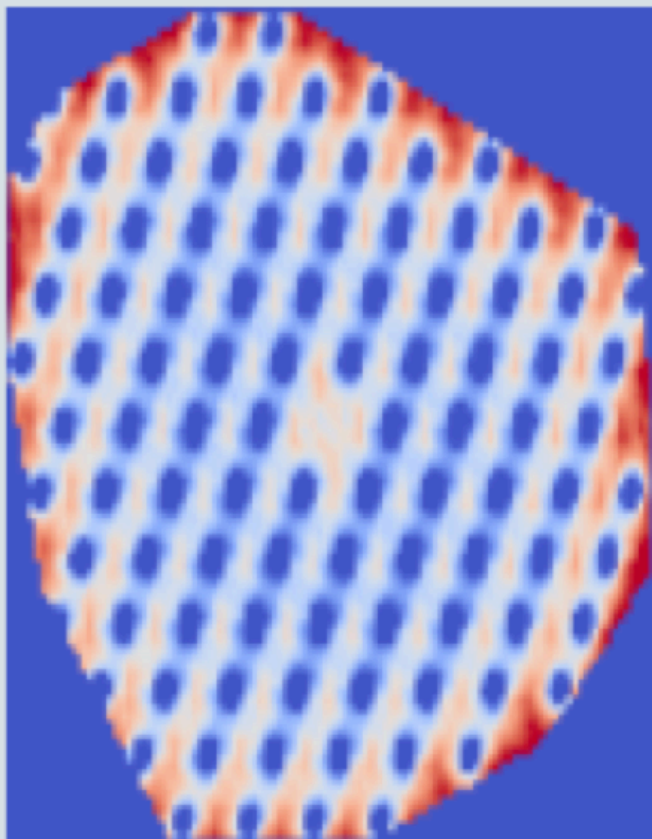


An aerial photograph of a wind farm situated on rolling green hills. Several white wind turbines are visible, with one prominently in the foreground on the left. Winding dirt roads or paths traverse the landscape between the turbines. The terrain is a mix of green grass and brown, tilled soil. The sky is clear and blue.

