CONSORTIUM FOR SMALL SCALE MODELING COSMO

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD



News from ICON & COSMO

D. Rieger, U. Schaettler, G. Zängl, L. Schlemmer, R. Potthast



Towards an ICON-Community

…some necessary bits and pieces

ICON

Documentation: Status Quo

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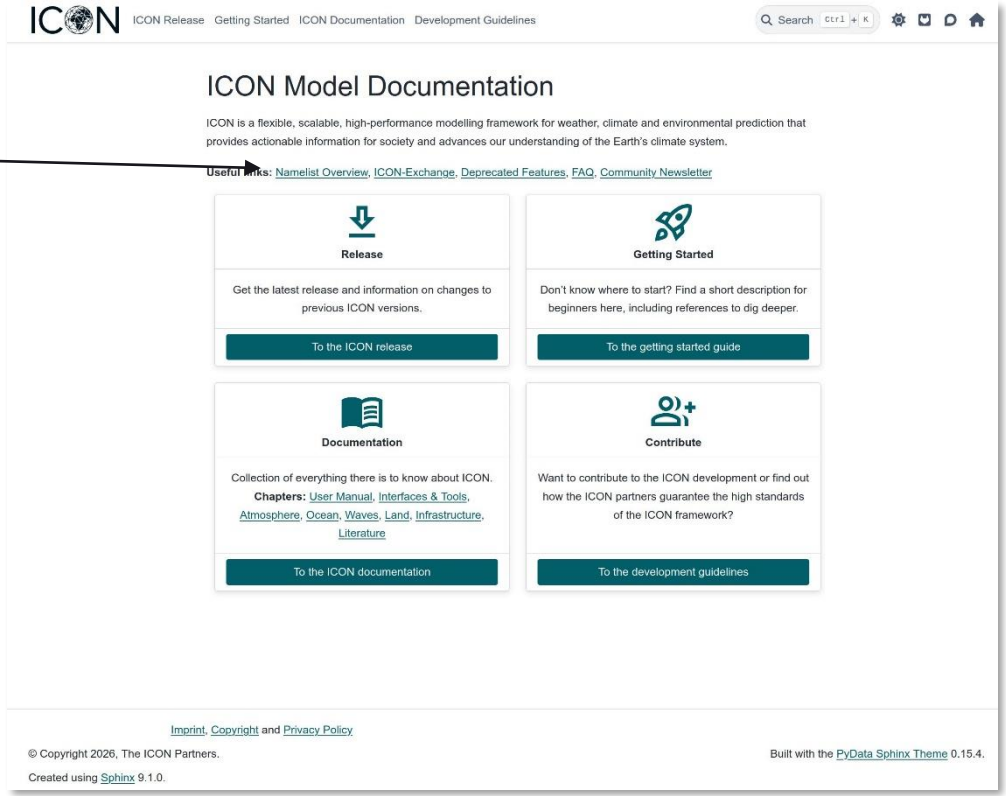
Namelist Overview
- Moved from PDF
- Parameters can be referenced in docs

Deprecation
- Announcements with dates, reasons etc.
- Alternatives

Release
- Download
- Release Notes
  enforced by CI



Documentation
- Varying coverage
- Nicely covered e.g.: Building; ecRad, …

Contribute
- Guidelines for developer, reviewer, documentation

Exchange
- Community support platform
- *See following slide*

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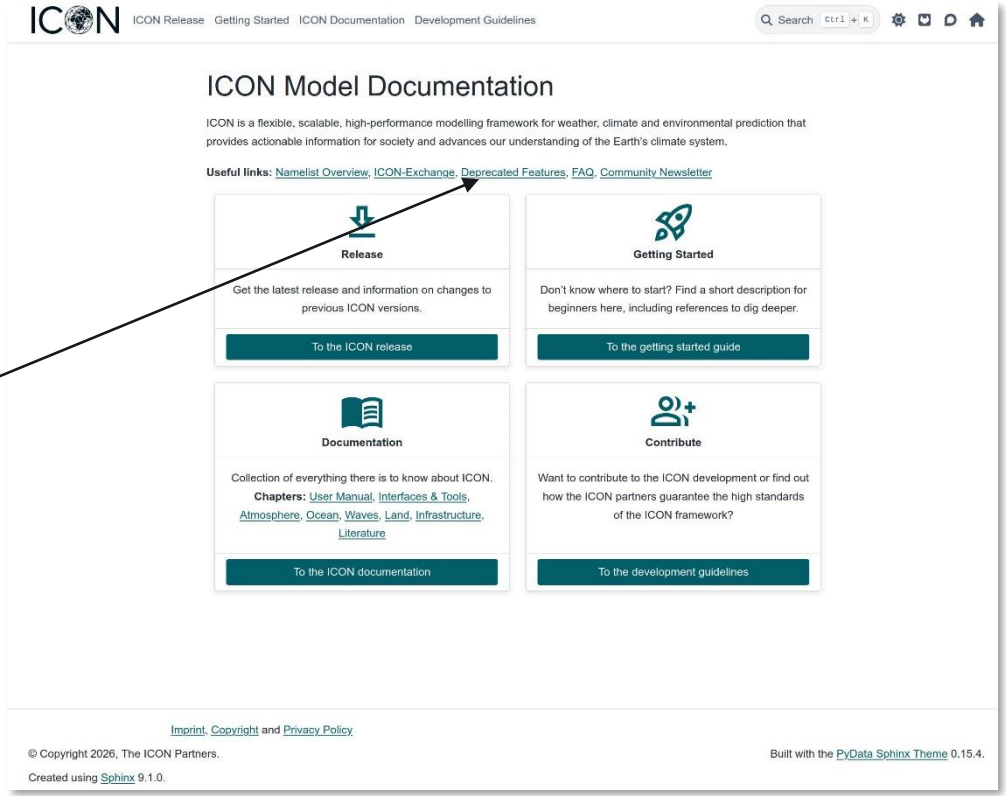

