ACCAF
Metaprogram

Impacts of cover crops on N mineral fertilization and consequences for agro-environmental performances of maize monocrop in climate change context.

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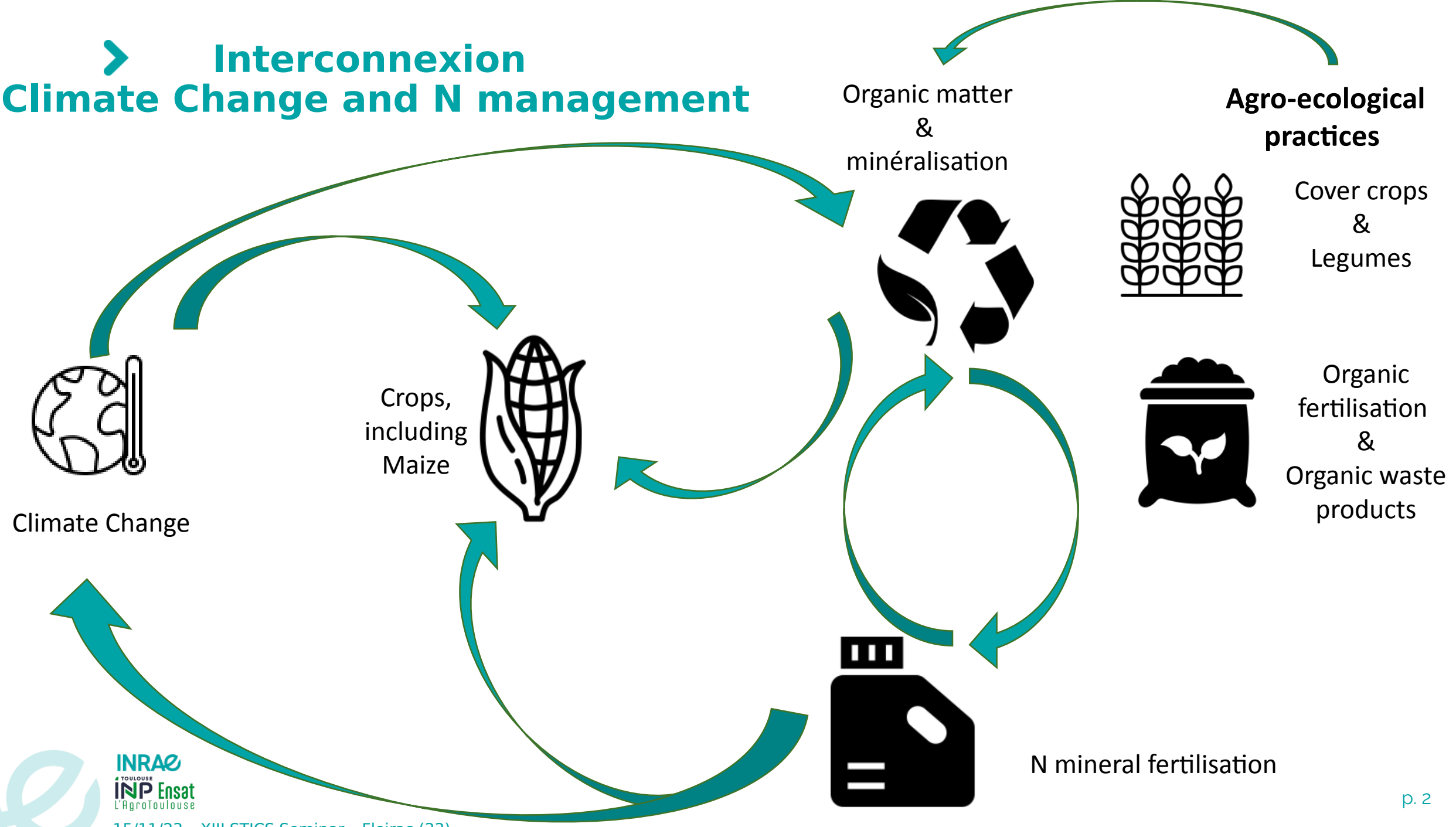
Interconnexion
Climate Change and N management



Hypotheses and general approach

- Adaptation and mitigation to climate change with agroecological practices
  - Store C in the soil with cover crops
  - Reduce/substitute synthetic mineral N intakes with legume covercrops
  - Adjust the dose of mineral fertilizer (balance)

- Simultaneous evolution of practices under the effect of the CC
- Not only a « calendar »
- Coupling decision models to STICS crop model
  - for sowing and fertilization date
  - for mineral N intakes (annual forecast supply balance)

Six agro-ecological scenarios

Main Crop: Maize		Fallow period management		
		Bs Bare soil	**Fb** Fabaceae (fababean) covercrop	**Rp** Brassicaceae (rapeseed) cover crop
Mineral N fertilization amount	**N_{fix}** Fixed (190 $kgN.ha^{-1}.yr^{-1}$)	Bs_N_{Fix} (ref)	Fb_N_{Fix}	Rp_N_{Fix}
	N_{bal} adapted yearly	Bs_N_{Bal}	Fb_N_{Bal}	Rp_N_{Bal}

Six agro-ecological scenarios , five studied sites

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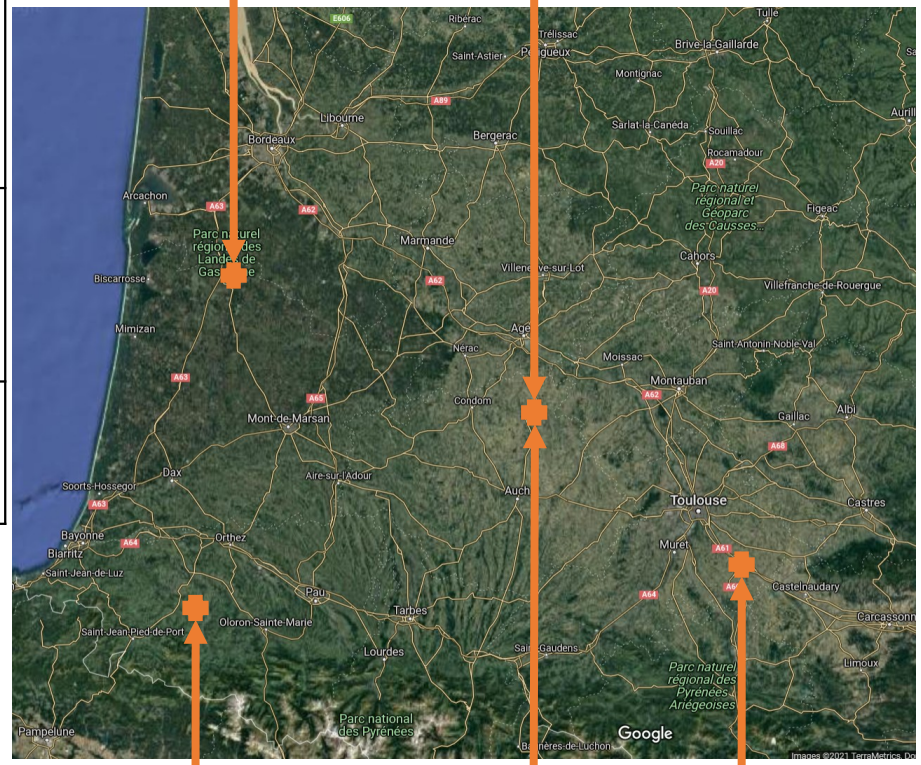

