

WP2 overview and progress

With thanks to

Lilo Bach, Martin Ridal, Per Uden, Tomas Landelius,
Jelena Bojarova, Esbjörn Olsson, Eric Bazile,
Patrick Le Moigne, Peter Jermey, Jemma Davie,
and many others...

WP2

Ensemble Data Assimilation Regional Reanalysis Dataset

SMHI

universität **bonn**



Deutscher Wetterdienst
Wetter und Klima aus einer Hand



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Toujours un temps d'avance

WP2 Tasks

T2.1 Ensemble-Variational DA Reanalysis ([Met Office](#))

T2.2 Deterministic Reanalysis ([SMHI](#), [MF](#))

T2.3 Downscaling ([MF](#))

T2.4 Cloud Fraction Reanalysis ([SMHI](#))

T2.5 Ensemble-Nudging DA Reanalysis ([UB](#))

T2.6 Reanalysis Cross-Evaluation ([MO](#), [SMHI](#), [DWD](#), [UB](#))

WP2 Deliverables Year 2

D2.1 Development of ensemble-variational data assimilation capability and report demonstrating ensemble uncertainty products (M21, [Met Office](#))

D2.2 Report of observations and datasets assembled for the ensemble-based variational assimilation (M24, [Met Office](#) → M27)

D2.5 Report of results and datasets of two physics HARMONIE runs for spread estimation (M12, [MeteoFrance](#) → M33)

D2.10 UERRA-MESA-CL 30-year European cloud fraction dataset and report (M24, [SMHI](#))

D2.11 Probabilistic observations will be generated for Kalman Filter ensemble DA and a report will be written (M15, [UBonn](#))

D2.12 The KF ensemble reanalysis (KFENDA) system will be developed and with a report demonstrating reanalysis uncertainty capability (M21, [UBonn](#))

WP2 Deliverables Year 3

D2.3 Preliminary report with ensemble diagnostics (M30, [Met Office](#))

D2.6 Preliminary report of the first period of the RA (M30, [SMHI](#))

D2.9 Ensemble surface reanalysis report (M30, [MeteoFrance](#))

UERRA Task 2.1 (**MO**):

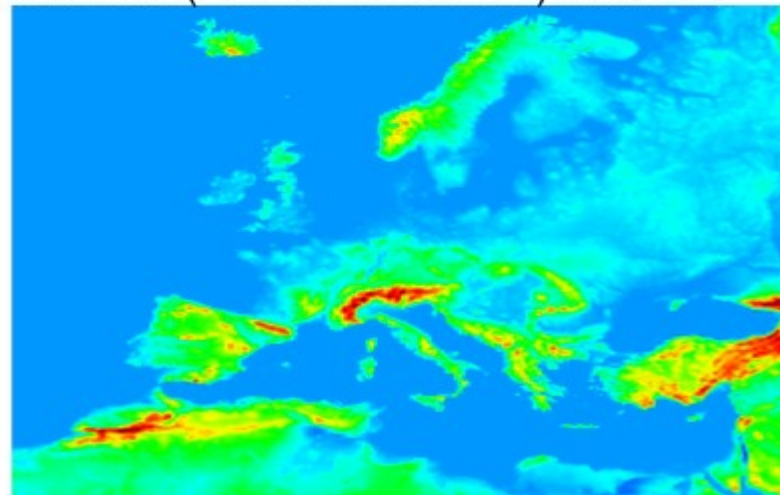
Ensemble Variational DA Reanalysis

- EURO4M project (2010-2014):
4DVar-based Unified Model regional reanalysis, tested in pilot 2 year period (2008-2009).
- UERRA project (2014-2018):
Multi-decadal, satellite-era (1979 – present) ensemble reanalysis.
- Resolution: 12km model, 24-36km DA (4D-Var, hybrid EnDA)
- Lateral boundary conditions: ERA (-Interim). ERA/**UERRA** observations.

EURO4M domain:



UERRA (EURO CORDEX) domain:



T2.1 Status

NWP systems ported to ECMWF Cray

Able to extract and process level 1b satellite radiances - now including TOVS

Capability to generate reject lists for *in situ* obs

Monitoring system (automated email alerts)

