Measuring the differences between climate model land surface simulations and FLUXNET observations

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University of Washington: Ben Buchovecky, Abigail Swann, Claire Zarakas.

University of Exeter: Monisha Natchiar.

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and Gab Abramowitz and Ben Booth for help with data.

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- Instead,
  - Write $Y = X\beta$, where β are regression coefficients.
  - Do PCA of $X\beta$.
  - Examine $Q = P\gamma$, where Q and P are the weights of the eigenvectors of the covariance matrices of Y and X and γ are the rotated β.

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Note – this is not how you actually do the calculations [2].

The problem

Take data from Monthly mean 30° N – S FLUXNET observations [3], and model output from AMIP, a CESM2 land surface PPE [4] and a HadCM3 land surface PPE [1].

Define Outputs, Y, as upward LH and SH, and surface temperature.

and Inputs, X, as downward shortwave and longwave radiative fluxes, near surface relative humidity and precipitation.

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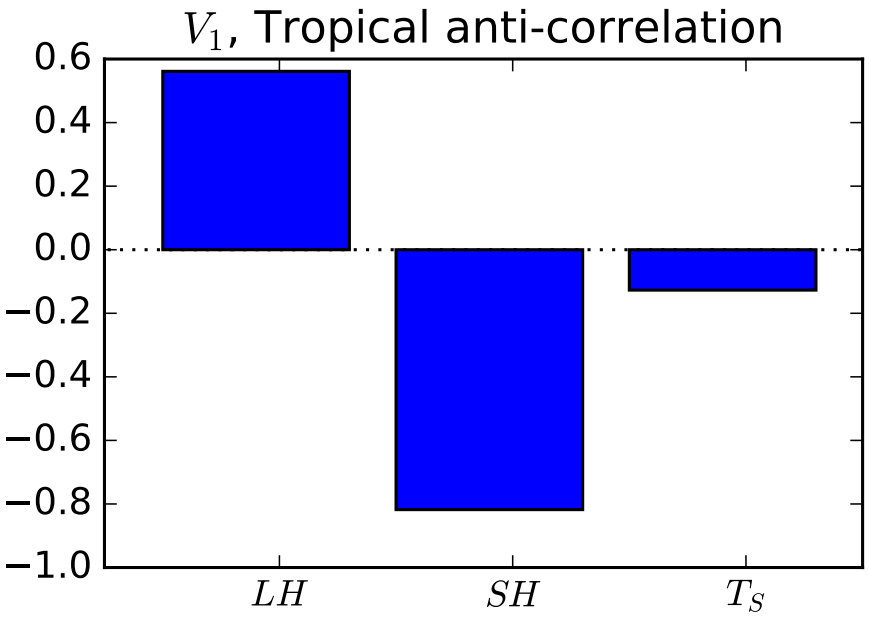
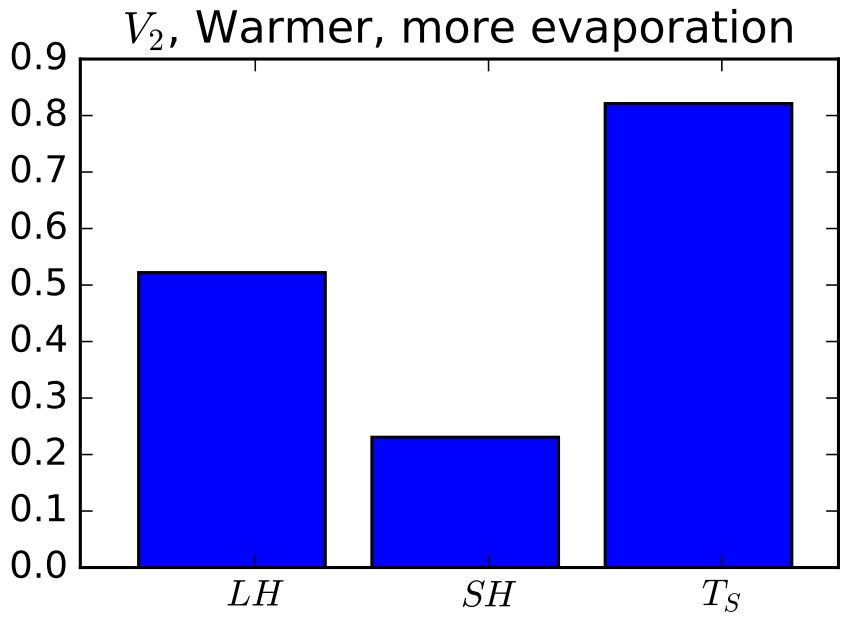
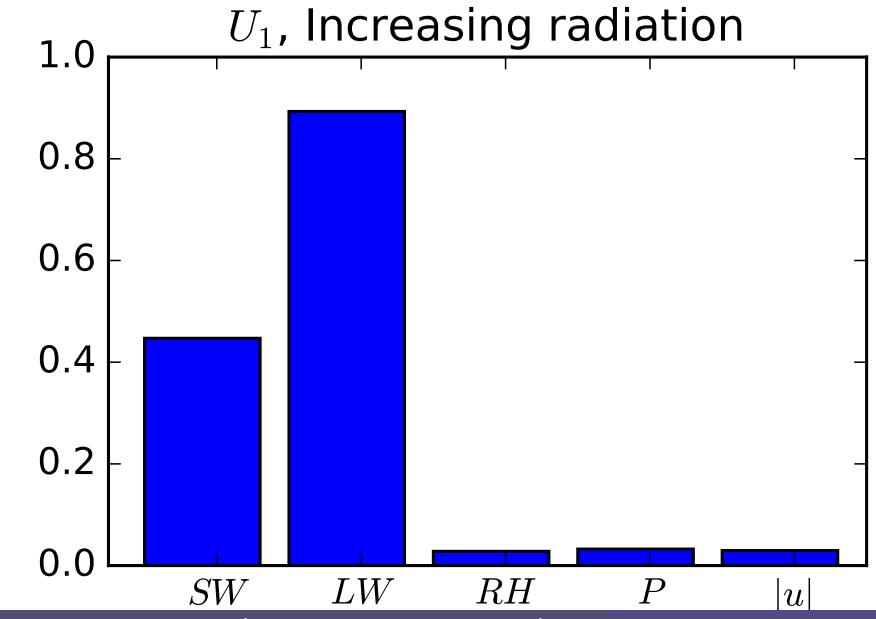
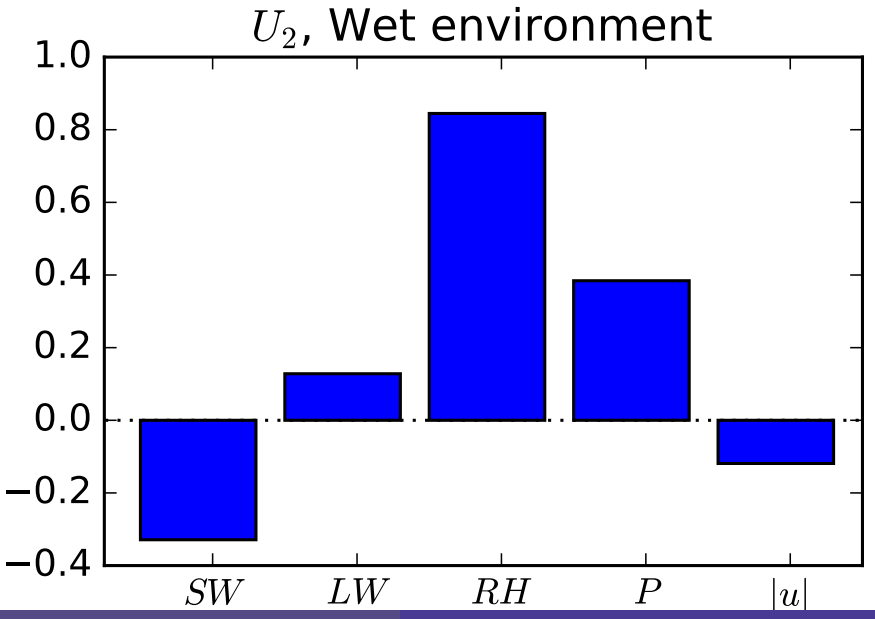
This is a compromise between accuracy and achievability...

