OIL SPILL TRAJECTORY PREDICTION IN INDIAN WATERS USING GNOME

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OUTLINE

- OIL SPILL /TYPES/SOURCES/ICG STATISTICS
- ENVIRONMENTAL IMPACT DUE TO OIL SPILLS
- NEED FOR AN OIL SPILL TRAJECTORY PREDICTION SYSTEM
- OIL SPILL MODELING AND TRAJECTORY FORECASTING SYSTEM AT INCOIS
- CASE STUDY
- EXPERIMENTAL SET UP OF ONLINE OIL SPILL ADVISORY SYSTEM

OIL SPILL /TYPES/SOURCES/ICG STATISTICS

WHAT IS AN OIL SPILL

- Release of liquid petroleum hydrocarbon into land /water body
- Form of water pollution

TYPES OF SPILL

Tier -1 < 7 Tonnes

Tier -2 >7 <700 Tonnes

Tier - 3 > 700 Tonnes

Natural seepage from seabed

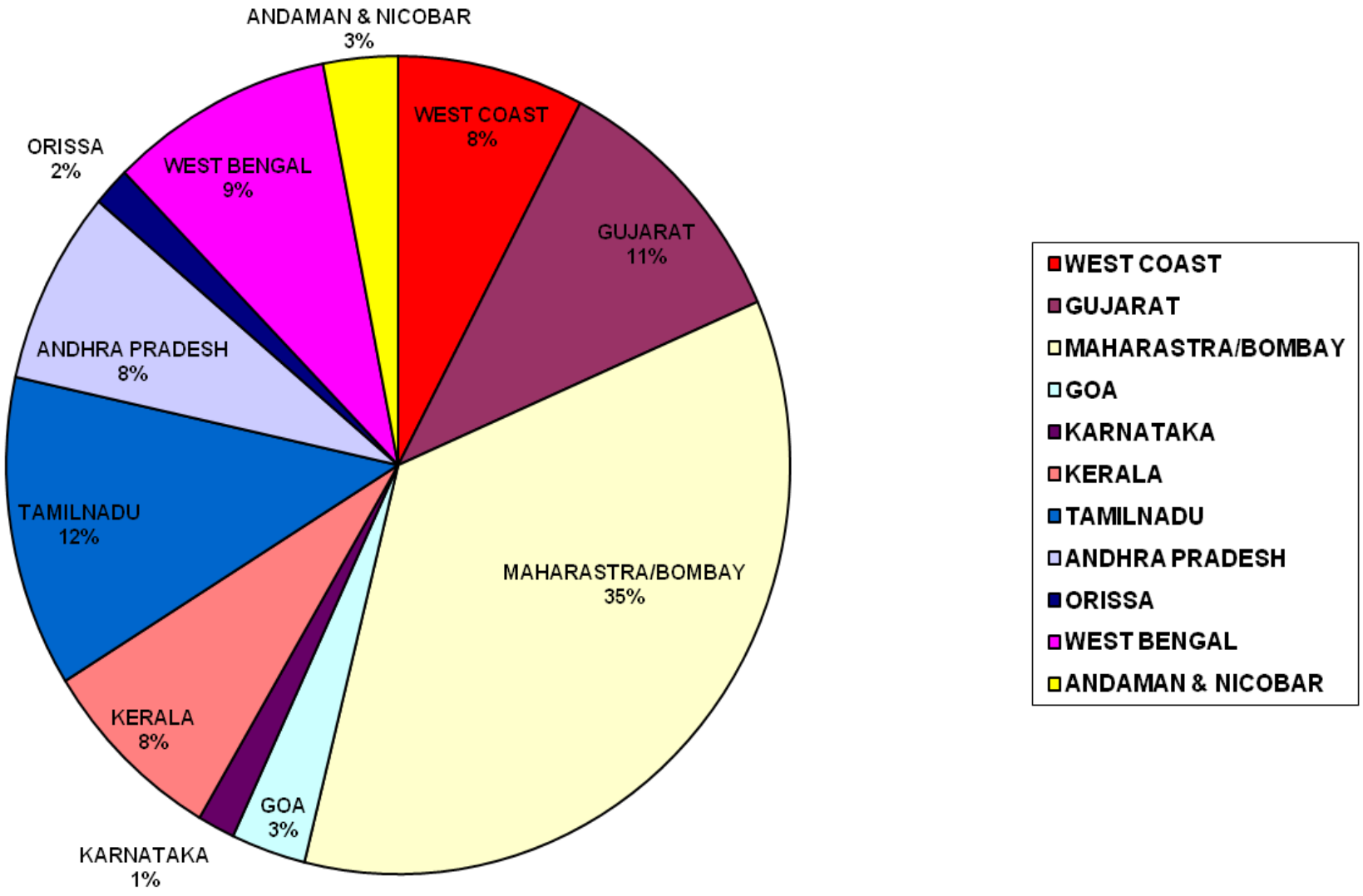
Ship-borne

SOURCES OF OIL SPILLS

Upstream Exploration and Production

Transfer to Downstream

OIL SPILLS ALONG THE COASTAL ZONES



Source : Indian coast Guard

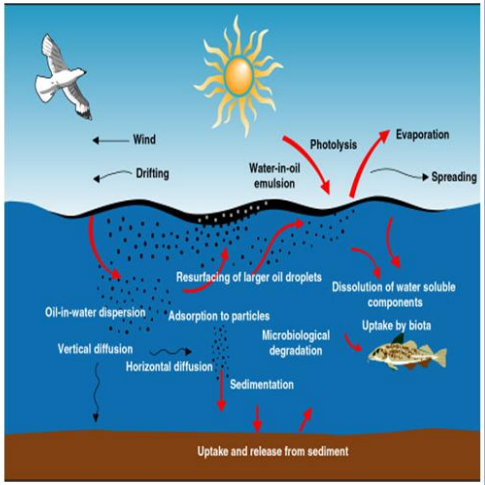
ENVIRONMENTAL IMPACTS DUE TO OIL SPILLS

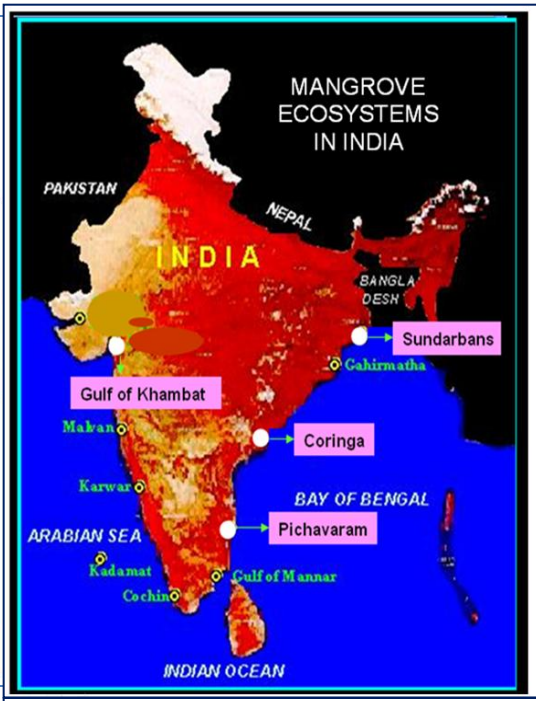
OIL WEATHERING

Oil weathering is defined as the process that makes changes in chemical composition and physical characteristics over time.

Soon after an oil spill incident, the following process will happen

- **Emulsion (water in oil)**
