

FPSOs for Deepwater – Design Issues and a Path Forward

Arun Duggal
FMC SOFEC Floating Systems
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Deepwater Field Measurements: Status and Future Needs
OTRC 2002

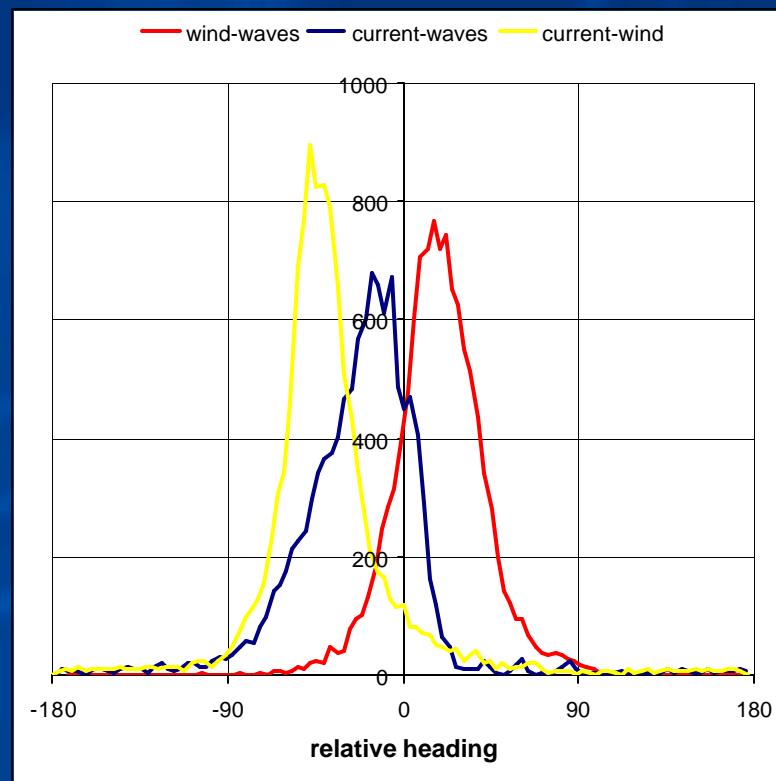
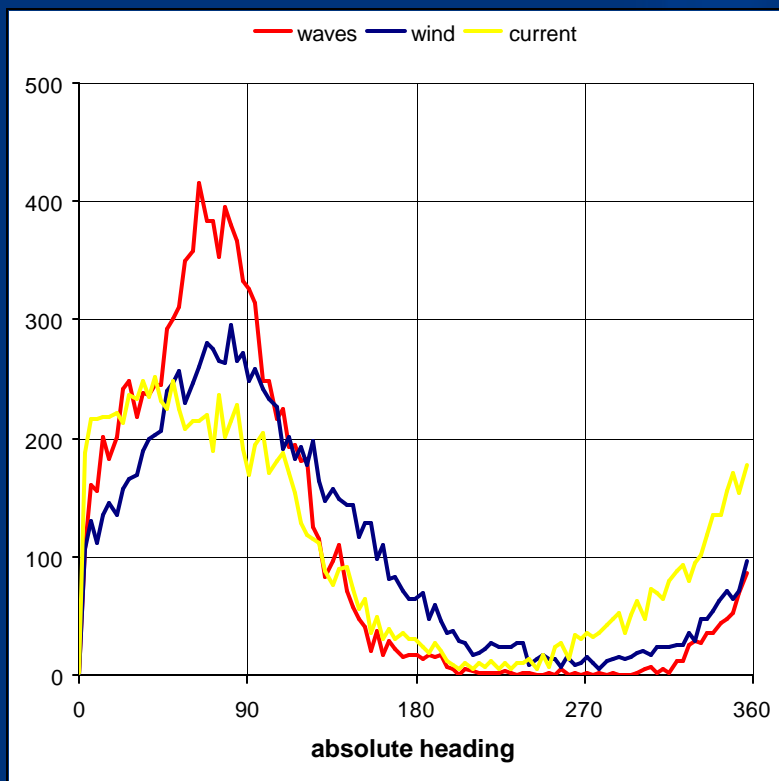
General Design Issues for Deepwater FPSOs

- Environmental Criteria
- Vessel-Environment Interaction
- Vessel Excursions
- Vessel Motions
- Mooring & Vessel Design Loads
- Riser System Design & Response
- Installation of Mooring and Risers
- Offloading Motions, Loads & Operation

