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Precipitation in convection-permitting climate models

PART I:

- Hourly precipitation
- Convection-permitting vs. convection-parameterizing regional climate models

PART II:

- Daily precipitation
- Convection-permitting vs. bias-adjusted km-scale regional climate models

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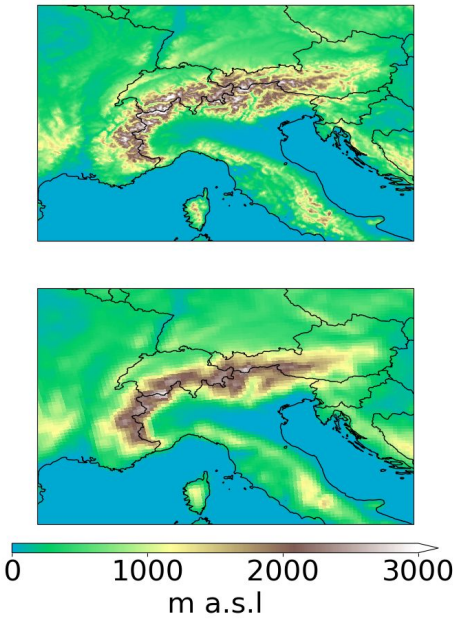
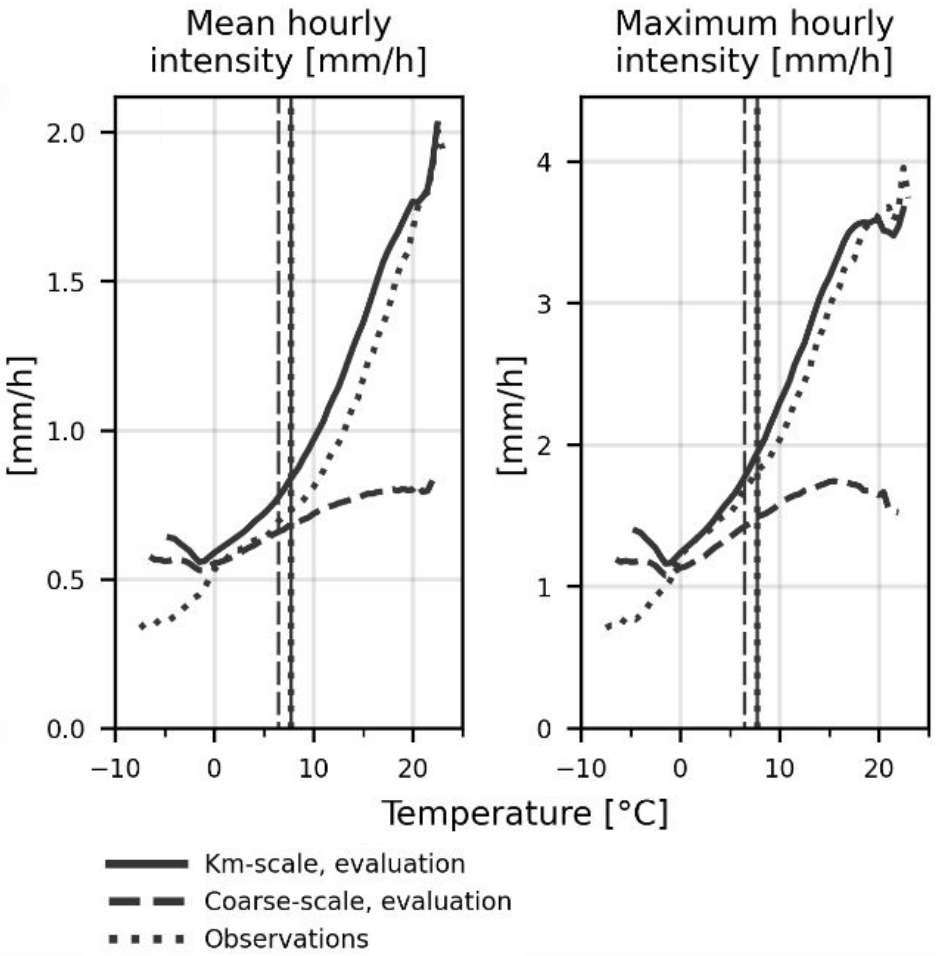
CORDEX-FPS Convection ensemble



	Evaluation run 2000-2009	Historical run ~1996-2005	RCP8.5 run ~2090-2099	
	22 simulations	18 simulations	18 simulations	**~3 km grid spacing** Convection represented explicitly
	19 simulations	16 simulations	16 simulations	**~12 km grid spacing** Convection parameterized
	Driven by ERA-Interim	Driven by GCMs (CMIP5)		
	Ban et al., 2021	*Pichelli et al., 2021*		

