Global Yield Gap Atlas

Comparative analysis of options for the spatial framework of yield gap analyses: A focus on soil data

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ISRIC World Soil Information

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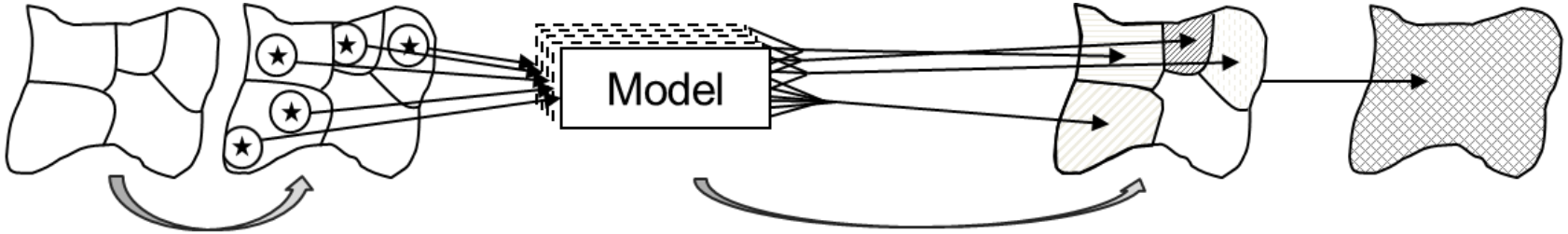
From field to atlas: upscaling of yield gap estimates



Stratification in climate zones

Identification of locations for data collection; buffer zones of 100 km around weather stations

Simulation of water-limited yield

Aggregation from location to climate zone and from climate zone to country

- Aggregation levels:
  - Weather stations (buffer zones around weather station are the simulation units)
  - Climate zones
  - Country

Van Bussel et al., 2015

GYGA climate zonation

- Matrix of three climatic variables relevant for crop production:
  - growing degree days
  - an aridity index (ratio mean annual precipitation to annual potential evapotranspiration)
  - temperature seasonality (standard deviation of monthly average temperatures)
- Only land on which at least one of the 10 major food crops is grown was considered for the classification of the three variables

