Hourly RUC and OOVAR validation

Mate Mile and contributions from others

Outline

- Hourly RUC
  - Goals, RUC meeting
  - Challenges
  - Preliminary results and future perspective
- OOPS LAM 3DVAR prototype
  - Installation
  - Preliminary validation
  - Questions

LACE action: Hourly RUC

- This new topic was opened this year to build hourly updated assimilation system.

- Many LACE countries were interested to do DA activities, developments towards the **increased analysis update frequency (RUC)** and to the related areas.

- A LACE Kick-off meeting was also organized in March 2015 to discuss the challenges of such assimilation system

- The materials of the meeting can be found on LACE webpage

RC LACE Data Assimilation
The hourly Rapid Update Cycle
Progress meeting

Venue ZAMG Vienna, Austria
Date: to be defined
Financial support: to be defined

RC LACE Data Assimilation
The hourly Rapid Update Cycle
Kick-off meeting

Venue: ZAMG Vienna, Austria
From 17th to 18th of March 2015.
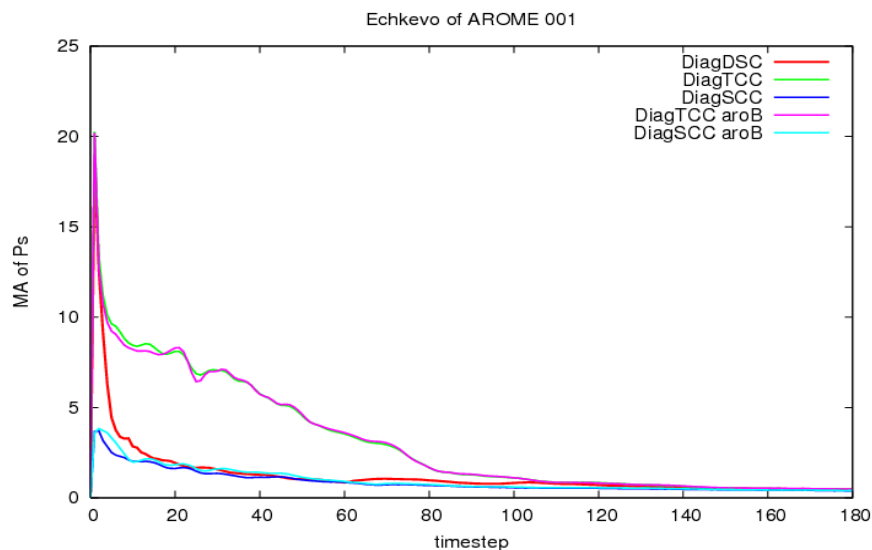
Action/Subject: *Hourly Rapid Update Cycle*

LACE action: Hourly RUC

- Outcome of the meeting (briefly):

  - 1h RUC system is for automatic and warning forecast purposes covering short- and very short-ranges for high priority parameters like wind speed and gust, precipitation, convective initiation, temperature around 0 Celsius, visibility and cloudiness
  - For the next 2-3 years, 3DVAR will be the core of the RUC systems.
  - Most important observations are conventional ones (SYNOP, TEMP, AMDAR+Mode-S), RADAR data, GNSS ZTD and geostationary satellite products with the utmost frequency and resolution.
  - On short term, the initialization and background error statistics (mostly the balance operator) have to be investigated and/or tuned. On longer term, the action has to be focused on flow-dependency aspects of the structure functions.

