# Oil Spill Modeling Working Group Meeting
# September 16-17, 2008

## Physical Transport Modeling Group

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### Processes

What resolution in time or space?---

a) Meteorology
- i) Measurement and Prediction of Winds
- ii) Wave generation
- iii) Events (e.g storms, hurricanes)

b) Gas Transfer

c) Waves
- i) Nonbreaking and breaking, two dimensional
- ii) Three dimensional, i.e., Langmuir effects.

d) Mixed layer dynamics
- i) Changes in mixed layer depth
- ii) Parameterizations of mixing (e.g. Langmuir) for droplets and dissolved chemicals.

d1) mixing and spreading coefficients
- i) Spreading
  - a. State of the art: calibration from field data
  - b. Estimates based on current shear and depth
  - c. Move into parameterizations based on wave and Langmuir dynamics
  - d. Move away from Fay-Holt spreading excepting gravity phase of the spill
- ii) Dispersion and dispersed oil
  - a. Droplet formation and refloating
  - b. Langmuir circulation and mixed layer
  - c. Wave dispersion of oil
    - i. State of the art: Delvigne
    - ii. Move to models that add to wave breaking, more wave dynamics to deal with entrainment and Langmuir circulation cells
    - iii.
- iii) mixing

e) Ice
- i) Measurement and prediction of surface distribution and concentration
- ii) Interactions between oil and ice in horizontal transport
- iii) Freezing / thawing cycle and effects of oil
  - A) Surface
  - B) Subsurface

- iv) Oil transport through brine channels

f) Rivers – fresh and salt water
- i) River turbulence
- ii) Bottom Friction
- iii) Plume dynamics

f1) Estuaries
- Type
  - i) Salt wedge
  - ii) Coastal Plane
  - iii) Fjord
  - iv) Inverse
- Processes
  - i) cohesive sediment transport
  - ii) traditional sediment transport (non-cohesive)
  - iii) wind driven dynamics
  - iv) tidal hydraulics
    - prediction of convergence zones
  - v) freshwater inputs
  - vi) canal and channel flows
  - vii) engineering aspects
    - water removal for irrigation
    - lock and dam systems
  - viii) Inlet dynamics/correctly modeling transition from estuary
  - ix) wetting and drying
  - x)

g) Tidal and water mass convergence / frontal zones.

h) Coastal circulation and larger scale currents.
- i) Freshwater currents
- ii) Wave induced transport
- iii) Inundation
- iv) Shelf processes

i) Deepwater circulation processes

j) Beaching / refloating and hydraulics

- Available pore volume
- Estimation of beach permeability, beach slope, landward topography (flat terrain vs. basin)
- Water table
- Wave runup
- Rewashing/refloating
  - Prediction of re-suspension
  - Parameterization a function of interstitial space, wave energy, type of breaker, beach slope, and tide stage

  - Age of oil
  - Inundation of beach function of wave runup
  - Sediment deposition during tidal cycles

- Long shore currents
- Cross shore sediment transport
- Tar mat creation
- asphalt
- grain size distribution change from washing

**Dispersed Oil Models**

- state of the art: pre planned simple box models and tools like SIMAP
- Langrangian elements; Do they contain droplet size distribution information?
- 3-D distribution of oil – requires droplet size distribution

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**Needs for Different Types of Models – Spatial and Temporal Scales**

a) Planning and Statistical
b) Response and short term prediction
c) Long term biological effects and NRDA

**Important Models**
a) Circulation (ROMS, POM, FVCOM, etc.)
b) Oil Transport (GNOME, TAP, OilMAP, SIMAP, etc.)

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**Exclusions**:
Oil effects on hydrodynamics

- not state of the art
- Examples:
  - Exxon Valdez 2 days under ideal conditions
  - gulf war: unusually high amount of oil; calm weather
  - Braer spill: low viscosity, presence of natural dispersion to large extent, no formation of slicks
- potential in next generation of models
- requires low wind conditions
  - Langmuir circulation breaks it up
  - advection from other processes breaks it up
- physical properties are important
  - viscosity
  - temperature

**Connections:**

- Transport team deals with 3-D distribution and movement and dissolution

- Input needs from *chemical group*
  - Physical Properties of oil (e.g. density, temperature, viscosity)
  - Type of spill
  - Algorithms for determining time dependence of oil state variables
- output goes to *biological group*
  - "hit data"
  - Persistence/time
  - Composition (properties of oil)
  - Droplet size

**Breakthroughs**

- Where to make transition from Langrangian to Eulerian
- How best to make transition
- Physical processes for one type of modeling, such as response, may or may not be useful for other aspects of oil spill such as planning or restoration
- Ensemble modeling/uncertainty

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**Tasking**:

Lead: CJ
Matrices completion date: end of November
Outline of white paper: end of December

a) Meteorology- Jerry Galt, Walter Johnson, CJ Beegle-Krause

b) Gas Transfer- CJ, Mark Reed

c) Waves- Michel Boufadel, Don Danmeier

d) Mixed layer dynamics- CJ, Jerry

d1) Mixing and Spreading Coefficients- Michel, CJ

e) Ice- Pooji Yapa, Walter

f) Rivers- Michel, Don

f1+g) Estuaries and Tidal conergence/frontal zones- Don, CJ, Jerry

h) Coastal circulation and larger scale currents-CJ, Walter

i) Deepwater circulation processes- CJ, Walter

j) Beaching/refloating and hydraulics- Michel, Jerry, Don