



Picture This: How USGS Captures Changing Water

Exploring HIVIS Time-Series Images and USGS Water Data

Objectives:

- Observe environmental changes using time-series images from a USGS HIVIS camera.
- Identify patterns in stream conditions, weather, vegetation, and seasonal change.
- Develop evidence-based explanations for changes observed in the landscape.
- Compare visual observations with real-time USGS water data, including gage height and water temperature.
- Interpret graphs to determine how measured hydrologic data supports or differs from visual observations.
- Recognize how stream systems respond to weather, seasons, and watershed processes.

Recommended level: Grades 6 – 12

Estimated Time: 30 minutes (plus optional extensions)

Next Generation Science Standards (NGSS) Standards:

- DCIs:
 - MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
 - MS-ESS3-1: Construct a scientific explanation based on evidence for how Earth's mineral, energy, and groundwater resources are distributed.
 - HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
 - HS-ESS3-5: Analyze geoscience data and results from global climate models to make evidence-based forecasts.
- CCCs: Patterns, Cause and Effect, Stability and Change, Systems and System Models

- SEPs: Asking Questions, Analyzing and Interpreting Data, Constructing Explanations, Obtaining, Evaluating, and Communicating Information, Using Mathematics and Computational Thinking

Key Terms:

HIVIS (Hydrologic Imagery Visualization and Information System): A USGS camera network that captures repeat images of streams and rivers to document changing environmental conditions over time.

Time-Series: A sequence of observations collected over time that allows scientists to identify patterns and changes.

Gage Height (Stage): The height of the water surface above a reference point at a monitoring station.

Streamflow: The amount of water flowing in a stream or river.

Water Temperature: The measured temperature of water at a monitoring location.

Runoff: Water from rain or snowmelt that flows across the land into streams and rivers.

Hydrologic Data: Measurements collected to describe water conditions such as water level, temperature, discharge, and water quality.

Evidence-Based Explanation: A scientific conclusion supported by observations or measured data.

Hydrograph: A chart that shows water gage height over time.

Background

Streams are constantly changing. A creek that appears calm one day may rise rapidly after a storm, become muddy during heavy runoff, freeze during winter, or slowly dry during periods of drought.

USGS scientists can monitor these changes in two important ways:

- HIVIS cameras continuously photograph rivers and streams, creating time-series images that reveal environmental changes.
- USGS streamgages collect measurements such as water level, temperature, and streamflow every few minutes.

Together, images and scientific measurements provide a more complete picture of what is happening in a watershed. Images help scientists observe conditions that numbers alone cannot show, while monitoring data helps explain changes that may not be obvious in images.

In this activity, you will become a water scientist by examining both visual evidence and measured data from Snakeden Branch above Lake Audubon in Reston, Virginia. Your challenge is to determine what happened at the stream and support your conclusions using scientific evidence.

Think - Individually

Before exploring the images, consider the following questions:

- What might cause a stream to rise or fall?
- Can you tell if it recently rained simply by looking at a stream?
- What are the types of clues you could see in an image that reveal weather conditions?
- Why might scientists collect both images and measurements instead of only one type of information?
- What changes would you expect to see in a stream over several weeks?

Explore the HIVIS Time-Series

Navigate to the HIVIS Camera - Snakeden Branch Above Lake Audubon at Reston, VA – USGS - 0164578734

https://apps.usgs.gov/hivis/camera/VA_Snakeden_Branch_above_Audubon_at_Reston

Spend a minute familiarizing yourself with the scene.

1. Observe the image
 - a. stream channel, water level, stream banks, vegetation lighting and shadows, water clarity, signs of weather
2. Select a date range for your time series (One week or two weeks)
 - a. Press **Play** and watch the complete sequence.
 - b. As you watch, record observations about changes over time.
 1. What happened to the water levels?
 2. Did the water appearance change at all?
 3. Any other changes observed in the water? (floating debris, faster moving water, ripples or turbulence)
 4. Did you observe any evidence of weather change? If you did, describe.
 5. Observe and describe any landscape changes.
3. Observe the hydrograph below the image
 - a. What data is currently being graphed?
 - b. Do you notice any changes in the data over the selected time period
 - c. Is that change reflected in the HIVIS imagery?

Review - Pair or Group Discussion

Compare observations with a partner or group.