Working suite for ensemble of 4DVars

Hybrid 4DVar for regional coded

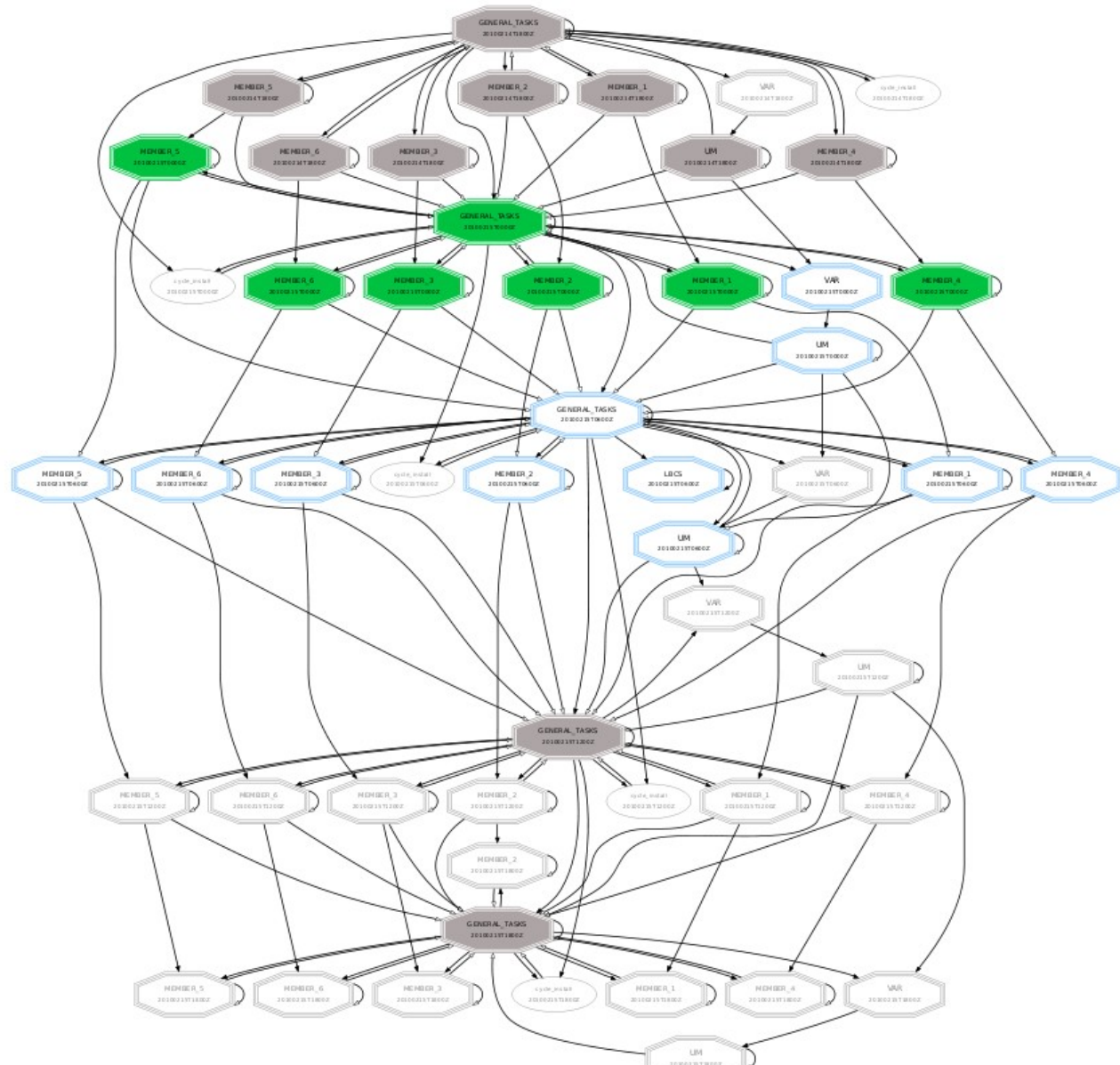
Initial set of model background errors calculated for L63 model

Variational bias correction for regional model - evaluating


Land surface DA for regional model - evaluating

New method of maintaining ensemble spread (Piccolo & Cullen 2016, MWR)

The suite



The suite



53,000 lines config/customisation
75%(2016), 50%(2017) of UK
allocation of ECMWF HPC

T2.1 Yet to do

- Check we can process older observations from ECMWF archive
- Ensure VarBC and land surface DA are stable
- Further tuning of ensemble system
- Evaluate hybrid 4DVar
- Aiming to start ensemble production runs April 2016
 - 4 parallel streamsand hybrid production run 3rd quarter 2016.

Question of boundary conditions

ERA-Interim (2007)

~80km resolution deterministic

ERA5 (2016)

~30km with an ensemble

Running from Jan 2016 to Dec 2017

T2.2 Deterministic Reanalysis ([SMHI](#), [MF](#))

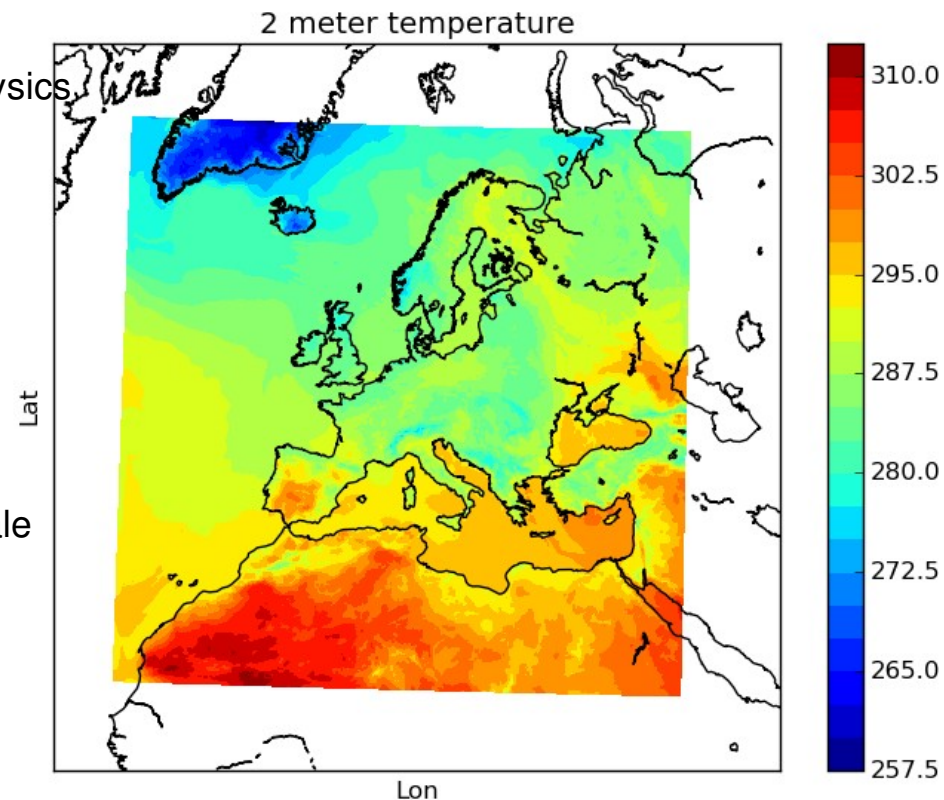
T2.4 Cloud Fraction Reanalysis ([SMHI](#))

