In-situ burn calculations

The following conclusions are based upon discussions with A. Allen, a well known burn expert ,model runs by Doug Walton of NIST, who is co-developer of the smoke plume model , ALOFT, and in-house estimates done by NOAA/HAZMAT scientists.

A typical burn regression rate for controlled burn of this product would be between 0.05 mm/sec to 0.10 mm/sec. This translates as between 1/8 and 1/4 bbl per hour per sq ft. of burn surface. Unfortunately, for burn conditions on the ship, much of the radiant energy from the flames will be unavailable to vaporize the product and ventilation will be limited, causing fluctuations in the burn rate and increased smoke production. Typical heat production would be between 35 to 40 megajoules per kilogram burned. Typical smoke production rates are between 9% and16%. The lower the heat generation rate and the higher the smoke production rate, the higher the ground level particulate concentration.

The surface winds are expected to be between 15 - 20 knots at the time of ignition, rising to 45-50 knots during the storm event. We assume neutral stability.

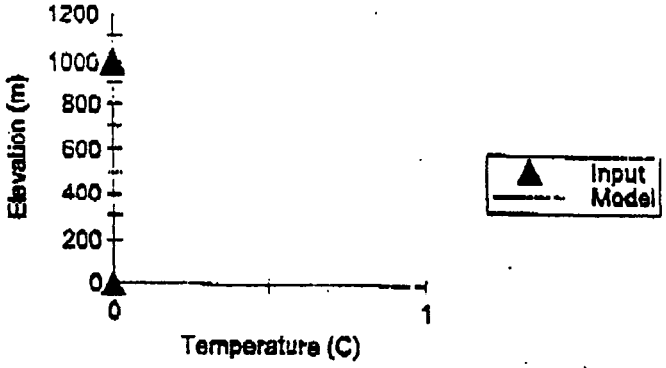
We do not have a good estimate of the anticipated burn area, Based on examination of the ship diagram, we assume a best case of 1000 sq. m. If this area is effectively ignited, the winds are moderate (In the 15 knot range), and the burn is efficient, then we would expect the center of the plume to rise to approximately 600 meters and produce a plume that would extend tens of kilometers downwind. The surface concentration of pm-10 should not exceed 150 micrograms/ cu. m. (LOC based on National Ambient Air Quality Standards).

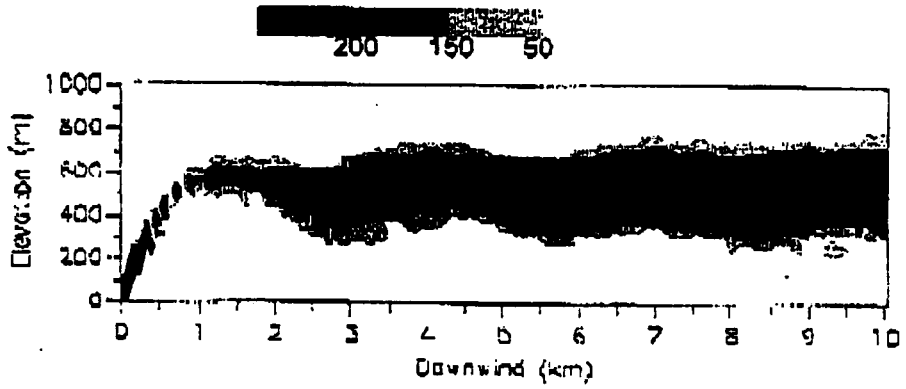
As you increase the surface wind speed, lofting continues to be reduced, and the plume stays closer to the ground. If, for example, we have only a quarter of the above burn area, and 30 knot winds, then the surface particulate concentration will exceed the LOC for 2-3 kilometers downwind. The center of the plume will rise to less than 400 meters.

Hence, the worst case scenario, one that could affect neighboring communities, would be if the burning is inefficient, generating a lot of smoke with little heat during high wind conditions with an onshore component.

