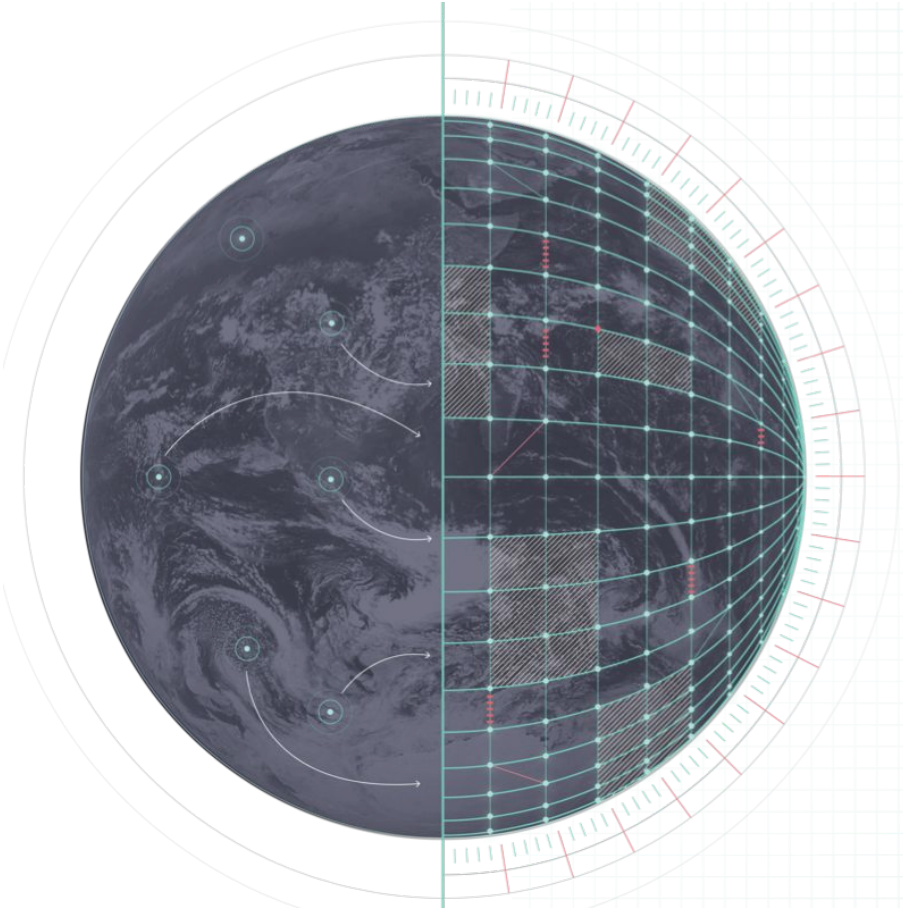


DESTINATION EARTH

On the Destination Earth On Demand Extremes workflow

Ulf Andrae, SMHI
Xiaohua Yang, DMI
And all the staff in DE_330 WP5

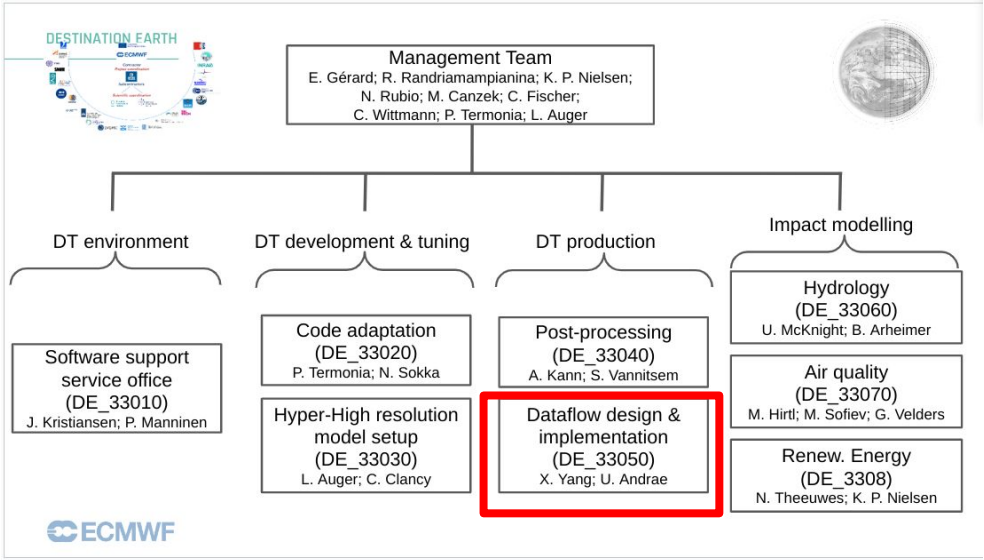
3rd ACCORD All Staff Workshop 27-31 March, Tallinn and hybrid

Funded by the European Union
Destination Earth
implemented by ECMWF esa EUMETSAT

Destination Earth On Demand Extremes in short

- Provide selected impact sectors (hydrology, air quality, renewables) with high resolution forecasts for extreme events, where required, when required
- Brings together 21 of 26 countries within ACCORD
- Funded by ECMWF via the Destination Earth program as DE_330_MF project
- Operational like development in fast forward mode, project runs from 1st of September 2022 to 1st of April 2024

See presentation by R. Randriamampianina on Thursday at 10.10 for all important details!

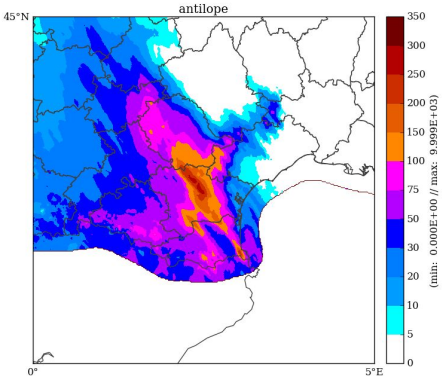


