# High Resolution Simulations of Turbidity Currents and River Outflows

Eckart Meiburg UC Santa Barbara



#### Coastal margin processes



#### Turbidity current

- Underwater sediment flow down the continental slope
- Can transport many km<sup>3</sup> of sediment
- Can flow O(1,000)km or more
- Often triggered by storms or earthquakes
- Repeated turbidity currents in the same region can lead to the formation of hydrocarbon reservoirs
- Properties of turbidite:
  - particle layer thickness
  - particle size distribution
  - pore size distribution



*Turbidity current. http://www.clas.ufl.edu/* 

### *Results: 3D turbidity current – Temporal evolution*

DNS simulation (Fourier, spectral element, 7x10<sup>7</sup> grid points)



Necker, Härtel, Kleiser and Meiburg (2002a,b)

- turbidity current develops lobe-and-cleft instability of the front
- current is fully turbulent
- erosion, resuspension not accounted for

Filling of a minibasin (w. M. Nasr, B. Hall)

Interaction of gravity currents with submarine topography:



Turbidity current/sediment bed interaction (w. M. Nasr)

'Flow stripping' in channel turns: lateral overflows



### Couple turbidity current solver to reservoir simulator

Long term strategy:

- carry out simulation of polydisperse turbidity current
- obtain spatial grain size distribution of the deposit
- convert grain size distribution into permeability and porosity distribution
- feed permeability/porosity distribution into reservoir simulator
- carry out simulations of porous media displacement processes

Channelization by turbidity currents: A Navier-Stokes based linear instability mechanism (with B. Hall, B. Kneller)

Field data show regularly spaced channels along the ocean floor



• *Hydrodynamic instability?* 

Sediment wave formation by turbidity currents (w. B. Hall, L. Lesshafft, B. Kneller)

Large scale wave forms at the ocean floor



- sediment waves are prime targets for oil reservoir formation
- formed by turbidity currents and bottom flows; mechanism?
- traditional assumption: lee waves, but no rigorous stability analysis available

# Sedimentation from river outflows (w. Peter Burns)



• Leaking mode