

# CAPITOLUL II

## PROPRIETATILE, MODIFICARILE FIZICO- CHIMICE SI COMPORTAMENTUL PETROLULUI DEVERSAT ACCIDENTAL

- Proprietati
- Degradare
- Deplasare

# Proprietatile hidrocarburilor

**Greutatea specifica/ densitate** :  $\rho$  (unitate de masura = g/cc)  
sau conform American Petroleum Institute, scara  
gravitatiei specifice in unitati  $^{\circ}\text{API} = 141,5 : \rho - 131,5$ .

(unde  $\rho = 0,75 \dots 0,97$  kg/dmc).

$$\rho_{\text{apa}} = 1 \text{ kg/dmc}$$

**(diferenta de densitate apa/hidrocarbura, caracteristica  
utilizata la proiectarea echipamentelor de interventie)**

**Vascozitatea**: se masoara in cSt si reprezinta *rezistenta la  
curgere*.

$$\nu_{\text{apa}} = 1 \text{ cSt}$$

**(diferenta de vascozitate apa/hidrocarbura, caracteristica  
utilizata la proiectarea echipamentelor de interventie)**

**Punctul de curgere (Pc):** *temperatura sub care poluantul nu curge  $-35^{\circ}+40^{\circ}$ , atunci cand temperatura mediului este sub Pc, poluantul ajunge in stare semisolida, vascozitatea acestuia creste la valori de peste 10.000 cSt persistand mult in timp, degradarea se reduce semnificativ.*

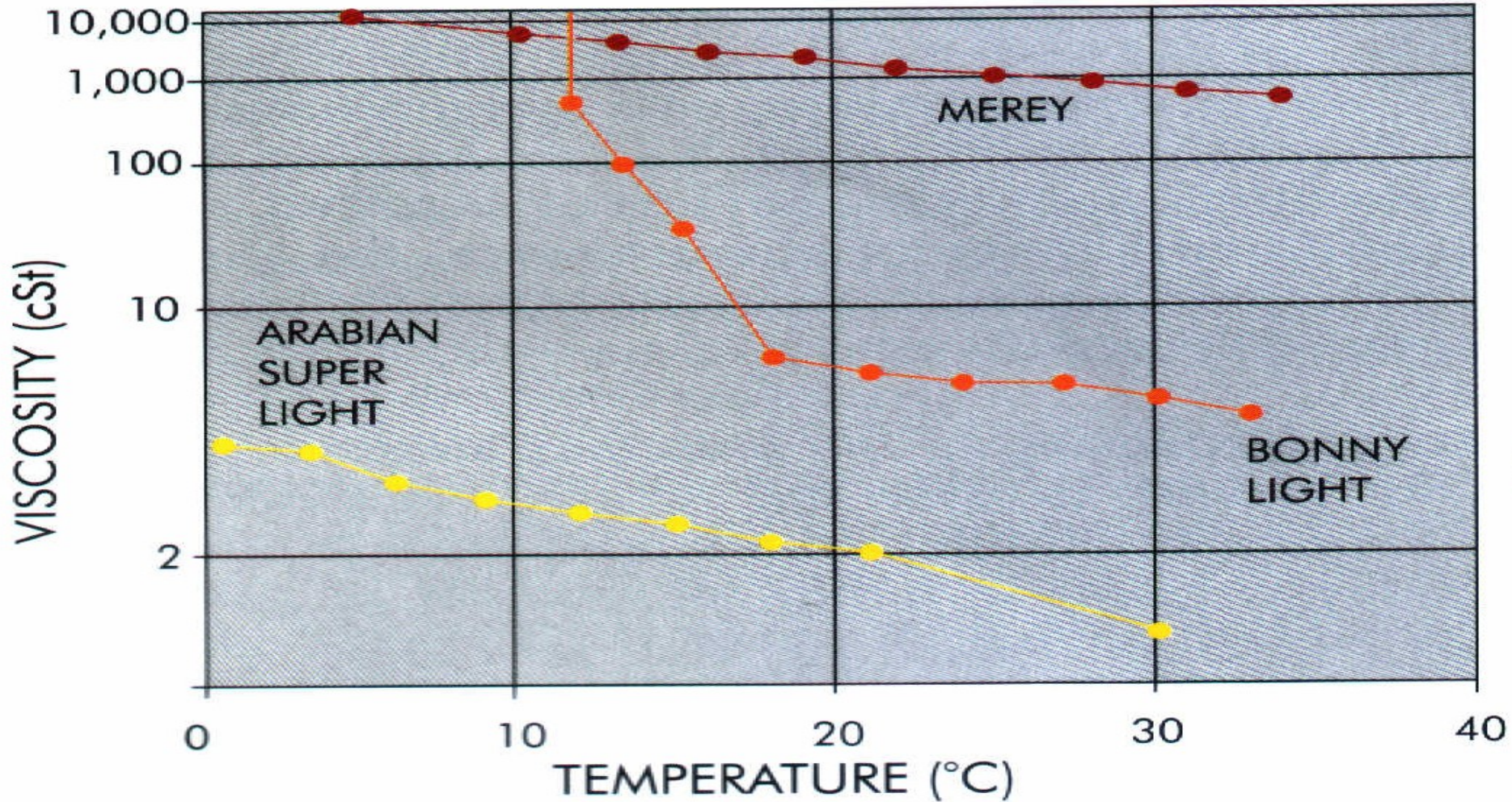
**Petrolul cu un continut mai mare de 10% parafine are un punct de curgere ridicat (la temperatura mediului ambiant  $+20$   $+25$  grade Celsius, se solidifica fiind transportat la cald).**

**Caracteristici de distilare:** *punctul de fierbere (Pf), cu cat valoarea temperaturii Pf este mai joasa cu atat evaporarea este mai puternica.*

$$t_{\text{apa}} = 100^{\circ}\text{C}$$

**Continutul in asfaltene, parafine :** *tendinta de emulsionare si vascozitatea cresc odata cu concentratia de asfaltene si parafine.*

# Variatia viscozitatii cu temperatura



# GRUPE DE COMPUSI CARE INTRA IN COMPONENTA PETROLURILOR

- **PARAFINE:** hidrocarburi saturate cu punct de fierbere ridicat volatilizare diminuata.
- **NAFTENE:** hidrocarburi saturate, atomii de hidrogen putand fi inlocuiti de alte elemente cum ar fi azotul, oxigenul sau sulful.
- **BENZENE:** hidrocarburi aromatice cu punctul de fierbere scazut, volatilizare foarte pronuntata, toxicitate ridicata/cancerigene.

# **Alte tipuri de compusi chimici prezente in petrolul brut**

- Asfaltenele: gudroane cu punct de fierbere foarte ridicat continand: sulf, azot, oxigen si metale cum ar fi nichel, vanadiu.**
- Rasinile: compusi pe baza de molecule cu un continut bogat de atomi de oxigen, azot sau sulf.**
- Aceste componente sunt responsabile de fenomenul de EMULSIONARE al petrolului.**

# Caracteristicile a trei titeiuri diferite apartinand grupelor diferite de persistenta

|             | Arabian<br>Super Light | Bonny Light | Merey     |
|-------------|------------------------|-------------|-----------|
| Origin      | Saudi Arabia           | Nigeria     | Venezuela |
| °API        | 48.5                   | 34.6        | 15.7      |
| SG at 15°C  | 0.79                   | 0.85        | 0.96      |
| Wax content | 12%                    | 13%         | 10%       |
| Asphaltenes | 7%                     | No data     | 9%        |
| Pour point  | -29°C                  | 12°C        | -18°C     |

# TOXICITATEA GRUPELOR DE COMPUSI

parafine < naftene < asfaltene < benzene



# CLASIFICAREA HIDROCARBURILOR PE GRUPE

- **Clasificarea se refera la capacitatea petrolului de a persista mai mult sau mai putin atunci cand este deversat pe suprafata apei sau a solului dupa cum urmeaza:**
- **Titeiuri nepersistente care se volatilizeaza rapid**
- **Titeiuri persistente (neprelucrat , cu asfaltene) care se degradeaza greu, raman timp indelungat pe suprafata apei sau a solului**

- **Clasificarea a fost facuta dupa densitate (densitatea este direct proportionala cu persistenta).**
  - **Perioada de injumatatire (PI) = timpul in care 50% din poluant s-a degradat natural, iar dupa 6PI e posibil ca pe suprafata poluata sa ramana 1% din poluant.**
- cu cat tieiul este mai persistent cu atat valoarea PI este mai ridicata*

# Clasificarea pe cele 4 grupe se refera la gradul de persistenta al poluantului deversat.

## Non-Persistent Gr.1

- **Gazolina**
- **Kerosen**
- **Benzina**
- **Motorina**

## Persistente Gr. 2, 3, 4

- **Titeiul neprelucrat**
- **Combustibili**
- **Uleiuri de motor/transmisii**

**Petrolul nu este persistent daca:**

- **peste 50% din volumul sau distileaza la o temperatura de 340°C,**
- **cel putin 95% din volumul sau distileaza la o temperatura de 370°C.**

# GRUPA I

- **Gazolina, kerosenul, benzina, motorina:**

**densitatea  $< 0,8$  kg/dmc**

**vascozitatea la  $15^{\circ}\text{C} = 0.5 - 2$  cSt**

**distilare la o temperatura  $< 200^{\circ}\text{C} = 50 - 100$**

**%**

**$> 370^{\circ}\text{C} \approx 20\%$**

**Produsi usori de grupa 1 care se raspandesc sub forma  
unui film subtire avand aspect de curcubeu,  
se evaporata rapid, (se degradeaza rapid in timp)**

**NU NECESITA INTERVENTIE**

# GRUPA II

**Titei (Nigerian light, Kikuk), pacura:**

**densitatea = 0,8 - 0,85 kg/dmc**

**punct de curgere > 5°C**

**vascozitatea la 15°C = 4 cSt (tendinta de solidificare la 8 cSt)**

**distilare la o temperatura < 200 °C = 33 %**

**> 370 °C = 34 %**

# GRUPA III

**Titei (Zair, Trinidad):**

**densitatea = 0,85 - 0,95 kg/dmc**

**punct de curgere > 5°C**

**vascozitatea la 15°C = 8 cSt (tendinta de solidificare la  
275 cSt)**

**distilare la o temperatura < 200 °C = 22 %**

**> 370 °C = 46<sub>15</sub>%**

# GRUPA IV

**Titei (Bahia, Cyrus), uleiuri de motor/transmisie:**

**densitatea  $> 0,95$  kg/dmc**

**punct de curgere  $> 30^{\circ}\text{C}$**

**vascozitatea la  $15^{\circ}\text{C} = 1500$  cSt ( peste 1500 solidificare)**

**distilare la o temperatura  $< 200^{\circ}\text{C} = 10\%$**

**$> 370^{\circ}\text{C} = 65\%$**

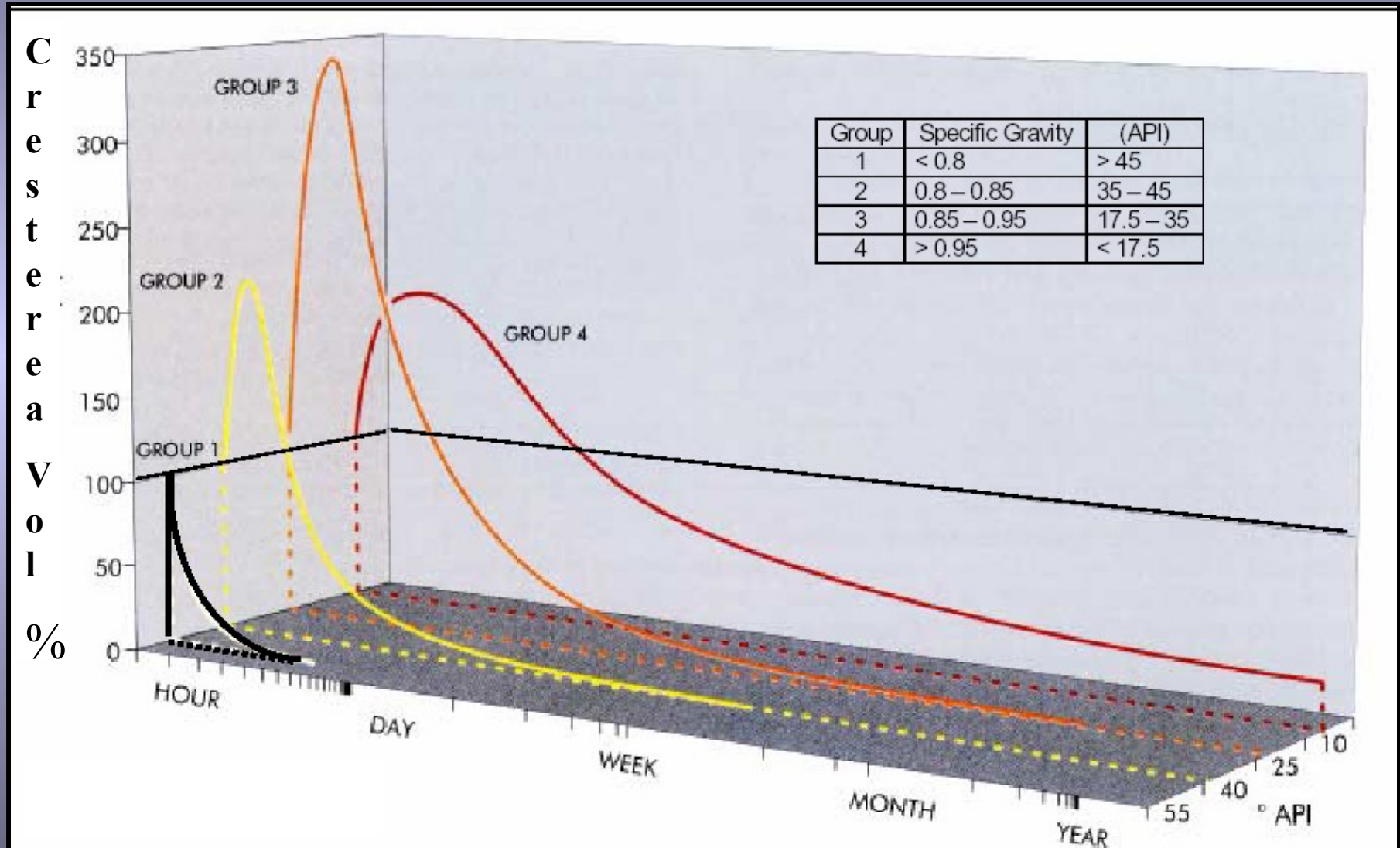




**Petrol neprelucrat, persistent ( $P_c = 33^\circ\text{C}$ ), care la o temperatura a apei de  $+28^\circ\text{C}$  devine semisolid formand fragmente care se pot deplasa pe distante mari punand in pericol zonele de tarm**

**NECESITA INTERVENTIE**

# Variatia volumului in timp pe grupe

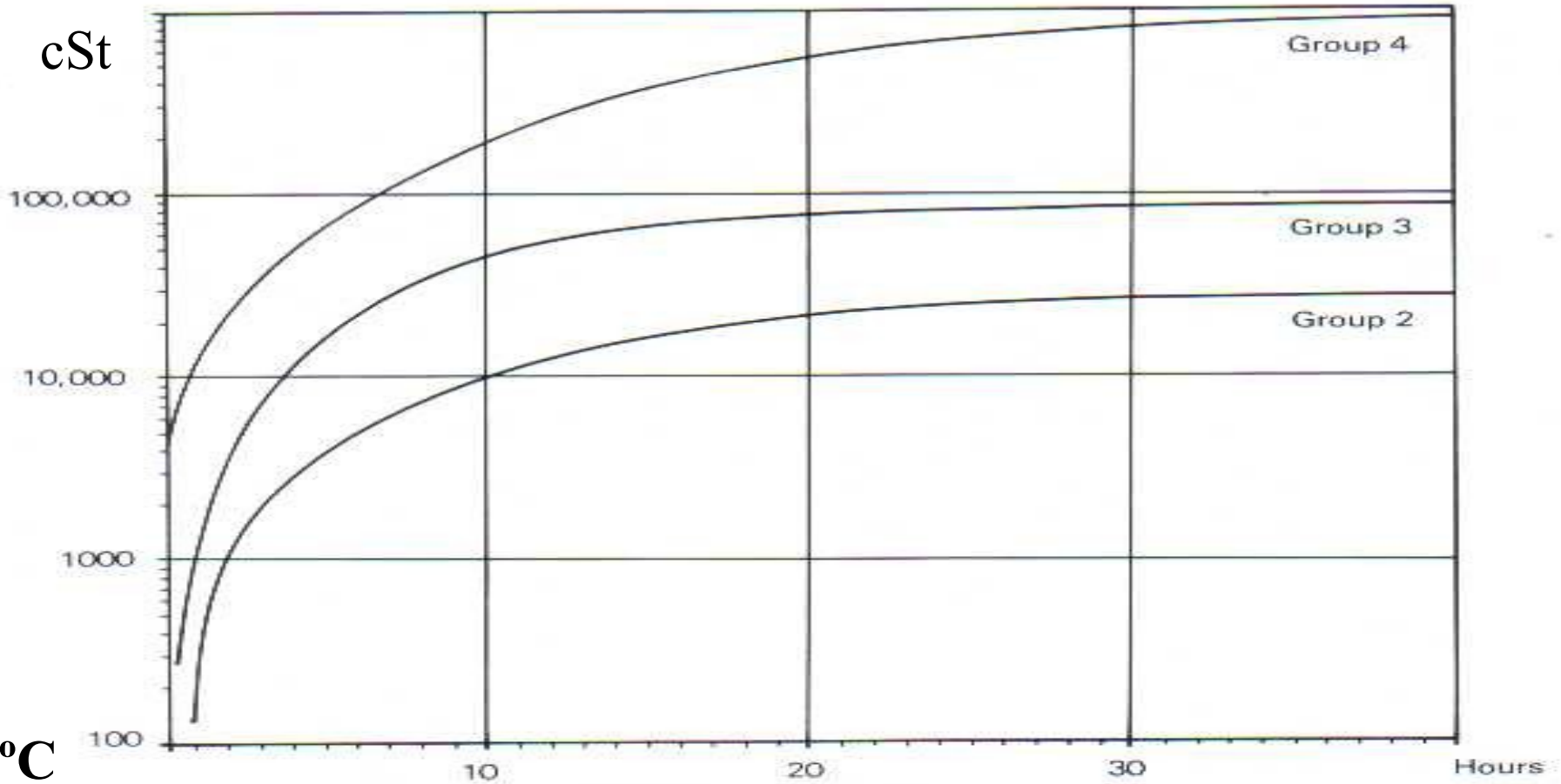


# Variatia viscozitatii in timp pe grupe

V  
a  
s  
c  
o  
z  
i  
t  
a  
t  
e  
a

L  
a

15°C



**Timpul in ore (pt grupa 1 viscozitatea nu depaseste 100 cSt)**

# PETROLUL CA POLUANT

are

CEL CU COMPONENTE  
NEPERSISTENTE

CEL CU COMPONENTE  
PERSISTENTE



**EFECTE**

TOXICE

SUFOCANT

# **PROCESE DE DEGRADARE (PENTRU HIDROCARBURILE PERSISTENTE)**

- **Dispersia**
- **Evaporarea**
- **Emulsionarea**
- **Fotooxidarea**
- **Biodegradarea**
- **Sedimentarea**

