NOAA/NWS PRECIPITATION FREQUENCY DATA SERVER

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1. INTRODUCTION

The rainfall frequency atlases and technical papers published by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) serve as national standards for rainfall intensity at specified frequencies and durations in the United States. The current standards were published between 1961 and 1977 (Frederick 1977, Hershfield 1961, Miller et al. 1973, Miller 1964). The NWS Hydrometeorological Design Studies Center (HDSC) is currently updating the standards for the Semiarid Southwest, the Ohio River basin and surrounding states, Hawaii, Puerto Rico, and the Virgin Islands. The results of the updates will be delivered in a variety of formats using a newly developed web portal named the Precipitation Frequency Data Server (PFDS). The PFDS is an easy to use, point-and-click interface (Figure 1) to official U.S. precipitation frequency estimates and intensities.

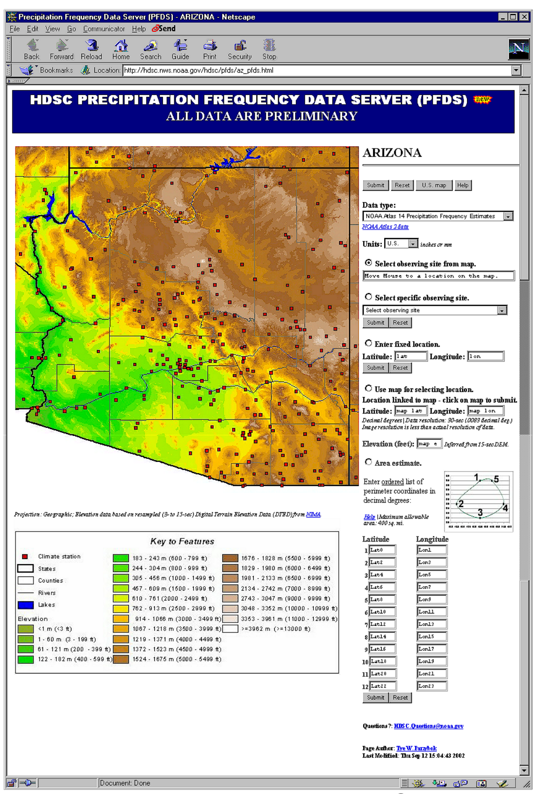

Figure 1. Precipitation Frequency Data Server web page for Arizona.

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The PFDS also serves as a tool for providing references and other information for other current precipitation frequency standards that are not yet updated. The idea of providing a dynamic means of accessing precipitation frequency via the web was first implemented in the late 1990's by Rocky Durrans, University of Alabama, with the launch of the Alabama Rainfall Atlas (http://bama.ua.edu/~rain/). The Alabama web portal is publicly accessible to view draft data. With the help from Durrans and his graduate students, development on the PFDS (known at the time as the "IDF GUI," short for Intensity-Duration Frequency Graphical User Interface) took place in 2000. Throughout 2001 and 2002, the NWS evolved the GUI into the present-day PFDS.

2. DATA

The PFDS operates from a large underlying Geographical Information System (GIS) dataset of spatially interpolated grids of precipitation frequency estimates. There are a total of 486 grids per study area (e.g. Semiarid): 162 for the mean values and 162 each for the lower and upper bounds of the 90% confidence limits. Figure 2 shows the complete table of available return intervals (2-year to 1000-year) and durations (5-minutes to 60-days) from the PFDS.

ALL Season Precipitation Frequency (mm)

	5-m	10-m	15-m	30-m	60-m	2-h	3-h	6-h	12-h	24-h	48-h	4-d	7-d	10-d	20-d	30-d	45-d	60-d
2-y	6.63	10.08	12.50	16.84	20.83	23.88	25.91	31.24	40.39	47.50	55.88	63.75	76.71	86.36	115.57	140.97	171.20	197.87
5-y	9.86	14.99	18.59	25.04	30.99	34.54	36.58	42.67	54.36	63.75	75.18	86.61	103.10	114.81	151.13	183.64	223.77	256.29
10-y	12.27	18.69	23.16	31.19	38.61	42.42	44.70	51.03	63.75	74.93	88.90	102.62	121.67	134.11	173.74	210.06	256.79	292.10
25-y	15.67	23.85	29.57	39.83	49.28	53.85	55.63	62.99	76.45	89.66	106.93	124.21	146.05	158.50	201.17	242.06	297.18	334.01
50-y	18.41	28.04	34.75	46.79	57.91	63.25	64.77	72.39	86.11	101.09	121.16	141.22	164.85	177.04	220.98	264.41	326.14	362.71
100-y	21.41	32.59	40.39	54.38	67.31	73.66	74.42	82.80	96.27	112.78	135.64	159.00	184.66	195.33	240.03	285.75	353.82	389.64
200-y	24.64	37.49	46.48	62.59	77.47	84.84	85.60	93.73	106.43	124.71	150.62	177.80	204.98	213.87	258.32	306.32	380.75	414.76
500-y	29.41	44.75	55.47	74.70	92.46	101.35	102.08	109.73	120.65	140.97	171.70	203.71	232.92	238.51	281.69	331.72	414.76	445.77
1000-y	33.45	50.90	63.09	84.96	105.16	115.32	116.08	122.94	131.83	153.92	188.21	224.79	255.27	257.56	298.70	350.27	439.42	467.61

Text version of table

Figure 2. PFDS table of draft precipitation frequency depths for Flagstaff, Arizona.

