carbon burial. Variations in the rate and proportion of carbonate burial through Phanerozoic time have been attributed to the influence of tectonics on eustasy, atmospheric CO2 concentration, MOR hydrothermal flux, and weathering and riverine flux. Variability in biologic production (Corg and Ccarb) through geologic time also had a significant impact on surface ocean chemistry and the sedimentary carbon record. In this study, a geochemical model with Phanerozoic atmospheric pCO2 and surface ocean temperature reconstructions from the literature was used to estimate the history of variations in surface-ocean chemistry (degree of saturation with respect to calcite and aragonite). The results show that, using present-day values of ocean salinity and alkalinity, the Early Paleozoic and Middle Mesozoic oceans were undersaturated with respect to CaCO3. For the present-day values of supersaturation (IAP/Ksp) of 3.0 to 4.5, paleo-alkalinity of ocean water would have been up to 2.5 times greater than at present, although the pH values of surface ocean water would have been somewhat lower than the present value. This alkalinity factor is consistent with a higher calcium concentration (up to 2.5x) due to increased MOR circulation and also higher salinity (up to 1.5x) attributed by other authors to segments of the geologic past. Our model results indicate that pCO2 was a contributing factor to shifts between calcite and aragonite saturation of seawater, however, additional changes in alkalinity were also needed to maintain supersaturation. In addition to MOR circulation, continental weathering of crystalline and older carbonate rocks was likely an important mechanism for maintaining supersaturation of surface-ocean water, particularly during times of increased carbonate storage.

GC72A-0208 1330h POSTER

New Mechanism for Tropical Ocean Influence on the Marine Carbon Cycle and atmospheric CO2

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The tropical ocean plays an important role in the transfer of organic carbon and calcite to the deep sea; and the exchange of carbon between the atmosphere and ocean. This is particularly true for the eastern equatorial Pacific (EEP, east of 120 W); where a substantial fraction of open ocean biological production occurs. Fluxes of organic carbon and calcite to the deep sea were reconstructed for the EEP from the last glacial maximum (LGM) to the Present to examine changes during the major reorganization of the marine carbon cycle at the deglacial. Organic carbon annual flux and seasonality were reconstructed using transfer functions and benthic foraminiferal assemblages. Calcite flux was reconstructed using 230Th normalized sediment calcite accumulation rates and a new proxy for %calcite dissolved at the seabed. This approach yields Holocene fluxes close to the expected and LGM values that satisfy a carbonate diagenesis model using expected LGM conditions. We find that LGM fluxes for both organic carbon and calcite were lower than at Present by 25 to 35%. At the LGM the molar ratio of organic carbon to CaCO3 fluxes was about 1.0. Both began to increase at about 18ckyr (calendar kiloyears) with organic carbon flux stabilizing at 16ckyr but calcite flux continuing to rise into the Holocene. This implies that at 16ckyr there was a decrease in the org. C/calcite flux ratio. The timing of this shift coincides with a strong reduction in the seasonality of production as indicated by the benthic foraminiferal proxy. The flux ratio shift would result from the decrease in f-ratio that occurs in planktonic communities as seasonality of production is reduced. It has been proposed that atmospheric CO2 content could be controlled by changes in the deep ocean org C/calcite flux ratio. The changes we document are in the right sense and timing to provide positive feedback on the increase in atmospheric CO2 recorded for the deglacial. This feedback is driven by changes in production seasonality which we propose is linked to shifts in the position of the ITCZ.

GC72A-0209 1330h POSTER

A New Box-Model to Explain Glacial/Interglacial Atmospheric CO_2 Variation

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During the last glacial era, the partial pressure of atmospheric carbon dioxide (CO_2) was around 200 ppmv. This is approximately 80 ppmv less than the preindustrial value of atmospheric CO_2. Estimates suggest that the ocean is the only reservoir large enough to account for such dramatic change in the carbon budget over these time scales.

The distribution of total CO_2 (dissolved CO_2, carbonate and bicarbonate) throughout the ocean, is controlled by air-sea exchange, the strength of the thermohaline flow, mixing between the surface and the deep water, and by the particulate flux of organic matter sinking to the bottom of the ocean. There is debate over the roles played by high and low latitude oceans in the storage of CO_2, and their relative importance in the process: box models of the CO_2 cycle have been proposed which suggest that conditions in the high latitude oceans greatly determine the amount of CO_2 the ocean is able to store. However, general circulation models (GCMs), indicate that the low latitude oceans influences CO_2 storage to a degree greater than the box models suggest.

We propose a box model which to a large extent resolves the debate. It does so while also retaining consistency with the fundamental fluid and thermodynamic equations governing this flow. We will describe this carbon dioxide preserving model, and will show that by changing the forcing the model yields glacial and interglacial solutions when realistic parameter values are used.

GC72A-0210 1330h POSTER

A Theory For The Influence Of The Subtropical Thermocline On The Solubility Pump Of Carbon

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We examine the abiotic carbon cycle in a single hemispheric basin and propose a new, quantitative theory relating atmospheric pCO_2 to the amplitude of surface wind stress and the diapycnal diffusivity. At the zeroth order, high latitude surface water controls atmospheric pCO_2 by dominating dissolved inorganic carbon (DIC) of the deep ocean reservoir as explained by classical 3-box models. At the next order the thermocline determines the ocean carbon inventory, where warm, thermocline waters are depleted in DIC relative to the deep ocean. In this study, we examine the impact of this thermocline inventory on atmospheric pCO_2. Assuming that the total amount of carbon in the atmosphere and in the ocean is conserved, a simple analysis predicts that atmospheric pCO_2 will scale linearly with the product of the thermocline depth and DIC concentration. The theory shows that atmospheric pCO_2 increases with surface wind stress because (1) the warm thermocline deepens with stronger Ekman pumping, and (2) the thermocline waters become increasingly undersaturated as the western boundary current is intensified and subduction occurs before equilibration with the atmosphere. The theory suggests that atmospheric pCO_2 scales as $w_{ek}^{1/2}$ or $w_{ek}^{3/2}$ depending on the intensity of the wind forcing. This is confirmed by experiments with the numerical basin model. Atmospheric pCO_2 is also enhanced by higher diapycnal diffusivity which increases the thickness of the thermocline. Both theory and basin model suggest that atmospheric pCO_2 scales as $\kappa^{1/3}$ in the diffusive thermocline limit. In the numerical experiments, over a reasonable range of parameters, the thermocline inventory itself can modulate atmospheric pCO_2 by up to 30 [ppmv] with this abiotic mechanism. Finally, we examine the sensitivities of a more complex global abiotic carbon cycle model and discuss how this simple theory might help understand the response of such models to the imposed forcing parameters.

