



# Land Use-land Cover Change around Canakkale Strait:1986-2011

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# Objective

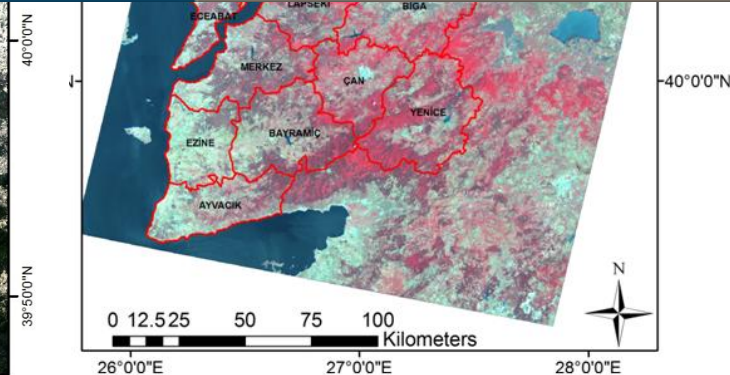
1. Identify, map, and quantify land cover and land use change (LCLUC) around Canakkale particularly for the period 1986 through 2011
2. Discuss what will be the impacts of LCLUC associated with bulding **suspension bridge over the Canakkale strait.**

# Study Area:

- The Canakkale (Dardanelles) strait is an international waterway together with the Bosphorus,
- The Dardanelles connects the Marmara Sea to the Mediterranean Sea via Aegean Sea.
- It is located at approximately  $40^{\circ} 13' N$   $26^{\circ} 26' E$ .
- The strait is 61 km long and 1.2 to 6 km wide, averaging 55 metres deep with a maximum depth of 103 metres
- Study area divided in three zones both Asian and European side of Turkey (Figure 1)
- A suspension bridge project has been planned, connecting town-lapseki in district of Canakkale on the Asian side to Sütluce village on the European side. (Canakkale Municipal 2013)



# Study Zones and Projected Bridge over Canakkale Strait



# Why did we study around Canakkale Strait:

- Canakkale Province has been getting attention inside Turkey as well as outside of Turkey
- Parcels close to Strait has been changed from one land use type to other dramatically.
- Because climate are appropriate to growth so many agricultural products, big company has been bought small parcels and consolidate them
- Each summer, there are many forest fires around coastal areas
- Çanakkale is also one of the popular place in the world because of history,
- The new bridge also will be built and connect the Asian side to European side of Turkey beside the Bosphorus 1 and Fatih Sultan Mehmet Bridge over Bosphorus Strait
- After bridge built, population expected to growth faster than as it is.
- Recent years, population has been increased from 48.000 to 104000 (1985 to 2012 respectively) (Turkish Statistical institute 2012)

**THERE ARE MORE REASON TO STUDY LAND USE LAND COVER CHANGE AROUND CANAKALE STRAIT**

What is the land cover around the  
Canakkale Strait

# Forest



# Forest





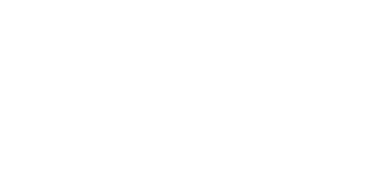
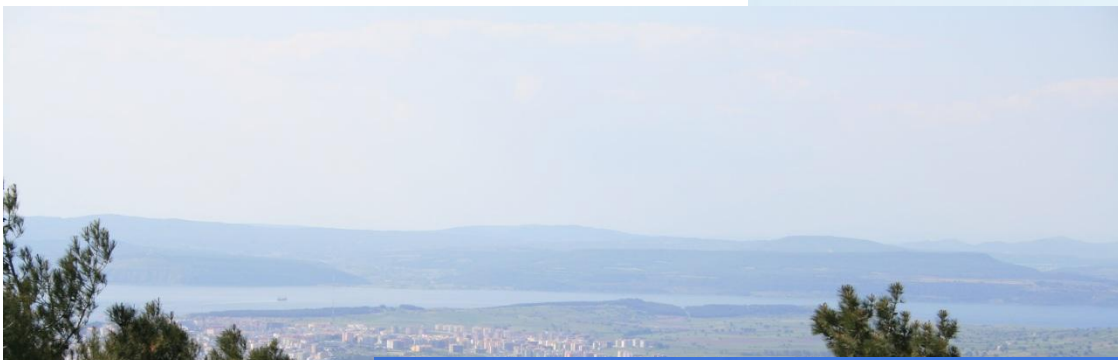