Will talk about the red box but we benefit a lot and are dependent of work done in other parts, and within ACCORD

Mission: Build a workflow that brings us a hectometric resolution forecast with any of AROME/ALARO/HARMONIE-AROME anywhere in Europe within the hour, and couple it with the appropriate impact model, on LUMI@CSC

Detect a possible extreme event from the global model

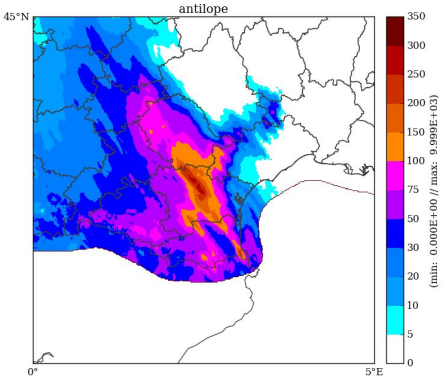
Mission: Build a workflow that brings us a hectometric resolution forecast with any of AROME/ALARO/HARMONIE-AROME anywhere in Europe within the hour, and couple it with the appropriate impact model, on LUMI@CSC



The Aude case 2018

Activate the appropriate setup over the domain of interest on < 1km resolution

Mission: Build a workflow that brings us a hectometric resolution forecast with any of AROME/ALARO/HARMONIE-AROME anywhere in Europe within the hour, and couple it with the appropriate impact model, on LUMI@CSC