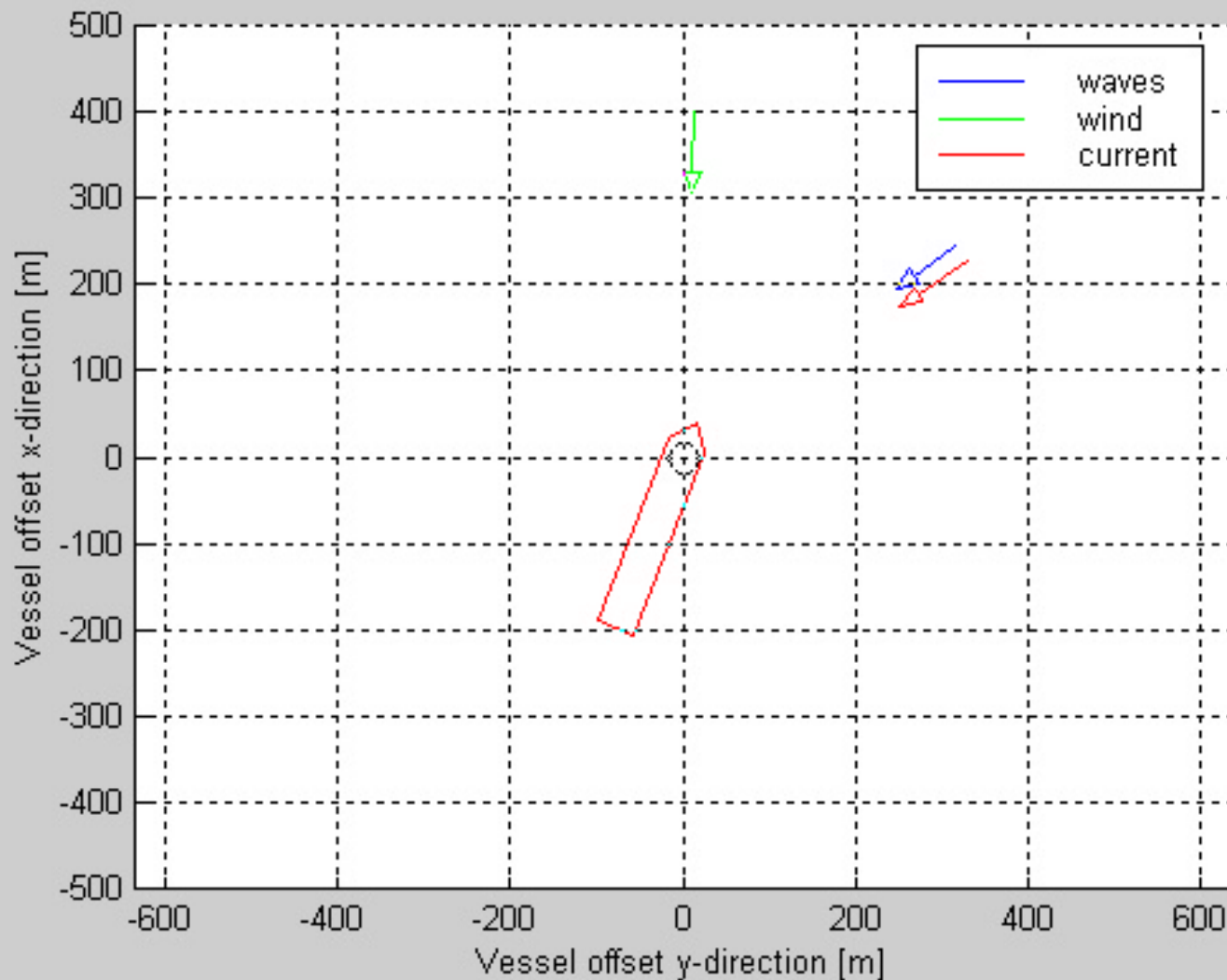
Design Issues for FPSOs

- Specification of Design Environmental Criteria
- Vessel Roll Motions
- Greenwater and Slamming
- Offloading Motions, Loads & Operation

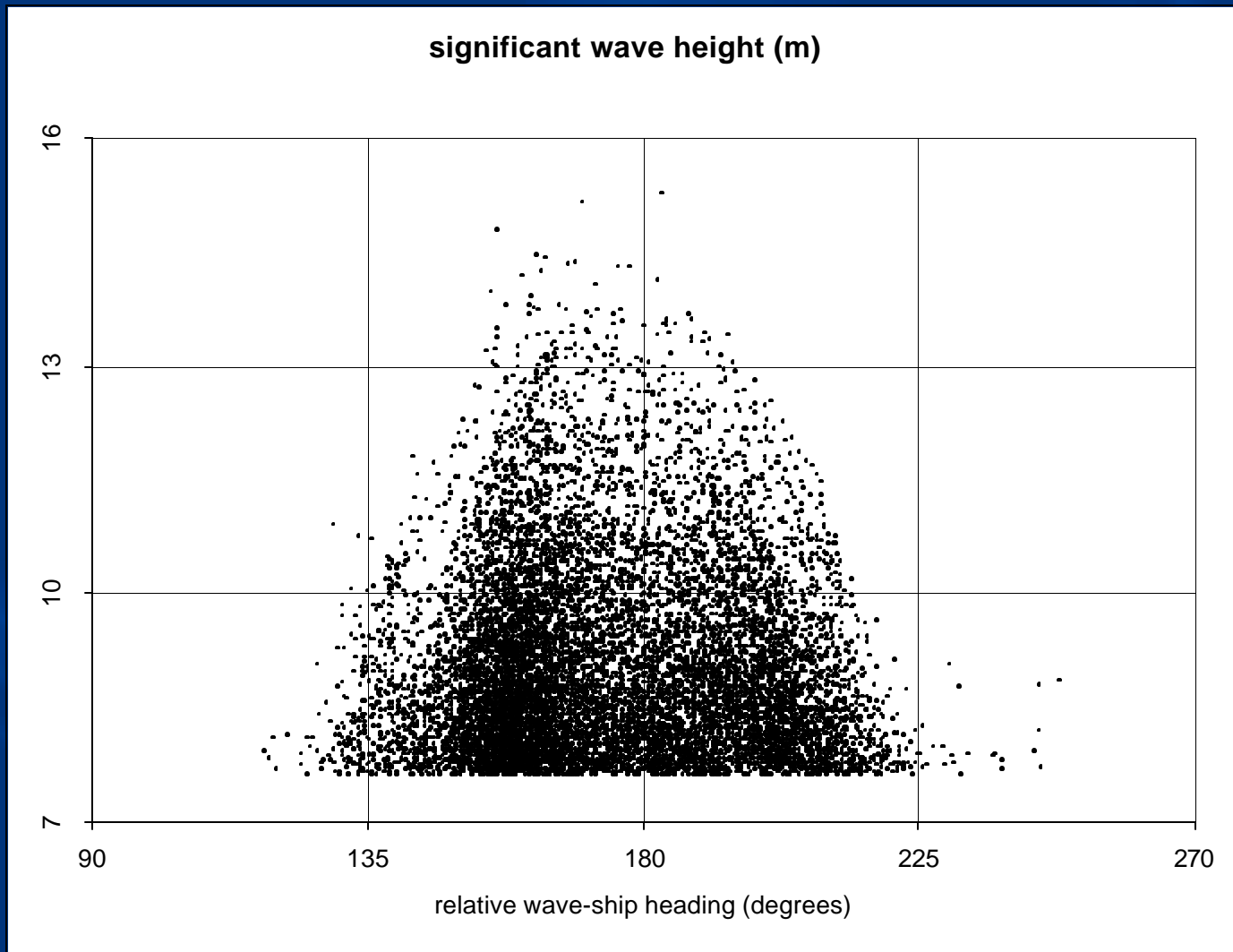
GOM Hurricane Hindcast Database: Environmental Alignment



