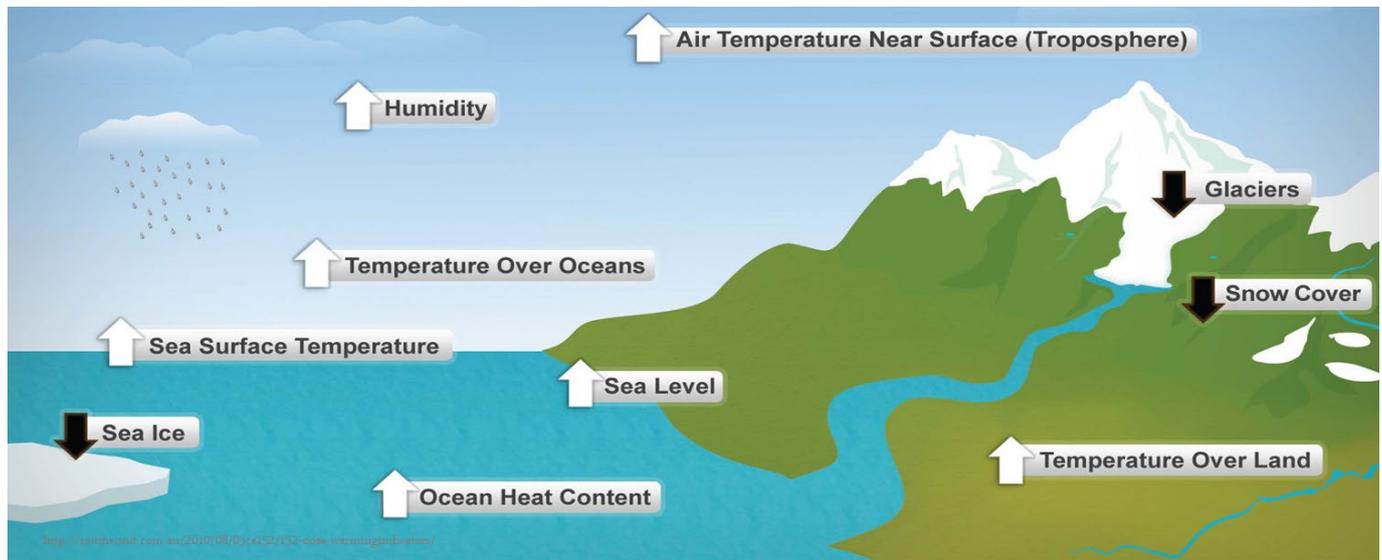




## What is Climate Change?

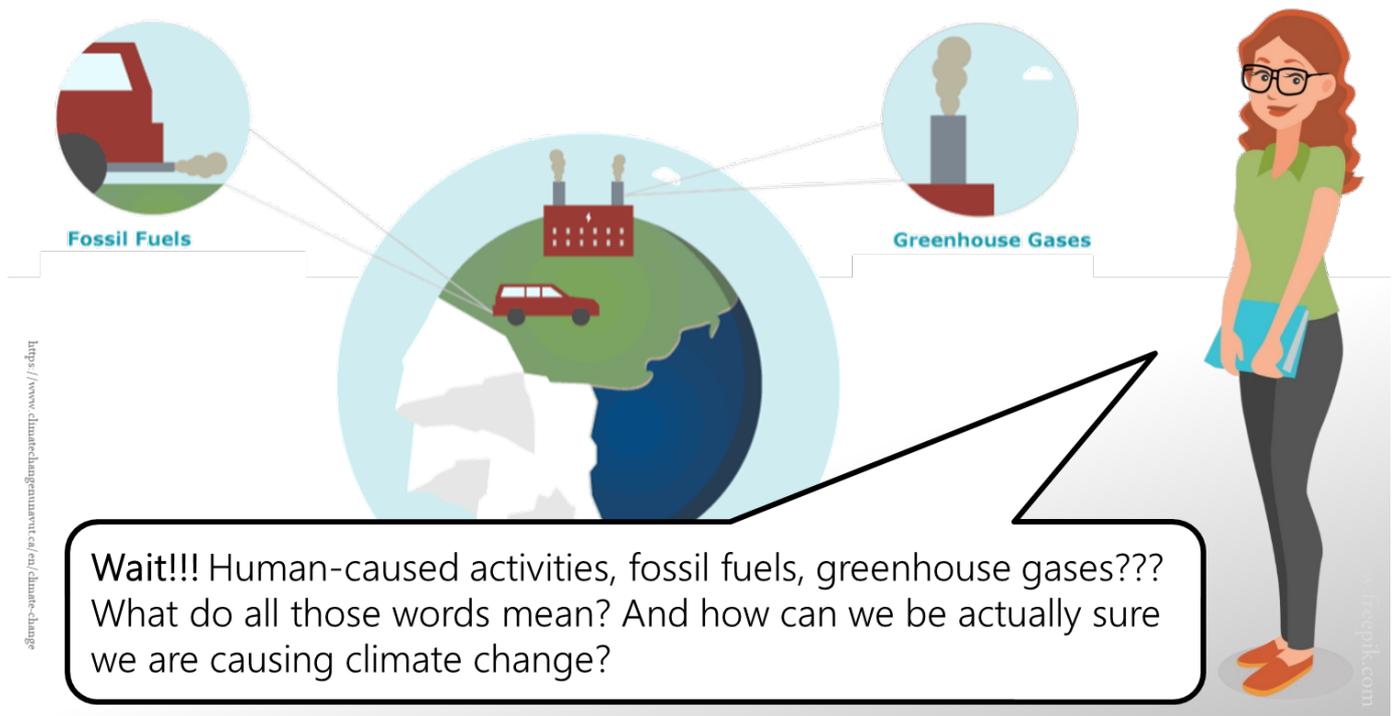
*Climate change* is a long-term change (that we can measure) in climate. The climate is always changing, as factors such as the amount of energy arriving from the Sun or concentrations of gases in atmosphere change as well.

