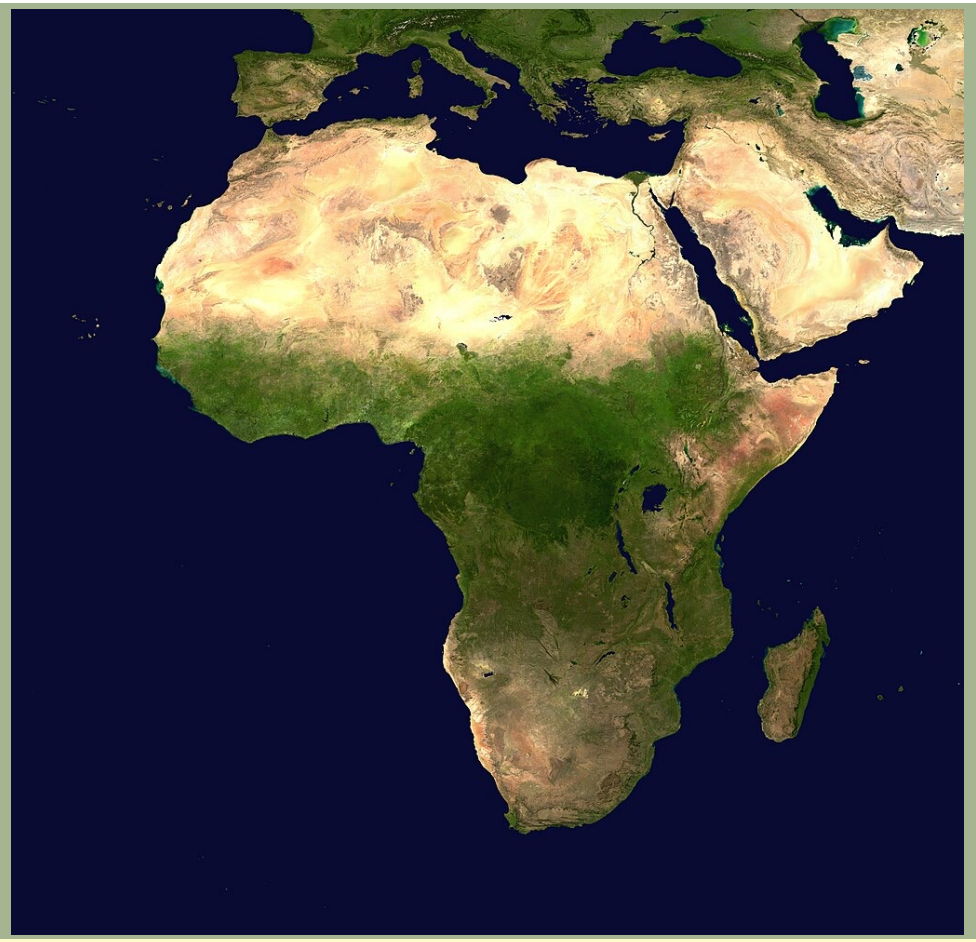
Evaluation of regional climate model ALARO-0 at 12.5 km resolution over the CORDEX-Africa domain



Laura Decorte

Supervisor: Prof. S. Crauwels (KU Leuven)

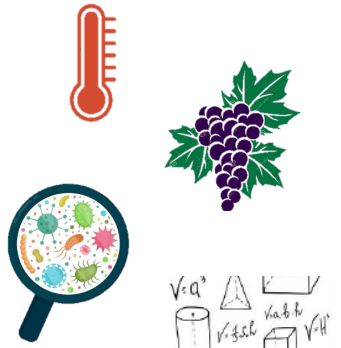
Co-supervisors: Dr. R. Hamdi (Koninklijk Meteorologisch Instituut), Dr. E.H. Blanquaert (Stellenbosch University)

Introduction

- Big effect of climate change on human and natural systems
- Impact studies: need for high-resolution climate data