FLUXNET basis

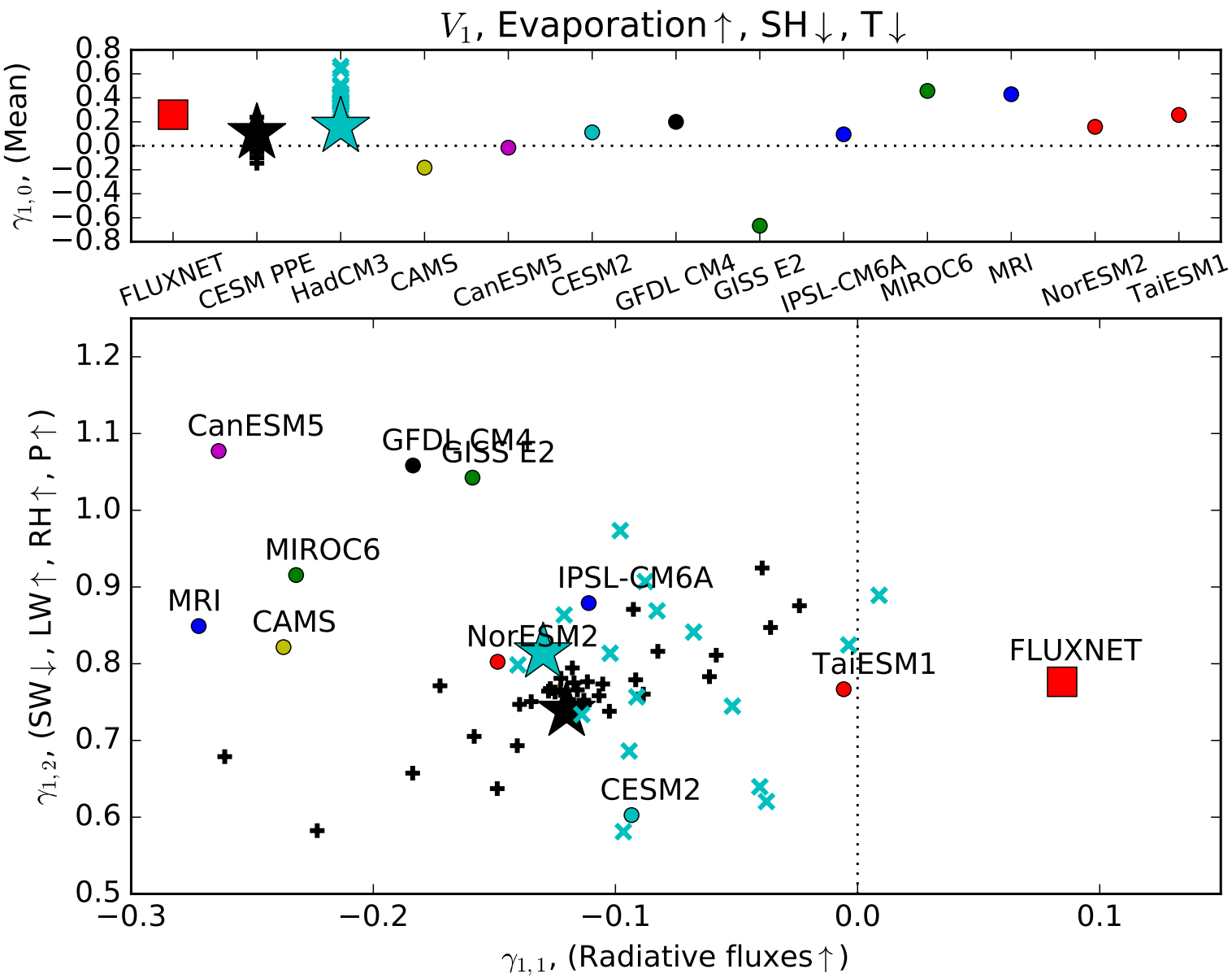




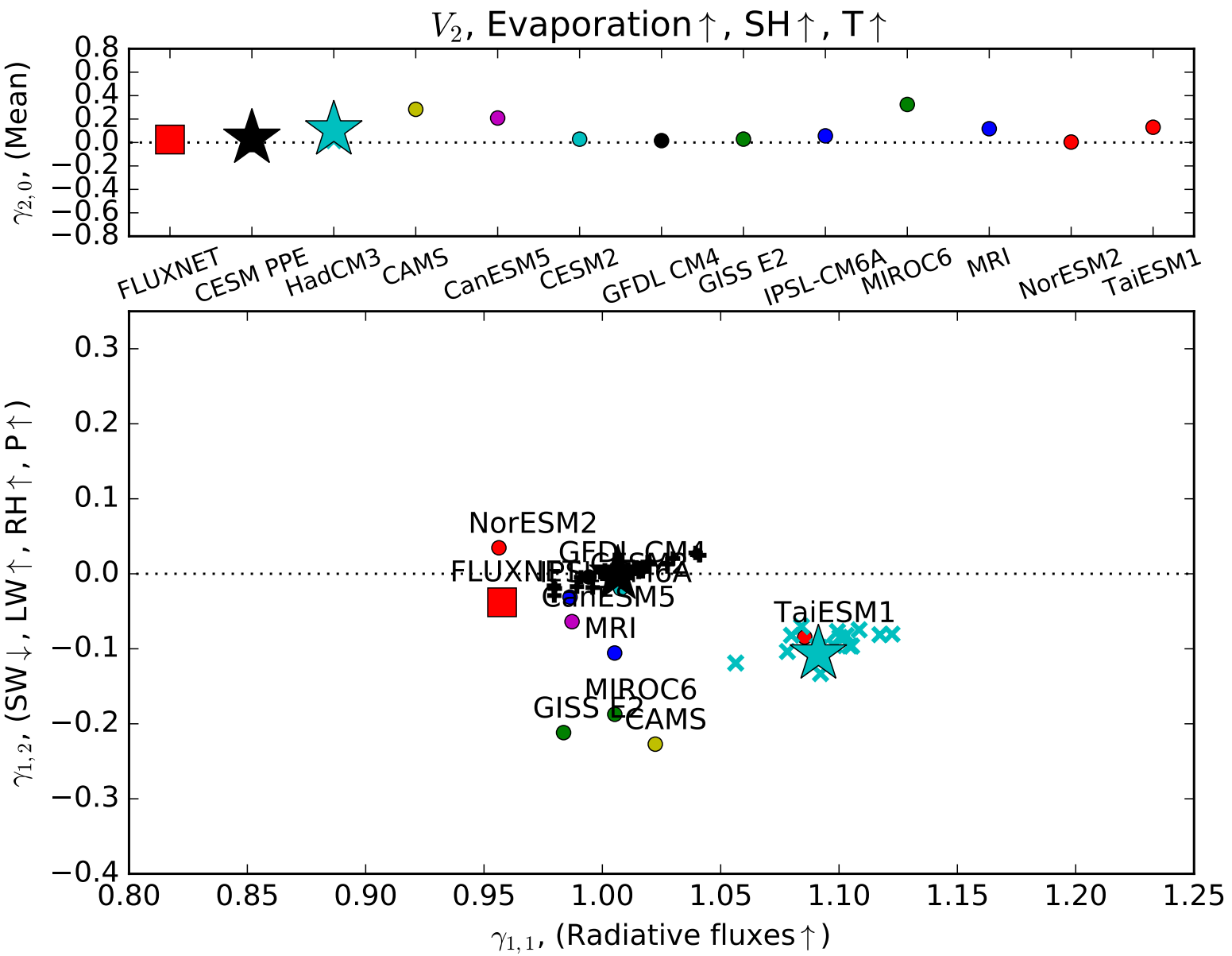




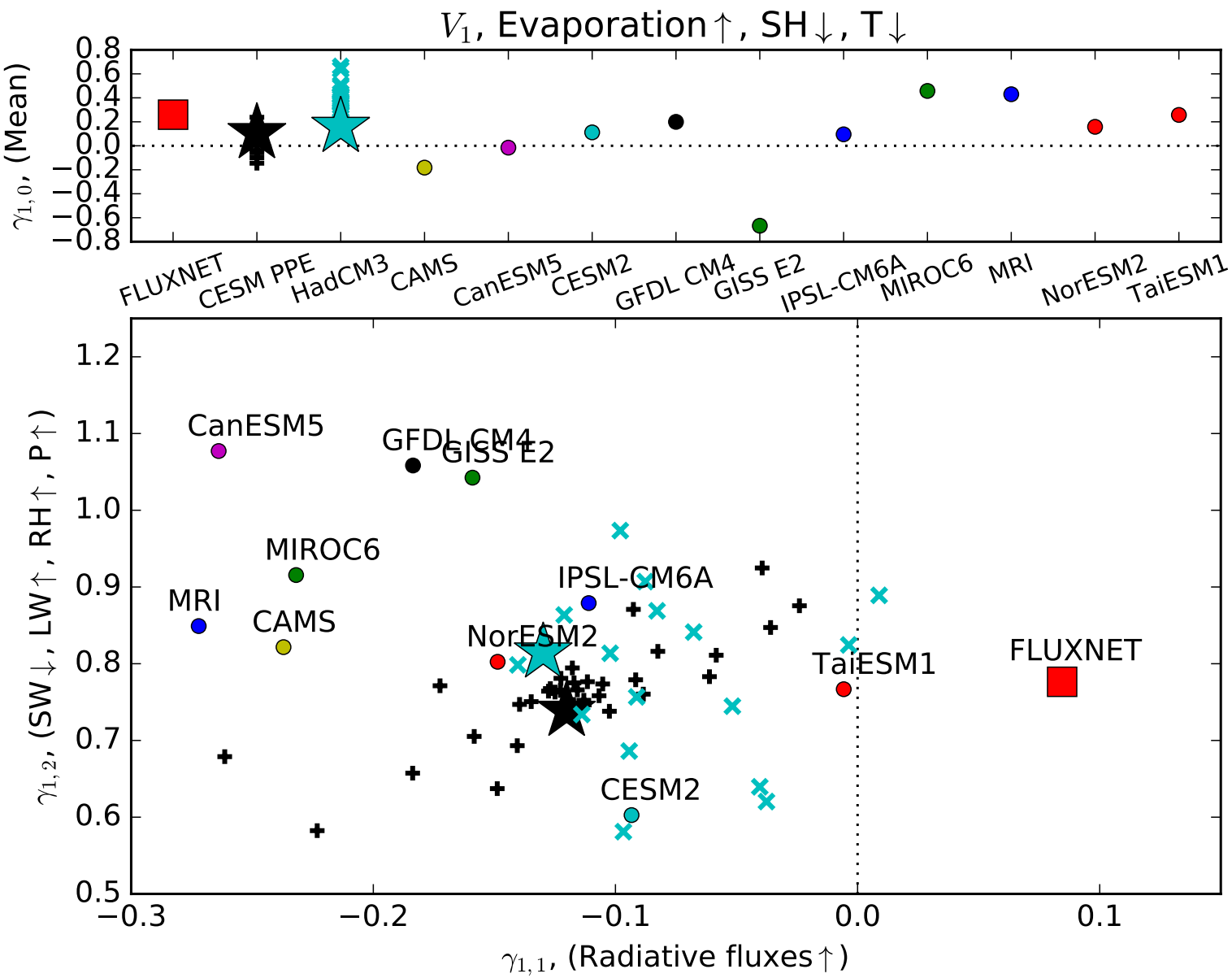
