Measurement of atmospheric CO_2 along a transect running from higher to lower altitude

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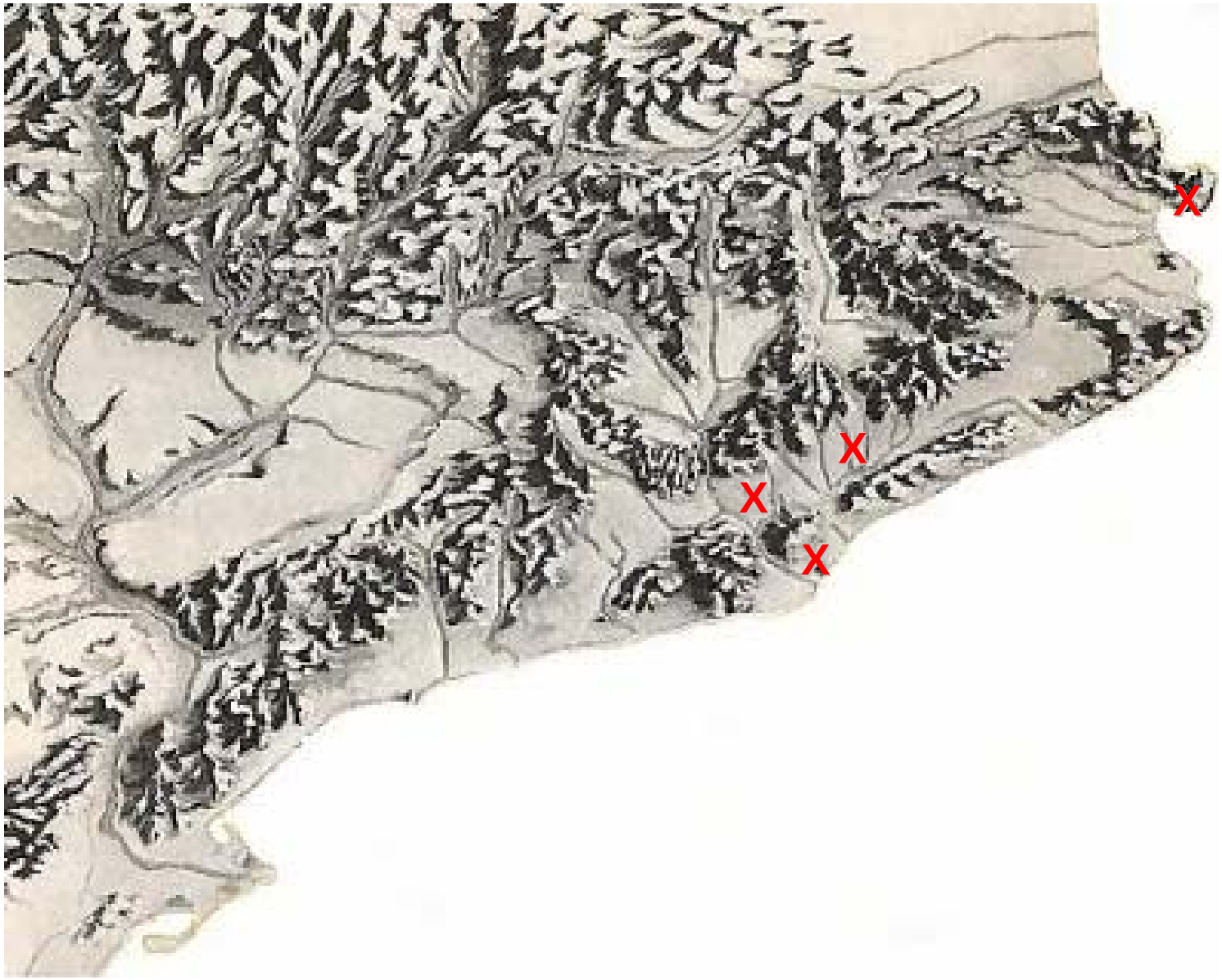
Background

- The distribution of atmospheric CO_2 concentration in the territory can be due to:
  - Distribution of sources and sinks of atmospheric CO_2
  - Transport of CO_2 due to long-range transport or local winds (breezes)
  - Atmospheric stability / Synoptic situation

Background



Questions

- Is there any CO_2 mixing ratio gradient related to the land use (city-countryside)?
- Is there any CO_2 mixing ratio gradient related to the development of local breezes (sea/land, katabatic winds)?
- Is there any CO_2 mixing ratio gradient related to the altitude (i.e. is there any decrease/increase when measurements are taken higher in altitude?)

