Sensitivity and uncertainty analysis of grassland models in Europe and Israel

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Grassland model inter-comparison in MACSUR

Construction:

- ✓ Model inter-comparison at selected sites in Europe (plot-scale simulations)
- ✓ Guidelines and minimum dataset requirement for model evaluation
- ✓ Common protocol for the modelling teams
- ✓ Data segregation
- ✓ Evaluation and uncertainty analysis of model outputs

Aims:

→ To quantify uncertainties on yield and carbon-flux outputs

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

→ To analyze the correlation between the ensemble and the individual model results

→ To establish highlights for getting better estimations

Grassland modelling

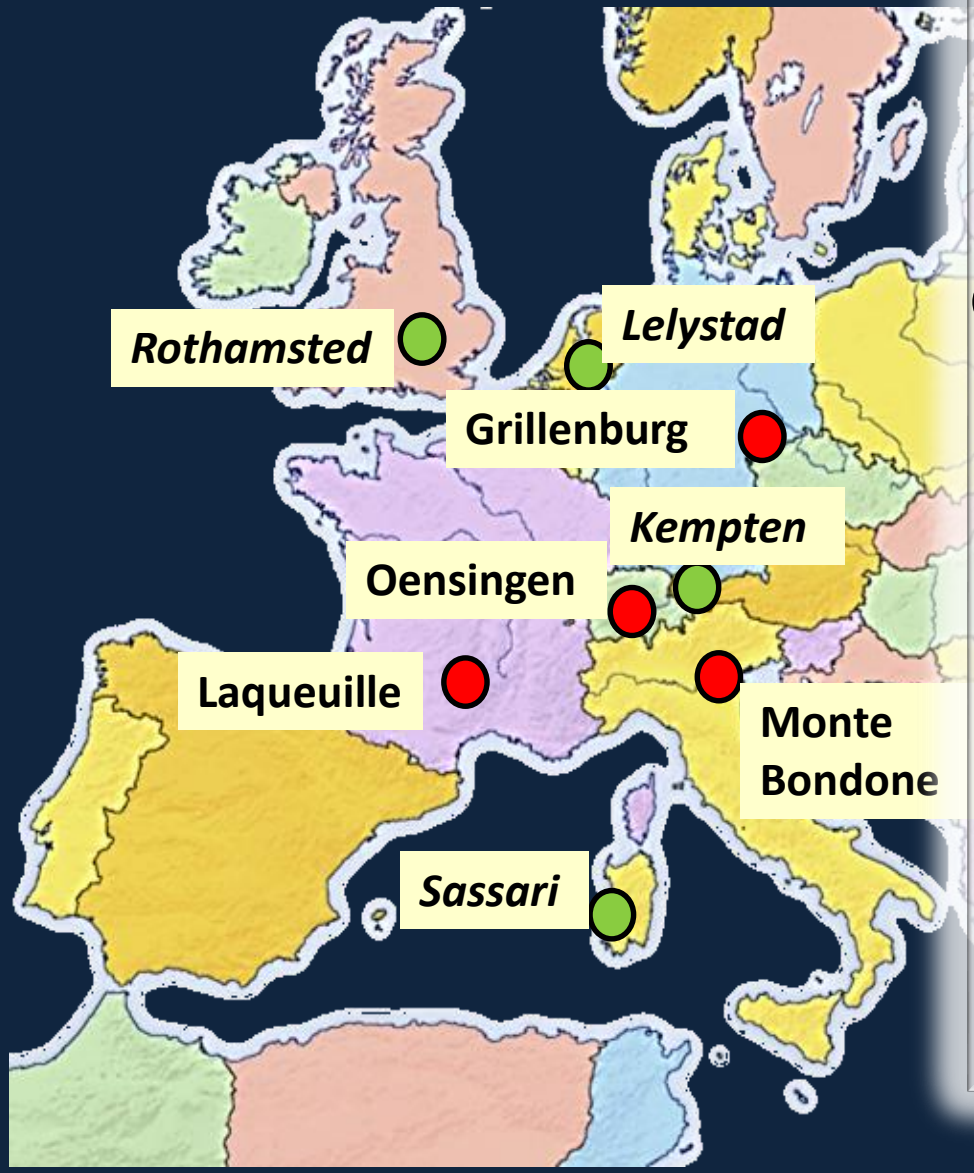
Parameters | Input variables | Initial values

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

Outputs: GPP, NEE, RECO, ET, ST, SWC, yield

Simulations: uncalibrated, calibrated, validated, sensitivity (CO_2, Temp, Prec.)

Study sites



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

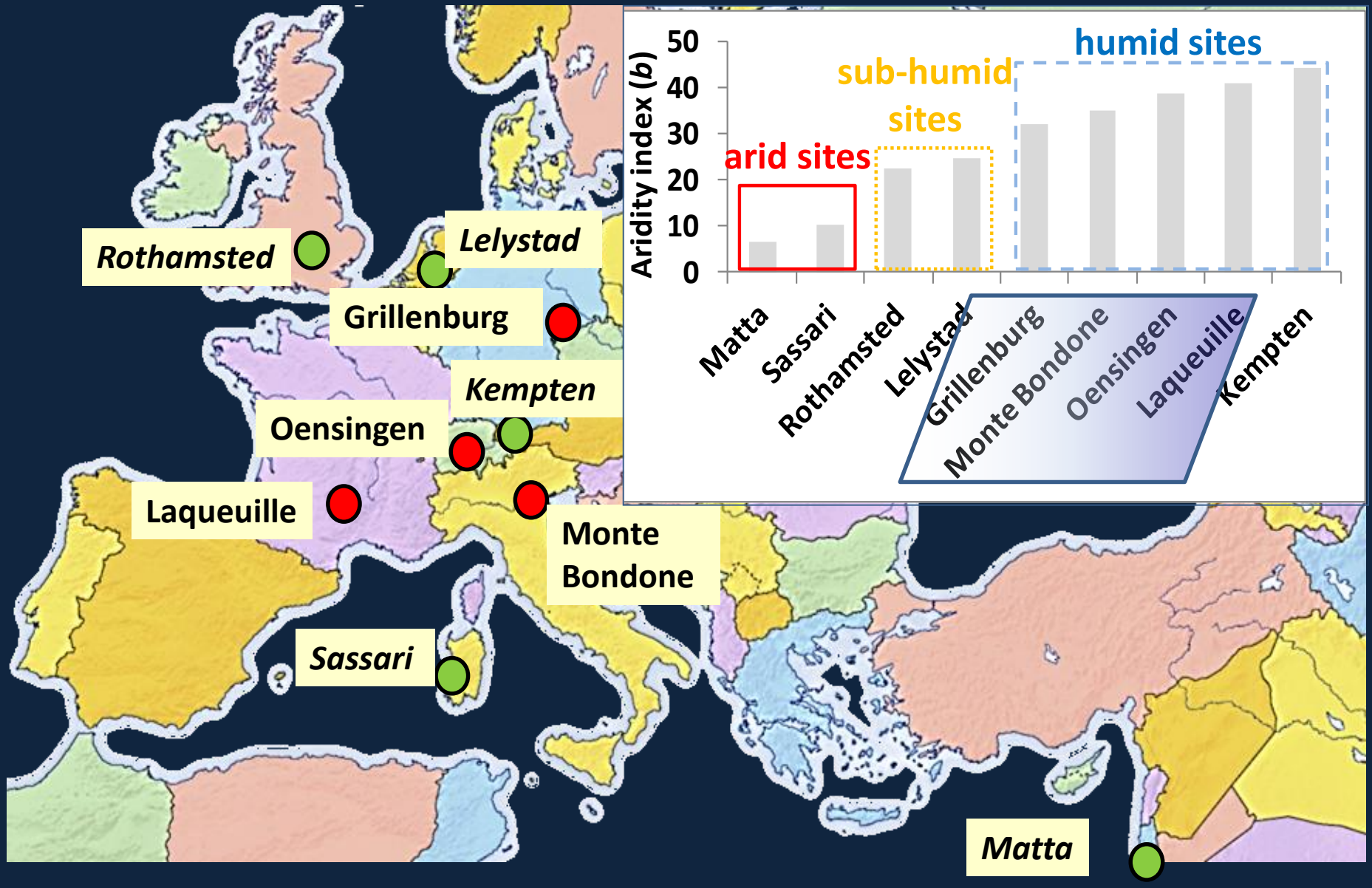
Grassland experimental sites
(yield)
Data: cutting events

