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Hydrology and Earth System Sciences
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Discussions

Interactive comment on “Comparison of six different soft computing methods in modeling evaporation in different climates” *by* L. Wang et al.

L. Wang et al.

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Major comments There is no mention of local optima problems associated with many soft computing methods. This should at least be acknowledged, any methods for avoiding these problems should be explained in the methods sections for each of the models.

Reply: as suggested, in the methods section, some statements were added for local optima problems of the applied models. We further evaluated the applied models with full weather inputs by changing training and testing period. Please see Table 14 for the results.

The results section is long and repetitive. It would be good to try to summarize the data as much as possible, and draw a bit of a narrative through the results. What is the key

message you're trying to communicate here? Some speciïňĄc suggestions are given below in the Tables and Figures sections.

Reply: results section was revised and a discussion section was added.

There is no discussion section. It would be good to have some general discussion of the generalizability of these results, and the implications for others working in the ïňĄeld.

Reply: a discussion section was added as suggested (discussion of the generalizability of these results, and the implications for others working in the ïňĄeld).

Minor comments l112-5: There is no justiïňĄcation given for the choice of these 8 models. Many more models are mentioned in the introduction. Why choose these 8 speciïňĄcally?

Reply: the specific reasons for selecting each soft computing model was provided in methods section as suggested.

l226: This sentence mentions a dataset, but this isn't actually described above.

Reply: In this study, MLR models are developed using the same dataset at eight stations in different climates (described in section 2.2) which was used to train and test the above soft computing models.)

l280-303: The important thing is that the sites are diverse. You are not trying to describe the sites, just use them to evaluate modes, yet lot of these statistics are just descriptive stats repeated from the table. Better would be to quote ranges (of means, variance, and extremes), and maybe try to relate those to global- or china-wide ranges, to show that the sites are representative.

Reply: we have added “For example, the monthly mean Ep ranged from 2.86 (CQ) to 7.26 mm (MQ) with associated Cv values changing from 0.32 to 0.75 in different climates; the minimum monthly Ep was about 0.15 mm while the maximum monthly Ep reached 15.89 mm. Accordingly, the monthly meteorological variables varied greatly for each station in different climates, for example, the monthly mean Rg at CQ was about 8.8 MJ m-2, while the Rg values increased to 20.41 MJ m-2at LSA station; the monthly mean Ta also changed from 4.17oC to 24.08oC. The diverse climatic characteristics can also been seen from the statistics of Cv, Cx, xmin and xmax for each parameters at above stations. The monthly variations of Ep and associated climatic parameters in each station were further illustrated in Fig.5, for example, the monthly Ep, Ta, Hs and Rg are generally higher in summer and lower in winter months and there were also differences for each parameter in different stations, which indicated that above stations are representative for studying Ep in different climates.)" into the Case Study and Data section

Section 2.3: No rationale is given for the choice of metrics. All three metrics are highly correlated (all rÂż0.9), from what I can see, and therefore two metrics don't provide much more information after the ïňĄrst. Consider using alternate metrics, such as the Nash-Sutcliffe model efïňĄciency coefïňĄcient, normalised mean error, correlation, or some of the metrics mentioned in Pachepsky et al. (2016).

Reply: as suggested Nash-Sutcliffe criterion was also included in the revised paper

l314-323: This section should be split up and moved into the relevant Methods subsections.

Reply: It was done as suggested.

l331 (and below): How are these "accuracy ranks" calculated? They are not mentioned in the methods section at all. Perhaps they should be included in the tables?

Reply: this was mentioned in the Results section.

l333-4: It is not clear that Ta and Rg are better at modelling Ep than RH or Ws, because RH and Ws are only included as fourth and ïňĄfth variables. If the inputs are highly correlated, then RH and Ws may also perform reasonably by themselves.

Reply: we have also added two input combinations as iv) RH and v) Ws. Now, the effect of each variable on Ep can be clearly seen.

l413: the RËĘ2 is not the same things as Pearson's Correlation CoefïňĄcient, except in the simple case of univariate linear regression. Also, the some of the correlations between Ws and Ep (I assume the R column in Table 1) are reasonably high, so it would be reasonable to assume some predictive power.