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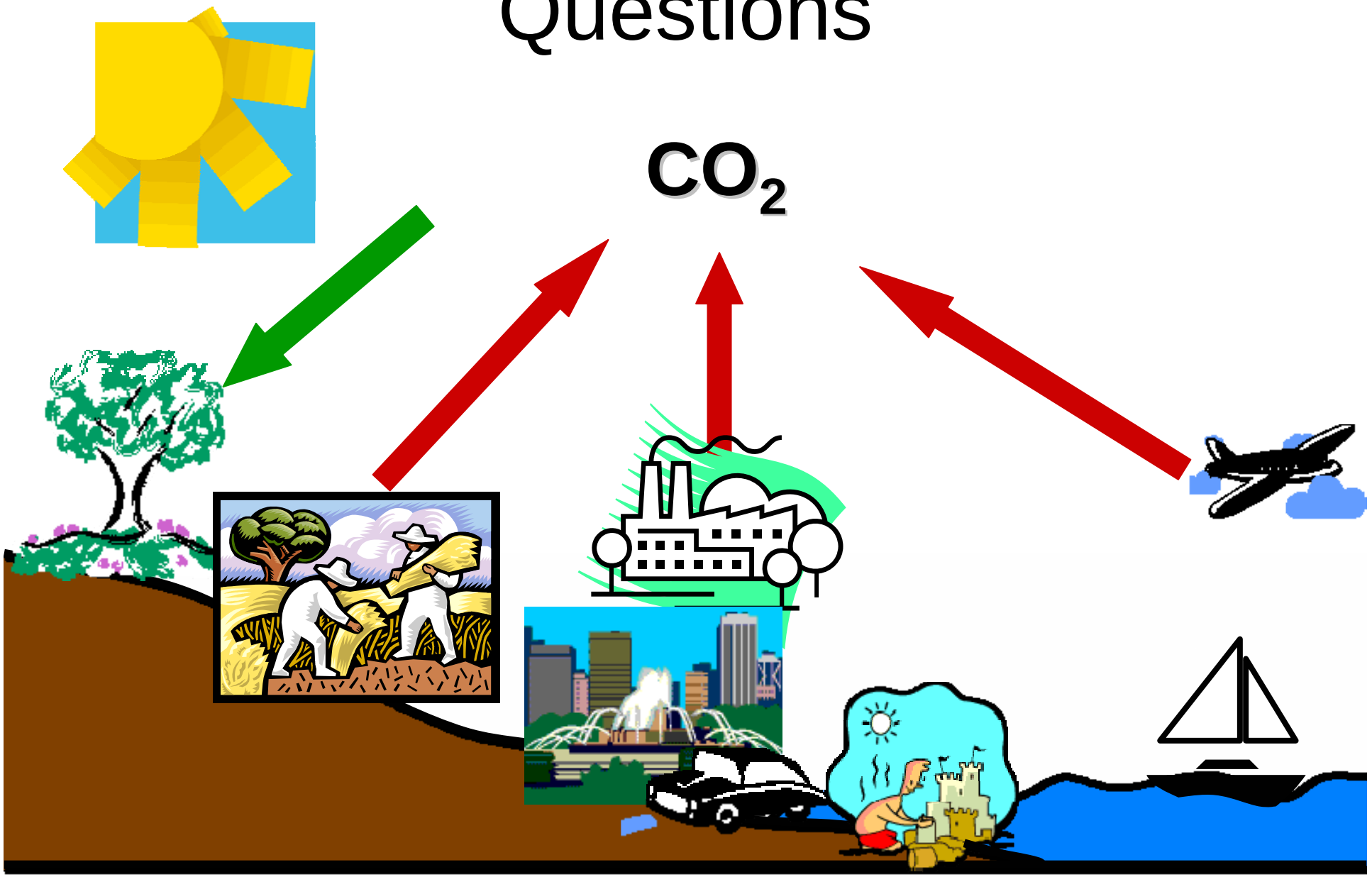

