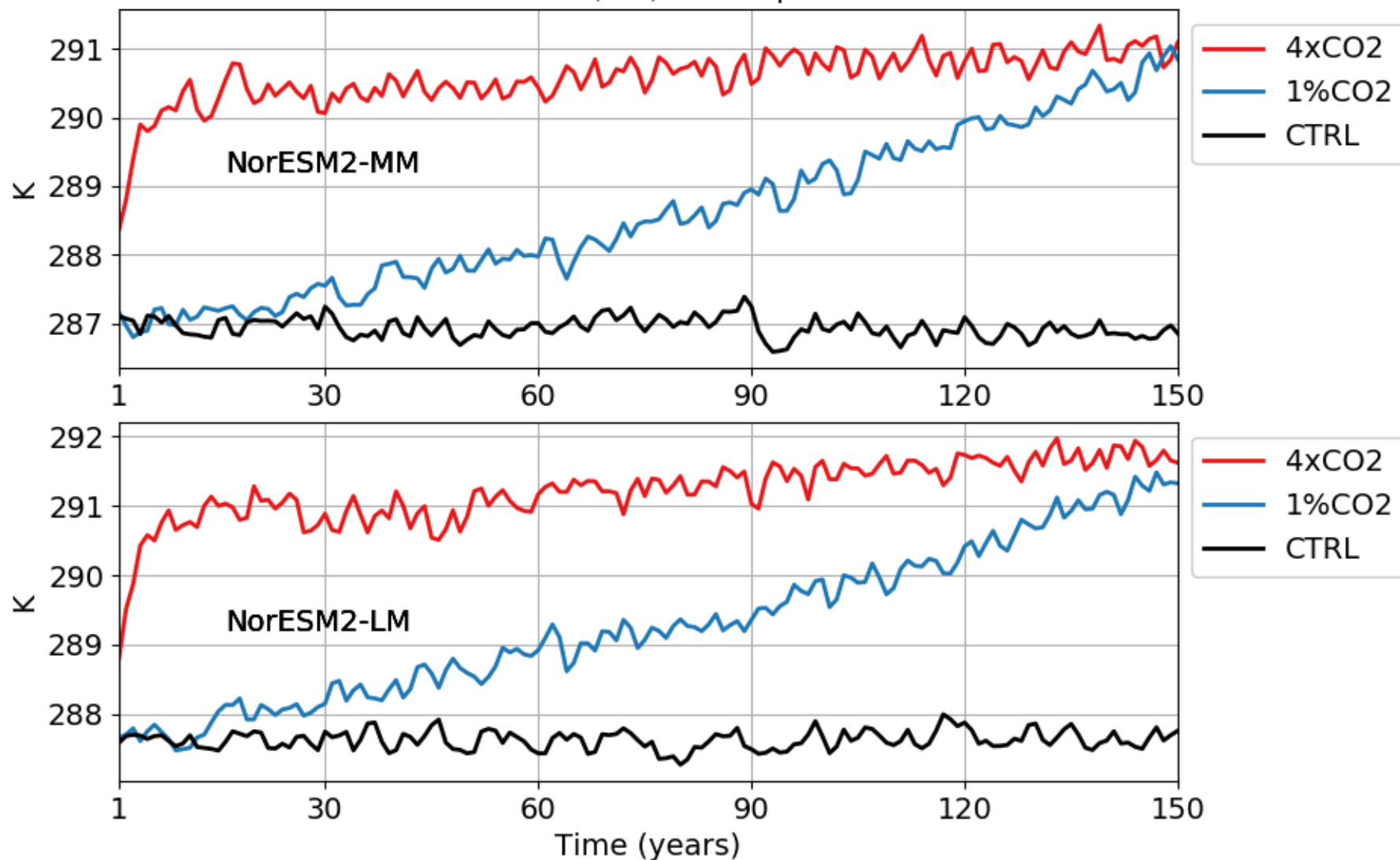
Courtesy: Fasullo (2020).