# DISPERSIA

## Efecte

- Reducerea volumului de pe suprafata apei

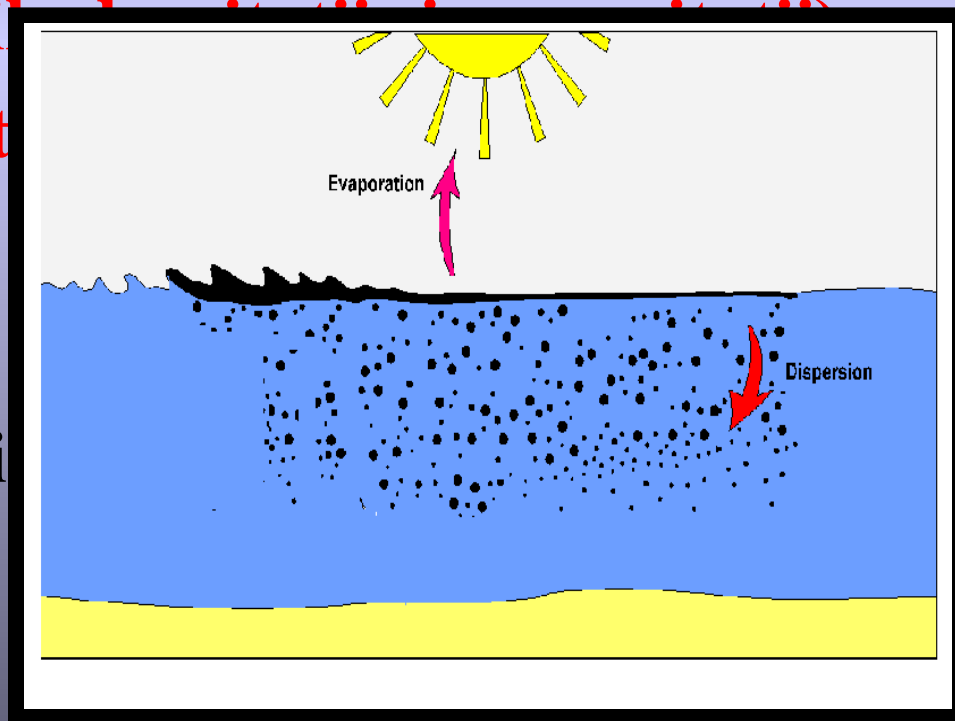
- Modificarea proprietatilor peliculei

(cresc valorile  $\sigma$  si  $\gamma$ )

- Poluarea se t

## Factori care influenteaza dispersia

- Starea de agitatie a marii
- Volumul de poluant
- Tipul poluantului(este



# DISPERSIA

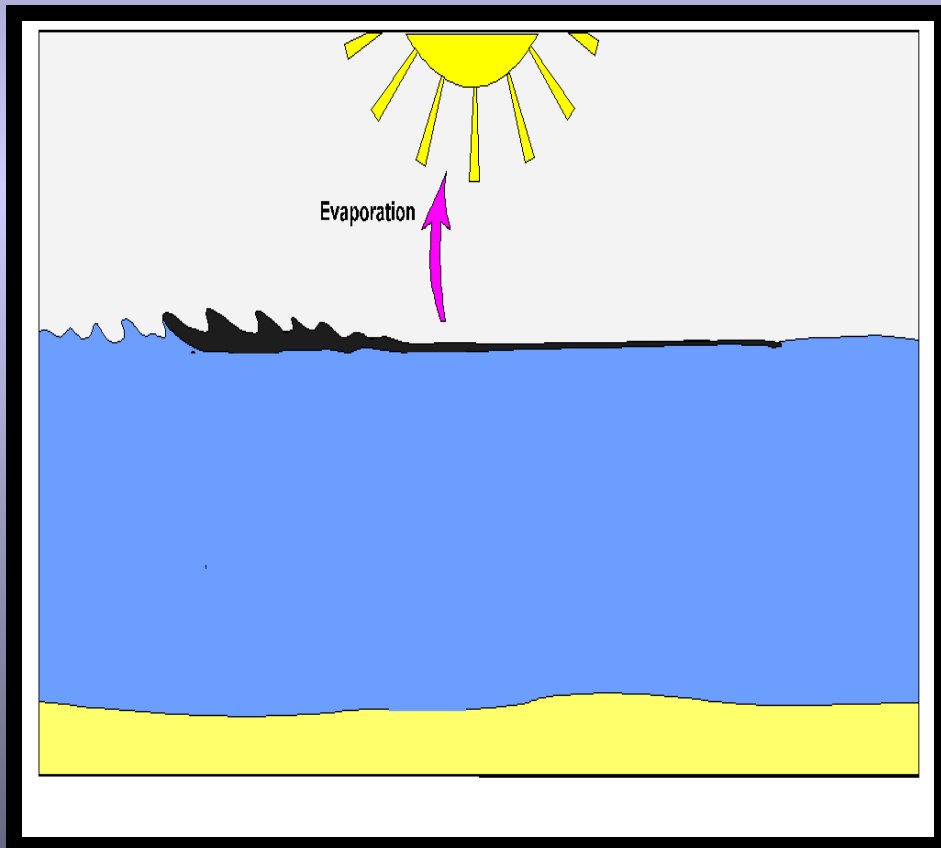
**Cantitatea de produs dispersat în timp în masa apei poate varia între 10-90 % din cantitatea totală de petrol deversată în funcție de condițiile hidro-meteo.**

# EVAPORAREA

30-40%

## Efectele evaporarii

- Reducere in volum
- Modificare proprietatilor
- Risc de incendiu/explozie
- Toxicitate in aer



## Factorii care influenteaza evaporarea

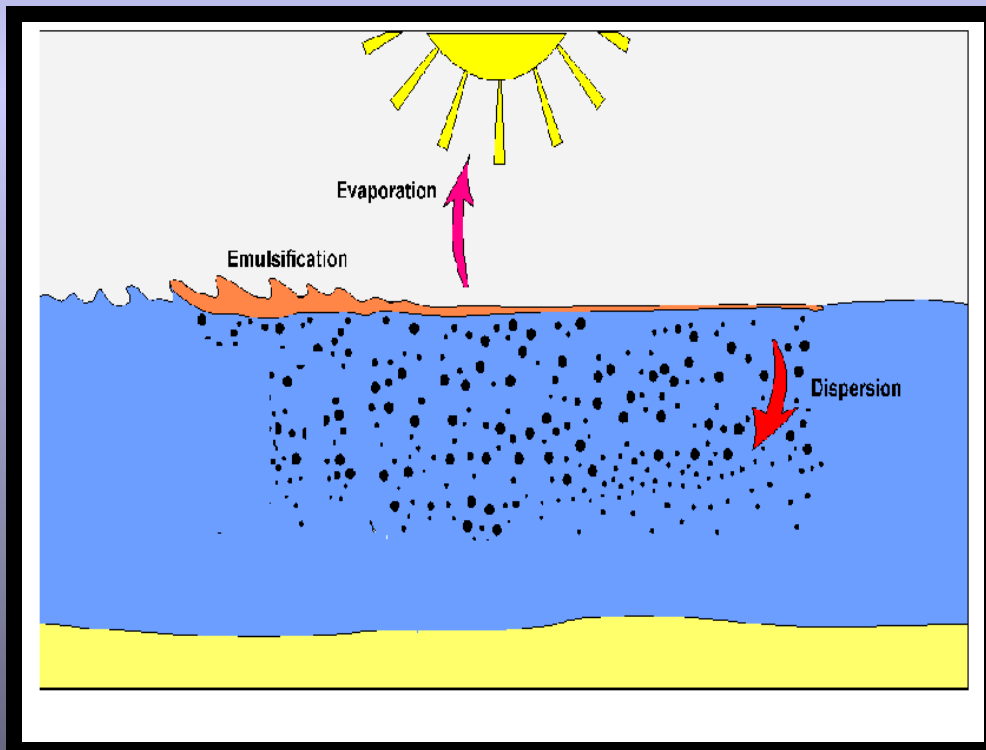
- Starea de agitatie a marii
- Volumul de poluant
- Tip petrolului
- Grosimea peliculei
- Supafata peliculei
- Temperatura
- Viteza vantului



# EMULSIONARE

## Efectele emulsionarii

- Crește volumul cu 80 %
- Modificarea proprietatilor
- Schimbarea culorii



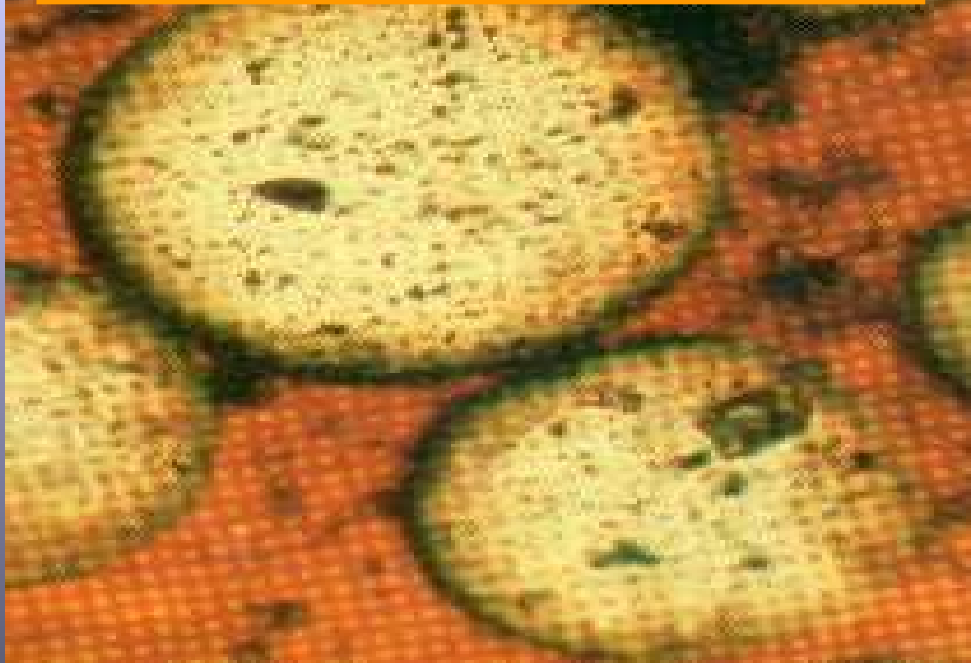
## Factorii care influenteaza emulsionarea


- Tipul petrolului
- Starea de agitatie a marii

# Emulsionare

**Poluant emulsionat  
plutind pe apa**

**Picaturi de apa emulsionata  
in petrol (Vedere la microscop)**



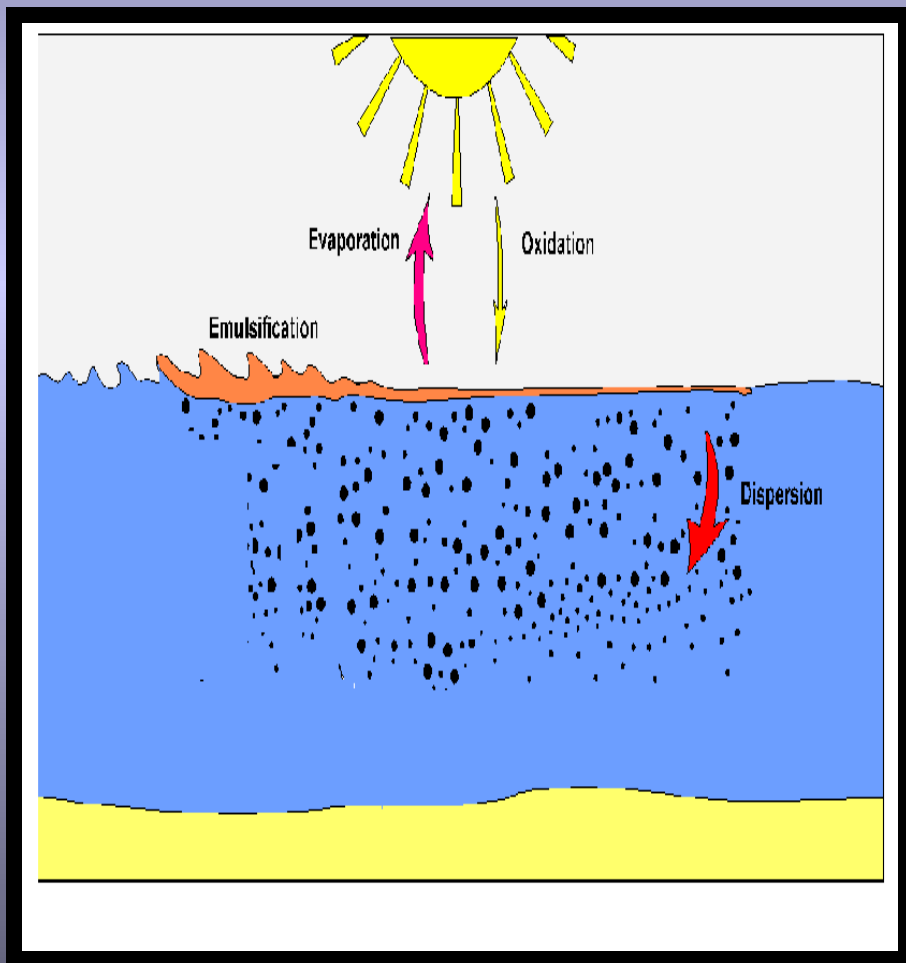


**Poluant emulsionat cu  
apa depus pe tarm**

# FOTO OXIDARE

(Proces de combinare a petrolului cu oxigenul)

**Efecte : degradarea peliculei de petrol.**



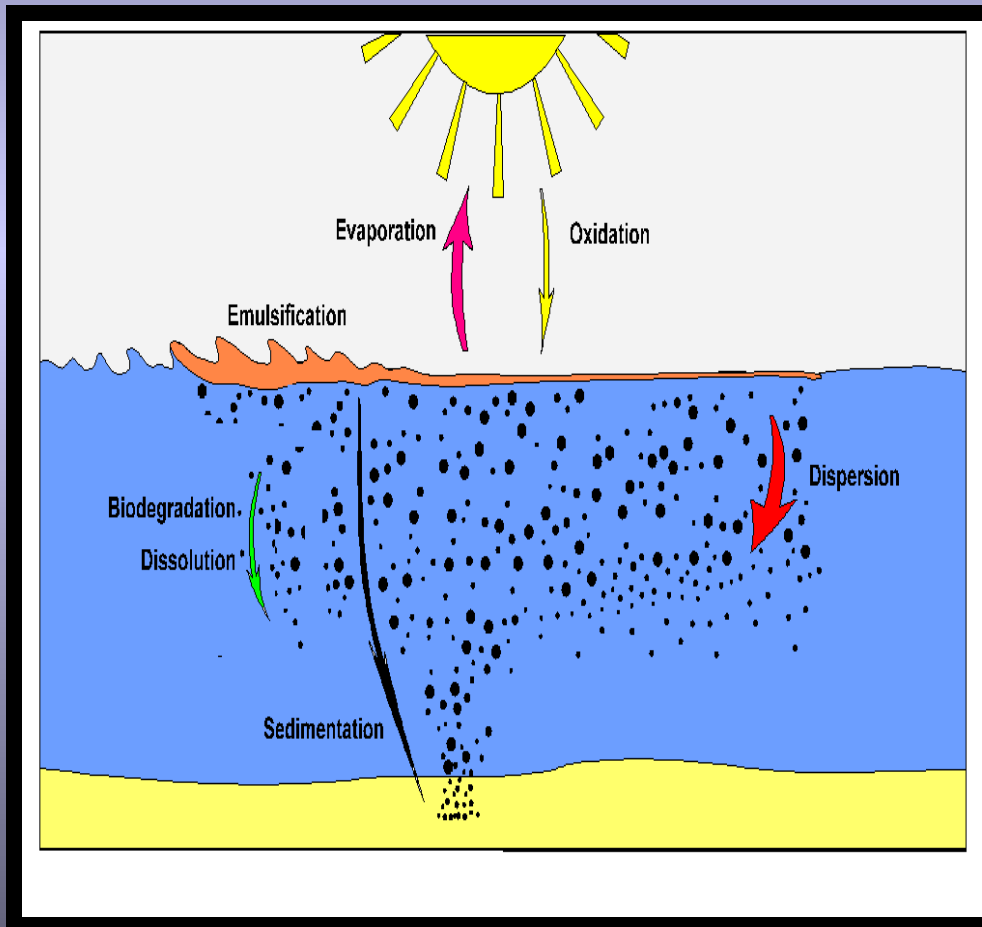
**Factori care favorizeaza fotooxidarea**

- **Tipul petrolului (petrolul usor oxidabil, este in general cel solubil si dispersabil in masa apei)**
- **Radiatiile UV**

# BIODEGRADAREA

(oxidarea petrolului sub actiunea bacteriilor si ciupercilor)

**Efecte : degradarea naturala,  
reducerea volumului de poluant**



## Factori care influenteaza fenomenul

- Temperatura
- Procentul de oxigen din apa
- Procentul de nutrienti din apa( bacterii, ciuperci )
- Tipul petrolului

# BIODEGRADAREA

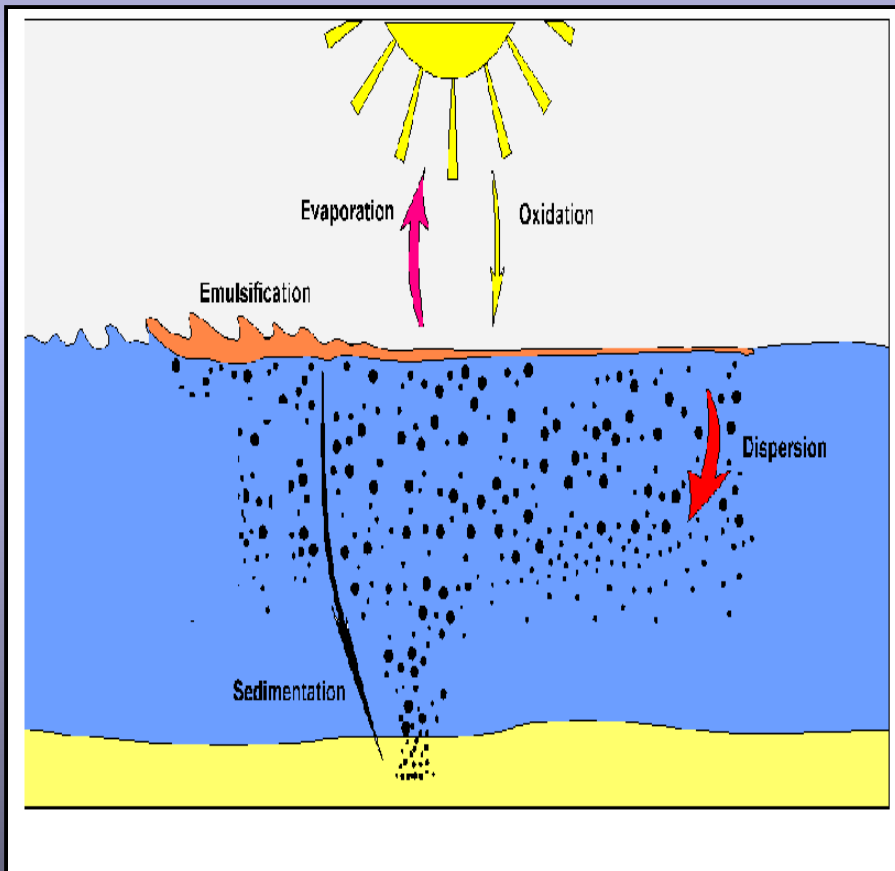
Coeficientul de degradare este dependent de temperatură,  
de disponibilitatea O<sub>2</sub>, a nutrienților și  
deasemeni de tipul hidrocarburii



# SEDIMENTARE

(aderarea particulelor de petrol la cele solide din masa apei)

**Efecte : reducerea volumului  
de petrol de la suprafata apei.**



**Factorii care amplifica  
sedimentarea**

- Turbulenta din masa apei (0-1000g sediment/m<sup>3</sup>)
- Starea de agitare a marii.



**Poluant amestecat cu sediment depus pe fundul  
apei in apropierea unui tarm**



# **PROGRAM DE MODELARE ADIOS FURNIZEAZA DATE DESPRE**

- EVOLUTIA IN TIMP PE VERTICALA A PELICULEI DE POLUANT: dispersie, evaporare, emulsionare**
- MODIFICAREA IN TIMP A CARACTERISTICILOR PELICULEI DE POLUANT: densitate viscozitate benzene**

**DATE DE INTRARE**

**TIP SI CANTITATE DE POLUANT DEVERSAT**

**CONDITII HIDRO METEO**

**MOMENTUL DEVERSARII**

# DATE REZULTATE

- **DISPERSAT (%)**
- **EVAPORAT (%)**
- **EMULSIONAT (%)**
- **RAMAS LA SUPRAFATA(%)**
- **EVOLUTIA BENZENELOR ( ppm )**
- **DENSITATE (kg/mc)**
- **VASCOZITATE (cSt)**

# **SUNT PREZENTATE DOUA CAZURI**

## **CAZ 1**

**CANTITATE DEVERSATA**

**5000mc**

**VANT- 1m/s ,VAL-0,3m**

**TEMPERATURA +7° C**

# CAZ 2

**CANTITATE DEVERSATA**

**5000mc**

**VANT- 15 m/s ,VAL-3,5 m**

**TEMPERATURA +20° C**

# CANTITATE DISPERSATA

The screenshot displays the ADIOS2 - [Disperse] software interface, which is used for simulating oil spill dispersion. The interface is divided into several sections: a left sidebar with input parameters, a central plot area, and a right sidebar with simulation details.

