

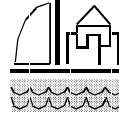
May 30–June 4

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# Brest, France

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<http://www.isopec.org>  
<http://www.ifremer.fr/isopec99/>



## The Ninth (1999) International Offshore and Polar Engineering Conference

# ISOPE-99

Concurrently: TECHNOMER and OSATES

Le Quartz, Brest, France  
May 30–June 4, 1999

## Technical Program

Refereed papers from 45 countries in 95 sessions and  
5 plenary sessions  
Forms (Inside) for Registration, Hotel, and Publication

*Organized by:*  
Technical Program Committee, ISOPE

*Sponsored by:*  
International Society of Offshore and Polar Engineers (ISOPE)  
with cooperating organizations (list inside)



ISOPE, P.O. Box 1107  
Golden, Colorado 80402-1107 USA  
Fax: +1-303-420-3760

## Welcome to ISOPE-99

We greatly appreciate the excellent responses and help we have received from colleagues around the world in the successful organization of the 9th International Offshore and Polar Engineering Conference (ISOPE-99), Brest, May 30–June 4, 1999. The Conference features 95 **sessions of refereed papers** and 5 **plenary sessions** from 45 countries.

The purposes of the ISOPE conference are to:

- promote technological progress and activities, international technological transfer and cooperation, and opportunities for engineers to maintain and improve technical competence; and
- provide a timely international forum for technical activities, cooperation, opportunity and fellowship among researchers and engineers,

by developing focused session topics with high quality (in both originality and significance) papers accepted through rigorous review, establishing high international standards for publication and worldwide distribution and promoting interdisciplinary interaction between academia and industry.

The International Society of Offshore and Polar Engineers (ISOPE) has already held 15 successful international meetings:

- The 1st (1990) European Offshore Mechanics Symposium (ISOPE EUROMS-90) in Trondheim, 1990;
- The 1st (1990) Pacific/Asia Offshore Mechanics Symposium (ISOPE PACOMS-90) Seoul; PACOMS-94 (SOSC-94) Beijing; and PACOMS-96 Pusan;
- The Annual ISOPE conferences, starting in Edinburgh, 1991 were held in San Francisco, Singapore, Osaka, The Hague, Los Angeles, Honolulu and Montréal. Since 1992, the annual ISOPE Conference has been held with the world's largest technical program of its kind with refereed papers;
- The 1st (1995) ISOPE Ocean Mining Symposium (OMS-95), Tsukuba, 1995, and ISOPE OMS-97 Seoul, 1997;
- the 1st (1996) International Deep-Ocean Technology (IDOT-96) Symposium and Workshop, Los Angeles.

On behalf of the Technical Program Committee, it is our pleasure to welcome participants from all over the world to the ISOPE-99 Conference in Brest.

Jin Chung, USA  
Michel Olagnon, France

Bob Frederking, Canada  
Yukio Ueda, Japan

**SUNDAY MAY 30**

09:00 ISOPE Board of Directors Meeting	Ile aux Moines
12:00 ISOPE-99 Executive Committee Meeting EUROMS and PACOMS Executive Committees	Ile aux Moines
15:00-18:00 CONFERENCE REGISTRATION	Reception Desk
18:00-21:00 BREST CITY RECEPTION	Salons de restauration
For Tour Information (see ISOPE bulletin board in Registration Area) Spouse Program ( <a href="http://www.ifremer.fr/isope99">http://www.ifremer.fr/isope99</a> )	see Bulletin Board

