Project:
GEOCARBON

Project full title:
Operational Global Carbon Observing System

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1. Introduction

1.1 Short summary

This deliverable describes the land and atmospheric input for the different carbon cycle data assimilation system (CCDAS) of GEOCARBON. The data streams include forcing data for the land and atmospheric models together with the data that will be assimilated by the different CCDAS. In order to avoid artificial narrowing of the spread between the different CCDAS results, we kept the diversity of input across the different systems and only standardized few of them (i.e., common input) when a clear consensus exists about the higher accuracy of one product versus the others. Note finally that all data streams described below will be made available to all partners and that the data that will be used for evaluation/validation of the CCDAS products will be described in following reports.

1.2 Rationale for this deliverable

This deliverable is crucial as it gathers all the inputs fields that are needed for the different carbon cycle data assimilation systems (CCDAS), in order to provide a re-analysis of the land and ocean carbon cycle over the past decades. This deliverable follows from an ensemble of discussions among the different partners that will run a CCDAS (either global or focussing only on the land fluxes). The main objectives were to select the bests input data streams for each component of the CCDASs (i.e., land surface description, meteorological forcing, fossil fuel emissions, biomass burning emissions, and observational data streams to be assimilated), but also to keep some diversity when no consensus exists. The deliverable thus only consists in a list of product, with their major characteristics.

1.3Problems encountered and envisaged solutions
No specific problems were encountered.

2 Full description

2.1 Land cover map and land cover change

Several land cover maps are used by the different CCDAS and possibly land cover changes, with no attempt to standardize them:

- A combination of the simplified Olson biomes (Olson et al., 1983) and the IGBP-DISCover Global Land Cover Classification (GLCC) data (Verant et al. 2004),
- Land cover maps based on Hurtt et al. (2006) and Pongratz et al. (2009) for JSBACH-CCDAS,
- Land cover change based upon the datasets of Goldewijk (2001) for pastures, Ramankutty and Foley (1999) for croplands, and Loveland et al. (2000) for the natural vegetation distribution.

2.2 Meteorological forcing

Meteorological forcing are used for the land surface models but also to guide the atmospheric transport models. Several data streams, with different strengths and weaknesses, are used:

- *The ECMWF interim reanalysis* (ERA-I, Berisford et al. 2009) that offers a coherent forcing over the past three decades. Main used variables are: 3D horizontal velocity and surface precipitation, pressure, downward radiation (shortwave and long wave), and humidity.
- *"CRU-NCEP" dataset* that combines i) CRU forcing based on observations that are further interpolated to provide monthly means at a resolution of 0.5°x0.5° for the period 1901-2002 (http://www.cru.uea.ac.uk/cru/data/), and ii) NCEP meteorological forcing (http://www.esrl.noaa.gov/psd/data/reanalysis/reanalysis.shtml) for the sub-monthly variations (see more information on "dods.extra.cea.fr/data/p529viov/readme.htm").
- *"Specific forcing for BETHY-CCDAS":* meteorological input data (daily precipitation, daily minimum and maximum temperatures and incoming solar radiation) are derived from a combination of available monthly gridded and daily station data by a method by Nijssen et al. (2001), using data from the Summary of the Day Observations (Global CEAS), National Climatic Data Center and the latest updates of gridded data by Jones et al. (2001).

2.3 Fossil fuel emissions

We decided to use a common fossil fuel emission to all CCDAS in order to facilitate the comparison of the natural land carbon flux estimates. Several products will be considered:

- *EDGAR-4 spatial patterns* scaled to sum up to annual CDIAC country emissions. Gridded on 1x1 degrees with monthly temporal resolution. Seasonal cycles based on Blasing et al. (2004) for the US, and on EDGAR for EurAsia. Extrapolation of trends/global totals to recent years is based on BP Fuel statistics. Full description under: http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/documentation_ff.html#ct_doc
- *CDIAC gridded emissions* (http://cdiac.ornl.gov/trends/emis/meth_reg.html): gridded emissions based on consumption data per country (Boden et al., 2011) but rescaled to global production statistics by LSCE. Product at 1°x1°, monthly resolution.
- *EDGAR-v4.2 + Temporal profiles*: Within the CARBONES-EU project, the University of Stuttgart is building a new product combining country-based annual EDGAR CO_2 emissions with country, sector, and time zone specific monthly to daily time profiles. Product at 1°x1°, hourly resolution.

2.4 Biomass burning emissions

Some groups are using the biomass burning emissions data from the Global Fire Data (GFED version 3: http://www.globalfiredata.org/Data/index.html.

2.5 Atmospheric data

Atmospheric CO2 concentration data are used to optimize the model parameters or surface fluxes. We converge to the use of ObsPack product from NOAA ESRL. This new method of packaging observational data will succeed the well-known GLOBALVIEW products, and enables complete tracking and citation of all datasets from all labs contributing in an appropriate method. ObsPacks will be created for all groups needing atmospheric data.

2.6 Land in situ FluxNet data

Eddy covariance flux measurements for Net Carbon Exchange, Latent Heat and Sensible Heat fluxes from the global network of observation sites are used by few CCDAS to constrain ecosystem physiology and fast C-cycle processes in the land surface model. We will use a global synthesis of around 100 sites, referred as the LATHUILE dataset, following the methodologies of *Papale et al.*, 2006. Measured sensible and latent heat fluxes are corrected for errors in the energy balance.

2.7 Remote sensing product of the vegetation activity

Several remote sensing products will be used to optimize the different land ecosystem models:

- *MODIS-NDVI:* Directionally corrected reflectances following Vermote et al. (2009) were used to create Normalized Difference Vegetation Index at 5km resolution. The derived NDVI were interpolated to a daily time series from 2000 to present (LSCE).
- *SeaWifs-fAPAR:* The product was derived from the Sea-viewing Wide Field-of-view Sensor as described in Gobron et al. (2002) and evaluated in Gobron et al. (2006).
- *AVHRR-NDVI:* This dataset is derived from the GIMMSg product at http://glcf.umiacs.umd.edu/data/gimms/. It was modified slightly for use in SIB-CASA model to remove biases related to Boreal snow cover, and to the lack of observations under clouds in the tropics.

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