Reply: we agree with you that the R indicates that the Ws have reasonable and predictive power. Therefore, we have added "In overall, soft computing models with full weather data (Rg, Ta, Hs, RH and Ws) generally had the best accuracy. This indicates that all these variables are required for better Ep estimation. It can be seen from the applications that adding RH or Ws inputs into the applied models generally increase their accuracies in predicting Ep in all stations even though these parameters have the lowest correlation with Ep (see Table 1)." into the discussion section.

l445: The description of the generalized model should be moved to the methods section and expanded.

Reply: It was done as suggested

l477-480: Performance is not additive, especially when the predictor variables have signiïňĄcant covariance, so it is almost inevitable that RH and Ws will appear to be worse predictors relative to Rg and Ta, when they have only been included in models with multiple other variables.

Reply: we have added two input combinations as iv) RH and v) Ws.

l479: Ws doesn't decrease *all* simulation metric results, and again, it is not clear how this variable would perform as a predictor in the absence of other inputs, which are likely correlated.

Reply: we have added two input combinations as iv) RH and v) Ws.

Tables Tables 1, 3-10, and 12: There is a *LOT* of data in all of the tables. It is very difïňĄcult to read information laid out like this. Consider using summary plots (possibly small multiples of parallel coordinate plots) instead and moving the tables to supplemental material, or colouring the table cells to give a clearer indication of performance (normalize colours per column).

Reply: we have showed the best models by bold numbers.

Tables 3-10: There is no explanation given anywhere as to why there are two columns in tables 3-10 for each of the three metrics. Explain in-text, and in the table captions.

Reply: we have explained these as Training and Testing period

Figures Figure 3: Colour the stars in the same colours as in Figure 4.

Reply: It has been corrected.

Figure 4: Put the legend outside above the graphs, make it larger.

Reply: It has been corrected.

Figures 6-13: - The paper is about comparison between models, not sites. But I have to scroll between 8 pages to compare all of the models. It would be better to have a grid for each site that included all 8 models.

Reply: It has been corrected.

- If you remove the x- and y-axis tags from all but the ïňĄrst row and column, you can save signiïňĄcant space, and probably ïňĄt all models on 2x4 grid, allowing more plots per page.

Reply: It has been corrected.

- The bubble effect only adds unnecessary visual detail. Remove the 3d effect, and use smaller circles, so the detail in the scatter plot can be seen properly.

Reply: It has been corrected.

- I guess that the scatter plots include the seasonal cycle. It may be useful to have corresponding residuals plots, to show under which conditions the modes are performing poorly. - Units should be mm/day, I think.

Reply: It has been corrected.

Technical notes l48: remove "and air". l49-50: Pan evaporation is a measurement, it doesn't play a role in the ecosystem. Remove clause, or move to previous sentence. l56: "..less _well_ understood.." l65: remove "the" l70: Full stop before "For example.." l95: "..in case of without local inputs and outputs" doesn't make sense. Reword. l97: remove ïňĄrst "the" l98: "On the contrary" probably should be "In contrast" l102: "at a few number of stations" makes no sense, re-write sentence, split at "forexample". l128: "_The_ MLP is _a_ well-known ..." l129-30: "_hierarchical_ networks _consisting of_ several layers.." l132: The neurons are the nodes. The connections are the synapses. Re-word sentence. l149: "two types of neurons, S-summation and D-summation, which...". l188: "MF" - abbreviation undeïňĄned. l190: "RMSE" - abbreviation undeïňĄned. l220: "variables are" l225: "analyse" l280: remove "It is clear that" l296: "has lower skewness", I think. l397: "indicate" l475: "..MLP _performance was_ superior to.." l476: Full stop after "stations". l479: "_Decreased_" (past tense) Table 1: Headers misaligned. R metric needs to be explained in footer. Also, it isprobably better to sort by variable ïňĄrst, and then by station, so that stations can becompared. If you do this, add minor grid lines between variables.

Reply: All these have been considered in the revised paper.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-247/hess-2016-247-AC1-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-247, 2016.

