Land-atmosphere coupling strength in dependence of the land-cover in European climate simulations

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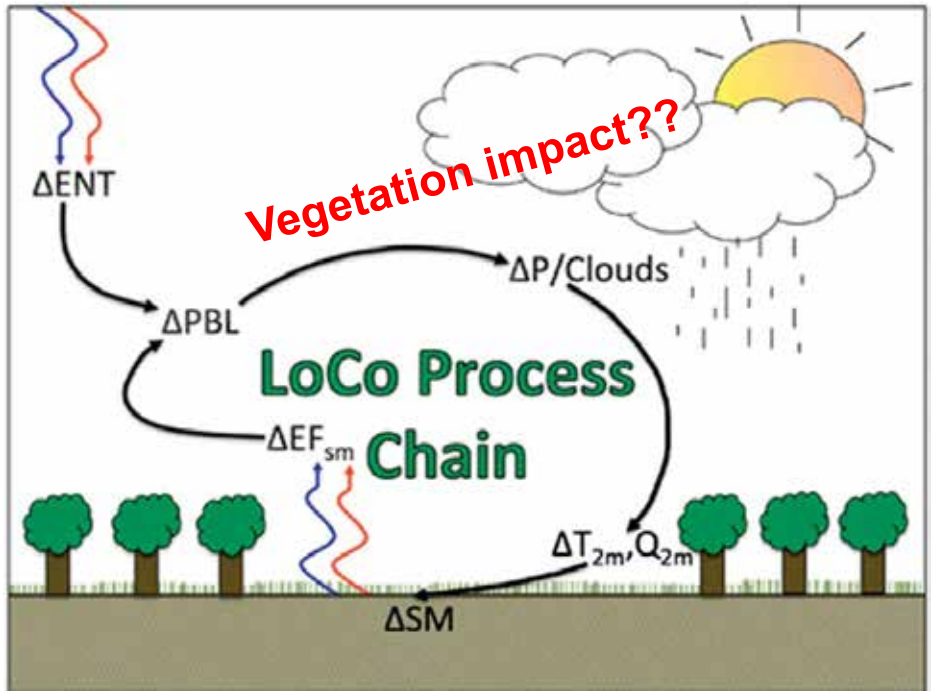
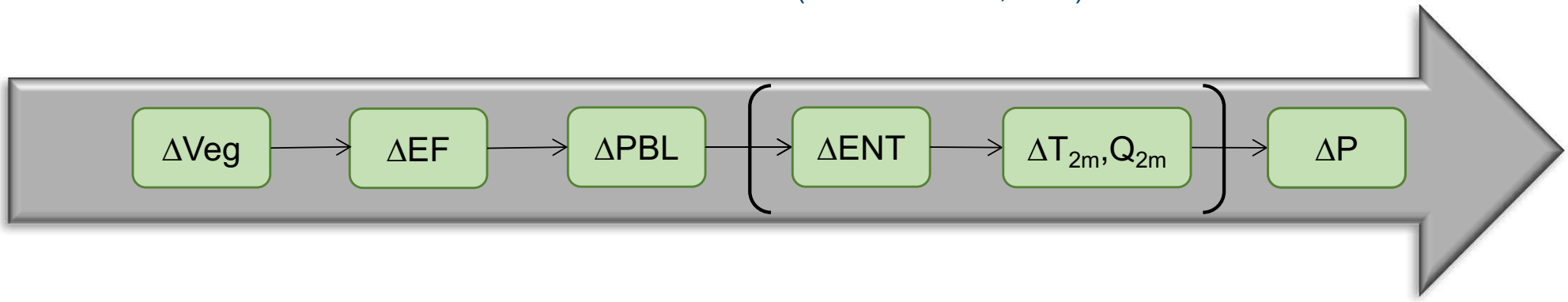
Objectives

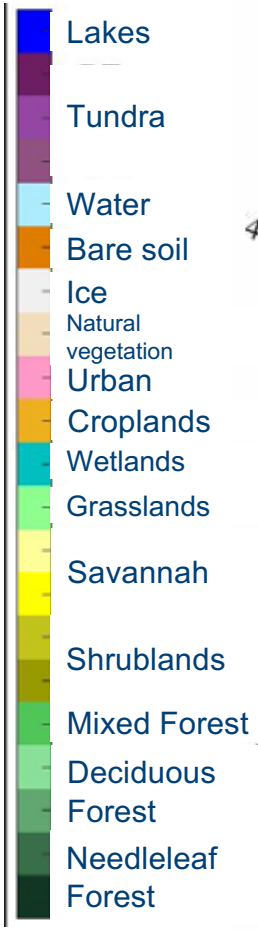
- Localization of potential land surface-precipitation coupling hotspots in Europe
- Investigate biogeophysical impacts of land-use and land-cover changes (LULCCs) on precipitation
- Can LULCCs work as mitigation option for climate change?



