



Differentiated Disturbance Effects on Carbon Exchange of Forest Ecosystems

- *Estimated with LDNDC* -

29.09.2014

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Climate Change:

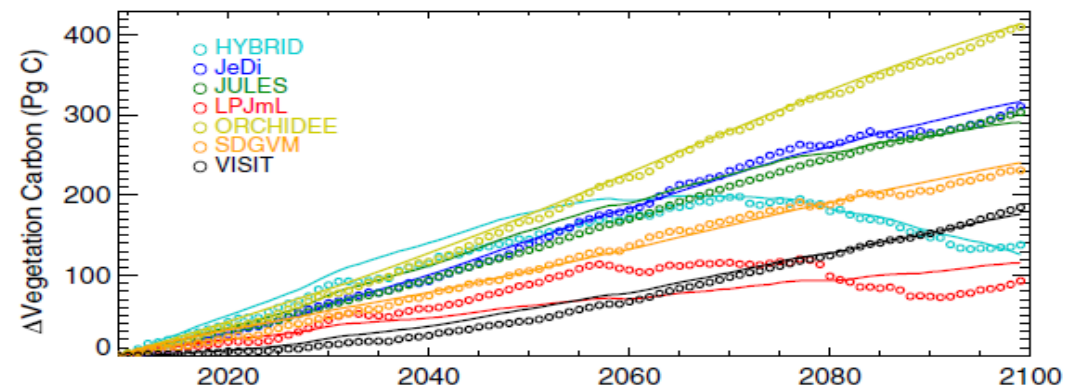
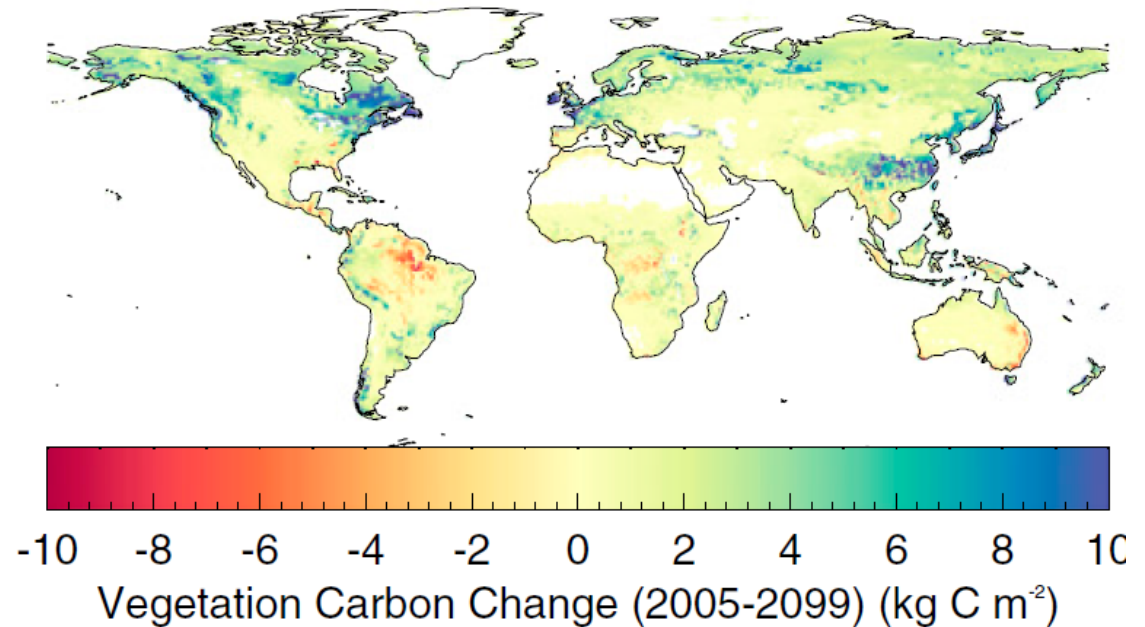
- Warming
- CO₂ increase

Indirect Changes

- Drought
- (Species composition)
- (Fire frequency)

