

A Consortium for CONvection-scale modelling  
Research and Development

## Tactus - from DEODE to ACCORD with love

Ulf Andrae SMHI

6th ACCORD All Staff Workshop 13-17 April, Marrakech and hybrid

# Common scripting in ACCORD, why?

In the ACCORD phase 2 strategy it's recognized that:

***“The design and development of a common development environment for ACCORD is a major priority as it will significantly increase the efficiency and the effectiveness of the collaboration between ACCORD members. In this context, an important goal for the coming years is the co-development of a common scripting system for research in ACCORD, paving the way to transform our current ecosystem of components into a coherent and cohesive integrated system.”***

In addition a starting point is defined:

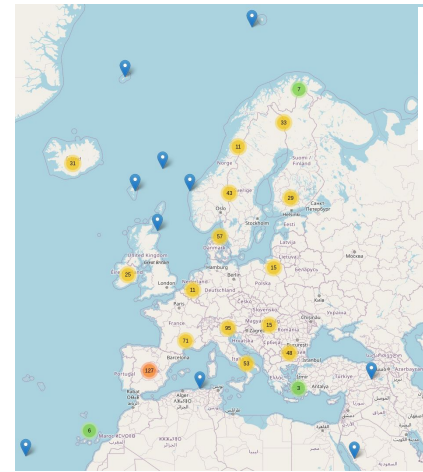
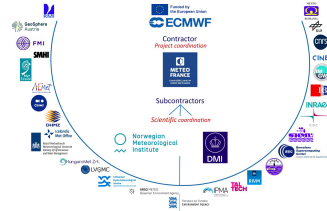
***“The design of ACCORD common scripting system will start from the DEODE scripting system and adopt a co-analysis and co-development strategy leading to a stepwise development and to a genuine co-ownership of the tools, also leveraging on existing knowledge and tools that can accelerate the development.”***

[https://www.accord-nwp.org/IMG/pdf/accord\\_strategy\\_2026-2030.pdf](https://www.accord-nwp.org/IMG/pdf/accord_strategy_2026-2030.pdf)

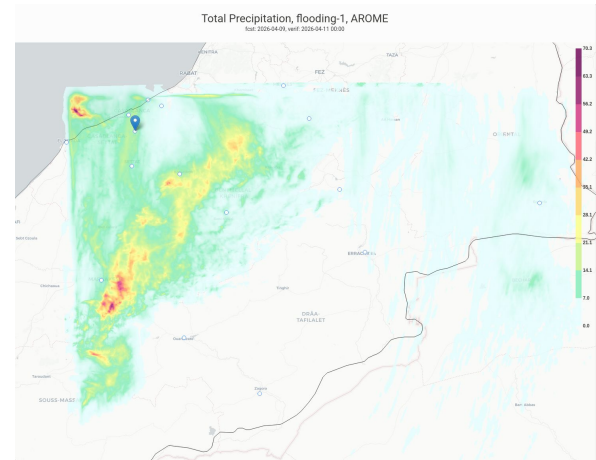
# Some DEODE background of Tactus

- Destination Earth On-Demand-Extremes ([DE330](#) aka DEODE) started in 2022
  - Produce high resolution forecast for extreme weather related events
- Required a new runtime environment for NWP and other applications, birth of **Deode-Prototype** -> **Deode-Workflow** -> **Tactus**
- Runs ALARO/AROME/HARMONIE-AROME at sub kilometre resolution using IAL CY49T2, with additions, forced by the global 4.4km DT in the daily DEODE production
- Technical development lead by Xiaohua Yang DMI & Ulf Andrae SMHI together with a large group of hard working colleagues from ACCORD institutes

More about DestinE and DE330 from Roger Randriamampianina on Friday



Geographical distribution of the ~700 cases covered by DEODE, from [DEODE case viewer](#)



DEODE precipitation forecast over Morocco for 2026-04-09, from <https://visualization.ecmwf-destine-deode.f.ecwcloud.host/>

