Collaborative Scientific Programming

Objectives and Content

This course introduces students to collaborative scientific programming using Python and Git-based tools, tailored to applications in meteorology, oceanography, and climate sciences. Through hands-on activities and real-world data, students learn foundational programming practices, scientific workflows, and modern collaboration techniques used in geophysical research.

Key components include:

- Introduction to meaningful learning theory and motivation for scientific programming
- Scientific Python routines using packages such as *Pandas*, *NumPy*, *Matplotlib*, *Cartopy*, and *SciPy*
- Git fundamentals for collaborative work, amongst others: *cloning*, *branching*, *pull/merge* requests, *commits*, *pushes*, and conflict resolution
- A group-based scientific project involving data processing, analysis, and visualization
- Use of GitLab as a platform for collaborative coding and version control
- Final presentations and discussion of project results with a climate science expert

Instruction is guided by evidence-based teaching methods from science education research and emphasizes peer collaboration, active participation, and real-world relevance.

Learning outcomes

Upon completing the course, students will:

KNOWLEDGE
- Understand the role of programming and version control in scientific research
- Identify and describe standard scientific Python packages and their purposes
- Recognize the principles of collaborative work in coding environments

SKILLS
- Use Git for collaborative version control and project management
- Write Python code to load, process, analyse, and visualise geophysical data
- Apply scientific reasoning to interpret and present analysis results

GENERAL COMPETENCE
- Collaborate effectively on coding tasks in a scientific setting
- Reflect on their own learning and development as scientific programmers
- Integrate programming more naturally into their disciplinary academic work

Teaching and learning methods

The course consists of five interactive sessions of three hours each over two weeks. Each session combines brief theoretical introductions with guided coding exercises, individual problem-solving, and collaborative group work. Real data from oceanography and meteorology is used throughout.

Recommended Previous Knowledge

The course is open to all students affiliated with the Geophysical Institute, especially Bachelor's and early Master's students. No prior experience with Git is required. Basic familiarity with Python is recommended.