Seasonal cycle of evapotranspiration over the Amazon Basin in observations and models

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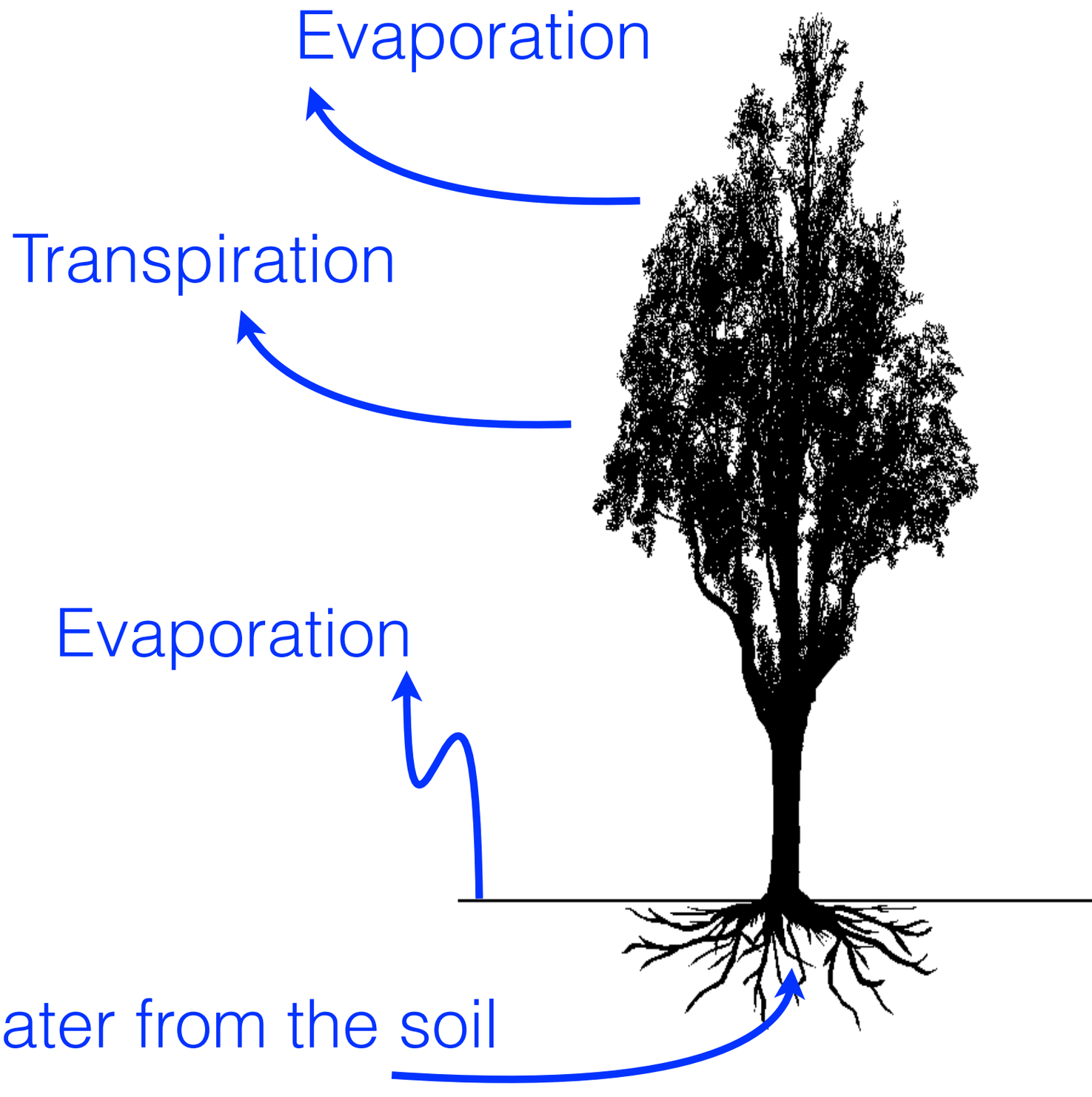
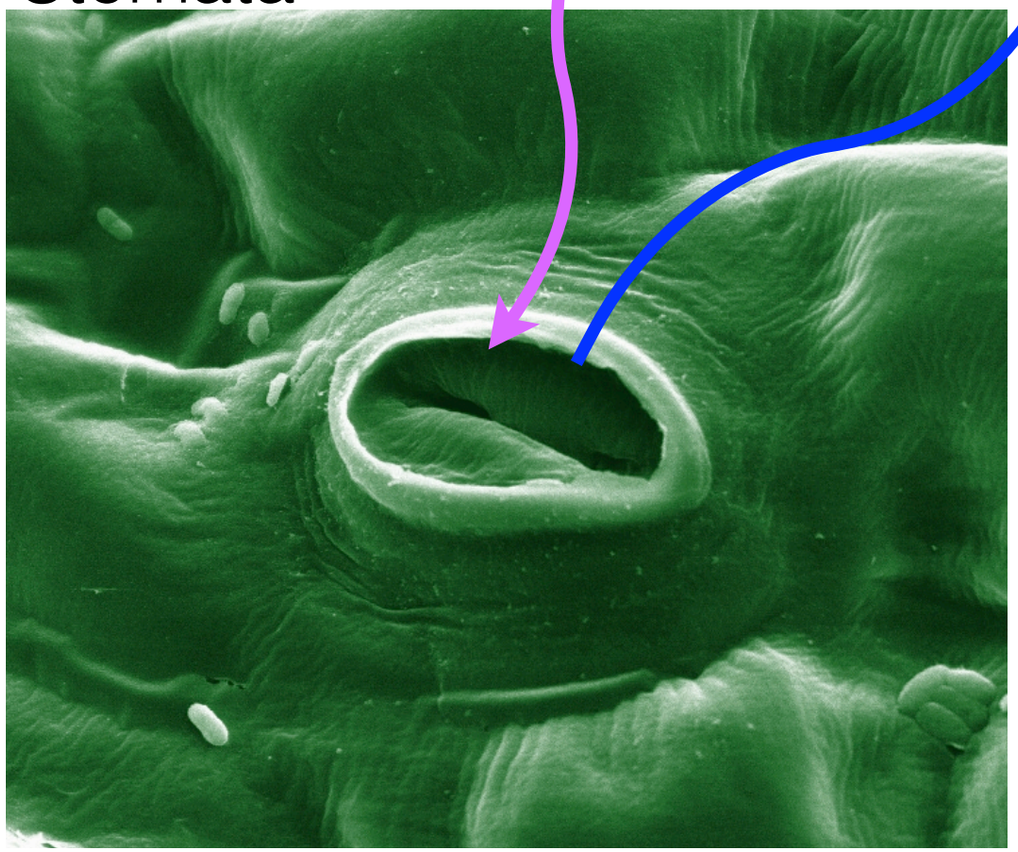
Plant-mediated water fluxes



Tree: Charlie Koven

Photosyn. and Transp. coupled through stomata



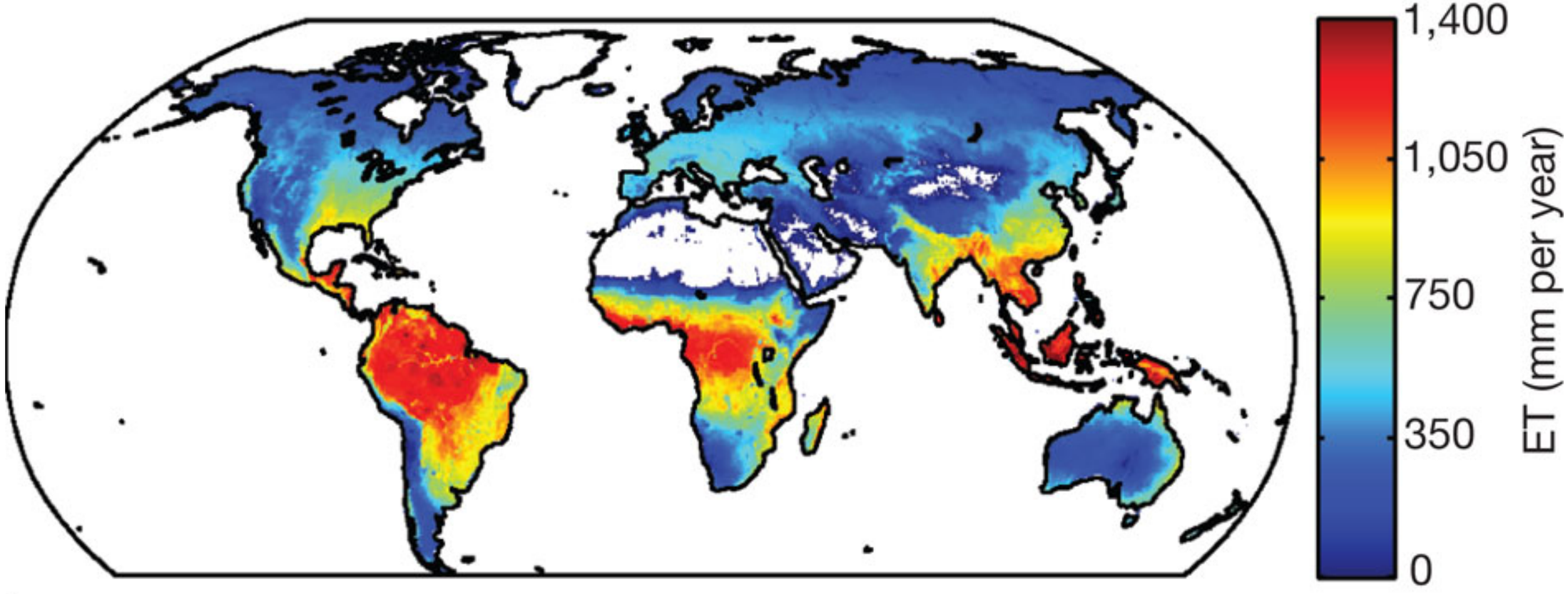
Tree: Charlie Koven

Hard to measure water fluxes at scale

Photo credit: Corey Rich

Options for estimating ET

- Up-scale ground data (fluxtowers)

