L E T T E R S

551.509.13

THE WMO INFORMATION SYSTEM AT IMD PUNE: A GLOBAL METEOROLOGICAL INFORMATION SYSTEM

1.   WIS was designed to extend WMO Members' ability to collect and disseminate data and products. WIS provides an integrated approach suitable for all WMO Programmes to meet the requirements for routine collection and automated dissemination of observed data and products, as well as data Discovery, Access and Retrieval (DAR) services for all weather, climate, water and related data produced by centres and Member countries in the framework of any WMO Programme. It is being built upon the Global Telecommunication System (GTS) of WMO's World Weather Watch (WWW), using standard elements and at a pace feasible for all Members.

WIS is an enhanced information system capable of exchanging large data volumes, such as new ground and satellite based systems, finer resolutions in numerical weather prediction and hydrological models and their applications. These data and products are to be made available not only to National Meteorological and Hydrological Services (NMHSs), but also national disaster authorities engaged in disaster mitigation for more timely alerts and actions wherever and whenever needed. WIS is the vital data communications backbone integrating the diverse real-time and non-real-time high priority data sets, regardless of location. Details about the WIS requirements, implementation plan, organizational arrangements and architecture and status implementation of GISCs etc can be seen on WMO website under the URL:http://www.wmo.int/pages/prog/www/WIS/.   The currently operational GISCs are Beijing, Exeter, Jeddah, Melbourne, Moscow, Offenbach, Seoul, Tokyo, Toulouse, Tehran, Washington and New Delhi. However, a brief about WIS, its implementation in IMD along with its salient features/ facilities have been discussed in the present article.

2.   WIS consists of three types of centres namely (GISC, DCPC, NC) and a communications network (comprising of managed, regional and internet networks) as shown in Fig. 1. The Global Information System Centres (GISCs) are connected by high speed dedicated networks allowing the rapid dissemination of information between GISCs. These centres collect and distribute the information available for global dissemination. The network connecting GISCs is known

TABLE 1

Functions of current Centres evolving as WIS centres

Current Centres	WIS Centres
NMHS	NC
RSMC	DCPC
WMC	DCPC and/or GISC
RTH	DCPC
RTH on MTN	DCPC and/or GISC
Others	NC and/or DCPC

as the "Core Network" of WIS and is based on the GTS Main Telecommunication Network (MTN) which has evolved under development initiative such as the Improved Main Telecommunication Network (IMTN) project that was completed in 2010. GISCs connect to centres within their area of responsibility by dedicated and public networks. This connectivity network is referred to as the GISC's "Area Meteorological Data Communication Network" (AMDCN) and includes using Regional Meteorological Telecommunication Networks (RMTNs) of the GTS and the Internet. This allows GISCs to distribute information to centres in their AMDCN from the global community as well as to collect and distribute information between centres in their AMDCN. GISCs also provide entry points, through unified portals and comprehensive metadata catalogues, for any request for data held within the WIS. The requests can be ad-hoc or via subscription services. GISCs are a new type of WMO centre providing these specialist functions and mostly are being offered by centres that functioned as World Meteorological Centres (WMCs) or major global analysis centres or Regional Telecommunication Hubs (RTHs) on the MTN as depicted in the Table 1.

