

TIME-TRAVELING PLANT SWEAT:

The search for more accurate ET estimates

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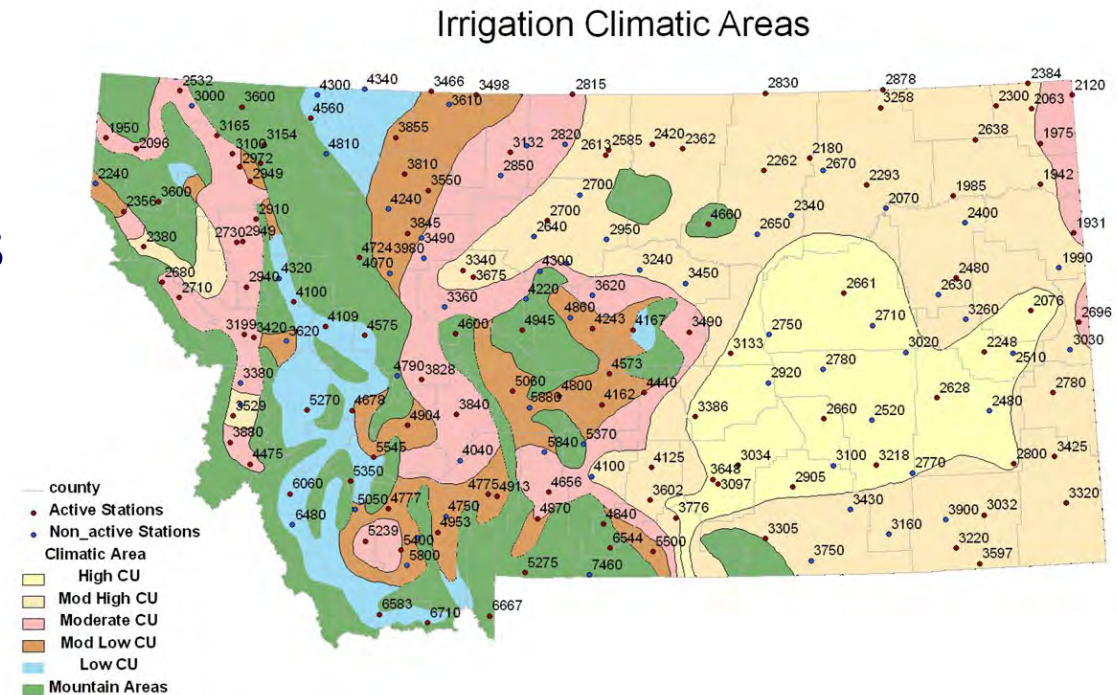


THEN: Single-variable ET estimates

November 19, 2008

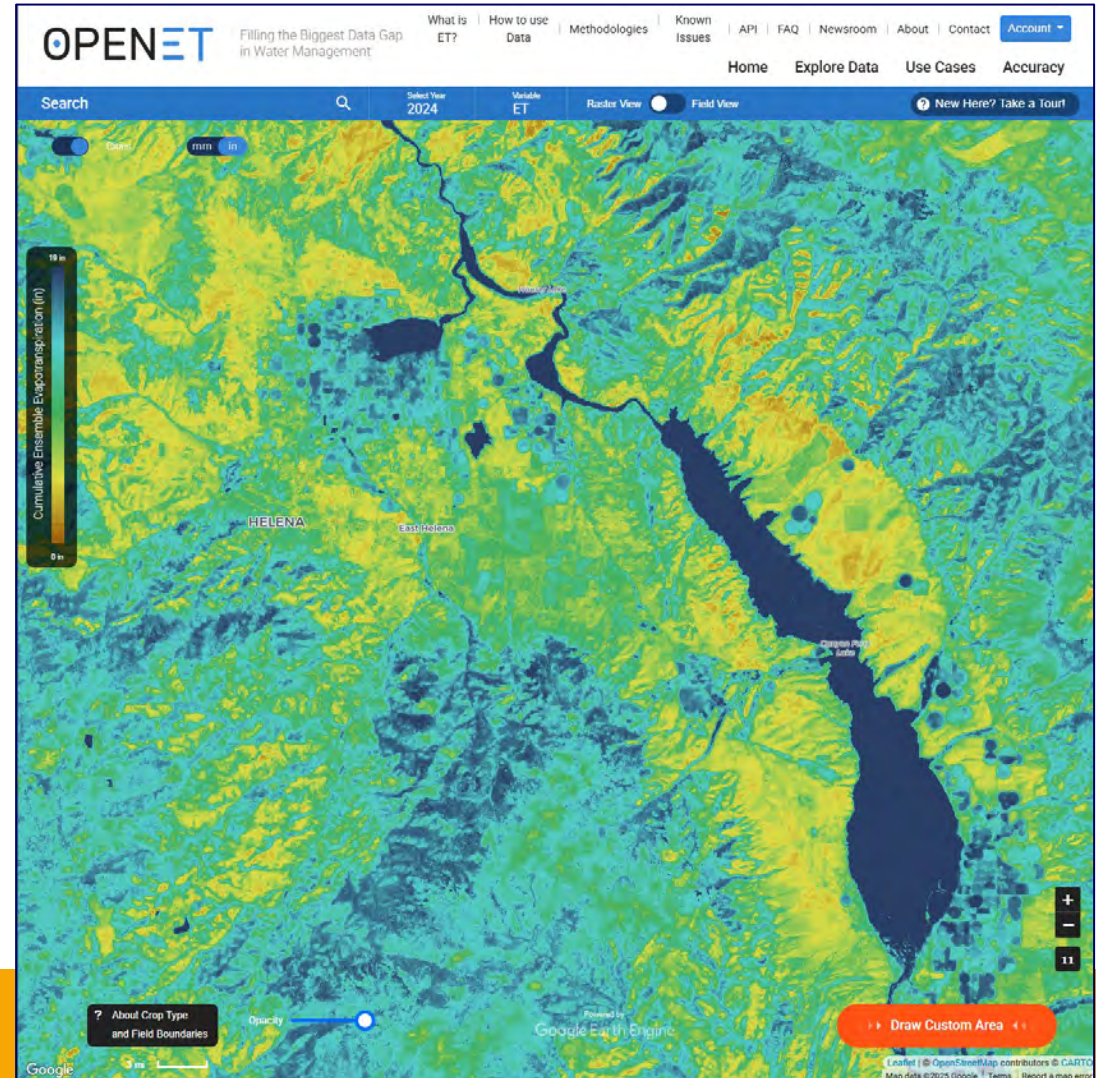
- Administrative Rules of Montana 36.12.1902: Use the Blaney-Criddle equation with a legacy climatology database for 180 pre-defined locations in Montana to estimate ET.
- Adjust using a county-wide “management factor” relating to agricultural statistics from the USDA.

