Application Form Bachelor Physics & Astronomy  
(NS-310B)   
Use of this form is mandatory for all large research projects, notably the bachelor research thesis ('bacheloronderzoek'). It must be handed in by the student at the **course leader (R. Holzinger, BBg 6.76)**, prior to the specified deadline (start of the project).

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| --- | --- | --- | --- |
| **Student** | | | |
| **First and last name of student** | Marte Voorneveld | | |
| **Student number** | 5911591 | | |
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| **Project supervisor** | | | |
| **Name and title (must be staff of the Department of Physics holding or in training for BKO)** |  | | |
| **Email address** |  | | |
| **Daily supervisor Fill out this section only if the project supervisor is not the daily supervisor!** | | | |
| **Name and title** |  | | |
| **Affiliation** |  | | |
| **Address** |  | | |
| **Telephone number** |  | | |
| **Email address** |  | | |
| **Research project** | | | |
| **Starting date** | 01/01/2020 | | |
| **Ending date** |  | | |
| **Number of EC (15 for regular project)** | 15 | | |
| **Honours project (yes, no)** | no | | |
| **Entry requirements** | | | |
| **At least 90 EC, including all mandatory courses (yes, no)** | yes | | |
| **Short description of the project, including:**  • background  • research question(s) • methods  Approximately 400 words | Veros is a new ocean modeling program built entirely in python. This opens it up to a lot of possibilities in regards to flexibility and speed compared to the older models written in languages such as Fortran. It also allows more flexibility in the usage of the vast extent of libraries written for python. To test this model out we will try to use fast global ocean simulation techniques(Mulder , 2017) and try to apply them to Veros in numerous oceanic basins from 140Ma to now. We will also try to model the transport and stream functions for this time period.  The central research questions of this paper will be: “Can a changing bathymetry over long time periods explain the current overturning currents in the oceans?” and “Can a simplified oceanic forcing be a useful tool for calculating very long term oceanic changes?”  A large part of this thesis will be focused on gaining knowledge on how to effectively use the Veros library and how to properly choose forcings for the different oceanic basins. The biggest challenge of this thesis will probably be on how to choose effective forcings for the ocean at such large time intervals. There is very limited data for this time interval on parameters such as: surface salinity, sea (surface) temperature and wind forcings. These will thus be estimated using estimation techniques described in existing literature.  The relatively new Python library Veros will be mainly used as a tool to build the simulations needed for this thesis. This thesis will be heavily relying on the 2017 paper on *Efficient computation of past global ocean circulation patterns using continuation in paleobathymetry* by T.E. Mulder et al as it provides a good framework for estimating forcings in these past basins. A large part of the paper itself will go into these forcings and the reasoning behind them. | | |
| **Agreements between student and supervisors** | | | |
| **Number of hours available for supervision** | | |  |
| **Planning/timing of the supervision (e.g. ‘weekly meetings’)** | | |  |
| **Agreed student work load (e.g. full time, 3 days/week etc.)** | | |  |
| **Student absence (holidays, courses etc.)** | | |  |
| **Supervisor absence (holidays, conferences, etc.)** | | |  |
| **Intermediate evaluations of student performance (specify at least one date)** | | |  |
| **Presentations to be held** | | |  |
| **Lab/group meetings to be attended** | | | biweekly project meetings |
| **Other activities agreed upon** | | |  |
| **Primary assessment criteria: (please see appendix for examples)** | | | • Project activities 60% • Thesis 30% • Oral presentation 10%  The assessment form **(**<https://students.uu.nl/sites/default/files/assessment_form_bonz_september_2018_tw.pdf>**)** provides detailed information (especially Part 2). |
| **Copyright** | | | |
| **By signing this document, the student declares to transfer the copyright of any and all products, including the tangible and intellectual products, of the research project to the Undergraduate School Betawetenschappen. The school may use said products in any way deemed appropriate in the light of the mores of the scientific community and scientific research. The rights of the student to be a co-author of publications or to be otherwise acknowledged are also recognized by the same standards. The student also declares to upload his final assessed thesis to the university publication archive IGITUR. At a later stage, the thesis may be made public via IGITUR, or its access may be restricted temporarily or indefinitely.** | | | |
| **Signatures** | | | |
| **Student Name:**  **Date:**  **Signature:** | |  | |
| **Project supervisor Name:**  **Date:**  **Signature:** | |  | |
| **BONZ coordinator Name:**  **Date:**  **Signature:** | |  | |