HYDROLOGY PROJECT

Technical Assistance

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Training module # SWDP - 13

How to report on rainfall data

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CSMRS Building, 4th Floor, Olof Palme Marg, Hauz Khas,
New Delhi – 11 00 16 India
Tel: 68 61 681 / 84 Fax: (+ 91 11) 68 61 685
E-Mail: dhvdelft@del2.vsnl.net.in

DHV Consultants BV & DELFT HYDRAULICS

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1. Module context

While designing a training course, the relationship between this module and the others, would be maintained by keeping them close together in the syllabus and place them in a logical sequence. The actual selection of the topics and the depth of training would, of course, depend on the training needs of the participants, i.e. their knowledge level and skills performance upon the start of the course.

2. Module profile

Title	:	How to report on rainfall data
Target group	:	Hydrologists, Data Processing Centre Managers
Duration	:	One session of 60 minutes
Objectives	:	After the training the participants will be able to*:* • Make yearly reports on rainfall data • Make special reports on rainfall data
Key concepts	:	• Yearly and special reports • Thematic maps • Year's meteorological characteristics vis-à-vis average patterms • Data validation and quality aspects • Unusual events • Long term statistics • Long term variability • Bibliography of past publications
Training methods	:	Lecture, softwares
Training tools required	:	OHS, computers
Handouts	:	As provided in this module
Further reading and references	:	

3. Session plan

No	Activities	Time	Tools
1	***General*** • Reporting of rainfall data • Reports	15 min	 OHS 1 OHS 2
2	***Yearly reports*** • Objectives and contents of typical yearly reports • Objectives and contents of typical periodic reports	15 min	 OHS 3 OHS 4
3	***Discussions on the aspects of reporting***	30 min	

4. Overhead/flipchart master

5. Handout

Add copy of Main text in chapter 8, for all participants.

6. Additional handout

These handouts are distributed during delivery and contain test questions, answers to questions, special worksheets, optional information, and other matters you would not like to be seen in the regular handouts.

It is a good practice to pre-punch these additional handouts, so the participants can easily insert them in the main handout folder.

7. Main text

Contents

How to report on rainfall data

1. General

- **Published reports are the primary visible output of the Hydrological Information System. They have several purposes**

  - **to provide information on availability of data for use in planning and design.** Rainfall data are used for a variety of purposes and are required at a range of time scales. Real time rainfall data are required for flood forecasting and hydropower and reservoir operation. Summaries of storm rainfall event data are required for assessment of the severity of events at weekly or monthly time scales. Rainfall bulletins for agricultural and irrigation operation are needed at similar time scales. **However, the HIS will data at yearly or longer reporting frequency and will not engage in shorter term operation reports.** Although the same data may be used for such reports they will not be the direct concern of the HIS.

  - **to advertise the work of the HIS and its capability and to create interest and awareness amongst potential users**.With the availability of data on magnetic media it is conceivable that all requests for data could be met by a direct and specific response to data requests. This in fact is now the practice in many developed countries where there are well established links between data users and data suppliers and annual reports are no longer published in print (although the same information may be provided on the Internet). In India, the availability of rainfall data may not be well known even in related government departments; the annual report of rainfall therefore provides a suitable means of demonstrating the capability of the HIS.

  - **to provide feedback to data producers and acknowledge the contribution of observers and co-operating agencies.** The HIS is an integrated system in which rainfall (and other) data are transferred by stages from the field, to local and regional offices for data entry, processing and validation. The annual report shows how observations at individual stations are integrated in the network. It provides an encouragement to observers and data processors to ensure that the raw and processed data are reliable.

- **The HIS provides opportunities for storage, retrieval and reporting on magnetic media and there is now no necessity to publish daily rainfall for all contributing stations.** The traditional annual report of daily rainfall is often not the most convenient format of rainfall data for users. For project or design purposes, the user often requires long term records for a single station or a group of stations - i.e., data by station rather than by year. This required the collation of data from a set of annual reports and the keying of the data into the computer for the required analysis. So long as the annual report gives a clear indication of data availability as a basis for user requests, it is now more efficient and cost effective to provide rainfall summary statistics rather than the full daily record.

