ABSTRACTS-POSTERS

Two years of continuous water vapor isotope ratio measurements at Mauna Loa: a new glimpse into humidity controls in the subtropics

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Long home to baseline measurements of trace gases important for climate, the Mauna Loa Observatory (MLO) now hosts the longest record of continuous *in situ* measurements of stable isotope ratios in water vapor. Since 2010 the University of Colorado Boulder has operated a Picarro water vapor isotope analyzer in close partnership with MLO, measuring the water vapor mixing ratio and isotope ratios of hydrogen and oxygen at a 10-second frequency. Unlike humidity measurements alone, the D/H and $^{18}O/^{16}O$ ratios provide an integrated history of condensation in MLO air masses, offering key constraints on the water cycle processes that shape humidity patterns in the subtropics. While the full two-and-a-half-year record reveals diurnal variability associated with the convective rise and fall of the boundary layer on the Big Island, strong correlations between the nighttime Picarro mixing ratio measurements, Hilo radiosondes, and MERRA reanalysis suggest nighttime isotope ratios are representative of free tropospheric conditions across the region. Nevertheless, extended periods of high isotope ratios indicate a possible role for local convective mixing in transporting boundary layer moisture upward. The dataset thus provides a rare opportunity to analyze the climatological flux of moisture between the boundary layer and free troposphere and to test the sensitivity of subtropical vertical moisture transport to global and synoptic-scale atmospheric circulation patterns.

Isotopic analysis of historic lichen collections reveals pollution sources and biological effects

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Atmospheric deposition of reactive nitrogen (N_r) is steadily increasing globally due to human industrial and agricultural activities. Sources and historical changes of N_r deposition potentially are traced by $\delta^{15}N$ of lichen biomass. Furthermore, the $\delta^{13}C$ composition of lichen biomass records changes in the $\delta^{13}C$ of atmospheric CO_2, which has decreased globally due to fossil fuel combustion and photosynthetic ^{13}C fractionation. We analyzed herbarium samples of the lichen *Letharia vulpia* thalli collected in the Rocky Mountain Region over the past 110 years for $\delta^{15}N$, $\delta^{13}C$, and %N. We predicted that thalli $\delta^{15}N$ and %N values of *L. vulpia* would increase due to increasing inputs of N_r from industrial sources while $\delta^{13}C$ values would decrease reflecting changes in $\delta^{13}C$ of atmospheric CO_2. Between 1895 and 1985, biomass %N increased roughly 64%, $\delta^{13}C$ decreased 2.6‰, and $\delta^{15}N$ increased 2.4‰; suggesting that the isotope composition of historic lichen tissue archived in herbaria can be used to track environmental change. Carbon isotope discrimination ($\Delta^{13}C$) of *L. vulpia* increased roughly 1.5‰ between 1895 and 1985, suggesting that lichen photosynthetic mechanisms have been altered by an atmosphere higher in CO_2, N_r deposition, or both.

Do soil fauna control the fate of litter-derived carbon through their effect on soil microbes?

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Litter decomposition is one of the main processes by which fixed plant carbon forms soil organic matter (SOM) and decomposes to CO_2. Soil fauna are commonly understood to accelerate the process of litter decomposition, but it is unclear whether they merely speed up the process of decomposition or whether they have an indirect effect by controlling the microbial community's activity. Microbial biomass has been recognized as a large contributor to the stabilized SOM fraction. Recent studies have provided evidence that proteins and fatty acids from microbial necromass are the major compound types that are stabilized in soil. How soil fauna affects microbial contributions to soil C stabilization remains unclear. Using ^{13}C and ^{15}N enriched leaf litter in a two year litter decomposition experiment in the field, we have traced litter-derived C and N into CO_2 fluxes, SOM fractions and microbial biomass (PLFA) and necromass (amino sugars). We applied a naphthalene treatment to reduce soil microarthropod abundance in order to determine their impact on the litter-C decomposition and incorporation into microbial biomass, necromass and SOM. Our results show an increased litter-C uptake by soil microbes and increased buildup of litter-derived microbial necromass in the absence of naphtalene, suggesting that microarthropods stimulate microbial turnover which could potentially lead to the accumulation of litter C in stable soil carbon stores. These results imply that soil fauna may have an important role in long-term soil C sequestration through their interaction with the microbial process of litter decomposition.