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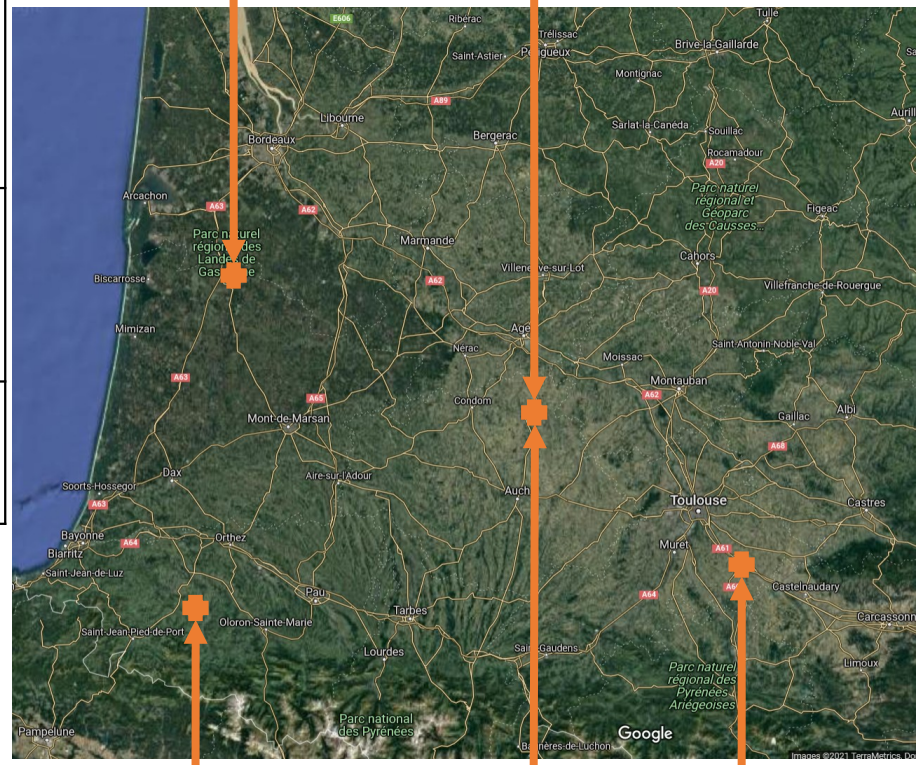
- Continuous run over 40 years

  → 2010-2050 (RCP 8.5)

