GROUNDWATER FLOW MODEL "SAARLAND" – A REGIONAL GROUNDWATER FLOW MODEL AS TOOL FOR WATER ADMINISTRATION

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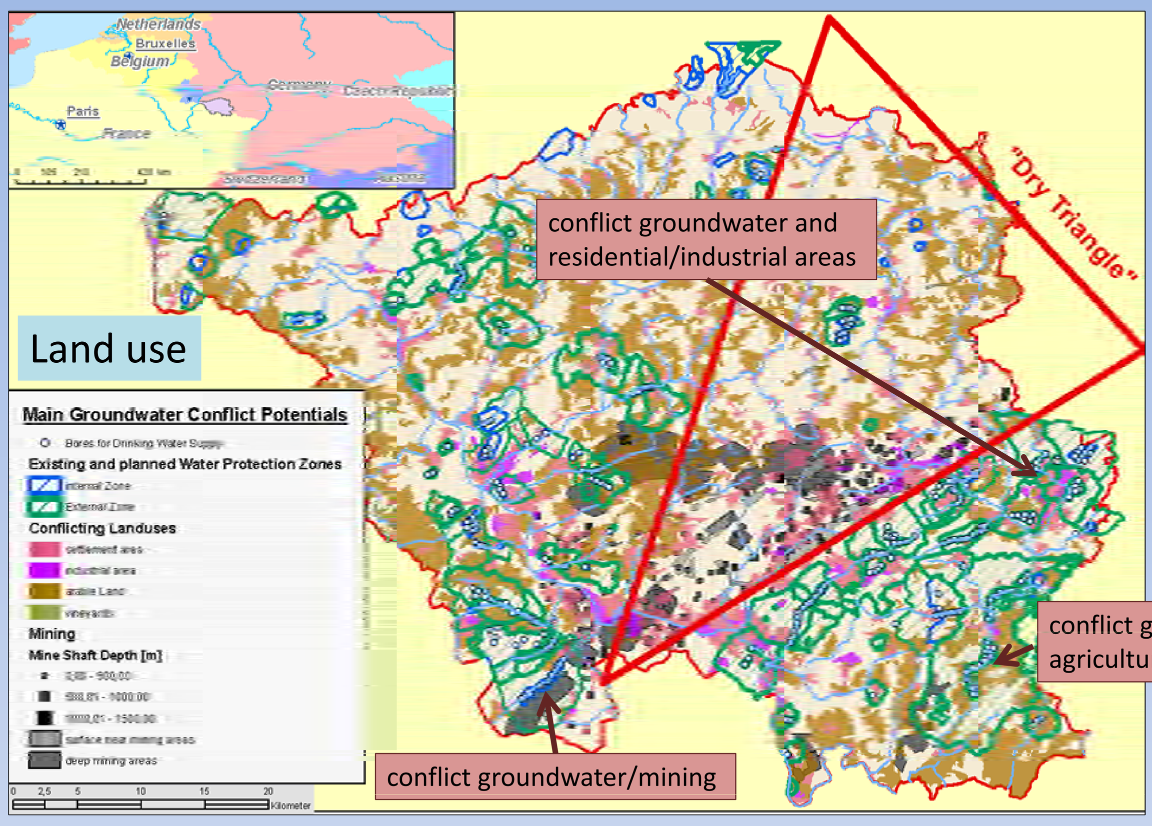
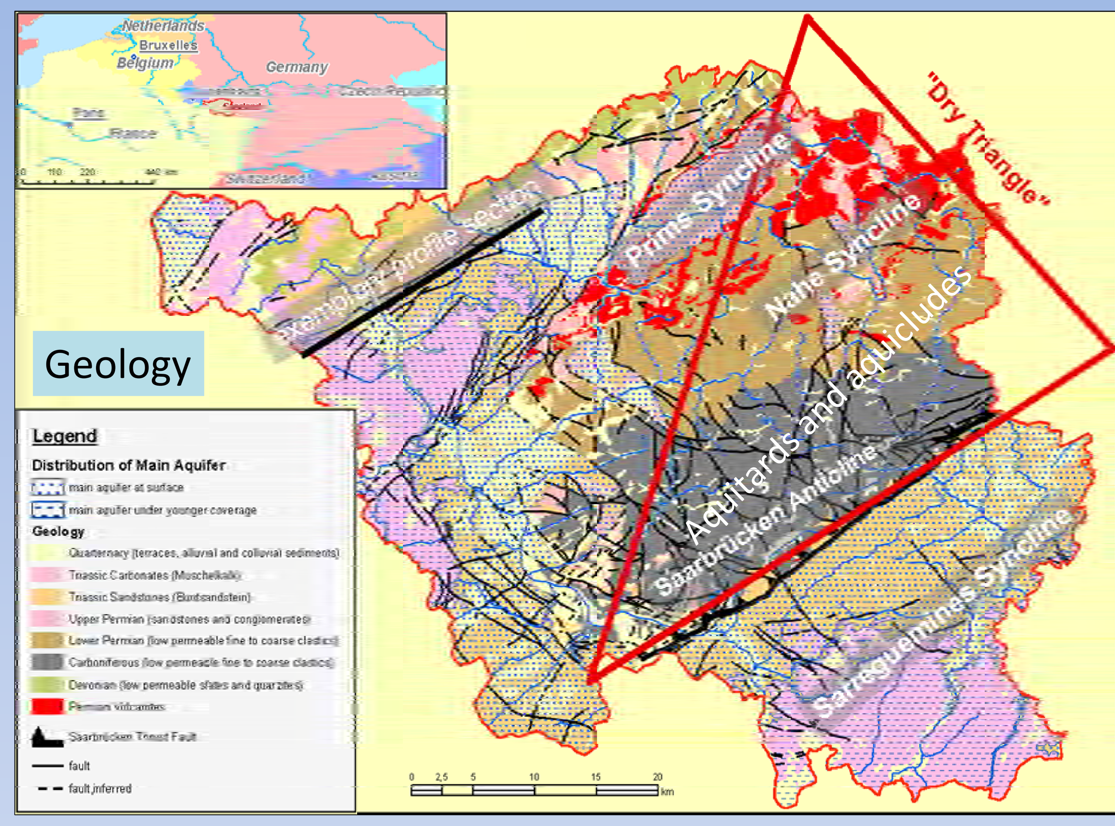
1. Motivation