- **Dispersion (Oil in water)**
- **Evaporation**
- **Spreading**
- **Adsorption**
- **Drifting**





IMPACTOF OIL IN MANGROVES

- Light fuels oils can cause mortality in 24-48 hours in red mangroves and black mangroves.
- Crude oils – coat the prop roots and reduce the ability to exchange gases.
- Long term persistence – cause leaf loss and to death.

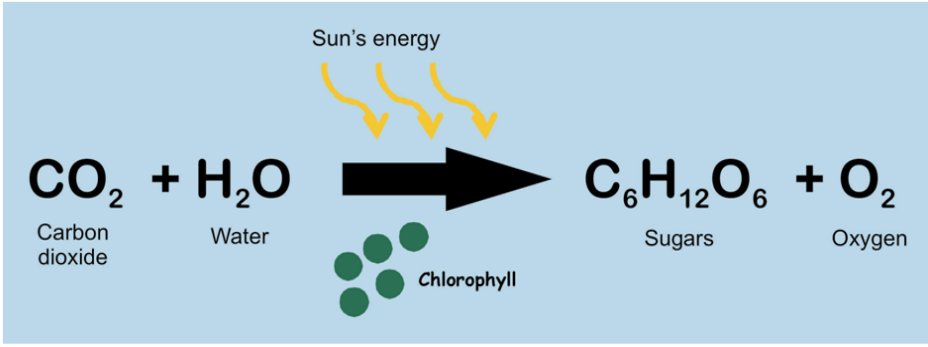
SIGNIFICANCE OF CORAL REEFS

- Coral reefs - natural barriers that protect nearby shorelines from the eroding forces of the sea,
- Coral reefs cover less than 1% of the Earth's surface, they are home to 25% of all marine fish species.

IMPACT OF OIL IN CORAL REEFS

- Effect the health of the larger reef community
- Some of the more territorial fish will even remain in the area until death.

IMPACT ON PHOTOSYNTHESIS IN THE MARINE ENVIRONMENT

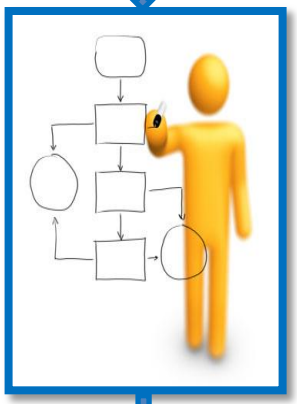


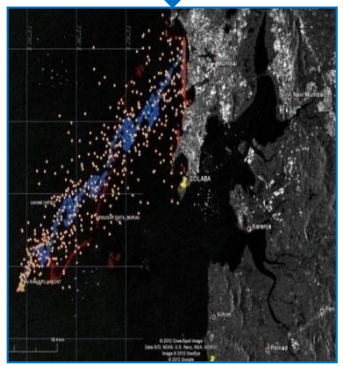
Phytoplankton can only carry out this process where there is sufficient light intensity penetrating the sea water. This area is called the ***photic zone*** and is often at the top 100 metres of the ocean.

Heavier oils will cover the surface, thereby not allowing the sunlight to penetrate.

