COURSE OF DOCTORAL STUDIES

Course title	Field of science (branch) code	University / Faculty	Institute / Department
Weather forecasting techniques	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 work	8	Seminars	1

Course annotation

Objectives: provide principles of the short- and medium-range weather forecasts methods based on numerical weather prediction (NWP) models and basics of dynamic meteorology.

Main topics:

Mechanisms of the change of 3-D pressure and temperature field. Principles of evolution of the synoptic scale weather systems. Quasi-geostrophic (QG) atmospheric flow theory. Jet streams (streaks) and their role in the development of synoptic-scale systems. Potential vorticity and its applications. Cyclogenesis and baroclinic instability in mid-latitudes. Weather prediction techniques. Numerical weather prediction (NWP) models: structure, dynamics, data assimilation, model physics and forecast products. The principles of ensemble prediction systems: their properties, forecast accuracy. Applications remote sensing in numerical weather prediction. Nowcasting and very short range weather forecasting.

Classifications of weather forecasts. The severe and hazardous weather definition and forecasting. Weather warning systems. Forecast verification metrics. The development and improvement of weather forecasting methods. Principles of extended range weather forecasting: deterministic vs probabilistic methods. The main weather prediction centres: forecast products and research activities.

ECMWF: description of forecast charts and data. Deutscher Wetterdienst (DWD): weather services. The Global Forecast System (GFS). Seasonal forecasting principles.

Required readings

World Meteorological Organization. 2015. Seamless prediction of the Earth system: from minutes to months. WMO-No. 1156. Geneva. ISBN 978-92-63-11156-2.
Access: https://library.wmo.int/pmb_ged/wmo_1156_en.pd

Holton R. J. 2004. An introduction to dynamic meteorology. ElsevierAcademic Press.
Access: https://www.zuj.edu.jo/download/an-introduction-to-dynamic-meteorology-0123540151-pd

Pu Z., Kalnay E. 2018. Numerical Weather Prediction Basics: Models, Numerical Methods, and Data Assimilation. In: Duan Q., Pappenberger F., Thielen J., Wood A., Cloke H., Schaake J. (eds) Handbook of Hydrometeorological Ensemble Forecasting. Springer, Berlin, Heidelberg
Access: https://www.inscc.utah.edu/~pu/6500_sp12/Pu-Kalnay2018_NWP_basics.pdf

Jollife I.T., Stephenson D.B. 2003. Forecast Verification: A Practitioner's Guide in Atmospheric Science.John Willey & Sons Inc. San Francisko.
Access: http://danida.vnu.edu.vn/cpis/files/Books/Forecast%20Verification%20-%20A%20Practitioners%20Guide%20in%20Atmospheric%20Science.pdf

Recommended data and educational data sources (bases) and data access nodes

ECMWF's operational forecasts: https://www.ecmwf.int/en/forecasts

Global Forecast System (GFS): https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/global-forcast-system-gfs

MetDesk WXCHARTS: https://www.wxcharts.com/

NWP Essentials: NWP and Forecasting: https://www.meted.ucar.edu/training_module.php?id=1153#.YD8t6_lc6Ro

Training module on NWP Model Monitoring: http://www.eumetrain.org/data/3/32/index.htm

WeatherOnline –Expert charts: https://www.weatheronline.co.uk/cgi-bin/expertcharts

The Deutscher Wetterdienst (DWD), World Meteorological Centre (WMC) –Prototype: https://www.dwd.de/EN/weather/wmc/wmc_node.html

Consulting lecturers name, surname	Degree	The most important works in the field of science (branch) have been published during the last 5 years
Gintautas Stankūnavičius	dr.	Valiuškevičius G., Stonevičius E., Stankūnavičius G., Brastovickytė-Stankevič J. 2018. Severe floods in Nemunas River Delta. Baltica, 31(2), 89–99.

		https://doi.org/10.5200/baltica.2018.31.09.
		Stonevicius E., Stankunavicius G., and 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, https://doi.org/10.1155/2018/5746191.
		Basharin D. and Stankūnavičius G. 2018. The long-term 20th century re-analysis features over the North Atlantic-Eurasia region. Boreal Environmental Research, 23, 139–148.
		Stankūnavičius G., Basharin D.V., Skorupskas R., Vivaldo G. 2017. Euro-Atlantic blocking events and their impact on surface air temperature and precipitation over the European region in the 20th century. Climate Research, 71, 203–218. https://doi.org/10.3354/cr01438
		Basharin D.V., Polonsky A.B., Stankunavicius G. 2016. Projected precipitation and air temperature over Europe using a performance-based selection method of CMIP5 GCMs. Journal of water and climate change. 7 (1), 103-113, doi:10.2166/wcc.2015.081
		Jarmalavičius D., Šmatas V., Stankūnavičius G.; Pupienis D., and Žilinskas G. 2016. Factors controlling coastal erosion during storm events. In: Vila-Concejo, A.; Bruce, E.; Kennedy, D.M., and McCarroll, R.J. (eds.), Proceedings of the 14th International Coastal Symposium (Sydney, Australia). Journal of Coastal Research, Special Issue, No. 75, pp. 1112 - 1116. Coconut Creek (Florida), ISSN 0749-0208.

| 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 |