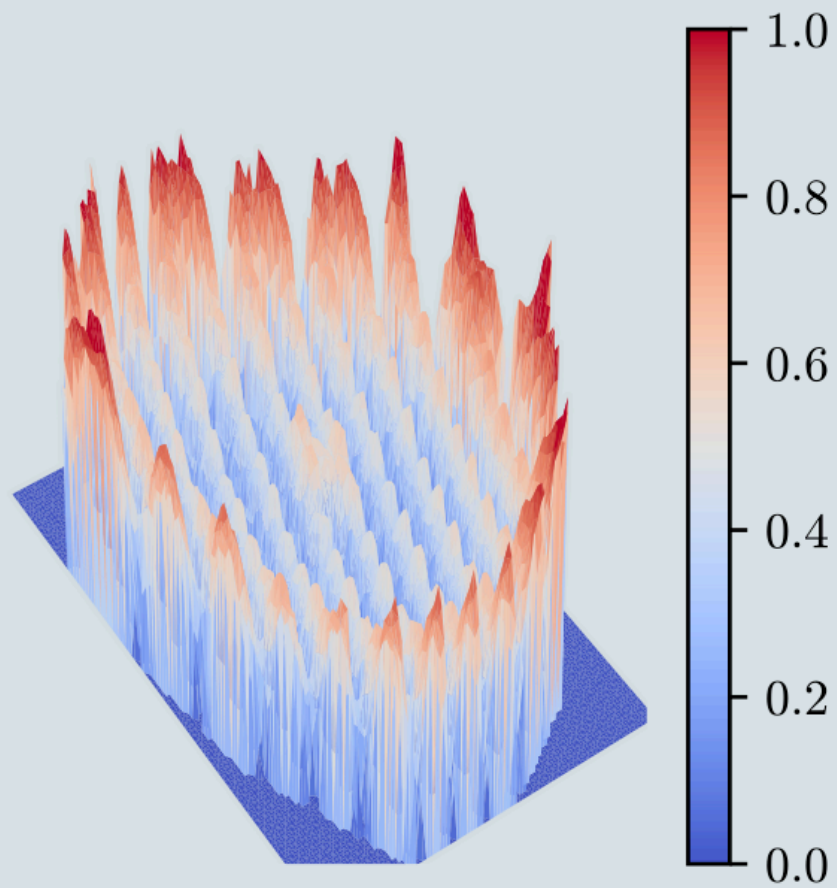
VARIANCE REDUCTION IN WIND FARM LAYOUT OPTIMIZATION

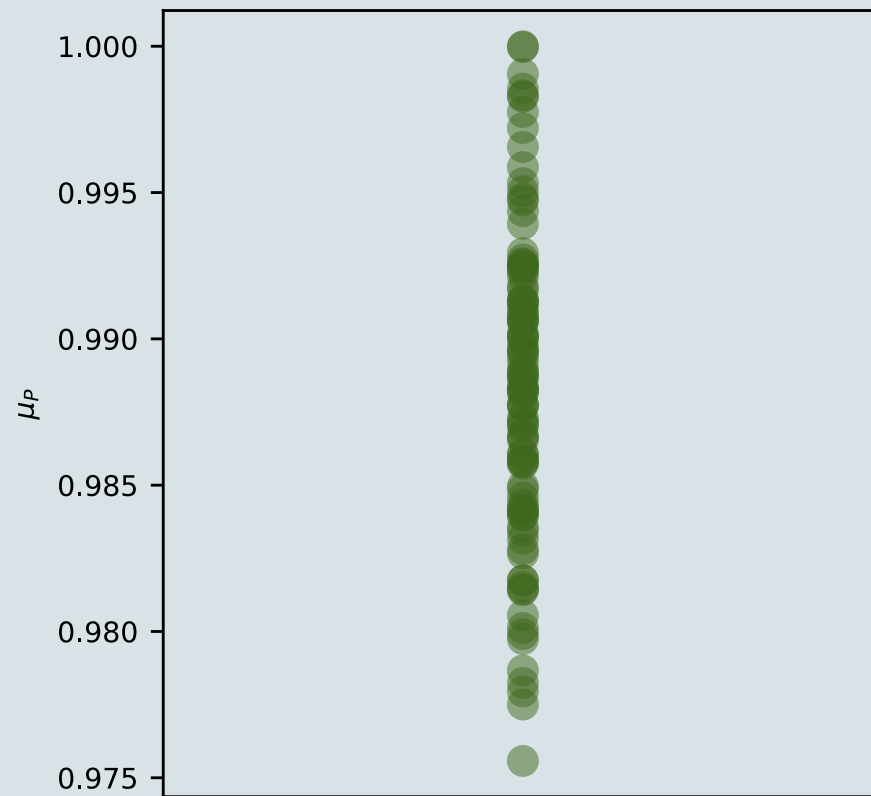
July 23, 2019

a

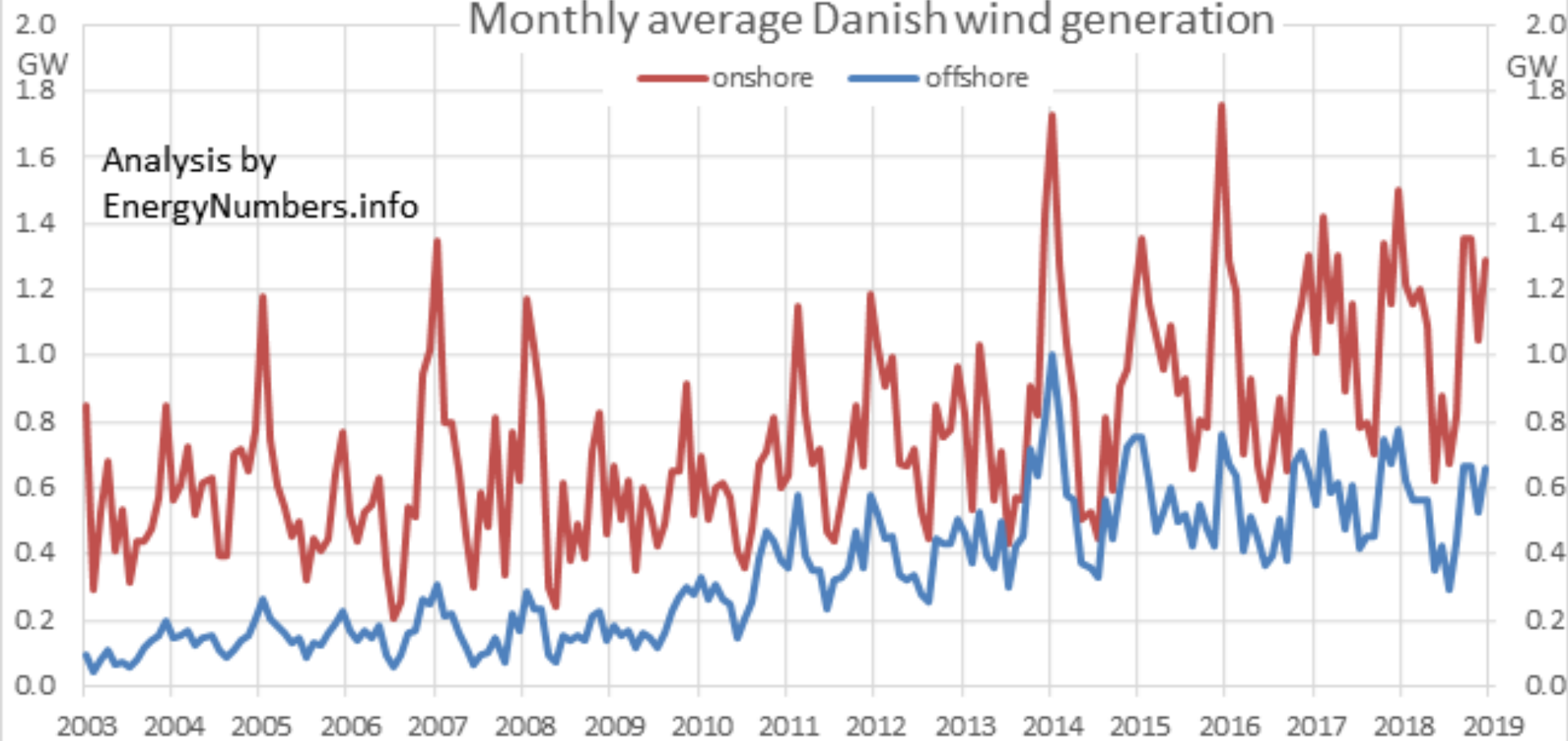


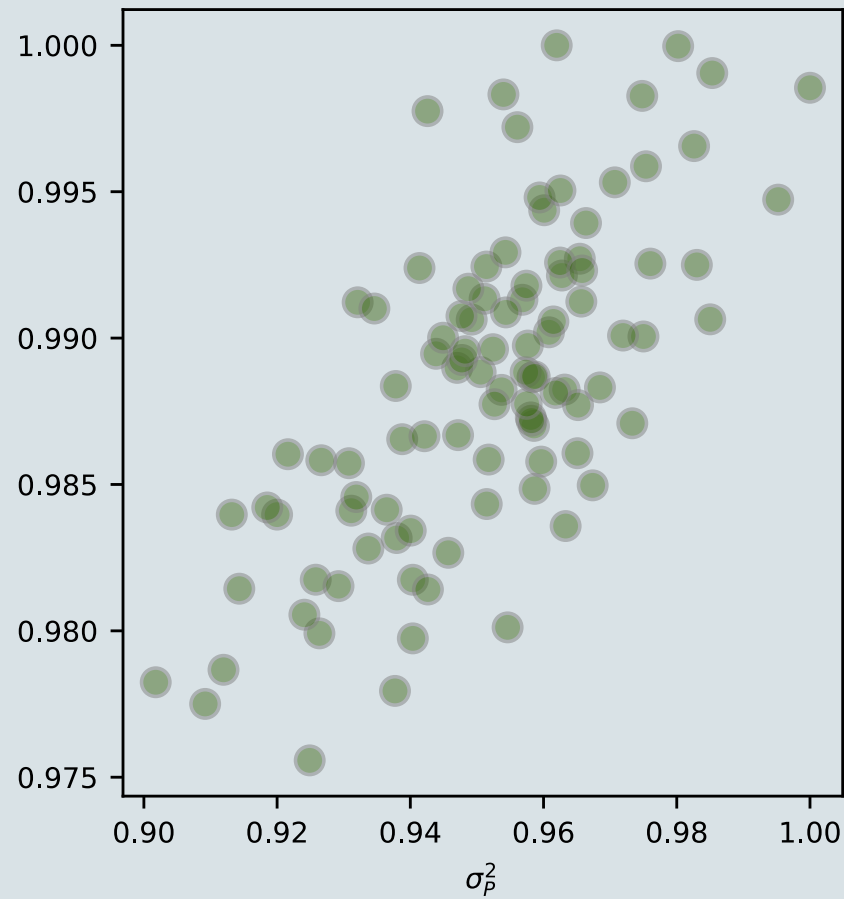
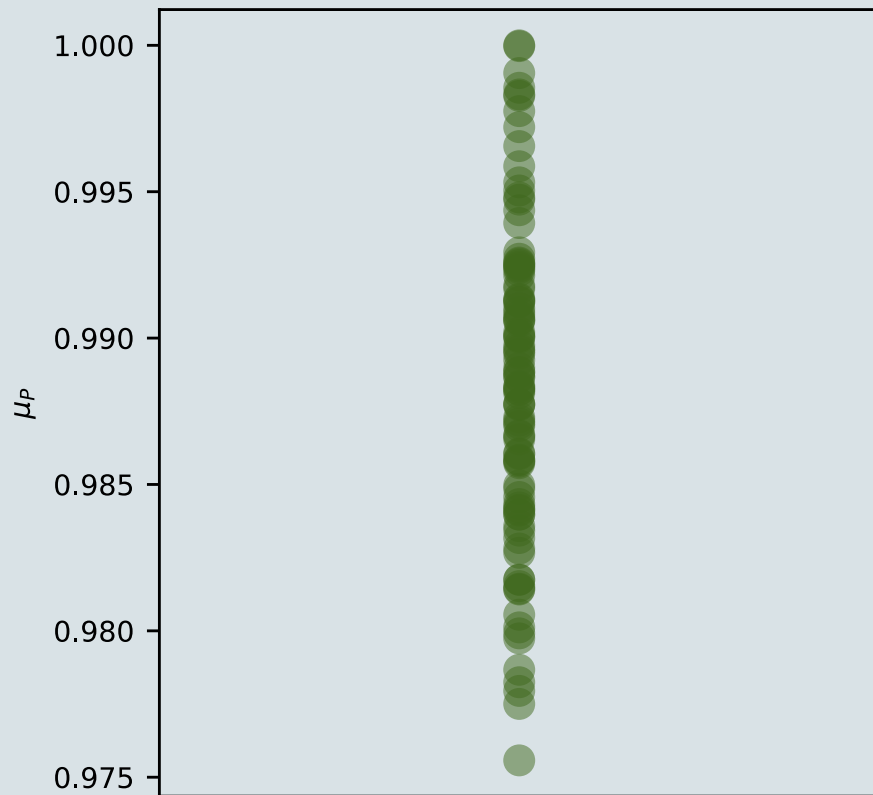
b