NEED FOR OIL SPILL TRAJECTORY PREDICTION SYSTEM

DISSEMINATION OF OIL SPILL ADVISORY TO USERS



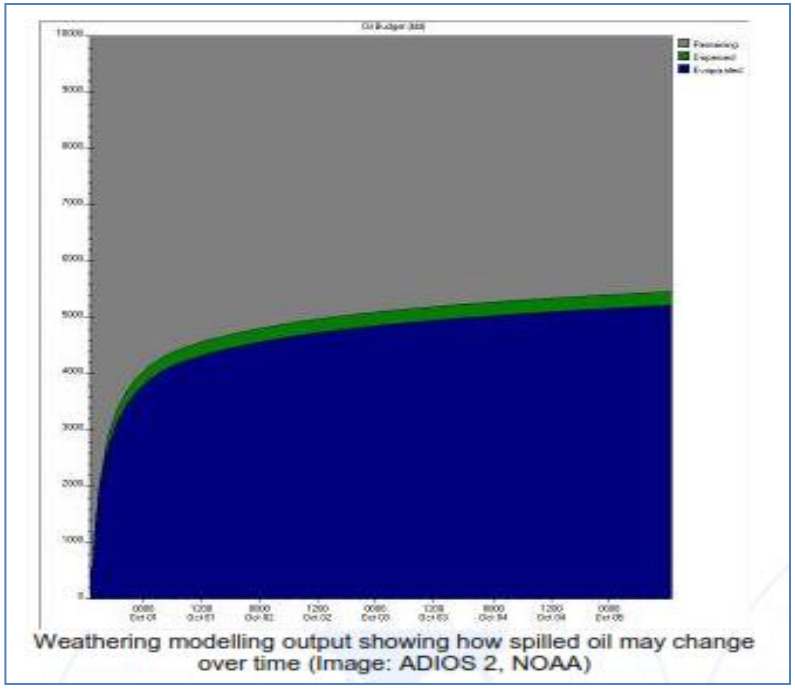


SIGNIFICANCE OF OIL SPILL TRAJECTORY PREDICTION

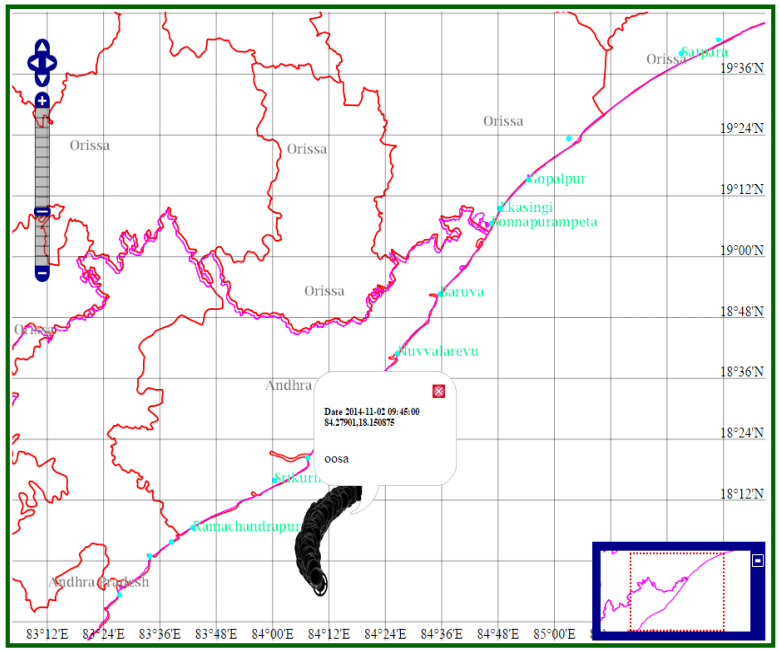
In order to prevent the impact of oil spills on the marine environment an oil spill trajectory prediction system is required, to provide the trajectory of an oil spill thereby protecting the Marine habitats.

In the event of oil spill, the direction and movement of the oil will be predicted in advance in our system and will be disseminated to the Users. The clean up and control measures will be planned and carried out accordingly.

OIL SPILL MODELING AND TRAJECTORY FORECASTING SYSTEM AT INCOIS



Weathering modelling output showing how spilled oil may change over time (Image: ADIOS 2, NOAA)



OIL WEATHERING AND TRAJECTORY MODELING

WEATHERING MODELS – Predicts the changes in the oil characteristics with respect to the time.

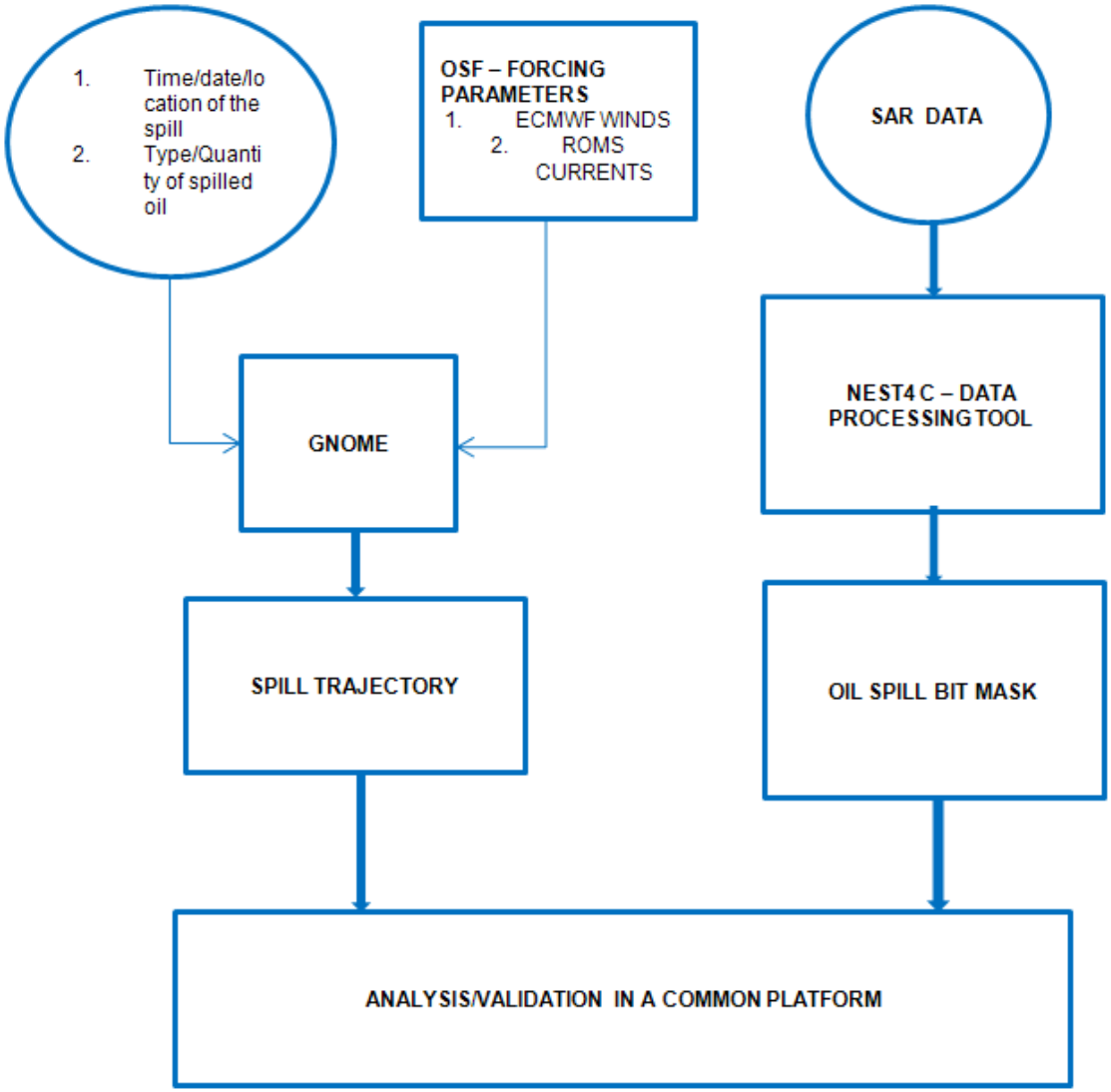
TRAJECTORY MODELS - Predicts the path of the spilled oil with respect to the time

