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Agroscope

Phenology and herbage yield and quality in Swiss permanent grasslands as linked to climate and climate change

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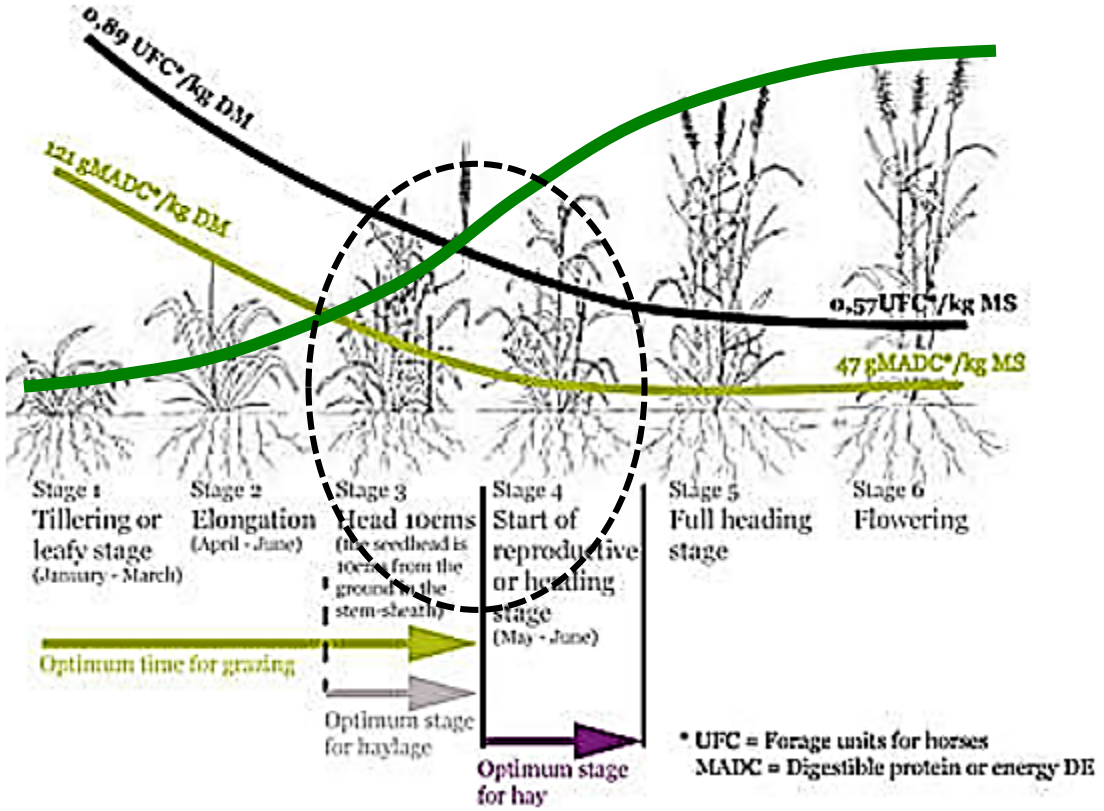
Avignon, Phenology 2022, 20.06.2022

