Process-based fine scale modelling for meteorology-chemistry-aerosol system: research & sci. education

First steps in Atmospheric Modelling

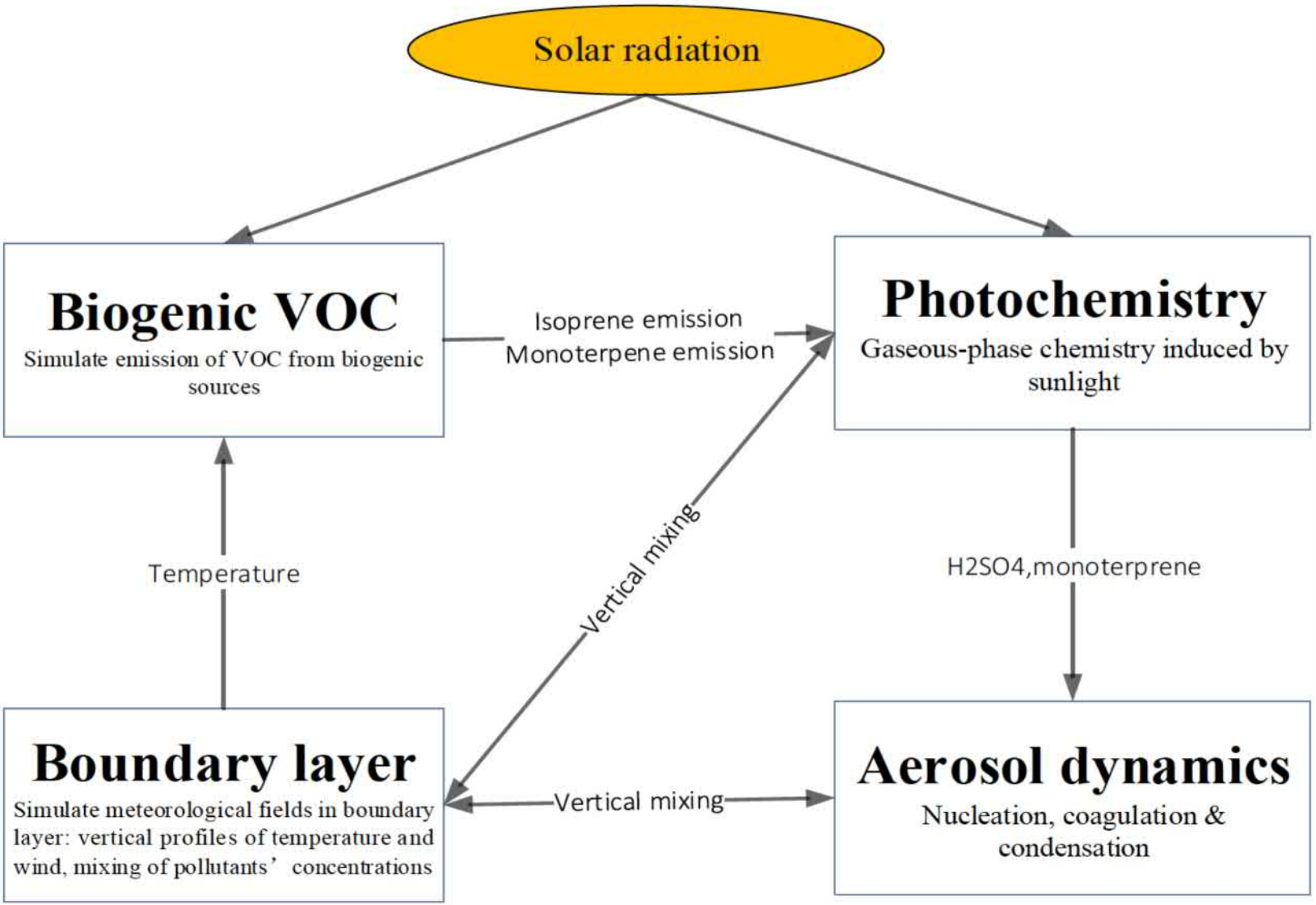
Why we need this course?

