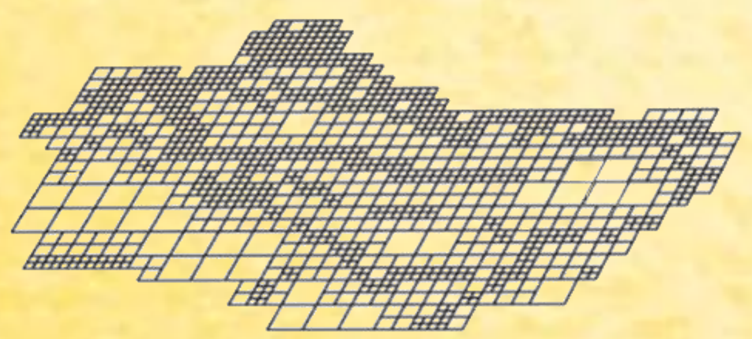
Modelling lake-groundwater interactions in preparation of future SWOT mission: the case of the gravel pit lakes in the Seine River alluvial plain, France.

1 Using the CNES large scale simulator, we evaluate the SWOT water level errors on gravel pits in La Bassée alluvial plain.

2 SWOT-like outputs are generated based on in-situ lake level measurements.

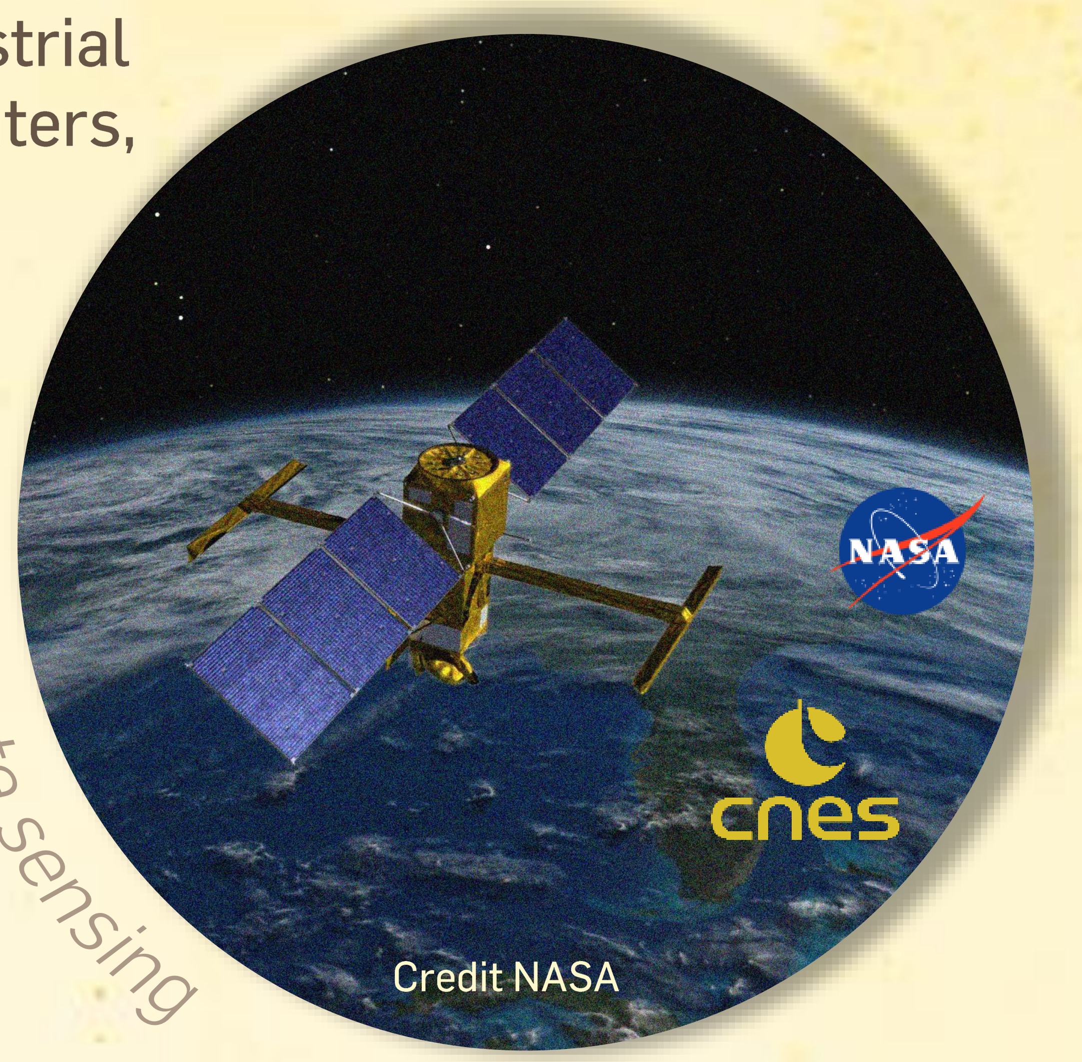
3 A modelling tool for gravel pit lake stage simulation, which includes groundwater interaction, is developed within the CaWaQS platform and tested using benchmark experiments.



