Interpreting the Toy Model

Toy model expresses $\mathrm{Var}(T) = \mathcal{F}\big(\mathrm{Var}(F_0), \mathrm{Var}(P),$ toy model coeffs.$\big)$

- **Q:** Do the toy model coeffs. show dependence on mean-state variables ?

- **Q:** What are the relative contributions of $\mathrm{Var}(F_0)$ and $\mathrm{Var}(P)$ to $\mathrm{Var}(T)$?

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- **Q:** Do the toy model coeffs. show dependence on mean-state variables ? **Not today!**
- **Q:** What are the relative contributions of $\mathrm{Var}(F_0)$ and $\mathrm{Var}(P)$ to $\mathrm{Var}(T)$? **Not today!**
- **Q:** **What is the role of soil moisture (mean-state and anomalies) on $\mathrm{Var}(T)$?**

Role of the land surface on surface temperature variability

- Start from the toy model expression for $\mathrm{Var}(T)$:

$$\mathrm{Var}(\widehat{T}_{tm}) = \frac{1}{\gamma^2}\left[\left(1-\lambda(1-\chi)\right)^2 \mathrm{Var}(F_0) + L^2\left(\alpha(1-\lambda)+\chi(1+\alpha\lambda-\beta)\right)^2 \mathrm{Var}(P)\right]$$

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  λ (evapotranspiration efficiency)

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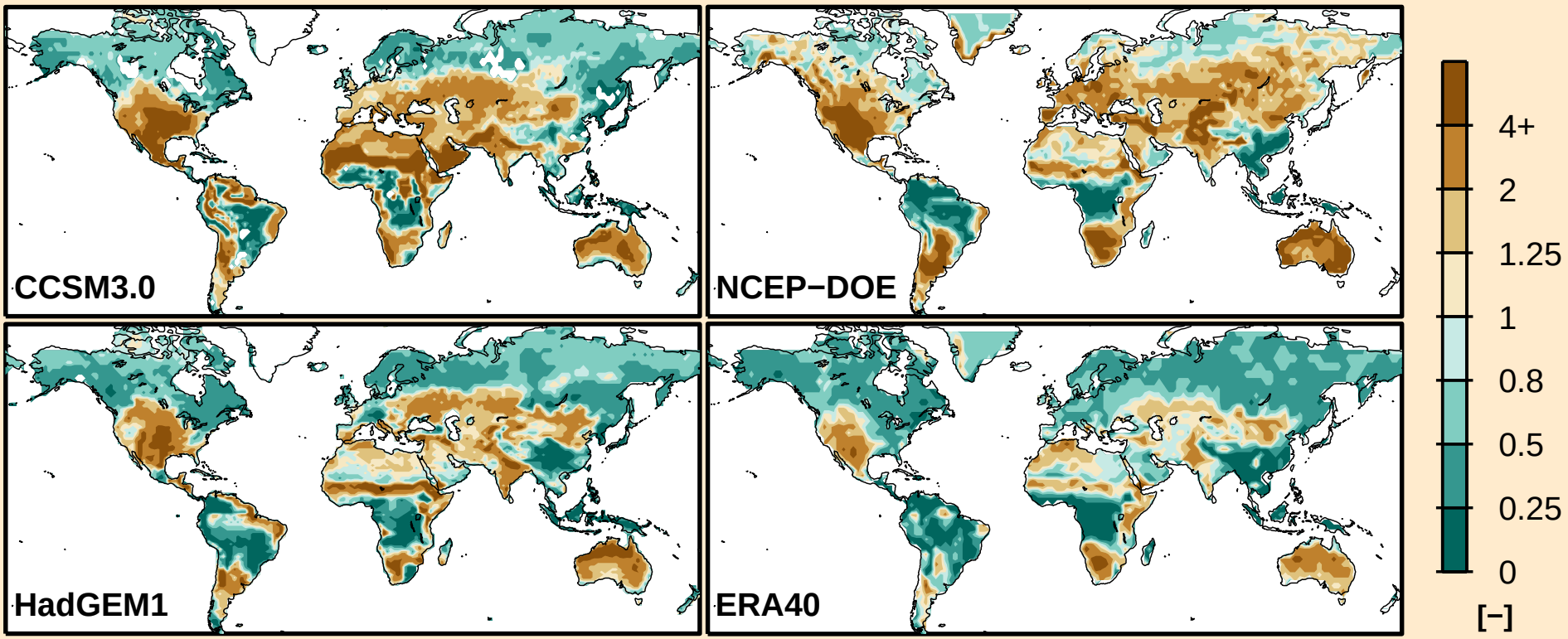
- **Define** $\dfrac{\gamma^2\,\mathrm{Var}(T)}{\mathrm{Var}(F)}$ **the surface temperature response**