Context

Phenology is key
for determining the optimum time
window for management

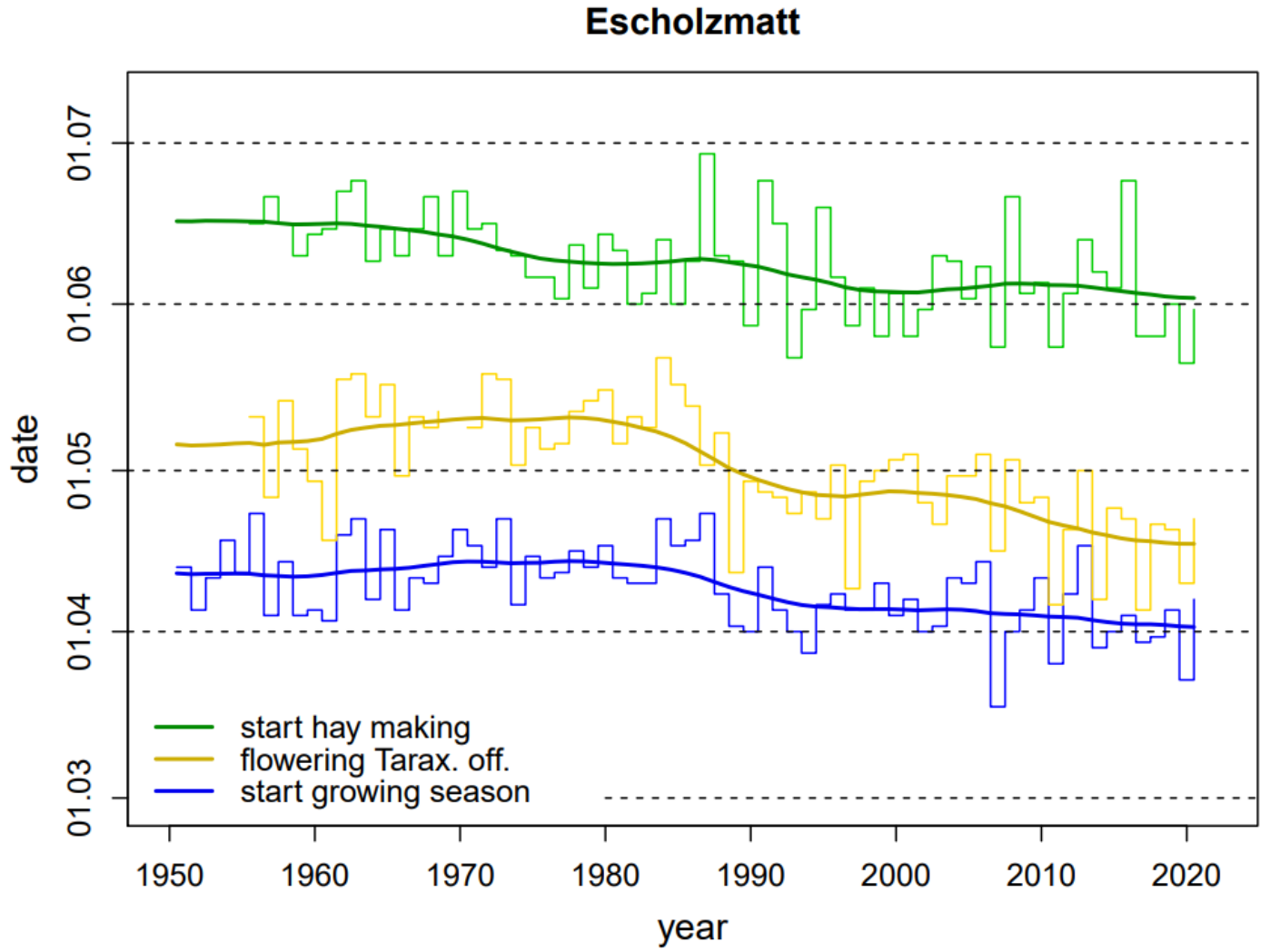
quality / digestibility

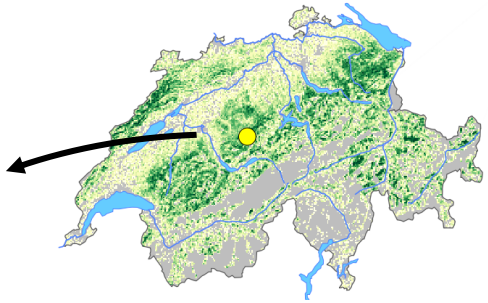
biomass



Development of grasses (Rousset, 2012).
© https://equipedia.ifce.fr/en/equipedia-the-universe-of-the-horse-ifce

Background





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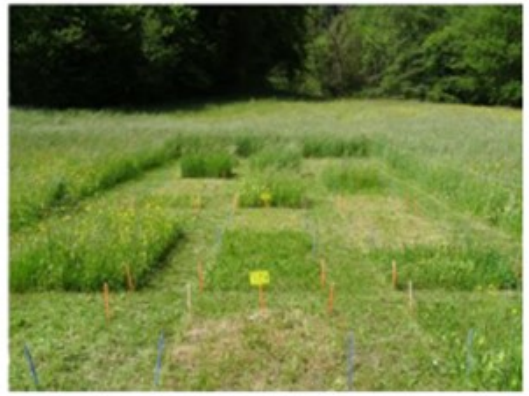
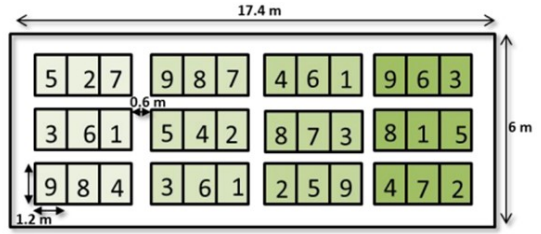
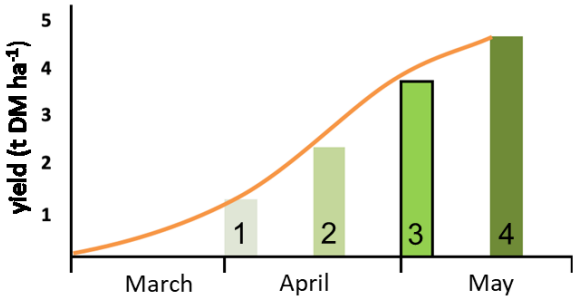
Project Obs'Herbe

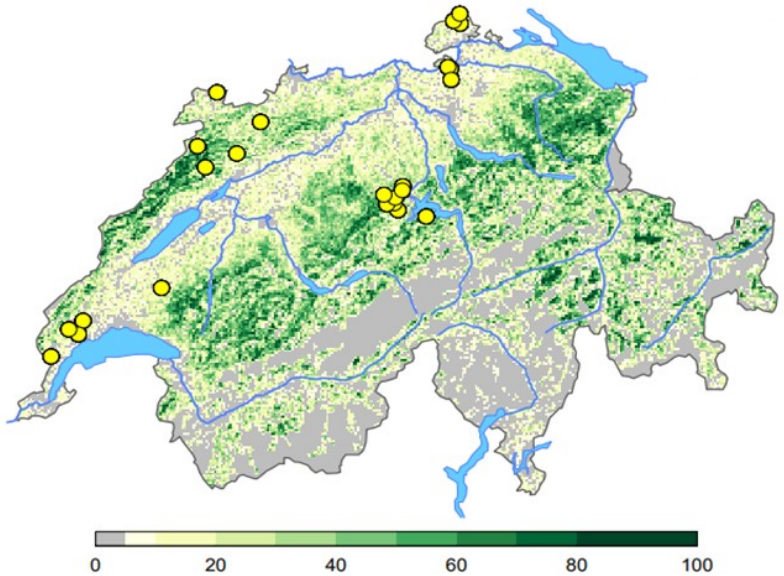
Goals

- Finding pertinent indices for herbage growth and forage quality (1st growth period);
- Assessing temperature sum thresholds for relevant pheno stages;









Setup

- 23 Sites distributed across Switzerland
- Three years of observations (for this analysis): 2017, 2018 and 2019
- 4 cuts every 2 weeks after start of growing season (bands 1 → 4)
- Temperature sum → INRA method (start on February 1st, effective temperature = max(min(T, 18°C), 0°C)

