COURSE OF DOCTORAL STUDIES

Course title	Field of science (branch) code	University / Faculty	Institute / Department
Climate Change and the Climate System Modeling	Natural Sciences, (Physical Geography) N006	Vilnius University / Faculty of Chemistry and Geosciences	Institute of Geosciences / Department of Hydrology and Climatology
Study methods	Number of credits allocated	Study methods	Number of credits allocated
Lectures		Consultations	1
Individual	8	Seminars	1

Course annotation

The aim of the course is to provide knowledges about the causes of climate change, the history of global and Lithuanian climate, general principles of climate system modeling, models structure, parameterization and application possibilities in various climate researches. To provide knowledge about climate forecasting as well as the sensitivity and vulnerability of natural and social spheres to climate change and their adaptive potential, ways to adapt to climate change.

Content. The concept of climate variability. Past climate reconstruction methods. Direct and indirect indicators of past climate. External and internal causes of climate variability. Impact of anthropogenic factors on climate. Greenhouse gases. Greenhouse physics.

Climate history. The Holocene climate in Europe. Global climate fluctuations over the period of instrumental measurements.

Types of climate models. Tasks of modeling. The most important components and types of models. Energy-balance, statistical-dynamical, general circulation models. Their structure, basic equations, parameterization, spatial and temporal resolution. Sensitivity, ergodicity and predictability of climate models. Positive and negative feedbacks in climate system. Regional climate models. Systematic errors in climate models. Modeling of past and future climate variability. Assessment of climate sensitivity to various factors: Solar radiation, Earth's orbital parameters, moisture circulation, stratospheric and tropospheric aerosols, changes in greenhouse gas concentration.

Greenhouse gas and other gas emission scenarios. Projections of changes in the composition of the atmosphere. Global and regional climate change projections. The climate of the Baltic Sea region and Lithuania in the 21st century.

Sensitivity of natural and socio-economic sectors to climate change and their vulnerability. Climate change mitigation measures. Adaptation of natural and social spheres to the changing climate. International and national climate change mitigation and adaptation policy.

Required readings

Bridgman H., Oliver J. 2006. The global Climate System. Patterns, Processes, and Teleconnections. Cambridge University Press.

Burroughs W.J. 2001, 2007. Climate Change. Cambridge.

Burroughs W. J. 2007. Climate Change: A multidisciplinare Approach. Cambridge.

Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). 2013-2014. http://www.ipcc.ch/

McGuffie, Henderson–Sellers A. 2005. A Climate Modelling Primer. Sydney.

Consulting lecturers name, surname	Degree	The most important works in the field of science (branch) have been published during the last 5 years
Arūnas Bukantis	Dr. (HP)	Šarauskienė, D., Akstinas, V., Kriaučiūienė, J., Jakimavičius, D., **Bukantis, A.**, Kažys, J., Povilaitis, A., Ložys, L., Kesminas, V., Virbickas, T., Pliūraitė, V. 2017. Projection of Lithuanian river runoff, temperature and their extremes under climate change. *Hydrology Research* 49(2): 344-362. Stonevičius, E., Rimkus, E., Kažys, J., **Bukantis, A.,** Kriaučiūienė, J., Akstinas, V., Jakimavičius, D., Povilaitis, A., Ložys, L., Kesminas, V., Virbickas, T., Pliūraitė, V. 2018. Recent aridity trends and future projections in the Nemunas River basin. *Climate Research* 75(2): 143–154. Povilaitis, A., Widén-Nilsson, E., Šarauskienė, D., Kriaučiūnienė, J., Jakimavičius, D., **Bukantis, A.,** Kažys, J., Ložys, L., Kesminas, V., Virbickas, T., Pliūraitė, V. 2018. Potential impact of climate change on nutrient loads in Lithuanian rivers. *Environmental engineering and management journal*. ISSN

		1582-9596. Vol. 17 (9): 2229-2240. Kriaučiūnienė, J., Virbickas T., Šarauskienė, D., . Jakimavičius, D., Kažys, J., **Bukantis, A.,** Kesminas, V., Povilaitis, A., Dainys, J., Akstinas, V., Jurgelėnaitė, A., Meilutytė-Lukauskienė, D., Tomkevičienė, A. 2019. Fish assemblages under climate change in Lithuanian rivers. *Science of The Total Environment*. Vol. 661: 563-574. Dainys, Justas, Jakubavičiūtė, Eglė, Gorfine, Harry, Pūtys, Žilvinas, Virbickas, Tomas, Jakimavičius, Darius, Šarauskienė, Diana, Meilutytė-Lukauskienė, Diana, Povilaitis, Arvydas, **Bukantis, Arūnas**, Kažys, Justas, and Ložys, Linas. 2019. Predicted Climate Change Effects on European Perch (Perca Fluviatilis L.) - A Case Study from the Curonian Lagoon, South-eastern Baltic. Estuarine, *Coastal and Shelf Science* 221 (2019): 83-89.
Egidijus Rimkus	Dr.	Stonevičius, E., **Rimkus, E.**, Štaras, A., Kažys, J., Valiuškevičius, G. 2017. Climate change impact on the Nemunas River basin hydrology in the 21st century. Boreal Environment Research, 22, 49–65. **Rimkus, E.** Stonevičius, E, Kilpys, J.,Mačiulytė, V., Valiukas, D. 2017.Drought identification in the eastern Baltic region using NDVI. Earth System Dynamics, 8(3), 627-637. Jaagus, J., Briede, A., **Rimkus, E.,** Sepp, M. 2018. Changes in precipitation regime in the Baltic countries in 1966–2015. Theoretical and Applied Climatology, 131 (1-2), 433-443. Stonevičus, E., **Rimkus, E.**, Kažys, J., Bukantis, A., Kriaučiūnienė, J., Akstinas, V., Jakimavičius, D., Povilaitis, A., Ložys, L., Kesminas, V., Virbickas, T., Pliūraitė, V. 2018. Recent aridity trends and future projections in the Nemunas River basin. Climate Research, 75, 143-154. Stonevicius, E., Stankūnavičius, G., **Rimkus, E.** 2018. Continentality and Oceanity in the Mid and High Latitudes of the Northern Hemisphere and Their Links to Atmospheric Circulation, Advances in Meteorology, Article ID 5746191, pp 12. https://doi.org/10.1155/2018/5746191/. **Rimkus, E.,** Briede, A., Jaagus, J., Stonevicius, E., Kilpys, J., Viru, B. 2018. Snow-cover regime in Lithuania, Latvia and Estonia and its relationship to climatic and geographical factors in 1961–2015, Boreal Environment Research, 2, 193-208. **Rimkus, E.**, Edvardsson, J., Kažys, J., Pukiene, R., Lukosiunaite, S., Linkeviciene, R., Stoffel, M., Corona, C. 2019. Scots pine radial growth response to climate and future projections at peat and mineral soils in the boreo-nemoral zone. Theoretical and Applied Climatology, 136 (1-2), 639–650. Kilpys, J., Pipiraitė-Januškienė, S., **Rimkus E.** 2020. Snow climatology in Lithuania based on the cloud-free moderate resolution imaging spectroradiometer snow cover product, International Journal of Climatology, 40(10), 4690-4706. **Rimkus, E.,** Mačiulytė, V., Stonevičius, E., Valiukas, D. 2020. A revised agricultural drought index in Lithuania, Agricultural and food sciences 29 (4), 359–371.
Approved by the Doctoral Committee for Physical Geography (N006) on 9th of March 2021, protocol no. (4.20 E) 610000-KT-24		
Committee Chairman assoc. prof. dr. D. Pupienis		