Working group 1 : Data assimilation

Participants :

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Report :
(including conclusions from discussions during the ALATNET seminar)

1. SURFACE ANALYSIS

1.a Analysis of surface and soil variables (temperature and humidity)

- Tuning of existing O.I. analysis (for DiagPack and to improve the initialization of soil variables)
- Assimilation of observations of different kinds (T2m, HU2m, Ts-IR, Ts-MO) to prepare the assimilation of satellite observations (MSG, AIRS, SMOS, ...), prepared using 1D experiments on experimental campaigns like MUREX, SMOS-PIRRENE, ...
- Operational implementation of a 2D-VAR surface analysis, independent from the upperair analysis
  - Spatialisation of the assimilated observations
  - Spatial coherence of deep soil parameters
  - Comparison and combination with an "off-line" soil water content
  - Adjoint model required
- Difficulty of a common analysis for surface and atmospheric fields :
  - Better coherence of analysed fields
  - No problem of spatialization of the assimilated observations
  - Pb : Utilization of a single assimilation period
  - Pb : Various spatial resolutions
  - Pb : Spectral/Grid points : minimization, definition of covariances
  - Pb : Impossibility to use analysed fluxes

1.b SST analysis

- Tuning of existing analysis
- Assimilation of satellite data

1.c Snow-cover analysis

- Implementing operationally the current scheme
- Use of a snow mask derived from satellite data

1.c Diag-Pack

- More analysed parameters (visibility, cloudiness, precipitations, ...)
- Extension to upper-air high temporal density data (AIREP, Profilers, ...)
- Solution of logistic problems for a truly nowcasting use
- Implementation of the existing versions (Austria, Portugal)

- Unavoidable question of the possible evolution towards a 3D-Var framework (better maintenance vs. less flexibility in the scale selection)

1.d Tasks, priorities, persons

- Surface analysis: G.P. Balsamo, F. Bouyssel, L. Gaytandjieva, N. Camara, S. Ivatek-Sahdan, ...
  - Assimilation of soil fields : G.P. Balsamo, F. Bouyssel
  - Analysis of PBL fields (smoother soil moisture fields, geography dependant structure functions) : N. Camara, S. Ivatek-Sahdan, someone from Portugal, ...
  - Snow cover : L. Gaytandjieva, F. Taillefer
  - SST : someone from Portugal and / or Morocco
  - OI of boundary layer fields portable to VAR ? : person is searched !!!!!
  - Towards a full variational approach ?? : see steering group
- Diag-Pack: G. Radnóti, F. Taillefer, Y. Wang, F. Bouyssel, J.L. Ricard
  - More analysed variables
  - More observations
  - Var-Pack ? : dependent on answers to the previous questions
- Steering group for strategy : C. Fischer, G. Radnóti, F. Bouyssel, L. Gaytandjieva, F. Taillefer

2. BLENDING

- Choice of the best strategy for coupling, structure functions, blending, "external" filtering ...
  - a lot of technical choices to be done
  - a strong need to keep the best possible consistency
- Prepare a stable application (scripts, code, links to ARPEGE and Full-Pos, optimisation in CPU and memory), for ...
  - sensitivity- and singular vectors extensions
  - "bogus-type" introduction of moisture at high resolution (⇒ data)
  - tests on IOPs (MAP, Fastex,)
  - the high resolution problematic (new variables, orography, ...)

3. 3D-VAR

3.a Algorithmic aspects

- Possibility to have the brightness temperature in the control variable of the 3D-Var minimization, in order to assimilate raw radiances. In the code, this corresponds to the key LTOVSCV.
- Asynoptic use of data:
  - The frequency of 3D-Var analysis (one-hourly, three-hourly, six-hourly...) is one issue to be studied.
  - Implementing 3D-FGAT (FGAT=First Guess at the Appropriate Time) gives the possibility to calculate accurately innovations related to asynoptic observations.
  - In a longer term perspective, 4D-Var allows to treat not also innovations but also increments related to asynoptic data in a way that is consistent with the time evolution of the model.
- Tuning / a posteriori validation:

– The work on the use of a posteriori diagnostics such as the minimum of the cost function should be continued, e.g. in order to estimate the background error standard-deviation to be used with the so-called "lagged NMC" statistics.
– Another issue is related to the representativeness errors, which are part of the observational errors, and which are likely to become smaller when the model resolution is increased.
– Some information may be derived from the adjoint solution of the minimization.

