Session 3
Understanding HNS behaviour at the sea surface

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Understanding HNS behaviour at the sea surface

- HNS behaviour
  - Processes involved
  - Environmental conditions
- Experimental tool: chemical bench
  - Presentation
  - Methodology & Protocol
- Results

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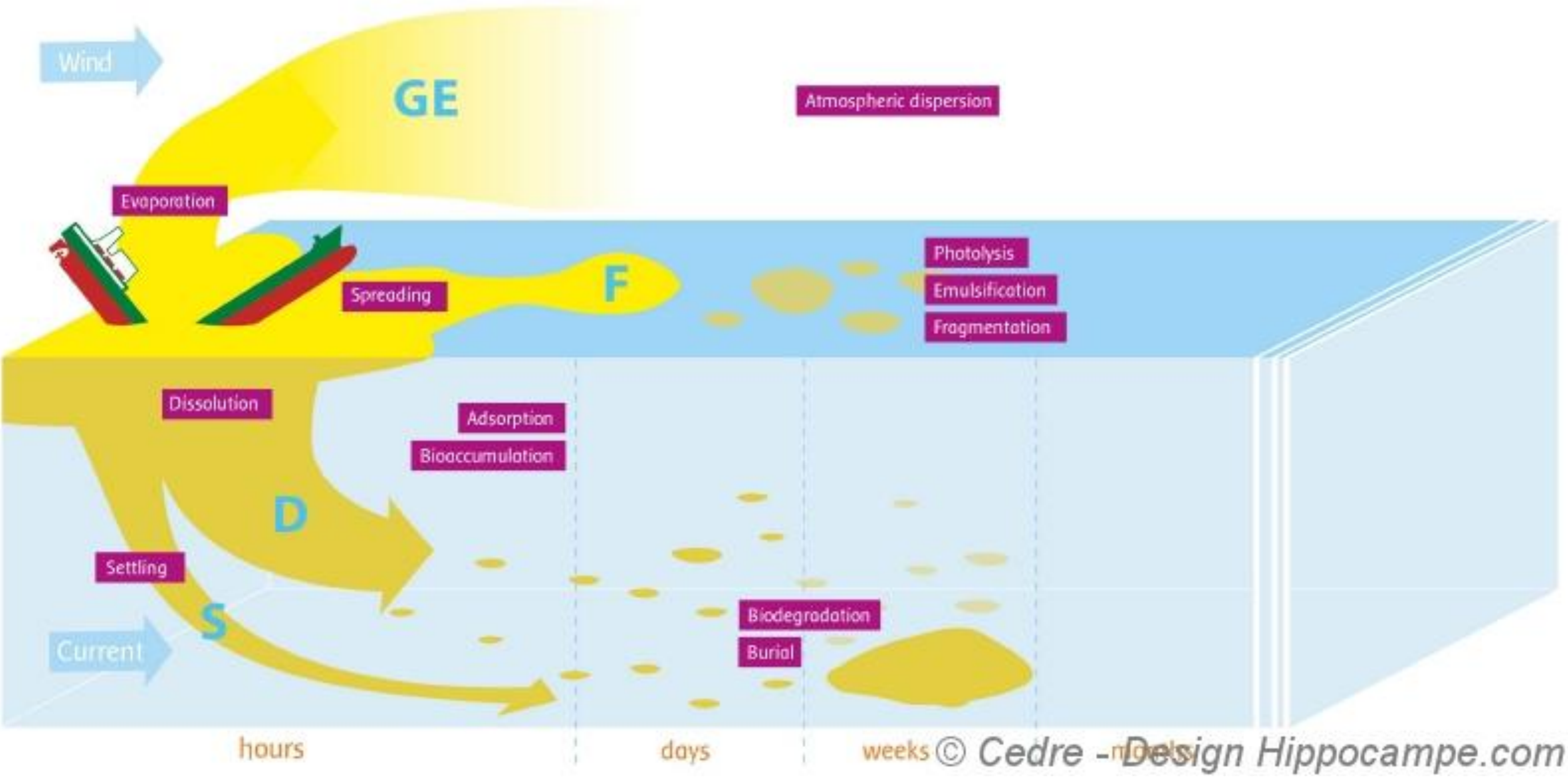
HNS behaviour – Processes involved



