Joint modelling of wind and hydro inflow for power system scheduling

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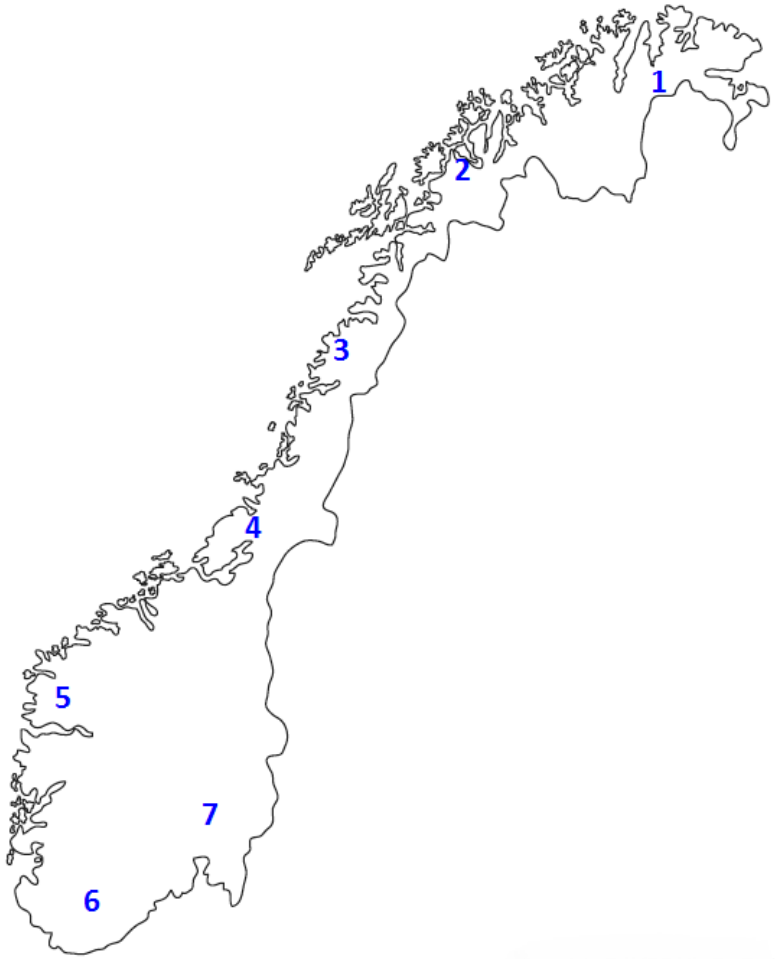
Background

- Introduction of wind in hydro-dominated systems
- Regions with limited transfer capacity
- Coordinate long-term hydro scheduling with wind
- Account for uncertainty in wind

Data

- Reanalysis wind data
- Observed inflow data (NVE)
- Daily and weekly average series



