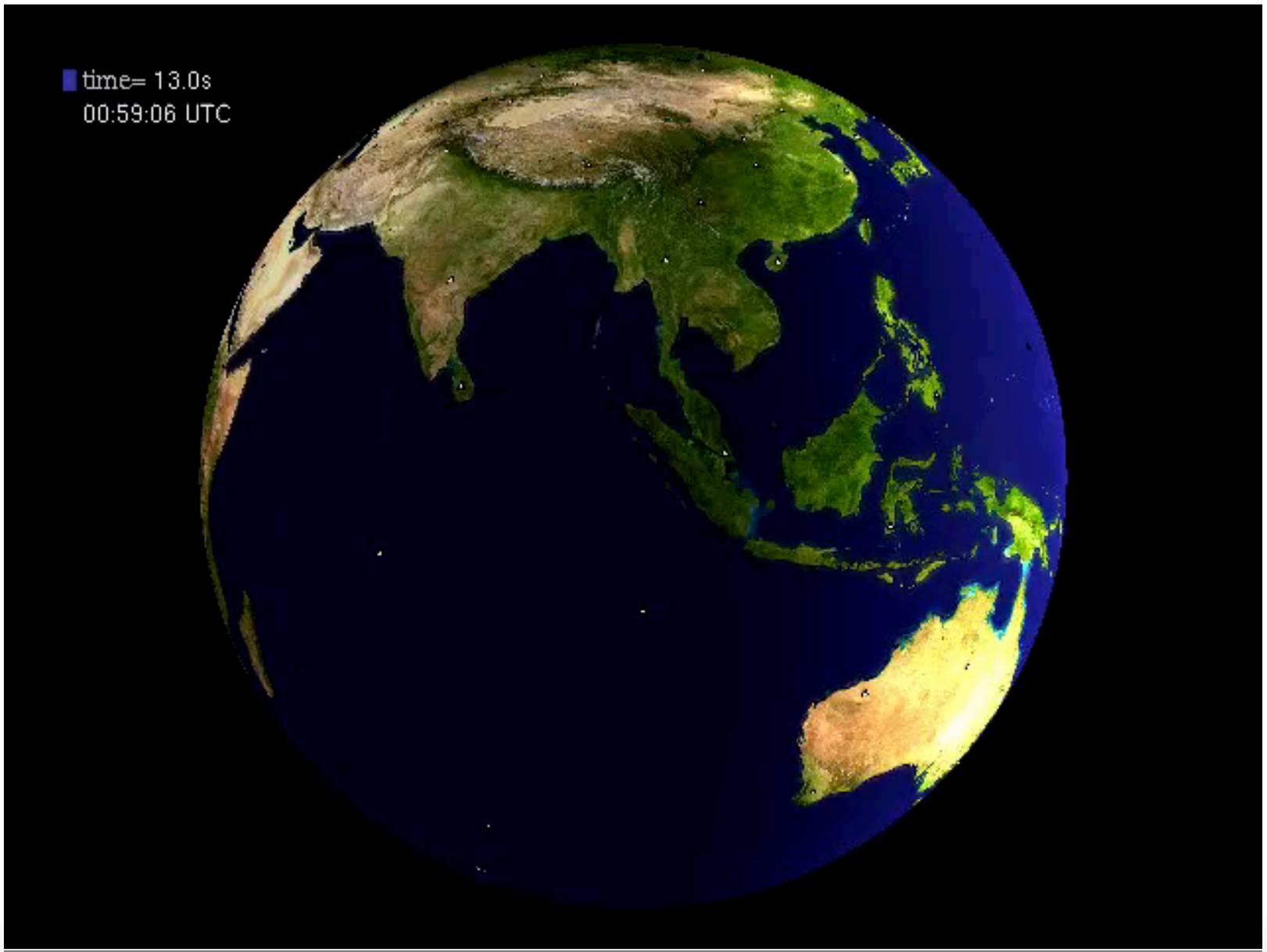
Computational Geophysics
ErSE 390C



Computational Geophysics - ErSE 390C

Fall Semester 2016

Schedule: (tentative)

