Volcano Deformation New Geodetic Monitoring

Interferometric synthetic aperture radar (InSAR) is a relatively new remote sensing tool that is capable of measuring ground-surface deformation with centimeter-to-subcentimeter precision at a spatial resolution of tens of meters over an area of hundreds to thousands of square kilometers. With its global coverage and all-weather imaging capability, InSAR has become an increasingly important technique for studying volcanoes in remote regions such as the Aleutian Islands. The spatial distribution of surface deformation data derived from InSAR images enables the construction of detailed mechanical models to enhance the study of magmatic processes. InSAR Imaging of Aleutian Volcanoes: • Provides a theoretical framework for InSAR observations and capabilities • Discusses state-of-the-art InSAR analysis techniques • Describes the structure, eruptive history, and magma composition of volcanoes along the entire Aleutian arc • Presents conceptual models for the magma plumbing systems of Aleutian volcanoes based on InSAR results combined with geophysical, geological and geochemical observations. • Synthesizes observations of deformation along the Aleutian arc and compares those results to other active arcs around the world. • Is illustrated throughout with high-resolution color satellite radar images

Frontiers in Earth Science is an open-access journal that aims to bring together and publish on a single platform the best research dedicated to our planet. This platform hosts all the rapidly growing and continuously expanding domains in Earth Science, involving the lithosphere (including geology, geophysics, geochemistry, and geography), the hydrosphere (including hydrology and cryospheric, marine and ocean sciences, complementing the existing Frontiers journal on Marine Science) and the atmosphere (including meteorology and climatology). As such, Frontiers in Earth Science focuses on the countless processes operating within and among the major spheres constituting our planet. In turn, the understanding of these processes provides the theoretical background to better use the available resources and to face the major environmental challenges (including earthquakes, tsunamis, eruptions, floods, landslides, climate changes, sea level rise, extreme meteorological events): this is where interdependent processes meet, requiring a holistic view to better live on and with our planet. Within this volume are included the Grand Challenge papers for the Earth Science field, authored by the Field Chief Editor, and several of the 16 online specialty sections, authored by the respective Chief Editors. These articles identify and describe the crucial challenges for Earth Science at the dawn of the 21st century.

This book serves as a guide to discovering the most interesting volcano sites in Italy. Accompanied by some extraordinary contemporary images of active Neapolitan volcanoes, it explains the main volcanic processes that have been shaping the landscape of the Campania region and influencing human settlements in this area since Greek and

Roman times and that have prompted leading international scientists to visit and study this natural volcanology laboratory. While volcanology is the central topic, the book also addresses other aspects related to the area's volcanism and is divided into three sections: 1) Neapolitan volcanic activity and processes (with a general introduction to volcanology and its development around Naples together with descriptions of the landscape and the main sites worth visiting); 2) Volcanoes and their interactions with local human settlements since the Bronze Age, recent population growth and the transformation of the territory; 3) The risks posed by Neapolitan Volcanoes, their recent activity and the problem of forecasting any future eruption.

Paroxysmal explosive activity is one of the most spectacular natural phenomena, which is recognized as having strong impact not only at a local scale but whose effects can also reach far areas and, indeed, can significantly affect the atmosphere, and the environment in the overall. The most devastating and recent example occurred in 2010, when the Icelandic Eyiafjallajökull volcano erupted disrupting air traffic all over Europe and the North Atlantic for weeks. Between 2008 and 2013, the long-lasting eruption of Chaitén volcano in Chile produced plumes 14-20 km high reaching the coast of Argentina and causing ash fallout as far as 800 km from the vent, and the continuously erupting volcanoes of the Kamchatka Peninsula and of the Aleutian arc have caused often treats to air traffic. The eruption of Pinatubo (Philippines) in 1991 had a strong impact all over the globe, causing significant and measurable atmospheric perturbation and impacting the world temperature. More recently, Mount Etna in Italy displayed tens of paroxysmal explosive episodes affecting the air traffic, viability, settlements, environment, and economics. Over time, several studies have been devoted to understanding what drives paroxysmal explosive activity. Owning to the treating characteristics, so far great efforts have been made trying to detect precursory signals, parameterize the phenomena, apply conceptual and experimental models, and assess the associated hazards. Published papers have used (i) geophysical data aimed at constraining the source region (depth, size, and position), (ii) gas chemistry and mineral geochemistry and petrology to identify the driving force of explosions and characterize the nature of the involved magmas, (iii) volcanology data and observations as well as ground-based and satellite remote sensing to quantify the volumes of erupted products and track the eruptive process, and (iv) laboratory experiments and plume models to characterize the rheology of the erupted products and forecast the impact of the eruptive clouds on the environment, climate, and the whole planet. In this book, we present a collection of ten papers written by 67 authors spanning from seismicity and ground deformation to geochemistry, volcanology and other geophysical techniques applied to the characterization of paroxysms at several active volcanoes.