  The HIS thus makes data reporting and use more efficient by:

  - reducing the amount of published data and cost of annual reports
  - providing statistical summaries in tabular and graphical from which are more accessible and interesting to the user

- ❖ avoiding duplication of effort by users in keying in of data by provision on magnetic media

- **Annual reports are produced with respect to rainfall over the hydrological year from 1 June to 31 May.** Since the hydrological year corresponds to a complete cycle of replenishment and depletion, it is appropriate to report on that basis rather than with respect to the calendar year. Such reports incorporate
  - ❖ a summary of information on the pattern of rainfall over the year in question
  - ❖ information on the long-term spatial and temporal pattern of rainfall in the region and how the recent year compares with past statistics.

Reports of long term statistics of rainfall will be prepared and published at 5 or 10 years intervals. These will incorporate spatial as well as temporal analysis.

- **Annual and other reports will be produced at the State Data Processing centre. Annual reports will be produced in draft form within six months from the end of the year covered by the publication and the report published within twelve months.**

2. Yearly reports

The annual report provides a summary of the rainfall pattern for the report year in terms of distribution of rainfall in time and space and makes comparisons with long term statistics. Details of the observational network and data availability are included. A summary of the hydrological impact of rainfall is provided with particular reference to floods and droughts. **The following are typical contents of the annual report:**

(a) Introduction
(b) The Observational Network
  - ❖ maps
  - ❖ listings
(c) A descriptive account of rainfall occurrence during the report year
(d) Thematic maps of monthly, seasonal and annual rainfall
(e) Graphical and mapped comparisons with average patterns
(f) Basic rainfall statistics
(g) Description and statistical summaries of major storms
(h) Data validation and quality
(i) Bibliography

2.1 Introduction

The report introduction, which may change little from year to year, will describe the administrative organisation of the rainfall network and the steps involved in the collection, data entry, processing, validation, analysis and storage of data. It will list those agencies contributing to the included data. It will describe how the work is linked with other agencies collecting or using rainfall data including the India Meteorological Department and operational departments in hydropower and irrigation. It will describe how additional data may be requested and under what terms and conditions they are supplied.

2.2 The observational network

The salient features of the observational network are summarised in map and tabular form.

The rainfall station map must also show major rivers and basin boundaries and distinguish each site by symbol between daily, autographic and digital recorder and whether rainfall alone is observed or the gauge is sited at a climatological station.

Tabulations of current stations are listed by named basin and sub-basin. Also listed are latitude, longitude, altitude, responsible agency, the full period of observational record and the period of observation which is available in digital format. A similar listing of closed stations, (or a selection of closed stations with long records) may be provided. All additions and closures of stations must be highlighted in the yearly report. Similarly station upgrading and the nature of the upgrading should be reported.

2.3 Descriptive account of rainfall during the report year.

An account of the rainfall occurrence in the region in the year can be concisely given in the form of a commentary for each month, placed in its meteorological context. Significant stretches of dry or wet periods in the parts of the region under reporting can be highlighted.

2.4 Maps of monthly, seasonal and yearly areal rainfall

Thematic maps showing spatial distribution of average rainfall over the region for monthly, seasonal or yearly periods provide a convenient summary of the rainfall pattern in space and time. Basin or administrative boundaries may also be shown to illustrate variations between districts or basins. The rainfall may be mapped as the actual value at each station for the specified period or by the drawing of isohyets of equal rainfall over the region. For such interpolations the rainfall is first interpolated on a very fine grid laid over the region using manual or computer-based techniques. Grid point values are then used to draw isohyets at suitable intervals.

2.5 Graphical and mapped comparisons with average patterns

Maps will also be provided to show relative rainfall - the amount as a percentage of the long term average. The period over which the long term average is taken must be noted.

For a few representative rainfall stations, a graphical comparison of the monthly rainfall amounts for the whole year can be made with the long term average patterns. The actual monthly distribution can be plotted against the long term average for minimum, maximum and average monthly amounts. This kind of plot also makes it easy to comprehend the type of temporal distribution of rainfall.

2.6 Basic statistics for various duration

This forms the core of the report. As noted above the full reporting of daily or hourly data is no longer required though sample tabulations of daily and hourly data may be provided for selected stations to illustrate the format of information available. Instead, summary statistics of monthly rainfall for the report year provide a ready means of making comparisons between stations and between months and will satisfy the needs of general data users.

Again stations are listed by basin and sub-basin order (rather than alphabetical or numerical order). In addition to monthly rainfall totals, the maximum daily amount in the year and the

date of its occurrence is noted. Any daily, monthly or annual totals which exceed previous maxima of record are shown in bold type.

