JPD 7.2 # Future International Cooperation in Observing Systems

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1. INTRODUCTION

Other speakers at this First AMS Conference on International Cooperation in the Atmospheric and Related Sciences and Services, a Symposium in honour of Richard E. Hallgren, have already described very well the history of international cooperation in meteorology, as well as expected future cooperation in data and services including satellite based systems, the oceans, and GEOSS.

In my contribution, I would like to focus particularly on the international exchange aspects of future international cooperation, touching on the exchange of surface-based observations, weather radar data, and the control and ownership of observing platforms and data.

2. HOW MUCH SURFACE-BASED OBSERVATIONAL DATA SHOULD BE EXCHANGED INTERNATIONALLY?

Historically, data have been exchanged internationally to enable other centres to carry out *synoptic* scale analyses and forecasts. Since the development of numerical weather prediction this has of course included regional or global numerical weather prediction. The agreed World Meteorological Organization (WMO) Regional Basic Synoptic Networks (RBSN) of surface stations from which observations should be internationally exchanged continue to be based on guidelines for spacing of stations which reflect, as is natural given the name, the *synoptic* scale.

In 1995, the 12th Congress of WMO adopted Resolution 40 regarding the international exchange of data and products. Annex 1 to the Resolution defines the “Data and Products to be Exchanged without Charge and With No Conditions on Use” .. the “essential data and products”. The preamble to Annex 1 states:

“*The purpose of this listing of meteorological and related data and products is to identify a* ***minimum set*** *[emphasis mine] of data and products which are essential to support WMO Programmes and which Members shall exchange without charge and with no conditions on use. The meteorological and related data and products which are essential to support WMO Programmes include, in general, the data from the RBSNs and as many data as possible that will assist in defining the state of the atmosphere at least on a scale of the order of 200 km in the horizontal and six to 12 hours in time.*”

The Annex then refers to six-hourly surface synoptic data from RBSNs. This is certainly a “minimum set”; in practice, many countries now internationally exchange surface synoptic observations more frequently than six hours, and at much higher resolution than “of the order of 200 km”, with or without placing conditions on their commercial use as “additional data” as allowed for under Resolution 40.

No matter what the policy, from a technical perspective, a horizontal scale of 200 km, and a time scale of 6 hours, no longer reflect what data is essential to be internationally exchanged to support WMO programmes. Global and regional models already run at much higher resolution than this, and with 4DVAR can make good use of more frequent observations.

The trend in global model resolution over the last 20 years, and expectations through to around 2020, are exemplified by figures for the European Centre for Medium Range Weather Forecasting (ECMWF) in Fig. 1. The horizontal resolution of the ECMWF atmospheric deterministic model in spectral terms was T105 in 1985 (effectively a horizontal grid spacing of 190 km). By 2006 the grid spacing had improved to 25 km. The ECMWF strategic plan 2006-2015 calls for a spacing of 16 km in 2010 and 10 km by 2015.

The rather good trend-line fit in Fig. 1 implies that the horizontal grid spacing of the ECMWF model halves every seven years. Extrapolation of that trend would have ECMWF introducing a global deterministic model with a grid spacing of about 6 km around 2020 (and probably an Ensemble Prediction System with a spacing around twice that).

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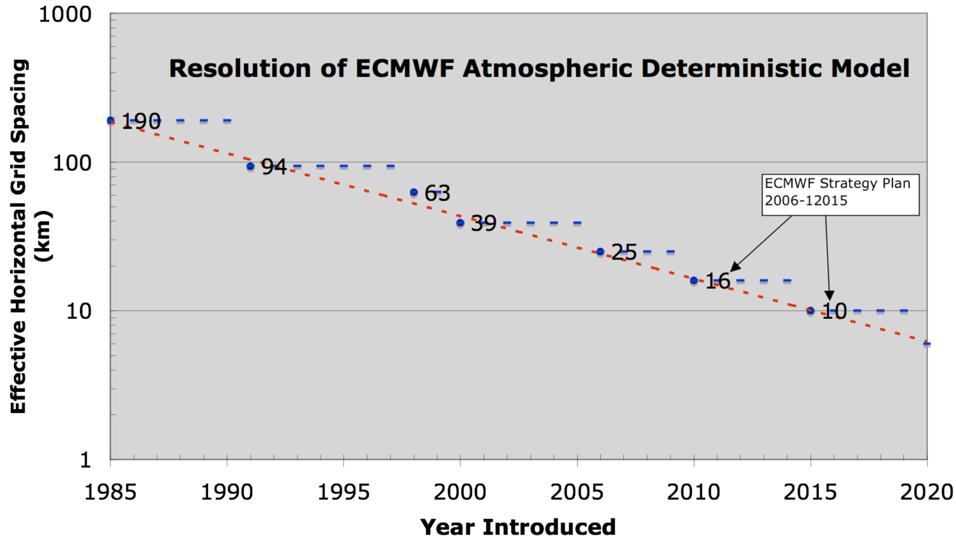

Fig. 1. Resolution of the ECMWF atmospheric deterministic model from 1985 through to 2006, with plans for 2010 and 2015, and extrapolation to 2020.

This has many implications for the international exchange of surface-based observations. Global models will be able to benefit from using observations with much greater spatial and temporal resolution than current RBSN definitions, and we should ensure that there are no technical and policy barriers to allowing this, so that all nations can benefit from the resulting improved regional and global prediction models.

