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- Credible model projections are critical for natural resource managers

  → Need a thorough model evaluation

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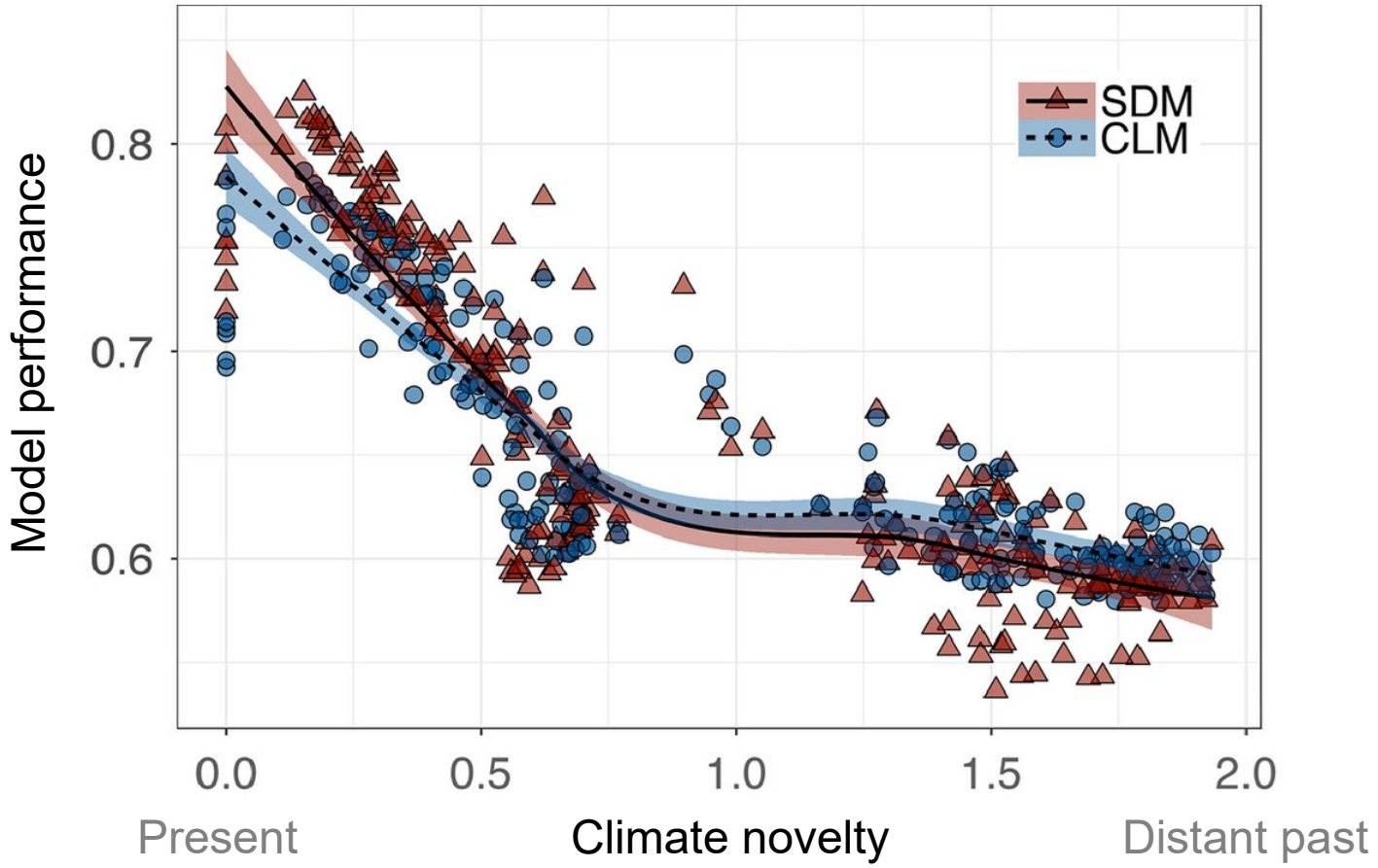
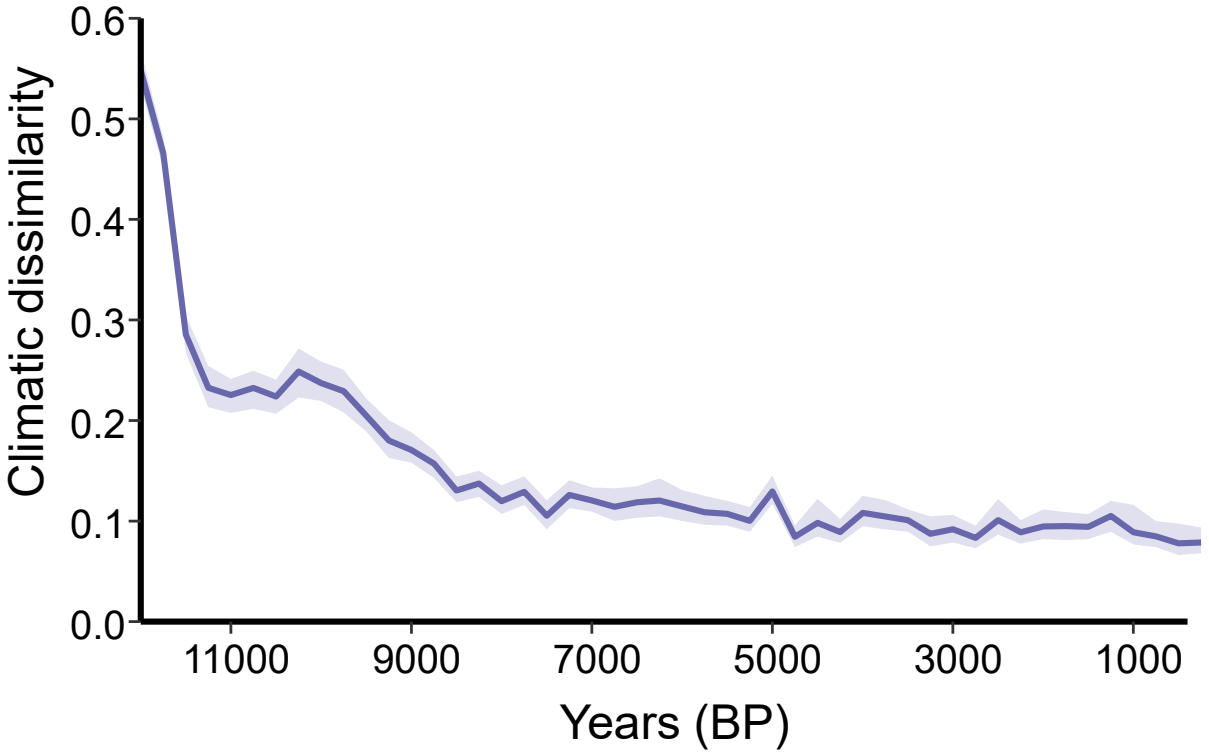
- One approach: compare model predictions to observations from previous time periods (hindcasting)

