Big Sky Carbon Sequestration Partnership

(Northern Rockies and Great Plains Carbon Sequestration Partnership)

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DISCLAIMER

ABSTRACT

The Big Sky Partnership, led by Montana State University, is comprised of research institutions, public entities and private sectors organizations, and the Confederated Salish and Kootenai Tribes and the Nez Perce Tribe. Efforts during the first performance period fall into four areas: evaluation of sources and carbon sequestration sinks; development of GIS-based reporting framework; designing an integrated suite of monitoring, measuring, and verification technologies; and initiating a comprehensive education and outreach program. At the first Partnership meeting the groundwork was put in place to provide an assessment of capture and storage capabilities for CO_2 utilizing the resources found in the Partnership region (both geological and terrestrial sinks), that would complement the ongoing DOE research. The region has a diverse array of geological formations that could provide storage options for carbon in one or more of its three states. Likewise, initial estimates of terrestrial sinks indicate a vast potential for increasing and maintaining soil C on forested, agricultural, and reclaimed lands. Both options include the potential for offsetting economic benefits to industry and society.

Complementary to the efforts on evaluation of sources and sinks is the development of the Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC) and a GIS Road Map for the Partnership. These efforts will put in place a map-based integrated information management system for our Partnership, with transferability to the national carbon sequestration effort.

The Partnership recognizes the critical importance of measurement, monitoring, and verification technologies to support not only carbon trading but other policies and programs that DOE and other agencies may want to pursue in support of GHG mitigation. The efforts begun in developing and implementing MMV technologies for geological sequestration reflect this concern. Research is also underway to identify and validate best management practices for soil C in the partnership region, and to design a risk/cost effectiveness framework to make comparative assessments of each viable sink, taking into account economic costs, offsetting benefits, scale of sequestration opportunities, spatial and time dimensions, environmental risks, and long term viability.

A series of meetings held in November and December, 2003, have laid the foundations for assessing the issues surrounding the implementation of a market-based setting for soil C credits. These include the impact of existing local, state, and federal permitting issues for terrestrial based carbon sequestration projects, consistency of final protocols and planning standards with national requirements, and alignments of carbon sequestration projects with existing federal and state cost-share programs.

Finally, the education and outreach efforts during this performance period have resulted in a comprehensive plan which serves as a guide for implementing the outreach activities under Phase I. The primary goal of this plan is to increase awareness, understanding, and public acceptance of sequestration efforts and build support for a constituent based network which includes the initial Big Sky Partnership and other local and regional businesses and entities.

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INTRODUCTION

The Big Sky Regional Carbon Sequestration Partnership was initially called the Northern Rockies and Great Plains Regional Carbon Sequestration Partnership. The proposed name change was initiated in December 2003, and is in the process of receiving DOE/NETL approval. The Big Sky Partnership, led by Montana State University, Bozeman, MT, seeks to: identify and catalogue CO_2 sources and promising geologic and terrestrial storage sites, develop a risk assessment and decision support framework to optimize the areas' carbon-storage portfolio, enhance market-based carbon-storage methods, identify and measure advanced greenhouse gas-measurement technologies to improve verification, support voluntary trading and stimulate economic development, call upon community leaders to define carbon-sequestration strategies, and create forums that involve the public. Idaho, Montana and South Dakota are currently served by this Partnership that is comprised of 13 organizations and the Confederated Salish and Kootenai Tribes and the Nez Perce Tribe. Additional collaboration is being sought with neighboring states and Canada, and with other private and non-profit entities.

Original Partners include

Montana State University
Boise State University
South Dakota School of Mines and Technology
Texas A&M
University of Idaho
The Sampson Group
EnTech Strategies
Environmental Financial Products
Nez Perce Tribe
The Confederated Salish and Kootenai Tribes
Idaho National Engineering and Environmental Laboratory
Los Alamos National Laboratory
Montana Governor's Carbon Sequestration Working Group
National Carbon Offset Coalition

EXECUTIVE SUMMARY

For reporting purposes, the activities and results for the Big Sky Partnership are organized into four somewhat overlapping components or efforts:

1. Evaluation of sources and potential for carbon sequestration sinks;
2. Development of GIS-based framework and the carbon cyberinfrastructure efforts;
3. Advanced concepts for monitoring, measuring, and verification, as well as for implementation, carbon trading, and evaluation; and
4. Education and outreach efforts.

The Partnership held their first meeting in Bozeman in October, 2003; the agenda included a discussion of the roles and contributions of each partner, the process of creating continuity among the geological and terrestrial efforts to provide a comprehensive assessment of capture and storage capabilities, and the unique contributions and research that our Partnership could provide to the DOE efforts. The subsequent efforts during the first three months of the grant have focused on startup activities in each of the four areas. It is noted that the reporting in this first quarter is somewhat abbreviated due to the delayed funding for the two DOE labs, INEEL and LANL. Both labs are now fully funded and fully engaged in the Partnership activities.

Evaluation of sources and sinks. Activities during the first performance period were focused on developing the methodologies for characterizing the potential for geological and terrestrial sequestration sinks and on identifying industrial and agricultural GHG sources. For geological sinks, the potential for subsurface formation of carbon dioxide sequestration is focusing on solubility and mineralization trapping, and examining the technical feasibility, the time frame until implementation, and offsetting economic benefits. For the terrestrial sinks, the methodologies are initially focusing on both technical and economic feasibility. Increasing soil C levels are dependent upon both the technical capacity of the soils to sequester and utilize additional carbon, and the incentives provided for landowners to change land use management practices. Activities to identify sources and assessment of transportation infrastructure are currently focused on identifying the state and federal databases and agencies, and addressing uncertainties inherent in matching/combining data sources.

