Research Proposals Utilizing Mt. Fuji Weather Station

International Workshop on Research at Mt. Fuji Weather Station

March 4(Sat.) 9:30 – 16:00

Mt. Fuji International Symposium

– Future of Mt. Fuji Weather Station–

March 5(Sun.) 10:00-16:00

(Room 202, Gakushikaikan, Tokyo)

NPO "Valid Utilizaition of Mt.Fuji Wether Station"

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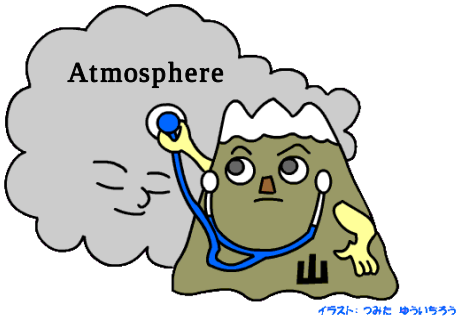
Research Proposals Utilizing Mt. Fuji Weather Station

Mt. Fuji Weather Station has been unattended since October, 2004, after 72 years attended operation. It is to be demolished in near future. A group of scientists has edited this booklet, who feel that demolishing the facility is a great loss and want to make valid use of it. Research proposals of interdisciplinary fields of science are shown as follows:

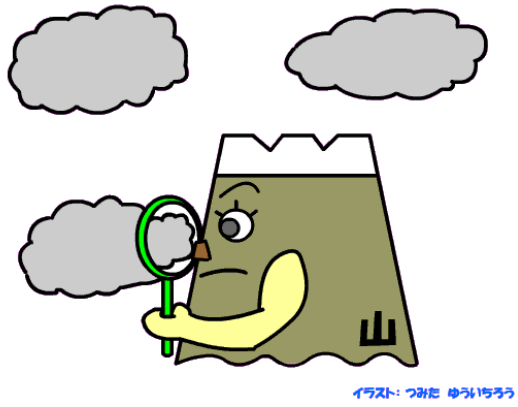
Atmospheric Chemistry

Since 1990, small scale observations have been performed on precipitation, gases and aerosols using the facility, in collaboration with the staff of the weather station. Continuous observations of trace gases and aerosols in the free troposphere is proved to be performed at the station, which can be a good support to airplane observations (Bandow, H., Kato, S., Kajii, Y. Osada, K., Iwasaka, Y. and Kido, M.).

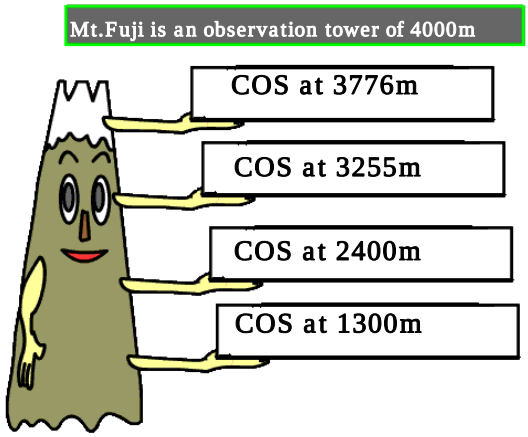


Base line observation of trace gases and aerosols over Japanese Islands is also possible (Igarashi, Y., Nagao, I., Kajii, Y., Kato, S., Mukai, H., Kobayashi, H. Hatakeyama, S, Komura, K and Abe, T.), as well as getting information on long range transport of chemicals (Igarashi, Y., Takahashi, H., Mukai, H., Kaneyasu, N., Kobayashi,H., Miura, K., Okuda, K., Yoshioka, K. and Hatakeyama, S.).

The summit is covered with fog very often, which means the cloud can be collected on site. Wet and dry processes in air chemistry can be efficiently studied at the summit (Minami, Y., Okochi, H., Dokiya, Y., Watanabe, K., Suzuki, I., Osada, K. Iwasaka, Y., and Kido, M.)

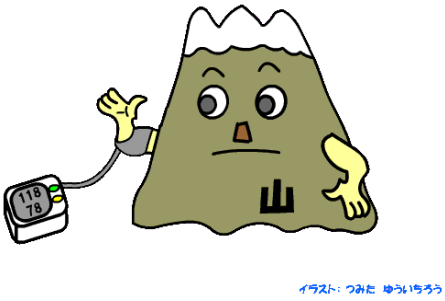


The mountain body can serve as an observation tower of 4000m. Vertical information on the concentrations of trace gases and aerosols will be obtained (Igarashi, Y., Takahashi, H., Osada, K., Kido, M., Miura, K., Katayama, Y., Dokiya, Y. , Minami, Y., Watanabe, K. and Suzuki, I.).



High Altitude Medicine

At the summit of Mt. Fuji, the air pressure is about 60 % of the surface, which means that the respiratory oxygen is as low as 12 %, causing the acute mountain sickness. The mechanism of the disease will be studied from the view point of blood circulation (Asano, K.), otorhinolaryngology (Ide, R. and Kanzaki, S.), pulmonary circulation (Masuyama, S. and Matsuda, A.) and preventive medicine (Horii, M.).



イラスト：つみた ゆういちろう

On the other hand, high altitude training is a promising training method in many fields of sport, the mechanism of which will be very efficiently investigated utilizing the facilities (Yamamoto, M. and Asano, K.).

Effect of high altitude on the metabolic pathway of fat and related compounds will also be studied utilizing the station (Takazakura, E. and Nagasaki, S.).

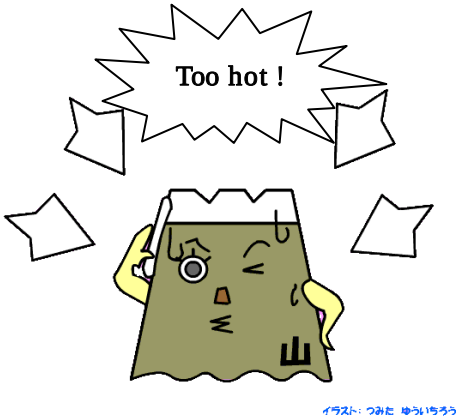
Astronomy

イラスト：つみた ゆういちろう

The summit of Mt. Fuji is one of the best sites in the world for the astronomical observation because of the very low temperature and humidity. It was proved by the successful operation of the Mt. Fuji Submillimeter-wave Telescope from 1998 to 2005 (Yamamoto, S.). With the telescope, information was obtained submillimeter-wave emission line of the atomic

carbon toward a number of nearby molecular clouds and explored formation and evolution of molecular clouds, which are birthplace of new stars.

In future, using this method, global circulation of interstellar matter in the Galaxy will be understood (Yamamoto, S.).