IWR WEATHER STATION MAP

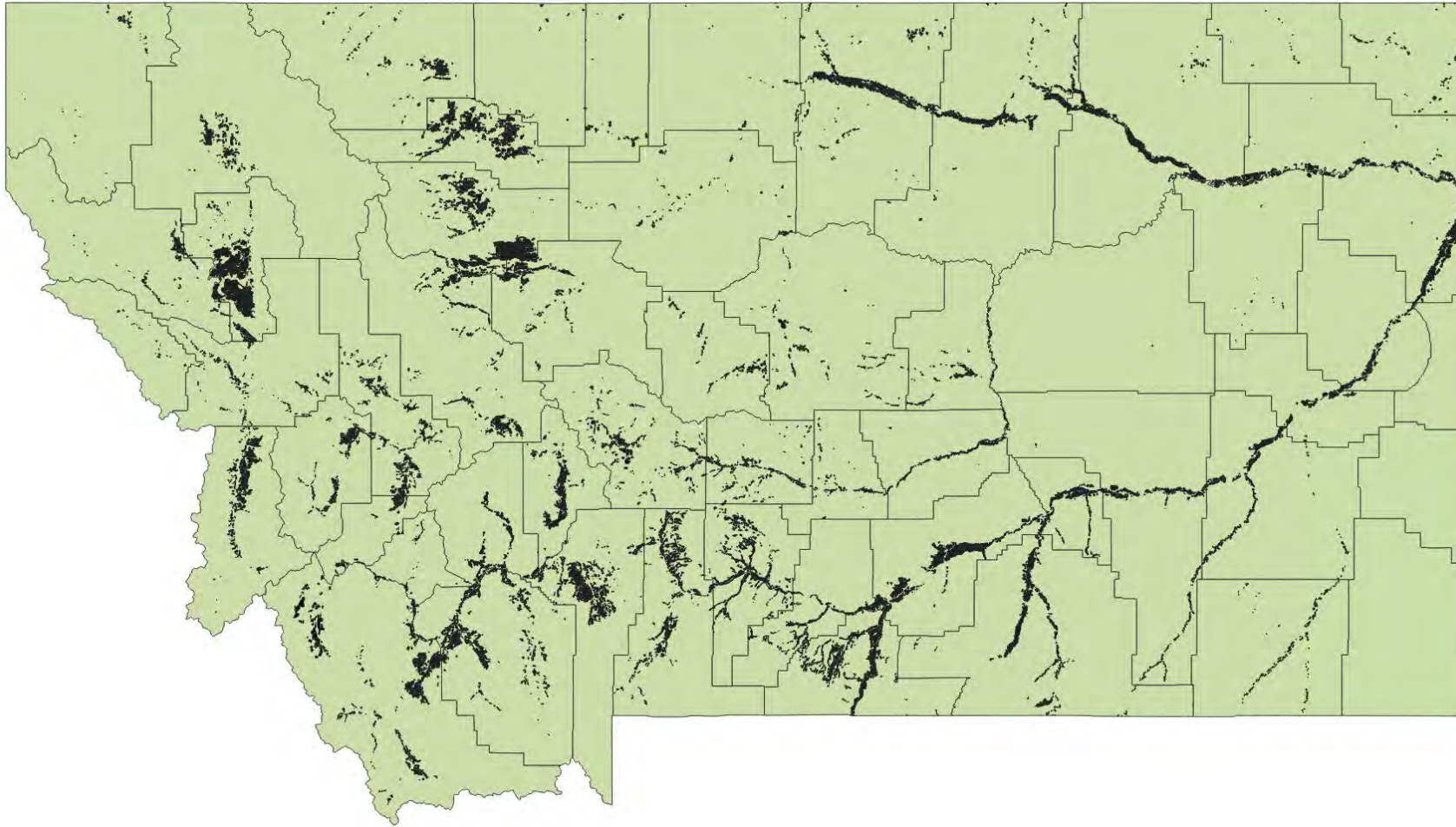


NOW: Remote Sensing with OpenET

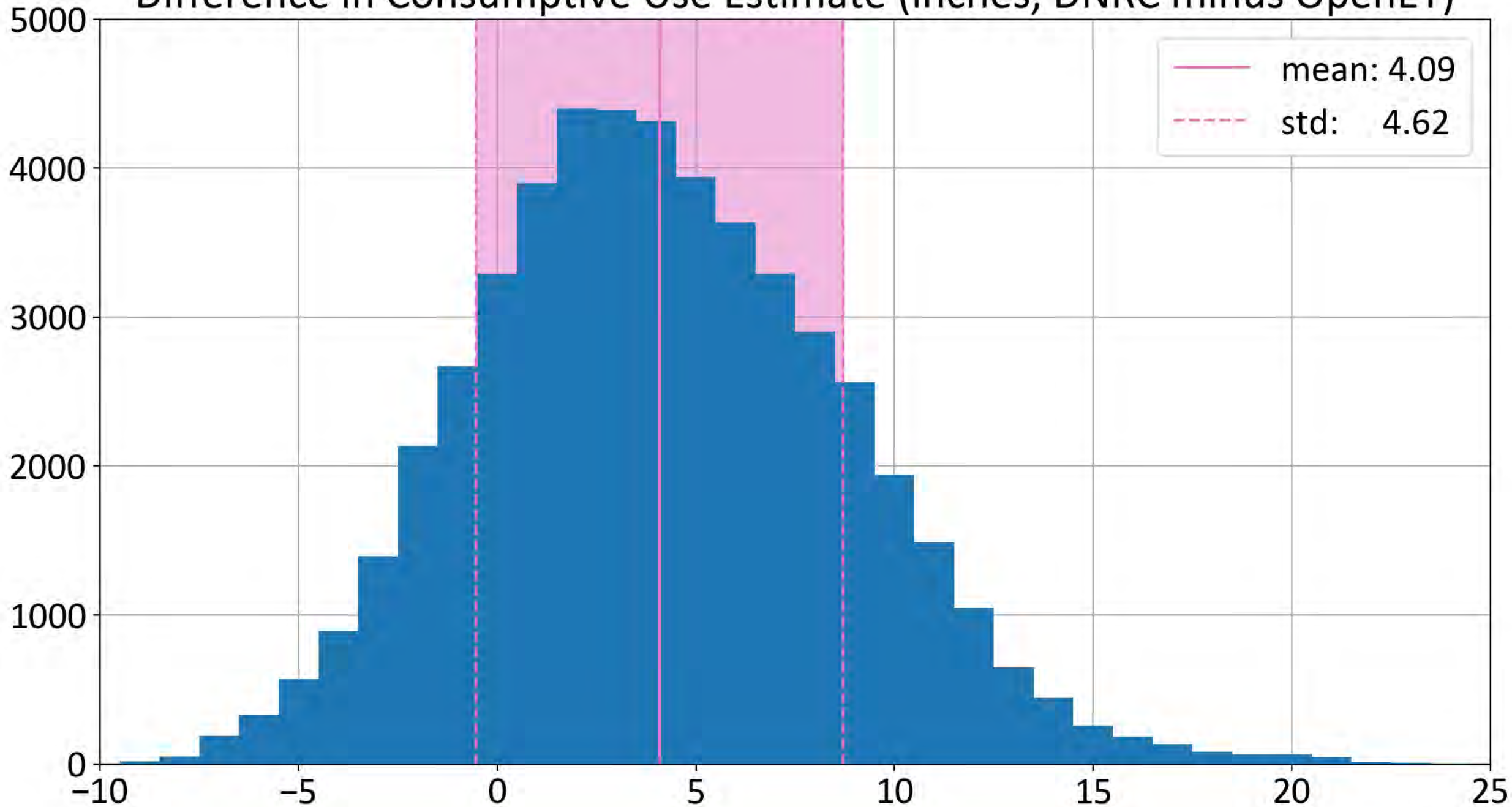
- Reference ET from Penman-Monteith equation, using 4-km GridMET daily meteorological variables.
- Actual ET/crop coefficient from ensemble of 6 models run on remote sensing observations produce more realistic estimates at 30m resolution.
- Monthly data 1991-2024.