Martin Ridal

**Per Unden, Esbjörn Olsson, Heiner Kornich, Ulf Andrae, Jelena Bojarova,
Patrick Samuelsson, Tomas Landelius**

WP2: Ensemble Data Assimilation Regional Reanalysis Dataset – SMHI

- 82 pm over 4 years (~27 consumed), plus 8 (WP4 downstream services), plus ~17 (WP5, 6, 7, 9 scientific coordination, management, outreach...)
- 5 year HARMONIE mini ensemble
 - Preparation for the longer re-analysis
 - Run from 2006-2010 using ALADIN and ALARO physics
 - 11 km, 576x576 grid points
 - Problems with large scale mixing (Jk) discovered
 - Needs to be re-run
 - Report (D2.5) is almost ready
- 50+ years regional reanalysis with HARMONIE
 - ALADIN physics will be used
 - Just started, but will be restarted when the large scale mixing problems are solved



WP2: Ensemble Data Assimilation Regional Reanalysis Dataset – SMHI

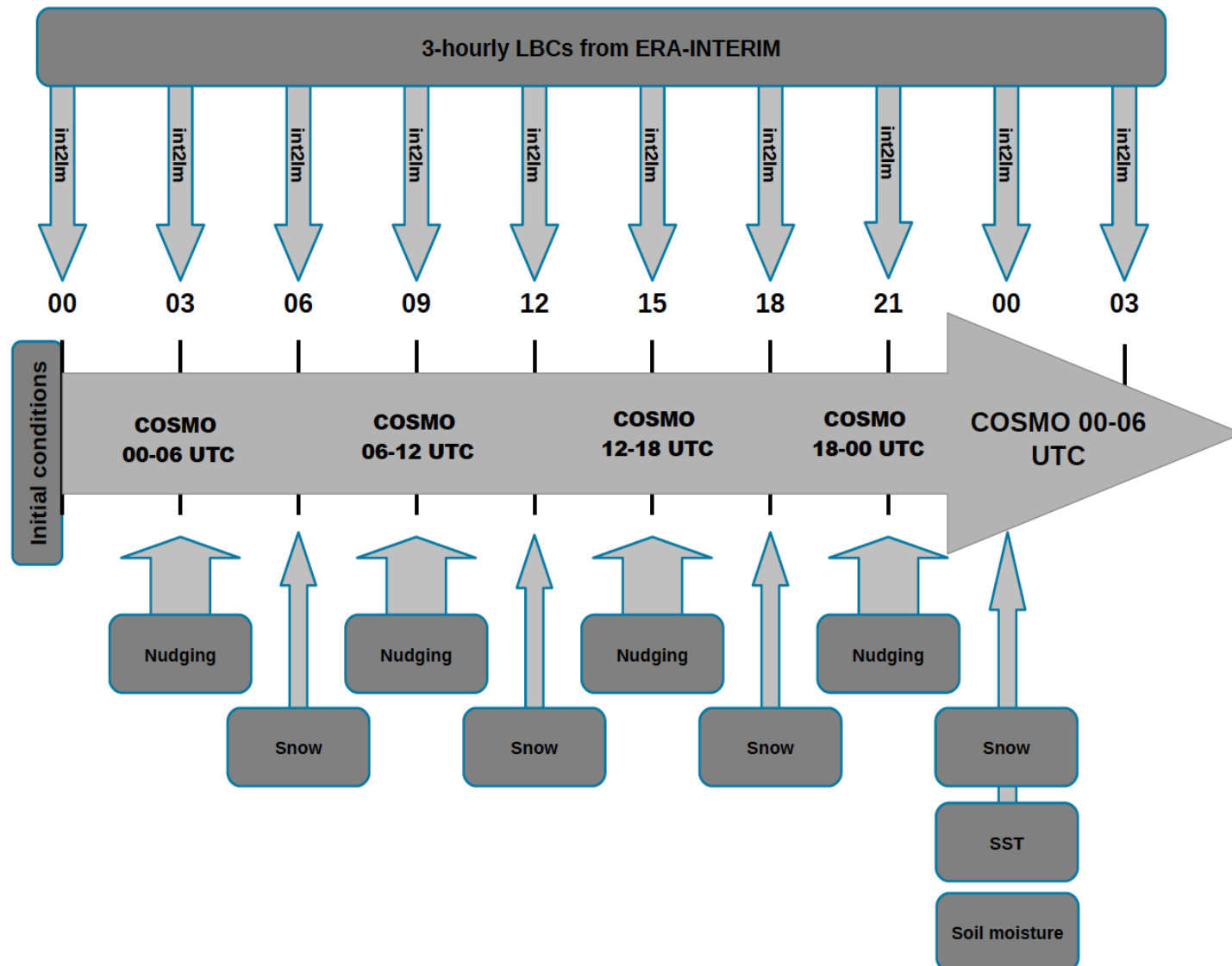
- SURFEX leaf area index (LAI) sensitivity
 - Sensitivity studies of prognostic
 - Investigate the possibility to assimilate LAI

- 30 years MESAN cloud analysis
 - 2D analysis of cloud fraction for 30 years
 - 5.5 km resolution 1982-2013
 - Super observations on 22 km grid created for one SEVIRI year (2009)
 - A new cloud mask for pre-SEVIRI period is under construction by the CM-SAF
 - Test analysis of cloud fraction made for 2009 at 22 km, using OI with super observations and NWP (HIRLAM and EURO4M)
 - Estimates of B and R matrices using Desroziers method converges.
 - After some remaining corrections (bias & obs weights) the analysis will be made on 5.5 km grid