The State of Saarland, with only 2570 km² one of the smallest states of Germany, has a long industrial history, based on coal mining and steal milling. Going back to the 18th century, this led to a massive immigration and to a high population density of 400 inhabitants per km². Both, industrial tradition and dense population, are the main reasons for a series of environmental conflicts, heavily impacting groundwater quality and public water supply.. This situation is aggravated by the widespread occurrence of low permeable rocks, especially in the more densely populated regions.

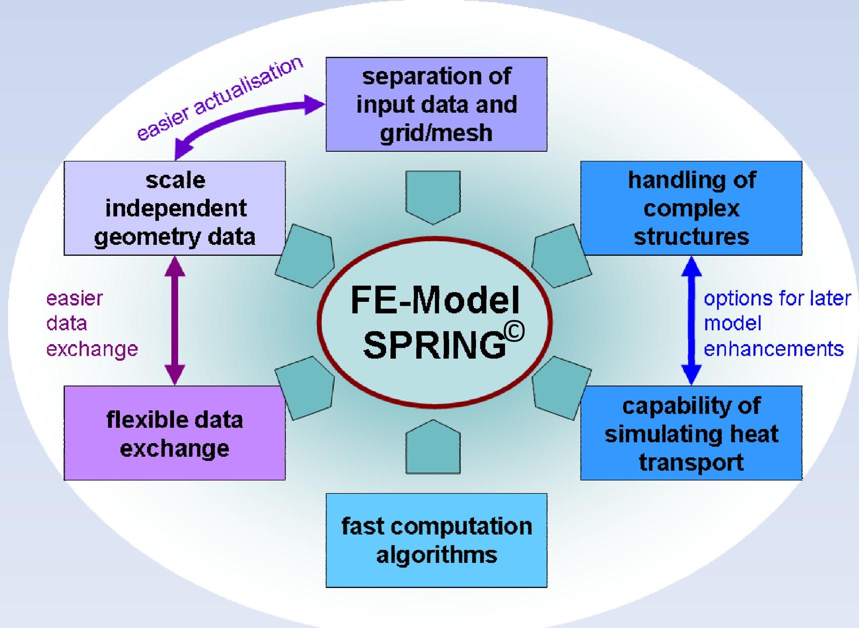


- To date no coherent overview over groundwater situation
- many groundwater models had been built for different purposes on local scale in the past
- but based on different strategies and data
- models therefore difficult to compare and even more difficult to verify
- very tight staff situation of the survey not to change in the future