V_1 comparison in FLUXNET basis



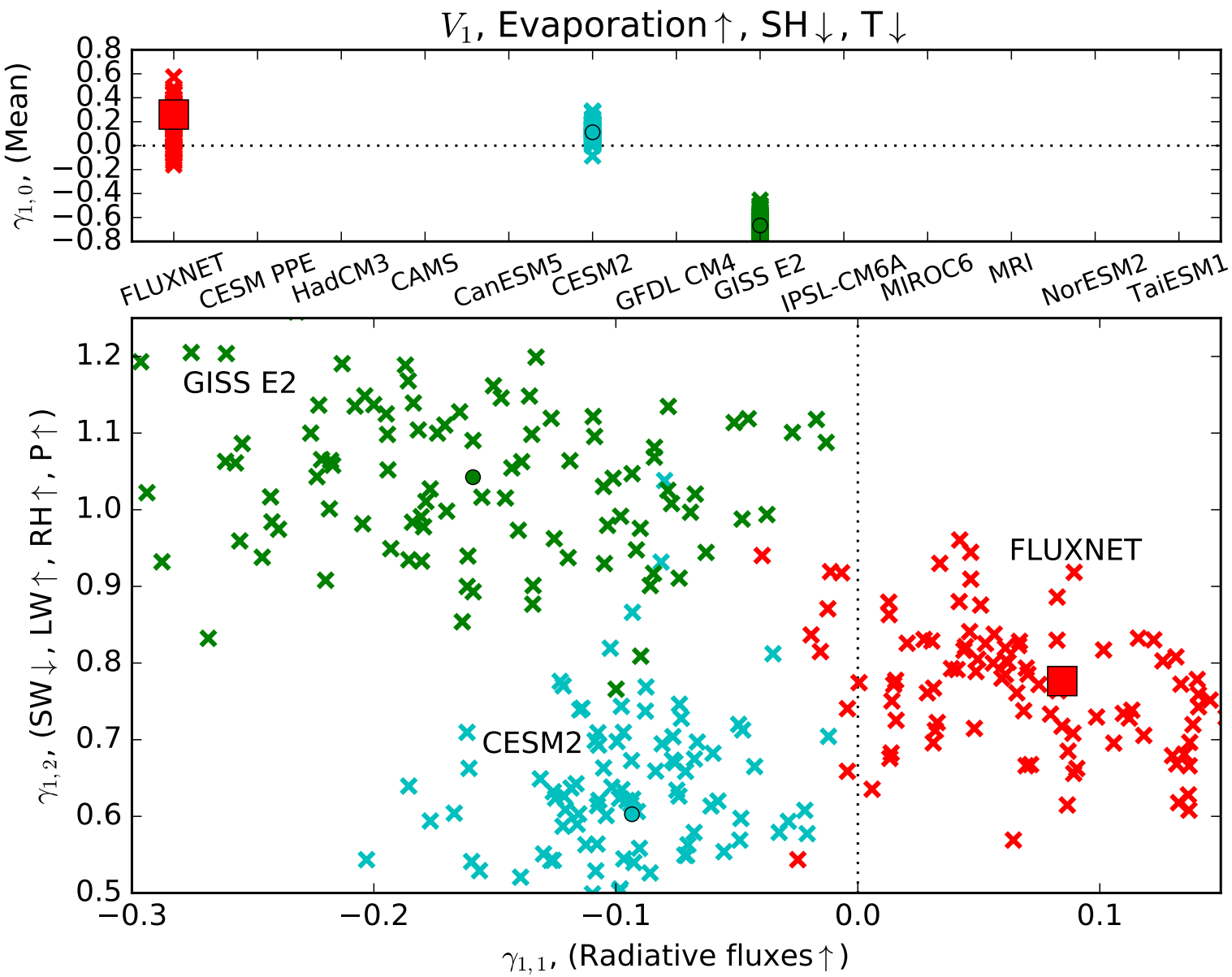
V_2 comparison in FLUXNET basis