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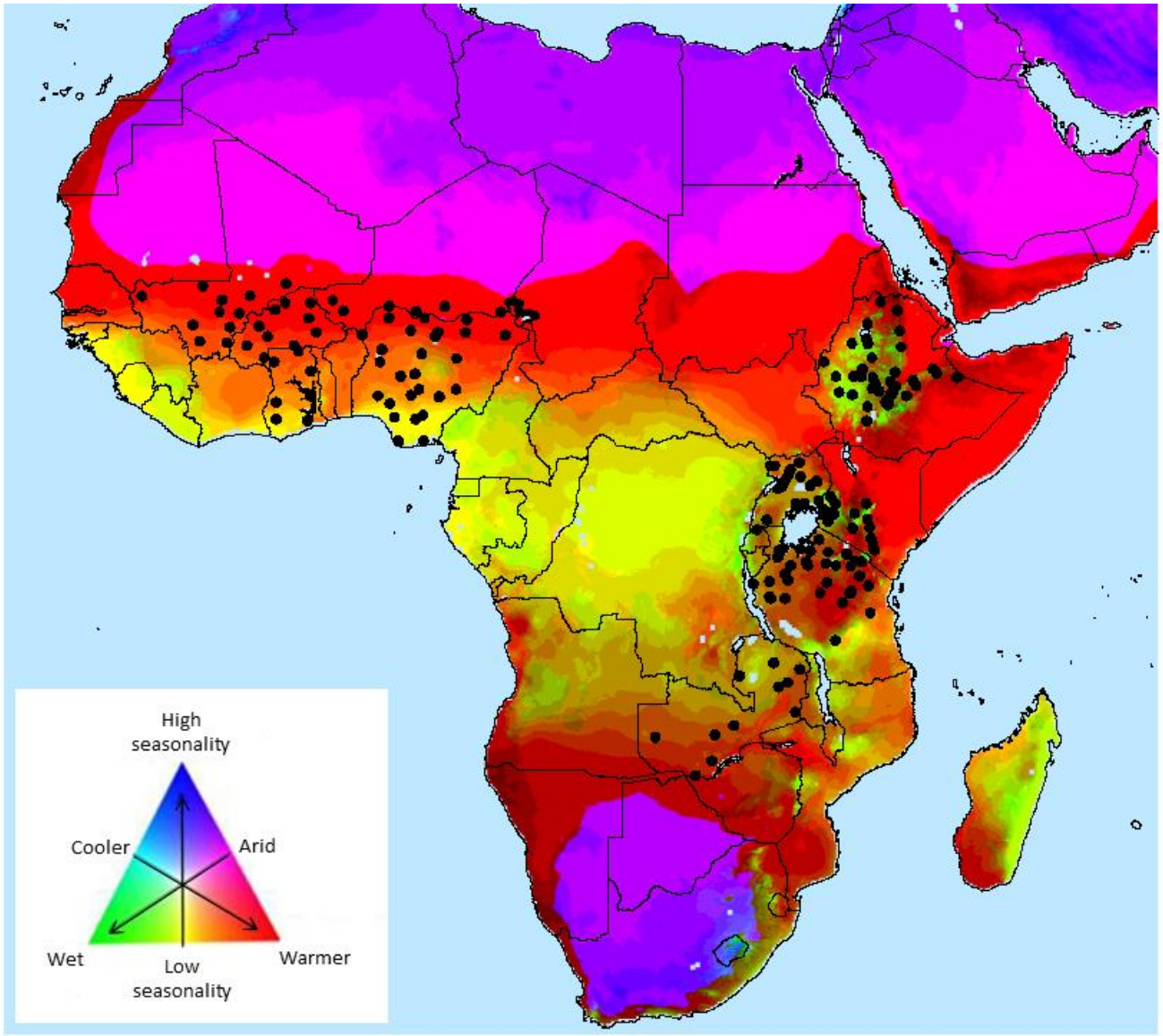
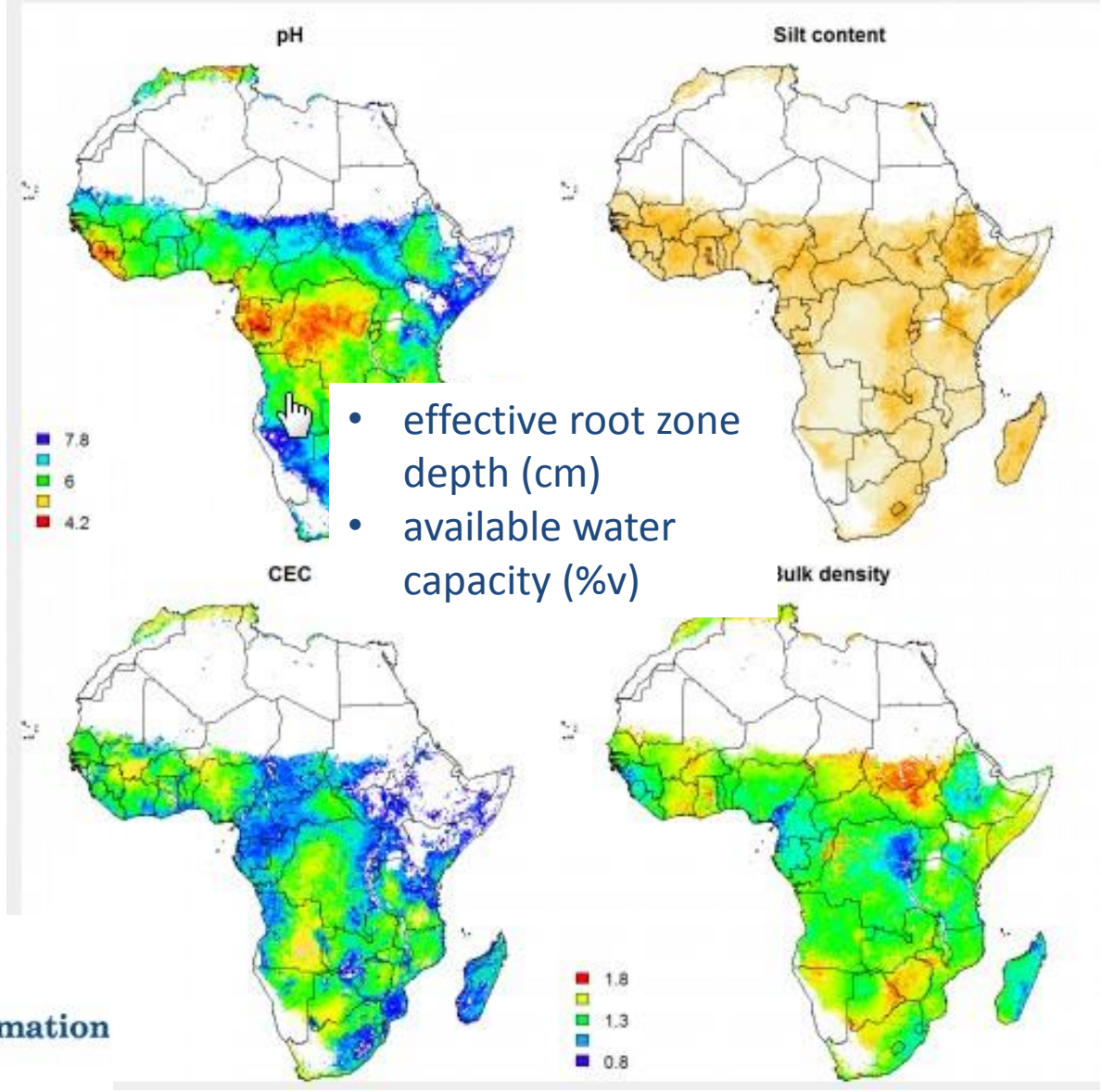
GYGA climate zonation