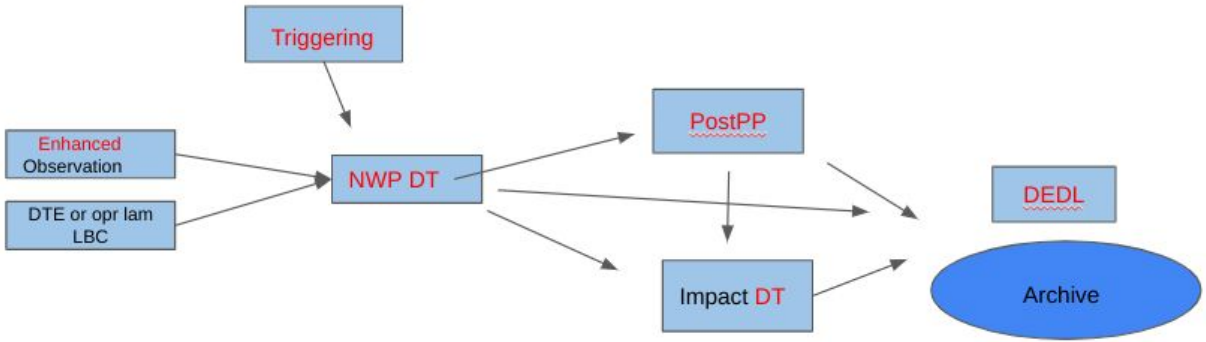


The Aude case 2018

Run the relevant impact model

In technical terms the demands amounts to:

- Build a framework that can handle all CSCs from a common codebase
- Interface it with ECMWF Destination Earth workflow on LUMI (CSC EuroHPC)
- Tightly couple to the selected impact models
- Make data available to downstream users via the data lake hosted by EUMETSAT



In technical terms the demands amounts to:

- Build a framework that can handle all CSCs from a common codebase
- Interface it with ECMWF Destination Earth workflow on LUMI (CSC EuroHPC)
- Tightly couple to impact models
- Make data available to downstream users
- *Work on adaptation to modern hybrid architectures (other parts of the project, presentation by D. Degrauwe)*
- *Prepare the NWP components to work well on hectometric scales (other parts of the project, presentation by C. Clancy)*

A high level on flexibility and configurability

- The triggering mechanism itself is a task for another group but amounts to activate a number of forecasts depending on detected risk of certain events.
- We should be able to select the appropriate configuration and vert/hor resolution depending on the targeted extreme/application
  - Air quality has different demands compared to hydrology
  - A stormy case over Iceland has different demands compared to heavy rain in Spain
- The output should be tailored to match the related application
  - Hydrology requires 2 fields, but need a long calibration period
  - Air quality requires ~30 fields (3D/2D)
  - Renewables requires ~15 minute output

A more data centric approach

We are starting with

- GRIB2 output to files
- Store in FDB (ECMWF Field DataBase)
- Puts some requirements on GRIB2
- Huge job together with ECMWF on defining a new SURFEX GRIB2 template
- Preparing for sub hourly output and ccsds packing

- The garden vegetation groupings will be **(TREE + BARE + GRAS)**. TREE will be in {TEBDU, TRDBU, TEBEU, TRBEU, BONEU, TENEU, BONDU}, where {TREE}U is the urban counterpart for a given tree type.
  - Implementation:

```
1034 TEBDU Urban temperate broadleaf deciduous
1035 TRBDU Urban tropical broadleaf deciduous
1036 TEBEU Urban temperate broadleaf evergreen
1037 TRBEU Urban tropical broadleaf evergreen
1038 BONEU Urban boreal needleleaf evergreen
1039 TENEU Urban temperate needleleaf evergreen
1040 BONDU Urban boreal needleleaf deciduous
```

```
1525 G025 Group 025 (NONE + GRAS + TEBDU)
1525 G026 Group 026 (NONE + GRAS + TRBDU)
1525 G027 Group 027 (NONE + GRAS + TEBEU)
1525 G028 Group 028 (NONE + GRAS + TRBEU)
1525 G029 Group 029 (NONE + GRAS + BONEU)
1525 G030 Group 030 (NONE + GRAS + TENEU)
1525 G031 Group 031 (NONE + GRAS + BONDU)
```

  - Is BARE = NONE or BARE = (NONE+ROCK+SNOW)? Currently I have assumed it is only NONE.
- Described new implementations of list of tile attributes, support roof/road/wall temperatures, accumulated parameters, and "Aggregated" covers.

