

Impact of Amazon fire on plant productivity

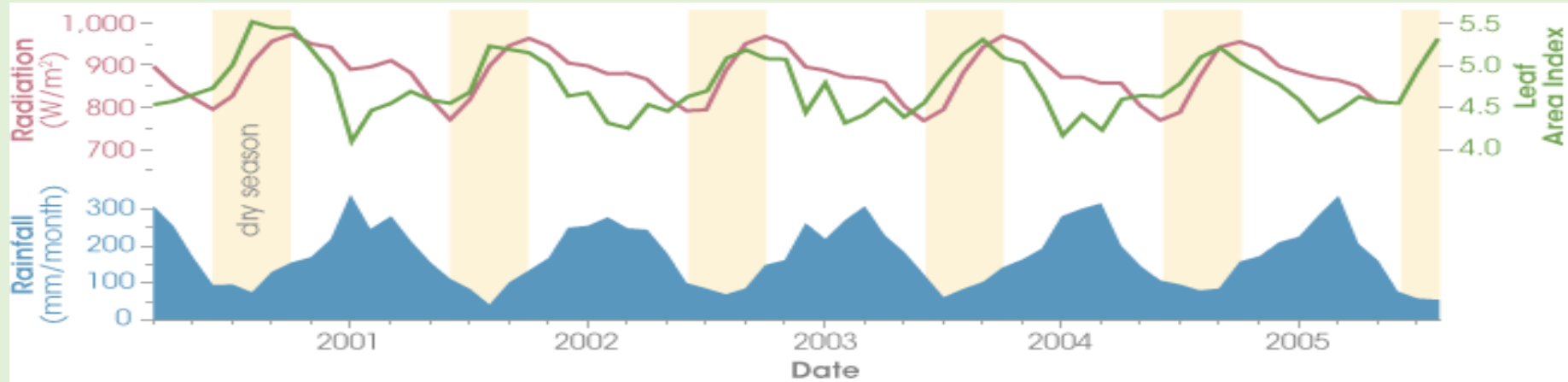
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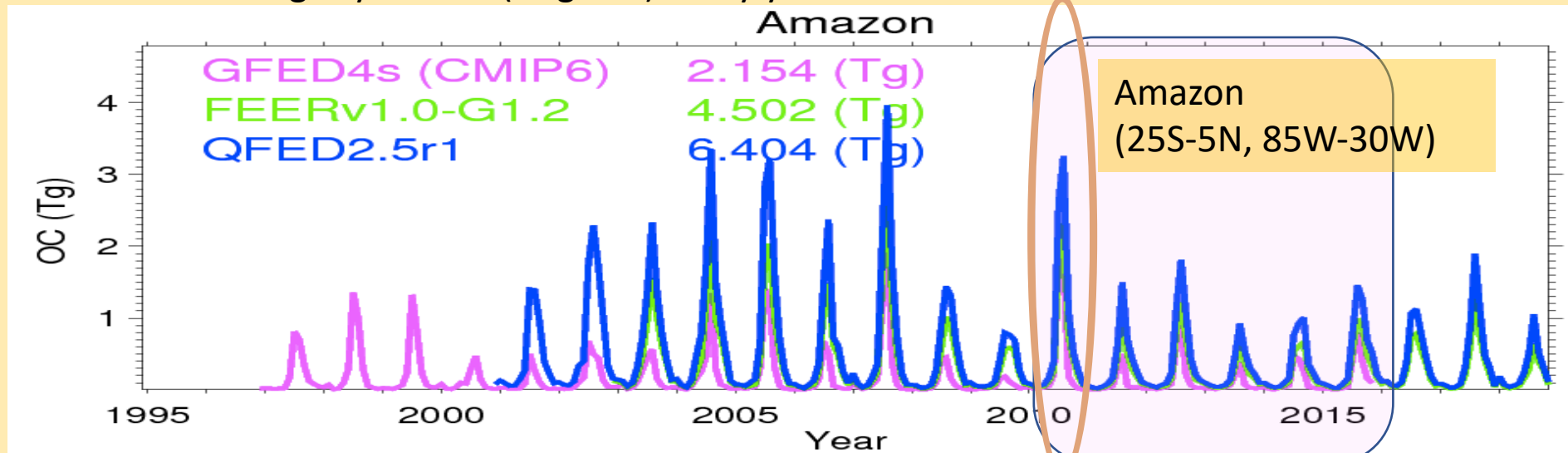
Why do we care?

Amazon forest thrive during dry season



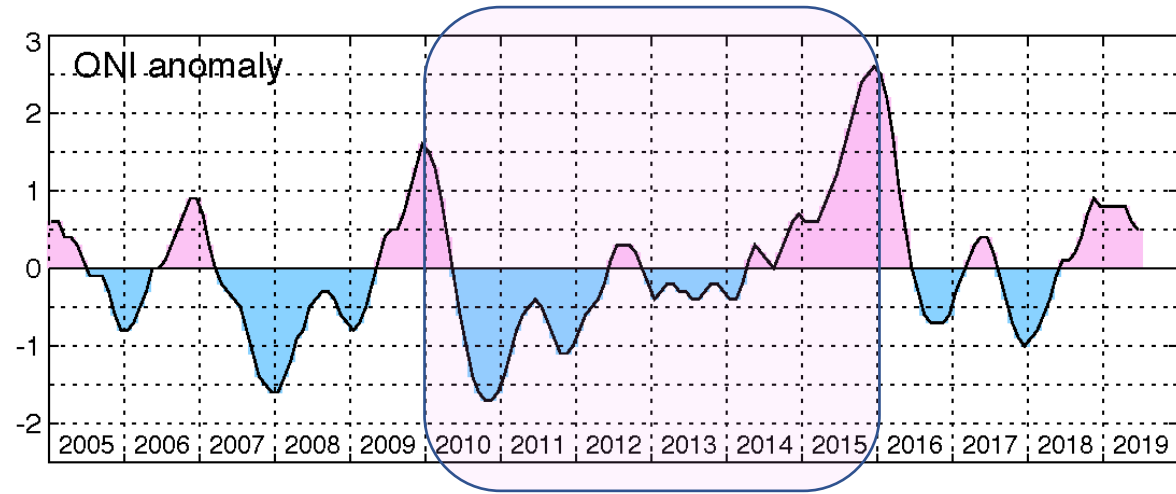
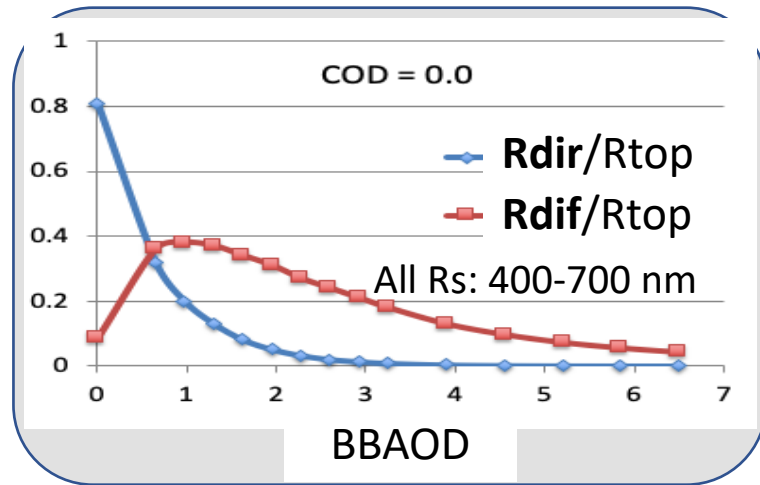
Radiation, Leaf Area Index, and Rainfall over Amazon during 2000-2005 (*Myneni et al. 2007*)

