Nevada National Security Site

Research at the Nevada National Security Site: The Nevada Desert Research Center

Introduction

Since the beginning of the industrial revolution the amount of carbon dioxide (CO_2) in the atmosphere has risen sharply and has the potential to dramatically affect global climate. It is important to determine how deserts and semiarid lands, which comprise nearly 40 percent of the Earth's land mass, will respond to the effects of this increase in CO_2 and related climate change.

Elevated CO_2 (550 ppm) was applied to the plot via a plenum and risers based on wind direction, allowing the natural wind to transport the CO_2 treatment across the plot. Soil disturbance was prevented by using a rotating platform for all measurement and sampling efforts.

Collaborative ecological studies are being conducted at the Nevada National Security Site (NNSS), formerly known as the Nevada Test Site (NTS), by a group of institutions to do just that. The participating entities include the University of Nevada Reno (UNR), University of Nevada Las Vegas (UNLV), and the Desert Research Institute (DRI), with support from Brookhaven National Laboratory and the National Nuclear Security Administration Nevada Site Office. Students and faculty from several U.S. universities are also conducting research at these ecological study sites. The NNSS provides a secure, controlled, unique environment ideal for research and data collection.

What is the purpose of the Nevada Desert Research Center (NDRC)?

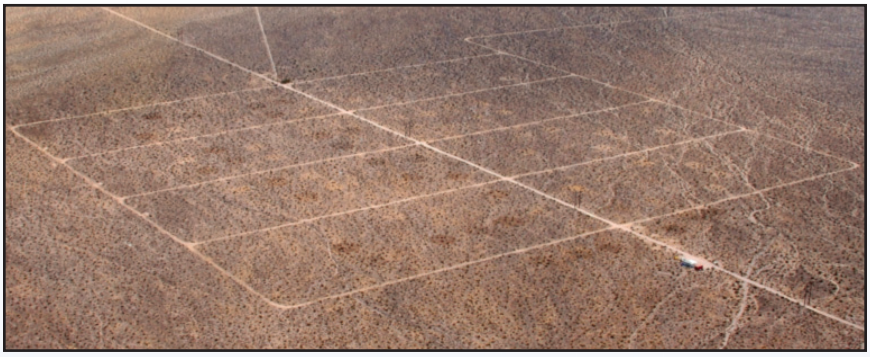
The NDRC's primary purpose is to assess the impact of climate change on the Mojave Desert. To do this, two research facilities were established. At the Nevada Desert FACE Facility (NDFF), scientists used nine plots of undisturbed desert land to monitor plant, root, microbial, insect, animal, and soil response to ambient and elevated CO_2. Free Air Carbon-dioxide Enrichment (FACE) is a system developed by Brookhaven National Laboratory to apply air containing elevated CO_2 concentrations to large areas of land without the compounding effects observed in glasshouse or open-top chamber studies. The elevated CO_2 application lasted for ten years (1997-2007) and now scientists are synthesizing the results as well as examining how long the elevated CO_2 that was applied to research plots will remain sequestered in the environment.

At the Mojave Global Change Facility (MGCF), the same core group of researchers is examining how the Mojave Desert will respond to other climate change variables, namely, altered precipitation, increased nitrogen deposition and disturbance of the biological soil crust. Ninety six plots (14 by 14 meters in dimension) were established at the MGCF in eight replicate blocks. For the first eight years these plots received a factorial combination of increased summer precipitation (three 75 mm applications three weeks apart), nitrogen addition (0, 10 and 40 kg/hectare) and crust disturbance. Given recent climate model results that are now predicting an effective decline in precipitation for the southwestern U.S., the addition of summer water has been discontinued.

By studying the processes of photosynthesis and respiration, how CO_2 is exchanged between the atmosphere and the land and other key factors, scientists have been gathering information to address the following questions to predict the consequences of climate change:

- Will there be changes in the rate at which plants grow over the next hundred years?
- Will the storage of carbon in the desert ecosystem change?
- Will the water balance change in this arid environment?
- Will the composition of desert plant species change?

Discussion on results to date



An oblique aerial view of the MGCF captured the darker wet soil of plots that had been recently irrigated on the west side of the facility (top). Plots that have crust disturbance treatments are lighter in color than the surrounding area.

The responses of plant and ecosystem processes to elevated CO_2 and climate change in the Mojave Desert are complex. Rainfall is a major controlling factor that is further influenced by soil nitrogen availability (a major plant nutrient). The results from the MGCF are being combined with data from NDFF to make predictions on the overall impact of future climate on the Mojave Desert. In general, it is anticipated that increased plant production and success of invasive species at elevated CO_2 will yield a more productive desert, but with the potential for an increased fire frequency. Higher temperatures are likely to result in a shift of plant species range with the potential for altering plant community composition and function. Changes in precipitation have the potential to either enhance plant production, leading to the potential for increased fire cycles and/or transition to a semiarid plant community with increased precipitation, or result in decreased production, increased mortality and thus a loss of plant diversity with decreased precipitation. Increases in nitrogen deposition (due to anthropogenic activities) while having the potential to enhance plant production, may result in the loss of nitrogen-fixing species. These predictions will assist land managers in restoration, re-vegetation, and various clean-up efforts as well as land use decisions.

The Nevada Desert FACE Facility and Mojave Global Change Facility are jointly operated by UNLV, UNR and DRI under the Nevada Desert Research Center. These are the only facilities of their kind located in an undisturbed desert ecosystem. The NDFF and MGCF were developed in conjunction with the National Science Foundation and the Department of Energy's Experimental Program to Stimulate Competitive Research.

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