Modelling mountain glacier dynamics

Course Objectives:

Indian research scholars in the field of Glaciology tend to lack exposure to numerical and analytic modelling tools of glacier dynamics. A two weeks long training programme is being proposed to bridge this gap. The emphasis would be on basic understanding and hands-on application. On completion of the course, the students are expected to be able to apply the methods learned in their own research. Apart from research scholars, a few interested Masters' level students would also be selected.

Course organisation:

- Preparatory course on the first week
- Main course on the second week
- 3 lectures of in the morning (55 mins each). Each lecture to be followed by 10 minutes of discussions led by students.
- 2 computer practicals/problem solving sessions in the afternoon (90 mins each) conducted by the instructors.
- Several 10 mins lectures by students on given topics during tutorial sessions
- 4 special lectures by guest speakers (60 mins each)
- real-life projects suprvised by the instructors
- project presentations by the students on the last day (15 mins each)

Instructors:

Week 1: R Shankar (Institute of Mathematical Sciences)
Raghu Murtugudde (University of Maryland)
Hilmar Gudmundsson (British Antarctic Survey)
Argha Banerjee (Indian Institute Science Eduacation and Research Pune)

Week 2: R Shankar (Institute of Mathematical Sciences)
Hilmar Gudmundsson (British Antarctic Survey)
Fabien Gillet-Chaulet (LGGE CNRS / UJF)
Argha Banerjee (Indian Institute Science Eduacation and Research Pune)

Tentative Course outline:

day01-day06 (18L+12T)

1. Glaciers (AB), 6L + 2T

glaciers and glacial geomorphology using google-earth
global glacier distribution, WGI
snow and ice
flow
energy and mass balance and their measurements
glacier and climate, forcing, feedbacks
climate sensitivity, AAR, ELA
Himalayan glaciers, supraglacial debris

2. Physics basics (RS), 5L + 3T

force, acceleration, vectors

dissipation, steady states, stability of steady states
pressure, force density, hydrostatic equilibrium
stress, force densities, strain rate, tensors
linear reponse

3. Fluid flow (AB/RS/HG), 3L + 2T

continuity equation, Euler eq in 1d
Viscosity, Newtonian liquid, Navier-Stokes in1d
Non linear viscosity, Glenn's flow law
Infinite sheet of n=1, n=3, and n=infinity liquids flowing over inclined plane

4. Numerics (RM), 4L + 3T

finite differences**,** limit, differentiation, Taylor Series
numerical integration of ODE
PDE (eg continuity equation and heat equation in 1-d)
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Day 07 (3L)

Review/revisions, 3L (led by students)

Day 08-Day11 (12L + 8T)

5. 0-d models (RS), 2L + 1T
6. Flowline model (AB), 2L+ 2T
7. Glacier mechanics (HG), 3L + 2T
8. Elmer Ice (FG), 3L + 3T
9. Projects (RS, AB, HG, FG), 1L + 1T

Day 12 – Day 13 (4L+projects)

review/revisions 3L (led by students)
projects (RS, AB, HG, FG)

Day 14 (3L)

project presentations