Online Young Scientist School (YSS) – MEGAPOLIS-2021

"Multi–Scales and –Processes Integrated Modelling, Observations and Assessments for Environmental Applications"

Hosts: University of Helsinki (UHEL, Helsinki, Finland) & Moscow State University (MSU, Moscow, Russia)

	Day 1	Day 2	Day 3	Day 4	Day 5	Small-Scale Research Projects (SSRPs) – 2 weeks				Final day
Helsinki time	Monday 15 Nov	Tuesday 16 Nov	Wednesday 17 Nov	Thursday 18 Nov	Friday 19 Nov	from 19th November	Wednesday 24 Nov	Wednesday 1 Dec	until 2nd December	Friday 3 Dec
09:45 – 10:00	*Welcome Words*									*Welcome Words*
10:00 – 10:45	**L1.** Introduction to Pan-Eurasian EXperiment (PEEX) programme (Hanna Lappalainen/ Markku Kulmala, UHEL) CONFIRMED	**L6.** Seamless online integrated modelling and specific challenges (Alexander Baklanov, WMO & Alexander Mahura, UHEL-INAR) CONFIRMED	**L11.** Aerosol - cloud - radiation interactions (Natalia Chubarova, MSU) CONFIRMED	**L16.** Satellite remote sensing: basics, approaches, applicability (Larisa Sogacheva, FMI) CONFIRMED	**L21.** Meteorological and hydrological measurements (Pavel Konstantinov, Pavel Terskiy, MSU) CONFIRMED	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	Students' oral presentations Defences of SSRPs
10:45 – 11:30	**L2.** Earth System Modelling and specific challenges (Risto Makkonen, UHEL/ FMI) CONFIRMED	**L7.** Process-based modelling for meteorology-chemistry-aerosol system and specific challenges (Michael Boy, UHEL) CONFIRMED	**L12.** Biogenic / natural / anthropogenic emissions (Michael Boy, UHEL-INAR) CONFIRMED	**L17.** SMEAR – atmospheric composition measurements (Part 1) (Tuukka Petäjä, UHEL-INAR) CONFIRMED	**L22.** Urban scale measurements (Pavel Konstantinov, Mikhail Varentsov, MSU) CONFIRMED	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	Students' oral presentations Defences of SSRPs
11:30 – 11:45	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*	*Coffee/ Tea Br.*					*Coffee/ Tea Br.*
11:45 – 12:30	**L3.** Hydrological modelling and specific challenges (Sergey Chalov, MSU) CONFIRMED	**L8.** Atmospheric boundary layer processes, modelling and challenges (Igor Esau, NERSC) CONFIRMED	L13. Chemical and meteorological data assimilation (Mariusz Pagowski, NOAA/CIRES) TBC	**L18.** SMEAR – ecosystem measurements (Part 2) (Jaana Back, UHEL-INAR) CONFIRMED	**L23. – P1** Environmental factors and human health: approaches and assessment (Varvara Mironova, MSU) CONFIRMED	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	Students' oral presentations Defences of SSRPs
12:30 – 13:15	**L4.** Numerical weather prediction and specific challenges (Reima Eresmaa, FMI) CONFIRMED	**L9.** Atmospheric gas- and liquid phases chemistry (Sergey Smyshlyaev, RSHU) CONFIRMED	L14. Evaluation of models and verification (Dominik Brunner, EMPA) TBC	L19. European strategy in meteo, hydro, atmospheric composition and ecosystems monitoring (Tuukka Petäjä, Jaana Back, UHEL-INAR) CONFIRMED	**L24. – P2** Environmental factors and human health: approaches and assessment (Varvara Mironova, MSU) CONFIRMED	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	Students' oral presentations Defences of SSRPs
13:15 – 14:00	**L5.** Atmospheric chemical transport modelling and challenges (Alexander Baklanov, WMO & Yang Zhang) CONFIRMED	**L10.** Aerosol properties, dynamics, chemistry and microphysics (Olga Popovicheva, MSU) CONFIRMED	**L15.** Ground-based observations: basics, approaches, applicability (Natalia Chubarova, MSU) CONFIRMED	**L20.** Russian strategy in meteo, hydro, atmospheric composition and ecosystems monitoring (Sergey Chalov, MSU) CONFIRMED	**L25.** GIS technologies in environmental sciences (Timofey Samsonov, MSU) CONFIRMED	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	*2 weeks of work in groups on SSRPs*	**Awarding Diplomas/ Certificates & Official closure of Online School**

14:00 – 15:00		*Lunch*		*Lunch*						
15:00 – 16:00		**Introduction** to Groups' Research Projects		**Questions** to Teachers of Groups' Projects			**Questions** to Teachers of Groups' Projects	**Questions** to Teachers of Groups' Projects		

