INTERNATIONAL INTERCOMPARISON OF STRUCTURE FUNCTIONS

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1. INTRODUCTION

Discussions have been held at various international meetings such as the Workshop on Variational Data Assimilation Systems, September 1996 at the Isaac Newton Institute Cambridge and the 3rd Workshop on Adjoint Applications in Dynamical Meteorology, June 1997 at Lennoxville, Quebec about the need to intercompare data assimilation systems. The 1997 CAS/JSC Working Group on Numerical Experimentation report No 25 on Research Activties in Atmospheric and Oceanic Modelling included in its introduction the recommendations from the 12th session of the group. This included a recommendation for an intercomparison of the response of data assimilation systems to data. It was proposed that this should start with a simple exchange of figures showing the vertical and horizontal extent of the response, in all variables, to the perturbation of one, isolated, datum. This started in 1997.

2. PARTICIPANTS AND EXPERIMENTAL DESCRIPTION

4 groups (UKMO, ECMWF, Météo-France, CMC) had participated by summer 1997 and NCEP had also completed experiments by October 1998. They used their trial or operational 3DVAR systems valid at that time. They have each tested the impact in their systems of a 1m/s westerly wind increment in January at 50N, 30W for both an airep at 250hPa and a ship. The data was treated in the same way as a routine observation and plots of wind increments and height increments at 250 hPa, for the AIREP, and at the 1000hPa, for the ship, and east-west sections of divergence and north-south sections of vorticity were exchanged along with information on observation error etc. The dates selected were 00UTC 18 January 1997 for UKMO and Météo-France, 15 January 1995 for ECMWF, 16 January 1997 for CMC and 20 January 1997 for NCEP. The choice of date should not greatly influence the results unless a particular centre uses background errors which depend on the synoptic situation. These results are available on the World Wide Web at http://www.met-office.gov.uk/sec5/NWP/DA_intercomparison/index.html.

3. RESULTS FOR AIREP

An example is shown in figure 1 where the 250hPa wind increments generated by the simulated AIREP westerly 1m/s increment at 250hPa are shown for the different systems. It can be seen that the general patterns are very similar apart from slight differences in horizontal scale, differences in maximum increment and the slight asymmetry in the Météo-France system. There are in fact major differences in the observation error assumed for AIREP winds in the different systems ie 3.6, 3.6, 4, 5.15 and 3.5 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively and the implied background errors at the observation location also vary greatly ie 5.9, 2.33, 4.3, 3.8 and 2.1 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively. This results in very different fits to the observation so that $y^o - Hx^a$ =0.27, 0.71, 0.47, 0.66 and

0.73 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively.

4. RESULTS FOR SHIP WIND

It has also been found that large differences in assumed observation errors for ship winds exist eg 1.7 m/s at UKMO and 3.6 m/s at CMC resulting in large differences in the fit to observations. Only ECMWF and NCEP allowed for the effect of surface friction so that their horizontal impact pattern is rotated with respect to that from the other systems. The observation error assumed for ship winds in the different systems was 1.7, 2.5, 3, 3.6, 3 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively. The implied background errors at the observation location also vary greatly ie 2.4, 1.3, 1.6, 2.3, 1.5 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively. This results in very different fits to the observation for UKMO and the other centres so that $y^o - Hx^a =$ 0.34, 0.76, 0.77, 0.73, 0.74 m/s for UKMO, NCEP, ECMWF, CMC and Météo-France respectively. The impact on 1000hPa geopotential height for various centres is shown in figure 2. Maximum height increments were 1.8, 0.9, 0.5 and 0.47 m and minimum height increments were -2.1, -1.1, -0.5 and -0.39m for UKMO, ECMWF, CMC and Météo-France respectively

5. CALL FOR FURTHER PARTICIPATION

Other groups are encouraged to participate, including those involved in limited area data assimilation, and further information can be obtained from the above e-mail address. It is planned that a workshop will be held to present the results of these and further experiments and that a paper will be produced.