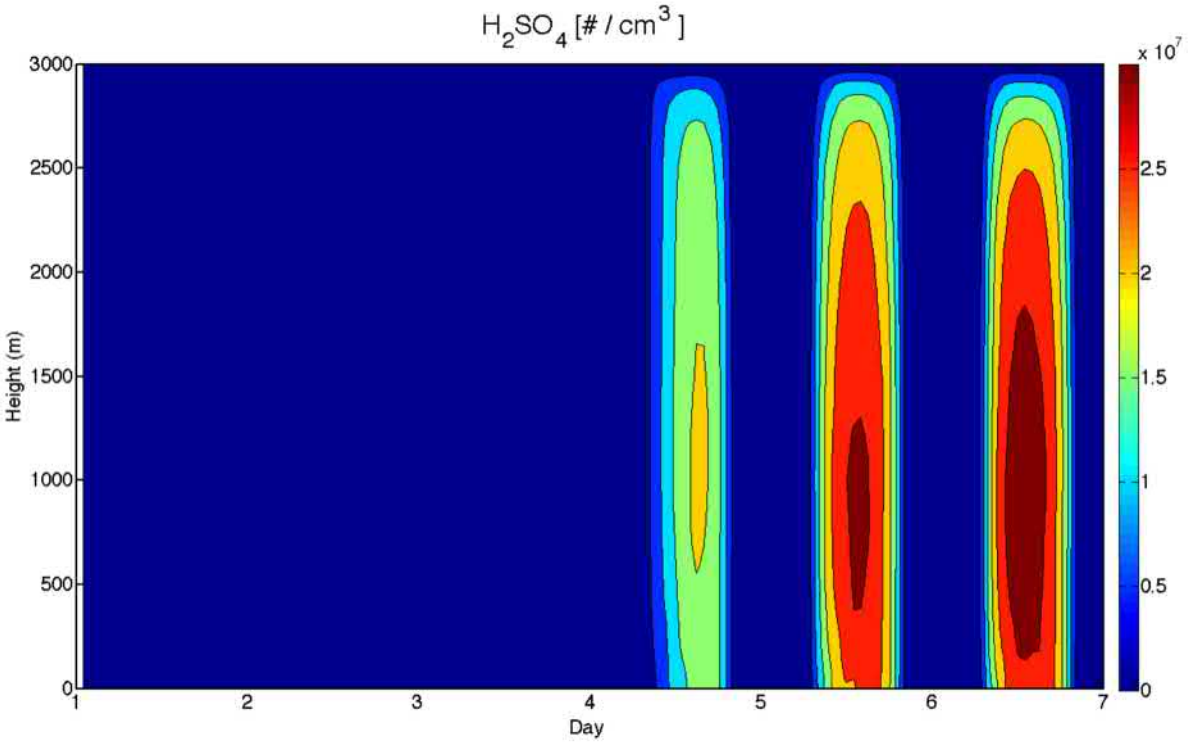
- **Climate change and air quality** are serious threats to the Earth´s future and human wellbeing.
- **At high latitudes in the Arctic climate change has proceeded fastest**, with its near-surface warming being about twice the global average during the recent decades.
- These changes have **dramatic impacts on the ecology and societies of the Arctic**, underlining the urgent need for a better understanding of the processes leading to climate change.
- Assessment of these research topics **require a multi-disciplinary research effort** to integrate available observations and knowledge to further develop and improve multi-scale and multi-component model systems (e.g. land-atmosphere interactions).
- The course "First steps in atmospheric modelling" focuses on the education of the "**Next Generation of Atmosphere Modellers**" and will provide a strong basic education in biological, chemical and physical atmospheric processes and their numerical solutions

Scientific content of the course

The course aims to teach every participant to **develop his or her own one-dimensional chemistry-transport model** including a module for emissions and deposition of biogenic VOCs and aerosol dynamics with lectures on:

- What is "good" coding
- General introduction to FORTRAN programming language
- Overview of models from process or box models to the complex structure of climate models
- Introduction to boundary layer meteorology (BLM)
- Emissions of anthropogenic and biogenic compounds
- Deposition of gas compounds and aerosols in the forest canopy
- Atmospheric chemistry
- Atmospheric aerosols dynamics
- Kpp and other complex techniques like model parallelization and optimisation
- Implementation of our achieved knowledge in large scale models and what are the main features of an Earth System Model (ESM)
- Career possibilities as an atmosphere modeller
- Where are the limitations in atmospheric modelling?