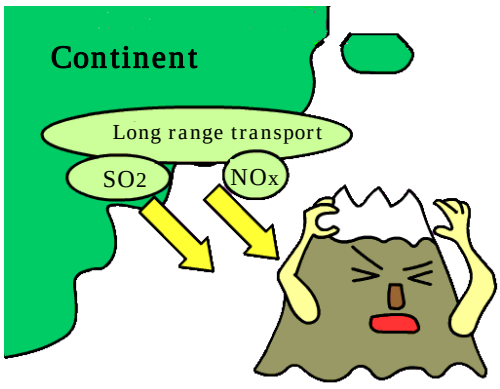


Ecology

Permafrost was found at the summit of Mt. Fuji in 1970s. The moss and lichens growing near the summit of Mt. Fuji utilize the melt of the permafrost for their life. Recently, the communities of these organisms are found to be changing because of the decrease of permafrost presumably due to the global warming (Masuzawa, T.).

When the station can be used, more detailed observation can be performed on the distribution of moss and lichens, which will be the actual measure of global warming (T. Masuzawa, T., Maruta, E. and Tomita, M.).

Glaciology



Mountain snow of high altitude conserves the history of air pollution as the concentration of chemical species (Suzuki, K.). Collaboration with precipitation chemistry will provide more detailed figures of the origin of chemical species (Suzuki, K., Minami, Y., Okochi, H., Dokiya, Y., Watanabe, K. and Suzuki, I.). Microscopic study on rime at the summit is also planned to elucidate the long range transport of polluted air.

1. Atmospheric Chemistry

2. High Altitude Medicine

Field	Atmospheric Chemistry
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Theme	Continuous monitoring of nitrogen oxides and their related chemical species at Mt. Fuji
Annual Expense*	¥ 2,000,000
Outline (Aim, methods and expected outcome of the research)	Nitrogen oxides are the key chemical species which control the quality of the atmosphere in terms of ambient atmospheric acidity and oxidizing capacity. Therefore, the monitoring of their concentrations and its trend in the global troposphere as well as understanding of their emission strength are of crucial importance. Focusing on the impact of economic burst of East Asian countries, especially China, to the global atmosphere, we have already started the continuous monitoring of total reactive nitrogens(NOy) and gaseous nitric acid at the remote site of Okinawa island in East China Sea, where the outflow from Chinese continent prevails by the Jet-stream in winter. NOy concentration at the site sometimes exceeds over 10 ppbv and that of nitric acid is comparable to that in the urban area even in such remote site. Based on the knowledge of atmospheric chemistry in addition to the data observed at the site so far, the monitoring of these chemical entities are of urgent concern, especially at the site where one can watch the representative quality of the free tropospheric air in the northern-hemispheric mid-latitude zone. The top of Mt. Fuji is such site almost like a fire-lookout for the global environmental change where one can find an emergency at first. Methods: Commercially available and modified NOx analyzers will be employed for continuous monitoring of NOx, total NOy, gaseous nitric acid, and aerosol nitrates, separately. Periodically, intensive observation campaign will be planed for measuring some NOy entities selectively, such as nitrous acid and organic nitrates including PANs. For detecting the global change of atmospheric chemistry, 10- to 15-year monitoring will be needed. For understanding the chemical scheme of the global troposphere related to NOy species, 2- to 3-year-round periodic observation campaigns for clarifying the partioning among the chemicals in the nitrogen oxides family should be conducted with the collaboration of other groups. Outcomes expected: The symptom of a global change in tropospheric chemistry will be detected on the very early stage through the continuous monitoring of NOx, NOy, and nitric acid. Fundamental understanding on chemical and photochemical system in the global troposphere will also be obtained through the observation of the short-term temporal change of the above-mentioned species under various conditions.

* not including the maintenance cost of the station

Field	Atmospheric Chemistry
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Theme	Observational study on chemical species in the precipitation and fog at Mt. Fuji
Annual Expense*	¥ 2,000,000
Outline (Aim, methods and expected outcome of the research)	Precipitation and fog samples have been occasionally collected at the summit and several sites of different heights on the slope from 1990. Chemical analyses of them prevailed that the concentrations of chemical species are generally low at the summit compared with lower elevation, having typical seasonal variations. However, no continuous observation could be performed yet. In this research a year round precipitation samples will be collected at the summit as well as fog samples in summer campaigns, at several elevation sites. Methods: Continuous precipitation samples (plastic samplers, weekly)and fog samples(in summer campaign, a passive sampler) will be collected. Determination of the concentrations of chemical species will be done by ion-chromatography. H_2O_2 will also be analyzed using the samples preserved. New sampling and analytical systems will be developed. Outcomes expected: Seasonal trends of chemical species in the precipitation at the summit of Mt. Fuji will be obtained. Vertical differences in the concentration of chemical species in the fog and precipitation will be shown. Using the results, compared with those of aerosols and trace gases, information on long-range transport of pollutants over the Asian Continent, on air chemistry in the free troposphere and etc. will be provided, which will be applied to the elimination of the damage of acid rain in ecosystem.

Field	Atmospheric Chemistry
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Col1aborators (affiliation, address, e-mail)	
Theme	Measurements of gaseous H_2O_2 and organic peroxides
Expense*	2,000,000 Yen/year
Outline (Aim, methods and outcome of the research)	Photochemical ozone and air pollutants transported from big cities are thought to be one of causes for the serious forest decline found in the mountainous area surrounding those big cities. In addition ozone reacts with natural hydrocarbons emitted from forest trees to form peroxidic compounds, which can damage plants as well. In the East Asia, on the other hand, NOx emission goes up quickly due to the rapid economic growth of China and other developing countries. It brings about the increase of back ground ozone as well as back ground peroxides. It is very important to analyze the oxidation processes in the atmosphere. In the work proposed here, we are going to measure the concentrations of peroxides in the atmosphere transported from the East Asian region in order to get information on the inter-conversions of peroxyl radicals such as OH, HO_2, and CH_3OO taking place in that atmosphere. ◆Methods of measurements Place: Top of Mt. Fuji and in the forests surrounding Mt. Fuji. By the comparison the effects of urban plumes and the back ground atmosphere can be analyzed. Methods: Sampling with mist chambers and subsequent analyses by use of an HPLC will be used. A fluorescence detector utilizing dimerization of p-hydroxyphenyl acetic acid and full-polymer tubing and column are to be used. Period: Every summer. ◆Expected results Photochemical processes in the back ground air transported from the East Asia can be analyzed. The contribution of the peroxides formed by the reactions of ozone with olefinic hydrocarbons can be studied, which enables to evaluate the contribution of such peroxides to the forest decline in the mountainous area.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Yasuhito Igarashi, (Geochemical Research Department, Meteorological Research Institute)
Theme	Observation of SO_2 and sulfate
Annual Expense*	¥ 5,000,000
Outline (Aim, methods and expected outcome of the research)	◆ Observation Purpose It is noticed that SO_2 is a source substance for acid rain, since it is discharged into the atmosphere by industrial activity in large quantities. In addition, SO_2 is oxidized in the atmosphere becoming sulfuric acid and works as a cloud nuclei of sulfate aerosol. Because sulfate aerosol scatters sun light which affects on climate. SO_2 exists in the unpolluted natural environment; a considerable quantity of SO_2 is emitted from volcanoes and it is generated also from gaseous reduced sulfur species such as DMS (dimethyl sulfide) emitted from the ocean, etc. Therefore, observation of SO_2 and sulfate aerosol in the free troposphere is important from the viewpoint of climate change and acidification issues. Long-term monitoring and process study are indispensable. By intensive campaign observation, we would like to grasp air mass and/or plume mixing and its relation to chemical reactions, etc. ◆ Observation Method An observation spot: at the summit for long-term monitoring. If possible to prepare with the plural same instrumental setup, we would like to observe in vertical distribution of SO_2 at 7.8 point of Mt. Fuji and Tarohbo (1300m asl) Observation instrument: a) UV fluorescence method is employed. Although the sensitivity of a commercial UV fluorescence SO_2 monitor is not sufficient to measure the BG level precisely, it is suitable for long-term observation due to its capability of automatic observation. b) Aerosol sulfate can be observed with a dry-process sulfate monitor that is a combination of a high temperature converter of sulfate to SO_2 and a UV fluorescence detector. Long-term monitoring should be continued for at least 20 years or so. During intensive campaign observation the method having high time resolution with other chemical species is a requisite. ◆ Prospective Results There are little continuous SO_2 observations in the free troposphere especially in the far East region. and long-term, SO_2 time series for the validation of chemical transport model are also little. It is worth offering long-term monitoring data to contribute for the improvement of a chemical transport model. Furthermore, by observing both of SO_2 and sulfate aerosol during long-range transport events from a continent as well as volcanoes such as Miyake-jima Island, we can know about the relation between the transportation and the oxidation processes. By comparing the data with ozone, hydrogen peroxide and other oxidants, we can obtain further knowledge about the chemical transformation.

