Detailed list of courses	
Name of the course	***Data Analysis in Geophysics***
number of instruction hours	lectures+practice (30+15)
outline of course/module content	Auxiliary results from linear algebra: matrices, eigen values, reduction to diagonal form, singular value decomposition, method of least squares. Multiple linear regression and correlation. Empirical orthogonal functions (EOF). Objective analysis: polynomial fitting, objective interpolation. Time series, spatial fields: a) deterministic theory: linear systems, Fourier transform, discrete sampling, aliasing, digital filters; b) stochastic theory in frequency domain as well as in the domain of wave numbers: linear systems with stochastic input, power spectra and cross-spectra of stationary stochastic processes, linear model with noise; d) wavelets. Exercises will comprise the implementation of various methods on computer. These will be used to analyze real or artificial (computer generated) data.
description of instruction methods	Lectures and consultations.
description of course/module requirements	Attending the lectures, solving a set of problems using computer and writing a report, oral exam.
Name of the course	***Seminar in Geophysics 1***
number of instruction hours	seminars (30)
outline of course/module content	Choices of geophysical research topics, selection of relevant literature, following geophysical seminars of other scientists and presentations of own seminars.
description of instruction methods	Selection of research area, extended discussions, preparations of own seminars. Setting up scientific hypotheses, methods and data analyses.
description of course/module requirements	Understanding of nature, theory, observations and modeling of geophysical processes. Presentations of various relevant scientific results and research.
Name of the course	***Seminar in Geophysics 2***
number of instruction hours	seminars (60)
outline of course/module content	Choices of geophysical research topics, selection of relevant literature, following geophysical seminars of other scientists and presentations of own seminars.
description of instruction methods	Choice of research subject, extended seminar discussions, preparations of presentations and seminars. Setting the hypoteses, elaboration of methods; analyses of results.
description of course/module requirements	Regular and active participation in seminars. Presentation of results in the seminar form.
Name of the course	***Atmospheric Modeling***
number of instruction hours	lectures+practice (45+30)
outline of course/module content	Structure of atmospheric models. Parameterizations of physical processes. Model's initial and boundary conditions. Numerical solution techniques and solution instabilities. Chaotic behavior of model's solutions. Stochastic processes. Ensemble forecasting. Structure of models for transport and dispersion of atmospheric pollutants. Photochemical air quality models.
description of instruction methods	Lectures and practices, extensive discussions, homeworks and reading of scientific articles. Team work and individual presentations. Discussions of actual problems in using and applying numerical models. Preparations for the individual presentations final exam.
description of course/module requirements	Homeworks, written and oral presentations, final exam (written or oral).

Name of the course	***Selected Lectures in Atmospheric Physics***
number of instruction hours	lectures+practice (30+15)
outline of course/module content	Atmospheric particulate matter (PM) formation processes. Interactions of PM other atmospheric constituents. PM interactions with clouds. Long-range transport and deposition of PM. PM radiative forcing and climate. The influence of atmospheric particles on human health. Measurement techniques and worldwide experimental studies. PM levels in Croatia.
description of instruction methods	Apart from the lectures, extensive discussions with students, particularly on the results of their home assignments and additional literature (recent scientific papers on the subject).
description of course/module requirements	Homeworks, i.e. team analyses of the real PM dataset. Each group (2-3 students) investigates different atmospheric problem based on the analysis of the measurement dataset. Oral presentation of a recent scientific paper. Final exam.
Name of the course	***Selected Chapters in Atmospheric Turbulence***
number of instruction hours	lectures +exercises (30+15)
outline of course/module content	Flow micro-scale instabilities. Atmospheric boundary layers. Turbulence and closure problems. Turbulent kinetic and potential energy prediction. Monin-Obukhov length scale modifications. Spectral aspects of turbulent flows. Reynolds stress tensor prediction. Modeling transport, dispersion and diffusion in the atmosphere. Local circulations revisited. Atmospheric dynamics and parameterizations of micro-scale processes in NWP & climate models.
description of instruction methods	Extended discussions in class. Homework assignments and reading scientific papers. Group work and reports. Follow up and discussion of current mesoscale and local weather phenomena. Data analysis and discussion. Choice of students' area of expertise possibly leading toward final exam topic.
description of course/module requirements	Understanding of nature, theory and modeling of atmospheric turbulence. Extending knowledge about mesoscale and microscale dynamics. Analytical and numerical modeling of turbulent processes in geophysical flows.