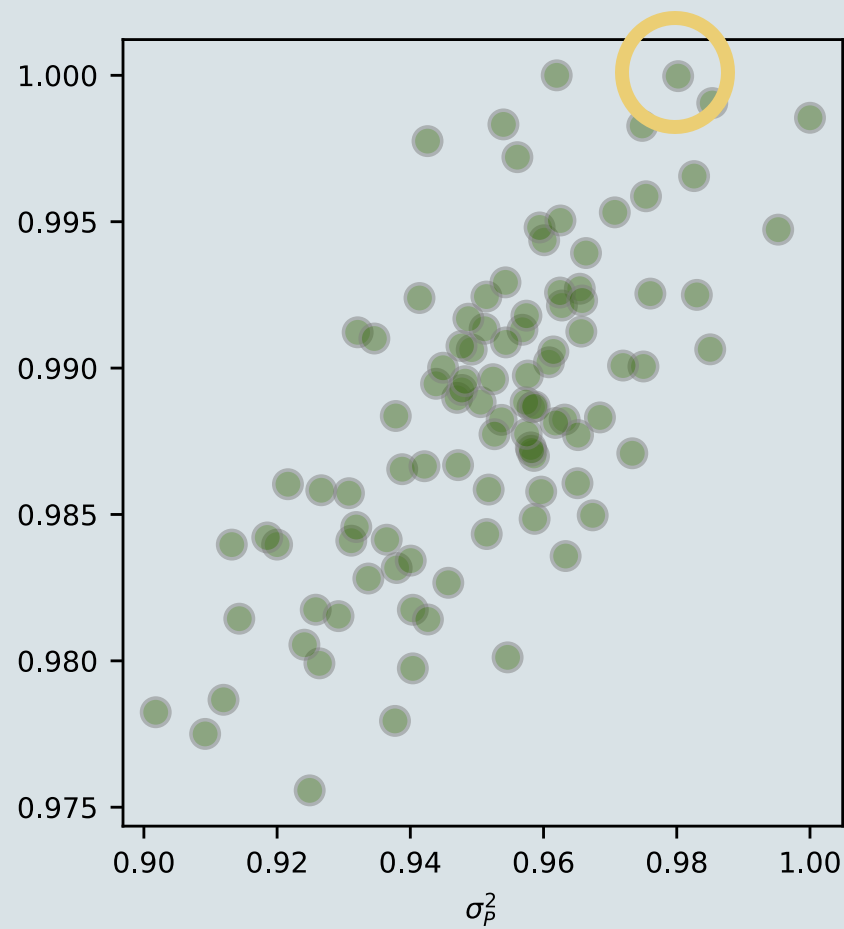
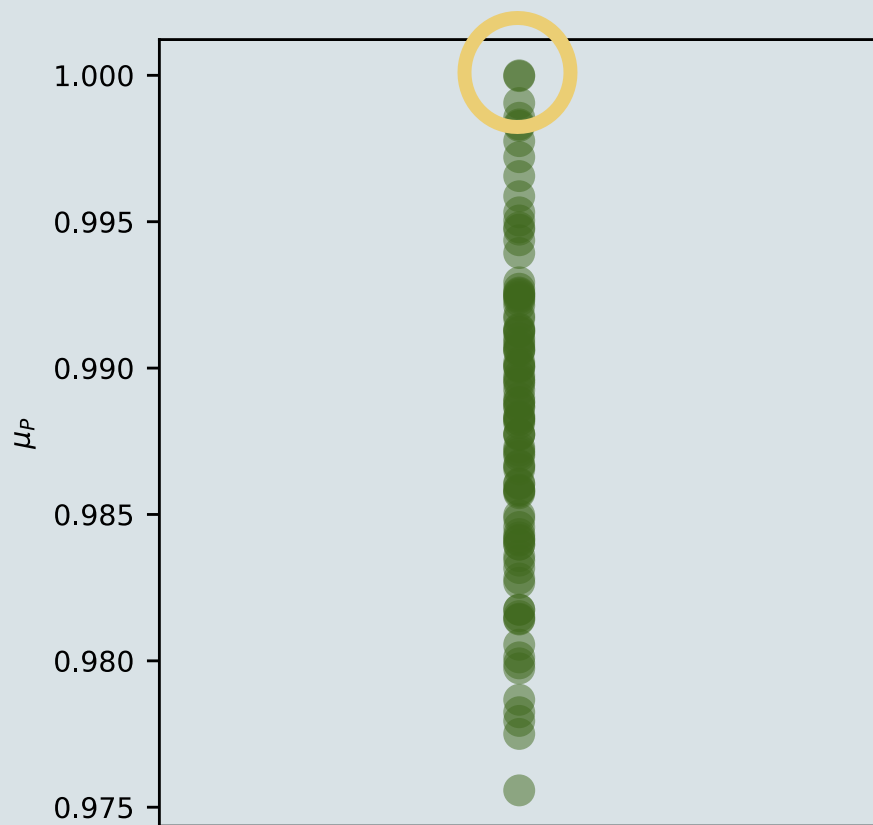