GC72A-0211 1330h POSTER

Role of Siberian Permafrost in the Global Atmospheric Carbon Budget

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The large (80-100 ppmv; 200 Pg) fluctuations in atmospheric CO_2 that coincide with past glacial cycles reflect biospheric feedbacks triggered by changes in solar input. These feedbacks are poorly understood but will likely influence the response of the Earth System to recent increases in global temperature and atmospheric CO_2. Siberian permafrost contains a large pool (ca. 700 Pg) of sediment carbon that is similar to the quantity of the carbon in the global atmosphere. Laboratory incubations, field measurements, and chemical analyses indicate that this carbon is highly labile and decomposes quickly when permafrost melts. A continuation of recent warming trends could trigger release of this carbon through either direct temperature effects on active-layer thickness and decomposition or increased frequency of forest fires, which cause a three- to five-fold increase in thaw depth. Similarly, melting of permafrost in Europe and Southern Siberia at the end of the Pleistocene may have released more than 400 Pg of CO_2-carbon to the atmosphere. This release could have contributed substantially to the increase in atmospheric CO_2 at the Pleistocene-Holocene boundary. These observations suggest that melting of Siberian permafrost could play a globally significant role in the past and future changes in Earths climate.

GC72B MCC: Hall D Sunday 1330h

Carbon Cycle and Climate: Past, Present, and Future Posters IV *(joint with A, B, H, OS, PP)*

Presiding: **N Zeng,** University of Maryland**; M Heiman,** Max-Planck-Institut fuer Biogeochemie**; N Gruber,** University of California, Los Angeles

GC72B-0212 1330h POSTER

Refinements in the Spatial and Temporal Resolution of Fossil-Fuel CO_2 Emissions Data

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Increasing sophistication of inverse models of the carbon cycle and more detailed understanding of carbon fluxes require finer spatial resolution and seasonal or greater temporal resolution of fossil-fuel CO_2 emissions data. Increasing pressure to formulate a feasible greenhouse-gas emissions policy for the USA requires spatial resolution of CO_2 emissions at scales much finer than national totals. We have calculated preliminary estimates of fossil-fuel CO_2 emissions for the entire USA on a month-by-month basis, and for each state on an annual basis, for the most recent 20 years. The methodology for obtaining the emissions estimates is similar to what we have used previously to estimate global and national annual totals, but relies on more detailed data by fuel type and end use. Efforts are underway to provide similar estimates of CO_2 emissions for the rest of North America.

GC72B-0213 1330h POSTER

Modeling the Seasonal and Interannual Variability of Nutrients, Biomass, and Carbon Species in the Subtropical North Atlantic and North Pacific

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A one dimensional, coupled ecosystem/carbon cycle model is used to analyze the biogeochemical-physical interactions and carbon fluxes at two time-series study sites: the Bermuda Atlantic Time-series Study (BATS) site, and the Hawaii Ocean Time-series (HOT) site. Physical forcing and biogeochemical boundary conditions are derived from the comprehensive BATS and HOT data sets. The observed parameters not used for model forcing and boundary conditions are used to verify model performance.

The seasonal and interannual variability of biomass, nutrients, and carbon species of these two sites are investigated and compared, and the long-term (decadal) trends of carbon stocks (DIC, DOC, and CO_2) are analyzed in the context of climate variability.

The two sites have very distinct physical forcing characteristics. At BATS, the winter mixed layer can reach 300 meters, while at HOT it rarely exceeds 100 meters. Also, the BATS region is affected by a pervasive translation of strong mesoscale eddies that promote large vertical excursions of the thermocline/nutricline. In the HOT region the mesoscale variability is more episodical such that the vertical transport of nutrients is achieved predominantly by vertical mixing. These differences in physical forcing have an impact on the nutrient and carbon balances of the two regions, which is clearly demonstrated by the model results.

GC72B-0214 1330h POSTER

Modeling the shallow water $CaCO_3$ cycle and fossil fuel CO_2

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Acidification of the ocean by invasion of fossil fuel CO_2 decreases the saturation state of $CaCO_3$ minerals, provoking excess dissolution of $CaCO_3$ on the sea floor and potentially decreasing the biogenic $CaCO_3$ production raining to the sea floor. We use a new model of benthic sediment chemistry, within the framework of a coarse-resolution GCM carbon cycle model interpolated to an ultra-high resolution bathymetric dataset, to estimate that $CaCO_3$ burial globally has already decreased by 5-12% since 1750, and could halve by the year 2100. The model predicts a rapid onset of fossil fuel CO_2 neutralization by the $CaCO_3$ cycle in the ocean.

GC72B-0215 1330h POSTER

Seasonal Amplitude of the Sea-Surface pCO_2: Early Results from a new VOS-Line in the North Atlantic

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The seawater pCO_2 and related parameters (e.g. SST, salinity, chlorophyll) have been measured on the volunteer-observing-ship (VOS) M/V Falstaff in the North Atlantic between Europe and the U.S. east coast. We present data for a restricted region (39° N- 41° N, 55° W- 60° W) collected during seven transits between February and July 2002. The observed seawater pCO_2 slightly increased from 342 μatm to 355 μatm (February to July, respectively) accompanied by a seasonal warming from 16°C to 24°C. Generally this region proves to be a weak sink for atmospheric CO_2 and the mean delta pCO_2 is about -45 μatm. With the onset of summer (June, July) the seawater pCO_2 gets closer to equilibrium (undersaturation of 20 to 30 μatm) which suggests that warming plays a major role. These results are in agreement with published data and calculated CO_2-fluxes that show that the North Atlantic ocean (north of 10° N) on average is a CO_2 sink (Lefèvre, 1999).

We attempt to explain the observed pCO_2 variability by accounting for the effects of temperature change, air-sea gas exchange, and biological carbon cycling (Takahashi et al., 2002). The temperature-only contribution was calculated to be +121 μatm. Processes other than the temperature effect were responsible for limiting the observed increase to +13. Such processes exerted a non-temperature effect of -108 μatm (calculated using the approach of Takahashi et al., 2002) on the seawater pCO_2. In order to separate the different effects that are included in this non-thermal pCO_2 variability we estimate the biological effect using two approaches. In the first one we use the chlorophyll data that were collected along these cruises and calculate the biomass change using an assumed C/Chl ratio. In the second approach we use the measured parallel drawdown of nutrients to estimate the biological effect on the seawater pCO_2. In the final step the net gas exchange effect on the pCO_2 will be estimated based on the Wanninkhof parameterization of the transfer coefficient. As a result we will be able to balance the observed seasonal pCO_2 change with the gas exchange, temperature and biological effect.