# AGRICULTURE



# Grassland





# WATER

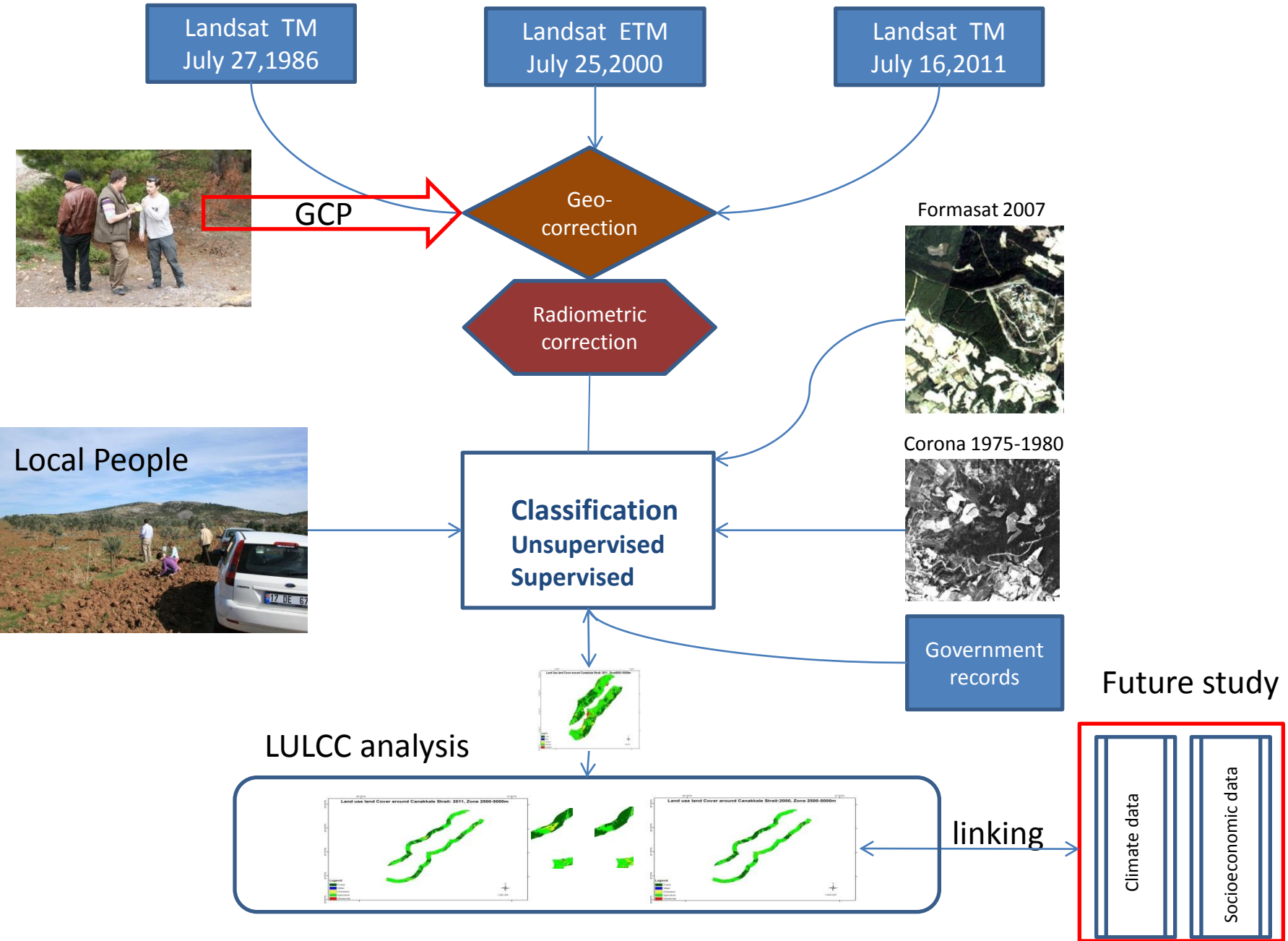




# Approaches

- Data
  - Landsat TM-ETM
    - July27 1986
    - July25 2000
    - July16 2011
  - Corona
    - June 29 1975
    - June 12 1980
  - Formosat
    - August 2007
  - GPS
  - Photographes
  - Soil maps (Futher analysis)

# Approaches



# Classification

- Supervised and unsupervised classification
- Classification accuracy
- Zonal statistics



