Coupled effect of agricultural practices and climate on carbon storage in two contrasted permanent tropical pastures

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Clément Stahl[1-2] *, Katja Klumpp[1], Robert Falcimagne[1], Catherine Picon-Cochard[1], Lecomte Philippe[3], Jean-François Soussana[1], Sébastien Fontaine[1] and Vincent Blanfort[1-3]

(1) INRA, UR 874, Research Unit on permanent grasslands, 63100 Clermont Ferrand, France (2) CIRAD, UMR Selmet, Campus Agronomique, BP 709, 97387 Kourou Cedex French Guiana (3) CIRAD, UMR Selmet, Campus international de Baillarguet - TA C-112/ A 34398 Montpellier Cedex 5 * clement.stahl@ecofog.gf

More than 15% of Amazon forest has been converted to pastures in last decades. Forests contain more C than a pasture, however, only little information is available on the potential C sequestration of those pastures in the long term and with respect to climatic variability. A better insight on how climatic variability and agricultural management affects net carbon exchange (i.e. NEE) of cattle pastures are, thus, important to increase C storage and to prevent from increasing greenhouse gas emission.

AIMS

- Investigate the drought effect on the carbon storage in two contrasted agricultural management.
- Evaluate the specific consequences of the climatic variability (i.e dry and wet season) on the GPP and Reco.

MATERIELS & METHODS

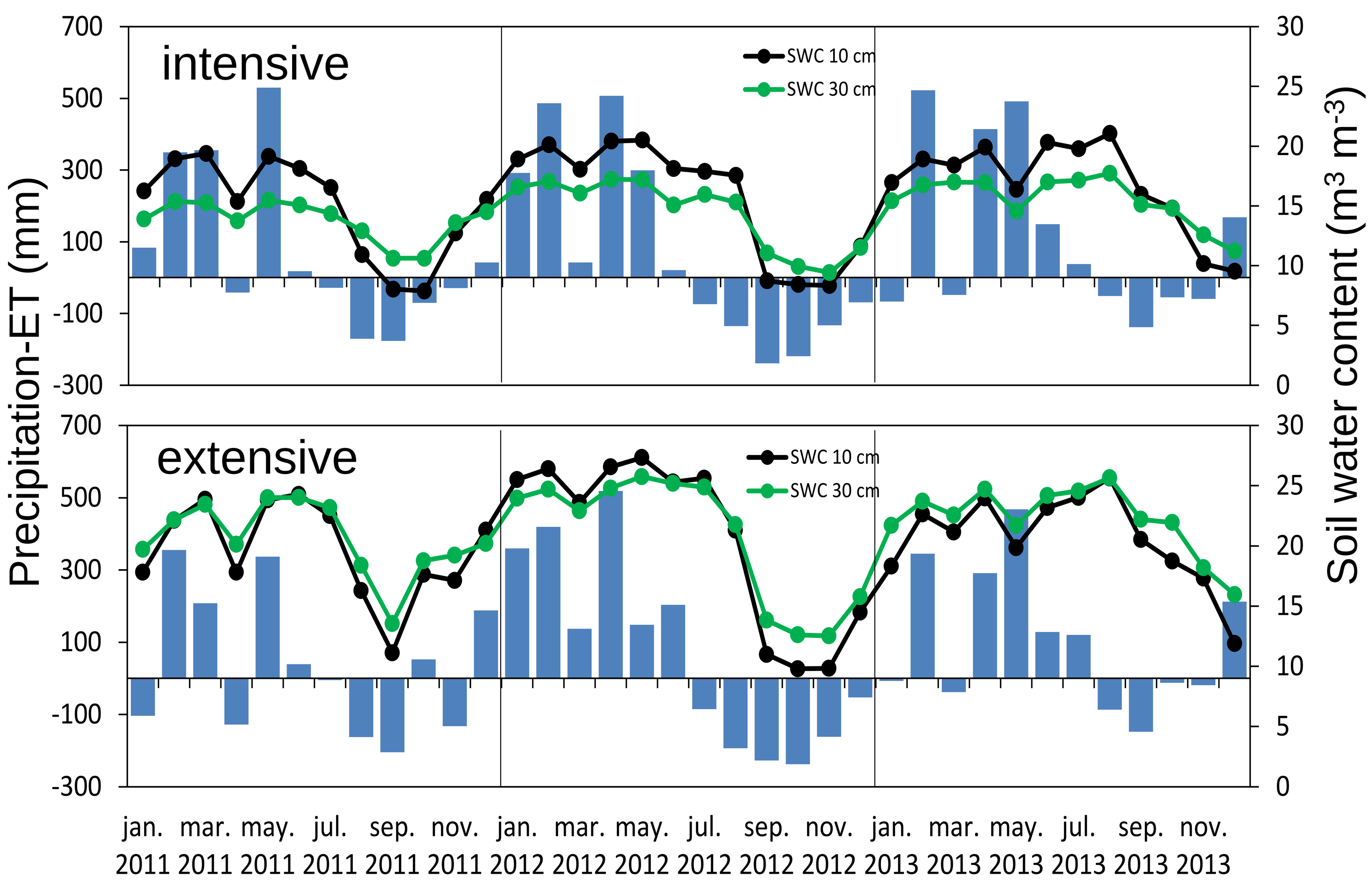
This study was conducted in two farms in French Guiana, South America (5°16'54"N, 52°54'44"W). Mean annual rainfall is 3041 mm and mean air temperature is around 25.7 °C. The study focused on a hilltop zone with clayey soils, classified as Ferralsols or Acrisols.

