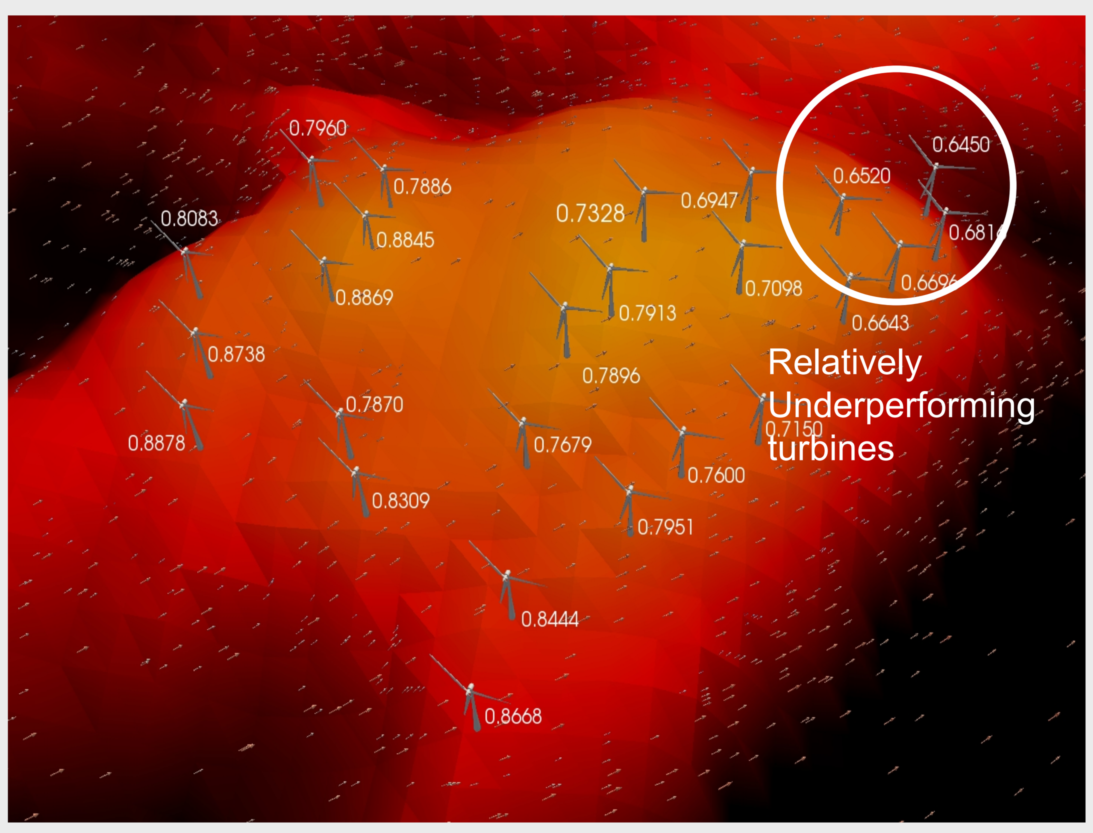
A HYBRID NUMERICAL AND STATISTICAL MODEL FOR WIND POWER FORECASTING

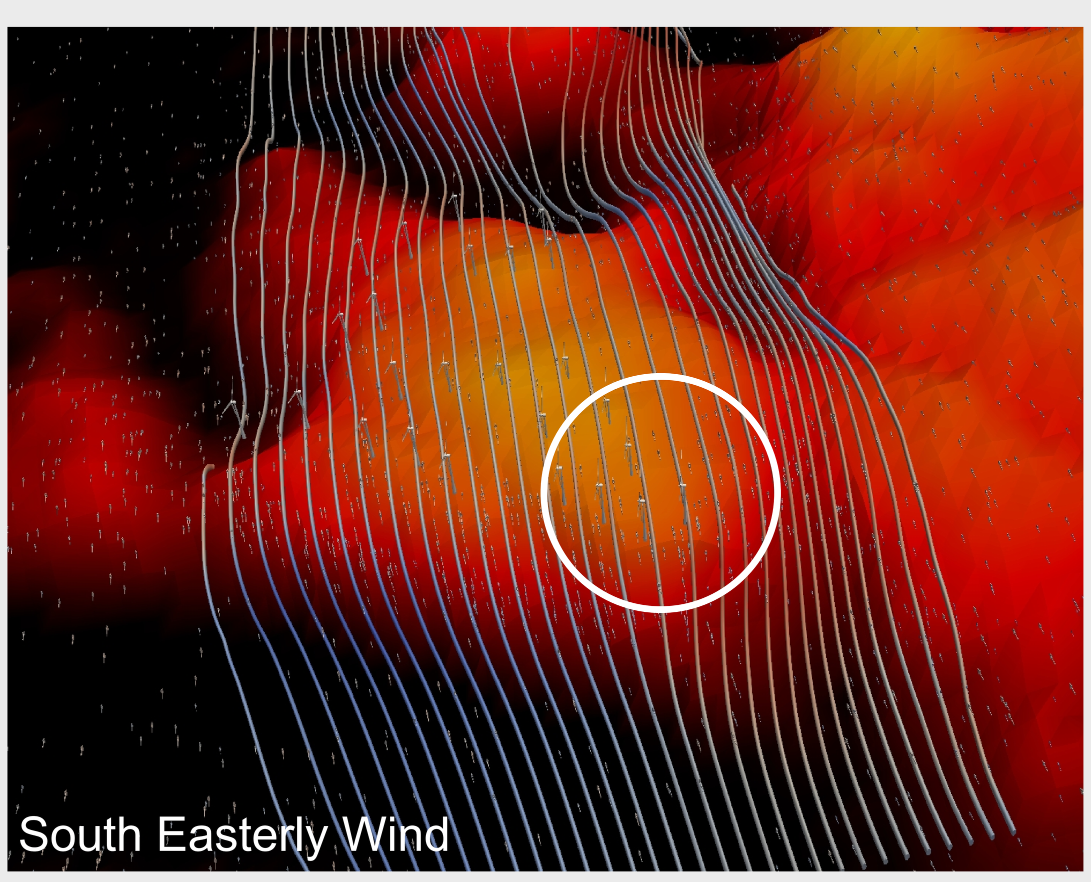
Adil Rasheed[1], Jakob Kristoffer Süld[2], Ingrid Vik[3], Magne Røen[3], Trond Kvamsdal[1]
[1]Applied Mathematics SINTEF ICT, [2]MET Norway , [3]TrønderEnergi AS

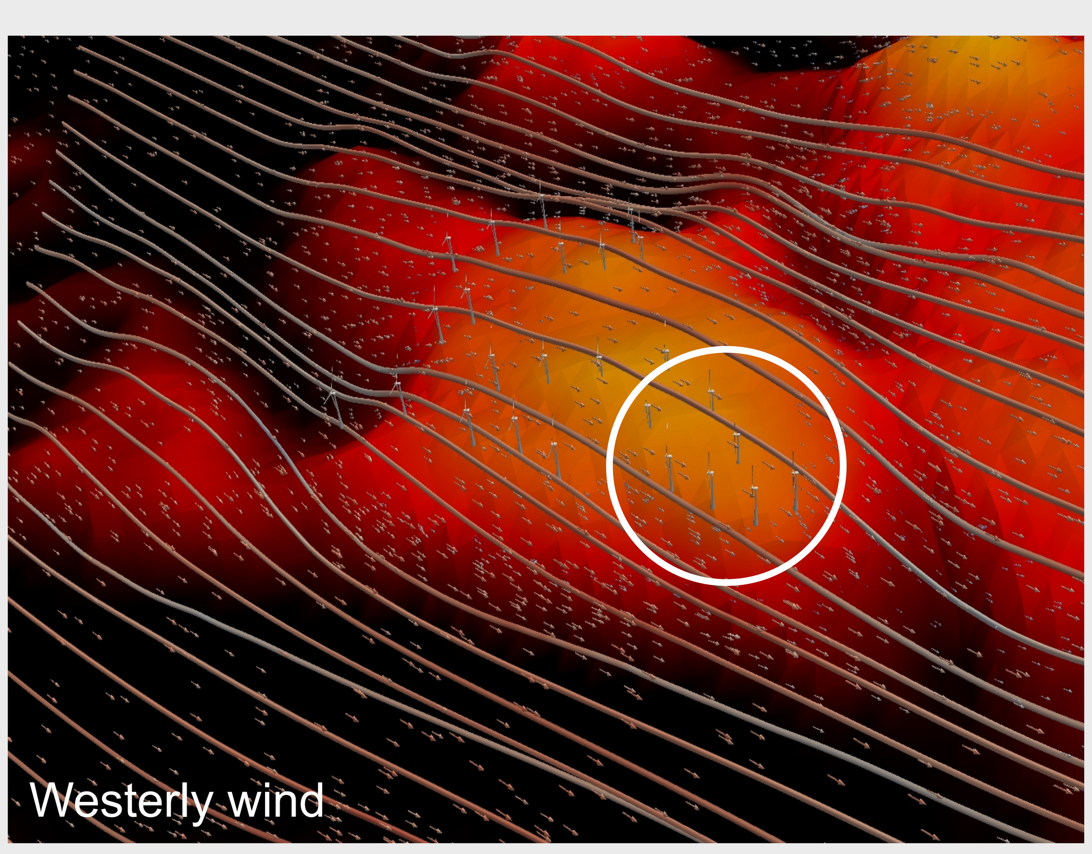
Abstract: A large scale introduction of wind energy in power sector causes a number of challenges for electricity market and wind farm operators who will have to deal with the variability and uncertainty in the wind power generation in their scheduling and trading decisions. Numerical wind power forecasting has been identified as an important tool to address the increasing variability and uncertainty and to more efficiently operate power systems with large wind power penetration. The work clearly demonstrates the power of a hybrid numerical and statistical model developed in the FSI-WT project.