Decrease of model performance in the past



Adapted from **Fitzpatrick et al.** (2018)

Future climatic conditions are expected to be challenging



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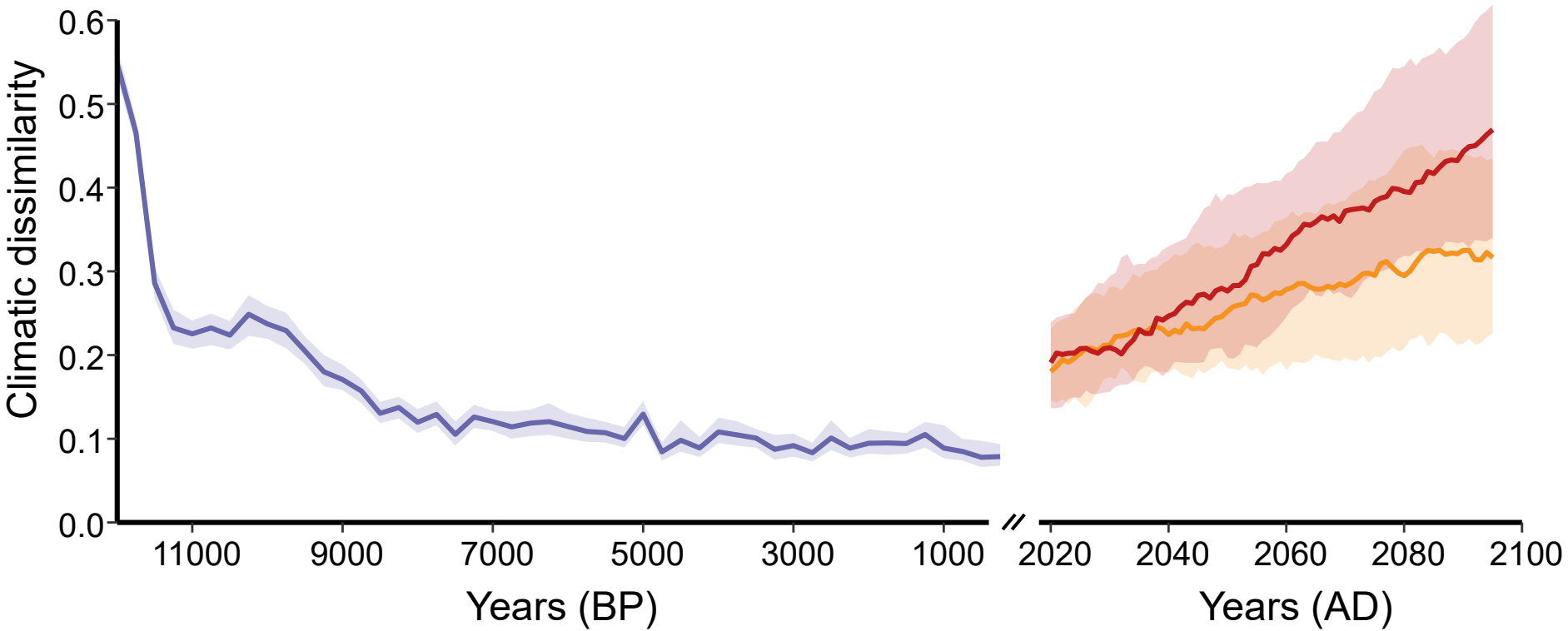

