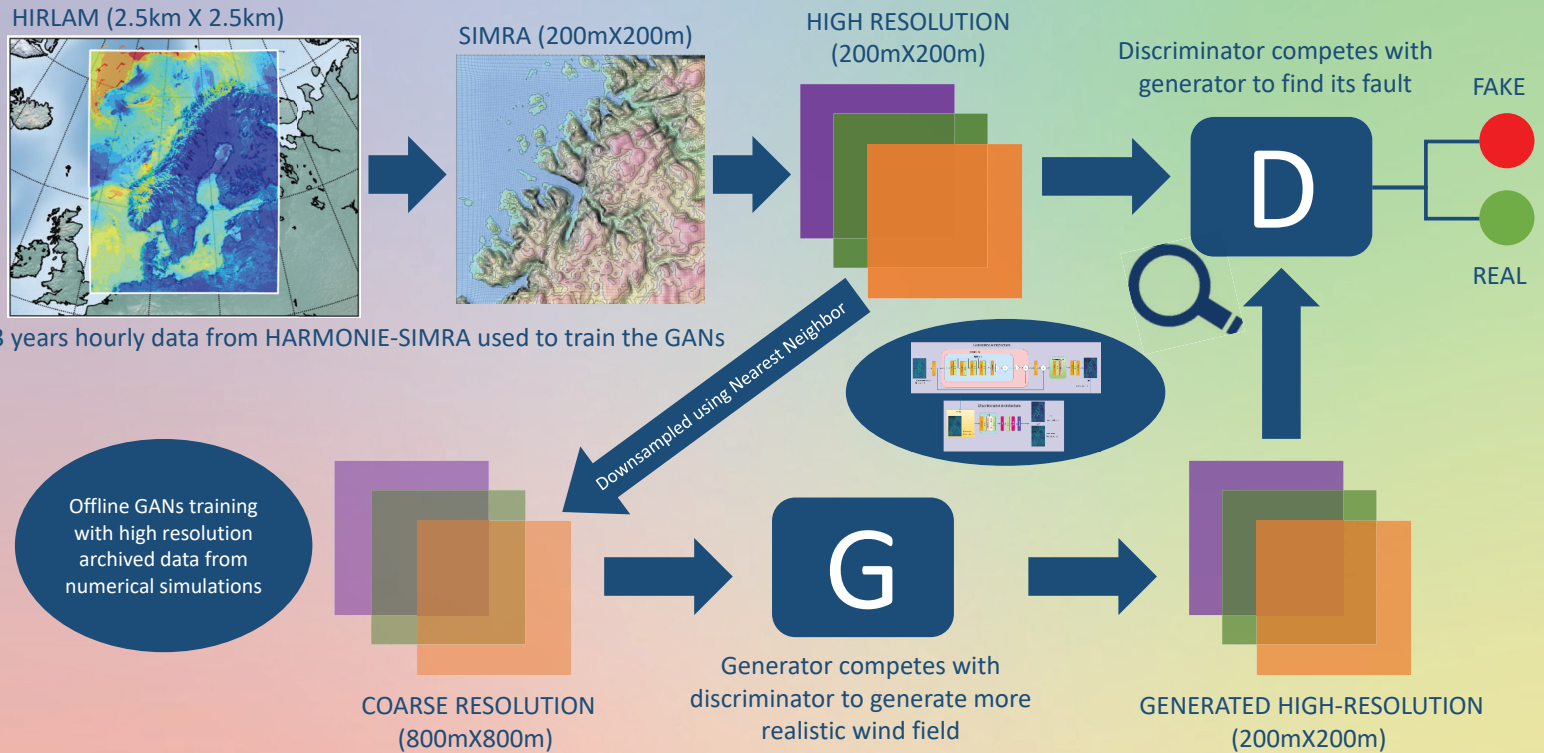# GANs enabled super-resolution reconstruction of wind field