week 1 Introduction to conservation laws for heat flow and wave propagation

week 2 Finite-differences method for heat flow

week 3 Finite-differences method for wave propagation

- No classes - Eid Al-Adha break

week 4 Higher-order Finite-differences method for tsunami waves

week 5 Introduction to Pseudo-spectral method

week 6 Pseudo-spectral method for wave propagation

week 7 Introduction to Finite-element method

week 8 Finite-element method for steady-state heat flow

week 9 Finite-element method for unsteady-state heat flow

week 10 Introduction to spectral-element method

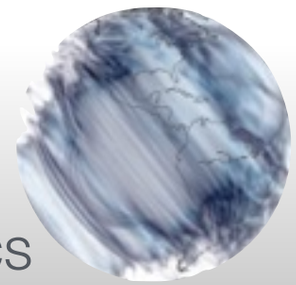
- No classes - semester break

week 11 Spectral-element method for heat flow

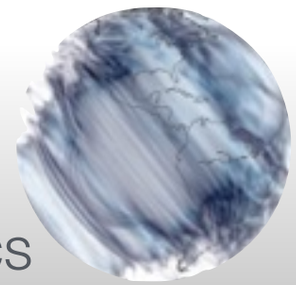
week 12 Spectral-element method for 1D wave propagation

week 13 Spectral-element method for 2D elastic wave propagation

week 14 Spectral-element method for 3D viscoelastic wave propagation



Spectral-element method



Computational Geophysics

A Spectral Element Method for Fluid Dynamics: Laminar Flow in a Channel Expansion

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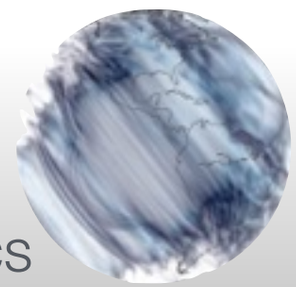
Department of Mechanical Engineering,
Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