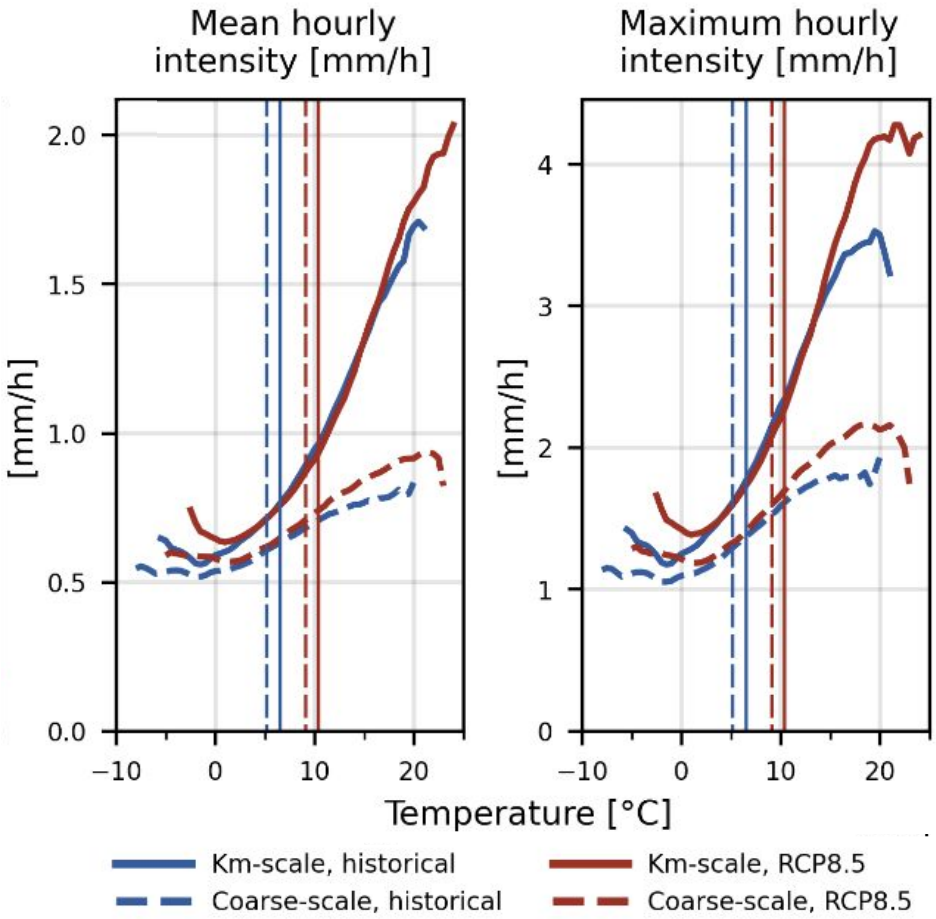


HOURLY PRECIPITATION INTENSITY AT A GIVEN MEAN DAILY TEMPERATURE

➔ km-scale models ≈ station data
(277 stations in AT)

➔ **Convection-parameterizing models exhibit larger biases at higher temperatures**

➔ Temperature dependent bias also seen in
wet hour frequency,
time of precipitation onset



➔ **Future increase in temperature = worse biases in driving models on average**

➔ As a result, **convection-parameterizing models misrepresent the climate change signal** of hourly precipitation characteristics

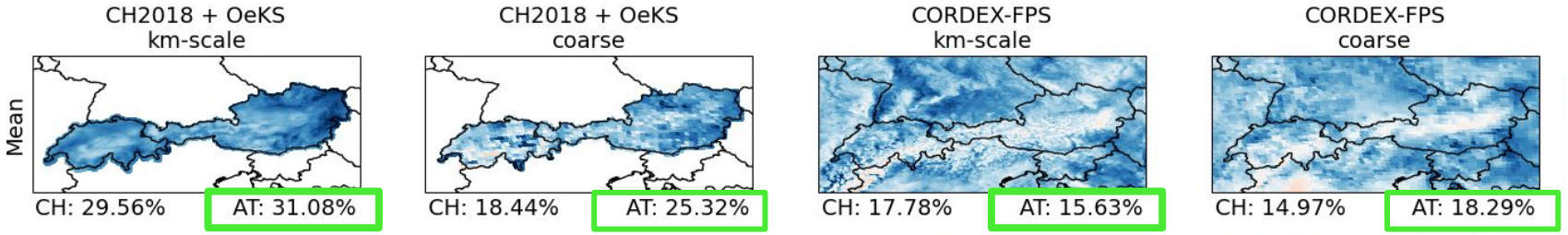
Bias adjusted datasets

	OeKS15: Austrian Climate Scenarios	**CH2018: Swiss Climate Scenarios**
No. of downscaled EURO-CORDEX simulations	**13** (All based on EUR-12)	**21** (9x EUR-12, 12x EUR-44)
Grid spacing	**1 km**	**2 km**
Method	Scaled Distribution Mapping	Quantile Mapping
Reference dataset	GPARD1	RhiresD