Creation of a state-wide groundwater model planned for

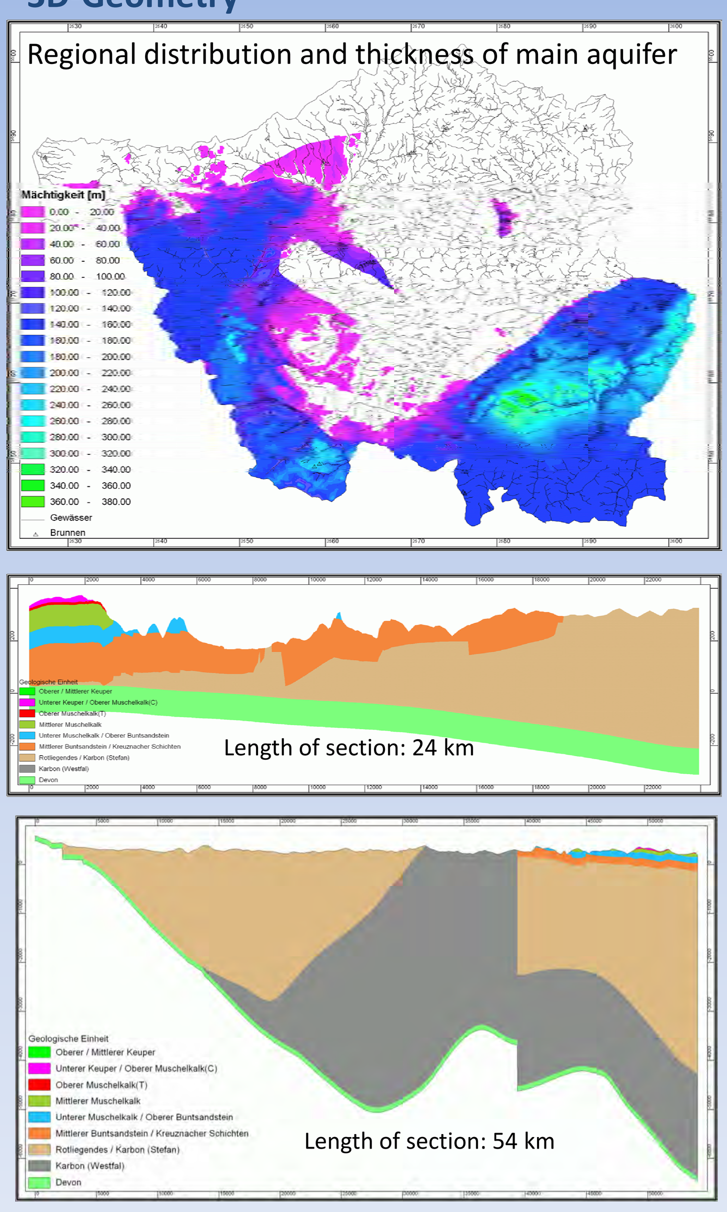
- Simplification of internal procedures
  - Geothermy
  - Storm water infiltration
- Delimitation of protected areas
- Groundwater abstraction licenses
- Groundwater contamination
- GW dependent ecosystems
- Geothermal atlas
- Water Framework Directive
- ....

main criteria for model selection:

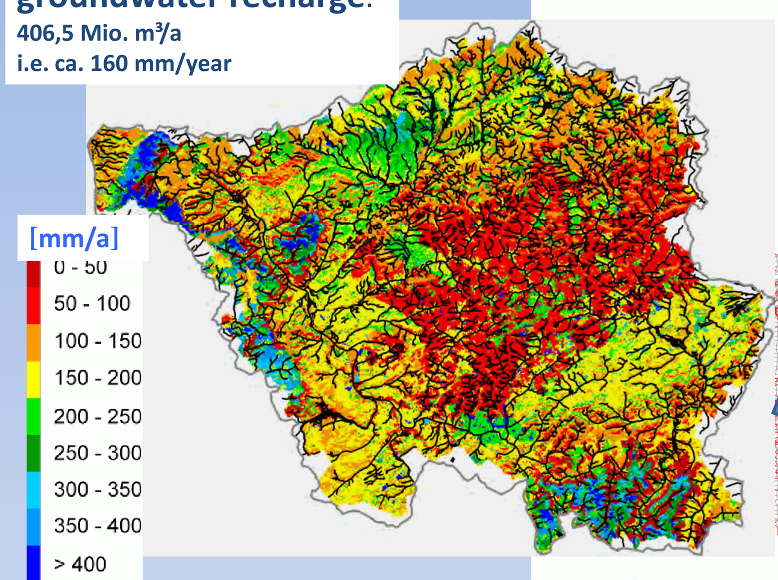


2. Input data and mesh generation

3D-Geometry

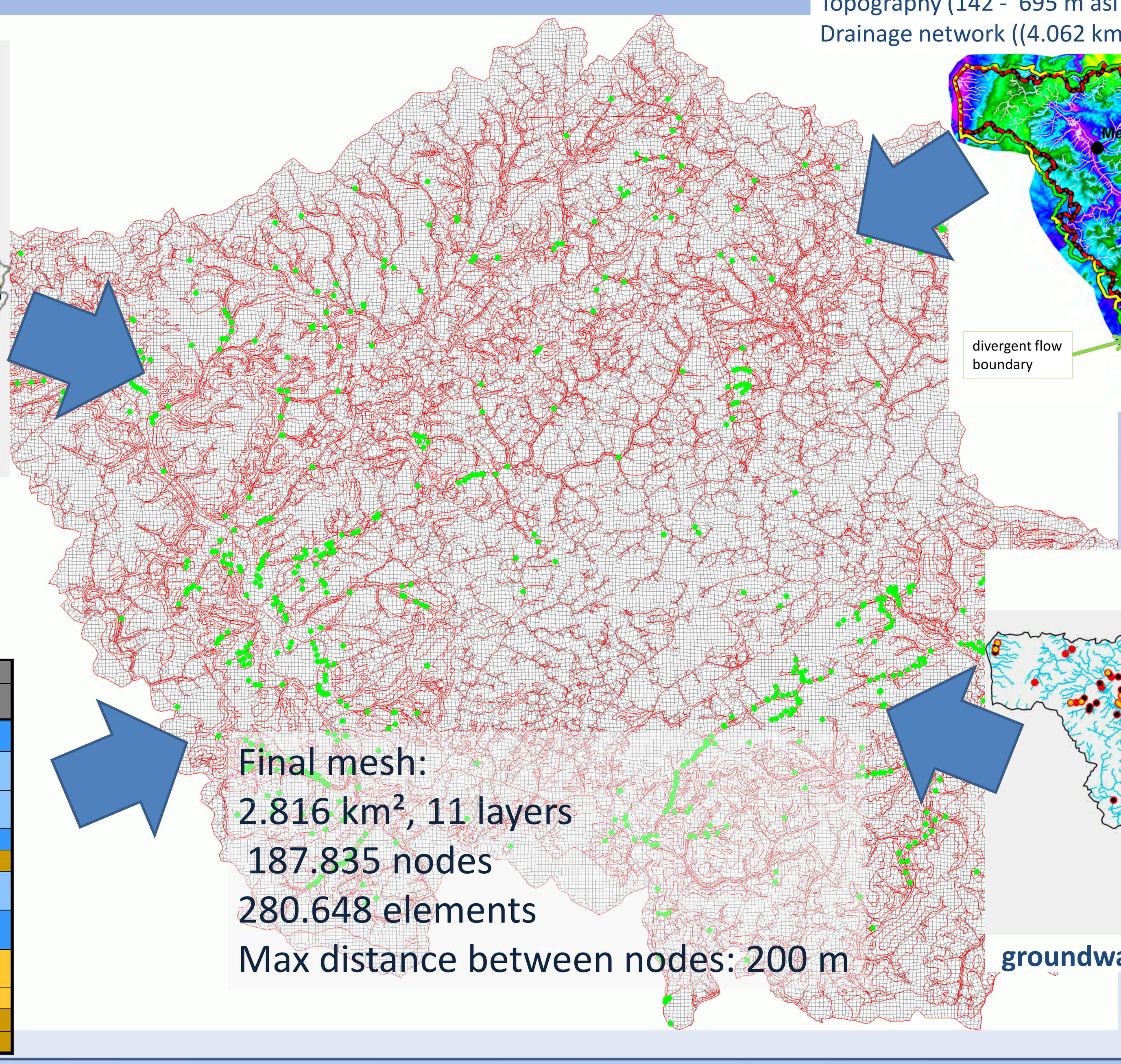


groundwater recharge:
406,5 Mio. m³/a
i.e. ca. 160 mm/year



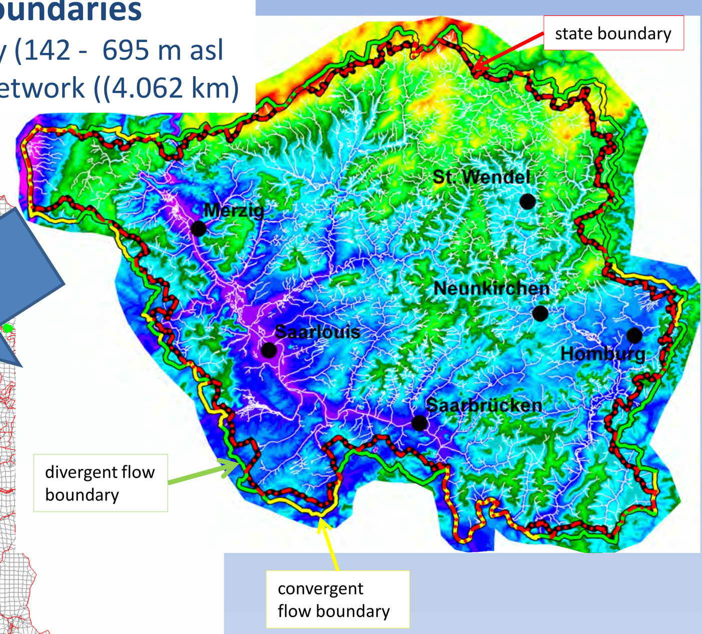
hydraulic parametrisation

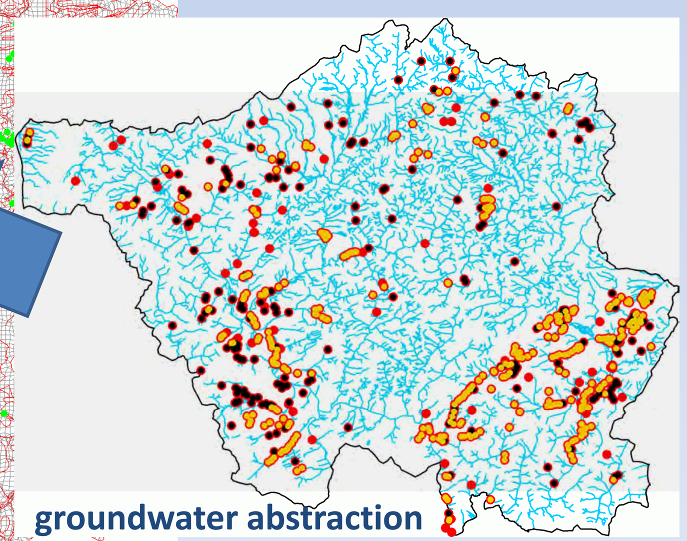
Layer	Stratigraphy			Permeability [m/s] HÜK	Starting values	Calibrated values
1	Quaternary	Flood plains, terraces	q	$10^{-6} – 10^{-4}$	10^{-4}	$10^{-4} - 5 \cdot 10^{-4}$
2	Upper Triassic	Upper Keuper Middle Keuper	ko km	10^{-5}	$9 \cdot 10^{-6}$	$9 \cdot 10^{-6}$
3	Upper Triassic / Middle Triassic	Lower Keuper Upper Muschelkalk	ku mo2	$10^{-6} - 10^{-4}$	$5 \cdot 10^{-6}$	$5 \cdot 10^{-6}$