- Challenges:

  - Control noise accumulation and imbalances
  - Observation constraint in every RUC analyses
  - Coupling strategy and coupling frequency
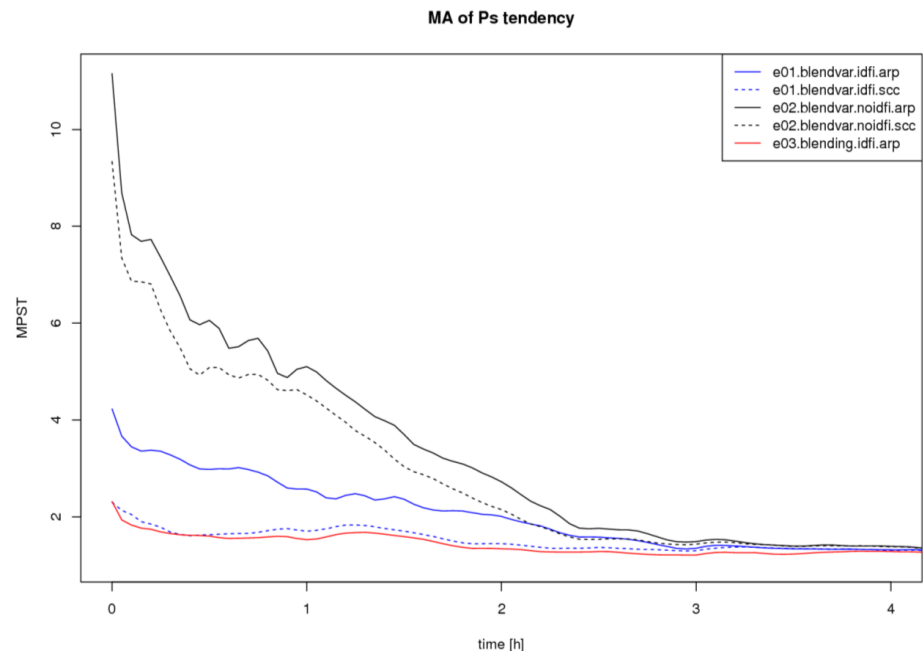 - The best estimate of background error statistics

LACE action: Hourly RUC

- *Control noise accumulation and imbalances*
  - SCC is beneficial to reduce noises at initial time
  - The use of initialization method (DFI, IDFI, SSDFI) has to be further studied

Echkevo domain for different AROME/Hungary configs
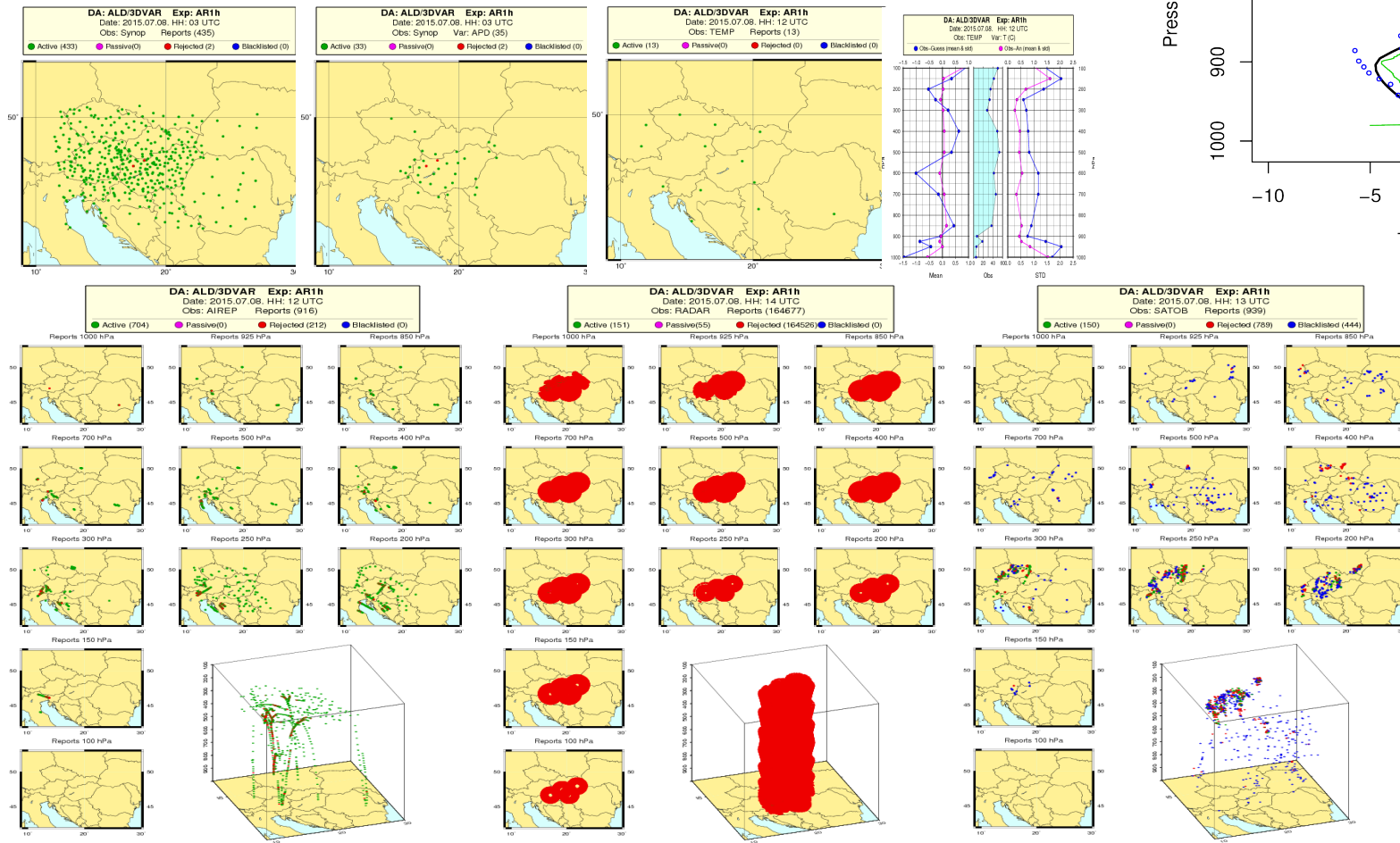

