POD-based reduced order model using LiDAR measurements from FINO1

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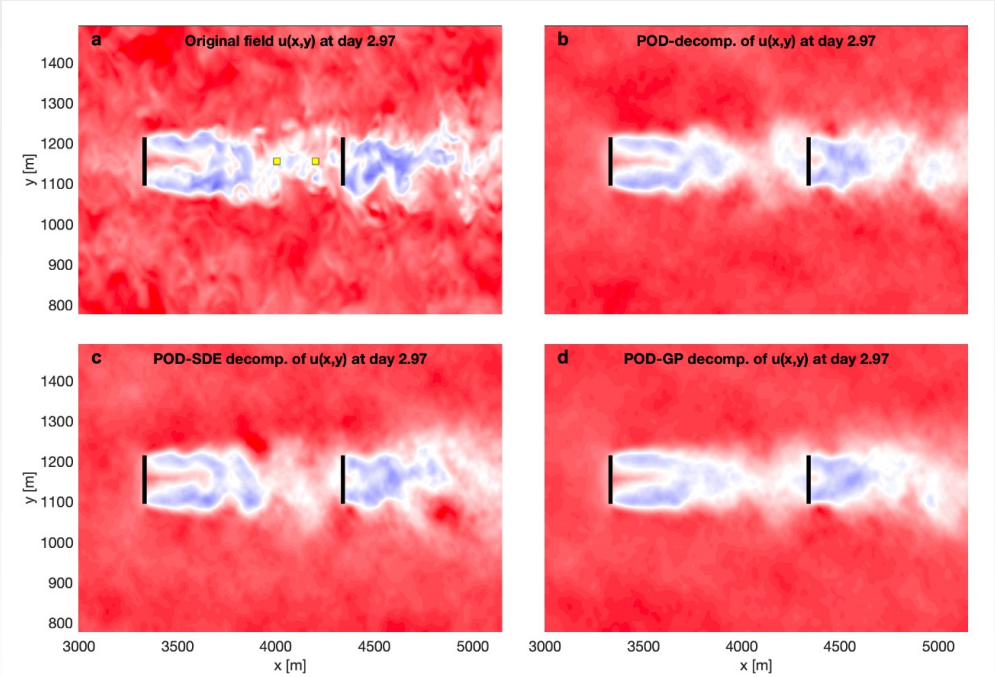
EERA DeepWind'2021, Trondheim, Norway

Motivation

- Wake is crucial to understand when optimizing wind farm layouts and during wind farm controlling.
- Experimental, numerical and analytical methods