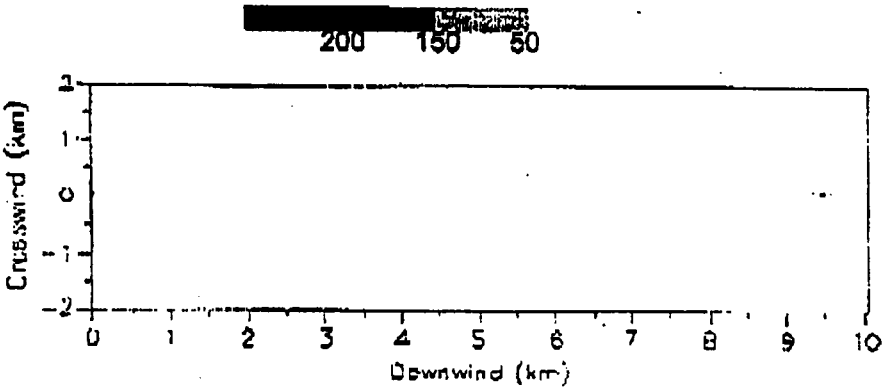
ALOFT-FT 3.05
Oregon
Alaska North Slope Crude
HRR - 1.750 (MW/m^2) BR - 0.05100(kg/s-m^2)
Wind - 15.0 (knots) S Theta - 10.0 (deg) S Phi - 10.0 (deg)

Fire	Area (m^2)
1	1000.0





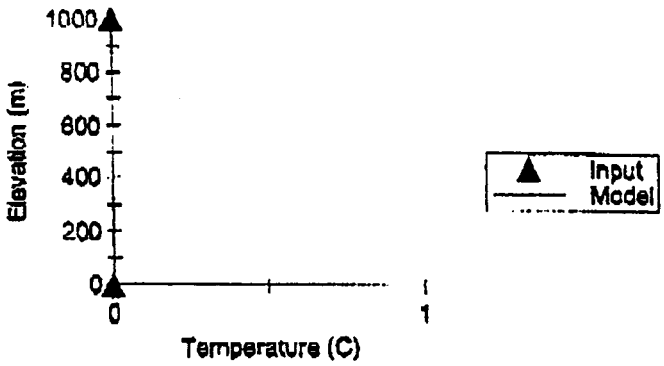
Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Vertical Plane, 0 km Crosswind

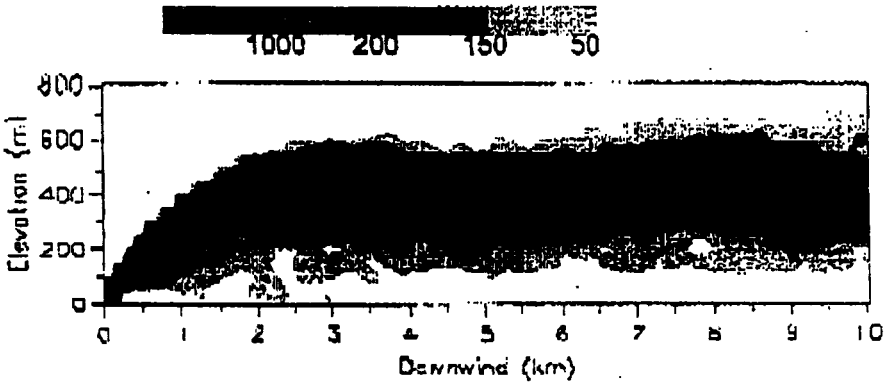


Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Horizontal Plane, 0 m Elevation

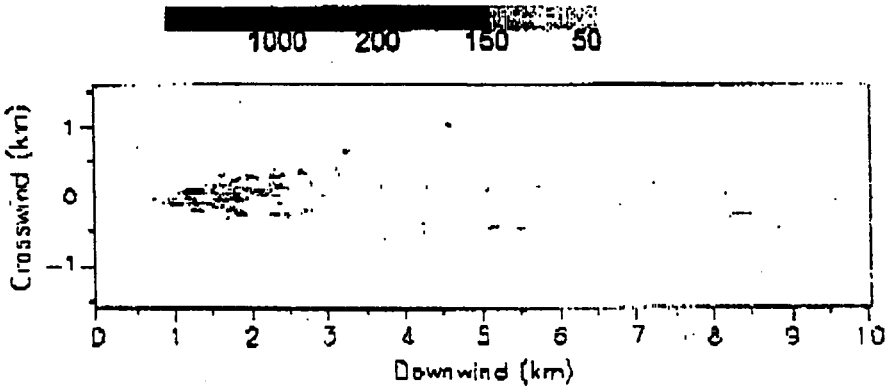
ALOFT-FT 3.05
Oregon
Alaska North Slope Crude
HRR - 1.750 (MW/m^2) BR - 0.05100(kg/s-m^2)
Wind - 29.1 (knots) S Theta - 10.0 (deg) S Phi - 10.0 (deg)

