“Mircea cel Batran” Naval Academy Scientific Bulletin, Volume XIV – 2011 – Issue 2
Published by “Mircea cel Batran” Naval Academy Press, Constanta, Romania

PRESENTATION ON THE PREDICTION ACTIVITY OF OIL POLLUTION USING GNOME AND ADIOS-2 SOFTWARE AND THE OPTIMAL CHOICE FOR INTERVENTION WITH VARIOUS MEANS USING THE INTEGRATED SHIP MANAGEMENT SIMULATOR TRANSAS 5000

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Abstract: *The utilization of GNOME software allows the user to estimate spatial evolution of a spilled oil quantity for a period of 96 hours, in a real-time of maximum 10 minutes when providing information on the oiltype, quantity and initial position. The use of ADIOS-2 software, after we have a clear picture of the space-time simulation on the evolution of the pollutant, gives us the choice of optimal intervention, based on comparative analysis of simulated effectiveness of intervention methods at our disposal. In this paper, we took three of the most often used simulation methods in the case of such interventions: intervention by skimming, using anti-pollution dams and absorption with the help of skimmers, the use of dispersants, the use of in-situ oil burning.*

Starting from the optimal version, the intervention materializes through the navigation simulatorTRANSAS 5000 usingmeans of interventionin simulated conditions close to reality(simulation of burning the area, simulation of oil collected by dams and the full-size of the oil stain in order to determine the number of vessels needed for the intervention)

1. INTRODUCTION

GNOME (General NOAA Operational Modeling Environment) is a trajectory model that simulates the movement of oil spills due to the wind, currents, tides and scattering. GNOME WAS developed by the Emergency Response Division (ERD) of NOAA's Office of Response and Restoration (OR & R). The latest version is 1.3.3 GNOME. [1]. We use this model during action against discharge to calculate the best trajectory prediction hydrocarbons discharged.

Adios-2 program (Automated Data Inquiry for Oil spills) was carried out by the Hazardous Materials Response Division Department (HAZMAT), working in government organizations and National Oceanic Atmospheric Administration, USA, and includes new models for estimating the effects of cleaning techniques common, such as chemical dispersion, skimming or burning oil (Figure 5.13)and presents environmental processes not included in the previous version, such as sedimentation.

ADIOS2 database include an estimate of the physical properties of petroleum and petroleum products. ADIOS2 uses this information to predict changes in properties of the oil once it is spilled. The database was compiled from various sources, including Department of Energy and U.S. industry. It uses mathematical equations and information from the database to predict changes over time in density, viscosity and water content from one type of oil or a petroleum product, the rates at which it evaporates from the sea surface and dispersed in water, and the rate oil emulsion that may form.

Adios 2 program database contains only those types of hydrocarbons having a lower density than water and therefore can float on the sea surface. In practical experience, a hydrocarbon which floats initially, reaches to sink after beeing mixed with sediments suspended in the water or from controlled burning hydrocarbon, in which residues may have a higher density than of water. The oil industry, density of oil is usually expressed in comparison with the density of water, using the API unit, fresh water with API = 10. Class 5 hydrocarbons were API <10 and therefore will not float on the water surface [2]. Adios 2 program components on modules, are shown in Fig.1 [3].

