Datasets and Definitions

- **Use 2 CMIP3 GCMs:** CCSM 3.0, HadGEM1

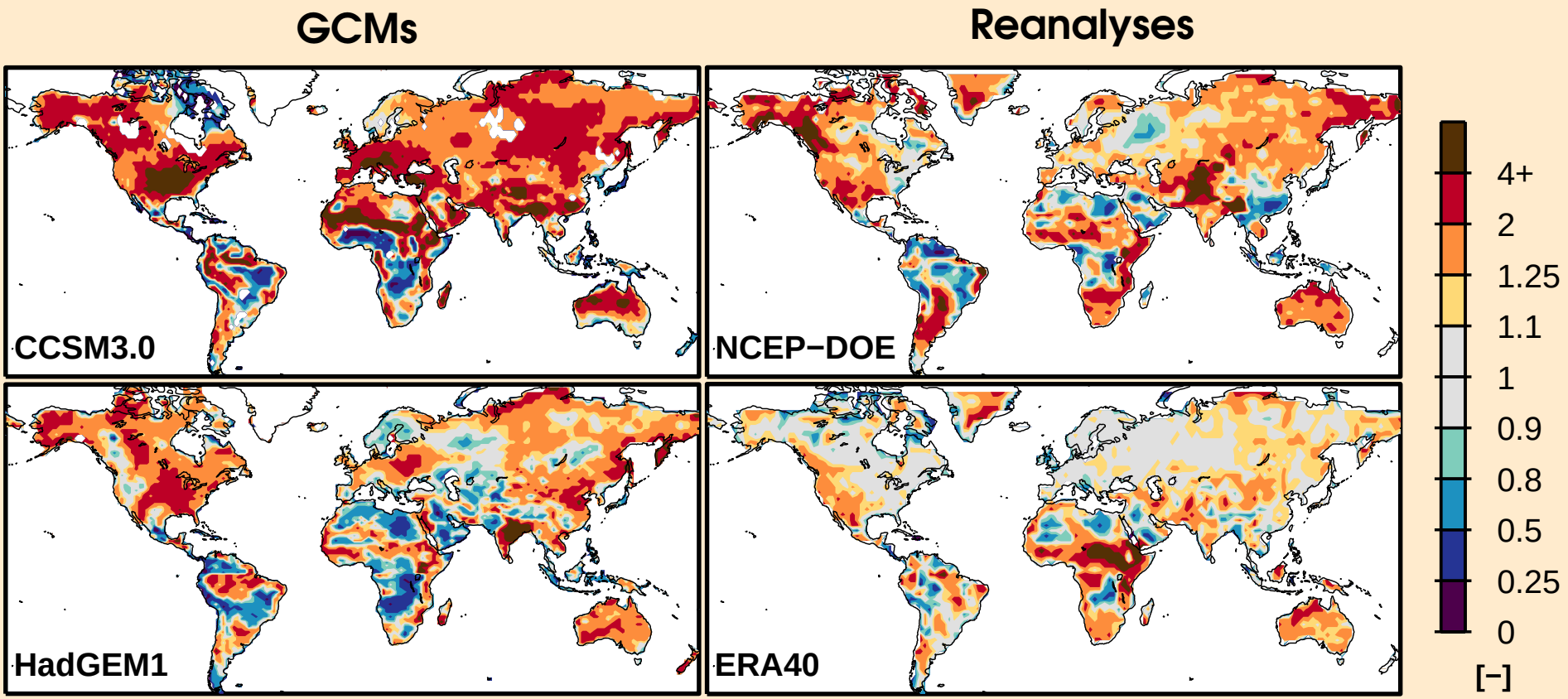
  last 30 years of climate of the 20th century runs (`20c3m`).

- **2 Reanalyses:** ERA-40 (1969-1999), NCEP-DOE (1979-1999).