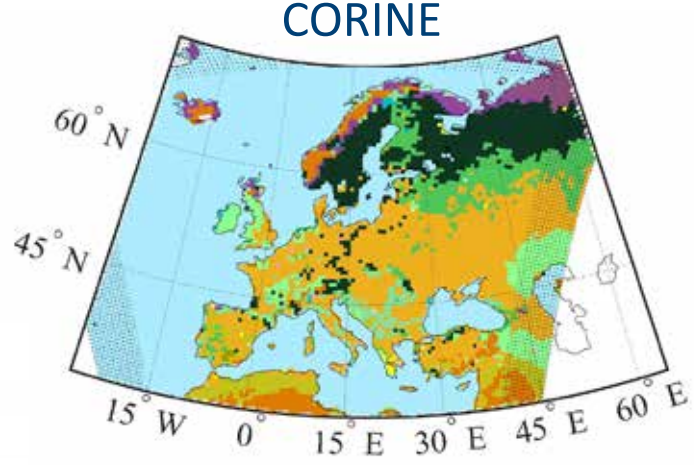
(Santanello et al., 2018)



Land-Cover Maps LUCAS Phase I



CORINE



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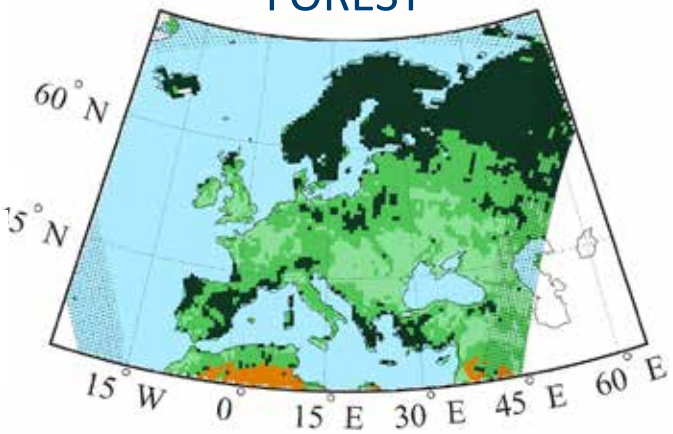

