Scaling Environmental Processes in Heterogeneous Arid Soils (SEPHAS)

The SEPHAS program focuses on studying environmental processes of arid soils at the meter (or yard) scale. Soils are the critical interface between the Earth's bio-, hydro-, and geospheres. Desert soils cover more than 25% of the land surface and play an important role in desert climate, hydrology, and ecology. Arid soils in particular are those found in deserts with less than 250mm (10in) of rainfall a year and have influences over water, energy, and element cycles, as well as a variety of biogeochemical processes, in a given ecosystem.

A core part of the SEPHAS program is its lysimeter facility located on DRI's satellite research location in Boulder City, Nevada. The SEPHAS program gives Nevada the extraordinary capacity to address basic scientific questions and practical problems unique to Nevada and other arid regions worldwide.

The SEPHAS program integrates cutting edge experimental research with computational and visual technology. Our current research areas include:

- Water, energy, and carbon balance of arid soils
- Arid soil restoration
- Infiltration and evaporation processes in arid soils

RESEARCH GOALS

- To better understand physical, chemical, and biological processes
- To build a bridge between benchtop and landscape-scale research

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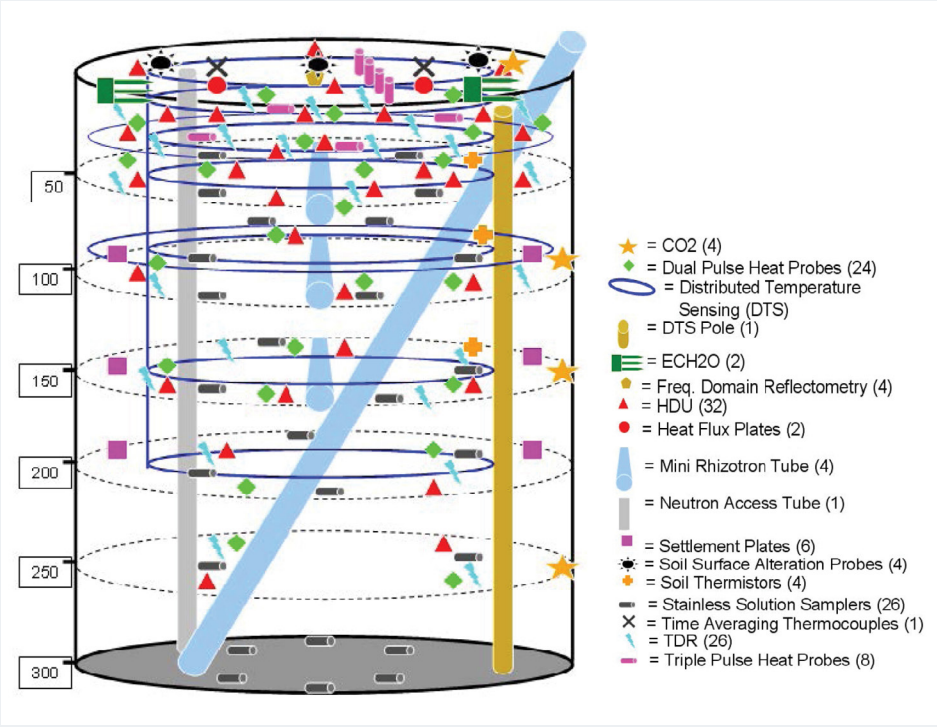
WHAT IS A LYSIMETER

A lysimeter is a device to determine the water balance and related fluid flow and transport processes in soils. For example, lysimeters are used to measure the fate of rainfall or irrigation water, whether it infiltrates and gets stored in the soil or is lost from the soil due to evapotranspiration and drainage.

Lysimeters come in all shapes and sizes, ranging from a simple bucket filled with soil to sophisticated devices equipped with highly-accurate scales and sensors to monitor flow and storage of water and energy, and transport of various components.

EDUCATION & OUTREACH

The SEPHAS Program encourages student involvement and provides opportunities for postdoctoral, graduate, and undergraduate student research. It maximizes educational benefits through PreK-12 educational outreach such as the DRI Science Alive Program. The lysimeter facility is an excellent place to show DRI research "in action" and is available for tours year-round.



Sensors to measure moisture content, temperature, heat, and CO2 inside of the SEPHAS lysimeter soil.

LYSIMETER FACILITY & INSTRUMENT DESIGN

The SEPHAS Lysimeter Facility consists of three weighing lysimeters of 2.2m (7.2ft) diameter and 3m (9.8ft) depth equipped with scales of 450g (1lb) resolution. Each lysimeter is filled with 12 m3 (424ft3 or 21 tons) of soil from Eldorado Valley, southwest of Boulder City in the Mojave Desert.

Each lysimeter is instrumented with 153 sensors installed at 15 different depths from 0 to 250cm (8.2ft). The sensors include 17 different instrument types for measuring soil water content, matric potential, temperature, and gas profiles. Ports at various locations allow for pore fluid sampling and access tubes for digital imaging of soil cross sections. When the soil was installed in spring 2008, four conservative tracers were applied uniformly within the lysimeter soil at four depths from 0.15–0.55m (0.49–1.8ft). The lysimeter facility also includes a micro-meteorology station equipped with an eddy covariance system that measures atmospheric conditions (rainfall, temperature, relative humidity, solar radiation, as well as wind speed and direction).

Data is collected at intervals between 15 minutes and 3 hours. Data loggers can be accessed remotely, and select real-time data is available online at dri.edu/sephas.

Since summer 2008, the lysimeters have collected data on rainfall, evaporation, soil moisture, air temperature, and other relevant environmental parameters. The information is important to better understand water conservation and management, ground and surface water recharge, improve flood control measures, and predict possible impacts of climate change on desert environments.

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