Uncertainty in simulating biomass yield and carbon-water fluxes from Euro-Mediterranean grasslands under climate changes

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International Livestock modelling and Research Colloquium

Grassland model inter-comparison in MACSUR

- ✓ Questionnaires to modelling teams
- ✓ Guidelines and minimum dataset requirement for model evaluation
- ✓ Common protocol for model inter-comparison
- ✓ Model inter-comparison at selected sites in Europe (plot-scale simulations)

Coordinator

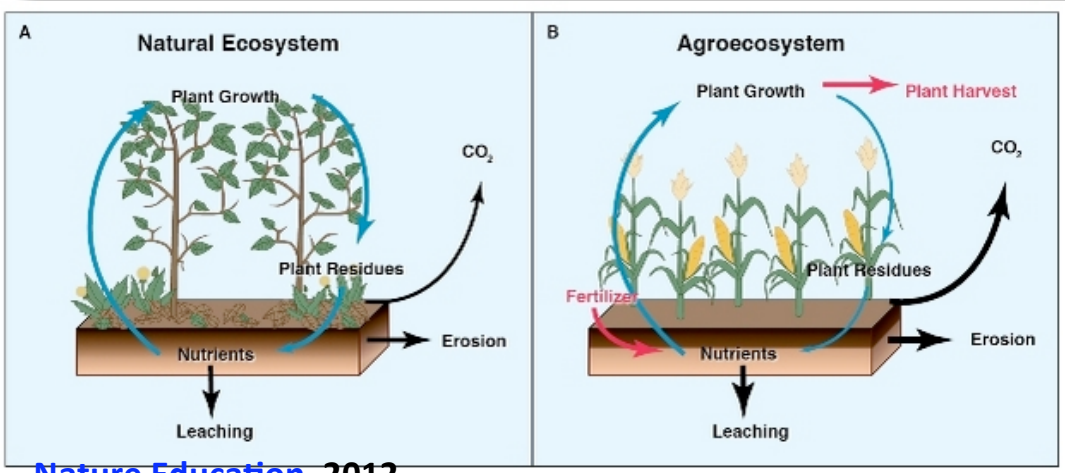
- •data segregation
- •output evaluation
- •uncertainty analysis

Aims:

→ To quantify uncertainties on yield an d carbon-flux outputs

→ To explore the sensitivity of grassland models to climate change factors

Systemic approach



Nature Education, 2012

+ Management

⇩

⇨ **Modelling**

Parameters

Input variables

Initial values

Grassland-specific	Crop models (adapted to grasslands)	Biome models
PaSim	STICS	Biome-BGC MuSo
SPACSYS	EPIC	LPJmL
AnnuGrow	ARMOSA	CARAIB

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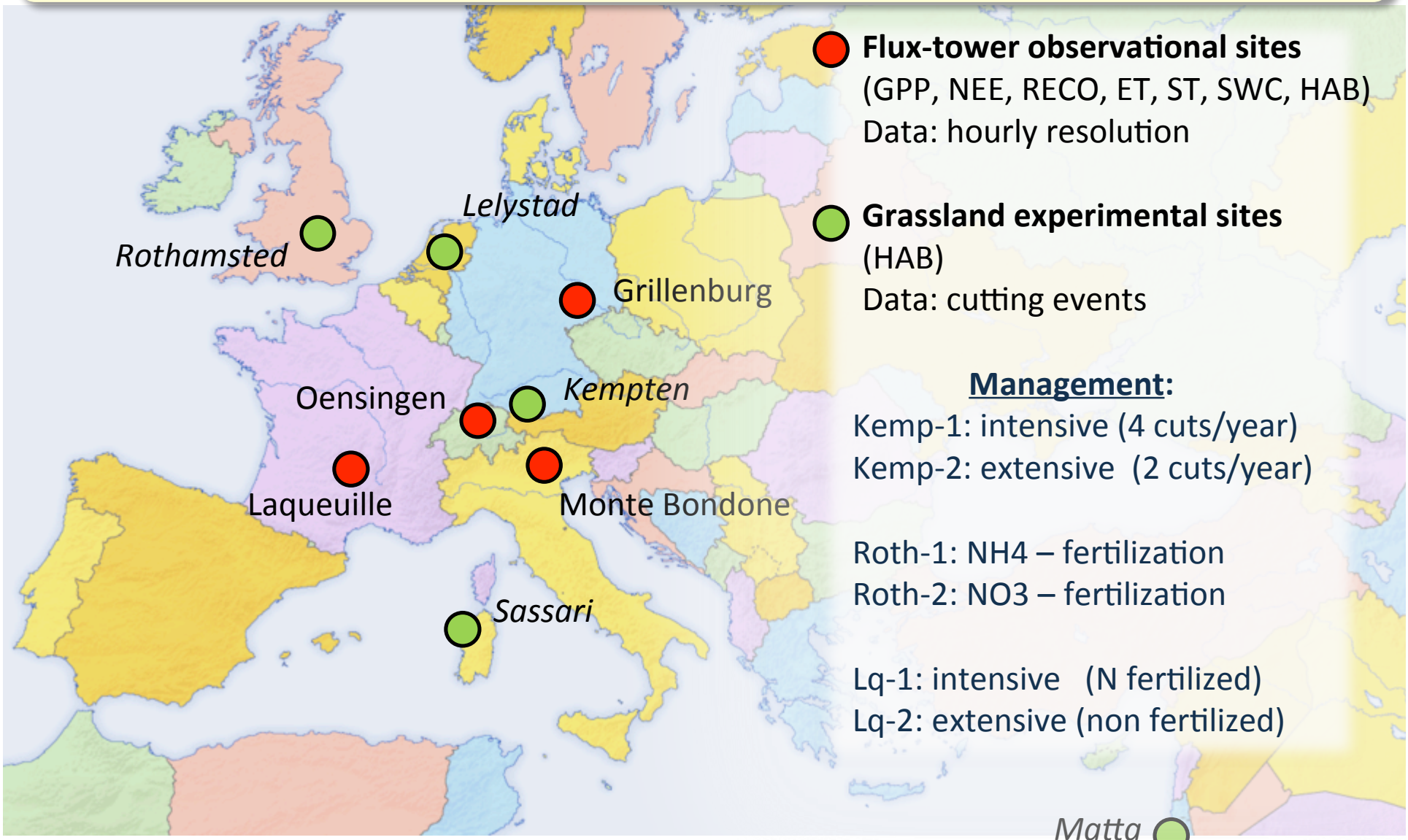
Outputs
(HAB, GPP, NEE …)