BUT.... **the change has always been slow**, and now the climate is changing faster, and **this change is accelerating faster** than at any time in human history.



## Why is the Climate Changing?

This recent climate change is occurring due to **human-caused activities** (called anthropogenic activities). Past and present human industry, including the burning (combustion) of **fossil fuels**, transportation, and agriculture, have increased the concentration of **greenhouse gases** in the atmosphere.



## Are Humans responsible for climate change?

Scientists have been able to collect evidence, and use models, to tell the difference between natural sources and human sources of climate change. Evidence also shows that human made CO<sub>2</sub> is the main cause of climate change.

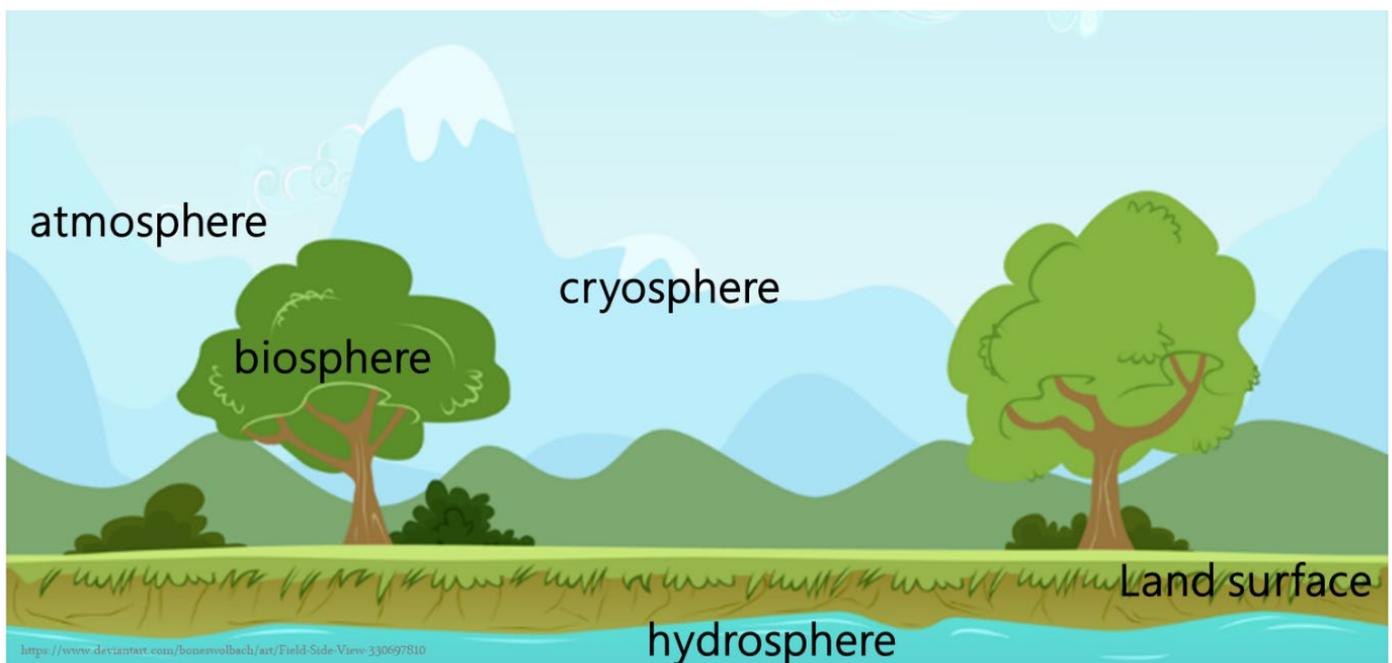


Lets start at the beginning, we need to find out what a *climate* is, where the carbon comes from, what greenhouse gases are, and how they cause the climate to change.