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

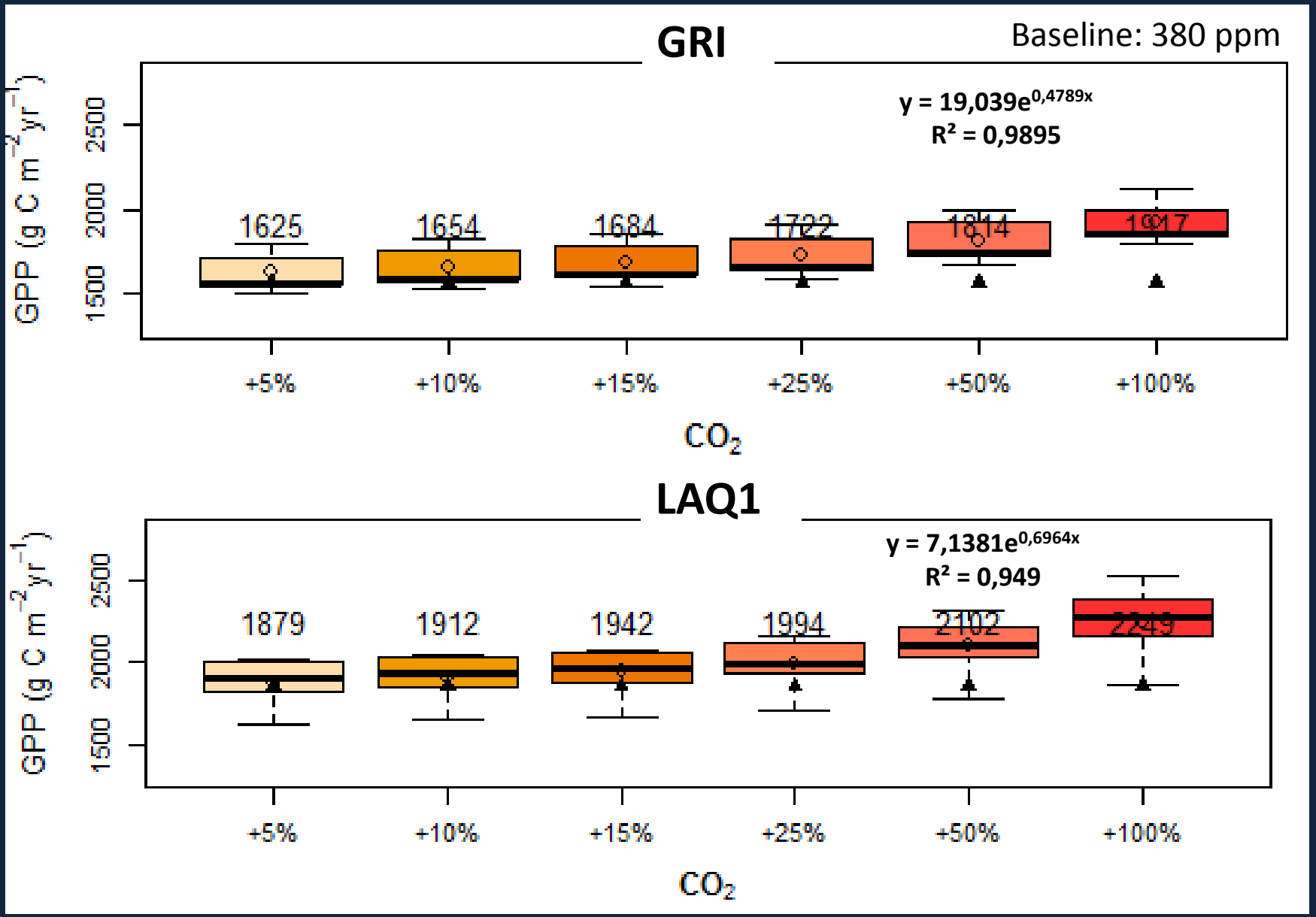
Roth-1: NH4 – fertilization
Roth-2: NO3 – fertilization

LAQ1: intensive (N fertilized)
LAQ2: extensive (non fertilized)

