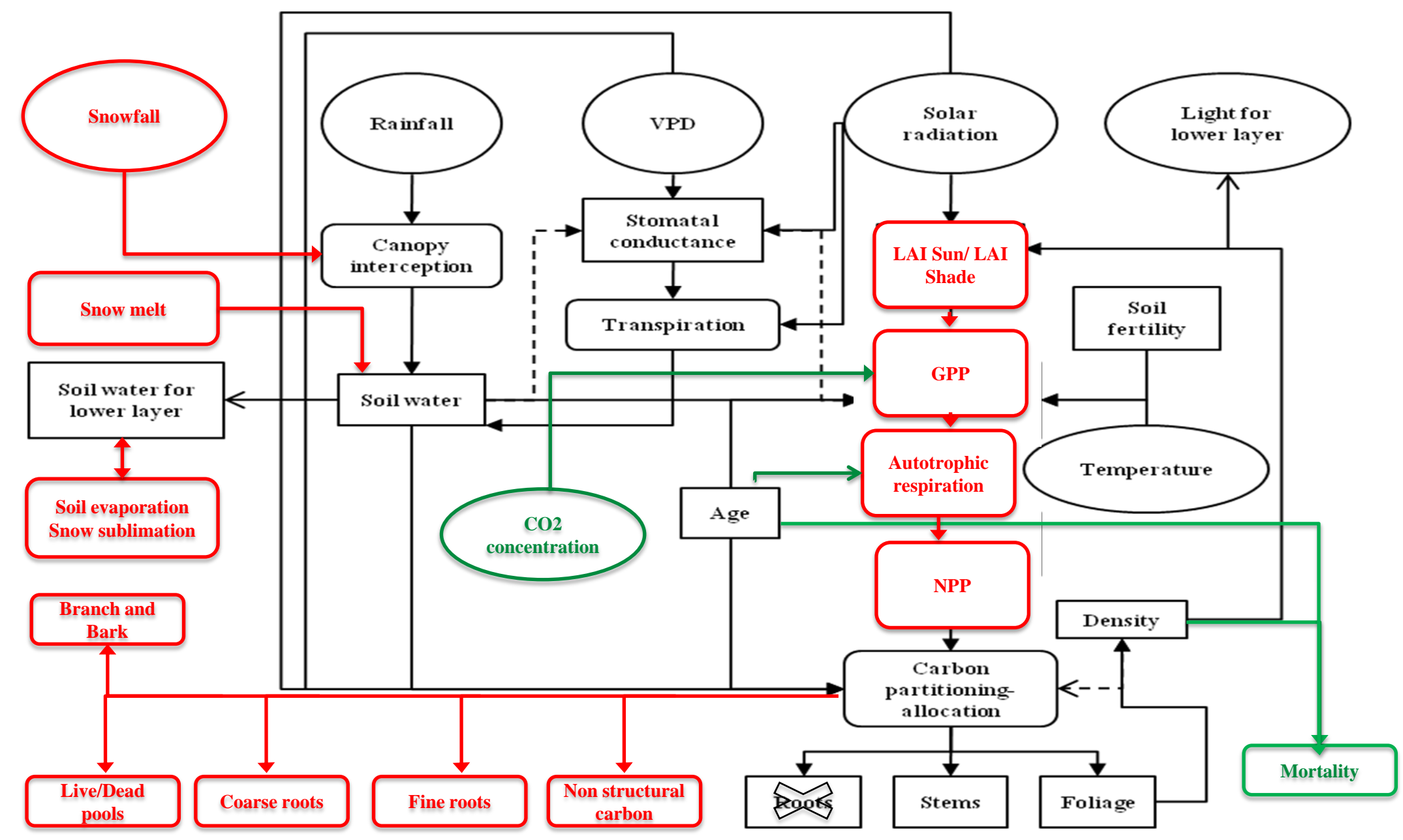


Combined climate and management effects in future forests: preliminary results from ISIMIP experiments for Sorø with 3D-CMCC-FEM

