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Evaluations of 1km grid Global Terrestrial carbon fluxes

GOSAT-2 PROJECT AT THE NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES

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Introduction

Many researchers have been trying to reveal distribution of carbon flux for understanding global carbon cycle dynamics.

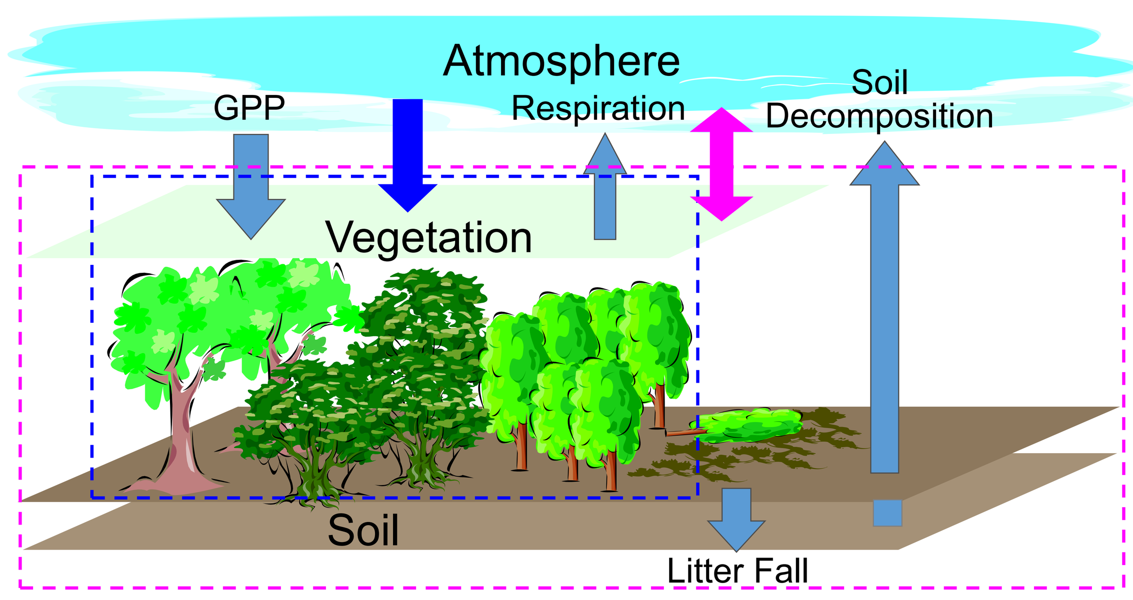
There are two types of estimating carbon fluxes using satellite data

○ Top-down approach
- estimates the carbon flux by using the distributions of CO_2 concentration and an atmospheric transport model

○ Bottom-up approach
- estimates the flux by using the surface information (e.g. leaf area, surface temperature) from the satellite data and a biosphere model

⇒ Many uncertainties are still remain in these carbon flux estimations
- the true values of carbon flux are still unclear
- estimations vary according to the type of the model (e.g. a transport model, a process based model) and input data.

Terrestrial Carbon Cycle



NPP (Net Primary Production) = GPP − Resp.

NEP (Net Ecosystem Production) = NPP − Soil Decom.

Purpose of this study

Estimating spatial distribution in carbon exchanges

Our approach is… satellite observations and model simulation

The satellite-based carbon flux estimations with reduced uncertainty will be very efficient for identifications of large emission area and terrestrial carbon stock regions.

In this study, we optimized the spin-up time of the terrestrial biosphere model (BEAMS) in each sub continental region using estimations of carbon fluxes by the atmospheric transport model (GOSAT L4A global CO2 flux).
1. Estimate the 1km grid global terrestrial carbon fluxes.
2. Validate the model estimation using the Flux tower measurement.

