Effects of improved land surface processes in the regional climate model REMO on climate means and extremes in Mainland Southeast Asia

EGU General Assembly 2024, 15.04.2024

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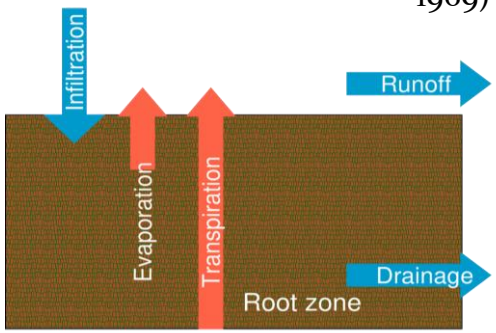
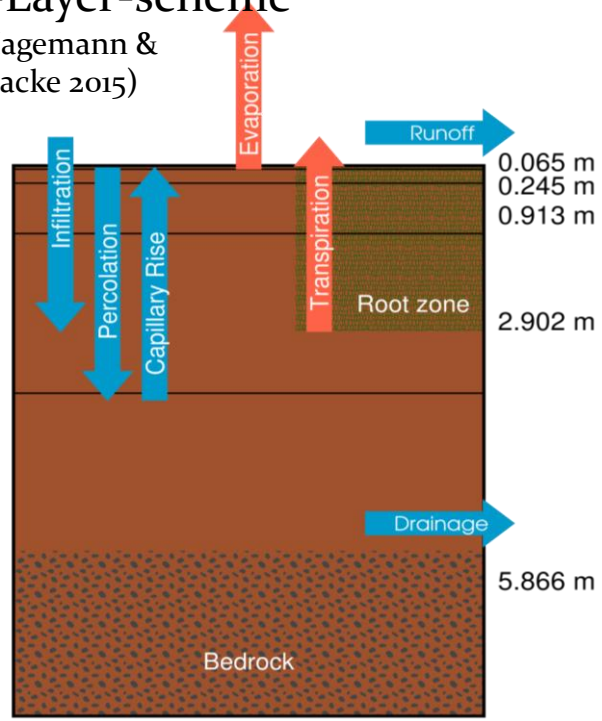
Model development

Bucket-scheme (Manabe 1969)



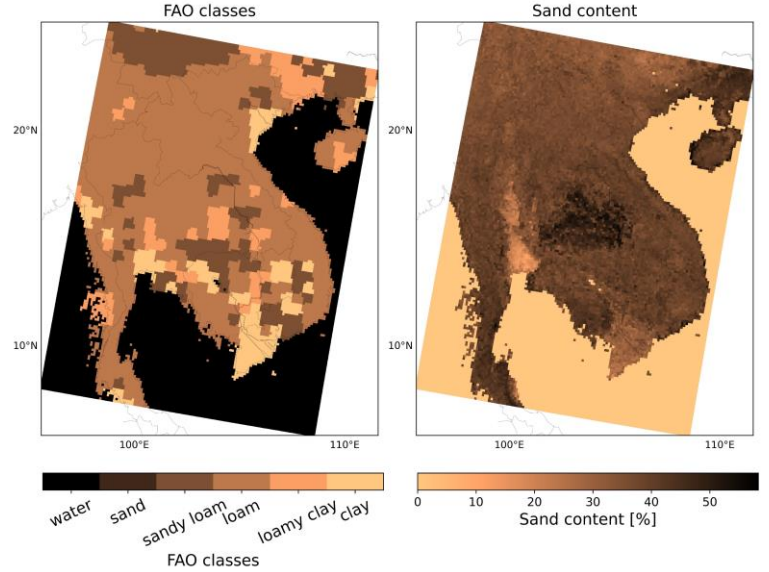
5-Layer-scheme (Hagemann & Stacke 2015)



