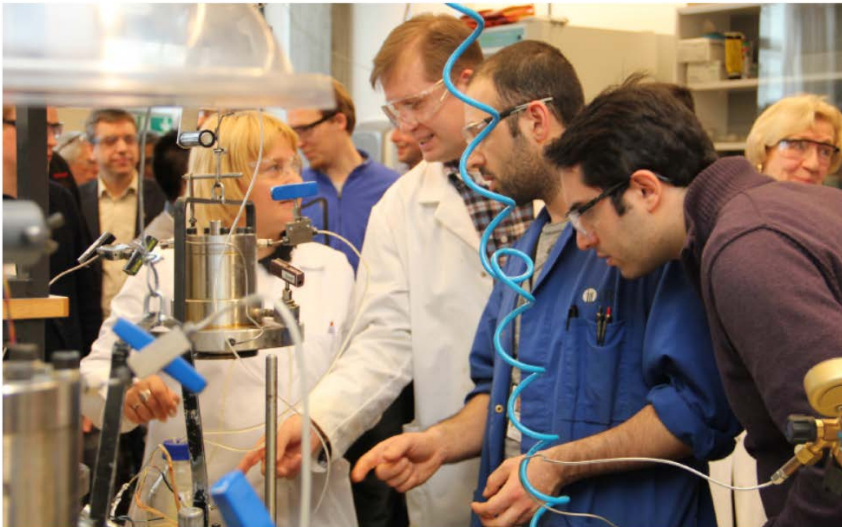


Joining forces to recover more



- forming a true base for the IOR
competence in Norway

by

Merete V. Madland

Joining Forces seminar at NPD in Stavanger 2nd & 3rd February 2016

The National IOR Centre of Norway



The national and international collaborators actively involved in the IOR Centre`s R&D activities

- UiB, UiO, NTNU
- TU Delft, DTU, Cornell University
- TNO, GEO, Geus
- The Institute for Study of the Earth's Interior (ISEI), Okayama University, Misasa, Japan; a Center of Excellence for the 21st Century (one of the most prestigious laboratories in geosciences, cosmosciences and micro-/nano technology in the world)
- University of Aberdeen
 - Professor Alex Kemp. Economic analyses of IOR-projects
- Sandia National laboratories, Albuquerque, New Mexico
 - Three-dimensional imaging and pore-scale modelling of carbonate rocks (former title: FIB-SEM imaging of chalk)
 - Contact: Dr. Hongkyu Yoon
- CoE Institute of Science and Technology in Luxembourg (material sciences)
- CoE Helmholtz Institute Freiberg for Resource Technology at Dresden with the TU Bergakademie Freiberg (economic geology and material sciences)
 - Dr. Bernhard Schultze/Dr. Jens Gutzmer
- École Polytechnique Université Paris-Sarclay (Physics)
- University of Münster Germany (Mineralogy)
 - Dr. Cristian Vollmer
- University of Edinburgh
- University of Houston (Geology)
- Università Bicocca Milano (Geology)
- NCAR
 - Dr. Dorit Hammerling/ Dr. Ram Nair
- Université de Lyon
 - Professor Olivier Tillement



Prof. Eizo Nakamura, ISEI, Misasa, Japan
Institute for the Study of the Earth's Interior



