Development on SURFEX data assimilation within HARMONIE

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What is HARMONIE

ACRONYM: HIRLAM ALADIN Research on Meso-scale Operational NWP in Europe

A script system (mini-SMS) around the source code used by Meteo France and ALADIN countries
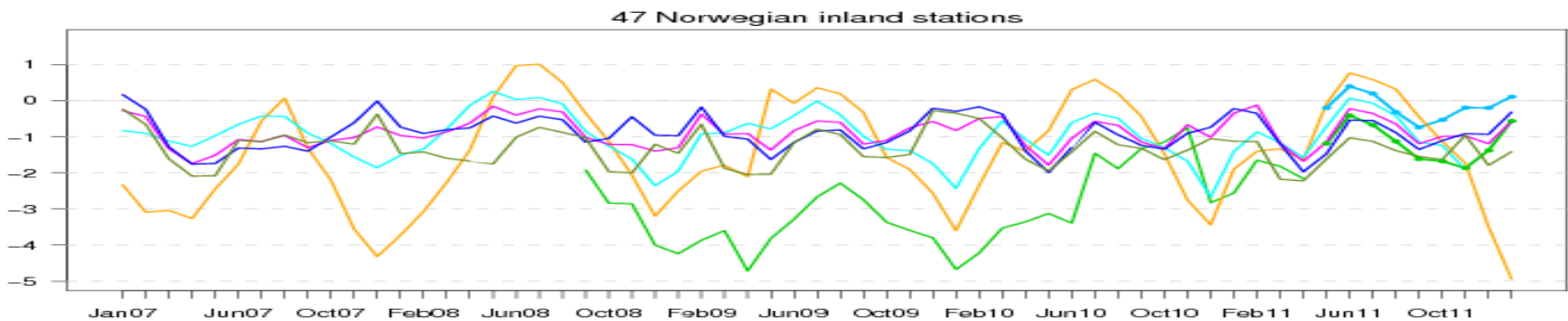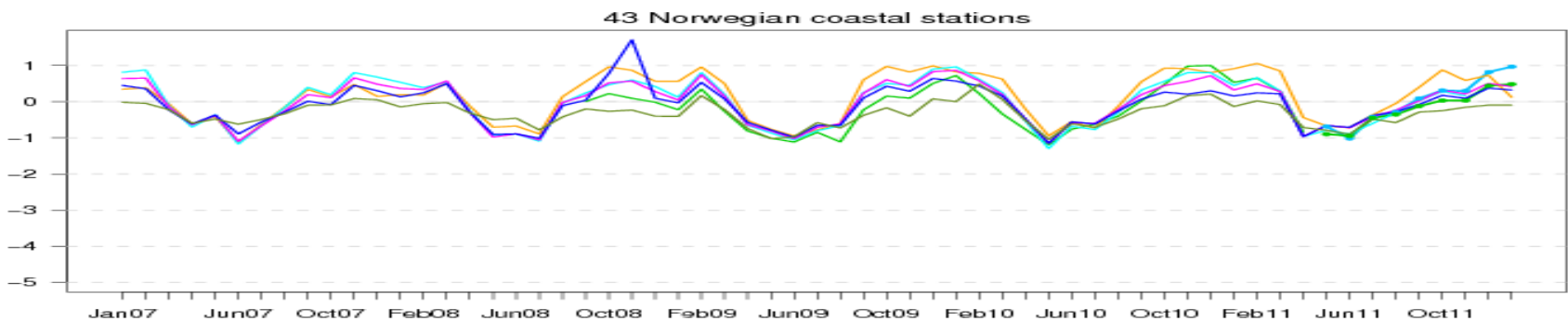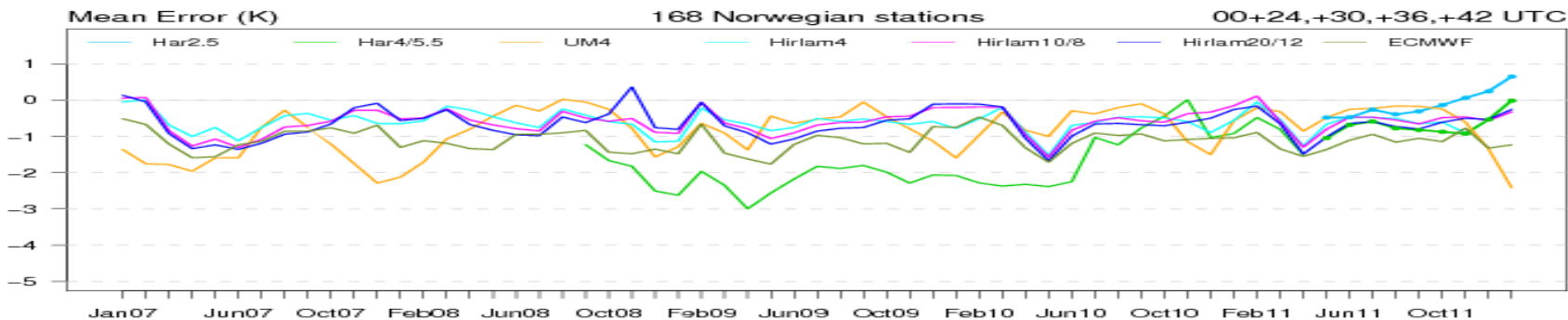
SURFEX in HARMONIE

