"Hydroacoustic Metrology of turbulent two-phase flows for sediment transport applications" project DMP

Plan de gestion de données créé à l'aide de DMP OPIDoR, basé sur le modèle "Science Europe : modèle structuré" fourni par Science Europe.

Renseignements sur le plan

Titre du plan	"Hydroacoustic Metrology of turbulent two-phase flows for sediment transport applications" project DMP
Version	Version initiale
Domaines de recherche (selon classification de l'OCDE)	Earth and related environmental sciences
Langue	fra
Date de création	2024-01-29
Date de dernière modification	2024-01-29

Renseignements sur le projet

Titre du projet	Hydroacoustic Metrology of turbulent two-phase flows for sediment transport applications
Acronyme	RUPTURE
Résumé	All geophysical water flows are multi-phase flows, most of the time turbulent. This is the case for river and coastal flows, where sediments on an erodible bottom are transported in response to hydrodynamic forces with various small-scale processes. Understanding these sediment transport processes in turbulent flows is essential to predict sediment transport, and anticipate the long-term impacts of the multiplication of extreme events on rivers and coastal systems. Therefore, many attentions have been directed towards turbulence resolving two- phase flow simulations approaches, leading to significant advances in sediment transport modelling, in a will to tackle the challenge of understanding and accounting for the small- scale interactions between the flow turbulence and the dispersed particles. However, the validity of these models is constrained by our inability to provide high-resolution sediment flux (as a local product of the dispersed particles phase velocity and volume fraction) measurements in dilute and dense turbulent two-phase flows. Recently, only hydroacoustic techniques involving coherent Doppler sonars have offered means to resolve fluxes as well as second order turbulence statistics for the dispersed phase in dilute and dense flow conditions, and further suggest their potential to concurrently follow the fluid phase using the

scattering properties of the turbulence itself, through the presence of turbulent microstructures formed by passive additive quantities. RUPTURE project stands in initiating new original research on sediment transport hydroacoustic metrology with the aim to define new methodologies prone to concurrently resolve both phases of turbulent two-phase flows, using pulse-to-pulse coherent Doppler sonar systems. RUPTURE will build on the most recent research in scattering theory, fluid mechanics and signal processing, implementing cutting-edge technology to produce comprehensive two-phase hydroacoustic flux measurements. RUPTURE will rely on a synergetic experimental and numerical approach to address its fundamental, analytical and methodological objectives. An experimental apparatus designed to reproduce isotropic turbulent single and two-phase flows using a calibrated micro bubble injection system, and its digital twin will assist RUPTURE in defining methodological scenarios for two-phase acoustic inversion, involving the contrasted scattering properties of turbulent microstructures and solid particles. This experimental/numerical synergy will provide an ideal environment to develop new generations of robust particle flux estimators in the frame of the statistical inverse theory, taking full advantage of the inherent stochastic nature of the echoes recorded by coherent Doppler sonars. The overall aim of these developments will be to investigate the dynamics of fine-scale sediment transport processes in dilute and dense geophysical aquatic flows, and their impacts on sediment fluxes. RUPTURE is the first attempt to develop a two-phase hydroacoustic inversion methodological frame using the flow turbulence properties recovered from passive additive quantities. At the time of project completion, RUPTURE will enhance our understanding of hydroacoustic particle flux measurements, and therefore improve our ability to resolve and understand the fine-scale sediment transport processes that are yet to be fully accounted for in the recent turbulence resolved two-phase flow simulations, due to the lack of high-resolution experimental datasets. To further answer this aspect, RUPTURE will produce unique datasets of hydroacoustic two-phase flow measurements dedicated to investigating the role of turbulence-particle interactions in the transport. Finally, subsequent improvements are anticipated to follow towards practical morphodynamic modeling used by environmental engineers for coastal and river systems management.

Sources de financement

- Agence Nationale de la Recherche : ANR-23-CE56-0001

Date de début 2024-01-01

Date de fin 2027-12-31

Partenaires

- LISIC LABORATOIRE D'INFORMATIQUE, SIGNAL ET IMAGE DE LA CÔTE D'OPALE https://ror.org/00tm1qp20
- UMR 8187 - LOG - Laboratoire d'océanologie et de géosciences https://ror.org/05m14rs93

Produits de recherche :

1. Hydroacoustic dataset - Single and two-phase flow experiments
2. Hydroacoustic dataset - Dilute and dense two-phase flow experiments (Jeu de données)
3. Numerical development for acoustic echoes simulations in two-phase turbulent flows (Modèle)