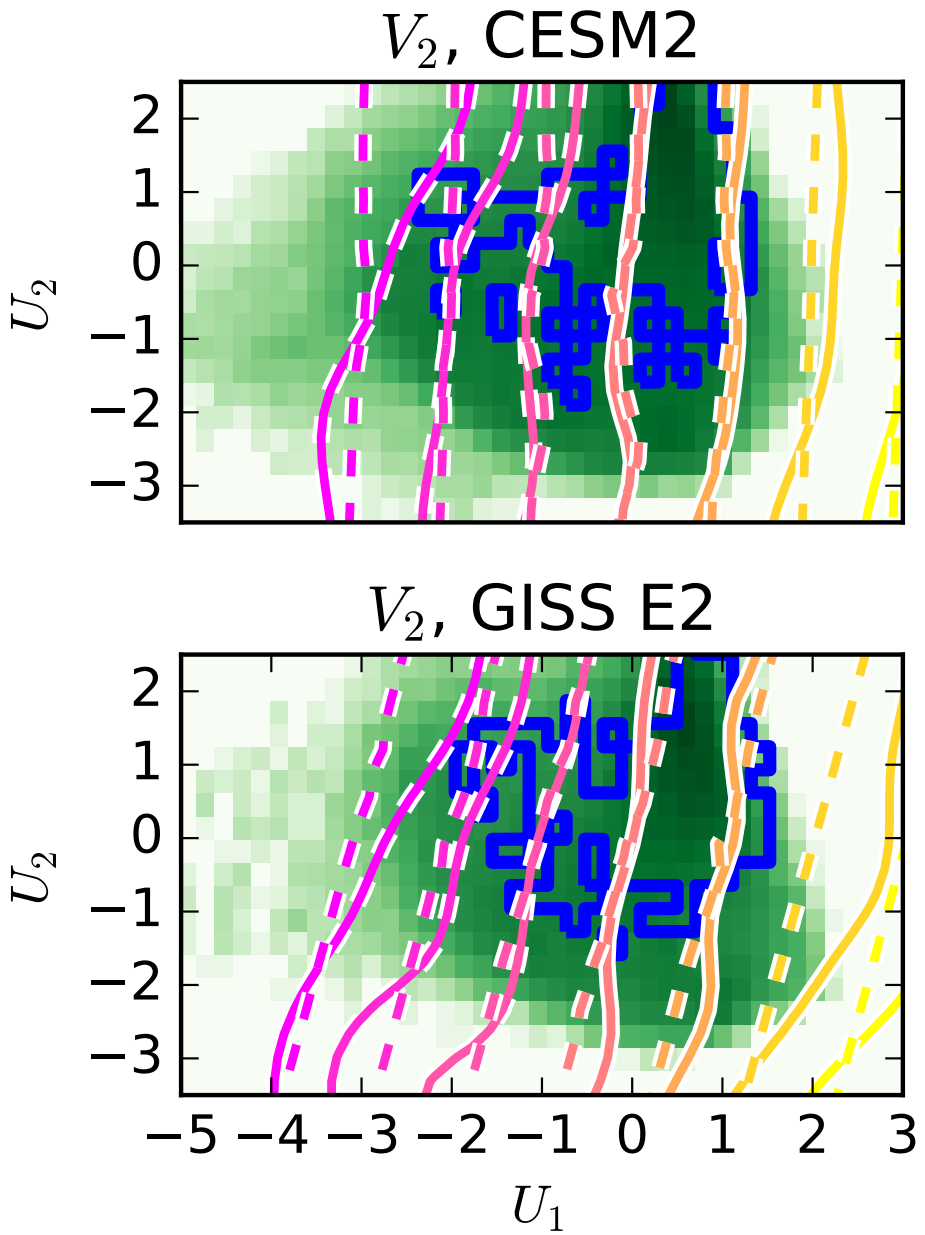
V_1 comparison in FLUXNET basis



V_1 sampling half the sites



What about non-linear models? Start with V_2...



