# Industry Technical Advisory Committee

## Cedre's activities – Update

Ivan Calvez (Research Dept.)

Cedre
www.cedre.fr

# update/examples of recent activities (2018-19)

## Short-termed or multiyears/multipartners projects

- Public/private partners

- Scientific studies (e.g. : substances fate/behaviour, etc.)
- Equipment/techniques assessments

→ Overview of the scope :

Oils

HNS

Marine litter, microplastics : a growing involvement/public expectations

## Recent on-site attendances

# I. HNS-related activities

# Testing optical sensors for HNS spills detection

Contract (sept. 2019): *KRISO* (Korea Research Institute of Ships and Ocean)

Partners: Seoul National University and *ONERA* (French aeronautics, space and defense research lab)

Aim: improve authorities capacity to detect/characterize HNS spills

Experimental spills:

- Cedre's outdoor basins (release under control waste treatment)
- Two hyperspectral cameras (VNIR and SWIR spectral domains)
- 10 L spills:
  - 5 HNS : E (toluene); FE (xylene; styrene); DE (acetone); ED (vinyl acetate)
  - 2 oils (fresh crude oil; weathered/emulsified oil)
- Variable wind (0-2 $m.s^{-1}$) → slick spread/thickness measurements

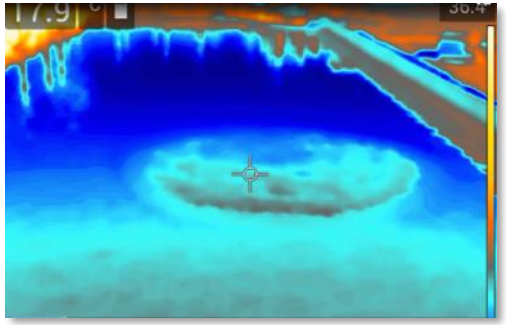
# Testing optical sensors for HNS spills detection

Contract (sept. 2019): *KRISO* (Korea Research Institute of Ships and Ocean)

Partners: Seoul National University and *ONERA* (French aeronautics, space and defense research lab)

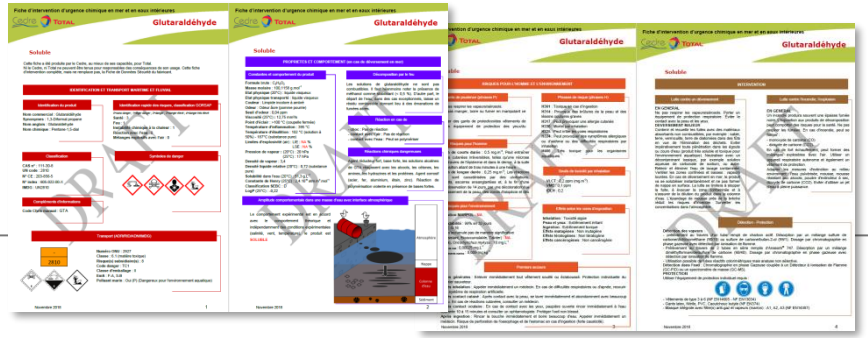
Aim: improve authorities capacity to detect/characterize HNS spills

Experimental spills:



Follow-up under discussion

- Chemicals used in O&G expl./prod. activities
  - Partners/contract: TOTAL
  - Properties / behaviour of chemicals used in E&P processes
    - E.g.: hydrate inhibitor, biocides, corrosion inhibitors, desemulsifier…
  - Experimental tools/setup:
    - Cedre's « HNS bench » (80 L tank.)
    - Controlled variables: light/UV, temp. (water/air), S%, wind, agitation… ;
    - Assessing evaporation vs dissolution processes
      - » PID (atm.); water samples → lab analysis (GC, HPLC, …)



# II. Marine litter / microplastics

# II. Marine litter / microplastics

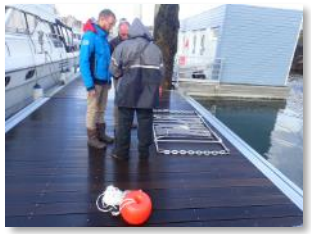
## Support of public policies on ML (e.g. EU's MSFD-descriptor 10):