Example of garden vegetation grouping

Courtesy: Matthew Griffith, Sebasiten Villaume ECMWF, Patric Le Moigne, Sören Borg Nielsen, Mikko Aalto, Patrick Samuelsson, Trygve Aspelien within DE_330

A more data centric approach

We are starting with

- GRIB2
- Store in
- Puts so
- Huge jo
  defining
- Prepari
  ccsds p

Exploring

- Writing directly to FDB from the NWP model, and other applications
- Read directly from FDB for downstream applications
- Removes a few unnecessary/costly IO steps

A challenge is that codevise the LAM output is not very similar to the ECMWF path

A more data centric approach

We are starting with

- GRIB2
- Store in
- Put's sc
- Huge jo
  defining
- Prepari
  packing

Exploring

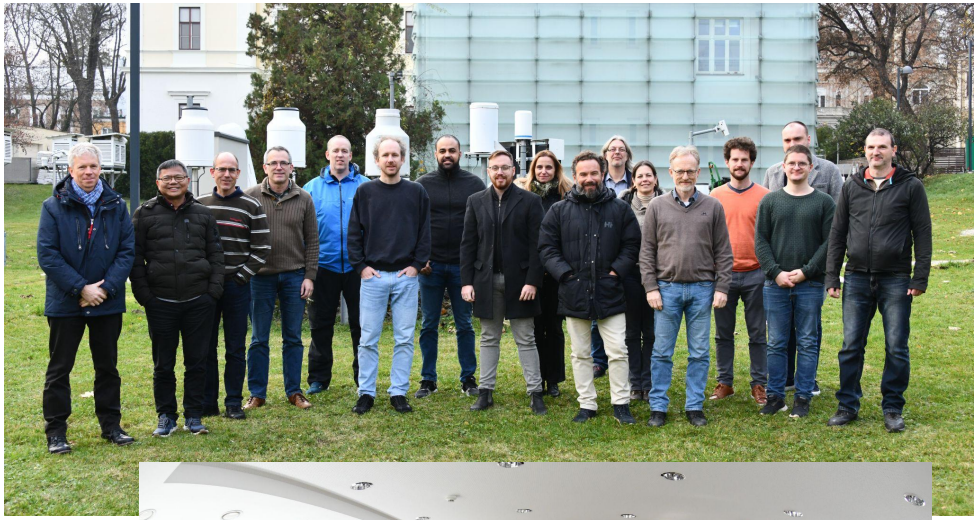
- Writing directly
  NWP model, a
  applications
- Read directly
  downstream a
- Removes a fe
  unnecessary/c

Aiming at

- Interface with the new ECMWF multiplex IO server accessing/pushing data runtime
- Do the work while data is in memory!
- Isn't necessarily happen during this phase

