



**FIG Working Week 2013**

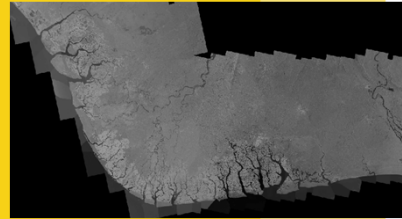
6–10 May, Abuja, Nigeria

“Environment for Sustainability”

**Niger Delta Flooding: Monitoring, Forecasting & Emergency Response Support from SPDC**

(6659)

By



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## CONTENT

- Nigerian Flooding Overview
- The Initial Response
  - Radar Remote Sensing
  - Location Based Mapping and Flood Prediction
- The SPDC Response
- Improving Flood Response
- Conclusion and Recommendations

## NIGERIAN FLOODING OVERVIEW

- Heavy Rainfall: heavy rain fall in July and subsequent flooding September and October 2012.
- Dam Failure: Lagdo Dam in Northern Cameroon.
- Flood extent: Central and Southern Nigeria
- Damage: 2.1 million displaced, 363 lives lost (as estimated by Nigeria's National Emergency Management Agency [NEMA])



## SNAPSHOT OF SHELL EMERGENCY RESPONSE ACTIONS

- 5th October: SPDC ER Team activated to monitor, forecast and manage the flood Impacts.
- 6th October: Radar imagery data acquisition activated
- Images acquired: 8th, 9th, 11th, 12th, 13th, 15th 16th & 17th October 2012, analysed & shared.
- During October and early November, 14 radar images(Radarsat2/CosmoskyMed) were acquired, initially on a daily basis then at a reduced frequency after the flooding had peaked
- Flood Reporting: 8 nos Flood Mapping Reports, Forecasts, Shared – internally/externally.
- Historical/Current flood & Tidal level data used to improve predictions.
- 17th October: Commenced helicopter based ground truthing



## OUR OPTIONS: USING SATELLITE BASED IMAGERY



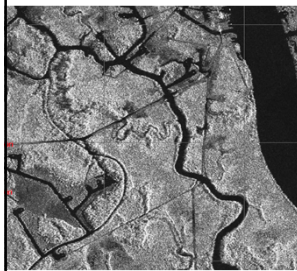
Hi-RESOLUTION  
OPTICAL

PROS:

- Close to what we know
- No expert required for interpretation

CONS:

- Cloud limits acquisition success.
  - Hence, long turnaround
- Limited Area coverage.



RADAR

PROS:

- All-weather acquisition
- Fast turnaround
- Large Area coverage

CONS:

- Not intuitive to untrained people
- Requires expert interpretation

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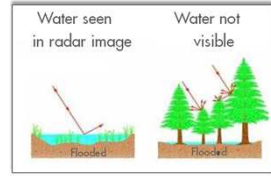
## SATELLITE RADAR BASED APPROACH

- The need for knowledge at a regional scale of the position and extent of flood water across the Niger Delta in relation to SPDC facilities and active locations (e.g. well-sites with drilling rigs).
- The need for assessment of present and future vulnerable SPDC assets within or near the flood-affected areas.
- Support the Nigerian Government and relief organizations with accurate and timely information to enable effective support to flood-affected people, communities and the environment.
- The need to obtain accurate, frequent regional information on flooding patterns across the Niger Delta.

