



Seasonality in water courses

Modules:

River management

Total duration: 3 hours +

Field work: Yes (2 days)

List of materials:

Paper and pen
PC lab, internet
Materials for the activity
along the river (listed
below)

Worksheets: --

Students' age: 16-18

Use of apps/software: Google
Earth

Brief disciplinary introduction

Hydrology is the science studying the cycle of water. The learning unit intends to introduce the student to the on the hydrology through the study of their immediate environment, especially to understand why water courses differ between sites (permanent vs non permanent water courses) and seasonality. Both features are important to understand biodiversity patterns as they represent different ecosystems submitted to different degrees of disturbance and seasonality affects to water quality and hence to environment to living beings. On the other hand, at the present a large body of research is not based only on directly collected data but in the access to public databases. An introduction to research is also connected with this topic and let to stimulate the use of Internet for 'hard' and contrasted information search and to train mathematical and inductive skills of students.

Keywords: hydrology, water intermittency, water quality, rain-runoff

Objective of the learning unit

To learn about:

- ✓ Different types of water courses in the region.
- ✓ How to search and download free environmental data from the web.
- ✓ Seasonal variation of water courses: the causes and immediate effects on the water environment.

To be able to :

- ✓ Develop skills for data analysis like graphing and simple statistics
- ✓ Observe nature as a “hobby” with support of IT.

Introduction (orientation)

Time estimated: 55 minutes

Where the activity takes place: in the computer laboratory

Method (how the students have to work): work groups

Instructions for the teacher:

Short introduction by the teacher to the water cycle (5 minutes). Then, the teacher stresses the different forms a water course can adopt: ephemeral (water only flows on moderate to heavy rains); intermittent (water flows several months per year associated to rainy season and/or low evapotranspiration); permanent (water flows always).

Slides of each type of water course in the area where the school is located are shown to the students (10 minutes).

Then the teacher shows to the students the basic use of Google Earth (10 minutes).

Finally a set of KML files (let to locate a place with Google Earth) for each of the water courses introduced in the slide show is provided in each computer and students are free to 'fly' over the places (15 minutes).

Finally students are given 10 minutes to freely describe their observations on Google Earth on 250 words. Teacher, however, will orient them to look at vegetation surrounding the water courses, the relief, possible pollution sources, etc.

In this task not only orientation and curiosity is stimulated but also they begin to use freely available tools about environmental information (Google Earth). Because it deal with seasonality of hydrological systems it is advisable to begin the implementation of the unit just at the beginning of the course, so it will be all the course to sample seasonal changes in flows.

Conceptualization

Time estimated: 60 minutes

Where the activity takes place: Homework

Method (how the students have to work): group-work

Instructions for the teacher:

The students are asked to generate hypothesis about flow oscillations including intermittency in water courses. Tips are provided: climate and seasonality; geological parent material; basin area; human disturbance like dams; water abstraction; artificial water discharges (e.g. wastewater treatment plants); etc. They have to write an essay about no more than 500 words that is delivered to the teacher and discussed in the planning of the experimentation phase.

Investigation

Time estimated: 1 hour & field trips

Where the activity takes place: in the computer laboratory with Internet and outdoor

Method (how the students have to work): group-work

Instructions for the teacher:

1) Planning

Location: In the computer lab

Time: 55 minutes

Materials:

Computers and internet, spreadsheets like Excel or LibreOffice Calc; data bases previously obtained from Water Authority.

Work groups.

The objective is to search environmental information on Internet; to download relevant pieces of information; to represent and to plan a fieldwork in field sites based on these findings.

The teacher introduces the students to real-time service of rains and hydrological observation system of the basin. The concrete example here is Segura Basin Water Authority in SE Spain, one of the driest areas of Europe mostly semiarid but with a strong gradient of precipitation (180-1200 mm of average annual rainfall).
<https://www.chsegura.es/chs/cuenca/redesdecontrol/SAIH/>

The students are shown how to access to any meteorological or to hydrological station in the basin and how to download data (10 minutes). Each group is instructed to download data from different stations giving them a time limit of 10 minutes to locate the stations, download data and consolidate data on a spreadsheet. Then all the groups are supplied with data of rainfall and water flow in a permanent river, and intermittent water course and an ephemeral water courses (as close to the school as possible), previously selected and downloaded by the teacher. The students are asked to produce graphs of rainfall-runoff along time (20 minutes). Then the whole class discuss results and are asked to plan a sampling scheme based on the graphs and on the essays produced in the conceptualization phase. The planning should capture seasonality of flows. The sampling will be applied on the areas explored on the phase of conceptualization.