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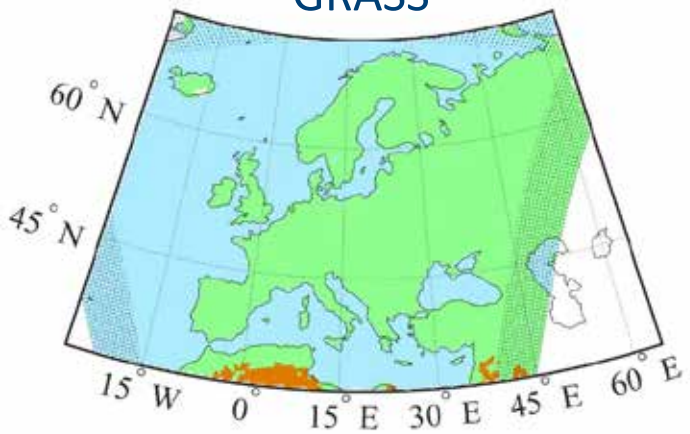
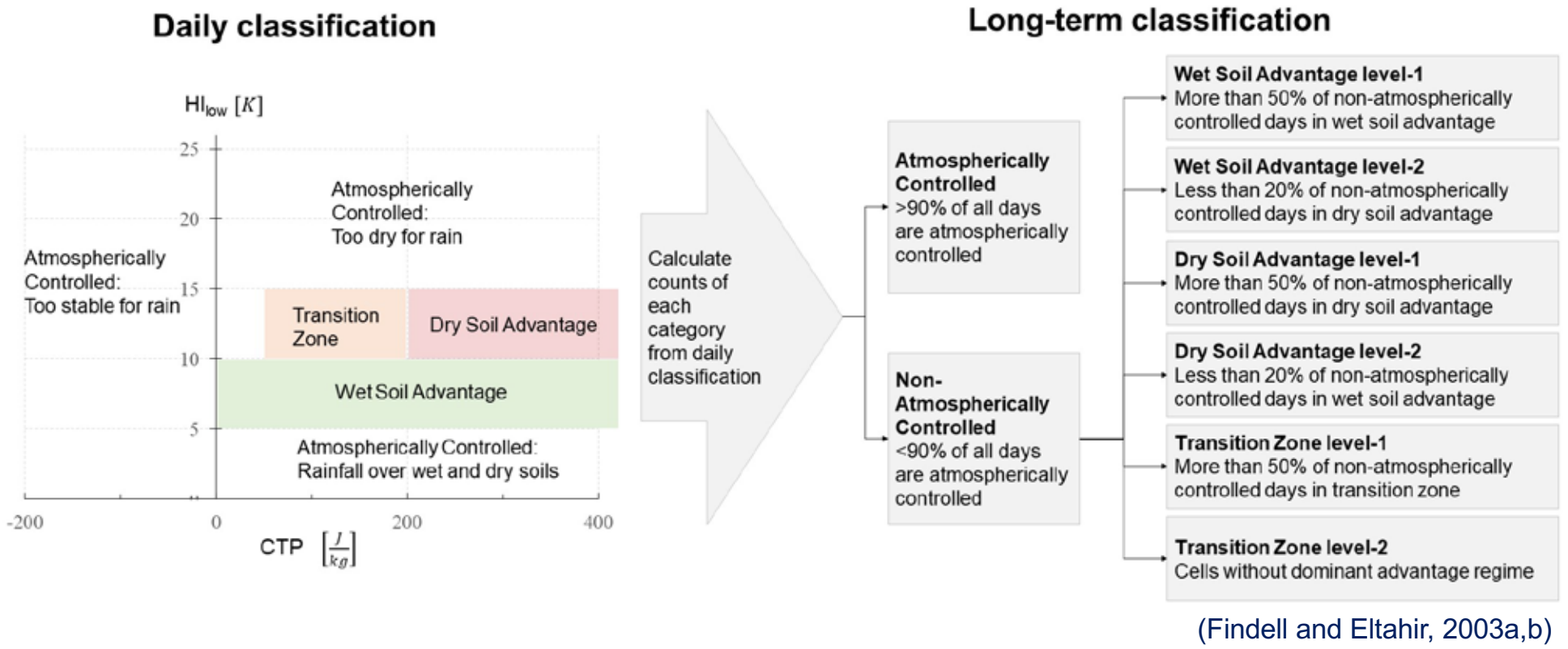


Set-up follows the experimental protocol of LUCAS Phase I:

- Forcing data: ERA-Interim reanalysis data
- EURO-CORDEX domain
- Period: 1986-2015
- Grid spacing: 0.44°
- Model: WRF3.8.1-NOAHMP

Convective Triggering Potential (CTP) – Low-level Humidity Index (HI_{low}) Framework



(Findell and Eltahir, 2003a,b)

Atmospheric Conditions in JJA

Convective triggering potential

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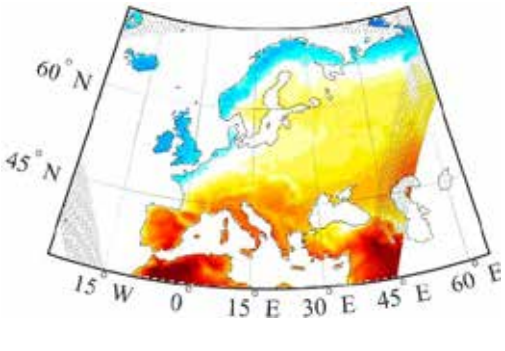
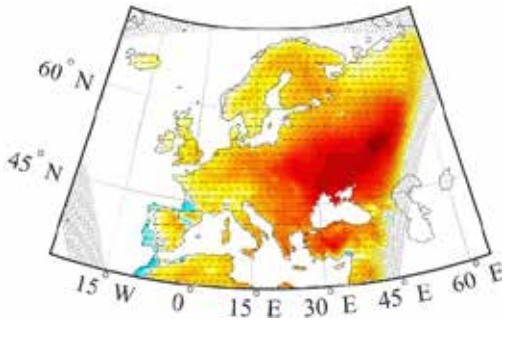
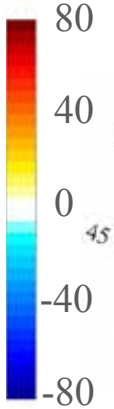


[J kg^{-1}]