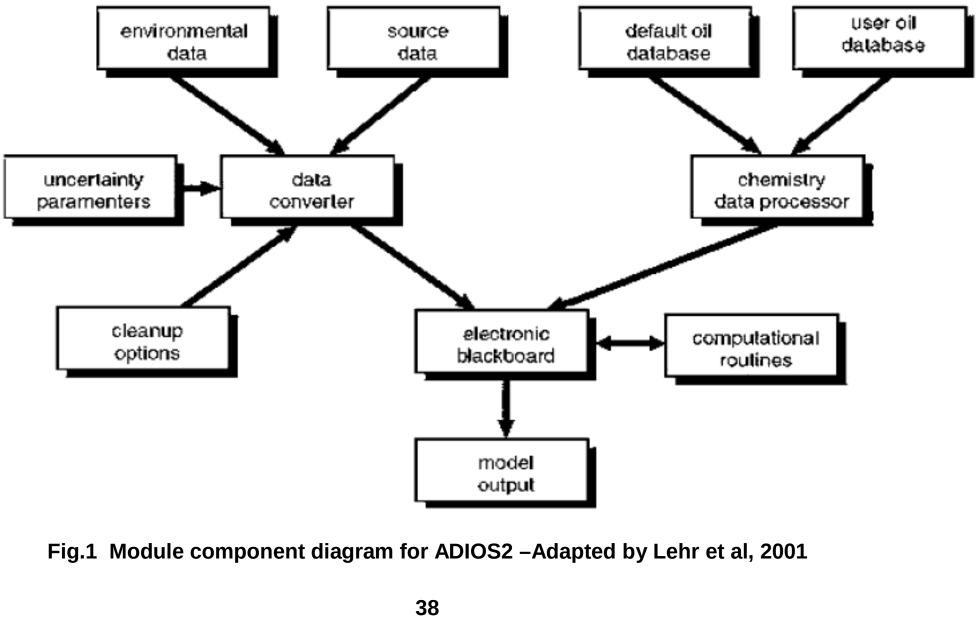


Fig.1 Module component diagram for ADIOS2 –Adapted by Lehr et al, 2001

2. METHOD

It was materialized by using software related to pollutant dispersion (GNOME program) and was installed on dangerous goods simulator-witch has a specific model for categories of pollutants (hydrocarbons) and of the variability of weather and hydrological monitoring SIMIN integrated hydro-meteorological system.

Based on data reported by SIMIN integrated system, the hydro-meteorological characteristics of polluted area (initially materialized through the point of discharge: latitude and longitude) are: wind speed - 5 m / s, wind direction: NE, current speed: 0.4 m / s current direction: S; water temperature: 14^0-$15\ ^0$C;

Initial data entry program GNOME:

- Spill position: 44^0 50 'N, 29^0 40' E;
- Selection date: 07.05.2010;
- Selection time 11.45;
- Selection of wind speed: 5 m / s;
- Select the type of hydrocarbon: Diesel-Tesoro Summer DF2
- Selection of the amount spilled: 150-160 tons (1000 barrels);
- Type of discharge: sudden.

3. RESULTS

3.1 Analysing results using GMOME program:

Since performance of pollutant dispersion simulation program, it is estimated that oil spill will reach $44^0$45' parallel after 7 hours, and the center of the spot after 24 hours will range shown in Fig. 2, near the intersection of 44^0 40' latitude to 29^0 30' longitude.

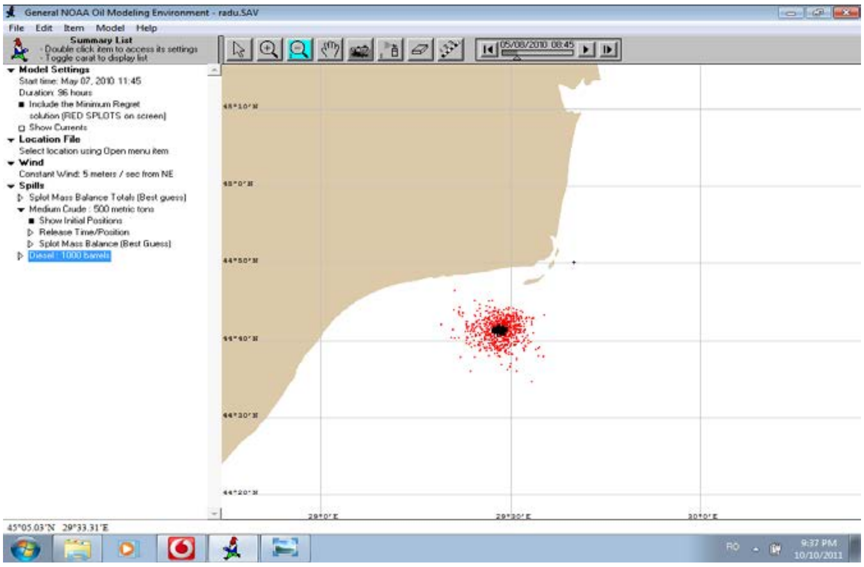


Fig. 2 Simulation of the oil spill position after 7 hours

At the end of 96 hours which allows the simulation program, the dispersion of the oil spill will cover an area between the beaches of the coast located between the parallels of 44^0 05'N and 44^0 40 'N and longitude of 29^0 30', unless it is interfered with the means of remediation, according to Fig. 3.

