Investigating cloud processes that explain the correlation between subtropical dry-zone RH and climate sensitivity

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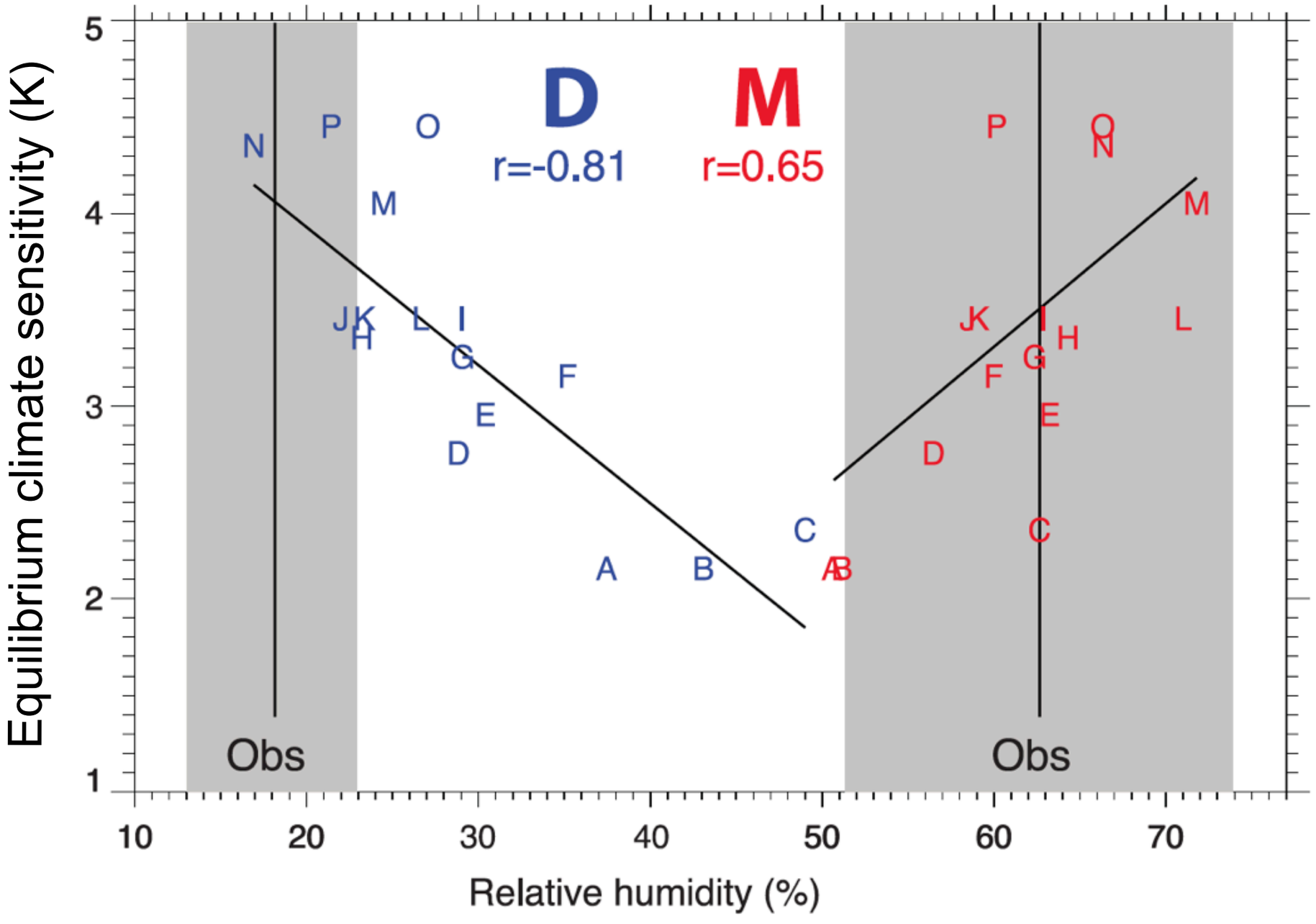
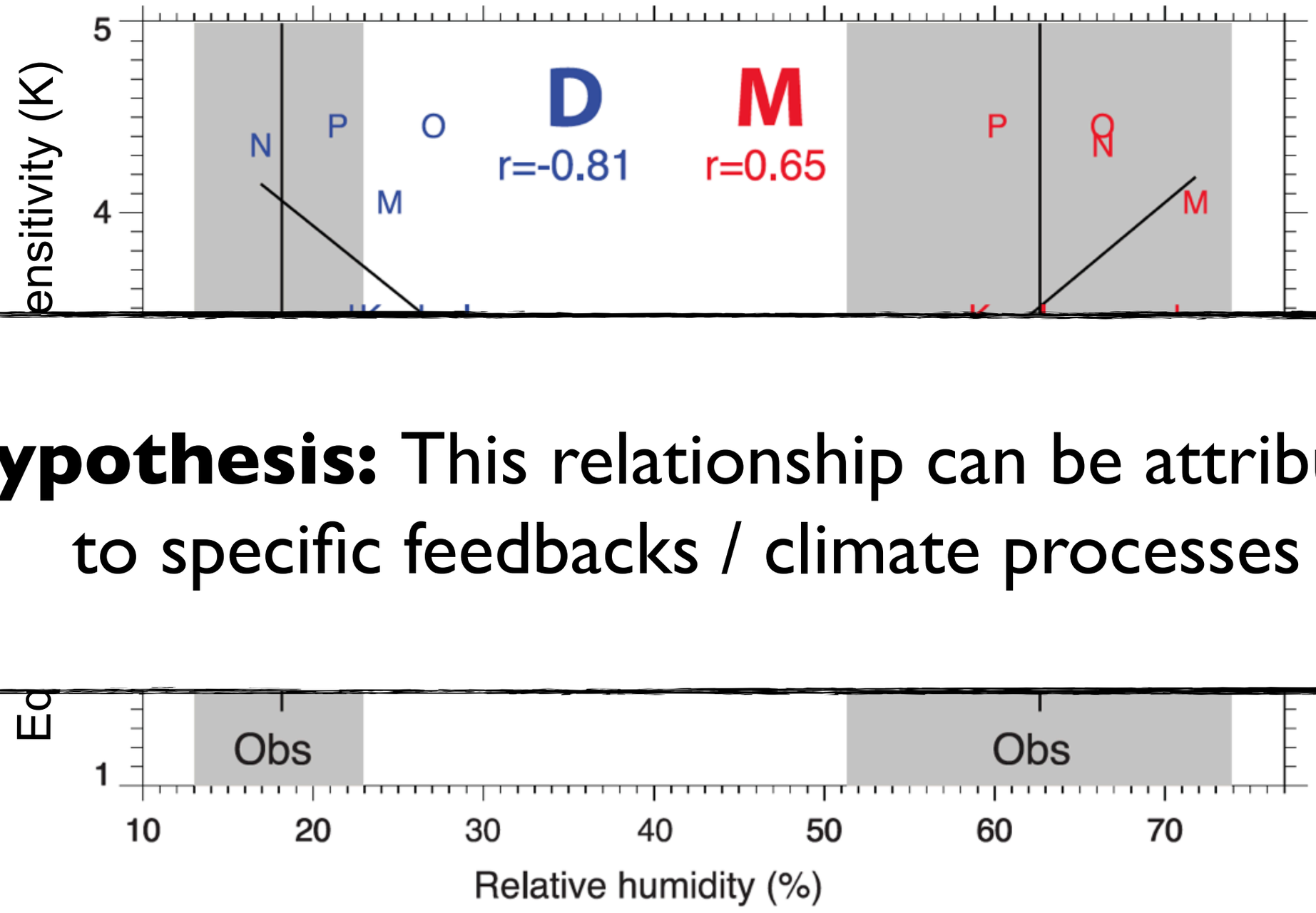
Fasullo and Trenberth (2012)