Amazon experience fires during dry season (Aug-Oct) every year



Objective 1

How biomass burning aerosols impact Amazon productivity via radiation only



Two experiments	allaer	nobbaer
Atmos dynamic fields	realtime BBAer over 2010-2015	realtime BBAer over 2010-2015
rad fields into land	realtime BBAer over 2010-2015	No BBAer

The **allaer** and **nobbaer** : The only difference in their GPP simulations is the different radiation fields in GEOScatchCN with and without impact of BB aerosols.

“replay” mode : We run GEOS in replay mode. Every 6h, the model dynamical state (winds, pressure, temperature, and humidity) is set to the balanced state provided by MERRA2 meteorological analyses.

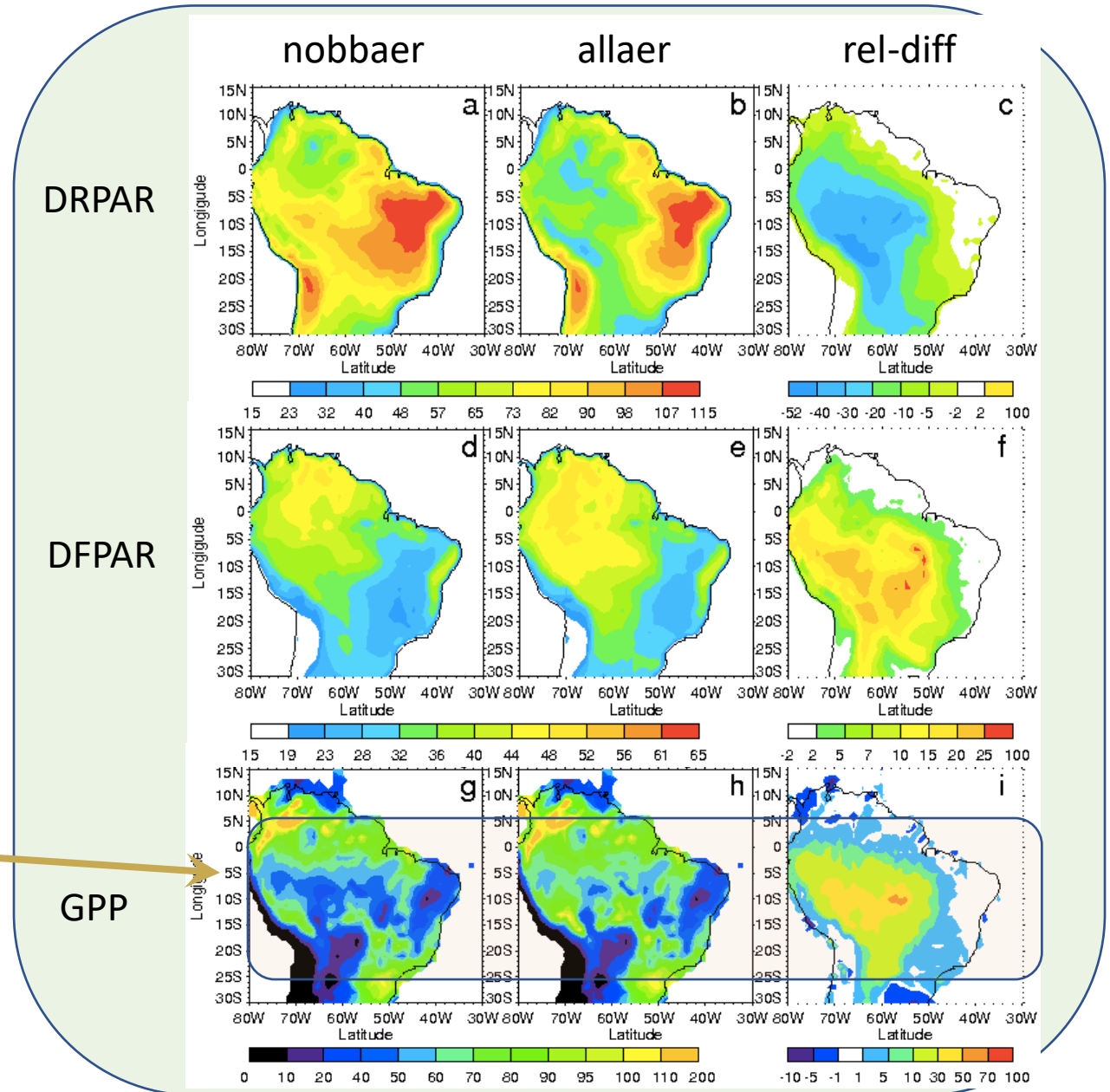
Objective 1

How Amazon PAR and GPP change due to the impact of biomass burning aerosol on radiation