- **Focus on summer:**

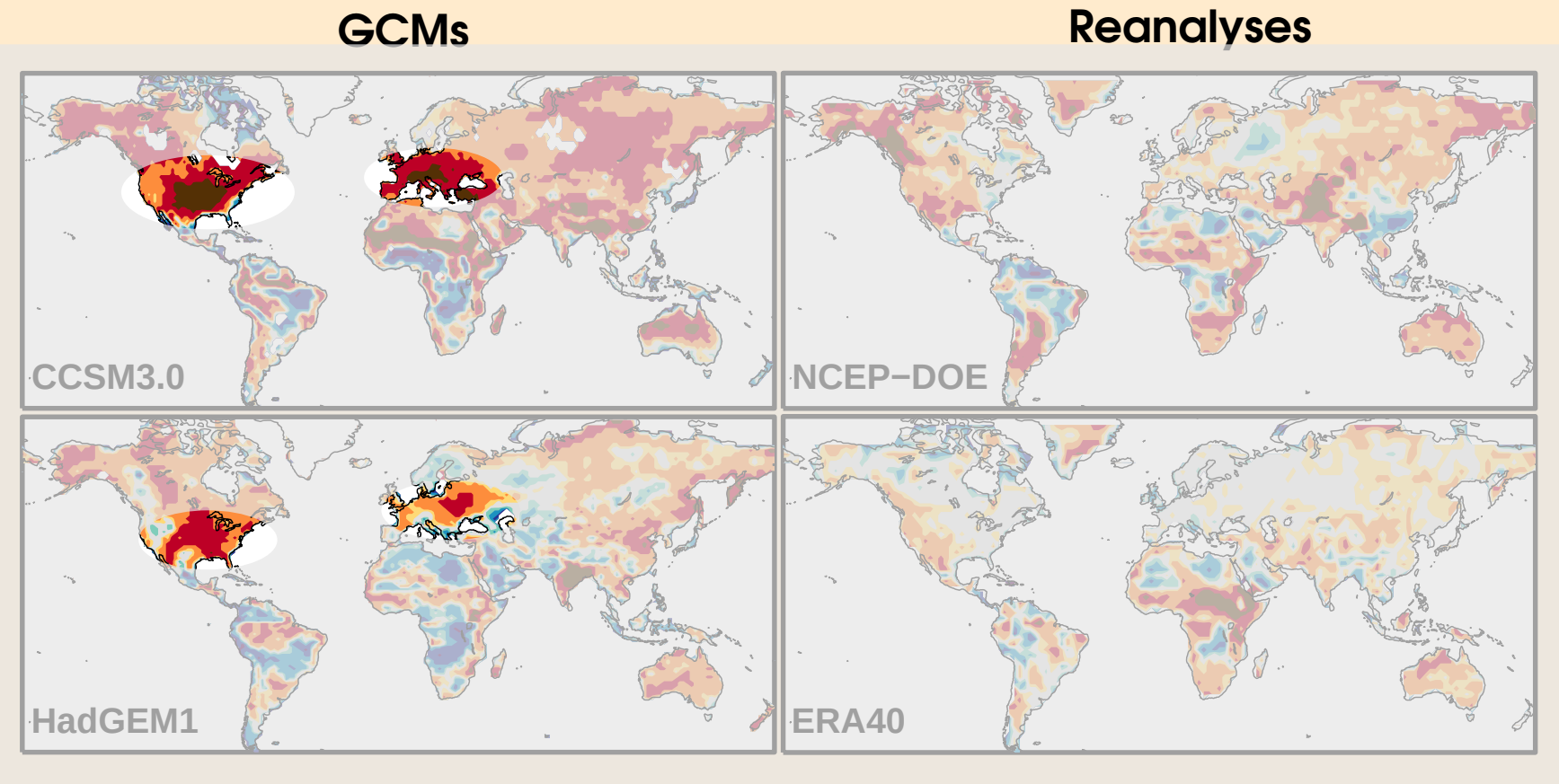
$$\text{Summer} \equiv \begin{cases} \text{June, July, August} \\ \text{December, January, February} \end{cases} \quad \text{if} \quad \begin{matrix} \vartheta > 0^\circ \\ \vartheta \leq 0^\circ \end{matrix} .$$

