e-ASIA Joint Research Program
Final Report

1. Project title : Development of Information Gathering and Utilization Systems using small UAV for Disaster Risk Assessment, Monitoring and Response

2. Joint Research period : August 1, 2016 ～ March 31, 2020

3. Research Team :

■ **Japan team** (up to 6 people including the Principal Investigator)
Funding period: August 1, 2016 – March 31, 2020
Total Funded Amount (in Local Currency): 35,100,000 JPY

	Name	Position	Affiliation	Role in the project
PI	Hiroshi Inoue	Principal Research Fellow	National Research Institute for Earth Science and Disaster Resilience	Development of UAV System
Collaborator	Takahiro Miwa	Principal Researchner	National Research Institute for Earth Science and Disaster Resilience	Application of UAV to volcano monitoring
Collaborator	Hiromichi Fukui	Professor	International Digital Earth Applied Science Research Center, Chubu University	Development of Aerial Image data utilization system
Collaborator	Satoru Sugita	Lecturer	International Digital Earth Applied Science Research Center, Chubu University	Development of Aerial Image data utilization system
Collaborator	Man Duc Chuk	Student	International Digital Earth Applied Science Research Center, Chubu University	Development of Aerial Image data utilization system
Total number of participants including students: 5				

■ **Philippines team** (up to 6 people including the Principal Investigator)
Funding period: October 1, 2016 – May 30, 2020
Total Funded Amount (in Local Currency): 3,359,200 PHP (PCIEERD) and 1,500,000 PHP (PHIVOLCS)

	Name	Position	Affiliation	Role in the project
PI	Bartolome C. Bautista	Deputy Director	Philippine Institute of Volcanology and Seismology	Project Leader, Leads PHIVOLCS Team in the development and completion of the project.
Collaborator	Arturo S. Daag	Chief Science Research	Philippine Institute of Volcanology	Senior member of the project, assist projects

		Specialist	and Seismology	leader and members in project activities
Collaborator	Daniel Buhay	Science Research Specialist 2	Philippine Institute of Volcanology and Seismology	Overall coordinator of project activities, in charge of UAV application in earthquake-related program
Collaborator	Dave Emerenciana	Science Research Specialist 1	Philippine Institute of Volcanology and Seismology	In charge of electronic parts on the assembly and development of drone
Collaborator	Johnlery P. Deximo	Science Research Specialist 1	Philippine Institute of Volcanology and Seismology	In charge of UAV application in risk-related program
Collaborator	Julius M. Galdiano	Science Research Specialist 1	Philippine Institute of Volcanology and Seismology	In charge of UAV application in tsunami-related program
Collaborator	Robjuneliea aa Lim	Science Research Specialist 1	Philippine Institute of Volcanology and Seismology	In charge of UAV application in volcano-related program
Collaborator	Robelyn Mangahas	Science Research Specialist 1	Philippine Institute of Volcanology and Seismology	In charge of UAV application in tsunami-related program
Collaborator	Emmanuel Mitiam	Science Research Analyst	Philippine Institute of Volcanology and Seismology	In charge of UAV parts purchase and assembly
Total number of participants including students: 9				

■ **Thailand team** (up to 6 people including the Principal Investigator)
Funding period: October, 26,2016 – October, 25, 2019
Total Funded Amount (in Local Currency): 3,000,000 THB

	Name	Position	Affiliation	Role in the project
PI	Wutthiphat Covanich	Senior Researcher	National Electronics and Computer Technology Center (NECTEC)	Development of UAV system and post process software
Collaborator	Kanokvate Tungpimolrut	Principal Researcher	National Electronics and Computer Technology Center (NECTEC)	Advisor and consultant
Collaborator	Kittipong Ekkachai	Senior Researcher	National Electronics and Computer Technology Center (NECTEC)	Development of UAV system
Collaborator	Vitvasin Vimolmongkolporn	Research Assistant	National Electronics and Computer Technology Center (NECTEC)	Development of UAV system
Collab	Satawat Prak	Research	National Electronics	Development of UA

orator	ancharoen	Assistant	and Computer Technology Center (NECTEC)	V system
Collaborator	Teesid Leelasawassuk	Researcher	National Electronics and Computer Technology Center (NECTEC)	Development of image processing algorithm for post process software
Total number of participants including students: 6				

Vietnam team (up to 6 people including the Principal Investigator)
Funding : In-kind

	Name	Position	Affiliation	Role in the project
PI	Bui Quang Hung	Center Director	FIMO Center, Vietnam National University	Leads FIMO Team in the development and completion of the projects.
Collaborator	Ha Duc Van	Researcher	FIMO Center, Vietnam National University	Reconstruct 3D models from UAV images and point cloud.
Collaborator	Phan Anh	Researcher	FIMO Center, Vietnam National University	Development of flood monitoring system using UAV images
Collaborator	Hoang Xuan Phuong	Researcher	FIMO Center, Vietnam National University	Development of forest fire monitoring system using UAV images
Collaborator	Luu Quang Thang	Researcher	FIMO Center, Vietnam National University	Development of forest fire monitoring system using UAV images
Collaborator	Pham Van Ha	Researcher	FIMO Center, Vietnam National University	Reconstruct 3D models from UAV images and point cloud.
Total number of participants including students: 6				

Indonesia team (up to 6 people including the Principal Investigator)
Funding : In-kind

