



Summer Workshop 25' London

Generative Learning for Data-Driven Turbulent Inflow

Project n°5

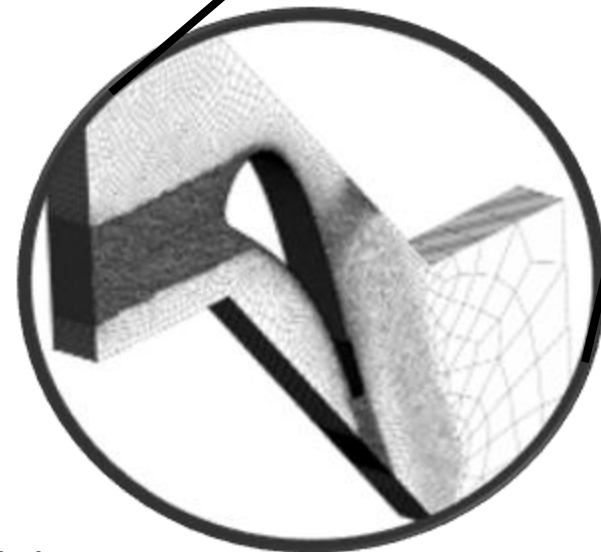
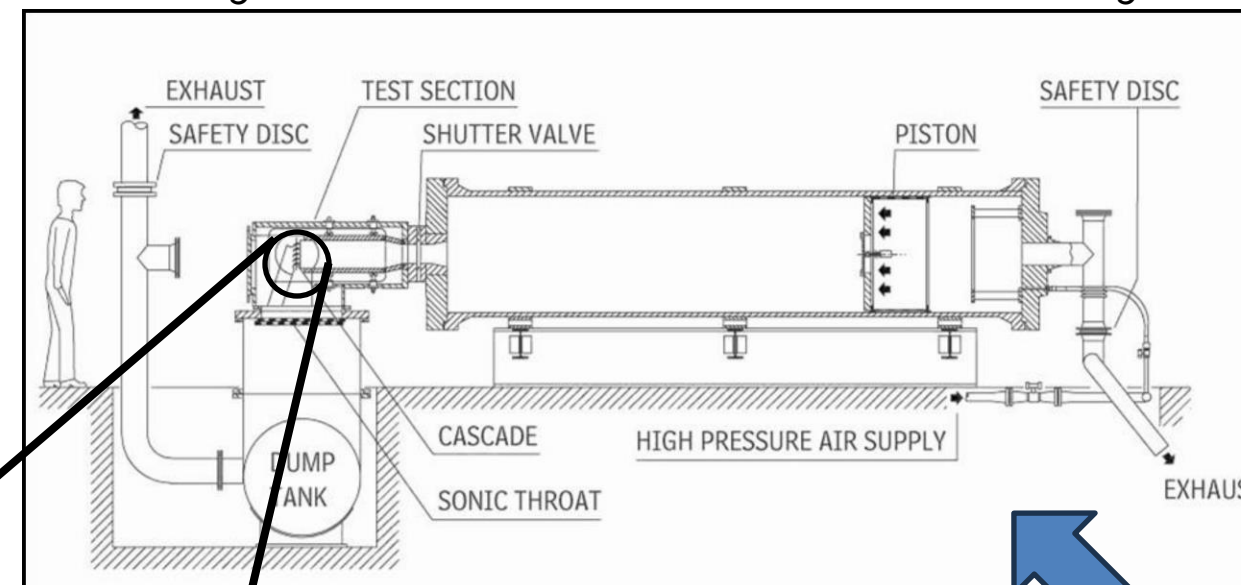
Joachim Dominique, Lionel Salesses, Margaux Boxho, Caroline Sainvitu
Cenaero