Encyclopedia of Geology, Second Edition presents in six volumes state-of-the-art reviews on the various aspects of geologic research, all of which have moved on considerably since the writing of the first edition. New areas of discussion

include extinctions, origins of life, plate tectonics and its influence on faunal provinces, new types of mineral and hydrocarbon deposits, new methods of dating rocks, and geological processes. Users will find this to be a fundamental resource for teachers and students of geology, as well as researchers and non-geology professionals seeking up-to-date reviews of geologic research. Provides a comprehensive and accessible one-stop shop for information on the subject of geology, explaining methodologies and technical jargon used in the field Highlights connections between geology and other physical and biological sciences, tackling research problems that span multiple fields Fills a critical gap of information in a field that has seen significant progress in past years Presents an ideal reference for a wide range of scientists in earth and environmental areas of study

National parks, wildlife refuges and sanctuaries, natural reserves, conservation areas, frontier lands, and marine-protected areas are increasingly recognized as essential providers of ecosystem services and biological resources. As debates about climate change and sustainability intensify, protected areas become more important as indicators of eco

Although geodetic monitoring techniques have been widely used in areas of seismic or volcanic activity, the difficulty inherent to their discrete nature means that they must be deployed carefully to ensure the best possible detection or sensitivity of these points (see e. g. , BALDI and UNGUENDOLI, 1987; JOHNSON and WYATT, 1994; SEGALL and MATTHEWS, 1997; Yu et al. , 2000). In many cases, a more global monitoring method, is required yet at the same time one that offers the highest level of sensitivity which enables detection of the phenomenon. Interferometry radar (InSAR) techniques have been shown to play an important role in seismic and volcanic monitoring because they cover large areas (100 x 100 km) and can be easily systematized in monitoring (see e. g. , MASSONNET and FEIGL, 1998; BDRGMANN et al. , 2000; MASSONNET and SIGMUNDSON, 2000; HANSSEN, 2001). The limitations inherent to the GPS and InSAR techniques (mainly observations at discrete surface points in the case of GPS and existence of non-coherent areas and the fact that, at present, the three displacement components cannot be obtained in SAR interferometry) can be overcome by using them together or other techniques (e. g. , PUGLISI and COLTELLI, 2001; RODRiGUEZ-VELASCO et al. , 2002; FERNANDEZ et al. , 2003).

A Complutense International Seminar on "Earth Sciences and Mathematics" was organised and held in Madrid at the Facultad de Ciencias Matemáticas of the Universidad Complutense de Madrid in September 2006. Scientists from both fields, Mathematics and Earth Sciences, took part in this International Seminar, addressing scientific problems related to our planet from clearly complementary approaches, seeking to gain and learn from this dual approach and proposing a closer collaboration in the near future. This volume is the second one of a Topical Issue on "Earth Sciences and Mathematics" and contains papers addressing different topics as analysis of InSAR time series, fuzzy classification for