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Grassland phenology

Dactylis glomerata

Lolium perenne

Taraxacum officinale

Trifolium pratense

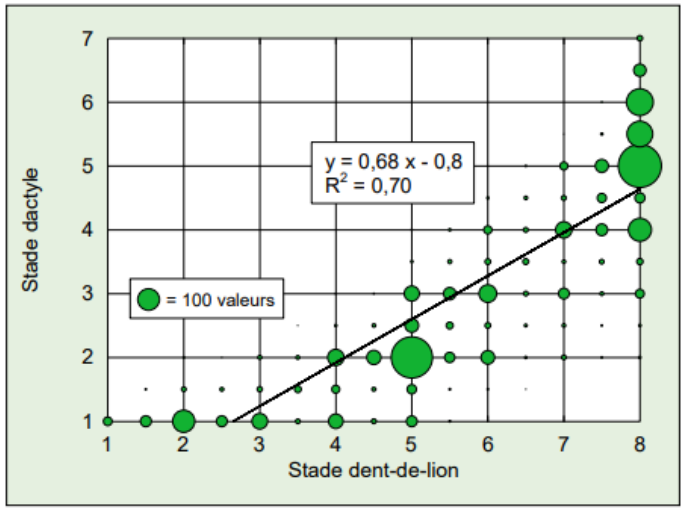


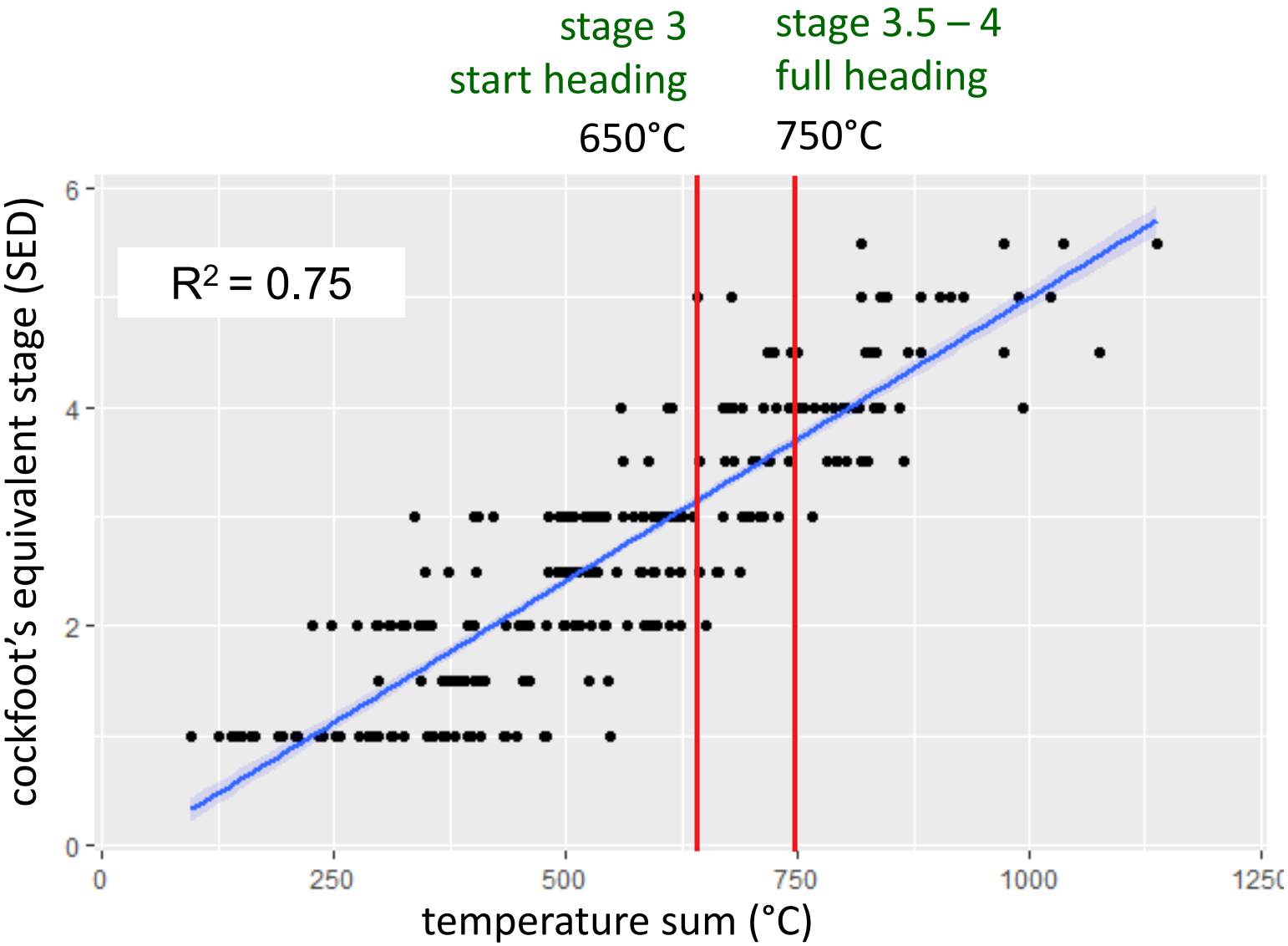
Fig. 8. Stades observés simultanément chez le dactyle et la dent-de-lion au cours de la 1re pousse de 1995 à 2004 sur l'ensemble des prairies permanentes observées (n = 2930).