URL: http://www.ifm.uni-kiel.de/fb/fb2/ch/research/cavassoo/index.htm

GC72B-0216 1330h POSTER

Ozone Effects on Global Net Primary Production and Carbon Sequestration Using a Biogeochemistry Model

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The effects of air pollution on vegetation may provide another important control on the carbon cycle that has not yet been widely considered. Prolonged exposure to high levels of ozone, in particular, has been observed to inhibit photosynthesis by direct cellular damage within the leaves and through changes in stomatal conductance. We have incorporated simple empirical equations derived for hardwoods, pines, and crops into the Terrestrial Ecosystem Model (TEM, version 4.3) to explore spatial and temporal variations of ozone effects on net primary productivity (NPP) and carbon sequestration across the globe. Although our results show up to a 2% reduction in annual NPP as a result of historical ozone levels during the late 1980s-early 1990s, regionally this reduction is much larger. The largest decreases (up to 39% in some locations) occur in the eastern U.S., Europe, and China, during months with high ozone levels and substantial production. Carbon sequestration during the early 1990s is reduced by as much as 0.43 PgC/yr, or 15%, with the presence of ozone. Thus the effects of ozone on net primary production and carbon sequestration should be factored into future calculations of the global carbon budget.

GC72B-0217 1330h POSTER

Decadal Variability of the Biosphere, the Climate, and the Carbon Cycle in a Coupled Atmosphere-Biosphere Model, CCM3-IBIS.

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We analyze a 500-year run of the coupled atmosphere, dynamic vegetation and soil model CCM3-IBIS that presents different slow modes of variability in the climate, vegetation and carbon cycle.

IBIS (Foley et al., 1996; Kucharik et al., 2000) is a dynamic vegetation model that describes the physical, physiological and ecological processes occurring in vegetation and soils in a coherent and mechanistic way. The model includes land-surface physics, canopy physiology, plant phenology, vegetation dynamics and competition, and carbon cycling. We coupled IBIS to the NCAR CCM3 at a T31 resolution (3.75o x 3.75o). We ran a 500-year equilibrium simulation of the 'present day' climate imposing a constant atmospheric CO2 concentration of 350 ppm and fixed sea-surface temperatures.

A spectral analysis shows that the precipitation, the leaf area index of the vegetation, the net primary productivity and the heterotrophic respiration present slow modes of variation at decadal timescales. Because we ran CCM3-IBIS with fixed sea-surface temperatures, this detected variability can only be attributed to changes in vegetation structure and functioning. A comparison with a similar run with fixed vegetation confirm this hypothesis. Transition zones between vegetation types like the Sahel contribute the most to the slow variability. This study shows that feedbacks between vegetation dynamics, the carbon cycle and the atmosphere alone can produce internal variability at decadal scale.

GC72B-0218 1330h POSTER

A Theoretical Analysis of Carbon Isotope Evolution of Decomposing Plant Litters and Soil Organic Matter

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Systematic variations in the carbon isotopes of soil organic matter (SOM) have been observed in a variety of ecosystems. Such variations may provide important insights into physical and biological processes that mediate carbon storage, nutrient availability and trace gas emissions. To study carbon cycles using carbon isotopes, it is important to link carbon isotope systematics with carbon dynamics models, so that carbon isotope variations can be interpreted in the context of rates and fluxes of carbon transport in ecosystems. However, quantitative description of carbon isotope systematics is lacking. This presentation describes a theoretical analysis, in which carbon isotopic evolution of decaying organic matter is modeled for a system in which the rate of litter or soil organic matter decomposition is controlled by substrate quality and microbial growth rate. The model examines two mechanisms controlling the isotopic evolution of carbon in a closed system: kinetic isotopic fractionation by soil microbes and differential decomposition. The model produces several important characteristics of a SOM decomposing system: 1) for a system with a single population of organic matter, the carbon-13/carbon-12 ratio in SOM increases with increasing carbon loss as a result of kinetic isotope fractionation of respiration; 2) for a give isotopic fractionation factor, the isotopic enrichment relative to the original organic material increases with the decomposition rate; and 3) for a system containing multiple organic matter components having different qualities and isotopic compositions (e.g., cellulose and lignin), the temporal evolution of the SOM isotope ratio reflects the competing dominance of isotopic fractionation and preferential reservation of one or more organic components. This model can be tested using litterbag or incubation experiments, and if validated may be used to help parameterization of carbon dynamic models.

GC72B-0219 1330h POSTER

Effects of Land use Change and Tree Coverage Decrease in key Aspects of the Carbon Budget of the Brazilian Cerrado savanna.

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The aim of this study is to evaluate differences in ecosystem carbon budgets among Cerrado vegetation with abundant trees, Cerrado vegetation dominated by native grasses, and formerly Cerrado areas converted to pasture. The work is being conducted in two Cerrado areas (with contrasting tree densities), in the Reserva

Ecologica do Roncador (RECOR-IBGE) and in one area converted to pasture, in the Embrapa-Cerrados, both located near Brasilia. We monitored key processes related to the carbon dynamics: soil respiration (using the dynamic chamber IRGA technique), litterfall (litterfall collectors) and decomposition (litter decomposition bags). In the woody area, soil respiration rates were similar to other tropical savannas(0.7-0.22gC m-2 h-1). The area with lower tree density had similar soil respiration, but with sharper seasonal variation (0.6-0.25gC m-2 h-1), lower litterfall (1,5x106gC ha-1 yr-1versus 3.0x106gC ha-1 yr-1 in the woody plot) and lower decomposition rates. The planted pasture showed higher soil respiration fluxes, with more intense seasonal variation compared to the Cerrado plots. The peak of soil respiration activity in the pasture occurred in the beginning of the rainy season, while in the Cerrado areas the peak occurred in the end of this season. The decrease of the arboreal component seems to decrease the carbon cycling in this ecosystem, while the conversion to pasture seems to accelerate the carbon cycling, switching to a less conservative and more seasonably variable ecosystem.

GC72B-0220 1330h POSTER

A Comprehensive GCM-Based Climate and Carbon Cycle Model: Description and Equilibrium Simulations

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We have produced an interactive global climate and carbon-cycle model using an existing atmosphere-ocean general circulation model (GCM) coupled to ocean carbon and terrestrial biosphere models. The goal of this effort is to produce a simulation tool capable of improved realism in future climate predictions. In particular, we seek to include and better understand feedbacks between the climate system and the carbon cycle. We use the Parallel Climate Model 2 (PCM-2) developed at NCAR as our climate model. The PCM-2 includes a version of NCARs CCM3 for the atmospheric GCM and a version of the POP model for the ocean GCM. The horizontal resolutions for atmosphere and ocean are T42 truncation (about 280 km) and 0.7 degrees (about 75 km), respectively. The ocean carbon model is based on OCMIP protocols, but modified to eliminate the phosphate-restoring restriction. The terrestrial biosphere model is IBIS-2 which simulates biophysical and biogeochemical surface fluxes and includes a dynamic vegetation model. We have integrated this coupled model system to an equilibrium state for soil carbon using a prescribed pre-industrial atmospheric CO2 concentration of 290 ppmv. This will serve as a starting point for transient simulations using prescribed greenhouse gas emissions. In addition to the pre-industrial equilibrium run, we have performed a post-industrial equilibrium run representative of a time when CO2 has been stabilized at 550 ppmv. Salient differences between the two runs will be described. In the enhanced greenhouse case, the global mean surface warms by 2.6 degrees C, the hydrologic cycle strengthens by 3.9 percent and sea ice area declines by 26 percent. The terrestrial biosphere is particularly responsive, however. Terrestrial NPP increases by 66 percent in the post-industrial greenhouse case, largely in response to the CO2 fertilization effect. As a result, the enhanced greenhouse case has 1250 Pg (49 percent) more carbon stored on land (vegetation and soil) than the pre-industrial case. This indicates the potential for a substantial carbon uptake and negative feedback on atmospheric CO2 concentrations in this particular model.

