

# Multilayer soil scheme and interactive vegetation in regional climate models – A case study for Mainland Southeast Asia using REMO

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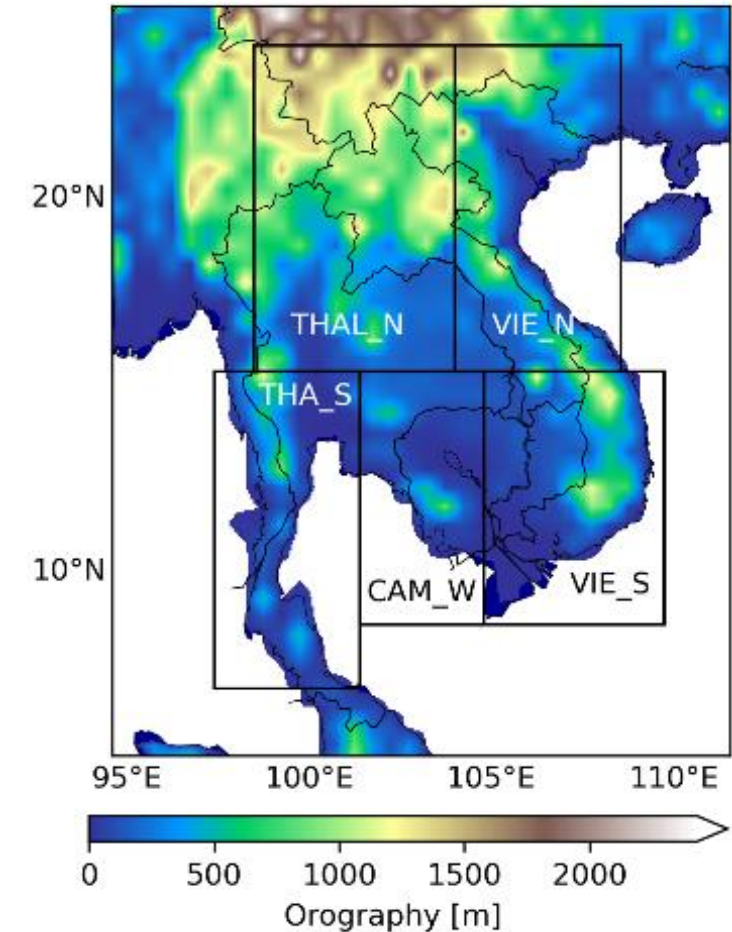
## General information:

- RCMs have large potential to improve represented land surface processes → soil hydrology, vegetation
- Presented schemes have shown improvements of REMO:
  - Soil hydrology in Central Europe (Abel 2023, Diss)
  - Vegetation in Europe (Wilhelm et al. 2014), Central Asia (Rai, Ziegler, Abel et al. 2022, TAAC)

## Study design:

- Study area: Mainland Southeast Asia (MSEA)
- Spatial resolution:  $0.11^\circ \times 0.11^\circ$
- Simulation period: 2000-2018
- Validation: ERA5Land, MODIS

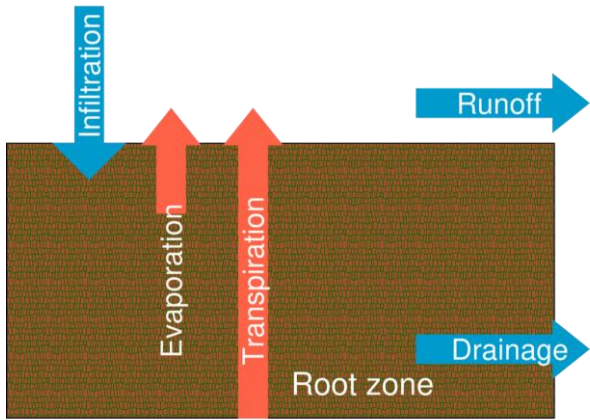
## Study area and subdomains



Abel et al. 2023, JMSJ (submitted)