FOREST-CORINE



[J kg^{-1}]



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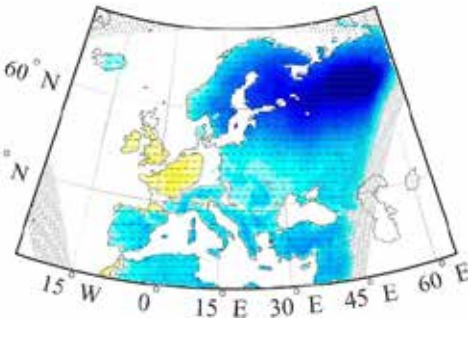

Low-level humidity index

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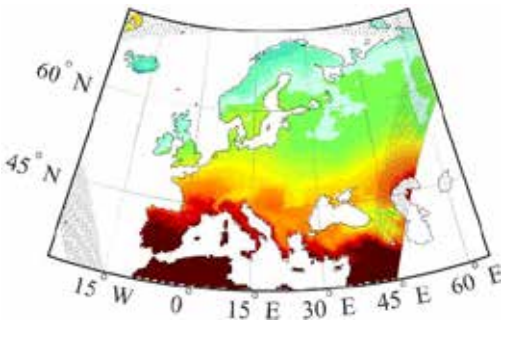

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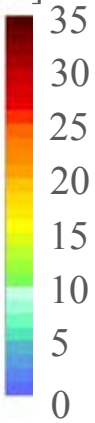

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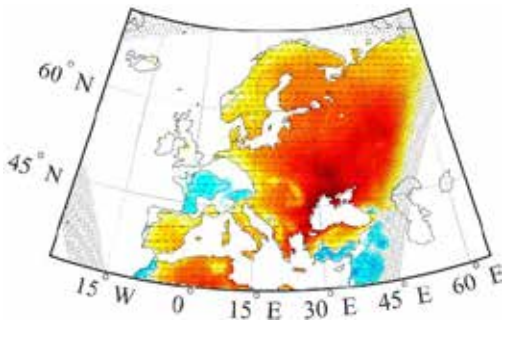

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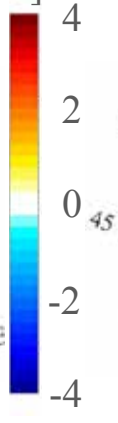

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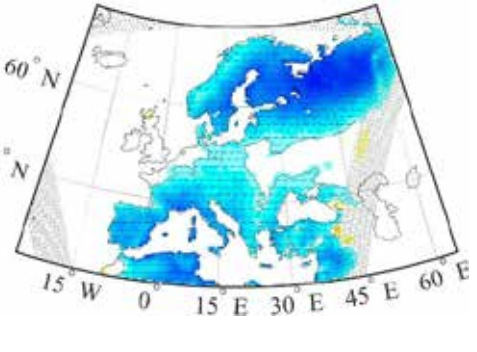

Coupling Hotspots in JJA

Classified coupling regimes

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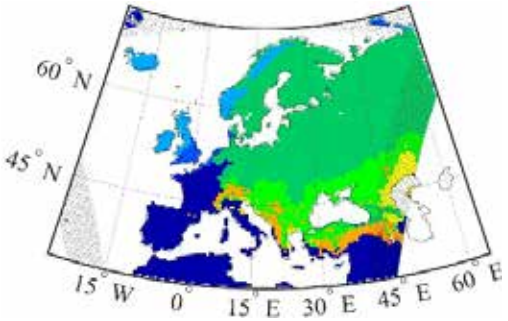

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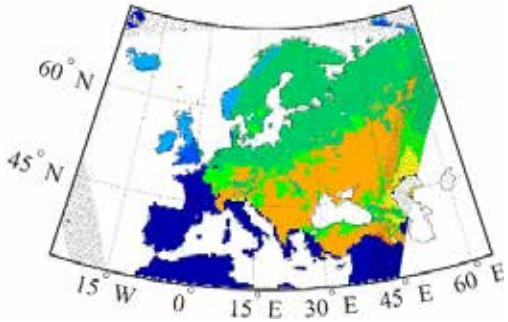

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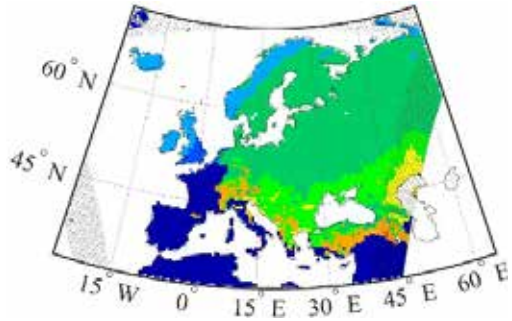

