FREEWAT
Free and Open Source Software Tools for Water Resource Management
EU HORIZON 2020 Project

European Commission

ict4water.eu

FREEWAT

(FREE and open source software tools for WATer resource management)

Final Meeting

September 20th – 22th 2017

IDAEA, CSIC Barcelona

Modeling Surface Water-Groundwater Interactions at the Palas Basin (Turkey) Using FREEWAT

Filiz Dadaser-Celik (Erciyes University)

50 anys

idaea

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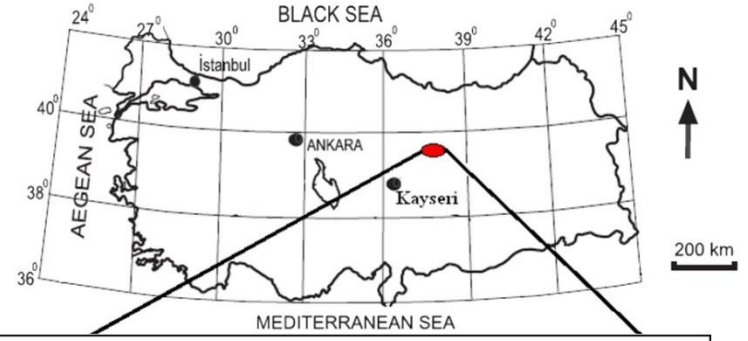
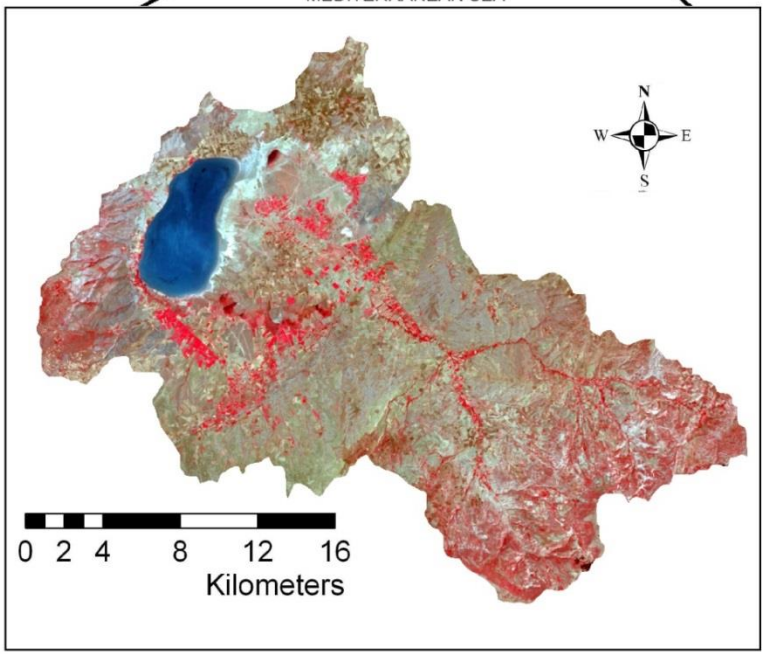
CSIC
CENTRE D'INVESTIGACIÓ I DESENVOLUPAMENT 1967-2017

EIP Water Online Market Place
Matchmaking for water Innovation
MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)

Palas Basin

- Closed basin
- Sparsely populated, no large commercial or industrial activity, relatively pristine watershed
- Pure agricultural basin
- Representative of semi-arid agricultural basins
- Hosts an ecologically important site - Tuzla (Palas) Lake





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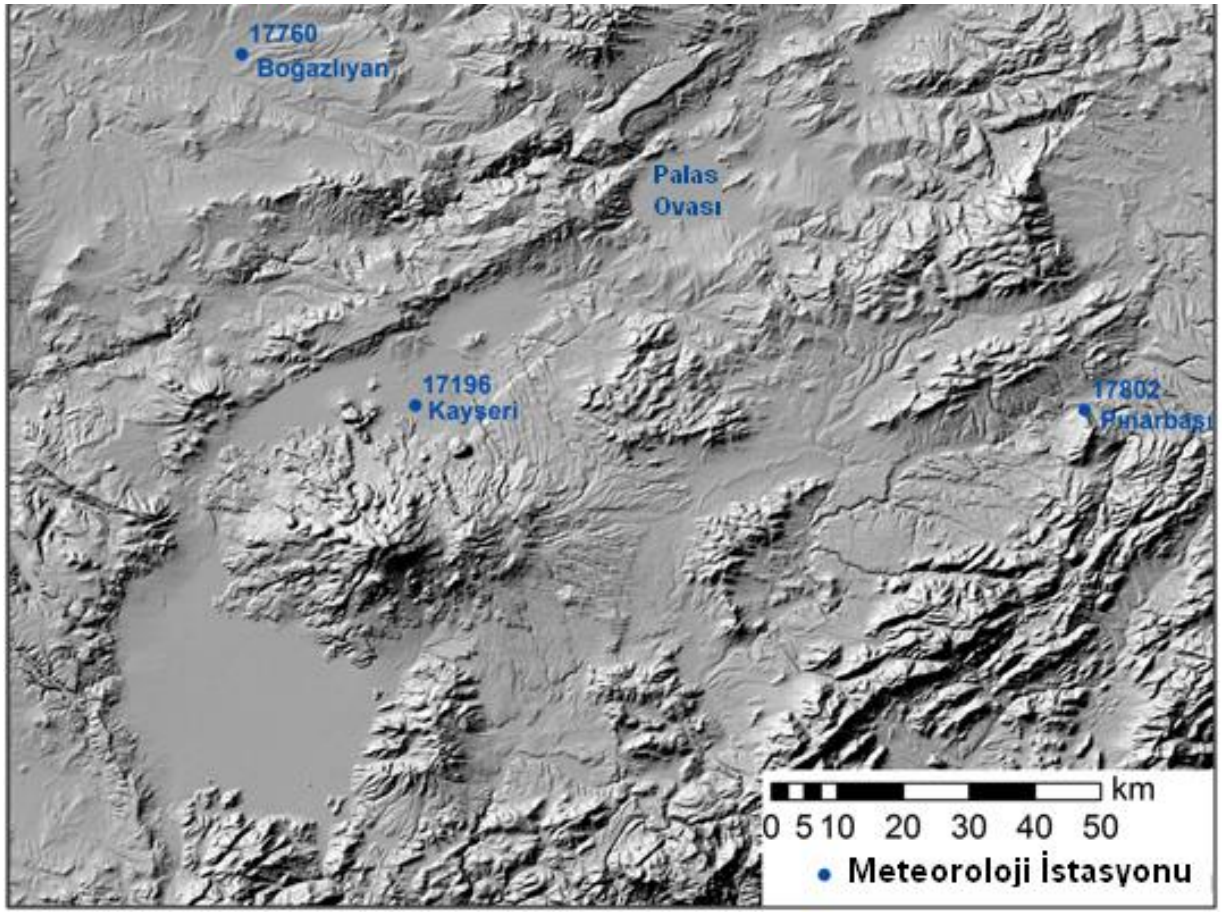
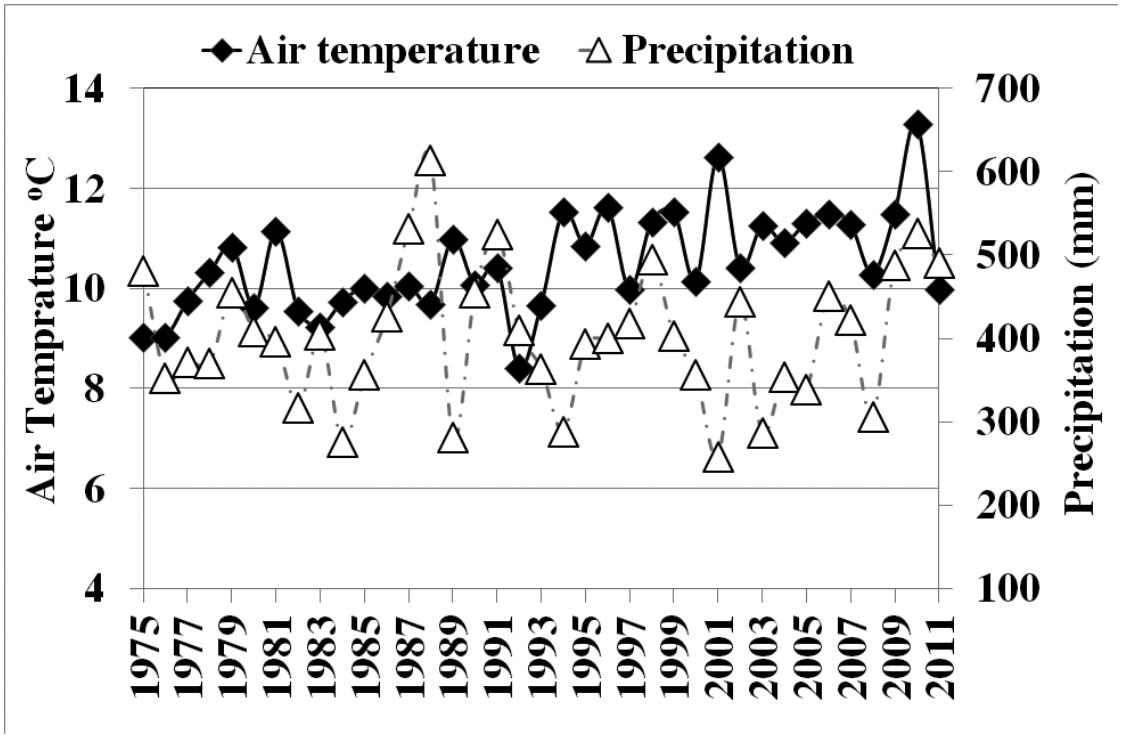
Palas Basin-Geography

