Appendix E – Summary of Existing Efforts and Networks Related to BCN

Networks

Currently, there is a diversity of methods related to biospheric carbon monitoring (Appendix B). Many existing research efforts and networks incorporate these several methods. Eddy covariance networks include FLUXNET (http://www.fluxnet.ornl.gov/fluxnet/index.cfm), the global network of flux towers, and the many regional and national networks that comprise FLUXNET (e.g. AmeriFlux, AsiaFlux, CARBOEUROFLUX, OzNet, and the now defunct Canadian Carbon Programme). Optical sampling networks include SpecNet (Spectral Network) and several projects emerging in Europe (BioSpec, COST Action ESO903, and SensorVeg). Recently formed remote sensing networks include ISIS (International Spaceborne Imaging Spectrometry). Similarly, there are several emerging commercially supported efforts to develop cyberinfrastructure capabilities for carbon, including Cisco's ALERTS, Google's "Google Earth Engine," and Microsoft's AZURE, all of which provide computing support for biospheric carbon databases. However, key issues of how to *link* these several efforts, many of them involving technical issues of calibration, data aggregation, and intercomparison of methods, remain largely unresolved. A key role of BCN will be to address these issues needed to effectively integrate these various emerging networks and cyberinfrastructure efforts.

Similar and Complementary Cyberinfrastructure Efforts

Because of the importance of global carbon monitoring in general coupled with the technical challenges required by the large amount of data required, there are current projects building complementary cyberinfrastructure to support efforts like the BCN. Two examples are Google's Earth Engine (http://earthengine.googlelabs.com/) and the CISCSO funded Automated Land change Evaluation, Reporting and Tracking System (http://ourplanetaryskin.org/). These are two different processing frameworks that combine satellite and other data products together for scientific processing. They both also use carbon monitoring, specifically tropical deforestation, as test cases.

Google Earth Engine (GEE), launched in 2010, is a repository of 25 years of satellite data including Landsat, MODIS, and a host of other sources of data and data products. In addition, GEE provides a processing engine via an API to support creation of new datasets by interpreting the existing data. Google has targeted carbon accounting as one of it's focused field of application, collaborating with Greg Asner of the Department of

Global Ecology at the Carnegie Institution at Stanford, Carlos Souza of Imazon and Matt Hansen of the Geographic Information Science Center at South Dakota State University. In December 2010, for the 16th UNFCCC conference (COP 16), Google made GEE available to developing countries for carbon accounting, and will provide 20 million free hours for scientists to help develop carbon accounting programs.

In a similar way, the Automated Land change Evaluation, Reporting, and Tracking System project (project ALERTS), part of the Planetary Skin Institute, and supported by CISCO system, is developing tools for land change tracking and their implications. Their aim is to enable the management of important resources to care for precious ecosystems. Currently, the historic and near real-time disturbances in ALERTS comes from the MODIS instrument, in particular, data from GOPHER, geospatial data mining algorithms from the University of Minnesota. ALERTS identifies sudden drops, gradual decreases, or gradual increases in vegetation, and can be used to help monitor changes in carbon.

Smaller scale efforts are being built on top of commercial cloud computing solutions. Microsoft's Windows platform, for instance, hosts a commercial application for carbon footprint data management by HCL Technologies (http://www.microsoft.com/casestudies/casestudy.aspx?casestudyid=4000007867). The tool allows integration of carbon emissions data, facilitating the task of adhering to regulatory demands for businesses. Another tool developed on top of Windows AZURE is an automated MODIS data processing tool (Li et al. 2010, Ryu et al. 2010), which showed a significant improvement in processing time for reprojecting the data into a uniform geographical format and deriving new environmental data by integrating satellite and ground-based data.

Networks

FLUXNET – http://www.fluxnet.ornl.gov/fluxnet/index.cfm

SpecNet – http://specnet.info

GeoChronos – http://geochronos.org

ISIS (International Satellite Imaging Spectroscopy) Working Group - http://www.isiswg.org/

PHENOCAM - http://klima.sr.unh.edu/index.html

Cyberinfrastructure

Cisco's ALERTS - http://ourplanetaryskin.org/

GeoChronos – http://geochronos.org

GloVis - USGS Global Visualization Viewer - https://lpdaac.usgs.gov/lpdaac/get_data/glovis

Google Earth Engine - http://earthengine.googlelabs.com/)

Microsoft's AZURE - http://www.microsoft.com/windowsazure/

NASA MODIS - http://modis.gsfc.nasa.gov/ and http://daac.ornl.gov/MODIS/

References Cited:

Li J et al. 2010 "eScience in the cloud: A MODIS satellite data reprojection and reduction pipeline in the Windows Azure platform." *Proceedings of the 24th IEEE International Symposium on Parallel & Distributed Processing* (IPDPS2010), pp 1–10, 2010. doi: 10.1109/IPDPS.2010.5470418.

Ryu et al. (2010) Global remote sensing in a PC: cloud computing as a new tool to scale land surface fluxes from plot to the globe. *FluxLetter* 3(3):9-13. Available online at: http://bwc.berkeley.edu/FluxLetter/