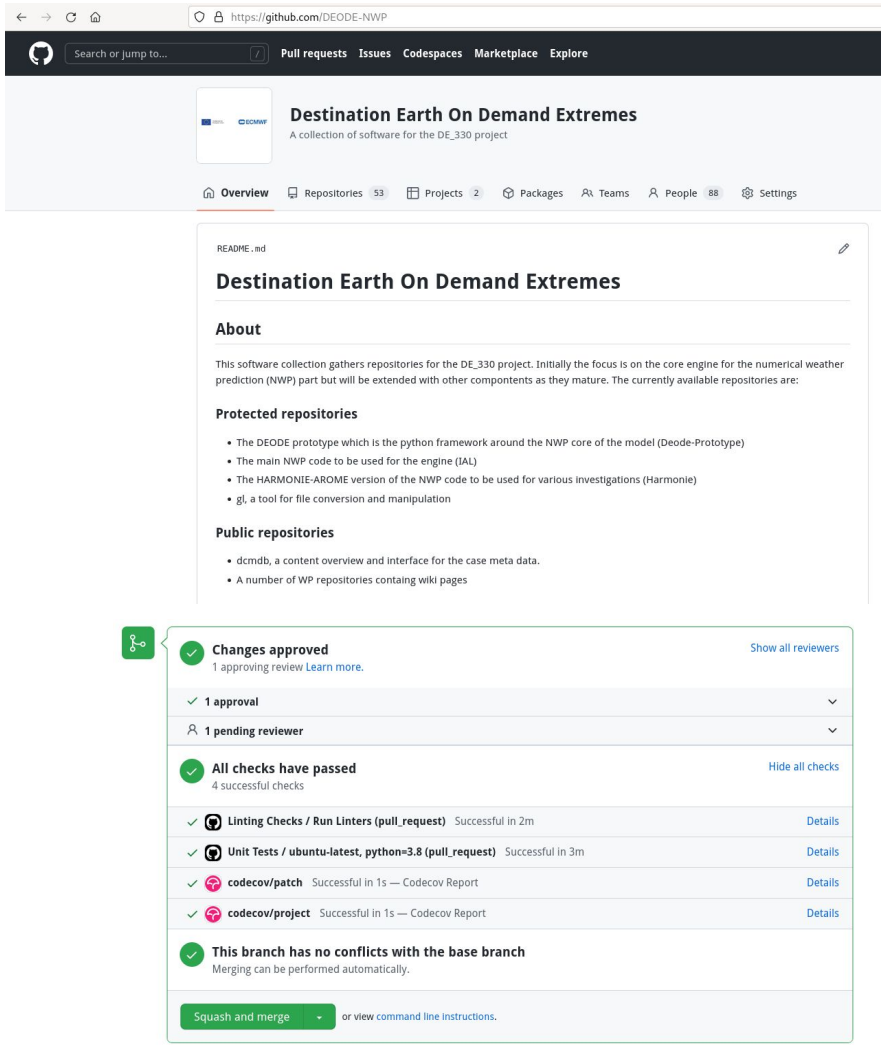
Designing a new scripting environment

- Building a new framework from scratch but based on earlier experiences
- A wide representation of NMSs: ARSO,DMI, Geosphere A, KNMI,LHMS, NHMI, RMI, SHMI, SMHI
- Distributed fast track development is a challenge! Communication, communication, communication, important to meet in person
- Create a new system with a common ownership



Details about the scripting

- Python based (surprise surprise)
- Large focus on following standards, unit testing, code coverage from the beginning. Apply github pipelines and CI/CD processes
- Modularity, e.g. separate ecflow from the tasks
- All tasks should be possible to run stand alone for easier development and debugging
- Config file driven (yaml, toml, json)



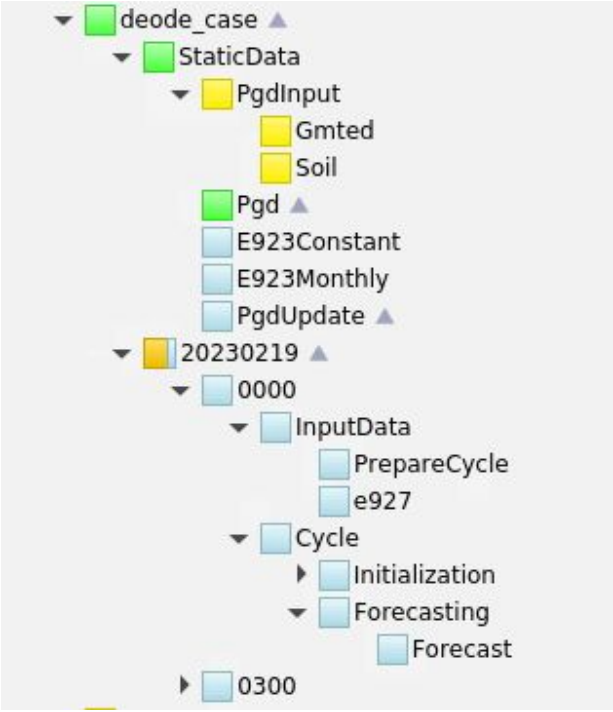
ECMWF https://github.com/DEODE-NWP

Where are we at the moment?