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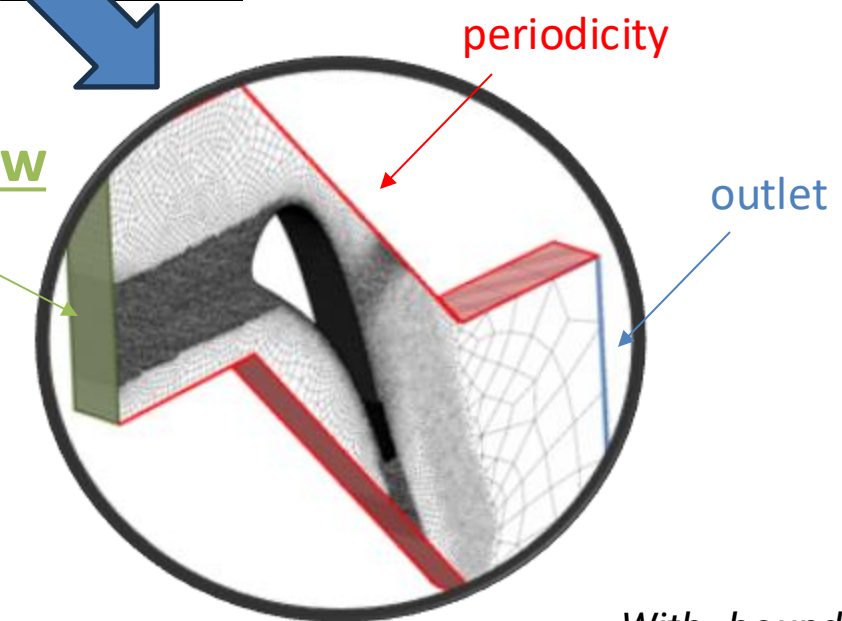
Numerical flow simulations of experimental studies

Image of the VKI wind tunnel for turbine blade testing



Small numerical subdomain

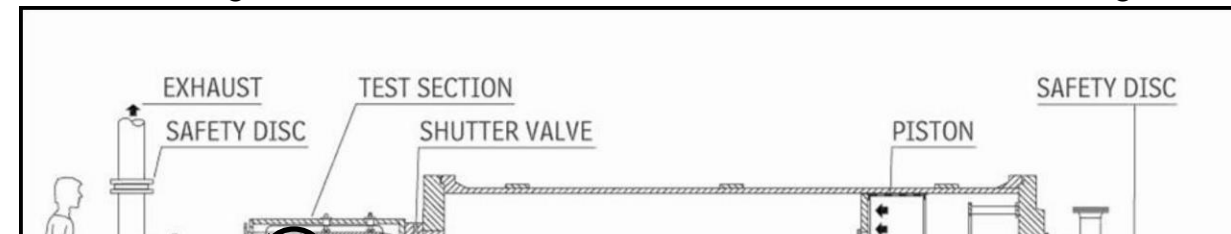
Turbulent inflow



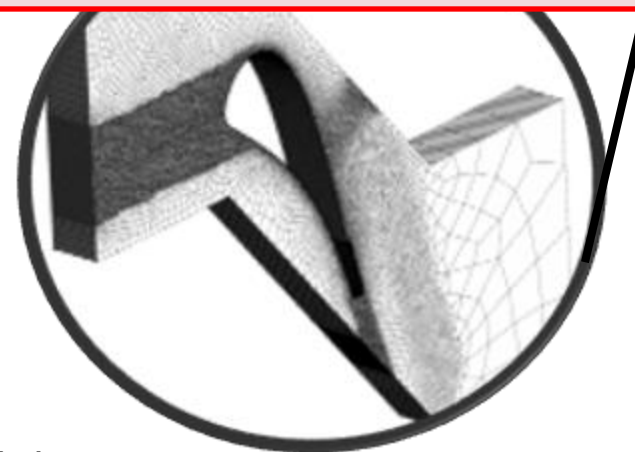
With boundary conditions
representative of real
operative conditions

Numerical flow simulations of experimental studies

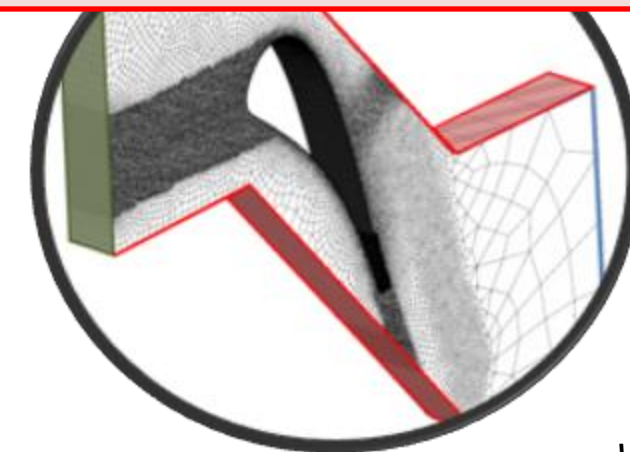
Image of the VKI wind tunnel for turbine blade testing



Needs for cost/memory efficient numerical method to match turbulent inlet conditions as accurately as possible