Field	Atmospheric Chemistry
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Col1aborators (affiliation, address, e-mail)	
Theme	Observation of ^{7}Be at the summit of Mt. Fuji
Annual Expense*	¥ 5,000,000
Outline (Aim, methods and expected outcome of the research)	◆ Observation Targets (Research object) Cosmogenic radioculide; ^{7}Be ◆ Observation Purpose Beryllium-7 is produced by nuclear spallation reactions between high energy cosmic-rays and atmospheric nuclei. It has been used for various purposes in the field of geoscience. Due to its electric charge, ^{7}Be probably attaches to the ambient aerosol soon after its production, thus it could be used as tracer for stratospheric air mass. Its observation coupled with O_3, it could help to know about the source of O_3. It has been found that enhanced ^{7}Be and O_3 concentrations along with low humidity will occur when the dry intrusion of upper air mass is observed. Thus in order to study about the stratosphere/troposphere air mass exchange and its impact on the atmospheric chemistry, we propose to observe ^{7}Be on site. ◆ Observation Method An observation spot: At the summit long-term monitoring should be done. If possible to prepare with the plural same instrumental setup, we would like to observe in vertical distribution of ^{7}Be at 7.8 point of Mt. Fuji and Tarohbo (1300m asl) High volume sampling is employed and 7Be is collected onto quartz fiber filters. The filter taken back to the laboratory and is subjected to γ-ray measurement using a Ge semiconductor detector coupled to a 4096 channel multi-channel analyzer. The 478 keV photo-peak was used to determine 7Be. Although at present only manual sampling allowing coarse time resolution of one day ors is possible, the automatic sampler capable of higher time resolution should be installed. ◆ Prospective Results Concerning the evaluation of S/T exchange, the recent modern chemical transport model calculation has been attempted, however the evaluation is still in the controversy. Observation of ^{7}Be could contribute to such discussion by offering the useful data. Information on not only O_3 but also other stratospheric oirigin trace substances could be obtained by such cosmogenic nuclides at the summit of Mt. Fuji.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Yasuhito Igarashi, (Geochemical Research Department, Meteorological Research Institute) E-mail：yigarash@mri-jma.go.jp Fax：+81-29-853-8728
Col1aborators (affiliation, address, e-mail)	Hiroshi Takahashi (Environment and Applied Meteorology Research Department, Meteorological Research Institute), Hitoshi Mukai (Center for Global Environmental Research, National Institute for Environmental Studies)
Theme	Long-term observation of free tropospheric O_3 and its vertical profile in the lower atmosphere
Annual Expense*	¥ 5,000,000
Outline (Aim, methods and expected outcome of the research)	◆ Observation target (Research object) Ozone (O_3) ◆ Observation Purpose It is current concern that emissions of NO_x, CO and NMHC will increase over the Asian continent due to increasing number of a car in China, though the SO_2 emission to the atmosphere may stay at the current level. Increase of NO_x will result in the 'photochemical smog' in wider area, and also could lead to increase a mass of ozone production. Hence, it is necessary to monitor O_3 for a long-term in the free troposphere over Japan located downstream of the Asian continent. In addition, in order to know about the temporal change in atmospheric oxidation capability attributable to the above-mentioned O_3 concentration change, observation of other chemical species along with O_3 in the troposphere seems also important. We need to evaluate natural ozone which is originally from the stratosphere and anthropogenic pollution ozone which basically comes from the boundary layer, considering the possible influence of global warming onto the global atmospheric circulation and related dynamics. There are two major research topics. One is the observation of the long-term change in 10 to 20 years with very much precise instrument, and another is the process research for the transport and chemical reactions involved. ◆ Observation Methods An observation spot: At a mountain summit for long-term monitoring. If possible, observation of vertical profile of O_3 at 7.8 point and Taro-bo with the same instrumental sets should be carried out. Observation instrument: The instrument using UV absorption to aim at a completely automatic measurement and achieving the adequate accuracy in terms of traceability Observation term: Long-term observation for more than 20 years and intensive observation along with other chemical species are desirable ◆ Prospective results O_3 in the free troposphere is basic parameter, since the long-term O_3 observation data can contribute to validate and improve a chemical transport model. By comparing provided data from other observatories at high mountains such as Mauna Loa, Hawaii, Jungfraujoch, Switzerland, Mt. Waliguan, China, etc., we can also picture wider aerial distribution of O_3 at mid altitude level in the troposphere, being with extrapolation by a numerical model. Moreover, this observation will help us to know about climate change affected by the change of O_3 (does to response relationship) as well as source intensity change. Observation of peroxides along with O_3 will help our further understanding on chemical processes related to oxidation capability of the atmosphere.