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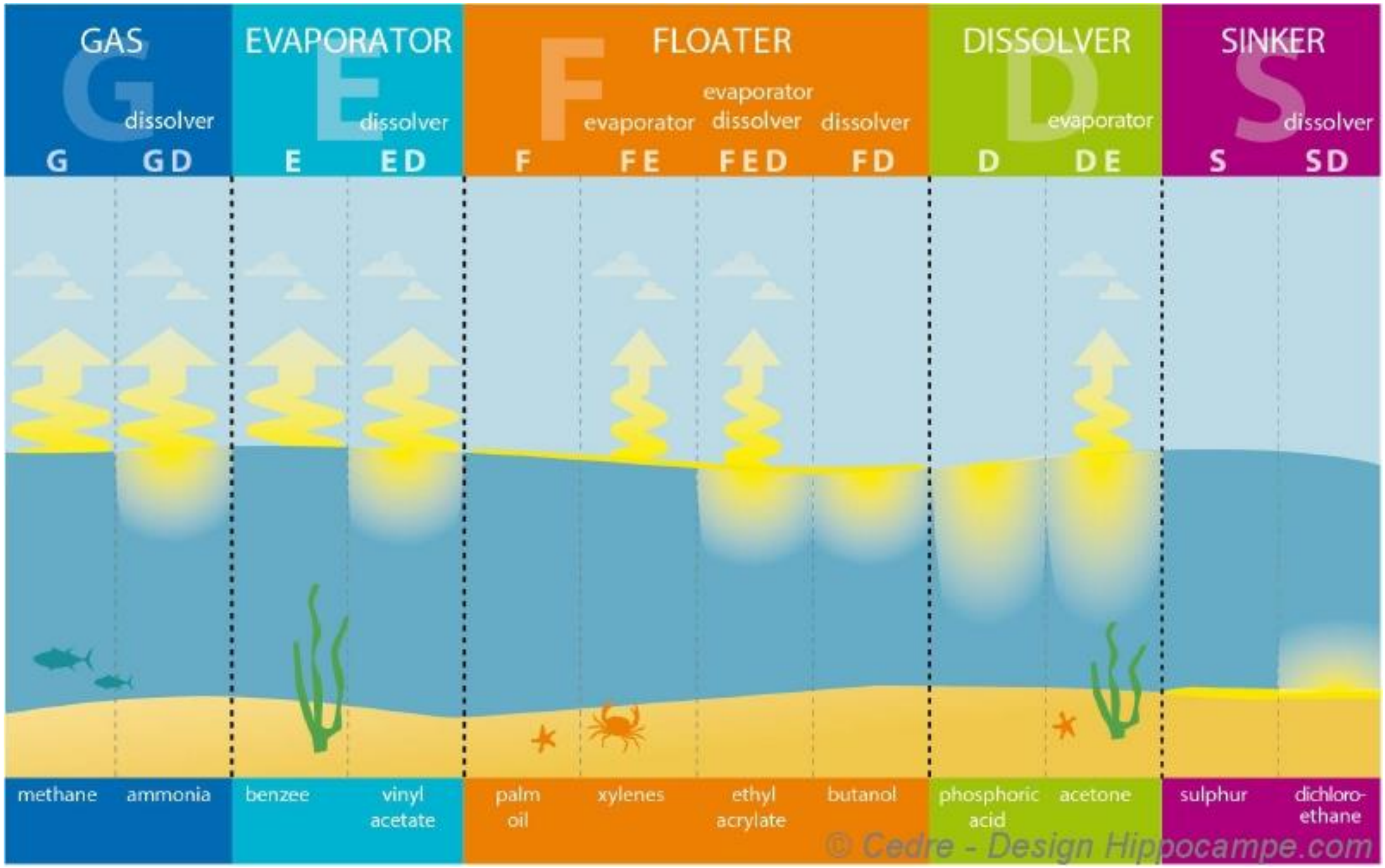
HNS behaviour – Processes involved

SEBC: Standard European Behaviour Classification
5 main categories of behaviours



HNS behaviour – Processes involved

Substance state: gas, liquid or solid

Density: in comparison with seawater (1.03)

Vapour pressure:

> 100 kPa: gas

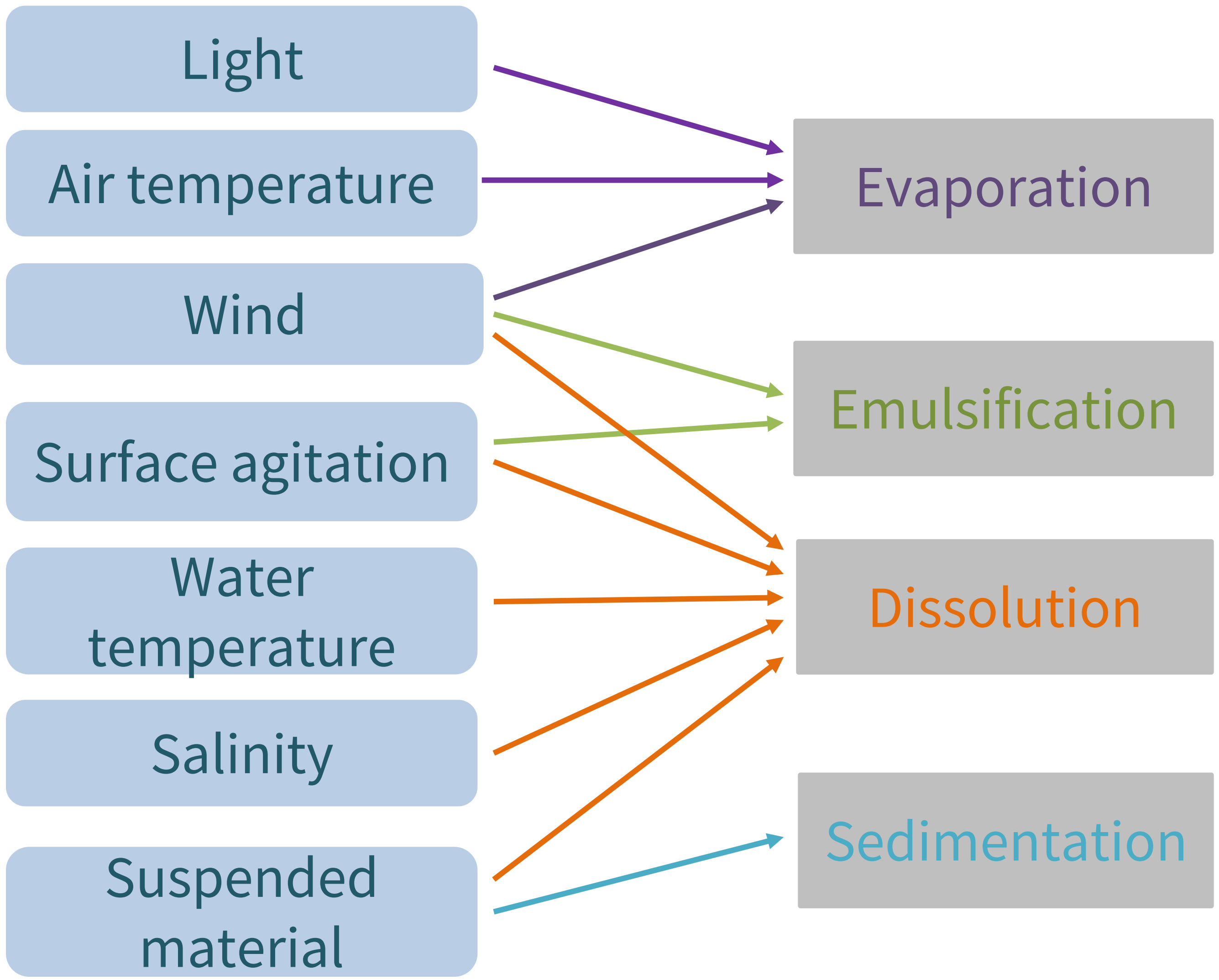
> 3 kPa: fast evaporation

< 0.3 kPa: evaporation negligible

Solubility:

Liquid:	< 0.1 %: solubility negligible
	> 5 %: high solubility
Solid:	< 10 %: solubility negligible
	> 100 %: high solubility

HNS behaviour – Environmental conditions

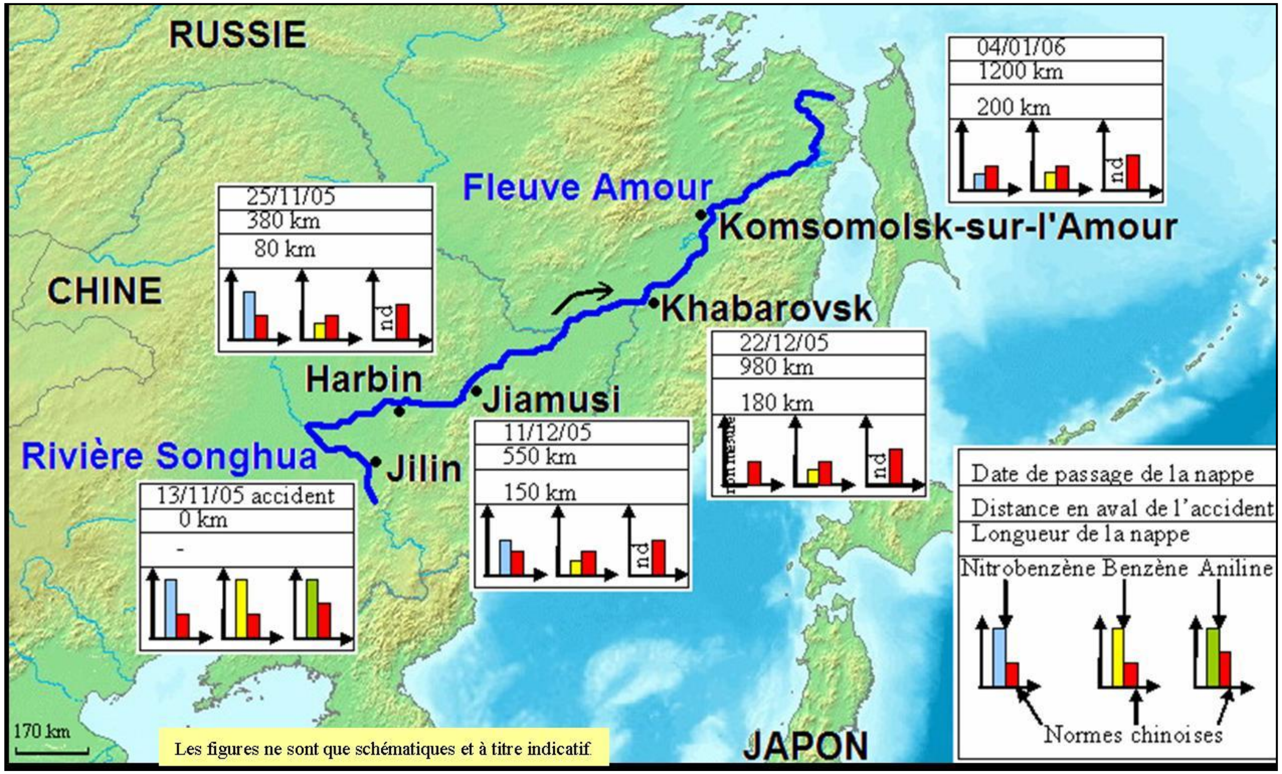


HNS behaviour – Environmental conditions

Jilin accident (China, 2005)

Explosion in a petrochemical industry: 5 dead people, evacuation of 10 000 persons.

