

## Cooling the City: Integrating ground-based measurements with modeling scenarios to address urban heat stress among vulnerable populations.

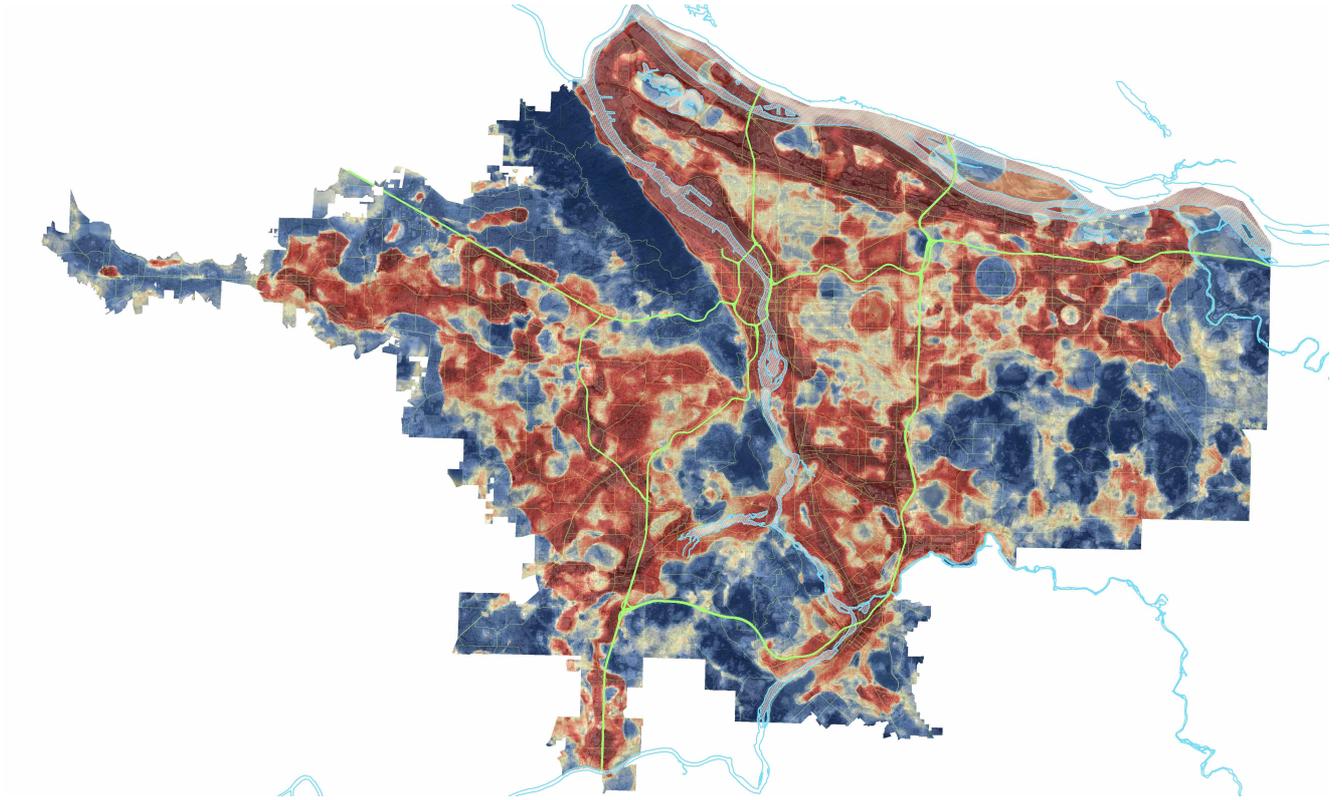
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The mounting evidence about the impacts of climate change on human health presents an urgent need to understand the implication of rising temperatures on the inhabitants of cities, where the majority of people now live. Acute increases in the magnitude, intensity, and duration of extreme weather events has the potential for causing major disruptions in commerce, social process, and human fatalities, especially among vulnerable populations (e.g. older adults, pre-existing health conditions, those with limited coping capacity). One such event is extreme heat, which causes more deaths across the globe per year than all other natural disasters combined. While numerous studies confirm and describe the creation of and processes that mediate urban heat islands (UHIs), few examine the opportunities for mediating microclimate through alternative physical design of the built environment. In this study, we ask two research questions: (1) what built environment characteristics help to explain the presence of UHIs? and (2) to what extent do alternative physical designs help to reduce ambient temperatures in UHIs? We address these questions by assessing the UHIs in the City of Portland, Oregon (USA) through a five stage research process. First, we conducted a series of vehicle-based temperature traverses to identify UHIs where vulnerability populations currently live. Second, we divided the city into 100m grid cells, and conducted a clustering analysis -- normal mixture modeling -- to define the built environment factors that help to explain the presence of UHIs in the study area. The land cover in the grid cells were further divided into seven distinct types of urban morphology. Third, using a computational fluid dynamic (CFD) model, ENVI-met, and a local weather station for calibration, we simulated the spatial distribution of temperature in all of the land cover categories. Fourth, we assessed, the extent to which modifications to the physical designs of the built environment, including land cover characteristics in the select sites would reduce temperatures. Finally, using the seven distinct types of urban morphology, we applied the promising modifications that provided the greatest reduction in ambient temperatures to rest of the city.