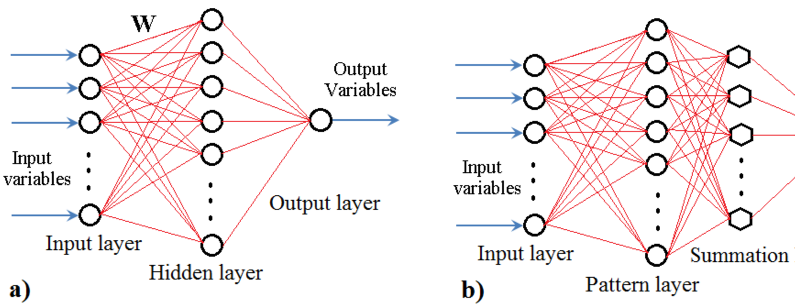
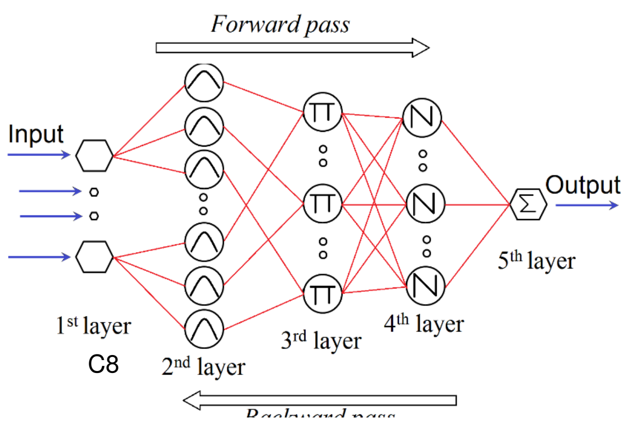


Fig. 1. Schematic architecture of: a) MLP neural network; b) GRNN.

C7



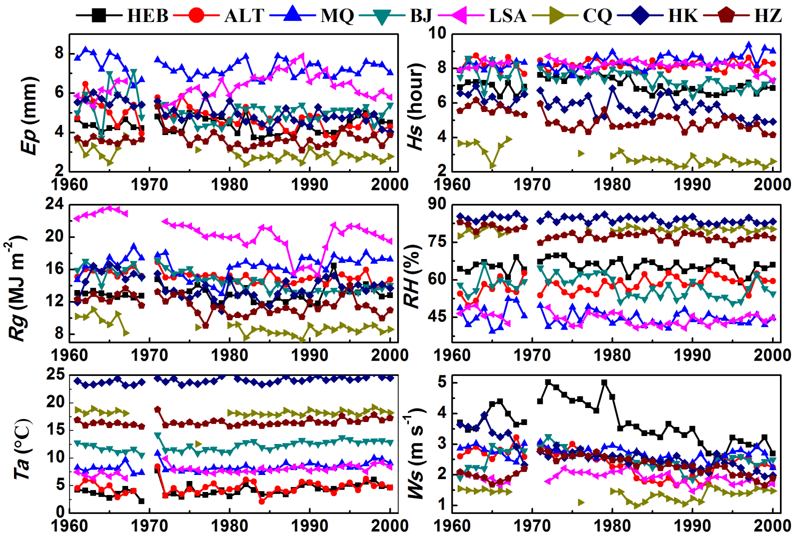

HEB
ALT
MQ
BJ
LSA
CQ
HK
HZ
Ep (mm)
Hs (hour)
Rg (MJ m-2)
RH (%)
Ta (°C)
Ws (m s-1)

Fig. 3.