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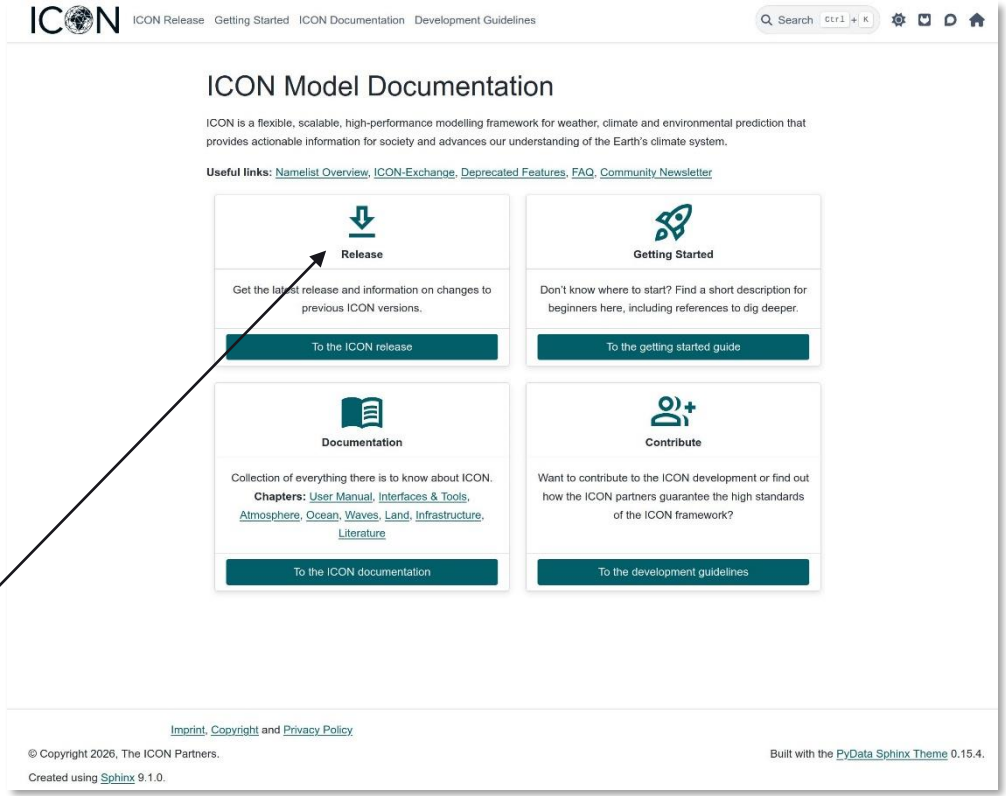

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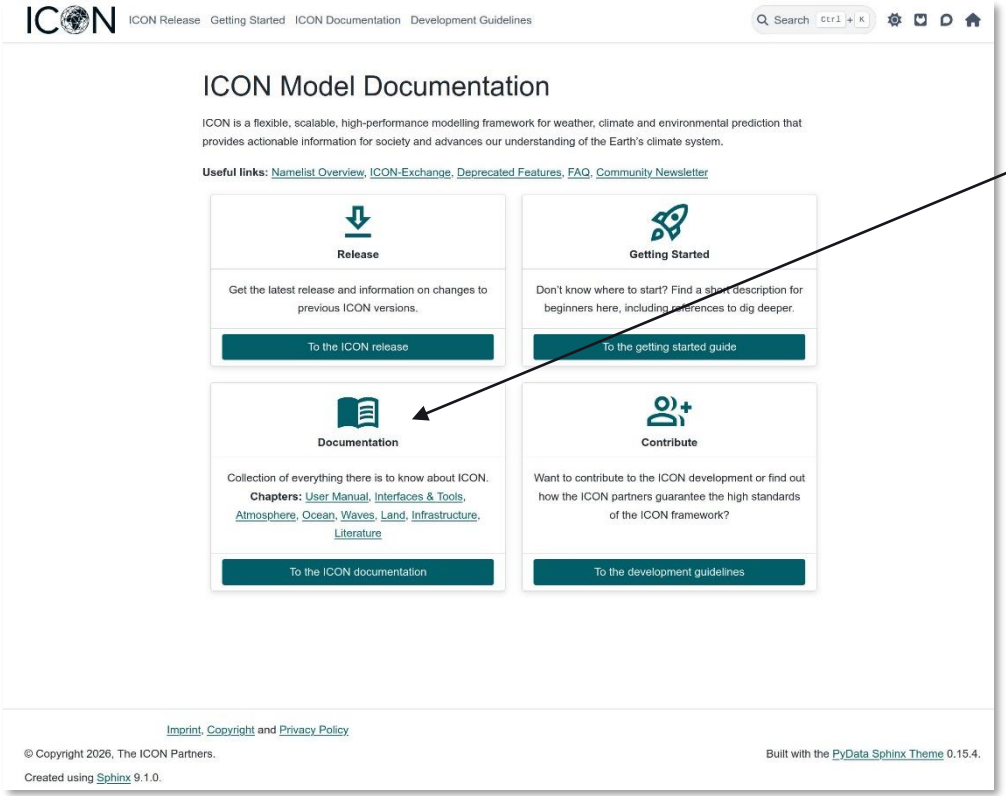

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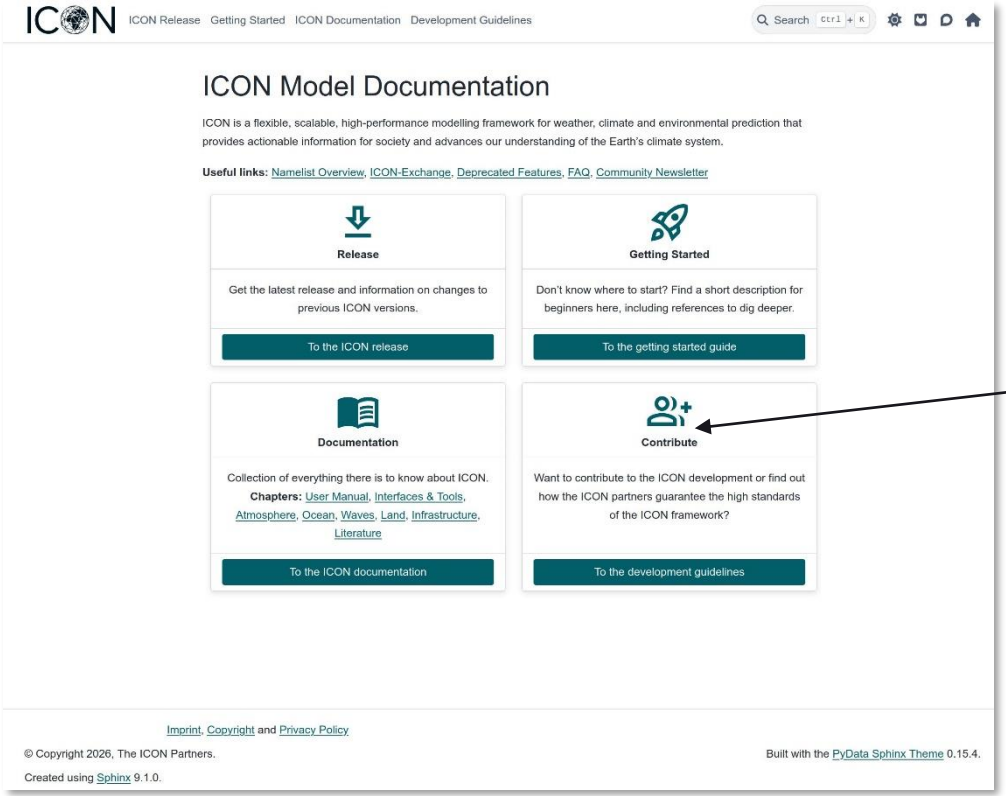