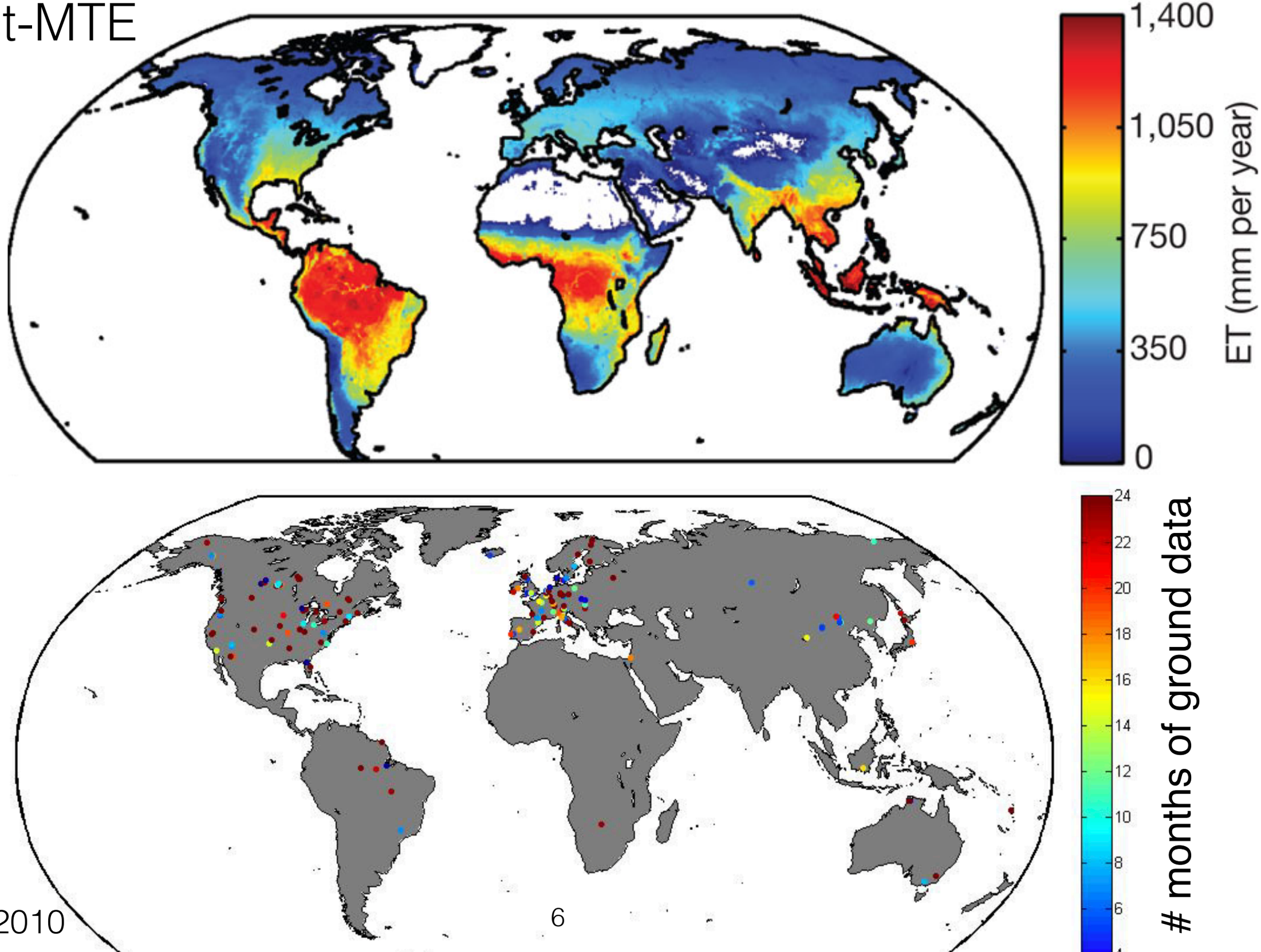


Fluxnet-MTE

Jung et al. 2010

Not much ground data in highest ET regions

Fluxnet-MTE



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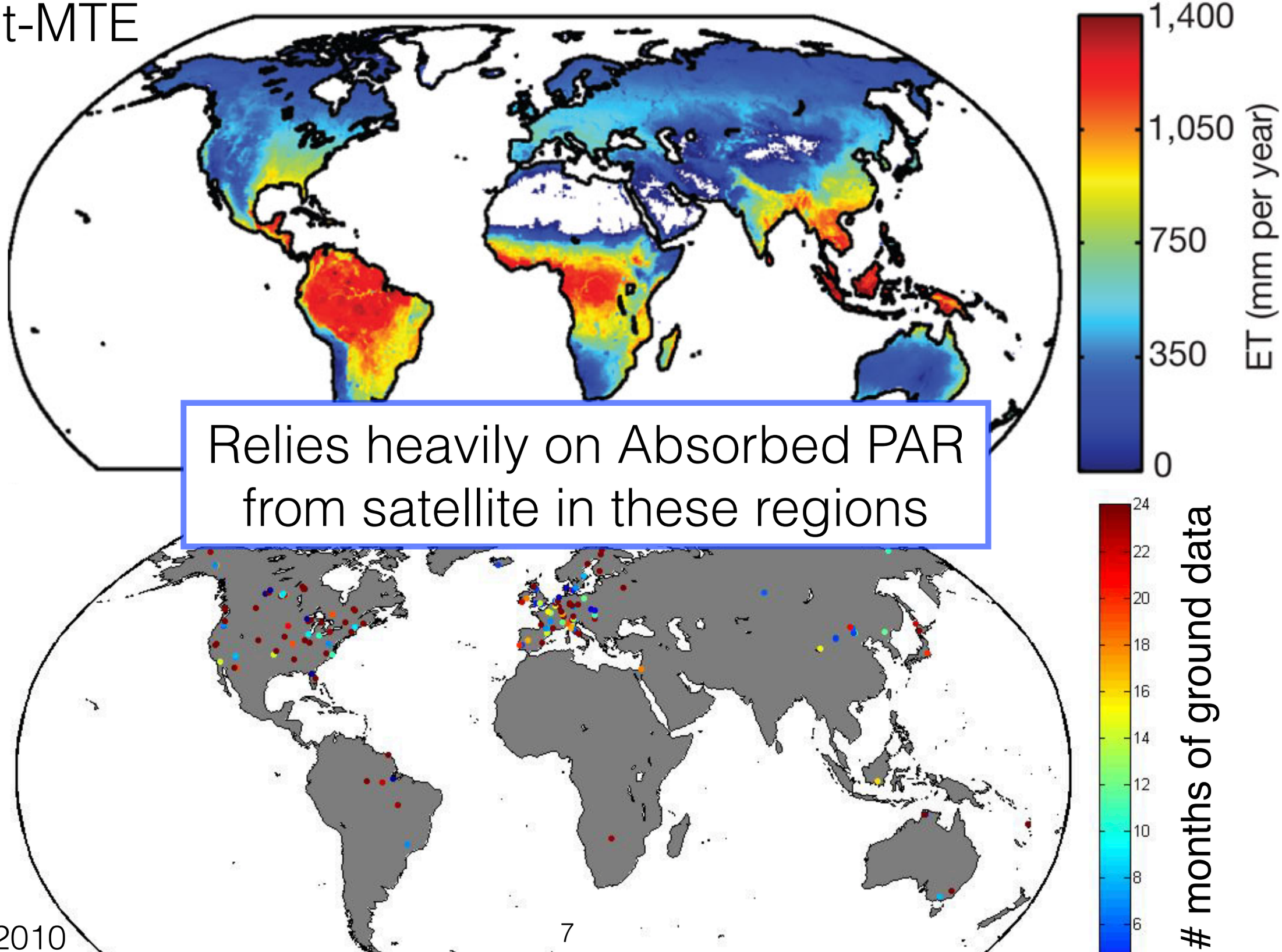
Fluxnet-MTE



Relies heavily on Absorbed PAR from satellite in these regions

Jung et al. 2010

Options for estimating ET

- Up-scale ground data (fluxtowers)
- Use an energy balance approach

Use Penman Monteith equation (or similar)

& satellite estimates for surface fields

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Relies heavily on Absorbed PAR
or NDVI from satellite

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$$ET = P - Q - \frac{dS}{dt}$$