**MONDAY MAY 31**

07:30 <b>On-Site Registration</b> starts at 07:30 (Monday only) Session Briefing	Salons de restauration
09:00 <b>Conference Opening</b>	Grand Théâtre
1. <b>TECHNOLOGY REVIEW</b> (V. 1)	Grand Théâtre
11:00 2. <b>HYDRODYNAMICS: Internal Waves</b> 3. <b>MOBILE OFFSHORE BASE (MOB)</b> (V. 1) 4. <b>TUBULAR STRUCTURES I</b> (V. 4) 5. <b>SOIL PROPERTIES</b> (V. 1) 6. <b>ADV SHIPS &amp; NAVAL SYSTEMS I</b> (V. 4) 7. <b>RISERS/MOORING/CABLE MECH I</b> (V. 2) 8. <b>RELIABILITY, RISK AND SAFETY I</b> (V. 4) 9. <b>UNDERWATER VEHICLES I</b> (V. 2) 10. <b>HYDRODYNAMICS: Forces I</b>	Sein Les Glénan Batz Belle-Ile Ouessant Groix Molène Bréhat Salon Iroise
13:20 <b>PLENARY I</b> (Geotechnical Engineering) <b>PLENARY II</b> (Viscous Effects)	Amphithéâtre Sein
14:00 11. <b>HYDRODYNAMICS: Breaking Waves</b> 12. <b>VERY LARGE FLOAT STRUCT (VLFS)</b> (V. 1) 13. <b>TUBULAR STRUCTURES II</b> (V. 4) 14. <b>SOIL AND ROCK MECHANICS</b> (V. 1) 15. <b>ADV SHIPS &amp; NAVAL SYSTEMS II</b> (V. 4) 16. <b>RISERS/MOORING/CABLE MECH II</b> (V. 2) 17. <b>RELIABILITY, RISK AND SAFETY II</b> (V. 4) 18. <b>UNDERWATER VEHICLES II</b> (V. 2) 19. <b>HYDRODYNAMICS: Forces II</b>	Sein Les Glénan Batz Belle-Ile Ouessant Groix Molène Bréhat Salon Iroise
17:00 ISOPE Technical Committee Meetings	Salons de restauration

**TUESDAY JUNE 1**

07:30 Session Briefing	Salons de restauration
08:00	
20. METOCEAN I: Waves I (V. 3)	Sein
21. VLFS and MOB (V. 1)	Les Glénan
22. TUBULAR STRUCTURES III (V. 4)	Batz
23. SOIL CONSOLIDATION (V. 1)	Belle-Ile
24. COLLISION/IMPACT/DAMAGE I (V. 4)	Ouessant
25. RISERS/MOORING/CABLE MECH III (V. 2)	Groix
26. RELIABILITY, RISK AND SAFETY III (V. 4)	Molène
27. UNDERWATER VEHICLES III (V. 2)	Bréhat
28. HYDRODYNAMICS: Waves	Salon Iroise
10:45	
29. METOCEAN II: Waves II	Sein
30. REMOTE SENSING & ENVIRONMENT (V. 1)	Les Glénan
31. ENVIRONMENTS & DATABASE I (V. 1)	Batz
32. SOIL DYNAMICS (V. 1)	Belle-Ile
33. COLLISION/IMPACT/DAMAGE II (V. 4)	Ouessant
34. RISERS/MOORING/CABLE MECH IV (V. 2)	Groix
35. COMPOSITE MATERIALS I (V. 4)	Molène
36. UNDERWATER VEHICLES IV: Workshop(V. 2)	Bréhat
37. HYDRODYNAMICS: Dynamics I	Salon Iroise
13:20	
PLENARY III (VLFS: Present and Future)	Amphithéâtre
PLENARY IV (Wave Climate)	Sein
14:00	
38. METOCEAN III: Sea State I	Sein
39. RISERS/MOORING/CABLE MECH V (V. 2)	Les Glénan
40. ENVIRONMENTS & DATABASE II (V. 1)	Batz
41. SOIL LIQUEFACTION (V. 1)	Belle-Ile
42. COMPOSITE MATERIALS II (V. 4)	Molène
 <b>CONFERENCE TOUR</b>	
16:30 Board of Editors Meeting	Ile aux Moines
20:00 ISOPE-99/ISOPE-2000 Seattle TPC Meeting	Salons de restauration

