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| **Level** | I |
| **Credits** | 6 |
| **Unit Descriptor** | This unit defines the standard required to: demonstrate that the earth’s climate has been constantly changing during geological history; explain some of the natural factors (forcings) that cause climate change; describe the natural greenhouse effect and its importance for life; show how human activities during the last 200 years are contributing to the enhanced greenhouse effect; differentiate between the natural greenhouse effect and the enhanced greenhouse effect; demonstrate the connection between increased quantities of “greenhouse gases” (GHGs), global warming and climate change; explain how increased levels of GHGs are leading to rising sea levels and oceanic acidification; and summarize future climate change projections for Vanuatu. |
| **Pre-requisites** | CCDRM01CCDRM02 |
| **Co – requisite** |  |
| **ELEMENT**1. Demonstrate that the earth’s climate has been constantly changing during geological history.
 | **PERFORMANCE CRITERIA*** 1. Using pictures that show conditions during different times in the earth’s history, give examples of periods in the earth’s history when the climate was much warmer or colder than today.
	2. Explain what happened to world-wide sea levels during the last ***Ice Age.***
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| 1. Explain some of the natural ***forcings (factors)*** that cause climate change.

  | * 1. Suggest possible reasons for the ***natural changes*** in climate that have occurred - volcanic eruptions, changes in solar radiation, variations in the earth’s orbit, etc.
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| 1. Describe the natural greenhouse effect and its importance for life.
 | * 1. Using a diagram, give a step-by-step explanation of the ***natural greenhouse effect***, pointing out the difference between ***incoming energy from the sun and outgoing energy from the earth.***
	2. List the names of major ***GHGs*** that contribute to atmospheric warming.

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| 1. Show how human activities in the last 200 years are contributing to the enhanced greenhouse effect.
 | 4.1 Explain some of the ways in which humans are contributing to increased emissions of GHGs - burning of fossil fuels, burning of bush for gardening, deforestation, waste management, cattle ranching, use of chemical fertilizers, wet rice cultivation, etc.4.2 Carry out a field investigation in the local area to find out how human activities are contributing to the ***enhanced greenhouse effect***.  |
| 1. Differentiate between the natural greenhouse effect and the enhanced greenhouse effect.
 | * 1. Summarize two ways in which the natural greenhouse effect is different to the enhanced greenhouse effect.
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| 1. Demonstrate the connection between increased quantities of “greenhouse gases” (GHGs), global warming and climate change.
 | * 1. Explain why increased levels of GHGs in the atmosphere are leading to global warming, giving statistical evidence.
	2. Explain how rising global air and sea surface temperatures impact on other aspects of climate - changing rainfall patterns, more frequent extreme events, humidity, ***atmospheric and oceanic circulation***, etc.
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| 1. Explain how increased levels of GHGs are leading to rising sea levels and oceanic acidification.
 | * 1. Explain how increasing levels of GHGs are causing rising sea levels through the thermal expansion of oceans and the melting of polar ice.
	2. Demonstrate the connection between increased GHGs, ***oceanic acidification*** and ***degradation*** of coral reefs.
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| 1. Summarize future climate change projections for Vanuatu
 | 8.1 Summarize future ***projections*** of climate change in Vanuatu and its effects on islands and seas. |
| **REQUIRED SKILLS AND KNOWLEDGE****Key competencies required for this unit**

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| **Key competency** | **Examples of application** |
| Collect, analyse and organize information | Collect, analyse and organize information on the natural greenhouse effect, local activities that contribute to the enhanced greenhouse effect, the effects of GHG emissions on the atmosphere and oceans, and future climate change in Vanuatu. |
| Communicate ideas and information | Give talks on: natural changes in climate during the earth’s history; the natural greenhouse effect: differences between the natural and enhanced greenhouse effects: and the effect of GHG emissions on increased temperatures, changing rainfall patterns, more frequent extreme events, rising sea levels and oceanic acidification. |
| Plan and organize activities | Organise a field investigation of local activities that are contributing to the enhanced greenhouse effect.  |
| Work with others and in teams | Work in small groups to conduct the field investigation and to discuss concepts associated with the causes and effects of climate change.  |
| Problem-solving | Determine the relationship between global temperatures and sea levels, and evaluate the effect of future climatic change on the islands and seas of Vanuatu.  |
| Graphical skills | Analyse and construct diagrams of the natural greenhouse effect, the enhanced greenhouse effect, sea levels during the Ice Age, and future climate change in Vanuatu.  |
| IT skills | Use the internet or printed materials to find out about climate change projections for Vanuatu.  |
| Show initiative | Arrange a meaningful presentation on the causes and effects of climate change to a group of people in the locality.  |

**Prior knowledge required*** Knowledge and experience of some of the factors that influence climate change (deforestation, volcanic eruptions, burning of fossil fuels, etc.) and of the links between the atmosphere and the oceans (evaporation, precipitation, heating of surface water by solar radiation, etc)
* Basic graphicacy skills - interpretation and construction of graphs and diagrams, mapping skills.

