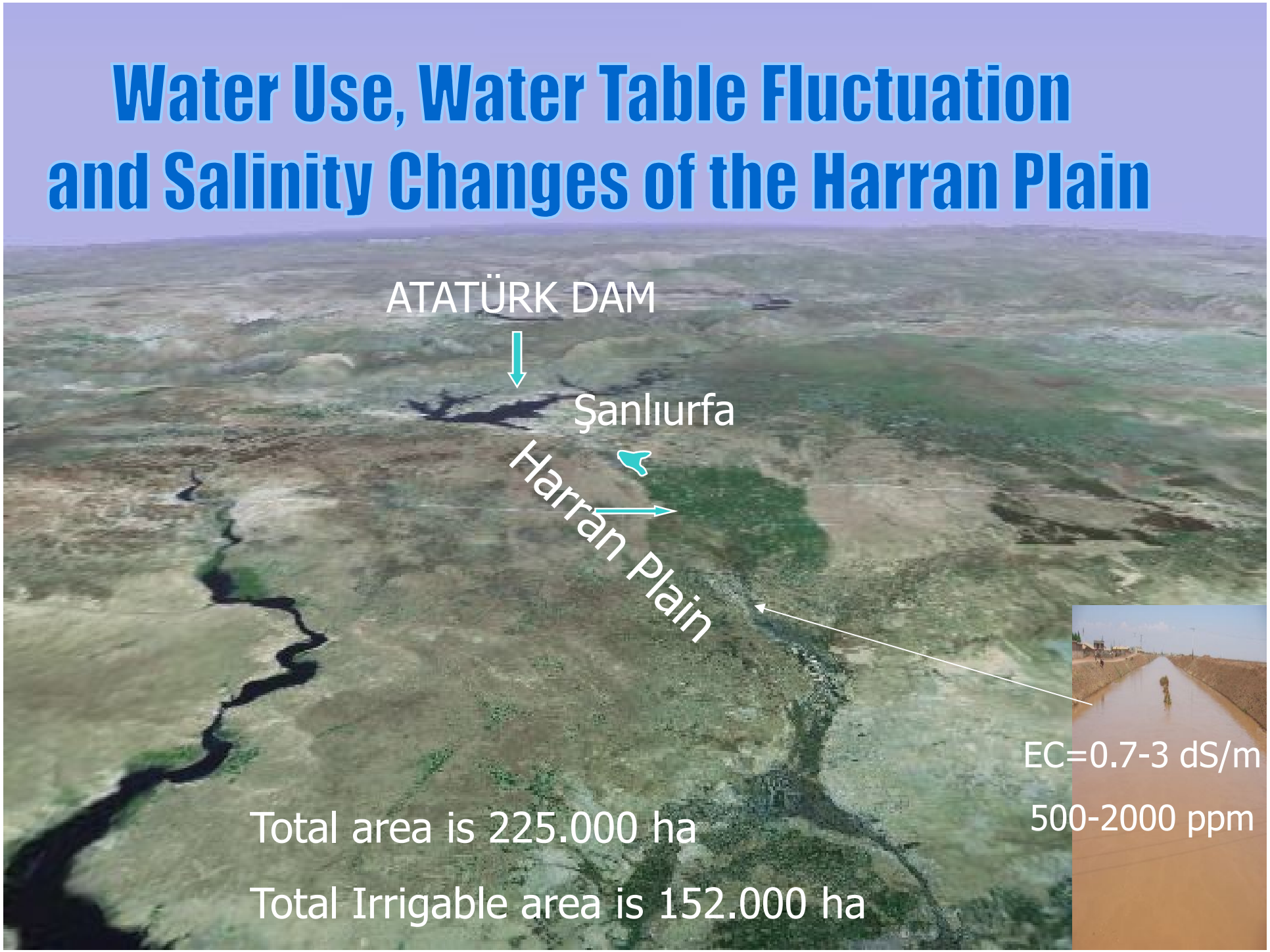
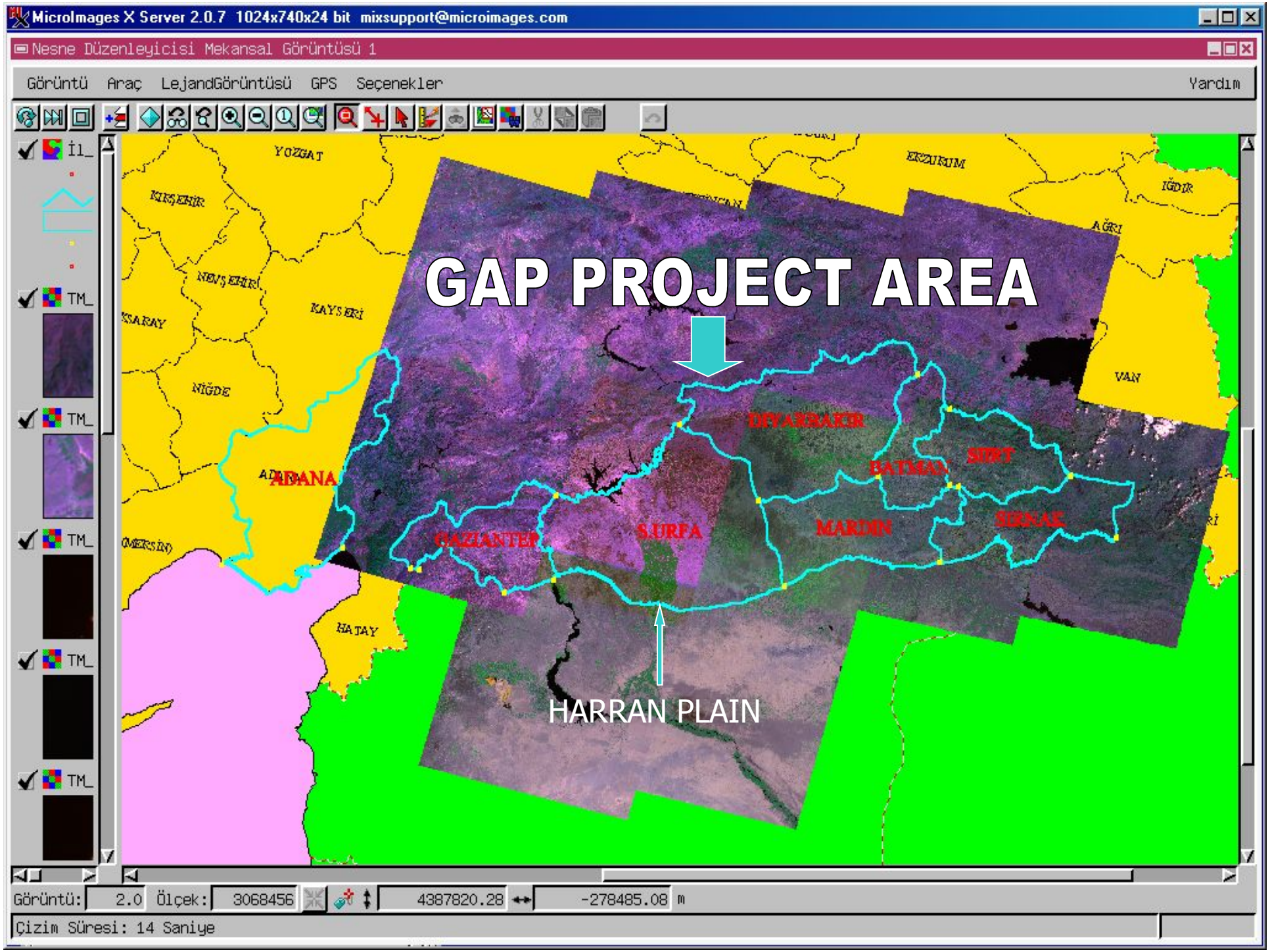
Water Use, Water Table Fluctuation and Salinity Changes of the Harran Plain

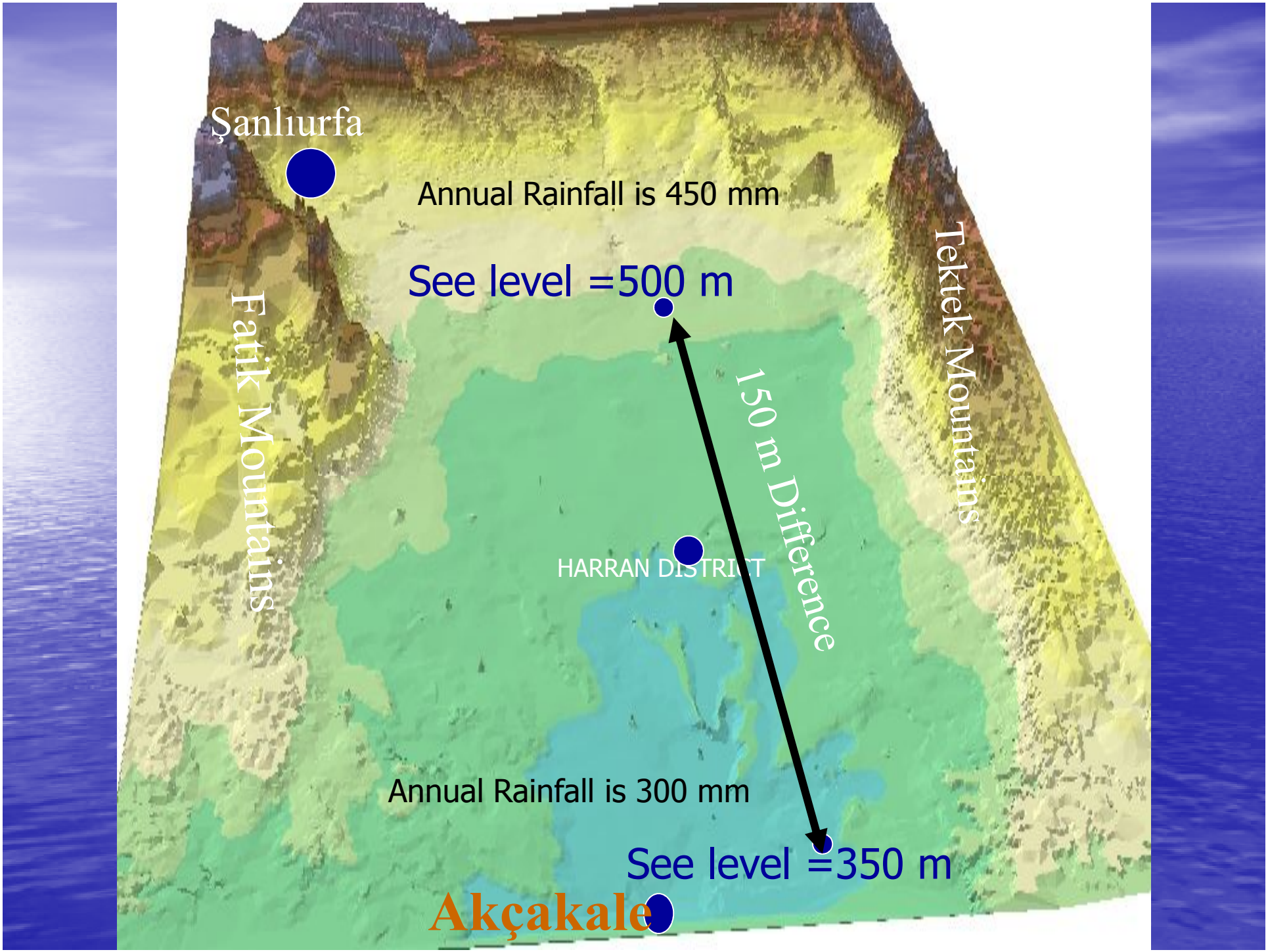



MicroImages X Server 2.0.7 1024x740x24 bit mixsupport@microimages.com
Nesne Düzenleyicisi Mekansal Görüntüsü 1
Görüntü Araç LejandGörüntüsü GPS Seçenekler Yardım
İl_
TM_
TM_
TM_
TM_
TM_
YOZGAT
KIRŞEHİR
NEVŞEHİR
KAYSERİ
NİĞDE
ADANA
MERSİN
HATAY
GAZIANTEP
ŞURFA
DIYARBAKIR
BATMAN
SIIRT
MARDIN
ŞIRNAK
VAN
EKZURUM
IĞDIR
AĞRI
GAP PROJECT AREA
HARRAN PLAIN
Görüntü: 2.0 Ölçek: 3068456 4387820.28 -278485.08 m
Çizim Süresi: 14 Saniye