1. What changes did everyone notice?
2. Which changes were easiest to identify?
3. Which observations required careful attention?
4. Did everyone interpret the same events similarly?

5. What evidence supports your conclusions?

Analyze and Reflect - Answer individually or in small groups

Based only on the images, answer the following:

1. What changed during the time series?
2. Which changes occurred gradually?
3. Which changes happened suddenly?
4. What do you think caused the observed changes? Support your explanation with specific visual evidence.

Explore the USGS Water Data

Open the monitoring station water data site - Snakeden Branch Above Lake Audubon at Reston, VA - USGS-0164578734

<https://waterdata.usgs.gov/monitoring-location/0164578734>

1. Adjust the graph to display the same dates used in your HIVIS timelapse.
2. Study the gage height graph.

Answer the following questions:

1. Does the graph show water levels rising or falling?
2. Did spikes in the graph match what you observed?
3. Were there any changes visible in the images that were difficult to see in the graph?
4. Were there changes on the graph that were difficult to notice visually from just the images?

Record any similarities or differences between the data observed and the HIVIS images observed.

Investigate Water Temperature

1. Add Water Temperature as the second variable on the graph.
2. Before viewing it, predict:
 - a. Will temperature increase and decrease at the same time as water level? Why or why not?

After viewing:

1. Was your prediction correct?
2. How did temperature change over time?
3. Did temperature appear connected to weather or season?

Turn on data for same time span in prior year.

Observe similarities and differences between the two years for:

(only one data type can be selected at a time)

1. Water levels
2. Temperature
3. Timing of seasonal changes

Discuss:

1. Which year appears wetter?
2. Which appears warmer?
3. Were seasonal patterns similar?

Data Interpretation

Use both the images and the graphs to complete the table.

Observation	Evidence from images	Evidence from water data
Highest water level		
Lowest water level		
Largest environmental change		
Weather event observed		
Temperature trend		
Evidence of runoff		

Write a short scientific explanation that answers: What happened at Snakeden Branch during your selected time period? Include: what you observed, what the data showed, what likely caused the changes, evidence supporting your conclusion

Extend Your Investigation

Visit the HIVIS Dashboard: <https://apps.usgs.gov/hivis/>

Choose another monitoring location from a different region of the United States.

Repeat the investigation

Compare: climate, vegetation, stream behavior, seasonal timing, water levels, temperature

Observation	Evidence from images	Evidence from water data
Highest water level		
Lowest water level		
Largest environmental change		
Weather event observed		
Temperature trend		
Evidence of runoff		

Answer the following questions:

1. Which stream changed the most?
2. Which environment looked the most different?
3. How might geography influence what you observed?
4. What similarities exist among watersheds in different parts of the country?

Reflection

Answer the following questions:

1. What was the most surprising change you observed?
2. Which visual clue was most helpful?
3. Did the water data support your interpretation?
4. Were there any differences between what you saw and what the measurements showed?
5. Why is it valuable for scientists to collect both images and numerical data?
6. How can long-term observations help communities prepare for floods, droughts, or changing environmental conditions?

Optional Extension Activities

Ideas for additional activities related to USGS HIVIS and USGS Water Data

Seasonal Comparison

Choose the same location during two different seasons and compare:

- Vegetation in and around the stream
- Water color
- Water level
- Temperature
- Weather conditions or events

Become a Hydrologist

Download the monitoring data from the Monitoring Location Page and create your own graph showing:

- Gage height
- Water temperature
- Streamflow (if available)
- Identify major events and annotate your graph with observations from the HIVIS images.

Compare Watersheds

Investigate two HIVIS locations from different climates (for example, a mountain stream and a coastal river). Create a short presentation explaining:

- Similarities
- Differences
- Weather influences
- Watershed characteristics

Helpful Links

USGS HIVIS Camera (Snakeden Branch)

https://apps.usgs.gov/hivis/camera/VA_Snakeden_Branch_above_Audubon_at_Reston

USGS Water Data Monitoring Location

<https://waterdata.usgs.gov/monitoring-location/0164578734>

USGS HIVIS Dashboard

<https://apps.usgs.gov/hivis/>

USGS Water Data

<https://waterdata.usgs.gov/>

USGS National Water Dashboard

<https://dashboard.waterdata.usgs.gov/app/nwd/en/>

USGS Water Science School

<https://www.usgs.gov/special-topics/water-science-school>