We found that six variables helped to predict over 90% of local variation in urban heat: percent canopy, percent vegetation, biomass density, mean building height, total building volume, building height standard deviation. While the canopy, vegetation, and biomass were negatively associated to heat intensity, and the building variables provided a net increase in local UHIs. We note that the seven types of urban morphologies encompass approximately 62% of the city -- the remaining 38% were a mix of multiple types. By exploring several modifications to the built environment, the ENVI-Met model demonstrated that the average temperature of study site can be decreased from 0.5 to 5.5oC by altering the ratios of green and grey infrastructure. Citywide, Highly promising options include increasing density of housing, while strategically introducing green infrastructure to development sites. In addition, by scaling up specific scenarios to the whole city we describe a patterns of development that can simultaneously reduce temperatures, while supporting the meeting many (although not all) development pressures.

Keywords: Urban Heat , Physical Design of Cities, Micro-climatology, Portland, Oregon (USA)



## Discovering Tourism Resources in the Two Fishing Villages of the Ozaki Peninsula in Kamaishi City, Iwate, Japan

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After the Great East Japan Earthquake of 2011, many reconstruction efforts have been developed, and new houses and commercial facilities were built in the tsunami-hit areas. The rebuilding of lives and businesses is being continued in some regions, but the local economy is deteriorating or stagnating in others. The Ozaki Peninsula is one of the peninsulas located at the Sanriku Coast, the large-scale ria coast in Kamaishi City in eastern Japan. Before the disaster, a regular service of excursion boats had commenced and many people visited the peninsula for trekking or sightseeing. However, the excursion boats were abolished, and the number of visitors to the peninsula decreased after the disaster. The Ozaki-Shirahama village consisting of around 130 households and the Sasu village consisting of 23 households on the peninsula have the same challenges and problems, and local residents are trying to find a way to revitalize the villages. For the past three years, the Ozaki Hyakunen Gakusya (Ozaki 100-year-old School) has been supporting the efforts of the local people and conducting walking events using nature trails. These events have been regarded by the people as a way to revitalize the villages since some of them participated in the events.

This study aims to support the revitalization of the villages, and twin objectives were set up. One is to discover tourism resources in the two fishing villages, and the other is to propose a new method to bring back visitors and help the area recover from the earthquake and tsunami disaster.

Door-to-door visits and interviews were employed to collect information on tourism resources as evaluated by the local people; field surveys were conducted in 2015 and 2016. Major subject matters of the interviews included: (1) use of the trail and regional resources in the past, (2) change in their lifestyle and livelihood, (3) history and folklore of past disasters, (4) things to pass down to the next generation, and (5) relationship with the other village. A tea ceremony and drinking parties were also held for facilitating participation of both females and males, and the contents of the conversations were recorded as memos.

The results indicated that the trail on the peninsula was used in school excursions, manganese ore mining, religious festivals, and that it was closely related to the lifestyle and livelihood of the local people. At the time of the disaster, all of them survived miraculously and fishery households provided victims with marine products as emergency supplies. Traditional customs such as boat festivals, the Kagura Dance, mutual support, and so on were expected to be passed down to future generations. The relationship between the two villages has always been competitive, but their individual lifestyles were identified. Through the field surveys, some maps and inventories that show the regional resources and historical issues were created. They are thought to be useful in discussing the possibility for expansion into the tourism industry.

Keywords: The Great East Japan Earthquake, tsunami, fishing village, trail, reconstruction



## Natural hazard impacts on transportation system in Russia

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The transportation system of the Russian Federation is one of the most extensive in the world. The safety of the transportation is among of the main goals of the national Transport Strategy of the country. In our study we investigate impacts of natural hazards on road and railway transportation. The road and railway infrastructure is exposed to impacts of various natural hazards and adverse weather conditions. The most dangerous of them are heavy rains, snowfalls, snowdrifts, floods, earthquakes, volcanic eruptions, landslides, snow avalanches, debris flows, rock falls, fog or icing roads, and some other natural factors that can trigger many accidents with victims and injuries. Using the data base of technological accidents that was created at the Faculty of Geography of the Lomonosov Moscow State University as well as statistics of the daily number of road accidents provided by the Russian traffic police and meteorological data, we analyze temporal variations and regional differences of the transport accidents' risk within the Russian federal regions and a contribution of various natural factors to occurrences of transport accidents.