City expanded



# Results

26°0'0"E

27°0'0"E

# Land use land Cover around Canakkale Strait:1986, Zone 0-10000m

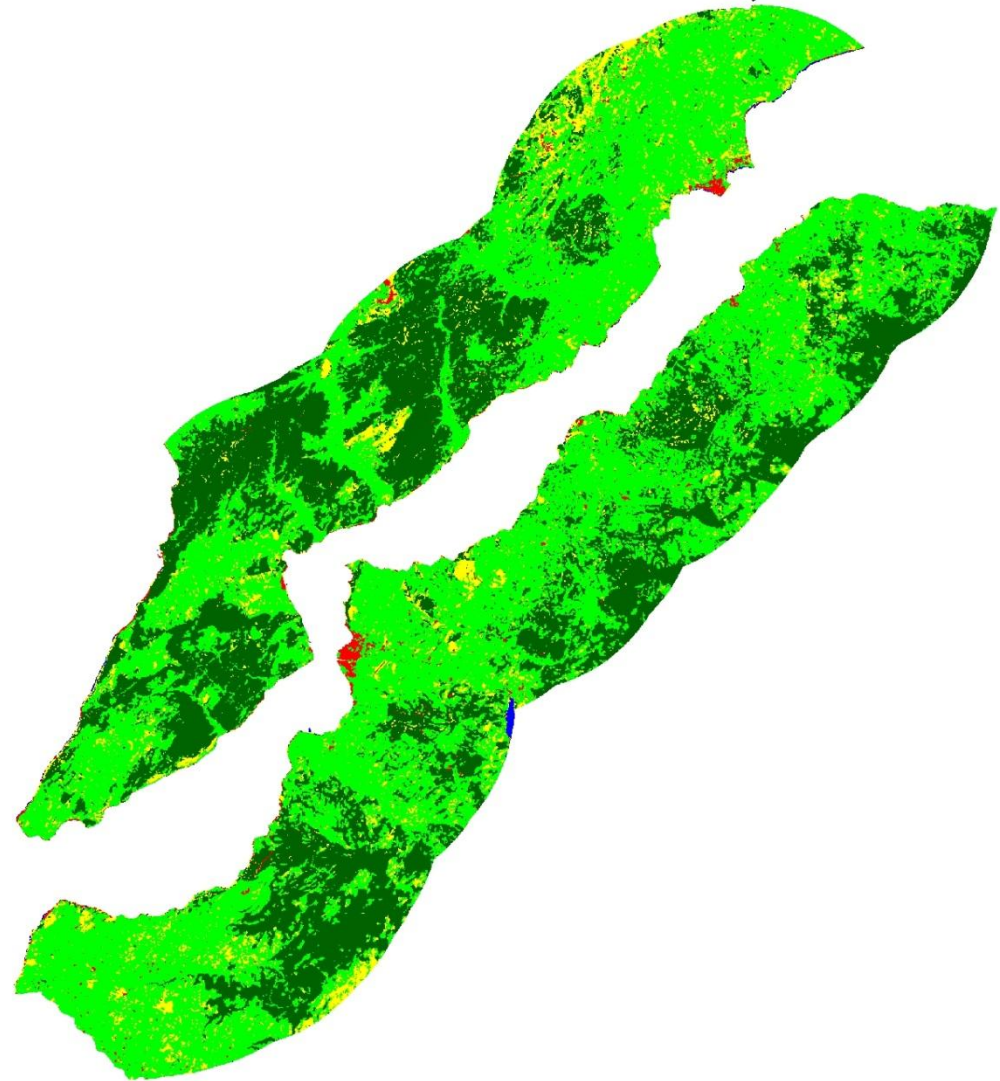
40°30'0"N

40°20'0"N

40°10'0"N

40°0'0"N

39°50'0"N



## Legend

- Forest
- Water
- Grassland
- Agriculture
- Residential



1:400.000

26°0'0"E

27°0'0"E

# Land use land Cover around Canakkale Strait:2000, Zone 0-10000m

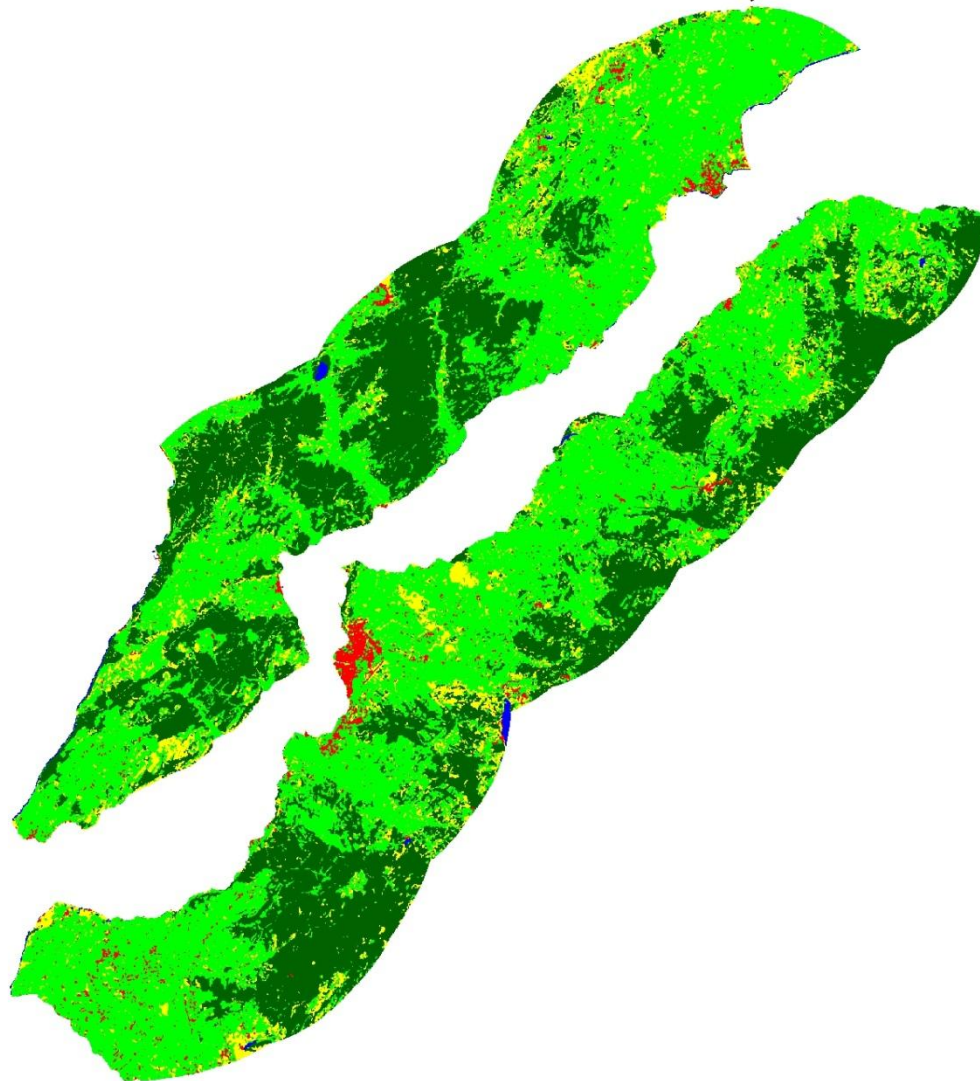
40°30'0"N

40°20'0"N

40°10'0"N

40°0'0"N

39°50'0"N



## Legend

- Forest
- Water
- Grassland
- Agriculture
- Residential



1:400.000

26°0'0"E

27°0'0"E