remote sensing, modelling gravitational instabilities, geodynamical evolution of the Alboran Sea, statistical warning systems for volcanic hazards, analysis of solutions for the hydrological cycle, study of the ice flow, magma intrusion in elastic layered media, river channel formation, Hartley transform filters for continuous GPS, and deformation modeling.
"This volume addresses the impact of the geological sciences, from 1963-2013, in such areas as geologic hazards, mineral resources, energy resources, water resources, soil resources, geology and health, geologic education, and the informing of general public policy. The chapters focus on how earth science informs and benefits society"--Provided by publisher.
Geodesy is the science dealing with the determination of the position of points in space, the shape and gravity field of the Earth and with their time variations. This book collects 36 selected papers from the International Symposium on Geodetic Deformation Monitoring held in Jaén (Spain) from 17th to 19th March 2005. It contains a good overview of theoretical matters, models and results.
Volcanic and Igneous Plumbing Systems: Understanding Magma Transport, Storage, and Evolution in the Earth's Crust synthesizes research from various geoscience disciplines to examine volcanic and igneous plumbing systems (VIPS) in-depth. VIPS comprise a network of magma transport and storage features in the Earth’s crust. These features include dykes, sills and larger magma bodies that form the pathway and supply system of magma beneath active volcanoes. Combining basic principles with world-class research and informative illustrations, this unique reference presents a holistic view of each topic covered, including magma transport, magma chambers, tectonics and volcanism. Addressing a variety of approaches to these topics, this book offers researchers and academics in the Earth Science fields, such as geophysics, volcanology and igneous petrology the information they need to apply the information to their own disciplines. Provides an easily understandable overview of current research on volcanic and igneous plumbing systems Includes full color illustrations to increase understanding Covers fundamental information needed to optimize comprehension Features a field example from world-class research in each chapter, including photographs and maps
Volcanoes and eruptions are dramatic surface man telemetry and processing, and volcano-deformation ifestations of dynamic processes within the Earth, source models over the past three decades. There has mostly but not exclusively localized along the been a virtual explosion of volcano-geodesy studies boundaries of Earth's relentlessly shifting tectonic and in the modeling and interpretation of ground plates. Anyone who has witnessed volcanic activity deformation data. Nonetheless, other than selective, has to be impressed by the variety and complexity of brief summaries in journal articles and general visible eruptive phenomena. Equally complex, works on volcano-monitoring and hazards mitiga however, if not even more so, are the geophysical, tion (e. g. , UNESCO, 1972; Agnew, 1986; Scarpa geochemical, and

hydrothermal processes that occur and Tilling, 1996), a modern, comprehensive treat underground - commonly undetectable by the ment of volcano geodesy and its applications was human senses - before, during, and after eruptions. non-existent, until now. Experience at volcanoes worldwide has shown that, In the mid-1990s, when Daniel Dzurisin (DZ to at volcanoes with adequate instrumental monitor friends and colleagues) was serving as the Scientist ing, nearly all eruptions are preceded and accom in-Charge of the USGS Cascades Volcano Observa panied by measurable changes in the physical and tory (CVO), I first learned of his dream to write a (or) chemical state of the volcanic system. While book on volcano geodesy.

The two-volume set LNAI 11288 and 11289 constitutes the proceedings of the 17th Mexican International Conference on Artificial Intelligence, MICAI 2018, held in Guadalajara, Mexico, in October 2018. The total of 62 papers presented in these two volumes was carefully reviewed and selected from 149 submissions. The contributions are organized in topical as follows: Part I: evolutionary and nature-inspired intelligence; machine learning; fuzzy logic and uncertainty management. Part II: knowledge representation, reasoning, and optimization; natural language processing; and robotics and computer vision.

Due to their unique geophysical and geodynamic environment, both the Arctic and Antarctic polar regions are often utilized for geodetic and geophysical observations. This book is a collection of papers on various aspects of the scientific investigation and observation techniques of the polar regions at both temporary and permanent observatories. Most papers focus on regional models based on data acquired in polar regions. Geodetic satellite positions systems (GNSS: GPS, GLONASS, GALILEO) will also be discussed as well as other space techniques (DORIS, VLBI). Gravimetry, absolute gravimetry, and tidal gravimetry are also discussed, as well as seismology and meteorology. The book also touches on data analysis and geodynamic interpretation and discusses methods of constructing autonomous observatories.

