

OPEN-SOURCE AQUACROP V7.0: OPPORTUNITIES FOR MODEL DEVELOPMENT

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Tunis, 12 December 2022

Regional gathering
Tunis, 12 – 16 December 2022





INTRODUCTION

- 1) AquaCrop v7.0
- 2) Regional modeling and data assimilation
- 3) Climate change: irrigation needs





AQUACROP V7.0

- Improvements of the crop model (perennial crops, fine-tuning, harmonisation of crop parameters, new calibrated crops)
- Programming language: Pascal → Fortran (optimization)
- **OPEN SOURCE**



AQUACROP V7.0



GitHub

<https://github.com/KUL-RSDA/AquaCrop>

Version-
controlled
Fortran code



Graphical
User
Interface



Stand-alone
executables



NASA's Land
Information
System



AquaCrop

- Overview
- Software
- News
- Applications
- Workshops
- Resources

AquaCrop, the crop-water productivity model

AquaCrop is a crop growth model developed by FAO's Land and Water Division to address food security and assess the effect of the environment and management on crop production. AquaCrop simulates the yield response of herbaceous crops to water and is particularly well suited to conditions in which water is a key limiting factor in crop production. AquaCrop balances accuracy, simplicity and robustness. To ensure its wide applicability, it uses only a small number of explicit parameters and mostly intuitive input variables that can be determined using simple methods. [Read more...](#)



AquaCrop new Version 7.0 now available!







Standard AquaCrop programme with users' interface and database - version 7.0

This is the standard crop water productivity software model with Graphical User Interface (GUI) and

AquaCrop stand-alone programme - version 7.0

This allows to run several predefined "projects" and to store results in output files for individual locations without using a Graphical User

AquaCrop-Github

The AquaCrop version 7.0 core code is released as open-source Fortran code, and is available on GitHub for free and transparent access to the latest and future

KUL-RSDA / AquaCrop Public

<> Code Issues Pull requests 1 Discussions Actions Projects Wiki Security Insights

main 9 branches 1 tag Go to file Add file <> Code

mbechtold Merge pull request #320 from mbechtold/default_crop_false ... b36e307 7 days ago 1,419 commits

src	ENH: first usage of use_default_crop_file to avoid redundant saving	8 days ago
tests	TST: add --omit_listprojects pytest switch for Perennial	4 months ago
.gitignore	BLD: support static standalone libraries	6 months ago
AUTHORS.md	ENH: typo CSIC	3 months ago
DISCLAIMER	ENH: updated AUTHORS, DISCLAIMER, LICENSE and README following ...	3 months ago
LICENSE	ENH: updated AUTHORS, DISCLAIMER, LICENSE and README following ...	3 months ago
README.md	ENH: another edit for LIS	3 months ago

README.md

AquaCrop

AquaCrop v7.0 is released as an open-source Fortran code, developed at KU Leuven and FAO (FAO and KU Leuven copyright), and based on the original AquaCrop v6.0 (FAO copyright). Compared to AquaCrop v6.0, the AquaCrop v7.0 features bug fixes, performance improvements and internal restructuring, a translation from Pascal to Fortran, and a range of new and/or updated scientific features.

The following applications are publicly distributed:

About

No description, website, or topics provided.

- Readme
- View license
- 11 stars
- 6 watching
- 5 forks


Releases 1

AquaCrop v7.0 Latest
on Aug 30

Packages

No packages published
[Publish your first package](#)