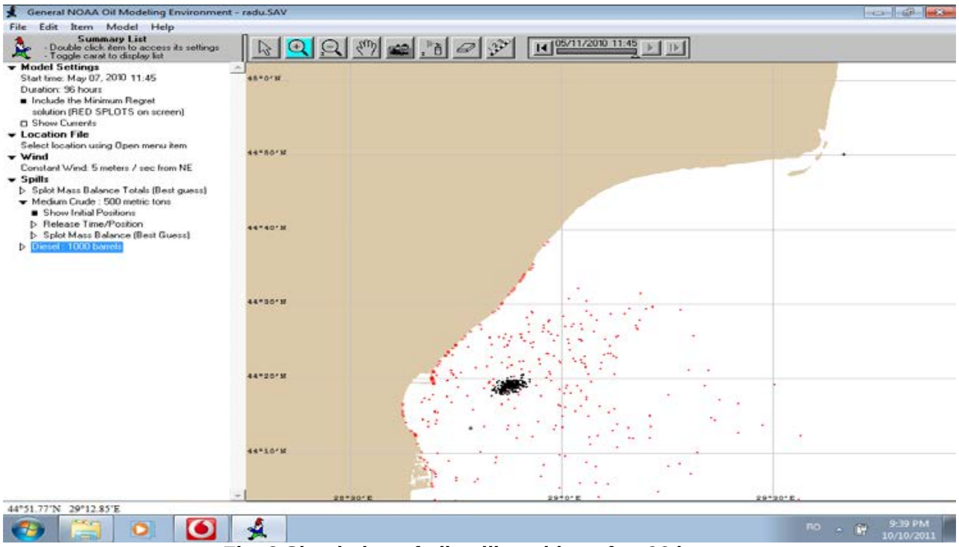


Fig. 3 Simulation of oil spill position after 96 hours

Using GNOME, allows the user to estimate the spatial evolution of the quantity of oil for a period of 96 hours in real time up to 10 minutes to provide information on hydrocarbon type, quantity and position (time is needed to introduce initial data, but also provide hydro-meteorological information in the district).

3.2. Prentation on the activity of oil pollution prediction using software ADIOS2 choosing optimal way in the means of simulated intervention with different means with the integrated ship simulator - "Navi-Trainer Professional 5000".

Using software Adios 2, after have we clear picture of the space-time simulation of the evolution of pollutant for the next 96 hours, we will provide first response for the optimal variant of intervention, based on comparative analysis of simulated effectiveness of intervention methods intended that are available. In this situation, we took three of the methods most often used for such interventions: intervention by dredging with dams and skkimer absorption, use of dispersants; use burning oil „in-situ".

The figures below are the results of simulated dredging with pollution dams and absorption with skimmers from the introduction of initial data (including hydro - meteorological from the SIMIN system), continuing with developments to the arrival of the ships (after 3 - 4 hours after the pollution outbreak situation), followed by quantitative analysis based on estimates of the amount evaporated, dispersed naturally and absorbed with suction dredging machine. The result gathering the ratio of the quantity of hydrocarbons in the initial amount and other phenomena related to physical and chemical properties of pollutants (evaporation, natural dispersion, etc.), are shown in Fig. 4.