Name of the course	***Atmospheric Predictability and Climate System Modelling***
number of instruction hours	lectures+practice (45+15)
outline of course/module content	Introduction to the atmospheric predictability theory. Liouville's equations and atmospheric predictability. Application of generalized theory of stability to deterministic and stochastic forecast of atmospheric state. Data assimilation for ensemble forecasts. Predictability of coupled processes. Ensemble forecasting system of *European Centre for Medium Range Weather Forecasts*. Hierarchy of climate models: null-dimensional, one-dimensional, two-dimensional and general atmospheric circulation models. Models of general oceanic circulation. Models of ice on the sea and land. Biophysical models of processes over the land. Biochemical oceanic models. Coupled models and their interaction. Climate changes theories.
description of instruction methods	delivering lectures, seminar and project tasks
description of course/module requirements	class attendance, seminar and project tasks
Name of the course	***Mesoscale Meteorology***
number of instruction hours	lectures+practice (30+15)
outline of course/module content	Orographically induced mesoscale processes. Internal gravity waves. Mountain waves. Linear approximation and nonlinear processes. Windward airflow deformation. Orographic precipitation. Lee side circulations. Lee side cyclogenesis. Thermal circulation in complex terrain. Mesoscale precipitation systems.

	Mesoscale observations. Satellites, radars, lidars, surface mesonetworks. Aircraft observations. Data analysis. Numerical modeling of mesoscale processes. Predictability.
description of instruction methods	Class attendance, homework, seminar and a class project
description of course/module requirements	Gaining knowledge of atmospheric mesoscale processes, their dynamic structure, observational methods and techniques, numerical modeling and predictability.
Name of the course	***Dynamical Oceanography***
number of instruction hours	lectures+practice (45+15)
outline of course/module content	Quasi-steady currents. Elementary current system. Wind-driven currents in the ocean (Sverdrup, Stommel, Munk). Wind-driven currents in inland seas (Weenink, Felzenbaum, Welander). Thermohaline circulation – inside inland basins and between the inland and open seas (estuarine circulation, inverse estuarine circulation). Free waves. General case of oscillations in rotating stratified fluid. High-frequency surface waves. Low-frequency shallow-water waves. Internal waves. Topographic effects. Forced waves. Analytical solutions for schematized oceans and inland seas: tides, response of the sea to the atmospheric forcing, seasonal variability. Resonant forcing of the sea.
description of instruction methods	Lectures and consultations.
description of course/module requirements	Attending the lectures and participating in the consultations, solving of a posed problem and orally responding to the examination questions.
Name of the course	***Physical and Chemical Properties of Seawater***
number of instruction hours	lectures+practice (30+15)
outline of course/module content	Lectures: Geochemical model of the seawater composition, major constituents and Dittmar's rule, definitions of salinity and measuring methods, salinity distributions in ocean and estuarine areas. Density of seawater calculated from temperature and salinity data, processes of stratification of seawater column and their role in vertical transport of matter. Gases, carbon systems, role of CO2 exchange between atmosphere and ocean in the global warming process. Minor elements, organic matter, pollutants, pollution and contamination of the Adriatic Sea. Nutrient cycles and their role in the eutrophication process and excessive mucous aggregations (mucilage phenomenon), mechanisms of eutrophication and mucilage events in the northern Adriatic. Practice: Research vessel - cruise planning, station positioning, sampling and sample storage, in situ measure of physical parameters, determination of physical and chemical parameters in the aboard laboratory. Land laboratory - data bases, import of data into the base, statistical and graphical analysis in ODV and other programs.
description of instruction methods	
description of course/module requirements	
Name of the course	***Selected Topics in Physical Oceanography***
number of instruction hours	lectures+practice (30+15)
outline of course/module	Numerical modeling of the sea dynamics. Basic equations, discretization, finite

content	differences, convergence, stability, analysis of numerical schemes for the shallow water equations. Typical approximations, boundary conditions, classification of the models. Princeton Ocean Model (POM). Verification of the model through comparison with analytical solutions. Application of the POM to the whole Adriatic and to the selected coastal area. Investigation of the relationship between wind- and buoyancy-driven dynamics.
description of instruction methods	Lectures and attended omputer exercises.
description of course/module requirements	Attending the lectures, implementing numerical model to solve given problem, oral exam.