- Palas Basin is a closed basin that is completely isolated by surrounding high mountains.
- Drainage area is 456 km^2 and surface area of 83 km^2.
- Average altitude is 1135 m.



Palas Basin-Climatology

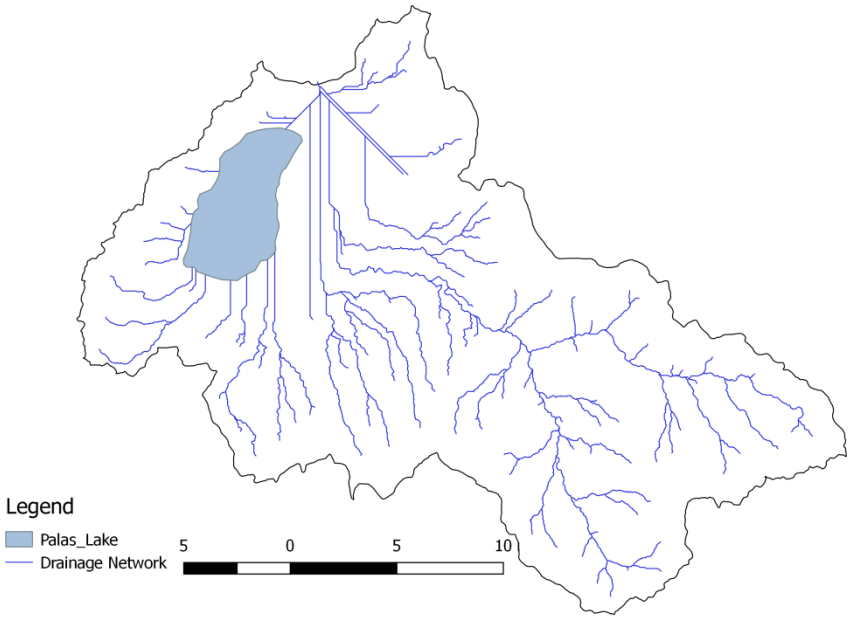
- The climate is typically continental.
- Average annual temperature of 10.5ºC
- Average annual precipitation of 400 mm.
- Average annual pan evaporation is about 1000 mm.

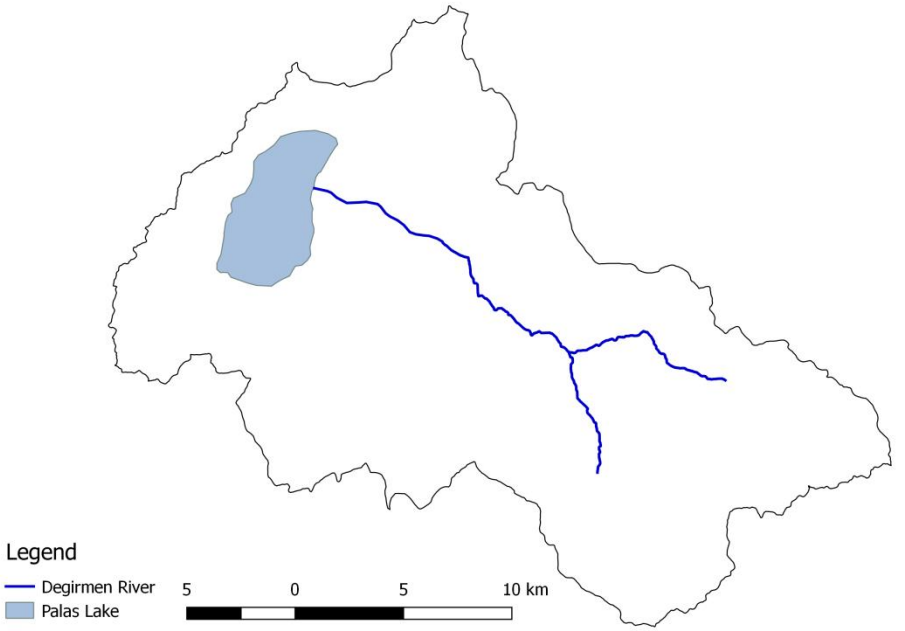


Palas Basin-Hydrology

- There is a saline lake, called Tuzla (Palas) Lake, to the west of the basin.The lake is fed by precipitation, groundwater flows and flows from a small stream, called Degirmen Stream.