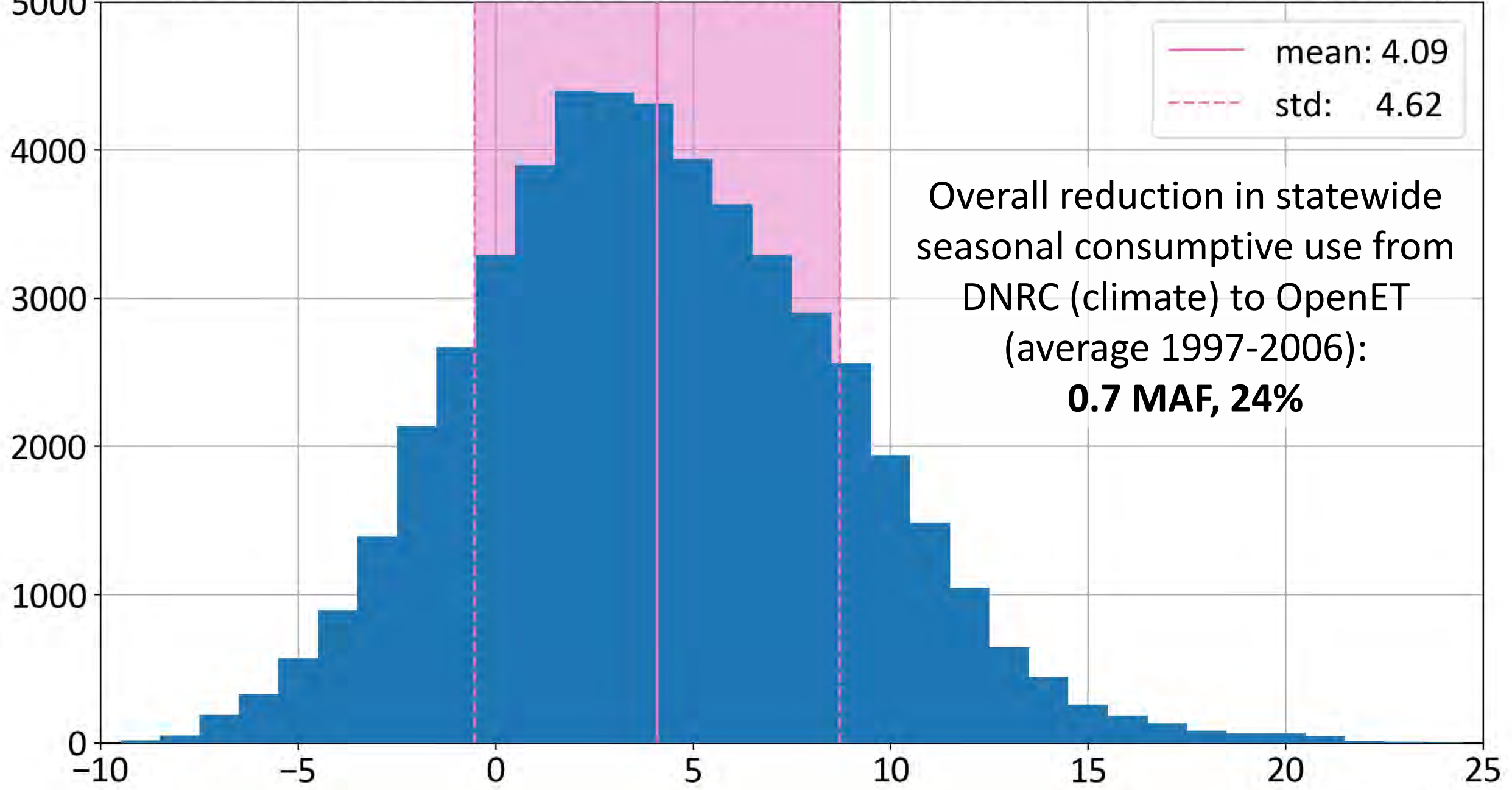
Statewide Irrigation Dataset: 51,000 fields



