

JEM 428
JEOLAJİ
MÜHENDİSLİĞİNDE
TASARIM
MODELLEME VE SİMÜLASYON-2

Sorumlu Öğretim Elemanı: Doç. Dr. Şebnem Arslan

Yeraltısuyu nümerik modelleme çalışmasına bir örnek: Ergene Havzası Kumlu Kompleks akiferin sayısal yeraltısuyu modeli

* Ökten, 2004 ve Ökten ve Yazıcıgil, 2005

Bu çalışmada yaklaşık 5900 hücreden oluşan Sonlu Farklar Akım Modeli akiferdeki kararlı ve kararsız akımı benzeştirmesi için kullanılmıştır. Model kalibrasyonu 1970 yılının Ocak ayında saha koşullarında gözlenen su seviyeleri ile yapılan kararlı akım koşullarında kalibrasyon ve bunu izleyen Ocak 1970-Aralık 2000 döneminde gözlenen su seviyeleri ile yapılan kararsız akım koşullarında kalibrasyon olmak üzere iki aşamada gerçekleştirilmiştir.

Ökten, S., 2004, Investigation of the Safe and Sustainable Yields for the Sandy Complex Aquifer System in Ergene River Basin, METU

Tez Danışmanı: Prof. Dr. Hasan Yazıcıgil

Ökten, S. & Yazıcıgil, H., 2005, Investigation of Safe and Sustainable Yields for the Sandy Complex aquifer system in the Ergene River Basin, Thrace Region, Turkey, Turkish Journal of Earth Sciences, Vol: 14, 209-226 p.

Ortaya ıkan model Ocak 2001 ve Aralık 2030 yılları arasını kapsayacak Őekilde 30 yıllık bir planlama d6nemi g6z 6n6ne alınarak akifer sisteminin eŐitli pompaj koŐulları altındaki tepkisini belirlemek ve alternatif yeraltısuyu y6netim senaryoları kurulması iin kullanılmıŐtır.

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EARTH SCIENCES

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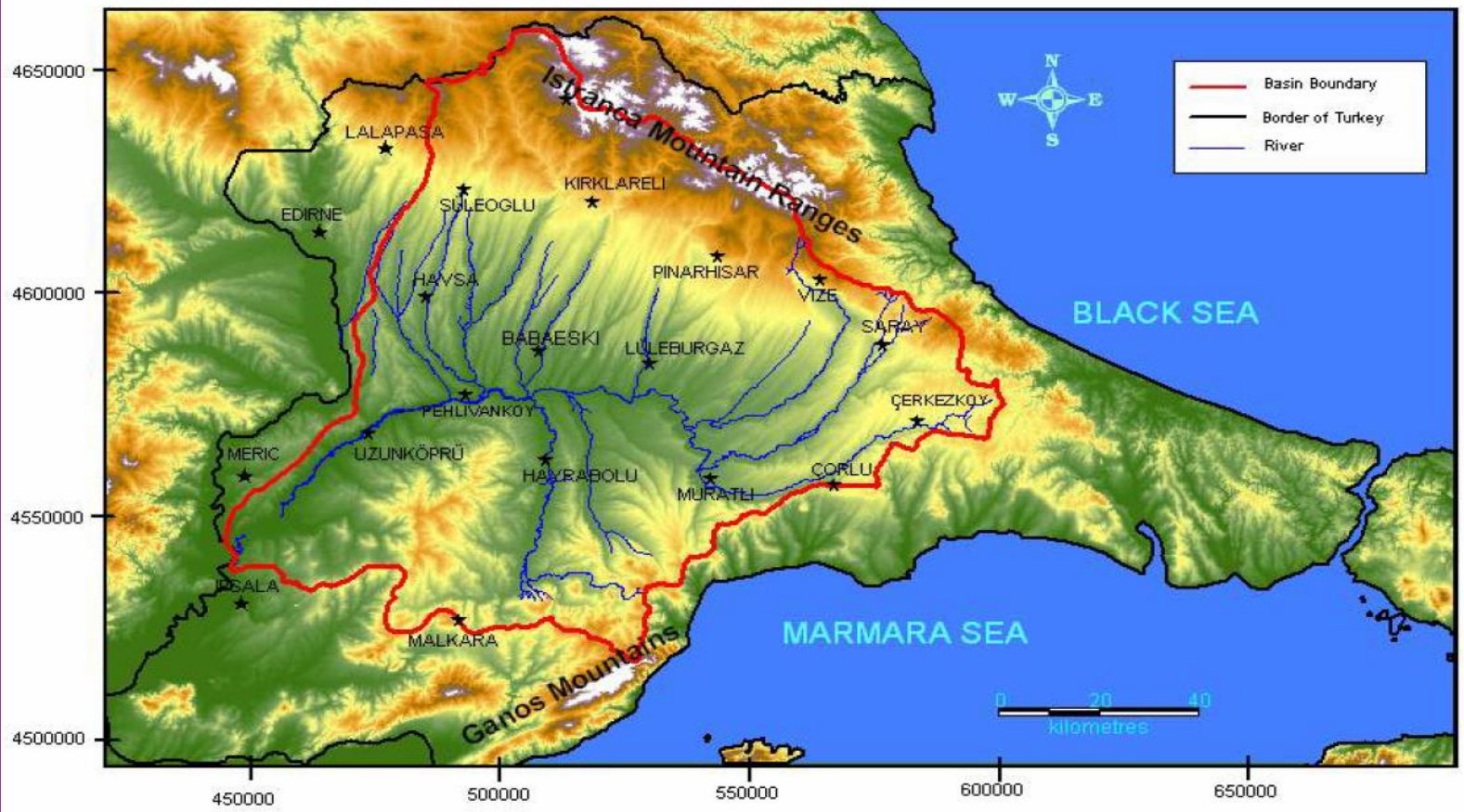
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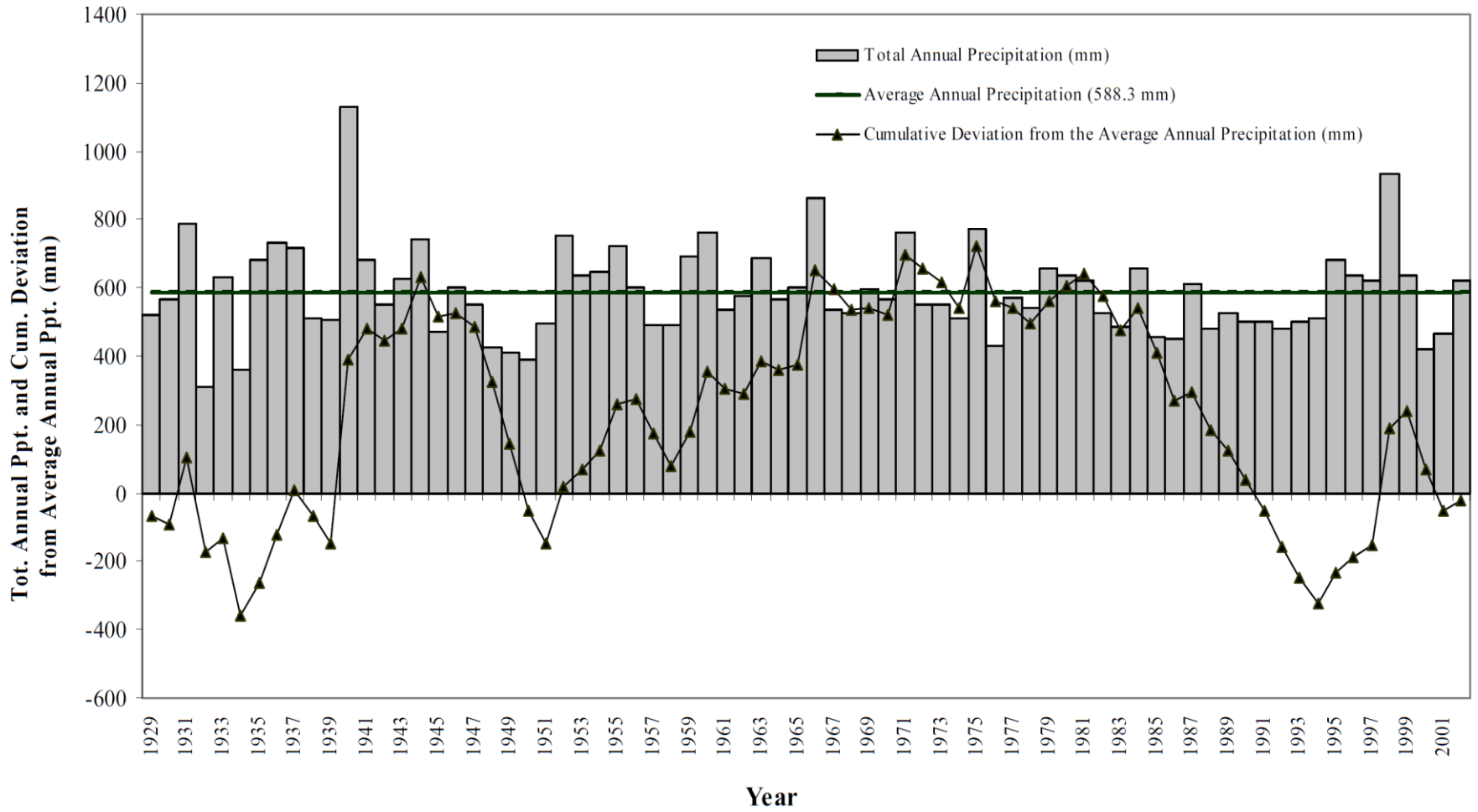
May-Aug 2005