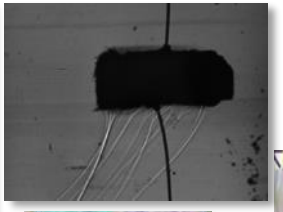
- Coordination of french ML monitoring programs (shoreline and estuary banks)
- France's representative in OSPAR technical group on ML

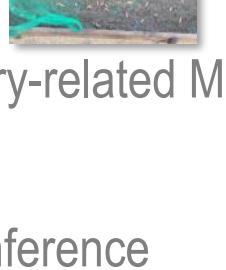
## Research on behaviour, weathering and impact of ML

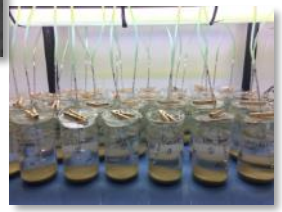
Current focus on cigarette butts, cotton buds and expanded polystyrenes

- Chemical and plastic analysis
- *In situ* and pilot experiments
- Ecotoxicity









## Studies

- Mapping of initiatives tackling ML
- Development of good practices to reduce fishery-related ML

## Awareness raising

- Organisation of participatory workshop and conference
- Involvement in « citizen science » programs, in public events, school visits…

# III. Oil related studies

# Chemical dispersion

## Ageing of chemical dispersants stored in Arctic climate

## Private partner/contract : 2016-2019

## Concern/aim:

- Dispersant efficiency over time/years of storage in cold climate?
- Study duration: 3 years (2016-19), prob. extended

## Tasks:

- 2 dispersants assessed yearly:
  - » Dispersant effectiveness (*via* standard IFP tests)
  - » Physical properties (dens. / visc.)
  - » Comparison/trends w. temperate, tropical conditions? (decantation, eff., etc...)

- Publication in due course

# *In Situ* Burning

## 2018/19: by-products toxicity assessment / residues & soots

- Partners/contract: TOTAL
- Aim/content:

  for 6 crude oils (incl. light, medium and heavy):

  – Ecotoxicity and biodegradability of burned oil residues

  – Statistical data analysis → development of predictive models for ISB efficiency / residue characterization
- Tasks

  – Experimental burns: lab scale (Cedre « burning bench ») & pilot scale (coll. INERIS)

  – Various weathering stages (fresh, topped, emulsified…)

# III. Oil studies – **Response techniques**

## » Experimental burns

**Water collected after burns**

- PAH concentrations

**Crude oils**

- Density
- Viscosity
- SARA distribution
- *n*-alkane concentrations
- PAH concentrations

**Soot**

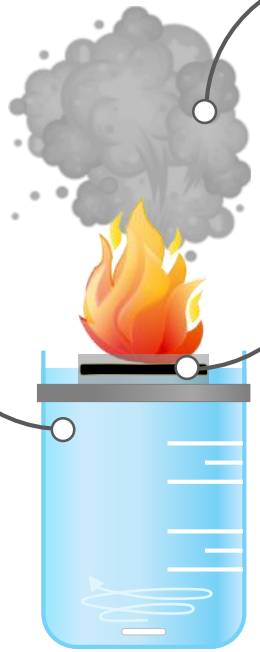
- Concentration of soot
- PAH concentrations