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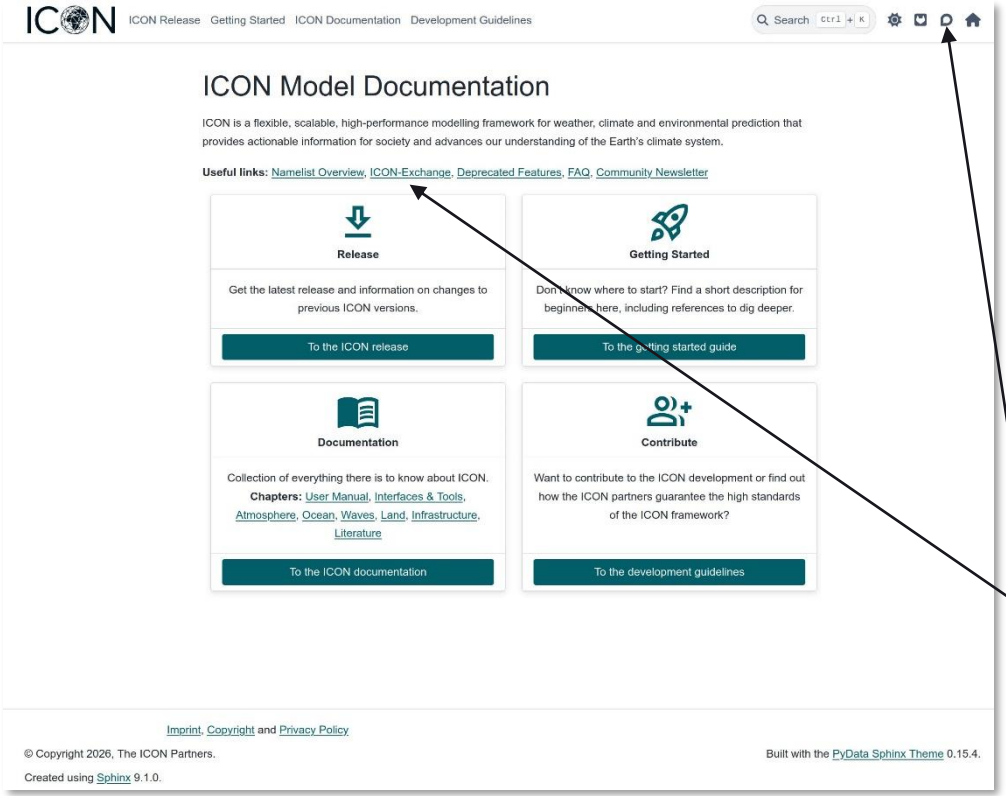

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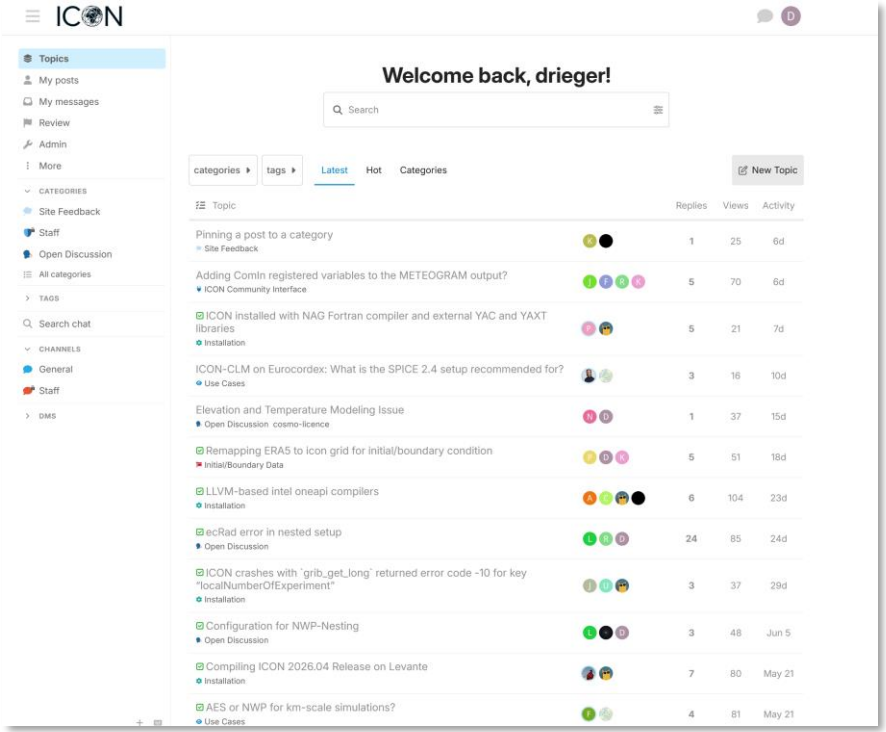
Community Hub: Exchange