4	Middle Triassic	Upper Muschelkalk	mo1	$10^{-5} - 10^{-3}$	$5 \cdot 10^{-5}$	$5 \cdot 10^{-5}$
5	Middle Triassic	Middle Muschelkalk	mm	$10^{-9} - 10^{-7}$	$5 \cdot 10^{-8}$	$5 \cdot 10^{-8}$
6	Middle Triassic / Lower Triassic	Lower Muschelkalk Upper Buntsandstein	mu so	$10^{-6} - 10^{-4}$	10^{-5}	$10^{-7} - 10^{-6}$
7	Lower Triassic / Permian	Middle Buntsandstein Kreuznach facies	sm ro3	$10^{-5} - 10^{-3}$	$5 \cdot 10^{-5}$	$10^{-6} - 10^{-4}$
8	Permian	Upper Rotliegend Lower Rotliegend	ro1, ro2 ru	$<10^{-5}$	$5 \cdot 10^{-6}$	$3 \cdot 10^{-7}$
9	Carboniferous	Stephanian	cst	$<10^{-5}$	$5 \cdot 10^{-6}$	$3 \cdot 10^{-7}$
10	Carboniferous	Westphalian	cw	$<10^{-5}$	$5 \cdot 10^{-7}$	$8 \cdot 10^{-8}$
11	Devonian	undifferentiated	d	$<10^{-5}$	$5 \cdot 10^{-7}$	$8 \cdot 10^{-8}$