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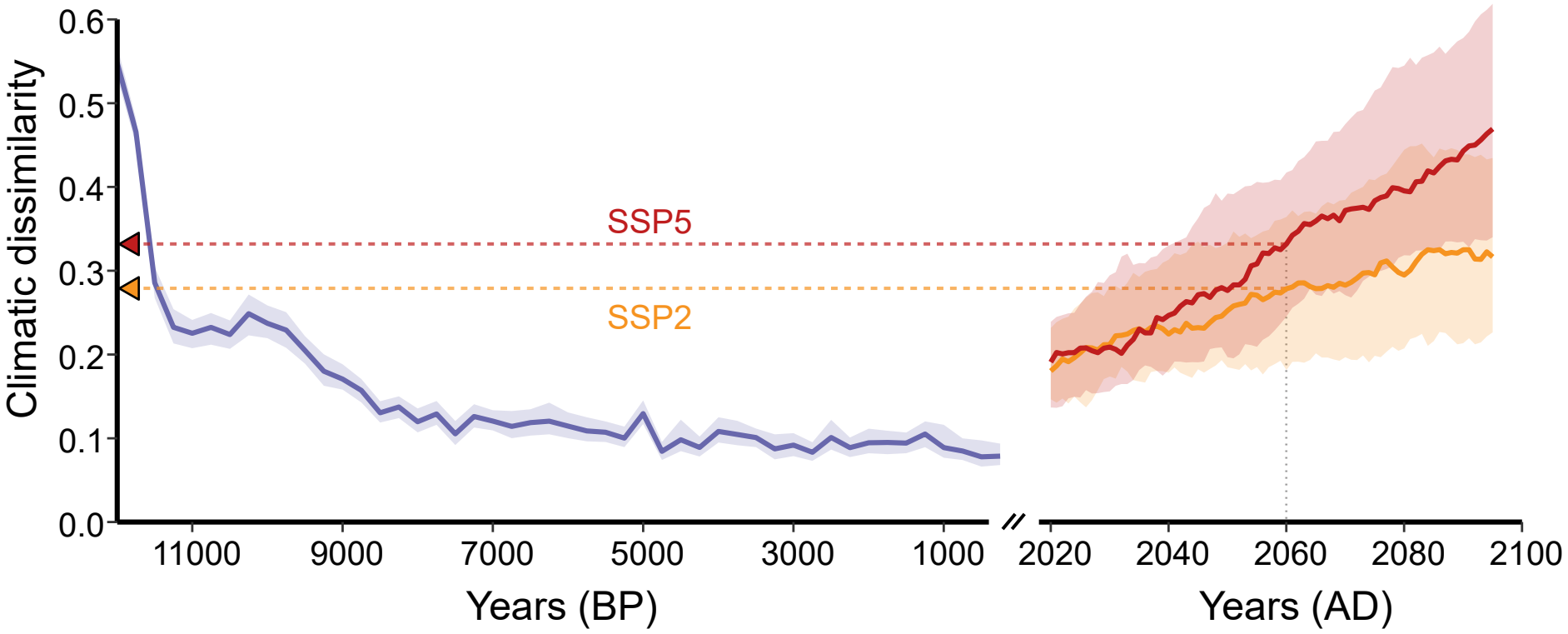

Urgency for action?

- Concerns about statistical model transferability into future climatic conditions

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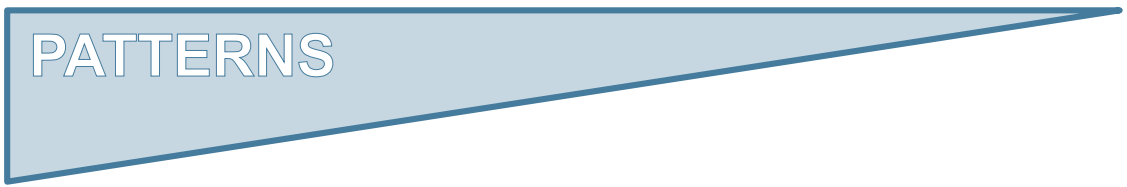
Yet to be verified !

What conveys model robustness and transferability?

Correlative models
(SDM)



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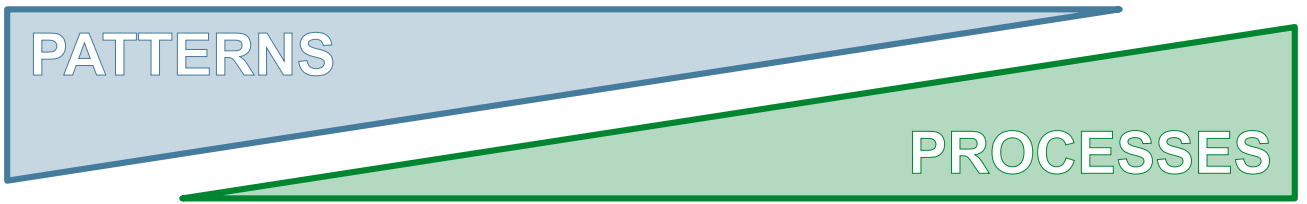

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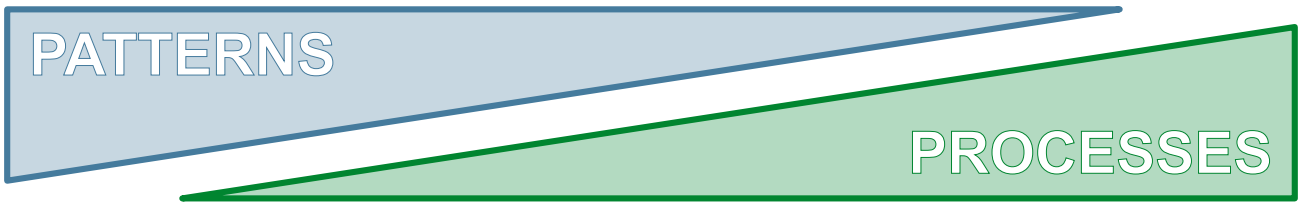