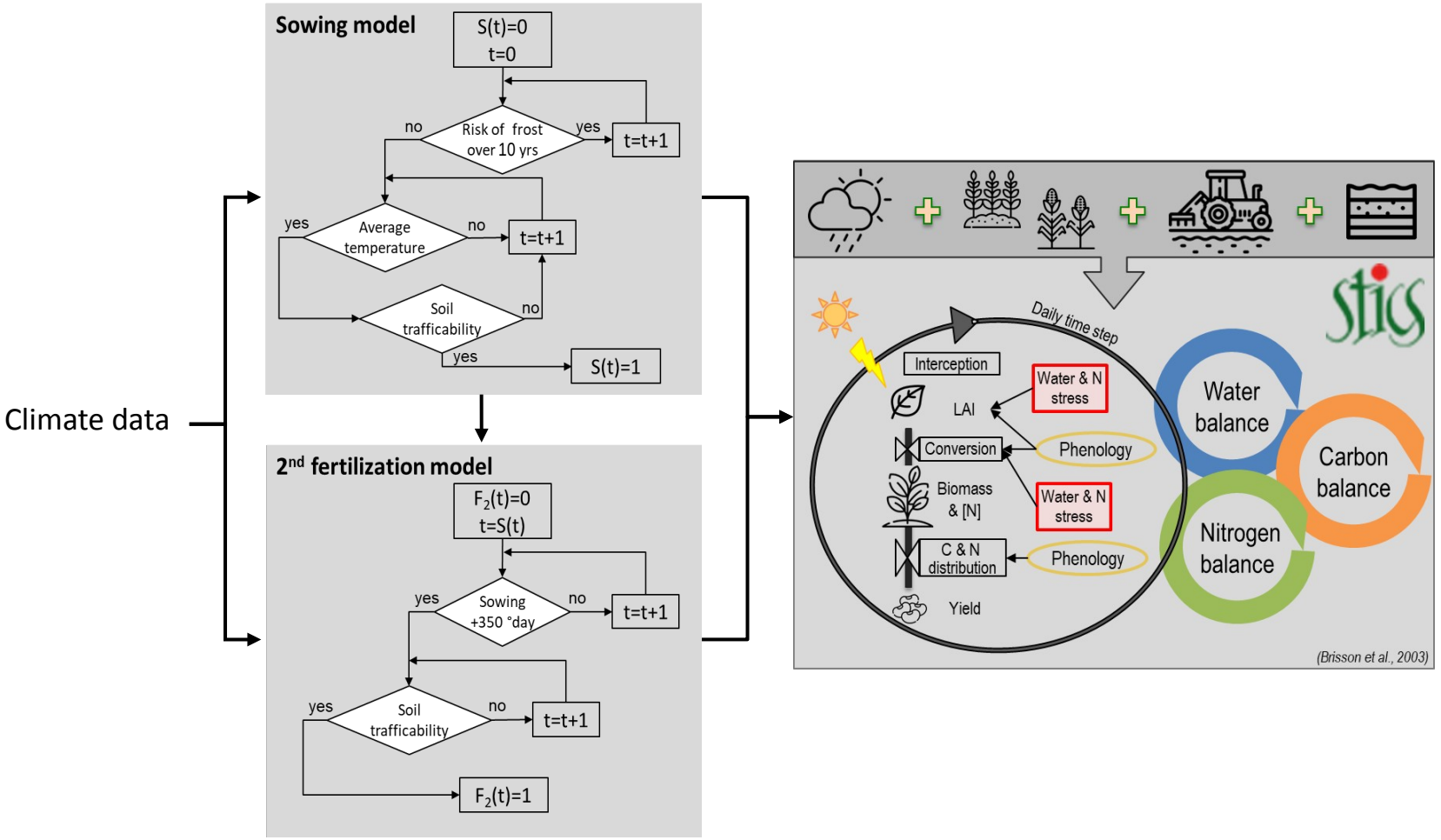
- Automatic irrigation

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
Liberté

DRIAS les futurs du climat



Modelling chain with R



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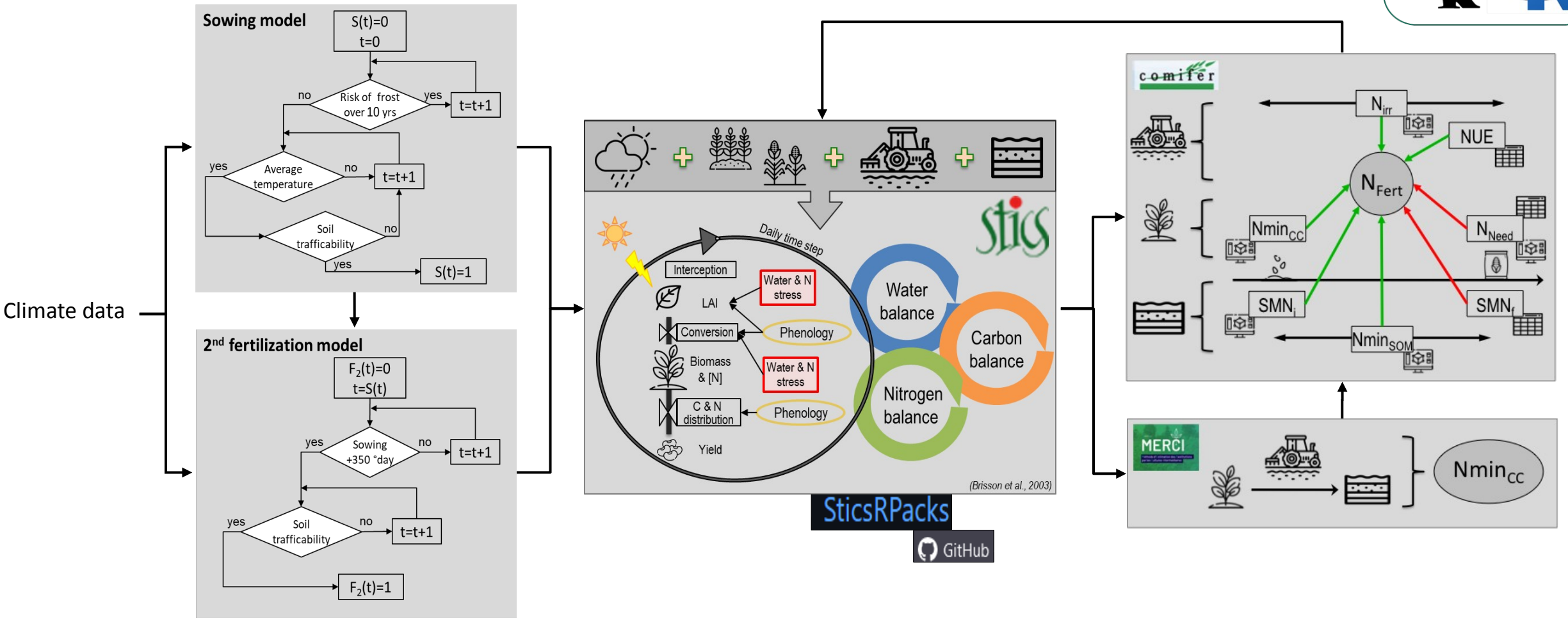
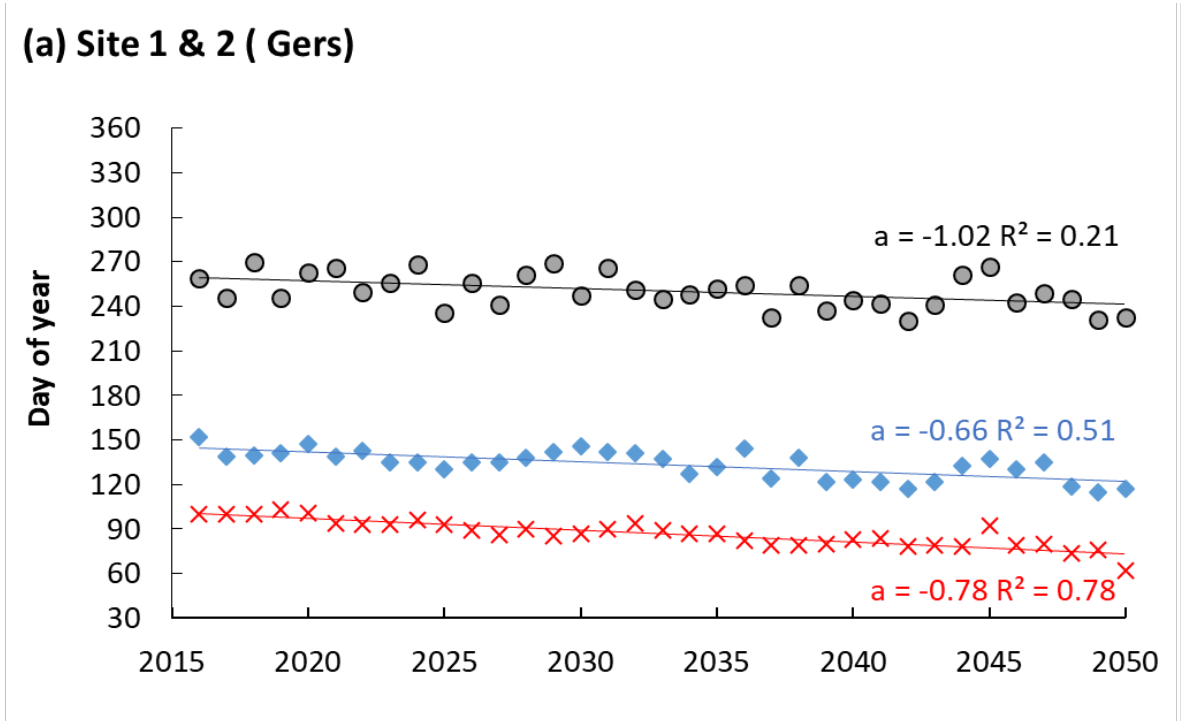
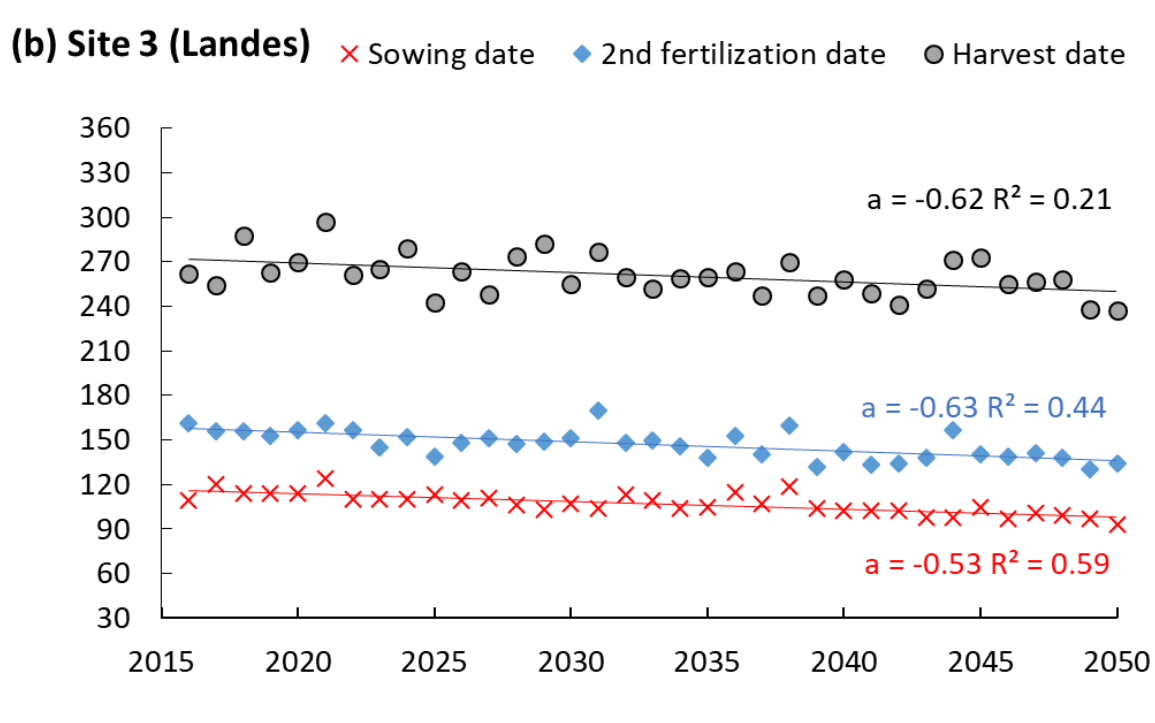
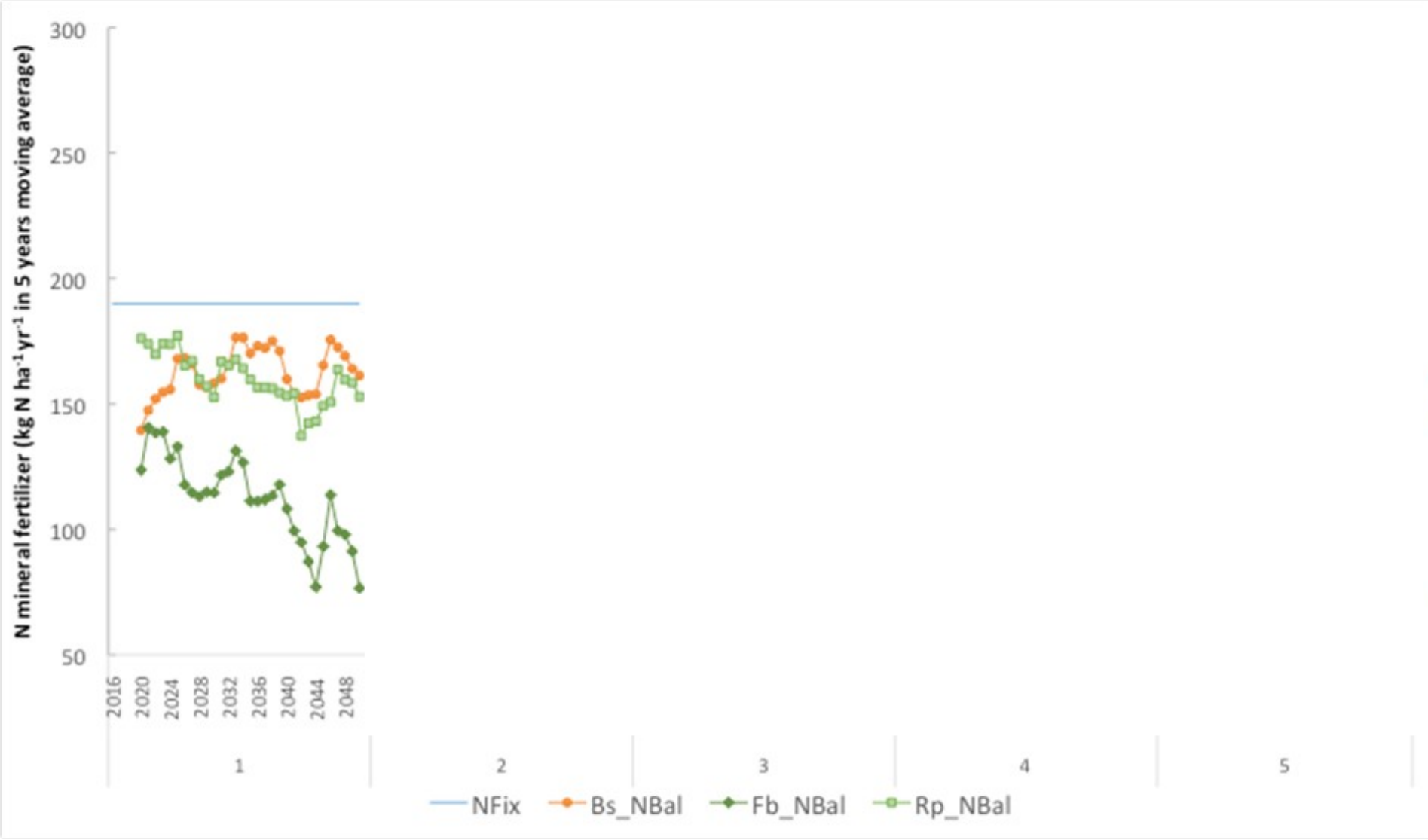