FPSO Heading during Passage of Hurricane

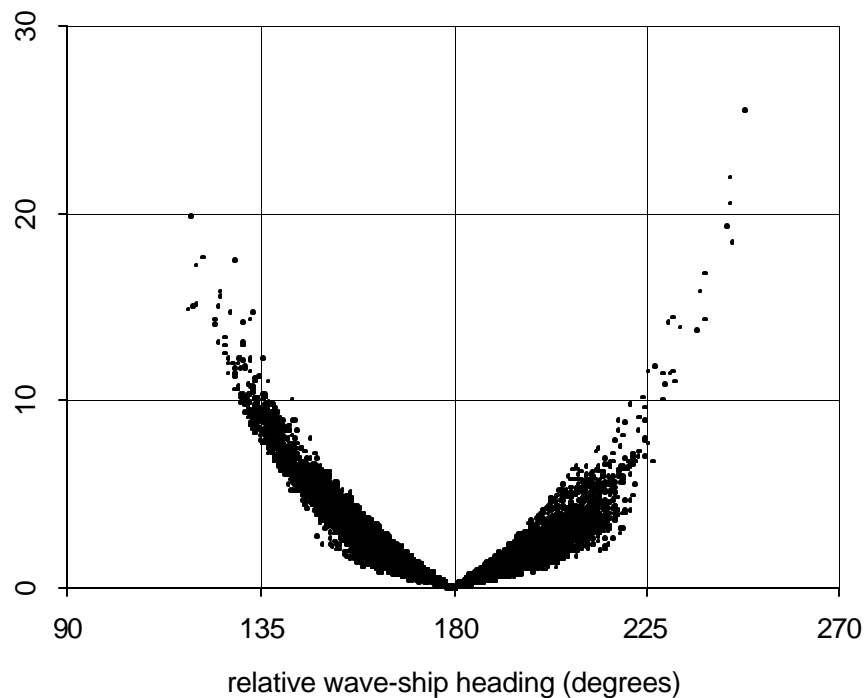


Wave Height and Vessel Heading

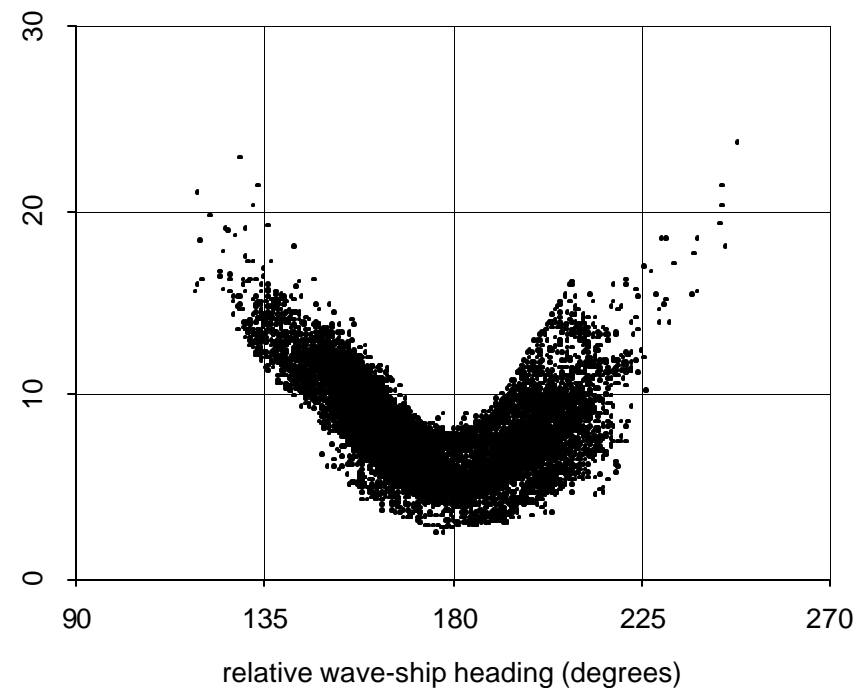


Effect of Wave Spreading on Roll Motions

MPM roll amplitude w/o wave spreading

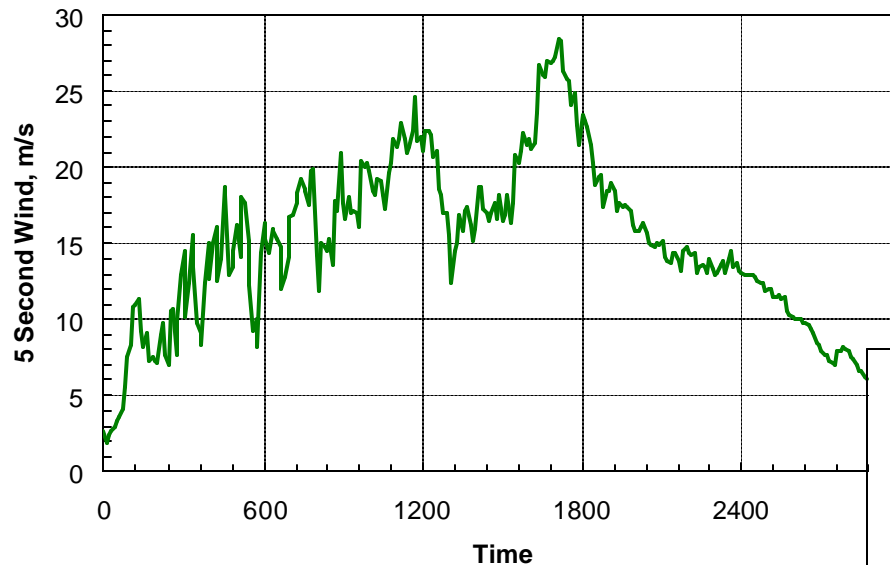


MPM roll amplitude w/ wave spreading