The pastures were established in 1978 (**old**) and 2008 (**young)** after deforestation of native rainforest and were grazed rotationally by livestock at low and high stocking density. The vegetation in the pastures was dominated by *Brachiaria humidicola*.

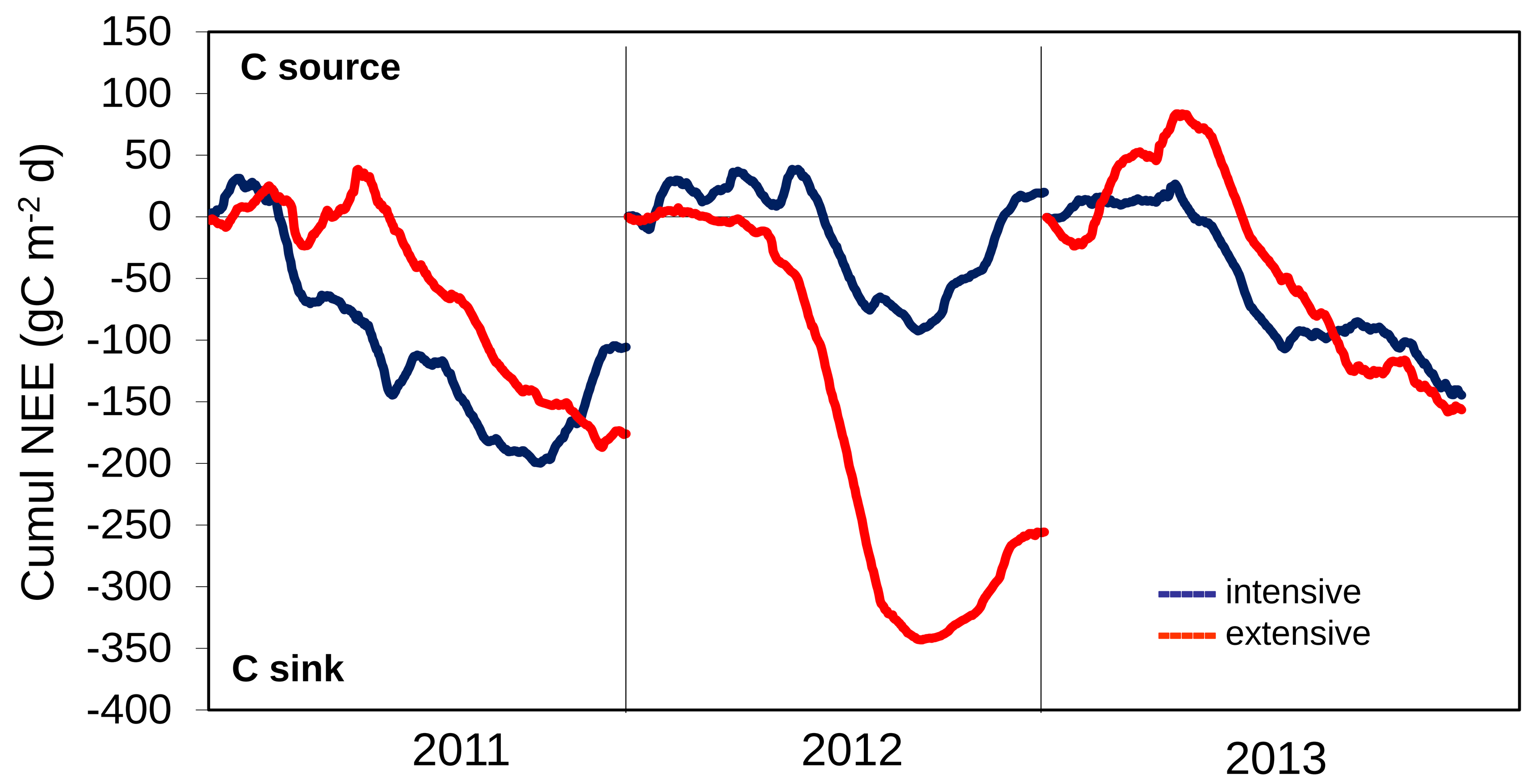
•**Young pasture** "ETVM", were grazed at **high** stocking density 4.4 LSU ha^{-1} yr^{-1} (**intensive**).
•**Old pasture** "Bio-Savane", were grazed at **low** stocking density 1.4 LSU ha^{-1} yr^{-1} (**extensive**).

