Modeling of oil spill dispersion in the southeastern Mediterranean Sea

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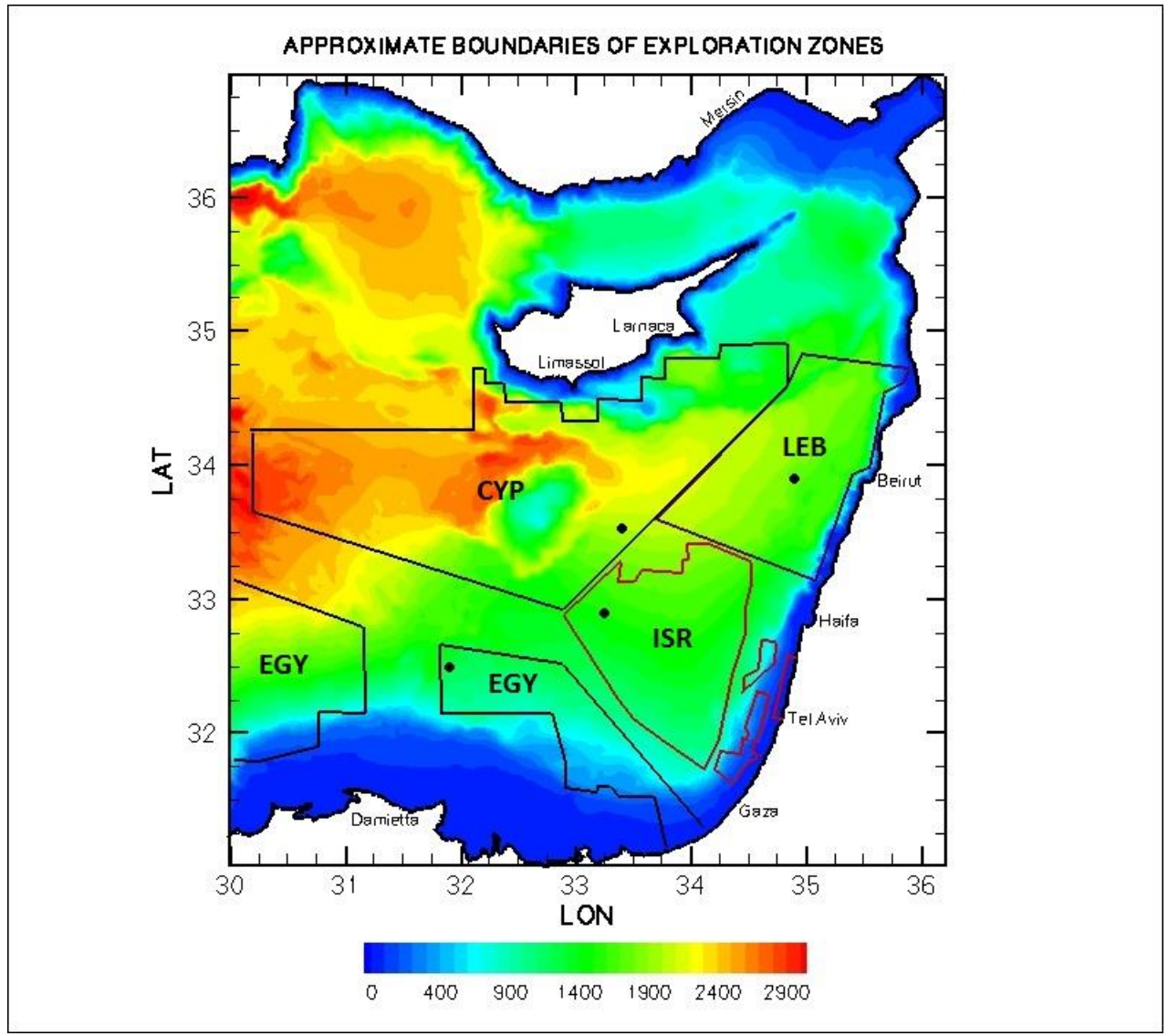
פורום אנרגיה: שיקולים סביבתיים, כלכליים, וביטחוניים במיקום אסדת הגז ממאגר לוויתן
7 ביוני 2018, מוסד שמואל נאמן, הטכניון

USGS assessment in 2010 of potentially recoverable natural gas and oil

- 3.45 billion m^3 of natural gas

- 1.7 billion bbl of oil

Exploration and drilling zones of Cyprus, Egypt, Israel, and Lebanon



Components of an oil spill model

- Processes to include
  - Winds
  - Current
  - Weathering
- Potential sources of meteo-oceanographic data
  - In situ measurements at the platform
  - Climatological (seasonal or monthly mean) data
  - Gridded analysis and forecast data
- Types of model
  - Progressive vector diagram (PVD)
    - Limited in time and space
    - No predictive capability
  - Ocean forecasting system + oil spill module
    - Higher spatial and temporal resolution → more accurate simulation
    - Prediction with lead time of several days to several weeks

MEDSLIK Oil Spill Model

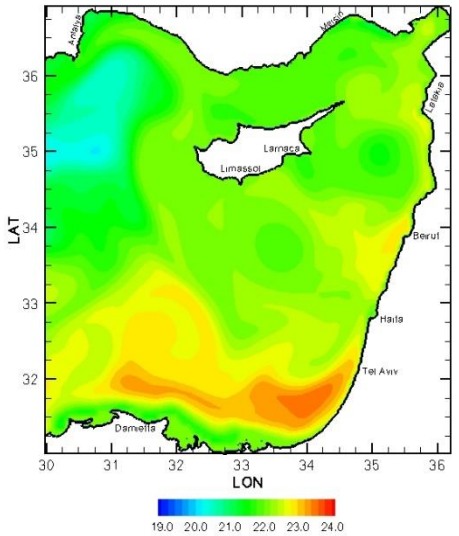
- Developed at the Cyprus Oceanographic Center
- Oil is assumed to consist of a collection of Lagrangian particles (trajectories) dispersed by
  - Currents
  - Wind drift
  - Random walk turbulent mixing
- Weathering of the oil through physio-chemical processes
  - Evaporation
  - Emulsification
  - Small scale (vertical) mixing
- Has been incorporated as part of the Mediterranean Operational Oceanography Network/MyOcean
- Has been used in regional exercises conducted by Cyprus-Egypt-Israel
- Current model of choice of the MOEP

