Enhanced flow rating using neural networks with water stage and EC as predictors

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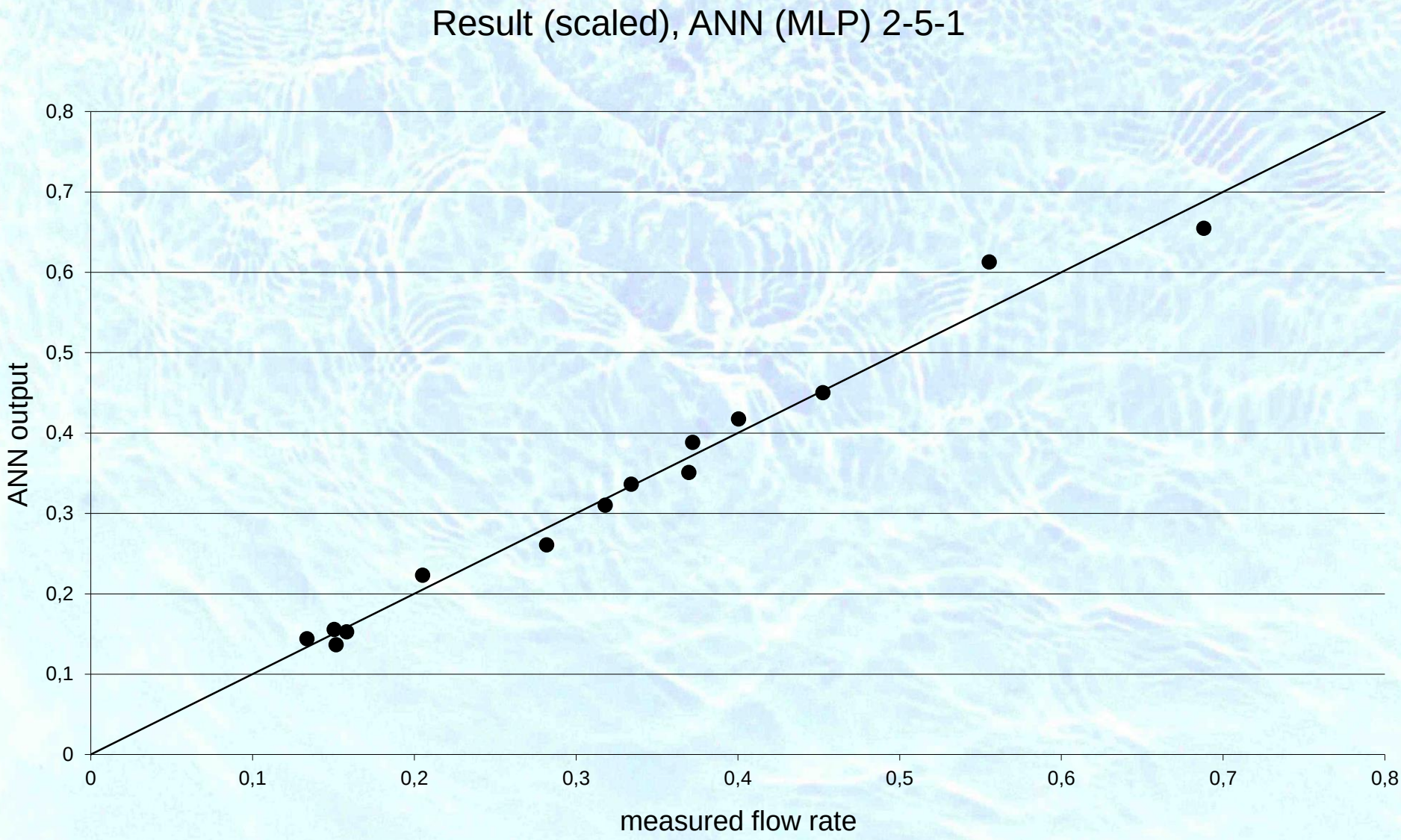
The point of departure:

- What we usually get on a continuous basis, is stage
- The typical rating function is discharge vs. stage

The idea:

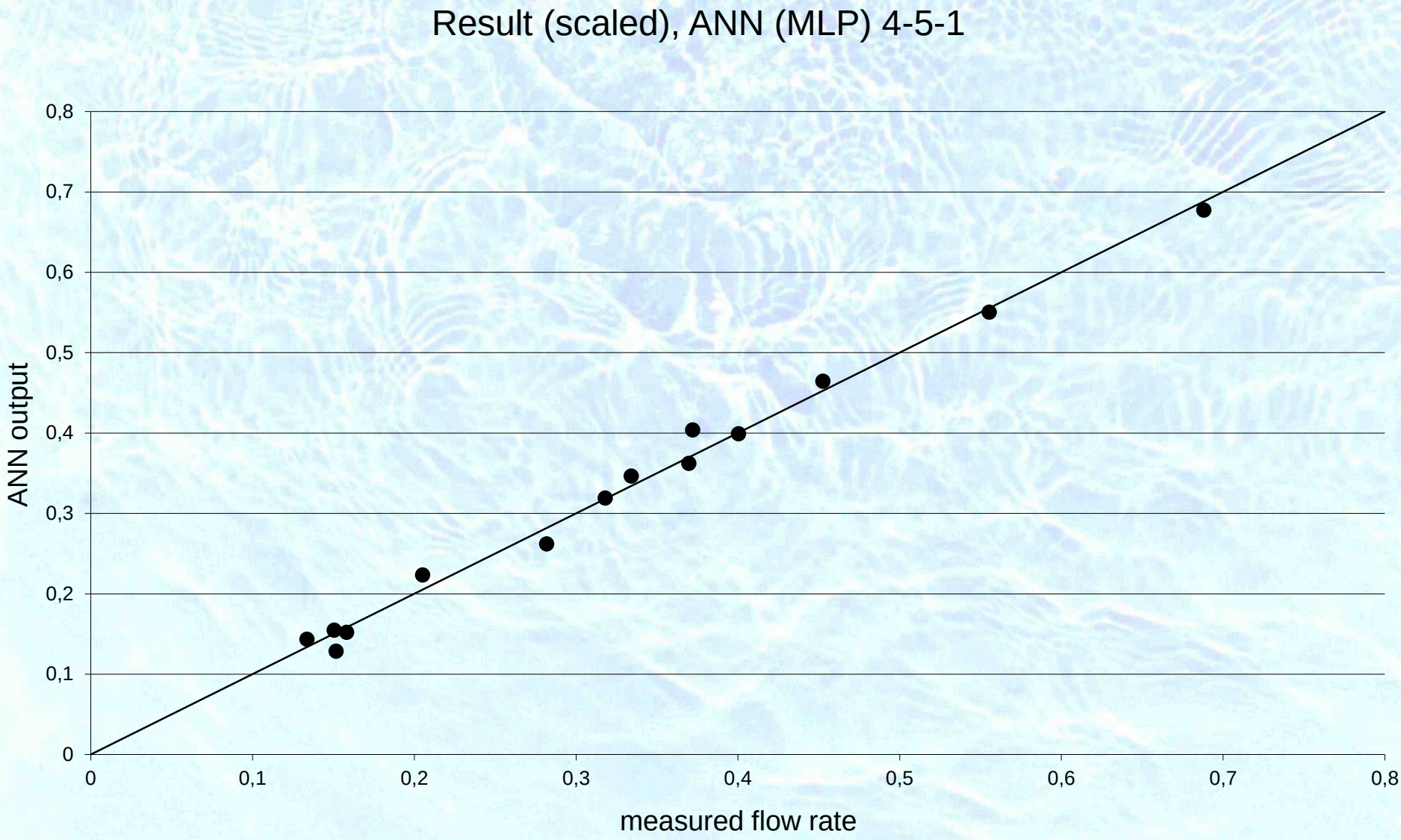
- EC can be recorded continuously at comparatively low cost
- So, why not use both?


Result (scaled), ANN (MLP) 2-5-1
ANN output
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
measured flow rate

The Q-EC relationship is hysteretic

- Both stage and EC are available (quasi-)continuously
- So is the time derivative of either
- ANN can be improved
- 2 more inputs: trends of stage, EC

⇨ 4-5-1 MLP


Result (scaled), ANN (MLP) 4-5-1
ANN output
measured flow rate
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8

RMSE (testing):

- 0.043 for 1-3-1 MLP (W $\Longrightarrow$ Q)
- 0.022 for 2-5-1 MLP (W,EC $\Longrightarrow$ Q)
- 0.014 for 4-5-1 MLP (W,ΔW, EC, sgn(ΔEC) $\Rightarrow$ Q)

Conclusions:

- Use of stage and EC improves performance over stage alone.
- Inclusion of temporal trends in stage and EC permits concentrating, flushing, anti-diluting and diluting conditions to be reproduced and results in notable further improvement of Q computed.