CaWaQS integrated platform for hydrosystems modelling

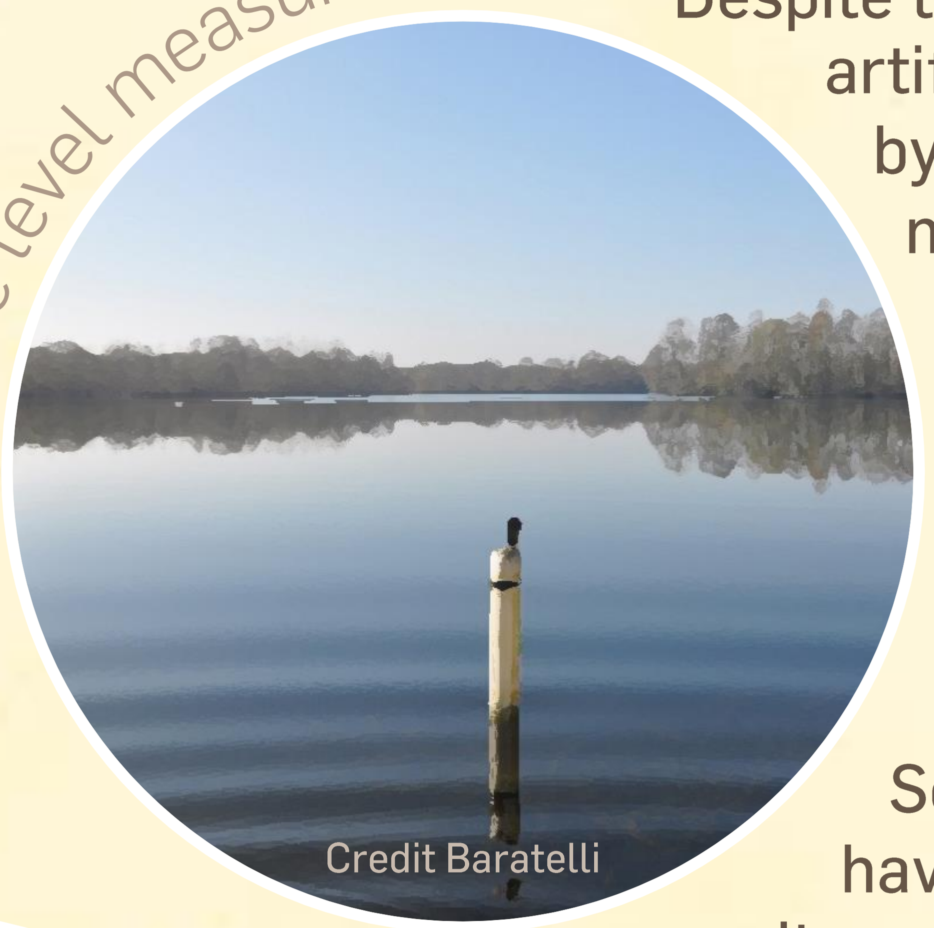
The Surface Water and Ocean Topography (SWOT) satellite mission, to be launched September 2021, will soon map near weekly the elevation of terrestrial surface waters, including reservoirs.