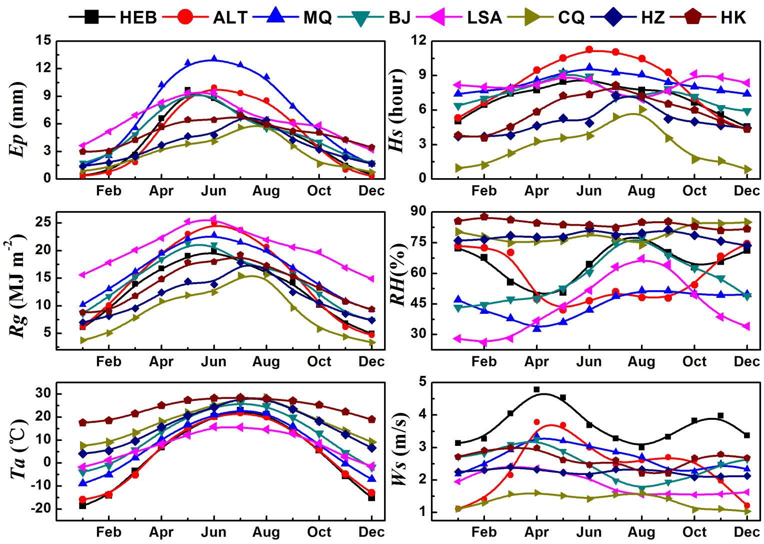
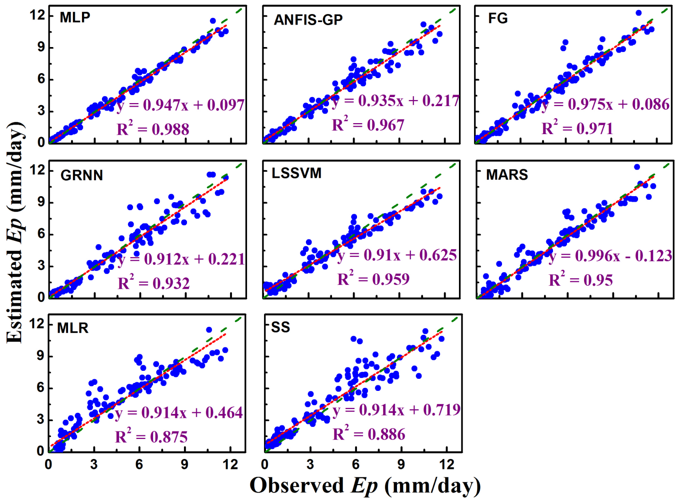

HEB
ALT
MQ
BJ
LSA
CQ
HZ
HK
Ep (mm)
Hs (hour)
Rg (MJ m-2)
RH(%)
Ta (℃)
Ws (m/s)

Fig. 4.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R² = 0.988
ANFIS-GP
y = 0.935x + 0.217
R² = 0.967
FG
y = 0.975x + 0.086
R² = 0.971
GRNN
y = 0.912x + 0.221
R² = 0.932
LSSVM
y = 0.91x + 0.625
R² = 0.959
MARS
y = 0.996x - 0.123
R² = 0.95
MLR
y = 0.914x + 0.464
R² = 0.875
SS
y = 0.914x + 0.719
R² = 0.886
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 5.

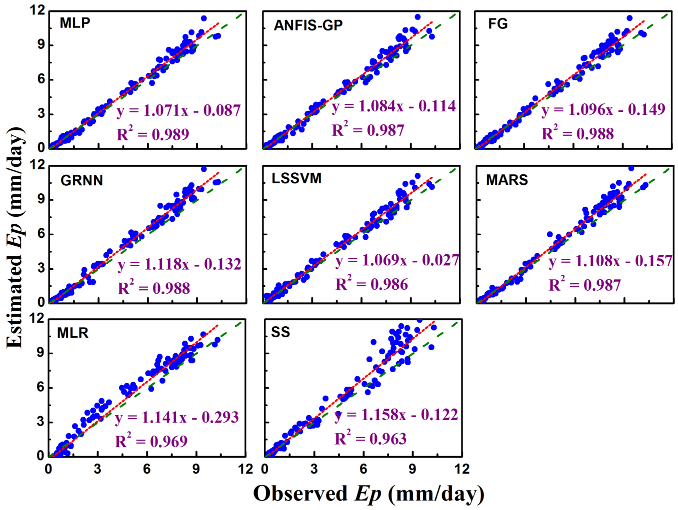
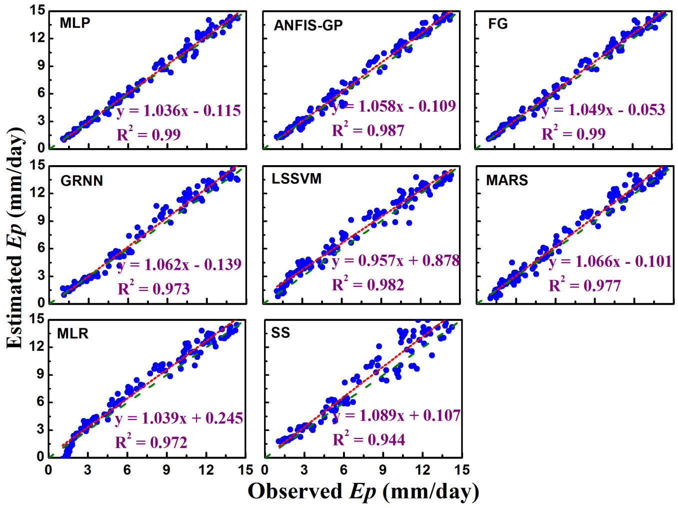