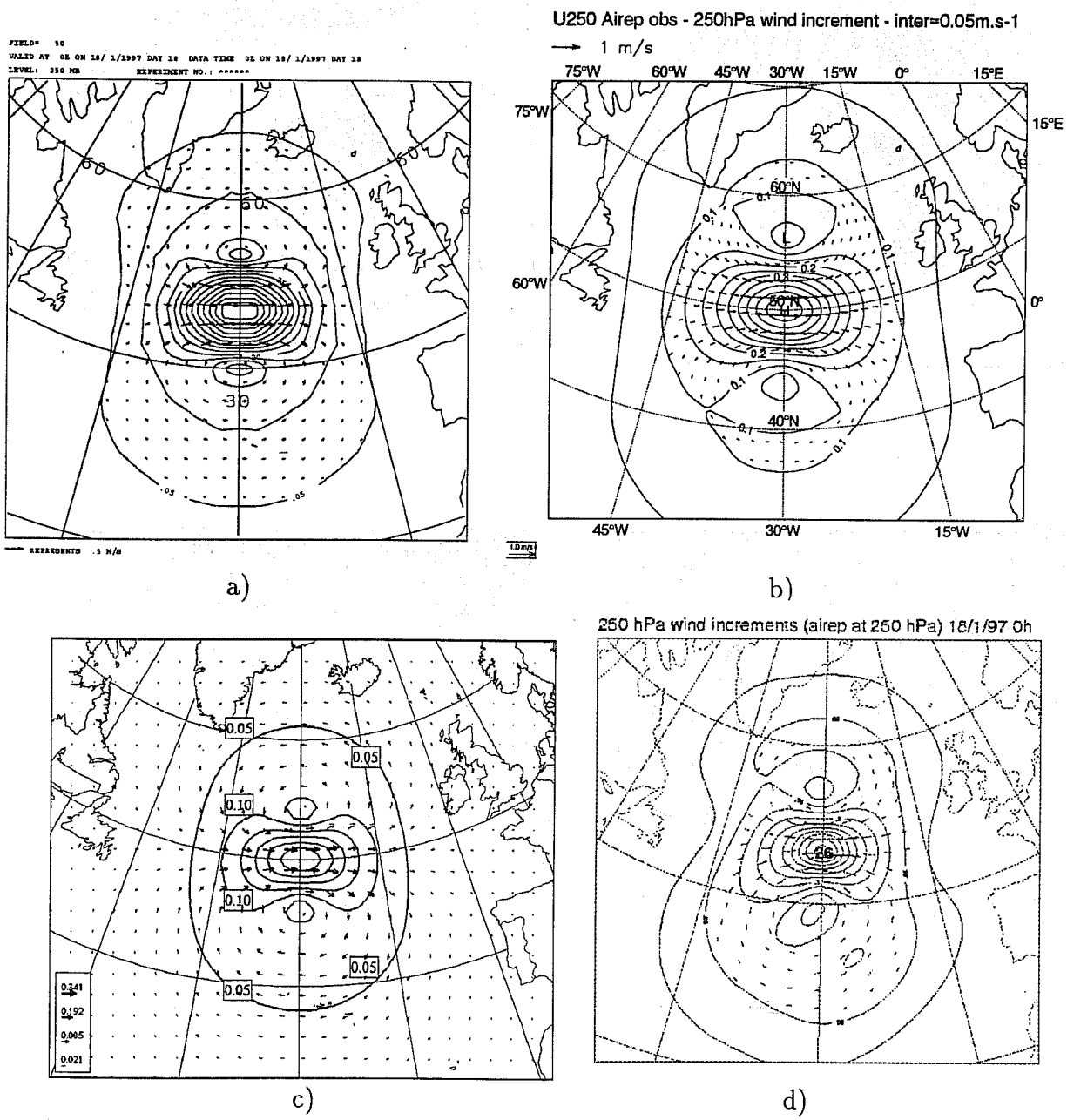

Figure 1: 250hPa wind increments generated by the simulated AIREP U-wind at 250hPa. Contour interval is $0.05 ms^{-1}$. a) UKMO. b) ECMWF. c) CMC. d) Météo-France.