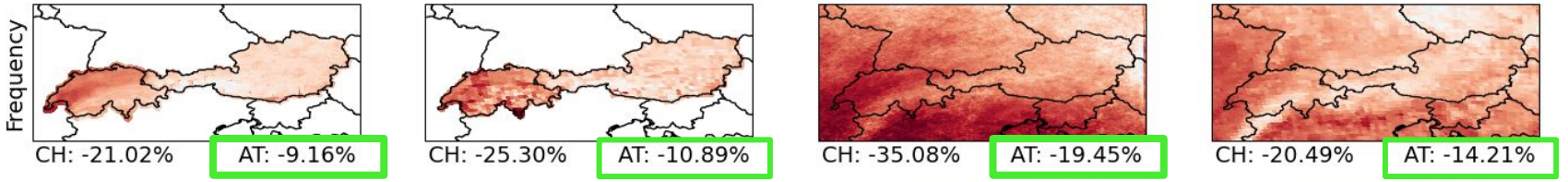
➔ OeKS15 + CH2018 are based on different underlying EURO-CORDEX sub-ensembles

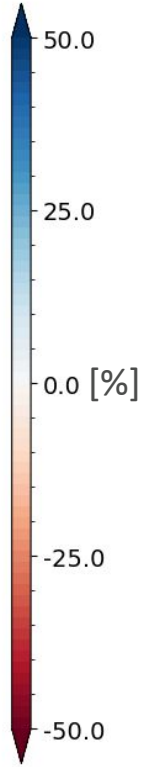
➔ **Daily** resolution

Climate change signal: DJF



Climate change signal: JJA





Consistent signs, but large **differences in magnitude** of change for some measures among datasets, also already at the coarse level

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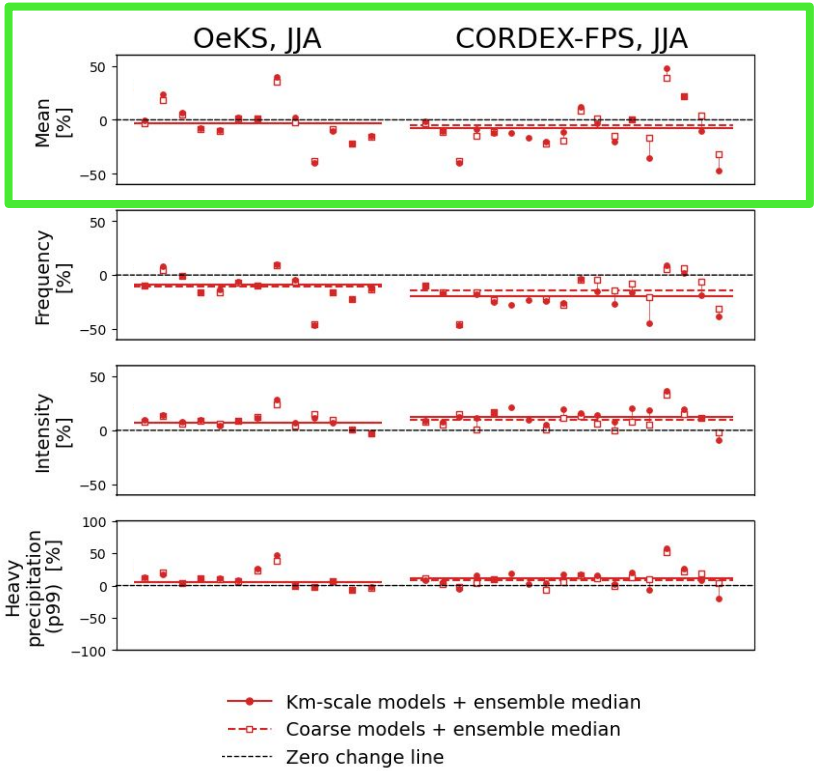
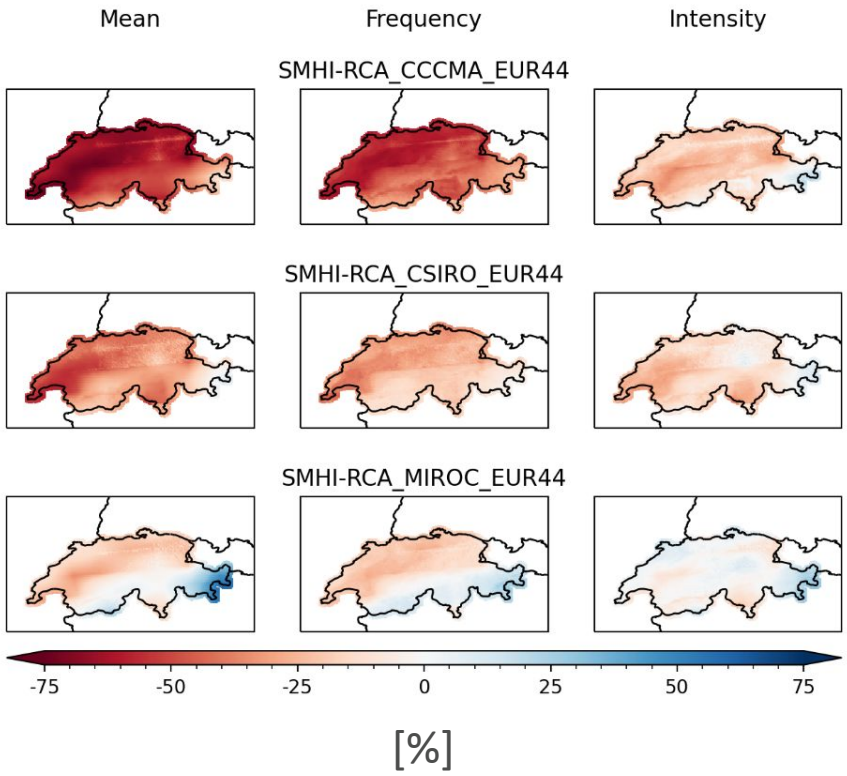
Climate change signal: model spread, JJA, Austria