The estimate of the weather impact on the car accidents number in Moscow is presented. Various weather phenomena and meteorological parameters that affect the increase and decrease in the number of car accidents in warm and cold seasons were identified; the extent of this influence was assessed. The weather conditions on the days with serious car accidents for 22 years period were considered. The daily numbers of accidents were compared with the weather conditions on the same days. During the cold season, there are much more weather events influencing the growth in the number of accidents than in the warm season. The snowfall intensity of more than 2 cm per day, the reduction in meteorological visibility, drizzle and snow storms lead to an increase of accident rate by 5–15%. The increase in the number of accidents happens in hot weather (maximum of air temperatures over +30 °C) during the warm season.

The 51% of the serious road accidents occur on the days with weak precipitation (less than 5 mm per day), 33% on the days with snow. The slippery road cover can be the reason of about third part of serious accidents: 30% of them occur on the days with transitions of air temperature through 0 °C, 28% on the days with glaze. The 82% of serious road accidents occur in the presence of complicated weather conditions during the cold season. During the warm period, about 50% of serious road accidents occur in the days with rain (27% of accidents on the days when it's intensity are less than 5 mm per day, and 23% - when more). The other weather factors are not significant. The 62% of serious road accidents occur in the presence of complicated weather conditions during the warm season.

More than 4.5% of all railway accidents recorded in the data base are triggered by different natural hazards or adverse weather conditions. During the study period of 1992-2015, railway accidents or violations of rail traffic under the influence of natural factors were recorded in 19 federal regions of Russia. Among of their triggers should be mentioned as follows: snow drifts, washout of railway lines as a result of heavy rains and flash floods, snow avalanches, rails deformation due to heat wave, landslides, debris flows, rockfalls, floods due to spring snowmelt, and some other natural phenomena.

Keywords: transportation safety, natural hazard impacts , adverse weather conditions, road and railway accidents, data base



# Intention to Use the National Park and Geopark for Disaster Risk Reduction: A Case Study of Sanriku Tsunami-hit Area

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Recovery is ongoing and the devastated scenery is gradually being improved in the tsunami-hit areas in the six-year period since the Great East Japan Earthquake and Tsunami of 2011. However, massive seawalls have been constructed along the coast for future tsunami disaster prevention, and it is feared that the beautiful natural scenery will disappear from the coastline of Japan. On the other hand, a new concept called “ecosystem-based disaster risk reduction (Eco-DRR)” is emerging internationally in recent years, and it seeks to reduce disaster risks by harnessing the disaster preventing/mitigating functions of ecosystems. In this, the Sanriku Reconstruction National Park (SRNP) has great potential in pioneering the practice of Eco-DRR in Japan. It is expected that the ecosystem of the area designated as a national park can mitigate the damage caused by natural disasters and also have a positive economic impact on the tsunami-hit areas. However, it might be difficult to understand the roles of ecosystems in disaster mitigation, as the concept might have been shared only within the expert community of researchers and administrative organizations. Hence, this study aims to: 1) share the knowledge and thoughts of local people in a meeting for discussing issues such as the roles of the SRNP and the method to assess the attractiveness of the area and 2) understand the prevailing awareness of Eco-DRR.

In order to understand the awareness of residents in a tsunami-hit area, a workshop on the roles played by the national park and geopark in disaster risk reduction (DRR) was held for the local residents, people involved in the tourism industry, government employees, and university students at Jyodogahama, located in the middle of the Sanriku seashore which is one of the best tourist sites in the national park. In this workshop, 26 participants were divided into three groups for discussion, and the contents of the discussions were recorded by cameras and IC recorders. In addition, one of the authors presided at the meeting and assigned one student to each group as a facilitator to ensure smooth progress of the discussion. Four points about the area were discussed: 1) its attraction and uniqueness; 2) the challenges and problems; 3) the roles played by the national park and geopark in DRR; 4) the way to convey its histories, attraction, and uniqueness. After the workshop, the contents were analyzed from the viewpoint of the speaker's attributes and the utterance order.

Some issues such as passing down of disaster histories, information provision, evacuation preparation, and raising of awareness for disaster prevention were thought to be key topics because they appeared repeatedly. On the other hand, few opinions and proposals regarding DRR mentioning the functions of natural environments such as disaster preventing forests and evacuation sites on hills were recorded. It implies that the local people had a shallow understanding of the roles of the ecosystem. Besides, marine products, natural scenery, and the unique landform were thought to be attractive as community resources for tourism promotion. Disaster issues were also thought of as important information to protect people who do not know the risks of tsunamis, and disaster education using this area for children and in-landers was regarded as necessary. From the viewpoint of the awareness of the local people, the relationship between nature conservation and DRR was not clearly found, but the importance of the natural environment and landform was perceived.

