Case #1: Environmental Impact Assessment Offshore Namibia

Oil spill scenarios:

- release of 150 m^3 of marine diesel over 30 minutes
- 10-day blow-out scenario releasing 11,000 bbl per day of light crude oil

Alternative response actions:

- 2 boom – skimmer systems in place after 2 days; 2 more after 4 days
- as above, with fixed wing dispersant aircraft operating in addition

Measures of success of response:

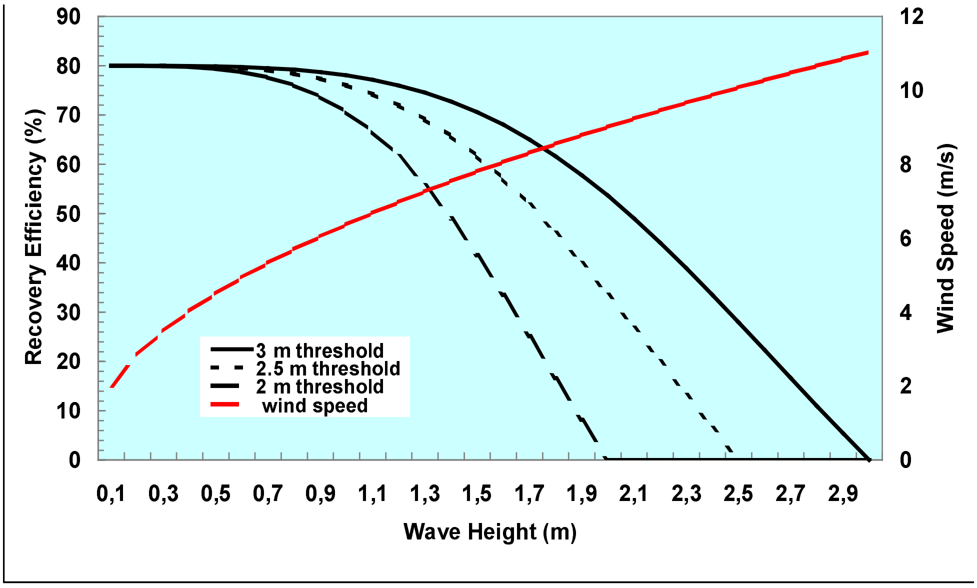
- reduced surface and subsurface exposure of marine organisms

Location map for application of OSCAR offshore Namibia.

Spill response capabilities

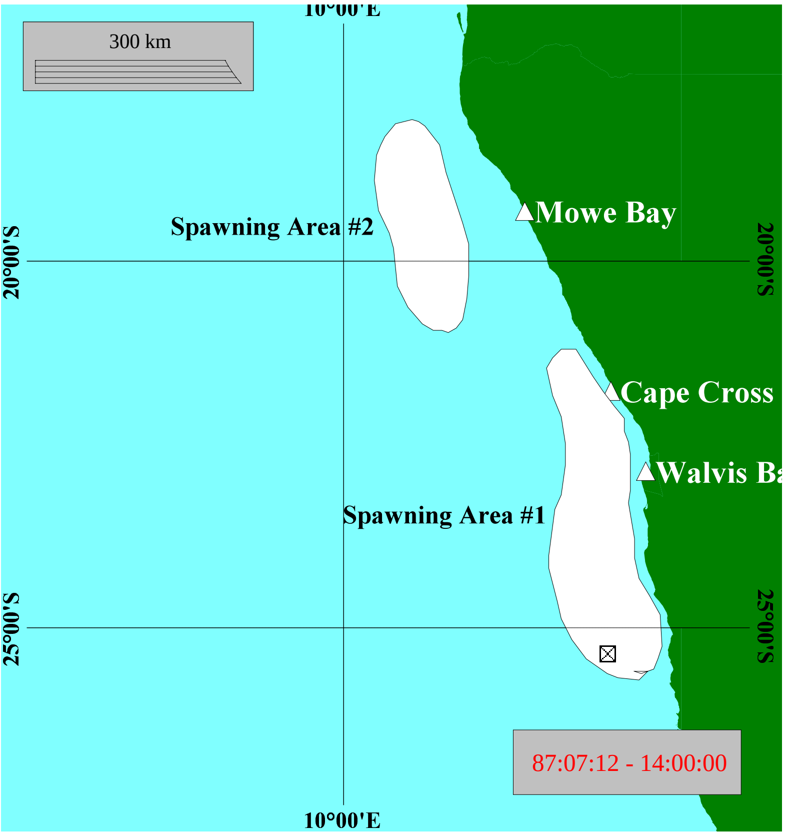
Mechanical Response System	Mobili-sation (hours)	Cruising Speed (knots)	Operational Speed (knots)	Boom Opening (m)	Nominal Skimmer Capacity (m^3/h)	Storage Capacity (m^3)	Maximum Operational Wave Height (m)
First Boom-Skimmer Systems (2)	48	12	1	100	150	1200	2.5
Second Boom-Skimmer Systems (2)	96	12	1	100	150	1200	2.5