https://exchange.icon-model.org

New platform

- Official Announcement in March 2026

Some statistics

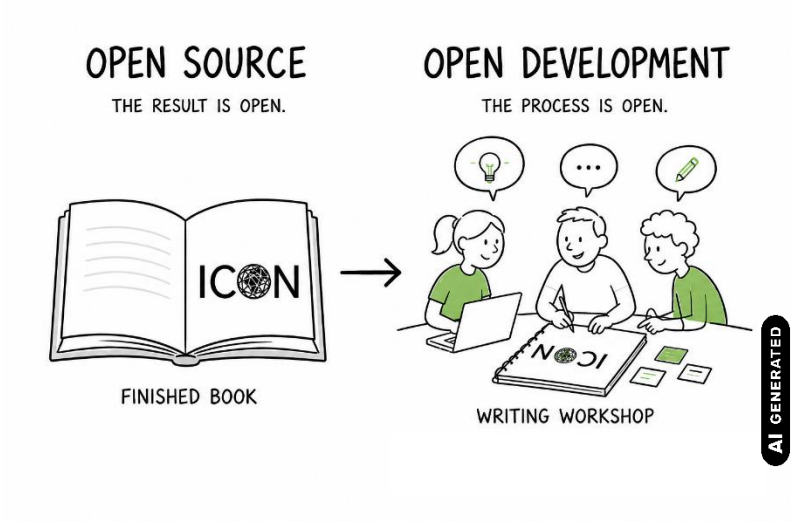
- On average working day around 80 page views
- ~100 topics opened
- Questions are usually answered within less than one day

Supplementary to docs

- Solutions should point to docs, if available there
- Discussions may serve as starting point for docs extensions

Future database for LLMs?

Open Development Workshop

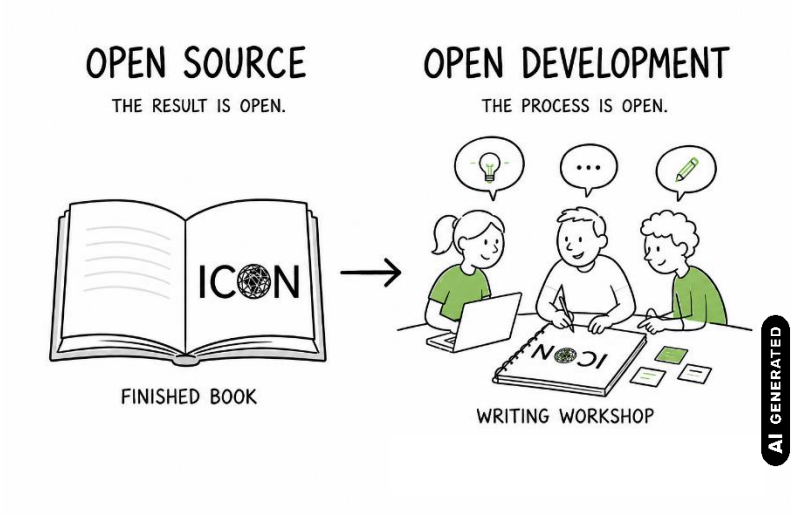


> ICON will continue to move towards Open Development. This is done in close collaboration with the open development team.
> *ICON Coordination*
> *https://gitlab.dkrz.de/icon/wiki/-/wikis/2026_03_05*

Recommendations Open Development Team

- Clear and concise guidelines documented on https://docs.icon-model.org
- Push https://exchange.icon-model.org
- Cleanup issues, merge requests, maintainer group
- Homogenize workflow and testing strategy & get to one common repository
- Enforce development workflows and guidelines for everyone
- Establish additional roles (~community management)
- Organize semi-annual meetings
- Establish an open monthly virtual ICON Coffee
- Establish red lines for contributions and community interaction
- Collect & establish existing informal “topic groups”

Open Development Workshop



My opinion:

Much of the investment in Open Development is **already paying off** by enabling a clear, transparent, and healthy development process.

Recommendations Open Development Team

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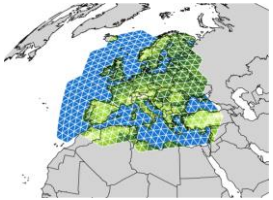
ICON for NWP: Recent activities and advances







Major improvements of DWD's operational system

- Further development of adaptive parameter tuning
- Bugfix: use t_s rather than t_skin for bare-soil evaporation
- Bugfix for vertical localization in global DA
- Revision of SST perturbations in global EPS and EPS parameter perturbations in ICON
- Retuning of stratospheric humidity relaxation in global DA
- Simplified prognostic 2D aerosol scheme
- Coming soon: increase EPS resolution from 26/13 km to 20/10 km

Important physics developments in ICON

- TKESV scheme
- Two-moment cloud ice scheme, dusty cirrus parameterization
- New Extpar data for soil properties (HiHydroSoil)
- Van Genuchten scheme for hydraulic soil properties
- Extension of skin temperature scheme to snow-covered areas

ICON-Ocean State Files – D. Krüger et al.

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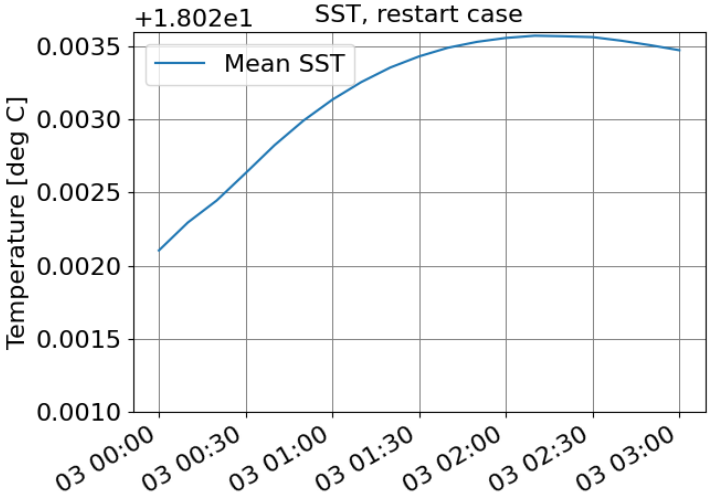
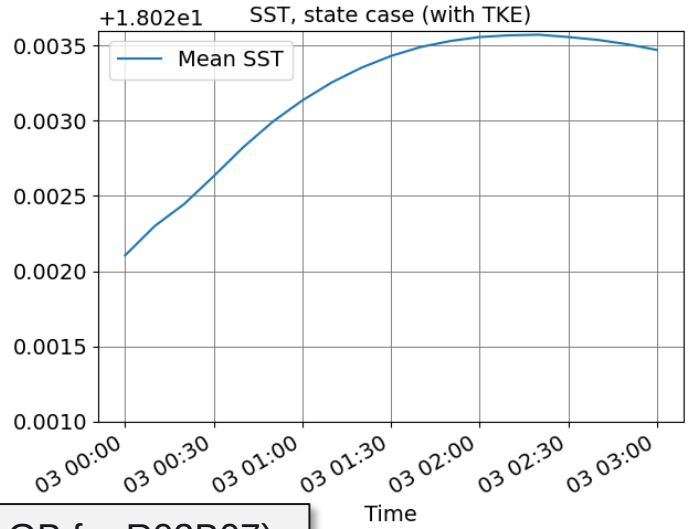