https://github.com/DEODE-NWP/Deode-Prototype

- On atos we are working on
  - **AROME@CY46t1** *(Florian)*
  - **HARMONIE-AROME@CY46h1** *(Trygve)*
  - AROME@CY48t3 (*NHMI*)
  - ALARO@CY48t3
  - *HARMONIE-AROME@CY48t3*
- Implementing from static file generation to the end of the forecast
- Surface assimilation to be implemented
- NOT dealt with at this stage, but later
  - Upper air assimilation
  - Probabilistic aspects
  - …

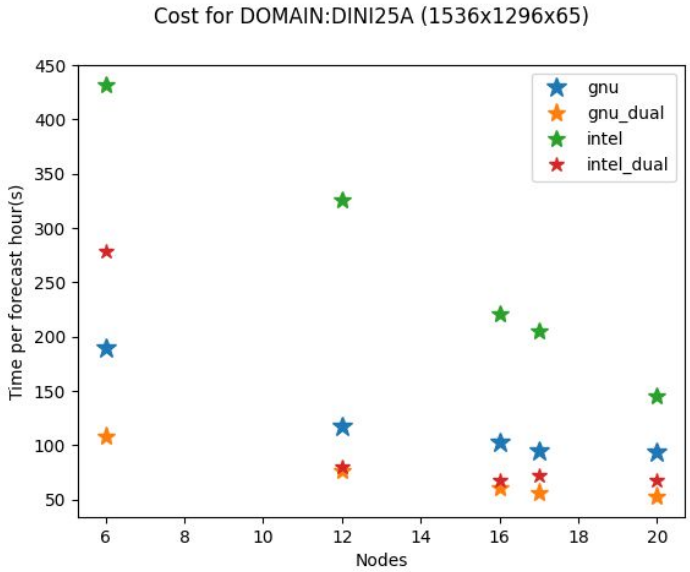
```
deode -config config.toml start suite
```

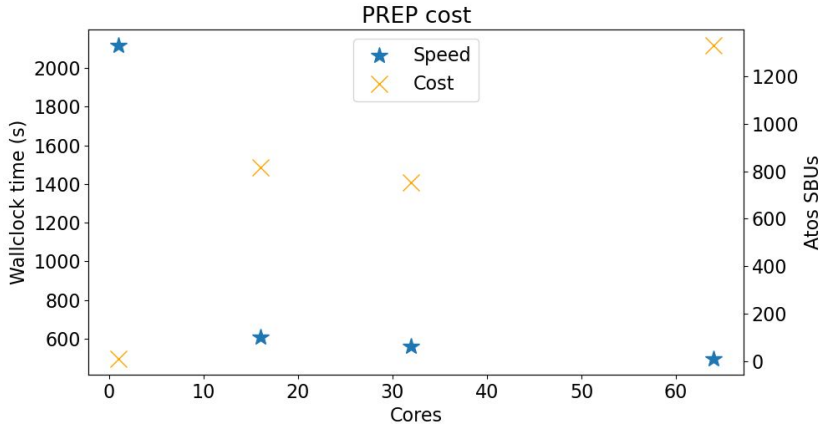


Worrying about the speed of all components, some examples

- PGD is now in the time critical path, strong requirements on speed
  - Use MPI parallelized version
  - Reduce input data amount by tiling
- PREP is not very fast by default
  - Use MPI parallelized version
- Run forecast model in single precision
  - Fine in a “clean” setup, but coupling AROME -> AROME poses challenges

