

## **VHub – Cyberinfrastructure for collaborative volcano research and risk mitigation**

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The VHub project is building a new online platform for collaboration in volcanology research, education, and outreach, and to accelerate the transfer of research tools to organizations charged with volcano hazard and risk mitigation (such as observatories). The project is funded by the US National Science Foundation and includes a core development team at University at Buffalo, Michigan Technological University, and University of South Florida, along with a group of collaborators from the international community. To ensure that VHub evolves in a manner that is most useful for observatories, the development team is also working closely with a small group of observatory partners (Table 1 provides the current list of collaborators and partner observatories).

Major components of VHub include:

- *Model warehouse* – A clearinghouse for computational models of volcanic processes, documentation of those models, and capabilities for online collaborative groups focused on issues such as code development, configuration management, benchmarking, and validation. Groups can establish appropriate levels of privacy control.
- *Simulation tools* – A subset of models will be available for online execution, eliminating the need to download and compile locally.
- *Data warehouse* – VHub will host some datasets and databases, and will have temporary storage available for some large datasets that are being used for a specific purpose such as a code benchmarking exercise. More importantly, the VHub team will be implementing iRODS middleware (see [irods.org](http://irods.org)) that allows a user to access data from a “cloud” of databases as if they were a single virtual database. This means that databases stay with their owners/maintainers, but are much more accessible to the user community (i.e., users do not have to learn the access procedure and format of multiple databases). Again, individual data owners determine the level of privacy, whether open to the world or only to a limited number of collaborators. For this approach to be successful the community will need to define standards and protocols for metadata, and we are working with major database projects to develop workshops and online discussions around this topic.
- *Teaching materials, workshops, and training* – VHub will be a platform for sharing simulations, calculational exercises, presentations, and other items useful in teaching university-level volcanology. VHub can also be a site to post videos and presentations from workshops and training events, and to have wikis and blogs around specific topics.

- *Stakeholder outreach* – The visualization and project tools that will be available through VHub should be useful for communicating with stakeholder groups and decision makers in areas around volcanoes. In addition to showing complex data and model results, there is potential for stakeholders to use automated project documentation/design software and online simulation tools to test their own hypotheses about how their volcano works.

The VHub development team is currently focused on getting the software and hardware infrastructure in place to support these (and other) capabilities. We will be “seeding” vhub.org with some modeling tools (e.g., the Tephra2 fall model, and the Titan2D model of mass flows) and datasets. In addition, an online collaboration group will be formed around multiphase models such as mfix. The collaborators in Table 1 will be using VHub to disseminate a wide variety of models ranging from tephra fall to Bayesian event tree analysis, as well as addressing data and database linkages. The VHub servers reside at Purdue University and the basic software infrastructure (see hubzero.org) is also maintained there.

Our Advisory Team (see Table 1) brings a range of experience and perspectives to help guide the development of VHub, including volcanic crisis response, collaboration and communication, advanced computational fluid dynamics, and geoinformatics. This group is already providing important input on many issues, including how we take advantage of other geoinformatics and cyberinfrastructure projects.

A more detailed description of the project can be found at [geohazards.buffalo.edu/vhub](http://geohazards.buffalo.edu/vhub). The VHub platform (vhub.org) will soon be broadly available online – watch for announcements via the volcano listserve and the IAVCEI website. VHub has potential to open the volcanology community to a new, global level of collaboration - the approach has already proven very successful in other disciplines. The VHub project is funded for four years, and ultimately its long-term success will depend upon the community as a whole “taking the driver’s seat,” while the development team just sets the stage. Please contact Greg Valentine or any member of the development team (see Table 1) if you are interested in learning more about or in using VHub.

**Table – VHub collaborator institutions and partner observatories (as of March 2010) and advisory team**

<b>Institution</b>	<b>Primary contact(s)</b>
<b>Collaborating research groups</b>	
Istituto Nazionale di Geofisica e Vulcanologia (Rome, Pisa, and Naples; Italy)	W. Marzocchi, A. Neri, A. Costa
Bristol University (UK)	R.S.J. Sparks
Massey University (New Zealand)	S. Cronin
Geological Survey of Japan	S. Takarada
Institute of Earth Sciences 'Jaume Almera' (Spain)	J. Marti
Institut de Physique du Globe de Paris	J.-C. Komorowski
Université Blaise Pascal, Clermont Ferrand (France)	T.H. Druitt
Earthquake Research Institute (Japan)	T. Koyaguchi
Instituto de Geofísica, Universidad Nacional Autónoma de México	J.L. Macias
Arizona State University (USA)	A. Clarke
Los Alamos National Laboratory (USA)	S. Dartevelle
Università degli Studi de Napoli Federico II (Italy)	C. Scarpati
Université de Genève (Switzerland)	C. Bonadonna
Universität Hamburg (Germany)	M. Hort
Barcelona Supercomputer Center (Spain)	A. Folch
U.S. Geological Survey – Cascade Volcano Observatory (USA)	L. Mastin
Smithsonian Institution (USA)	L. Siebert
<b>Partner observatories</b>	
Osservatorio Vesuviana (Italy)	A. Costa
Observatorio Vulcanológico y Sismológico – Pasto (Colombia)	M. Calvache
Montserrat Volcano Observatory	P. Cole
<b>Advisory team</b>	
J. Eichelberger (USGS Volcano Hazards Program)	
S. Nakada (Earthquake Research Inst. & IAVCEI President)	
J. Barclay (Univ. East Anglia)	
C. Baru (San Diego Supercomputer Center)	
J. Dufek (Georgia Tech)	
<b>Development team</b>	
University at Buffalo	G. Valentine, M. Jones, S. Gallo, E. Calder, M. Bursik, B. Pitman, D. Moore-Russo, C. Renschler, M. Sheridan, J. Bajo, S. Melander
Michigan Technological University	S. Carn, W. Rose
University of South Florida	C. Connor, L. Connor, L. Courtland