# Land Use land Cover around Canakkale Strait: 2011 , Zone5000-10000m

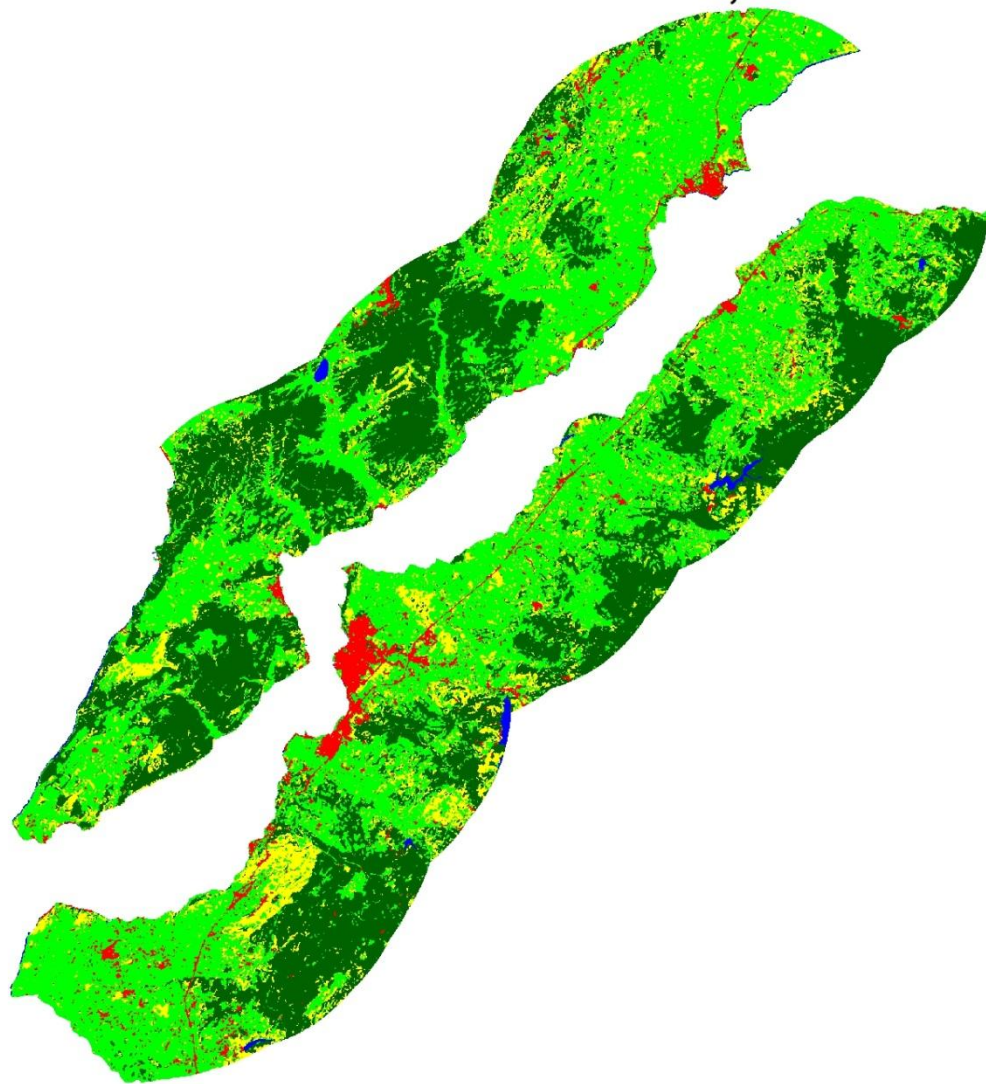
40°30'0"N

40°20'0"N

40°10'0"N

40°0'0"N

39°50'0"N



## Legend

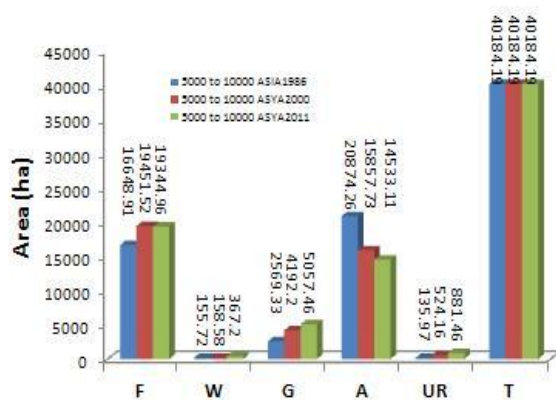
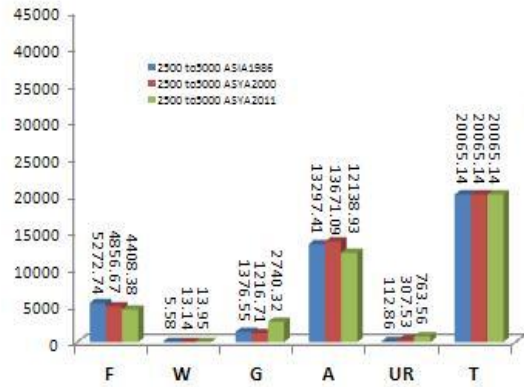
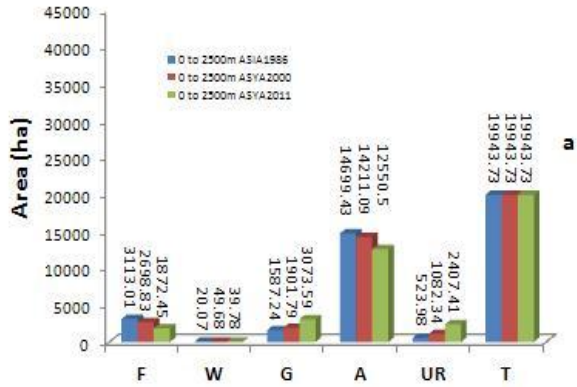
- Forest
- Water
- Grassland
- Agriculture
- Residential



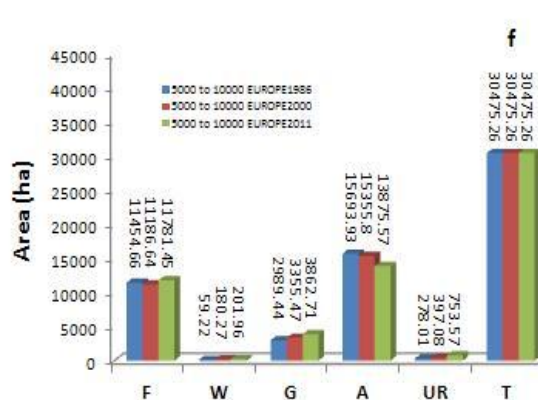
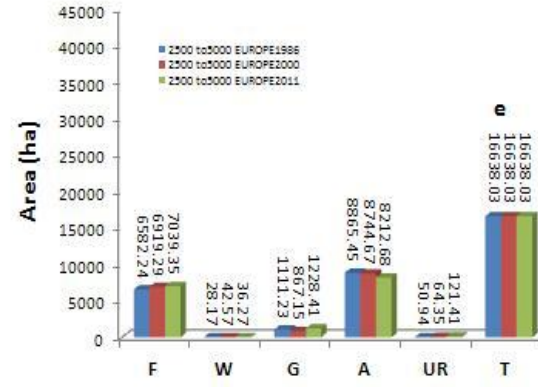
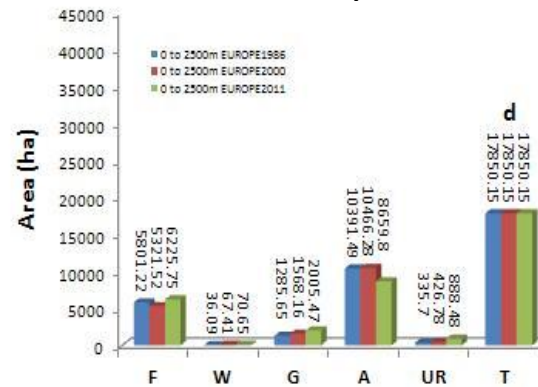
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# Land use land cover 1986, 2000 and 2011