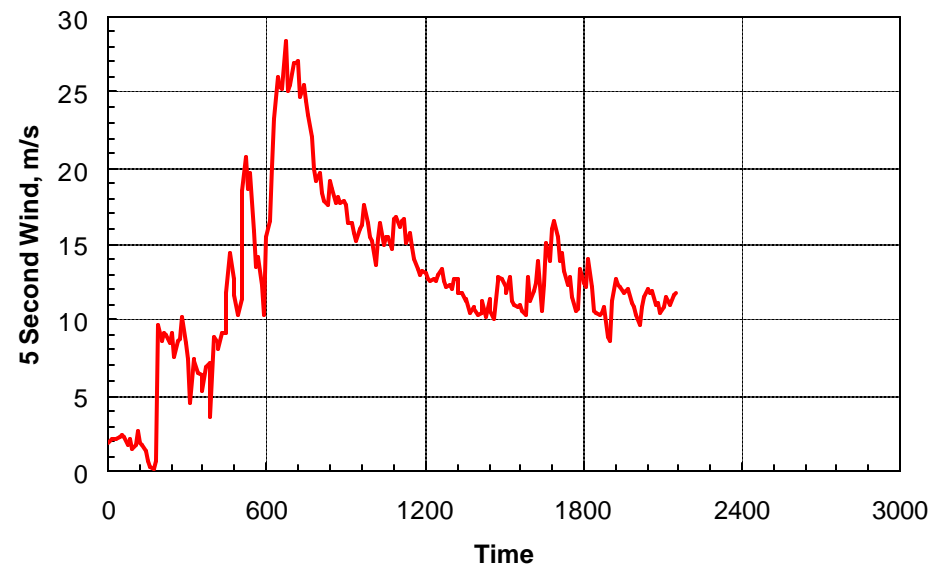


Squalls “Measured” off West Africa

Squall #1



Squall #2

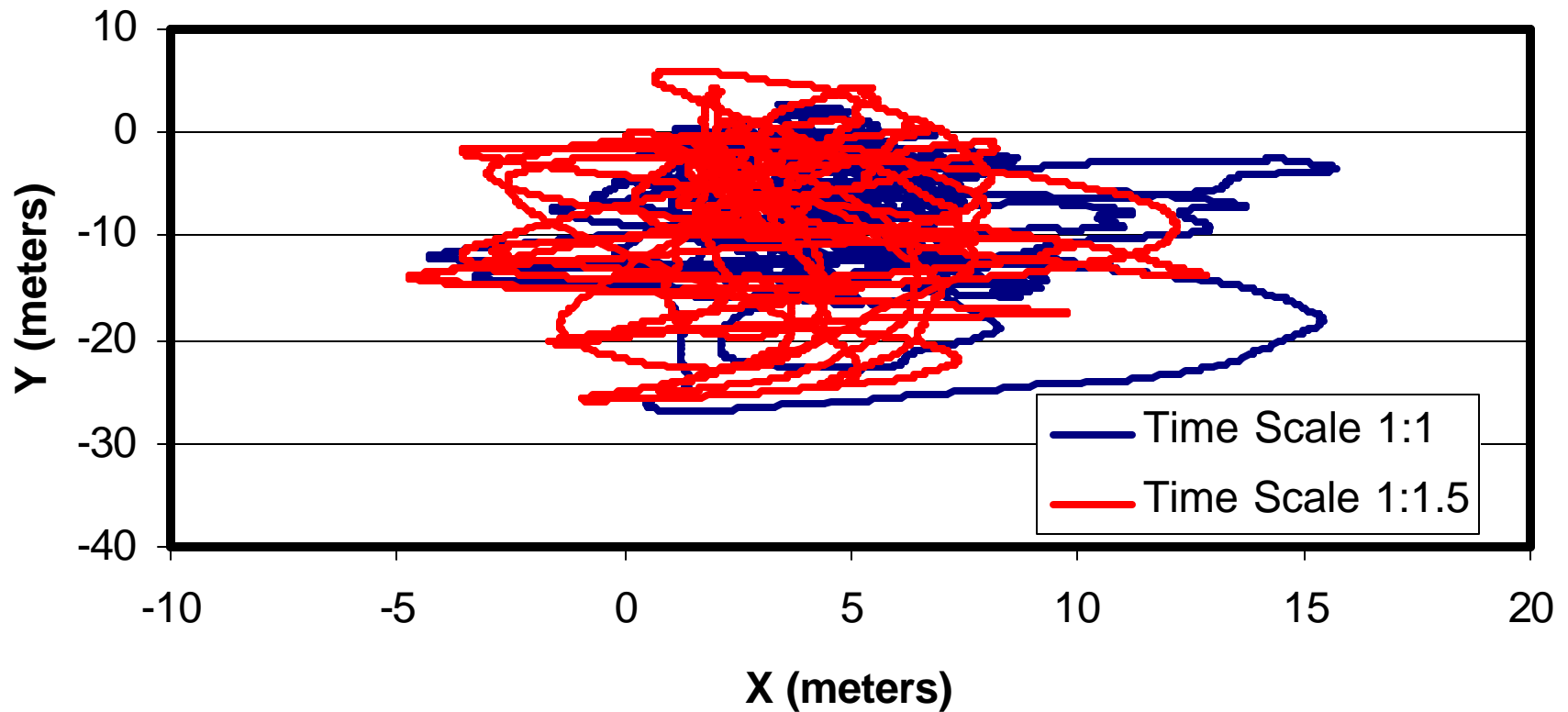


Impact of Time Scale Modification: Squall #1

Tension = 620 MT

Tension = 590 MT

Squall #1

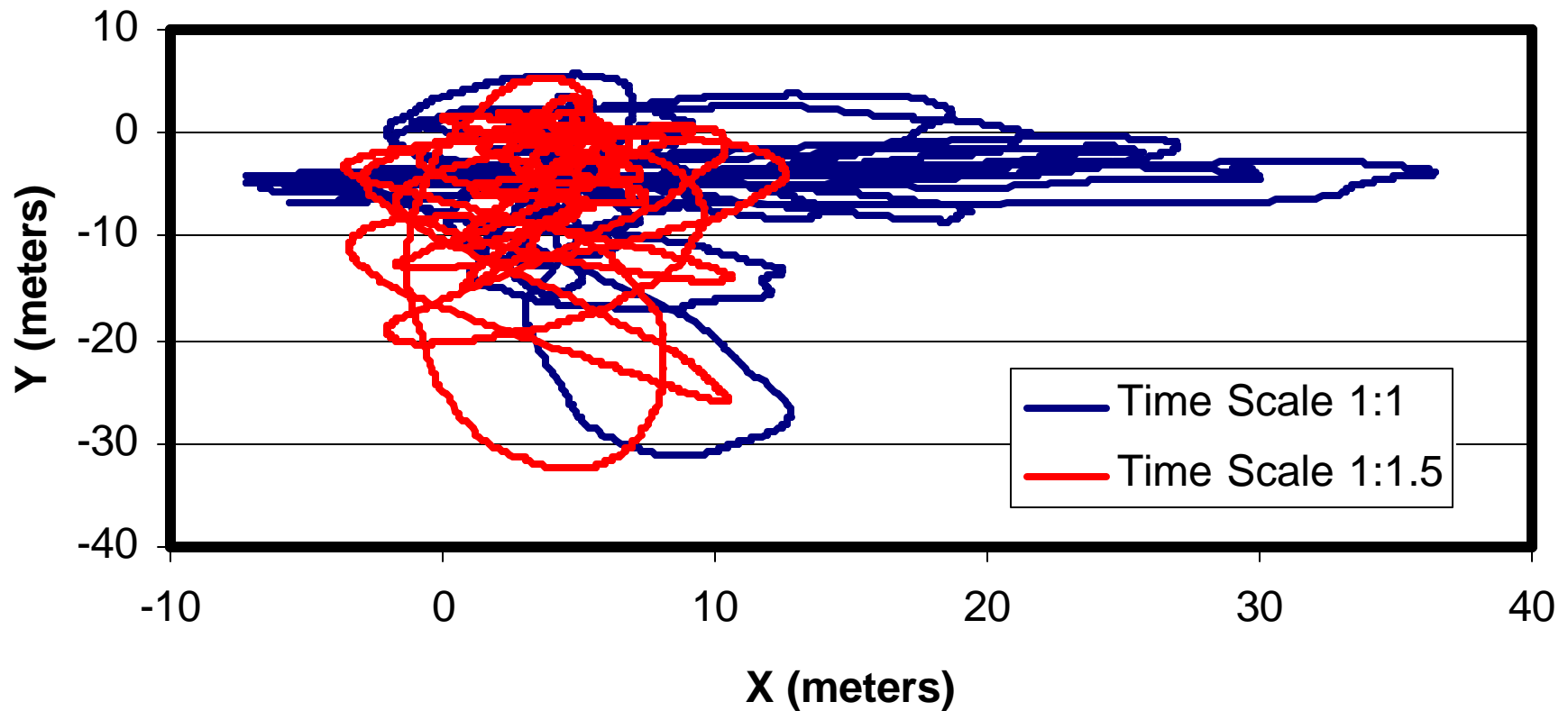


Impact of Time Scale Modification: Squall #2

