GROUP ON EARTH OBSERVATIONS

GEO DI-01 Disasters Task Team

GSNL - Geohazard Supersites and Natural Laboratories

Biennial report for Candidate/Permanent Supersite - November 2014

Hawaiian Volcanoes

Status	*Candidate Supersite*
Proposal documents	*Proposal* *Supplementary material*
Acceptance letter(s)	*Hawaii_notification_letter.pdf*
Previous reviews	*No previous report*
Point of Contact	*Michael Poland (mpoland@usgs.gov)* *USGS – Hawaiian Volcano Observatory* *51 Crater Rim Drive* *Hawaiʻi National Park, HI 96718-0051*

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<In this section please list all science teams who used/received data in the table below>

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Science team issues

<In this subsection please describe existing issues regarding the organization of the scientific research on the Supersite, e.g. if there are too few science teams, how to improve participation, coordination issues, etc.>

- In the table above, I listed individuals rather than teams. The "team" concept is difficult to define. A professor is a team leader (the professor's students are probably working with Supersite data), but such academic groups generally do not have formal definitions.

- There is little to no coordination between science teams. They behave independently and do not communicate unless they happen to view one another's presentations at conferences. It may be possible to increase communication by holding some sort of coordination meeting, probably in conjunction with some other conference that would be well-attended by the science teams (AGU or FRINGE, for example), but even then it is probable that less than half of the science team members would be present. Other Supersites, like Iceland and Italian volcanoes, probably have less of this sort of issue, since the Supersites are integral parts of larger, well-funded research initiatives (FUTUREVOLC and MED_SUV, respectively).

- Related to the above point, there was little response to the PoC's request for information to help with amassing this report. Supersite users are not required to report results or communicate with the PoC (or each other) once they have been approved to receive data. Perhaps there could be a more formal method for approving Supersite users? Such a procedure would not only improve accountability by requiring users to agree to a code of conduct, but could also streamline access to data, so that individual users do not have to be added to proposals supported by individual space agencies.

In situ data

<In this section please list all in situ data types available for the Supersite in the table below>

Type of data	Data provider	How to access	Type of access
GPS	*USGS – Hawaiian Volcano Obs.*	*UNAVCO*	*unregistered public*
Seismic	*USGS – Hawaiian Volcano Obs.*	*IRIS*	*unregistered public*
Gas Emissions	*USGS – Hawaiian Volcano Obs.*	*Published USGS Open-File Reports (current through 2012)**	*unregistered public*
Gravity	*USGS – Hawaiian Volcano Obs.*	*Published manuscripts**	*unregistered public*
Tilt	*USGS – Hawaiian Volcano Obs.*	*Contact HVO scientists***	*GSNL scientists*
Camera	*USGS – Hawaiian Volcano Obs.*	*Contact HVO scientists***	*GSNL scientists*
Strain	*USGS – Hawaiian Volcano Obs.*	*Contact HVO scientists***	*GSNL scientists*

** Denotes data that are only released when published because significant data processing is necessary to achieve useable results. Peer review is necessary to assure the quality of the processed data.*

*** Denotes data that are not made publically available due to lack of a suitable archive, but that can be obtained through collaboration with scientists at the USGS Hawaiian Volcano Observatory.*

In situ data issues

<In this subsection please describe existing issues regarding the open access to in situ data, e.g. if there are some datasets which are not open, why, if access is straightforward or cumbersome, future developments, etc. >

Some datasets (e.g., gas emissions, gravity) require significant post-processing. Because of the need for stringent quality control, such data are not made publically available until the have been through the peer review process and published (either in journals or USGS Open-File Reports). Other datasets (e.g., tilt, strain) are only available by contacting the data provider, since there are no established archives or agreed-upon formats for storing such data. The data may also be complex, requiring that the provider offer guidance on data processing and interpretation.

Satellite data

<In this section please list all satellite data types available for the Supersite in the table below>

Type of data	Data provider	How to access	Type of access
ENVISAT	*ESA*	*http://eo-virtual-archive4.esa.int/?q=Hawaii*	*registered public*
RADARSAT-1	*CSA*	*Supersites Web page**	*registered public*

ALOS-1	*JAXA*	*Supersites Web page**	*registered public*
TerraSAR-X	*DLR*	*Available after proposal submission to and acceptance by DLR*	*GSNL scientists*
Cosmo-SkyMed	*ASI*	*POC requests access from ASI for individual users, data then accessible via UNAVCO*	*GSNL scientists*
RADARSAT-2	*CSA*	*POC requests access from CSA for individual users, data then accessible via UNAVCO*	*GSNL scientists*
Sentinel-1*	*ESA*	*https://scihub.esa.int/dhus/*	*registered public*
ALOS-2*	*JAXA*	*https://auig2.jaxa.jp/ips/home*	*successful proposers*

NOTE: This list only includes SAR data, which typically require payment or approval of a research proposal. Freely available data (e.g., MODIS, Landsat) are not listed.