- Fully implemented in cy36h1.1 also for alaro/aladin physics

- Used by all(?) HIRLAM countries in either alaro or arome configurations

- Default using surface assimilation (CANARI + OI_main) and full blending of the upper air fields
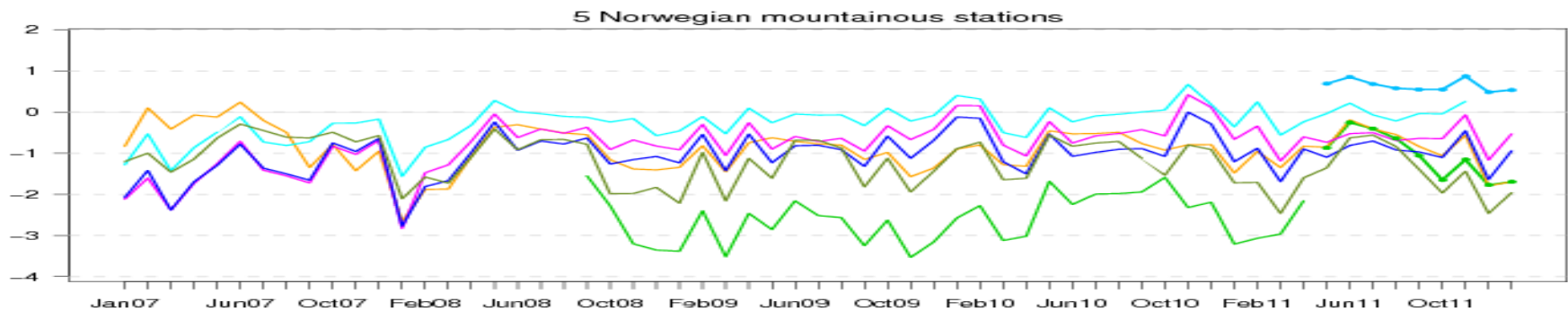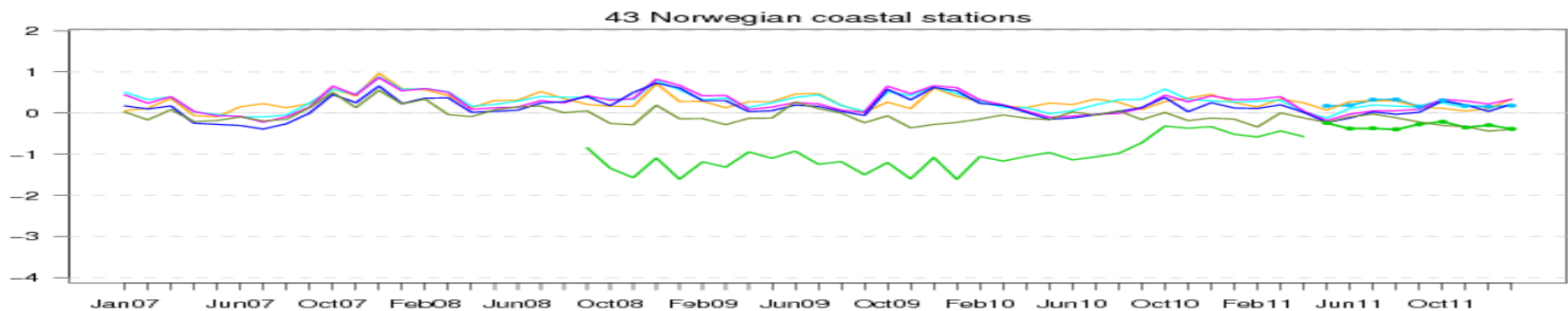
Cold bias without SURFEX