Development and calibration of new natural gas δ^{13}C and δ^{2}H reference standards

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In the 1980's the U.S. National Bureau of Standards (now known as the National Institute of Standards and Technology or NIST) was involved in the development of a suite of natural gas standards for molecular and stable carbon and hydrogen isotopic analyses. These reference materials included a coal-related gas (RM 8559, NGS-1), an oil-related gas (RM 8560, NGS-2), and a biogenic gas (RM8561, NGS-3). For more than twenty years, these materials were distributed by Chevron and NIST and used in research and technology development by industry, academia, and governmental agencies. Further details related to the development of these standards may be found in Wise and Watters (2007).

Recently the supply of these gases diminished and the NIST discontinued the distribution of these materials. The residual gas, cylinders, and manifold assembly were transferred to a private research institution. Although a "round-robin" type interlaboratory study of select natural gases from China was recently conducted (Dai et al., 2012), this was not a true calibration and the gases used in this study have not been made available for general use as a reference standard.

In response to this situation, the Energy Resources Program of the U.S. Geological Survey (USGS) initiated a project to develop a new suite of gas standards to replace the old NGS gases. An undertaking of this magnitude is beyond the capabilities of the USGS alone, and consequently, this project is a collaborative effort by researchers from academic, governmental, and industrial organizations from around the world. USGS personnel are taking the lead to administer and coordinate all of the work related to the development of these standards including (but not limited to): (1) collection of gas samples (as needed), (2) distribution of aliquots of the gases for calibration, (3) compilation and statistical analysis of the calibration data, (4) preparation of a final report, and (5) storage and distribution of the new standards.

To date, a technical advisory committee was formed, basic work plan formulated, suitable gases identified, calibration methods identified and gases sub-sampled and distributed to suitable laboratories for calibration. This presentation will detail the history and progress of this project.

Dai, J., Xia, X., Li, Z., Coleman, D.D., Dias, R.F., Gao, L., Li, J., Deev, A., Li, J., Dessort, D., Duclerc, D., Li, L., Liu, J., Schloemer, S., Zhang, W., Ni, Y., Hu, G., Wang, X., and Tang, Y., 2012. Interlaboratory calibration of natural gas round robins for δ^{2}H and δ^{13}C using off-line and on-line techniques. Chemical Geology, **310-311**, 49–55.

Wise, S.A. and Watters Jr., R.L., 2007. U.S. National Institute of Standards and Technology Report of Investigation: Reference Materials 8559, 8560, 8561. 7 pp.

High spatial variation in the consumer isoscape: is it individual specialization?

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Small mammals in Southeast Alaska inhabit a landscape of habitat patches comprised of old-growth, young-growth, thinned and clearcut forest stands. We used stable carbon and nitrogen isotopes to estimate the diets of sympatric Keen's mice (*Peromyscus keeni*) and dusky shrews (*Sorex monticolus*) on Prince of Wales Island (POW), Alaska across these four habitat types and at six different landscape locations. We also collected and analyzed all potential prey items. Multi-source dual-isotope mixing models were used to determine the range of possible contributions of each food source. $\delta^{13}C$ and $\delta^{15}N$ for mice and shrews did not overlap with mice exhibiting higher variation of up to 7‰ in carbon and 11 ‰ for nitrogen between habitats and across the landscape. All prey items were also isotopically distinct. The relatively wide isotopic niche of mice suggests either specialized foraging behavior of individuals within a generalist species or faithfulness to specific foraging habitats. This study highlights the importance of considering habitat use when examining isotopic patterns of consumers.

Relating isotopic fractionation of snow to sublimation and ecosystem fluxes in a high elevation subalpine forest.

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Under certain conditions sublimation can fractionate stable isotopes of water. In this study we compare the wintertime ecosystem fluxes of water vapor to isotopic enrichment of snowpack at a high elevation subalpine forest. Data were collected during the winter 2012-13 at the GLEES, WY AmeriFlux site, where the snowpack formed in late October and was sampled mid- (January and February) and late- (April) winter. Mid- and late-winter cumulative precipitation totaled 330 mm and 760 mm which corresponded to a mid- and late-winter snowpack of 0.90 m and 1.87 m. Cumulative sublimation losses as estimated from eddy-covariance data were consistently 24% of the total cumulative precipitation throughout the winter. Below canopy water vapor fluxes were similar to those above, confirming that sublimation primarily originated in the snowpack. Through mid-winter there was no isotopic fractionation of snow water away from the local meteoric water line. Preliminary analysis suggests that the major sublimation events were related to advection of sensible heat toward the snowpack under cloud free conditions.

