Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-P04 Room:Convention Hall Time:May 22 18:15-19:30

Analysis of Net Biome Productivity (NBP) from vegetation models and application to global atmospheric CO2 inversion

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The "top-down" estimation of the carbon flux through atmospheric CO2 inversion relies on prior CO2 flux information between the atmosphere and the earth surface, as well as the atmospheric CO2 concentration measurements. Among the prior information, the terrestrial biosphere remains in large uncertainties. To provide better constraint of CO2 inversion estimates, the modelled results of net biome productivity (NBP) from TRENDY project were analyzed and examined to apply for atmospheric CO2 inversion.

In TRENDY, a number of the DGVMs (Dynamic Global Vegetation Models) were driven globally by common climate forcing and historical atmospheric CO2 record to simulate for the period of 1901-2010, with three different scenarios aiming at reducing the uncertainties of land carbon budget. For our purpose, the modelled NBPs from the 8 DGVMs with scenario S2 (time-varying CO2 and climate) were analyzed to derive the mean feature of contemporary terrestrial biospheric net carbon budget and mean response to the changing climate system/recent global warming.

On a global scale, the model-averaged NBP show inter-annual variations correlated with inter-annual climate phenomenon/ENSO, and also an upward trend which suggests a regime shift around 1970 towards an increase in land carbon gains. EOF analysis to the average TRENDY-NBP also shows an increasing trend in the principal component of EOF1 over the recent three decades along with inter-annual variations. That indicates the leading EOF spatial pattern might respond to a long-term change as well as inter-annual variability in the climate system. While the modelled NBP are increasing globally, the variance among the models is also increasing with time, reflecting the model divergence in the processes relevant to the climate change. By examining multiple EOF patterns, in conjunction with global characterises of NBP distribution and its uncertainties, we explore the application of information from the model-ensemble results to atmospheric CO2 inversion.

Keywords: CO2, terrestrial ecosystem, inverse modelling, climate change