Food and Agriculture Organization of the United Nations

GLOBAL SYMPOSIUM ON SOIL INFORMATION AND DATA

MEASURE
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ASSESSING THE SOIL CAPACITY TO PRODUCE FOOD AND BIOMASS WORLDWIDE

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ESALQ

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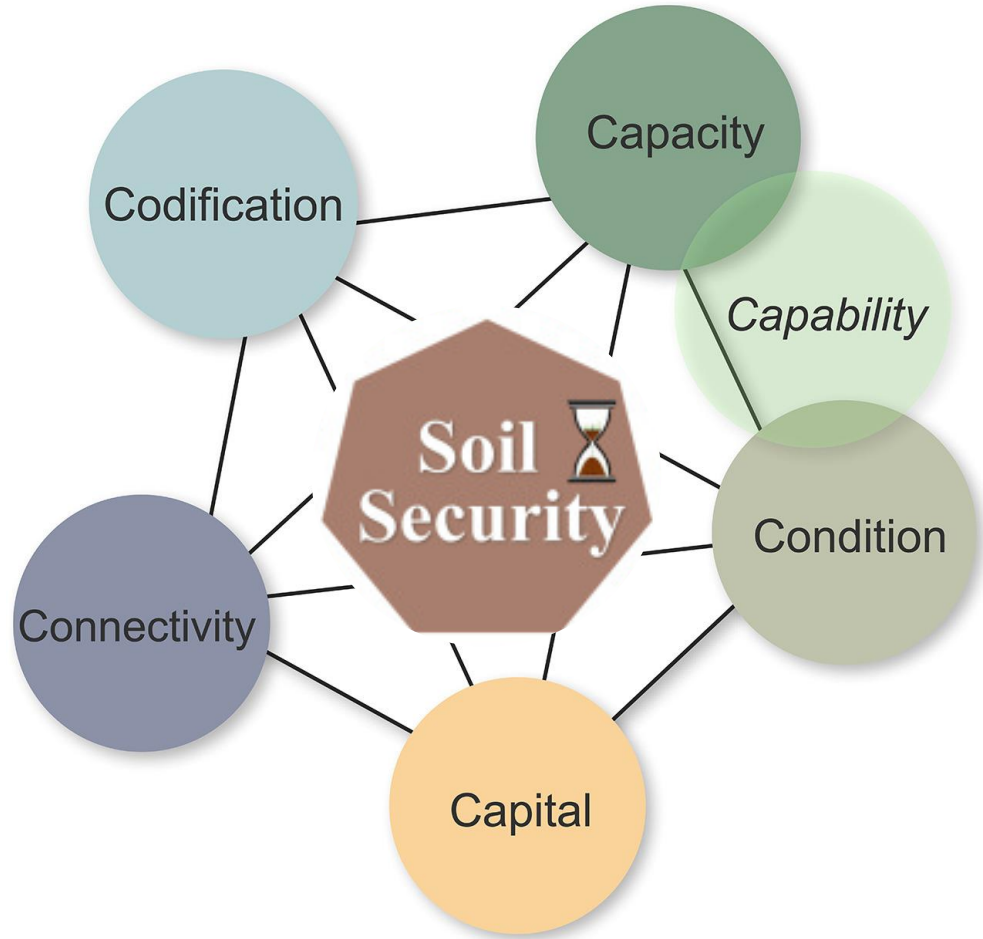
GLOBAL SOIL PARTNERSHIP

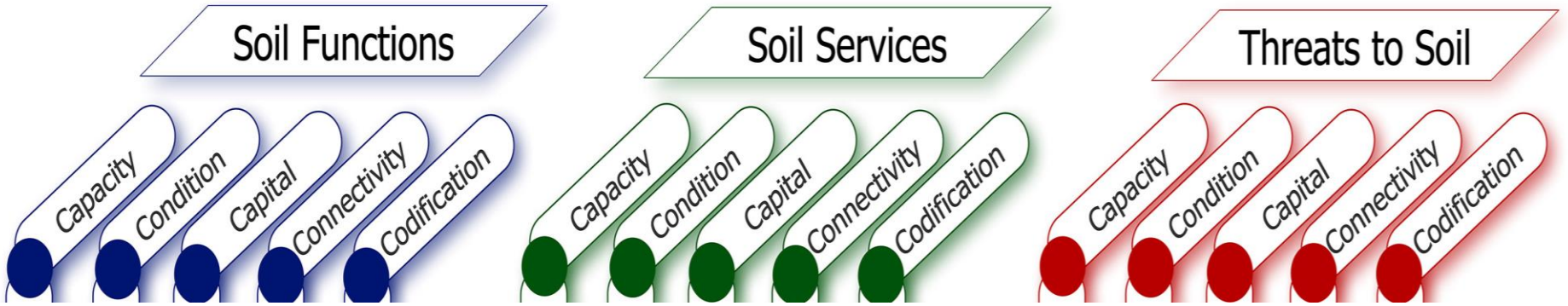
Introduction



Souce: Evangelista et al. (2024)

Introduction

Soil security roles and dimensions

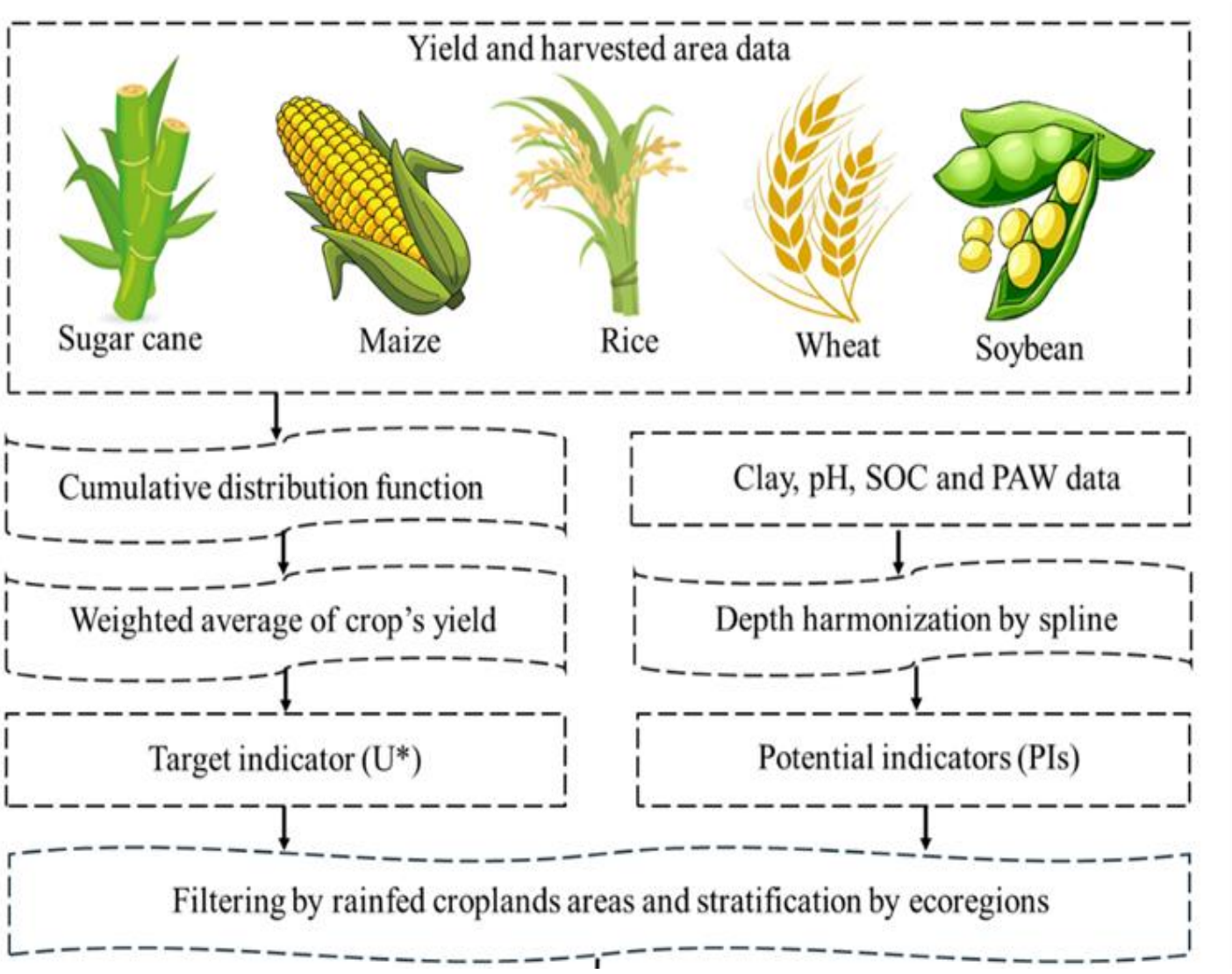


Souce: Evangelista et al. (2024)