Contributeurs

Nom	Affiliation	Rôles
FROMANT Guillaume - https://orcid.org/0000-0003-4348-3041	LISIC LABORATOIRE D'INFORMATIQUE, SIGNAL ET IMAGE DE LA CÔTE D'OPALE - 201019115N	• Coordinateur de projet • Personne contact pour les données (Numerical Simulation, Dataset 2, Dataset 1) • Responsable de la conservation à long terme des données (Numerical Simulation, Dataset 2) • Responsable de la documentation des données (Dataset 1, Numerical Simulation, Dataset 2) • Responsable de la production ou de la collecte des données (Dataset 1) • Responsable de la protection des données (Dataset 1) • Responsable de la qualité des données (Dataset 2, Dataset 1, Numerical Simulation) • Responsable des questions éthiques (Dataset 2) • Responsable du dépôt et de la diffusion des données (Dataset 1, Dataset 2, Numerical Simulation) • Responsable du plan • Responsable du stockage des données (Dataset 1, Dataset 2, Numerical Simulation) • Responsable du traitement et de l'analyse des données (Numerical Simulation, Dataset 2, Dataset 1) • Responsable juridique (Dataset 1)

Droits d'auteur :

Le(s) créateur(s) de ce plan accepte(nt) que tout ou partie de texte de ce plan soit réutilisé et personnalisé si nécessaire pour un autre plan. Vous n’avez pas besoin de

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"Hydroacoustic Metrology of turbulent two-phase flows for sediment transport applications" project DMP

Description des données et collecte ou réutilisation de données existantes

Hydroacoustic dataset - Single and two-phase flow experiments

Description générale du produit de recherche

Nom	Hydroacoustic dataset - Single and two-phase flow experiments
Description	Bistatic coherent Doppler sonar profile measurements in single and two phase flow experiments conducted in a grid-turbulence tank equipped with a system for generating micro-air bubbles of controlled size and volume fractions (as fluid tracers). Narrowly distributed spherical PMMA particles will be used for the dispersed phase. For each case, turbulence will be controlled, as well as the size and volume fraction of the fluid tracers (bubble) and plastic particles (PMMA).
Workpackage	WP1
Mots clés (texte libre)	Turbulence, two-phase flow experiment, Doppler sonar, hydroacoustics
Contient des données personnelles ?	Non
Contient des données sensibles ?	Non
Prend en compte des aspects éthiques ?	Oui

Est-ce que des données existantes seront réutilisées ?

Justification	No

Comment seront produites/collectées les nouvelles données ?

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Description générale du produit de recherche

Nom	Hydroacoustic dataset - Dilute and dense two-phase flow experiments
Description	Bistatic coherent Doppler sonar profile measurements in two phase flow experiments conducted in a grid-turbulence tank equipped with a system for generating micro-air bubbles of controlled size and volume fractions (as fluid tracers). Narrowly distributed spherical PMMA particles will be used for the dispersed phase in dilute (low concentration) and dense (High concentration) conditions. For each case, turbulence will be controlled, as well as the size and volume fraction of the fluid tracers (bubble) and plastic particles (PMMA).
Type	Jeu de données
Workpackage	WP3
Mots clés (texte libre)	Turbulence, coherent sonar systems, turbulence-particles interactions, two-phase flow simulations
Langue	eng
Contient des données personnelles ?	Non
Contient des données sensibles ?	Non
Prend en compte des aspects éthiques ?	Oui

Est-ce que des données existantes seront réutilisées ?

Justification	No

Comment seront produites/collectées les nouvelles données ?

Numerical development for acoustic echoes simulations in two-phase turbulent flows

Description générale du produit de recherche

Nom	Numerical development for acoustic echoes simulations in two-phase turbulent flows
Description	Single and two-phase flows numerical models will be produced to simulate the echoes scattered in turbulent two-phase flow conditions, reproducing experiments from Dataset 1. A code will be produced, and numerical outputs of the demodulated signals recorded by each of the coherent Doppler sonar receivers.
Type	Modèle
Workpackage	WP2
Mots clés (texte libre)	Numerical simulation, two-phase flows, acoustic inversion, flow measurements
Langue	eng
Contient des données personnelles ?	Non
Contient des données sensibles ?	Non
Prend en compte des aspects éthiques ?	Oui

Est-ce que des données existantes seront réutilisées ?

Justification	Yes. Data from Dataset 1 will be used to validate the model and develop new methods for inversion two-phase flow measurements.

Comment seront produites/collectées les nouvelles données ?

Question sans réponse.

Documentation et qualité des données

Hydroacoustic dataset - Single and two-phase flow experiments

Quelles métadonnées et quelle documentation (par exemple mode d'organisation des données) accompagneront les données ?

Description	The data management will follow INSPIRE French norm. We will ensure that research data is Findable, Accessible, Interoperable and Reusable (FAIR), and soundly managed. Log documents will be provided indicating the date, time and data collection conditions alongside the dataset, as well as python scripts capable to read the (raw) data.
Standards de métadonnées/données	• INSPIRE Metadata Regulation : https://rdamsc.bath.ac.uk/msc/m66
Code langue des métadonnées	eng

Quelles seront les méthodes utilisées pour assurer la qualité scientifique des données ?

Description	The data acquired via newly conceived instrumentation or system will require new validation/calibration protocols that will be detailed in specific report and peer-review articles

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Quelles métadonnées et quelle documentation (par exemple mode d'organisation des données) accompagneront les données ?