Remote sensing



Credit NASA

In-situ lake level measurements


Credit Baratelli

Despite their rather small size, artificial lakes created by sand and gravel mining are promising candidates for remote sensing. Numerous of them shape La Bassée alluvial landscape, middle reach of the Seine River. Some have been continuously monitored for over a few years.

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Gravel pit lakes create openings through the aquifer, providing direct access to groundwater and make it possible for remote sensing to offer an integrated vision of water resources in alluvial plains.

Credit Jost

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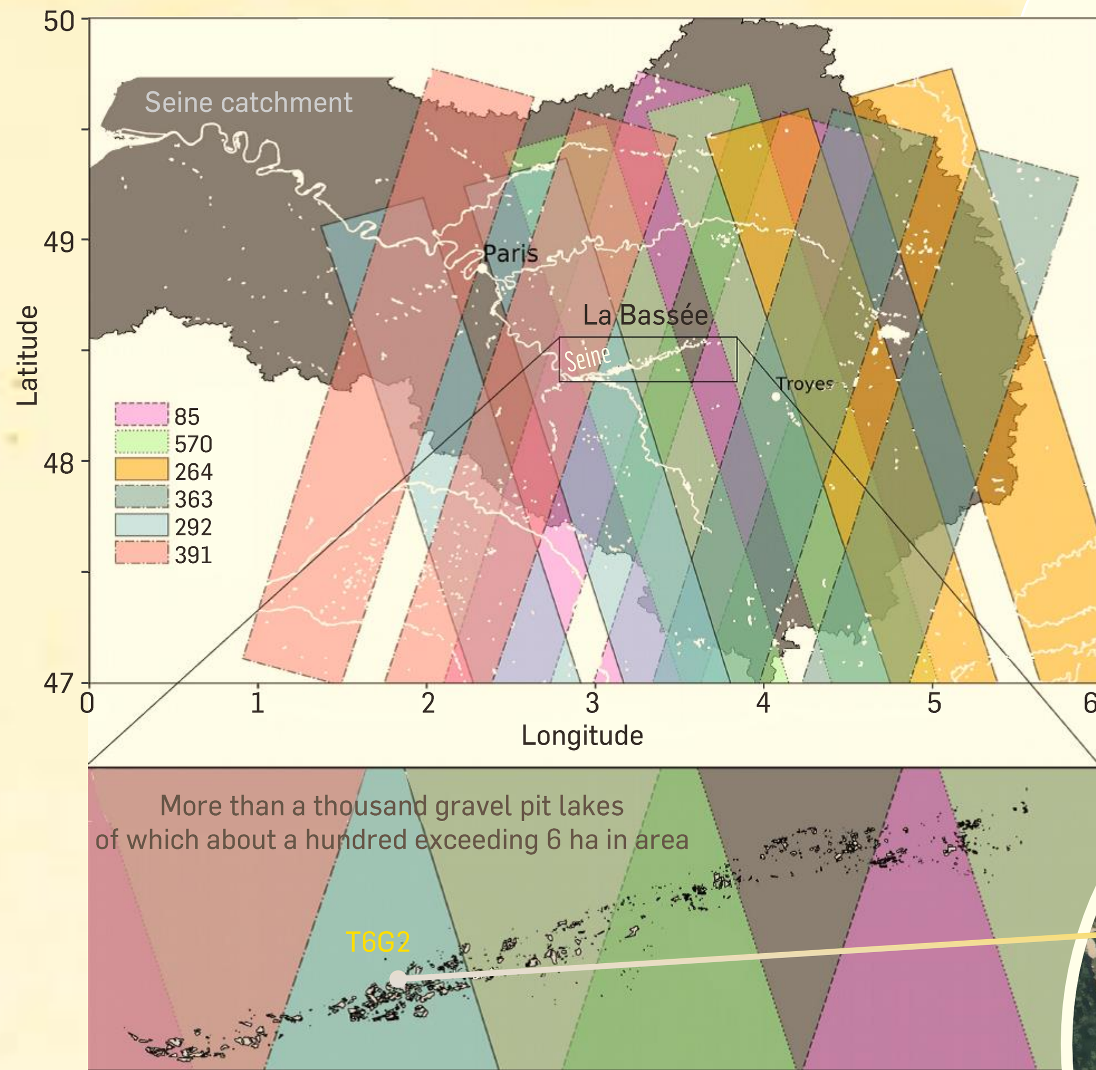
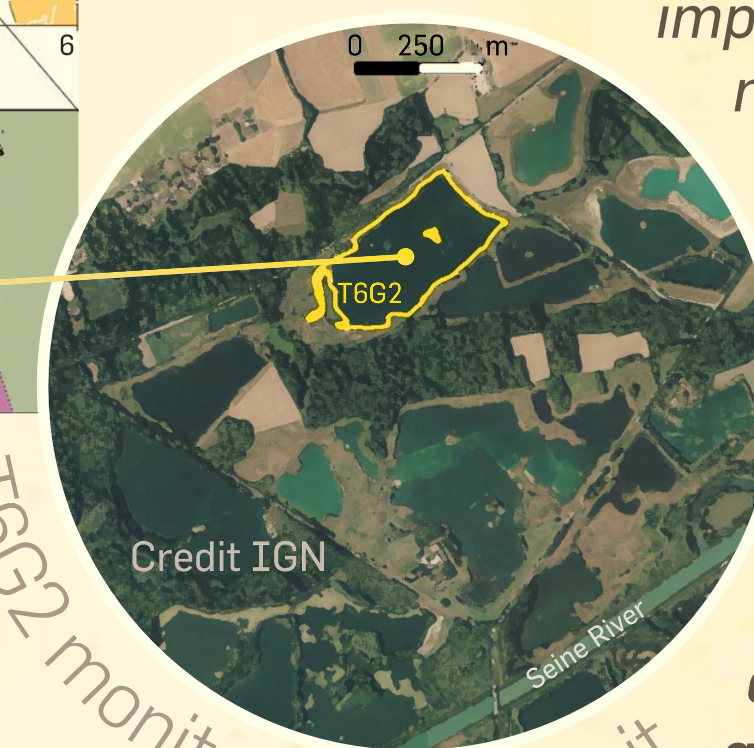
La Bassée gravel pit lakes under the SWOT microscope