**Left Sidebar (Scenario 1):**

- API = 38.7
- Pour Point = -10 deg C
- Flash Point = unknown
- Density = 0.838 g/cc at 7 deg C
- Viscosity = 9.0 cSt at 7 deg C
- Adhesion = unknown
- Aromatics = unknown
- Emulsification**  
Mousse begins to form when 23% of the oil has evaporated
- Wind and Wave Conditions**  
Wind Speed = 1 m/s from 297 degrees  
Wave Height = 0.3 meters
- Water Properties**  
Temperature = 7 deg C  
Salinity = 32 ppt  
Sediment Load = 5 g/m3 (ocean)  
Current = 0.3 m/s towards 256 degrees
- Release Information**
  - Instantaneous Release**  
Time of Release = March 13, 2100  
Amount Spilled = 5000 metric tons

**Central Plot (Scenario 1):**

Oil Dispersed (percent)

The graph shows the percentage of oil dispersed over time. The x-axis represents time from 0000 Mar 14 to 0000 Mar 16. The y-axis represents the percentage of oil dispersed, ranging from 0 to 2.5. The curve shows a rapid increase in dispersion, reaching approximately 2.4% by the end of the simulation period.

**Right Sidebar (Scenario 2):**

- Oil Type**  
LEBADA ROMANIA (custom oil)  
Location = ROMANIA  
Synonyms = none listed  
Product Type = crude  
API = 38.7  
Pour Point = -10 deg C  
Flash Point = unknown  
Density = 0.833 g/cc at 20 deg C  
Viscosity = 4.1 cSt at 20 deg C  
Adhesion = unknown  
Aromatics = unknown
- Emulsification**  
Mousse begins to form when 19% of the oil has evaporated
- Wind and Wave Conditions**  
Wind Speed = 15 m/s from 53 degrees  
Wave Height = 3.0 meters
- Water Properties**  
Temperature = 20 deg C  
Salinity = 32 ppt  
Sediment Load = 5 g/m3 (ocean)  
Current = 0.6 m/s towards 45 degrees
- Release Information**
  - Instantaneous Release**  
Time of Release = July 20, 1300 hours  
Amount Spilled = 5000 tons

**Central Plot (Scenario 2):**

Oil Dispersed (percent)

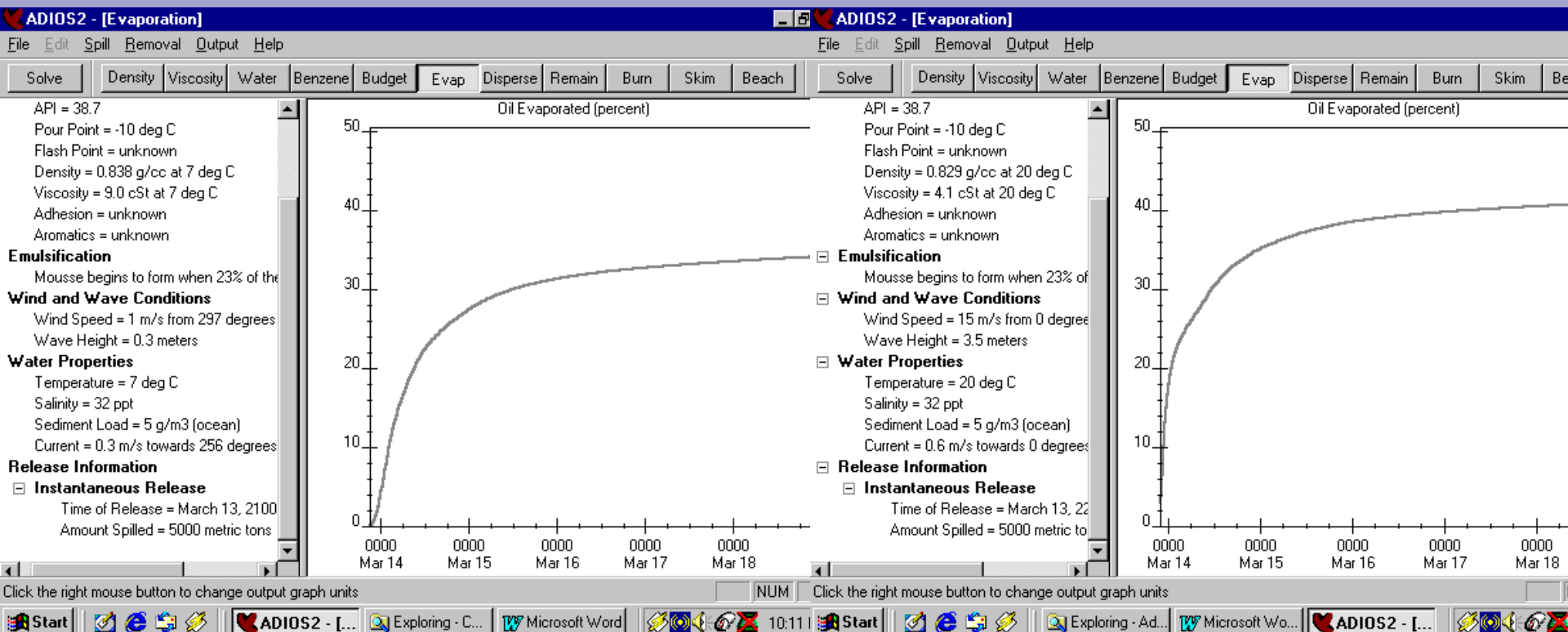
The graph shows the percentage of oil dispersed over time. The x-axis represents time from 0000 Jul 21 to 0000 Jul 25. The y-axis represents the percentage of oil dispersed, ranging from 0 to 12. The curve shows a steady, linear increase in dispersion, reaching approximately 8.5% by the end of the simulation period.

**Bottom Bar:**

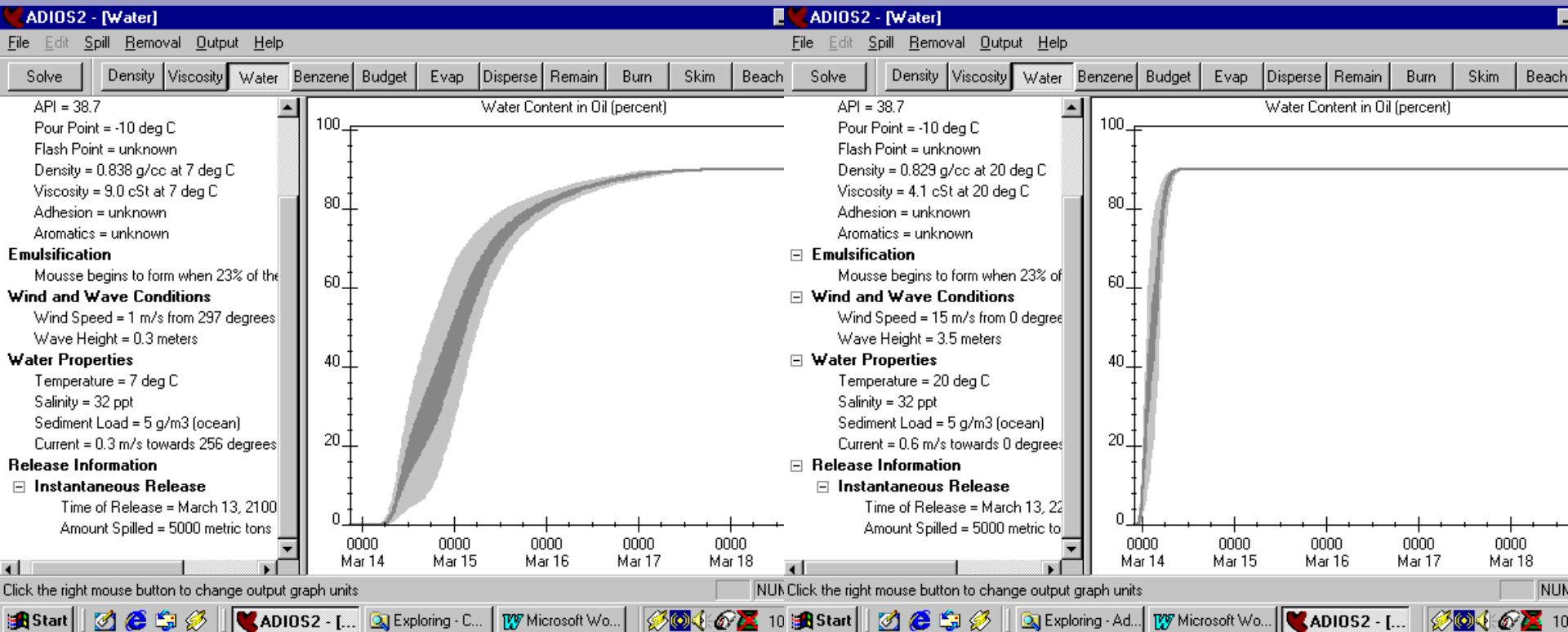
Click the right mouse button to change output graph units

Windows taskbar shows the Start button, several open applications (including ADIOS2 - [...], Exploring - C..., and Microsoft Wo...), and the system tray with the time 1:08 PM.

