Comparing Croatia Climates: A GLOBE Data Exploration

Purpose

Through explorations of GLOBE atmosphere data from Croatia, students will build an understanding of two climate zones.

Overview

Students compare GLOBE atmosphere data from a coastal and inland location in Croatia to explore differences in climate. Then they expand this understanding by putting the Croatia example into the context of the world map of Koppen-Geiger Climate Classification and make predictions about what other areas of the world have a regional climate similar to the two Croatian locations.

Student Outcomes

Students will be able to:

- Summarize weather data from two different GLOBE schools in Croatia with summary statistics
- Classify the climate of the locations based on their summary statistics and cite evidence for their classifications
- Compare the two climates and explain why two relatively close locations have different climate

Science Concepts

- *Earth Systems Science*
- *Weather and Climate*
- *Seasons*
- *Weather can be described with quantitative measurements*
- *Weather changes day to day and over seasons.*

Science Practices

- *Analyzing and interpreting data*
- *Constructing explanations*
- *Obtaining, evaluating, and communicating information*

Time

Two class periods (100 minutes) for the computer-based activity

One class period (50 minute) for the pencil and paper activity

Level

Middle and high school (grades 6-12)

Materials and Tools

For the computer-based activity:

- Computers with access to Microsoft Excel or Google Sheets
- The data file linked with this activity
- *Student Activity Sheets A* and *B*
- *Data Analysis Instructions*

For the pencil and paper activity:

- *Weather Data*
- *Student Activity Sheet B*

For both versions:

- *Climate Zone Chart*
- *Map of Koppen-Geiger Climates*
- *Map of GLOBE School Locations*

Preparation

- Copy the activity sheets for each student.
- Copy the other handouts needed in color for each pair or group, or prepare to project them for the class.

Prerequisites

Students with some knowledge of spreadsheet software will be able to accomplish the computer-based version of this activity with greater ease than students who are not familiar with the software. If your students are not familiar with the software, you might choose to do this activity over a longer time and guide the experience for students, or use the pencil and paper version of the activity.

If you are using the computer-based version, make sure the spreadsheet file that students

will use is loaded into computers and that the file opens.

Crosswalks to other GLOBE Learning Activities

This activity is a good introduction to the more in depth analyses of climate zones in *C2: What Is Your Climate Classification?* and *How Do Seasonal Temperature Patterns Vary Among Different Regions of the World*?

Background

The Koppen-Geiger Climate Classification system (see map on page 9) is based on annual and monthly averages of temperature and precipitation, divided into five major climate types (A-E). Each zone is subdivided depending on specific climate conditions. A sixth category (H) is often used as a designation for climate affected by high altitude. The version of the Koppen-Geiger map in this activity is from the following journal article and is freely available for educational use at:

> Peel MC, Finlayson BL & McMahon TA (2007), Updated world map of the Köppen-Geiger climate classification, Hydrol. Earth Syst. Sci., 11, 1633-1644.

In Croatia, climate varies within a relatively small geographic area. The relatively warm Mediterranean sea causes the climate of coastal areas to be much warmer than the climate of inland areas. In coastal Croatia, snow is very rare in winter. There are two types of C climate in the coast. Inland the climate is D, a moist, mid latitude climate with cold winters.

- **Temperate Climate (C)** is warmer than a continental climate and found at mid-latitudes. Most precipitation occurs in the winter and summers are dry. This category includes climates called “Mediterranean” which have mild temperatures due to proximity to the Mediterranean Sea.
- **Continental Climate (D)** is moist with cold winters and found in mid-latitude locations. The average temperature in warmest month is greater than 10°C while the coldest month is below freezing.

About the data:

The data that students explore in this activity were collected by students at two GLOBE schools in Croatia.

- Location 1: Inland Croatia, Tehnicka skola Daruvar (Koppen Dfb climate)
- Location 2: Coastal Croatia, OS Murterski Skoji School (Koppen Csa climate)

What To Do and How To Do It

Step 1. Orient students to the project.

Ask students to relate a time when they have experienced changes in weather conditions when they have traveled from one location to another in a short period of time.

Show students a map of the climate zones of the world (page 9). Ask students what they notice about the Koppen-Geiger Climate Classification (*Students may notice that there are five major climate zones and many subcategories within each zone, plus a sixth zone for high altitudes*).