1) Soil hydrology:
Single- to **multilayer**

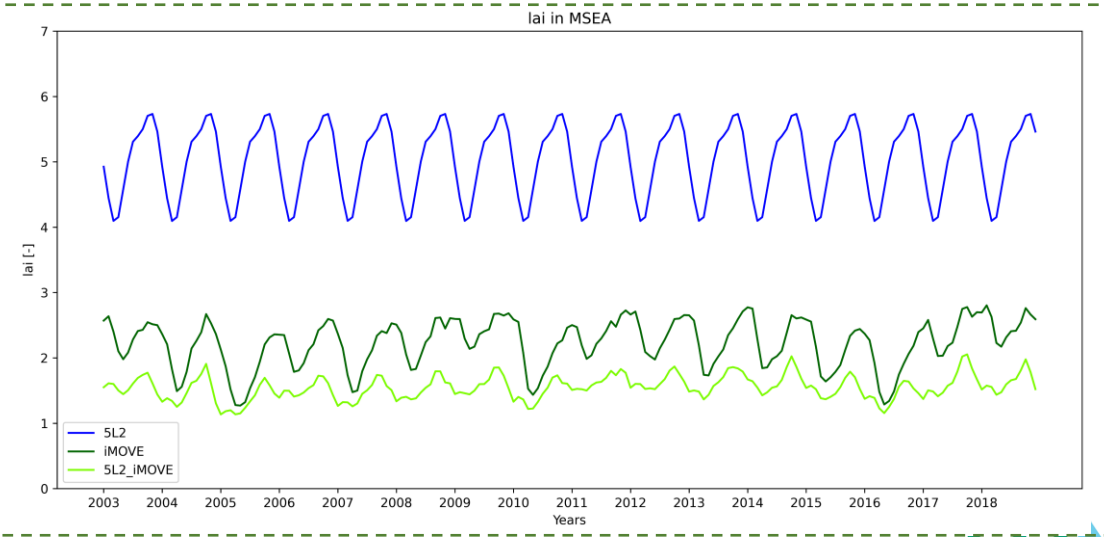
2) **Land surface data**

- FAO to SoilGrids
- Discrete to continuous PTFs
- Layered soil information
- Deeper roots



3) Vegetation:

Static to **interactive**



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Simulations

Simulation	Soil layers	Soil data / PTF	Vegetation
REMO2015	1	FAO / discrete	Static, monthly prescribed
imove	1	FAO / discrete	Interactive
5L	5	FAO / discrete	Static, monthly prescribed
5L2	5	SoilGrids / continuous	Static, monthly prescribed
5L2_imove	5	SoilGrids / continuous	Interactive

- Simulations: warm start, 2001-2018, 0.11°, Mainland Southeast Asia
- Validation data: MODIS, ERA5Land, GLEAM