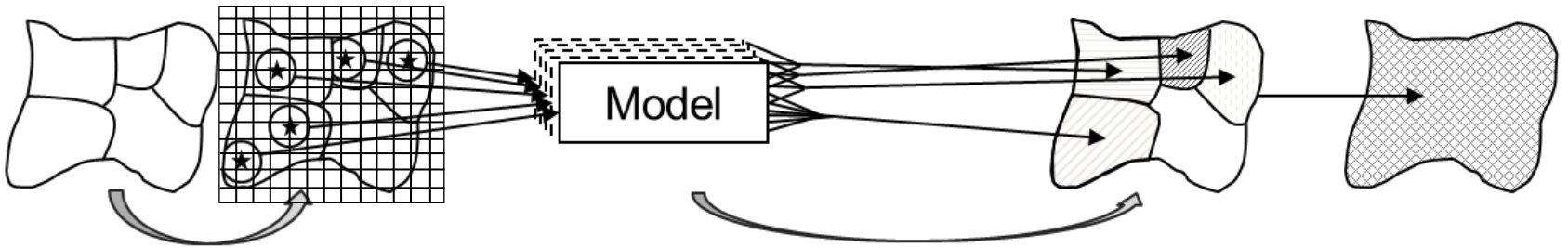
Alternative spatial frameworks using AfSIS soil data

ISRIC/AfSIS: 3D regression kriging with
~12,000 legacy profiles
(including ISRIC-WISE)



- effective root zone depth (cm)
- available water capacity (%v)

Alternative spatial frameworks using AfSIS



Identification of locations for data collection

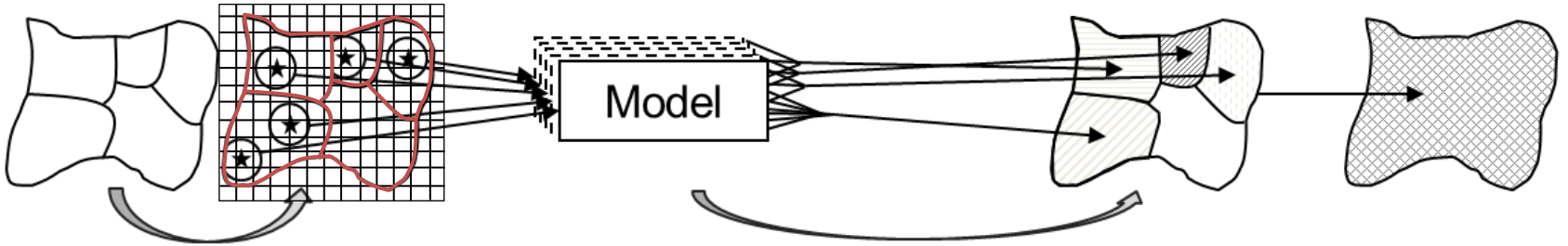
Simulation of water-limited yield

Aggregation from location to CZ and from CZ to country

Alternative 1	Selection of **all** soil properties which fall within the climate zones
Alternative 2	Selection of **all** soil properties which fall within the buffer zones of weather stations
Alternative 3	Selection of **dominant classified** soil properties which fall within the climate zones
Alternative 4	Selection of **dominant classified** soil properties which fall within the buffer zones of weather stations