**interface for downloading Radarsat-1 and ALOS-1 data appears to no longer be functional (as of November 2014).*

***denotes data that have yet to be delivered, although access permissions have been established to some degree.*

Satellite data issues

<In this section please describe existing issues regarding the access to satellite data, e.g. if there are some datasets which are not open, why, if access is straightforward or cumbersome, future developments, etc. >

- RADARSAT-1 and ALOS-1 archive data are supposed to be available after registration on the Supersite Web site, but a test of the links in November 2014 revealed errors that prevent downloads. This is probably an easily fixable issue, but suggests that no one is using this method for accessing the data (otherwise, the problem would have been noted before).

- Currently, there is no streamlined method for requesting user access to SAR data; each space agency has a different access policy. CSA and ASI require users to be sponsored by the PoC and then to submit contact information and a brief research plan, which is reviewed before approval. ASI has not denied any applications, but CSA has denied some requests based on user nationality. DLR requires that an interested user submit a proposal via the TerraSAR-X Science Service System. This is independent of the PoC, so there is no way for the PoC to be aware of how many Supersite proposals have been submitted and approved. JAXA has approved a Hawaiʻi Supersite proposal for ALOS-2 data, but the mechanism for adding new users is not clear.

- There is no Supersite-specific archive or collection point for non-SAR satellite data. Such datasets are usually free (EO-1, Landsat, MODIS, ASTER, etc.) and constitute an important source of information for synergistic studies. It should be relatively straightforward to build a collection/archive for visual and thermal remote sensing data related to Hawaiʻi. Such a resource could also host DEMs and

other information that would be helpful to Supersite researchers (see "Conclusive remarks and suggestions for improvement" section below).

Research results

<Here please give an overview of the scientific achievements, also with reference to the original Supersite proposal >

The original Supersite proposal emphasized the synergy between space-based, airborne, and ground-based data as a tool for investigating large-scale research questions in Hawaiʻi. For example, what is the nature of magma supply to Hawaiian volcanoes? What data provide the best indication that a volcano may erupt? How can predictions of the timing, magnitude, and location of volcanic eruptions be improved? What is the relation between volcanic and tectonic activity?

The first several years of Supersite results have make use of a diversity of datasets to address many of these topics. For example, magma supply has been found to fluctuate on timescales of years, which has a direct impact on the nature of eruptive activity. Feedbacks between volcanism and tectonism have been documented, although the mechanism for the feedback is not yet understood. While SAR data constitute the bulk of the space-based resources, their application has extended far beyond deformation studies. For example, methods have been developed to use InSAR coherence to map lava flow evolution over time, regardless of weather conditions (something visual remote sensing data and ground-based observations cannot provide). In addition, SAR data have provided crucial support for other studies—for instance, allowing for the calculation of vertical deformation that is required to correct gravity data, which are then used to measure subsurface mass change.

Nevertheless, "big" questions remain, and there are outstanding opportunities for exploiting the available data—particularly with regard to combining SAR and other space-based visual and thermal imagery. In addition, recent results have raised new questions. For example, does Kīlauea's south flank instability behave as a single unit, or multiple quasi-independent blocks? What are the spatial and temporal characteristics of aseismic slip events on Kīlauea's south flank? What is the volume of magma storage beneath the surface of Kīlauea and Mauna Loa? Continued operation of the Hawaiʻi Supersite will provide the means for pursuing these and other topics.

