



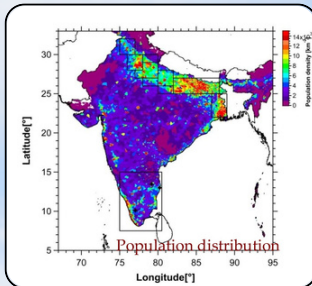
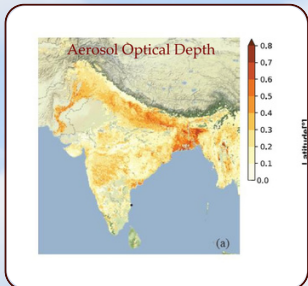
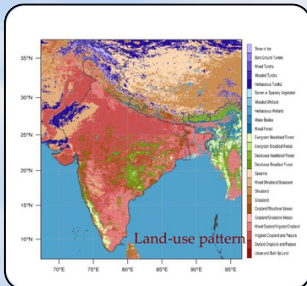
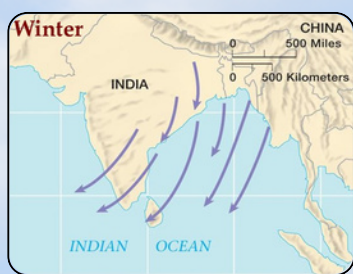
Overall goal/objective: To provide detailed understanding about atmospheric processes and their interactions covering the range from molecular to global scale helping in improved knowledge about climate change.

Specific Objectives:

- Running the courses, which are relevant to the requirements as basis by the top institutions for their doctoral programs
- Educate students with strong fundamentals, intellectual discipline, research aptitude in atmospheric and climate sciences with strong ethics
- To cover the larger aspect of the fundamentals in atmospheric and climate sciences so that students satisfied the broad need of climate change aspect across the diverse spectrum of fundamental research to industry-oriented requirements

Why this program ?

The challenging problems need quality Research Capacity Building !

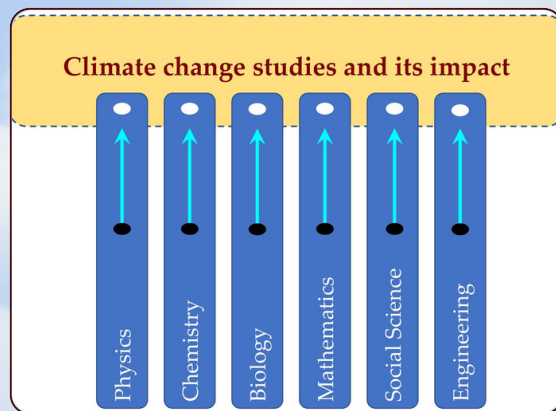
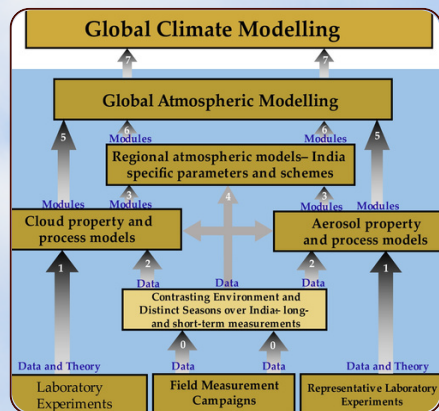


Program Outline

- Students already enrolled in engineering departments of the Institute for entry to the IDDD program
 - To be eligible for this programme, the student should have 8 CGPA at the end of 5th semester (the entry timeline similar to other IDDD programs)
- Additionally aligned for two-year M. Tech. program
 - Sponsored candidates from CPCB/SPCB/National Laboratories/NGOs/etc
- Up to 15 students may be admitted to this programme
 - 10 IDDD + 5 sponsored M. Tech.
- Drawing from the expertise available at IIT Madras, a multidisciplinary program is proposed for UG Engineering / International / Sponsored Candidates with faculty from following departments
 - Civil Engineering (CE)
 - Applied Mechanics (AM)
 - Chemistry (CY)
 - Chemical Engineering (CH)
 - Mechanical Engineering (ME)
 - Humanities and Social Sciences (HSS)

Approach and requirements

How this program can help in building India specific top quality capacity building



Requires multidisciplinary approach: Hence unique program

Proposed/Intended Job Prospects

- Ph.D. in Atmospheric and Climate Sciences Programs all over the World.
- Nominally there are more than 100 PhD positions are advertised per year across the globe in atmospheric and climate sciences, and allied areas.
- Organizations working on Environment, Weather, Climate Change, Ecology and Energy Issues (E.g. TERI, IMD (Indian Meteorological Department, WMO (World meteorological Organisation), UNEP (United Nations Environment Program), CPCB (Central Pollution Control Board), Climate Investment Funds (CIF), GCF (Green Climate Fund))