Temperature Variance Errors



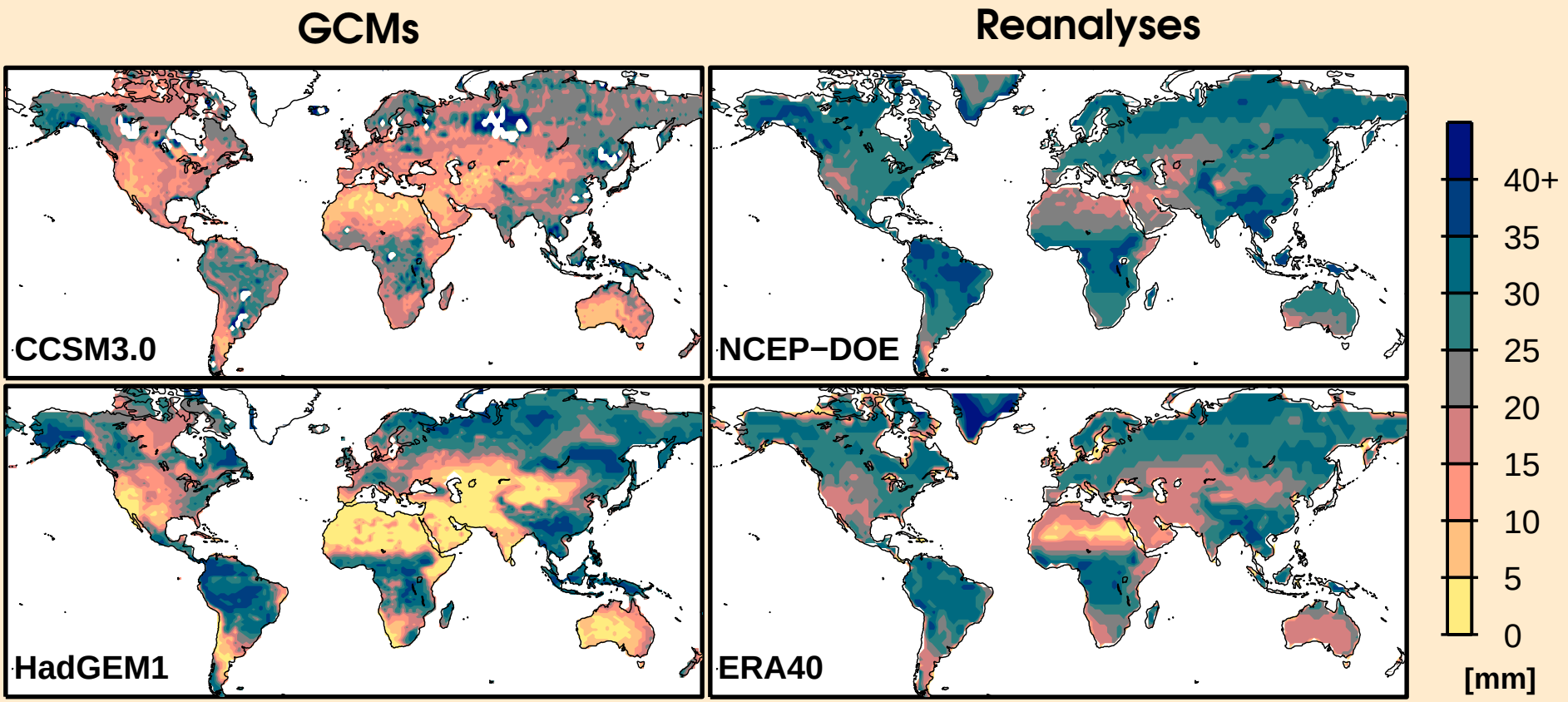
- Plotted as $\dfrac{\mathrm{Var}(T_{dataset})}{\mathrm{Var}(T_{observations})}$, $T \equiv$ 2-meter temp.
  $T_{observations}$: U. of Delaware