Keywords: Sanriku Reconstruction National Park, ecosystem-based disaster risk reduction, workshop



# Ecosystem service and the economical effect in the Sake brewery on the coastal sand system in Chiba Prefecture, Japan.

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### 1. Introduction

The coastal sand system is a buffer zone between the sea and the land, and a fresh water layer is 10 m underground before and after. Water from the fresh water layer has been used as the preparation water of sake breweries on the coastal sand system, and plays a role as an ecosystem service. The number of sake breweries on the coastal sand system in Chiba Prefecture, Japan was 59 in 1925, and was about six times compared to 2016. Moreover, in the Taisho era, the infrastructure did not advance, and the transportation did not develop. Therefore, the regional persons drank sake which was made in neighboring breweries. I presumed that sake breweries made sake utilizing rich natural coastal environments and were prosperous. However, there are no cases studied about the economic efficiency of the sake breweries. In this study, I examined about the economical efficiency of sake breweries that conducted brewing utilizing rich coastal nature.

### 2. The calculation methods

I translated the sales figures of sake breweries in 1921 into sales figures in 2016.

1 yen = 16,186.6667 yen (this price was calculated based on the price of rice)

<http://nenbetu.atukan.com/>

Tax payment = taxable sales × 0.08 (consumption tax) - taxable sales × 0.08 (consumption tax) × 0.7

(Deemed purchase rate: Manufacturing industry)

Taxable sales = Tax payment / 0.024

### 3. Result and Consideration

As a result, calculated sales figures of sake breweries in 2016 into those of sake breweries that were in Tokyo Bay side in 1921, two breweries made over 500 million yen. In other cases, two breweries made over 300 million yen, and five breweries made over 100 million yen. On the other hand, looking at the top sales (nationwide version) rank (Tokyo commence and industry Co., Ltd) of nationwide sake breweries in 2010, the number of breweries where sales were 100-500 million yen was 246 and accounted for 47% of the whole. The number of breweries where the sales were 500-1000 million yen was 42 and accounted for 8% of the whole. Compared to sales of sake breweries that were run in sturdy sites in 1921, two breweries with sales of 500 million yen or more were included in the top sales of 81 nationwide sake breweries. In conclusion, although there are differences in the background of the times, such as the favorite alcohol of the people in those days being limited to Japanese sake, I presume that the sake brewery conducted brewing utilizing the bounty of rich coastal nature and had an economic effect.

Keywords: Ecosystem Service, Coastal Sand System, Sales Figures, Japanese Sake Brewery, Economic Effect

# Dynamics of coastal sand dune system and their drivers in the Ishikari coast, Hokkaido, Japan

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The coastal sand dune system, which has its own ecosystems and landscapes, is known as a green infrastructure with their various ecosystem services. But most of all them were developed for agricultural and residential land-use in Japan. Ishikari coast in which located north part of Japan, Hokkaido, is one of the well preserved natural sandy coast in Japan, and still keeping coastal sand dune system in natural. However, data for elucidating the coastal ecosystem and their multi functions is insufficient, although there are many studies focused on each function of the coast. Therefore, in this research, we focused on whole system of the coastal sand dune system to clarify the dynamics of the coastal sand dune system and the drivers influenced them through a year at Ishikari coast.

The results of coastal dunes topography survey revealed that erosion and sedimentation has repeatedly occurred through a year. The changes of altitudes were 1 m or more, and horizontal positions of shoreline were 40 meters per year. The topographic change of the coastal dunes has occurred noticeable in the non-vegetation zone, i.e. beach area. But there was no periodic change or a common tendency between the sites.

The climate data of the Ishikari coast shows a clear seasonal change that the temperature is low and the strong sea breeze dominates in winter, but warm and calm wind from inland dominates in the summer. Therefore, it is inferred from the EC value of the soil that salt which moves to inland by the wind decreases in the summer season.

There was clear zonation of vegetation in coastal sand dune depend on the distance from shoreline, dune plants were on the seaward of the dunes and inland plants were on the stabilized dune. While inland plants could not grow near shoreline, dune plants were widely distributed on the dunes. But the coverage rate of dune plants was small on stable dunes because of shading by tall inland plants.

The Ishikari coast was found to be typical coastal sand dune system with resilience, which has a zonation structure of vegetation. Although the influence of the seasonal change of the surrounding weather on the vegetation and the behavior of the landform, the temporal wave attack like summer storm has changed shoreline and foredune. However, it was revealed that the amount of change is largely suppressed by the establishment of vegetation.

Keywords: coastal sand dune system , green infrastructure, ecosystem based disaster risk reduction, resilience

# The Great East Japan Earthquake's Impact on Human Society as Described in Haiku of 2012 and 2013

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## 1. Introduction

The magnitude 9.0 earthquake occurred on March 11, 2011, had severe impact on human society by the destruction of huge mass of living areas and taking away many lives. The psychological effects resulting from this disaster are still ongoing. The destruction of coastal settlements in Kesenuma has lost not only people but also their psychological support by the community. Before the earthquake, people made their living with rich bounty of sea and nature, the earthquake and tsunami left a deep sorrow and ineffable pain (Aoki, Fujita and Kumagai 2014). Even one or two years after, many people are yet suffering with serious injuries. When cherry blossom bloomed on damage trees felled, when the fish were landed in reconstructed fish markets, when volunteers and victims deepened their ties, people found their hope and were continuing to move forward, although still irritated in slow progress of reconstruction in the disaster areas. A great deal of reconstruction has already begun, but it will take longer time to complete it (photo). The current bustle of the city is caused by the activities of the migrant construction workers and their vehicles. A large amount of capital has been invested, but no one knows how long this will continue. After this investment ends, people should resume daily life with a focus on tourism and fisheries.