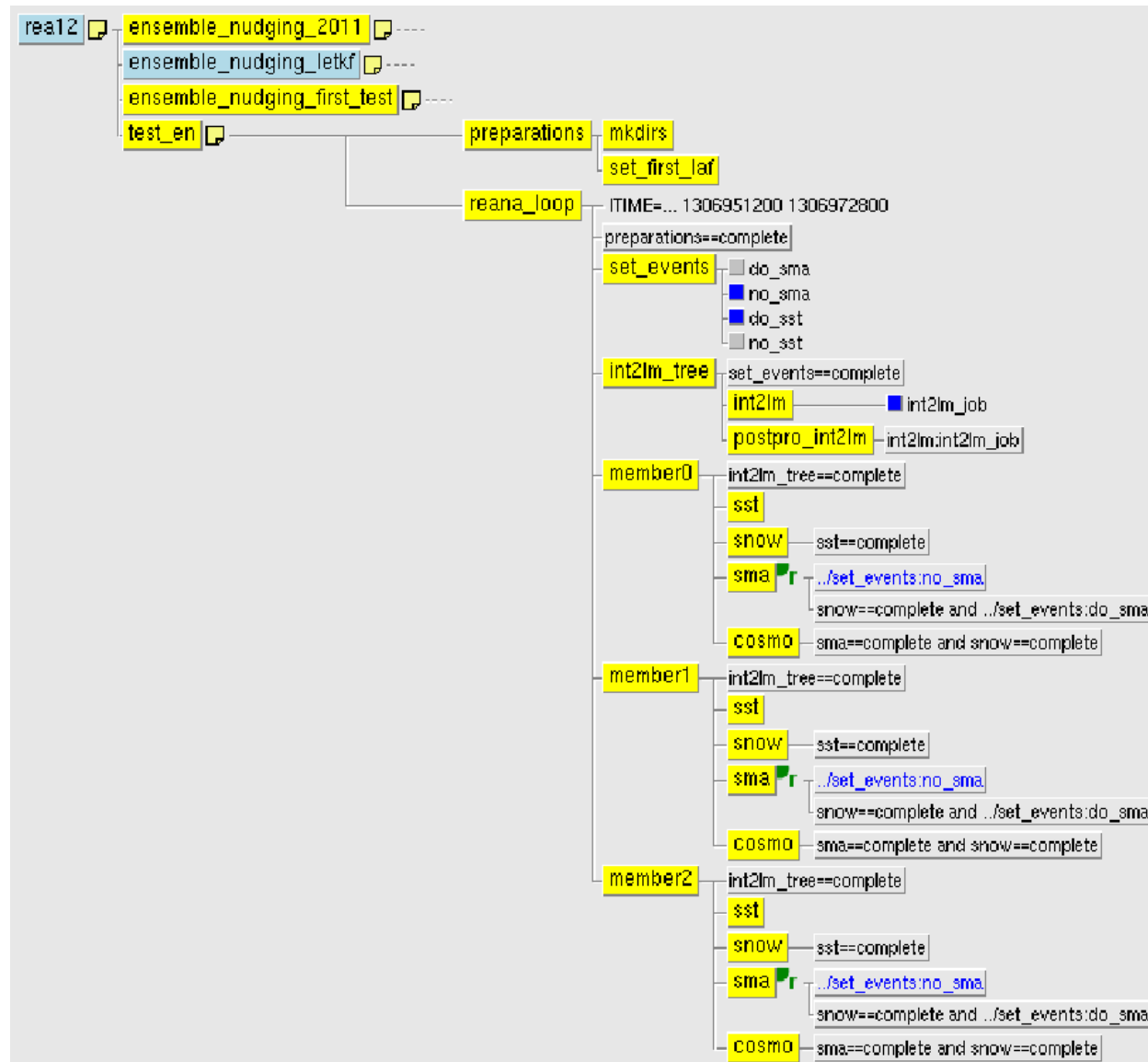
T2.5 Ensemble-Nudging DA Reanalysis (UB)