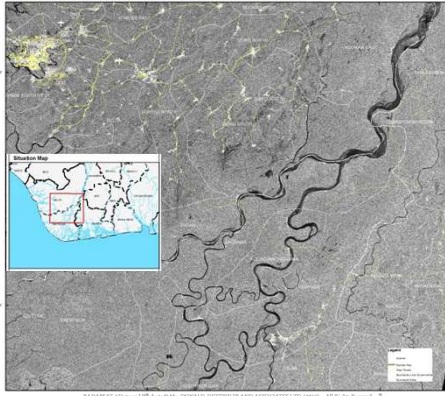


## RADAR DETECTION OF FLOODING (SYNTHETIC APERTURE RADAR)

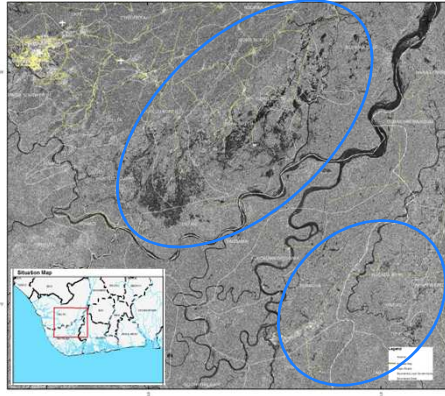
Radar Imagery showing pre and post flooding