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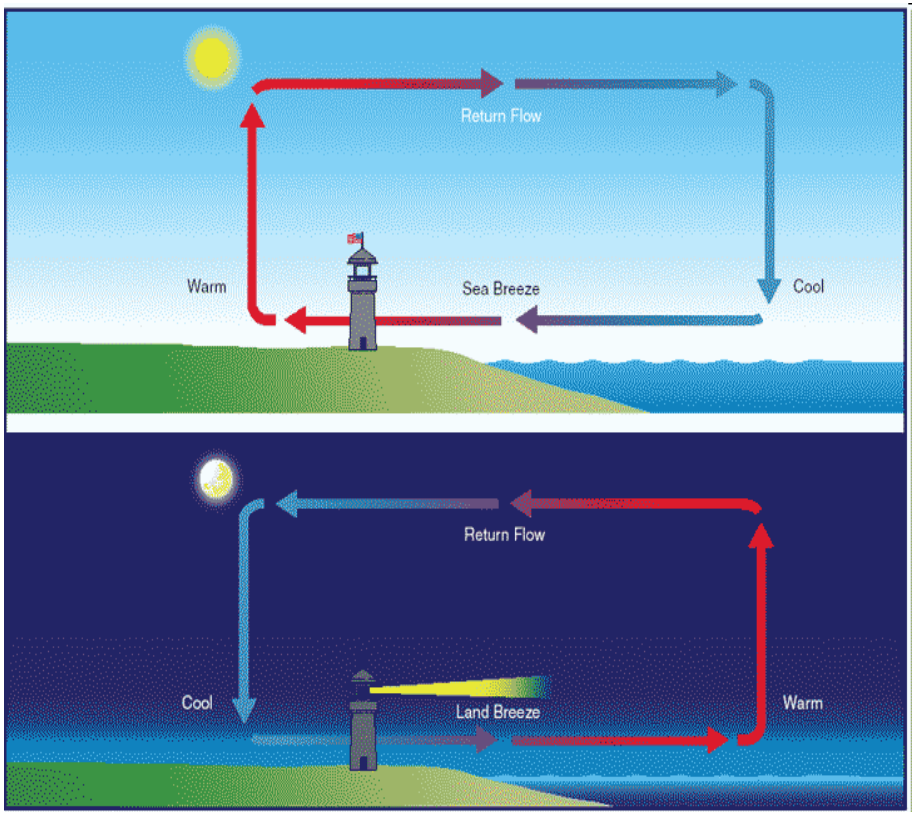
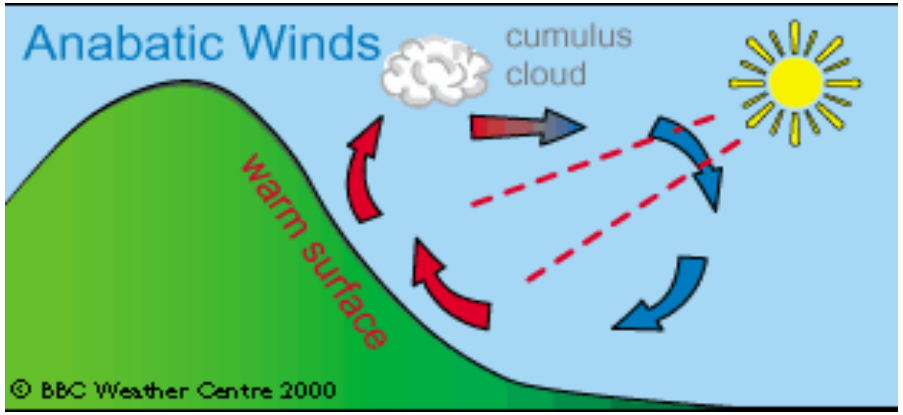
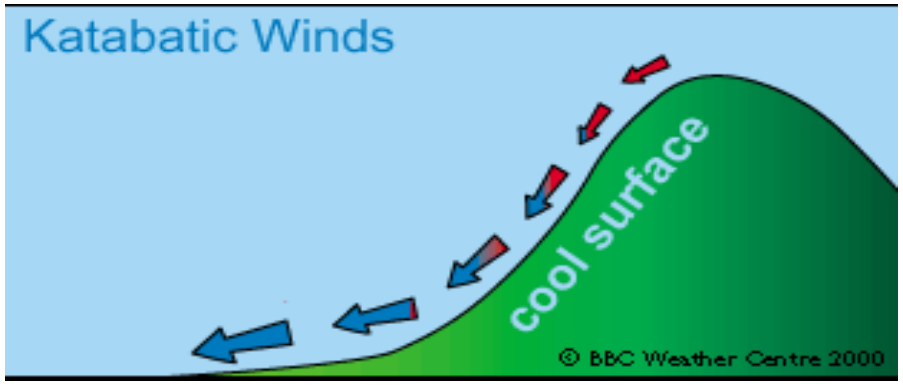
Sea / land breezes