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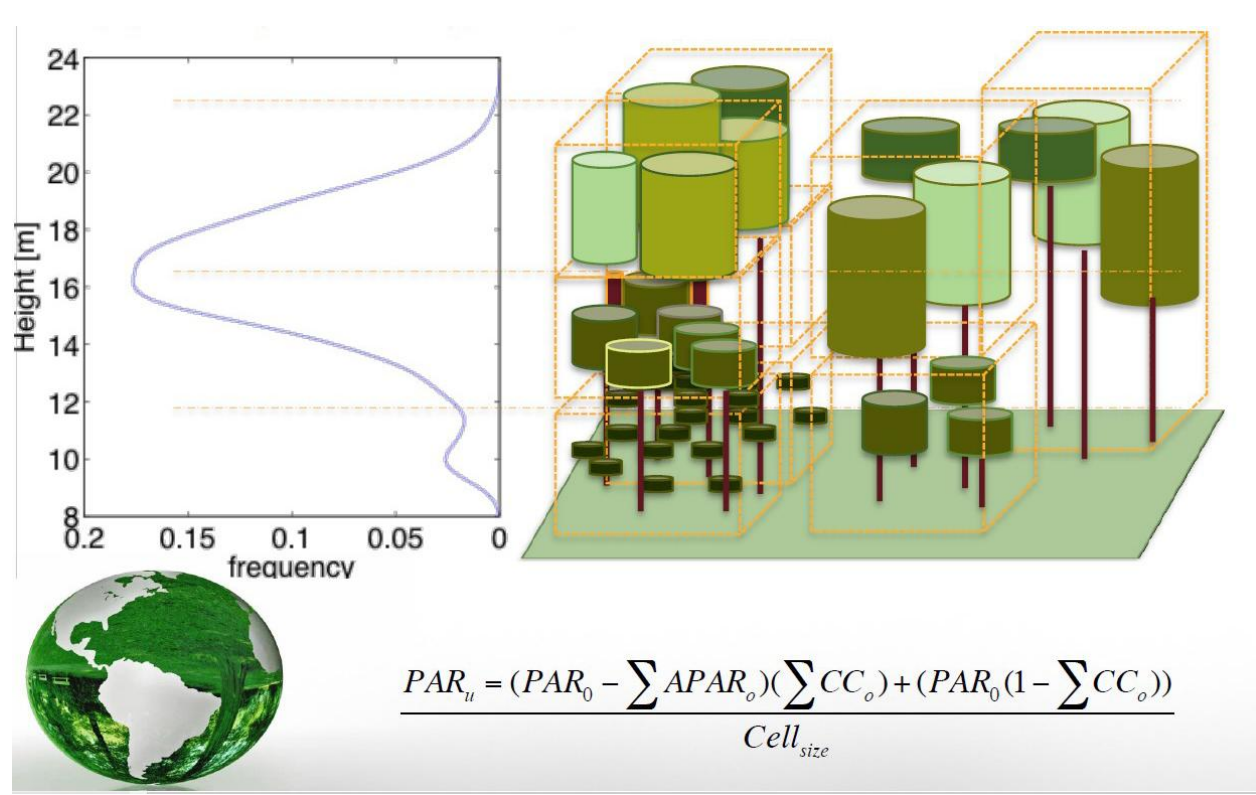