Prof./Prof. Ida Lykke-Jacobius, DTU/UIS



Prof. Dag K. Dysthe, UiO



Dr. Olwijn Leeuwenburgh
TNO



Prof. Johan Sjöblom, Uppsala/NTNU



Prof. Arne Graue, UiB



Prof. Lawrence M. Cables III, CU



Ass. Prof. Martin Fernø, UiB



MSc Nina Egeland,
Research Assistant, UIS



Post doc. Bergit Brattekkås, UIS/UiB



PhD student Mario Silva & Postdoc. Thomas Brichart

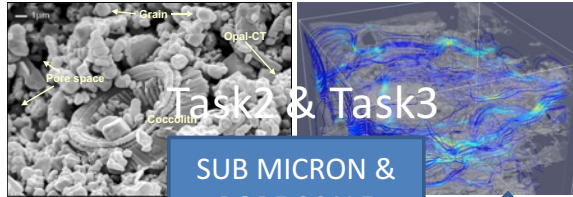
CURRENT R&D ACTIVITIES

Mobile and immobile oil and EOR methods

Theme 1: Tasks and Task Leaders



Udo Zimmermann
Professor UiS
udo.zimmermann@uis.no



Task 2 & Task 3
SUB MICRON & PORE SCALE INVESTIGATIONS



Espen Jettestuen
Senior Scientist IRIS
eje@iris.no



Aksel Hiorth
Professor/Chief Scientist
UiS/IRIS
Aksel.hiorth@uis.no/ah@iris.no

CORE SCALE MEASUREMENTS & IMAGING



Task 1

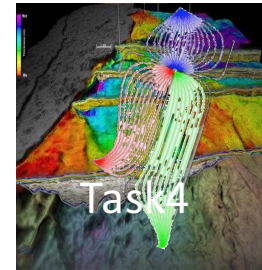
INTERPRETATION & EOR FLUIDS OPTIMIZATION

UPSCALING & SECTOR SCALE OPTIMIZATION

CORE SCALE SIMULATIONS



Arne Stavland
Chief Scientist IRIS
as@iris.no

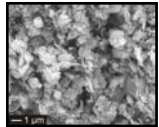


Task 4

Combine multiphase models with chemistry

- interpret & upscale lab experiments

IORCoreSim
(DOUCS)



Geochemistry

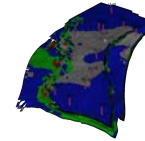
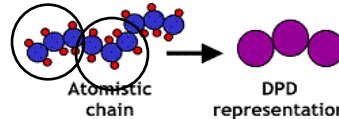
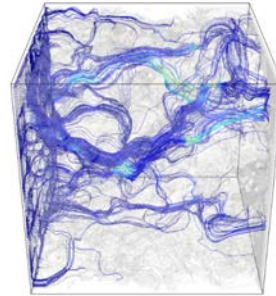
Polymer,
Silicate

Surfactant

MEOR

Tracers,
Nanoparticles and
...?

Pore scale
(LB & DPD)



ECLIPSE,
OPM,

+

IORSim

Geo-
chemistry

Polymer,
silicate

Surfactant

MEOR

?

Theme 1 – current projects



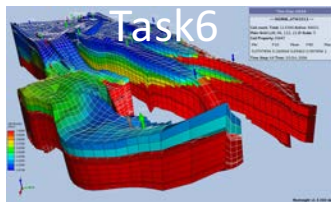
Theme 2: Tasks and Task Leaders



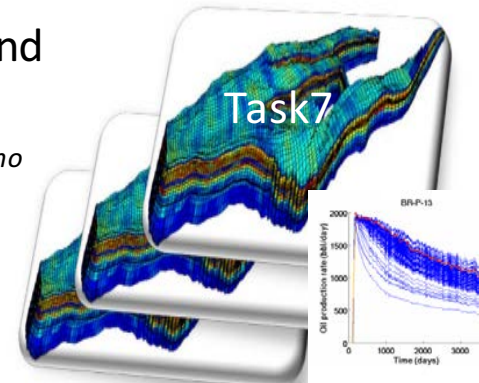
Robert Köfkorn
Senior Researcher
IRIS
Robert.Kloefkorn@iris.no