Objective: To assess the relationship between crop's yield and soil attributes (in surface and subsoil layers) across the world's ecoregions and to map the soil capacity to produce food and biomass worldwide with a soil security assessment framework (SSAF)

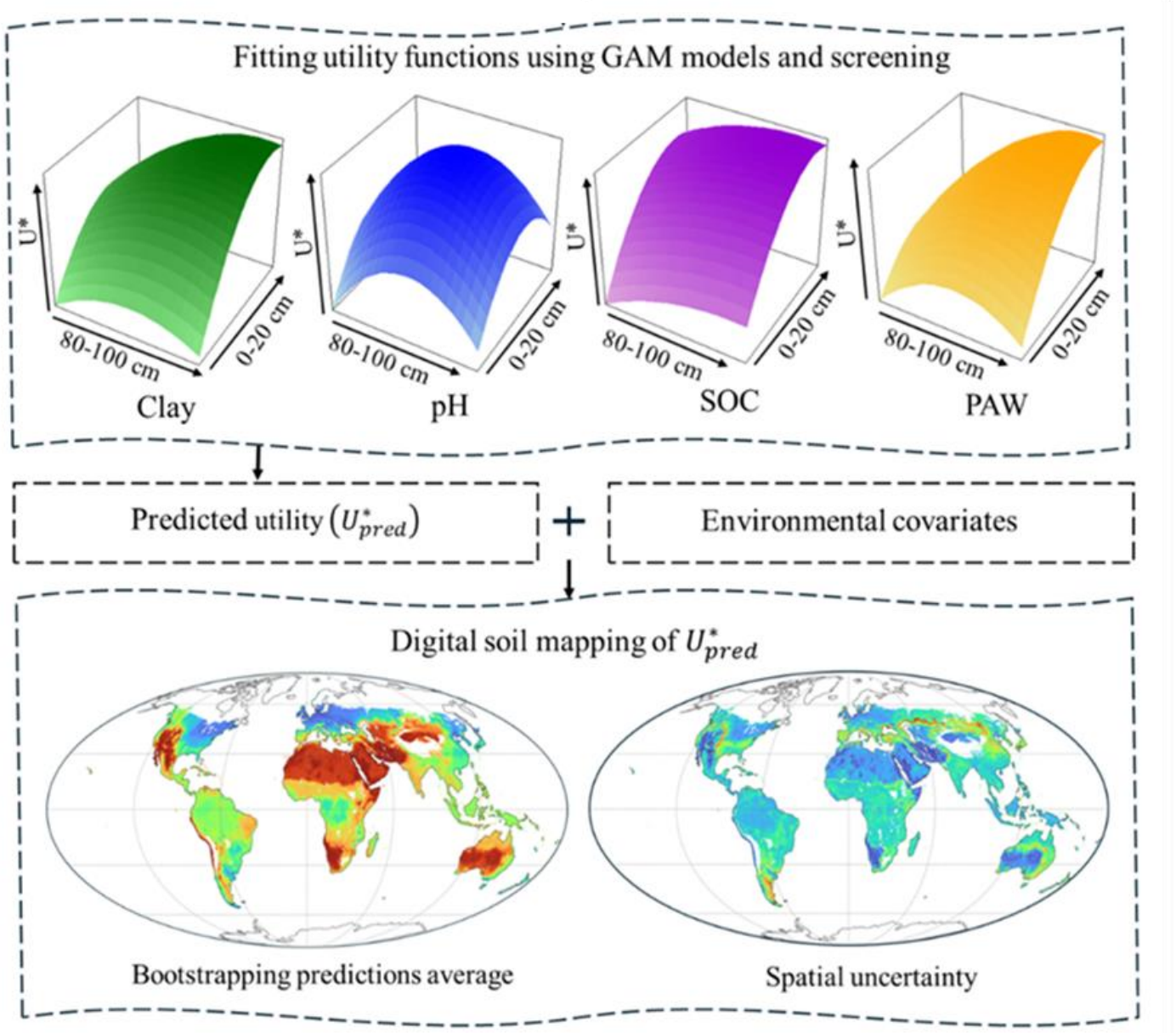
Material and Methods

Data obtention, scoring and filtering



Material and Methods

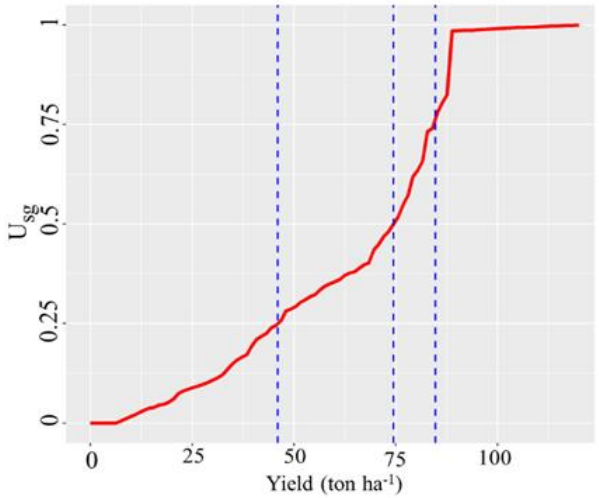
Utility function fitting and Digital Soil Mapping