Dispersant Response System	Mobili -sation (hr)	Cruising Speed (knots)	Opera-tional Speed (knots)	Spray Width (m)	Applica-tion Rate (m^3/min)	Disper-sant Tankage (m^3)	Maximum Opera-tional Wind Speed (knots)	Re-filling Time (hr)	Total Avail-able Disper - sant (m^3)
Fixed Wing Aircraft	48	280	140	50	2.1	21	30	2	100

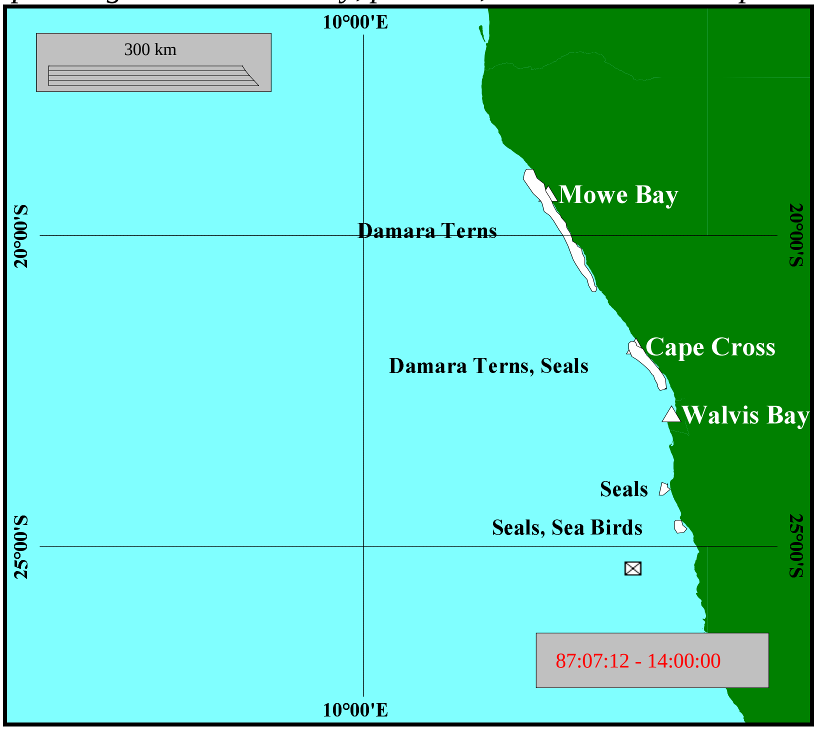


Relationship of wave height to recovery efficiency of boom-skimmer systems (left axis) and wind speed (right axis), for a fully developed sea.

Important Natural Resource Areas

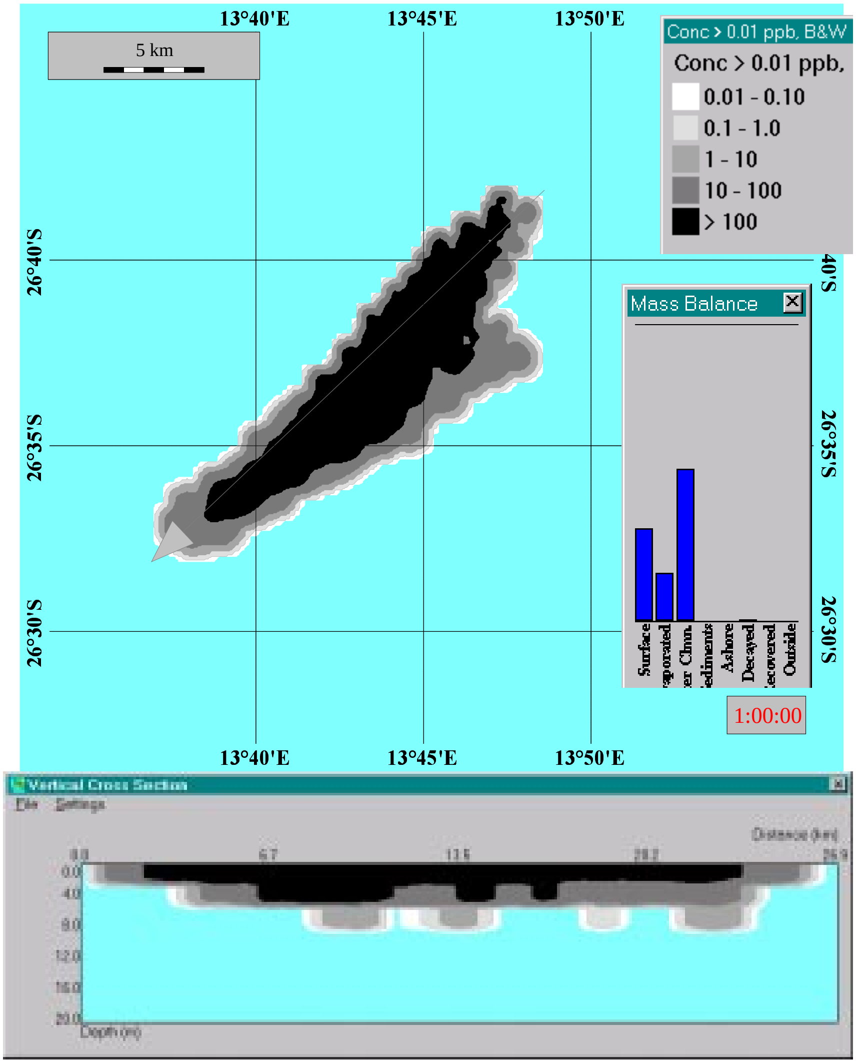


Spawning areas "downstream" of the Norsk Hydro exploration site. Hake, pilchard, sole, and pelagic goby use spawning area #1. Anchovy, pilchard, and mackerel use spawning area #2.66