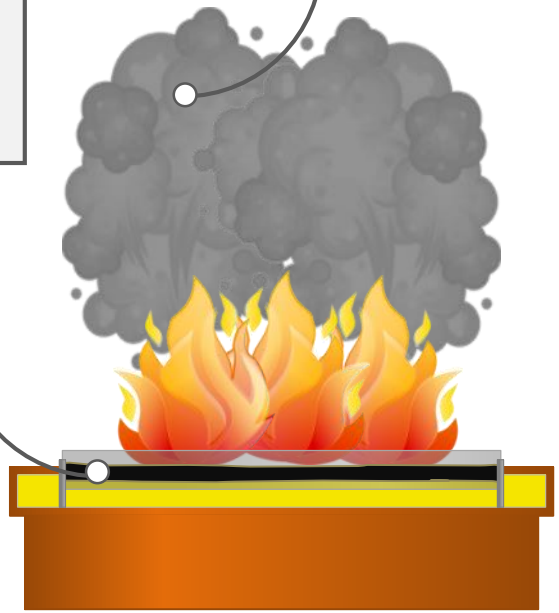
**Residues**

- Burning efficiency
- Density
- Viscosity
- SARA distribution
- *n*-alkane concentrations
- PAH concentrations

**Monitoring of gas emissions and physical parameters (coll. INERIS)**

- Gas emissions ($CO_2$, CO, $SO_2$, NO…)
- Temperatures
- Soot quantification (weight)
- Atmospheric pressure
- Flow rates…





Small-scale experiments (Cedre's bench)

Pilot-scale experiments (INERIS)

# III. Oil studies – **Response techniques**

» Ecotoxicity evaluation

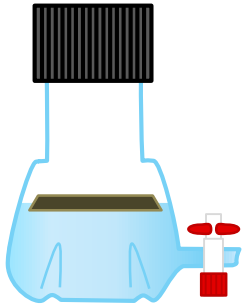
**Soot**

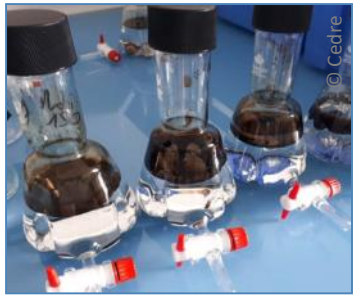
**Crude oils**
*(before burning)*

**Residues**
*(after burning)*

**Water after burning**

**Water Accommodated Fractions**
(WAFs)






**Measurements**

Bioluminescence inhibition
*(Microtox FX®)*

PAH concentrations
*(GC/MS)*

» Biodegradability of oil residues assessed at lab scale (28 days tests)

» Statistical data analysis : in progress

# Biodiesels behaviour– 2018 / 2019

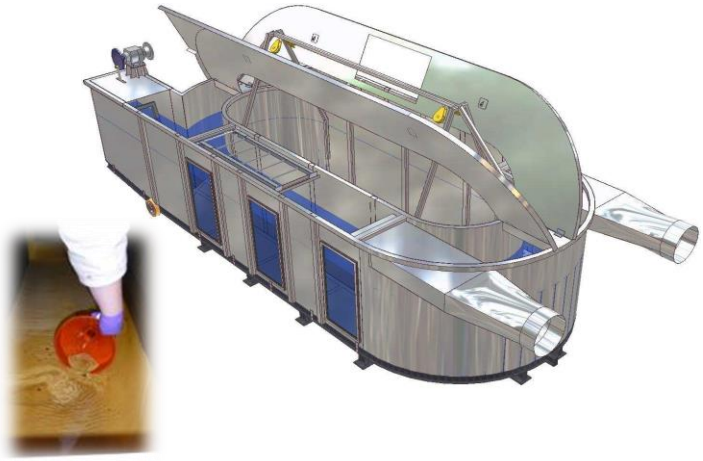
## Partners/contract: TOTAL

## Aim

- Compare the fate and behavior of *B10* and its associated base products (*B0* and *FAME* -Fatty Acid Methyl Esters)

## Tasks

- Experimental spills / weathering studies
  - meso scale (flume tank/Polludrome®)
    - » Sample & lab analysis
      - Dens., visc., water %, …
      - Evap. rate, flash point,
      - *n*-alkanes, PAHs,
      - Biodegradation…