Temperature Variance Errors



- Artificial *hot spots* of variability in the GCMs

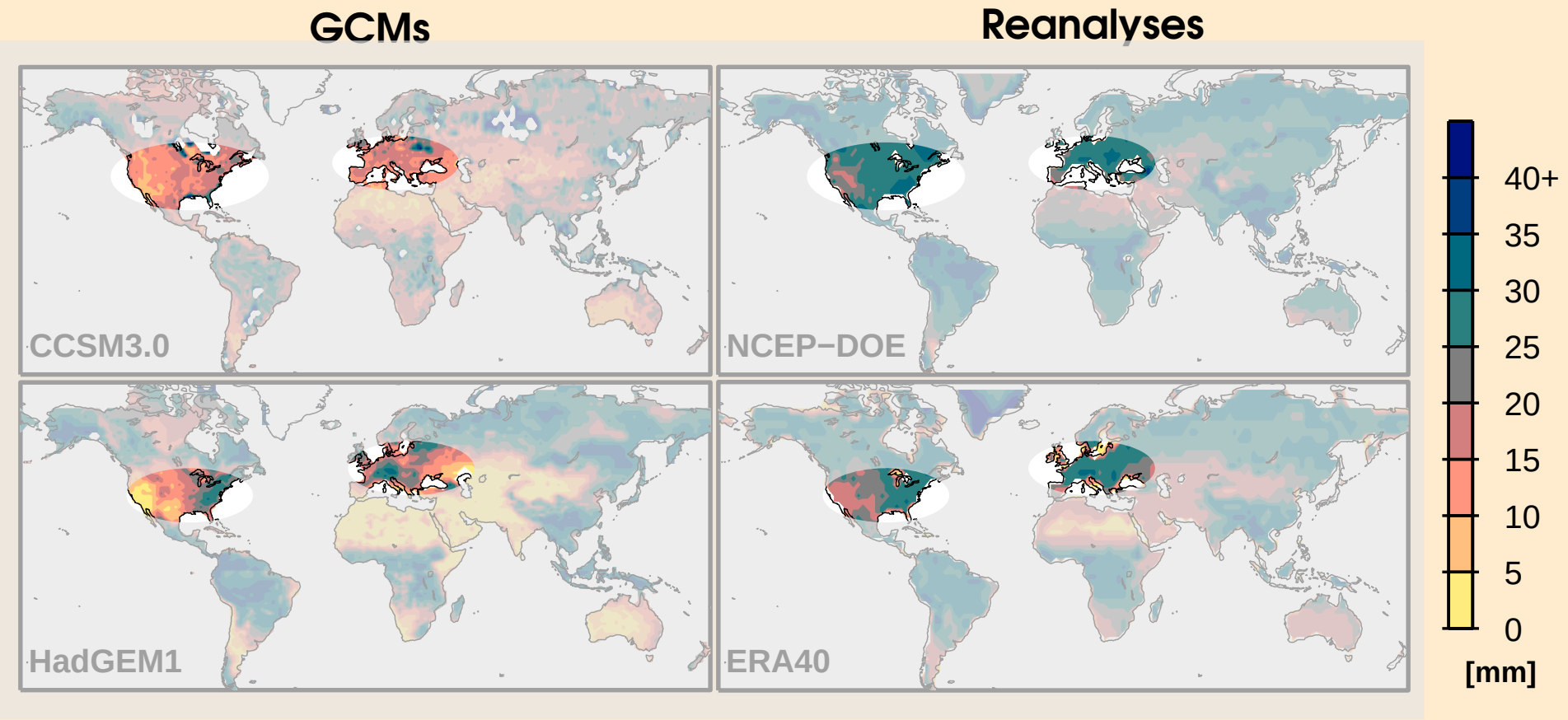
Summertime mean soil moisture



Soil moisture content in the top 10 cm of soil: $\overline{m}$

Saturation $\simeq$ 65 mm

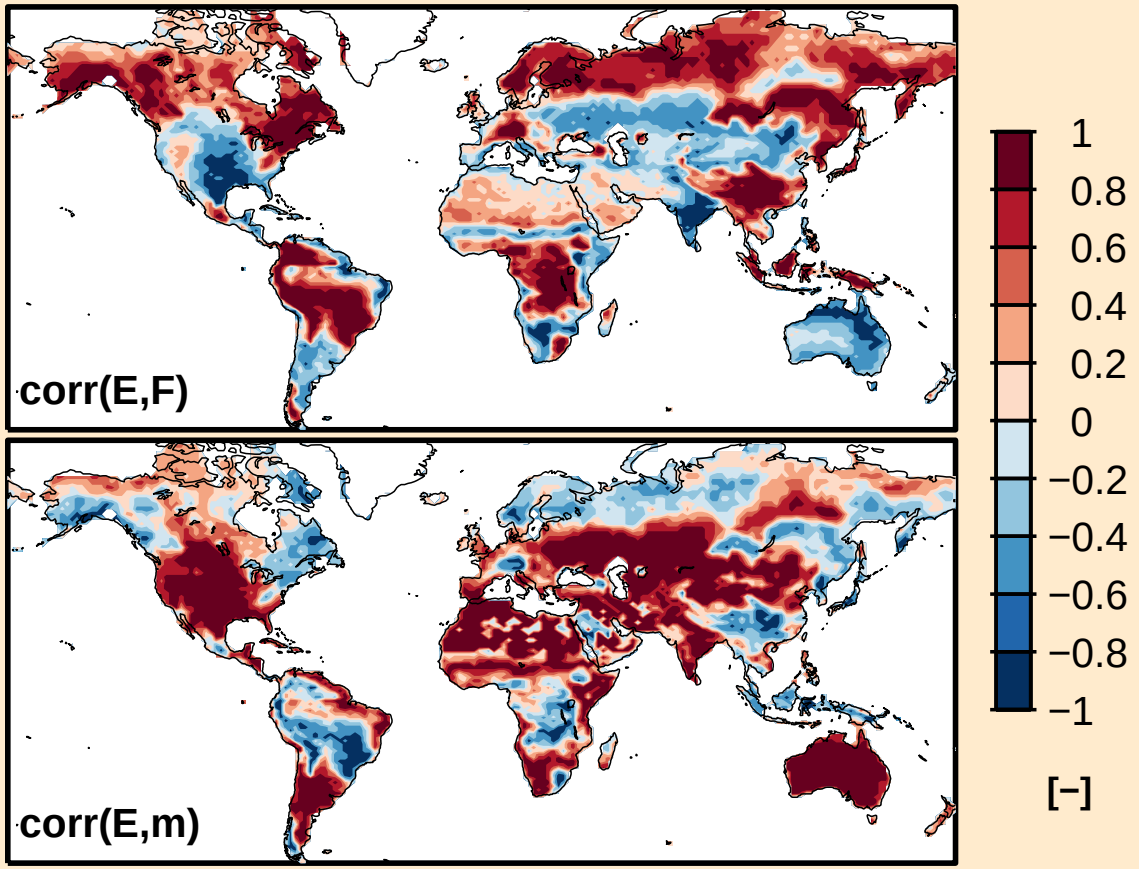
Summertime mean soil moisture



- GCMs are overall *much* dryer

Correlations involving Evapotranspiration (1/2)