Comparison of these four alternatives for sorghum in Burkina Faso and Ethiopia

Alternative spatial frameworks using AfSIS



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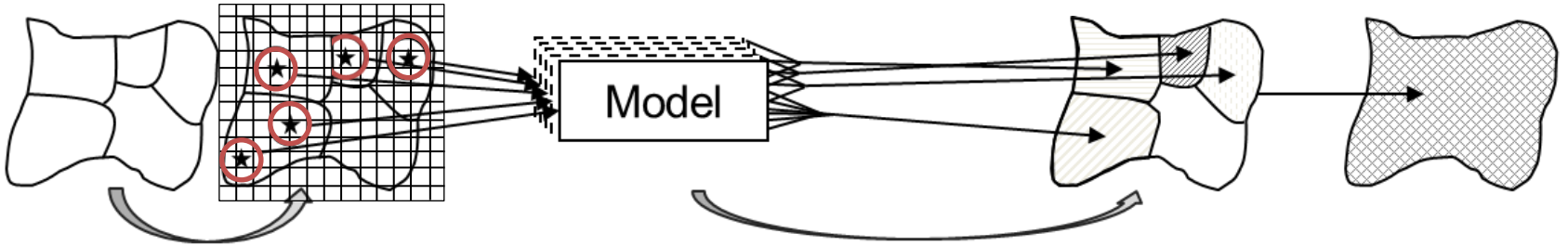

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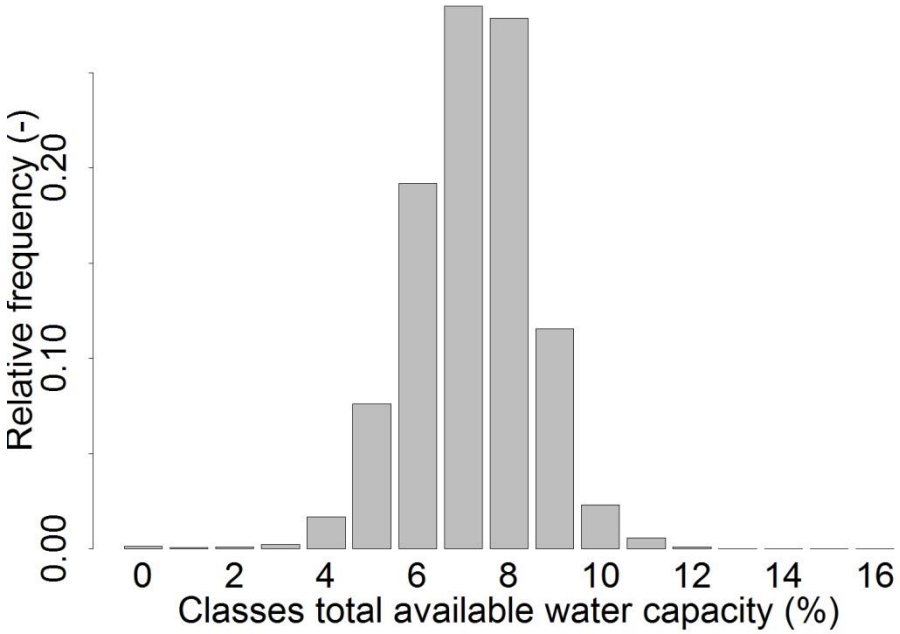
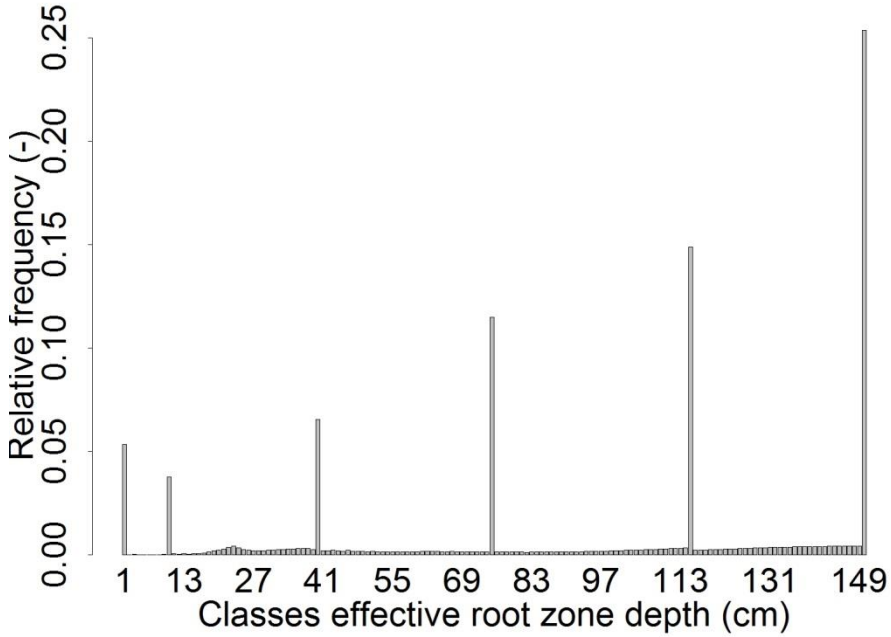
Frequency distribution of AfSIS data