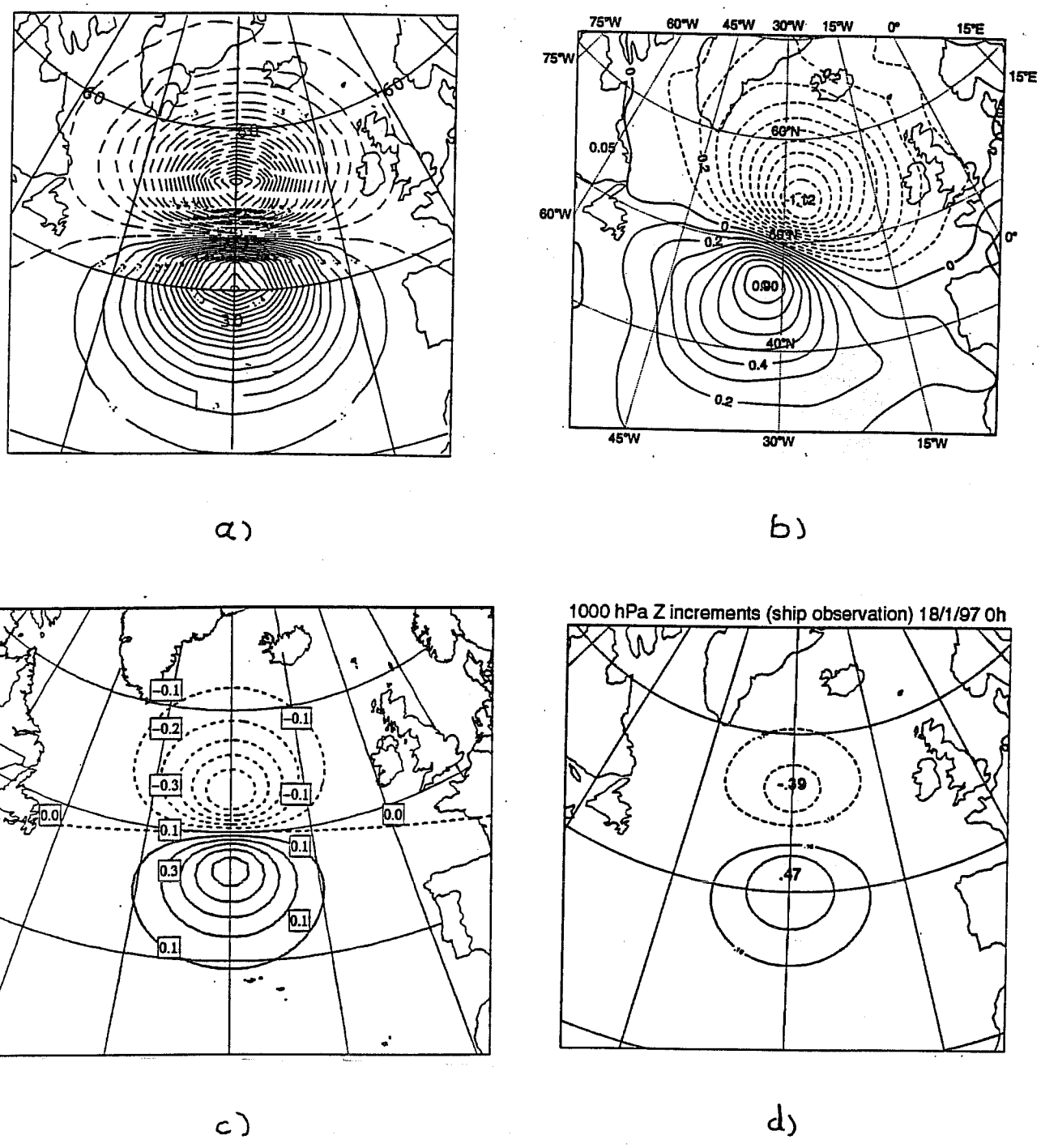

Figure 2: 1000hPa geopotential height increments generated by the simulated ship wind. Contour interval is 0.1m apart from Météo-France who use 0.16m. a) UKMO, b) ECMWF, c) CMC, d) Météo-France.