Tell students that in this activity they will investigate the climate zone of two locations in Croatia based on temperature information collected by GLOBE students. Let students know that scientists use 30 years of weather data to classify climates. In this activity they will use far fewer years and see if they can figure out the climate.

Step 2. Students take averages to see seasonal differences in temperature and precipitation.

(Note: Proceed to Step 3 if you are not doing the computer-based version of this activity.)

Instruct students to follow the directions on the *Data Analysis Instructions* to perform the calculations. Using the spreadsheet file, they will fill out *Student Activity Sheet A*.

Before they begin, ask students about the skills that they will need to use (how to average numbers and how to sum numbers).

Step 3. Students describe each place and decide which Koppen-Geiger Climate Zone it is within.

Have students use their completed *Student Activity Sheet A* (or the *Weather Data* page

if you are not using spreadsheets) with the *Climate Zone Chart* to decide which climate zone each location is within. Have students provide their answers on *Student Activity Sheet B.*

Step 4. Students discuss why there is a difference between places.

Have students explain to each other what climate zone they think the two locations are within. Then share with students what climate zone each location is within according to long records of weather data (30 years). Remind students of the map of climate zones of the world that they saw earlier in this activity.

Have students brainstorm what could be the reason for the differences between the climate of the two locations. Students may suggest latitude differences, or elevation. The latitude and elevation are provided in the spreadsheet for each location. Students should notice that the numbers are similar. Show students the Koppen-Geiger map of the world and the location of Croatia on the Mediterranean Sea. Show students the Croatia Map and point out the proximity to the coast. What if both locations were near a large body of water? Would you expect the same results? Why or why not? How did you reach that conclusion? Does it make sense?

Ask students how certain they are about their climate zone results. Ask students what causes some uncertainty. Students may mention that having a longer record of temperature and precipitation would make them more certain. Students may also notice that Location 2 (OS Murterski Skoji) had incomplete data. Students may also notice that winters are very close to the threshold in D for Location 1 (Tehnicka skola Daruvar).

Assessment

- If using the computer-based version of this activity, ensure students have calculated correct averages in the table on *Student Activity Sheet A* to assess understanding of calculating averages in Excel.
- Students explanations of the climate zone that they have selected for each location and the evidence they cite on *Student Activity Sheet B* will allow assessment of understanding of how to use the climate key and classify locations by climate zone.

Extensions: Delve Deeper into GLOBE Data

- Have students explore their climate zone by collecting GLOBE temperature and precipitation data (using the atmosphere protocols available at globe.gov).
- Have students use the GLOBE Advanced Data Access Tool to explore the seasonal temperature pattern in the southern hemisphere and compare it to the pattern in the northern hemisphere.
- Explore the impact of latitude on seasonal patterns of temperature with the GLOBE Climate and Latitude Learning Activity in this GLOBE Data Explorations series.
- Have students collect air temperature and precipitation data according to the GLOBE Atmosphere Protocols and classify their own climate.

Credits

This activity is part of *GLOBE Data Explorations*, a collection of activities developed by the UCAR Center for Science Education (scied.ucar.edu), a GLOBE partner. Activities were reviewed by science educators and staff at GIO and field tested by teachers.

Comparing Croatia Climates
Student Activity Sheet A

Name _____

Date _____

In this activity you will classify the climate based on weather data collected by GLOBE students in Croatia over five years (2002-2006) in two locations. Note that we are only using five years of data instead of 30 years, which is what climate zones are based upon. Use the spreadsheet provided to determine mean temperature and mean precipitation for both locations over the five-year period. (See the *Data Analysis Instructions.)*

Location 1
School name: _____
Elevation: _____
Latitude: _____
Longitude: _____

	Average temperature (°C)
ALL DATA	
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Average Annual Temp:	

	Average precipitation (mm)
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Location 2
School name: _____
Elevation: _____
Latitude: _____
Longitude: _____

	Average temperature (°C)
ALL DATA	
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Average Annual Temp:	

	Average precipitation (mm)
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Name _____

Date _____

What's the climate?

For location 1:
I think the Koppen- Geiger Climate Zone is _____

This is the evidence in support of that hypothesis:

How sure are you?
- ☐ Very sure
- ☐ Somewhat sure
- ☐ Not sure

Are there any other data that you'd like to have to be even more sure? If so, what type of data?

