

The application of Medslik to the Lebanon oil spill case

G. Coppini (CMCC), M. De Dominicis (INGV), G. Zodiatis (OC-UCY), R. Lardner (OC-UCY), N. Pinardi (INGV), R. Santoleri (CNR-ISAC), S. Colella (CNR-ISAC), F. Bignami (CNR-ISAC), D.R. Hayes (OC-UCY), C. Soloviev (OC-UCY), G. Georgiou (OC-UCY), G. Kallos (UAth)

Marine Pollution Bulletin 62 (2011) 140–153



ELSEVIER

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul



Hindcast of oil-spill pollution during the Lebanon crisis in the Eastern Mediterranean, July–August 2006

Giovanni Coppini ^{a,b,*}, Michela De Dominicis ^a, George Zodiatis ^c, Robin Lardner ^c, Nadia Pinardi ^b, Rosalia Santoleri ^d, Simone Colella ^d, Francesco Bignami ^d, Daniel R. Hayes ^e, Dmitry Soloviev ^c, Georgios Georgiou ^c, George Kallos ^e

^aIstituto Nazionale di Geofisica e Vulcanologia, Sezione di Bologna, Italy

^bCentro Interdipartimentale di Ricerca per le Scienze Ambientali, Università di Bologna, Ravenna, Italy

^cOceanography Centre, University of Cyprus, Nicosia, Cyprus

^dConsiglio Nazionale delle Ricerche, Istituto per le Scienze dell'Atmosfera e del Clima, Rome, Italy

^eUniversity of Athens, Athens, Greece

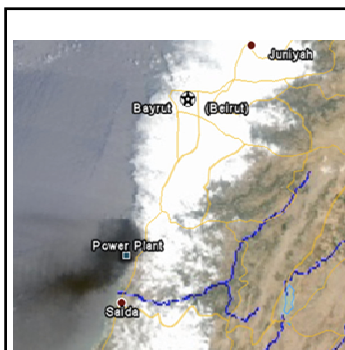


Outline

- Jieh power station (Lebanon) and the accident
- The response of MOON partners
- The monitoring and forecasting of the oil spill
- Conclusion



Jieh location and on-shore position of the Jieh power station taken from Google Earth before the crisis



Accident factsheet:

- 1) The spill occurred in mid-July 2006 from the Jieh power plant, which is located 30 km south of Beirut, probably as a result of two bombing raids on the mornings of 13 and 15 July.
- 2) The amount of oil spilled was variously reported as being between 15,000 and 20,000 tons. According to UNEP information (UNEP, 2007), the oil contained in the tanks was heavy IFP-number 6 fuel

MODIS AQUA image 16 July (08:30 GMT). A black smoke plume is visible and bombing has occurred.