Contamination of Songhua river by 100 T of benzene (E)



Harbin, 380 km
Nitrobenzene = 34 x standard

Jiamusi, 550 km
Nitrobenzene = 10 x standard

HNS behaviour

Limits of existing data

- Independent procedures for the evaluation of each process
- Normalised conditions (20 or 25 °C, freshwater)

Needs

- Evaluation of the processes occurring simultaneously
- Evaluation of the impact of environmental conditions

→ **Development/Use of a specific tool**

Experimental Tool - Presentation

"Chemical Bench Test"

Allow the evaluation of the overall fate of HNS under controlled environmental conditions

- Cylindrical tank of 80L
- Valves at different depths
- Wind generator
- Water and air temperature control system

Experimental tool – Methodology

Processes

- Evaporation
  - PID measurements
- Dissolution
  - Water sampling
  - GC-MS analysis
- Persistence
  - Slick sampling

Environmental conditions

- Wind speed/surface agitation
- Water and air temperature
- Salinity
- Solar radiations (upcoming)

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Experimental tool – Protocol

- Tank filled with seawater
- 150 mL of HNS spilled at the surface
- Follow-up of the processes during 8,5h:
  - Continuous PID measurements
  - 5 water sampling times (1h : 3h ; 5h ; 7h ; 8,5h)
  - Slick sampling at 8,5h if possible

- 10 HNS
- 2 temperatures and 3 wind velocities

Experimental tool – Protocol

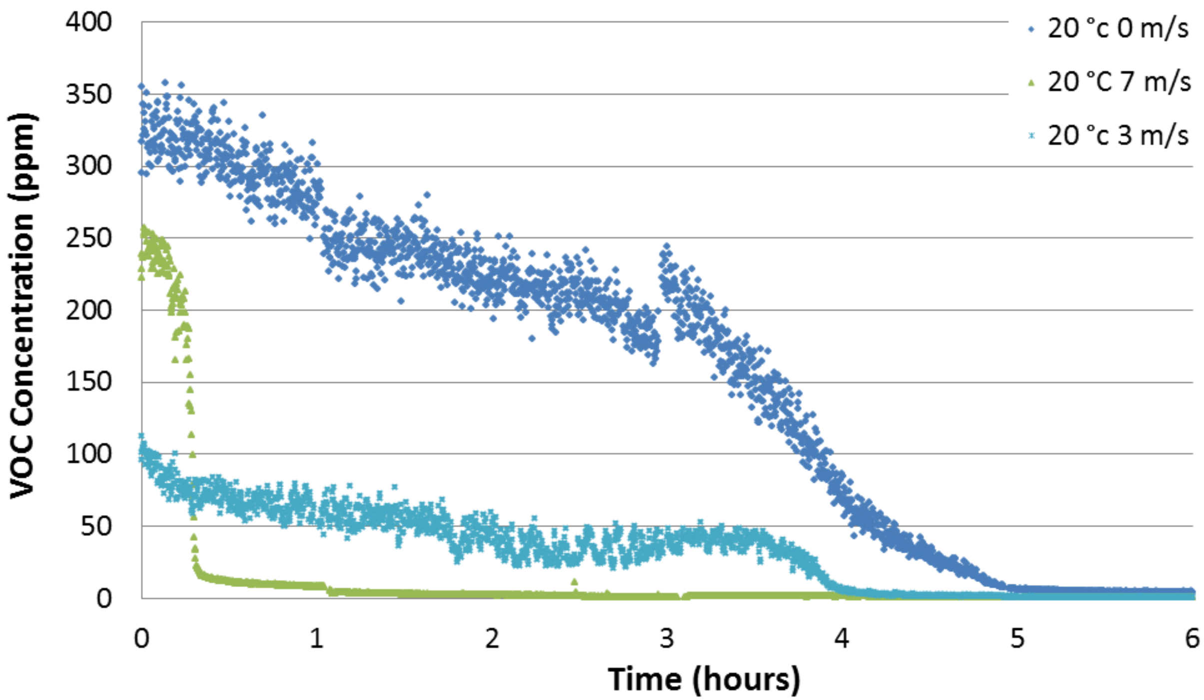
10 HNS – 5 SEBC classes

HNS	CAS Number	SEBC
1-nonanol	2430-22-0	F
2,2,4-Trimethyl-1,3-pentanediol-1-isobutyrate	25265-77-4	F
2-ethylhexanoïc acid	149-57-5	FD
2-ethylhexyl acrylate	103-11-7	F
Butyl acetate	123-86-4	FED
Butyl acrylate	141-32-2	E
Heptane	142-82-5	E
Pentane	109-66-0	E
Toluene	108-88-3	E
Xylene	1330-20-7	FE

Results – Evaporation

- Impact of wind speed

Butyl acrylate (E)