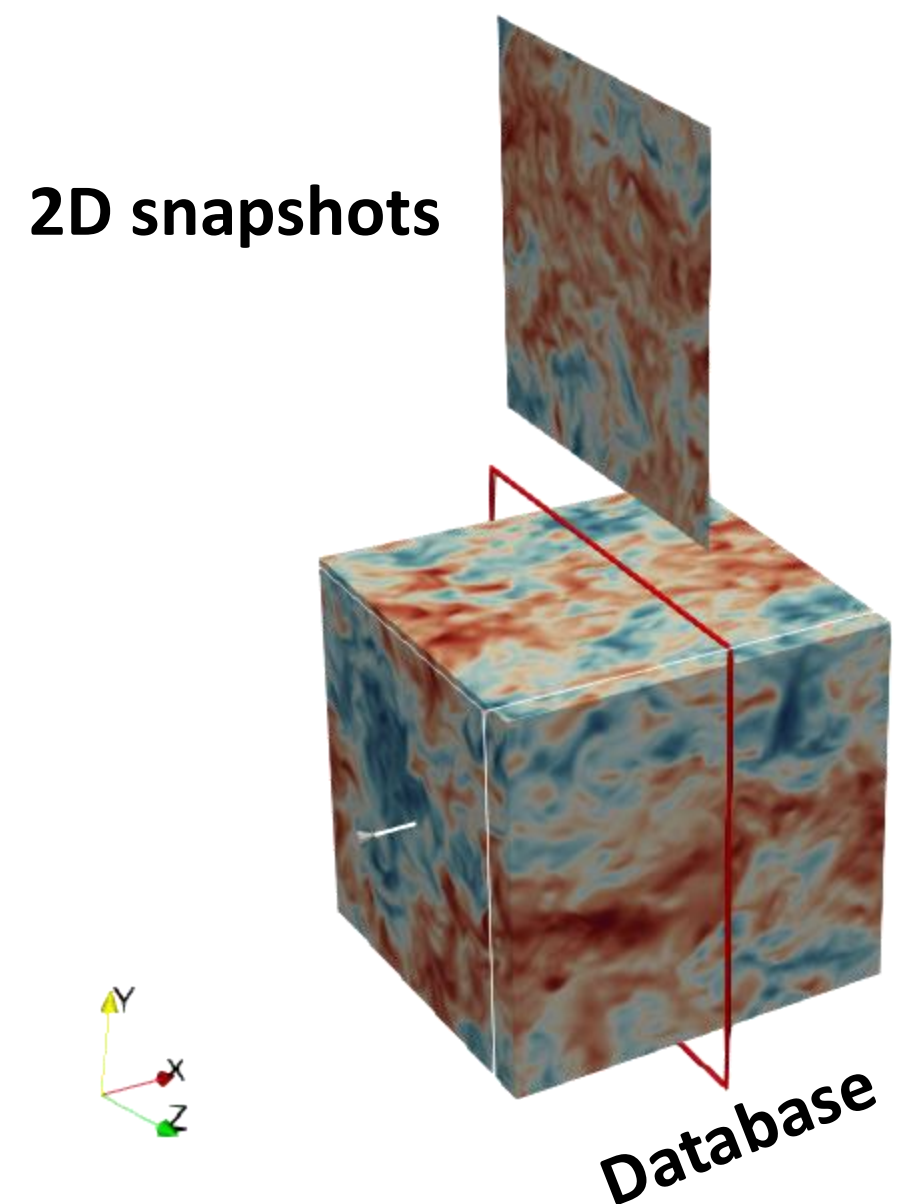
Small numerical subdomain



With boundary conditions representative of real operative conditions

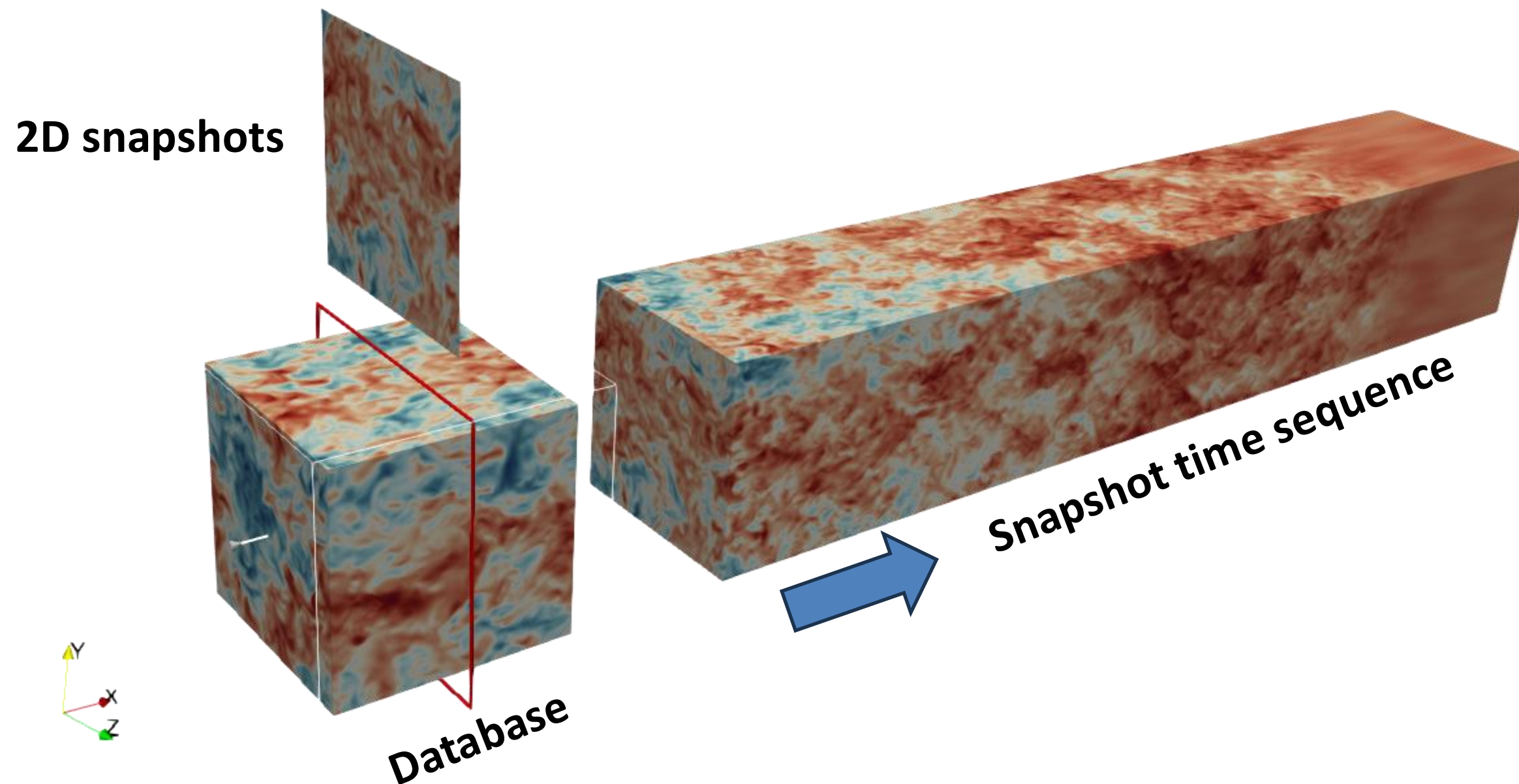
