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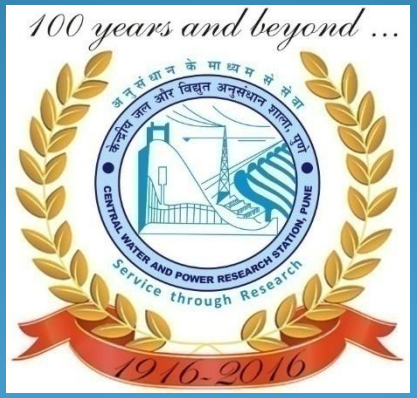
Decision Support System (DSS)



Dr. N.D. Atkekar
Scientist 'D'
CWPRS

The very essence of mankind is water. Fortunately in India we are blessed with abundant water in the form of visible and invisible sources of water.

Visible water is the one which is available in rivers, lakes, wells nalas etc. The invisible water is rain water and ground water.

The efficient management of both of these water is the need of the time. The tools like ‘Decision Support System’ are the effective mean for such application

Decision Support System Concept

❖The concepts involved in DSS were first articulated in the early 1970s by Scott Morton, who defined DSS as follows:“DSS means interactive computer-based systems, which help Decision Makers utilize Data and Models to solve Unstructured Problems.”

❖DSS has many applications in our day to day life. Simple decisions like going to office by public transport or private transport, putting our child in which school etc., we make use of DSS.

Decision Support System Concept

- DSS have also been used in integrating weather conditions and air traffic management, for optimizing reservoir operations, auditing health insurance claims, financial planning for small business and designing freight networks.

- Real estate investment companies typically use DSS to manage the day to day running of their businesses. With the advent of new technology like AI, Machine Learning, Big data Internet of Things etc, the DSS is becoming a smart tool for the decision makers.

DSS in Water Resources

- Knowledge of water resources helps planners make up-to-date and informed decisions on flood forecasting, water supply management, irrigation, hydro generation, as well as environmental monitoring and planning.

- Hydrometric observations coupled with real-time telemetry provide the basis for an objective analysis of water resources.

- The telemetry and real-time Decision Support Systems (DSSs) brings the data to life.

DSS in Water Resources

- A DSS provides the Water Management Authorities a well structured, user friendly, practical and complete water resources management information system .
- Decision Support System allows decision makers to analyze hydrologic data, run hydrologic simulation models, run basin water allocation models and study the effect of potential decisions.
- DSS is used to provide information about floods and potential hazards. It includes real-time weather conditions, local and data about floods, as well as historical data, floodplain boundaries and much more

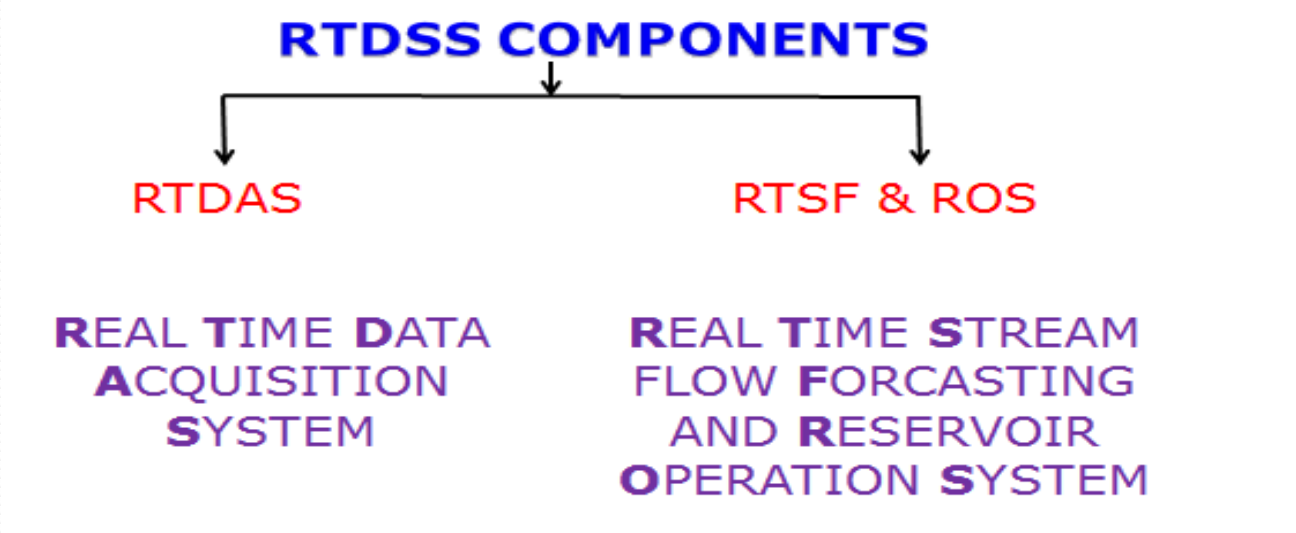
Applications of a DSS in Water Resources