	Name	Position	Affiliation	Role in the project
PI	Eko Yulianto	Director	Research Center for Geotechnology, Indonesian Institute of Sciences	PI
Collaborator	Mudrik, Rahmawan Daryono	Researcher	Research Center for Geotechnology,	Actove fault mapping

			Indonesian Institute of Sciences	
Collaborator	Wawan Hendriawan Nur	Researcher	Research Center for Geotechnology, Indonesian Institute of Sciences	Geodatabase Disaster Risk Model, GIS and Spatial Planning
Collaborator	Bamban Setiadi	Researcher	Research Center for Geotechnology, Indonesian Institute of Sciences	Remote sensing
Collaborator	Afnindar	Researcher	Research Center for Geotechnology, Indonesian Institute of Sciences	Spacial Information System
Collaborator				
Total number of participants including students: 5				

4. Summary of the joint research (*up to 4 pages for section 4. to 6. including figures.*)

WP 1: UAV system development and evaluation
WP 2: Data management System
WP 3: System introduction package
WP 4: Applications

4-1 Japan; WP1, 2, 3, and 4

NIED coordinates the entire project and organized six e-ASIA UAV workshops, September 2016 in Japan, April 2017 in the Philippines, November 2017 in Vietnam, and July 2018 in Indonesia, January 2019 in Thailand, September 2019 in Japan, hosted by each country member.

NIED developed a fixed wing UAV system based on aircraft models 1) Skywalker X-5, a flying wing with 120cm wingspan, and 2) X-UAV MiniTalon, a V-tail plane with 130cm wing span. NIED tested them to fly 120 km in 120 minute and 140km in 140 minutes, respectively. X-5 was tested at Mt.Fuji for climbing 2700m altitude difference, which enables safe flight from the foot to the summit of all volcanoes in Japan except Mt.Fuji (3776m). A method of landing by hand-held net and parachute were developed to reduce the chance of damage at landing. MiniTalon was modified to Quad Plane, a Vertical Take-Off and Landing(VTOL) plane, a hybrid aircraft of quad copter, using FPV racing drone parts. The VTOL plane enabled even easier take-off and safe and precise landing. The maximum flight range was reduced to about a half of the original plane, but 70 km flight range is more than enough for most applications. The aircrafts were also tested to fly in heavy rain and snow and proven to be utilized in all weather conditions for impact assessment of disasters.

Experiments to monitor volcano craters in Japan, at Yakedake, Sakurajima, Izu-Oshima, Tokachi-dake, were conducted by using the planes. It was also utilized for geomorphological studies of Japanese mountains with an altitude of 3000m, and glacier studies of Nepal Himalaya with an altitude of 5000m.

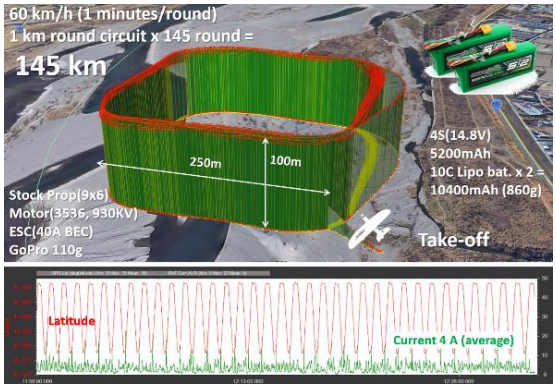
NIED held hands-on workshops of building fixed-wing drones in Thailand, Philippines, and Vietnam, to initiate the development and applications of drones for the project member countries. Workshop and seminars were also held at AIT in Bangkok, in Tonga, and in Bhutan as dissemination part of the project. NIED technically assisted fixed wing UAV development and experiments in the Philippines.

Chubu University and NIED, in collaboration with Digital Earth Lab., developed an 'Oblique Photo Browser' and 'Vertical Photo Placer' to utilize aerial photos for quick impact assessment of disasters. The Vertical Photo Placer provides a crude orthomosaic photos on GIS map without any image processing. Oblique Photo Browser enables the user to map the footprint of the photos, to sort and extract photos which show a particular point on the ground on the map, and to browse the extracted photos superimposed on the map to investigate the damage.

Chubu University examined a method for integrating UAV, satellite and aerial images, by comparing and prototyping of representation of multiple image

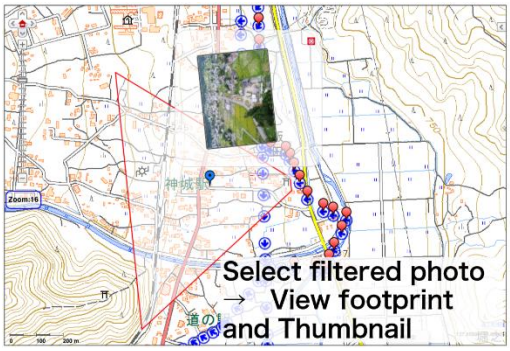
sources, real-time monitoring data and statistical data, basic map data, and examined integration of integrated processing method into a package for the purposes of quick disaster responses.

NIED and Chubu University conducted experimental introduction of UAV systems to seven local governments and two fire departments in southern Mie Prefecture to be prepared for great Nankai Trough Earthquake and Tsunami and year-round heavy rains. The Vertial Photo Placer and Oblique Photo Browser was introduced to the disaster information management system of Minami-Ise town.

