### Groundwater-surface water interactions

10:00 – 10:10 : Introduction

10:10 - 10:30 - <u>Anne Jost</u> (SU) "Impact of sand and gravel mining in La Bassée alluvial plain, Franc<u>e"</u>

10:30 - 10:50 - <u>Alexandre Pryet</u> (ENSEGID) "Stream-aquifer interactions: facing the challenges of drinking water production near contaminated streams"

10:50 - 11:10 - <u>Agnès Rivière</u> (PSL) "Water and energy fluxes at the surface-subsurface interface of the Orgeval, France"

11:10 - 11:30 - <u>Véronique Durand</u> (UPSud) "Monitoring hyporheic

exchanges during a dam controlled experiment"

11:30 - 12:00 - open discussion

12:00 - 13:00 - buffet lunch

13:00 – DARCY LECTURE <u>Masaki Hayashi</u> (University of Calgary, Canada) "Alpine Hydrogeology: The Critical Role of Groundwater in Sourcing the Headwaters of the World"







# A. Jost, S. Wang, F. Picourlat, B. Labarthe, N. Flipo Impact of sand and gravel mining in La Bassée alluvial plain, France

# Sand and gravel mining

- Increasing need for aggregates for construction purpose
- Sand & gravel typically located in alluvial and glacial deposits
- Extraction creates artificial lakes





# Gravel pit lakes



#### Water transitions (1984 to 2015)

# Gravel pit lakes impacts

- Potential long term environmental risks
- ✓ Local water quality
- Changes in hydrological patterns & groundwater storage

Alluvi	al de	oosit	s			
Received	en de la companya	stantadel		<u>alaalaa</u>	uaaaaaa	
the state of the s						
halk						
	E I I I I I I I	The second second		1 1 1 1 1 1 1		Links and the local division of the











Hydrodynamic impacts of gravel pit lakes

Impact of sand and gravel mining in La Bassée alluvial plain, France

- ✓ In combination with local monitoring
- ✓ To assimilate observations of surface water levels from the future SWOT satellite mission

Hydrological modelling provides the framework to quantify the impact of gravel pit lakes on groundwater resources at the plain scale

✓ La Bassée as a case study

✓ its natural resources and territorial challenges
✓ including a lake module in the modelling platform
✓ quantifying the gravel pit lakes water budget

### Natural resources and territorial challenges



22 June 2018

#### Natural resources and territorial challenges

Statement in the

# Strategic issues in the alluvial plain

#### Leisure activities

#### **Flood prevention**

#### Water resources

**Agricultural land** 

Granular resources

Inland waterways transport **Biodiversity** 

22 June 2018

Credit: VNF

### Including a lake module in the EauDyssée platform



#### The EauDyssée platform for hydrosystem modeling

### Including a lake module in the EauDyssée platform

Seepage between gravel pit lake and aquifer (L/T)

$$Q = \frac{KA}{\Delta l} (h_a - h_l) = C (h_a - h_l)$$

C conductance (L<sup>2</sup>/T)

Net rate of seepage (L<sup>3</sup>/T)

$$S_{p} = \sum_{m}^{M} C_{m} \left( h_{am}^{n} - h_{l}^{n-1} \right)$$

Gravel pit lake budget

$$h_l^n = h_l^{n-1} + \Delta t \frac{P - E + R + S_p}{A_s}$$



# Gravel pit lake/aquifer interactions

### Including a lake module in the EauDyssée platform

- ✓ Head discrepancies between the two codes using or not the lake package are on the same order of magnitude
- LIBWET shows higher convergence ability than LAK for decreasing time steps



50 rows x 50 columns – 62.5 m wide

#### Benchmark validation test: LIBWET vs. LAK of MODFLOW





#### Local groundwater model including gravel pit lakes

22 June 2018

#### Gravel pit lakes piezometric impact

~ 0.1-m water level drop (steady-state)  $\Delta h = h_{no\_gravel\_pit} - h_{gravel\_pits}$ 





Gravel pit lakes water budget (1995-2010)

22 June 2018



Gravel pit lakes water budget (1995-2010)

## Conclusion and perspectives

- A first attempt to estimate the global effect of sand and gravel extraction on groundwater budget in a major wetland
- Decreasing water table due to evaporatory losses, in agreement with literature
- An increasing number of excavated gravel pit lakes contributing to the observed worldwide trend of increased water withdrawal due to evaporation from artificial lakes and reservoirs.

# Conclusion and perspectives

- Sensitivity analyses: banks conductance & lake evaporation
- Gravel pit lakes impact on stream-aquifer exchanges
- Data-model comparison: La Bassée observational network



#### ✓ Future SWOT satellite mission: benefit of virtual observations





with the participation of L. Abasq, F. Baratelli, E. Cuisinier, A. Mouhri, A. Rivière C. Ottlé & K. Pétrus



### **THANK YOU FOR YOUR ATTENTION**