- Seasonal reservoir planning
- Planning a new reservoir or transfer
- Reservoir sedimentation
- Drought management
- Combined management of reservoirs and water transfers
- Conjunctive use of surface and groundwater
- Groundwater recharge and over-exploitation
- Increased efficiency of water management in general including factor such as crop selection, canal seepage, reservoir operation and the competition between domestic, industrial and agricultural water demands
- Water quality management.

Components of DSS

The Real Time Decision Support System (RTDSS) in water resources scenario consists of broadly two components:-

- Rear Time Data Acquisition System (RTDAS)
- Real Time Stream Flow Forecasting and Reservoir Operation System (RTSFF & ROS).

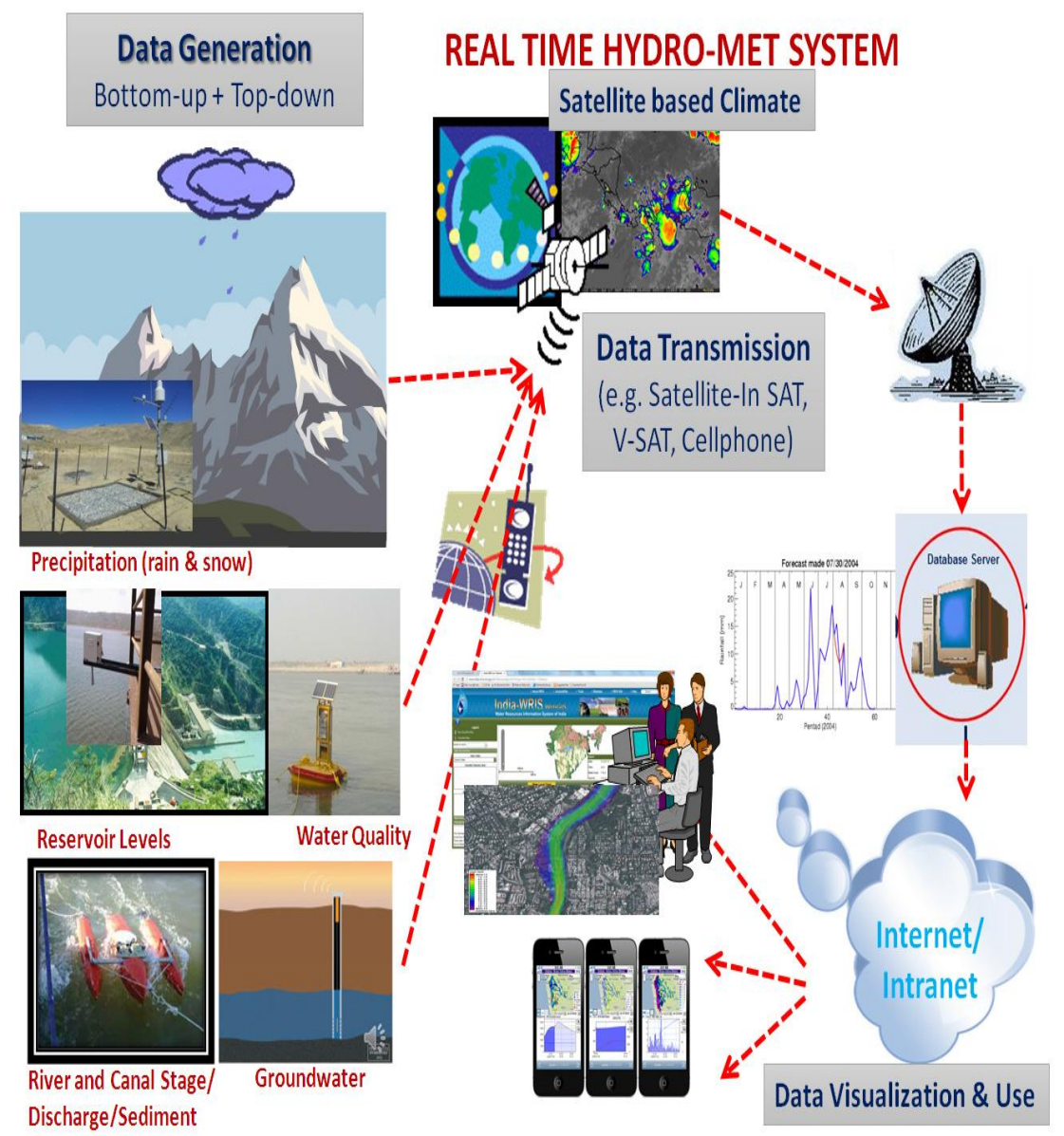


Real Time Data Acquisition System

The RTDAS consists of installation and commissioning of various automated sensors to record hydro-meteorological data and to transmit the data in real time via SATELITE or GPRS (General Packet Radio Service) communications as per the site conditions and appropriate to a data center.

A typical RTDAS consists of:

a) Sensors
b) Data collection platform
c) Telemetry
d) Data base Management



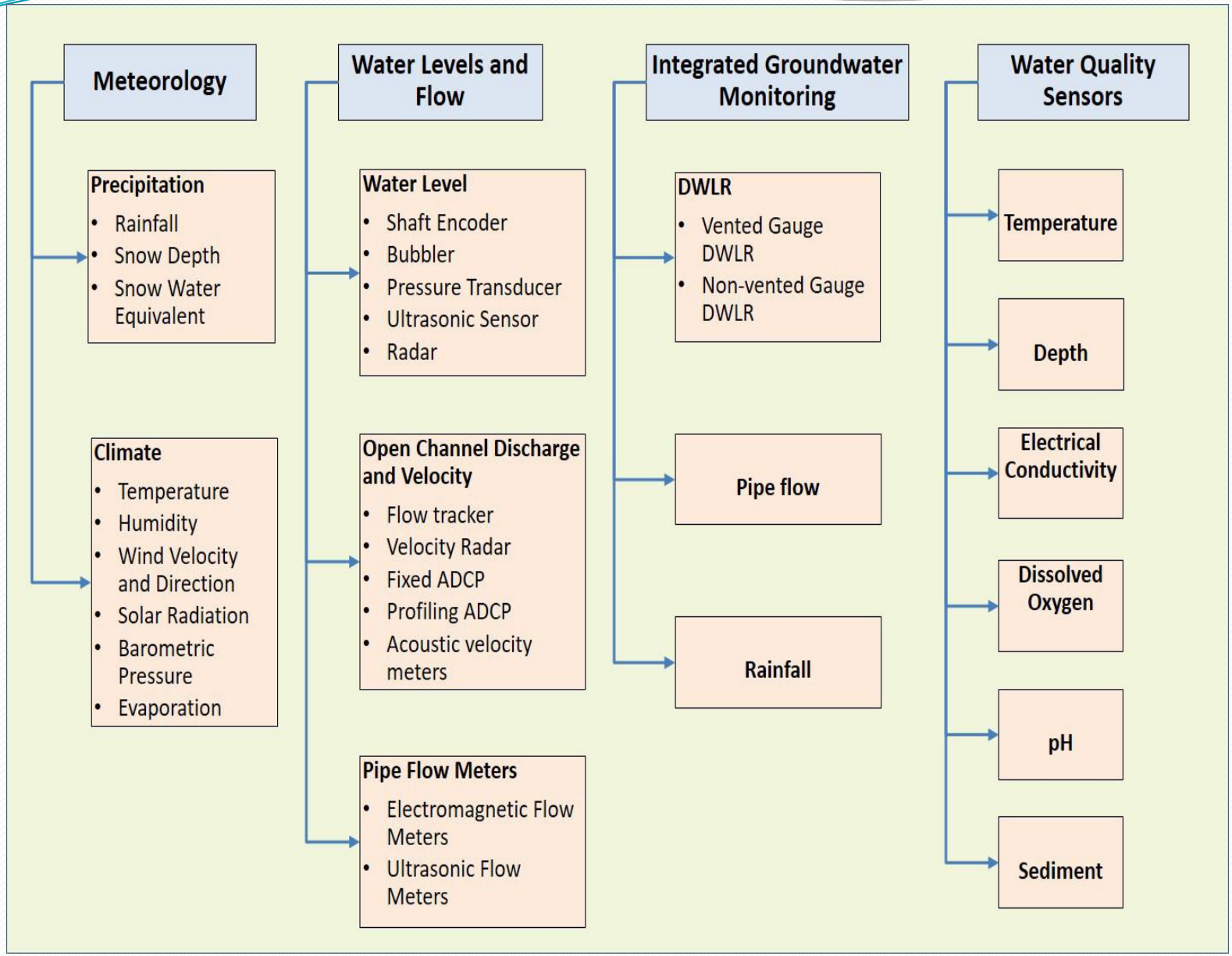
RTDAS System

Sensor

The sensors for DSS system would be provided for:

1. Meteorology: rainfall, snow and weather parameters.
2. Surface water measurement: stream flow water level and discharge water storage measurements (reservoir level and capacity).
3. Groundwater measurement: water level, and pipe flow.
4. Water quality: portable and laboratory equipment for water quality testing; sediment(turbidity and bed load movement)

Sensor


Meteorology
Precipitation
• Rainfall
• Snow Depth
• Snow Water Equivalent
Climate
• Temperature
• Humidity
• Wind Velocity and Direction
• Solar Radiation
• Barometric Pressure
• Evaporation
Water Levels and Flow
Water Level
• Shaft Encoder
• Bubbler
• Pressure Transducer
• Ultrasonic Sensor
• Radar
Open Channel Discharge and Velocity
• Flow tracker
• Velocity Radar
• Fixed ADCP
• Profiling ADCP
• Acoustic velocity meters
Pipe Flow Meters
• Electromagnetic Flow Meters
• Ultrasonic Flow Meters
Integrated Groundwater Monitoring
DWLR
• Vented Gauge DWLR
• Non-vented Gauge DWLR
Pipe flow
Rainfall
Water Quality Sensors
Temperature
Depth
Electrical Conductivity
Dissolved Oxygen
pH
Sediment

Data Collection Platform (DCP)

- This is the platform where the sensors are mounted. The DCP supplies power to various sensors, charges the battery using solar panels, stores the data in the data logger and provides protection to equipment from dust, water and theft.
- Most stations in a real-time network are required to run on battery power with solar charging due to the fact that stations are often located in areas of hydrologic significance, which is usually in the upper catchments of the basin.

