ICTP DIPLOMA PROGRAMME IN EARTH SYSTEM PHYSICS 2014-15 SYLLABUS

NUMERICAL METHODS I- {15 Lectures = 22.5 hours}

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Numerical methods for Earth-system modeling II.
The aim of this course is to provide students with no experience on scientific computing with the basics of the numerical techniques used in earth system modeling. The point of view of the lectures is not theoretical but more programming oriented. From this perspective, topics covered in the course are:
1. Introduction to Finite Differences and floating point representation. 2. Ordinary Differential Equations discretization: accuracy and stability. 3. The 1D linear advection equation: the Forward in Time Forward in Space scheme. Stability analysis. 4. The 1D linear advection equation: the upstream scheme. CFL condition. 5. The 1D Linear advection equation: the leapfrog scheme. 6. The leapfrog computational mode. Robert-Asslin and Robert-Asslin-Williams filters. 7.The 1D linear advection equation: the semi-Lagrangian technique. 8. The 1D linear advection equation: an implicit time discretization. 9. The 1D diffusion equation: an explicit discretization and stability analysis. 10. The 1D advection-diffusion equation. 11. The linearized 1D shallow water equations system: an explicit discretization. 12. Summary and review of selected topics.
References:
Lecture notes provided during the course.
For some interested student, more in depth treatments can be found for example in:
Dale D. Durran, Numerical Methods for Fluid Dynamics With Applications to Geophysics, Second Edition, Springer Verlag 2010.
ECMWF Training Lecture notes.
(http://old.ecmwf.int/newsevents/training/lecture_notes/pdf_files/NUMERIC/Num_meth.pdf)