*Summer School on **Non-Homogeneous Fluids and Flows***

Outline of course lectures (as of 28. March 2012)

Vincenzo Armenio

Turbulence in stratified flows

- Generality and governing equations of stratified flows
- Homogeneous turbulence in stable stratified flows
- Wall bounded turbulence in stable stratified flows
- Numerical modeling of stratified flows

Vladimir Zeitlin

Multi-layer Rotating Shallow Water - a mathematical laboratory for studying large-scale geophysical and astrophysical flows

- Fundamentals: basic properties of the model, waves vs. vortices, geostrophic adjustment.
- Geostrophic vs ageostrophic instabilities and their saturation: barotropic, baroclinic and inertial instabilities; instabilities of coastal currents and density fronts
- Wave-wave and wave-meanflow interactions: parametric excitation of waveguide modes and structure formation
- Beyond the standard model. More physics: moist-convective rotating shallow water and shallow-water magnetohydrodynamics.

Chantal Staquet

Internal gravity waves

- Internal gravity waves : basic properties, resonant interactions, wave-induced mean flow.
- Interactions of internal gravity waves with a mean flow : background
- Interactions of internal gravity waves with a mean flow : application to the atmosphere.
- Wave induced mean flow in the Southern Ocean.

Philippe Fraunié

Turbulent mixing in Atmosphere and Ocean

- Vertical mixing in Startified flows, Lagrangian methods, Double diffusion, Turbulent measurements, HF and VHF radars

High resolution Numerical methods for Atmosphere and Ocean

- Shallow water models, Conservative schemes, Spectral Elements and applications, Two phase flows

Eleuterio F. Toro

Advanced numerical methods for hyperbolic equations and applications

- Introduction to numerical methods for hyperbolic equations.
- Numerical fluxes for finite volume and DG methods
- High-order non-linear methods: the ADER approach
- A case study: blood flow in vessels with variable material properties

Dmitri Kuzmin

Finite Element Methods for Convection-Dominated Transport Equations with Applications to Incompressible Flow Problems

- Stabilization techniques for convection-diffusion equations: upwinding, artificial diffusion, Petrov-Galerkin and Taylor-Galerkin methods
- Methods for problems with steep fronts: discontinuity capturing terms, discrete maximum principles, flux-corrected transport algorithms
- Finite element solvers for nonlinear systems: incompressible Navier-Stokes equations, k-epsilon turbulence model, moving boundary problems

Further lectures will be announced soon

Yuli D. Chaschechkin

Eduard Feireisl

Antonín Novotný