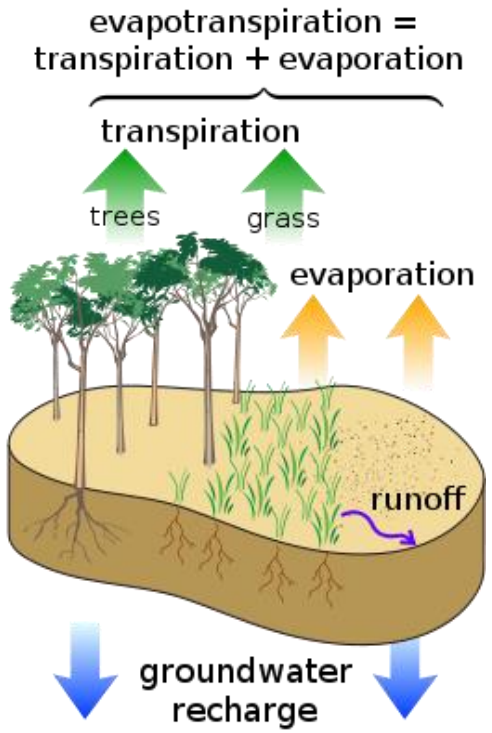
Spatial Analysis of Actual Evapotranspiration Estimates from the GAMUT Weather Stations using Geographic Information System



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Utah State University

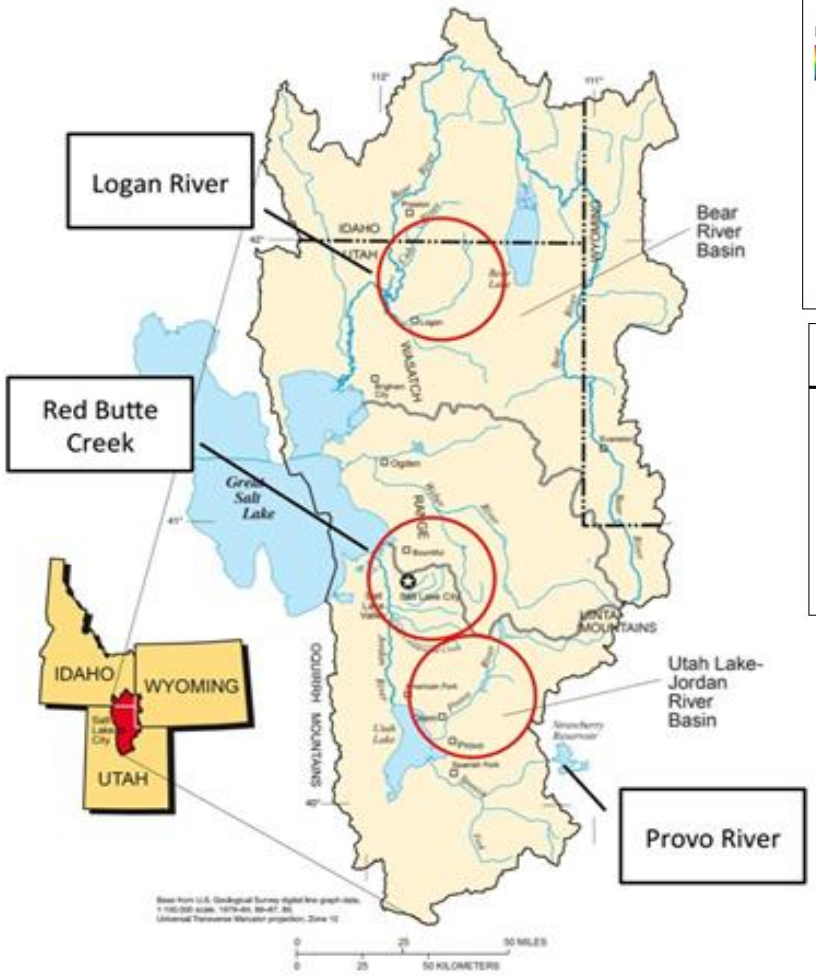
20 November 2014

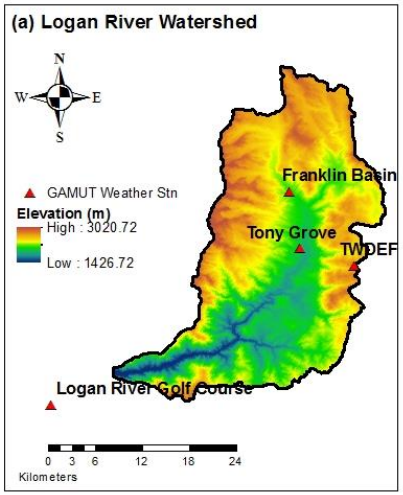
Evapotranspiration (ET)