Final mesh:
2.816 km², 11 layers
187.835 nodes
280.648 elements
Max distance between nodes: 200 m

model boundaries
Topography (142 - 695 m asl
Drainage network ((4.062 km)

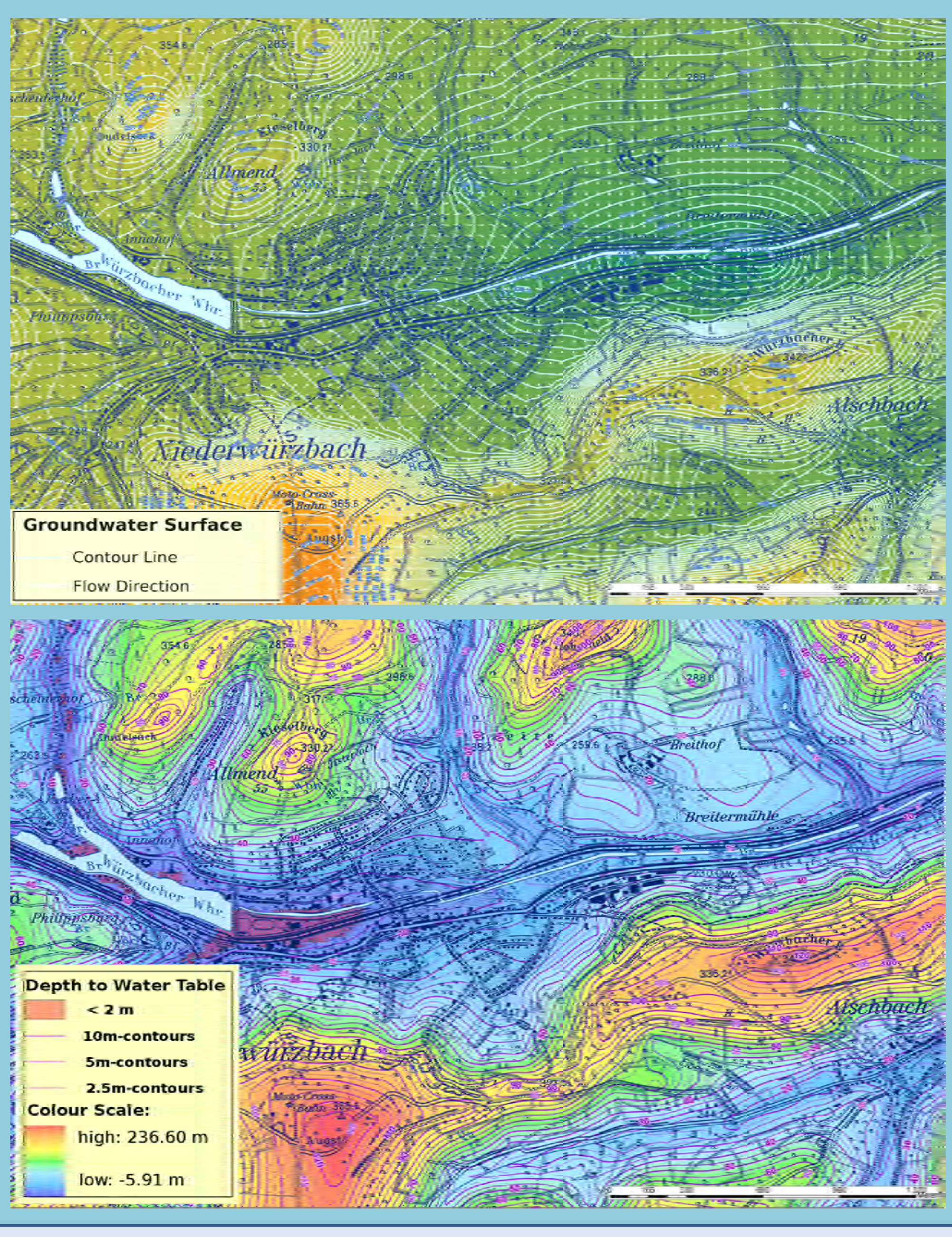




