

# **Educational and Research Programs in Atmospheric Sciences, Institut Teknologi Bandung <sup>\*)</sup>**

**Bayong Tjasyono HK.  
Faculty of Earth Sciences and Technology  
ITB – Indonesia**

## **Introduction**

Institut Teknologi Bandung (ITB), lies in Bandung (West Java) about 150 km toward southeast from Jakarta (the capital of Indonesia). Bandung (700 m, a.s.l) is a basin area surrounded by volcanos, for example Mt. Tangkuban Perahu (2100 m, a.s.l) about 20 km toward north from ITB. It is a tourism area to view a scene of the crater. There are three state universities in Bandung, namely Institut Teknologi Bandung, University of Padjajaran, and University of Education.

ITB covers three studies i.e., Science, Technology and Art, comprises five Faculties, five Schools, and one Graduate School with many Graduate Programs among these are related to the Asia Science Forum, such as Faculty of Earth Sciences and Mineral Technology, and Faculty of Mathematics and Natural Science, Each Faculty or School has one or more Graduate (Master and Doctoral) Programs.

Faculty of Earth Sciences and Mineral Technology comprises eight departments, namely : Department of Meteorology, Geophysics, Oceanography, Geological Engineering, Mining Engineering, Metallurgical Engineering, Petroleum Engineering and Geophysical Engineering. Since August 1, 2007, this Faculty was developed into two new faculties, namely :

- 1. Faculty of Earth Sciences and Technology** covers three departments and two graduate programs that are :  
Departement of Meteorology  
Departement of Oceanography  
Departement of Geological Engineering  
Graduate Program in Earth Sciences  
Graduate Program in Geological Engineering

---

<sup>\*)</sup> Submitted to Asia Science Forum, 10 – 11 September 2007, Sendai International Center, Japan.

## **2. Faculty of Mining and Petroleum Engineering comprises :**

Departement of Mining Engineering  
Departement of Petroleum Engineering  
Departement of Metallurgical Engineering  
Departement of Geophysical Engineering and  
Graduate Programs

### **Educational Program in Meteorology and Atmospheric Sciences**

Study of meteorology is offered in undergraduate program, Department of Meteorology. While atmospheric sciences is offered in graduate (Master and Doctoral) program of Earth Sciences.

#### **Department of Meteorology**

The preceding years, Meteorology was joined together with Oceanography and Geophysics at the Department of Geophysics and Meteorology, Faculty of Mathematics and Natural Science. Since 1998 this Department was developed into three departments, namely Department of Meteorology, Department of Oceanography and Department of Geophysics. The three Departments are belong to Faculty of Earth Sciences and Mineral Technology. And since August 1, 2007 this Departement of Meteorology together with Department of Oceanography and Geological Engineering belong to Faculty of Earth Sciences and Technology.

#### **a. Undergraduate (Sarjana) Program in Meteorology**

Departement of Meteorology executes Sarjana (undergraduate) program of meteorology. The curriculum of undergraduate program is designed for 8 semesters (4 years) with 144 scu (semester credit unit). Students earn Sarjana degree when they finish 144 credits of required course, submit a script and pass the comprehensive examination.

#### **b. Graduate (Pascasarjana) Program in Earth Sciences**

ITB has one Graduate School which offer many programs. One of these programs is Graduate Program in Earth Sciences belonging to Faculty of Earth Sciences and Technology (a new Faculty). The execution of graduate program is conferred to the Faculty members. The Graduate Program of Earth Sciences covers three divisions i.e., Physical Oceanography, **Atmospheric Sciences**, and Geophysics (Seismology).

### b.1. Master Program

The Master Program in Oceanography and Atmospheric Sciences was founded in 1996. The objective is to aid in achieving the national development goal through producing graduate with deepened academic knowledge and professional ability, and to develop oceanographic and atmospheric sciences, and seismology. The Master Program in Oceanography and Atmospheric Sciences was certified by **National Accreditation Body** and received the rating of **Excellent**. In 2006, the name of the Master Program is now to be changed into Master Program in Earth Sciences like the name of Doctoral Program.