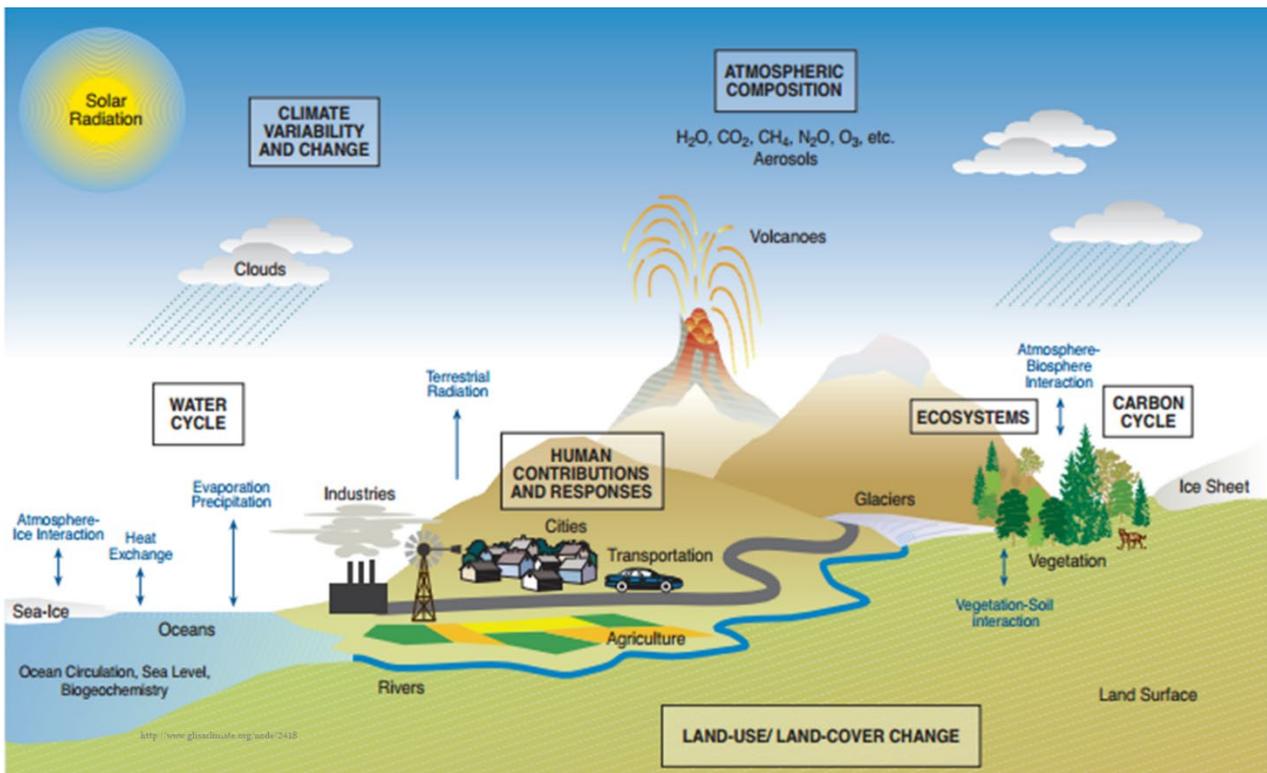
## Components of Climate

The climate system is an **interactive** system consisting of five major components

Component	Comprised of:
Atmosphere	N <sub>2</sub> , O <sub>2</sub> , Ar, H <sub>2</sub> O, CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, O <sub>3</sub> , aerosols
hydrosphere	Rivers, lakes, oceans
cryosphere	Sea ice, ice sheets, glaciers, and permafrost
Land surface	The top layer of the Earth, exposed to the atmosphere
biosphere	All living organisms found below, above and on the land