Lilo Bach

Process cycle for production of ensemble regional reanalysis COSMO-EN-REA12



Reanalysis suite in ecflow

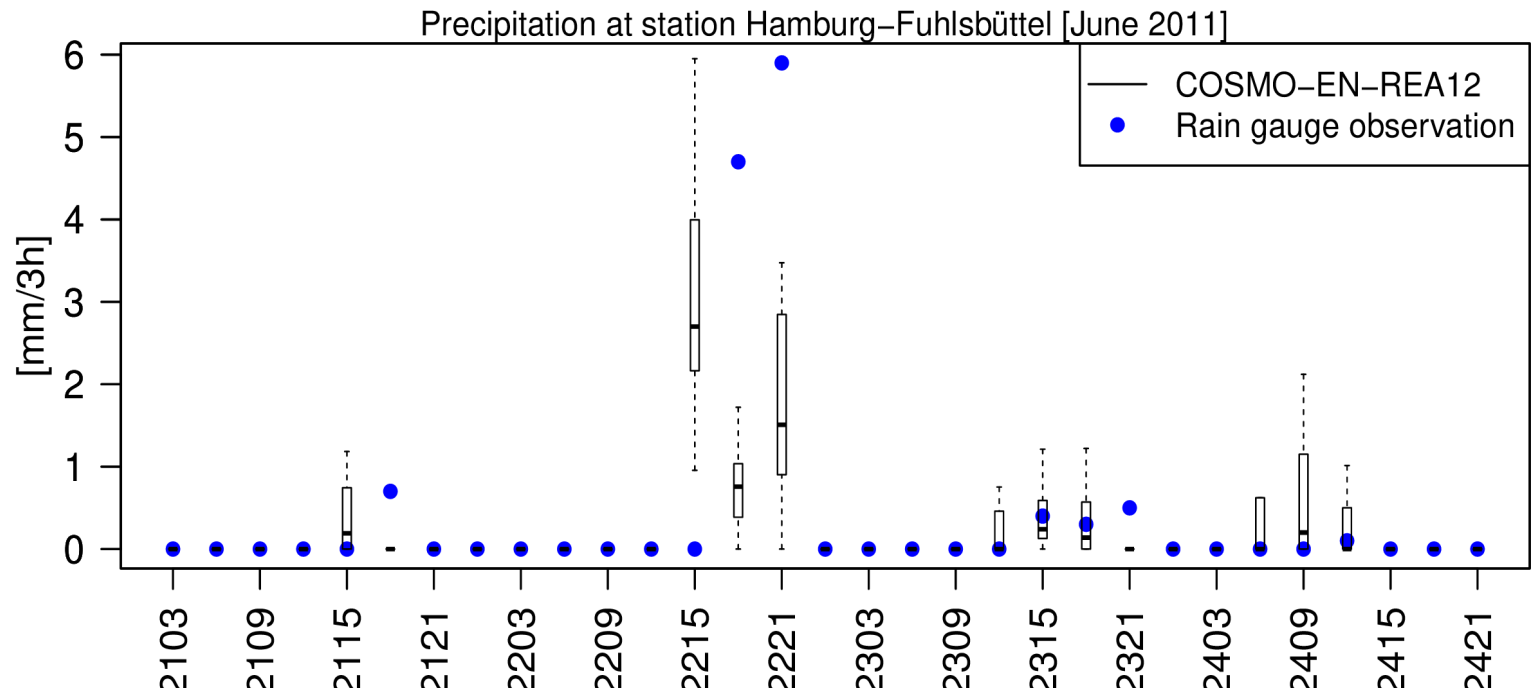
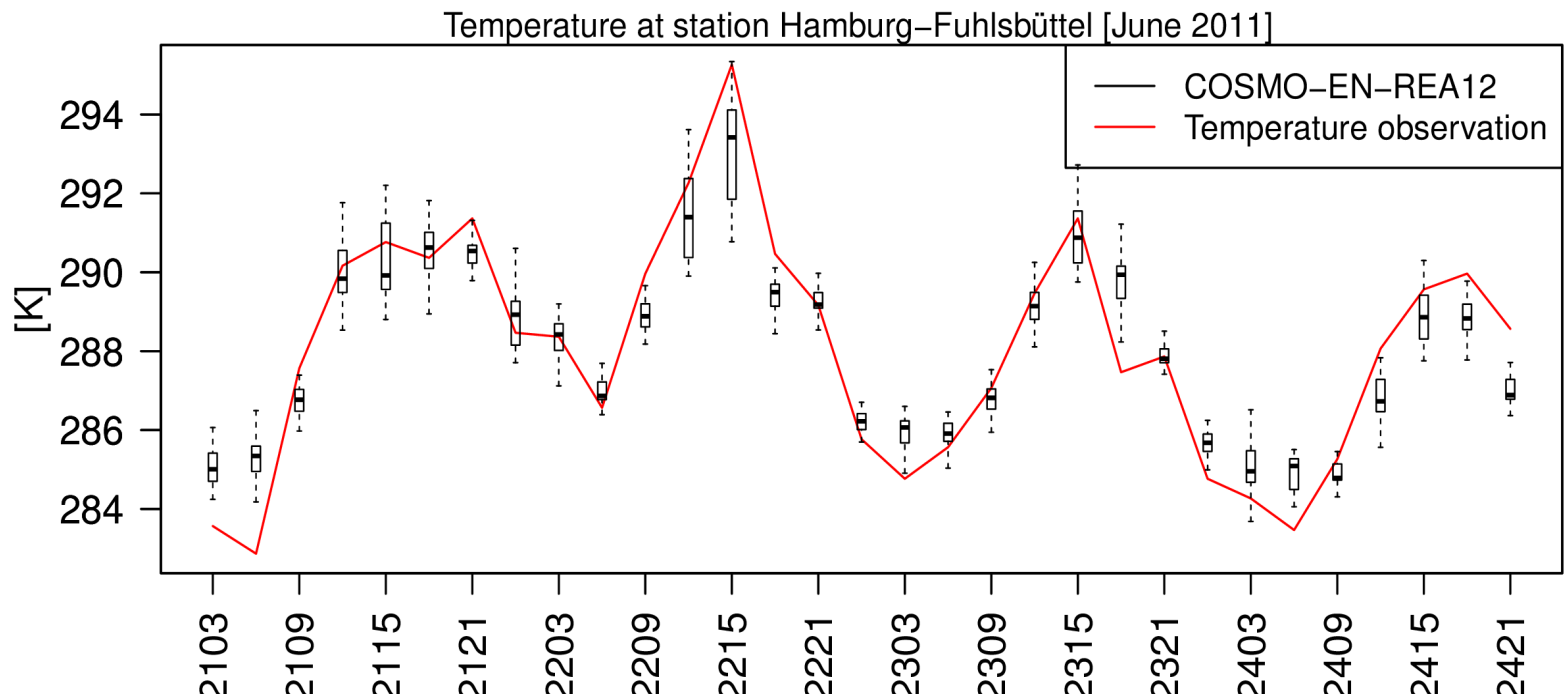