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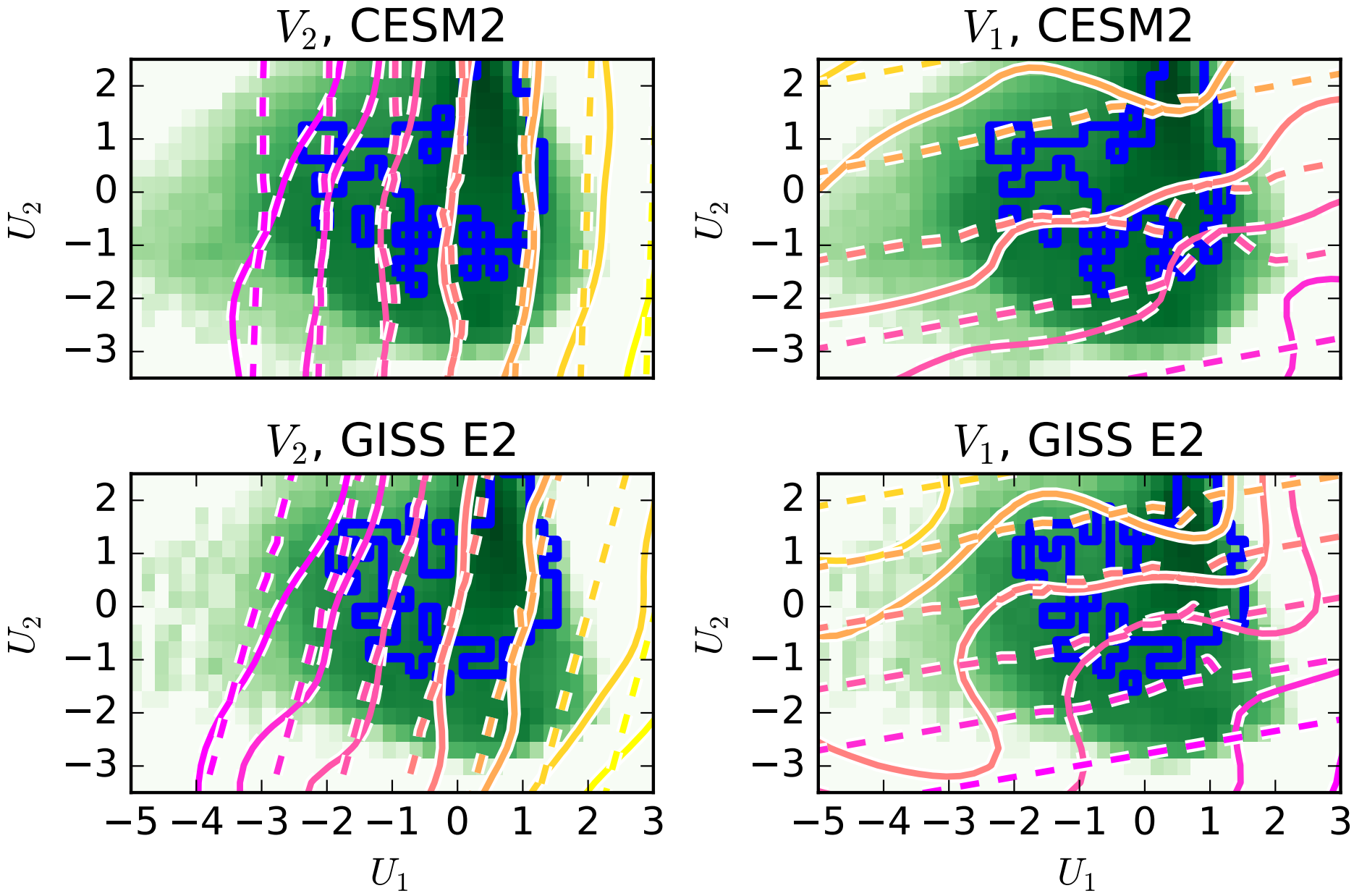