GC72B-0221 1330h POSTER

Can we Constrain Carbon Assimilation and Allocation in a Multi-Species Hardwood Forest Using Water Flux Measurements?

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Annual carbon budgets of terrestrial ecosystems and how climate perturbations alter them remain an active research area. A combination of measurements collected at multiple spatial and temporal scales is used in conjunction with models to quantify the relationship between water fluxes and C budgets. A multilayer model for canopy CO2 uptake is employed in which the primary input is mean canopy stomatal conductance scaled via sap-flux of water vapor (gw) in a multi-species hardwood forest stand at the Duke Forest, NC, USA. The ecophysiological model relates stomatal conductance of CO2 (gCO2) to the ratio of internal (Ci) to external CO2 concentration (Ca) that is then used to calculate net assimilation (Anet) after correction for differences in diffusivities. Modeled assimilation rates agreed well with instantaneous leaf level measurements in the upper canopy, collected via porometry and monthly daytime carbon fluxes measured via eddy-flux augmented with daytime soil and wood respiration. Additionally annual biomass production augmented with construction and maintenance respiration agreed well with annual carbon uptake. The combination of sapflux measurements and the model provide reliable constrains on CO2 budgets in terrestrial ecosystems and showed lower carbon uptake in hardwood forest of the southeast than previously published.

GC72B-0222 1330h POSTER

Carbon isotope discrimination of the terrestrial biosphere on multiple temporal and spatial scales

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We simulate carbon isotope discrimination of the terrestrial biosphere at a 1^{o} spatial resolution and 10-minute time step for 1983 1993 using a multistage model of C3 carbon isotope discrimination, global maps of C3/C4 plant ratios, and an ecophysiological model of the terrestrial biosphere (SiB2). The model is driven by observed meteorology from the European Center for Medium Range Weather Forecasts (ECMWF) and constrained by satellite derived Normalized Difference Vegetation Index (NDVI). Results of the simulation are evaluated by comparing the modeled response of C3 discrimination to daily variations in vapor pressure deficit (vpd) and monthly variations in precipitation to observed changes in discrimination inferred from Keeling plot intercepts. Results are also used to examine the amount of isotope discrimination that should be expected on various temporal and spatial scales and to look at controls on interannual variability in terrestrial discrimination.

In the simulation, mean annual C3 discrimination during this period is $19.2\pm0.1^{o}/_{oo}$; total mean annual discrimination by the terrestrial biosphere (C3 and C4 plants) is $15.9\pm0.05^{o}/_{oo}$. In general, modeled C3 discrimination is somewhat less sensitive to changes in water availability than observed discrimination, although this may be in part due to a mismatch in the spatial scales of the model and observations. At a 1^{o} resolution, C3 discrimination varies by as much as 5 per mil from one day to the next in response to changes in vpd. Monthly variations in discrimination are usually small, although transitions from wet to dry months and back again may produce changes as great as 0.5 per mil. At the annual time scale, water availability is the primary control on C3 discrimination for any particular grid cell; however, when globally averaged, interannual variations in discrimination are dominated by changes in the ratio of C3 to C4 assimilation rates rather than water stress induced changes in discrimination by C3 plants.

GC72B-0223 1330h POSTER

Boreal Peatland Response to Fire: An Example in Western Canadian Bogs

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Peatland ecosystems cover an estimated 3-4 % (350-400 million ha) of the earths land surface, with 100.8 x 10^{6} ha distributed in the boreal and subarctic regions of Canada. Photosynthetic production exceeds microbial decomposition in these ecosystems, resulting in an accumulation of stored organic matter, or peat, that, in western Canada, is greater than 40-cm in depth. Worldwide, boreal and subarctic peatlands sequester atmospheric carbon at a rate of 76 Tg yr^{-1} representing a 455 Pg carbon pool, with continental western Canadian peatlands retaining 42 Pg C as peat collectively. Within and between individual landforms, peatland function varies substantially due to variation in vegetation composition and edaphic conditions, such as pH, water chemistry, and hydrology. Site characteristics vary microtopographically in ombrotrophic bogs, particularly with respect to vegetation dominance and height above water table, resulting in functional differences. Fire consumes an estimated 1,470 km^{2} of peatland annually in boreal, continental, western Canada (Turetsky et al. 2002), altering peatland composition and function dramatically. Vegetation succession after fire varies depending on fire severity within the bog, resulting in decomposition and peat accumulation differences between high, dry hummocks and low, wet hollows. To assess direct carbon loss due to combustion variability, four 10-cm diameter cores were collected from hummocks and hollows, respectively, from each of 10 plots along a randomized transect through a bog recently burned in a 114,047-ha fire near Chisolm, Alberta in June 2001. Cores were separated into burned and underlying unburned sections, ashed, and determinations of organic matter loss were made using the methods of Turetsky and Wieder (2001). The samples showed twice as much carbon loss from hollows compared to hummocks, suggesting the water retention abilities of the *Sphagnum fuscum* dominated hummocks prevented combustion, while the desiccation prone hollows burned to a greater extent. To assess post-fire functional variation in two previously burned, *Sphagnum* dominated, western Canadian bogs, 10-cm diameter cores were collected 30-45 cm in depth from hummocks and hollows, respectively, from each of 10 plots along a randomized transect. Vegetation surveys were conducted at each plot, as well as assessments of microtopographic variation and time since fire. Cores were frozen and sectioned at 1-cm intervals for macrofossil analysis, bulk density, and organic matter content by loss on ignition. In general, *S. fuscum* dominated hummocks showed greater peat accumulation than hollows, presumably due to greater decomposition in the hollows. Decomposition, while greater overall in the hollows, varied in relation to the occurrence of fire, with material closer to the fire horizon showing greater amounts of unidentifiable debris, an indicator of decay. Therefore, the affects of fire on peatlands are highly variable, but coincide with vegetation composition and functional properties of the landform.