# CANTITATE EVAPORATA

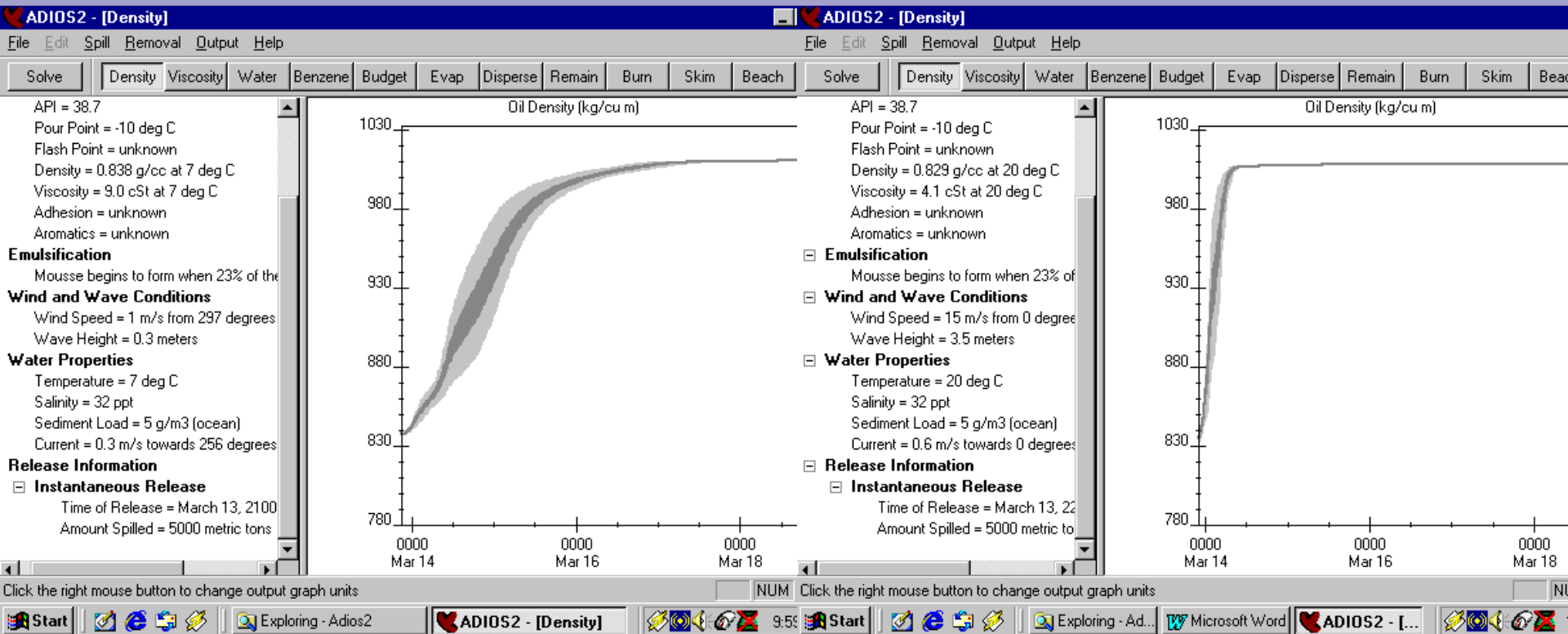


# EMULSIONARE

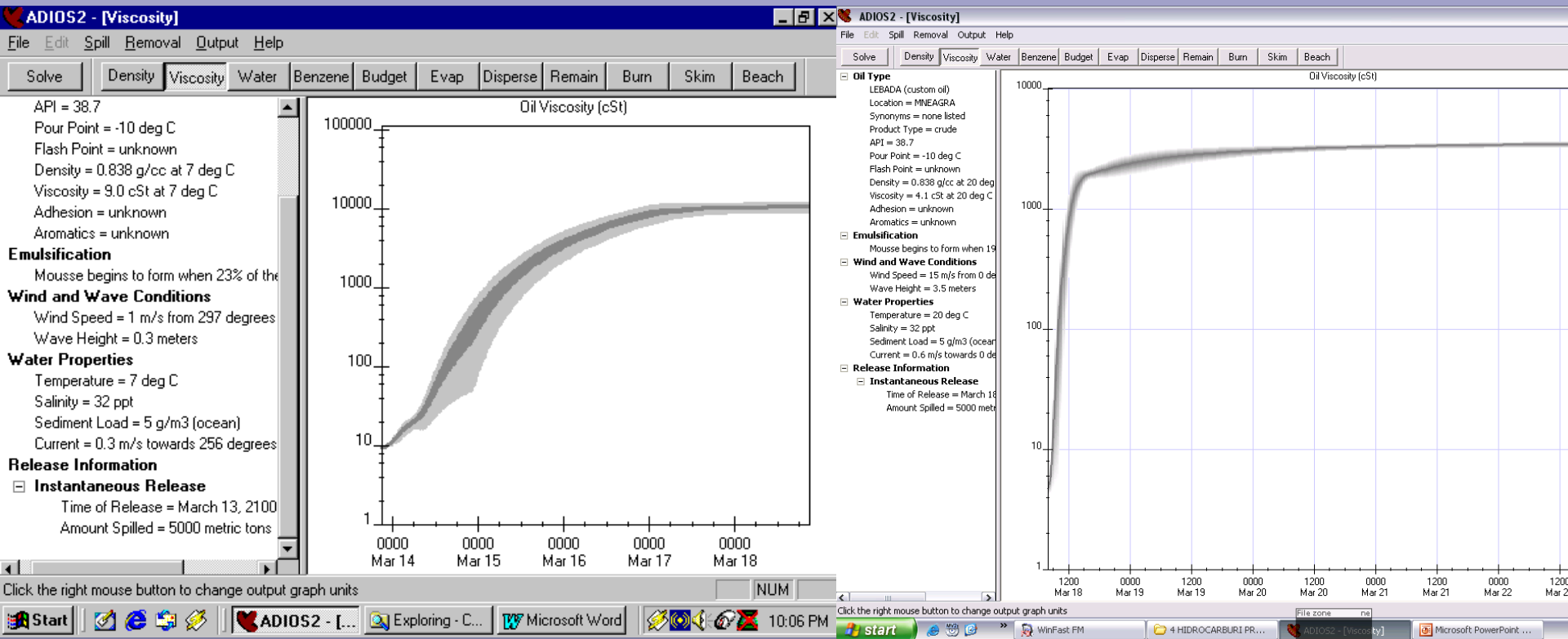




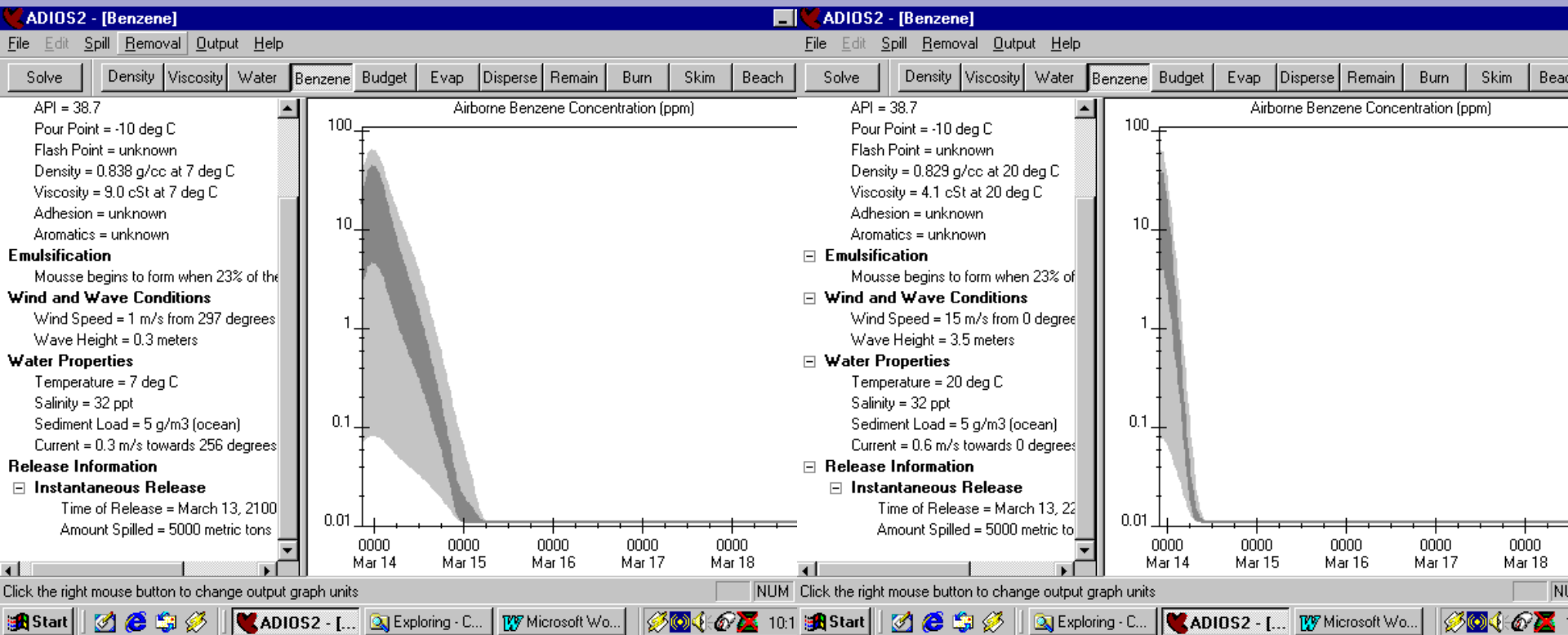
# EVALUAREA DENSITATII



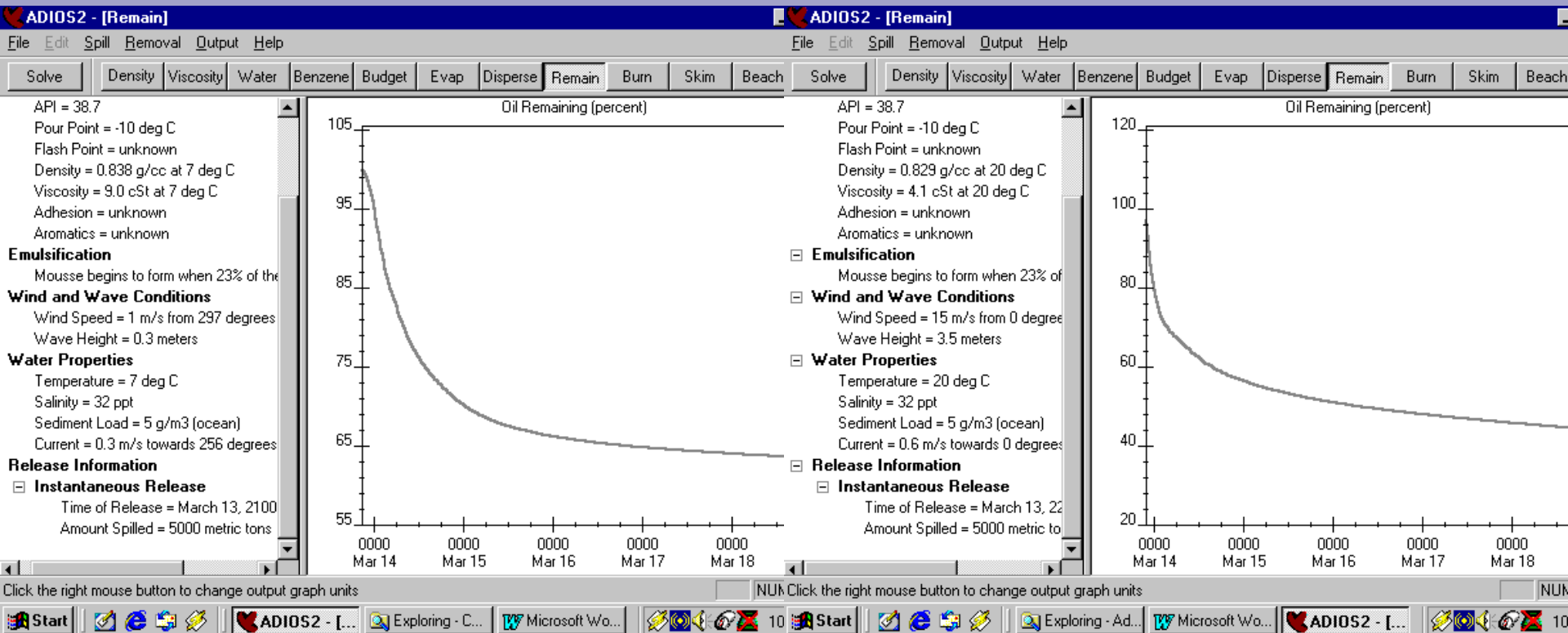
# EVALUAREA VASCOZITATII



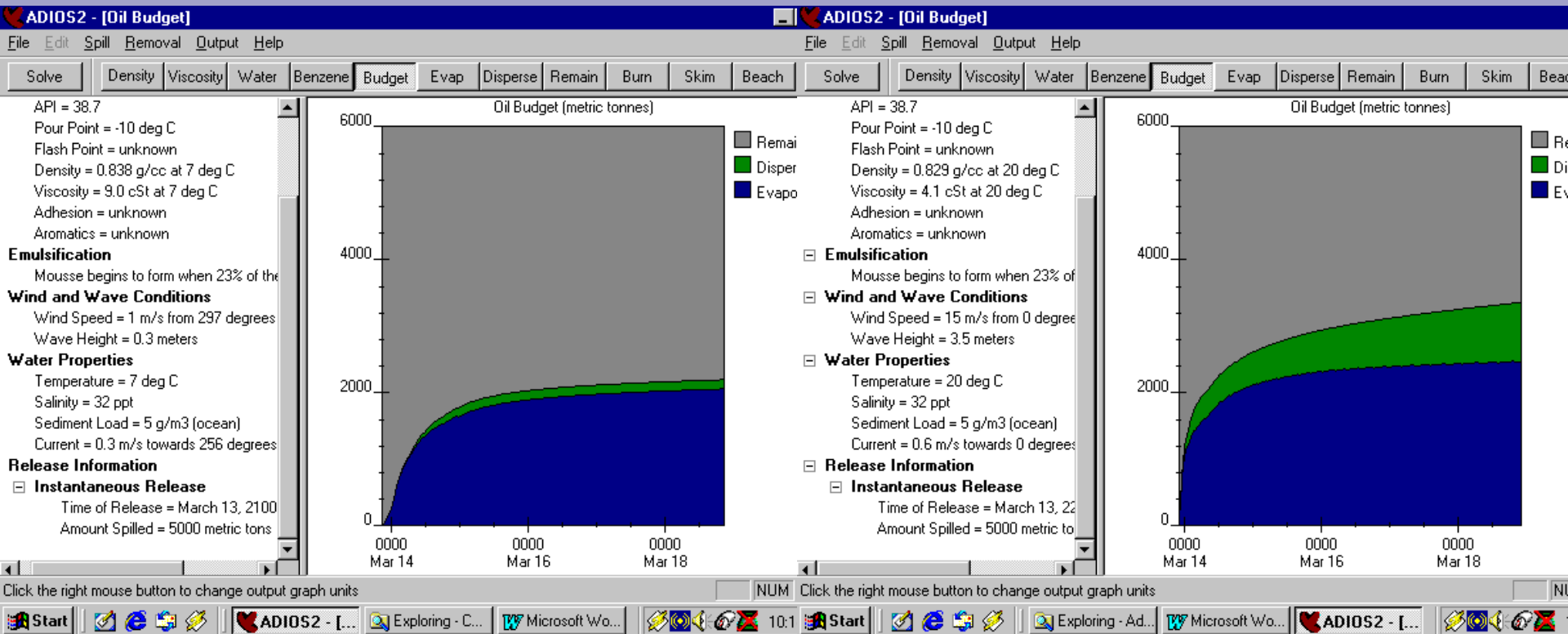
# BENZENE



# RAMAS LA SUPRAFATA



# BUGETUL



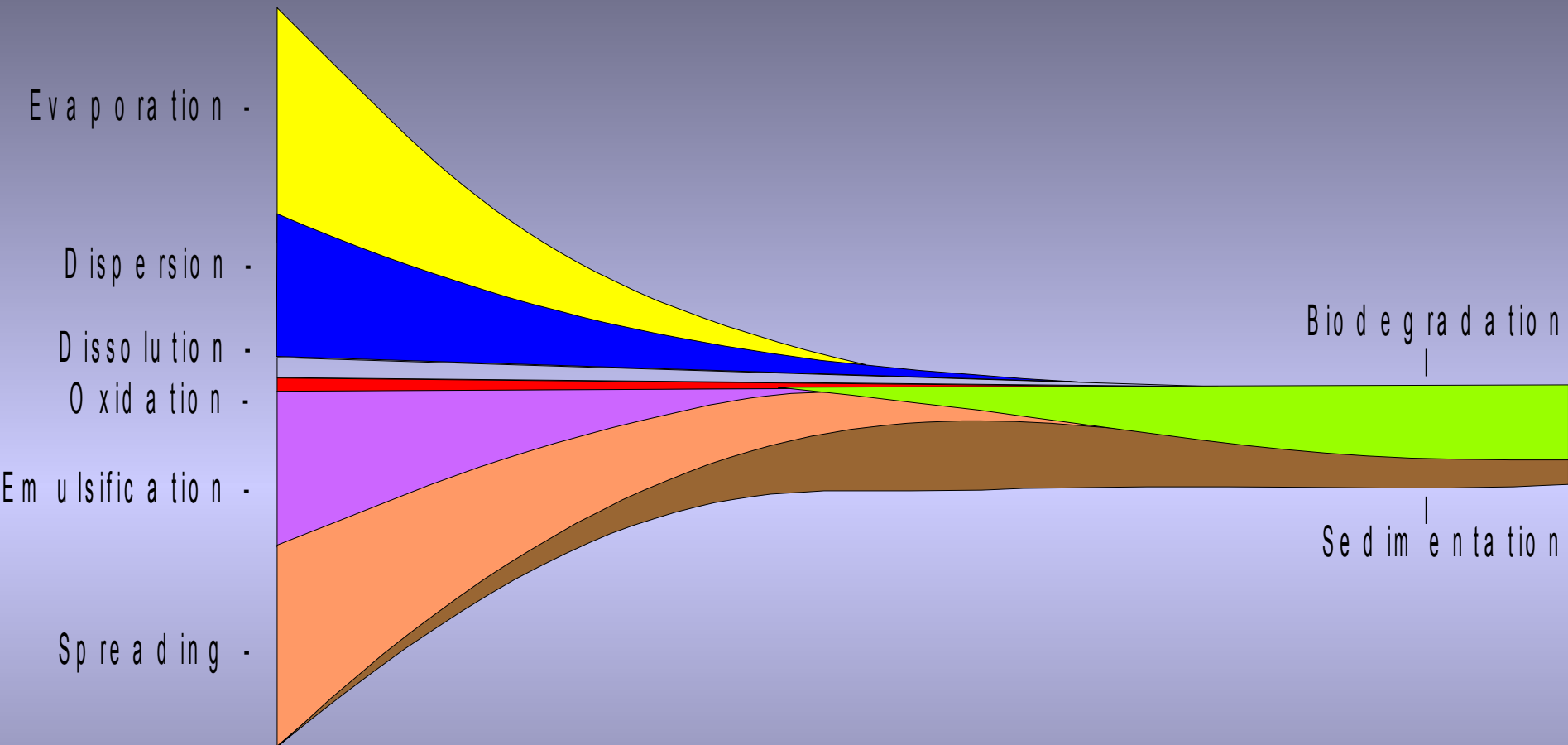
Hour

Day

Week

Month

Year



**Evolutia / transformarile suferite in timp de o pelicula de titei deversata in mediul acvatic**

# **EVOLUTIA POLUANTULUI PE ORIZONTALA IN MEDIUL ACVATIC**

**Consta in:**

**RASPANDIREA GRAVITATIONALA  
DEPLASAREA PE SUPRAFATA APEI**

**FACTORI CARE INFLUENTEAZA  
EVOLUTIA PE ORIZONTALA**

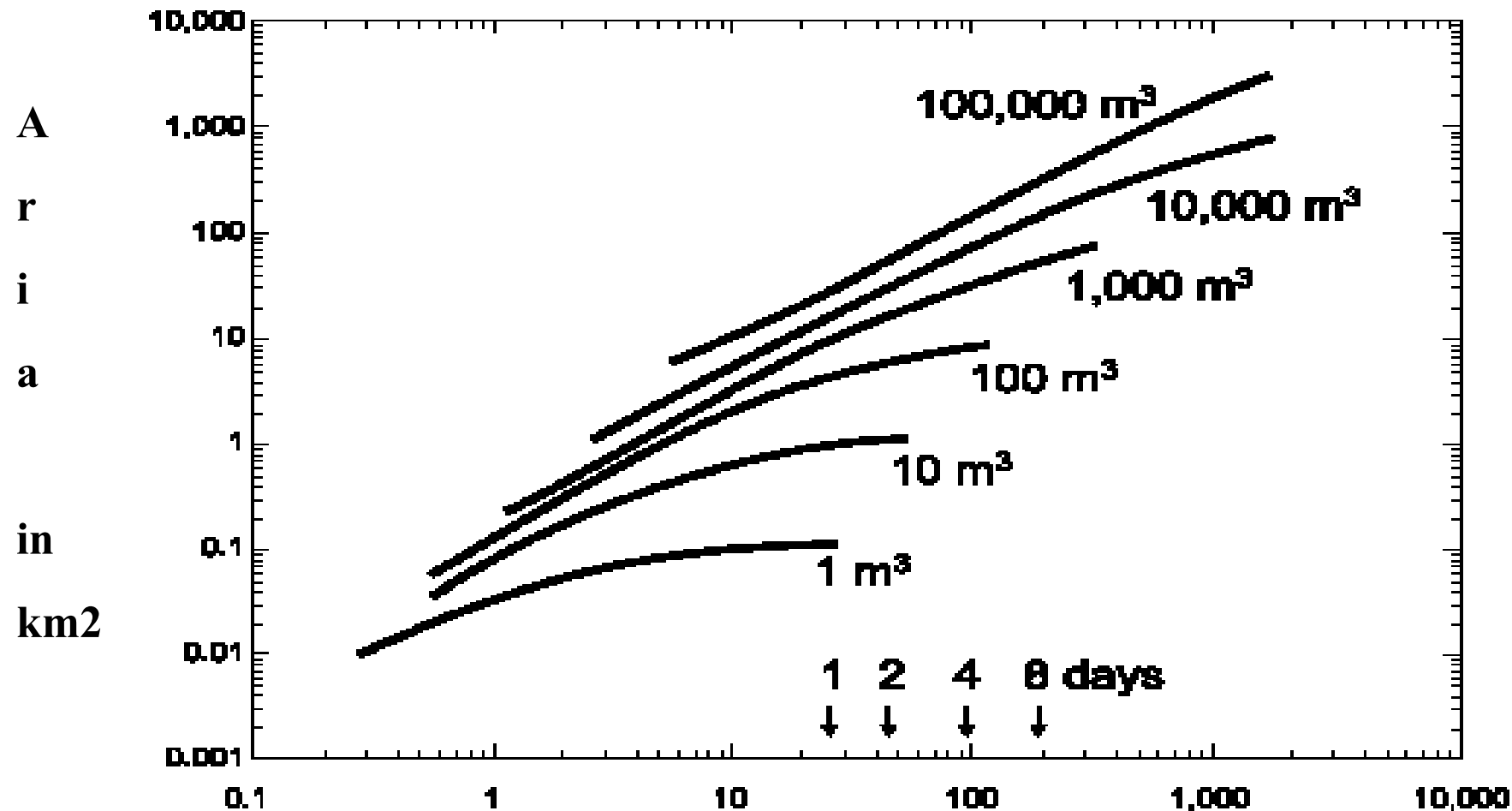
**FORTE GRAVITATIONALE  
TENSIUNI SUPERFICIALE  
CONDITII HIDRO-METEO  
VASCOZITATEA**

**Se considera un mediu linistit fara vant si fara curenti de suprafata**

|                                | <b>Timpul de la deversare</b> | <b>5t</b>    | <b>50t</b>   | <b>500t</b>  |
|--------------------------------|-------------------------------|--------------|--------------|--------------|
| <b>Suprafata infestată kmp</b> | <b>1h</b>                     | <b>0,006</b> | <b>0,016</b> | <b>0,076</b> |
|                                | <b>2h</b>                     | <b>0,016</b> | <b>0,023</b> | <b>0,107</b> |
|                                | <b>5h</b>                     | <b>0,065</b> | <b>0,065</b> | <b>0,169</b> |
|                                | <b>10h</b>                    | <b>0,183</b> | <b>0,183</b> | <b>0,24</b>  |
|                                | <b>24h</b>                    |              | <b>0,518</b> | <b>0,68</b>  |
|                                | <b>48h</b>                    |              |              | <b>1,93</b>  |
|                                | <b>72</b>                     |              |              | <b>3,54</b>  |
|                                | <b>96</b>                     |              |              | <b>5,45</b>  |
|                                | <b>500h</b>                   |              |              | <b>64,8</b>  |
| <b>Grosime peliculă mm</b>     | <b>1h</b>                     | <b>0,980</b> | <b>3,6</b>   | <b>7,5</b>   |
|                                | <b>2h</b>                     | <b>0,348</b> | <b>2,5</b>   | <b>5,3</b>   |
|                                | <b>5h</b>                     | <b>0,088</b> | <b>0,9</b>   | <b>3,4</b>   |
|                                | <b>10h</b>                    | <b>0,031</b> | <b>0,3</b>   | <b>2,4</b>   |
|                                | <b>24h</b>                    |              | <b>0,1</b>   | <b>0,84</b>  |
|                                |                               |              |              |              |
|                                | <b>48h</b>                    |              |              | <b>0,30</b>  |
|                                | <b>72</b>                     |              |              | <b>0,16</b>  |
|                                | <b>96</b>                     |              |              | <b>0,105</b> |
|                                | <b>500h</b>                   |              | 48           | <b>0,009</b> |



# Aria ocupata, in timp, in functie de cantitatea de poluant deversata



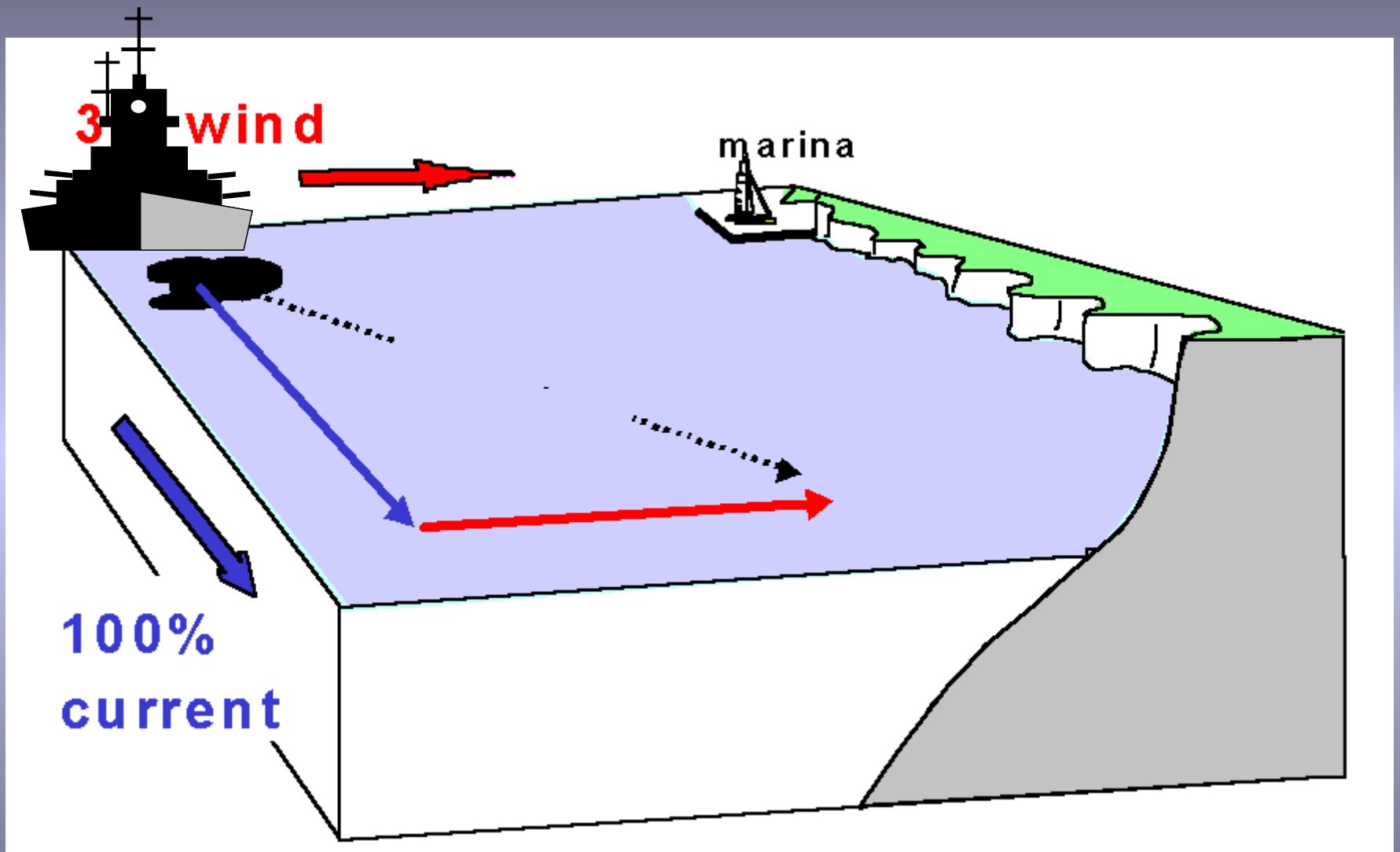
Timpul scurs din momentul initial al deversarii in ore