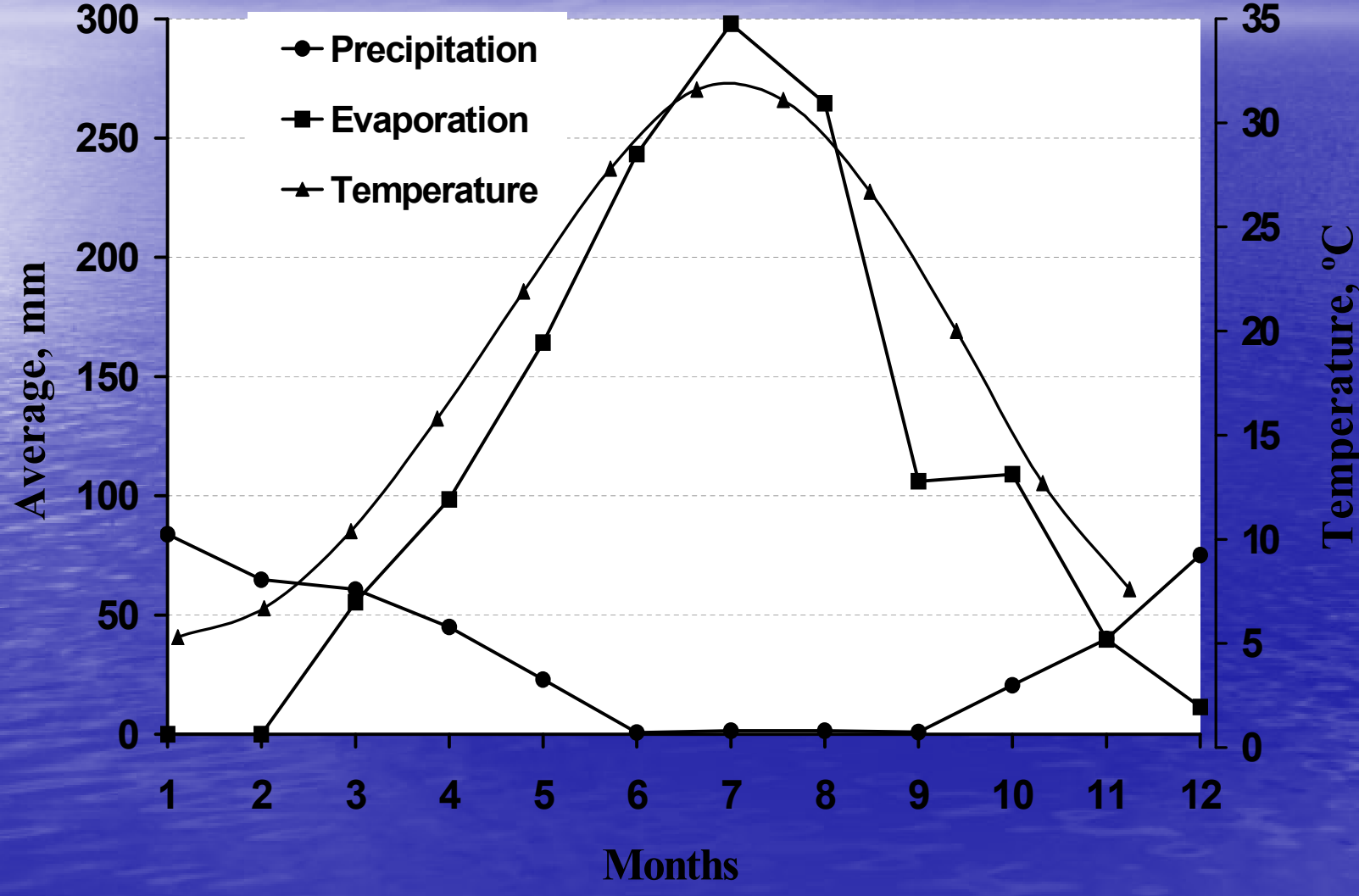
HARRAN PLAIN

DTM MAP

Why salinity occurs at the Harran Plain?


Şanlıurfa
Annual Rainfall is 450 mm
See level =500 m
Fatik Mountains
Tektek Mountains
150 m Difference
HARRAN DISTRICT
Annual Rainfall is 300 mm
See level =350 m
Akçakale

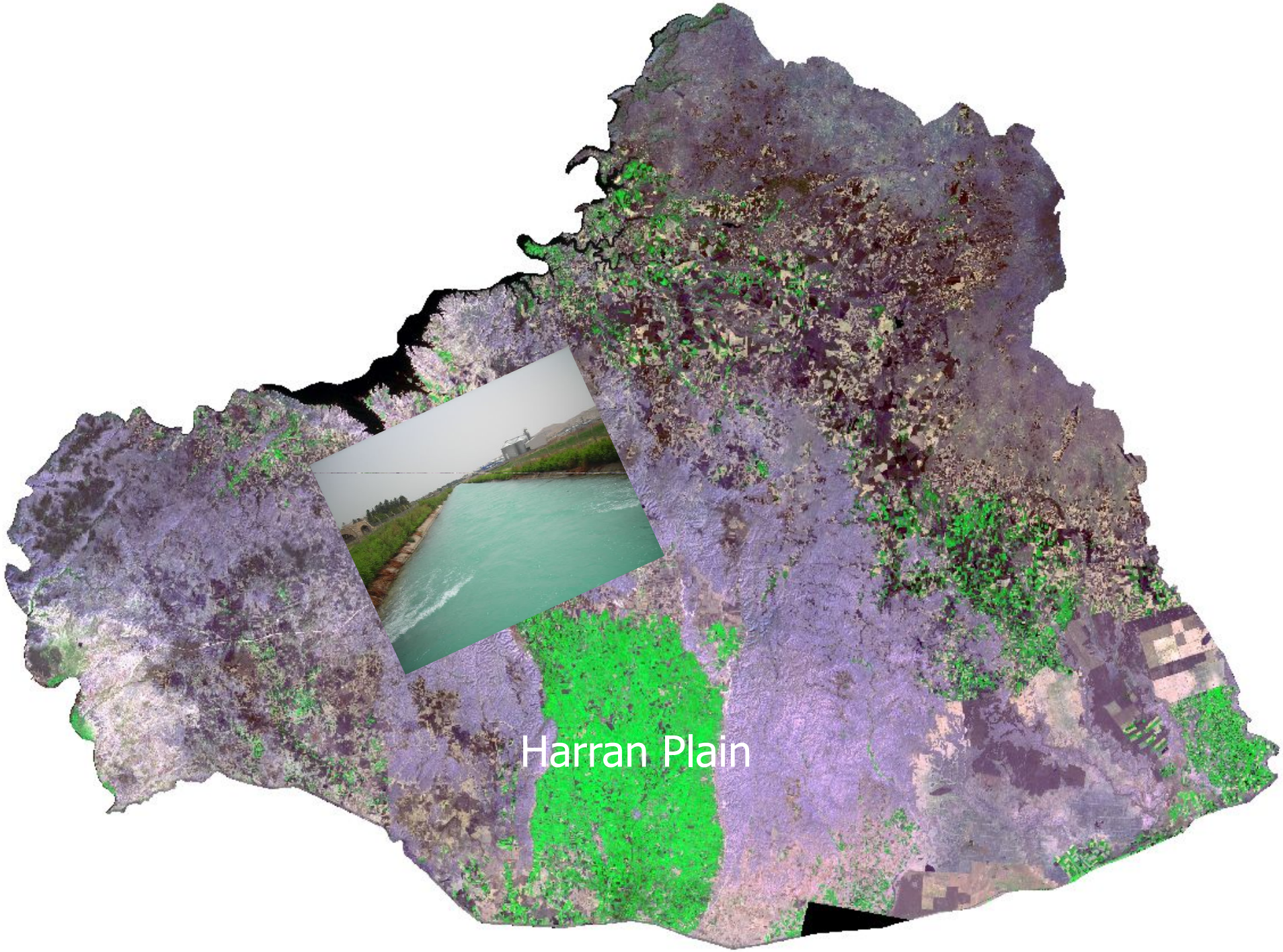
High temperature, high evaporation low rainfall