Objectives

Develop Generative Learning Approaches for Data-Driven Turbulent Inflow



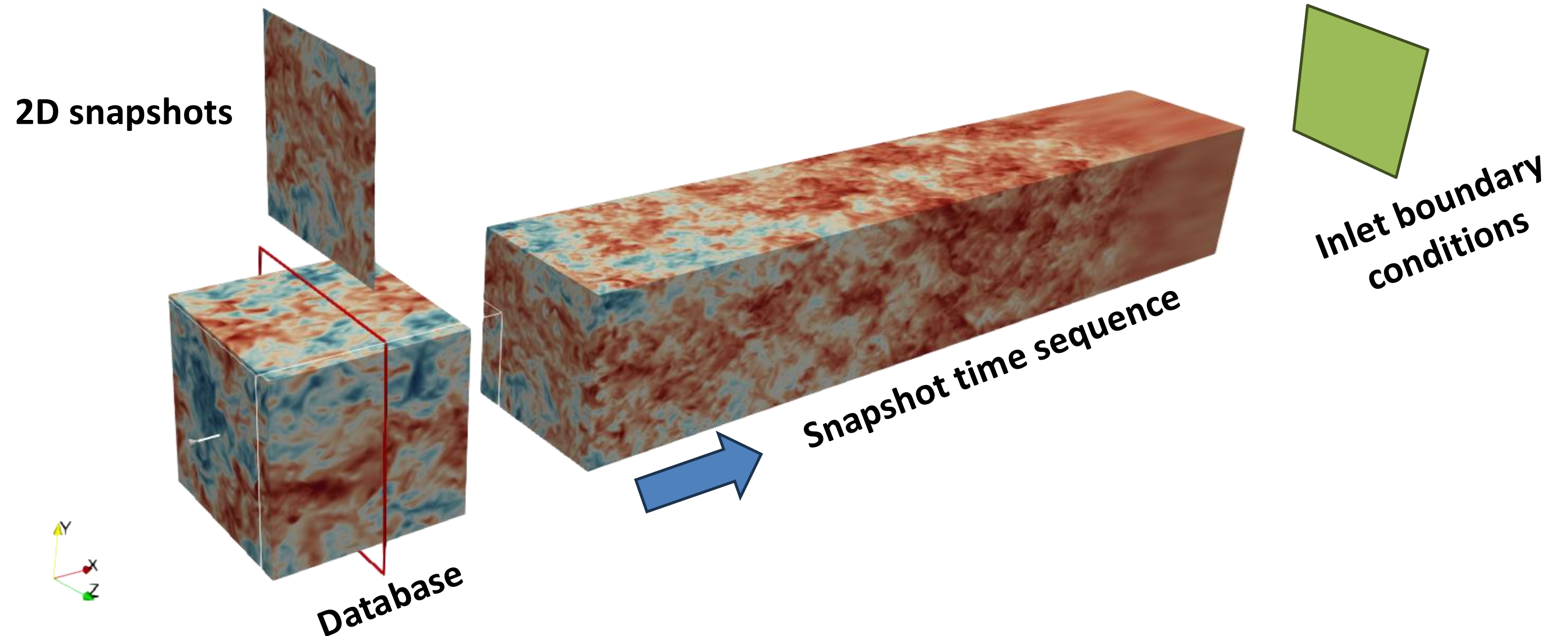
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