Stable water isotopes in CLM (ISOCLM)

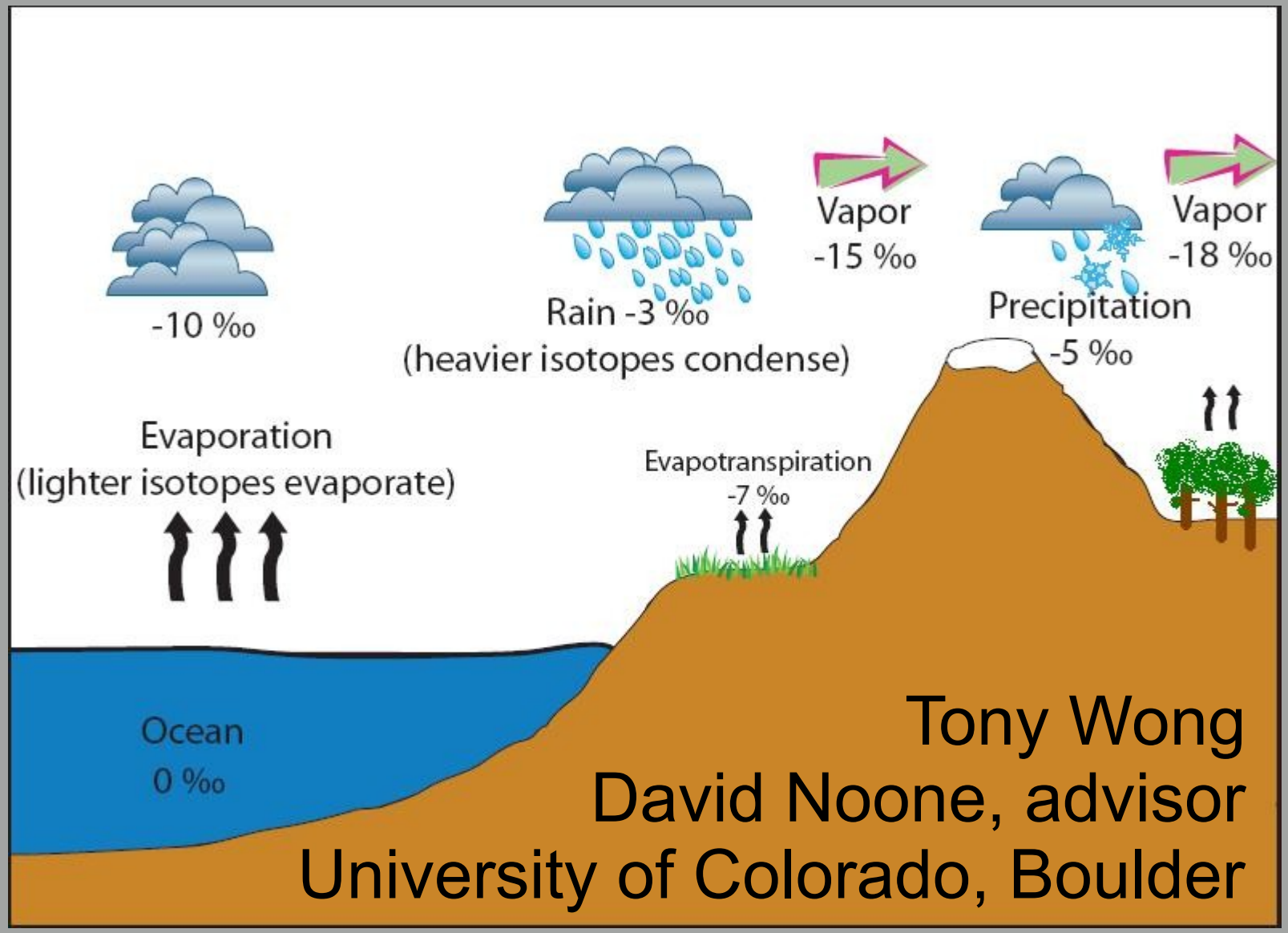