MODIS AQUA image July 17 10:50 GMT: smoke continues



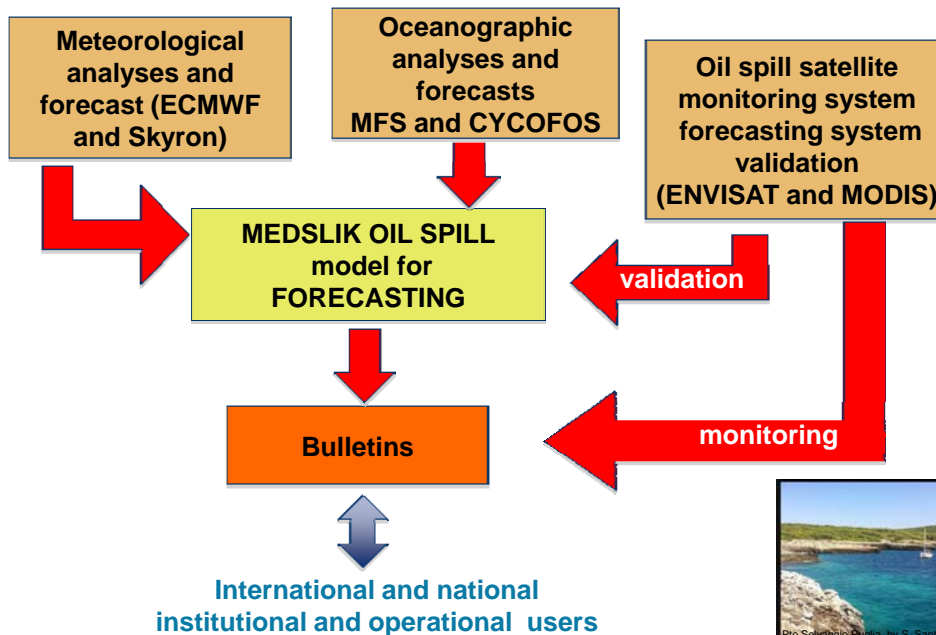
Puglia, by S. Santini

The response on MOON partners

- OC-OCY and INGV prepared bulletins for regional and national authorities (REMPEC, Lebanese Ministry of Environment, Italian Ministry of Environment)
- Later the accident was used as a test based for monitoring and forecasting system validation by MOON partners (INGV, OC-UCY, CNR-ISAC, Univ of Athens, Univ. of Bologna),
see Coppini et al. 2011



Monitoring and forecasting integrated service



Model runs and sensitivity experiments.

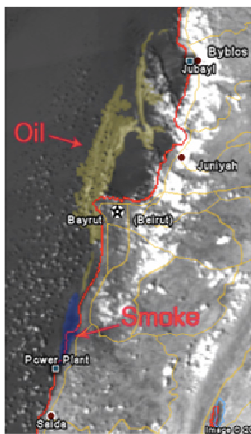
In experiments 1 and 2, the hydrodynamics models MFS and CYCOFOS and the oil-spill model MEDSLIK were used in the basic configuration.

Experiments 3, 4, 5 and 6 evaluated the responses of MFS to changes in the wind parameters and in the current-transfer depth.

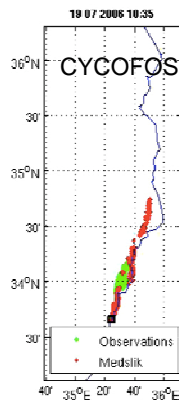
	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6
Current field	CYCOFOS (6-hourly forecast)	MFS (1-hourly mean forecast)	CYCOFOS (6-hourly forecast)	MFS (1-hourly mean forecast)	CYCOFOS (6-hourly forecast)	MFS (1-hourly mean forecast)
Wind field	SKIRON (1-hourly forecast)	ECMWF (6-hourly mean forecast)	SKIRON (1-hourly mean forecast)	ECMWF (6-hourly mean forecast)	SKIRON (1-hourly forecast)	ECMWF (6-hourly mean forecast)
Spill position	33°40'N 35°24.75'E	33°41'N 35°10'E	33°40'N 35°24.75'E	33°41'N 35°10'E	33°40'N 35°24.75'E	33°41'N 35°10'E
Start spill date	13/07/2006 08:00	13/07/2006 08:00	13/07/2006 08:00	13/07/2006 08:00	13/07/2006 08:00	13/07/2006 08:00
Spill duration	144 h	144 h	144 h	144 h	144 h	144 h
Total mass of spill	18,770 tons	18,770 tons	18,770 tons	18,770 tons	18,770 tons	18,770 tons
Type of oil	API = 20	API = 20	API = 20	API = 20	API = 20	API = 20
Wind-correction factor	3%	3%	0	0	1.2%	1.2%
Wind angle factor	0	0	0	0	0	0
Current depth	30 m	30 m	Surface	Surface	Surface	Surface
Number of particle released	90,000	90,000	90,000	90,000	90,000	90,000



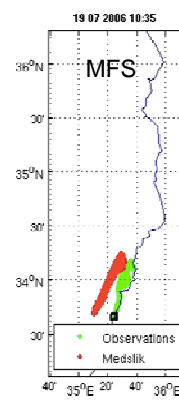
18 July oil spill monitoring and forecasting



MODIS AQUA image from 19 July 2006 at 10:35 GMT.

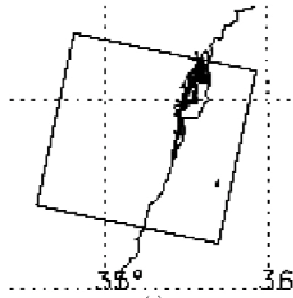


position of the oil slick on 19 July at 11:00 GMT (after 147 h) as predicted by CYCOFOS.

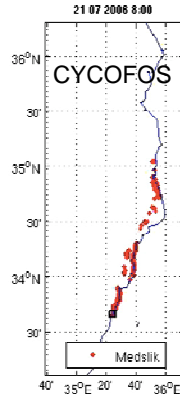


position of the oil slick on 19 July 2006 at 11:00 GMT (after 147 h) as predicted by MFS.