Duy Tan H. Tran[1], Haakon Robinson[1], Adil Rasheed[1,2], Omer San[3], Mandar Tabib[2], Trond Kvamsdal[2,4]
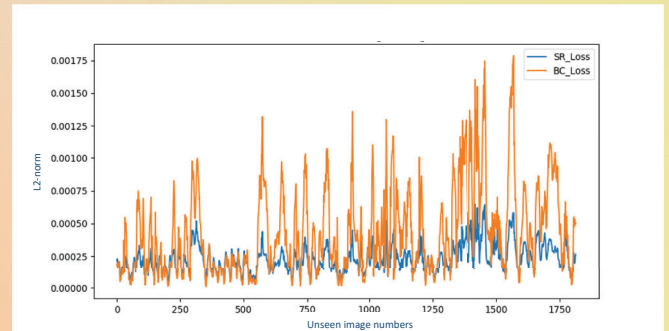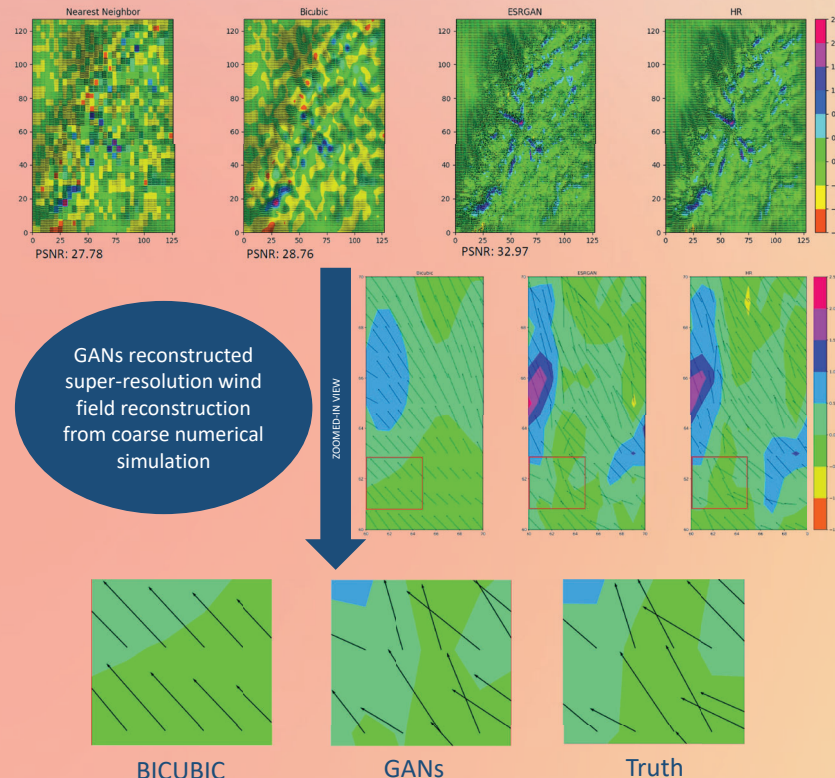[1]Department of Engineering Cybernetics, NTNU | [2]Mathematics and Cybernetics, SINTEF Digital | [3]Mechanical and Aerospace Engineering, OUS | [4]Department of Mathematical Sciences, NTNU
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Research challenge: Generating high resolution wind field in complex terrain without conducting computationally expensive high resolution numerical simulations

Solution: Learn the flow characteristics using Generative Adversarial Networks (GANs) offline for efficient online predictions

HIRLAM (2.5km X 2.5km)

SIMRA (200mX200m)

HIGH RESOLUTION (200mX200m)

Discriminator competes with generator to find its fault

FAKE

REAL

D

3 years hourly data from HARMONIE-SIMRA used to train the GANs

Downsampled using Nearest Neighbor

Offline GANs training with high resolution archived data from numerical simulations

COARSE RESOLUTION (800mX800m)

G

Generator competes with discriminator to generate more realistic wind field

GENERATED HIGH-RESOLUTION (200mX200m)

RESULTS: Comparison between Bicubic Interpolation, GANS and Ground truth

Nearest Neighbor — PSNR: 27.78
Bicubic — PSNR: 28.76
ESRGAN — PSNR: 32.97
HR

GANs reconstructed super-resolution wind field reconstruction from coarse numerical simulation

ZOOMED-IN VIEW

BICUBIC

GANs

Truth

HIGHLIGHTS OF THE WORK

➢ A novel approach of combing physics based computational fluid dynamics simulator with the power of advanced machine learning algorithm like GANs is demonstrated for generating high resolution wind field in complex terrain.
➢ The GANs network learns the main characteristics of the flow in complex terrain and comfortably outperforms commonly used interpolation technique
➢ A significant improvement in computational efficiency (X100000)