Sunday - Thursday	
Audio/Visual Practice	Ile aux Moines
On-site Registration	Reception Desk
Conference Headquarters	Bureau Président
Proceedings Pickup/Sales	Reception Desk

**WEDNESDAY JUNE 2**

07:30 Session Briefing	Salons de restauration
08:00	
<b>43. METOCEAN IV: Sea State II</b>	Sein
<b>44. OFFSHORE I: Systems and Design I (V. 1)</b>	Les Glénan
<b>45. POLAR I: JOIA Projects (V. 2)</b>	Batz
<b>46. SOIL IMPROVEMENT I (V. 1)</b>	Belle-Ile
<b>47. ACOUSTICS &amp; MEASUREMENTS I (V. 4)</b>	Ouessant
<b>48. PIPELINES I: Hot Pipe (V. 2)</b>	Groix
<b>49. FIBER ROPE MOORING I: Design (V. 2)</b>	Molène
<b>50. MATERIALS &amp; WELDING I (V. 4)</b>	Bréhat
<b>51. HYDRODYNAMICS: Dynamics II (V. 3)</b>	Salon Iroise
10:45	
<b>52. METOCEAN V: Climatology</b>	Sein
<b>53. OFFSHORE II: Systems and Design II (V. 1)</b>	Les Glénan
<b>54. POLAR II: Ice Mechanics &amp; Forces (V. 2)</b>	Batz
<b>55. SOIL IMPROVEMENT II (V. 1)</b>	Belle-Ile
<b>56. ACOUSTICS &amp; MEASUREMENTS II (V. 4)</b>	Ouessant
<b>57. PIPELINES II: Stability (V. 2)</b>	Groix
<b>58. FIBER ROPE MOORING II: Tests (V. 2)</b>	Molène
<b>59. MATERIALS &amp; WELDING II (V. 4)</b>	Bréhat
<b>60. HYDRODYNAMICS: Dynamics III</b>	Salon Iroise
13:20	
<b>PLENARY V (Wave Measurements)</b>	Sein
14:00	
<b>61. HYDRODYNAMICS: NWT I</b>	Sein
<b>62. OFFSHORE III: FPSO/TLP/SPAR I (V. 1)</b>	Les Glénan
<b>63. POLAR III: Atmospheric Icing I (V. 2)</b>	Batz
<b>64. DEEP FOUNDATION (V. 1)</b>	Belle-Ile
<b>65. COASTAL ENGINEERING I</b>	Ouessant
<b>66. PIPELINES III: Modeling &amp; Design I (V. 2)</b>	Groix
<b>67. FIBER ROPE MOORING III: Workshop (V. 2)</b>	Molène
<b>68. MATERIALS &amp; WELDING III (V. 4)</b>	Bréhat

**Find Update in Program on Website:**  
<http://www.ifremer.fr/isope99> or <http://www.iso-pe.org>.

20:00	Salons de restauration
<b>Annual Conference Banquet Program and Best Paper and ISOPE Awards</b>	
Session Briefing Audio/Visual practice	Salons de restauration Ile aux Moines

**THURSDAY JUNE 3**

07:30 Session Briefing

Salons de restauration

08:00

<b>69. HYDRODYNAMICS: NWT II</b>	Sein
<b>70. OFFSHORE IV: FPSO/TLP/SPAR II (V. 1)</b>	Les Glénan
<b>71. POLAR IV: Atmospheric Icing II (V. 2)</b>	Batz
<b>72. PILE FOUNDATION (V. 1)</b>	Belle-Ile
<b>73. COASTAL ENGINEERING II (V.3)</b>	Ouessant
<b>74. PIPELINES IV: Modeling &amp; Design II (V. 2)</b>	Groix
<b>75. OCEAN ENERGY &amp; RESOURCES I (V. 1)</b>	Molène
<b>76. MATERIALS &amp; WELDING IV (V. 4)</b>	Bréhat
<b>77. HYDRODYNAMICS: Dynamics IV (V.1)</b>	Salon Iroise