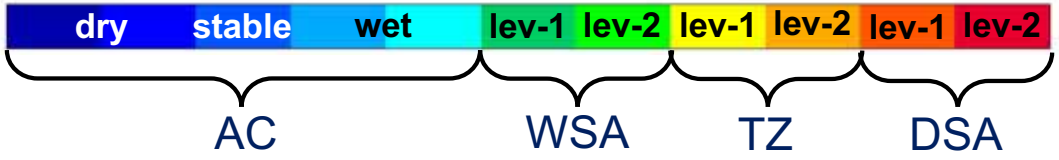

Non-atmospherically controlled (nAC) days per season

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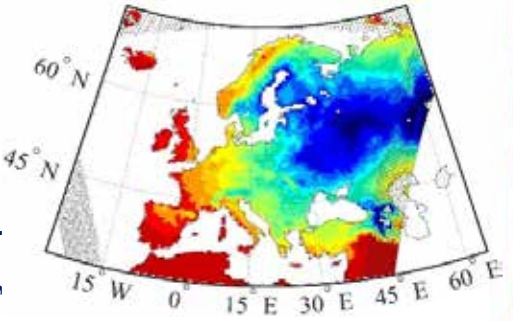

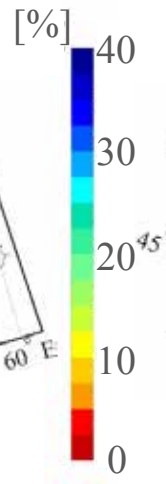

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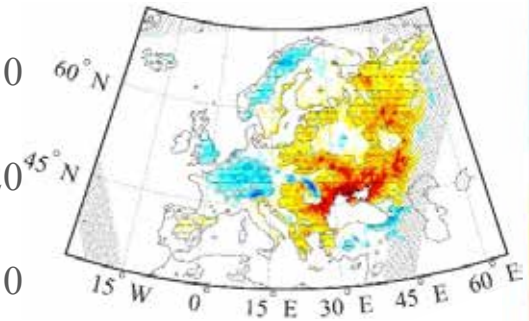

