

# Spectral-element method



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

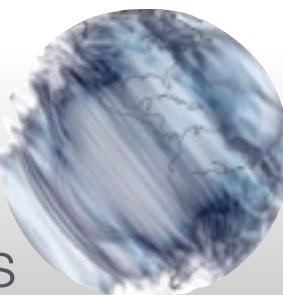
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## Computational Fluid Dynamics

**Patera**, 1984



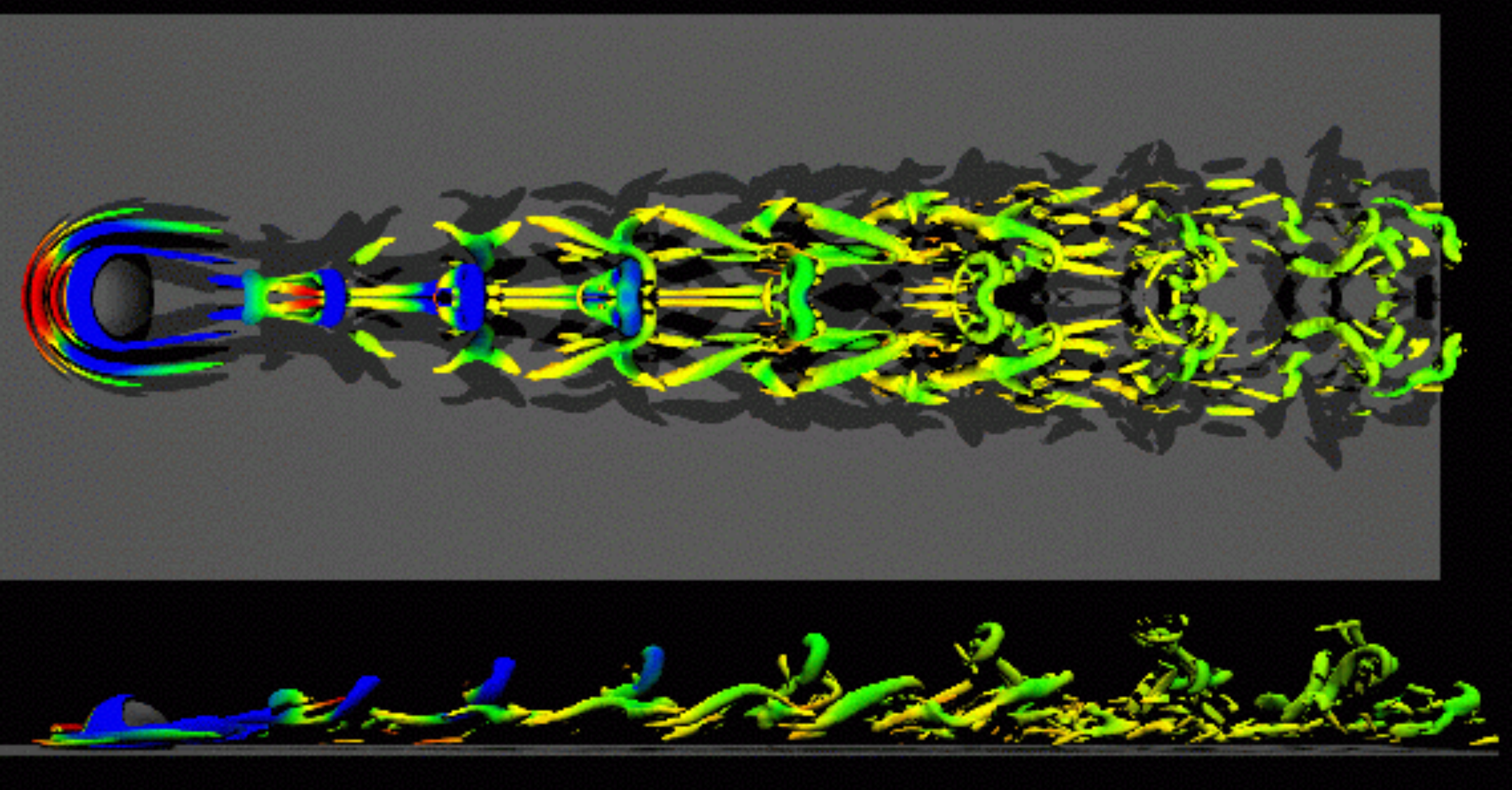
A spectral element method that combines the generality of the finite element method with the accuracy of spectral techniques is proposed for the numerical solution of the incompressible Navier–Stokes equations. In the spectral element discretization, the computational domain is broken into a series of 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