Do biofuel crops contribute to soil carbon storage in deep soil? Insights from a dual labeled Sorghum root and shoot decomposition experiment

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The contribution of roots to soil organic matter formation and internal nutrient cycling is poorly understood, especially in agroecosystems. We are conducting a field incubation to elucidate the fate of decomposed litter and root C and N in a *Sorghum bicolor* production system. A field incubation of aboveground litter in the topsoil (0-30cm) and roots at three depths (0-30cm, 30-60cm and 60-100cm) of *Sorghum bicolor v.* Btx 623 will be carried out using dual labeled ^{13}C and ^{15}N biomass produced in a continuous labeling chamber. Several varieties of sorghum are being explored as potential bioenergy feedstocks; while we are gaining understanding of the production potentials of these crops, little to no attention has been paid to variation in the belowground biomass production and characteristics of bioenergy feedstocks. These differences have significant implications for sustainability of agroecosystems in the short-term in terms of soil health and in the long-term for C sequestration and the global C cycle.

The Use of ^{13}C Differentially Labeled Litter to Study Temperature Sensitivity of Organic Matter

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The effect of temperature on the rate of decomposition of labile and resistant organic matter is necessary for understanding the potential effect of climate change on soil organic matter pools. The temperature sensitivity of organic matter has been studied a variety of ways using long-term field manipulations, mean annual temperature gradients, and short and long-term incubations with occasionally contrasting results. We are utilizing a new method where we are incubating ^{13}C labeled litter that has a different ^{13}C signature for the labile and resistant components to study the temperature sensitivity of organic matter. Differentially labeled Big bluestem litter has been incubated in a Kansas soil at 15ºC and 35ºC and the CO_2 concentration and ^{13}C signature of the CO_2 is being periodically measured in a one year incubation to follow the decomposition of the labeled litter. Preliminary results indicate that the more resistant litter component is more temperature sensitive, supporting the Arrhenius equation and our general theories of organic matter decomposition.

Above-ground litter contribution to mineral soil organic matter in a tall grass prairie: a dual labeled litter study.

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We have a fairly complete understanding of the factors that control above-ground litter mass loss and can model it well in most ecosystem types. Yet, paradoxically, we have almost no measured estimate of the relative contribution of litter mass loss to: i) CO_2 losses to the atmosphere, ii) incorporation of litter derived-C and N to the mineral soil. Questions, such as: “How much of the soil organic C and N derives from above-ground litter? At which depth and in which SOM fraction are litter-derived C and N stored? ” are today largely unexplored. As a consequence these processes are not accurately parameterized in models, and biological controlling factors largely ignored. The cause of this is mostly due to methodological limitations. Using isotope labeled litter we can now trace the fate and accurately quantify the incorporation of litter-derived C and N into the mineral soil and the loss to the atmosphere. Additionally by integrating experimental with modeling approaches, the acquired data and process understanding can be used to better parameterize models and improve their process representation. We present here results from the first two years of an on-going litter decomposition experiment where dual labeled (^{13}C and ^{15}N) *Andropogon gerardii* leaf litter is left to decompose in a native tall grass prairie (Konza, LTER site) inside collars, at direct contact with the soil (i.e., no litter bags). A fauna manipulation treatment is imposed to assess the effects of fauna on litter decomposition rates and incorporation of litter-derived C and N belowground. Litter mass loss, litter-derived CO_2 and litter-derived C and N input to the soil and SOM fractions and plant uptake of litter derived N are quantified using the mass balance approach integrated with conventional gravimetric methods and modeling. Results from the first 18 months of decomposition show that the suppression of microarthropods decreases mass loss rates and alters N dynamics, but that it does not appear to significantly affect the relative amount of C recovered in soil and CO_2 fluxes. Complete findings from the first two years of incubation will be reported, with an emphasis on litter-C and N contribution to SOM at different soil depth and SOM fractions.

Elementar vario ISOTOPE cube, vario PYRO cube, iso TOC cube – a new generation of elemental analyzers from a familiar company

Art Kasson, IRMS Product Manager, Elementar Americas Inc.

The vario ISOTOPE cube and vario PYRO cube systems are designed for efficient measurement of light elements when interfaced to an IRMS. The vario ISOTOPE cube can run samples in various configurations including CN, CNS, or CHNS, while the vario PYRO cube can run samples in CN, CNS, or OH mode. Both cubes have the ability to measure solid organics, but can also be outfitted with the vario Liquid Sampler (VLS) for the robust analysis of liquid matrix samples. An outline of their design and function will be briefly discussed.