Mountain breezes





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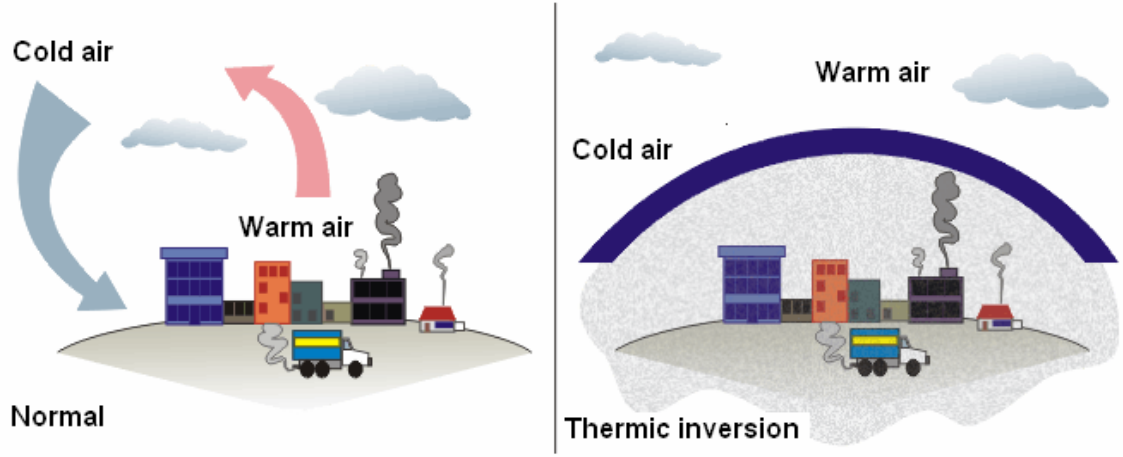
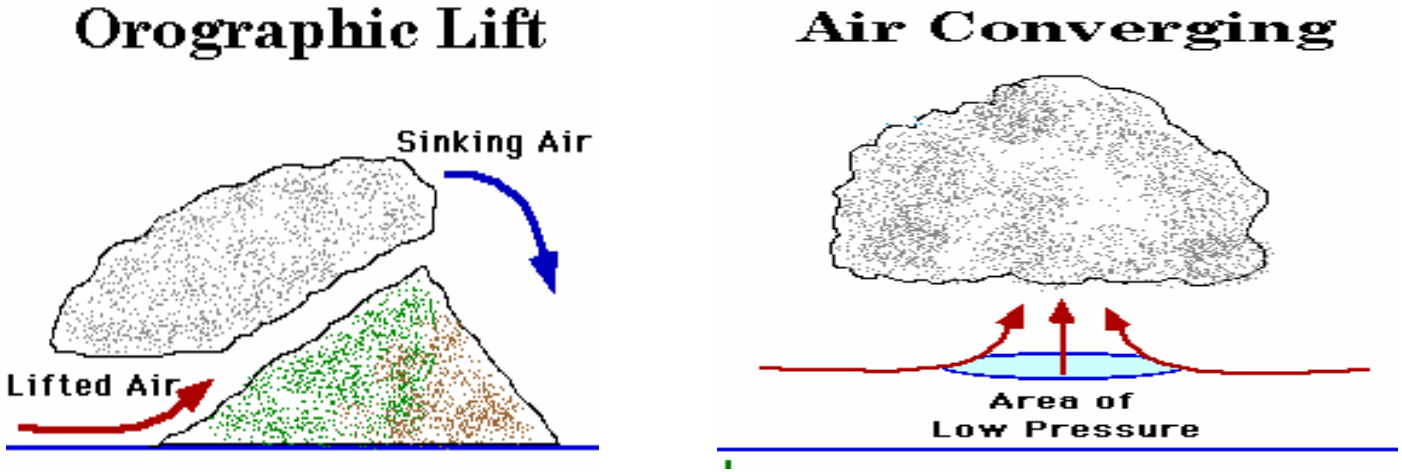
- Is there any CO_2 mixing ratio gradient related to the development of local breezes (sea/land, katabatic winds)?
- **Is there any CO_2 mixing ratio gradient in the altitude (i.e. is decrease/increase when measurements are taken higher in altitude) related to atmospheric stability?**

