Modules

Community Sediment Model

Working Group 4

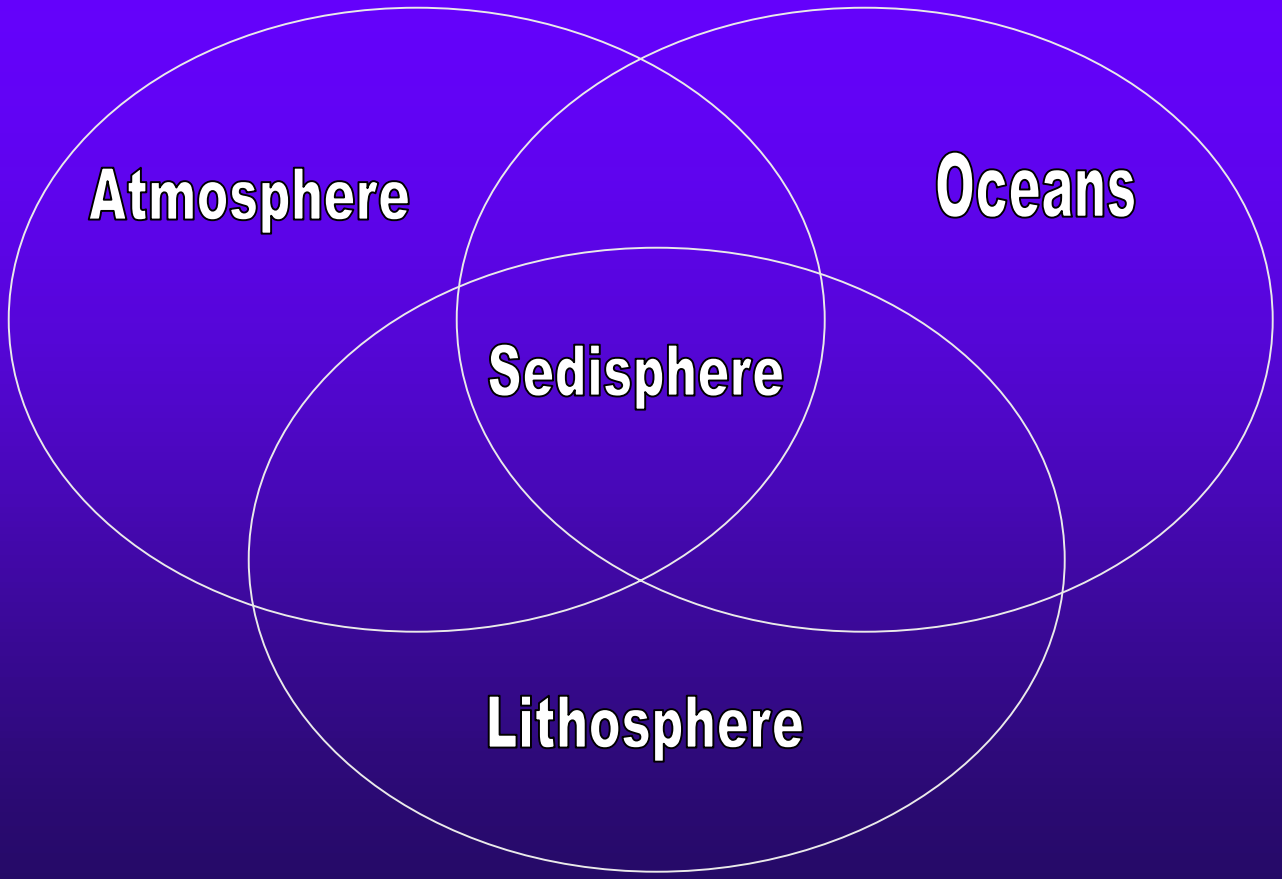
Modules - philosophy

- **Modules** are defined here as distinct sets of processes that require specific sets of modeling rules/equations; modules can have shared tools
- These are process-modules, not method-modules
- Morphology has to emerge rather than be imposed (e.g., we don't propose an explicit delta model)
- The idea is that there is a "Manager" that will decide what processes apply where; the manager also deals with time-step disparities

Modules - philosophy

- Time scales… the Paola-trilogy proposes three basic timescales that have to be recognized at an early stage
  - Deterministic small scale
  - Chaotic mesoscale
  - Deterministic large scale
- Modules may differ depending on whether the model used is 1D vs. 3D, length scales 10^{-1} vs. 10^{6} m, and widely differing time scales

Venndiagram



Coupling

- Atmosphere, ocean, lithosphere are the large external drivers
- For ocean and atmosphere, input either from other models or by means of crude parameterization
- Atmosphere (weather/climate)
  - Temperature
  - Precipitation
  - Wind
  - Relative humidity
  - Chemistry

Coupling

- Ocean
  - Sea level
  - SST
  - Tides
  - Waves
  - Currents
  - Chemistry
- Lithosphere
  - Tectonics (events)
  - Flexure/Isostasy
  - Thermal/Heat flow
  - Compaction
  - Sediment deformation (e.g., growth faults)

Modules

- General actors
  - Eolian [3-4]
  - Glacial [1] (ice dynamics linked to sed transport)
    - Erosion [1]
    - Entrainment into ice [0]
    - Transport [3]
    - Deposition [1]
  - Volcanism [3]
  - Diagenesis [2-3]
  - Humans [1]
  - Biota influencing all surface mechanics
    - Bioturbation [2]
    - Pelletization [1-2]
    - Strength properties [1-2]

Modules that are currently not well understood

- 0 – we are clueless
- 1 – empirical understanding
- 2 – some physically based equations
- 3 – some calibration, but work needed
- 4 – ready to go

Modules

- General actors (pan-marine)
  - Evaporites [3]
  - Carbonate environments
    - Sediment production [2-3]
    - Cementation [2-3]

Modules

- We used the Source-to-Sink framework as a vehicle to present the following modules:
- Terrestrial
  - Hydrologic processes (surface/subsurface) [3-4]
  - Sediment production [1-2]
  - Solute loss [1]
  - Soil formation [2-3]
  - Mass wasting
    - Ravel (talus processes) [0-1]
    - Soil/colluvium mass transport [2-3]
    - Soil/colluvium landsliding [1-2]
    - Bedrock landsliding [1]
  - Periglacial processes [2-3]
  - Surface wash (rain splash) [2-3]
  - Debris flow (sed transport and bedrock scour) [1-3]

Modules

- Terrestrial (contd)
  - Fluvial processes
    - Sediment transport [3-4]
    - Bedrock incision [1-2]
    - Channel formation [1]
    - Channel dynamics [3-4]
    - Floodplain [1-2]
  - Peats [3]
  - Lacustrine [2-3]
- Coastal
  - Surf-zone sediment transport [2]
  - Tidal sediment transport [3]
  - Estuaries/stratified flow transport [2]
  - Plumes [3]

Modules

- Shelf
  - Wave & current transport [2-3]
  - Fluidized muds [2]
- Slope
  - Internal waves [1]
  - Turbidity currents [3, once in motion]
  - Debris flows [2-3]
  - Slumps [1]
- Abyss
  - Geostrophic sediment transport [3]
  - Pelagic deposition [3]