

Overview of Current Status of Operational Database and Archive Systems for NWP of NMC/CMA

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Abstract

Basic information on the operation database and the archive system for Numerical Weather Prediction (NWP) of National Meteorological Center / Chinese Meteorological Administration is given in this paper. And the new generation real-time database system using the commercial database system (SYBASE) in data management is also introduced briefly. Real-time experimental run of the new generation database system shows the commercial database system could be applied in real-time meteorological data management, however, relatively powerful computer is required.

1. Real-time database system

1.1 Basic information

Fig.1 shows the data flow for NWP systems of NMC/CMA. It is clear that the database and archiving are important components of the operation NWP system, as they conduct data management in an efficient manner. Real-time meteorological database of NMC/CMA is mainly served for NWP operational system, short- and medium-range weather forecasts of the NMC and regional meteorological offices /CMA. It processes and classifies all real-time data from GTS and NTS. Currently, the real-time database system consists of five sub-databases, weather bulletin database, element database, field database (NWP data from NMC/CMA as well as from ECMWF, NCEP, and JMA by GTS), typhoon database and precipitation database.

The real-time database system that is used currently in NMC/CMA is the second generation, and its data processing flow could be sketched in Fig. 2. It was developed in 1990 on the VAX6320 computer using *index file management method* supported by the VMS operation system and was put into operation in late 1991. Since Jan. of 1998, this system has been moved onto Alpha4000 computer, which has the same operation system as VAX6320 but run 7-8 times faster than VAX6320, with minor changes of the codes. WMO suggested standard compress formats, BUFR and GRIB, are used in the inner storage of databases. Each database is archived with magnetic tapes, after fixed time period (e.g. 3days, 11days, and 6days for weather bulletin database, element database, and field database, respectively).

1.2 NWP field database

The NWP field database is one part of real-time database system. In the past 9

years, NWP field databases were developed for NMC's global model (i.e., T42L9, T63L16 and T106L19) and limited area model (LAFS and HLAFS models) on different computers, such as M-360, VAX, CYBER, YH-2 and CRAY-J90, associated with the upgrade of operational models and computer system. It has been on CRAY-J90 since 1995.

Different from the file structure of database on other computer flats, the direct read and write of file structure is used for creating the NWP database on CRAY-J90. There are two parts in the structure of NWP database, namely, *an index file* that gives the read/write pointers, clean pointer, formation date and time etc. *and several data files* that consist of index area and data area (see Fig. 3 and Table 1). The design of the NWP field database makes it easy to resize and transplant.

Table 1 Contents in index area of a data file

Control information	Formation date	
	Address of index area	
	Write point of index area	
	Address of data area	
	Write point of data area	
	Length of data file	
	Number of entries in index area	
Data information	Entry 1	Forecasting hours
		Variable name
		Level
		Address of data area
	Entry 2

1.3 New generation of real-time database

The new generation of real-time database system is one component of the Meteorological Information Satellite Network System (MISNS) (Fig. 4) that is based on VSAT technology, satellite networks and computerized telecommunication techniques. The MISNS is composed of National Information Control Center (NICC), Regional Information Control Center (RICC), Provincial Information Control Center (PICC) and City level Information Management Systems (CIMS). All subsystems like satellite data transmission network, satellite voice network, satellite-based data broadcast network can be utilized in a comprehensive manner. The MISNS is responsible for data and products collection, and management within China.

1.3.1 Data management

Different from current operational database system, the commercial database system, SYBASE, is applied to develop the new generation real-time database system. The main advantages of using SYBASE rather than file management system are,

- (1) powerful in functions, managing many types of data that old generations could not manage, such as graphic and image data, and having more comfortable system interface and graphic interface for users;
- (2) easy in program coding, achieving powerful data management by directly using many basic tools available in SYBASE;
- (3) better in system's expansion and in compatibility.

1.3.2 Real-time experimental run

The new generation database system consists of three more sub-databases, graphic and image database, forecast products database, and management information database than operational one. And it has unified data structure and interface for all level (national, regional, provincial and prefectural) meteorological offices of CMA. This system can be run in flat forms of IBM RS/6000 series, Alpha 2000 and personal computers. After two-three year development, The new generation database system has been undergoing a real-time experimental run since Jan. of 1999.