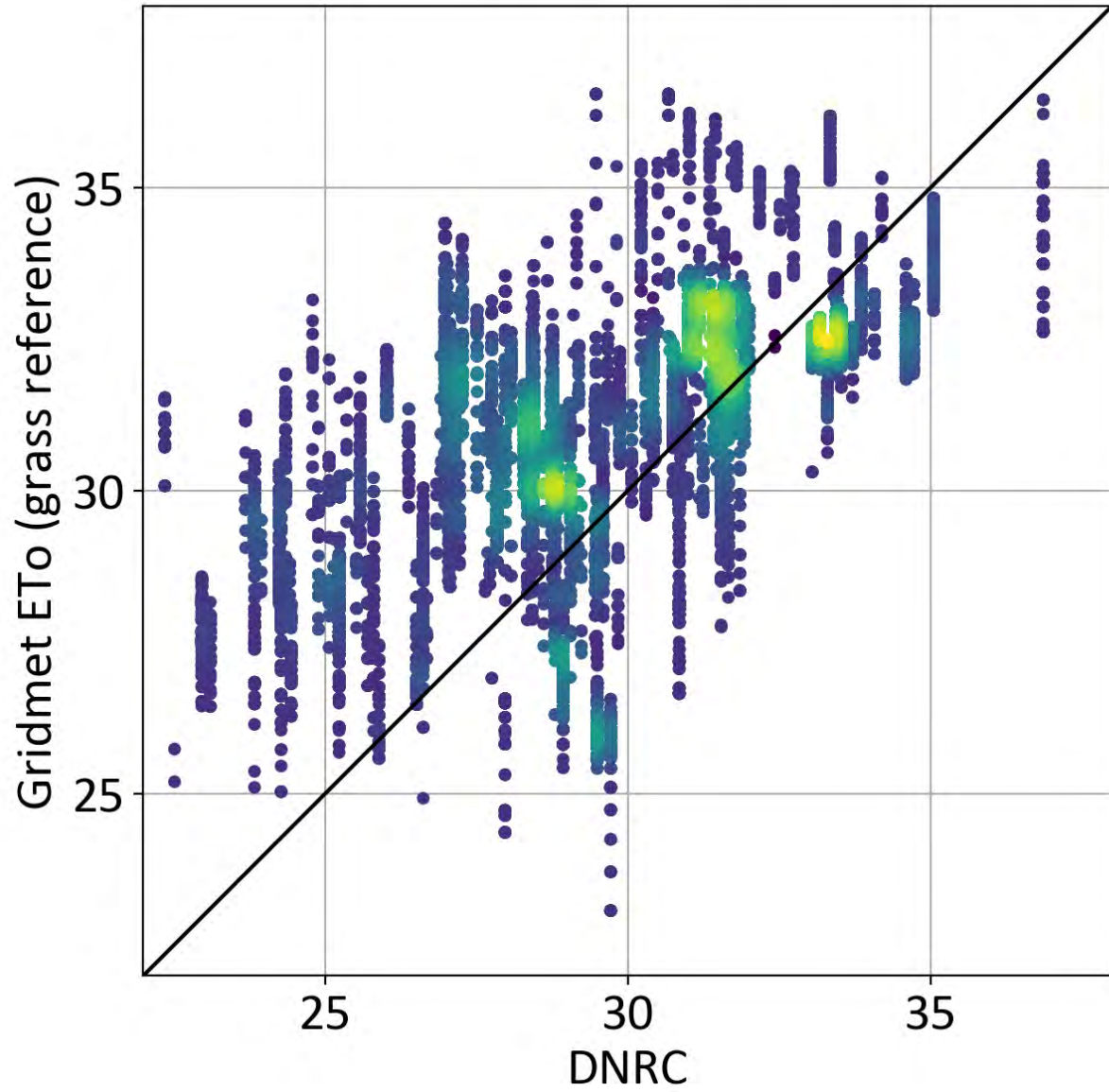
Difference in Consumptive Use Estimate (inches, DNRC minus OpenET)