Two regimes of surface temperature variability

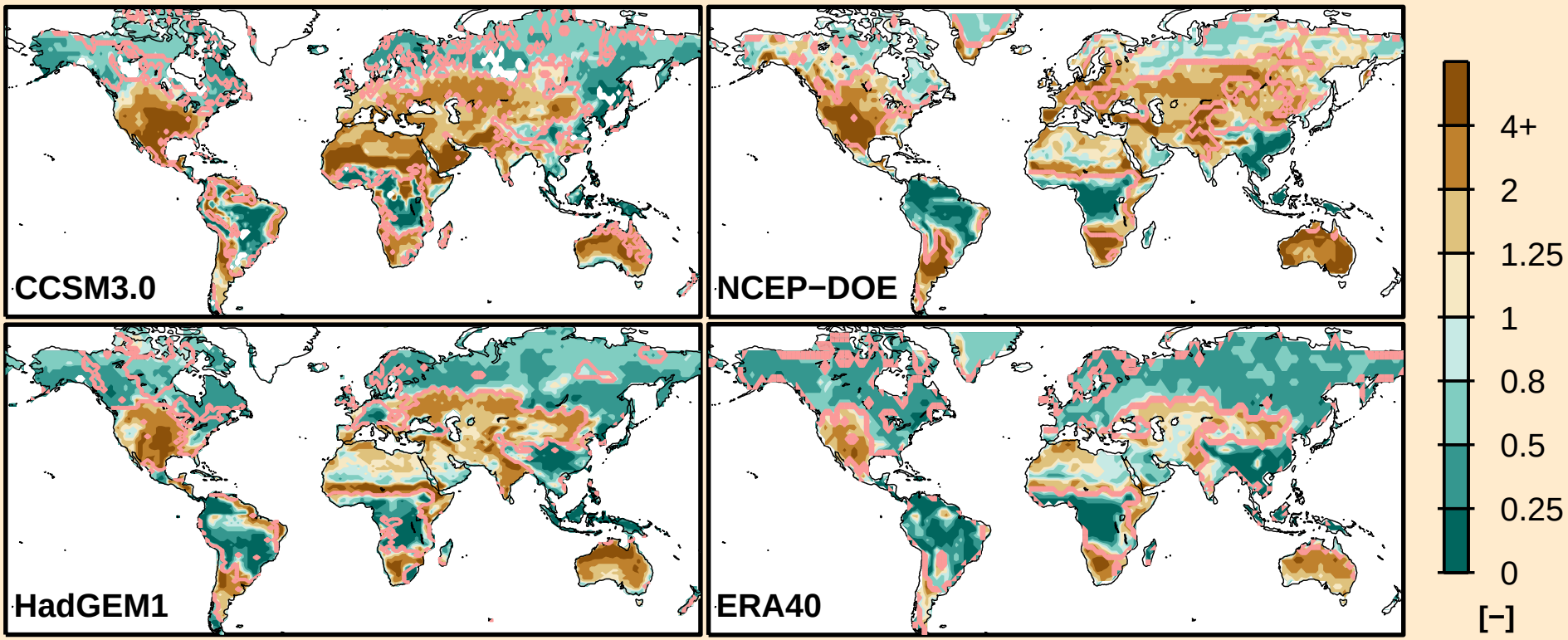
Temperature response $\gamma^2 \mathrm{Var}(T) / \mathrm{Var}(F)$



