Isoflux Inversion Progress Report: Towards Building a Regional Bayesian Inversion for $\delta^{13}C$ of Terrestrial CO_2 Fluxes

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Year to year terrestrial CO_2 uptake and release is highly variable, and much uncertainty surrounds the links between CO_2 fluxes and local to regional weather and climate variability. Plant discrimination against the stable carbon isotope, ^{13}C, is related to stomatal conductance, and is therefore a useful tracer of plant water use efficiency. Furthermore, ^{13}C is a useful tracer of the differential responses of C_3 and C_4 plant functional types to climate and weather anomalies. Both aspects of the terrestrial carbon cycle are of great interest to those seeking to understand the potential effects of global climate change on croplands, forests and natural CO_2 sinks. For the first time, spatial and temporal density of $d^{13}C$ of CO_2 atmospheric observations is high enough to allow for regional inversions of $d^{13}C$ of CO_2 to optimize prior estimates of plant discrimination and disequilibrium flux (an isoflux resulting from the combination of a finite residence time of carbon in terrestrial biosphere pools and a changing atmospheric signature due to human burning of fossil fuels with a plant-derived $d^{13}C$ signature). We present a progress report on the first regional inversion of $d^{13}C$ of CO_2, performed using a traditional Bayesian synthesis framework and the fixed-lag Kalman smoother technique of Bruhwiler and others. Influence functions (footprints) are generated with FLEXPART, driven by National Centers for Environmental Prediction Global Forecast System meteorology. Prior isofluxes (CarbonTracker 2010 posterior net ecosystem exchange multiplied by biosphere $d^{13}C$ from SiB) are of 3-hour, 1x1 degree resolution. Unoptimized fire and fossil fuel emissions are also from the CarbonTracker system, and background CO_2 and $d^{13}C$ values are taken from NOAA/ESRL marine boundary layer and aircraft data. We are working towards discrimination and disequilibrium fluxes optimized at 5x5° resolution for multiple years over the North American region, from 145-25°W longitude and 10-80°N latitude.

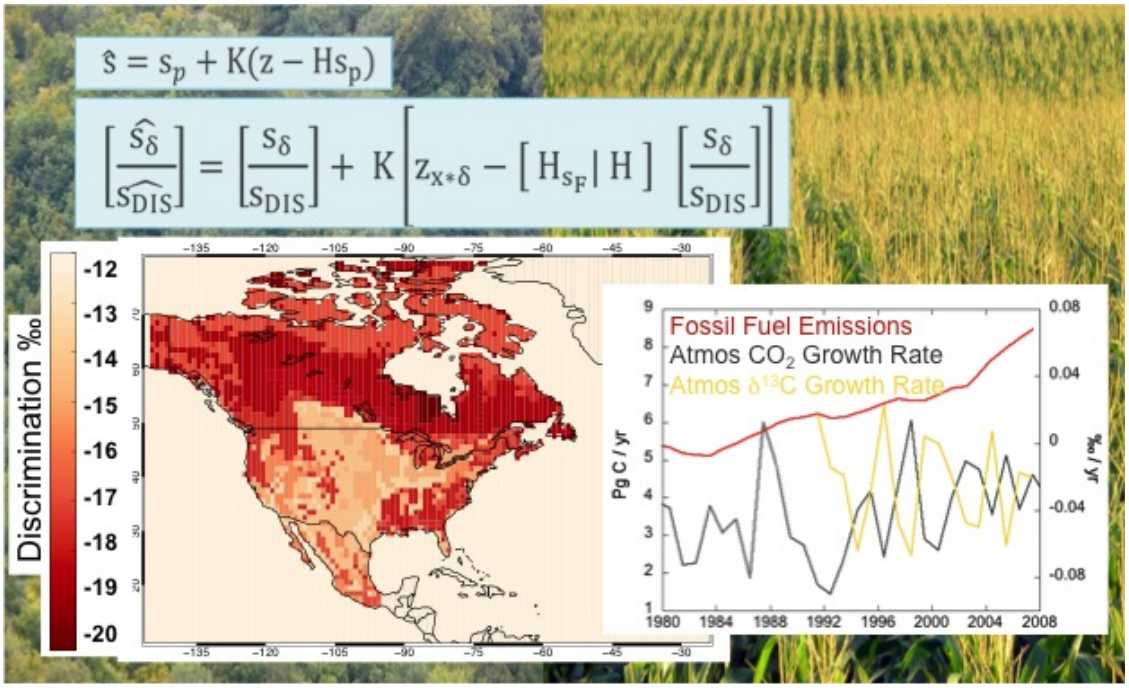

Figure 1. Posterior plant discrimination results for May 2007 (LH panel) and global atmospheric CO_2 and delta ^{13}C growth rates and fossil fuel emissions (RH panel).