2. Work Programme of the Summer School

Programme of Lectures, Practical Exercises, and Social Events For the 2nd Young Scientist Summer School on "Integrated Modelling of Meteorological and Chemical Transport Processes / Impact of Chemical Weather on Numerical Weather Prediction and Climate Modelling"

The idea with the lectures at the Summer School is that the students get an understanding of the basic components that are included in integrated meteorological-chemical-aerosol-cloud-transport models. These include both the physical/chemical components and how these components numerically can be realised and implemented into these models.

All lectures are 45 minutes long followed by a 15 min. break.

Day 1: Sunday, 3 July 2011

08:00 – 09:00: Breakfast

08:00 – 09:30: Registration

09:30 – 09:45: Official Opening
(Prof. Sergey Stepanenko, OSEU, Ukraine)

09:45 – 10:15: Welcome + Arrangements
(Dr. Sergey Ivanov, OSEU, Ukraine)

- Programme details, lectures, exercises, poster session, rules, meals, accommodation, etc
- What is required from the students to receive a diploma from the School?

10:15 – 11:00: Introduction Lecture
(Prof. Alexander Baklanov, DMI, Denmark)

Introduction to Integrated Modelling of Meteorological and Chemical Transport Processes
Meteorological modelling, integration of gases and aerosols, on-line versus off-line, feedbacks, etc.
Objective: what will be the basic subjects of the school, short overview of all these subjects.

Block 1: Meteorological Modelling *(8 Lectures)*

11:15 – 12:00: Lecture 1
(Prof. Sergey Stepanenko, OSEU, Ukraine)

General Introduction into the Atmosphere and Atmospheric Motions
Definitions, chemical composition, vertical structure, layers of the atmosphere, main meteorological characteristics/variables (importance for Numerical Weather Prediction (NWP)), basic forces, basic dynamics, thermodynamics, etc.
Temporal and spatial scales of atmospheric motions.
Basic system of equations for atmospheric motions (continuity, temperature, momentum).

12:15 – 13:00: Lecture 2
(Dr. Laura Rontu, FMI, Finland)

Numerical Weather Prediction (NWP) and HIRLAM
NWP – general introduction (briefly – climate modelling).
versions of HIRLAM and HARMONIE with respect to horizontal and vertical resolutions, time steps, applications for different tasks/activities, etc.
Overall general introduction.

- Equations briefly (based on Lecture 2).
- Numerics/methods for solution.
- Input/Output HIRLAM data.
- Physics – generally (radiation, clouds and condensation, surface (incl. SURFEX) and soil processes, orography effects, etc.)
- Data assimilation and initialization.

13:00 – 14:00: Lunch

14:00 – 14:45: Lecture 3
(Dr. Laura Rontu, FMI, Finland)

Atmospheric radiation, precipitation, clouds
Definitions, spatial and temporal variability, +briefly approach and parameterizations used in HIRLAM: STRACO, Rasch-Kristjansson, Kain-Fritsch, etc. Approaches in HIRLAM.

- Atmospheric radiation: general – definitions, sun vs. Earth, balance, spatial and temporal variability;
- Clouds: general – definitions, classification, spatial and temporal distribution (focus on troposphere),
- Precipitation: general – definitions, water phase changes in atmosphere, CCN, humidity, spatial and temporal variability (focus on ABL);

15:00 – 15:45: Lecture 4
(Prof. Sergey Zilitinkevich, FMI/UH, Finland)

Turbulence and planetary boundary layers: recent developments in physics and parameterization in atmospheric models
Definitions, spatial and temporal variability, classification, mixing layer height, briefly description of approaches and parameterizations used in HIRLAM.

- ABL definition, +surface layer,
- spatial structure, temporal diurnal evolution,
- classes-types (SBL, CBL, UBL, etc.),
- mixing layer height, parameterizations in NWP

16:00 – 18:00: Exercises

At the beginning, students in groups shall discuss the outcome of their home reading assignments with teacher of the exercise and prepare short oral presentation of planned research activities for the upcoming exercises. This presentation should include the main goal, objectives, practical way of realisation of the exercise, etc. Each group should give prepared presentation (max 5 minutes and followed by questions) for all participants of the school.
Familiarization with booklet

18:00 – 19:00 – Dinner

19:00 – 21:00 – Ice Breaking Party

Day 2: Monday, 4 July 2011

08:00 – 09:00: Breakfast

09:00 – 09:45: Lecture 5
(Prof. Sergey Zilitinkevich, FMI/UH, Finland)

Turbulent Diffusion
Diffusion, turbulence closures

10:00 – 10:45: Lecture 6
(Dr. Alexander Mahura, DMI, Denmark)

Treatment of Land-use and Urbanization
Land-use, classification, datasets, land surface schemes, urban classification.
Urbanization approaches, anthropogenic heat flux, roughness, albedo; building effects parameterizations; soil model for submesoscales; city districts (centre, high buildings, industrial commercial, residential); examples.