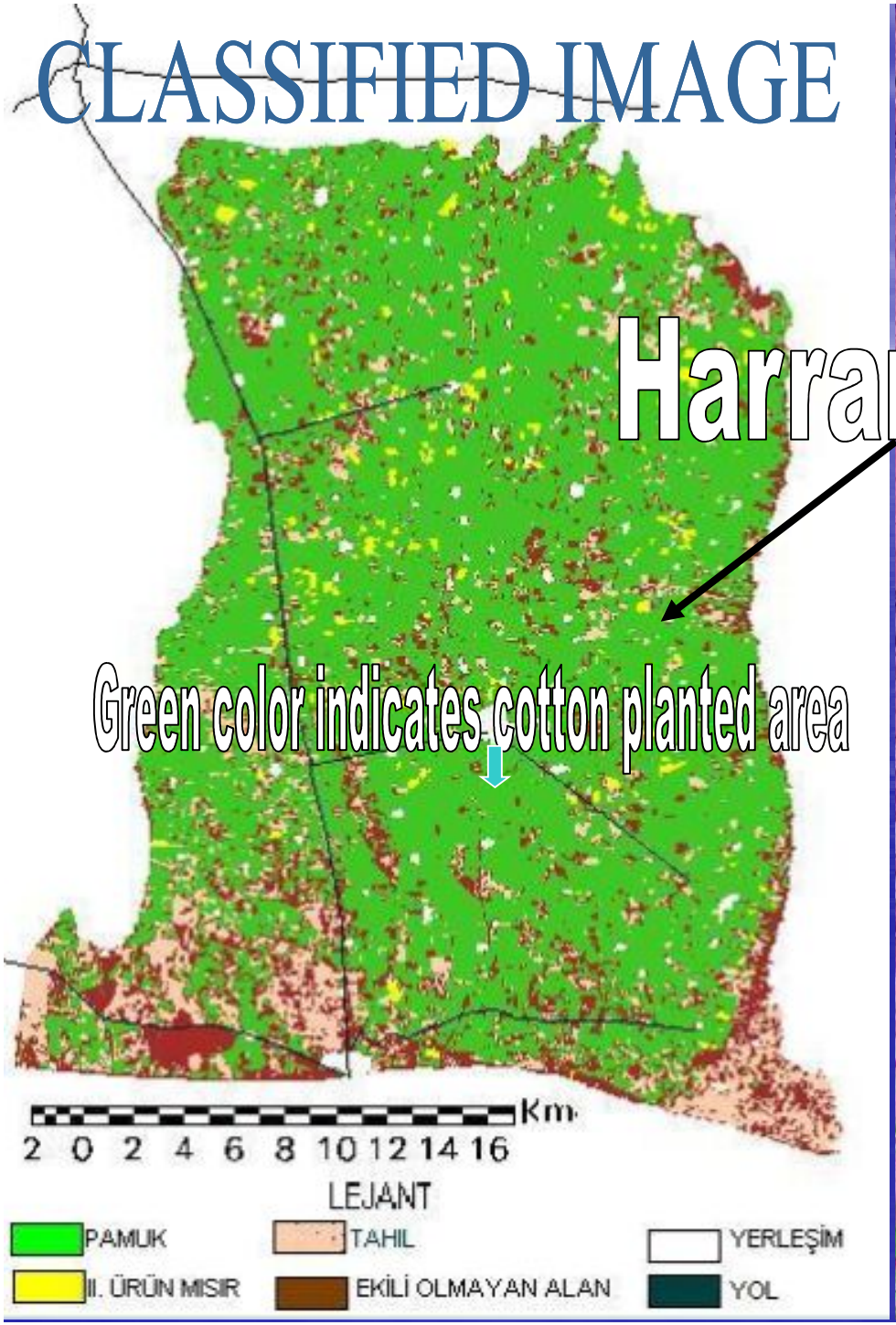
Excessive Irrigation

Water Loss

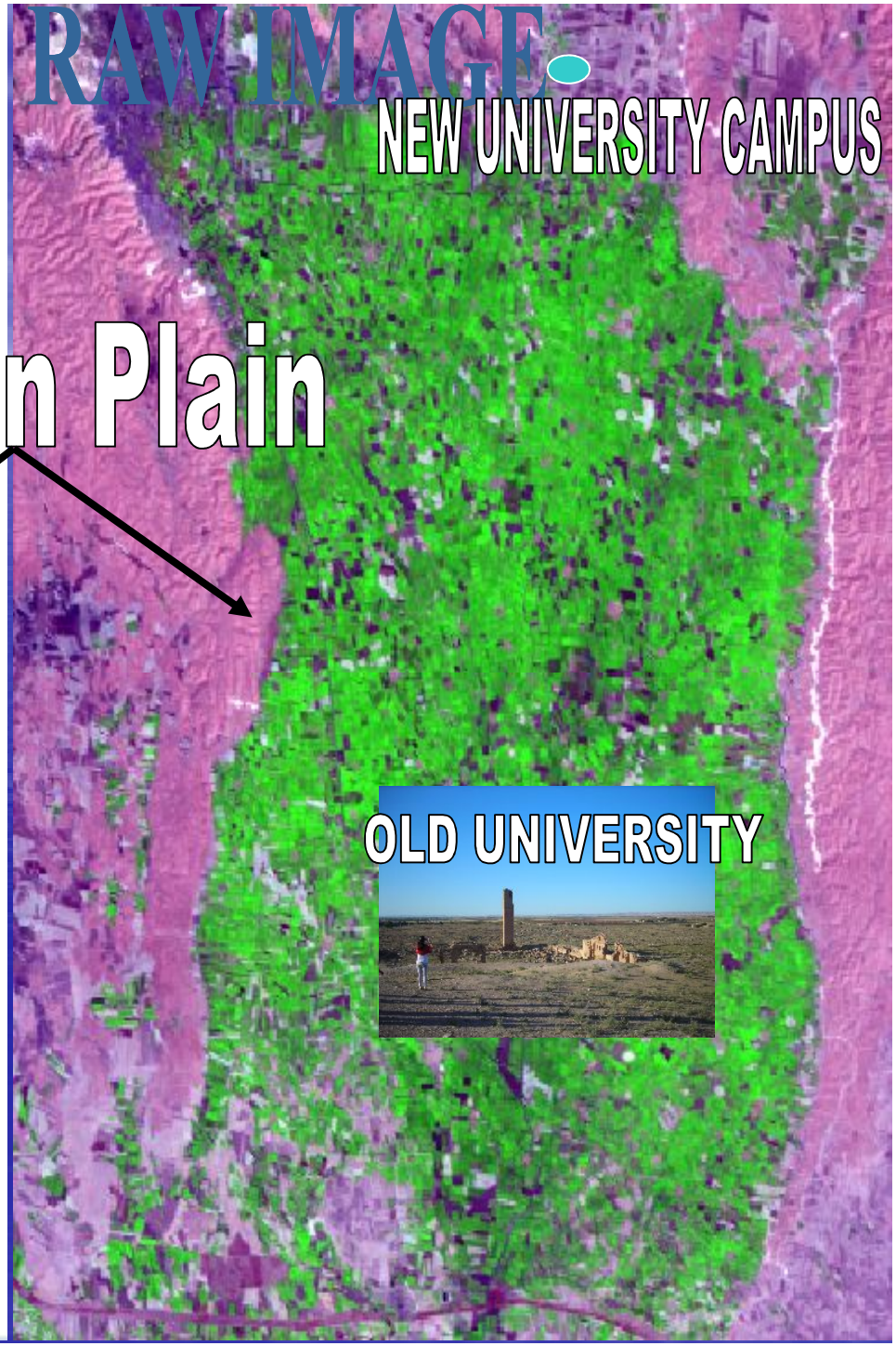

High Water Table


Harran Plain

CLASSIFIED IMAGE



RAW IMAGE

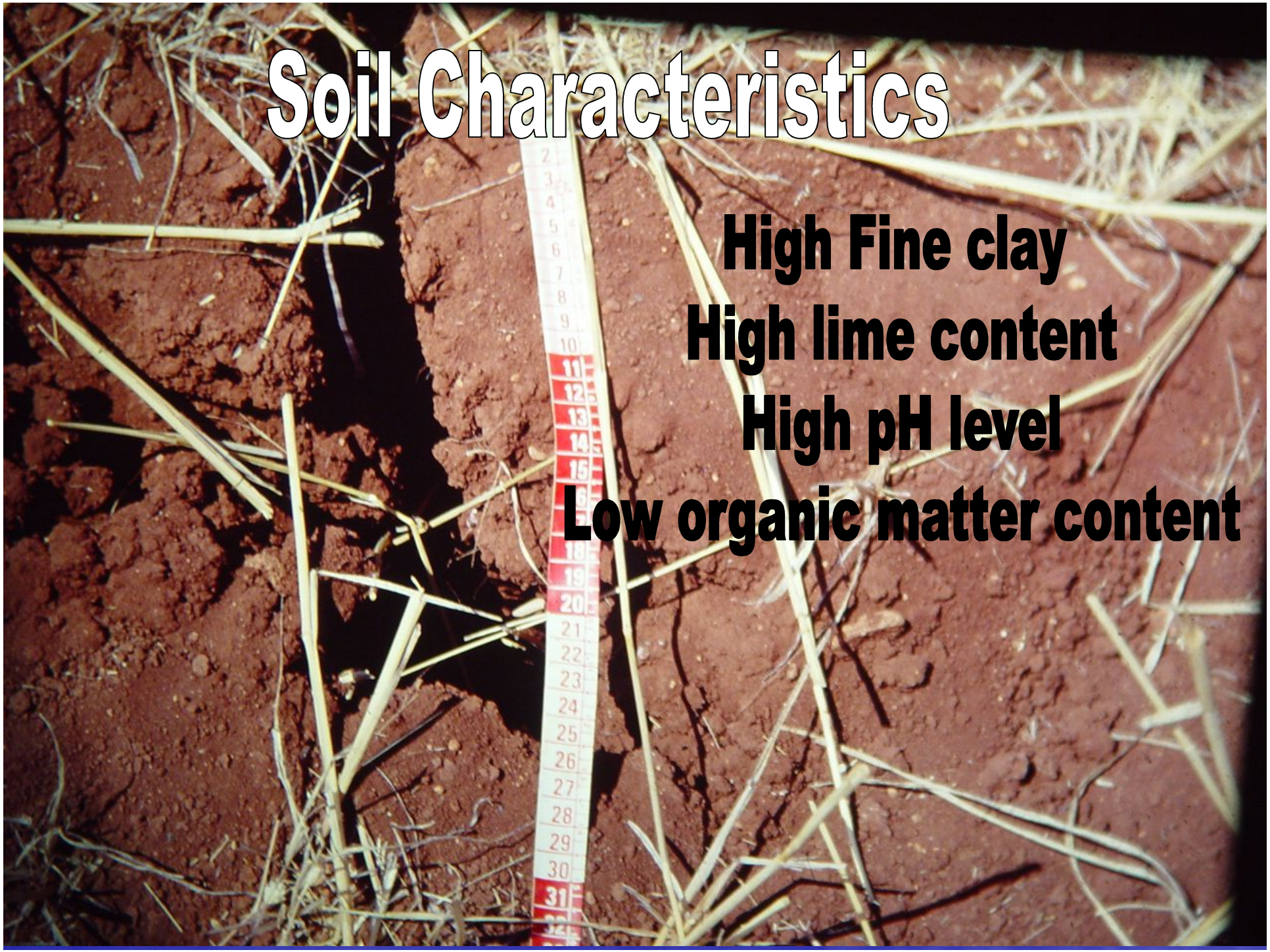


WATER BUDGET

Water Budget For Harran Plain (m^3)	
Total Water Entering Into the Plain	1.345.000.000
Amount of the Unused Water flow Outside boundary	243.000.000
Total Plant Water Consumption	916.000.000
Accumulated Water In the Plain	186.000.000

ACTUAL LAND USE TYPE FOR 2004	AREA (Ha)	RATIO IN TOTAL AREA (%)		TOTAL PLANT WATER CONSUMPTION (m^3)
COTTON	86286	59.3		916.211.476
II. CROP CORN	3162	2.2		
CEREAL	19425	13.3		
UNCULTIVATED AREA	36671	25.2		Penman Monteith Equation
TOTAL AREA	145544	100		

High Temperature


Soil Characteristics
High Fine clay
High lime content
High pH level
Low organic matter content