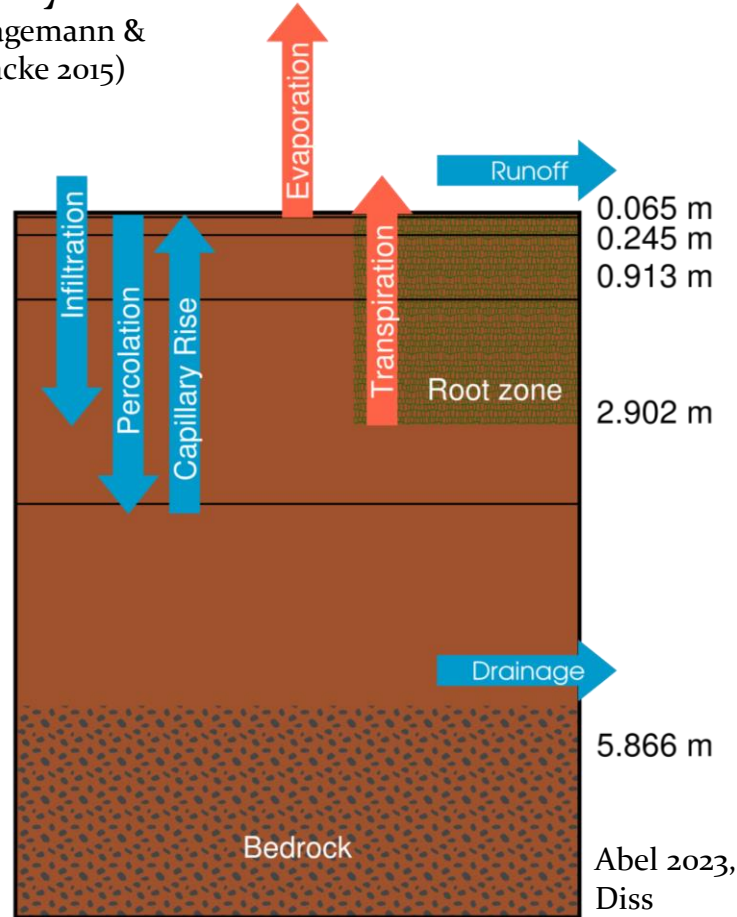
➤ **Soil hydrology:** From a **single** to a **multi** layer soil scheme:

Bucket-scheme (Manabe 1969)



5-Layer-scheme

(Hagemann & Stacke 2015)



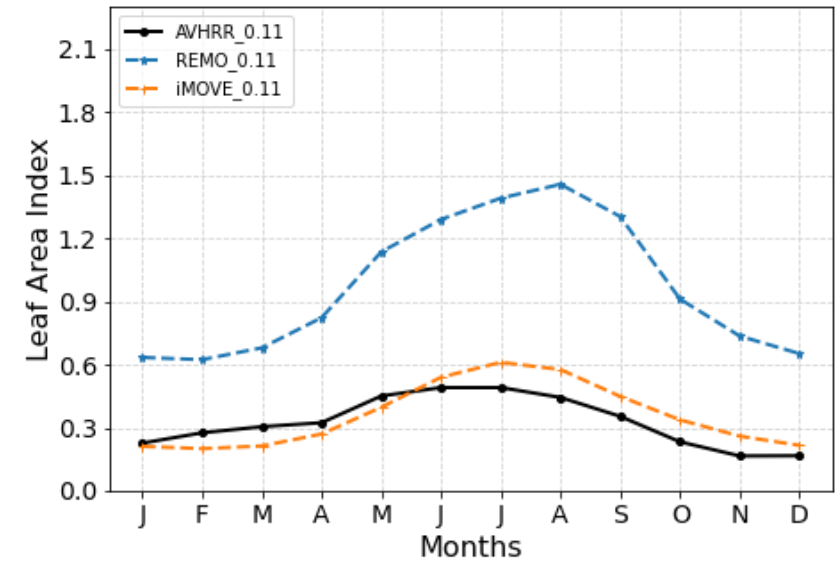
Advances:

- Water below root zone
- Vertical water movement
- Different soil layers enable more realistic representation of soil moisture-related processes and variables