# III. Oil studies – **behaviour / fate studies**

**B10**

+1 h | +2 h | +4 h | +26 h | +77 h

+ 7 days

**Agitation stopped**

**0 minute**
Oil droplets in water column

**20 minutes**
Coalescence of oil droplets at the surface

**60 minutes**
Separation of biodiesel and free water in the bottle

Cedre

# III. Oil studies – **behaviour / fate studies**

**B10**

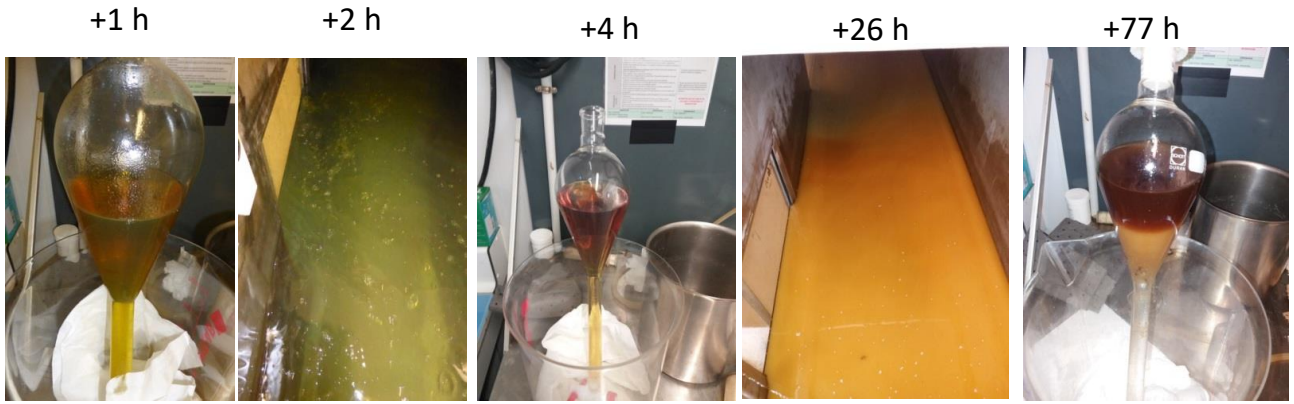
+1 h | +2 h | +4 h | +26 h | +77 h

+ 7 days

Pipeline spill
(Ste Anne s/Brivet,
France, 2016)

# III. Oil studies – **behaviour / fate studies**

**B10**




+ 7 days

**2019:** ecotoxicity tests on B0, B10 and B30 (30% of HVO), B30 weathering at pilot scale (Polludrome®)

- **For further details** (evaporation, biodegradation, visc., dens., etc.)

**Jézéquel, R. Duboscq, K., Valadeaud, F., Le Floch, S. 2019.** Fate, Behavior and Impact Assessment of Biodiesels in Case of an Accidental Spill. Proceedings of the 2019 Artic and Marine Oilspill Program (AMOP) Technical Seminar, Environment Canada, Halifax. 2019.

# ULSFO / Lubes – 2018 / 2019

Partners: French Navy; FR MoE (MTES)

Aim: Improve knowlegde on behaviour → response options?

Tasks

- Weathering and dispersibility study (flume tank)
- Recovery efficiency (skimmers + indoor test tanks)

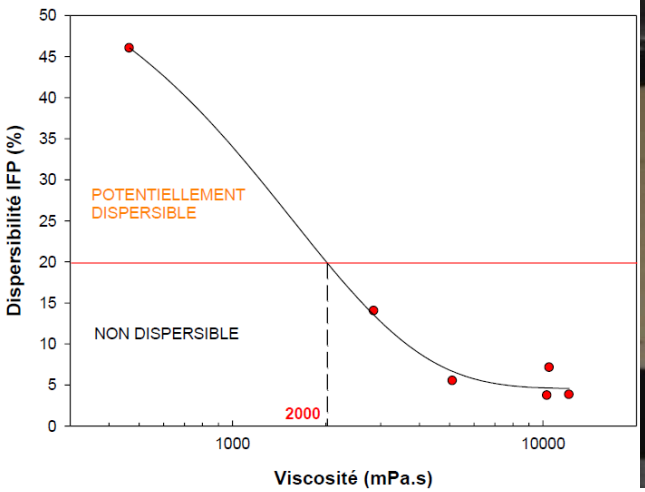
Problems…

- 2018: ULSFO supply
- 2019: ?