→ Carbon balance

- Photosynthesis
- Respiration

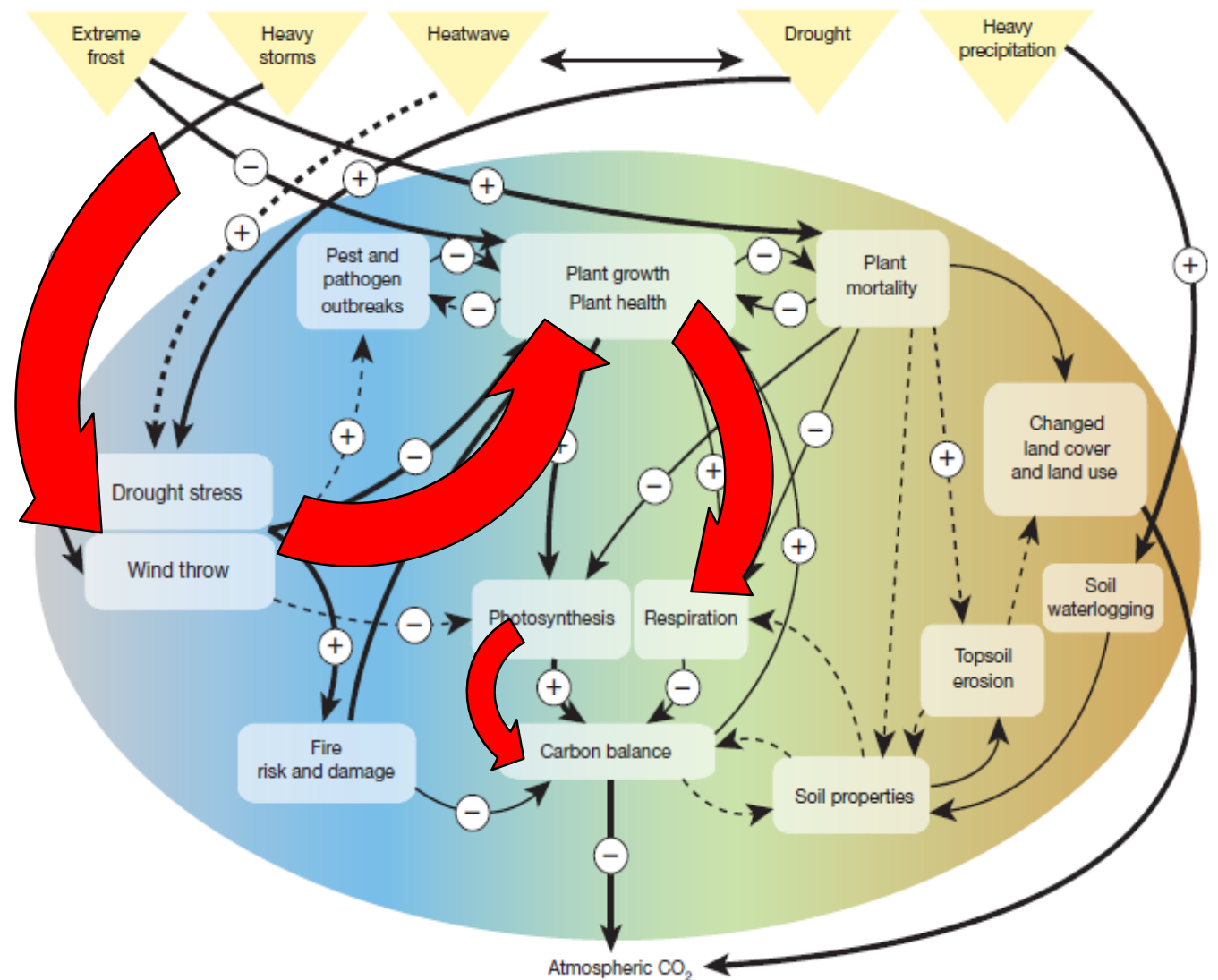


Friend et al. 2014 (PNAS)

Introduction

Other disturbances:
e.g. wind-throw

Impact on carbon
cycle not covered in
models!