Field	Atmospheric chemistry
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Col1aborators (affiliation, address, e-mail)	Shungo Kato Tokyo Metropolitan University Hachioji, Tokyo: shungo@atmchem.apchem.metro-u.ac.jp
Theme	Observation of atmospheric radicals such as NO, NO_2, NO_3 and HOx in the free troposphere
Expense*	2 millions of Japanese yen per year
Outline (Aim, methods and outcome of the research)	The main aim of the research is the observation of atmospheric radicals in the free troposphere. The only expeditions which have been done before were always using aircraft observations. It costs a lot and we have a lot of limitation for such campaigns. However, observatory in Mt. Fuji could provide us quite frequently the opportunities of sampling of the free tropospheric air. The mountain top is free from local air pollution hence we could expect considerable amount of NO_3 radicals in night time. Due to high reactivity NO_3 radicals are not well observed under the atmosphere up to recently. At the first stage of this research, we would like to start measurement of NOx and VOCs in order to judge the NO_3 concentration at night. The source of NO_3 radicals are the reaction of NO_2 and O_3 and decomposition of N_2O_5. The loss of NO_3 is quite complex. Major loss might be reactions with VOCs. Therefore, we measure key species playing as possible source and sinks. Next step is the measurements of radical molecules using laser spectroscopic techniques. Not only NO_3 family but also HOx (OH and HO_2 radicals) might be measuring targets. We would like to test our knowledge about atmospheric chemistry in the free troposphere and evaluate the roles of radicals for loss processes of important trace species like HCFCs. The investigation of the dynamical behavior of NOx family is also essential for the clarification of acidification of the atmosphere.

Field	Atmospheric Science
Main researcher (affiliation) (address; e-mail)	Naoki Kaneyasu National Institute for Advanced Industrial Science and Technology 16-1 Onogawa, Tsukuba 305-8569, Japan; e-mail: kane.n@aist.go.jp
Col1aborators (affiliation, address, e-mail)	
Theme	Research on the physical and chemical properties of atmospheric aerosols related to direct and indirect effect on climate change
Expense*	2,000,000 yen / yr
Outline (Aim, methods and expected outcome of the research)	***Background of the research*** Little observational data have been reported for the optical properties of aerosols in the free troposphere. Concentrations of optically-active species in the free troposphere, such as sulfate, black carbon, particulate organics, and soil dust are also sparsely measured. The mechanism and the pathways of long-range transports of air pollutants in East Asian region have mostly been studied for those in the planetary boundary layer. To evaluate direct effect of anthropogenic aerosols on climate, in particular in the Asia-Pacific region where emissions of air pollutants are expected to increase, *in-situ* measurements of optical, microphysical, and chemical properties are indispensable for aerosols not only in the planetary boundary layer but in the free troposphere. The summit of Mt. Fuji is also advantageous in studying the indirect effect (via cloud droplets) of aerosols on climate since it is situated at the downwind area of Asian continent where emission of cloud condensation nuclei (CCN) is expected to increase. ***Method*** Instrumentation: Continuous measurements of aerosol optical properties with Integrating Nephelometer and Absorption Photometer. Monitoring of concentrations for some components such as black carbon and sulfate with Aethalometer (or multi-angle absorption photometer) and sulfate monitor, respectively. Continuous operation of CCN counter. Semi-continuous aerosol collection with filter samplers. Period: long enough to detect year-to-year trend. ***Expected outcome*** The long-term data set obtained in this study will be used to evaluate the performance of global chemical transport models, and thus to contribute to improve the prediction of aerosol radiative forcing in global scale. The optical parameters of aerosols in the free troposphere are essential in improving the "atmospheric correction" used in satellite remote sensing data processing. Concurrent measurements of aerosol number concentration, composition, and CCN provide basic data to detect and evaluate the indirect climatic effect of aerosol in this region, which leads to improve the climate change prediction.

Field	Atmospheric Chemistry
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Theme	Vertical distribution of atmospheric carbonyl sulfide in lower troposphere
Annual Expense*	¥ 1,500,000
Outline (Aim, methods and expected outcome of the research)	Stratospheric sulfate aerosols are known to have an important role in global warming as a cooling agent. COS is one of the precursor of stratospheric sulfate aerosols, recent increase of COS is focused in relation to the anthropogenic activities. The measurement of COS has mainly been performed by the airplane sampling. And information on the concentration of COS has been limited to be that of upper troposphere. However, it is reported, recently that natural ecosystem serves as sources and sinks of COS, thus the importance of continuous measurement of COS is emphasized. Methods: Air samples will be collected simultaneously using aluminum bags at more than 4 points (e.g. 3776m, 3255m, 2400, 1300m), every 4 hours, continuously (from a few days to weeks). The sample air will be condensed using liquid oxygen followed by the determination of the concentrations of COS by FPD-GC. Outcomes expected: Continuous vertical profile of COS at the lower troposphere, including free troposphere will be obtained, which cannot be obtained in ordinary airplane samplings. The data will serve as a key factor in elucidating the mechanism of global warming.

Field	Atmospheric science
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Col1aborators (affiliation, address, e-mail)	
Theme	Optical properties of Asian dust in free troposphere
Expense*	¥500,000
Outline (Aim, methods and expected outcome of the research)	Radiative forcing of Asian dust, or KOSA in Japanese, can be either positive or negative. The evaluation of the radiative effect of Asian dust on climate on regional and global scales involves large uncertainties. The accurate estimation of the radiative forcing requires knowledge of their optical properties like single scattering albedo and phase function. In particular, the evaluation of the optical properties of Asian dust in free troposphere is important because of high possibilty of long-range transportation of the dust in free troposphere. Methods: An automatic filter sampler controlled with an optical particle counter, which is developed, will be used at the summit. The size distributions are measured with an Coulter Counter. The refractive index is estimated from the measured size distribution and the absorption coefficient measured with a spectrophotometer on the basis of Mie theory. Outcomes expected: The optical properties of Asian dust in free troposphere will be obtained. Therefore it would enable to estimate the effect on climate precisely and to improve the accuracy of satellite and other remote sensing for Asian dust.

Field	Airborne radioactivity
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Col1aborators (affiliation, address, e-mail)	Takuya ABE (D3) Low Level Radioactivity Laboratory, K-INET, Kanazawa University abetaku@llrl.ku-unet.ocn.ne.jp
Theme	Measurement of short-lived cosmic-ray induced radionuclides at the summit of Mt. Fuji
Expense*	200 k yen
Outline (Aim, methods and outcome of the research)	1. Many kinds of short- and long-lived radionuclides (CP nuclide) are produced at high altitude due to nuclear reactions between cosmic-rays and air components. 2. Production rate of the CP-nuclide is expected to be 1~2 orders of magnitude higher at the summit of Mt. Fuji than at sea level. No measurement has been made to measure production rate at high altitude because activity levels of these nuclides are extremely low and difficult to detect by ordinary low background Ge detector. 3. By the use of extremely low-background Ge detector at Ogoya Underground Laboratory, we succeeded to detect short-lived CP-nuclide such as ^{28}Mg (half-life = 20.9 h), ^{24}Na (14.96 h), ^{18}F (110 m), ^{39}Cl (56 m) , ^{38}Cl (37 m). in 50L of rain water. 4. In order to analyze rain-data it is very important to know production rate at the altitude of cloud formation, However there is no measurements. 5. In this work, we will try to detect ^{28}Mg and ^{24}Na in the air by using extremely high volume air sampler. 6. Sampling collection: 13,000 m^3 (sampler 2m^3/min x 1 day 3 sets) 7. Bring back air-filter to LLRL by train and measure at Ogoya Underground Laboratory. 8. Simulation experiments at KEK. 9. Data analyses.