Key parameters

Gravel pit lakes	La Bassée	T6G2	
Area (km²) (% plain)	28 (8%)	0.22	
only lakes > 6 ha	19 (5%)		
Maximal depth (m)	12	6	
SWOT observation days	3, 10, 14, 20	3, 10, 20	
Orbit numbers	85, 292, 391, 570	85, 292, 570	
Maximal and standard deviation SWOT-like water surface elevation error (m)		Max	Std
	Orbit 85	0.32	0.12
	Orbit 292	0.26	0.11
	Orbit 570	0.28	0.14

Future SWOT swaths over La Bassée





T6G2 monitored gravel pit

La Bassée is a wetland of national importance, as much for ecological interests as for its economic relevance. The alluvial deposits and the underlying fractured chalk host aquifers containing significant ***groundwater resources****.*

Take home messages

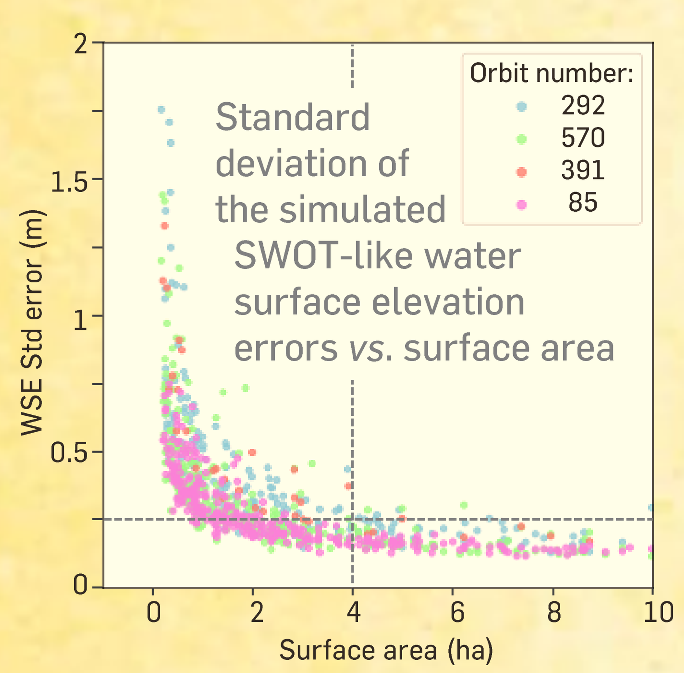
1 Hundreds of small water bodies will be sampled 1 to 3 times in a 21-day cycle by the four SWOT orbits covering La Bassée alluvial plain.

2 Water level retrieval with a vertical resolution better than 0.25 m on gravel pit lakes larger than 6 ha.

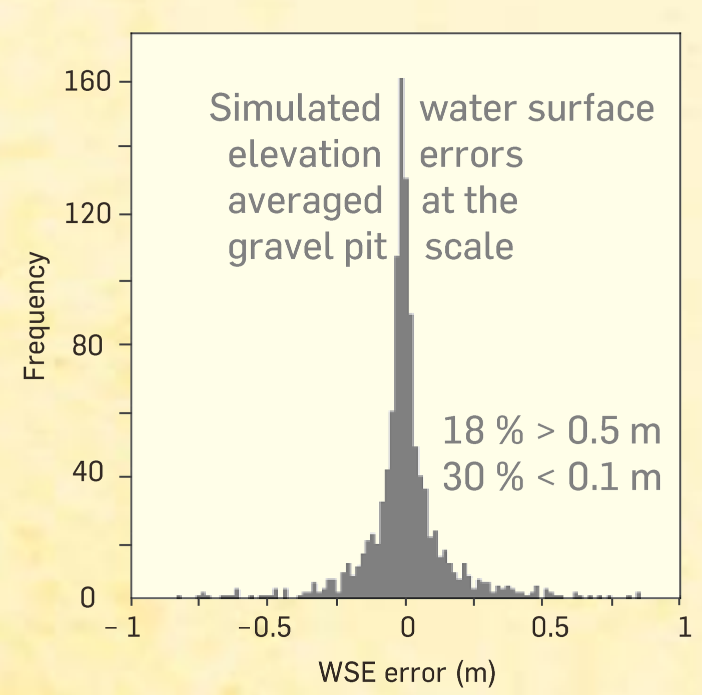
3 A validated and operational module to simulate lake stage fluctuations, offering performance equivalent to Modflow Lak package.

4 Toward an operational tool at the satellite launch: Assimilation of in situ and satellite remote sensing data to La Bassée 3D hydrodynamic model.