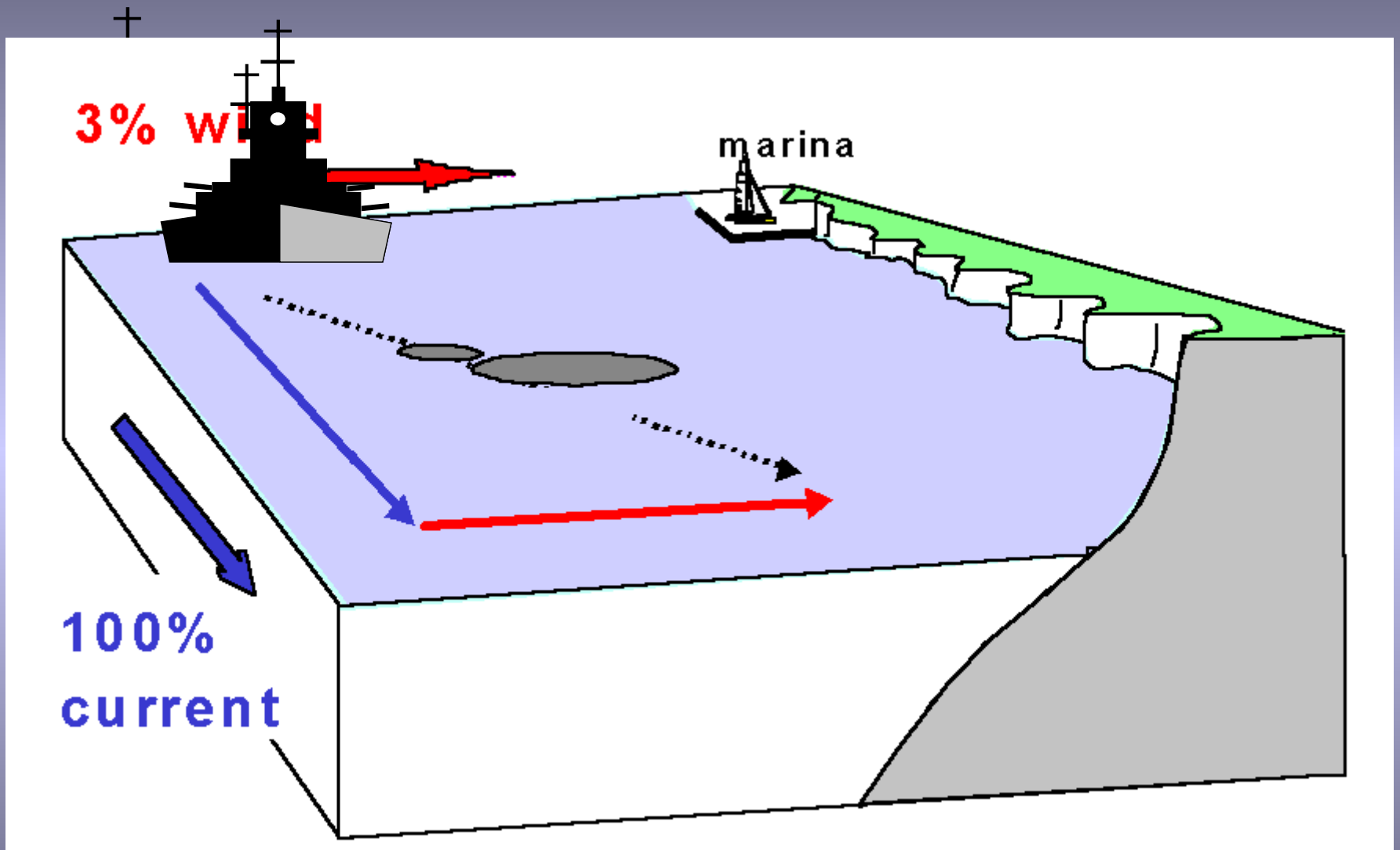
# DEPLASAREA PE SUPRAFAȚA APEI

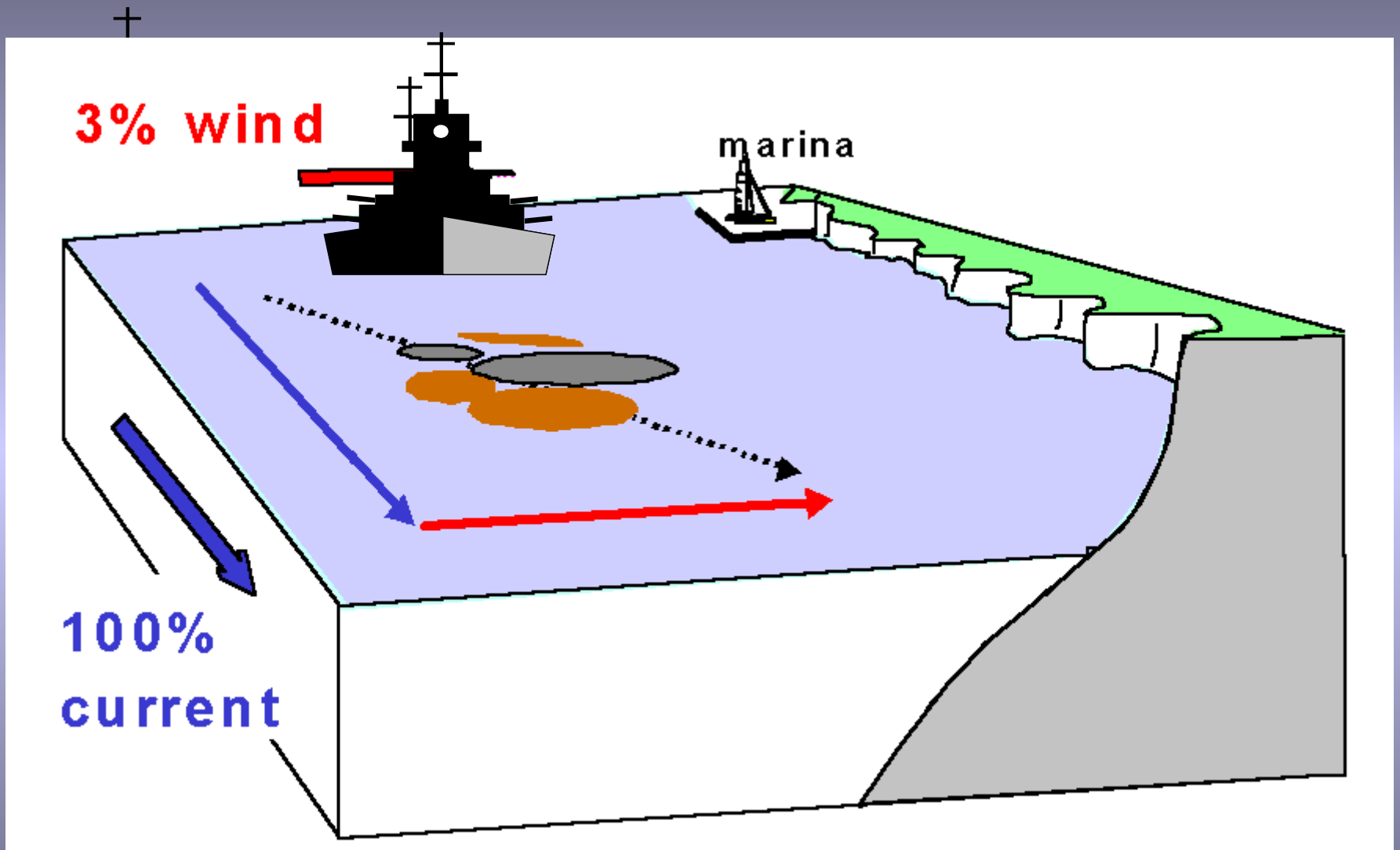
**VECTORUL DEPLASARII PELICULEI DE  
POLUANT REZULTA DIN INSUMAREA  
CELOR DOI VECTORI:**

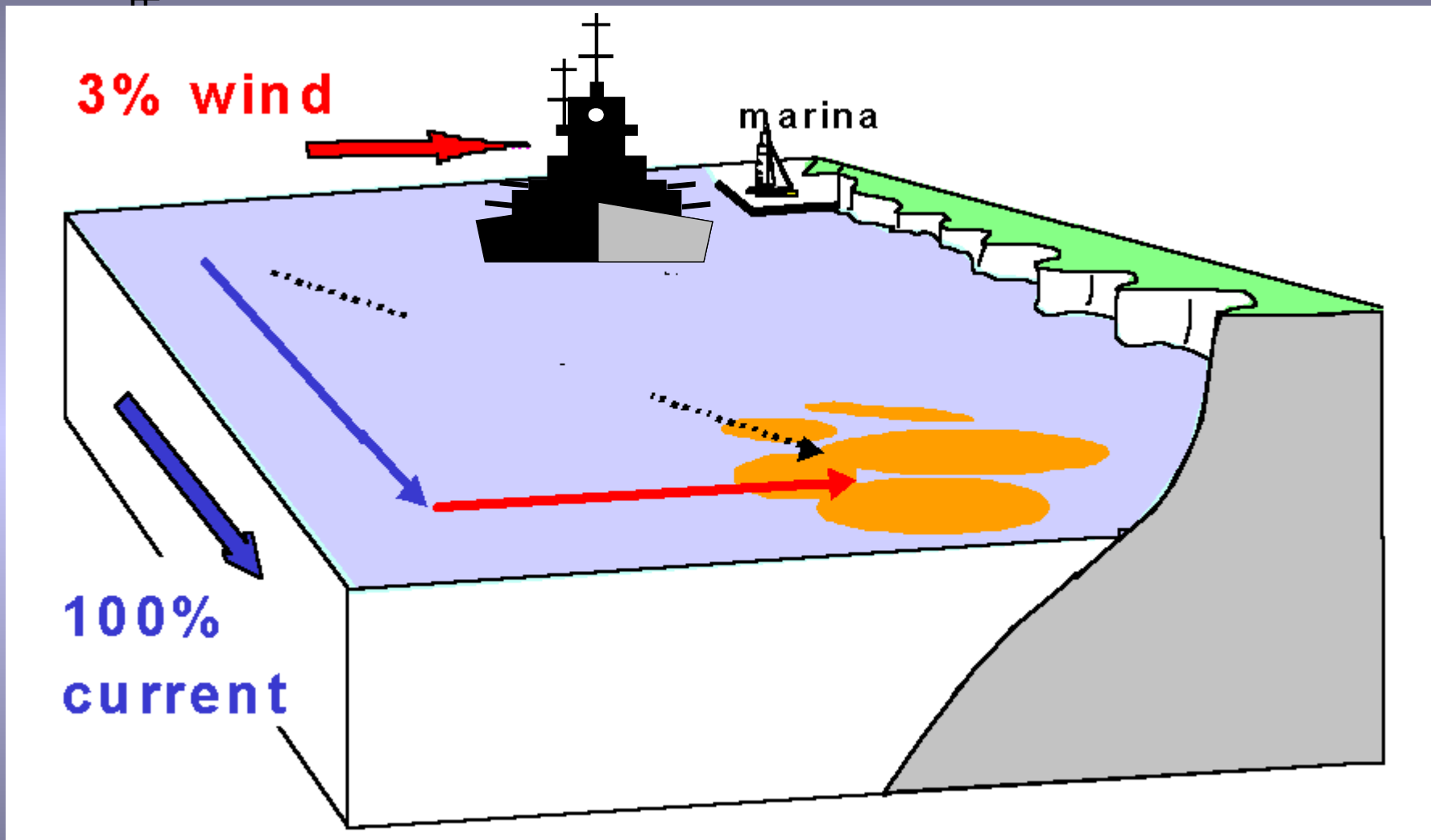
**VECTORUL - CURENTULUI DE SUPRAFATA si  
3% din VECTORUL VINT**

$$\mathbf{V_p} = \mathbf{V_c} + 3\% \mathbf{V_v}$$

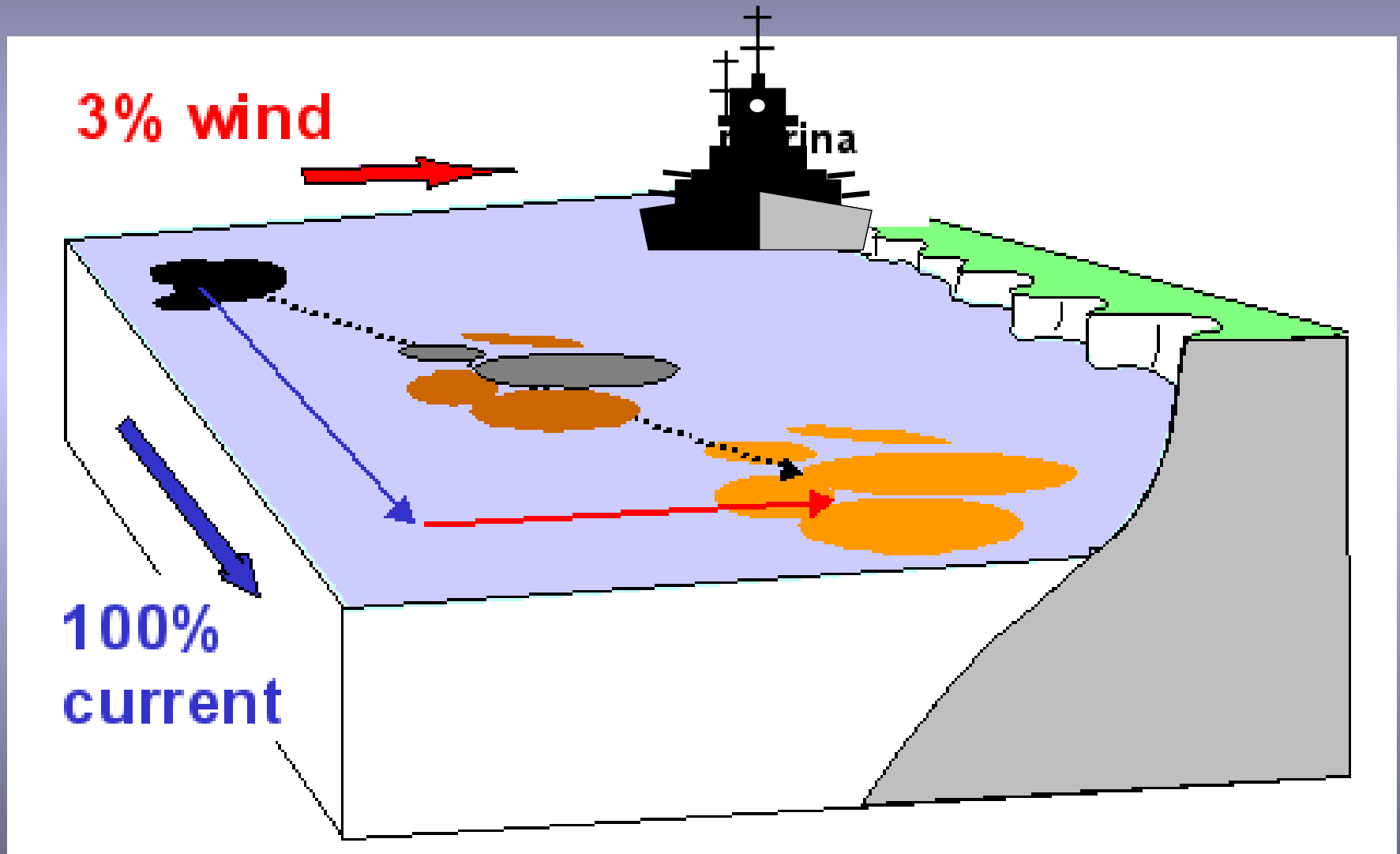








# DEPLASAREA PE APA A POLUANTULUI



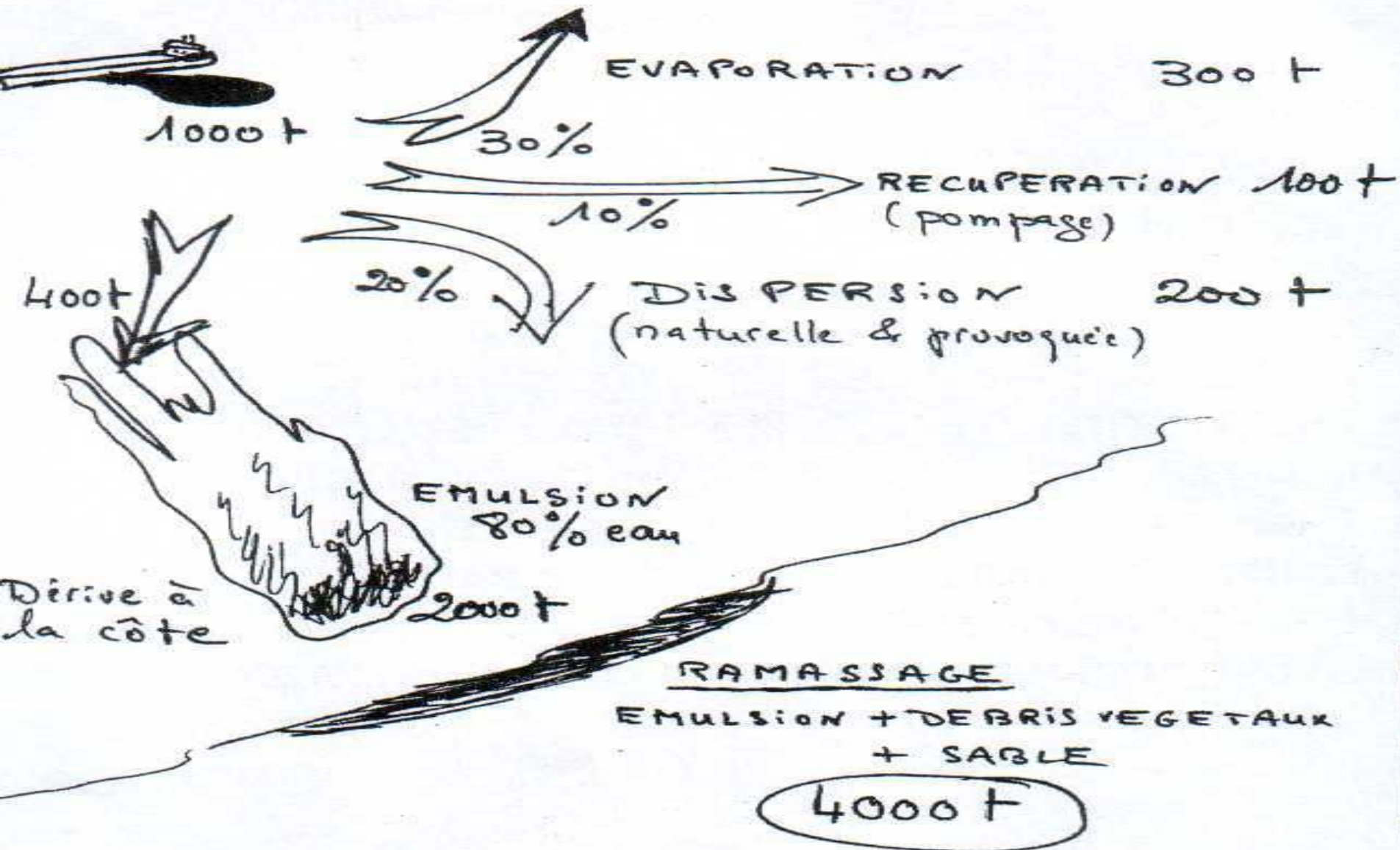


# **Evolutia volumului unei pete de poluant deversata pe apa**

**Deversarea unei cantitati de 1000t poluant in  
mediul acvatic poate produce pe tarm 4000t  
material poluat**

**se considera urmatoarele:**

# Evaluarea volumului de poluant in deplasarea spre un tarm nisipos



**SOFT PENTRU MODELAREA  
DEPLASARII POLUANTULUI IN  
MEDIUL MARIN  
(GNOME)**

# **DATE DE INTRARE**

- **TIP SI CANTITATE DE POLUANT DEVERSAT**
- **CONDITII HIDRO-METEO**
- **LOCATIA**

# DATE OBTINUTE

- **VECTORUL DEPLASARII PELICULEI**
- **SUPRAFATA PELICULEI**
- **FRONTUL DEPLASARII**
- **LOCALIZAREA PELICULEI LA UN MOMENT DAT**
- **ESTIMAREA TRASEULUI IN TIMP SI SPATIU**

