Forecasting Future Floods

A Carolina Essentials™ Activity

Teacher Worksheet

Overview

Moving water is one of the most powerful forces in nature. A swift-moving river at flood stage can move cars and topple houses from their foundations. The greater volume of water and the faster the flow, the greater the destructive force of water. The key to keeping people safe is warning them when rivers are at flood stage, the volume of water in the river, and the speed at which it is traveling.

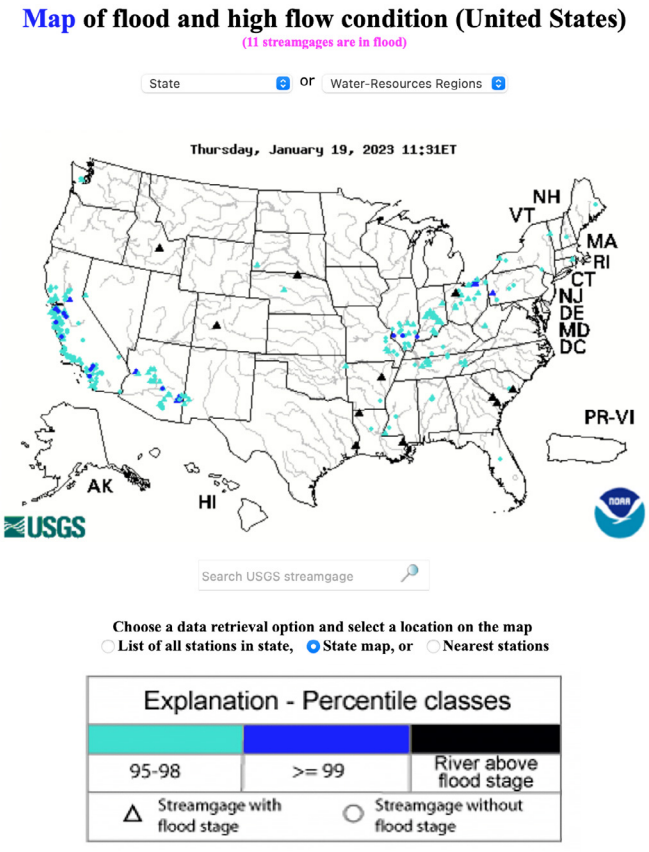
How is river flow measured and how is it monitored? Thanks to advances in technology, river flow rate and water depth are measured automatically at thousands of automated stations across the United States. The U.S. Geological Survey (USGS) is the nation's largest water, earth, and biological science and civilian mapping agency. It collects, monitors, analyzes, and provides scientific understanding of natural resource conditions, issues, and problems. USGS is upgrading its water monitoring capabilities with the Next Generation Water Observing System (NGWOS), "which will provide high temporal and spatial resolution data on streamflow, evapotranspiration, snowpack, soil moisture, water quality, groundwater/surface-water connections, stream velocity distribution, sediment transport, and water use."

In this data and analysis activity, students monitor water levels and discharge flow rates in the Pearl River from real-time and historic data, analyze the data for potential flood hazards, and generate a flood warning forecast. Local streams and rivers can be substituted for the Pearl River data which makes the activity more pertinent to students. Directions for locating local data follow.

Earth and Space Science
Grades: 6–8

Phenomenon

What observations can you make with this data?



Source: USGS WaterWatch. 2023. Map of flood and high flow condition (United States). https://waterwatch.usgs.gov/index.php?id=ww_flood.

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TIME REQUIREMENTS

PREP	ACTIVITY
15–45 min	30–40 min

Teacher Prep: 15–45 min
Student Activity: 30–40 min

SAFETY REQUIREMENTS

No PPE is required for the activity.

MATERIALS

Streamflow data via internet access or printed data tables

HELPFUL LINKS

Carolina Quick Tips®: Colliding Air Masses

The Ups and Downs of Weather

In a Fog? Cloud Formation

Thermal Convection Currents

REFERENCE LINKS

USGS Next Generation Water Observing System

WaterWatch (current stream flow and historical data)

REFERENCE KITS

STC-Middle School™, STC³ Edition: Weather and Climate Systems

Essential Question

How can stream flow data be used to forecast future flood events?

Activity Objectives

1. Analyze and interpret local stream flow data and make a flood hazard forecast.
2. Describe current stream flow monitoring technology.