3 Dimensional CMCC Forest Ecosystem Model (3D-CMCC FEM)

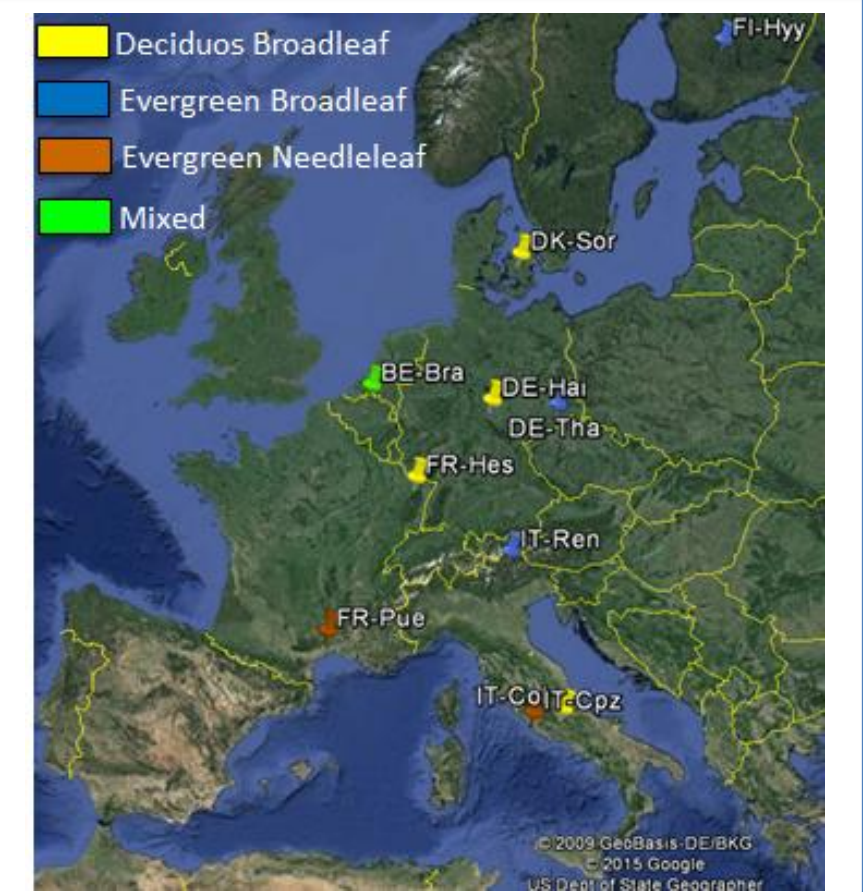
- process-oriented forest ecosystem model
- Spatial Resolution: variable from 1km² to 100 m²
- Temporal resolution: daily, monthly, annual
 - Multi layer approach
 - Multi age approach
 - Multi species approach
 - LUE family models
- Parameterized for different species
- Outputs: e.g. GPP, NPP, Latent Heat, DBH, ...

3D-CMCC-FEM main flow chart (v.4.0 Collalti et al. 2014)(v.5.1 Collalti et al., 2016)(v.5.2.2 Collalti et al., in prep)

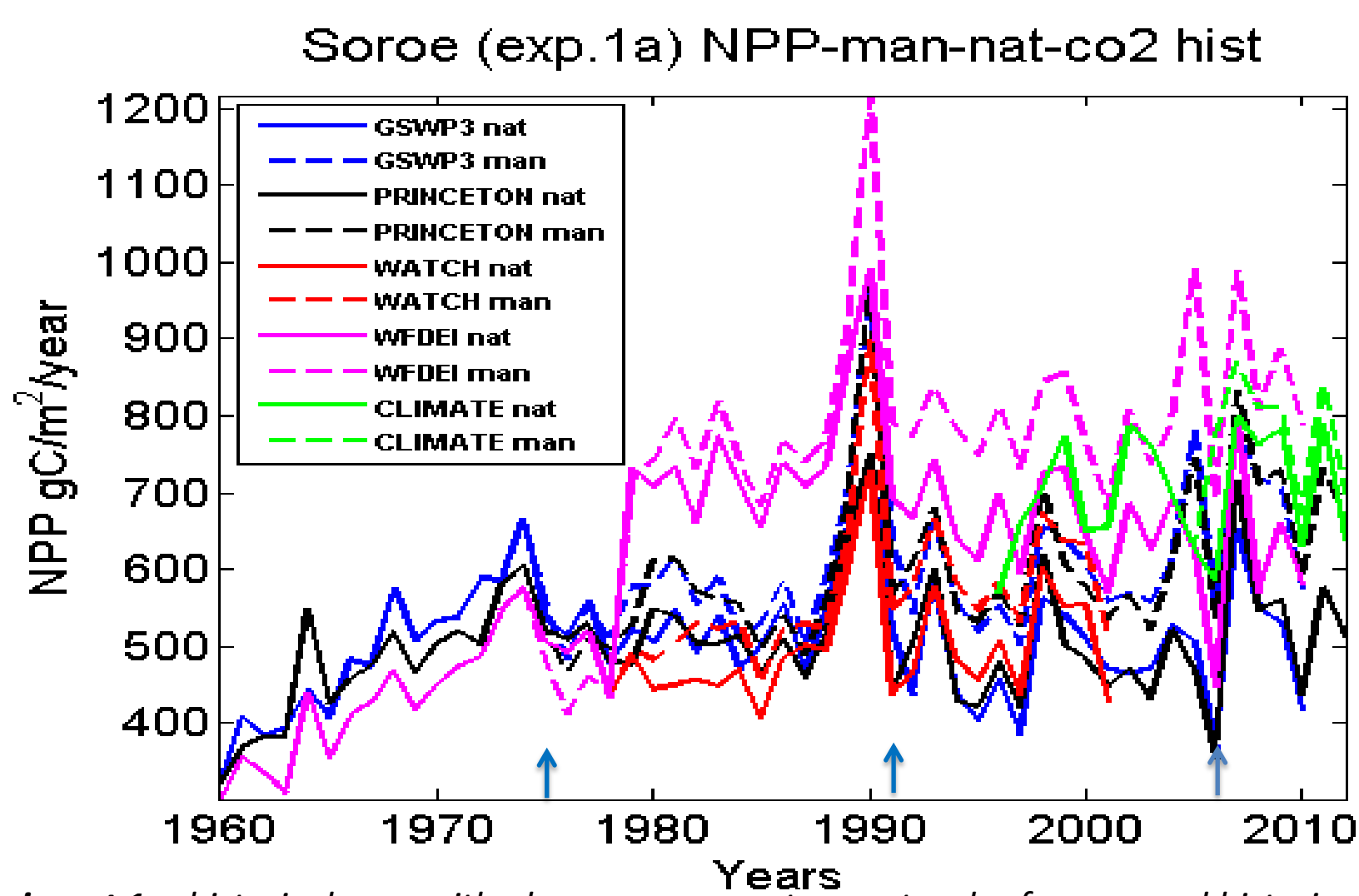
Improvements in 3D-CMCC-FEM v.5.2.2 (jointly with CNR and UNITUS)