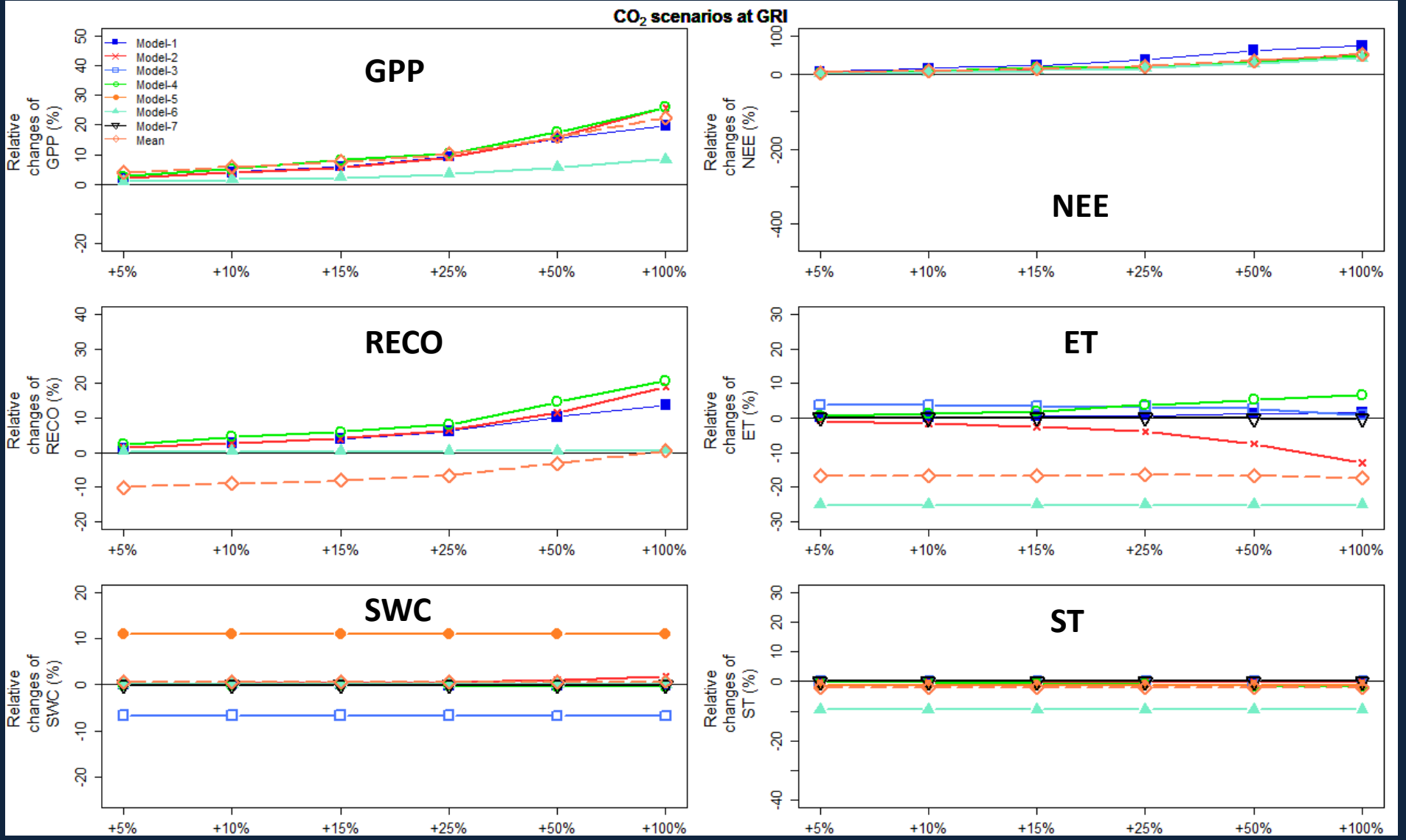
Study sites


Rothamsted
Lelystad
Grillenburg
Kempten
Oensingen
Laqueuille
Monte Bondone
Sassari
Matta
Aridity index (b)
50
40
30
20
10
0
arid sites
sub-humid sites
humid sites
Matta
Sassari
Rothamsted
Lelystad
Grillenburg
Monte Bondone
Oensingen
Laqueuille
Kempten