Publications

<In this subsection please list all publications obtained using datasets (in situ and EO) obtained through the Supersite initiative>

Peer reviewed journal articles
Pinel, V., Poland, M.P. and Hooper, A., 2014, Volcanology: Lessons learned from synthetic aperture radar imagery. Journal of Volcanology and Geothermal Research, doi:10.1016/j.jvolgeores.2014.10.010.
Poland, M.P. and Orr, T.R., 2014, Identifying hazards associated with lava deltas. Bulletin of Volcanology, 76, article 880, doi: 10.1007/s00445-014-0880-0.
Bagnardi, M., Poland, M.P., Carbone, D., Baker, S., Battaglia, M. and Amelung, F., 2014. Gravity changes and deformation at Kīlauea Volcano, Hawaii, associated with summit eruptive activity, 2009–2012. Journal of Geophysical Research,

119(9): 7288–7305, doi:10.1002/2014JB011506.

Chen, J., Zebker, H.A., Segall, P. and Miklius, A., 2014. The 2010 slow slip event and secular motion at Kilauea, Hawai`i inferred from TerraSAR-X InSAR data. Journal of Geophysical Research, 119(8): 6667–6683, doi:10.1002/2014JB011156.

Shirzaei, M., Walter, T.R. and Bürgmann, R., 2013. Coupling of Hawaiian volcanoes only during overpressure condition. Geophysical Research Letters, 40(10): 1994-1999, doi:10.1002/grl.50470.

Shirzaei, M., Bürgmann, R., Foster, J., Walter, T.R. and Brooks, B.A., 2013. Aseismic deformation across the Hilina fault system, Hawaii, revealed by wavelet analysis of InSAR and GPS time series. Earth and Planetary Science Letters, 376(15 August): 12-19, doi:10.1016/j.epsl.2013.06.011.

Wauthier, C., Roman, D.C. and Poland, M.P., 2013. Moderate-magnitude earthquakes induced by magma reservoir inflation at Kīlauea Volcano, Hawai'i. Geophysical Reserach Letters, 40(20): 5366-5370, doi:10.1002/2013GL058082.

Richter, N., Poland, M.P. and Lundgren, P.R., 2013. TerraSAR-X interferometry reveals small-scale deformation associated with the summit eruption of Kīlauea Volcano, Hawai'i. Geophysical Research Letters, 40(7): 1279-1283, doi:10.1002/grl.50286.

Plattner, C., Amelung, F., Baker, S., Govers, R. and Poland, M.P., 2013. The role of viscous magma mush spreading in volcanic flank motion at Kīlauea Volcano, Hawai'i. Journal of Geophysical Research, 118(5): 2474–2487, doi:10.1002/jgrb.50194.

Lundgren, P., Poland, M., Miklius, A., Orr, T., Yun, S.-H., Fielding, E., Liu, Z., Tanaka, A., Szeliga, W., Hensley, S. and Owen, S., 2013. Evolution of dike opening during the March 2011 Kamoamoa fissure eruption, Kīlauea Volcano, Hawai�i. Journal of Geophysical Research, 118(3): 897-914, doi:10.1002/jgrb.50108.

Poland, M. P., Miklius, A., Sutton, A.J., and Thornber, C.R., 2012. A mantle-driven surge in magma supply to Kīlauea Volcano during 2003–2007. Nature Geoscience, 5(4): 295–300, doi:10.1038/ngeo1426.

Dietterich, H.R., Poland, M.P., Schmidt, D.A., Cashman, K.V., Sherrod, D.R. and Espinosa, A.T., 2012. Tracking lava flow emplacement on the east rift zone of Kīlauea, Hawai'i, with synthetic aperture radar coherence. Geochemistry, Geophysics, Geosystems, 13(Q05001), doi:10.1029/2011GC004016.

Baker, S. and Amelung, F., 2012. Top-down inflation and deflation at the summit of Kīlauea Volcano, Hawaii observed with InSAR. Journal of Geophysical Research, 117(B12406), doi:10.1029/2011JB009123.

Montgomery-Brown, E.K., Sinnett, D.K., Larson, K.M., Poland, M.P. and Segall, P., 2011. Spatiotemporal evolution of dike opening and décollement slip at Kīlauea Volcano, Hawai'i. Journal of Geophysical Research, 116(B03401), doi:10.1029/2010JB007762.

Jung, H.S., Lu, Z., Won, J.S., Poland, M.P. and Miklius, A., 2011. Mapping three-dimensional surface deformation by combining multiple-aperture interferometry and conventional interferometry: application to the June 2007 eruption of Kilauea Volcano, Hawaii. IEEE Geoscience and Remote Sensing Letters, 8(1): 34-38, doi:10.1109/LGRS.2010.2051793.