Svein Skjæveland
Professor Emeritus
UoS
svein.m.skjeveland@uis.no



DEVELOPMENT & IMPROVED METHODOLOGY FOR FULL FIELD RESERVOIR SIMULATION TOOLS



IMPROVE VOLUMETRIC SWEEP

FIELD SCALE EVALUATION & HISTORY MATCHING & OPTIMIZATION



TRACER TECHNOLOGY & TRACER DEVELOPMENT



Geir Nævdal
Chief Scientist
IRIS
Geir.Naevdal@iris.no



Tor Bjørnstad
Chief Scientist/Professor Emeritus
IFE/UoS
tor.bjornstad@ife.no

Improving the volumetric sweep

- **IFEs tracer laboratories:**
 - New tracers with different characteristics are developed to determine S_{or} and to investigate where in the reservoir the remaining oil resources are
- **Reservoir simulation tools:**
 - New developments with regards to IOR processes in the open source full field simulator, OpenPorousMedia (OPM). OPM gives the academic freedom and also suits the educational job of the IOR centre, as all code is free and available for all
 - Current focus includes basic investigations on model formulations for multiphase flow in fractured porous media, and modelling of near well flow scenarios, interaction with the chemical simulator IORSim, compositional modelling and higher order numerical methods
- **Field scale evaluation and History matching:**
 - Good reservoir models are necessary to predict the future and make the correct decisions. Ensemble based methodology is used both in history matching and optimization. Essential in the research is to include all types of data in the history matching and to use simulation tools that can simulate these data

Theme 2 – current projects



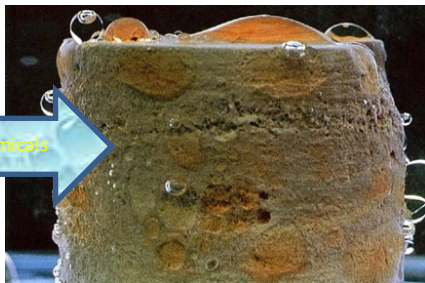
2015-12

OUR STRENGTHS AND HOW WE DISTINGUISH OURSELVES FROM OTHERS

Joining forces – two examples

The IORSim (NIORC incl. Schlumberger)

- A simulator for predicting the effect of rock fluid interactions on oil recovery based on industry standard reservoir models
 - Upscale from core scale
 - Predict the performance of IOR chemicals on field scale
 - Effect of combining several EOR methods



Schlumberger

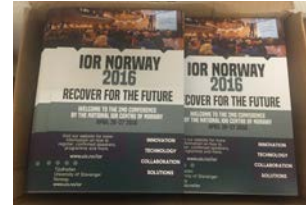
The Yard test (NIORC incl. Halliburton, and SNF, SAR, and Matek-Samson)

- Quantifying the degradation of polymer when passing different chokes
 - Two polymers, at three concentrations, are being pumped through valves



HALLIBURTON

**The National
IOR Centre
of Norway**



Dissemination



Dissemination NIORC 2014-2015

Resultatindikatorer

Resultater 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 Akkumulert hittil

Allmennrettede formidlingstiltak

Oppslag i massemedia (aviser, radio, TV mm)

134 7

141

Populærvitenskapelige publikasjoner (artikler/bøker, debattbøker/-artikler, høringer, utstillinger, skjønnlitteratur etc.)

0 14

14

Brukerrettede formidlingstiltak

Rapporter, notat, artikler, foredrag på møte/konferanser retta mot målgruppene i prosjektet.