→ Faster evaporation for stronger wind

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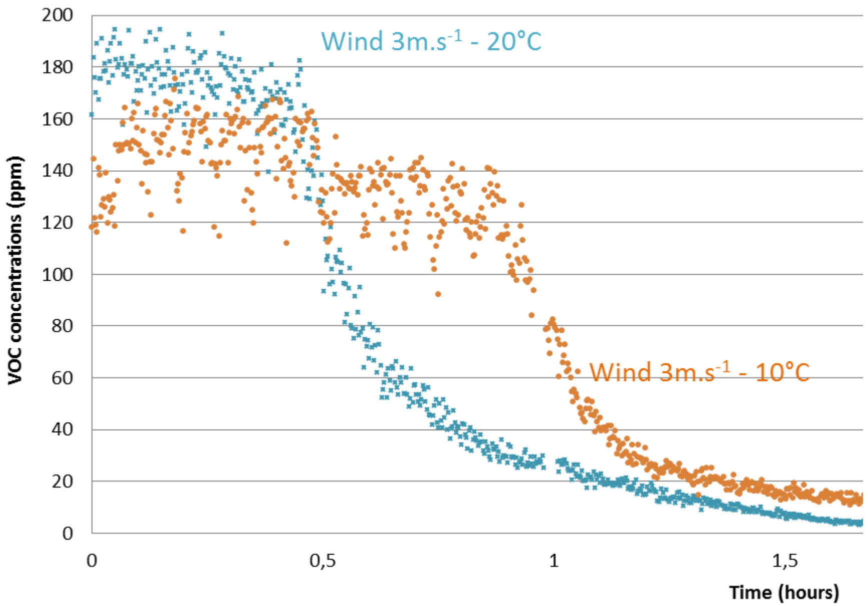
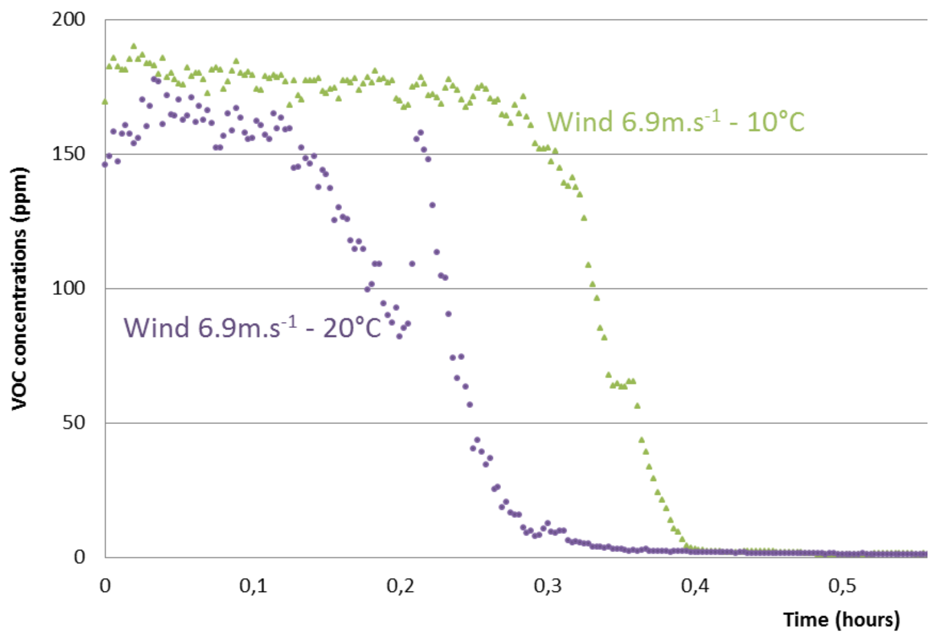
Results – Evaporation

- Impact of temperature

Xylene (FE)