Solar radiation
Biogenic VOC
Simulate emission of VOC from biogenic sources
Isoprene emission
Monoterpene emission
Photochemistry
Gaseous-phase chemistry induced by sunlight
Temperature
Vertical mixing
H2SO4,monoterprene
Boundary layer
Simulate meteorological fields in boundary layer: vertical profiles of temperature and wind, mixing of pollutants' concentrations
Vertical mixing
Aerosol dynamics
Nucleation, coagulation & condensation


H_2SO_4 [# / cm^3]
x 10^7
3000
2500
2000
1500
1000
500
0
Height (m)
1
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3
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7
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2
1.5
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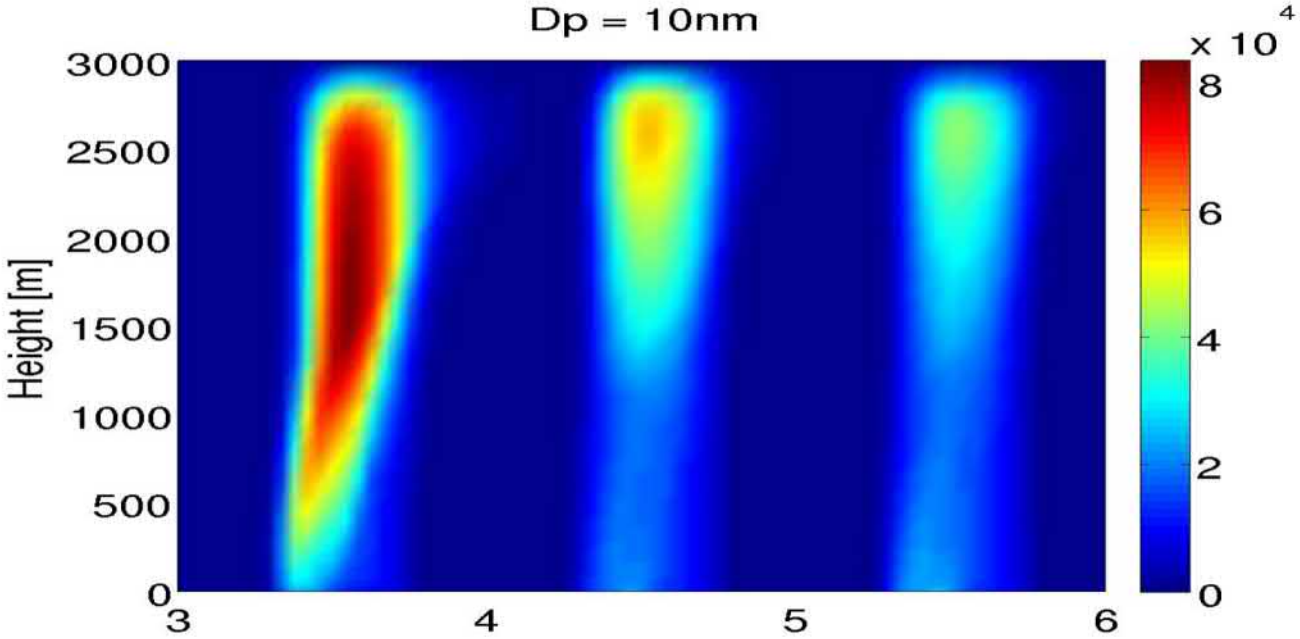
Dp = 10nm
x 10^4
3000
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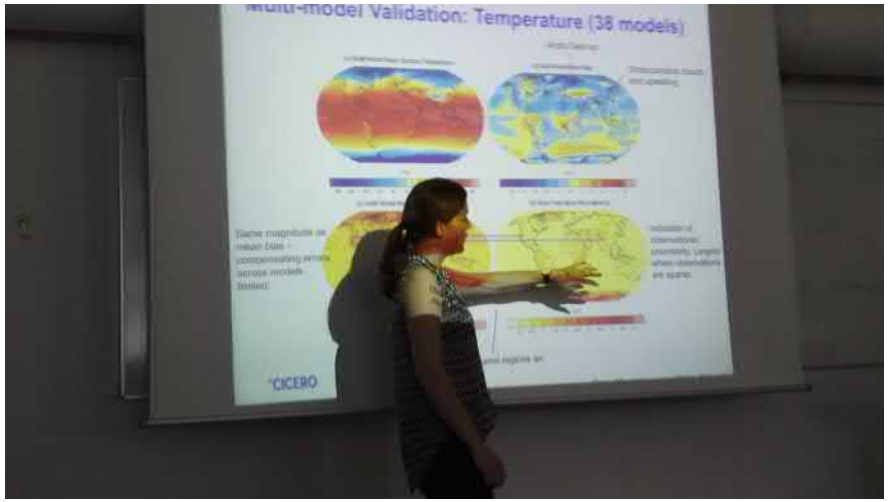
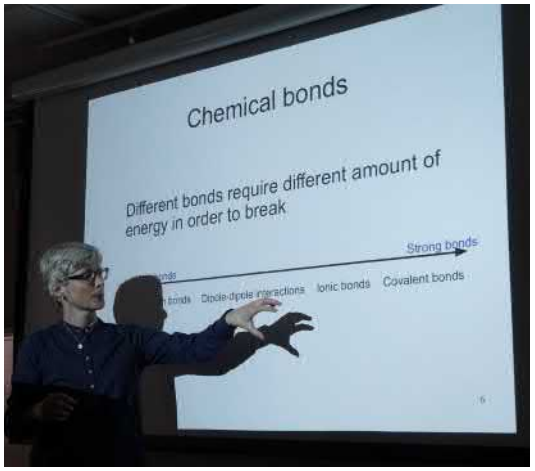
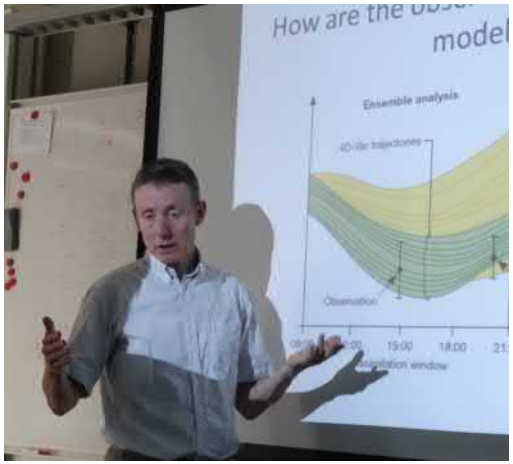
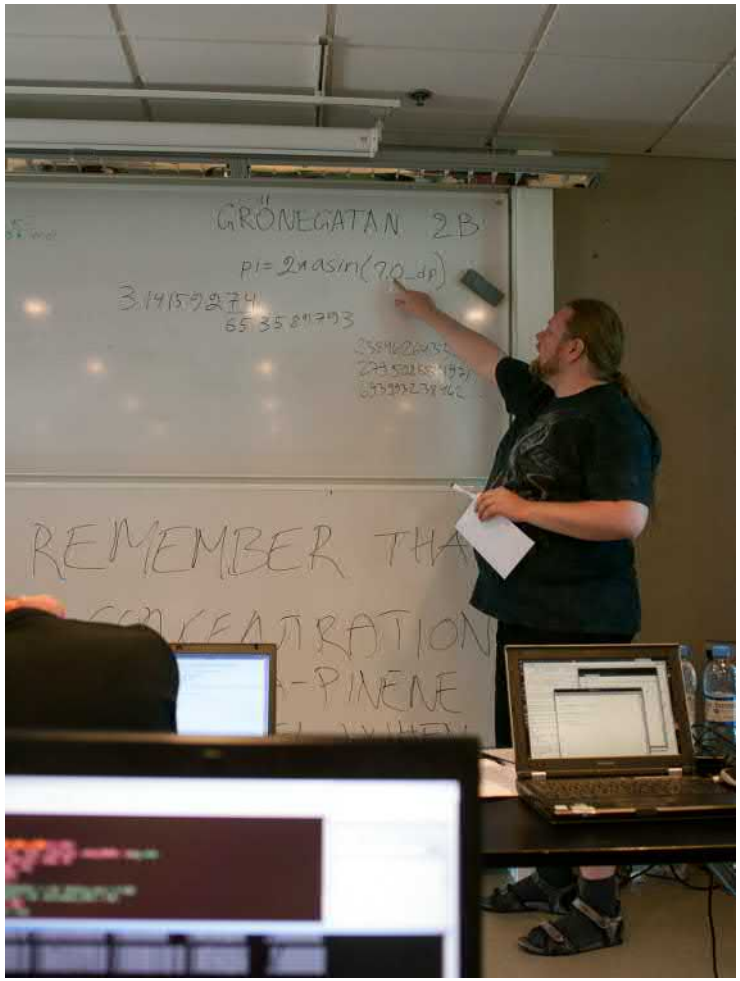
Structure of the course