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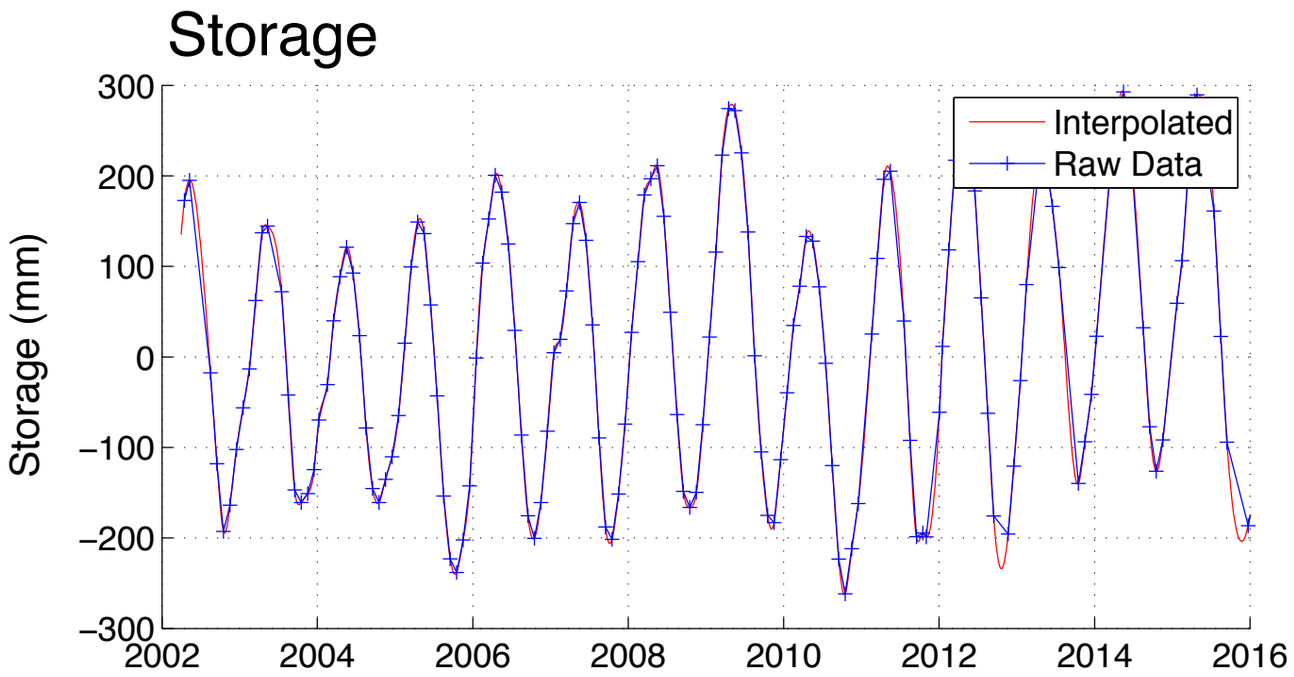
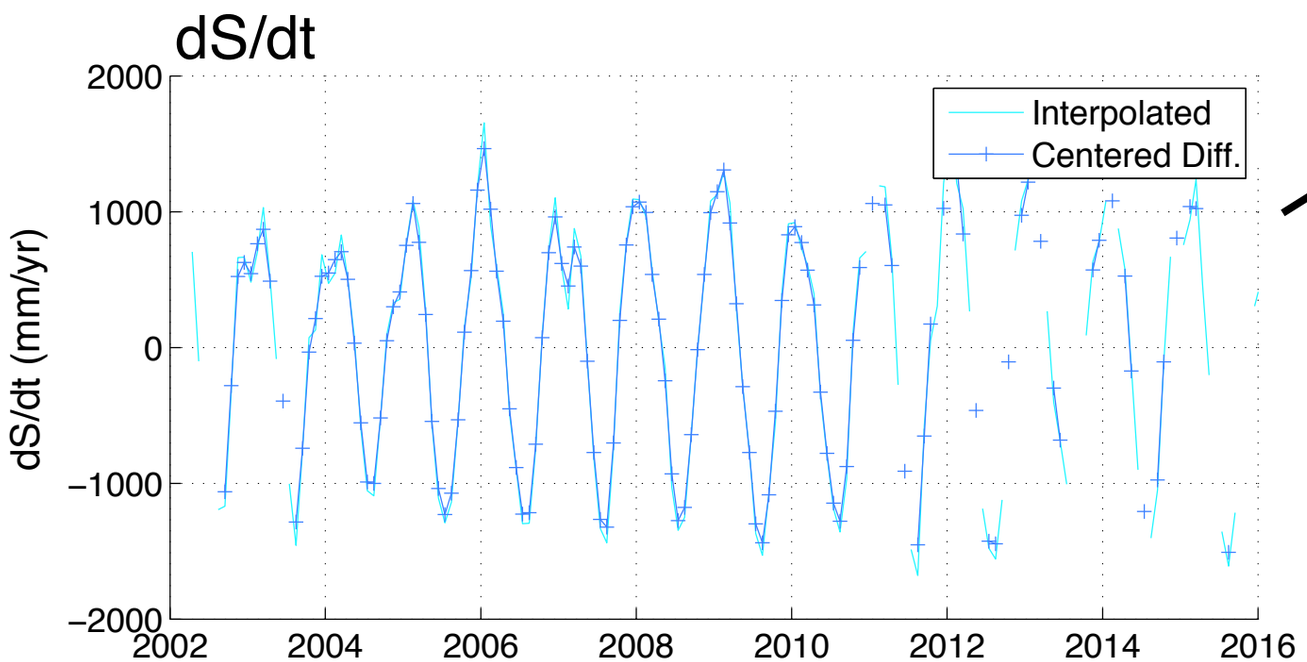
$$ET = P - Q - \frac{dS}{dt}$$

Typically done for timescales over which this is zero

But we can estimate storage & dS/dt from GRACE





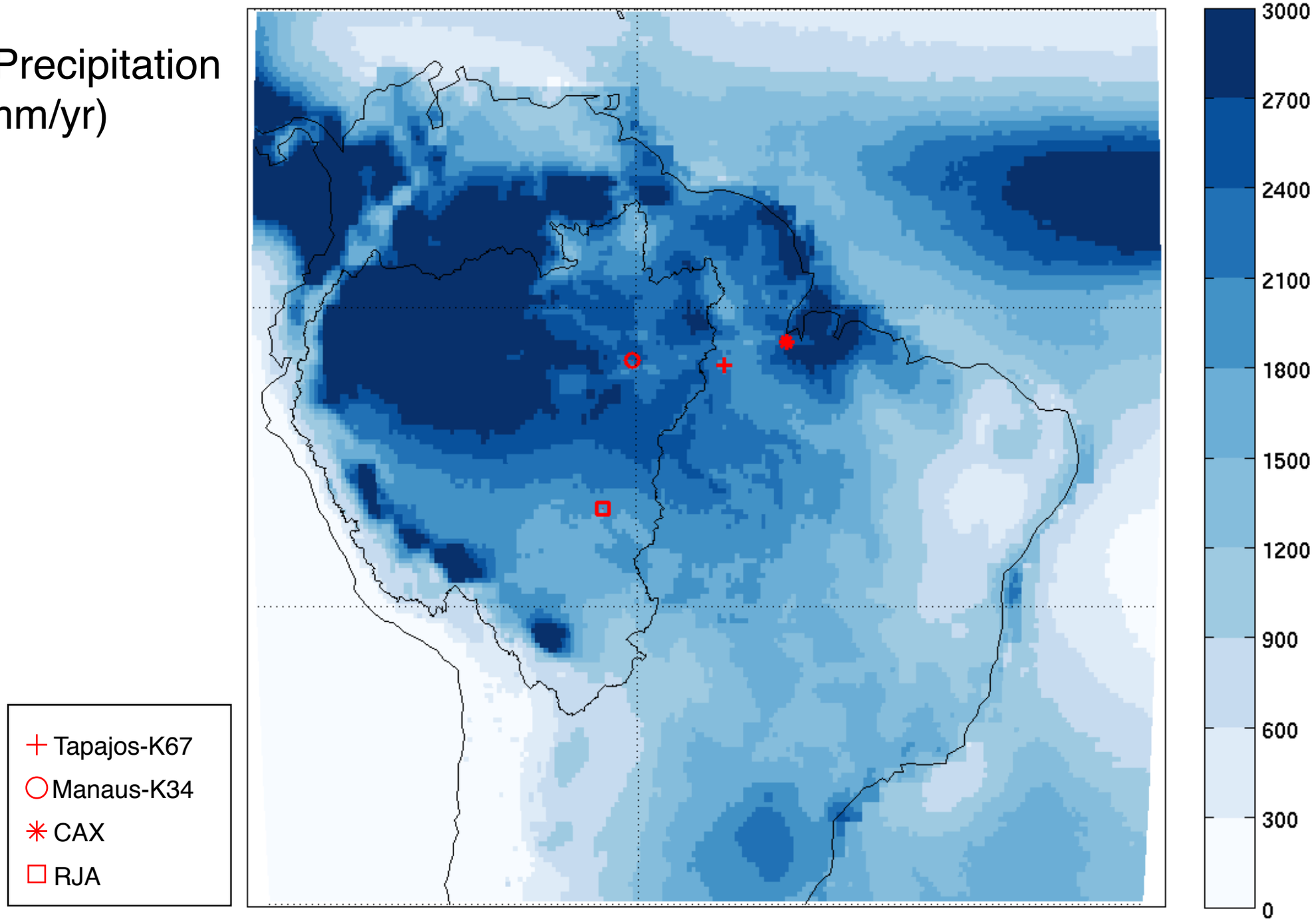
$$ET = P - Q - \frac{dS}{dt}$$

Storage & dS/dt for the Amazon Basin estimated from GRACE

Swann and Koven, 2017

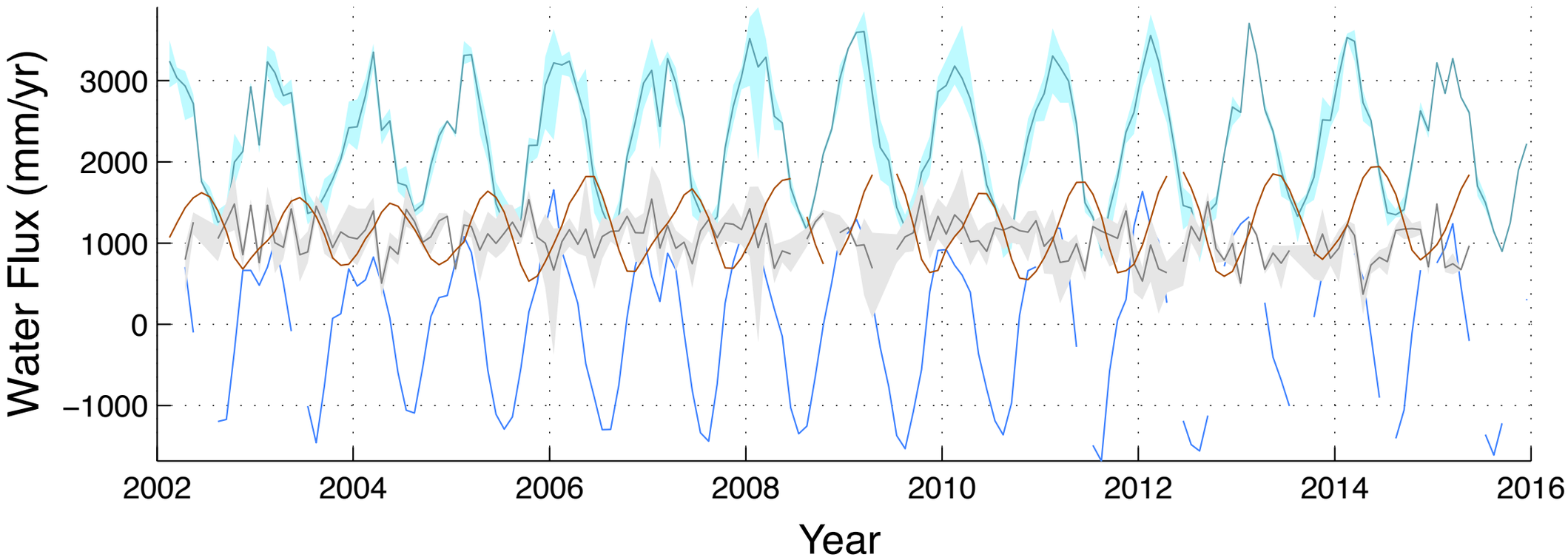
Amazon Basin, upstream of the gauging station at Óbidos

Annual Precipitation (mm/yr)



