remote sensing

MDPI

Additional material

Insuring Alpine grasslands against drought-related yield losses by Sentinel-2 satellite data

Mariapina Castelli [1,*], Giovanni Peratoner [2], Luca Pasolli [1], Giulia Molisse [1,3], Alexander Dovas [2], Gabriel Sicher [2,4], Alice Crespi [1,5], Mattia Rossi [1,6], Mohammad Hussein Alasawedah [1], Evelyn Soini [7], Roberto Monsorno [8], Claudia Notarnicola [1]

1 Eurac Research, Institute for Earth Observation; Mariapina.castelli@eurac.edu
2 Laimburg Research Centre, Research Area Mountain Agriculture
3 Present address: Trove Research
4 Present address: Hagelschutzkonsortium - Condifesa Bolzano
5 Present address: Eurac Research, Center for Climate Change and Transformation
6 Present address: Joint Research Center (European Commission)
7 Laimburg Research Centre, Research Area Agricultural Chemistry
8 Eurac Research, Center for Sensing Solutions

* Correspondence: mariapina.castelli@eurac.edu; Tel.: +390471055381

Citation: Lastname, F.; Lastname, F.; Lastname, F. Title. *Remote Sens.* **2023**, *XX*, x. https://doi.org/xxxxxxx/xxxxx

Academic Editor: Firstname Lastname

Received: date
Accepted: date
Published: date

Table S1.

Management and botanical composition of the investigated meadows at the test sites. The nutrient input was estimated according to the amount and the dilution of the liquid manures (slurry, manure effluent) as estimated by the farmers and to the reference values of the nutrient content of organic manures for South Tyrol [1]. AG = autumn grazing; FM = farmyard manure, ME = manure effluent, S = slurry, SL = liquid phase of separated slurry, BS = biogas slurry; G = grasses, L = legumes, F = forbs. The main species, listed by decreasing rank of yield proportion, are those providing 80% yield proportion. Ach mil = *Achillea millefolium*, Alo pra = *Alopecurus pratensis*, Ant syl = *Anthriscus sylvestris*, Arr ela = *Arrhenatherum elatius*, Bro hor = *Bromus hordeaceus*, Dac glo = *Dactylis glomerata*, Ely rep = *Elymus repens*, Fes pra = *Festuca pratensis*, Lol per = *Lolium perenne*, Phl pra = *Phleum pratense*, Poa pra = *Poa pratensis*, Poa tri = *Poa trivialis*, Ran acr = *Ranunculus acris*, Sil vul = *Silene vulgaris*, Tar off = *Taraxacum officinale*, Tri pra = *Trifolium pratense*, Tri rep = *Trifolium repens*.

Site (Province)	Parcel Code	Cut frequency [cuts year^{-1}]	Manure type	Nutrient input [kg ha^{-1} year^{-1}]			Species number	Yield proportion [%]			Main species
				Total N	P	K		G	L	F	
Laurein (BZ)	L1	2	FM + ME	112	24	157	27	69	9	22	Lol per, Dac glo, Phl pra, Bro hor, Poa pra, Tar off, Tri rep, Sil vul
	L2	3					24	72	20	8	Poa pra, Tri rep, Dac glo, Ely rep
Ritten (BZ)	R1	3 + AG	S + SL	183	33	240	19	69	12	19	Dac glo, Alo pra, Tri rep, Fes pra, Poa tri, Tar off, Ran acr
	R2	3 +AG					15	75	18	7	Dac glo, Alo pra, Tri rep, Fes pra, Poa pra
	R3	4	FM + S	189	45	192	19	83	4	13	Alo pra, Poa pra, Bro hor, Tar off
	R4	4					11	85	11	4	Alo pra, Poa tri, Tri pra
Fondo (TN)	F1	3	BS	179	38	233	14	75	0	25	Alo pra, Ant syl
	F2	2					8	99	0	1	Ely rep, Arr ela, Poa pra

Figure S2.