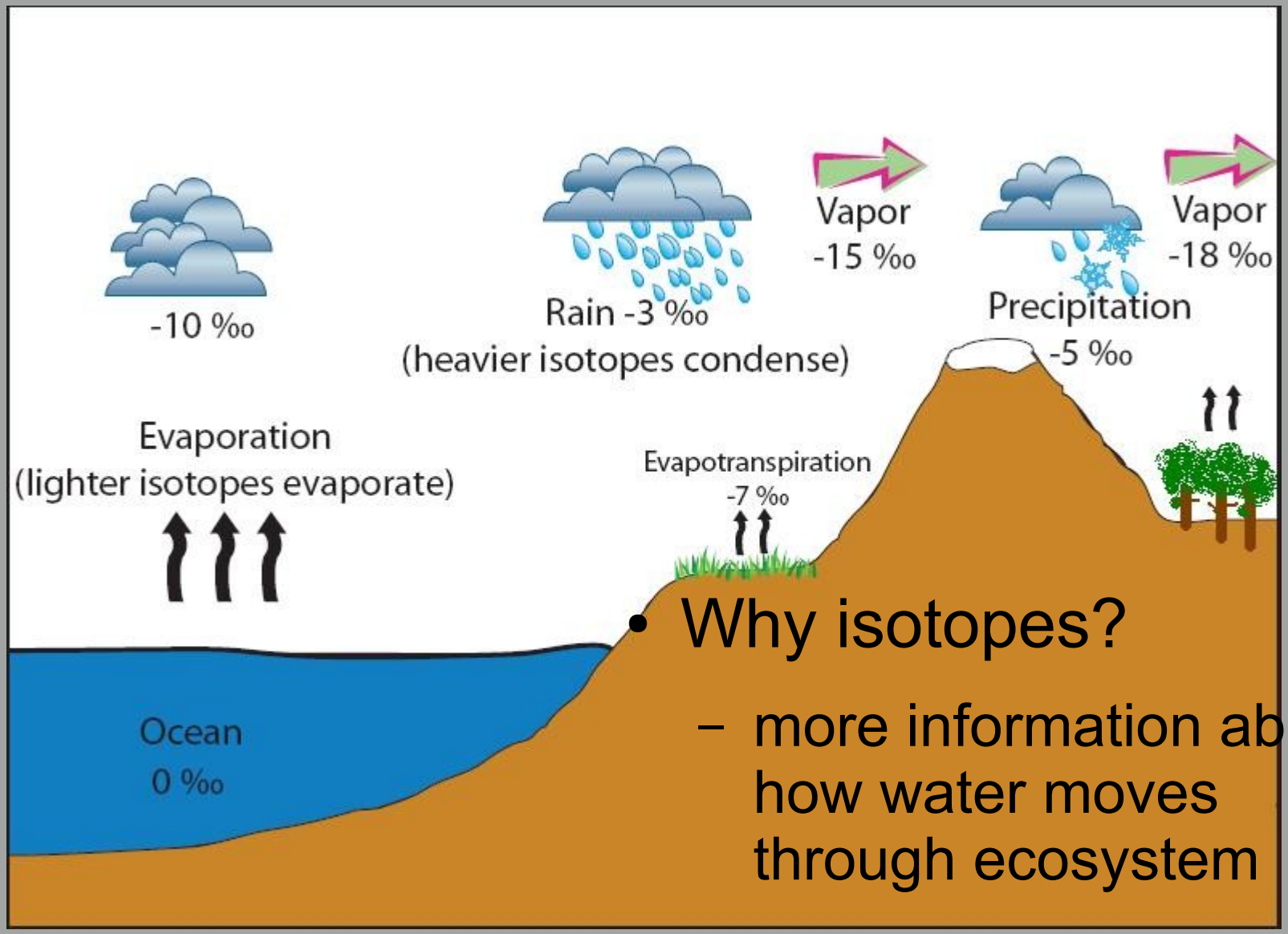