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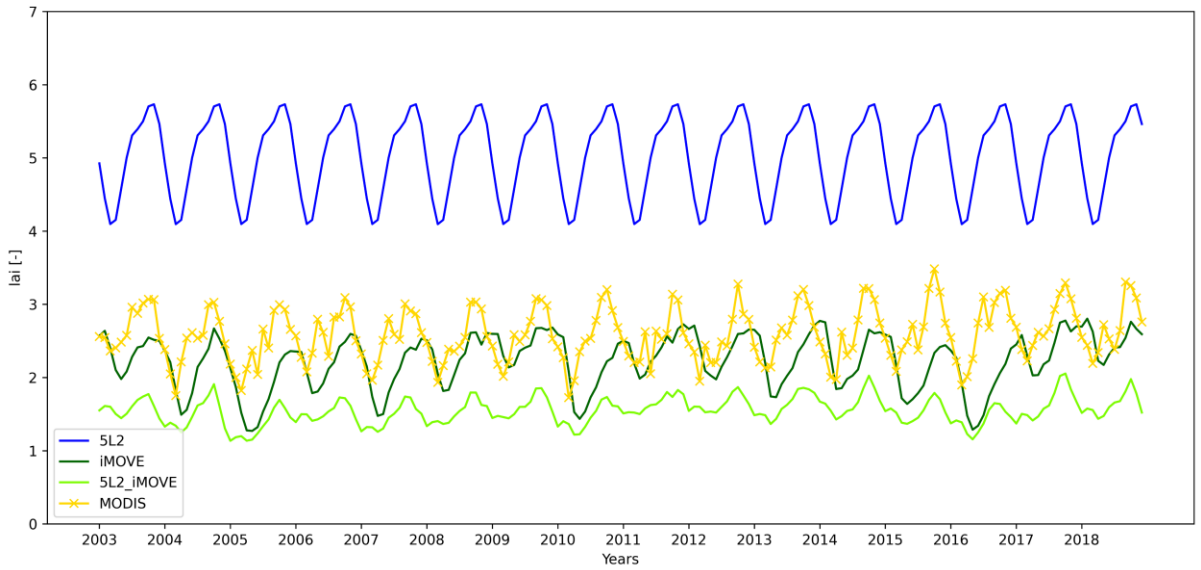
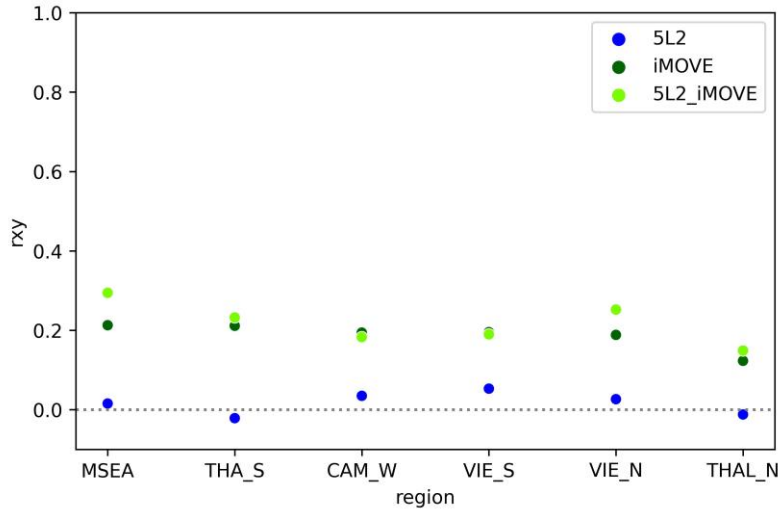
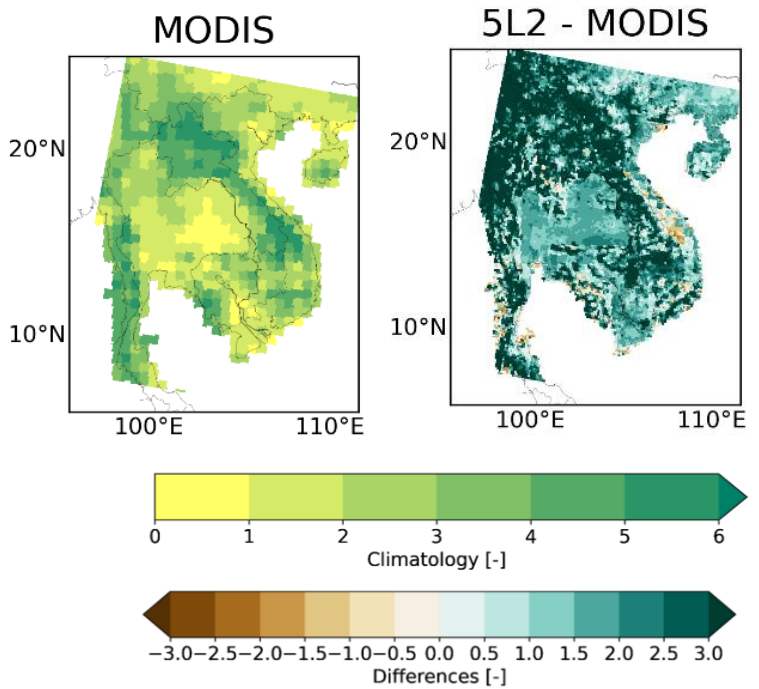
Results - LAI