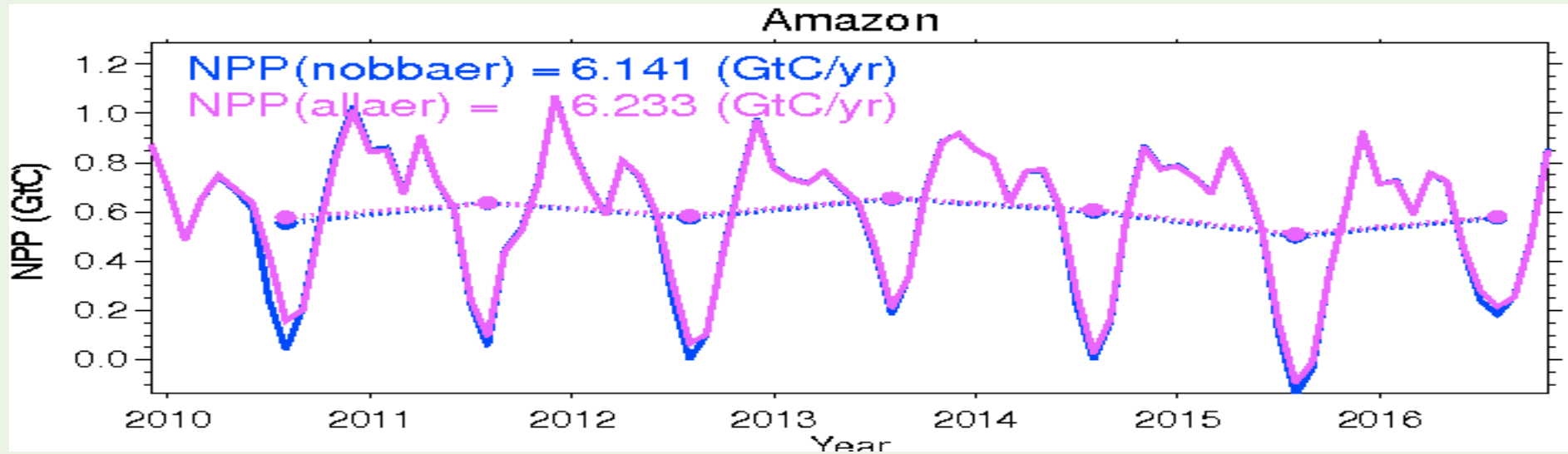
201008	nobbaer	allaer	Rel-diff
	W/m2	W/m2	%
DRPAR	78	66	-15.7
DFPAR	32	35	10.3
	GtC	GtC	%
GPP	1.9	2.1	9.9

Amazon: land over 25S-5N, 80W-30W

Red-diff (%) = (allaer – nobbaer) / nobbaer



Objective 1 What is the NPP response?



Amazon (25S-5N, 85W-30W) during 2010-2016:

- NPP is increased by 1.5%/yr with the impact of BBAer-radiation-plants
- Average NPP is enhanced by ~92 TgC/yr
- Regional fire emitted ~250 TgC/yr

=>1.5% of NPP enhancement equivalent to ~37% of C loss by fires

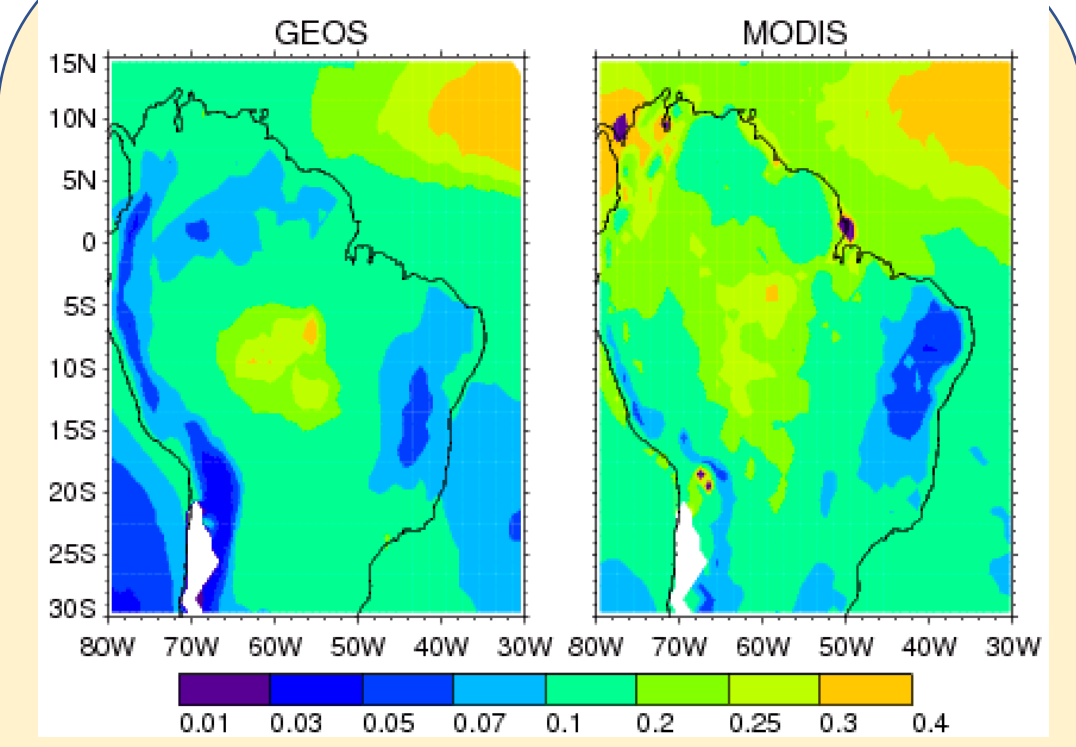
Summary

1. The impact of BBaer on radiation fields that drive GEOSCatchCN could increase Amazon GPP up to 10%, via increasing DFPAR by 10% and decreasing DRPAR by 16%, on a monthly basis during 2010-2016
2. Consequently, Amazon NPP is increased by 1.5%/yr, which is $\sim 92\text{TgC/yr}$. This NPP enhancement is equivalent to $\sim 37\%$ of C loss due to Amazon fires. Of course, this compensation occurs only once, while the loss of plants, particularly forest, could persist for decades.
3. The effectiveness of the aerosol light fertilizer is strongly dependent on the presence of cloud: much stronger (as much as 5 times higher) in clear sky conditions than in full cloudy conditions.

