

Hyper-resolution hydrological modelling to assess water and food security in Malawi

Daniela Anghileri¹, Noemi Vergopolan², Solomon Gebrechorkos¹, Justin Sheffield¹
d.anghileri@soton.ac.uk

1:  UNIVERSITY OF
Southampton

2:  PRINCETON
UNIVERSITY

 General
Assembly 2021

EGU21-6340

RESEARCH QUESTION

Rainfed crop production in smallholder farming systems is key for food security in Malawi



Modelling challenges:

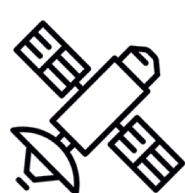
- Data availability (for setup and validation)
- Computational feasibility
- Focus on green water in the soil rather than blue water ^[1]

Can we reliably model hydrological processes at small scale in high heterogeneous landscapes in data sparse regions?

[1] Falkenmark, 2018 DOI: 10.1007/978-981-10-6695-5_9
[2] Chaney et al., Hydrol. Proc.. 30, 2016, DOI: 10.1002/hyp.10891
[3] Vergopolan et al., HESS, 25, 2021, DOI: 10.5194/hess-25-1827-2021
[4] Cédric et al., J. of Hydromet., 2011, DOI: 10.1175/2011JHM1345.1

APPROACH & RESULTS

REMOTE SENSING Inputs

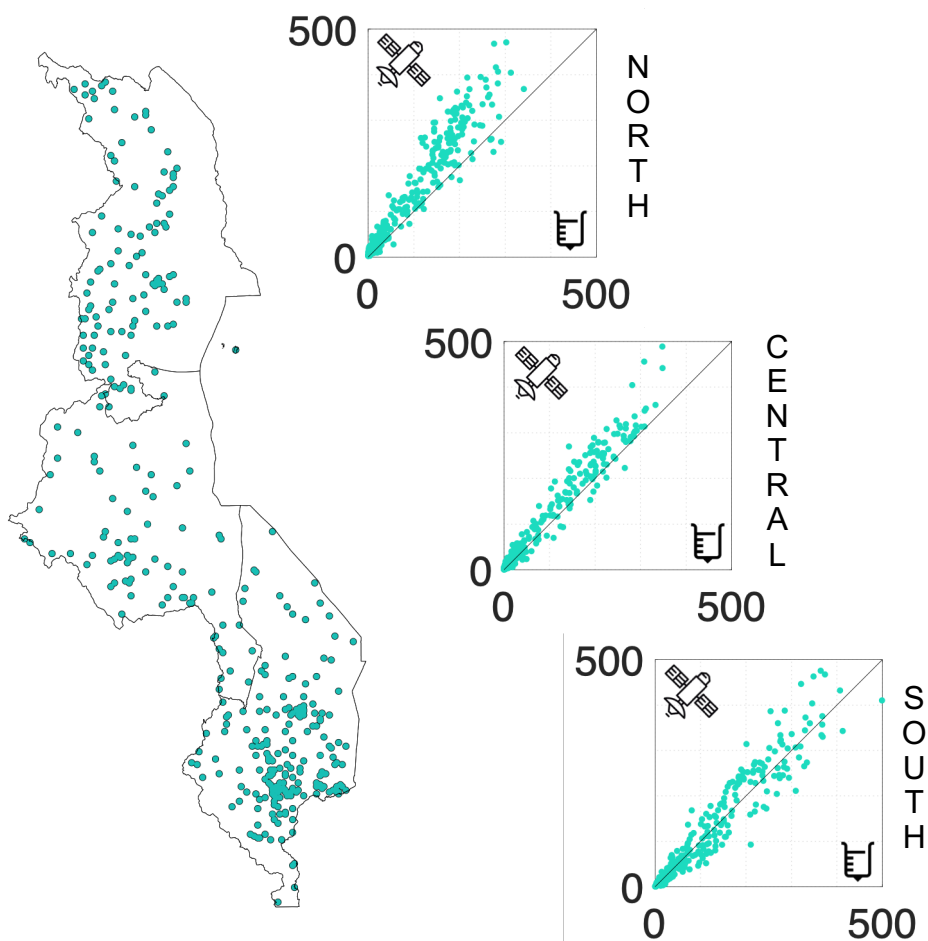


SRTM DEM 30 m
ERA5-Land 10 km, 3 hours
SoilGrid dataset, 250 m
POK-based GlobCover 30 m