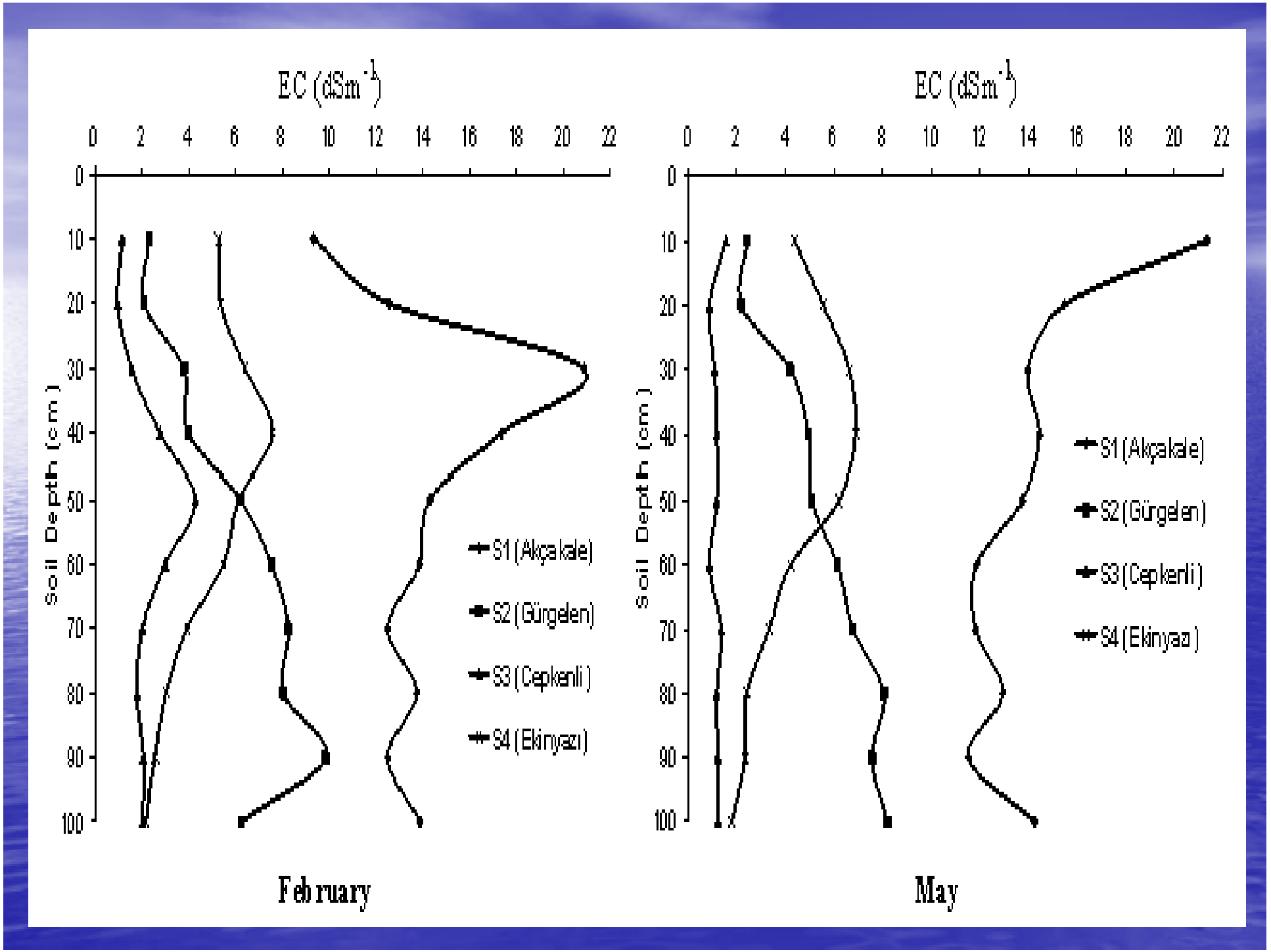

CRACS CAUSES WATER LOSS
This soil has high capillary rise force

1 Table 1. Some physical and chemical properties of the soils studied

Soils	Depth (cm)	pH (Paste Ext.)	ECe (dS m^{-1})	ESP	Particle Size Distribution (%)			CEC cmol$_c$ kg^{-1}	Organic Matter (%)	$CaCO_3$ (%)
					Sand	Silt	Clay			
S1 Non-irrigated Soil	0-10	7.65	9.3	21.9	9.9	25.2	64.9	33.8	0.94	16.6
	10-20	7.73	12.6	27.2	12.0	25.2	62.8	35.0	0.90	19.9
	20-30	7.50	20.9	25.3	12.0	25.2	62.8	37.8	0.92	17.9
	30-40	7.38	17.4	26.7	7.8	25.2	67.0	37.0	0.78	18.4
	40-50	7.66	14.3	27.4	7.8	27.3	64.9	36.7	0.66	18.5
	50-60	7.74	13.9	32.9	9.9	27.3	62.8	36.5	0.64	19.8
	60-70	7.84	12.5	32.7	9.9	27.3	62.8	36.3	0.70	19.5
	70-80	7.83	13.7	36.7	7.8	25.2	67.0	34.5	0.58	20.2
S2 Irrigated Soil	0-10	8.15	2.3	7.4	7.8	21.0	71.2	28.6	1.38	22.4
	10-20	8.04	2.1	7.4	12.0	21.0	67.0	29.4	1.44	24.2
	20-30	8.14	3.8	9.3	14.0	14.7	71.2	30.4	1.20	25.5
	30-40	7.79	4.0	15.1	7.8	25.2	67.0	30.2	0.84	26.1
	40-50	7.72	6.2	18.6	7.8	27.3	64.9	30.0	0.78	25.9
	50-60	7.76	7.5	19.3	7.8	25.2	67.0	31.7	0.78	26.1
	60-70	8.10	8.3	23.8	12.0	23.1	63.0	29.1	0.72	25.1
	70-80	7.85	8.0	27.8	16.2	21.0	62.8	28.7	0.70	23.8
	80-90	7.75	9.8	29.0	18.3	16.8	64.9	28.6	0.64	25.0
	90-100	7.80	6.2	27.3	18.3	16.8	64.9	30.5	0.66	25.0

Analyses Results of Saline-alkaline Land

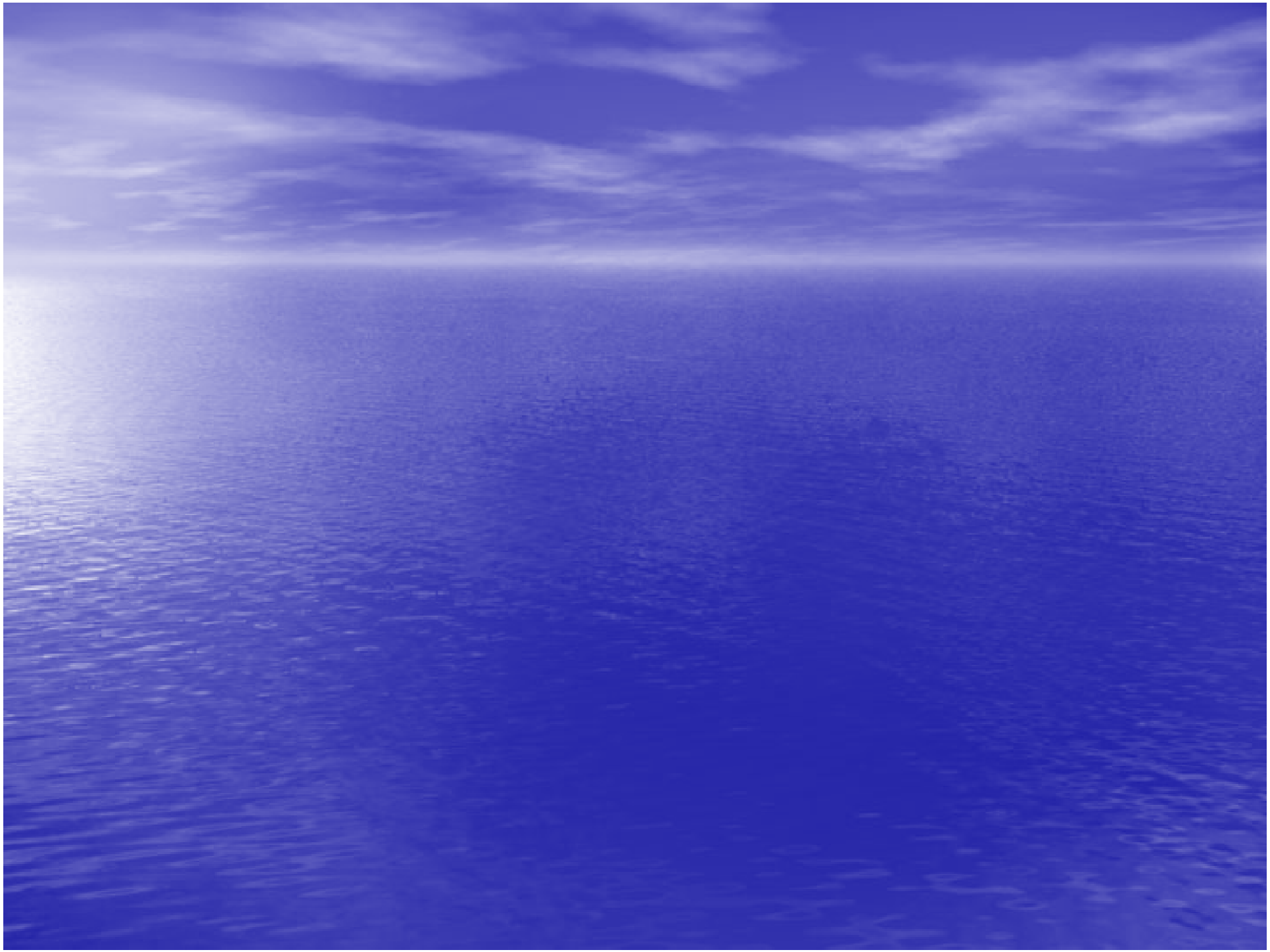
Derinlik (cm)	EC (dS/m)	ESP	Çözünebilir Anyon ve Katyonlar (me/l)					
			$Ca^{+2}+Mg^{+2}$	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
0-10	28.74	25.74	161.85	252.2	0.68	2.40	101.20	311.10
10-20	11.12	21.51	70.35	108.7	0.39	2.80	20.04	156.60
20-30	11.78	26.28	60.25	117.4	0.33	3.80	20.00	154.20
30-40	12.62	25.84	67.95	128.3	0.30	2.50	21.36	172.70
40-50	12.61	27.00	66.15	121.7	0.27	2.00	22.08	164.10
50-60	11.30	29.38	46.00	115.2	0.23	2.60	20.80	138.00
60-70	11.44	25.45	51.40	120.0	0.21	3.10	18.00	150.50
70-80	11.80	21.04	67.45	120.9	0.24	2.90	26.40	159.30
80-90	11.33	24.39	74.50	121.3	0.27	2.00	25.40	168.70
90-100	12.41	24.29	75.05	124.8	0.27	2.40	26.68	171.00


EC (dSm-1)
0 2 4 6 8 10 12 14 16 18 20 22
0 10 20 30 40 50 60 70 80 90 100
Soil Depth (cm)
S1 (Akçakale)
S2 (Gürgelen)
S3 (Cepkenli)
S4 (Ekinyazı)
February
EC (dSm-1)
0 2 4 6 8 10 12 14 16 18 20 22
0 10 20 30 40 50 60 70 80 90 100
Soil Depth (cm)
S1 (Akçakale)
S2 (Gürgelen)
S3 (Cepkenli)
S4 (Ekinyazı)
May

Water Quality and Water Table Fluctuation

Water source	pH	EC_w (dS/m)	Soluble Cations and Anions (mmol$_c$/l)							SAR	Water Class
			Na^+	K^+	$Ca^{2+}+Mg^{2+}$	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}		
Irrigation Water	8.36	0.38	0.78	0.07	2.15	2.40	1.30	1.80	1.50	0.75	C_2S_1
Main Drainage Canal Water	8.30	0.99	4.04	0.09	4.50	2.00	2.00	2.24	2.39	2.69	C_3S_1