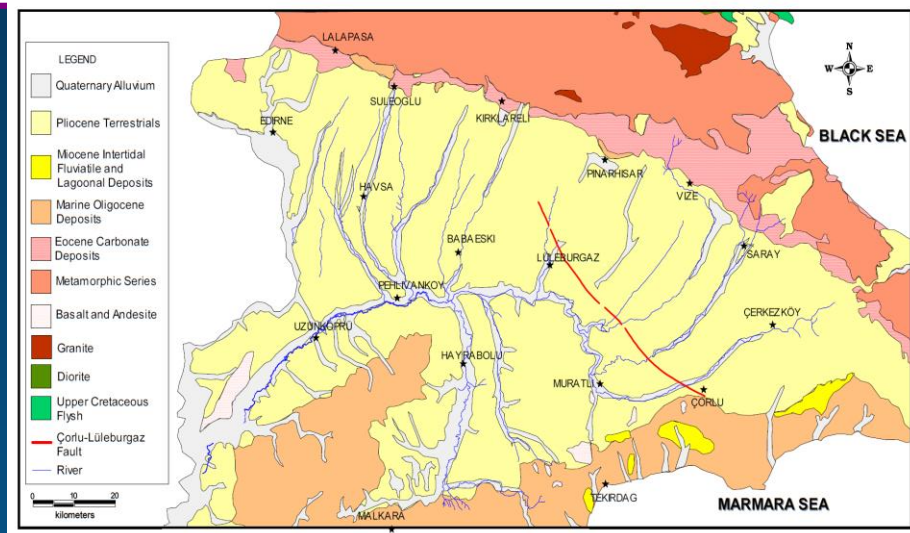
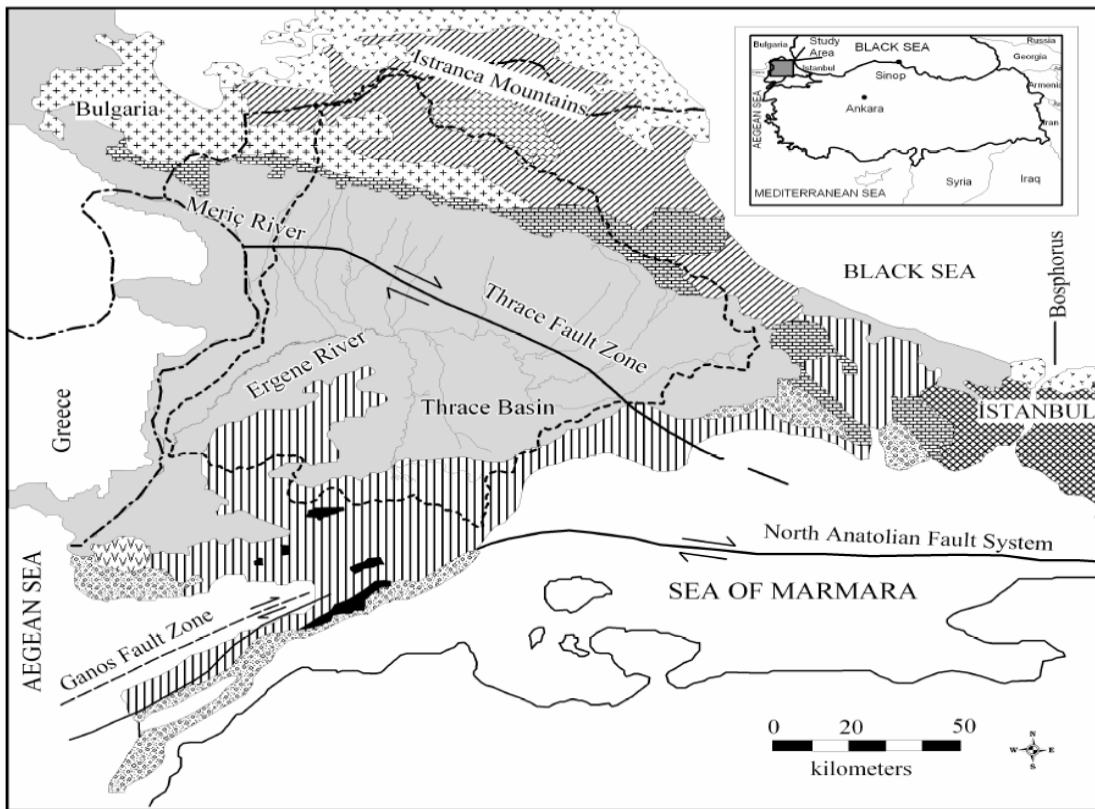
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Havza alanı: 11325 km²
Kuzeyde Istranca dağları,
güneyde Korudağ ve Ganos
dağları ile sınırlanmış.

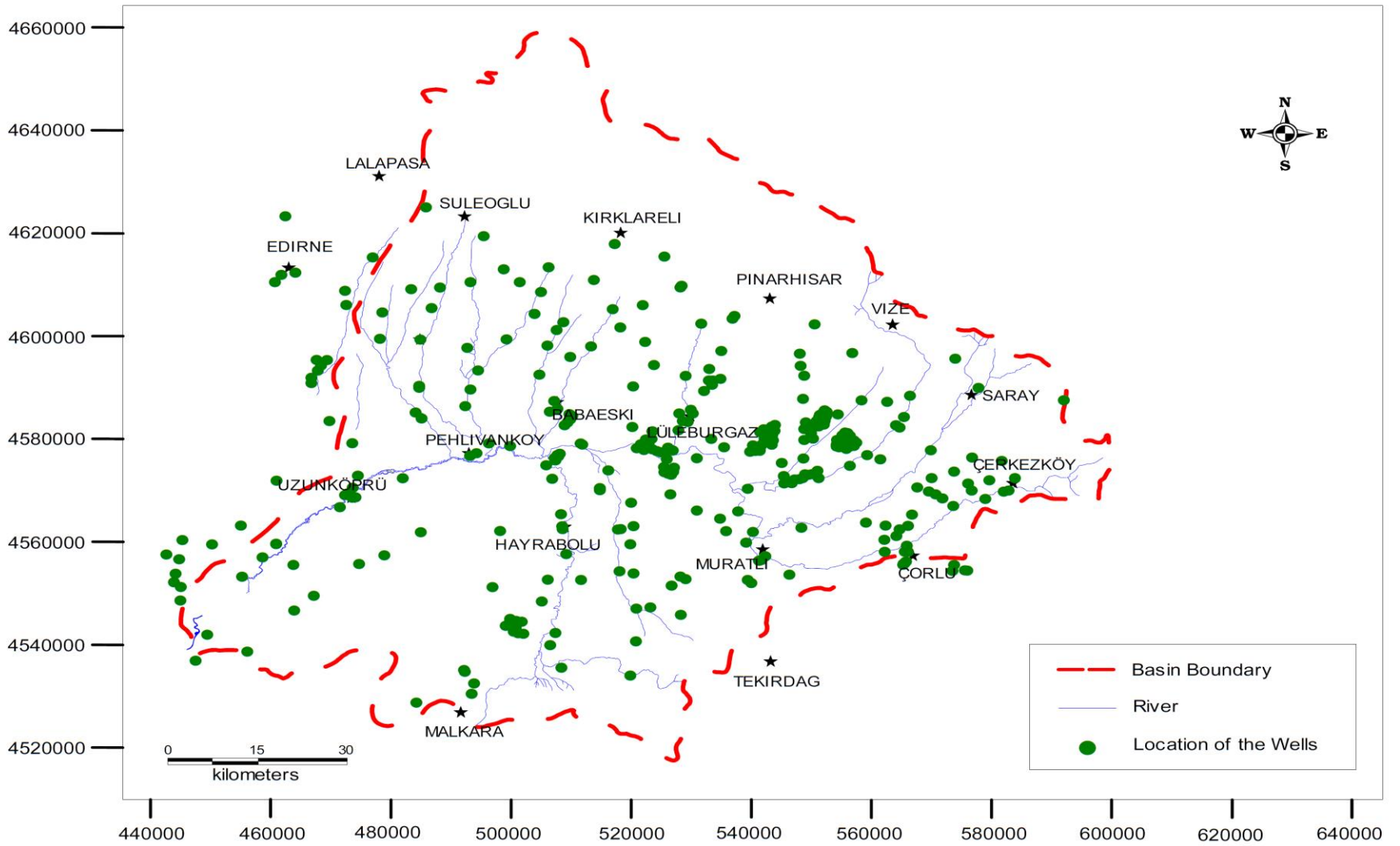


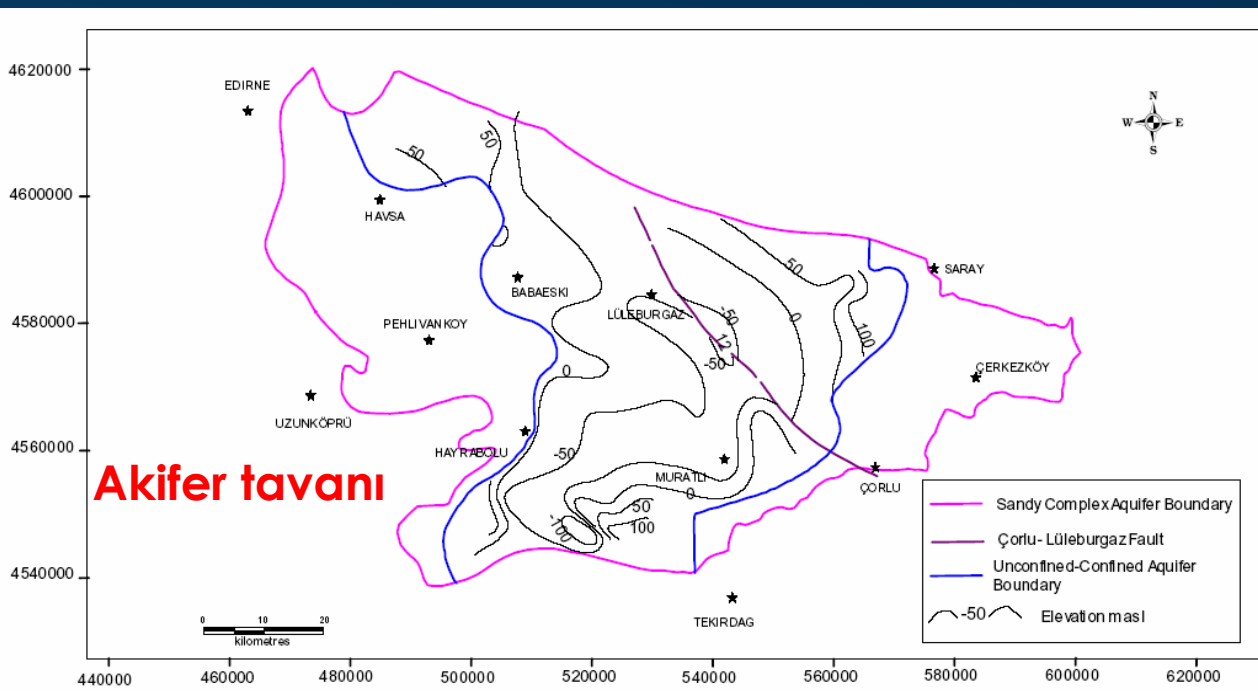
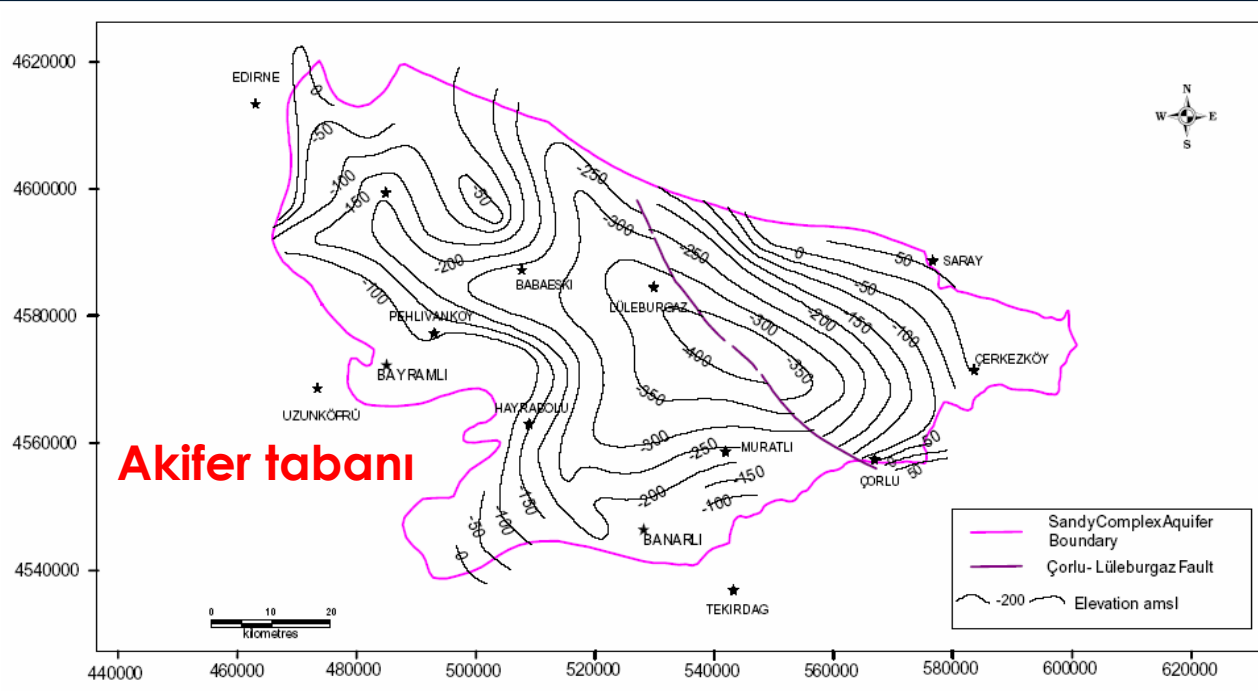