1

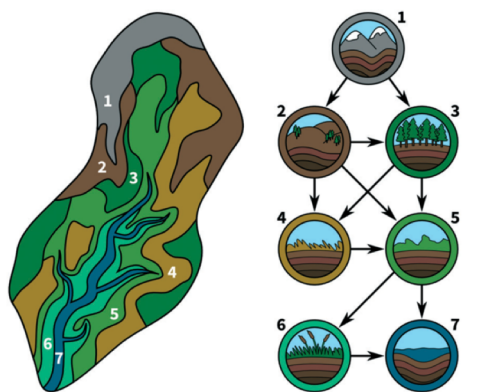


Validation of precipitation using
396 ground stations (mm/month)

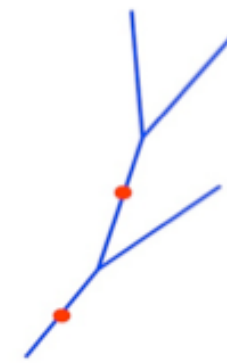


ERA5Land precipitation
overestimates observed precipitation
(especially in Northern Malawi)

HYDROBLOCKS ^[2,3] Land Surface Model



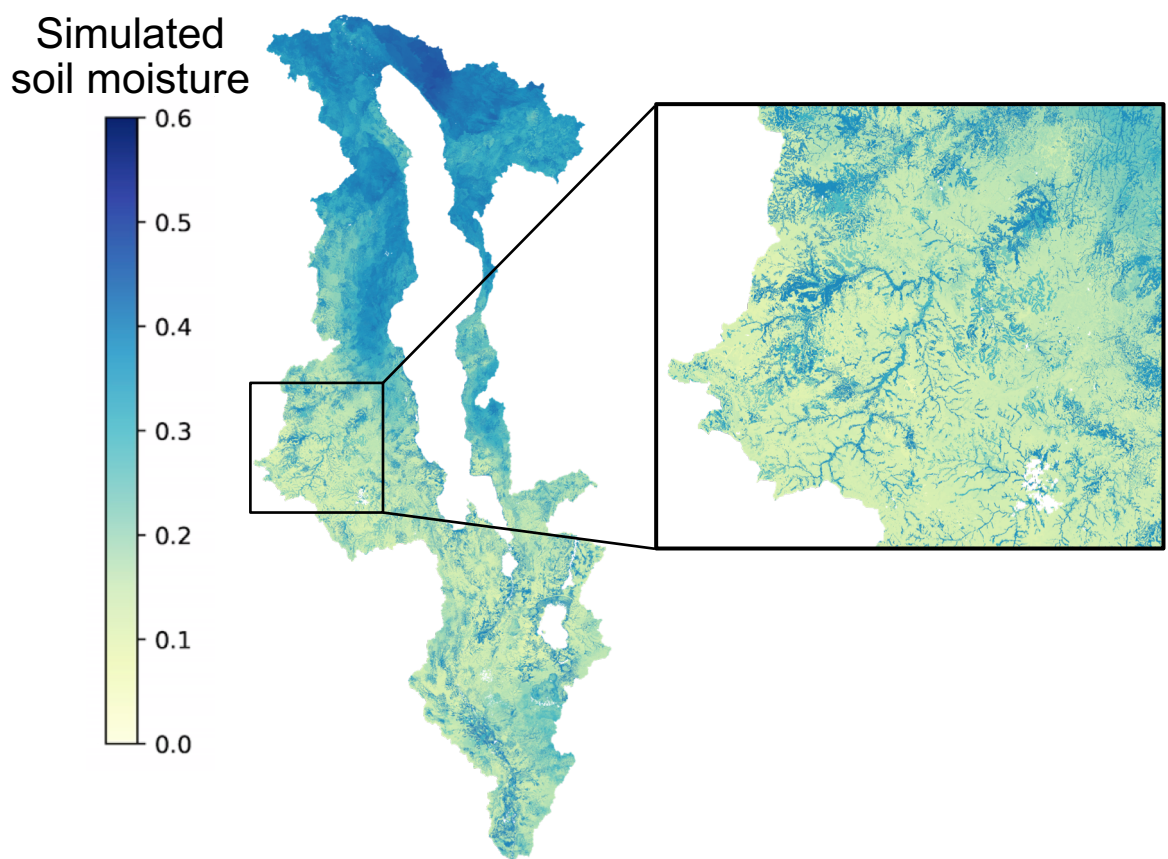
RAPID ^[4] River Routing Model



2

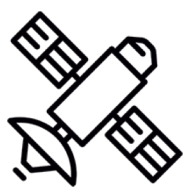


Mean soil moisture (top layer)
in the wet season (2010-2020)