This volume aims at providing answers to some puzzling questions concerning the formation and the behavior of collapse calderas by exploring our current understanding of these complex geological processes. Addressed are problems such as: - How do collapse calderas form? - What are the conditions to create fractures and slip along them to initiate caldera collapse and when are these conditions fulfilled? - How do these conditions relate to explosive volcanism? - Most products of large caldera-forming eruptions show evidence for pre-eruptive reheating. Is this a pre-requisite to produce large volume eruptions and large calderas? - What are the time-scales behind caldera processes? - How long does it take magma to reach conditions ripe enough to generate a caldera-forming eruption? - What is the mechanical behavior of magma chamber walls during caldera collapse? Elastic, viscoelastic, or rigid? - Do calderas form by underpressure

following a certain level of magma withdrawal from a reservoir, or by magma chamber loading due to deep doming (underplating), or both? - How to interpret unrest signals in active caldera systems? - How can we use information from caldera monitoring to forecast volcanic phenomena? In the form of 14 contributions from various disciplines this book samples the state-of-the-art of caldera studies and identifies still unresolved key issues that need dedicated cross-boundary and multidisciplinary efforts in the years to come. * International contributions from leading experts * Updates and informs on all the latest developments * Highlights hot topic areas and identifies and analyzes unresolved key issues This open access book summarizes the findings of the VUELCO project, a multi-disciplinary and cross-boundary research funded by the European Commission's 7th framework program. It comprises four broad topics: 1. The global significance of volcanic unrest 2. Geophysical and geochemical fingerprints of unrest and precursory activity 3. Magma dynamics leading to unrest phenomena 4. Bridging the gap between science and decision-making Volcanic unrest is a complex multi-hazard phenomenon. The fact that unrest may, or may not lead to an imminent eruption contributes significant uncertainty to short-term volcanic hazard and risk assessment. Although it is reasonable to assume that all eruptions are associated with precursory activity of some sort, the understanding of the causative links between subsurface processes, resulting unrest signals and imminent eruption is incomplete. When a volcano evolves from dormancy into a phase of unrest, important scientific, political and social questions need to be addressed. This book is aimed at graduate students, researchers of volcanic phenomena, professionals in volcanic hazard and risk assessment, observatory personnel, as well as emergency managers who wish to learn about the complex nature of volcanic unrest and how to utilize new findings to deal with unrest phenomena at scientific and emergency managing levels. This book is open access under a CC BY license.

This doctoral thesis applies measurements of ground deformation from satellite radar using their potential to play a key role in understanding volcanic and magmatic processes throughout the eruption cycle. However, making these measurements is often problematic, and the processes driving ground deformation are commonly poorly understood. These problems are approached in this thesis in the context of the Cascades Volcanic Arc. From a technical perspective, the thesis develops a new way of using regional-scale weather models to assess a priori the influence of atmospheric uncertainties on satellite measurements of volcano deformation, providing key parameters for volcano monitoring. Next, it presents detailed geodetic studies of two volcanoes in northern California: Medicine Lake Volcano and Lassen Volcanic Centre. Finally, the thesis combines geodetic constraints with petrological inputs to develop a thermal model of cooling magma intrusions. The novelty and range of topics covered in this thesis mean that it is a seminal work in volcanic and magmatic studies.

Piton de la Fournaise and Karthala are both shield volcanoes in the southwest Indian Ocean. This publication summarizes the

work done on these very active basaltic volcanoes. Piton de la Fournaise has a long history of scientific research and monitoring, with many data collected during recent eruptions. It is certainly one of the most studied volcanoes in the world. The work presented in this monograph includes geological, geophysical, geochemical and petrological aspects, but also studies on physical geography, natural hazards and the sociological and behavioural approaches.' The Karthala volcano may be less well known, but it serves as an interesting comparison to Piton de la Fournaise. Although situated close to the volcanoes of Hawaii, it differs from them by its more alkaline magmas and less frequent activity. It was also monitored for more than 25 years, producing extraordinary eruptions in recent years.