# ULSFO / Lubes – 2018 / 2019

## Weathering and dispersibility study (flume tank/"*Polludrome*"®)

- Rapid and significant emulsification (max. values @ ~24h)
  - » Water content: ~90%
  - » Viscosity: ~ 10,000 mPa.s
  - » Density: ~ 1.005
- pot. dispersible up to ~2,000 mPa.s (~10 hrs weathering in exp. conditions)



*After 24h in the flume tank*

# ULSFO / Lubes – 2018 / 2019

## Weathering and dispersibility study (flume tank/"*Polludrome*"®)

- Rapid and significant emulsification (max. values @ ~24h)
  - » Water content: ~90%
  - » Viscosity: ~ 10,000 mPa.s
  - » Density: ~ 1.005
- pot. dispersible up to ~2,000 mPa.s (~10 hrs weathering in exp. conditions)
- Adhesion: increase with time (in relation w. viscosity)
  - – Potential for oleophilic skimmers
- Volume x10
  - – Storage capacities?

# ULSFOs : *IMAROS* project (2020-21)

**I**mproving response capacities and understanding the environmental impacts of new generation low sulphur **MAR**ine fuel **O**il **S**pills

## EC DG/ECHO funded

- Leader: Kystverket/NCA (NO)
- Partners: Swedish Coast Guard (SW) + RBINS (BE) + Royal Danish Navy (DK) + Cedre (FR) + Transport Malta (MT)

## Proposal: accepted by EU (sept. 2019)

- next: grant agreement → 2 yrs starting from jan. 2020

## Cedre's planned contributions:

- Characterisation: physico-chemical properties; weathering; ecotoxicity assessments
- Response options: chem. dispersion; ISB; shoreline cleanup; recovery

# Fate of oil spilled in tropical environment (French Guyana 2019/2020)

Partners : FR MoE; TOTAL

Additionnal expertise/support:

- CNRS (MIO, GDR *LiGA* French sci. res. Network)
- French Navy, CNES

Aim/Scope: assess natural weathering of crude oil before it reach French Guyana mangrove

1 - Weathering of a crude oil at sea under tropical conditions (*in situ* experiment) (Floating cells: 15 – 24 oct. 2019)

2 – Fate of weathered crude oil in coastal waters with increasing concentrations of suspended matter (*ex situ* experiment: tanks/oscillating table) (25 oct. – 12 nov. 2019)