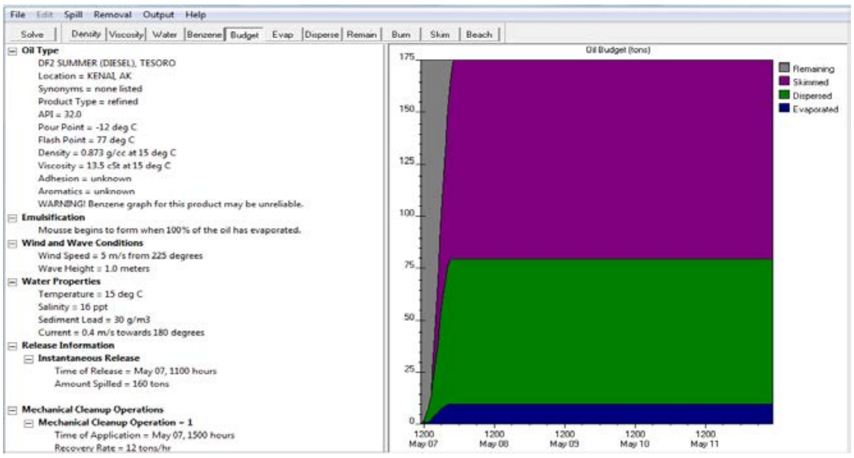


Fig 4. Results obtained by dredging and absorption with skimmers

Thus, the total amount of approximately (150-160 t), in the first 10 hours after the discharge, 45% was recovered, 5% evaporated, 39% dispersed naturally when considering intervention with 2 Skimmers with the capacity 6t/h (Fig. 5), the materialization of their simulated intervention beeing done with the simulator "Navi-Trainer Professional 5000" (Fig. 6).

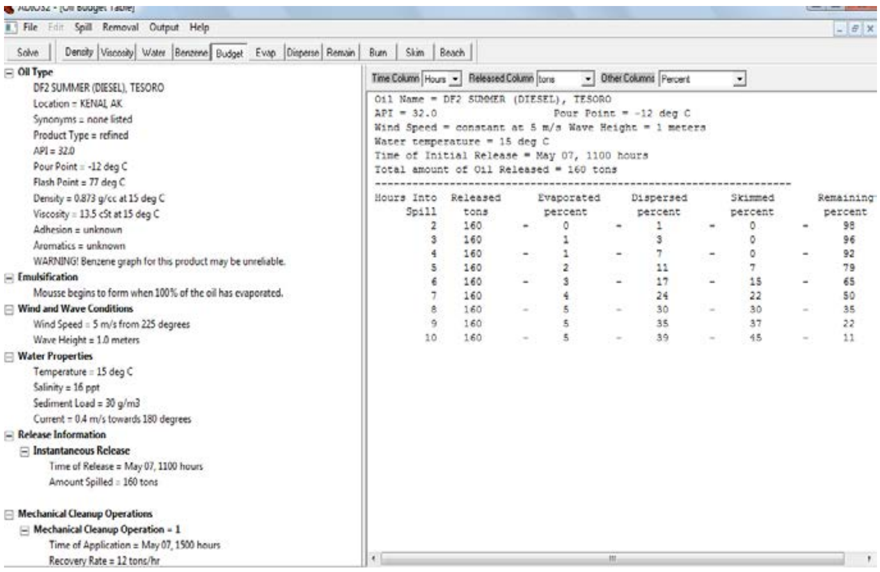


Fig 5. Situation in percentage for mechanical dredging and absorption in the first 10 hours after discharge

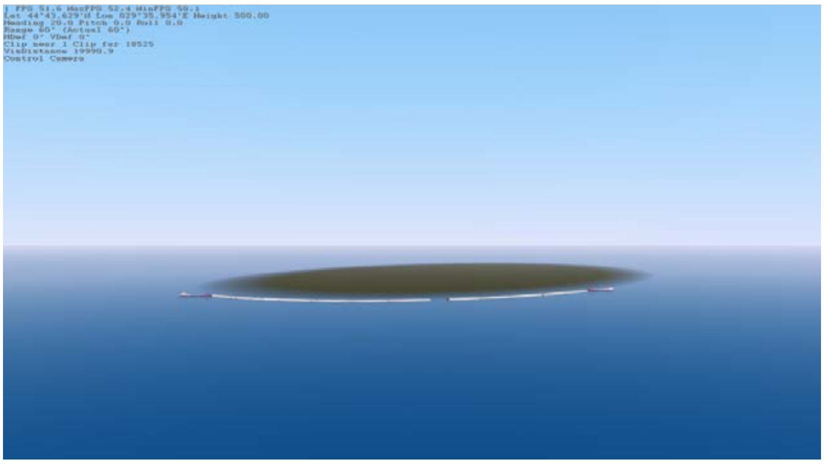


Fig. 6. Simulated oil spill collected by dams (mechanical dredging) and absorption with skimmers - simulator "Navi-Trainer Professional 5000"