Benacek: Testing IDFI for BlendVar

Action/Subject: *Hourly Rapid Update Cycle*

LACE action: Hourly RUC

■ ## Observation inventory

SYNOP+ZTD,AMDAR+Mode-S,TEMP, AMV,RADAR,Satellite

Strajnar: 1h RUC vs 3h RUC

Mid-level temp asynoptic anal times during night

Mid-level humidity asynopitc anal times

Action/Subject: Hourly Rapid Update Cycle

LACE action: Hourly RUC

- *Coupling strategy and coupling frequency*
  - SCC is beneficial, but the hourly LBC coupling in the assimilation cycle might not be adequate and has to be studied
  - LBC coupling with 30min frequency has to be tested
- *The best estimate of B matrix*
  - For climatological structure functions of 1h RUC, 3h forecast differences should be used, hence in 1h forecasts, energy and variance spectra on small scales are rather weak.
  - Flow-dependency?

LACE action: Hourly RUC

- Materials of the first RUC meeting are available on LACE webpage

- Promising results from Austria.

- Keep in mind that new meeting will be organized (details to be defined later) to everybody who wants to step towards such DA system.

OOPS LAM 3DVAR (OOVAR) prototype

- The prototype of the OOPS LAM 3DVAR became available at the end of 2014 thanks to Meteo-France colleagues

- The provided tarball consists the following:

  - *3dvar.xml*

  - *gmkpack-oovar.tar.gz*

  - *slurm-21301299.out*

  - *modset-3dvar-oops.tar.gz*

- and doesn't consist the mainpack which is the basis of oovar modset (*cy40_op1*) and was fetched from beaufix

OOPS LAM 3DVAR (OOVAR) prototype (*installation...*)

- However the **OOPS project is already in a mature phase** and new cycles are seriously involved in OOPS refactoring, the LAM code modifications are still under discussion.

- The prototype is basically **a mock-up version of LAM 3DVAR** and You shouldn't expect clear and validated assimilation version.