MLP
y = 1.071x - 0.087
R² = 0.989
ANFIS-GP
y = 1.084x - 0.114
R² = 0.987
FG
y = 1.096x - 0.149
R² = 0.988
GRNN
y = 1.118x - 0.132
R² = 0.988
LSSVM
y = 1.069x - 0.027
R² = 0.986
MARS
y = 1.108x - 0.157
R² = 0.987
MLR
y = 1.141x - 0.293
R² = 0.969
SS
y = 1.158x - 0.122
R² = 0.963
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 6.


MLP
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R2 = 0.99
ANFIS-GP
y = 1.058x - 0.109
R2 = 0.987
FG
y = 1.049x - 0.053
R2 = 0.99
GRNN
y = 1.062x - 0.139
R2 = 0.973
LSSVM
y = 0.957x + 0.878
R2 = 0.982
MARS
y = 1.066x - 0.101
R2 = 0.977
MLR
y = 1.039x + 0.245
R2 = 0.972
SS
y = 1.089x + 0.107
R2 = 0.944
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 7.

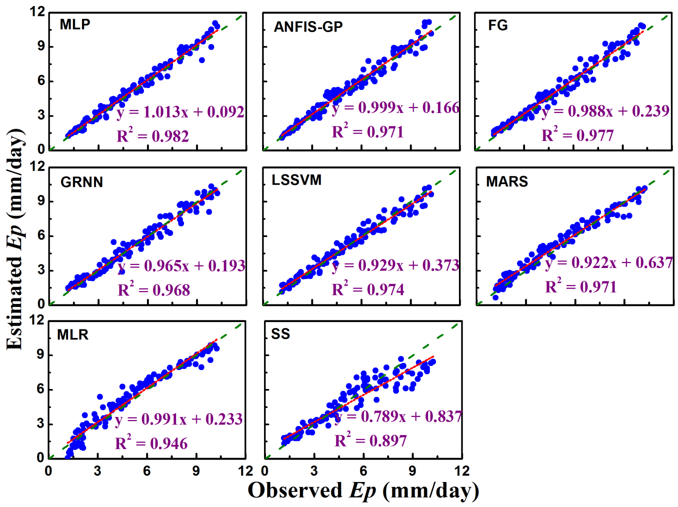

MLP
y = 1.013x + 0.092
R2 = 0.982
ANFIS-GP
y = 0.999x + 0.166
R2 = 0.971
FG
y = 0.988x + 0.239
R2 = 0.977
GRNN
y = 0.965x + 0.193
R2 = 0.968
LSSVM
y = 0.929x + 0.373
R2 = 0.974
MARS
y = 0.922x + 0.637
R2 = 0.971
MLR
y = 0.991x + 0.233
R2 = 0.946
SS
y = 0.789x + 0.837
R2 = 0.897
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 8.