Flowchart of the methods for the experiment of S2 LAI enrichment by S1 SAR data

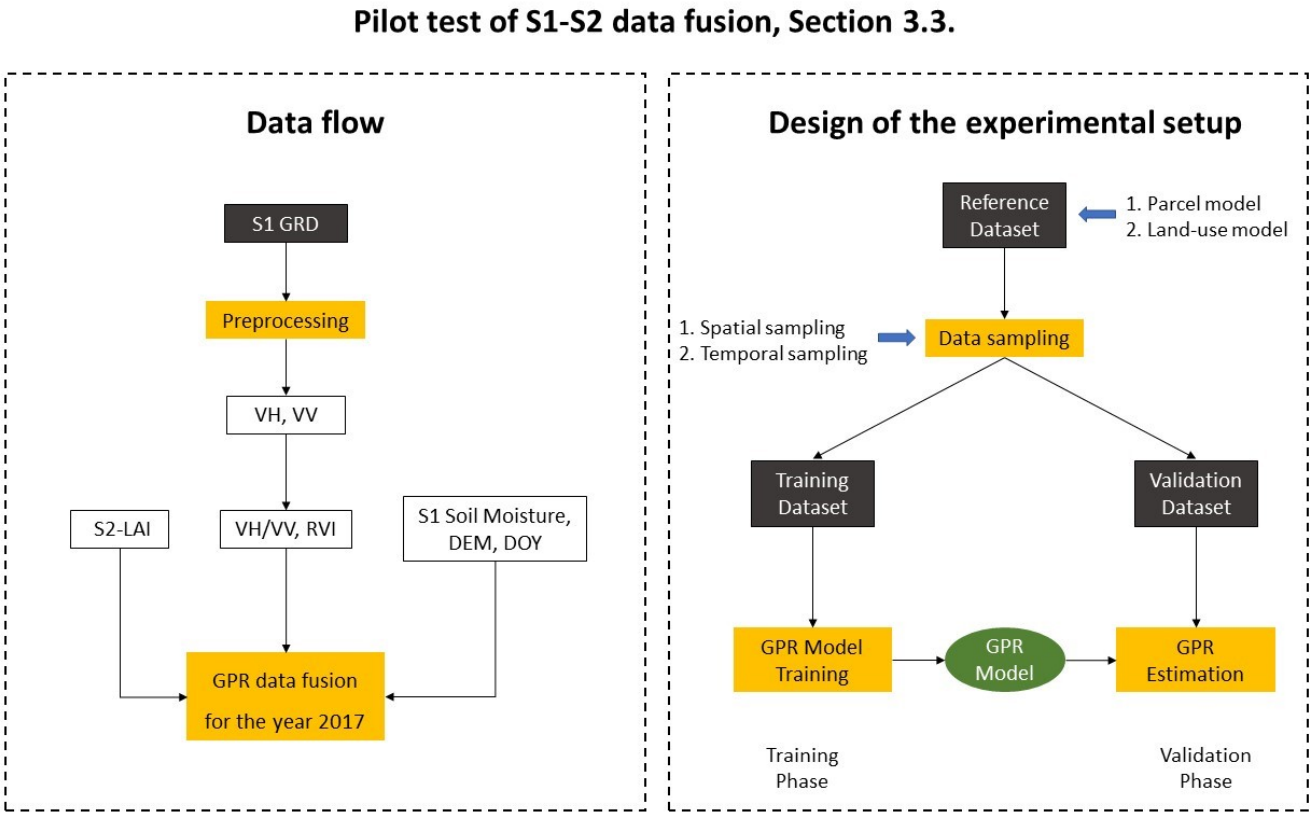
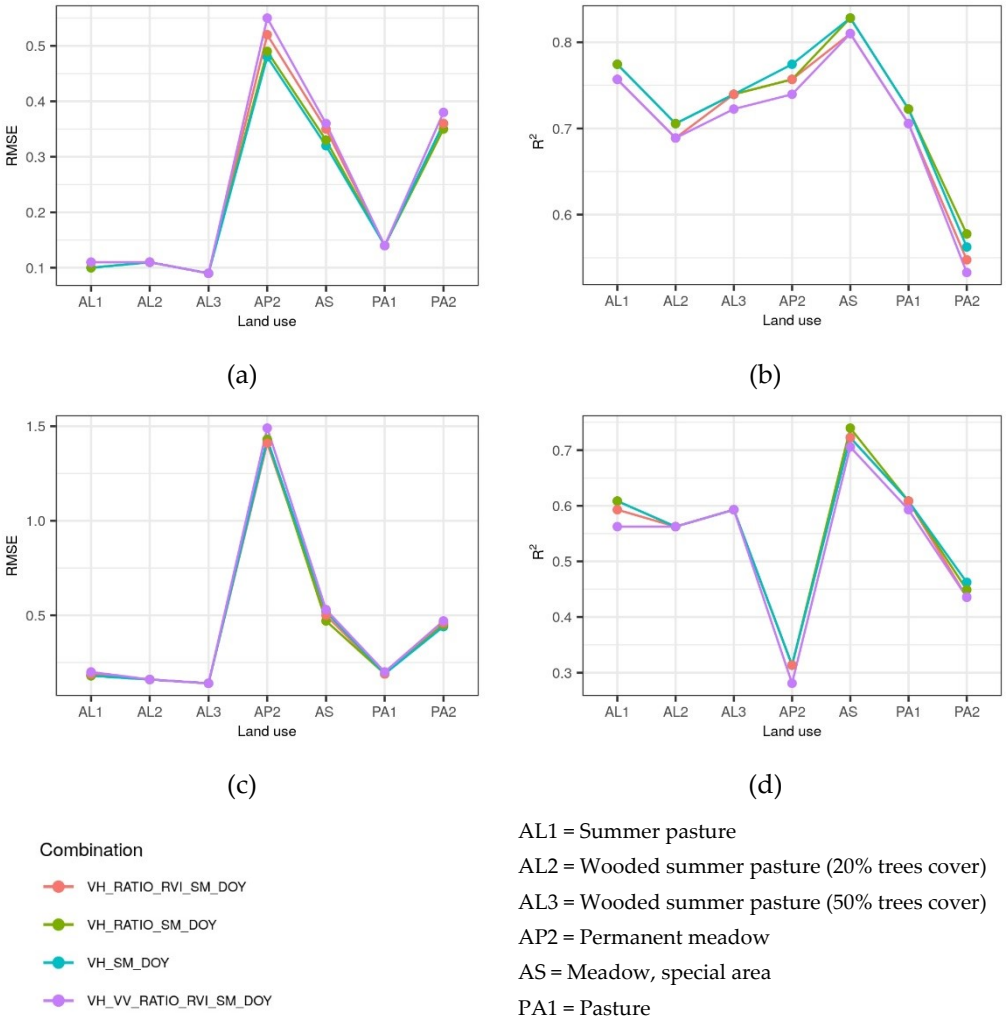