Questions

Inversion layers: accumulation of CO_2 near the surface



Unstable atmosphere: enhancement of vertical movements



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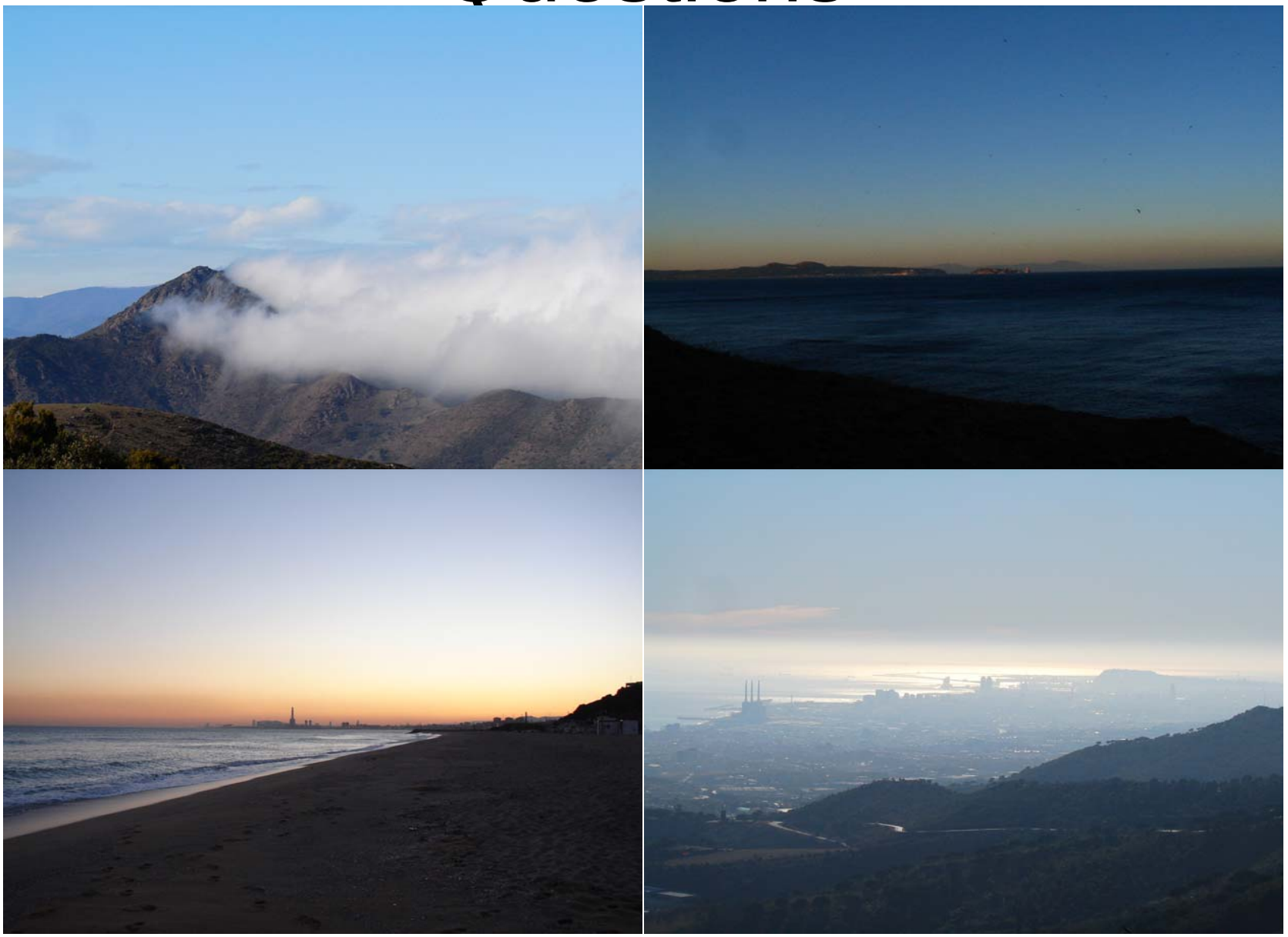