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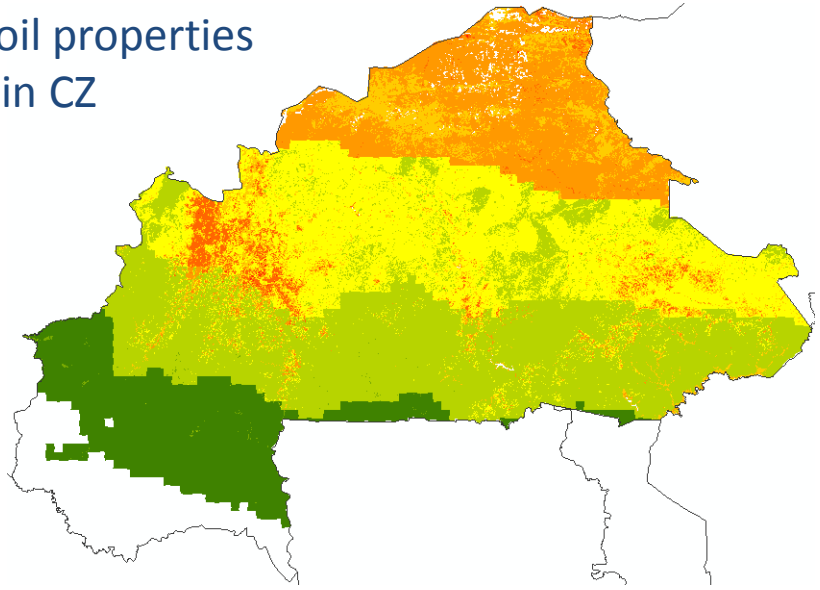
AfSIS classification and selection

Total available water capacity classes (%)	Effective root zone depth classes (cm)
≤ 4	30 – 50
4 – 5	50 – 100
5 – 6	100 – 130
6 – 7	> 130
7 – 8	
8 – 9	
9 – 10	
≥ 10	

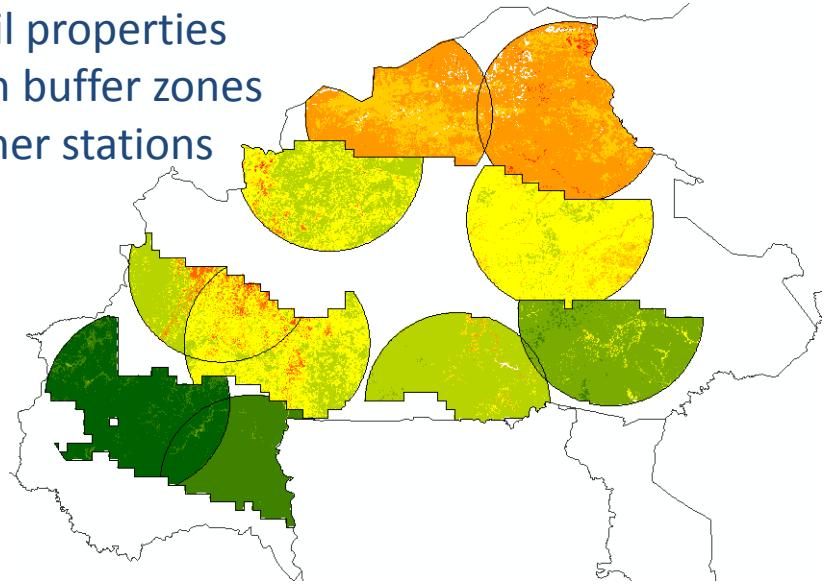
- Effective root zone depth and total available water capacity combinations selected until at least 50% of the total area is represented or at most 5 combinations have been selected
- Effective root zone depth ≤ 30 cm → considered not suitable for crop growth, excluded from simulations