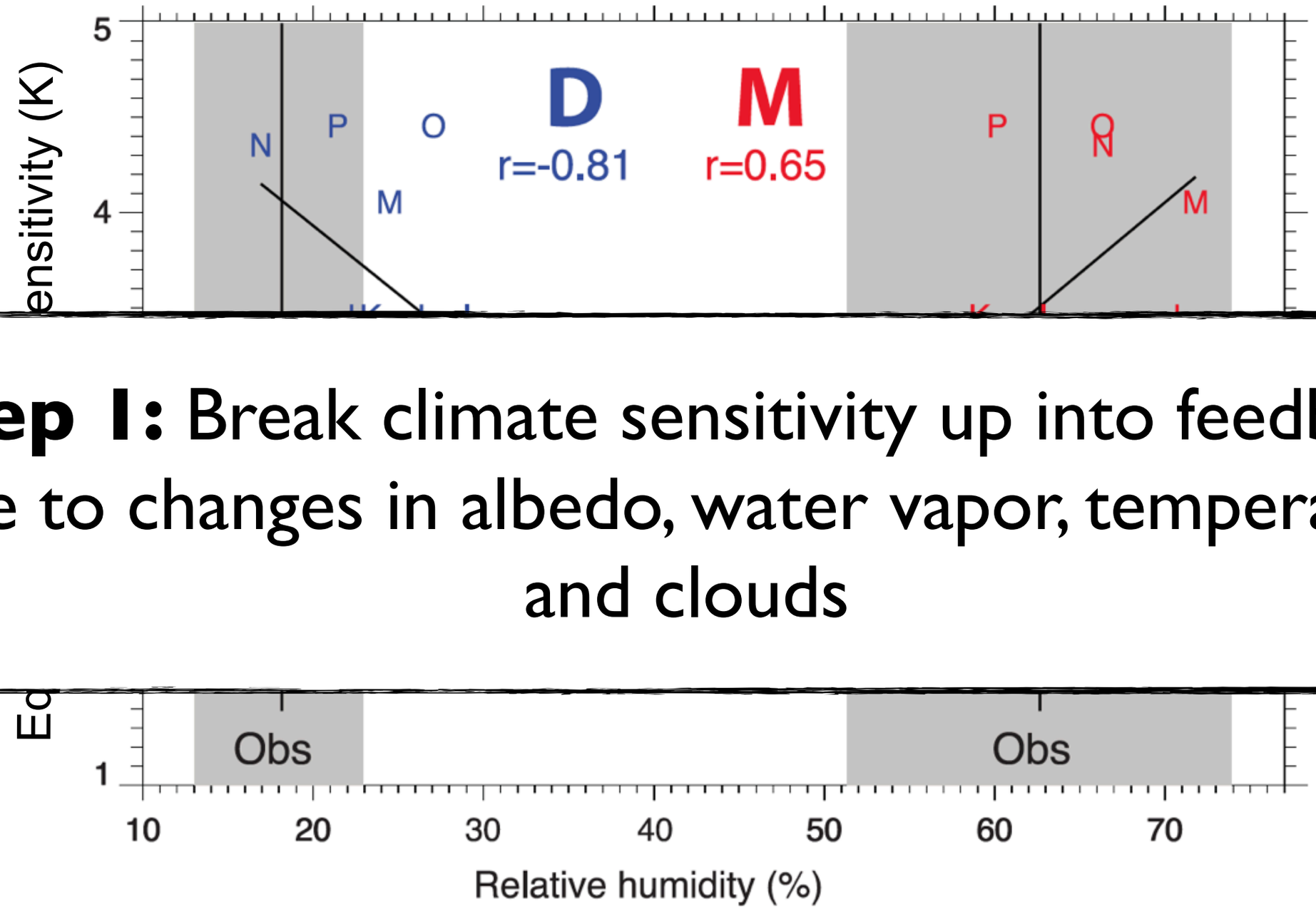


Fasullo and Trenberth (2012)



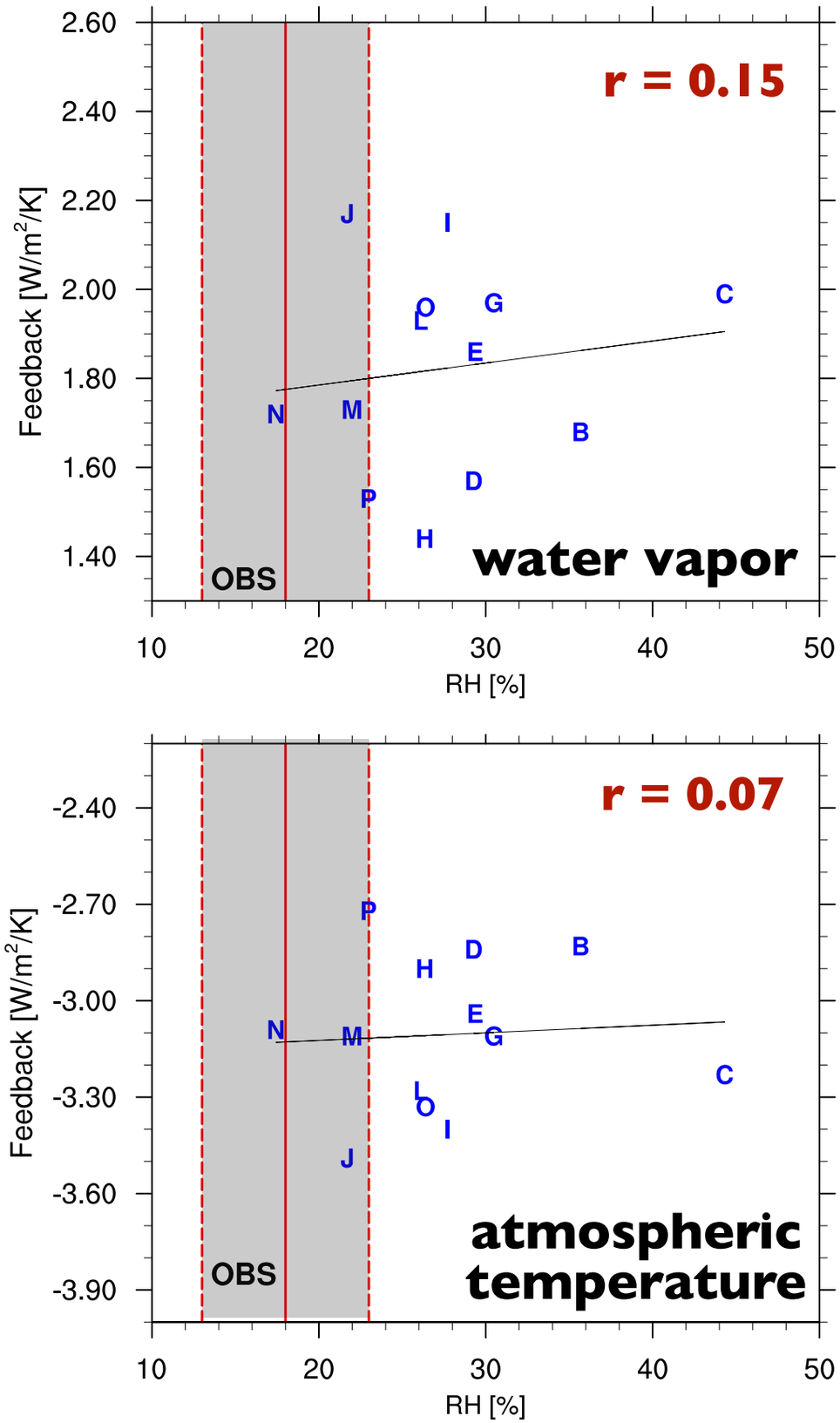
Hypothesis: This relationship can be attributed to specific feedbacks / climate processes

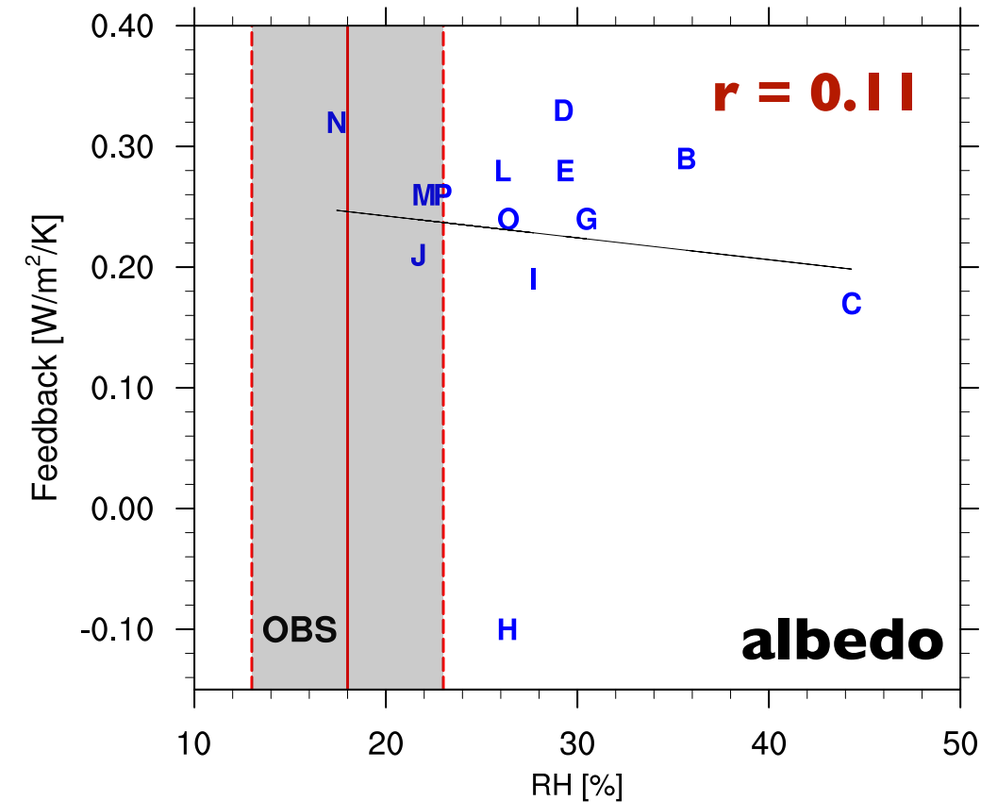
Fasullo and Trenberth (2012)