Status and plans

- Implementation of reanalysis suite for production of COSMO-EN-REA12 into ecflow as well as finished including external analyses, data archiving is left to be implemented
- Reanalysis will be based on ensemble nudging (→ obs uncertainty)
- Deterministic and probabilistic evaluation of two test experiments (T2M and precipitation, summer and winter months)
- **Agreement on time span with other partners at GA is necessary**
 - Production will start very soon after GA
- Other option of EN-LETKF works technically, but has major problems that require further research
- Plans for this year's research (besides production)

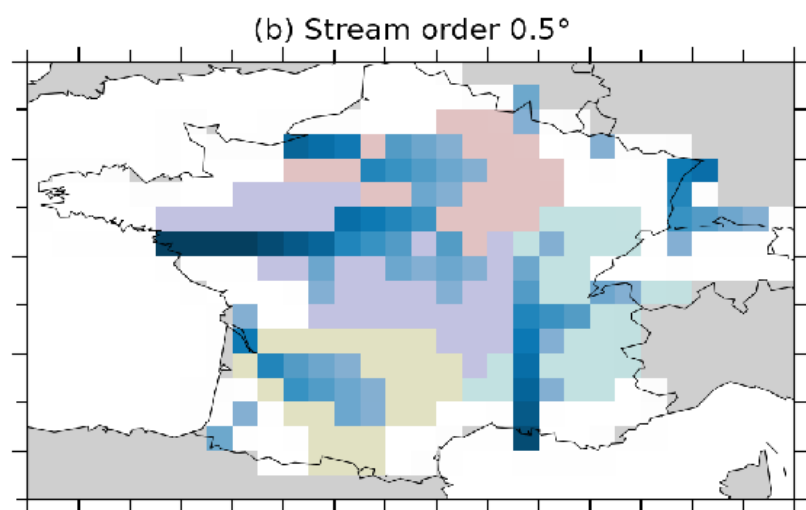
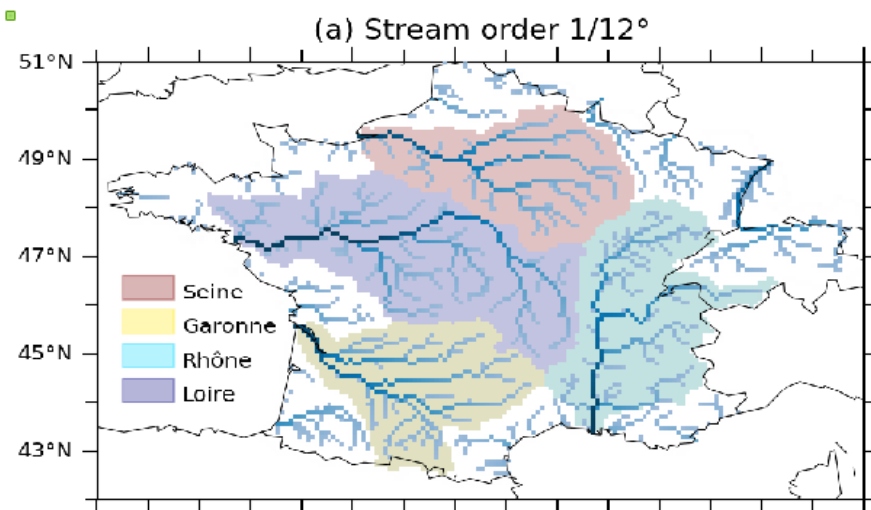
Uncertainties in ensembles of regional reanalyses?

- Contributions of model error, LBC-uncertainties, obs uncertainties to spread / spread skill ratios
- Separate and mixed experiments based on nudging with ICON and ERA-5 LBCs, perturbed physics ensemble (short time spans)



What's new since Tortosa's GA for MF surface re-analysis ?

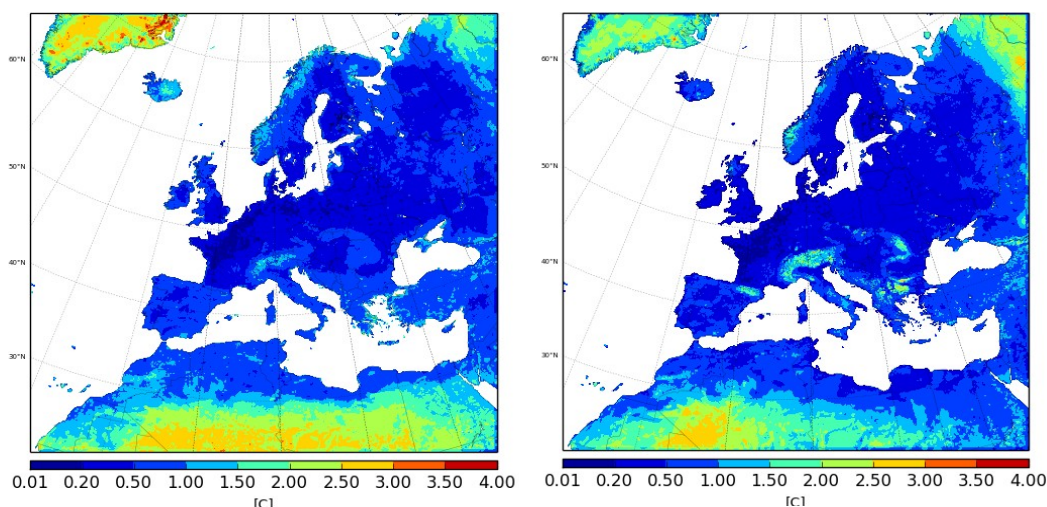
- Cornel Soci left to ECMWF 1/11/2015 after 5 years at MF (EURO4M/UERRA) replaced by Rachid Abida since 1/10/2015. Camille Sczypta 15/02/2016 for SURFEX/TRIP
- Several experiments with different physics @5.5km (Dec2009, Jan2010, June 2010) to evaluate the impact of an ensemble background
 - ALADIN physics with 2 surface schemes: ISBA and SURFEX
 - ALARO physics with 2 surface schemes: ISBA and SURFEX
 - Background for T2M, Hu2m and Wind are improved with the model at 5.5km vs the downscaling of the 11km background (C. Soci et al, EMS2014)
- Improving MESCAN precipitation analysis in mountainous region
- For MESCAN-SURFEX simulations: convert MESCAN output analysis to NetCdf for SURFEX
 - For 2016: adapt hydrologic TRIP model to high resolution to be coupled with SURFEX