For location 2:
I think the Koppen- Geiger Climate Zone is _____

This is the evidence in support of that hypothesis:

How sure are you?
- ☐ Very sure
- ☐ Somewhat sure
- ☐ Not sure

Are there any other data that you'd like to have to be even more sure? If so, what type of data?

In the file, notice that there are two tabs at the bottom of the screen – one for Location 1 and one for Location 2. Clicking on a tab will bring you to that section of the data.

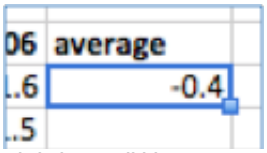
AVERAGE MONTHLY TEMPERATURE	2002	2003	2004	2005	2006	average
January	0.9	-0.7	-0.7	0.2	-1.6	=average(B8:F8
February	7.0	-1.7	2.6	-1.9	1.5	AVERAGE(numbe
March	8.8	7.1	5.7	4.6	5.3	
April	11.0	10.5	11.8	11.2	12.3	
May	18.2	18.7	14.3	16.0	15.4	
June	20.9	23.4	19.0	18.9	19.4	
July	22.2	22.3	20.1	21.2	22.8	
August	21.2	24.2	21.0	19.2	19.2	
September	15.8	16.1	15.9	17.1	17.7	
October	12.0	9.6	13.7	11.9	13.8	
November	10.5	9.1	6.6	5.5	8.6	
December	1.9	2.1	1.7	1.7	4.2	

Calculate average monthly temperatures for each location.

1. Click on a cell of the spreadsheet to the right of the temperature data.
2. Add **=AVERAGE(** to the cell.
3. Select the five January average temperatures by clicking on the January 2002 cell of data and then dragging to the right to select January 2003, 2004, 2005 and 2006. This will indicate which data you want to average.
4. Go back to the cell with the formula and you will see something like **= AVERAGE(B8:F8**. Add a **)** to the end of the formula and hit the return key. The spreadsheet should calculate the average from the data you selected.
5. To average the rest of the months, click on the cell with the formula you just wrote, click on the blue square in the lower right corner (see image below) and drag downward until you are at the December row.

Calculate average annual temperature for each location.

1. Click on the cell below the monthly averages that you just calculated and type the formula for an average **=AVERAGE(** to the cell.
2. Select the twelve monthly average temperatures in the column, add a **)** to complete the formula. Click return.



Click the small blue square in the lower right and drag downward to copy the formula to cells below.

Calculate the average monthly precipitation for each location.

1. Click on a cell of the spreadsheet to the right of the temperature data.
2. Add **=AVERAGE(** to the cell.
3. Select the five January precipitation measurements by clicking on the January 2002 cell of data and then dragging to the right to select January 2003, 2004, 2005 and 2006. This will indicate to the formula which data you want to average.
4. Go back to the cell with the formula. Add a **)** to the end of the formula and hit the return key. The spreadsheet should calculate the average from the data you selected.
5. To average the rest of the months, click on the cell with the formula you just wrote and drag downward on the blue square in the lower right corner (see image above) until you are at the December row.

Calculate total average precipitation for each location.

1. Click on the cell below the monthly averages that you just calculated and type the formula for to add the numbers **=SUM(** to the cell.
2. Select the twelve monthly average precipitation numbers in the column, add a **)** to complete the formula and hit the return key.

Calculate the percentage of precipitation between April and September.

In order to find the climate zone, you will need to know how much precipitation falls from April to September.

1. Click on an empty cell and type the formula to add the numbers **=SUM(** to the cell.
2. Select the April, May, June, July, August, and September monthly average precipitation numbers, add a **)** to complete the formula and hit the return key.
3. To find out what percentage of precipitation this is, click an empty cell and add the formula **=(A/B)*100** in which 'A' is the total precipitation between April and September and 'B' is the total average precipitation.

Comparing Croatia Climates
Weather Data

In this activity you will classify the climate based on the weather data below. It was collected by GLOBE students in Croatia over five years (2002-2006) in two locations. Note that we are only using five years of data instead of 30 years, which is what climate zones are based upon.