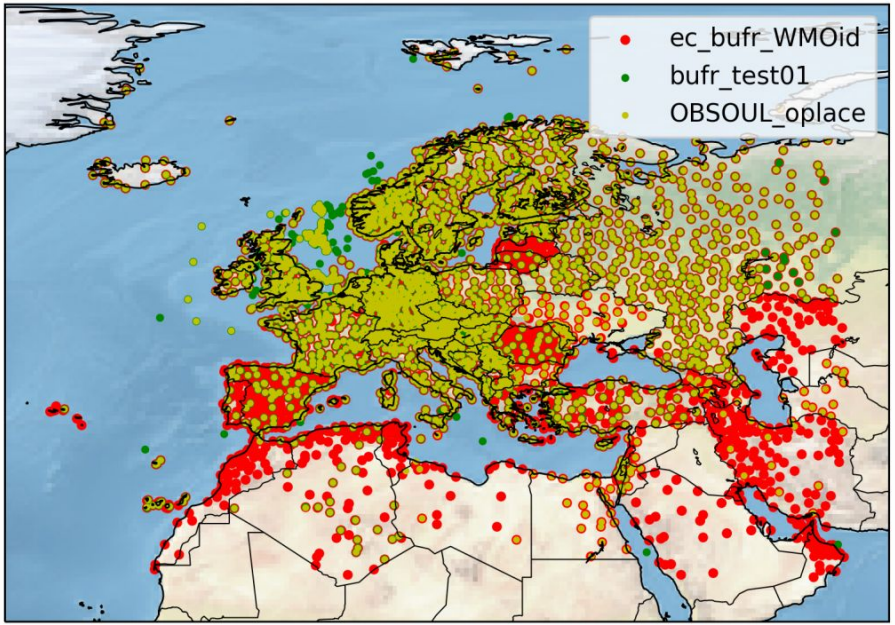
Highly dependent developments done by others!





Observations

- The first phase does not focus on implementing full scale data assimilation but setting up real time acquisition takes time
- Relying of observation input from participating NMSs
  - Granted data from LACE
  - Investigation of potential input from UWC-W, MetCoOp and others
- Collection of high density observation streams such as crowd sourced data
- Now focusing on gathering data for verification and postprocessing



Monitoring of observations over Europe
Courtesy: Benedikt Strajnar

What's the benefit for ACCORD?

- A shared system with interoperability within the ACCORD framework
- Common repository including codes and scripts with modularity, and thereafter opportunity to work on same system platform, same source code versions
- Real time input data acquisition on a non-operational platform (EuroHPC). This requires merge of obs stream from operational centers + plus high density addons, a good opportunity to future research collaboration on DA and on operational production as well.
- standardisation on FDB/GRIB2 for internal interoperability

QUESTIONS?

Acknowledged co-workers

sdfsdfsdf

Paulo Medeiros Kasper Hintz Søren B Nielsen Emy Alerskans Stefan Rethmeier Fabrizio Baordo Mikko Partio Mikko Aalto Elmeri Nurmi Erik Gregow Christoph Wittmann Florian Weidle Phillip Scheffknecht Adam El-Said Siebren de Haan Trygve Aspelien Eivind Støylen Roel Stappers Ole Vignes Samuel Viana Daniel Martin Javier Calvo Juan Jesus Gonzalez Maria Monteiro Bolli Pálmason Guðrún Nína Petersen Sigurður Þorsteinsson Xiaohui Zhao Maria Derkova Oldrich Spaniel Radmila Brozkova Antonin Bucanek Alena Trojakova Martina Tudor Martynas Kazlauskas Rimvydas Jasinskas Kristina Kryžanauskienė Boryana Tsenova Konstantin Mladenov Milen Tsankov Alex Deckmyn Jure Cedilnik Neva Pristov Benedikt Strajnar