11:00 – 11:45: Lecture 7
(Prof. Eigil Kaas, Univ of Copenhagen, Denmark)

Numerical schemes, Advection
Definition, different numerical approaches and numerical schemes.

12:00 – 12:45: Lecture 8
(Prof. Eigil Kaas, Univ of Copenhagen, Denmark)

Numerical schemes, Advection
Continuation of lecture 6 - Definition, different numerical approaches and numerical schemes.

13:00 – 14:00: Lunch

Block 2: Atmospheric Chemical Transport Modelling *(9 Lectures)*

14:00 – 14:45: Lecture 1
(Prof. Alexander Baklanov, DMI, Denmark)

General Introduction to the Physical and Chemical Atmospheric Processes & Physical Atmospheric Processes, characteristics of atmospheric composition and air quality, model evaluation.

The basic Atmospheric Chemical Transport Modelling (ACTM) processes are shortly introduced. This includes: advection, diffusion, deposition, emission, chemistry, aerosols, and clouds. These processes will be handled in more details in the following lectures.
Definitions, diffusion, deposition and land use. How are they solved in CTM. Different numerical treatments. Means of characterization of atmospheric composition, appropriate measures and consequences for the CTM evaluation.

15:00 – 18:00: Exercises

Each group will give a short summary of the problem they will look at and how they will solve it (max. 5 min). Afterwards will the students continue their exercise in groups.

18:00 – 19:00 – Dinner

19:00 – 21:00 – Poster Session

Day 3: Tuesday, 5 July 2011

08:00 – 09:00: Breakfast

Chemistry Block

09:00 – 09:45: Lecture 2
(Dr. Larissa Nazarenko, NASA, USA)

Fundamentals of Atmospheric Gas-Phase Chemistry
State of the art and future challenges (where are improvements of our knowledge needed)

10:00 – 10:45: Lecture 3
(Dr. Larissa Nazarenko, NASA, USA)

Development of Chemical Gas-Phase Mechanisms for Air Quality Modelling
How do we treat gas-phase chemistry in ACTM. Development of lumped mechanisms.

11:00 – 11:45: Lecture 4
(Dr. Larissa Nazarenko, NASA, USA)

Liquid Phase Chemistry
Basic reactions, differences between cloud and aerosol chemistry.

12:00 – 12:45: Lecture 5
(Dr. Larissa Nazarenko, NASA, USA/ Prof. Sergey Smyshlyaev, RSHU, Russia)

Implementation of Chemistry in ACTM
Numerical treatment (Gear solver versus fast solvers), applications of Air Quality Models to Assessment and Forecasting, how is chemistry treated in Enviro-HIRLAM and other ACTMs

13:00 – 14:00: Lunch

Aerosol Block

Objective: giving the basic knowledge of physical and chemical properties of the aerosol particles in the atmosphere, the description of the major physical processes which influence these properties, the interaction between aerosols and clouds and their numerical treatment in the models.

14:00 – 14:45: Lecture 6
(Dr. Elisabetta Vignati, Joint Research Centre, Italy)

Aerosol particle properties
Physical and chemical characteristics of aerosol particles in ACTM:

- chemical components and their importance with the spatial scales
- particle dimension and the concept of size distributions (number, surface and mass) and their mathematical description (as size bins, as log-normal modes)
- aerosol-cloud interaction: chemical and physical properties of cloud condensation nuclei

15:00 – 17:00: Exercises
The students continue their exercise.