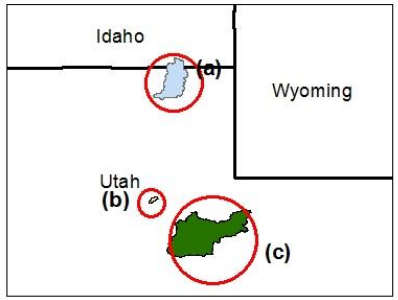
- (ET) is a term used to describe the sum of evaporation and plant transpiration from the earth's land surface to atmosphere.
- It is normally expressed in millimeters (mm) per unit time.
- The rate expresses the amount of water lost from a cropped surface in units of water depth.

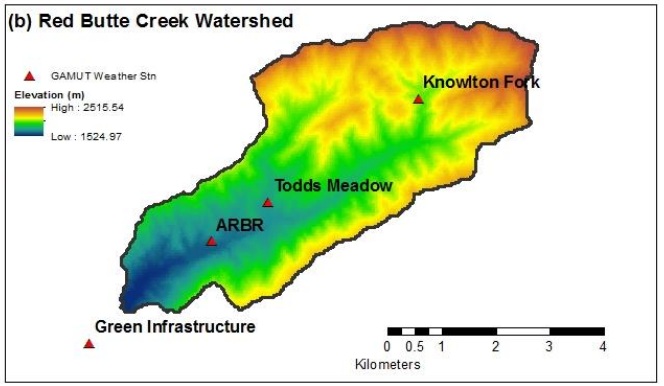
GAMUT : **Gradients Along Mountain to Urban Transitions**