Received March 29, 1983; revised October 4, 1983

Computational Fluid Dynamics

Patera, 1984

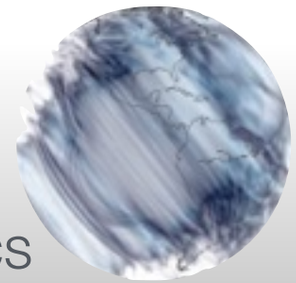


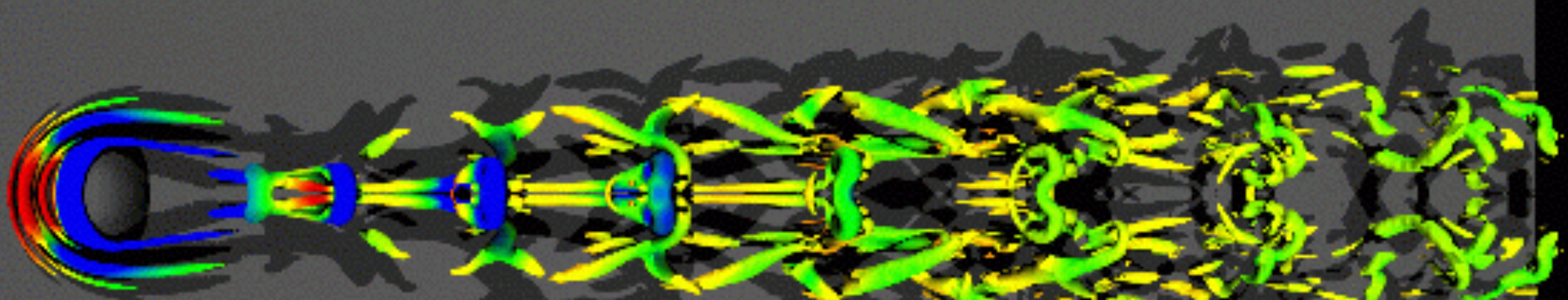
Computational Geophysics

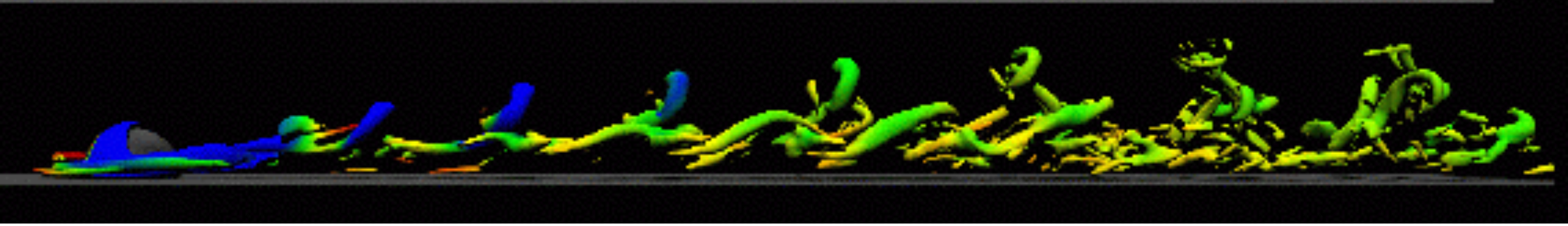
A spectral element method that combines the generality of the finite element method with the accuracy of spectral techniques is proposed for the numerical solution of the incompressible Navier–Stokes equations. In the spectral element discretization, the computational domain is broken into a series of elements, and the velocity in each element is represented as a high-order Lagrangian interpolant through Chebyshev collocation points. The hyperbolic piece of the governing equations is then treated with an explicit collocation scheme, while the pressure and viscous contributions are treated implicitly with a projection operator derived from a variational principle. The implementation of the technique is demonstrated on a one-dimensional inflow–outflow advection–diffusion equation, and the method is then applied to laminar two-dimensional (separated) flow in a channel expansion. Comparisons are made with experiment and previous numerical work.