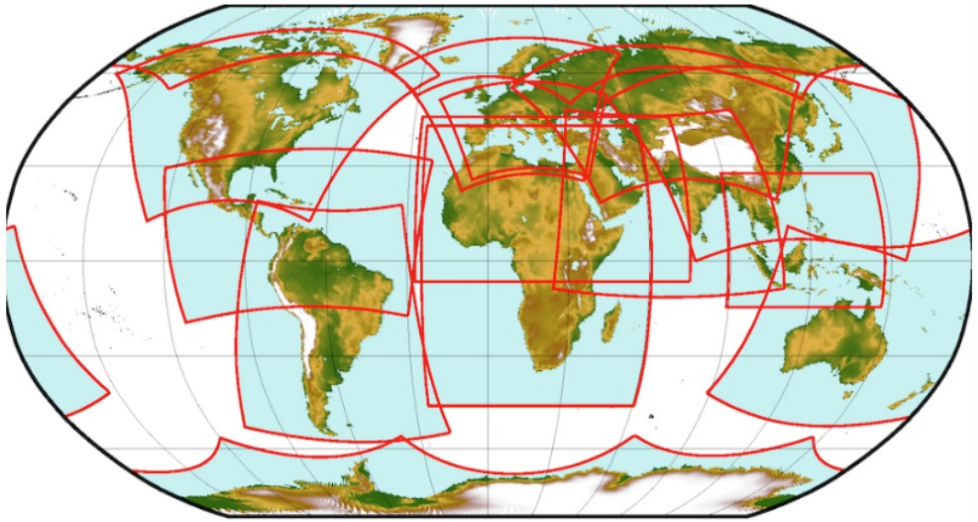
ClimaVin

Study impact of climate change on grapevines in different regions



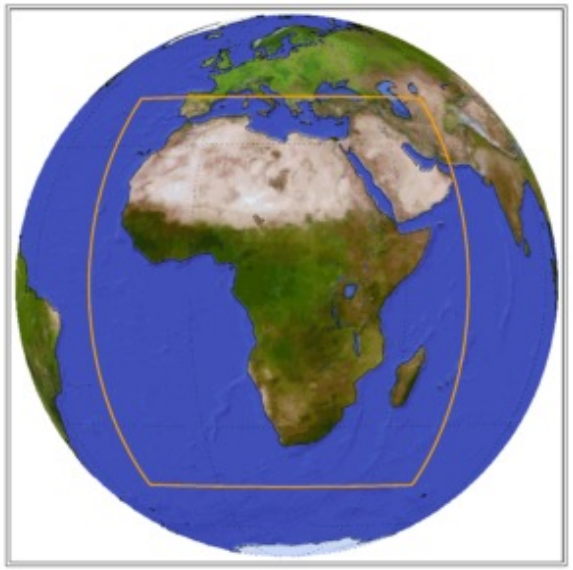
Introduction

- CORDEX:
  - A lot of climate simulations
  - **Africa**: high resolution data is scarce, highest resolution: 25 km



- Goal:

  → Tackle scarcity by evaluating Regional Climate Model (RCM) over African domain at high resolution



Methods

Set-up of simulation by ALARO-0

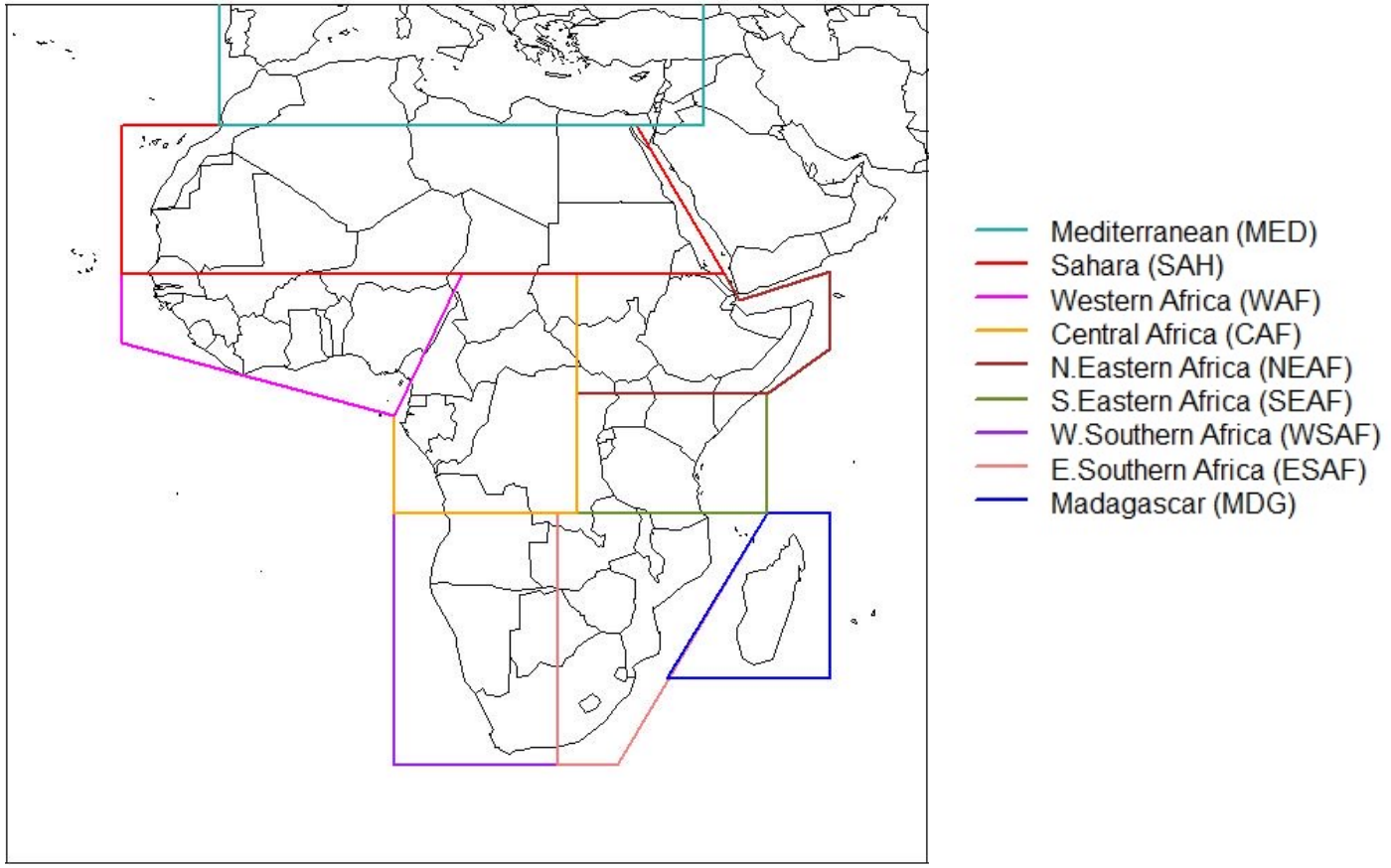
- ALARO-0
  - Operational **weather forecasting**
  - **RCM** over Europe and Asia