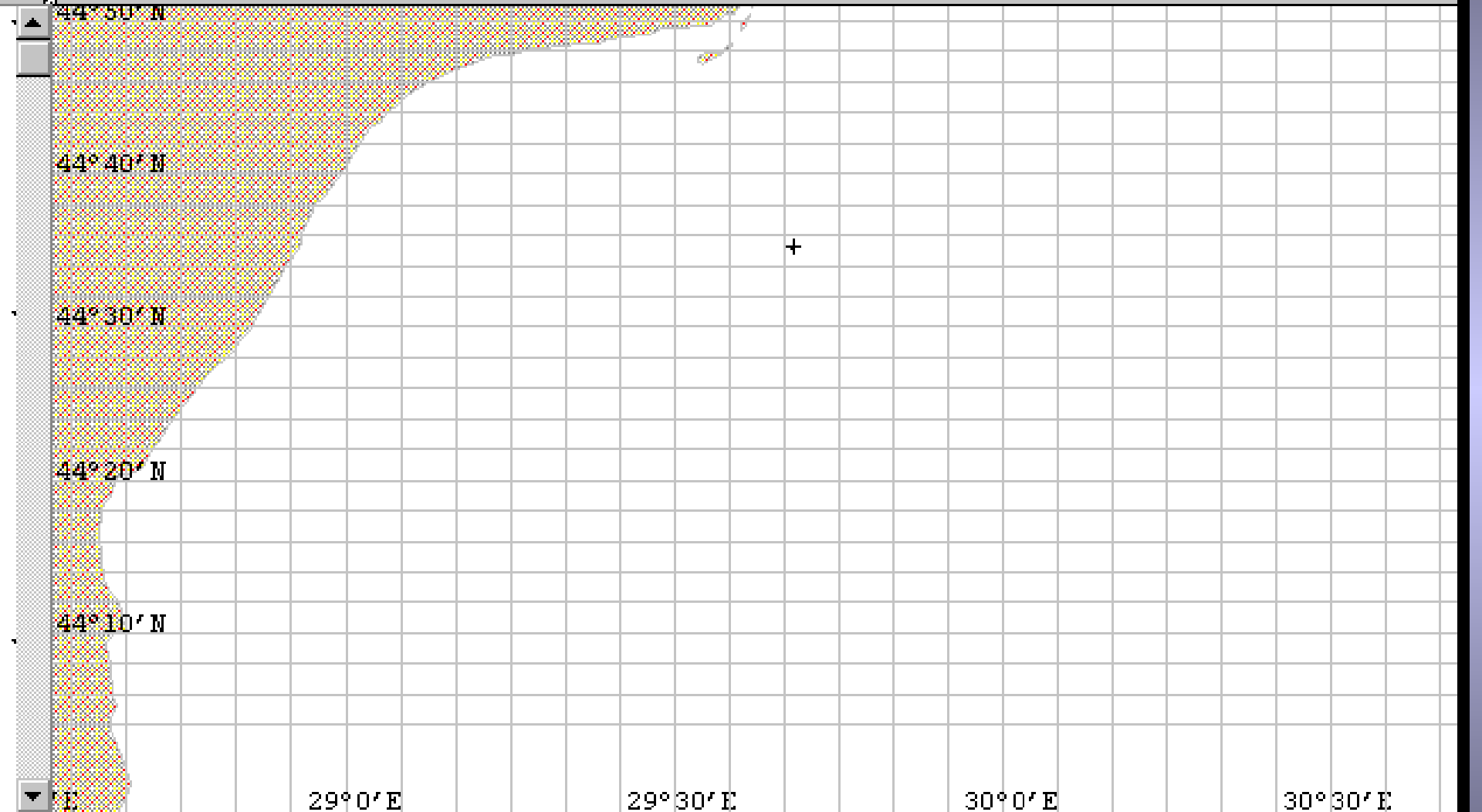
**LOCATIE:44<sup>0</sup>35'N/29<sup>0</sup>41'E**

**DATA 21.09.2001 ORA 09 33 DEVERSAT**

**Cantitate: 5000mc**

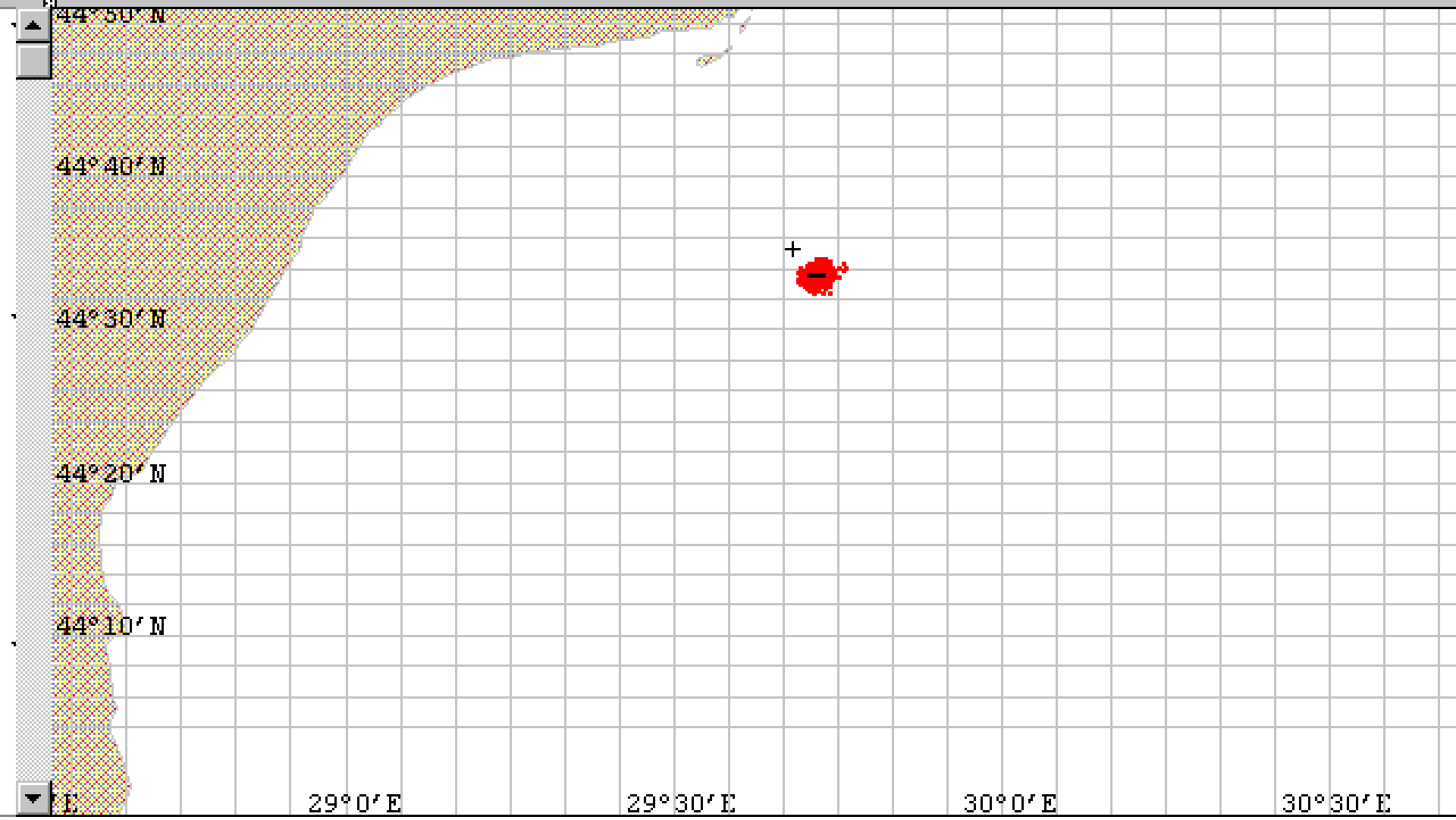
**VINT = 10 m/s DIN W**

09/21/2001 09:33



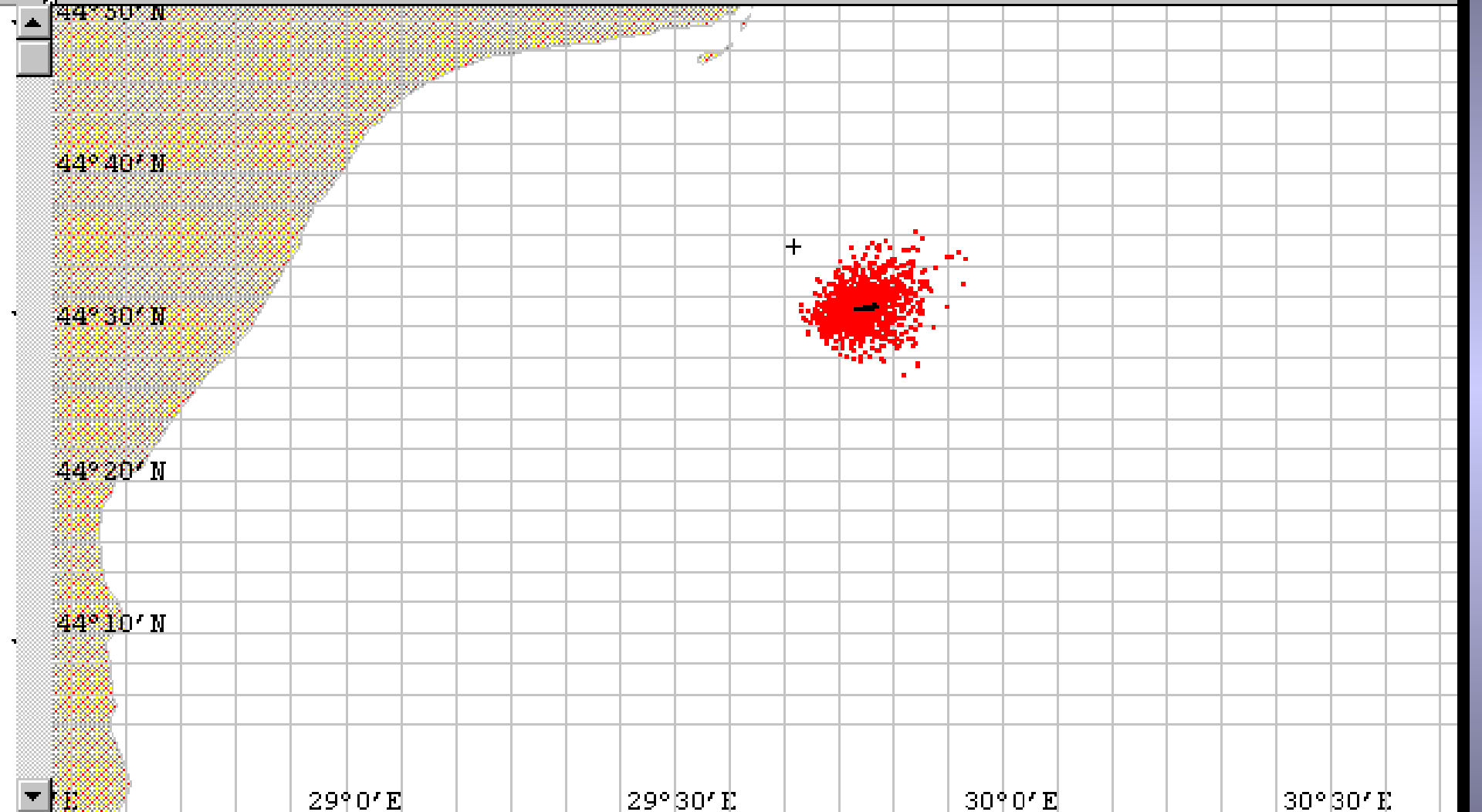
44°23'45"N 29°28'18"E [grid: fane3.CUR, unscaled: 0.1674 m/s, scaled 0.1674 m/s]

Navigation toolbar containing icons for:  
 - Panning (hand icon)  
 - Zooming (plus and minus magnifying glass icons)  
 - Oil spill simulation (ship and oil slick icons)  
 - A date/time display showing 09/21/2001 13:33 with navigation arrows.





09/21/2001 20:33

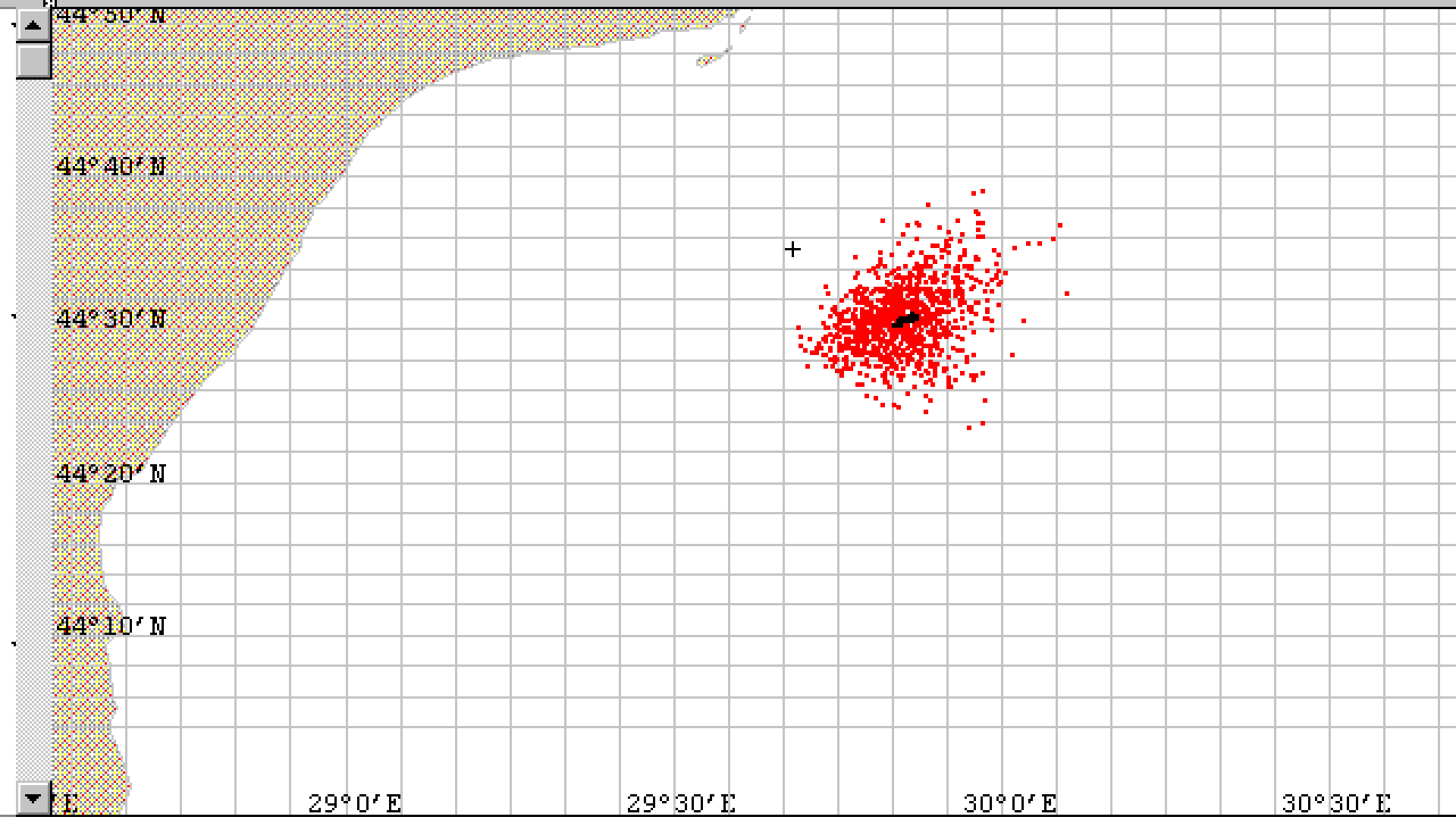


43°58'37"N 29°51'12"E [grid: fane3.CUR, unscaled: 0.0236 m/s, scaled 0.0236 m/s]

Navigation toolbar containing icons for:
 

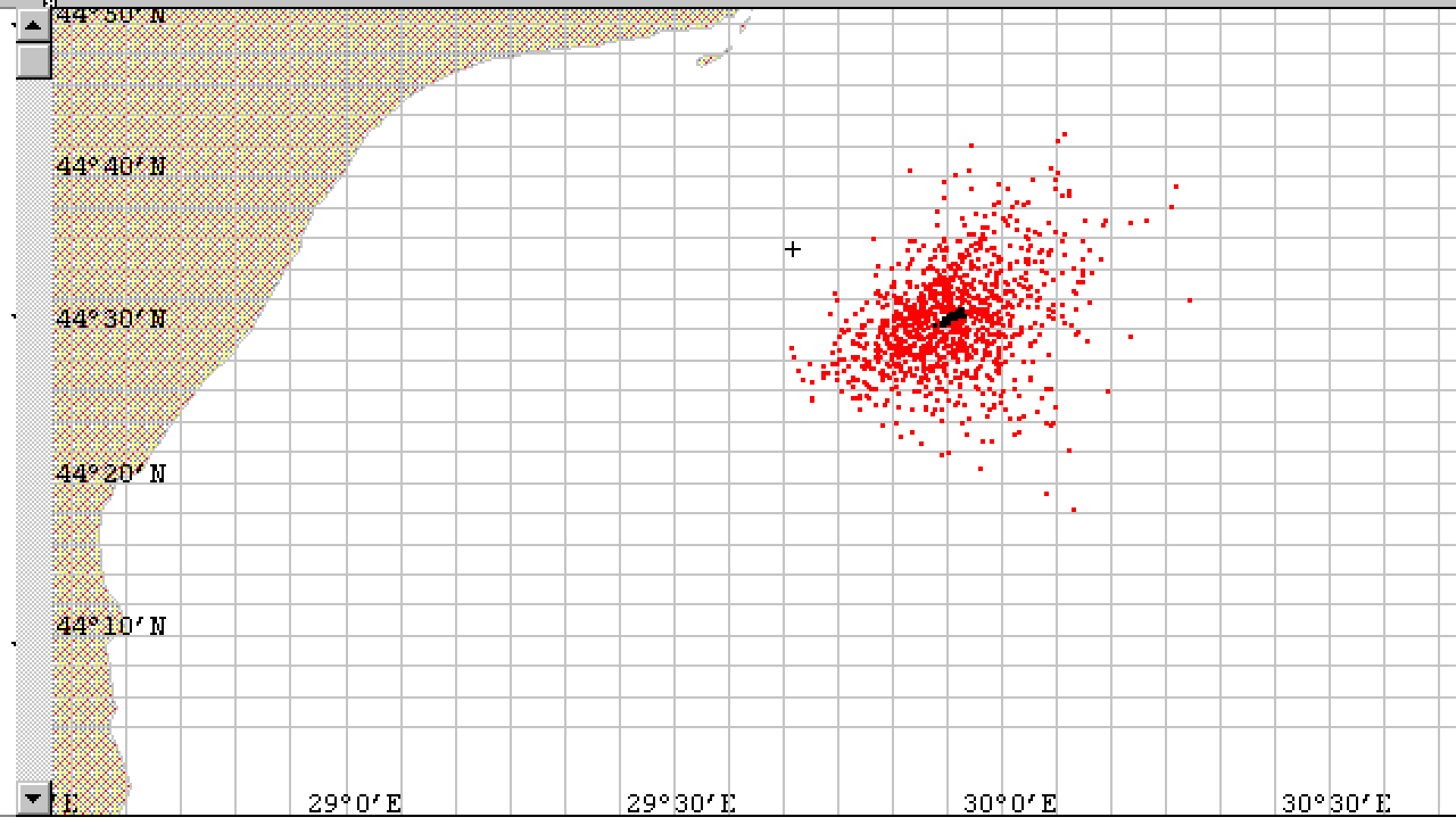
- Map navigation (arrow, hand)
- Zoom in (+)
- Zoom out (-)
- Map pan (hand icon)
- Oil spill source (ship icon)
- Oil spill dispersal (cloud icon)
- Map layer (book icon)

 A date and time display shows: 09/22/2001 01:33. Playback controls (stop, play, fast forward) are also present.