Description	The data management will follow INSPIRE French norm. We will ensure that research data is Findable, Accessible, Interoperable and Reusable (FAIR), and soundly managed. The raw data will be stored on the Green Data center server at ULCO and on a dedicated external hard drive. The data will be open-access and the long-term preservation is ensured. Log documents will be provided indicating the date, time and data collection conditions alongside the dataset, as well as python scripts capable to read the (raw) data.
Standards de métadonnées/données	• INSPIRE Metadata Regulation : https://rdamsc.bath.ac.uk/msc/m66
Code langue des métadonnées	eng

Quelles seront les méthodes utilisées pour assurer la qualité scientifique des données ?

Description	Publications

Numerical development for acoustic echoes simulations in two-phase turbulent flows

Quelles métadonnées et quelle documentation (par exemple mode d'organisation des données) accompagneront les données ?

Description	The data management will follow INSPIRE French norm. We will ensure that research data is Findable, Accessible, Interoperable and Reusable (FAIR), and soundly managed. The simulation codes will be hosted on the Green Data center server at ULCO, on an online repository (BitBucket) and on a dedicated external hard drive. Git will be used as a version control system. The codes will be open-access and the long-term preservation is ensured. Log documents will be provided indicating the date, time and data collection conditions alongside the dataset, as well as python scripts capable to read the (raw) data.
Standards de métadonnées/données	• INSPIRE Metadata Regulation : https://rdamsc.bath.ac.uk/msc/m66
Code langue des métadonnées	eng

Quelles seront les méthodes utilisées pour assurer la qualité scientifique des données ?

Description Publications

Exigences légales et éthiques, code de conduite

Hydroacoustic dataset - Single and two-phase flow experiments

Comment les autres questions juridiques, comme la titularité ou les droits de propriété intellectuelle sur les données, seront-elles abordées ? Quelle est la législation applicable en la matière ?

Description University of the Littoral Opal Coast will be the owner of the data

Quels sont les aspects éthiques à prendre en compte lors de la collecte des données ?

Description No need

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Comment les autres questions juridiques, comme la titularité ou les droits de propriété intellectuelle sur les données, seront-elles abordées ? Quelle est la législation applicable en la matière ?

Description University of the Littoral Opal Coast will be the owner of the data

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Numerical development for acoustic echoes simulations in two-phase turbulent flows

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Description University of the Littoral Opal Coast will be the owner of the data

Quels sont les aspects éthiques à prendre en compte lors de la collecte des données ?

Description No need

Traitement et analyse des données

Hydroacoustic dataset - Single and two-phase flow experiments

Comment et avec quels moyens seront traitées les données ?

Description

Data will be processed using the algorithms contained in the open source HYDRAC software. Matlab software will also be used

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Comment et avec quels moyens seront traitées les données ?

Description

Data will be processed using the algorithms contained in the open source HYDRAC software. Matlab will be used as well.

Numerical development for acoustic echoes simulations in two-phase turbulent flows

Comment et avec quels moyens seront traitées les données ?

Description

The simulations will be launched on the ULCO's cluster machine Calculco. Matlab and Python will be used

Stockage et sauvegarde des données pendant le processus de recherche

Hydroacoustic dataset - Single and two-phase flow experiments

Comment les données seront-elles stockées et sauvegardées tout au long du projet ?

Besoins de stockage	The raw data will be stored on ULCO's Green Data Center server and on a dedicated external hard drive. The aim is for the data to become open-access and that long-term preservation can be ensured.
Volume estimé des données	5
Unité	To
Mesures prises pour la sécurité des données	Since at least two copies of the dataset will be available (Green Data Center and external hard drive), this prevent us from loosing the data. Our data are not politically or commercially sensitive.

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Comment les données seront-elles stockées et sauvegardées tout au long du projet ?

Besoins de stockage	The raw data will be stored on ULCO's Green Data Center server and on a dedicated external hard drive. The aim is for the data to become open-access and that long-term preservation can be ensured.
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Numerical development for acoustic echoes simulations in two-phase turbulent flows

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Volume estimé des données	5
Unité	To
Mesures prises pour la sécurité des données	Since at least two copies of the dataset will be available (Green Data Center and external hard drive), this prevent us from loosing the data. Our data are not politically or commercially sensitive.

Partage des données et conservation à long terme

Hydroacoustic dataset - Single and two-phase flow experiments

Comment les données seront-elles partagées ?

Modalités de partage	At the end of the project, the data and metadata will become open access. If someone wants to use it, he/she will have to contact RUPTURE PI. RUPTURE PI will give the data, with the associated documentation to use it (even if the reference will be already mentioned in the metadata).

Comment les données seront-elles conservées à long terme ?

Justification	At project completion, each dataset or numerical simulation will be stored on a Zenodo repository, and will be given a DOI.
Volume estimé des données	5

Hydroacoustic dataset - Dilute and dense two-phase flow experiments

Comment les données seront-elles partagées ?

Modalités de partage	At the end of the project, the data and metadata will become open access. If someone wants to use it, he/she will have to contact RUPTURE PI. RUPTURE PI will give the data, with the associated documentation to use it (even if the reference will be already mentioned in the metadata).

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Volume estimé des données	5
Unité	To

Numerical development for acoustic echoes simulations in two-phase turbulent flows

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Unité	To