Why do a few turbines under-perform consistently in wind farms ? Can a RANS based model capture the flow behaviour in a complex terrain ?



Offline simulations conducted with the most frequently encountered wind and stratification conditions:

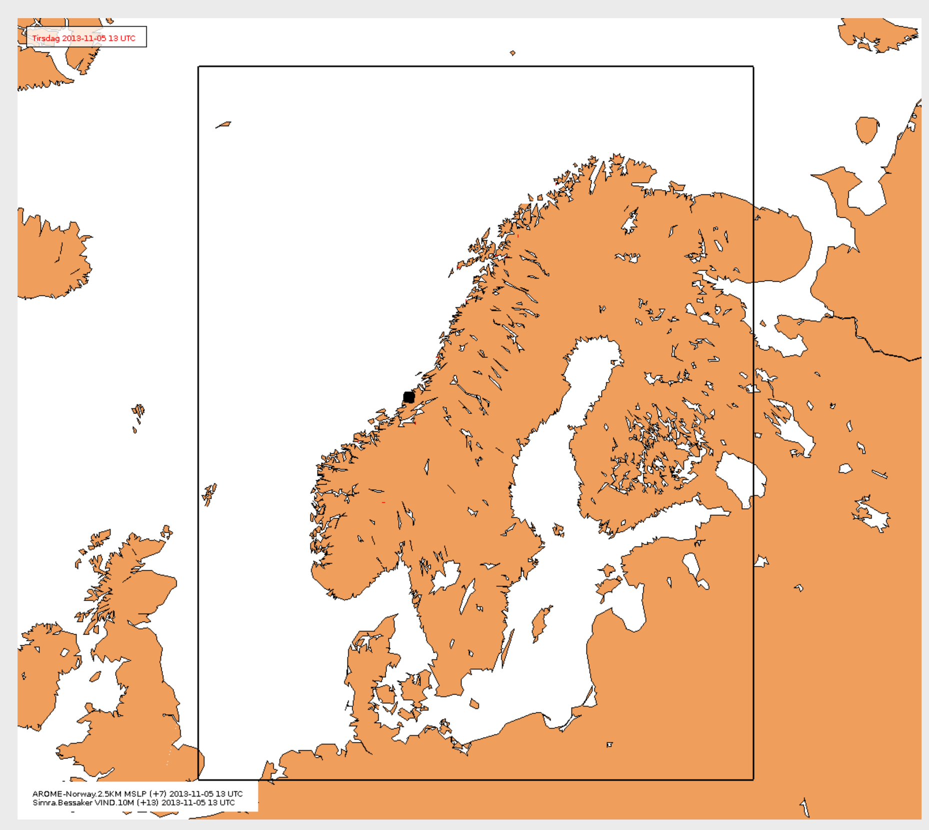




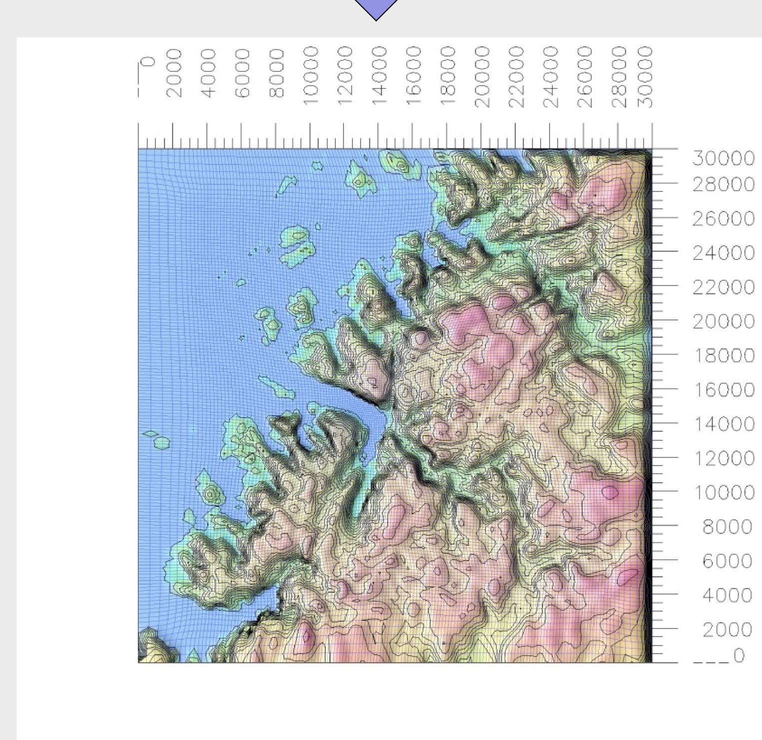
Stream limes for two most dominant wind directions. The figure clearly shows that the wind has a tendency to go around the hill which is perhaps related to the strong stratification in the region thus avoiding a few turbines which consistently underperform.

