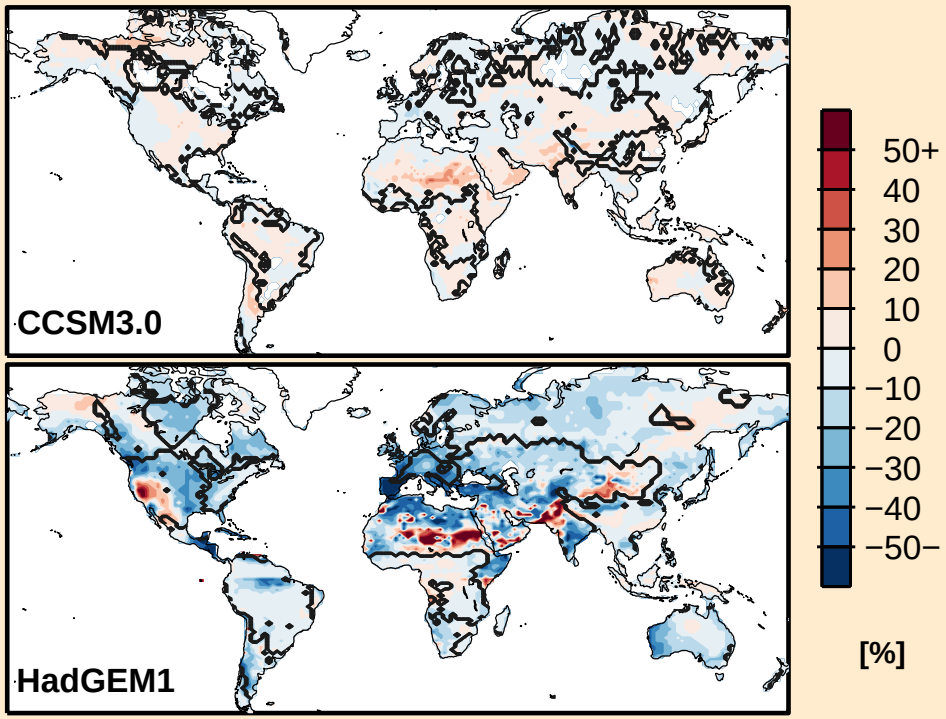
Toy Model Applications

- **1.** Attributing GCM $\mathrm{Var}(T)$ errors to forcings and/or toy model coefficients. **Not today!**
- **2.** **Insight on late 21st century $\mathrm{Var}(T)$ projections.**

SRES A1b Summer soil moisture / temp. variance

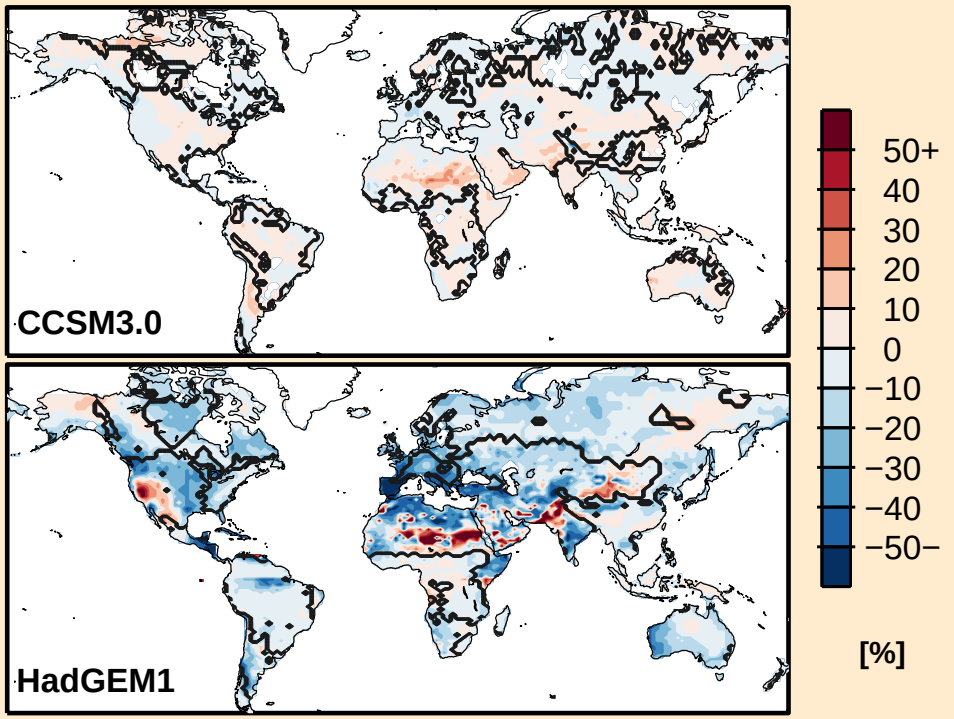
$$\frac{\overline{m}_{2069-2099} - \overline{m}_{1969-1999}}{\overline{m}_{1969-1999}} \times 100$$