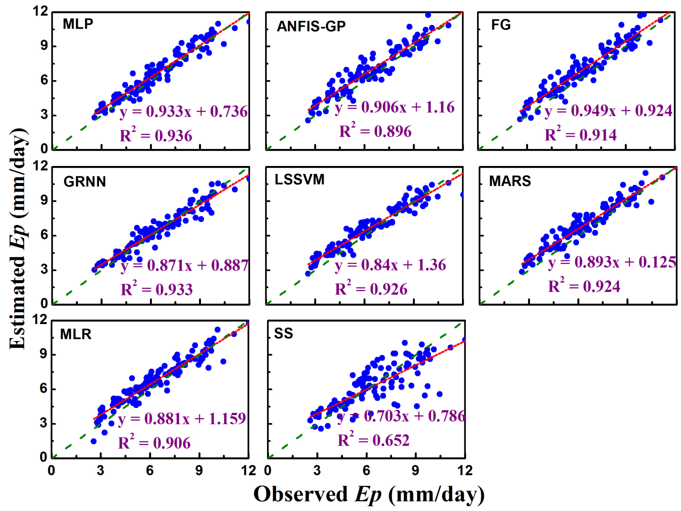

MLP
y = 0.933x + 0.736
R² = 0.936
ANFIS-GP
y = 0.906x + 1.16
R² = 0.896
FG
y = 0.949x + 0.924
R² = 0.914
GRNN
y = 0.871x + 0.887
R² = 0.933
LSSVM
y = 0.84x + 1.36
R² = 0.926
MARS
y = 0.893x + 0.125
R² = 0.924
MLR
y = 0.881x + 1.159
R² = 0.906
SS
y = 0.703x + 0.786
R² = 0.652
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 9.

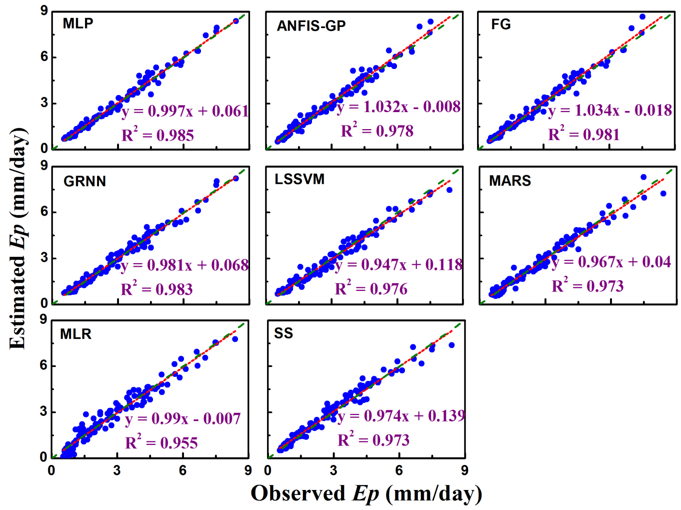

MLP
y = 0.997x + 0.061
R² = 0.985
ANFIS-GP
y = 1.032x - 0.008
R² = 0.978
FG
y = 1.034x - 0.018
R² = 0.981
GRNN
y = 0.981x + 0.068
R² = 0.983
LSSVM
y = 0.947x + 0.118
R² = 0.976
MARS
y = 0.967x + 0.04
R² = 0.973
MLR
y = 0.99x - 0.007
R² = 0.955
SS
y = 0.974x + 0.139
R² = 0.973
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 10.