Meteo-oceanographic conditions

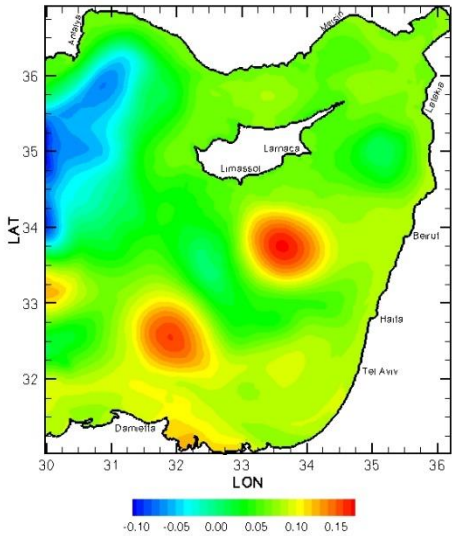
- Model domain
  - “Levantine domain” - 1/60 degree resolution
- Hydrodynamic simulations for dynamic downscaling
  - Princeton Ocean Model (POM)
    - 3D, time dependent, free surface, primitive equations model
  - Initial and lateral boundary conditions extracted from daily MOON/Myocean reanalysis*
  - Wind stress from the 6 hourly ERA-Interim reanalysis*
  - Surface temperature and salinity nudged to ocean reanalysis*
  - Spin up for 3 days
  - Worst case scenarios – 30 day well blowouts for 4 different sets of representative environmental conditions (typical and extreme)

* Conditions can also be extracted from forecast systems

Snapshot example of meteo-oceanographic conditions used to run the oil spill module

