

Hydraulic Engineering for environment and sustainable development

an Australian – French collaboration

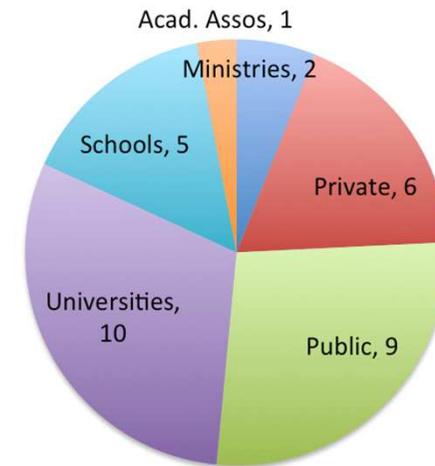
Jean-Michel Tanguy CEO GISHEDD

Vincent Lemiaile CSIRO

CSIRO in brief

- * The Commonwealth Scientific and Industrial Research Organization ([CSIRO](#)) is Australia's national science organization.
- * Data61 is the newest business unit created in 2016 and it aims to become the leading organization in digital technologies and data science in Australia. One of the focus areas identified by Data61 is in the field of **disaster risk management** in which digital innovation is set to play a major role in the near future.
- * As Australia faces a range of natural hazards including fires, floods, severe storms and cyclones, there is a strong need to better understand these complex physical phenomena and develop the next generation of scientific tools to mitigate the associated risks and investigate possible mitigation strategies and adaptation pathways.
- * CSIRO through three of its business units (Data61, Land and Water, Oceans and Atmospheres) is driving [a national initiative](#) in this space with strong collaborative links with Australian organizations as well as international partners.

GIS HEDD in brief



- * GIS HEDD is a joint initiative of 32 French organizations
- * Preparation and submission of ANR (French Research Agency) and H2020 (EU) calls of papers
- * Preparation of the 3rd Edition of the Franco-Chinese Forum on Water Science in Shanghai 24 - 28 October 2017
- * Preparation of IAHR-International Conference on Coasts and Estuaries – ICEC- Caen 2018
- * Organization of the “Lower Mekong Delta Coastal Zone Project” Saigon 12-14 April 2017
- * Call for mini-projects funded by the GIS
- * Organization of an annual “doctoral students day”
- * ANSWER : collaborative initiative on Navier-Stokes analytical solutions

CSIRO – GIS topics of common interest

- * **Field data assimilation and ensemble prediction**
- * **Flood forecasting: remote sensing**
- * **Flood modeling : SPH models**
- * **Landslides**
- * **Biomechanics**
- * **Applied mathematics**
- * **Virtual and augmented reality**
- * **Experimental facilities**
- * **Oceanography**