In figures 7 and 8 are the results simulated with the use of burning oil layer. The simulation was performed experimentally for an area of 10000 m2, which may be increased or decreased, the surface layer thickness varying simultaneously operator thus adapting the results based on input from "on the spot". As the layer thickness and surface discontinuities can exist because of the hydro-meteorological conditions in the district, in many cases we have several areas of combustion, although it is the same discharge. The program will present the amount of hydrocarbons burned in situ on the surface and experimental film thickness (7 mm) compared to the entire amount, according to Figure 7 and Figure 8, and the achieve of combustion simulation was performed using the simulator "Navi-Trainer Professional 5000" (Fig . 9)

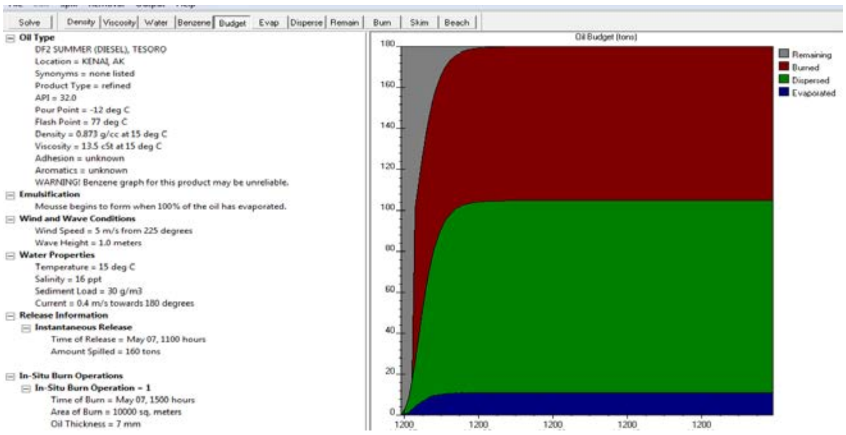


Fig. 7 Results for burning a hydrocarbon surface of 10,000 m2, the total amount reported

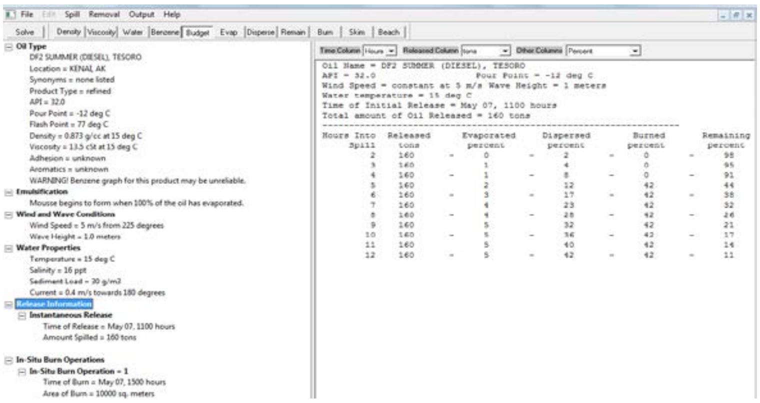
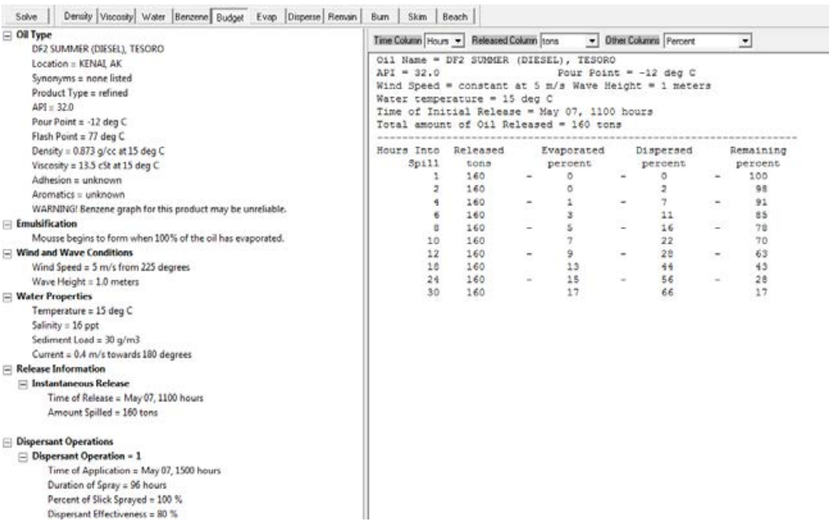