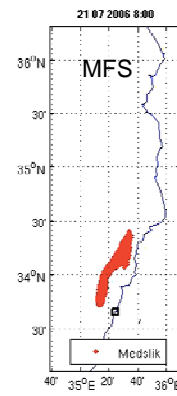
21 July oil spill monitoring and forecasting



The ASAR ENVISAT image for day 21 Oil spill (black) is mostly located in the gulf of Beirut but has already reached Chekka, located south of Tripoli.



The position of the oil slicks (red) as predicted for 21 July at 8:00 GMT (after 192 h) by CYCOFOS

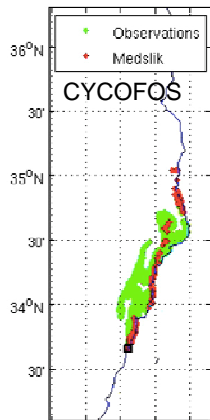


The position of the oil slicks (red) predicted for 21 July at 8:00 GMT (after 192 h) by MFS.

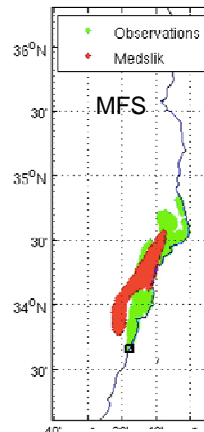
23 July oil spill monitoring and forecasting



MODIS AQUA images from 23 July 2006, 8:35 GMT. The oil (green) is already in Tripoli. Mushroom-like feature.

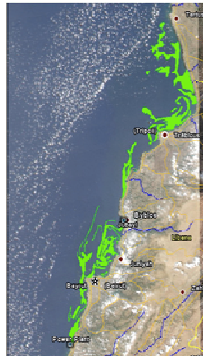


The positions of the oil slicks and oil concentrations predicted by CYCOFOS (red) on 23 July at 9:00 GMT (after 241 h) compared with the slick observed by MODIS (green),

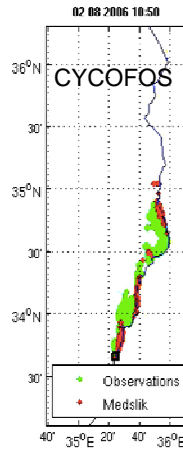


The positions of the oil slicks and oil concentrations predicted by MFS (red) on 23 July at 9:00 GMT (after 241 h) compared with the slick observed by MODIS (green),

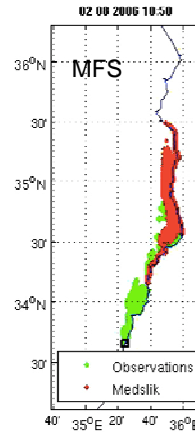
2 August oil spill monitoring and forecasting



Magnified portion of the MODIS AQUA image from 2 August at 10:50 GMT: Oil (green) is still located in the gulf between Tripoli and Tartus. There is no evidence of oil in the gulf between Tartus and Latakia.

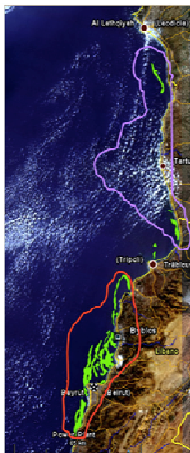


The positions of the oil slicks and oil concentrations predicted by CYCOFOS for 2 August at 11:00 GMT (after 483 h) compared with the slick observed by MODIS (green),

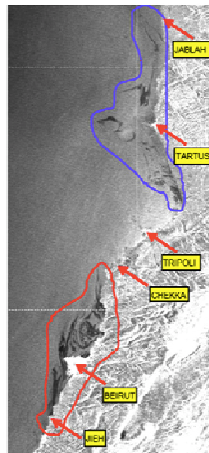


The positions of the oil slicks and oil concentrations predicted by MFS for 2 August at 11:00 GMT (after 483 h) compared with the slick observed by MODIS (green),

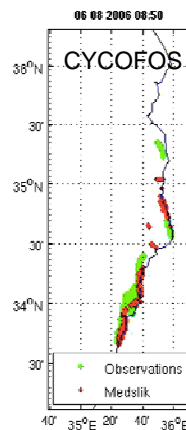
6 August oil spill monitoring and forecasting