Investigated sites



Flux-tower observational sites
(GPP, NEE, RECO, ET, ST, SWC, HAB)
Data: hourly resolution

Grassland experimental sites
(HAB)
Data: cutting events

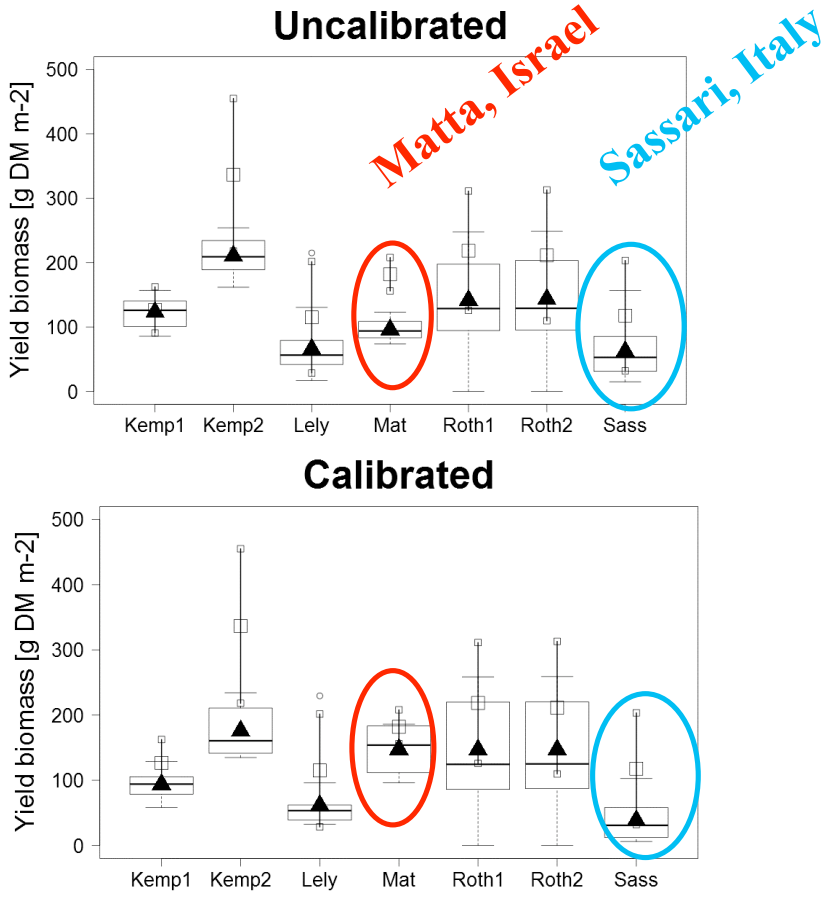
Management:
Kemp-1: intensive (4 cuts/year)
Kemp-2: extensive (2 cuts/year)