- Average flow rate for Degirmen Stream is 0.56 $m^3 s^{-1}$





Palas Basin-Economic Activities and Water Uses

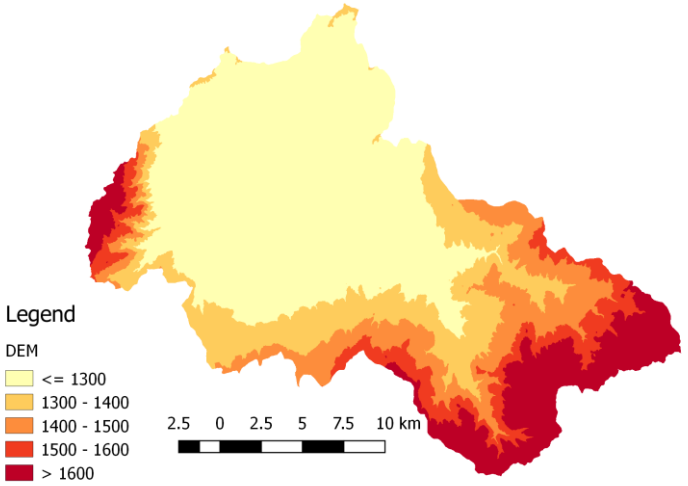
- The major economic activities in the Palas Basin are agriculture and animal husbandry.
- In general, three different plant species (sugar beet, sunflower) are cultivated in the region and these plants are irrigated by Degirmen Stream flowing east to the west in the basin or ground water.
- Groundwater use is widespread in the western basin but information regarding pumping rates is very limited.
- Rainfed (dry) agriculture is dominant in the remaining regions, where cereals are the main plant species cultivated. There are no industrial and commercial activities in the basin.

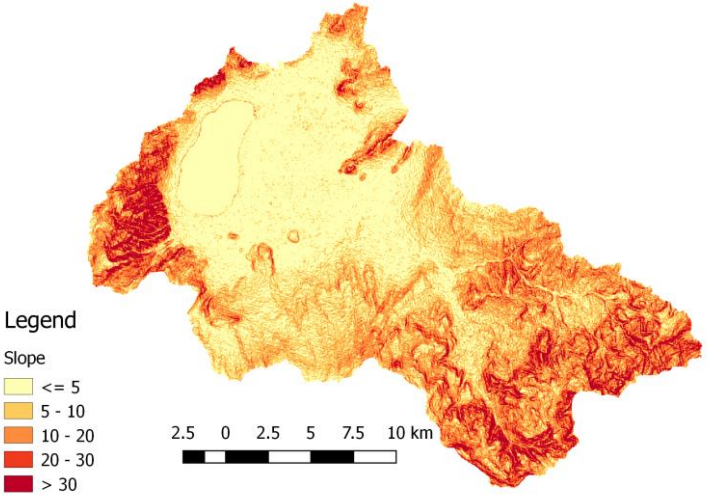
Objectives

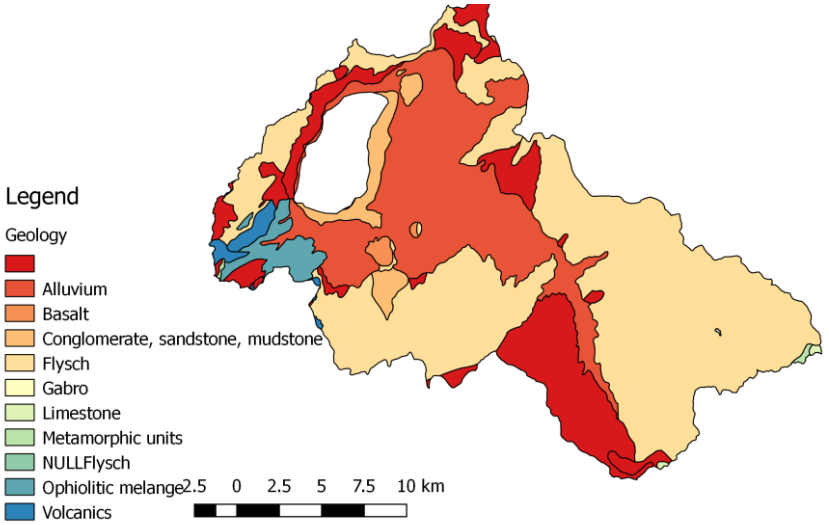
•to determine the water transport to Tuzla Lake which collects surface and groundwater generated in the basin

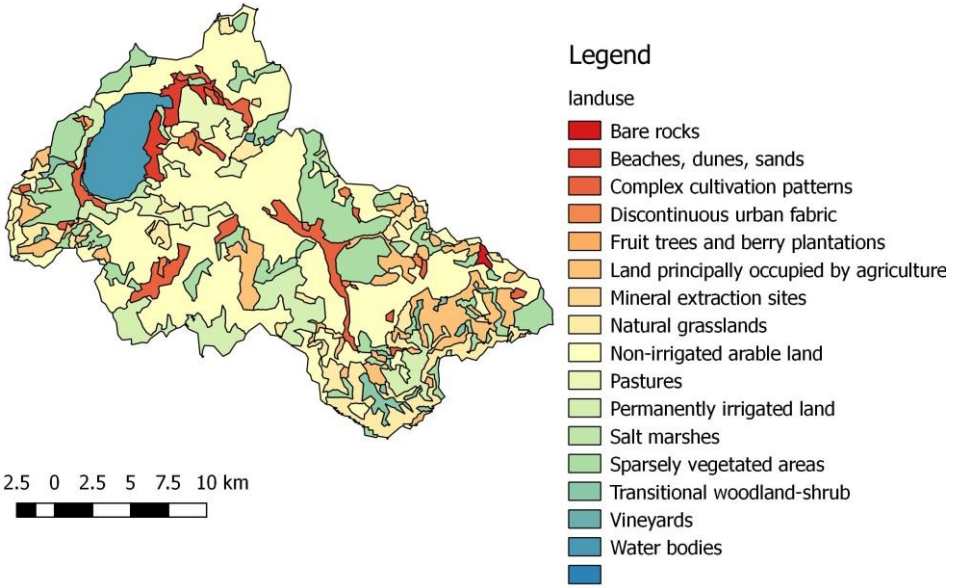
•to develop water management strategies for reducing the negative impacts associated with agricultural activities