93 101

194

Vitenskapelige utgivelser

Publisert artikkel i antologi

0

0

Publisert artikkel i periodika og serier

0 37

37

Publiserte monografier

0 1

1

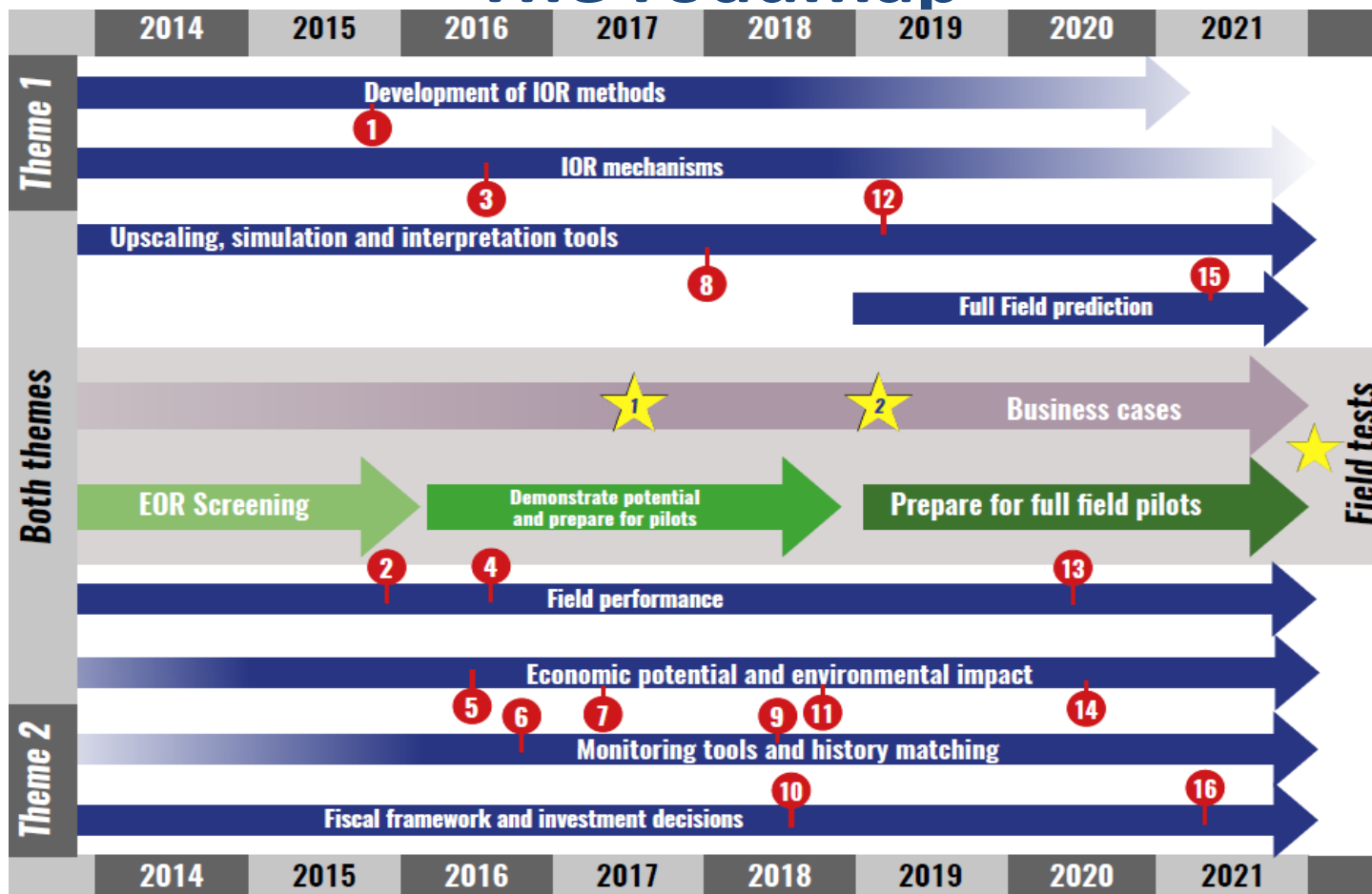
Planning- which R&D activities?

- Internal project announcements
- Regular workshops, seminars meetings w/ the research and industry partners
- The Technical Committee (TC) (4-5 meetings per year):
 - The advisory body to the Board, consisting of representatives from each of the 12 user partners
- The Board (4-5 meetings per year):
 - Monitors the implementation of the projects and approve annual work plans and budgets
 - Ensures that the activities described in the project description, financing plan and annual work plans are completed within a defined timeframe, and this includes in-kind contributions from the two service companies delivered as specified
 - Consists of one representative from each research partner; UiS, IRIS, IFE, and a representative from five of the user partners (industry); to ensure industry relevance and engagement
 - RCN, Norwegian Petroleum Directorate and Petoro have observer status