Results Burkina Faso

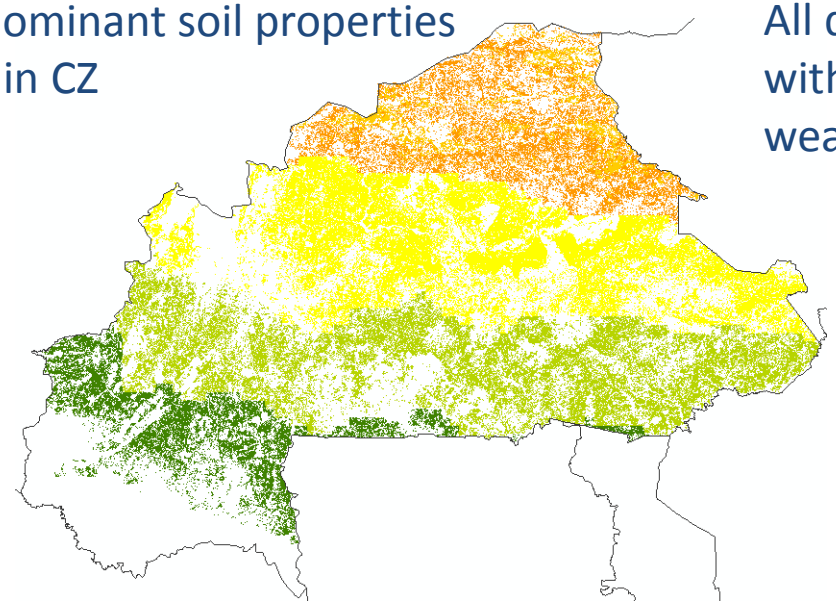
All soil properties within CZ



All soil properties within buffer zones weather stations



All dominant soil properties within CZ



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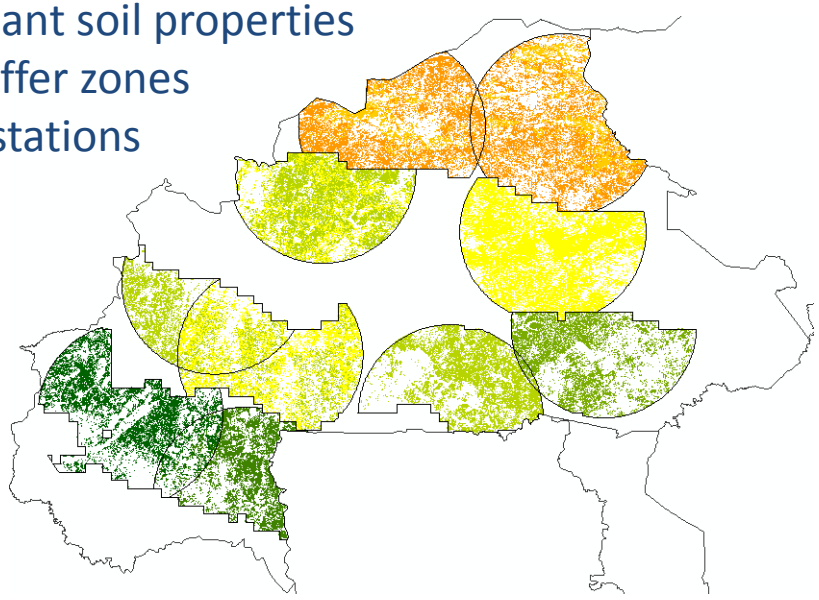
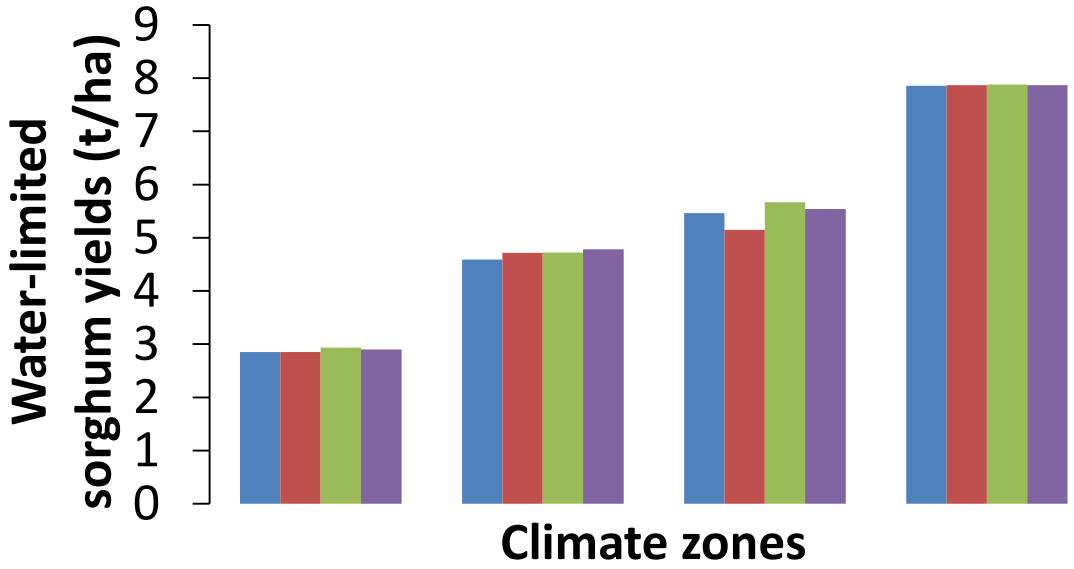