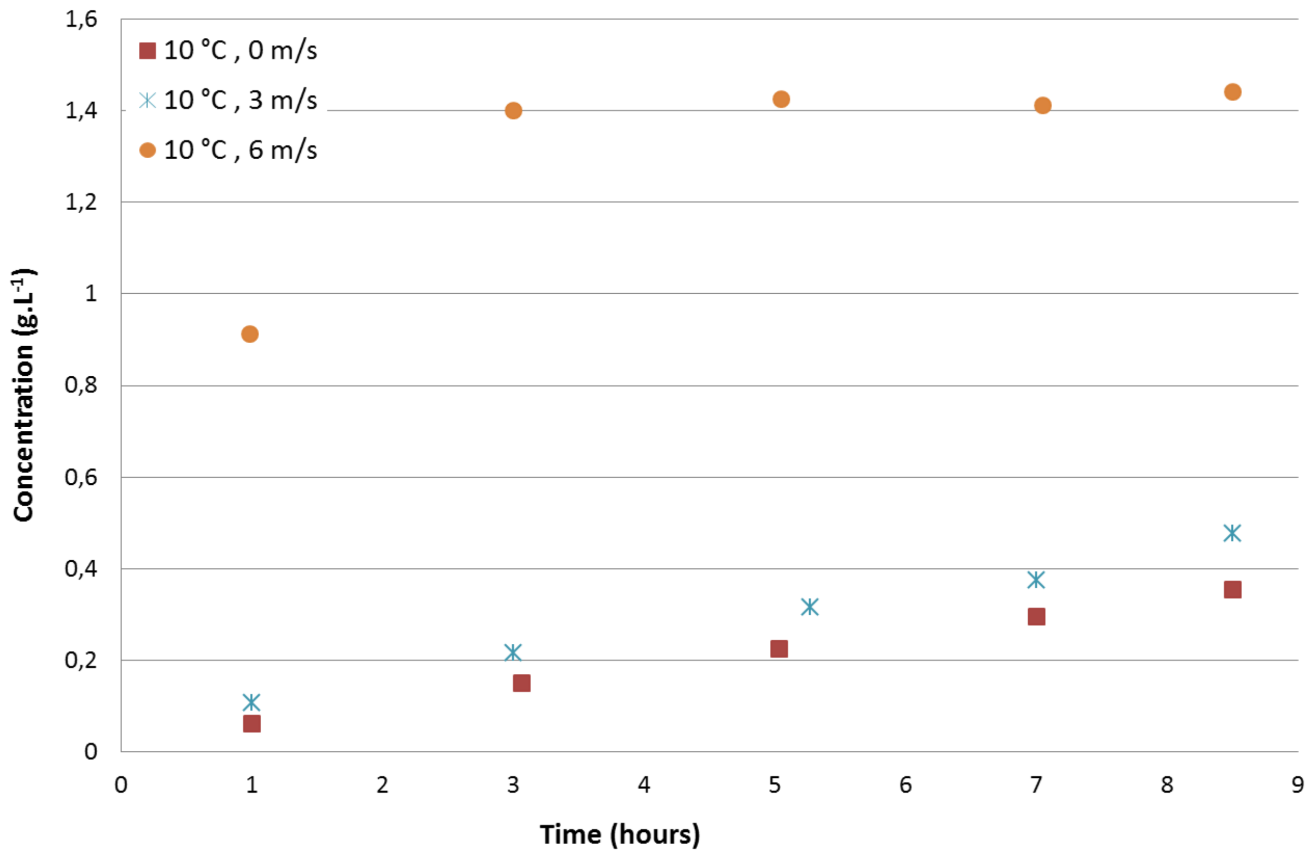


→ Faster evaporation for higher temperature

Results – Dissolution

- Impact of wind speed and so surface agitation

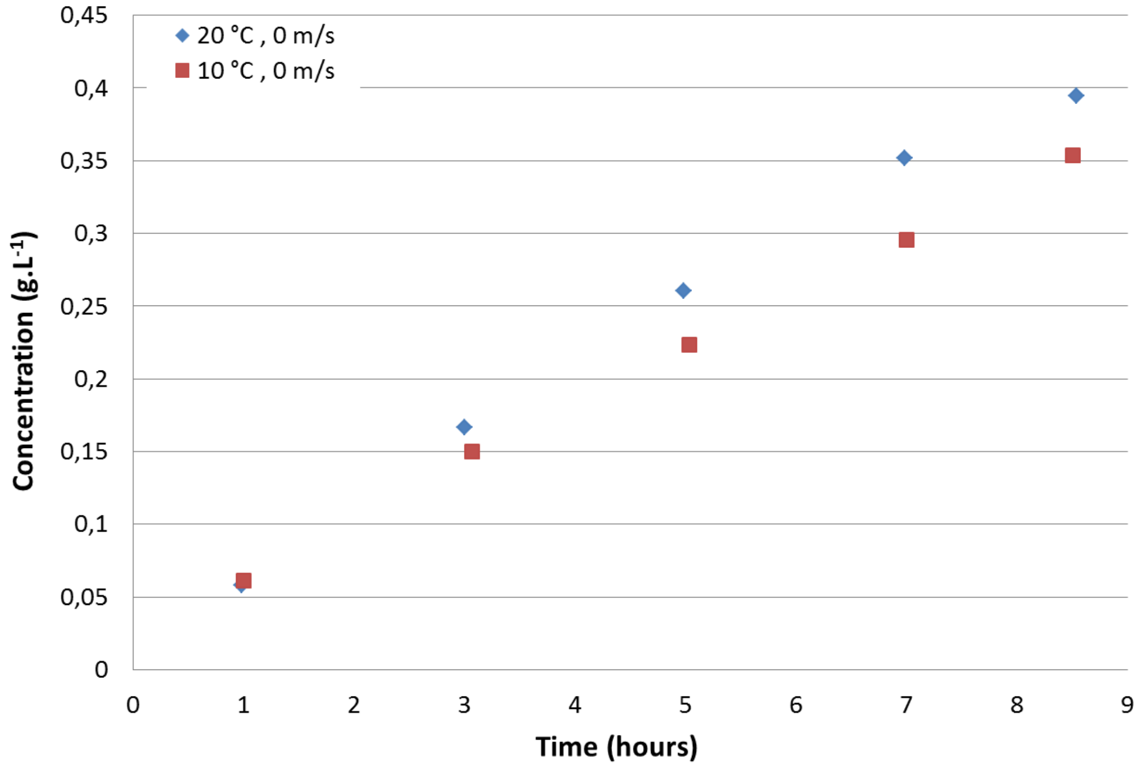
2-ethylhexanoïc acid (FD)



Results – Dissolution

- Impact of temperature
  - Direct: not much seen, maybe due to a small ΔT?