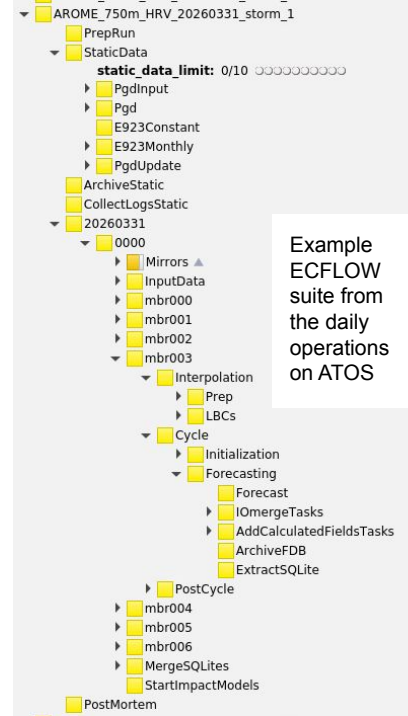
Past talks by undersigned : [ASW 2023](#), [ASW2024](#)

# Current capabilities of Tactus in DEODE

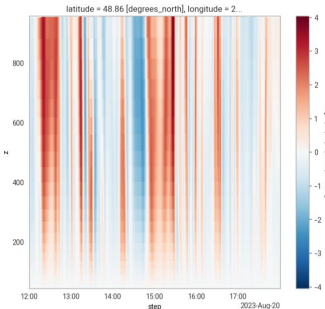
For any of the CSCs in ACCORD we can:

- Generate physiography files
  - SURFEX and E923 ones
- Interpolate boundaries from IFS or any CSC
- Run a forecast, deterministic or as an EPS
- Start a run from any time and output with any frequency (down to the timestep )
- Additional postprocessing in python
- Archive to FDB for easy distribution of data via polytope
- Produce sqlite files suitable for harp
- Launch various downstream applications

The implemented functionality is tailored for DEODE needs and the CSC configurations for sub kilometre resolutions



Vertical wind cross section with 30s resolution for data stored and retrieved from FDB

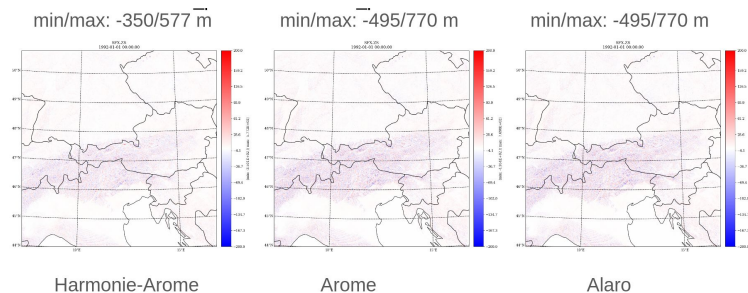


# Work on IAL@CY49T2 present in the daily runs

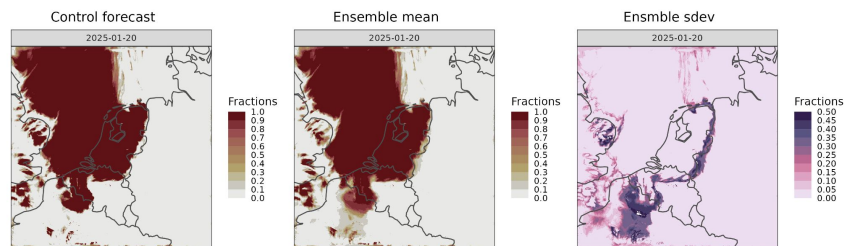
It's not only about the scripting but a combination of IAL + tactus

- A massive technical work allows us to run
  - all CSCs from the same binary, impossible without bringing in various ACCORD contributions
  - with intel and gnu compiler, in double and single precision (AROME/HARMONIE-AROME)
  - on three different HPCs (ECMWF atos, LUMI, LEONARDO)
- WMO compliant GRIB2 with sub hourly support for upper air and (some) SURFEX fields
- A lot of new science on dynamics, physics and predictability aspects implemented

Additional work on GPU refactoring and e.g MULTIO aspects not yet in daily operations