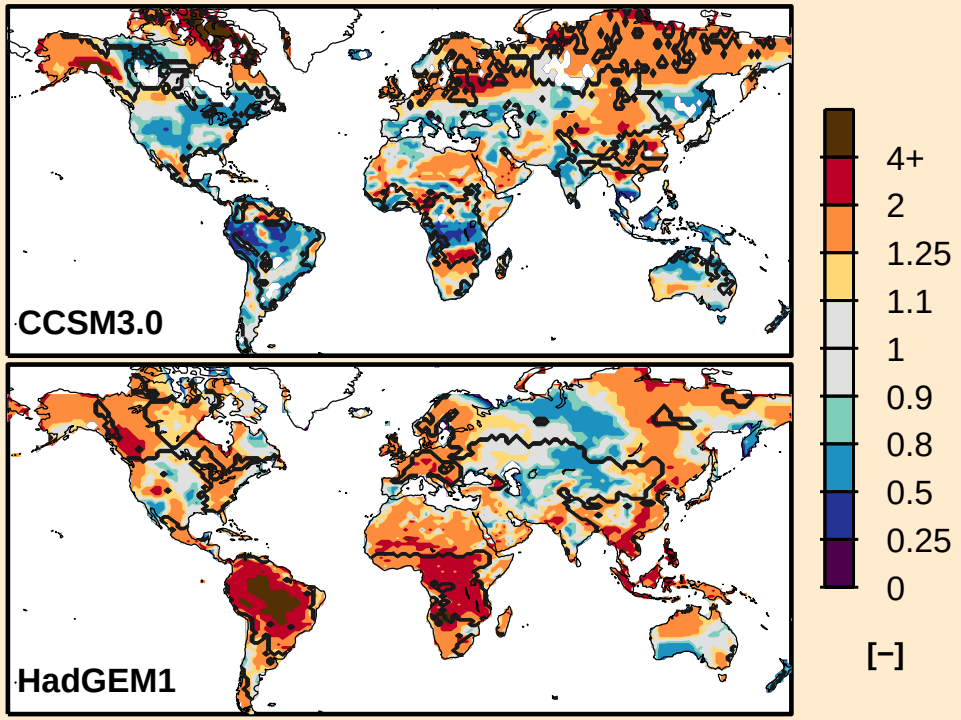


SRES A1b Summer soil moisture / temp. variance

$$\frac{\overline{m}_{2069-2099} - \overline{m}_{1969-1999}}{\overline{m}_{1969-1999}} \times 100$$