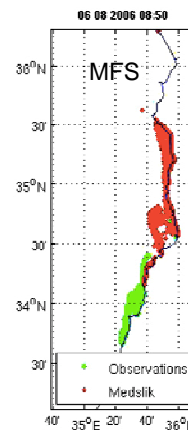
MODIS TERRA image at 8:50 GMT;



ASAR image at 7:51 GMT, courtesy of ESA and JRC

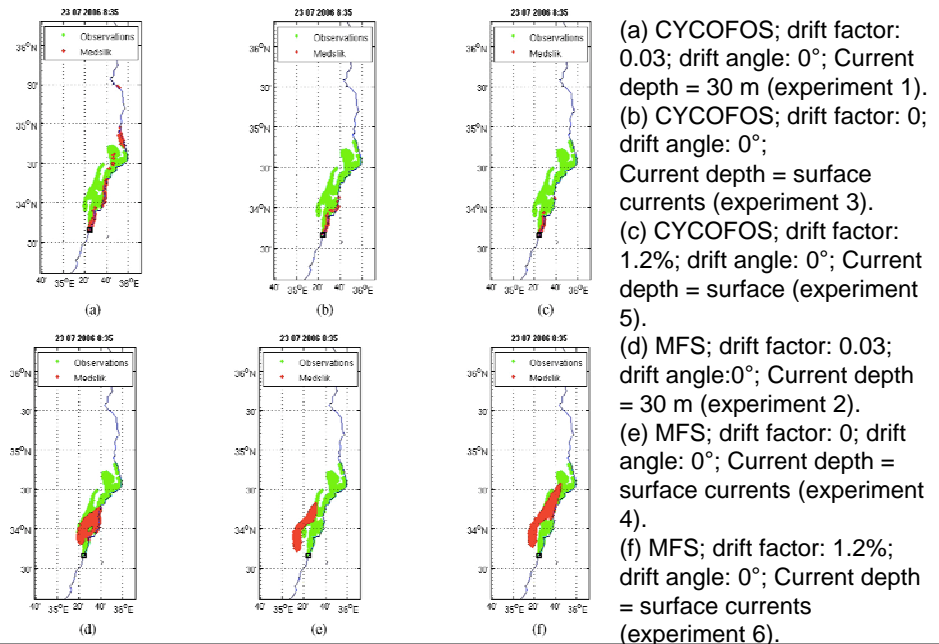


The positions of the oil slicks predicted by CYCOFOS (red) on 6 August at 9:00 GMT (after 576 h) compared with the slick observed by MODIS (green).



The positions of the oil slicks predicted by MFS (red) on 6 August at 9:00 GMT (after 576 h) compared with the slick observed by MODIS (green).

Comparison of MFS and CYCOFOS simulations (red) for 23 July 2006 using different wind parameters and current depths and the oil-slick extent shown by the MODIS TERRA 8:35 GMT satellite image (green).



Conclusions

- The Lebanon oil-pollution event is the largest such incident in the Eastern Mediterranean Sea to date. The oil spill affected most of the Lebanese coast and, as the oil spill drifted northward for more than a month, reached the southern Syrian coast.
- During the entire period of the Lebanese oil-pollution crisis in July–August 2006 MOON was able to provide daily information on the displacement of the oil slicks.
- Operational oceanography providing satellite images and real-time forecasts (currents and oil spill), made possible to precisely map oil-spill damage, even close to the coast.
- The integration of different satellite observing products (ASAR, MODIS) used for oil-slick detection and for validation of the MEDSLIK oil-spill drift predictions are robust and capable of providing valuable operational information during this oil-spill accident.

Conclusions

- Sensitivity experiments to different deterministic oil-spill drift factors show that the best results still requires ad hoc tuning of parameters such as the current depth from the hydrodynamic model and the wind-drift factor and angle.
- The MFS vs CYCOFOS comparison shows that the CYCOFOS currents better represent the coastal trapping of the oil. This difference in performance is due to the higher horizontal resolution of the CYCOFOS forecasting system.
- The coastal impact was observed to be heaviest from Jieh up to south of Beirut, but significant impacts between Beirut and Chekka and northward along the Syrian coast were also reported. MEDSLIK coupled to MFS probably overestimated the northernmost part of the slick on the Syrian coast, even though the validation of this hindcast is difficult because the quantities of oil that reached the northern Syrian shores were not clearly reported.