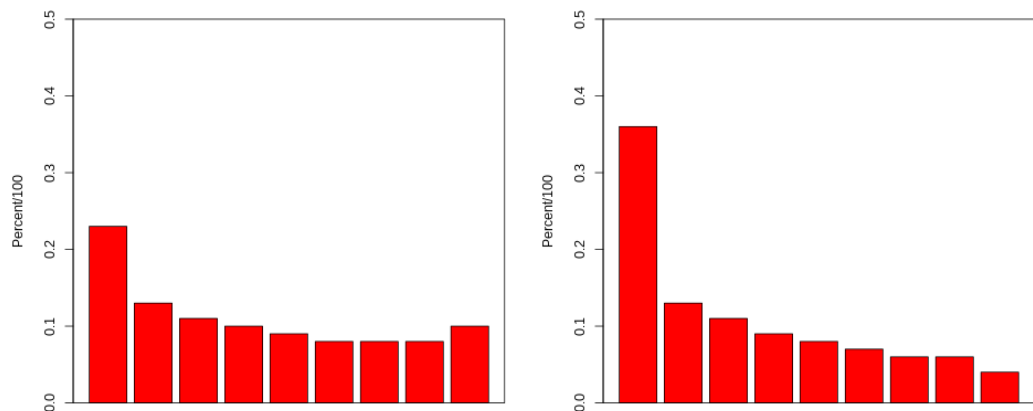
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What's new since Tortosa's GA for MF surface re-analysis ?

- Ensembles of temperature at 2m (T2m) and 24-h precipitation (RR24) re-analyses have been produced on 5.5 km grid for evaluation purposes, for two periods namely December 2009 - January 2010 and June 2010.
- For T2m/Hu2m ensemble analysis : perturbed observation with 6 members. For precipitations ... more uncertainties ... ! More details in MF presentation ...



Ensemble mean standard deviation of T2m re-analyses at 6TU for January 2010 (left panel) and for June 2010 (right panel).



Rank histogram of RR24 analyses from an ensemble of 8 members (left) with 8 different backgrounds and one observation data set, and of 8 members with one background and 8 data sets of perturbed observations (right panel), for June 2010. The rank is represented on abscissa.