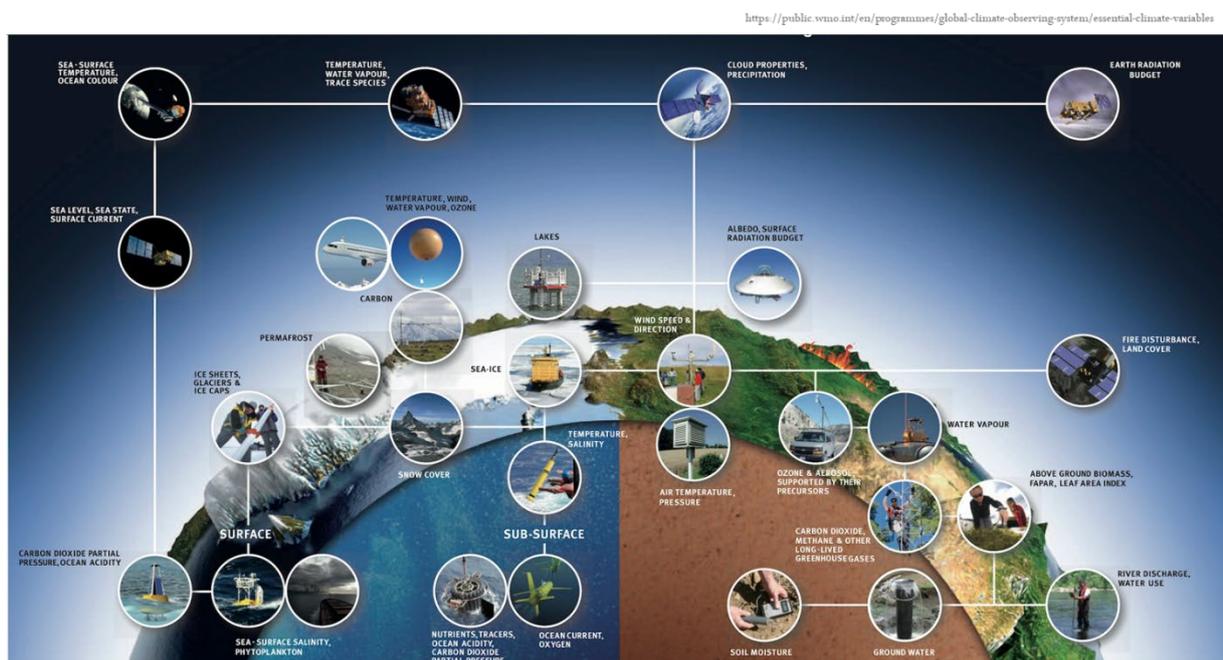


The components are influenced by many variables, the most important of which is the Sun. Any change, whether natural or human caused, in the components of the climate system and their interactions, may result in climate changes.



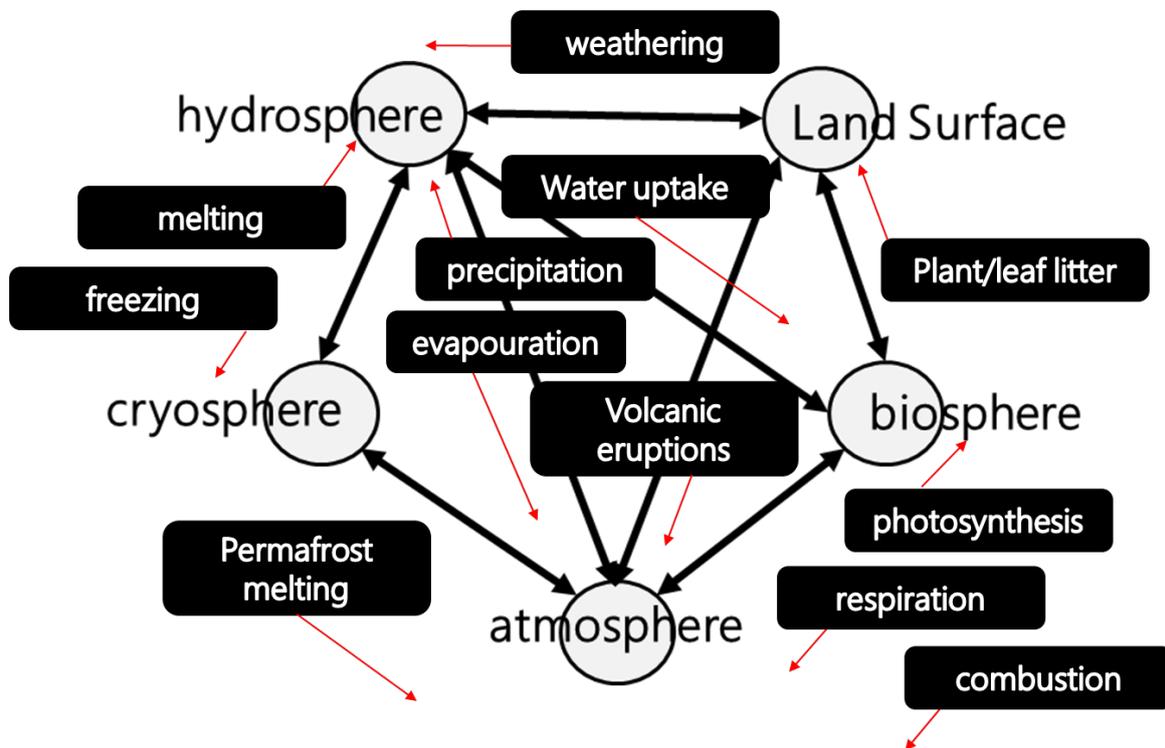
## Essential Climate Variables

*Climate* is influenced by **Essential Climate Variables (or signals)** that can be physical, chemical or biological. They include temperature, precipitation, and amounts of solar radiation. Climate is also determined by altitude, longitude, and the distance to large bodies of water, and in contrast to weather, which is normally limited to a smaller area, changes are much more gradual. These are measured to help us understand how the climate is changing



