

# Impact of Diffuse Radiation Changes on the Land Carbon Sink over the Post Pinatubo Period

L. M. Mercado<sup>1</sup>, N. Bellouin<sup>2</sup>, S. Sitch<sup>2</sup>, O. Boucher<sup>2</sup>, C. Huntingford<sup>1</sup>, P.M. Cox<sup>3</sup>

<sup>1</sup>Centre for Ecology and Hydrology, Wallingford, UK, <sup>2</sup>Met Office Hadley Centre, UK. <sup>3</sup>School of Engineering Computer Science and Mathematics, University of Exeter, UK.

E-mail: [Imme@ceh.ac.uk](mailto:Imme@ceh.ac.uk)

## Background

- Large emissions of aerosols to stratosphere from eruption of Mount Pinatubo in 1991 caused decrease in incoming solar radiation & decrease in Northern hemisphere summer temperatures in years (1992/93)
- Post Pinatubo years coincided with El Niño period (usually associated with land biosphere carbon source)
- However, observational evidence suggest a land carbon sink<sup>1,2,3</sup>

## Hypothesis explaining land C sink

- Decrease in Soil Respiration in response to cooling<sup>4</sup>
- Increase in Net Primary Productivity due to more efficient photosynthesis under higher diffuse irradiance<sup>5,6</sup>
- Combination of the above

## Question

Was there a contribution to the post Pinatubo land Carbon sink from enhanced photosynthesis due to increased diffuse irradiance?

## Methods

- Met Office Land Surface Model<sup>7</sup>
- Model Forcing: CRU<sup>8</sup>(T, P, cloud cover) GCM direct & diffuse radiation (incl. Tropospheric & Stratospheric Aerosols)<sup>9</sup>

## Summary

Land C sink in 1992

- Due to combination of effects:

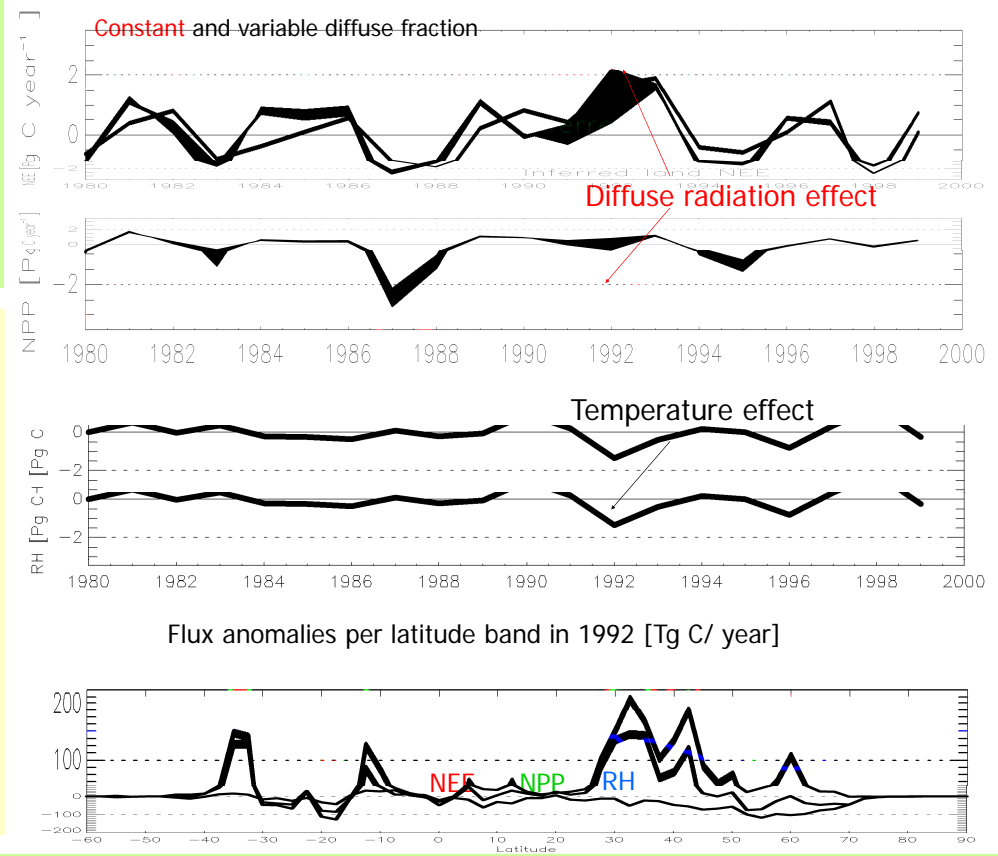
- Large contribution diffuse radiation fertilization on plants.
- Temperature on Soil Respiration.

- Regional Contributions:

- Temperate 50%, Tropics and SH 30%, Boreal 20%.

## Results

Global Net Ecosystem Exchange and Net Primary Productivity anomalies



## References

- Ciais, P. et al., *Science* 269 (5227), 1098 (1995).
- Keeling, C. D. et al., *Nature* 375 (6533), 666 (1995).
- Battle, M. et al., *Science* 287 (5462), 2467 (2000).
- Lucht, W. et al., *Science* 296 (5573), 1687 (2002).
- Gu, L. H. et al., *Science* 299 (5615), 2035 (2003).
- Roderick, M. L. et al., *Oecologia* 129 (1), 21 (2001).
- Mercado, L. M. et al., *Tellus* 59B (3), 553 (2007).
- New, M. et al., *J.Clim* 13, 2217 (2000).
- Bellouin, N., Met Office Hadley Centre Technical Note 73 (2007).