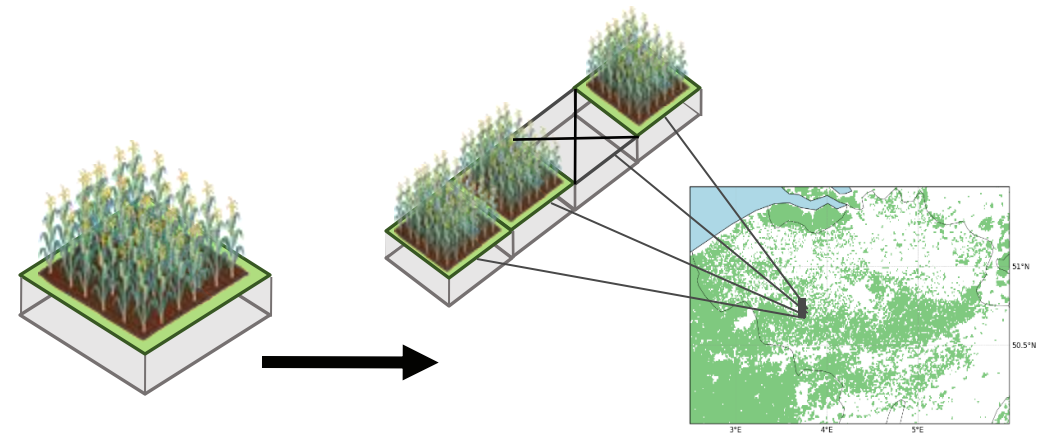
Contributors 9





NEW OPPORTUNITIES

- New modules e.g. salinity, soil-water transport, ... readily exchangeable
- Computationally expensive simulations optimized
- Regional system tested with various meteorological forcings over Europe:
 - Re-analysis MERRA-2
 - Re-analysis and climate forecasts of ISIMIP3
- Evaluated in terms of **soil moisture, biomass**
- Predictions of **irrigation**