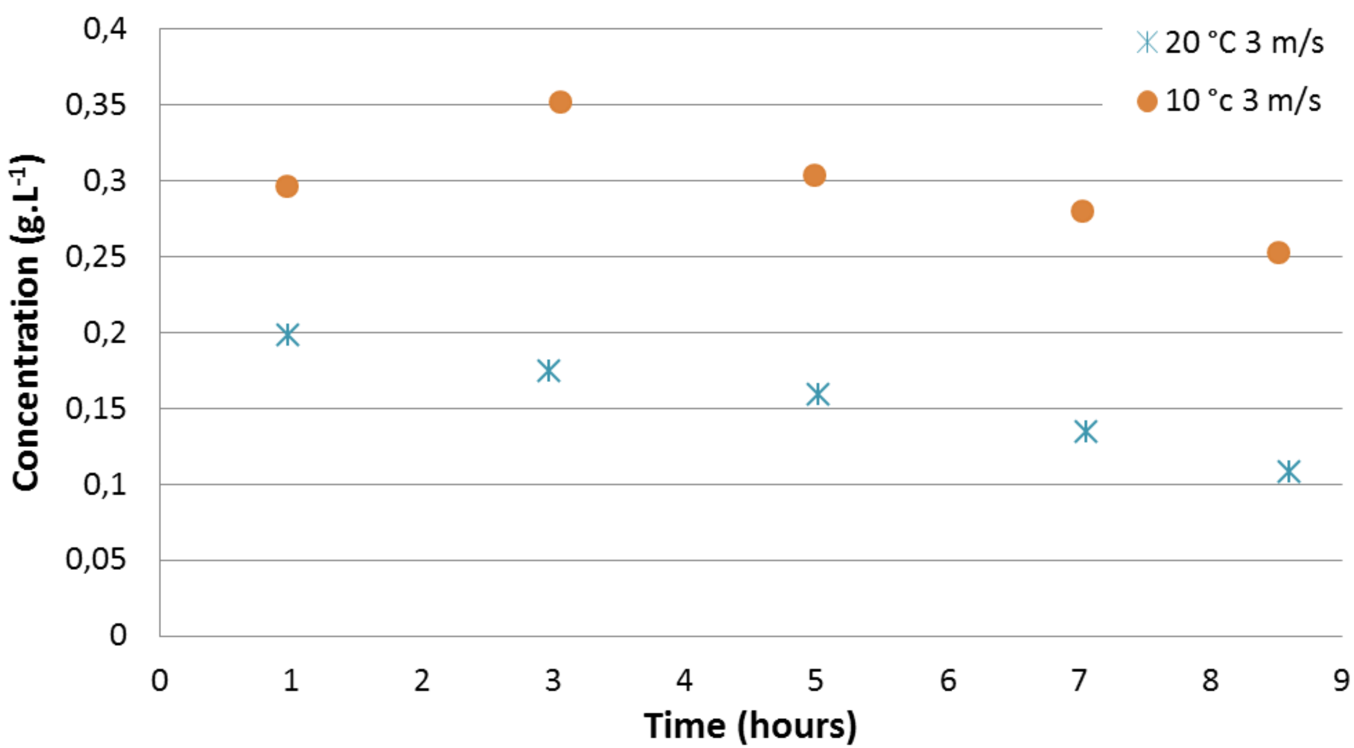
2-ethylhexanoïc acid (FD)



Results – Dissolution

- Impact of temperature
  - Indirect: less evaporation so enhancement of the dissolution

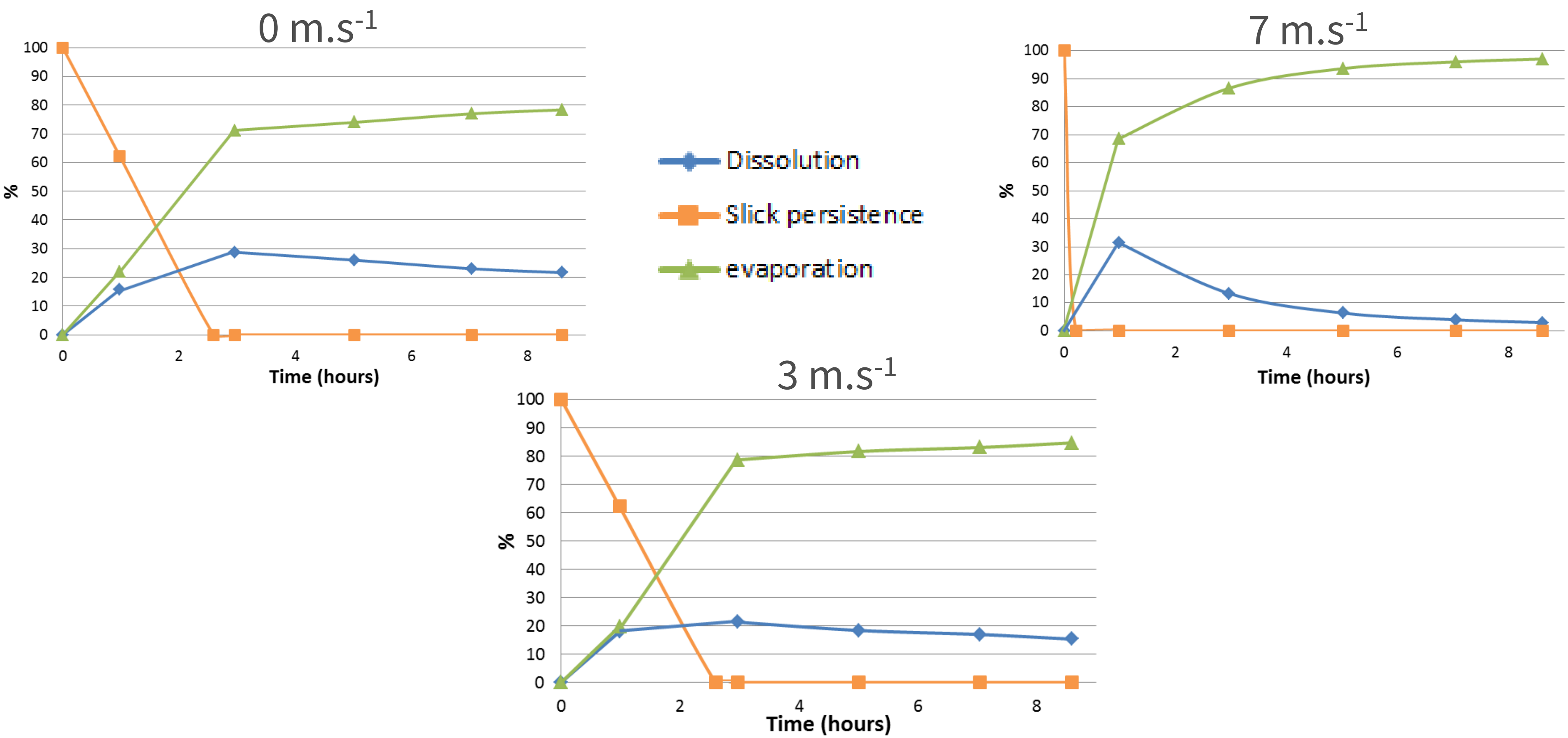
Butyl Acetate (FED)