The land surface is able to
amplify and **damp**
surface temperature variability

Two regimes of surface temperature variability

Temperature response $\gamma^2 \mathrm{Var}(T)/\mathrm{Var}(F)$

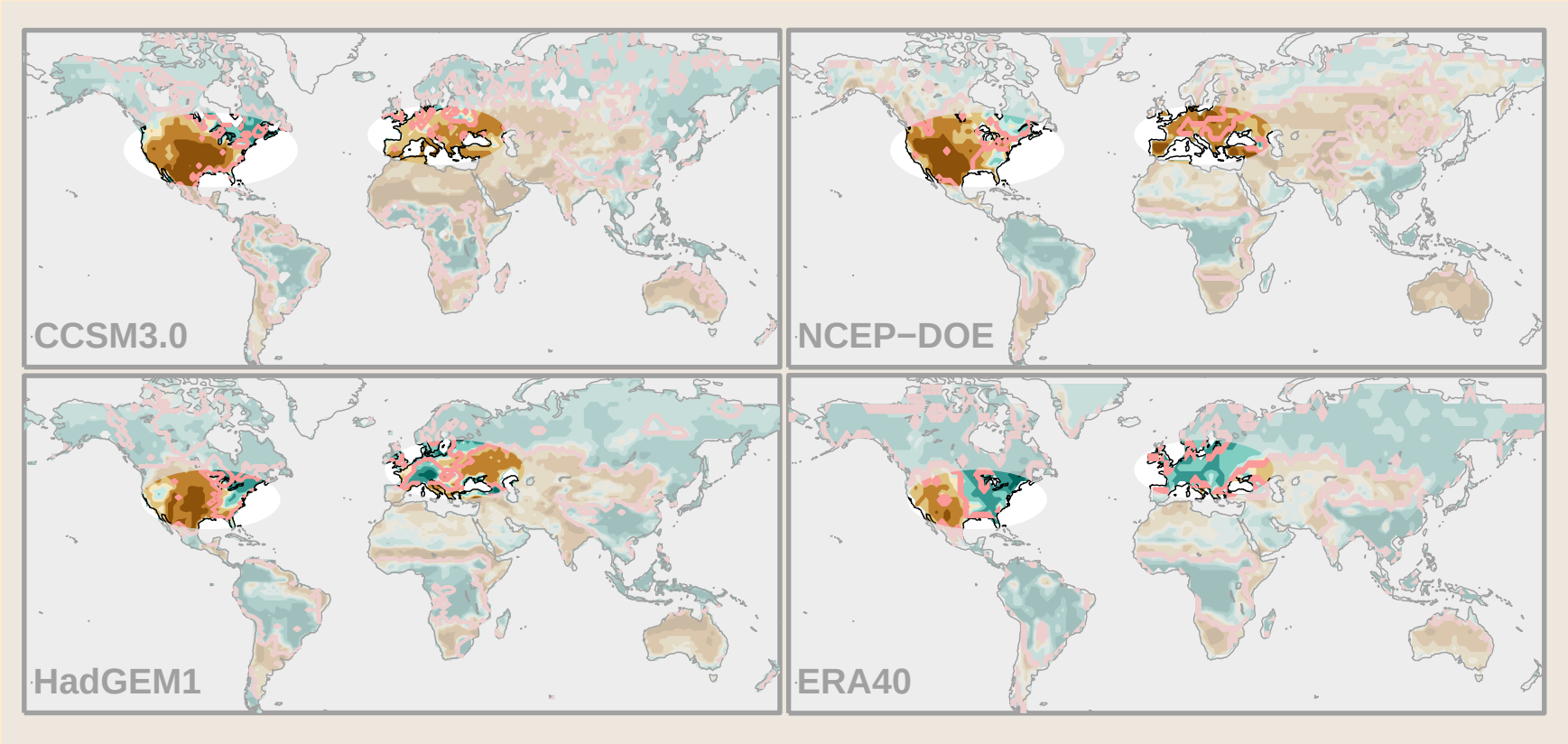


Superpose with global mean soil moisture:

Dry soils amplify $\mathrm{Var}(T)$**,**
Wet soils damp $\mathrm{Var}(T)$

Two regimes of surface temperature variability

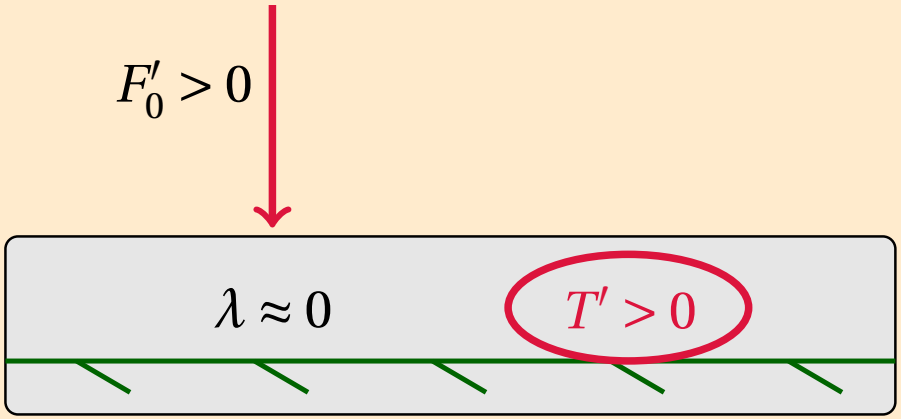
Temperature response $\gamma^2 \mathrm{Var}(T) / \mathrm{Var}(F)$



- GCMs and reanalyses do NOT agree in regions of $\mathrm{Var}(T)$ errors

Land-surface amplified regime

- λ : evapotranspiration efficiency
- χ : coupling coefficient (modulates net effect of m' on T')



- Non-precipitating F' are unattenuated by land surface

Land-surface amplified regime

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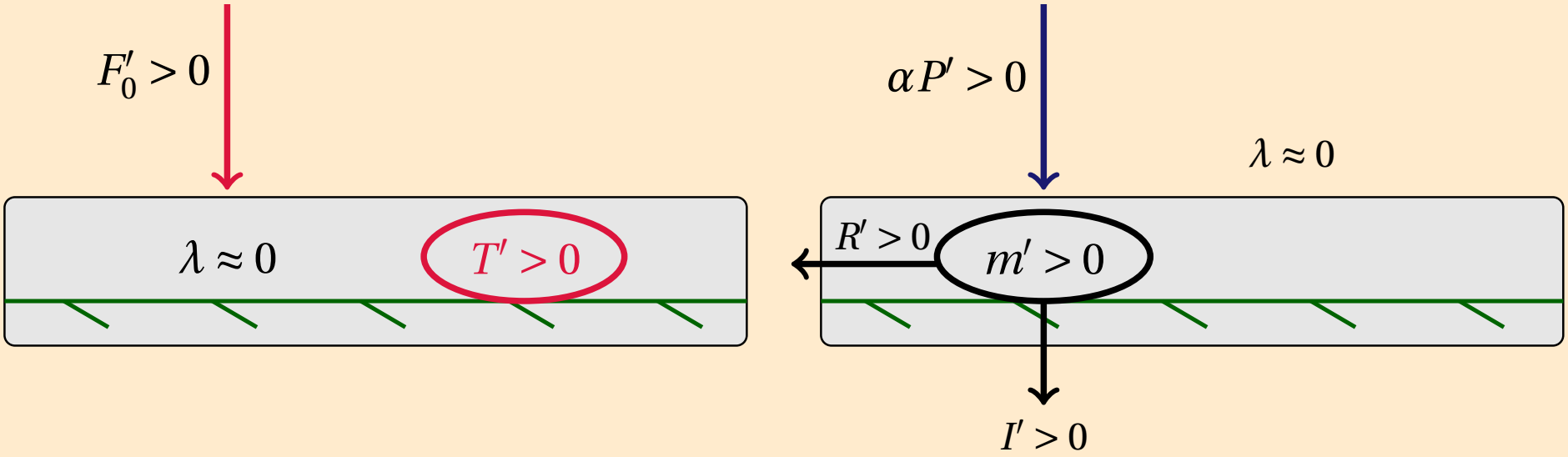