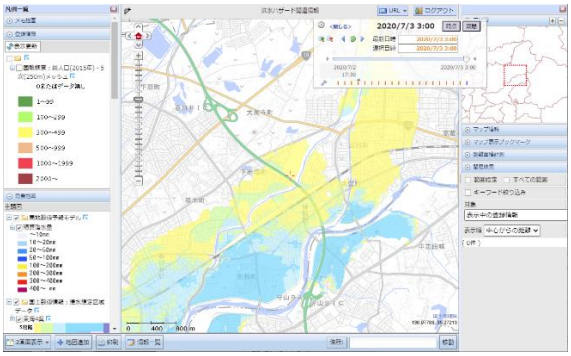


145 km flight range test by NIED

Long range Quad Plane by NIED



Oblique Photo Browser by Chubu Univ.



Risk Information Platform by Chubu Univ.

4-2 Thailand; WP2, 3 and 4

4-2 Thailand; WP2, 3 and 4

Thai NECTEC discussed with the Forestry Offices to conclude that UAVs should be used to pinpoint wild-fires in timely manner to minimize the damages, because the smaller fire is the easier to manage. NECTEC assembled a fixed wing UAV Skywalker X8 with two cameras, one mobile phone and an FPV system. The UAV meets the minimum requirements of 20km flight range to take photos with GPS locations.

NECTEC developed a post flight patrolling software. A UAV video is played back on one window with the GPS location, heading and the flight path on another window. The forestry officer can have almost the same information as they patrol the forest on helicopter to look for wild-fires.

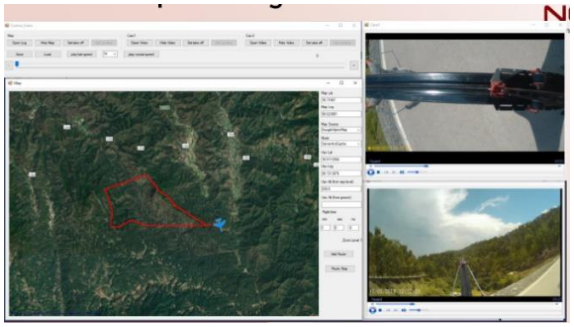
NECTEC made test flights at Oob Khan National Park in Chiang mai in May 2018. The results is summarized as a) the fixed-wing UAV achieved 20km flight range as planned, b) the communication range between the UAV and ground control station is more than 10km line of sight, c) it is not easy to find open space in the park for take-off and landing, d) it is not easy to take-off and land without such wide and open spaces, e) usable period of UAV is largely limited by wind and rain conditions, f) data acquired by UAV is good enough for monitoring wild fire, g) Department of National Parks, Wildlife and Plant Conservation would like to setup a UAV team, and h) there was no wild-fire during the test period and NECTED will improve the system in the peak wild-fire season from February to April in 2019.

NECTEC revised and improved fixed wing UAV (Skywalker x8) so its flight range was increased. The final version of NECTEC UAV managed to fly 76km and ascend 900m in 60 minute flight with 35% battery left. Because of the additional range, only one take off site was required in order to have the UAV to cover the whole area of Oob Khan notional park in Chiang Mai. Unfortunately, the prototype VTOL UAV was not reliable enough to be used in field test.

In addition, the post flight patrolling software was further improved so that it supported multiple videos from one flight. Moreover, a number of features and functions were added to ease the process of configuring the software and detecting wild fire.

The system was tested again in February 2019. A total of 6 flights were performed in the time span of 3 days to cover the whole area of national park. It was shown that the park ranger can identify a number of wild fire using the post flight patrolling software during the test. In addition, the video of the surrounding area was very valuable information for wild fire damage minimization planning. In January 2020, the system was used again to collect aerial video to be used as supporting data to help define the boundary of the national park and tourism.


X8 drone on catapult drone by NECTEC


Post-flight software by NECTEC

4-3 Philippines; WP3 and WP4

PHIVOLCS acquired two units of quadcopters and used to document recent events of lahars, landslides and earthquakes. PHIVOLCS hosted the 2nd e-ASIA UAV workshop in Manila in April, 2017. UAVs were used to map and document impacts of earthquake and volcanic eruption events (e.g., M6.7 10 February 217 Surigao del Norte Earthquake, 13 January 2018 Mayon Volcano Eruption, etc.). PHIVOLCS built capacity of staff to assemble and operate a cost-effective

fixed-wing plane Skywalker X5. A comprehensive manual for assembling the plane is made. A photogrammetric software Agisoft PhotoScan was familiarized and a simple DSM database was developed.

Two experiments in volcano crater mission were conducted. The fixed wing drones reached the summit crater of Taal Volcano in April 2017 and Mayon Volcano in August 2017, and photos and videos were collected. Oblique photography for exposure database development was tested in a shoreline community of Albay in August 2017. A splash-proof type of the plane was tested on Taal lake in June 2018 to address the problem of landing.

Local Government Unit officers of Albay, Quezon, and Batangas Provinces are being involved in the conduct of UAV test flights as part of promoting potential users of UAV in Disaster Risk Reduction (DRR) activities.

The eruption of Mayon Volcano from January to March 2018 produced pyroclastic density current and lava flows. To estimate the new deposits, a total of 36 UAV missions were deployed and produced a total of 24 DEMs. Another project in Mayon that focused on lahar studies utilized UAV to study the lahar channels, lahar events and its impact that occurred in Mayon in late 2019.