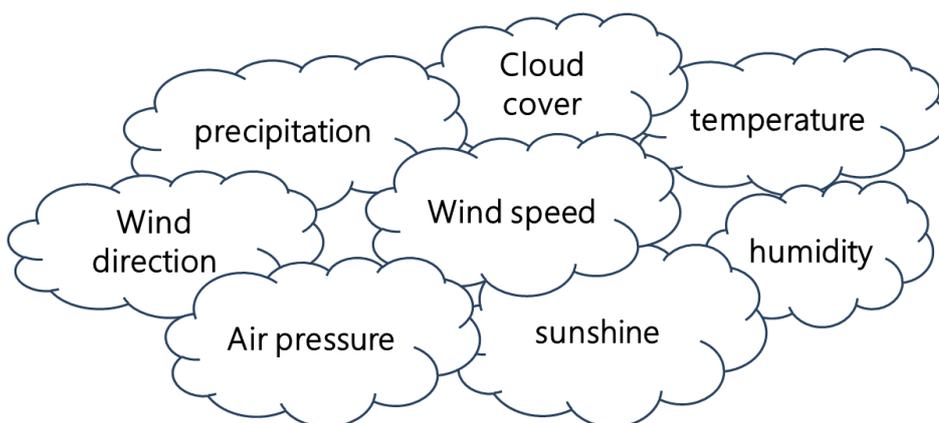
## Influences on Components of Climate

There are many different interactions that affect the climate – these are just a few. Which processes do you think can be influenced by human activity?



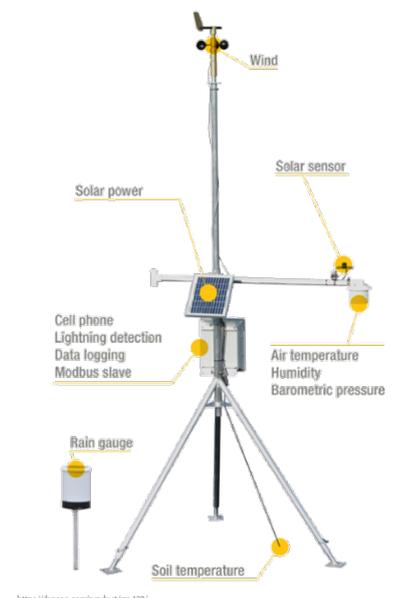
## What is weather?

Weather is the day-to-day changes in the atmosphere around the earth. The type of weather that is likely in any area is determined by the season (wet/dry or spring/summer/autumn/winter) AND the climate of the area. Weather normally occurs within an expected range of conditions. Extreme weather events are rare events that occur outside the expected range.