In order to record this impact of disaster, poets conducted a haiku meeting in Kesenuma Ocean on July 29, 2012 in the affected areas Kesenuma, and collected 1752 haiku from inland and abroad (Kesenuma Haiku Association 2012). And the July 28, 2013, they collected 1734 haiku. Many volunteers and donation promoted this haiku meeting (Kesenuma Haiku Association 2013). Here, we describe the impact left in the haiku.

## 2. Method of Study

Generally, understanding of haiku will be differed by the knowledge of the disaster and the taste of haiku selection. So, we employed two types of respondents, e.g. respondents of the disaster area and respondents of other areas. They read the haiku and counted the number of disaster haiku.

## 3. Results

In 2012, respondents of disaster area selected 642 haiku (Table 1) by more than one person. But 98 of these haiku were not selected by the respondents of other areas. On the other hand, other areas selected 680 haiku by more than one person, but 136 of those haiku were not selected by disaster area. So the selection of disaster haiku was different by the area. This showed the different knowledge among areas on the disaster. And there are many haiku selected by only one respondent (Table 2). This showed the difference among individual knowledge on the disaster. In 2013, the disaster area selected 370 haiku by more than one person, other areas selected 494. Since total numbers of haiku in two years has no big difference, the disaster haiku was reduced within a year. Selected haiku mostly showed the tragic events, but some showed pleasure of landing of bonito.

#### 4. Statistical analysis

From 2012 to 2013, the percentage of haiku composed by the disaster was decreased at the statistical significance level of 0.01 in all respondents (Table 3). Haiku recognized as to be composed by the disaster was decreased in all level (Table 4).

#### 5. Detailed comparison of appreciation among respondents

Generally, variety of the appreciation on haiku was formed by their experiences of disaster and their taste of haiku. Although some variety will exist, more than 10 persons selected the same haiku. In 2012, they selected 157 haiku and 45 in 2013. So we can say disaster haiku was found in this experiment. Those haiku were listed in table 5 and 6.

#### 6. Conclusion

6.1 Haiku has memorized the disaster areas by 157 in 2012 haiku data and 45 in 2013.

6.2 The appreciation of haiku was affected by the respondents' knowledge of disaster area and their taste of haiku.

6.3 We recognized haiku that can give empathy on many people and those haiku were listed.

Acknowledgements: Haiku Association of Kesenuma District, Haiku International Association and Mr. Richard JAMBOR were thanked.