E with F , m

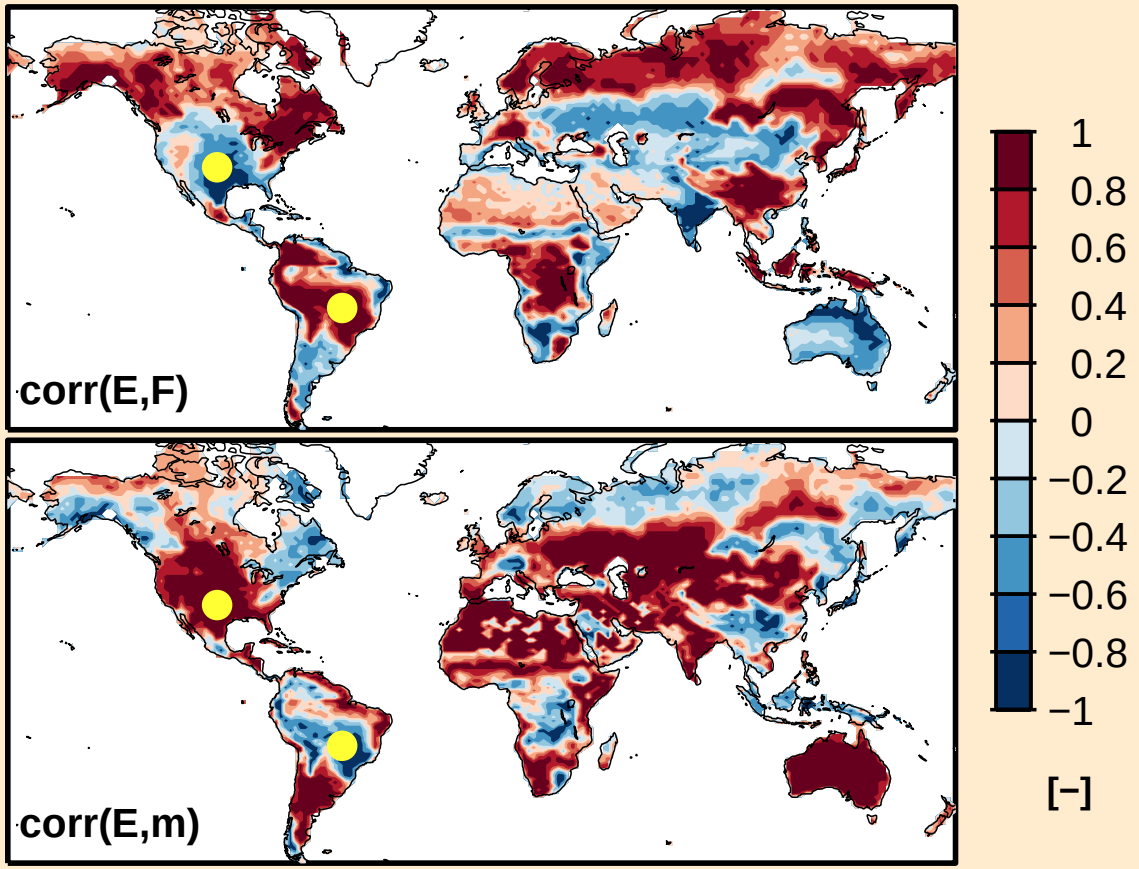


(HadGEM1 data)

Correlations involving Evapotranspiration (1/2)

How can E decrease when F , m increase ?

E with F , m



(HadGEM1 data)