USES OF OIL SPILL MODELS

1. **Contingency planning - to protect the marine organisms**
2. **Mock drills/ exercise - conducted by various offshore industries as a part of regulations**
3. **Oil spill response operations - to issue the advisory in the event of oil spills.**

OIL SPILL TRAJECTORY PREDICTION- METHODOLOGY

METHODOLOGY



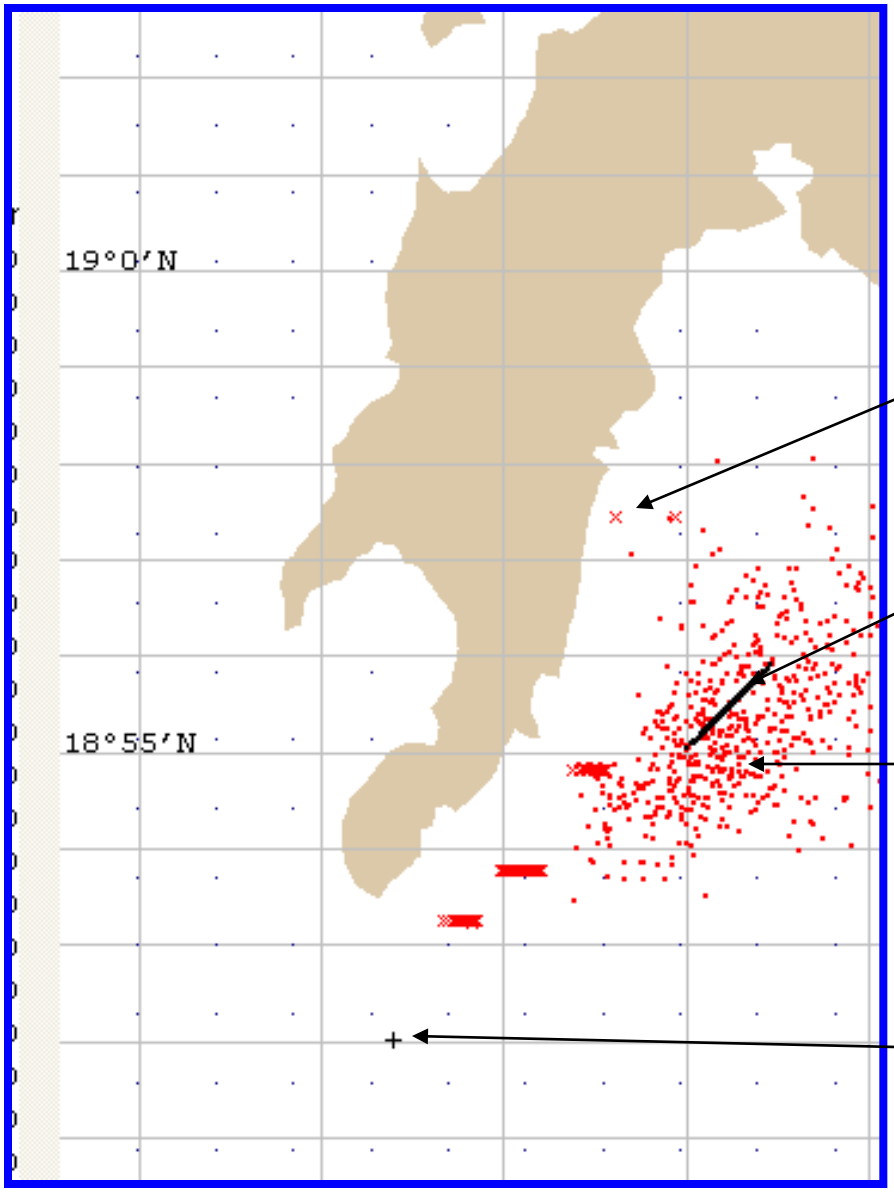
DESCRIPTION

- GNOME, an oil spill trajectory model developed by NOAA is used in this prediction system.
- The details such as time, date, location, type and quantity of the oil spilled will be obtained the Regulatory authority / users. The major forcings like ECMWF winds and ROMS currents are the driving parameters.
- The predicted trajectory will be disseminated to the users in movie, image and text formats.
- The available SAR data will be subjected to oil spill detection
- Both the observed and the predicted trajectory will be compared in a common platform.

GNOME- (General NOAA Operational Modeling Environment)

- GNOME was developed by the Emergency Response Division of NOAA's Office of Response and Restoration.
- First release - March, 1999 ,Recent version - GNOME 1.3.9 - Sep 2014
- Predict how wind, currents and other processes might move and spread oil spilled on the water.
- It gives the best estimate (black color) and Minimum regret estimates (red color) of spill trajectories.

MAGNIFICATION OF THE OUTPUT IMAGE



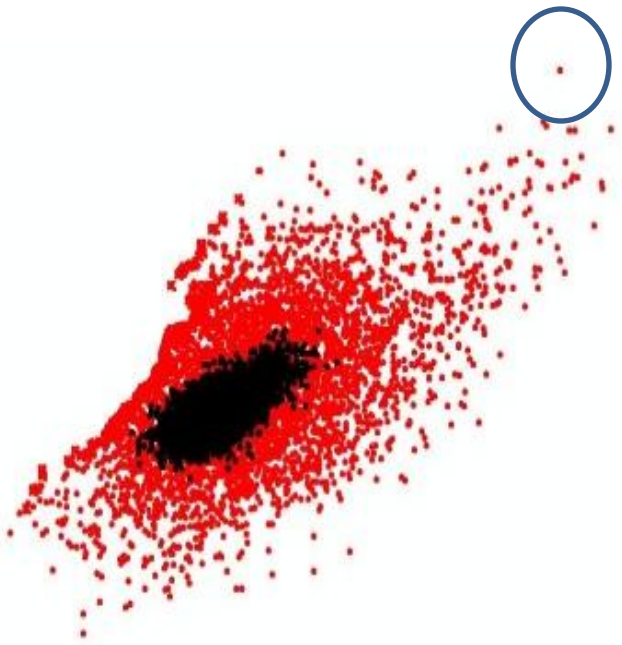
SLICKS HITTING THE SHORELINE

BEST ESTIMATE

MIN REGRET ESTIMATE

POINT OF SHIP COLLISION

Every LE/spill dots indicates…



- Position in Lon, ,lat (degrees)
- Time of release (seconds)
- Status of the particle with time.
- Particle id(No)
- Age – time since release (seconds)