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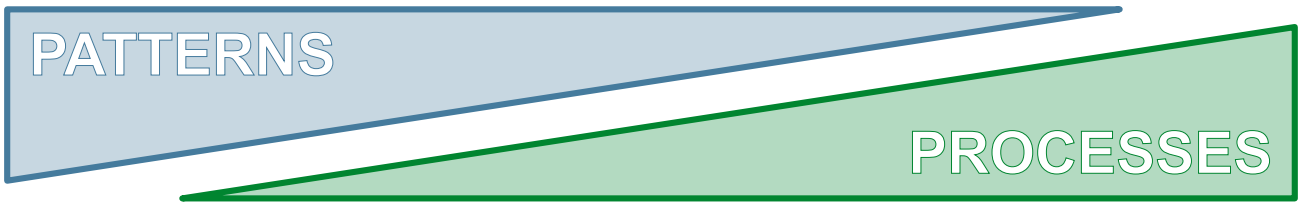

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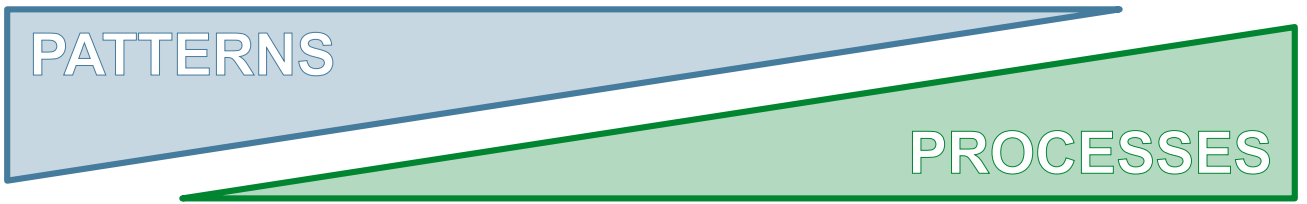

Fitted process-based models

- calibrated with current distribution data
- causal relationships

Adapted from **Dormann et al.** (2012)

Van der Meersch & Chuine (2023)

Multi-model comparison across the Holocene

- 5 European tree species (*F. sylvatica, A. alba, Q. ilex, Q. robur, Q. petraea*)

- 8 models: 4 correlative models (RF, BRT, GLM, GAM)
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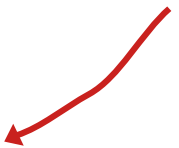

model based
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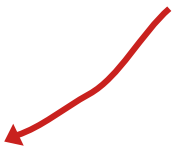