According to the performance of real-time experimental run of the new generation database system, it is found that commercial database system, SYBASE, could be also applied in real-time meteorological data management (SYBASE has been used in climate data management for several years in NMC/CMA), and the new generation database system runs stable and reliable. However, few disadvantages are exposed, i.e., overhead of SYBASE is high, and data processing by using SYBASE under current computing resources is not very efficient since not only data searching but also data renewing (inserting and deleting etc.) of *huge amount* of meteorological data are required in the real-time database system. Therefore, relatively powerful computer is necessary for the new generation database system to reduce data processing time.

2. NWP archive system

2.1 Equipment

Since 1996, the NWP archive system of NMC/CMA has been established on Automated Cartridge System (ACS) driven by CRAY-J90 computer, and tape loading and unloading are done by a robot. There are two types of tape machine on ACS, 3490E TimberLine for CART tapes (storage capacity at 800MB/per tape) and SD3 RedWood for REDW tapes (three kinds of capacities, 10GB, 25GB and 50GB /per tape). The ACS also is used for file back-up of NWP system, and for data migration of CRAY-C92 etc.

2.2 Archive data flow

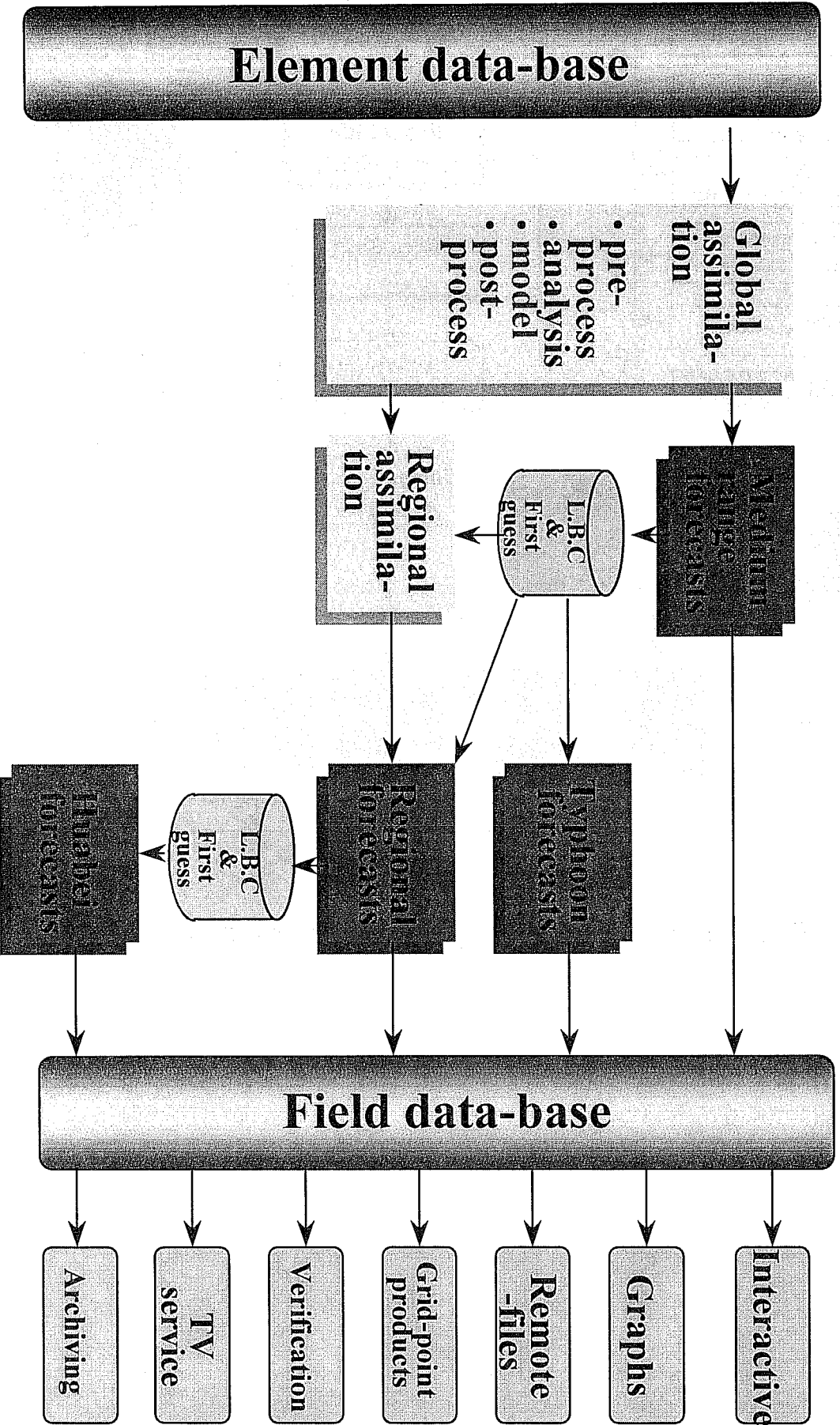
All data are collected to CRAY-J90 and classified into two categories, permanent and long-term storage (usually three years), before they are archived (see Fig. 5).