Fig. 8 Representing reported percentage on the elapsed time since discharge (11.00) currently ongoing processes (combustion, dispersion, evaporation and pollutant remaining) for intervention in situ burning of an area of 10000m^2

Fig. 9 Simulation of the combustion zone method of intervention in terms of simulator "Navi-Trainer Professional 5000"

Simulated results when using dispersants, which although are scattered all over, their effectiveness is around 80%, and that period, and their action is spread over a longer period. Thus, after 30 hours after discharge, the situation is as follows: 66% hydrocarbon dispersed, 17% evaporated and 17% hydrocarbon compact (Fig. 10)



Hours Into Spill	Released tons	Evaporated percent	Dispersed percent	Remaining percent
1	160	0	0	100
2	160	0	2	98
4	160	1	7	91
6	160	3	11	85
8	160	5	16	78
10	160	7	22	70
12	160	9	28	63
18	160	13	44	43
24	160	15	56	28
30	160	17	66	17

Fig.10 Representing relative percentage to the elapsed time since discharge (11.00) for ongoing processes (chemical dispersion, evaporation and pollutant remaining) for spraying dispersants

4. CONCLUSIONS

By comparing different situations evidenced by global charts for each type of method, in accordance with annexes and given the estimated time for each method, costs (use of more expensive dispersants because their price and scattering method), post-application of methods in terms of view of their environmental impacts (dispersants are toxic, their use in large quantities causing even more serious effects than not using them, and by burning, smoke and combustion compounds released affecting large areas, especially under the action of local winds - breezes as Fig . 11), we see that the most appropriate method when hydro-meteorological conditions permit, is usage of suction dredging method using the absorption skimmers dams . Special weather situation for the optimal variant can change (sea level will limit the intervention of vessels), policy makers opted for one of the variants. It should be noted that the presented methods provide solutions to fit within a maximum of 15-20 min. Following the decision to move to the next stage, the intervention itself, with the ships.

For the model adopted, intervention materializes through navigation simulator "Navi-Trainer Professional 5000"

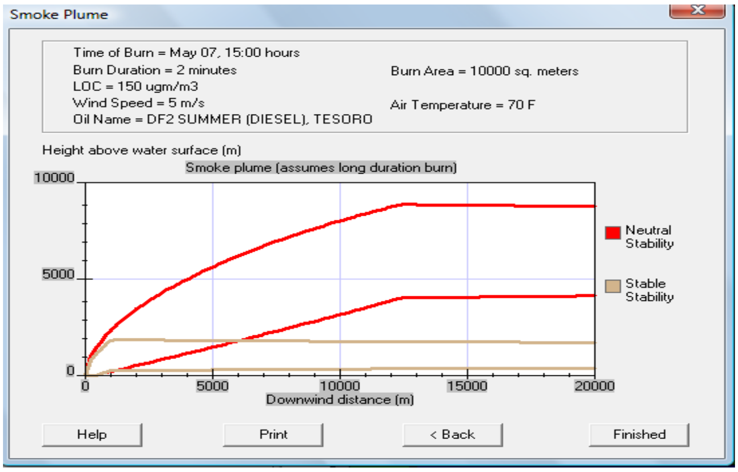


Fig. 11 Vertical and horizontal distances estimated that the smoke will dsperse from burning in situ

5. REFERENCES:

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[3] Lehr W. , Jones R., Evans Mary, Simecek-Beatty Debra, Overstreet R., 2001 *Revisions of the ADIOS oil spill model.* Environmental Modelling & Software 17 (2002) pg.191–199