- Radiative effects of P' on E' are negligible

Land-surface amplified regime

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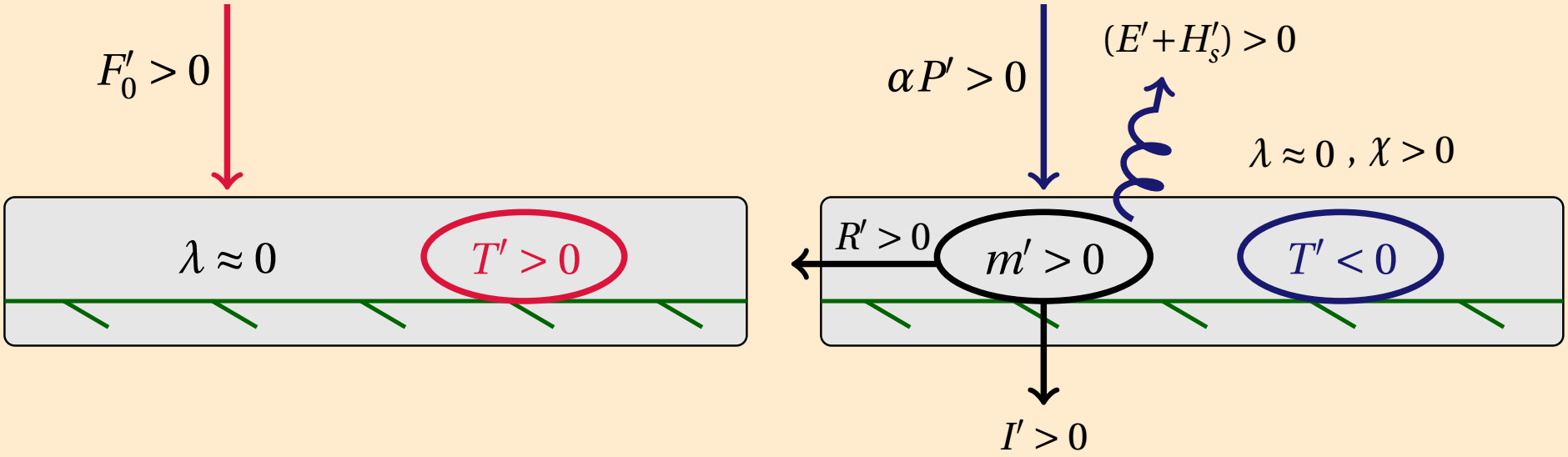

Soil moisture anomalies modify E' and H_s'.

Radiative effects of P' on T' are amplified by land surface

Land-surface damped regime

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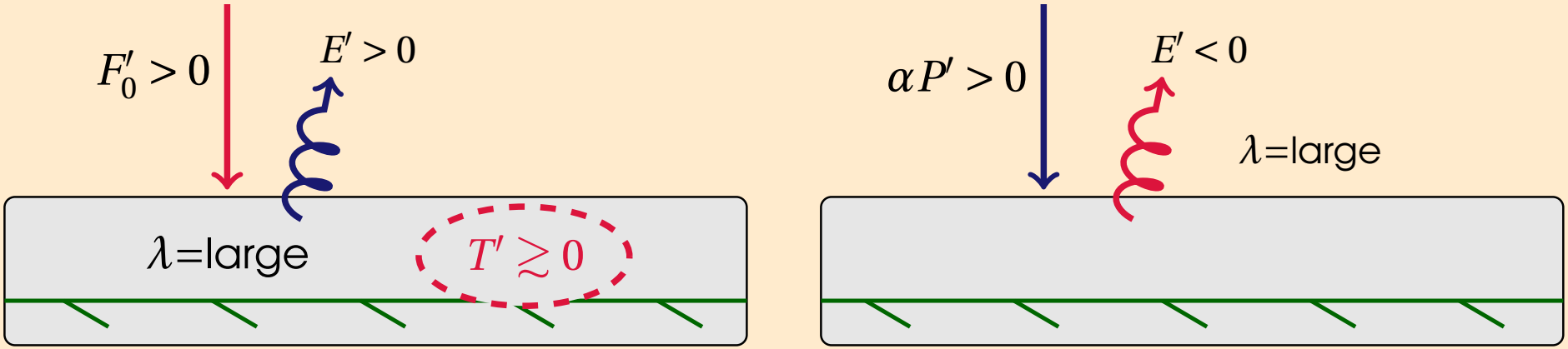
- χ : coupling coefficient (modulates net effect of m' on T')



