What is an atmospheric science field project?

Scientists from many disciplines of research – for example, atmospheric scientists, oceanographers, geologists, social scientists – come together to conduct research on a particular weather or climate phenomenon. They use many types of research tools such as aircraft, ships, radars, lidars, atmospheric profiling instruments, sea surface temperature sensors, ocean salinity sensors, and radiometers to collect data. The data is then analyzed and used to help create weather can climate models. These atmospheric field research projects can last from a few weeks to several months in order to ensure the weather they are looking for does indeed pass by the research area.

In the following activity, you are are going to:

- practice putting together your own atmospheric science field project;
- learn how these atmospheric field projects are conducted; and
- understand why they are beneficial to society all of the world



UPDATED: June 2022

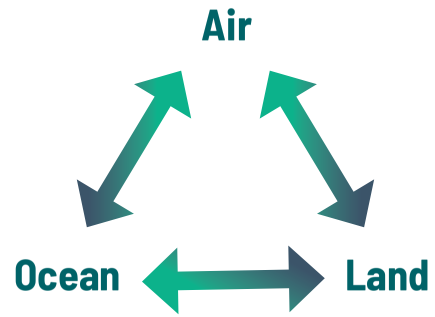
CASE STUDY

VOCALS: Variability of Ocean-Cloud-Atmosphere-Land Study

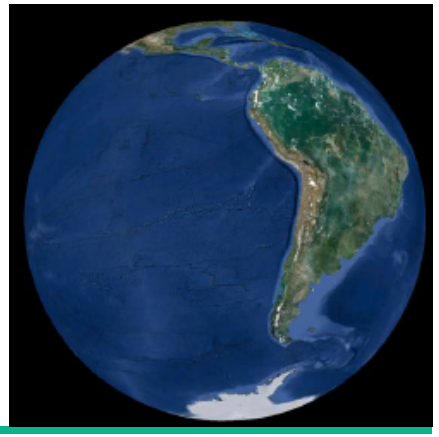
SCIENCE MISSION

The Earth's climate system is like a giant puzzle that scientists are trying to put together. The more accurate one piece of the puzzle is, the better the entire puzzle fits together.

This research project will provided scientists with valuable new data that were not known before about how the **ocean, air** and **land** *work together* in the Southeast Pacific Ocean region (SEP), the vast area east of South America.



Our ability to understand and predict **natural** and **human-induced** changes to this system depends on understanding the processes that occur in each of these three individual parts of the environment, but also understanding how the three interact with one another.



Scientists understand that these interactions are key to the complicated systems that make up the Earth's climate.

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CASE STUDY

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ABOUT VOCALS

VOCALS was an international project, the major goal was to improve the understanding of the **atmosphere - ocean - land system** in the Southeastern Pacific Ocean region on daily to yearly basis The main program objectives were:

- To explore the interactions between aerosols, clouds, and drizzle in the part of the atmosphere near the sea surface called the marine boundary layer (MBL)
- To improve the understanding of global climate models of clouds and atmospheric particles over the Southeastern Pacific Ocean region
- To improve climate and weather predictions in the Southeastern Pacific Ocean region

The lack of data about the interactions between the **atmospheric - oceanic - land** means that our state-of-the-art computer models used for climate prediction show large errors in ocean regions. VOCALS involves teams of researchers from over 40 institutions in nine countries.


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CASE STUDY

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SCIENCE MISSION

Learning more about how human activity impacts the Southeastern Pacific climate system will be an important part of VOCALS.

The scientists will explore how aerosols from copper smelters affect cloud formation. Particles floating around in the atmosphere are a key element to cloud formation; too many of them may not be such a thing!

Researchers will also look at how changes in the climate impact the fishing industry in Chile and Peru. If oceans temperatures warm, the nutrients needed to feed the fish may not be delivered to the region harming both the environment and the fishing industry on which many people rely.