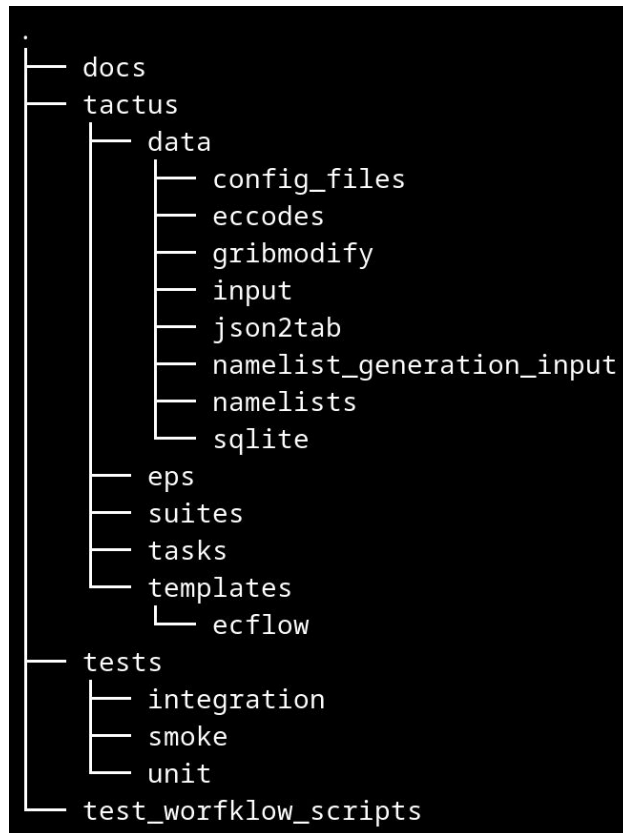
Comparing GMTED and GLO90 topography database for all CSCs  
Courtesy Erik Gregow, FMI



Examination of VSIQSAT perturbations in HARMONIE-AROME  
Courtesy: Xiaohui Zaho, IMO

# Tactus design in brief

- Written as a python package (currently using python 3.10)
- Using poetry as a package manager ( under conda/micromamba ). Under revision (pixi, uv)
- Separation between core functionality and tasks
- Unique functionalities ( e.g. grib2sqlite conversion ) lives outside tactus
- CSC and scheduler agnostic (almost) - ecflow interface separated
- Support for full ecflow suite, or run a single task without a scheduler
- Configurable with yaml/toml/json files
- Aims at portability, isolate platform dependent settings (data location, batch job control, ...)



Tactus directory structure

# Examples of functionalities

- [toolbox.py](#): E.g. handling of file transfers (ecfs, FDB, scp, s3 )
- [namelist.py](#): for namelist construction and control
- [os\\_utils.py](#): File search, create dir with correct permissions
- [sfx.py](#): Controls surfex related tasks (Prep, PGD)
- gather ecflow interfaces in [scheduler.py](#), and suites
- ...

Task definitions could (should) be short

```
class ArchiveFDB(ArchiveTask):
    """Archiving task for time dependent data dedicated for FDB."""

    def __init__(self, config):
        """Construct object.

        Args:
            config (deode.ParsedConfig): Configuration
        """
        ArchiveTask.__init__(self, config, "FDB", include=["fdb"])
```

## non-exclusive list of code

```
— boundary_utils.py
— datetime_utils.py
— domain_utils.py
— namelist.py
— os_utils.py
— plugin.py
— scheduler.py
— submission.py
— toolbox.py
— suites
  — suite_utils.py
  — tactus.py
— tasks
  — archive.py
  — boundaries.py
  — cleaning_tasks.py
  — compilation.py
  — e923.py
  — forecast.py
  — iomerge.py
  — sfx.py
  — sqlite.py
```

# Tactus from the user perspective

Create a configuration file

```
tactus case \  
  ?tactus/data/config_files/configurations/cy49t2_alaro \  
  deode/data/config_files/modifications/ddh.toml \  
  myconfig.toml -o test.toml
```

Launch an ecflow suite from the generated config file

```
tactus start suite -c test.toml
```

Run a single task ( suitable for development ) given data availability

```
tactus run -task Forecast -c test.toml
```