CMIP6 status

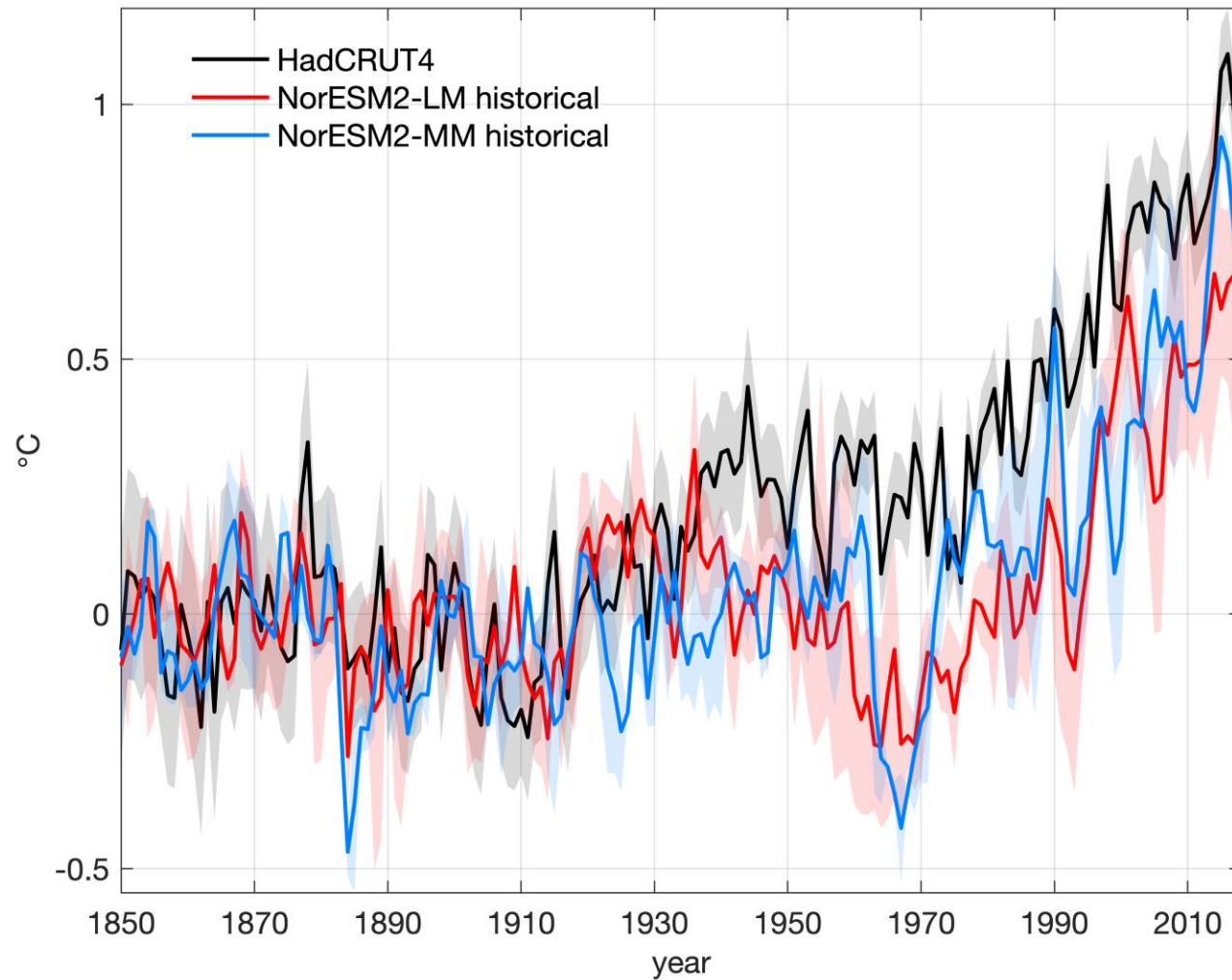
- Through ESGF there are currently **86** NorESM2-LM, **12** NorESM2-MM, **8** NorCPM1 and **4** NorESM1-F experiments available.
- The various NorESM configurations have contributed to the following MIPS:
 - **NorESM2-LM:** AerChemMIP, C4MIP, CDRMIP, CFMIP, CMIP, DAMIP, LUMIP, OMIP, PAMIP, PMIP, RFMIP, ScenarioMIP.
 - **NorESM2-MM:** AerChemMIP, CMIP, RFMIP, ScenarioMIP.
 - **NorCPM1:** CMIP, DCP.
 - **NorESM1-F:** CMIP, PMIP.
- For development and production **200 million CPU hours** have been used and **3 PB** of data produced.