As per the table, under WIS framework of WMO, RTH New Delhi acts as a DCPC in view of its long services rendered as a designated Regional Telecommunication Hub for the Global Telecommunication System (GTS) under the MTN. Its role is the collection and dissemination of meteorological data and products within its area of responsibility and also exchange of such data/products with other RTHs. There are eight DCPCs under the GISC New Delhi. The details are given in Fig. 2. Metadata of most of the centres are hosted on the present GISC. Other centres of MoES can also be brought under suitable category of WIS.
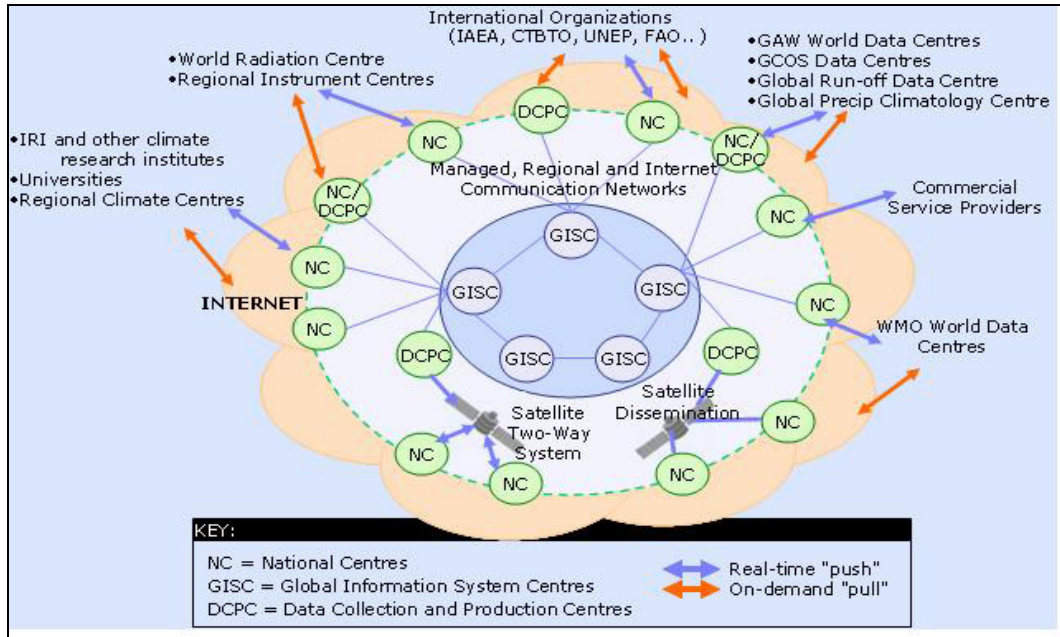
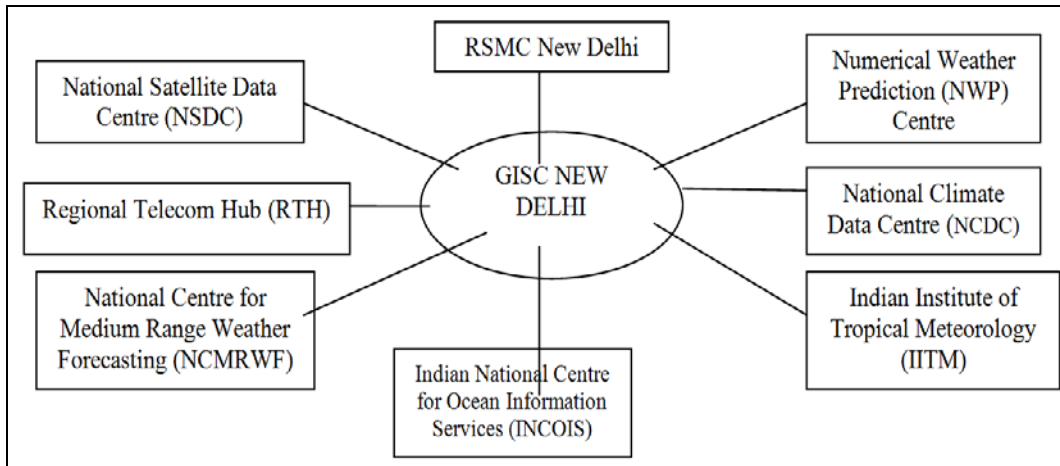**Fig. 1.** Three types of WIS centers and a communications network

Fig. 2. The DCPCs under the GISC New Delhi

The data centers are the heart of GISC. These data centres are mostly as per the existing functions in the World Weather Watch and other WMO programmers. Centres are categorized as either National Centres (NCs) or as Data Collection and Production Centres (DCPCs). The primary difference between NC and DCPC is the principal focus of a centre and its area of responsibility. If a centre has a national focus it is an NC, if it has a regional or global primary focus, then it is a DCPC. In general, NCs and DCPCs will be responsible for the collection and/or generation of sets of data, forecast products, processed or value-added information, and/or for providing archiving services. National Centers (NCs) will collect and distribute data on a national basis and will coordinate or authorize the use of the WIS by national users, normally under a policy established by the respective Permanent Representative with WMO. There are Seven NCs under the GISC New Delhi. The details are given in Fig. 3.