The grids are the result of a complex procedure involving extensive quality control of observed point precipitation values, L-moment computations (Hosking and Wallis 1997), PRISM interpolation (Daly 1997) and derivation using a residual, add-back procedure. To expedite the software overhead associated with a true spatial database, the PFDS operates directly from ArcInfo ASCII Grids. An added advantage to this data structure, is the fact that the same grids that the PFDS accesses, can be downloaded and imported into a GIS. The ASCII grids are at a resolution of 30-seconds and in units of inches*1000. Since for NWS precipitation frequency studies 10 square miles is considered a "point," this resolution is more than adequate for providing accurate point estimates from a grid.

3. METHODOLOGY

The PFDS operates with conventional web-tools, including cgi-bin (Perl) scripts, java script and one C program. The main cgi-bin script is activated when a user selects a location, either by manually entering a longitude/latitude coordinate or clicking on the state map. The cgi-bin script develops a comprehensive output web page on the fly.

Since the PFDS is not an Internet Map Server (IMS), a so-called "information" function had to be coded so that when provided a longitude/latitude coordinate, the PFDS could return the appropriate precipitation frequency estimates. "Getcell," a fast-running, C-compiled program, was written to accomplish this simple, yet crucial function. "Getcell" uses the header information provided in the ArcInfo ASCII Grid and the supplied longitude latitude coordinate to calculate the x and y location of the desired grid cell within the grid matrix. The output is the cell value. "Getcell" also has the capability of calculating the mean, maximum or minimum of a set (i.e. area) of grid cells represented by a list of user-input longitude/latitude coordinates. This powerful capability makes it possible for the PFDS to provide areal estimates of precipitation frequency. The standard output from "Getcell" is the precipitation frequency estimate, which is then stored in an array for later use by the PFDS cgi-bin engine.

4. INPUT

The opening PFDS screen is a clickable map of the United States. Upon clicking on a state, a state-specific interface appears (See figure 1). From this page the user selects the following:

- A location: Either via clicking on the map or manually entering a longitude/latitude coordinate
- Type of output: Depth-Duration Frequency (DDF) or Intensity-Duration-Frequency (IDF)
- Units: millimeters or inches
- Type of estimate: Point or areal

For reviews of the observing-site precipitation frequency estimates and prior to spatial interpolation from point estimates, a modified version of the PFDS allows the user to select specific observing stations (e.g. Flagstaff, AZ) instead of choosing an arbitrary location based on latitude/longitude.

The background on the state maps is color-shaded topography to help orient users. Also, the elevation, latitude and longitude dynamically change in the nearby text boxes as the mouse pointer pans across the map.

5. OUTPUT

After the main cgi-bin script has successfully extracted all 486 precipitation frequency estimates from the underlying grids, an output web page (Figure 5) is built on the fly. There are two basic types of output: Depth-Duration Frequency (DDF) and the Intensity-Duration Frequency (IDF). Both outputs are based on the same data, but present the data differently. The PFDS provides DDF graphs in two formats to provide a complete perspective of the data. Figures 3 and 4 illustrate these. The classic IDF graph, which is widely used, is shown within Figure 5. The output pages also consist of data tables (see Figure 2) of the precipitation frequency depths (or intensities), as well as tables of the lower and upper bounds of the 90% confidence limits. Location maps and helpful links are also provided. The imbedded maps on the output page are provided by a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server (http://tiger.census.gov/cgi-bin/mapbrowse-tbl/). The graphs are produced using gnuplot (http://www.gnuplot.info/), while the remainder of the page is basic HTML.

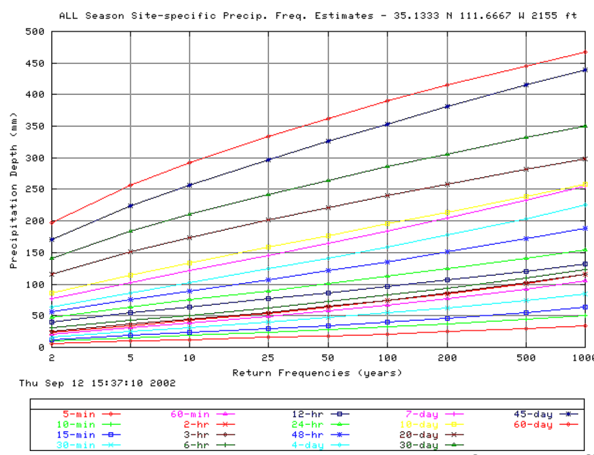

Figure 3. Depth-Duration Frequency graph for Flagstaff, Arizona (draft).