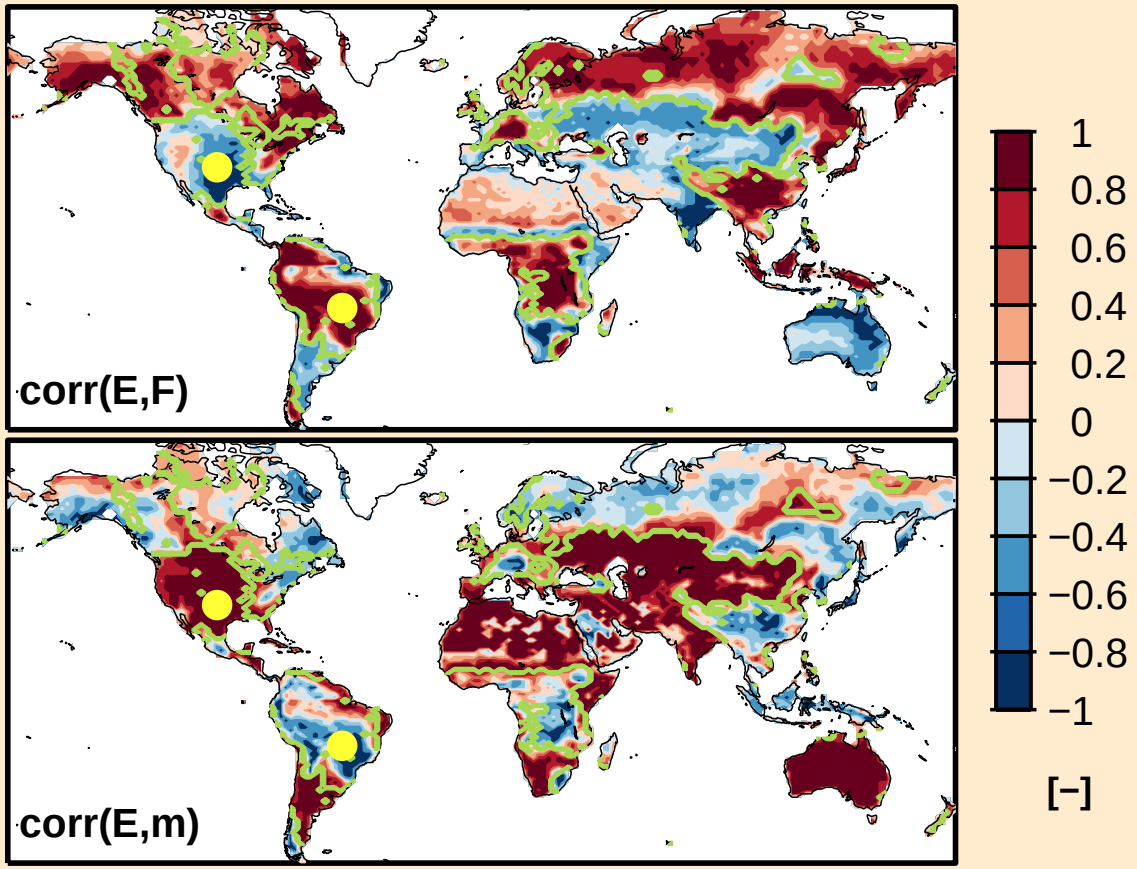
Correlations involving Evapotranspiration (1/2)

How can E decrease when F, m increase ?

Dry soils
($\overline{m}$ < global mean)
$\Longleftrightarrow$
Moisture-limited
$(\mathrm{corr}(E, m) > 0)$

Wet soils
($\overline{m}$ > global mean)
$\Longleftrightarrow$
Energy-limited
$(\mathrm{corr}(E, F) > 0)$

E with F, m
$\overline{m}$ = global mean value



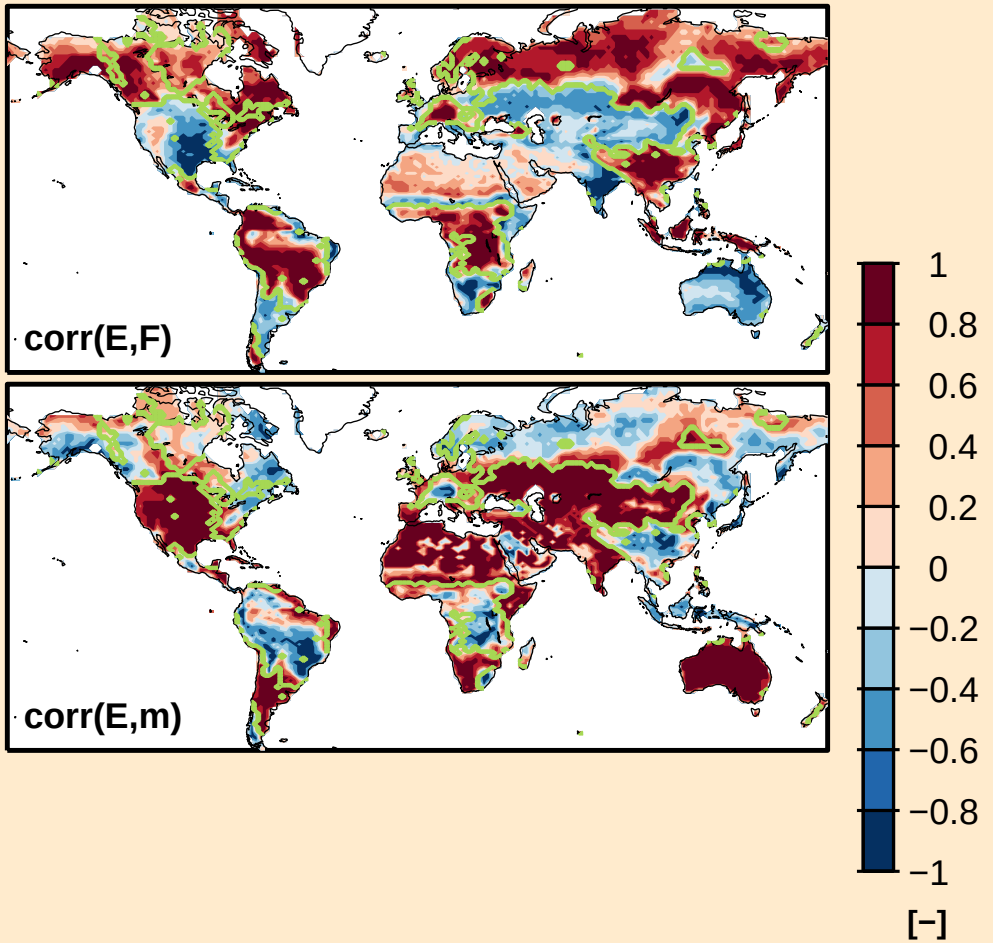
(HadGEM1 data)