3.b Cycling

- One issue is the possibility to combine the blending and the variational analysis. Some typical options are :
  – Blend-Var (Blending first, then Var),
  – Schtroumpf-Var (the "Schtroumpf" idea is to combine large scales from ARPEGE and small scales from ALADIN directly in spectral space, without using digital filters as in Blending),
  – No-blend.
- A specific cycling strategy for double-nested models could be investigated.

3.c Background errors (Jb)

- There is a likely consistency between the choice of the first-guess and the choice of the background errors that is to be taken into account: errors are expected to be relatively larger scale in an ALADIN six-hour forecast than in an ARPEGE analysis. Blended fields are likely to be intermediate between the two other possible first-guesses.
- One issue is the methodology that is used to create a sample of forecast error estimates, from which statistics are calculated. This corresponds e.g. to the NMC method and to its mesoscale variant (sometimes called "lagged NMC"). Existing statistics can be used for the moment. It may be interesting to investigate the behaviour of the meso-scale variant of the NMC method for higher resolution.
- Features related to background errors that are studied and represented in 3D-Var could be generalized. This includes e.g. heterogeneous and anisotropic features.

3.d Tasks, priorities, persons

- Persons : C. Fischer, M. Siroka, A. Horányi, G. Bölöni, S. Alexandru, W. Sadiki, L. Berre, S. Stefanescu, S. Alexandru
- Non-operational baseline version ? Where ? Who ?
- Best strategy - M. Siroka, C. Fischer + student in Toulouse
- Lagged statistics - G. Bölöni, A. Horanyi.
- New formulations for Jb - L. Berre, S. Stefanescu.
- Tuning, validation - W. Sadiki
- Double nesting - S. Alexandru, A. Horányi.
- Left others - (LTOVSCV, 3D-FGAT...), but deadline within 2 years !

4. 4D-VAR

4.a Remarks

- Due to its cost, may not be a goal for full operational application (if for instance we manage to stretch the ARPEGE control variable)

- Crucial research tool however, be it only for the "golden circle" problematic (4D-Var, EPS, Kalman filter) and its associated "adaptative observation strategies"
- The question of the optimal relative resolution between direct model, control variable and observation network should not be further abandonned to global models!
- Part of the work on the "regularised physics" must be done at high resolution
- There is always the chance of a new "economy" breakthrough

4.b Required work on simplified physics

- Assessment at mesoscale
- Test of linearity
- Instabilities in direct model
- Instabilities in AD model
- Application to sensitivity studies and to singular vectors

4.c Tasks, priorities, persons

- 4D-Var algorithm : C. Soci, R. Ajjaji
- Sensitivity studies
- Singular vectors
- Simplified physics - Volunteers needed + R. Ajjaji + D. Banciu + C. Loo

5. OBSERVATIONS

5.a Remarks

- Everything is to be done if we want a true meso scale assimilation (obs-operators, measurement error statistics, quality control, debiasing procedures, monitoring,)
- We are very late on such issues!
- Beware of the land vs. sea change of perspective
- The Gourdon Paradox : "Everybody wants to use its home observations, but very few effort is put on their actual use and improved usage." ?

5.b Available observations

- High-density conventional data
  - Impact in 3D-Var
  - Link with OI surface analysis
- Satellite observations in raw format
  - TOVS
  - New microwave sounders (AIRS, IASI)
- Radar
  - Wind
  - Reflectivity
- GPS ground based
  - Total water content

5.c Pseudo-observation approach

- METEOSAT imagery ⇒ pseudo-profiles of T & q

- Other applications, e.g. radar reflectivities ?

5.d Quality control

- Screening
  - How the ARPEGE version is working?
  - Validation / tuning (thinning)
  - Screening on mesoscale (new types of observations)
- New formulations
  - Var-QC
  - Other

5.e Tasks, priorities, persons

- Persons : R. Randriamampianina, S. Kertész, M. Szczech, C. Soci, M. Belo Pereira, D. Merkova, G. Gregoric
- Observational Data Base (ODB) - everybody is concerned for installation
- New observations :
  - Extension of the usage of conventional data (high density observations) - ????
  - Satellite - R. Randriamampianina, M. Szczech
  - Radar - C. Soci, M. Belo Pereira, student from Slovakia (?), G. Gregoric (??)
  - Pseudo-observations (bogus) - Meteosat imagery - stagiaire in Toulouse + other center sharing the work , D. Merkova (?)
  - Using map data - Slovenians??
- Screening : validation, tuning for mesoscale - S. Kertesz
- Steering group on bogus technique + other sources of data : Y. Bouteloup (?), M. Szczech, M. Jerczynski (?), S. Kertesz