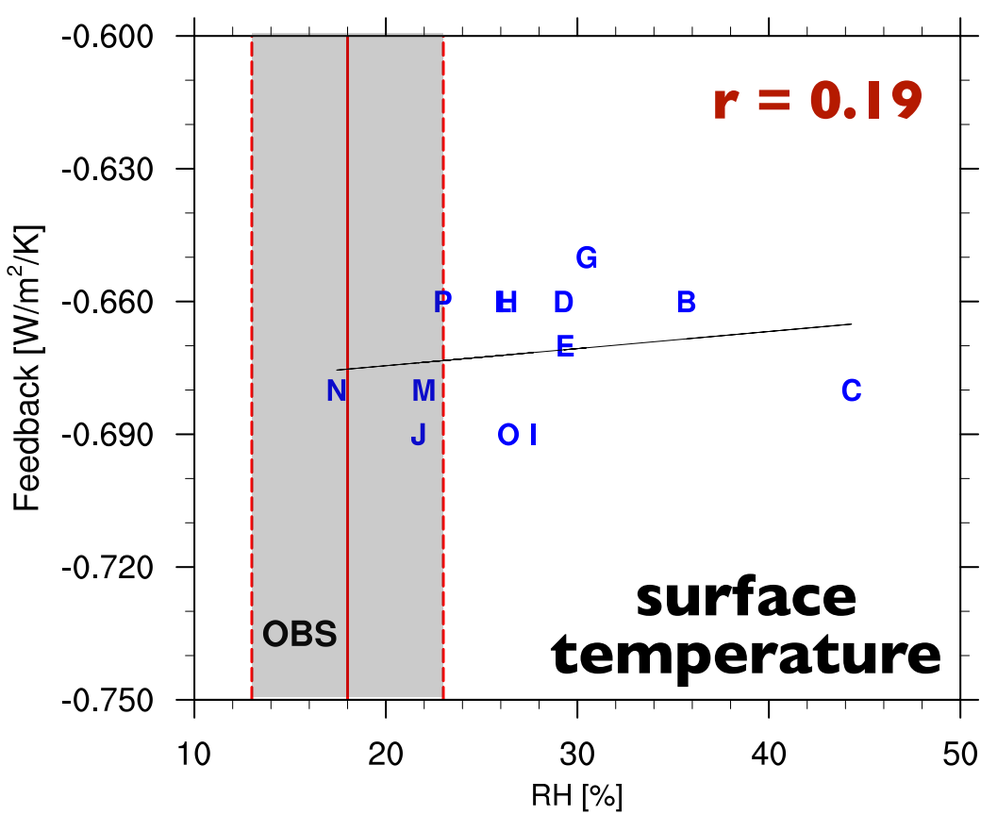


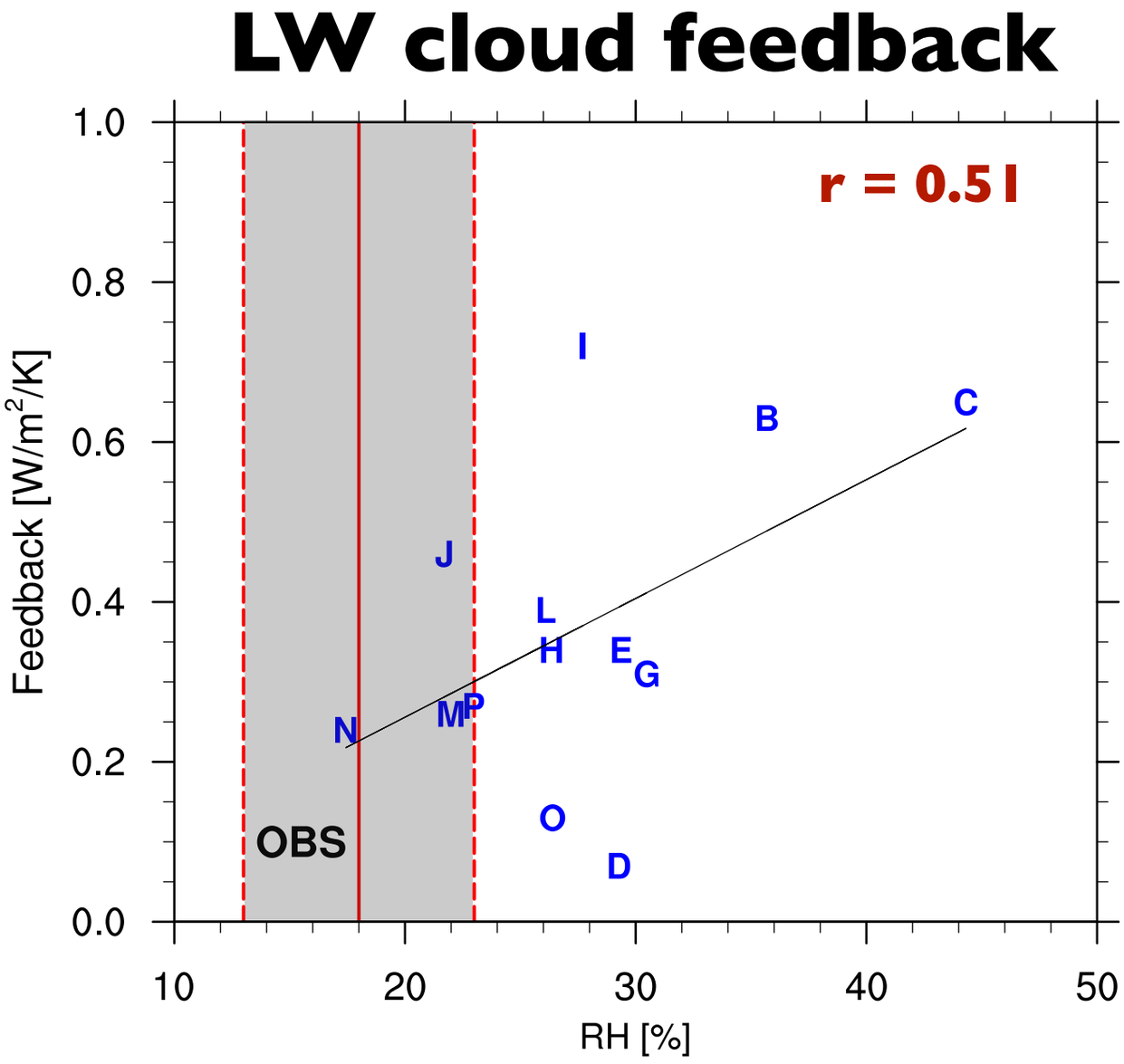
Step 1: Break climate sensitivity up into feedbacks due to changes in albedo, water vapor, temperature and clouds