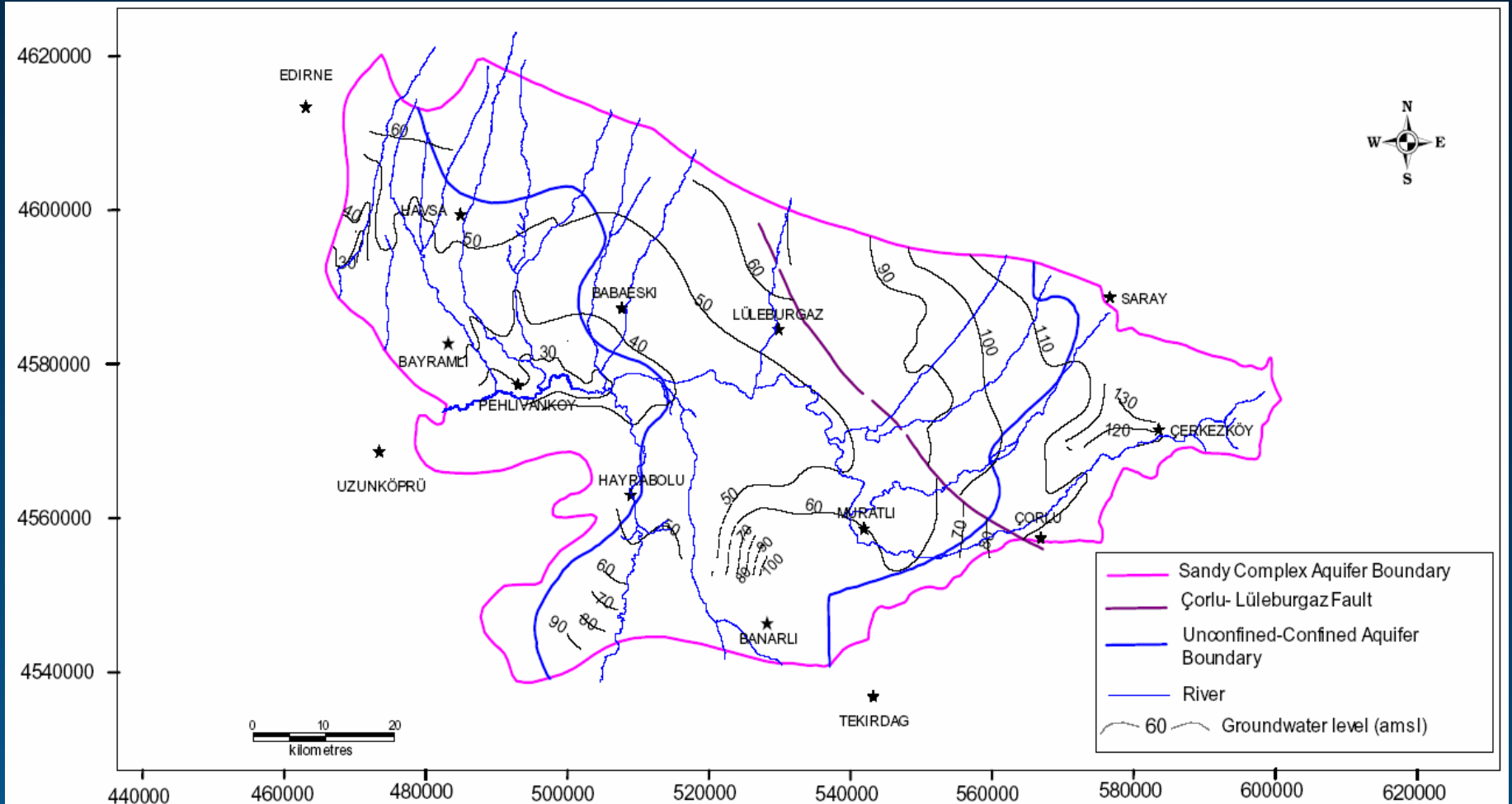
AGE	FM	LITHOLOGY	EXPLANATION		HYDROGEOLOGICAL UNIT	
			CENTRAL PART OF THE BASIN	NORTHERN PART OF THE BASIN		
TERTIARY	QUA		Alluvial gravel, sand and silt		Good aquifer conditions in separated old and recent alluvium	
	PLIOCENE		Clay & silt interbedded with some limestone			
			Medium to coarse grained gravelly sand with sandy clay frequently inbedded, rare lignite		Good to excellent aquifer conditions all over the Basin (Sandy Complex)	
	MIOCENE		Clay and shale with, frequent fine to coarse grained sandstone layers. Abundant lignite			Poor aquifer conditions in discontinuous strata.
			DANISMEN	OSMANCIK	Sandstone and Shale	
	OLIGOCENE	MUHACIR		Shale and clay with some fine grained sandstone interbedded, lignite beds.		Fair quality in and near outcrop areas, saline water in greater depth.
				PINARHISAR	Biclastic, sandy limestone	
		KIRKLARELI	Dominantly biogenic limestone marl and shale, rare sandstone			
			KESAN	Very well stratified shale, silty shale interbedded with sandstone (Flysh type sediments)		
	DANAMANDIRA	Conglomeratic Sandstone				
PALEOZOIC	BASEMENT		Metamorphic and intrusive rocks		Good aquifer conditions in outcrop areas.	

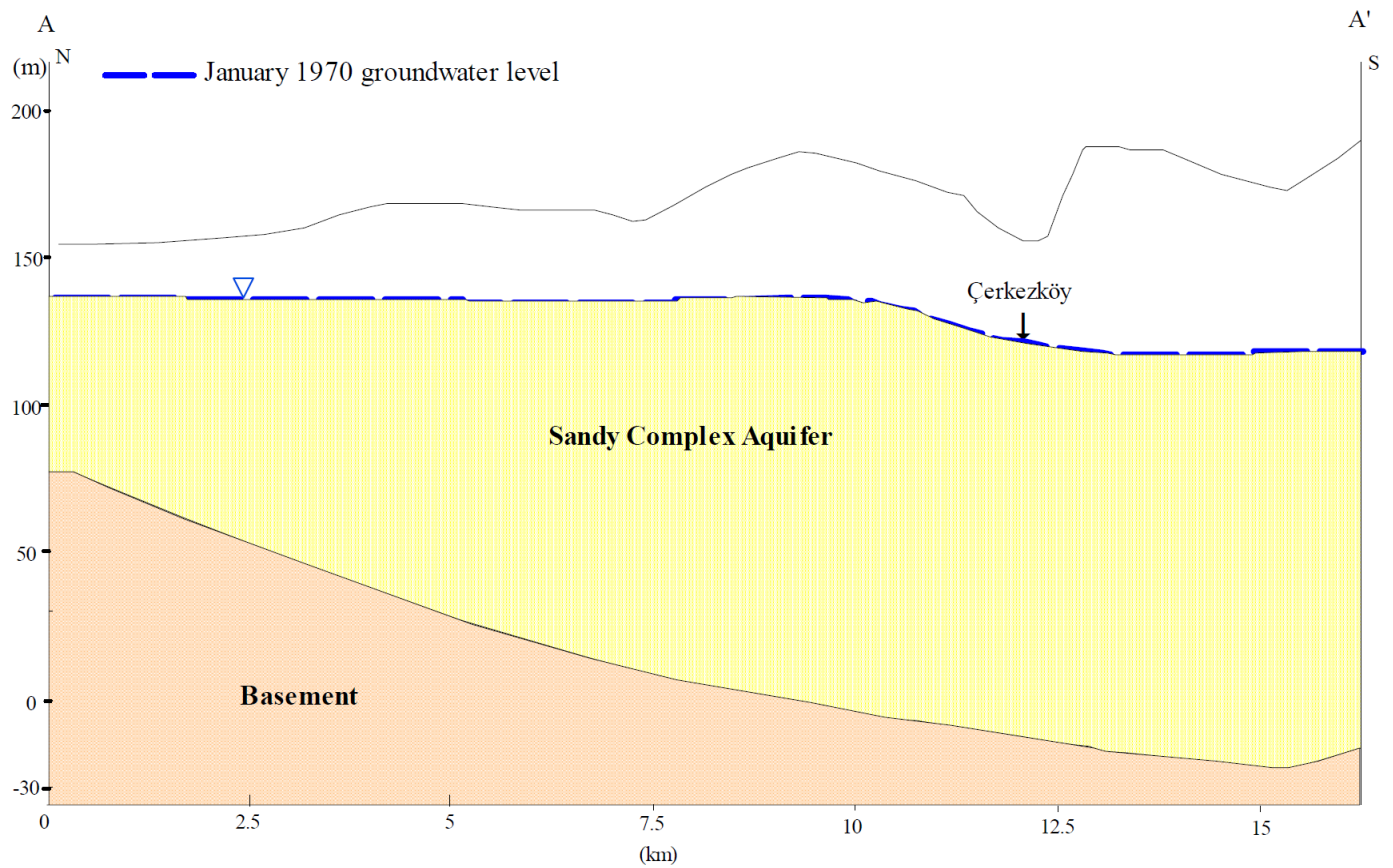
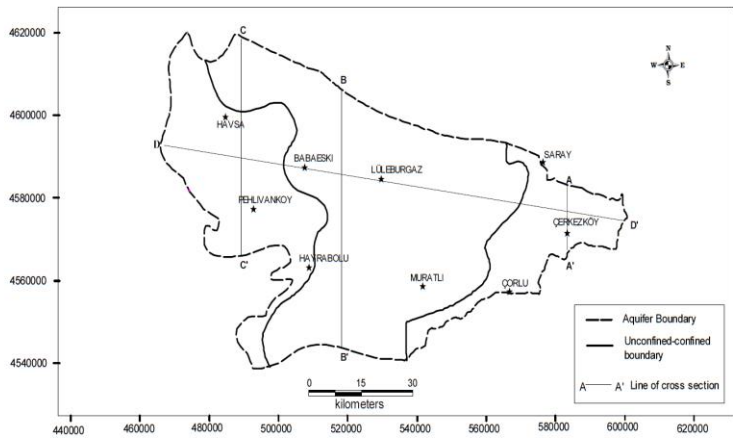
Stratigrafik kesit (Doust ve Arıkan, 1974)