Earlier sowing and harvest dates



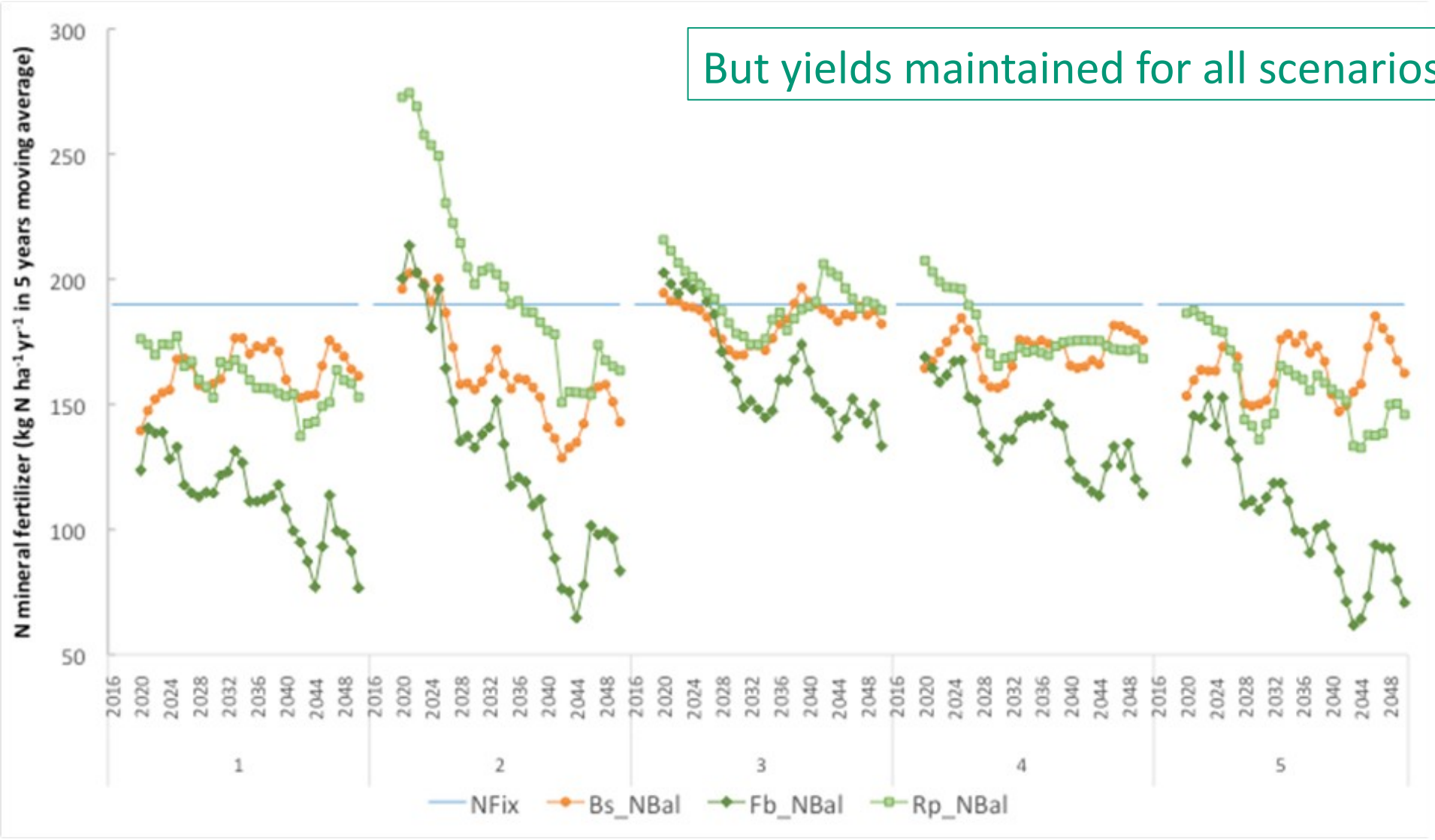


Changes in N fertilization need



Changes in N fertilization need

But yields maintained for all scenarios !



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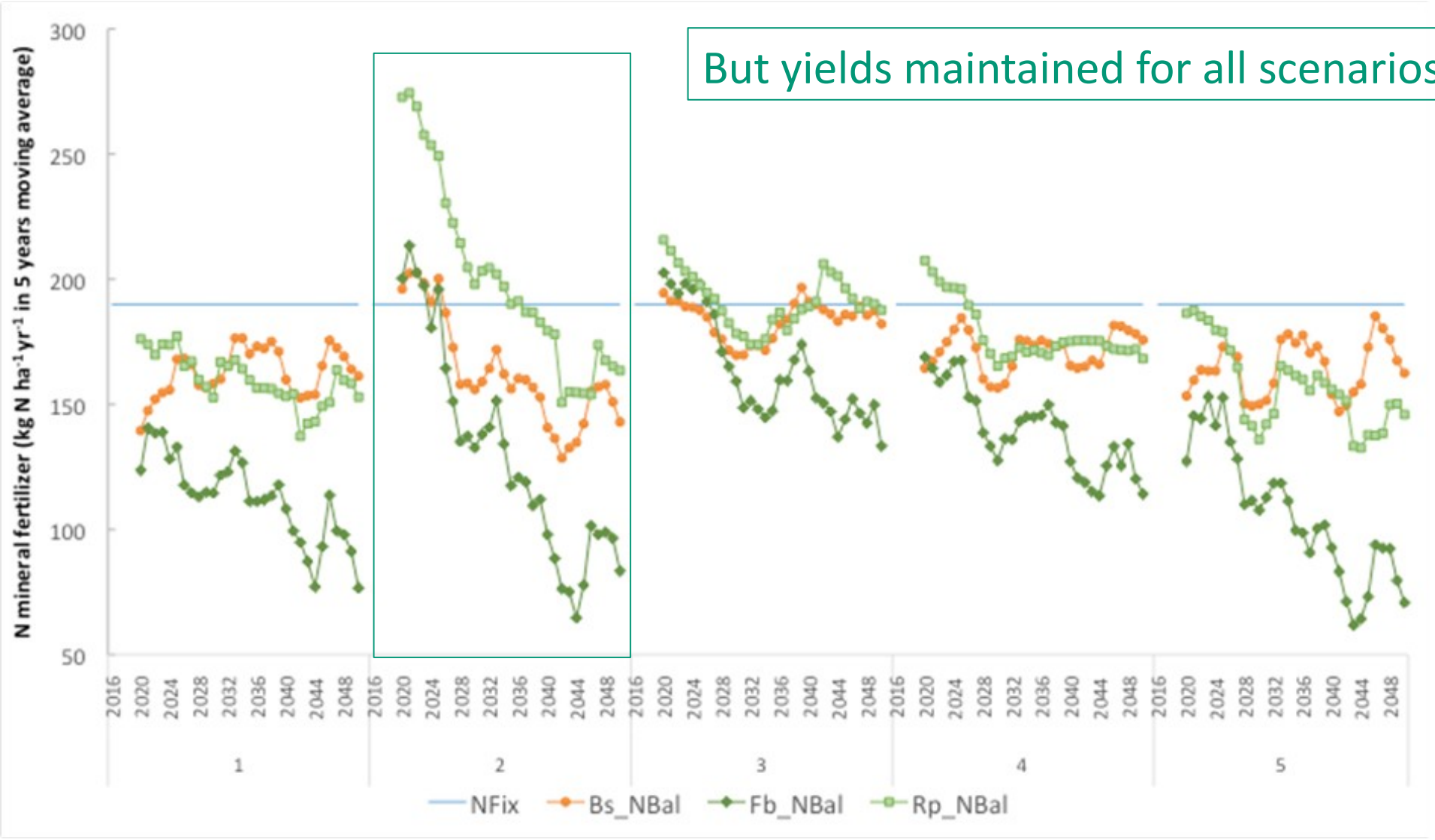

