Processes in hydrology, atmosphere, and cryosphere ….
COURSE SYLLABUS

1.	**Course title:** *Processes in hydrology, atmosphere, and cryosphere*	
2.	**Lecturer:** *Prof. dr. hab. Jarosław Napiórkowski* *Prof. dr. hab. Marzena Osuch* *Dr. Tomasz Wawrzyniak* *Dr. hab. Magdalena Mrokowska* *Dr. Dariusz Baranowski* **Coordinated by Prof. dr. hab. Jarosław Napiórkowski**	
3.	**Field, type, and level of studies, year of study:** *Environmental and Earth Sciences, PhD Studies, all years*	
4.	**Course character:** *Monographic lecture*	
5.	**Teaching method:** *In-person (in IG PAS, Warszawa, ul ks. Janusza 64)*	
6.	**Language:**	*English*
7.	**Course type and number of hours:** *Lectures: 9h, Seminars: 4h, Workshops: 3h, Total: 16h*	
8.	**Estimated load of students' independent work:**	*25h*
9.	**Total workload and number of ECTS points:**	*41h, 2 ECTS*
10.	**Short description and main focus of the course:** *The course provides a comprehensive introduction to hydrology, including a discussion of the most important processes in the hydrological cycle: evaporation, transpiration, condensation, precipitation, and runoff. Key topics include modelling processes in rivers, the atmosphere, and the cryosphere. The course combines lectures, seminars, and workshops.* *Agenda (16 hours of lectures, seminars, and workshops)* ***9 March 2026 (Monday) Room 213*** *13:00 - 14:30 Prof. Dr. Hab. Jarosław Napiórkowski (Lecture 2h)* *"Hydrologic models"* *13:30 – 14:15 Lunch break* *14:15 – 15:45 Prof. Dr. Hab. Marzena Osuch i Dr. Tomasz Wawrzyniak (Lecture 2h)* *"Modelling the ground temperature of perennial permafrost" (Part I)*	

	15:45 – 16:00 Coffee break *16:00 - 17:30 Prof. Dr. Hab. Marzena Osuch i Dr. Tomasz Wawrzyniak (Seminar 2h)* *“Modelling the ground temperature of perennial permafrost” (Part II)* ***10 March 2026 (Tuesday) Room 516*** *10:00 – 12:30 Dr. Hab. Eng. Magdalena Mrokowska (Lecture 3h)* *“Hydrodynamic Models Laboratory - lab presentation and introduction to modelling of buoyancy-driven flows”* *12:30 – 13:30 Lunch break* *13:30 - 16:00 Dr. Hab. Eng. Magdalena Mrokowska (Worksop 3h)* *“Hydrodynamic Models Laboratory - lab presentation and introduction to modelling of buoyancy-driven flows”* ***12 March 2026 (Thursday) Room 213*** *10:00 - 11:30 Dr. Dariusz Baranowski (Lecture 2h)* *“Principles of numerical modelling for atmospheric and oceanic applications”* *11:30 – 11:45 Coffee break* *11:45 – 13:15 Dr. Dariusz Baranowski (Seminar 2h)* *“Principles of numerical modelling for atmospheric and oceanic applications”*

11.	**References:**

Kirkham, M.B., 2014, Chapter 10 - Field Capacity, Wilting Point, Available Water, and the Nonlimiting Water Range, Editor(s): M.B. Kirkham, Principles of Soil and Plant Water Relations (Second Edition), Academic Press, Pages 153-170, ISBN 9780124200227, https://doi.org/10.1016/B978-0-12-420022-7.00010-0.

Runkel, R.L., Bencala, K.E., 1995. Transport of reacting solutes in rivers and streams. In: Singh, V.P. (eds) Environmental Hydrology. Water Science and Technology Library, vol 15. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-1439-6_5

Aghakouchak, A., Habib, E., 2010. Application of a Conceptual Hydrologic Model in Teaching Hydrologic Processes, Int. J. Engng Ed. Vol. 26, No. 4, pp. 963–973, https://www.ijee.ie/articles/Vol26-4/21_Ijee2318.pdf

The Hydrologic Cycle, NOAA, https://www.noaa.gov/jetstream/atmosphere/hydro

Woo, Ming-ko, 2012. Permafrost Hydrology. Springer-Verlag,. ISBN: 978-3-642-23461-3; ISBN: 978-3-642-23462-0

French, H.M., 2017. The Periglacial Environment. 4th ed., John Wiley & Sons, Ltd., ISBN: 978-1-119-13278-3.

Salby, M.L., 2012.Physics of the Atmosphere and Climate. Cambridge University Press,

Williams, P., 2010. Stochastic physics and climate modelling. Eds. Tim Palmer, and Paul Williams. Vol. 480. Cambridge: Cambridge University Press.

Hanwell, James D. Atmospheric processes. Routledge, 2019

Tokyay, T., Constantinescu, G., Meiburg, E., 2014. Lock-exchange gravity currents with a low volume of release propagating over an array of obstacles. Journal of Geophysical Research-Oceans 119(5), 2752-2768.

He, Z., Okon, S.U., Zhu R, Pähtz T, Meiburg E, 2025. Dynamics of gravity currents under external and internal stratification in geophysical systems, Earth-Science Reviews, 271, 105270. https://doi.org/10.1016/j.earscirev.2025.105270

12.	**Prerequisites:** *Basic knowledge of Earth sciences and physics.*	
13.	**Educational outcomes:**	**PQF level 8 codes:**
	Knowledge: *understanding of geophysical principles, in the field of hydrology, atmosphere, and cryosphere, introduction to the state-of-the-art methods that are being developed*	*P8S_WG*
	Practical Skills: *ability to analyse hydrologic and climate-related data, apply research methods in geophysics*	*P8S_UW*
	Social Skills: *ability to work in interdisciplinary research teams, critical analysis of scientific literature, and recognise the value of knowledge in solving practical problems*	*P8S_KK*
14.	**Evaluation of the educational outcomes:** *Active participation in discussions during lectures, seminars, and workshops; Final assessment in the form of a written report or examination*	
15.	**Criteria to complete the course:** *at least 80% attendance, successful completion of assignments, and final assessment*	
16.	**Contact with the lecturer:** *Coordinated by Prof. dr. hab. Jarosław Napiórkowski (jnn@igf.edu.pl)*	