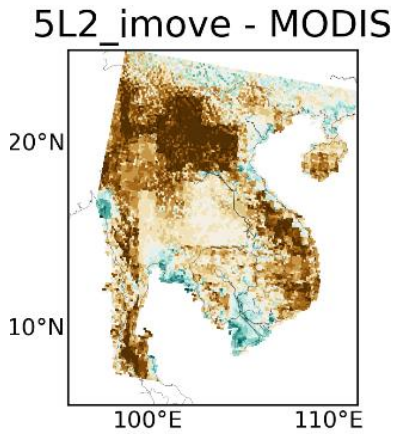
Time series of LAI in MSEA (monthly)



Correlation of monthly anomalies (removed annual cycle)







- LAI strongly overestimated when prescribed
- Interactive approach closer to MODIS
- Temporal lag in iMOVE-versions
- Spatial heterogeneity of differences

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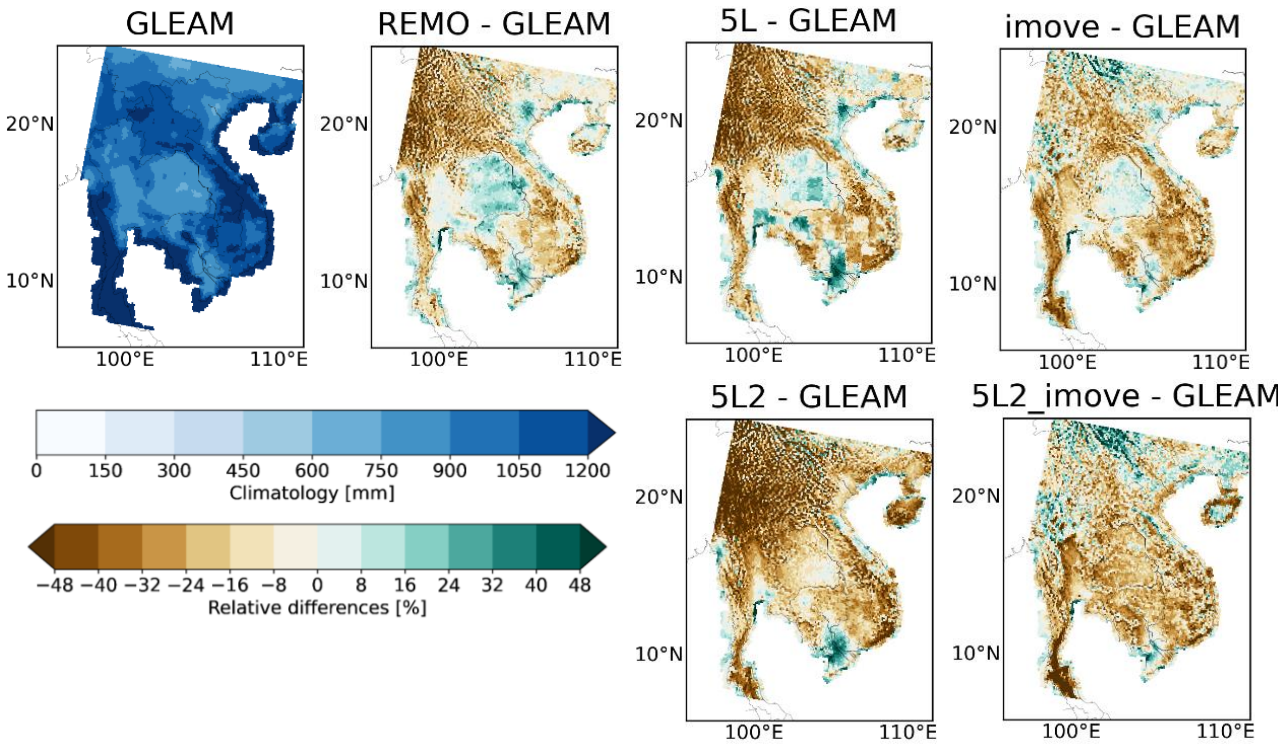
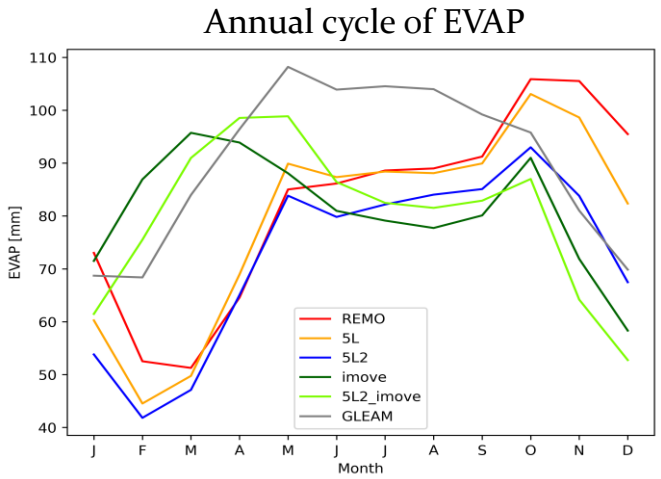
Results - Evapotranspiration