3. WEATHER RADAR DATA INTERNATIONAL EXCHANGE AND ASSIMILATION

In the past, weather radars have primarily been thought to be of use for only local and regional applications, but this view is rapidly changing as the speed of telecommunications allows large amounts of data to be transferred.

Furthermore, the improved resolution of numerical models, as well as advances in data assimilation, make it feasible to assimilate both reflectivity information and (if available) single doppler wind components. For example, Benjamin *et al* (2008) report that as of around now (January 2008) the operational RUC, running at a horizontal resolution of 13 km over North America, will be operationally assimilating 3D weather radar reflectivity data.

Global models are rapidly approaching resolutions where assimilation of weather radar data will be of benefit. As with surface-based data, we need to ensure that systems and policies are in place to enable the free and unrestricted international exchange of such data.

One example of regional international exchange is that in Europe, where weather radar data has been exchanged for many years, starting with the initial planning of the COST-72 project in the early 1980s. The current OPERA-3 programme (Operational Programme for the Exchange of weather Radar information) is the Weather Radar programme of EUMETNET, the Network of the European Meteorological Services. Such programmes lay the groundwork for international data exchange issues including formatting, calibration and quality control, and will lead to their use in numerical models as well as in more traditional ways.

4. CONTROL AND OWNERSHIP OF DATA AND PLATFORMS

We have been used to control and ownership of (atmospheric) observing systems and data by National Meteorological and Hydrological Services, and subsequent international exchange. The situation is changing, in part because of the increasing multidisciplinary nature of systems. But a key driving force is also the desire to be opportunistic and take advantage of third party observations, as well as opportunities for using platforms operated by others.

Since the dawn of international meteorology we have of course relied on ships, and the Voluntary Observing Ship programme arranged under WMO auspices, to provide observations at sea. NMSs have no control over the ships and their routes.

The aviation counterpart to this is the AMDAR Programme, operated through the WMO AMDAR Panel. Fig. 2 provides an example of the global coverage of such reports now achieved.

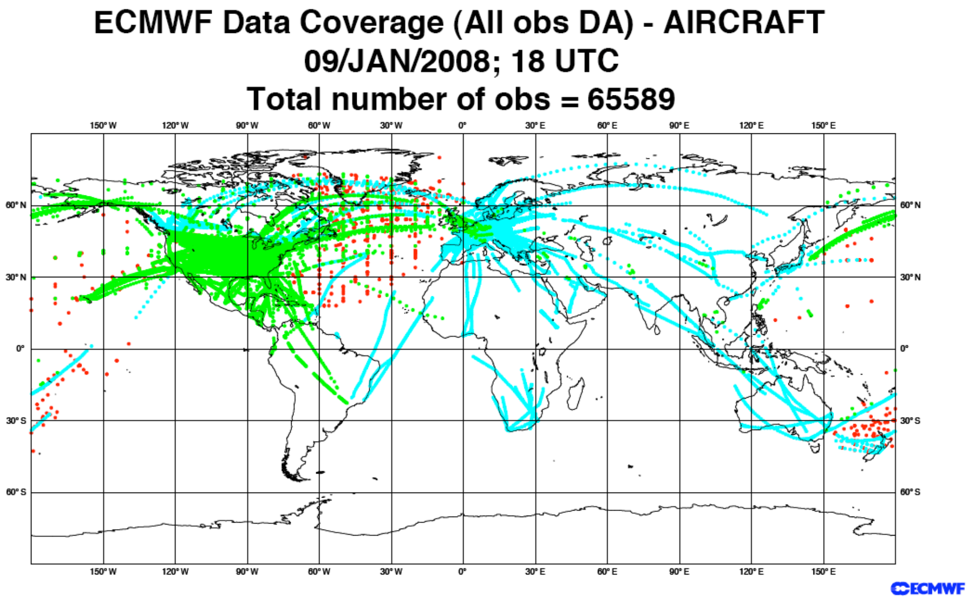

Fig. 2. Sample ECMWF monitoring results for aircraft observations (almost all automated) for a six hour period in January 2008.

The AMDAR Programme has been a highly successful international cooperative effort, with a significant positive impact on numerical weather prediction as reported by, for example, Cardinali *et al*, (2003). But it relies on platforms and communications and onboard systems operated by airlines and other parties. Fortunately they are very cooperative third parties, who share an interest in better global weather (and climate) monitoring and improved predictions. However, there can be interesting issues around data ownership and commercial sensitivity which complicate the international exchange of information. At least the situation for international exchange in the context of Resolution 40 is very clear; Annex 1 states that essential data include *"All available aircraft reports, e.g. data in AMDAR, AIREP codes, etc.*". Ongoing future expansion of the AMDAR Programme will need to take account of this.

5. CONCLUSIONS

Fundamental to past and future international cooperation in meteorology is the free and unrestricted international exchange of observational data. The horizontal grid spacing of global models such as the ECMWF deterministic system is halving every seven years. International data exchange systems and policies will need to cope with the future global availability of data which formerly was only relevant and useful only at local or sub-regional level, including weather radar data, as well as increasing amounts of data which are provided by or owned by third parties rather than government bodies.

6. REFERENCES

Benjamin, S., et al, 2008: *Implementation of the radar-enhanced RUC.* Paper 6.2, 13th Conference on Aviation, Range and Aerospace Meteorology, New Orleans.

Cardinali, C., Isaksen, L., and E. Andersson, 2003: Use and Impact of Automated Aircraft Data in a Global 4DVAR Data Assimilation System. *Mon. Wea. Rev.,* **131**, 1865-1877.