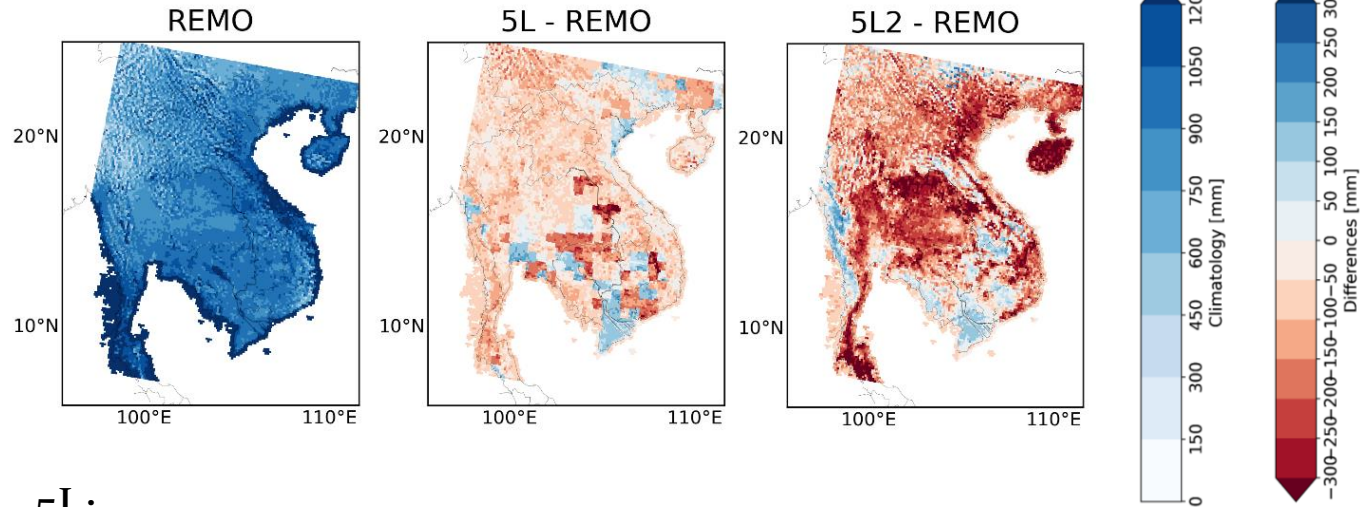
➤ **Vegetation:** from **static** to **interactive**

Advances:

- 16 plant functional types per grid box
- Interaction of vegetation with atmosphere instead of prescribed static values → example: Leaf Area Index



Changed following Rai, Ziegler, Abel et al. 2022, TAAC



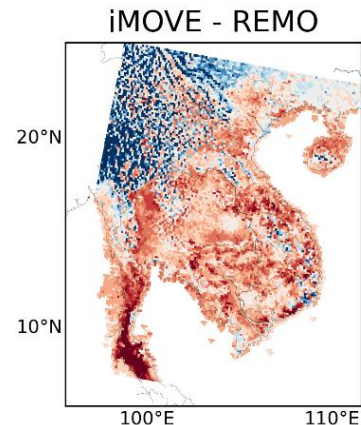
REMO → standard version  
iMOVE → interactive vegetation  
5L → 5-Layer-Scheme  
5L2 → 5-Layer-Scheme with improved surface data and parameterizations

5L:

- Vertical water movement
- 5 soil classes from FAO (0.5°) (FAO 1974)
- Consider soil hydrological properties → decreasing EVAP in sandy soils

5L2:

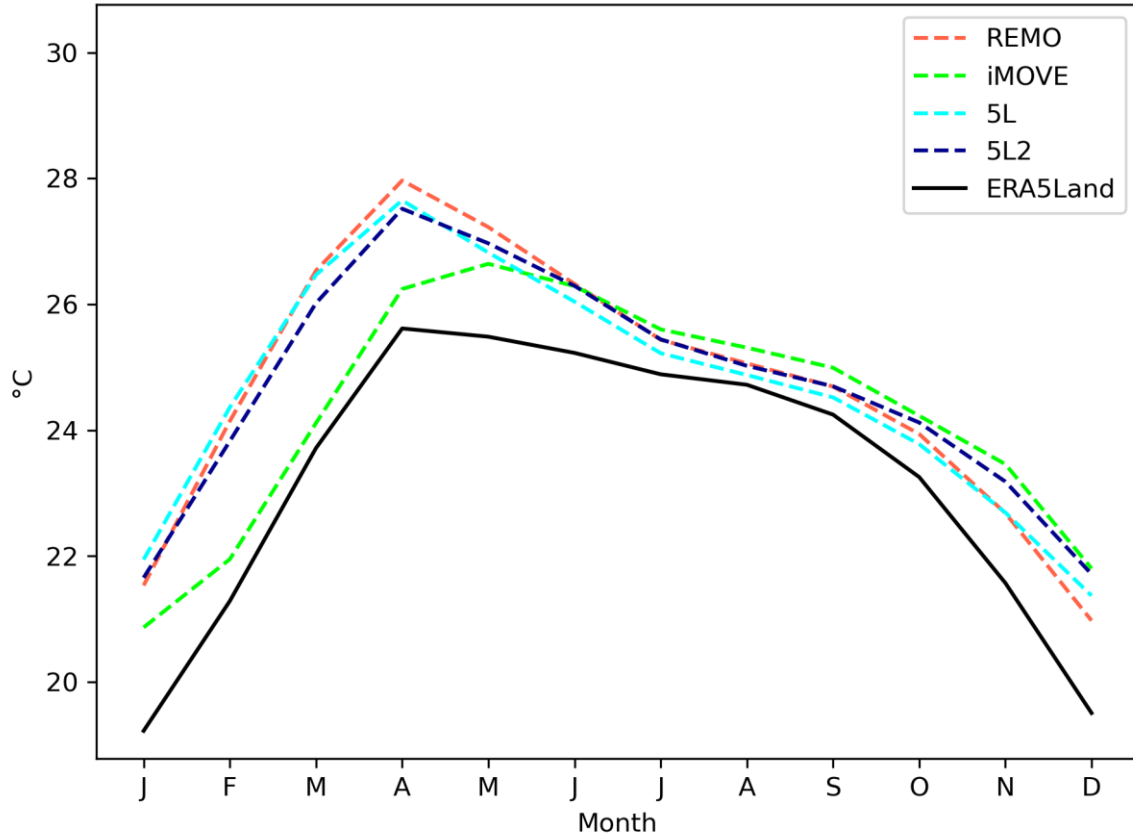
- Rooting depths from iMOVE
- SoilGrids (0.009°) (Hengl et al. 2014), vertical soil properties, and continuous pedotransfer functions → homogenization