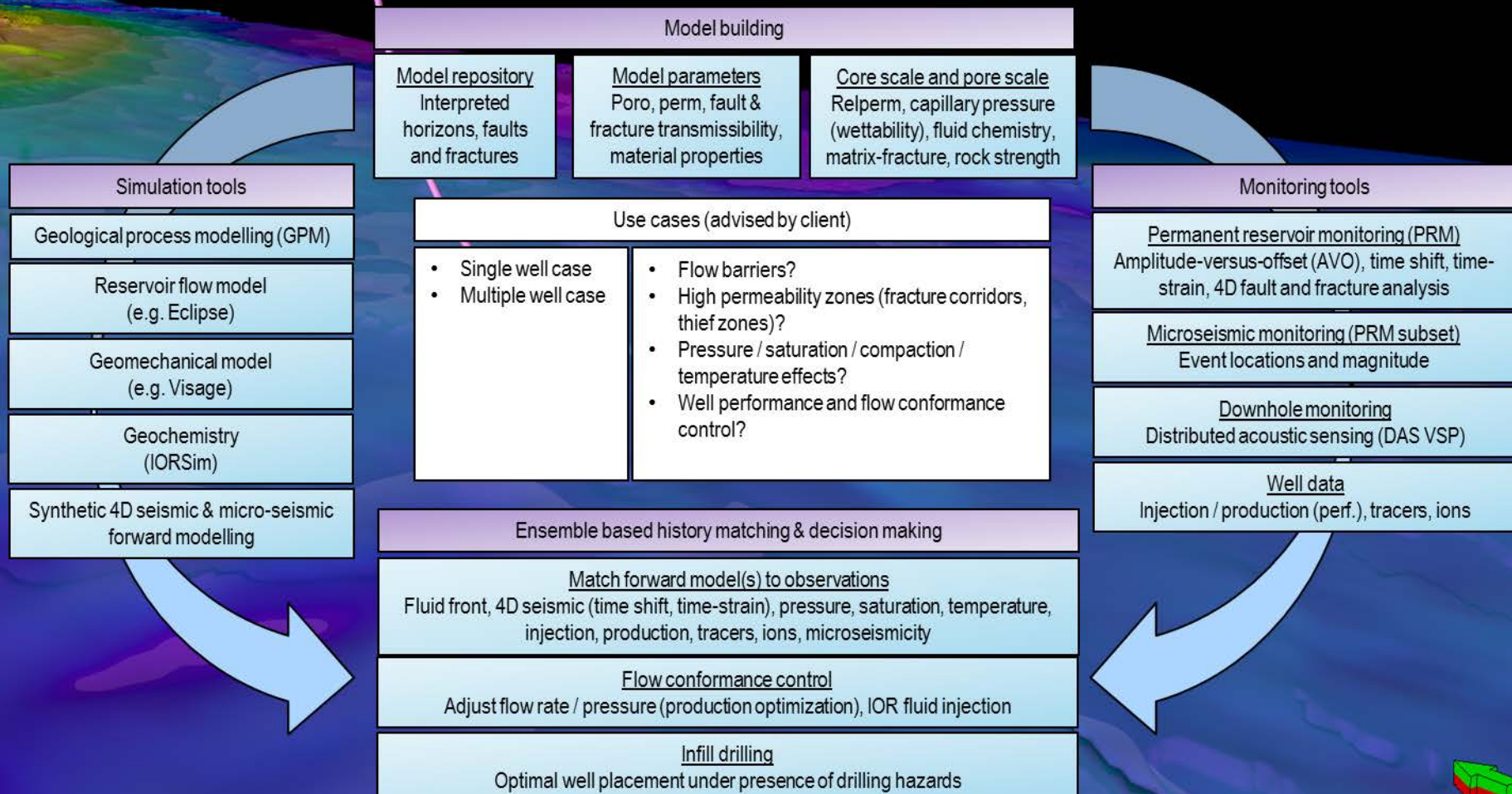


PLANS FOR FUTURE R&D PROJECTS

The roadmap



Objective: Integration of IOR tools and technologies



IOR Workshop 25th April 2016

All partners, national and international collaborators and any other interested parties are invited to an internal workshop to discuss current issues regarding IOR/EOR research

- Theme: «How can research contribute to pilots?»
 - Experiments and modeling
- Chair: Kåre Vagle (CoP)
- Program
 - Introduction
 - Presentation of plans for two integrated projects

Programme:

Chair: Kåre Vagle, ConocoPhillips

09:00 Registration

09:30 Welcome

09:40 *"EOR/IOE Research Integration from University to Industry for Offshore Newfoundland"*