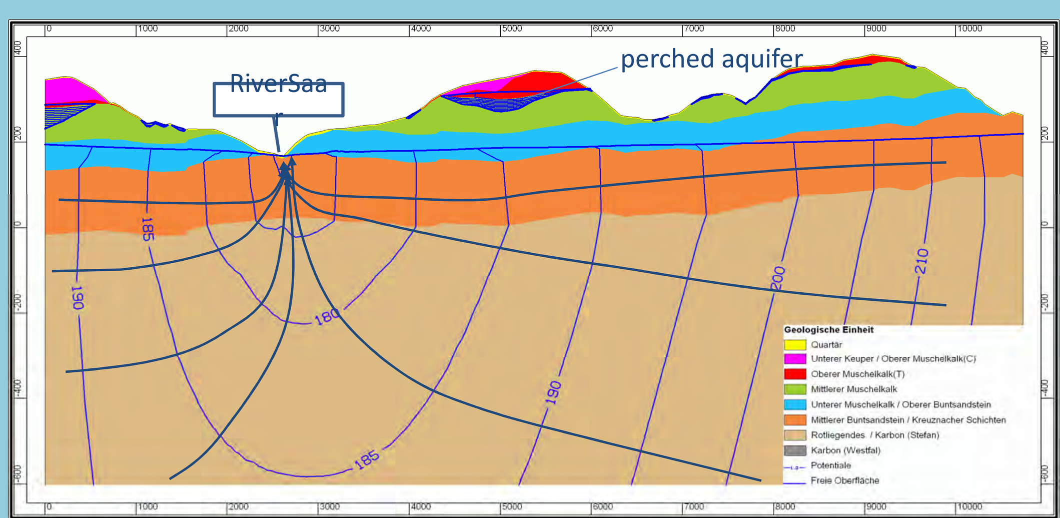
groundwater abstraction

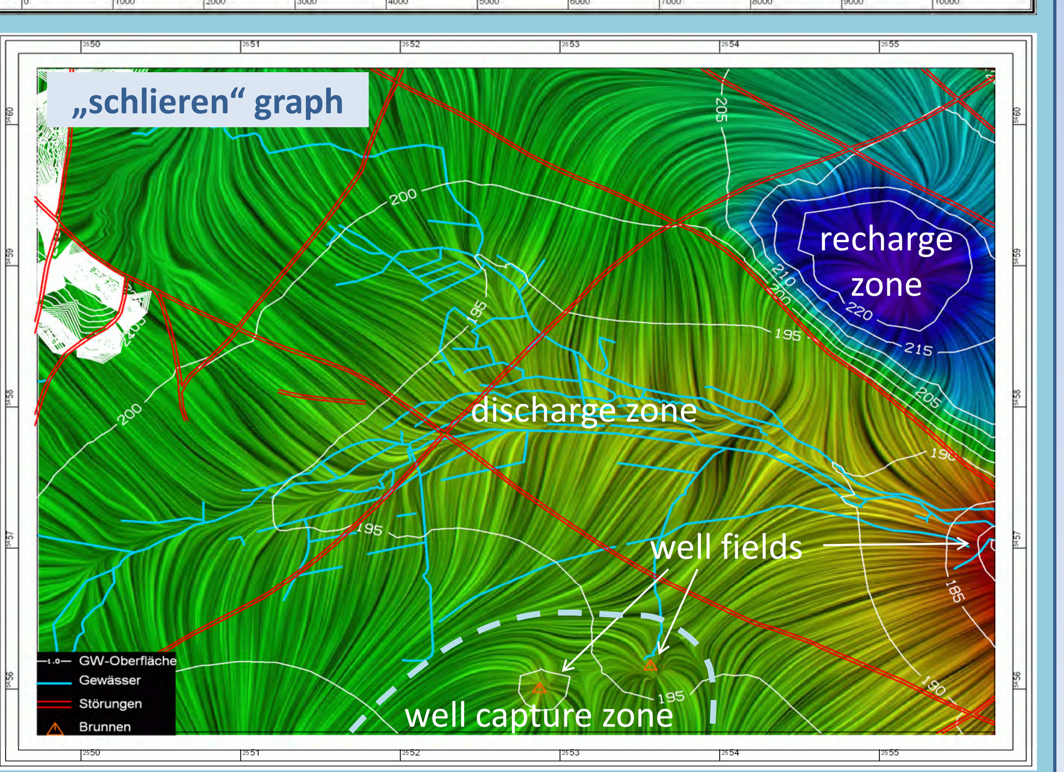
3. Results and outlook

Information about water table:



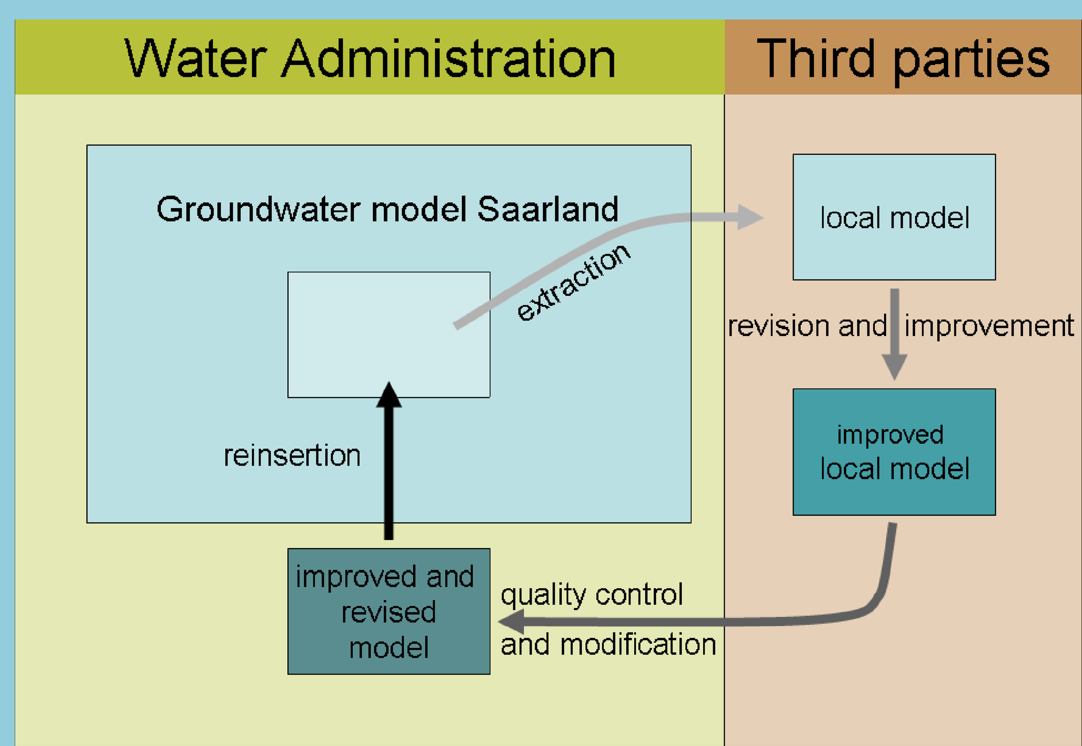
Insight into regional GW flow patterns:





Actualisation stategy:

Continuous improvement of model resoluion and quality through data exchange with third parties



need for new tools to keep costs for model up-date low!

need for standardised data formats for easier data exchange!