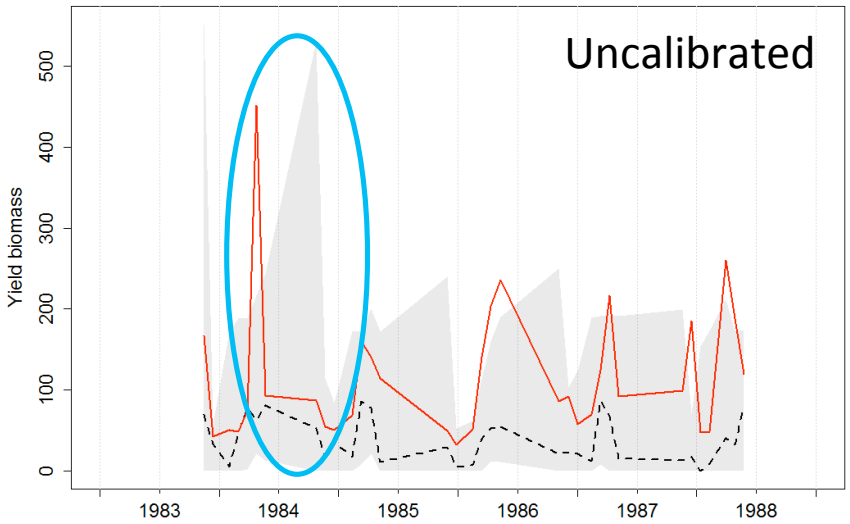
Roth-1: NH4 – fertilization
Roth-2: NO3 – fertilization

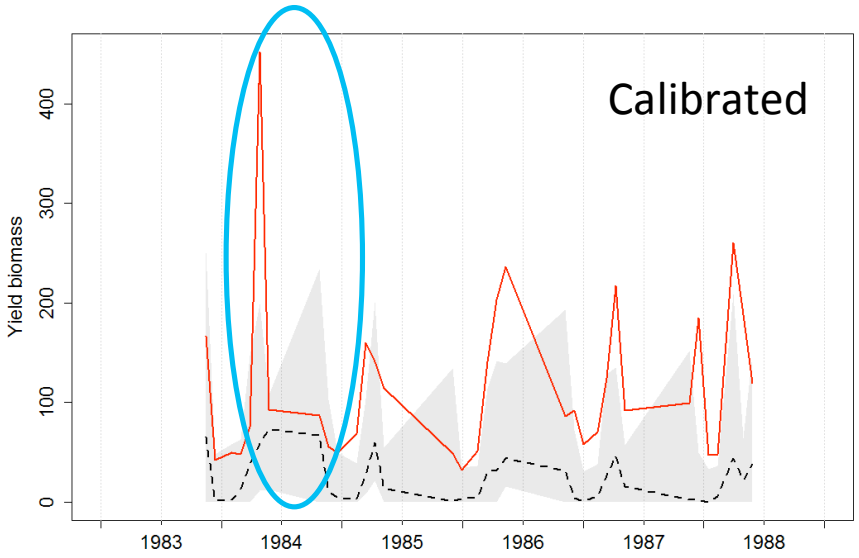
Lq-1: intensive (N fertilized)
Lq-2: extensive (non fertilized)

UNCALIBRATED vs CALIBRATED runs

(HAB, g DM m^{-2})