Since 2010, we measured C sink potential by eddy covariance technique of the two pastures. Eddy covariance flux measurements followed European flux guidelines, and gaps and poor quality data were reconstructed using the gap-filling strategy of Reichstein et al. (2005).

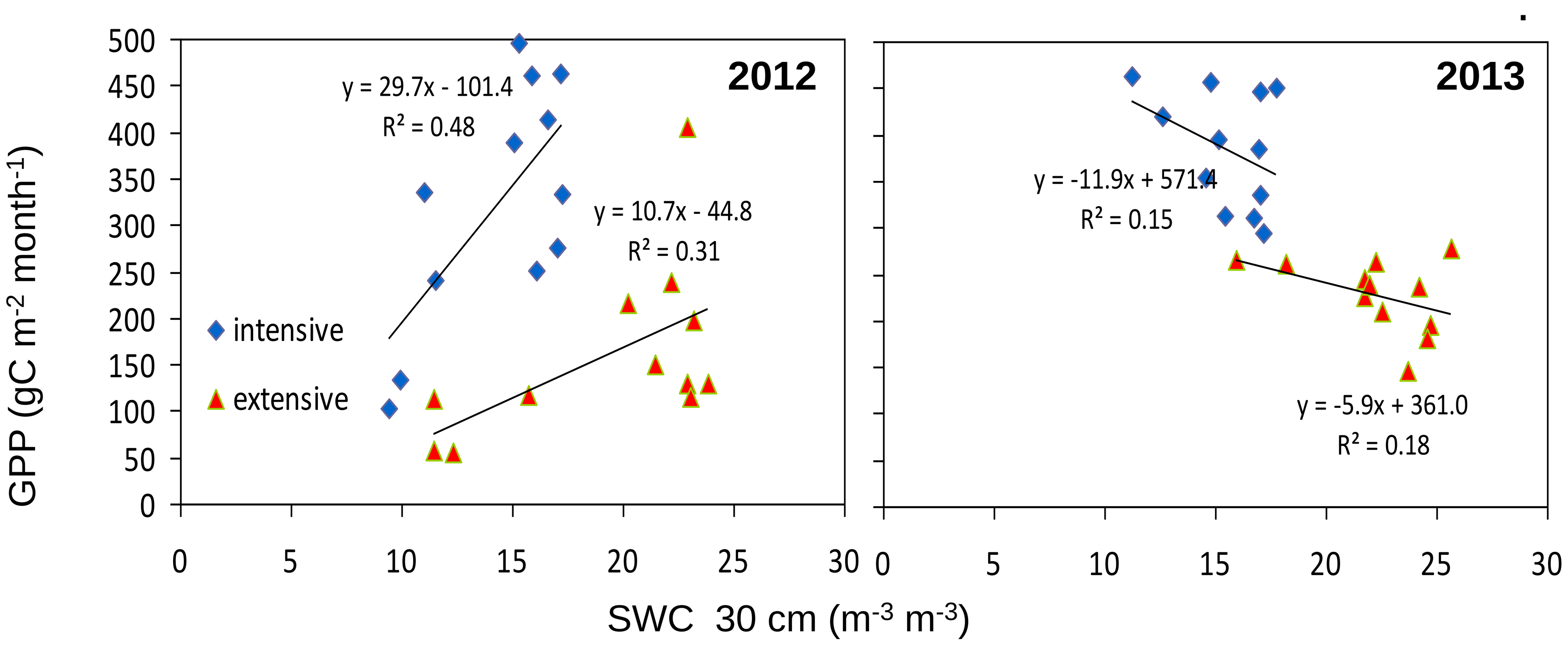
RESULTS

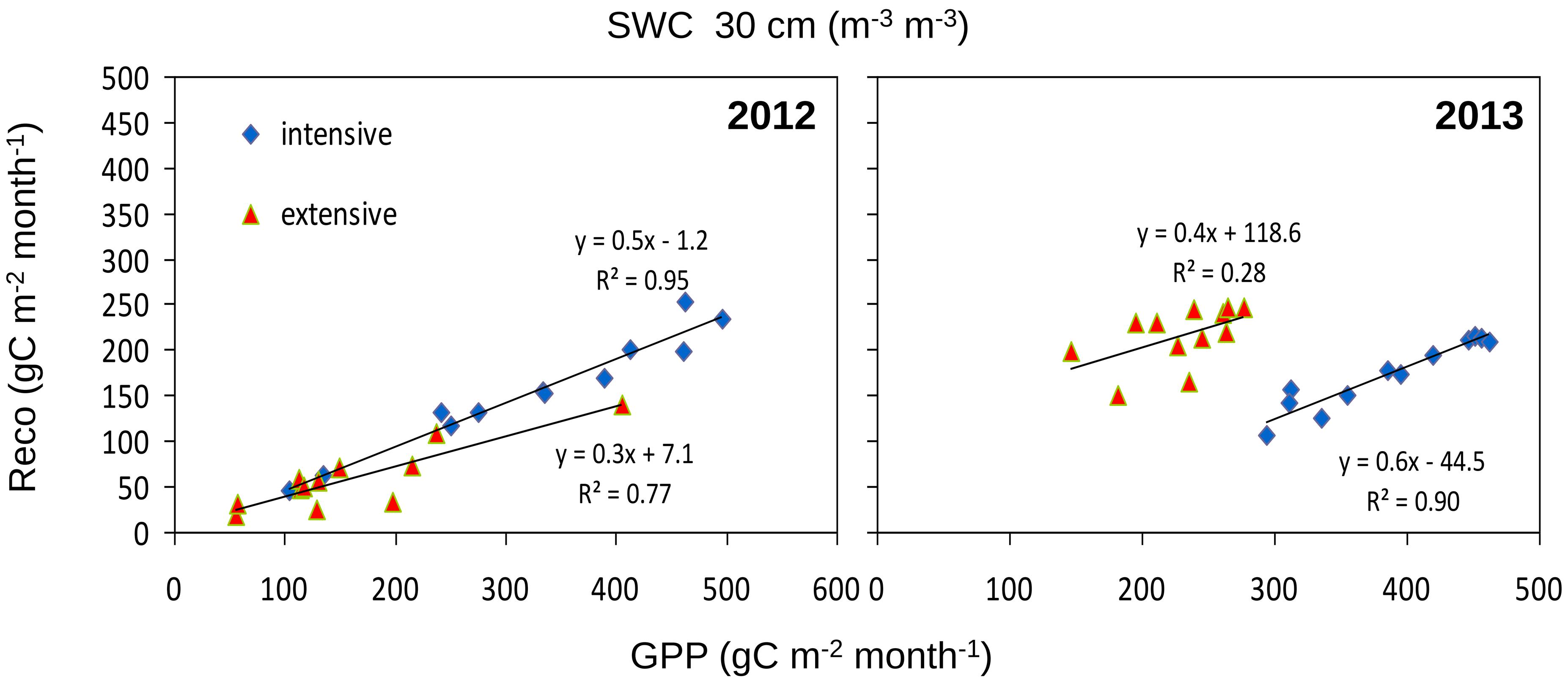


Seasonal variation of water conditions during the 3 years. 2012 was the driest year of our study, and 2013 was the wettest.



Seasonal variation of net carbon storage (NEE) in the two pastures, show an effect of the water conditions modulated by the management. Extensive management allows a better net C storage for dry years, while during the wet year grazing treatments perform in the same way.





t C ha^{-1} an^{-1}	2011	2012	2013
intensive	-1.06	+0.20	-1.45
extensive	-1.76	-2.56	-1.57

Annual Net Ecosystem Exchange (NEE) in the two pastures

In dry years, GPP increases with soil water content (SWC) while in wet years GPP declines with SWC.
The part of GPP respired (Reco) is similar for both treatments in dry years, while a higher fraction of GPP is respired in wet years by the intensive grazing, which may explain the lower NEE (less negative) during these years.

CONCLUSION

- Intensity of dry season is different between dry and wet years leading to a high inter- and intra-annual C storage variability in relation to water condition.
- The old extensive pasture shows a higher net C storage but is more affected to intermediate water conditions, between wet and dry season, allowing the higher C storage in dry years.
- GPP and Reco are sensitive to SWC, but change their pattern in dry and wet years

We thank the farmers, who permit to samples their pastures. We thank also the great technician assistance of Cirad Guyane and Inra Clermont during this experimentation.