THE USE OF REMOTE SENSING DATA FOR ADVANCING AMERICA'S ENERGY POLICY

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Executive Summary

After briefly reviewing America's Energy Policy laid out by the Obama Administration, we outline a couple of avenues wherein remote sensing (RS) data of the Earth can be used systematically and effectively to advance America's Energy Policy. Currently, vast amounts of RS data are used primarily for scientific understanding of the Earth system and weather and climate prediction. We discuss how tracking of global and local remote sensing data of Green House Gas (GHG) fluxes in the atmosphere and Carbon sequestered in the land and oceans can pave the way toward effective monitoring of the cap-and-trade programs as well as international climate treaties. Furthermore, we explore how vast amounts of RS data can be systematically mined to aid in finding additional energy resources in United States (fossil fuels as well as renewable sources of energy such as wind, solar, and geothermal). We will then lay out an implementation path to the future by outlining the needed technology investments, development of observation platforms, as well as economic policies that could advance America's energy independence.

1. The Vision

The guiding principles of America's Energy Policy as articulated by the Obama Administration are[1]: 1) Achieve energy independence from foreign oil and secure our energy future by producing more energy at home (fossil fuels and renewable sources of energy) as well as promoting energy efficiency, and investing in clean and next-generation technologies such as cars that run independently of oil, 2) Tackle global climate change by reducing GHG emission and closing the Carbon loophole.

Increasing world-wide energy demand and consumption is one of the root causes of GHG emissions, hence Goals (1) and (2) are coupled tightly together in that by consuming less forms of fossil fuels for energy and switching to renewable or nuclear sources of energy, or investing in clean technologies to contain the carbon emission, the levels of GHG emissions will naturally drop.

2. Use of Remote Sensing Data in Tracking GHG Emissions

Remote Sensing data is crucial for tracking GHG emissions at both global and local scales. Figure 1 (from left to right) illustrates this point by showing images (courtesy of NASA's Terra and Aqua Satellites/MODIS instrument)[2] of emissions from fire burning over large scales, i.e. the entire continent of Africa as well as small scales such as a localized region near London, England (as a result of a fuel depot fire).

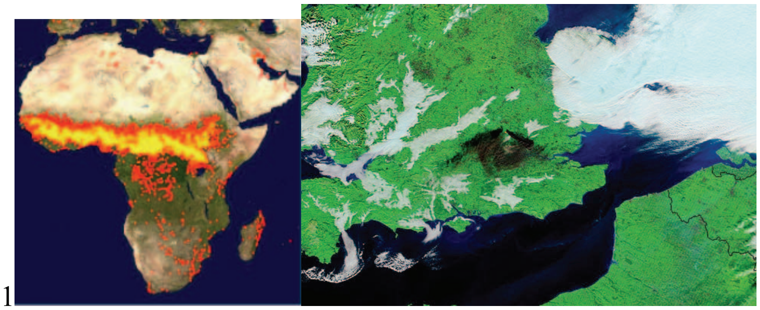

Figure 1

As we will show in the paper, high resolution spatial and temporal images of the GHG emissions combined with sophisticated numerical models can effectively provide the tools for decision makers to not only monitor and enforce cap and trade programs (or other international treaties), but also use the knowledge gained from the analysis tools to apply targeted Carbon Capture and Storage (CCS) technologies where the temporal and spatial concentration of Carbon is the greatest. Tools such as Carbon Tracker developed by ESRL/NOAA have made initial progress in tracking carbon fluxes around the globe[3]. The Department of Energy is currently investing Millions of dollars developing the CCS technologies. Integrating the GHG RS tracking system (i.e. mapping CO_2 fluxes spatially and temporally using high resolution RS data combined with advanced models) with CCS technologies will deliver greater enhancements at lower cost.

3. Use of Remote Sensing Data in Energy Resource Finding

We will illustrate in the paper how remotely sensed data of Earth parameters can provide an enormous reservoir that can be mined for mapping energy resources at home. The data can be

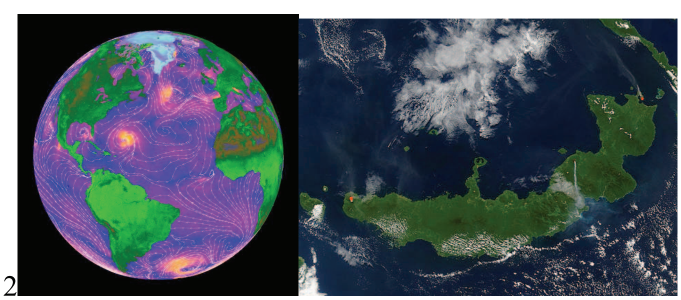

Figure 2

particularly valuable in mining renewable energy sources such as wind, solar, and geothermal energy. For example, Figure 2 (left panel) shows a map of global ocean winds as obtained by

NASA's QuikSCAT satellite. Data such as this, point out to the importance of these measurements, not just for scientific understanding of Earth system and predicting weather and climate, but also for achieving energy sustainability. Detailed data mining can aid in site planning to tap renewable energy sources more effectively. The right panel shows how mapping of young volcanic activity can help in identifying geothermal energy in certain volcanic soils that can be tapped (image courtesy of NASA Terra Satellite/MODIS instrument).

4. The Path Forward

To enable the vision for America's Energy independence, several actions are needed which will be fully explored in the paper, most notably:

1. Timely investment in future satellite observations of the Earth as a system, and its most important manifestation – climate – are crucial because, as will be discussed in this paper, climate and energy are inextricably linked. Demand for energy is essential to increasing standards of living worldwide, and this is the root cause of the challenge of climate change. We are already ahead of the IPCC-predicted worst case emissions curve for CO_2, and even if we stabilized at current levels, the changes set in motion by human activities will likely take decades to centuries to equilibrate out!

These climate quality observations mentioned above are not only crucial for understanding the Earth's highly coupled system and forecasting of Earth's (short term) weather and (longer term) climate, but also for detecting and systematically mining future energy resources. The way forward for world community is three-fold: 1. Limiting future climate change, 2. Adapting to already changing environments, and 3. Connecting the science of climate research with the decision-makers. Initiatives like NASA's "Climate in the Balance" (see Figure 3) serve to integrate an observing system architecture with existing ground and data handling assets. Where appropriate, technology development incubators as well as a virtual scientific institute devoted to improving the performance and reliability of our predictive models by anchoring them to increasingly higher quality, and longer time series data sets acquired by the missions comprising the Climate Initiative will be needed. One of the most daunting challenges to providing decision-ready information is the need to downscale the data from the global to the regional and local perspectives where the decisions need to be made. This downscaling portion of the new initiative will push the limits of compute power well beyond the current state of the art. Thus, we will need to begin to think in terms of cloud computing, where we harvest the world's compute power to solve our climate modeling problems.

2. Investing in Carbon Capture and Storage (CCS) technologies while integrating RS GHG tracking system to take maximum advantage of spatial and temporal distribution of carbon in Earth's atmosphere, land, and oceans.

Figure 3. Climate in the Balance – Are we as a people able to stem the tide of climate change for our children and grandchildren, retaining the desired blue dot, or do we reach enough climatic tipping points such that the nonlinear systems behavior dominates, and we follow the climate trajectory of the planet Venus, with its extremely high surface temperatures and toxic atmosphere?

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[1] See http://www.whitehouse.gov/issues/energy-and-environment

[2] NASA Images available at http://visibleearth.nasa.gov part of EOS Project Science Office located at NASA Goddard Space Flight Center

[3] See http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/index.html