NorESM2 DECK simulations

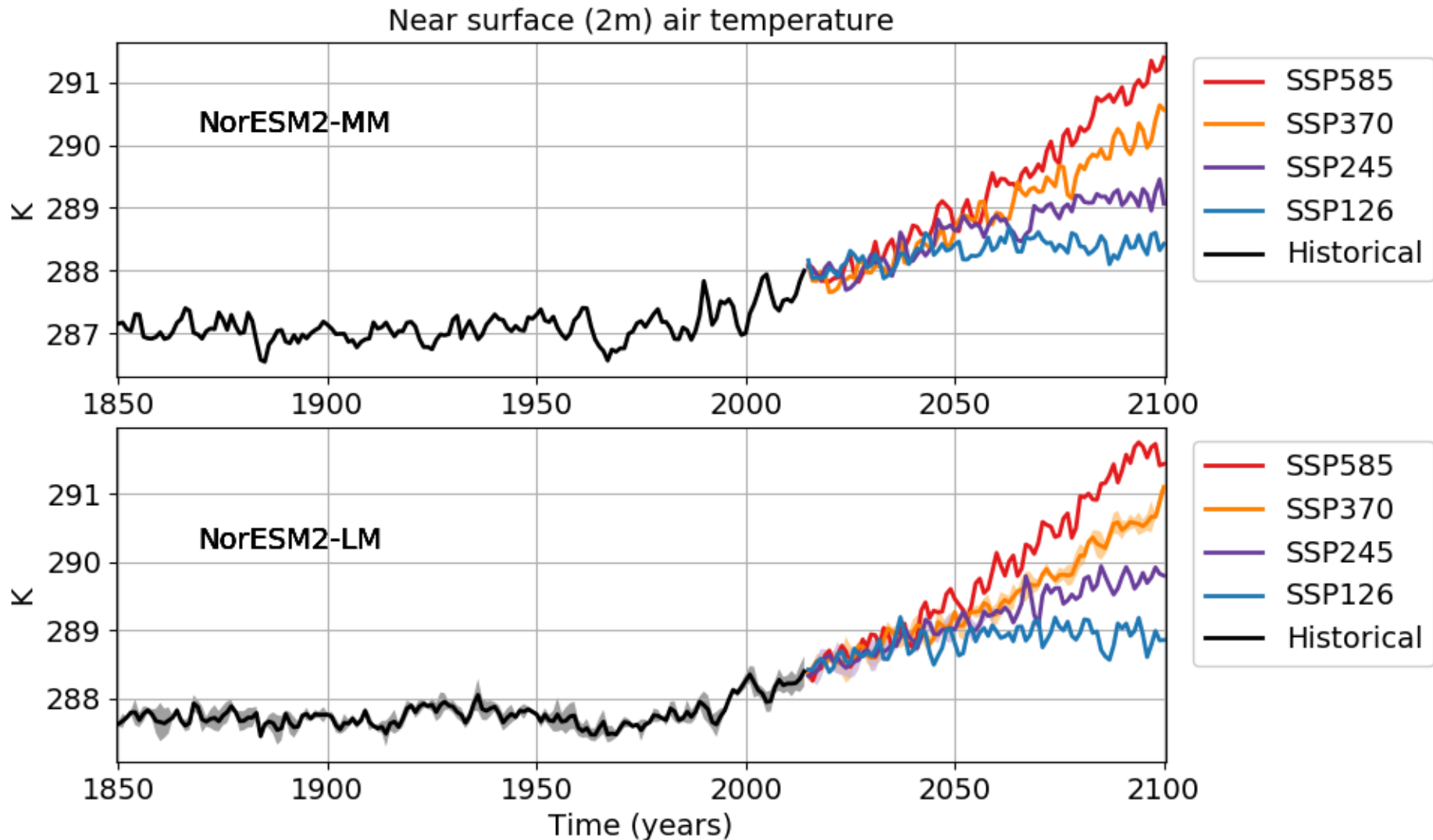
Near surface (2m) air temperature



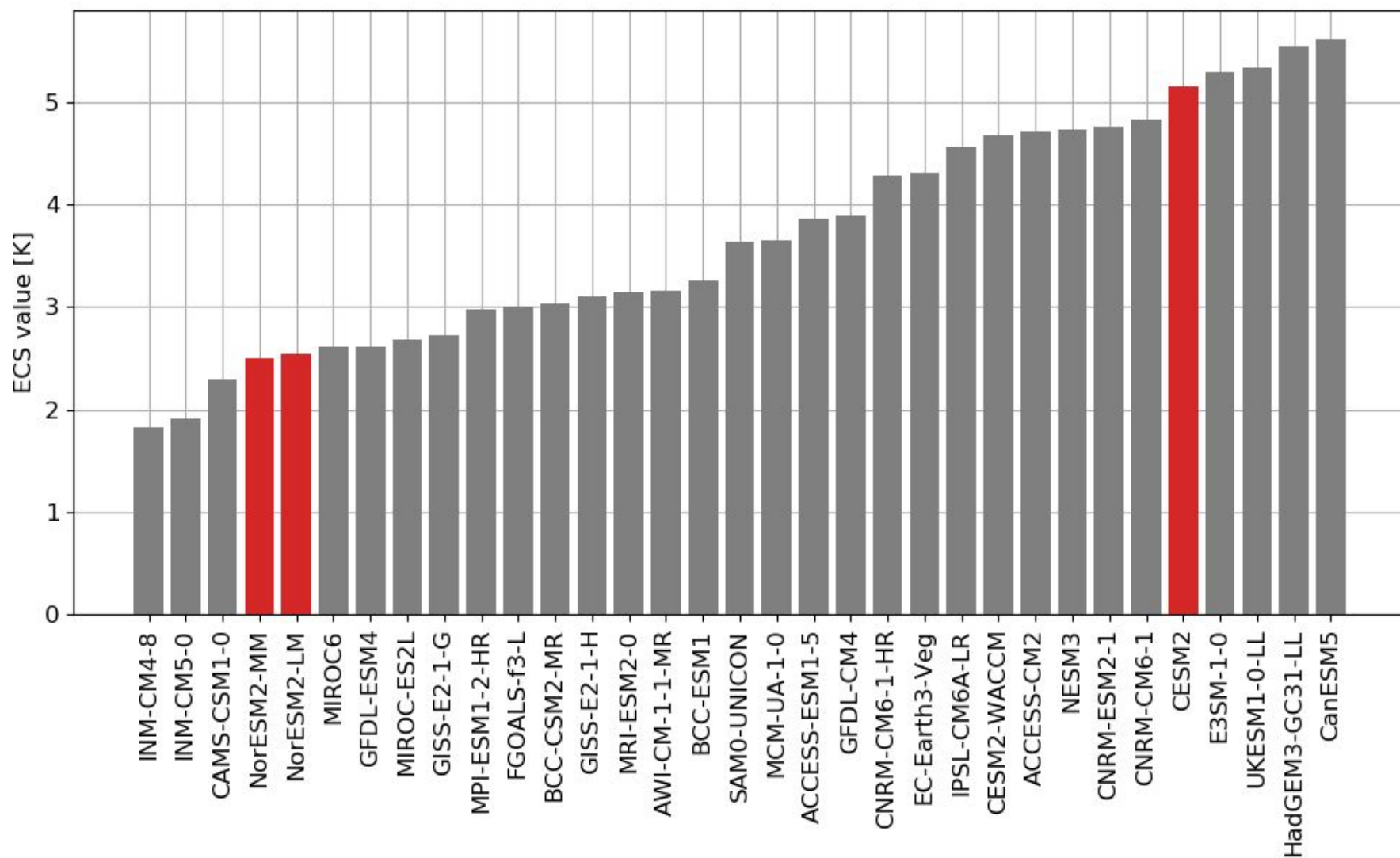
NorESM2 historical simulations



NorESM2 historical and scenario simulations

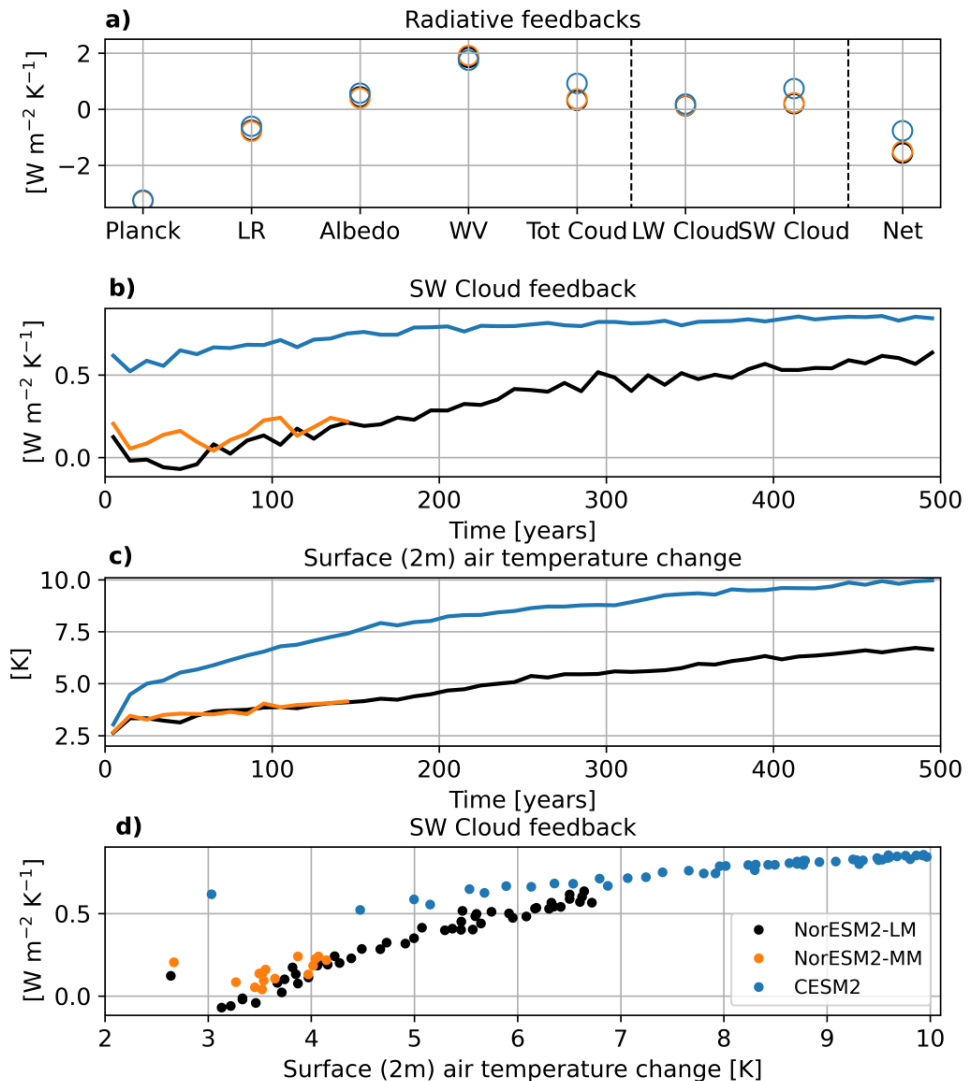


CMIP6 equilibrium climate sensitivity



CMIP6 equilibrium climate sensitivity

- Very different transient climate sensitivity between NorESM2 and CESM2.
- Caused by different depth distribution of heating in the Southern Ocean, subsequently impacting SST, clouds and radiation.