Next Generation Science Standards* (NGSS)

PE MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data • Analyze and interpret data to determine similarities and differences in findings.	**ESS3B: Natural Hazards** • Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	**Patterns** • Graphs, charts, and images can be used to identify patterns in data.

Teacher Preparation and Disposal

Copy or upload the student activity guide. If not using the included Mississippi River data, select a USGS monitoring station in or near your location and record the station number. If you wish to complete this activity without student internet access, download and copy the stream flow data for use in class.

1. Navigate to WaterWatch. The website houses current stream flow conditions.
2. Select as many streams or rivers for student analysis as you want, from any monitored site.
3. Pick the region or state from the drop-down menu.
4. Select the site(s), and record the site monitoring ID.

At this point, you can choose to copy data for student use if there is no internet access or assign students a monitoring site number for them to record data if internet access exists.

Student Background Reading

WaterWatch is a U.S. Geological Survey (USGS) website that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the United States. The real-time information generally is updated on an hourly basis. WaterWatch provides streamgage-based maps that show the location of more than 3,000 long-term (30 years or more) USGS streamgages; use colors to represent streamflow conditions compared to historical streamflow; feature a point-and-click interface allowing users to retrieve graphs of stream stage (water elevation) and flow; and highlight locations where extreme hydrologic events, such as floods and droughts, are occurring.

The streamgage-based maps show streamflow conditions for real-time, average daily, and 7-day average streamflow. The real-time streamflow maps highlight flood and high flow conditions. The 7-day average streamflow maps highlight below-normal and drought conditions.

WaterWatch also provides Hydrologic Unit Code (HUC) maps. HUC-based maps are derived from the streamgage-based maps and illustrate streamflow conditions in hydrologic regions. These maps show average streamflow conditions for 1-, 7-, 14-, and 28-day periods, and for monthly average streamflow; highlight regions of low flow or hydrologic drought; and provide historical runoff and streamflow conditions beginning in 1901.

WaterWatch summarizes streamflow conditions in a region (state or hydrologic unit) in terms of the long-term typical condition at streamgages in the region. Summary tables are provided along with time-series plots that depict variations through time. WaterWatch also includes tables of current streamflow information and locations of flooding. (Source: USGS WaterWatch. 2023. About WaterWatch. https://waterwatch.usgs.gov/index.php?id=ww_about.)

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Student Procedure

1. Complete the background reading in the section above.
2. Observe both graphs carefully.
3. On both graphs, circle the location where you think the possibility of flooding may occur.

Teacher Preparation and Tips

1. Go to https://waterwatch.usgs.gov/.

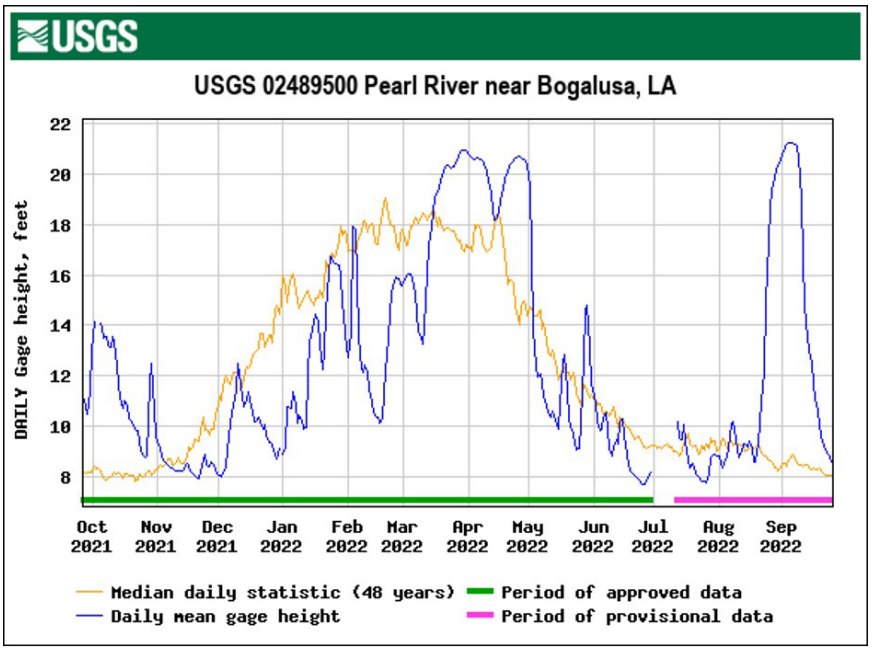
2. Select "Current Streamflow" (upper left map).