- New forest structure scheme with no limitation of canopy layers
 - New phenology and radiation/interception scheme
 - Totally diagnostic autotrophic respiration
 - New CO₂ fertilization effect
 - Improved hydrological scheme
- 3 types of mortality: growth efficiency, age-dependant, self-thinning
- 12 structural C-N biomass pools, 1 non-structural C-N biomass pool
- Management: thinning, harvesting and replanting



Preliminary results from the ISIMIP experiments 1a-2a for the Sorø site (Id:21 - Denmark)



Experiment 1a: historical runs with obs. management vs. natural reference and historical co₂

Stand initialization:

• Stand and soil data (provided by PROFOUND Database)

Management settings (experiments 1a 2a):

• Obs. management+Business As Usual (after obs. stop)(**man**)
e.g. Sorø: Obs. management: 1960^T, 1975^T, 1990^T, 2005^T.
BAU: 2020^T, 2035^T, 2050^T, 2061^H, 2062^P, 2077^T, 2092^T.
• Natural reference without management (**nat**)

CO₂ concentration (experiments 1a 2a):

• Historical CO₂+ fixed CO₂ from 2000 onwards (**noco2**)
• Historical CO₂ + CO₂ RCP 2.6, 4.5, 6.0, 8.5 (**co2**)

Climate forcing (experiments 1a 2a)