REGIONAL MODELING AND DATA ASSIMILATION

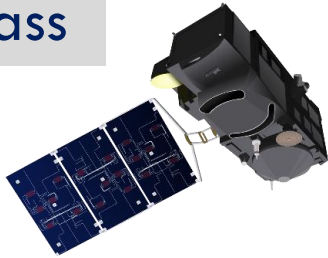
Shui – EU – KU LEVEN

Project: 773903



REGIONAL MODELING

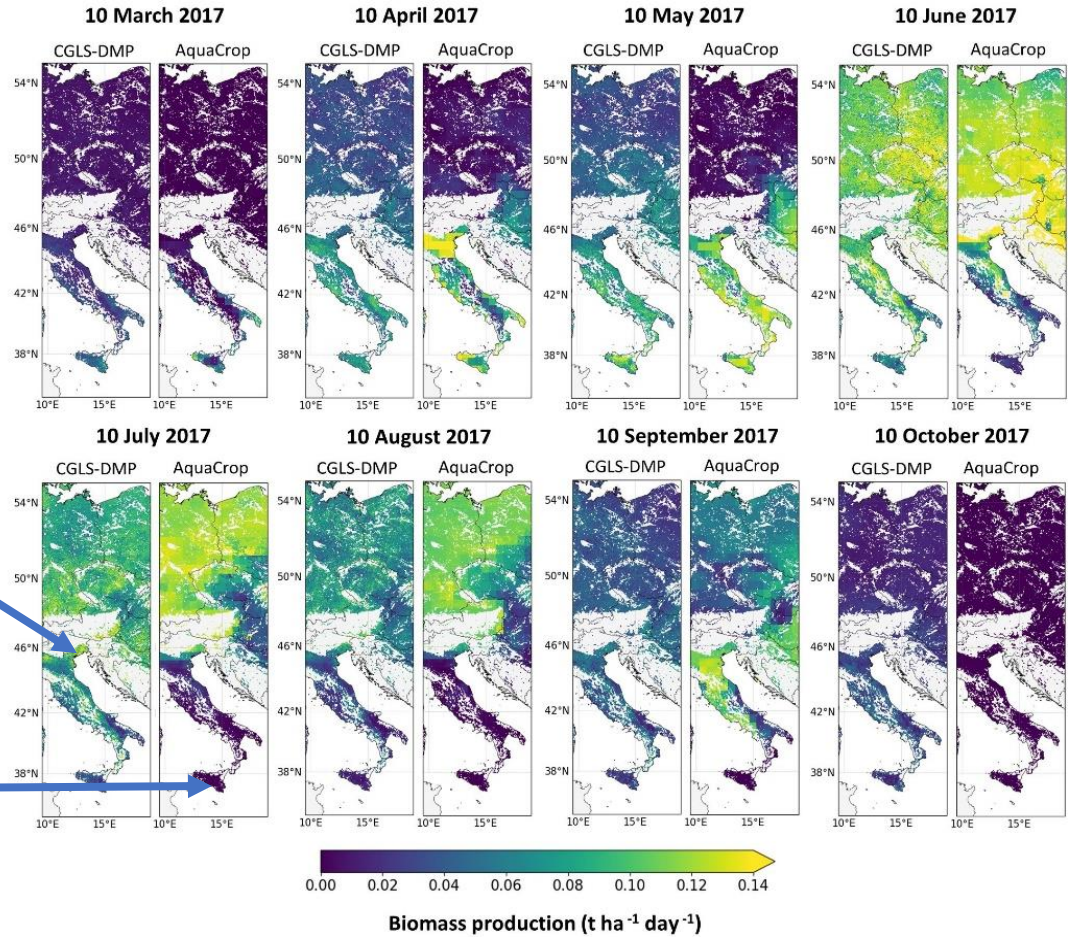
Biomass



Satellite
(Copernicus dry
matter productivity)