Set-up simulation	
Domain	CORDEX-Africa
Horizontal resolution	12.5 km
Period	2001-2020
Lateral boundary conditions	ERA5
Downscaling approach	Continuous, new ERA5 boundary conditions every 3 hours

Methods

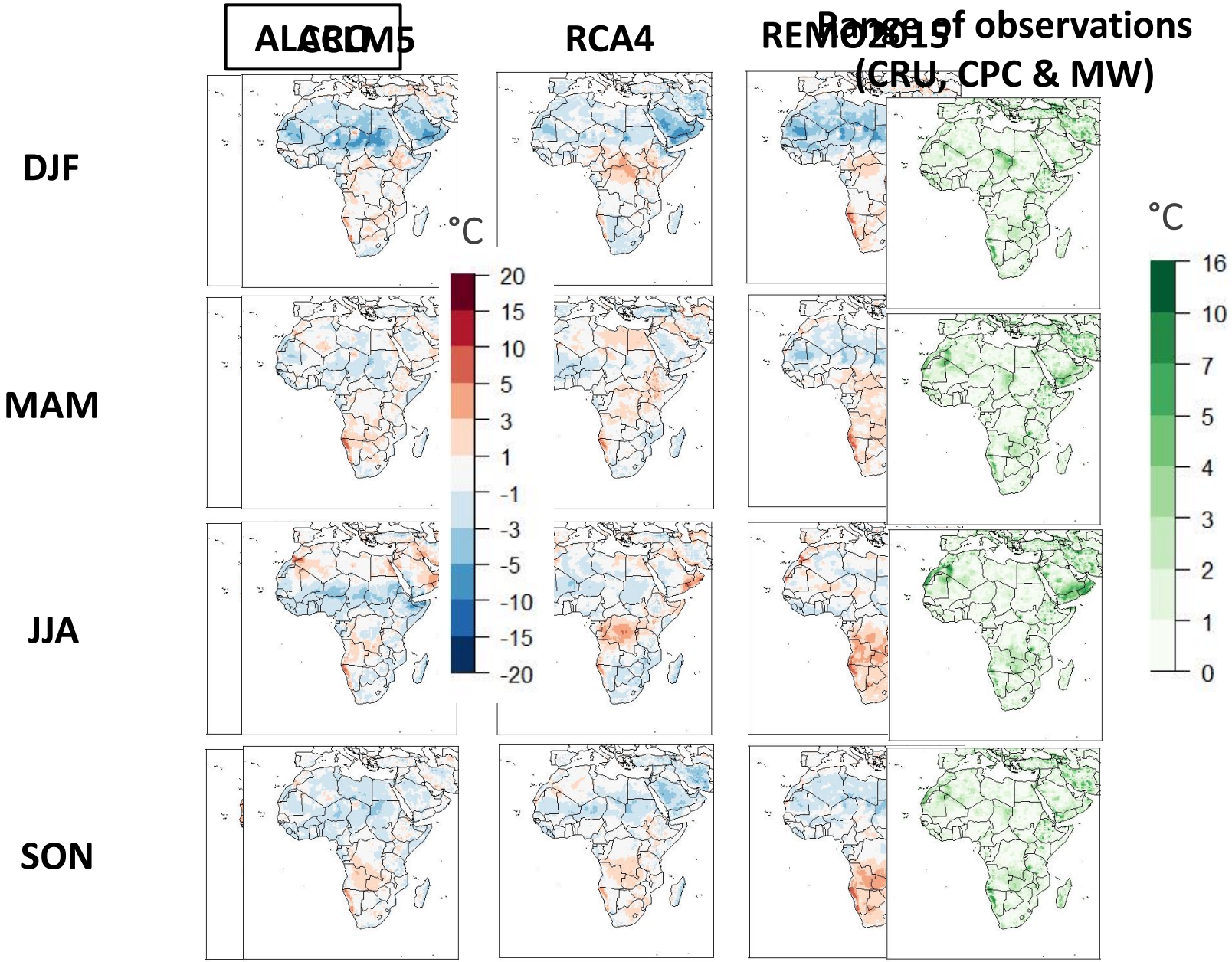
Evaluation of ALARO-0 over CORDEX-Africa domain