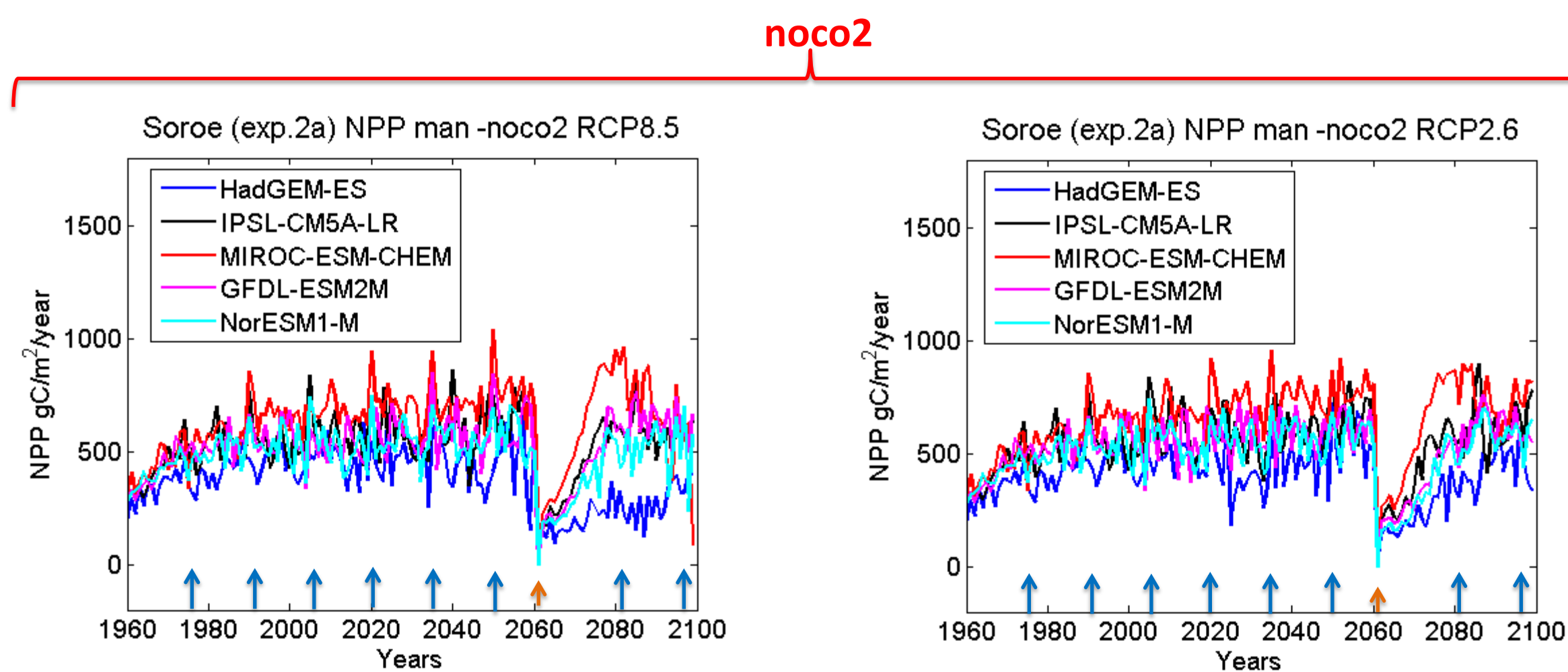
(provided by PROFOUND Database)

Historical runs (experiment 1a hist):

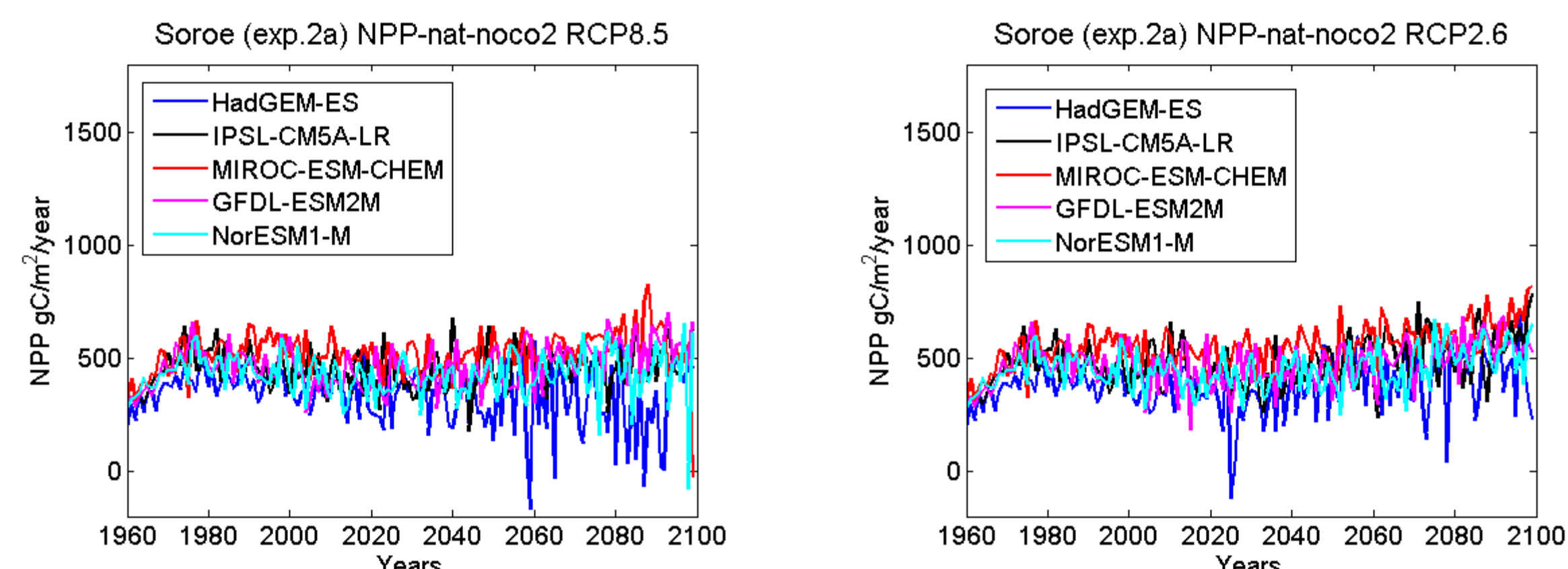
• Observations from local met. Stations
• PGMFD (PRINCETON) v.2
• GSWP3
• WATCH (WFD)
• WATCH+WFDEI