- Much smaller than restart files (~300 MB vs. 3.5 GB for R02B07)
- Changes in Namelists possible
- Initialisation similar to atmospheric initicon-routine
- Fillvalues and missing values also implemented
- Both NetCDF and GRIB2 format possible

Zentrum für Geoinformationswesen der Bundeswehr



Consortium News



ICON Licensees / Users

Running ICON

- Brazil (Navy, INMET), Qatar, Oman, UAE

In preparation

- Botswana, Nigeria, Zimbabwe, Rwanda, Cyprus

Still need to migrate

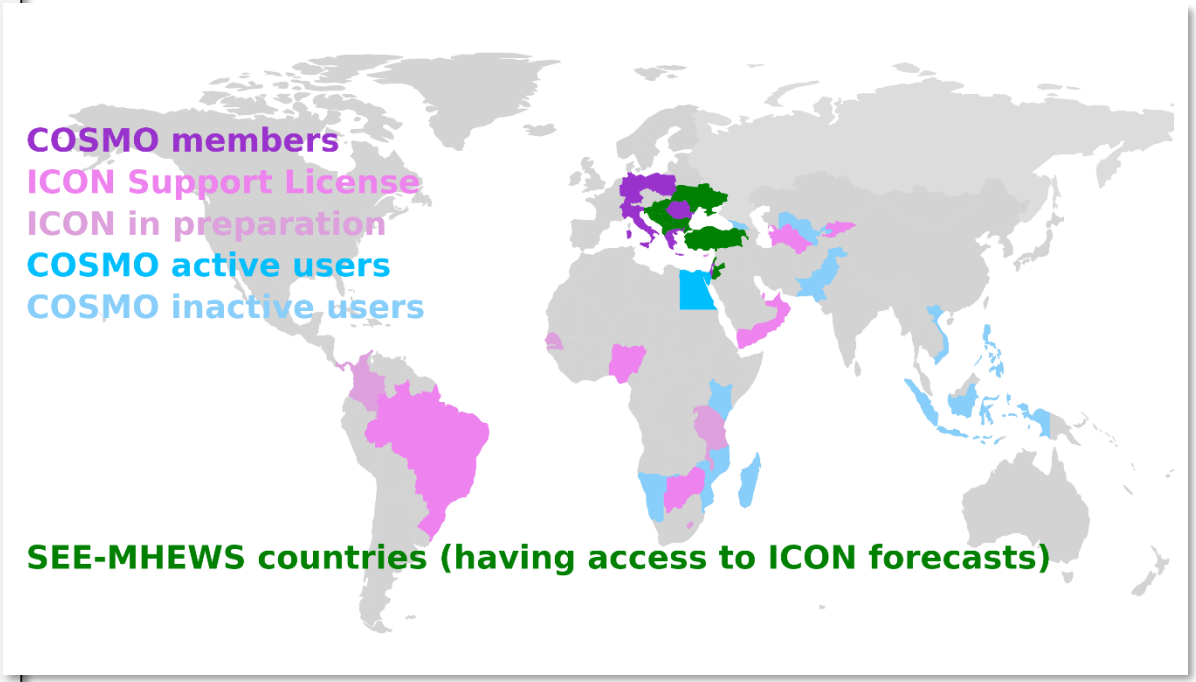
- Turkmenistan (need new HPC)
- Malawi (in contact)
- Egypt (no contact right now)

Contacts to

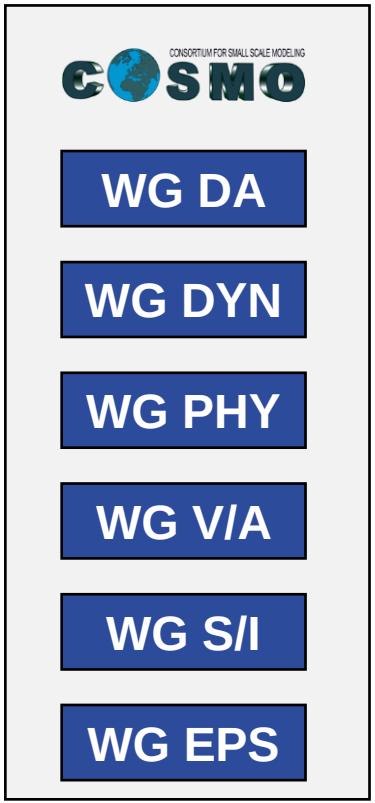
- Lesotho, Tanzania, Senegal

Possible paying countries

- In negotiation: Barbados
- Stalled: Bahrain, Columbia, Panama



COSMO Structure



- **WG DA – Christoph Schraff (DWD)**
  Data Assimilation
- **WG DYN – Michael Baldauf (DWD)**
  Dynamics and Numerics
- **WG PHY – Jan-Peter Schulz (DWD), Harel Muskatel (IMS)**
  Physics
- **WG V/A – Amalia Iriza-Burca (NMA), Andrzej Mazur (IMGW-PIB)**
  Verification and Applications
- **WG S/I – Massimo Milelli (CIMA), Gabriella Ceci (CMCC)**
  Support and Infrastructure
- **WG EPS – Chiara Marsigli (ARPAe)**
  Predictability and Ensemble Methods

COSMO Structure

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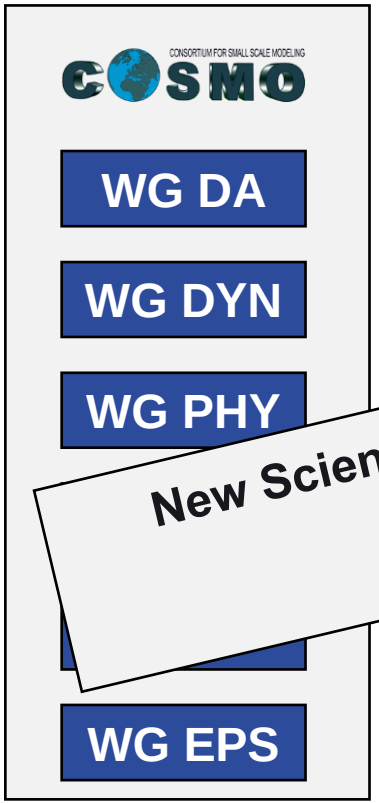