- Evaluation
  - Division in **subdomains** according to IPCC
  - Monthly and seasonally averaged values for **temperature** and **precipitation**
  - **Observational** datasets: CRU, CPC, MW, CHIRPS
  - Other **models** with lower resolution: REMO2015 (25 km), CCLM (25 km), RCA4 (50 km)
    - Forced by ERA-Interim
  - Longest overlapping period: 10 years (2001-2010)



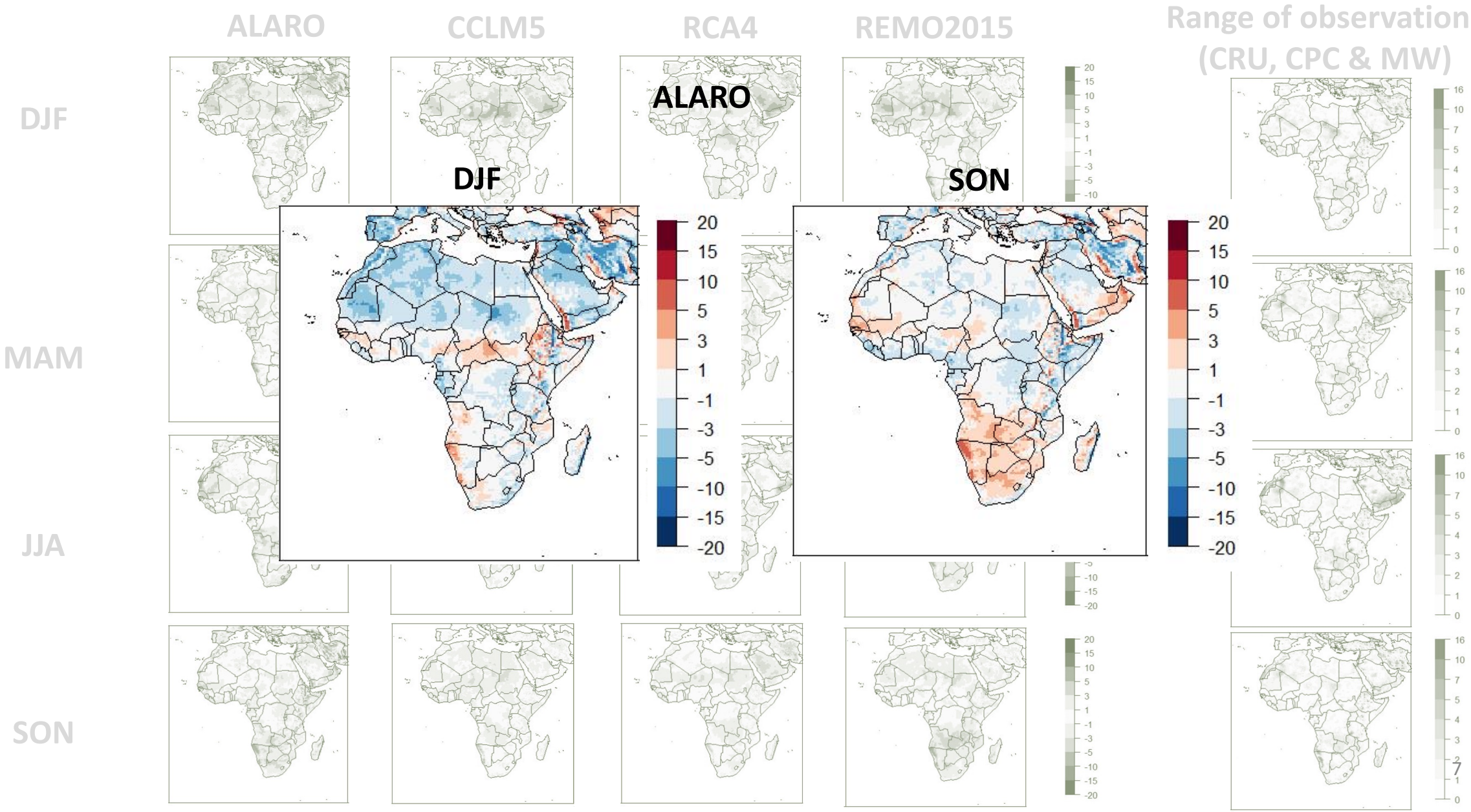
Results

Bias of mean 2m temperature per season: model – mean of observations 2001-2010



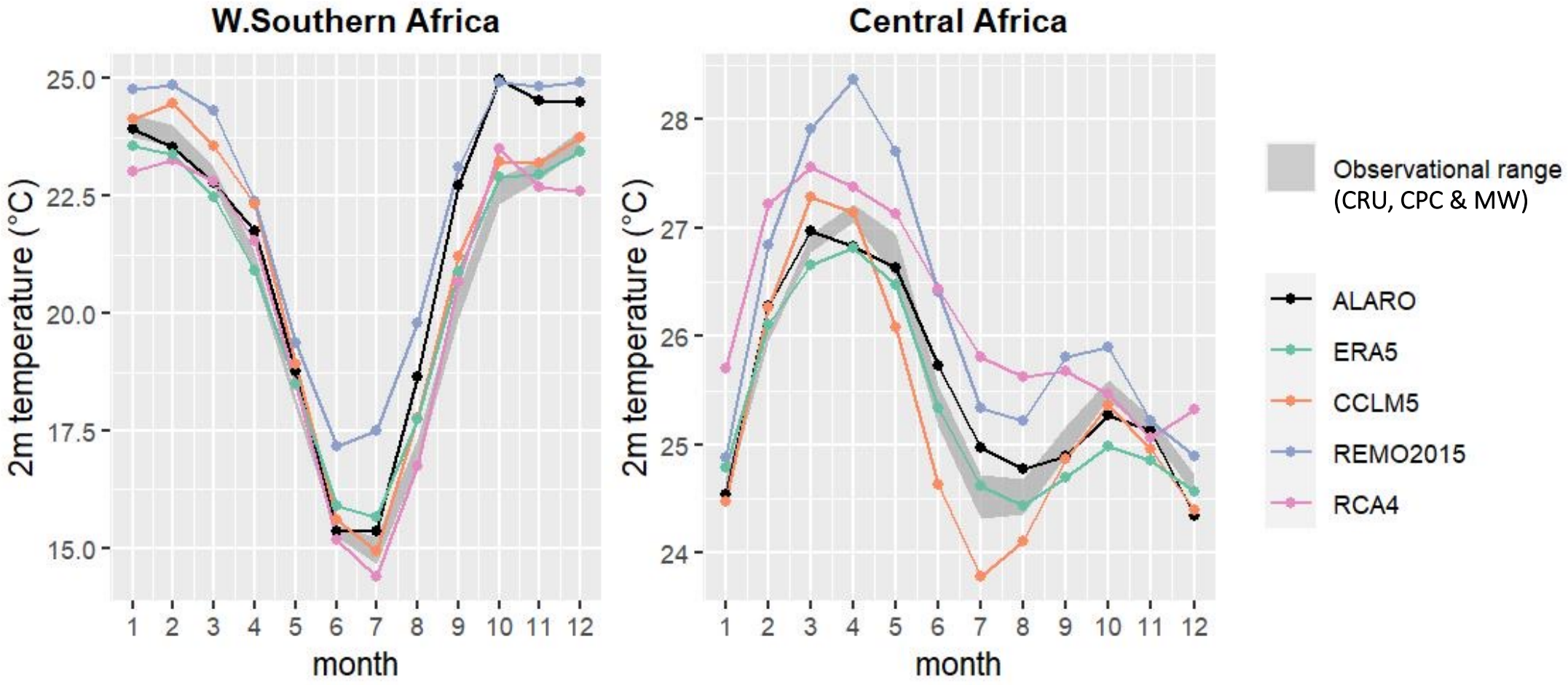
Results

Bias of mean 2m temperature per season: model – mean of observations 2001-2010



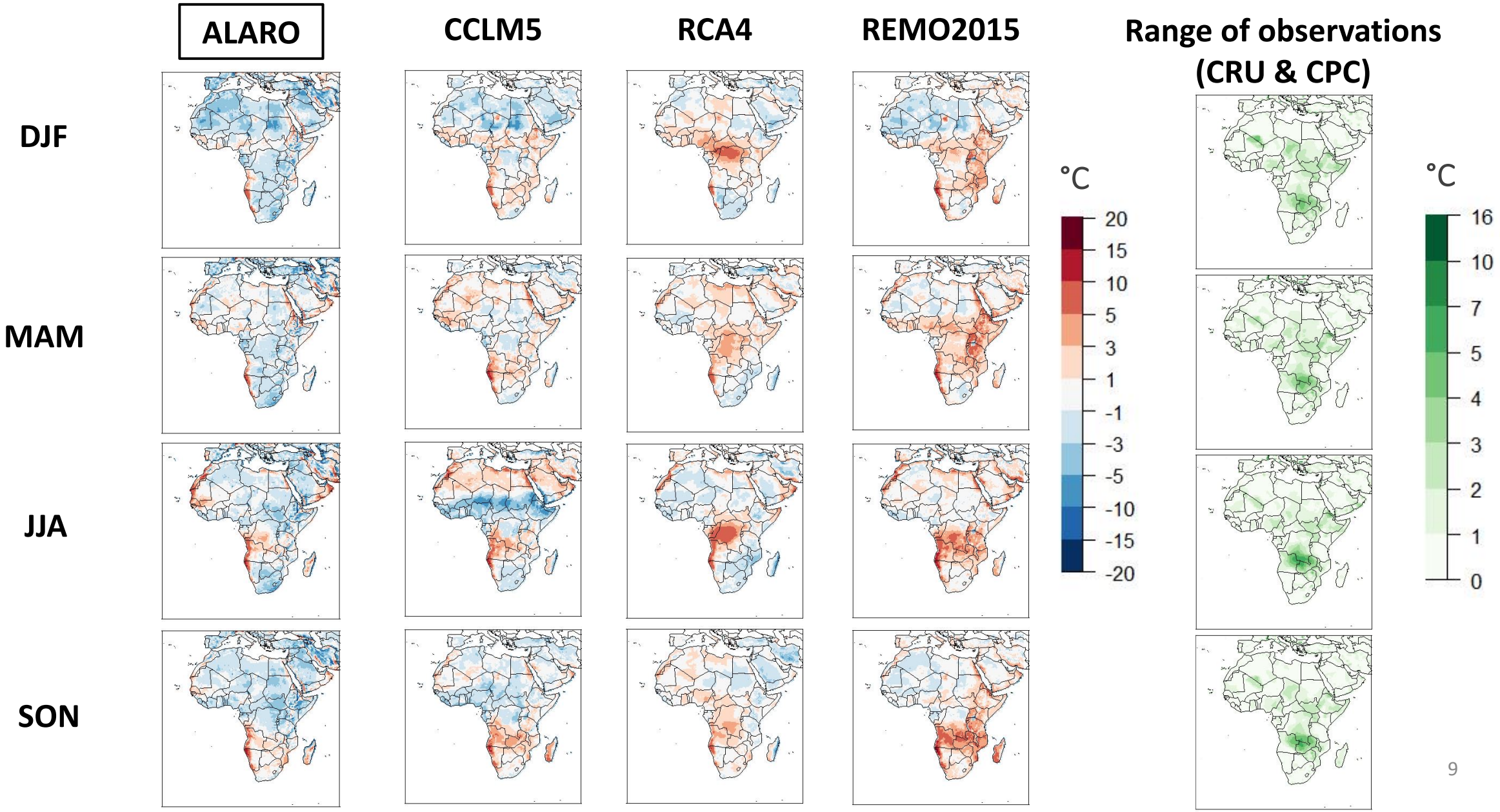