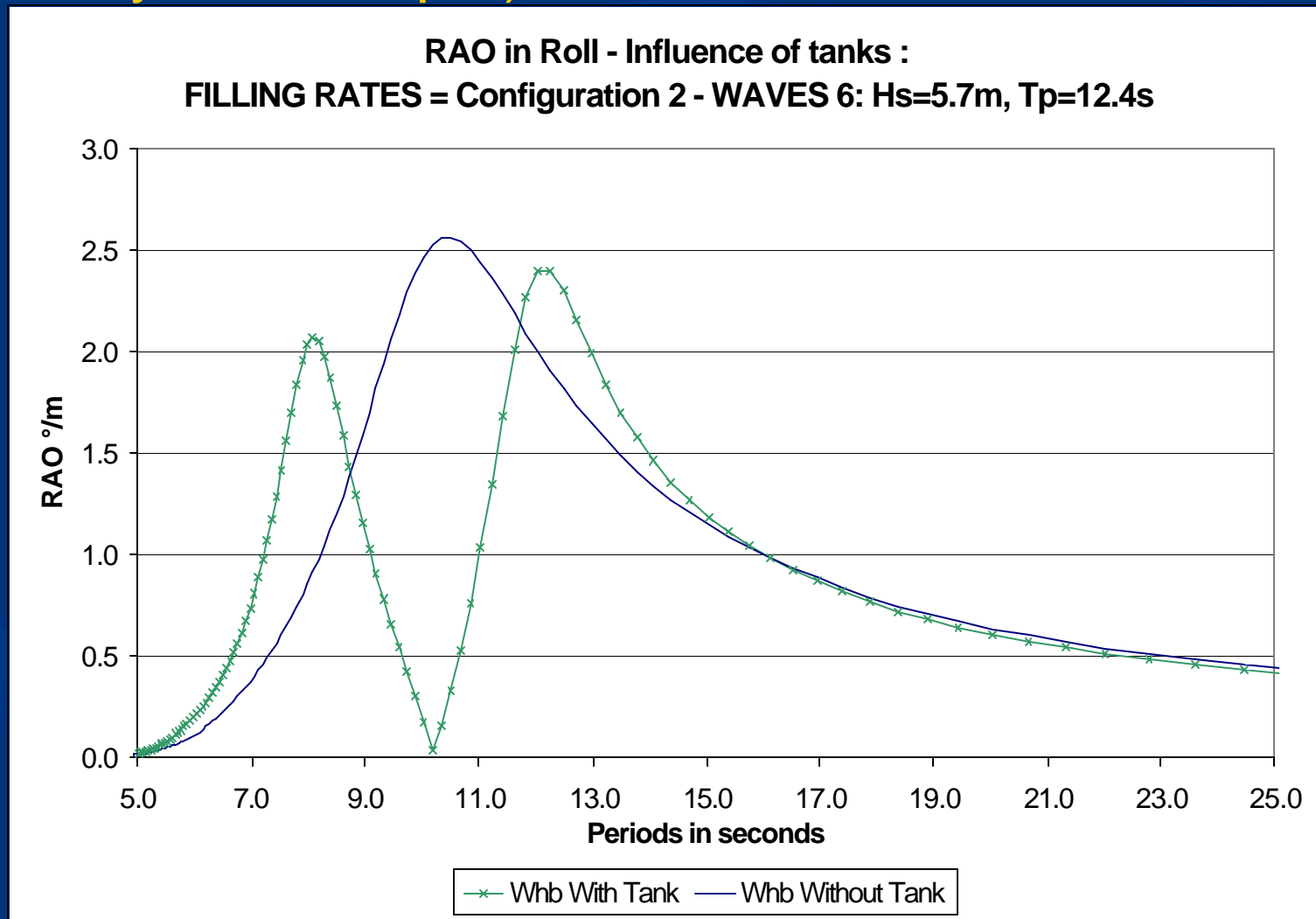
Tension = 700 MT

Squall #2

Tension = 770 MT



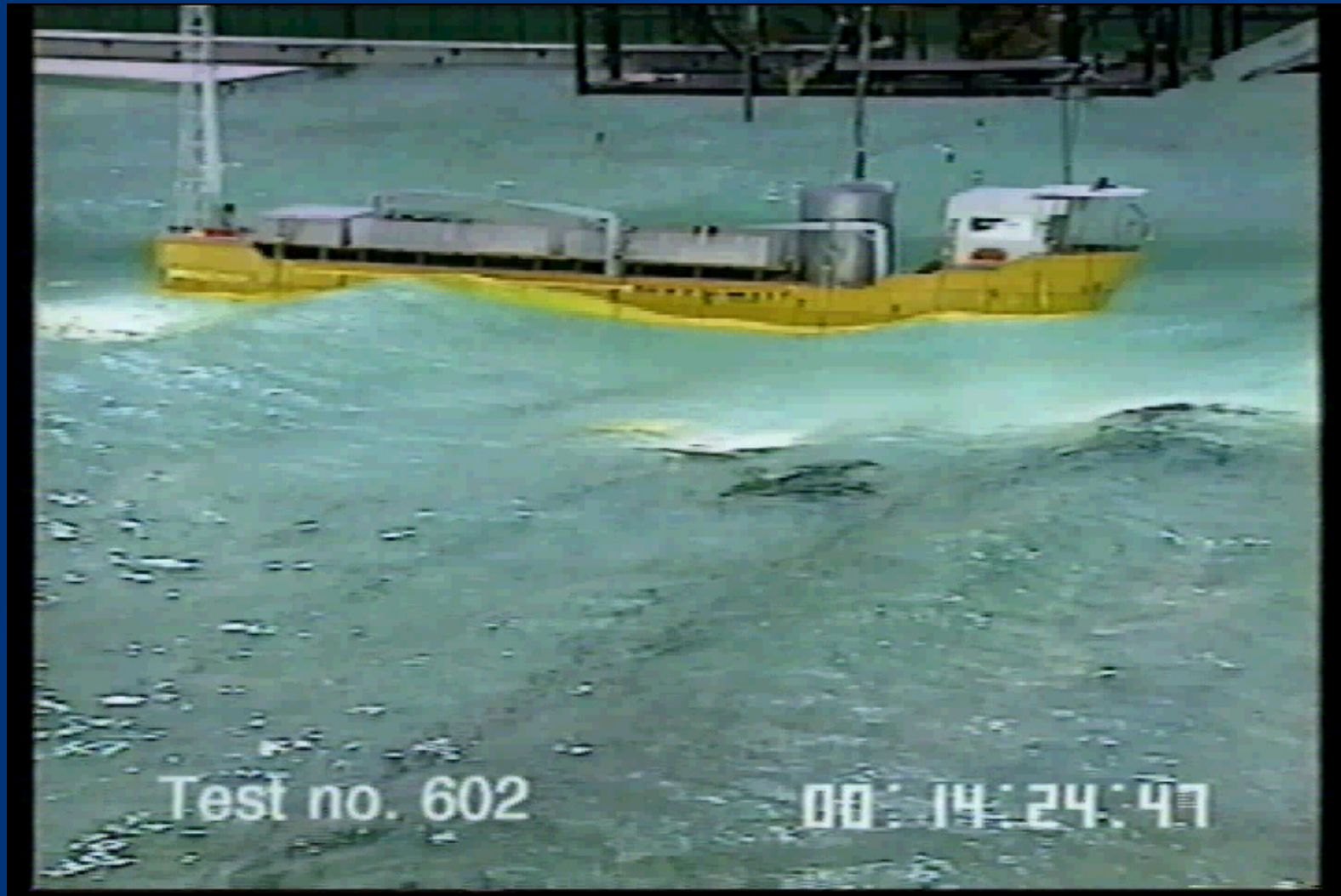
Impact of Fluid Sloshing on Roll Motions (courtesy of Principia)



Roll JIP

- Model Tests to Focus on Physics, Sensitivity Studies, Concepts
- Field Measurements to study Roll Response
 - ‘Glas Dowl’ North Sea - 22 months of existing data
 - ‘Bleo Holm’ North Sea - 2 months of data; ongoing for JIP
 - ‘Glas Dowl’ Sable field S.A - Monitoring from 1/1/2003
 - Petrobras ‘P-35’ FPSO Brasil
 - ‘Girassol’ FPSO West Africa
- Environmental Data Measurements
- Vessel Heading, Position, Draft and Cargo Tank Levels, Thruster Use

