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  
      o Prediction of re-suspension  
      o Parameterization a function of interstitial space, wave energy, type of breaker, beach slope, and tide stage
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- 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
- Lagrangian elements; Do they contain droplet size distribution information?
- 3-D distribution of oil – requires droplet size distribution
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.)
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
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