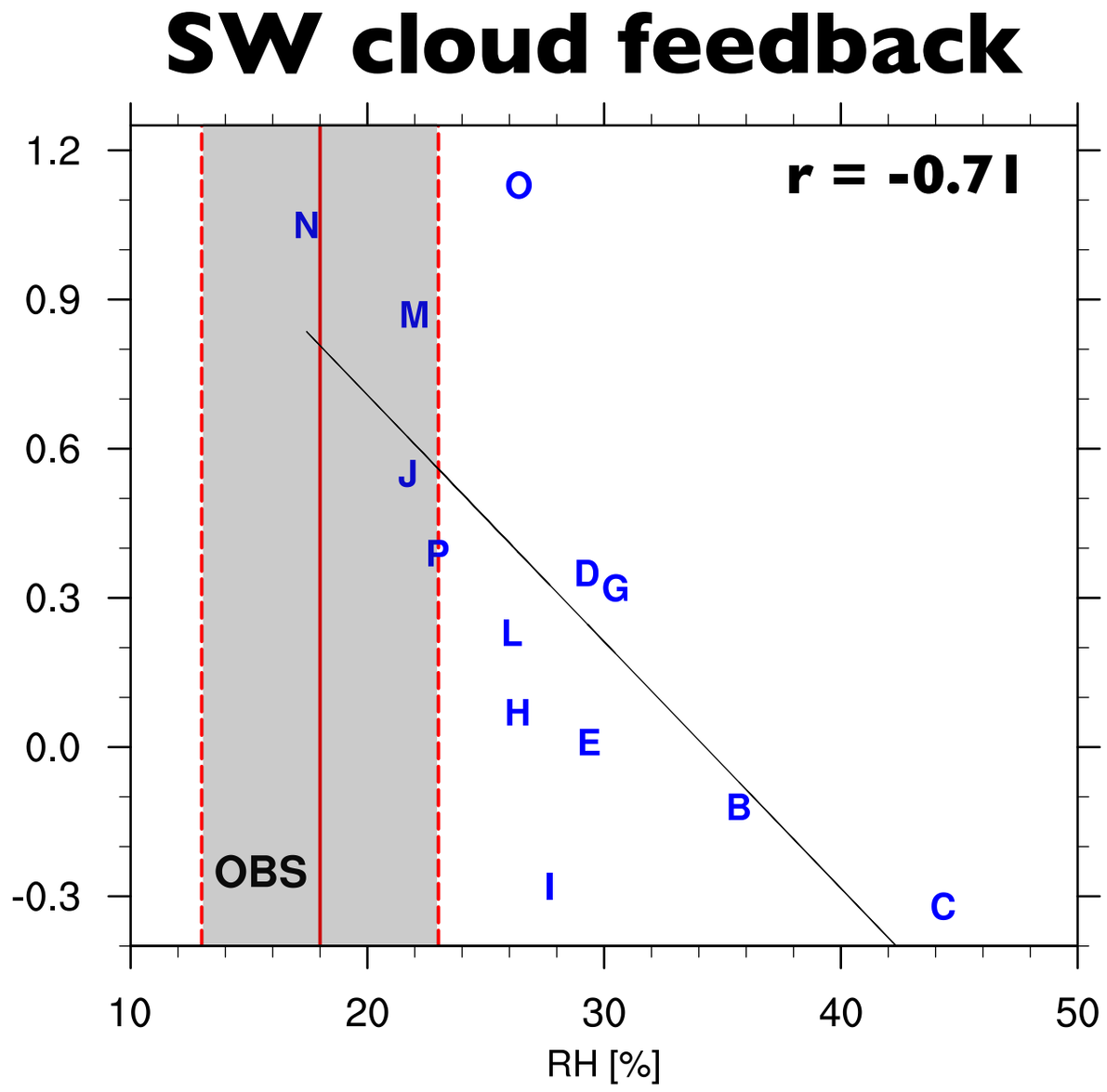
Non-cloud feedbacks



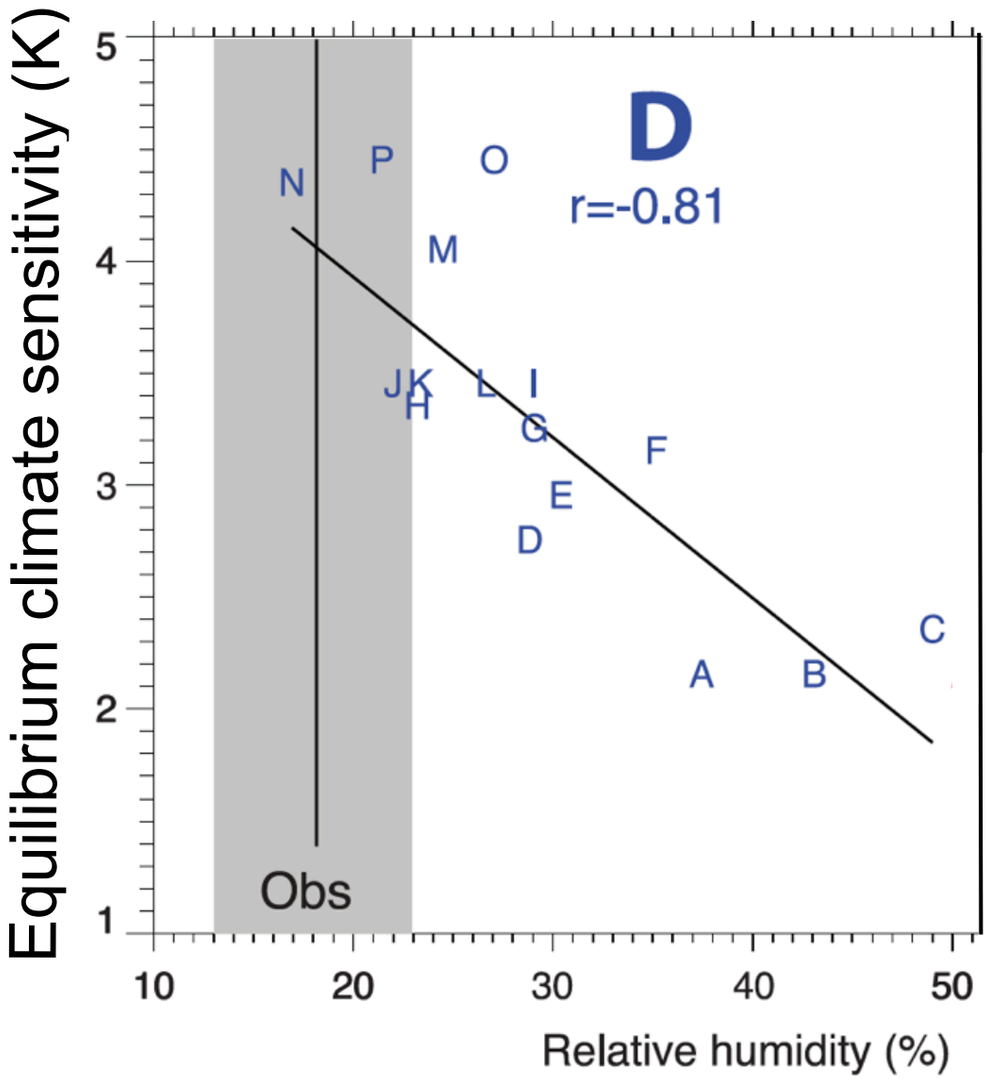


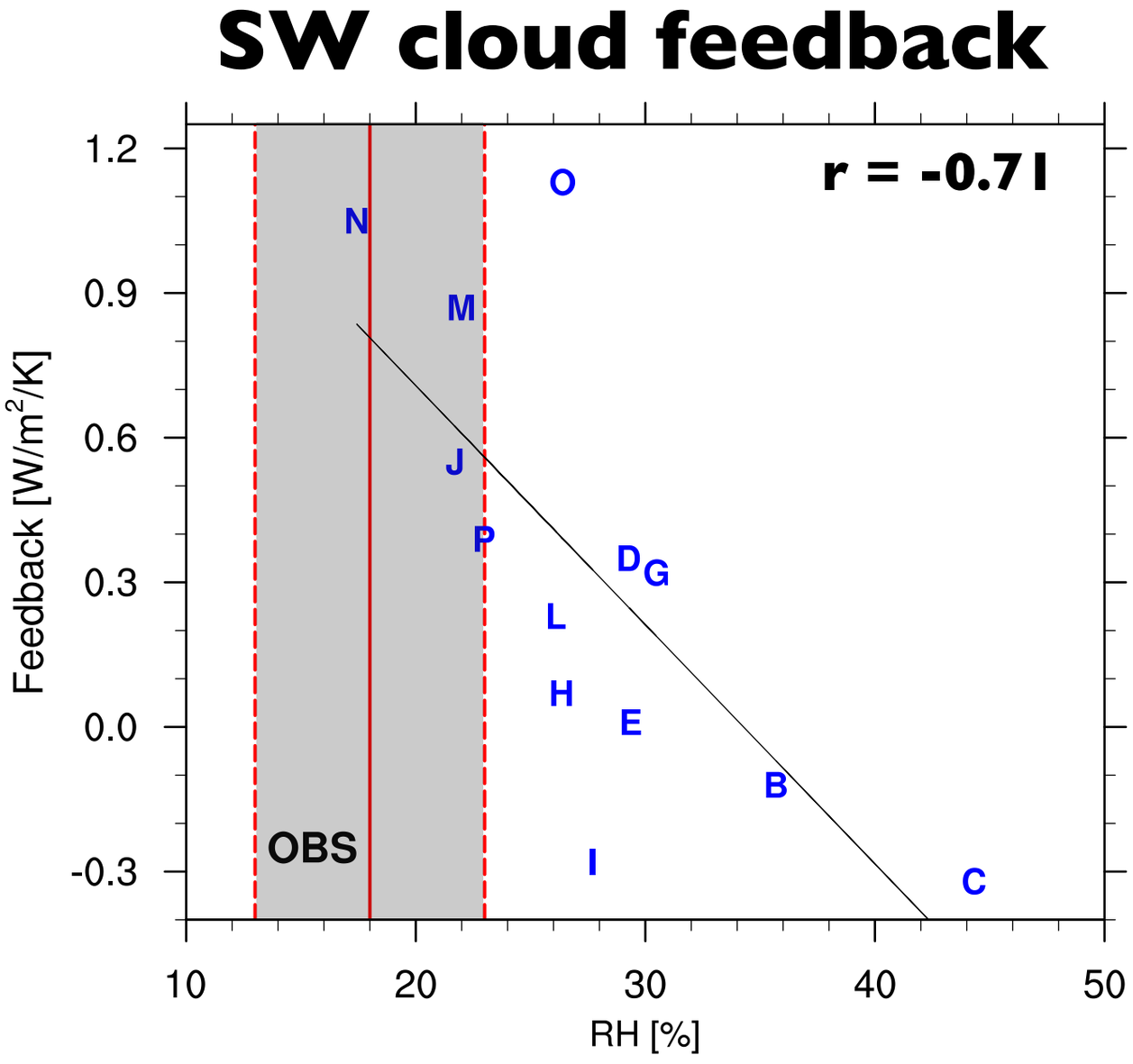






13 data points → significant at 95% confidence level for r > 0.54