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New Scientific Project Manager (SPM) starting 01/2027:

C. Marsigli (ARPAE, Italy)

COSMO Projects

APOCS (WG V/A)

- **Application of Personal weather station and Opportunistic sensor data CrowdSourcing**
  Lead: A. Surowiecki (IMGW-PIB, Poland)
  - application of alternative weather data acquired by the Personal Weather Stations and other Opportunistic Sensors into research and operations

ACLIIM (WG PHY)

- **Aerosol-Cloud Interactions in ICON Model**
  Lead: H. Muskatel, (IMS, Israel)
  - Coupling of CAMS aerosol with microphysics incl. validation
  - mixed-phase Spectral Bin Microphysics (SBM)

COSMO Projects

KAOS (WG EPS)

- **Addressing the complexity in the weather forecast**
  Lead: C. Marsigli (ARPAE, Italy)
  - coordinate ensemble development, focusing on perturbation schemes, unified verification, nowcasting, and evaluating ICON-LEPS integration with national EPSs.

MED-PRECIP-EM (WG PHY)

- **Mediterranean Precipitation Improvement using EMVORADO**
  Lead: J. Shpund (IMS, Israel)
  - Using EMVORADO to evaluate radar signatures across increasingly complex microphysics will reveal how to improve kilometre-scale precipitation forecasts, especially in the Mediterranean.

.gitlab-ci.yml 5.19 KiB

```yaml
include:
  - local: .gitlab/ci/basic.yml
    rules:
      - if: $CI_PIPELINE_SOURCE == "web" && "$[[ inputs.web-add-basic-stage ]]" == "true"
      - if: $CI_PIPELINE_SOURCE != "web"
  - local: .gitlab/ci/unit/icon.yml
    rules:
      - if: $CI_PROJECT_PATH == "icon/icon-model"
        when: never
      - if: $CI_PIPELINE_SOURCE == "web" && "$[[ inputs.web-add-unit-stage ]]" == "true"
      - if: $CI_PIPELINE_SOURCE == "merge_request_event"
        changes:
          - "*.in"
          - .gitlab/ci/unit/icon.yml
          - config/dkrz/*
          - configure
          - externals/**/*
          - src/**/*
          - support/**/*
          - test/unit-tests/**/*
          - utils/**/*
  - local: .gitlab/ci/unit/ragnarok.yml
    rules:
```



Gitlab-CI Overview

ICON

Gitlab-CI - General Overview

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Structure

- Central configuration in **`.gitlab-ci.yml`**
- **Stages:** logical phases, e.g. *Build → Test → Deploy*
- **Jobs:** individual tasks within a stage
- **Runners:** execute jobs in defined environments
- **Artifacts & cache:** store results and accelerate workflows

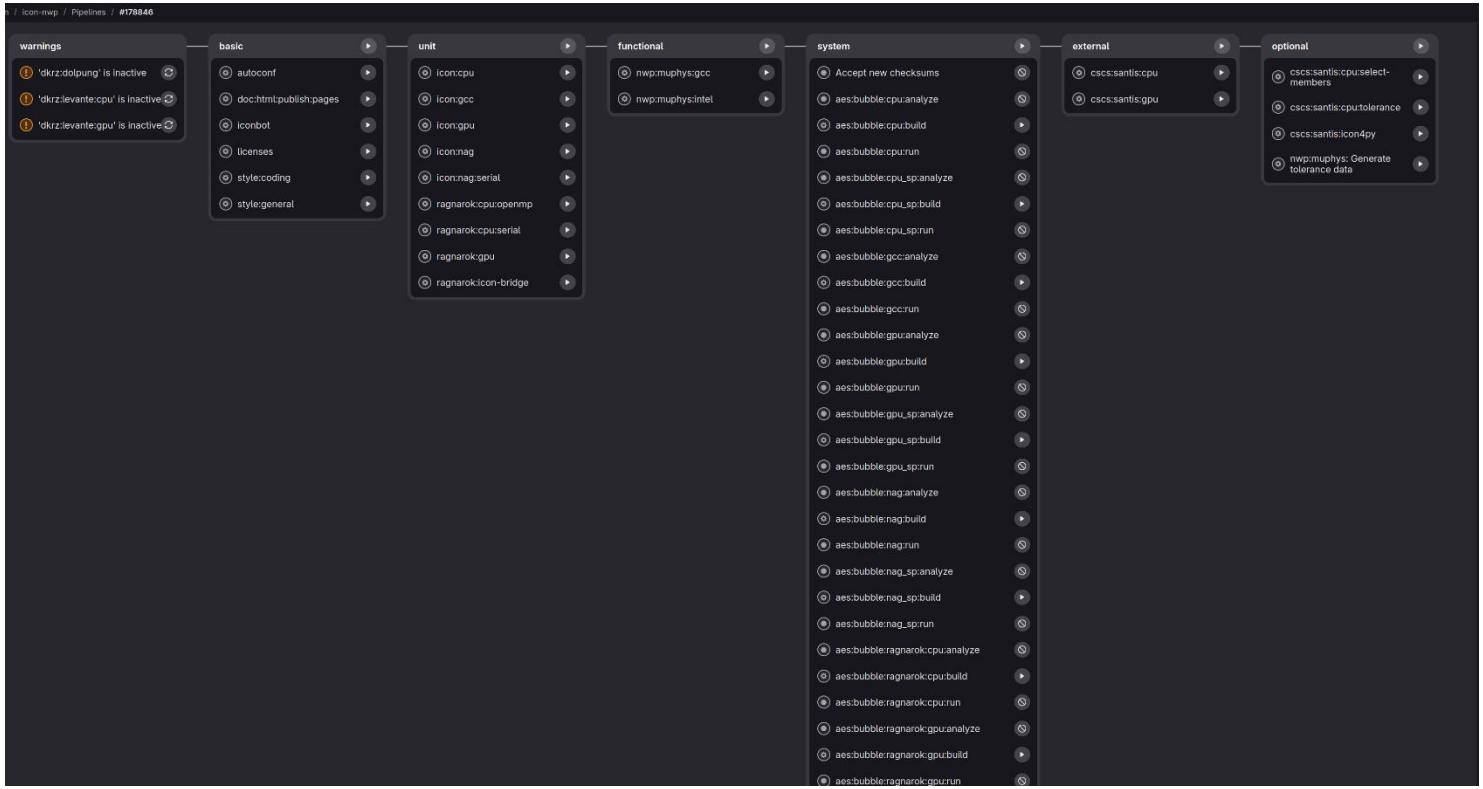
Objectives

- Automate builds, tests, and deployments
- Detect errors early through continuous integration
- Ensure reproducible and transparent software delivery
- Enable faster development with consistent quality