Definition of a "mean phenology" by relating the phenology of individual species to the one of a *reference species* (*Dactylis glomerata*)

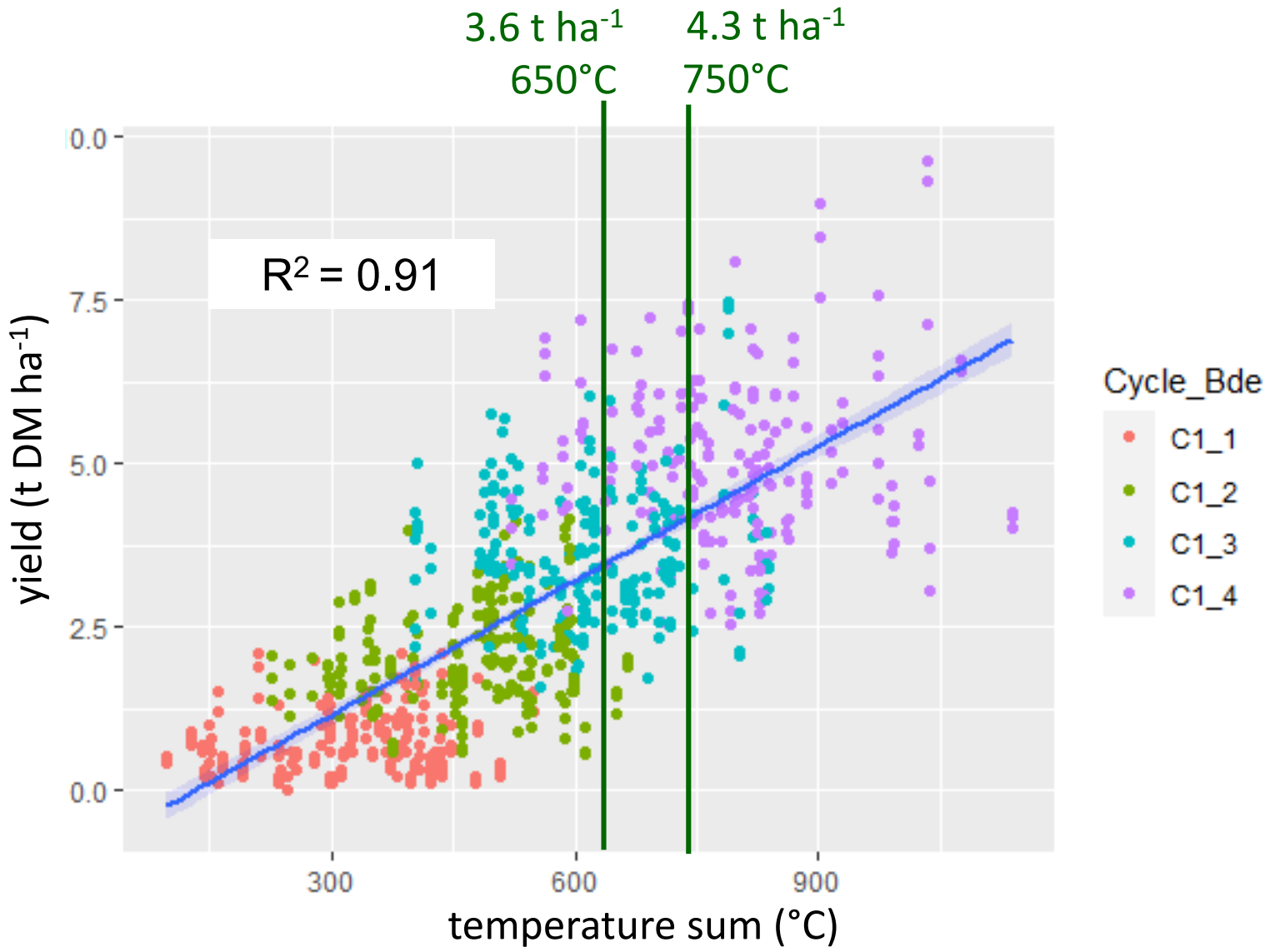
Stade Equivalent Dactyle (SED) (cocksfoot's equivalent stage)

Jeangros & Amaudruz (2005)