GC72B-0224 1330h POSTER

The Carbon Cycles of Chinese Terrestrial Ecosystems

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The changes of Chinese terrestrial carbon storage depend not only on biogeochemical and climatological processes, but also on human activities and their interaction with carbon cycle. China,covering about 133.7 million hectares of forested land, has climate regimes ranging from tropical, to subtropical, temperate and cold temperate zones, and from southeast to northwest humid, semi arid and arid zones. A long history of agricultural exploitation, forest management practice,

rapid change in land use, forestry policies, and economic growth suggest that Chinese terrestrial ecosystems play an important role in the global carbon cycles. Our recent results suggest that total carbon storage in Chinese terrestrial ecosystems is about 144 Pg C, including 7.3 Pg C in vegetation and 136.7 Pg C in soil. Chinese forests released about 0.68 Pg C between 1949 and 1980. Forest carbon storage has increased significantly after the late 1970s from 4.38 to 4.75 Pg C by 1998, mainly due to forest expansion and regrowth. Total organic carbon storage in soils in China is estimated to be about 70.31 Pg, representing 4.7% of the world storage. The results also indicated that a soil organic carbon loss of 7.1 Pg was primarily due to human activity, in which the loss in organic horizons has contributed to 77%This total loss of soil organic carbon in China induced by land use represents 9.5% of the worlds soil organic carbon decrease.

GC72B-0225 1330h POSTER

Climate Signatures of Photosynthesis Variability

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Rising CO2 concentration and climatic change are likely to alter vegetation distribution and function and hence terrestrial carbon uptake. In turn, changes in vegetation activity can strongly impact the climate through physiological and structural processes. We explore the possible climatic fingerprints of terrestrial carbon sink variations.

We analyze the relationship between spatial and temporal variations in GPP (Gross Primary Production)and those of different climatic variables in a 120-years control run performed with the Community Climate System Model with atmospheric CO2 fixed at 280ppmv. The model simulates a large inter-annual variability in GPP (sigma=23PgC/yr; mean=116PgC/yr) in response to the climate and water stress conditions. Results will be presented on the variations in mean surface air temperature, diurnal temperature range, and Bowen ratio with GPP.

GC72B-0226 1330h POSTER

Seasonality and Long-Term Trends in the Oceanic Carbon Cycle near Hawaii (Station ALOHA)

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Predictions of the future behavior of the oceanic carbon cycle require a detailed understanding of the response of this cycle to meteorological perturbations. One of the strongest perturbations is the seasonal cycle, which has a pronounced impact on the upper ocean carbon cycle. We investigate this cycle in the subtropical gyre on the basis of a long-term upper ocean time series records from station ALOHA near Hawai'i. The samples were taken from 1988 until present and analyzed by the Carbon Dioxide Research Group at the Scripps Institution of Oceanography. The time series for dissolved organic carbon (DIC), the ocean surface partial pressure of CO_2 (pCO_2), the $^{13}C/^{12}C$ ratio of DIC ($\delta^{13}C$) as well as mixed layer temperature (T) and depth show distinct seasonal cycles. The seasonal changes of oceanic pCO_2 values are mainly determined by the annual cycle of T. They are smaller than their atmospheric counterparts during almost the entire time series implying a net uptake of CO_2 from the atmosphere. To examine the role and importance of the processes acting on the carbon cycle at ALOHA, we employed a diagnostic box model (based on the setup described by Gruber et al., 1998). Our results indicate that net community production (NCP) is the only consistent sink term for DIC in the upper ocean carbon budget. In spring and summer, NCP removes 31.4μmol kg^{-1} from the surface mixed layer. This is balanced only in parts by air-sea gas-exchange that adds 10.8μmol kg^{-1} leading to the observed drawdown of DIC. In fall and winter the weak net removal of 15.9μmol kg^{-1} by NCP is more than compensated by the combined addition of 24.9μmol kg^{-1} by air-sea gas-exchange, entrainment, and horizontal transport. These results indicate that the seasonal dynamics of the upper ocean carbon cycle are the result of a complex interaction of various processes, implying that this cycle likely doesn't respond in a simple manner to climatic perturbations. This is highlighted by the observation that the long-term oceanic pCO_2 trend is about two thirds stronger than the atmospheric pCO_2 increase without an obvious link to long-term trend in climate at this site.

GC72B-0227 1330h POSTER

A continental-scale Inventory of Soil Organic Carbon and Stable Carbon Isotopes from Australian Sandy Soils

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The Australian CRC for Greenhouse Accounting has completed a robust continental-scale inventory of soil organic carbon (SOC) storage in well-drained sandy soils of the Australian continent. The SOC reservoir is known to vary spatially with primary variables of climate, texture, drainage, and vegetation conditions, all of which have been addressed by this study. Early phases of this project developed a robust soil sampling and carbon analysis program for the determination of SOC and 13-Carbon pools on a continental scale, which is based on a stratified sampling methodology and simplified analytical techniques. With this methodology a wide range of research problems can be addressed at a variety of spatial scales. The current analytical phase of this project has completed work on soils of coarse texture (sandy) in well-drained conditions, and established a robust relationship of two depth-specific SOC pools to mean annual temperature (MAT) and mean annual precipitation (MAP), while also taking into account the local variability with respect to the distribution of trees and grass. Forty three sites in Australia have been sampled across a wide range of climate regimes and analysed for percent carbon and δ^{13}C, among other key soil physical and chemical properties. Subsequent analysis has produced best-fit empirical relationships of the 0-5 cm and 0-30 cm pools of SOC and 13-Carbon isotopic ratios to MAP and MAT, where correlation coefficients are greater than 0.7. Current research of this project is under way to assess the variability of SOC and 13-Carbon with soil textural conditions (particle size distribution), by analysis along soil texture gradients and by analysis of particle size fractions of each site.

GC72B-0228 1330h POSTER

Gaining insight into the interannual variability of air-sea CO_2 fluxes using satellite observations

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While estimates of interannual air-sea CO_2 flux variability in the tropics tend to converge, the role of the mid and high-latitude oceans is poorly understood. Most of the interannual variability in air-sea CO_2 flux at these latitudes is caused by variations in surface ocean mixing and associated entrainment, in biological export production, in warming or cooling of surface waters, and in gas exchange velocity. Each of these processes leaves a signature that has been observed by satellite for at least five years. Here we present a first attempt to quantify these processes and their contribution to air-sea CO_2 flux variability in the extra-tropics.

We use sea surface height (SSH) from Topex/Poseidon to estimate the impact of interannual variations in the depth of the surface mixed layer. We assume that all interannual variations in SSH are caused by variations in the heat content of the water column. Based on model results, this assumption is valid for large areas outside the equatorial region. We then use the observed linear relationship between the mean surface mixed layer depth and heat content to estimate the variations in the mixed layer depth, and the associated variations in the entrainment of carbon from the intermediate depth ocean. We use chlorophyll a retrievals from SeaWiFS to compute primary production. To estimate export production, we combine these primary production estimates with estimates of the e-ratio inferred from primary production and temperature. We use sea surface temperature from various satellites to estimate the effect of warming and cooling on the solubility of CO_2. Finally we use wind speed observations from ERS to estimate variations in the gas exchange coefficient.