model based
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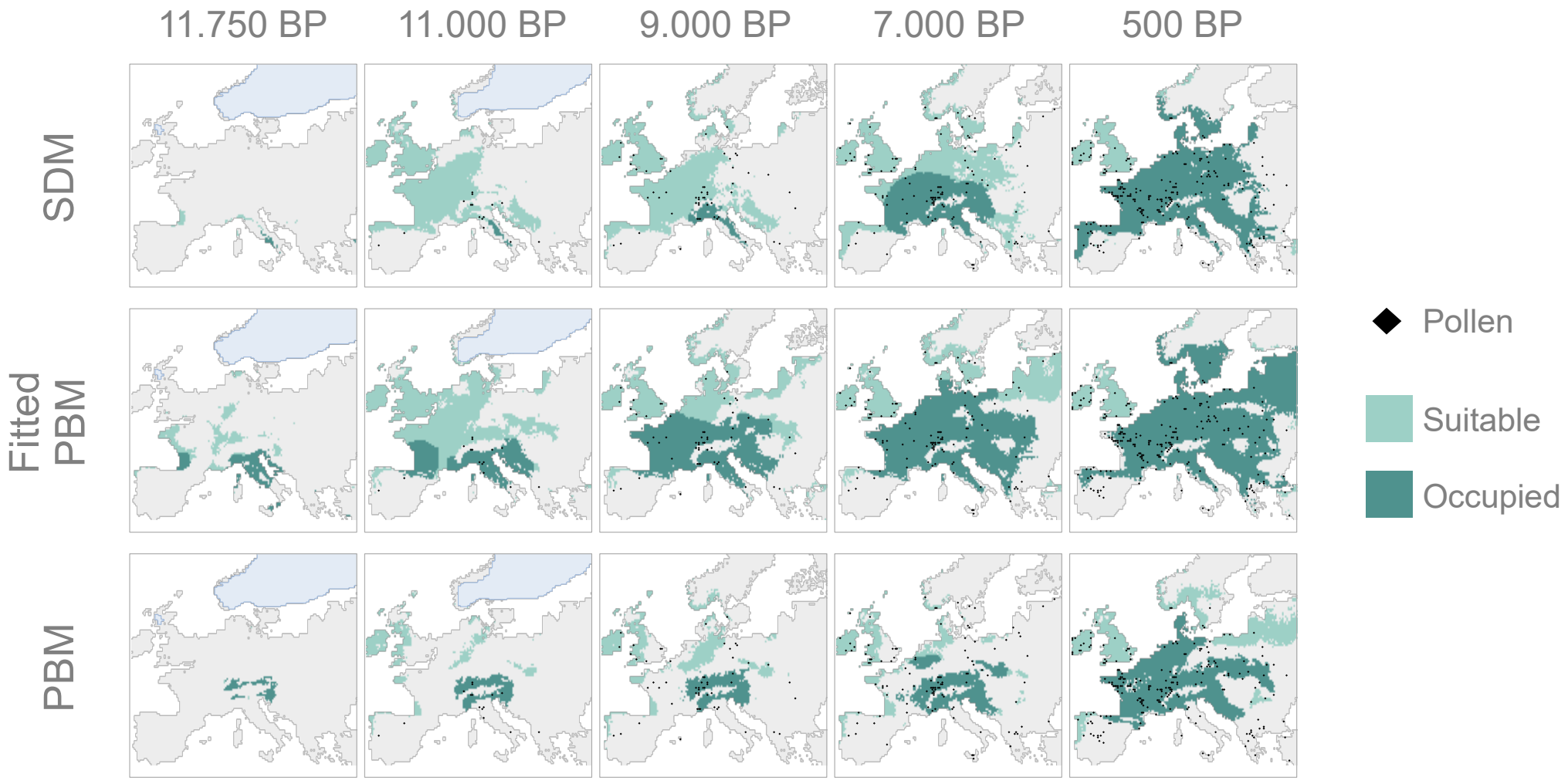
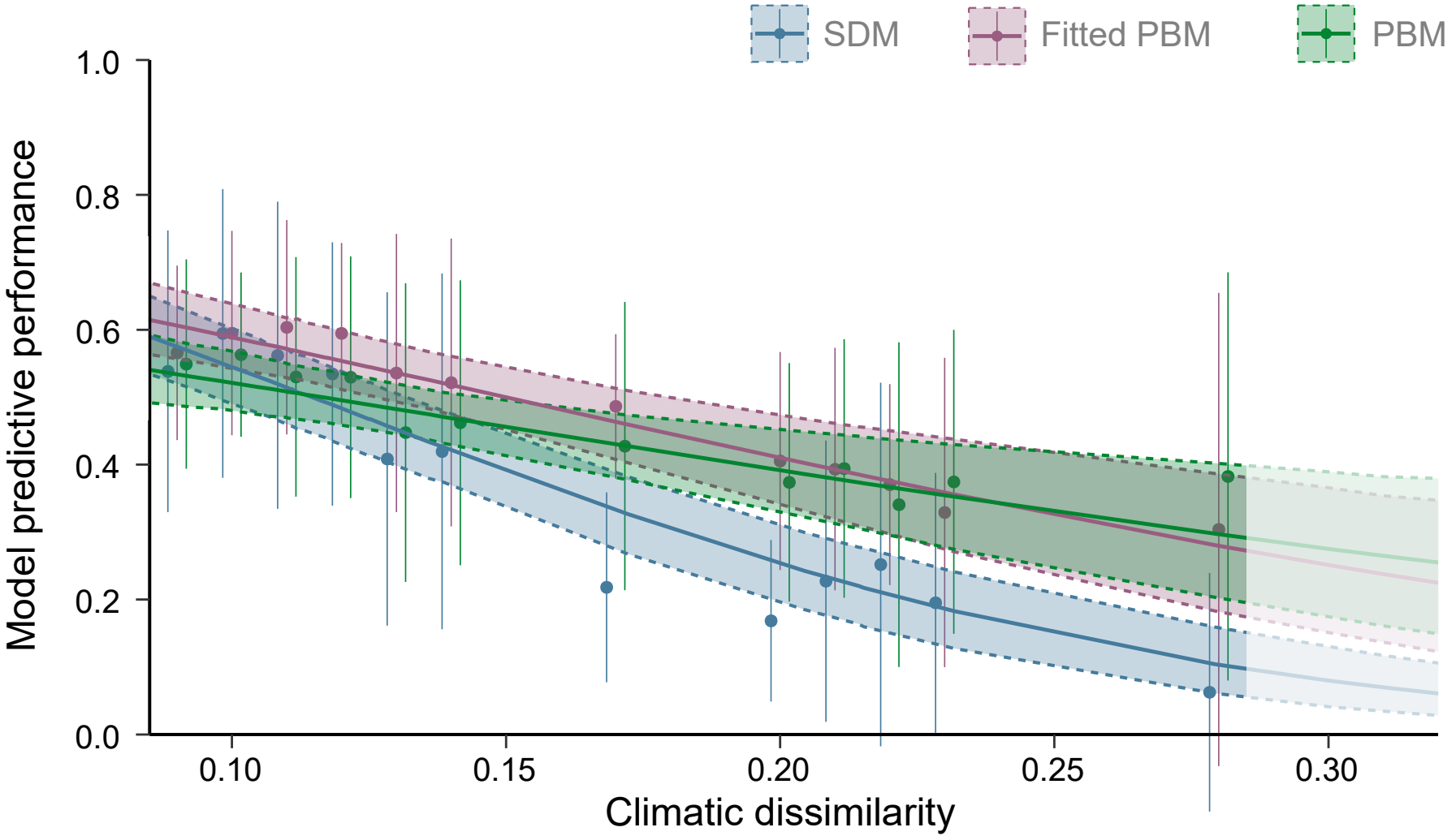
- past climate data from HadCM3B simulations (+ daily weather generation)
- model performance evaluated against fossil pollen data

