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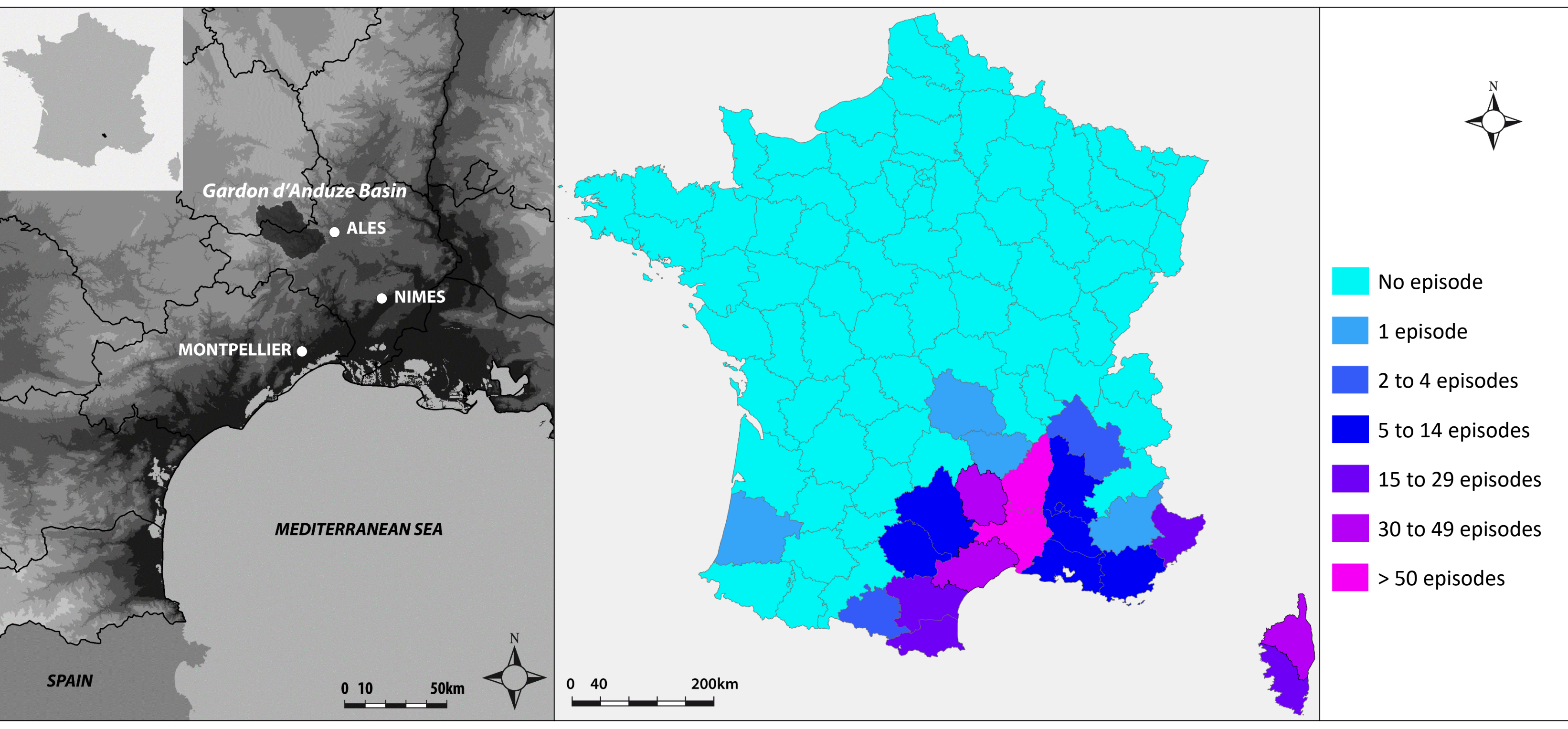
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Neural network flash flood forecasting : generalizing to ungauged basins

