

Quelle IA générative pour les données environnementales ?

Gabriel V. Cardoso (Ecole des Mines - PSL)



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Disclaimer: the answer is Diffusion models

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- Efficiently exploit architectural bias in Neural Net **for images**: Kadkhodaie et al., 2023; Zhang et al., n.d.
- Easier to **condition / fine-tune**: G. Cardoso et al., 2023; Chung et al., 2023
- Well established and growing **theoretical groundings**: Strasman et al., 2026; Conforti et al., 2025; Gentiloni-Silveri et al., 2025

A brief recall on diffusion models

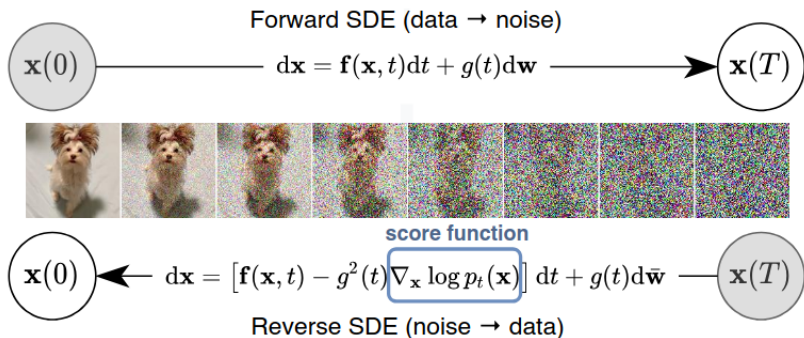


Figure: Illustration of score-based (Diffusion) generative models from Song et al., 2021.

Learning generative model for climate data

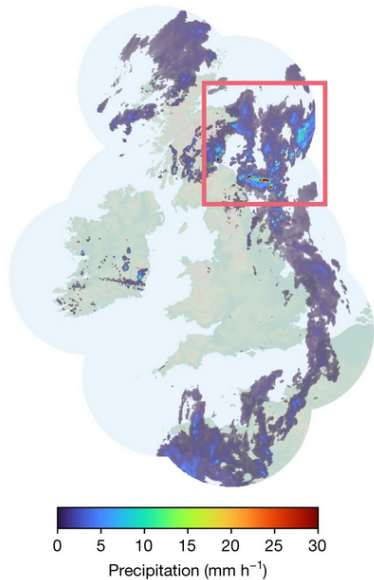
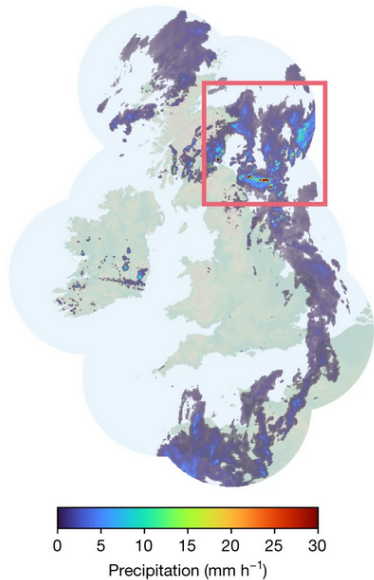


Figure: Radar rainfall example taken from Ravuri et al., 2021.

Learning generative model for climate data



Is this correctly simulated by
"off-the-shelf" diffusion models?

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Solutions:

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Our approach: Do Gaussian noising but adapt final distribution to heavy tail ! (Fassina et al., 2026).

Next chapters

Can we **generate only** heavy rain episodes ?

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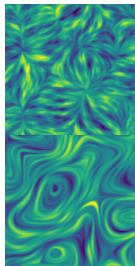
Coming soon ... ¹

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Generative model as proxy

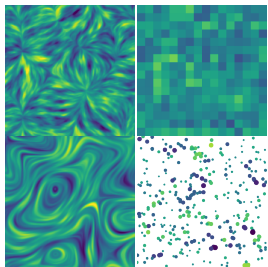
No data but **large and nice simulator / model** ? Can Diffusion models help me ?

Anisotropic Gaussian processes through diffusion models



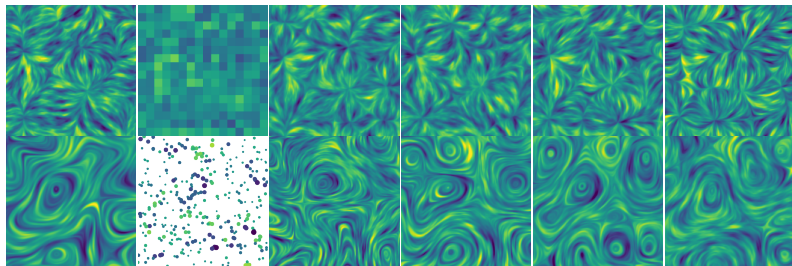
"true
sample"

Anisotropic Gaussian processes through diffusion models



"true
sample" observation

Anisotropic Gaussian processes through diffusion models



"true
sample"

observation

Posterior

samples

So what?

Observation

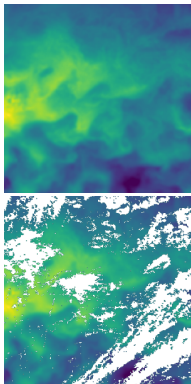


Figure: Using diffusion models to condition Gaussian processes on partial observation of sea surface temperature G. V. Cardoso et al., 2025.

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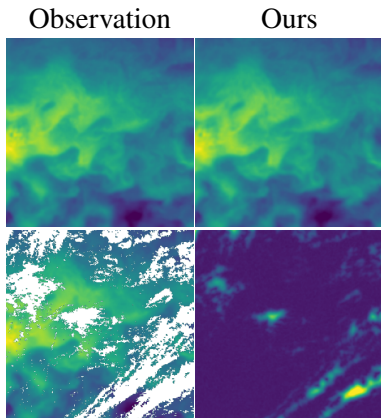


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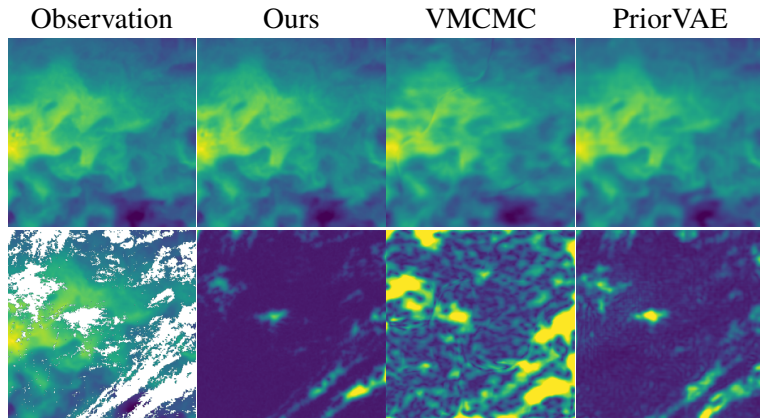


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Take home message

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- However, still being adapted to non-image data.



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- Diffusion models are great !
- However, still being adapted to non-image data.
- Use with caution, develop their potential for environmental data
with us !



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