GPP sensitivity to CO_2 scenarios: ensemble model

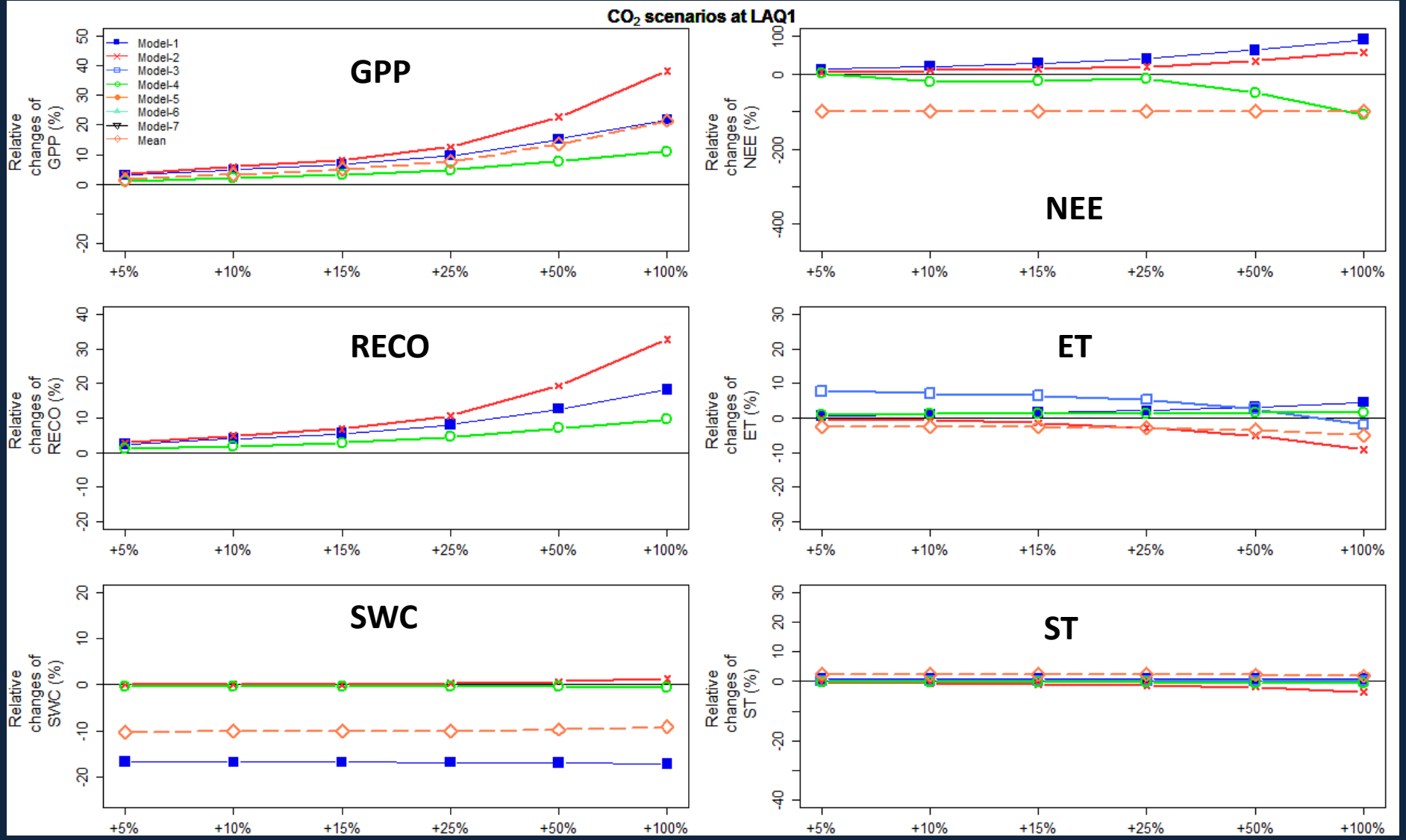


Sensitivity of outputs to CO_2 scenarios at GRI

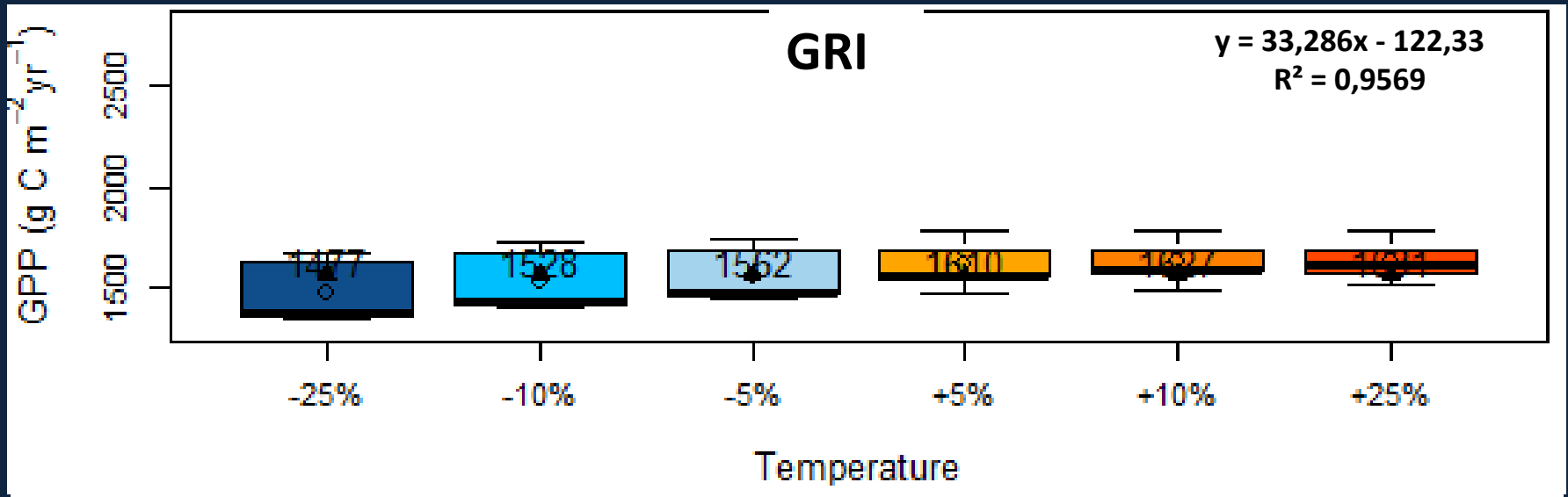