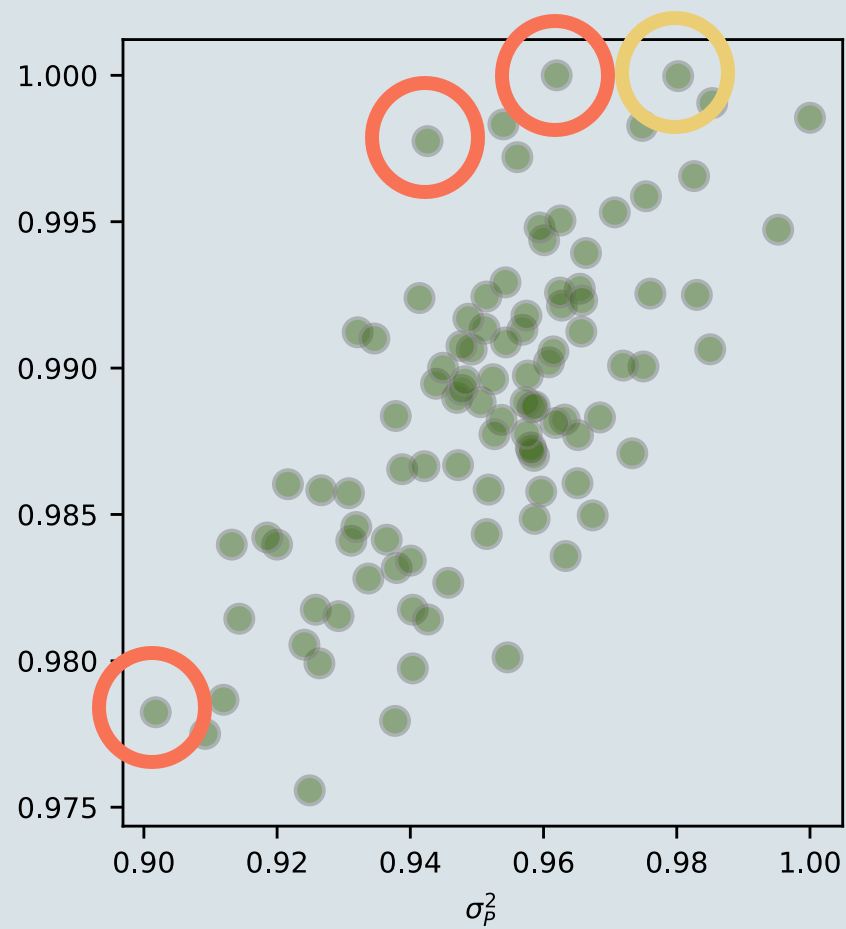
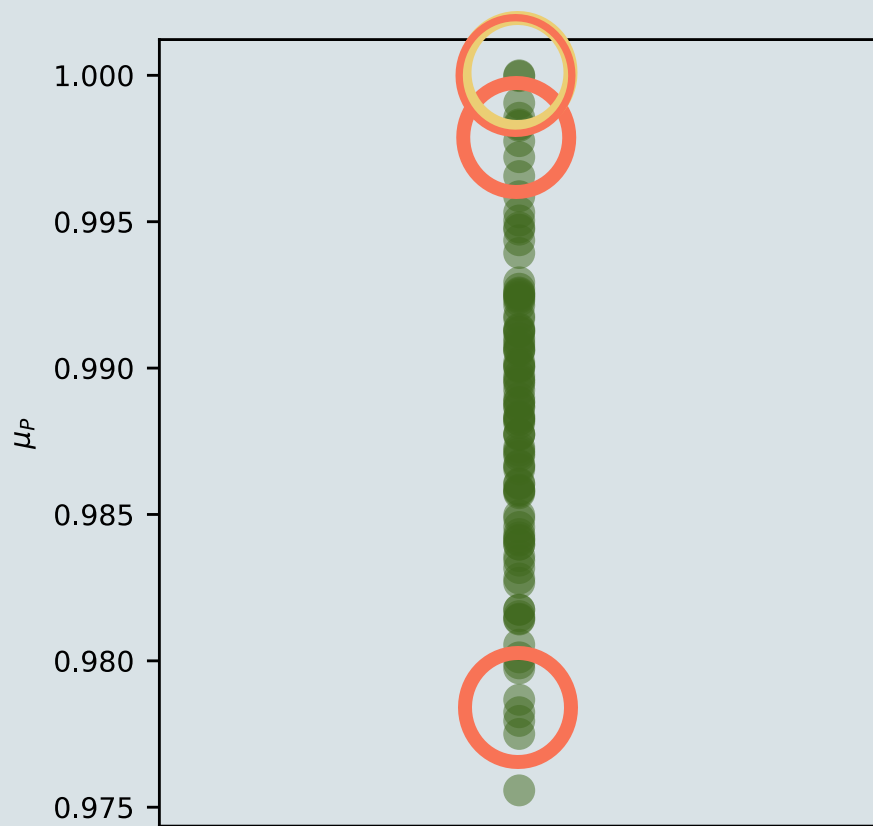


Monthly average Danish wind generation









ε -constraint method

$$\begin{array}{ll} \text{minimize} & f_2 \\ \text{w.r.t.} & x_j, j = 1, 2, 3, \dots, n \\ \text{subject to} & f_1 \leq \varepsilon \end{array}$$

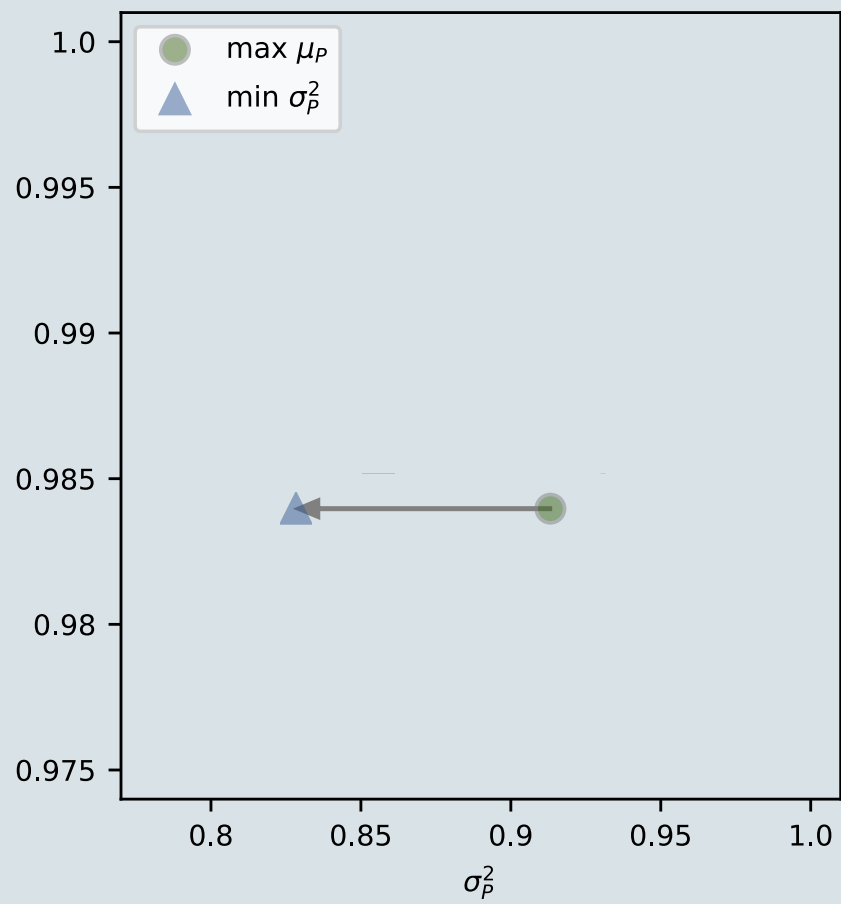
ε -constraint method

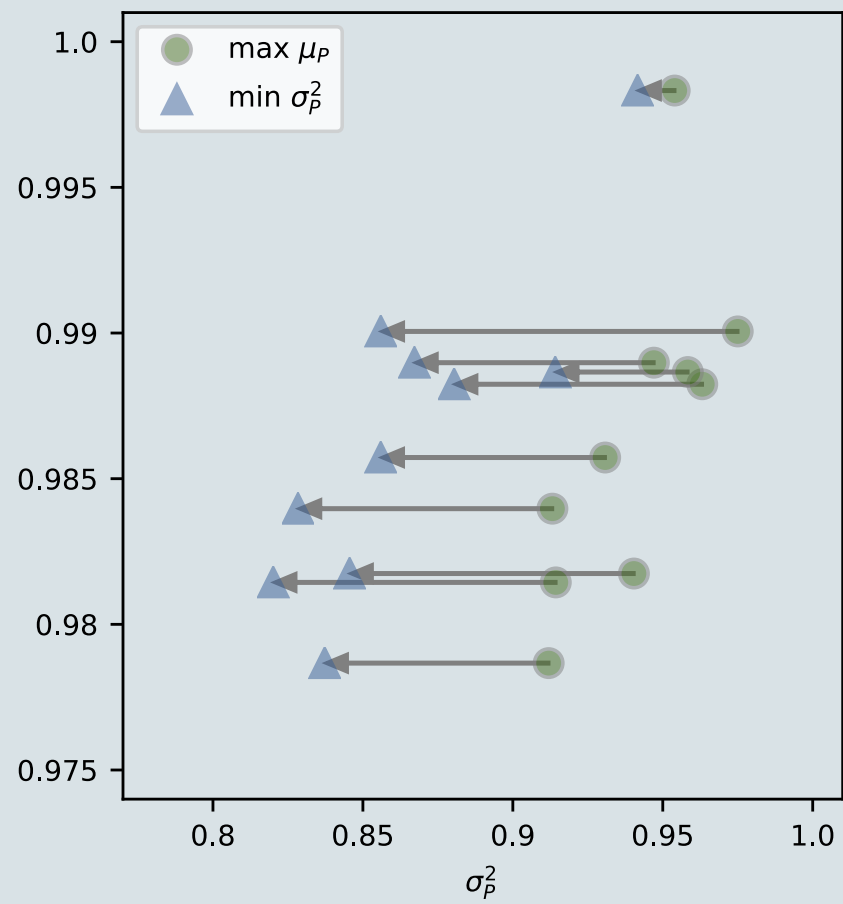
STEP 1:

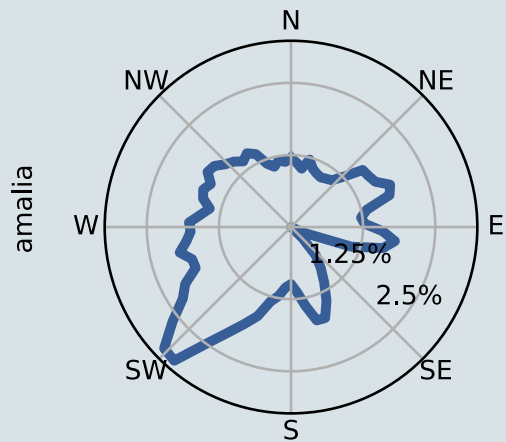
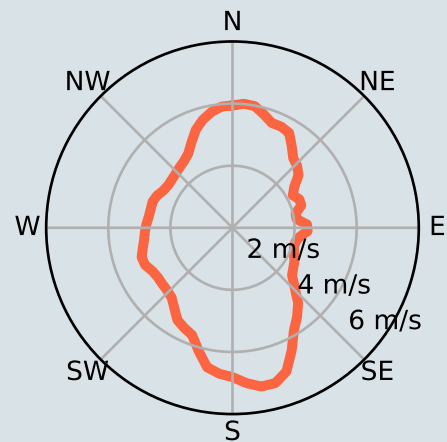
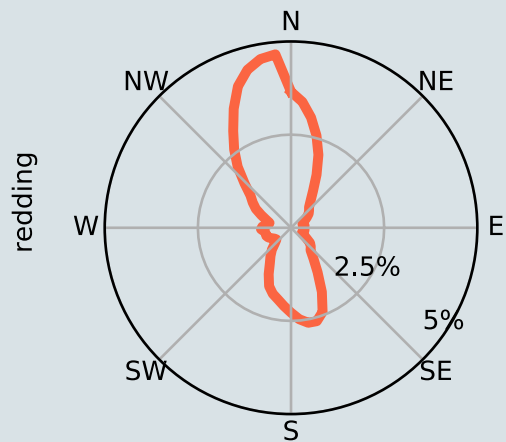
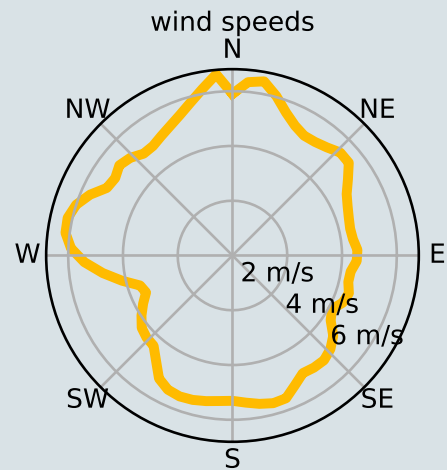
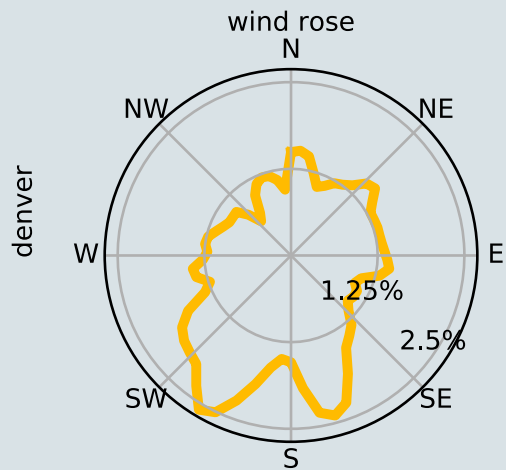
maximize	μ
w.r.t.	$x_j, y_j, j = 1, 2, 3, \dots n_{\text{Turbs}}$
subject to	boundary constraints spacing constraints

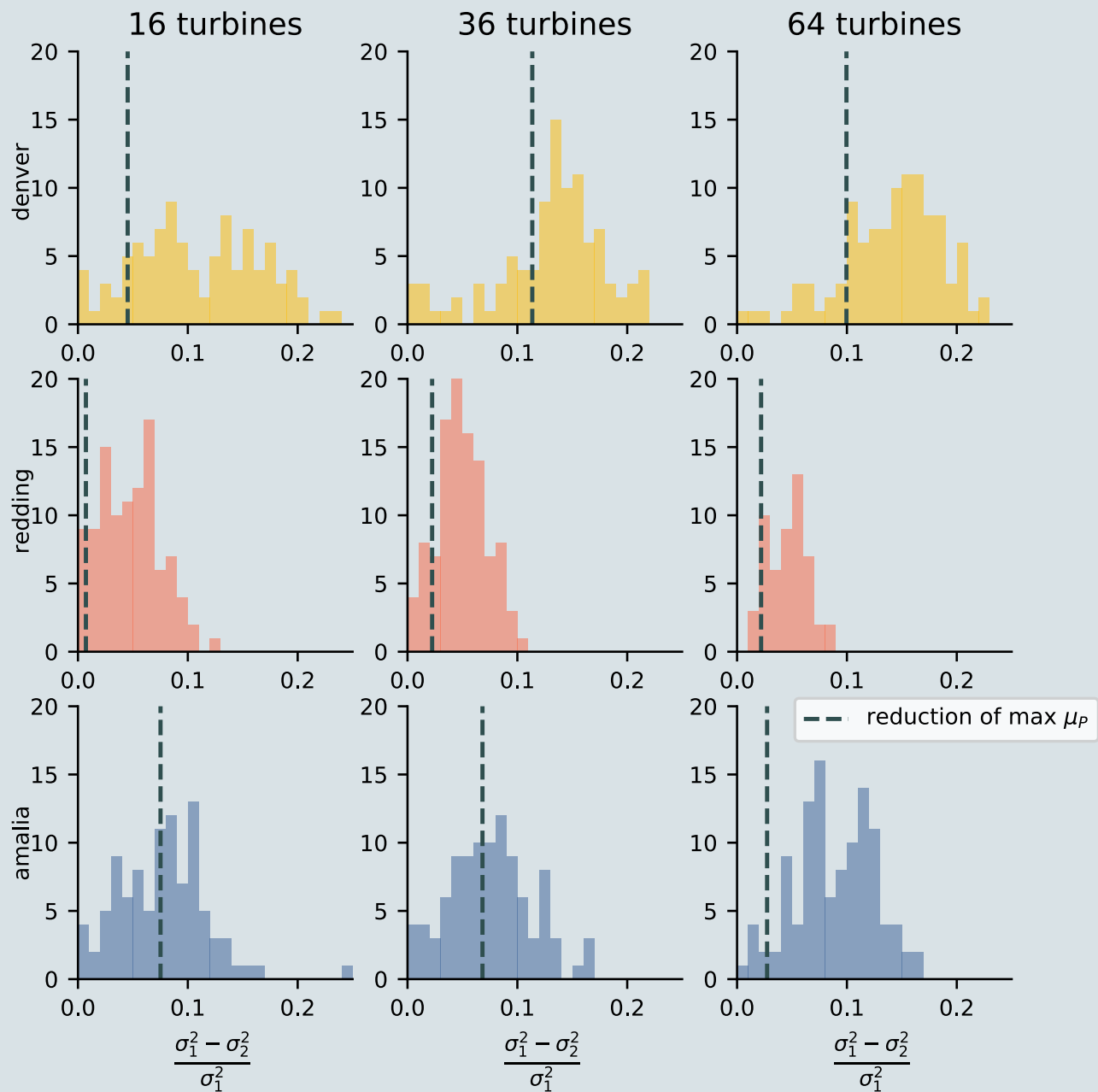
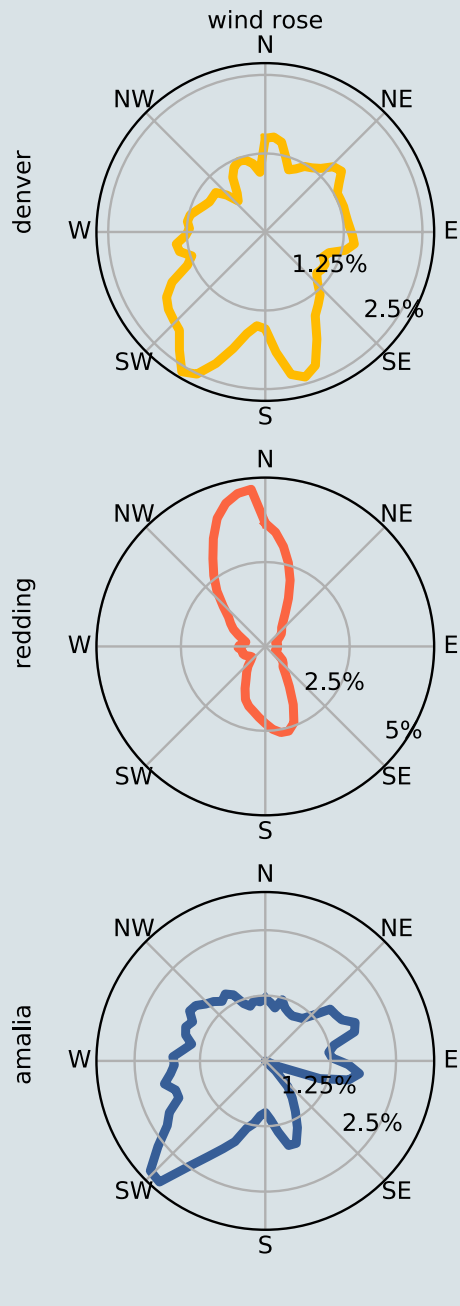
STEP 2:

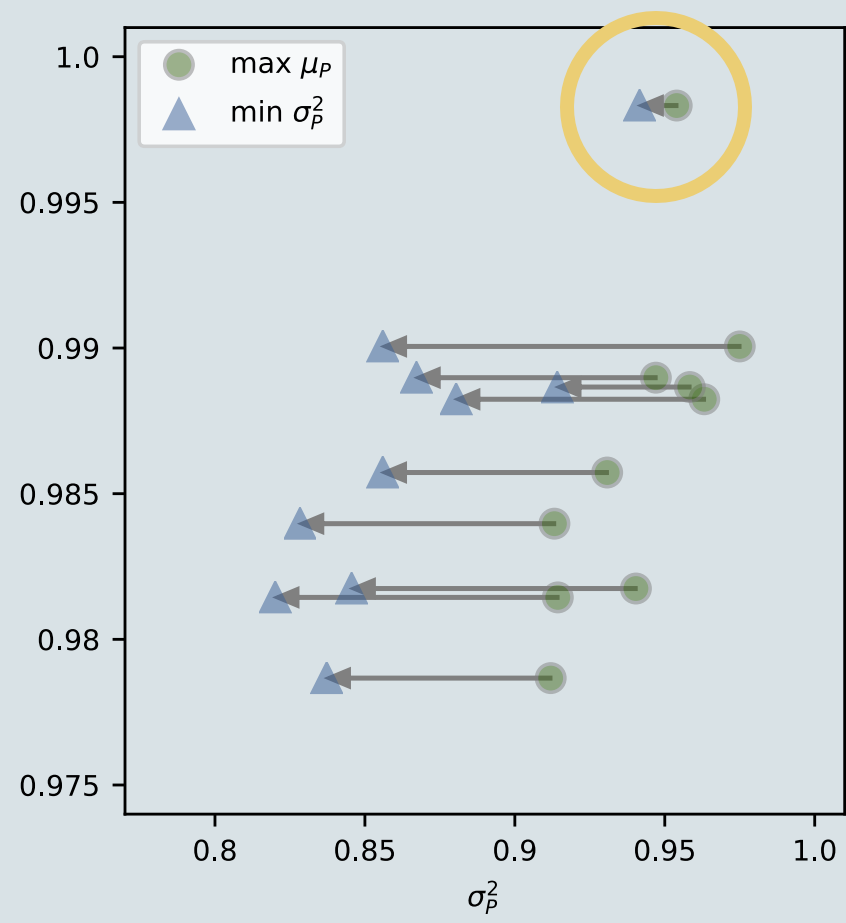
minimize	σ^2
w.r.t.	$x_j, y_j, j = 1, 2, 3, \dots n_{\text{Turbs}}$
subject to	boundary constraints spacing constraints $\mu_2 \geq \mu_1$