# Oil spill response equipment – tests/assessments

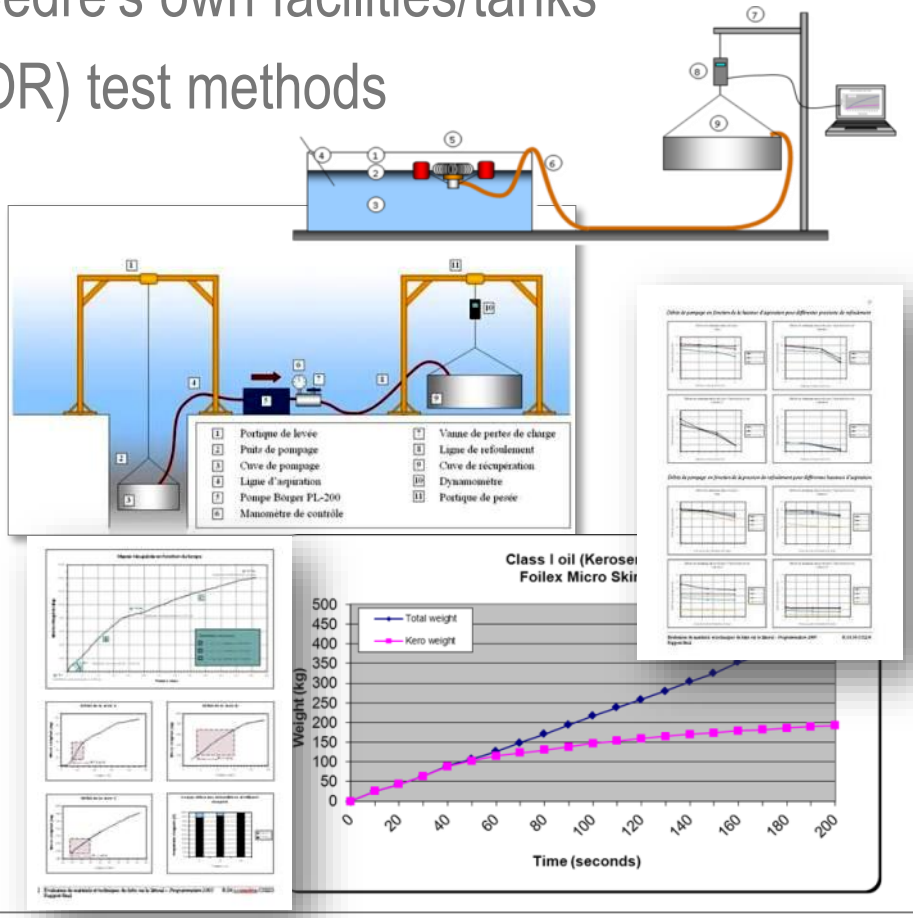
# Examples 2018-2019

# Skimmers, pumps, tests “as usual”

- measurement of performances
- in controlled environment ; Cedre’s own facilities/tanks
- according to standard (AFNOR) test methods

e.g. WINDTRANS - *ZELDA 2 HVLS* pump (*High Volume Low Speed*)

e.g. Elastec/MARCO *Portable Filterbelt*



# Field assessments

## C&R equipment for fast current/high speed waters

- **2013, 2015:** NOFI *Current Busters 4* & *2*
- **2017**: LAMOR *MOS 15*
  DESMI *Speed-Sweep*
- **2018**: Elastec *R3S*
  NORLENSE *Oiltrawl NO-T-600*
- **2019 (oct.)**: Paravanes

2015:

2017:

Estuary (Loire, France)

Fast currents, shallow waters
Potential risk for accidental spills (harbour, refinery, energy plant, …)
Sensitivities (economic, environmental)
Awareness of local stakeholders & industry

# Field assessments

## C&R equipment for fast current/high speed waters

2018:

*Elastec R3S*

*NORLENSE Oiltrawl NO-T-600*

2019: 4 paravanes

- » required bollard pull
- » operability: fold/unfold procedures, maneuverability, min./max. currents…
- » tensile/tractive force Vs. current speed
- » …

# 2018-19: Assessing sensors for oil punctual detection

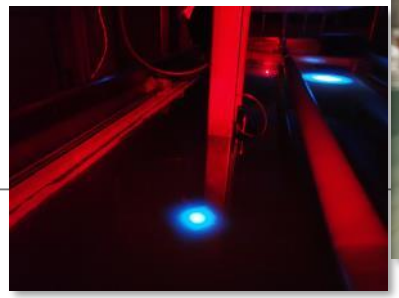
## Private contract/customer (industrial applications)

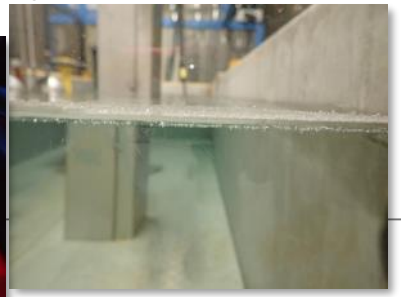
## Aim comparative assessment of performances for several oil sensors *available on the market*

## Content

- Tests/assessments carried out at Cedre, using its own facilities
- Design of project-specific ("custom") experimental/testing setups