- EVAP is mostly underestimated
- FAO-fragments of 5L are removed in 5L2, but further EVAP reduction
- LAI reduction by iMOVE leads to EVAP reduction in flat lands but improved representation in mountains
- Improvement of annual cycle during dry months

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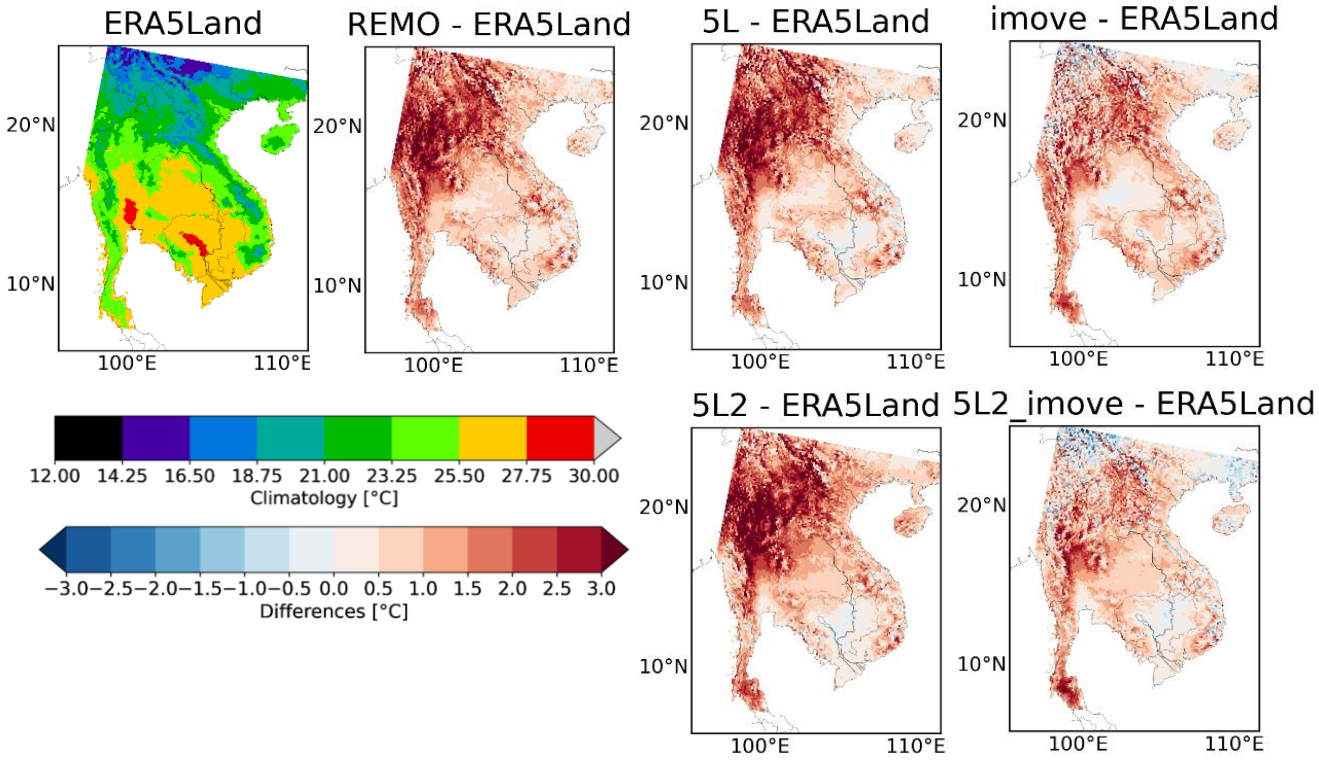
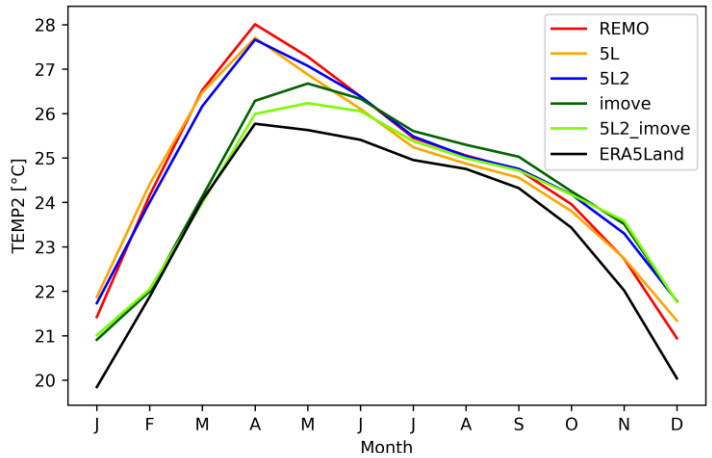
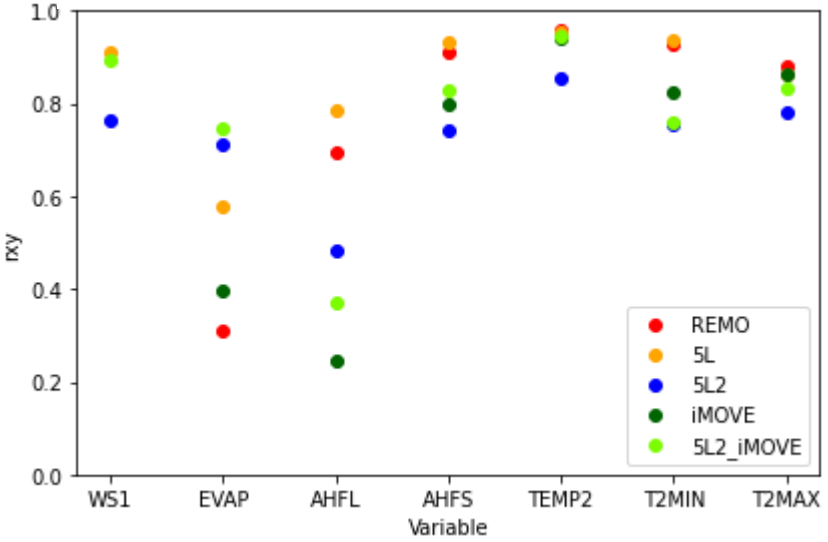
Results – Temperature and anomalies of further variables