Location 1
School name: Tehnicka skola Daruvar
Elevation: 145.3 meters above sea level
Latitude: 45.5972° N
Longitude: 17.2216° E

	Average temperature
January	-0.4°C
February	1.5°C
March	6.3°C
April	11.4°C
May	16.5°C
June	20.3°C
July	21.7°C
August	21.0°C
September	16.5°C
October	12.2°C
November	8.0°C
December	2.3°C
Average Annual Temp:	11.4°C

	Average precipitation
January	49.3 mm
February	55.5 mm
March	46.9 mm
April	96.8 mm
May	85.0 mm
June	62.5 mm
July	62.6 mm
August	106.6 mm
September	91.1 mm
October	46.6 mm
November	75.2 mm
December	39.9 mm

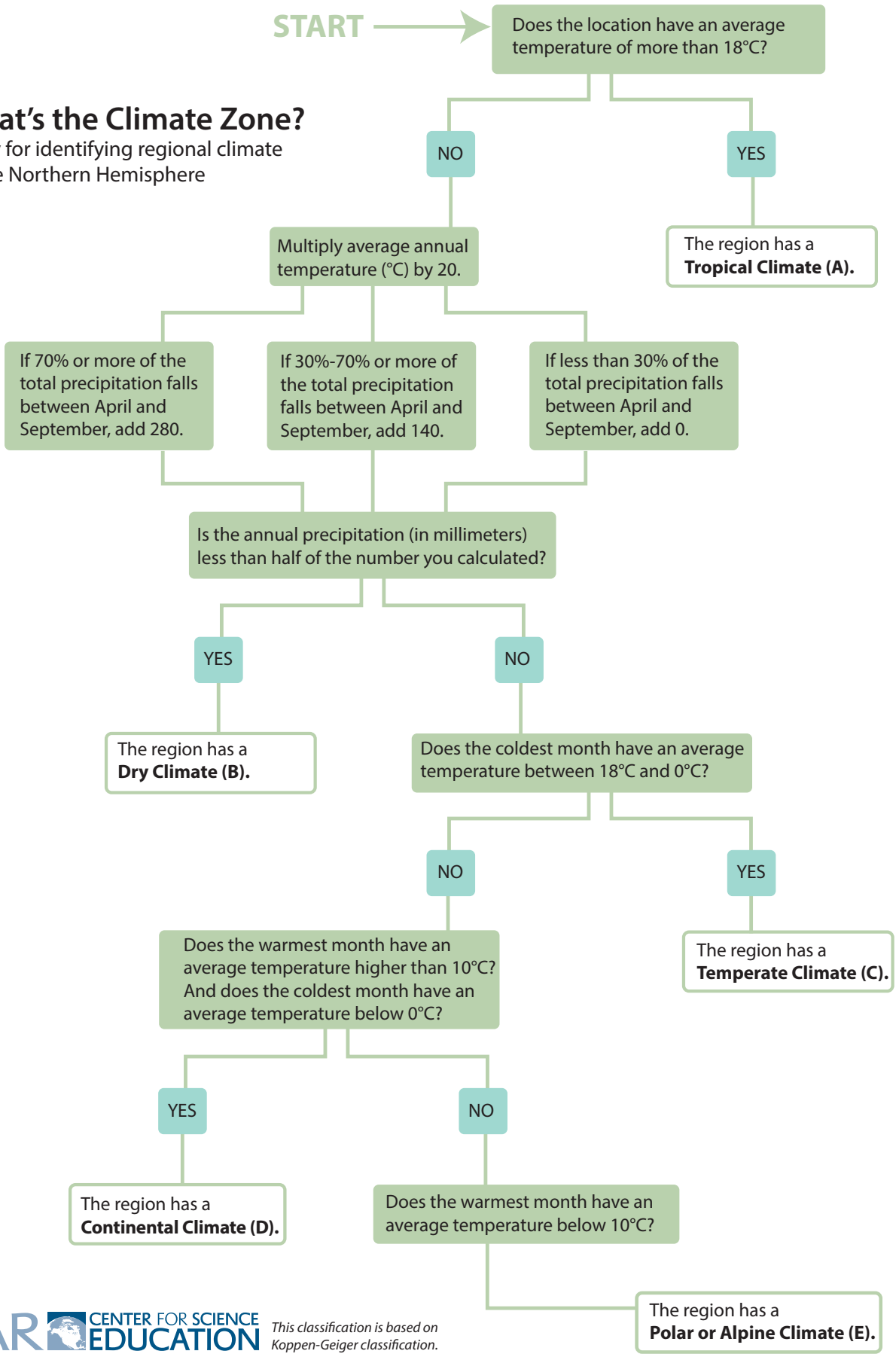
Location 2
School name: OS Murterski Skoji
Elevation: 16.6 meters above sea level
Latitude: 43.8098° N
Longitude: 15.5907° E