The iso TOC cube is a totally new analyzer for TOC stable isotope analysis for all types of samples ranging from ultrapure water, drinking water, industrial waste water, suspensions, marine/estuarine samples or solids with even very difficult sample matrices. The iso TOC cube combines, for the first time, the features of a high performance water analyzer with a century of experience in organic elemental analysis of carbon and stable isotope measurements. As a stand alone unit, the iso TOC cube offers all benefits of the well known vario TOC cube. TOC, NPOC, TC, TIC, DOC and POC can be measured without restrictions. In combination with the Isoprime 100 the 13C/12C ratio in TOC, DOC and TIC is available in 10 minutes analysis time. The coupling of a high temperature TOC now enables the dedicated researcher to explore new avenues in a wide range of applications without the need for very labor intensive sample preparations.

Bioavailability of iron (Fe) and zinc (Zn) from Fe and Zn biofortified pearl millet

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Background: Millet is a major food staple in Northwestern India and the Sahel in Africa. This grain's drought resistance is resulting in progressively greater use.

Objective: The purpose of this study was to determine the absorption of iron and zinc from pearl millet biofortified with two micronutrients that are typically deficient in non-fortified plant-based diets globally.

Methods: The study was undertaken in 40 children aged 2 years in Karnataka, India (n = 21 test/19 controls). Three test meals providing approximately 84 ± 17 g dry pearl millet flour were fed on a single day for zinc and 2 days for iron between 9 am and 4 pm. Quantities of zinc and iron absorbed were measured with established stable isotope extrinsic labeling techniques and analyses of duplicate diets.

Results: The mean (±SD) quantities of iron absorbed from test and control groups were 0.54 ± 0.39 mg/d and 0.18 ± 0.13 mg/d respectively ($P = 0.001$). The quantities of zinc absorbed were 0.95 ± 0.47 mg/d and 0.67 ± 0.24 mg/d respectively ($P = 0.03$). These data do not include absorption of the modest quantities of iron and zinc contained in snacks eaten before and after the three test meals.

Conclusions: In conclusion, quantities of both iron and zinc absorbed when iron and zinc biofortified pearl millet is fed to children aged two years as the major food staple is at least adequate to meet the physiological requirements for these micronutrients.

Exploring the potential of an Isotopic N_2O Analyzer capable of real-time measurements

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We evaluated the potential of the Isotopic Nitrous Oxide (N_2O) Analyzer (Los Gatos Research), which can measure isotopic values of N_2O ($\delta^{15}N^{\alpha}$, $\delta^{15}N^{\beta}$, $\delta^{15}N$ and $\delta^{18}O$) as well as [N2O] at real-time. The analyzer can provide continuous and precise measurements of the isotopic values with a quantum cascade laser along with cavity enhanced laser absorption spectroscopy technique. We evaluated the analyzer by characterizing the rates and isotopic properties of N_2O produced from soils and sediments, N_2O dissolved in water, and a N_2O standard certified for $\delta^{15}N$. In quantifying N_2O production from soils, we used four soils collected from various grasslands across the US Great Plains. Specifically, we investigated a relationship between N_2O production rates and soil water content (SWC) by manipulating soil water levels in a lab setting. We hypothesized that N_2O production rates would be positively correlated with SWC. We observed that soils adjusted at high SWC (30 to 40%) produced significant amounts of N_2O. Parallel experiments using ^{15}N labeling (NH_4^+ and NO_3^-) suggested that N_2O from the soils with high SWC were produced mostly via denitrification. Most of the soils adjusted with low SWC (10 to 20%) produced little N_2O. When we observed measurable N_2O from one soil with low SWC, the ^{15}N labeling experiment suggested that N_2O was produced via nitrification. Our measurements demonstrate that the Isotopic N_2O Analyzer can be a powerful tool to investigate N_2O dynamics in various materials, such as soils and water, in different environmental settings.

