Data assimilation Sessions &
Plan for cooperation in ACCORD DA area

Roger Randriamampianina

Thanks to: Benedikt Strajnar and Loïk Berre

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Outline

➢ Working strategy within ACCORD DA area

➢ Outcome of the 1rst ACCORD workshop
  ○ Few points from the DA sessions
  ○ Few points from the discussions
Working strategy within ACCORD DA area

➢ After consultation with Benedikt Strajnar and Loïk Berre

➢ Until now:
  ○ In LACE:
    ■ well organised stays/scientific visits
    ■ working days (once a year)
      ● exchange of developments/achievements. Direct interaction with developers
  ○ In HIRLAM:
    ■ working weeks
      ● exchange of developments/achievements. Direct interaction with developers
      ● Solve together concrete problems (hands in)
  ○ Video meetings:
    ■ Five groups of topics (Conv obs; radiances, retrievals, radar data, algorithm)

➢ We would like to try
  ○ Stays will be planned further when both host and visitor have maximized working time.
  ○ working days/week:
    ■ Roger will collect in advance all the achievements to be known preferably prior to the meeting
    ■ The information about 1) needed settings, 2) short description of lesson learned, and 3) scientific documentation or presentation.
    ■ Minimum two of “DA1/DA3 meetings “-- guaranteeing the blue points above will be organised.
Working strategy within ACCORD DA area

➢ Formation of teams
  ○ Research teams (DA2, DA4, DA5, DA6):
    ■ Teams will be formed to deal with some high priority tasks from the rolling work plan
    ● Reasonable number of research teams
    ● Face to face meetings will be organised in order to solve together concrete problems
    ● Regular video meetings will be organised
  ○ Support teams (DA1, DA3, DA7):
    ■ can be as many as needed and can define regular or by demand video meetings
    ■ meet at working weeks
    ● exchange of developments/achievements. Direct interaction with developers

➢ Avoid repetition of development works
  ○ Porting of developments:
    ■ CSC leaders are responsible for the implementation of the new developments
    ■ All developments/achievements should be ready to be used in each CSC
    ■ All developments will be delivered in form of “pluggable” functions into all three CSC DA system
      ● Function: comprises all needed manipulation of input data, namelist setup and takes care files naming conventions
    ■ Developers are responsible for the “functions”, short how-to describing the implementation process, changed source codes, and scientific documentation if appropriate
    ■ Little by little we build a common and modular DA system
    ■ The functions will be prepared to be called in Bator, Canari, Screening, or minimisation
Avoid repetition of development works

- Transparent developments:
  - In long term we will have transparent development throughout all CSCs
  - Use of Davaï for testing all developments

Co-leading the teams:

- The teams work will be co-lead with one or two members from the teams
Outcome of the 1rst workshop

➢ **DA1: Further development of 3D-Var (alg. Settings)**
  - Accounting for low resolution observations using supermodding approach (Máté Mile PhD): https://doi.org/10.1002/qj.3979
  - Accounting for large scale information:
    - Variational assimilation without $J_k$ term but using $B^\sim$ and $x^\sim_p$ (Ole Vignes)
    - Need of new strategy to construct EDA-based LAM EPS (Ulf Andrae)
    - Variational constraint scheme was proposed (Carlos Geijo)
  - Need for tuning of B error covariance when increasing the model resolution (Viktoria Homonnai)
  - weak coupling between surface and upper-air DA: concept proved (Jostein/Yurii/Trygve)

➢ **DA2: Development of flow-dependent algorithms**
  - Multi-incremental 4D-Var and improved use of observations in Harmonie-AROME (Jan Barkmeijer)
  - Hybrid EnVar in Harmonie-AROME (Jelena Bojarova)
  - 3D/4DEnVar in AROME-France (Pierre Brousseau)
    - 3D-Var in and outside OOPS are identical
    - OOPS_3DEnVar considered for e-suite in 2022
    - size of the EDA?
  - Variational constraint (tested with field alignment) in Harmonie-AROME (Carlos Geijo)
DA3: Use of existing observations

- **Radar data:**
  - There is room for improvement in AROME for both DOW (Jana Sanchez) and REFL (Maud Martet)
  - Reflectivity DA tested in high res ALARO (Benedikt Strajnar)

- **Aircraft-based observations:**
  - Mode-S EHS EMADDC (Alena Trojáková) and MRAR (Gabriella Tóth)

- **Scatterometer:**
  - Impact of ASCAT in 3D/4D-Var (CY43) and testing of HY-2B in CY46 (Isabel Monteiro)