Scientific objectives

- Knowledge of the near-infrared techniques to measure atmospheric CO_2 mixing ratios
- Understand the CO_2 distribution along a horizontal transect related to land and anthropogenic uses
- Understand the CO_2 distribution along a horizontal transect related to wind transport

Conceptual objectives

- Learn how to measure meteorological parameters (wind velocity, RH, QFE-QNH, dew point) using the proper devices.
- Introduce the georeference technologies (GPS; Google Earth) and topographic maps.
- Work with spreadsheets: statistics and graphic representation.
- Improve the knowledge of topography and distribution of land uses of a territory close to the student’s place.

Procedural objectives

- Apply the scientific method.
- Develop autonomic skills.
- Cooperative work between scientists, students and teachers.

Material needed

- CO_2 sensor
- Support and protector for the sensor
- Portable meteorological station
  - -Temperature, Humidity, Atmospheric Pressure, Wind speed and direction
- GPS and topographical map
- Worksheet

Material needed

CO_2 sensor

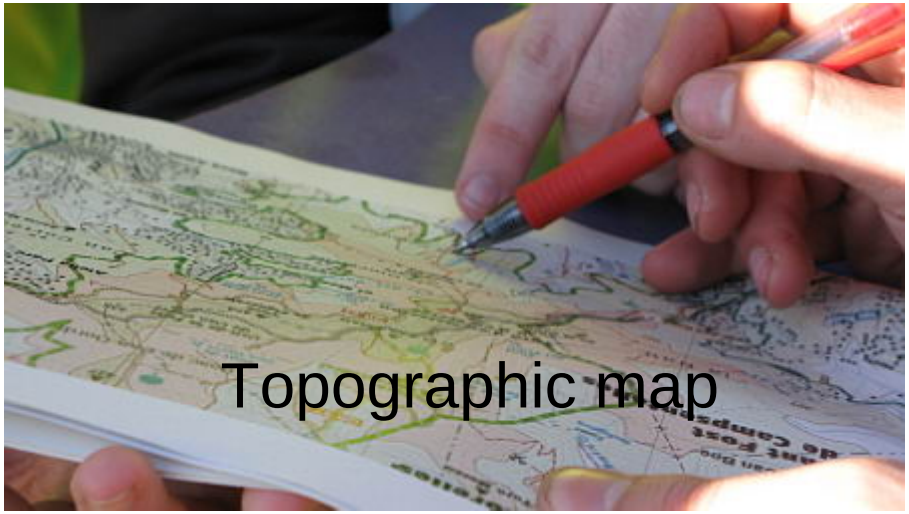
Solar radiation and rain protection

Portable meteorological station

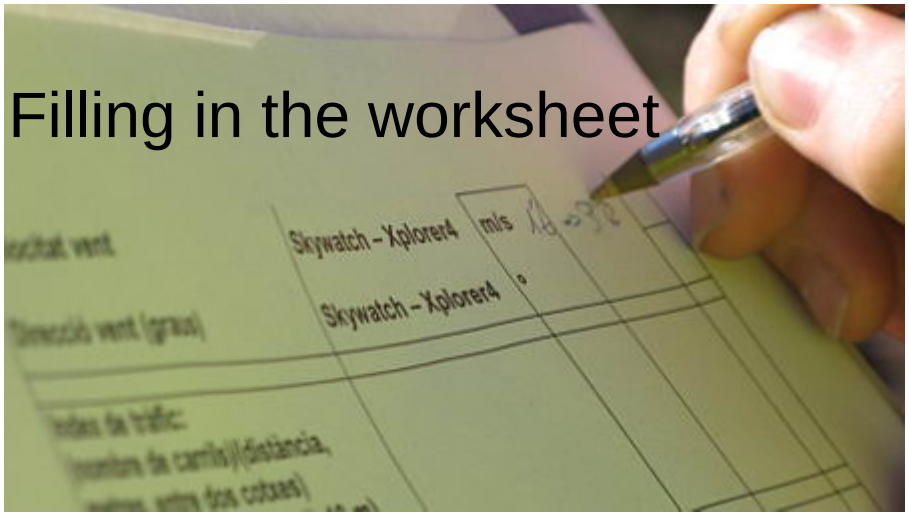
Support for the CO_2 sensor

Material needed

Anemometer and barometer



Topographic map



Filling in the worksheet

Development of the activity

1. Description of the measurement site
2. Description of the meteorological situation
3. Measurement of meteorological parameters: temperature, humidity, dew point, pressure, wind speed and direction
4. Measurement of CO_2 concentration (4 + 2 minutes): mean, maximum and minimum of the last 2 min