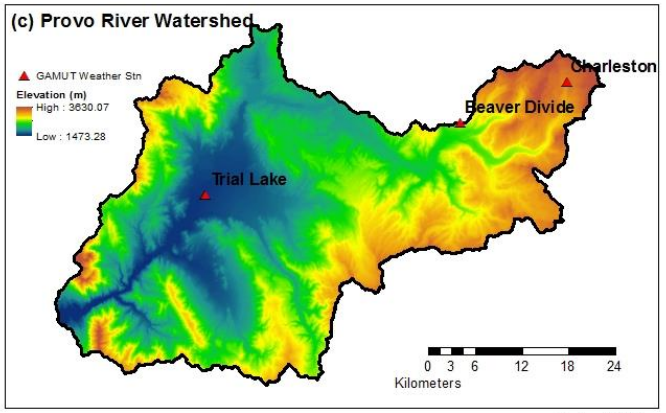
Study Area











Author: Kshitij

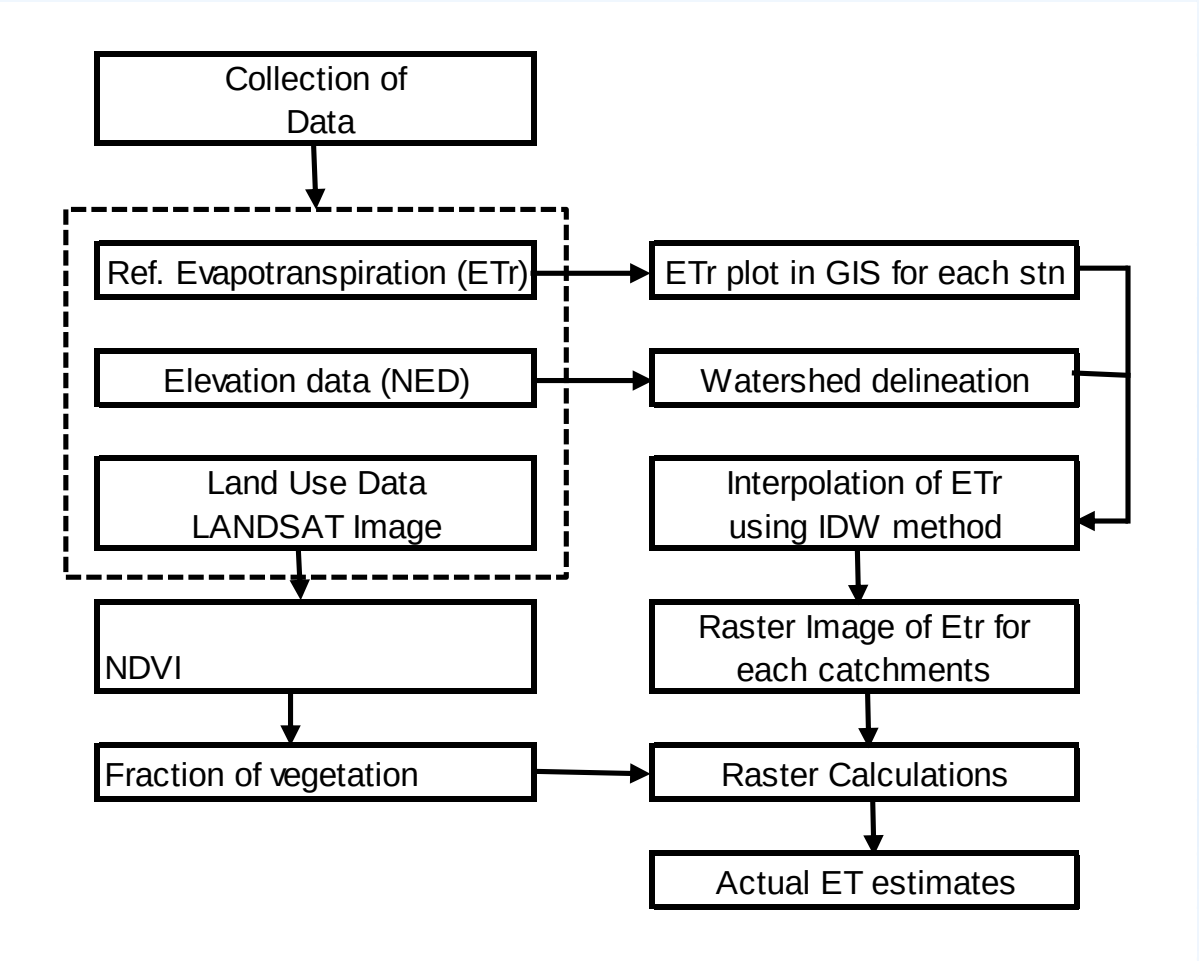
Logan river basin: 558 km^2
Red Butte creek watershed : 22 km^2
Provo River basin : 1691 km^2

Source : http://iutahepscor.org/resources.shtml

ET estimates available

Station	Latitude (y)	Longitide (x)	Elevation (m)	Network	Data Available From
Franklin Basin	41.950	-111.581	2109.52	Logan River	27-Feb-14
Logan River Golf Course	41.706	-111.854	1364.89	Logan River	27-Jan-14
Tony Grove	41.885	-111.569	1927.86	Logan River	30-Apr-14
TW Daniels Experimental forest	41.865	-111.507	2629.20	Logan River	9-Jan-14
Beaver Divide Climate	40.613	-111.098	2508.00	Provo River	14-May-14
Trial Lake Climate	40.485	-111.463	3040.00	Provo River	28-Jan-14
Charleston Climate	40.678	-110.948	1659.00	Provo River	26-Aug-14
Above Red Butte reservoir Climate	40.781	-111.807	1666.04	Red Butte Creek	3-Jan-14
Green Infrastructure Climate	40.761	-111.830	1487.12	Red Butte Creek	18-Dec-13
Knowlton Fork Climate	40.810	-111.767	2178.10	Red Butte Creek	3-Jan-14
Todds Meadow	40.789	-111.796	1763.00	Red Butte Creek	10-Jan-14

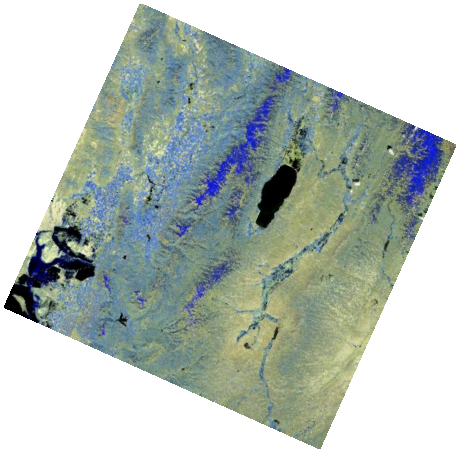
Methodology and Data



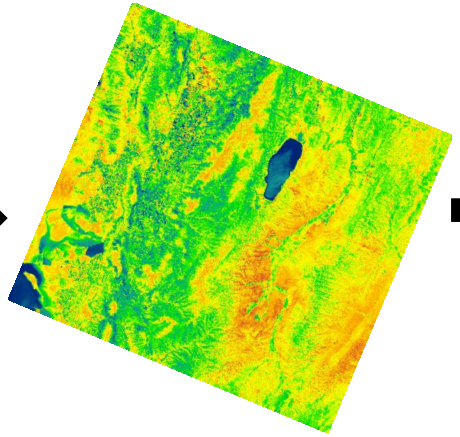
Landsat image: http://glovis.usgs.gov/
ETr data: http://data.iutahepscor.org/tsa/
DEM : ArcGIS Server, http://elevation.arcgis.com

Methodology .....