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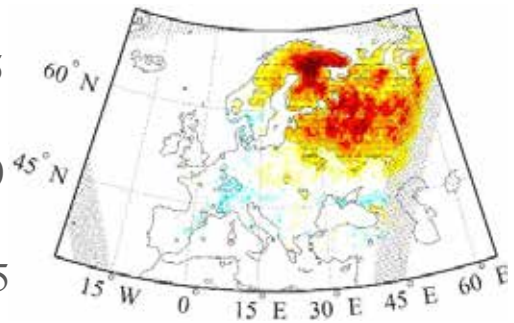
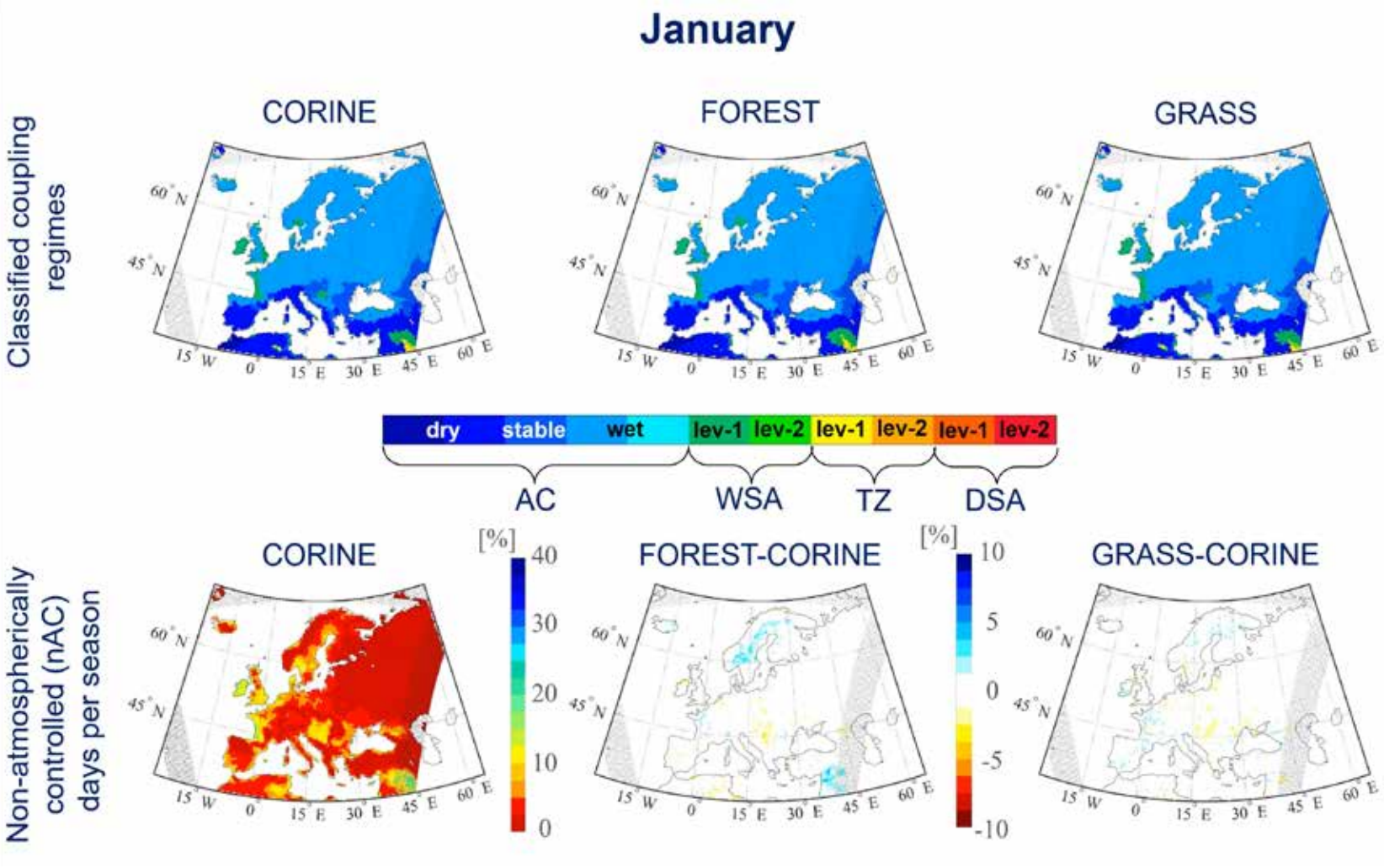


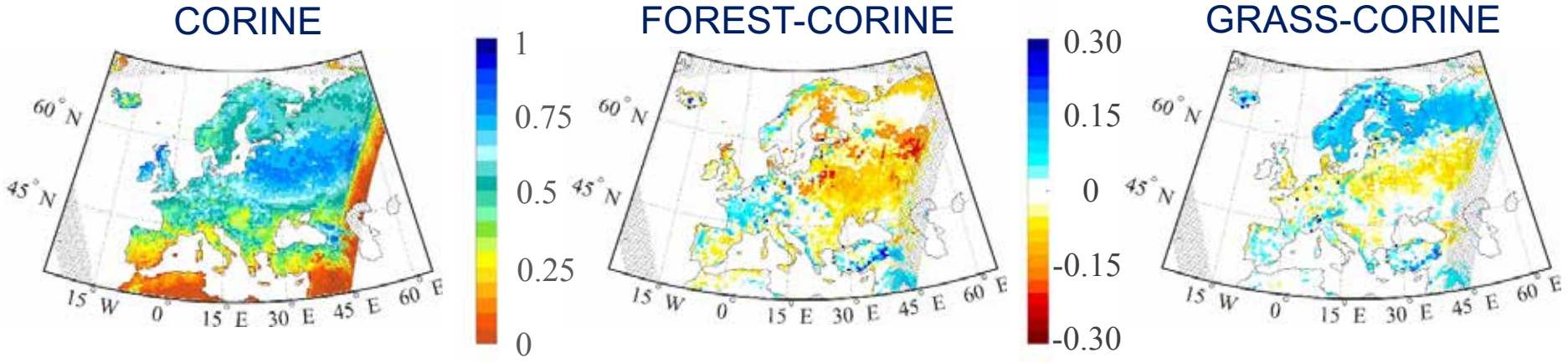
Identification of Coupling Hotspots



Precipitation and Cloud Impacts

- Leading question: Are feedbacks between EF, clouds and precipitation as predicted by the framework?