Telemetry

- This device receives data from DCP (data logger) and transmits them to data centres via an appropriate telemetry method.
- The telemetry proposed under the project is based on technologies such as:
  - Global System for Mobile (GSM)/ General Packet Radio Service (GPRS)
  - Indian National Satellite System (INSAT)
  - Very Small Aperture Terminal (VSAT).

Data Base Management System

- This system is installed at the data center and receives the data from telemetry devices.
- The data are then checked for quality and consistency, stored in a structured format, and made available to stakeholders by different means.
- This section shares information about the national database management software
  E- SWIS which is already available for all CWC agencies.

Real Time Stream Flow Forecasting and Reservoir Operation system (RTSFF&ROS)

- The important inputs to the DSS system are historical data, real time data and forecast data. Based on these inputs DSS system works for modelling, analysis and stream flow forecasting.
- RTSFF&ROS help us in the daily operation of the real time forecasting with the help of hydraulic modelling software.
- Commonly used software for Hydraulic modelling are HEC-RAS, Mike 11, Mike Flood etc.

RTSFF & ROS

- River bathymetry, river water levels and discharge, reservoir water levels and discharge, gate positions, rainfall, air temperature, soil moisture, wind speed and direction, relative humidity are some of the important inputs to
- Traditionally, rule curves are used to specify reservoir releases according to the current reservoir level, hydrological conditions, water demands and time of the year.
- Now RTSF&ROS provides the information to efficiently operate the reservoirs

RTSFF & ROS

- With the help of inflow forecast, RTSF&ROS gives guidance to the Reservoir Operation System. ROS involves domestic water use, industrial water use, irrigation, flood control, hydropower generation and navigation.
- RTSF&ROS system is basically a knowledge based system that uses weather data, forecast data, manual and RTDAS inputs, satellite data.
- One has to calibrate RTSF &ROS model to forecast river flows in upstream of reservoirs and near flood prone areas.

RTSFF & ROS

- Rainfall forecast is available from several sources:
  1. Indian Meteorological Department (IMD)
  2. National Centre for Medium Range Weather Forecast (NCMRWF)
  3. National Oceanographic and Atmospheric Administration (NOAA)
  4. Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES).

