



HAL
open science

DATA Aggregation effects in regional yield simulations

Holger Hoffmann, Kurt Christian Kersebaum, Gang Zhao, Senthold Asseng, Marco Bindi, Davide Cammarano, Julie Constantin, Elsa Coucheney, Rene Dechow, Luca Doro, et al.

► **To cite this version:**

Holger Hoffmann, Kurt Christian Kersebaum, Gang Zhao, Senthold Asseng, Marco Bindi, et al.. DATA Aggregation effects in regional yield simulations. 2016 ASA/CSSA/SSSA Meeting “Resilience Emerging from Scarcity and Abundance”, Nov 2016, Phoenix, France. 3 p. hal-01606108

HAL Id: hal-01606108

<https://hal.science/hal-01606108>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

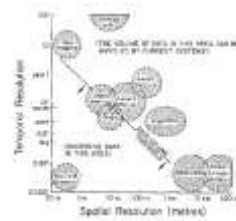
L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Data Aggregation Effects in Regional Yield Simulations

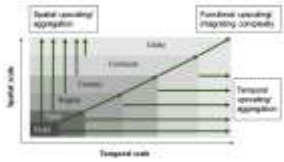
Holger Hoffmann, Kurt-Christian Kersebaum, Gang Zhao, Senthil Asseng, Senthil; Marco Bindi, Davide Cammarano, Julie Constantin, Elsa Coucheney, Rene Dechow, Luca Doro, Henrik Eckersten, Thomas Gaiser, Balázs Grosz, Edwin Haas, Belay Kassie, Ralf Kiese, Steffen Klatt, Matthias Kuhnert, Elisabet Lewan, Marco Moriondo, Claas Nendel, Helene Reynal, Pier P. Roggero, Reimund Rötter, Stefan Siebert, Carmen Sosa, Xenia Specka, Fulu Tao, Edmar Teixeira, Giacomo Trombi, Jagadeesh Yeluripati, Eline Vanuytrecht, Daniel Wallach, Enli Wang, Lutz Weiermüller, Zhigan Zhao, Frank Ewert



Introduction | Scale and resolution

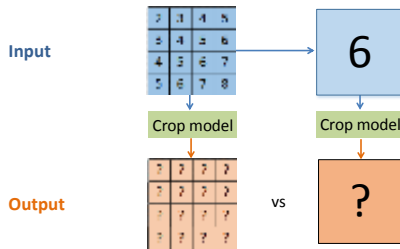


Meentemeyer 1989, after Townsend 1987



Ewert et al. 2006, 2011

Introduction | The aggregation effect



Zhao et al. 2015a (modified)

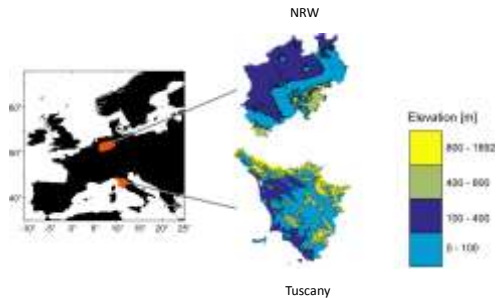
Introduction | Current literature: 14 examples

Region	Data	Method	Resolution	Model type (no.)	Response variable	Error	Reference
NRW (DE)	climate	average	≤100 km	crop (13)	maize / wheat yield	Bias ≤ 3.5 [%] RMSE ≤ 4.5 [%]	Hoffmann / Zhao et al. 2015a
DE, FR	climate	average	≤50 km	crop (1)	maize / wheat yield	RMSE ≤ 4.7 [%]	De Wit et al. 2005
US	climate, soil, land-use	average, majority, other	≤45 km	crop (1)	maize yield	Bias ≤ 2.3 [%]	Folberth et al. 2012
FI	climate	average	≤100 km	crop (4)	barley yield	Bias ≤ 1.5 [%]	Angulo et al. 2013
NRW, (DE)	soil	maps	≤1:10 ⁶	crop (4)	wheat yield	Bias ≤ 2.9 [%]	Angulo et al. 2014
DE	climate, management	average	≤100 km	crop (1)	wheat phenology	RMSE ≤ 4.4 [%]	Van Bussel et al. 2011
DE	climate, soil, majority	average, majority	≤100 km	crop (1)	wheat heat stress	Bias = 0.003 °C	Rezaei et al. 2015
W US	climate, soil, topography, vegetation	average	≤110 km	ecosystem (1)	NPP	Bias = 18 [%]	Pierce et al. 1995
S-E AU	climate RS ¹	average	≤0.96 km	energy balance (1)	Eta	Bias ≤ 15 [%]	Ershadi et al. 2013
N-E DE	soil	maps [*]	≤1:10 ⁶	crop (1)	nitrogen leaching	Bias ≤ 8.6 [%]	Kersebaum & Wenkel
DE	climate	average	≤100 km	crop (1)	wheat yield	RMSE ≤ 5 [%] (approx.)	Zhao et al. 2015b
DK	climate, soil	various	various	crop (1)	wheat yield	Bias ≤ 14 %	Olesen et al. 2000
US	climate, soil	various	≤2.8 [*]	crop, (1)	maize / wheat yield	MAE ≤0.29 (t/ha) ≤0.7 t ha ⁻¹ (gm)	Eastaring et al. 1998