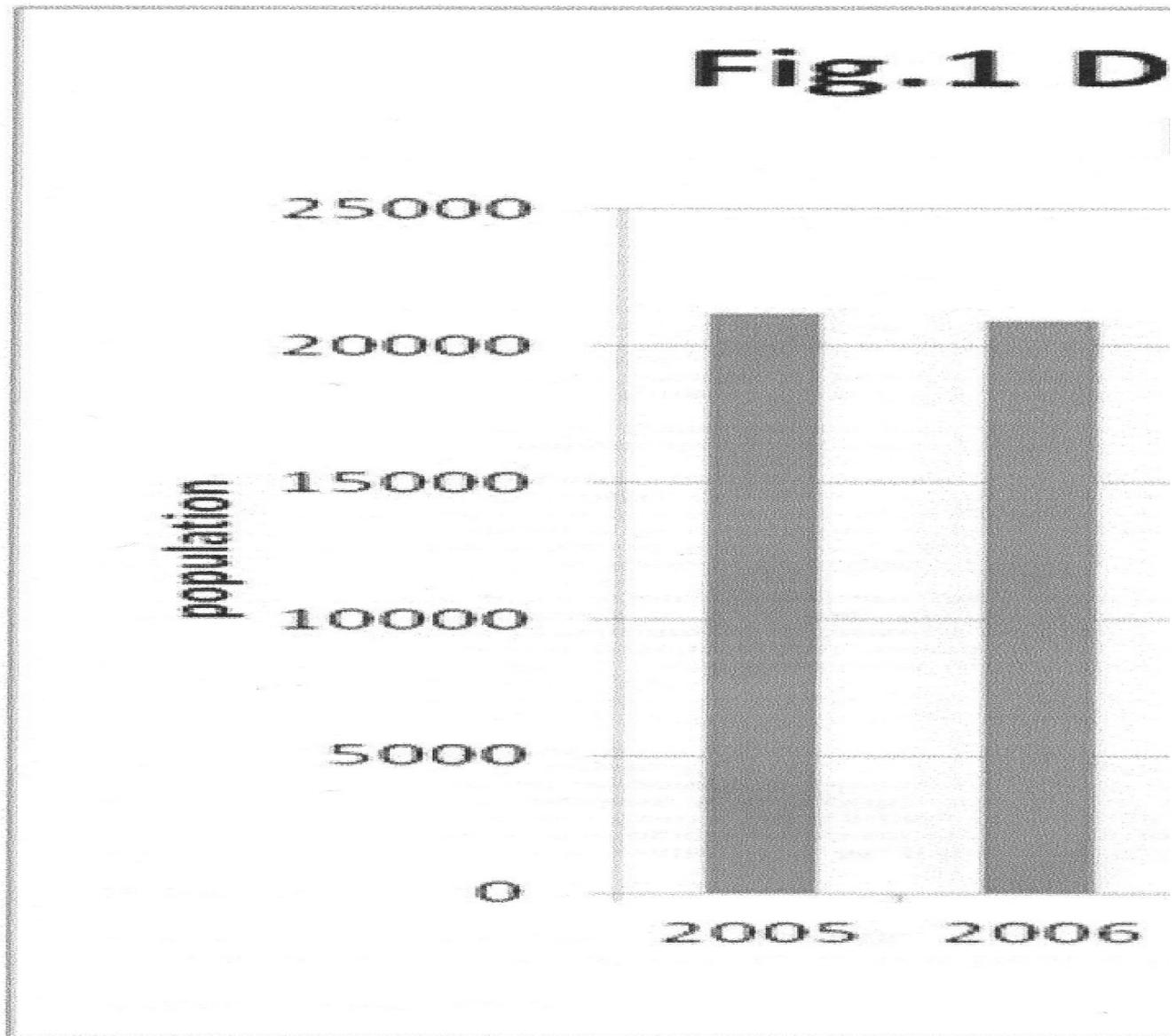
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Haiku Association of Kesenuma District (2013) Praying restoration 25th Haiku Contest of Kesenuma Sea, Book of haiku advanced collection, 1734 verses.

Keywords: The Great East Japan Earthquake, haiku, 2012-2013



# CHANGING PROPERTIES OF ARCHITECTURE BY MAJOR EARTHQUAKES THE FATIH MOSQUE, ISTANBUL, TURKEY

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Fatih Mosque was built (1462 –1470) Fatih Sultan Mehmet (Mehmet II) by the chief architect Atik Sinan. It is understood from the historical knowledge that; Fatih Mosque, one of the oldest and most important religious monuments of Istanbul, had to be renewed many times due to natural events like storms and hurricanes or manmade incidents such as fire. At the earthquake that happened in May 22, 1766, the main dome entirely collapsed, the walls heavily damaged, Imaret (soup kitchen) and the madrasas were ruined. The mosque was evaluated as irreparable and was decided to be rebuilt at the same place with a different plan and was started to be built in 1767. Fatih Mosque continued being affected by earthquakes and following the earthquake in July 10, 1894, the last impact was the earthquakes Kocaeli and Duzce in 1999. The major physical damages were cracks at the domes, minarets, tombs and the fountain yard and dislocation of the stones at other buildings of the complex. Fatih Mosque was renewed and consolidated. Maintenance was barely finished in 2013 and the mosque was reopened. Nowadays, the amendments at old madrasas and the walls that include the fountain are still in progress. In this study, in light of all information (references, pictures, etc.), the differences between the first and the last plan of the mosque and the negative or positive relations between the main structure and other additional parts will be evaluated. Furthermore, other geological and tectonic factors that cause Istanbul's important historical monument to be affected this much by earthquakes will be discussed. After all, the important fact is that; both the rebuilding and repairs supported by serious scientific studies done in recent years, provided a major contribution for this great monument in reaching to present with all its glory.

Keywords: Fatih Mosque , Istanbul, Massive Earthquakes

# CFD Modelling of the Local Effects of Caldera, Crater Walls and Windfield Variations on Trapping Potentially Harmful Volcanic Gases

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In the recent decades, progress in affordable computing capacity and the development of reliable computational fluid dynamics (CFD) solutions to solve high-resolution engineering issues have opened the possibilities to simulate environmental micro- to meso-scale fluids and solid-fluid processes with ease at an ever decreasing cost.