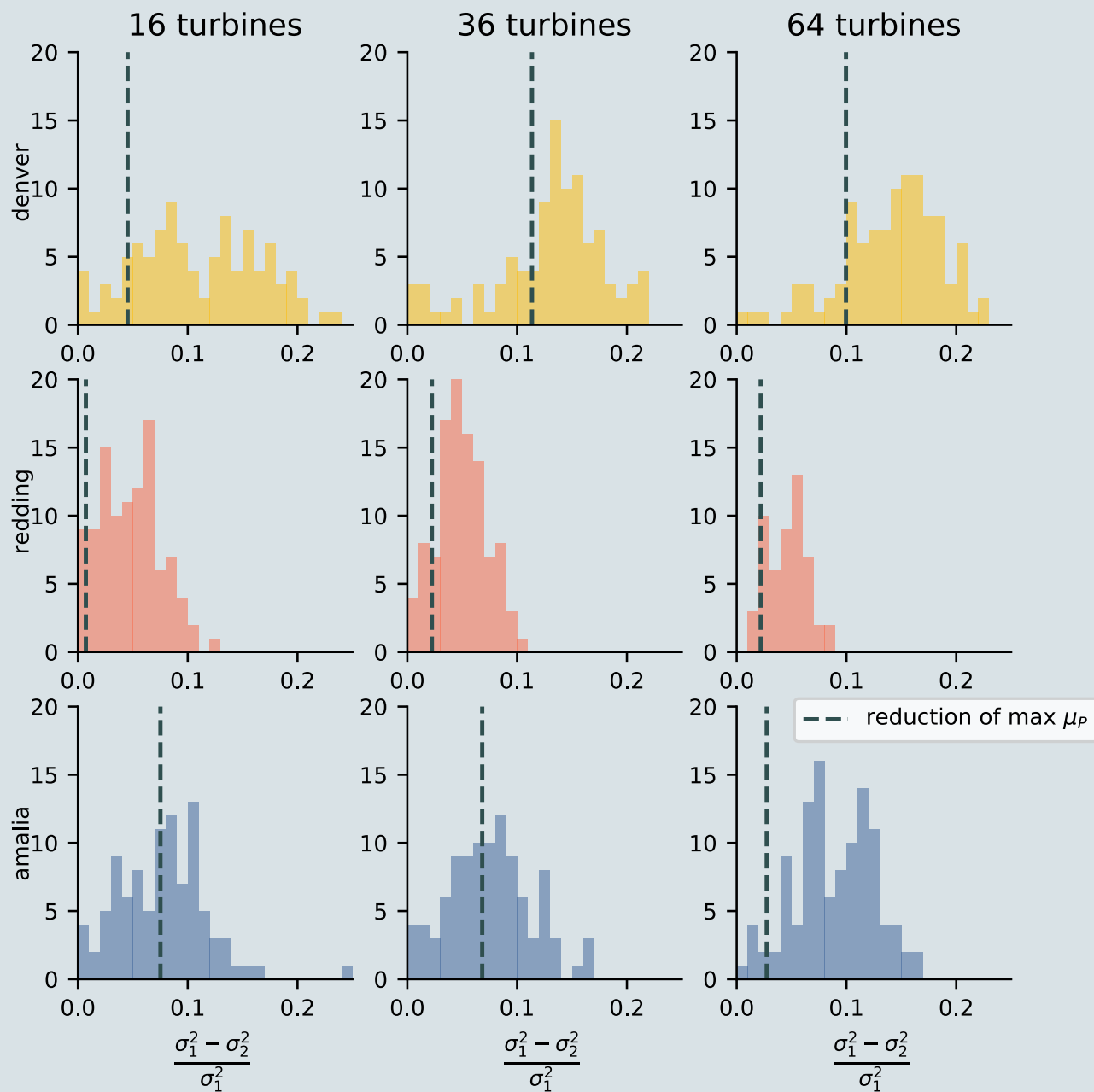
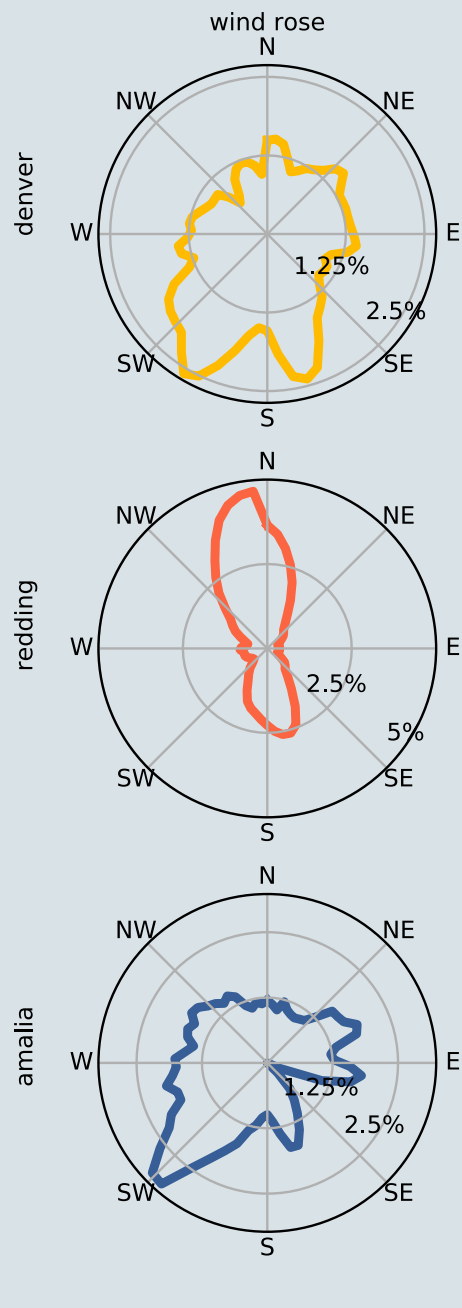