Industrial sector

- Industries manufacturing meteorological/climate/environmental sensors/Climate Change and risk assessment/sustainability consultants/Insurance(example: McKinsey, ERM, JBA Consultant, and Ernst and Young)
- Climate change think tanks – Example: CEEW, E3G, Center for Climate and Energy Solutions (CCES)

Current participating faculty

- Sachin S. Gunthe (CE; Coordinator)**
- Anindita Sahoo (HSS)**
- Anubhab Roy (AM)**
- Balaji C. (ME)**
- Chandan Sarangi (CE)**
- Rajakumar B (CY)**
- Ravikrishna R (CH)**
- Shiva Nagendra S. M. (CE)**

Proposed credit structure

Sr.	Course Number	Course Name	L	T	E	P	O	C
Semester 7 (Sem – I for M. Tech)								
1	ME5127	Core 1: Introduction to Atmospheric Science	3	0	0	0	6	9
2	CE5235	Core 2: Understanding climate dynamics and its mysteries	3	0	0	0	6	9
3	CEXXX	Atmospheric Science Laboratory	0	0	0	6	3	9
Total Credits								27
Semester 8								
1	CE5525	Core 3: Atmospheric Chemistry and Physics	3	0	0	0	6	9
2		Elective 1						9
3	CE5XXX	Core Lab 1: Atmospheric Simulation Laboratory	0	0	0	6	3	9
4		Elective 2						9
5		Total Credits						36
Project-I (Summer)								20
Semester 9								
1		Elective 3						9
2		Project 2						25
Total Credits								34
Semester 10								
1		Project 3						40
Total Credits								40
Total Credits								157

L: Lecture; T: Tutorial; E: Extended Tutorial; P: Laboratory; O: Outside class hours; C: Credits

Project: 85 credits to be completed in the Summer (after 8th Semester), 9th and 10th semester

Electives: 3 electives to be completed from the basket of elective courses given below.

In tune with the overall structure of the dual degree program being offered in the Institute, the number of courses to be offered and the credit distribution are as follows:

No. of PMT CORE courses to be offered: 3 (27 credits)

No. of electives to be offered: 3 (27 credits)

No. of CORE laboratory courses to be offered: 2 (18 credits)

Project work/internship: 1 (85 credits)

Total credits for the ID-DD specialization: 157

List of Electives

Sr.	Course No	Course Name	L	T	E	P	O	C1
1	CH5370	Environmental Quality Monitoring and Analysis	3	0	0	0	6	9
2	CE6180	Environmental Impact Assessment	3	0	0	0	6	9
3	CE5971	Aerosol Science and Technology	3	0	0	0	6	9
4	CYXXXX	Atmospheric Chemistry and Processes	3	0	0	0	6	9
5	CE5015	Environmental Monitoring and Data Analysis	3	0	0	0	6	9
6	CE5260	Models for water and Air Quality	3	0	0	0	6	9
7	ID5025	Geophysical Fluid Dynamics	3	0	0	0	6	9
8	CH5350	Applied Time Series Analysis	3	0	0	0	6	9
9	IDXXXX	Climate Change and Society	3	0	0	0	6	9
10	CE6215	Soil-Plant-Atmosphere continuum	3	0	0	0	6	9
11	CE5960	Remote Sensing of Earth Resources	3	0	0	1	6	10

Learning Outcomes

Students graduating with a dual degree in Atmospheric and Climate Sciences should be capable of understanding and applying the following:

- Fundamentals of Atmospheric Physics and Chemistry
- Momentum, Energy, and Mass Transport Processes in the Atmosphere
- Mathematical modelling of Atmospheric systems and climate dynamics
- Aerosol Science and Technology
- Environmental Impact and Risk Assessment
- Measurement, Analysis, and Interpretation of Atmospheric Characteristics
- Indian monsoon system: Impact of climate change on extreme weather events
- Impact of climate change on society: Culture and languages

Who can enrol in this program?

A B. Tech student or a Dual Degree student of IIT Madras in any discipline can upgrade/opt for this program provided the student has a CGPA of 8.0 or above up to the 5th semester. The total number of seats will be fixed at 15, and the rules of the Institute will govern allocation of dual degree specialization and award of the degree. This program would also be operated as M. Tech. program for the sponsored Organisations working on Environment, Weather, Climate Change, Ecology and Energy Issues (E.g. TERI, IMD (Indian Meteorological Department, WMO (World meteorological Organisation), UNEP (United Nations Environment Program), CPCB (Central Pollution Control Board), Climate Investment Funds (CIF), GCF (Green Climate Fund)). Various organisations have already expressed the strong interest assuring to encourage their employees and officers for this program. Further, this program is also aimed to be made available for the international students under I2MP program.