Model

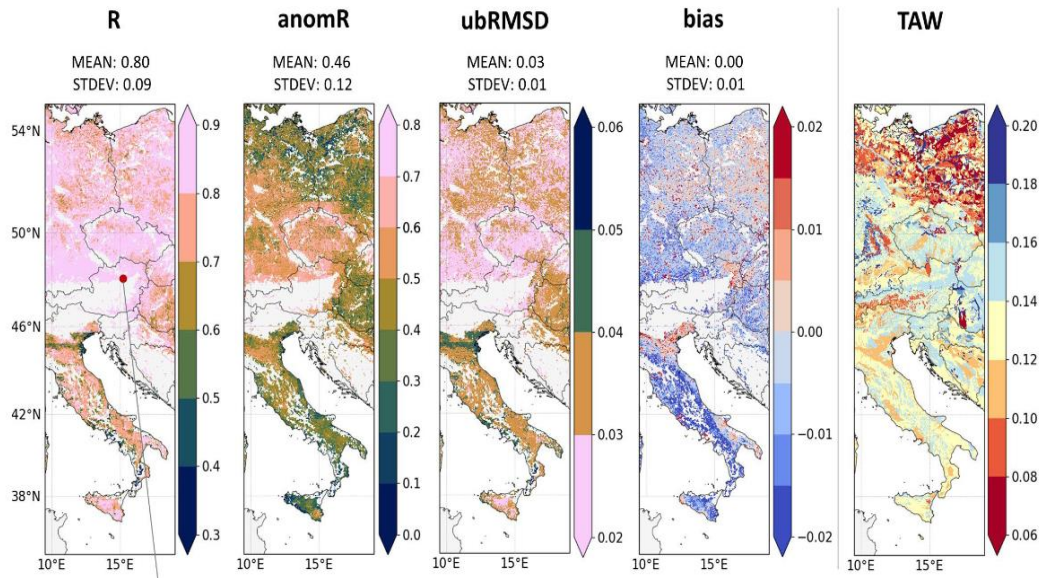


de Roos et al., 2021:
<https://doi.org/10.5194/gmd-14-7309-2021>

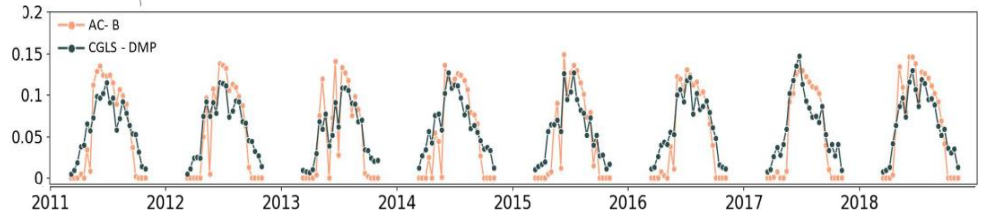


REGIONAL MODELING

Biomass



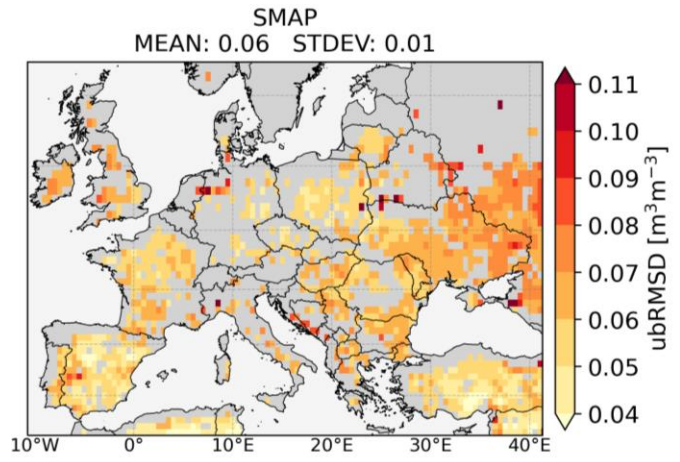
Daily production ($T\ ha^{-1}\ day^{-1}$)



~1 km

de Roos et al., 2021:
<https://doi.org/10.5194/gmd-14-7309-2021>

Soil moisture



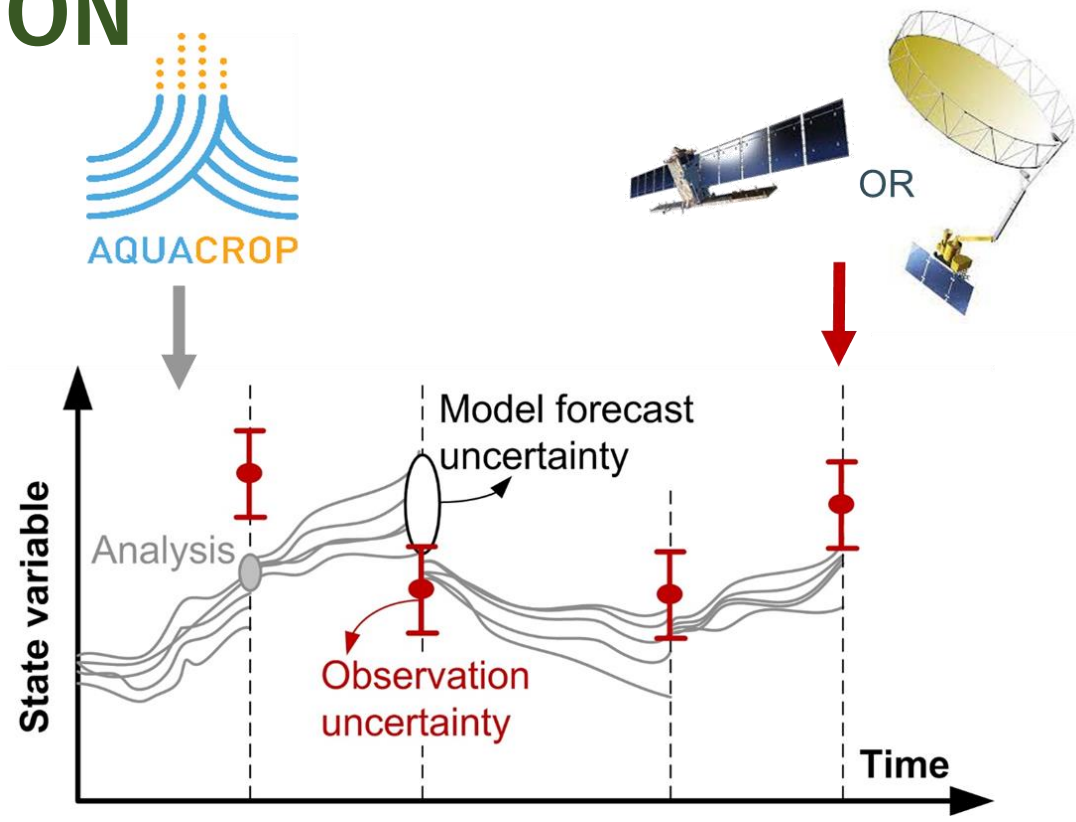
Busschaert et al., 2022;
<https://doi.org/10.5194/hess-26-3731-2022>