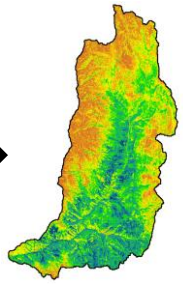
Composite LANDSAT image



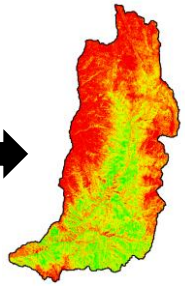
NDVI

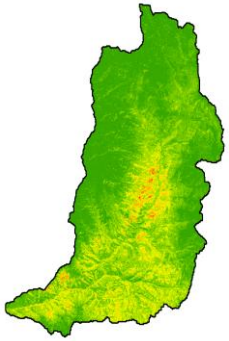


NDVI Extract for selected basin



Fraction of Vegetation (FOV)





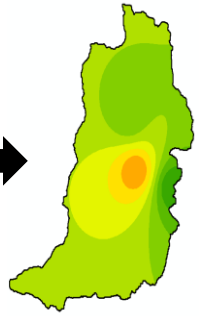
Actual ET

$$* NDVI = \frac{(NIR-RED)}{(NIR+RED)}$$

(a,b)

$$FOV = \left(\frac{NDVI-NDVI_{soil}}{NDVI_{veg}+NDVI_{soil}}\right)^2$$

Point estimates of ETr



Interpolated ETr

*Normalized Difference Vegetation Index

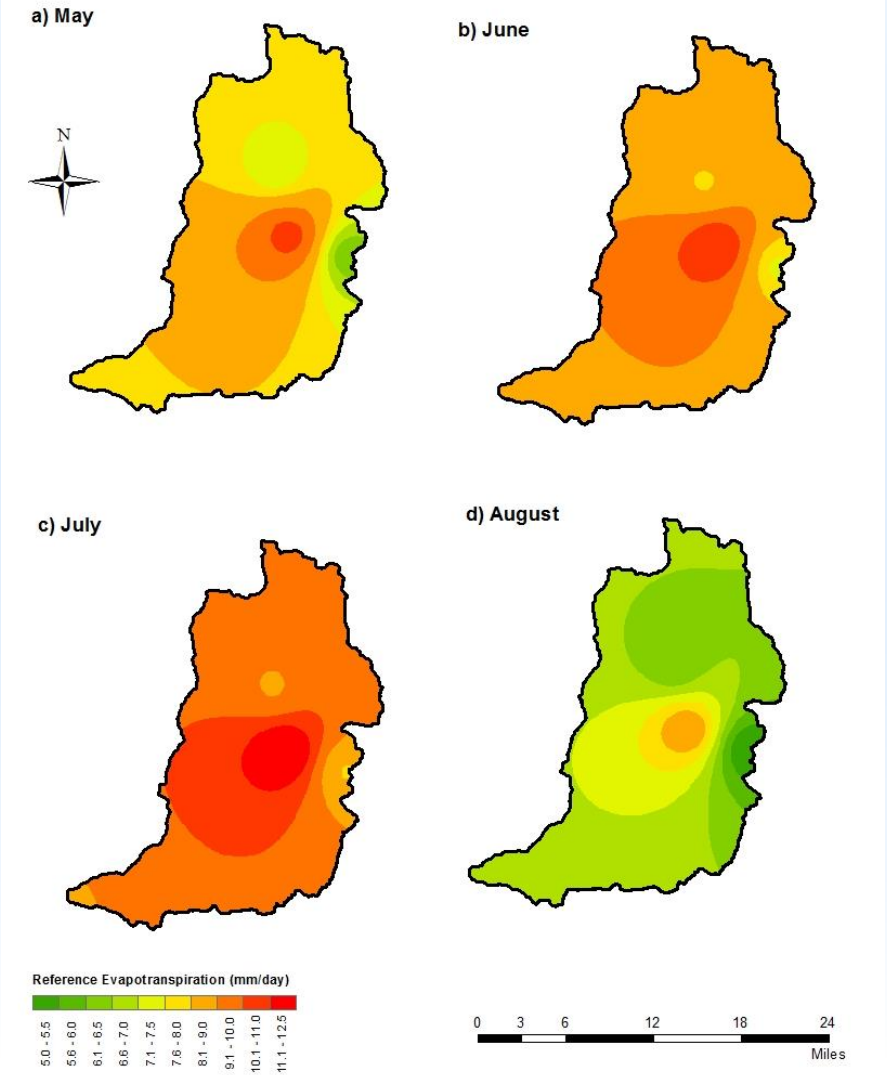
[a]*Brunsell &. Gillies (2003).* [b] Gillies, et al., (1997)