Computational Fluid Dynamics

Patera, 1984

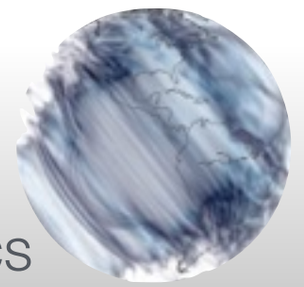


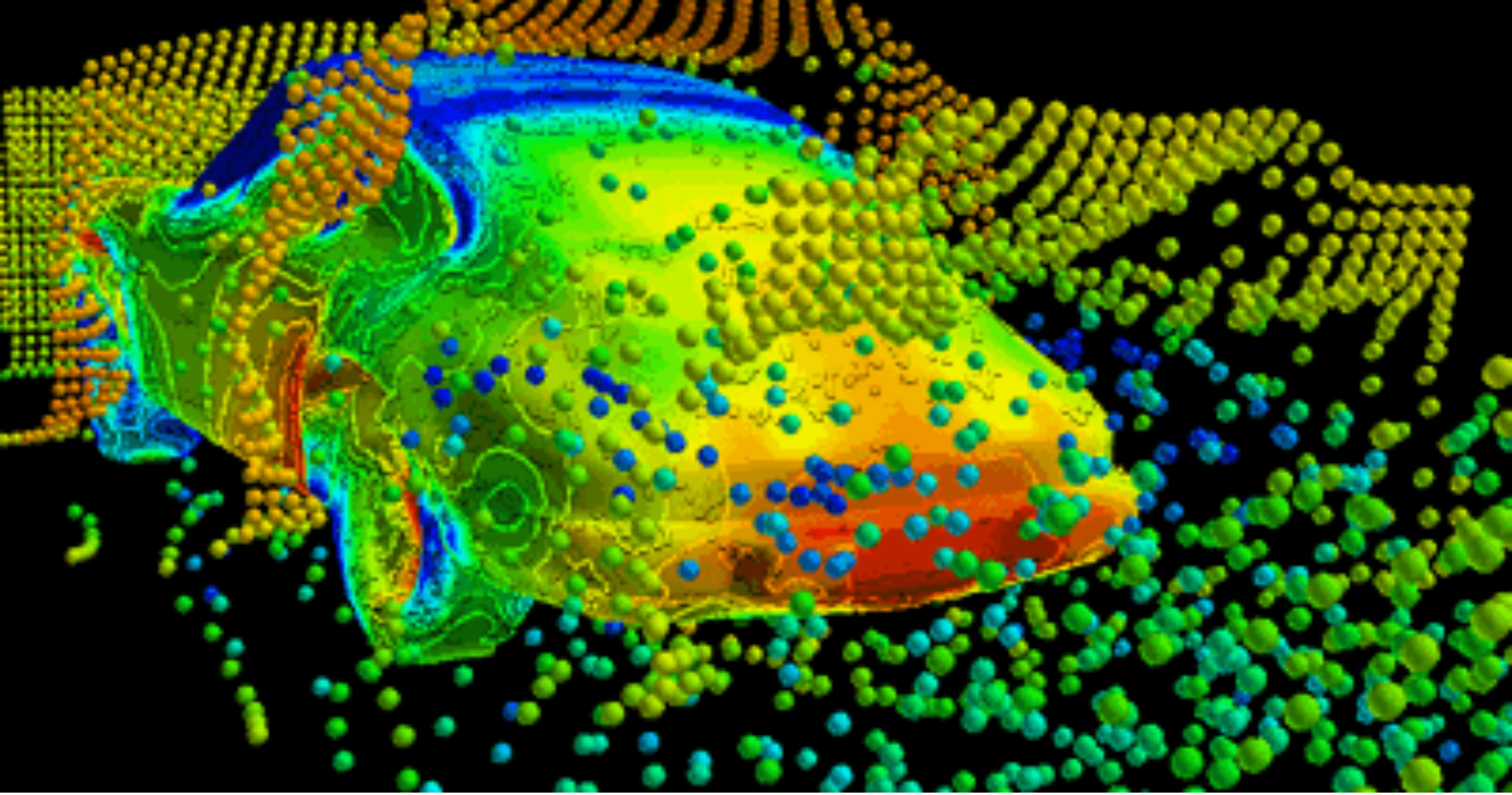




Computational Fluid Dynamics

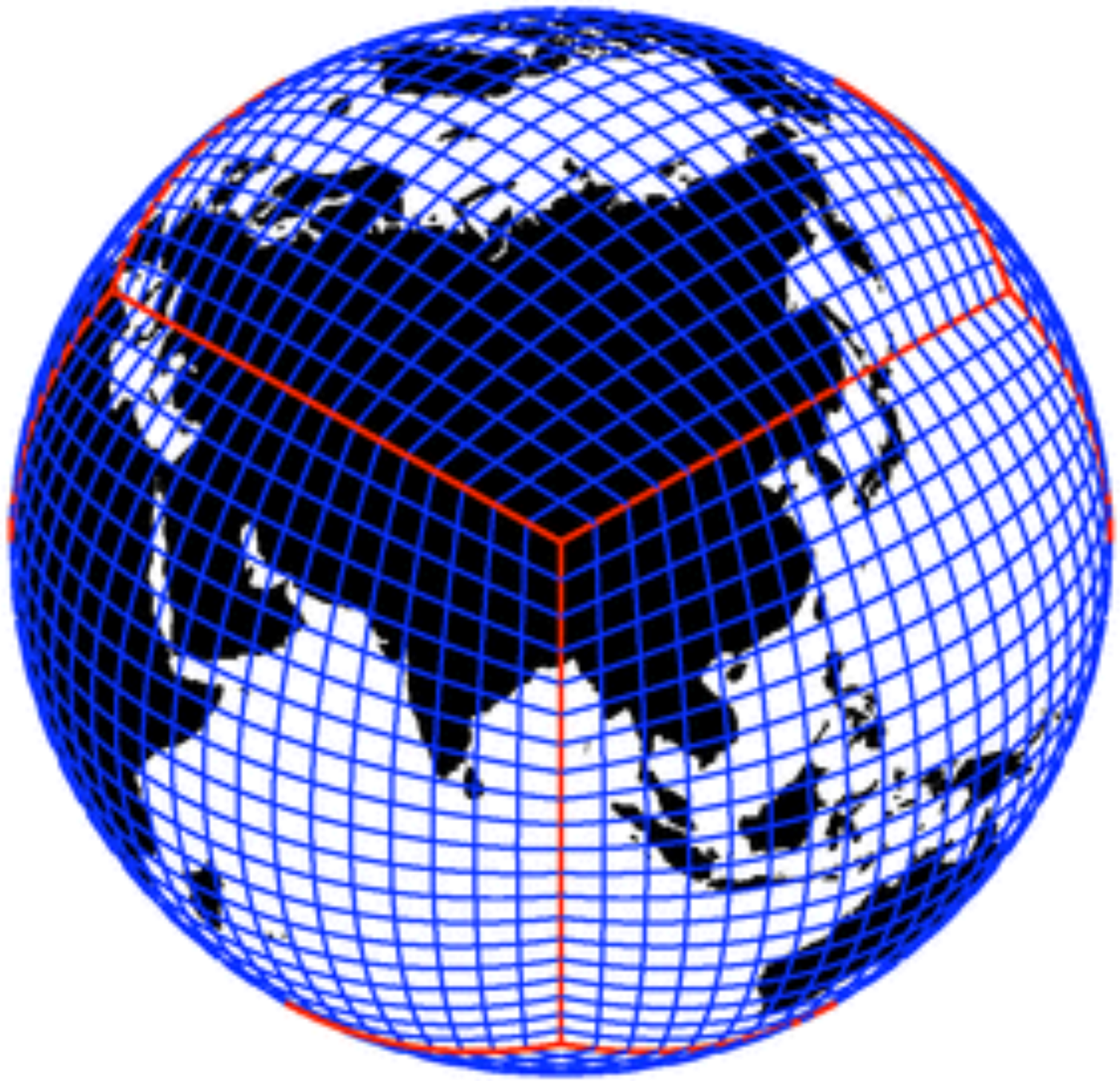
Computational Geophysics



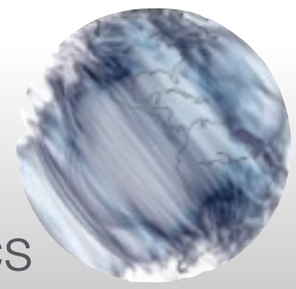