Soil series and groundwater sampling time	Sampling Months	Water Table Depth (cm)	pH	EC_w (dS/m)	Soluble Cations and Anions ($mmol_c/l$)							SAR	Water Class*
					Na^+	K^+	$Ca^{2+}+Mg^{2+}$	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}		
Groundwater sampling time at the non-irrigated Akcakale soils	February	110	7.32	29.57	295.7	0.13	188.6	0.80	2.80	145.20	335.58	30.45	C_4S_4
	May	88	7.47	7.61	68.7	0.26	38.4	0.80	1.70	36.40	68.41	15.69	C_4S_2
	August	120	7.27	29.36	293.9	0.13	166.4	8.80	0.50	150.76	300.33	32.23	C_4S_4
	November	180	7.85	7.00	64.4	0.21	42.3	5.20	2.30	28.20	2.28	14.00	C_4S_2
Groundwater sampling time at the irrigated Gurgelen soil	February	180	7.48	7.27	49.6	0.17	46.5	0.80	1.20	38.72	55.52	10.28	C_4S_2
	May	150	7.22	7.46	37.8	0.20	64.1	0.60	2.40	33.60	65.53	6.68	C_4S_1
	August	153	8.10	6.85	46.9	0.22	58.0	1.80	2.50	24.80	76.03	8.72	C_4S_1
	November	190	7.43	6.85	45.4	0.15	61.0	2.60	3.60	28.40	1.54	8.22	C_4S_1



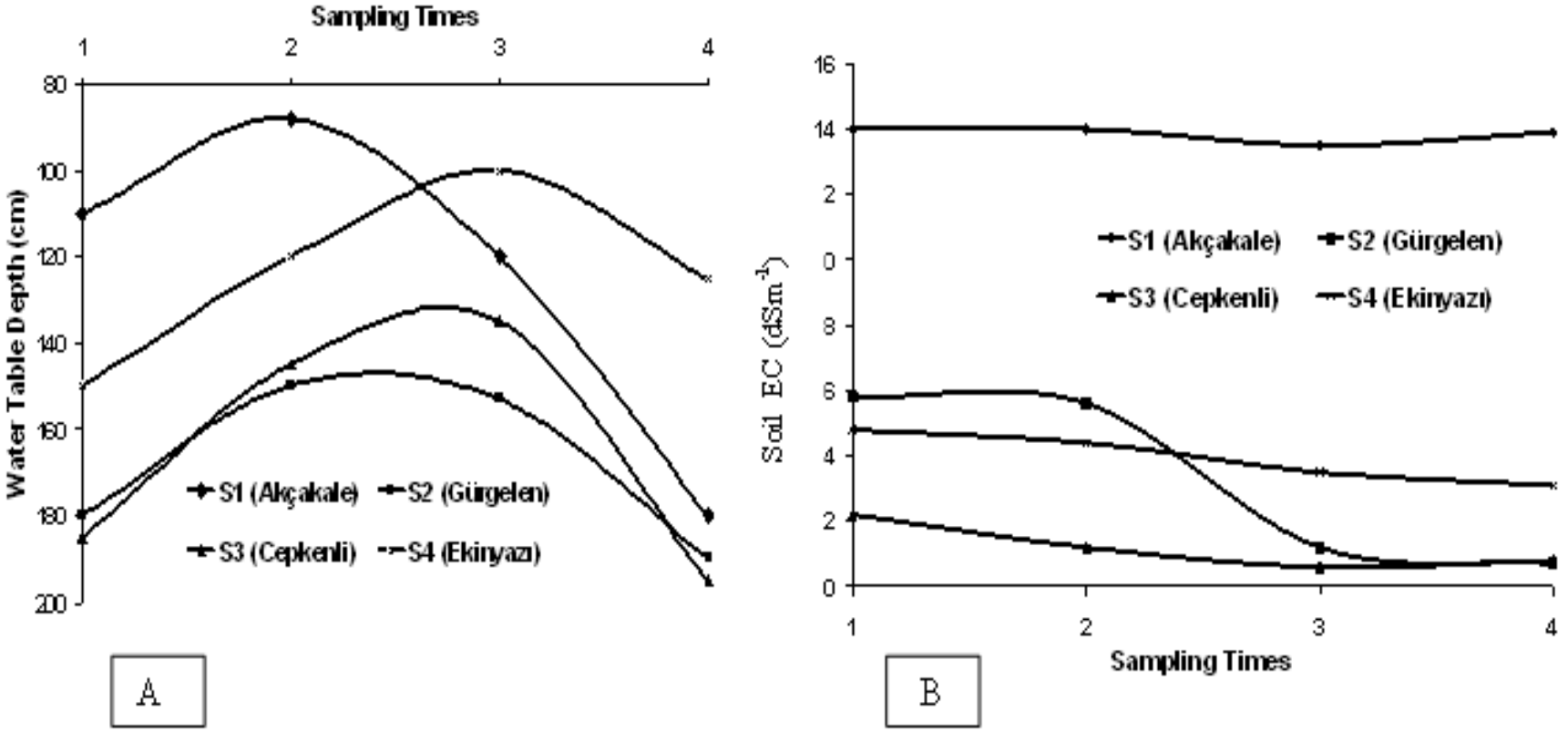
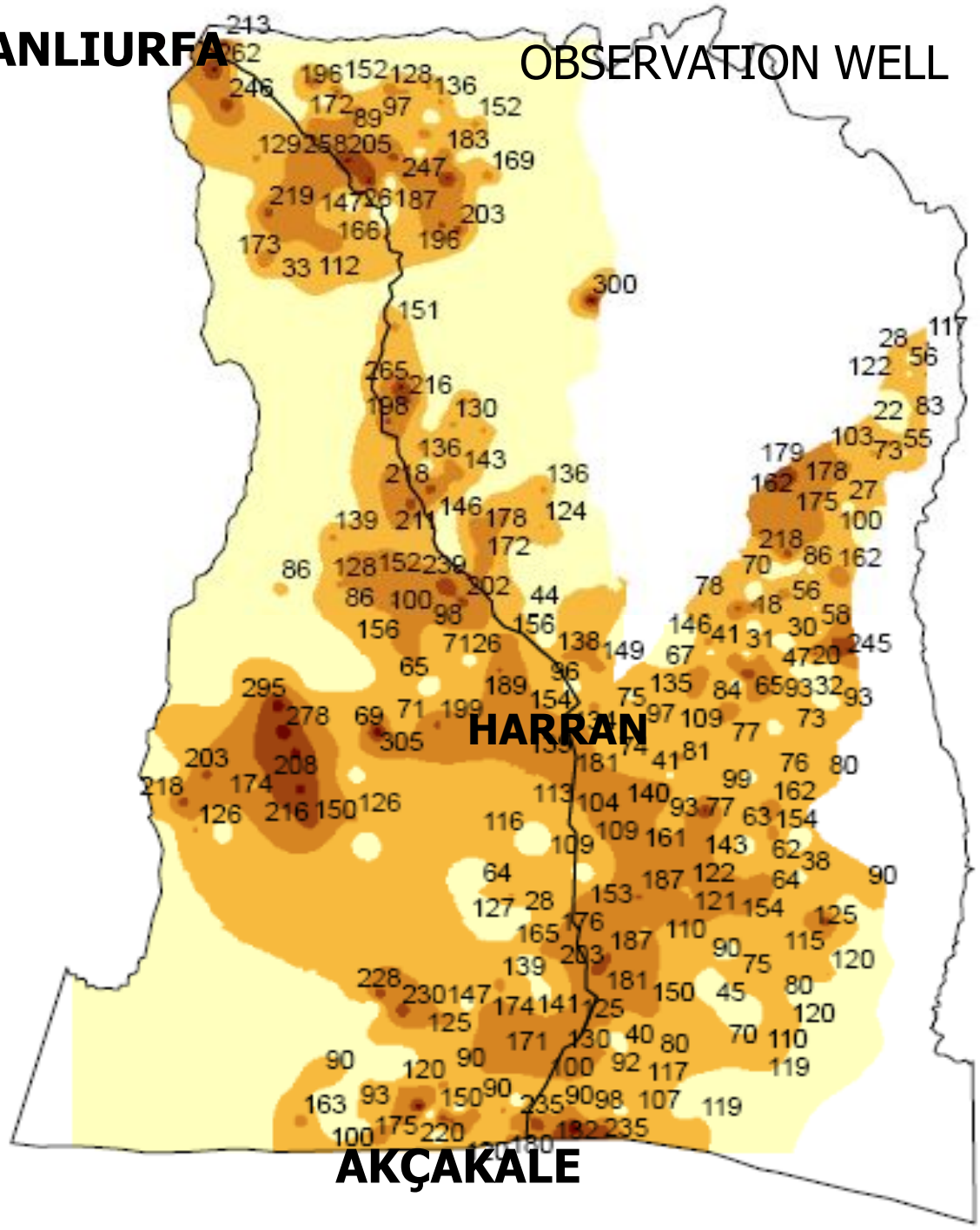
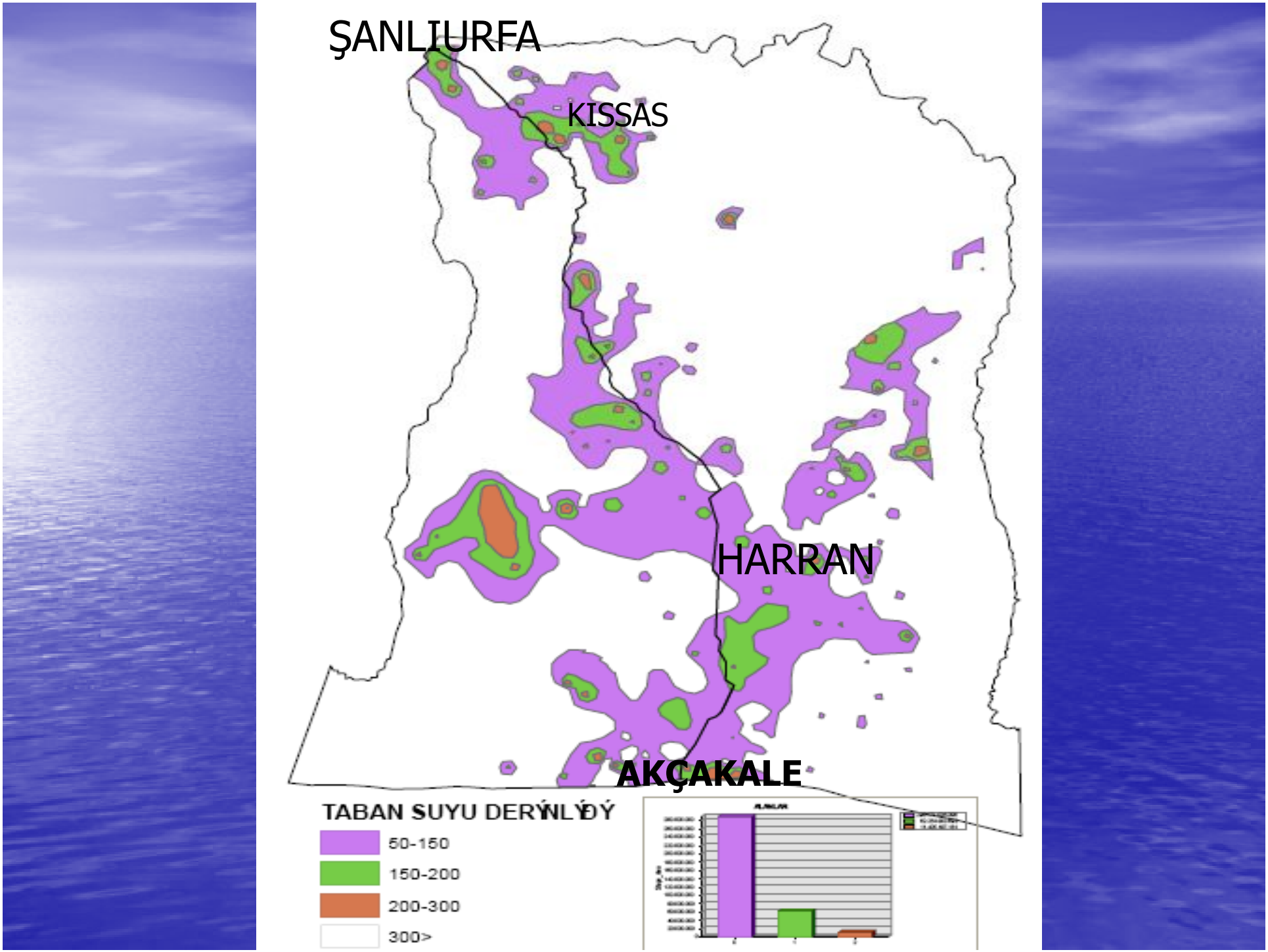