Improving BEAMS

・the points and improvements

Terrestrial Biosphere model
・By spin-up running to calculate initial carbon pool before time series simulation
・In many case Spin-up running make the model steady state

BEAMS case
・Because of diagnostic type model BEAMS can simulate the carbon flux only in the periods of the satellite data existing

In 2001, BEAMS states is steady state, and NEP become ± 0

Improvements

Steady states (NEP = 0) ⇒ Coordinating the spin-up time to fit GOSAT L4A estimations

1. By spin-up running, simulating the vegetation and soil pool in the steady state

2. Coordinating the spin-up time to BEAMS carbon pool to GOSAT NEP in each GOSAT L4A region

GOSAT NEP : positive region

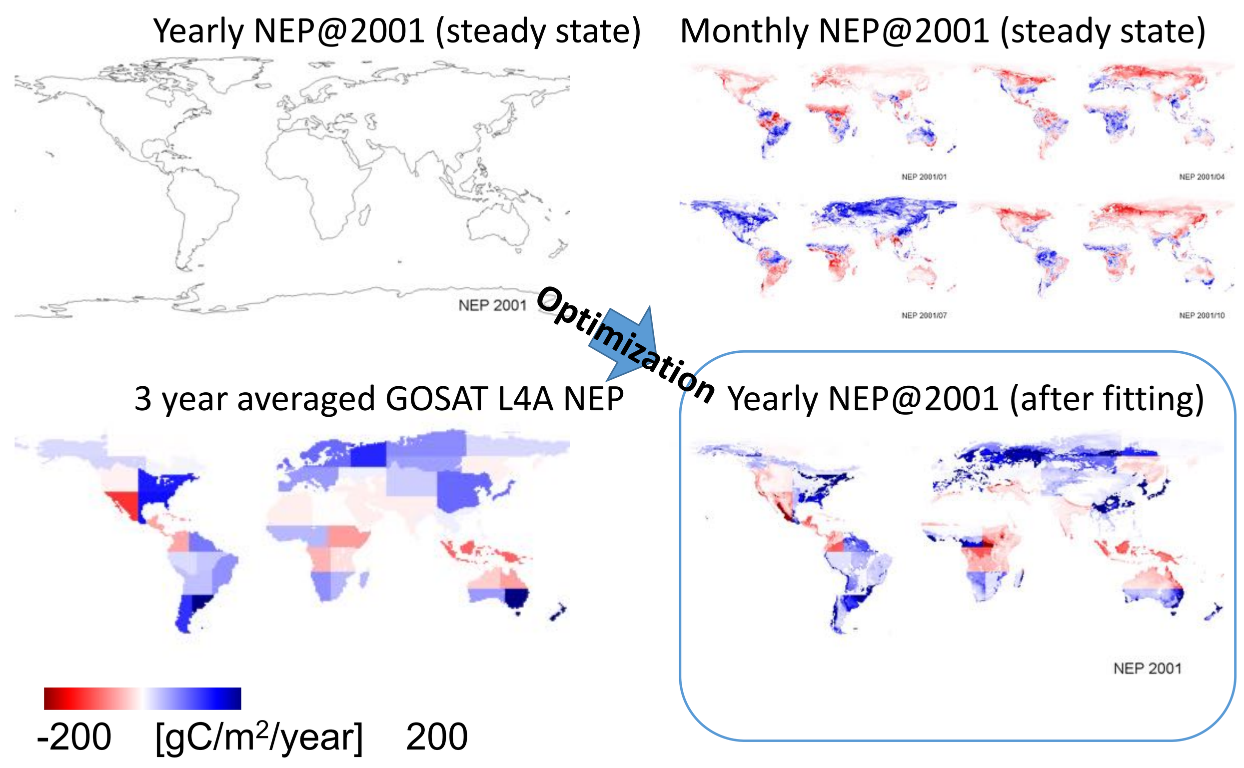
Remove vegetation pool -> Grow vegetation to fit GOSAT NEP