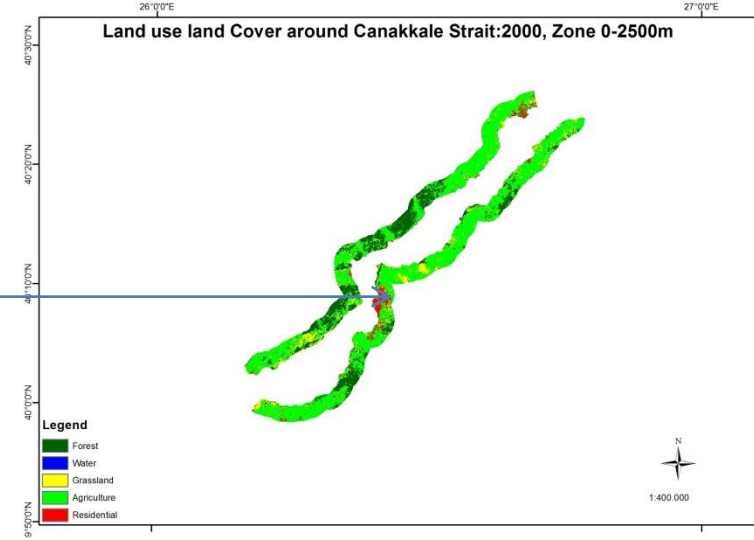
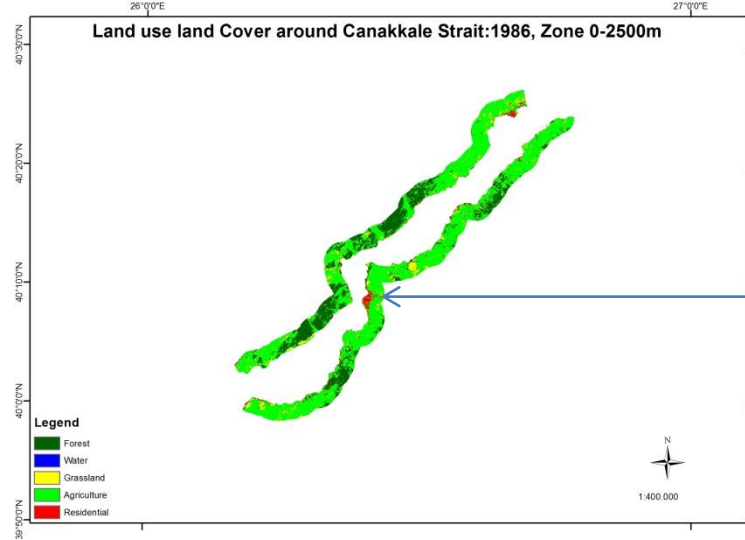
## Asia



## Europe



# Land Cover Change analysis 1986-2000



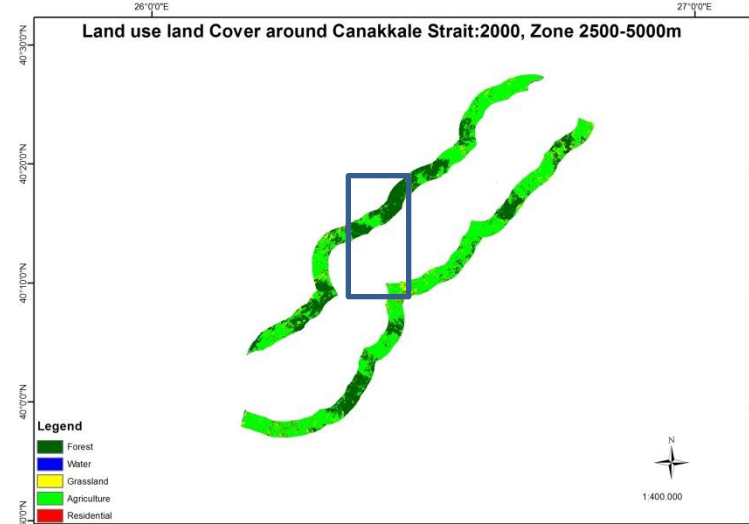
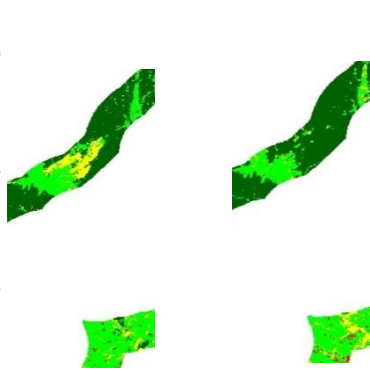
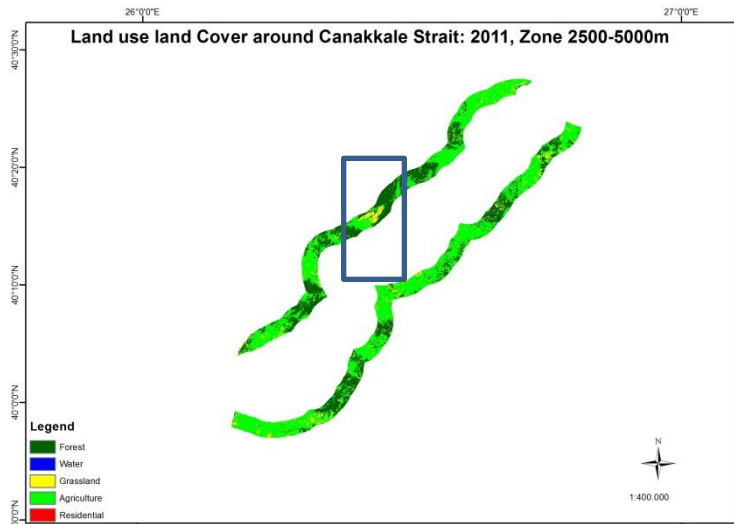
### Asian side 1986-2000 Zone 0-2500m