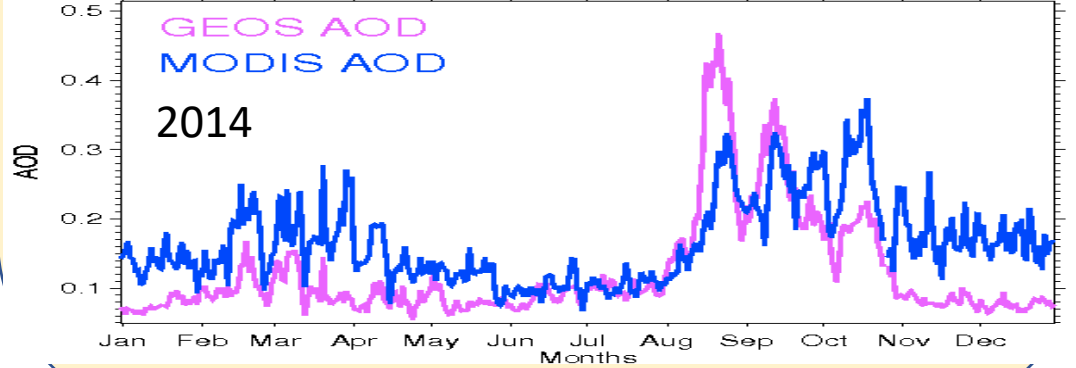
Backup

Sanity check for GEOS performance

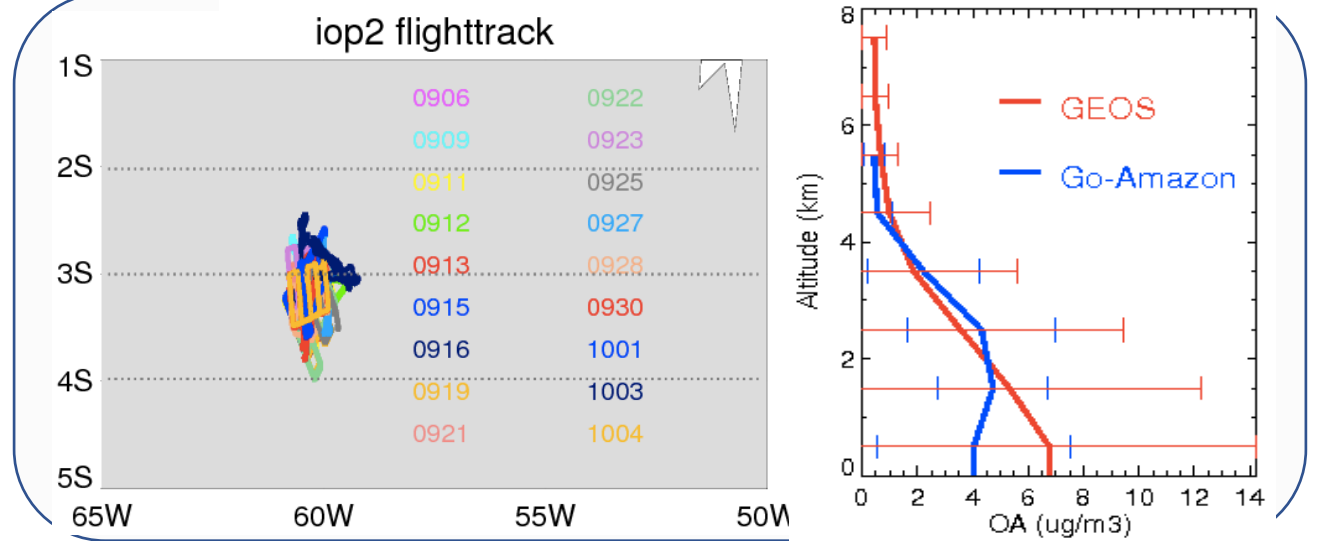
Compare AOD with MODIS



AOD Budget over Amazon, 1



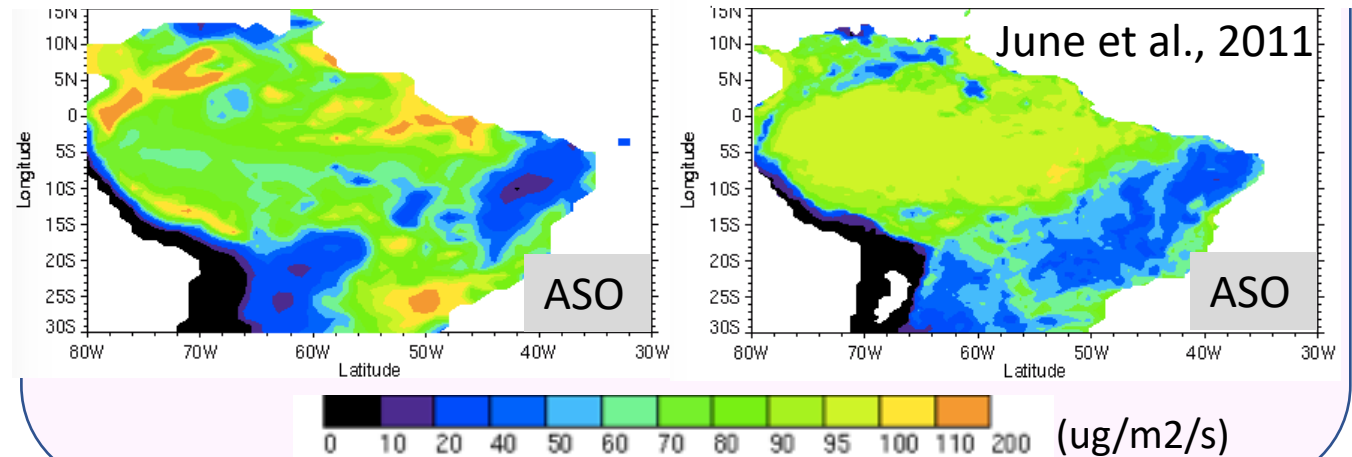
GoAmazon 2014 Sept-Oct



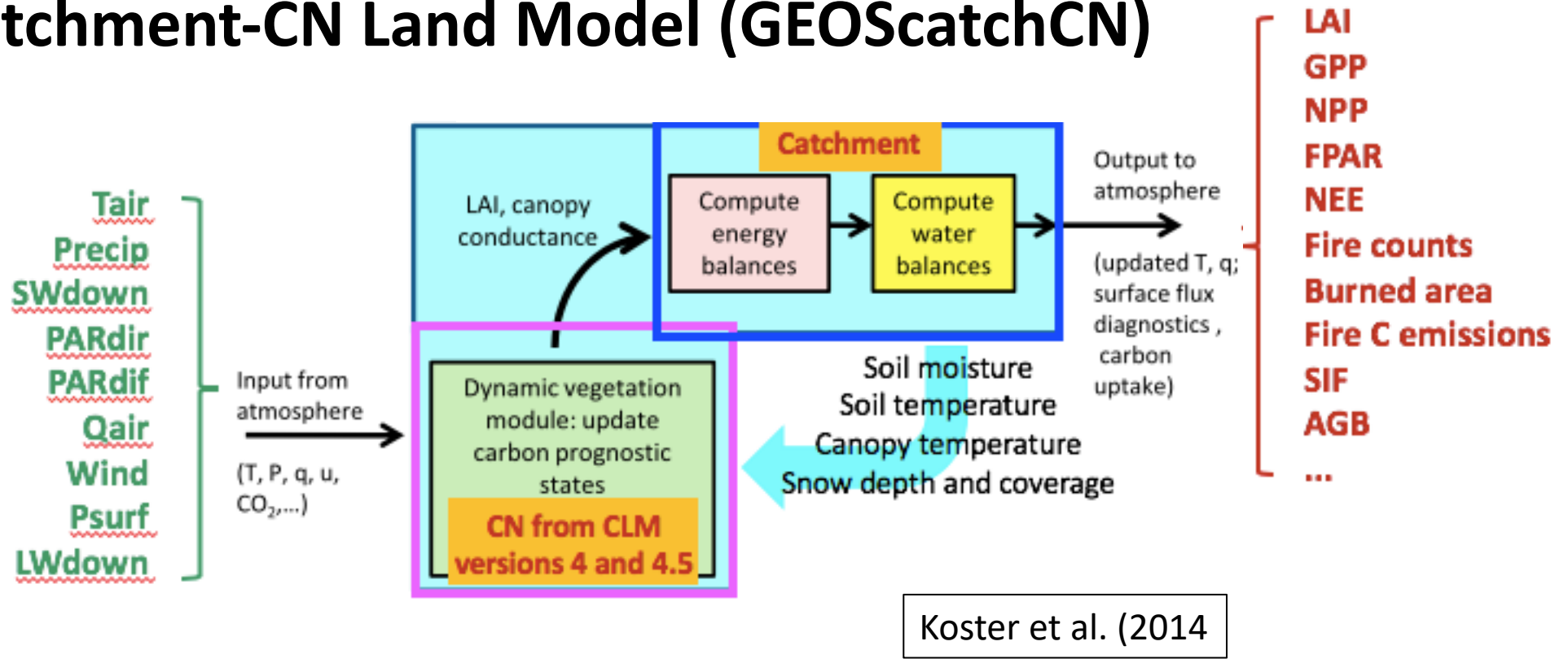
GPP

GEOS 2010-2016

Ensemble 1983-2011



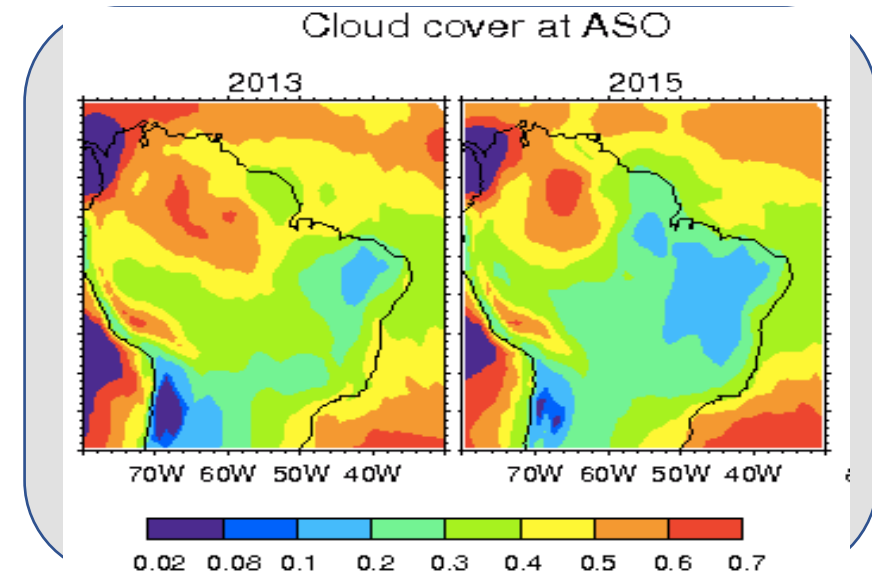