Uncertainty of the simulated yield from all models at Sassari site

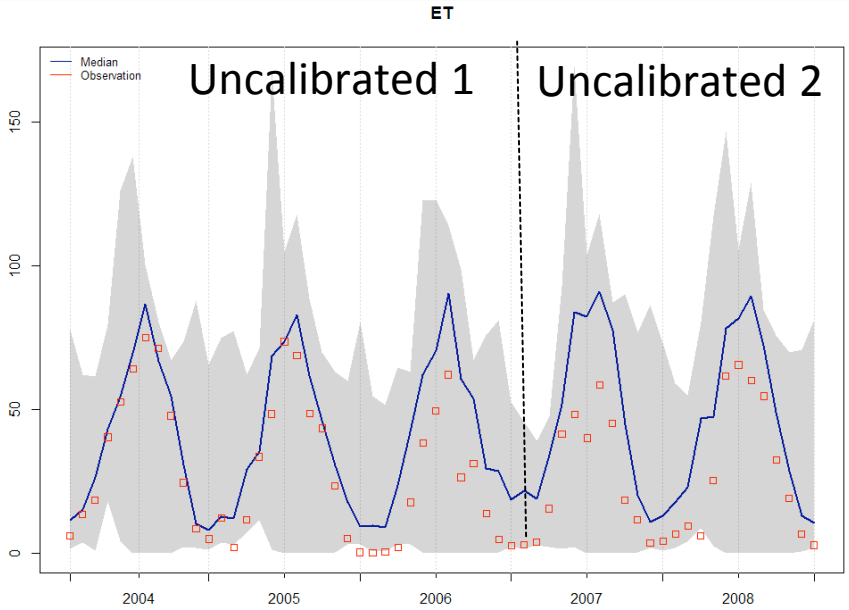
envelope of simulated HAB

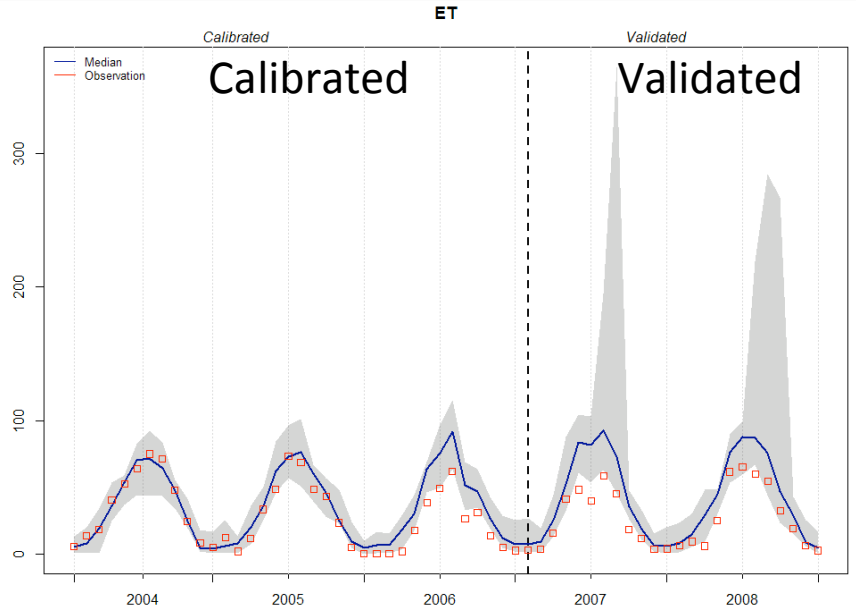
-------- observed data

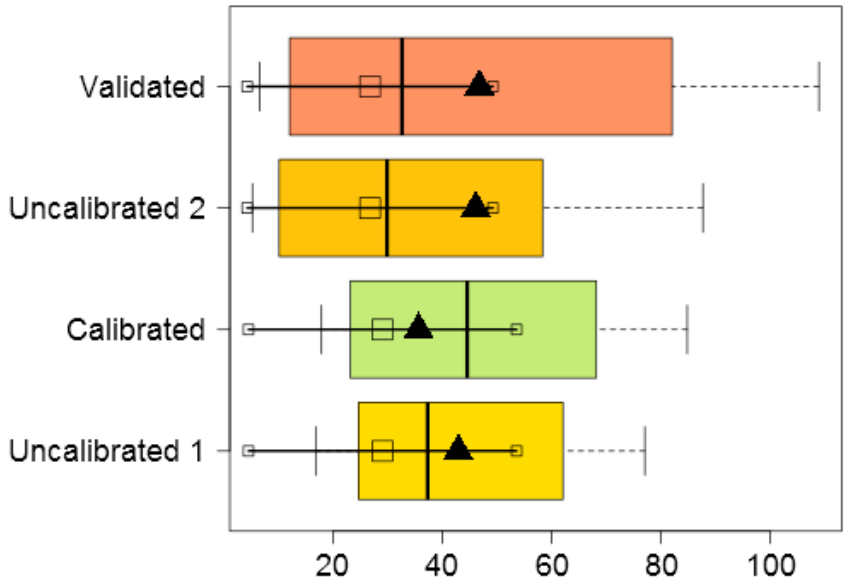
- - - - - median of all models

UNCALIBRATED, CALIBRATED, VALIDATED

Actual Evapotranspiration with monthly resolution at Grillenburg (Germany)

