THE CURRENT STATUS OF SHORT-RANGE NWP OPERATIONAL SYSTEM AND THE PLAN FOR DEVELOPING MEDIUM-RANGE NWP OPERATIONAL SYSTEM IN CHINA

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1. Introduction

This paper briefly describes the current status of the short-range NWP operational system in Beijing Meteorological Center (BMC). The data auto-collect and processing system for provincial use and the plan for developing medium-range NWP operational system are also addressed.

The short-range NWP system has been operated in BMC since Jan, 1980. Its products serve as the essential tools for helping the local forecasters to make forecasts. But either types or qualities of its products can not meet the raising demands of developing national economy. This system will be replaced by a new medium-range NWP operational system discussed in section 4 of this paper.

Section 2 of this paper describes the auto-collect and processing system for provincial use. It provides a new important tool for provincial weather forecast offices. Various meteorological data and guidance forecasts transferred from BMC are quickly available in the local weather forecast offices by means of this system.

2. Outline of the current short-range NWP operational system

The limited area 3-level primitive equation model was the earlist one in operational run in Nov. 1979 in BMC. In Feb. 1982, it was replaced by the 5-level northern hemispheric primitive equation model (5L-NHM). In Aug. 1983 the 5-level limited area primitive equation model (5L-LFM) was added to the short-range NWP operational system. Up to now, the above-mentioned two models are still running at the BQS (Beijing Telecommunica- tion Hub) system discussed as follows:

2.1 The BQS system

The BQS system established in Jan. 1980 consists of three computers, i.e., two M-160 and one M-170 made in Japan. The computers M-160 with a dual-computer configuration are an on-line and real-time computer system connected with other communication centers at home and abroad through its 128 circuits. The advanced high speed transmission with 9600 bits per second, on Beijing-Tokyo and Beijing-Offenbach international meteorological circuits, became operational in 1984 and 1982 respectively. About 10 MB meteorological messages are collected and about 100 MB messages are switched continuously day and night. The information after data-collection processing and chart-preparation is then transferred to the computer M-170 via CTCA (channel-to-channel adapter).

The computer M-170 is used mainly for performing the short-range NWP operational system and automatic plotting. The further improvement of the short-range system is limited by the current capacity of the computer system. By 1990, BMC plans to obtain some larger computers and to set up a medium and high speed data transmission network to replace the BQS system.

Table.1. Specification of the operational objective analysis

Model	5L-NHM	5L-LFM
Coordinate	p-σ mixed	σ
Area	Northern hemishpere	Asia and Western Pacific
Grid length	381 km	190.5 km
Number of grid points	51*51	37*45
Analysis time	12 GMT	00 GMT
Analysis method	successive correction	same
Cut-off time	6.5 hours after map time	5 hours after map time
Levels and elements	surface: P,T,T-Td,U,V 850,700,500hpa: Z,T-Td,U,V 300,200,100hpa: Z,U,V	same
Initialization	no	no

Table.2. Daily operational timetable (GMT)

Model	5L-NHM (12 GMT)	5L-LFM (00 GMT)
Data time	09:00--15:00	21:00--03:00
Decoding	18:02--18:27	04:32--04:56
Analysis	18:27--18:54	04:56--05:18
Plotting	18:54--19:06	/
Forecast	19:06--21:02	05:18--06:48
Plotting	21:02--21:12	06:49--06:51
Grid-code	21:12--21:22	06:51--06:52
Mos	21:22--21:27	/
Saving	21:27--21:36	06:52--06:54
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Run-time	3 h 34 m	2 h 22 m

2.2 The current short-range NWP operational system

The current short-range NWP operational system including decording, objective analysis, 5L-NHM model, 5L-LFM model and MOS prediction sub-system has been running at the computer M-170. Successive corrective analysis method is used for the objective analysis. Before analysis the data must be checked up, which includes extreme value check, radiosonde freezing check, hydrostatice check and vertical stability check. Table 1 shows the main specification of operational objective analysis. Physical processes taken into account in two models include friction, turbulent vertical transports of momentum, horizontal diffusion of momentum and heat, and large-scale condensation. The cumulus convection is added only in 5L-LFM.

