# Research Activities

Mt. Fuji is an iconic UNESCO World Heritage site. However, the important role that Mt. Fuji plays for scientists as a laboratory above the clouds is less well known.

Since the summer of 2007, Mt. Fuji Weather Station has been operated by the non-profit organization "Valid Utilization of Mt. Fuji Weather Station", renting part of the station from the Japan Meteorological Agency. For 2 months during the summer research campaigns, the organization runs an open research station for interdisciplinary science and education.

The summit of Mt. Fuji (35.21°N, 138.43°E, 3776 m a.s.l.) is in the path of the East Asian upper air mass, which is transported from the Asian Continent through the free troposphere. Mt. Fuji therefore provides an ideal observation site for atmospheric chemistry and physics research, such as monitoring fine particulate matter, sulfate aerosols, and mercury. Mt. Fuji also serves as a good observation site for lightning, cosmic rays, and transient luminous events (sprites) as well as a base for high-altitude medical research including the training of climbers. Scientists studying the permafrost and the mountain's ecology also use the station.

#### **Atmospheric Chemistry**

The summit of Mt. Fuji reaches into the free troposphere, which is the atmosphere between an altitude of 1000 m and the start of the stratosphere. In this layer, substances travel long distances without being subject to land surface friction.

Substances produced on the Eurasian Continent are carried from west to east by westerly winds generated in the mid-latitudes of the northern hemisphere, so Mt. Fuji, which is located at the eastern edge of the Eurasian Continent, is the optimum site for observing these substances.

With the current rapid economic growth in Asia, the importance of the observations and research conducted at the Mt. Fuji station will increase because the station is located directly downwind of some of the largest combustion and other atmospheric effluent sources on Earth. For the last 10 years, many chemical and physical studies have investigated aerosols, including fine particulate matter and fog/cloud water; trace gases, such as carbon dioxide, ozone, carbon monoxide, and sulfur dioxide; and organic gases. An International Symposium on Atmospheric Chemistry and Physics at Mountain Sites (ACPM2017) will be held in Japan in November 2017, led by this group (Chairperson: Prof. S. Hatakeyama; Vice-Chairpersons: Prof. H. Okochi and Prof. K. Miura).

#### Atmospheric Electricity, Lightning, and Cosmic Ray Studies

The top of Mt. Fuji is often covered by thunder clouds, providing an ideal observation site for lightning, especially summer lightning, which usually occurs at cloud heights above 4000 m. On the roof of the station, atmospheric electricity measurements are performed with field mills and other instruments to understand the relationship between the electric field and the behavior of lightning-induced radiation.