How it works

- A commit or merge request triggers a pipeline
- GitLab runs jobs according to dependencies and rules
- Independent jobs can run in parallel
- Status, logs, and results are available in GitLab

Gitlab-CI - ICON Overview





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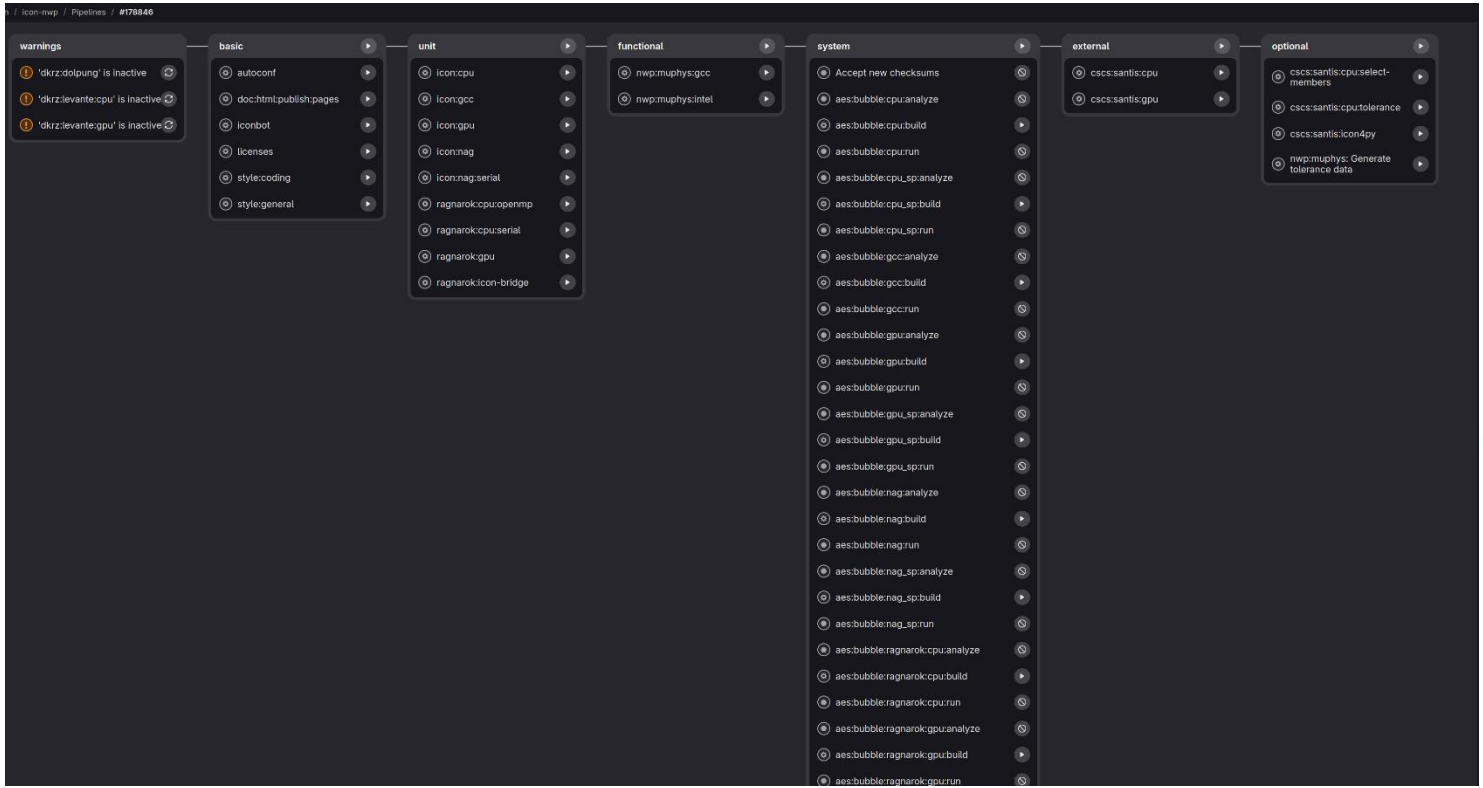

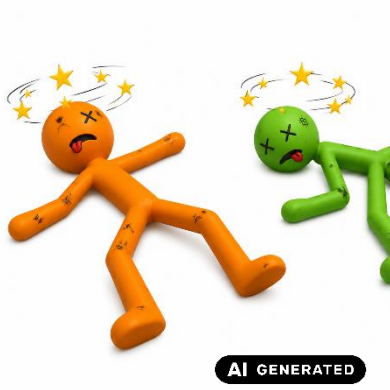

Gitlab-CI - ICON Overview

Structure: Stages

- **warnings:** Information on downtime of systems *(reduced CI functionality)*
- **basic:** Tests that ensure a proper workflow and code quality *(no execution of ICON code)*
- **unit:** Test small code units (functions, …) independently
- **functional:** Test larger code units in standalone *(e.g. microphysics, cloud cover, …)*
- **system:** Complete ICON tests *managed by the gitlab-ci*
- **external:** Complete ICON tests, *externally managed (mostly buildbot)*
- **optional:** Generate tolerance updates, …