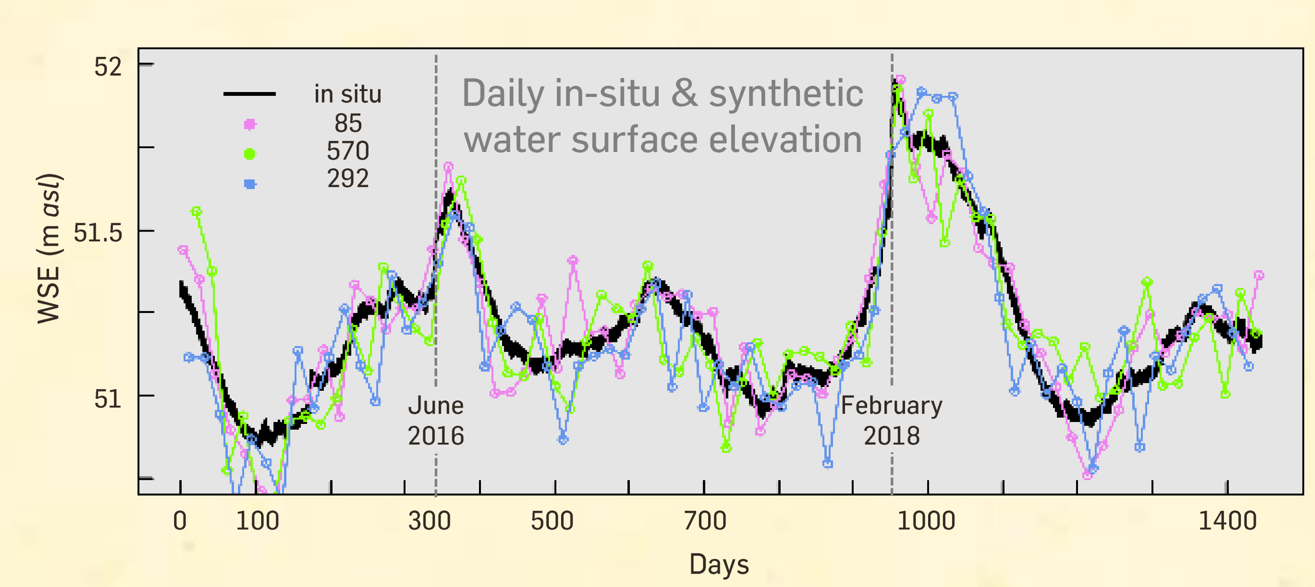
Using the CNES Large-Scale SWOT Hydrology Simulator