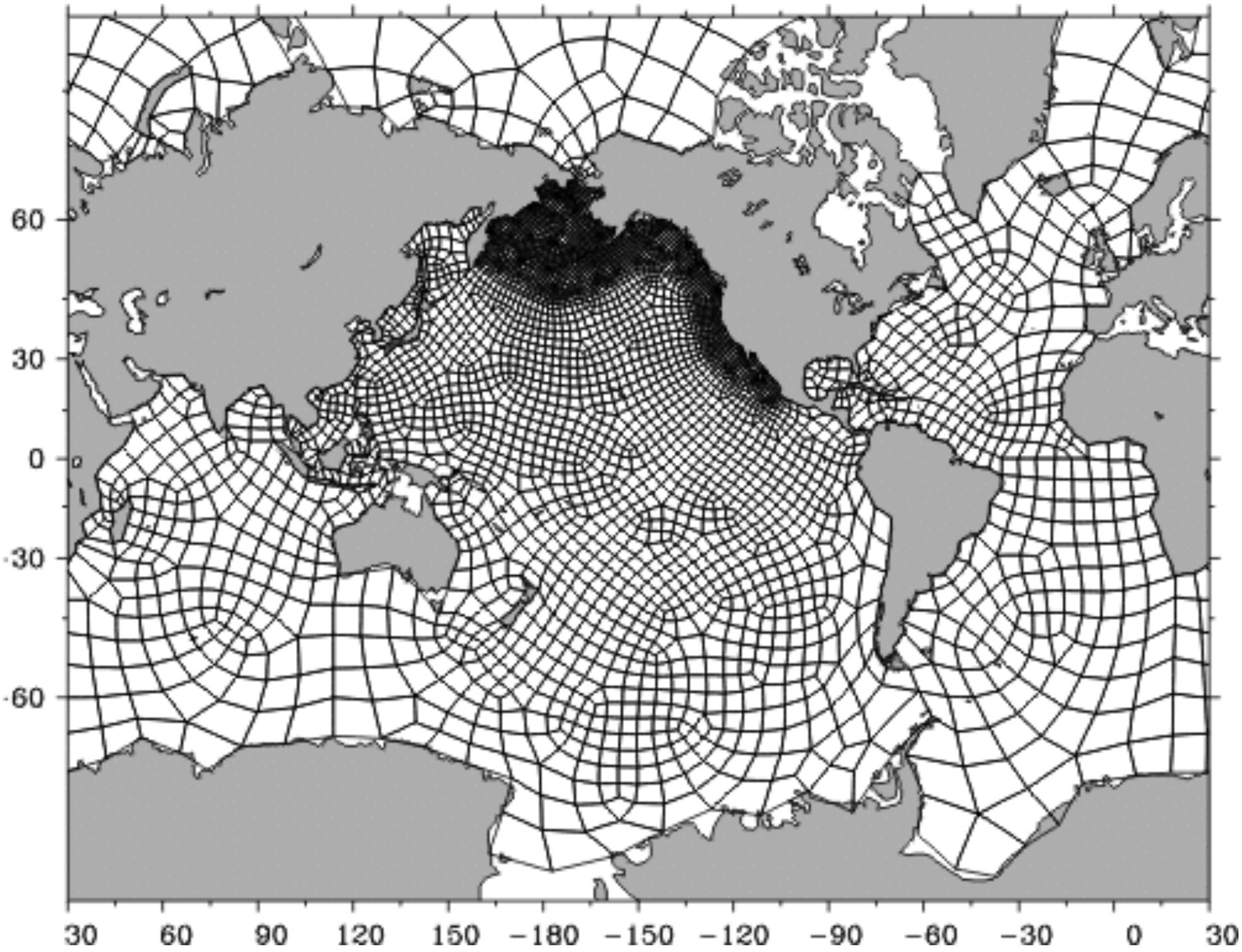
Computational Fluid Dynamics

Computational Geophysics

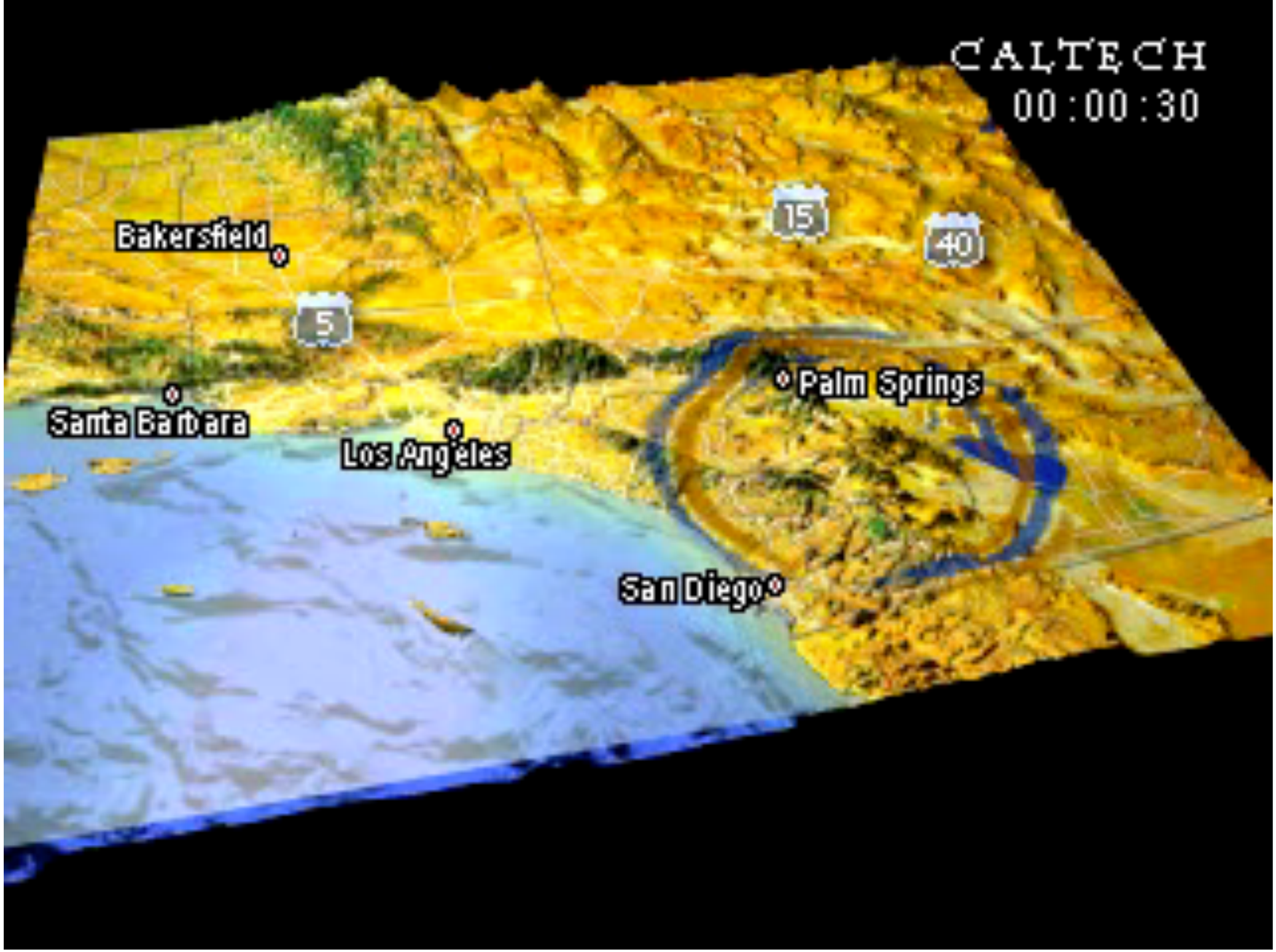


Climate modeling

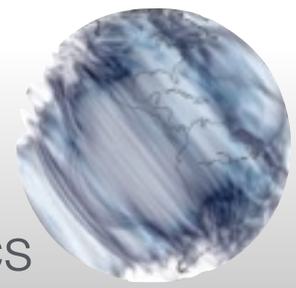




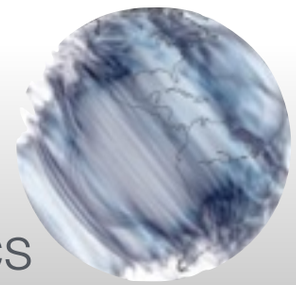
Ocean modeling