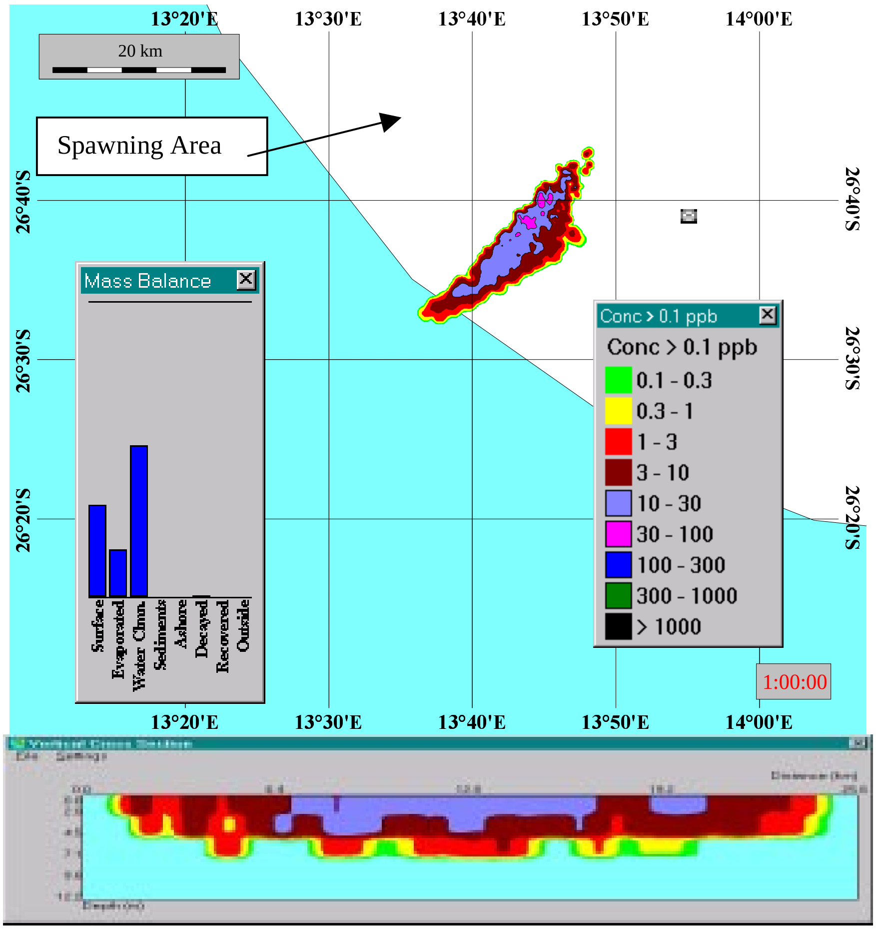


Major bird and marine mammal locations within the potential impact area.