  - ✓ Simultaneous assessment of 19 oil sensors (8 detection technologies)
  - ✓ Spills = [3 different oil/viscosities] **x** [2 weathering status (fresh, emulsif.)] **x** [various thicknesses (sheen → 10 cm)]
  - ✓ Ambient conditions (w/ -w/o): light; rain; ice; debris; turbidity…





# *Lizama 158* well (San Vicente de Chucuri, Santander, Colombia)

## Events

- 02→15 march 2018: crude oil seepage (next to a decommissioned well)
- estimated 90 cu.m spill in the river (est. from 23,900 cu.m of oil/water/mud collected)
- 20 km of contaminated streams (Lizama, Sogamoso,…) // rural/agricultural area
- Residents reloc. // water supply (residents; livestock…) // fishing ban

→ Human health, environ. impacts, livelihoods,… ?

## International support

- April 3rd : Colombia MoE requested technical assistance from *UN Environment*.
- International expertise team (Joint UNEP/OCHA Environment Unit)
- Cedre (1 expert) joins through EU Civil Protection's contribution (ERCC)

## Surveys/assessment for the benefit of Colombia MoE

- Situation report + pot. environmental impacts (3 weeks after the spill)
- Adequacy of initial response/cleanup ops by the RP; techn. advice

## *Pipeline leak* (Yvelines, France)

- feb. 2019 : pipeline leakage (rural area; 30km West from Paris)
- Estim. few hundreds cu.m. of crude;
  - Mostly contamination of 4 ha of agricultural land
  - Unknown vol. in small streams system *via* drainage system (→ 12 km contam.)

- Cedre's assistance requested/contracted by RP
  - Early response phase :
    - » surveys (watercourses/banks)
    - » technical advice/assistance in cleanup operations
    - » public meetings (local authorities)
    - » laboratory analysis (crude fate/behaviour: solubility, biodegradability, …)
  - Post-emergency monitoring:
    - » Soil/sediments contamination; baseline levels (biogenic/petrogenic?... ; meeting with authorities.

## *CSL Virginia* (07/10/2018 ; 15 n.m. north of *Cap Corse*)

- Stricken by *Ulysse* (RoRo-Passenger)
- Bunker fuel spill (≈ 550 $m^3$)
- At sea: mechanical recovery (FR Navy, IT, support from *EMSA*)
- Shoreline: 1st oiling events on D9

  - » Large geogr. extent: many sensitivities (socio-econ. environmental…)
  - » Patchy distribution of emulsified balls, lumps, patches…
  - » Extensive cleanup operations (16 oct. 2018 → summer 2019)

## – Cedre's involvement

- At sea: 1 expert in *Crisis Management Team* (FR maritime authorities)
- Shoreline: field expertise/ ops support (for Préfecture du Var)
  - Oiled shorelines surveys
  - Technical advice (cleanup techniques, endpoints…);
  - Cleanup ops follow-up, situation reports…

# V. Spill incidents: **recent incident response supports**

*Grande America* (10/03/2019; ConRo vessel; 200 n.m. off French coastline)

- 2,200 T. bunker fuel + 190 T. diesel // 365 (45 HNS) cont. // 2,200 vehicles
- Fire/explosions – sank on 12/03 (4,600 m depth)
- Oil leaks – slicks spotted on 13/03
- At sea: mechanical recovery (FR Navy + support from ES & EMSA)
- … no shoreline oiling (days, weeks, months…)

– Cedre's involvement:

- 24/7 « emergency room » + briefings w. FR maritime authorities
  - HNS risk assessment
  - Expertise in support of at-sea response ops (French Navy)
    - » Oil behaviour (lab. analysis, weathering/behaviour )
      → response techniques/options
    - » Coord. « drift assessment committee » (daily modelling/reporting)
- Advise to coastal authorities (anticipation of shoreline pollution)

Cedre

www.cedre.fr

# Thank you
# for your attention

Droits réservés *Cedre* - Diffusion et reproduction interdites