Swann and Koven, 2017

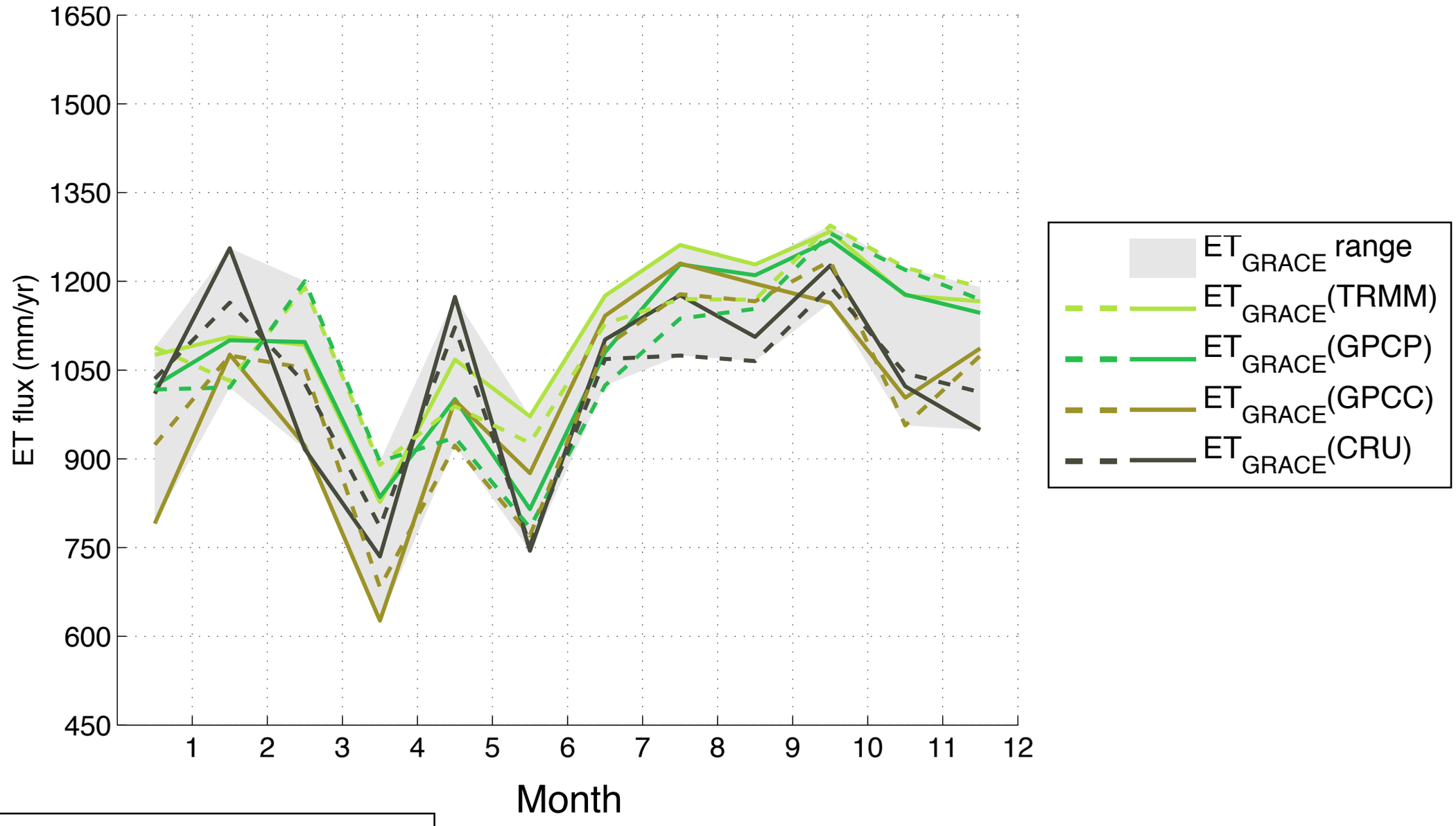
Water Budget for the Amazon Basin



$$ET = P - Q - \frac{dS}{dt}$$

Swann and Koven, 2017

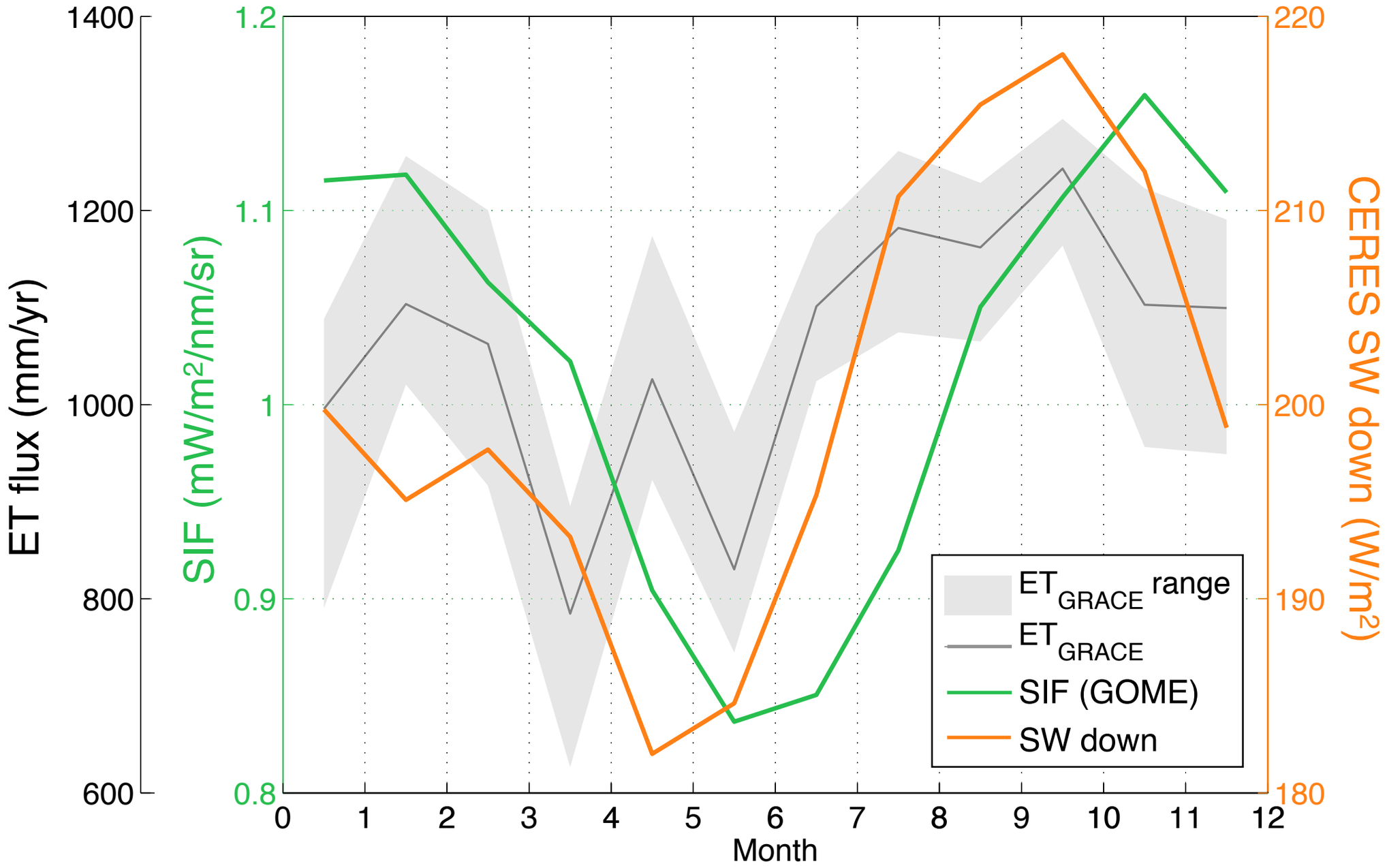
Seasonal Cycle of ET for the Amazon Basin