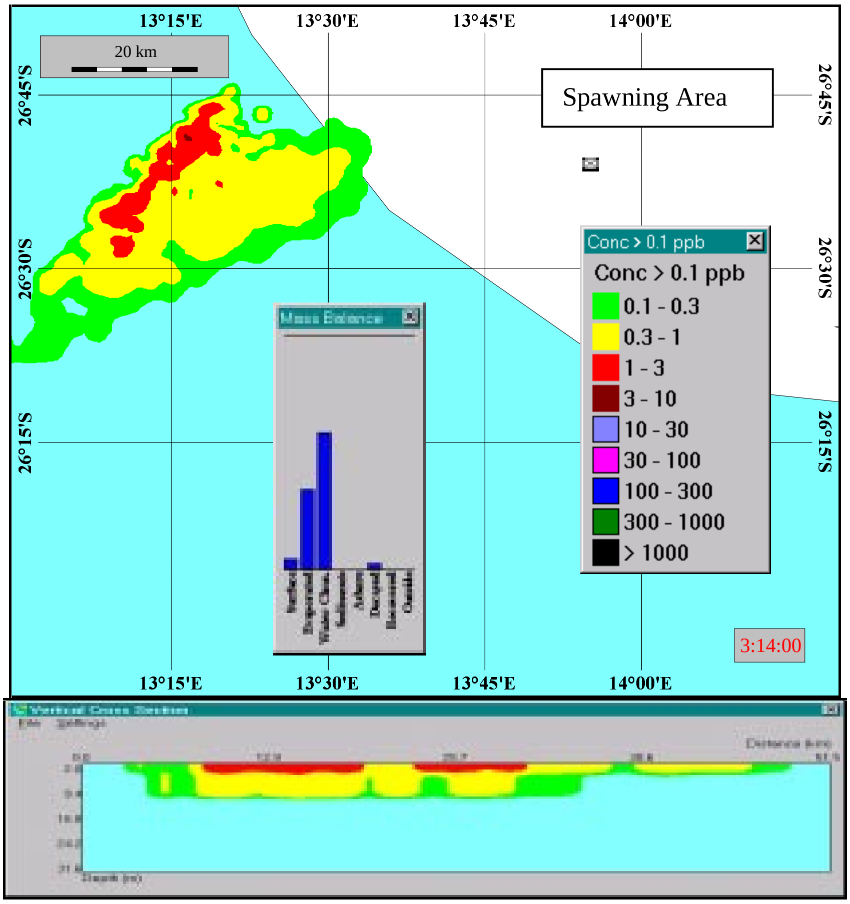
Release of 150 m^3 of diesel fuel



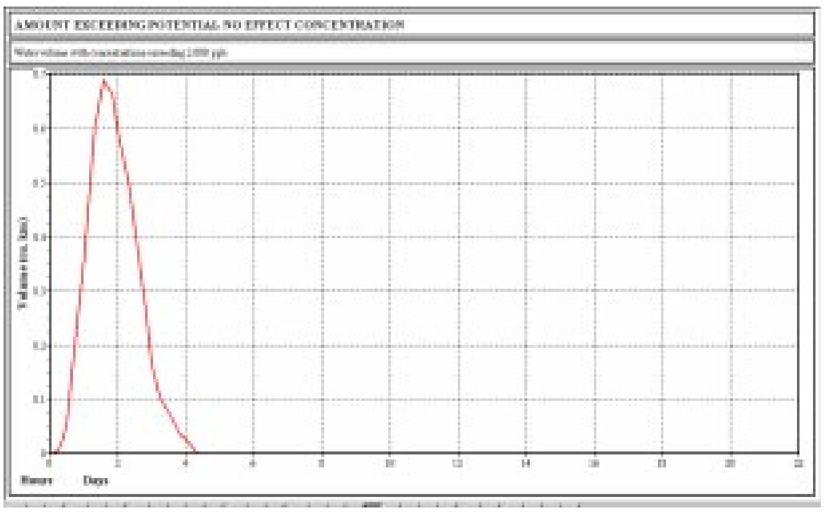
Total hydrocarbon concentrations (THC) in the water column 1 day after hypothetical diesel fuel spill. The white area is the southern tip of spawning area # 1 shown in Figure 4. The vertical cross section is drawn from north-east to south-west. Light winds result in little vertical and horizontal mixing in this example. Maximum concentration is about 500 ppb THC.



Dissolved hydrocarbon concentrations 1 day after the hypothetical diesel spill. The vertical cross section is drawn from north-east to south-west.



Concentration field of dissolved hydrocarbons about 3.5 days after the diesel spill. All concentrations are in the background range for the North Sea of 1-3 ppb. Vertical cross section is drawn from northeast to southwest. Despite winds under 5 m/s during this scenario, less than 5% of the oil remains on the sea surface at this time.



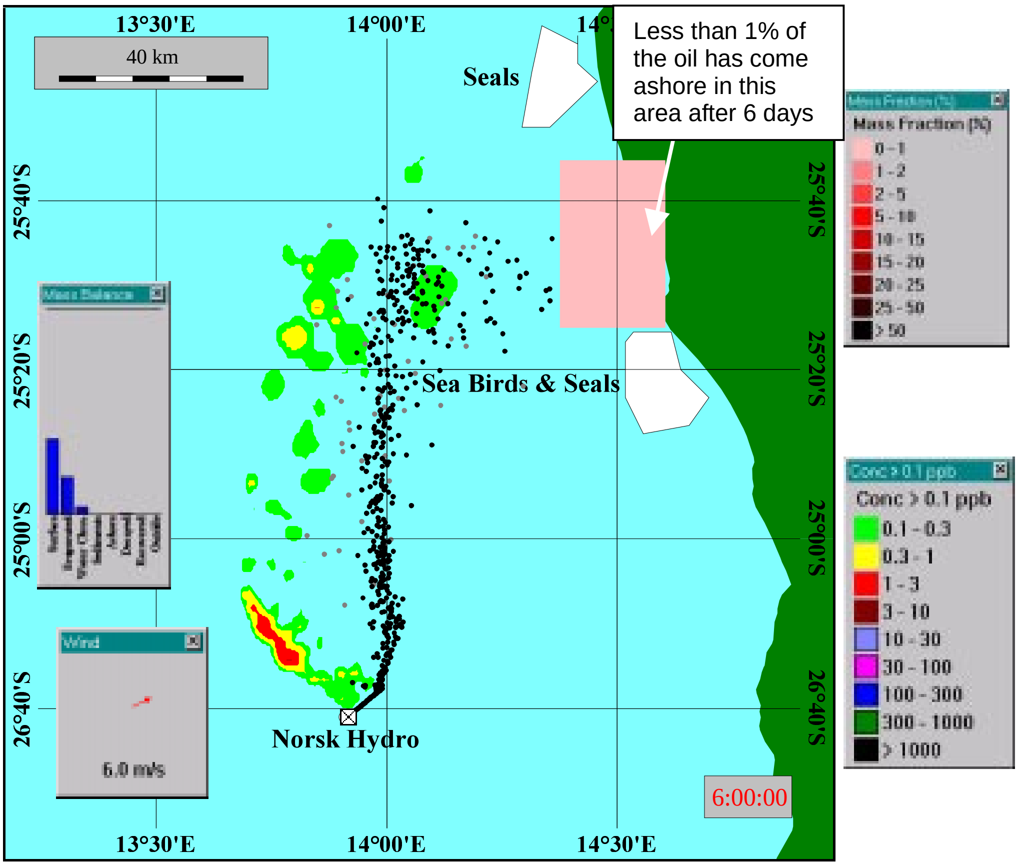
Volume of water exceeding a potential no-effect (PNEC) concentration of 2 ppb. This total volume represents less than 0.03% of the total spawning volume, assuming spawning to occur in the top 50 m of the water column.