The length of the course is 12-days (Mon-Fri) and consists of the **specific scientific and general lectures in the morning.**









Structure of the course

Followed by **coding sessions with intensive supervision in the afternoon**. In the past this type of hands-on teaching has generated strong positive feedbacks from the students in the courses we gave.

Overload of the students!!!!

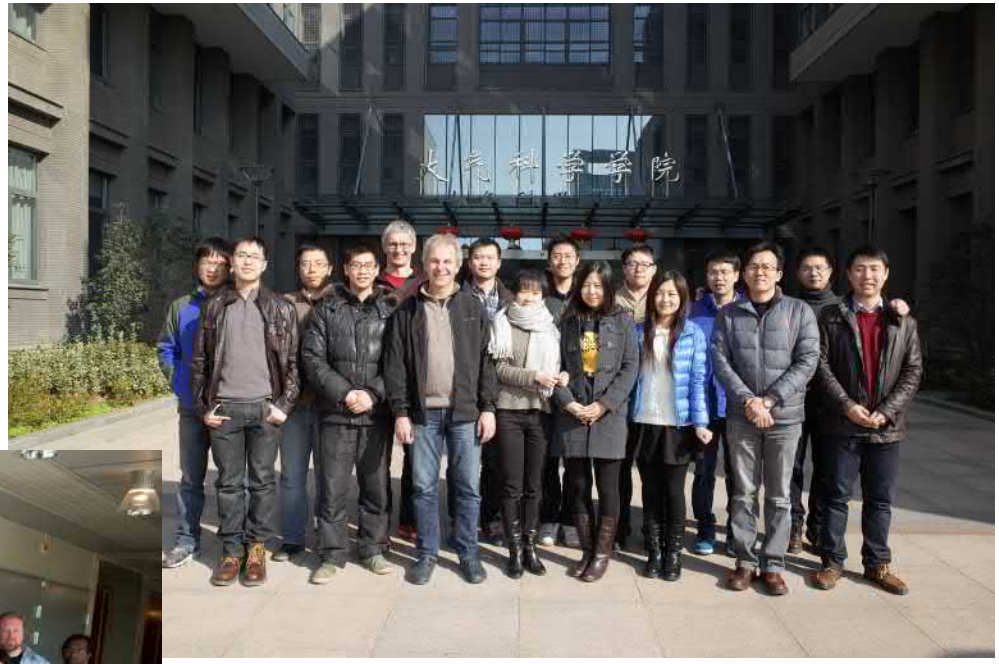
To avoid overloading of the students by intensive day-after-day coding

Overload of the students!!!!