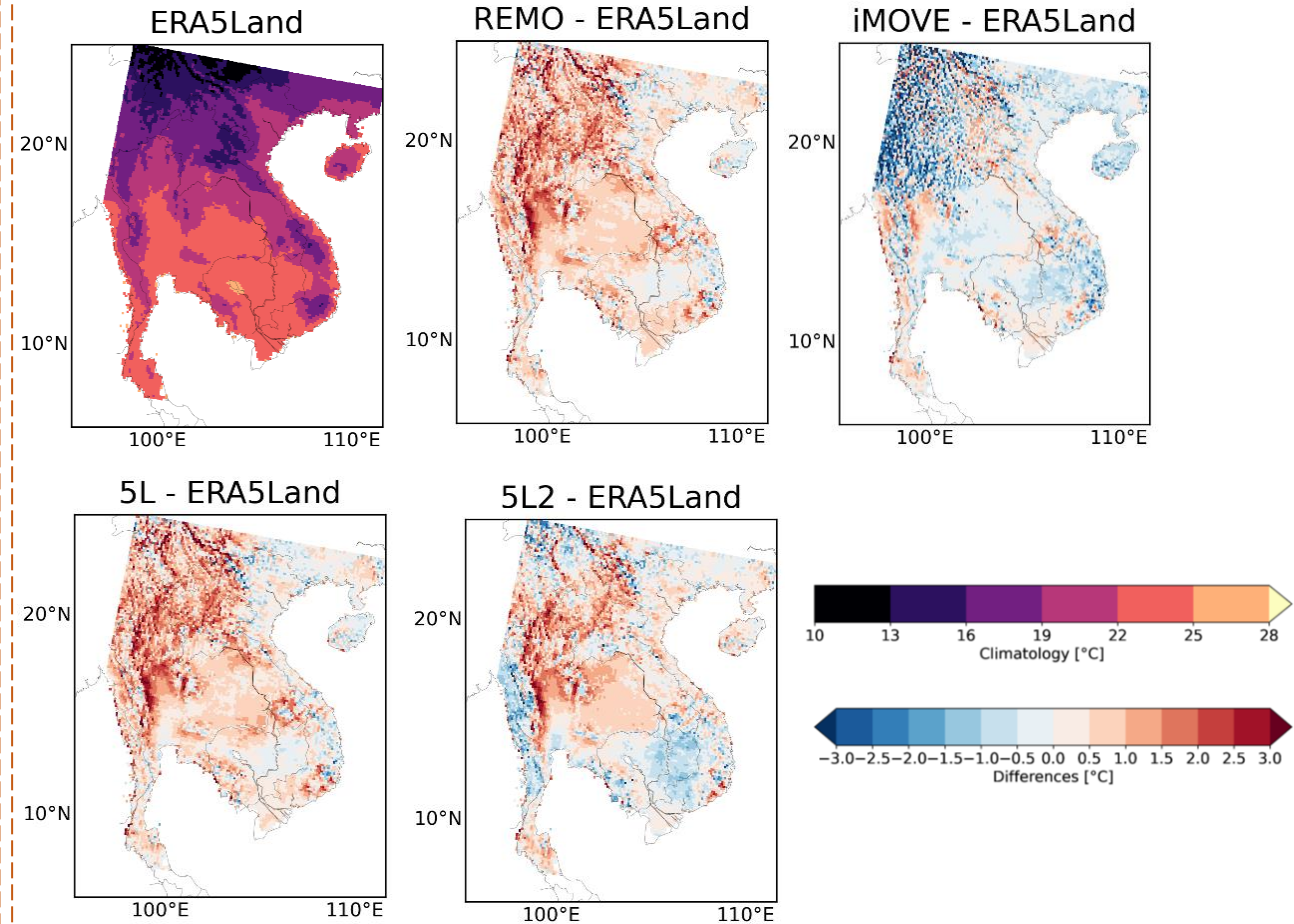
iMOVE:

- Reduction of EVAP implies LAI reduction
- Pixelated structure in mountain ranges of the North

## 2m Temperature

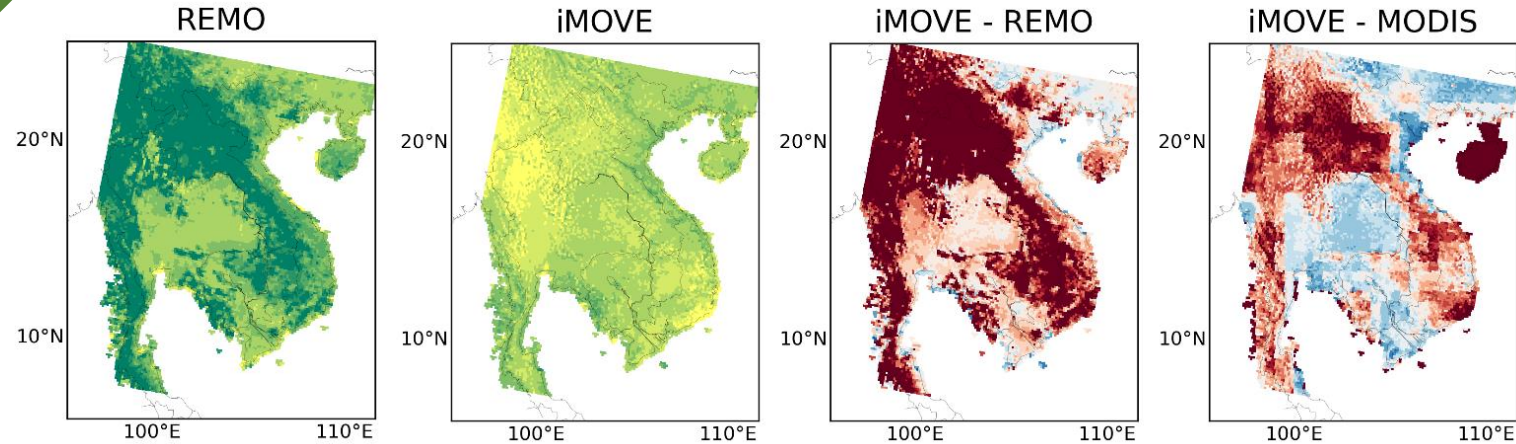
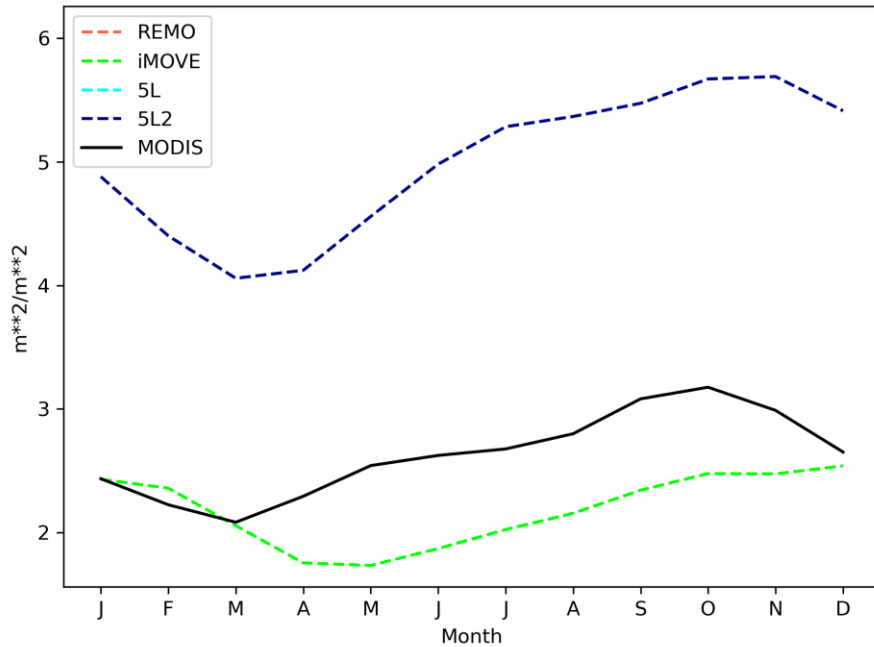