Both the 5L-NHM model and the 5L-LFM model have been performing operationally once a day at 12 GMT and 00 GMT respectively. Daily operational timetable is given in table 2. The analyzed and predicted results are disseminated automatically to the local meteorological offices in China in the form of facsimile and grid codes via the national meteorological telecommunication links and local telecommunication links.

2.3 Products

There are 87 kinds of forecast and analysis chart produced by the 5L-NHM, the 5L-LFM models and MOS sub-system. These charts including geopotential hight, temperature, thickness, sea surface pressure, the dynamic and thermal diagnostic parameters, such as relative vorticity, vertical velocity, divergence, moisture flux, potential pseudo-equivalent temperature, dew-point deficit etc. are also transferred to the local weather stations.The large-scale flow for 24-72 hr is made by 5L-NHM model. The 5L-LFM model makes 24 hr and 36 hr precipitation forecasts. ALL the products have been used widely by local forecasters working throughout 29 provinces and 260 districts.

3. The auto-collect and processing system

BMC is testing an auto-collect and processing system for provincial use. It will be equipped at some provincial weather forecast offices. This system will make all the forecasting products and meteorological data transterred from BMC available much faster at the provincial weather forecast offices. And then it can also transfer the local products to the weather stations via the local micro-computer network. This system can handle following tasks:

(1) Collecting various meteorological data from BQS system, timely and reliably with the micro-computer switching system
(2) Editing, archiving and processing the meteorological data and producing some specific local data bases.
(3) Receiving and displaying processed graphic data made by BMC partly instead of facsimiles transferred from BMC.
(4) Making local forecasts with the implementation from the local data bases.
(5) Disseminating the local forecasts and other meteorological data according to the requirements from weather stations.

This system is being developed as a modern meteorological facility, connecting the provincial weather forecast offices with BMC and the local weather stations within its own region. The forecast method and the information exchange between BMC and provincial weather offices will be realized objectively as well as automatically.

4. The project of developing medium-range NWP system

It is getting clear that the current short-range NWP operational system can not meet the requirements of the developing economy in China. Therefore a plan for establishing a new medium-range NWP system has been studied.

4.1 Components of the new medium-range system

The new system shown in Fig 1, consists of 9 sub-systems including operational watch, data acquisition, pre-processing, four-dimension assimulation system, forecast model, post-processing system, dissemination, archive/retrieve on the various bases and man-computer interaction. The main tasks are as follows:

(1) Collecting data from GTS and NTS, then pre-processing, assimulating the meteorological data in order to provide the initial fields for the forecast model.
(2) Running the global spectral model, the limited area fine mesh model and meso-scale model to make forecasts for 4-10 days, 1-3 days, and nowcasting respectively.
(3) Archiving, retrieving, disseminating various data and products.
(4) Making weather element forecasts by means of MOS or PP techniques.

In order to ensure the main tasks to be finished in time, we have been learning the advanced techniques from the developed countries. The specialists and scientists throughout China now are invited to take part in the associated research projects.

4.2 Establishing a distributed local computer network system.

The planing system is based on a new computer network system including one super computer and two large computers together with the other computer systems such as the BQS system (M-160, M-170), the new data telecommunication system, the climatological data processing system (M-360) and the satellite data processing system (IBM-4381). It will form a distributed computer system.

The super computer will be dedicated mainly to the objective analysis, four-dimensional assimulation and forecast model. The mean processing capability of the super computer should be equivalent to the level of Cray X-MP/24 and should have at least 4 MW memory (each word equals 64 bits) and expandable up to 8 MW.

As the front-end computers for the super computer, the two large computers are oriented to data reception, pre-processing, graphic-handling, real-time data base, and superviser control for operational NWP system. The CPUs run above 10 MIPs and each main memory capacity is 4 MW.

4.3 The experimental medium-range NWP system design and further plans

According to the present computer capability in BMC, an experimental version of the medium-range NWP system executed on the computer M-360 has been developed ahead of the new computer system, including 7 parts i.e., data base, pre-analysis, objective analysis, initialization, prediction, post-processing, and verification.