- Radiation anomalies spawn E anomaly, opposing F_0' and $\alpha P'$

Land-surface damped regime

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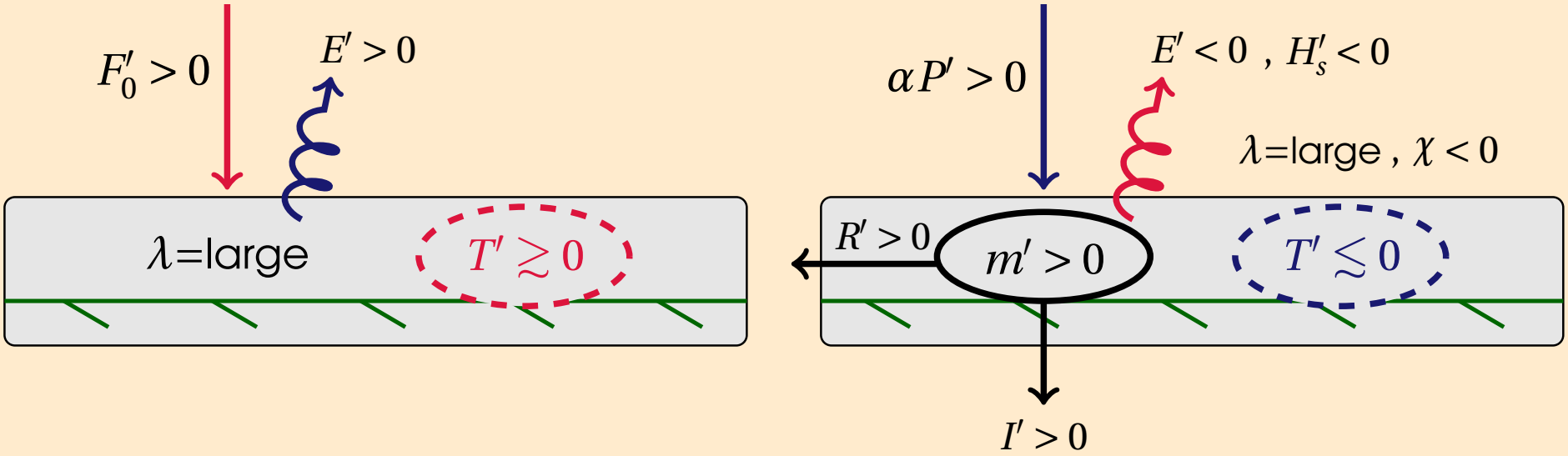
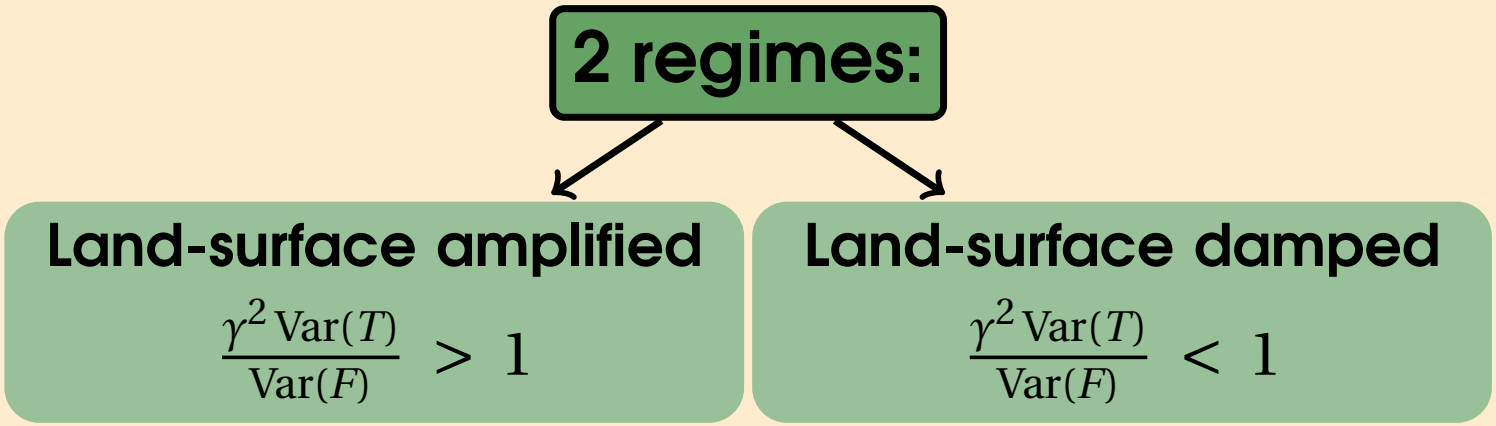


Soil moisture anomalies modify sensible heat flux

Radiative effects of P' on T' are damped by land surface

Surface temperature variability is regime dependent



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