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| **EVIDENCE GUIDE****Critical aspects of evidence required to demonstrate competency in this Unit*** Correct definitions of Ice Age, natural forcings of climate change, human forcings of climate change, natural greenhouse effect, enhanced greenhouse effect, GHGs, atmospheric circulation, oceanic circulation, oceanic acidification, degradation, and climate projections.
* Meaningful explanations of the natural greenhouse effect and the enhanced greenhouse effect; factors producing climate change; the relationship between GHG emissions, global warming, and climate change; and the effects of climate change on the atmosphere and oceans.
* Application of concepts of climate change to the local environment, for example by finding out ways in which human activities are contributing to the enhanced greenhouse effect.
* Evaluation of the effects of future climatic change on the islands and seas of Vanuatu.
* Effective communication to other people of the causes and effects of climate change.
* Interpretation and construction of diagrams, graphs and maps.
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| **Context of Assessment**  | * Assessment of underpinning knowledge and communication of ideas can be done in the classroom through observation and discussion.
* Assessment of awareness talks on the causes and effects of climate change in Vanuatu can be done in the field or in the classroom.
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| **Resource Implications** | * Access to the internet and/or printed materials for research on climate projections.
* Toolkit pictures for “Learning About Climate Change the Pacific Way” produced by GIZ-SPC.
* Teachers’ Guide for the above.
* PCCSP / VMGD Climate Projections Brochure for Vanuatu.
* “An Inconvenient Truth” – DVD featuring Al Gore, produced in 2006.
* Choice of large sheets of paper and felt pens, blackboard and chalk, notebooks, etc.
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**RANGE STATEMENT**

The range statement relates to the unit of competency as a whole.

**The Ice Age** refers to a period of time extending from approximately 2 million years ago to 18,000 years ago when there were alternating periods of lower and warmer temperatures. During the colder or “glacial” periods, ice sheets covered large parts of the land surface and sea levels fell. During the warmer, or “interglacial” periods, temperatures were similar to those of today; the ice sheets retreated and sea levels rose again.

**Natural forcings or factors causing changes in climate** include changes in the amount of solar radiation, variations in the earth’s orbit around the sun and major volcanic eruptions that produced massive amounts of dust.

**The natural greenhouse effect** refers to way that our atmosphere allows incoming energy from the sun to reach the earth’s surface, but traps some of the outgoing energy from the earth, so keeping the planet warmer than it should be.

**Incoming energy from the sun** is also known as incoming solar radiation. It consists of all wavelengths of solar energy, both short-wave and long wave. This type of radiation consists of both light and heat.

**Outgoing energy from the earth** is also known as outgoing heat radiation. It consists of long-wave radiation only. This type of radiation is mostly heat and can be trapped by GHGs.

**Greenhouse gases (GHGs)** are gases present in the atmosphere that can absorb the outgoing heat radiation and send it back to the earth. Examples are carbon dioxide, methane, nitrous oxide and water vapour.

**The enhanced greenhouse effect** refers to the way in which the natural greenhouse effect is increased by human activities that lead to increased concentrations of carbon dioxide and methane in the atmosphere.

**Atmospheric circulation** refers to the way in which the air moves around our planet. It is driven by solar energy and the general effect is to transfer the heat from the tropics to the polar zones. Winds are evidence of this atmospheric circulation.

**Oceanic circulation** refers to the way in which oceanic waters move around the planet. Surface currents are caused by the winds blowing over them. Deep water currents are caused by differences in temperature and salinity around the planet.

**Oceanic acidification** refers to the way in which increasing quantities of carbon dioxide are being absorbed by the oceans. This results in more carbonic acid in the sea water.

**Degradation of coral reefs** refers to the way in which coral reefs are being spoilt or being reduced in quality and quantity.

**Projections** are estimations of what is going to happen in the future.