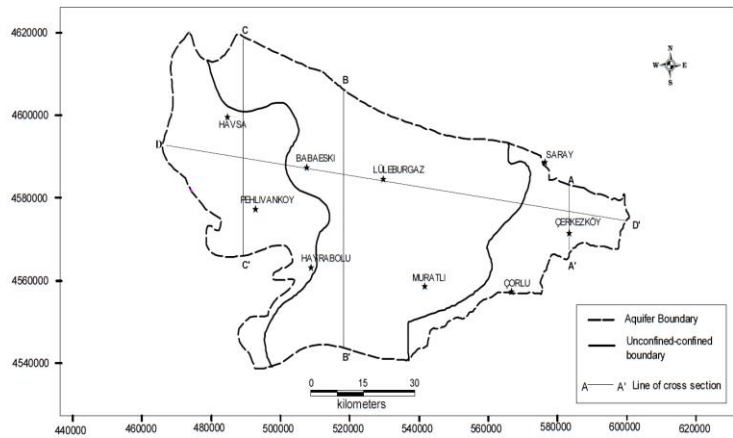




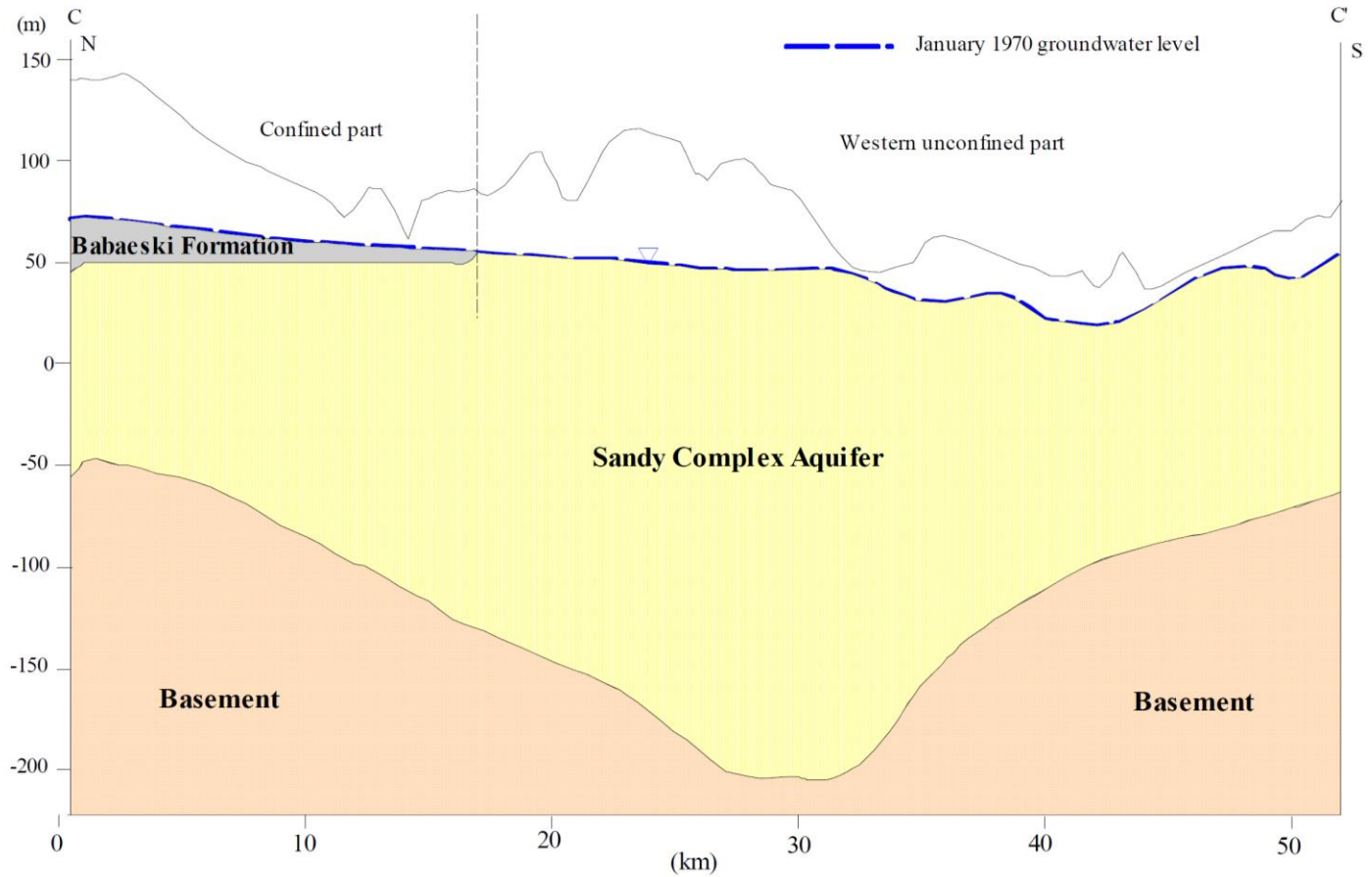
Yeraltısuyu seviyesi

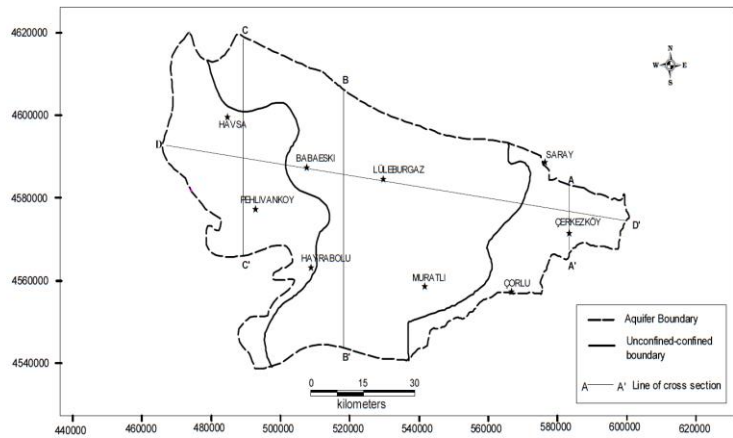




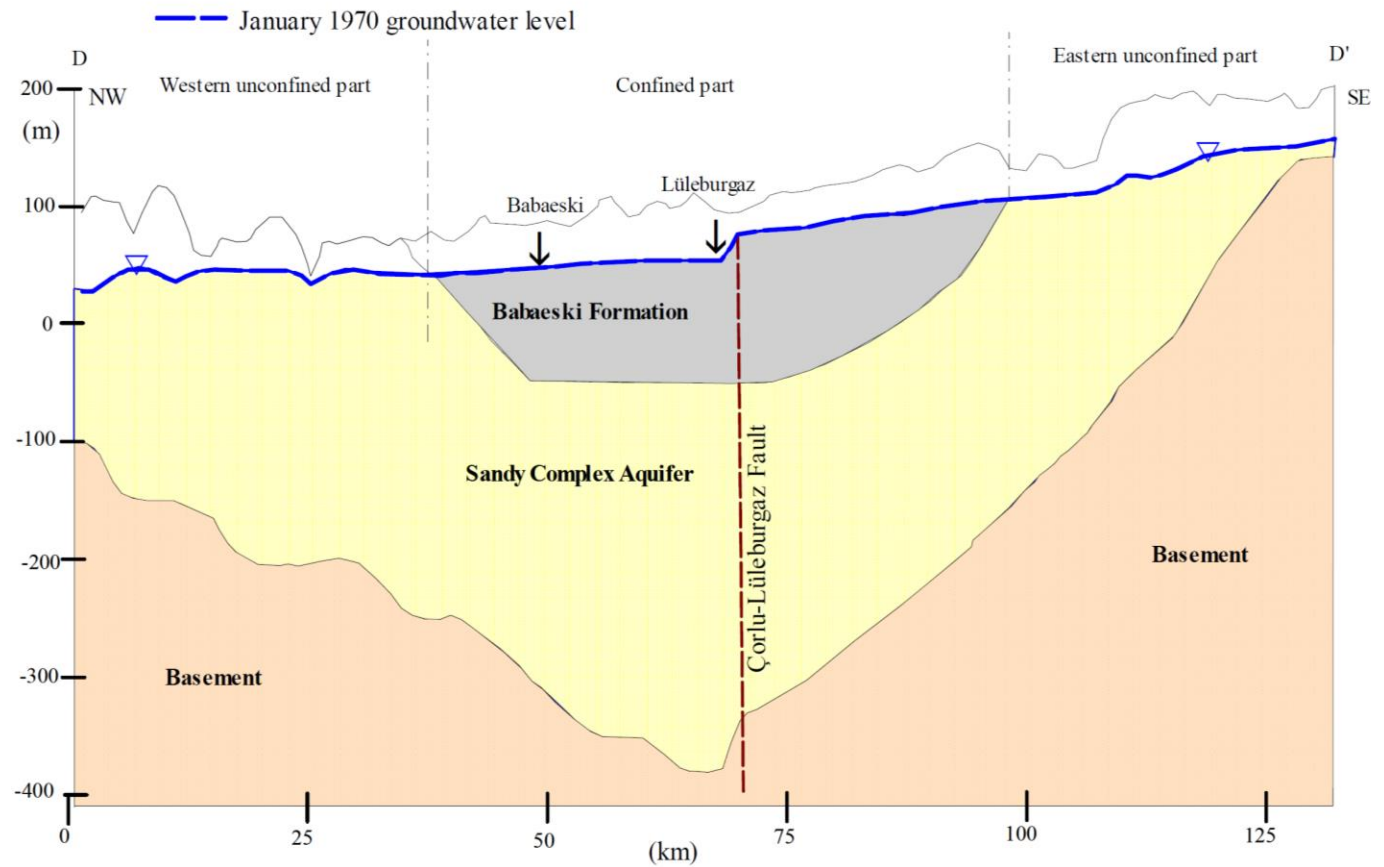