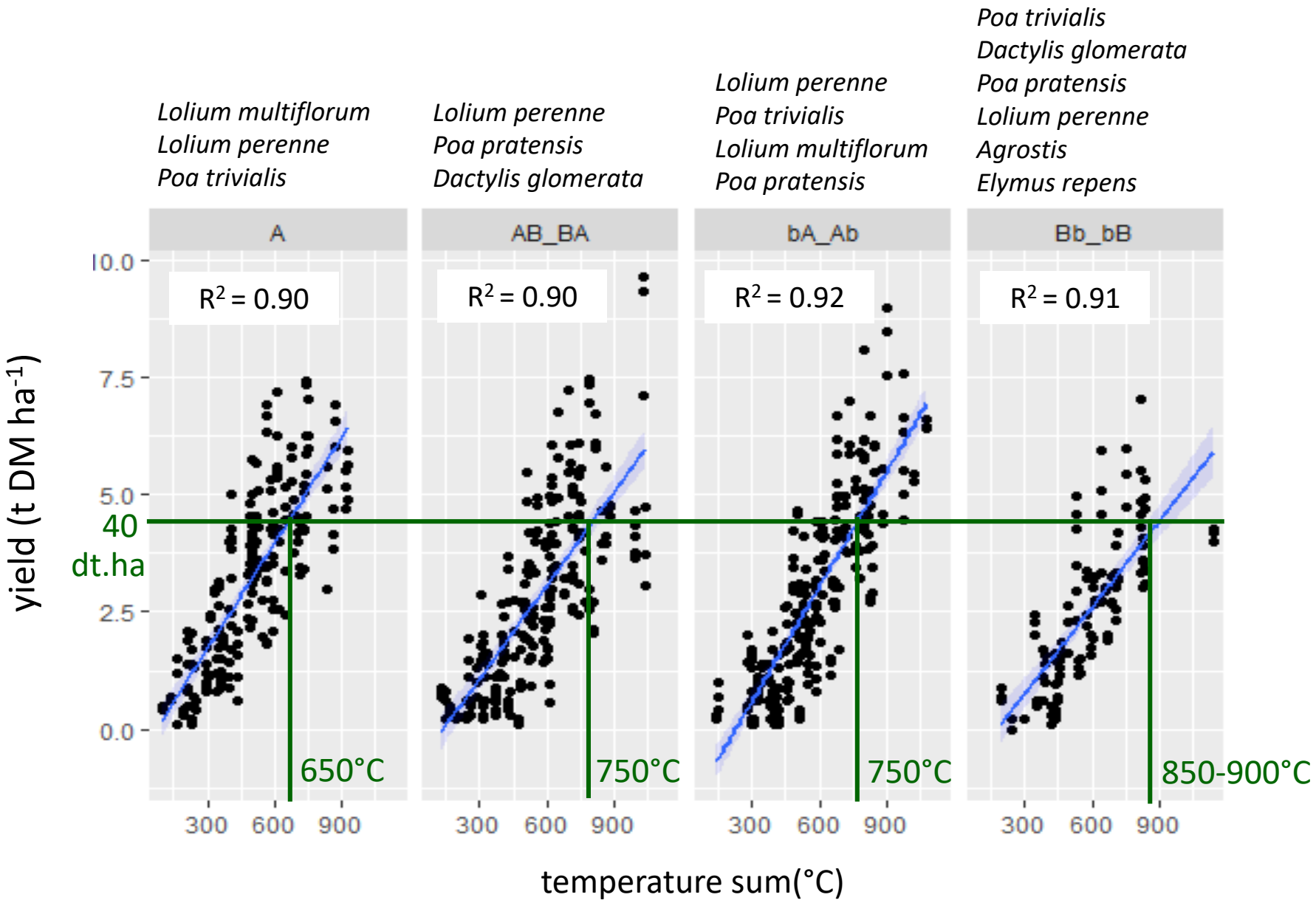
Results: phenology



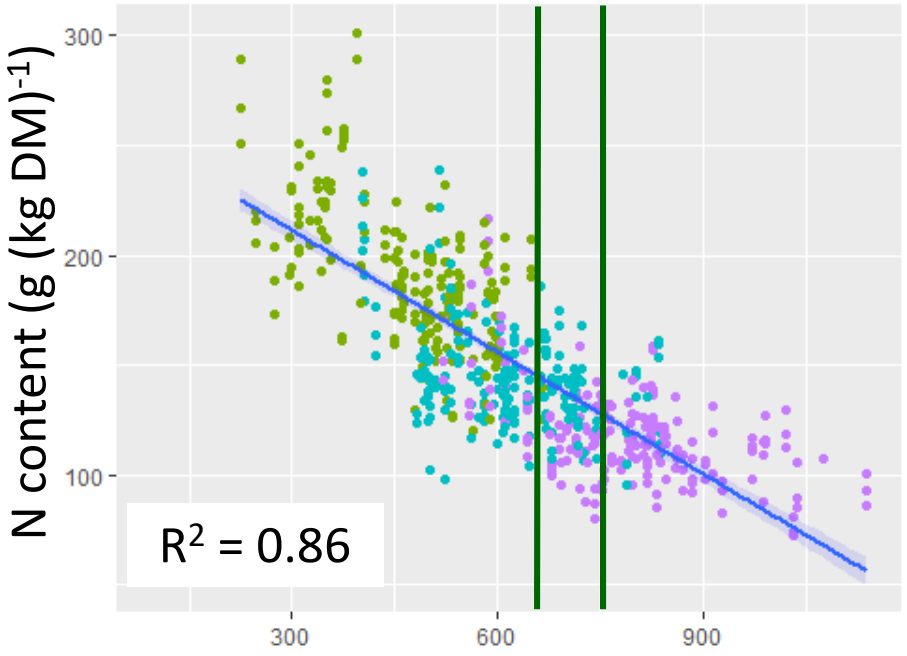
Results: DM yield



Results:

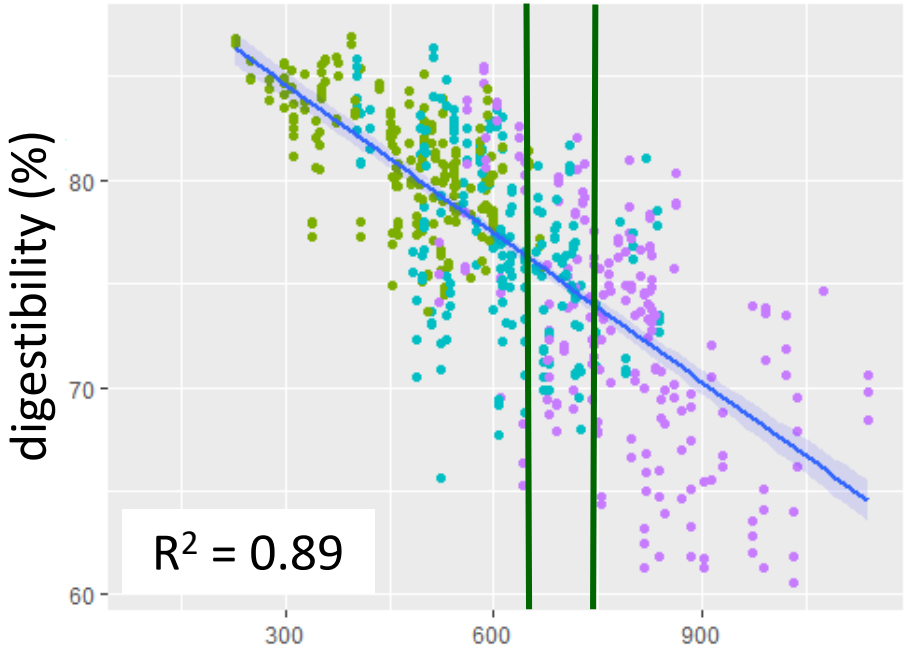

Lolium multiflorum
Lolium perenne
Poa trivialis
Lolium perenne
Poa pratensis
Dactylis glomerata
Lolium perenne
Poa trivialis
Lolium multiflorum
Poa pratensis
Poa trivialis
Dactylis glomerata
Poa pratensis
Lolium perenne
Agrostis
Elymus repens
A
AB_BA
bA_Ab
Bb_bB
R² = 0.90
R² = 0.90
R² = 0.92
R² = 0.91
yield (t DM ha-1)
10.0
7.5
5.0
2.5
0.0
40
dt.ha
650°C
750°C
750°C
850-900°C
300
600
900
temperature sum(°C)