Annual cycle of TEMP2



Correlation of monthly anomalies with ERA5Land



- 5L and 5L2 increase warm bias (lower EVAP)
- iMOVE results in general cooling → good fit in dry months (cp. EVAP)

- Temporal correlations are good for EVAP and TEMP but heat fluxes get worse? → contradicting to results from Central Europe

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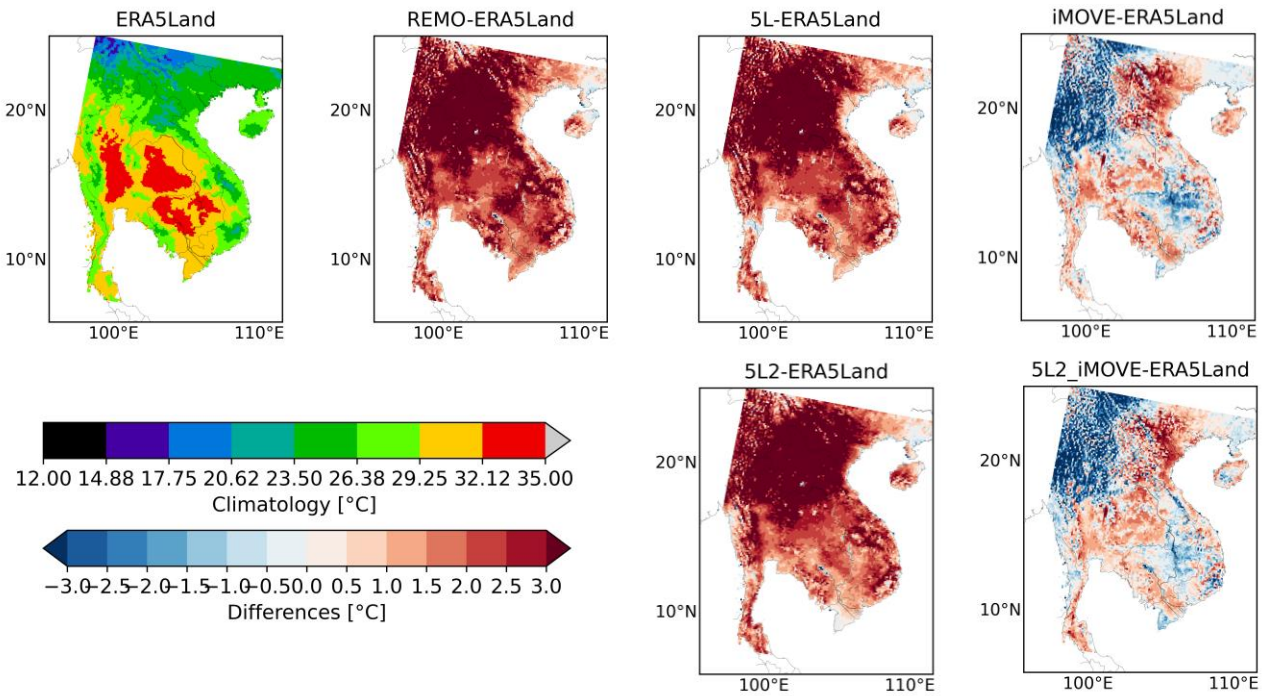
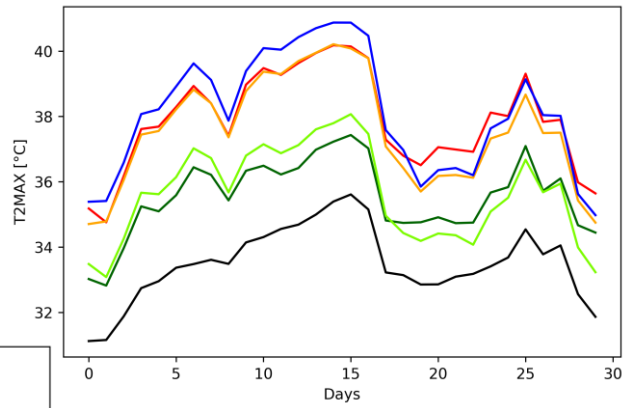
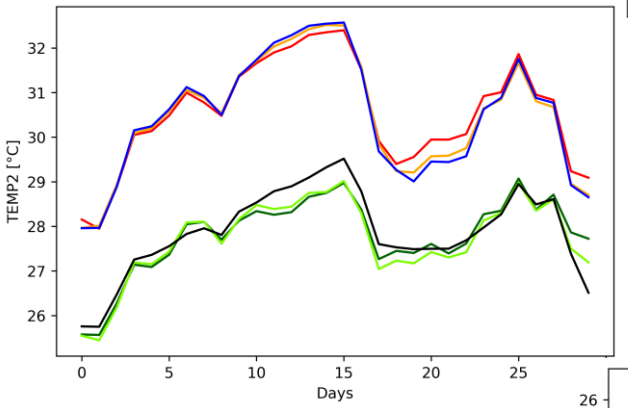
Results – Heatwave April 2016 (daily data)