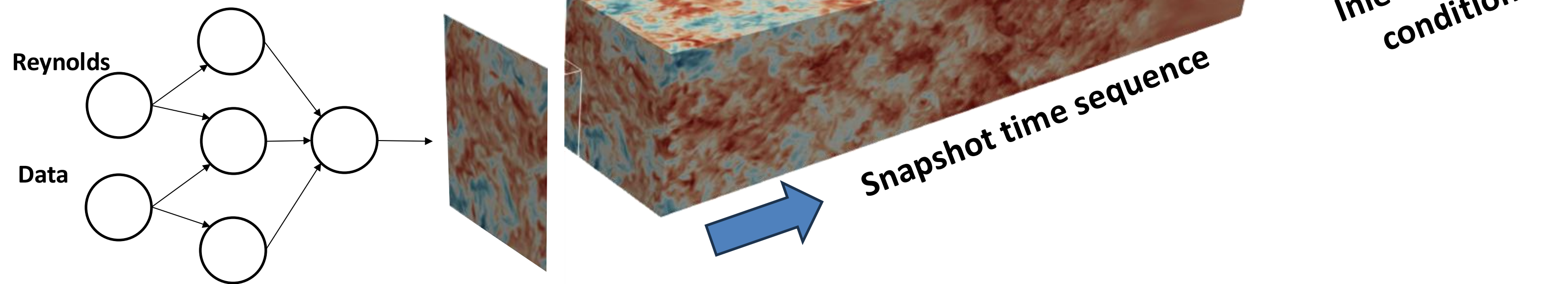
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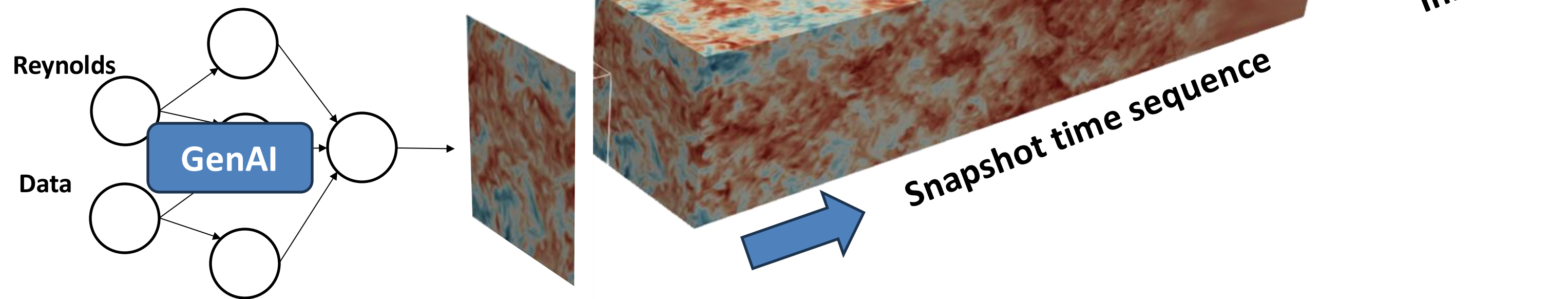
Objectives

