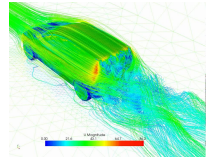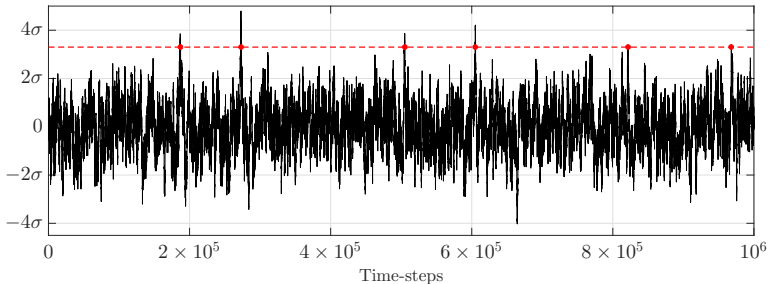# Extreme fluctuations in turbulent flows

## Strong impact on immersed structures

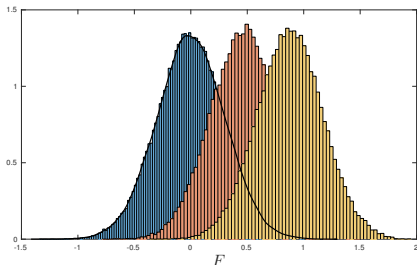- Premature wear, low output, breakdowns.

## Direct Numerical Simulation is irrelevent for **rare events**



How to simulate events with typical return times of **months**
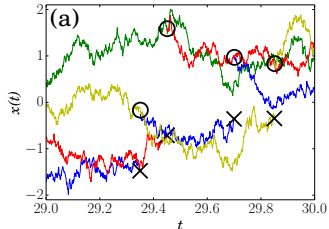without having to simulate months of turbulence ?

# We use *importance sampling*



Shift the distribution towards extreme values

## Population Dynamics

- Evolution of a population of simulations

- Periodically duplicated/dicarded



Application to a simple test case : computational cost for **statistics** & **dynamics** for **extreme drag fluctuations** reduced by a factor 100