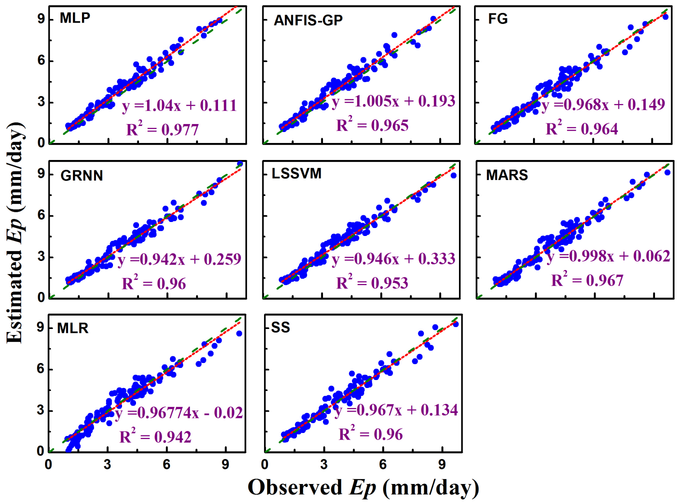
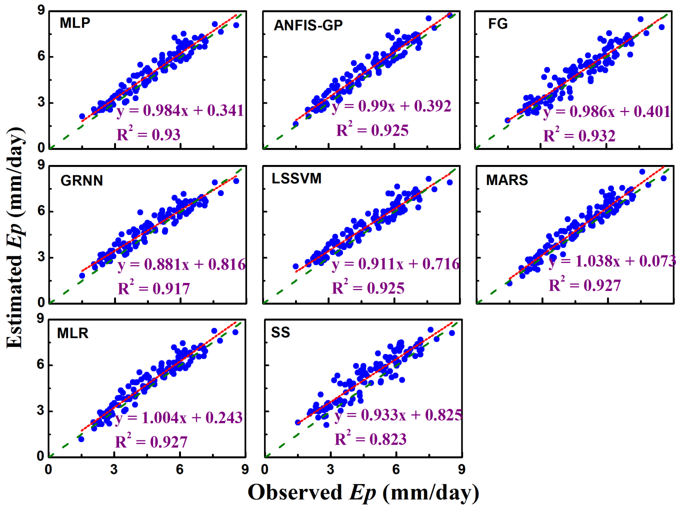

MLP
y =1.04x + 0.111
R² = 0.977
ANFIS-GP
y =1.005x + 0.193
R² = 0.965
FG
y =0.968x + 0.149
R² = 0.964
GRNN
y =0.942x + 0.259
R² = 0.96
LSSVM
y =0.946x + 0.333
R² = 0.953
MARS
y =0.998x + 0.062
R² = 0.967
MLR
y =0.96774x - 0.02
R² = 0.942
SS
y =0.967x + 0.134
R² = 0.96
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 11.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R² = 0.93
ANFIS-GP
y = 0.99x + 0.392
R² = 0.925
FG
y = 0.986x + 0.401
R² = 0.932
GRNN
y = 0.881x + 0.816
R² = 0.917
LSSVM
y = 0.911x + 0.716
R² = 0.925
MARS
y = 1.038x + 0.073
R² = 0.927
MLR
y = 1.004x + 0.243
R² = 0.927
SS
y = 0.933x + 0.825
R² = 0.823
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 12.

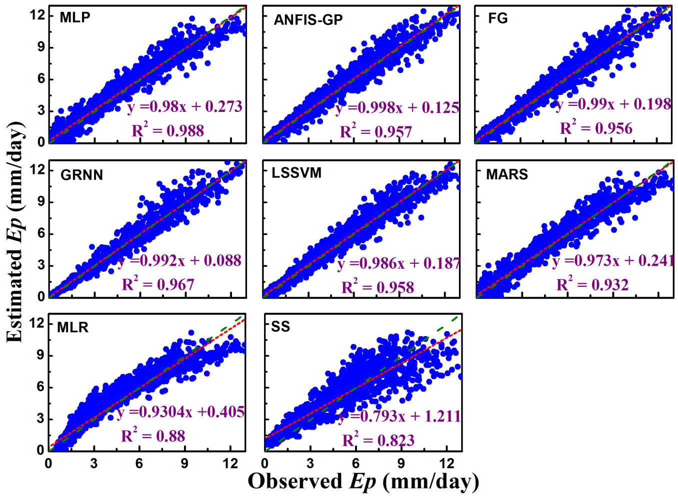
MLP
y =0.98x + 0.273
R2 = 0.988
ANFIS-GP
y =0.998x + 0.125
R2 = 0.957
FG
y =0.99x + 0.198
R2 = 0.956
GRNN
y =0.992x + 0.088
R2 = 0.967
LSSVM
y =0.986x + 0.187
R2 = 0.958
MARS
y =0.973x + 0.241
R2 = 0.932
MLR
y =0.9304x +0.405
R2 = 0.88
SS
y =0.793x + 1.211
R2 = 0.823
Estimated Ep (mm/day)
Observed Ep (mm/day)

Fig. 13.