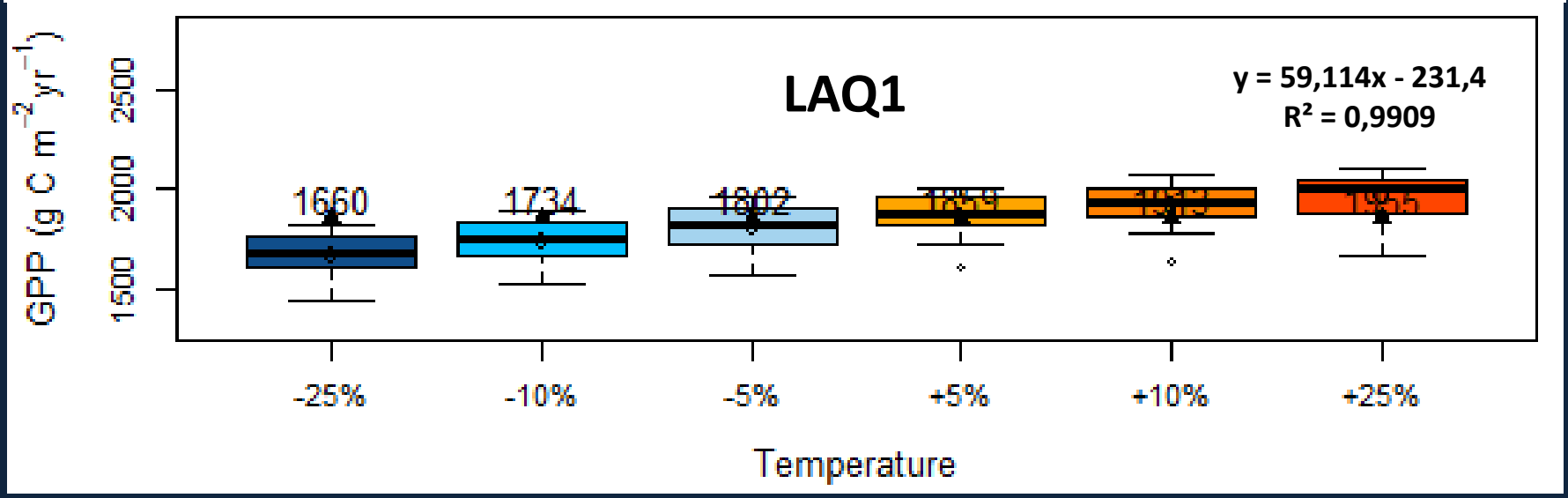
Baseline: 380 ppm

Sensitivity of outputs to CO_2 scenarios at LAQ1

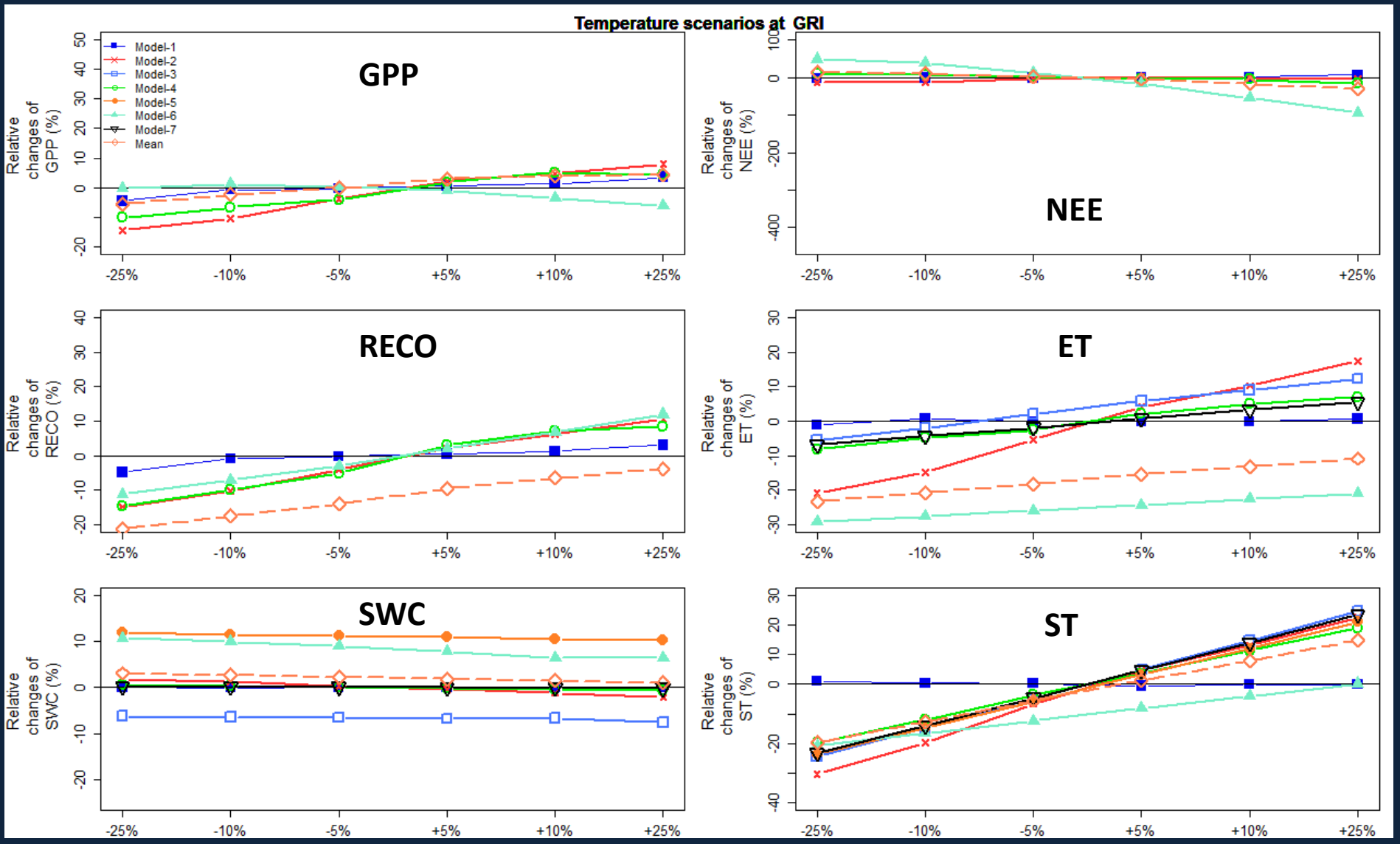


GPP sensitivity to T scenarios: ensemble model