Figure 3. Relationships between water table fluctuation vs sampling times (A) and average soil electrical conductivity (ECe) for each site (at 1m depth) at different sampling times (B). The sampling times 1, 2, 3 and 4 represent February, May, August and November, respectively.


etrex
VISTA Cx
GARMIN

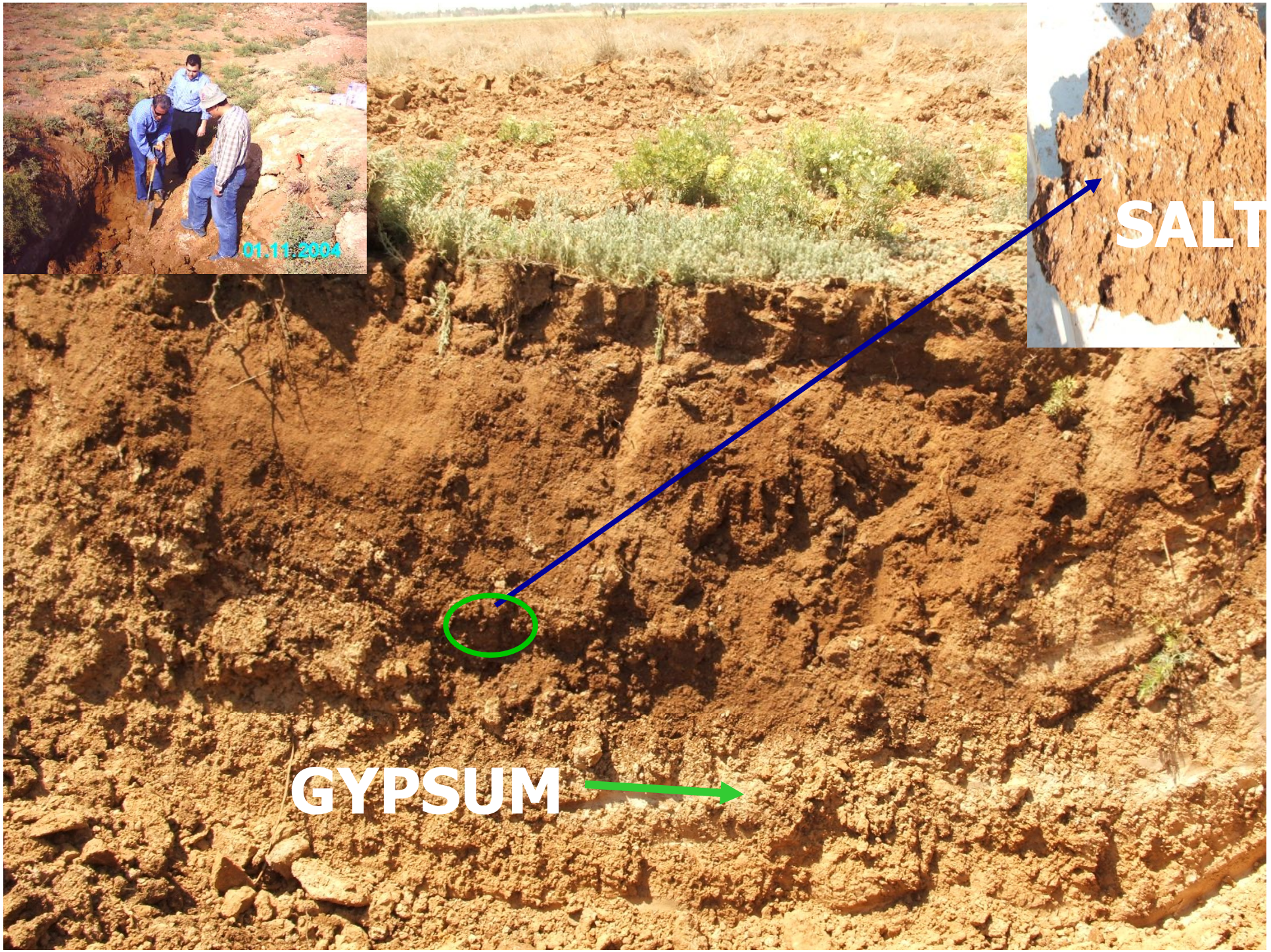

ŞANLIURFA
OBSERVATION WELL
HARRAN
AKÇAKALE


ŞANLIURFA
KISSAS
HARRAN
AKÇAKALE
TABAN SUYU DERÝNLÝÐÝ
50-150
150-200
200-300
300>


HANNA
HI 8733
Conductivity
meter
ON
OFF
199.9
µS
1999
µS
19.99
mS
199.9
mS
TEMPERATURE COEFFICIENT
IRRIGATION WATER
EC=0.4 dS/m


Salt Affected Soil

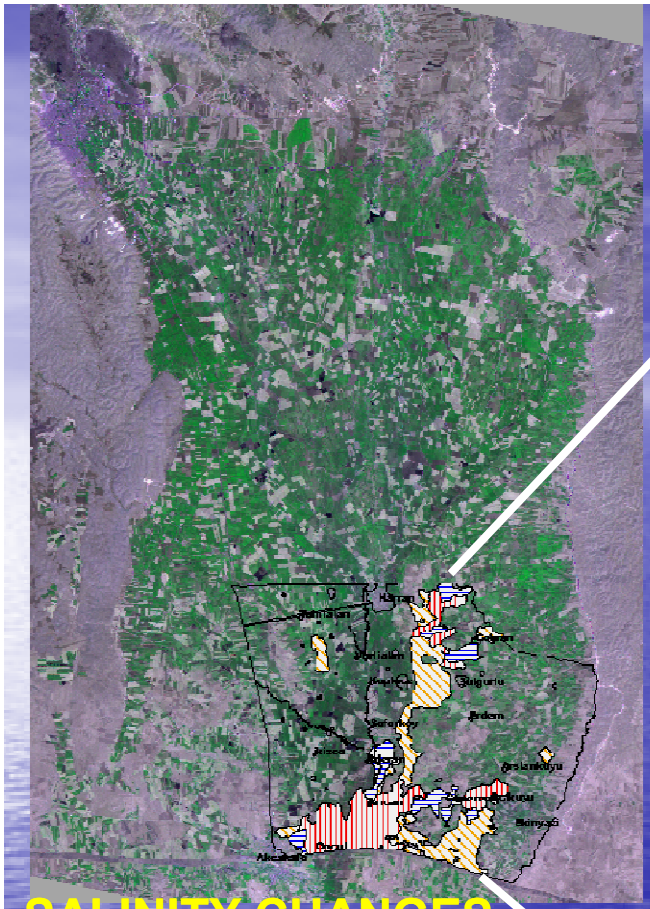

High Evaporation
Annual irrigation=400 mm
Annual Evaporation over 2000 mm

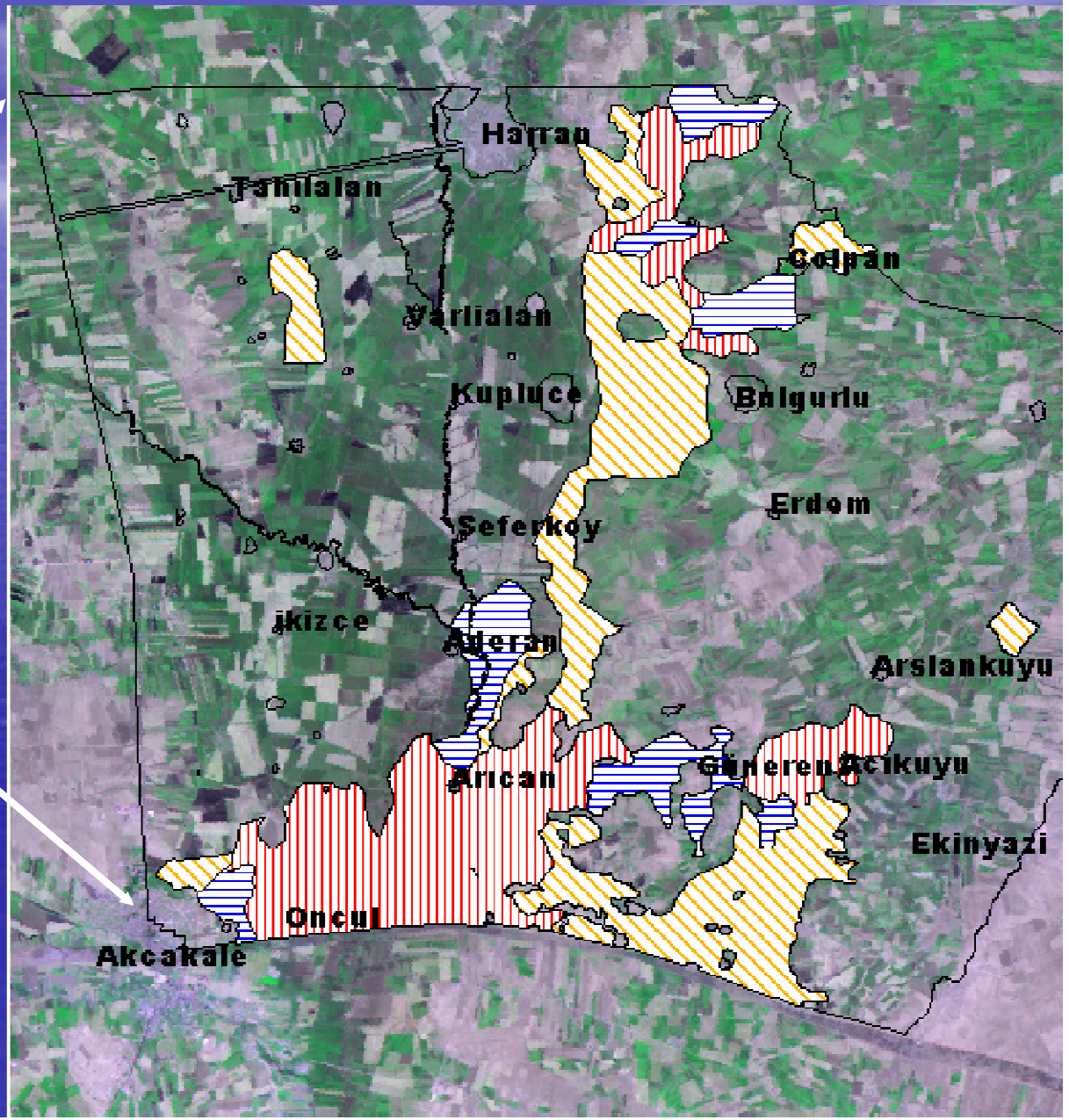

01.11.2004
SALT
GYPSUM


SALT
NaCl
CaCl
NaHCO3
NaSO4

SALT DYNAMIC

Profile Description	Depth cm	EC dS/m	pH (Ext.)	CEC me/100 g	Ex. Na (me/100 g)	$CaCO_3$ %	ESP	Particul Size Distribution			Texture Class
								Sand	Silt	Clay	
Az	0-5	78.0	7.4	42.1	24.2	20.5	57.5	1.4	39.1	59.5	C
Bwz1	5-21	44.5	7.5	36.3	20.6	18.3	56.7	0.8	32.5	66.7	C
Bwz2	21-48	19.6	7.3	34.0	22.7	21.2	66.7	2.9	28.4	68.7	C
Cy	48-75	6.2	7.4	32.2	22.8	32.8	70.8	46.56	31.44	22.0	L
Cy	75-200	7.5	7.5	30.3	23.0	24.3	75.9	48.56	29.44	22.0	L