Anchovies swimming in a school.
Image: Wikipedia Commons

Chile has some of the world's largest open pit copper mines. This mine, named Chuquicamata, is located in northern Chile.
Image: *Wikipedia Commons*

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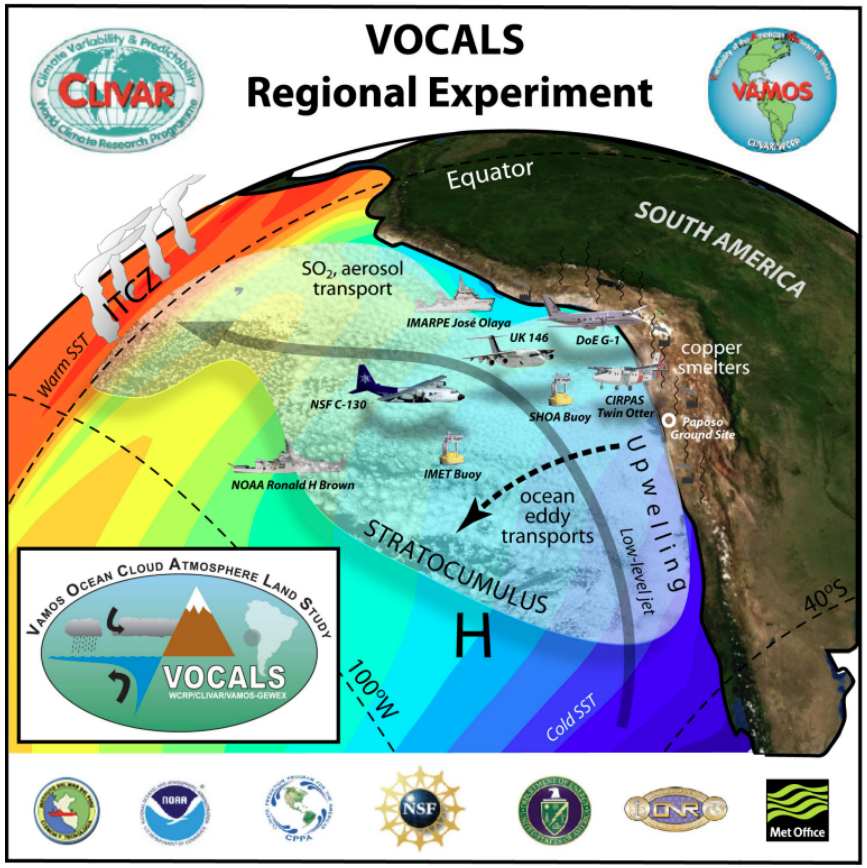
MORE ABOUT VOCALS

At the heart of the VOCALS field project is an intensive observational field study in which several aircraft, research ships, and a research buoy system took part in a coordinated observational plan to answer key scientific questions related to the climate system of the Southeastern Pacific Ocean and land region.

This unique area of the world is very rarely studied, yet its variations have important impacts on the global climate.

There are also great economic impacts, with the regional fisheries representing almost one-fifth of the worldwide marine fish catch.



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CASE STUDY

VOCALS: Variability of Ocean-Cloud-Atmosphere-Land Study

Preparing cloud water for chemical analysis

VOCALS daily planning meeting

A radar technician adjusts the antenna on board the research ship

Inside the C-130 research aircraft, a scientist analyzes data

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CASE STUDY

VOCALS: Variability of Ocean-Cloud-Atmosphere-Land Study

ONLINE RESOURCES

- **VOCALS Science**
  http://www.youtube.com/watch?v=MTfbtQMZxH8
- **VOCALS Test Flight NSF/NCAR C-130**
  http://www.youtube.com/watch?v=7329AqazWgk
- **NSF/NCAR C-130: Atmospheric Research Aircraft**
  http://www.youtube.com/watch?v=3rpFXN6oWlo
- **VOCALS Field Project People & Scenery**
  http://www.youtube.com/watch?v=r9Mwz0HNxaQ
- **Window to the Universe: Introduction to VOCALS**
  http://www.windows2universe.org/vocals/science.html