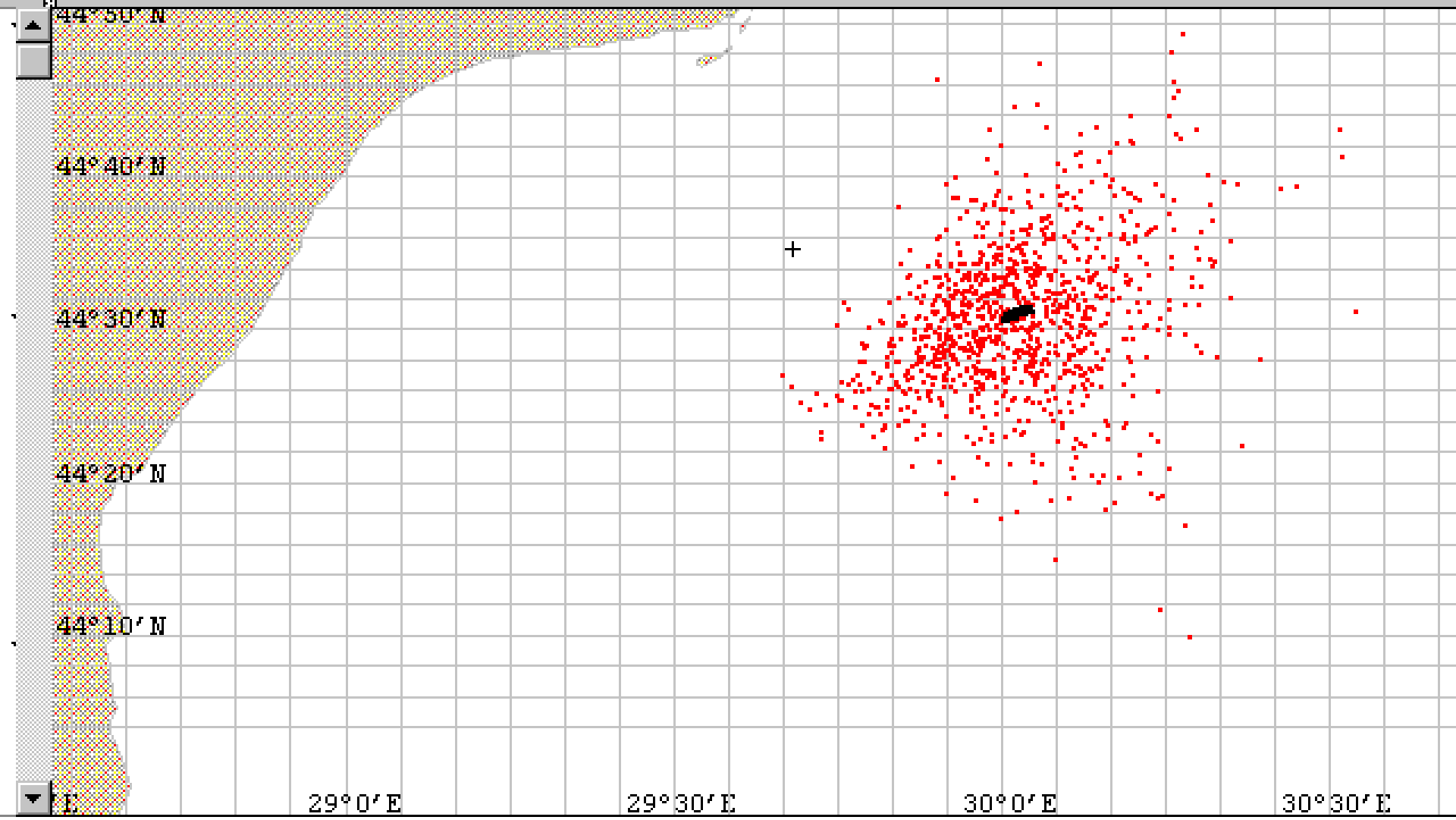
Navigation toolbar containing icons for:
 

- Map navigation (arrow)
- Zoom in (+)
- Zoom out (-)
- Hand cursor (highlighted in cyan)
- Oil spill source (ship)
- Oil spill source (dispenser)
- Oil spill source (box)
- Timeline controls (play, stop, back, forward)
- Timeline display: 09/22/2001 07:33



Navigation toolbar containing icons for:
 

- Map navigation (arrow, hand)
- Zoom in (+) and zoom out (-)
- Map layers (ship, oil spill, terrain)
- Timeline controls (play, stop, back, forward) and a date/time display: 09/22/2001 15:33

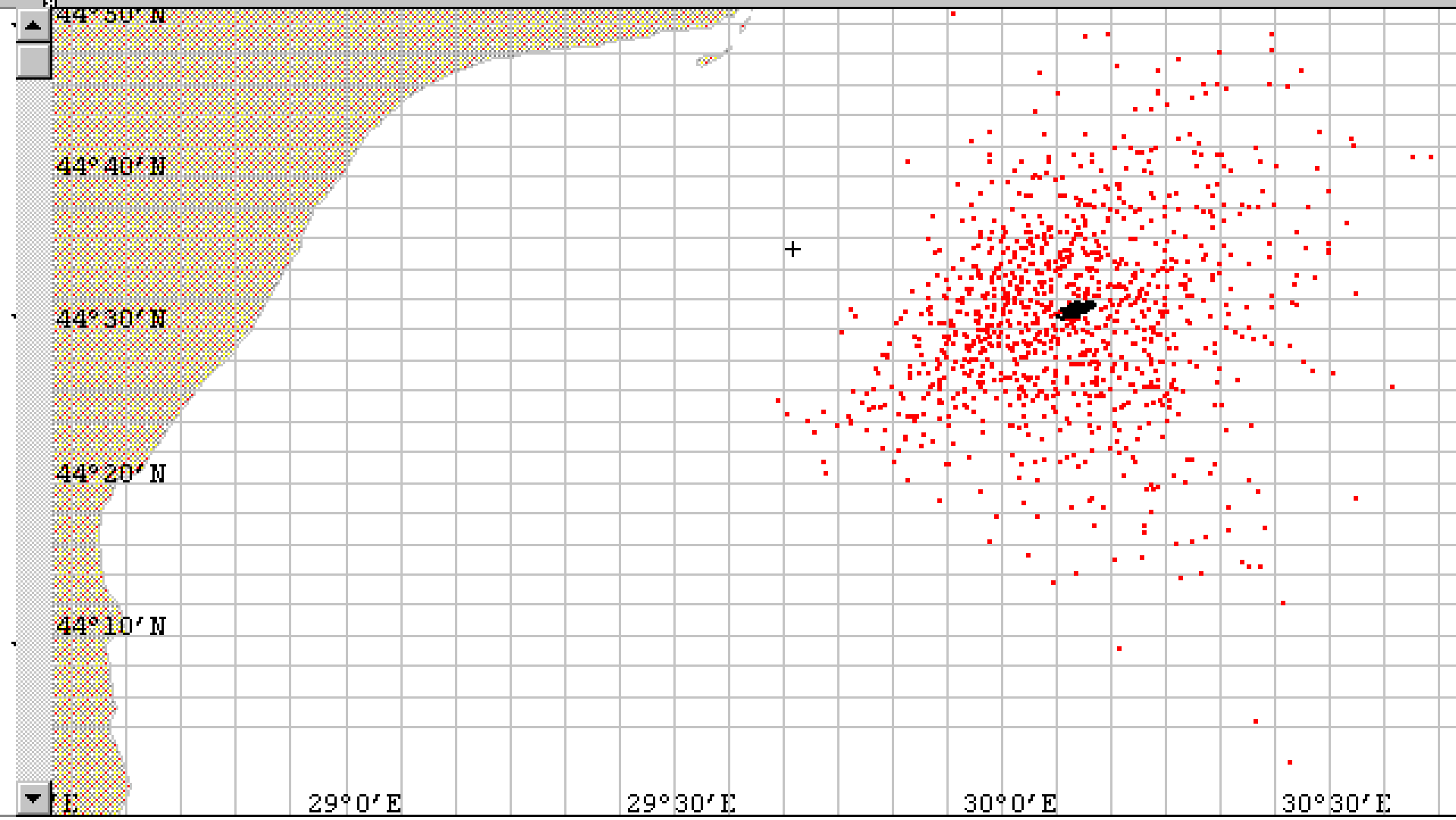


44°44'16"N 29°28'31"E [grid: fane3.CUR, unscaled: 0.3145 m/s, scaled 0.3145 m/s]

Navigation toolbar containing icons for:
 

- Mouse pointer
- Zoom in (+)
- Zoom out (-)
- Hand (pan)
- Oil spill source (ship)
- Oil spill source (spill)
- Map layer (rectangle)

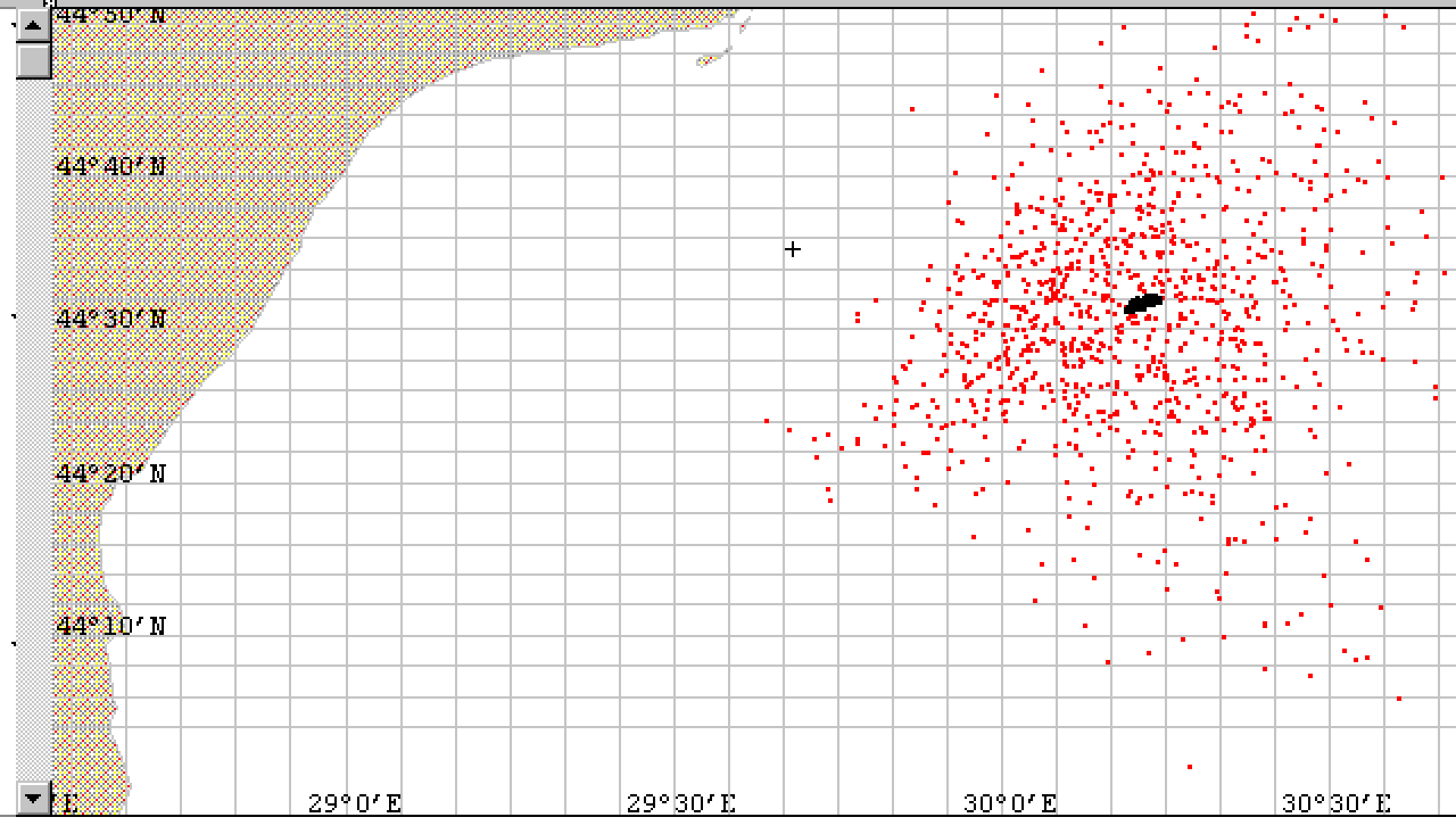
 A date and time display shows: 09/22/2001 22:33. Playback controls (back, forward, stop) are also present.



File Edit Item Model Help

Navigation toolbar containing icons for:
 

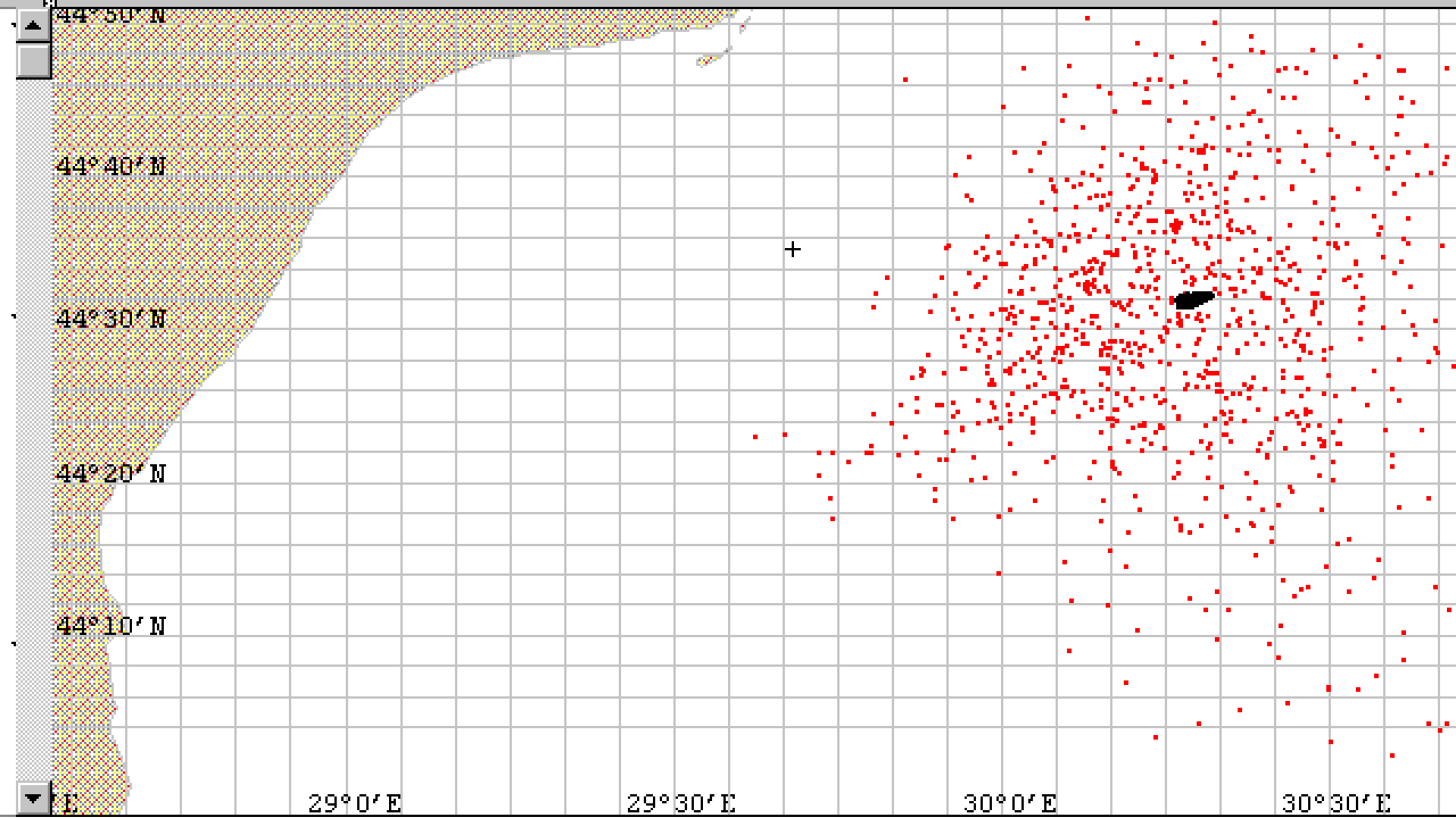
- Mouse cursor
- Zoom in (+)
- Zoom out (-)
- Hand (pan)
- Oil spill source (ship)
- Oil spill source (dispenser)
- Oil spill source (box)
- Time navigation: Previous, Time display (09/23/2001 06:33), Next, Play/Pause



Reset model to start time.

Navigation toolbar containing icons for:
 

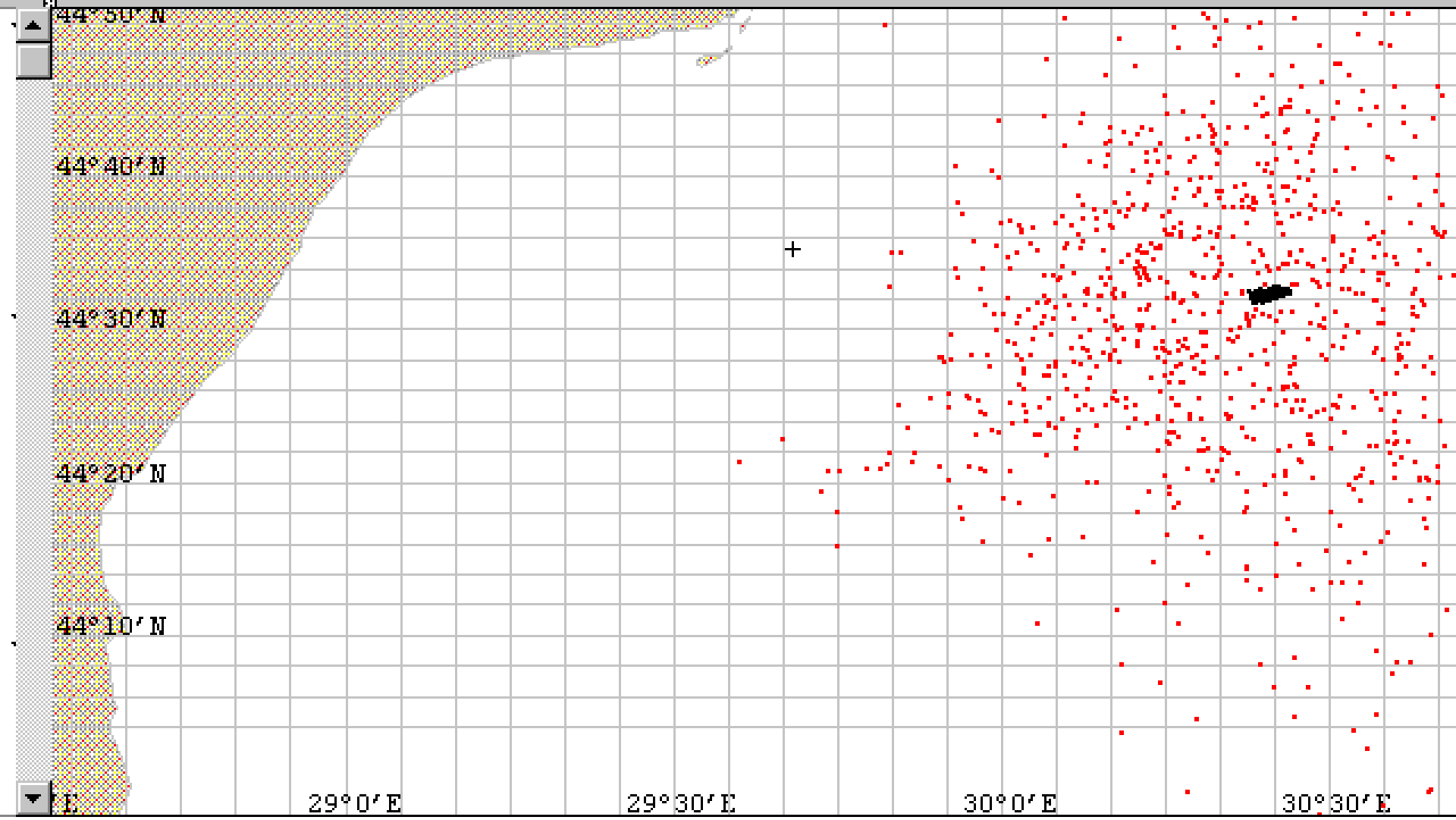
- Map navigation (arrow, hand)
- Zoom in (+) and zoom out (-)
- Oil spill source (ship icon)
- Oil spill type (droplet icon)
- Map layer (book icon)
- Timeline controls (play, stop, back, forward) and a date/time display showing 09/23/2001 12:33.



Reset model to start time.