Data Used



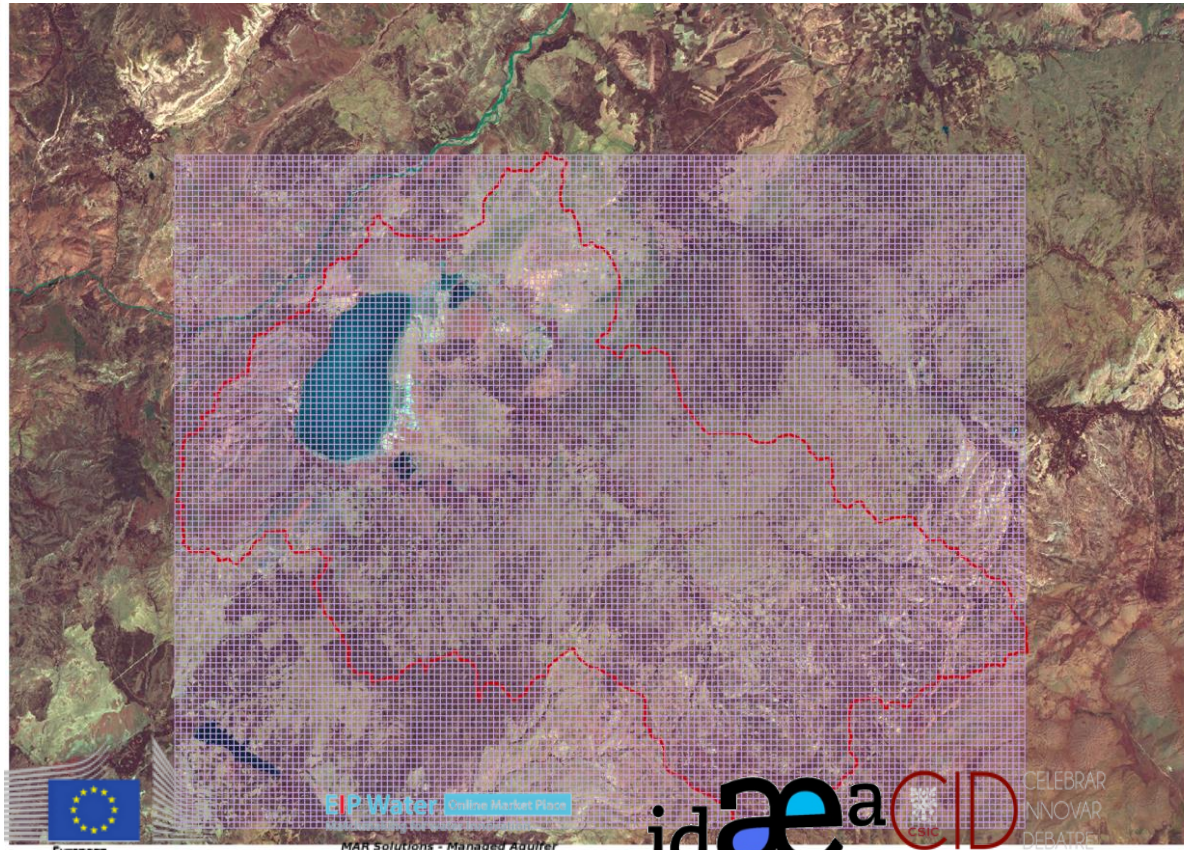




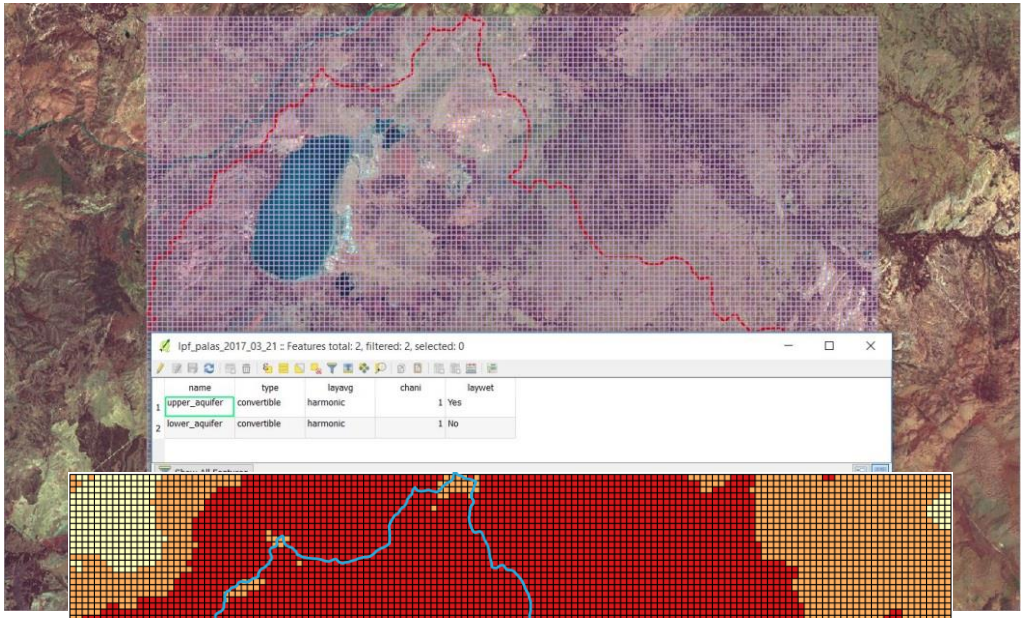


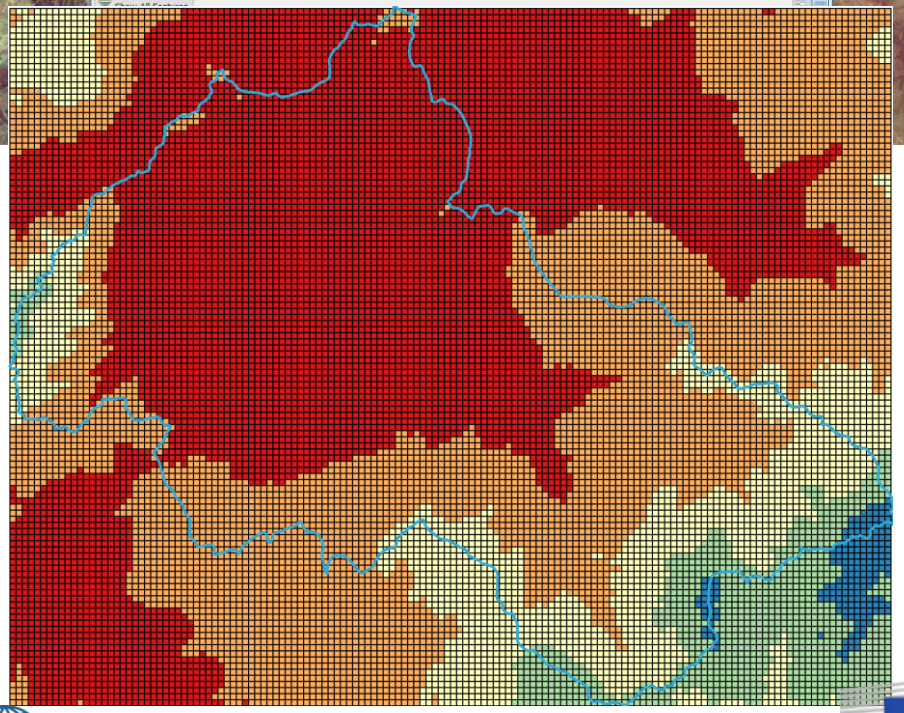
Study Area and Grid

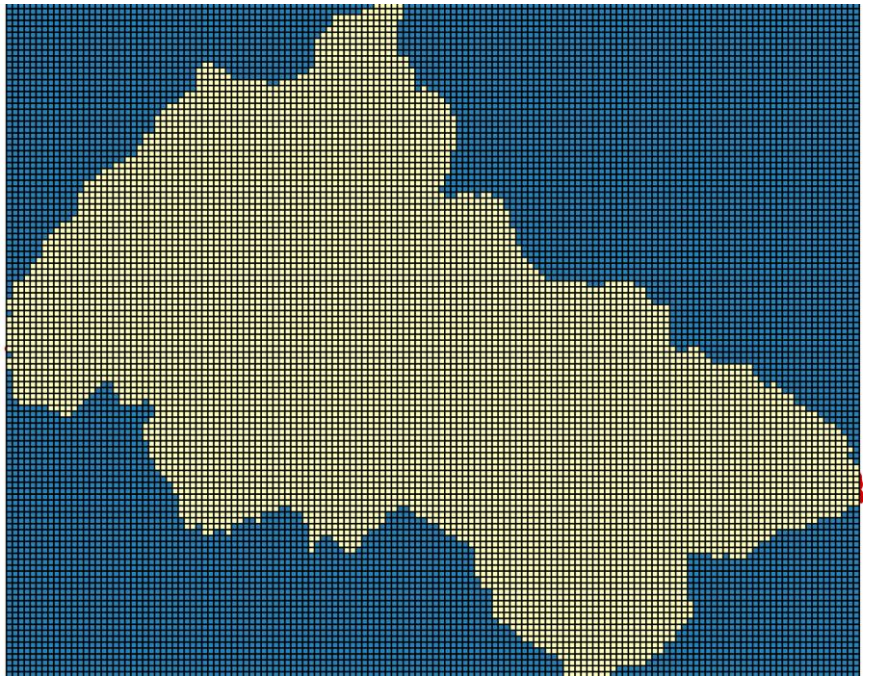
The model grid is created based on the entire watershed.
Grid resolution of 250 m x 250 m was selected, which created a total of 16416 grids.



Model Development