Results

Annual cycle of 2m temperature for 2001-2010



Results

Bias of max 2m temperature per season: model – mean of observations 2001-2010



Results

Bias of max 2m temperature per season: model – mean of observations 2001-2010

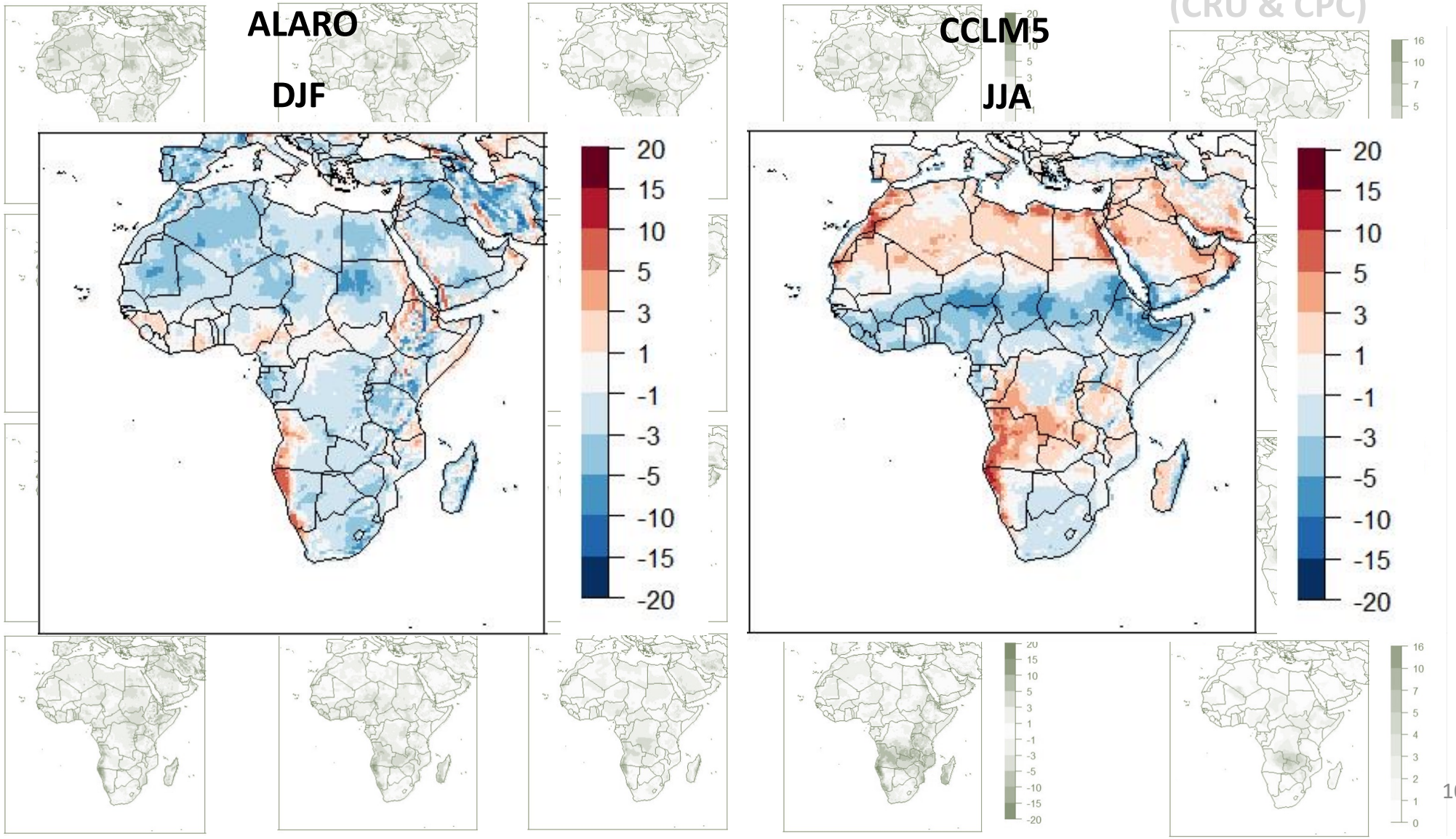
ALARO | CCLM5 | RCA4 | REMO2015 | Range of observations (CRU & CPC)

