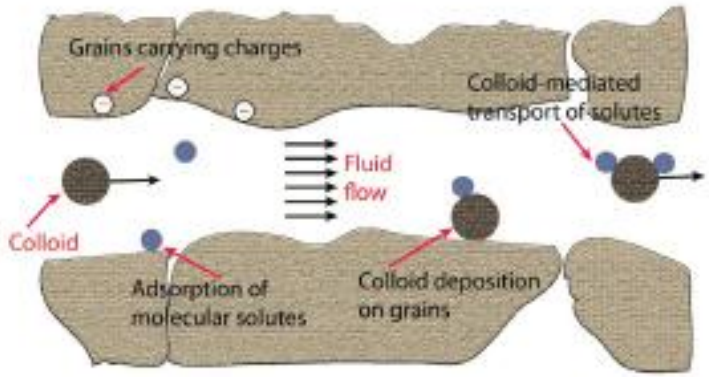
# ON THE NEED OF NEW ONTOLOGIES IN POLYDISPERSE TURBULENT TWO-PHASE FLOW MODELLING

Jean-Pierre Minier

EDF R&D, MFEE, 6 quai Watier 78400 Chatou, France

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# Context of disperse turbulent two-phase flows and present needs

- A range of **industrial applications** and **environmental issues**
- **Discrete elements** (‘particle’=droplets, bubbles, colloids, solid particle) embedded, *i.e.* transported and dispersed, in (usually) **turbulent flows**

- hybrid physics-based models (entity1=‘CVE’ + entity2=‘grain’) required

**What is important and currently needed in this domain**

Proper formulations of the concepts/relations between concepts are essential to channel modelling efforts and relate to corresponding scientific fields.

# Challenges and current terminology

- Disperse turbulent two-phase flows raises new challenges
- several **fundamental interactions** at play (fluid-particle, particle-particle, particle-wall) implying several **scientific domains** (fluid mechanics, interface chemistry, tribology, etc.)
- Complete **out-of-equilibrium statistical physics** (there are no scale separation, equipartition of energy, dissipation-fluctuation theorem, etc.)

**But, at present**, . . .

- The reference terminology relies on 'Eulerian/Lagrangian methods'

**Implying several dangers** . . .

- This terminology is vague (models? solvers?) AND misleading
- It is **damaging** since it not only prevents physical insights and connections to other domains but, more importantly, it encourages **countless but meaningless 'comparative studies'** (which means an utter waste of effort, time, money, motivation, etc.)

# First steps towards new ontologies

- New concepts need to be introduced but also **apparently well-defined ones have to be revisited**
- In particular, particle-based and field-based approaches are meaningful but are, as such, . . . **incomplete** for this subject!
- E.g., for **particle-based methods**: what particles are we talking about?
  - **kinetic-based formulations are ill-based** for random media with non-zero space and time correlations
  - the concepts of 'particle' and 'field' need to be made explicit AND complete
  - only then can **relations with well-defined stochastic models** be made!
- E.g., for **statistical distributions**: what PDFs are we talking about?
  - is it a one-body, a two-body, or a $N$-body PDF? for which variables?
  - Boltzmann-like formulations are NOT directly applicable

**Current effort (cf. first attempts in Physics Reports 665 (2016), 1-122)**

**Concepts (particles, fields, distributions, moments, state vectors, etc.) need to be properly defined and relations between them built!**

Q: **what about ontologies for numerical-based formulations in relation to previously-established ones for physics-based models**?