Future runs (experiment 2a hist+scenario):

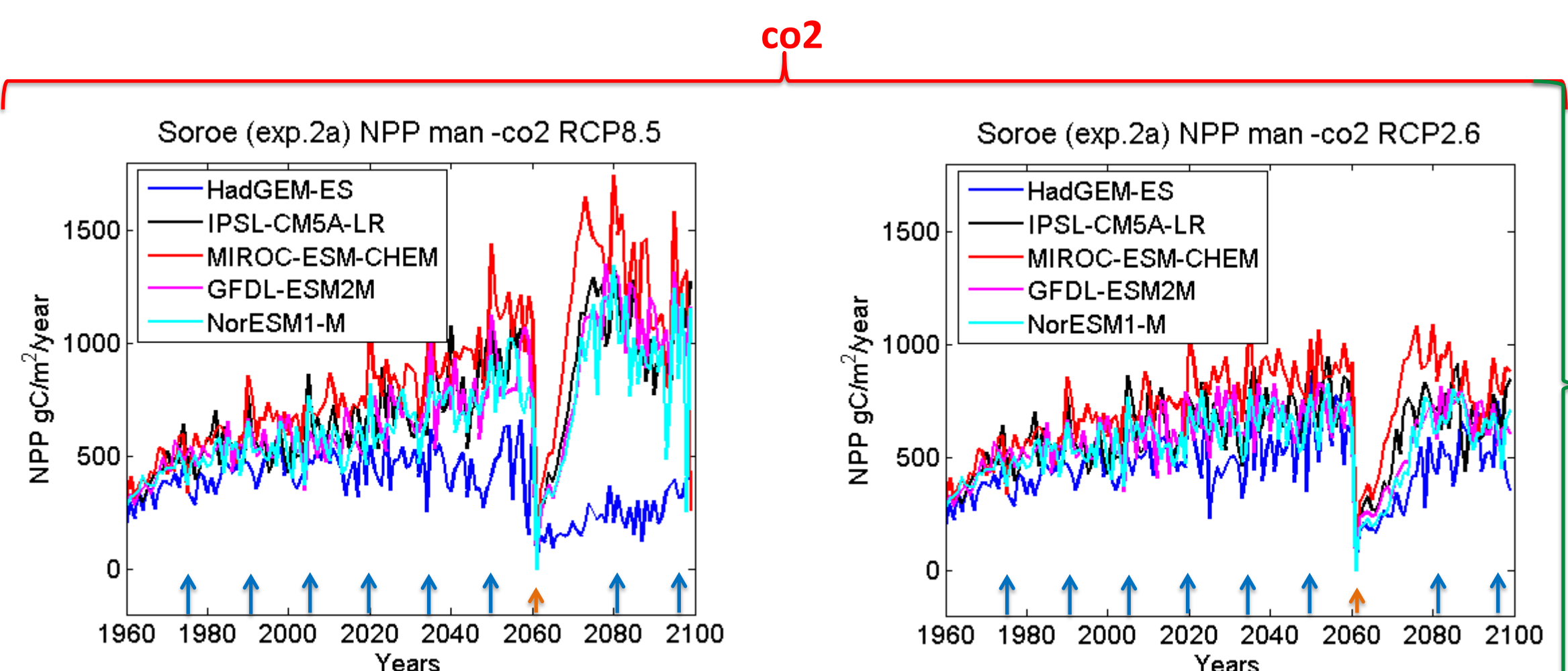
• HadGEM2-ES (hist to 2005 + RCP: 2.6, 4.5, 6.0, 8.5)
• IPSL-CM5A-LR (hist to 2005 + RCP: 2.6, 4.5, 6.0, 8.5)
• MIROC-ESM-CHEM (hist to 2005 + RCP: 2.6, 4.5, 6.0, 8.5)
• GFDL-ESM2M (hist to 2005 + RCP: 2.6, 4.5, 6.0, 8.5)
• NorESM1-M (hist to 2005 + RCP: 2.6, 4.5, 6.0, 8.5)