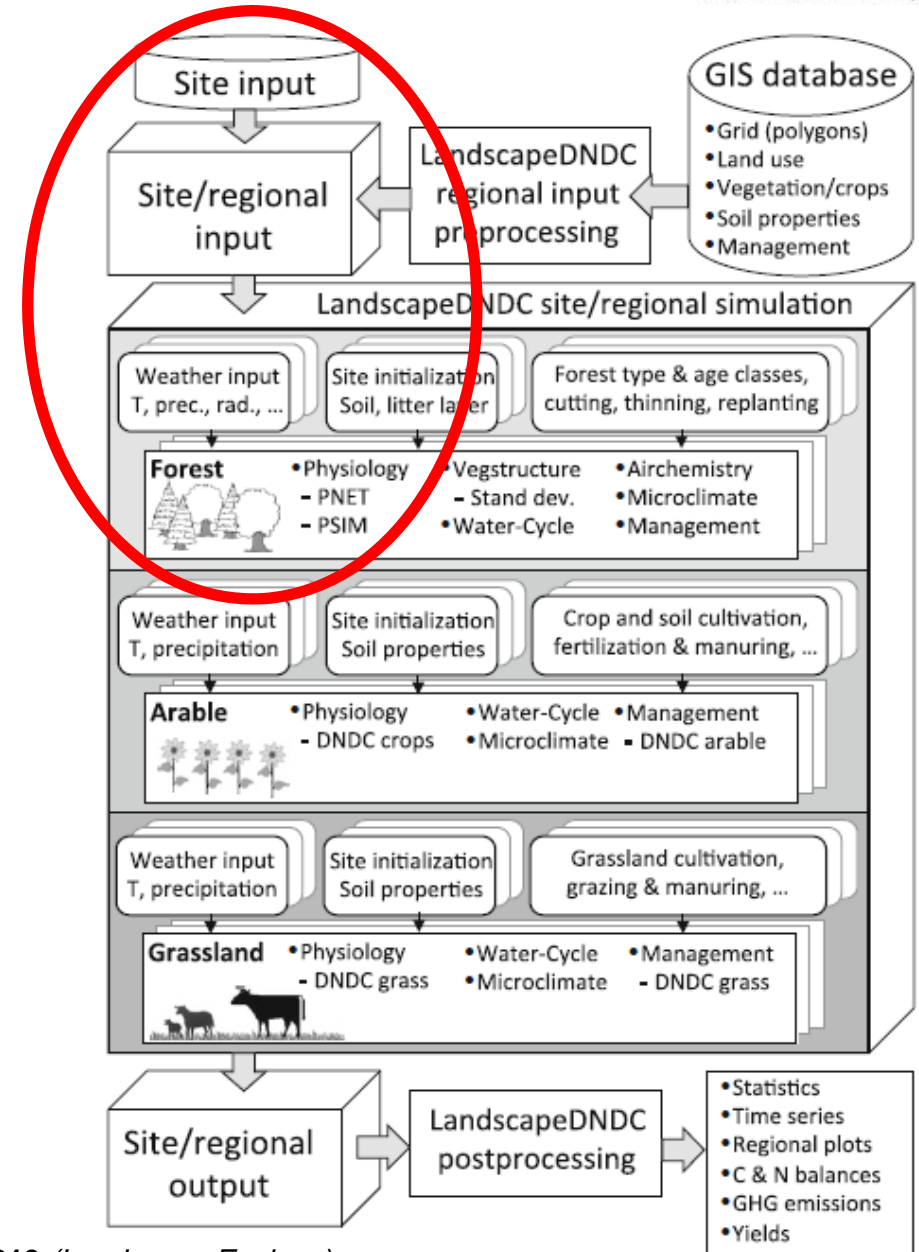


Reichstein et al. 2013 (*Nature*)

The Model

LandscapeDNDC

- Site mode
- Disturbance
- Daily weather input

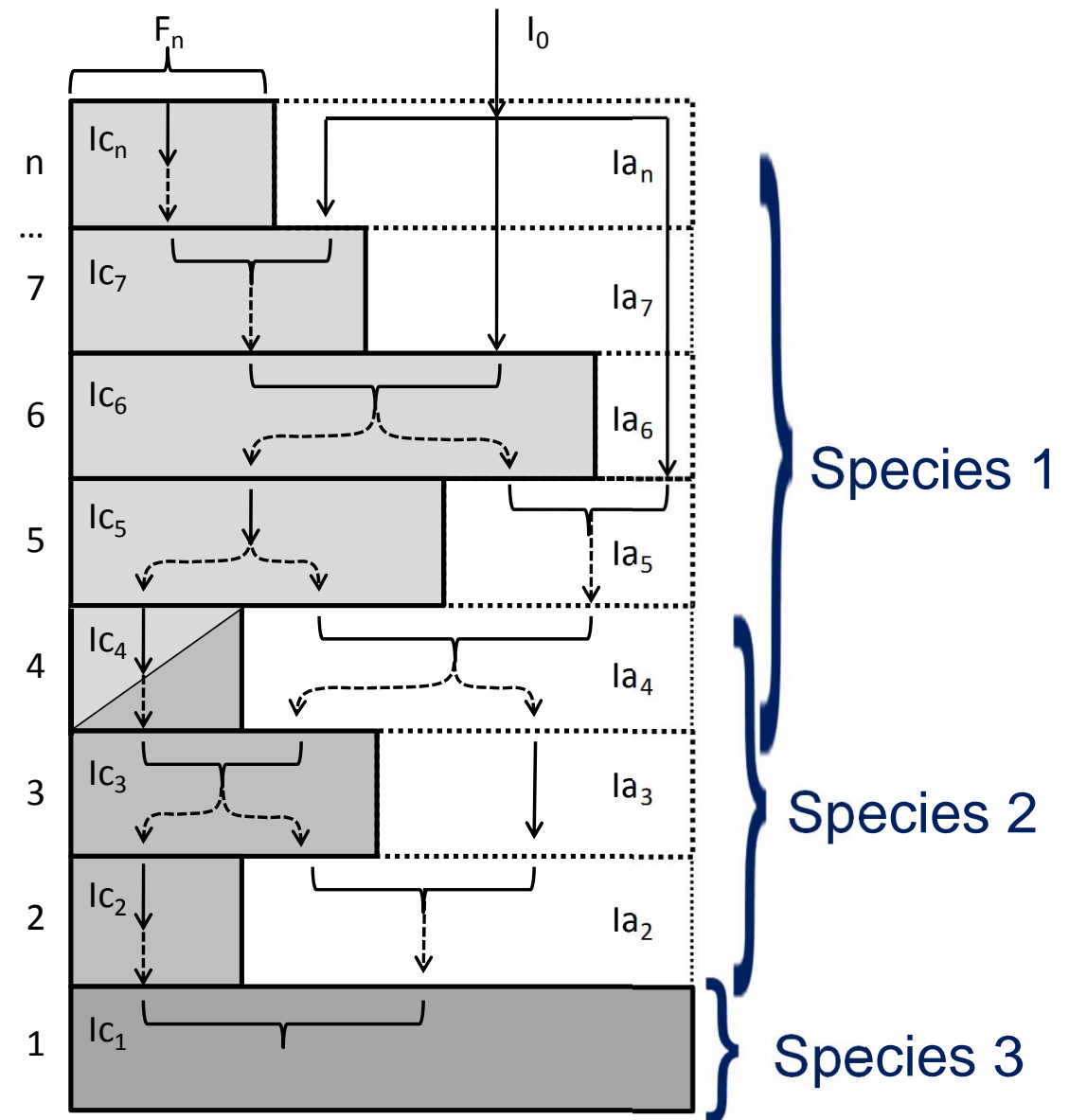


Haas et al. 2013 (*Landscape Ecology*)

