

RESEARCH DEPARTMENT MEMORANDUM



To: HR, HO, RD division and Section Heads

Copy: Ioannis Mallas, Giovanna De Chiara, Jan Haseler, Hans Hersbach, Drasko Vasiljevic

From: Patricia de Rosnay

Date: February 17, 2011 File: R58.3/PdR/1128

Subject: Use of ASCAT Level 2 Multi-parameter BUFR Product in operations in IFS cycle 36r4

As recommended by the ASCAT Science Advisory Group, EUMETSAT developed a Level-2 multi-parameter BUFR product containing both soil moisture and wind information. This combined wind and soil moisture product will replace, from 28 February 2011, the current Level-2 ASCAT products, received in separate files for wind and soil moisture. In this memorandum the bit identicalness of analysis experiments using the operational Level-2 ASCAT wind and soil moisture products and the new multi-parameter ASCAT product is verified.

1 ASCAT products

At ECMWF, ASCAT wind and soil moisture products are available at low resolution (24km) and at high resolution (12 km). All the products are archived on ECFS in the emos directory:

- ec:/emos/ASCH/ Level-1b high resolution wind.
- ec:/emos/ASCA/ Level-1b low resolution wind.
- ec:/emos/ASC2 Level-2 low resolution wind.
- ec:/emos/ASEL Level-2 low resolution ASCAT EARS product (EUMETSAT Advanced Retransmission Service).
- ec:/emos/ASHS High resolution soil moisture.
- ec:/emos/ASCS Low resolution soil moisture.

For operations, a single merged BUFR file, containing the three products ASC2, ASEL and ASCS respectively, is archived on MARS. It is used as analysis input in operations (type=ai,obstype=139,expver=0001).

In addition to these wind-only and soil-moisture-only products, ECMWF receive since 17 January 2011 the new multi-parameter BUFR product. This product is stored on ECFS:

- ec:/emos/AHWS/ Level-2 High resolution wind and soil moisture,
- ec:/emos/ALWS/ Level-2 Low resolution wind and soil moisture.

On 28 February 2011 EUMETSAT will stop delivering ASC2 and ASCS. These two products will be replaced by the AWLS product. So, the product to be tested for operational applications at ECMWF is ALWS, which is expected to be equivalent to combined data of ASC2 and ASCS.

2 Numerical experiments

Several experiments were conducted in order to check that the new Level-2 multi-parameter BUFR product is suitable to be used, and gives identical results that the two Level-2 products it is replacing. Experiments are analysis experiments, at T255, from 01 February 00 UTC to 02 February 00 UTC.

The first two experiments use wind data only.

- fhm2 is the control experiment. It uses the wind-only product ASC2 available on ECFS as input of the analysis.
- fhm6 is the test experiment which uses the new ALWS product containing wind data and soil moisture (not used in this experiment).

The experiment fhm2 uses the control branch `dap_CY36R4_ascat_ctrl` (36r4 merged with `dah_CY36R4_esuite`) and the `fetchobs` script has been modified on `/vol/ifs_sms` in order to use the ECS2 BUFR file from ECFS. The experiment fhm6 uses the `dap_CY36R4_ascat_new_product` (36r4 merged with `dah_CY36R4_esuite`) in which `fetchobs` has been modified in `/vol/ifs_sms` to use the new product ALWS from ECFS. So, the only difference between the two experiments is `fetchobs` which gets ECS2 for fhm2 and ELWS for fhm6.

For both experiments data count, Jo cost function, and spectral norms are compared in 4D-Var trajectories. Experiments fhm2 and fhm6 are bit-identical for both the 00 UTC and 12 UTC cycles of 01 February 2011 and 00UTC on 02 February.

This shows that the wind data content is equivalent in the new product ALWS and in the current operational product ASC2.

The second set of experiments aims at testing the use of both wind and soil moisture products, as they are both used in operations (including monitoring of soil moisture). So, this set of experiments uses combined products ASC2, ASEL and ASCS, as it is the case in operation. In addition the use of ASCAT soil moisture data in the Simplified Extended Kalman Filter (SEKF) soil moisture analysis is activated in order to check also soil moisture data assimilation with the new product.

- fhmp uses the MARS archive (ASC2+ASEL+ASCS).
- fhm4 uses ECFS archive concatenated in a single BUFR file in `fetchobs` in the same order as it is done for the MARS archive (ASC2+ASEL+ASCS).
- fhm5 uses ECFS archive concatenated in a single BUFR file in `fetchobs` in a different order: ASC2, ASCS, ASEL respectively.
- fhmq uses the new product ALWS combined with ASEL.
This experiment uses the branch `dap_CY36R4_ascat_new_product` as it (`fetchobs` does a "cat" of ALWS and ASEL).

Table ?? summarizes the experiments conducted indicating BUFR files and their order, as well as usage or not of ASCAT soil moisture data in the SEKF.

Experiment	BUFR files used and order	SEKF ASCAT soil moisture DA
fhm2	ECFS: ASC2	no
fhm6	ECFS: ALWS	no
fhmp	MARS (ASC2,ASEL,ASCS)	yes
fhm4	ECFS: ASC2,ASEL,ASCS	yes
fhm5	ECFS: ASC2,ASCS,ASEL	yes
fhmq	ECFS: ALWS, ASEL	yes

Table 1: Experiments conducted to test the new multi-parameter BUFR product ALWS that will replace on 28 February 2011 the Level-2 BUFR wind-only and soil moisture-only products ASC2 and ASCS.

As in the previous set of experiments, data count, Jo cost function, and spectral norms are compared in the first and last trajectories of the 00UTC and 12UTC analysis of 20110201.

Experiments fhmp and fhm4 are using the same number of observation and they are bit identical for Jo and spectral norms. This confirms that the order of the data in the MARS archive is ASC2, ASEL and ASCS respectively.

As expected fhm5 is not bit identical to fhmp and fhm4 because the order of the data is different and so, the thinning is slightly different. As a result, the number of observations is the same for the three experiments (in the last trajectory for example, ASCAT wind data number is 36274 on 2011020100), but the distance to observation function differ (for example in the last trajectory at 00UTC on 01 February 2011, it is 9866.299075724 for fhmp and fhm4 and it is 9877.463188946 for fhm5).

For operational use of ALWS we will have to combine ALWS and ASEL. So the relevant test to do for operational use of the multi-parameter product is to compare fhm5 (ASC2, ASCS, ASEL) with fhmq (ALWS, ASEL) in order to ensure that, when the order of data is the same, using the current Level-2 product ASC2 and ASCS is equivalent than using the new product ALWS.

Experiments fhmq and fhm5 are using the same number of observations (same as fhm4 and fhm5 also), their observation distance cost functions and spectral norms are bit identical for both soil moisture and wind. This shows that the new product ALWS (= ASC2+ASCS) is suitable to be used in operations. Using ASCAT soil moisture data in the SEKF soil moisture analysis, also confirms the equivalence in term of soil moisture data content.

3 Conclusions

Based on the experiments described above, we conclude that the new Level-2 multi-parameter BUFR product delivered by EUMETSAT and replacing the current wind-only and soil-moisture-only products from 28 February 2011 can be safely implemented in operations. Three products are combined in our MARS archive and for the implementation of the new product, the order of data will be slightly different from the current data order of the ASCAT data MARS archive. This memorandum shows that when current Level-2 products and the new multi-parameter product are used with data in the same order in the BUFR file, results are bit-identical.

Acknowledgements

Thanks to Drasko Vasiljevic and Erik Andersson for their useful comments concerning data order effects on the cost function.