Several UAV applications were used to rapidly assess the impacts on several large destructive earthquakes. Impacts ranges from mapping and documenting ground rupture, liquefaction, earthquake-induced landslides and damage to buildings. These events are the following: 22 April 2019 Ms6.1 Central Luzon Earthquake; 27 July 2019 Ms 5.4,5.9 and 5.8 series of EQ in Itbayat, Batanes; and October 2019, Ms 6.3,6.1 and 6.5 series of earthquake in Cotobato.

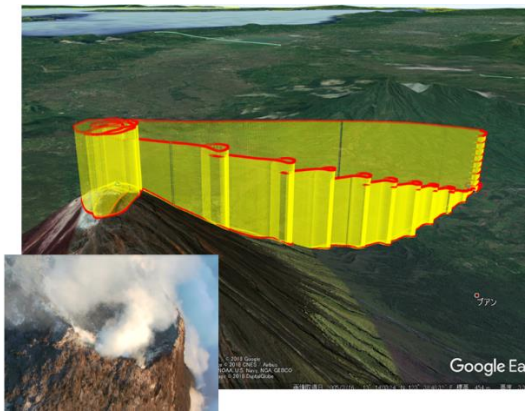
In December 2018, PHIVOLCS organized the 1st Fixed-wing UAV Assembly and Operations Workshop for the three Local Government Units and DOST Collaborators. Likewise, in December 2018 PHIVOLCS started building modified fixed wing with vertical take-off and landing capability and this was tested in Angeles City Flying Club tarmac. This was followed by a PHIVOLCS in-house assembly training in April 2019.

In August 2019, PHIVOLCS had a following training that conducted a UAV VTOL quad-plane assembly and operations workshop in Albay, Legaspi which was participated by five Local Government Units. Three mini-talon quad-plane were successfully assembled and subjected to test flight as part of the mission and operations training.

Several PHIVOLVS UAV team members were able to acquire Operators License from Civil Aviation Authority of the Philippines (CAAP), a regulatory government agency that issues operators' license for AUV.

Papers related to the UAV project were presented in Dec 2018 and 2019 in the annual Geological Congress in the Philippines.

UAV workshop for Philippines LGUs



Mayon volcano mission by PHIVOLCS

4-4 Vietnam; WP4 (in-kind participation)

FIMO center of VNU hosted the 3rd e-ASIA UAV workshop in Hanoi in November 30 to December 1, 2017, after a drone building workshop by NIED. VNU conducted a research to extract feature of building footprint and trees from aerial image to reconstruct 3D models with different levels of detail, which is needed for infrastructure monitoring during disasters. VNU developed a web application for 3D model visualization for monitoring disaster and urban planning. VNU applied a method to classify land cover by schematic segmentation of the integrated satellite and UAV images.

In recent 16 years in Vietnam, there have been around 1170 forest fires with 6234 ha of forests lost each year. Therefore, there is an urgent need in forest fire monitoring and early warning. In 2018, FIMO started developing a Vietnamese forest fire monitoring system in collaboration with Forest Protection Department for the Trang An Scenic Landscape Complex.

Solution for forest fire early warning in the Complex is to develop an algorithm based on historical data of forest fire in relation to temperature, rainfall, humidity from satellite image. Spatial analysis is used to study the impact factors. The system also makes a risk map for the year 2020 and near real-time monitoring using satellite images and sensor network in the field. UAV flight is used to check in case of high risk and inform the local government, fire police, and local people.

Solution for Illegal Cutting Monitoring in the complex is to detect land cover anomaly by satellite images and deep learning to launch UAV to obtain higher resolution pictures to dispatch forest guards


e-ASIA UAV workshop in Vietnam


VNU Guest House 3D reconstruct

4-5 Indonesia, WP4 (in-kind participation)

Research Center for Geotechnology LIPI hosted 4th e-ASIA workshop on 2-3 July, 2018, inviting Volcanology and Geological Agency who reported the use of UAVs. LIPI reported UAV utilization for mapping Lembang Fault and Synthetic Aperture Radar. The field trip was conducted to visit Tebing Keraton to observe Lembang Fault, and to visit Kawah Ratu Gunung - Tangkuban Perahu.

LIPI applied UAV imagery data process for flood and drought monitoring in Central Java. LIPI also applied UAV to support active fault detection Palu-Koro Fault System, Slawlasi, Indonesia

5. Outputs and Anticipated Outcomes of Joint Research

5-1 Scientific achievements and implemented activities of the joint research

The project developed long-range fixed wing UAVs and imagery processing tools for practical use in the field of disaster operated by general users. PHIVOLCS applied the developed UAVs to map volcano, coastal topography and earthquake faults and published scientific results to the papers. The teams experimentally introduced UAVs to operational organizations and local governments for monitoring and impact responses of disaster.

5-2 Synergistic effects of the international joint research

Sharing good practices on the development of UAV were acquired and utilized by the members. New skills and techniques in drone development, and applications, constraints and requirements were shared during annual workshop.

5-3 Broader impacts including contribution to society

Involvement of Local Government Units and operational agencies, such as forest department, in series of training workshop is a good achievement. They will apply the technology in their tasks such as risk inventory, mapping of resources, tourism, illegal land use, etc.

5-4 Development and sustainability of the cooperation

Acquired technical capacities in this project will continue, since application of UAVs has been a mainstream component when doing volcano monitoring, eq impact documentation and mapping.