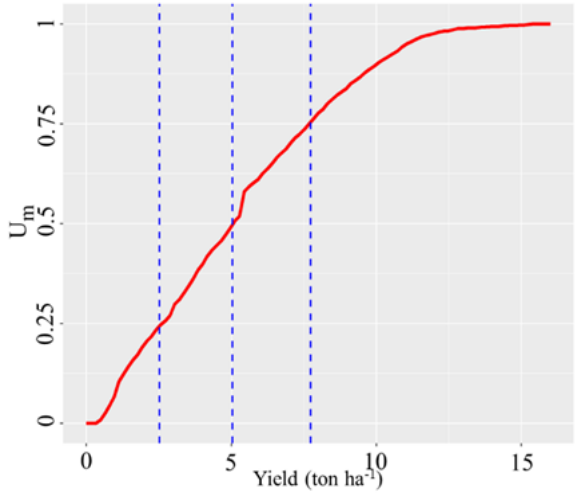
Results

Scored yield data

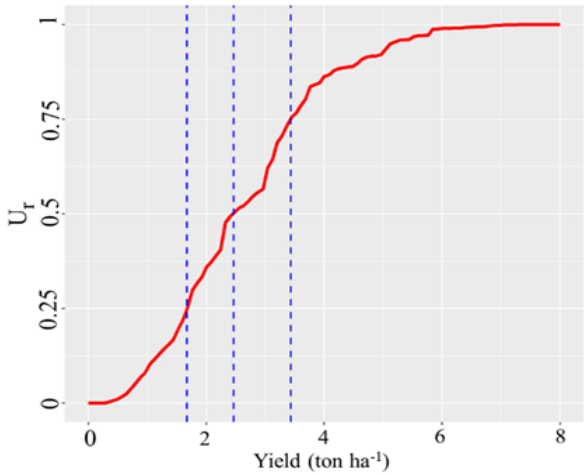
Sugar cane



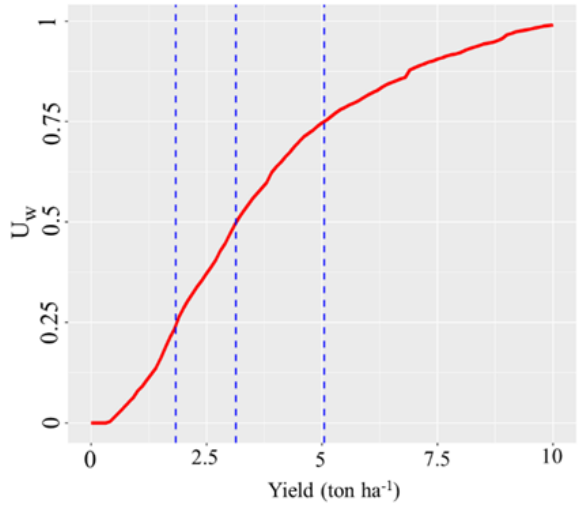
Maize



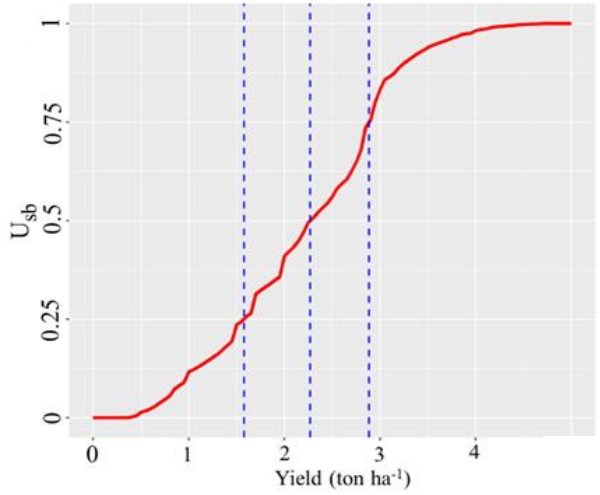
Rice



Wheat

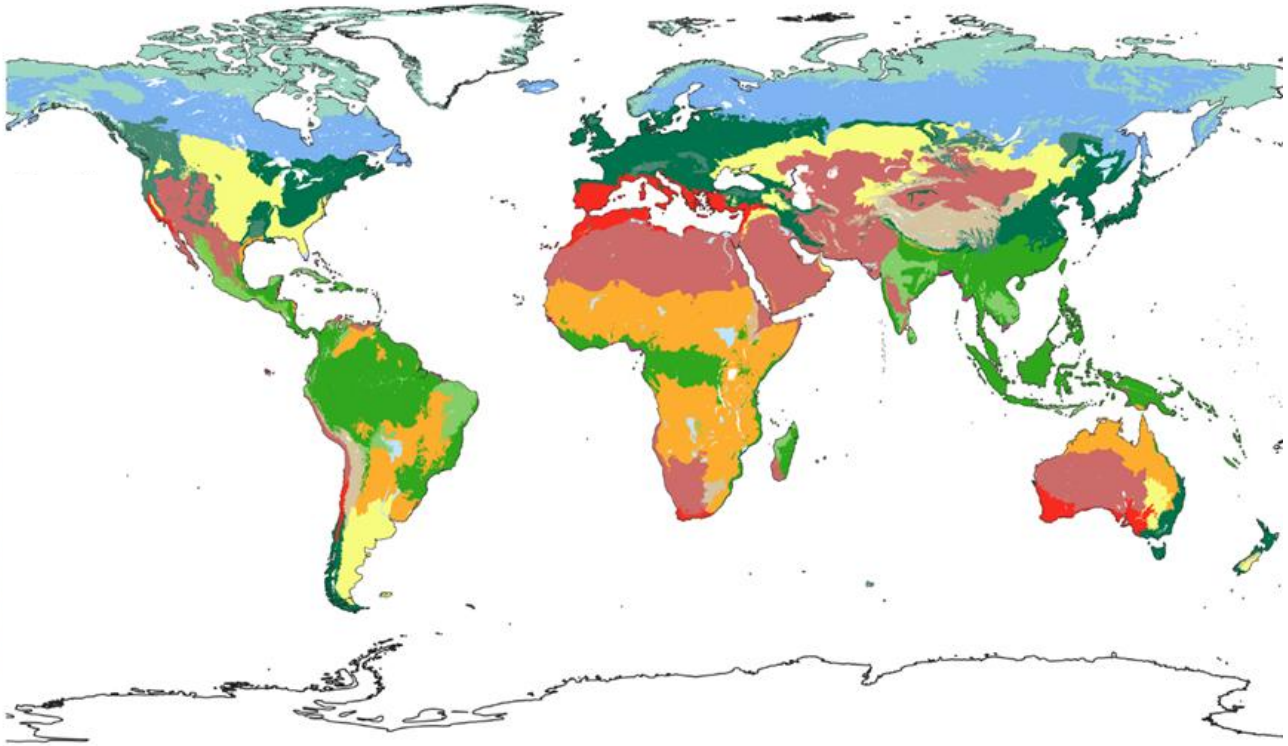


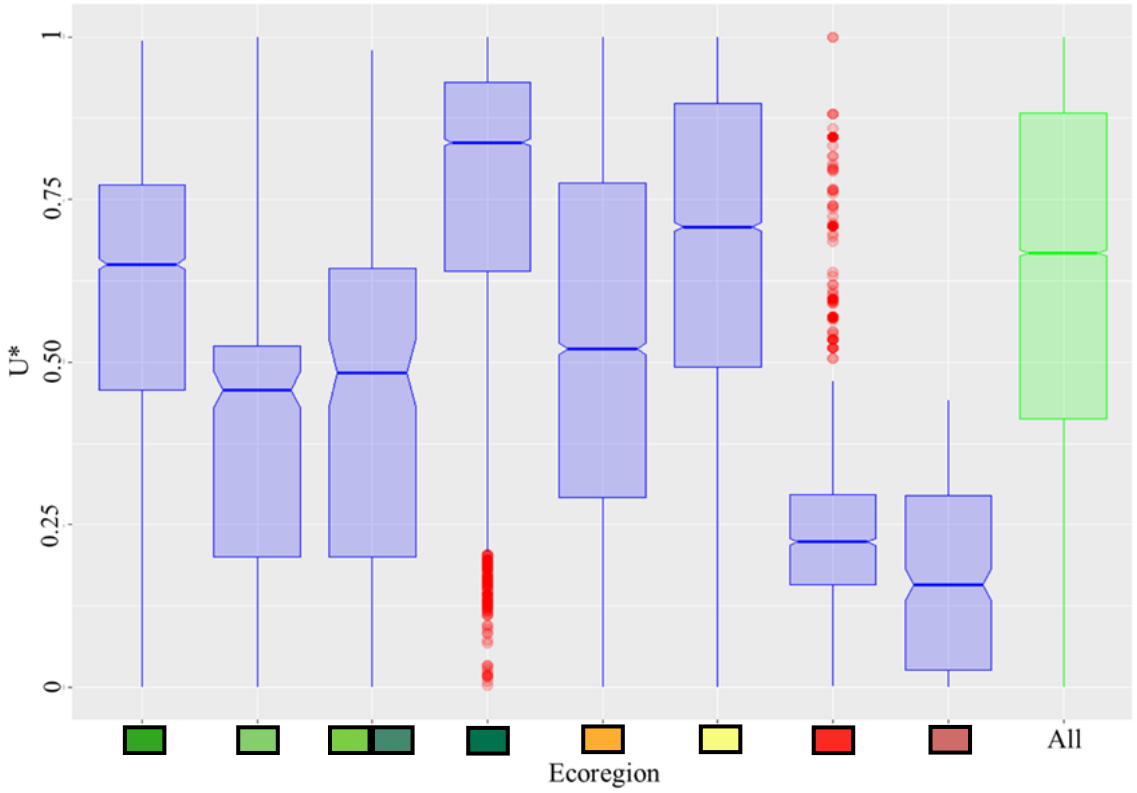
Soybean



Results

Data stratification by ecoregion





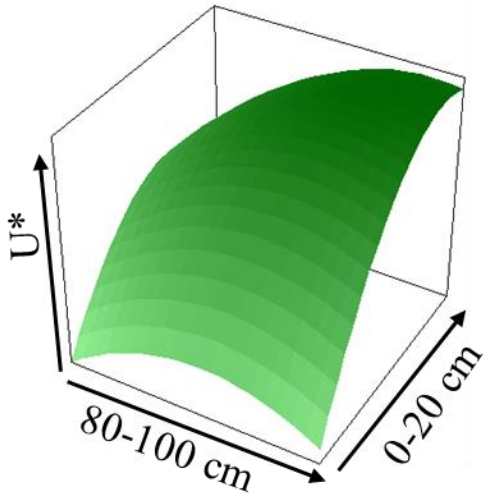
- Tropical and subtropical moist broadleaf forests
- Tropical and subtropical dry broadleaf forests
- Tropical and subtropical coniferous forests
- Temperate broadleaf and mixed forests
- Temperate coniferous forests
- Boreal forests or taiga
- Tropical and subtropical grasslands, savannas…
- Temperate grasslands, savannas, and shrublands
- Flooded Grasslands and Savannas
- Montane grasslands and shrublands
- Tundra
- Mediterranean forests, woodlands, and scrub
- Deserts and xeric shrublands
- Mangroves