CASE STUDY

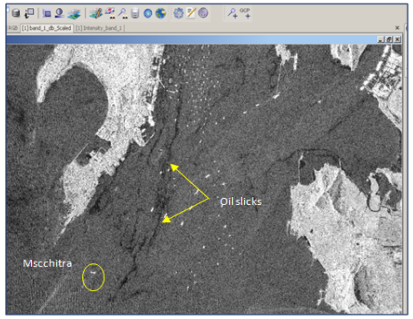
INCOIS ADVISORY DURING OIL SPILLS /MOCK DRILLS / SEARCH RESCUE OPERATION

MSC CHITRA SPILL- CASE STUDY

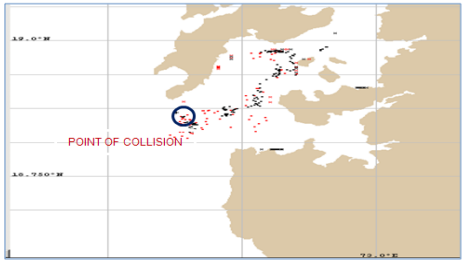
OIL SPILL DUE TO VESSEL COLLISION

- A huge quantity (700 tons) of fuel oil spill occurred after the collision at 18°51'59"N,72°48'48"E on 7th august 2010. The model was set for mumbai creek region . With all the necessary details and forcing parameters , the model was run for the next 10 days.
- The predicted trajectory is compared with the observation obtained on 15.08.2010, 19.00hrs (RADARSAT DATA) in origin pro plots.

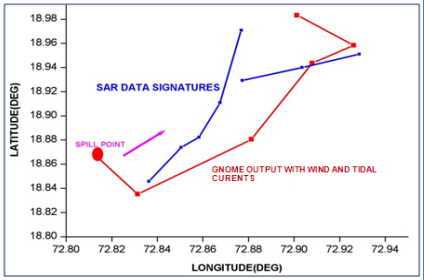
OIL SLICKS IN THE SAR DATA ON 15.08.2010,19.00 HRS

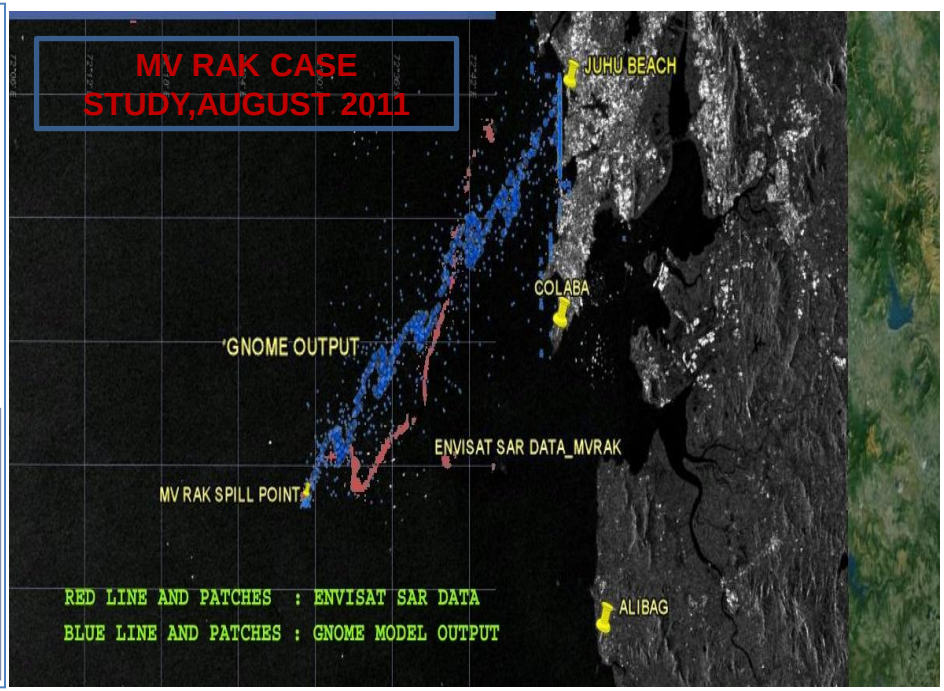


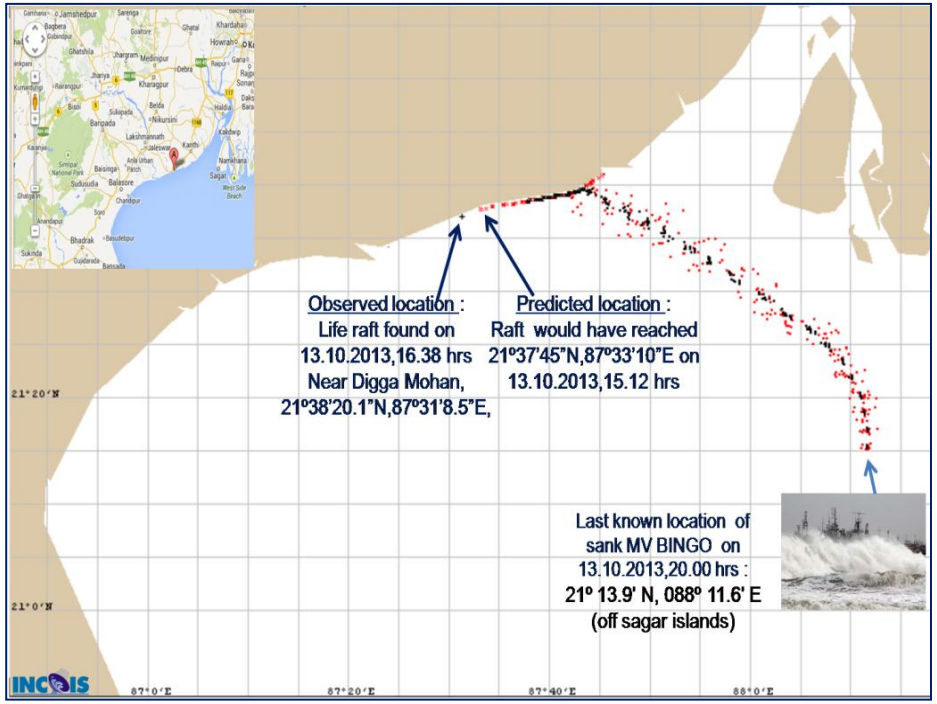
PREIDCTED TRAJECTORY DURING 15.08.2010,19.00