Results: yield quality



650°C 750°C

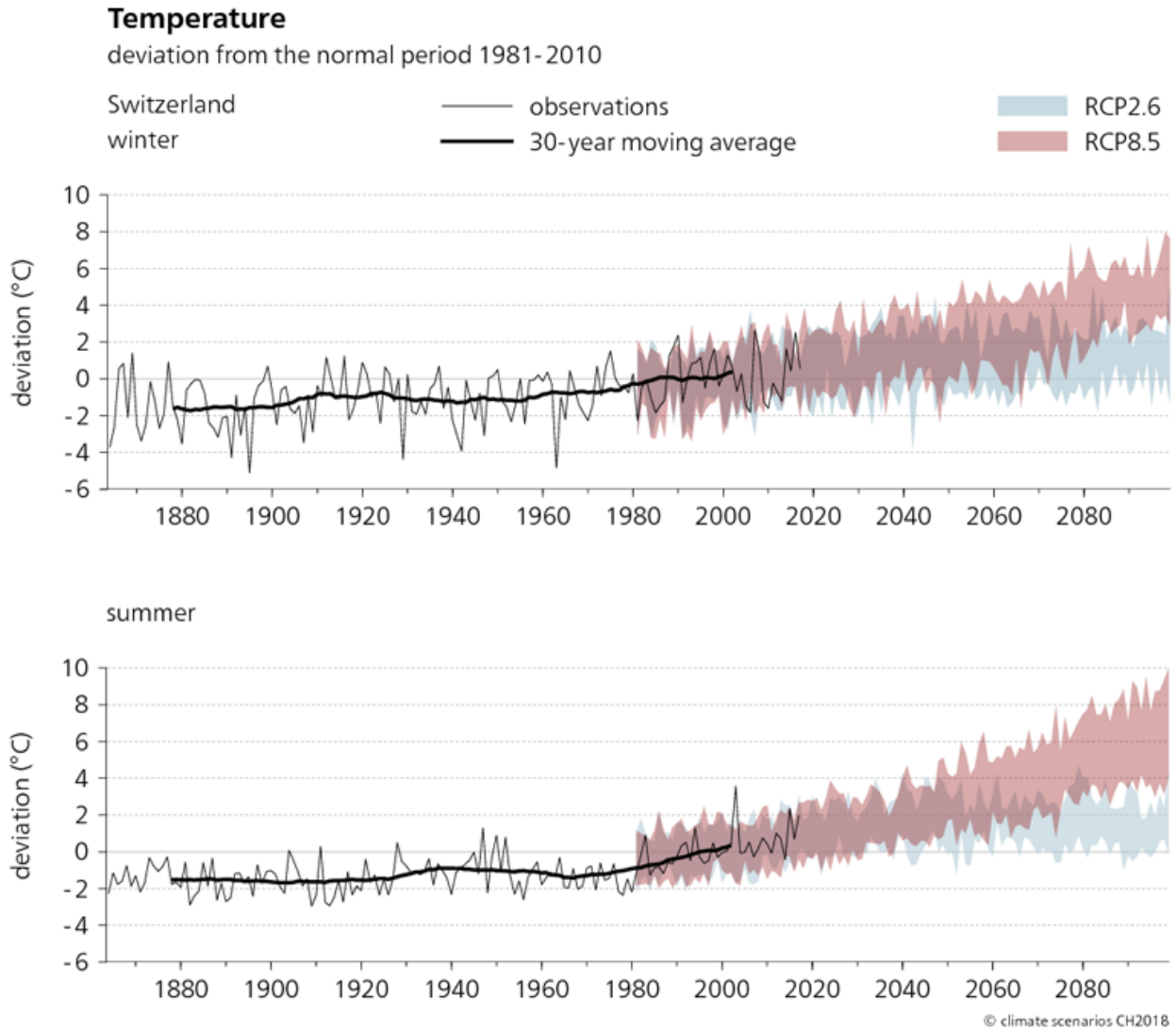
146.6 g kg^{-1} 128.1 g kg^{-1}



650°C 750°C

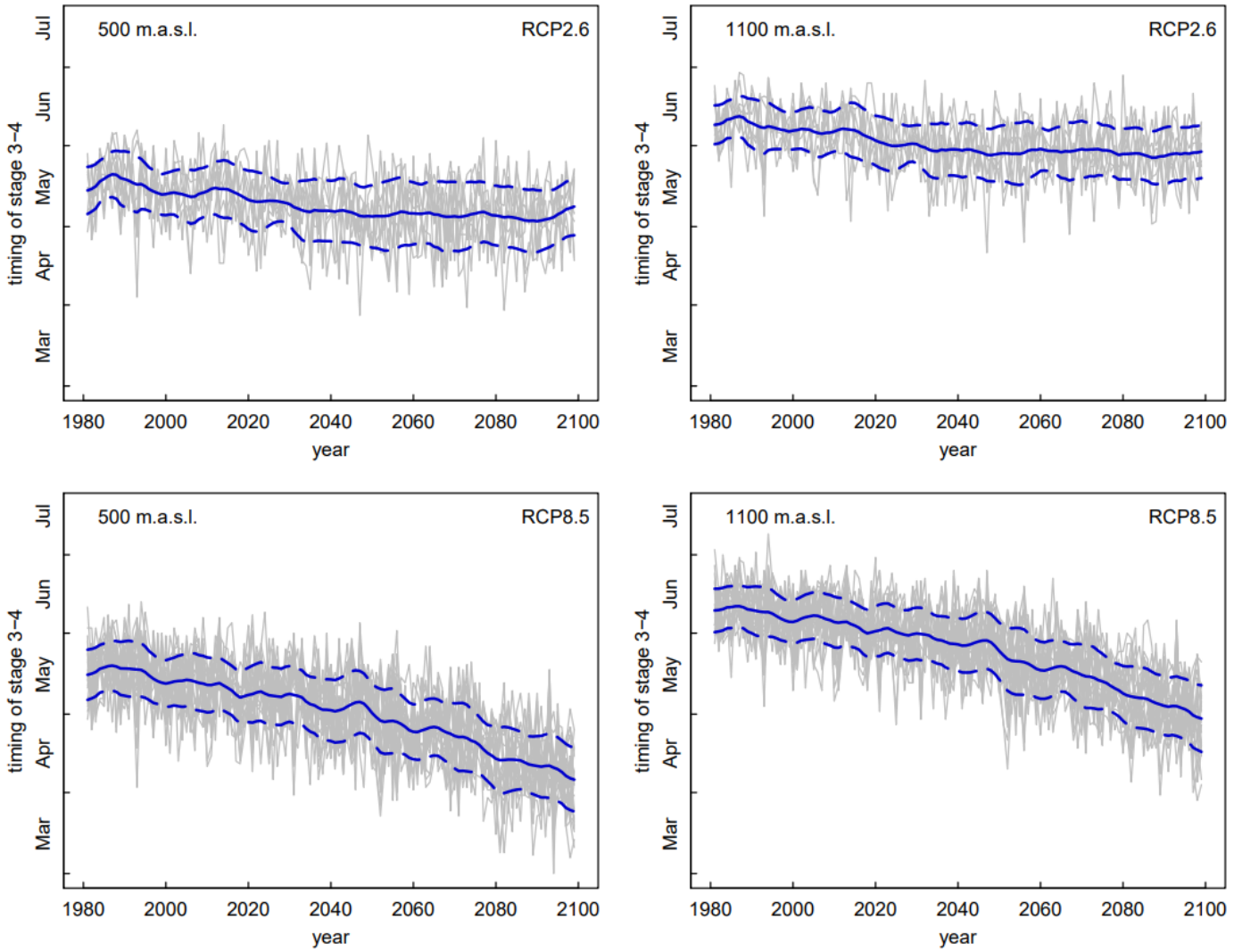
76.2% 73.8%

Climate change



An additional +2°C until the mid of the century

Impacts of climate change



Depending on scenario and geographic location, optimum time window shifting to as early as mid of April by the mid of the century