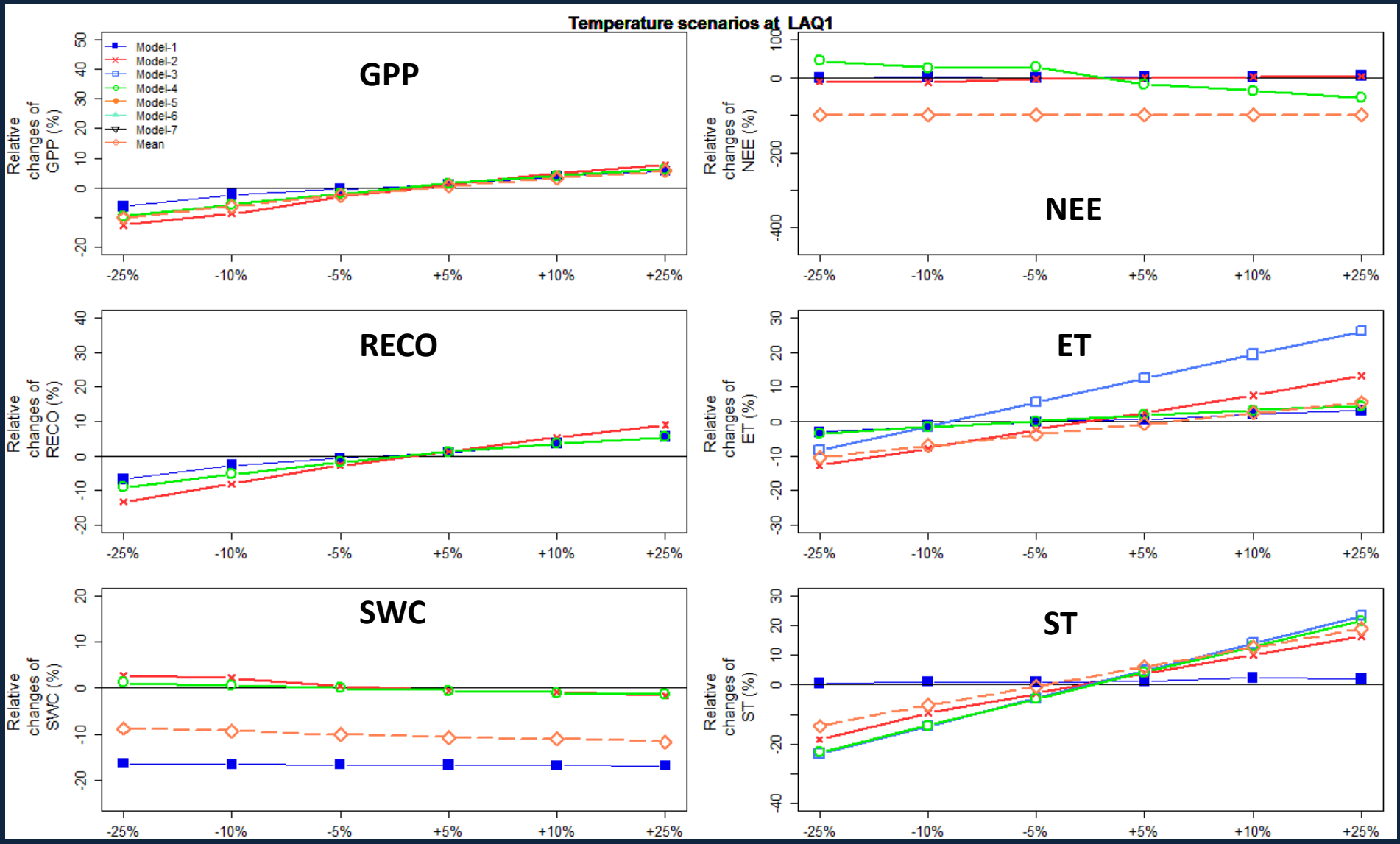




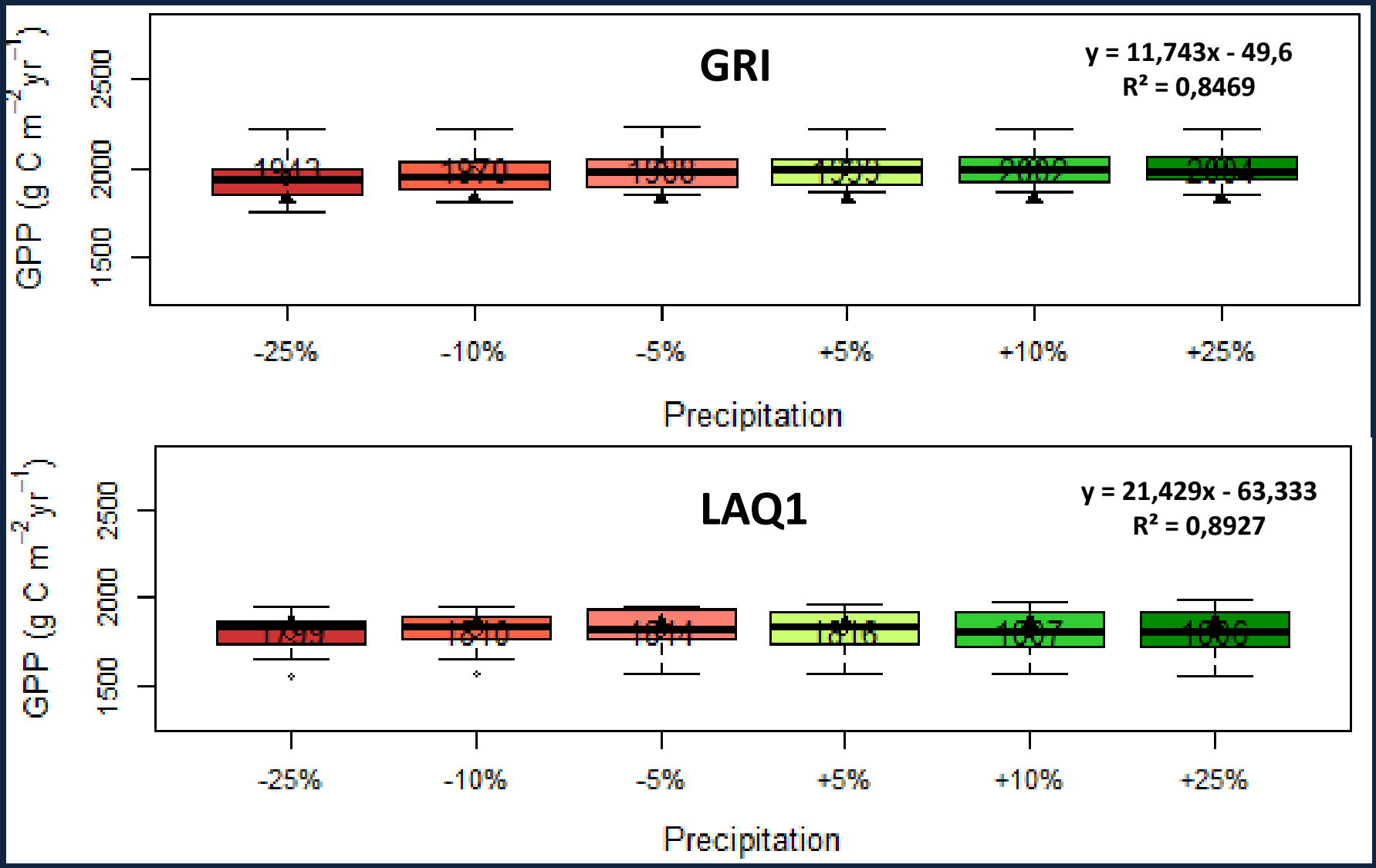
Sensitivity of outputs to T scenarios at GRI



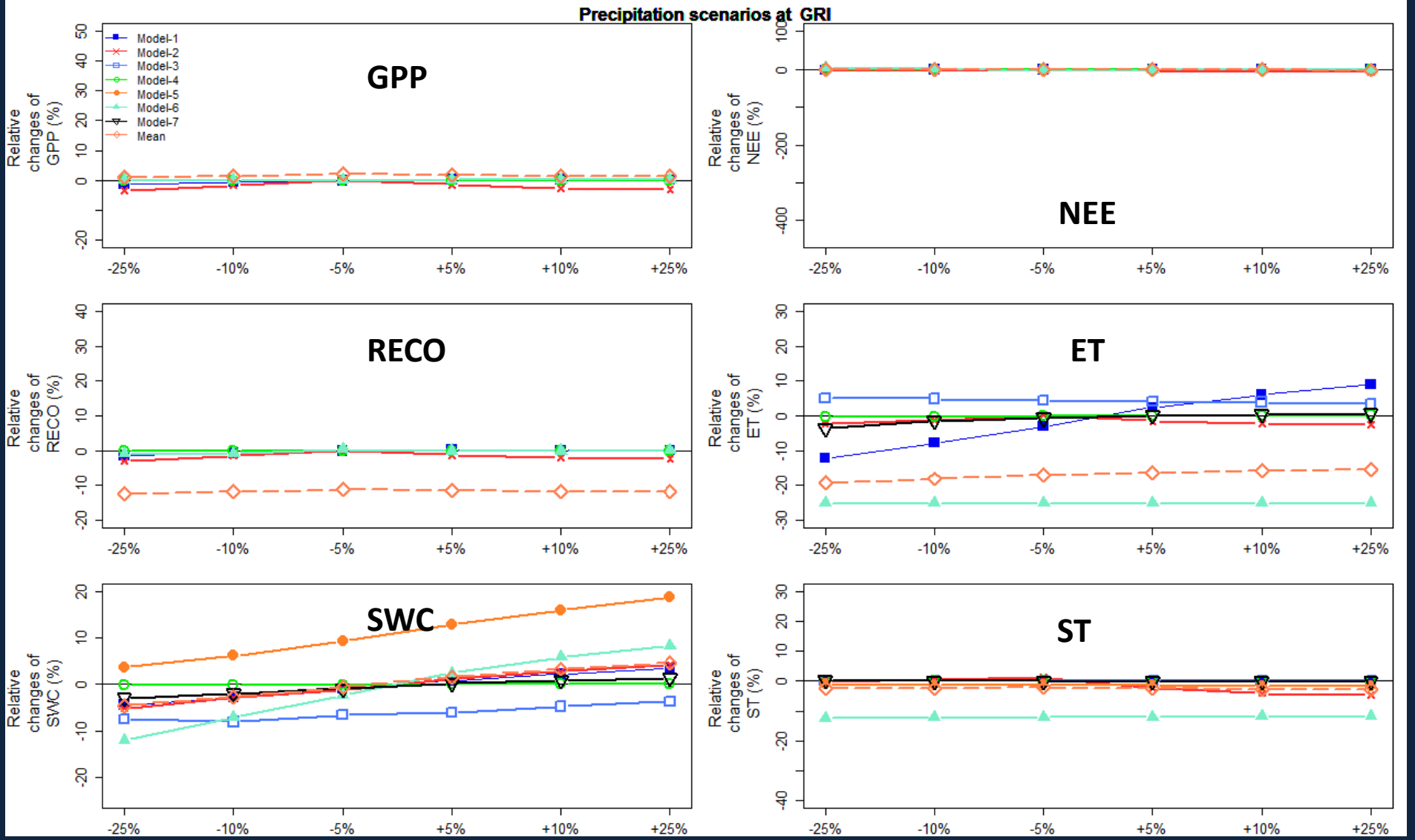
Sensitivity of outputs to T scenarios at LAQ1