Table 2 List of main part of operational NWP archive data

Model	Grid database	Time (UTC)	Size (MB)	Data files
T106L19	Analysis	00,06,12,18	300	Processed observational data file for model analysis; spectral coefficients file; and special files for model etc.
	Prediction (1-10days)	12	500	
HLAFS	Analysis	00,06,12,18	25	Processed observational data file for model analysis; and special files for model etc.
	Prediction (1-60 hours)	00,12	26	
MTTP	Analysis	00,12	10	Processed observational data file for model analysis; typhoon track data file; and background field for typhoon bogus etc.
	Prediction (1-48 hours)	00,12	26	
Permanent storage				Long term storage

Fig. 1 The Structural Chart of the Operational NWP Systems

NMC, CMA



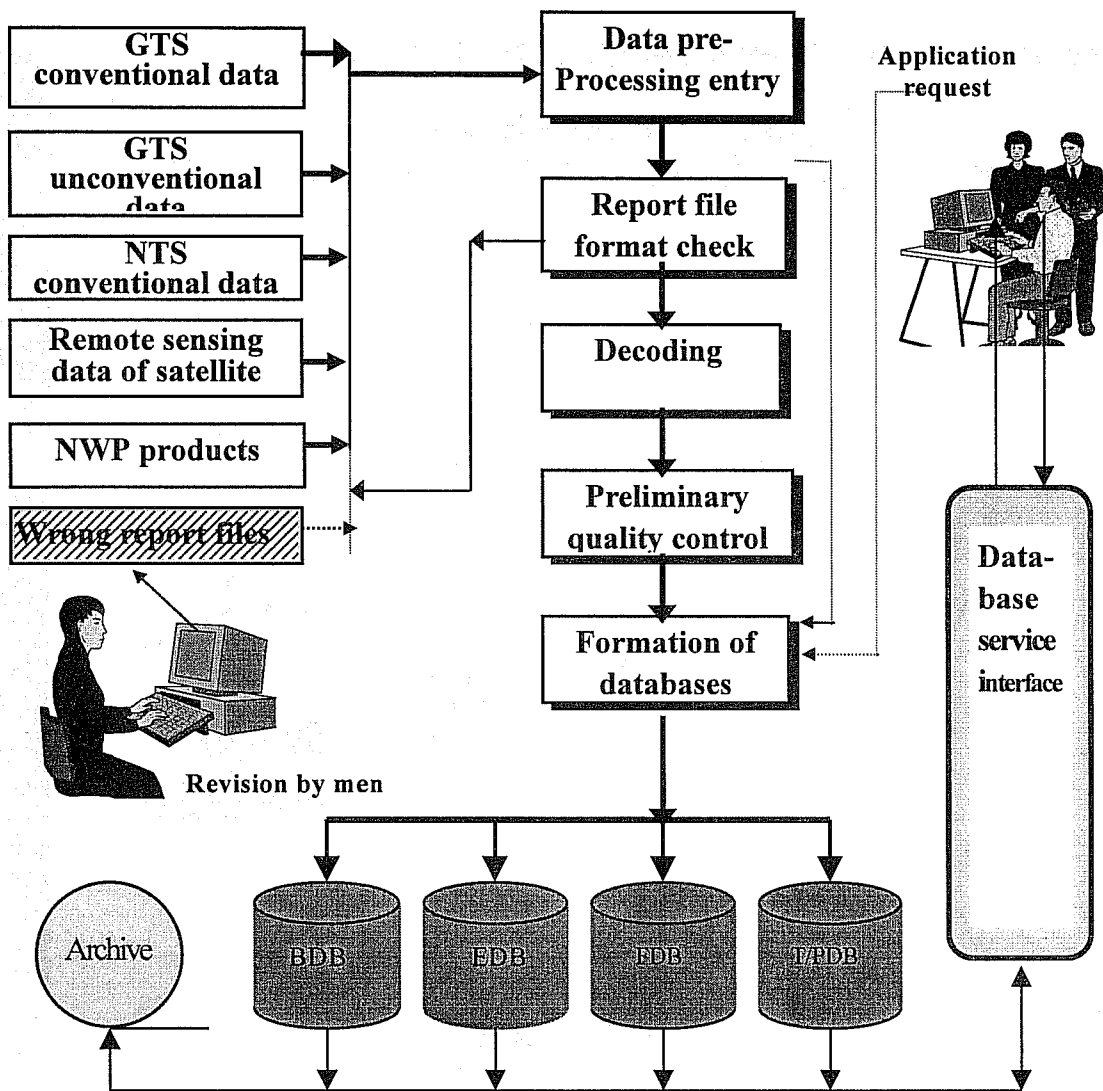
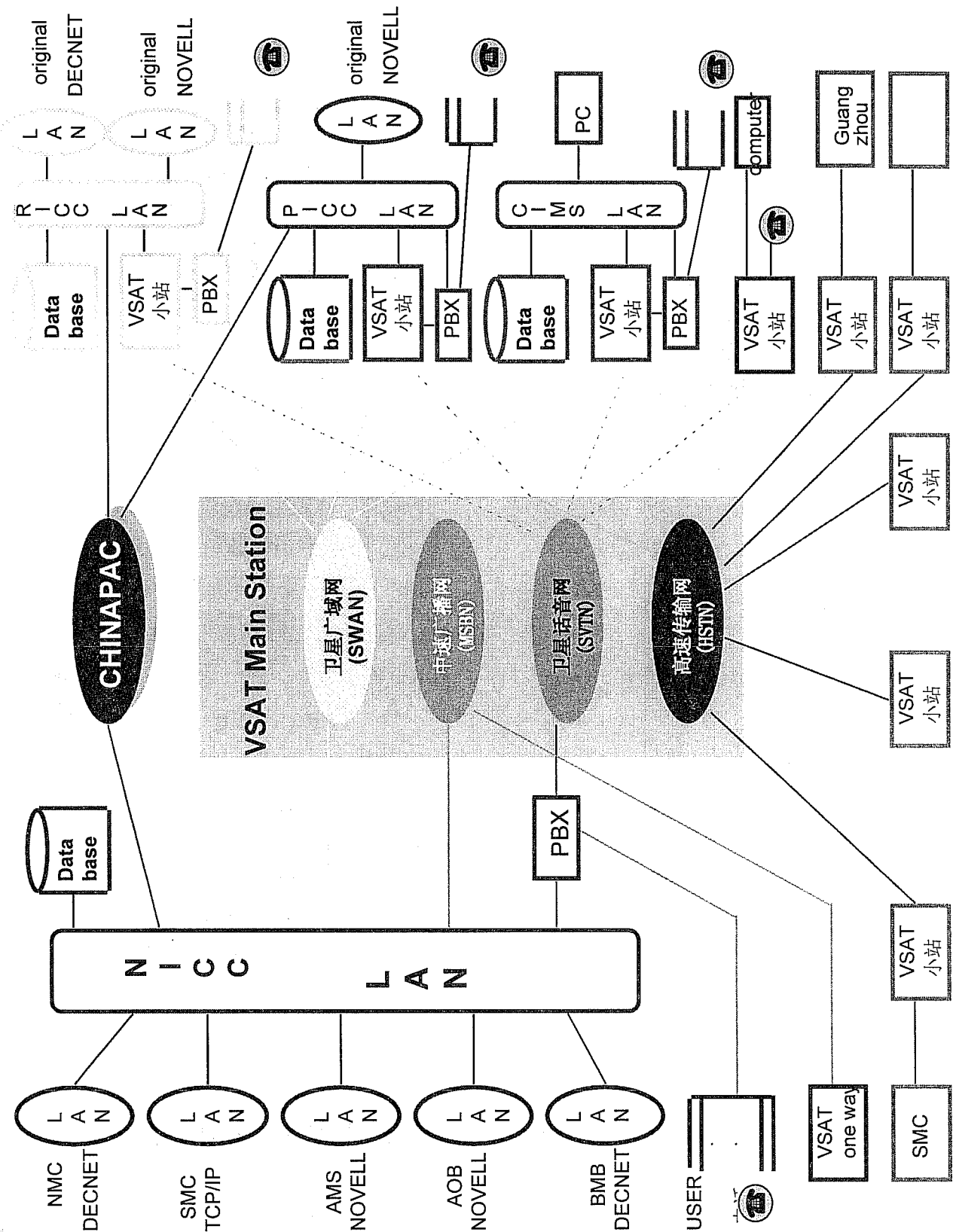