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GLOSSARY OF TERMS

Field Projects

Aerosols/Particles
Tiny particles in the atmosphere; they come from both natural sources (volcanic eruptions, sea salt, and wildfires) and human sources (burning fossil fuels like coal, oil, and gas); aerosols play an important part in the atmosphere – they help clouds form, they are part of air pollution, and they can impact climate change

Atmosphere
The protective layer around the Earth that allows animals and plants to live; it is made up of a mixture of gases, including nitrogen, oxygen, water vapor, argon, and carbon dioxide

Atmospheric (Air) Pressure
Air pressure is caused by the weight of the huge numbers of air molecules that make up the atmosphere; typically, when air pressure is high there skies are clear and blue. The high pressure causes air to flow down and fan out when it gets near the ground, preventing clouds from forming; when air pressure is low, air flows together and then upward where it converges, rising, cooling, and forming clouds; air pressure is highest a that ground level and decreases at altitude increases

Baseline Data
A measurement used as a basis for comparison

Chemical composition
The amount of different chemicals in the air

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GLOSSARY OF TERMS

Field Projects

Convection
The way heat (energy) in liquids or gases is transferred; the warmer part rises and the cooler, denser part sinks; cumulus and cumulonimbus clouds are convective, which means they formed as a result of convection

Field Project
Scientists from many areas of research (e.g. - meteorology, oceanography, geography, social sciences) come together to conduct research on a particular weather or climate phenomenon; they use many types of research equipment to collect data; the data is then analyzed and used to help create weather and climate models; these atmospheric field research projects can last from a few weeks to several months

Greenhouse Gases
Gases in atmosphere such as water vapor, carbon dioxide, and methane, which trap heat around the Earth and warm the atmosphere

Hurricane
Hurricanes (also known as tropical cyclones or typhoons) form over the ocean in the tropics with the right mix of humidity, warm sea surface temperatures, and low atmospheric pressure; these storms can be very large and can produce torrential rain and damaging winds

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GLOSSARY OF TERMS

Field Projects

Model
Carefully designed computer programs that include equations that describe the atmosphere and are run on supercomputers, to help predict future weather and climate; weather models are used to forecast day-to-day changes in weather, or rather to predict what will happen at a specific place and point in time in the near future, typically no more than five to seven days out; climate models are used to determine how the average conditions will change in the future

Ocean Salinity
The amount of mineral salts dissolved in seawater; water with a high salinity is denser than water that contains less salt; salinity can impact ocean currents, which play a part in how heat is transferred around the Earth

Platform
An aircraft, ship, truck, etc. that can carry the instruments being used to collect measurements in a field project

Sink
Anything that absorbs and holds gases, liquids, or particles is considered a sink; plants take up CO_2 during photosynthesis, so an area with a large number of plants can be considered a CO_2 sink

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GLOSSARY OF TERMS

Field Projects

Source
Anything that releases (or provides) gases, liquids, or particles is considered a source; plants and animals give off CO_2 during respiration, and CO_2 is released during volcanic eruptions and when organic matter burns (during forest fires, for example), each of which can be considered a source of CO_2

Stratosphere
The second layer of the Earth's atmosphere as you go upward from the surface of the Earth; temperatures are cooler in the lower part of the stratosphere and higher in the upper part of the stratosphere; this layer of the atmosphere contains a lot of naturally produced ozone, it doesn't have much water vapor, and the air is stable so commercial aircraft often fly in this layer to avoid turbulence.

Tropopause
The boundary between the troposphere and the stratosphere

Troposphere
The lowest layer of the Earth's atmosphere; almost all of the weather on Earth occurs in the this layer; it begins at the surface of the Earth and extends about 10 km (6.2 miles) above sea level; air is warmest at the bottom of the troposphere near the Earth's surface, and air cools as it rises up in the troposphere

Water Vapor
Water in its gaseous state (instead of liquid or solid/ice); clouds, rain, and snow all require water vapor to form; water vapor is also the Earth's most important greenhouse gas, and it is responsible a high percentage of the natural greenhouse effect, which helps keep the Earth warm enough to support life

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