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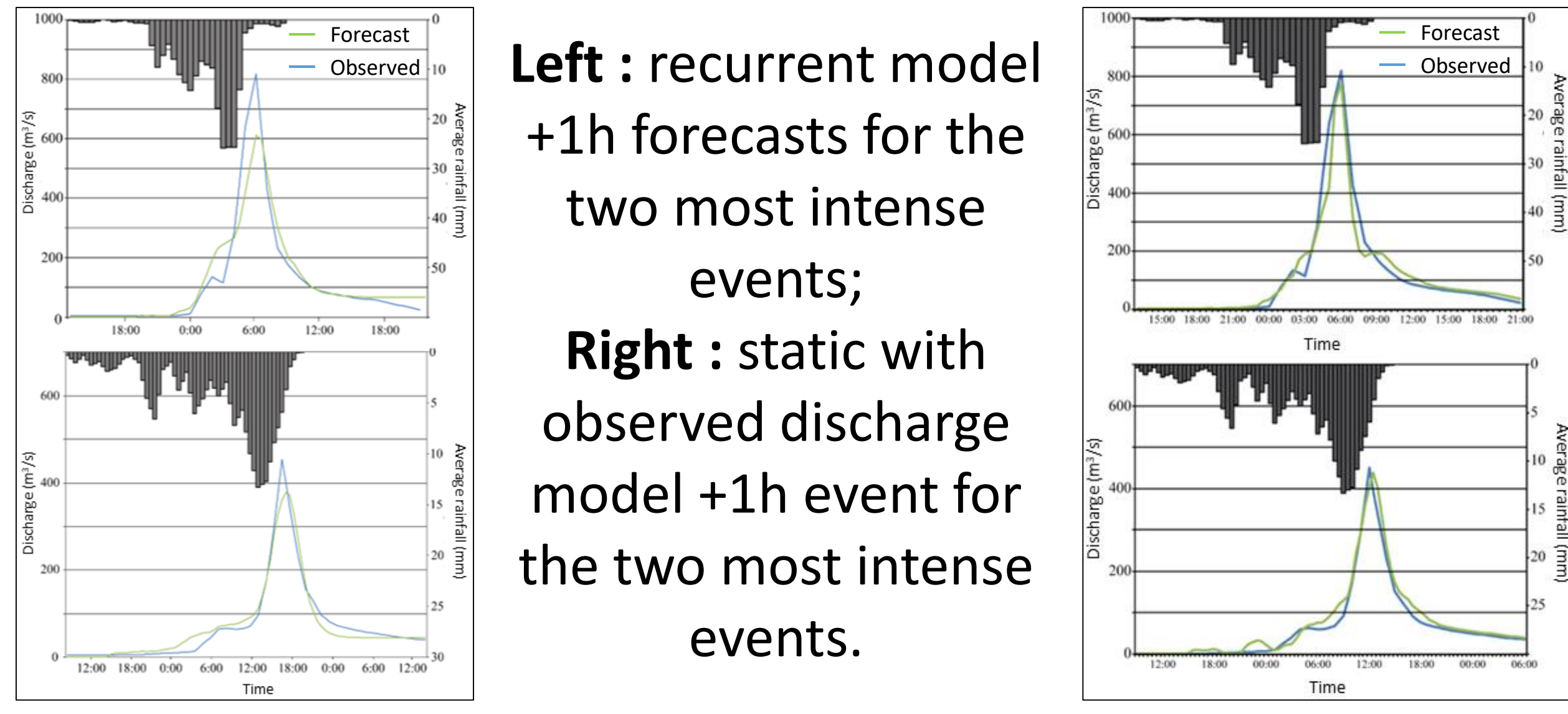
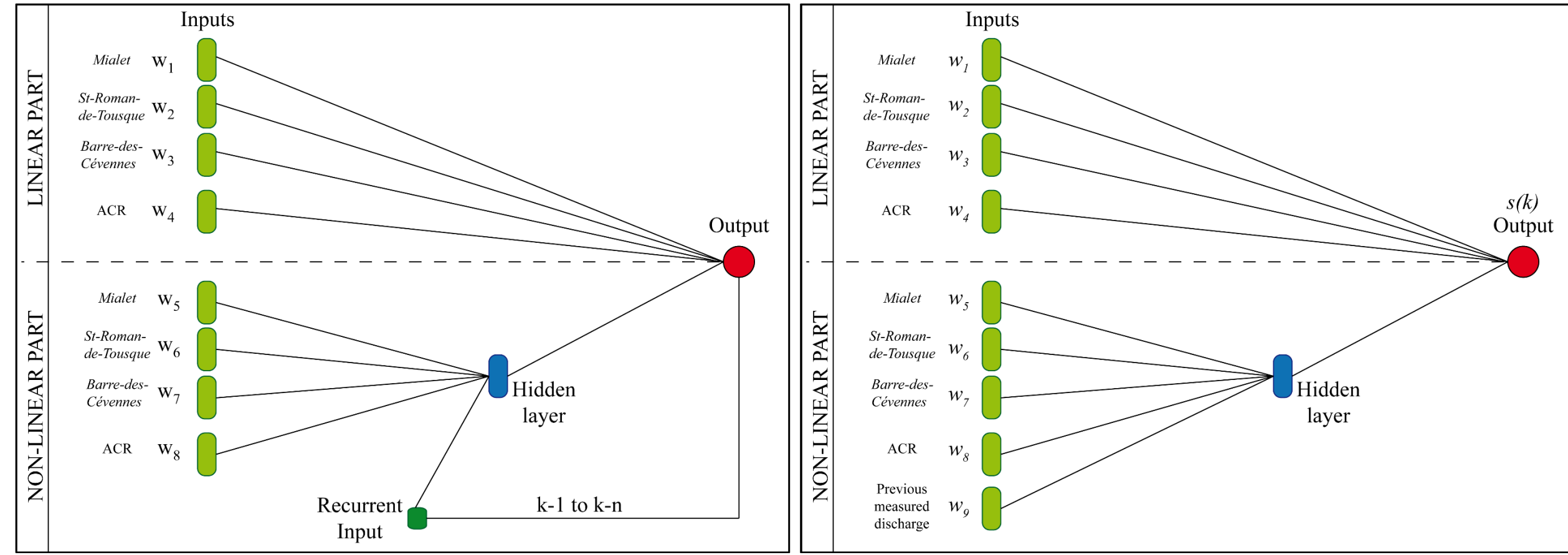
1. The Cévennes region : a remarkable region for flash floods