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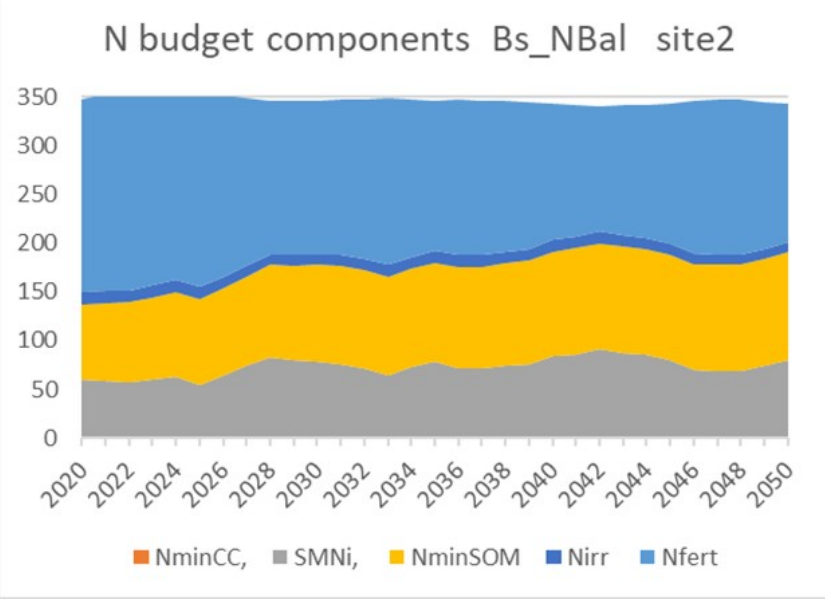
Due to contrasted N budget patterns



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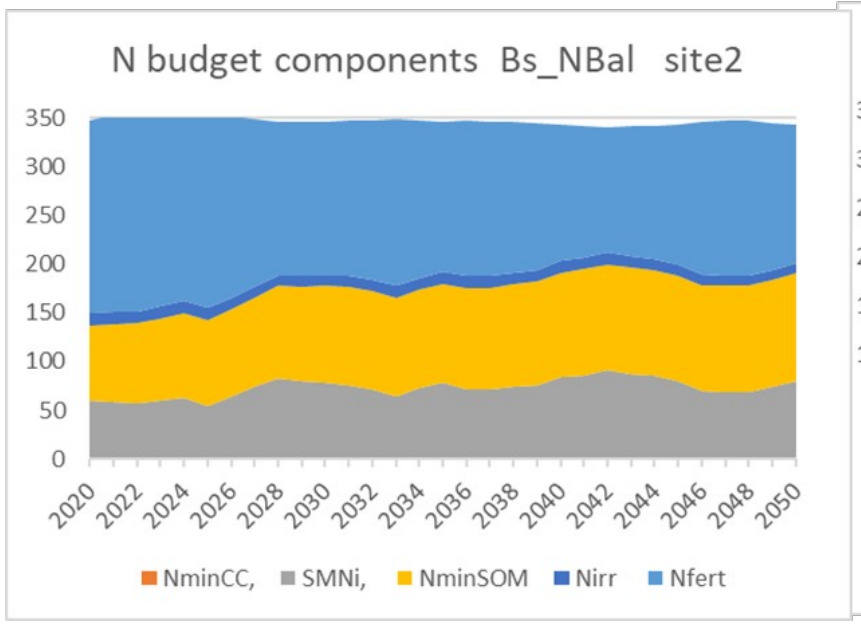