Temperature 2m

Mean Error (K)   168 Norwegian stations   00+24,+30,+36,+42 UTC

Har2.5   Har4/5.5   UM4   Hirlam4   Hirlam10/8   Hirlam20/12   ECMWF
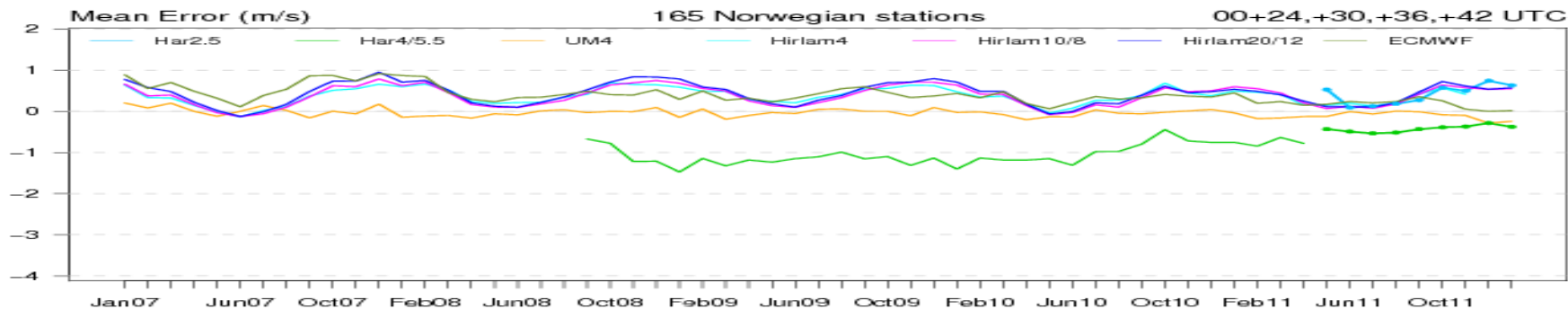
43 Norwegian coastal stations