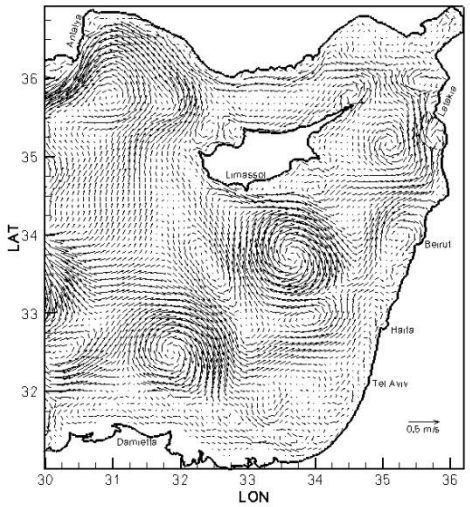


SST

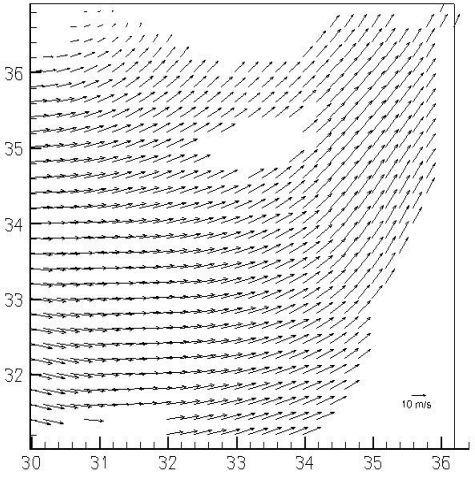


FREE SFC HGT

CURRENTS

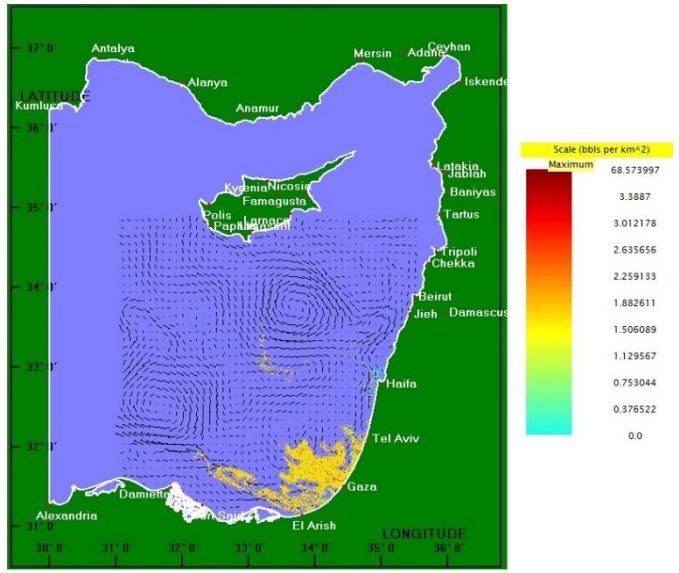


WIND

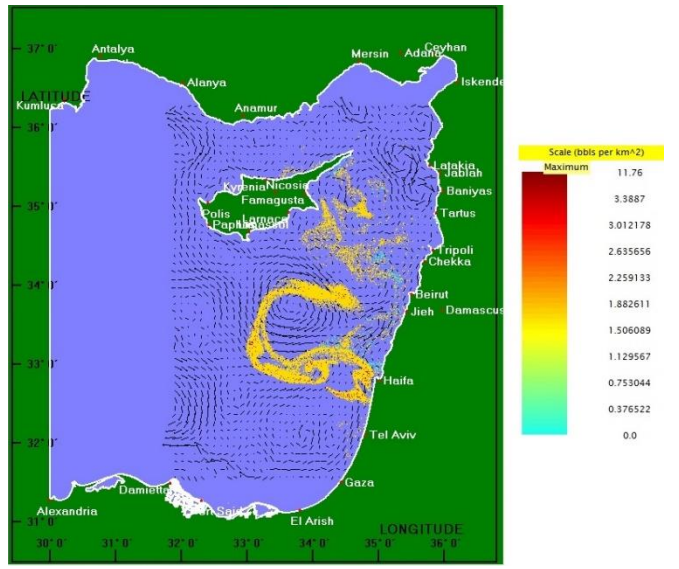


Wells in Israeli EEZ, Dec 2010 - Oil on surface

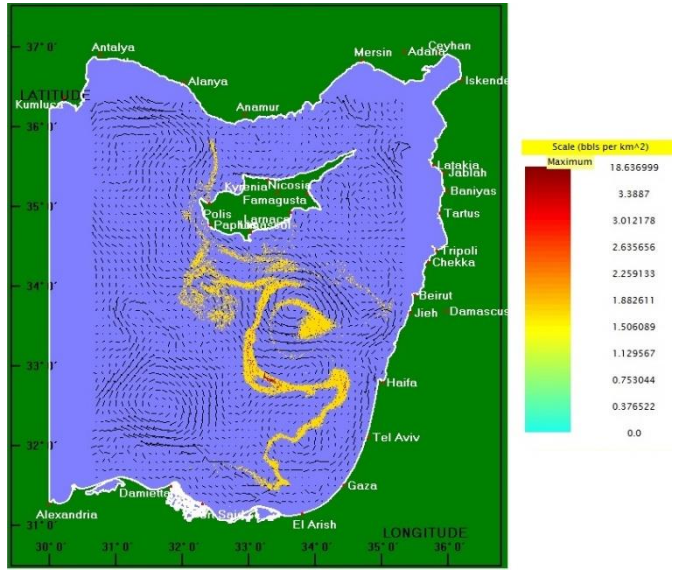
SHELF
(20 km)



SLOPE
(70 km)

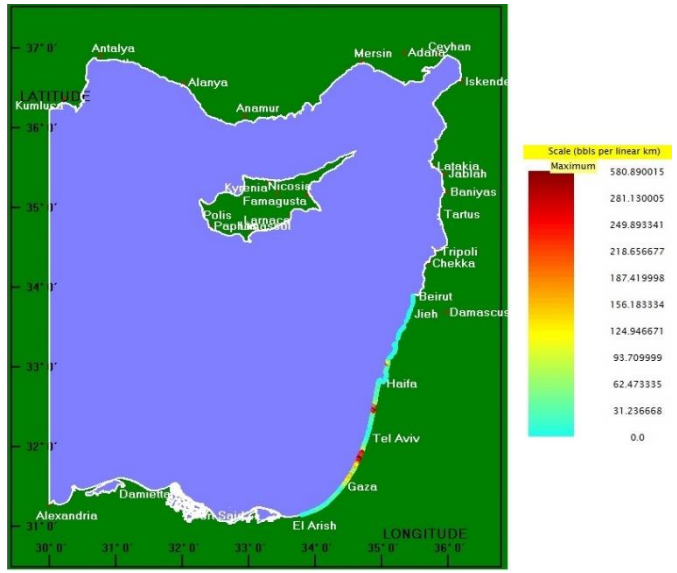


DEEP
(140 km)

