

Comparison of parameters in new oil spill model with old oil spill model

This guide has been developed by comparing the scientific documentation for the new and old oil spill models (being DHI_OilSpill_Model.pdf and MIKE321PASA.pdf, respectively).

NOTES:

Values in black text are oil specific values used for the supplied test runs

Values in green text are environmental parameters which have been randomly chosen/set for the supplied test runs

Values in blue text are constants or assumed constants which should not change regardless of oil type or environmental conditions

Values in red text are parameters which can be varied in the new model to provide a fit to the old model results

				Type 2: Middle Oil, Low Aromatics	Type 4: Medium Crude Oil	Comments	Old Model Equivalent
Process	Class Constants	Unit	Parameter			<i>All items in this section are found under ECO Lab / Oil Spill Module > Classes > Oil > Constants</i>	
General	Schmidt number	[-]	Sc	2.7	2.7	CONSTANT	Specified internally as 2.7
	Average molecular weight of volatile fraction	g/mol	MW	123	121	VARIABLE TO BE SPECIFIED	Specified internally for each oil fraction (values given in Table 11.2 of M321PASA.pdf) – use average of Fractions 1, 3 and 5
	Vapour pressure of volatile fraction	atm	Pvp	0.005	0.005	Assume CONSTANT	Specified internally for each oil fraction (values given in Table 11.2 of M321PASA.pdf)
Simple Evaporation	Oil specific constant (App A)	[-]	evapA	3	2	CONSTANT but oil specific – only used for simple evaporation which is only found in new model. These aren't used if complex evaporation is chosen which is comparable to evaporation in the old model.	Process not included
	Oil specific constant (App B)	[-]	evapB	0.045	0.045		
	Distillation percentage at 180°C	%	evap180	10	5		
Spreading	Terminal thickness	mm	Hterm	0.1	0.1	Assume CONSTANT	Parameter not used
Biodegradation	Decay rate, volatile fraction	/day	kbiodv	0.005	0.005	Assume CONSTANT	Process not included
	Decay rate, heavy fraction	/day	kbiodh	0	0	Assume CONSTANT	
Emulsification	Maximum water content	m ³ /m ³	MaxWater_Fract	0.5	0.85	VARIABLE TO BE SPECIFIED	<i>Oil Spill Parameters > Emulsification:</i> Maximum water content
	Kao constant	[-]	Kao	3.3	3.3	CONSTANT	Emulsification is parameterised differently in the new model. These two parameters replace <i>Oil Spill Parameters > Emulsification:</i> Constant (k2) due to water release which is no
	Kaw constant	[-]	Kaw	200	200	CONSTANT	

To be considered in conjunction with supplied example models ELOS-run-Type2/4.m21fm and NSA-run-Type2/4.npa