Courtesy: Gjermundsen et al., (2021)







NorESM infrastructure

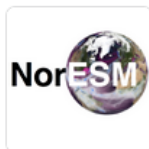
- Repository hub for NorESM code, documentation and tools:
<https://github.com/NorESMhub>
- NorESM2 User's Guide:
<https://noresmdocs.readthedocs.io>
- Time-invariant location of NorESM input data:
<https://www.noresm.org/inputdata>

GitHub: NorESMhub

 NorESMhub



 Overview  Repositories 47  Projects 2  Packages  Teams 13  People 49




Norwegian Earth System Modeling hub

Repository hub for NorESM code, documentation and tools




 16 followers  <https://NorESM-docs.readthedocs.i...>


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Pinned




 **NorESM** Public


Norwegian Earth System Model and Documentation

 Python  29  65

 **BLOM** Public



Bergen Layered Ocean Model

 Fortran  13  24

 **CAM** Public

Forked from [ESCOMP/CAM](#)

Community Atmosphere Model including CAM6-Nor branches

 1  17

 **NorESM-docs** Public

Documentation of the NorESM model system and components


 Python  2  7

 **CTSM** Public

Forked from [ESCOMP/CTSM](#)



Community Terrestrial Systems Model (includes the Community Land Model of CESM)


 Fortran  3  9

 **WW3** Public

Forked from [NOAA-EMC/WW3](#)

WAVEWATCH III

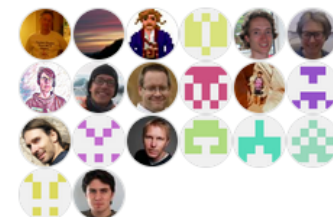
 Fortran  1

 View as: Public ▾

You are viewing the README and pinned repositories as a public user.

You can [create a README file](#) visible to anyone.

People



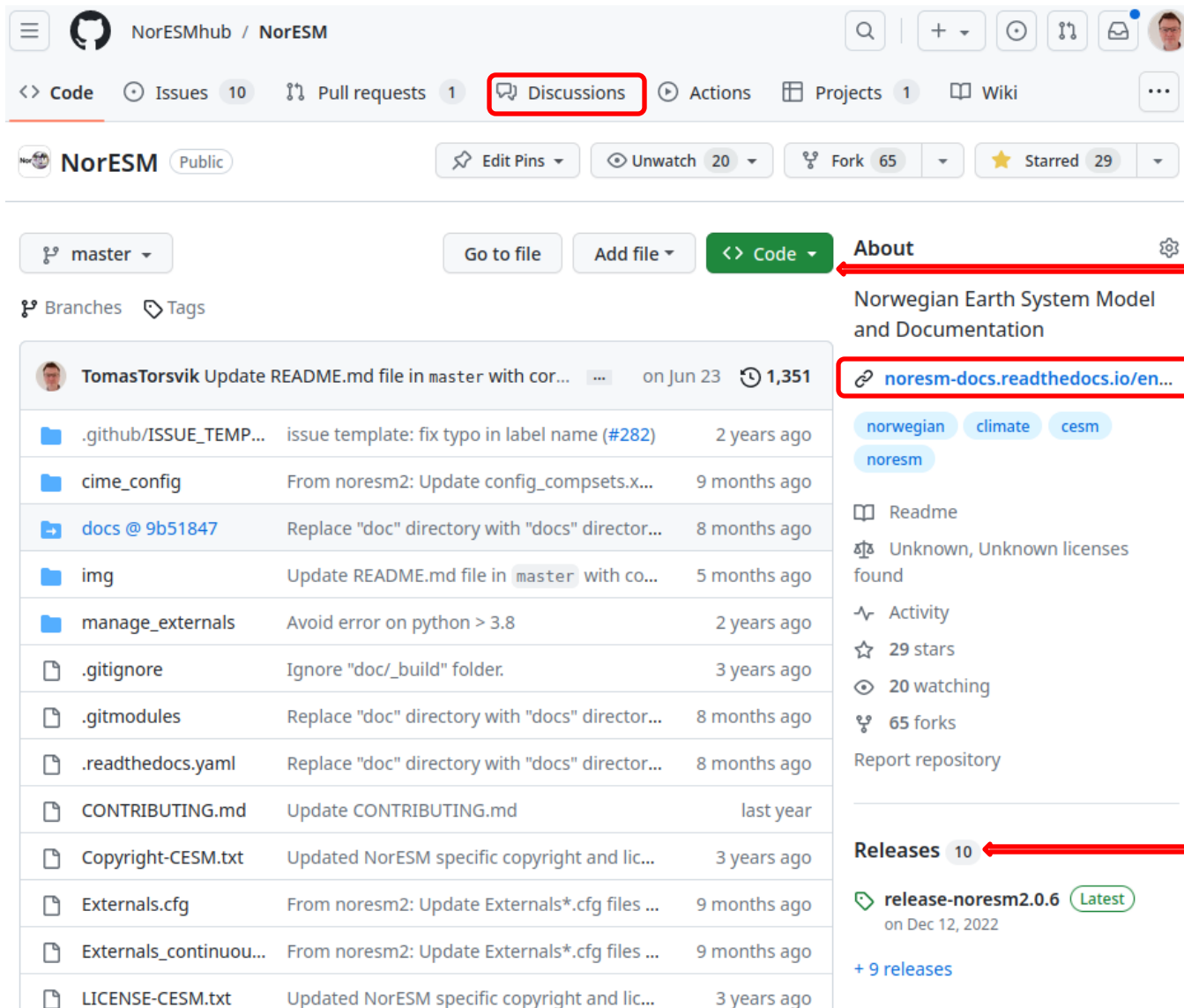
[View all](#)