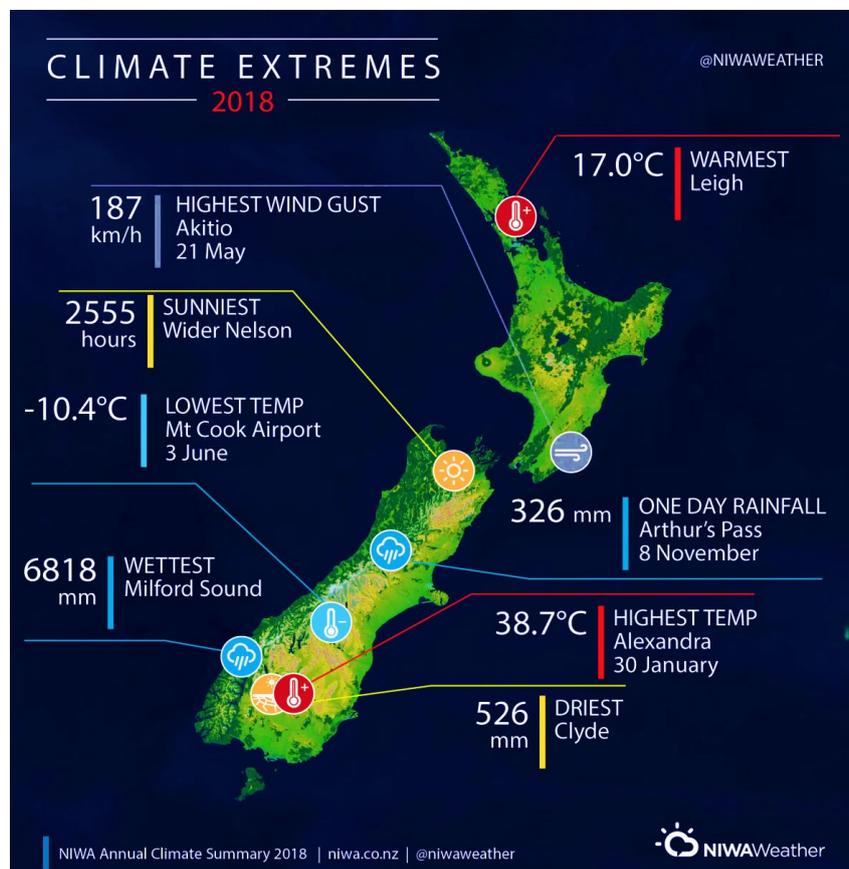
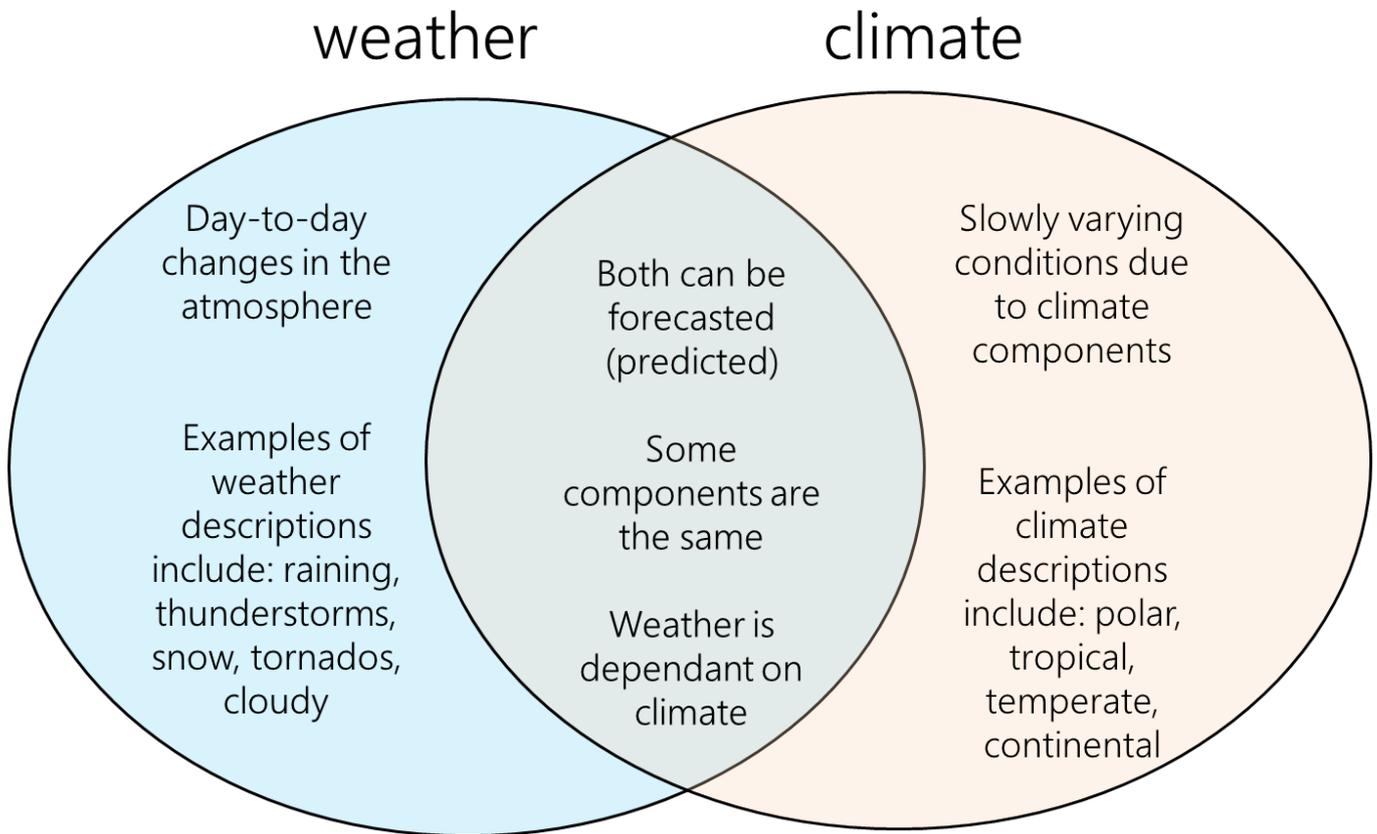


