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

Reporting Template:
Assume best practices

Task Assignment	**Process**	**Underlying Physics and Parameters Involved**	**Status, level of understanding (to processes only)** **Scale:** **1(good) - 3(bad)**	**Input / Output**	**Methods: Description of Approach or Gaps**	**Comments/References**
Bill	Surface Spreading	- Fay spreading - Property of oil (surface tension, viscosity, density, rheology), resurfacing oil droplets - Advective entrainment spreading - Currents, wave action: shear forces - Wind shear (and generates waves)	2- Fay Spreading 3- Advective entrainment 2- Current and wind shear	Inputs: - Oil properties - Sea state - Surface current shear, shore boundary - Wind shear - Droplet size distribution (resurfacing) - Turbulence Outputs: - Thickness as a fcn time and space (non uniform thickness)	- Limited field data, more controlled experiments - Dependent on droplet size distribution from entrainment -Lagrangian approach - Modified Fay (viscosity of oil)? - Need for fundamental data (uneven thickness) - Re-surfacing but not using straight quiescent - Surface turbulence: bbdepends on waves	-No allowance for oil viscosity , oil surface tension - Non-Newtonian fluids - Overlap with entrainment - Ask Ali and Joe for reference about turbulence/rise velocity/Stokes - Langmuir cells
Ed	Evaporation: Thin film - Assumes well-stirred oil phase	- Vapor pressure - Temperature - Pseudo-component approach (distillation cuts for crude) - Refined product?	1	Inputs - Simulated distillation curve (SDC): inferred from GC - Wind speed, atmospheric stability - Temperature - Cloud cover Outputs - Loss by distillation cut to atmosphere	- Calculating vapor pressure - Need to develop criteria to determine the boundary between thin and thick film, well-mixed and diffusion control	*Does it matter for the end user? - Lack of information: not needed for every oil, just for general classes
Ed	Evaporation: Thicker viscous oil – diffusion limited	- Transport within oil (molecular diffusion and convection in oil)	2	Inputs -Same as above - Water content - Viscosity from boiling point fractions remaining - Viscosity from emulsification - Thickness of slick Outputs - Same as above	- Semi-empirical diffusion relationship needs to be developed - Diffusion controlled in the oil phase - Spreading flow causes mixing	NOAA OCSEAP Payne Kirstein *et al*. 1984 Environment Canada Database Lehr et al, 199*
Ed	Evaporation: Oil surface limited	- Crust formation limits	3			
Joe	Entrainment: Droplet formation/breaking	- Shear (large scale) - Wave breaking - Properties of oil (time varying) - Dispersant addition	2-3	Inputs - Oil properties: viscosity, interfacial tension, rheology - Water temperature - Wave parameters:	- Not enough data: height of waves, wave energy, oil properties - Work is going on in this area	- Wave parameters dictates size of droplets: plunging wave will entrain more oil although size will be the same

				height, speed, breaking vs. spilling - Wind speed - Whitecap fraction Outputs - Droplet size distribution - Entrainment rate		
Joe	Dispersion: Dilution – oceanic dispersion	- Currents and shear (pycnoclines, tidal, large scale, etc.) - Turbulence - Buoyancy - Droplets stay in water column - (Overlap with Physical Transport Group B)	2	Inputs (from Transport group) - Oceanic turbulence (kinetic energy and energy dissipation rates) Outputs - Concentrations as a function of space and time		
Jim	Dissolution	-Available surface area driven: surface slick or droplets - Droplets in water column, size of droplets - Gradient distribution within droplet? - Oil composition	1-2	Inputs - Oil properties - Droplet size distribution and concentration Outputs - Mass transfer from the drop to the water - Dissolved concentration by boiling point cut, or by component	- Data is compound specific	Faksness Thesis 2008 NOAA OCSEAP Payne Kirstein *et al*. 1984
Mark	Evaporation: HC water column	- Component concentration - Wind - Wave penetration/mixing - Bubble formation - Temperature	2-3	Inputs - Wave field - Concentration by component - Depth of mixing layer, penetration depth - Temperature - Vapor pressure Outputs		- Significant for toxicity
Ali/Jim	Water-in-Oil (WIO) Emulsification	- Oil composition (waxes, asphaltanes) - Mixing energy - Evaporation - Photo-oxidation - Stability - Temperature - Salinity?	2	Inputs - Oil properties (time-varying) - Concentration - Mixing energy (from physical transport) Outputs - Water content, stability, viscosity	- Undecided - Merve: stability; asphaltine, resins, and wax content - Requires modeling	
Bill	Tar ball/mat Formation	- Weathering (all of the above) - Oil composition (crude, heavy oil, diesel, C12 and up) - Interaction with suspended particulate matter (SPM) - Mixing - Chemical processes unique to tar	3	- Same as emulsification		Khelifa 2005, Goodman 2002(?)