Surface blow-out

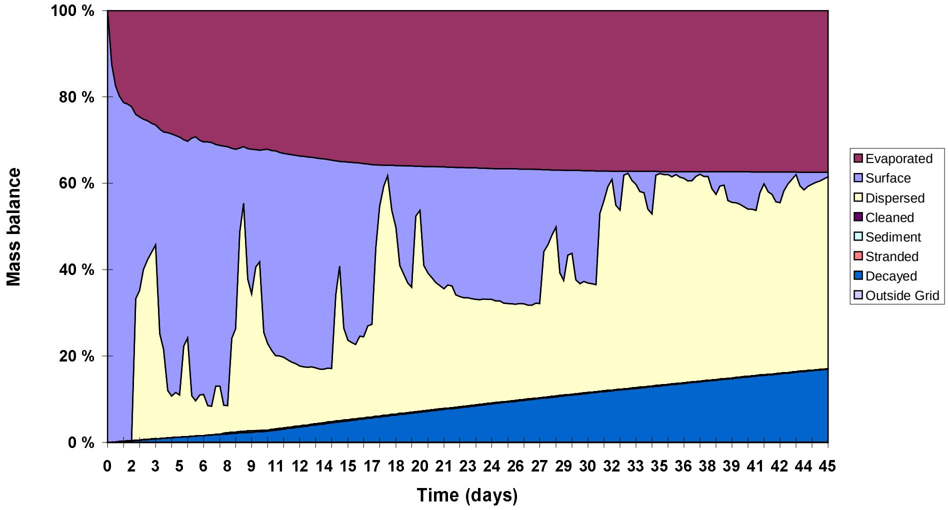
Scenarios evaluated for oil spill response effectiveness. All scenarios assume a surface blowout of 11000 bbl of light crude oil continuing over 10 days. The 4 systems are those specified in Table 3.1

Hypothetical Release Date	Specification of Response	Time for First Oil to Reach Land (days)	Maximum Oil Ashore (% of total)	Reason for Selection
87.07.12	no response	6	1.3	shortest time to shore
87.07.12	4 mechanical systems	6	1.1	response evaluation
88.02.01	no response	16	22	most oil ashore
88.02.01	4 systems	16	18	response evaluation
88.02.01	4 mechanical systems plus Hercules Dispersant Aircraft	16	5.5	investigate mitigation of coastal effects with dispersant use

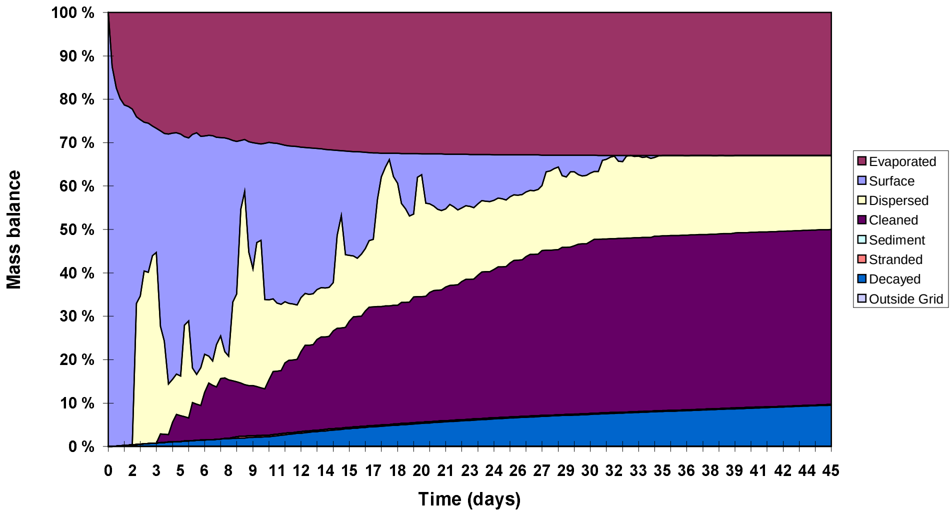
Release date 870712



Distribution of surface oil (black) and subsurface dissolved hydrocarbons 6 days after the beginning of the hypothetical release beginning 870712. At this time a little less than 1% of the oil, (1100 barrels, or 145 tonnes) has come ashore.