Seine – janvier 1910



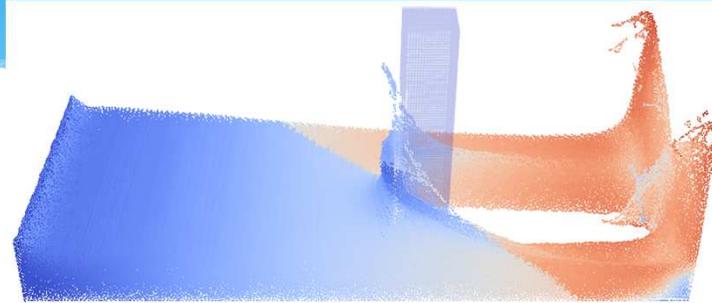
Gironde – décembre 1999



Field data assimilation and ensemble prediction

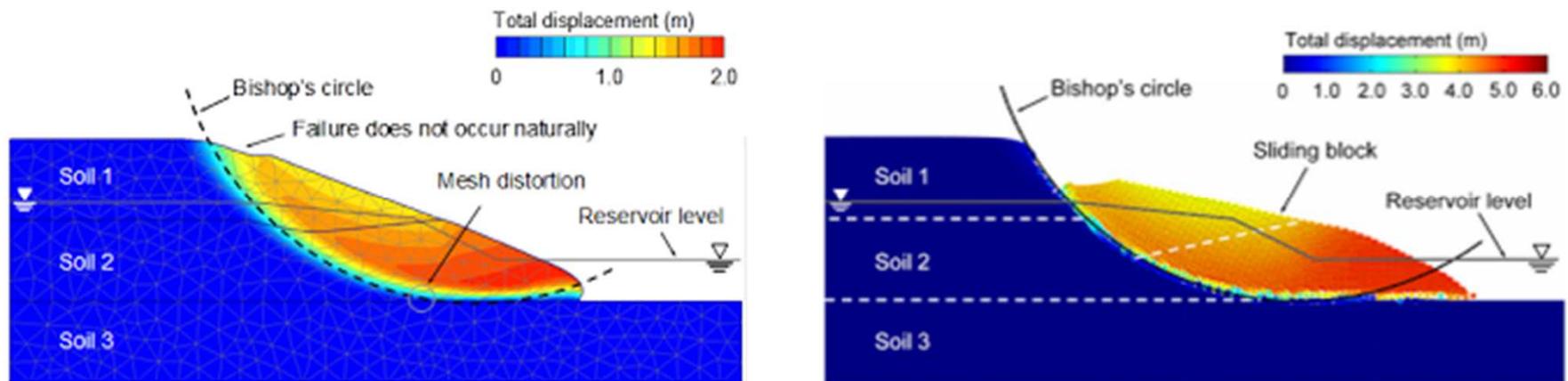
- * **Real time flood forecasting models** cannot take into account all the parameters describing the complex and great variety of basins.
- * soil moisture content or the spreading of an inundation have such a crucial effect that model predictions not including them can yield unrealistic results.
- * All available field data should also be collected and assimilated into the models. Data assimilation is essential to give an accurate information to people settled in flooded regions and therefore possibly at risk.
- * The water research group of the civil engineering department at Monash University is developing flood forecasting models. This is also in progress in SCHAPI in France.
- * A potential collaboration between CERFACS and CSIRO has already been identified on the same topic. A possibility is to send a doctorate student who is currently involved in data assimilation research at CERFACS, at CSIRO during his/her last year of PhD.
- * CSIRO - Monash university – CERFACS – SCHAPI

Numerical modeling



- * The Smoothed Particle Hydrodynamics (SPH) method is used for fluid flow simulation. In SPH the continuous medium is discretized into a set of particles that interact with each other and move at the fluid's velocity. These models can simulate complex behaviors for example of short crested breaking waves, sediment transport and bed evolutions, debris flows, multiphase flows.
- * SPH theory started here in Australia by its founder: J.J. Monaghan in the late 80's. A group of French researchers developed an OpenSource software GPUSPH which can be used in hydraulics and specifically to reproduce the experimental results of ANSWER.
- * CSIRO – EDF – CNAM - Monash university