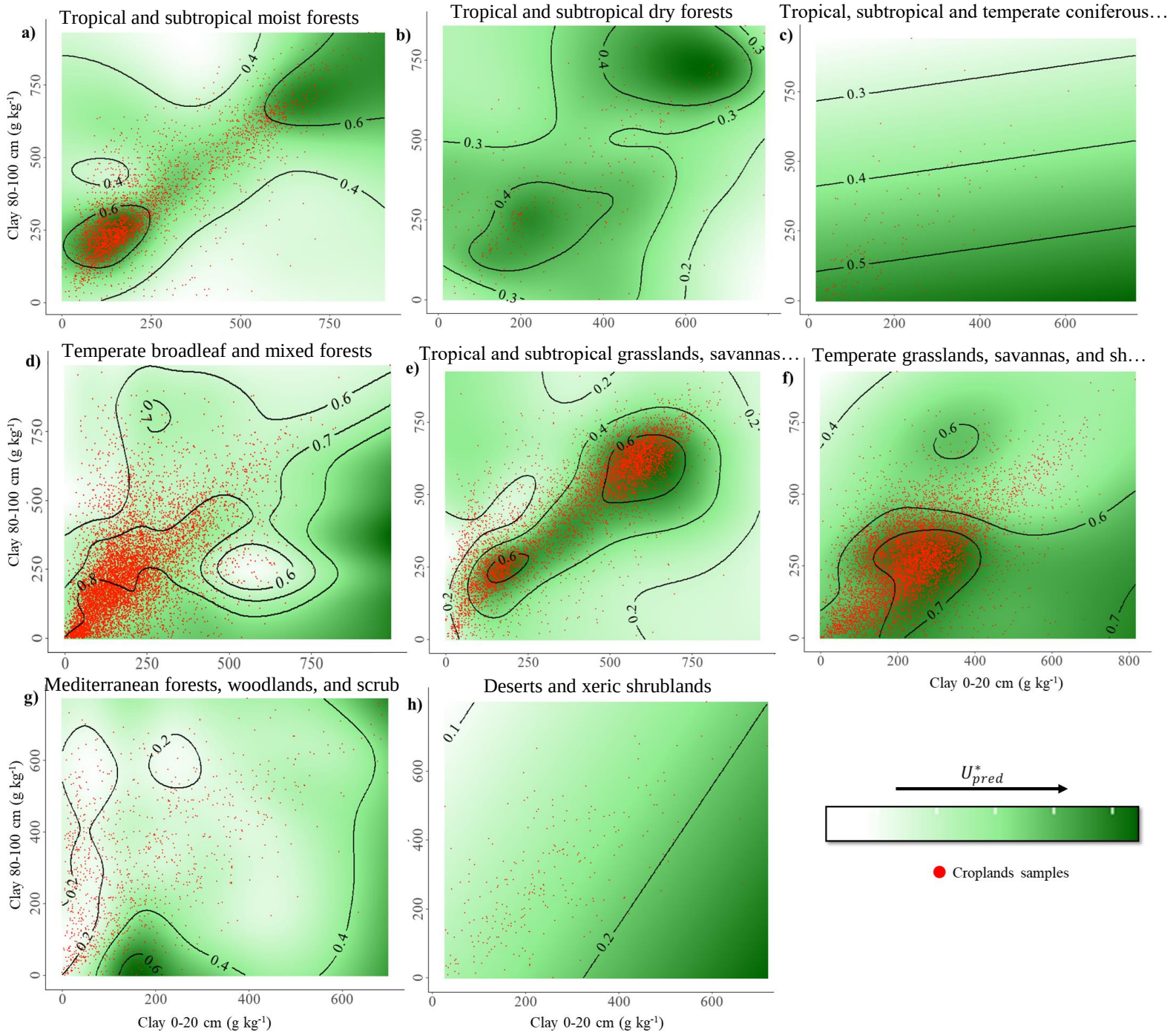
Results

Utility function fitting: Clay

R^2-ad

From 0.01 to 0.30

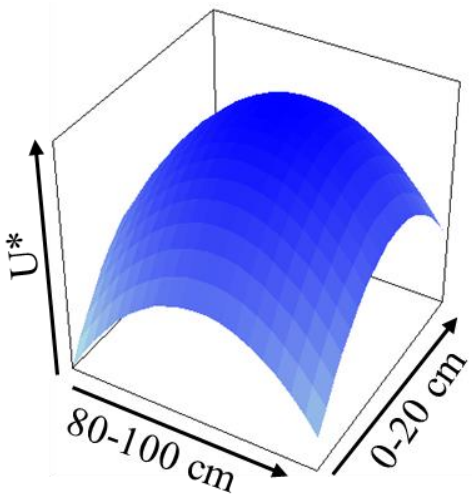


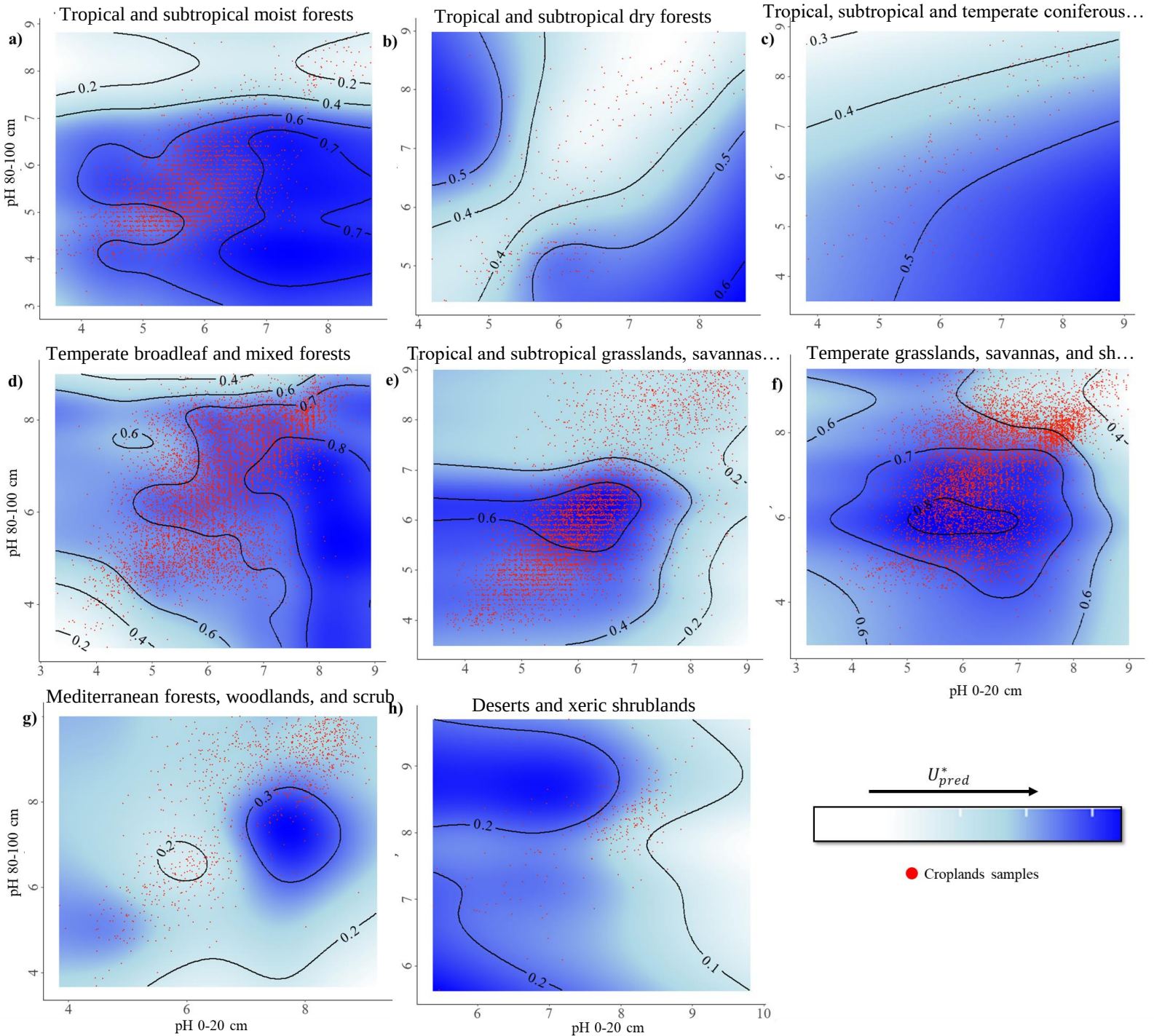


Results

Utility function fitting: pH

R^2-ad
From 0.02 to 0.22

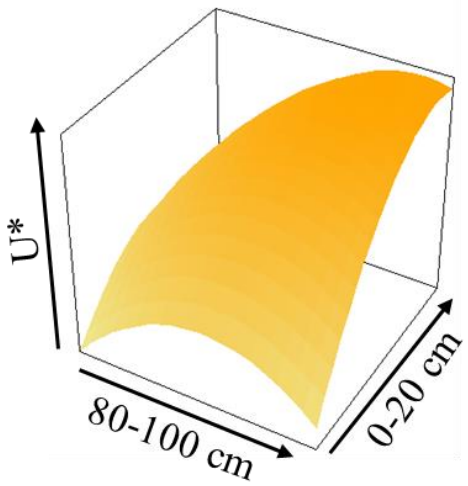


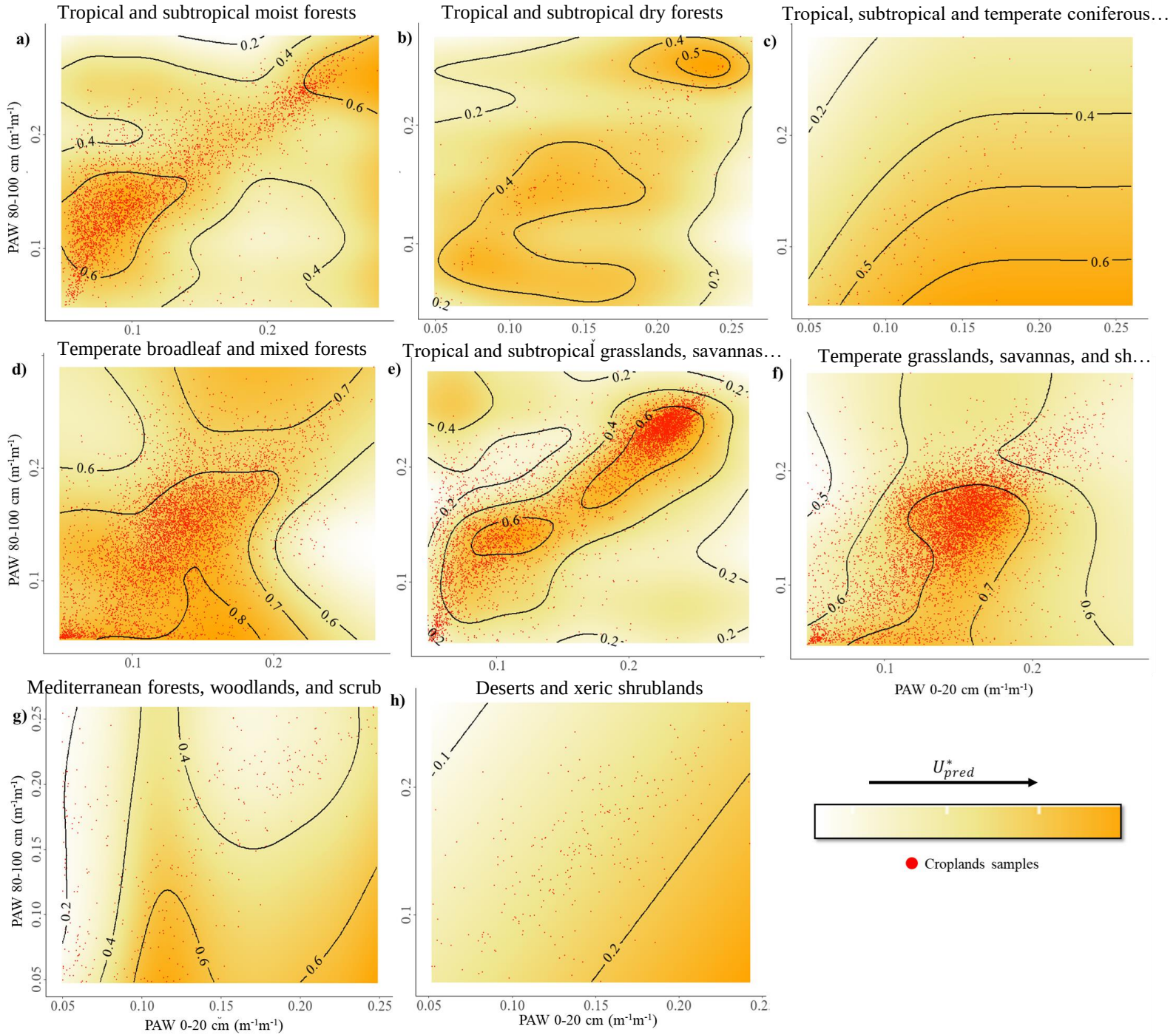


Results

Utility function fitting: PAW

R^2-ad
From 0.01 to 0.36



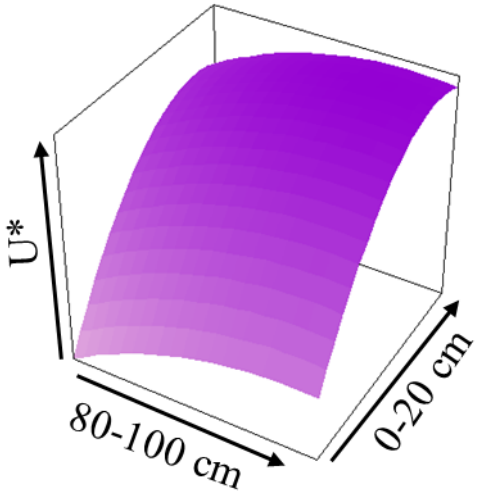