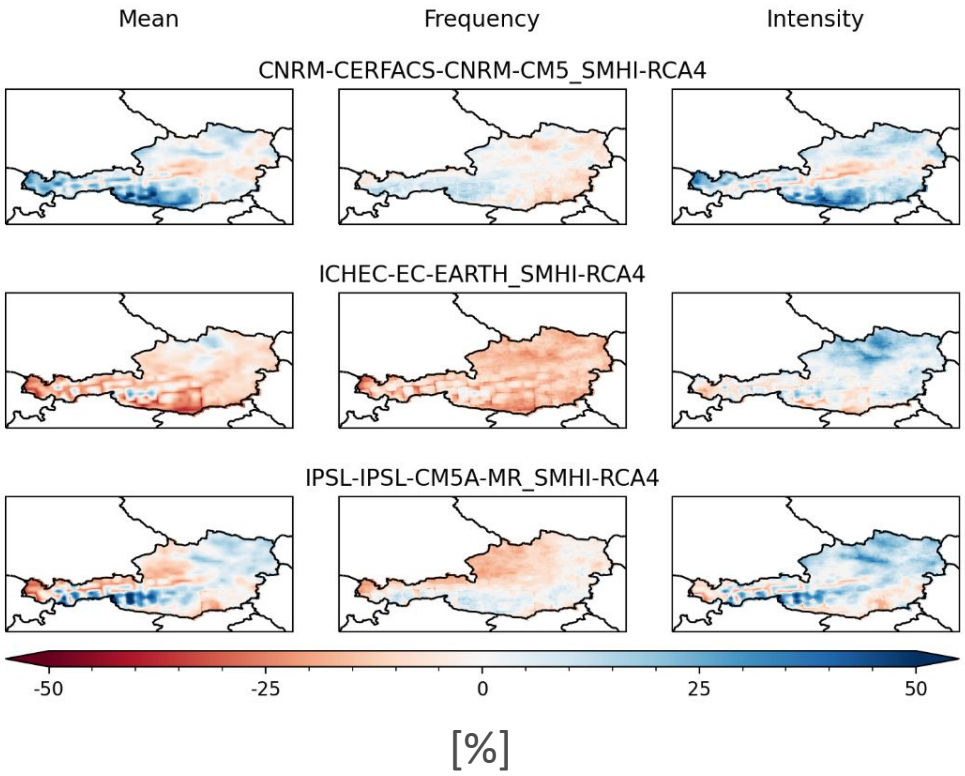


➔ Both **km-scale** ensembles strongly **inherit the signal** from coarse models
(by construction for OeKS, but also seen in CORDEX-FPS):
the choice of coarse models matters!

➔ **Small quantitative differences** between the methods, but…

Climate change signal: selected bias-adjusted models (JJA)





Spurious climate change signal seen in individual models, also visible in the ensemble median

Take-home points

PART I

- At **hourly timescales**, km-scale models match station data well, but **biases in convection-parameterizing models increase with temperature**
- This affects the **reliability of the climate change signal** in the convection-parameterizing models

PART II

- Mostly **consistent signs** of change between the ensembles
- Large **differences in magnitude** of change for some measures
- The km-scale ensembles strongly **inherit the climate change signal** from coarse models - the **choice of coarse models matters**!
- **Unphysical climate change signal** resulting from bias adjustment