10:45

<b>78. HYDRODYNAMICS: NWT III (V.3)</b>	Sein
<b>79. OFFSHORE V: FPSO/TLP/SPAR III (V. 1)</b>	Les Glénan
<b>80. POLAR V: Environment (V. 2)</b>	Batz
<b>81. SLOPE STABILITY (V. 1)</b>	Belle-Ile
<b>82. COASTAL ENGINEERING III (V.3)</b>	Ouessant
<b>83. PIPELINES V: Modeling &amp; Design III (V. 2)</b>	Groix
<b>84. OCEAN ENERGY &amp; RESOURCES II (V. 1)</b>	Molène
<b>85. MECHANICS &amp; ANALYSIS I (V. 4)</b>	Bréhat
<b>86. HYDRODYNAMICS: Vortex &amp; Vibr I (V.3)</b>	Salon Iroise

13:00

OMWG Meeting

Ile aux Moines

<b>87. HYDRODYNAMICS: NWT IV (V.3); Workshop</b>	Sein
<b>88. OFFSHORE VI: FPSO/TLP/SPAR IV(V. 1)</b>	Les Glénan
<b>89. POLAR VI: Operations (V. 2)</b>	Batz
<b>90. EARTHQUAKE ENGINEERING (V. 4)</b>	Belle-Ile
<b>91. COASTAL ENGINEERING IV (V.3)</b>	Ouessant
<b>92. PIPELINES VI: Hydro Interactions (V. 2)</b>	Groix
<b>93. OCEAN ENERGY &amp; RESOURCES III (V. 1)</b>	Molène
<b>94. MECHANICS &amp; ANALYSIS II (V. 4)</b>	Bréhat
<b>95. HYDRODYNAMICS: Vortex &amp; Vibr II (V.1)</b>	Salon Iroise

**Breton Night**

Centre d'Instruction Naval

20:00 Thursday June 3

**FRIDAY JUNE 4**

**Mont Saint Michel** Tour: 270 FF; departure at 08:30 and expected return around 20:00.

**Technical Visit to Ecole Navale** (French Naval Academy): see bulletin board.

**Other Optional Tours:** Find places to visit for tour in this program and on ISOPE 99 Web site and visit the conference registration desk, and check the ISOPE bulletin board on May 30, Sunday.

## ISOPE-99 Brest

The Conference features 95 technical and opening sessions and 5 plenary sessions with top experts from industry, academia and government. About 420 refereed papers **after review** will be presented and discussed by researchers, engineers and managers from more than 45 countries.

The Conference Proceedings will be available in a set of 4 volumes (2,900 pp. est.) during the conference and later for worldwide post-conference mail order from ISOPE.

### SESSION LIST BY TOPICS

#### OFFSHORE RESOURCE & TECHNOLOGY

1. TECHNOLOGY REVIEW (V. 1)	Grand Théâtre
3. MOBILE OFFSHORE BASE (MOB) (V. 1)	Les Glénan
12. VERY LARGE FLOAT. STRUC. (VLFS) (V. 1)	Les Glénan
21. VLFS and MOB (V. 1)	Les Glénan
75. OCEAN ENERGY & RESOURCES I (V. 1)	Molène
84. OCEAN ENERGY & RESOURCES II (V. 1)	Molène
93. OCEAN ENERGY & RESOURCES III (V. 1)	Molène
44. OFFSHORE I: Systems and Design I (V. 1)	Les Glénan
53. OFFSHORE II: Systems and Design II (V. 1)	Les Glénan
62. OFFSHORE III: FPSO/TLP/SPAR I (V. 1)	Les Glénan
70. OFFSHORE IV: FPSO/TLP/SPAR II (V. 1)	Les Glénan
79. OFFSHORE V: FPSO/TLP/SPAR III (V. 1)	Les Glénan
88. OFFSHORE VI: FPSO/TLP/SPAR IV (V. 1)	Les Glénan