6. Future Goals and Plan of Activities after the project period

NIED continue to improve the performance of UAV. NIED and Chubu University will integrate RTK GNSS to the UAV for more precise mapping, continue activities to implement the systems to selected local governments in Japan, and also in the Philippines in collaboration with PHIVOLCS. The projects are supported by an aXis program funded by JST in 2020. NIED and Chubu University plan to cooperate with a private company to commercialize the UAV to implement the systems to Japanese local governments, and with Asian Institute of Technology (AIT) to those in Asian countries.

Thai NECTEC will further revise the post flight software for other applications such as solar farm inspection and so on. It is expected that the knowledge gain during the project will be applied to industrial applications in Thai as it is more sustainable in long term.

Philippines PHIVOLCS will continue to apply UAVs to active faults mapping, lahar mapping, tsunami hazard and risk assessment, and volcano monitoring, and introduce the system to local governments. PHIVOLCS will cooperate with NIED and Chubu University to develop and apply RTK GNSS on UAV to deliver higher accuracy maps and DTMs for volcano and landslade monitoring in the Philippines.

7. Scientific Achievements and Implemented Activities (Publication, Research Exchange, Workshop, etc.)

For this item, please fill in the attached Excel file.

8. Recommendations and Comments to the Program

UAV technology is continuing to develop. There should be a continuous collaboration among the e-Asia partners to have such best practices sharing. It is desirable to have follow-up workshop sessions to engage our continuous development and partnership.

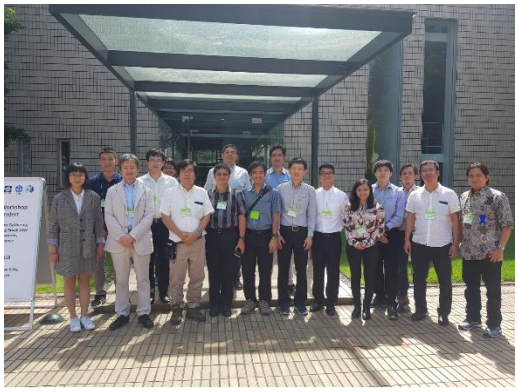
Participation of in-kind contributors was not fully functioning. It may be due to the poor coordination by the project, but partially due to the funding system itself. Obligations of in-kind participants to the project and to the funding agency should be clarified in the call for proposals. No participants is expected if they have large obligation without funding, but no output is expected if there is no obligation.

9. Others (agenda of workshop, photos of research teams, meetings, and etc.)

6th e-Aasia UAV workshop in Chubu University, Japan on September 9, 2019

9:30	Opening addresses Prof. Hiromichi Fukui, Chubu Univ.
9:40	Photo Session
9:45	1) Overview of e-ASIA UAV project

	Hiroshi Inoue(NIED) 15 min
10:00	Japan report(NIED, Chubu Univ.) 60 m in 2) Overview of Japan team's achievement, Hiroshi Inoue, NIED (4 min) 3) Development of long-range small fixed wing system for monitoring disasters, Hiroshi Inoue, NIED (14 min + 3 min) 4) Development and Implementation of Oblique Photo Browser, Satoru Sugita, Chubu University (14 min + 3 min) 5) Development of Vertical Photo Placer, Man Duc Chuc, Chubu University/VNU (9 min + 2 min) 6) Visualization Platform of Multiscale Spatial Information, Hiromichi Fukui, Chubu University (9 min + 2 min)
11:00	Thailand report(NECTEC) 60 min 7) Overview of Thailand team's achievement, Wutthiphat Covanich, NECTEC (7min + 3min) 8) Development of long range UAV and flight procedure for wild-fire monitoring, Vitvasin Vimolmongkolporn and Satawat Prakancharoen (30min + 5min) 9) Development of post flight software for wild-fire monitoring, Wutthiphat Covanich (15min + 5 min)
12:00	Lunch Break
13:00	Philippine report (PHIVOLCS) 60 min 10) Overview of Philippine Team's Achievements – Arturo S. Daag (17 min + 3 min) 11) Application of UAVs on the Disaster Risk Reduction Activities of DOST-PHIVOLCS – Robelyn Z. Mangahas (17min + 3 min) 12) Development of low-cost quad-plane drones for utilization of Local Government Units on their DRR Activities – Daniel Jose L. Buhay (17 min + 3 min)
14:00	Vietnam report (VNU) 30 min 13)Forest Fire Early Warning and Illegal Cutting Monitoring in the World Heritage "Trang An Landscape Complex", Dr. Bui Quang Hung (10 min + 7 min) 14)Forest and landscape data collection in Trang An Landscape Complex using UAV, Ha Duc Van (10 minutes + 3 min)
14:30	Indonesia report (LIPI) 30 min 15) Drone data processing for Flood and Draught monitoring in Central Java, Bambang Setiadi, (12 min + 3 min) 16) Applications of Drone to support active fault detection in Palu Koro Fault System in Sulawesi Indonesia, Afnindar Fakhrurrozi (12 min + 3 min)
15:00	Coffee Break
15:15	Invited talks for future directions (60 min) 17) Utilization of Drone to Heavy Rain Disaster in July 2018 in Kumano-cho Town, Yoshihiro Mimpo, Kumano-cho Town (13 min + 2 min) 18) Ontake volcano eruption: UAV was useful at that time?, Kazushi Tanoue, Nagoya University (13 min + 2 min) 19) Disaster Monitoring Activities Utilizing Remote Sensing Technology, Kazuo Yoshikawa, PASCO Corporation (13 min + 2 min). 20) Feasibility Survey for Long-range Unmanned Aerial Vehicles for Disaster Management, Takahide Matsuura, Terra Labo Corp. (13 min + 2 min)
16:15	Discussion (30 min)
16:45	Comments by Prof. Yoshimori Honkura, JST (15 min)
17:00	Closing


IDEAS, Chubu Univ.