Image credit: Science Education Resource Center, Carleton College

Motivation



- Why isotopes?
  - more information about how water moves through ecosystem

Image credit: Science Education Resource Center, Carleton College

Motivation

- CLM specifically...

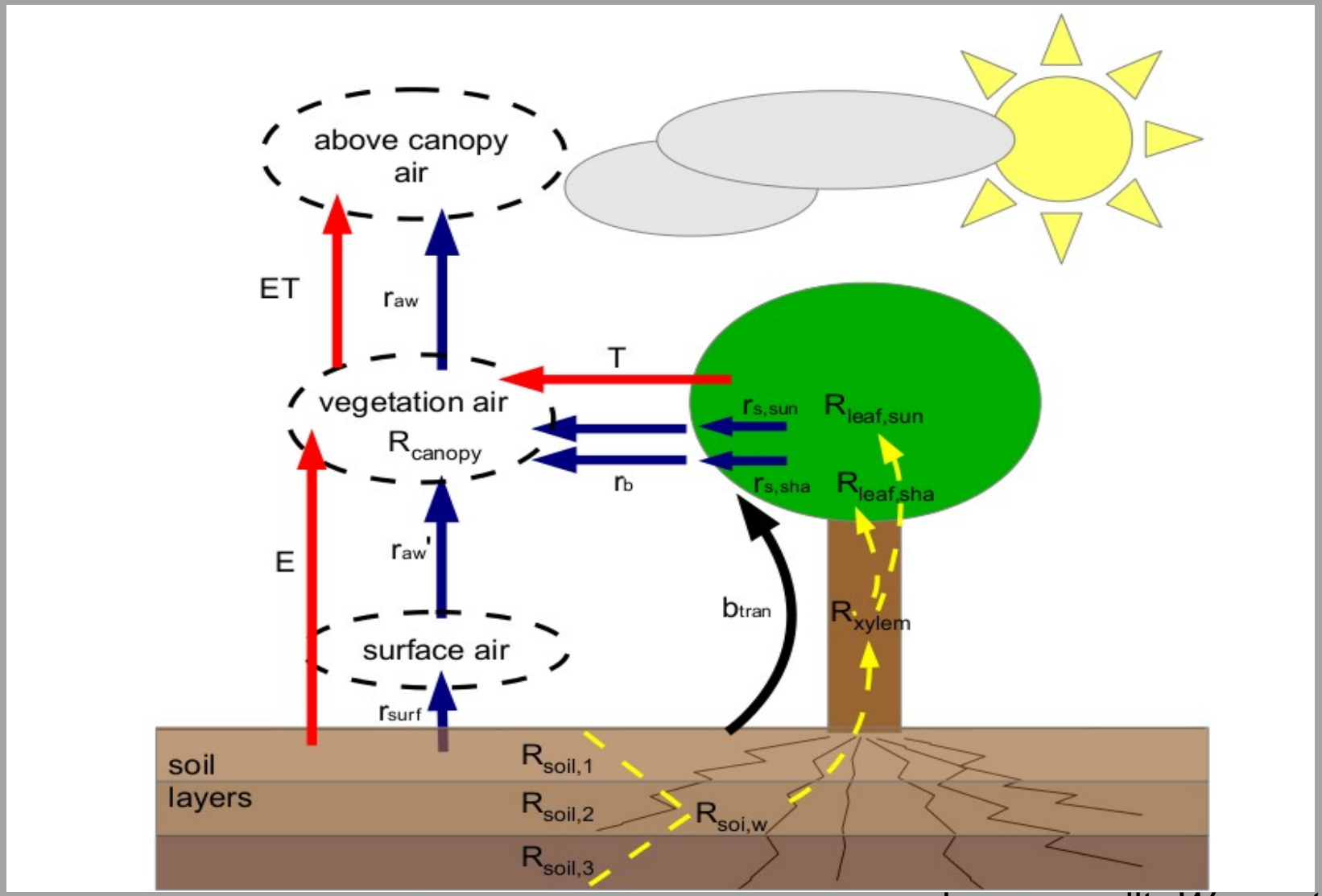


Image credit: *Wong et al., in prep*

Motivation

- Exploited this using ISOLSM (*Riley et al. 2002; Noone et al., 2002; Bonan, 1996*)
  - Study of integrity of ET partitioning estimates derived from stable water isotope ratios.