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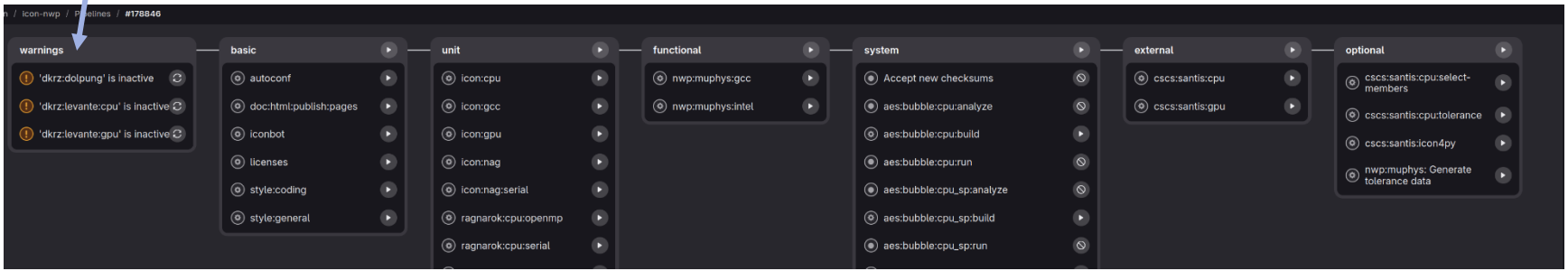

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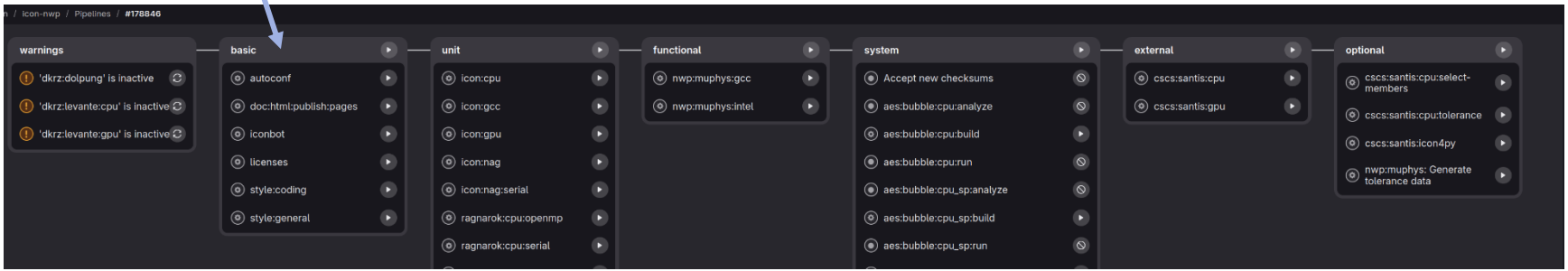

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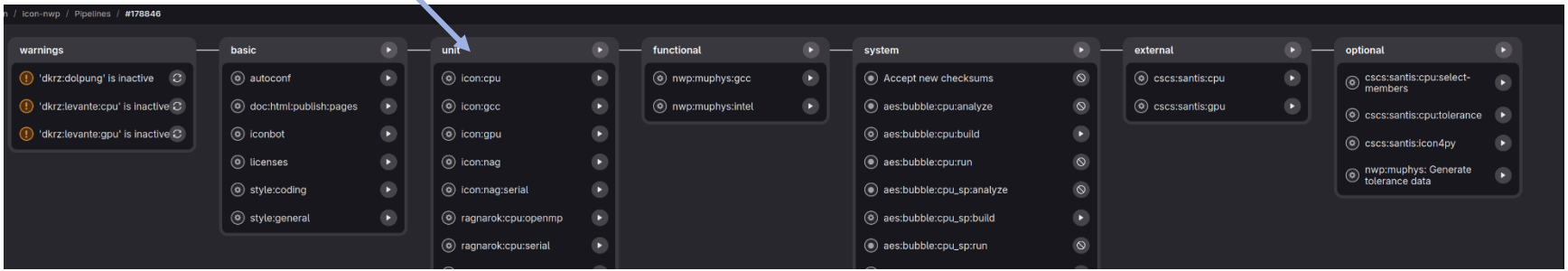

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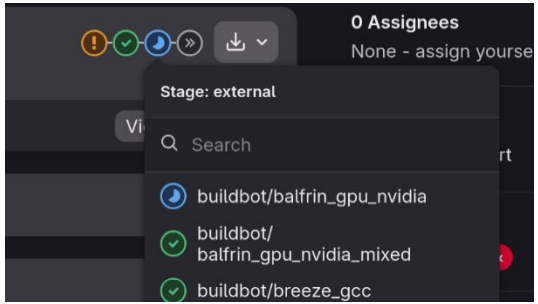
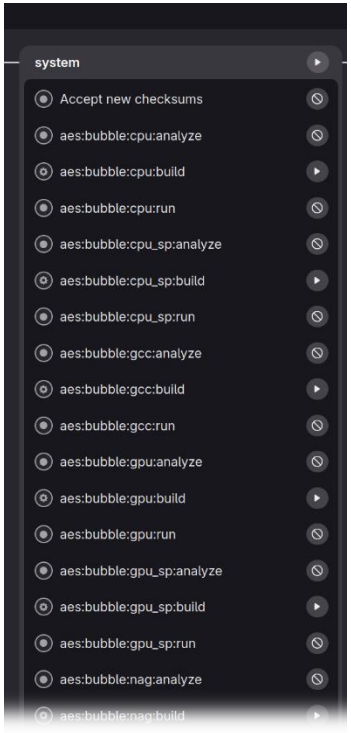


Gitlab-CI - stage:basic

Job	Objectives
licenses	Check license header of all files. Exceptions: **`REUSE.toml`**
release-notes	Check if release notes were added. Exception: **`[no_release_notes]`**
cla-check	Check if authors signed an agreement to ICON's license conditions
style:coding	**`pre-commit`** for coding style. Generates a patch (**`git apply`**)
style:general	Multiple scripts to check for encapsulation, access, encoding, …
autoconf	Generate **`configure`** from human-readable **`configure.ac`** *(fix software stack)* Generates a patch (**`git apply`**)
iconbot	Notifier in Merge Requests *(CLA links, ping subscribed users)*
doc:html:check	Generates HTML documentation from Markdown *(View app button)*

Gitlab-CI - stage:system



Systems tests *(currently MPI-M/AES only, but planned for NWP!)*

- Direct integration in gitlab-ci using jacamar-runner
  runs as user on HPC and offers slurm & PBS support
- Very long list due to job chains
  build → run → analyze → Accept new checksums
- For ICON, this is rather new and will likely replace buildbot step-by-step
  Only a technical difference! Tests can be identical

Questions?

Daniel Rieger
Numerical Models Division
daniel.rieger@dwd.de

