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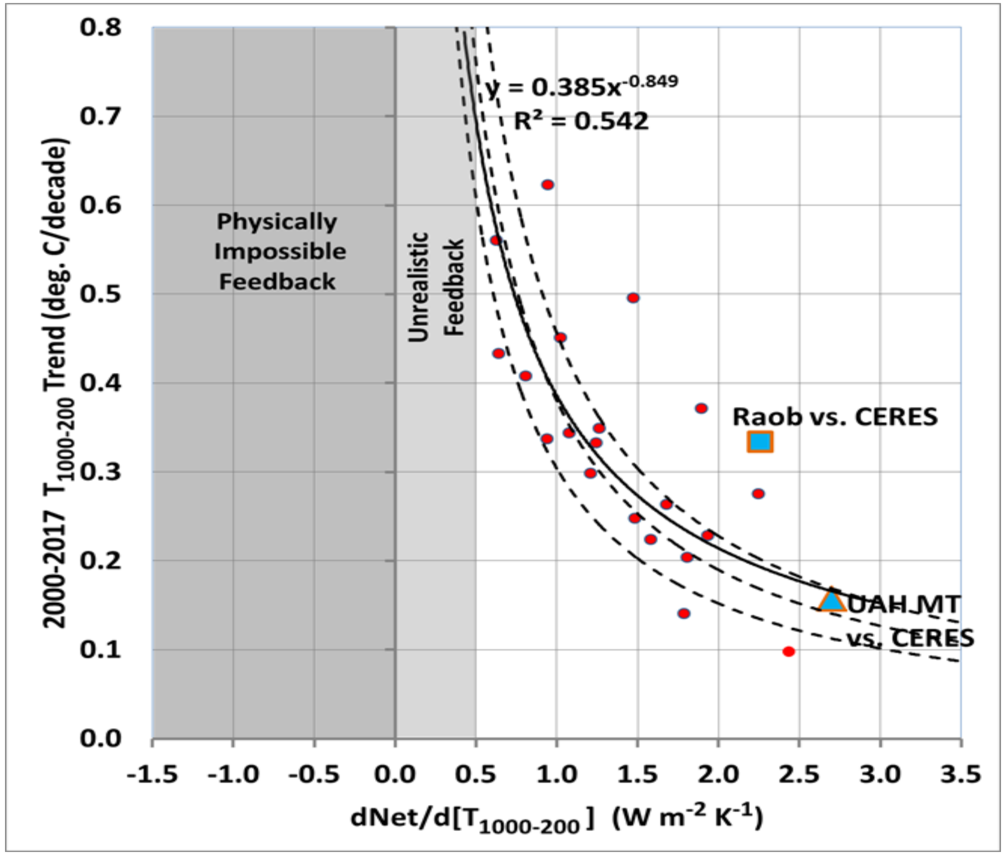
Estimates of Climate Feedback Parameter

λ = Δ energy flux per ΔK



Obs : Ceres vs. Radiosonde/Satellite Tropospheric layer temperature (most of flux leaves from troposphere, not surface)

Strong relationship between bulk trend and λ. Empirical estimate is 2.3 to 2.7, models 0.6 to 2.4 (CMIP5). Empirical result shows small positive feedback vs. neutral result.

Note: Raob trend since 2000 includes spurious warm shift of Vaisala RS92 sondes in ~2010 due to software change.

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Bulk Atmosphere Temperature Trend as an Emergent Constraint for ECS

Direct relationship between Tropospheric and Surface temperature qualifies as a candidate for Emergent Constraint. Right: 38 CMIP6 Models and Obs for ECS vs. Emergent Constraint (McKitrick and Christy 2020)

Empirical evidence suggests ECS is between 1.1 and 1.8 K (red oval) while models show two clusters of 2.8 and 4.7 K

Christy and McNider (2017) found empirical TCR (Tropospheric) to be +1.1 ±0.3 K with model mean +2.3 K.