Open questions: “mean phenology”

- How to define it?
- Should relative abundances be taken into account?
- Are linear relations appropriate?

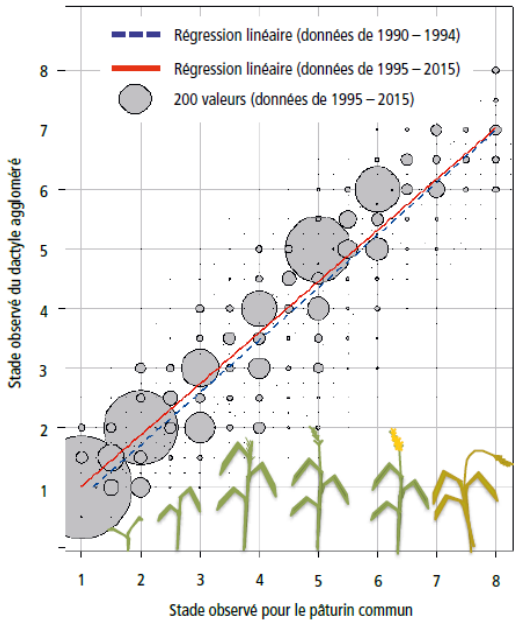


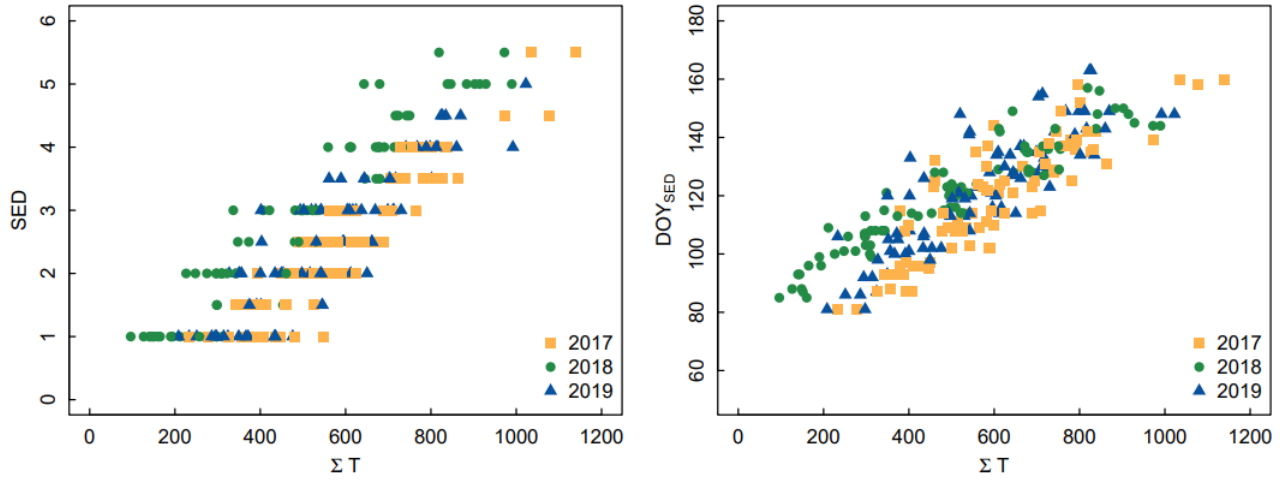
Tableau 2 | Nouvelles équations «stade équivalent dactyle» pour les prairies permanentes