17:00 – 18:00 – Dinner

18:00 – 20:00 – Odessa City Excursion

Day 4: Wedsday, 6 July 2011

08:00 – 09:00: Breakfast

09:00 – 09:45: Lecture 7
(Dr. Elisabetta Vignati, Joint Research Centre, Italy)

Aerosol Physics
The physical processes which determine aerosol number and mass concentrations in the atmosphere and their parameterizations in ACTM:
- Aerosol dynamics: nucleation, coagulation and condensation
- Emissions, wet and dry deposition

10:00 – 10:45: Lecture 8
(Dr. Elisabetta Vignati, Joint Research Centre, Italy)

Aerosol Physics
Continued lecture - aerosol dynamics, emissions and deposition

11:00 – 11:45: Lecture 9
(Dr. Elisabetta Vignati, Joint Research Centre, Italy)
& (Dr. Alexander Mahura, DMI, Denmark)

Cloud physics (+Pollen?)
Aerosol-cloud interaction: formation and growth of clouds and their parameterisations in ACTM.
+
Biological Air Quality Block: sub-Micronics and pauci-Micronics biological particles. Relationship with other pollutants. Health impacts. Pollen allergy. Pollen dispersion modelling. Pollen Grains as Biological Particles Involved in Different Aerobiological Processes

Block 3: Possible Feedbacks of Gases, Aerosols, Clouds *(7 Lectures)*
on Climate and Meteorological Models

Objective: description of the main feedback mechanisms of the chemical weather (atmospheric green-house gases and aerosols) impact on NWP and climate processes, in order to understand how important it is to include feedbacks from gases, aerosols, clouds, etc. in NWP and climate models. The goal is to give an orientation/understanding of which feedback processes are the most

important: impact of feedbacks from gases, aerosols (direct, semi-direct, indirect effects), clouds, etc. on short and long time-range meteorological models. This subject is the main focus of the school. First part focuses on physical processes behind these feedbacks, second - on model examples.

12:00 – 12:45: Lecture 1
(Prof. Alexander Baklanov, DMI, Denmark)

Physical description
Possible feedback processes of aerosols and clouds in atmospheric chemical aerosol cloud transport models.

13:00 – 14:00: Lunch

14:00 – 14:45: Lecture 2
(Prof. Sergey Smyshlyaev, RSHU, Russia)

Physical description
Possible feedback processes of gases in atmospheric chemical aerosol cloud transport and climate models.

15:00 – 18:00: Exercises
The students continue their exercise.

18:00 – 19:00 – Dinner

Day 5: Thursday, 7 July 2011

08:00 – 09:00: Breakfast

09:00 – 09:45: Lecture 3
(Prof. Alexander Baklanov, DMI, Denmark)

Model examples
The importance of feedbacks on NWP and climate models based on model examples: scales (time and space), gases, aerosols, important of different mechanisms, prioritization of different tasks, etc.

10:00 – 10:45: Lecture 4
(Prof. Sergey Smyshlyaev, RSHU, Russia)

Model examples

11:00 – 11:45: Lecture 5
(Prof. Sergey Ivanov, OSEU, Ukraine)

Model examples

12:00 – 12:45: Lecture 6
(Iratxe Gonzalez-Aparicio, Tecnalia, Spain & Adomas Mazeikis (LHMS, Lithuania)

Model examples

13:00 – 14:00: Lunch

14:00 – 14:45: Lecture 7
(Prof. Eigil Kaas, Univ of Copenhagen, Denmark)

Applications to different integration …
Applications to different integration (CEEH modeling chain, etc.) …

15:00 – 18:00: Exercises
The students continue their exercise.

18:00 – 19:00 – Dinner

Day 6: Friday, 8 July 2011

08:00 – 09:00: Breakfast

09:00 – 13:00: Exercises

10:00 – 13:00: Meeting for NWP+ACT Integrated Modeling strategy & Enviro-HIRLAM/HARMONIE activities, research and development
(lead by Alexander Baklanov and Laura Rontu)

13:00 – 14:00: Lunch

14:00 – 17:00: TEMPUS meeting
(lead by Sergey Zilitinkevich, Lev Karlin and Andrey Belotserkovskiy)

14:00 – 18:00: Exercises
Finalization of the exercise and oral presentation by research groups

19:00 – 21:00 – Final Official Dinner

Day 7: Saturday, Thursday, 9 July 2011

08:00 – 09:00: Breakfast

09:00 – 11:00: Oral Presentations (max 15 minutes per group) from the student groups.
(lead by Alexander Mahura)

11:15 – 12:30: Awarding Diplomas of the School + Joint Photo

12:30 – 13:00 Official Closure of the Summer School

13:00 – 14:00: Lunch

14:00 – 15:00: Meeting on Publication of Student Lecture-Textbook and Workbook, Video and Web-materials

15:00: Starting departure of the school participants