Estimation of Evapotranspiration Using Multimodel Ensemble

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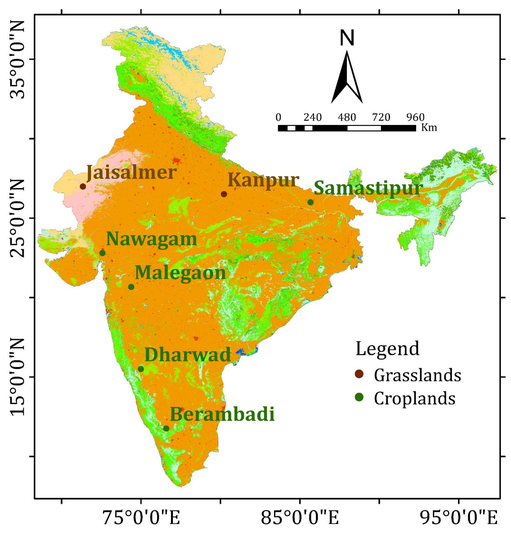
Poster No: S164

Motivation and Objectives

- Ensemble evapotranspiration (ET) is a modeling strategy that involves integrating multiple ET models to improve overall accuracy and reliability.
- The approach acknowledges the limitations of individual models, considering variations in structure, assumptions, and parameterization thus addressing uncertainties, and leveraging the strengths of different models under varying conditions.
- This study aims to combine three ET models: Priestley Taylor – Jet Propulsion Lab (PT-JPL), Soil Plant Atmosphere and Remote Sensing Evapotranspiration (SPARSE – Layer and Patch)and Surface Temperature Initiated Closure (STIC) using three approaches: Mean, BMA and kNN.

Study area and Datasets



- The study is done at in-situ scale for seven sites as well 1 km scale for the whole India.
- For in-situ scale data is obtained from flux towers as well as meteorological stations.
- For 1 km data MODIS data and IMDAA data for meteorological variables are used.

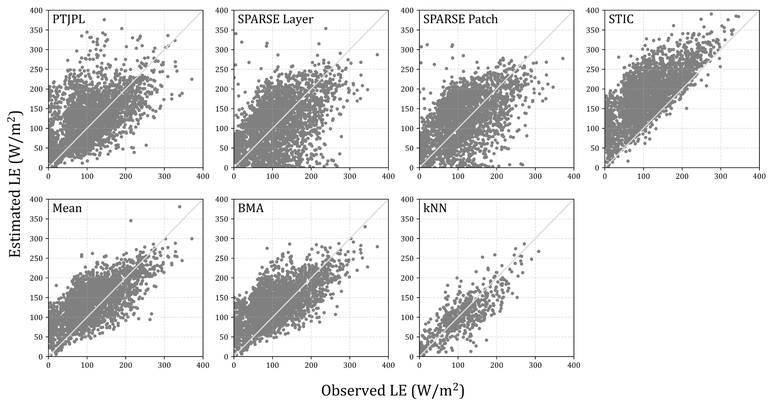
Methodology

- Daily ET is estimated using individual models at field scale as well as 1km scale.
- Individual outputs are combined to get an ensemble using three methods:
  - ✓ Mean: Simple averaging of the four individual model outputs.
  - ✓ BMA: Weighted average, where the weights are determined by the posterior probabilities of the models.
  - ✓ kNN: predictions based on the average of the k-nearest data points.

Results and Discussions

RMSE (Wm^{-2}) for the models and ensembles.

	PTJPL	SP L	SP P	STIC	Mean	BMA	KNN
Nawagam	60.51	88.55	72.00	68.76	44.27	48.1	34.62
Samastipur	46.07	81.93	72.40	57.54	57.44	55.04	34.91
Jaisalmer	75.31	54.51	54.80	96.74	62.46	68.45	15.29
Malegaon	38.48	68.44	66.69	69.87	45.83	27.72	18.46
Berambadi	59.22	64.48	60.69	102.26	52.9	53.03	36.87
Dharwad	79.57	59.05	65.98	107.84	65.92	62.6	36.53
Kanpur	49.45	43.75	47.15	63.5	37.94	38.14	34.47
All	63.02	66.39	63.31	86.88	54.06	52.92	36.52

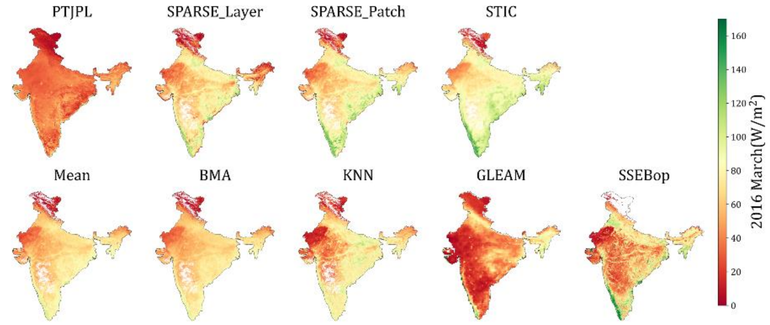


Plots of observed vs estimated ET from models and ensembles for all the sites combined

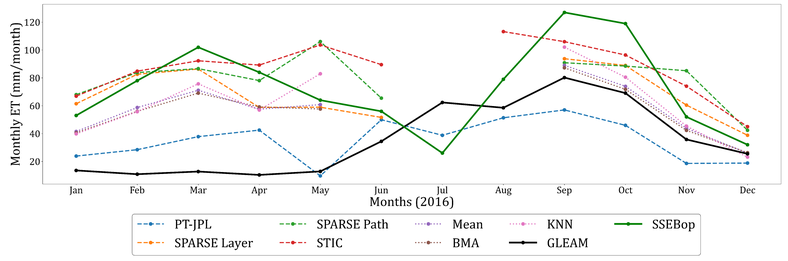
- **1 km scale**

Validation statistics for the models and ensembles.

MODIS	PTJPL	SP L	SP P	STIC	Mean	BMA	KNN
10:30 AM	42.08	35.33	30.04	33.27	25.04	28.76	25.65
1:30 PM	43.89	35.79	32.07	32.92	26.5	30.17	27.39



Spatial maps of ET from models and ensembles.



Time series plots of ET from models and ensembles.

Conclusions

- ET estimated from ensembles are more accurate compared to that of individual ET models in both scales.
- At field scale kNN performed better than Mean and BMA whereas the performance of all ensembles are similar at 1 km scale.
- Landcover specific model development may improve the results.

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