47 Norwegian inland stations

Wind under-estimation without SURFEX

Wind speed 10m

Experiences with HARMONIE 36h1.1

- Previous versions of Harmonie had large and systematic errors related to the physics, e.g.:
  - very low surface temperatures in winter
  - too low wind speed over land
- 36h1.1 **with SURFEX** shows significant improvements which can be related to
  - tiling (nature/sea/lake/town)
  - canopy module (multilayer surface scheme)
  - increased wind speed (from B to C) with reduced drag as a function of st.dev. of Small Scale Orography (A)
  - mean orography instead of envelope
- Further improvements related to physics can be achieved by offline experiments with SURFEX, i.e.
  - snow schemes D95/3-L
  - lakes get more important with increased resolution
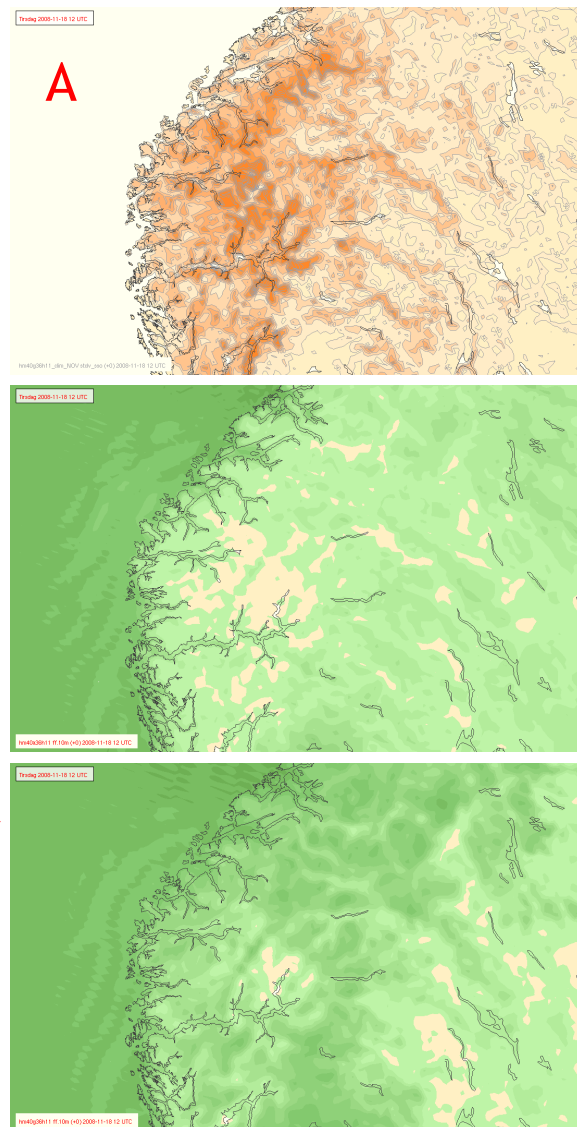
Courtesy of Mariken Homleid (met.no)

A

B

C

Surface assimilation in HARMONIE (I)

- Without SURFEX → CANARI
- With SURFEX
    → OI_main (CANARI + OI_main)
    → EKF (CANARI + EKF_main (only soil))

- Focus in HIRLAM on:
    - fjords
        - SST and strong gradients in topography
    - lakes (frozen/unfrozen)
    - snow/ice (sea ice & glaciers)

Surface assimilation in HARMONIE (II)

Different LSM in upper air model and SURFEX:

=>Special treatment and update of some variables are done in OI_main but at the moment not done for EKF.

Action:

OI_main and EKF_main should be merged!

Future assimilation in HARMONIE

HIRLAM aims to use EKF with several
   offline perturbed runs on large domains

Need for efficiency and speed!!!

Also need for:

    - a good (and easy) initialization!

    - easy modification or overriding of
      ECOCLIMAP climate files

Bottlenecks and wanted features (I)

- Parallelized versions of pgd/prep/offline

- Homogenization of OI_main and EKF_main

- More sophisticated initialization direct from files (FA/grib)

  - Treatment of mismatch of Land/Sea mask between forcing model and SURFEX

- Interpolation of LFI between different geometries (if LFI is kept as SURFEX format)

Bottlenecks and wanted SURFEX features (II)

- An external spatialization tool (Euro4M)

- Assimilation interface to SURFEX

- ODB interface (?)

- easy stand alone installation and execution! Collaboration partners are important.

- Mariken will tell you more about snow issues afterwards

Post-processing by SURFEX: an interesting application?

www.yr.no

Points=>
local
adaptions

Offline SURFEX as a high resolution post-processing tool?