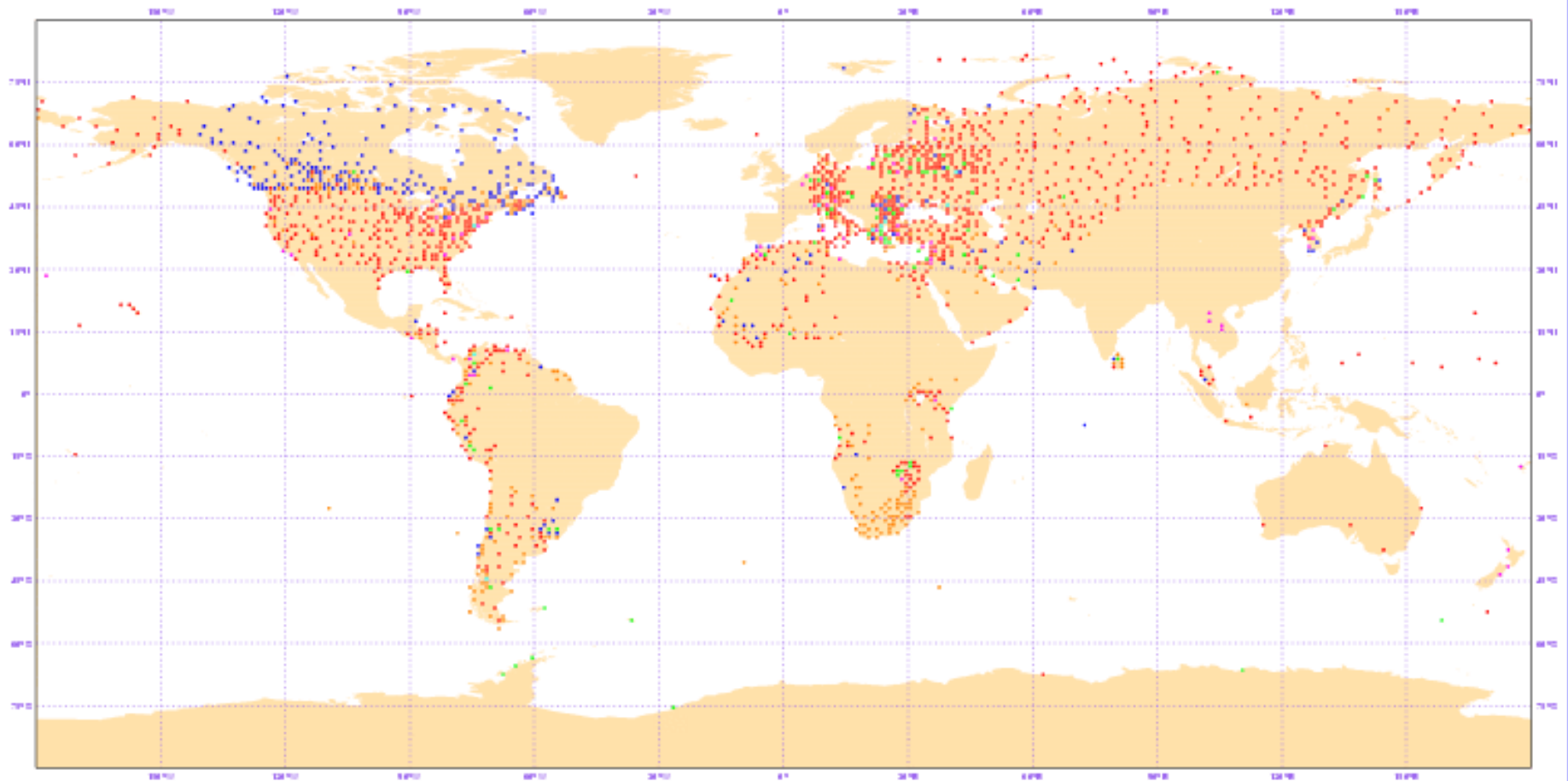


1960s – the missing obs

July 1966

ERA-40 Number of BUFR reports in 1°1 degree boxes.
average daily number of SYNOP of different kinds reports in July 1966
altogether 312061 reports in the month.

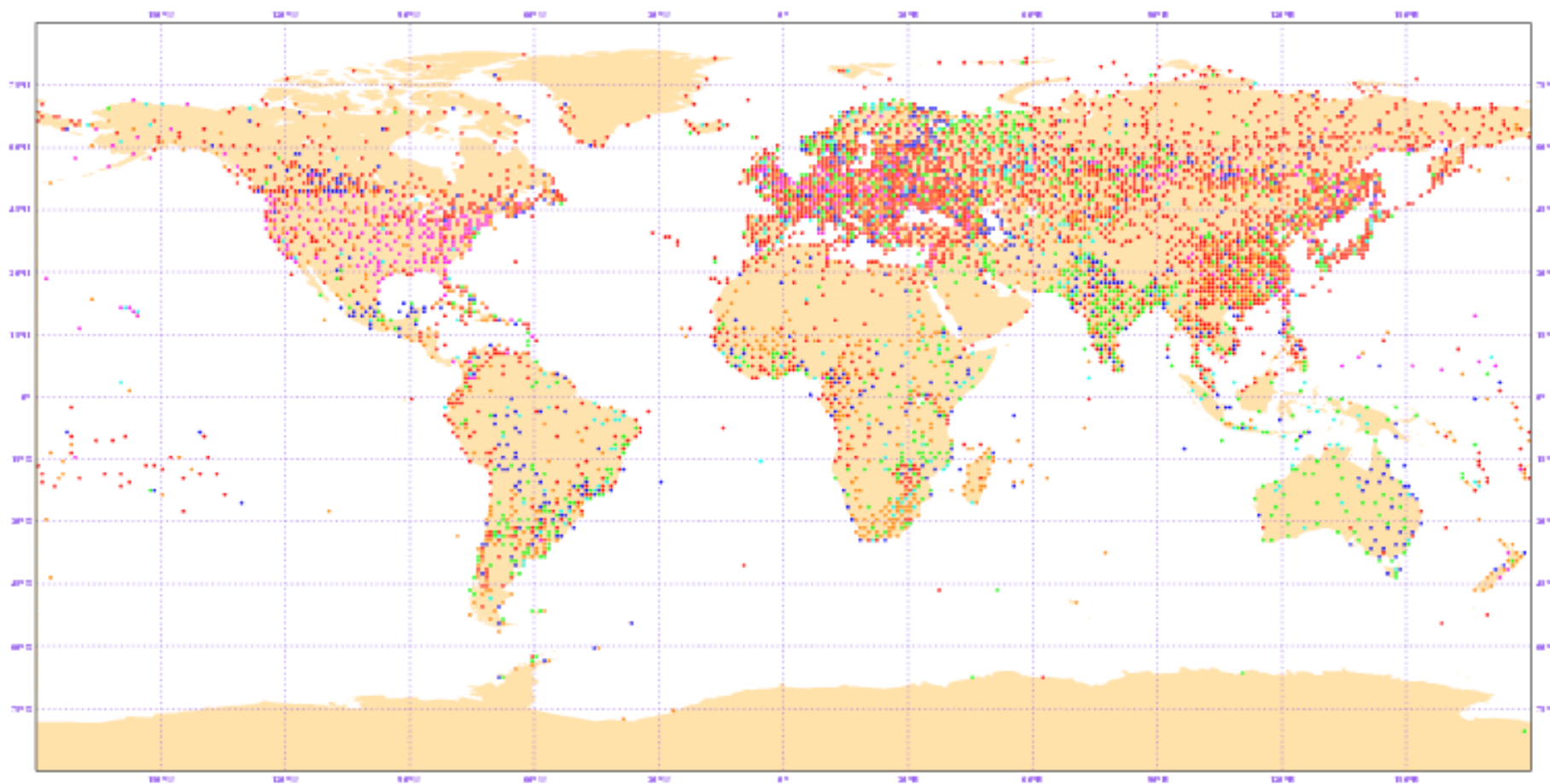
• 001-01 • 0.1-1 • 1-2 • 2-4 • 4-10 • 10-100 • 100-999



July 1967

ERA-40 Number of BUFR reports in 1°1 degree boxes.
average daily number of SYNOP of different kinds reports in July 1967
altogether 832226 reports in the month.

• 0.01-0.1 • 0.1-1 • 1-2 • 2-4 • 4-10 • 10-100 • 100-9999



WP2 Summary

- Delays / technical issues
- Also good progress
- Observation gaps
- Question over use of ERA5