Top languages

 Fortran  Python  HTML
 Shell  Dockerfile

 Repositories

GitHub: NorESM



NorESMhub / NorESM

<> Code Issues 10 Pull requests 1 Discussions Actions Projects 1 Wiki

NorESM Public

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master

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Norwegian Earth System Model and Documentation

noresm-docs.readthedocs.io/en...

norwegian climate cesm noresm

Readme Unknown, Unknown licenses found Activity 29 stars 20 watching 65 forks Report repository

Releases 10

release-noresm2.0.6 Latest on Dec 12, 2022 + 9 releases

Files

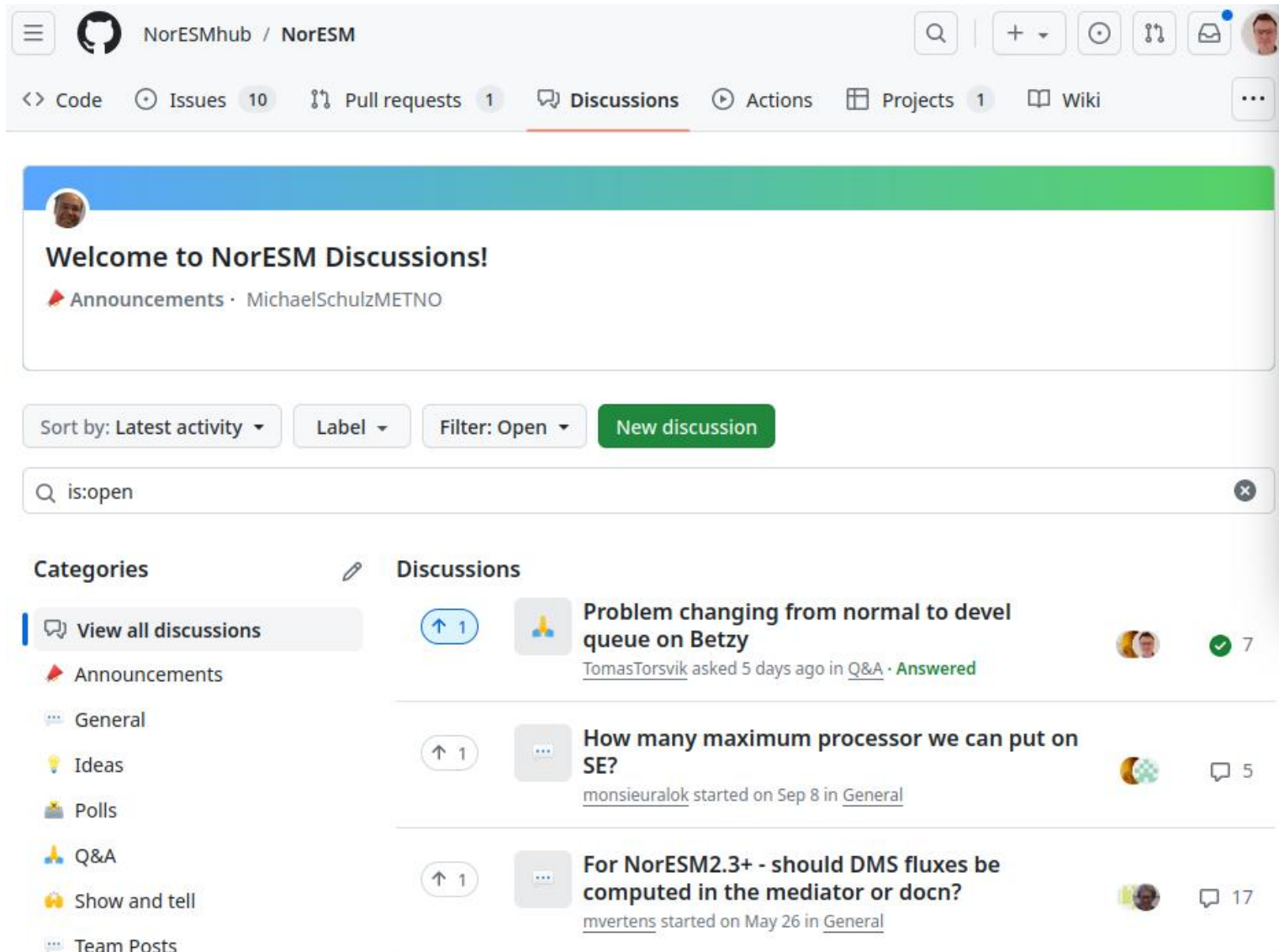
File	Description	Time
.github/ISSUE_TEMP...	issue template: fix typo in label name (#282)	2 years ago
cime_config	From noresm2: Update config_compsets.x...	9 months ago
docs @ 9b51847	Replace "doc" directory with "docs" director...	8 months ago
img	Update README.md file in master with co...	5 months ago
manage_externals	Avoid error on python > 3.8	2 years ago
.gitignore	Ignore "doc/_build" folder.	3 years ago
.gitmodules	Replace "doc" directory with "docs" director...	8 months ago
.readthedocs.yaml	Replace "doc" directory with "docs" director...	8 months ago
CONTRIBUTING.md	Update CONTRIBUTING.md	last year
Copyright-CESM.txt	Updated NorESM specific copyright and lic...	3 years ago
Externals.cfg	From noresm2: Update Externals*.cfg files ...	9 months ago
Externals_continuou...	From noresm2: Update Externals*.cfg files ...	9 months ago
LICENSE-CESM.txt	Updated NorESM specific copyright and lic...	3 years ago