The reconstructed interannual variations in air-sea CO_2 flux are of the order of $\pm$0.5 PgC/yr when integrated over an entire basin. These estimates are larger than those deduced from ocean model simulations, but the satellite inferred estimates are also associated with large uncertainties. Although our estimates are highly dependent on the selected data and algorithms, they present the advantage of being based on observations and not on ocean models, which are known to vary too little at high latitudes, or on atmospheric inversions, which have difficulty to separate the land from the ocean.

GC72B-0229 1330h POSTER

LMDz a New Atmospheric Transport Model With "Zoom" Capability

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Analysis of continuous CO_2 measurements over the continents currently offers the potential to better understand the carbon fluxes between the terrestrial biosphere and the atmosphere, as well as providing an alternate check on fossil fuel emissions to help monitor future Kyoto type treaties on sub-continental scales. To do so requires much higher spatial and temporal resolution in the transport model than has been used in the past to analyse so called 'baseline' measurements such as those at Mauna Loa and the South Pole which are remote from strong CO_2 fluxes. An optimal way to achieve this increase in resolution is to use a model with a flexible grid such that an area of interest can have higher resolution than others, thus saving computational expense.

We present the LMDz (Laboratiore Meteorologie Dynamique zoom) model, describing its grid set-up and advection and convection schemes. Its ability to model large-scale features such as the seasonal cycle amplitude at baseline stations, as well as high frequency continental stations over Europe will be shown. We present several sensitivity studies using different spatial and temporal resolution, a new advanced planetary boundary layer scheme, and the impact of using different estimates of the surface CO_2 fluxes. We examine the models behaviour both from a Lagrangian and Eulerian point of view. Finally, we outline the use of the self-adjoint aspect of the atmospheric transport model, and how the model can be used in an inverse mode to retrieve flux information from the atmospheric data at high spatial and temporal resolution.

GC72B-0230 1330h POSTER

Measurements of atmospheric O2/N2

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Improvements made to an established mass spectrometric method for measuring changes in atmospheric

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O_2/N_2 are described. With the improvements in sample handling and analysis, sample throughput and analytical precision have both been increased. Aliquots from each pair of flasks are repeatedly measured over a period of two weeks, with an overall standard error in each flask of ± 4.5 per meg, corresponding to about 1 ppm O_2 in air.

Records of changes in O_2/N_2 from six global sampling stations (Barrow, American Samoa, Cape Grim, Amsterdam Island, Macquarie Island, and Syowa Station) are presented. Combined with measurements of CO_2 from the same sample flasks, ocean and land carbon uptake were calculated from the two sampling stations with the longest records (Barrow and Cape Grim). The calculations take into account estimates of O_2 outgassing from the oceans during the 1990s due to global warming ($0.29 \pm 0.4 \times 10^{14}$ mol of O2 yr^{-1}; Keeling and Garcia 2002). From 1994-2001, the averaged ocean and land uptake of CO_2 was 1.6 ± 0.6 and 1.2 ± 0.4 GtC yr^{-1}, respectively.

Interannual variability exists in both the ocean and land uptakes. In order to assess the potential sources of this variability, empirical orthogonal functions (EOF) of the three longest available atmospheric potential oxygen (APO) timeseries (Cape Grim, Barrow and American Samoa) were computed using the detrended and deseasonalized data averaged into months, and normalized. The dominant EOF appears statistically robust and explains 51% of the combined variance. It is characterized by loadings of the same sign and similar values at all three stations, suggesting that EOF1 may be related to fluctuations in the global mean APO, as opposed to geographic variability. Associations of EOF1 with various climatic fields and indices will be discussed.

GC72B-0231 1330h POSTER

Anthropogenic CO2 uptake by the ocean based on the global chlorofluorocarbon dataset

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We estimate the oceanic inventory of anthropogenic CO2 from 1980 -1999 using a technique based on the global chlorofluorocarbon dataset. The uncertainty in our approach is shown to be small by comparison to direct anthropogenic CO2 observations and through the use of an ocean general circulation model. Our analysis suggests the ocean stored 14.6 Pg of anthropogenic carbon from mid-1980 to mid-1989 and 17.6 Pg C from mid-1990 to mid-1999 implying an ocean-wide net uptake of 1.6 and 2.0 0.4 Pg C / yr respectively. Our results provide an upper limit on the solubility driven anthropogenic CO2 flux into the ocean and suggests most ocean general circulation models are overestimating oceanic anthropogenic CO2 uptake over the last two decades.

GC72B-0232 1330h POSTER

Documenting Biophysical Activities on Land Surfaces

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The biophysical activities on land surfaces have been documented from spectral measurements made in space for decades. These estimates often were derived from the Normalized Difference Vegetation Index, which is simple to compute but very sensitive to perturbations and prone to yield misleading or erroneous results. Advances in the understanding of radiation transfer and availability of higher performance instruments have lead to the development of a new generation of geophysical products poised to provide reliable, accurate information on the state and evolution of terrestrial environments. Specifically, a series of optimized algorithms have been developed to estimate the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) for various instruments. Such an approach allows the synergistic use of FAPAR products derived from different sensors and the construction of global FAPAR time series independent from the life time of these specific sensors. The outline of the methodology will be summarized and the results from an application conducted with SeaWiFS data will be presented.

GC72B-0233 1330h POSTER

Rectification changes with model resolution and from year to year

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Atmospheric models have been used with both forward and inverse approaches to imply air-sea and air-land carbon fluxes. Generally, models predict similar meridional variability of the zonal annual mean of surface atmospheric CO2 for the components due to air-sea fluxes and fossil emissions; conversely, models predict very different meridional structure for the third component, the baseline for air-land fluxes. For instance, the neutral biosphere boundary condition in the TRANSCOM-1 Intercomparison (12 models) generated large discrepancies: a high group of models simulated surface atmospheric CO2 that was 2-3 ppm higher on average at 60N than in the Southern hemisphere, a middle group found that that difference was 0 to 0.6 ppm, and a low group (1 model) predicted a negative difference, -1.5 ppm. These discrepancies imply anywhere from a large northern hemisphere carbon sink to no sink at all. To investigate such discrepancies, we made multi-year simulations with the U.S. Community Climate Model CCM3, an atmospheric general circulation model (GCM). We used carbon flux boundary conditions from the third phase of TRANSCOM model comparison, namely monthly NEP maps from a steady state simulation of the terrestrial model know as CASA. Simulations were made for up to 22 years at six different resolutions: T21, T31, T42, T63, T85, T170 (i.e., varying from 5.6 to 0.7 degrees). We found that the 60N-South Pole difference for the annual mean rectifier varied substantially from year to year, e.g., from 0.8 to 2.0 ppm (T63), and that interannual variability increased when going from coarser to finer model resolution. Furthermore, long simulations from T31, T42, and T63 allow us to discern a linear trend (slope of 0.7; intercept of 0.5 ppm) for the magnitude of the rectifier (in ppm at 60N) as a function of model resolution (degrees). Ongoing simulations will allow us to determine if this trend persists across the full range of model resolutions. The large interannual variability found in our CCM3 simulations implies that inferring terrestrial carbon fluxes is prone to large uncertainties when using an atmospheric GCM. The sensitivity of predicted CO2 gradients to model resolution in CCM3 suggests that large systematic errors may be present in previous estimates of air-land carbon exchange. Model resolution may need to be improved dramatically to be able to accurately predict such carbon exchange. Interannual variability and differences in model resolution may account for much of the variability found in previous comparisons of atmospheric model simulations of carbon exchange with the terrestrial biosphere.