- **Atmospheric Motion Vectors:**
  - adding data from middle level clouds (Zsofia Kocsis)

- **Clear sky radiances:**
  - adding ATMS, MWHS2, CrIS, IASI: (M Lindskog, R Eresmaa, J Campins, E Whelan)
  - *consider updating the VarBC coefficients differently, e.g when we have full coverage of instrument* (R. Eresmaa)

- **High resolution radiosonde:**
  - Descent data (Roger Randriamampianina, Eoin Whelan)
  - *vertical interpolation was questioned* (Reima Eresmaa)

- **GNSS ZTD:**
  - applied also in RUC from fixed (B Strajnar) and *moving (train) platforms* (Phillip Scheffknecht)

- **Netatmo surface pressure:**
  - (see next slide)
Outcome of the 1rst workshop

DA4: Use of new observations types

- Surface pressure from Netatmo:
  - quality control (machine learning) and bias correction under investigation (iOBS project)

- Surface pressure from smartphones:
  - data are out of personal ID but collected with reduced location accuracy
  - quality control and bias correction need to be worked out

- High resolution T2m and Hu2m from Netatmo:
  - promising results in nowcasting in MetCoOp and at ZAMG

- Commercial microwave links:
  - work in progress (Phillip Scheffknecht)
  - need a suitable observation operator for "rain rate" type of observation

- MTG lightning:
  - pseudo observations tested successfully in AROME-France (Felix Erdmann)
  - potential observation operators based on microphysics and regression models were shown (Pauline COMBARNOUS)

- All-sky radiance:
  - work in progress (Alertness project, Roohollah Azad)

- Aeolus HLOS data:
  - successfully tested with 3D/4D-Var in Harmonie-AROME (Susanna Hagelin)
  - rather neutral impact on analyses and forecasts
Outcome of the 1rst workshop

➢ DA5: Development of assimilation setups suited for nowcasting
  o Radar reflectivity:
    ■ tested in AROME RUC (Florian Meier)
  o High resolution T2m and Hu2m from Netatmo:
    ■ promising results in nowcasting in MetCoOp and at ZAMG
  o Atmospheric motion vectors:
    ■ added in MetCoOp nowcasting (David Schönach)
  o Field alignment and Variational constraint schemes:
    ■ successfully tested in OSSE framework (Carlos Geijo)

➢ DA6: Participation in OOPS (Pierre Brousseau)
  o Testing 3D-Var in AROME-France:
    ■ MASTERODB and OOVAR analysis identical in CY46
  o Testing 3D-Var in ALARO:
    ■ tested technically with 3D-Var and ALARO in MF machine
  o Adding hydrometeors variables:
    ■ tested in AROME-France with direct assimilation of radar data (Maud Martet)
  o Adding NH variables:
    ■ tested with single observations
Outcome of the 1rst workshop

➢ DA7: Observation pre-processing and diagnostic tools
  ○ Obsmon:
    ▪ Many new features (Paulo Medeiros)
  ○ MTEN:
    ▪ New presentation of the results (Zheng Qi Wang)
  ○ SAPP:
    ▪ Well presented by Yelis Cengiz. *Exchange of settings and setup seems to be required.*

➢ DA8: Basic data assimilation setup (Maria Monteiro)
  ○ Bator with conventional observation:
    ▪ All ready
  ○ Surface assimilation:
    ▪ All tested cycling
  ○ Background error statistics:
    ▪ 6 out of 8 have the downscaled version
  ○ Upper-air DA:
    ▪ cycling available in 3 out 8
  ○ Modular scheduler:
    ▪ good progress
More thoughts from the discussions

- **Sub-hourly data assimilation**: Roger plans to organise a dedicated team to discuss this issue.
- **Experience with single precision (Filip Vana)**:
  - SP will be used for trajectory runs and observation handling in ODB.
  - No speed-up on Cray because of hacked Lapack library which uses double precision internally.
- **Need for non-hydrostatic EnVar (Pierre Brousseau)**:
  - Studied only in one case with severe convection.
  - OOPS_EnVar is a good environment to add and evaluate different variables in the control vector.
- **Surface pressure vs. geopotential assimilation**:
  - It is preferable to use pressure in combination with bias correction.
  - The development is available but not yet in the common/export codes.
- **Tuning observation errors**:
  - Desrozier’s approach is not enough. More diagnostic tools or evaluation approaches are needed.
- **Correlated observations errors**:
  - Changing the thinning distance and inflation of the observation error was shown to provide similar results.