## Recording the weather

Modern portable weather stations have measuring devices to record not only temperature and amount of rain, but the wind amount and direction, the amount of sunlight and the air pressure. All of this information is saved digitally, and can be sent wirelessly to computers and phones. Before this meteorologists (weather scientists) had to go to stations everyday and take physical readings



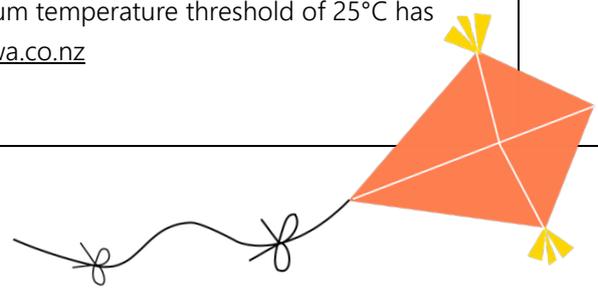
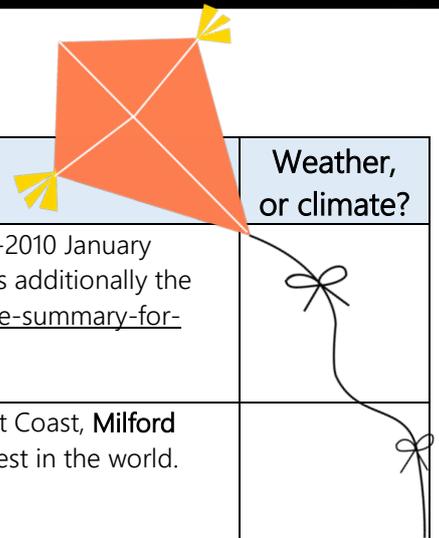
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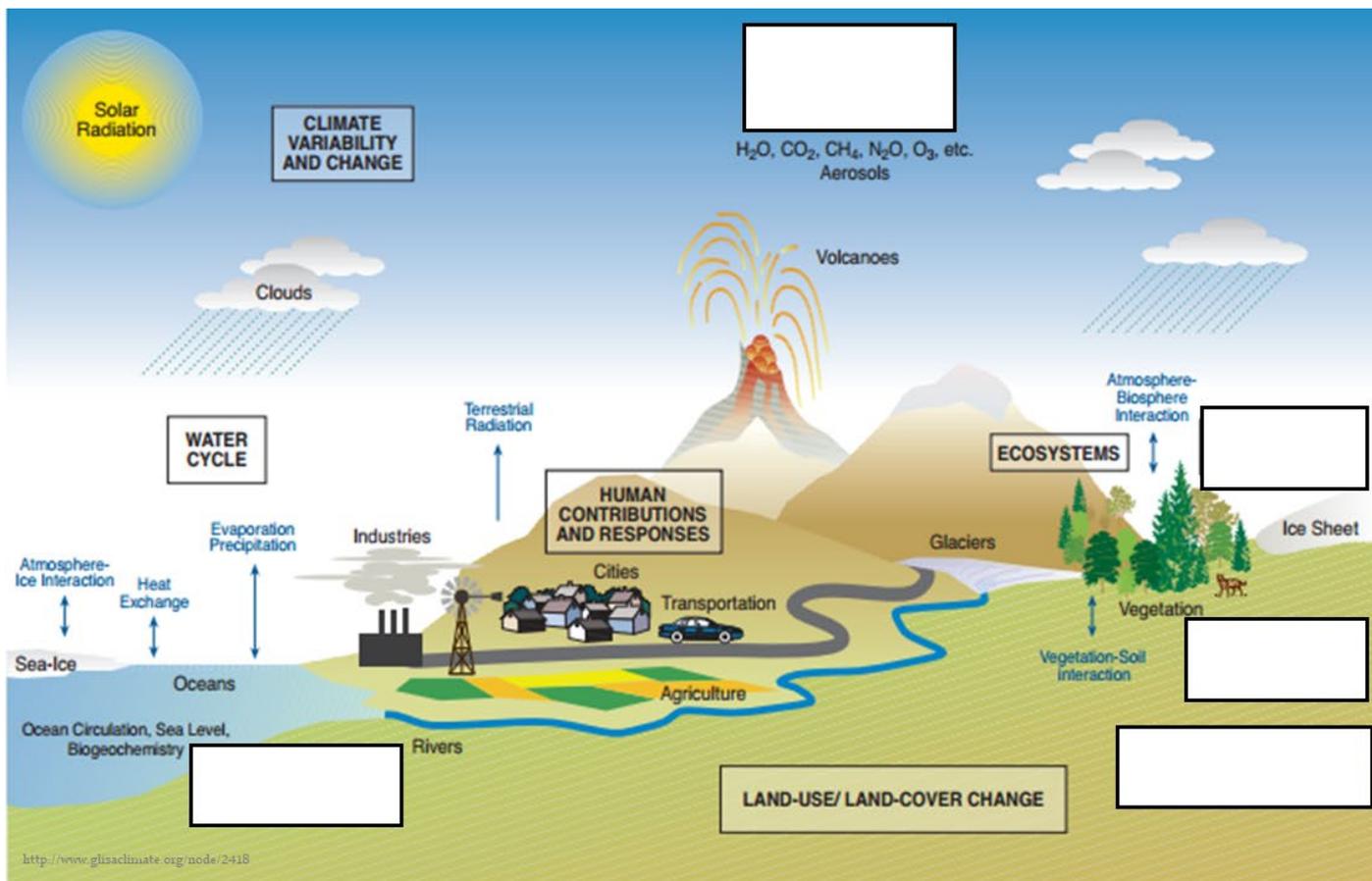