GC72B-0234 1330h POSTER

A comparative assessment of simulated variations in Nebraska sand dune vegetation cover using Landsat TM NDVI and AVHRR Vegetation and Temperature Condition Index

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The Nebraska Sand Hills are currently stabilized by vegetation cover that is sensitive to climate variability and extremes (e.g., long and severe droughts). Previous work examined climate, vegetation, soil, and hydrology interactions in the Nebraska Sand Hills using the CENTURY ecosystem model, 30-m resolution Landsat Thematic Mapper (TM) Normalized Difference Vegetation Index (NDVI) data, and 30-m digital elevation model data. Key results of this previous work indicated 1) the importance of surface hydrology in the vegetation response to climate variability and extremes, and 2) that correlations improved between CENTURY-simulated biomass and Landsat TM NDVI when using increasingly larger spatial samples which tended to average out the impact of localized hydrology in the western Nebraska Sand Hills. However, the assessment of the simulated vegetation response to climate extremes was limited by the insensitivity of Landsat TM NDVI to monitor land cover changes in sparse vegetation and semi-arid regions. In this study, we assess the CENTURY simulated vegetation cover for the western Nebraska Sand Hills using the 4 km Advanced Very High Resolution Radiometer (AVHRR) derived NOAA/NESDIS/ORA Vegetation and Temperature Condition Index (VT). As a combination of NDVI, and brightness temperature, VT was designed to monitor the chlorophyll and moisture content in the vegetation as well as changes in thermal conditions at the surface; making it a sensitive monitor of the water- and temperature-related vegetation stress under drought conditions. Initial analyses suggest a closer relationship for the Nebraska Sand Hills between the CENTURY-simulated biomass and spatially coarse AVHRR VT than between the CENTURY-simulated biomass and the high resolution Landsat TM NDVI. In addition, these preliminary results suggest the VT data is likely to be a more realistic monitor of climate-induced vegetation change in the Nebraska Sand Hills than the higher spatially resolved Landsat TM NDVI.

URL: http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci/

GC72B-0235 1330h POSTER

Winter Fluxes of CO2 and Energy at Tundra in the Arctic

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We have been trying to measure continuous fluxes of CO2, sensible and latent heat (H & lE) in the Arctic to reveal the tundra ecosystem responses to global change. Winter fluxes were obtained over snow covered wet sedge tundra at Barrow, Alaska in 1999, 2000 and 2001, using open path infrared gas analyzer (E009a, Advanet, Japan) and three dimensional sonic anemometer (DA600, Kaijo, Japan). Other micrometeorology variables such as air temperature, humidity, soil temperature, wind profile, soil heat flux were measured. Snow depth was about 0.4m in 1999 spring and 0.33 in 2000 and 0.28 in 2001. Snow over tundra moved easily by strong wind, especially at low temperatures. We observed a large amounts of upward CO2 flux in late April, when the friction velocity, u* increased over 0.25 m/s. The CO2 flux increased over 2 g CO2 m-2h-1 quadratically with u*; however, energy fluxes H and lE at this time did not change. The emitted CO2 (25 g CO2 m-2 during the event) was thought to be released from snow pack layer with the snow saltation. We detected no phase change from snow to vapor when wind speed was up to 10 m/s. We found a large amount of sublimation in early January 2001, under strong wind condition, with wind speed over 20 m/s at 4.6 m. Huge upward CO2 flux, H and lE were observed and also we observed vertical gradients of air temperature and relative humidity between the heights of 0.9 and 3.2 m above the ground that indicated upward fluxes. Furthermore, we detected an increase of soil temperature at 1-cm depth from the surface. Total fluxes of CO2, H and lE during the two-day blizzard period, were 198 g CO2 m-2, 12 and 16 MJ/ m2 (sublimation of 6.5 mm), respectively, even though there was no energy flux. We calculated the friction stress, the kinetic energy of air (wind) and snow particles. The energy released by the collision of snow was revealed to be the major energy source for sublimation in mid winter. However, the source of huge upward CO2 flux was unclear.

GC72B-0236 1330h POSTER

Coarse Resolution Vegetation Phenology Modeling

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Vegetation phenology refers to recurring changes in vegetation and their connection to climate. Monitoring vegetation phenology helps to quantify the timing and length of the vegetative period for a given plant functional type (PFT). Our objective was to develop an improved and generic vegetation phenology model using remotely sensed datasets and ecophysiological modeling. Remotely sensed datasets included Leaf Area Index (LAI) from a recently developed 1989-1997 1 km database for the conterminous US. For this period and region, we calculated the potential gross primary production (GPPpot) and then used analytical functions to derive PFT-specific relationships between observed LAI and GPPpot. For each PFT, half of the observed LAI were used for model development and half for generating error statistics. The resultant model thus related the timing of leaf growth and senescence to an environmental index (GPPpot) that integrated multiple limiting environmental factors without any a priori knowledge of specific PFT phenological controls. The phenology model is prognostic, i.e., can be run independently of remote sensing, is simple to calculate and could be easily incorporated into a variety of modeling approaches.

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Future Global Carbon Cycle and Climate Simulation Based on Satellite Data and Simple Earth System Model: Sensitivity to the Light Saturation Effect

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A simple Earth system model, the Four-Spheres Cycle of Energy and Mass model (4-SCEM), was developed to simulate global warming due to anthropogenic CO2 emission. The model consists of the Atmosphere-Earth Heat Cycle model (AEHC), the Four Spheres Carbon Cycle model (4-SCC), and their feedback processes. The AEHC is a one-dimensional radiative convective model, which includes the greenhouse effect of CO2 and H2O. The 4-SCC is a box-type carbon cycle model, which includes CO2 fertilization, vegetation area variation, the vegetation light saturation effect, and HILDA ocean model. Following feedback processes were included, (1) water vapor feedback, (2) biospheric CO2 fertilization, and temperature dependencies on (3) soil decomposition, and (4) ocean surface chemistry.