The Model

PSIM (forest model)

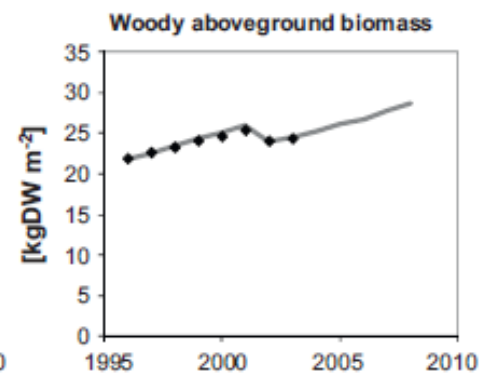
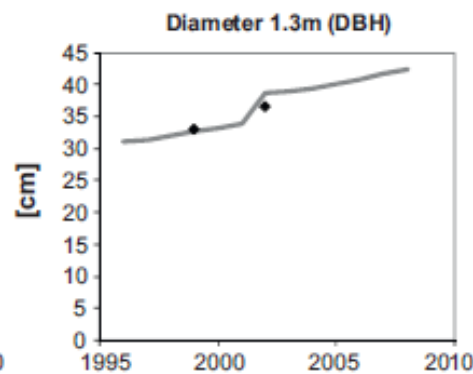
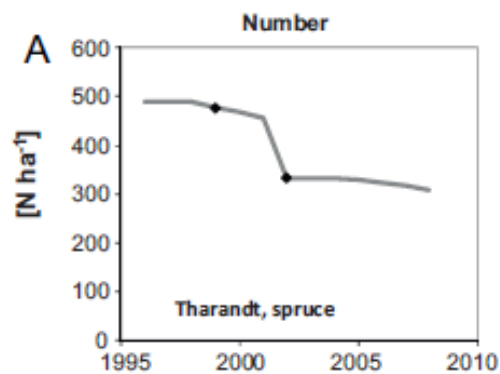
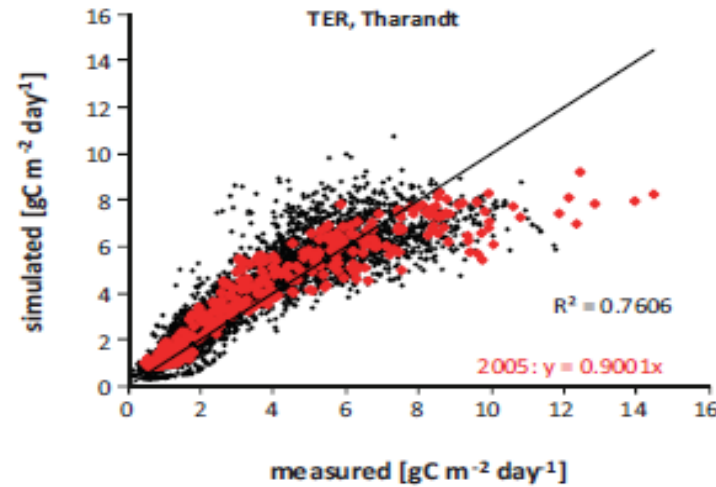
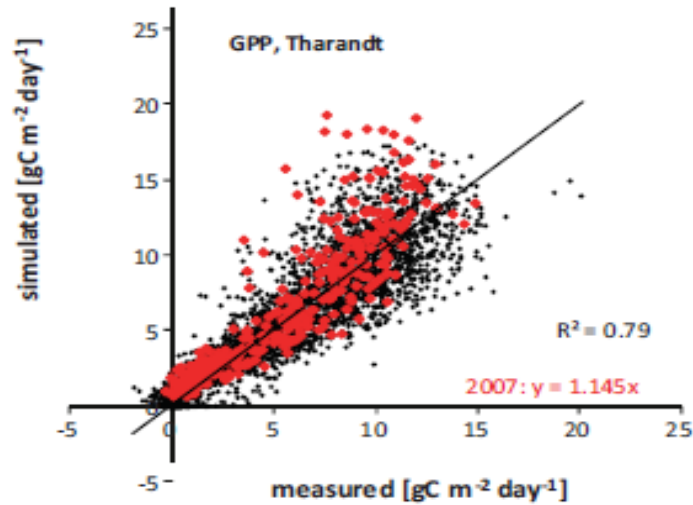
- 2D canopy (accounts for gaps!)
- Vertically layered (explicit species position)
- Each layer with separate pools, fluxes and properties



Grote et al. 2011 (*ForestSystems*)