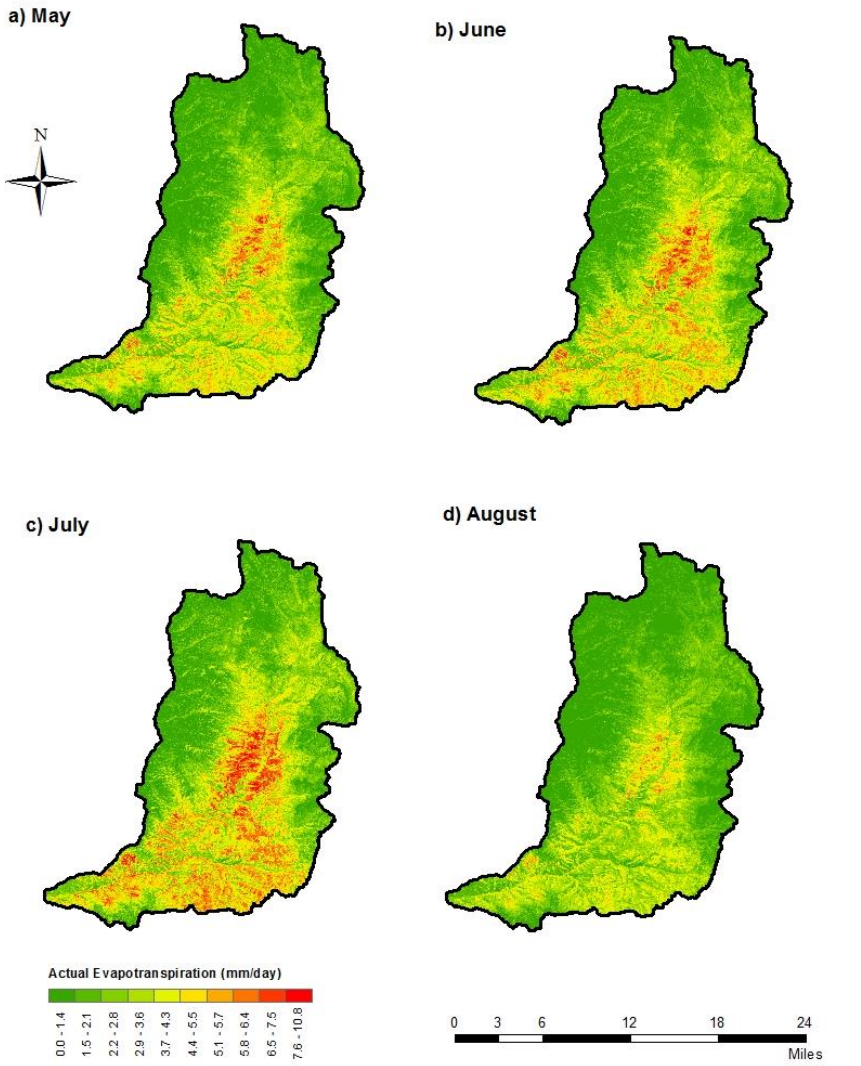
- Actual ET estimated as a product of reference ET and fraction of vegetation (Assuming more ET in dense vegetation)
- One landsat image is considered for each month (image dates: 2014/5/27; 2014/6/28; 2014/7/14; 2014/8/15)
- ASCE-EWRI Reference ET equation for tall crop