18th August 2012 – pre-flood

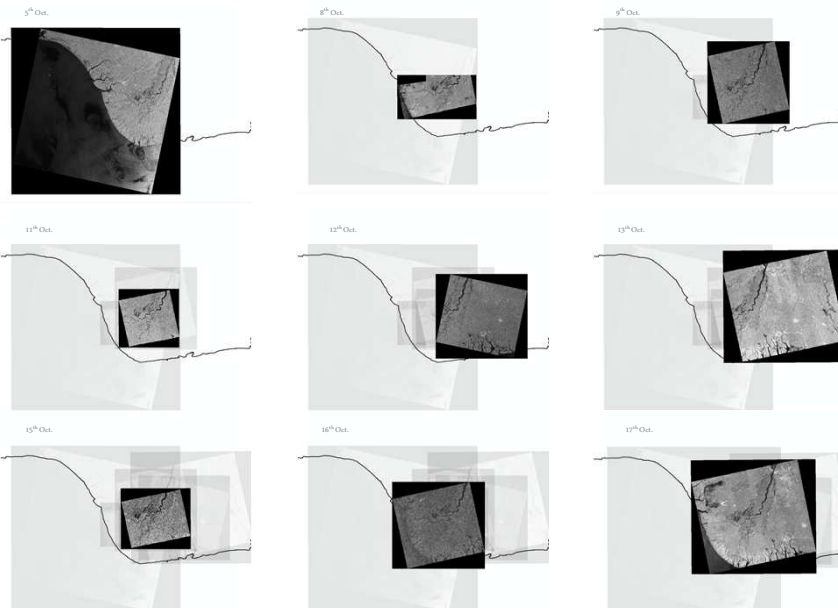


16th October 2012



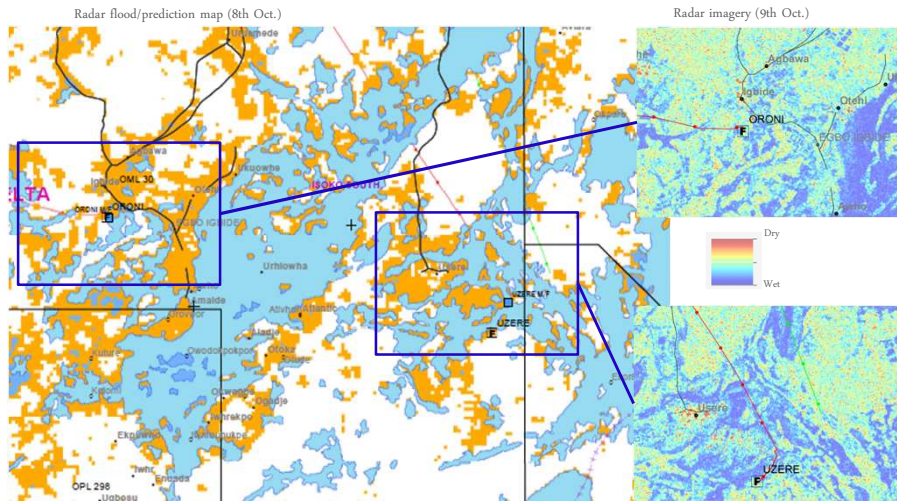
## RADAR TIME SERIES

Radar Imagery scenes acquired in October 2013



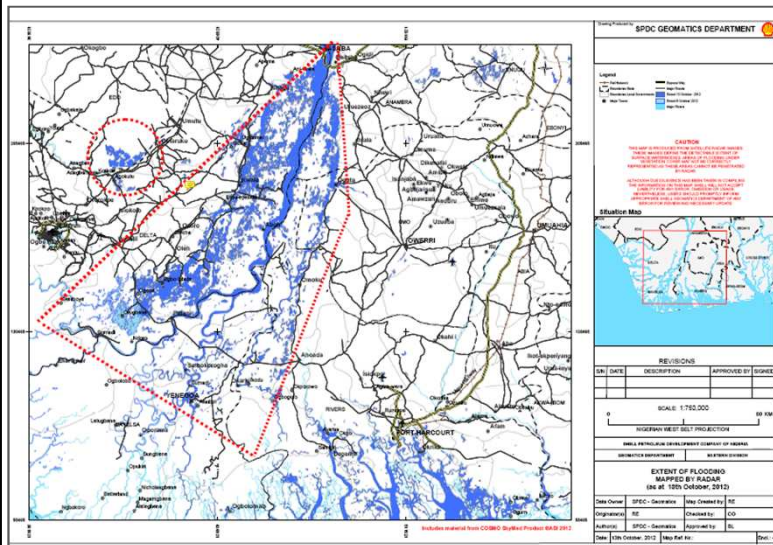
## LOCATION-BASED MAPPING AND PREDICTION

- Flood prediction using SRTM DEM for rise in water level



## EXTENT MAPPING FROM RADAR

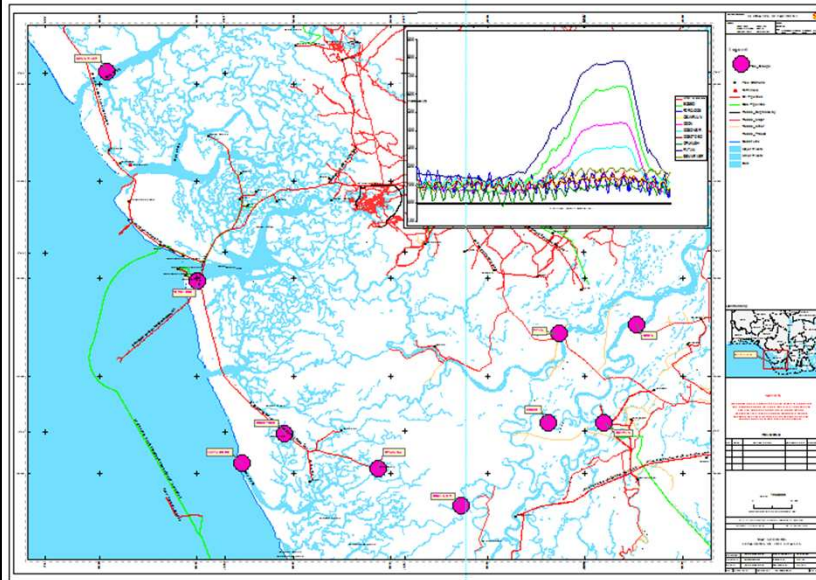
Typical flooding map for contingency planning