#### REMOTE SENSING & ENVIRONMENT

31. ENVIRONMENTS & DATABASE I (V. 1)	Batz
40. ENVIRONMENTS & DATABASE II (V. 1)	Batz
30. REMOTE SENSING & ENVIRONMENT (V. 1)	Les Glénan

#### GEOTECHNICAL ENGINEERING

5. SOIL PROPERTIES (V. 1)	Belle-Ile
14. SOIL AND ROCK MECHANICS (V. 1)	Belle-Ile
23. SOIL CONSOLIDATION (V. 1)	Belle-Ile
32. SOIL DYNAMICS (V. 1)	Belle-Ile
41. SOIL LIQUEFACTION (V. 1)	Belle-Ile
46. SOIL IMPROVEMENT I (V. 1)	Belle-Ile
55. SOIL IMPROVEMENT II (V. 1)	Belle-Ile
64. DEEP FOUNDATION (V. 1)	Belle-Ile
72. PILE FOUNDATION (V. 1)	Belle-Ile
81. SLOPE STABILITY (V. 1)	Belle-Ile

#### PIPELINE/RISER/CABLE MECHANICS

48. PIPELINES I: Hot Pipe (V. 2)	Groix
57. PIPELINES II: Stability (V. 2)	Groix
66. PIPELINES III: Modeling & Design I (V. 2)	Groix
74. PIPELINES IV: Modeling & Design II (V. 2)	Groix
83. PIPELINES V: Modeling & Design III (V. 2)	Groix
92. PIPELINES VI: Hydro Interactions (V. 2)	Groix
7. RISERS/MOORING/CABLE MECH I (V. 2)	Groix
16. RISERS/MOORING/CABLE MECH II (V. 2)	Groix

25. RISERS/MOORING/CABLE MECH III (V. 2)	Groix
34. RISERS/MOORING/CABLE MECH IV (V. 2)	Groix
39. RISERS/MOORING/CABLE MECH V (V. 2)	Les Glénan
49. FIBER ROPE MOORING I: Design (V. 2)	Molène
58. FIBER ROPE MOORING II: Tests (V. 2)	Molène
67. FIBER ROPE MOORING III: Workshop (V. 2)	Molène

#### UNDERWATER VEHICLES & ROBOTICS

9. UNDERWATER VEHICLES I (V. 2)	Bréhat
18. UNDERWATER VEHICLES II (V. 2)	Bréhat
27. UNDERWATER VEHICLES III (V. 2)	Bréhat
36. UNDERWATER VEHICLES IV: Workshop (V. 2)	Bréhat

#### POLAR & ICE ENGINEERING

45. POLAR I: JOIA Projects (V. 2)	Batz
54. POLAR II: Ice Mechanics & Forces (V. 2)	Batz
63. POLAR III: Atmospheric Icing I (V. 2)	Batz
71. POLAR IV: Atmospheric Icing II (V. 2)	Batz
80. POLAR V: Environment (V. 2)	Batz
89. POLAR VI: Operations (V. 2)	Batz

#### METOCEAN

20. METOCEAN I: Waves I (V. 3)	Sein
29. METOCEAN II: Waves II (V. 3)	Sein
38. METOCEAN III: Sea State I (V. 3)	Sein
43. METOCEAN IV: Sea State II (V. 3)	Sein
52. METOCEAN V: Climatology (V. 3)	Sein