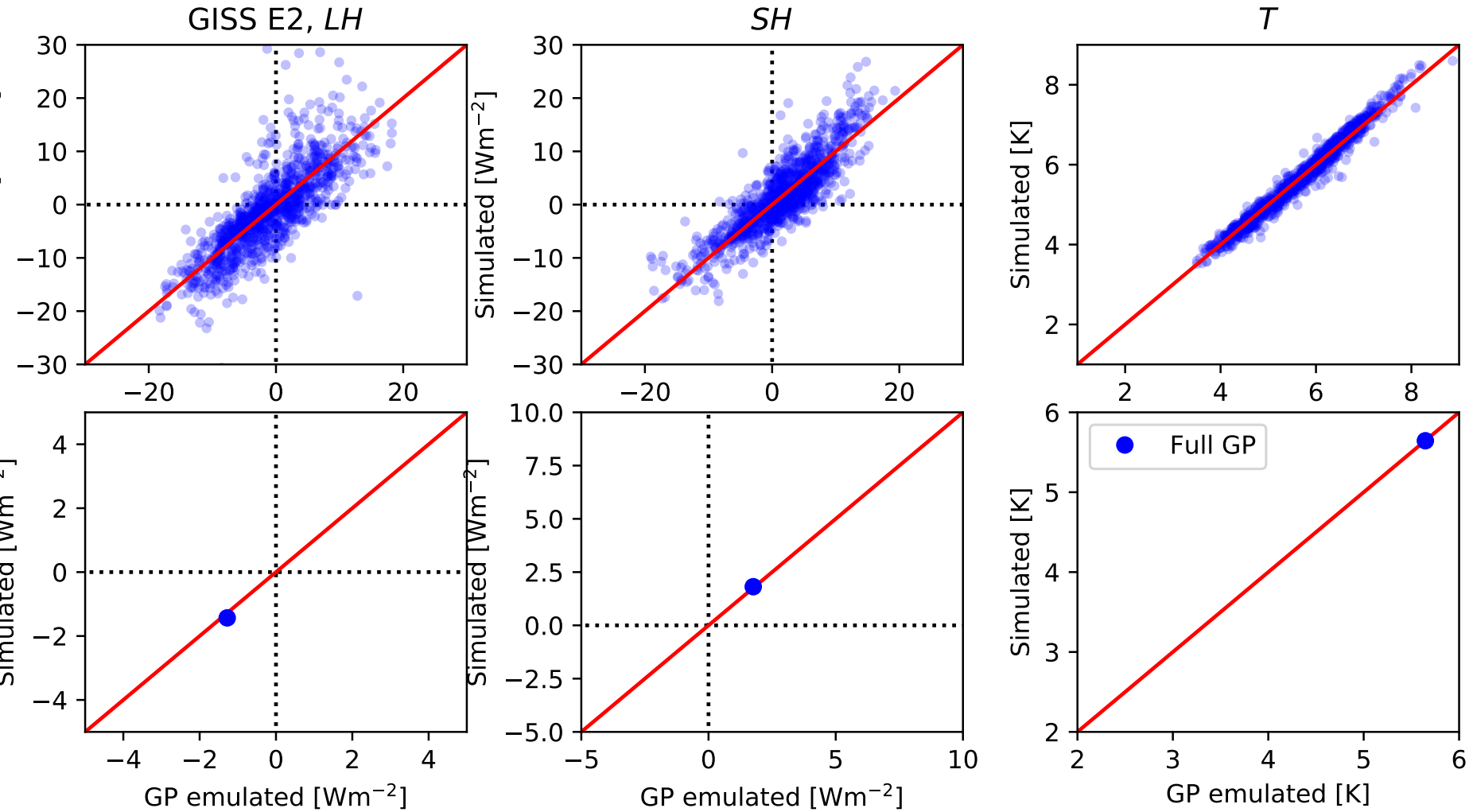
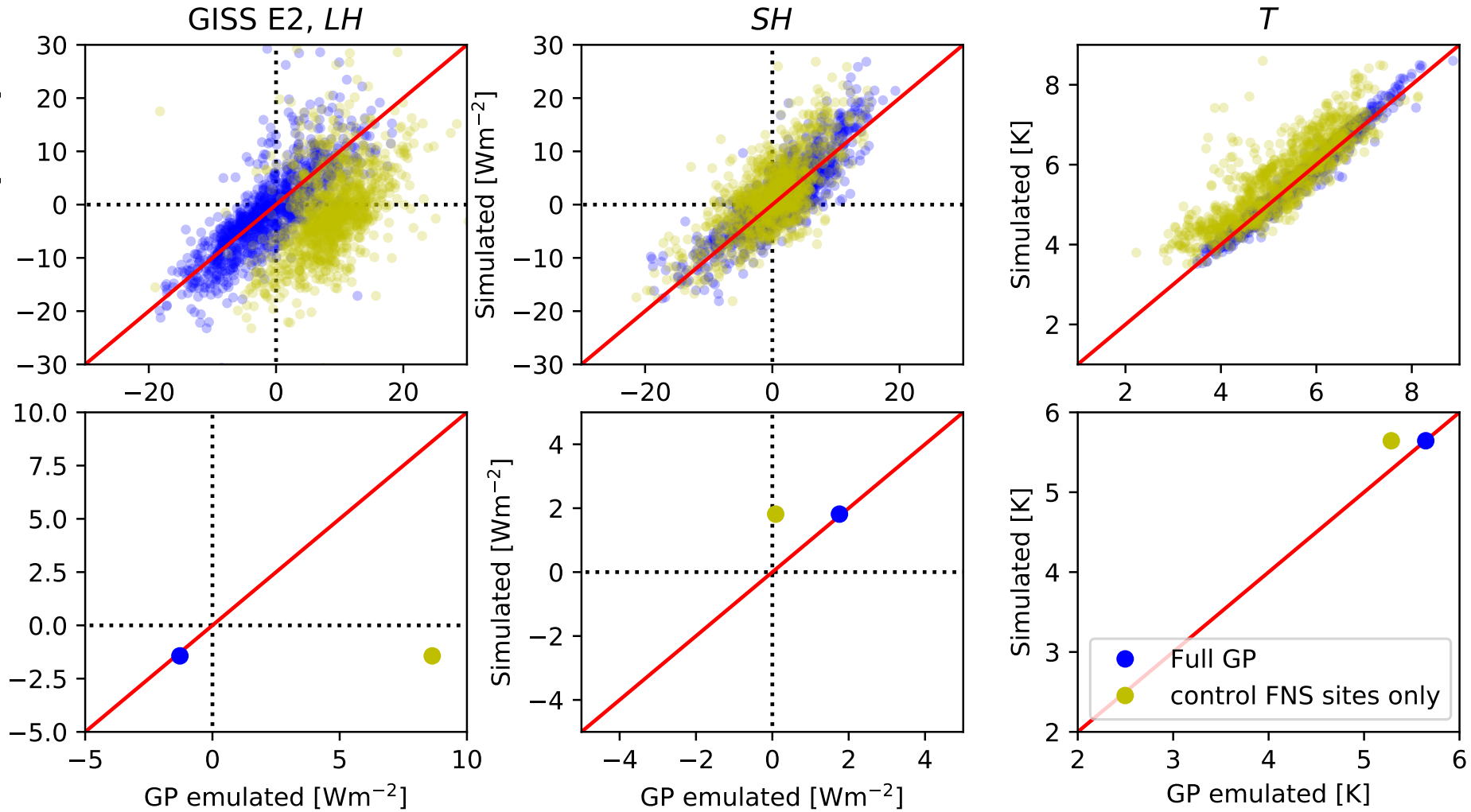


