Geophysical Research Abstracts
Vol. 16, EGU2014-67, 2014
EGU General Assembly 2014

The combined influence of the main European circulation patterns on carbon uptake by ecosystems

Ana Bastos (1), Célia Gouveia (1,2), and Ricardo Trigo (1)

(1) IDL, Universidade de Lisboa, Lisboa, Portugal (afbastos@fc.ul.pt), (2) Escola Superior de Tecnologia de Setúbal, Instituto Politécnico de Setúbal, Portugal

Understanding how natural climate variability affects carbon uptake by land and ocean pools is particularly relevant to better characterize human impact on the carbon cycle. Recently, we have contributed to assess the major role played by the El-Niño/Southern Oscillation in driving inter-annual variability (IAV) of carbon uptake by land ecosystems and significantly influencing global CO_2 air-borne fraction [1]. Despite the prominent role played by ENSO, other important teleconnections on the hemispheric scale have deserved less attention.

On the European scale, the main mode of variability is the North-Atlantic Oscillation (NAO), which controls storm tracks position and drives changes in temperature and precipitation over the whole region, affecting vegetation dynamics [2]. Besides NAO, a few additional large scale circulation patterns the Scandinavian (SC) and East-Atlantic (EA) Patterns, are also known to influence significantly the European climate [3]. Different combinations of these teleconnection polarities have been recently shown to modulate the overall role of the NAO impact location and strength, thus affecting winter temperature and precipitation patterns over Europe [4].
This work aims to answer the following questions:
(i) how do NAO, EA and SC affect vegetation carbon uptake IAV?
(ii) do the interactions between these three modes have a significant impact on land CO_2 IAV?
(iii) what is the contribution of the different physical variables to ecosystems' response to these modes?
(iv) how well do the state-of-the-art Earth System Models (ESMs) from CMIP5 represent these climate variability modes and the corresponding carbon fluxes?

We first analyze observational data to assess the relationships between the different combinations of NAO, SC and EA polarities and IAV of gross and net primary production (GPP and NPP, respectively), as well as the most relevant driving factors of ecosystem's response to those variability patterns. Although the winter state of NAO has, as expected, the largest impact on European-wide carbon uptake patterns, the other modes appear to have a strong influence in particular regions, presenting overlapping effects with different signs which are due to differentiated responses to temperature and precipitation variability. We then rely on the historical experiment (CO_2 concentration driven) of 12 ESMs from CMIP5 to assess the capability of those models to represent NAO, EA and SC patterns, the associated physical variables as well as the corresponding land carbon fluxes. Although all models simulate NAO reasonably well, and most represent EA and SC patterns satisfactorily, the response of the carbon cycle to these variability modes still needs further improvements.

References

[1] Bastos, A., Running, S. W., Gouveia, C.M., Trigo, R.M., (2013): *J. Geophys. Res. Biogeosci.*,**118**, 1247-1255, doi:10.1002/jgrg.20100.

[2] Gouveia, C.M., Trigo, R. M., DaCamara, C. C., Libonati, R., Pereira, J. M. C. (2008): *Int. J. Climatol.*, **28**, 1835–1847, doi: 10.1002/joc.1682.

[3] Trigo R.M., Valente M.A., Trigo I.F., Miranda P.M., Ramos A.M., Paredes D., García-Herrera R. (2008): *Annals of the New York Academy of Sciences*, **1146**, 212–234, doi: 10.1196/annals.1446.014.

[4] Comas-Bru, L., McDermott, F. (2013): *Q.J.R. Meteorol. Soc.*, doi: 10.1002/qj.2158.