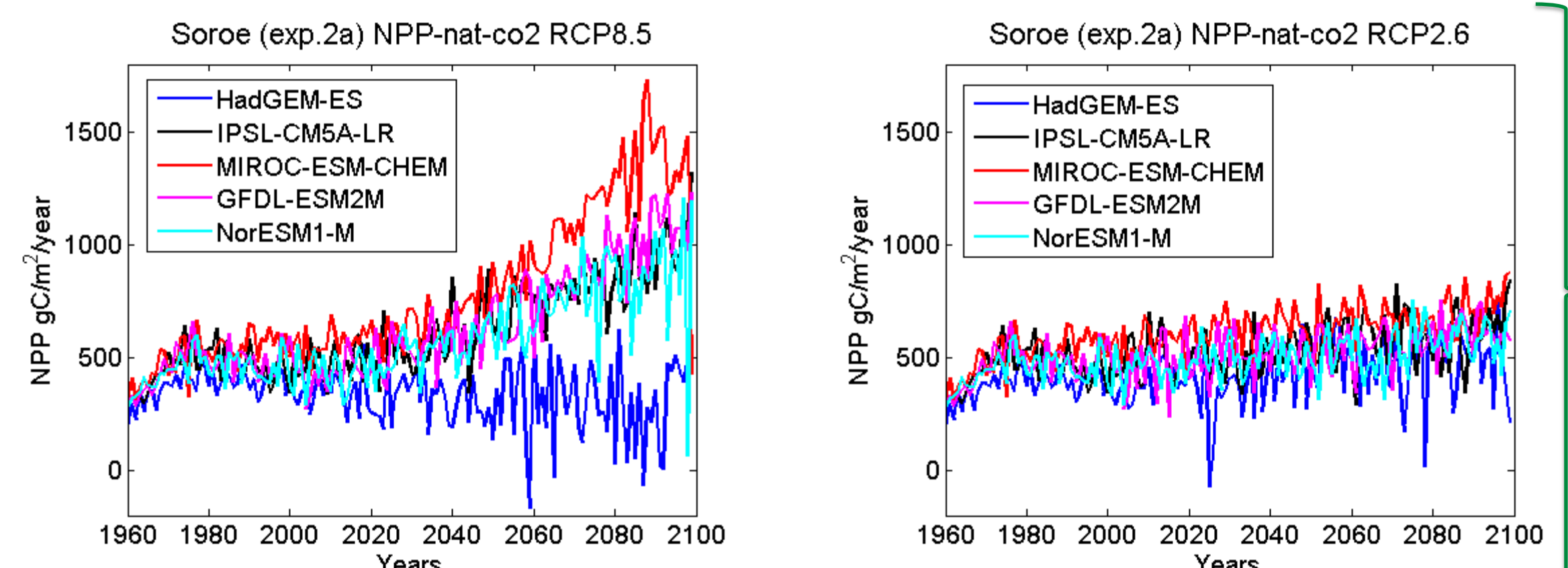
Experiment 2a: historical runs + GCMx RCP 8.5 vs. 2.6, Obs. management + BAU and historical co₂ + fixed from 2000 onwards vs. historical co₂ + RCP 8.5 vs. 2.6



Experiment 2a: historical runs + GCMx RCP 8.5 vs. 2.6, natural references and historical co₂ + fixed from 2000 onwards vs. historical co₂ + RCP 8.5 vs. 2.6



Obs. management + BAU (man)



Natural references (nat)

• Collalti A., Perugini L., Santini M., Chiti T., Nolè A., Matteucci G., Valentini R. "A process-based model to simulate growth in forests with complex structure: Evaluation and use of 3D-CMCC Forest Ecosystem Model in a deciduous forest in Central Italy". *Ecological Modelling*, 272, 362–378, 2014
• Collalti A., Marconi S., Ibrom A., Trotta C., Anav A., D'Andrea E., Matteucci G., Montagnani L., Gielen B., Mammarella I., Grünwald T., Knohl, A. Valentini R., Santini M. "Validation of 3D-CMCC Forest Ecosystem Model (v.5.1) against eddy covariance data for ten European forest sites", *Geoscientific Model Development*, 9, 1-26, 2016