Lesley James, Memorial University of Newfoundland

10:00 Speaker 2: To be announced

10:20 Speaker 3: To be announced

11:40 *"Title to be announced"*

Martin Ferno, UiB

12:00 LUNCH

The Ekofisk field

13:00 *"Ekofisk – Lab to Field"*

Robert Moe, ConocoPhillips

13:30 *"Estimation of reservoir parameter changes using 4D seismic data of Ekofisk Field"*

Tuhin Bhakta, IRIS

14:00 *"Ekofisk IOR integration project"*

Jarle Haukås, Schlumberger

14:30 *"IOESim – an add on tool to Eclipse for IOR simulations"*

"The two way coupling between IOESim and Eclipse"

Jan Sagen, IFE

15:00 Coffee break

The Snorre field

15:30 *"Title to be announced"*

Vegard Roine Stenerud, Statoil

16:00 *"In-depth water diversion - upscaling from lab to field"*

Arne Stavland, IRIS

16:30 *"Explaining and modelling the rheology of polymer fluids with the kinetic theory"* Dmitry Shogin, Postdoc, UiS

17:00 Summing up

Annual IOR conferences

- attracting new national and international collaborators

- [Welcome to IOR NORWAY](#)

[2016](#) <http://www.uis.no/research-and-phd-studies/research-centres/the-national-ior-centre-of-norway/ior-norway-2016/>

- April 26-27 2016

- For more information:

uis.no/ior



WELCOME TO
THE FIRST ANNUAL CONFERENCE
BY THE NATIONAL IOR CENTRE OF NORWAY
IOR NORWAY 2015

SPEAKERS

TOMAS MØRCH, ØIVIND FEVANG, HANS C. RØNNEVIK, JOSE LUIS MOGOL-LON, MARCO ROTONDI, PETTER OSMUNDSEN, REIDAR BRATVOLD, EUAN DUNCAN, ADOLFO HENRIQUEZ, LAURA DOVERA, BO CERUP-SIMONSEN, FLEMMING OLE RASMUSSEN, MARTIN LANDRØ, OLAF HUSEBY, LAWRENCE CATHLES III, GEIR NÆVDAL, LARRY LAKE, DORTHE WILDENSCHILD, CHUN HUH, ANN MUGGERIDGE, ALF BIRGER RUSTAD, AKSEL HIORTH, ØYSTEIN PETTERSEN, ANDREW PUTNIS, HONGKYU YOON, JOHAN OLAV HELLAND

TJODHALLEN - UNIVERSITY OF STAVANGER
APRIL 28-29, 2015



WWW.UIS.NO/IOR



**IOR NORWAY
2016**

RECOVER FOR THE FUTURE

WELCOME TO THE 2ND CONFERENCE
BY THE NATIONAL IOR CENTRE OF NORWAY
APRIL 26-27 2016

Visit our website for more information on how to register, confirmed speakers, programme and more.

www.uis.no/ior

INNOVATION

TECHNOLOGY

COLLABORATION

SOLUTIONS

Tjodhallen
University of Stavanger
Norway
www.uis.no/ior

IOR NORWAY 2016

NIORC in collaboration w/ NFiP (Petroleum Research School of Norway)

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APRIL **IOR NORWAY**
2016
RECOVER FOR THE FUTURE

09:00 Registration

10:00 Welcome to IUS
Marit Boyesen, Rector, University of Stavanger
10:05 "Joining forces to recover more"
Marena V. Madland, Director, The National IOR Centre of Norway
10:20 "TOR- Government perspective"
William Christiansen (OED)

THEME 1: PILOTS AND FULL FIELD CRITERIA FOR SUCCESS

10:40 "Monitoring of the Ekofisk field with 4D seismic data from a permanently installed seafloor system"
Per Gunnar Folstad, ConocoPhillips
11:00 "CO2 Foam EOR Field Pilots for More Efficient and Sustainable Petroleum Production"
Arne Graue, Uib
11:20 "Water diversion EOR technique - Challenges related to Technology Development and Field Implementation"
Kjetil Skrettingland, Statoil
11:40 Questions
11:50 PhD Stand up 1
12:00 Lunch with PhD session