Correlations involving Evapotranspiration (2/2)

- Decompose radiation forcing anomalies into **non-precipitating** and **precipitating** components:

$$F' = F'_0 - L\alpha P' \qquad (2)$$

where $\langle F'_0, P' \rangle \equiv 0$,
$\alpha > 0$ (unitless)



(HadGEM1 data)

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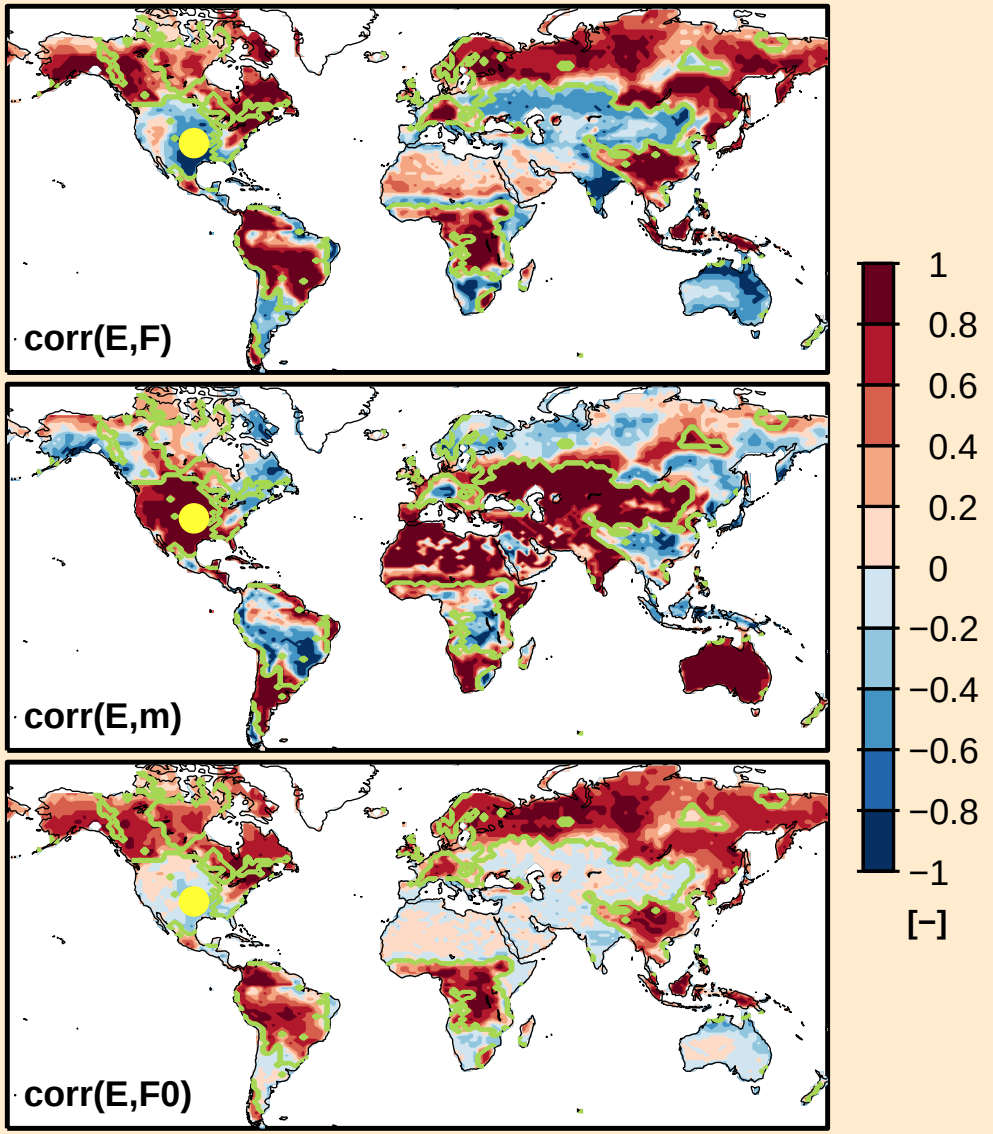