- In Hungary we tested this OOVAR in our rather old computer:

  - Linux wfma 2.6.18-164.11.1.el5 #1 … EST 2010 x86_64 x86_64 x86_64 GNU/Linux

  - IBM iDataPlex linux cluster with 560 cores (070 nodes)

  - PBS TORQUE SERVER 2.4.6

  - Intel MPI Library 3.2.1, MPIICC, MPIIFORT, IFORT Version 11.1

  - PERL Version v5.8.8 (Lately v5.10 is also installed)

  - GRIB_API version 1.9.9

  - NetCDF version 4.1.3

  - Auxlibs 2.5

  - Boost Library Version 1.33.1 (installed for OOPS), (Lately v1.51.1 is also installed)

OOPS LAM 3DVAR (OOVAR) prototype (*installation...*)

- Problems about installation can be found on LACE forum with more details.

- Mainpack and gmkpack:
  40_op1.01.mainpack, gmkpack.6.6.0

- To highlight some of those issues:

  - error in error_covariance_3d_mod.F90 routine "name in only-list does not exist [SETUP_CTLVEC]

  - CY40 crashed (not regularly on Level 3) due to auto-generated interface blocks: modi_vegetation_update.F90, modi_init_surf_atmn.F90
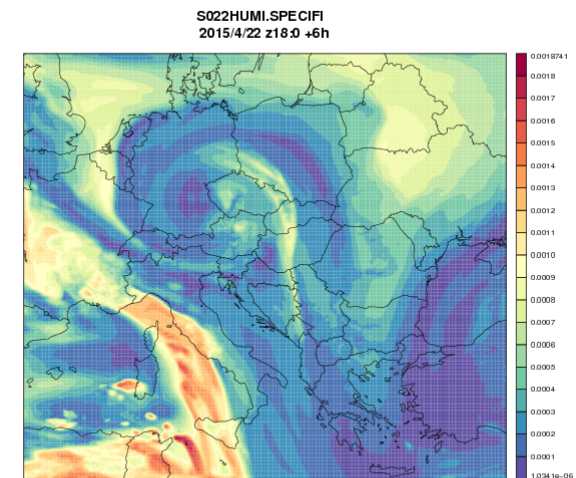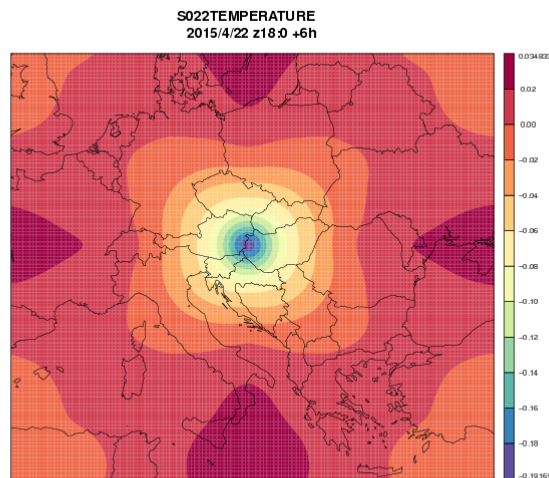
OOPS LAM 3DVAR (OOVAR) prototype (*installation...*)

- Additional libraries in userpack and the compilation script were generated for the OOVAR considering modset.

- Create userpack with OOVAR modset: **40_oops.01.INTEL111059.x, gmkpack.6.6.0**

- Issues related to modset installation briefly:

  - Insert BOOST libs

  - ambiguous file ftn_c_string_conversion.o for archive liboops.local.a

  - Problems with OpenMP references

  - Static linking of XML libs

OOPS LAM 3DVAR (OOVAR) prototype
(*validation... debugging...*)

- Try to run OOVAR with adaptation of ALADIN and AROME 3DVAR settings

- Hardcoded command line arguments, MIN1 → MINI (hardcoded as well)

- Dates are also hardcoded in OOVAR proto

- Crashed in SUTOPH (SIGFPE) ? RMESOQF(JLEV) new formula in cy40 (backphasing cy38t1 for temporal solution)

- (Running DA pre-proc and screening with cy40 – this cycle wasn't validated in OMSZ!)