Results – Wrap up

- Goal = present an overall fate of each HNS

Butyl acetate (FED) – 10 °C



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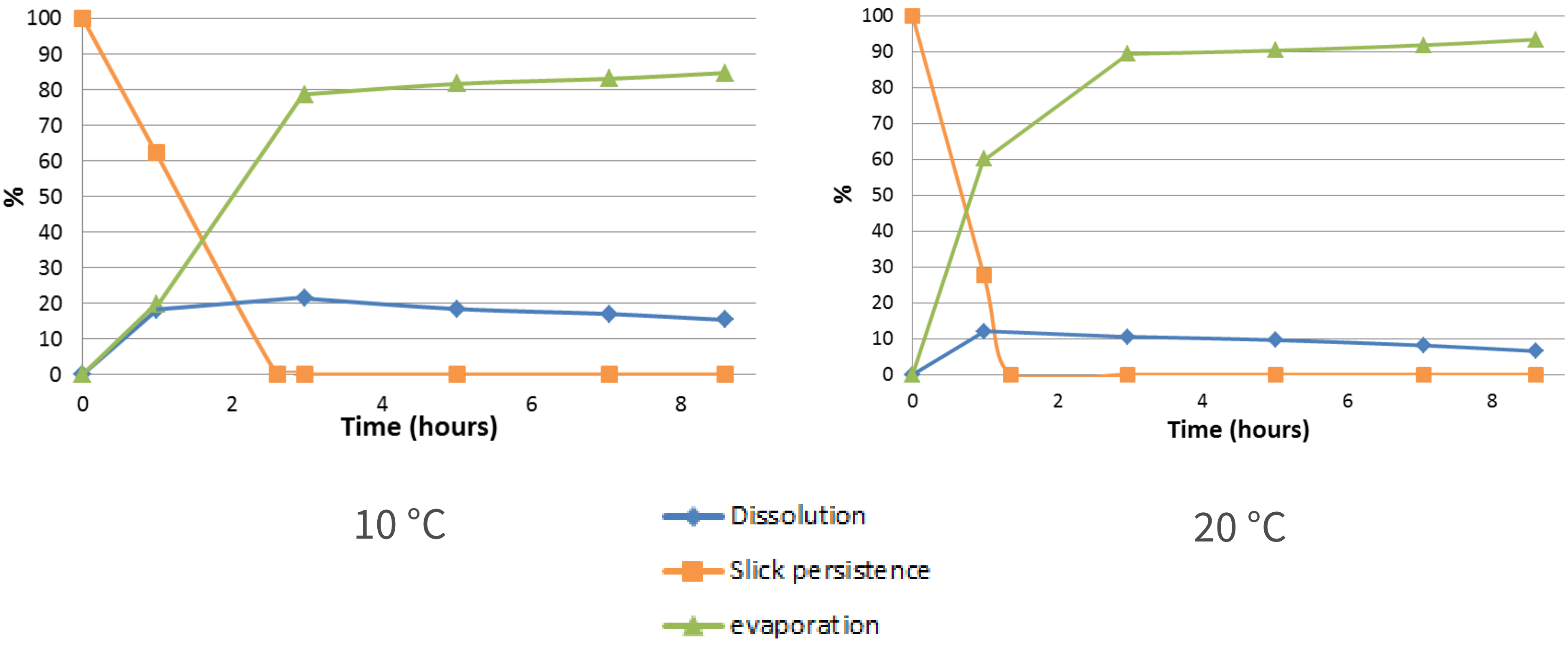
Results – Wrap up

- Goal = present an overall fate of each HNS

Butyl acetate (FED) – 3 $m.s^{-1}$



Conclusions

- HNS behaviour at the sea surface = complex processes
- SEBC based on properties determined in standard conditions and separately

- Evaluation of an overall fate thanks to a dedicated tool where environmental parameters can be controlled

- Final goal = establish, for each HNS, an abacus of behaviours depending on the environmental conditions

Thank you for your attention

Any questions?