Figure S3.

Summary of the performances of the combinations of input features providing lowest RMSE and highest r for the different land uses. (a) and (b): RMSE and R^2 for the parcel scale analysis. (c) and (d): RMSE and R^2 for the analysis performed aggregating all the parcels with the same land use.



AL1 = Summer pasture
AL2 = Wooded summer pasture (20% trees cover)
AL3 = Wooded summer pasture (50% trees cover)
AP2 = Permanent meadow
AS = Meadow, special area
PA1 = Pasture
PA2 = Wooded pasture (20% trees cover)

Figure S4.

Summary of the temporal gap-filling experiment for different numbers of missing acquisition dates. (a) and (b): RMSE and R^2 for the parcel scale analysis. (c) and (d): RMSE and R^2 for the analysis performed aggregating all the parcels with the same land use.

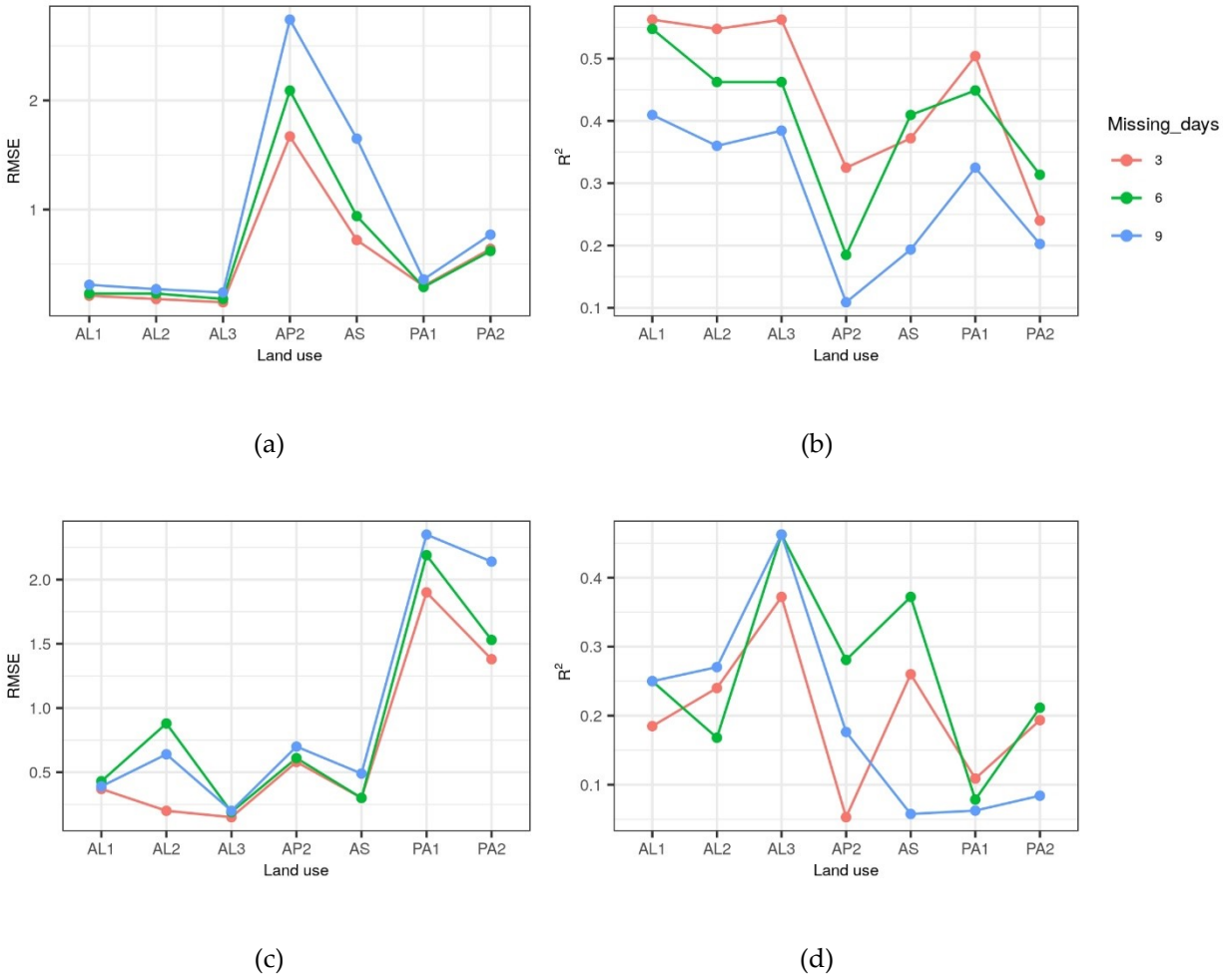


Figure S5.

Summary of the spatial gap-filling experiment for different dimension of the gaps, corresponding to 30%, 50%, or 70% of the pixels. (a) and (b): RMSE and R^2 for the parcel scale analysis. (c) and (d): RMSE and R^2 for the analysis performed aggregating all the parcels with the same land use.