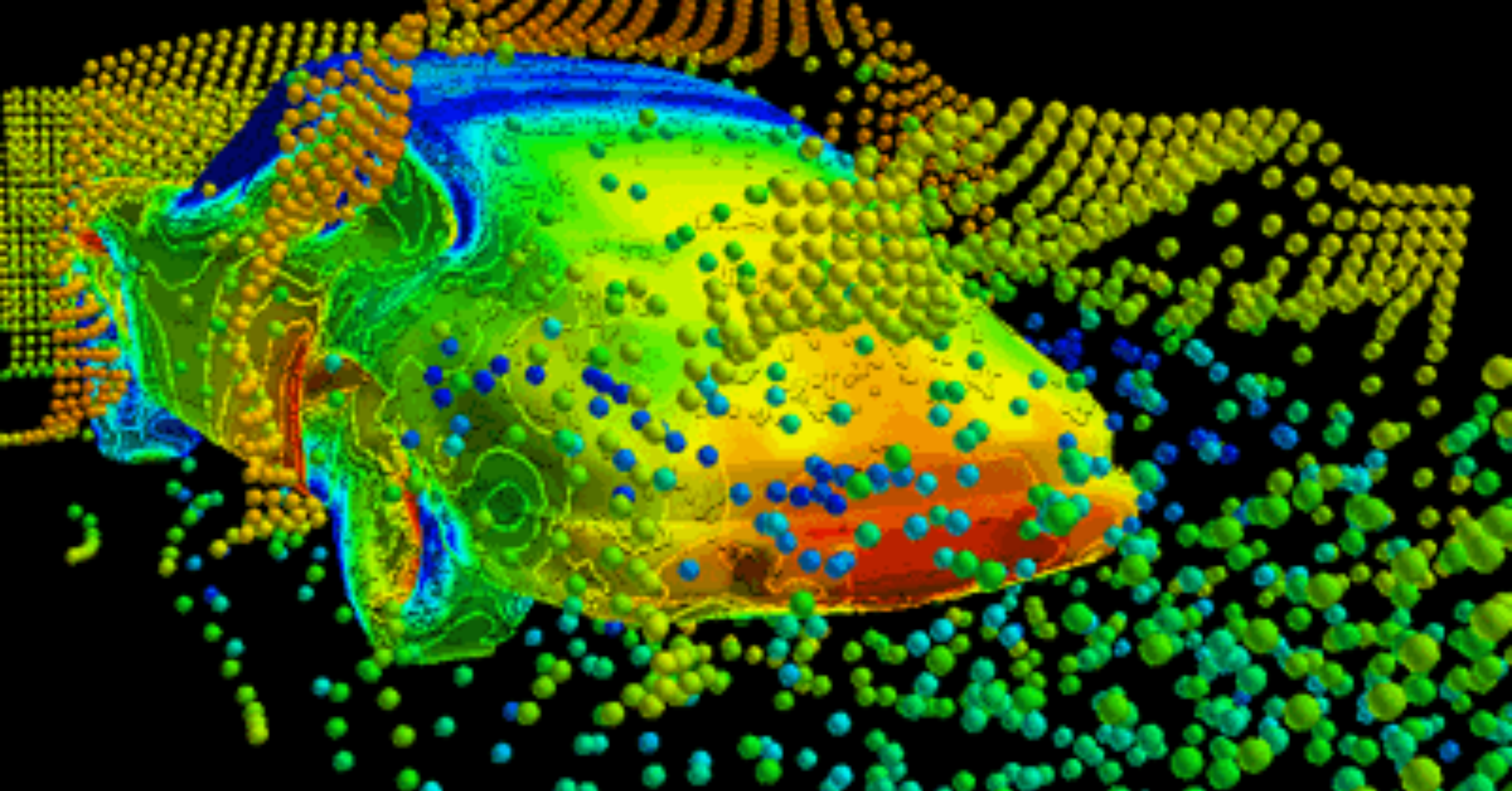


# Computational Fluid Dynamics

Computational Geophysics





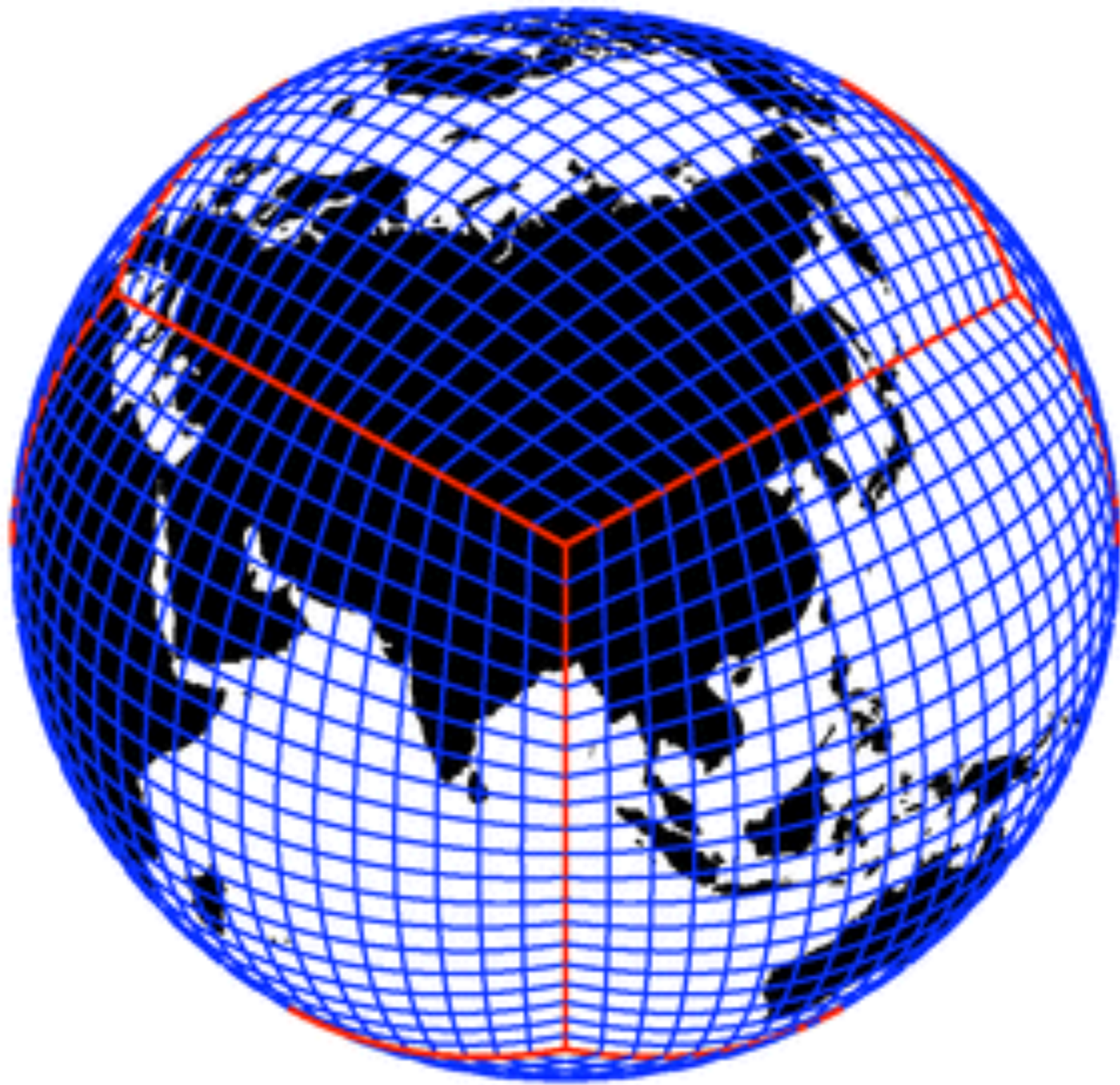


# Computational Fluid Dynamics

Computational Geophysics



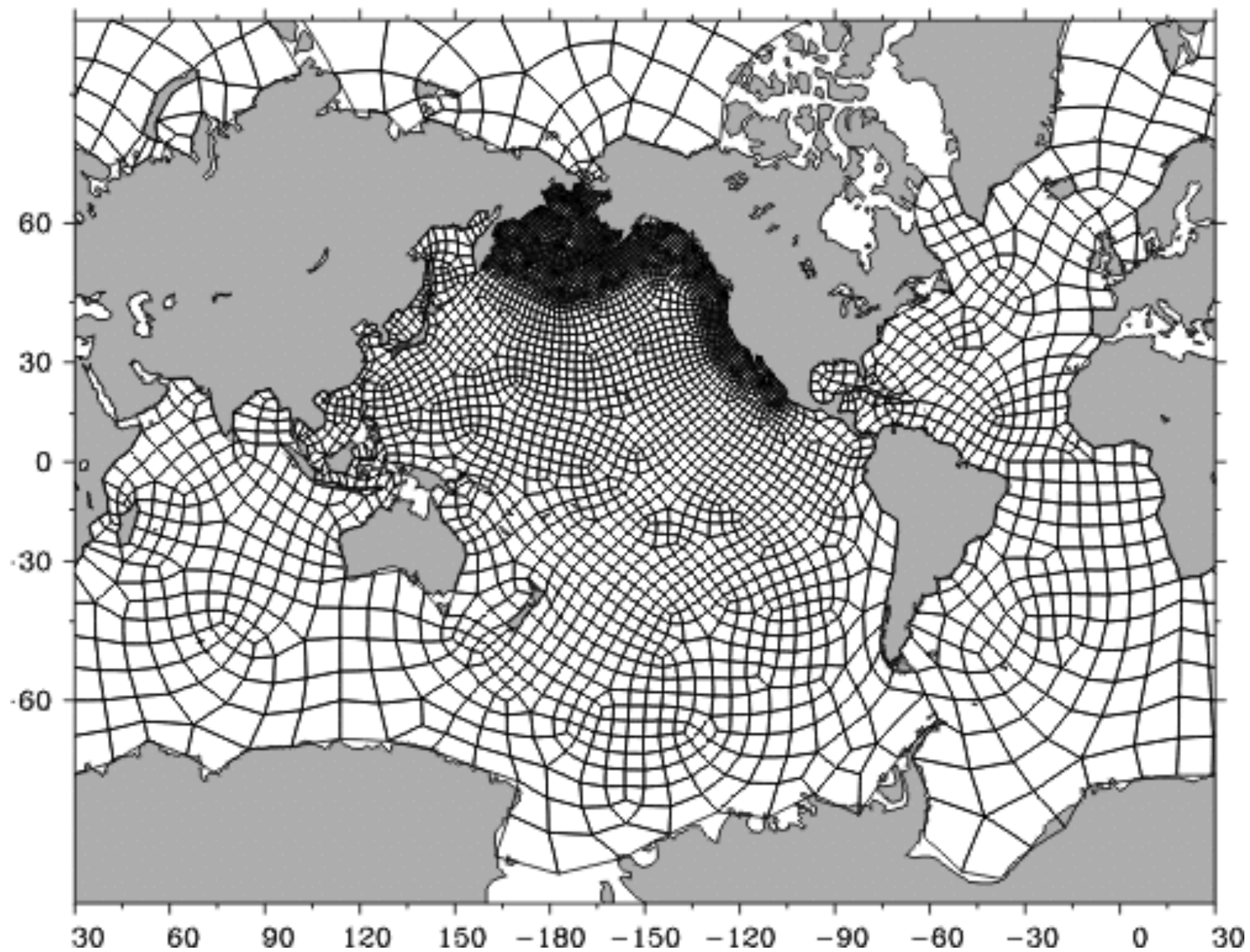