RESULTS

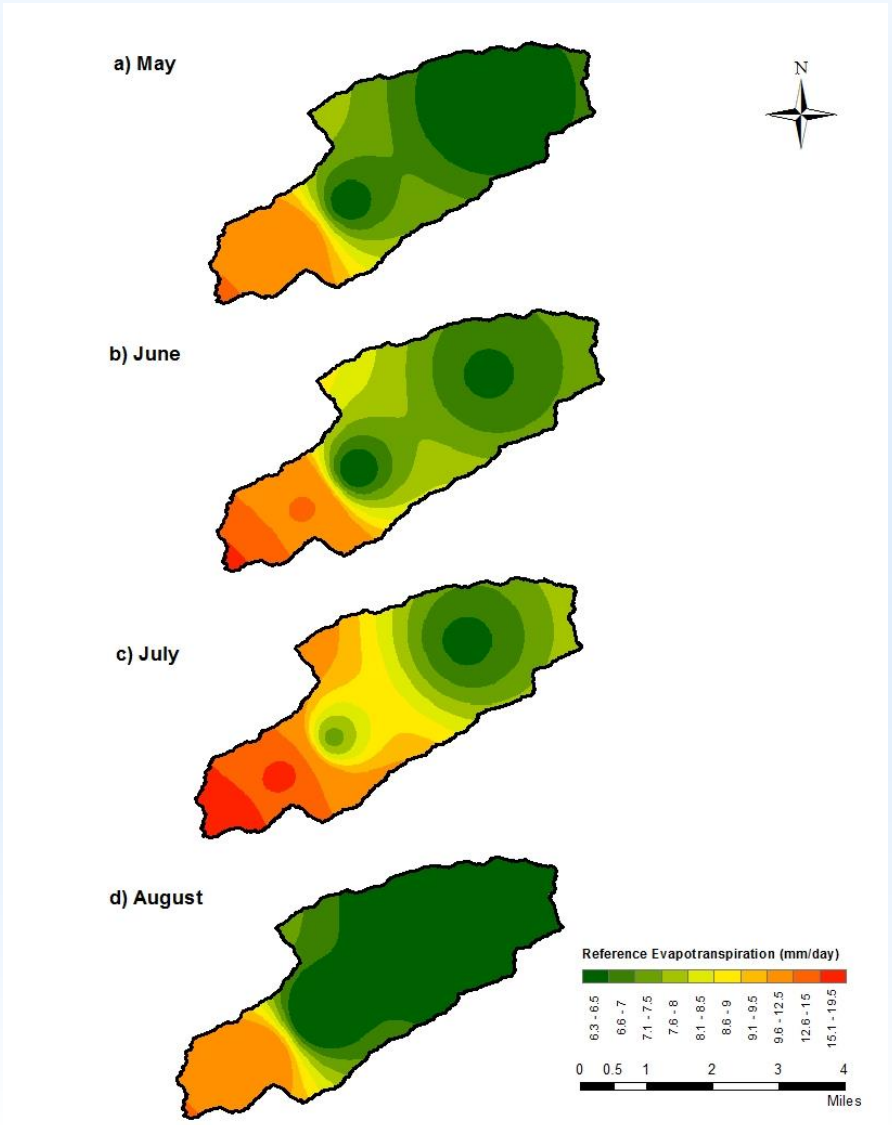
Evapotranspiration (mm/day)
Jan
April
July
February
May
August
March
June
September
Franklin Basin
Tony Grove
Logan River Golf Course
TW Daniels Experimental forest
Above Red Butte reservoir Climate
Knowlton Fork Climate
Todds Meadow
Green Infrastructure Climate
Beaver Divide Climate
Trial Lake Climate
Charleston Climate