$$F_T = \frac{R_{ET} - R_E}{R_T - R_E}$$

simple mass balance
(e.g., *Williams et al., 2004)*

$$R_E = \frac{1}{\alpha_{k,E}} \left(\frac{\frac{R_{surf}}{\alpha} - h\, R_{can}}{1-h} \right)$$

$$R_T = \frac{1}{\alpha_{k,T}} \left(\frac{\frac{R_{leaf}}{\alpha} - h\, R_{can}}{1-h} \right)$$

Craig and Gordon, 1965

$$\alpha_{K,E} = \left(\frac{D}{D_i} \right)^{n_E}$$

$$\alpha_{K,T} = \left(\frac{D}{D_i} \right)^{n_T}$$

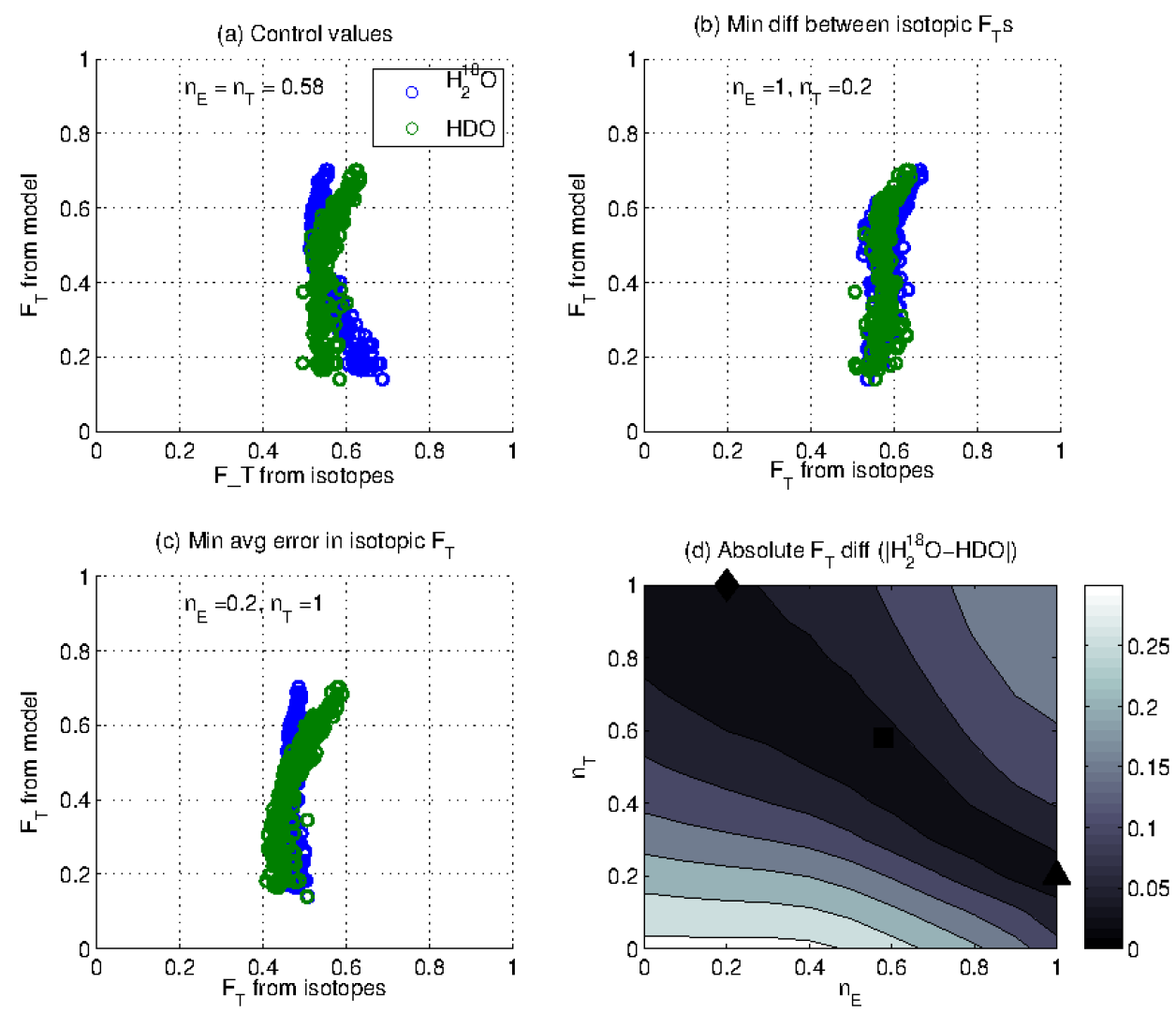
Merlivat, 1978

VS.