Configuration options and more documentation under

<https://accord-nwp.github.io/tactus/>

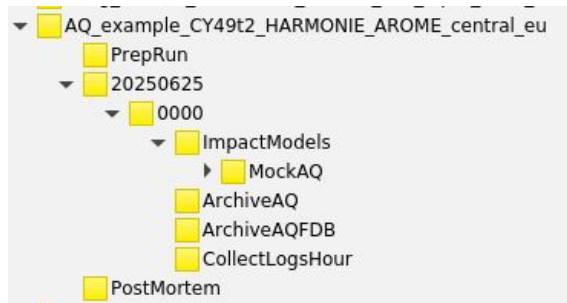
still coloured by the DEODE focus

```
[general.times]  
  forecast_range = "PT48H"  
  start = "-P1D"  
  
[general.output_settings]  
  fullpos = "PT10M"  
  ddh_dl = "PT10M"  
  
[boundaries.ifs]  
  selection = "IFSSENS"  
  
[eps.general]  
  members = "0:7"  
  
[eps.member_settings.boundaries.ifs]  
  bdmember = "0:7"  
  
[namelist_update.master.forecast.NAMDDH]  
  "BDEDDH(1,1)" = 4.0  
  "BDEDDH(2,1)" = 1.0  
  "BDEDDH(3,1)" = "@DOMAIN.XLONCEN@"  
  "BDEDDH(4,1)" = "@DOMAIN.XLATCEN@"
```

Example of a user config starting an ensemble running yesterday with high frequency GRIB output and activating ddh

# Tactus and plugins

- Use tactus as a python package that can be imported
- Examples from DEODE
  - Tactus-test-runner
  - Verification suite
  - Several impact models like Air quality, wildfire, frost forecasting, anemoi, nowcasting
- Reuse existing support methods
- Opens up for further separation between core functionalities and e.g. DEODE, ACCORD NWP or ACCORD climate applications

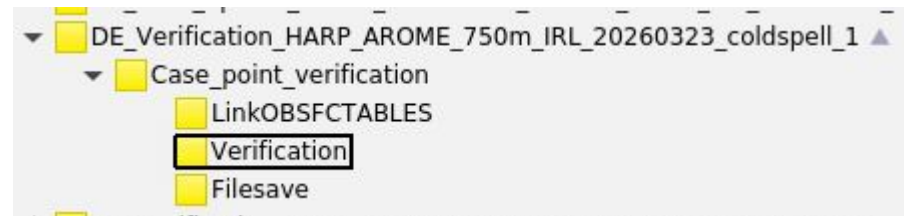


```
"""Combine AQ template."""
import os
import re
import sys
from collections.abc import Iterator
from datetime import timedelta
from pathlib import Path
from typing import Literal

from deode.config_parser import ParsedConfig
from deode.logs import logger
from deode.tasks.base import Task
from deode.tasks.batch import BatchJob
from isodate import parse_duration

class CombineAQ(Task):
    """Combine AQ output."""
```

```
[tool.poetry.dependencies]
deode = {git = "git@github.com:destination-earth-digital-twins/Deode-Workflow.git", tag = "v0.25.0"}
dicttoxml = "^1.0.0"
python = ">=3.10,<3.13"
netcdf4 = ">=1.6"
```