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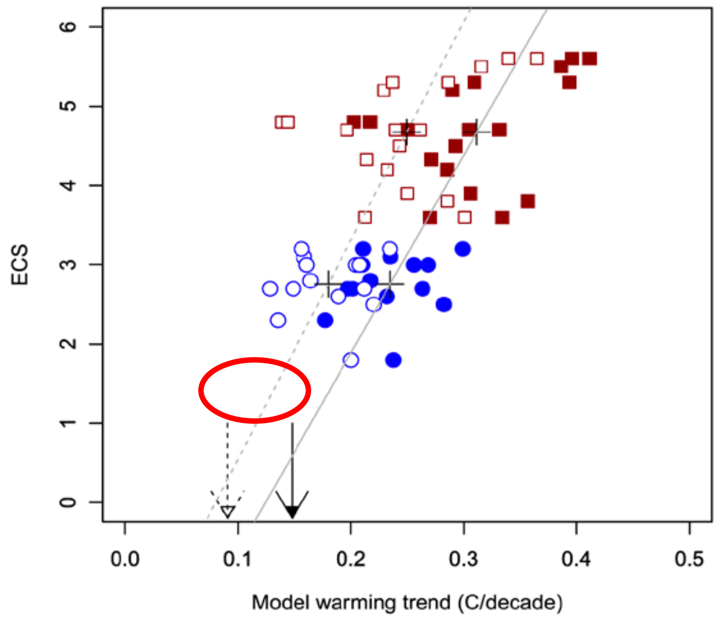

Figure 4. Model ECS values plotted against model warming trends. Red squares = high ECS group, blue circles = low-ECS group. Open shape = MT trend, closed shape = LT trend. Inverted triangles = mean observed LT trend (solid), mean observed MT trend (open).

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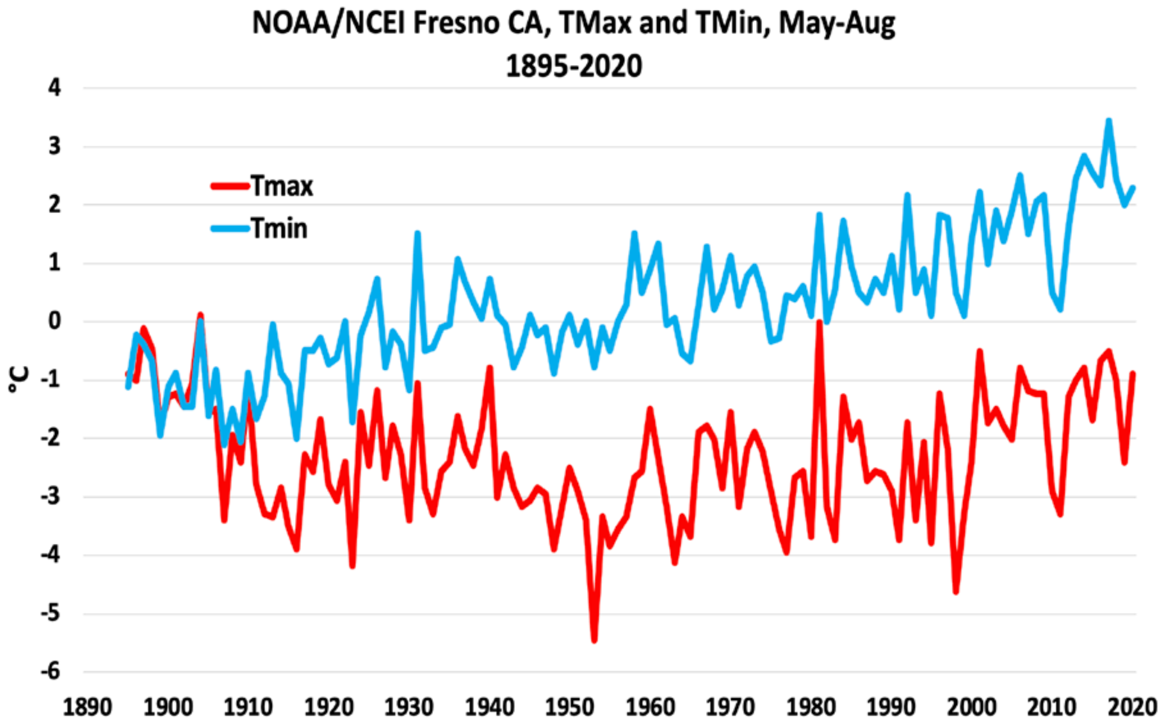
Climate Metric 1 Global *near-surface-air* temperature dataset

***UAH-**NMAT over ocean (Junod and Christy 2019), **UAH-**TMax over land (under construction)*

“Average” land surface temperature (TMax+TMin)/2 is a contaminated metric due to TMin being measured in the nocturnal boundary layer which is highly susceptible to disturbance – see right for station in California

Project is building a surface temperature dataset (NMAT+Tmax) to better represent the surface impacts of the greenhouse effect



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Climate Metric 2 Long-term Pacific Coast Snowfall Dataset

CA completed through 2020, **OR-WA** completed through 2019 (painstaking task)

High variability (r1 = 0) implies sensitivity to random Pacific Ocean pressure patterns?

Are these patterns sensitive to change with further warming?