Simulations performed on a five-year period for 800 gravel pit lakes

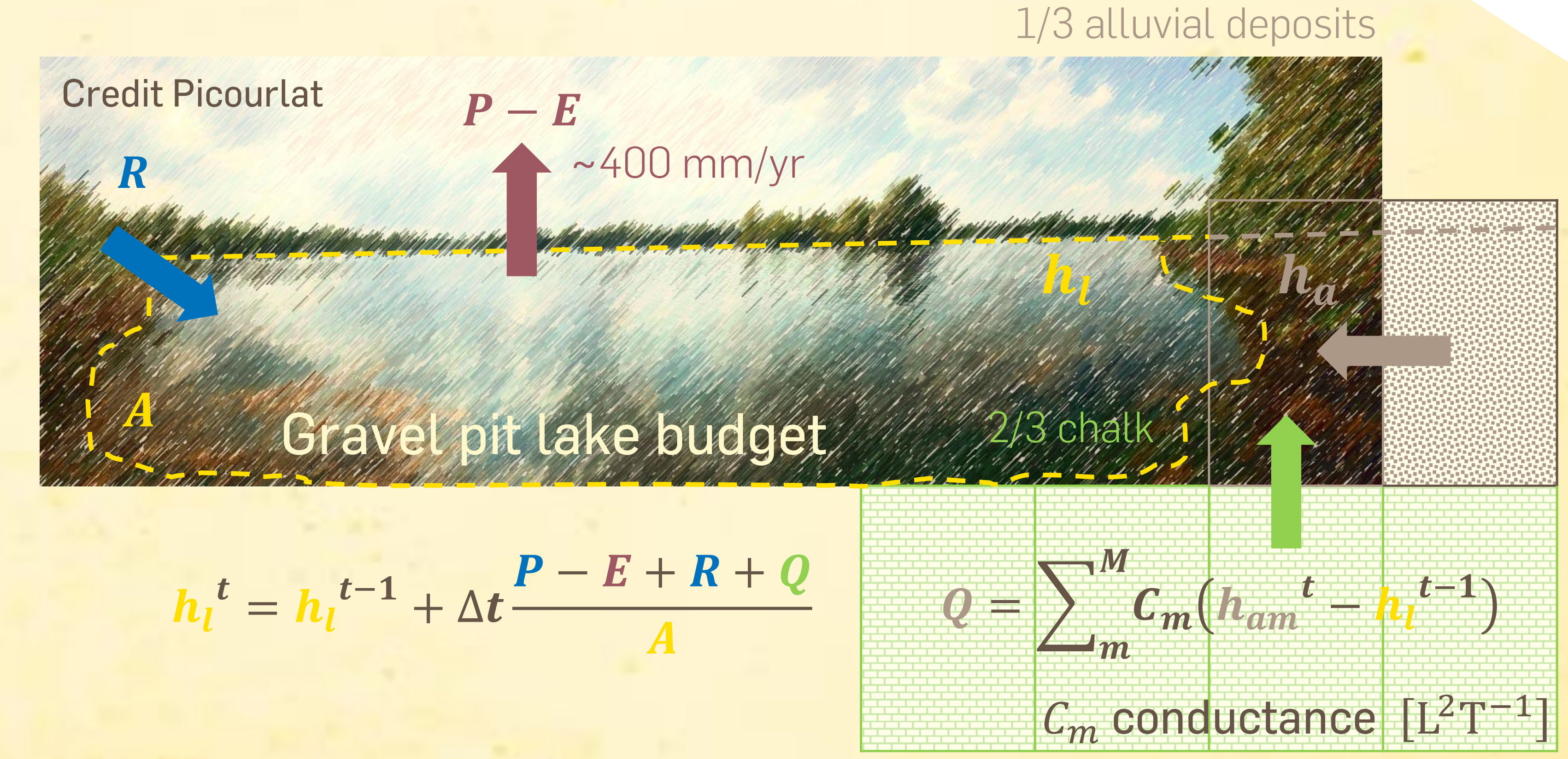


over 2015-2019 for T6G2



Building a lake module in the CaWaQS platform

1/3 alluvial deposits



$$h_l^{\,t} = h_l^{\,t-1} + \Delta t \frac{P - E + R + Q}{A}$$

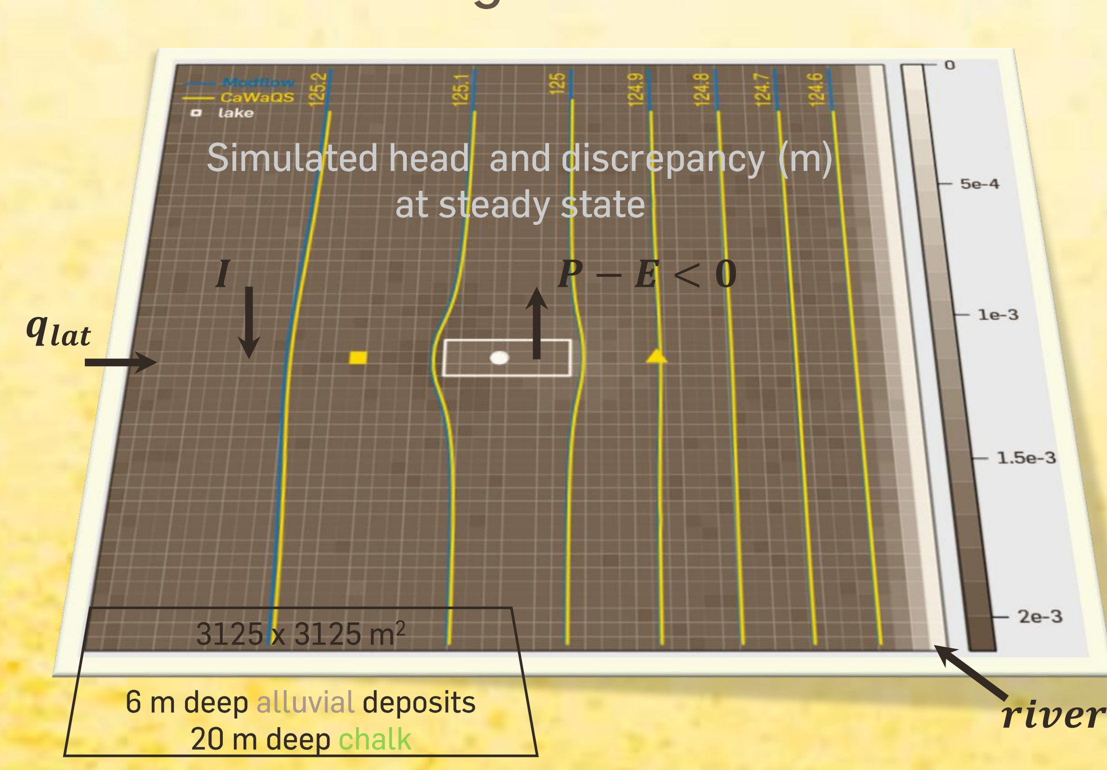
$$Q = \sum_m^M C_m \left(h_{am}^{\,t} - h_l^{\,t-1}\right)$$