Water Isotopic Measurements in the National Ecological Observatory Network

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Stable isotopes provide robust information on the structure, function, and processes of ecological systems and can be powerful tools to address continental scale ecological issues. For example, $\delta^{18}O$ and δD undergo predictable transformations in the hydrological cycle that allow tracing of water sources throughout the biosphere and climate system, and facilitate partitioning of energy balance and evaporation components. Accordingly, H_2O isotopic measurements have been incorporated as key data products in the National Ecological Observatory Network (NEON). The current NEON design includes $\delta^{18}O$ and δD measurements in the atmospheric water vapor and liquid and solid precipitation across NEON terrestrial sites nation-wide. The water vapor measurements at each site are conducted at multiple measurement levels (varying from 4 to 8 levels depending on ecosystem canopy structures). The collection and analysis of the isotopic fractions along with the chemistry in the liquid and solid precipitation over the continental landscape maps the water cycling pathway at large spatial scale and also illustrates local chemistry input to ecosystems. The profile of isotopic water vapor measurements -- from the ground level through and above the canopy to the well mixing layer -- provides the understanding of the water vapor storage as well as the local water cycling pathway in the vertical dimension. Results from these measurements are important components to understand the local and regional water balance and energy budget, as well as the water allocation vertically inside the ecosystem canopy. Here, we will present NEON sampling sites across US, the conceptual design of the profile system for isotopic measurements of water vapor from ground through and above the canopy, the instrumentation and sampling strategy for water vapor, as well as liquid and solid precipitation.

Global measurement of nitrous oxide and its stable isotopes in the troposphere using cavity ring-down spectroscopy

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Nitrous oxide (N_2O), a greenhouse gas with ~300 times the global warming potential of CO_2, is currently increasing at a rate of ~0.26% yr^{-1}, mainly due to increased microbial production from fertilized agricultural systems (IPCC 2007). As the third most powerful greenhouse gas and the primary species responsible for stratospheric ozone destruction, N_2O is directly threatening ecosystem and human health (IPCC 2007, Ravishankara et al. 2009). A better understanding of the controls over N_2O production - especially in agricultural systems - is essential to more effective mitigation policies.

Due to the complexity of microorganism processes within soil, the spatiotemporal effects of fertilizer on N_2O production at a high resolution remain largely unconstrained. Advances in the use of stable isotope techniques can aid in determining the sources and mechanisms involved in soil N_2O emission. The most recent development in stable isotope technology goes beyond measuring total ^{15}N and ^{18}O in N_2O. Determining the intramolecular, or site-specific, position of ^{15}N (β position $^{15}N^{14}N^{16}O$ versus α position $^{14}N^{15}N^{16}O$) is a more robust tool for unraveling the biological and physical controls over atmospheric N_2O. The position-specific ^{15}N is measured as site preference (SP), which is defined as [$\delta^{15}N\alpha$ - $\delta^{15}N\beta$]. Unlike total $\delta^{15}N$-N_2O, it has been shown that SP values are independent of the substrate's isotopic composition in microbial processes, with SP values of ~33‰ and ~0‰ for nitrification-derived N_2O versus denitrification-derived N_2O, respectively (Sutka et al. 2006).

Isotope ratio mass spectrometry is currently employed for determining site-specific ^{15}N, which is labor-intensive and relatively complex due to the need for two extractions of each sample unless modifications are made to the instrument. Picarro Instruments recently developed a wavelength-scanned cavity ring-down spectrometer coupled with a quantum cascade laser capable of the mid-infrared wavelength detection needed for N_2O. This technique allows for streamlined simultaneous and continuous measurement of N_2O concentration, $\delta^{15}N\alpha$-N_2O, and $\delta^{15}N\beta$-N_2O with the precision capability of 0.05 ppb and 0.5‰ for mole-fractions and isotopic delta values, respectively.

A subset of sites from the NOAA Global Monitoring Division (GMD) Cooperative Sampling Network is being measured in order to describe the global distribution of N_2O and its isotopes on a seasonal level, and to refine current models of the global N_2O cycle. As fertilizer application continues to increase due to global food demand, it is expected that nitrification should also increase (Pérez et al. 2001), and we should therefore be able to detect this increase using SP measurements. In addition, we expect to see a seasonal cycle in N_2O isotopomers due to stratospheric mixing in the spring of each hemisphere (causing an enrichment in total $\delta^{15}N$ and SP) and heightened ocean and soil microbial activity in the summer and fall of each hemisphere (causing an increase in N_2O concentration as well as a depletion in total $\delta^{15}N$).