Baker, M.S., 2012. Investigating the Dynamics of Basaltic Volcano Magmatic Systems with Space Geodesy. Ph.D. Dissertation, University of Miami, Open Access Dissertations Paper 917 (http://scholarlyrepository.miami.edu/oa_dissertations/917).

Sansosti, E., Casu, F., Manzo, M. and Lanari, R., 2010. Space-borne radar interferometry techniques for the generation of deformation time series: An advanced tool for Earth's surface displacement analysis. Geophysical Research Letters, 37(L20305), doi:10.1029/2010GL044379.

Poland, M., 2010. Localized surface disruptions observed by InSAR during strong earthquakes in Java and Hawai'i. Bulletin of the Seismological Society of America, 100(2): 532-540, doi:10.1785/0120090175.

Montgomery-Brown, E.K., Sinnett, D.K., Poland, M., Segall, P., Orr, T., Zebker, H. and Miklius, A., 2010. Geodetic evidence for en echelon dike emplacement and concurrent slow-slip during the June 2007 intrusion and eruption at Kīlauea volcano, Hawaii. Journal of Geophysical Research, 115(B07405), doi:10.1029/2009JB006658.

Conference presentations/proceedings

2014 IGARSS: The Hawai'i Supersite: Improved understanding of Hawaiian volcanism made possible by increased data accessibility (presented by M.P. Poland)

2013 AGU: The Hawai`i Supersite: Update and results (presented by M.P. Poland)

2013 IGARSS: The GEO Geohazards and Natural Laboratories initiative (presented by J. Hoffmann)

NOTE: It would be impossible to list all presentations that make use of Hawaiʻi Supersite data (there would be several dozen), especially without direct input from science team members; therefore, only presentations that directly address the Hawaiʻi Supersite are listed above.

NOTE: As this is the first progress report for the Hawaiʻi Supersite, publications beyond just the past two years are included. Some of these reports made use of ESA data that are now publically available at no cost, and others were written before the formal establishment of the Supersite in 2012. They are included here for completeness, as the research was accomplished in the spirit of the Supersite, and they exemplify the results that are possible by combining air-, ground-, and space-based datasets to better understand Hawaiian volcanism.

Research products

There are no formally complete, publically available research products; therefore, the table below has been left blank. Supersite data have been used to make a variety of non-publically-available products, however, and have aided with some software development. Examples include:

- ***Hawaiʻi Supersite data were used to develop and test new functionality in the freely available GMTSAR software. These data provide better "real world" examples for testing than imagery typically provided for such purposes by space agencies.***

- ***Hawaiʻi Supersite data were used to develop new methods for extracting three-dimensional displacement data from SAR imagery.***

- ***Deformation maps are a first step in any SAR data processing and are available on a number of websites hosted by individual Supersite users.***

- ***Deformation time series are an increasingly common application of SAR data. Scott Baker (UNAVCO) has long-range plans to upload his Hawaiʻi time series to the UNAVCO InSAR archive to make them available to the community, but this resource is still being beta tested and Scott is not formally supported to complete this task.***

- ***Software for mapping lava flows (and other surface change) using coherence is in development, having been proven in the published study of Dietterich et al. (2012).***

<In this subsection please list all research products available for the Supersite in the table below>

Type of product	Product provider	How to access	Type of access
e.g. ground deformation time series, source model, etc.	*Name of scientist(s)*	*Link to publication, research product repository or description of procedure for access*	*E.g. public, registered, limited to GSNL scientists, etc.*

…	…	…	…
…	…	…	…

Research product issues

<In this subsection please describe existing issues regarding how the science teams provide access to their research products, e.g. if products are open to other scientists (in numerical form), if they are open to the public, how access is provided, future developments, etc. >

There are currently few publically available Supersite products. This was not made a condition of approving the Hawaiʻi Supersite, so it is understandable that most Supersite researchers have yet to post products beyond their own publications. Some products have also been restricted—for example, stacking and displacement calculation methods developed by Hyung-Sup Jung and coworkers are considered proprietary by the organization that gave them access to software source code. Funding, staff, and other assistance are also needed to assist with the dissemination of research products. Few organizations have the funding to develop a resource to its full potential, especially once the research has been published (the GMTSAR software from the Scripps Oceanographic Institution is a notable exception, but those investigators have been specifically funded to complete that work). In the academic community, where publishing is emphasized, there is little reward for making research products accessible. If the public (or even scientific) availability of research products, like time series and software, is considered a critical outcome for the Supersites initiative, more support needs to be obtained for such endeavors.