Field	Atmospheric chemistry
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Col1aborators (affiliation, address, e-mail)	Hiroshi Okochi Tokyo Metropolitan University hokouchi@cc.tmit.ac.jp
Theme	Observational study on transformation and deposition of chemical species through the processes of rain and fog
Expense*	¥ 3,000,000-
Outline (Aim, methods and expected outcome of the research)	Atmospheric chemical species usually experience a dissolution into, and a drought escape from cloud/fog particles for several times until the eventual deposition. Liquid phase of the hydrometeor gives an occasion of faster chemical reaction. Cap cloud, which is often observed at the summit of Mt. Fuji, is one of the situations of such wet processes. And because Mt. Fuji is an isolated high mountain, air mass would be clearly traced. Also, the mountain provides a large difference in elevation between the observational sites within a horizontally short distance. Methods: Cloud (fog) water will be collected near the cloud base and at the summit. Precipitation will be also collected at several elevations. Aerosols will be sampled just below the cloud base. Major inorganic solutes will be measured, and their precursor in aerosols will be analyzed. Oxidants such as H_2O_2 will be also measured, if possible. Outcomes expected: Role of clouds in a transformation of chemical species as a medium to accelerate the reaction will be clarified. Knowledge on promotion of the deposition of the species by seeder-feeder mechanism and large deposition rate of them at high elevation will be obtained, which have been derived only from the observation at the mountainous sites at around 1,000m elevation.

Field	Atmospheric Physics
Main researcher (affiliation) (address; e-mail)	Kazuhiko Miura Tokyo University of Science, 1-3 Kagurazaka, Shinjuku-ku, Tokyo 162-8601, Japan : miura@rs.kagu.tus.ac.jp
Collaborators (affiliation, address, e-mail)	
Theme	Measurements of aerosol size distribution at the summit and the base of Mt. Fuji
Expense*	¥ 2,000,000
Outline (Aim, methods and expected outcome of the research)	In order to evaluate the effect of atmospheric aerosols on climate change it is necessary to measure the long-term variation of background level at the fixed point. As the summit of Mt. Fuji is usually positioned in the free troposphere, we can measure the variation of aerosol in the free troposphere. Sulfate and secondary organic aerosol play an important role as cloud condensation nuclei and they are generated by gas to particle conversion so it is very interesting to study the new particle production and particle growing process. We investigate the physical process of aerosols in the free troposphere by measuring the size distribution from 4.4 nm to 5000 nm in diameter. Methods: The size distribution from 4.4 nm to 5000 nm in diameter will be measured with a scanning mobility particle sizer (TSI 3936N25) and two optical particle counters (RION KC18, KC01D), at three fixed stations (the summit, mountainside (7 go 8 syaku shelter), base (Taro-bo shelter)). Moving observation will be performed with a portable optical particle counter (RION KR12) and a portable condensation particle counter (TSI 3007) between the fixed stations in summer campaigns. Outcomes expected: The size distribution from 4.4 nm to 5000 nm in diameter will give us the information about the process of new particle production and particle growing in the free troposphere. We can also evaluate the effect of anthropogenic aerosols in Asia on background level by investigating the vertical profile and transport process.

Field	Environmental Chemistry
Main researcher (affiliation) (address; e-mail)	Hitoshi Mukai National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506 Japan; lnmukaih@nies.go.jp
Col1aborators (affiliation, address, e-mail)	Marcel van der Schoot (CSIRO, CMAR, Aspendale, Marcel.VanDerSchoot@csiro.au)
Theme	Observation of Carbon dioxide at Mt. Fuji
Annual Expense*	¥ 1,500,000
Outline (Aim, methods and expected outcome of the research)	Latitudinal band from 30N to 40N is a highly populated region which can potentially produce a large amount of CO_2. In order to monitor latitudinal average of CO_2 concentration at this latitude, a special monitoring site is needed, because local emission sources can easily affect the concentration at the site. Mt. Fuji is considered to be one of the best sites for monitoring of background air. Methods: Continuous CO_2 analyzer will be installed with some standard cylinders at the observatory. To minimize consumption of the standard gases, specially designed analyzer should be used. Outcomes expected: Very smooth seasonal and long-term trend data will be obtained with the information on vertical difference in CO2 concentration, by comparing the data from other stations in Japan. China has one station at Mt. Waliguan in Qing-Hai province. The data from Mt. Fuji can be compared to the data from the Chinese site, showing the influence of emissions from the Asian region.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Ippei Nagao Nagoya University, Furocho, Chikusaku, Nagoya, 464-8601, Japan: i.nagao@nagoya-u.jp
Col1aborators (affiliation, address, e-mail)	
Theme	Observation of oxidation products of DMS in the free troposphere
Expense*	¥ 1,000,000
Outline (Aim, methods and expected outcome of the research)	DMS is thought to be one of important precursors of sulfate aerosols, and new particle formation from sulfuric acids probably takes place in the free troposphere where preexisting particles are less abundant than in the boundary layer. However, under the condition of low temperature, productions of dimethyl sulfoxide (DMSO) and dimethyl sulfone ($DMSO_2$) from DMS oxidation compete the production of sulfuric acids, resulting in reducing a contribution of DMS to a new particle formation. Therefore following two terms should be studied: (1) to understand a relative abundance of DMSO and DMSO2 to MSA and H2SO4 in the free troposphere, (2) (if possible) to relate these fractions to the meteorological and photochemical conditions. Methods: Continuous sampling of aerosols will be carried out at two sites (the summit of Mt. Fuji and around 5-Goume). Sampling period should be planed under consideration of meteorological conditions. Then chemical compositions of aerosols are analyzed to quantify the amounts of MSA, SO_4^{2-}, DMSO and $DMSO_2$. Meteorological conditions are also recorded. Outcomes expected: Although several studies on the relative abundance of DMSO and MSA are carried out in the marine boundary layer, these studies in the free troposphere are limited. Therefore this study will help us to study a contribution of DMS to a new particle formation and to quantify the branching ratio of these pathways in the free troposphere where new particle formation will take place.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Tomoaki OKUDA Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama 223-8522, Japan: okuda@applc.keio.ac.jp
Col1aborators (affiliation, address, e-mail)	
Theme	Observation of polycyclic aromatic hydrocarbons (PAHs) and trace metals in aerosol in free troposphere
Expense*	1,000,000 JPY
Outline (Aim, methods and expected outcome of the research)	Backgrounds: Recent studies have been concerned with sources and behaviors of atmospheric aerosols, because they can be related with serious health hazards such as increasing risks of respiratory diseases. In the Chinese urban area, a large amount of aerosol is emitted from anthropogenic sources and natural sources. They will be transported to around Japan via troposphere; however, no continuous observation of particulate pollutants (such as polycyclic aromatic hydrocarbons (PAHs) and trace metals) was not achieved yet. Methods: Daily concentrations of trace metals in the aerosol will be measured at the summit of Mt. Fuji. Automatic continuous air sampler will be installed at the sampling site. 20 kinds of PAHs and 16 kinds of metals in every aerosol sample were analyzed by using HPLC/fluorescence detection for PAHs and inductively coupled plasma mass spectrometry equipped with a laser ablation sample introduction system (LA/ICP-MS) for metals. Outcomes expected: This is the first trial in the world to obtain continuous daily concentrations of trace metals in the aerosol at free troposphere. Long range transport processes and chemical reaction during the transport will be solved by comparing the data of PAHs and metals at the summit of Mt.Fuji with those at a source region (for example, ground observation data at Beijing, China).