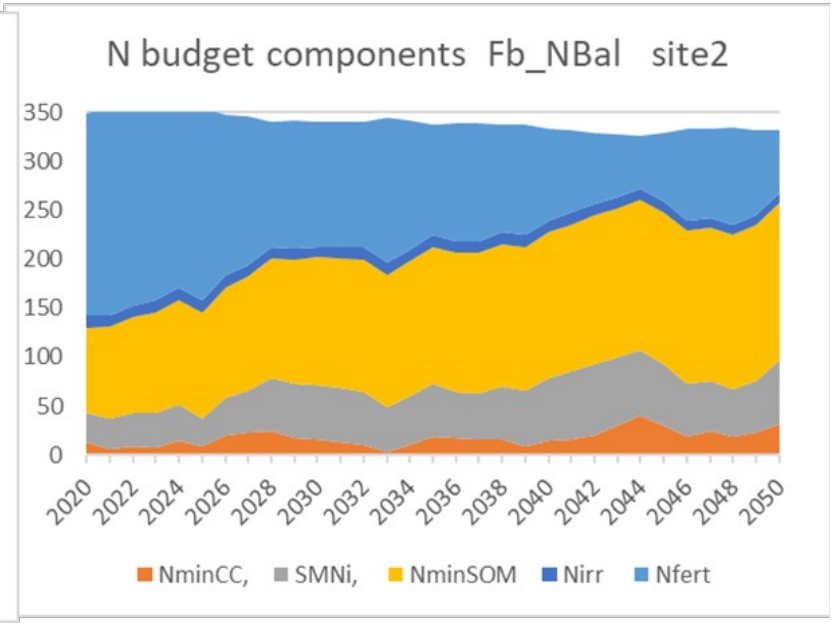

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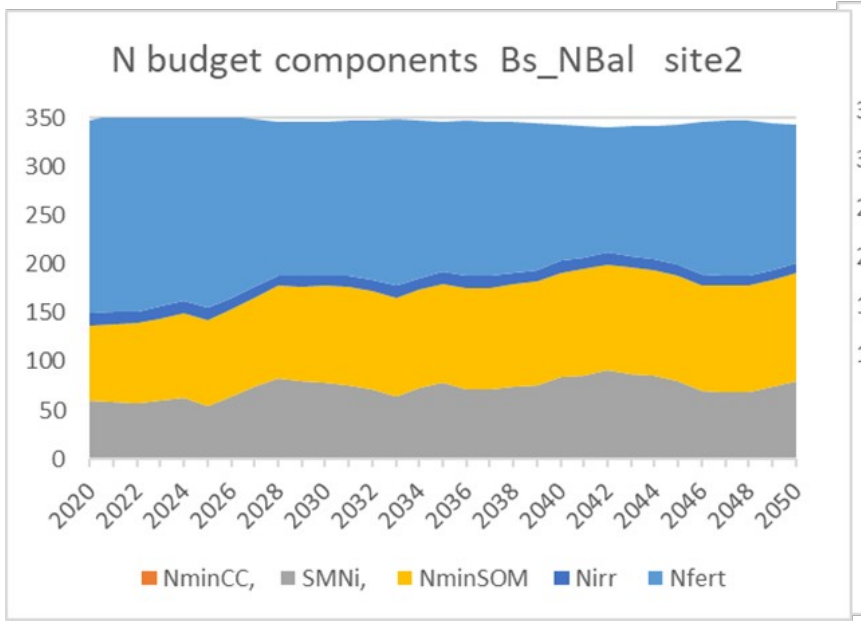
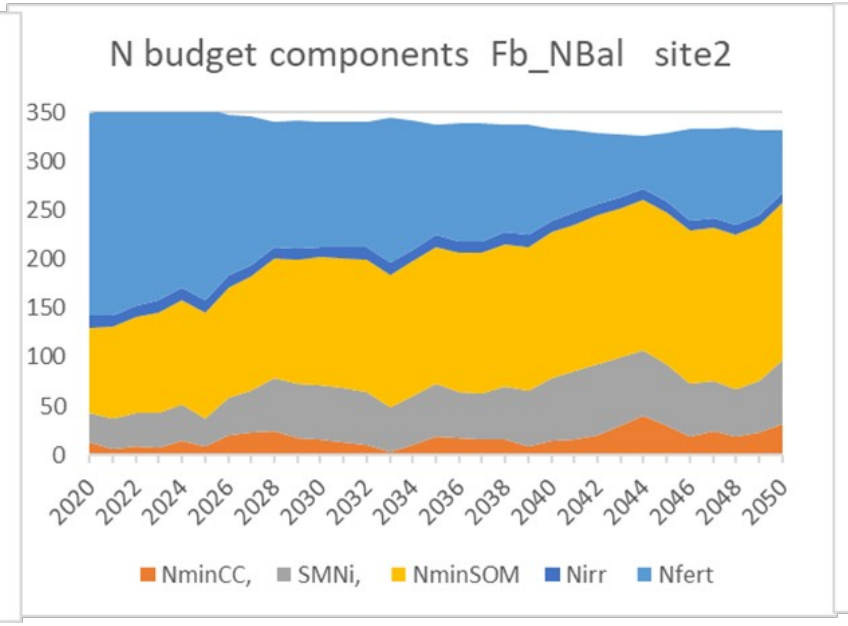
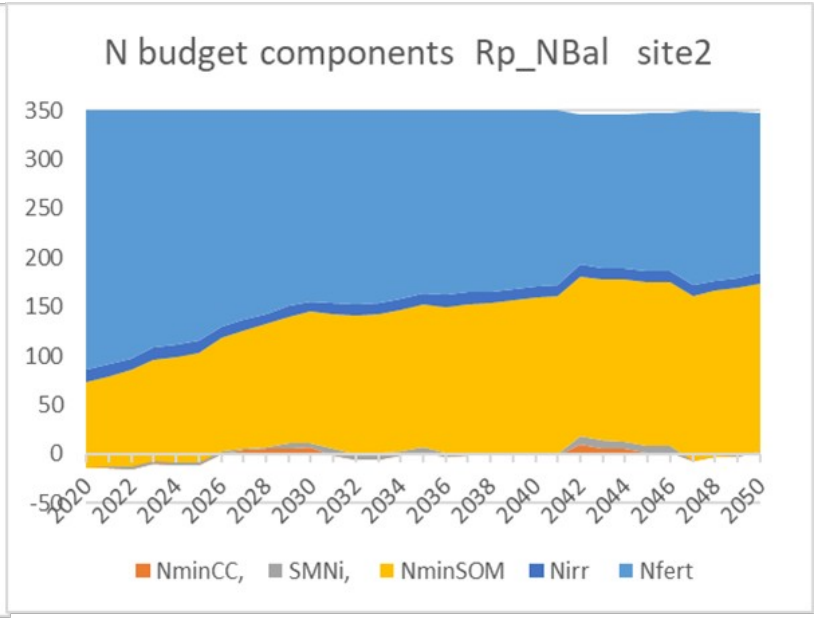
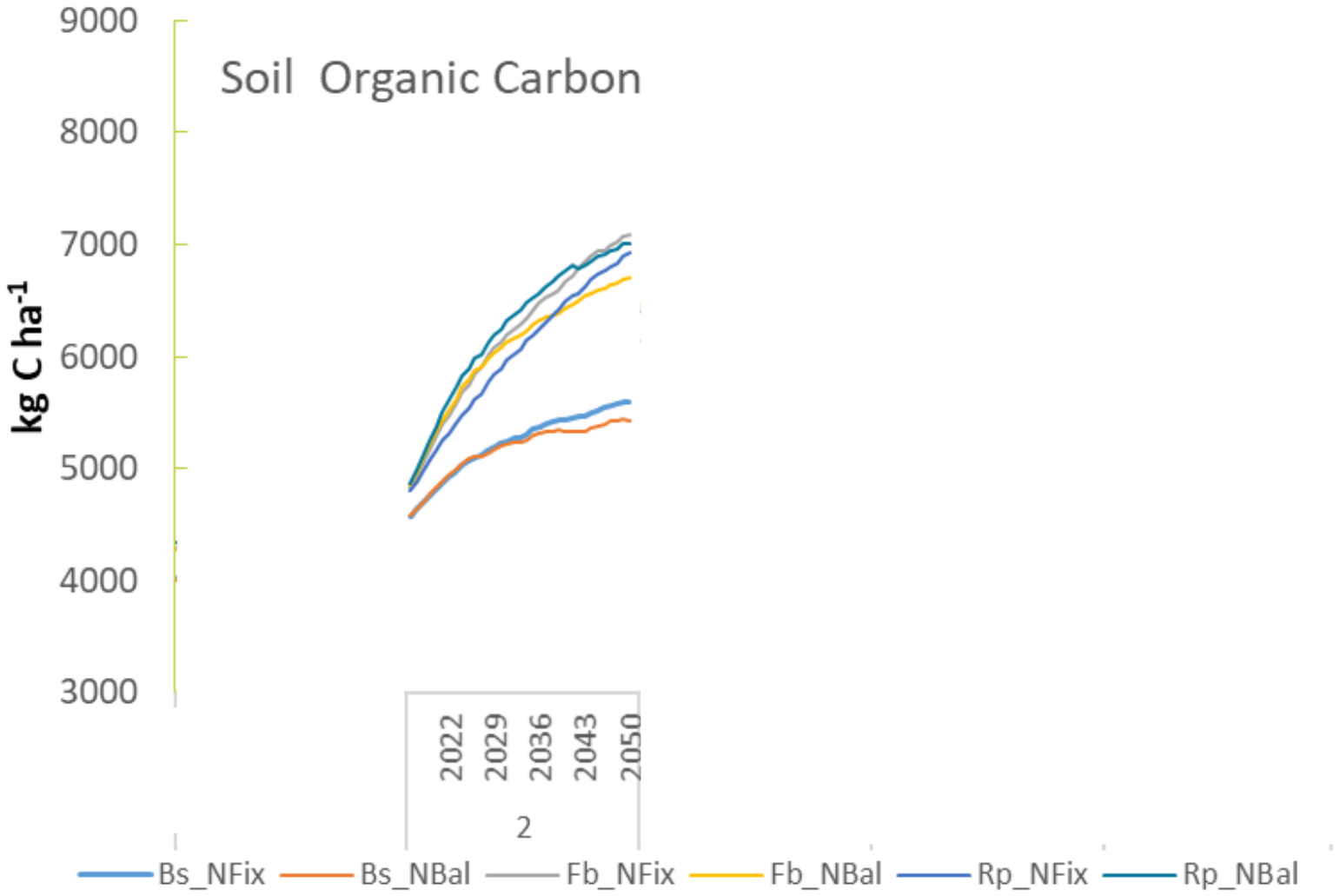