The curriculum of master program is designed for 4 semesters (2 years) with 36 scu (semester credit unit) i.e., 3 semesters for following compulsory (17 scu), elective (13 scu) subjects and 1 semester for submitting a thesis (6 scu) and final examination on the thesis. The compulsory subjects consist of Advanced Geostatistics (3 scu), Physical Oceanography 2 (scu), Atmospheric Science (2 scu), Advanced Signal Analysis (3 scu), Advanced Numerical Analysis (3 scu), Structure and Material of the Earth (2 scu) and Geo-hazards (2 scu). The elective subjects depend on the division of Master Program, for example the division of Atmospheric Sciences has the elective subjects as follows : Atmosphere Dynamics, Sea – Air Interaction, Weather Prediction, Monsoon Meteorology, Cloud and Rain Microphysics, Global Climatology. This elective may be taken from other divisions or other Graduate Program which is related to the Master Program in Earth Sciences, see table 1.

Table 1. Distribution of subjects for each semester is :

<b>Semester 1</b>	<b>scu</b>	<b>Semester 2</b>	<b>scu</b>
1. Advanced Geo-statics	3	1. Advanced Signal Analysis	3
2. Physical Oceanography	2	2. Advanced Numerical Analysis	3
3. Atmospheric Science	2	3. Structure & Material of the Earth	2
4. Electives	5	4. Electives	4
	<b>12</b>		<b>12</b>

<b>Semester 3</b>	<b>scu</b>	<b>Semester 4</b>	<b>scu</b>
1. Geo-hazards	2	1. Thesis	6
2. Electives	4		
	<b>6</b>		<b>6</b>

## b.2. Doctoral Program

The Doctoral Program in Earth Sciences was founded in 2003. The Master and Doctoral program are under the Graduate School, Institut Teknologi Bandung (ITB) and have been run by the Department of Geophysical Engineering, Meteorology and Oceanography. Students who wish to be accepted in the Doctoral Program should have Master degree at a university or college in Indonesia or abroad. The required qualification are Master degree of Science or Engineering with sufficient mathematical and physical background, and pass the entrance selection.

The curriculum of doctoral program is designed for 6 semesters (3 years) with 56 scu that are : Comprehensive subjects (12 scu), Writing of Proposal (6 scu), Qualifying Exams (2 scu), Development of Method (3 scu), Experiment/Survey Analysis (12 scu), Writing of Dissertation (6 scu), Electives (12 scu), and Dissertation (closed) Exams (3 scu). In semester I, students have to follow Comprehensive subjects (12 scu) depending on their divisions (Physical Oceanography, **Atmospheric Sciences** or Seismology).

Table 2. Distribution of subjects (scu) for each semester is :

<b>Semester 1</b>	<b>Semester 2</b>	<b>Semester 3</b>
1. Comprehensive subjects (12)	1. Writing of Proposal (6) 2. Qualifying Exams (2)	1. Development of Method I (3) 2. Experiment/Survey & Analysis I (6) 3. Electives (3)
<b>Semester 4</b>	<b>Semester 5</b>	<b>Semester 6</b>
1. Experiment/Survey & Analysis II (6) 2. Electives (6)	1. Writing of Dissertation I (6) 2. Electives (3)	1. Dissertation (Closed) Exams (3)

The Graduate (Master and Doctoral) Prgram is supported by three Research Groups, namely :

1. Atmospheric Sciences Research Group (Prof. Bayong Tjasyono HK, leader).
2. Oceanography Research Group (Prof. Safwan Hadi, leader).
3. Geophysical Science & Engineering Research Group (Prof. Sri Widiyantoro, leader).

These research groups was founded by ITB in 2005. Each department has one or more research groups, so that the total is about 90 research groups. **The Faculty of Earth Sciences and Technology** has 4 research groups, namely :

Atmospheric Sciences research group related to Department of Meteorology.

Oceanography research group related to Department of Oceanography.

Geology and Paleontology research group, and Applied Geology research group related to Department of Geological Engineering. While Geophysical Science & Engineering research group is under the Faculty of Mining and Petroleum Engineering.

## **Scientific Research in Atmospheric Sciences**

### **a. Justification of the Research**

Most of Asian Continent is located in northern hemisphere, while Indonesia is geographically located in latitude between  $10^{\circ}$  N and  $10^{\circ}$  S known as an equatorial region. This region has surplus energy in all seasons. Insolation (incoming solar radiation) is in the considerable number. Because of the Indonesian region is covered by 70% waters and only 30% land, it gains a great number of condensation latent heat released from condensed water vapor into cloud droplets.

It is very interesting to investigate weather and climate due to equatorial atmospheric complexity and the unique of cloud formation in the Indonesian equatorial region. Mixing between waters and land as an Islands and mountainous region under the influence of monsoon Asia cause large variability of the local climate in Indonesia. There are three main types of the rainfall distribution, namely monsoon, equatorial and local types.