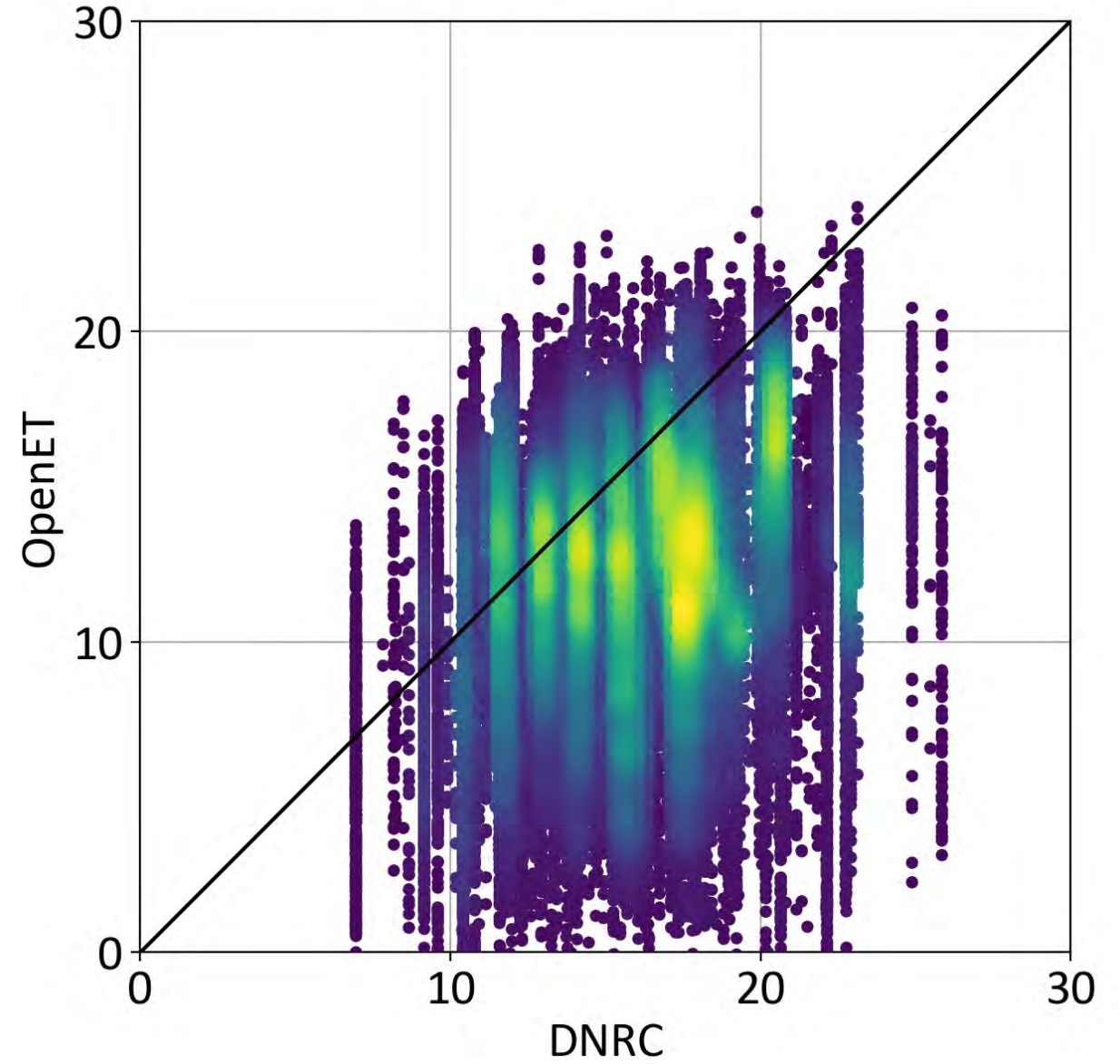
Difference in Consumptive Use Estimate (inches, DNRC minus OpenET)



Mean Seasonal ET (inches)