Class	Forest		Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	76.06	2052.72	2.36	1.17	10.20	193.95	6.02	856.08	0.84	9.09
W	0.00	0.09	<b>24.09</b>	11.97	0.14	2.61	0.01	1.62	0.35	3.78
G	6.19	167.04	<b>64.31</b>	31.95	26.83	510.21	5.84	829.26	4.51	<b>48.78</b>
A	16.53	446.04	0.36	0.18	59.13	<b>1124.46</b>	87.21	12393.81	67.90	<b>734.94</b>
R	1.22	32.94	8.88	4.41	3.71	70.56	0.92	130.32	26.40	<b>285.75</b>

### European side 1986-2000 Zone 0-2500

Class	Forest		Open Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	84.68	4506.48	0,1	0,09	25.18	394.92	8.59	899.01	0,2	0,72
W	0.00	0	70,1	50,98	0.07	1.08	0.02	2.07	0,1	0,27
G	4.05	215.55	13,9	10,07	18.73	293.67	6.89	721.44	8,1	34,92
A	10.60	564.03	1,6	1,17	53.09	832.5	83.46	8735.04	<b>60,7</b>	<b>259,47</b>
R	0.67	35.46	14,3	10,41	2.93	45.99	1.04	108.72	<b>30,9</b>	<b>132,12</b>





### Asian 1986-2000 Zone 2500-5000m

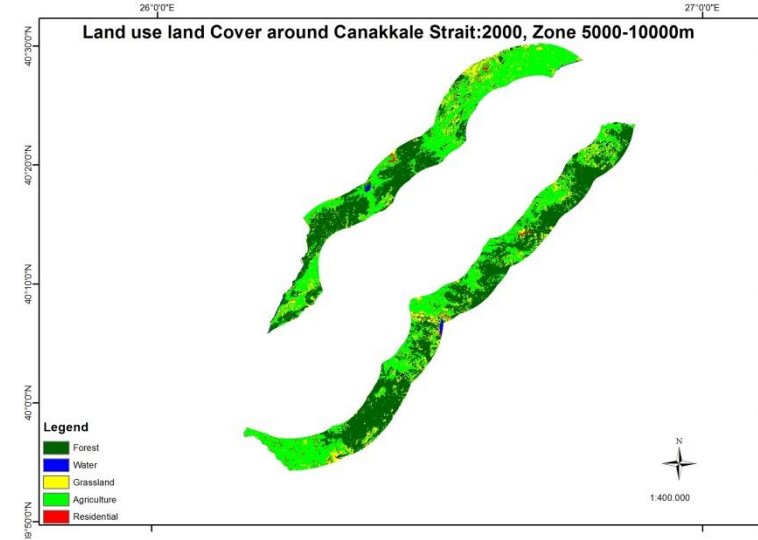
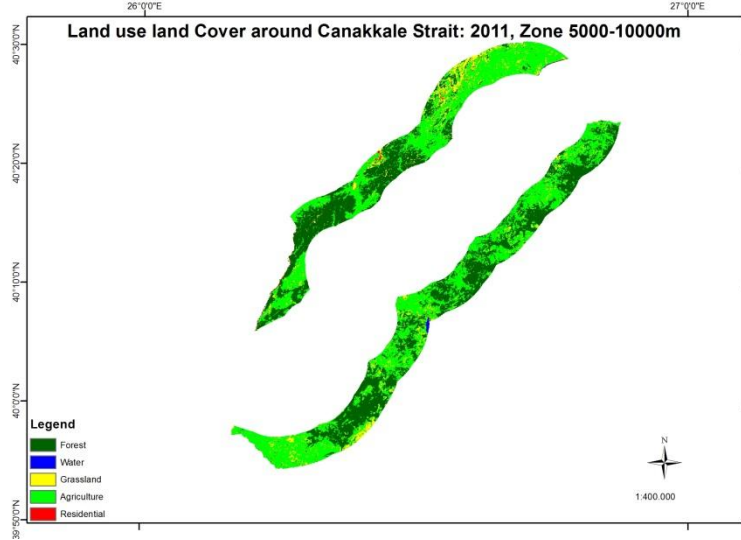
1986

	Forest		Water		Grassland		Agriculture		Urban	
Class	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	84.60	4108.77	0.00	0	10.07	122.49	7.56	1033.65	2.55	7.83
W	0.00	0	40.41	5.31	0.00	0	0.00	0.27	0.00	0
G	3.92	190.26	55.48	7.29	22.10	268.92	6.54	894.06	5.21	16.02
A	11.27	547.29	0.00	0	66.91	814.05	85.37	11670.39	86.39	265.68
R	0.21	10.35	4.11	0.54	0.92	11.25	0.53	72.72	5.85	18

### European 1986-2000 Zone 2500-5000m

1986

	Forest		Open Water		Grassland		Agriculture		Residential	
Classes	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	84.10	5819.04	0.00	0	14.71	127.53	7.27	635.67	0.00	0
W	0.00	0	61.10	26.01	0.10	0.9	0.01	1.26	0.00	0
G	7.20	498.33	27.91	11.88	10.07	87.3	5.81	508.41	8.25	5.31
A	8.56	592.02	0.42	0.18	74.40	645.12	86.57	7569.9	90.49	58.23
R	0.14	9.9	10.57	4.5	0.73	6.3	0.34	29.43	1.26	0.81