(HadGEM1 data)

Correlations involving Evapotranspiration (2/2)

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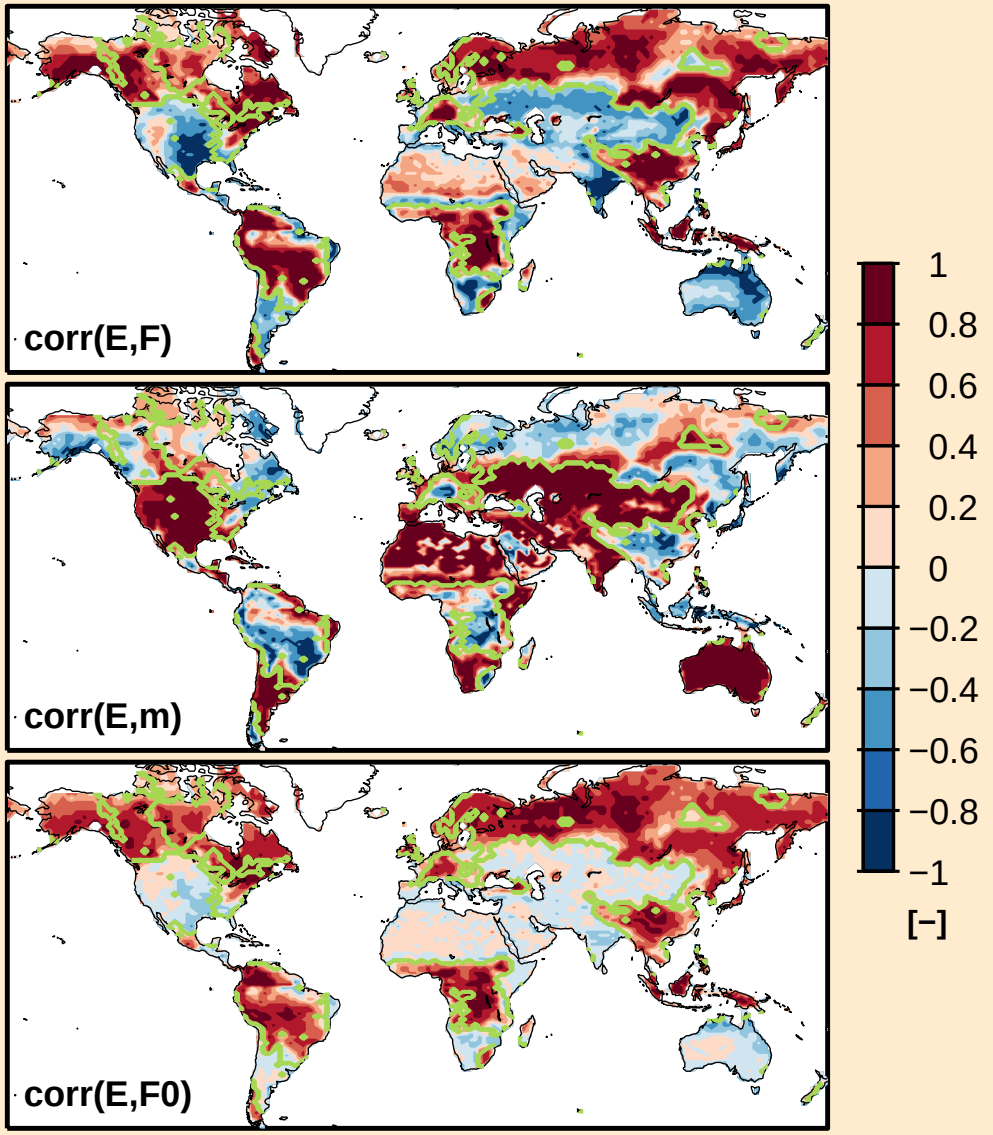
where $\langle F'_0, P' \rangle \equiv 0$,
$\alpha > 0$ (unitless)

- **Over dry soils:** $F' > 0$
  $\Longleftrightarrow$ **moisture deficit**
- **Over wet soils:** $m' > 0$
  $\Longleftrightarrow$ **energy deficit**



(HadGEM1 data)