Development of Forest Drought Index and Forest Water Use Prediction in Gyeonggi Province, Korea Using High-Resolution Weather Research Forecast Data and Localized JULES Land Surface Model

HoonTaek Lee[p1], Juhan Park[1, 2], Sungsik Cho[3], Seung-Jae Lee[2], Hyun Seok Kim[1, 2, 3, 4]

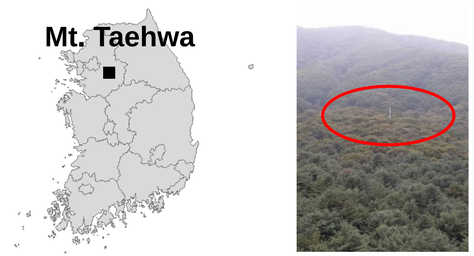
Corresponding Author cameroncrazies@snu.ac.kr

[1]Department of Forest Sciences, Seoul Nat'l. Univ., Korea
[2]National Center for AgroMeteorology, Seoul Nat'l. Univ., Korea
[3]Interdisciplinary Program in Agricultural and Forest Meteorology, Seoul Nat'l. Univ., Korea
[4]Research Institute of Agriculture and Life Sciences, Seoul Nat'l. Univ., Korea

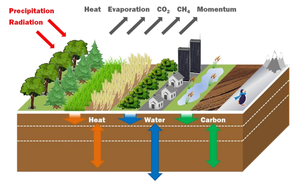
Introduction

- Evapotranspiration (ET) is one of major components of forest water cycle and influences on many downstream users including aquatic organisms and human.
- More frequent and severe drought is expected in the future climate condition.
- Land surface model (LSM) is widely being used to deal with the complicated energy material exchange between land and atmosphere.
- The goal of this study is to predict forest water use and develop drought index for forest.

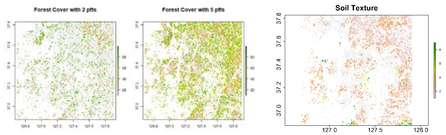
Materials and Methods



- In Mt. Taehwa, deciduous broadleaf and needleleaf sites (TDK and TCK, respectively) were constructed. Leaf area index (LAI), and meteorological factors (e.g., rainfall, wind speed, radiation) were measured at flux tower.
- Eddy covariance (EC) method was used to measure ET, which was used for model validation.

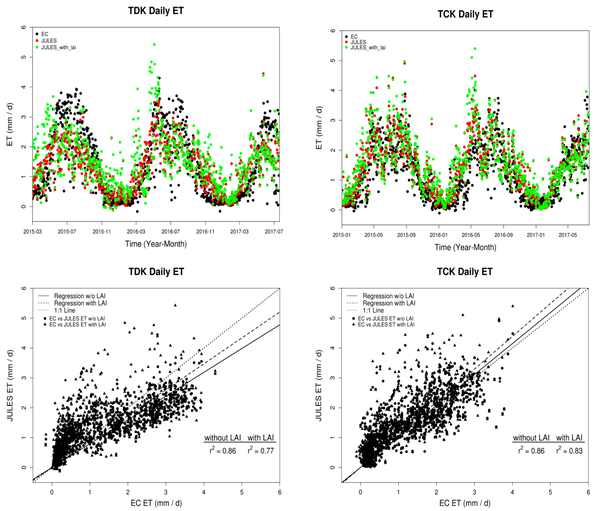


- ET was simulated with Joint UK Land Environment Simulator (JULES) with a prescription of in-situ measured LAI.
- ET estimation of JULES was evaluated by comparing modelled ET and measured ET in study sites to each other in advance to do grid-based estimation.

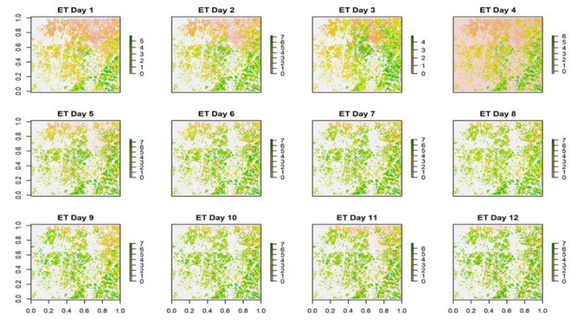


- For the grid-based estimation, 1) high-resolution (hourly and 810 m x 810 m) 12-days weather research forecast data including predicted LAI, 2) soli texture map, and 3) forest cover map were enforced to the model. Reclassified forest plant functional type of JULES was applied to the forest cover map (2 default types ➔ 5 detailed types) to depict more detailed heterogeneity of surface grid.
- Modified Keetch-Byram Drought Index (KBDI) was developed by employing estimated ET by JULES in calculating the index

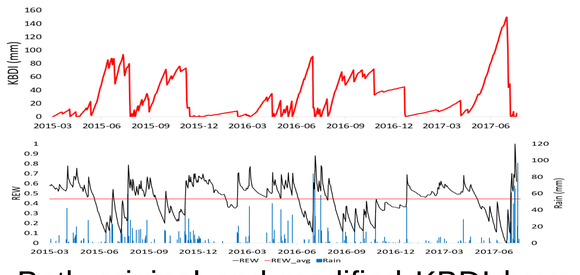
Results



- Comparison between measured ET by EC method and JULES estimation showed nice correlations in terms of value and time series pattern, both.
- After applying measured LAI, the regression line became closer to the one-to-one line.



- Using the same setting with what was used for the study sites, Gyeonggi Province ET was simulated.
- The ET prediction was done for the next 12-days with high-resolution (hourly, 810 m x 810 m).



- Both original and modified KBDI have a good agreement with rainfall and relatively extractable water of soil.
- Modified KBDI more nicely reflected severe drought condition, especially for 2017 spring.

Conclusion

- Localized JULES excellently estimated forest water use in the study sites, and, succeeded in predicting ET in Gyeonggi Province with high-resolution.
- Real-time ET prediction in Gyeonggi Province is being served in website (http:// http://df.ncam.kr/waterUseForest/index.do) to demanders through data acquisition and processing system (DAPS).
- Modified KBDI which reflects rainfall and soil moisture was developed by using modelled ET by JULES.
- This work can be extended to wider range (e.g., national scale) with more input and validation data.

Acknowledgement

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