For stations with digital or autographic records a similar tabulation is provided by basin giving the maximum observed amount for selected durations including 1 hour, 2, 3, 6, 12 and 24 hours with dates of occurrence.

2.7 Description and statistical summaries of major storms

Major storms which are known to have had an impact on flooding or operation of water resources are described in more detail. Selection of events for description may be made in terms of impact or on an objective basis of areal amount and distribution. For rainfall regimes of arid and semi-arid regions a lower value is adopted whereas for high rainfall regimes a higher threshold value is adopted. Usually, a threshold of about 10% of the seasonal normal rainfall may be taken for the most frequent storm duration over the region. The threshold value also depends upon the size of the catchment area. For smaller catchment a higher threshold and for larger catchments smaller threshold value may be adopted. An average precipitation depth of 50 mm per day over a catchment of medium size (say 10,000 – 15,000 sq. kms.) would be appropriate. The peripheral isohyet for one day storm must be at least 50 mm in the moderate rainfall regime whereas it must be about 10 to 20 mm for arid or semi-arid regions with low seasonal rainfall.

Storms should be described with respect to their meteorological context, centre of concentration, movement across the river basins and also the characteristics of the time distribution of rainfall within the storm.

2.8 Data validation and quality

The limitations of data should be made known to users. The validation process not only provides a means of checking the quality of the raw data but also a means of reporting. The number of values corrected or in-filled as a total or a percentage may be noted for individual stations, by basin or by agency. The types of anomaly typically detected by data validation and remedial actions should be described.

2.9 Bibliography

Data users may be interested to know of other sources of rainfall data or of related climatic or hydrological data. The following should be included.

- Concurrent annual reports from the HIS of climate or hydrological data
- Previous annual rainfall reports (with dates) from the HIS.
- Previous annual rainfall reports (with dates) published by each agency and division within the state
- Special summary reports of rainfall statistics produced by the HIS or other agencies.

A brief note on the administrative context of previous reports, methods of data compilation, and previous report formats would be helpful.

3. Periodic reports - long term statistics

Long term point and areal statistics are important for planning, management and design of water resources systems. They also play an important role in validation and analysis. These statistics must be updated regularly and an interval of 10 years is recommended. **The following will be typical contents of such reports.**

- Introduction
- Data availability - maps and tabulations
- Descriptive account of annual rainfall since last report
- Thematic maps of mean monthly and seasonal rainfall
- Basic rainfall statistics - monthly and annual means, maxima and minima
  - ❖ for the standard climatic normal period (1961-90) where available
  - ❖ for the updated decade
  - ❖ for the available period of record
- Additional point rainfall statistics for example, daily maximum rainfall, persistence of dry or wet spells during the monsoon, dates of onset or termination of the monsoon.
- Additional areal mean rainfall statistics for administrative or drainage areas for periods of a month or year
- Analysis of temporal variability using moving averages or residual mass curves to identify major wet and dry periods for a number of representative stations.
- Frequency analysis of rainfall data

3.1 Frequency analysis of rainfall data

The frequency of occurrence of rainfall of various magnitudes is important in the application of mathematical models for synthesising hydrological data. Estimates of design runoff from small areas are often based on rainfall-runoff relations and rainfall frequency data due to sparse streamflow measurements and limitation in transposing such data among small areas. Generalised estimates of rainfall frequencies for a few durations up to 72 hours and up to a few hundred years are useful if are readily available. Some such maps are available at country level for specified duration of rainfall and frequency of occurrence (or return periods). These maps must be revised after having collected a significant amount of additional data. Standard methods recommended by India Meteorological Department must be followed for the derivation of such maps. Though the primary responsibility for making such maps lies with the India Meteorological Department, it is appropriate to include such maps in the reports with the permission of the IMD.

Information on rainfall frequency is a vital input for planning domestic or industrial water supply, agricultural planning, hydropower and other water use sectors. Inferences on various time intervals such as daily, weekly, ten-daily, fortnightly and monthly are usually required for planning in various sectors.

4. Periodic reports on unusual rainfall events

Special reports should also be prepared on the occurrence of unusual rainfall events. As these will also have unusual hydrological consequences, the reports will normally be combined with reports of the resulting streamflow and flooding within the affected area. **The rainfall component of such reports will include the following**

- tabulations of hourly or daily point rainfall within the affected area
- isohyetal maps of total storm rainfall
- hyetograph plots of rainfall time distribution based on recording raingauges
- assessment of event return periods for selected durations based on point rainfall
- areal storm rainfall totals over affected basins