Develop Generative Learning Approaches for Data-Driven Turbulent Inflow



Objectives

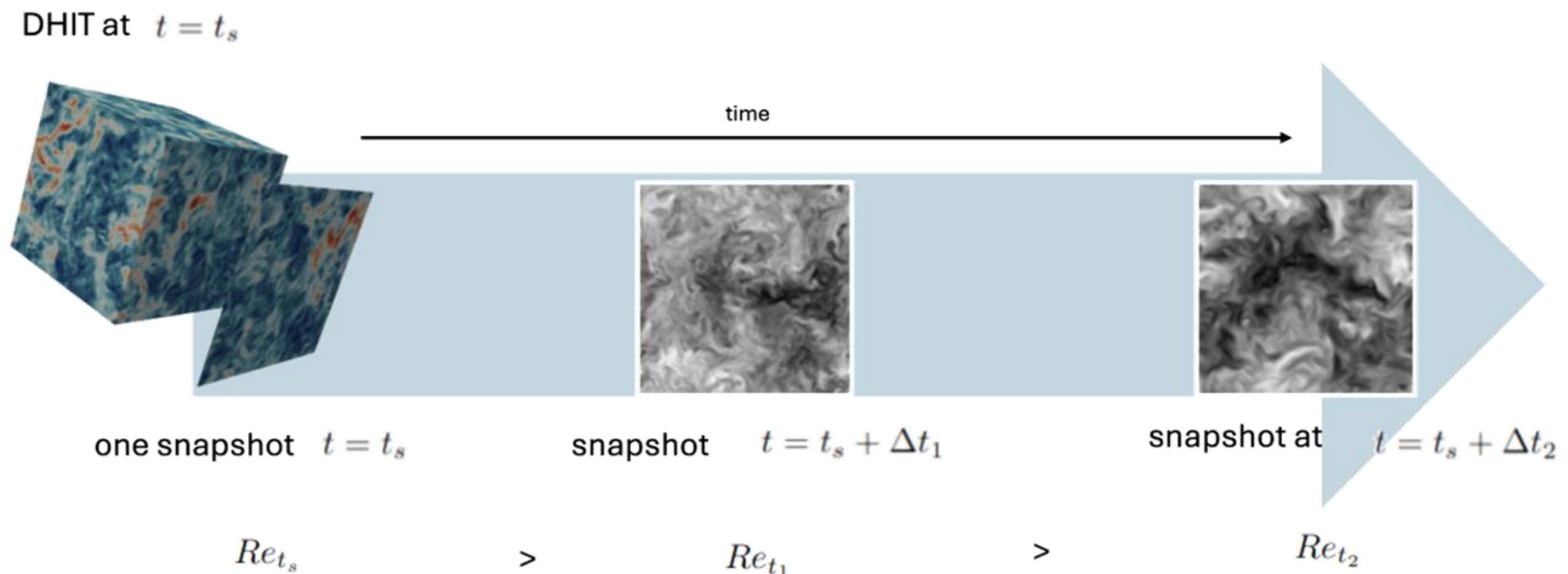
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The Data

Cenaero provides a database of Decaying Homogeneous Isotropic Turbulence (DHIT) simulations