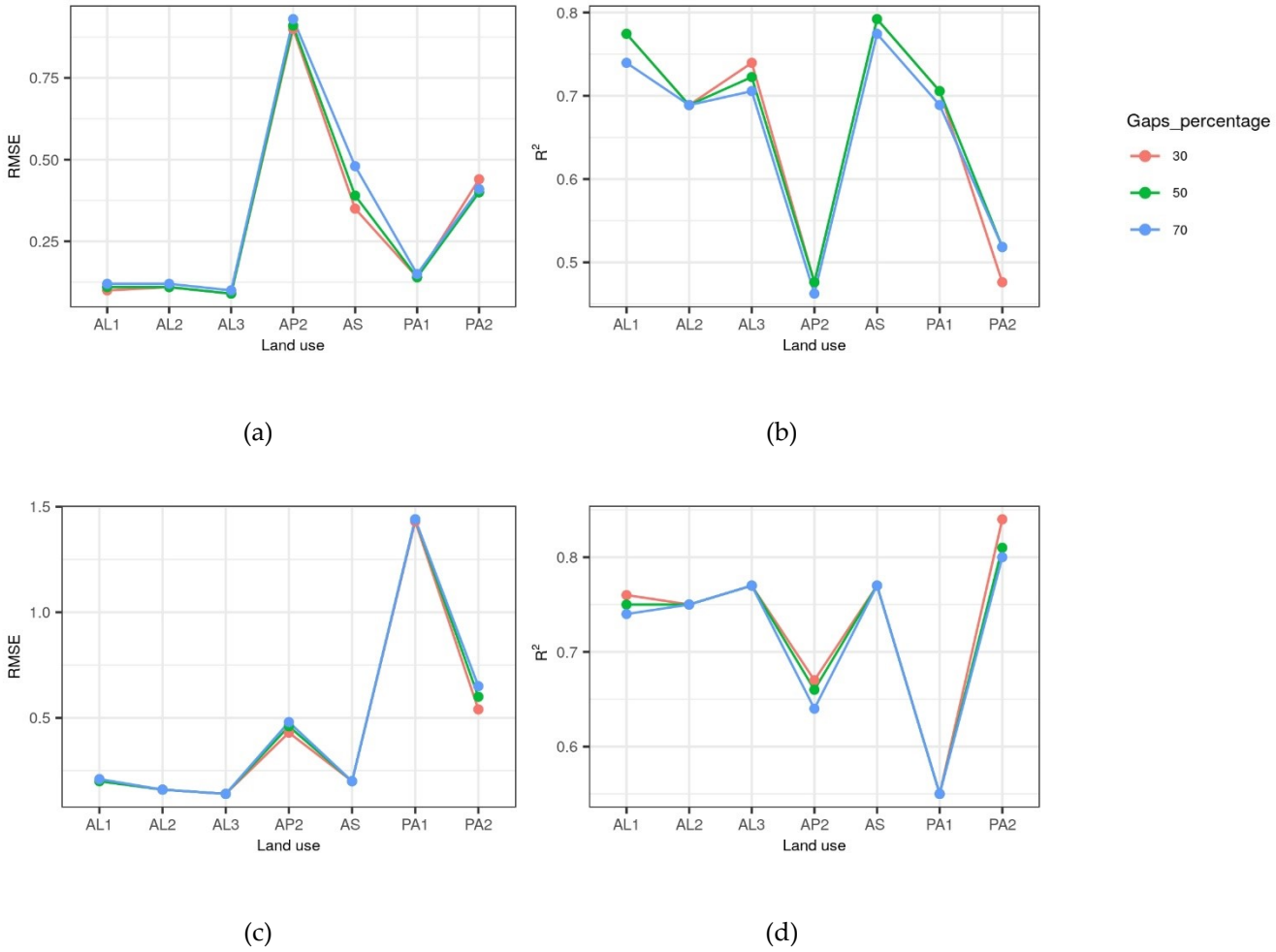


Figure S6.