Left : location of the Gardon d'Anduze basin in the Cévennes range ; **Right** : number of events above 200 mm in 24 hours from 1958 to 2010 per administrative department (Meteo France).

- Numerous heavy rainfall episodes leading to flash floods,
- More than 100 fatalities and billions of damage costs in the past years,
- Low predictability and great difficulty to understand hydrological processes.

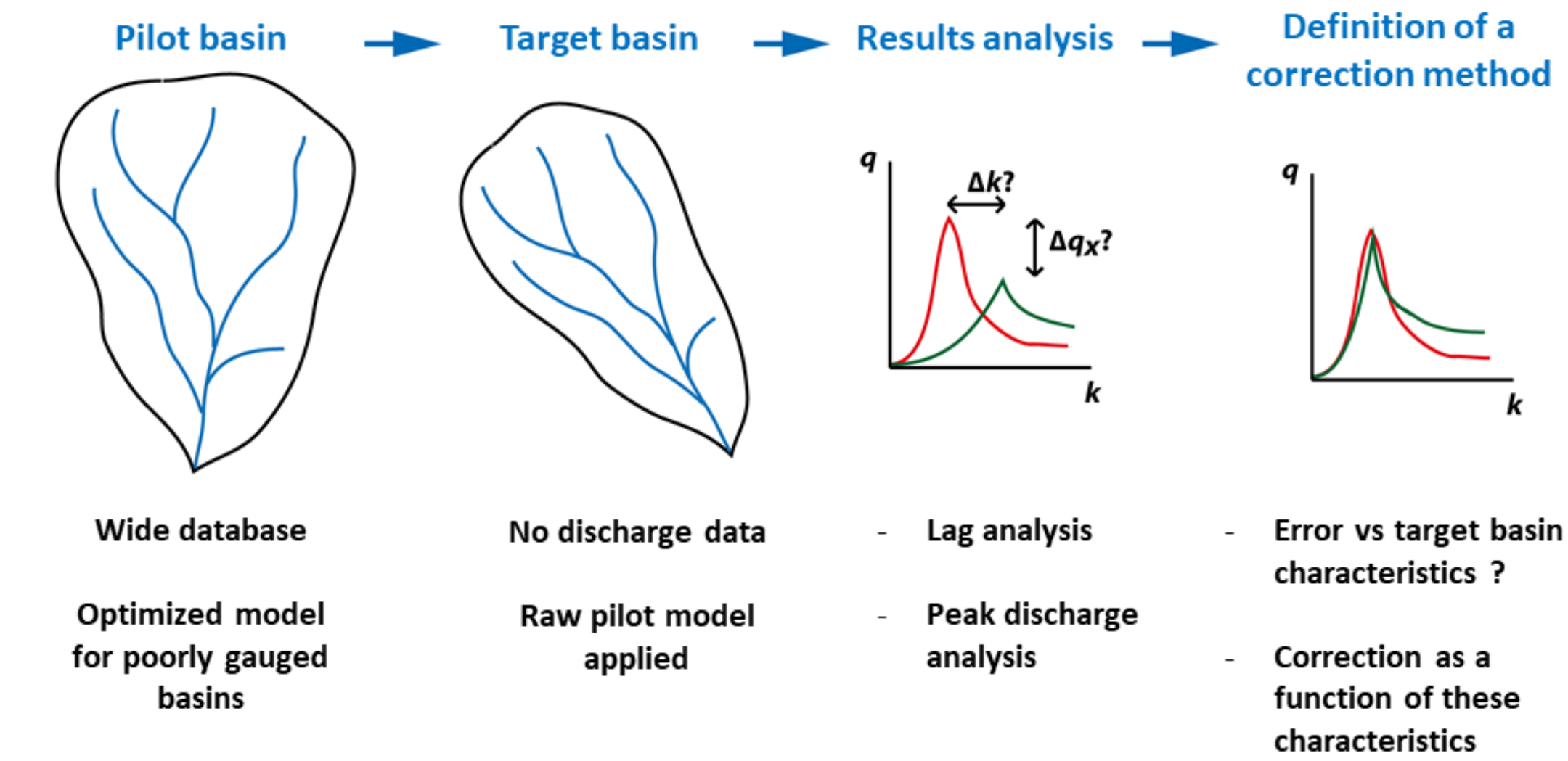
2. Neural networks for hydrology : adapting to available data