We used 4 different Precip datasets, 2 differentiation methods for dS/dt

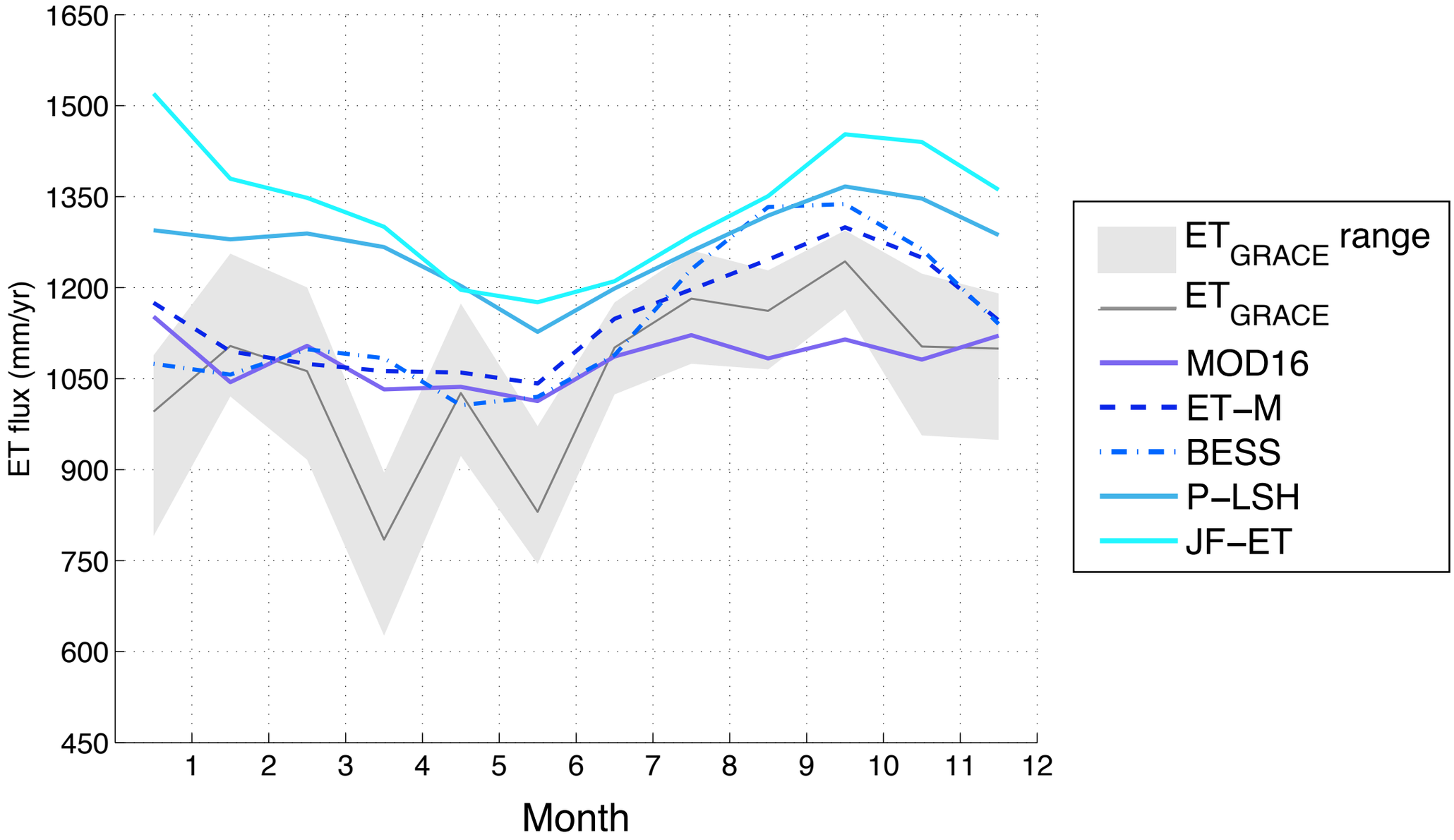
Swann and Koven, 2017

Seasonal Cycle closer to radiation than photosynthesis



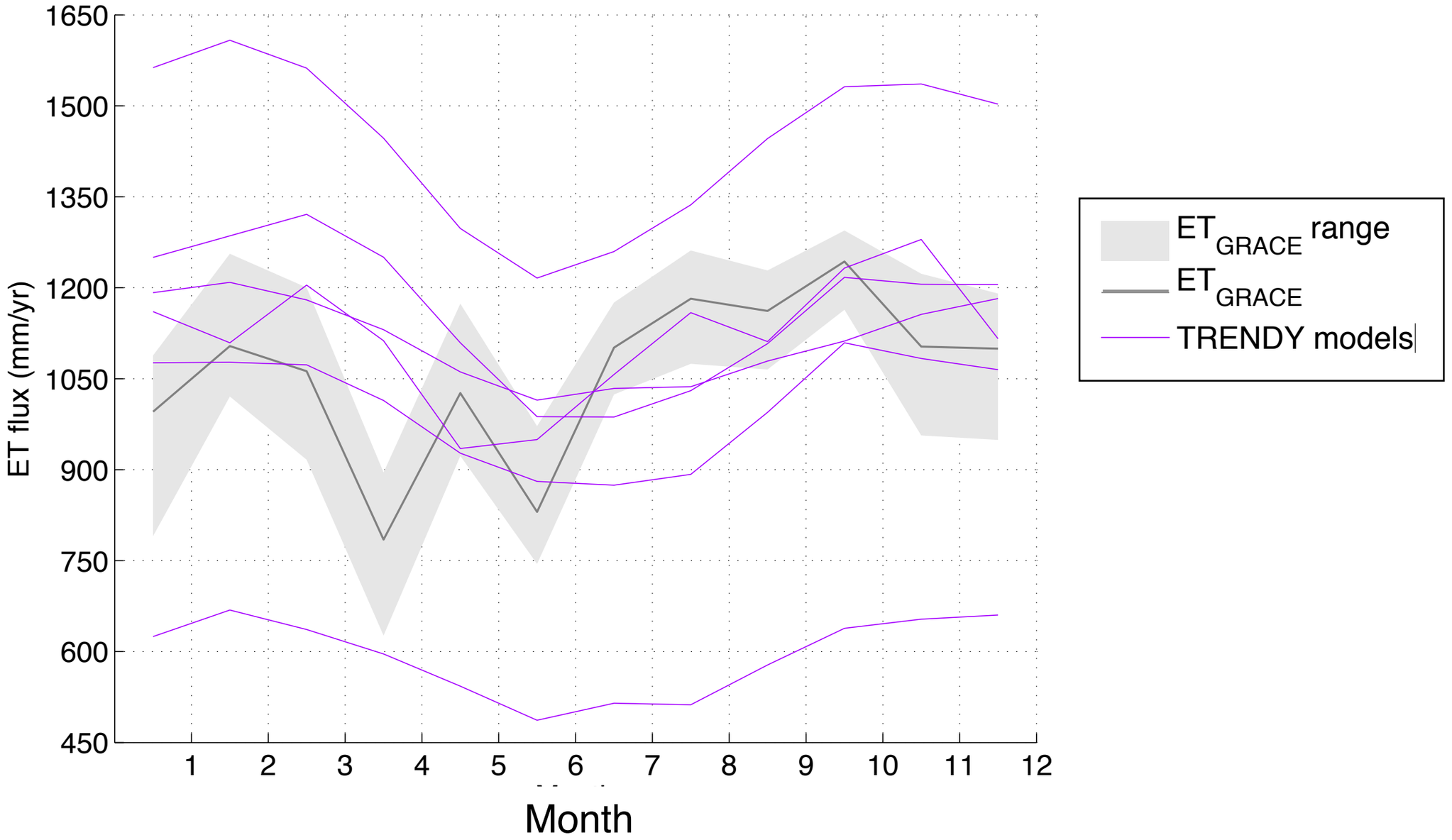
Swann and Koven, 2017

Energy Budget approaches: no wet season suppression



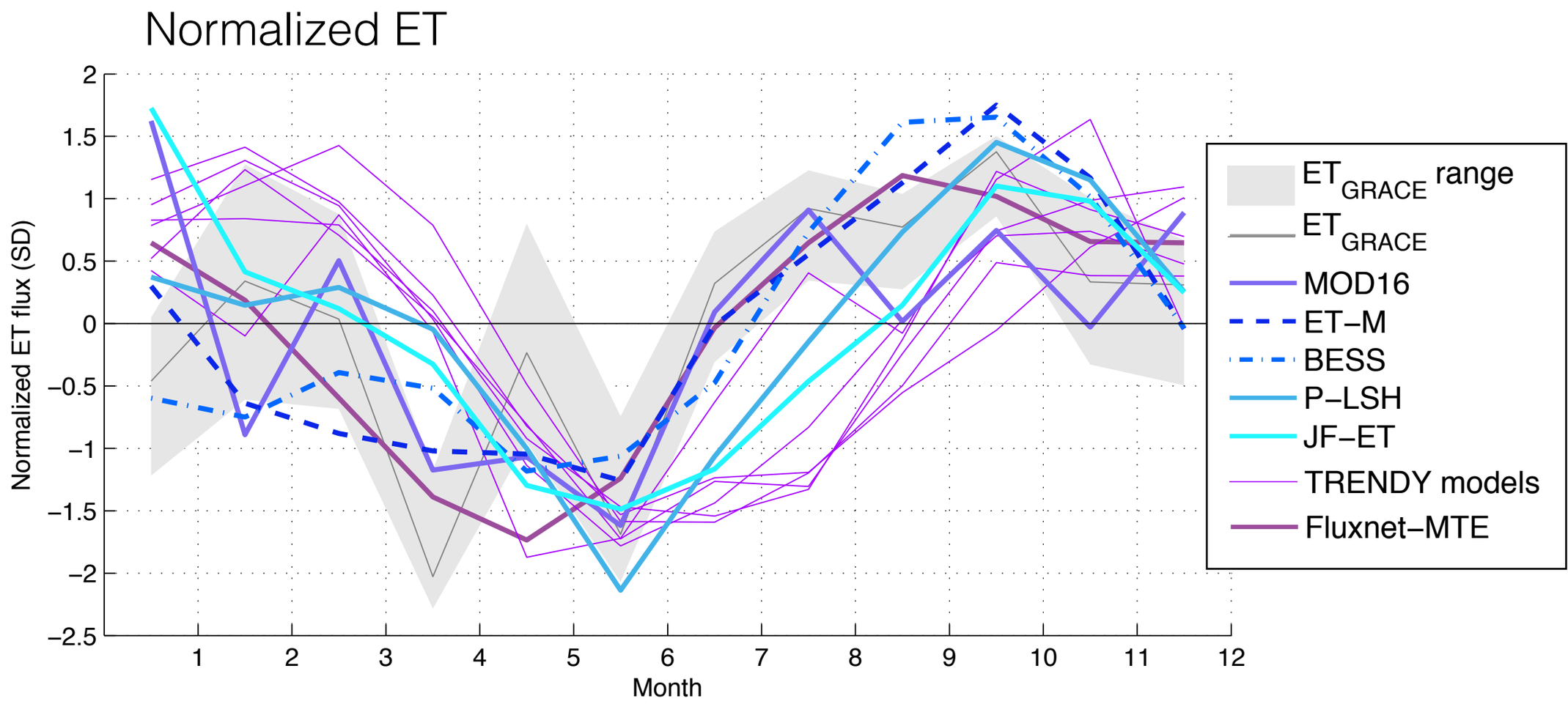
Swann and Koven, 2017

TRENDY models: amplitude ok, phase is delayed



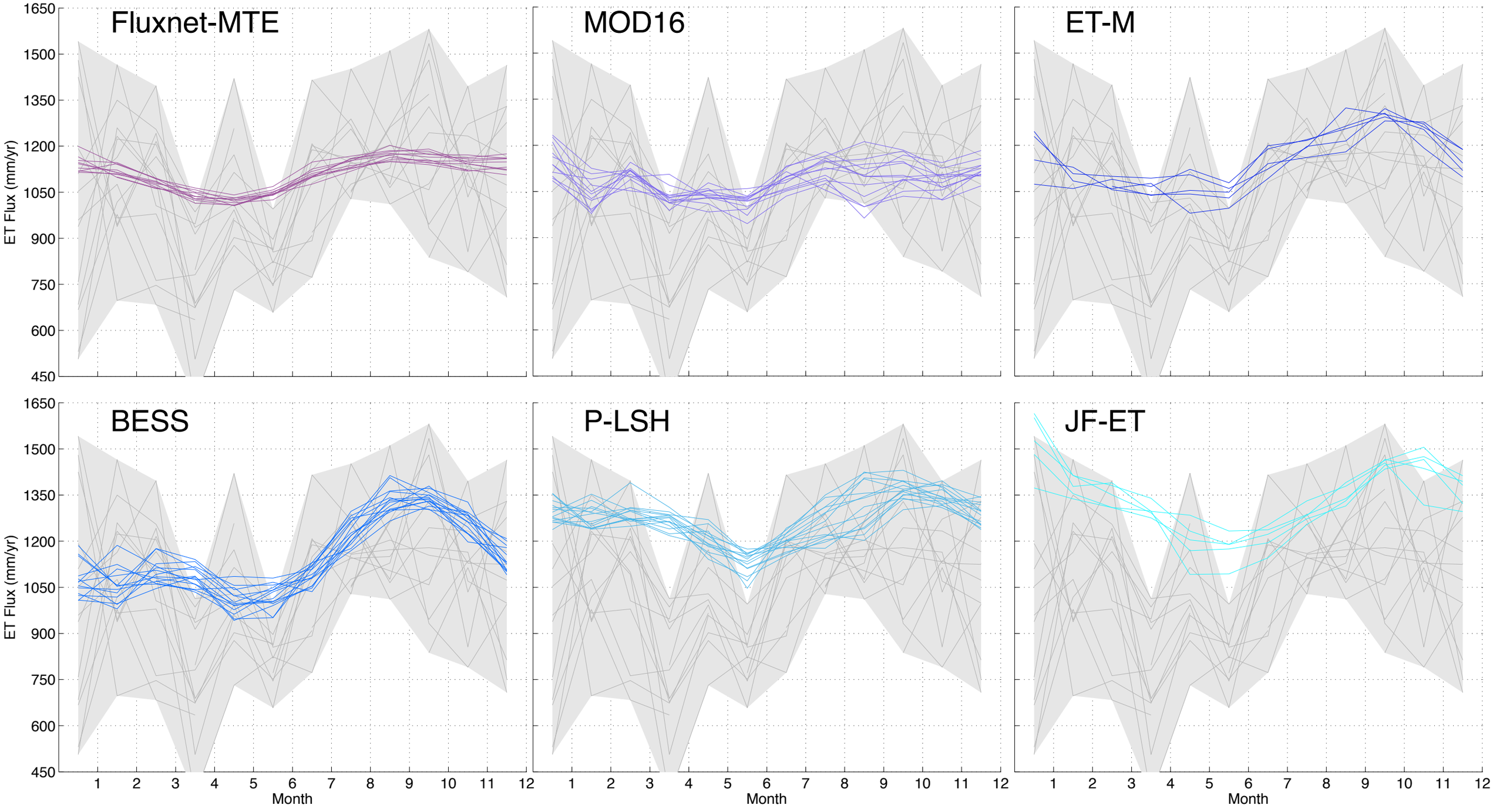