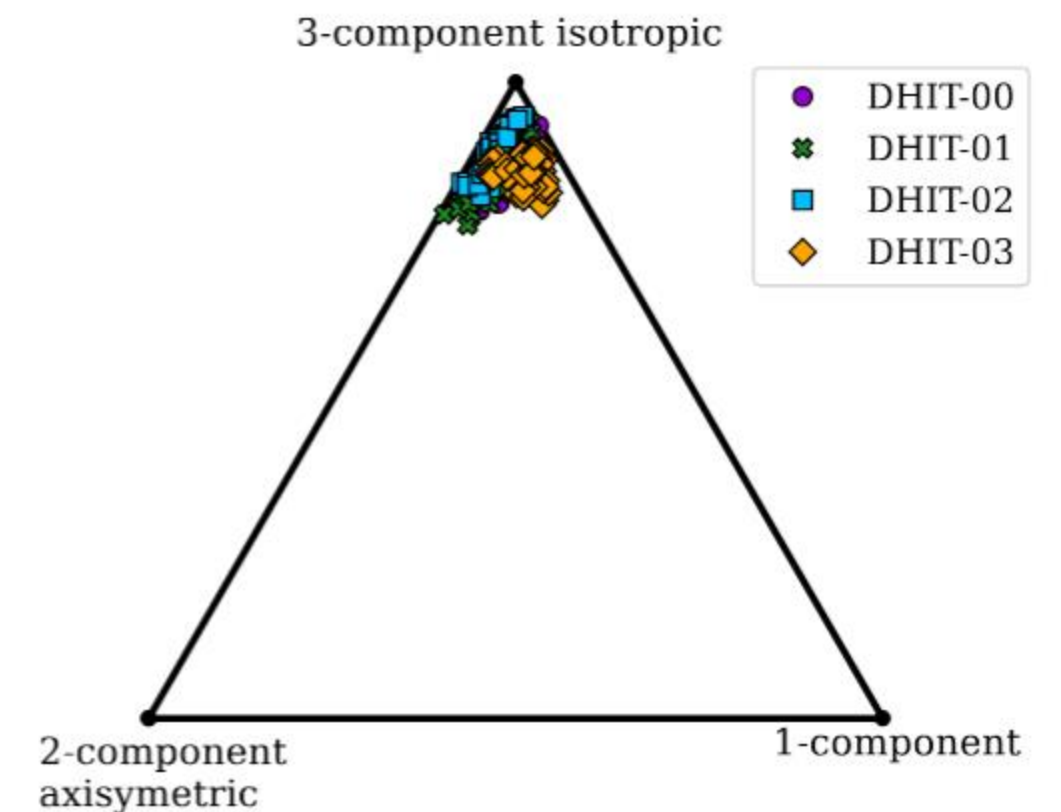
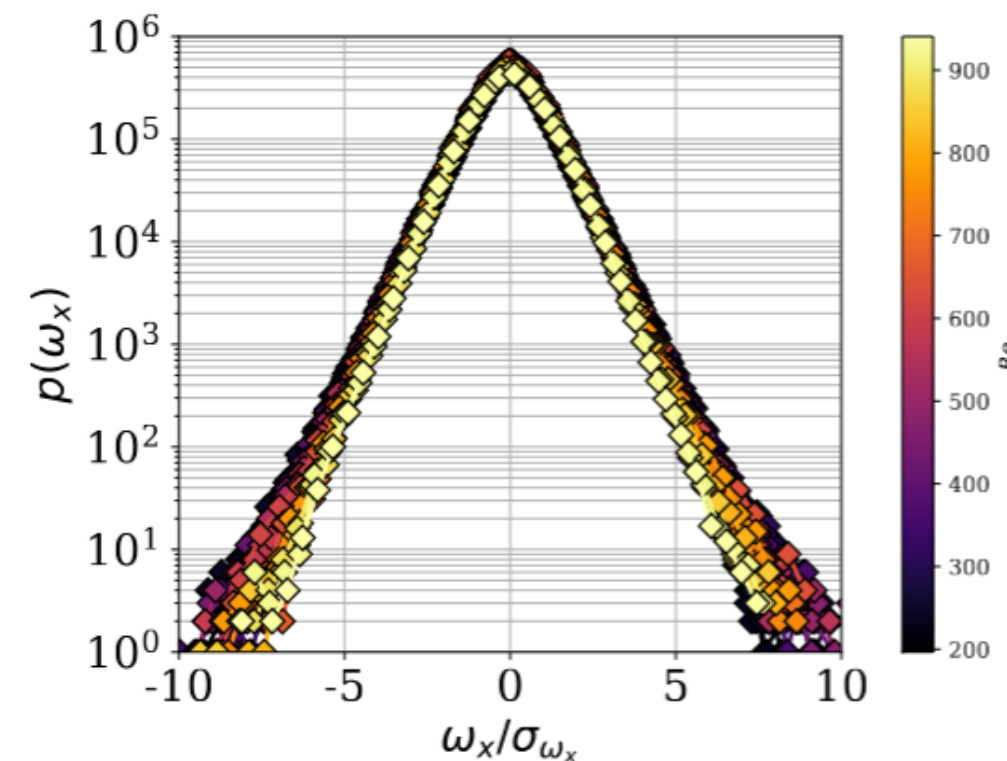
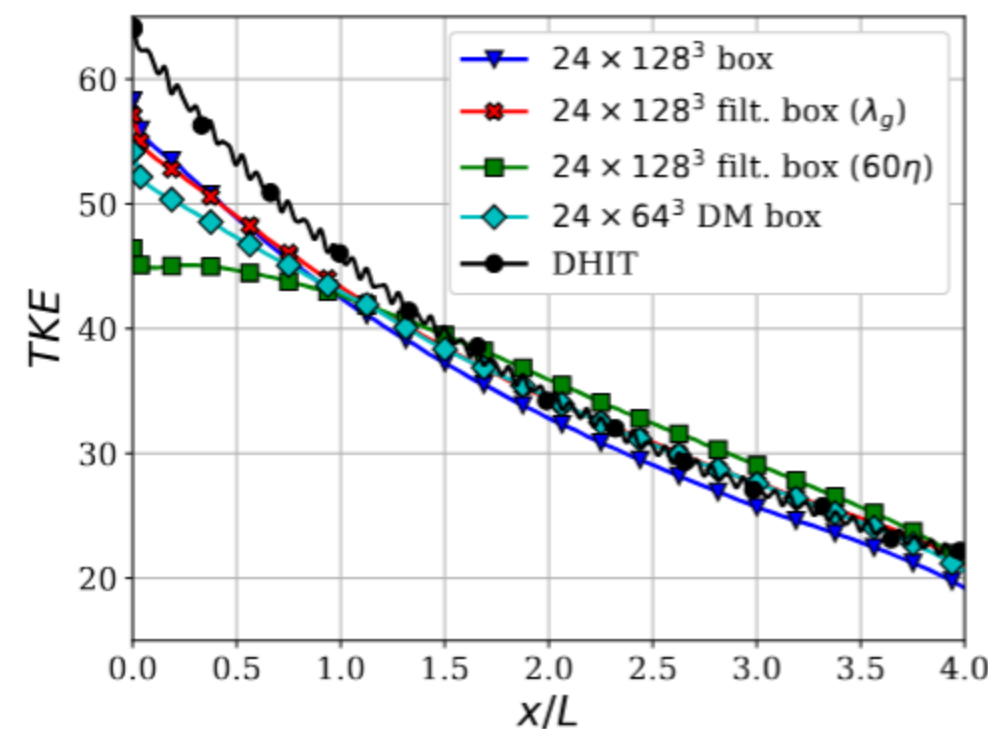
- 214 turbulent box at various Reynolds numbers
- Sized 128 x 128 x 128
- Data augmentation schemes