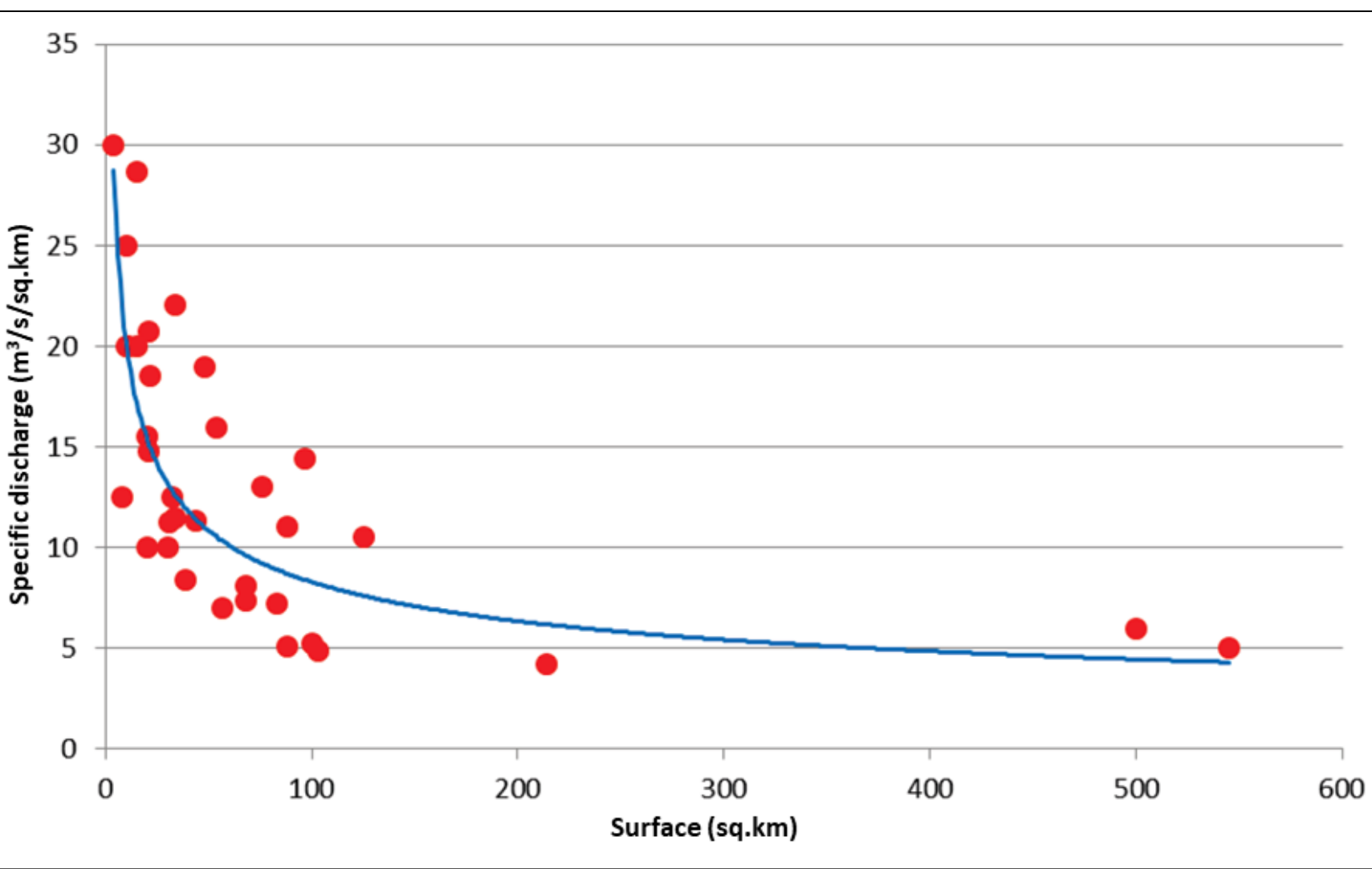
Left : recurrent model +1h forecasts for the two most intense events;
Right : static with observed discharge model +1h event for the two most intense events.