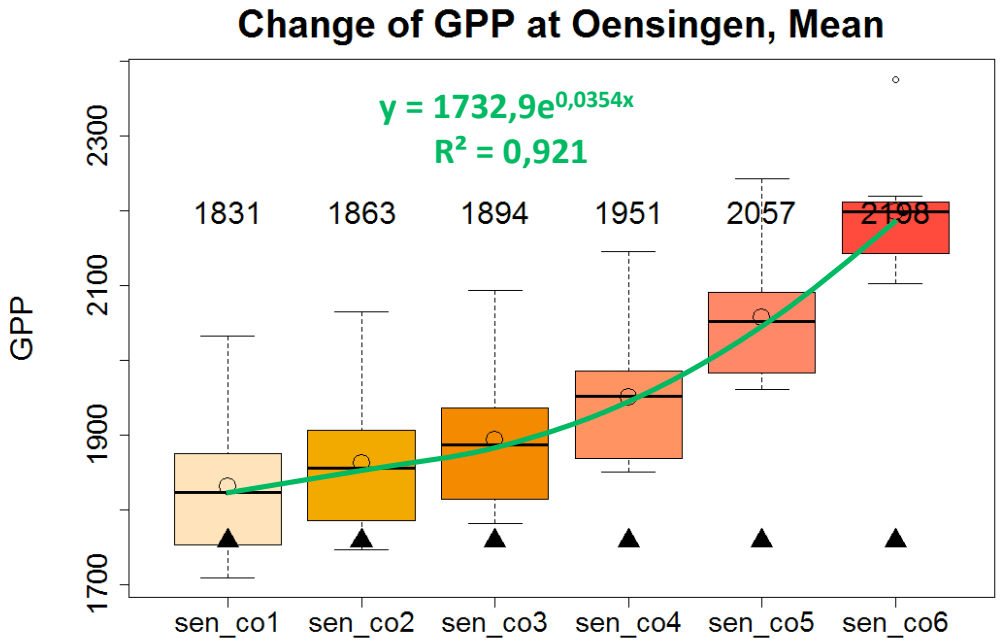


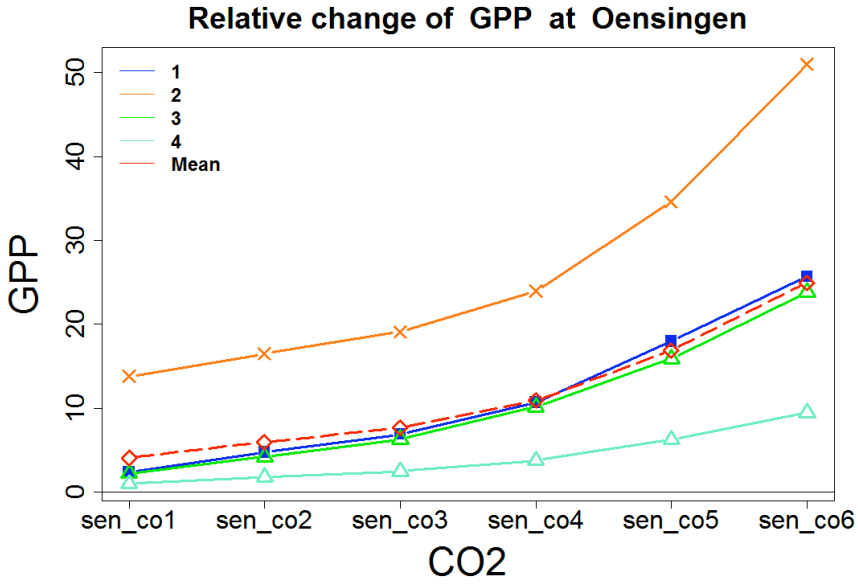




SENSITIVITY TEST

(Yearly Gross Primary Production vs CO_2)