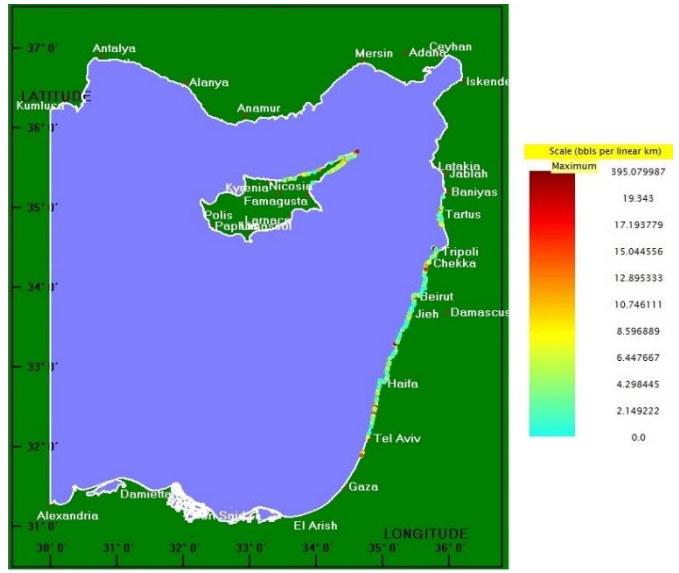


Wells in Israeli EEZ, Dec 2010 - Oil on coast

SHELF



SLOPE



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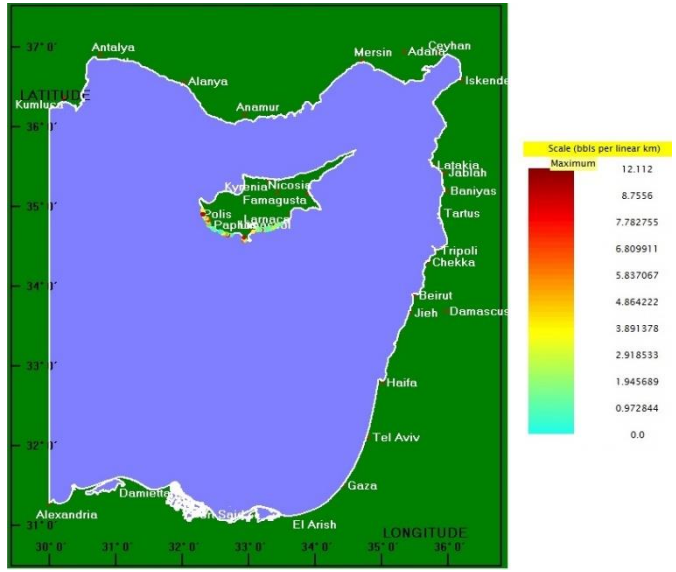
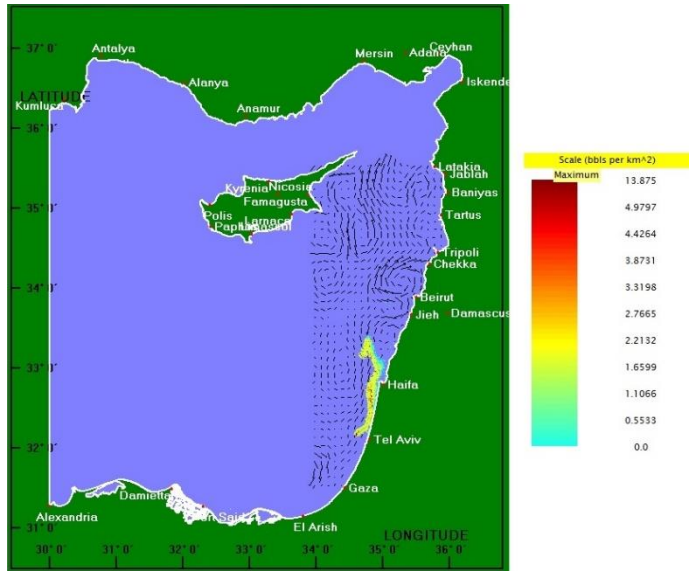
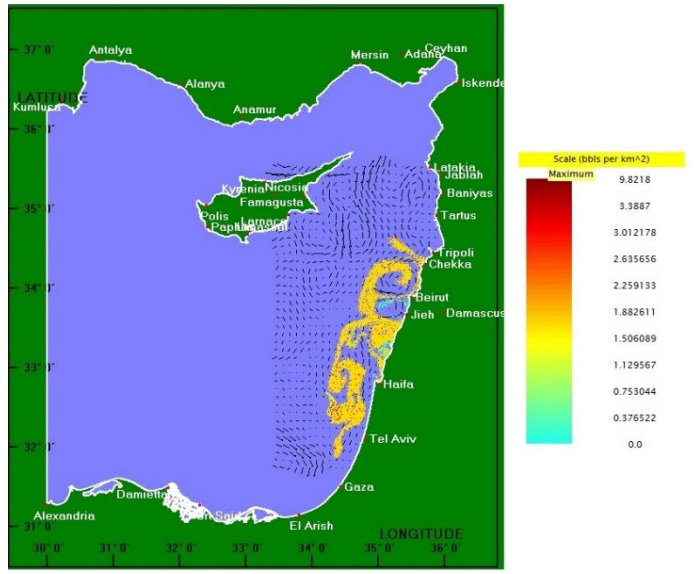


Wells in Israeli EEZ, Sep 2007 - Oil on surface

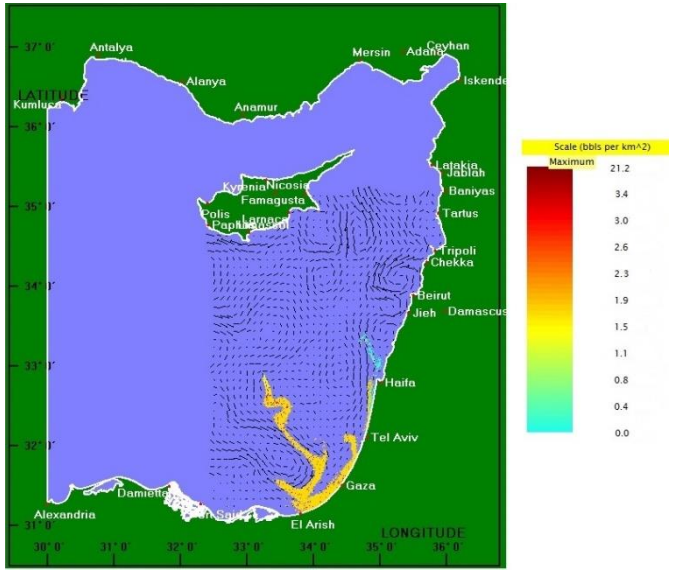
SHELF
(20 km)





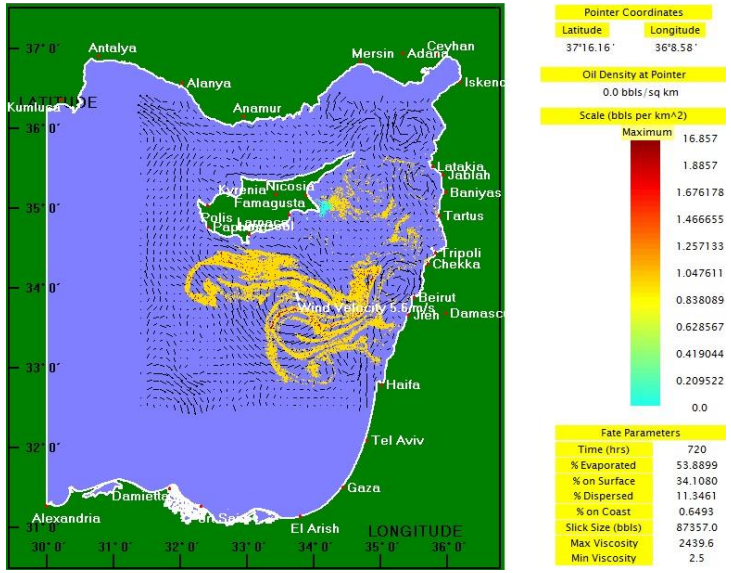
SLOPE
(70 km)