Synthetic Aperture Radar Interferometry (InSAR) is a powerful tool to measure surface deformation and is well suited for surveying active volcanoes using historical and existing satellites. However, the value and applicability of InSAR for geodynamic monitoring problems is limited by the influence of temporal decorrelation and electromagnetic path delay variations in the atmosphere, both of which reduce the sensitivity and accuracy of the technique. The aim of this PhD thesis research is: how to optimize the quantity and quality of deformation signals extracted from InSAR stacks that contain only a low number of images in order to facilitate volcano monitoring and the study of their geophysical signatures. In particular, the focus is on methods of mitigating atmospheric artifacts in interferograms by combining time-series InSAR techniques and external atmospheric delay maps derived by Numerical Weather Prediction (NWP) models. In the first chapter of the thesis, the potential of the NWP Weather Research & Forecasting (WRF) model for InSAR data correction has been studied extensively. Forecasted atmospheric delays derived from operational High Resolution Rapid Refresh for the Alaska region (HRRRAK) products have been compared to radiosonding measurements in the first chapter. The result suggests that the HRRR-AK operational products are a good data source for correcting atmospheric delays in spaceborne geodetic radar observations, if the geophysical signal to be observed is larger than 20 mm. In the second chapter, an advanced method for integrating NWP products into the time series InSAR workflow is developed. The efficiency of the algorithm is tested via simulated data experiments, which demonstrate the method outperforms other more conventional methods. In Chapter 3, a geophysical case study is performed by applying the developed algorithm to the active volcanoes of Unimak Island Alaska (Westdahl, Fisher and Shishaldin) for long term volcano deformation monitoring. The volcano source location at Westdahl is determined to be approx. 7 km below sea level and approx. 3.5 km north of the Westdahl peak. This study demonstrates that Fisher caldera has had continuous subsidence over more than 10 years and there is no evident deformation signal around Shishaldin peak.

The 1995 to present eruption of Soufrière Hills Volcano on Montserrat is one of the most important and best-studied eruptions of an explosive andesitic volcano. This volume presents scientific findings from the period between 2000 and 2010; it follows on from Memoir 21, which focused on the early years of activity between 1995 and 1999. In addition to descriptions and analysis of the growth, collapse and explosions associated with lava domes, there are papers on the deformation of the volcano caused by the deep magma, the petrology and geochemistry of the lavas and associated gases. Of particular note are: an overview of the

insights into the deep structure of the volcano that resulted from a major international seismic tomography experiment; and an analysis of the quantitative risk assessment process that has run now for most of the eruption, the longest such continuous assessment in the world.

Special Paper 498 contains 12 new scientific papers, assembled as part of an NSF-sponsored workshop in 2011. The work highlights study of persistently active volcanoes and their hazards, mostly in Central America. Such volcanoes are termed "open vents" by volcanologists, and they offer the chance to study active processes. Insight into how volcanoes work and how hazards might be mitigated are the goals of the work. Overall, the volume presents insight into hazards infrastructure collaborations and development for geoscientists and students.

Volcanic eruptions are common, with more than 50 volcanic eruptions in the United States alone in the past 31 years. These eruptions can have devastating economic and social consequences, even at great distances from the volcano. Fortunately many eruptions are preceded by unrest that can be detected using ground, airborne, and spaceborne instruments. Data from these instruments, combined with basic understanding of how volcanoes work, form the basis for forecasting eruptionsâ€"where, when, how big, how long, and the consequences. Accurate forecasts of the likelihood and magnitude of an eruption in a specified timeframe are rooted in a scientific understanding of the processes that govern the storage, ascent, and eruption of magma. Yet our understanding of volcanic systems is incomplete and biased by the limited number of volcanoes and eruption styles observed with advanced instrumentation. Volcanic Eruptions and Their Repose, Unrest, Precursors, and Timing identifies key science questions, research and observation priorities, and approaches for building a volcano science community capable of tackling them. This report presents goals for making major advances in volcano science.

Updates in Volcanology - From Volcano Modeling to Volcano Geology is a new book that is based on book chapters offered by various authors to provide a snapshot of current trends in volcanological researches. Following a short Introduction, the book consists of three sections, namely, "Understanding the Volcano System from Petrology, Geophysics to Large Scale Experiments," "Volcanic Eruptions and Their Impact to the Environment,' and "Volcanism in the Geological Record." These sections collect a total of 13 book chapters demonstrating clearly the research activity in volcanology from geophysical aspects of volcanic systems to their geological framework. Each chapter provides a comprehensive summary of their subject's current research directions. This book hence can equally be useful for students and researchers.