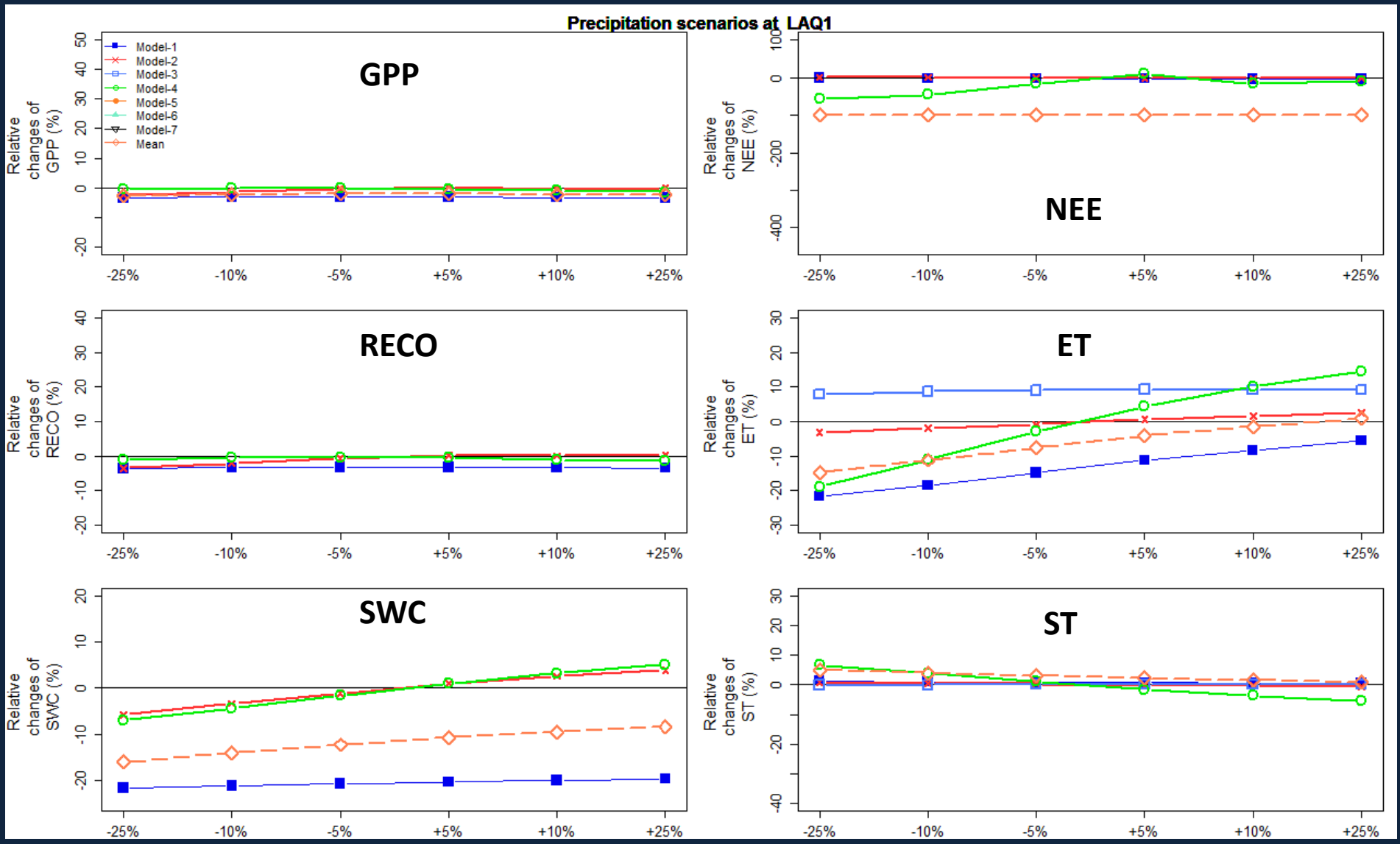
GPP sensitivity to P scenarios: ensemble model



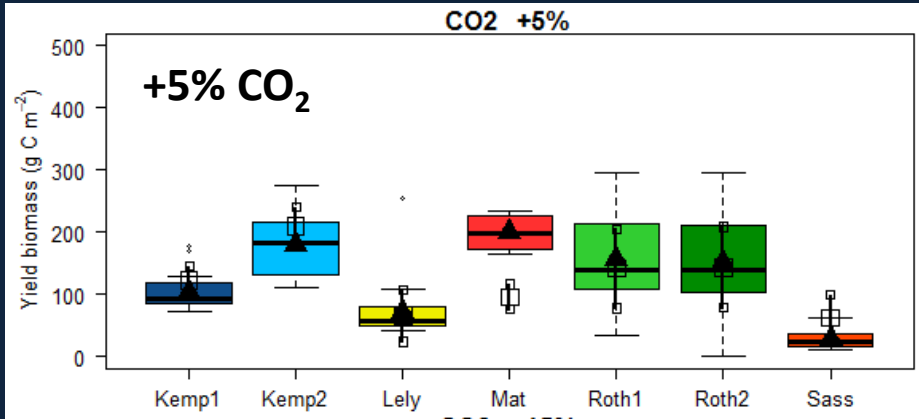
Sensitivity of outputs to P scenarios at GRI