Scatterplots of estimated FPI and aboveground biomass (a) at pixel level considering all observations, (b) at pixel level without the observations close to mowing dates, (c) at parcel level considering all observations, and (d) at parcel level without the observations close to the mowing dates. The grey shaded areas represent the 95% confidence intervals of the slope of the regression line.

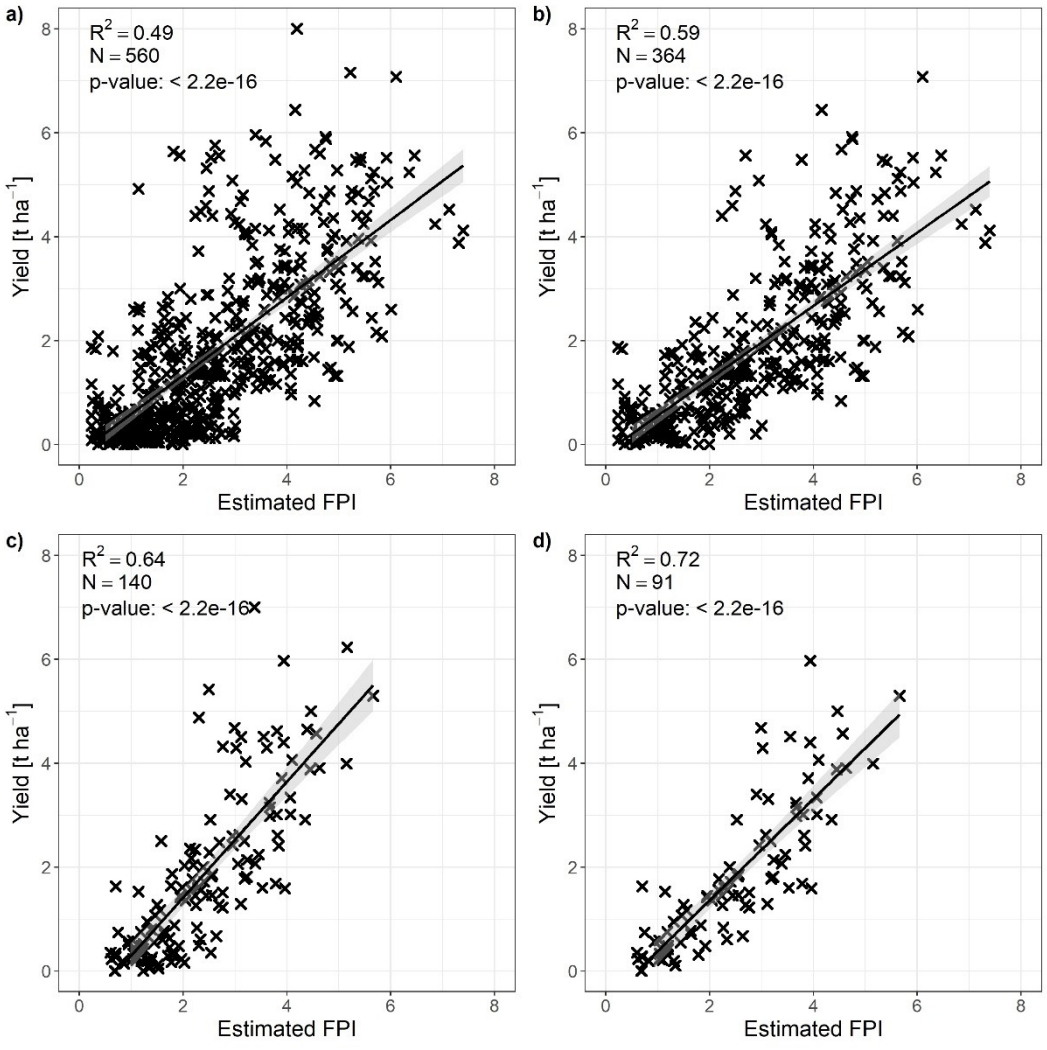


Figure S7.

Scatterplots of estimated LAI (referred to the date two days before AGB sampling date) and aboveground biomass (a) at pixel level considering all observations, (b) at pixel level without observations close to the mowing dates, (c) at parcel level considering all observations, and (d) at parcel level without observations close to the mowing dates. The grey shaded areas represent the 95% confidence intervals of the slope of the regression line.