GIS-based efforts. The activities in the first performance period have included the establishment of a GIS subgroup to examine the potential for using GIS-based systems in both research and outreach/education efforts of the Partnership. Our efforts involve the integration of six focus areas: core data; communication; model/data integration; GIS tools; data delivery; and education/outreach. The planning activities have resulted in the creation of the Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC) and a GIS Road Map for the Partnership.

Advanced Concepts. The Partnership recognizes the critical importance of measurement, monitoring, and verification technologies to support not only carbon trading but all policies and programs that DOE and other agencies may want to pursue in support of GHG mitigation. For terrestrial sequestration, research is underway to identify and validate best management practices for soil C in the partnership region. Results from this research will be used to validate the potential of soils to store carbon, and validate the Century Model predictions for soil C sequestration rates. Preliminary results were presented at a soil C sequestration monitoring workshop in October, 2003.

Monitoring and Measurement Verification (MMV) activities this period, as they pertain to geological (and terrestrial) sinks, include some initial assessment of the state of the art for technologies that have a high likelihood of being mature enough to be applicable in Phase II small scale applications, and designing a risk/cost effectiveness framework to make comparative assessments of each viable sink, taking into account economic costs, offsetting benefits, scale of sequestration opportunities, spatial and time dimensions, environmental risks, and long-term viability. In conjunction with the GIS efforts and ongoing research at LANL, MSU, SDSMT, and INEEL, the Partnership is developing a well-integrated ensemble of diagnostics for MMV at each sequestration site.

Finally, substantial work is underway to identify sequestration guidelines and local/state permitting issues and planning standards. The NCOC is meeting with landowners and source emitters to assess the impact of existing local, state, and federal permitting issues on terrestrial sequestration projects. Development of the draft protocols that will be coordinated with the 1605 B National GHG Registry has begun this period.

Education and Outreach. The activities this performance period include the completion of a comprehensive Education and Outreach Plan (see Appendix), a partnership listserv, and the development of an internal website. The primary goal of the Education and Outreach Plan is to increase awareness, understanding, and public acceptance of carbon sequestration while building support for the efforts of the Partnership. A public website for the Big Sky Partnership will be launched in late February, 2004. In addition, enhanced collaboration with the University community through visiting appointments, seminar series, and co-sponsored activities at professional meetings is underway. An advisory committee that includes representation from local constituencies is being formed, with the first meeting tentatively planned for late Spring 2004.

EXPERIMENTAL SECTION

This section highlights the research that has been initiated this quarter that supports the objectives of the Partnership. As noted earlier, the information reported in this section is somewhat abbreviated because of the delayed funding to two key partners, INEEL and LANL.

Evaluation of source and sinks

Activities during the performance period were focused on developing a methodology for characterizing the potential of subsurface formation for carbon dioxide sequestration via solubility and mineralization trapping. The approach relies upon the use of bulk whole rock chemical analyses for formation geomedia. These analyses are used to calculate normative mineralogies. Separate approaches are being used for igneous (Lowenstern, 2000) and sedimentary (Cohen and Ward, 1991) rocks. A commercially available, mixed equilibrium-kinetics geochemical computer (Bethke, 2002) is used for modeling the weathering reactions that transform carbon dioxide to solid phase carbonate mineral. Kinetic expressions for these reactions are derived from Lasaga et al. (1994) and Drever (1997).

The Big Sky Partnership is in the process of searching for and acquiring public domain information about potential geologic carbon sequestration sites.

1. The USGS has issued several compact discs describing the location and potential for oil and gas resources in the Rocky Mountain northwest region. These inventories provide brief descriptions and extensive bibliographies of the resources. From these CDs, we have identified a few potential geologic provinces: the Idaho-Snake River downwarp in Idaho; the Williston Basin, the Sweetgrass Arch, Bowdoin Dome, and the Bearpaw uplift in Montana; and the Black Hills region in South Dakota.
2. Two groups, the Petroleum Information Corporation and NRG Associates, compile information on the production history of oil and gas wells. The Petroleum Information Well History Control System (WHCS) is a proprietary, commercial database containing information for most oil and gas wells in the U.S. The Significant Oil and Gas Fields of the United States is a database commercially available from NRG Associates, Inc. The database includes reserves, cumulative production, and various other types of information for most oil and gas fields of the United States larger than 1 million BOE.

3. We are also contacting the Montana Board of Oil and Gas Conservation and the South Dakota Department of Environment and Natural Resources, Minerals and Mining Program, Oil and Gas Section as state resources for information about potential sequestration sites and information pertaining to oil and gas fields. These agencies compile reservoir and production information and contain maps of the oil and gas fields in these states.

For regional sources, we have completed the compilation of state-level aggregate data regarding emissions from fossil fuel consumption, using EIA state data. Facility-level data for energy utilities and selected industries have been compiled for South Dakota, and this will serve as a template for the other states in our partnership. Data on CH_4 from stationary and mobile combustion sources, oil and gas production, enteric fermentation and manure management, burning of agricultural wastes, and wastewater treatment, as well as data on N_2O emissions from similar sources have been compiled for South Dakota. This information will be incorporated into the GIS database for the Big Sky Partnership.