The WMO data representation formats, *i.e.,* Table Driven Code Forms (TDCFs) are used for real-time exchange of operational critical data, but the user can select from a wide variety of optional data representation formats.
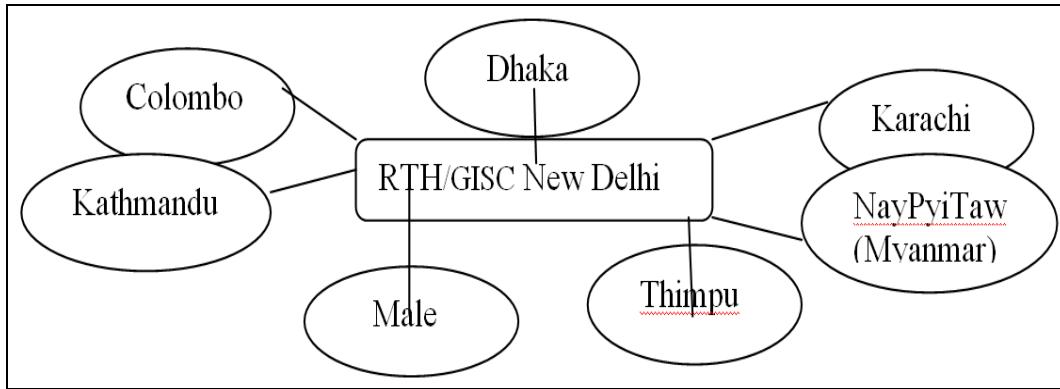
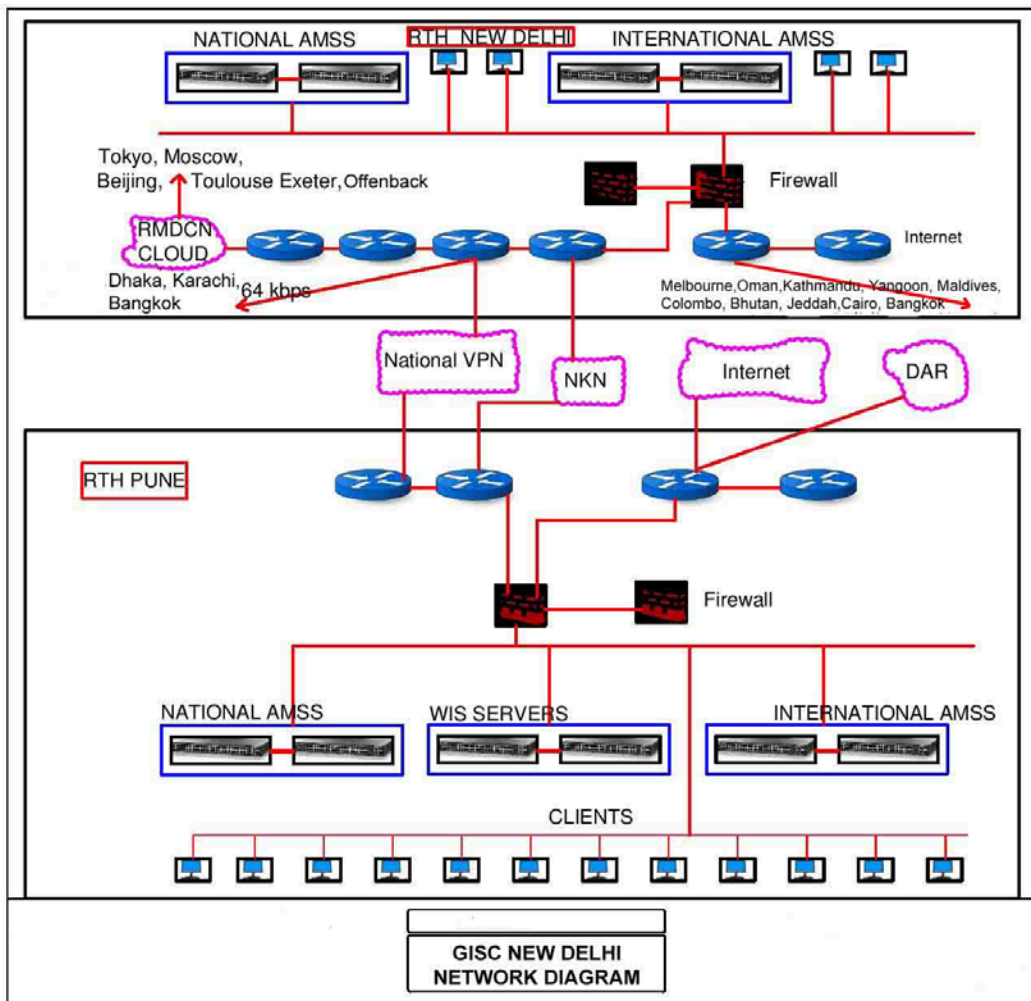**Fig. 3.** NCs under the RTH /GISC New Delhi

