NUKLEUS and UDAG multi-model ensembles (ICON-CLM): A comparison of temperature and precipitation extremes

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INTRODUCTION

- NUKLEUS ensemble: 3 RCMs (COSMO-CLM, ICON-CLM, REMO) x 3 GCMs (EC-Earth3-Veg, MIROC6, MPI-ESM1.2-HR)
- UDAG ensemble: 1 RCM (ICON-CLM) x 4 GCMs (EC-Earth3-Veg, MIROC6, MPI-ESM1.2-HR, CNRM-ESM2-1)

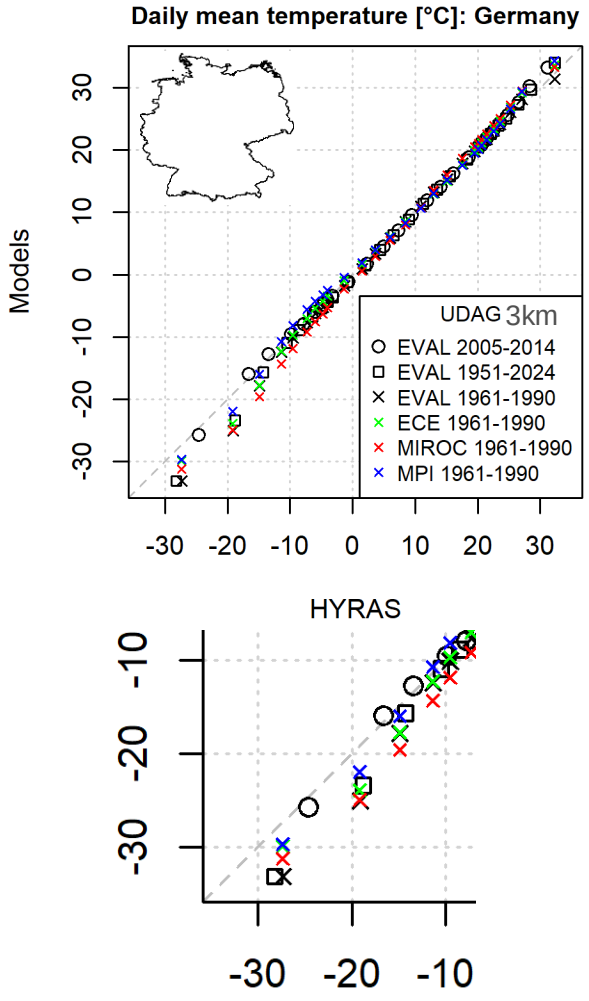
	NUKLEUS 3 km	UDAG
ICON-CLM	2.6.4, 2.6.5 RC	2024.07
Evaluation	2005-2014	1951-2024
Historical	1961-1990	1951-2014
Scenario	GWL2K, GWL3K SSP3-7.0	2015-2100
MPI (2037-2066/2066-2095), EC-Earth (2024-2053/2047-2076), MIROC (2038-2067/2070-2099)		

- Reference data for evaluation: DWD-HYRAS (1 km resolution)
- Comparisons of percentiles, p-values: 0, 0.01, 0.1, 0.5, 1…5, 10…90, 95…99, 99.5, 99.9, 99.99% (100 % for temperature)