Switchgrass cultivars alter microbial contribution to deep soil C

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Switchgrass (*Panicum virgatum* L.) is a perennial, cellulosic biofuel feedstock capable of growing under a wide variety of climatic conditions on land marginally suited to cultivated crops. Due to its perennial nature and deep rooting characteristics, switchgrass contributes to soil C sequestration deep in the soil profile. However, phenotypic variability in switchgrass cultivars can impact belowground plant allocation and could influence the soil microbial community. We quantified microbial contributions to SOM to a depth of 150 cm using a pulse-chase ^{13}C labeling experiment of two 3-yr old switchgrass cultivars, Kanlow and Summer. We measured total and relative abundance and ^{13}C signatures of phospholipid fatty acids (PLFA).The lowland variety, Kanlow, had greater total PLFAs compared to Summer, an upland, mesic variety. Community structure was dominated by actinomycetes and gram + bacteria and varied with depth. Forty eight hours after labeling, ^{13}C signal was detected in fungi and AMF to a depth of 90 cm. Plant-derived switchgrass C was quickly transferred to microbial biomass deep into the soil and was correlated with belowground plant biomass. Belowground C transfers are essential to accurately determining cultivar-specific effects in C cycling.

Stable Isotope Fingerprinting of Stray Hydrocarbon Gases in Colorado Groundwater

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The Colorado Oil and Gas Conservation Commission (COGCC) recently approved new baseline water quality monitoring regulations requiring oil and gas operators to sample water wells within a half mile radius of new well permits before and after drilling. These regulations include protocols for stable carbon (□^{13}C) and hydrogen (□^{2}H) isotope analysis of free or dissolved methane in the water, in order to distinguish between microbial and thermogenic sources of natural gas. Microbial methane is generated by microbial fermentation and CO_2 reduction pathways in shallow subsurface rocks, soils and waters. Thermogenic gas, consisting of methane and higher molecular weight alkanes, is produced by the thermal decomposition of organic material at higher temperature and pressure. Thermogenic gas is produced in deep geologic formations, but may also occur in shallow coal seams, geologic formations bought to the surface by tectonic activity or erosion of overburden, or as gas that has migrated vertically though fracture networks or along faulty well bores. Here we present a compilation of existing COGCC stable isotopic data of water samples and produced natural gases from the Wattenberg Field of Colorado. Data were accessed from the COGCC online database (http://cogcc.state.co.us/). Among water samples containing methane, the majority of samples contained microbial methane, characterized by > 98 % methane as a percentage of total hydrocarbons, and methane □^{13}C values of < -65 ‰. A small percentage of samples contained thermogenic natural gas, characterized by > 5 % ethane and higher alkanes, and methane □^{13}C values of > -60 ‰. With the □^{13}C of ethane and higher alkanes, it is possible to identify the specific geologic formations or wellbore depth intervals from which stray gases originate. This is made possible by the unique isotopic fingerprints associated with different production formations, due to vertical and lateral gradients in thermal maturity. We demonstrate these interpretive methods of gas isotope fingerprinting with several examples. Incorporation of stable isotope analysis in the new COGCC regulations is a useful and cost-effective measure for protecting groundwater resources and identifying the origins of natural gas found in the environment.

Evaluation of Ability to Determine Transpiration Fraction From Stable Water Isotopes in Water by Synthesis of Models and Observations in an Alpine Forest

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The partitioning of latent heat flux into contributions from ground evaporation and plant transpiration in land surface models is a key feature of any hydrological scheme, but notoriously difficult to resolve. Indeed, global scale models show significant differences in the terrestrial energy balance, which can be traced to poor constraints on the pathways of water on the landscape which control the evapotranspiration (ET). In addition, the depth of water uptake has been shown to be highly correlated with ecosystem ET partitioning, but vegetation rooting profiles are difficult to observe and therefore present a significant source of uncertainty. Stable isotope ratios in water from soil, leaves and water vapor have been used to help constrain the ET partitioning and to track water movement in ecosystems, but many previous studies have been limited in two regards: 1) lack of sufficient data to provide true closure, and 2) lack of an adequate modeling framework to incorporate many of the processes that control the ET.
We present results for the partitioning of ET from an isotopically-enabled land surface model (ISOLSM) that is driven by meteorology, hydrological and isotopic data collected at the Manitou Experimental Forest during the summer of 2011. The data span 146 days and captures the transition of the hydrological regime in the Rocky
Mountains between early season snow melt, mid-summer drying and late summer monsoonal rains. An ensemble of 394 realizations has been produced, constrained by observations of latent heat, sensible heat and CO2 fluxes. Even when all three flux constraints are met, the transpiration fraction is not well-constrained.

The model experiments show that previous work using isotopic observations of vapor and leaves may have significant uncertainty in ET partitioning estimates. On the other hand, root-weighted soil isotope values have proven to sufficiently provide this final constraint on transpiration fraction. A sensitivity analysis of rooting profile and ET partitioning reveals the soil isotope ratios depend strongly on the rooting profile.