A second area of work has been to evaluate and verify the soil C potentials with the estimates forthcoming from the Century simulation model. A preliminary evaluation for South Dakota has been completed and is being summarized; the evaluation of soil C potential on croplands in Montana is currently underway (see related material below). For forested lands, the USFS data on forest carbon stocks by state, by major species is available and ready to be incorporated into the GIS database.

We are integrating soil and climate databases with our econometric simulation models to estimate soil carbon trajectories at the MLRA level in Montana, and to test the impact of alternative management scenarios and carbon policy scenarios on the cost of sequestering soil C and on the size of the terrestrial sinks. Capalbo et al. (2004) have shown that modifying current agricultural management practices as a means of sequestering carbon is a relatively low cost way to offset greenhouse gas emissions in Montana. We examine the sensitivity of the estimates of the amount of soil carbon sequestered and the costs of sequestering carbon to uncertainties in the underlying economic and biological parameters of the modeling framework, to regulatory uncertainties, and to scale of analysis. We show that the resulting changes in the costs and quantities of soil carbon sequestered are a nonlinear function of the changes in the soil carbon rates, yields, or economic parameters, and depend upon the spatial heterogeneity of the area. The analysis of changes in yields supports DOE's position that sequestering soil C could be a long-term win-win situation for producers and could provide offsetting benefits to society We are in the process of extending this analysis to the other States in our partnership (SD, ID, WY) that have significant amount of agricultural lands.

For rangeland sequestration, work is in progress on undertaking a literature review on rangeland options and how rangeland management practices relate to changes in levels of soil C. Rangelands comprise a sizeable portion of the land resources in our partnership region and are of critical importance to our neighboring states. Preliminary estimates suggest that rangelands can store up to an additional 0.3 mg C/ha/yr and restores grasslands storing nearly twice that amount. Possible options that have been identified for rangeland carbon storage to date include juniper invasion control, mesquite invasion, and cheatgrass control. These options along with baseline estimates of soil C levels at the MLRA level are being compiled by Texas A&M colleagues for inclusion with the GIS terrestrial sink inventory.

Field-scale studies were established at six farm fields in the Golden Triangle in north central Montana (Figure 1). The purpose of these studies is to determine the effect of cropping intensity (annual vs. alternate year) and tillage (conventional vs. no-till) on soil C levels across different soil types and terrains. At each farm, a field of 32 ha was divided into four strips (8 ha) representing the following cropping/tillage systems: traditional summer-fallow – wheat; no till chemical fallow – wheat; conventional tillage pea-wheat; and no till pea-wheat. Within each strip four sites were identified for sampling/monitoring of soil carbon changes over time. The sites (total of 16 per farm) were georeferenced via GPS and buried metal spikes. The sampling scheme incorporates five cores around a center-point forming a star-shaped pattern (Figure 2). Each core is divided into three depths of 0-10, 10-20, and 20-50 cm and the core-depths surrounding each center point are bulked into a single sample. Soil samples are collected on a two-year time interval beginning with the initial background sampling in the Fall of 2002. These field studies are projected to last at least 10 years.

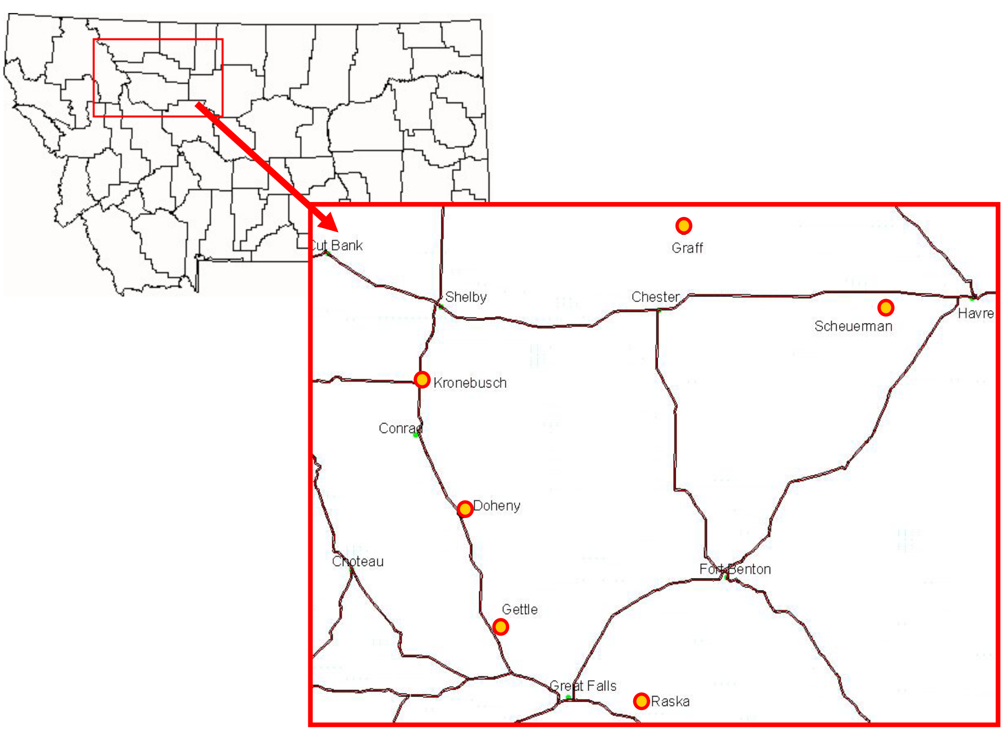

Figure 1. Locations of six farms in north central Montana for the on-farm cropping system comparisons.