~50 km

Regional AquaCrop simulations forced with re-analysis MERRA-2 or ISIMIP agree well with satellite-based and in situ reference data of *soil moisture* and *biomass*



DATA ASSIMILATION



Satellite data correct soil moisture and biomass
Uncertainty reduction



CLIMATE CHANGE AND NET IRRIGATION REQUIREMENT

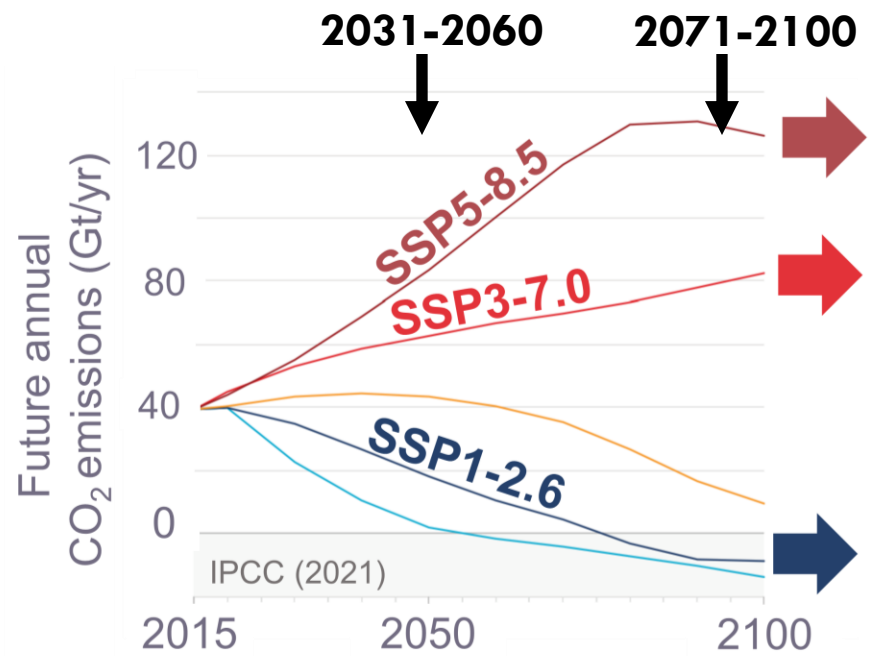
For an average C3 crop grown during the summer months