Results sorghum Burkina Faso climate zones



- Alternative 1: all soil properties within climate zones
- Alternative 2: all soil properties within weather station buffer zones
- Alternative 3: dominant classified soil properties within climate zones
- Alternative 4: dominant classified soil properties within weather station buffer zones

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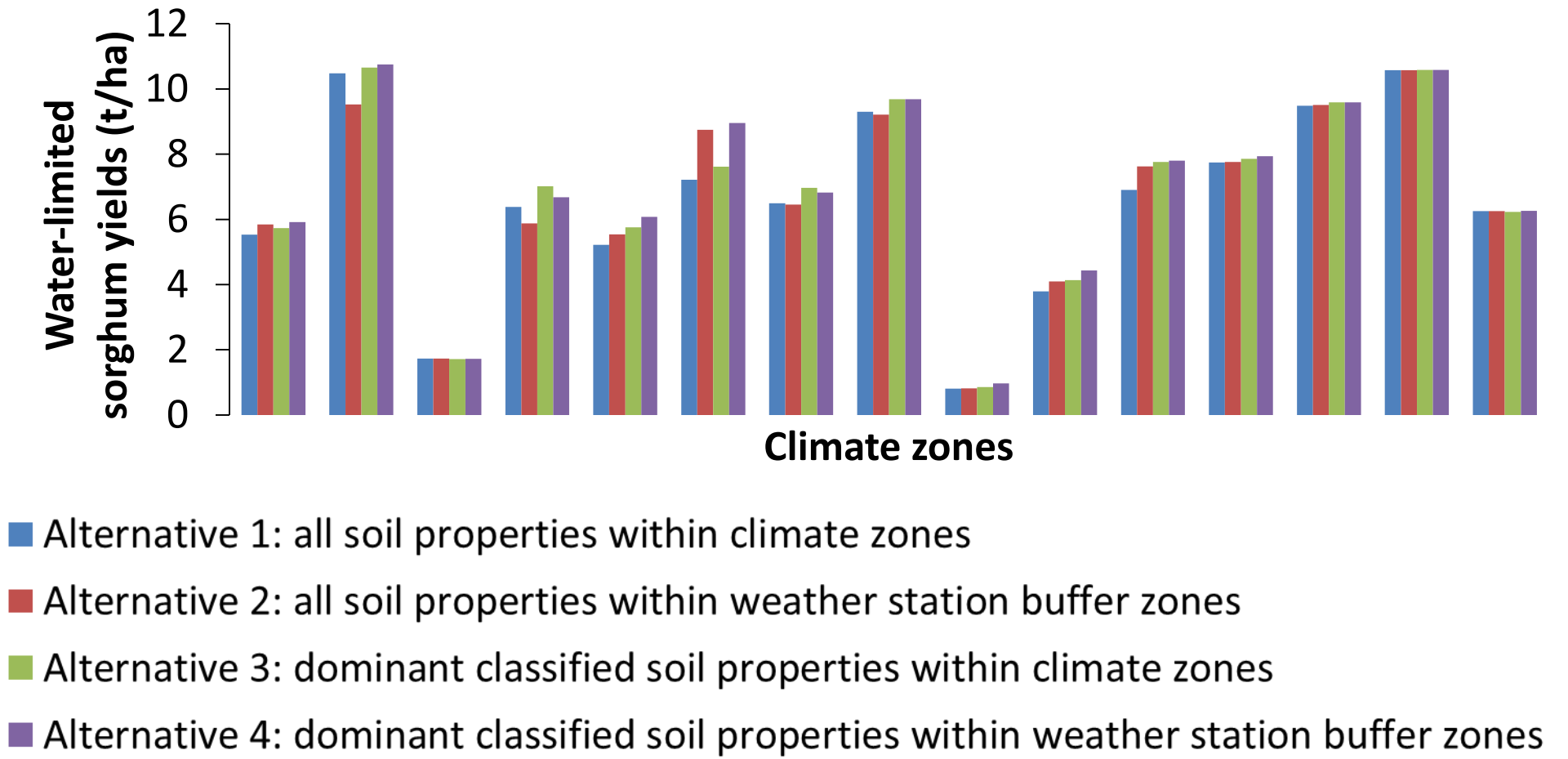
Results sorghum Ethiopia climate zones