Fire	Area (m^2)
1	1000.0





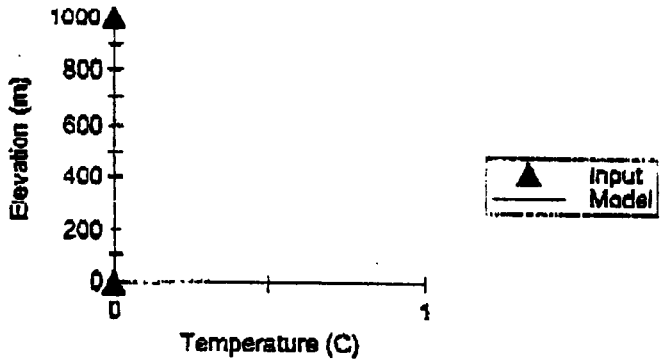
Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Vertical Plane, 0 km Crosswind

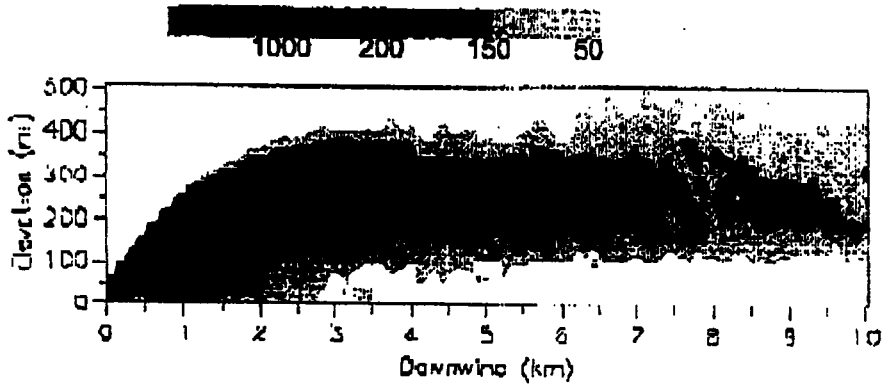


Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Horizontal Plane, 0 m Elevation

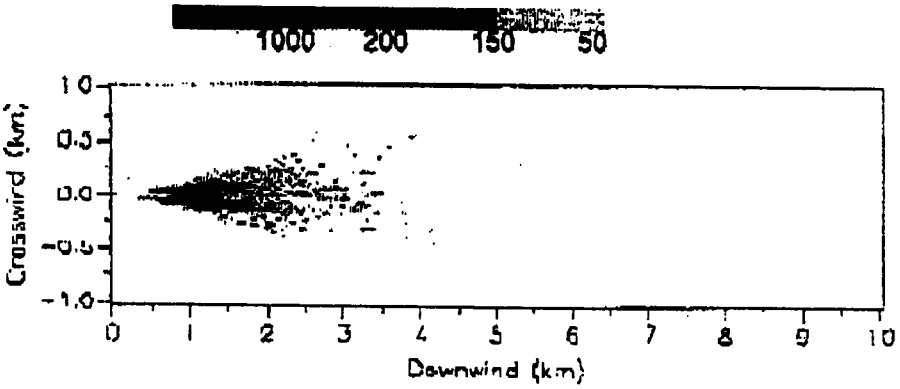
ALOFT-FT 3.05
Oregon3
Alaska North Slope Crude
HRR - 1.750 (MW/m^2) BR - 0.05100(kg/s-m^2)
Wind - 29.1 (knots) S Theta - 10.0 (deg) S Phi - 10.0 (deg)

Fire	Area (m^2)
1	250.0





Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Vertical Plane, 0 km Crosswind



Smoke Particulate PM10 Concentration (micrograms/cubic meter - one hr avg) Horizontal Plane, 0 m Elevation