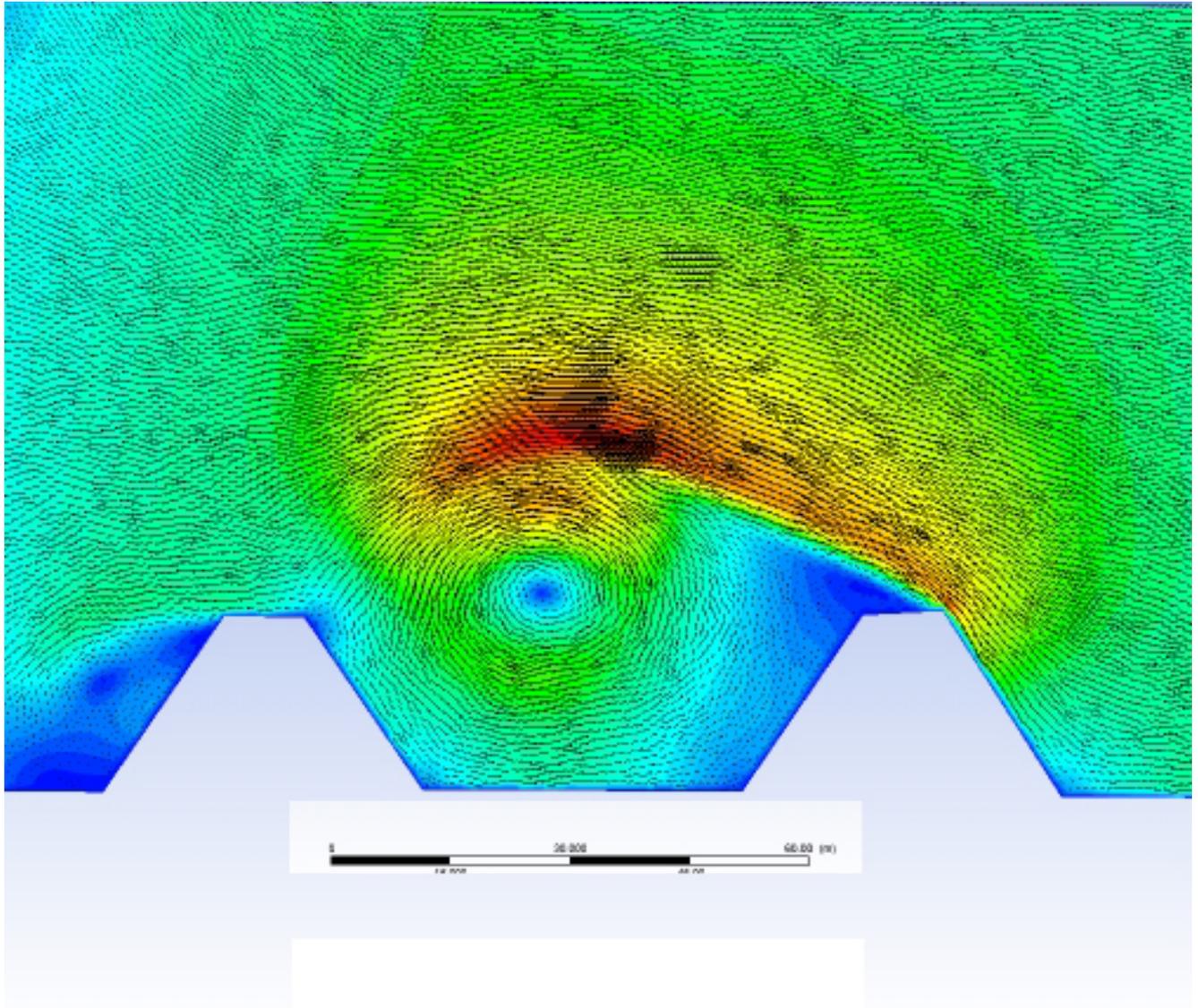
In the present contribution, the author assesses the role of volcanic crater morphometry on different windfields, in order to better understand the hazards that gases pose to local inhabitants and tourists. Indeed, eco-tourism and adventure tourism is bringing an ever increasing number of non-locals to various volcanoes, which aren't always sufficiently instrumented (i.e. the Kelut or Semeru and Tengger Caldera in Java, Indonesia).

The method uses the fluid dynamic solution FLUENT, recognized as one of the best and most reliable engineering software for CFD computing. The computation domain is a 2D 100 m length x 100 m height with the boundary conditions being the ground using consolidated ash material, the "outlets" controlled by pressure variation and the inlet controlled through a velocity field. The ground represents the caldera walls, which have been grown and reduced from 5 m height to 50 m height in order to experiment the effects of a change in the caldera/crater floor. The velocity field was also experimented with velocities from 10 m.s<sup>-1</sup> to 30 m.s<sup>-1</sup>.

The results have shown that the velocity field variation and the size of the caldera/crater have a direct incidence on the formation of dynamic eddies inside and outside the crater/caldera. Flow separation is most likely to occur at higher wind-speeds and deeper caldera/craters also create pool effects where rotating eddies can trap volcanic gases.

This simulation does not take into account the temperature inversions that often occur in topographic depressions, creating pools of cold air trapped in the topographic low. The air is considered to be at a constant temperature with a limited effect of ground heating from radiation.