Earthquake and Volcano Deformation is the first textbook to present the mechanical models of earthquake and volcanic processes, emphasizing earth-surface deformations that can be compared with observations from Global Positioning System (GPS) receivers, Interferometric Radar (InSAR), and borehole strain- and tiltmeters. Paul Segall provides the physical and mathematical fundamentals for the models used to interpret deformation measurements near active faults and volcanic centers. Segall highlights analytical methods of continuum mechanics applied to problems of active crustal deformation. Topics include elastic dislocation theory in homogeneous and layered half-spaces, crack models of faults and planar intrusions, elastic fields due

to pressurized spherical and ellipsoidal magma chambers, time-dependent deformation resulting from faulting in an elastic layer overlying a viscoelastic half-space and related earthquake cycle models, poroelastic effects due to faulting and magma chamber inflation in a fluid-saturated crust, and the effects of gravity on deformation. He also explains changes in the gravitational field due to faulting and magmatic intrusion, effects of irregular surface topography and earth curvature, and modern concepts in rate- and state-dependent fault friction. This textbook presents sample calculations and compares model predictions against field data from seismic and volcanic settings from around the world. Earthquake and Volcano Deformation requires working knowledge of stress and strain, and advanced calculus. It is appropriate for advanced undergraduates and graduate students in geophysics, geology, and engineering. Professors: A supplementary Instructor's Manual is available for this book. It is restricted to teachers using the text in courses. For information on how to obtain a copy, refer to: http://press.princeton.edu/class_use/solutions.html

A Complutense International Seminar on "Earth Sciences and Mathematics" was organised and held in Madrid at the Facultad de Ciencias Matemáticas of the Universidad Complutense de Madrid September, 13th-15th, 2006. Scientists from both fields, Mathematics and Earth Sciences, took part in this International Seminar, addressing scientific problems related with our planet from clearly complementary approaches, seeking to gain and learn from this dual approach and proposing a closer collaboration in the near future. This volume is the first one of a Topical Issue on "Earth Sciences and Mathematics" and contains papers addressing different topics as deformation modelling applied to natural hazards, inverse gravimetric problem to determine 3D density structure, advanced differential SAR interferometry, climate change, geomagnetic field, Earthquake statistics, meteorological studies using satellite images, climate energy balance models, study of soils properties, and multifractal data sets.

It is widely recognized that the degree of development of a science is given by the transition from a mainly descriptive stage to a more quantitative stage. In this transition, qualitative interpretations (conceptual models) are complemented with quantification (numerical models, both, deterministic and stochastic). This has been the main task of mathematical geoscientists during the last forty years - to establish new frontiers and new challenges in the study and understanding of the natural world. Mathematics of Planet Earth comprises the proceedings of the International Association for Mathematical Geosciences Conference (IAMG2013), held in Madrid from September 2-6, 2013. The Conference addresses researchers, professionals and students. The proceedings contain more than 150 original contributions and give a multidisciplinary vision of mathematical geosciences.

The United States has more than 65 active or potentially active volcanoes, more than those of all other countries except Indonesia and Japan. During the twentieth century, volcanic eruptions in Alaska, California, Hawaii, and Washington devastated thousands of square kilometers of land, caused substantial economic and societal disruption and, in some instances, loss of life. More than 50 U.S. volcanoes have erupted one or more times in the past 200 years. Recently, there have been major advances in our understanding of how volcanoes work. This is partly because of detailed studies of eruptions and partly because of advances in global communications, remote sensing, and interdisciplinary cooperation. The mission of the Volcano Hazards Program (VHP) is to "lessen the harmful impacts of volcanic activity by monitoring active and potentially active volcanoes, assessing their hazards,

responding to volcanic crises, and conducting research on how volcanoes work." To provide a fresh perspective and guidance to the VHP about the future of the program, the Geologic and Water Resources Divisions of the United States Geological Survey (USGS) requested that the National Research Council conduct an independent and comprehensive review. Review of the U. S. Geological Survey's Volcano Hazards Program is organized around the three components of hazards mitigation. Chapter 2 deals with research and hazard assessment. Chapter 3 covers monitoring and Chapter 4 discusses crisis response and other forms of outreach conducted by the VHP. Chapter 5 describes various cross-cutting programmatic issues such as staffing levels, data formats, and partnerships. Chapter 6 offers a vision for the future of the Volcano Hazards Program, and Chapter 7 summarizes the conclusions and recommendations of the preceding chapters. Throughout the report, major conclusions are printed in italics and recommendations in bold type. The committee has written this report for several different audiences. The main audience is upper management within the USGS and the VHP. However, the committee believes that scientists within the VHP will also find the report valuable. The report is written in such a manner as to be useful to congressional staff as well.