Fig.2 Flow chart of data processing for real-time database

Fig. 4 VSAT Network Structure



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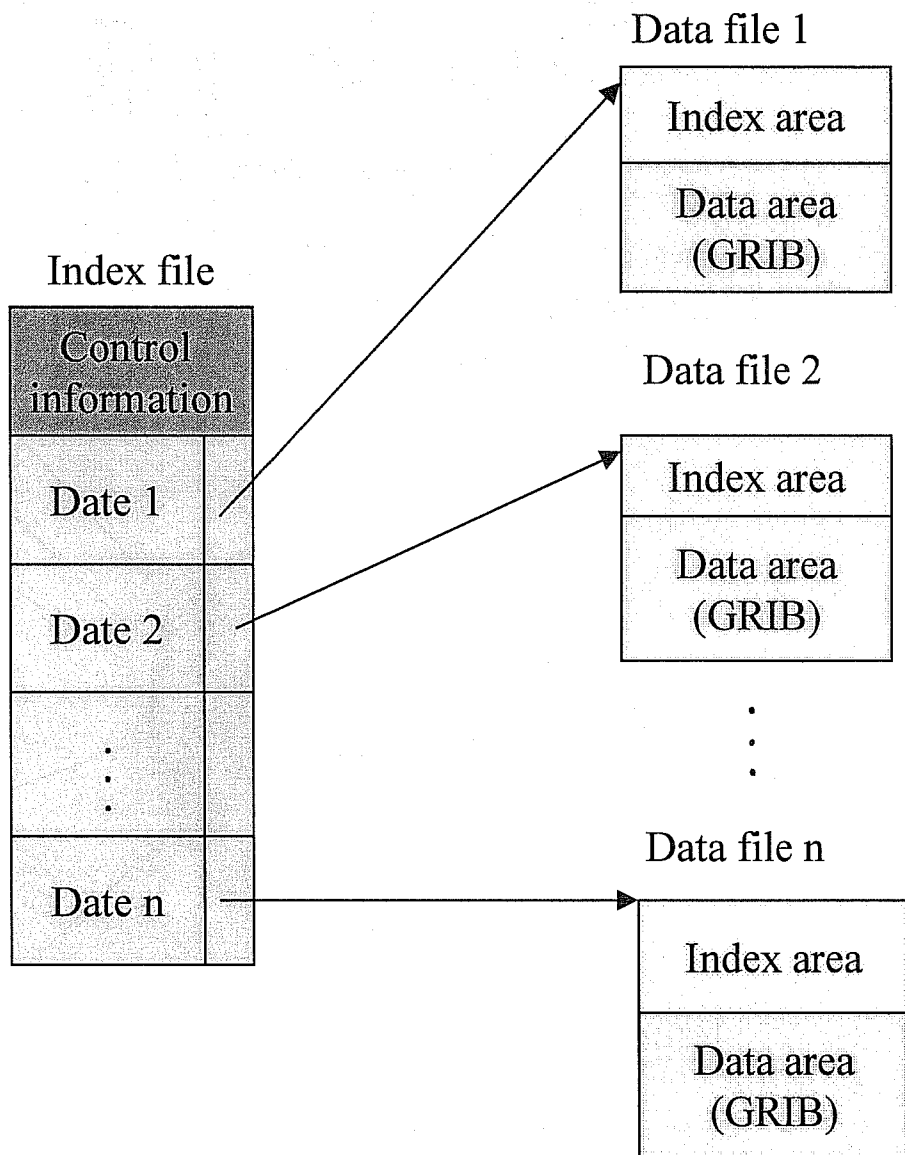