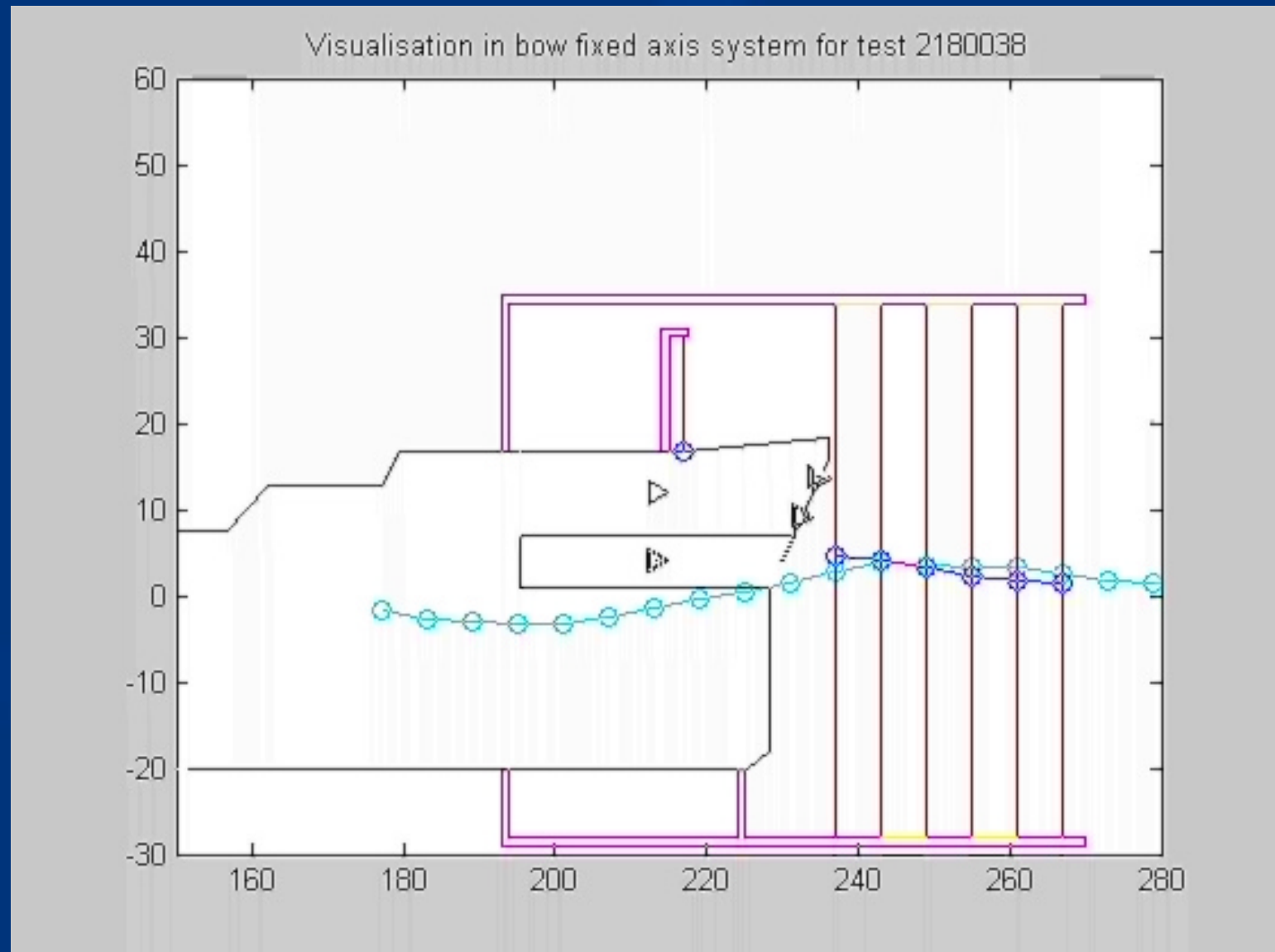
Terra Nova: Model Tests



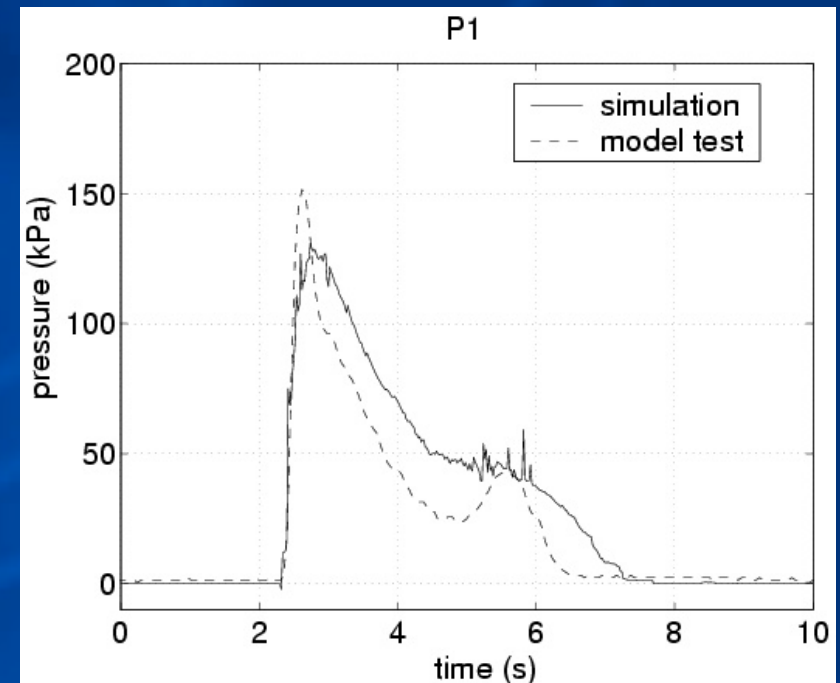
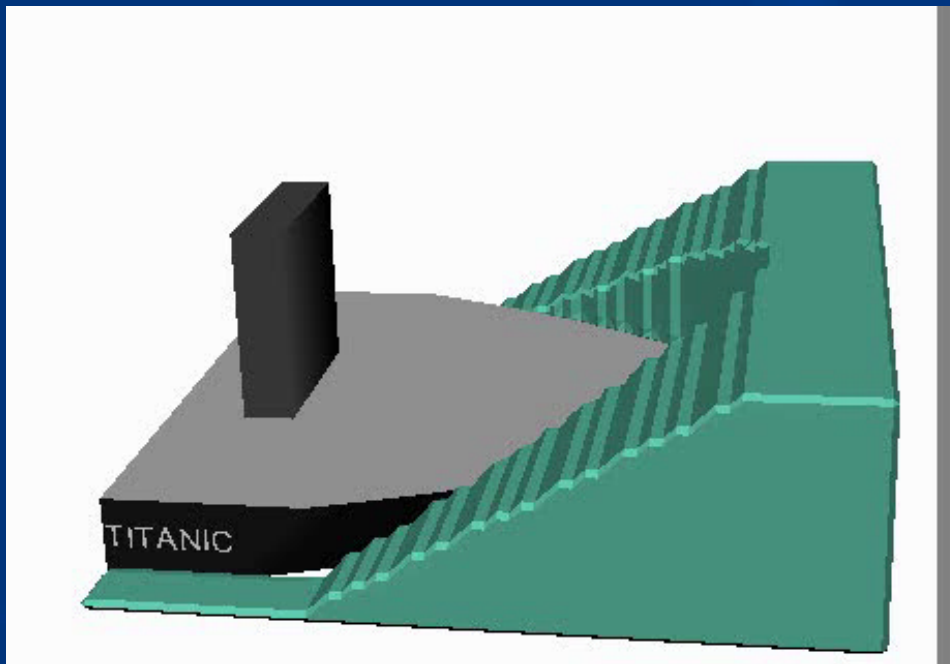
Terra Nova: On Site