Increased C storage in the soil with cover crop



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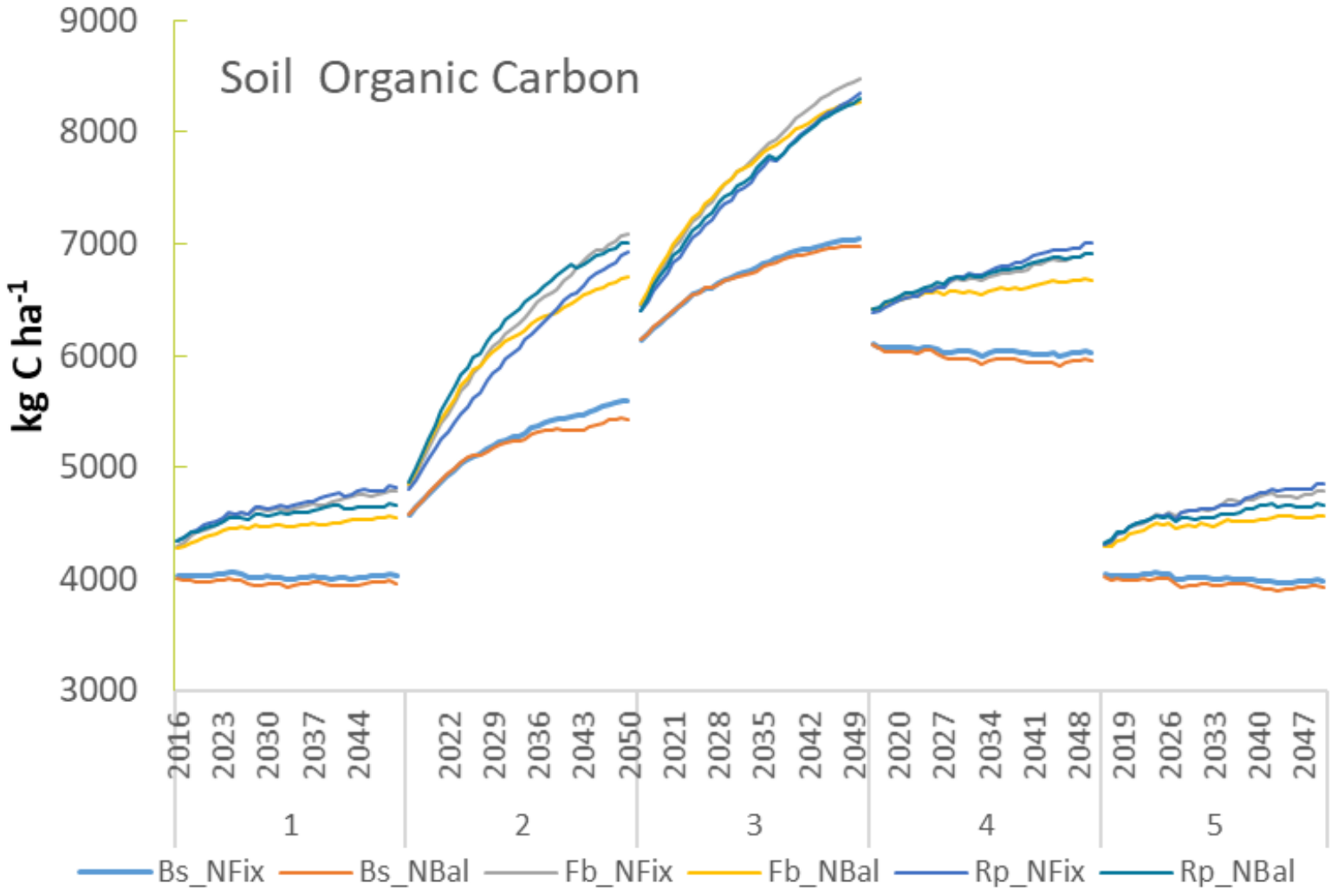
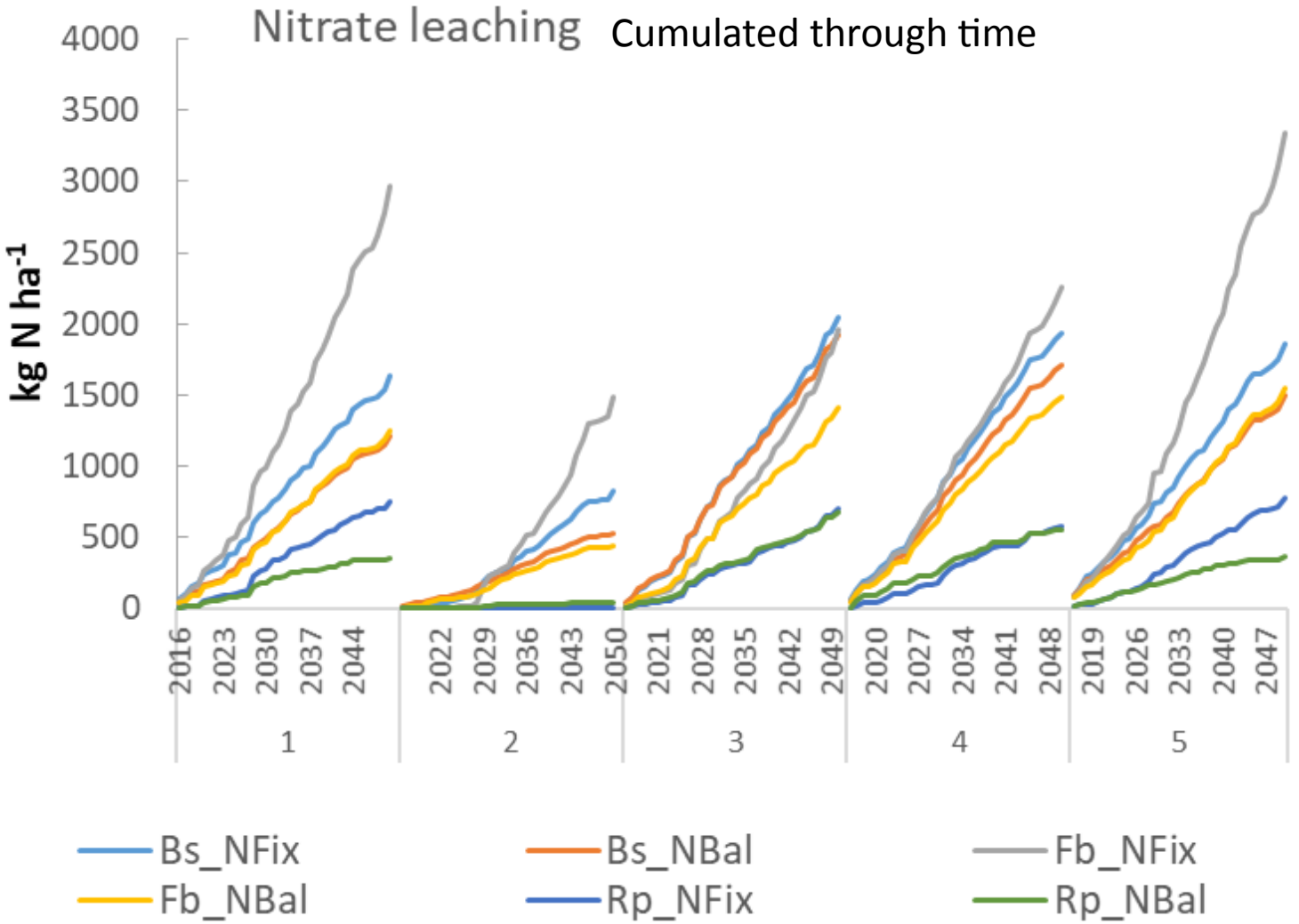
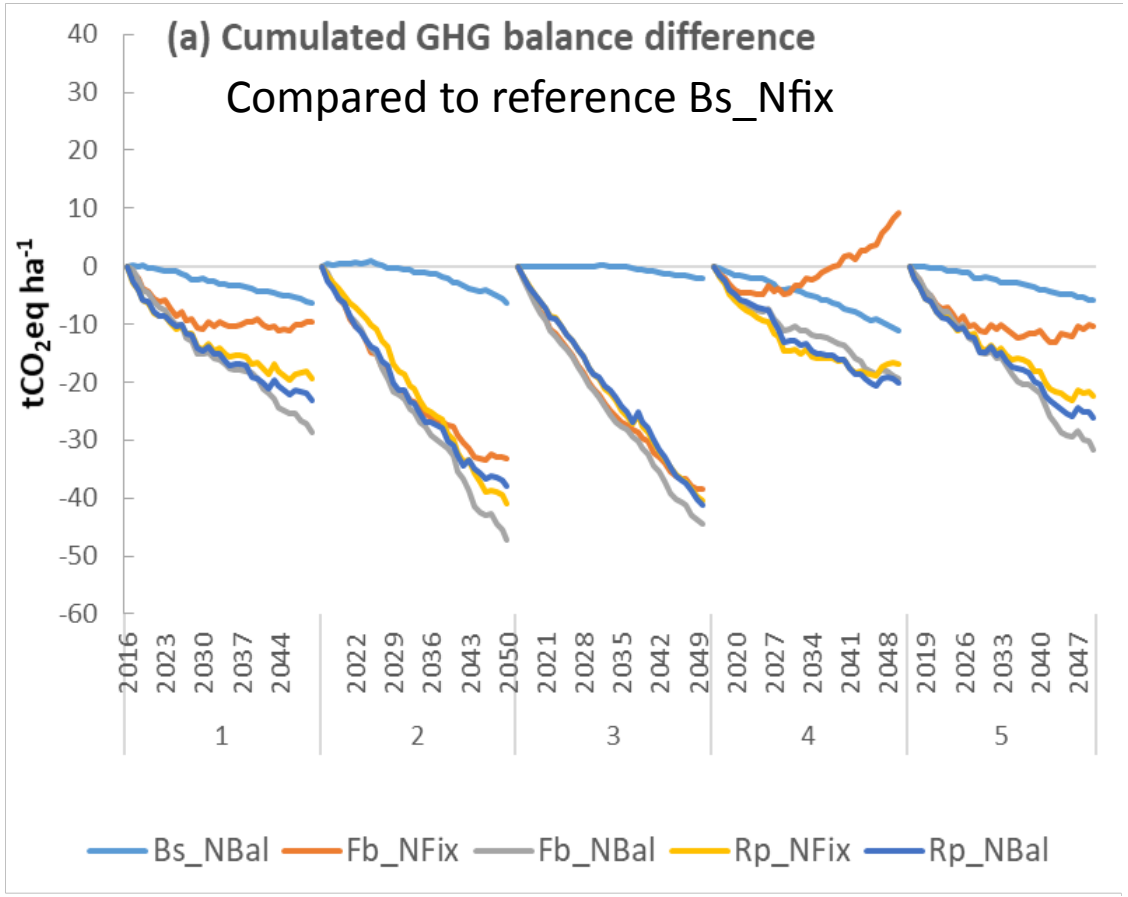


Adapting fertilization *and* introducing cover crop simultaneously to control nitrate leaching



Importance of C storage and N fertilization in GHG balance



N management is essential !