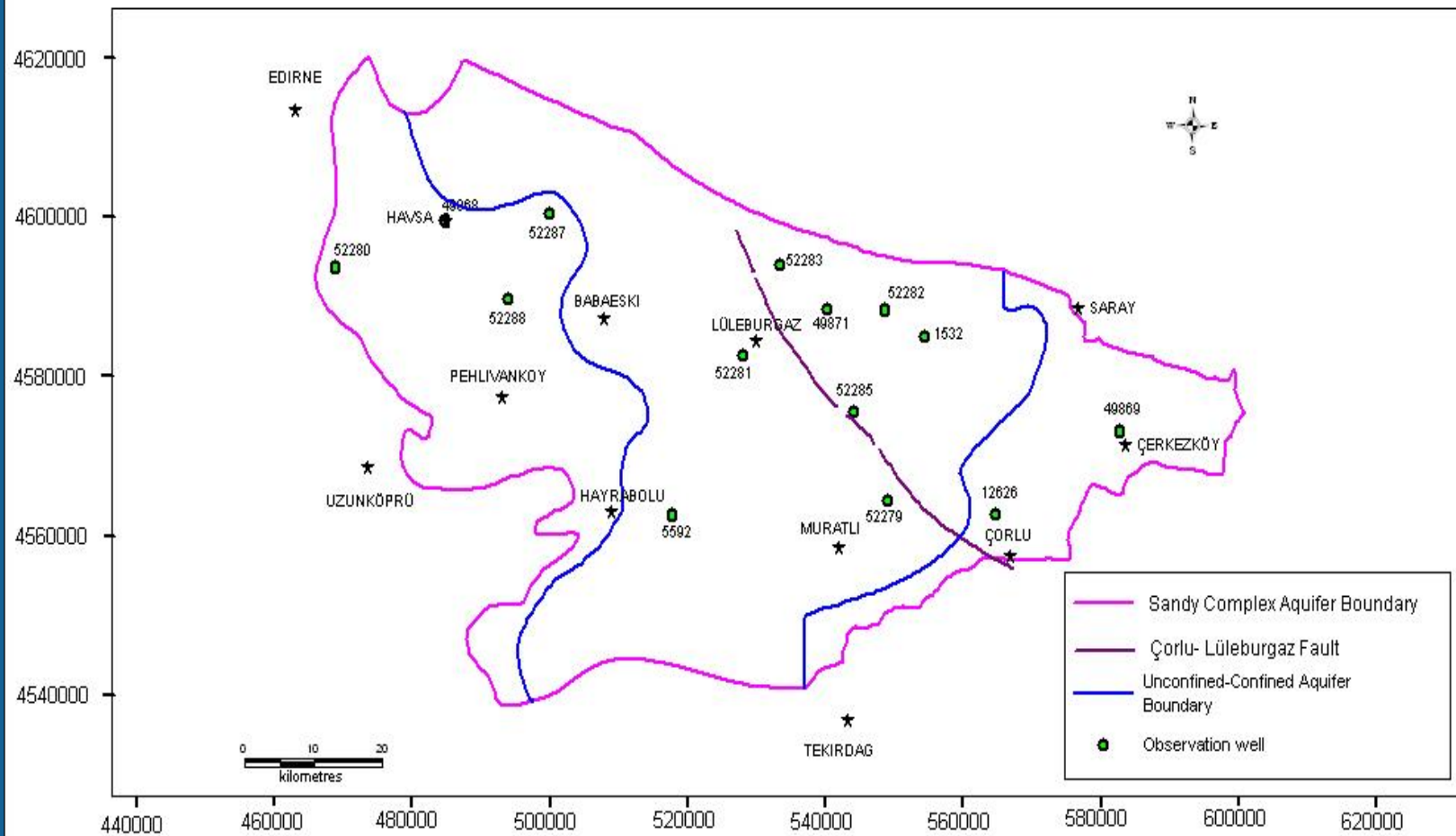
Enine kesit C-C'

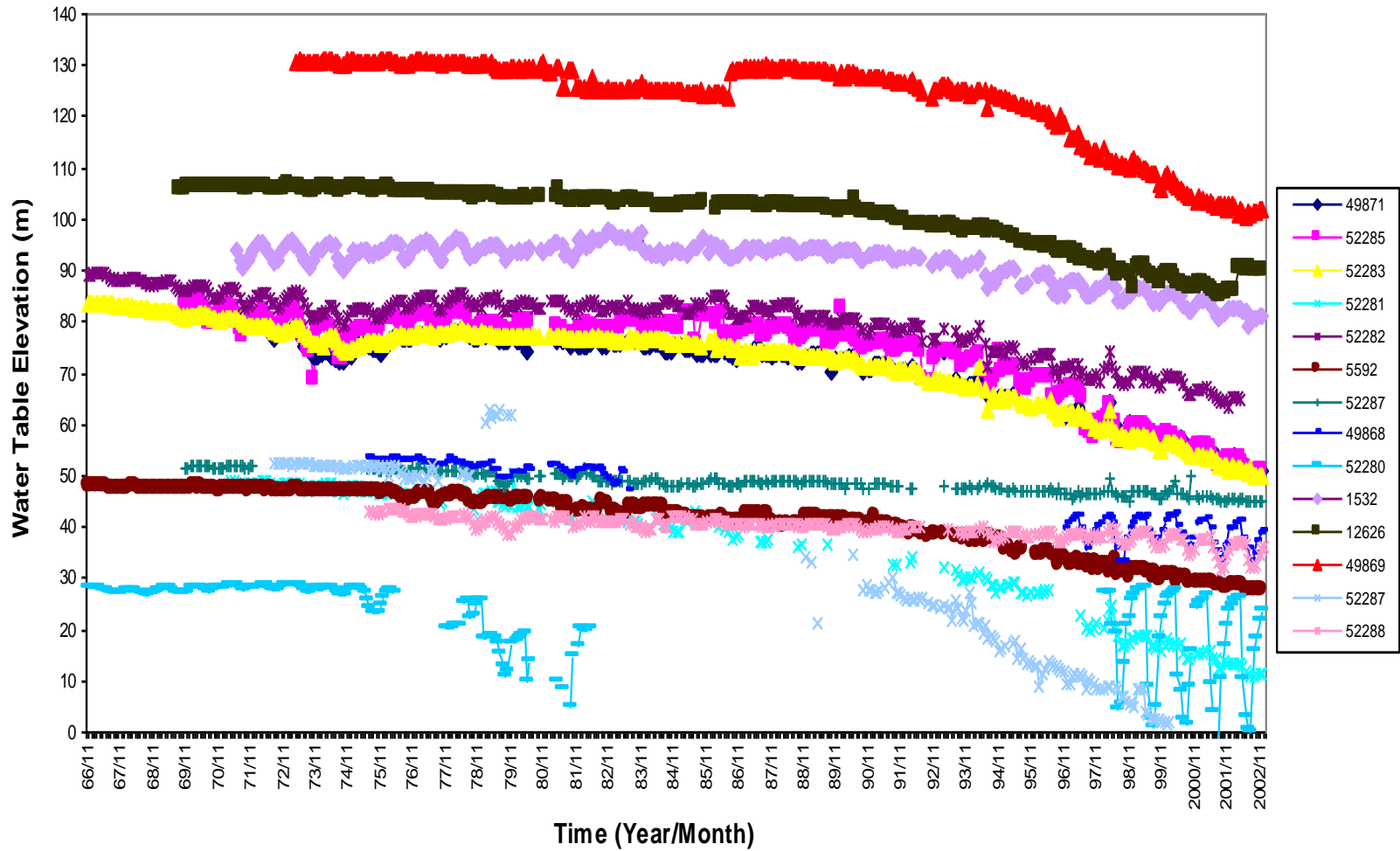




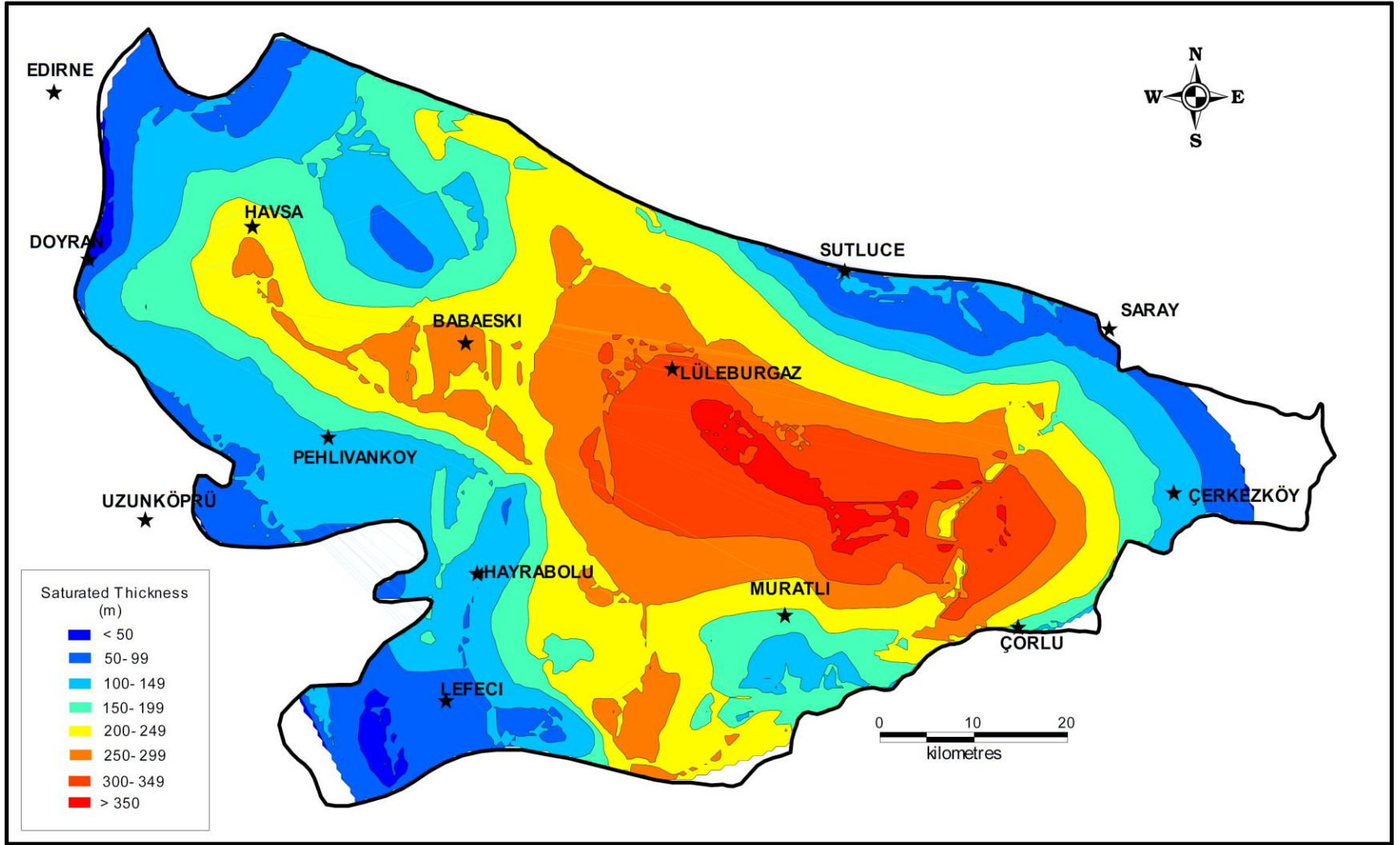
Enine kesit D-D'