DJF

MAM

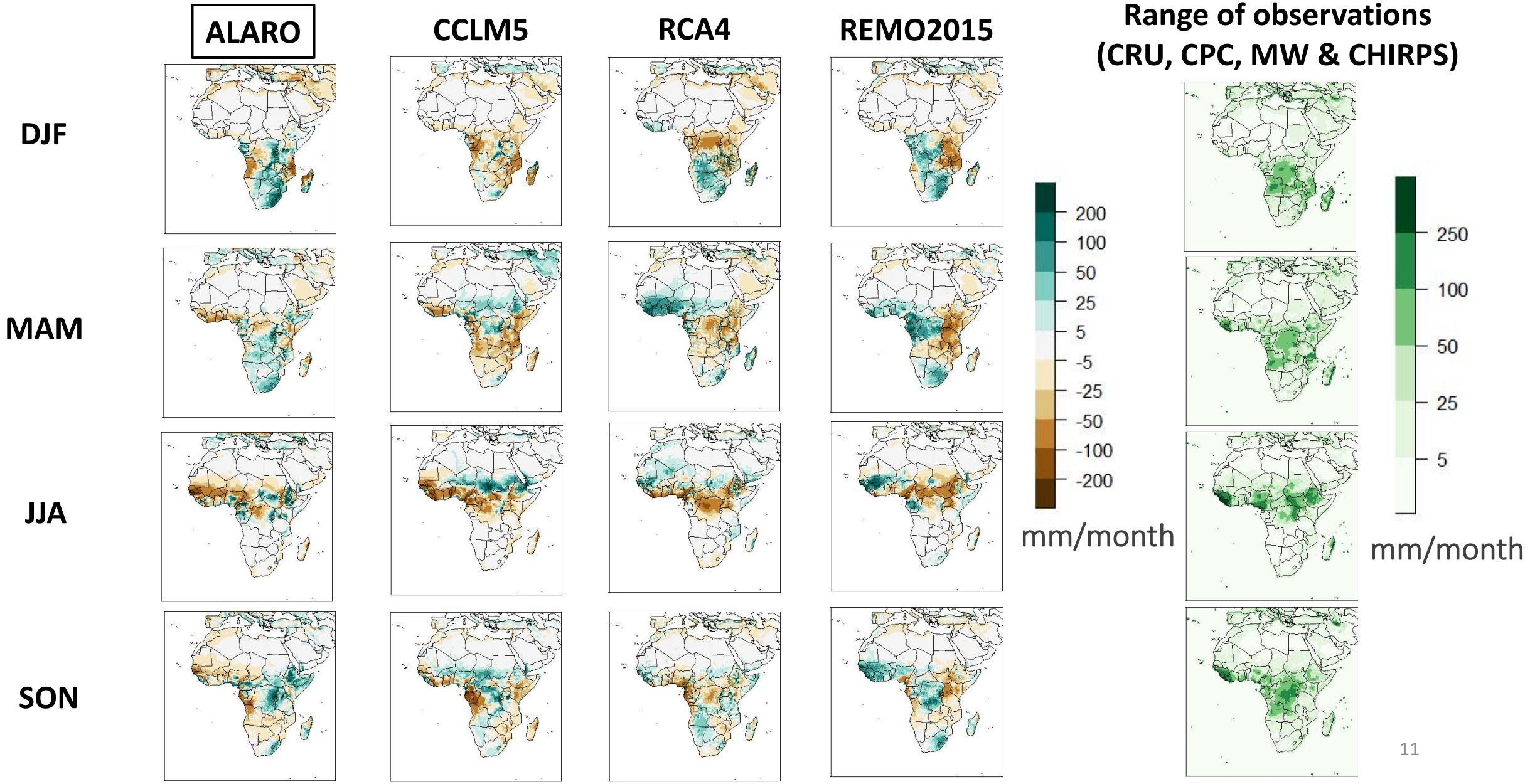
JJA

SON



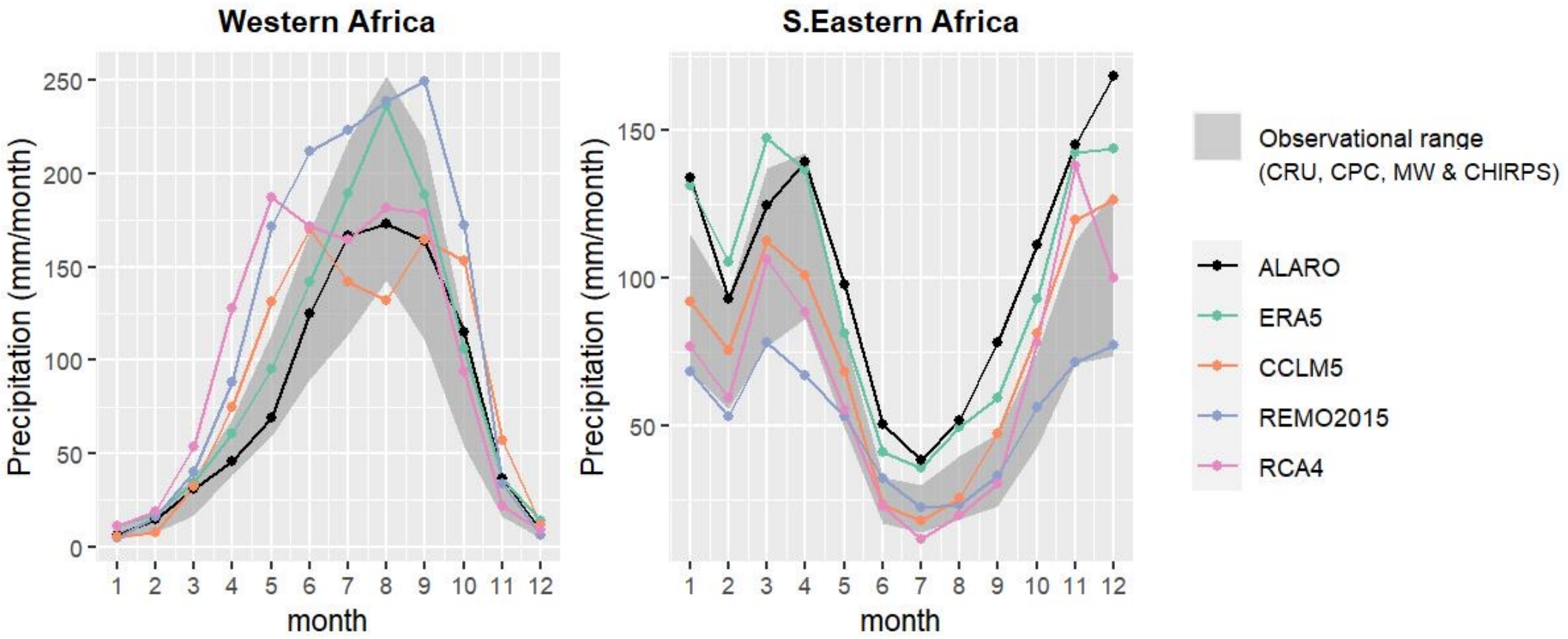
Results

Bias of mean monthly precipitation: model – mean of observations 2001-2010



Results

Annual cycle of monthly precipitation for 2001-2010



Conclusion

- Performance of ALARO over Africa:
  - Biases of all variables **comparable** to those of **other models**
  - **Captures** temperature and precipitation **cycles and patterns**
  - Can be used for **future projections** and **impact studies**, taking into account shortcomings, using bias correction

- ALARO over other domains:
  - Asia: also **underestimation** of daily **temperature range**
  - Europe and Asia: ALARO performs **better for precipitation** (~3MT)
    - Africa: true for **some regions** (e.g. Western Africa)

Perspectives

Climate modelling

- Evaluation: **diurnal** cycle, precipitation **extremes**
- Future climate **projections** with ALARO
- Further **downscaling** to 4 km over SA

Impact study