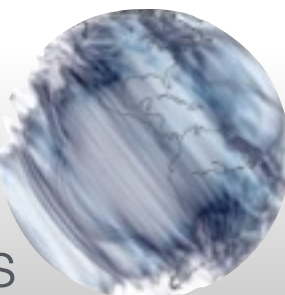
Climate modeling



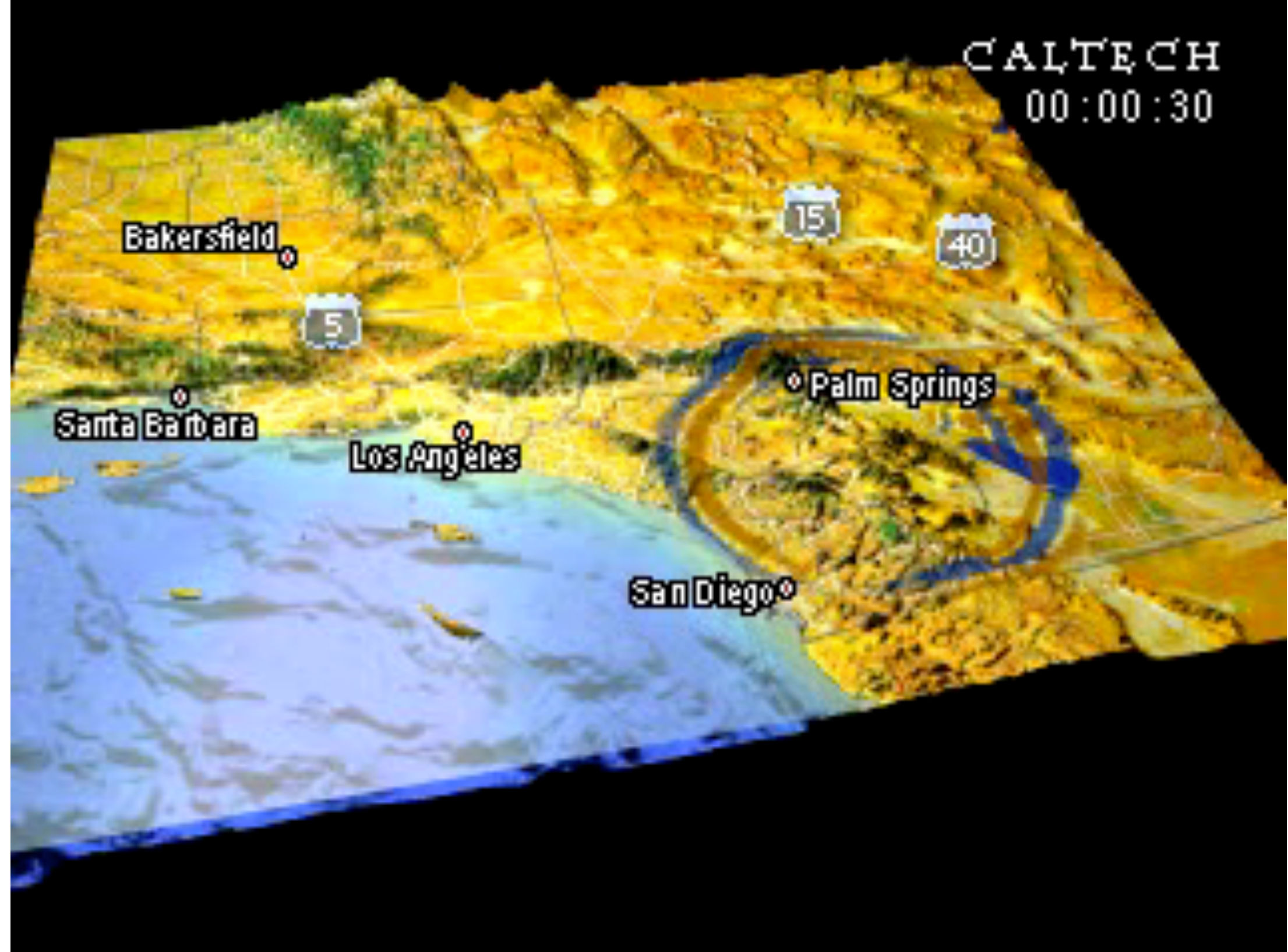




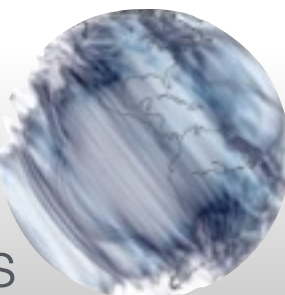
Ocean modeling







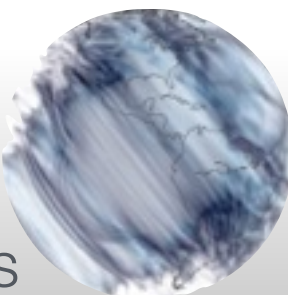