Akifer kalınlığı



Matematiksel Model

Sabit yoğunlukta yeraltısuyunun gözenekli ortamda üç boyutlu hareketi aşağıdaki PDE ile tanımlanabilir.

$$\frac{\partial}{\partial x} \left(K_{xx} \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(K_{yy} \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(K_{zz} \frac{\partial h}{\partial z} \right) - W = S_s \frac{\partial h}{\partial t}$$

Denklem 1

Bu denklemde x, y, z kartezyen koordinatlar

H hidrolik yük

K hidrolik iletkenlik

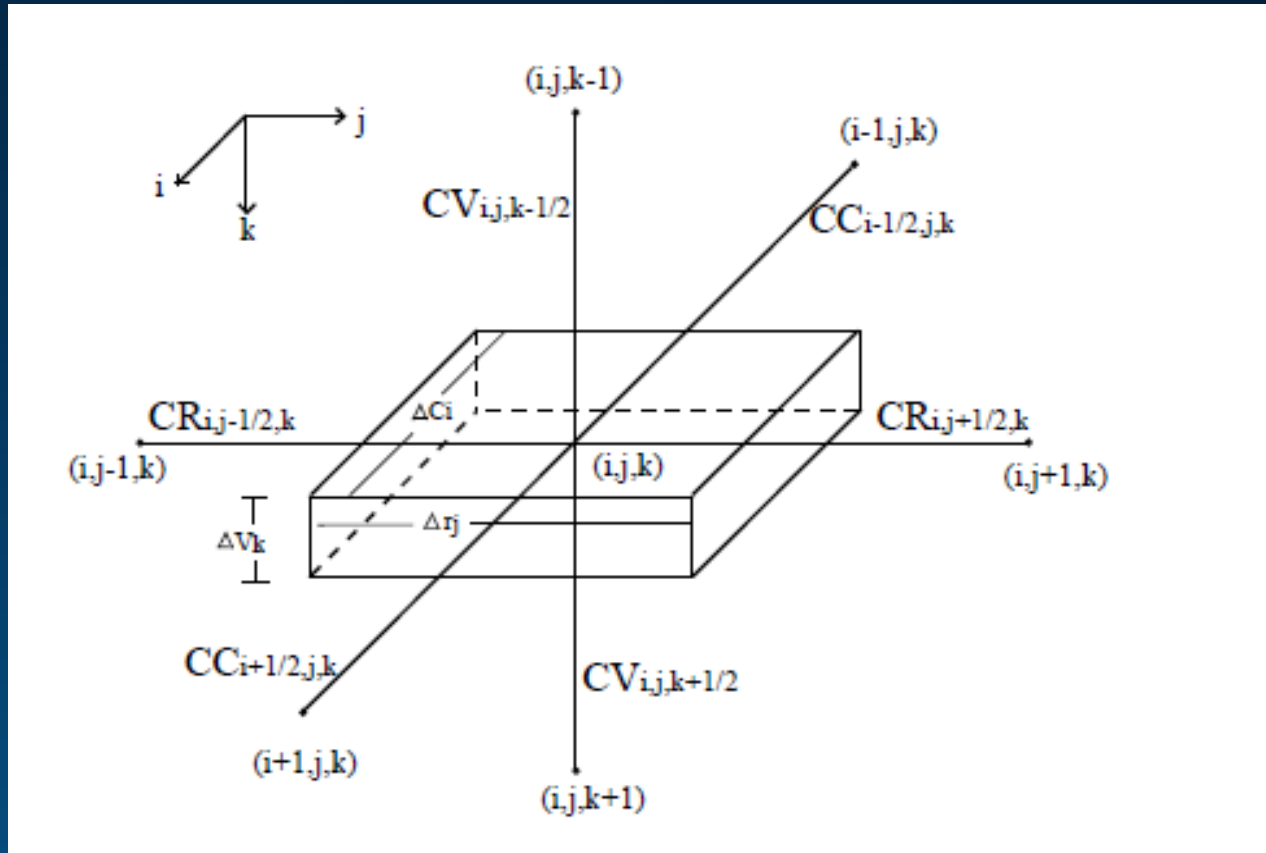
W birim hacim başına hacimsel akı

S_s geçirimli materyalin özgül depolama katsayısı

t zaman

Nümerik Model

Denklem 1'i çözebilmek için akifer sistemi bir nokta ağına ayrılır.



Model hücreleri arasındaki iletkenlik terimlerinin tanımı

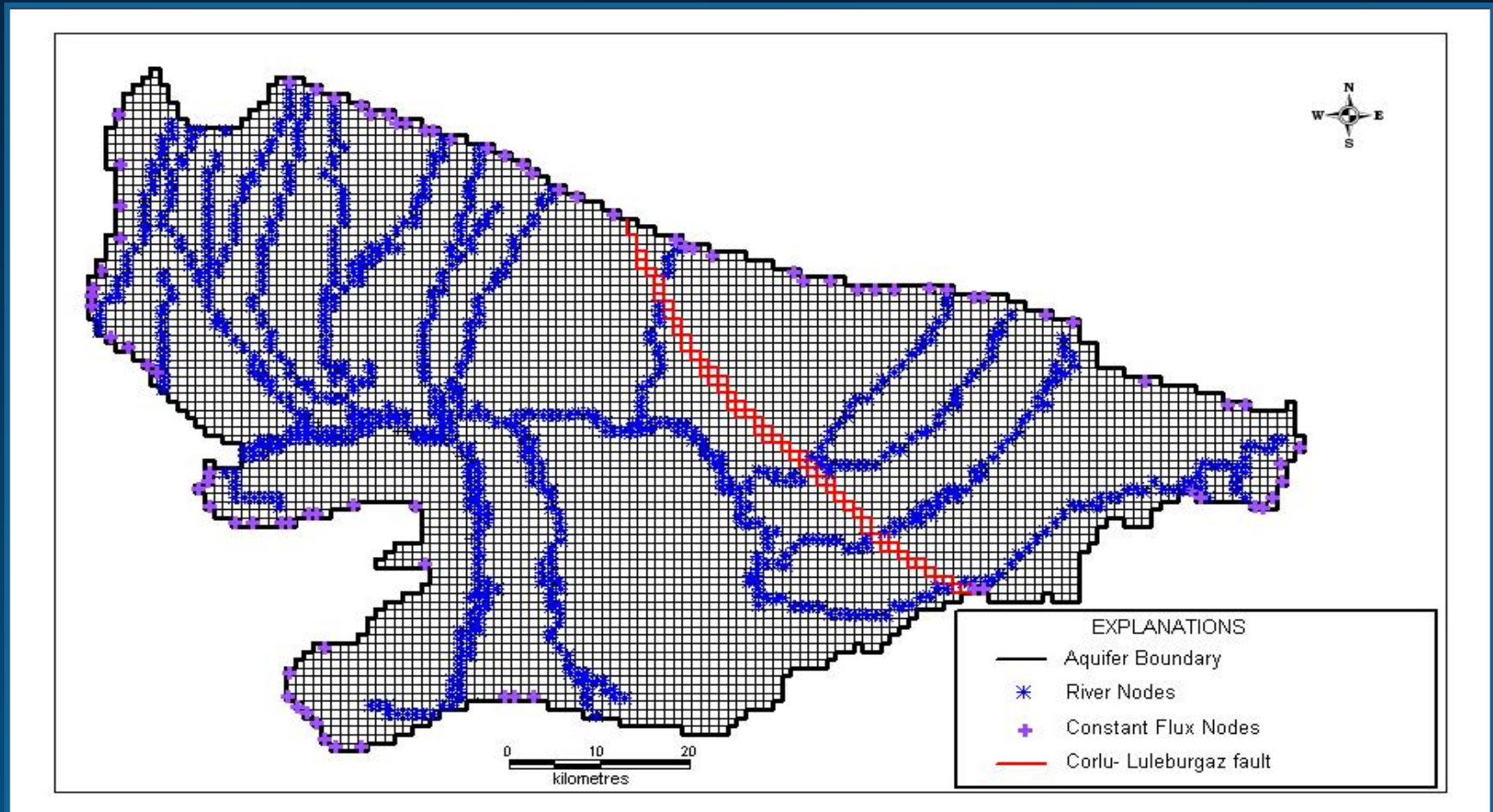
Model Girdi

Başlangıç hidrolik yük
Sınır koşulları
S, K dağılımı
Akifer taban-tavan
yükseklikleri
Beslenme-boşalım verileri
Dikey iletimlilik