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				Type 2: Middle Oil, Low Aromatics	Type 4: Medium Crude Oil	Comments	Old Model Equivalent
	Emulsion rate	s/m ²	kem	2e-6	2e-6	Assume CONSTANT	longer required This parameter replaces <i>Oil Spill Parameters > Emulsification</i> : Constant (k1) due to water uptake which is no longer required
Buoyancy (dissolution)	Density of volatile fraction at 20°C	kg/m ³	densL	796	813	VARIABLE TO BE SPECIFIED	Specified internally for each oil fraction (values given in Table 11.2 of M321PASA.pdf)
	Density of heavy fraction at 20°C	kg/m ³	densH	886	997	VARIABLE TO BE SPECIFIED	
Water solubility (dissolution)	Water solubility, volatile fraction	kg/kg	Cwsatv	2e-5	2e-5	Assume CONSTANT	Specified internally for each oil fraction
	Water solubility, heavy fraction	kg/kg	Cwsath	2e-7	2e-7	Assume CONSTANT	
Volumetric temperature expansion coefficient (density)	Volatile fraction	1/°C	ktempv	0.0007	0.0007	Assume CONSTANT	Parameter not used
	Heavy fraction	1/°C	ktempH	0.0007	0.0007	Assume CONSTANT	
Photooxidation	Decay rate, volatile fraction	/day	kphotv	0	0	VARIABLE TO BE SPECIFIED	Process not included
	Decay rate, heavy fraction	/day	kphotoH	0	0	VARIABLE TO BE SPECIFIED	
	Light extinction coefficient	/m	eta	1	1	Assume CONSTANT	
Dissolution	Dissolution rate, volatile fraction	/day	kdisl	0.4	0.4	Assume CONSTANT	Dissolution is parameterised differently in the new model. These two parameters replace <i>Oil Spill Parameters > Dissolution and Entrainment</i> : Mass transfer coefficient (ks) which is no longer required
	Dissolution rate, heavy fraction	/day	kdish	0.4	0.4	Assume CONSTANT	
Vertical Dispersion	Wind speed for wave breaking	m/s	wspdi	5	5	Assume CONSTANT	Vertical dispersion is parameterised differently in the new model. These two parameters replace <i>Oil Spill Parameters > Dissolution and Entrainment</i> : Oil in Water Interfacial tension which is no longer required
	Wave energy dispersion rate	J/m ³ /s	E	1000	1000	Assume CONSTANT	
Vertical Limits	Max distance below surface for surface amount	m	minSurfDist	0.05	0.05	Assume CONSTANT	Parameter not used
	Max distance above bed for bottom amount	m	minBotDist	0.05	0.05	Assume CONSTANT	Parameter not used
Viscosity	Mooney constant	[]	Mooney_K	0.654	0.654	VARIABLE TO BE SPECIFIED Typically 0.7 for crude oils to 0.25 for home heating oil	Specified internally as 0.654
	Dynamic oil viscosity at reference temperature	cP	ViscosityT0	1.76	54.894	VARIABLE TO BE SPECIFIED	<i>Oil Spill Parameters > Oil Properties</i> : Viscosity at reference temperature

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							NOTE: this viscosity is kinematic viscosity in cS so should be multiplied by the oil density / 1000 to get the dynamic viscosity in cP
	Reference temperature for dynamic oil viscosity	°C	Viscosity_temp	40	54.4	VARIABLE TO BE SPECIFIED	<i>Oil Spill Parameters > Oil Properties</i> : Reference Temperature
	Coefficient of exponential temperature dependency	[]	Viscosity_coef	-0.136	-0.136	Assume CONSTANT	Viscosity variation is parameterised differently in the new model. This parameter replaces an internally specified constant of 3.98 which is no longer required
Oil Area	Oil area growth rate constant	/s	AreaGrowth	30	30	Assume CONSTANT (default is 150) Can be modified to fit post-discharge slick thickness to old results.	Specified internally (although no value is given in documentation)
Process Switches	Options		Parameter			All items in this section are found under ECO Lab / Oil Spill Module > Classes > Oil > Constants	
Simple Evaporation Type	Logarithmic (0)/ Quadratic (1)		Evap_Type	0	0	SWITCH TO BE SPECIFIED	Process not included
Vertical Dispersion	Off (0) / On (1)		Enable_Dispersion	1	1	SWITCH TO BE SPECIFIED	<i>Oil Spill Parameters > Dissolution and Entrainment</i> : [Tick box] Include entrainment
Evaporation	Off (0) / On (1)		Enable_EVAP	1	1	SWITCH TO BE SPECIFIED	<i>Oil Spill Parameters > Heat Transport</i> : [Tick box] Include Evaporation
Biodegradation	Off (0) / On (1)		Enable_BIOD	0	0	SWITCH TO BE SPECIFIED	Process not included
Photooxidation	Off (0) / On (1)		Enable_PHOT	0	0	SWITCH TO BE SPECIFIED	Process not included
Surface dissolution	Off (0) / On (1)		Enable_Diss_s	1	1	SWITCH TO BE SPECIFIED	<i>Oil Spill Parameters > Dissolution and Entrainment</i> : [Tick box] Include dissolution
Water column dissolution	Off (0) / On (1)		Enable_Diss_wc	0	0	SWITCH TO BE SPECIFIED	Process not included
Water uptake	Off (0) / On (1)		Enable_Wateruptake	0	0	SWITCH TO BE SPECIFIED	<i>Oil Spill Parameters > Emulsification</i> : [Tick box] Include emulsification
Water release	Off (0) / On (1)		Enable_Waterrelease	0	0	SWITCH TO BE SPECIFIED	
Droplet diameter change	Off (0) / On (1)		Enable_Diameterchange	0	0	SWITCH TO BE SPECIFIED	Process not included
Area change	Off (0) / On (1)		Enable_Areachange	1	1	SWITCH TO BE SPECIFIED	No switch available – process is not optional
Constants	Type	Units	Value (range)			All items in this section are found under ECO Lab / Oil Spill Module > Constants	
	Gas constant	Atm m ³ /mol K	8.206e-5 (-)	8.206e-5	8.206e-5	CONSTANT	Specified internally as 8.206e-5
	Dynamic viscosity of water at 20°C	cP	1.002 (0-1000)	1.2	1.2	VARIABLE TO BE SPECIFIED Varies with salinity and temperature – can be	Parameter not specified (<i>Basic Parameters > Water Properties</i> : Salinity can be used to