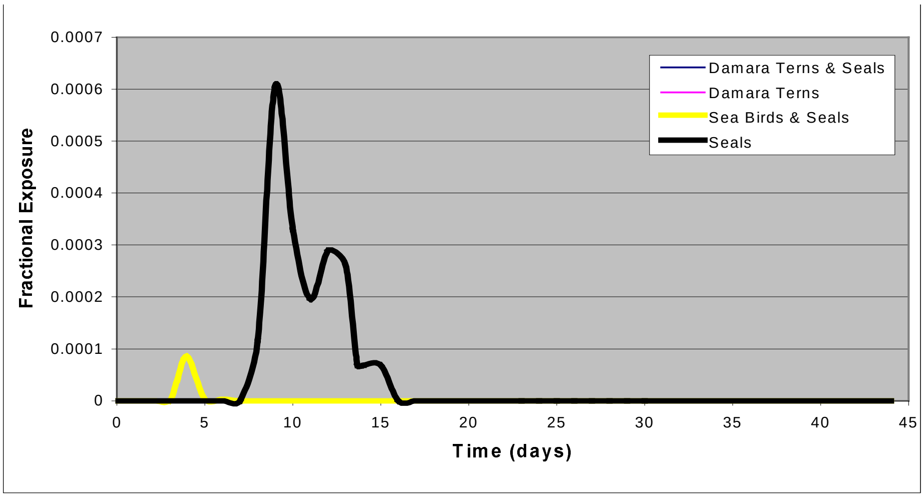


(a)

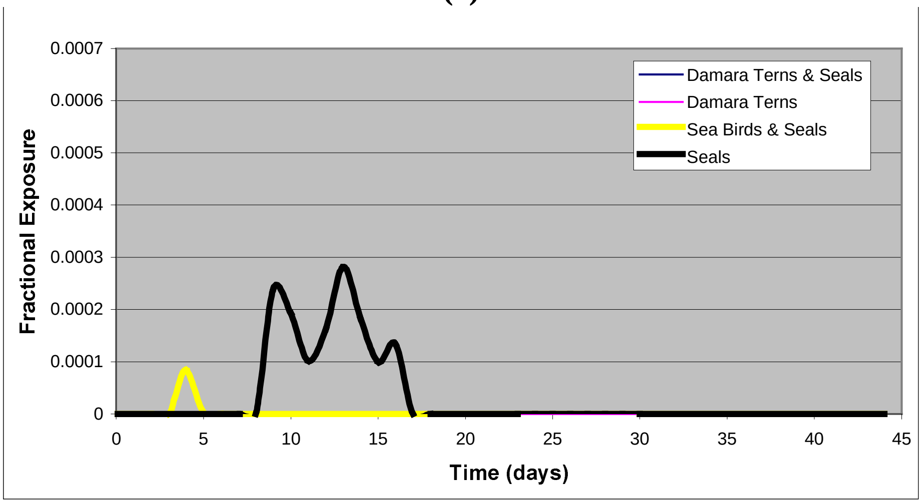


(b)

Mass balance time series for the simulated blowout starting 870712. (a): without response; (b): with 4 boom-skimmer systems operating.



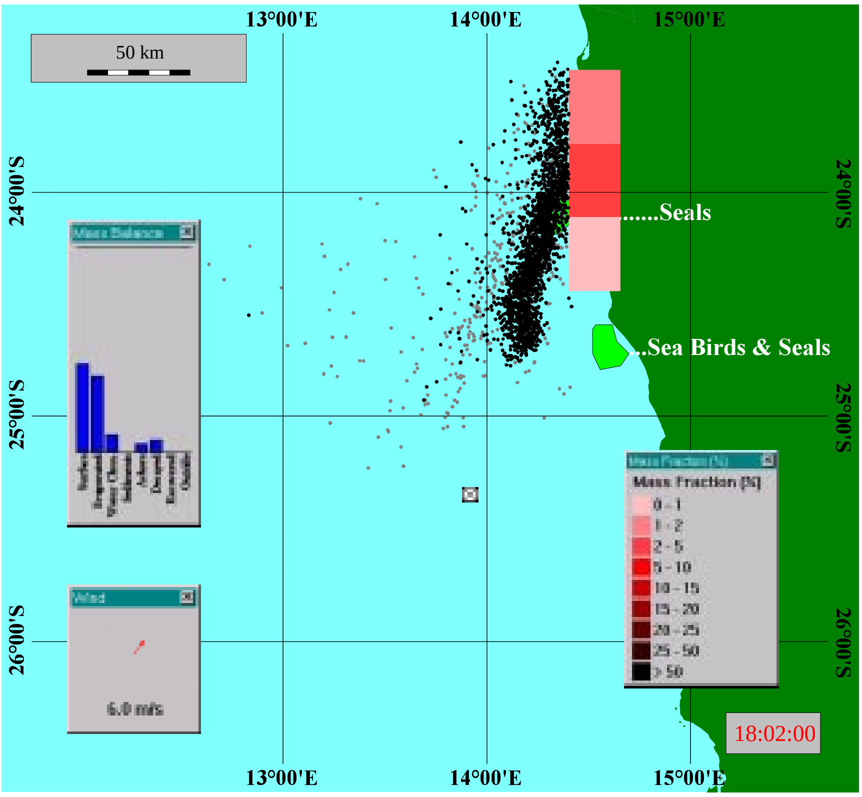
(a)