$$\frac{\mathrm{Var}(T_{2069-2099})}{\mathrm{Var}(T_{1969-1999})}$$

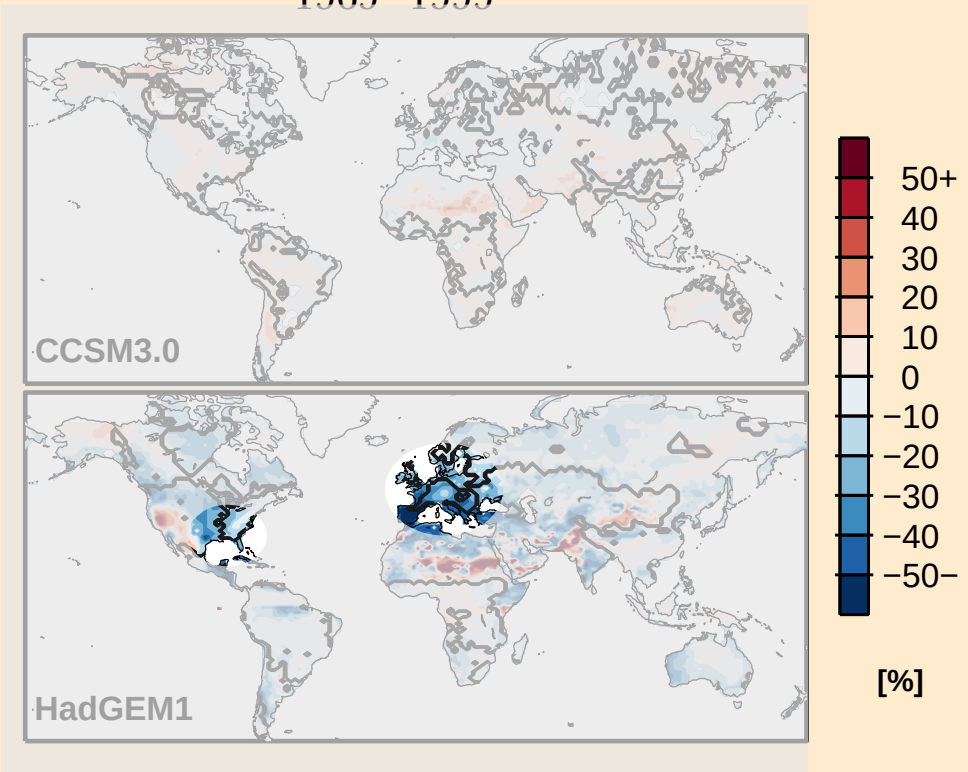


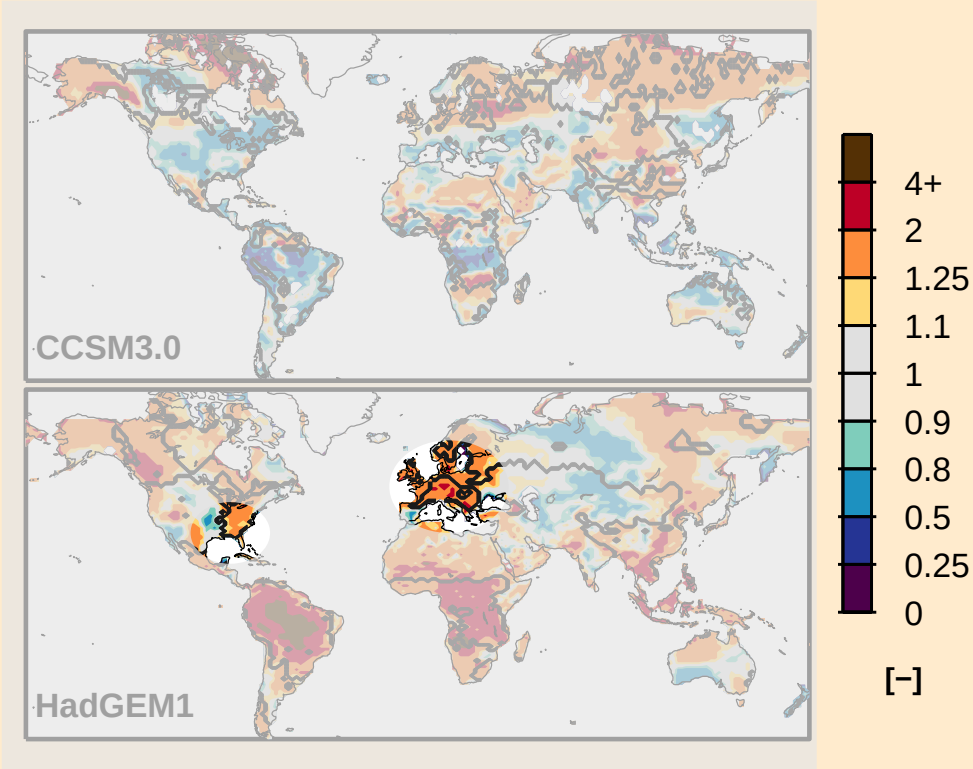


SRES A1b Summer soil moisture / temp. variance

$$\frac{\overline{m}_{2069-2099} - \overline{m}_{1969-1999}}{\overline{m}_{1969-1999}} \times 100$$