Link to download source code

Link to NorESM documentation

List of code releases, i.e. NorESM versions

GitHub: NorESM discussions page



The screenshot shows the GitHub interface for the NorESMhub / NorESM repository. The top navigation bar includes links for Code, Issues (10), Pull requests (1), Discussions, Actions, Projects (1), and Wiki. The Discussions tab is selected and highlighted. Below the navigation bar, there is a welcome message from MichaelSchulzMETNO. The main content area displays a list of discussions. On the left, there is a sidebar with categories: View all discussions, Announcements, General, Ideas, Polls, Q&A, Show and tell, and Team Posts. The discussions list includes three items: 'Problem changing from normal to devel queue on Betzy' (answered), 'How many maximum processor we can put on SE?' (started on Sep 8), and 'For NorESM2.3+ - should DMS fluxes be computed in the mediator or dochn?' (started on May 26).

NorESMhub / NorESM

<> Code Issues 10 Pull requests 1 Discussions Actions Projects 1 Wiki

Welcome to NorESM Discussions!

Announcements · MichaelSchulzMETNO

Sort by: Latest activity Label Filter: Open New discussion

is:open

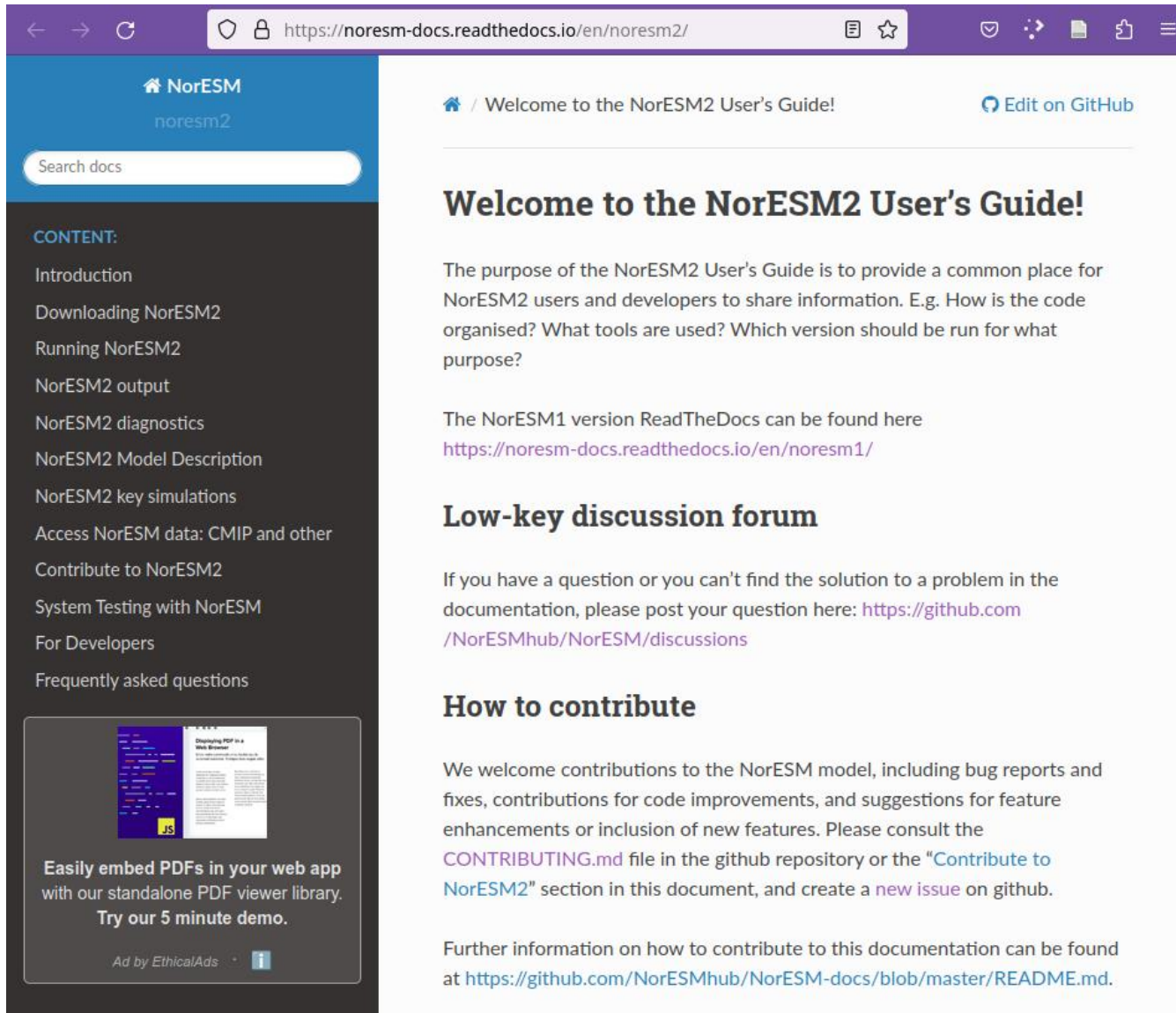
Categories

- View all discussions
- Announcements
- General
- Ideas
- Polls
- Q&A
- Show and tell
- Team Posts

Discussions

- Problem changing from normal to devel queue on Betzy**
TomasTorsvik asked 5 days ago in Q&A · Answered 7
- How many maximum processor we can put on SE?**
monsieurlok started on Sep 8 in General 5
- For NorESM2.3+ - should DMS fluxes be computed in the mediator or dochn?**
mvertens started on May 26 in General 17

ReadTheDocs: NorESM documentation



The screenshot shows a web browser displaying the NorESM2 User's Guide. The browser's address bar shows the URL <https://noresm-docs.readthedocs.io/en/noresm2/>. The page has a blue header with the NorESM logo and a search bar. A dark sidebar on the left lists the table of contents. The main content area has a white background and contains the title 'Welcome to the NorESM2 User's Guide!', an introductory paragraph, a link to the NorESM1 documentation, a section for a discussion forum, and a section for how to contribute.

Navigation and Search:

- Home icon / Welcome to the NorESM2 User's Guide!
- [Edit on GitHub](#)
- Search docs

CONTENT:

- Introduction
- Downloading NorESM2
- Running NorESM2
- NorESM2 output
- NorESM2 diagnostics
- NorESM2 Model Description
- NorESM2 key simulations
- Access NorESM data: CMIP and other
- Contribute to NorESM2
- System Testing with NorESM
- For Developers
- Frequently asked questions

Welcome to the NorESM2 User's Guide!

The purpose of the NorESM2 User's Guide is to provide a common place for NorESM2 users and developers to share information. E.g. How is the code organised? What tools are used? Which version should be run for what purpose?

The NorESM1 version ReadTheDocs can be found here
<https://noresm-docs.readthedocs.io/en/noresm1/>

Low-key discussion forum

If you have a question or you can't find the solution to a problem in the documentation, please post your question here: <https://github.com/NorESMhub/NorESM/discussions>

How to contribute

We welcome contributions to the NorESM model, including bug reports and fixes, contributions for code improvements, and suggestions for feature enhancements or inclusion of new features. Please consult the [CONTRIBUTING.md](#) file in the github repository or the "Contribute to NorESM2" section in this document, and create a [new issue](#) on github.

Further information on how to contribute to this documentation can be found at <https://github.com/NorESMhub/NorESM-docs/blob/master/README.md>.

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