MODEL OUTPUT & SAR DATA ON 15.08.2010,19.00 HRS







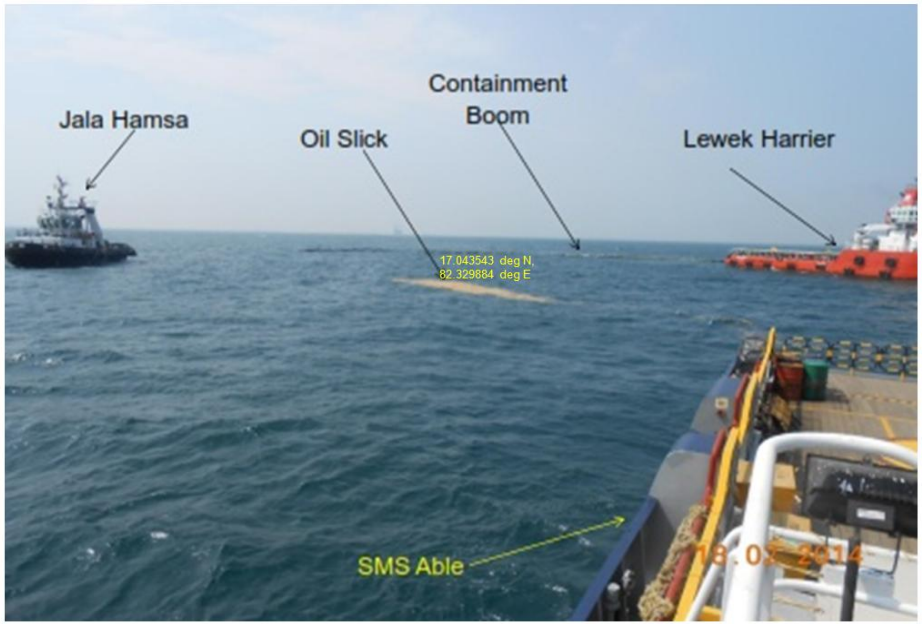
MV BINGO SUNK ,OCTOBER 2013

A cargo ship named MV Bingo sank on 12 October, 2013 in the vicinity of Sagar island in the northern Bay of Bengal in the wake of very severe cyclone *Phailin*. The Indian coast guard sought the help of INCOIS to locate personnel left the ship in a life raft on Sun, Oct 13, 2013 at 0917 hrs IST. Accordingly the trajectory from the last known position 21º 13.9' N, 088º 11.6' E (off sagar islands) of MV BINGO was generated using GNOME. Model was forced with forecasted ROMS currents and ECMWF winds. The predicted trajectory was found to be moving towards the coast. That information was sent to Indian coast guard. Finally, the Coast Guard found the beached life raft near Digga Mohan at 21º38'20.1" N, 87º 31'8.5" E within 3.5 km of predicted location. The prediction of the likely path of the raft helped the Indian coast guard in finding the life raft, and in turn saving the 18 crew members.

PREDICTED TRAJECTORY DURING PHAILIN CYCLONE, OCTOBER 2013

RIL MOCK DRILL,FEBRUARY 2014

POSITION OF THE HUSK ON PHOTO BY 11.15 HRS, 18022014

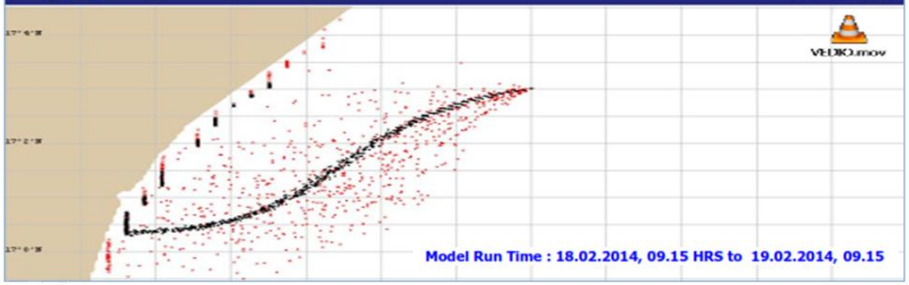


Oil Spill trajectory modeling

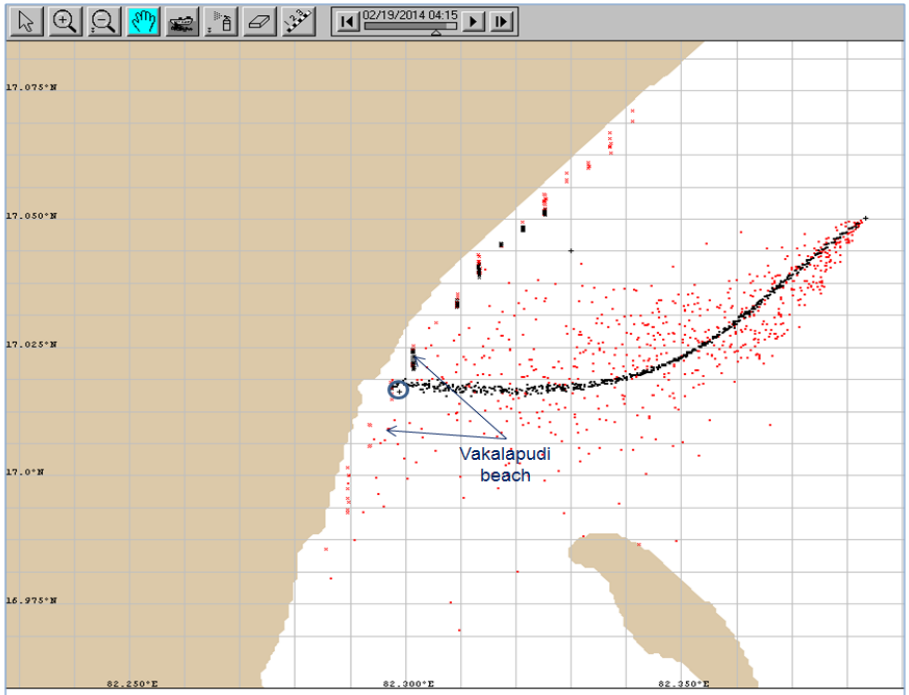
Oil Spill trajectory modeling was carried out with the support from Indian National Centre for Ocean Information Services (INCOIS).