Also several students will be asked to volunteer as 'hydrological wards'. As rainfall is difficult to forecast more than a few days in advance it may be not useful to conclude the planning of the experimentation fixing dates for observation. It is better to be flexible and have an eye on the meteorological developments. The idea also is to stimulate students to Earth observation techniques and let them to understand inherent meteorological variability and observe its effects on hydrology. Hydrological wards will continuously monitor the rains and hydrological monitoring system and will be asked to learn to themselves to monitor meteorological forecasting.

For Spain amet.es (National Weather Service) and windy.com (independent webpage with worldwide coverage and richly interactive) will be suggested. The hydrological wards do alert and advise the teacher and other students about coming or happened events and will suggest good dates to monitor flows.

2) Performing

Location: work groups along the water course, outdoor

Time: 2 days

Materials:

Water current meter. As it is expensive it can be substituted by a piece of cork and cronometers incorporated on the mobile phones. Conductivity meter and/or water thermometer. Conductivity meters measures electrical conductivity and hence estimate water salinity, are also expensive but are widely available from many users. Carpenter's meter to measure channel dimensions and estimate flows with the measured water speed. Mobile phones (cronometer; GPS; photographs). Notebook and pen.

Each of the two days the group of students will ove along the water courses. Ideally at least one intermittent and one ephemeral water course will be chosen. And the monitored length will be 1-2 km. As students move along the water course they will record:

1. Spatial continuity of flow. GPS coordinates will be recorded when flow disappear and when it is resumed.
2. Flow estimated by the channel cross-section (measured with carpenter's meter) and flow speed (current meter or alternatively measuring the speed of a piece of cork in a short reach of the stream. The flow will be measured each 100 m. And students will keep the records of cross-sections and water speed. GPS coordinates will be also recorded and measurements points will be marked in the first visit to try to repeat measurements in the same pot at the second visit.
3. Conductivity, salinity and temperature at the same points than flow is measured.
4. Photographs of each point.
5. Presence of flood marks. Flood marks are rests of vegetation, debris and/or sediments that are intercepted by vegetation or prominent features like large rocks. Height of flood marks and perpendicular distance to the center of the channel let to estimate the dimension of floods.

3) Data analysis

Location: Homework

Time: 1-4 hours

Materials: Field records and computers.

Each group will be in charge of analyzing a piece of information. Both field visits will be analyzed at the same time. They have to graph and tabulate data.

First group will prepare maps of spatial continuity of flow on both season. They will be instructed to create a KML file to represent results on Google Earth as well as to introduce vector data on QGIS. The final objective of this group is to obtain a map of differences on water flow continuity. Second group do represent flow variations along the water course and between field visits.

Third group will proceed similarly but with measurements of water quality and the photographs. Photographs will be used to visually assess differences in water colour and transparency. Students will establish an ad hoc scale of 4 levels of water transparency and color. Fourth group will locate flood marks on a map and will estimate the cross-section of the flood in each point.

Conclusion

Time estimated: 55 minutes

Where the activity takes place: in the classroom, computer lab

Method (how the students have to work): group-work (of 5-7 students)

Instructions for the teacher:

Students have to prepare a presentation with software for presentations.

. Each group will have 7 minutes for the presentation. Then the teacher will open a common discussion of the groups to put in common the different pieces of information (15 minutes). Finally, the teacher will conduct a discussion to obtain a common conclusion set of the research about seasonality of water courses on the area of the school.

Discussion

Time estimated: 30 minutes

Where the activity takes place: in the school

Method (how the students have to work): Open presentation to the school students

Instructions for the teacher:

The short duration is intended to students understand and learn to summarize as much as possible the communication of scientific results as well as to coordinate a presentation with different participants.

Four students elected by their pairs will carry out a presentation structured with: (i) introduction and objectives; (ii) methods; (iii) results; and (iv) discussion and conclusions.