	Average temperature
January	6.0°C
February	7.2°C
March	10.7°C
April	14.4°C
May	20.2°C
June	24.4°C
July	26.9°C
August	24.7°C
September	22.0°C
October	18.8°C
November	13.0°C
December	9.3°C
Average Annual Temp:	16.4°C

	Average precipitation
January	67.2 mm
February	53.2 mm
March	58.6 mm
April	81.6 mm
May	50.9 mm
June	34.2 mm
July	55.6 mm
August	82.5 mm
September	41.6 mm
October	70.1 mm
November	102.4 mm
December	112.5 mm

What's the Climate Zone?

A key for identifying regional climate in the Northern Hemisphere



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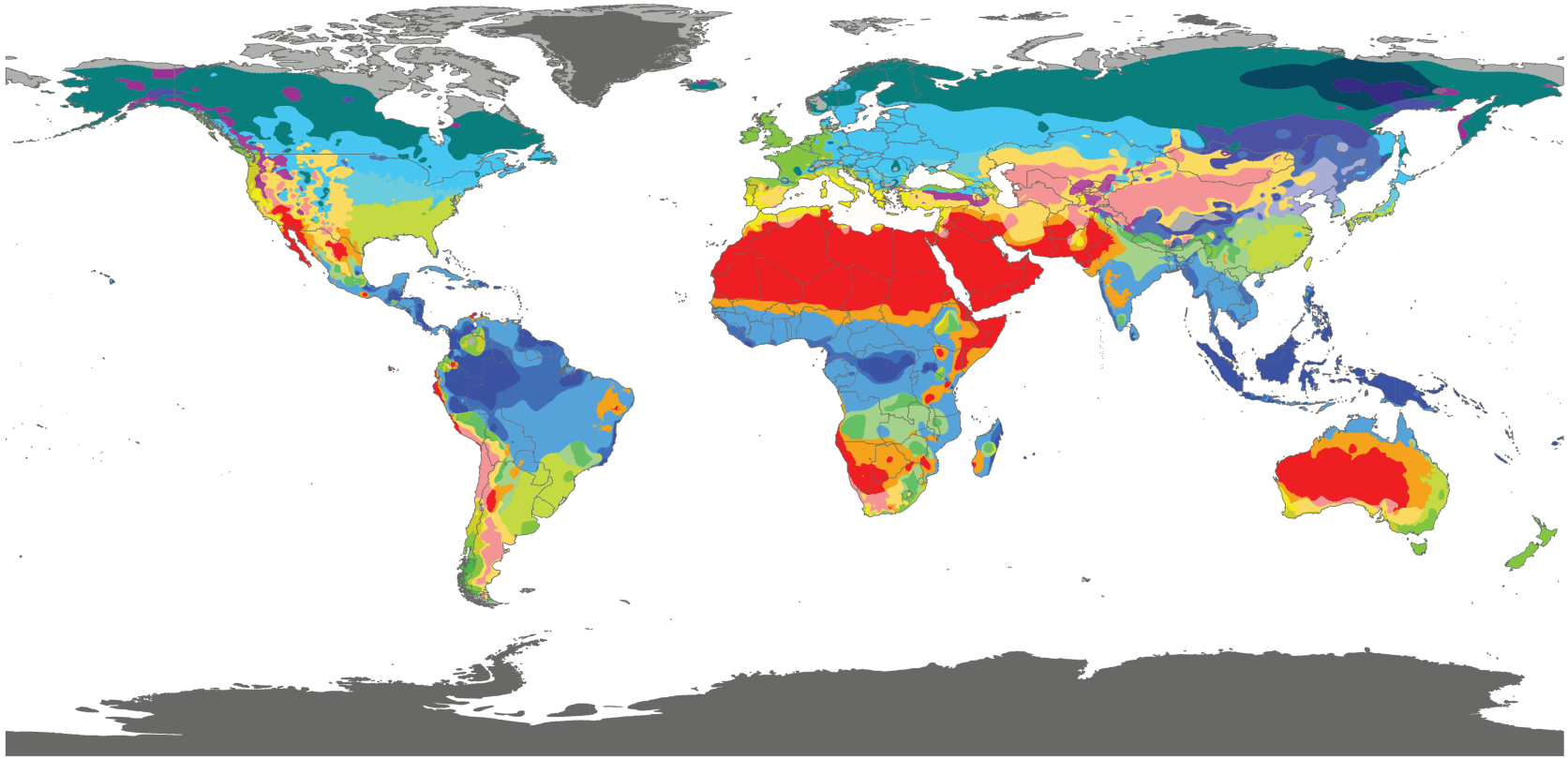
This classification is based on Koppen-Geiger classification.