CO2

+100% CO_2 (760 ppm) → **+25%**

+50% CO_2 (570 ppm) → **+17%**

+25% CO_2 (475 ppm) → **+11%**

+15% CO_2 (437ppm) → **+8%**

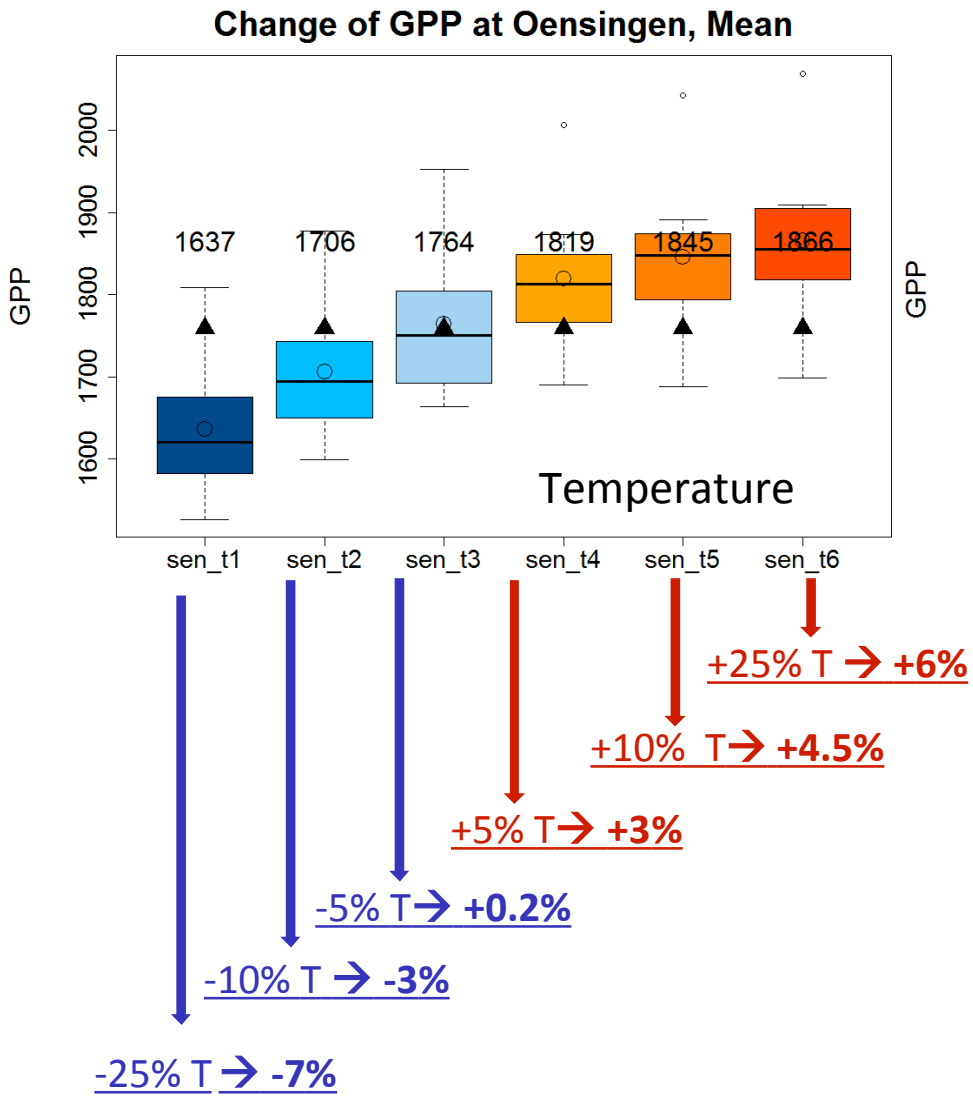
+10% CO_2 (418 ppm) → **+6%**

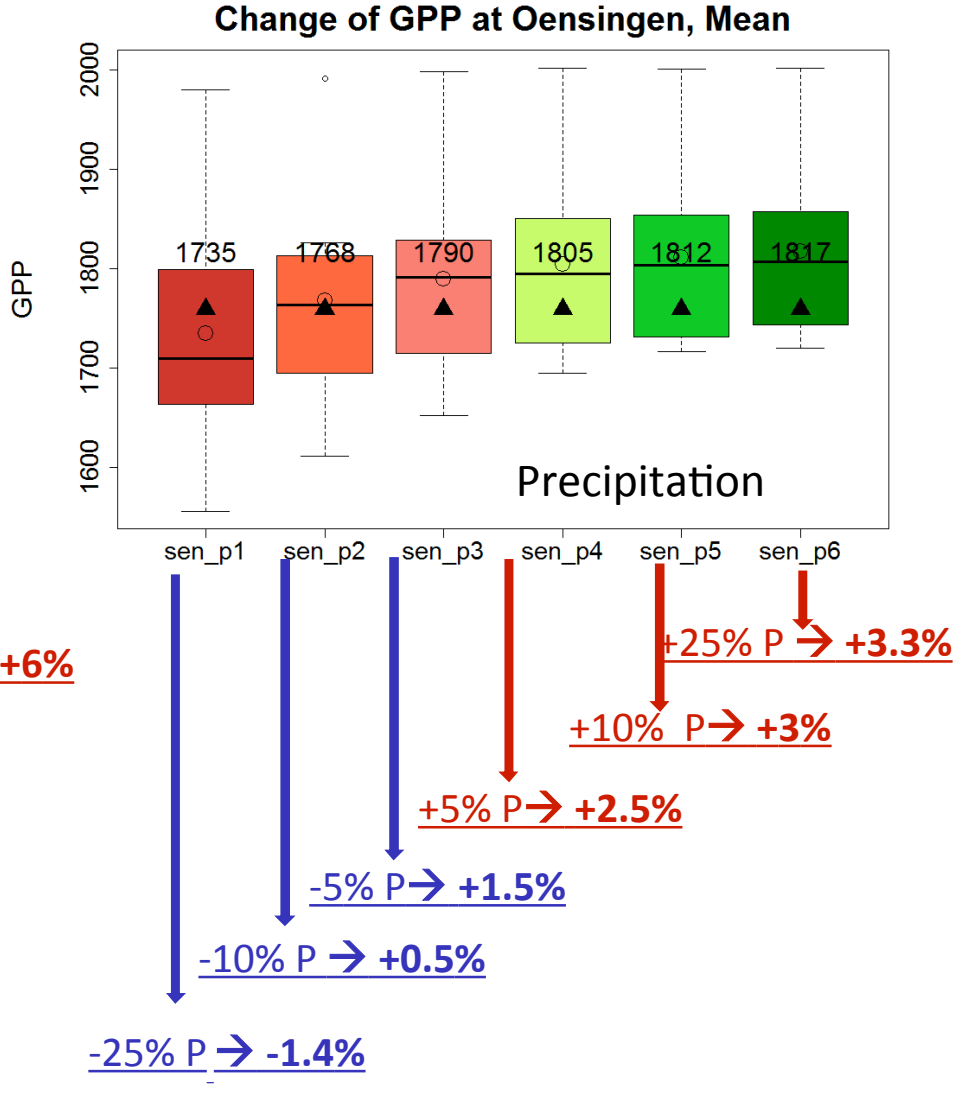
+5% CO_2 (399 ppm) → **+4%**

Baseline: 380 ppm

SENSITIVITY TEST

(Yearly Gross Primary Production vs Temperature and Precipitation)