Data characteristics

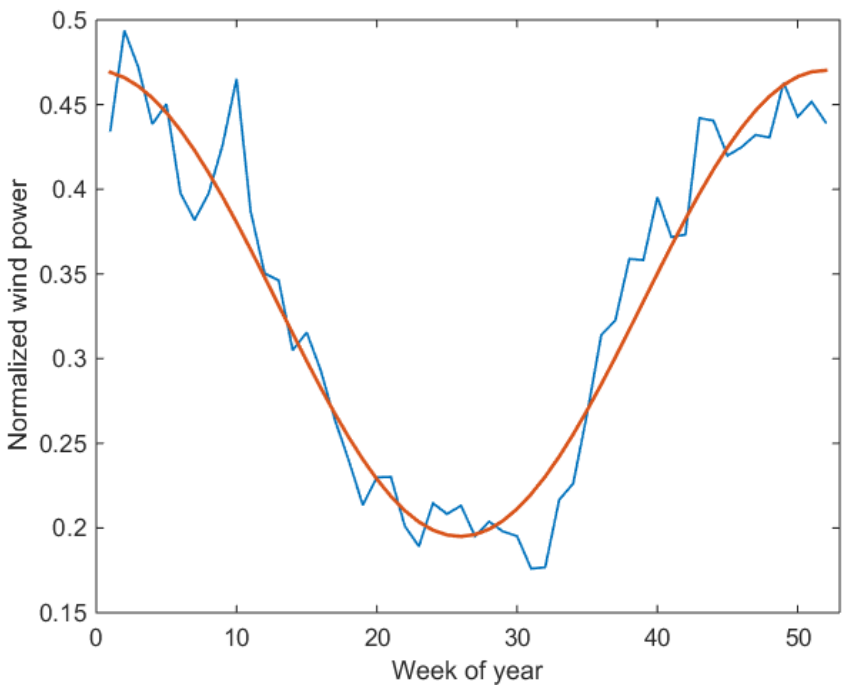
- Seasonality – wind and inflow

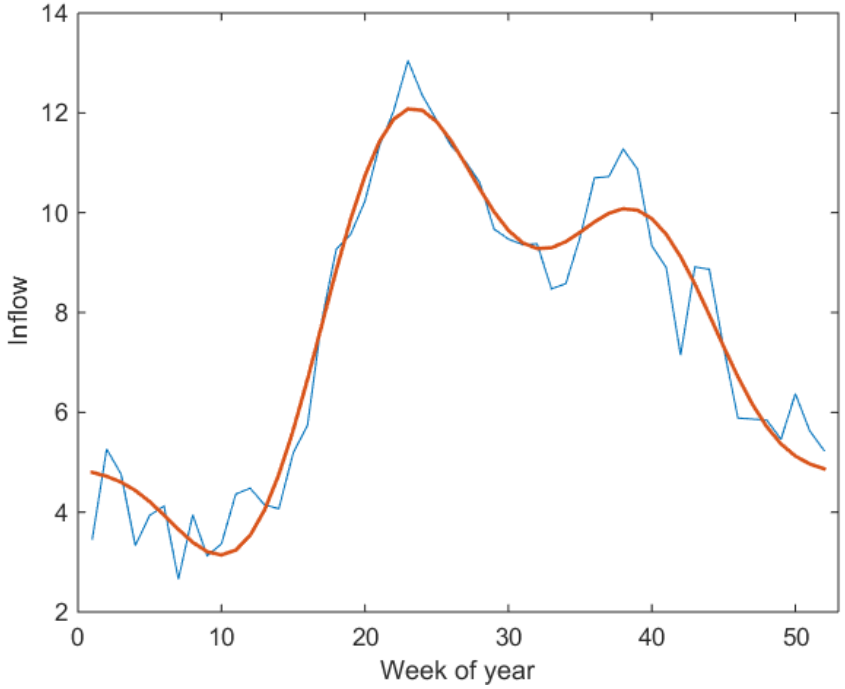
  Non-stationary

- Serial correlation

- Inter-dependence

Seasonality





Sample weekly mean (blue) and estimated seasonal mean (red) for region 5

Joint model wind and inflow

- Deseasonalize individually
  – harmonic regression

- Series now assumed stationary

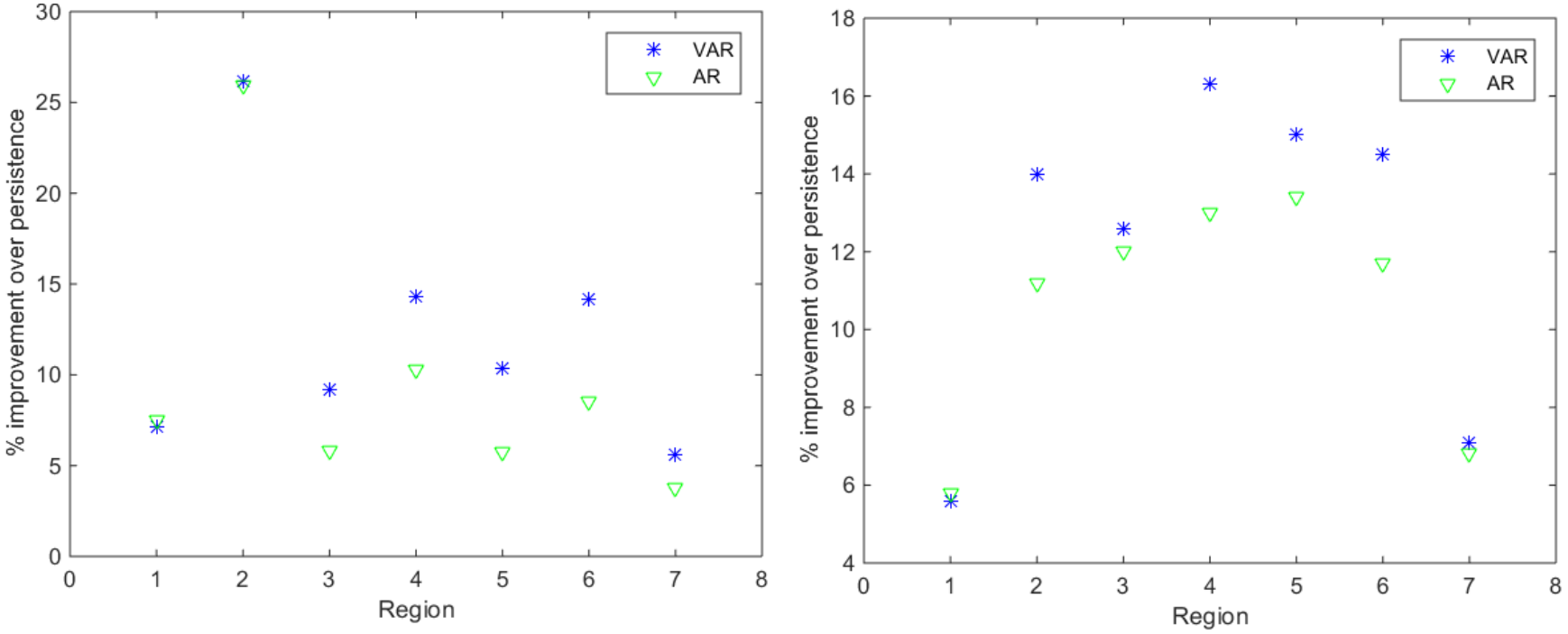
- Lagged and contemporaneos dependencies
  – vector autoregressive model of order *p* (VAR(*p*))

Modelling results

VAR(1), region 5. Parameter estimates and corresponding standard error

Data	φ_{11}	SE	φ_{12}	SE	φ_{21}	SE	φ_{22}	SE
Region 1	0.144	0.019	*-0.015*	*0.019*	*0.008*	*0.014*	0.696	0.014
Region 2	0.175	0.020	*0.030*	*0.020*	0.157	0.016	0.550	0.016
Region 3	0.199	0.020	*0.026*	*0.019*	0.074	0.020	0.409	0.019
Region 4	0.229	0.021	*-0.010*	*0.020*	0.169	0.020	0.280	0.020
Region 5	0.213	0.020	0.052	0.020	0.095	0.019	0.363	0.019
Region 6	0.185	0.021	0.050	0.021	0.140	0.019	0.414	0.019
Region 7	0.240	0.019	*0.021*	*0.017*	*0.032*	*0.017*	0.612	0.015

Forecasting performance



Percentage improvement over persistence forecast in terms of mean Euclidean error for daily (left) and weekly (right) series

Concluding remarks

- Joint modelling of wind and inflow can improve forecasting performance
- Can improved *quality* be translated into improved *value*?
- TODO: Investigate impact of stochastic wind-inflow representation in SDDP-based scheduling models

Thank you