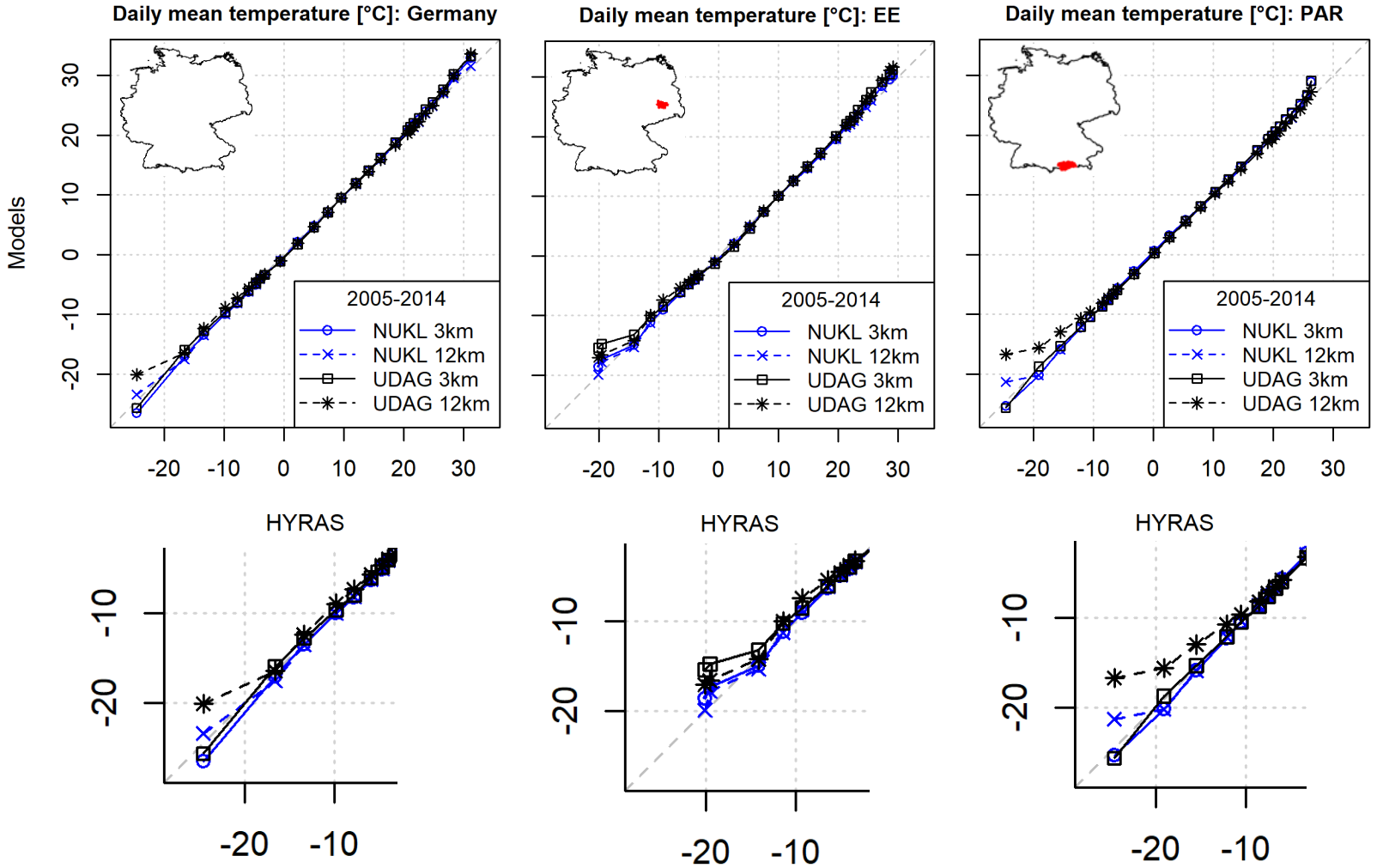
REFERENCE (HYRAS) VS. EVALUATION

TEMPERATURE

UDAG



NUKLEUS and UDAG: 2005-2014

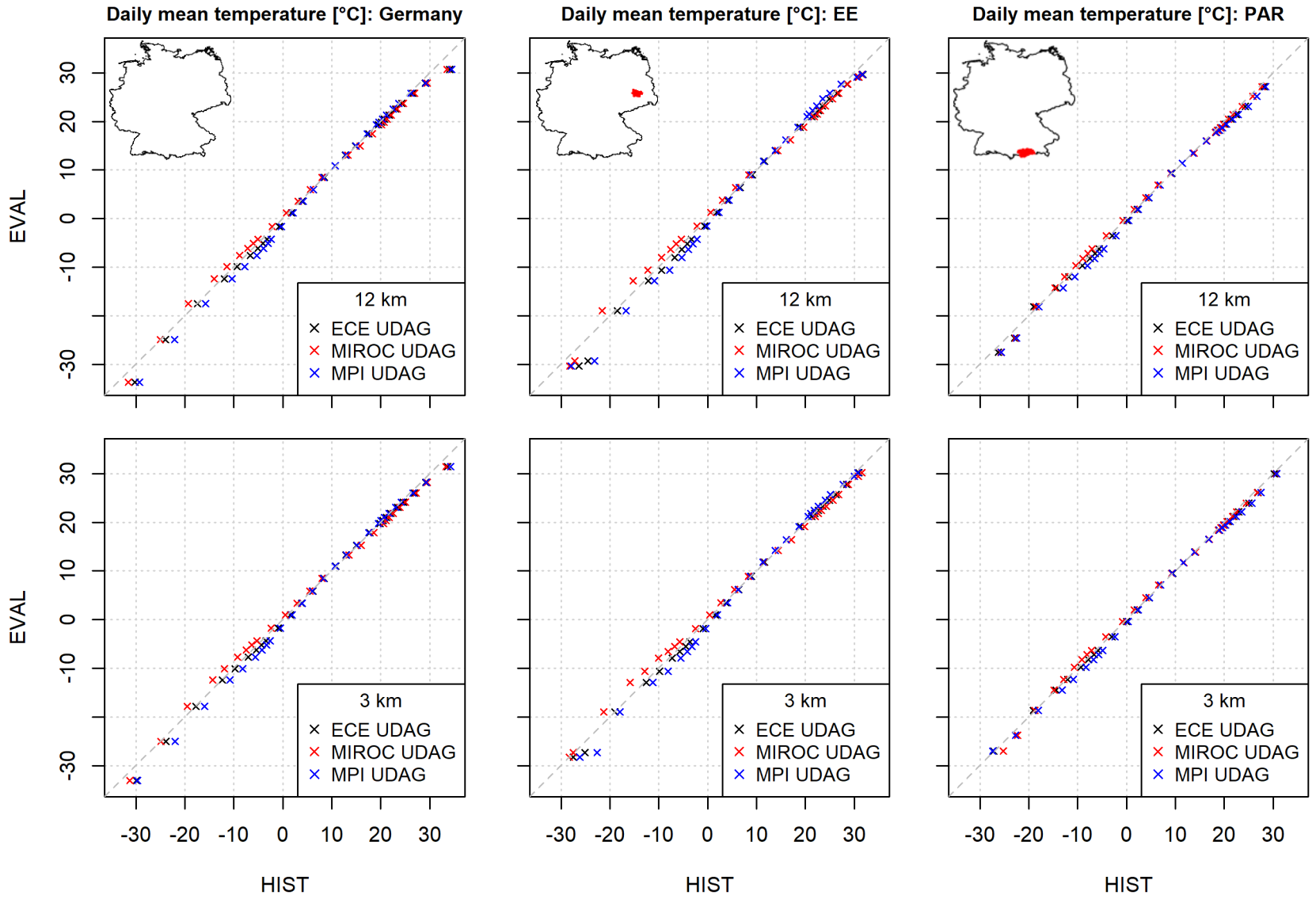


HISTORICAL VS. EVALUATION

TEMPERATURE

12 km

3 km

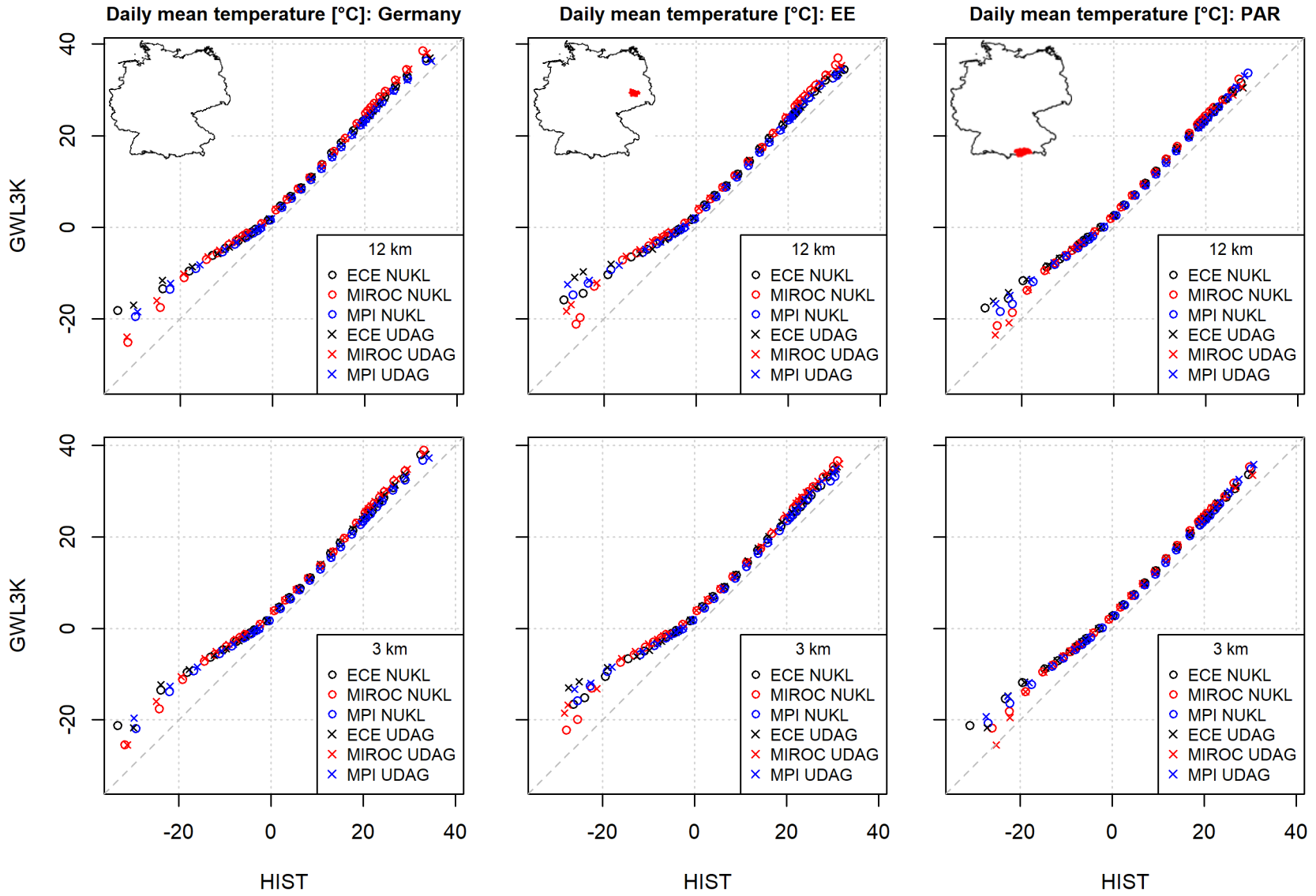


HISTORICAL VS. SCENARIO

TEMPERATURE

12 km