Dissemination and outreach

<In this section please describe what other actions (other than publication) have been made to inform the public, the scientific community and the stakeholders, of the existence of your Supersite, of the scientific opportunities, results, benefits, and any other relevant aspects.>

Dissemination and outreach (beyond scientific publications) were not requirements of the Hawaiʻi Supersite at the time it was proposed, so there are no specific activities to cite in this section. SAR and ground-based data, however, are used extensively in public lectures given in Hawaiʻi and in briefings given to local land and emergency managers. In those contexts, the data have an important broader impact than scientific research alone (see "Societal benefits" section below).

Funding

<In this section please describe if and what funding has been used for the activities described above. Please provide reference to projects and proposals related to the Supersite. >

No specific funding has been obtained for the Hawaiʻi Supersite, which is probably a contributing factor for the lack of coordination among Supersite users and the lack of a strong Web presence (compared to the Icelandic and Italian volcanoes Supersites). Individual users have no doubt obtained research funding and have leveraged the availability of Supersite data in their proposals, but since there is no reporting requirement, the PoC is not aware of those projects. Given the broad applications which Supersite data are used to support, it would be very difficult to catalog all funding that has been used in conjunction with Supersite data, and it is probably not a useful exercise anyway.

Societal benefits

<In this section please describe who are the stakeholders (other than the scientific community); what societal benefits have been achieved through your Supersite during the reference period, and who have been the most benefiting stakeholders. We remind you that GSNL is included in the GEO Disasters Benefit Area.>

The most direct beneficiary of remote sensing data (particularly SAR) provided by the Hawaiʻi Supersite has been the U.S. Geological Survey's Hawaiian Volcano Observatory (HVO). Founded, in 1912, HVO maintains a dense network of geophysical stations around the island (which have been made available to the Supersite) and also collects geochemical and geological data on volcanic and seismic activity. These measurements fulfill a US Congressional mandate (the Stafford Act) to provide volcano and earthquake hazard warnings, supported by research, to local populations, emergency managers, and land-use planners. SAR data constitute a critical resource for this monitoring and research, but would be cost-prohibitive if not for the Supersite.

Insights gained using Supersite data are communicated to a number of other organizations by HVO, including the National Park Service and Hawaiʻi County Civil Defense—the agencies that are tasked with managing responses to volcanic and earthquake crises in the lands they oversee (HVO is tasked with providing those groups with the information they need to make decisions about evacuations and other actions). Supersite data also contribute to the development of interpretations that are communicated to the public as part of daily volcanic activity updates, weekly newspaper articles, on-line content, and community outreach events (presentations, open houses, exhibits, etc.).

Conclusive remarks and suggestions for improvement

<In this section the Point of Contact is asked to summarize the achievements and the issues, and to provide comments, impressions, remarks, and suggestions to improve the GSNL initiative and/or the specific Supersite activities.>

The Hawaiʻi Supersite has been an unparalleled success. One need only look at the long list of publications in high-impact journals to appreciate the scope of research that Supersite data have

supported, and the preceding sections detail the many achievements across a variety of categories. Continued availability of SAR and ground-based data will certainly feed new lines of research into Hawaiian volcanism and will also support hazards monitoring and mitigation efforts in Hawaiʻi. This is not to say that there is no room for improvement in Supersite operations. While capitalizing on the initial success of the Hawaiʻi Supersite, the years to come should also focus on the following issues:

- Some data are not particularly timely in their distribution. RADARSAT-2 data, for example, are only provided in batches once every few months (the quota has also nearly been exhausted). This compromises efforts to respond to rapidly evolving events. While disaster response is not the purview of the Supersites initiative (falling more into the category of the International Charter for space and major disasters), the scientific response to a crisis can result in new insights into volcanic and earthquake processes that can be applied as part of a disaster response. In this context, Cosmo-SkyMed data are invaluable, as they are provided via FTP within a few hours of acquisition. The Hawaiʻi Supersite owes a debt of gratitude to ASI for this service.

- The procedure for accessing Supersite SAR data should be standardized. ASI, DLR, CSA, and JAXA currently have different methods for requesting access to Supersite data. The PoC coordinates requests to access ASI and CSA data, but DLR requires individual proposals, which the PoC may be unaware have been submitted. This makes it difficult to know who is working with Supersite data, thereby complicating efforts to coordinate work and to report results (including this progress report). The procedure for Supersite users to access ALOS-2 data through JAXA is not yet clear, as those data have yet to be widely provided (although data are now available for ordering as of November 2014, and a Hawaiʻi Supersite proposal for ALOS-2 data was accepted by JAXA).