DEEP
(140 km)



Deep water wells – Dec 2010 - Oil on surface

CYP



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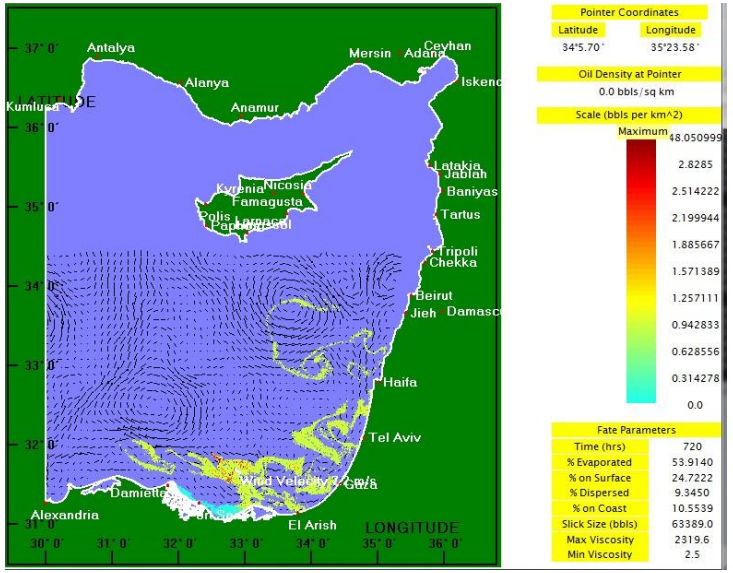
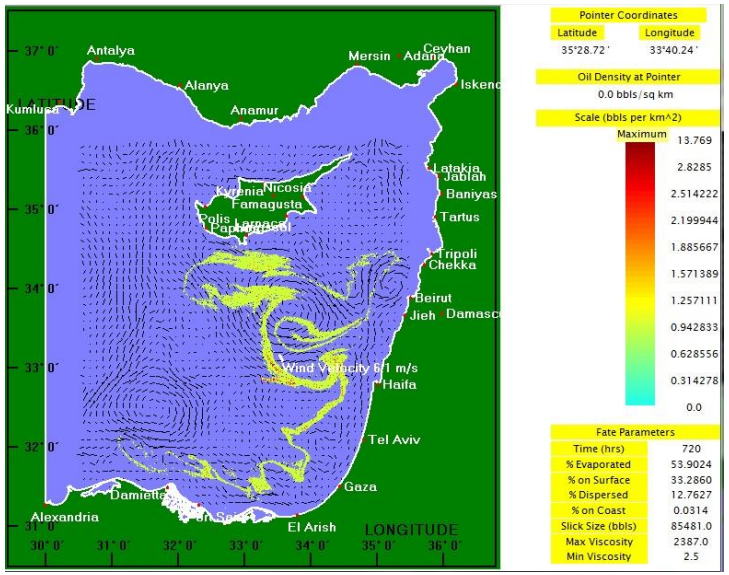
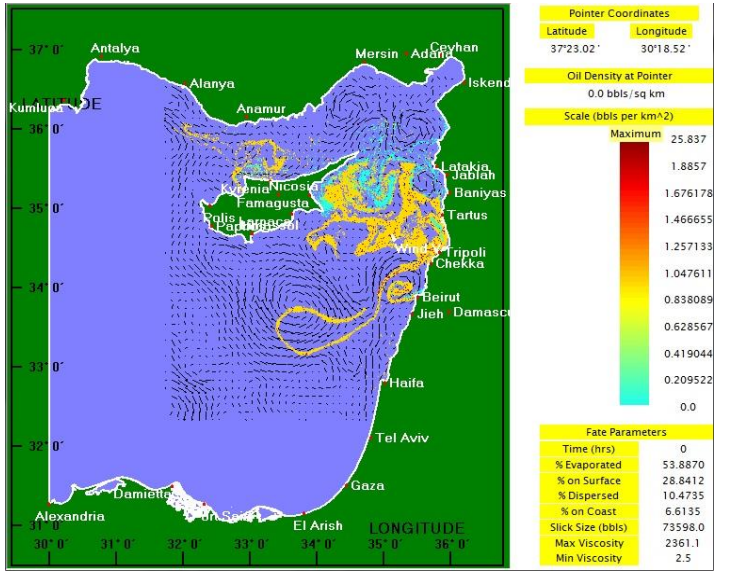