The difference of physical characteristics between ocean and continent, between sea and land yield the gradient pressure force is directed from ocean/sea to continent/land in summer/day-time, on the contrary the gradient pressure is directed from continent/land to ocean/sea in winter/night-time. As a mountainous region Indonesian is also affected by local winds such as valley and mountain winds. Therefore, local winds (sea-land breezes and valley-mountain winds) and monsoon circulation affect the diurnal and seasonal weather and climate variations. While other natural phenomena such as, El Niño / La Niña in Equatorial Pacific ocean, Dipole Mode in Indian ocean, Madden – Julian (40 – day) Oscillation, and so on affect the non seasonal climate variations over Indonesia.

Displacement of the intertropical convergence zone (ICZ) toward northern or southern hemispheres according to solar annual migration influence the rainfall amount in the equatorial region. Due to the Coriolis parameter or earth's vorticity is very small near the equator, tropical storm in high intensity rarely occur in the Indonesian waters in spite of the occurrence of the tropical cyclone in outer the Indonesian waters able to influence weather especially the increase of wind speed, rainfall amount and the height of sea wave.

The equatorial region of Indonesia not only important in atmospheric sciences investigation, but also in other earth sciences research programs like in oceanography and seismology investigation. The passage of the ITF (Indonesian Through Flow) from Pacific to Indian ocean and the IMC (Indonesian Monsoon Current) through the Indonesian waters will keep increasing to investigate scientifically the Indonesian waters. The passage of Mediterranean and Pacific seismic lines through Indonesia cause this region as an anxious area of earth-quake. Tsunami occurred in December 2004 was caused by earth-quake in the strength of 10 Richter scale. About 200.000 people was killed in this natural phenomenon.

## **b. Research Program**

### **i. Research Interest**

Physical and dynamical processes of the atmosphere. Interaction of Monsoon – El Niño / La Niña – Southern Oscillation – Dipole Mode. Weather and climate modeling and analysis. Seasonal and non-seasonal climate variability. Long-term variations and global climate change. Coastal and maritime meteorology. Physical processes of convective clouds and rainfall. Tropical storms in environs the Indonesian waters and its impact on the weather.

### **ii. Current Research**

Prediction model and analysis of ENSO. The impact of ENSO on the season in Indonesia. Drought and flood mechanism in Indonesian region. Weather modification and rain enhancement. Atmospheric boundary layer and sea – land breeze circulations. Air pollution monitoring and modeling. Characteristic of convective clouds and rainfall in the equatorial monsoonal region. Wind modeling and mapping related to wind energy.

Research in atmospheric sciences is carried out by Research Group of Atmospheric Sciences. Academic staff members are as follows ;

1. Bayong Tjasyono HK, Professor (Dr. 1979, Université de Clermont, Institut et observatoire de Physique du Glôbe, France), leader. Email : bayong@geoph.itb.ac.id
2. Tri Wahyu Hadi, Senior Assistant Professor (Dr. 2003, Kyoto University, Japan). Email : tri@geoph.itb.ac.id
3. Armi Susandi, Senior Assistant Professor (Dr. 2004, University of Hamburg, Max-Planck Institut für Meteorologie, Germany), contact person. Email : armi@geoph.itb.ac.id
4. Plato Martuani Siregar, Assistant Professor (Dr. 2006, ITB, Indonesia). Email : plato@geoph.itb.ac.id, and 5 members have Master degree.

### **Concluding Remark**

ITB makes the effort to increase the quality of academic staff members in teaching and research by continuing their studies to the Doctoral Program in Indonesia or abroad, it is expected that 80% academic staff members who earn Doctoral degree in 2010. In such a manner ITB able to become directly to research university.

Atmospheric Sciences research needs a strength of understanding on monsoon Asia and natural phenomena which influence weather and climate in Indonesian region by increasing the quality of staff members of Atmospheric Sciences Research Group from 40% (now) to 80% (in 2010) who earn Doctoral degree. From the aspect of geographical and meteorological position, it is very interesting to investigate the atmosphere over Indonesia due to the atmospheric complexity and the unique of convective clouds formation in the equatorial monsoonal region.

### **References**

1. Institut Teknologi Bandung. Graduation day – ITB, March 2007.
2. Institut Teknologi Bandung. Master and Doctoral Programs in Earth Sciences, 2004.
3. Institut Teknologi Bandung. Workshop on research platform at ITB, 2005.
4. Bayong Tjasyono HK. Atmospheric Sciences Roadmap Action Plan, Research Group of Atmospheric Sciences, Faculty of Earth Sciences and Technology, ITB, 2007.