SALINITY CHANGES

1987 : > 5500 ha

1997 : > 7400 ha

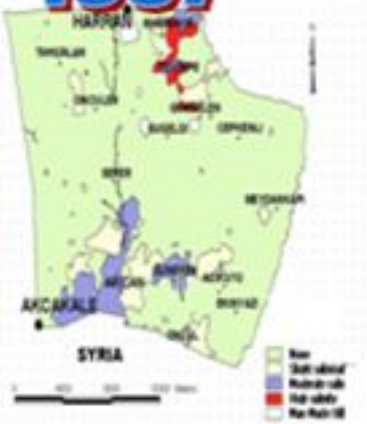
2000 : > 11000 ha

2004 : 15000 ha

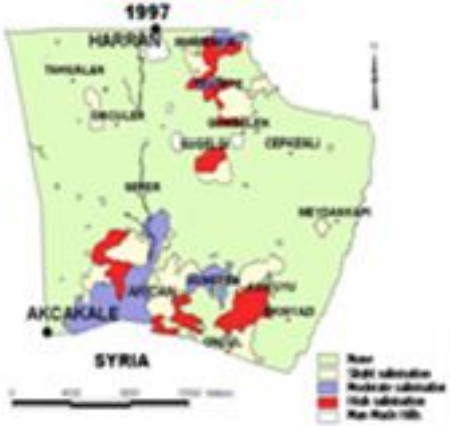
2010 18000 ha

SALINITY MONITORING

1987



1997



SALINITY CHANGES

1987 : = 5500 ha

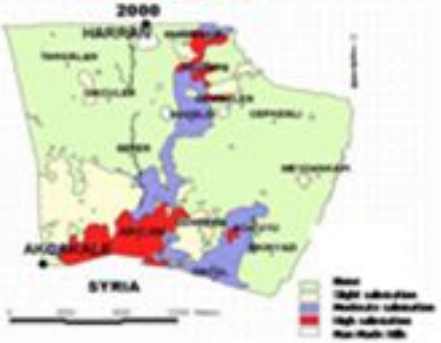
1997 : = 7400 ha

2000 : = 11000 ha

2004 : = 15000 ha

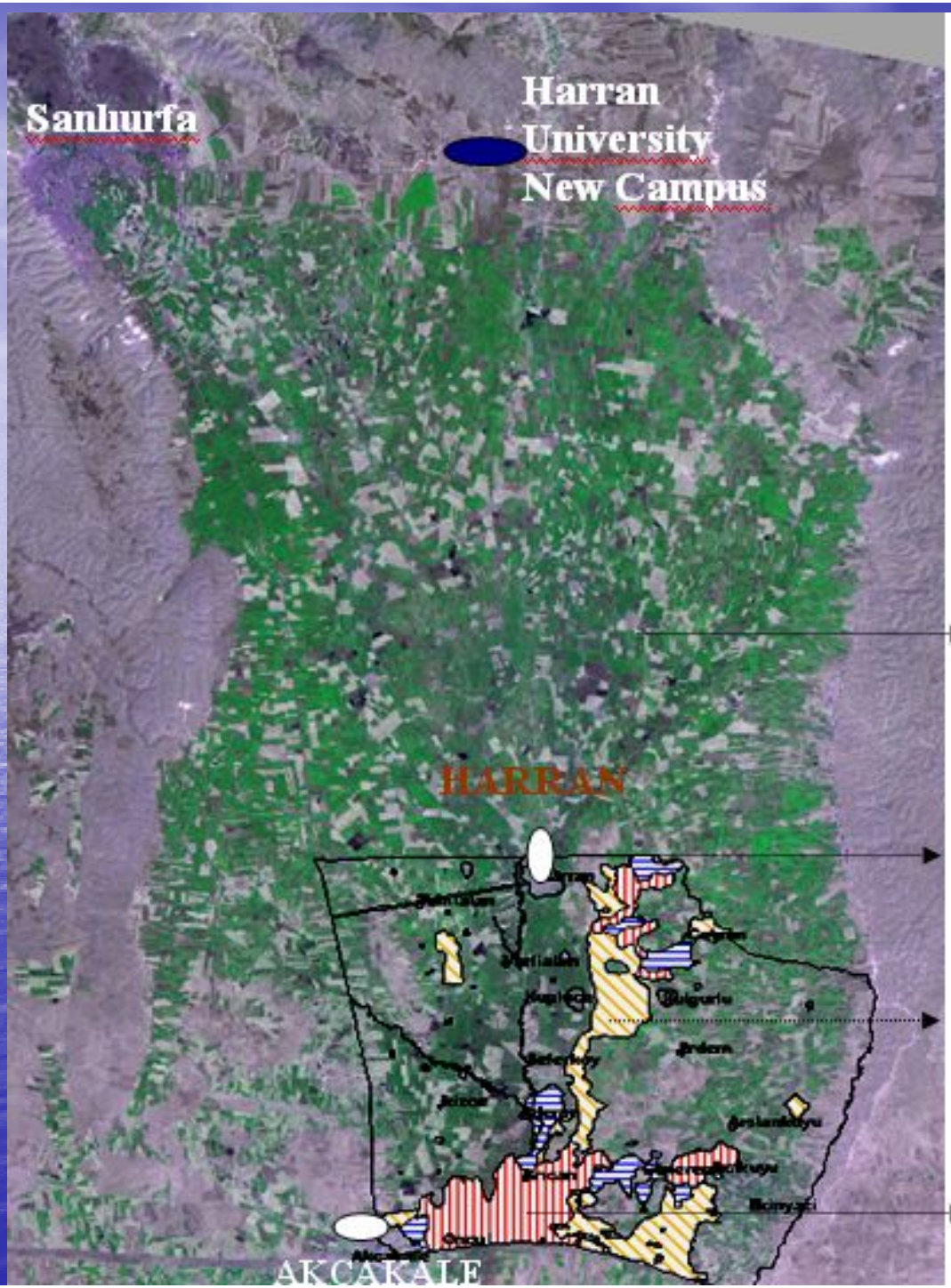
2010 : = 18000 ha

2000



2004

HARRAN PLAIN



Non-saline Saline Area

Slightly Saline Area

Moderate Saline Area

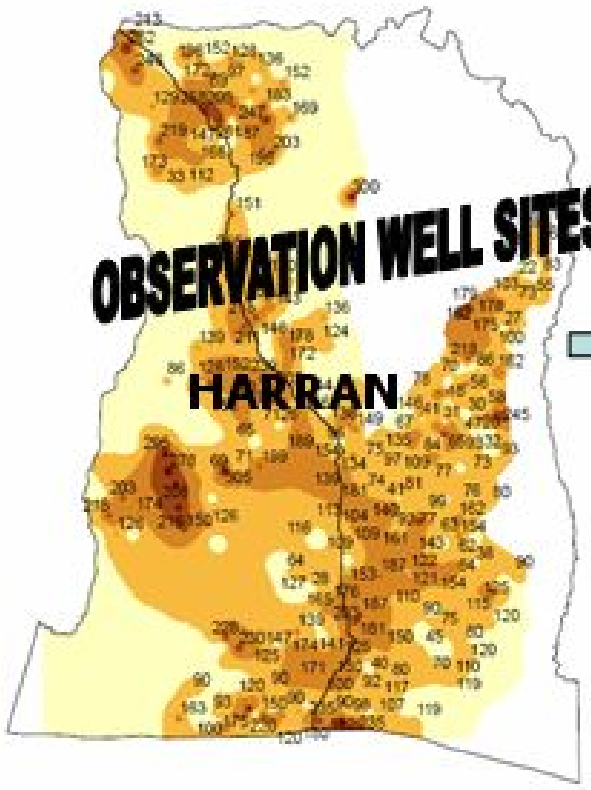
Strong Saline Area

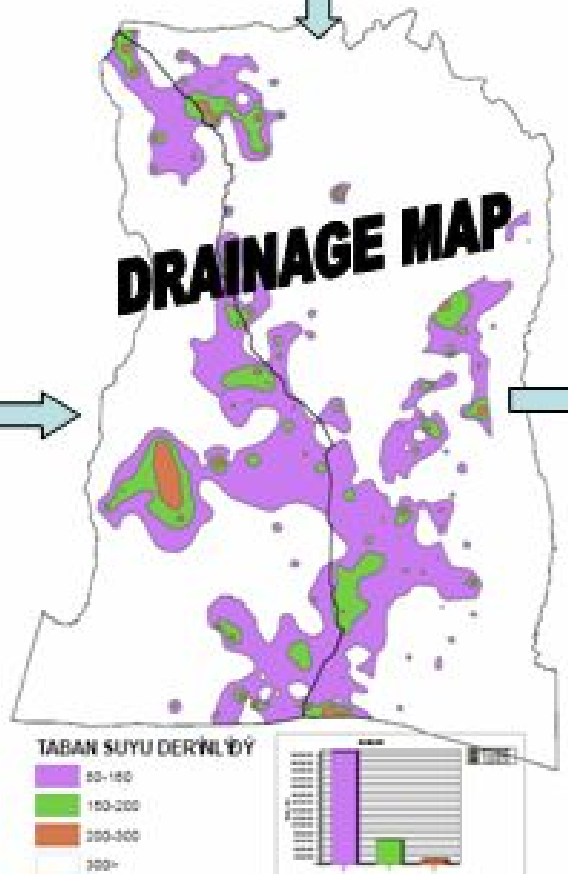
Salinity Changes in 1997, 2000 ve 2004

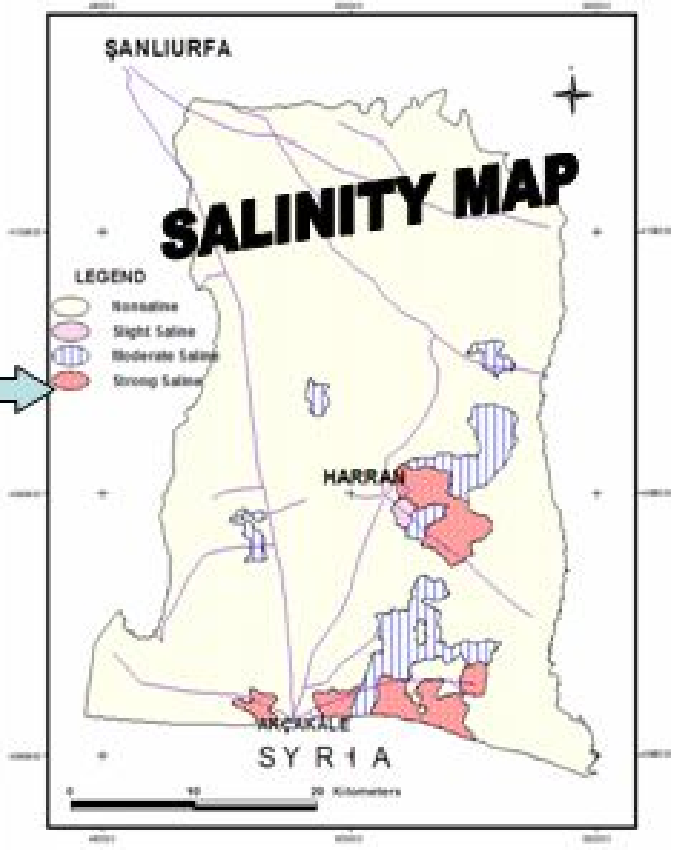
Salinity Classes	1997 Alan (ha)	2000 Alan (ha)	2004 Alan (ha)
Slight Saline	3150	4814	4229
Medium Saline	2219	3912	2300
Saline-Alkaline	2128	2676	8276
Total area	7487	11430	14805