$$R_T = \alpha^* \left[\alpha_k R_x \left(\frac{e_i - e_s}{e_i} \right) + \alpha_{k,h} R_x \left(\frac{e_s - e_a}{e_i} \right) + R_a \left(\frac{e_a}{e_i} \right) \right]$$

Flanagan et al., 1991

Motivation



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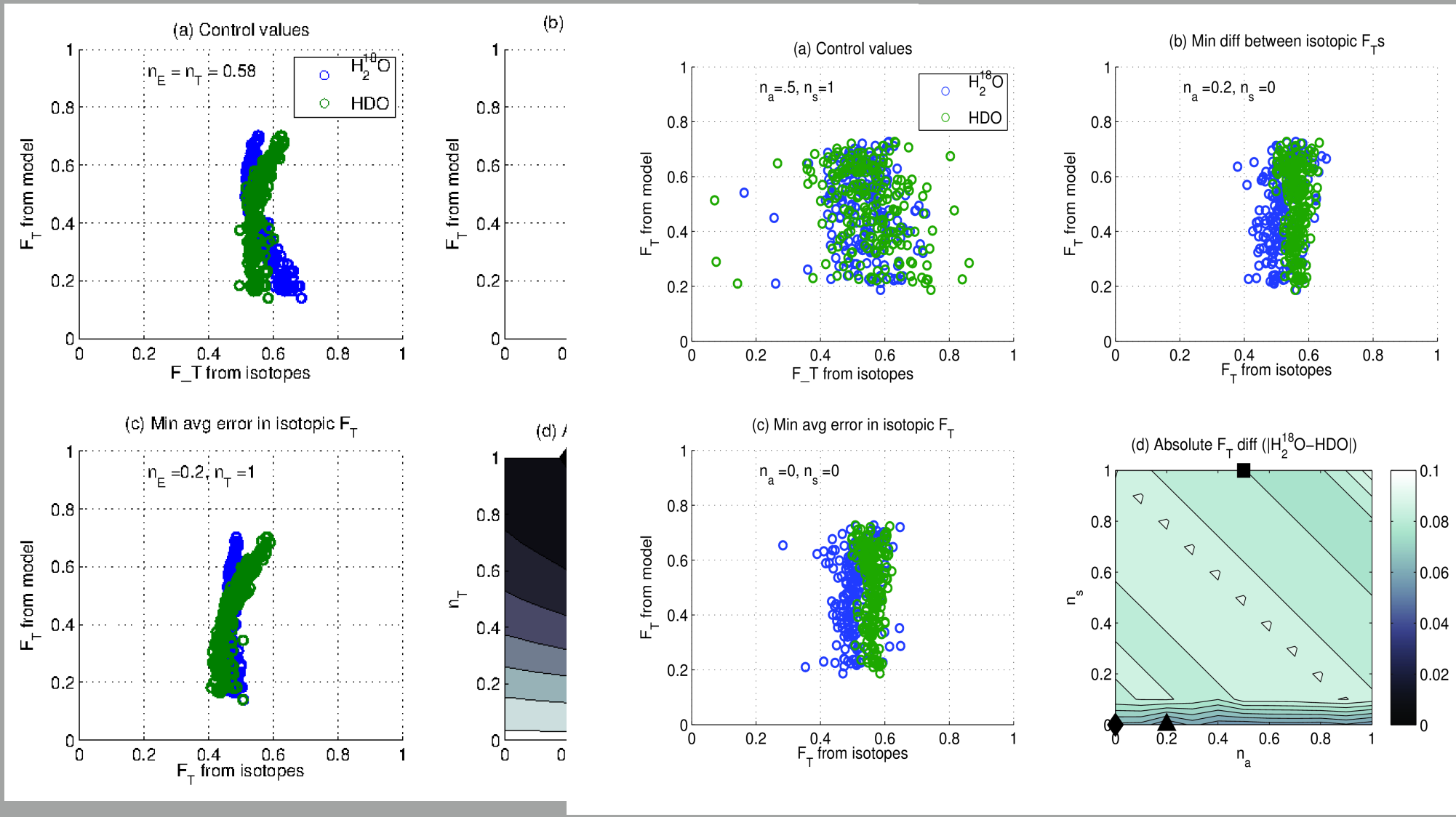