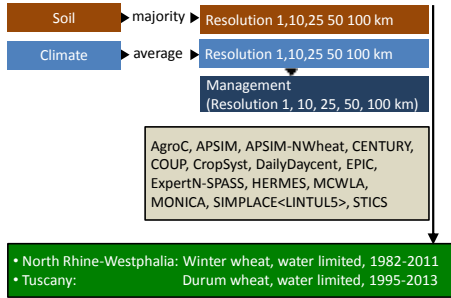
Motivation

To what extent are crop model outputs affected by spatial data resolution and aggregation of the model input data?
 How does this depend on the data and aggregation method?
 How does this depend on the region?

Methods | Regional focus

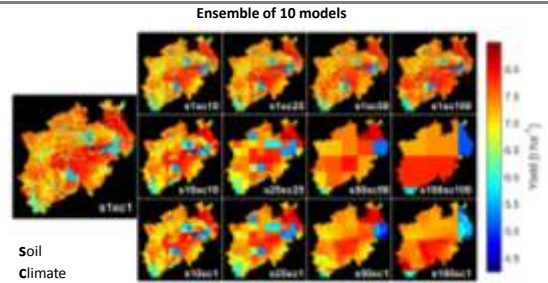


Methods | Aggregation and simulations



7

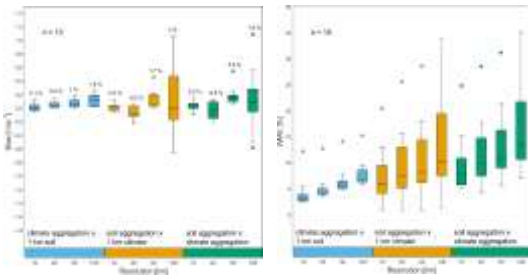
NRW winter wheat grain yield (average 1982-2011)



Hoffmann et al. 2016

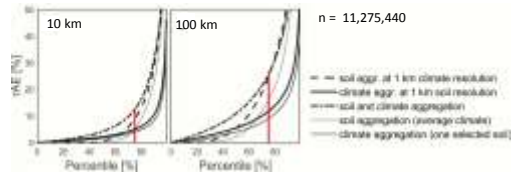
8

NRW Winter wheat grain yield bias, rMAE



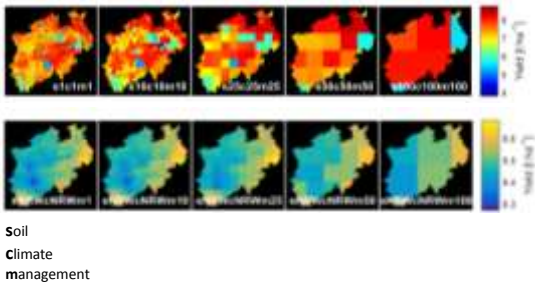
9

NRW Winter wheat grain yield rAE



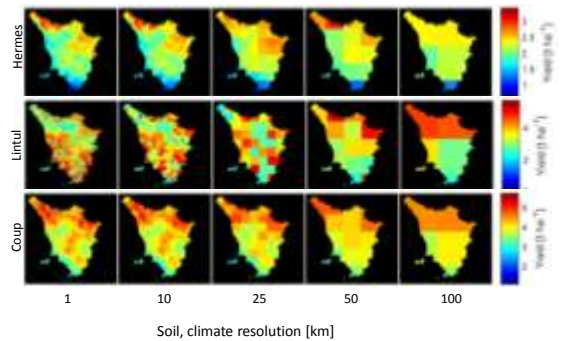
10

NRW winter wheat grain yield (average 1982-2011)
 -> management



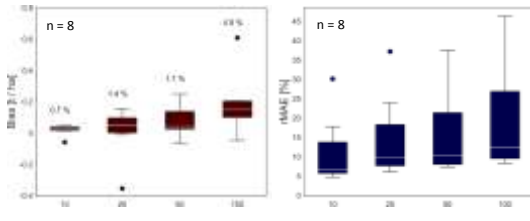
11

Tuscany durum wheat grain yield (average 1995-2013)



12

Tuscany durum wheat grain yield (average 1995-2013)



Soil, climate resolution [km]

13

Discussion & outlook

1. aggregation effects...
 - are generally smaller (bias) than other sources of yield variability
 - are partially larger (rMAE) depending on data and aggregation method
 - soil matters
 - management as defined here neglectable
 - results comparable across regions
2. known unknowns
 - spatial patchiness, spatial range, spatial variance, no. of spatial clusters
 - model linking (data – model interactions need to be analyzed)?
 - management, crop rotation (temporal vs. spatial effects)?
 - generalization of effects (mathem. rules/models)?
 - aggregation vs. other scaling methods (e.g. sampling)?
 - correction for aggregation errors?
 - ...

14

www.scale-it.net