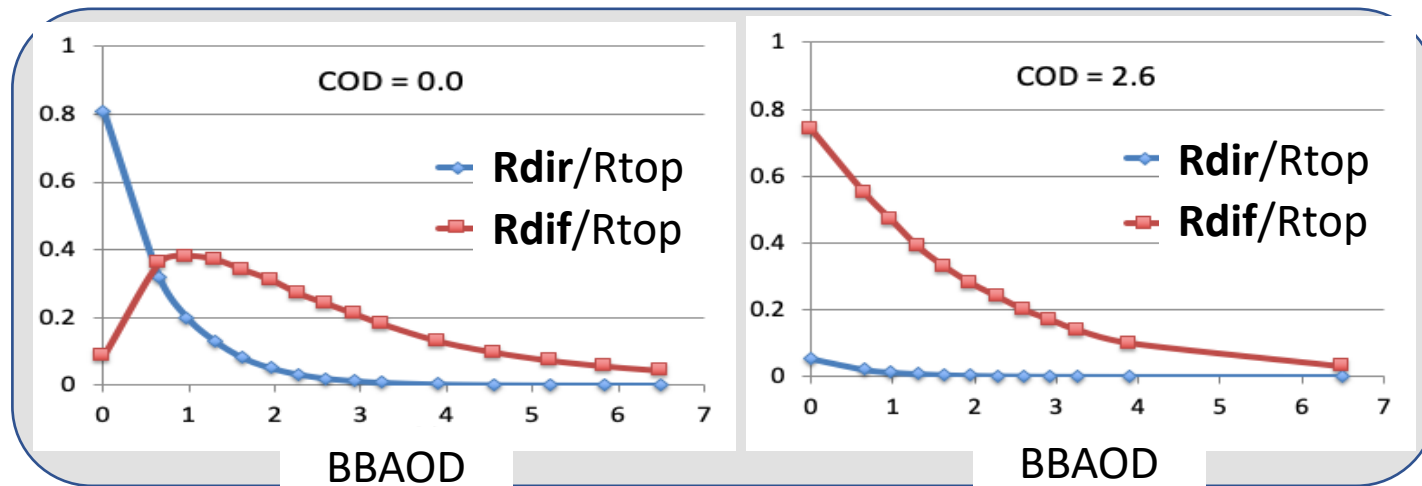
GEOS Catchment-CN Land Model (GEOScatchCN)



- Photosynthesis and transpiration depend non-linearly on solar radiation, via the light response of stomata
- The canopy is treated as two leaves (sunlit and shaded) in CLM4
- The DRPAR and DFPAR absorbed by the vegetation is apportioned to the sunlit and shaded leaves as described by Thornton and Zimmermann (2007).