Suyun Kaynağı	EC (dS/m)	Çözünebilir Katyon ve Anyonlar (me/l)							SAR	Su Sınıfı
		Na^+	K^+	Ca+Mg	CO_3^{-2}	HCO_3^-	Cl^-	SO_4^{-2}		
Sulama Suyu	0.380	0.78	0.07	2.15	2.40	1.30	1.80	1.50	0.71	C_2S_1
Ana Tahliye Kanalı Suyu	0.990	4.04	0.09	4.50	2.00	2.00	2.24	2.39	4.04	C_3S_1

GROUNDWATER AND SALINITY MAPPING USING GIS



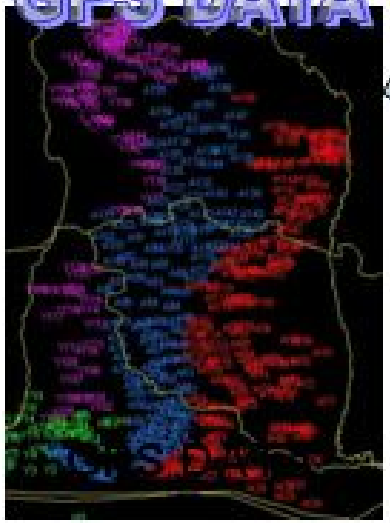




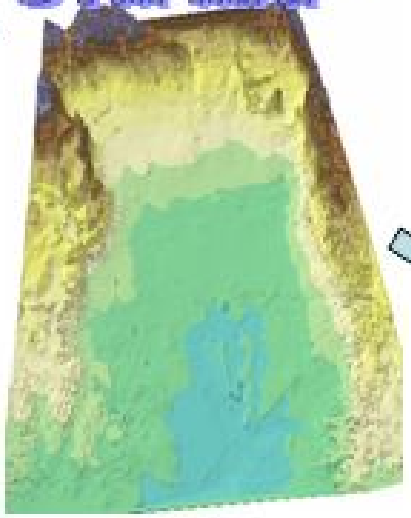
SALINITY MAPPING

LANDUSE

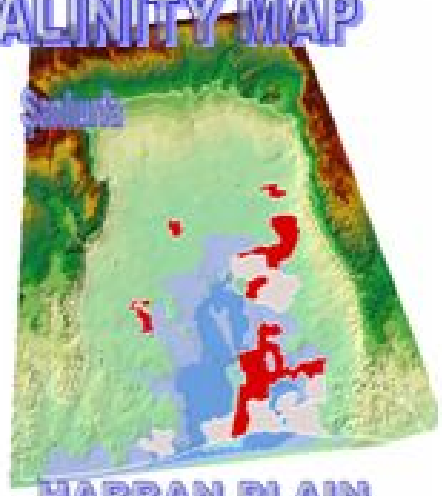
GPS DATA



DTM MAP

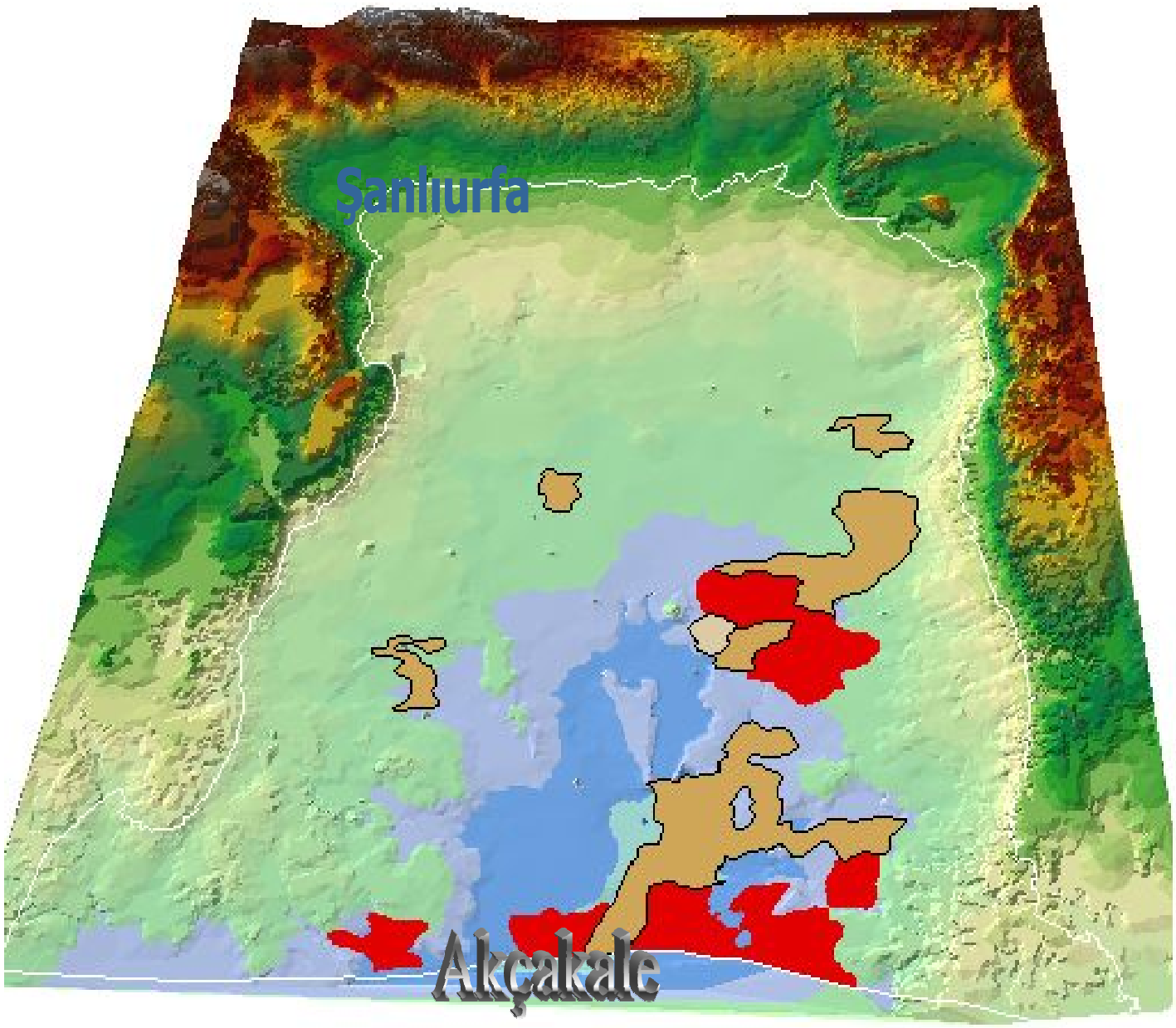


SALINITY MAP



HARRAN PLAIN

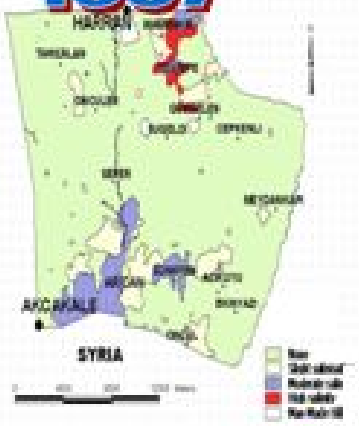
2010



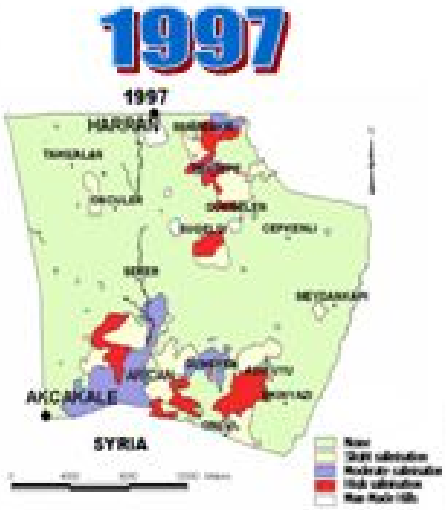
TUZSUZ-(130294.58 ha)
HAFİF TUZLU-(293.73 ha)
ORTA TUZLU-(7740.87 ha)
ŞİDDETLİ TUZLU-(6412.04 ha)
tini2
Elevation
340 - 350
350,000 - 360
360,000 - 370
370,000 - 380
380,000 - 390
390,000 - 400
400,000 - 410
410,000 - 420
420,000 - 430
430,000 - 440
440,000 - 450
450,000 - 460
460,000 - 470
470,000 - 480
480,000 - 490
490,000 - 500
500,000 - 510
510,000 - 520
520,000 - 530
530,000 - 540
540,000 - 550

SALINITY MONITORING

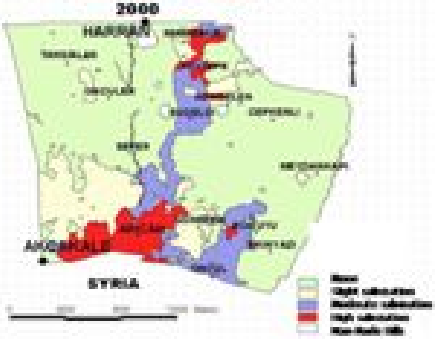
1987



1997



2000



SALINITY CHANGES

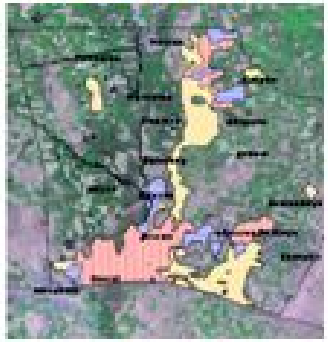
1987 : = 5500 ha

1997 : = 7400 ha

2000 : = 11000 ha

2004 : = 15000 ha

2004



HARRAN PLAIN


Actually water amount is enough for whole plain
BUT
Farmers live at the norhern part of the plain use more water


Farmers used drainage water for irrigation

Water Use and Management Problems


TURKEY
In dry climate we need suitable water use technics
and water should be manage carefully


Thank You for Your Attention