Navigation toolbar containing icons for:
 

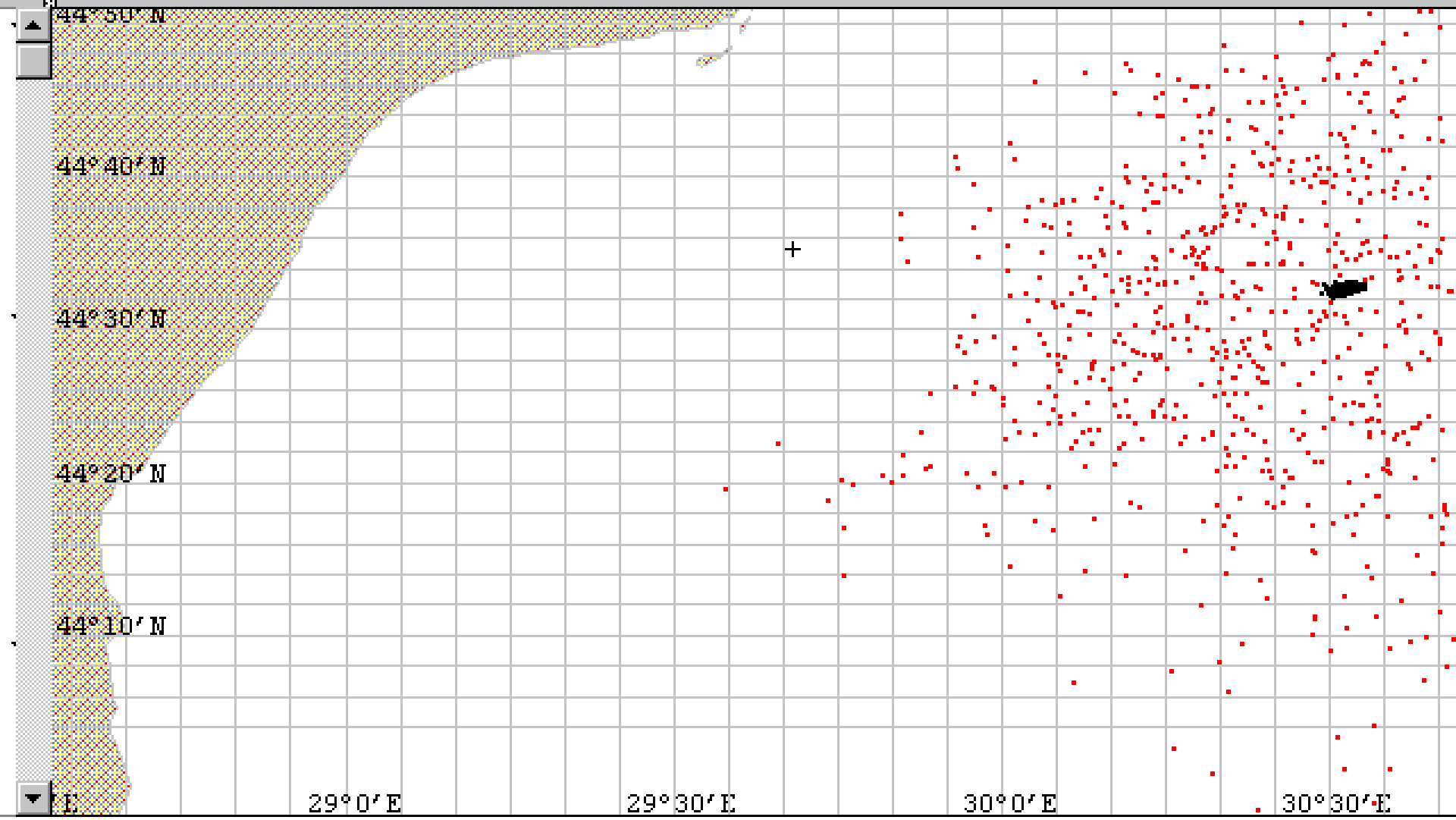
- Map navigation (arrow, zoom in, zoom out, pan)
- Oil spill simulation (oil slick, oil slick with arrows)
- Map layers (3D box)
- Timeline controls (play, stop, previous, next)
- Timeline display: 09/23/2001 21:33



Reset model to start time.



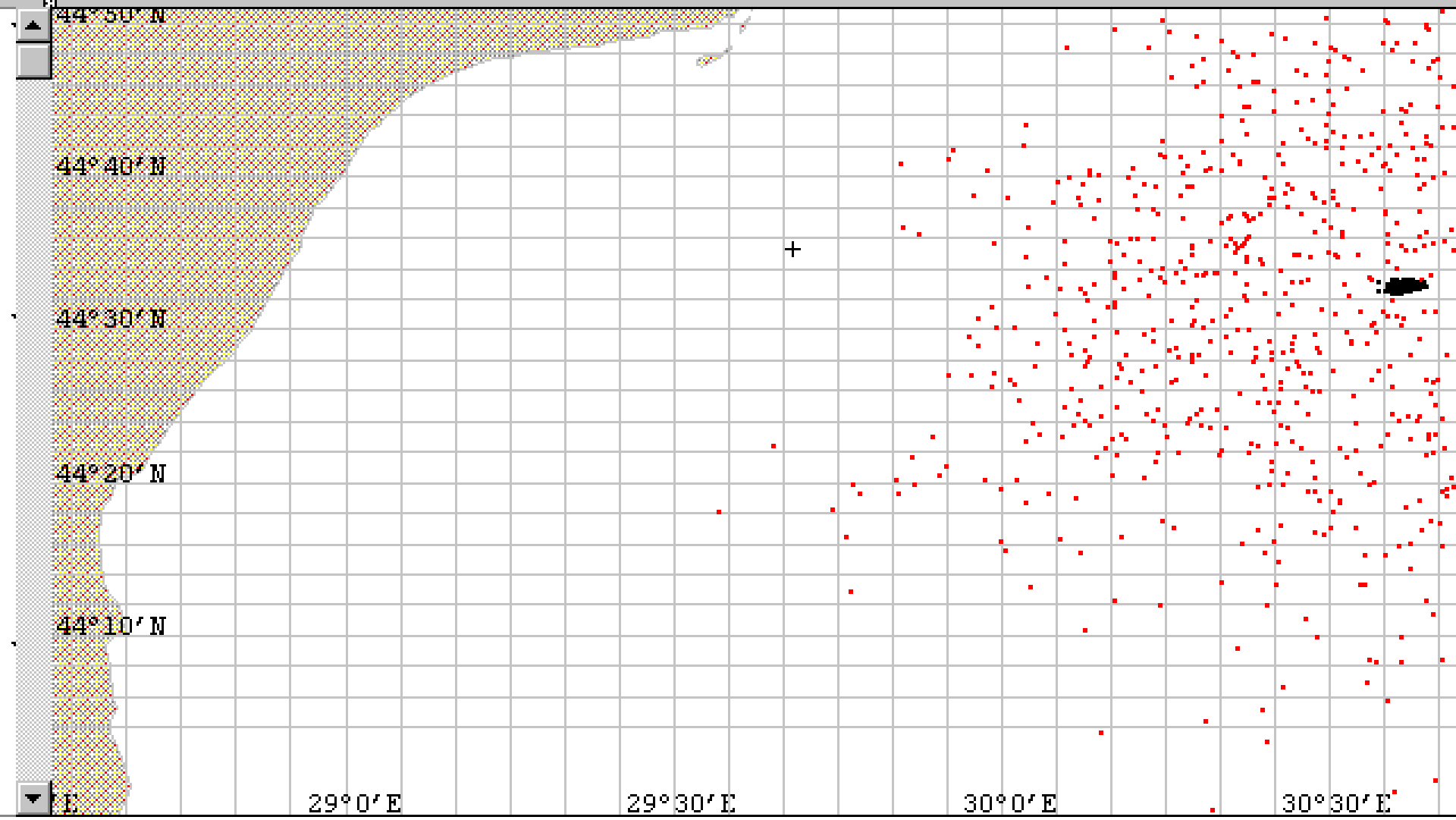
Navigation toolbar containing icons for pan, zoom in, zoom out, hand, and other functions. A date/time display shows 09/24/2001 06:33 with playback controls.



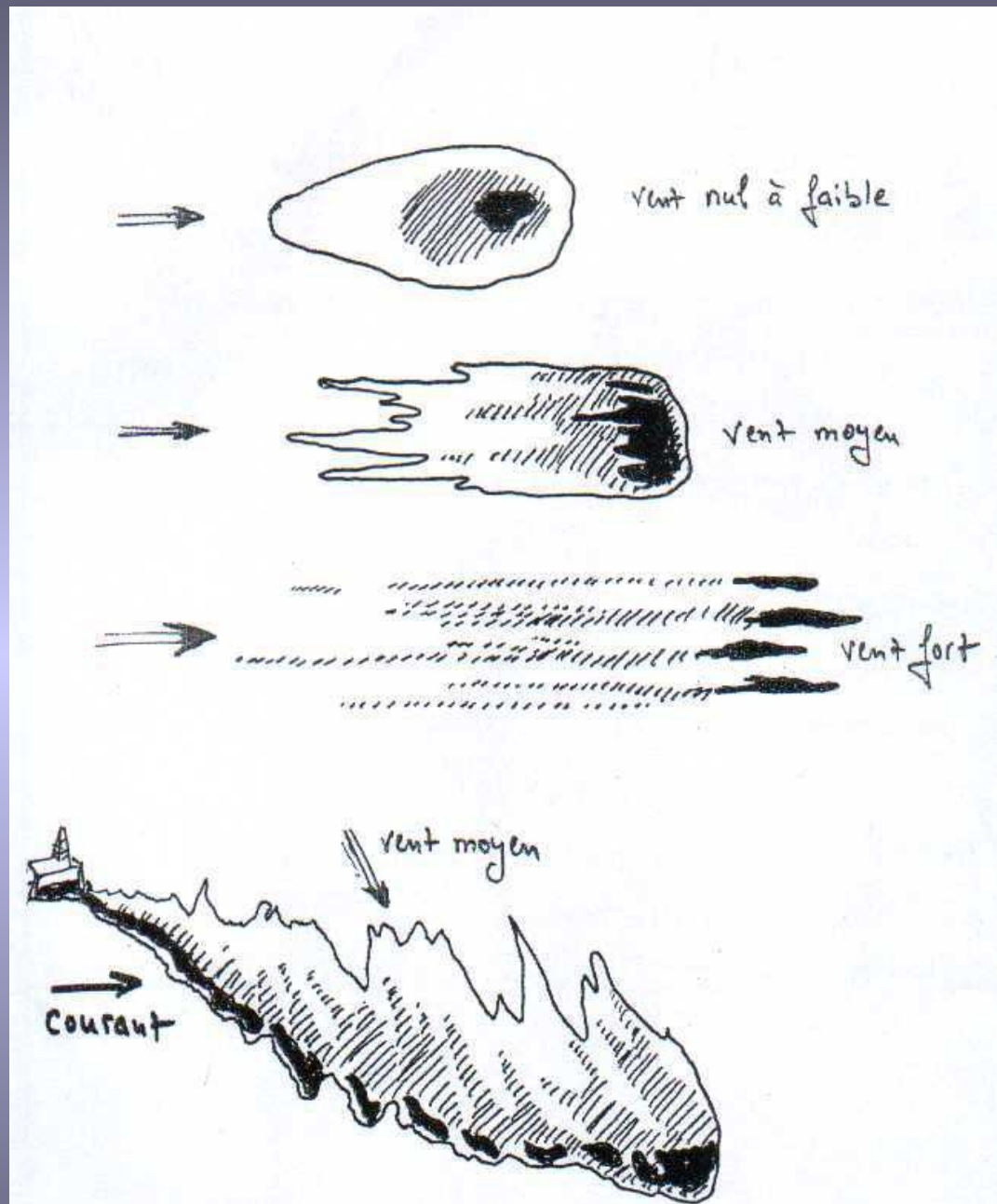
Reset model to start time.

Navigation toolbar containing icons for:
 

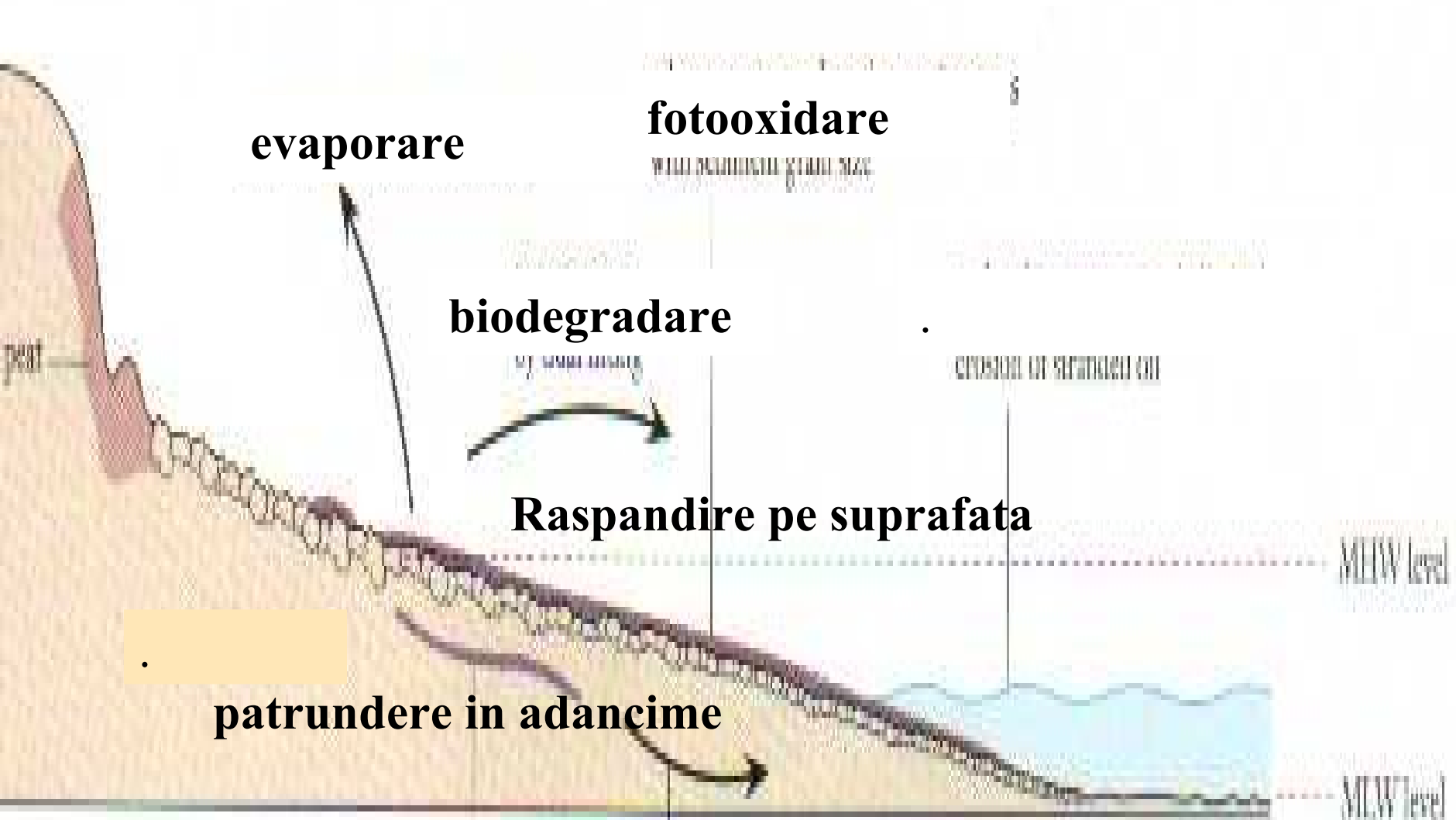
- Mouse cursor
- Zoom in (+)
- Zoom out (-)
- Hand (pan)
- Oil spill source (ship)
- Oil spill source (dispenser)
- Oil spill source (box)
- Timeline controls: Previous, Play/Pause, Next
- Timeline display: 09/24/2001 13:33



In functie de viteza vantului pelicula este compacta, alungita, sau fragmentata in fasii.

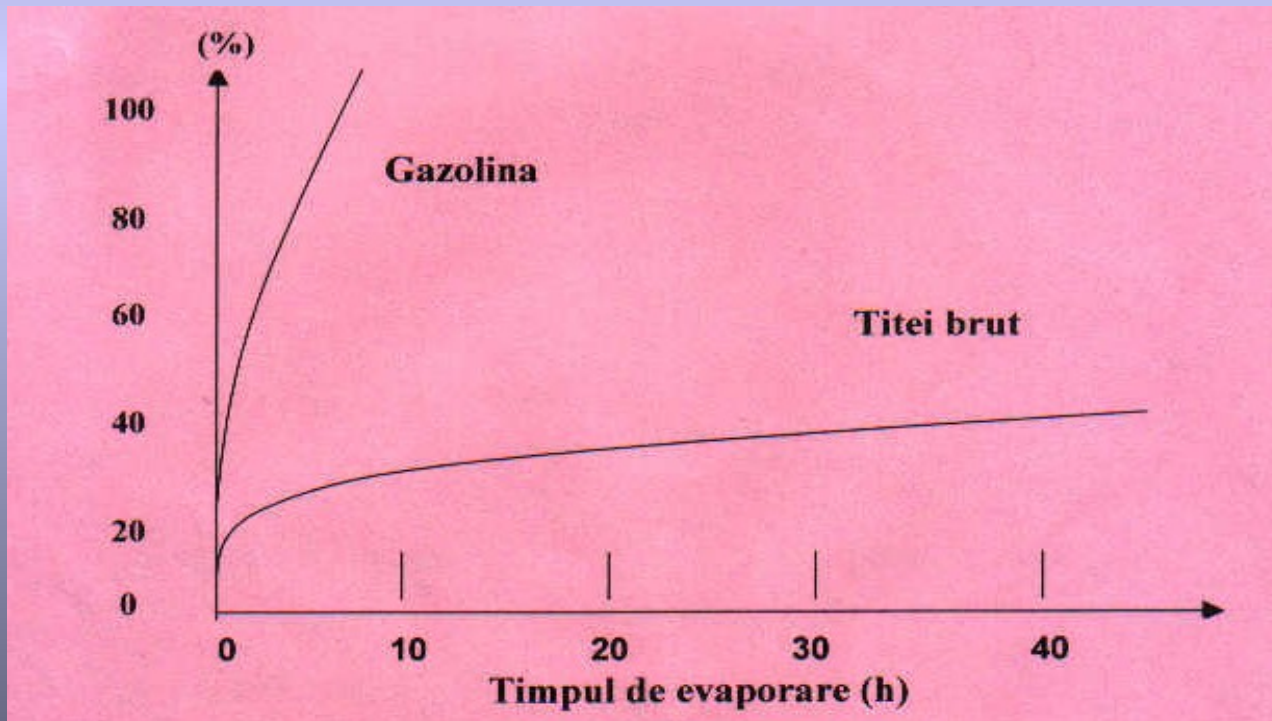


# Evolutia pe sol a poluantului



# EVOLUTIA POLUANTULUI DEVERSAT PE SOL (fenomene care au loc)

- **EVAPORAREA POLUANTULUI** este direct proportionala cu: temperatura solului, marimea suprafetei poluate, viteza vantului, tipul si cantitatea poluantului.



- **PATRUNDEREA IN ADINCIME** - depinde de:  
tipul si umiditatea solului, tipul si cantitatea de produs deversat,
- **Gradul de permeabilitate** ( in m/sec) masoara viteza de patrundere fiind diferit pt. tipurile de tarm:  
bolovanis/pietris = 10m/s ; nisip fin = 0,0001 m/s

**Capacitatea de retinere a poluantilor din sol este datã în functie de tipul solului, fiind prezentata in tabelul urmator:**

| <b>Tipul de sol</b>                    | <b>Capacitatea de retentie (R), l/m<sup>2</sup></b> |
|----------------------------------------|-----------------------------------------------------|
| <b>Pietrisuri grosiere</b>             | <b>5</b>                                            |
| <b>Pietrisuri si nisipuri grosiere</b> | <b>8</b>                                            |
| <b>Nisipuri medii grosiere</b>         | <b>15</b>                                           |
| <b>Nisipuri fine si medii</b>          | <b>25</b>                                           |
| <b>Nisipuri fine</b>                   | <b>40</b>                                           |

- **RASPANDIREA PE SUPRAFATA - datorita fortelor gravitationale si inclinarii solului**
- **BIODEGRADAREA - dependenta de: temperatura, disponibilitatea de O<sub>2</sub>, a microorganismelor, de tipul si cantitatea de poluant.**

# CONCLUZII

- **Cand se deverseaza, petrolul sufera o serie de procese:**
  - **transferul acestuia de pe suprafata apei in coloana acvatica si in atmosfera,**
  - **persistenta in timp,**
  - **modificarea caracteristicilor.**
- **Transformarile poluantului depind de: conditiile hidro/meteo si de caracteristicile acestuia.**
- **Scara timpului dupa care se apreciaza persistenta la suprafata apei se masoara in saptamani. Petrolul nepersistent, nu ramane la suprafata apei mai mult decat cateva ore.**



# CONCLUZII

- **Sedimentarea si biodegradarea determina ultima faza a transformarilor poluantului.**
- **In timpul transformarilor cresterea progresiva a viscozitatii implica alegerea tehnologiei optime de recuperare.**
- **Evaluarea transformarilor poluantului deversat este un element important in alegerea tehnologiei de depoluare.**