- Design of two models : recurrent for poorly gauged basins (left) and static with observed discharge for well gauged basins (right).
- Output noise governing in the first case, state noise governing in the second case.
- 58 intense events in the database, with one very intense event, out of the training set.
- Specific discharge forecasts up to 2h without rainfall forecasts.

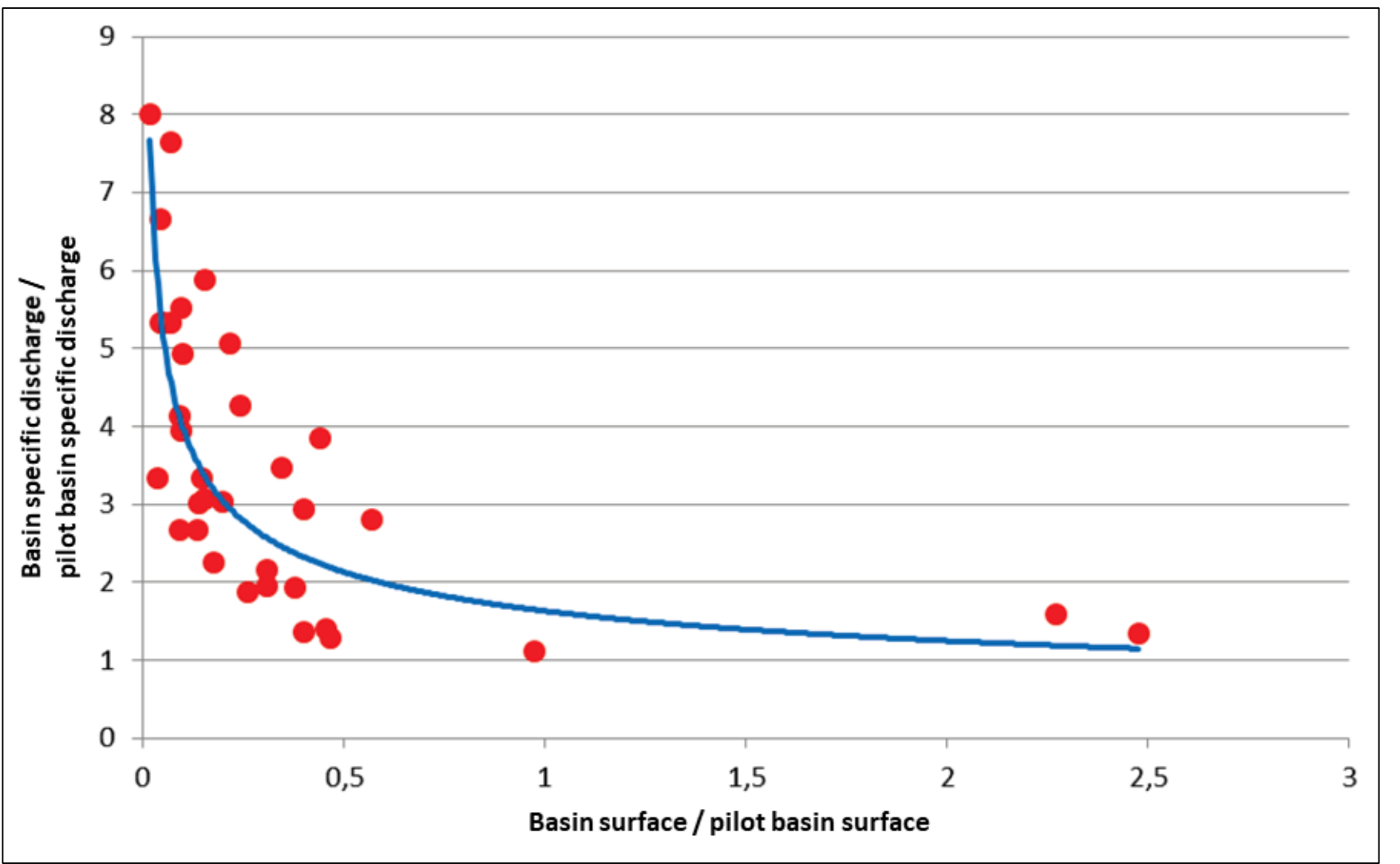
3. Statistical modeling on ungauged basins : how to ?