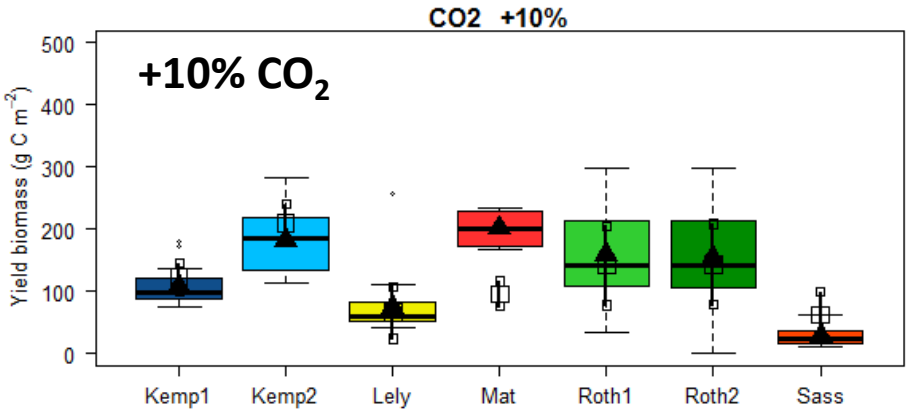


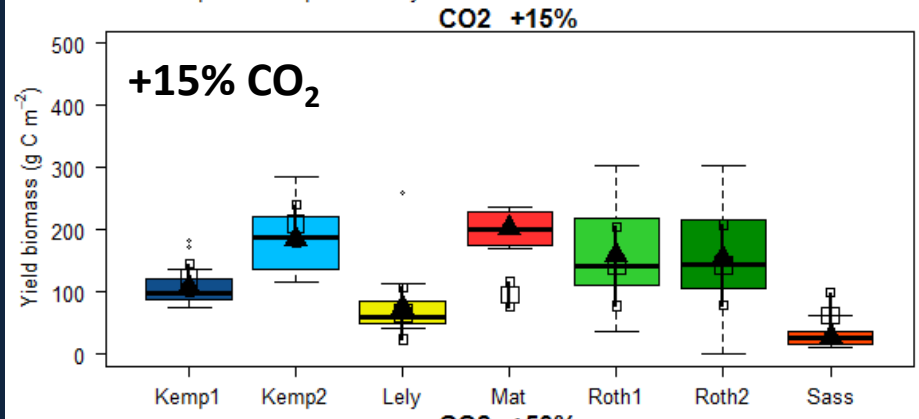
Sensitivity of outputs to P scenarios at LAQ1

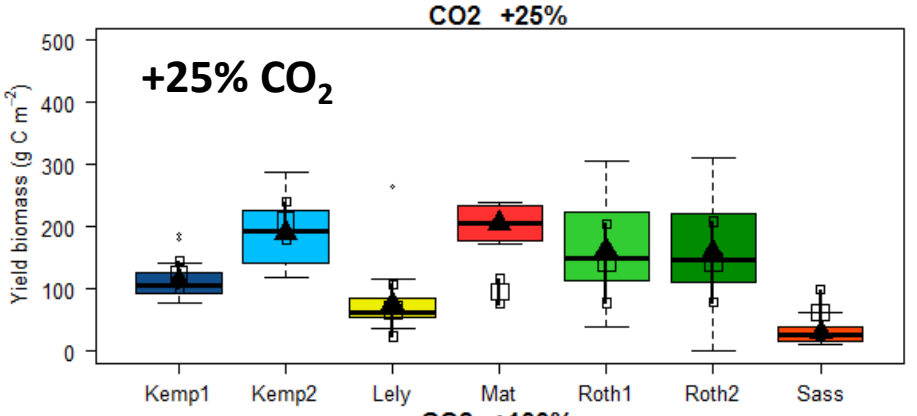


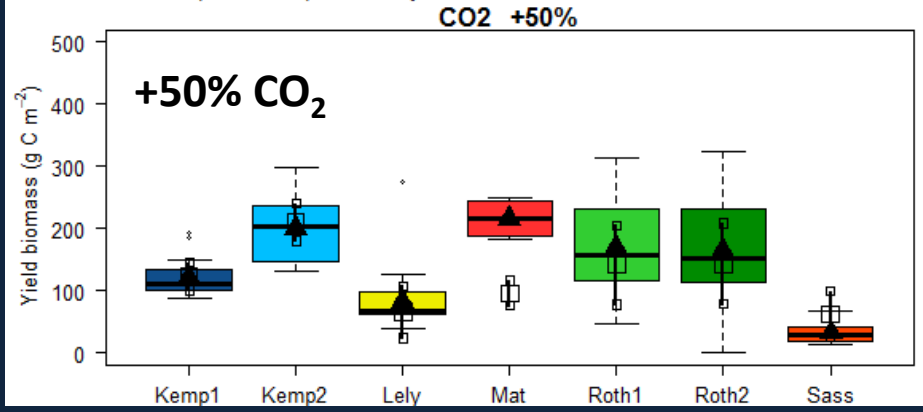
Sensitivity of yield biomass to CO_2

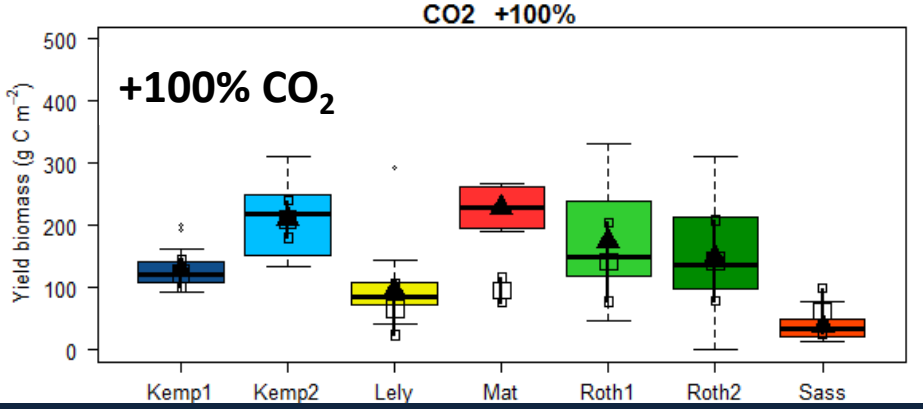












Conclusions

- The responsiveness of different models to climate change factors shows a wide spread of the outputs that is difficult to interpret based only on visual basis
  - Some models are not sensitive at all while some models do not show a down-regulation of photosynthesis at elevated CO_2 concentrations (so that simulated GPP could indefinitely increase with increasing atmospheric CO_2 concentrations)

- The ensemble average tends to be a better representation of the observed outputs then single model realizations, which is a similar conclusion to the one obtained with crop models in other studies

Thank you for your attention!