		balls				
Ali	Sedimentation (water column)	- SPM interaction/concentration - Droplet size (micro size) - Oil weathering - Emulsification	2	Input: - SPM concentration, physical properties (size, density) - Droplet size distribution, concentration of droplets, density - Mixing energy/ water turbulence: effects kinetics, size of aggregates, settling rate Outputs: - Vertical/horizontal (dispersion) transport of oil droplets - Eventual transport to sea floor - Concentration of oil droplets	- Kinetics of oil-SPM aggregation formation - Effects of mixing energy - Sediment loading in coastal waters important	- Use of chemical dispersants will increase sedimentation in coastal waters - CRRC Report Khelifa 2008
Jim	Photo-oxidation	- Alters chemistry - Enhanced polarity (solubility) - Toxicity - Free radical formation, cross linking - Increases stability WIO emulsions	2	Inputs: - UV exposure (cloud cover) - Surface area of slick - Oil composition - Outputs: - Emulsion stability - Solubility	- Empirical data: UV exposure and emulsion stability; UV exposure and toxicity (beyond scope of this discussion)	- Don't know impact on Toxicity (not the same issue as ingested oil)
Mark	Biodegradation /Microbial degradation	- Oil components - Surface availability - Temp - Nutrients - Presence of hydrophilic microorganisms	2	Input: - First order rate - Oil component: distillation cuts - Oil location Output: - Breakdown of components or mineralization - Reduction in water column concentration	- Convert components into metabolites - Applies to whole oil, oil on surface, oil on sea floor	- Biodeg is done for dissolved phase - OCSEAP Report, Payne *et al*. 1984 -Long term process for whole oil on seashore, etc.
Mark/Ali	Shoreline Interactions	- Shoreline type, particle interaction - Wave - Tide - Current - Oil properties - Weathering state	2-3	Inputs: - Shoreline type, holding capacity - Wave - Tide - Current - Oil properties - Weathering state	- Holding capacity as a fcn of shoreline type and oil viscosity - Removal rate as a fcn of wave exposure and current	- Dagmar Etkin, AMOP 2008, report 2006 -Reed et el, 1985-6?(cozoil) -Canadian model, Mark and Ali will find - Lab scale experiment (Cedre meso-scale) - Spill of opportunity

				- Viscosity Outputs: - Oil on shore (sink), oil washing offshore (source), oil entrained near shore (sink)		
Mark/Ali/Joe	Bottom Interactions	- Water depth - Bottom type - Oil/particle/sand interaction - Wave - Current - Oil properties (heavy oil major concern) - Weathering state	3	Input: - Bottom type - Wave conditions - Bottom current - Oil type and composition, - Droplet size distribution, concentration Output: - Oil conc on sea floor, benthic boundary layer - Oil resuspension	- Continuation of langrangian transport - Theoretical, experimental, field work - Resuspension vs shear stress	Treat as concentration of resuspened oil and treat like SPM -LE, Langrangian Element NOAA 2005 (see Bill for reference)
Jim	Sinking Oil	- Oil density > water - Turbulence/current - Sediment entrainment - Stratification	1-2	Input: - Oil water density - Turbulence - Stratification Output: - Sinking rate		NRC/NAS 1999
Bill	Subsurface vessel	- Release rate - Dissolution - Droplet breakup (shear, buoyancy, turbulence)	3	Input: - Release rate - Oil composition/properties - Depth of release - Hydrodynamics Output: -Droplet size distribution - Rise rate - Breakup/dissolution - Amt of oil to surface, surface slick	- Basic research work is needed: initial breakup	- Release rate often not known - Source strength issue
Mark	Subsurface pipeline	- Pressure - Dissolution - Stratification/mixing with particulates - Spreading is governed by other processes	2	Input: - Pressure - Same as above Output: -Same as above		
Mark	Subsurface well blowout	- Fluids mixture, source composition less certain	2	- Oil composition: 3 phase fluid flow -Same as pipeline above Outputs: -Same as above		Yapa, Johansen
Mark/Ali/Jim	Oil Ice Interactions	- Oil properties - Ice properties (type, age)	3	Inputs: - Ice properties, concentration		Reed, SL Ross, Oil in Ice JIP , Payne et al 1985,9, 1991; Environment Canada Review

				- Oil properties - Oil release point relative to ice - Season -Wind, currents Outputs: -Weathering rates -Spreading		

Responsibilities:

1. Draft (not white paper) extended abstract, 2-3 pages max, how it's been done in past, what is present date, who's working on it? expanded back ground, gaps and what needs to be done, add references
2. Submit all drafts to Bill to by Oct 31 2008, Bill will compile and send out one draft.

3. Reminder from earlier discussions:

The physical fates and behavior group will review recent research into the processes that affect eventual distribution, effects, and recoverability of spilled oil:

- spreading,
- evaporation,
- dispersion,
- dissolution,
- emulsification,
- sedimentation,
- photo-oxidation,
- bio-degradation,
- shoreline and bottom interactions.

Of special interest are recent studies of the time-dependent changes in physical-chemical parameters of spilled oil including

- density,
- viscosity,
- rheology,
- water content,
- emulsion stability,
- droplet size distribution,
- surface tension,
- adhesion characteristics, and
- chemical composition.