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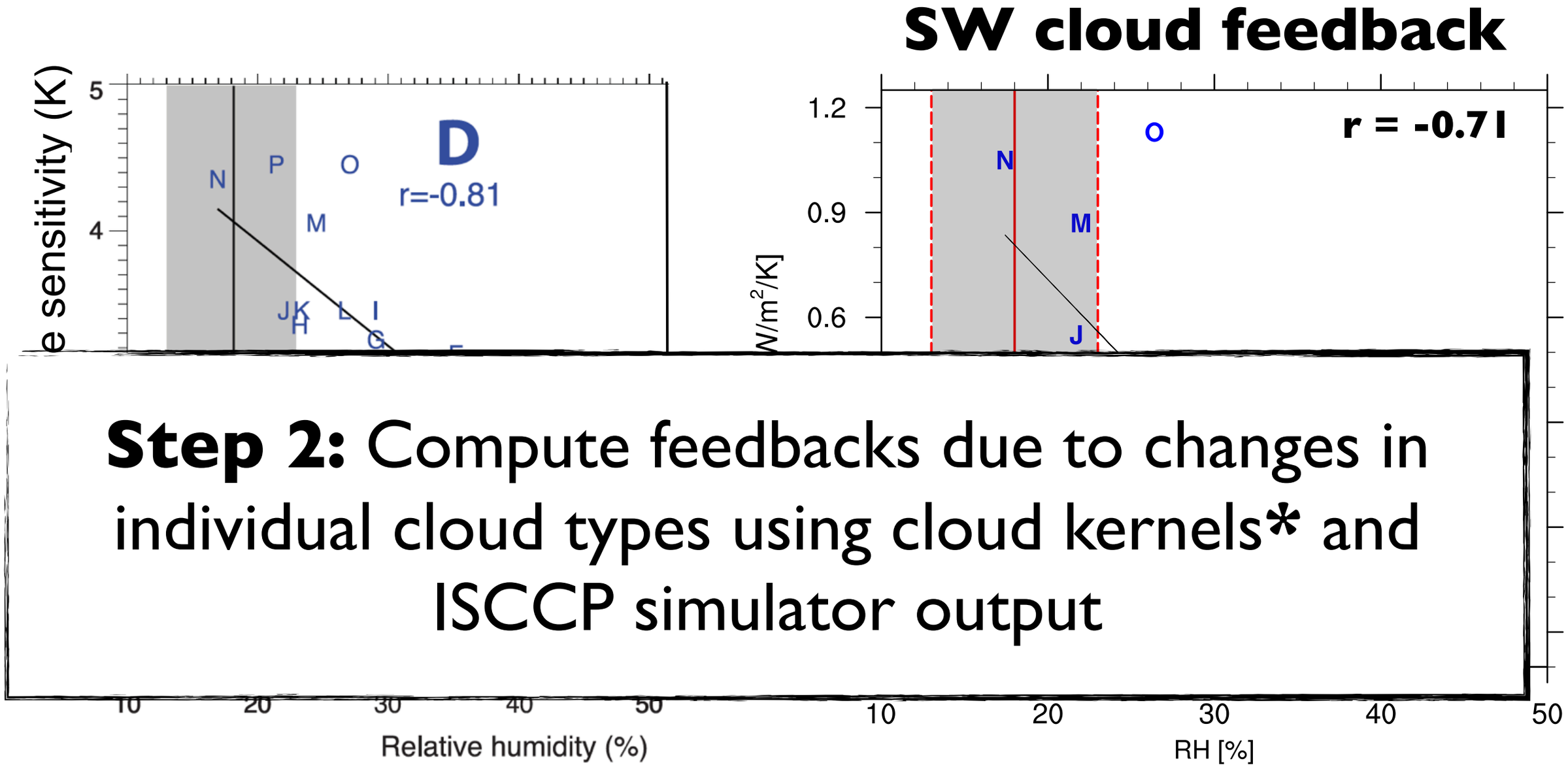


Step 2: Compute feedbacks due to changes in individual cloud types using cloud kernels* and ISCCP simulator output

* Zelinka et al. (2012)