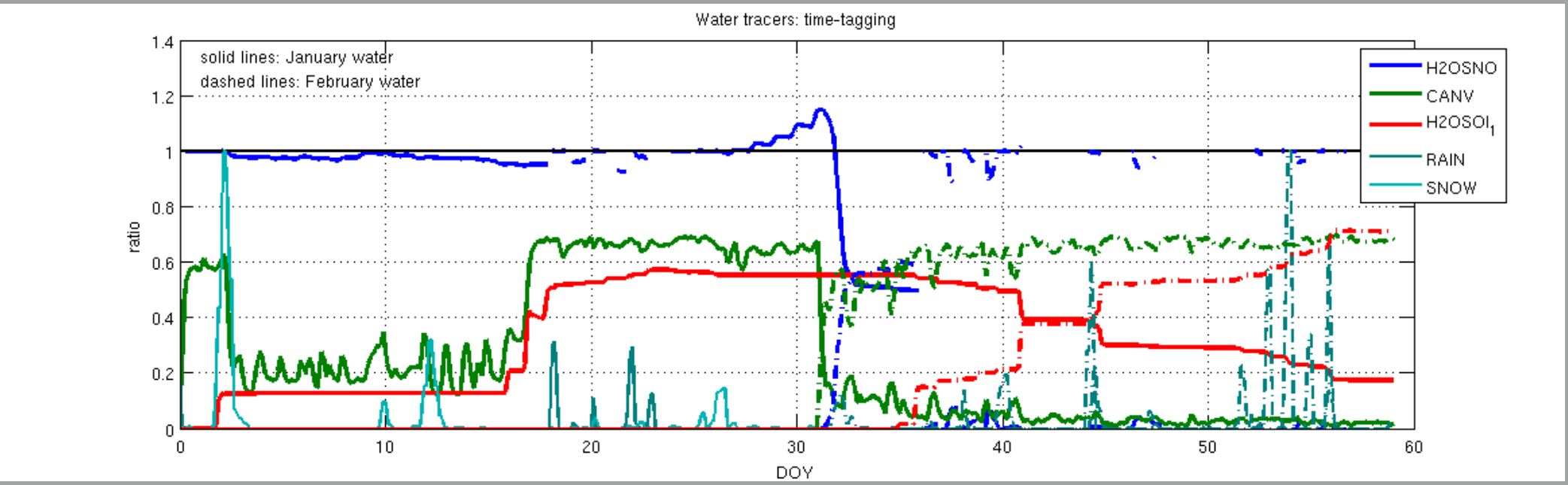
Image credit: *Wong et al., in prep*

Motivation

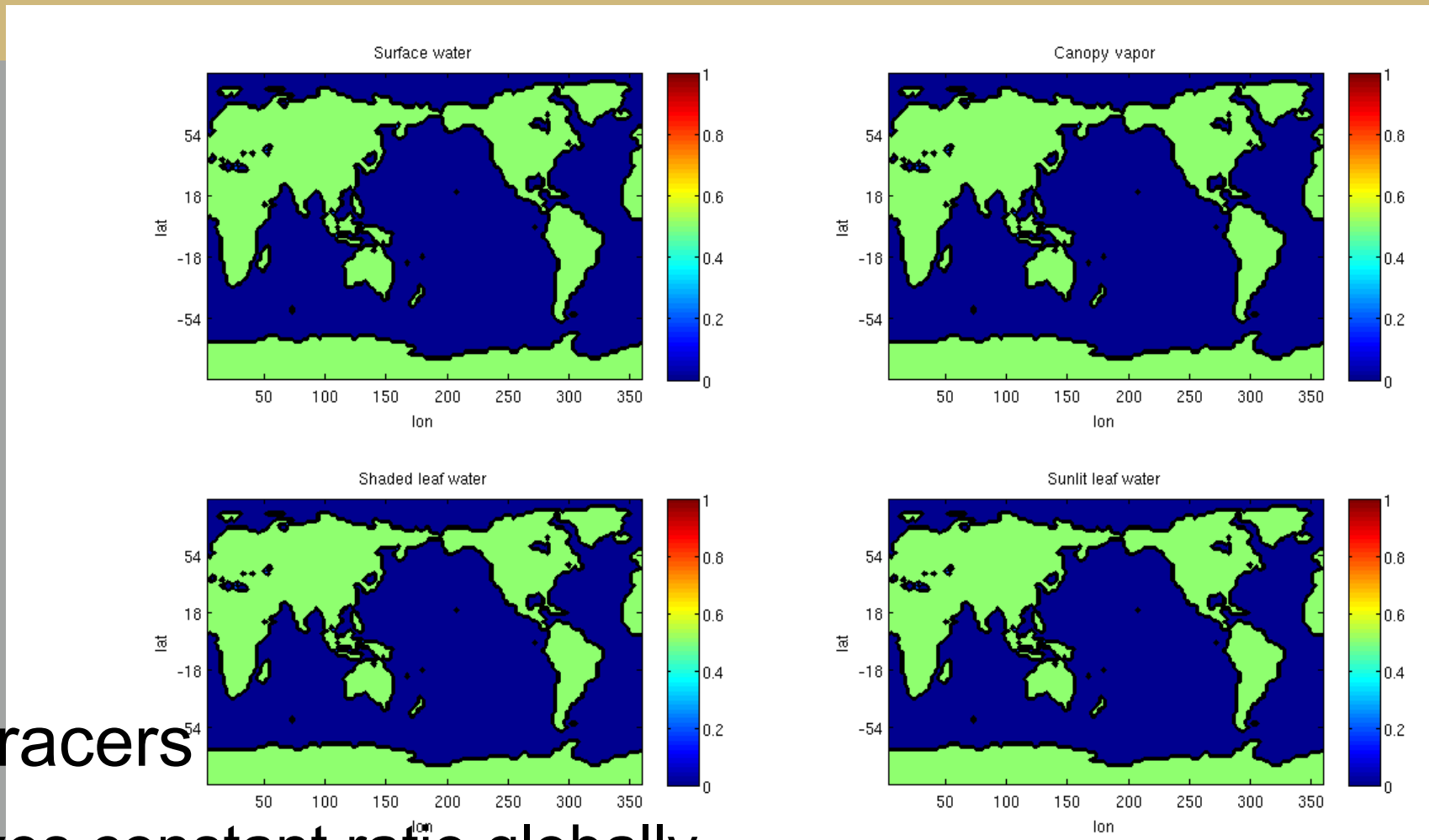
- Generic tags
  - track any “type” of water throughout the hydrologyical cycle
  - e.g., water from a specific location in space or time
  - allows us to see where the water is at all times. get residence times, etc.

Current status

- Water tagging
  - time-tagging in 1 column (almost done):



Current status



- Isotope tracers
  - preserves constant ratio globally
  - dying when run in parallel; in progress
  - dying when ratios are tweaked slightly, simulating noisy input; in progress

Future direction

ISO...

CLM
+ CAM (Jesse Nusbaumer, Chuck Bardeen)
+ POP (Jiaxu Zhang, Esther Brady)
+ RTM (Jiang Zhu, Alexandra Jahn)
+ CICE (Dave Bailey, Alexandra Jahn)

- isotope-enabled global simulations
- global water tagging simulations
- anything your heart desires

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Important consideration: how to move forward?