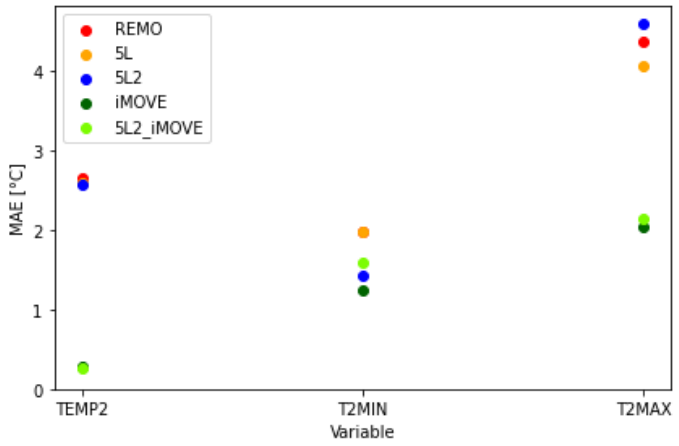


Time series of T2MAX



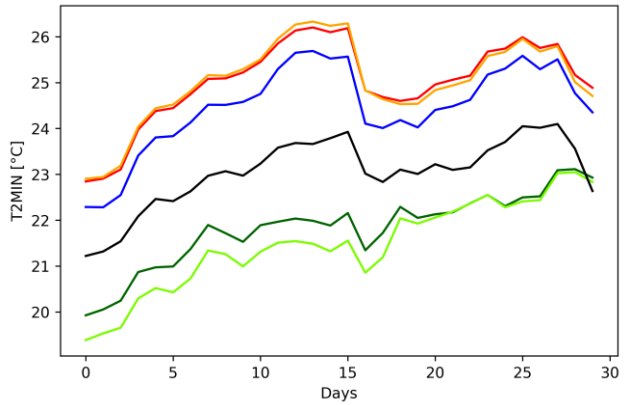
Time series of TEMP2





- TEMP2 reduction lowers bias of heatwave (TEMP2, T2MAX)
- Reduction causes sign change for T2MIN
- Overall lower MAEs

Time series of T2MIN



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Conclusions

- Higher information content (soil moisture in different layers, vegetation parameters)
- LAI is clearly improved and depends on atmospheric conditions but spatial discrepancies (mountains)
- EVAP gets reduced → good seasonality in dry months
- Improvement of TEMP2, also true for heatwave in April 2016 and T2MIN and T2MAX
- Surface flux correlation decreases → contradicting to results from Europe

- Strong potential, but better understanding of the processes necessary

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Thanks for your attention

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