Objective 2

How sensitive is the impact of BBAer-radiation-plants on environment clouds?



Two experiments	callaer	cnobbaer
Atmos dynamic fields	Same BBAer over 2010-2016	Same BBAer over 2010-2016
rad fields into land	Same BBAer over 2010-2016	No BBAer

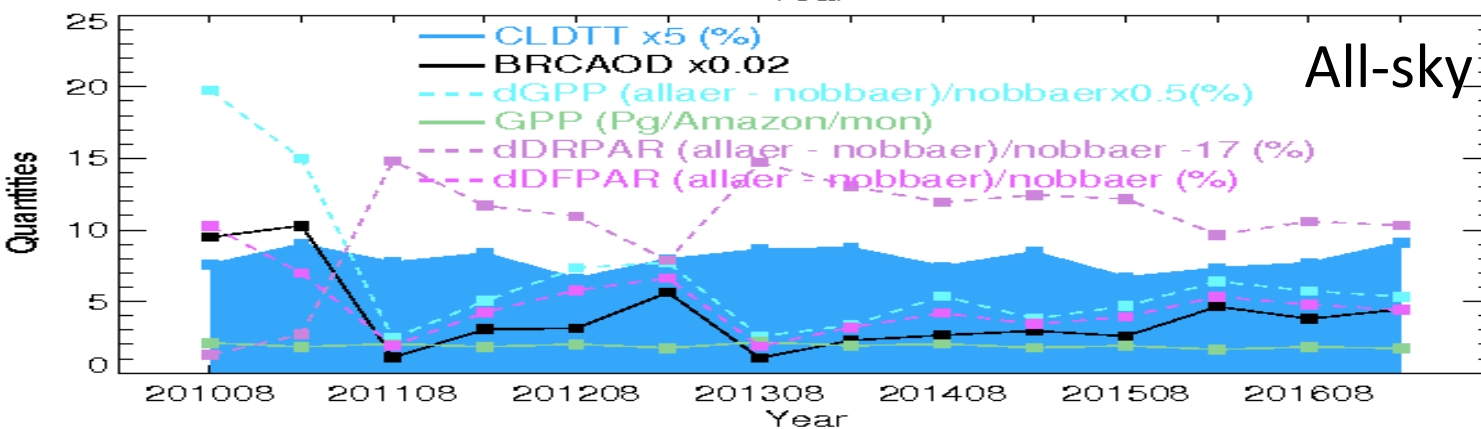
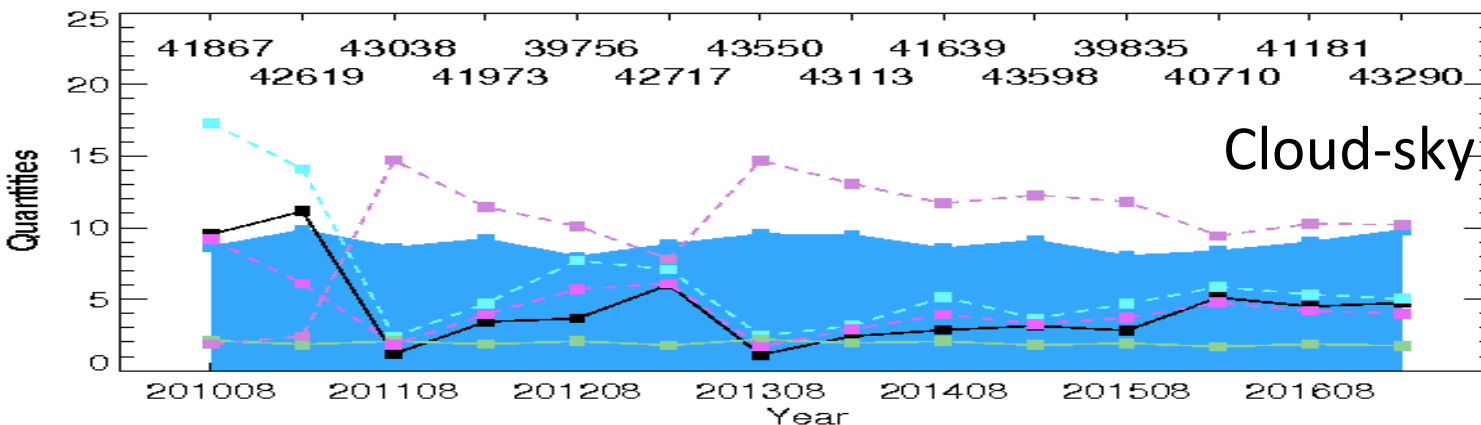
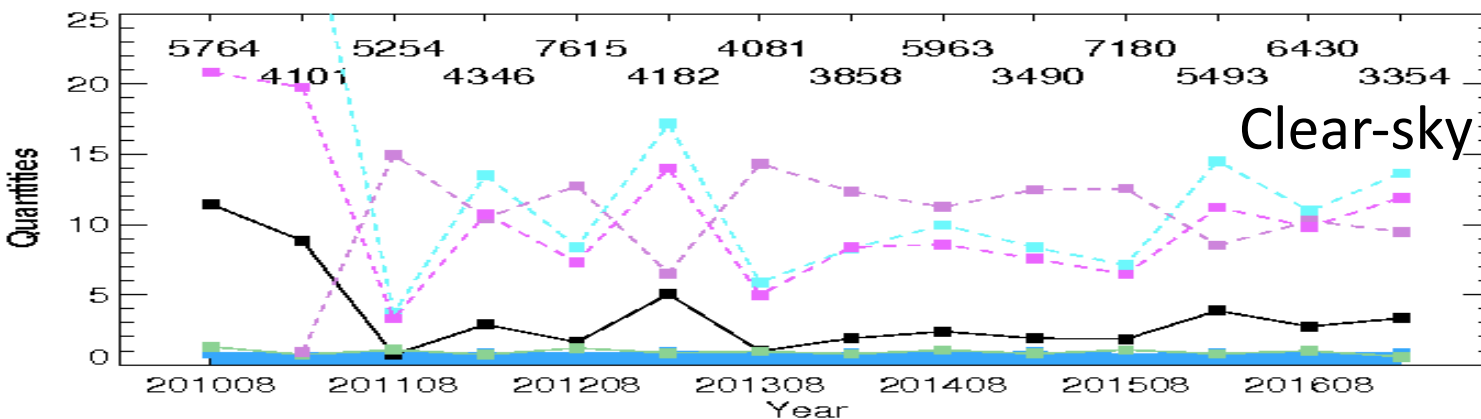
We will analyze the cloud, GPP and PAR-to-GEOScatchCN of **callaer** and **cnobbaer** for 7 Aug-Sept seasons. We will investigate how interannual cloud variation adjusts the impact of BBAer-radiation-plants.