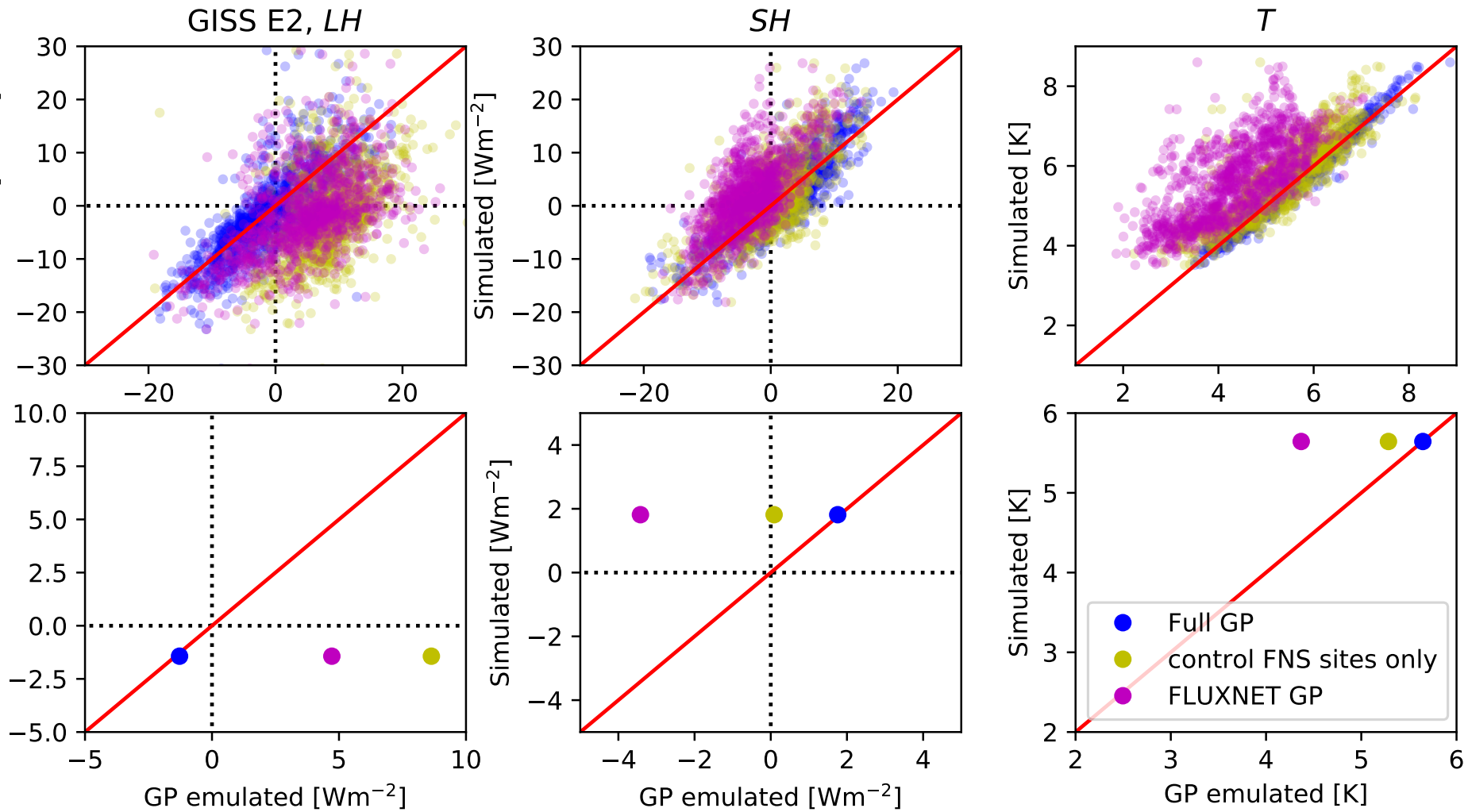
GISS E2 climate change (1)