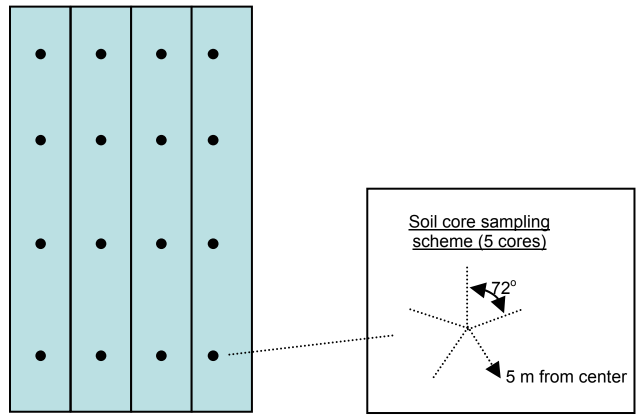

Figure 2. Hypothetical sampling scheme for long-term soil carbon studies.

Soil samples collected from this study were dried to 40° C then ground to pass through a 2 mm sieve. Subsamples were removed and ground to a fine powder using a ball mill. Total carbon analyses were performed using an automated dry combustion analyzer or Leco CNS-2000 analyzer (Leco Corporation, Saint Joseph, MI). The inorganic carbon fraction was determined using the procedure of Sherrod et al. (2002). Organic carbon was then calculated by difference, i.e. organic C = total C – inorganic C. Nitrous oxide samples were collected using vented chamber techniques (Hutchinson and Mosier, 1981) (Figure 3). Vented soil chambers covering a 1000 cm^2 area and with a 10 cm head-space were inserted between the crop rows. The protocol used for collecting and processing the gas samples was similar to one described by Lemke et al. (1999). Nitrous oxide flux was estimated from the concentration change in the chamber headspace over a predetermined collection period (e.g. 30 minutes to 1 hr). Samples were drawn from the headspace using a 20 to 30 mL syringe and then transferred to a pre-evacuated 13 ml exetainer. The concentration of N_2O in the sample exetainer was determined using a gas chromatograph equipped with an electron capture detector.

Intact core, crushed (< 2 mm), and ball-milled soil samples were scanned using an ASD "Fieldspec Pro FR" VNIR spectroradiometer (Analytical Spectral Devices, Boulder, CO). This spectroradiometer has a spectral range of 350-2500 nm, 2 nm sampling resolution and spectral resolution of 3 nm at 700 nm and 10 nm at 1400 and 2100 nm. Soils were scanned from below with a "mug lamp" foreoptic and white light source, a borosilicate bottom glass "puck" to hold samples and a Spectralon® panel for white referencing. Four and two composite scans (consisting of 10 internally averaged scans of 100 ms each) were obtained for the crushed and milled samples respectively, with a 90° rotation between each.

Figure 3. Nitrous oxide gas samples are collected using a vented chamber made of plexiglass. Without cover (left). With cover (right)

GIS-based efforts

The activities in the first performance period have included the establishment of a GIS subgroup to examine the potential for using GIS-based systems in both research and outreach/education efforts of the Partnership. Our efforts involve the integration of six focus areas: core data; communication; model/data integration; GIS tools; data delivery; and education/outreach. The planning activities have resulted in the creation of the Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC), a vision statement for BSP-CC, and a GIS Road Map for the Partnership. The Road Map and draft vision statement are included in the appendix to this report.

Efforts are proceeding with the compilation of information relevant to point and terrestrial area sources of GHGs in MT and integration into a GIS framework as appropriate. INEEL/UI/BSU are coordinating efforts to collect spatially-referenced data for geological formations. The Partnership is assembling soil, climate, crop and land use databases and integrating these data with the C-Lock system developed by SDSMT and with economic data on land use practices and the economic frameworks developed at MSU for quantifying soil carbon sequestration potential.

Advanced Concepts

Advanced concept activities this period include designing integrated measurement, monitoring, and verification for geological and terrestrial sinks, regulatory protocols, and risk assessment/tradeoff frameworks. Measurement, monitoring, and verification activities, and capture technologies, are complementing ongoing research at the labs and research institutions; to date we have assessed the focus and extent of these research efforts and will develop plans in the second quarter to create alignments and extensions to this research. The direction of the MMV research is shown in Figure 4. MMV efforts have begun to design the accounting framework to monitor changes in natural underground storage sites, identify reaction mechanisms that may enhance or damage the underground reservoirs, quantify leak rates, and