Objective 2

Cloud vs aerosol effect

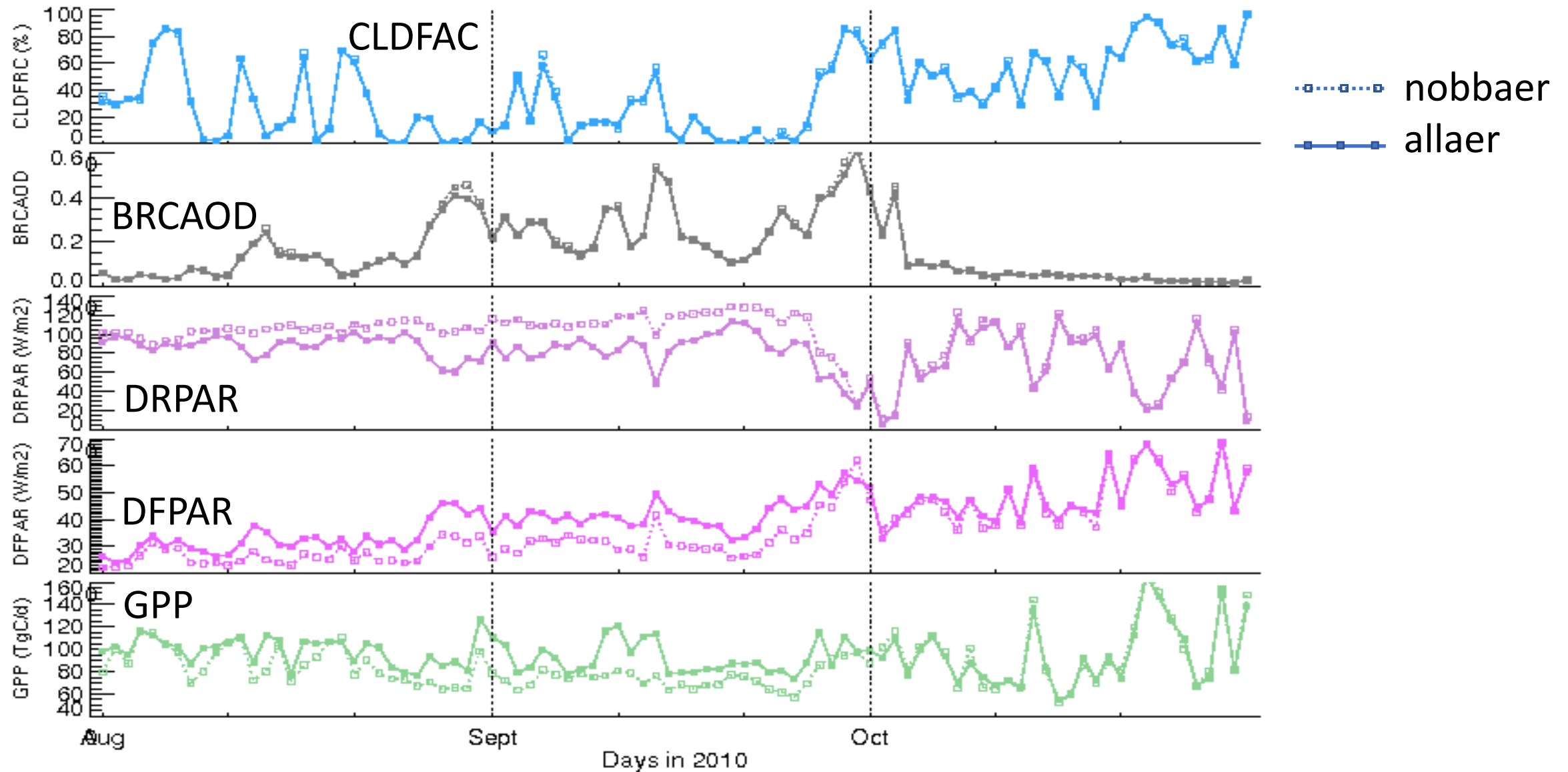
Every Aug-Sept over 2010-2016

Amazon (80W-30W, 25S-5N)