Swann and Koven, 2017

Phase is delayed, especially in models



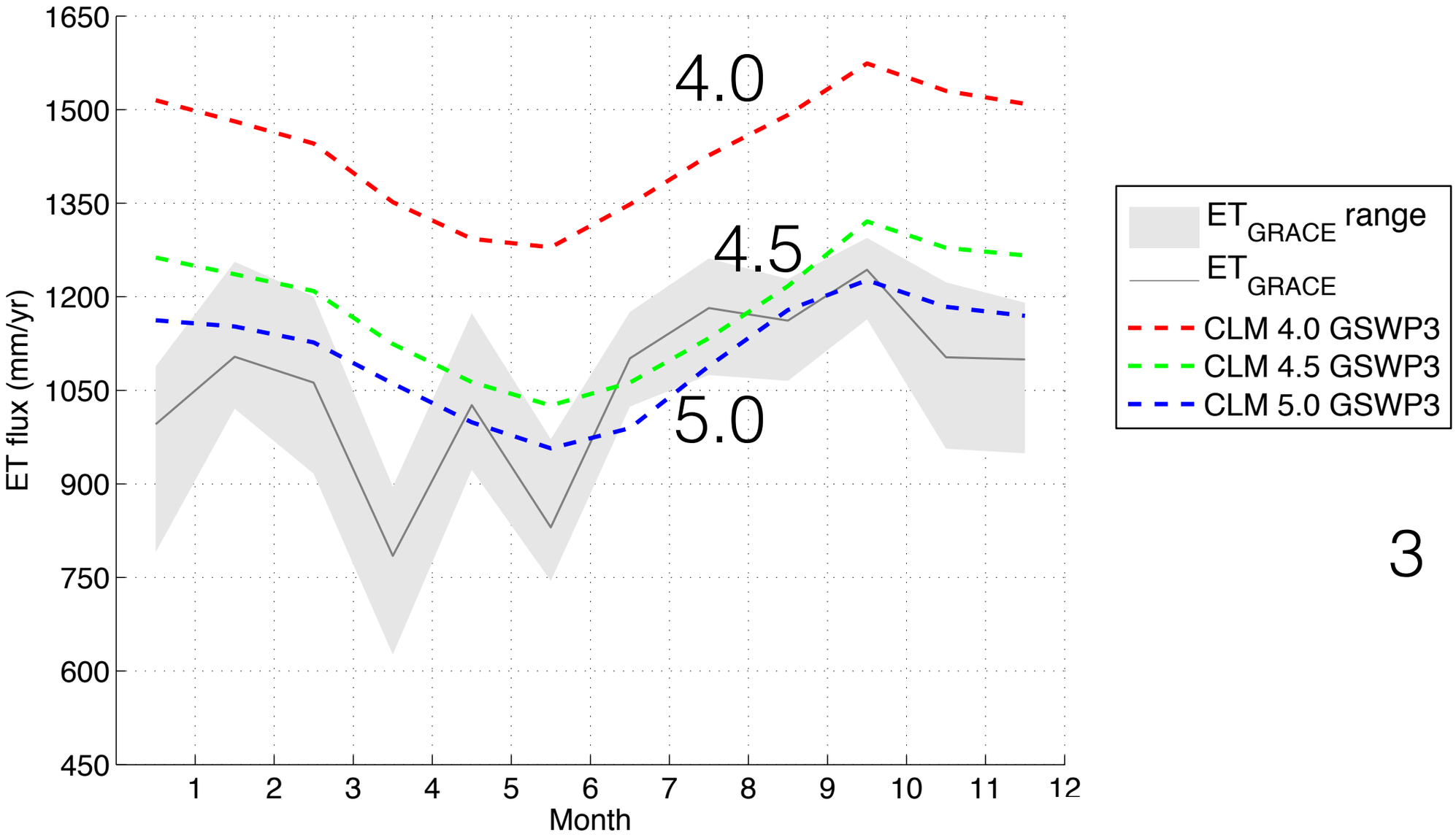
Swann and Koven, 2017

None of the products capture the seasonality in any year



Swann and Koven, 2017

CLM: average value differs between versions



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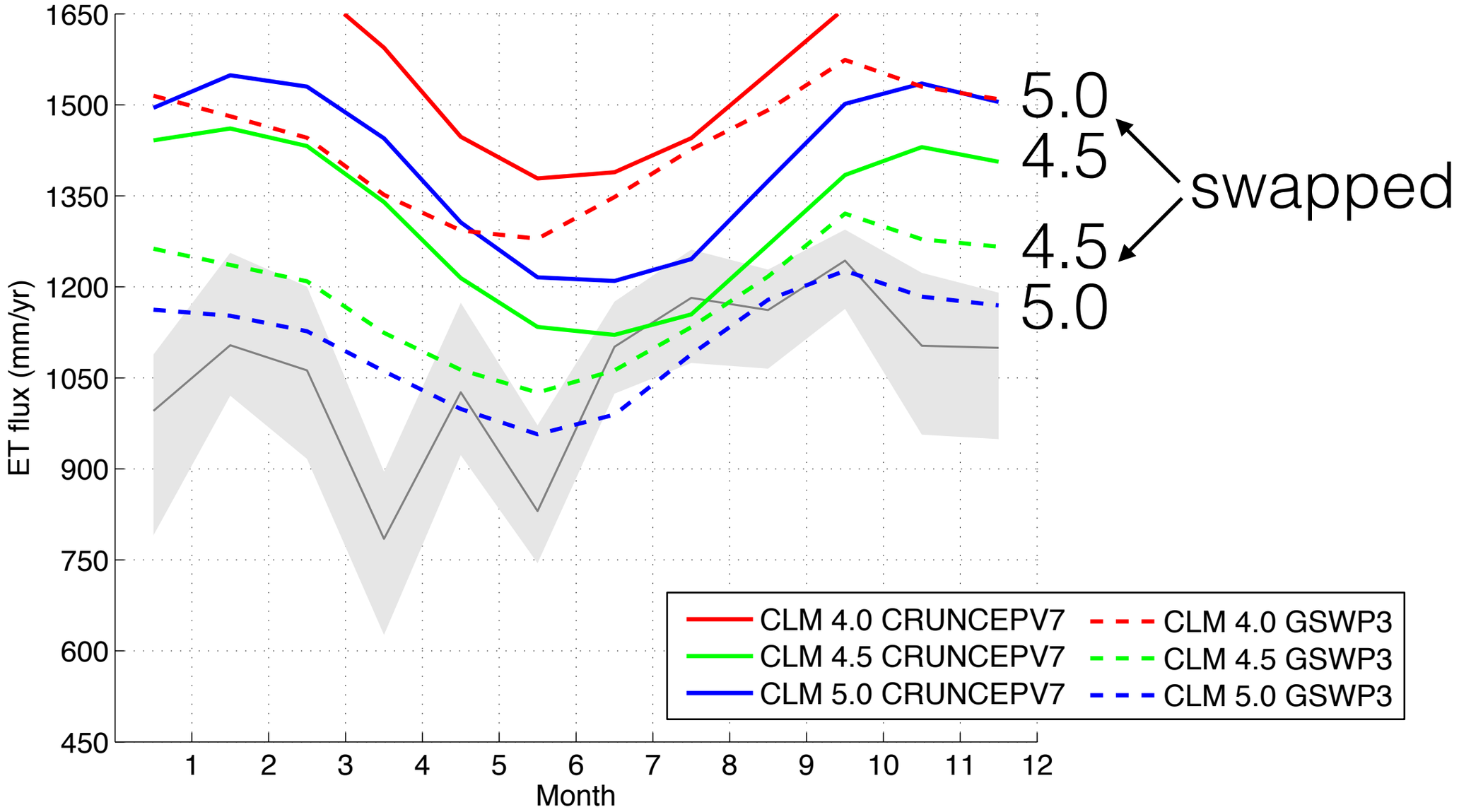
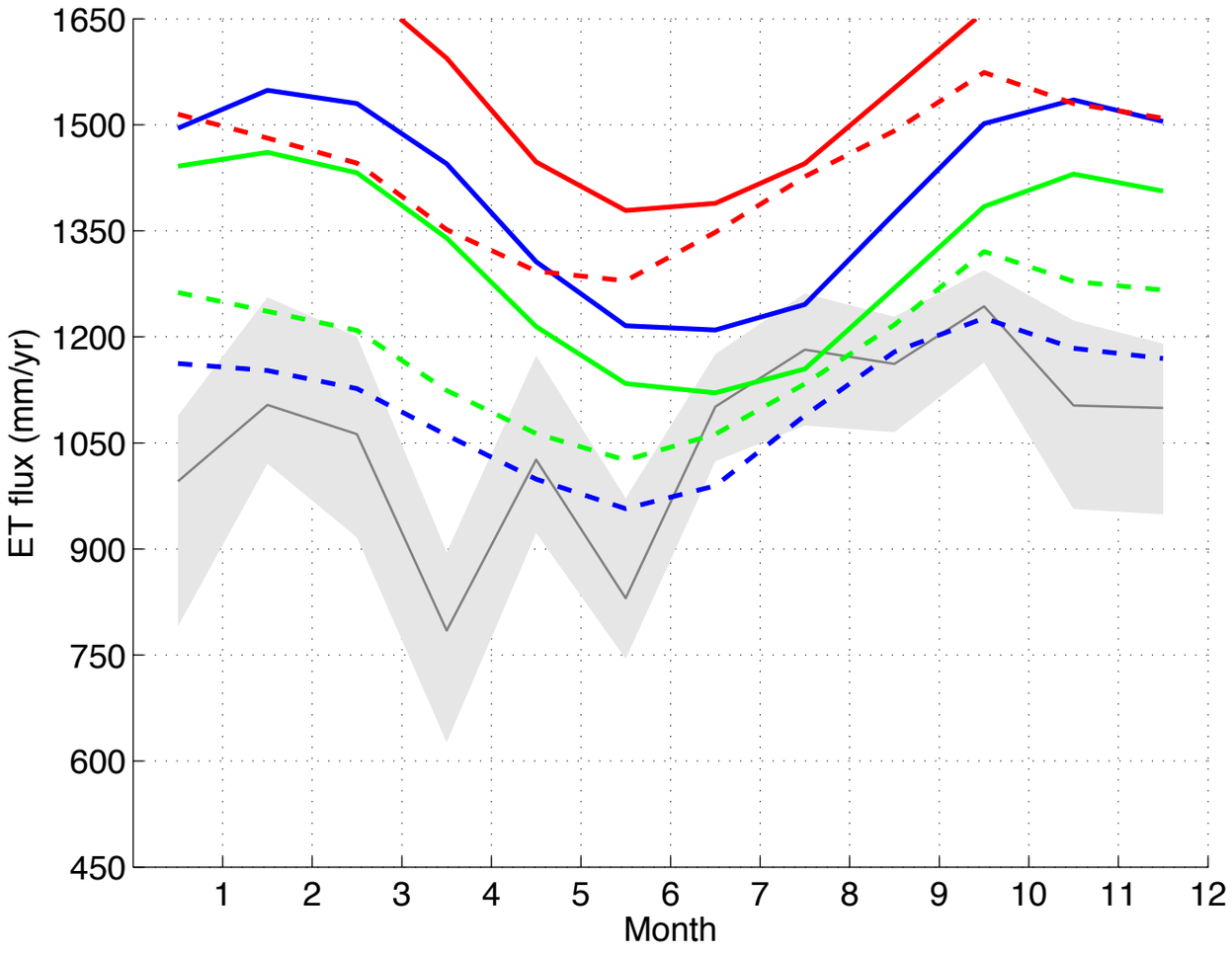
CLM: 4.5 to 5 not consistent wit different forcing