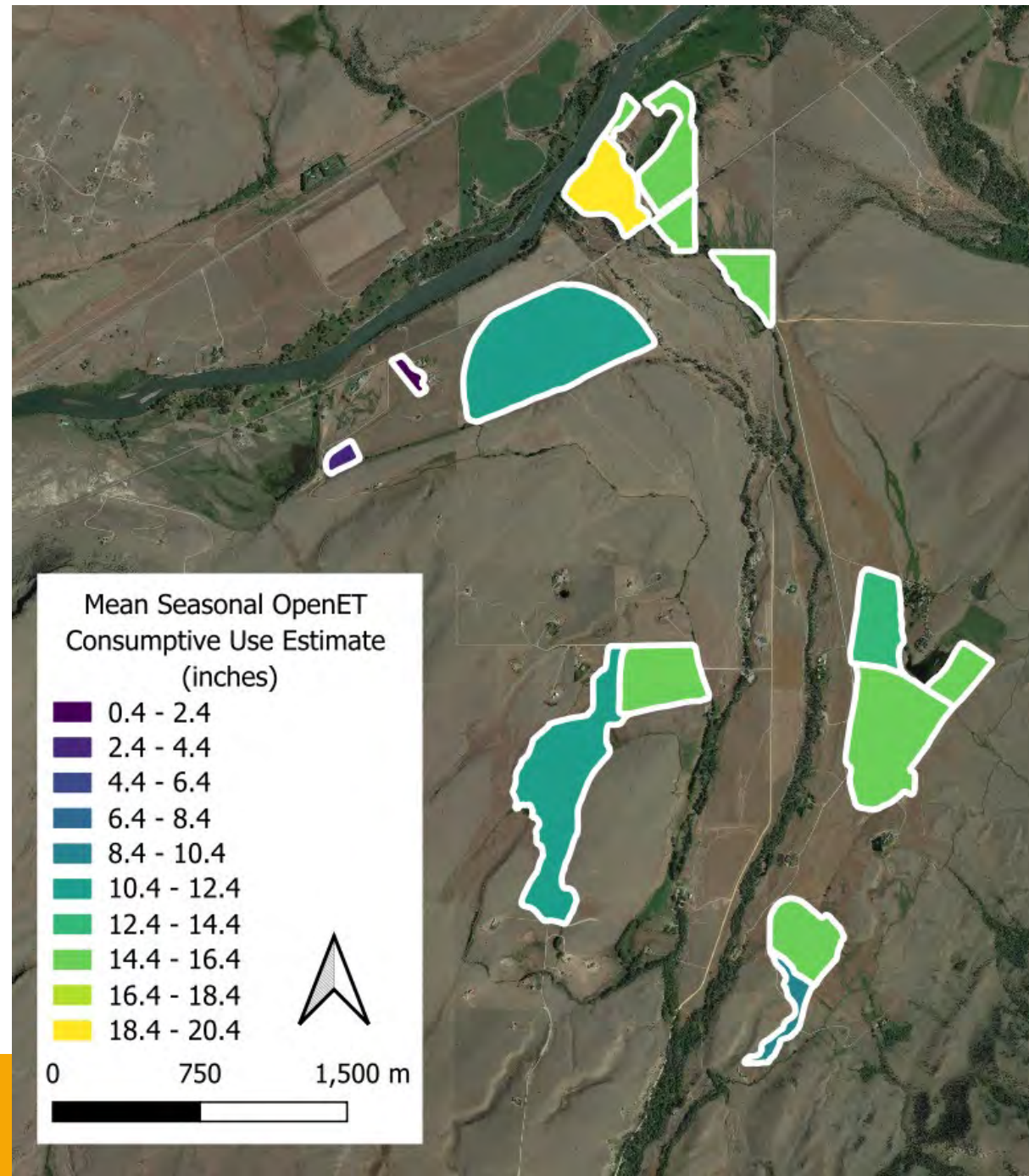
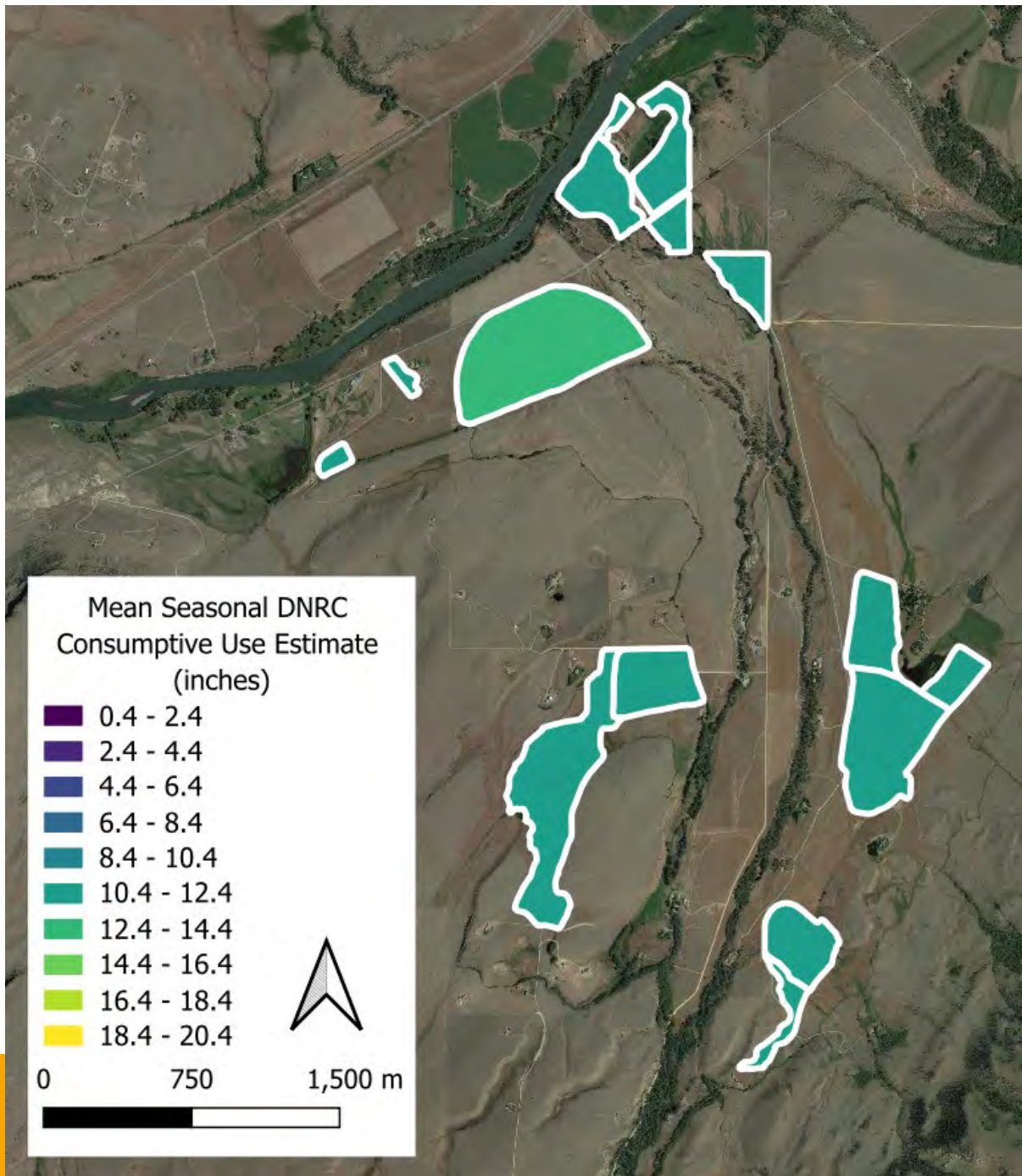
Mean Seasonal Consumptive Use (inches)