Shui – EU – KU LEVEN

Project: 773903

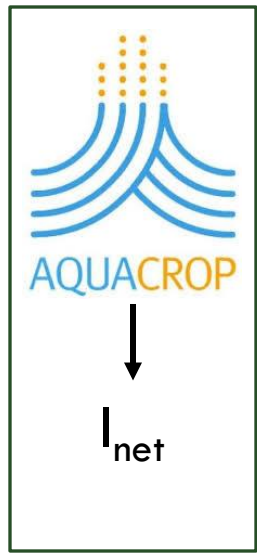


AMOUNT OF NET IRRIGATION

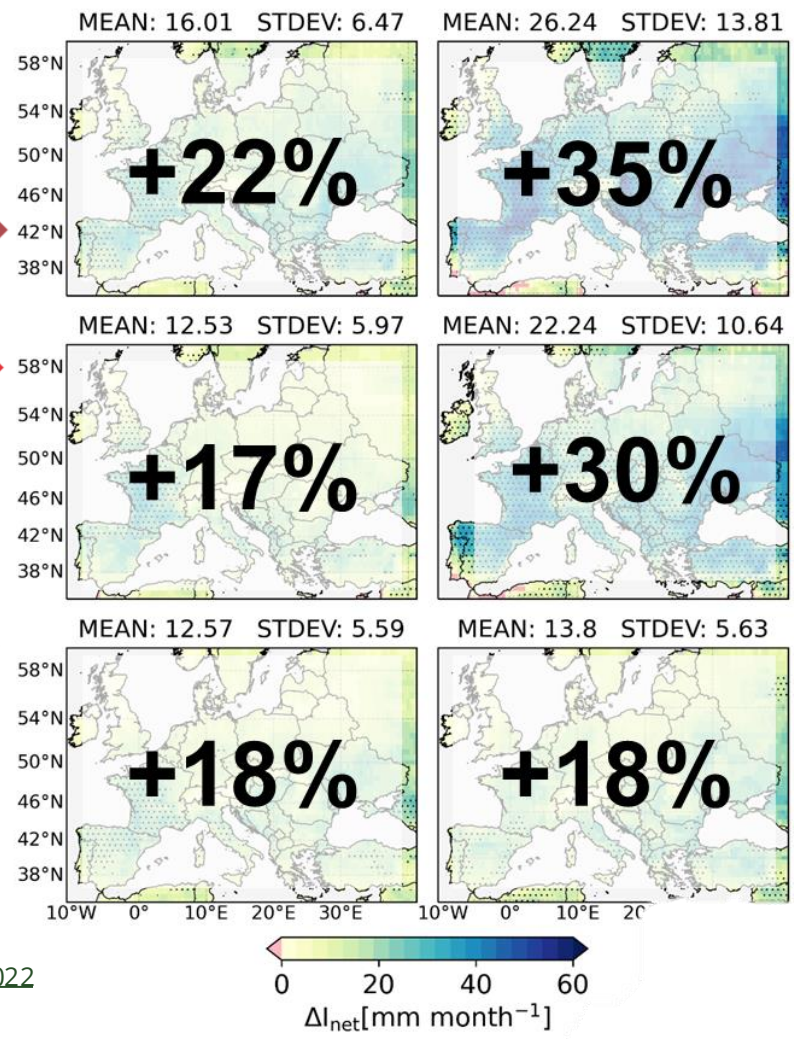


ISIMIP3

Inter-Sectoral Impact Model Intercomparison Project
5 GCMs
3 climate scenarios



Busschaert et al., 2022
<https://doi.org/10.5194/hess-26-3731-2022>



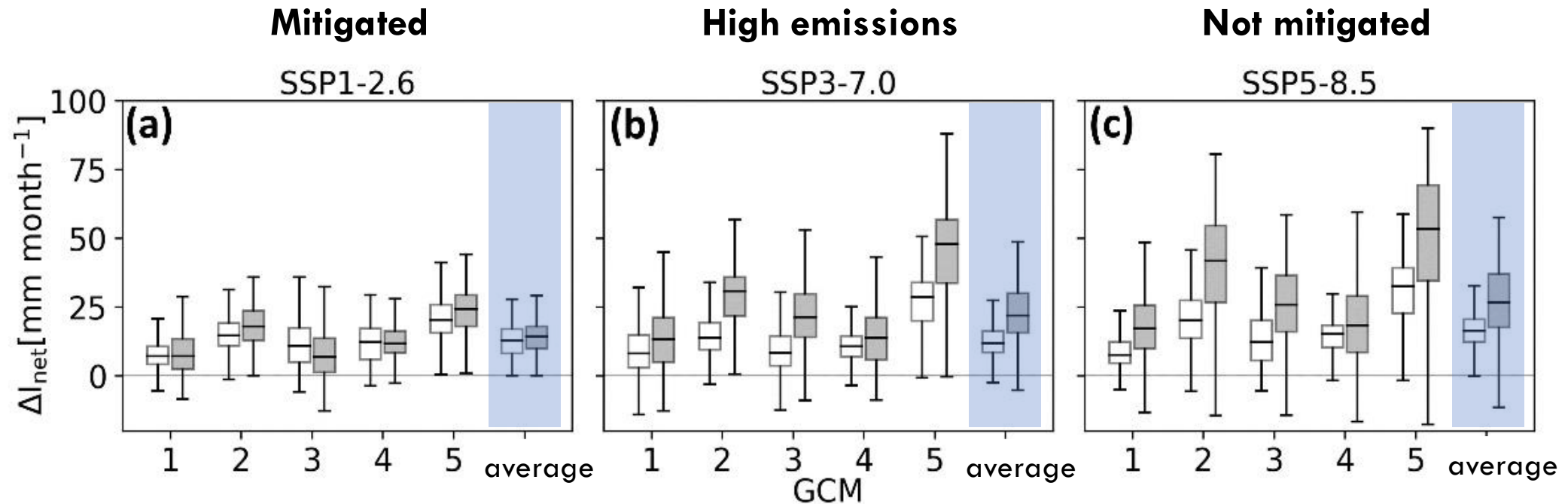
Not mitigated

High emissions

Mitigated



AMOUNT OF NET IRRIGATION

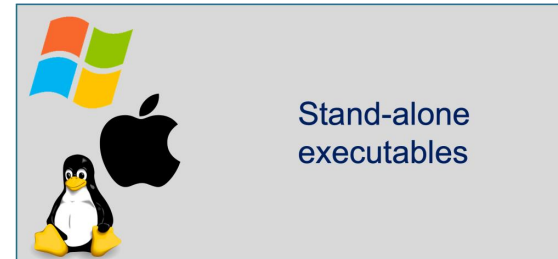
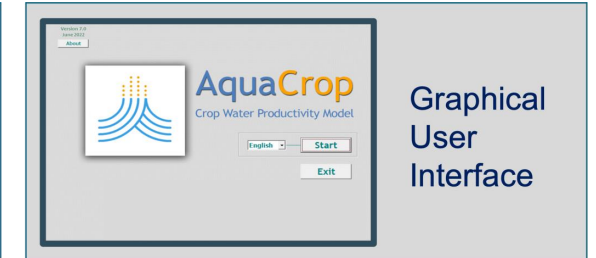


Future I_{net} depends on the emission scenario but **more strongly on the GCM**



CONCLUSIONS

- AquaCrop v7.0:
 - Scientific updates
 - Bug fixes, optimization
 - Open source, Windows, MacOS, Linux
- New research:
 - New code modules can be tested by broad community
 - Computationally expensive simulations optimized
 - Satellite-based regional data assimilation
 - Climate scenarios
 - And much more in future research...





Thank you!