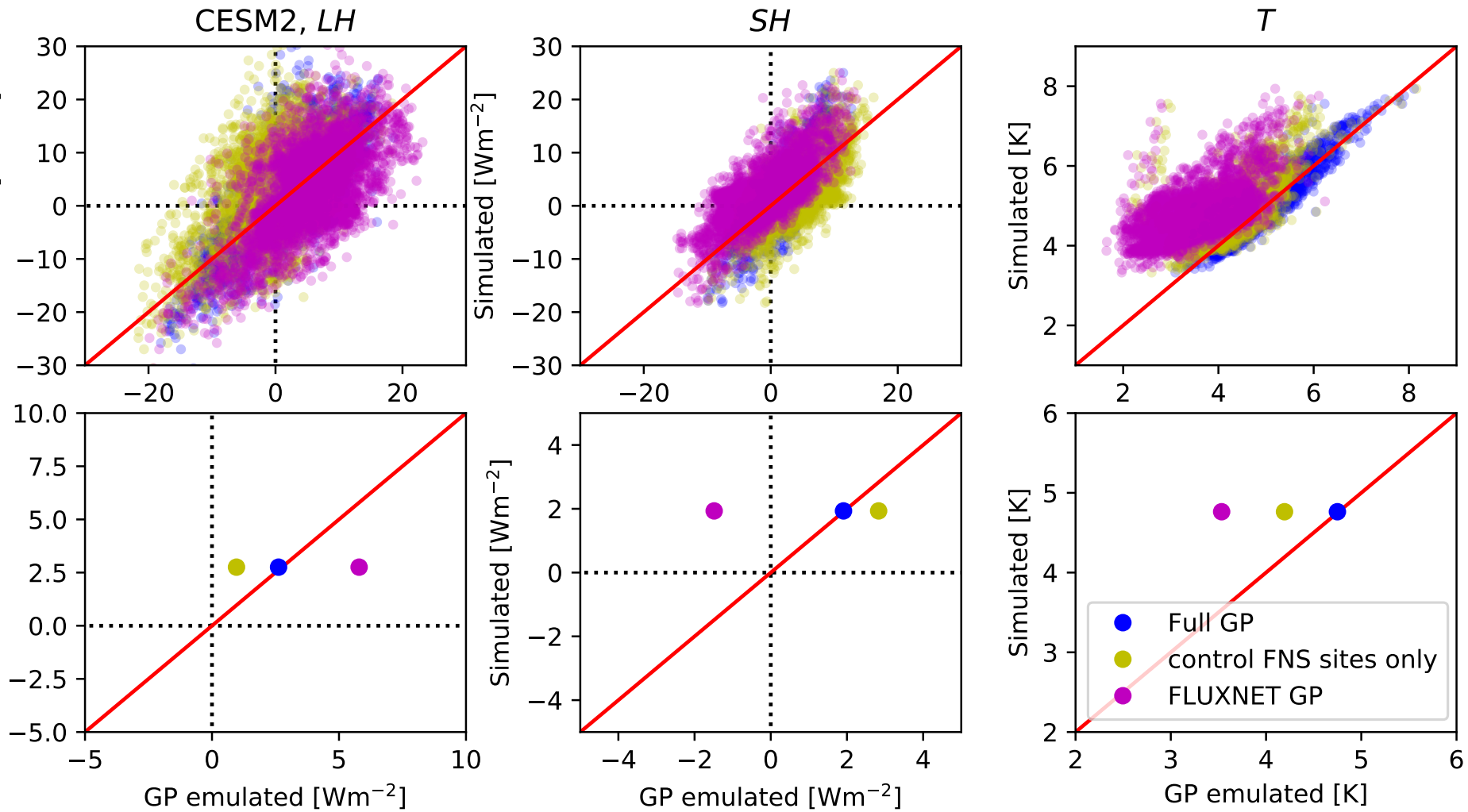
GISS E2 climate change (2)



GISS E2 climate change (3)



CESM2 climate change



Summary

- FLUXNET and GCM data were written down as functions of the same variables using Continuous Structural Parameterization.
- V_1 ($E \uparrow$, $SH \downarrow$) shows a variety of negative responses to U_1 downward radiative flux in GCMs, and a positive one in FLUXNET.
- V_2 ($E \uparrow$, $SH \uparrow$) shows a more consistent positive response to U_1 across all data, although FLUXNET is among the weakest.
- There are deficiencies in representation, but statistical modelling suggests that a more FLUXNET-like land surface might produce differing turbulent fluxes under AMIP+4K climate change.

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