Alteration of energy and hydrological fluxes due to afforestation
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AFFORESTATION
The Eastern United States has seen an increase in afforestation (the process of naturally planting forests in a given area that has not historically contained forests) over the last 100 years.

This change in land surface can then affect the atmosphere and can alter the surface energy budget.

We study 3 locations: Billings, OK (1), Blacksburg, VA (2), and State College, PA (3), for the period from 1850 to 2000.

Percent change of Temperate Broadleaf, Deciduous (TBD) Forest from 1850

Percentage change of other land use/land cover classes from 1850 to 2020

FLUXES
Because the net climate forcing of temperate forests is uncertain (Bonan 2008), we look at the different hydrological and energy fluxes that are affected by afforestation, which includes:

- Evapotranspiration (ET) – process of evaporation of moisture from the ground/soil and transpiration from plant stomata.
- Sensible Heat (Q_s) – the energy that goes into heating the air
- Latent Heat (Q_l) – the energy that goes into cooling the air by the process of evapotranspiration.
- Ground Heat Flux (Q_g) – energy that goes into heating the ground and soil
- These all in turn affect climate variables of a region such as specific humidity and temperature
- Surface Energy Balance (R_{net}) = Q_s + Q_l + Q_g

METHODOLOGY
a. Analyze surface data from the CLM2 (Community Land Model) in the CESM (Community Earth System Model) to see the changes in forests across most of the United States
b. Setup a single column model (SCM) version of a coupled Community Atmosphere Model (CAM) and Community Land Model (CLM2) using the Community Earth System Model (CESM) analyzing 28 days of output at a specific grid point in Billings, OK

MODEL OUTPUT FOR BILLINGS, OKLAHOMA

Levels in Atmosphere:
- surface
- ~ 300 meters
- ~ 1300 meters
- ~ 5000 meters
- ~ 10,000 meters

Model outputs indicate:
- Three air masses moved throughout the region
- Boundary layer is located around 1500 meters

The latent heat (Q_l) flux plays a larger role in the net surface balance due to evaporation from crops

REFERENCES

CONCLUSION
- As sensible and latent heat fluxes are altered, the temperature will also change.
- According to the sensible heat equation, Q = mcΔT we can assume that as sensible heat increases, temperature also will increase.
- The R² value indicates the model works well in balancing fluxes.
- Vegetation plays a large role in fluxes.

FUTURE WORK
- Change the default grid point to other areas in the Eastern United States where afforestation has occurred.
- Modify the model input surface data from the Community Land Model to change the percent vegetation composition to see the affects it has on the climate.

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