Oral session


Flight demo at University Ena Campus


Technical session at University Lodge in Hida


Excursion to Yakedake Volcano (left)


Flight (net catch) demo at Yakedake volcano

Lists of Achievements and Implemented Activities

1. Original Publication of Articles etc.

【Notes】
Please fill in **only the achievements of this project** by country in order of publication date. Only "published" is targeted, but please write "in press" too only for Final Report.
Please count Proceedings with peer review as original paper.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

1. 1 Original Publications (Articles co-authored among Research Teams)

All Authors' Names, Title, Journal Name, Volume, Edition, Page, Year of Publication	DOI Code	Publication Status	Remarks (e.g. publication in top level journals etc.)

0 Total

1. 2 Original Publications (Articles by Single Team only)

All Authors' Names, Title, Journal Name, Volume, Edition, Page, Year of Publication	DOI Code	Publication Status	Remarks (e.g. publication in top level journals etc.)	Country name of the team

0 Total

Lists of Achievements and Implemented Activities

2. presentations at Academic Conferences etc. (Seminars, Workshops, Symposia)

【Notes】
Please fill in **only the achievements of this project** by country in order of presentation date.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

2. 1 Conference Presentations (Joint Presentations among Research Teams)

Date	Type of Presentation	Speaker, "Title", Conference Name, Location, etc.

0 Total

2. 2 Conference Presentations (by Single Team)

Date	Type of Presentation	Speaker, "Title", Conference Name, Location etc.	Country name of the team
November 14, 2016	Oral Presentation	Hiroshi INOUE , , 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Japan
November 14, 2016	Oral Presentation	Satoru Sugita and Hiromichi Fukui "Development of GIS based Aerial Photo Viewer as a Part of Integrated Disaster Management System" 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Japan
November 14, 2016	Oral Presentation	Daniel Jose Buhay,"", 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Philippines
November 14, 2016	Oral Presentation	Wutthiphat Covanich, "", 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Thailand
November 14, 2016	Oral Presentation	Bui Quang Hung, "", 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Vietnam
November 14, 2016	Oral Presentation	Mudrik Daryono, "", 1st e-ASIA (Kick-off) workshop, at JST, Tokyo, Japan	Indonesia
April 24, 2017	Oral Presentation	Satoru Sugita and Hiromichi Fukui "A Prototype of Oblique Aerial Photo Browser and Database for Residential Areas along Tsunami Threatened Coast and Active Fault in Japan" 2nd e-ASIA workshop, at PHIVOLCS, Quezon City, Philippines	Japan
April 24, 2017	Oral Presentation	Hiroshi INOUE, "Progress Report of Japan", 2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Japan

April 24, 2017	Oral Presentation	Bart Bautista, ″Progress Report of Philippines″, 2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Philippines

April 24, 2017	Oral Presentation	Wutthiphat Covanich,"Progress Report of Thailand", 2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Thailand
April 24, 2017	Oral Presentation	Arturo Daag, "Current applications of UAV in PHIVOLCS: Landslide monitoring", 2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Philippines
April 24, 2017	Oral Presentation	Robjunelieaaa Lim, "Current applications of UAV in PHIVOLCS: Lahar mapping and monitoring",2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Philippines
April 24, 2017	Oral Presentation	Daniel Jose Buhay, "Current applications of UAV in PHIVOLCS: Earthquake hazard mapping",2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Philippines
November 30, 2017	Oral Presentation	Wutthiphat Covanich, "Opportunities for application of UAV in wildfire management in Thailand", 2nd e-Asia UAV workshop, at PHIVOLCS, Quezon City, Philippines	Thailand
November 30, 2017	Oral Presentation	Hiroshi Inoue, "Mapping vlcano crater by UAV", 3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Japan
November 30, 2017	Oral Presentation	Satoru Sugita, Hiroshi Inoue, Yuji Asahi, Tomohide Seko, Hiroshi Itoh, Yuichi Furuse, and Hiromichi Fukui "UAV Photo Sharing System using "Oblique Photo Browser""3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Japan
November 30, 2017	Oral Presentation	Art Daag, "", 3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Philippines
November 30, 2017	Oral Presentation	Wutthiphat Covanich, "", 3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Thailand
November 30, 2017	Oral Presentation	Wawan Kiswara,"", 3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Indonesia
November 30, 2017	Oral Presentation	Bui Quang Hung, "", 3rd e-ASIA workshop, at VNU, Hanoi, Vietnam	Vietnam
July 2, 2018	Oral Presentation	H.Inoue,"Overview of e-ASIA UAV projectDevelopment of Information Gathering and Utilization Systems using small UAV for Disaster Risk Assessment, Monitoring and Response", 4th e-ASIA UAV workshop, Bandung	Japan
July 2, 2018	Oral Presentation	H.Inoue "Development of Information Gathering and Utilization System Using Small UAV for Disaster Risk Assessment, Monitoring and Response, Progress report and plan of Japan team", 4th e-ASIA UAV workshop, Bandung	Japan
July 2, 2018	Oral Presentation	H.Inoue, "Progress Report of Work Package 1&4, Development and applications of fixed wing drones", 4th e-ASIA UAV workshop, Bandung	Japan
July 2, 2018	Oral Presentation	Teesid Leelasawassuk, "Development of the On-Board Computational Unit on a UAV", 4th e-ASIA UAV workshop, Bandung	Thailand
July 2, 2018	Oral Presentation	Wutthiphat Covanich, "E-ASIA progress report and activity plan", 4th e-ASIA UAV workshop, Bandung	Thailand
July 2, 2018	Oral Presentation	Vitvasin Vimolmongkolporn and Satawat Prakanchareon, "Skywalker X8 Development Sharing", 4th e-ASIA UAV workshop, Bandung	Thailand
July 2, 2018	Oral Presentation	Cathey Pogai, "Applications of UAVs on the 2018 Mayon Volcano Eruption", 4th e-ASIA UAV workshop, Bandung	Philippines
July 2, 2018	Oral Presentation	"Robjunelieaaa B. Lim, "Project Progress and Accomplishments (Years 1 and 2)", 4th e-ASIA UAV workshop, Bandung	Philippines