ISR

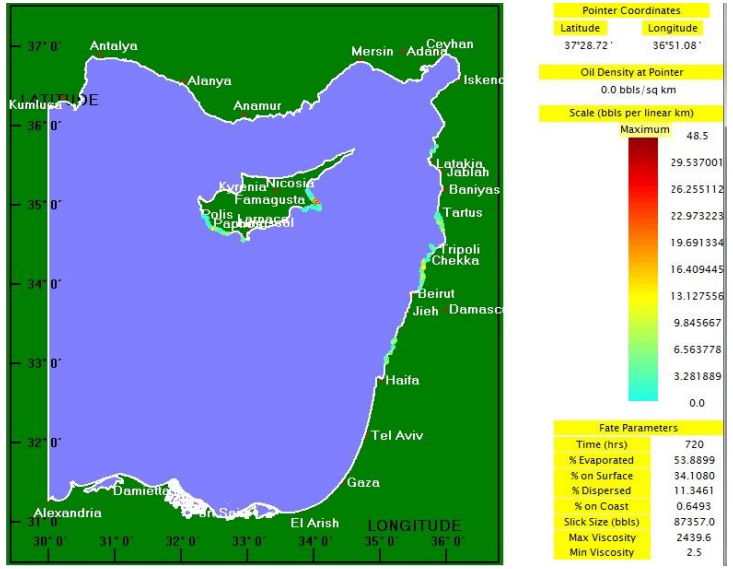


LEB



Deep water wells – Dec 2010 - Oil on coast

CYP



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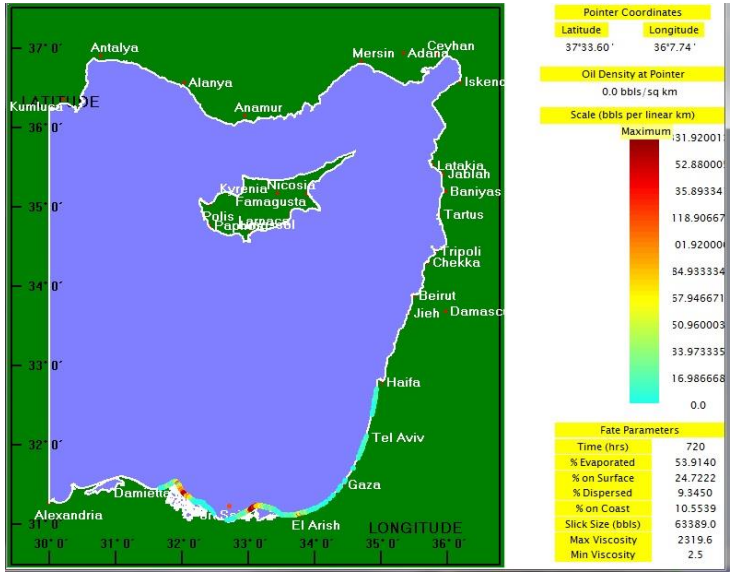

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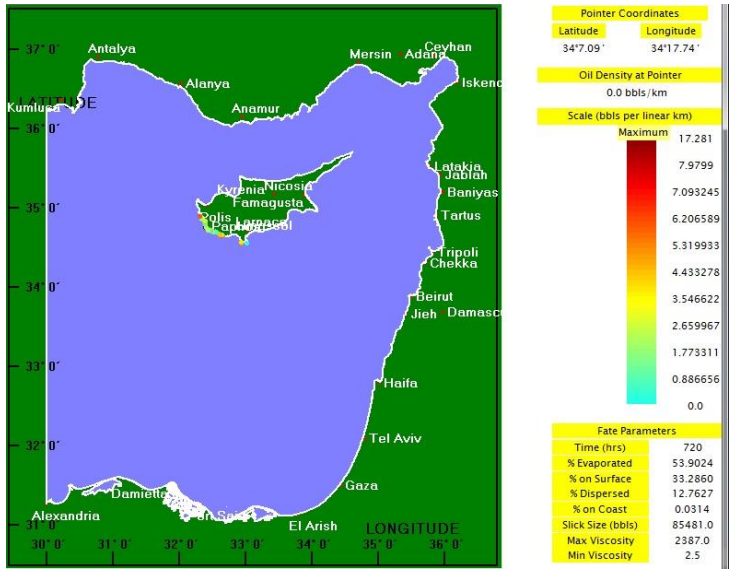

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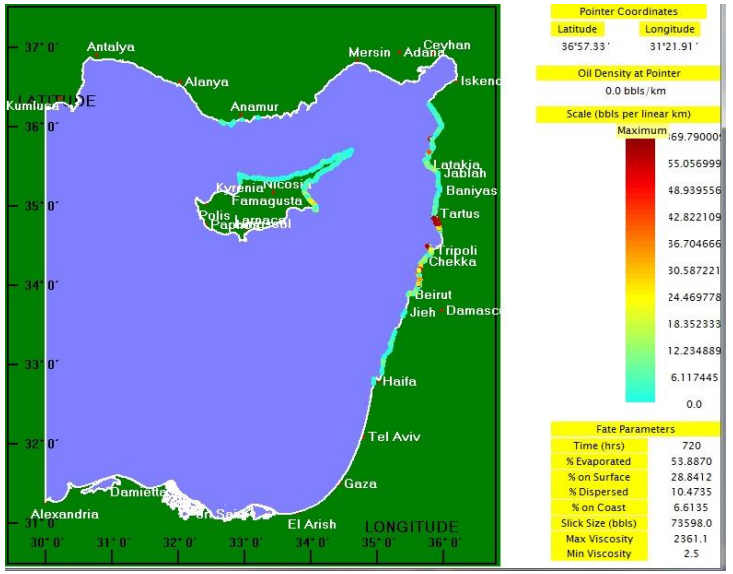
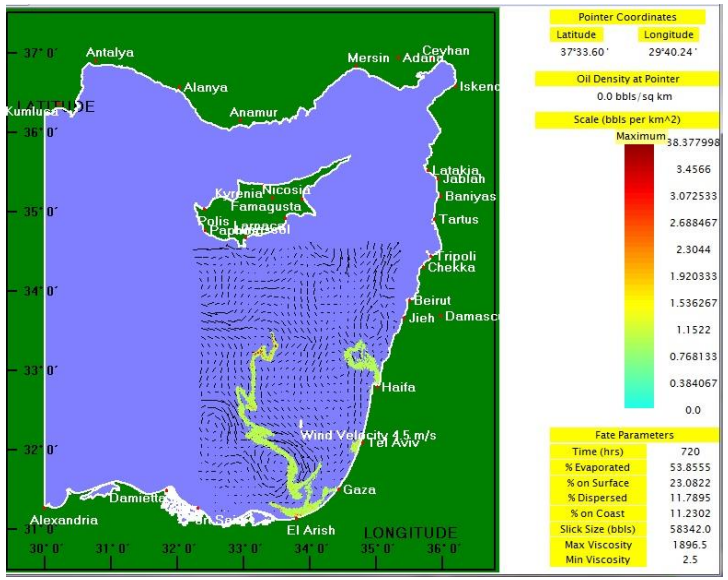