We obtain computationally efficient and
realistic hydrological simulations at 3 hours
time resolution and 30 m effective spatial
resolution

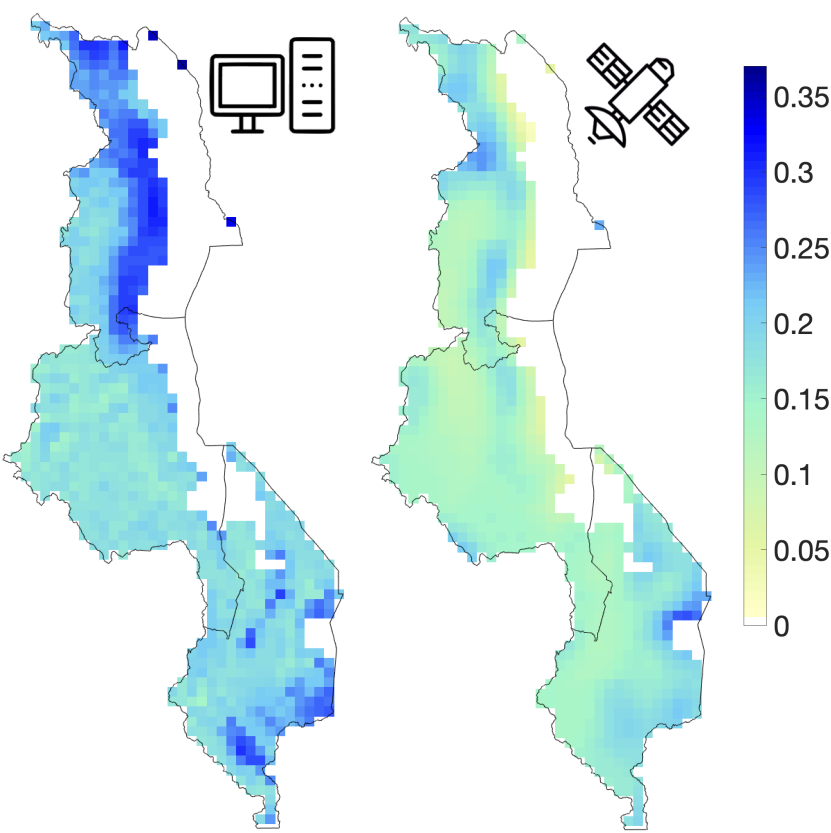
REMOTE SENSING from independent sources for validation



SMAP soil moisture 9 km
MODIS actual
evapotranspiration 500 m
MODIS land surface
temperature 1 km

3

HB simulation vs SMAP
mean annual soil moisture
(2015-2019)



The spatial patterns are
reproduced, but the model
validation at fine spatial scale
still remains a challenge