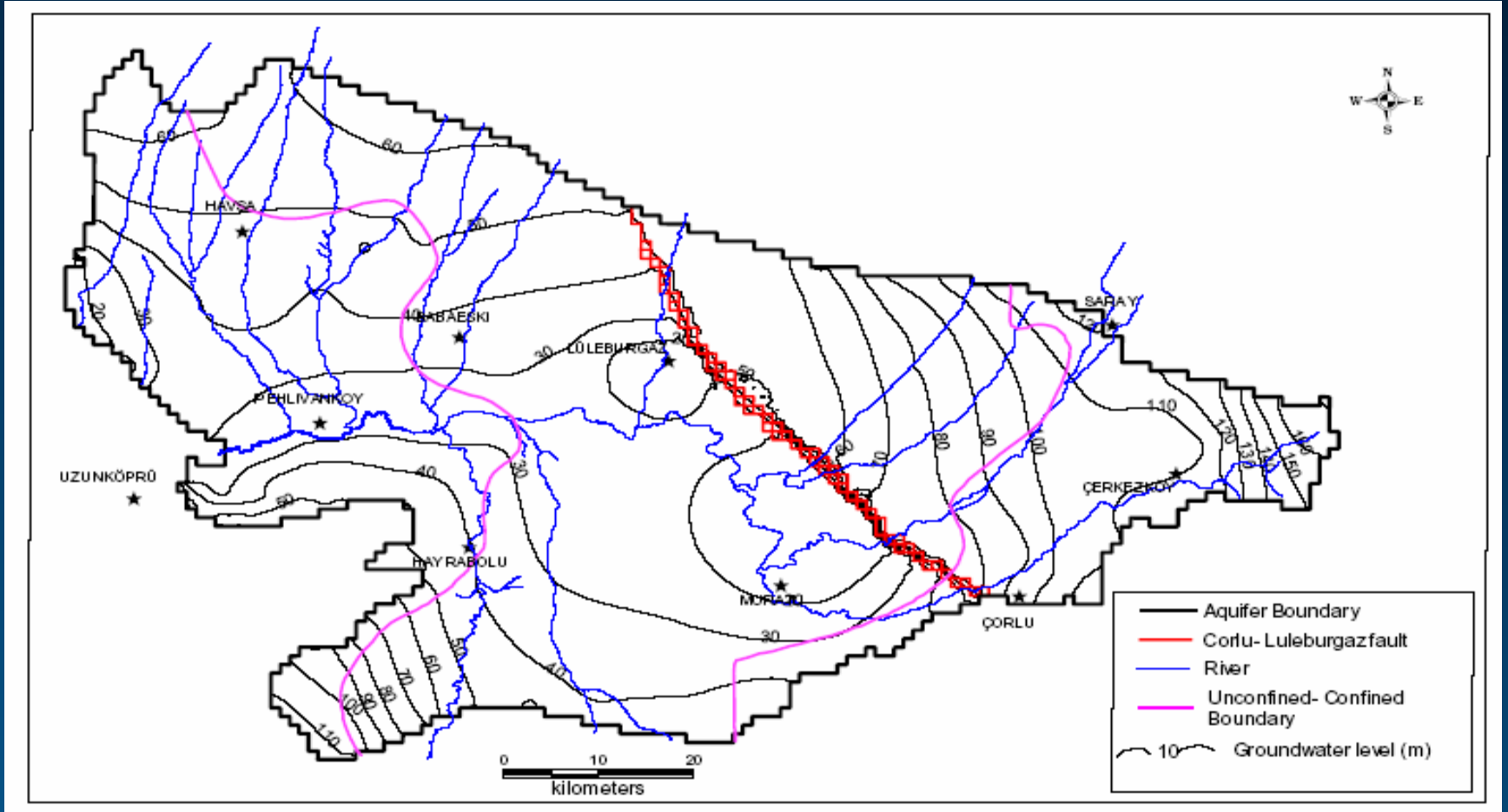
Model Çıktı

Bütün girdi parametreleri
Zaman basamakları bilgisi
Hacimsel bütçe
Hesaplanmış hidrolik yük
ve düşüm
Tüm hücrelerde akış
terimleri

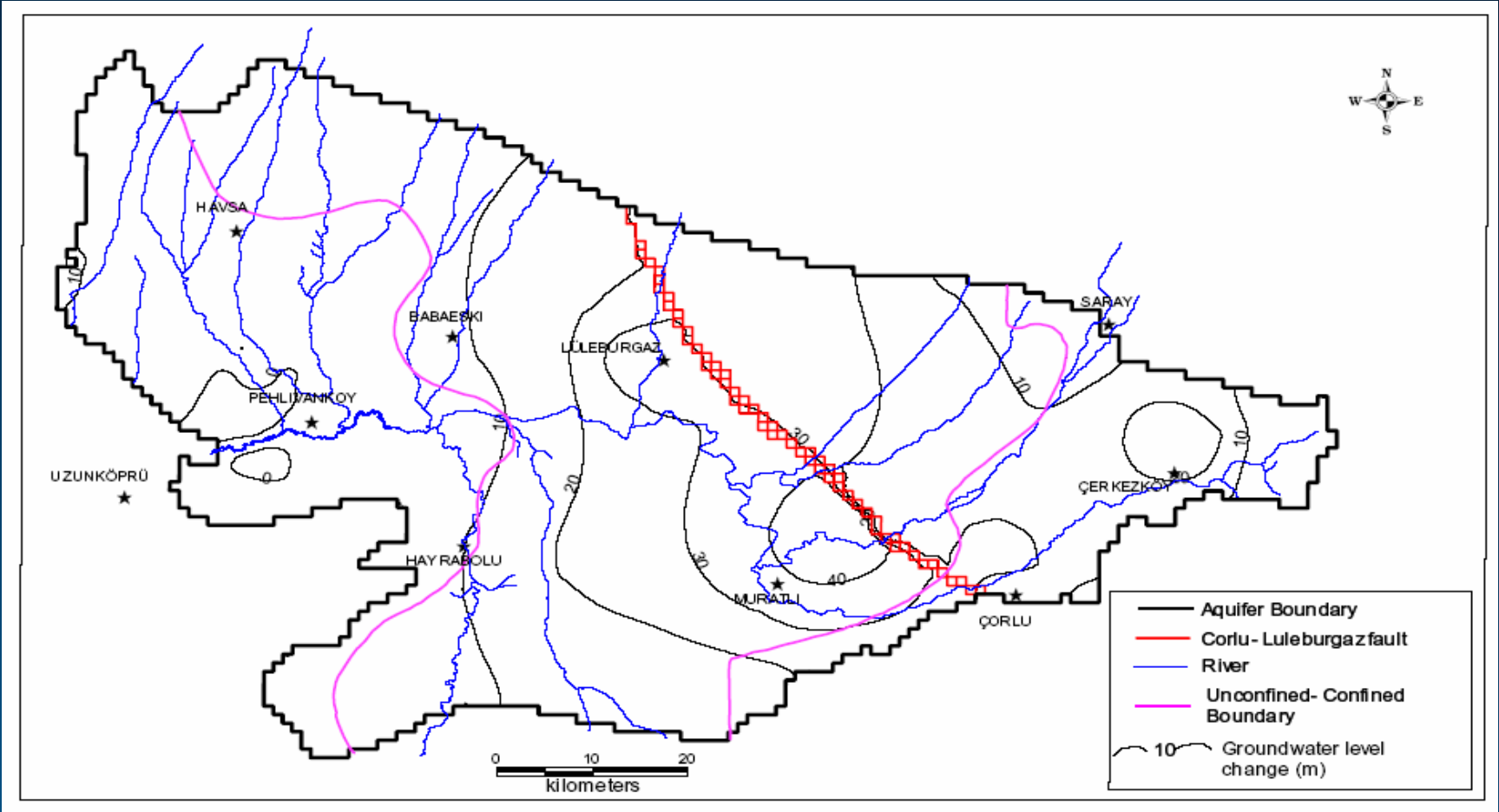
Sonlu Farklar Grid sistemi



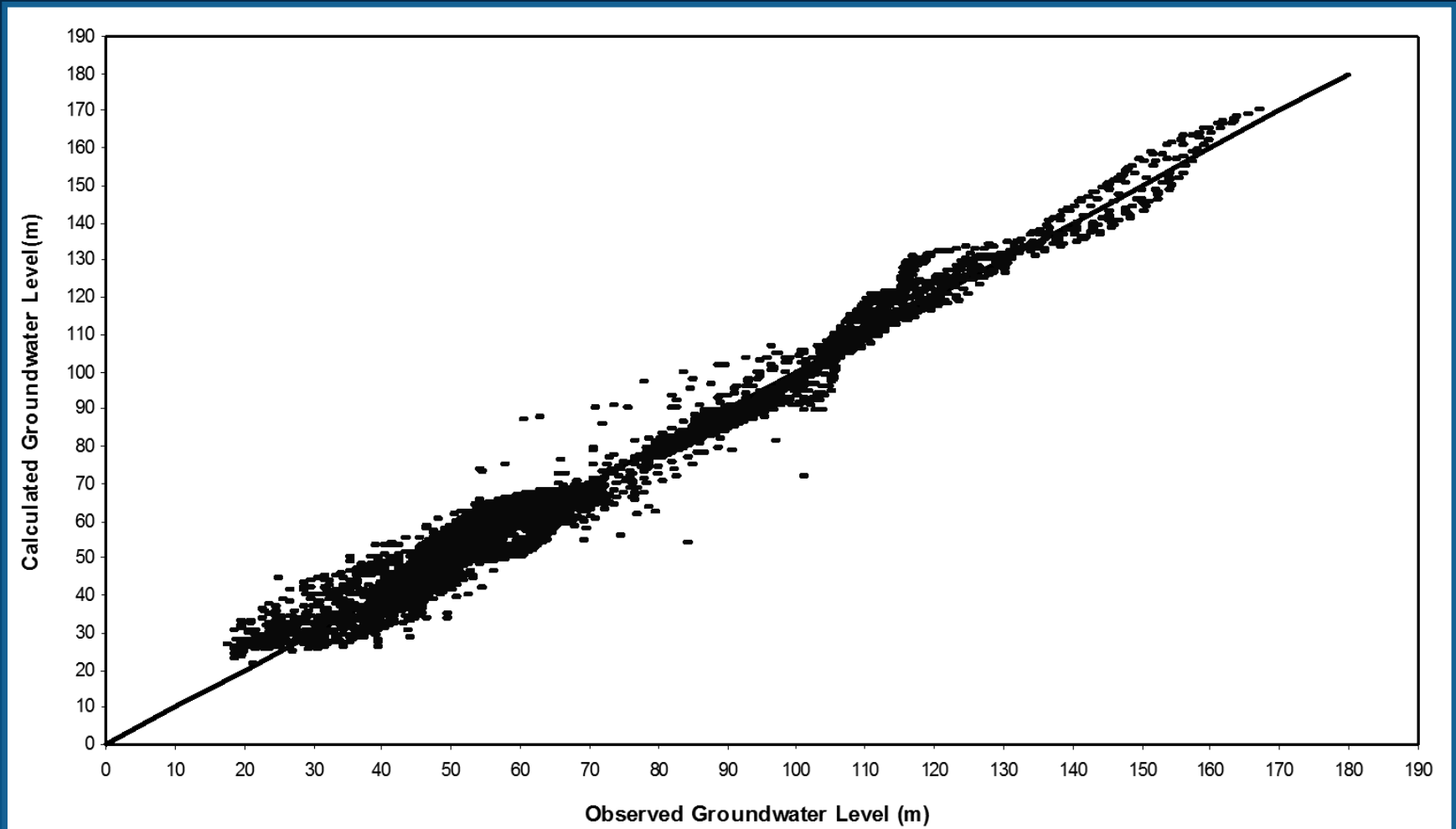
Kararlı akım koşullarında kalibre edilmiş modelin verdiği yeraltısuyu seviyeleri