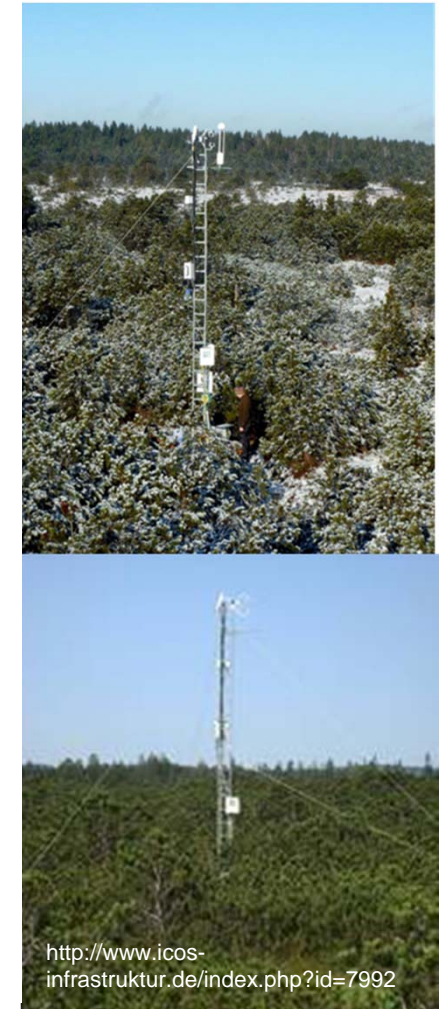
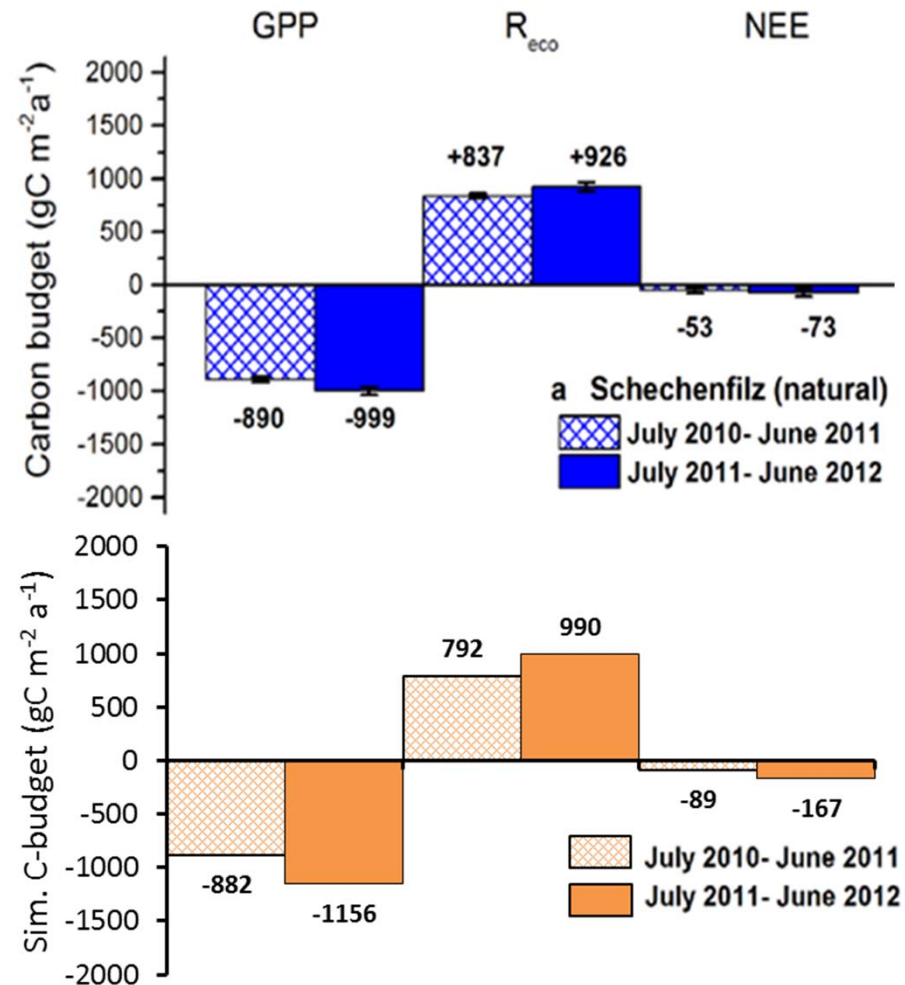
Evaluations

Tharandt: spruce, thinned (Fluxnet site)



Grote et al. 2011 (*Agricultural and Forest Meteorology*)

Schechenfilz:
open forest,
ground vegetation
(TERENO site)



Measurements from: Hommeltenberg et al. 2014 (*Biogeosciences*)