$$\frac{\mathrm{Var}(T_{2069-2099})}{\mathrm{Var}(T_{1969-1999})}$$

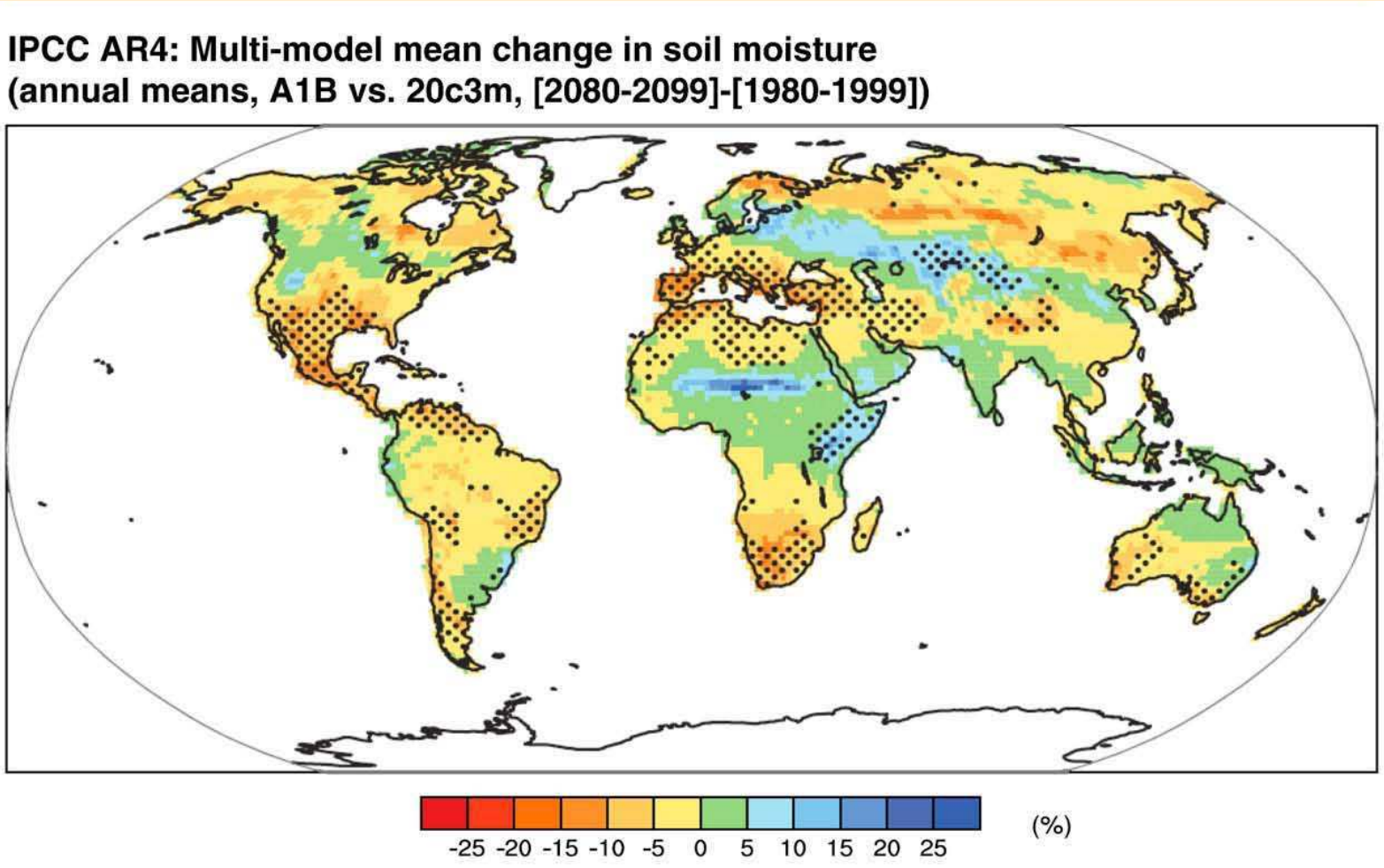




$\Longrightarrow$ **Large temperature variance increase where:**

$\overline{m}_{1969-1999} > m_{crit}$ (solid black line) and $\overline{m}_{2069-2099} < m_{crit}$.

AR4 soil moisture in late 21st century



HadGEM1 soil moisture projections in W. Europe, Central US are consistent with AR4 ensemble average.