Source: Ørsted

Motivation

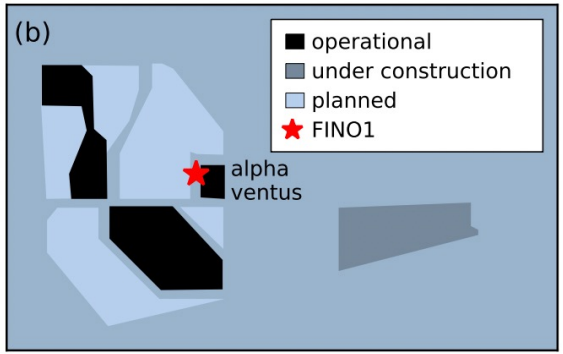


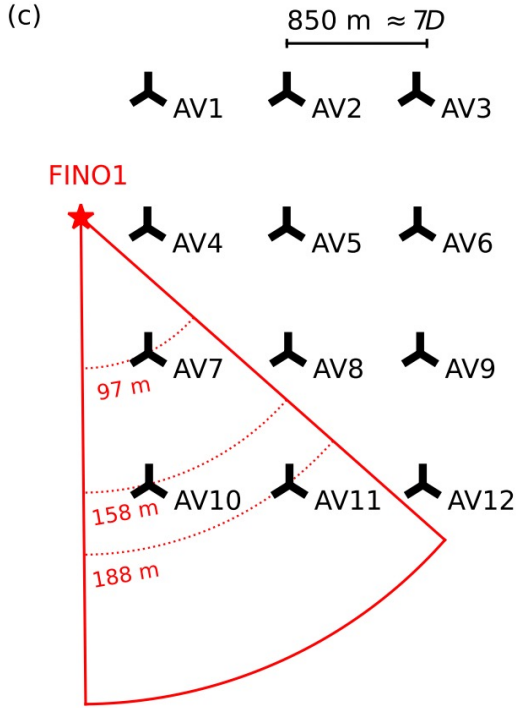
Source: M. Bakhoday

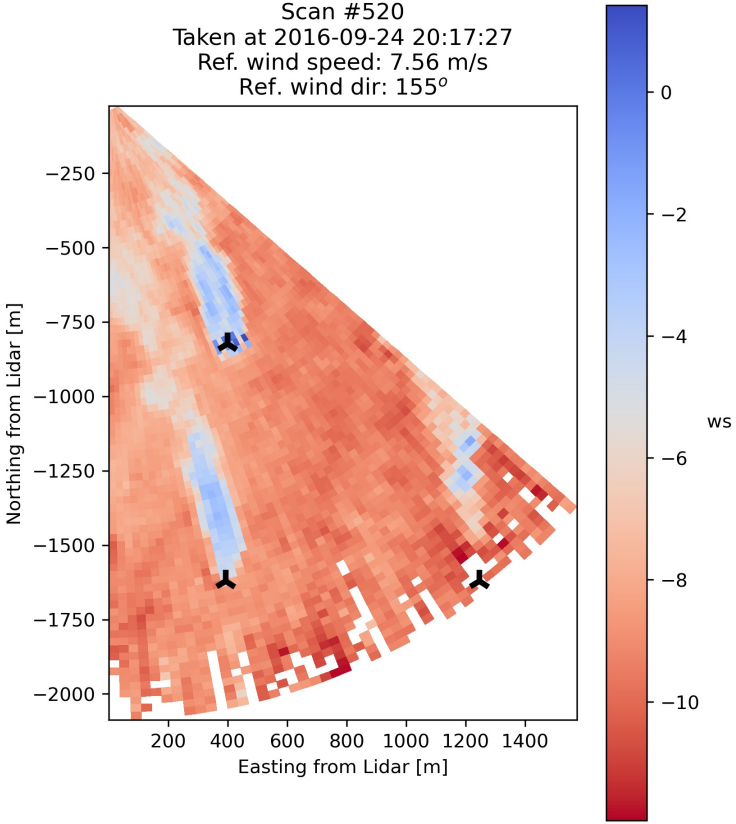
(a) Original stream-wise velocity u directly from LES
(b) Reconstructed u by the standard POD scheme
(c) Reconstructed u from the Stochastic Differential Equations-based model
(d) Reconstructed u from the Standard Gaussian Process based model.

Proper Orthogonal Decomposition (POD) and LiDAR measurements

Data – LiDAR measurements



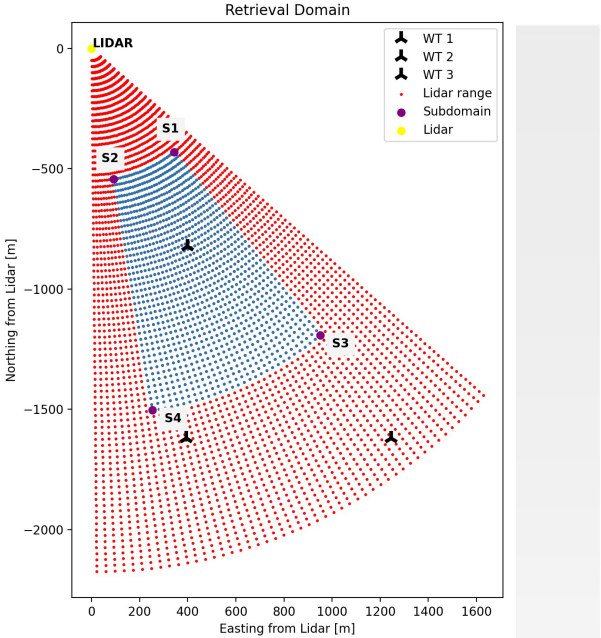


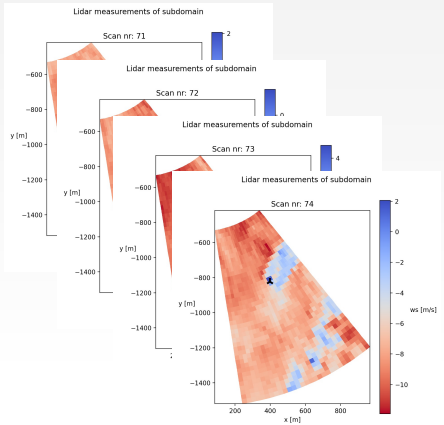


Source: M. Krutova

Methodology

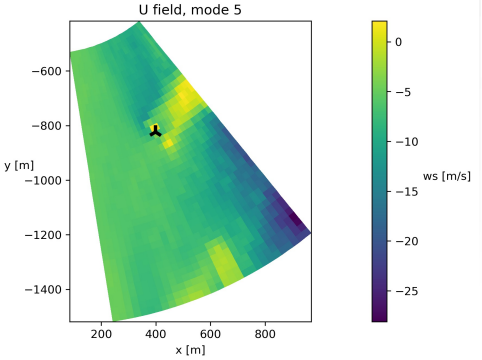
- Data
  - Radial velocity
  - Subdomain
  - Quality control
- Reduced Order Model (ROM)
- Proper Orthogonal Decomposition (POD):
  - Qualified data sent into the POD algorithm





POD

$$u'(x,t) = \sum_{i=1}^{N} a_i(t)\,\phi_i(x)$$



Ongoing and future work

- Retrieval and gap filling
- Weighting coefficient a:
    - Focus: Galerkin approach for non-linearities
    - Stochastic weighting coefficient

- Classify data into stabilities before POD
- Comparison and validation

Thank you

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This work is partly supported by the CONWIND project, ENERGIX, grant number 304229