- INCOIS provided direction of the spill based on the weather conditions from the spilled locations. Following details were provided to INCOIS:
- Location of Spill: Lat. 17 degrees 03 min North, Long 82 degrees 23 min East

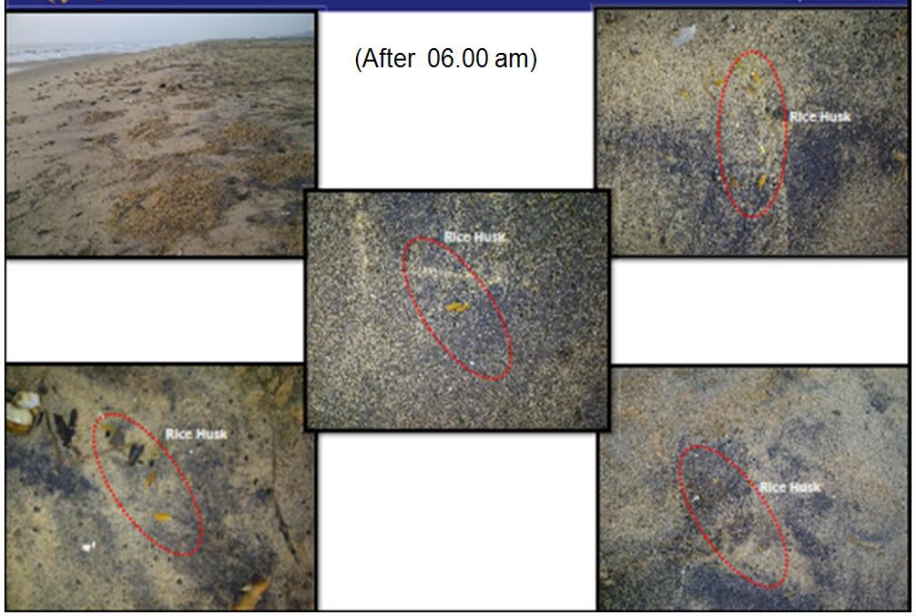
Oil Spill Trajectory predicted by INCOIS



PREDICTED POSITION OF THE HUSK BY 04.15 HRS, 19022014



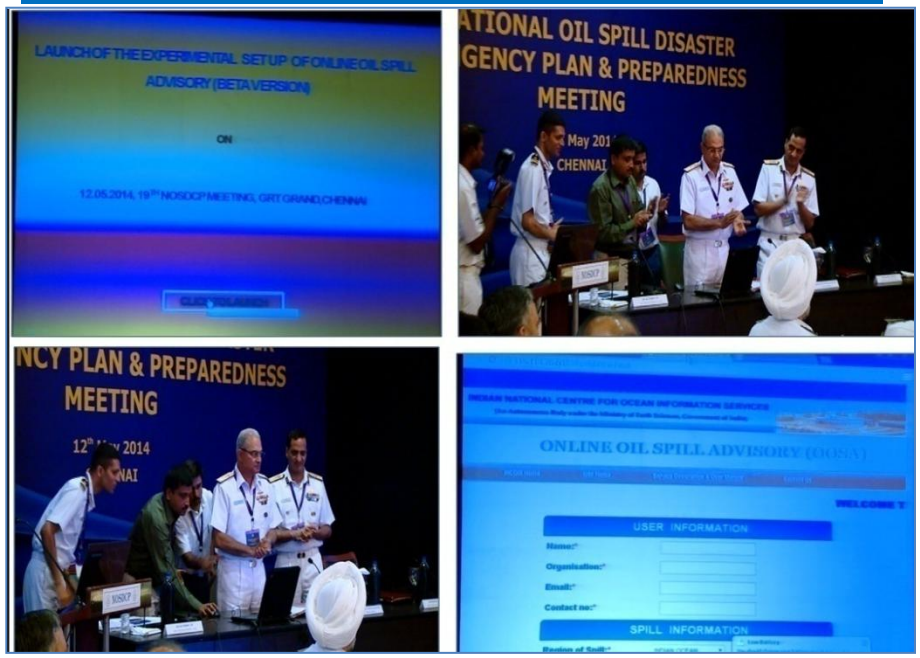
Traces of rice husk sighted on Vakalapudi beach – 19 Feb 14