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				Type 2: Middle Oil, Low Aromatics	Type 4: Medium Crude Oil	Comments	Old Model Equivalent
						calculated using: http://www.ifh.uni-karlsruhe.de/science/envflu/research/brinedis/density&viscosity_calculator.xls	calculate value in conjunction with <i>Basic Parameters > Water Properties: Temperature</i>)
	Switch for simple or complex evaporation	[]	Complex (0) / Simple (1)	0	0	SWITCH TO BE SPECIFIED	Simple evaporation not included
Forcings	Parameter	Units	Notes			All items in this section are found under ECO Lab / Oil Spill Module > Forcings	
	Horizontal drift speed	m/s		-	-	Calculated from hydrodynamics	Calculated internally
	Horizontal drift direction	°N		-	-	Calculated from hydrodynamics	Calculated internally
	Vertical drift speed	m/s		-	-	Calculated from hydrodynamics	Calculated internally
	Wind speed	(m/s)	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	2	2	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Wind speed
	Water temperature	°C	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	15	15	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Water Properties:</i> Temperature
	Water density	kg/m ³	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	1022.12	1022.12	VARIABLE TO BE SPECIFIED Varies with salinity and temperature – can be calculated using: http://www.ifh.uni-karlsruhe.de/science/envflu/research/brinedis/density&viscosity_calculator.xls	Parameter not specified (<i>Basic Parameters > Water Properties:</i> Salinity can be used to calculate value in conjunction with Temperature as above)
	Solar radiation	W/m ²	Can be given as Constant or Time Series (.dfs0)	100	100	VARIABLE TO BE SPECIFIED Can be calculated using equations in Section 11.6.3 of MIKE321PASA.pdf. Set to constant value here as only used in photo-oxidation process which is turned off for the comparison as process not available in old model.	Calculated internally for use in heat transfer process
	Significant wave height	m	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	0	0	VARIABLE TO BE SPECIFIED	Parameter not used
	Mean wave period (T02)	s	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	0	0	VARIABLE TO BE SPECIFIED	Parameter not used
	Probability of a particle being absorbed when	0-1	Can be given as Constant, Time Series	0	0	VARIABLE TO BE SPECIFIED	Parameter not used

