Australian Government
Geoscience Australia

Open Source Hydrodynamic Modelling

ANUGA

Figure 1. An example flood hazard scenario, simulated by ANUGA (P. Milevski, Wollongong City Council).

Natural hazards such as floods, storm surges and tsunamis occur every year, often resulting in devastating impacts to communities. To reduce the impact, accurate modelling is required to predict where water will flow, at what speed and over what duration, before the event has taken place.

As well as having the potential to cause significant loss of life and injury to people, these events can damage or destroy homes and businesses and their contents. They also frequently cause widespread damage and disruption to infrastructure, including transport, communications, power, water and sewerage. Social impacts—such as those on health and relationships—can be significant, particularly for the higher impact events.

ANUGA is free software which models water flow arising from these events. The resulting knowledge may be used to develop hazard mitigation strategies, such as the design and location of levees and retarding basins. The results may also be used to guide land use planning and the development of evacuation plans—reducing loss of life, injury and damage to property in affected communities.

The ANUGA software was developed collaboratively by the Australian National University (ANU) and Geoscience Australia (GA) and was released for the first time in December 2006 on Sourceforge <http://sourceforge.net/projects/anuga>.

ANUGA continues to be developed by GA and the ANU with active participation in the software's development encouraged from the open source community.

ANUGA models water flow in two-dimensions. A major capability of ANUGA is that it can model the process of wetting and drying as water enters and leaves an area. This means

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it is suitable for simulating water flow onto a beach or dry land, and around structures such as buildings. ANUGA is also capable of modelling highly dynamic flows involving shock waves and rapidly changing flow speeds (that is transitions from sub critical to super critical flows).

ANUGA has attracted considerable interest from organisations and individuals involved with tsunami and flood modelling. ANUGA has been used to understand tsunami risk to the Western Australian coastline and in 2007, won the Asia-Pacific Spatial Excellence Award and Emergency Management Australia Safer Communities award. ANUGA has also been applied to model flood and storm surge scenarios.

Although the use of ANUGA requires some familiarity with programming, it is not difficult to set up a model which is defined as a short script using the programming language Python. Each script consists of the study area definition, elevation data (interpolated onto a triangulated mesh), the initial water level, boundary conditions (such as the tide, an incoming wave or river flow), and other forces that may impact water levels such as rainfall.

To download the software or find out more information about ANUGA visit <http://anuga.anu.edu.au>.

REFERENCES

Jakeman, J.D., Nielsen, O.M., Van Putten, K., Mleczeko, R., Burbidge, D. & Horspool, N. (2010) Towards spatially distributed quantitative assessment of tsunami inundation models, Ocean Dynamics, DOI 10.1007/s10236-010-0312-4.

Nielsen, O., Roberts, S., Gray, D., McPherson, A. & Hitchman, A. (2005) Hydrodynamic modelling of coastal inundation, MODSIM 2005 International Congress on Modelling and Simulation, Modelling and Simulation Society of Australia & New Zealand, 518-523.

Figure 2. *Simulated inundation using ANUGA versus observed inundation of the 2004 Indian Ocean Tsunami impact on Patong Beach. Blue regions indicate the areas where the predicted inundation matched the inundation survey. Red regions indicate areas where inundation was predicted but not observed, and yellow regions correspond to areas of observed inundation that were not predicted (Jakeman et al. 2010).*

Figure 3. *Complex reflection patterns and tsunami run-up into Monai Valley, Japan, simulated by ANUGA (Nielsen et al. 2005).*

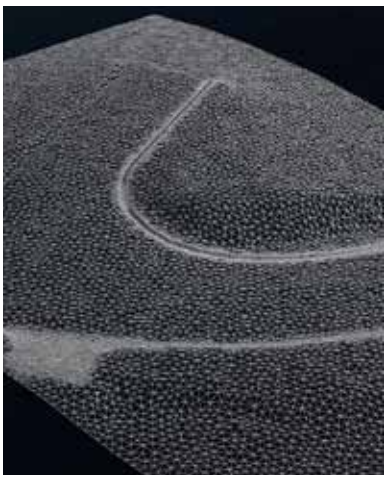

Figure 4. *Example of a fine terrain mesh in ANUGA developed for modelling potential flood impacts on road design. Mesh resolution varies with level of detail required (P. Milevski, Wollongong City Council).*