Evaporative Fraction (latent heat/(latent+sensible heat))



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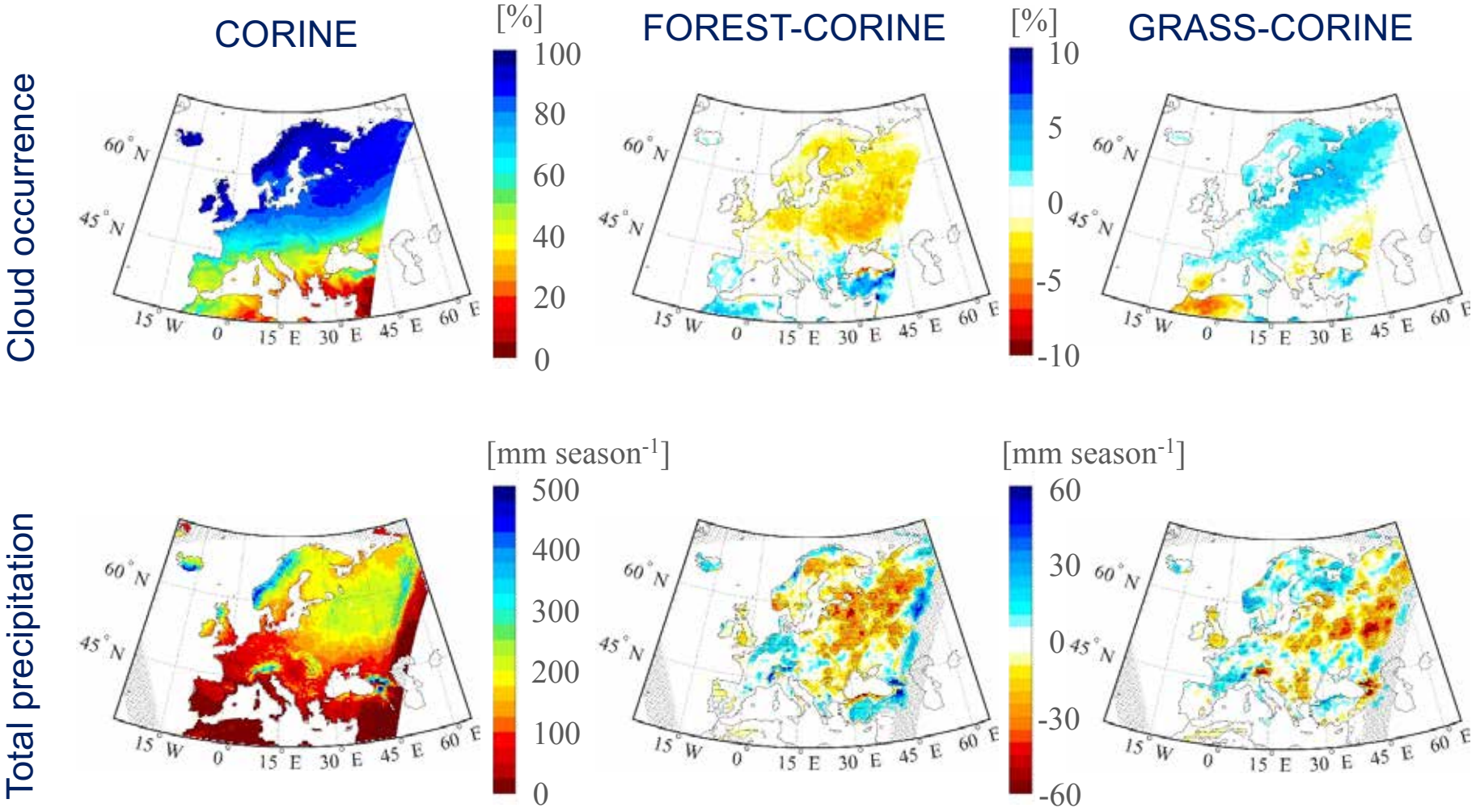
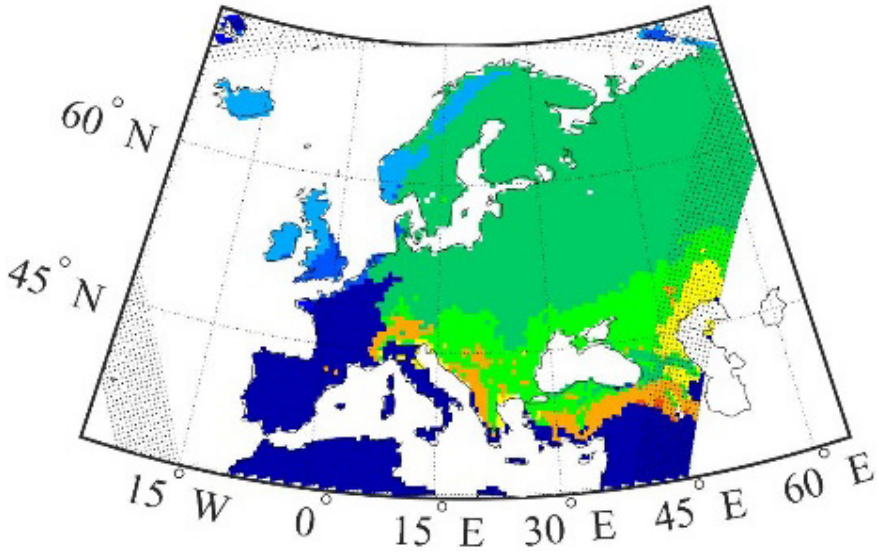