Deep water wells – Sep 2007 - Oil on surface

CYP



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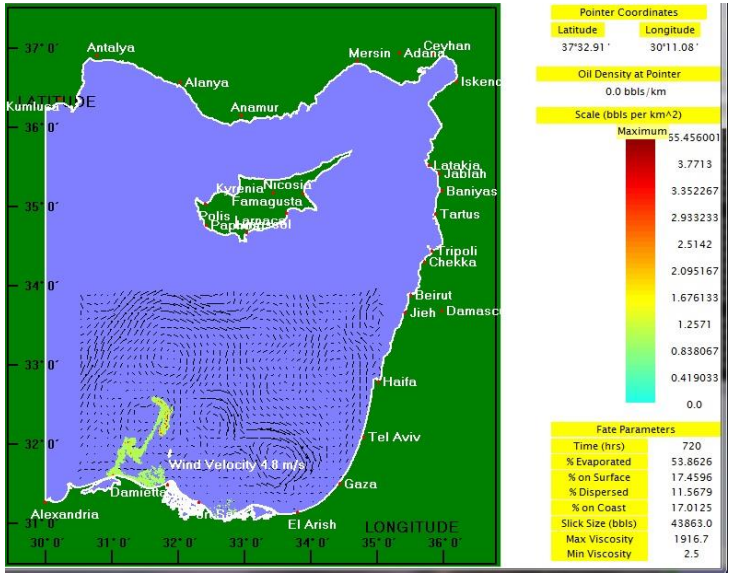

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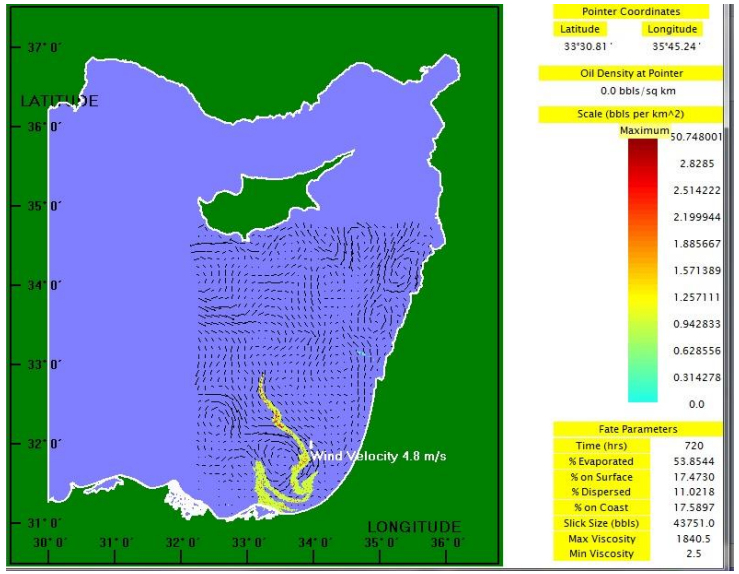

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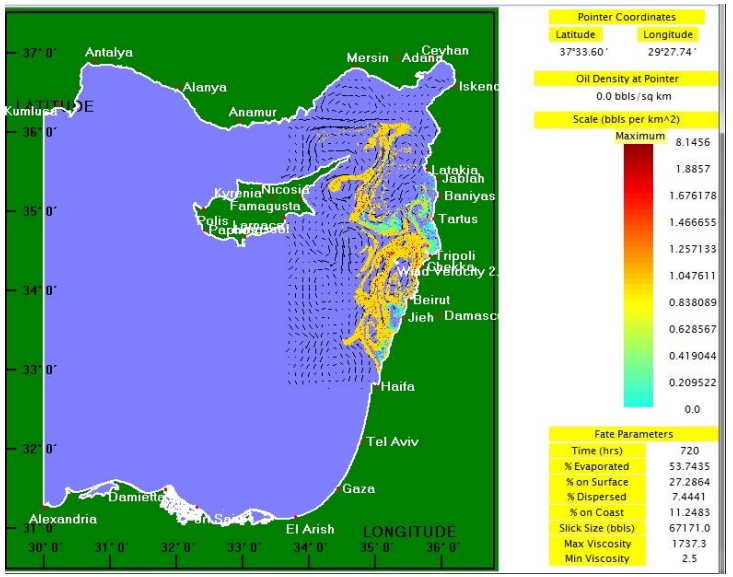