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	beached		(.dfs0) or 2D map (.dfs2 or .dfsu)				
	Probability of particle not moving	0-1	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	0	0	VARIABLE TO BE SPECIFIED	Parameter not used
	Dispersant activity map	[]	Can be given as Constant, Time Series (.dfs0) or 2D map (.dfs2 or .dfsu)	0	0	VARIABLE TO BE SPECIFIED	Process not available
Dispersion	Parameter		Options			All items in this section are found under ECO Lab / Oil Spill Module > Dispersion	
Horizontal > Oil	Formulation {drop-down list}		No dispersion	-	-		Option not available
			Dispersion coefficient	3	3	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Dispersion:</i> [Radio Button] Independent of the current – longitudinal / transversal with the same value
			Scaled eddy viscosity	-	-	VARIABLE TO BE SPECIFIED	Option not available (scaled with current is not comparable)
Vertical > Oil	Formulation {drop-down list}		No dispersion	-	-		Option not available
			Dispersion coefficient	0.01	0.01	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Dispersion:</i> [Radio Button] Independent of the current – vertical value
			Scaled eddy viscosity	-	-	VARIABLE TO BE SPECIFIED	Option not available (scaled with current is not comparable)
Particle Sources	State Variables	Unit	Parameter			All items in this section are found under ECO Lab / Oil Spill Module > Particles Sources > Particles Source N > Oil	
	Volatile oil fractions	kg	Volatile_Mass	30% of total discharge: 528.342 kg/s	8% of total discharge: 159.441	VARIABLE TO BE SPECIFIED ¹	Can be assumed to be equivalent to the sum of Oil Fractions 1, 3 and 5 multiplied by total discharged mass
	Heavy oil fractions	kg	Heavy_Mass	68.99% of total discharge: 1215.011 kg/s	78.3% of total discharge: 1560.527	VARIABLE TO BE SPECIFIED ¹	Can be assumed to be 100% minus the sum of Oil Fractions 1, 3 and 5 minus <i>Oil Spill Parameters > Emulsification:</i> Wax content minus <i>Oil Spill Parameters > Emulsification:</i> Asphaltens content multiplied by total discharged mass
	Wax	kg	Wax_Mass	1% of total discharge: 17.611 kg/s	2.2% of total discharge: 43.846	VARIABLE TO BE SPECIFIED ¹	<i>Oil Spill Parameters > Emulsification:</i> Wax content (%) multiplied by total discharged mass

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	Asphaltene	kg	Asph_Mass	0.01%of total discharge: 0.176 kg/s	11.5% of total discharge: 229.196	VARIABLE TO BE SPECIFIED ¹	<i>Oil Spill Parameters > Emulsification:</i> Asphaltens content (%) multiplied by total discharged mass
	Water fraction in oil	kg/kg	Water_Fract	0	0	Assume 0%	Parameter not used
	Droplet diameter	m	DropletD	0.001	0.001	Assume CONSTANT	Parameter not used
	Area of oil	m ²	Oil_Area	6	6	VARIABLE TO BE SPECIFIED ² Calculated as area of initial oil spill divided by number of particles initially released. Can be modified to fit initial slick thickness to old results.	Parameter not used
	Immersed state switch	[0/1]	Immersed	1	1	If oil spill discharge is at sea, assume 1	Switch not used
Drift profile	Options		Parameters			All items in this section are found under ECO Lab / Oil Spill Module > Drift profile	
Type {drop- down list}	Use raw data from hydrodynamics		-	-	-	-	Option not available
	Use bed shear profile		-	-	-	Activates <i>ECO Lab / Oil Spill Module > Bed Roughness</i>	Single process not available (other processes cannot be excluded)
	Use surface wind acceleration		-	-	-	Activates <i>ECO Lab / Oil Spill Module > Bed Roughness and ECO Lab / Oil Spill Module > Wind forcing</i>	Single process not available (other processes cannot be excluded)
			Wind weight	-	-	VARIABLE TO BE TUNED	Parameter not used
			Wind angle	-	-	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Deflection angle
			Kinematic viscosity (of water)	-	-	VARIABLE TO BE SPECIFIED Varies with salinity & temperature – can be calculated using: http://www.ifh.uni- karlsruhe.de/science/envflu/research/brinedis/ density&viscosity_calculator.xls	Parameter not used
	Use bed shear profile and wind induced profile		-	-	-	Activates <i>ECO Lab / Oil Spill Module > Bed Roughness and ECO Lab / Oil Spill Module > Wind forcing</i>	Process pairing not available (other processes cannot be excluded)
			Wind drift	-	-	VARIABLE TO BE TUNED	Parameter not used
			Depth of influence	-	-	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Depth of wind
			Offshore limit	-	-	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Shore current zone
	Use bed shear profile, wind induced profile and surface wind acceleration						All three processes are included by default