Seismic wave propagation



Seismic wave propagation



Computational Geophysics

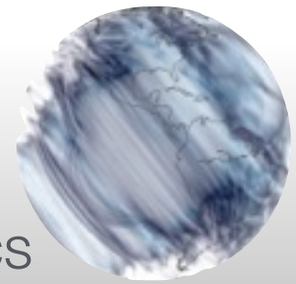
Spectral-element software

Computational Fluid Dynamics

Nek5000
NekBox
Nektar++
..

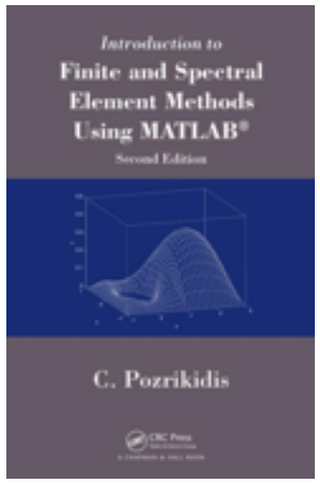
Seismic wave propagation

SPECFEM (2D, 3D, 3D_GLOBE)
RegSEM
SES3D
..



Finite-element literature

books



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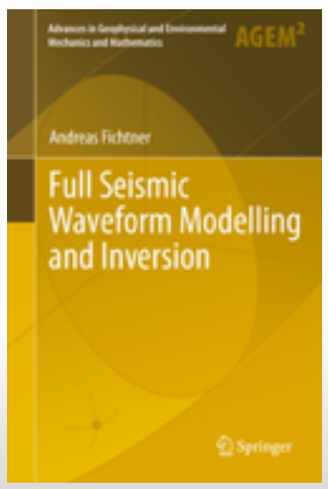

A. Fichtner.
Full Seismic Waveform Modelling and Inversion,
Springer, 2011. ISBN: 978-3-642-15807-0