Previous studies on future projection of atmospheric CO2 have a problem because of few time-series constraints on the model especially in the biospheric processes. Then, the recent NPP trends from the 4-SCEM and satellite data were directly compared for validation. The satellite-based one showed the NPP increase in past 20 years at a rate of 3.8 % per 10 years. Although 4-SCEM based analysis also showed a recent increase in NPP, the result was a half (with climate feedback) or one-eighth (without climate feedback) of satellite based one. Although large discrepancies are still remained, we can conclude that the carbon cycle model with climate feedback is more reasonable than that without climate feedback.

The future status of the global carbon cycle and climate was simulated up to the year 2100 based on the IS92a emission scenario. The atmospheric CO2 concentration reaches 645 ppmv in 2100. Sensitivity analysis showed that uncertainties derived from the light saturation effect of vegetation and land use emissions were the primary cause of uncertainties in projecting future CO2 concentrations. Satellite-based net primary production trends analyses can somewhat decrease the uncertainty in quantifying CO2 emissions due to land use changes.

URL: http://sys.eps.nagoya-u.ac.jp/∼ichii

GC72B-0238 1330h POSTER

A Better Representation of European Croplands into a Global Biosphere Model

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Croplands cover a quarter of Europe's surface (about an hundred million hectares), their impact on carbon and water fluxes must therefore be estimated. Global biosphere models such as ORCHIDEE (http://www.ipsl.jussieu.fr/ ssipsl/) were conceived to simulate natural ecosystems only, so croplands are often described as grasslands. Not only cropland productivity depends on climate and soil conditions but also on irrigations, fertilisers input, date of sowing... In addition crop species are usually selected genetically to shorten and accelerate their growth. Agronomic models such as STICS (Brisson et al. 1998) give a more realistic picture of croplands as they are especially designed to account for this human forcing. On the other hand they can be used at the local scale only. First we evaluate the ability of the two models to reproduce the seasonal behaviour the leaf area index (LAI), the aerial biomass, and the exchanges of water vapour and CO2 with the atmosphere. For that we compare the model outputs with measurements performed at five sites that are representative of most common European crops (wheat, corn, soybean). As expected the agronomic STICS better behaves than the generic model ORCHIDEE in representing the seasonal cycle of the above variables.

In order to get a realistic representation of croplands areas at the regional scale, we decided to couple ORCHIDEE with STICS. First we present the main steps of the coupling procedure. The principle consists in forcing ORCHIDEE with five more realistic outputs of STICS: LAI, date of harvest, nitrogen stress, root profile, and vegetation height. On the other hand, ORCHIDEE computes its own carbon and water balance. The allocation scheme was also modified in ORCHIDEE in order to conserve the coherence between LAI and leaf biomass, and we added a harvest module into ORCHIDEE. The coupled model was validated against carbon and water fluxes observed respectively at two fields (wheat and corn) in the US. We also conducted at European scale two experiments where all arable lands are covered by corn for the first one, and by natural grasslands for the second one. We compared the fluxes between these two simulations. In the case of corn cover, the vegetative period is reduced and the absorption of carbon is more enhanced (until 15 per cent) during the maximum extension of vegetation.

This work shows that croplands can be integrated into global biosphere models to simulate CO2 and water vapour regional fluxes, which should allow a better representation of those ecosystems for climate studies.

GC72B-0239 1330h POSTER

Experimental warming increases soil carbon flux in a recently burned Alaskan boreal forest

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The response of boreal forest soils to global warming remains controversial despite their significance in the global carbon cycle. In particular, our understanding of soil carbon storage is critical to our ability to predict the future response of boreal forests to global warming due to their large carbon sink capacity. Historically, boreal forests have been thought to be carbon sinks over time due to the short growing season which prevents soil microbes from completely decomposing annual primary production. However, recent empirical evidence indicates that climate change, and warming in particular, is already decreasing the amount of carbon stored in boreal forest soils. In addition, forest fires claim an increasing average area of boreal forest each year (1 x 106 acres in Alaska in 2002), and affect a significant portion of this ecosystem. Fire-affected boreal forests may have different responses to global warming than mature forest. Here, we present results from a study in which we experimentally raised the average daily ambient temperature of a recently burned black spruce forest in central Alaska during the growing season by 1 $^{\circ}$C (mid-day temperatures increased by 4 $^{\circ}$C) using twelve, 1.77 m2 open-top greenhouse chambers and twelve control plots for 3 years after fire. Soil CO2 flux was significantly higher in greenhouses than controls for all measurements taken during the third summer of warming (greenhouse mean: 89 g C m-2 ; control mean: 66 g C m-2 ($p < .04$); repeated measures ANOVA). BIOLOG ecoplate^{TM} analysis indicates that bacterial diversity and abundance were slightly higher in greenhouse plots. The change in bacterial community composition may be partially responsible for the elevated soil CO2 flux. These results suggest that in a warmer climate, fire-disturbed boreal forests may store less carbon than their present carbon storage. Furthermore, the interaction between global warming and fire may result in a positive feedback to atmospheric CO2, and therefore, a positive feedback to global warming.

GC21A MCC: Hall D Tuesday 0830h

How Can Scientists Improve Public Understanding of Climate Change and Variability? Posters *(joint with A, B, H, PP, PA)*

Presiding: **E T Sundquist,** U.S. Geological Survey**; A J Stevermer,** NOAA Air Resources Laboratory, University of Colorado

GC21A-0148 0830h INVITED POSTER

Don't be Shy: The Public Really Wants to Know About Your Latest Research

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Scientists could do a lot to improve the flow of information to the general public on their climate change research. Unfortunately, very few take initiatives in this regard, and some feel it would be unseemly to do so. AGU typically issues a half dozen press releases each year on climate research published in our journals, yet virtually never has one of the researchers called our attention to an upcoming paper and suggested that it would be newsworthy.

Similarly, at most AGU meetings, we organize several press conferences on climate change research, but rarely does a scientist tell us in advance that he will be presenting some provocative results that might be of interest to the media. As with journal papers, we learn of the research indirectly and approach the scientists, seeking their cooperation. Almost always, they say yes and do help us inform the media about their work.

Climate change is in fact one of the two top subject areas for media response, both in terms of requests for full journal papers and articles actually published about them. Repeatedly, however, public information officers at universities, government agencies, research institutions, and journal publishers complain that "their" scientists do not talk to them about their projects. Since most institutions have professional science writers on their staffs, this disconnect represents untold missed opportunities. Scientists should see it as one of their key obligations to inform the public on how effectively they have used their grants.

AGU helps advance the dialogue between scientists and the public, via the media, in various ways: through our online publication, "You and the Media," by sponsoring journalism awards to encourage good science writing, through Mass Media Fellowships for young scientists, and, of course, by disseminating press releases and holding press conferences.

GC21A-0149 0830h POSTER

Exploring Local Approaches to Communicating Global Climate Change Information

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Expected future climate changes are often presented as a global problem, requiring a global solution. Al-