EXPERIMENTAL SET UP OF ONLINE OIL SPILL ADVISORY SYSTEM

ONLINE OIL SPILL ADVISORY SYSTEM

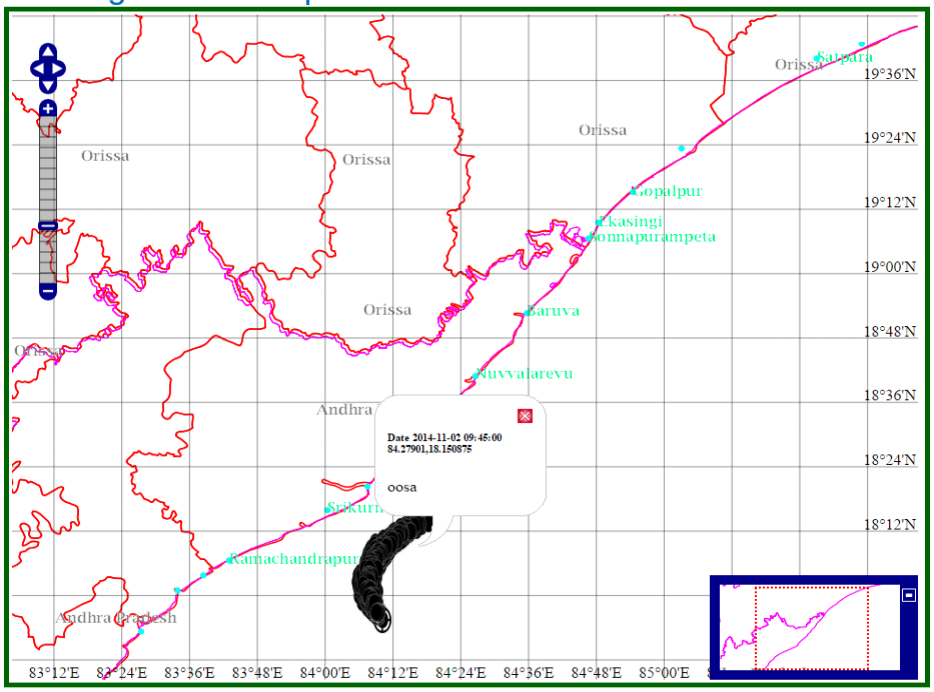
LAUNCH - EXPERIMENTAL SET UP OF OOSA,12.05.2014

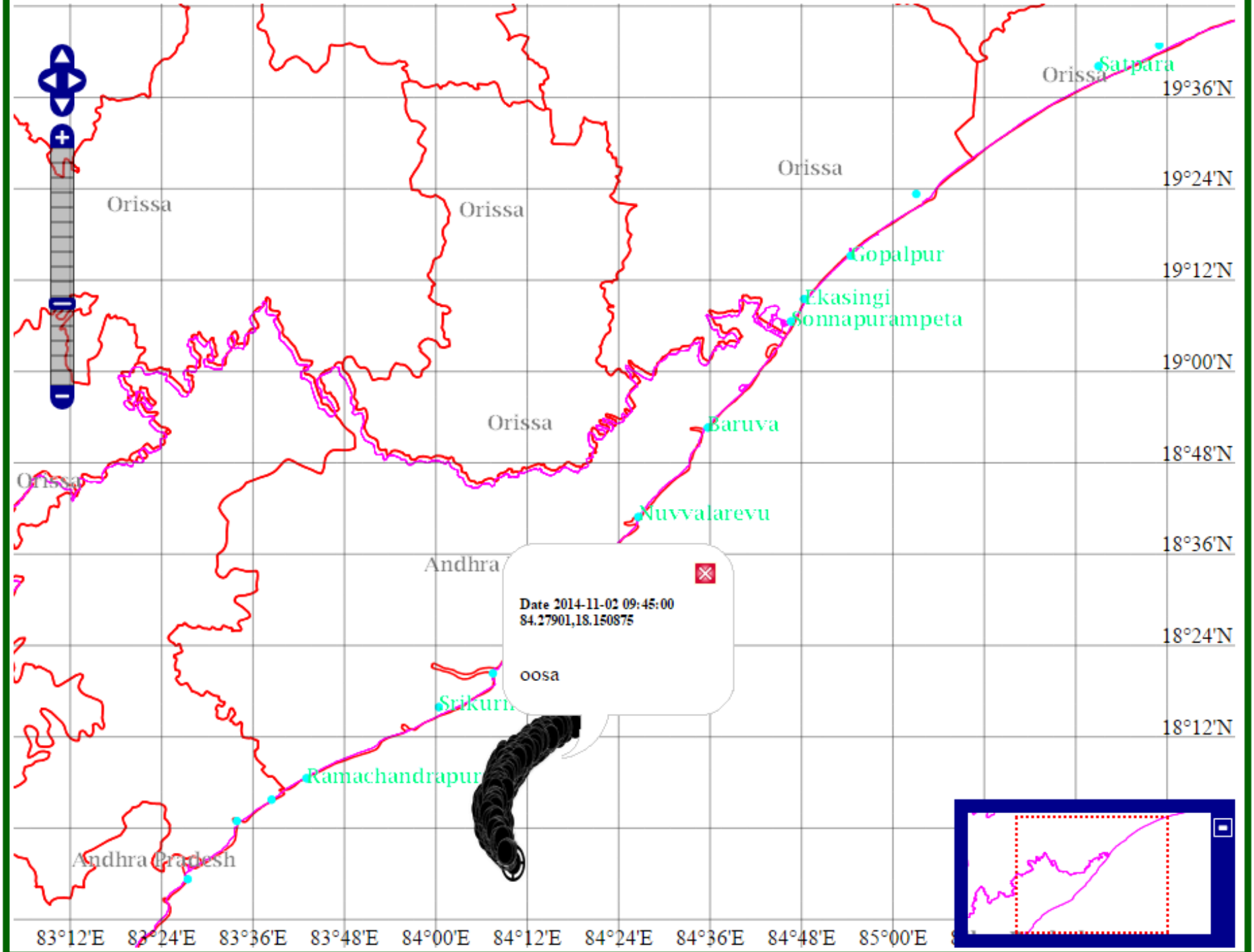


OOSA – BETA VERSION

1. The Experimental set up of GNOME based Online Oil Spill Advisory system is launched for the Indian Coast guard, port authority, maritime boards and other agencies involved in clean up measures
2. OOSA will generate the predicted trajectory after submitting the details of the spilled oil. The trajectory will be displayed in an open layers web map indicating the nearby locations with respect to time.
3. Future upgradation includes the integration of Hydrodynamic outputs from flow model 21 flexible mesh (mike 21)
4. Various officials from ICG, RIL, ONGC, PORTS have registered this product .

http://www.incois.gov.in/portal/osf/osf.jsp

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85°00'E

THANK YOU

“Environmental protection is a fundamental duty of every citizen of this country under Article 51-A(g) of our Indian Constitution”

http://ibnlive.in.com/news/2010-mumbai-oil-spill-damage-worth-rs-515-crore/187533-3.html

- The report puts the cost of damage at a whopping Rs 515 crore.
- It also says that fishermen suffered financial losses to the tune of Rs 525 lakh
- the tourism industry suffered a loss of Rs 87 lakh.