The case study

Lackenberg, Bavarian Forest wind-throw in Jan. 2007

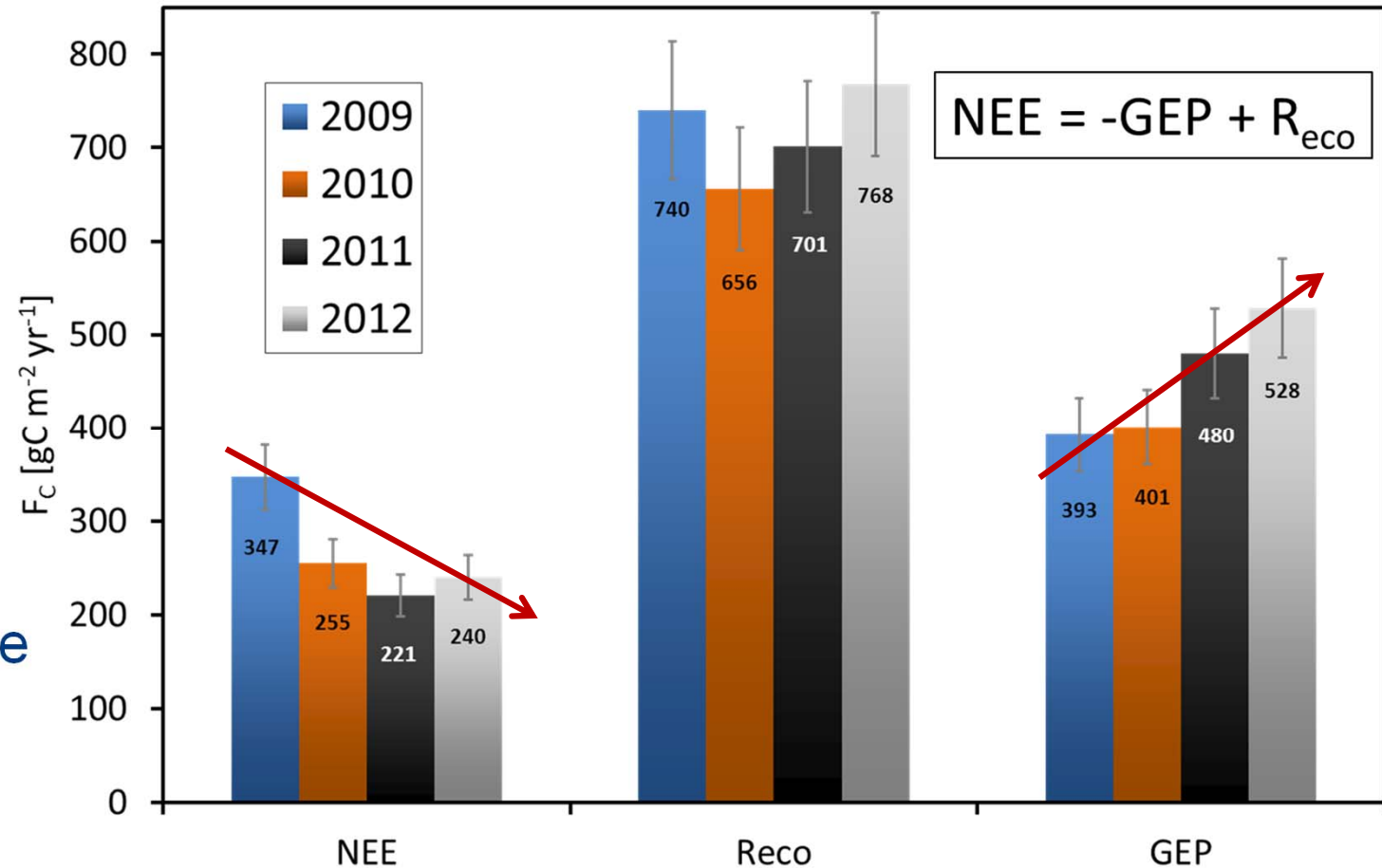
- Measurements since 2009
- Original forest initialization estimated
- After disturbance initialization from inventory



Measurements:

CO₂ exchange (start 2009):

- Increase in gross primary productivity (GPP)
- Decrease in net ecosystem exchange (NEE)



Lindauer et al. 2014 (*Agricultural and Forest Meteorology*)