Conclusion: Main results

- **Evapotranspiration regimes** are well delimited by **summer mean soil moisture** (in GCMs/Reanalyses)

- **Evapotranspiration regimes** can be extended to **surface temperature variability regimes**

  Soil-moisture related processes can either **amplify or damp** radiation variability

- Over moisture-limited (energy-limited) soils:

  the radiative effects of precipitation and its effect on evapotranspiration add up (compensate)

Conclusion: Unanswered questions

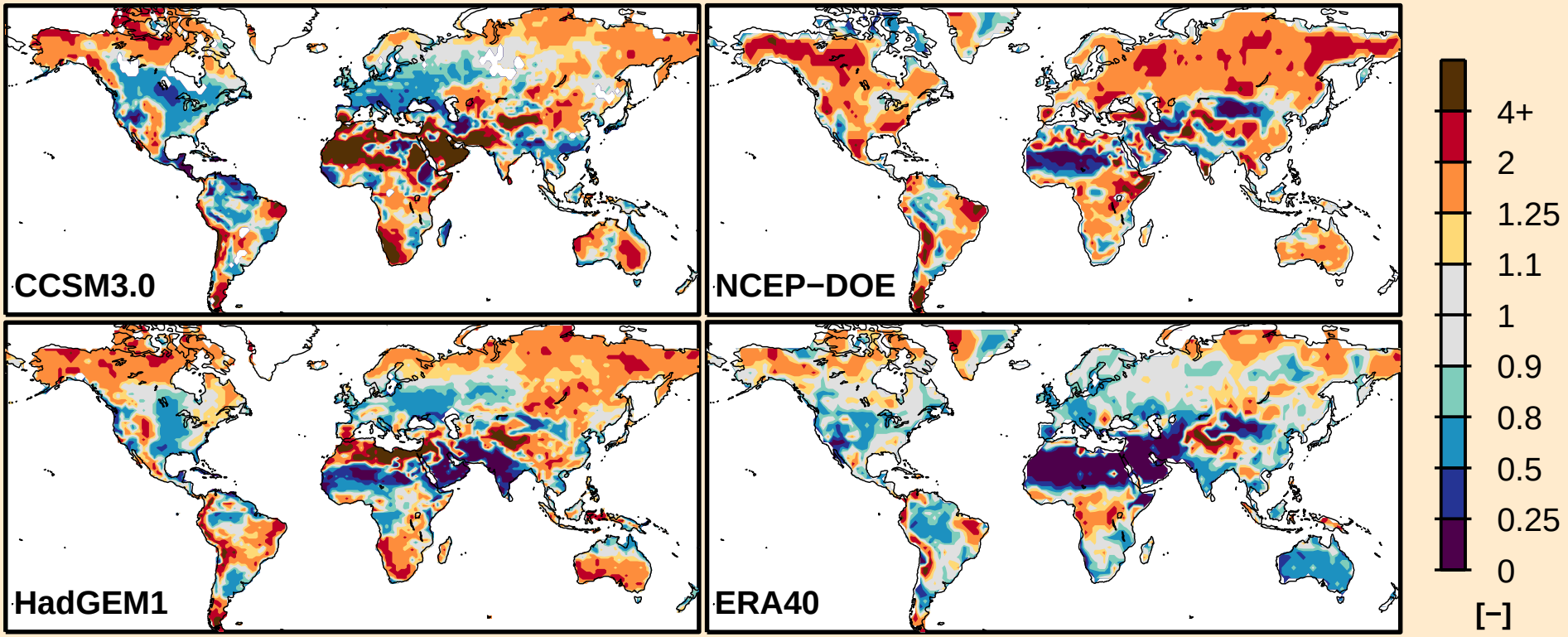
- **By what mechanism is sensible heat flux negatively correlated with soil moisture ?**

- **Why is the toy model underestimating GCM/Reanalysis $\mathrm{Var}(T)$?**

  Parameterization errors? Role of feedbacks? Storage?

- **Why are GCMs too dry in mid-latitudes during summer ?**

Summertime mean precipitation errors ?



- Plotted as $\frac{\overline{P}_{datasets}}{\overline{P}_{observations}}$, $P_{observations}$: U. of Delaware data.

Thank you.

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Questions ?