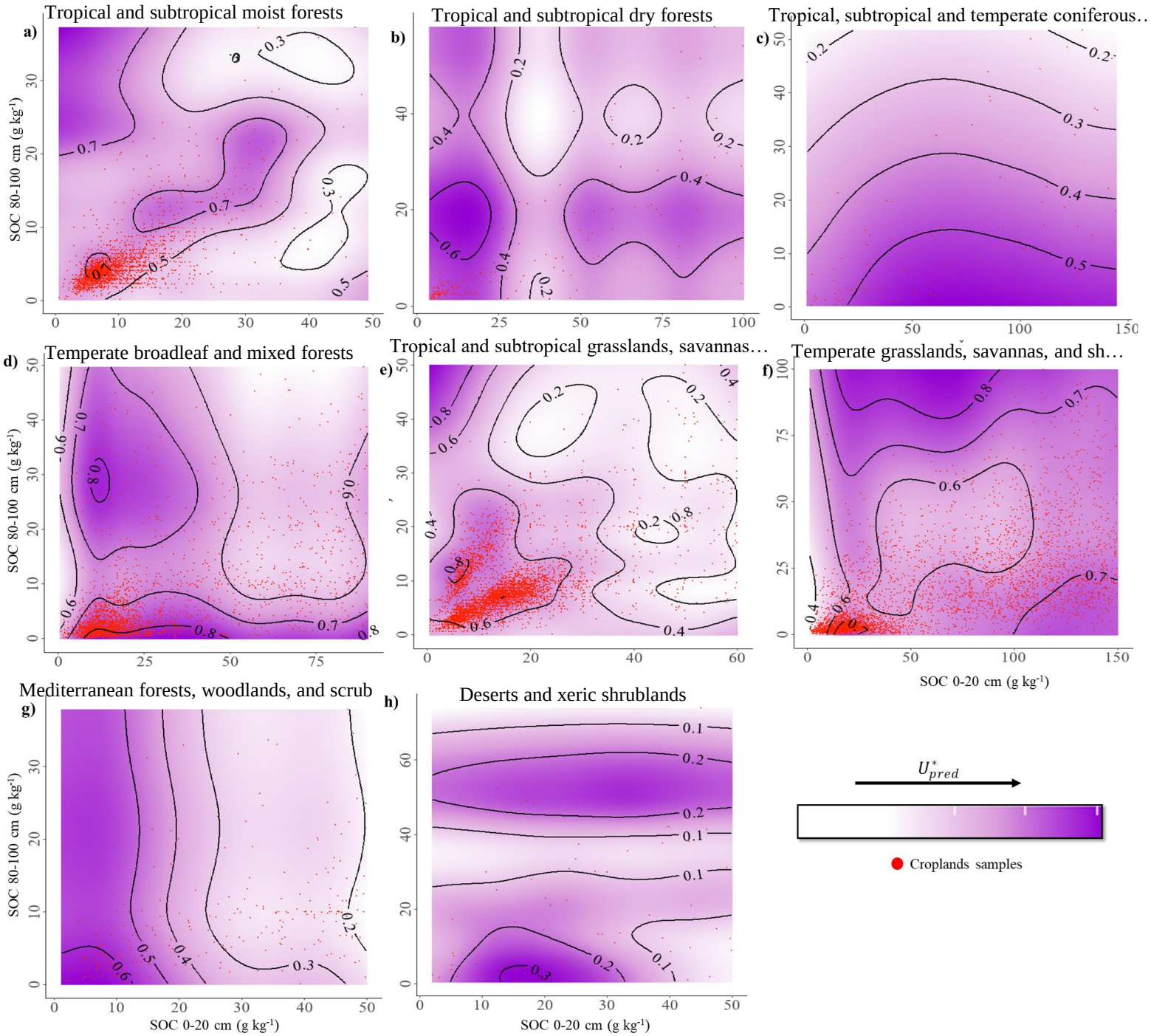
Results

Utility function fitting: SOC

R^2-ad

From 0.09 to 0.46





Results

GAM model with all soil attributes statistics

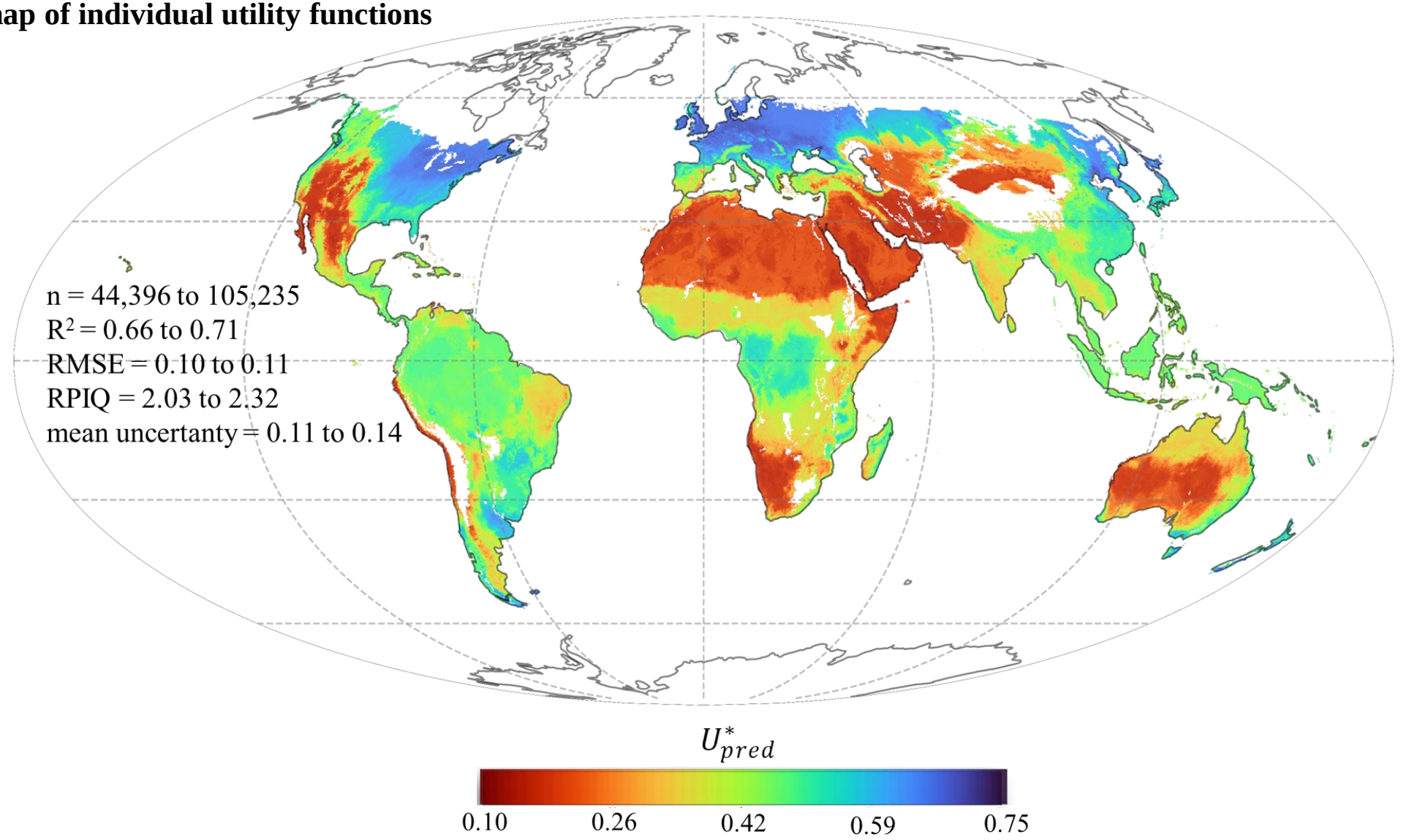
Ecoregion	0-20 layer			Both layers		
	n	a-R^2	RMSE	n	a-R^2	RMSE
Tropical and subtropical moist broadleaf forests	3,084	0.20	0.17	3,010	0.28	0.16
Tropical and subtropical dry broadleaf forests	188	0.39	0.14	155	0.59	0.10
Tropical, subtropical, and temperate coniferous forests	115	0.12	0.23	58	0.59	0.14
Temperate broadleaf and mixed forests	6.872	0.15	0.20	1,177	0.20	0.16
Tropical and subtropical grasslands, savannas, and shrublands	4,600	0.52	0.17	4,302	0.49	0.16
Temperate grasslands, savannas, and shrublands	4,062	0.23	0.20	2,967	0.26	0.15
Mediterranean forests, woodlands, and scrub	45	0.40	0.11	38	0.42	0.09
Deserts and xeric shrublands	76	0.17	0.11	40	0.66	0.05