Two hydrostratigraphic units were identified:

- an upper unit is an alluvial aquifer consist of sandy and clayey material with varying thickness according to topography.
- a lower unit is an aquifer consisting of clayey material with thickness of about 100 m.

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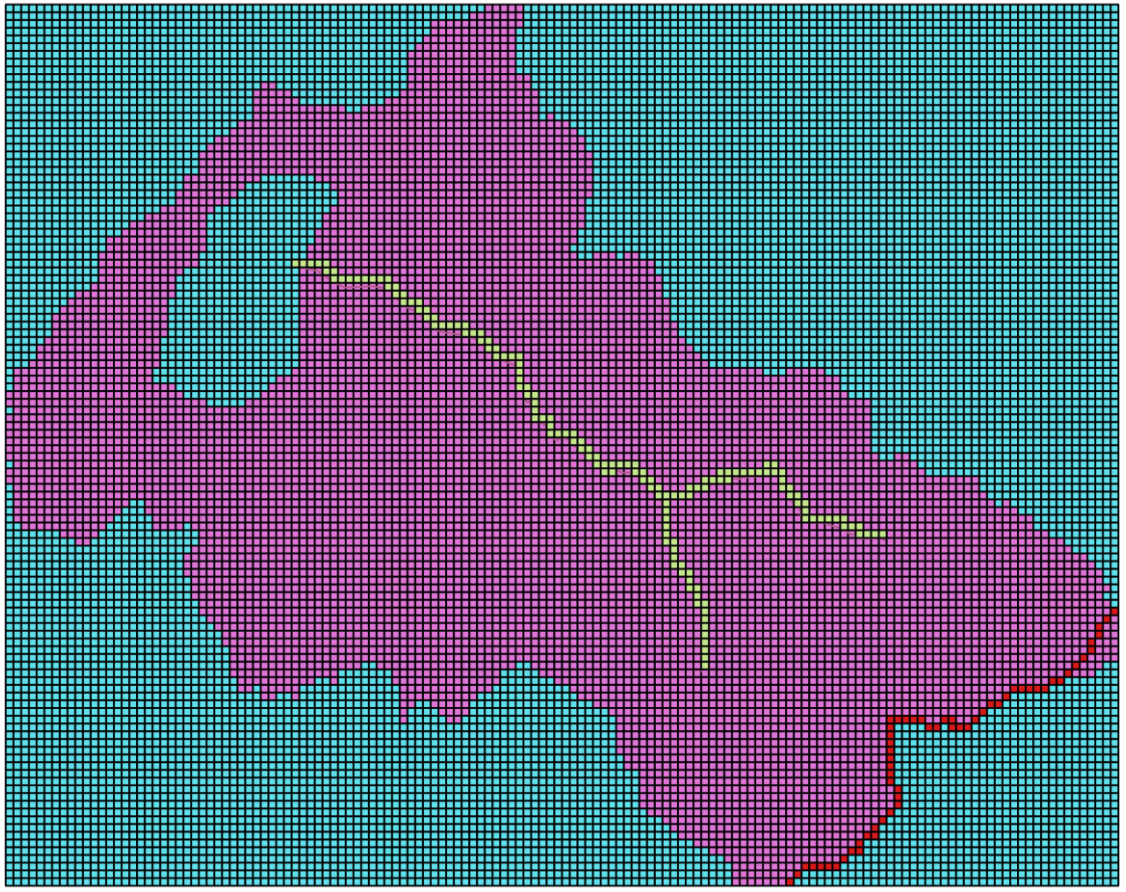
Boundary Conditions