July 2, 2018	Oral Presentation	Satoru Sugita, et al. Hiroshi INOUE, Yuji ASAHI, Tomohide SEKO, Hiroshi ITOH, Yuichi FURUSE, and Hiromichi FUKUI, "Introduction of Drone and Oblique Photo Browser to Disaster Information System of Local Government", 4th e-ASIA UAV workshop, Bandung	Japan
July 2, 2018	Oral Presentation	Hiromichi, Fukui, "Integration of multi-scale imagery of satellite, aircraft, drone, and ground camera to GIS for disaster management", 4th e-ASIA UAV workshop, Bandung	Japan

30 Total

Lists of Achievements and Implemented Activities

3. Workshops, Seminars, Symposia and Other Events (Organized by the Project)

【Notes】
Please fill in **only the achievements of this project** in order of event date.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

Event duration	Name of Organizer	Title of the Event	Location (Country, City, Venue)	Number of Participants (Including Team Members)	Overview
2016/11/14～ 2016/11/16	Hiroshi INOUE, NIED	e-ASIA UAV Kick-off Workshop	Japan, Tokyo, JST and Tsukuba, NIED	17	Overview of the plan and sharing 2017 plan
2016/12/12～ 2016/12/16	Bartorome Bautista, PHIVOLCS	UAV Assembly Training	Philippines, Quezon City, PHIVOLCS	11	Building and operation of fixed wing UAV
2017/3/15～ 2017/3/17	Wutthiphat Covanich	Drone Workshop	Thailand, Pathumu Thani, NECTEC	10	Building and operation of fixed wing UAV
2017/4/18～ 2017/4/20	Bartorome Bautista, PHIVOLCS	UAV Assembly Training	Philippines, Quezon City, PHIVOLCS	10	Building and operation of fixed wing UAV
2017/4/24～ 2017/4/27	Bartorome Bautista, PHIVOLCS	e-ASIA UAV 2nd Workshop	Philippines, Quezon City, PHIVOLCS	30	Progress report and plan, UAV test flight
2017/7/3～ 2017/7/7	AIT GIC Center	UAV Assembly Training	Geoinformatic Center, Asian Institute of Te	7	Building and operation of fixed wing UAV
2017/11/18～ 2017/12/1	Bui Huang	e-ASIA UAV 3rd Workshop	Vietnam, Hanoi, Vietnam National Universit	10	Progress report and plan, UAV test flight
2018/7/2～ 2018/7/3	Eko Yulianto	e-ASIA UAV 4th workshop	Indonesia, Bandung, LIPI	30	Progress report and plan

8 Total

Lists of Achievements and Implemented Activities

4. Record of Research Exchanges

【Notes】
Please fill in the record of **resaerch exchange only of this project**.
"Duration of exchange" is not the number of days stayed on the site, but the number of days from departure to return home.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

Date of Departure	Date of Return	Last Name & First Name	Country of Affiliation	Affiliation	Position	Exchange Destination (Country, City, Research Organization etc)	Description of Exchange Content/Purpose	Duration of Exchange (autocompleted)
January 6, 2016	January 16, 2016	Taro Yamada	Japan	Yamada University	Professor	NANOTEC,NECTEC, Bangkok	○○	11
2016/8/2	2016/8/11	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Philippines, Manila City, PHIVOLCS Vietnam, Hanoi, VNU Indonesia, Bandung, LIPI	Meeting	10
2016/11/13	2016/11/17	Eko Yulianto	Indonesia	Research Center for Geotechnology, LIPI	Director	Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/13	2016/11/17	Mudrik Daryono	Indonesia	Research Center for Geotechnology, LIPI	Researcher	Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/14	2016/11/17	Bui Quang Hung	Vietnam	FIMO Center, Vietnam National Univ.	Director	Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	4
2016/11/13	2016/11/17	Daniel Jose Buhay	Philippines	PHIVOLCS		Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/13	2016/11/17	Dave Benedict Emerenciana	Philippines	PHIVOLCS		Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/13	2016/11/17	Kanokvate Tungpimolrut	Thailand	NECTEC		Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/13	2016/11/17	Kittipong Ekkachai	Thailand	NECTEC		Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5
2016/11/13	2016/11/17	Wutthiphat Covanich	Thailand	NECTEC		Japan, Tokyo, JST, NIED	1st e-ASIA UAV workshop	5