- Crashed after Iteration 30 – Coredump

- Recompling userpack with debugging compiler options suggested modifications in:

  - allobs_mod.F90

  - gom_setup.F90

  - obsvec_mod.F90

  - suctrl_gflattr.F90

OOPS LAM 3DVAR (OOVAR) prototype (*validation… debugging…*)

- After these (not so wise) modifications OOVAR analysis was created with ALARO settings, AROME still crashed.

- Making single temperature experiment quickly with ALARO OOVAR, realistic increments have been produced for temperature, but not for humidity.

- Validation has to be continued…

OOPS LAM 3DVAR (OOVAR) prototype
(*first thoughts... questions...*)

- It is hard to understand the new dataflow of the variational method.

- For the overview of the new OOPS refactoring, good knowledge on OOP and C++ is needed.

- The structure and the organization of the configurations are also changed a lot
  - Check stdout
  - Check 3dvar.xml

- For instance change logging through xml use all of these:

  Info, *Trace*, Debug, Warning, Error, Fatal

- Another example there is no implementation of M1QN3. Instead of Quasi-Newton technique there are several others: PCG, DPCG, Lanczos etc.

```
Trace    : Setup MPI
[0#18707@wfmc035] MPI startup(): shared memory data transfer mode
[0#18707@wfmc035] MPI Startup(): process is pinned to CPU00 on node wfmc035
[0#18707@wfmc035] Rank    Pid      Node name   Pin cpu
[0#18707@wfmc035] 0        18707    wfmc035    0
[0#18707@wfmc035] Init(): I_MPI_DEBUG=+5
 NPROC,MYPROC=          1          1
 --- End of MPL setup ----------------------------------------
MPL_BUFFER_METHOD:  2   128000000
Trace    : IfsModel::IfsModel
Trace    : IfsModel: tstep is PT1M
Trace    : IfsModel created
Trace    : AllObs constructed
Info     : AllObs asking for Cumulated computation
Trace    : ObsCumulated created
Trace    : Observations:Observations ObsType created
Trace    : Observations created
Info     : Input observations:Observation Infos for 1 types:
Info     : AllObs nobs= 1 Min=0, Max=0, Average=0
Debug    : There are 1 states
Debug    : ControlVariable:reading
Debug    : <state>
Debug    :   <ifile>1</ifile>
Debug    : </state>
Trace    : IfsState::IfsState created and read in.
Info     : ControlVariable:ControlVariable: read bg at 2015-04-23T00:00:00Z
Trace    : ControlVariable:ControlVariable done.
Info     : Background State:
```

```
  <lrmodel>
    <tstep>PT1M</tstep>
  </lrmodel>
  <tlmodel>
    <tstep>PT1M</tstep>
  </tlmodel>
  <ninner>30</ninner>
  <gradient_norm_reduction>1e-6</gradient_norm_reduction>
  <test>off</test>
  <diagnostics>
    <departures>ombg</departures>
  </diagnostics>
</iteration>
</var4d>
<final>
  <diagnostics>
    <departures>oman</departures>
  </diagnostics>
  <prints>
    <frequency>PT1H</frequency>
  </prints>
</final>
<cost_function>
  <cost_type>3D-Var</cost_type>
  <window_begin>2015-04-23T00:00:00Z</window_begin>
  <window_length>PT0H</window_length>
</cost_function>
<output>
  <date_first>2015-04-23T00:00:00Z</date_first>
  <first>PT0S</first>
  <frequency>PT1H</frequency>
  <type>an</type>
</output>
</config>
```

OOPS LAM 3DVAR (OOVAR) prototype
(*first thoughts... questions...*)

- Which part of the OOPS do You think LACE can contribute? OOVAR? Any interested part of the DA configurations?

- Manpower? Local work ↔ OOPS

- LACE Training about OOP and C++?

- Practical exercises during next DAWD regarding OOPS?

- HARMONIE 4DVAR WW and OOPS design mini-workshop in ECMWF (probably between 24th and 26th of Nov. 2015)