Example of deciduous *Quercus* paleosimulations



Decrease of model performance when moving further into the past



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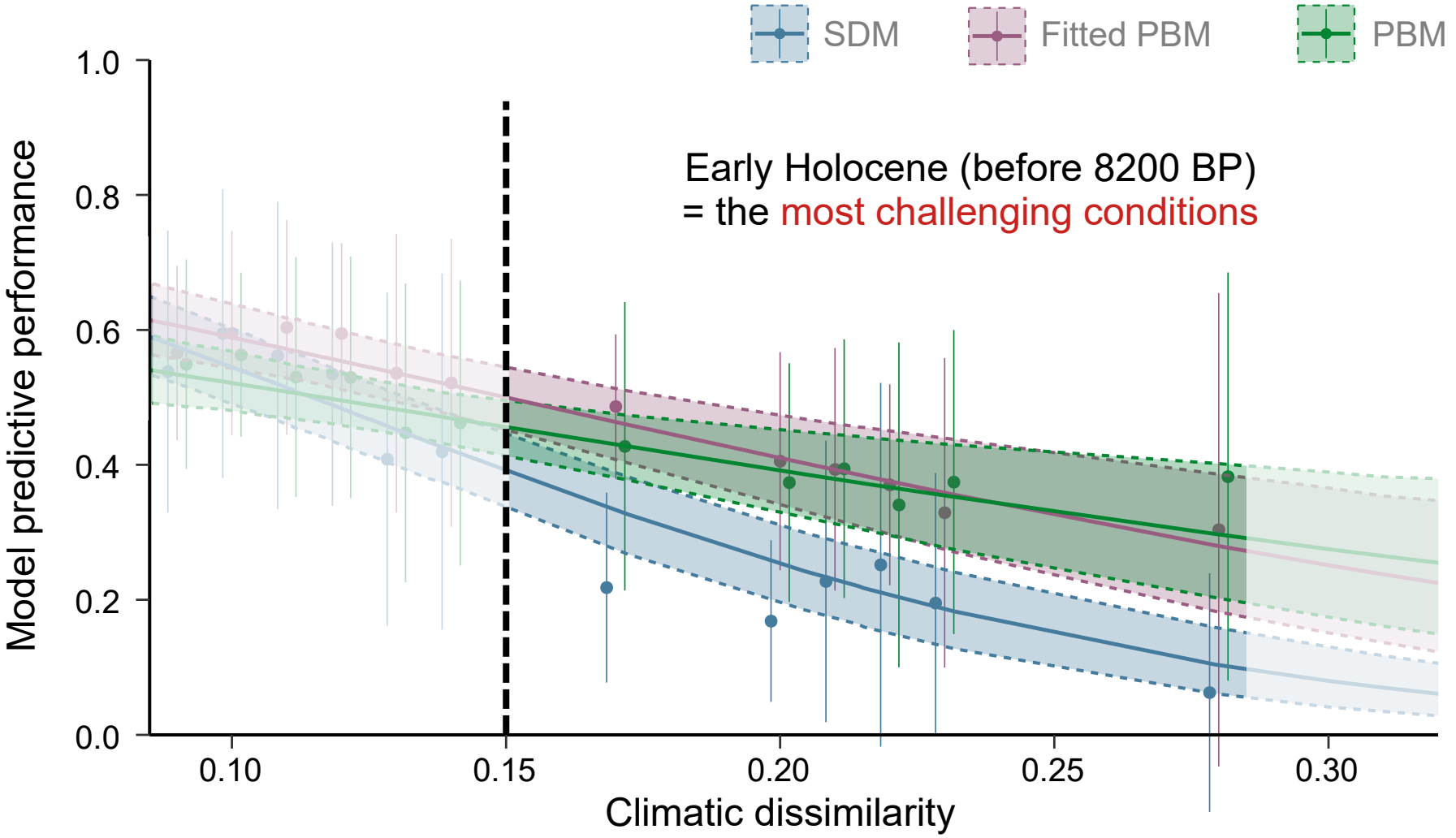
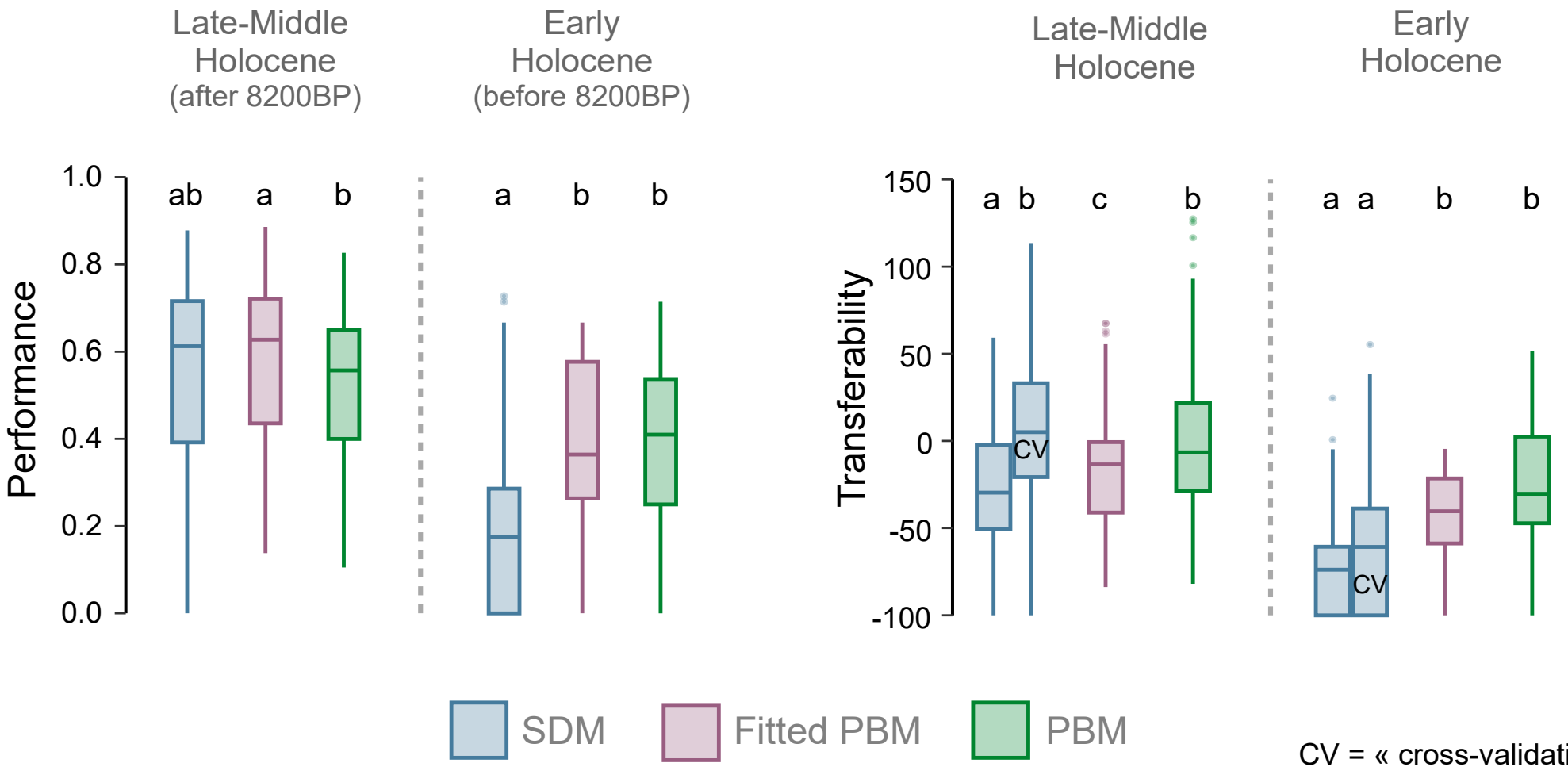