Advances in Mapping from Remote Sensor Imagery: Techniques and Applications reviews some of the latest developments in remote sensing and information extraction techniques applicable to topographic and thematic mapping. Providing an interdisciplinary perspective, leading experts from around the world have contributed chapters examining state-of-the

Large-scale volcanic deformation recently detected by radar interferometry (InSAR) provides new information and thus new scientific challenges for understanding volcano-tectonic activity and magmatic systems. The destabilization of such a system at depth noticeably affects the surrounding environment through magma injection, ground displacement and volcanic eruptions. To determine the spatiotemporal evolution of the Lazufre volcanic area located in the central Andes, we combined short-term ground displacement acquired by InSAR with long-term geological observations. Ground displacement was first detected using InSAR in 1997. By 2008, this displacement affected 1800 km2 of the surface, an area comparable in size to the deformation observed at caldera systems. The original displacement was followed in 2000 by a second, small-scale, neighbouring deformation located on the Lastarria volcano. We performed a detailed analysis of the volcanic structures at Lazufre and found relationships with the volcano deformations observed with InSAR. We infer that these observations are both likely to be the surface expression of a long-lived magmatic system evolving at depth. It is not yet clear whether Lazufre may trigger larger unrest or volcanic eruptions; however, the second deformation detected at Lastarria and the clear increase of the large-scale deformation rate make this an area of particular interest for closer continuous monitoring.

A four-year seafloor geodetic study to measure vertical deformation on the submerged south flank of Kilauea volcano was conducted to monitor volcanic collapse on the active Hilina slump. The Hilina slump is a hazardous feature that has been the site of significant deformation, major earthquakes with ground cracking and associated tsunami in the past and will likely be so in the future. Monitoring current deformation on the seafloor has extended the geodetic measurements on the volcano. Because the majority of Kilauea is submerged, offshore measurements are important. I describe the techniques used to collect and process the

data and present the results of this first seafloor geodetic monitoring study on Kilauea. A new technique was developed to collect campaign-style pressure sensor measurements on the seafloor in a geologically active area. Measurements were collected on three research cruises. The effects of density, tide, atmospheric pressure, sea surface height and tilting of the sensors during data collection were accounted for when converting the pressures into depths of a series of seafloor monuments. The depths were compared from year to year using two different methods to calculate the vertical deformation on the seafloor. Results revealed a pattern of significant uplift of up to 9.0 +/- 2.4 cm/year on the midslope bench region of the Hilina slump and no significant vertical deformation seaward on the outer bench. Extensive modeling of the data yielded a series of best-fit models. These models were compared with previous models to either affirm or refute them. Previous models that required the offshore portion of the decollement to be locked have been refuted and a shallow fault source has been rejected as the main source generating the observed vertical deformation signal. Models requiring significant seaward slip on a deep decollement fault plane due to volcanic spreading have been affirmed. Our model requires a locked outer bench and significant seaward slip of 25.0 to 28.1 +/- 7.3 cm/year on the offshore portion of the decollement fault plane that continues between 24.8 and 27.0 +/- 0.5 km from the rift zone.
Since the publication of the first volume “Infrasound monitoring for atmospheric studies” published in 2010, significant advances were achieved in the fields of engineering, propagation modelling, and atmospheric remote sensing methods. The global infrasound network, which consists of the International Monitoring Network (IMS) for nuclear test ban verification completed by an increasing number of regional cluster arrays deployed around the globe, has evidenced an unprecedented potential for detecting, locating and characterizing various natural and man-made sources. In recent years, infrasound has evolved into a broad interdisciplinary field encompassing academic disciplines of geophysics and innovative technical and scientific developments. The advances in innovative ground-based instruments, including infrasound inversions for continuous observations of the stratosphere and mesosphere, provide useful insights into the geophysical source phenomenology and atmospheric processes involved. Systematic investigations into low-frequency infrasound signals and the development of complementary observational platforms point out new insights into the dynamics of the middle atmosphere which play a significant role in both tropospheric weather and climate. This monitoring system also provides continuous relevant information about natural hazards with high societal benefits, like on-going volcanic eruptions, surface earthquakes, meteorites or severe weather. With this new edition, researchers and students benefit from a comprehensive content of both fundamental and applied inter-disciplinary topics.
This monograph represents a sampling of the themes presented at the AGU Chapman Conference held in Waikoloa Beach on the Island of Hawai?i, August 20-24, 2012--
A comprehensive guide for students and researchers to the physical processes inside volcanoes that control eruption frequency, duration, and size.
Uncertainties are pervasive in natural hazards, and it is crucial to develop robust and meaningful approaches to characterize and communicate uncertainties to inform modeling efforts. In this monograph we provide a broad, cross-disciplinary overview of issues relating to