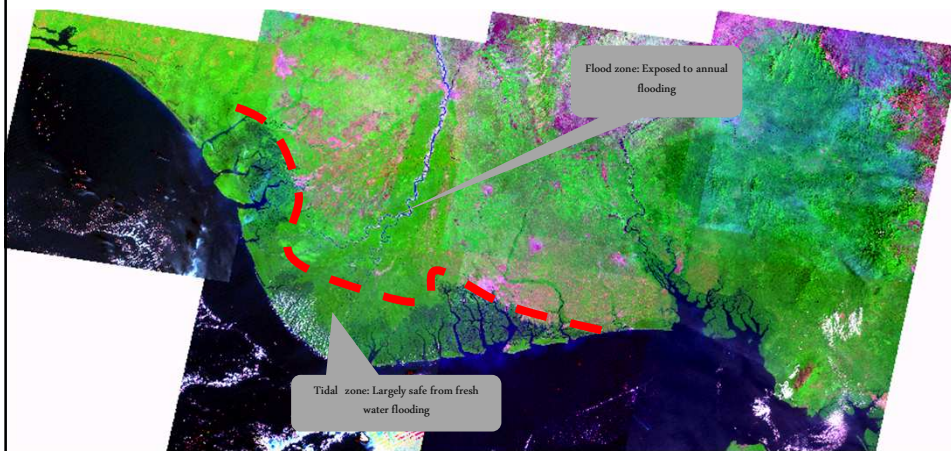
## INSITU FLOOD LEVEL MAPPING

Historical water levels taken at several locations



## THE SPDC RESPONSE

- Controlled shutdown of vulnerable facilities.
- Controlled evacuation and demobilization of vulnerable work site.
- Support to third parties for emergency and relief operations.



## CHALLENGES TO IMPROVED FLOOD MODELING/FORECASTING

- Limited up Topographic Map with Contour lines for the Niger Delta
  - we used our limited data, including SRTM DEM and survey data.
- Delta-wide Land use/Land cover map not maintained.
- Inadequate Metocean/Hydrodynamic data stations in the region.
- Inadequate coordination of efforts in the application of technologies by agencies & organisations.

## OBSERVER IMPACT OF THE FLOODING

- 1000's of people displaced from their homes & livelihood.
- Excessive flooding of roads, waterways, highways; thus compounding logistics challenge in the region.
- Some facilities shutdown due to high flood Level: Loss of production.
- Engineering projects suspended.
- Rig operations impacted
- Above led to unplanned deferments



## WHERE DO WE GO FROM HERE?

- Review/Improve non-oil and gas emergency response process.
- Expand spread of Metocean stations to key flood nodes for continuous monitoring & weather-casting in areas of operation.
- Strengthen satellite based Radar surveillance. Joined-up efforts/collaboration required.
- Acquire Remote Sensing DEM data for Lower Niger to Improve quality of flood prediction.
- Acquire Remote Sensing Land Cover and Land Use data for Lower Niger to improve quality of flood prediction.
- Reach out/collaborate with other agencies  
(governmental/non-governmental) & organisations.

## PEOPLE, DATA AND OTHER SUPPORT BY SHELL

Although, Not the Focus of this Presentation, But Include:

- **\$1m donation to red cross.**
- **Staff donation matched by company.**
  - **Maps & satellite imagery.**
  - **Support to agencies / authorities.**
  - **Direct support to impacted people.**

**and Logistics.**



## OUR CHALLENGES & LIMITATIONS

- Managing Expectations; Demand for GI Apps in SPDC beyond available resources.
- Simple but accurate mapping Requires Up-to-Date Metre/Sub-Metre optical Satellite Imagery; this is constrained By cloud Cover in the Niger Delta region.
- Availability of up to date topographic maps and information at the Local, State and National level.

## CONCLUSION & RECOMMENDATIONS

- Over 80% of E&P Assets have Spatial Component and have been mapped. Mapping at Local, State and National Level can be Supported Significantly using Satellite Imagery.
- Applications of GI in managing flooding and Emergencies, are Limited ONLY by Skills, Creativity and Capacity of Practitioners in one Hand and Resources (Budget) Made Available by Policy Makers.
- A GI strategy is worth incorporating into a national policy relating to the response and management of disasters such as flooding.
- Responding and Managing Disasters in a National Scale requires the collaboration with various organizations and allied professionals in a Coordinated Manner.
- However, it is Worth Noting, that the Protection of life and Property and Preservation of Our Fragile Environment go Beyond Technology Solutions – All Hands MUST be on the Deck.

## ACKNOWLEDGEMENTS

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  - Bola Lasisi & Richard Evers – Co-authors (Geomatics Dept, SPDC, PH).
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