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Kazuo OSADA Graduate School of Environmental Sciences, Nagoya University, Nagoya, 464-8601, kosada@nagoya-u.jp
Col1aborators (affiliation, address, e-mail)	Yasunobu IWASAKA (Kanazawa University) kosa@t.kanazawa-u.ac.jp Mizuka KIDO (Toyama prefectural Environmental Science Research Center, Toyama) mizuka.kido@eco.pref.toyama.jp
Theme	Relationship between ammonia and aerosol nucleation at Mt. Fuji
Annual Expense*	¥ 500,000
Outline (Aim, methods and expected outcome of the research)	Ammonia is the only alkaline gas in the atmosphere and will neutralize acidic aerosol particles. One theory of ternary nucleation involve ammonia, water vapor and sulfuric acid and suggests that thermodynamically stable clusters can form under typical atmospheric concentration levels of the precursor gases. However, free tropospheric measurements of ammonia and related parameters are very sparse. To study nucleation and transformation of aerosols, we propose continuous ammonia measurements. We are trying to develop sensitive and automated system of ammonia measurements on the remote site such as Mt. Fuji. The system needs AC power and daily maintenance to perform the measurements, and occupies about 1x2 m area and 1.5 m height for the whole equipment. We will also measure and collect size-segregated aerosol particles during some intensive observation periods. Measurements and collection of aerosols could be collaborated with other groups. These data may provide an insight into nucleation and transformation of aerosols in free troposphere.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Hiroshi Takahashi Meteorological Research Institute, 1-1, Nagamine, Tsukuba, 305-0052, Japan htakahas@mri-jma.go.jp
Col1aborators (affiliation) (address; e-mail)	
Theme	Vertical distribution of aerosol in relation to laminar flow, turbulent flow and forced uplift by mountains
Expense*	¥ 1,000,000
Outline (Aim, methods and outcome of the research)	When Mt. Fuji Weather Station is regarded as an observation platform of upper atmosphere of Japan, signals expected are those of the concentrations of various chemical species transported long distant such as from the Asian Continent. Then, the influence from the boundary layer near by should be eliminated as well as possible. The summit of Mt. Fuji is thought to be in free troposphere most of the time, however, detailed separation of the individual data has not been performed yet, such that the which aliquot is from the boundary layer. This research aims the separation and elimination of those noises from the observation of aerosol in free troposphere. Methods Particle counters will be operated continuously at 3776m, 3255m, 2400m and 1300m for several years. Observation campaigns will also be planned to see the seasonal difference and atmospheric conditions such as laminar flow and turbulent flow. Outcome expected The detailed separation methods will be obtained of noises from the boundary layer in three ways: (1) ordinary separation (2) transportation and mixing process accompanied with disturbance (3) diurnal change in non-disturbance intervals. The results will serve as the theoretical background of other observation in free troposphere, which will also contribute to the forecasting the future atmospheric environment.

Field	Atmospheric Chemistry
Main researcher (affiliation) (address; e-mail)	Katsuhiro Yoshioka Shimane Prefectural Institute of Environmental Science, 582-1, Nishihamasada, Matsue, 690-0122, Japan: yoshioka-katsuhiro@pref.shimane.lg.jp
Col1aborators (affiliation, address, e-mail)	
Theme	The long time monitoring of the time variation of the vertical distribution of radon concentration
Expense*	First year: ¥4,000,000 next: ¥500,000/year
Outline (Aim, methods and expected outcome of the research)	The atmospheric distribution of ^{222}Rn concentration has been influenced by the geographical distribution of ^{226}Ra concentration in the crust. The continuous observation of ^{222}Rn concentration has not almost been performed in the upper altitude of the atmospheric boundary layer and/or the free troposphere, but in the lower, ^{222}Rn concentrations have been measured frequently in Japan. The vertical distribution of ^{222}Rn concentration from the surface layer to the free troposphere has been very important data due to estimate the vertical mixing process of the air mass. On the remote ocean, the atmospheric ^{222}Rn concentration depends on the mixing ratio of the continental air mass and the maritime and/or the spatial scale of the diffusion and mixing. Accordingly, the survey ^{222}Rn concentrations are very important data due to the verification of the mixing process in the long rang transport. Method: In this observation, ^{222}Rn concentration is measured by the continuous measurement equipment. This equipment has given good results at various places in many studies as yet. In this study, measurement points are necessary more than three altitudes from the surface layer to the summit. Outcomes expected: The vertical distribution of the atmospheric ^{222}Rn concentration has been expected with the diurnal variation by the vertical mixing of the air mass due to the thermal convection. The time variation of the vertical mixing process could be verified due to the time variation of the vertical distribution of ^{222}Rn concentration. In the free troposphere, ^{222}Rn due to the long range transport from the Asian continent would be detected easily for the lower level of background ^{222}Rn concentration.

Field	High Altitude Medicine
Main researcher (affiliation) (address; e-mail)	Katsumi Asano (Inst. of Health & Sport Sciences, Univ. of Tsukuba) E-mail hypk.asano@kca.biglobe.ne.jp Tel&Fax: 029-851-0015
Col1aborators (affiliation, address, e-mail)	Masayoshi Yamamoto (National Inst, of Fitness and Sports) Kou Mizuno (Tohoku Fukushi Univ.) Takeshi Nishiyasu (Univ. of Tsukuba) Masako Horii (Kanagawa Prefecture)
Theme	Human studies on consecutive monitoring of cerebral blood flow dynamics, cardiorespiratory function at rest & exercise and sleep architecture for 4 weeks at the top of Mt. Fuji
Expense*	¥ 3,000,000
Outline (Aim, methods and outcome of the research)	1. Cerebral blood flow dynamics and cardiorespiratory functions at rest and exercise will be measured before and during 4 weeks on 12 healthy young male consists of 6 Himalayan climber and 6 control subjects. Enhancement of sympathetic autonomic nervous system at Mt. Fuji would be considered to increase of cerebral blood flow and cardiorespiratory function at rest and exercise. Comparative studies on these prameters would be done between Himalayan climbers and control subjects. 2. Consecutive monitoring of sleep architecture for 4 weeks nights will be done on 12 healthy young male consists of 6 Himalayan climbers and control subjects Polysomnographic recordings will be performed during this period and comparative studies would be done between subjects dosing of Diamox and placebo. Effectiveness of Diamox dosage for prevention of acute mountain sickness at Mt. Fuji would be confirmed by activation of respiration during sleep. 3. Our recent results: Mizuno, K. and Asano, K. et al. Cnsecutive monitoring of sleep disturbance for four night at the top of Mt. Fuji (3776m) Psychiatry and Clinical Neurosciences 59, 223-225, 2005