Case Study: Sixmile Creek

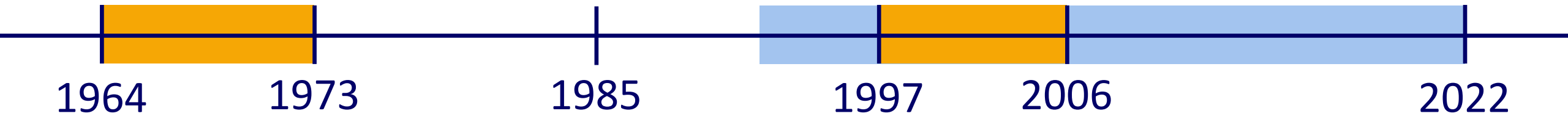
- Park County
- 15 fields
- Mix of grass/alfalfa
- 1 center pivot





The Limitations

- Satellite imagery only available from 1985 onwards
- OpenET data only reliable from 1991 onwards



The Limitations

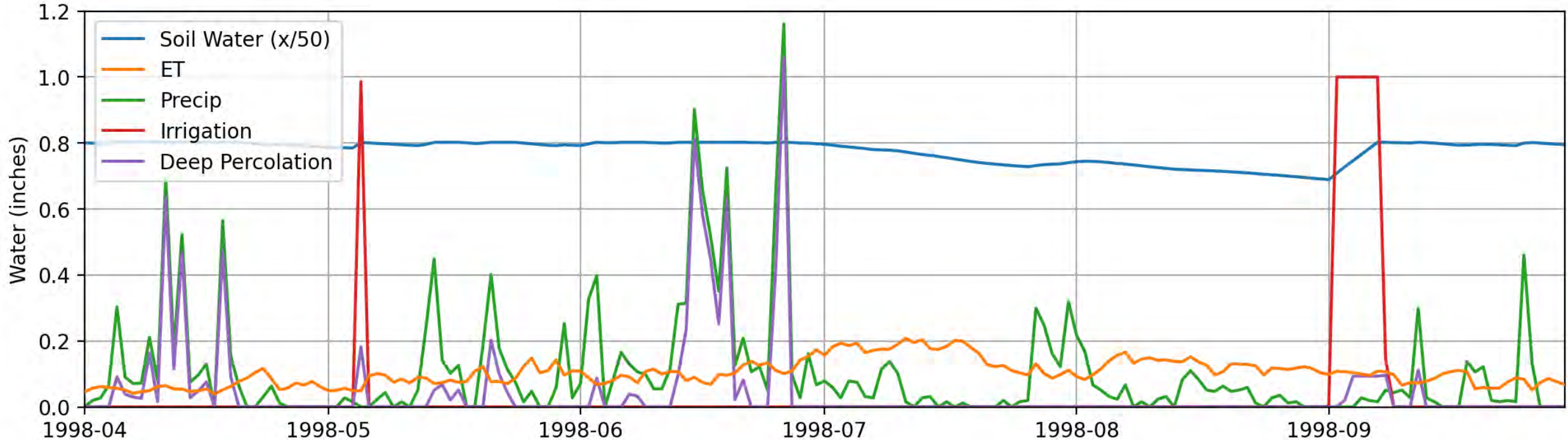
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The Solution? Time Travel!



Soil Water Inverse Model (SWIM)

- Based on ET-demands, dual crop coefficient method
- This version uses NDVI satellite data to approximate crop coefficients
- Calibrated on OpenET and gridded snow data



SWIMming back in time

- Calibrate SWIM on 30 years (1993-2022) of satellite data to determine field properties/model parameters
- Run calibrated model on historic gridded meteorology data to estimate ET before the availability of satellite data.
- Major assumption: crop type/field management constant through time



Continuing Development

- Multi-objective calibration scheme
- Calibration and “time travel” for all fields in the SID