- The scope of the Supersite is not clear—it is difficult to answer the relatively simple question "what constitutes Supersite data?" Are ENVISAT scenes, which are freely available, considered Supersite data? Should a project that relies solely on publically available Sentinal-1 imagery and Kīlauea GPS data be considered a Supersite effort? And how far back do Supersite data extend, given that the Hawaiʻi Supersite was only approved formally as a permanent Supersite in 2012? For instance, are 1990s-era RADARSAT-1 data considered part of the Supersite?

- There is a noteworthy lack of non-SAR remote sensing data in the Hawaiʻi Supersite. Most such data are freely available—for example, LANDSAT, MODIS, and ASTER—but there is no archive for Hawaiʻi-specific imagery. In addition, there has been no effort to obtain commercial visual/thermal data over Hawaiʻi, such as Pléiades, SPOT, Worldview, and Quickbird. The USGS would be the logical lead for such an effort, since they maintain the LANDSAT archive and also have developed the Hazards Data Distribution System (HDDS) for archiving remote sensing data (including some commercial imagery) related to natural hazards. An extension of this archive, which already exists for the current lava flow crisis in Hawaiʻi, would constitute a valuable resource for the Hawaiʻi Supersite, but would require support for implementation given the volume of data that would have to be assembled.

- In addition to a lack of non-SAR remote sensing data, there is also a lack of supporting data, like digital elevation information. Some of these data are freely available, including SRTM and USGS NED. There are also some LIDAR and Airborne SAR datasets (acquired by universities and other academic institutions) that provide high-resolution (1–5 m) topography over Hawaiʻi. Such data are essential for exploiting the improved resolution of SAR systems like TerraSAR-X and Cosmo-SkyMed, but are not easily accessible, especially to non-US investigators. CEOS could play an important role in advocating that topographic data be made available to the Supersites, in Hawaiʻi and elsewhere.

- The potential availability of TanDEM-X data to the Supersite is not clear. Are TanDEM-X scenes included as part of the Supersite? If so, how do interested investigators request access? Should a Supersite proposal be submitted, in much the same way as was done for TerraSAR-X data? Or can the PoC's current TanDEM-X proposal be considered a Supersite proposal?

- Is there any hope of obtaining more Cosmo-SkyMed data than are currently being provided to the Supersite? Right now, data are made available on 4 tracks (1 ascending and 1 descending each for Mauna Loa and Kīlauea) once every 16 days. There is potential for 4 acquisitions on each track per 16 days, and there is an entire track covering Kīlauea that has not been made available. ASI has provided more data over Kīlauea to other agencies—most notably the Jet Propulsion Laboratory through an agreement with NASA. Additional data provided to the Supersite would greatly increase the temporal resolution of deformation and surface change time series, allowing for investigation of short-term processes (such as lava flow emplacement and rapid deformation transients). ASI's internal structure has heretofore prevented all Hawaiʻi data being supplied to the Supersite, but perhaps CEOS could negotiate a more comprehensive data policy for the Supersites?

- The current website for the Hawaiʻi Supersite is poor, and does not provide easy access to data. Unfortunately, there is no support for a Supersite Web presence (Susanna Gross, at UNAVCO, has done an admirable job considering that she has not received any help). The Hawaiʻi Supersite website should include a simple interface to available data (or instructions on how to request access) as well as a description of recent research to highlight progress. Such an effort will require funding for personnel to maintain and enhance the current site.

- Lacking a dynamic Web presence, there is no means of sharing important results obtained by science team members (nor are there any mechanisms in place to compel science team members to make the Supersite aware of their results). This progress report is a valuable forum for relating results in an analytical way (for example, through a list of publications), but lacks a section for in-depth descriptions of noteworthy research successes, which might include figures or other dynamic content. Such a forum for sharing results does not necessarily need to exist as part of this progress report (indeed, it would be difficult to assemble such results in a timely fashion to meet reporting deadlines), but does need to exist somewhere so that the science team has a means of demonstrating the importance of the Hawaiʻi Supersite to CEOS, individual space agencies, funding agencies, government agencies, academic institutions, and the general public.