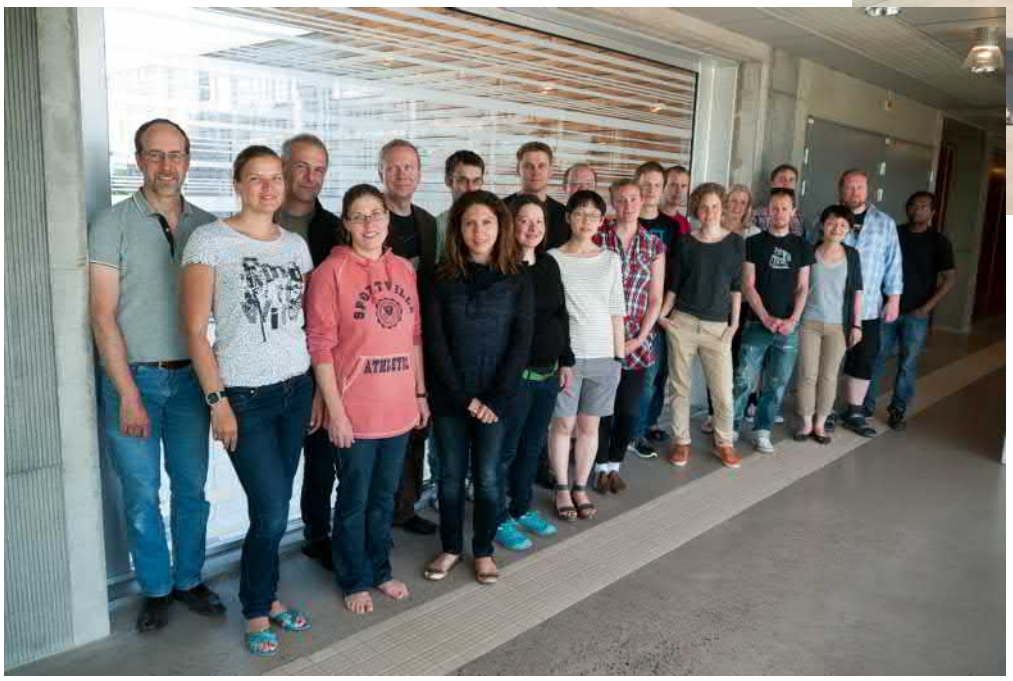
We will always offer physical exercises or social activities on several evenings for all participants.

History of the course

Until now we had six intensive courses in four countries



Intensive Modelling course in Nanjing, China, winter 2014



Intensive Modelling course in Lund, Sweden, summer 2013

History of the course

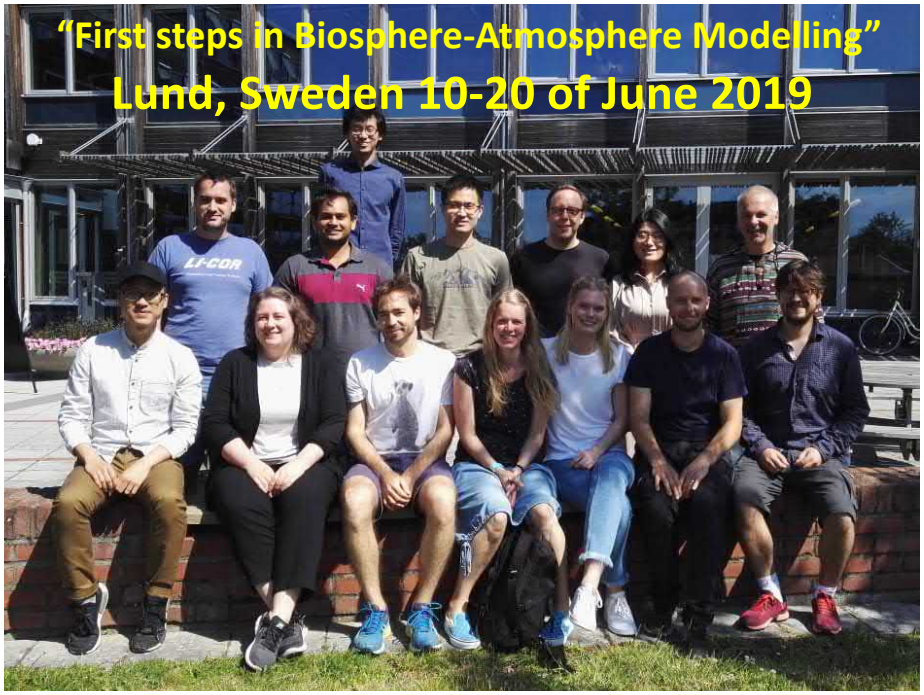
Until now we had six intensive courses in four countries

Intensive Modelling course in Lund, Sweden, summer 2016

Intensive Modelling course in Aarhus, Denmark, summer 2017

History of the course

Until now we had six intensive courses in four countries



Intensive Modelling course in Lund, Sweden, summer 2019

Intensive Modelling course in Hyytiälä, Finland, summer 2018

Future

Next course will be at Istanbul Technical University,
26th of October to 6th of November 2020