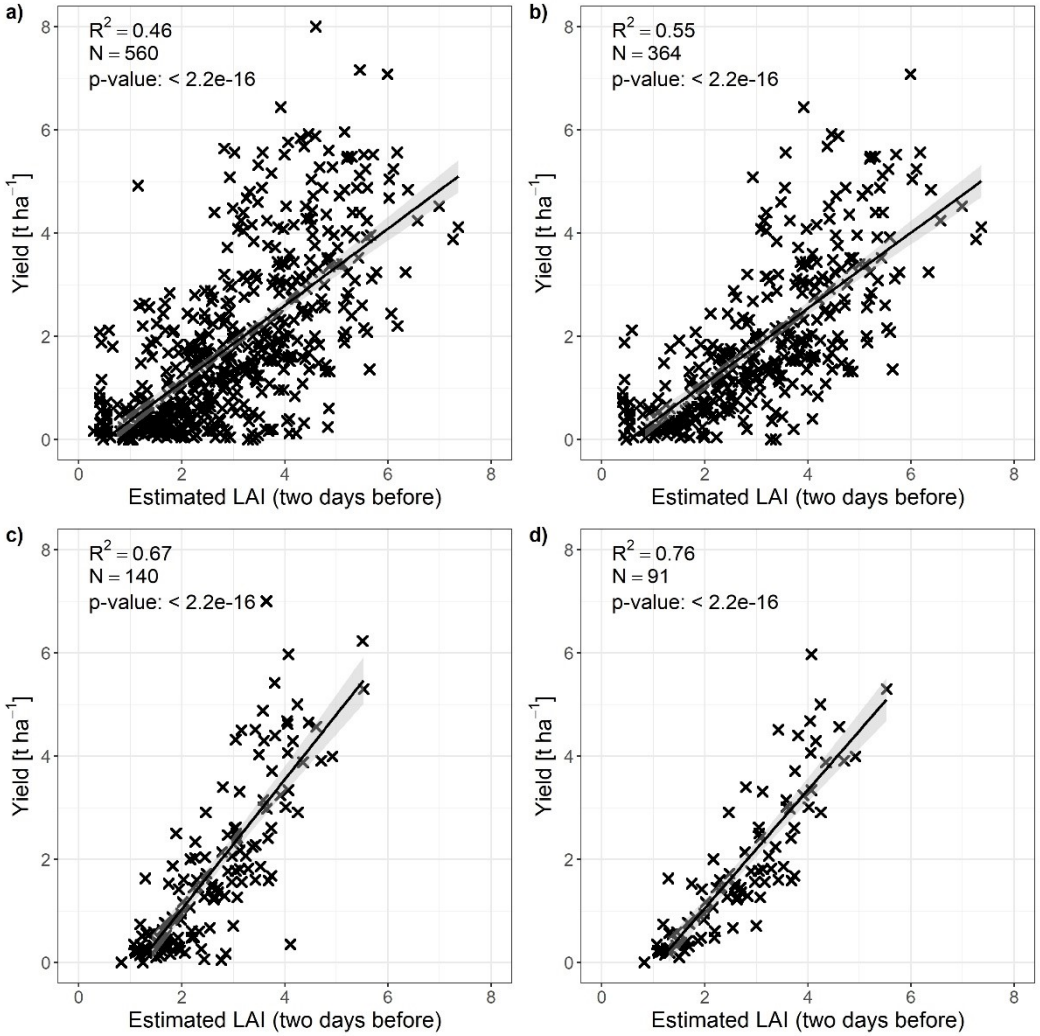
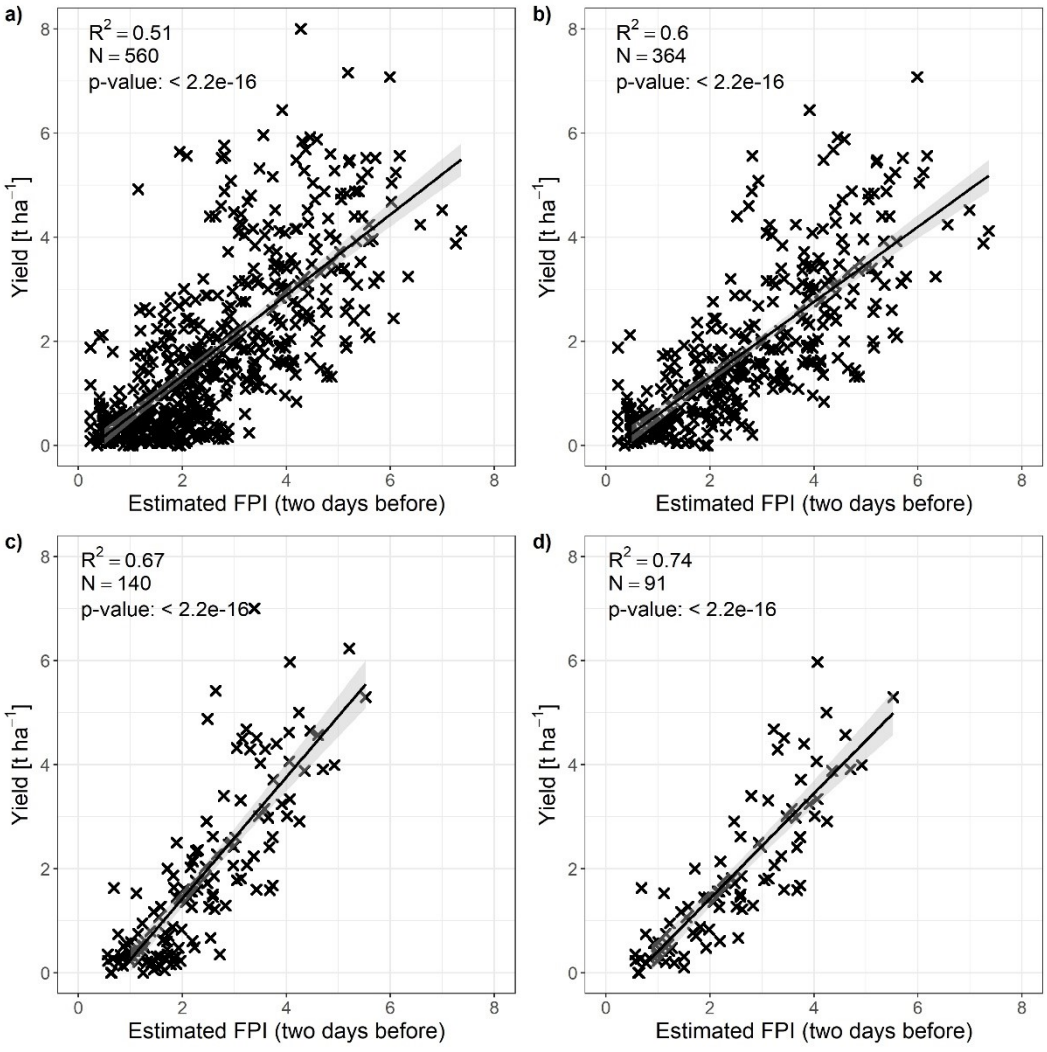


Figure S8.

Scatterplots of FPI (referred to the date two days before AGB sampling date) and above-ground biomass (a) at pixel level considering all observations, (b) at pixel level without observations close to the mowing dates, (c) at parcel level considering all observations, and (d) at parcel level without observations close to the mowing dates. The grey shaded areas represent the 95% confidence intervals of the slope of the regression line.



References

1. Peratoner, G.; Sicher, G.; Matteazzi, A. Richtwerte des Nährstoffgehalts von Wirtschaftsdüngern in Südtirol. Tabellenwerk 2022. *Pfatten/Vadena: Versuchszentrum Laimburg*. 2022. Available online: https://t1p.de/kmm9.