Process-based models are more performant/transferable?



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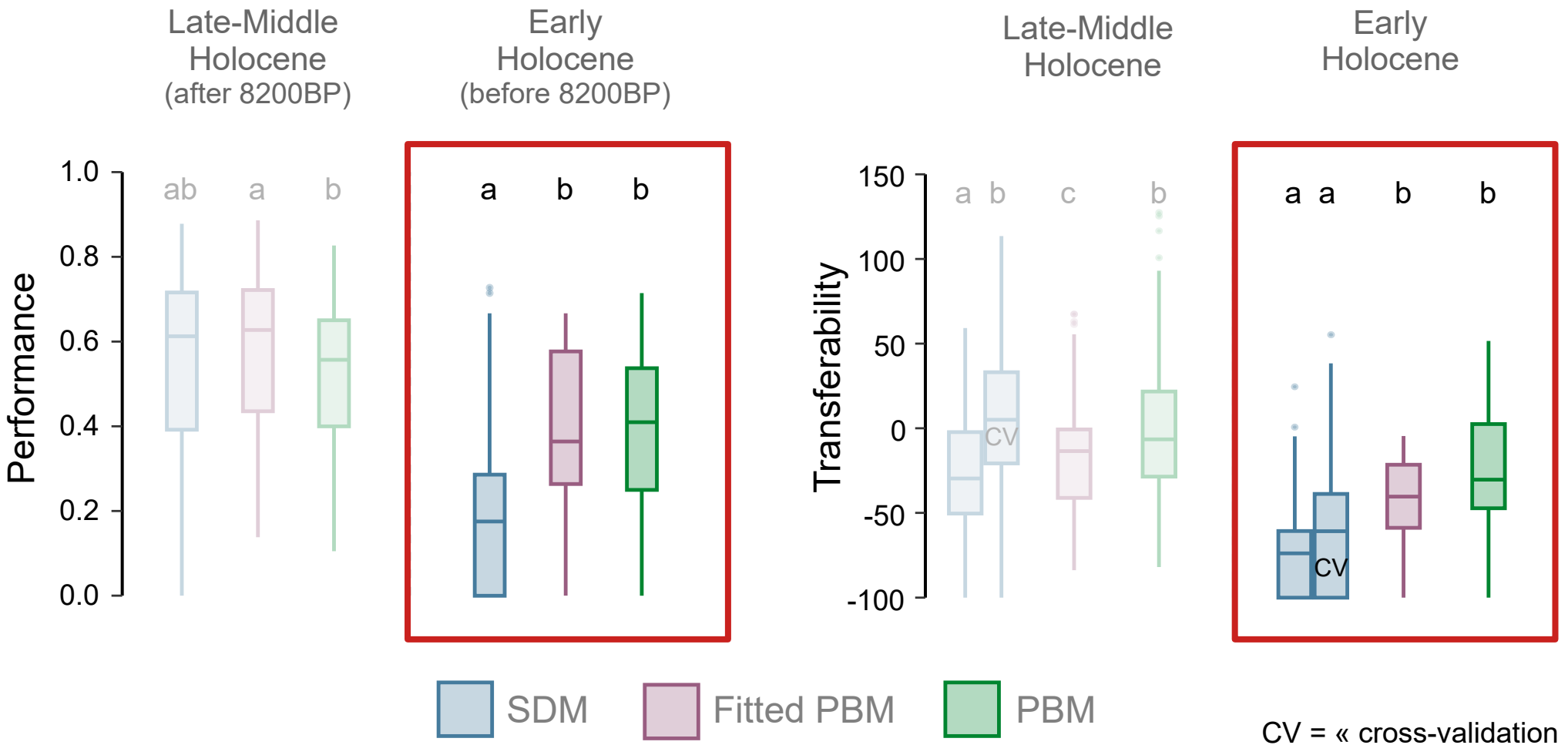