C_m conductance $[L^2T^{-1}]$

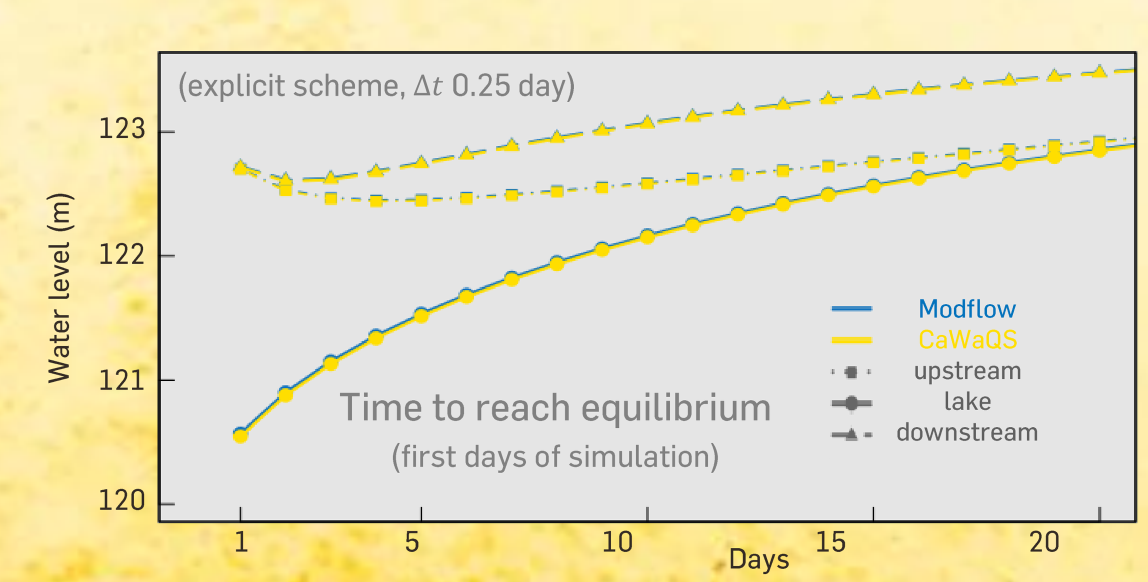
Gravel pit lake/aquifer interactions

Validation on benchmark experiments

Case design



CaWaQS vs. Modflow



In progress

Coupling Remote Sensing, In-situ and Models

for water resources management

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