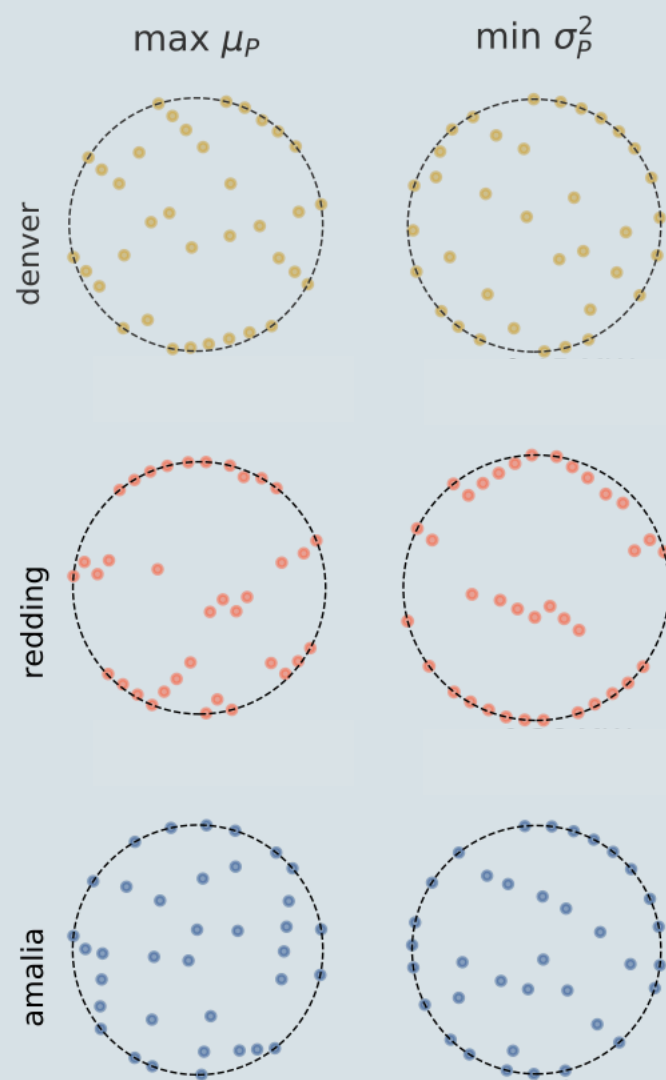




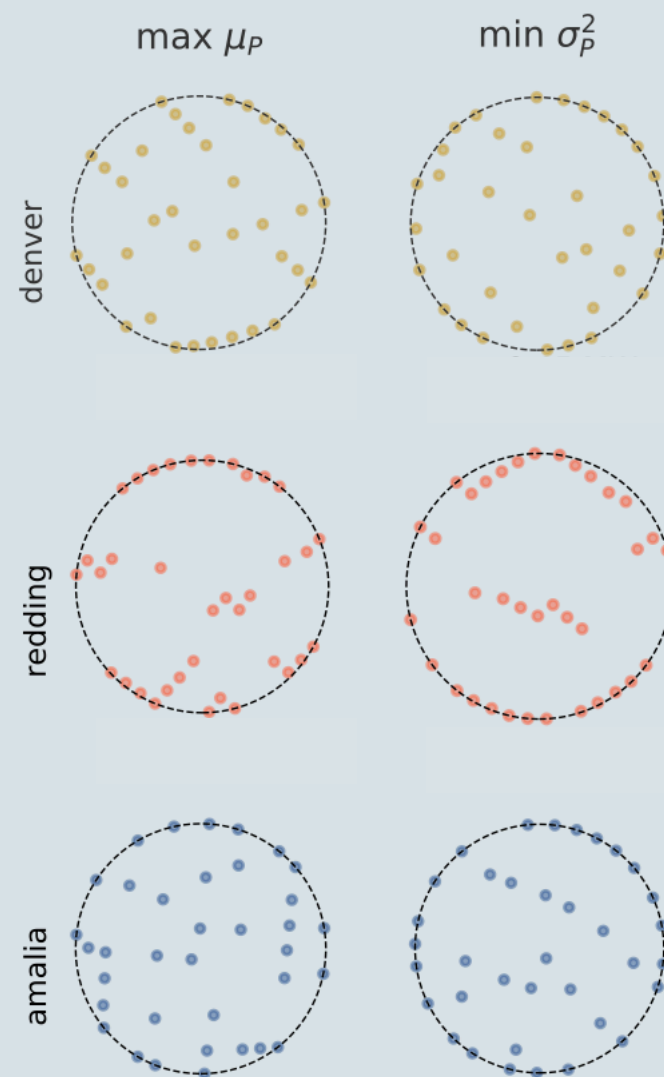
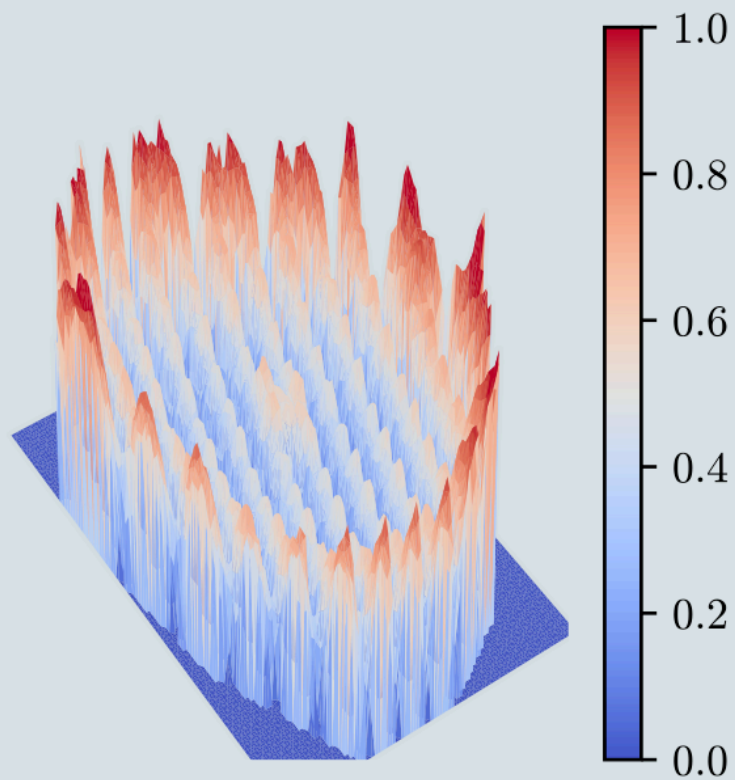




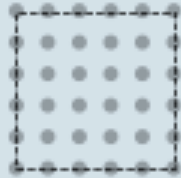




b



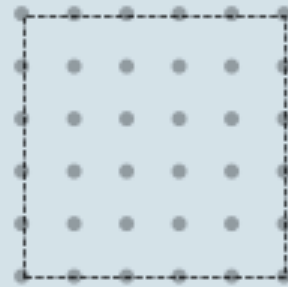
3D



4D



5D



6D



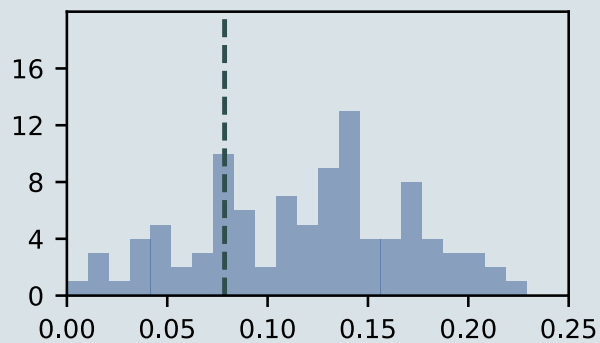
7D



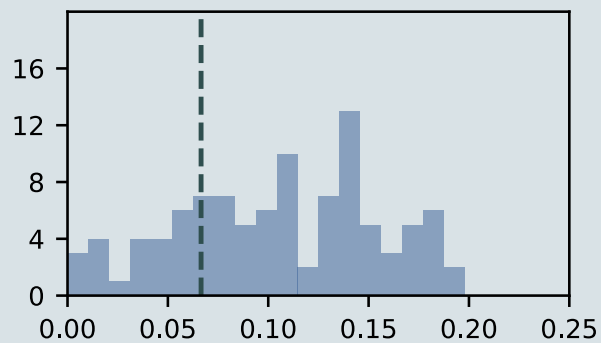
8D



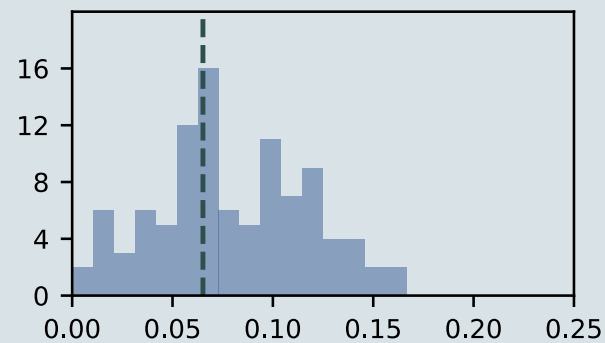
3D



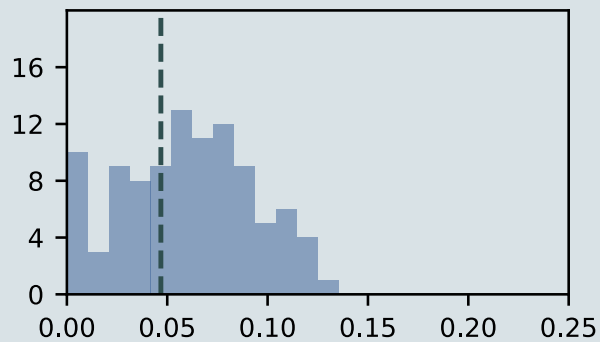
4D



5D

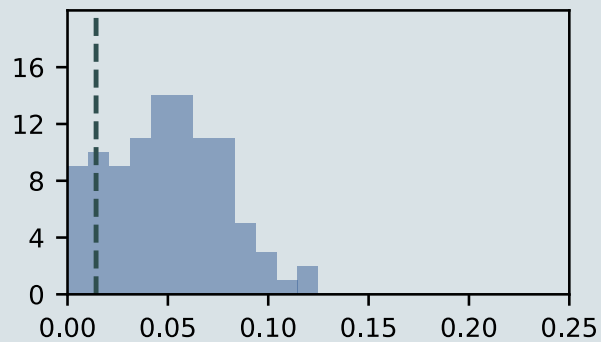


6D



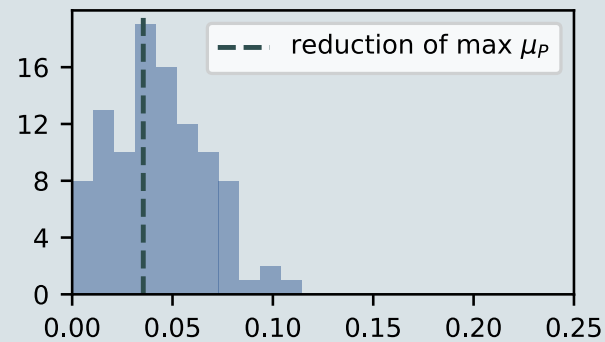
$$\frac{\sigma_1^2 - \sigma_2^2}{\sigma_1^2}$$

7D



$$\frac{\sigma_1^2 - \sigma_2^2}{\sigma_1^2}$$

8D



$$\frac{\sigma_1^2 - \sigma_2^2}{\sigma_1^2}$$

circle