What is the curriculum?

ID-DD-ATMOSCC has a very flexible curriculum. The programme spans four semesters of the five-year dual degree programme. This course will ensure that the students who enter this specialisation from different streams have a basic understanding of atmospheric and climate systems to equip them to pursue further in-depth research or application in any area of atmospheric and climate sciences. This program can also orient students appropriately to the opportunities available in the current landscape of entrepreneurship.

Program objective

To provide detailed understanding about atmospheric processes and their interactions covering the range from molecular to global scale helping in improved knowledge about climate change.

Atmospheric and Climate Sciences is an interdisciplinary dual degree programme aimed at nurturing and developing the next generation of atmospheric and climate scientists. The effects of climate change are imminent, with far-reaching consequences in all spheres of our life. Increased participation in research related to atmospheric and climate sciences is imperative to improving our understanding of the complex systems involved in climate change. To train and orient potential future researchers toward world-class atmospheric and climate science research programs, we propose an interdisciplinary dual degree master's program to combine the disciplines of science, engineering, and social sciences. The goals of atmospheric and climate science research are to understand, record ultimately, and predict the underlying processes inducing the climate change in an attempt for us to manage, adapt, and help in the design of remedial measures. The Indian climate system is unique in weather patterns and atmospheric sciences, which requires detailed understanding and focus on research and development in this area to elucidate futuristic climate change impacts. Such research and capacity building need to be backed by a robust fundamental understanding, developed, and supported by local experts, and we cannot rely on several international agencies. Such dependence should be minimum for need-based collaborations. This program aims to mitigate this status in some measure. IIT Madras has faculty working in atmospheric sciences and climate change in various departments. Atmospheric and Climate Change studies is a multidisciplinary area, and no single department can have the critical mass to offer a dual degree program in atmospheric sciences; therefore, this proposed interdisciplinary dual degree program will cut across various departments and institutions. The dual degree program in Atmospheric and Climate Sciences will focus on the fundamental elements of atmospheric and associated environmental systems and the technical aspects of climate change at multiple scales of the planetary ecology. The curriculum has been developed with this focus.

Infrastructure

The major infrastructure required for this program is adequately and sufficiently available at IIT Madras, which include but not limited to advanced state-of-the-art particle and gas phase instruments, weather stations, and supercomputing facilities.

Structure of the laboratory courses

The laboratory courses are designed in such a way that each laboratory experiment/simulation will have one hour of theory classes to orient student with the detailed fundamentals about the experiments and model, which is being covered in the laboratory class. For example, the simulation laboratory, which will introduce students to the global climate models like WRF-Chem, GEOS-Chem, etc. will also include one hour of theory about the development, governing equations, and structure of the models. This will be followed by the hands on the global models, which need to be run on large clusters. We do have an access to large clusters through our collaborations with Harvard University and Max Planck Institute for Chemistry.

Potential Career Options

- Ph.D. in Atmospheric and Climate Sciences Program all over the World. Nominally there are more than 100 PhD positions are advertised per year all across the globe in atmospheric and climate sciences, and allied areas. With increasing awareness about climate change impacts, a demand for climate scientists is also on increase specifically about Indian climate system.
- Organisations working on Environment, Weather, Climate Change, Ecology and Energy Issues (E.g. TERI, IMD (Indian Meteorological Department, WMO (World meteorological Organisation), UNEP (United Nations Environment Program), CPCB (Central Pollution Control Board), Climate Investment Funds (CIF), GCF (Green Climate Fund))
- Industries manufacturing meteorological/climate/environmental sensors.
- Non-Governmental Organisations, consultancy firms, and think tanks working in the areas of climate sustainability, climate policies, climate change and risk assessment, etc.

Conclusions

At the end of this program the students will be well versed with the fundamentals and underlying processes of complex atmospheric system with special emphasis on Indian climate. Students are expected to improved opportunities for higher studies in the top ranked universities and institutions across the globe in atmospheric and climate sciences. This program will help in achieving the following goals:

- Provide students the quantitative assessment of atmospheric dynamics, climate change factors and interactions, and societal impact.
- In-depth understanding and practical knowledge about numerical and climate models.
- Hands on experience on atmospheric chemistry and physics laboratory, and
- Participate in real-time and on ground large scale international field measurement campaigns with top collaborators.