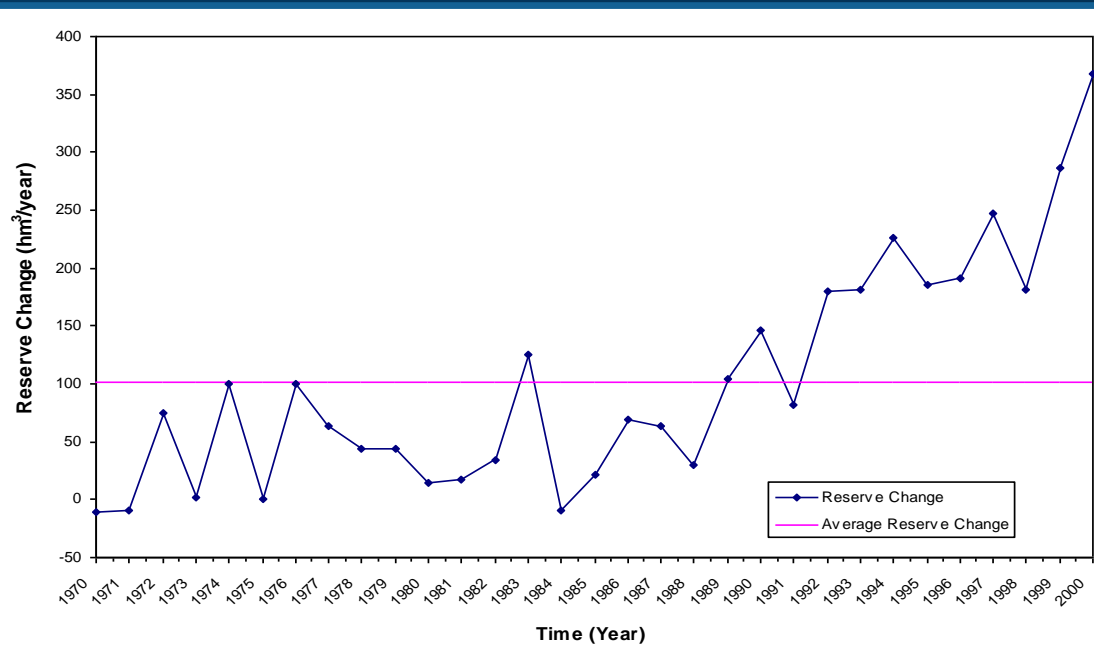
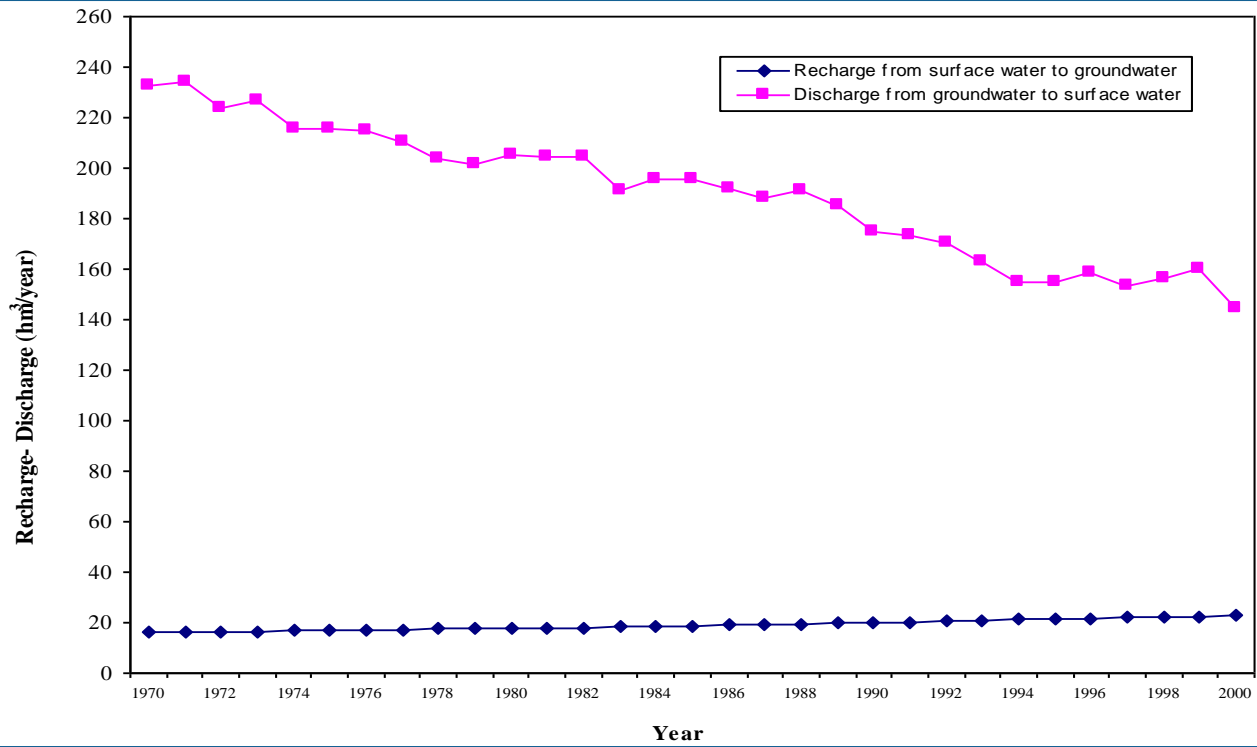


Kararlı akım koşullarında kalibre edilmiş modelin verdiği düşümler

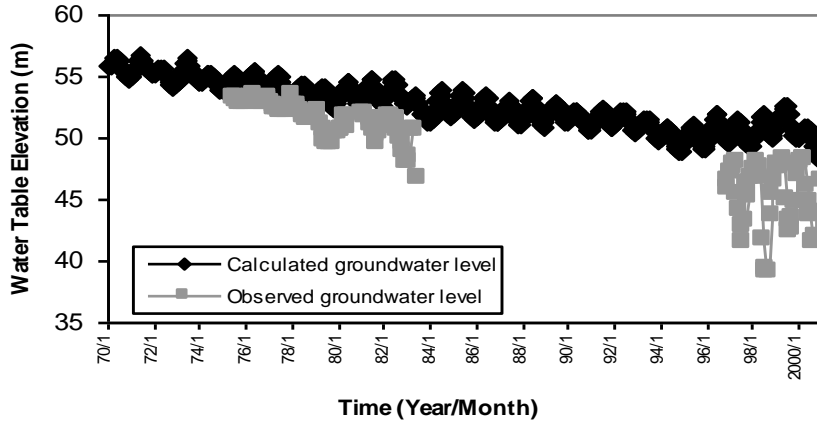


RMSE= 4.86 m

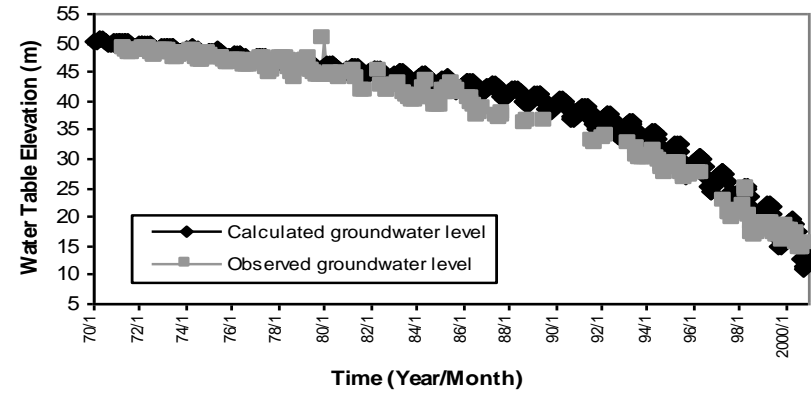




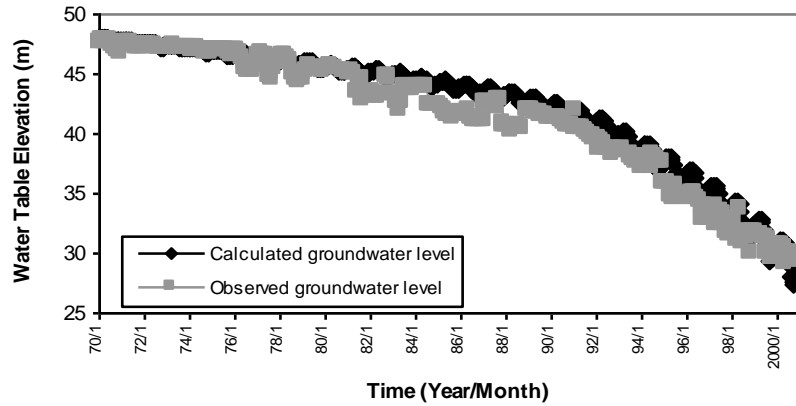
Observation Well no: 49868 (Havsa- Merkez)



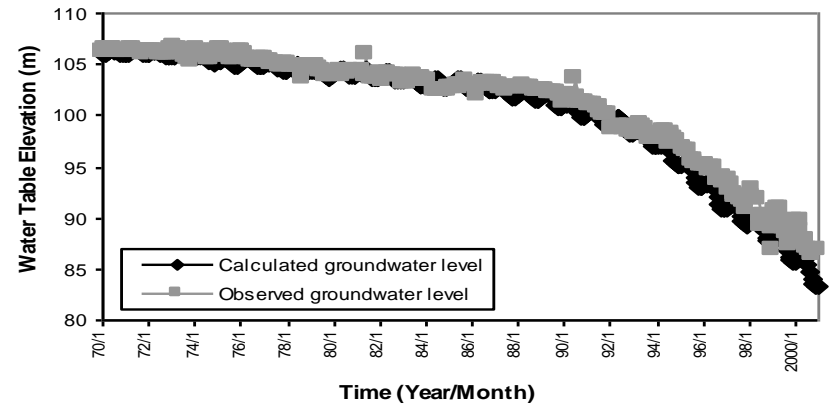
Observation Well no: 52281 (Salhane)



Observation Well no: 5592 (Dambaslar)



Observation Well no: 12626 (Marmarcık)



Kaynaklar:

Doust, H., and Arıkan, Y., 1974, “The geology of the Thrace Basin”, 2nd Biannual Petroleum Congress of Turkey, pp 119- 131.

Yazıcıgil, H., Rasheeduddin, M., 1987, “Optimization Model for Groundwater-Management in Multi- Aquifer Systems”, Journal of Water Resources Planning and Management, ASCE 113 (2), 257-273.