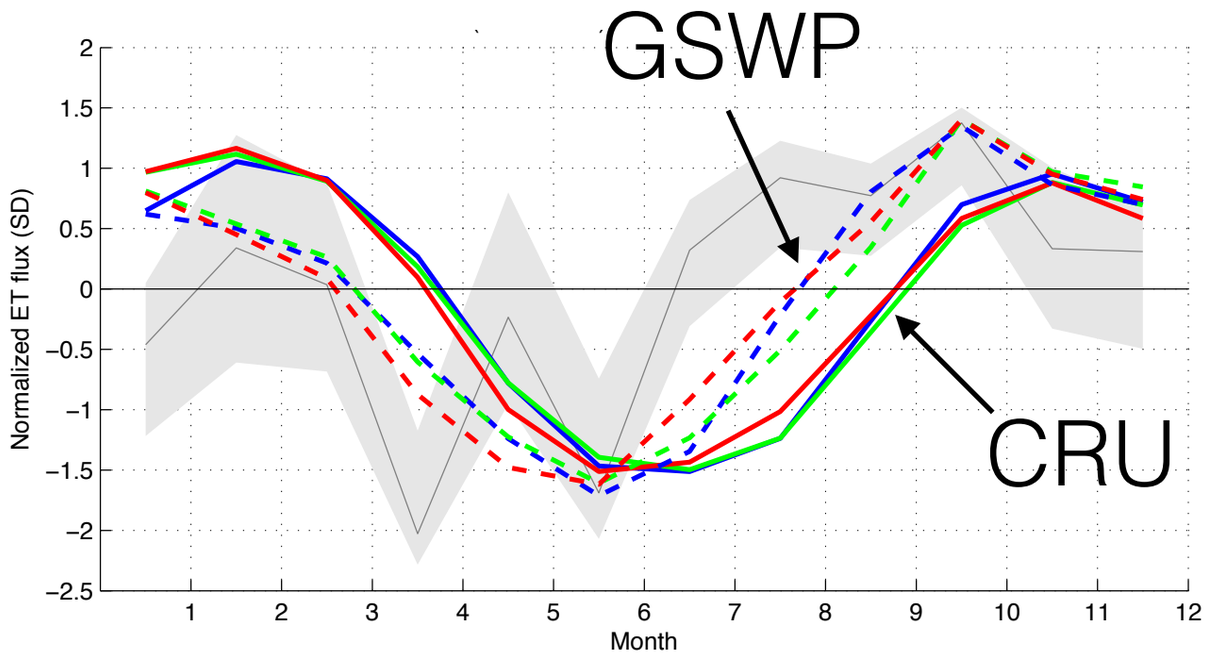


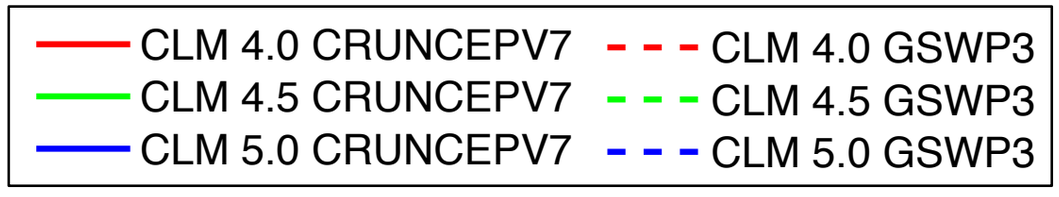
4.5 -> 5: one big switch is plant hydraulics

Must be driven by some aspect of forcing: humidity?

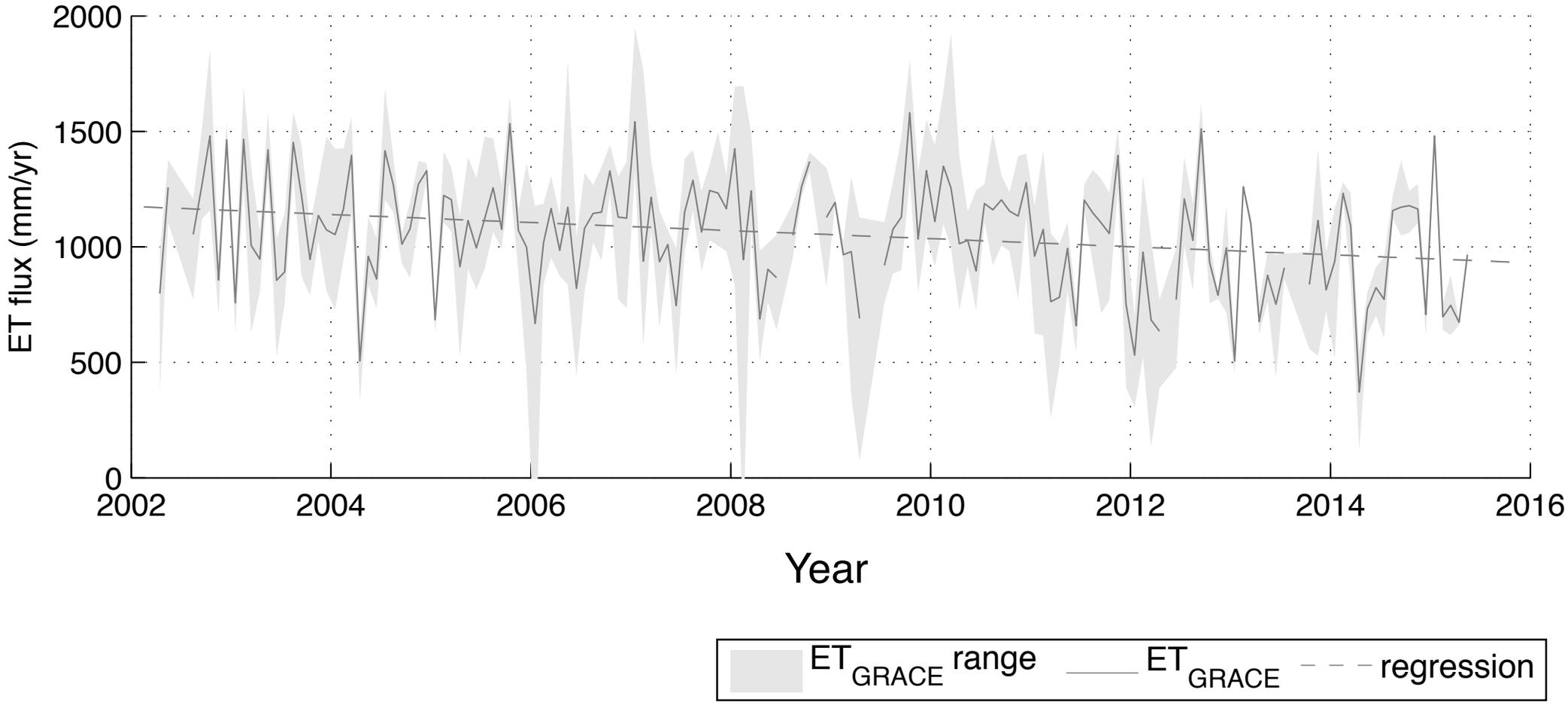
CLM: Forcing dataset matters! (But phase is still delayed)







ET trend over time (!), -1.46 mm/yr



Deforestation?
CO_2 fertilization?