2016/12/11	2016/12/18	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Philippines, Manila City, PHIVOLCS	Workshop, Meeting	8
2017/3/14	2017/3/23	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Thailand, Bangkok, NECTEC	Workshop, Meeting	10
2017/4/17	2017/4/28	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	12
2017/4/23	2017/4/28	Hiromichi Fukui	Japan	Chubu University	Professor	Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/4/23	2017/4/28	Satoru Sugita	Japan	Chubu University	Associate Professor	Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/4/23	2017/4/28	NECTEC member	Thailand	NECTEC		Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/4/23	2017/4/28	NECTEC member	Thailand	NECTEC		Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/4/23	2017/4/28	NECTEC member	Thailand	NECTEC		Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/4/23	2017/4/28	NECTEC member	Thailand	NECTEC		Philippines, Quezon City, PHIVOLCS	The 2nd Annual Meeting and Workshop	6
2017/5/11	2017/5/12	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Thailand, Bangkok, NECTEC, AIT	Meeting	2
2017/8/8	2017/8/20	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Philippines, Manila City, PHIVOLCS Province of Albay	Drone aerial photograph, UAV survey, Meeting	13
2017/11/29	2017/12/2	Wawang	Indonesia	LIPI	Researcher	Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/27	2017/12/2	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	6
2017/11/29	2017/12/2	Hiromichi Fukui	Japan	Chubu University	Professor	Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	Satoru Sugita	Japan	Chubu University	Associate Professor	Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	Art Daag	Philippines	PHIVOLCS		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	ALISSANDRA PAULINE MARIANO	Philippines	DOST		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	NECTEC member	Thailand	NECTEC		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	NECTEC member	Thailand	NECTEC		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4

2017/11/29	2017/12/2	NECTEC member	Thailand	NECTEC		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2017/11/29	2017/12/2	NECTEC member	Thailand	NECTEC		Vietnam, Hanoi, VNU	3rd e-ASIA UAV workshop	4
2018/5/16	2018/5/19	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Thailand, Chiang Mai, Royal Forest Department Bangkok, AIT Geoinfomatic Center	UAV meeting	4
2018/6/14	2018/6/23	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Philippines, Manila City, PHIVOLCS, Taal Volcano	Meeting, Drone aerial photograph, UAV survey	10
2018/7/1	2018/7/4	Van Duc Ha	Vietnam	FIMO Center, VNU University of Engineering and Technology	Researcher	Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop	4
2018/7/1	2018/7/4	Hiromichi Fukui	Japan	Chubu University	Professor	Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop	4
2018/7/1	2018/7/4	Satoru Sugita	Japan	Chubu University	Associate Professor	Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop	4
2018/7/1	2018/7/8	Hiroshi Inoue	Japan	NIED	Principal Research Fellow	Indonesia, Bandung, LIPI Thailand, Bangkok, NECTEC, AIT	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	8
2018/7/1	2018/7/4	Rob	Philippines	PHIVOLCS		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
2018/7/1	2018/7/4	Cathy	Philippines	PHIVOLCS		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
2018/7/1	2018/7/4	NECTEC member	Thailand	NECTEC		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
2018/7/1	2018/7/4	NECTEC member	Thailand	NECTEC		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
2018/7/1	2018/7/4	NECTEC member	Thailand	NECTEC		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
2018/7/1	2018/7/4	NECTEC member	Thailand	NECTEC		Indonesia, Bandung, LIPI	The 4th e-ASIA UAV Bandung Workshop, UAV meeting	4
				Total (Person)	42		Total (Person-day)	230

Lists of Achievements and Implemented Activities

5. Patent Applications

【Notes】
Please fill in **only the achievements of this project** by country in order of presentation date.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

5. 1 Independent Applications by Single Team

Application Number	Name of Patent/Patent Name	Application Date	Patent Applicants (Fill in All Members)	Publication Number (leave blank if unpublished)	Inventor	Country of Application	Registration Number (leave blank if unregistered)	Country Name of the Team
WO20xx-xxxxxx		January 21, 2016	○○ Univ、Univ.of xx	WO/2016/xxxxxx	○○○○、○○・○○	PCT	WO20xx-xxxxxx (20xx.xx.xx)	Thailand

0 Total (Number of Application)

0 Total (Number of Registration)

5. 2 Joint Applications

Application Number	Name of Patent/Patent Name	Application Date	Patent Applicants (Fill in All Members)	Publication Number (leave blank if unpublished)	Inventor	Country of Application	Registration Number (leave blank if unregistered)
WO20xx-xxxxxx		January 21, 2016	○○ Univ、Univ.of xx	WO/2016/xxxxxx	○○○○、○○・○○	PCT	WO20xx-xxxxxx (20xx.xx.xx)

0 Total (Number of Application)

0 Total (Number of Registration)

Lists of Achievements and Implemented Activities

6. Awards

【Notes】
Please fill in **only the achievements of this project** by country in order of date of Award.
The information on this form is only disclosable. Please submit Non-disclosable information in a separate file.

Date of Award	Name of Award	Recipient	Remarks	Country Name of the Team
October, 5, 2017	UAV Startup	Wutthiphat COVANICH and Thailand Team		Thailand

1 Total