Presenter: Louise Busschaert

aquacrop@fao.org

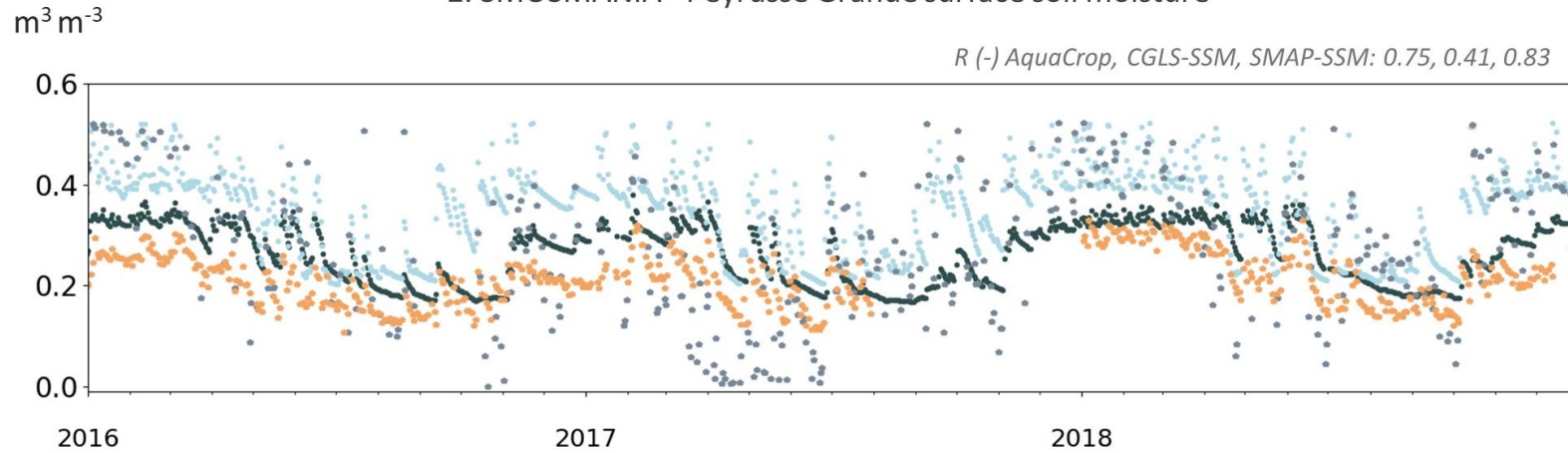
AquaCrop version 7.0

- Open source, version-controlled from v7.0 onwards
- Fortran code:
 - Earth and climate sciences
 - C and Python interfaces can be generated
 - Direct integration into NASA's Land Information System and other applications
 - Basis for regional applications
- Bug fixes, code optimization
- Performance improvement: runtime reduction 10 x

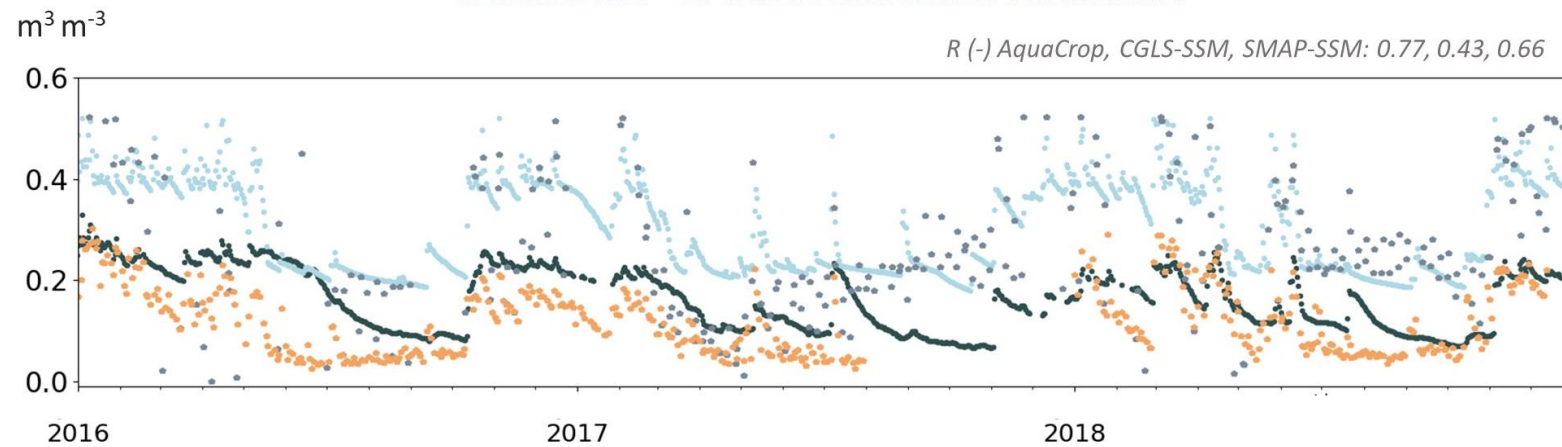
<https://github.com/KUL-RSDA/AquaCrop>

Regional crop modeling

2. SMOSMANIA - Peyrusse Grande surface soil moisture



3. REMEDHUS – La Cruz de Elias surface soil moisture



in situ – AquaCrop – CGLS-SSM – SMAP-SSM