ISCCP Cloud Classification

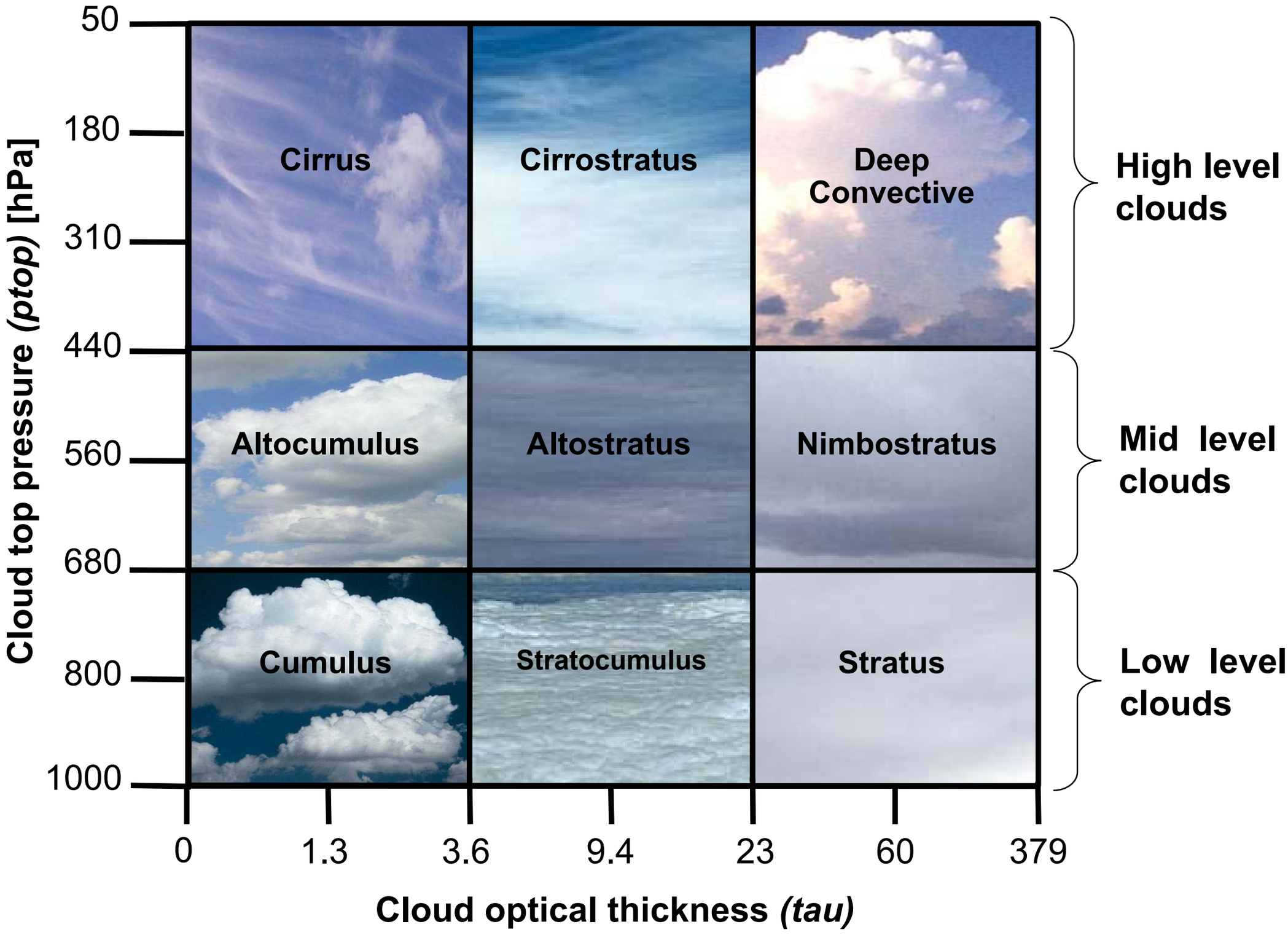
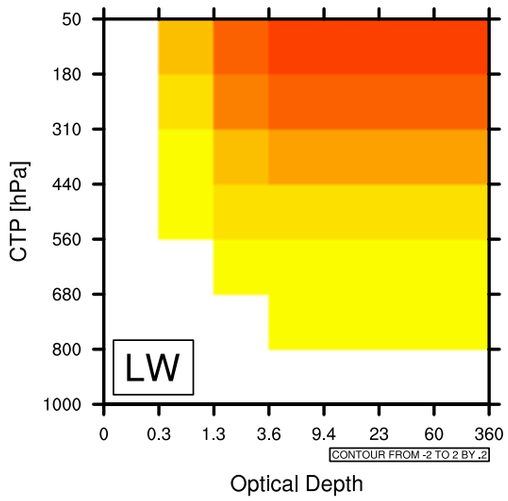
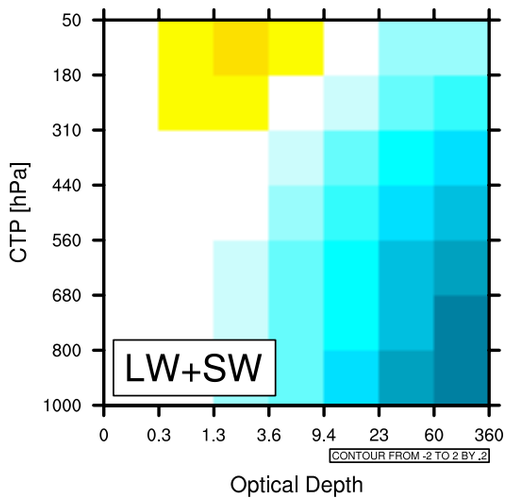