# Tactus-test-runner

- On top of unit testing we also need to test tasks with real data and in combination - tactus-test-runner!
- Runs a number (  $\sim 2 \times 25$  ) of full suite configurations
- Reproducibility check ( norms and output ) implemented, reuse DAVAI tools
- Built to use tactus under the hndh, i.e. tasks and suites are run as in tactus
- Can run in single task mode as well
- This should be seen as a complement to DAVAI



```

$ poetry run ttr -c ial_pr.toml -w
Using config file: ial_pr.toml
Include: /etc/ecmwf/nfs/dh2_perm_b/snh/git/Tactus-test-runner/config_files/case_definitions.toml
No validation schema for config section "cases". Using default.
tag not given but derived from git information
tag: ial_317ca55_
test_dir: norm_checker_0ab520f_configs
Our version 317ca55ce7acadb3cd5fb033054869f5f40e2b52
from https://github.com/destination-earth-digital-twins/IAL/pull/259
Comparison against /scratch/snh/deode_generated_references/v1_15_1
gnu_R32_CY49t2_AROME_500m_template_20250902 | MISSING - no summary found
gnu_R32_CY49t2_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 3 error(s), 0 success(es), 0 missing(s)
gnu_R32_CY49t2_HARMONIE_AROME_500m_template_20250902 | FAILURE - 1 error(s), 0 success(es), 2 missing(s)
gnu_R32_CY49t2_HARMONIE_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 3 error(s), 0 success(es), 0 missing(s)
gnu_R64_CY49t2_ALARO_500m_template_20250902 | MISSING - no summary found
gnu_R64_CY49t2_ALARO_DEMO_60x80_2500m_20250902 | FAILURE - 3 error(s), 0 success(es), 0 missing(s)
gnu_R64_CY49t2_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 3 error(s), 0 success(es), 0 missing(s)
gnu_R64_CY49t2_HARMONIE_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 3 error(s), 0 success(es), 0 missing(s)
intel_R32_CY49t2_AROME_500m_template_20250902 | MISSING - no summary found
intel_R32_CY49t2_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 2 error(s), 1 success(es), 0 missing(s)
intel_R32_CY49t2_HARMONIE_AROME_500m_template_20250902 | FAILURE - 0 error(s), 1 success(es), 2 missing(s)
intel_R32_CY49t2_HARMONIE_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 2 error(s), 1 success(es), 0 missing(s)
intel_R64_CY49t2_ALARO_500m_template_20250902 | MISSING - no summary found
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intel_R64_CY49t2_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 2 error(s), 1 success(es), 0 missing(s)
intel_R64_CY49t2_HARMONIE_AROME_DEMO_60x80_2500m_20250902 | FAILURE - 2 error(s), 1 success(es), 0 missing(s)
add '-v' for more info

```





# Tactus in ACCORD, the first steps

- Bring tactus to ACCORD and combine it with CY50T2
  - Choose CY50T2 to stay at the front and make synergy with DEODE phase 3 activities
- Implement the three CSCs reflecting the current usage in ACCORD
  - ALARO as defined by ALARO users
  - AROME as defined by AROME users
  - HARMONIE-AROME as defined by UWC
- Keep the DEODE CSC setups as reference and for sub kilometre research
- Make it work on ECMWF atos and Meteo France HPC belenos
- **Further steps to be outlined and discussed in the scripting session on Wednesday**

# Status of <https://github.com/ACCORD-NWP/tactus>

- Separate DEODE specific and core functionalities
  - Stay in sync with latest DEODE development
- Connect to IAL@develop (CY50T2) with e.g. compilation support
- Started to work our way through the configurations on atos and local platform(s)
- Will require updates in the IAL develop branch and possibly some more frequent technical tags

## Selection of current issues

<input type="checkbox"/>	Author	Label	Projects	Milestones	Reviews	Assignee	Sort	
<input type="checkbox"/>		Feature/fix	deploy docs workflow	✓	#22 opened 3 days ago by mfroelund	Member	Review required	22 tasks
<input type="checkbox"/>		Support multiple searchpaths for namelist files through TACTUS_CONFIG_DATA_DIR	✓	#20 opened 4 days ago by mfroelund	Member	Review required	22 tasks	
<input type="checkbox"/>		Config files for Fahrenheit	✗	#16 opened last month by trygveasp	Member	Review required	22 tasks	
<input type="checkbox"/>		Add CY50t2 config files	✗	#14 opened on Mar 12 by uandrae	Member	Review required	22 tasks	

 **ProTip!** Check team mentions with [team:ACCORD-NWP/ial-contributors](https://github.com/ACCORD-NWP/ial-contributors).

Aim to take a few steps forward in a end of May WW at RMI

# Future governance of tactus

- ACCORD owns the background IPR of the code and should take the responsibility for the maintenance and coordination
- Will require close coordination with the DEODE phase 3 team in the coming two years and possibly emerging climate (and other) applications
- Continue to be developed for the consortium needs and by the consortium members

More about governance aspects on Wednesday

# Conclusions

- The work on accordifying tactus has started
- We welcome more people to work on the technical aspects
- The system is not yet ready for general use but we'll inform once we're there

Thanks for the attention!

Questions?

***Tactus***: a principal accent or rhythmic unit, especially in 15th- and 16th- century music. (from Oxford dictionary)