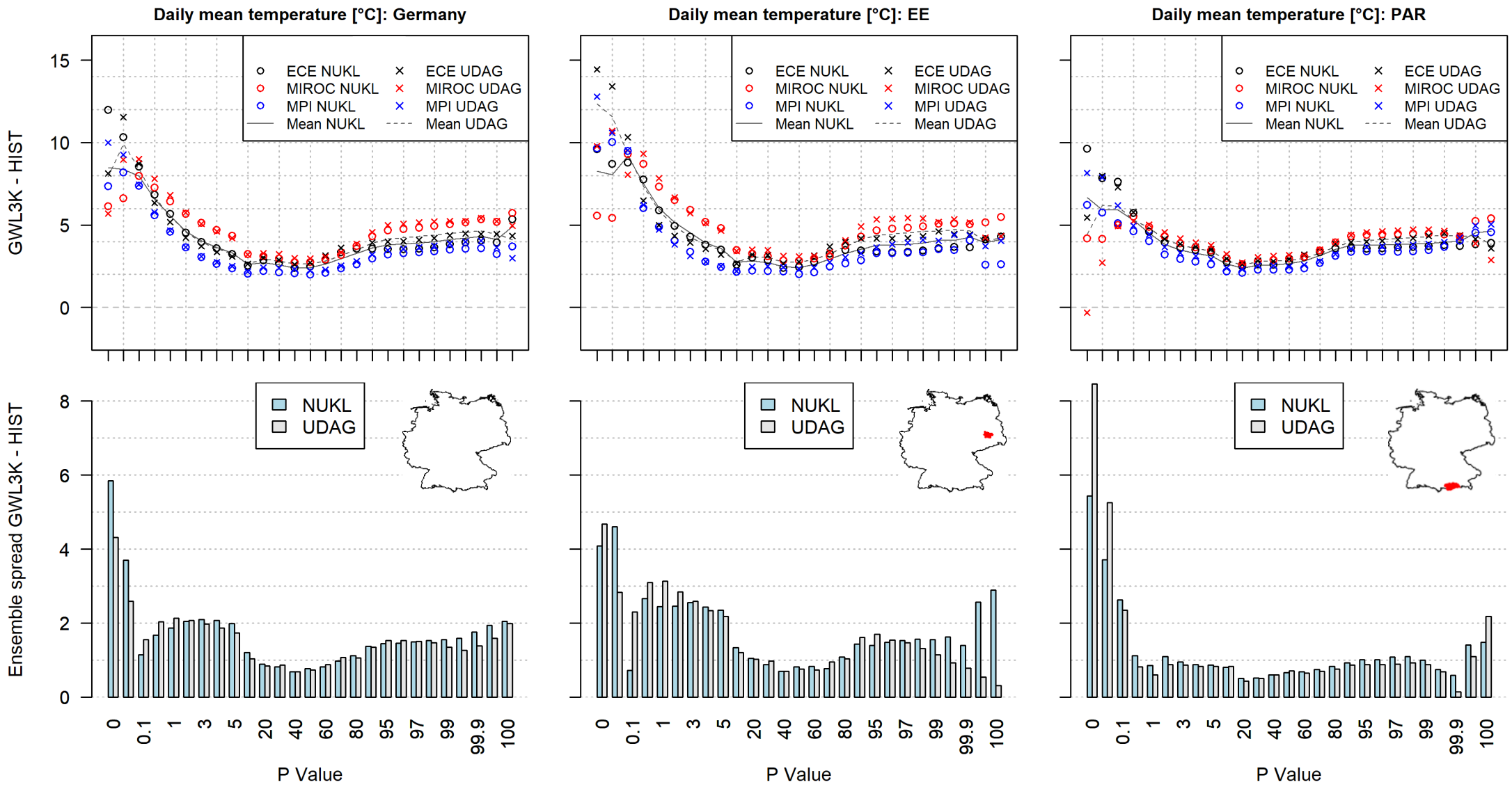
3 km



HISTORICAL VS. SCENARIO

TEMPERATURE

3 km



HISTORICAL VS. SCENARIO

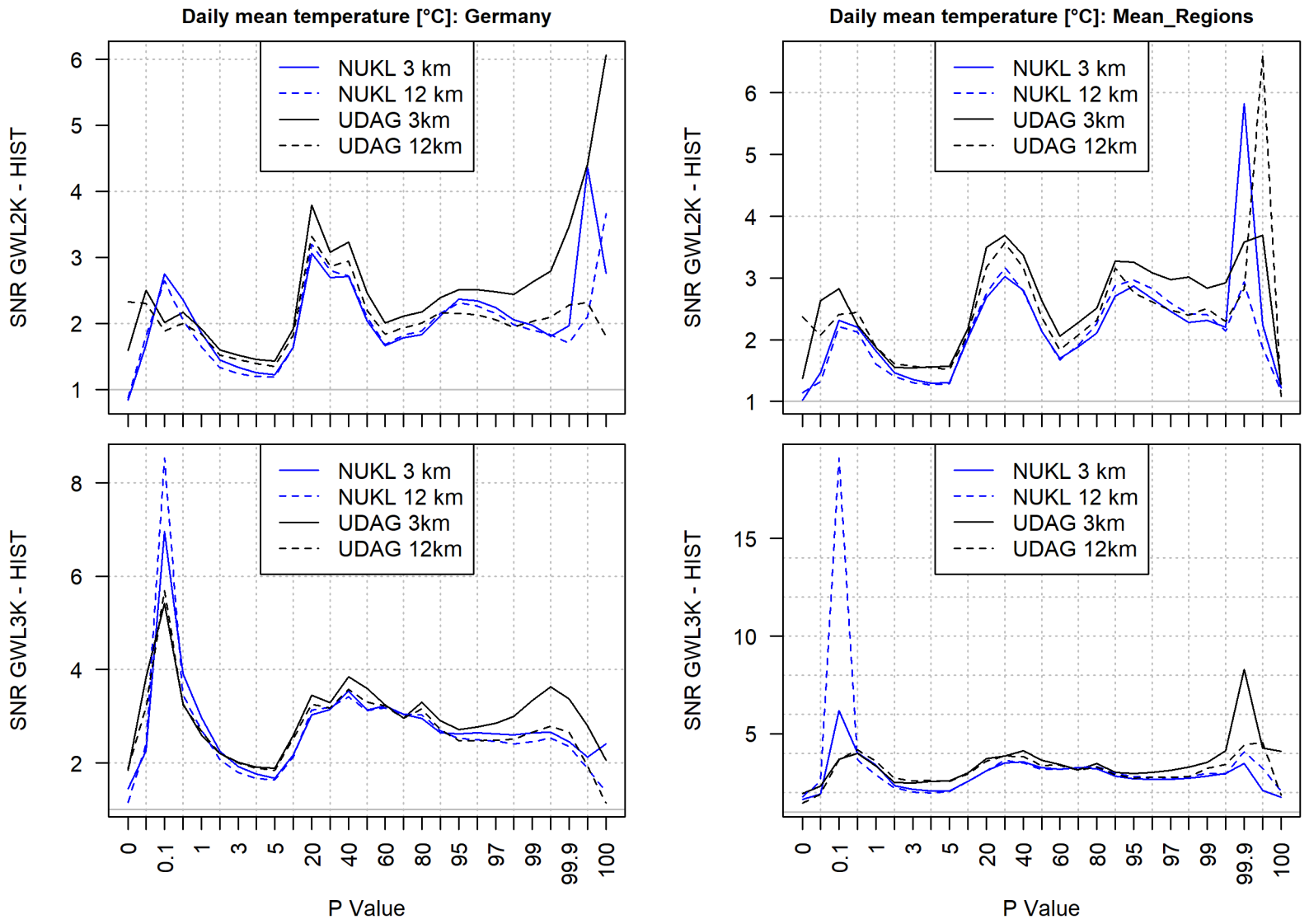
TEMPERATURE

Signal-to-noise ratio

SNR=Signal/Noise

Signal: Ensemble mean of change signal

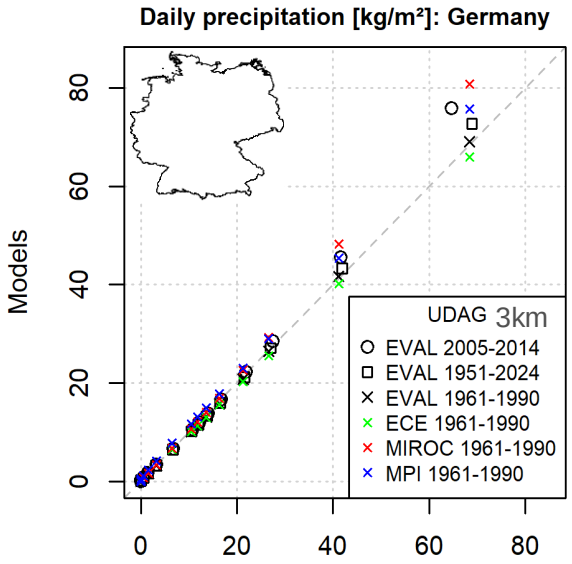
Noise: Ensemble spread