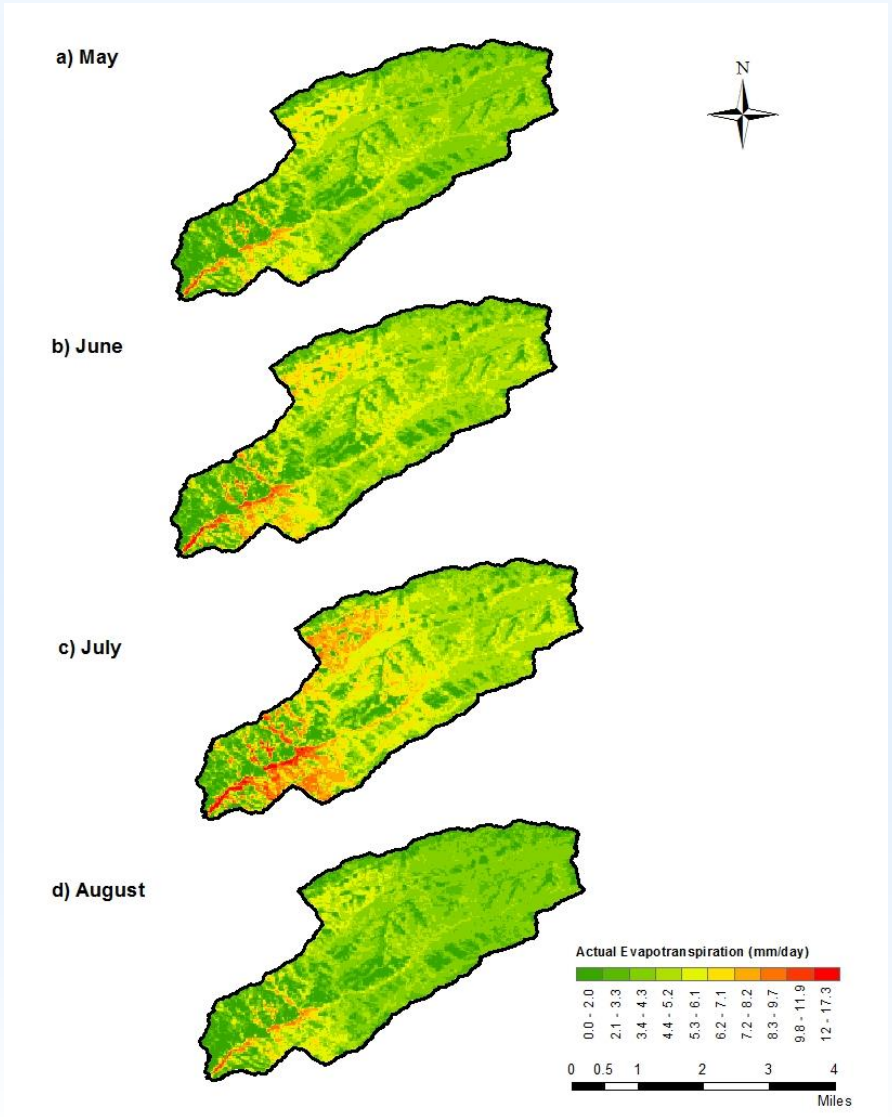
Reference ET and actual ET map for Logan river basin for different months