## Min. 2m Temperature

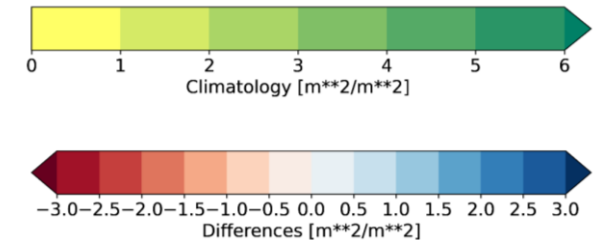


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- Seasonal cycle is represented well with static vegetation
- More realistic values with iMOVE

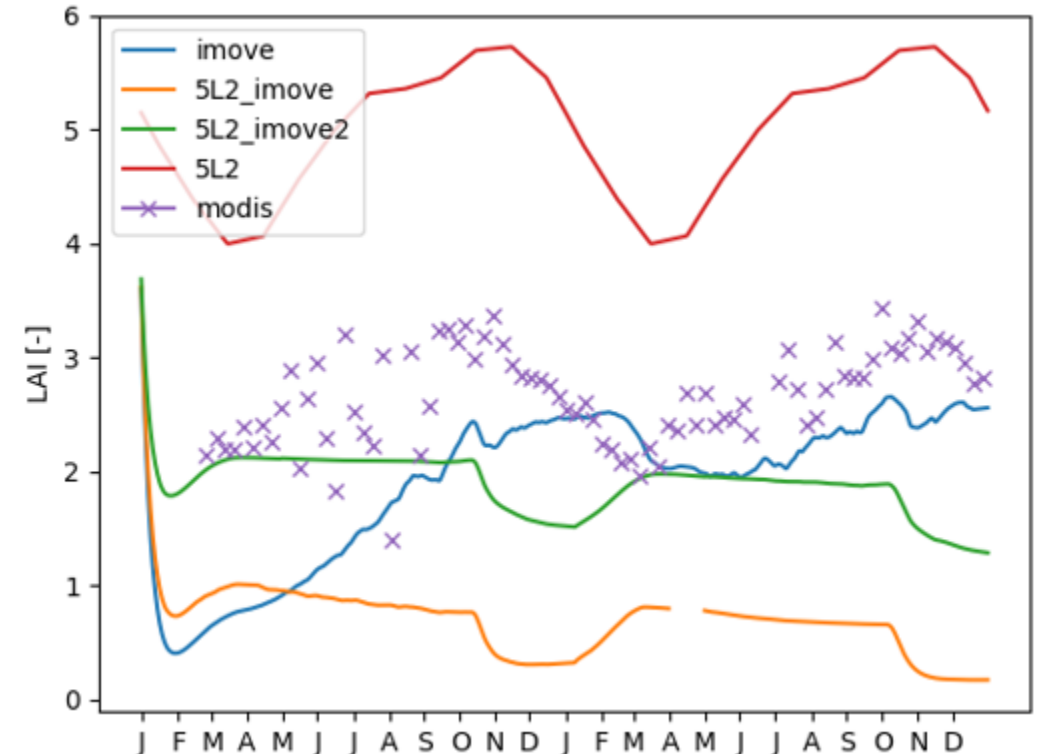


- Strong reduction with iMOVE
- REMO with clear orographic signature
- iMOVE lacks this pattern which is also represented by MODIS
- Overestimation in flat, underestimation in mountain areas



- More realistic representation of land surface processes and related variables in both schemes
- Some not intuitive behaviors of variables not directly affected by the schemes (model calibration over Europe?)
- Elimination of fragments due to inclusion of highly-resolved and more detailed data
- Combination of multilayer soil and interactive vegetation is promising and currently in progress

LAI, MSEA-11, daily data from 2000-2001



Thanks for your attention



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