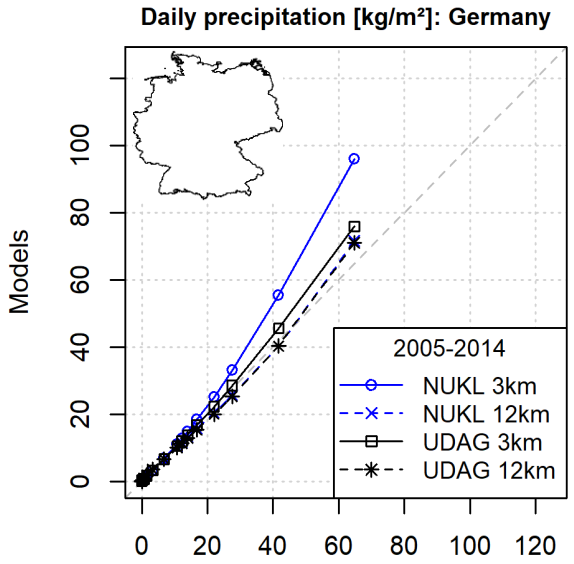
REFERENCE (HYRAS) VS. EVALUATION

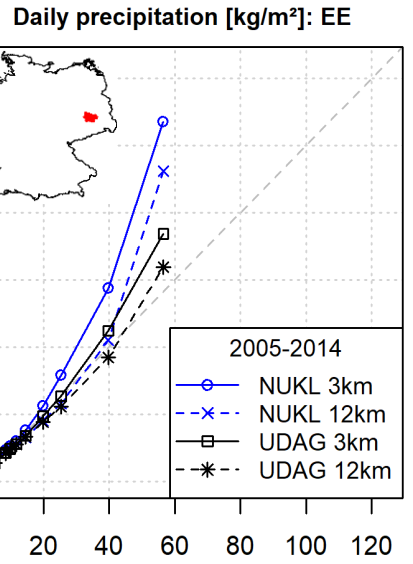
PRECIPITATION

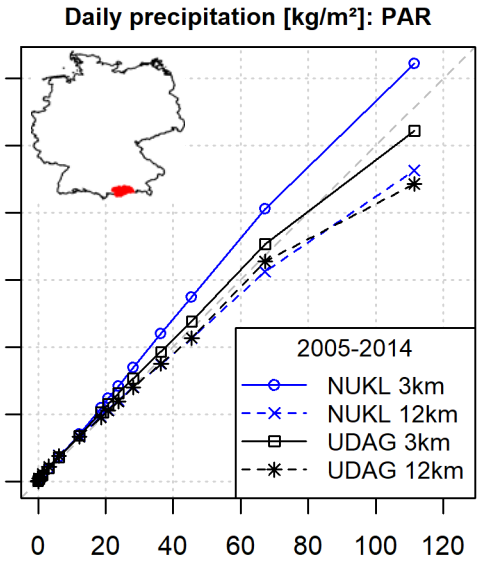
UDAG



NUKLEUS and UDAG: 2005-2014





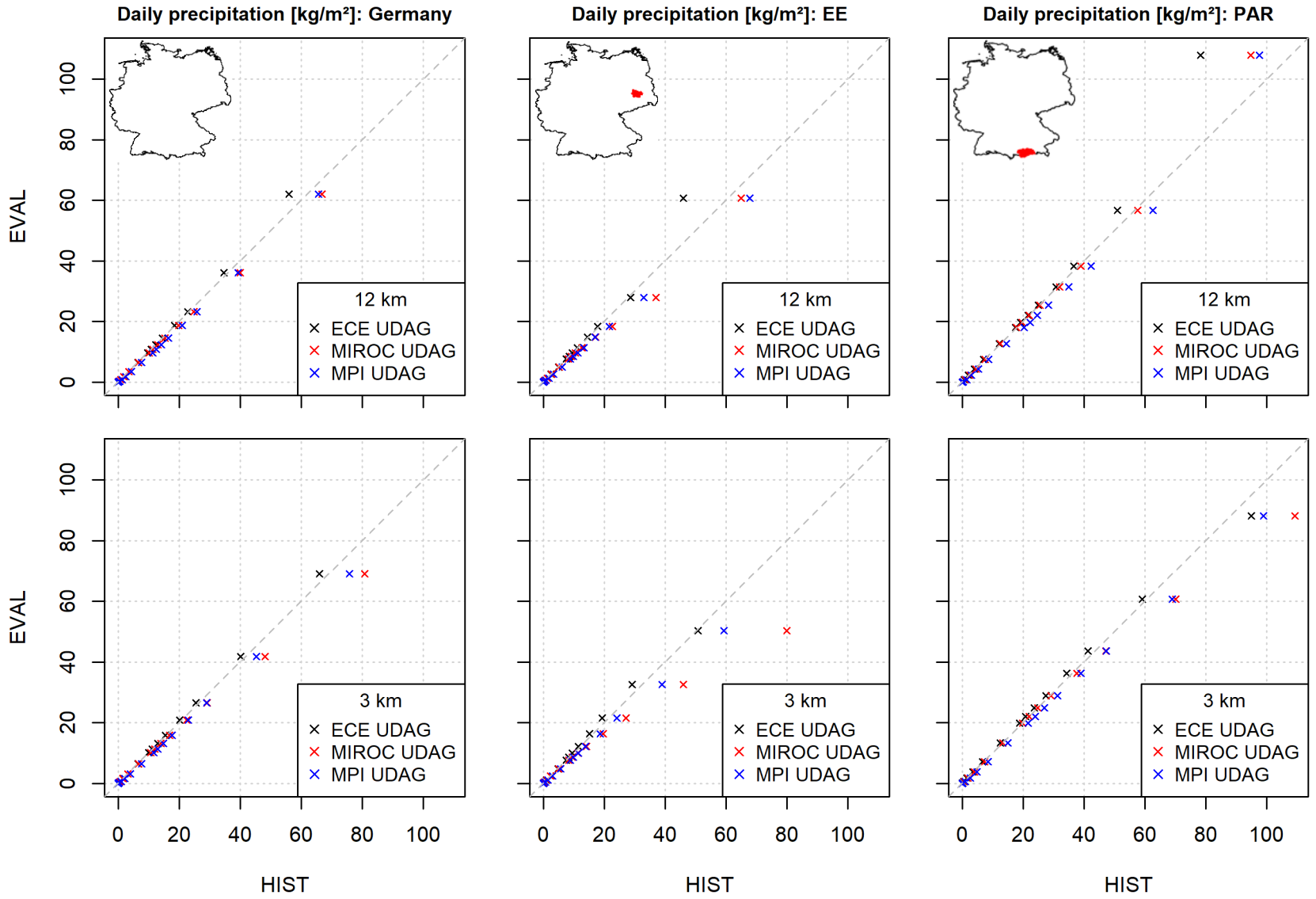


HISTORICAL VS. EVALUATION

PRECIPITATION

12 km