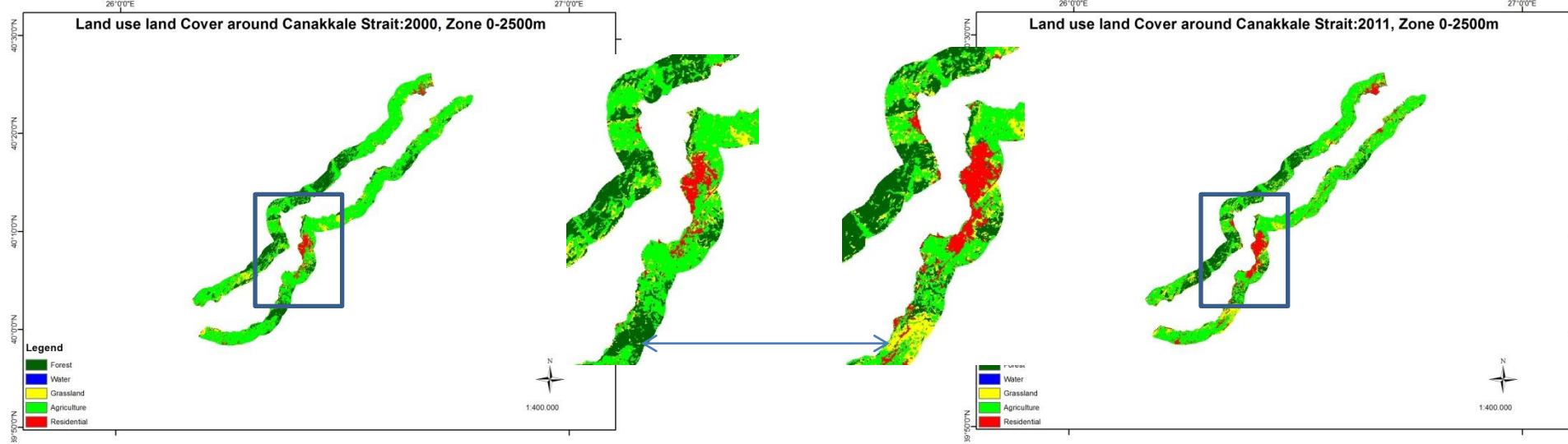
### Asian 1986-2000 Zone -5000-10000m

	Forest		Water		Grassland		Agriculture		Residential	
Class	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	77.63	15100.65	2.10	3.33	7.20	301.86	7.16	1135.89	5.24	27.45
W	0.00	0	60.05	95.22	0.00	0.09	0.00	0.27	0.02	0.09
G	2.65	515.43	8.34	13.23	16.68	699.21	8.09	1282.59	9.13	47.88
A	19.64	3820.41	27.36	43.38	75.63	3170.52	<b>84.31</b>	<b>13369.68</b>	<b>80.75</b>	<b>423.27</b>
UR	0.08	15.03	2.16	3.42	0.49	20.52	0.44	69.3	4.86	25.47

### European 1986-2000 Zone 5000-10000m

	Forest		Open Water		Grassland		Agriculture		Residential	
Class	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	<b>88.41</b>	<b>9890.37</b>	2.25	4.05	18.26	612.72	6.16	945.99	0.39	1.53
W	0.00	0	32.00	57.69	0.03	0.99	0.00	0.54	0.00	0
G	3.10	346.95	45.23	81.54	25.22	846.27	10.68	1639.62	18.90	75.06
A	8.38	937.98	4.14	7.47	55.15	1850.49	<b>82.56</b>	<b>12678.48</b>	55.28	219.51
R	0.10	11.34	16.38	29.52	1.34	45	0.59	91.17	25.43	100.98

# Land Cover Change analysis 2000 to 2011

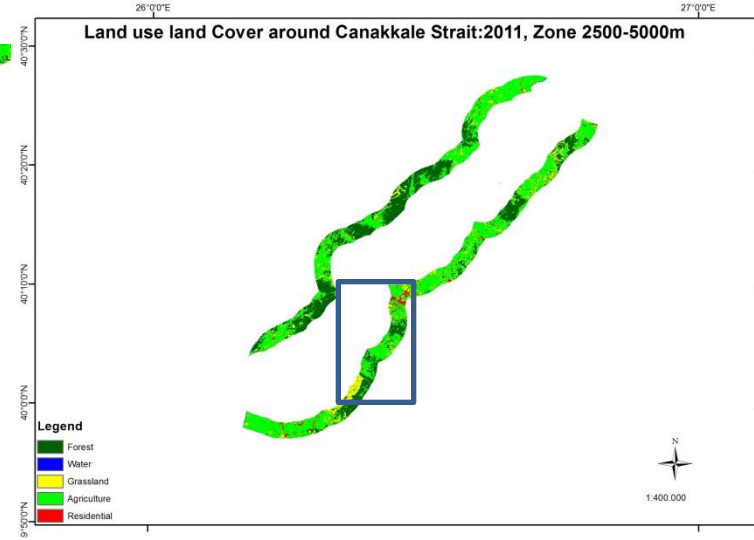
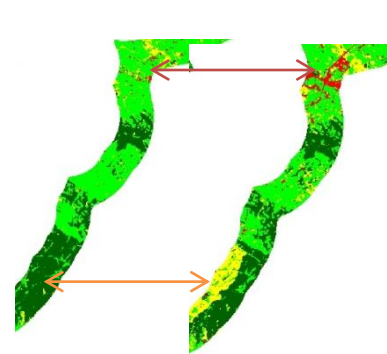
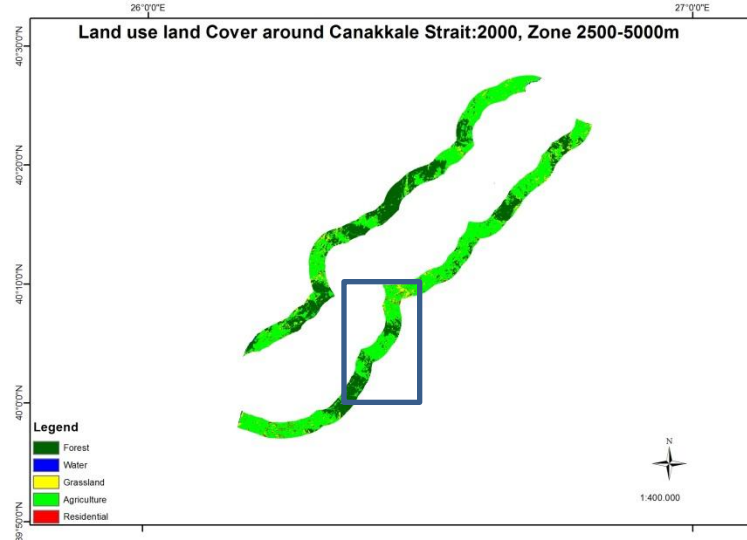