Name of the course	***Physics of the Earth's Interior***
number of instruction hours	lectures + practice (45+15)
outline of course/module content	Propagation of volume waves in the heterogeneous medium. Scattering and attenuation of volume waves. Coda waves. Anisotropy in the Earth. Free oscillations of a layered sphere.
description of instruction methods	Class attendance, exercises and homework.
description of course/module requirements	Final exam (oral or written).
Name of the course	***Physics of the Earthquake Source***
number of instruction hours	lectures + practice (45+15)
outline of course/module content	Elastic rebound theory. Energy of deformation prior to the earthquake. Faults and fractures. Representation of the seismic source. Simple example of slip on the fault. Analyses of displacement discontinuity. Kinematics of seismic source (far-filed). Seismic spectrum at low frequencies. Dynamics of rupture. Seismic moment. Seismic moment tensor. Estimation of seismic moment. Volumetric sources. Basic theory and examples. Far-field kinematics. Inhomogeneous isotropic media. Unilateral fracture. Nucleation, spreading, and stoppage of fracture. Near-field source kinematics.
description of instruction methods	Oral teaching, exercises, discussions, homework
description of course/module requirements	Final (written or oral) exam
Name of the course	***Seismotectonic Parameters and Earthquake Magnitude***
number of instruction hours	lectures + practice (30+15)
outline of course/module content	Earthquake cycle: classical and alternative models of characteristic and random earthquakes. What controls ruptures and hypocenters: fault asperities, barriers,flats and ramps. Displacement variations along a fault, fault growth and fault segmentation. Relations between fault length, tectonic activity and maximal earthquake magnitude. Presentation of keynote examples from Croatia and worldwide.
description of instruction methods	Lectures, exercises and consultations
description of course/module requirements	Regular attendance to lectures and active participation in discussions, presentation of solutions to key-type problems in seismotectonics
Name of the course	***Selected Chapters of Seismology***
number of instruction hours	lectures + practice (30+15)
outline of course/module content	The programme is defined on the basis of chosen subjects. Some of the themes are: propagation of elastic waves in anisotropic media, inverse problems in seismology, surface waves and free oscillations of the Earth, earthquake statistics,

	etc. Current literature is used along with obligatory literature.
description of instruction methods	Oral teaching, exercises, discussions, homework
description of course/module requirements	Final (written or oral) exam
Name of the course	***Selected Chapters of Geophysical Exploration***
number of instruction hours	lectures + practice (30+15)
outline of course/module content	The high resolution seismic reflection method (the HRS method) in near surface investigations: theoretical bases, instruments and equipment, data acquisition, data processing, processing software, interpretation. Seismic down-hole and cross-hole explorations. Three-dimensional (3D) seismic reflection explorations. Seismic tomography. Application of the seismic methods. Electrical methods. Vertical and horizontal resolution of the methods. Surface electrical tomography: theoretical bases, multi-electrode systems, survey geometry, projecting of field measurements, two-dimensional (2D) and three-dimensional (3D) explorations, data processing, interpretation, case histories. Dual gradient mapping and TUBEL method. Magnetotelluric method. Electromagnetic method. Georadar investigations. Potentials of the electrical methods in karst explorations. Remote sensing gravity. Microgravity explorations. Gravity explorations of underground cavities. Aeromagnetic explorations. Complex geophysical explorations.
description of instruction methods	Lectures, exercises, seminary, consultation
description of course/module requirements	Seminary, oral examination
Name of the course	Planetary Magnetism
number of instruction hours	lectures+practice (20+20)
outline of course/module content	Planetary magnetic fields, physical principle of generation mechanism, maintaining and evolution of the magnetic field. Planetary magnetospheres, induced magnetospheres, interrelationship between Solar wind and planetary magnetospheres as well as atmospheres. Magnetic field modelling: main and external field, both on global and regional scales.
description of instruction methods	Teaching, leading and supervising individual researches
description of course/module requirements	Lectures participation, carrying out small projects, presentations of the results, preparation of presentations regarding the newest results on planetary magnetic fields