Panel Discussions:

Initial Droplet Size-Action Items
- Ground truthing
- Field-10’s of cm range
- Experiments
- Effect of dispersants on initial droplet size as well as fate of droplets. What does dispersant do to surface tension?
- Important parameters: size of orifice, surface tension (10dynes/cm), viscosity, mixing energy, GOR
- Effect of distribution coming out of pipe (before entering water)
- Energy Dissipation rate can be comparable to system to be predicted
- Issue of many obstructions possible (Can CFD resolve this?)
- Can we reach consensus before spill?
- Geometry
- Boundary layer flow in pipe before release from pipe
- Predict droplet size distribution (specific conditions-scale matters, making prediction hard; can volume distribution impact? fundamentals best in number of a size distribution)
- Is there a generic droplet size distribution? (Size independent?)

Plume Models-Action Items:
- Use CFD models to calibrate well against simple things; then it can be used for more complex
- What are the critical sizes for oil to leave the plume?
- Polydispersed distributions (glass bead experiment)
- Is there a similarity to single-phase plumes? Volcanoes; all buoyancy-intrusion layer; gas-buoyancy, not into intrusion layer
- When plume is in acceleration phase, stronger dependency on buoyancy flux?
- Do condition favor gas hydrate formation? Temp and pressure come together quickly, but dilution increase, concentration dissolved gas is low; Not likely in plume, unless something “stuck” in plume
- When do bubbles act as discrete individual bubbles vs. a plume?
- Small changes in rise velocity (10%) get very different fates (dissolution changes)
- Rise velocities in swarms and turbulent plumes
- Lagrangian predicts one intrusion layer, not all the intrusion layers
- Do you get hydrate shells? Ira says hydrate skins form on bubbles so bubbles survive longer-there is onset time
- How well do we need to know location of intrusion layer to pass off to lagrangian models? -Use LCS to look for repelling conditions
CFD-Action Items:
- Why reduce complexity? Make problem manageable, where are you making these choices?
- Does fine grid represent physics of dissolved components?
- How well do we have to capture phenomenon to answer question?
- Major limitations of CFD. How to treat phases is difficult. Need to compare against analytical solution or lab data.
- Look at transition between stratified constrained and velocity constrained
- Can we learn something from sediment plumes?
- Kinetic energy is developed in H2) column. Need to know this for dispersant mixing into plume.
- CFD LES should be used on region close to discharge (20 diameters from source-hardest to understand)- do it with single phase and then understand how adding more phase changes (key to droplet size distribution)
- Stratified cross flow is difficult
- TAMU is producing validation sets for plume CFD models.
- Issue of turbulence closure (fine resolution, many models will not converge, what to validate with?)
- Validation? 0th order at centerline; time averaged velocity field (easiest to compare to); quiescent measure volume flow rate; entrainment; cross flow difficult (might want to take profiles); turbulence intensity; Reynolds stress
- Smooth particle hydrodynamics-can use for plume? Droplets? Trick is in the interface; surface slick is continuum of droplets; can we simulate droplets breaking off and coalescing to get thickness of slick; predictive capability not as good-not capturing physics
- Can CFD models call Infochem for every time step? No-will use “tricks” to speed it up
- Vendors working on ways to address hydrates.
- Sweet and sour crudes no that well understood-will DWH sweet translate to our Arctic?
- Some validation for hydrates and complex mixtures to test equation of state-Infochem

Lagrangian Models: Action Items
- Representing entrainment when oil reaches the surface
- Using conditions of large scale models for oil spill (small scale)\(\rightarrow\) sub grid scale
- Droplet Size issue must be addressed. What are these? Paris et al assume 100micrometers.
- Issue: Big 3d LEM models can have big errors. Not that good on reliable forecasts out for a few days (error bars are mainly km)
- Test models with same circulation models and see how well they do
• Issue of Science (very sophisticated models) publications vs. response models
• What processes that led to “disappearance” of oil and how well solved?

Fate Modeling: Action Items

• How much oil gets to the surface is different compared to surface area? How much oil is more complex.
• Spreading we do okay, but thickness isn’t just how much oil per square meter.
• Instruments for the DHW couldn’t measure the small droplets and couldn’t get to depths that were necessary.
• What do we know right now about tar and oma in regards to formation throughout the water column? Some are formed down at near the emission (ended up all over the seabed), was that because they aggregated in the water column or from burning or because there were components in the reservoir that were denser)-video on youtube shows an expulsion of tar directly into the ROV from the DWH-clearly there was tar that came out, but it sank it didn’t rise. Quite complex, and no simple answer exists.
• Wouldn’t necessarily get better results if you can model currents and wind better, regarding the topics for ‘what we need to know, and don’t know”. Might get better results if the vertical extent and the plume are modeled better, i.e., stratification and such. What are important fates that plume models should be able to resolve? Dissolution…anything else?
• When is a droplet dissolved?
• Particle interaction with bottom?
• Better understanding of small droplets in the intrusion layer.
• Issue of Patchiness
• OMA, solid formation: where, mechanisms/processes, what forms?
• For each stage of modeling, what processes are most important?
• Which processes have models and no data? Where no models and data? Which nine of either?
• Modeling ice covered waters-water depths much lower
  o Do we know temperature dependency of Infochem database
  o Physical rates change-bubble dissolution time-do we know this?
  o Fresh water lens and riding on sweater
  o Ice interaction (shielding effect)
  o Impact of leads, oil in ice
  o Uncertainty
• Photolysis
• Dirty bubbles and hydrate skins
• How much dissolved oil created from intrusion layer? What rate do droplets rise? Marine snow associated to sinking of droplets?
• Better understanding of droplets in intrusion? Better understanding of tiny droplets.