Keywords: volcanic gases, hazards, computational fluid dynamics, volcanic vent, caldera, crater



## Evolution Mechanism of Karst Sinkhole in Wuhan City, China

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Based on analyzing of 29 karst sinkholes in Wuhan City, China, their system structure was determined from three elements, i.e. karst, cover and groundwater. The sinkholes mechanism of rainfall, drilling and pile constructing importing karst system was discussed by field monitoring and numerical simulating. The results are as follows:(i) the geological conditions developing sinkhole include of three aspects, cover structure is upper clay and lower sand, shallow karst is developed, and hydraulic connection between pore water - karst water is good; (ii) In natural environment, the cave in cover soil has two developing stage that is from hydraulic corrosion to stress failure;(iii) Drilling and pile constructing often trigger sinkhole that is from two aspects of structure changing, i.e. the covering soil has high hydraulic gradient at the moment of drill connecting pore water and karst water, the head difference of two groundwater is more than 15m during pile constructing.

Keywords: Covered karst, Sinkhole mechanism, Natural environment, Human activity

# Kamchatka and North Kurile Volcano Explosive Eruptions in 2016 and Danger to Aviation

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There are 36 active volcanoes in the Kamchatka and North Kurile, and several of them are continuously active. In 2016, five of the Kamchatkan volcanoes (Sheveluch, Klyuchevskoy, Bezymianny, Karymsky and Zhupanovsky) and three volcanoes of North Kurile (Alaid, Ebeko and Chikurachki) had strong and moderate explosive eruptions. Moderate gas-steam activity was observing of Kizimen, Avachinsky, Koryaksky, Gorely, Mutnovsky and other volcanoes.

Strong explosive eruptions of volcanoes are the most dangerous for aircraft because they can produce in a few hours or days to the atmosphere and the stratosphere till several cubic kilometers of volcanic ash and aerosols. Ash plumes and the clouds, depending on the power of the eruption, the strength and wind speed, can travel thousands of kilometers from the volcano for several days, remaining hazardous to aircraft, as the melting temperature of small particles of ash below the operating temperature of jet engines.

The eruptive activity of Sheveluch volcano began since 1980 (growth of the lava dome) and is continuing at present. Strong explosive events of the volcano occurred in 2016: on 10, and 29 January, 18, and 27 February, 23 March, 02 April, 02 May, 18 September, 09 and 19 December: ash plumes rose up to 10-12 km a.s.l. and extended more 2000 km to the different directions of the volcano. Strong and moderate hot avalanches from the lava dome were observing all year. Activity of the volcano was dangerous to international and local aviation.

Explosive-effusive eruption of Klyuchevskoy volcano lasted from 03 April till 06 November. Strombolian explosive volcanic activity began from 03 April, and on 23-24 April a lava flow began to effusing along the Apakhonchich chute on the southeastern flank of the volcano. Vulcanian activity of the volcano began from 02 May. Ash plumes rose up to 7-8 km a.s.l. and extended more 600 km to the different directions of the volcano. Activity of the volcano was dangerous to international and local aviation.

Extrusive-explosive-effusive eruption of Bezymianny volcano began from 05 December (extrusive phase) and probably continues (effusive phase). A moderate explosive phase probably occurred on 15 December –gas-steam plume containing some amount of ash drifted for about 118 km to the west of the volcano. Activity of the volcano was dangerous to local aviation.

Karymsky volcano has been in a state of explosive eruption since 1996, and this eruption finished on 10 October 2016. Ash plumes rose up to 4-5 km a.s.l. and extended more 300 km mainly to the eastern directions of the volcano in January-February. Activity of the volcano was dangerous to local aviation.

Explosive eruption of Zhupanovsky volcano began on 06 June, 2014, and finished 20 November, 2016. Explosions sent ash up to 8-10 km a.s.l. on 19, 21, and 24 January; 05, 07, 09, and 12 February; 24 March, and 20 November. Ash plumes extended for about 550 km mainly to the eastern directions of the volcano. Activity of the volcano was dangerous to international and local aviation.

Explosive-effusive eruption of Alaid volcano occurred from 01 October, 2015, till 10 August 2016. Ash plumes extended for about 260 km from the volcano in February-April. Lava flow effused on the south-western flank of the volcano (for about 400 m). Activity of the volcano was dangerous to local aviation.

The moderate explosive events at the Ebeko volcano with burst of ash up to 2.6 km a.s.l. occurred on 19-20 October, 08, 11-17, 19-20 and 28-30 November, 8-10, and 12-14, 17, 19-27 and 31 December.

Activity of the volcano was dangerous to local aviation.

The eruptive activity of Chikurachki volcano occurred on 28-31 March; 27 July; 17-19, and 30 August.

Explosions sent ash up to 4 km a.s.l., and ash plumes drifted to the different directions from the volcano.

Activity of the volcano was dangerous to local aviation.

Keywords: volcano, eruption, Kamchatka and Kurile