Seismic wave propagation







# Seismic wave propagation



# Spectral-element software

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Computational Fluid Dynamics

**Nek5000**

**NekBox**

**Nektar++**

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Seismic wave propagation

**SPECFEM (2D, 3D, 3D\_GLOBE)**

**RegSEM**

**SES3D**

**Salvus**

**EFISPEC3D**

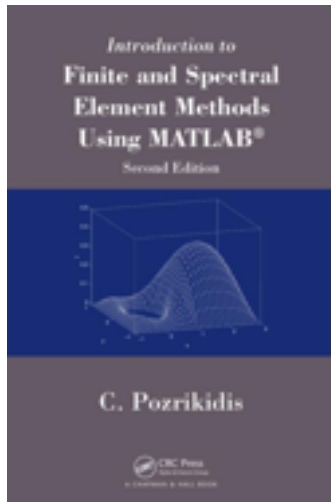
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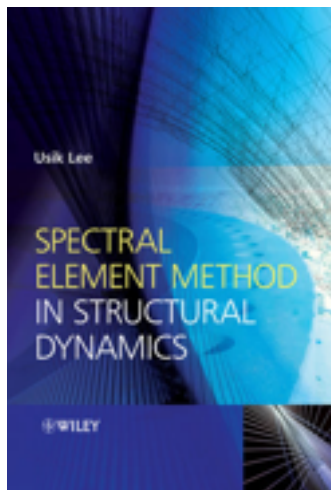
# Finite-element literature

## books



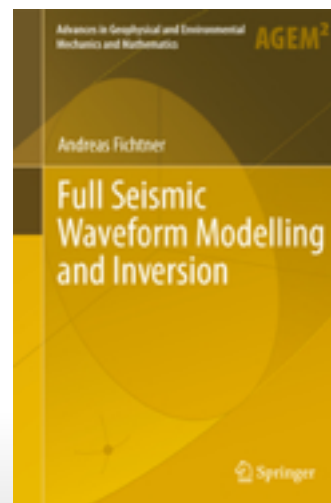
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A. Fichtner.

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