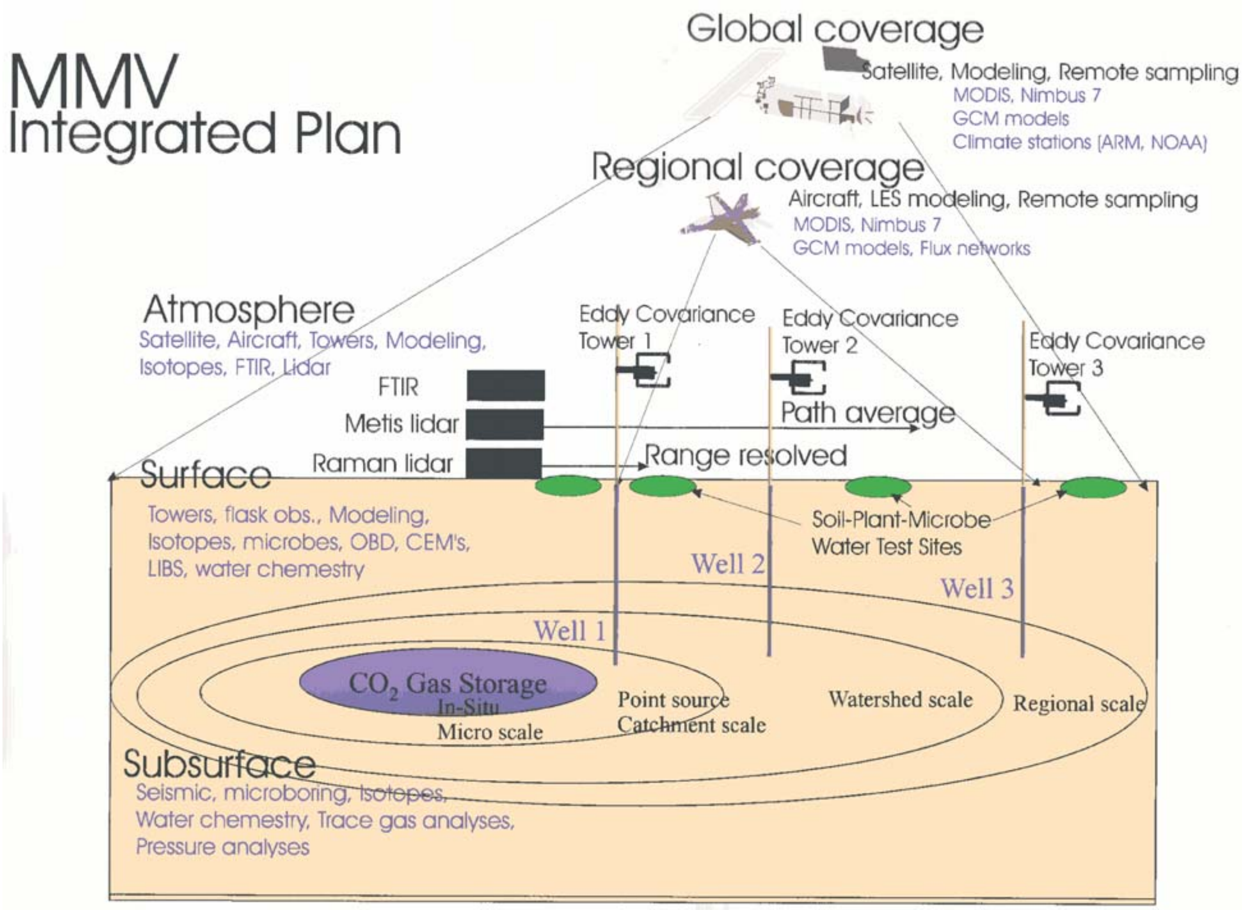

Figure 4. MMV Integrated Plan. Source: LANL

document any environmental impacts. The integrated MMV concept is premised on the idea that each sequestration site is monitored on global, regional, local, and microscopic scales, and reflects the underlying premise that all MMV technologies must be cost effective and applicable to each viable source and sink, and made broadly available. Efforts are underway to work with regional businesses and communities to ensure that this occurs (see related discussion under education and outreach). LANL is using gap analysis for edification and comparison to DOE research program priorities and to better coordinate this information with information forthcoming from other federal agencies.

At the October Partnership meeting, the researchers began to design a framework to evaluate sequestration options that exist within the Partnership region taking into account economic costs (including opportunity costs), possible side effects, riskiness of the options, permanence or sequestration effectiveness, and public and private policy incentives. This is being further developed into a seminar for presentation at LANL in March 2004. In addition, the MSU researchers are working with LANL to investigate the cost effectiveness of new technologies for geological sequestration.

For terrestrial sequestration, research is underway to identify and validate best management practices for soil C in the Partnership region. Results from this research will be used to validate the potential of soils to store carbon, and validate the Century Model predictions for soil C sequestration rates. Preliminary results were presented at a soil C sequestration monitoring workshop in October, 2003.

Finally, substantial work is underway to identify sequestration guidelines and local/state permitting issues and planning standards. Meetings were held in November and December 2003 with landowners and emitters to initiate discussions on impact of permitting regulations on terrestrial sequestration options. Development of the draft protocols that will be coordinated with the 1605 B National GHG Registry have begun this period.

Education and Outreach. The activities during this performance period for this component include the completion of the Education and Outreach Plan (this is being revised in response to DOE and other outside review), a partnership listserv, and the development of an internal website. A public website for the Big Sky Partnership will be launched in late February, 2004. In addition, enhanced collaboration with the University community through visiting appointments, seminar series, and co-sponsored activities at professional meetings is underway. An advisory committee that includes representation from local constituencies is being formed, with the first meeting planned for Spring 2004.