Field	High Altitude Medicine
Main researcher (affiliation) (address; e-mail)	Masako Horii Kanagawa Health Service Association, 58 Nihon-Odori,Naka-Ku, Yokohama, 231-0021, Japan ： horii@beige.ocn.ne.jp
Col1aborators (affiliation, address, e-mail)	Toshio Kobayashi(Shinshu Univ., School of Medicine) Shigeru Masuyama(Ryotokuji Univ) s_masu@za2.so-net.ne.jp NorihiroKamikomaki(KeihaiRosaiHospital) nori-k@db3.so-net.ne.jp
Theme	Acetazolamide in Prevention of Acute Mountain Sickness
Annual Expense	¥ 10,000,000 ＊
Outline (Aim, methods and expected outcome of the research)	Acetazolamide(Diamox) a drug often used in the treatment of the eye condition glaucoma is useful in the prevention of Acute mountain sickness (AMS). AMS occurs commonly during visit to 3,000-4500m. Rarely (but even at these altitudes) the condition progresses to cause more serious problems which are potentially fatal pulmonary and cerebral edema. Aim ： The purpose of this study is to confirm the way to use and dose of Diamox for Japanese mountaineers at high altitude. It founded on the results of questionnaire study to investigate the effects of Diamox on prevention of AMS, which 409 members climbed over 6,000m high mountains during the period between Jan.2000 and Dec.2001. [Japanese Journal of Mountain Medicine 23 : 115-122, 2003.] Methods ： Subjects are 100 mountaineers scheduled going to climb oversea high mountains and volunteers. The period of this study is June to September. The climbers group make up about ten mountaineers and five days include stay 3-4 nights at the top of Mt.Fuji. The subjects take Diamox according to method of double blind protocol. In addition to general health parameters at sea level and at the top of Mt.Fuji, ACE gene measurement will be done. The standard of acclimatization depends on AMS score (Lake Louise) and SpO2 measurement.

Field	High Altitude Medicine
Main researcher (affiliation) (address; e-mail)	Rika Ide Eiju General Hosp. 2-23-16 Higashi-ueno, Taito-ku, Tokyo, 110-8645 Japan : ride@m6.dion.ne.jp
Col1aborators (affiliation, address, e-mail)	Sho Kanzaki (Keio university Hosp. Medical school) : skan@sc.itc.keio.ac.jp
Theme	Effect of inner ear function under hypobaric hypoxia
Expense*	¥3,000,000
Outline (Aim, methods and expected outcome of the research)	Previous study investigated that the cochlear and vestibular function were decreased in hypobaric hypoxia but the pathogenesis were not showed in detail. It is necessary to investigate inner ear function not only Central Nervous System function in hypobaric hypoxia. Another hand, it may be a help to elucidate one of the pathogenesis sudden deafness that circulation disorder in inner ear is considered one of the cause. OAEs(=otoacoustic emissions) measured in the external ear canal represent acoustic energy presumed to be generated within the cochlea. OAEs reflect some aspect of the active biophysical mechanisms within cochlear and it was clinical potential to objectively measure cochlear activity originating the outer hair cells. Methods: TEOAE(= transient evoked otoacoustic emissions), DPOAE(=distortion products of otoacoustic emissions) and Tympanogram will measured in 0m(sea level), 2400m and 3776m(at the summit). SpO2 and heart rate(=HR) will measured at same time. Before the climbing, the otoscope examination and pure tone audiogram will be performed. It will be except middle and inner ear disorder. Outcomes expected: Cochlear function in hypobaric hypoxia will be revealed. It will be shown the trend of different altitude. After of accommodation, the results will compaired with before. It will be able to pursuit the process of accommodation in inner ear function.

Field	High Altitude Medicine
Main researcher (affiliation) (address; e-mail)	Shigeru Masuyama （Faculty of Heath Sciences, Ryotokuji University） E-mail：s_masu@za2.so-net.ne.jp Phone：047-382-2111
Col1aborators (affiliation, address, e-mail)	1 Human study on dynamic change of pulmonary circulation during short stay on the summit of Mt. Fuji. 2 Human study on dynamic change of blood coagulation and fibrinolysis system during short stay on the summit of Mt. Fuji.
Theme	Atsuko Masuda(Tokyo Medical and Dental University)
Expense*	30,000US$
Outline (Aim, methods and expected outcome of the research)	1 Responsiveness to hypoxemia of pulmonary circulation especially of pulmonary artery is key factor to initiate High Altitude Pulmonary Edema(HAPE). Serial change of pulmonary artery's response to vasoactive agents such as nifedipine or sildenafil is researched. 2 Sudden death cases during mountaineering and trekking have been reported. Infarctional episodes of coronary , cerebral and pulmonary arteries are believed responsible for such cases, which is partially explained by modification in blood coagulation and fibrinolysis system. Factors such as hypoxia, hypothermia, dehydration and exercise stimulus are though to contribute the modification. Serial change in activity of blood coagulation and fibrinolysis and effect of anticoagulant on it would be assessed. Human subjects are volunteer based mountaineer and trekkers. Studies will be done before and during several days stay on the top of Mt. Fuji.

Field	High altitude medicine
Main researcher (affiliation) (address; e-mail)	Eisuke Takazakura Kurobe City Hospital, 1108-1 Mikkaichi, Kurobe City Toyama 938-8502,Japan :sakura@med.kurobe.toyama.jp
Col1aborators (affiliation, address, e-mail)	Shigeyoshi Nagasaki Kurobe City Hospital, 1108-1 Mikkaichi, Kurobe City Toyama, 938-8502,Japan:r-sports@med.kurobe.toyama.jp
Theme	Is staying at high altitude effective for improvement of metabolic syndrome?"
Expense*	¥1,000,000
Outline (Aim, methods and expected outcome of the research)	Weight loss is frequently observed at high altitude. We reported that at high altitude increase of resting energy expenditure(REE) , lipolysis and improvement of insulin resistance were shown in obese subjects. However, the mechanism behind pathophysiologic changes is still not fully understood. In this study to elucidate the mechanism of improvement factors of metabolic syndrome at high altitude we tested these factors at sea level and at various points of high altitude. Methods: Eight healthy peoples will be examined at Kurobe City Hospital(sea level),at Mt. Tateyama Murodoudaira(2,450m), at summit of Mt. Tateyama(3,000m) and at Mt. Fuji(3,776m). After staying for 2days at each altitude, blood samples of each will be drown. REE, HOMA-R(plasma insulin/glucose x 405), lipids, Leptin, noradrenalin and adiponectin will be assayed. Outcomes expected: results may suggest as follows; at high altitude REE and lypolysis may be accelerated according as the levels of altitude via the activation of sympathetic nervous system which may be resulted in loss of abdominal fat. Furthermore, decrease of HOMA-R, improvement of insulin sensitivity, may be brought about by hypoxia according as the levels of altitude. Staying at high altitude may be beneficial to subjects with metabolic syndrome , which may be more remarkable at higher altitude.