- Investigate relationship between **grapevine phenology** and **climate variables**
- Project future **bioclimatic indices**

Thank you!

Email: laura.decorte@kuleuven.be

- Top, S., Kotova, L., De Cruz, L., Aniskevich, S., Bobylev, L., De Troch, R., Gnatiuk, N., Gobin, A., Hamdi, R., Kriegsmann, A., Remedio, A. R., Sakalli, A., Van De Vyver, H., Van Schaeybroeck, B., Zandersons, V., De Maeyer, P., Termonia, P., and Caluwaerts, S.: Evaluation of regional climate models ALARO-0 and REMO2015 at 0.22° resolution over the CORDEX Central Asia domain, Geosci. Model Dev., 14, 1267–1293, https://doi.org/10.5194/gmd-14-1267-2021, 2021.
- Giot, O., Termonia, P., Degrauwe, D., De Troch, R., Caluwaerts, S., Smet, G., Berckmans, J., Deckmyn, A., De Cruz, L., De Meutter, P., Duerinckx, A., Gerard, L., Hamdi, R., Van den Bergh, J., Van Ginderachter, M., and Van Schaeybroeck, B.: Validation of the ALARO-0 model within the EURO-CORDEX framework, Geosci. Model Dev., 9, 1143–1152, https://doi.org/10.5194/gmd-9-1143-2016, 2016.