In recent years, the mediun-range NWP forecast has been developed rapidly and has made a remarkable progress. The advanced technique of medium-range NWP system has been applied partly to the new experimental system as much as possible. A hemispheric spectral model with 9 levels in vertical (T42 L9) based on an earlier version of ECMWF spectral model (T42 L15) has

been tested at the M-360 computer. The three-dimensional multi-variate optimum interpolation method for the objective analysis, the nonlinear normal mode method for the initialization as well as some important physical parameterization including the horizontal and vertical diffusion, Kuo's cumulus convection scheme, ground surface temperature and the topography treatment are considered.

At present, each of them mentioned above is being tested separately with FGGE data on M-360 computer. Early next year these 7 parts will be connected with each other for making 4 day prediction test with real-time data on M-360 computer.

The present experimental mediun-range system is the preparation for further developing global spectral model capable of 7-10 day forecast upon the capacity of the available computer source.

Now most excellent scientists and professors from universities and institutes inside China, such as the Beijing University, the Academy of Meteorological Science, the Institute of Atmospheric Physics (Academia Sinica) and BMC etc. are concentrating on this key project, meantime it is essential to further develop the extensive co-operation between China and the developed countries.

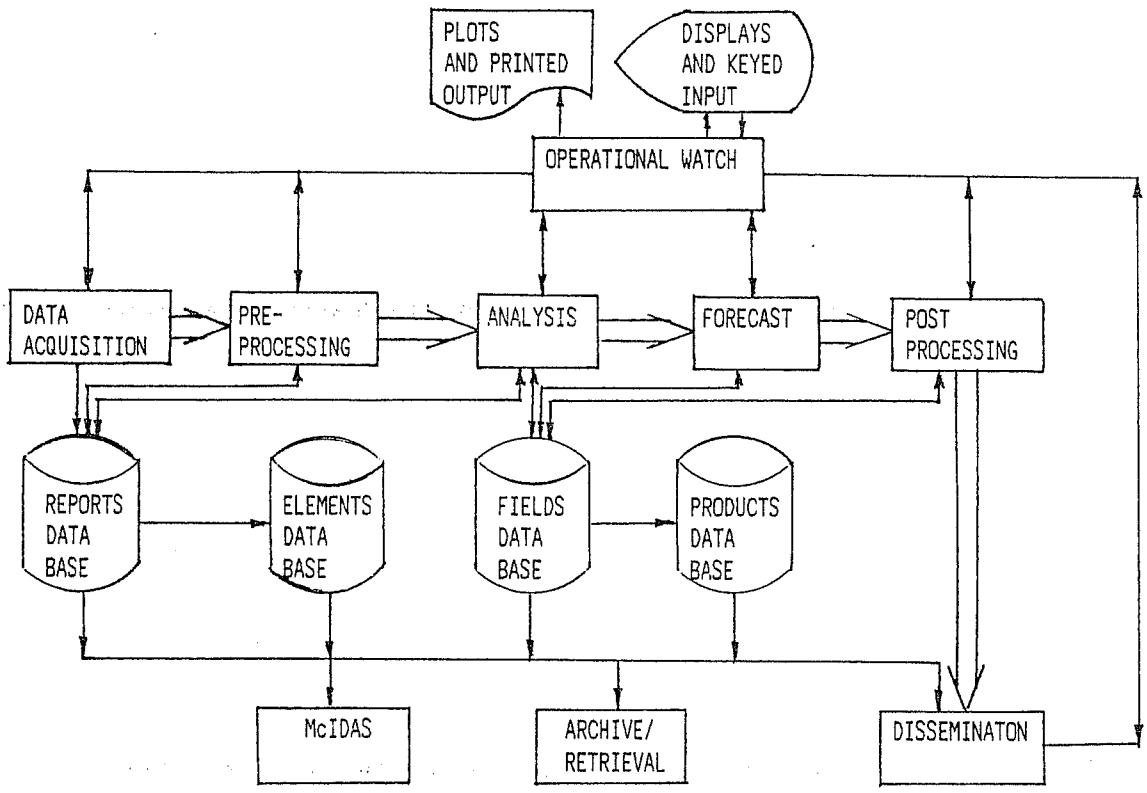

FIG.1 THE MEDIUM-RANGE NWP OPERATIONAL SYSTEM