5. Other interesting features of the site: traffic index (city); etc.

Development of the activity

VAISALA REFERENCE NUMBER:

Date: Samplers:

Name	Center:

Weather	Sky	Cloudy	Partially cloudy	Misty	Clear
	Precipitation	Non	Light rain	Showers	

Site (localization):

	Instrumentation	UNITY	VALUE	CALIB.
Time (UT)		hh:mm		
Latitude	GPS			
Longitude	GPS			
Altitude (masl)	GPS Topographic map	m		
QNH Pressure reduced to the sea level	Skywatch – Xplorer4	hPa		
QFE Real pressure at the site	Skywatch – Xplorer4	hPa		
Relative Humidity	Hygrometer TESTO	(%)		
Dew point temperature	Hygrometer TESTO	ºC		
Ambient temperature	Hygrometer TESTO	ºC		
Wind speed	Skywatch – Xplorer4	m/s		
Wind direction	Skywatch – Xplorer4	º		
Traffic index: (number of lanes)/(distance, in meters, between two cars)				
F (freely) x<0.1 (ex:1 lane, 10 m) N (normal) 0.1<x<1 (3 lanes, 3 m) H (heavy) 1<x				

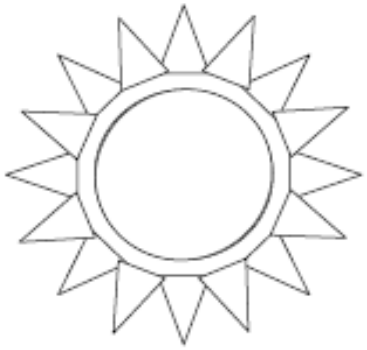
Development of the activity

Sun/shadow Suntrap/Shady				
RECORDED COMPROVATION				
Starting minute		mm:ss		
Recording interval		s		
Ending minute		mm:ss		
Minimum CO_2 concentration ppmv last 2 minutes (minus 30 seconds)	Vaisala CarboCap	ppmv		
Mean CO_2 concentration ppmv last 2 minutes (minus 30 seconds)	Vaisala CarboCap	ppmv		
Maximum CO_2 concentration ppmv last 2 minutes (minus 30 seconds)	Vaisala CarboCap	ppmv		

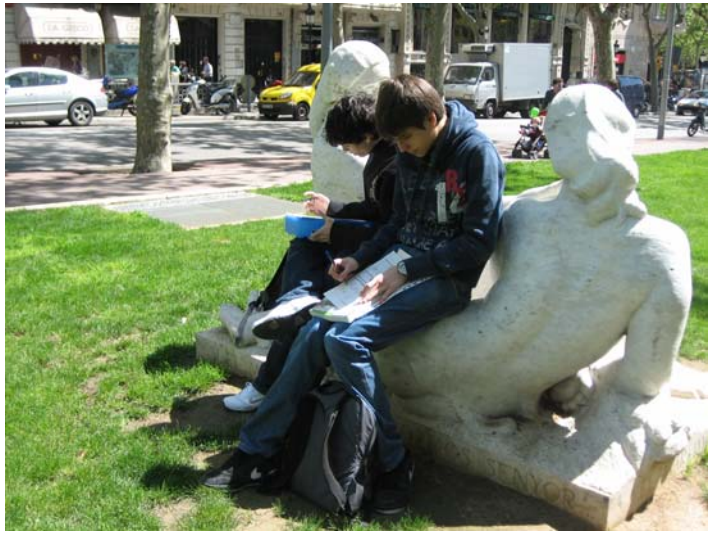
Comments, other interesting points:

Description of the site:

Compass rose:



Make sure that before leaving you have all following instruments:

	√
Vaisala CarboCap	
Skywatch – Xplorer4	
TESTO	
GPS	

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