- Dynamical and physical adaption to the local conditions
    - forcing must be interpolated to the higher resolution
- Allow much higher resolutions
    - if offline is parallellized of course:-)
- Allow assimilation and hindcast mode
    - e.g. a planned snow avalanche warning project

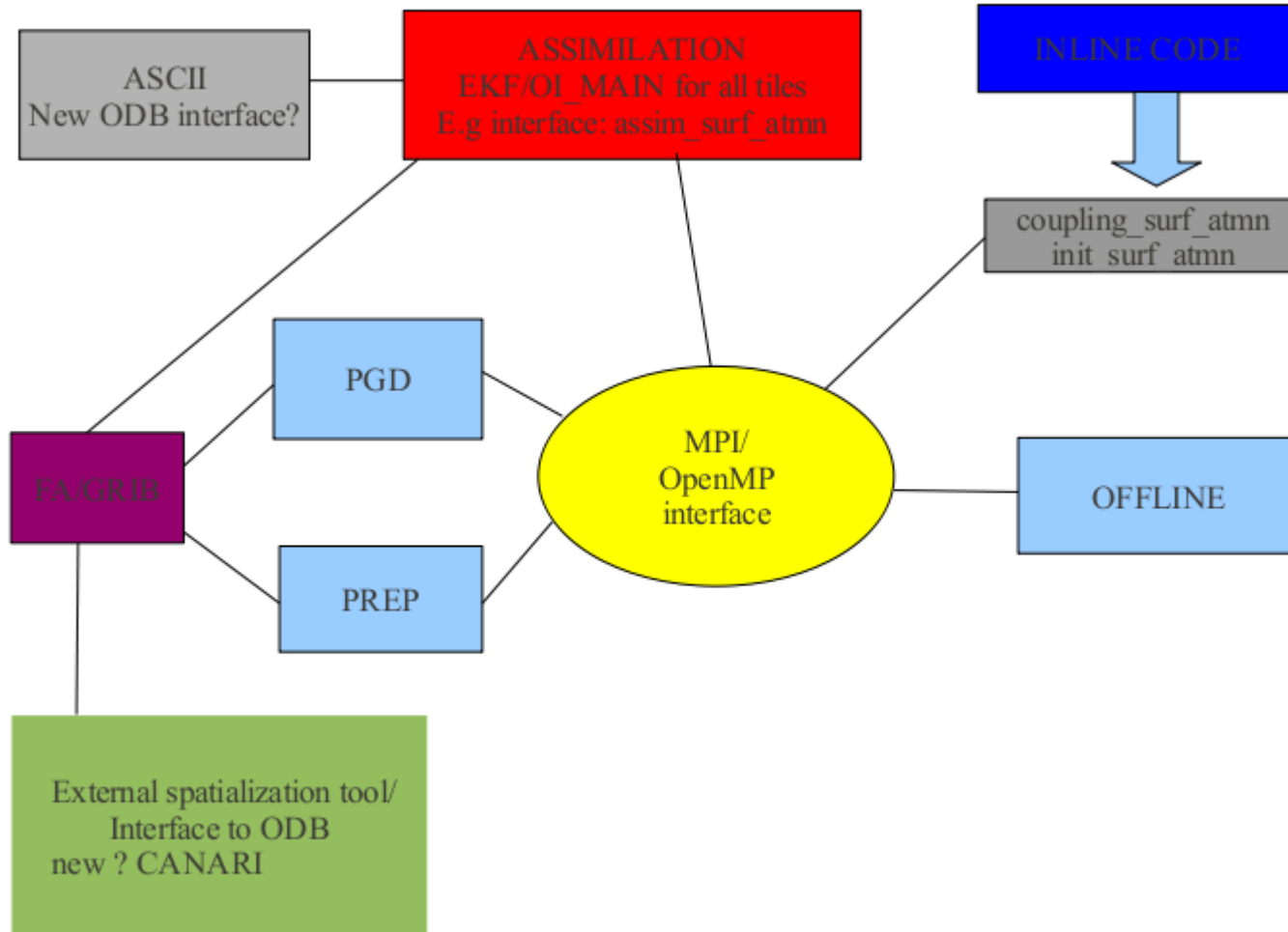# Parallell pgd/prep/offline: Design proposal (I)

- Same parallellization for all executables

- Similar to inline code

- Should be a relatively small module

- Easy usability also for non-NWP communities

Using CANARI for this is like translated to English from Norwegian:

"to shoot sparrows with a cannon"=overkill

Design proposal (II)

Thank you for the attention!

Mariken and myself are available for questions/discussions until Thursday!