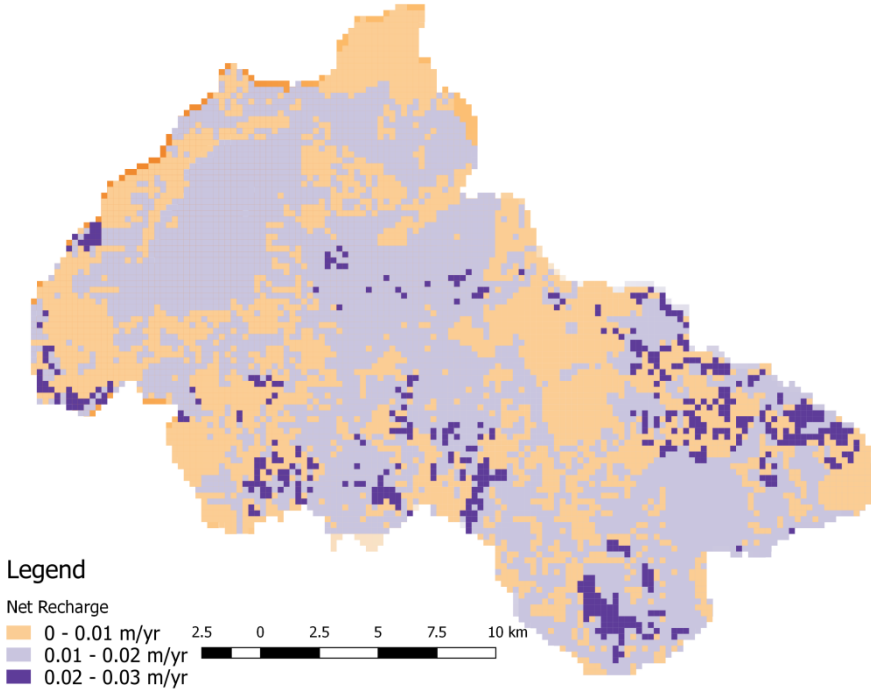


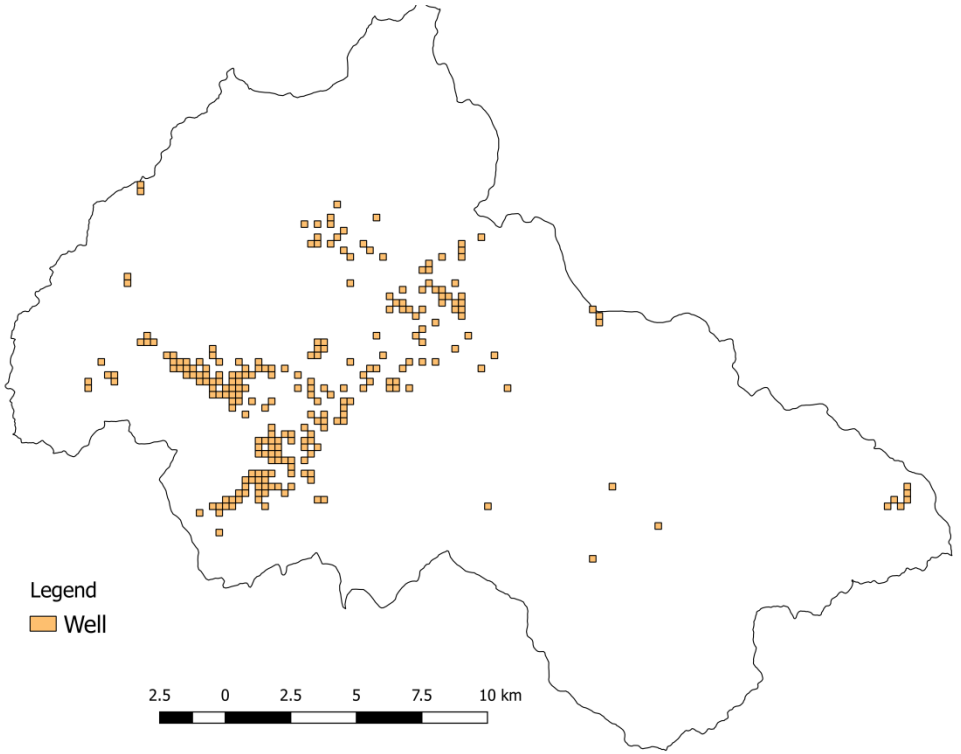
- Western Boundary: **Lake (LAK)**

- Eastern, Western, Northern and Southern Boundaries : **No-flow**

- Değirmen River: **River (RIV)**

Sinks/Sources





Net recharge to deep aquifer was simulated with Soil and Water Assessment Tool (SWAT)

Participatory Approach

Key Stakeholders

- Ministry of Forestry and Water Works (in Ankara)
- Directorate of State Hydraulic Works (in Kayseri)
- Directorate of Food, Agriculture, and Livestock (in Kayseri)
- Directorate of Forestry and Water Works (in Kayseri)
- Directorate of Environment and Urbanization (in Kayseri)
- Municipality of Kayseri
- Nature Protection Center (NGO)

The interests of stakeholders

- water management
- groundwater management
- water planning
- environmental protection
- water quality management
- GIS