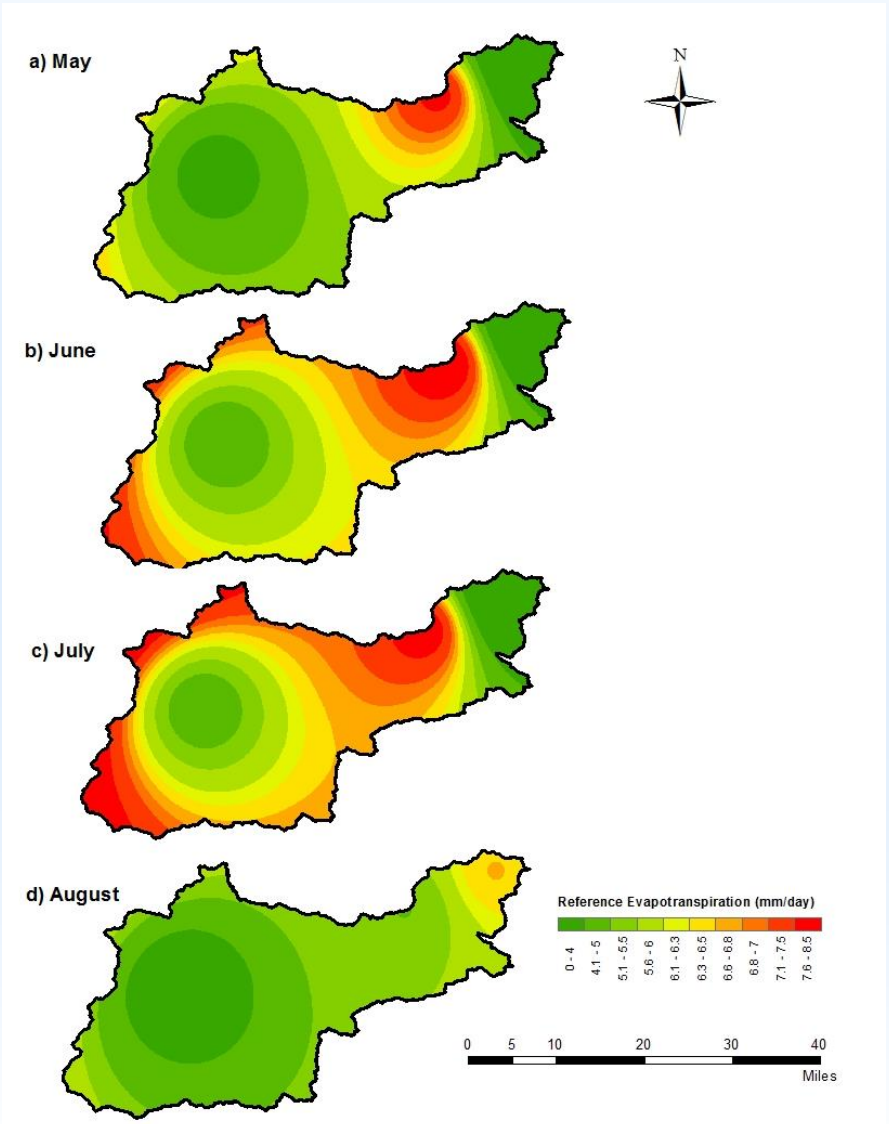


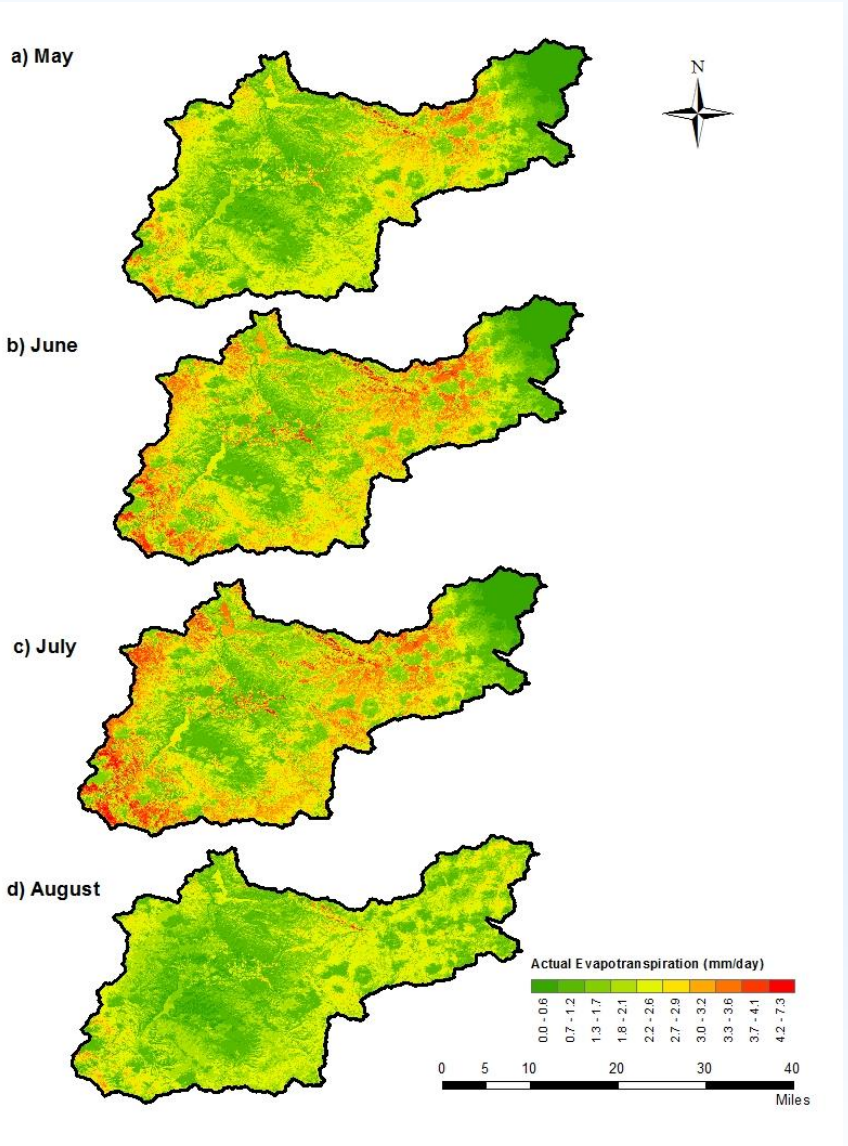
Reference ET and actual ET map for Red Butte creek watershed for different months





Reference ET and actual ET map for Provo river basin for different months





Application …

The spatial map of AET can be helpful to,

- plan irrigation schedule properly by estimating the amount of water lost through ET (to quantify the soil water consumption accurately)
- study the water balance in a watershed or any geographical boundary
- serve as a boundary condition for hydrological and climate modelling

Conclusion

- Consideration of elevation for interpolation
- Interpolation of basic parameters and apply ET equation for each pixel

Further work …

- Portion of total precipitation lost through ET

References

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THANK YOU