RESULTS AND DISCUSSION

Since this is only the first reporting period, research results and findings are limited and likely to be preliminary. On the efforts to quantify the region's geological sinks, a limited number of Snake River Plain rock compositions and water chemistries have been compiled to test our approach and to debug the input files (in particular, the kinetic rate laws) used in our models. Additionally, a University of Idaho graduate student has been recruited to work on the project (winter semester 2004). He will be involved in assembling relevant data for the project as well as modeling activities.

Preliminary results for terrestrial sequestration sinks indicate that the soils in our Partnership region have the capacity to store and productively utilize more soil C. However, the potential "size" of these sinks depends upon many biophysical and economic factors and the design of the policies and programs that are in place to sequester carbon. Our research is making inroads to better understanding the incentives that producers and land use managers face in our Partnership region, that in turn impacts the amount of additional soil C that can be sequestered and held in these terrestrial sinks.

An initial vision statement for the GIS efforts and a GIS Road Map was completed and is being reviewed by the Partnership. The BSP-CC group, which was formed in response to the needs of the Big Sky Partnership, is unique in its integrated focus on providing core data for constructing map-based data layers for identifying source and sinks, as well as a framework for modeling results that are more transparent to policy makers, and for outreach and education purposes that reach all segments of society. GIS will be used to synthesize all aspects of carbon science and decision support for improved policy analysis and outreach. The BSP-CC group will serve as a liason with other GIS efforts in the DOE Partnerships and within the DOE carbon sequestration program.

Efforts underway with the advanced concepts and Outreach and Education Activities will enable us to report some results/output in the next quarterly reports. The Education and Outreach Plan combined with the public website lays the foundation for critical interaction and partnerships with the regional constituencies and local communities.

CONCLUSION

During the first performance period, the Big Sky Partnership initiated activities in four areas: evaluation of sources and carbon sequestration sinks; development of GIS-based reporting framework; designing an integrated suite of monitoring, measuring, and verification technologies; and initiating a comprehensive education and outreach program. The groundwork was put in place to provide a comprehensive assessment of capture and storage capabilities for CO_2 utilizing the resources found in the Partnership region (both geological and terrestrial sinks). Likewise, initial estimates of terrestrial sinks indicate a vast potential for increasing and maintaining soil C on forested, agricultural, and reclaimed lands. Both sequestration options include the potential for offsetting economic benefits to industry and society. Because the region has a wide array of geological formations as well as land use options, the analysis of the technical and economic feasibility of both geological and terrestrial sinks would be transferable to other regions and other countries.

Complementary to the efforts on evaluation and feasibility of regional sources and sinks is the development of the Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC) and a GIS Road Map for the Partnership. These activities are putting in place a map-based integrated information management system for our Partnership, with transferability to the national carbon sequestration efforts. This framework will also be critically important to the evaluation of future sequestration technologies, which by necessity must utilize simulation modeling and other related techniques for assessing environmental impacts and cost effectiveness. The BSP-CC efforts will provide a means to systematically integrate databases and models, and provide for policy analysis and visualization of the many dimensions of impacts of sequestration technologies. GIS and BSP-CC will be integral to assessing the differences and similarities among regions and sequestration alternatives.

The Partnership recognizes the critical importance of measurement, monitoring, and verification technologies to support not only carbon trading but all policies and programs that DOE and other agencies may want to pursue in support of GHG mitigation. The efforts begun in developing and implementing MMV technologies for geological sequestration reflect this concern. Research is also underway to identify and validate best management practices for soil C in the partnership region, and to design a risk/cost effectiveness framework to make comparative assessments of each viable sink, taking into account economic costs, offsetting benefits, scale of sequestration opportunities, spatial and time dimensions, environmental risks, and long term viability. Scientifically sound information on MMV is critical for public acceptance of these technologies.

A series of meetings held in November and December, 2003, have laid the foundations for assessing the issues surrounding the implementation of a market-based setting for soil C credits. These include the impact of existing local, state, and federal permitting issues for terrestrial based carbon sequestration projects, consistency of final protocols and planning standards with national requirements, and alignments of carbon sequestration projects with existing federal and state cost-share programs.

Finally, the education and outreach efforts during this performance period have resulted in a comprehensive plan which serves as a guide for implementing the outreach activities under Phase I. The primary goal of this plan is to increase awareness, understanding, and public acceptance of sequestration efforts and build support for a constituent based network which includes the initial Big Sky Partnership and other local and regional businesses and entities.

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APPENDICES

GIS Road Map for Carbon Sequestration, Draft, 4-Dec-03

Initial Planning:

- **Vision Statement.** Formulate a vision statement that outlines the specific goals that GIS will serve the in the partnership and the project.

- **Needs Assessment.** Conduct a needs assessment. List stakeholders (data providers, data managers, GIS users). Identify each stakeholder's data needs.

- **Resource Evaluation.** Conduct comprehensive evaluation of personnel, computational, and data resources. Identify resource gaps.

- **Core Data:** Create a list of core data that will be highest priority to the partnership.

- **GIS Tools:** Determine what GIS tools will be needed for information management, analysis, data fusion, model coupling, and visualization.

- **Preliminary Information Management Plan:** Plan how GIS data will be logically staged, stored, and delivered. Plan the physical system (servers, networks, storage devices) that will support the enterprise.