Nom commun	Nom latin	Equation (y = stade équivalent dactyle, x = stade espèce)	R^2
Dent de Lion	*Taraxacum officinale*	$y = 0{,}096x^2 - 0{,}324x + 1{,}395$	0,74
Pâturin commun	*Poa trivialis*	$y = 0{,}858x + 0{,}162$	0,84
Fléole	*Phleum pratense*	$y = -0{,}158x^2 + 2{,}174x - 0{,}411$	0,74
Trèfle violet	*Trifolium pratense*	$y = 0{,}898x + 0{,}504$	0,85
Marguerite	*Leucanthemum vulgare*	$y = 1{,}006x - 0{,}070$	0,77
Vulpin des prés	*Alopercurus pratensis*	$y = 0{,}109x^2 - 0{,}206x + 1{,}214$	0,77
Ray-grass anglais	*Lolium perenne*	$y = 0{,}907x + 0{,}384$	0,84
Anthrisque sauvage	*Anthriscus sylvestris*	$y = 0{,}089x^2 + 0{,}035x + 0{,}929$	0,83
Renoncule âcre	*Ranunculus acris friesianus*	$y = 0{,}085x^2 + 0{,}092x + 0{,}801$	0,84
Flouve odorante	*Anthoxanthum odoratum*	$y = 0{,}032x^3 - 0{,}239x^2 + 0{,}560x + 0{,}787$	0,82
Cardamine des prés	*Cardamine pratensis*	$y = 0{,}762x - 1{,}786$	0,52

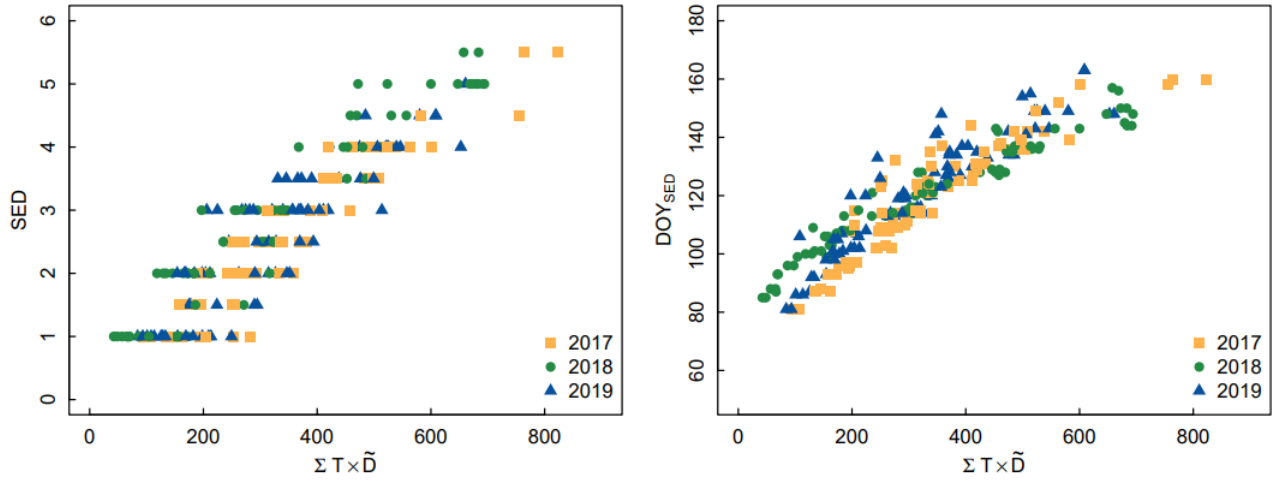
Vuffray et al. (2016)

Open questions: temperature sums

- Which temperature, over which time window?
- Considering temperature only, or including other factors such as day length (DL)?



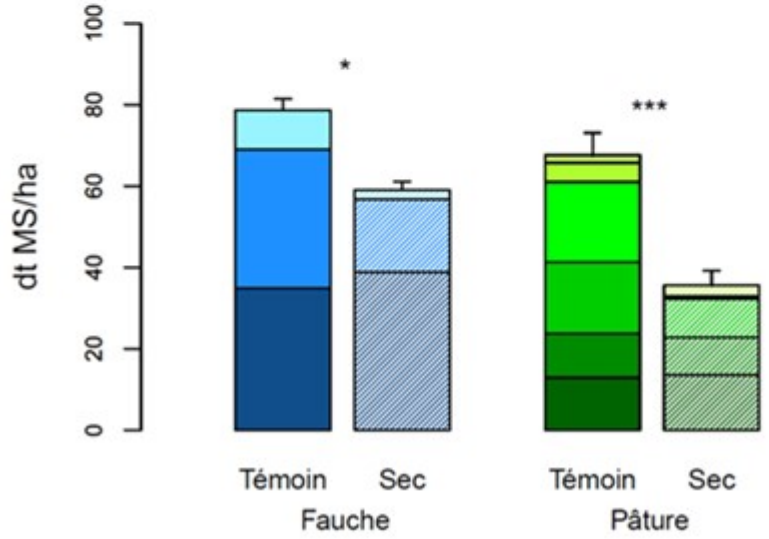
$$\sum_{?}^{DOY} T$$



$$\sum_{?}^{DOY} T \cdot \frac{DL - DL_{min}}{DL_{max} - DL_{min}}$$

Open questions: role of management

- How does “mean phenology” depend on species / PFTs composition?
- What are the effects of management?
- What are the repercussions of extreme events?
- How are these determinants intertwined?















Thank you for your attention

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