Three steps to improve Power production

STEP 1: A Multiscale Wind Forecast System



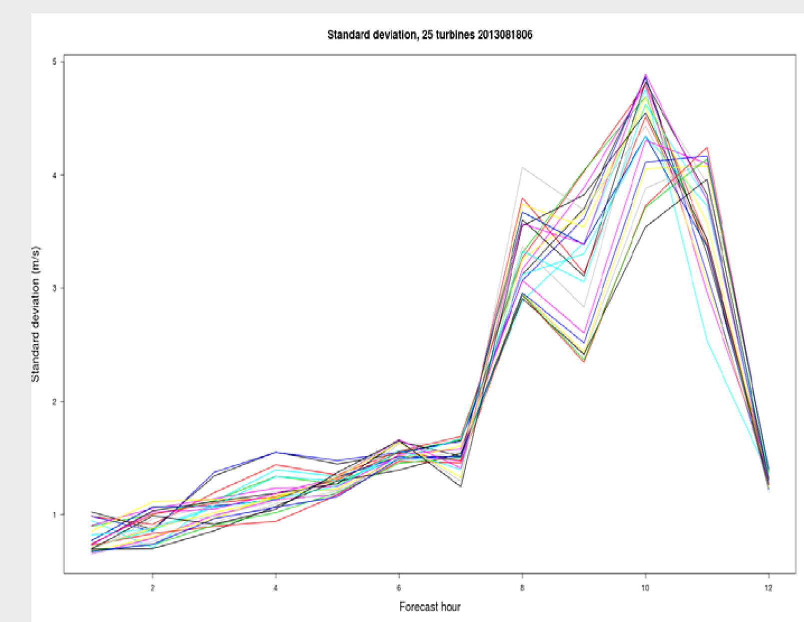
HARMONIE-SIMRA coupling



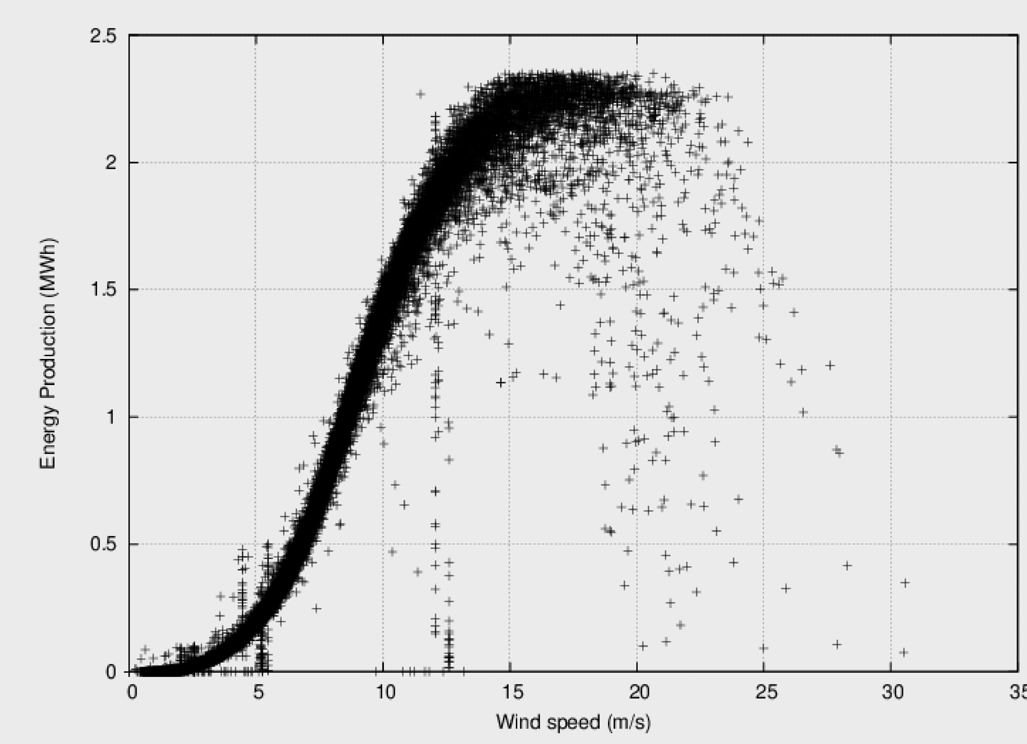
Wind, Temperature and Turbulent Kinetic Energy Field

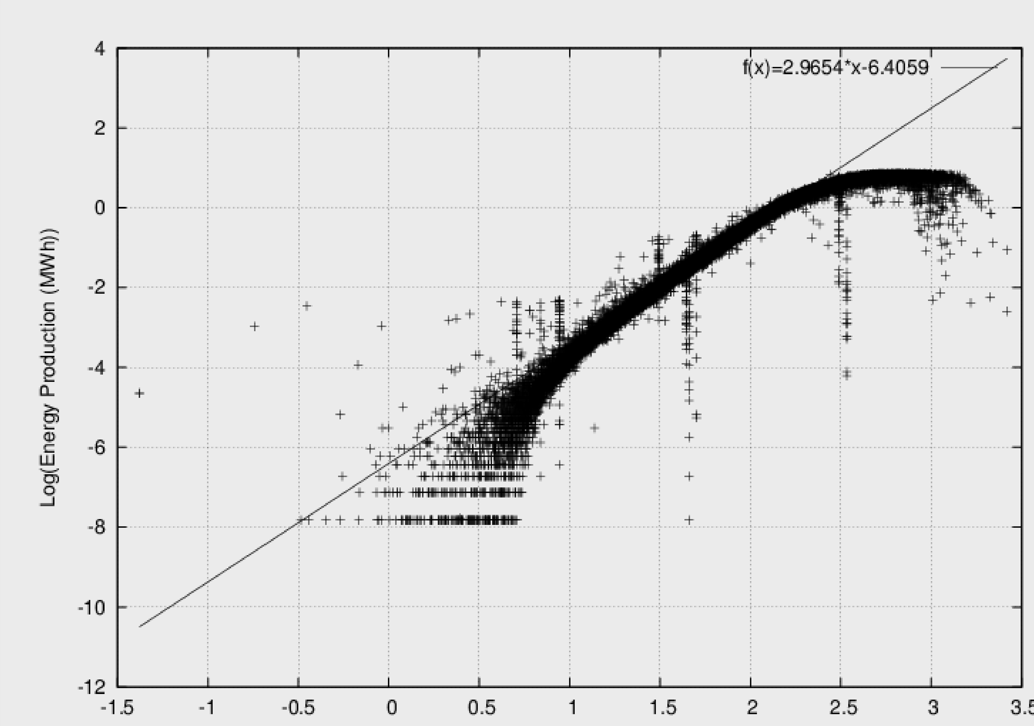
Kalman filter using the historical wind observation data from the wind mast located In the wind farm

STEP 2: Uncertainty quantification by running 10 different ensemble runs



STEP 3: Better dynamic wind to power conversion curve using historical power production data





Improved power production in real time with quantified uncertainty

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