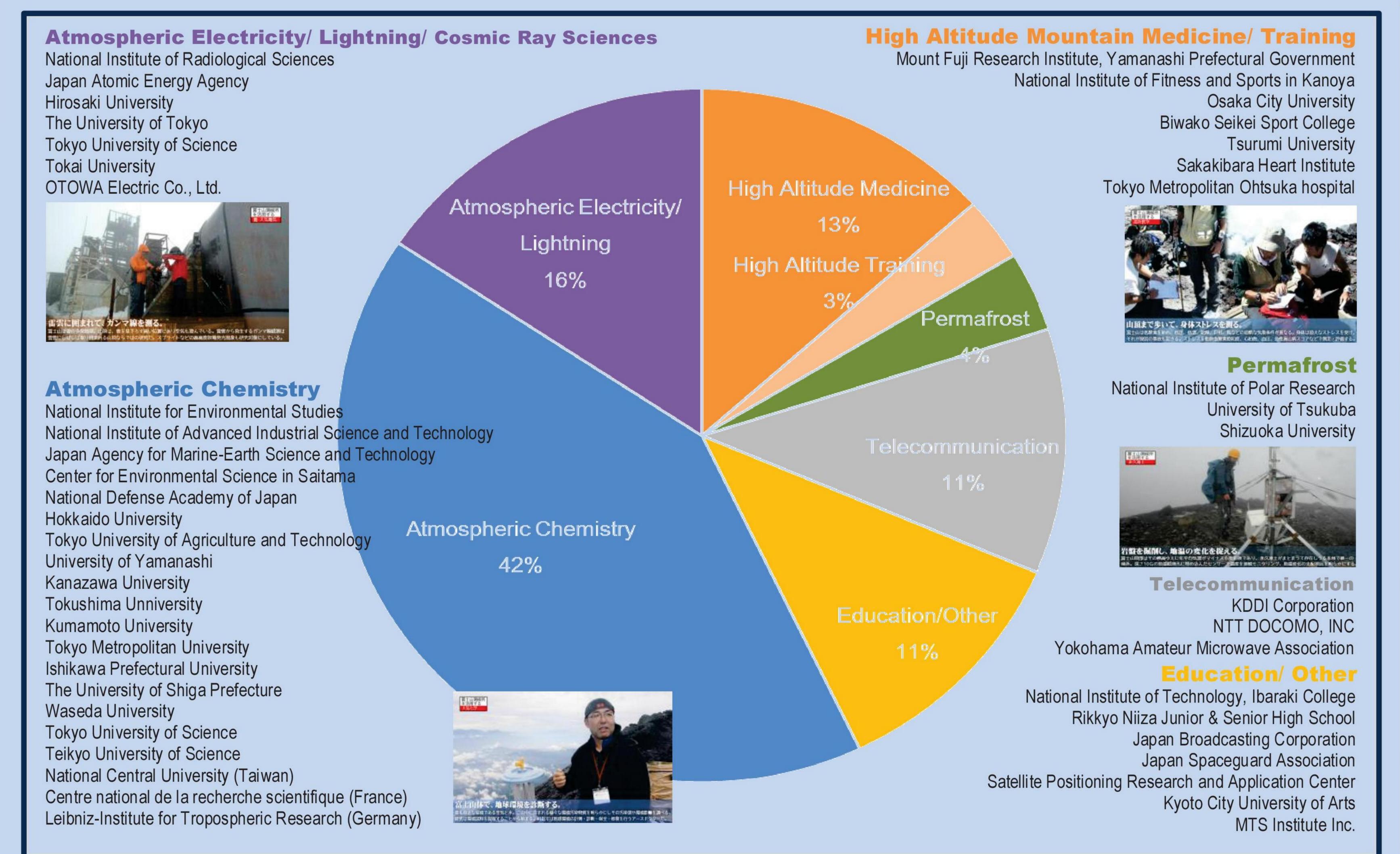
Cosmic radiation intensity grows stronger as the altitude increases because the atmospheric layer becomes thinner. This has raised concerns about the effects of cosmic radiation on the health of aircraft crew. A system for cosmic radiation measurements with advanced instruments has been constructed at Mt. Fuji Weather Station to obtain real-time accurate dosimetry of cosmic radiation exposure at aviation altitudes.

The altitude of Mt. Fuji is 3776 m, and the atmospheric pressure at the summit is only 60% of that at ground level. Symptoms of acute mountain sickness (AMS) occur above 2500 m and are the main cause of accidents on Mt. Fuji. We are investigating the pathophysiology, prevention, and treatment of AMS. The first barrier to high-altitude adaptation occurs at 4000 m. We estimate the high-altitude adaptation and evaluate the effects of high-altitude training.

#### Permafrost and Ecology

Permafrost can be found at the summit of Mt. Fuji. Research on special moss and lichens, which depend on the permafrost for water resource, is expected to help elucidate the effect of global warming on the distribution of permafrost.

From 2010, another research group investigating permafrost started digging holes as deep as 10 m near the summit.



## Space Science Education

We provide not only the infrastructure needed for researchers to conduct their experiments but also support for selected project teams run by students who have had their study funded.

One such project is "The Fuji-Sat Challenge Team", which is organized by space -technology-oriented students. They use a simulated satellite on top of Mt. Fuji in their work. They also provide valuable help with environmental conservation by removing litter.