3. Select the state or water-resources region you would like students to investigate.

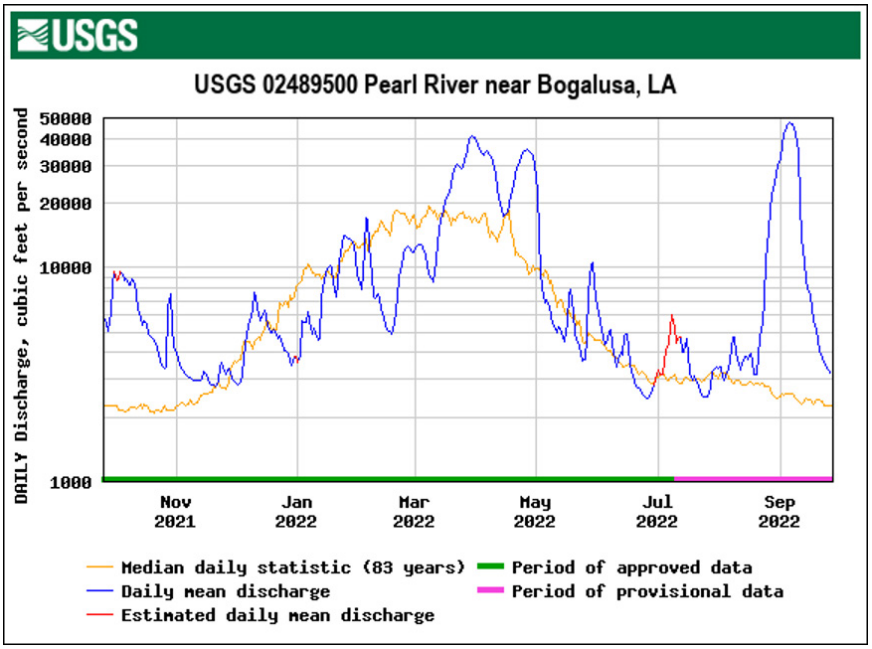
4. Select the monitoring station(s) from which you would like to get data. If students do not have internet access, you can select the monitoring station. Click on the station point, then click the USGS number in the pop-up window. Select 7-day, 30-day, or 1-year data, then select the data to graph. Decide if you want gage height, an indicator of water level, or discharge rate, an indicator of the volume of water and how fast it is flowing.

Data and Observations

The following data grids were downloaded on September 26, 2022.



Source: USGS WaterWatch. 2023. USGS 02489500 Pearl River near Bogalusa, LA, Daily Gage Height. https://waterdata.usgs.gov/monitoring-location/02489500/#parameterCode=00065&period=P7D.



Source: USGS WaterWatch. 2023. USGS 02489500 Pearl River near Bogalusa, LA, Daily Discharge. https://waterdata.usgs.gov/monitoring-location/02489500/#parameterCode=00065&period=P7D.

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Analysis and Discussion

1. How long has daily gage height been recorded on the Pearl River? How long has daily discharge on the Pearl River been recorded?

   48 years; 83 years

2. Explain any pattern in seasonal variations in river gage height and discharge.

   March and April (spring) have the largest values on both graphs. This may indicate spring rains or snowmelt draining from areas to the north. September to November (autumn) has the lowest readings on both maps, indicating lack of precipitation or snowmelt.

3. What is the gage height and discharge rate for the possible flood events you identified?

   Student answers will vary, but the best flood candidates are early April, early May, and early September. Heights: 21 ft., 21 ft., and 21.5 ft., respectively. Discharge rates: 40,000 ft^3/s, 38,000 ft^3/s, and 49,000 ft^3/s. The early September event is the worst one.

4. What weather events could be responsible for the possible flood events?

   In the spring, low pressure systems from the Gulf of Mexico or the Pacific could bring heavy rains. In September, a tropical depression, tropical storm, or hurricane may be likely to cause increases in gage height and greater discharge rate.

5. Write a brief (3 sentences or less) flood warning that will capture the attention of citizens in Bogalusa, Louisiana.

   Student answers will vary.

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TEACHER NOTES

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