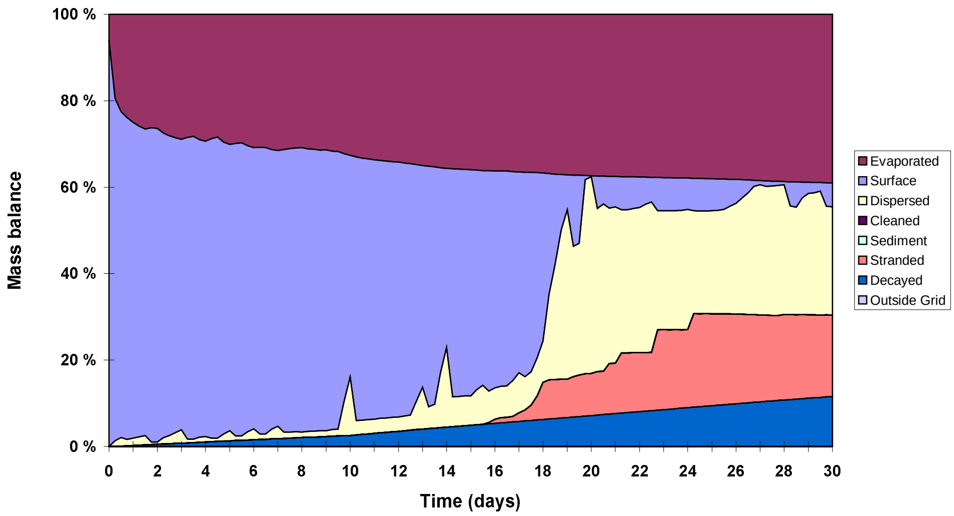
(b)

Time series of areal coverage of oil in the coastal areas shown in Figure 3.4. (a): Without response; (b): with 4 boom-skimmer systems in operation. Fractional exposure is the fraction of each resource area in Figure 3.4 that is covered with oil at a particular time.

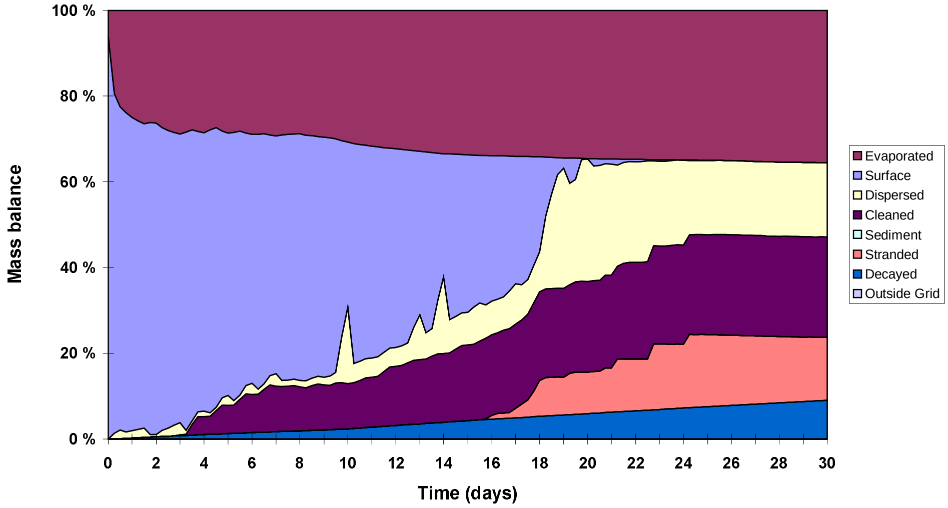
Release 880201



Distribution of surface oil 18 days after the beginning of the hypothetical release beginning 880201. In this scenario, with no response action, over 20% of the oil, (22000 barrels, or 2900 tonnes) eventually comes ashore.



(a)