GOSAT NEP : negative region

Remain vegetation pool -> Force vegetation to grow to fit NEP

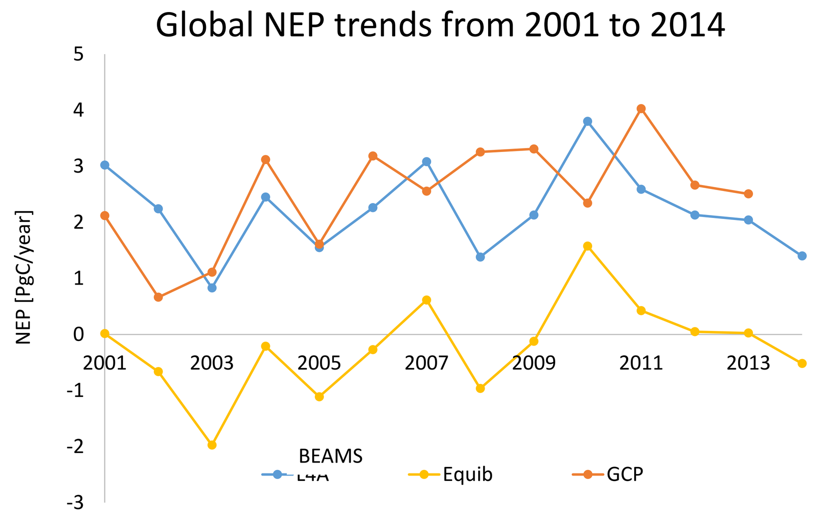
(GOSAT L4A NEP = L4A flux - GFED - ODIAC)

We use two satellite data (GOSAT (atmosphere), MODIS (land surface)), can estimate the carbon flux in high accuracy



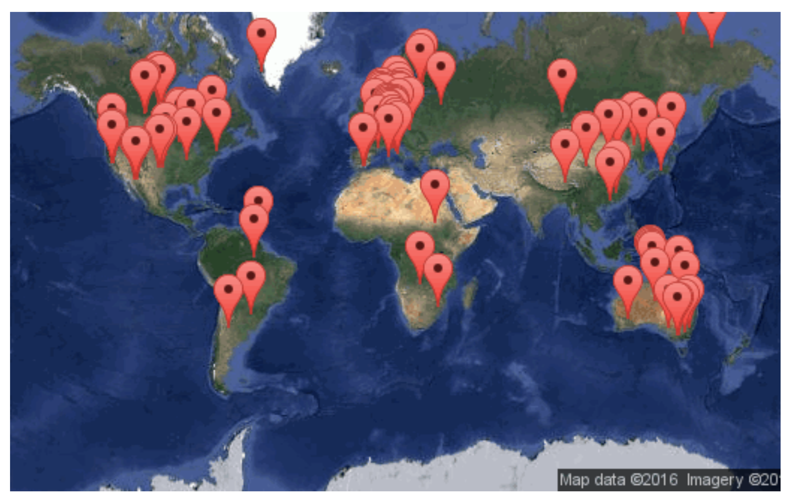
Model & Validation data

Model	BEAMS	NIES-TM (GOSAT L4A)
Major inputs	MODIS Land Products (x6)	GOSAT L2 (SWIR)
Ancillary data	$AtmCO_2$ (GOSAT L4B) Precipitation (GPCP ver. 2.2) DEM (SRTM) Temp, humidity, wind (JRA55)	GLOBALVIEW-CO2 Fossil Fuel (ODIAC) Burning (GFED3.1&4.0) Wind speed (JRA25/JCDAS)
Spatial res.	1km x 1km	64 regions (Land:42)
Temporal res.	monthly	monthly
Period	Jan/2001～Dec/2014	Jun/2009～Oct/2012