### **Development of Scientific Education Tools**

New and unique scientific education tools for junior high and high school students are being developed by utilizing Mt. Fuji's environment. For example, a high-school science teacher has been developing an experimental method intended for classroom use to teach students how to investigate low pressure, severe wind and rain, sunshine, high UV light, and natural radioactivity.

# High-Altitude Mountain Medicine and Organization's History

In 2004, it was announced that Mt. Fuji Weather Station would be switching to unmanned operation. We felt that precious knowledge about maintaining a high-altitude research station would be lost, so we established a non-profit organization of more than 250 researchers to use the former Mt. Fuji Weather Station. The organization began observations and research at the Mt. Fuji Weather Station after receiving permission to use the facilities from the Japan Meteorological Agency in the summer of 2007, when the station became available for summer research work by the private sector.

For the 2 months between July and August each year, research is conducted at the Mt. Fuji Weather Station, including in the fields of atmospheric chemistry, high-altitude medical sciences, cosmic-ray science, and ecology. The number of researchers who take part in the Mt. Fuji project has been increasing yearly.

Altitude Research Group). 2006 March 4-5: First International Workshop/ Symposium in Tokyo, on International Valid Utilization of Mt. Fuji Weather Station. June 15: Mt. Fuji Science School started November 22-23: Second International Workshop/ Symposium at the University of Tokyo, funded by the MEXT grant for the Mt. Fuji Project for establishing a high mountain observation platform in an extreme environment. July 10-September 5: First Summer Campaign at

November 27: Valid Utilization of Mt. Fuji Weather

Station founded (re-organization from Mt. Fuji High

the Mt. Fuji Weather Station, 212 researchers participated over 58 days. July 17: World Eco-Science Network Meeting sponsored by Dentsu Ltd.

2008 July 10-August 31: Second Summer Campaign 379 researchers participated over 53 days. July 10-August 30: Third Summer Campaign

424 researchers participated over 52 days. NIES started year-round observation of carbon dioxide, using batteries. July 12-August 30: 4th Summer Campaign 467 researchers participated over 50 days. NIRS started

year-round observation of cosmic rays. AIST and Tokyo Metropolitan University started using wireless LAN for data communication and semi-real-time data publication. March 11, East Japan Earthquake and Fukushima

Daiichi Nuclear Disaster July 12-September 1: 5th Summer Campaign 373 researchers participated over 53 days. Radioactivity was measured on the climbing route, live camera images of cloud were broadcast by wireless LAN to the organization

> completed at two stations, at the summit and in Yokohama. July 13-August 31: 6th Summer Campaign 366 researchers participated over 54 days. A new air inlet was constructed for the third building. A 5-year contract

> members, and children and parents' programs were

with the Japan Meteorological Agency was signed. July 16-August 30: 7th Summer Campaign 427 researchers participated over 42 days. PM2.5 was

observed. Sakurajima volcanic gas was detected by Dr. S. Kato during SO<sub>2</sub> observations at the summit. July 1-August 29: 8th Summer Campaign 434 researchers participated over 60 days. A gigantic jet was observed by Dr. M. Kamogawa and Tokyo Gakugei University group. Live camera images were broadcast to

the public. September 27, 2014: Eruption of Mt. Ontake 3067- m volcano on the west side of Kiso Valley.

July 8-August 28: 9th Summer Campaign 530 researchers participated over 22 projects in 52 days. Also included a new student program, "Fuji-Sat" Real-time SO<sub>2</sub> data, with live camera images and a virtual tour of the

station published on the home page. July 1-September 1: 10th Summer Campaign 456 researchers participated over 63 days. A Taiwan-Japan project on atmospheric mercury and VOCs was

carried out by the National Central University and TUAT. July 1-September 1: 11th Summer Campaign

**November 7-10: ACPM2017** International Symposium on Atmospheric Chemistry and Physics at Mountain Sites will be held at Gotemba, Japan.