uncertainties faced in natural hazard and risk assessment. We introduce some basic tenets of uncertainty analysis, discuss issues related to communication and decision support, and offer numerous examples of analyses and modeling approaches that vary by context and scope. Contributors include scientists from across the full breath of the natural hazard scientific community, from those in real-time analysis of natural hazards to those in the research community from academia and government. Key themes and highlights include: Substantial breadth and depth of analysis in terms of the types of natural hazards addressed, the disciplinary perspectives represented, and the number of studies included Targeted, application-centered analyses with a focus on development and use of modeling techniques to address various sources of uncertainty Emphasis on the impacts of climate change on natural hazard processes and outcomes Recommendations for cross-disciplinary and science transfer across natural hazard sciences This volume will be an excellent resource for those interested in the current work on uncertainty classification/quantification and will document common and emergent research themes to allow all to learn from each other and build a more connected but still diverse and ever growing community of scientists.

Remote sensing data and methods are increasingly being implemented in assessments of volcanic processes and risk. This happens thanks to their capability to provide a spectrum of observation and measurement opportunities to accurately sense the dynamics, magnitude, frequency, and impacts of volcanic activity. This book includes research papers on the use of satellite, aerial, and ground-based remote sensing to detect thermal features and anomalies, investigate lava and pyroclastic flows, predict the flow path of lahars, measure gas emissions and plumes, and estimate ground deformation. The multi-disciplinary character of the approaches employed for volcano monitoring and the combination of a variety of sensor types, platforms, and methods that come out from the papers testify to the current scientific and technology trends toward multi-data and multi-sensor monitoring solutions. The added value of the papers lies in the demonstration of how remote sensing can improve our knowledge of volcanoes that pose a threat to local communities; back-analysis and critical revision of recent volcanic eruptions and unrest periods; and improvement of modeling and prediction methods. Therefore, the selected case studies also demonstrate the societal impact that this scientific discipline can potentially have on volcanic hazard and risk management.

Modern Earth System Monitoring represents a fundamental change in the way scientists study the Earth System. In Oceanography, for the past two centuries, ships have provided the platforms for observing. Expeditions on the continents and Earth’s poles are land-based analogues. Fundamental understanding of current systems, climate, natural hazards, and ecosystems has been greatly advanced. While these approaches have been remarkably successful, the need to establish measurements over time can only be made using Earth observations and observatories with exacting standards and continuous data. The 19 peer-reviewed contributions in this volume provide early insights into this emerging view of Earth in both space and time in which change is a critical component of our growing understanding. Published by the American Geophysical Union as part of the Geophysical Monograph Series, Volume 172 .The Kamchatka Peninsula and contiguous North Pacific Rim is among the most active regions in the world. Kamchatka itself contains 29 active volcanoes, 4 now in a state of semi-continuous eruption, and I has experienced 14 magnitude 7 or greater earthquakes since accurate recording began in 1962. At its heart is the uniquely acute subduction cusp where the Kamchatka and Aleutian Arcs and Emperor Seamount Chain meet. Volcanism and Subduction covers coupled magmatism and tectonics in this spectacular region, where the torn North Pacific slab dives into hot mantle. Senior Russian and American authors grapple with the dynamics of the cusp with perspectives from the west and east of it, respectively, while careful tephrostratigraphy yields a remarkably precise record of behavior of storied volcanoes such as Kliuchevskoi and Shiveluch. Towards the south, Japanese researchers elucidate subduction earthquake processes with unprecedented geodetic resolution. Looking

eastward, new insights on caldera formation, monitoring, and magma ascent are presented for the Aleutians. This is one of the first books of its kind printed in the English language. Students and scientists beginning research in the region will find in this book a useful context and introduction to the region's scientific leaders. Others who wish to apply lessons learned in the North Pacific to their areas of interest will find the volume a valuable reference.