- **Policies, Standards, and Procedures:** Define how GIS work will be performed through the use of policies, standards, and procedures. Establish common protocols (e.g., datum, terminology, data fields, metadata content guidelines, etc…) and peer-review process.

- **Roles:** Define the roles of the various GIS groups in the partnership.

- **Schedule and Milestones:** Formulate comprehensive Phase I GIS schedule, including specific GIS tasks, milestones, and deliverables.

- **Web Site:** Plan and begin implementing GIS pages for website, including both limited access and public materials. Post meeting notes, discussions, and documents.

- **Communication and Outreach:** Plan professional presentations, publications, and public outreach.

Major Questions:

- Who is the leader or champion of the GIS effort for the partnership?

- How can the rest of us provide input and support the leadership role?

Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC) Vision
draft, 14-Jan-04

The Big Sky Partnership Carbon Cyberinfrastructure (BSP-CC) provides map-based, integrated information management for the national carbon sequestration effort. The BSP-CC effort is distinguished by use of geographic information system (GIS) to synthesize all aspects of carbon science (theory, models, data, and experiments) and decision support (analysis and visualization) in a geographical context for improved policy and market analysis. The carbon cyberinfrastructure involves integration of six focus areas:

- **Core Data:** comprehensive digital library of map-based data layers needed by project stakeholders (researchers, managers, decision makers, and the public).
- **Communication:** between project stakeholders to assure that data needs are met.
- **Model/Data Integration:** fusion, data and model coupling, and data and model warehousing.
- **GIS Tools:** state-of-the-art capabilities for spatial information management, consensus building, data fusion, model coupling, and technical and policy analysis, and visualization.
- **Data Delivery:** enterprise design that assures reliable accessibility and integration with the decision making process.
- **Education and Outreach:** intuitive map-based approach that explains fundamental carbon science and enables critical thinking.

Big Sky
Carbon Sequestration Partnership

Education & Outreach Plan

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I. BACKGROUND

On August 16, 2003, the U.S. Department of Energy (DOE) named seven regional partnerships of state agencies, universities and private companies to form the core of a nationwide network to determine the best approaches for capturing and permanently storing greenhouse gases (GHGs) in their regions. DOE has designated Montana State University (MSU) in Bozeman to lead one of the partnerships. Called the Big Sky Carbon Sequestration Partnership ("Partnership"), the group consists of 14 public and private organizations including two Indian tribes. Funded with a $1.6-million DOE grant matched by $400,000 of state and regional dollars, the Partnership will identify the most suitable ways of sequestering GHGs in Montana, Idaho and South Dakota.

The Partnership will also develop a framework to validate and potentially deploy carbon sequestration technologies, study regional regulations, safety and environmental concerns and explore public acceptance issues. At the end of the first, two-year phase, the Partnership will recommend technologies for small-scale validation testing in a Phase II competition expected to begin in 2005.

This document outlines the Partnership's education and outreach goals, key constituents and activities. It is intended to serve as a guide for implementing outreach activities under Phase I, commencing October 1, 2003 through June 2005.

PARTNERSHIP TEAM	
Partner Name	**Location**
Montana State University	Bozeman, MT
South Dakota School of Mines and Technology	Rapid City, SD
University of Idaho	Moscow, ID
Boise State University	Boise, ID
Los Alamos National Lab	Los Alamos, NM
Idaho National Engineering and Environment Lab	Idaho Falls, ID
National Carbon Offset Coalition	Butte, MT
Montana Governor's Carbon Sequestration Working Group	Bozeman, MT
Texas A&M University	College Station, TX
EnTech Strategies, LLC	Washington, DC
The Sampson Group	Arlington, VA
Environmental Financial Products	Chicago, IL
The Confederated Salish and Kootenai Tribes	Pablo, MT
Nez Perce Tribe	Lapwai, ID

II. EDUCATION AND OUTREACH GOALS

The primary goal of the Education and Outreach Plan is to increase awareness, understanding and public acceptance of carbon sequestration and build support for the Partnership; however, each constituent group also has targeted outreach goals. The Partnership's eight key constituencies include: scientific and research community; the university community; environmental non-governmental organizations (NGOs); industry; farmers, ranchers and land owners; Native American Tribal Nations; state legislative and regulatory officials; Congressional delegations and the general public. Targeted goals for these constituencies are:

University Community: Encourage new and future research scientists and collaborations and design a competition for carbon sequestration research papers in collaboration with the American Society of Mechanical Engineers (ASME).

Environmental NGO Organizations and Professional Societies: Define and facilitate opportunities for technical and public outreach collaborations.

Industry: Secure sponsorship for carbon sequestration research paper contest and other outreach activities, and facilitate partnerships for participation in voluntary carbon trading pilot programs.

Farmers, Ranchers and Landowners: Facilitate partnerships for participation in voluntary carbon trading pilot programs and collaborate on education and outreach activities.

Native American Tribal Nations: Facilitate partnerships for participation in voluntary carbon trading pilot programs and collaborate on education and outreach activities.

State and Regulatory Officials: Determine the legislative and regulatory barriers and pathways to implementing carbon sequestration projects and explore economic development opportunities that may emerge from the development and commercialization of carbon and GHG measurement technologies.