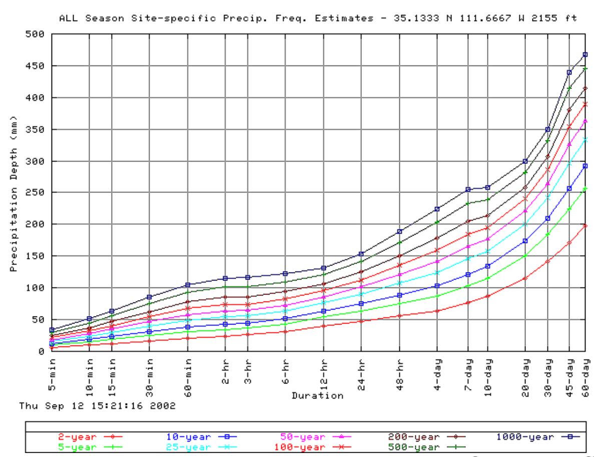

Figure 4. Depth-Duration Frequency graph for Flagstaff, Arizona (draft).

The capability to save the table data to a text file allows users to more easily import the data into models, reports or different graphing software. Other buttons on the output page lead users to online help and the spatial download page. The spatial download page provides instructions on how to download various GIS files (grids and vectors), as well as other files types (.pdf and .jpg).

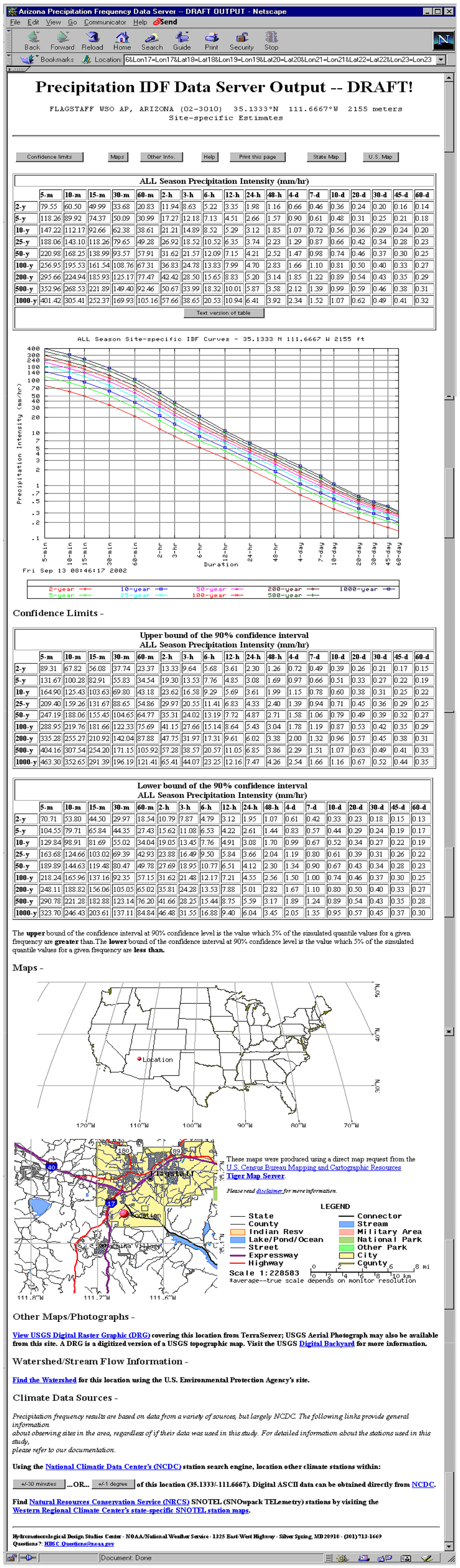

Figure 5: Full IDF output from PFDS for Flagstaff, Arizona (draft).

6. SUMMARY AND FUTURE WORK

The PFDS, which was originally motivated and designed after the online Alabama Rainfall Atlas, has evolved into the online repository and web portal for official U.S. precipitation frequency data. It also serves as an information center for all current precipitation frequency standards, whether they have been recently updated or not. By early 2003 the Semiarid and Ohio River Basin projects will be complete and for the first time the PFDS will be populated with official precipitation frequency standards. This will also mark the first time the PFDS will be open to the public for use.

New data will be added to the PFDS as it becomes available. Furthermore, the capabilities and functionality of the PFDS may be expanded in the future. For example, the addition of an Internet Map Server (IMS), which would allow users to interact with precipitation frequency maps via the web, would be a powerful supplement.

PFDS URL:http://hdsc.nws.noaa.gov/hdsc/pfds/

7. ACKNOWLEDGMENTS

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8. REFERENCES

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