THEME 2: RESERVOIR CHARACTERIZATION AND PRODUCTION OPTIMIZATION

13:00 "Bayesian inversion methods for time-lapse seismic reservoir characterization and monitoring"
Dario Grana, University of Wyoming
13:20 "Can fluorescent nano-objects be used as reservoir tracers?"
Thomas Birchart, The National IOR Centre of Norway, IFE
13:40 "Optimization of subsurface flow"
Jan Dirk Jansen, TU Delft
14:00 "Gradient free production optimization under geological uncertainty"
Andreas Stordal, The National IOR Centre of Norway, IRIS
14:20 Questions
14:30 Coffee break
15:00 PhD Stand up 2
15:10 Popular Science presentation

THEME 3: IMPROVED UNDERSTANDING/MODELING OF THE IOR PROCESSES

15:30 "The Benefits and Risks of Fractures in Enhanced Oil Recovery"
Kandy Searight, New Mexico IT
15:50 "A study of in-situ combustion for heavy oil recovery"
Margot Gerritsen, Stanford
16:10 "Impact of choke valves on the IOR polymer flooding efficiency. Lessons learned from Large scale tests"
Arne Stavland, The National IOR Centre of Norway, IRIS
16:30 Questions
16:40 Debate
17:00 End of day one
19:00 Conference dinner at Clarion Hotel Stavanger

27
APRIL

THEME 4: THE OIL INDUSTRY AND IOR

09:00 00 "Making the impossible, possible. What's needed to take oil recovery on the NCS to the next level?"
Karl Erik Schjøtt-Pedersen, Norsk olje og gass
09:20 "Challenges and Opportunities with IOR/EOR - Johan Sverdrup Field Development Planning"
Bjorn Egil Ludvigsen, Maersk
09:40 "Complex Fluids in EOR: Brazil-Norway ongoing collaborations"
Marcio S. Carvalho, Pontificia Universidade Católica do Rio de Janeiro
10:00 Questions
10:10 PhD stand up 3
10:20 Coffee break with PhD session

THEME 5: PORE SCALE FUNDAMENTALS

11:00 "Direct pore scale modeling approaches to wettability"
Masa Prodanovic (UT Austin)
11:20 "Is reactive flow important for IOR?"
Jan Ludvig Vinningland, The National IOR Centre of Norway, IRIS
11:40 "Confined fluid films, forces between mineral surfaces and the mechanical effects of pore fluid chemistry"
Anja Rayne, UIO
12:00 "Submicron Investigations - What can we learn?"
Mona Minde, The National IOR Centre of Norway, UIS
12:20 Popular science presentation

12:40 Lunch with PhD session
14:00 Entertainment

THEME 6: SIMULATION OF IOR PROCESSES

14:10 PhD stand up 4
14:20 "Flow -- an open source research tool for reservoir simulation"
Robert Kloforn, The National IOR Centre of Norway, IRIS
14:40 "IORSim an add on tool to ECLIPSE for simulating IOR processes"
Aksel Kjørth, The National IOR Centre of Norway, IRIS
15:10 "Methodologies and robust algorithms for subsurface simulators"
Mary Wheeler, The University of Texas at Austin
15:30 Questions
15:40 Summing up
16:00 End of Conference

PHD AWARD

In order to highlight the young IOR researchers an award will be given to the most promising PhD fellow participating in the poster session.

The award will be presented during the summing up of the conference.



Speaker: Karl Eirik Schjøtt-Pedersen

CEO of Norsk olje og gass, Karl Eirik Schjøtt-Pedersen will present the topic *–Making the impossible, possible. What's needed to take oil recovery on the NCS to the next level?–*



Prof. Arne Graue, Physics at the Department of Physics and Technology, University of Bergen



William Frank Chesterton, Climate, Industry and Technology Department - the Norwegian Ministry for Petroleum and Energy



Prof. Margot Gerritsen, Department of Energy Resources Engineering, Stanford