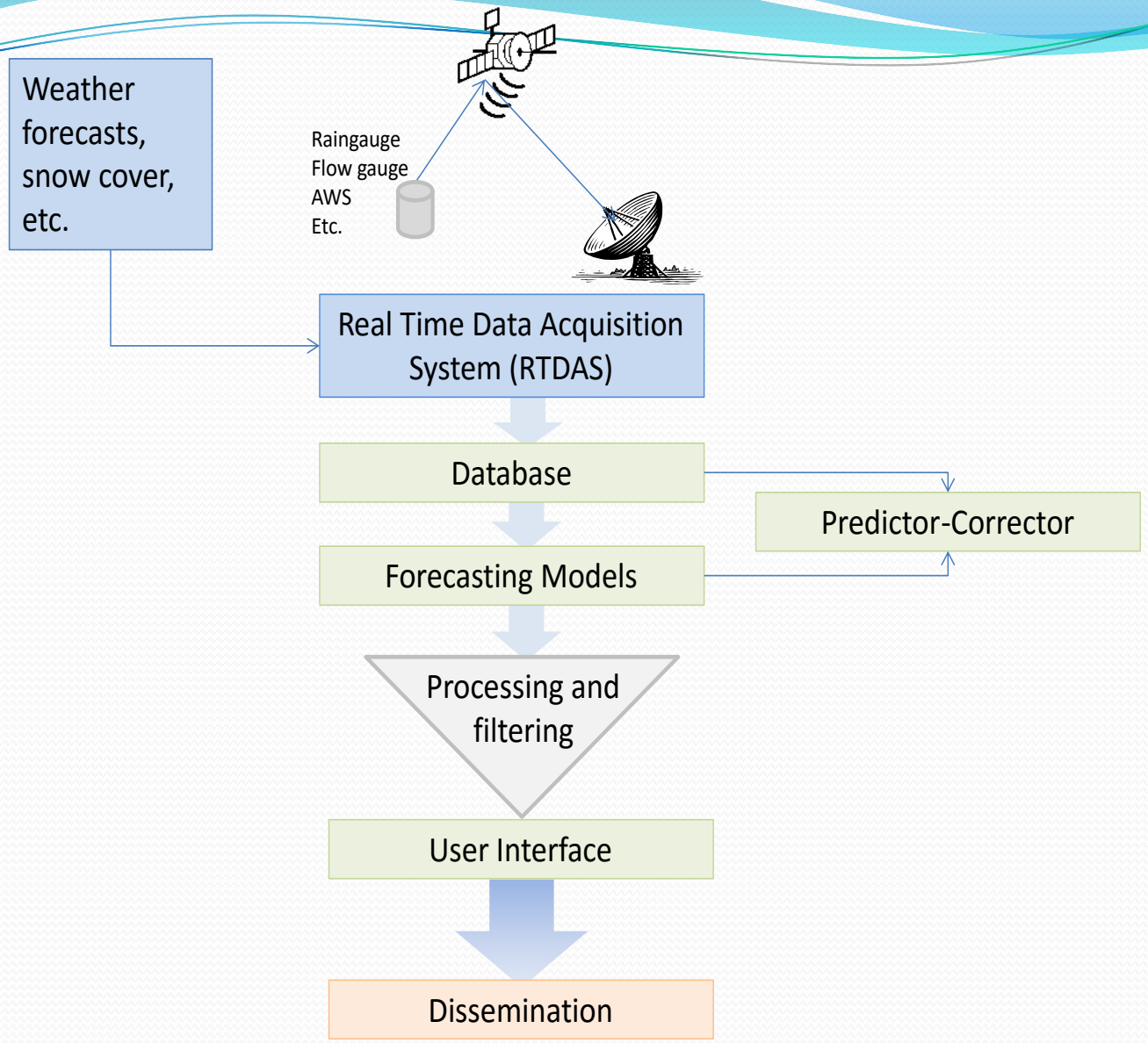
- Satellite data is available from IMD, ECMWF, GeoSMF, Dartmouth Flood Observatory, TRIMM/GPF, MODIS.

RTSFF & ROS for Krishna & Bhima Basin

- In Maharashtra, RTSF & ROS for Krishna and Bhima River Basins have been developed under HP-II .
- The RTDAS included the installation of new equipment to monitor rainfall, water level, river discharge, reservoir water level, reservoir outflow discharge and climatic variables.
- The system utilises a combination of INSAT and GSM/GPRS data communications to relay data in real time.
- A real time data centre has been established at Pune where IT hardware, databases and software have been installed.

RTSFF & ROS for Krishna & Bhima Basin

- The RTDAS uses General Packet Radio Service (GPRS) modem transfer information from the out-stations to the RTDAS database.
- The outstations are powered by using solar panel with a 30 day battery backup and data loggers can store up to 12 months.
- The RTDSS has been developed using DHI software. NAM was used for rainfall-runoff and MIKE11 for hydrodynamic modelling and forecasting.
- The DHI RTDSS database is linked to the RTDAS database to allow the real time transfer of information



Real Time System for flood warning

Advantages of DSS

- Improves performance and effectiveness of the user
- Allows for faster decision-making
- Reduces the time taken to solve problems
- These combine to save money
- Has been seen to improve collaboration and communication within groups
- Provides more evidence in support of a decision
- May increase decision-maker satisfaction
- Providing different perspectives to a situation
- Helps automate various business systems

Disadvantages of DSS

- Too much emphasis/control given to the machines.
- May reduce skill in staff because they become dependent on the computers
- Reduction in efficiency because of information overload
- Shift of responsibility - easy to blame computer!
- Disgruntled employees who feel they are now only doing clerical work
- False sense of being objective - humans still feed information in and decide how exactly to process it.


Thank you