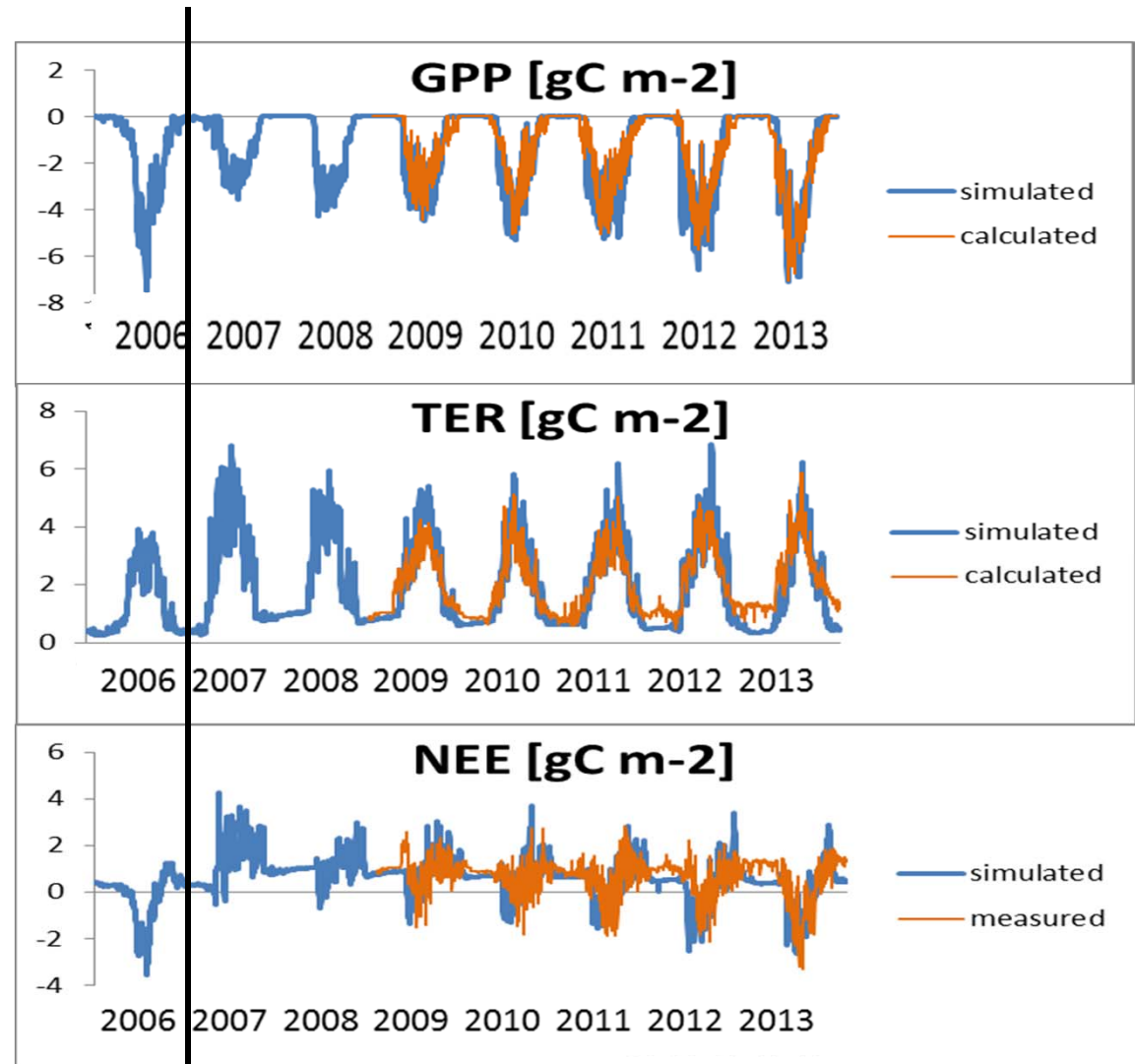
Results

Simulations:

CO₂ exchange
(start 2006):

- High correlations to fluxes (R² ~0.7)
- *Problems in winter*
- Wind-throw induced
 - decrease of GPP
 - Increase in TER
 - Net carbon release

Wind-throw



Lindauer et al. 2014 (*Agricultural and Forest Meteorology*)

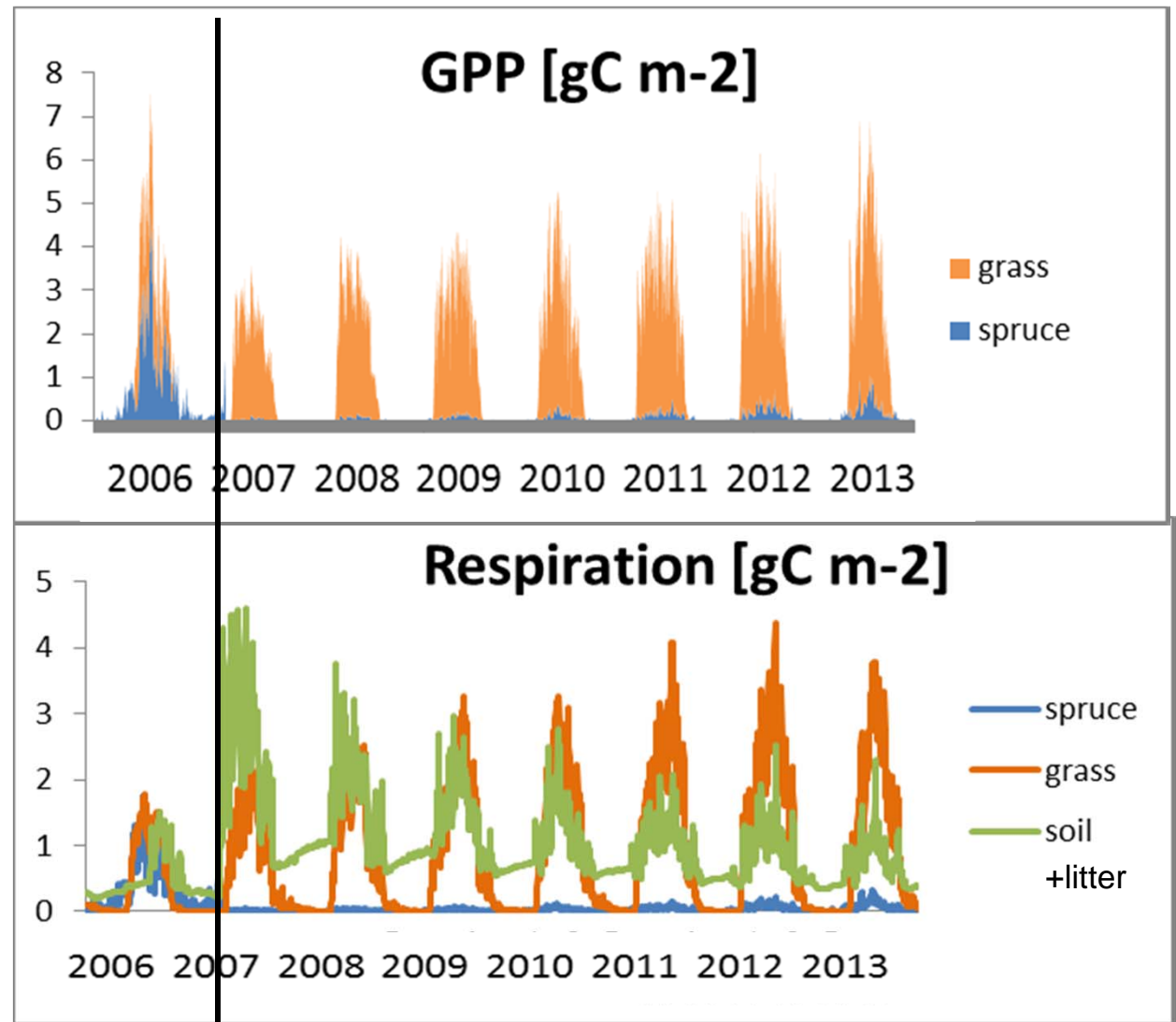
Results

Simulations:

CO₂ exchange
(start 2006):

- Higher grass contribution (decreasing)
- Higher soil respiration (decreasing)

Wind-throw



Lindauer et al. 2014 (*Agricultural and Forest Meteorology*)

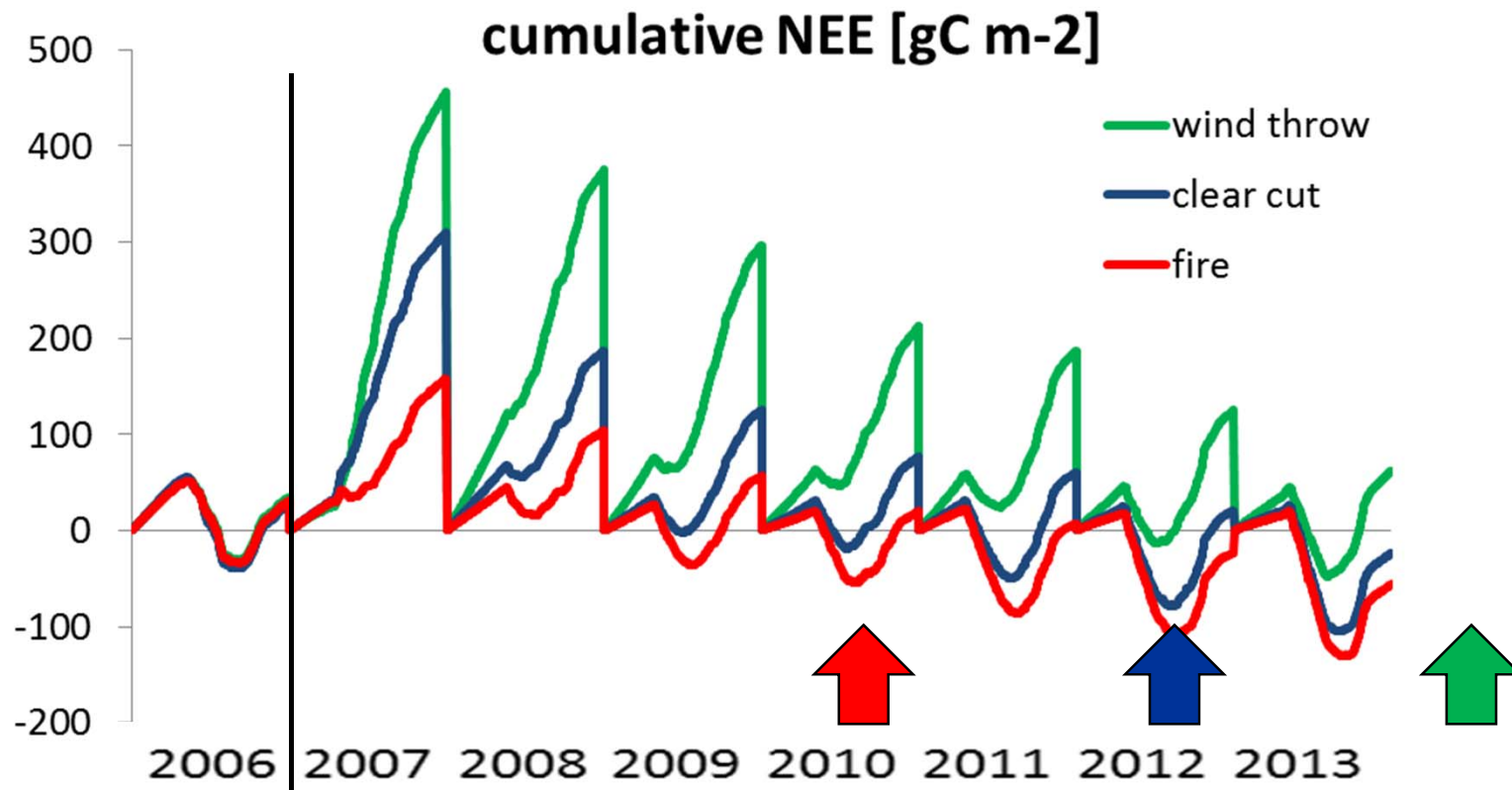
Uncertainties

- Species composition ('grass')
- Deadwood decomposition
- Microclimate



Disturbance Simulation

	dead	exported
• Wind-throw:	all trees	none
• Clear cut:	all trees	stem wood
• Fire (severe):	all trees	aboveground



Take home

- Disturbances are important to consider in long-term carbon balance
- Different disturbances have different impacts to long-term carbon balance

Werner et al. 2013 (*GCB-Bioenergy*)

Thank you for your attention



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