The Metrics

Cenaero provides a set of physically grounded evaluation metrics

a-priori metrics and *a-posteriori* metrics



Expected outcomes

Participants tasks

Develop a **generative model** capable of producing a **sequence of 2D turbulent snapshots** for a given Reynolds number

The generated fields must replicate both **the statistical properties** and **dynamic behaviour** of the reference dataset

Produce demo code accessible on GitHub

Reporting (slides and report)

Why should you join ?

Are you an ML practitioner ?

Are you interested in Generative Models ?

Join us in London to take on this challenge !!!



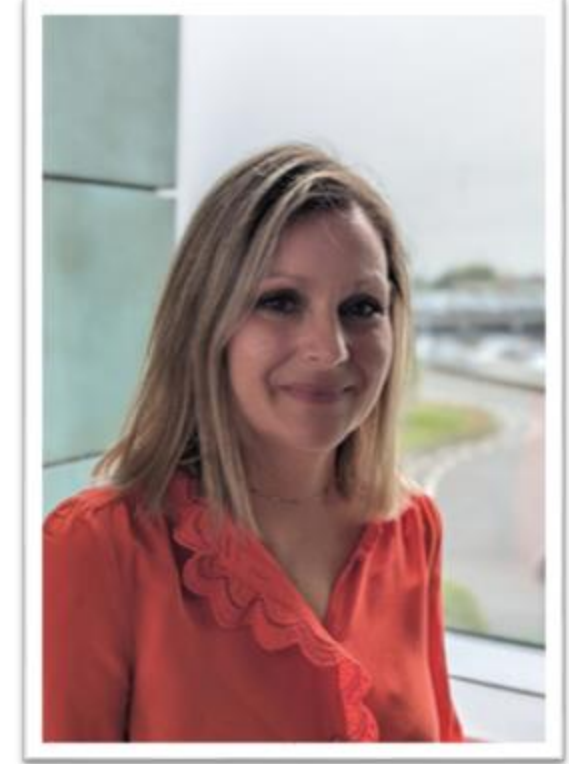
Joachim Dominique



Lionel Salesses



Margaux Boxho
(remotely)



Caroline Sainvitu

TRAIL Summer Workshop 25' London

TRUSTED AI LABS

Thank you for your attention !