World map of Köppen-Geiger climate classification



Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSh		Cwc	Cfc	Dsc	Dwc	Dfc	
	BSk				Dsd	Dwd	Dfd	

Contact : Murray C. Peel (mpeel@unimelb.edu.au) for further information

DATA SOURCE : GHCN v2.0 station data
Temperature (N = 4,844) and
Precipitation (N = 12,396)

PERIOD OF RECORD : All available

MIN LENGTH : ≥30 for each month.

RESOLUTION : 0.1 degree lat/long

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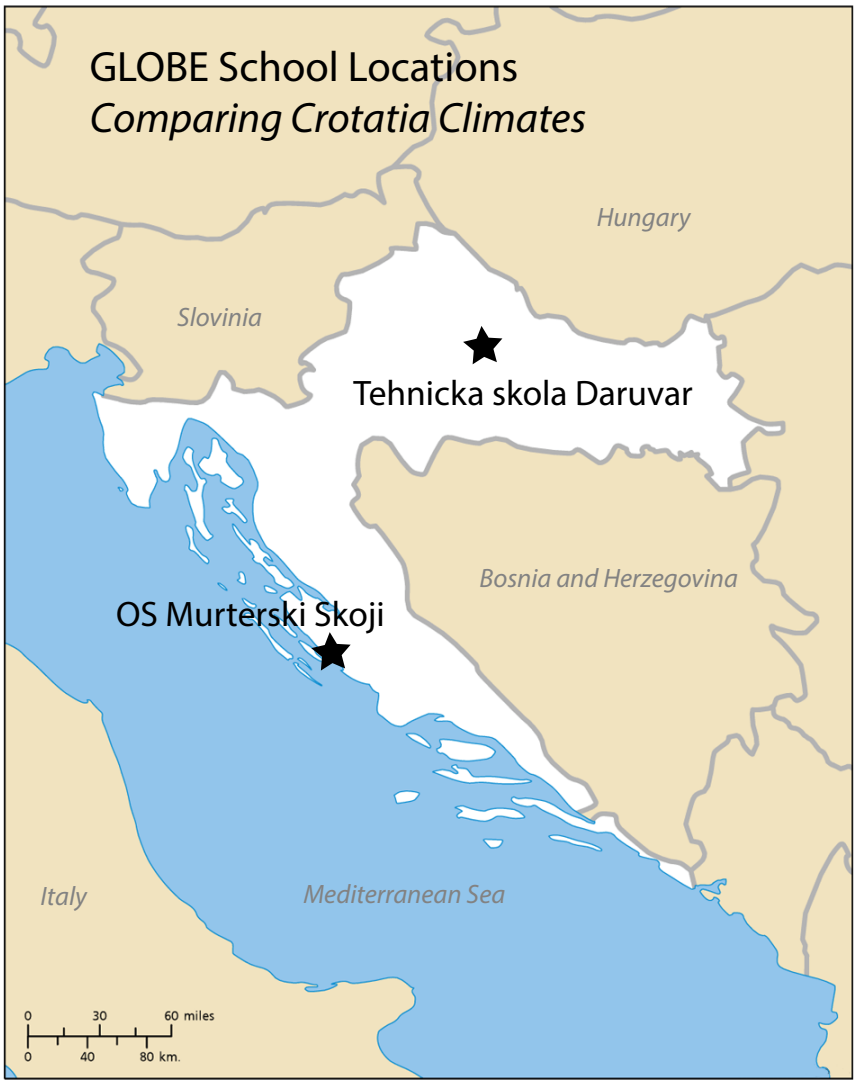
Courtesy of Peel et al (2007)


GLOBE School Locations
Comparing Crotatia Climates
Hungary
Slovinia
Tehnicka skola Daruvar
Bosnia and Herzegovina
OS Murterski Skoji
Italy
Mediterranean Sea
0 30 60 miles
0 40 80 km.