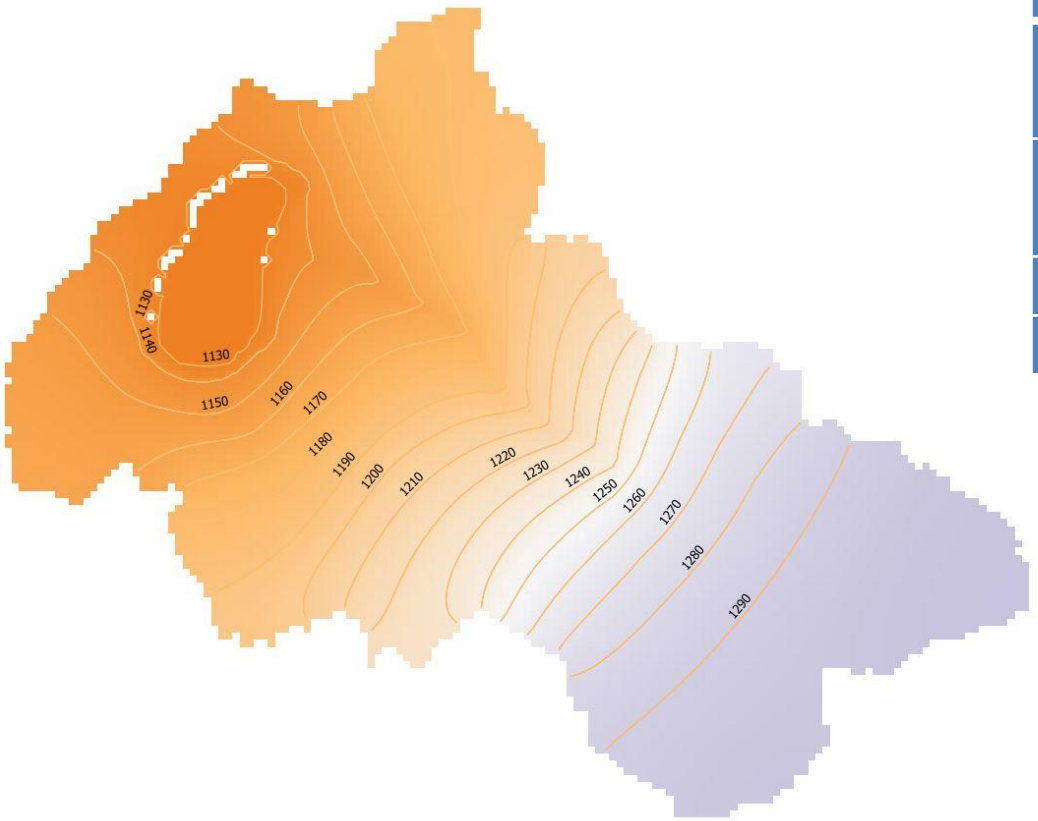
Seven focus group meetings have been conducted during July, 2016 – May 20

Scenarios

Three scenarios were run on the model to evaluate the effects of different pumping rates on groundwater input to Tuzla Lake. In the reference condition, groundwater abstraction was 1.49 million m^3/yr.

- The first scenario was run for determining the conditions without groundwater abstraction in the Palas Basin. The model was run by activating only groundwater recharge. In other words, groundwater abstraction was not simulated.
- The second scenario was run to understand the effects of decreases in groundwater pumping in the basin. Groundwater abstraction was decreased by 50% to 0.75 million m^3/yr compared to the reference condition.
- The second scenario was run to understand the effects of increases in groundwater pumping in the basin. Groundwater abstraction was increased by 50% to 2.25 m^3/yr from compared to the reference condition.

Results



Palas Basin Water Budget

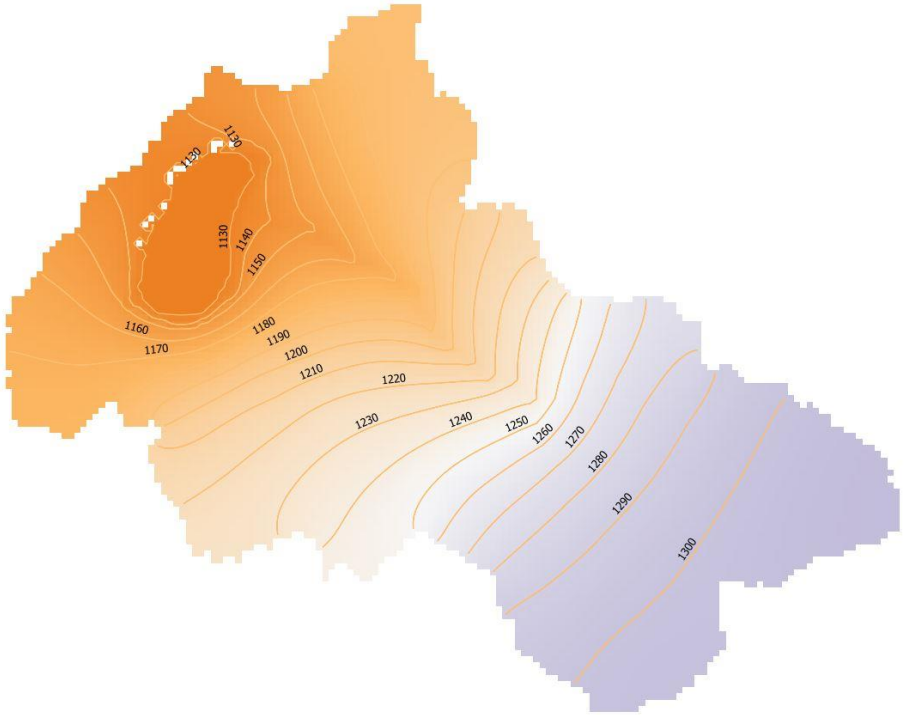
INFLOWS (million m^3/year)		OUTFLOWS (million m^3/year)	
River Leakage	0.18	River Leakage	2.25
Recharge	5.09	Lake Seepage	1.53
		Wells	1.49
Total	5.27	Total	5.27

Tuzla Lake Water Budget

INFLOWS (million m^3/year)		OUTFLOWS (million m^3/year)	
Precipitation	7.05	Evaporation	21.19
Runoff	12.61		
Groundwater	1.53		
Total	21.19	Total	21.19

Results

Scenario 1: No Pumping



Palas Basin Water Budget

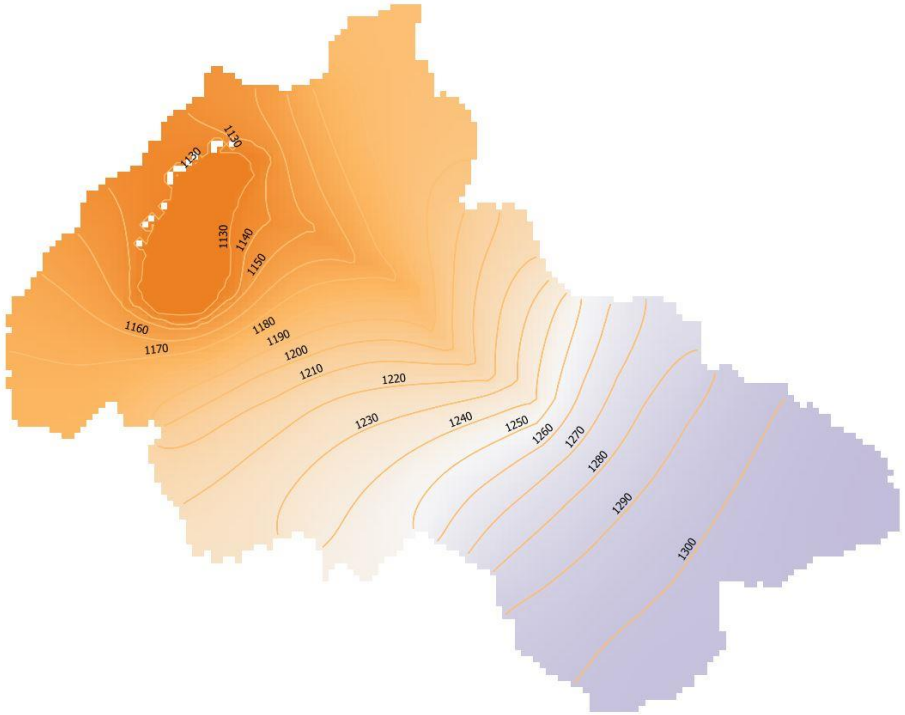
INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
River Leakage	0.16	River Leakage	3.12
Recharge	5.10	Lake Seepage	2.14
		Wells	-
Total	5.26	Total	5.26