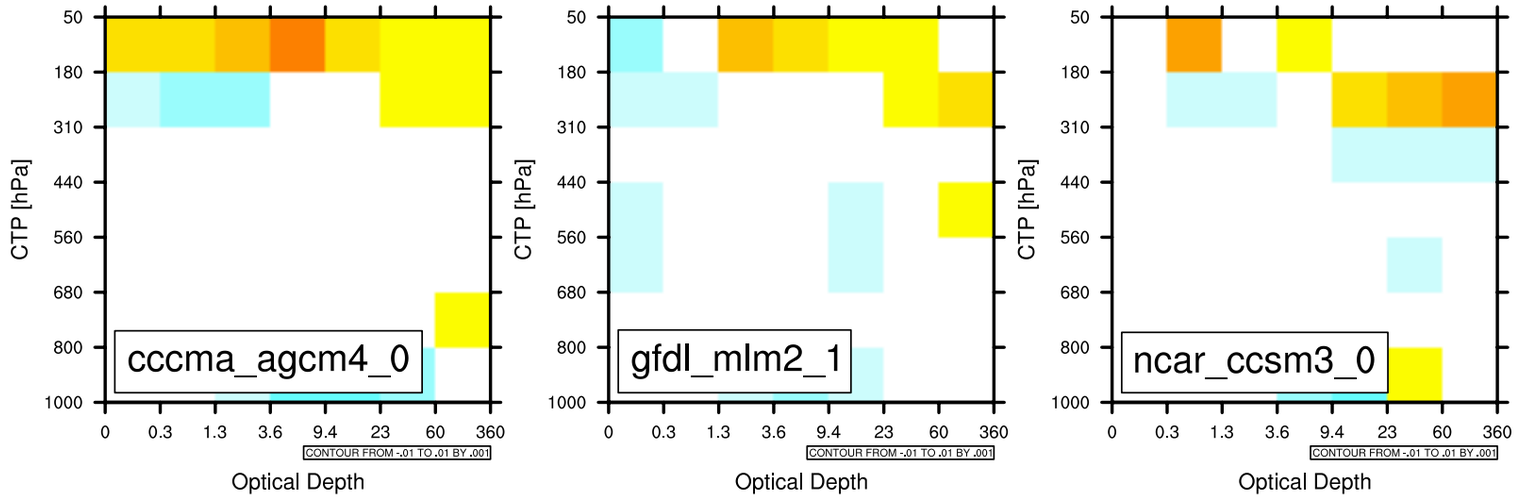
image credit: Swati Gehlot

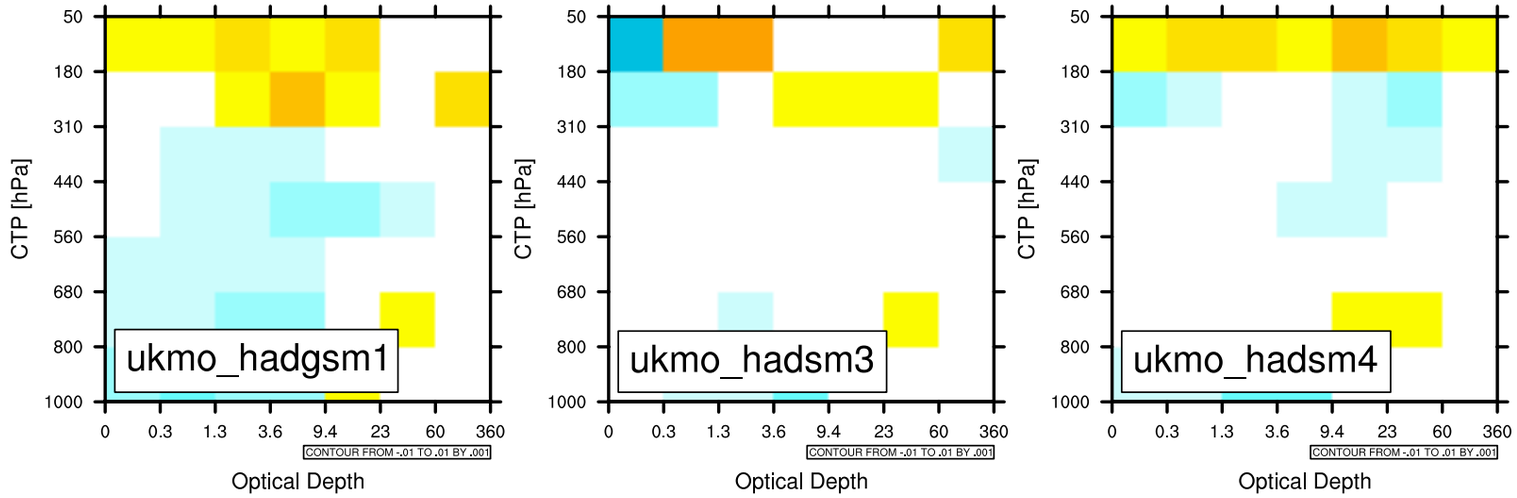
Cloud Kernel

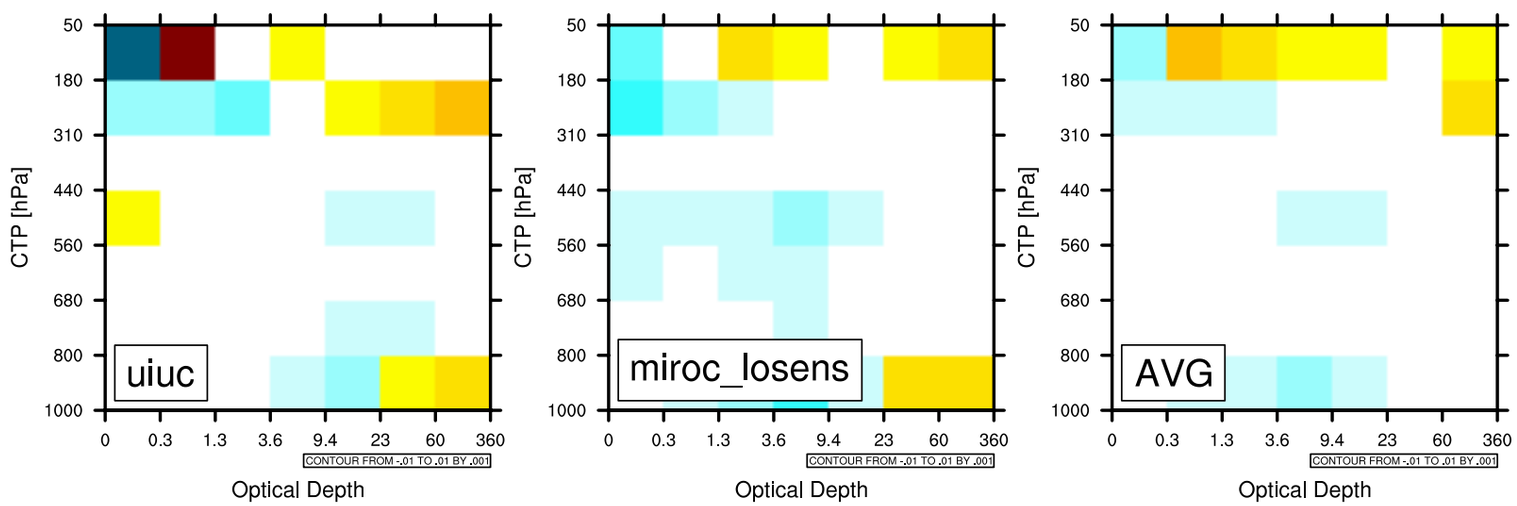


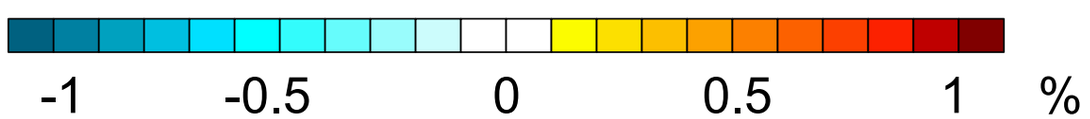


Change in CFMIP cloud fractions

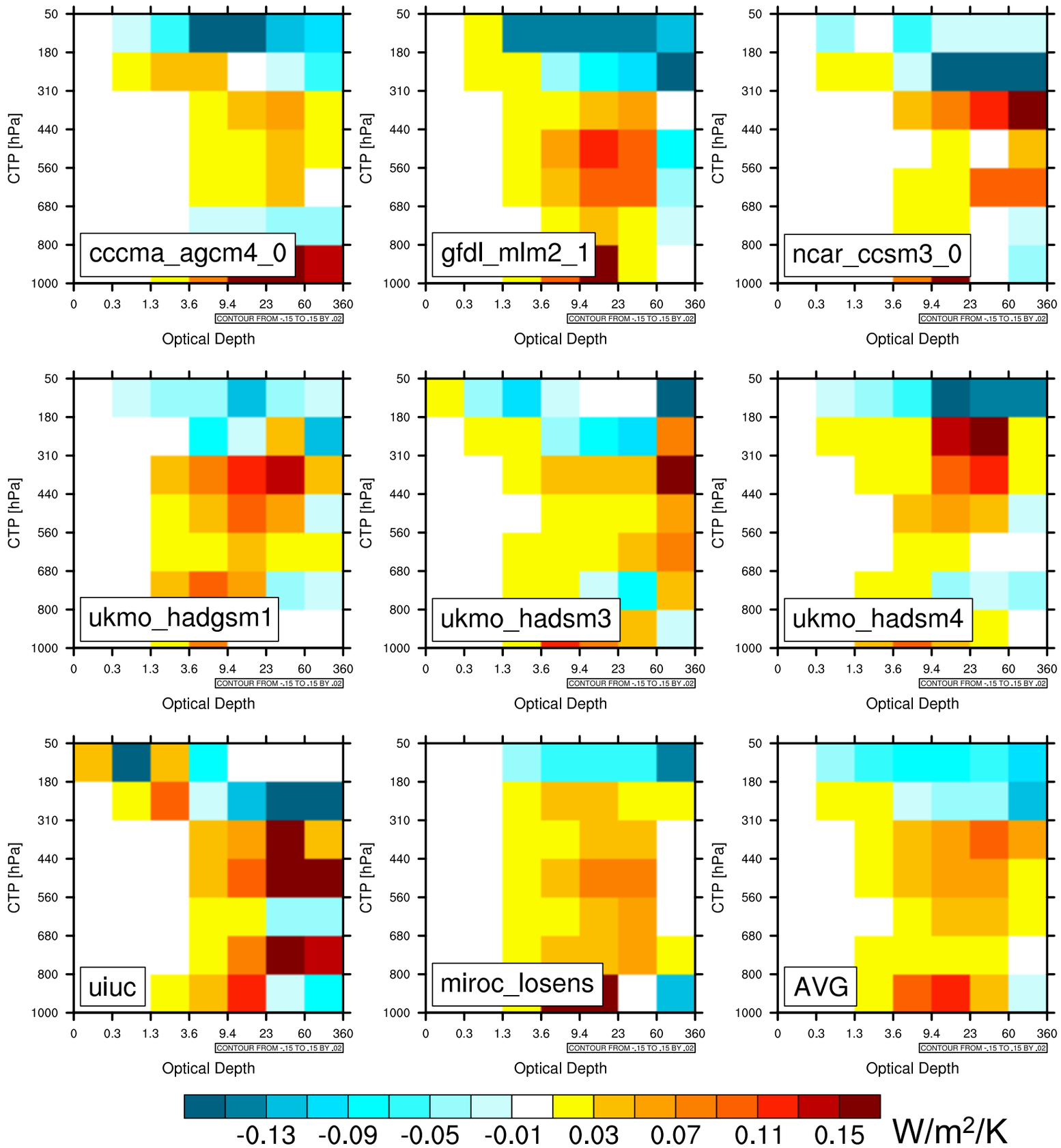


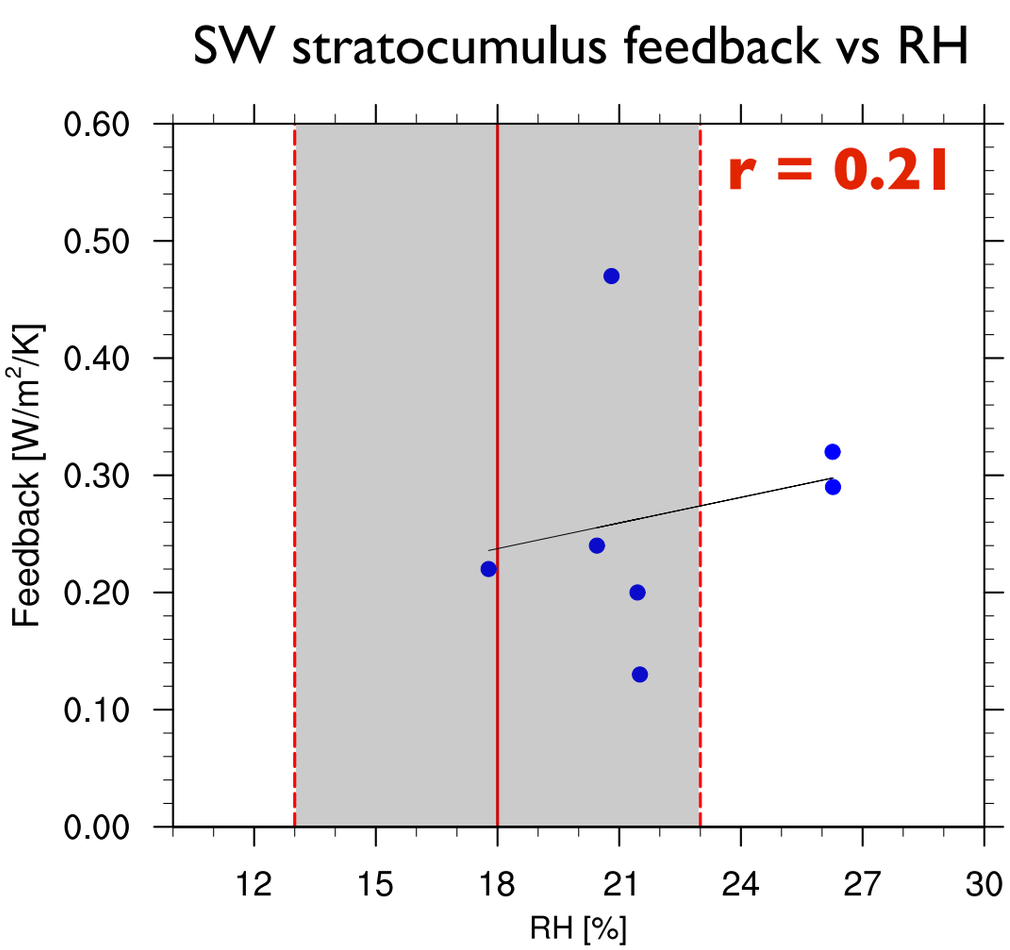


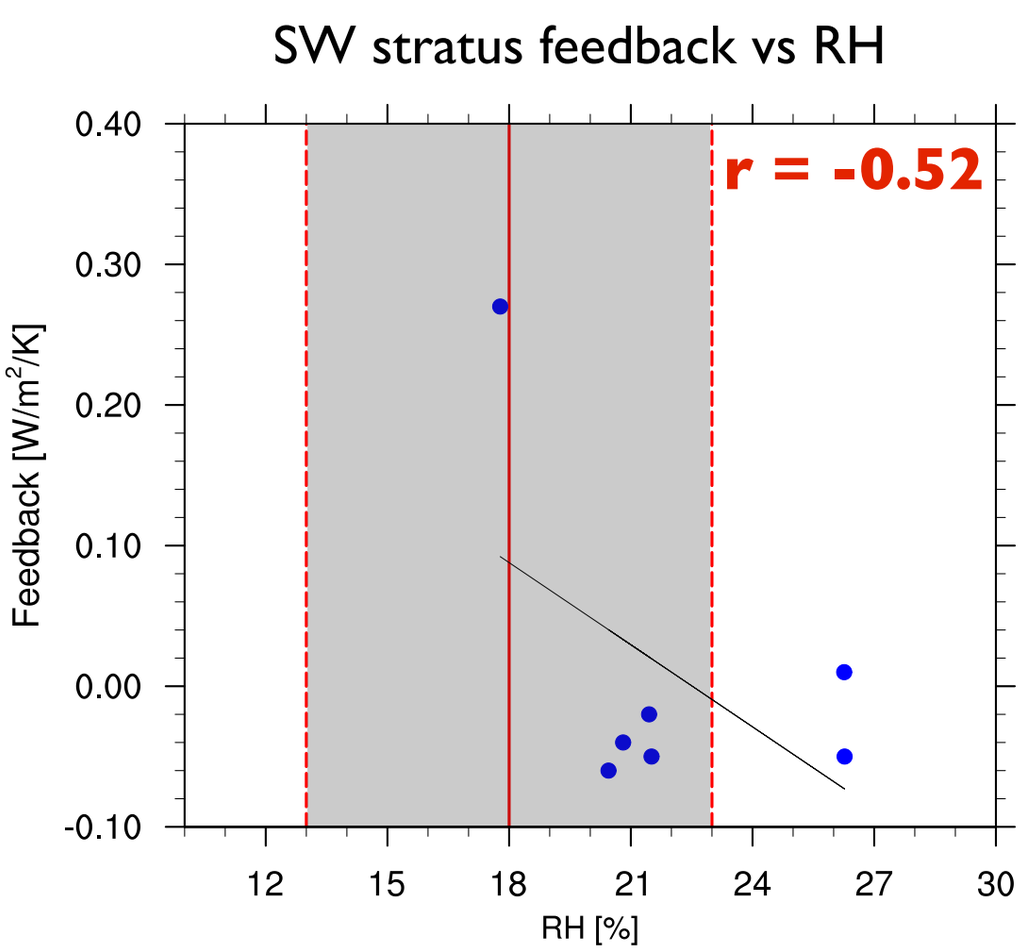


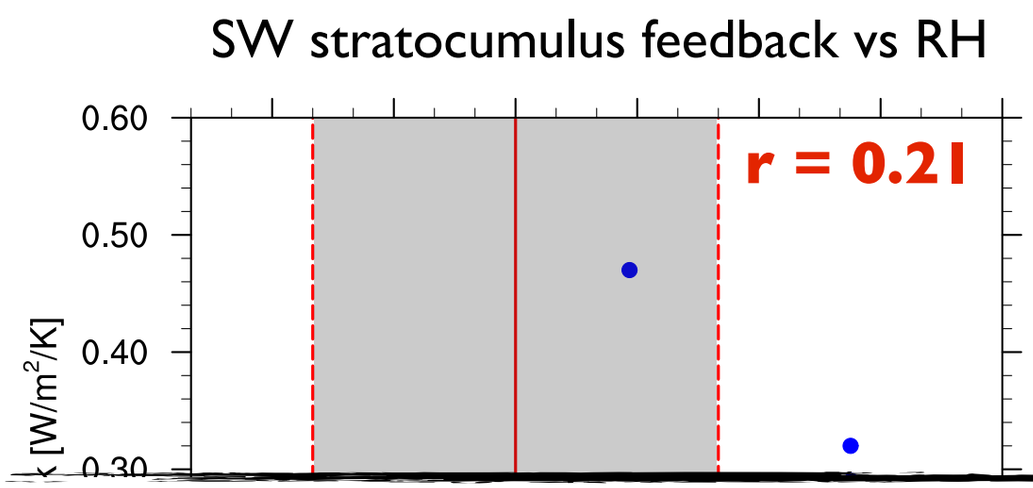


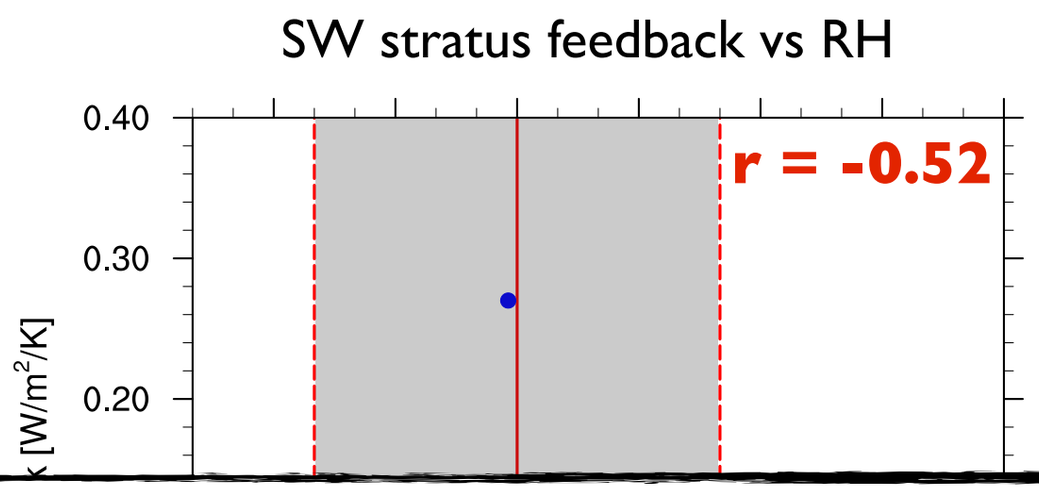
CFMIP SW Cloud Feedback




SW stratocumulus feedback vs RH
r = 0.21
Feedback [W/m²/K]
0.60
0.50
0.40
0.30
0.20
0.10
0.00
12
15
18
21
24
27
30
RH [%]


SW stratus feedback vs RH
r = -0.52
Feedback [W/m²/K]
0.40
0.30
0.20
0.10
0.00
-0.10
12
15
18
21
24
27
30
RH [%]





No individual cloud type feedback is significantly correlated with dry zone RH

To summarize:

- SW cloud feedback explains the relationship between climate sensitivity and RH in subtropics in CMIP3
- SW cloud feedback can be decomposed into contributions from individual cloud types
- CFMIP data is insufficient to allow for regression analysis analogous to CMIP3