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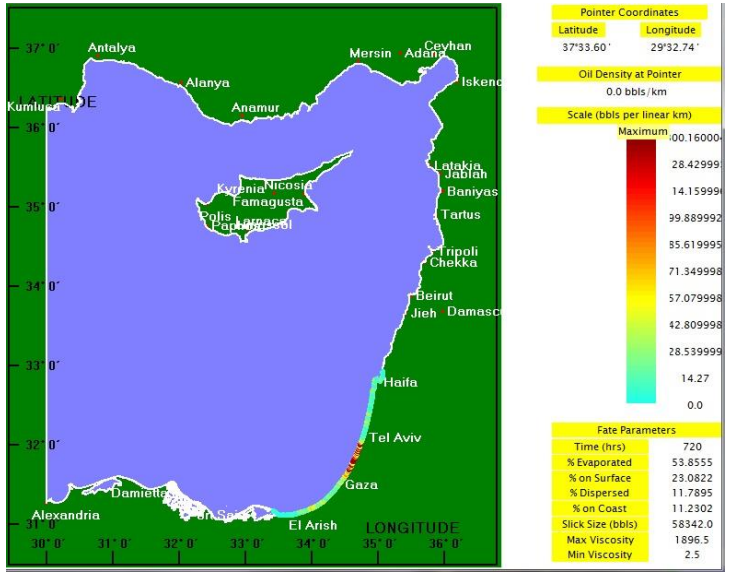

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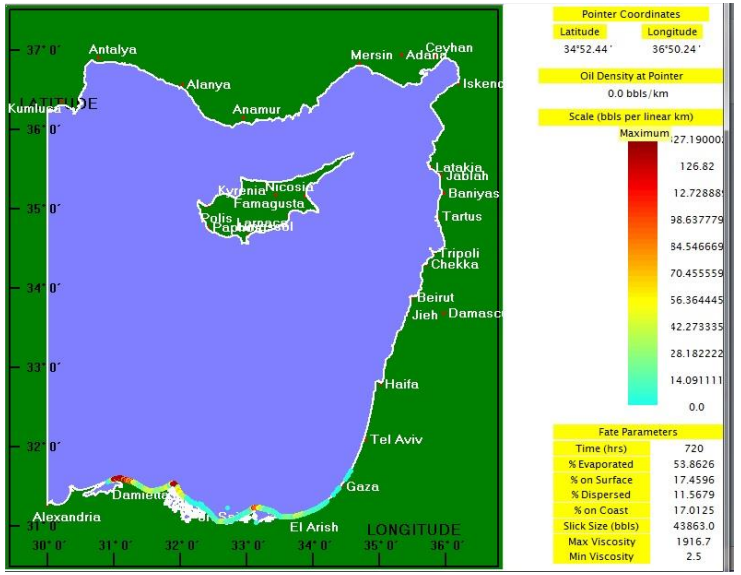

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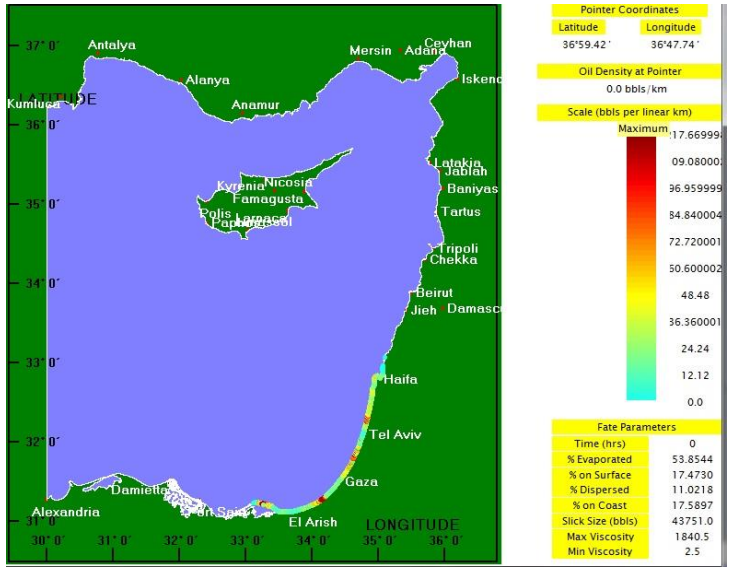

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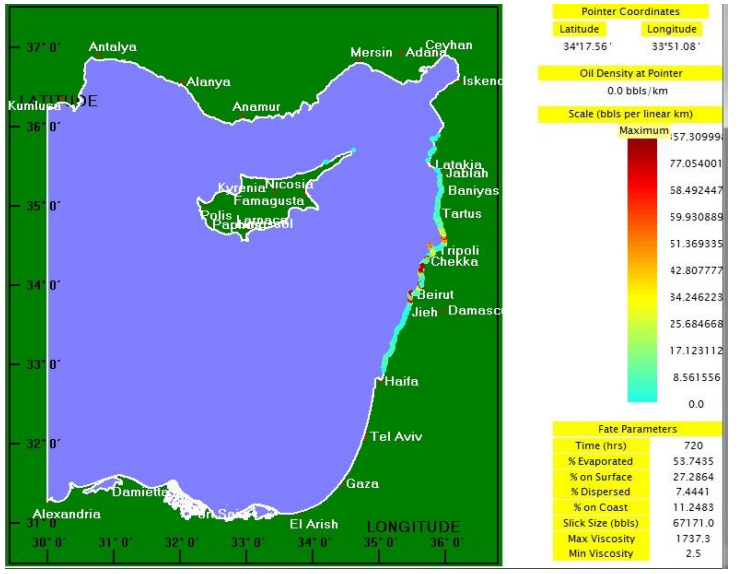

Conclusions

- Better meteo-oceanographic conditions and better models will provide more reliable simulations or predictions
- Wells closer to shore are more likely to lead to coastal deposition, but most adversely affected area maybe more limited
- Very high potential for cross border transport of oil slicks, especially from deep water wells
- NIMBY or “out of sight out of mind” will not work since drilling by any of the countries in the region may affect its neighbors