

## **MODIFICATIONS AND UPGRADES FOR THE BIOSPHERE 2 LABORATORY**

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The Biosphere 2 Laboratory (B2L) consists of medium scale synthetic communities of plants and soils (mesocosms) encased in a gas-tight glass and metal shell. The B2L includes ocean, rainforest, intensive forestry and desert areas that can be (or soon will be) studied as isolated whole systems. Since mid 1996, Columbia University has managed the facility and has made a host of renovations designed to optimise the use of B2L for the experimental studies of global change impact on Earth systems. Lightweight curtains allow reversible closure of the rainforest and three intensive forestry sections currently operated at three different CO<sub>2</sub> concentrations. These and other modifications provide unique research opportunities to study “system-level” responses to elevated CO<sub>2</sub> and climate change, yielding data that are needed to validate models that scale up from leaf to canopy to ecosystem. Lessons learned in B2L will lead to new approaches in research and complement less well-controlled experiments such as long-term ecological reserves (LTER) and free atmosphere carbon dioxide enrichment (FACE).

Each biome is a large controlled environment chamber in which fluxes of water, carbon and other compounds can be monitored precisely for measurements of the whole system mass balance and response to changing CO<sub>2</sub> and/or other climatic factors (e.g. net ecosystem carbon exchange (NEE), transpiration, trace gas production and isotopic balances). Each isolated terrestrial mesocosm is equipped with CO<sub>2</sub> injection and extraction systems so that the CO<sub>2</sub> partial pressure can be controlled in the range of 400 μmol mol<sup>-1</sup> (close to present level) to 1200 μmol mol<sup>-1</sup>. Fans installed inside each mesocosm prevent temperature stratification, and water supply and drainage systems have been modified so the rainforest, desert and intensive forestry biomes have a single-pass water system. Water balances are calculated by metering and reporting all water fluxes occurring in the system. Arrays of research instrumentation in each biome measure temperature, light, PAR, humidity, soil temperature and soil moisture. A separate data network of data loggers acquires data from sensor matrices in each biome and makes the data available remotely in real time. Analytical grade IRGAs monitor CO<sub>2</sub> values from multiple sample points in each biome while industrial grade IRGAs work in concert with mass flow controllers for the maintenance of prescribed CO<sub>2</sub> levels. Portable instrumentation is used throughout the facility for measurements on leaves.