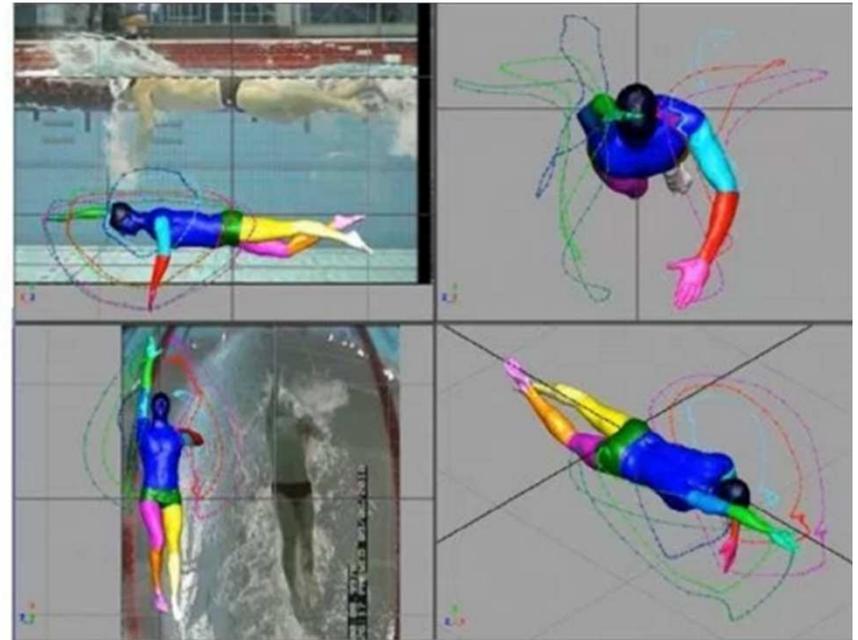
Landslides



Comparison between FEM (left) and SPH (right) for analysis of post-failure slope movement (Bui et al. 2011).

- * SPH model is used to modelize and predict land slides. This new model will be presented to IFSTTAR's soil mechanics department.
- * CSIRO - Monash university – IFSTTAR - BRGM

Biomechanics



- * The hydrodynamic lab of the University of Poitiers collaborates with athlete swimmers (French team) to optimize their swim in a wide canal.
- * CSIRO has taken a different approach. It has developed a new process to measure and model the movement of bodies, like divers, based on multi-camera recordings without sensors out of the water. Australian Diving Team was involved in the project.
- * Both experiences should be shared in this context.
- * CSIRO - Université de Poitiers

Applied mathematics

- * The project ANSWER launched by GIS HEDD is aimed in developing educational products in the hydraulic field, based on analytical solutions of the Navier-Stokes equations in different fields of hydraulics.
- * Some of these analytical solutions must be developed, tested in experimental flumes, visualized (if possible) in nature and compared with numerical modeling tools. Some solutions are already known, sometimes established in related fields, others are not yet known and must be developed.
- * The connection with the applied mathematical community is essential for physicians who want to work in this field. More contacts with mathematicians should be initiated in Australia as well as in France.
- * CSIRO - La Trobe University - Tasmania university - EDF - CEREMA

Oceanography



- * A specialized team of CSIRO is involved in international projects like IPCC. They use different classes of models to simulate the interactions of waves, currents, sediment transport and coastal evolutions at Australian scale, downscaling to local areas of interest. This approach aims at evaluating coastal evolution in the future, taking into account IPCC projections scenarios on climate change.
- * CSIRO – BRGM – CEREMA - IFREMER

Step 1 : student exchange

- * CERFACS : post doc student will spend some months in CSIRO to start a collaboration on data assimilation in 2D river hydraulic models
- * CERFACS : proposition of a post doc on remote sensing data assimilation
- * ENTPE : 5 months traineeship in hydraulics (CSIRO)
- * ENTPE : 5 months traineeship in sedimentology (Monash)
- * University of Poitiers: biomechanics : interest to exchange
- * EDF : collaboration on SPH models

Step 2 : extending the scope

- * Topics
 - * Climate change effects on hazards, adaptation measures...
IPCC downscaling processes
- * Applications in the Pacific Zone
 - * Scientists working in these zones (IRD...)
- * Organizations involved in these topics
 - * Météo-France, Ecole Polytechnique, IRD...
 - * Ministère de la Transition écologique et solidaire and Ministère de la Cohésion des territoires

Step 3 : a workshop in 2018?

- * Vincent Lemiale from CSIRO will visit us in Paris next January (meeting organized with EDF, CEREMA, CERFACS, SCHAPI)
- * Call for GIS HEDD organizations and others to collaborate on the topics of common interest already identified within CSIRO – GIS collaboration
- * Starting the organization of a workshop for October 2018, in Sydney next to the International Disaster Risk Management conference (IDRIM)
- * Installation of the Organizing committee and the Scientific committee with the help of French Embassy, AFRAM and CSIRO