Field	High altitude medicine and physiology
Main researcher (affiliation) (address; e-mail)	YAMAMOTO Masayoshi National Institute of Fitness and Sports 1 Shiromizu, Kanoya Cikty, Kagoshima, 891-2393 yamamoto@nifs-k.ac.jp
Col1aborators	ASANO Katsumi hypk.asano@kca.biglobe.ne.jp
Theme	Development of High Altitude Acclimatization Training by Using Mt. Fuji's Environment
Expense*	¥ 3,000,000
Outline (Aim, methods and outcome of the research)	Purpose: The altitude of 3500-4000m is suitable training field for acclimatizing high altitude to climb high mountains or working at high place. But there are few places above 4000m in Japan. Therefore, high altitude sickness is a serious problem for Japanese mountaineers or workers going to high places in foreign countries. Mt. Fuji (the highest mountain in Japan) is anticipated to be the best place to solve the problem. We attend to try to find the methods (sojourning days and frequency at the mountain) for acclimatizing to high altitude by using Mt. Fuji. Methods: The subjects have various fitness tests at a laboratory at sea level. And they go up Mt. Fuji and do various exercise or take rest at the summit. After returning to sea level, the subjects have the same tests again, and find the training effects. Value of this study: We will be able to find how we should do the acclimatization training in Japan for going to higher altitude of foreign country. Especially, we can prevent many accidents caused every year by middle or high aged mountaineer who go to mountain such as Himalaya.

Field	Astronomy
Main researcher (affiliation) (address; e-mail)	Satoshi Yamamoto（Department of Physics, The University of Tokyo） yamamoto@taurus.phys.s.u-tokyo.ac.jp
Col1aborators	
Theme	Astronomical Observation in the Terahertz Region with a Transportable Telescope
Expense*	¥ 10,000,000
Outline (Aim, methods and outcome of the research)	The summit of Mount Fuji is a unique site in Japan for astronomical observations in the submillimeter-wave to terahertz band because of its very cold temperature and very low humidity conditions during the winter season. It is one of the best sites in the world, which was proven by our successful operation of the Mount Fuji Submillimeter-wave Telescope from 1998 to 2005. With this telescope, we delineated the distribution of the submillimeter-wave emission line of the atomic carbon (492 GHz and 809 GHz) toward a number of nearby molecular clouds, and explored formation and evolution of molecular clouds, which are birthplaces of new stars. Based on this success, we propose to make an extensive observation of the nitrogen ion line at 1460 GHz with a small-sized telescope. Since the nitrogen ion exists in the warm ionized medium, we will be able to study distribution and kinetics of such plasma clouds in interstellar space and their roles in the formation and evolution processes of molecular clouds. With this study, we aim at throughout understanding of global circulation of interstellar matter in the Galaxy. For this purpose, we will develop the transportable THz telescope with the aperture diameter of about 20 cm. As a receiver, we will employ the low noise HEB mixer receiver, which is now developing in our laboratory of the University of Tokyo. The observing system is so compact that it can be installed and operated with a few persons at the summit of Mount Fuji. Although the sky transmittance is only 10 – 15 % at 1460 GHz, we are expecting to detect the nitrogen ion lines toward various sources. This is a pioneering project for the THz astronomy, and will certainly be a good basis for a future proposal for the THz observation from space.

Field	Ecology
Main researcher (affiliation) (address; e-mail)	Takehiro Masuzawa Faculty of Science, Shizuoka University 836, Otani, Suruga-ku, Shizuoka, 422-8529, Japan sbtmasu@ipc.shizuoka.ac.jp
Col1aborators (affiliation, address, e-mail)	Emiko Maruta (Toho University, maruta@bio.sci.toho-u.ac.jp) Miki Tomita (Shizuoka University)
Theme	Research on permafrost of Mt. Fuji and long term changes in moss and lichen community
Expense*	¥ 500,000
Outline (Aim, methods and outcome of the research)	Mt. Fuji is the only place in Japan where permafrost has been found. Near the summit, owing to the high altitude, the environment for plants is very severe such as low temperature, strong wind, low humidity and immature volcanic soil. However, plenty lichen and moss are found near the summit of Mt. Fuji, some of which are living on the scarce water which slowly melts from the permafrost and freezed soil. Therefore, observation on the distribution of the lichen and moss community will provide information of the existence of permafrost as well as the knowledge of the mechanism of lichen and moss living in the extreme environment. Methods: Geothermal measurement will be performed at 0, 5, 15, 30, 50, 70 cm from the surface, utilizing temperature sensors followed by the calculation to estimate the position of permafrost. For the research on lichen and moss community, the permanent quadrats will be utilized which have been already set up in the previous research, showing that plenty of lichen and moss were existing near the summit of Mt. Fuji. Outcome Expected: In addition to the previous results obtained for the distribution of lichen and moss from 1998 using the permanent quadrats, a long term trend of lichen and moss will be shown at several sites near the summit of Mt. Fuji. The results will be utilized as an index of the position of permafrost, which can serve as a visual influence of global warming.

Field	Glaciology
Main researcher (affiliation) (address; e-mail)	Keisuke Suzuki Faculty of Science, Shinshu University, Asahi 3-1-1,Asahi, Matsumoto, 390-8621, Japan kei@shinshu-u.ac.jp
Col1aborators (affiliation, address, e-mail)	
Theme	Research on chemical species in mountain snow as indexes of atmospheric environment
Expense*	¥ 1,000,000
Outline (Aim, methods and outcome of the research)	Mountains of high altitude preserve clean atmosphere because of the severe meteorological conditions, however, recently, anthropogenic pollutants are found in the snow samples of high mountains, transported long range from the source area. Measurement of chemical species in dry and wet deposition in the snow of high mountains will provide information of the source of the pollutants. Methods Samples will be collected from the vertical layers of snow pile for the determination of chemical species. The history of the layer will be found by other determination methods. Outcome Expected The results will show the deposition amounts of chemical species in the snow layers of known history, as well as to develop a new simple method in obtaining sequential samples at high mountains.