



# 25<sup>TH</sup> SALT WATER INTRUSION MEETING 17-22 JUNE 2018 GDAŃSK POLAND

**SWIM 2018 Pre-Conference Short Course:**

## **Modeling Groundwater Flow in Coastal Zones**

### **WHY IS THIS COURSE IMPORTANT?**

Groundwater in coastal zones is a precious resource that supports the livelihoods of hundreds of millions of people worldwide. The growing demand for freshwater increases the risk of seawater intrusion. Climate change and sea level rise both affect groundwater reserves as well. Groundwater models of flow and solute transport are important tools to understand the coastal aquifer systems and make predictions about future developments. The course objective is to impart knowledge and skills that will enable the participants to characterize and model coastal groundwater systems.

### **WHO SHOULD ATTEND?**

This course is aimed at practitioners and researchers that want to improve their quantitative skills for the study of coastal aquifers. Basic knowledge of groundwater hydrology and, to a lesser extent, seawater intrusion will be assumed. The course will make use of Python, a scripting language that has become a firmly established tool in science and engineering. Some familiarity with the language will be required (self-guided tutorials available on request before the start of the course).

### **WHO IS PRESENTING?**

The course will be presented by world-renowned experts in the field of coastal groundwater research and modelling.

Presenters include Christian Langevin (USGS), Mark Bakker (TU Delft), and Frans Schaars (Artesia Water)

### **WHAT WILL THE COURSE COVER?**

- Theory of variable-density flow and solute transport
- Sharp-interface analytical solutions
- FloPy, a Python tool for the MODFLOW code family
- MODFLOW SWI package
- SEAWAT

### **COURSE DETAILS**

**Thurs 14 June-Sat 16 June  
2018**

**Gdańsk, Poland, Mercure  
Gdańsk Stare Miasto hotel**

**This includes course notes,  
classroom teaching, tutorials,  
morning and afternoon  
refreshments and lunches.**

**Attendees are to arrange their  
own travel and accommodation  
and laptop for the course.**

### **COURSE FEE**

**1300 PLN**

### **CONTACT US**

**[swim2018poland@gmail.com](mailto:swim2018poland@gmail.com)**

### **REGISTER AT**

**[swim2018.syskonf.pl](http://swim2018.syskonf.pl)**

Day 1		Thursday 14 <sup>th</sup> June 2018	
TIME		THEME/TOPIC	PRESENTERS
0830		Coffee & Registration	Mark Bakker (TU Delft), Frans Schaars (Artesia Water), and Christian Langevin (USGS)
Day theme		Sharp-interface analytical solutions in Python	
0845	1	<b>Welcome and general introduction</b> <ul style="list-style-type: none"> <li>Course overview</li> <li>Tools and methods</li> <li>Laptop installation and testing: Python, SEAWAT, SWI, and FLOPY example scripts.</li> </ul>	
0915	2	<b>Exercise A. Density, pressure, and head</b> <ul style="list-style-type: none"> <li>Calculations of density, density slope, pressure, head, and freshwater head</li> </ul>	
0945	3	Explanation and discussion of Exercise A	
1030		Morning Tea	
1100	4	<b>Introduction to programming analytical solutions in Python</b> <ul style="list-style-type: none"> <li>Example script: Badon Ghijben-Herzberg principle</li> </ul>	
1130	5	<b>Exercise B</b> <ul style="list-style-type: none"> <li>Single layer confined interface flow</li> <li>Sensitivity analysis: which parameters are important?</li> </ul>	
1230		Lunch	
1300	6	Explanation and discussion exercise B.	
1415	7	<b>Increasing complexity: steady state solutions</b> <ul style="list-style-type: none"> <li>Unconfined flow</li> <li>With wells</li> </ul>	
1500		Afternoon Tea	
1530	8	<b>Exercise C</b> <ul style="list-style-type: none"> <li>Sea level rise</li> <li>Critical pumping rate</li> </ul>	
1615	9	Explanation and discussion exercise C.	
1700		Discussion and close	
17:15		End of Day 1	

Day 2		Friday 15th June 2018	
TIME		THEME/TOPIC	PRESENTERS
0830		Coffee & Registration	Frans Schaars (Artesia Water), Mark Bakker (TU Delft), and Christian Langevin (USGS)
Day theme		Transient sharp-interface SWI package	
0845	1	Refresher	
0900	2	<b>Introduction</b> <ul style="list-style-type: none"> <li>MODFLOW SWI theory</li> <li>FLOPY Example: 2D development of a fresh water lens</li> </ul>	
0945	3	<b>Exercise C: 2D development of a fresh water lens</b> <ul style="list-style-type: none"> <li>Comparison with steady state solution</li> <li>Sensitivity analysis for SWI parameters</li> </ul>	
1030		Morning Tea	
1100	4	Explanation and discussion exercise C.	
1130	5	Exercise D: building a FLOPY MODFLOW-SWI model from scratch	
1230		Lunch	
1300	6	Explanation and discussion exercise D.	
1345	7	<b>Exercise E: transient impact on interface position</b> <ul style="list-style-type: none"> <li>Sea level rise</li> <li>Recharge decrease</li> <li>Sea water intrusion overshoot</li> </ul>	
1500		Afternoon Tea	
1530	8	Explanation and discussion exercise E.	
1600	9	<b>Examples of MODFLOW SWI case studies</b> <ul style="list-style-type: none"> <li>Terschelling</li> <li>....</li> </ul>	
1700		Discussion and close	
17:15		End of Day 2	

Day 3 Saturday 16th June 2018			
TIME		THEME/TOPIC	PRESENTERS
0830		Coffee & Registration	Christian Langevin (USGS), Frans Schaars (Artesia Water), and Mark Bakker (TU Delft)
Day theme Transient - SEAWAT			
0845	1	Refresher	
0900	2	<b>Introduction</b> <ul style="list-style-type: none"> <li>MODFLOW and MT3D overview</li> <li>SEAWAT concepts</li> </ul>	
1015	3	Overview of the Henry Problem	
1030		Morning Tea	
1100	4	Exercise A: Simulation of the Henry Problem	
1215	5	Explanation and discussion of Exercise A	
1230		Lunch	
1300	6	<b>Exercise B:</b> <ul style="list-style-type: none"> <li>Design, run, and calibrate a 2D cross-section model</li> </ul>	
1445	7	Explanation and discussion exercise B.	
1500		Afternoon Tea	
1530	8	<b>Exercise C: Design and Run a 3D saltwater intrusion model</b> <ul style="list-style-type: none"> <li>Determining the effects of a proposed wellfield</li> </ul>	
1645	9	Special topics in saltwater intrusion modeling	
1700		Discussion and close	
17:15		End of Day 3	