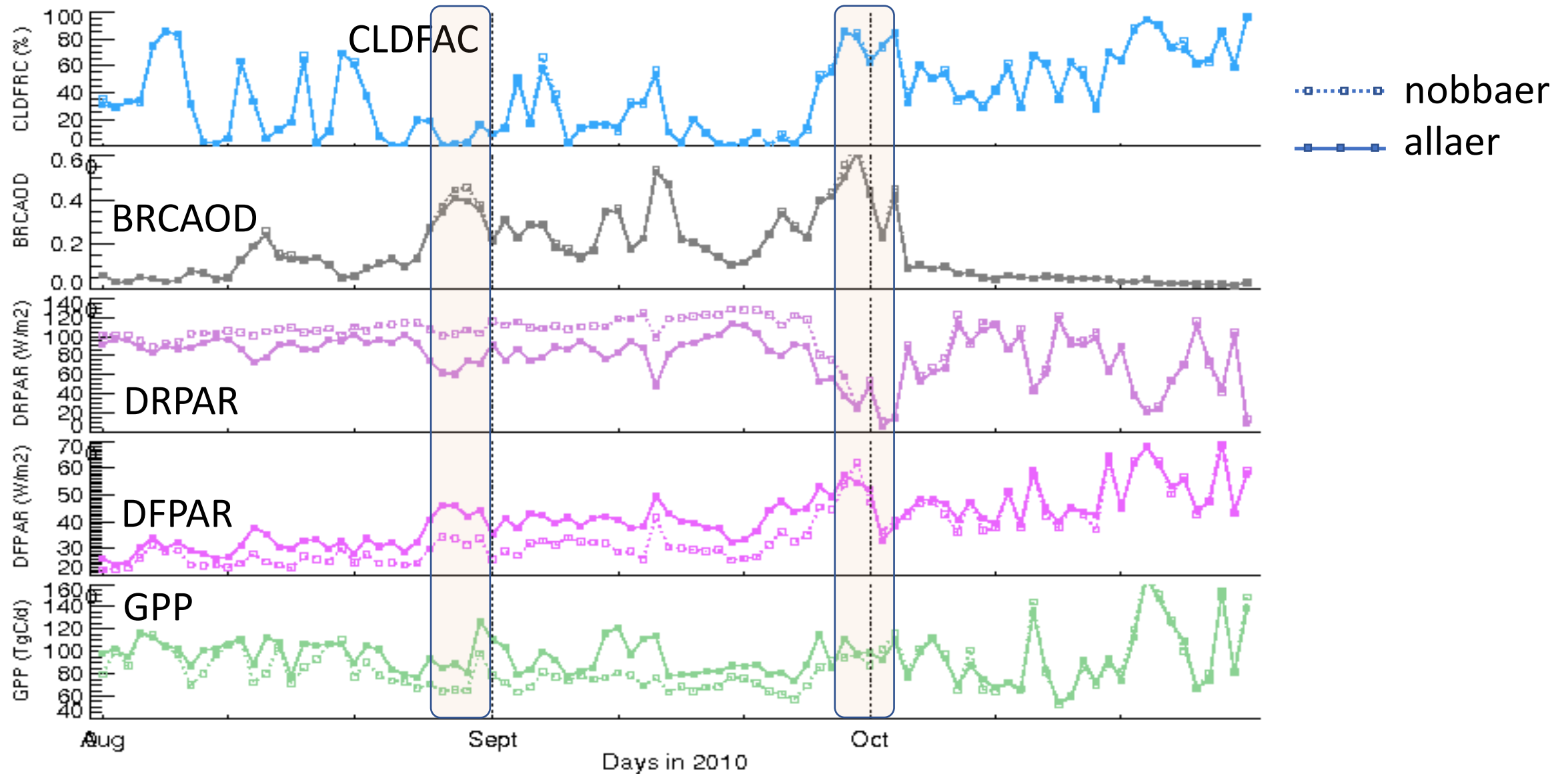
Objective 2: Cloud vs aerosol effect

At a selected site (54°W, 15°S) during Aug-Oct 2010

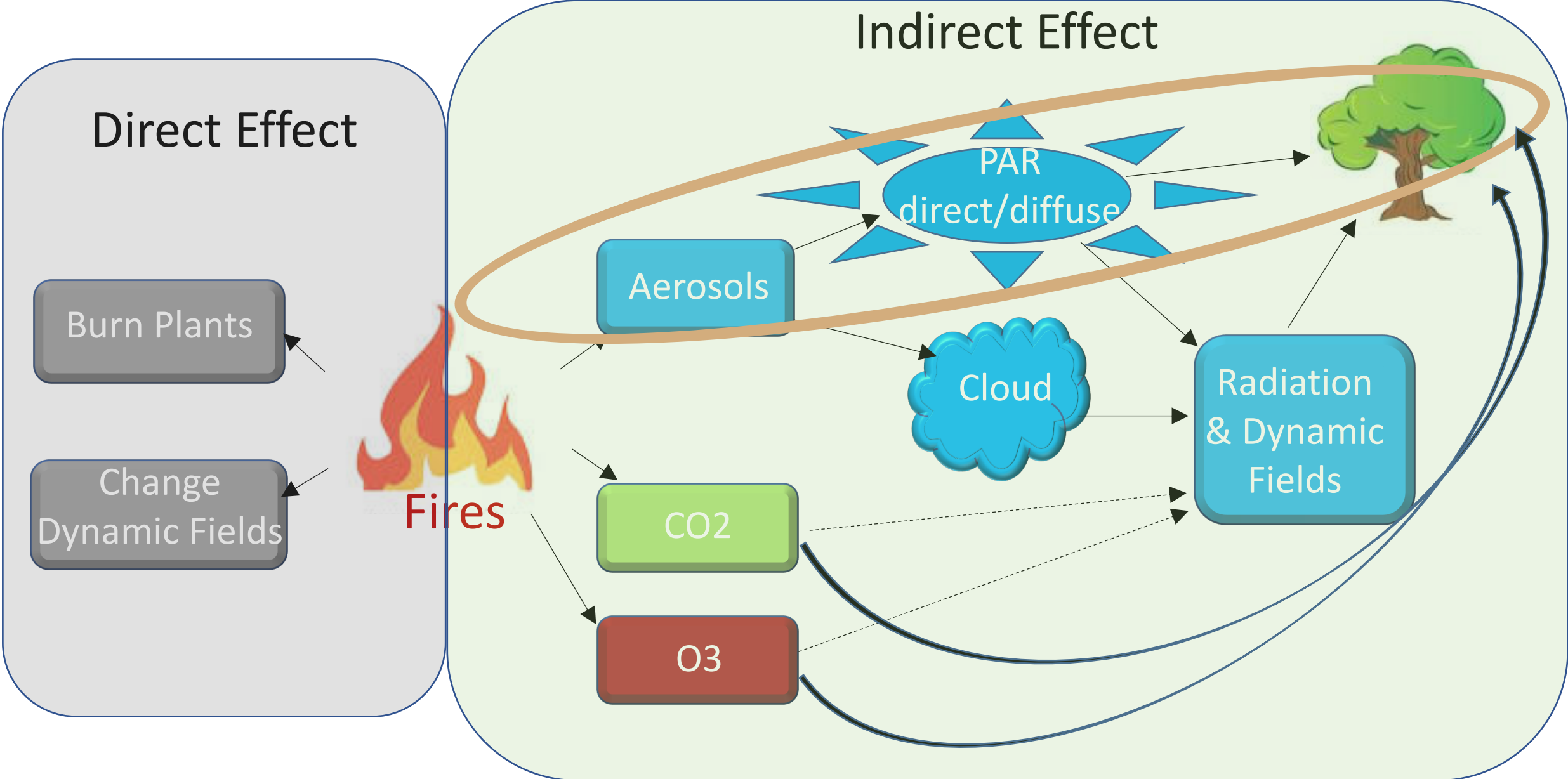


Objective 2: Cloud vs aerosol effect

At a selected site (54°W, 15°S) during Aug-Oct 2010



How fires impact plants



How fires impact plants: future study