Lectures Blocks Covering Aspects of:	• B1 – Introduction to PEEX programme; • B2 – Modelling (Earth system, numerical weather prediction, atmospheric chemical transport, online integrated, atmospheric boundary layer) and specific challenges; • B3 – Chemistry (gas, liquid) and aerosols (properties, dynamics, chemistry, microphysics, interactions); • B4 – Emissions, data assimilation, models evaluation; • B5 – Ground-based and remote sensing observations; EU and Russian strategies for hydro-meteorological, ecosystems and atmospheric composition monitoring; SMEAR stations measurements; measurements for atmospheric composition, ecosystems, meteorological, hydrological, urban scale; • B6 - GIS technologies in environmental sciences; Environment (land, water, terrestrial ecosystems) and human health assessment.
Practical Exercises as Small-Scale Research Projects (SSRPs):	as **Small-Scale Research Projects (SSRPs)** on multi-scales and –processes modelling, observations, data visualization, analysis, and assessment for environmental applications (max 6 students per each project; max school capacity --- up to 50 participants/persons for school in total) led by teachers - Risto Makkonen, Michael Boy, Alexander Mahura, Roman Nuterman – whom designed and realized SSRPs with students SSRPs are arranged from 2nd day until official oral presentation/ defence of research projects' outcomes on the last day of the school Proposed Models for SSRPs (& responsible teachers): ➢ **Resp. Michael Boy, Petri Clusius - ARCA (3 SSRPs) CONFIRMED** The Atmospherically Relevant Chemistry and Aerosol Box Model (ARCA box) is used for simulating atmospheric chemistry and the time evolution of aerosol particles and the formation of stable molecular clusters. The backbone of ARCAs chemical library comes from the Master Chemical Mechanism (MCM), extended with Peroxy Radical Autoxidation Mechanism (PRAM), and is further extendable with any new reactions. Molecular clustering is simulated with the Atmospheric Cluster Dynamics Code (ACDC). The particle size distribution is represented with two alternative methods whose size and grid density are fully configurable. The evolution of the particle size distribution due to the condensation of low volatile organic vapors and the Brownian coagulation is simulated using established kinetic and thermodynamic theories. ARCA also provides a graphical user interface which improves its usability and repeatability of the simulations. A detailed manual and several tutorials are available at the MSM website under 'ARCA box'. https://www2.helsinki.fi/en/researchgroups/multi-scale-modelling/atmospherically-relevant-chemistry-and-aerosol-box-model ➢ **Resp. Alexander Mahura, Roman Nuterman, Georgii Nerobelov, Mykhailo Savenets - Enviro-HIRLAM (4 SSRPs) CONFIRMED** (*see Baklanov et al., 2017*) is a fully online-coupled ACT-NWP (Atmospheric Chemistry Transport – Numerical Weather Prediction) modeling system for regional-, meso- and urban scale different environmental applications. The NWP part developed by HIRLAM consortium is used for operational weather forecasting. The Enviro-components were mainly developed in a close collaboration with the Universities from different countries. It includes of gas-phase chemistry CBMZ and aerosol microphysics M7 which includes sulfate, mineral dust, sea-salt, black and organic carbon. There are modules of urbanization for land surface scheme, natural and anthropogenic emissions, nucleation, coagulation, condensation, dry and wet deposition, and sedimentation of aerosols. The Savijarvi radiation scheme has been improved to account explicitly for aerosol radiation interactions for 10 aerosol subtypes. The aerosol activation scheme was also implemented in STRACO condensation-convection scheme. The nucleation is dependent on aerosol properties and the ice phase processes are reformulated in terms of classical nucleation theory. See details at: https://www2.helsinki.fi/en/researchgroups/multi-scale-modelling/enviro-hirlam ➢ **Resp. Risto Makkonen, Putian Zhou - EC-Earth (2 SSRPs) CONFIRMED** (*see Hazeleger et al., 2010*) is developed jointly by 28 European research institutes. The Coupled Model Intercomparison Project 5 (CMIP5) was the first CMIP for EC-Earth. EC-Earth comprises of atmosphere model IFS, ocean model NEMO and vegetation model LPJ-GUESS, coupled with OASIS coupler. Aerosols and chemistry are included through the global chemistry-transport model TM5. The Integrated Forecasting Model (IFS) is the atmospheric model developed at European Centre for Medium-Range Weather Forecasts. The IFS is coupled to the ocean model NEMO, which is run with 1º horizontal resolution and 42 vertical levels. The ice model LIM is coupled directly to the ocean model. EC-Earth describes aerosols using a 7-mode size distribution (*Vignati and Willson 2004),* with 4 soluble and 3 insoluble modes. TM5 includes most abundant aerosol species: sulfate, black carbon, organic carbon, sea salt and mineral dust. TM5 uses a grid of 3ºx2º for aerosols and chemistry.
Finals	Welcome words Oral presentations & defence of SSRPs – with awarding certificates/ diplomas (**5 ECTS credits**) ceremony for students successfully presented and defended their projects, and official closure of the school Note: • YSS training includes lecture material and realization of practical exercises as SSRPs followed by oral presentations on the last day the school & by completion of a short joint summary report per each SSRP (by each group of students); • For each student the gained experience will include: realization of SSRP; working as an international team of young researchers; utilization of individual best skills; working as a member of a team; learning collaboration and communication skills and attitude between teams involved in other SSRPs; opportunity to address scientific and technical questions to lecturers and teachers; preparation of oral presentations and project report in English. • For young researchers the useful experience will also include: technical aspects of the models setup; steps of compilation; running the model with different settings and controlling the model runs (initialization, compilation, climate files generation, preparation of boundary conditions, steps of forecasting, etc.). • Moreover, students will also improve experience on visualization and analysis of modelling results using different visualization tools (Metview, Grads, IDV, Python, MatLab, etc.), spatial-temporal representation of 2D and 3D surface and model levels data for various meteorological, climatological, and chemical/aerosol parameters, etc.
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