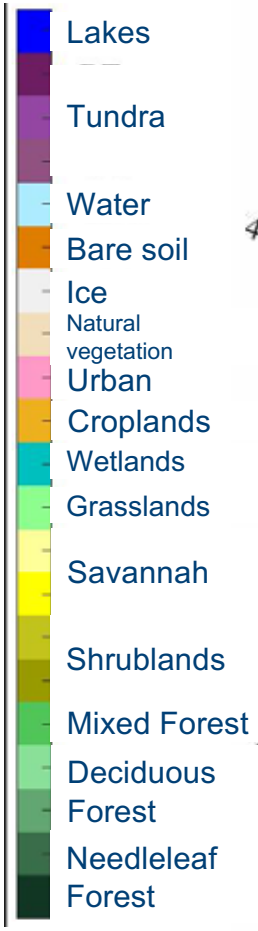
Summary

- Coupling hotspot in north-eastern Europe in JJA
- Coupling strength was modified by LULCC
- Afforestation has drying effect
- Deforestation has moistening effect
- But in general impacts on summer precipitation rather low
  - The only significant reductions occur in the region of strong coupling and over mountains



Thank you for your attention! ☺

Land-Cover Maps LUCAS Phase I



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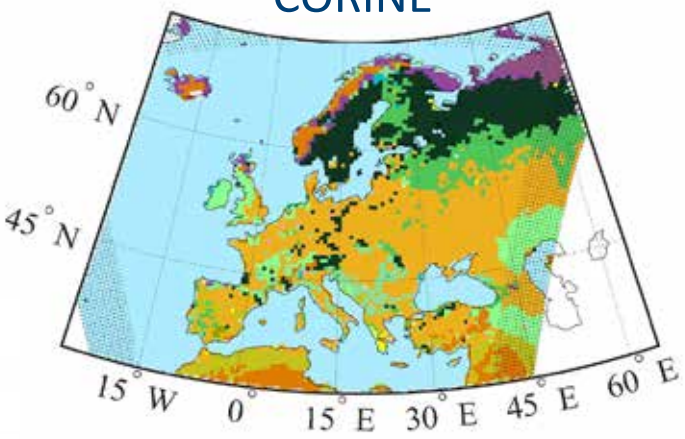
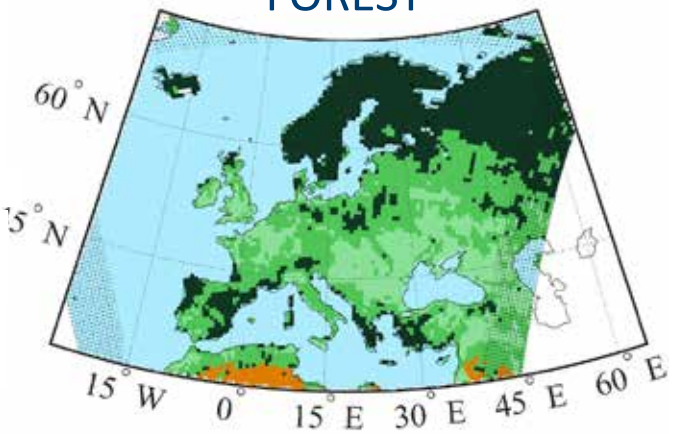


WRF-UHOH configuration:

- Land surface model: NOAH-MP
- Microphysics: New Thompson scheme
- Convection: Kain-Fritsch scheme
- PBL: MYNN Level 2.5 PBL scheme
- Surface Layer Scheme: MYNN scheme
- Radiation (LW&SW): RRTMG scheme

FOREST



GRASS