Congressional Delegations: Implement a carbon sequestration symposium on Capitol Hill in 2004 and 2005 for the Partnership's Congressional delegations and their staffs.

General Public: Broaden understanding of carbon sequestration and stimulate informed public discussion.

III. MAIN ACTIVITIES

The main education and outreach activities designed to help achieve the above goals include:

Education and Outreach Plan: The plan outlines the Partnership's education and outreach goals, constituencies, activities and timeline and serves as a guide for implementing Phase I outreach activities.

Partnership Listserv: A Partnership Listserv is an electronic "mailing list" that will enable members to send messages or announcements to everyone in the Partnership at once. The Partnership will establish both an internal Listserv for Partnership business issues and an external Listserv open to all interested parties. Messages sent or posted to the external mailing list will be saved in a list archive and posted on the Partnership website.

Partnership Brochure: The brochure will provide background information on carbon sequestration, DOE's carbon sequestration program and the Partnership. It will be written in non-technical language and address the most frequently asked questions of policymakers, the media, and the general public.

Partnership Poster and Display: A partnership poster and display will be developed for general distribution and use in conference poster sessions and public outreach events.

Website: A website designed to share information about the Partnership and carbon sequestration will be developed. Content will include: Partnership introduction; key issues; DOE program overview; Partnership news and publications; events and a community bulletin board.

Community Roundtable Discussions: A series of community roundtables or small seminars to discuss the Partnership activities and carbon sequestration approaches will be held. Seminars will be conducted at high schools, universities, state legislatures and other public venues.

Strategic Workshops: The Partnership will hold three workshops -- one in Montana, Idaho and South Dakota -- to engage community leaders who will be key to implementing carbon sequestration projects. Groups may include: elected and regulatory officials; state sequestration advisory committee members; tribal leaders; journalists; environmental NGOs; labor organizations; entrepreneurs; industry; landowners and academia. Workshops will be held to introduce carbon sequestration and determine barriers and implementation strategies for carbon sequestration projects in each state. The information exchanged at these workshops will provide the basis for the potential development of a public outreach plan for deployment during Phase II.

Washington Seminar on Carbon Sequestration: Corresponding to the date of the DOE National Energy Technology Laboratory's (NETL) Carbon Sequestration Conference in 2005, the Partnership will sponsor a seminar in Washington, D.C. for interested stakeholders that includes an award ceremony and reception for the research paper competition co-sponsored with ASME. The seminar will provide an opportunity for the Partnership to directly interface with its Congressional delegations, introduce Partnership activities and outline possible carbon sequestration approaches for the region. A photographer will cover the seminar and news stories will be developed for various local news outlets.

Carbon Sequestration Research Paper Competition: In collaboration with ASME, the Partnership will design a carbon sequestration research paper competition for undergraduate and graduate students in MT, ID and SD that includes a discussion on the issues of implementing a Phase II project. ASME will review the papers and one or more awards will be given to a student in each state. The prize will be a trip to Washington, DC, attendance at the 2005 NETL Carbon Sequestration Conference and the Partnership's Capitol Hill Seminar. An awards ceremony and reception that is covered by press will be held following the seminar. (The number of prizes awarded will be continent on the Partnership's ability to raise funds from industry sponsors.)

IV. TASKS AND TENTATIVE TIME LINE

TASK	TIMELINE
Education and Outreach Plan	October 15, 2003
Listserve	November 15, 2003
Website (Content)	February 27, 2003
Website Launch	March 15, 2004
Website Maintenance	March 15, 2004 - ongoing
Brochure	March 31, 2004
Poster and Display	March 31, 2004
Community Roundtable Discussions	April 1, 2004 - ongoing
Strategic Workshops	April 1, 2004 - ongoing
Washington Seminar on Carbon Sequestration	To correspond with NETL Carbon Sequestration Conferences in 2005
Sequestration Research Paper Competition	February 2004 call for papers
Carbon Sequestration Research Paper Competition Awards Ceremony	To correspond with 2005 Capitol Hill Seminar and NETL Carbon Sequestration Conference

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A. AWARDEE ACTION (AWARDEE COMPLETES PART A. 1-5)

1. Document Title: Big Sky Carbon Sequestration Partnership

2. Type of Document: X Technical Progress Report ☐ Topical Report ☐ Final Technical Report
☐ Abstract ☐ Technical Paper ☐ Journal Article ☐ Conference Presentation
Other (please specify) __________

3. Date Clearance Needed: 1/31/04

♦4. Results of Review for Possible Inventive Subject Matter:

a. X No Subject Invention is believed to be disclosed therein.

b. ☐ Describes a possible Subject Invention relating to __________

i. Awardee Docket No.: __________

ii. A disclosure of the invention was submitted on __________

iii. A disclosure of the invention will be submitted by the following date: __________

iv. A waiver of DOE's patent rights to the awardee: ☐ has been granted, ☐ has been applied for, or ☐ will be applied for by the following date: __________

♦5. Signed [signature] (Awardee) Date 1/30/04

Name & Phone No. Susan Capalbo, 406-994-5619

Address 207 Montana Hall; VP Research Office; Montana State University, Bozeman, MT 59717-2460

B. DOE PATENT COUNSEL ACTION

☐ Patent clearance for release of the above-identified document is granted.

☐ Other: __________

Signed __________ Date __________
(Patent Attorney)

♦ **Must be** completed by the awardee.