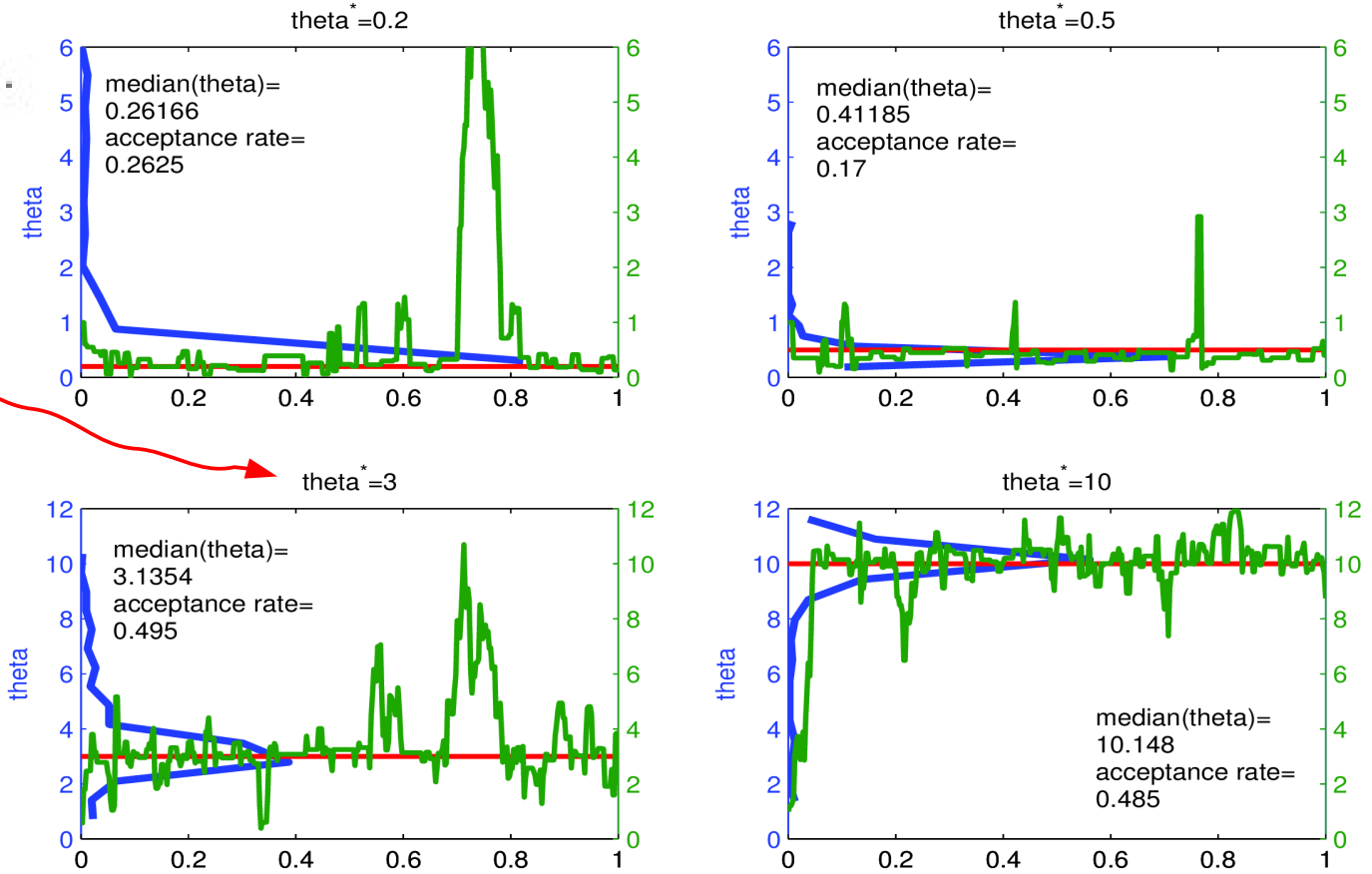
- ISOCLM in CLM4.0 (needs to play nice with CAM5 and friends)

Future direction

- Me: parameter estimation and Bayesian calibration in ISOCLM

$$H = -\rho_{atm} C_p \frac{T_{p,atm} - T_s}{f_r T_{ah}}$$

$$\lambda E = -\lambda \frac{\beta_{soi} \rho_{atm} (q_{atm} - q_s)}{f_r T_{aw}}.$$



Thanks!

- Jiaxu Zhang, Jesse Nusbaumer, Chuck Bardeen, Jiang Xhu, Esther Brady, Bette Otto-Bliesner, Alexandra Jahn, Dave Bailey, David Noone

- Questions?