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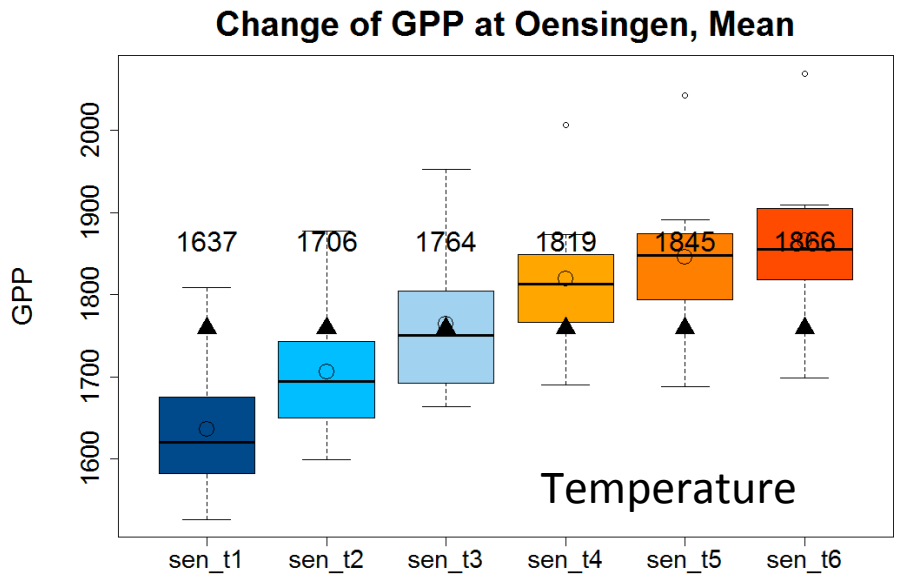
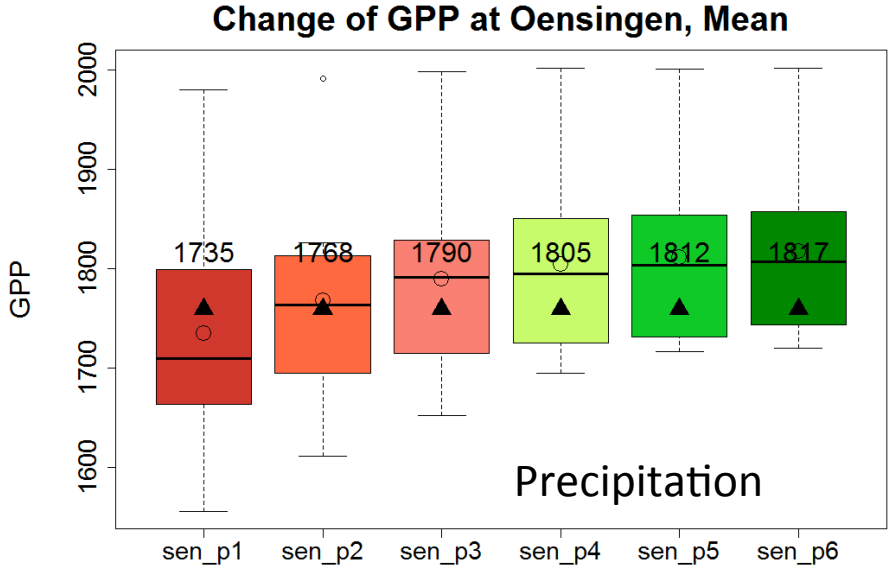
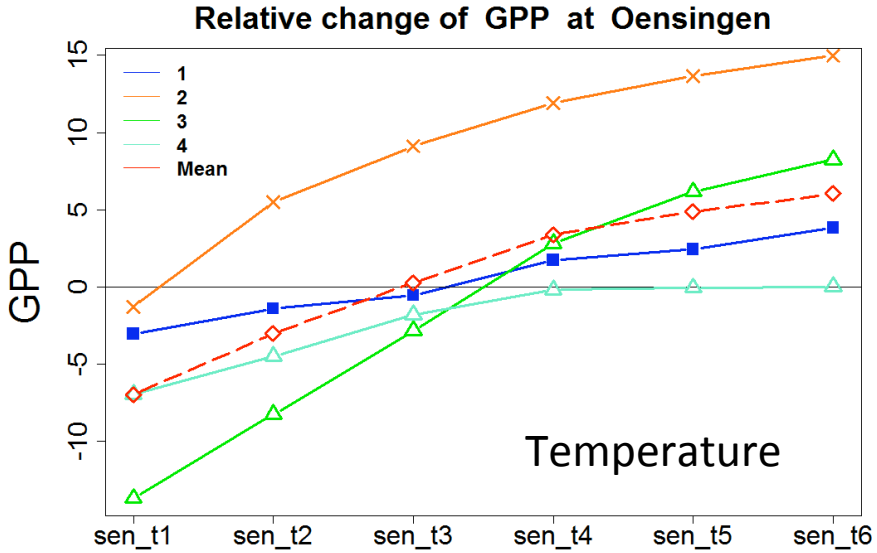
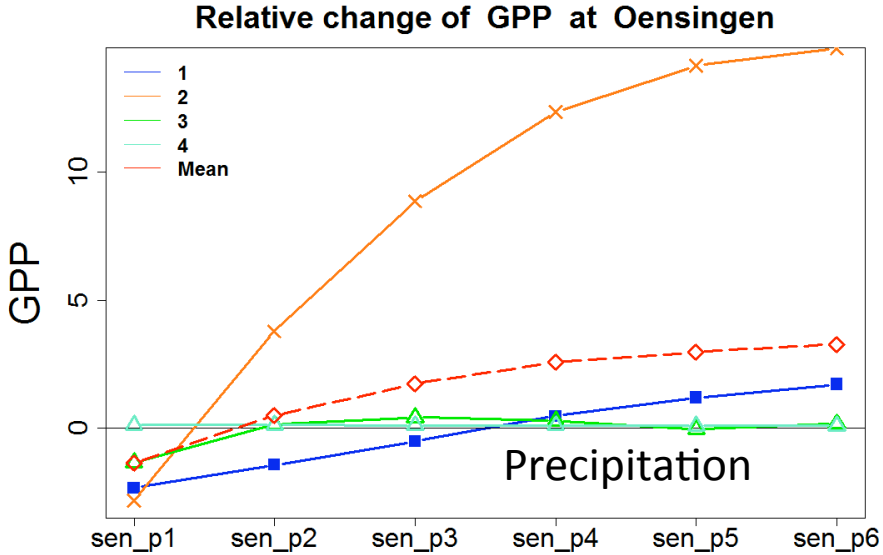
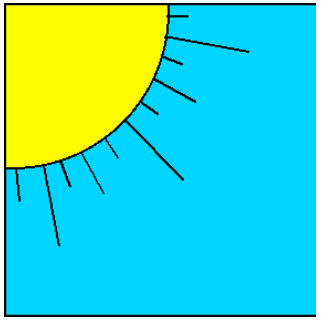








Conclusions



- Overall, model calibration improves accuracy and reduces uncertainty in biomass and carbon-water cycle estimations

- Alternative models show different sensitivity to climate change factors
  - Estimated Gross Primary Productivity is roughly exponentially increasing with the atmospheric CO_2 level (by up to ~25% when doubling [CO_2])
  - The effect of temperature on the GPP changes is higher than the effect of precipitation

Action plan and perspectives

MACSUR

◆ To analyze the envelope of model outputs of sensitivity tests on the yield biomass production

◆ To estimate the interactions between different scenarios and model simulations related with the sensitivity of the applied model

Perspectives

◆ To expand the collaboration with new sites, models on different treatments and/or grazing animals

Thank you for your attention!