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			Wind drift	0.01	0.01	VARIABLE TO BE SPECIFIED Controls the speed at which the slick moves in response to the wind and should be modified to give results that agree with old run. Typical value otherwise is 0.01 to 0.04 from reading DHI_OilSpill_Model.pdf	Parameter not used
			Depth of influence	5	5	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Depth of wind
			Offshore limit	5	5	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Shore current zone
			Wind weight	0.02	0.02	VARIABLE TO BE SPECIFIED	Assume equivalent to <i>Basic Parameters > Wind Conditions:</i> Friction constant
			Wind angle	15	15	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Deflection angle
			Kinematic viscosity (of water)	1.17e-006	1.17e-006	VARIABLE TO BE SPECIFIED Varies with salinity & temperature – can be calculated using: http://www.ifh.uni-karlsruhe.de/science/envflu/research/brinedis/density&viscosity_calculator.xls	Parameter not used
	Use bed shear profile and surface wind acceleration			-	-	Activates <i>ECO Lab / Oil Spill Module > Bed Roughness</i> and <i>ECO Lab / Oil Spill Module > Wind forcing</i>	Process pairing not available (other processes cannot be excluded)
			Wind weight	-	-	Assume CONSTANT	Parameter not used
			Wind angle	-	-	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions:</i> Friction Deflection angle
			Kinematic viscosity (of water)	-	-	VARIABLE TO BE SPECIFIED Varies with salinity & temperature – can be calculated using: http://www.ifh.uni-karlsruhe.de/science/envflu/research/brinedis/density&viscosity_calculator.xls	Parameter not used
Additional Pages	Options		Parameters			All additional pages result from options chosen on page <i>ECO Lab / Oil Spill Module > Drift profile</i>	
ECO Lab / Oil Spill Module > Bed Roughness: Type {drop-down list}	Bed roughness from hydrodynamic model		-	-	-	-	Option not available

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	User specified bed roughness						
			Bed Roughness (either constant or varying)	0.1	0.1	VARIABLE TO BE SPECIFIED (logarithmic profile assumed internally)	<i>Basic Parameters > Eddy and Logarithmic Velocity Profile: Bottom roughness</i>
ECO Lab / Oil Spill Module > Wind forcing: Type {drop-down list}	User specified wind, speed and direction						
			Wind Speed (either constant or varying)	2	2	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions: Wind Speed</i>
			Wind Direction (either constant or varying)	330	330	VARIABLE TO BE SPECIFIED	<i>Basic Parameters > Wind Conditions: Wind Direction</i>
	User specified wind, velocity components			-	-	VARIABLE TO BE SPECIFIED (either constant or varying)	Option not available

¹Oil mass discharge rates calculated as follows:

- With a discharge rate of $2\text{m}^3/\text{s}$ for 30 minutes in the old model, this is a total volume of 3600m^3
- The densities for each of the oil fractions are given in Table 11.2 of M321PASA.pdf and these, together with the %age distributions for the oil between the fractions (old model) were used to calculate a total discharged mass (3170052kg for Type 2, 3587418kg for Type 4 in this case)
- Assuming the various %age distributions as listed in the table for the new model, these were used to calculate total mass discharged for each of the volatile, heavy, wax and asphaltene fractions and this was then divided by 1800s to derive a discharge rate in kg/s for each fraction

²Initial guess for Oil_Area calculated as follows:

- Initial discharge volume for old model is $2\text{m}^3/\text{s} * 60\text{s (timestep)} = 120\text{m}^3$
- Initial thickness of slick is 0.1m (see p88 of M321PASA.pdf) so initial area of slick is 1200m^2
- In new model, 200 particles are discharged per timestep to represent this 1200m^2 area so each particle represents $1200/200 = 6\text{m}^2$ – this value is used for the first guess at Oil-Area but could be varied to get a better fit to old results

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