Slamming: Model Test Data



CFD Model (Univ of Groeningen)



Offloading from FPSOs



Offloading in the Gulf of Mexico



Model Testing: Fish-Tailing

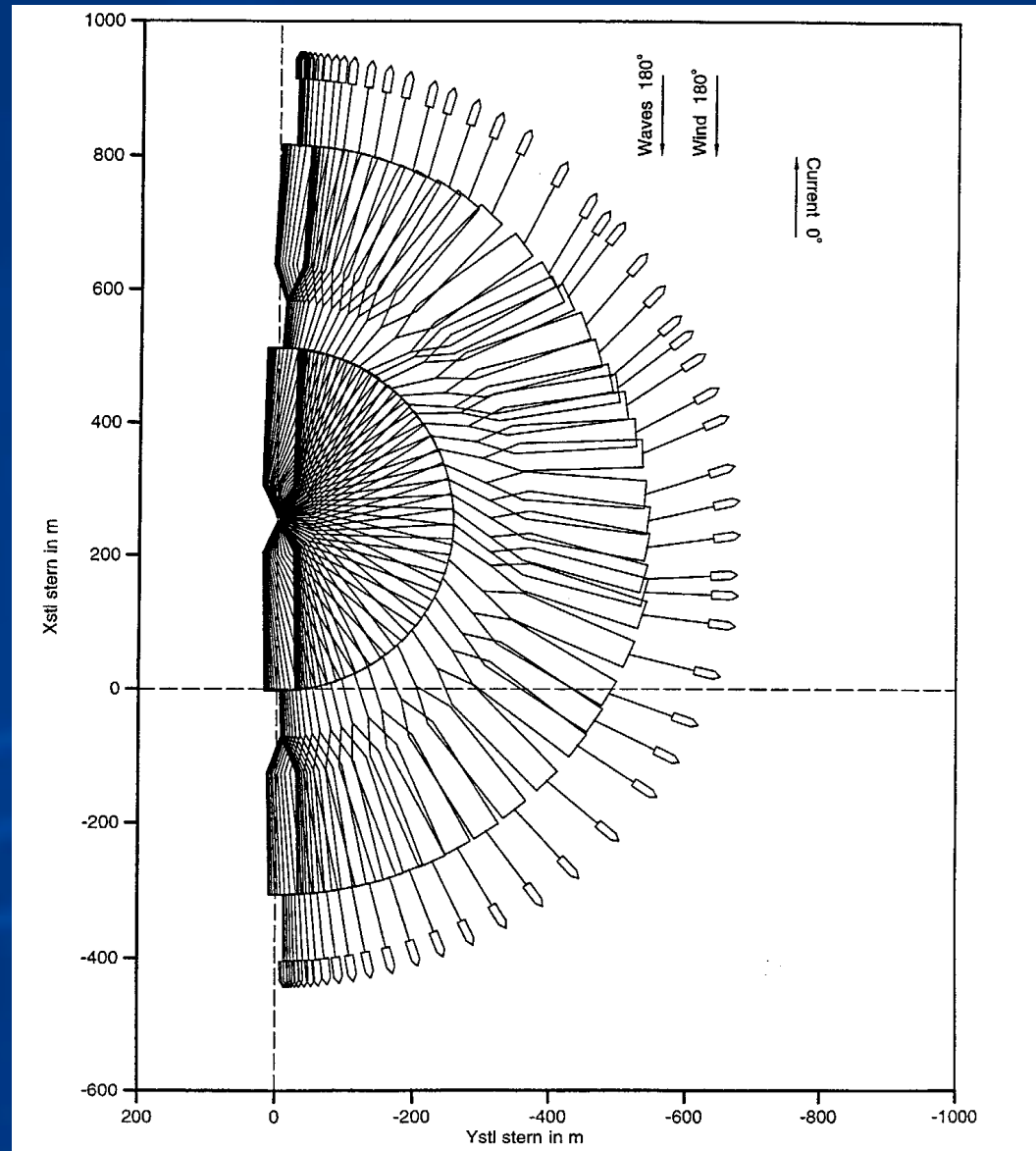


Offloading: Numerical Analysis

Offloading JIP:

Participants include

- Operators
 - Designers
 - Marine Personnel
 - HSE/MMS
-
- Model Tests
 - Development of Design Tool



Conclusions

- Appropriate Specification and Use of Design Environmental Criteria is Critical to Identify Extreme Responses
- Specification of Criteria is a function of Platform Type
- Model Testing and Field Measurement Programs (in addition to numerical and analytical studies) are essential for understanding Critical Issues and Evaluating Solutions
- Well Executed JIPs can be effective in studying these issues, especially if participants cooperate and share knowledge, data, and costs