3 km

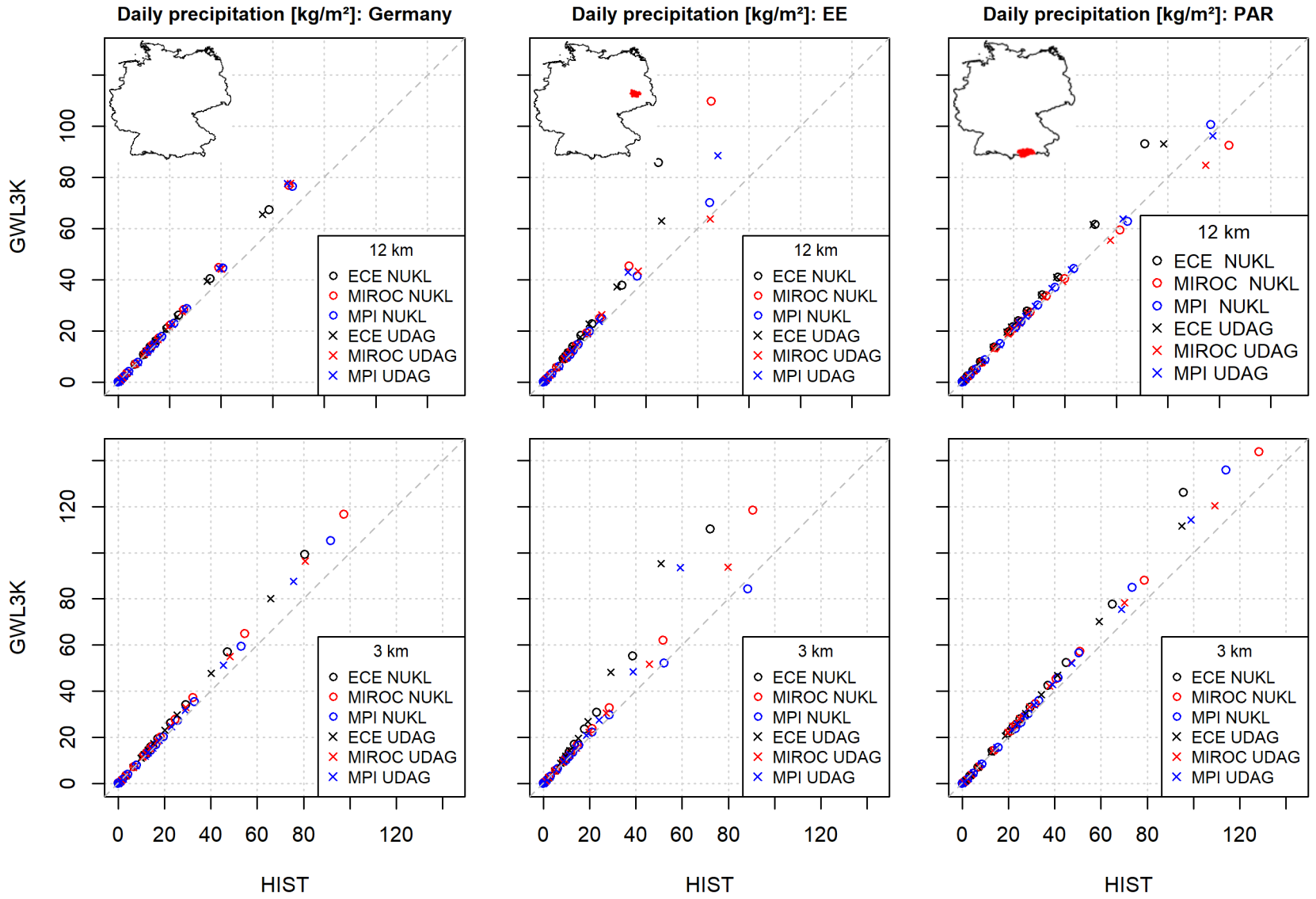


HISTORICAL VS. SCENARIO

PRECIPITATION

12 km

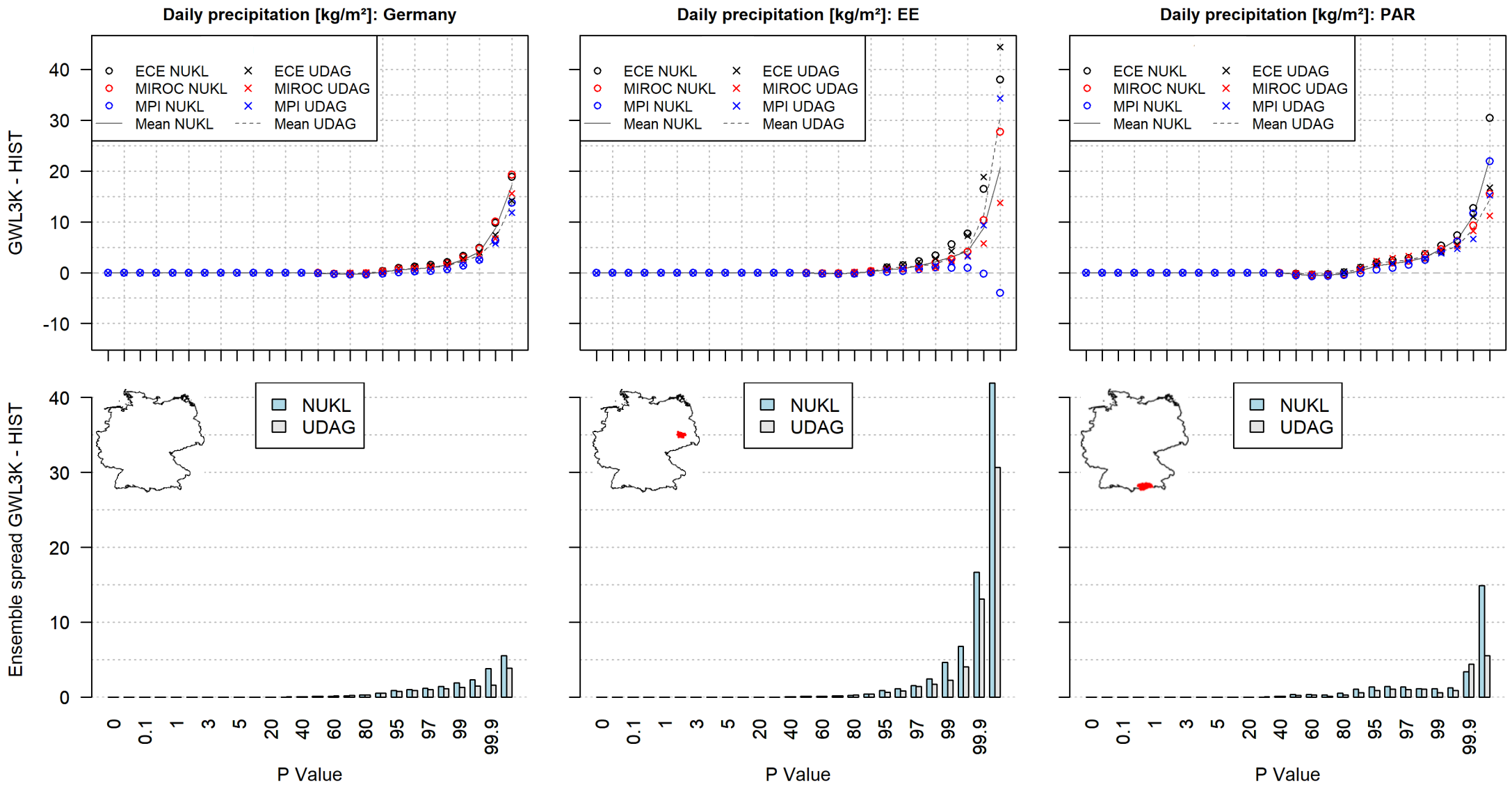
3 km



HISTORICAL VS. SCENARIO

PRECIPITATION

3 km



HISTORICAL VS. SCENARIO

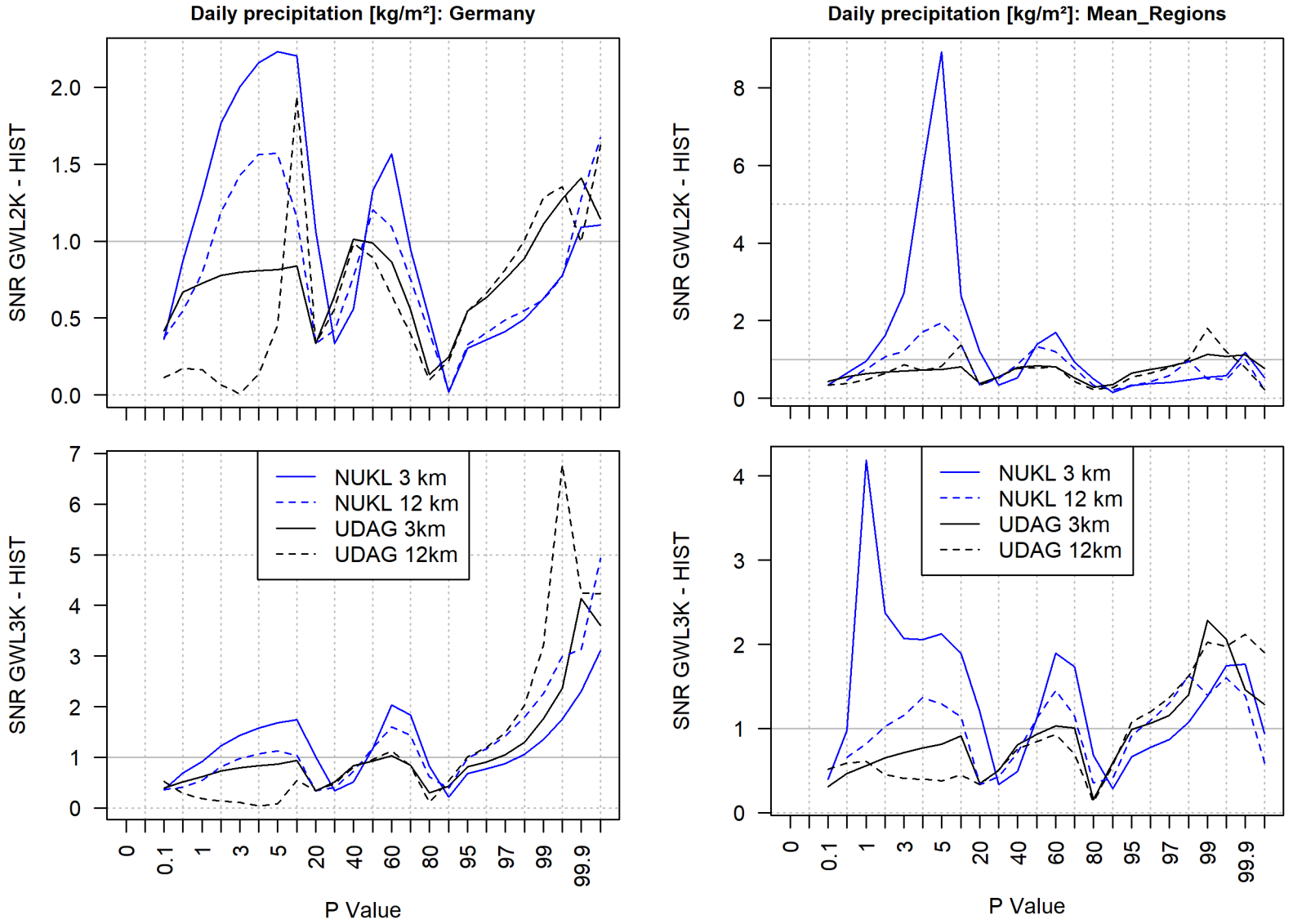
PRECIPITATION

Signal-to-noise ratio

SNR=Signal/Noise

Signal: Ensemble mean of change signal

Noise: Ensemble spread



SUMMARY

Temperature:

- High agreement between the evaluation simulations and the observational data for p-values between 1 and 99% and between change signals for 12- and 3-km
- The differences between the simulations (driven by different GCMs) are greater than the differences between the NUKLEUS and UDAG
- Highest changes and bandwidth for lowest p-values. Mostly higher changes for the UDAG ensemble. Signal-to-noise ratio mostly above 1 for all p-values and simulations

Precipitation:

- Overestimation of extreme precipitation up to 80% (P99.99, Eval., Nukleus 3 km, EE region), reduction in UDAG 3 km
- Biases highest in 3km simulations for MIROC BCs
- Higher extreme precipitation in CC period significant for Germany
- Higher noise level in NUKLEUS than UDAG for precipitation extremes (P99.99%: 35% EE, 200% PAR), improved signal-to-noise ratio for UDAG