- Application of the model to 15 other "ungauged" basins
- Bad results expected : taking advantage of the meaningfulness of errors ?
- Building a correction method based on the basin characteristics.



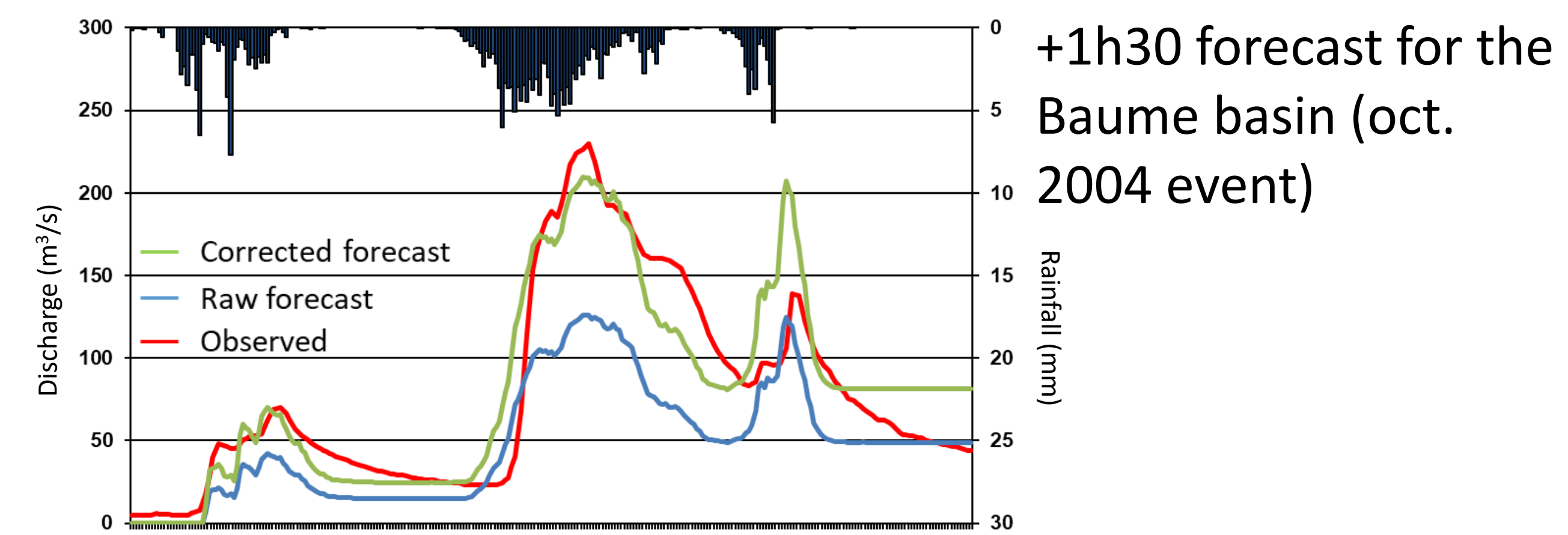
Dimensional (left) and non dimensional (right) relationship between specific discharge and surface.



4. Results on ungauged basins of the Cévennes range

- For more than 30 sq.km basins and when representative rainfall are available, the model proved it was able to generalize to ungauged basins.
- Its ability to generalize is limited to hydro-climatic similar areas but could be transposed to other areas.

| Lead time | 0h30 | 1h | 1h30 | 2h |
|---|------|-----|------|-----|
| Average predicted percentage of peak | 94% | 87% | 87% | 87% |
| Median predicted percentage of peak | 87% | 84% | 86% | 86% |
| 70 to 130% predicted percentage of peak | 80% | 80% | 88% | 80% |



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