1. Read the following statements and write "weather" or "climate" or "both"

Statement	Weather, or climate?
1. January <b>2018</b> (New Zealand mean temperature 20.3°C; 3.1°C higher than the <b>1981-2010</b> January average) was New Zealand's hottest month on record, which of course means it was additionally the country's hottest January on record <a href="https://www.niwa.co.nz/climate/monthly/climate-summary-for-january-2018">https://www.niwa.co.nz/climate/monthly/climate-summary-for-january-2018</a>	
2. With a mean annual rainfall of 6,412 mm each year, a high level even for the West Coast, <b>Milford Sound</b> is known as the wettest inhabited place in New Zealand and one of the wettest in the world. Rainfall can reach 250 mm (10 in) during a span of 24 hours. <a href="https://en.wikipedia.org/wiki/Milford_Sound">https://en.wikipedia.org/wiki/Milford_Sound</a>	
3. On 23 <sup>rd</sup> September, 2018, the temperature in Cambridge reached a high of 16°C <a href="https://www.windy.com">https://www.windy.com</a>	
4. Snow is more common inland in both main islands of New Zealand, though snow to sea level does occur on average once or twice per year in the central and southern South Island. <a href="https://en.wikipedia.org">https://en.wikipedia.org</a>	
5. On <b>10 April 1968</b> : <u>Cyclone Giselle</u> caused peak gusts of 145 knots (270 km/h) near Wellington, after colliding with an Antarctic storm moving north. Giselle led to the sinking of the interisland ferry <u>TEV Wahine</u> , and the loss of 53 lives. Total damage caused by the storm was estimated at \$14 million. <a href="https://en.wikipedia.org">https://en.wikipedia.org</a>	
6. In New Zealand generally there are relatively small variations between summer and winter temperatures, although inland and to the east of the ranges the variation is greater (up to 14°C) <a href="https://www.niwa.co.nz">https://www.niwa.co.nz</a>	
7. NEW ZEALAND HERALD "Severe rain warnings after flooding overnight" 9 Jul, 2018 <a href="https://www.nzherald.co.nz">https://www.nzherald.co.nz</a>	
8. <b>25 July and 14 August 2011</b> <u>New Zealand snowstorms</u> : The first severe winter storm brought the coldest winter snap in fifteen years. During August snow fell consistently down to sea level in Wellington for the first time since 1976, and snowflakes even fell for a brief time in <u>Auckland</u> for the first time in 80 years. <a href="https://en.wikipedia.org">https://en.wikipedia.org</a>	
9. Antarctica is the coldest, windiest and driest continent. Scott Base is New Zealand's permanent Antarctic base. Sited on the coast, temperatures, although very low, are higher than those recorded inland. <a href="https://www.niwa.co.nz">https://www.niwa.co.nz</a>	
10. Future High and low temperature extremes in New Zealand: "Increasing temperatures result in more "hot days" and fewer frosts. New Zealand does not experience the extreme high temperatures that occur in many other parts of the world. A daily maximum temperature threshold of 25°C has therefore been chosen to mark a "hot day" <a href="https://www.niwa.co.nz">https://www.niwa.co.nz</a>	



2. Fill in the missing labels



The climate system is an interactive system consisting of five major components: the **atmosphere**, the **hydrosphere**, the **cryosphere**, the **land surface** and the **biosphere**, influenced by various *forcing mechanisms*, the most important of which is the Sun. Any change, whether natural or human caused, in the components of the climate system and their interactions, may result in climate changes. (IPCC)

1. Label the five components above
2. Use information from the diagram, and the word bank, to label some interactions between components

○ weathering ○ evaporating ○ freezing ○ photosynthesis ○ respiration ○ plant/leaf litter ○ precipitation  
 ○ combustion ○ melting ○ volcanic eruptions ○ transpiration ○ plant water uptake ○ permafrost melting