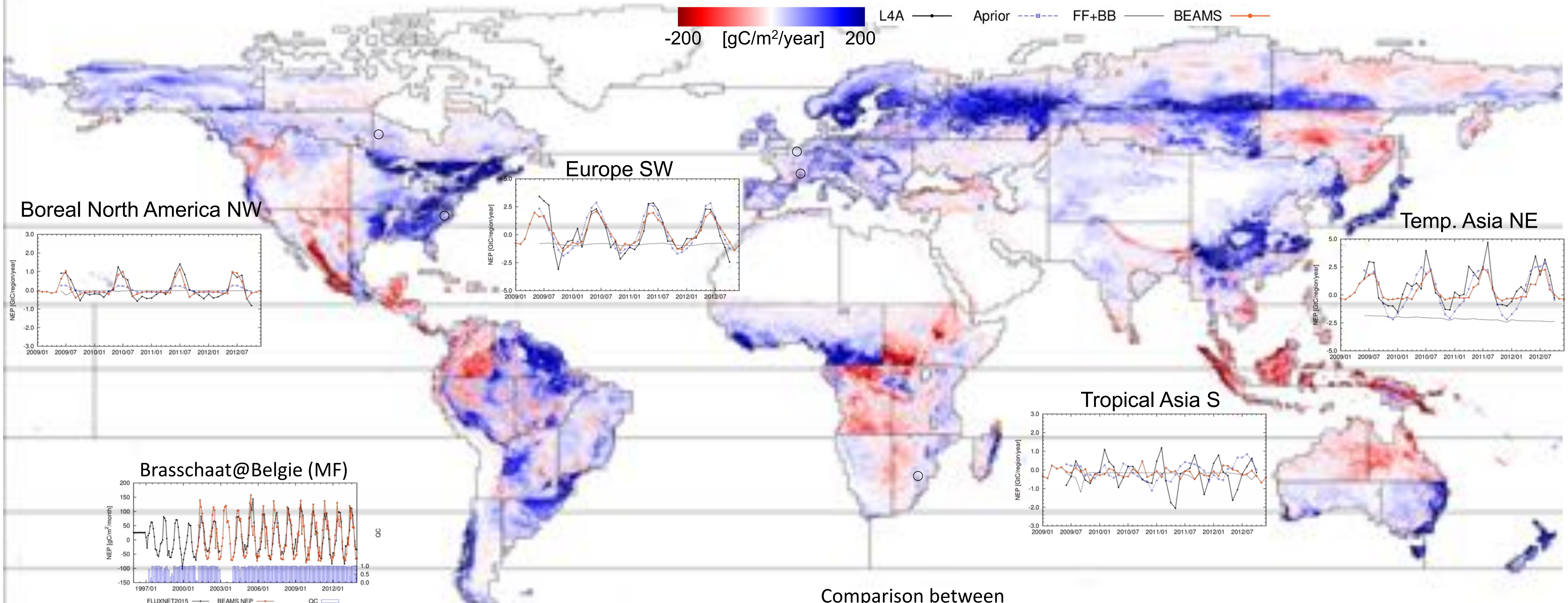


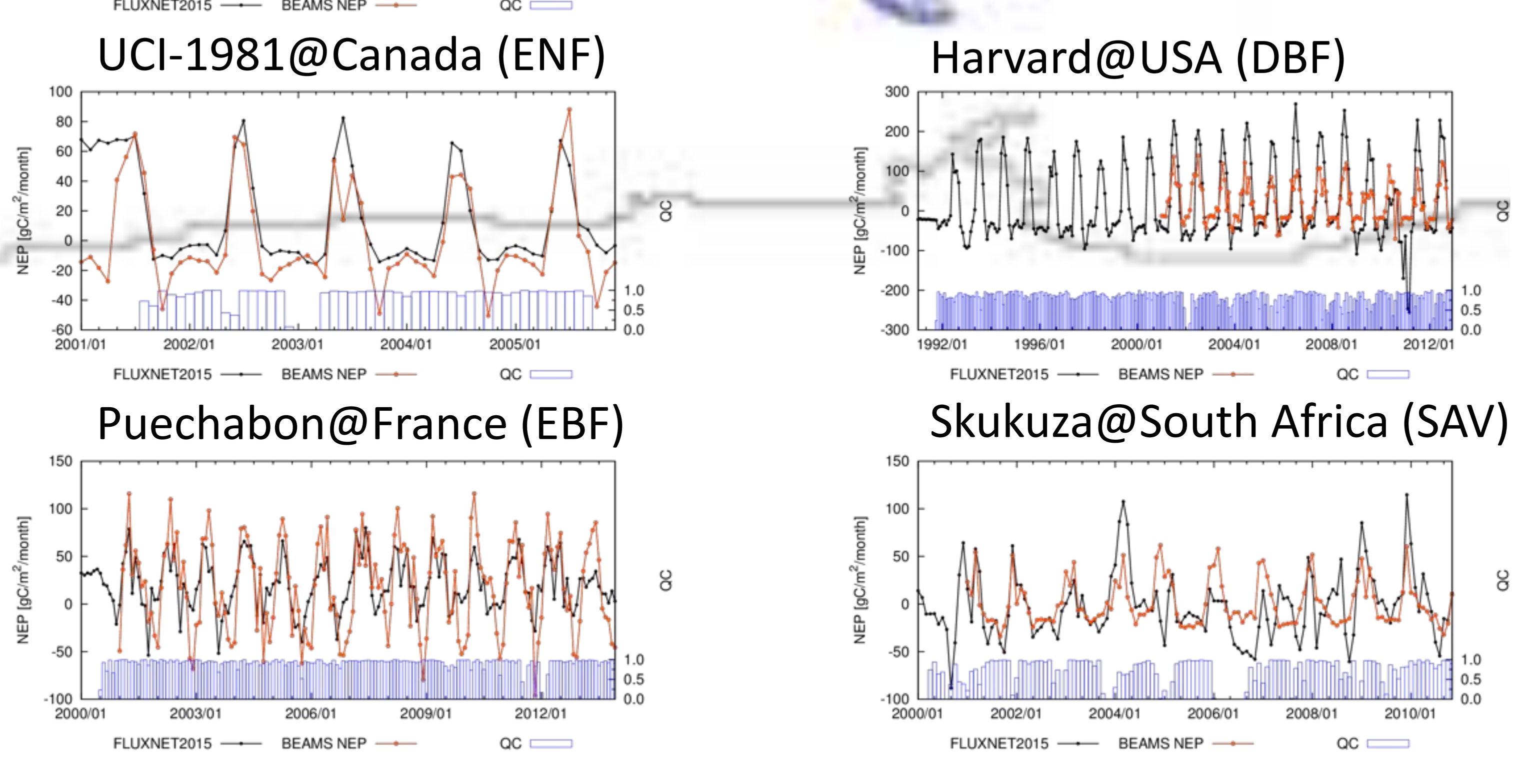
FLUXNET2015 Dataset

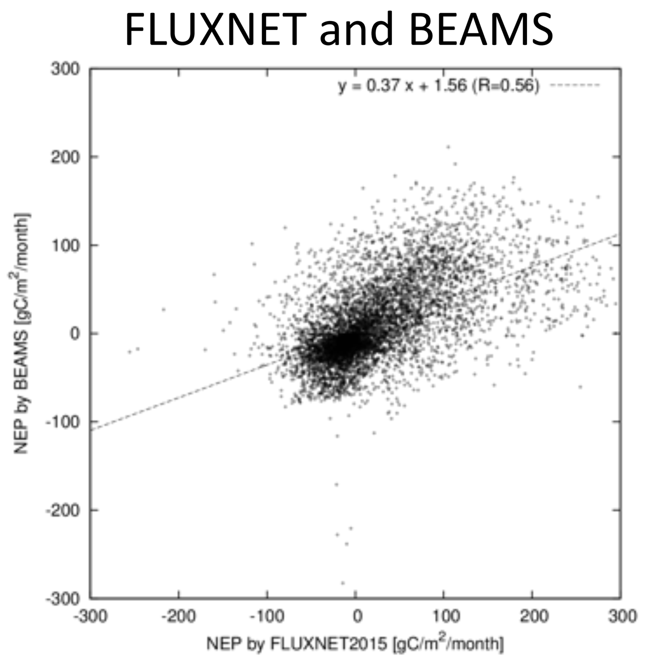
The FLUXNET2015 Dataset includes various regional flux networks data collected at each sites. We used 113 sites data for validating our model results. These flux sites are classified following vegetation type (Croplands, DBF, EBF, ENF, Grass, Mixed Forests, Closed Shrub, Open Shrub, Savannas, Woody Savannas, Permanent Wetlands).



The spatial distribution of annual NEP averaged from2001 to 2014







Conclusion

・Estimating global 1km grid scale NEP
・The temporal patterns (global, temperate, and cool temperate region) for this period were indicated similar trends between BEAMS and other estimations, and perhaps these trends may be reasonable patterns.
・In a tropical regions, the accuracy of NEP remained a matter of discussion. Main reason is the LAI datasets in these regions.

Major NEP rich country (ave. 14year)

	NEP [GtC/year]
Japan	0.07
Argentina	0.08
New Zealand	0.08
Chile	0.09
Australia	0.12
Canada	0.21
Brazil	0.30
China	0.33
United States	0.35
Russia	0.52
(EU)	0.27

・Future work:
☆ More optimizations of BEAMS flux by using land cover types in order to be moderately changing around GOSAT L4A boundary.

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