Tuzla Lake Water Budget

INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
Precipitation	7.36	Evaporation	22.11
Runoff	12.61		
Groundwater	2.14		
Total	22.11	Total	22.11

Results

Scenario 2: %50 reduced pumping



Palas Basin Water Budget

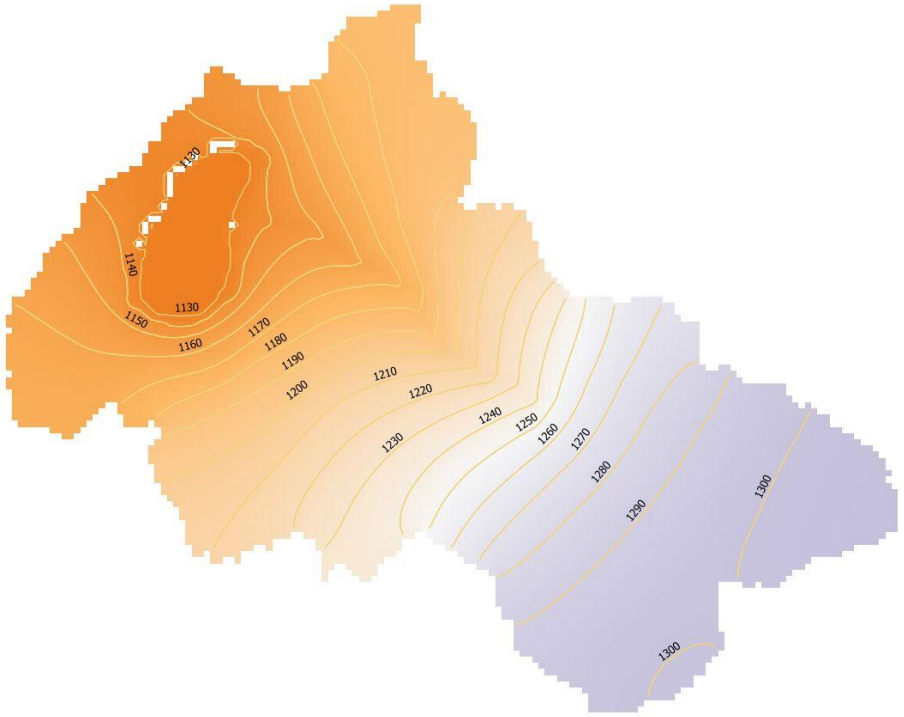
INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
River Leakage	0.16	River Leakage	2.68
Recharge	5.10	Lake Seepage	1.84
		Wells	0.74
Total	5.26	Total	5.26

Tuzla Lake Water Budget

INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
Precipitation	7.20	Evaporation	21.65
Runoff	12.61		
Groundwater	1.84		
Total	21.66		21.65

Results

Scenario 3: 50% increased pumping



Palas Basin Water Budget

INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
River Leakage	0.18	River Leakage	1.82
Recharge	5.09	Lake Seepage	1.22
		Wells	2.23
Total	5.27	Total	5.27

Tuzla Lake Water Budget

INFLOWS (million m³/year)		OUTFLOWS (million m³/year)	
Precipitation	6.89	Evaporation	20.72
Runoff	12.61		
Groundwater	1.22		
Total	20.72	Total	20.72

Conclusions

Condition	Reference	Scenario 1	Scenario 2	Scenario 3
INFLOWS (million m^3/year)				
River Leakage	0.18	0.16	0.16	0.18
Recharge	5.09	5.10	5.10	5.09
Total	5.27	5.26	5.26	5.27
OUTFLOWS (million m^3/year)				
River Leakage	2.25	3.12	2.68	1.82
Lake Seepage	1.53	2.14	1.84	1.22
Wells	1.49	0	0.74	2.23
Total	5.27	5.26	5.26	5.27

Conclusions

With the FREEWAT platform, we

- simulated the groundwater component of the hydrologic system in the Palas Basin
- represented the linkage between surface water and groundwater in the Palas Basin
- developed understanding of the relationships between water management practices and water transport mechanism.

Capacity Building

27 Şubat-2 Mart 2017-DSİ-13 people

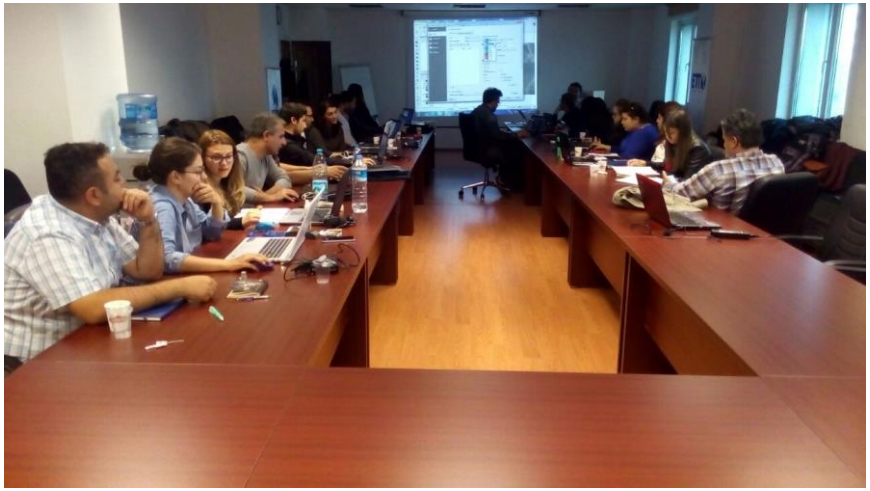
Total 72 people

24 Institutions

State Institutions
Universities
Reseach Centers
Irrigation Associations
Etc.

5-8 Nisan 2017-ERU-20 people

24-26 Nisan 2017-SYGM-17 people



2-5 Mayıs 2017-ERU-21 people

Thank You

Contact

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