Fig. 3 Sketch map of structure of NWP field database

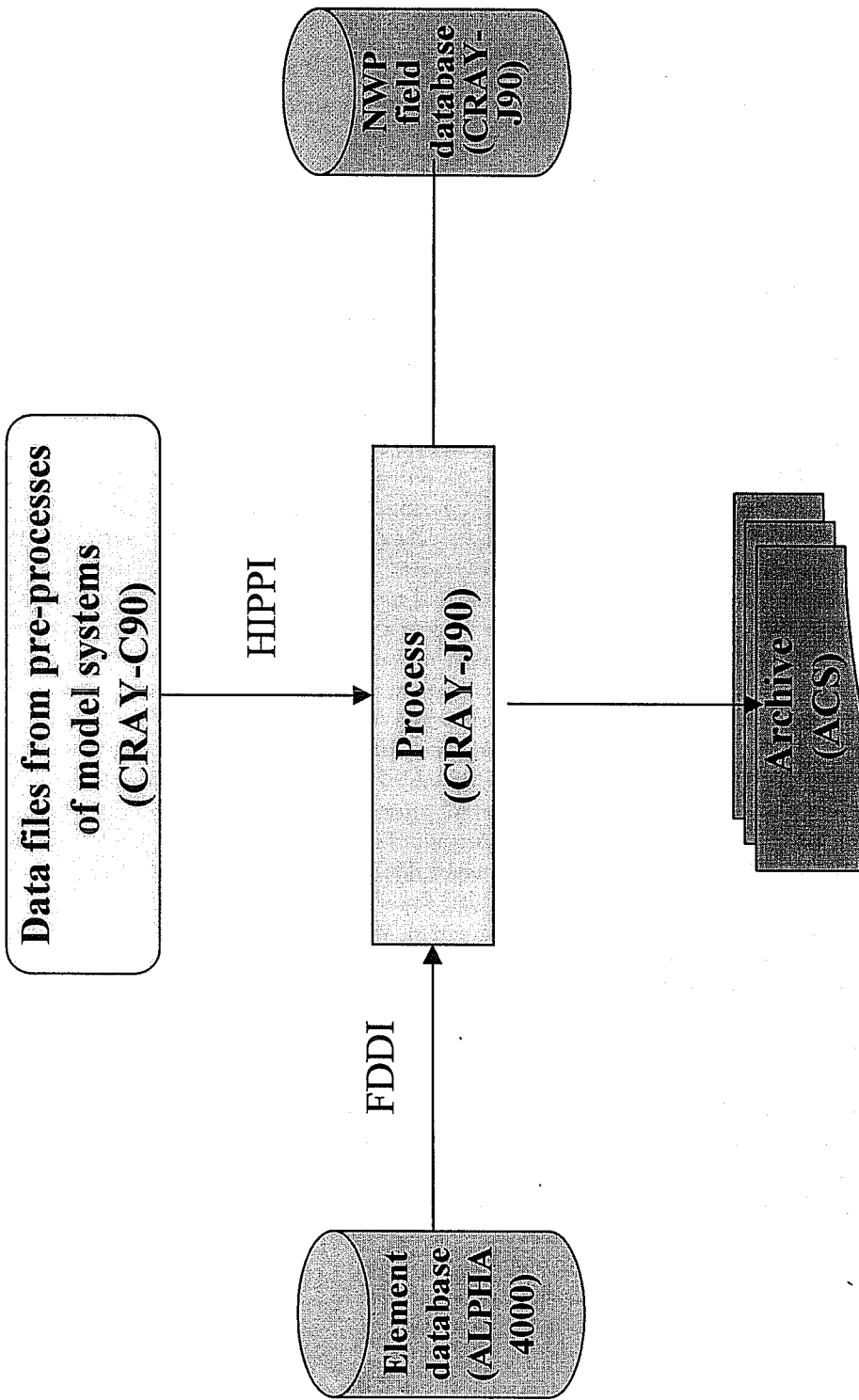


Fig. 5 Data flow for archive