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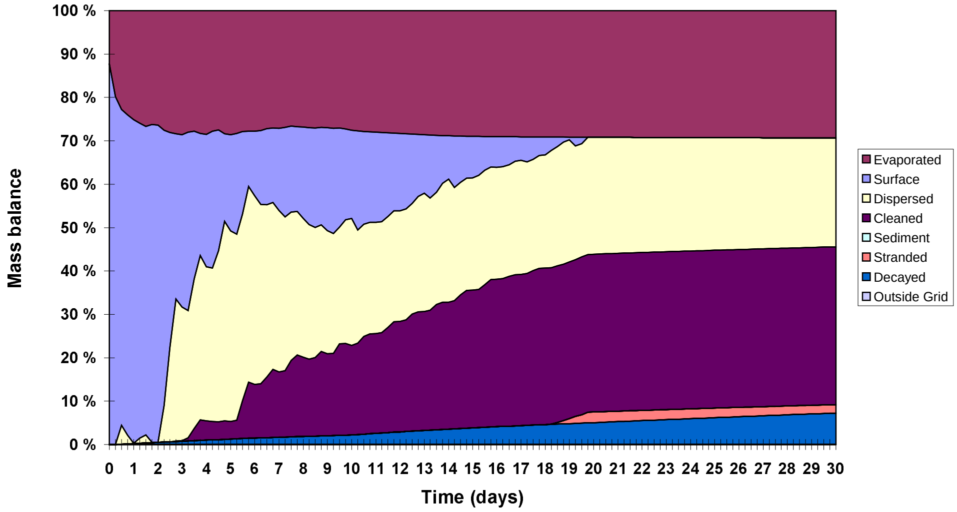
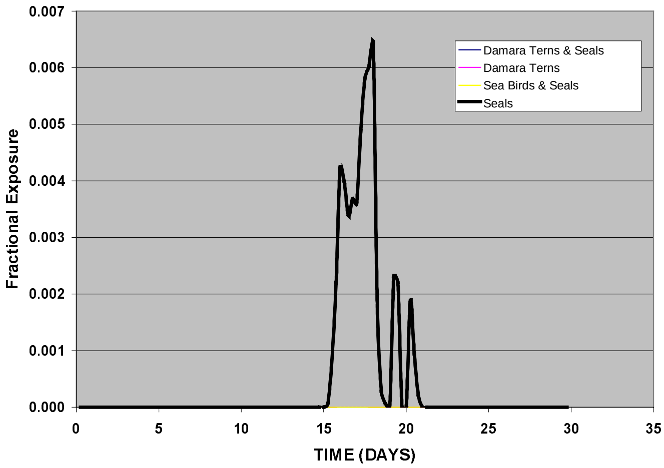
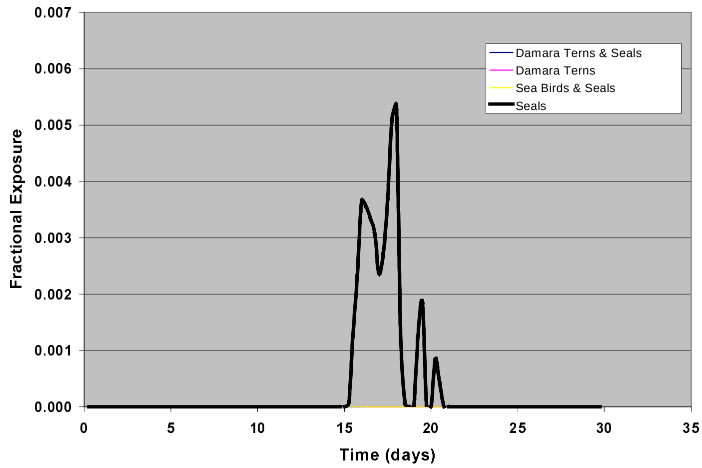


(c)

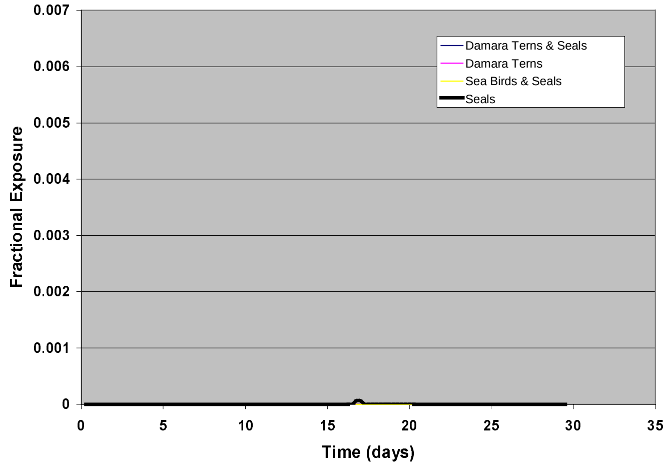
Mass balance time series for simulated blowout beginning 880201. (a) without response; (b) with 4 boom-skimmer systems in operation, and (c) with 4 boom-skimmer systems and the Hercules-Addspack dispersant aircraft in operation.



(a)



(b)



Potential for exposure to surface oil in designated natural resource areas. (a) no response; (b) with 4 boom-skimmer systems in operation, and (c) with 4 boom-skimmer systems and the fixed wing dispersant plane in operation. In the latter case potential effects of oil in the designated seal area are virtually eliminated. (Fractional exposure is the fraction of each resource that is covered with oil at a particular time.)

Summary and Conclusions

The work reported here encompasses analyses of specific potential spill scenarios for oil exploration activity planned offshore of Namibia. The analyses are carried out with the SINTEF Oil Spill Contingency and Response (OSCAR) 3-dimensional model system.

A spill scenario using 150 m^3 of marine diesel demonstrates the rapidity with which such a spill will dissipate naturally, even in light winds. Vertical and horizontal mixing bring subsurface hydrocarbon concentrations to background levels within a few days.

A hypothetical 10-day blowout scenario releasing 11,000 bbl per day of light crude oil is investigated in terms of the potential for delivering oil to selected bird and marine mammal areas along the Namibian coast. Worst case scenarios are selected to investigate the potential mitigating effects of planned oil spill response actions. Mechanical recovery significantly reduces, and in some cases eliminates, potential environmental consequences of these worst case scenarios. Dispersant application from fixed wing aircraft further reduces the potential surface effects.

The response plan. specifies delivery of 2 mechanical cleanup systems, each consisting of approximately 300 m of boom and a skimmer with a capacity to pump up to 150 m^3 per hour, within 48 hours, and another 2 systems within 96 hours. In general, this level of response significantly reduces potential environmental consequences of these worst case scenarios. The addition of dispersant capability delivering 21 tonnes of dispersant per trip further reduces the potential surface effects.

The analysis supplies an objective basis for net environmental benefit analysis of the planned response strategies.

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