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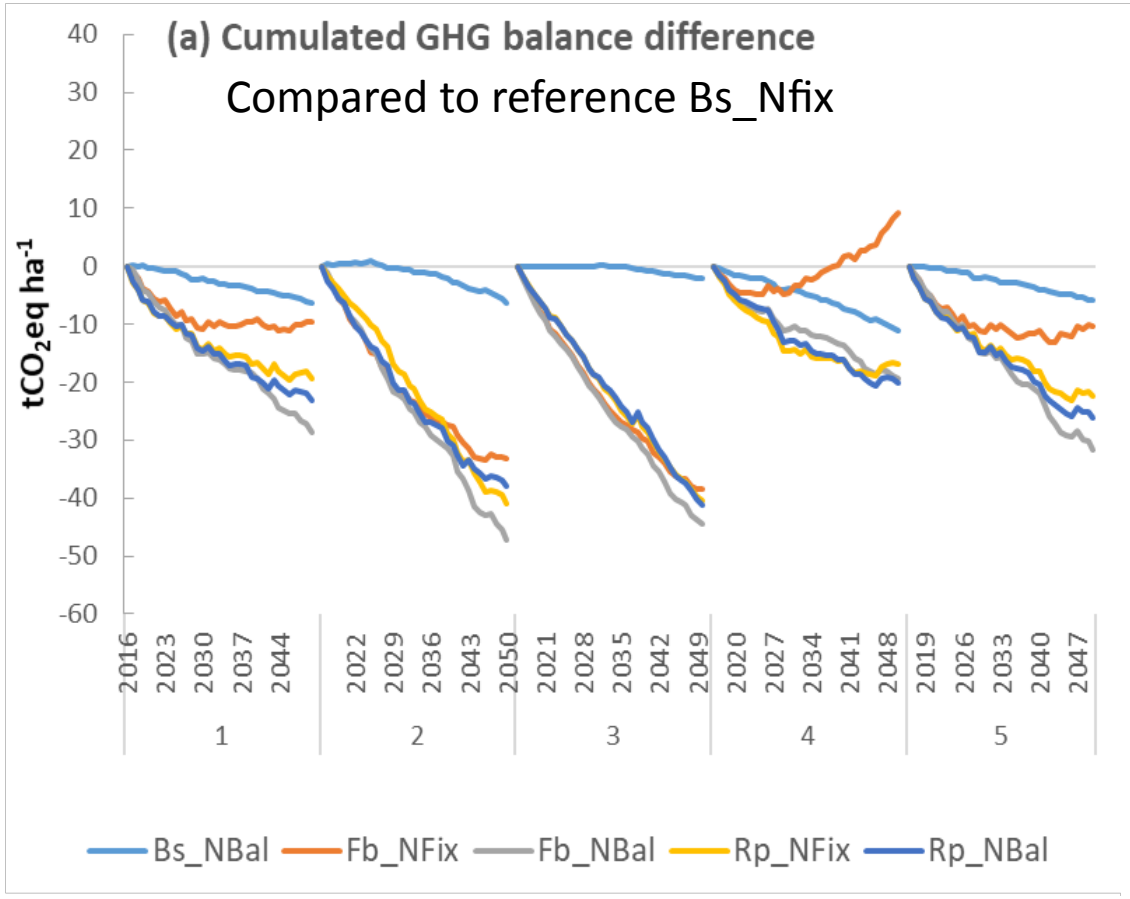

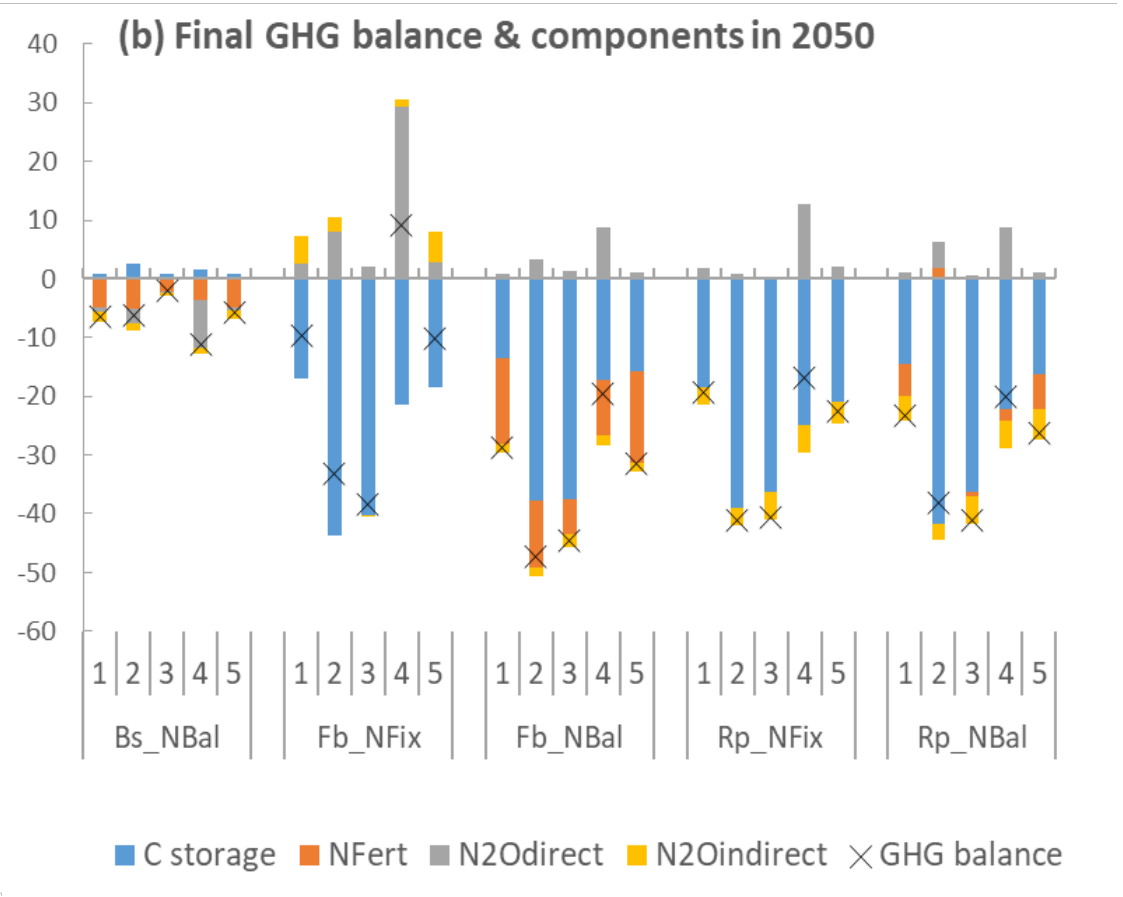

Conclusion- methodological perspectives

- An operational modeling chain in R :
  - Adaptable for other practices (dates of tillage, organic fertilization, variety choice …) and other crops
  - Automatic and simultaneous changes due to climate change for crops and practices
- Potential application on larger spatial scales and more diversified rotations

Conclusion- Agro-environmental performances

- Changes due to climate change for crops *and* practices
- Influence of cover crops and/or adapting N fertilization
  - Major changes in N fertilization needs with maintained yield
  - Increased SOC
  - Range depends on pedoclimate
- **Major potential for mitigation but N management is essential**

Thank you for your attention!

Dynamic calculation of N fertilization with STICS variables

$$N\,fert = N_{need} \times NUE - \left(SMN_i + Nmin\,CC + N\,min\,SOM + N_{irr}\right) + SMN_f$$

Yield (*n-1 à n-5*) × *(STICS)*

[N]/t *(COMIFER)*

Abacus *(COMIFER)*

Nmin soil *(STICS)*

QN plant, C/N *(STICS)*

%Nmin *(MERCI2)*

Mean (n-1 à n-3) *(STICS)*

Abacus *(COMIFER)*

Maize (n-1) — Intercrop (n) — Maize(n)