# CZO Metadata Worksheet

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| Data File Name | GroundHOG Measurements |
| Record Period | 08/15/2015 to 12/1/2016 |
| Descriptive Title | Garner Run and Shale Hills 2015 and 2016 GroundHOG Data (Soil Gas and Soil Moisture) |
| Update Frequency | Annually |
| Abstract | Shale and sandstone are the most common lithologies of the forested ridges throughout the Appalachian Mountains. The overall goal of this thesis was to determine whether these two rock types impart distinct biogeochemical properties to soils and plants. The effects of rock type (lithology) on soil gas concentration, nutrient concentration and nutrient limitation were studied in the Ridge and Valley province of central Pennsylvania. To increase understanding of lithological controls on soil gases (Chapter 1), we monitored the depth distribution of soil CO2 and O2 concentrations in central Pennsylvania in two watersheds on different lithologies. We deployed gas monitoring instrumentation on two catena transects that included four topographical positions, one located on sandstone and the other on shale. As expected, with increasing soil depth O2 concentrations decreased while pCO2 increased. CO2 and O2 concentrations varied more with topographical position than with lithology, as the valley floor positions in both catenas had the highest pCO2 for a given depth. Both manual sampling from gas access tubes throughout the soil profile and continuous sampling by buried sensors documented these patterns. |
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| Data Value Descriptions | Sheet Names:   * HS SHHI O2 =Hand sampled Shale Hills Oxygen; units =% * HS SHHI CO2 = Hand sampled Shale Hills CO2; units = ppm * HS GR O2 = Hand sampled Garner Run -Oxygen; units =% * HS GR CO2 = Hand sampled Garner Run - CO2; units = ppm * HS Soil Moisture = Hand sampled Shale Hills and Garner Run Soil Moisture; Units = decimal and % volumetric water content * AS-SPMS- AVG = Automated Data from the south planar midslope at Shale Hills - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_20\_Avg**, units = %; **O2\_D\_20\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_20\_lo\_Avg**, units = ppmv; **CO2\_20\_hi\_Avg**, units = ppmv; **CO2\_D\_20\_lo\_Avg**, units = ppmv; **CO2\_D\_20\_hi\_Avg**, units = ppmv; * AS-NPMS- AVG =Automated Data from the north planar midslope at Shale Hills - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_20\_Avg**, units = %; **O2\_D\_20\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_20\_lo\_Avg**, units = ppmv; **CO2\_20\_hi\_Avg**, units = ppmv; **CO2\_D\_20\_lo\_Avg**, units = ppmv; **CO2\_D\_20\_hi\_Avg**, units = ppmv; * AS-2015-TMMS- AVG = Automated Data from Tussey Mountain in 2015 - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_30\_Avg**, units = %; **O2\_80\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_30\_lo\_Avg**, units = ppmv; **CO2\_30\_hi\_Avg**, units = ppmv; **CO2\_80\_lo\_Avg**, units = ppmv; **CO2\_80\_hi\_Avg**, units = ppmv; * AS-2015-LRMS- AVG = Automated Data from Leading Ridge in 2015 - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_30\_Avg**, units = %; **O2\_140\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_30\_lo\_Avg**, units = ppmv; **CO2\_30\_hi\_Avg**, units = ppmv; **CO2\_140\_lo\_Avg**, units = ppmv; **CO2\_140\_hi\_Avg**, units = ppmv; * AS-2016-TMMS- AVG = Automated Data from Tussey Mountain in 2016 - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_30\_Avg**, units = %; **O2\_80\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_30\_lo\_Avg**, units = ppmv; **CO2\_30\_hi\_Avg**, units = ppmv; **CO2\_80\_lo\_Avg**, units = ppmv; **CO2\_80\_hi\_Avg**, units = ppmv; * AS-2016-LRMS- AVG = Automated Data from Leading Ridge in 2016 - has both O2 and CO2; Labels: **Timestamp**, units = Day (01/01/2001); **O2\_30\_Avg**, units = %; **O2\_140\_Avg**, units = %; **DiffVolt\_1\_Avg**, units =Mv; **DiffVolt\_2\_Avg**, units =Mv; **CO2\_30\_lo\_Avg**, units = ppmv; **CO2\_30\_hi\_Avg**, units = ppmv; **CO2\_140\_lo\_Avg**, units = ppmv; **CO2\_140\_hi\_Avg**, units = ppmv; |
| Keywords | Soil Gas, CO2, O2, automated sensors, hand sampled, soil moisture, TDR |
| Methods | Field measurements were taken using a multi-sensor set-up, known as the GroundHOG (Brantley et al. 2016) that includes automated gas sensors and hand samplers for gas, soil water content and soil porewater. In the upslope wall of the soil pit, automated gas sensors, time domain reflectometry (TDR) wave guides, and gas access tubes were installed.  Gas access tubes for hand sampling were constructed using stainless steel tubing, stainless steel mesh, epoxy, and Swagelok caps. Manual samples were collected fortnightly during the growing season, from May to August. Samples were taken directly after purging the tube. Soil gas CO2 concentrations were analyzed in the laboratory within 48 hours of field collection by an infraredgas analyzer (LI-7000, LI-COR Inc., Lincoln, NE). Samples were calibrated with standard curves made from multiple volumes of two CO2 standards of 970 and 10,300ppm (Gas and Technology Services INC., Santa Maria, CA). Following Hasenmueller et al. (2015), we used the ideal gas law to calculate soil CO2 concentration. After the CO2 syringe sample was taken, percent (v/v) oxygen was measured using a Model 901 Headspace Oxygen Analyzer (Quantek Instruments, Graton, MA), calibrated with local air assuming a concentration of 20.95% O2.  Automated sensors used for CO2 measurements (Eosense, formally Forerunner Research, Nova Scotia, CA) were factory-calibrated for a range of 0 to 20,000ppm for all but the deepest sensors, which were calibrated over the range 0 to 40,000ppm. Automated sensors used for O2 measurements (Apogee Instruments, Utah).  Soil volumetric water content was measured with the fortnightly gas samples using time domain reflectometry (TDR) waveguides and a TDR100 (Campbell Scientific, Logan, UT). |
| Citation | The following acknowledgment should accompany any publication or citation of these data: Logistical support and/or data were provided by the NSF-supported Shale Hills Susquehanna Critical Zone Observatory.  This research was conducted in Penn State's Stone Valley Forest, which is funded by the Penn State College of Agriculture Sciences, Department of Ecosystem Science and Management and managed by the staff of the Forestlands Management Office.  This research was conducted in Rothrock State Forest which is funded and managed by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry. |
| Publications | Unpublished, please embargo public access to this dataset.  Lillian Hill’s Masters Thesis |
| Data Use Notes | The user of Shale Hills Susquehanna CZO data agrees to provide proper acknowledgment with each usage of the data. Citation of the name(s) of the investigator(s) responsible for the data set, in addition to the generic statement above, constitutes proper acknowledgment. Author(s) (including Shale Hills Susquehanna CZO investigators) of published material that makes use of previously unpublished Shale Hills Susquehanna CZO data agree to provide the Shale Hills Susquehanna CZO data manager with four (4) copies (preferably reprints) of that material for binding as soon as it becomes available. The user of Shale Hills Susquehanna CZO data agrees not to resell or redistribute shared data. The user of these data should be aware that, while efforts have been taken to ensure that these data are of the highest quality, there is no guarantee of perfection for the data contained herein and the possibility of errors exists. These data are defined as either public or private, such that a password may be required for access. |