R^2-ad (0-20 cm)
From 0.15 to 0.40

R^2-ad (both layers)
From 0.20 to 0.66

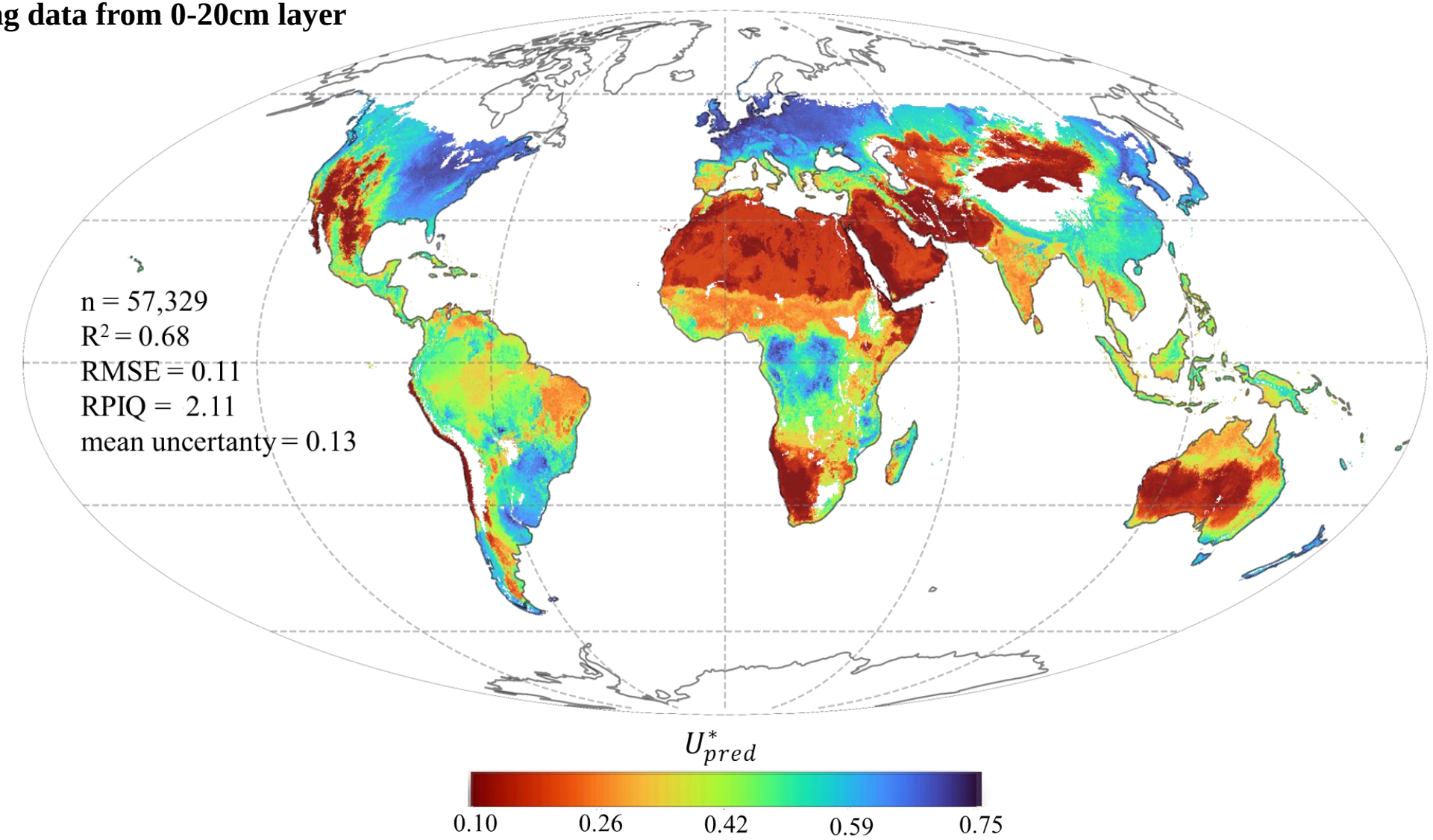
Results

Mean map of individual utility functions



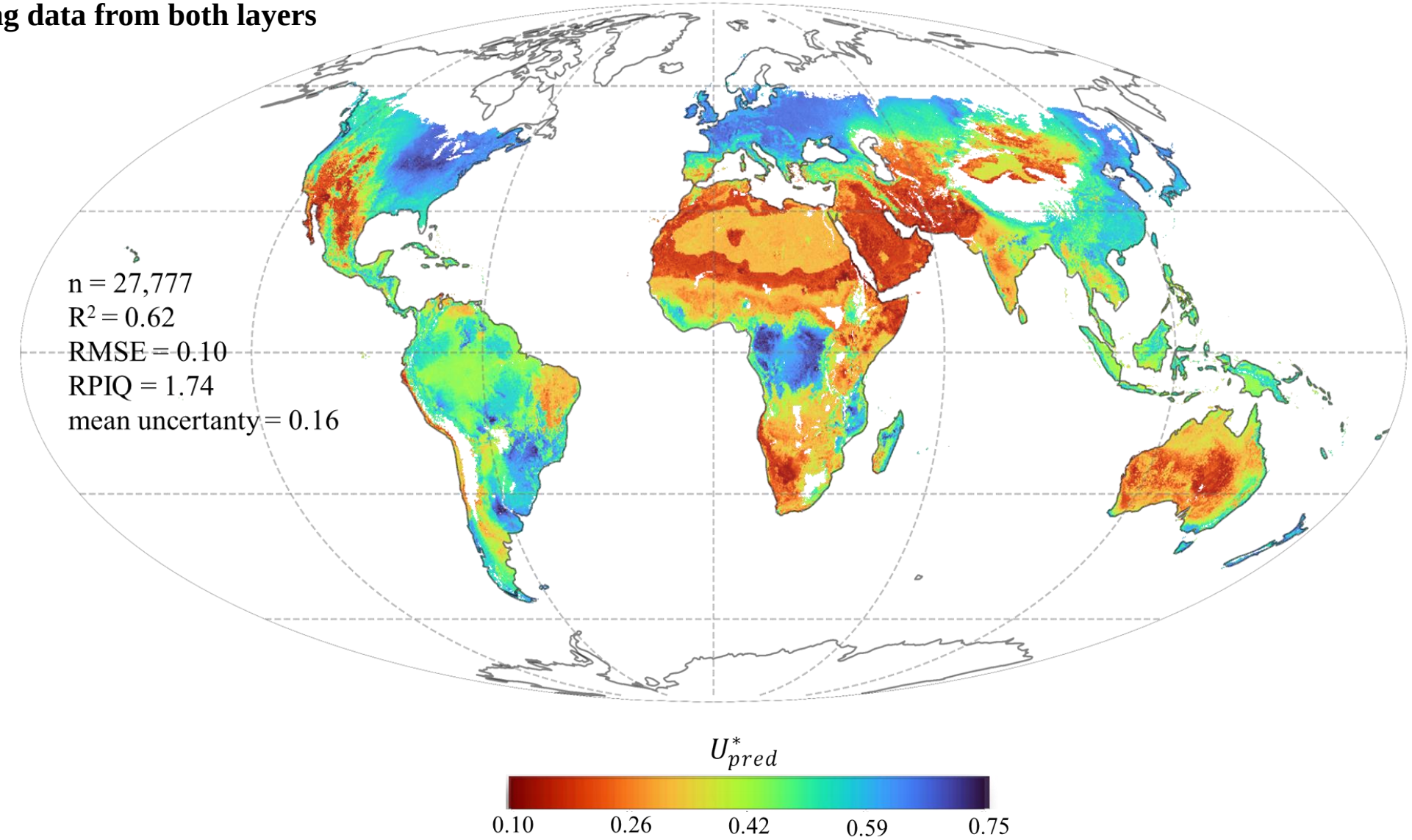
Results

Map using data from 0-20cm layer



Results

Map using data from both layers



Final Considerations

We assessed how the soil attributes drive the food and biomass production across world's ecoregions and its spatial distribution by high resolution mapping;

We used bivariate utility function in SSAF for the first time;

We showed the importance of subsoil attributes for crops production;

The main limitation is related to accuracy of utility functions and the interference of non soil factors in its behavior;

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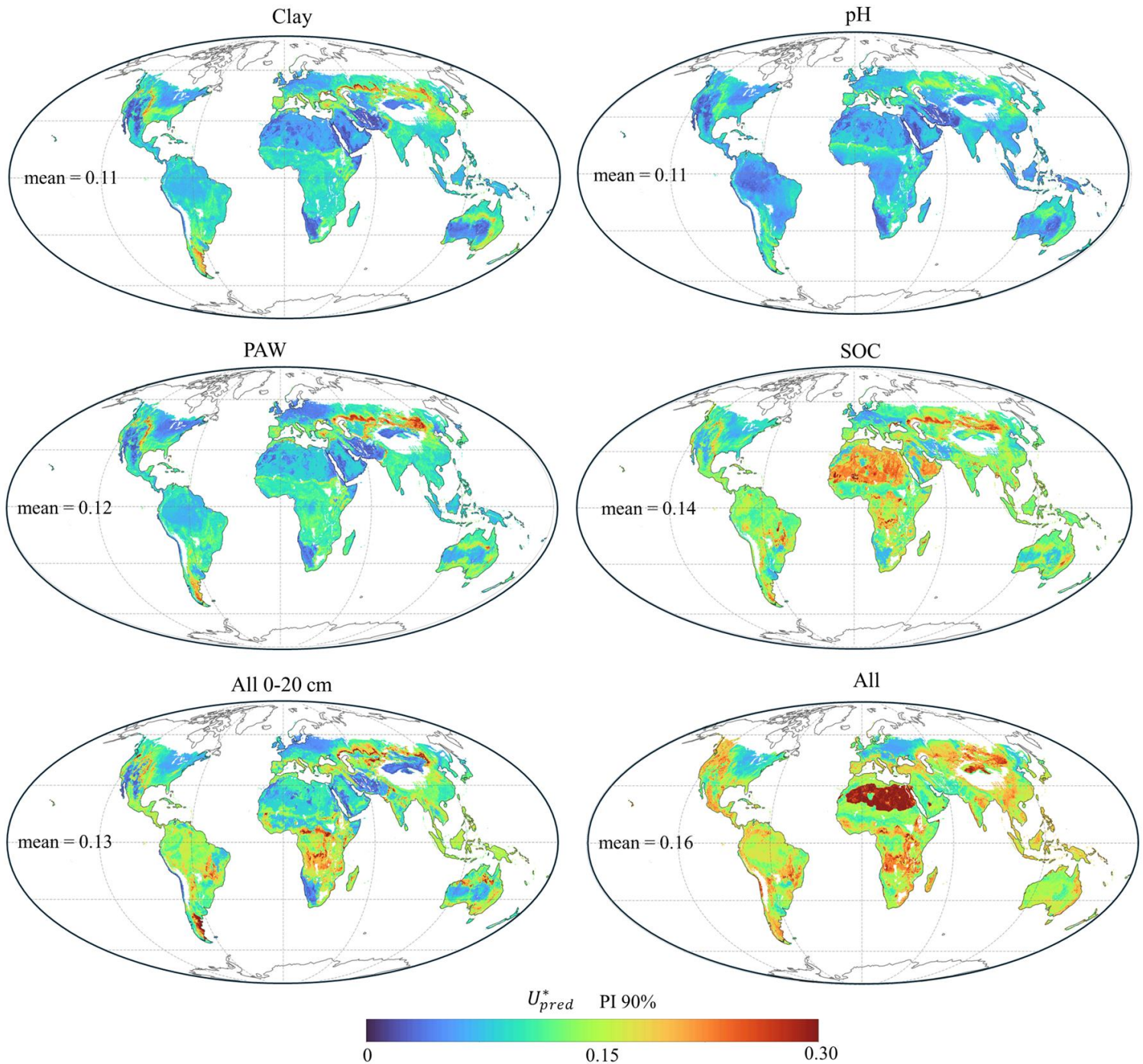
THANK YOU

Utility function fitting: GAM model statistics

Ecoregion	Clay			pH			PAW			SOC		
	n	a-R^2	RMSE	n	a-R^2	RMSE	n	a-R^2	RMSE	n	a-R^2	RMSE