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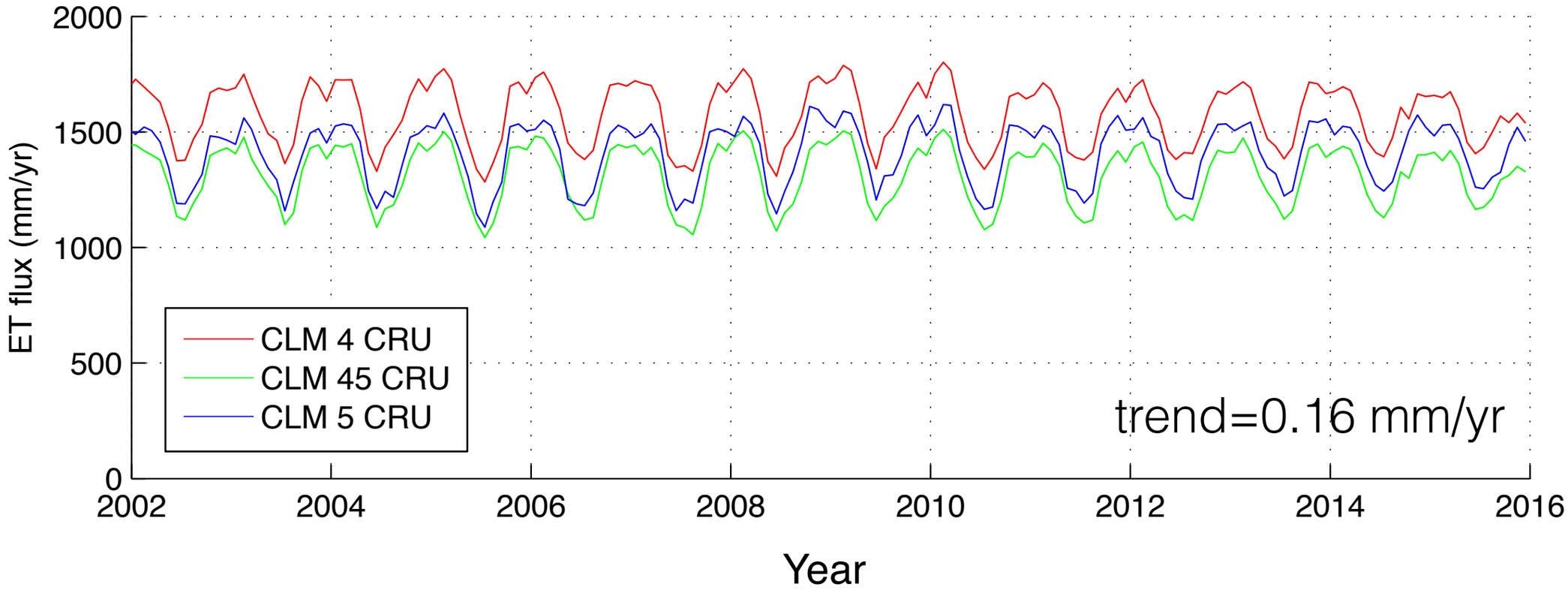
Little ET trend over time in CLM 5



Includes Land Use
And CO_2 fertilization

=> +LAI compensates

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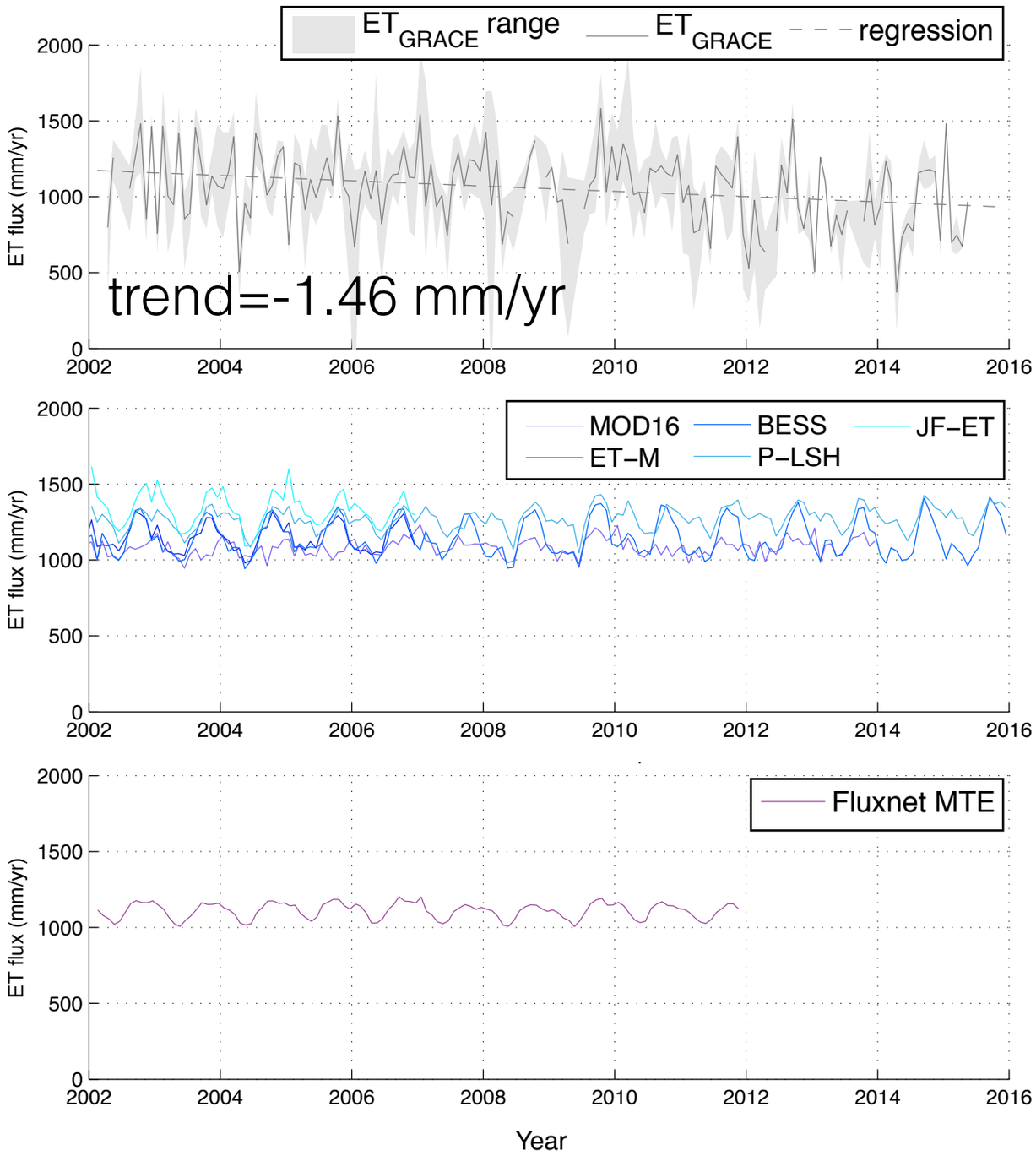
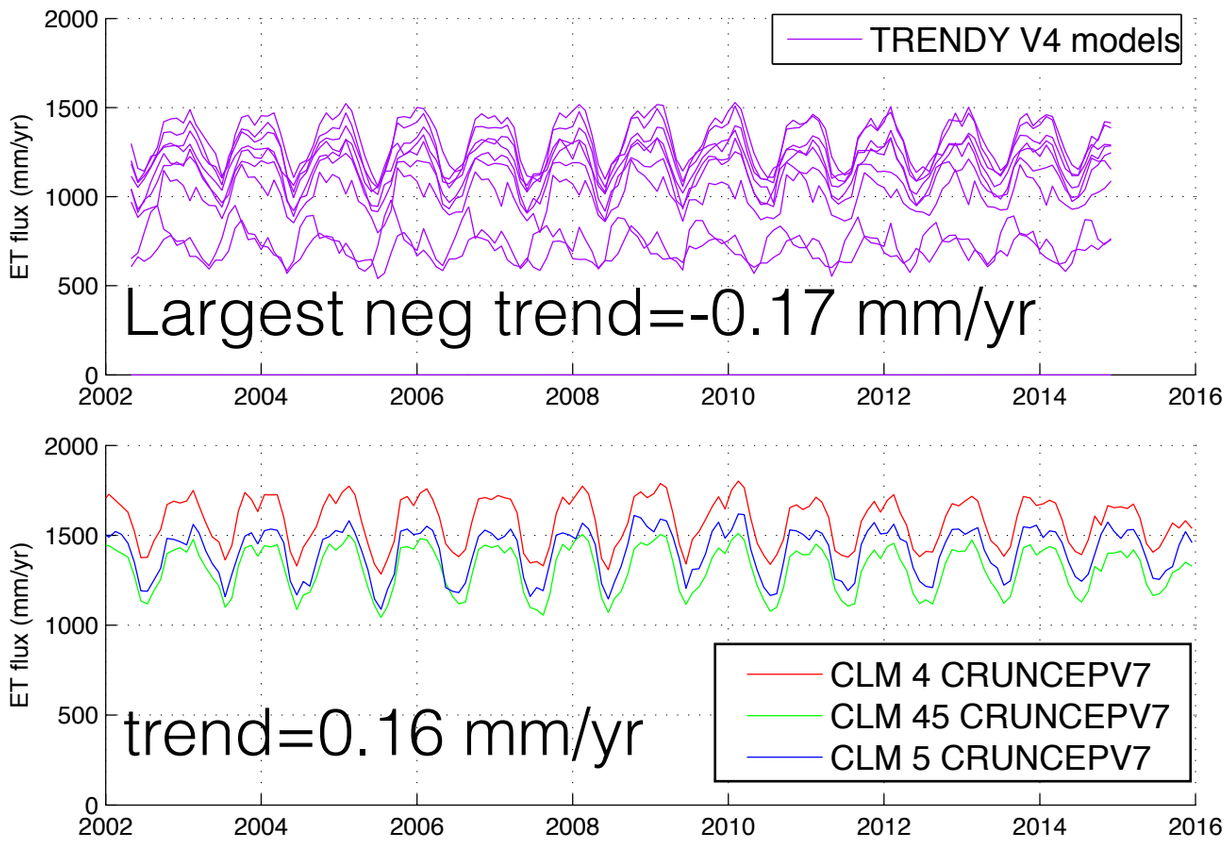
ET trend not present in models or other products



Products don't include CO_2 fert



Models include CO_2 fert And Land Use

Swann and Koven, 2017

Amazon Basin ET estimated from GRACE

- Big wet-season suppression
- Data products lack wet season suppression
- Models are delayed in phase of wet-up
- Forcing data matters, but phase is still off
- Plant hydraulics (4.5 ->5) does not have a consistent effect on Amazon ET
- Data shows downward trend, but not captured by models or products

ED2.1 model, in regular and “big leaf” mode