Fig. 4. System overview

3. India Meteorological Department (IMD) fulfills the required International roles, each designated as Global Information System Centre (GISC) or Data Collection or Production Centre (DCPC) duties within the framework of WMO Information Systems (WIS). GSIC New Delhi is one of the 15 GISCs from the approved WIS centres. Fujitsu PRIMERGY servers are installed to manage the GISC functionalities (two servers for GISC portal and

Fig. 5. The main page of MESSIR-WIS

four servers for GTS functionalities). All the servers are configured in hot standby redundant modes of operation for various functions (NMTC, RTH and GISC). Its primary role is to collect from and disseminate information to WIS centres in its area of responsibility through "Area Meteorological Data Communication Network" (AMDCN) and includes using Regional Meteorological Telecommunication Networks (RMTNs) of the GTS and the Internet. GISCs also provide search portals through which information from WMO and other interoperable systems can be discovered and accessed.

The RTH (mirror) has been implemented at Pune to provide swift recovery /backup of essential services in the event of outage of main RTH New Delhi system due to fire or natural disaster etc as per WIS guidelines of WMO. The mirror RTH consists of two Automatic Message Switching System (AMSS); one acting as a National AMSS and other as International AMSS, each configured in hot standby redundant mode of operation. The national AMSS manages collection and dissemination of data in India (NMTC functions). The International AMSS manages data exchange with all the international centres (RTH functions). The AMSS is the heart of meteorological telecommunication, the main functions are to receive, check and forward automatically, the meteorological data and products according to the WMO standards. The data received through national and international AMSS are fed into the GISC server through local area network (LAN). With AMSS, we interconnect our Meteorological sub-systems. It is able to handle more than hundred circuits at any practical speed through any standard communication protocol available at present. A hardware firewall has been implemented to safeguard the system from any intrusion/ attack/ hacking from outside

world. Cisco routers and switches are installed for interconnecting various subsystems, systems over LAN and outside over GTS, WAN and internet etc. GPS time server has been implemented for time synchronization of each system and sub-systems connected at NMTC. There are supervision terminals to manage the GISC /AMSS operation, error correction, manual data submission/ retrieval, metadata editing/ creation as well as for the purpose of system administration. There is a scope to accommodate upcoming latest requirements as well as WMO recommendations for communication over GTS in near future. The system overview is given in Fig. 4.

4.   The Mirror RTH and GISC are state of the art technology system installed at Pune, which run on the application software supplied by M/s Corobor, France. The Mirror RTH system (MESSIR-COMM has all the features /facilities available with RTH system (TRANSMET) of New Delhi as described by Singh (2010). The application software for GISC functionality is MESSIR-WIS. It is basically a metadata catalogue web service, giving access to meteorological metadata and allowing the download of the related data and products. It allows the synchronization of the metadata with other DCPCs, GISCs or NCs, based on the protocol OAI- PMH. It also allows creating and editing its own metadata. Each metadata in the MESSIR-WIS catalogue has its own settings for every privilege (or operation) allowed to each user profile. A user can only have one associated User Profile.

There are also User Groups in MESSIR-WIS. They may be created and managed by the Administrator and may correspond to any logical entity from the corresponding WIS centre's point of view. A user may

belong to one or more groups. The System Administrator has no separate group at all, as he belongs to all groups by definition.