Tropical and subtropical moist broadleaf forests	3,682	0.20	0.19	3,701	0.12	0.20	3,599	0.19	0.19	3,043	0.14	0.18
Tropical and subtropical dry broadleaf forests	298	0.19	0.17	307	0.18	0.18	282	0.17	0.18	206	0.39	0.13
Tropical, subtropical, and temperate coniferous forests	154	0.03	0.26	149	0.02	0.27	152	0.06	0.26	83	0.10	0.26
Temperate broadleaf and mixed forests	8,058	0.11	0.19	6,681	0.09	0.21	5,851	0.06	0.19	2,675	0.20	0.19
Tropical and subtropical grasslands, savannas, and shrublands	6,660	↑0.30	0.23	6,756	↑0.22	0.25	6,141	0.31	0.23	4,502	0.41	0.18
Temperate grasslands, savannas, and shrublands	8,077	0.08	0.22	7,874	0.20	0.21	7,791	0.07	0.28	3,956	↓0.09	0.21
Mediterranean forests, woodlands, and scrub	1,164	0.25	0.16	1,112	0.06	0.12	397	↑0.36	0.18	303	↑0.46	0.18
Deserts and xeric shrublands	258	↓0.01	0.13	258	↓0.07	0.12	256	↓0.01	0.13	100	0.33	0.10


Clay
mean = 0.11
pH
mean = 0.11
PAW
mean = 0.12
SOC
mean = 0.14
All 0-20 cm
mean = 0.13
All
mean = 0.16
U^*_{pred} PI 90%
0
0.15
0.30