Course title: Methods of numerical modeling of the atmosphere

Form of teaching: lecture – 26 hrs., 3p. ECTS; practices – 52 hrs., 10 p. ECTS, **total – 78 hrs., 13p. ECTS**
Course completion requirements : lecture – finale exam; practices – projects evaluation, evaluation of activity
Language of instruction: English

1. Short description, objectives:

The aim of the course is to present the basics of numerical modeling of the atmosphere, to familiarize students with the history of the development of numerical methods in the atmosphere, present basic numerical methods for solving equations describing the state of the atmosphere, parameterization of subgride process, the determination of initial and boundary conditions, methods of data assimilation and verification of models.

2. Prerequisites:

1. reading and writing in English,
2. basic knowledge of atmospheric dynamics, mathematical analysis and algebra,
3. basic skills in FORTRAN programing.

3. Learnin outcomes

W01 – knows the methods of atmospheric data collecting and transmitting (14K-1A_W02, 14K-1A_W07)
W02 - has knowledge of the numerical solution of equations of the atmospheric dynamics, knows the rules of use of numerical algorithms for program building (14K-1A_W07, 14K-1A_W12)
W03 - have knowledge of the principles of numerical forecasting of the state of atmosphere (14K-1A_W05, 14K-1A_W07)
W04 – knows the possibilities of practical use of numerical models of the atmosphere (14K-1A_W08, 14K-1A_W11)
U01 – makes use of meteorological databases (14K-1A_U04)
U02 – knows how to perform numerical experiments using a climatological software (14K-1A_U02, 14K-1A_U07)
U03 - knows how to correctly interpret and statistically analyze the output from complex climate models (14K-1A_U03, 14K-1A_U05)
U04 - learns independently under supervision(14K-1A_U11)
K01 – is able to critically evaluate the popular interpretation of the results of climate models reported by the media (14K-1A_K03)
K02 – is able to organize the work of a team that uses numerical methods to study the climate and work as a member of this team (14K-1A_K05)
K03 - sees the possibility of using acquired skills in business practice (14K-1A_K06)
K04 – understand the rapid progress of numerical methods and the need to update a knowledge in this field (14K-1A_K01, 14K-1A_K02)

4. Course description:

1) History of numerical modeling of the atmosphere
2) The basic equations of the atmosphere
3) Numerical discretization of equations atmospheric dynamics
4) Parameterization of subgride process
5) Data assimilation in numerical models of the atmosphere
6) The methods of verification of numerical models
7) Applications of numerical models of the atmosphere

5. Course evaluation

Finale exam (W01-W04) – 50% total score,
projects evaluation (U101-U04, K01-K04) – 25% total score,
evaluation of activity (K01-K02) – 25% total score.

6. Teaching methods

Teaching methods: lecture, multimedia presentations, discussion, work with the source material (book, article), methods of practical exercises, auditorium

7. Recommended reading list

[1]. Kalnay, E., 2003, Atmospheric Modeling, Data Assimilation and Predictability. Cambridge.
[2]. McGuffie, K., Henderson-Sellers, A., 2011, A Climate Modelling Primer. John Wiley & Sons, Inc.
[3]. Jacobson, M.Z., 2005, Fundamental of Atmospheric Modeling. Cambridge University Press
[4]. Pielke, R.A., 2002, Mesoscale Meteorological Modeling, Academic Press