Thus, each MESSIR-WIS user is allowed to perform those tasks on MESSIR-WIS (on the metadata and on the data) which are permitted by the combination of the corresponding User Profile and User Group(s).

The main page of MESSIR-WIS is obtained by entering the URL of the web service: http://wis.imd.gov.in. The main page is as shown in Fig. 5.

The system has following advanced features / facilities :

Registration Services **:** The MESSIR-WIS is configured to allow Self-Registration. It allows a Guest User to fill a registration request form. Both the Guest and the administrator receive an email with details about the registration request. The user cannot login before the validation of his account by the Administrator. The starred fields are mandatory. Except the username, all other values may be modified later by the user himself or well by an administrator. At least one Transmission Mode is mandatory at registration and requires an associated Protocol (e-mail or FTP) and a Format for the data to be sent (Individual Files, ZIP Archive or GTS Packing). The name may be any string, while the address must be a valid E-mail address or an existing ftp directory of any level, following the selected Protocol. These settings are used by MESSIR-WIS for both Subscriptions and GTS Data 'Send' functionalities.

Metadata catalogue service : The MESSIR-WIS has a metadata catalogue web service, giving access to meteorological metadata and allowing the download of the related data and products based on the policy defined by the centre. Each metadata in the MESSIR-WIS catalogue has its own settings for every privilege (or operation) allowed to each user profile. It also allows creating and editing the metadata. All the metadata for GTS data has been created as per Vol C1 of WMO catalogue, Metadata for any new data set/ product can be generated using the template provided for the purpose.

Metadata Synchronization : MESSIR-WIS allows the synchronization of the metadata with other DCPC, GISC or NCs, based on the protocol OAIPMH.

Search Data Service :   There are four different panels for metadata searching. Each of them returns a list of metadata corresponding to the search parameters and to the user privileges. The data are available to the user following the content of each metadata and the user group(s). Select the 'Search Data' panel to access the four Search Data sub-panels. Selecting one of them will bring the focus to the selected panel.

Each of the four panels of 'Search Data' contains a 'Search' button. Clicking this button will return a list of metadata in the Search Results list on right panel.

Simple Search : The 'Simple Search' panel allows searching for metadata by Keywords and/or Region and/or Category. By default, all available records are returned (depending only on the user privileges and metadata settings). Each control present on the panel acts as a filter for the request.

Advanced Search : The 'Advanced' Search panel allows searching for metadata by the Keywords and Data Presentation, Search accuracy, Region, Category and time.

Product Search : MESSIR-WIS allows defining a Product as keyword in a metadata. This mechanism allows the user to search the metadata catalogue for a given Product (or well for many Products at once). In the 'Product' Search panel, the user must select from one to many Products in the drop-down list (use Ctrl + Click for Multiple Selections). The 'Search' button will return all metadata having as keyword, the value defined for each of the selected Products.

GTS Data Search **:** Each metadata contains a link indicating the place where the described data is stored. This link usually allows the user getting the data. GTS Data must be available in the database (ODB) which is mainly managed by MESSIR-COMM (*i.e.*, RTH application). The GTS data is retrievable following its TTAAiiCCCC code, which must also be indicated in the metadata.

Additionally, there are several other features/ facilities available in the system which can be seen through the buttons available on the panel of the "Home" page of the WIS and are self explanatory.

5. There is a fundamental need within meteorology, oceanography, hydrology and climate for understanding past and present states of the environment. This requires the collection and open sharing of information. Installation of the GISC New Delhi   has given a thrust to achieve quick and reliable exchange of large volume of almost all data types, related data products and their widely available electronic (on-line) catalogue. Such catalogue is quite useful for rapidly integrating real-time and non-real-time (archive) data sets to better interpret weather events by the forecaster

resulting into timely issue/ dissemination of forecast and warning (if any) for public, print media and TV etc. The implementation of the system have taken the India Meteorological Department a step forward in the global meteorological community to fulfill the WIS telecommunication requirement for data exchange in south Asia and adjoining countries. It has put our country in one of the 15 approved WIS centres(global data information communication systems).

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