#### HYDRODYNAMICS

2. HYDRODYNAMICS: Internal Waves (V.3)	Sein
11. HYDRODYNAMICS: Breaking Waves (V.3)	Sein
28. HYDRODYNAMICS: Waves (V.3)	Salon Iroise
61. HYDRODYNAMICS: NWT I (V.3)	Sein
69. HYDRODYNAMICS: NWT II (V.3)	Sein
78. HYDRODYNAMICS: NWT III (V.3)	Sein
87. HYDRODYNAMICS: NWT IV: Workshop(V.3)	Sein
10. HYDRODYNAMICS: Forces I (V.3)	Salon Iroise
19. HYDRODYNAMICS: Forces II (V.3)	Salon Iroise
37. HYDRODYNAMICS: Dynamics I (V.3)	Salon Iroise
51. HYDRODYNAMICS: Dynamics II (V.3)	Salon Iroise
60. HYDRODYNAMICS: Dynamics III (V.3)	Salon Iroise
77. HYDRODYNAMICS: Dynamics IV (V.3)	Salon Iroise
86. HYDRODYNAMICS: Vortex & Vibr I (V.3)	Salon Iroise
95. HYDRODYNAMICS: Vortex & Vibr II (V.3)	Salon Iroise

#### COASTAL ENGINEERING

65. COASTAL ENGINEERING I (V.3)	Ouessant
73. COASTAL ENGINEERING II (V.3)	Ouessant
82. COASTAL ENGINEERING III (V.3)	Ouessant
91. COASTAL ENGINEERING IV (V.3)	Ouessant

## TUBULAR STRUCTURES

4. TUBULAR STRUCTURES I (V. 4)	Batz
13. TUBULAR STRUCTURES II (V. 4)	Batz
22. TUBULAR STRUCTURES III (V. 4)	Batz

## MATERIALS/FATIGUE/WELDING/ COMPOSITE

50. MATERIALS & WELDING I (V. 4)	Bréhat
59. MATERIALS & WELDING II (V. 4)	Bréhat
68. MATERIALS & WELDING III (V. 4)	Bréhat
76. MATERIALS & WELDING IV (V. 4)	Bréhat
35. COMPOSITE MATERIALS I (V. 4)	Molène
42. COMPOSITE MATERIALS II (V. 4)	Molène

## RELIABILITY/ MECHANICS/ IMPACT/ EARTHQUAKE

85. MECHANICS & ANALYSIS I (V. 4)	Bréhat
94. MECHANICS & ANALYSIS II (V. 4)	Bréhat
8. RELIABILITY, RISK AND SAFETY I (V. 4)	Molène
17. RELIABILITY, RISK AND SAFETY II (V. 4)	Molène
26. RELIABILITY, RISK AND SAFETY III (V. 4)	Molène
24. COLLISION/IMPACT/DAMAGE I (V. 4)	Ouessant
33. COLLISION/IMPACT/DAMAGE II (V. 4)	Ouessant
90. EARTHQUAKE ENGINEERING (V. 4)	Belle-Ile

## NAVAL SYSTEMS AND ACOUSTICS

6. ADV SHIPS & NAVAL SYS I (V. 4)	Ouessant
15. ADV SHIPS & NAVAL SYS II (V. 4)	Ouessant
47. ACOUSTICS & MEASUREMENTS I (V. 4)	Ouessant
56. ACOUSTICS & MEASUREMENTS II (V. 4)	Ouessant

<b>Brest City Reception</b> Host: <b>Hon. Pierre Maille</b> , Mayor and President of the Brest Urban Community <b>18:00-21:00 SUNDAY</b> May 30	Salons de restauration
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<b>Conference Opening</b> <b>09:00 MONDAY</b> May 31	Grand Théâtre
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<b>Annual Conference Banquet</b> <b>20:00 WEDNESDAY</b> June 2	Salons de restauration
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<b>Breton Night</b> <b>20:00 THURSDAY</b> June 3	Centre d'Instruction Naval
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Dinner in the majestic hall of the Navy Instruction Center (**Centre d'Instruction Naval**), overlooking the Brest Bay, with the well-known « *Bleizi-ru* » Celtic music group and gavotte dancing.

## ISOPE-99 Technical Program Committee (TPC)

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 Dr. J. Koo, Exxon Research & Engineering Co., Annandale, NJ, USA  
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