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Mechanisms, not calibration method, convey model robustness

- Expert and fitted PBMs less affected by the increase in climatic dissimilarity

- Fitted PBMs similar to expert PBMs

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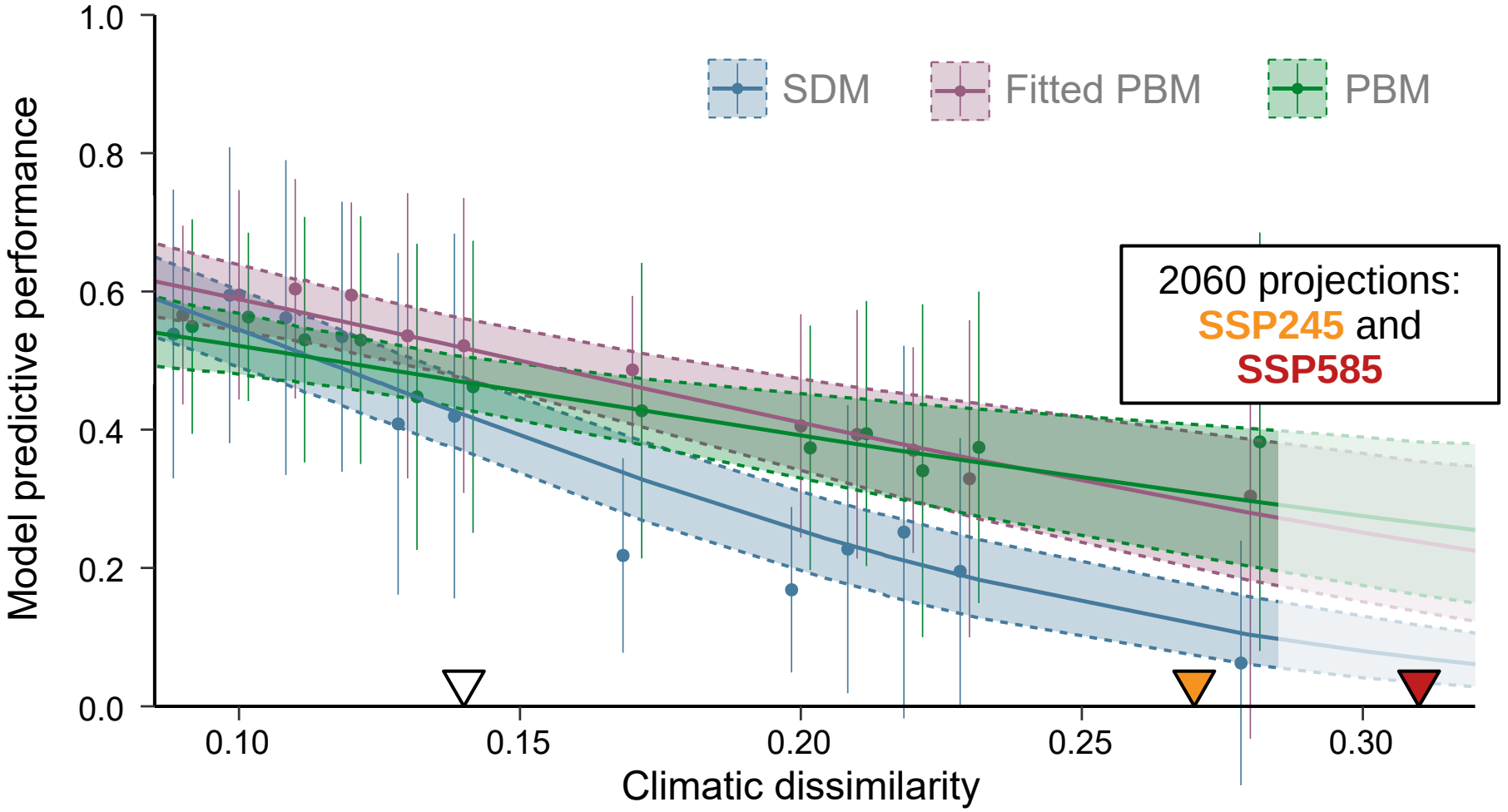
→ Biological mechanisms are necessary to improve the robustness of models

(more important than the calibration method?)

A real advantage to increase projections reliability in the upcoming decades?



On our way to scale-up process-based models

- Fitted PBMs bring together the strengths from statistical and mechanistic approaches

- Inverse calibration: an opportunity to improve parameter estimates?

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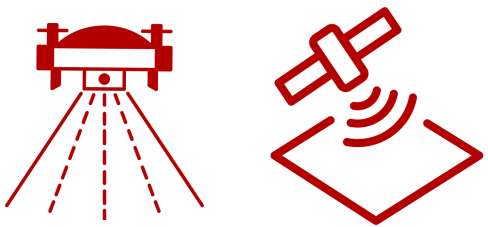

Data fusion

Mechanisms

→ Spread the use of process-based approches?