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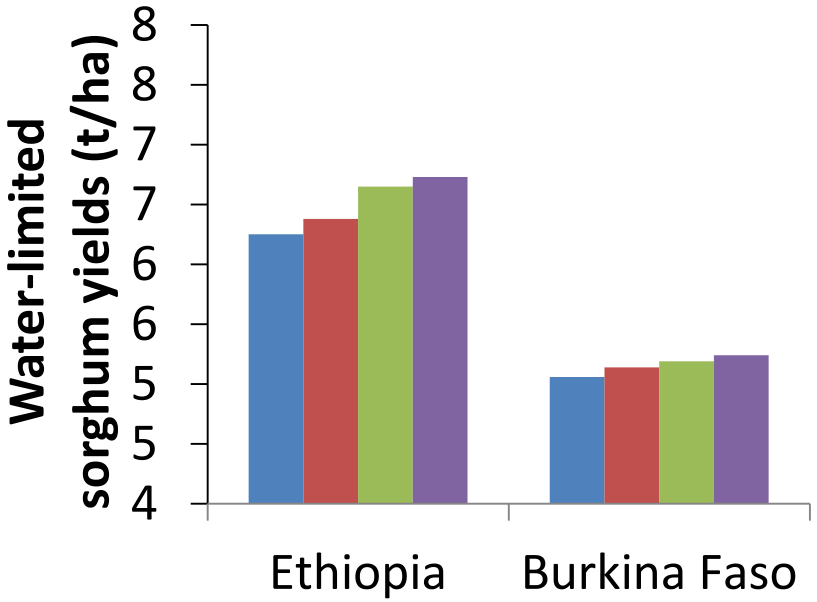
Results sorghum Ethiopia and Burkina Faso



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- Alternative 3: dominant classified soil properties within climate zones
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Conclusion

Results justify scaling of soil properties,
i.e. selection of dominant soil properties around weather stations:

- Introduced errors in national yield gaps small
- Variable errors in yield gaps among climate zones, but overall errors are small

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Summary GYGA approach

- Old approach:
  - ISRIC-WISE database
  - Selection of three main soil mapping units, selection of soil units until at least 50% of soil mapping unit was covered
  - Excluding soil units not suitable for crop growth
- New approach:
  - AfSIS soil database: Total available water capacity (%) and Effective root zone depth (cm)
  - Selection until at least 50% of the total area is represented or at most 5 combinations have been selected
  - Effective root zone depth ≤ 30 cm → considered not suitable for crop growth, excluded from simulations

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Thanks for your attention!

www.yieldgap.org

http://africasoils.net/

ISRIC World Soil Information

Africa Soil Information Service AfricaSoils.net

University of Nebraska Lincoln

Wageningen University Wageningen UR

Water for Food Robert B. Daugherty Institute University of Nebraska

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- Van Bussel, L.G.J., P. Grassini, J. van Wart, J. Wolf, L. Claessens, H. Yang, H. Boogaard, H. de Groot, K. Saito, K.G. Cassman and M.K. van Ittersum. 2015. From field to atlas: Upscaling of location-specific yield gap estimates. Field Crops Research. 177, 98-108.
- Van Ittersum, M.K., Rabbinge, R., 1997. Concepts in production ecology for analysis and quantification of agricultural input-output combinations. Field Crops Res. 52, 197–208.

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