### Asian side 2000-2011 Zone 0-2500m

Classes	Forest		Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	73.30	1372.59	4.75	1.89	28.91	888.66	3.13	393.03	1.77	42.66
W	0.21	3.96	71.72	28.53	0.01	0.27	0.09	11.07	0.24	5.85
G	5.19	97.2	10.41	4.14	20.20	620.91	7.82	981.54	8.22	198
A	21.16	396.18	11.99	4.77	49.99	1536.57	87.57	10990.71	53.29	1282.86
R	0.13	2.52	1.13	0.45	0.88	27.18	1.39	174.15	36.47	878.04

### European side 2000-2011 Zone 0-2500

Classes	Forest		Open Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	75.62	4707.81	2.80	1.98	15.60	312.93	3.39	293.22	0.63	5.58
W	0.02	1.26	75.29	53.19	0.01	0.18	0.10	9	0.43	3.78
G	8.28	515.43	7.64	5.4	20.32	407.43	6.61	572.4	7.60	67.5
A	16.08	1000.89	14.14	9.99	63.46	1272.6	88.56	7669.44	57.78	513.36
R	0.01	0.36	0.13	0.09	0.61	12.33	1.34	115.74	33.57	298.26

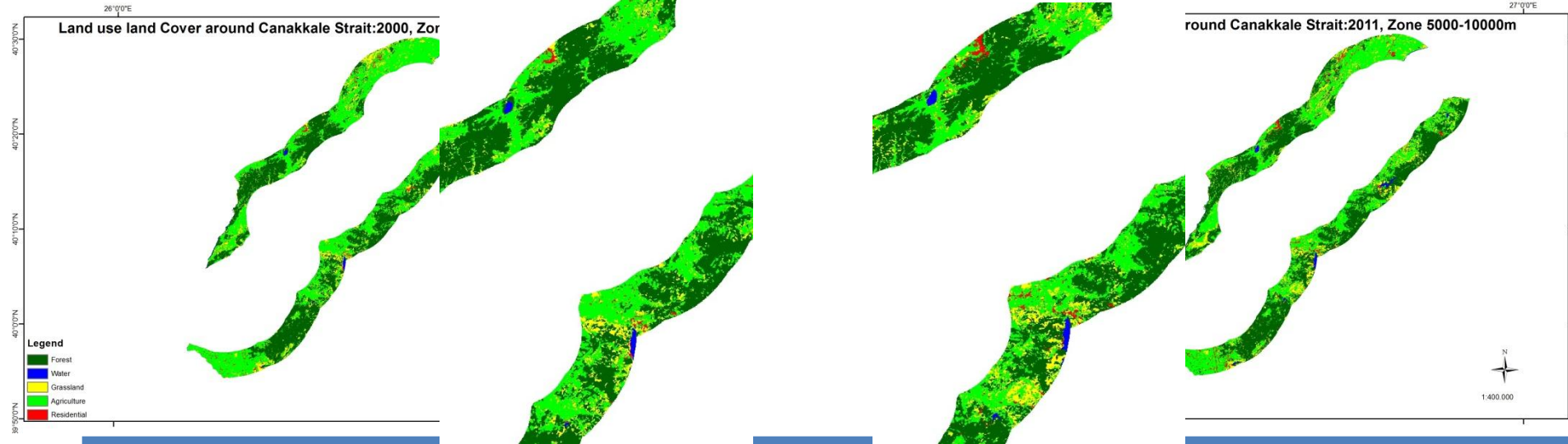


### Asian side 2000-2011 Zone 2500-5000m

Classes	Forest		Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	85.66	3776.4	3.23	0.45	<b>27.43</b>	<b>751.68</b>	2.67	323.55	0.60	4.59
W	0.00	0	76.13	10.62	0.00	0	0.02	2.52	0.00	0
G	1.34	58.95	1.94	0.27	<b>16.27</b>	<b>445.77</b>	5.33	647.37	8.43	64.35
A	12.97	571.95	18.71	2.61	56.00	1534.68	90.39	10972.35	77.20	589.5
R	0.02	1.08	0.00	0	0.30	8.19	1.59	193.14	13.77	105.12

### European side 2000-2011 Zone 2500-5000m

Classes	Forest		Open Water		Grassland		Agriculture		Residential	
	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	89.79	6320.88	1.74	0.63	20.20	248.13	4.23	347.67	1.63	1.98
W	0.01	0.45	92.06	33.39	0.00	0	0.10	8.46	0.22	0.27
G	1.77	124.65	2.73	0.99	13.17	161.82	6.99	574.29	4.45	5.4
A	8.42	593.01	2.98	1.08	66.36	815.22	88.03	7229.25	87.40	106.11
R	0.01	0.36	0.50	0.18	0.26	3.24	0.64	52.92	6.30	7.65



### Asian side 2000-2011 Zone 5000-10000m

2000

	Forest		Water		Grassland		Agriculture		Residential	
Class	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	90.87	17578.26	22.25	81.72	17.83	901.89	5.68	825.48	7.28	64.17
W	0.00	0.27	42.70	156.78	0.00	0	0.01	1.44	0.01	0.09
G	2.74	531	8.16	29.97	33.33	1685.43	12.40	1802.79	16.22	143.01
A	6.29	1217.43	16.96	62.28	48.30	2442.69	79.96	11620.35	58.42	514.98
R	0.09	18	9.93	36.45	0.54	27.45	1.95	283.05	18.06	159.21

### European side 2000-2011 Zone 5000-10000m

2000

	Forest		Open Water		Grassland		Agriculture		Residential	
Class	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
F	85.20	10038.24	13.46	27.18	16.89	652.41	3.35	464.67	0.55	4.14
W	0.02	1.8	80.84	163.26	0.00	0	0.10	13.77	0.19	1.44
G	5.44	640.62	3.43	6.93	25.29	977.04	11.17	1549.8	24.03	181.08
A	9.33	1099.17	1.96	3.96	57.42	2217.87	83.54	11592	58.76	442.8
R	0.01	1.62	0.31	0.63	0.40	15.39	1.84	255.33	16.47	124.11

# Conclusions

- Land use land cover change for all classes are more complex in Asian side
- LULCC in Zone 0-2500m dynamic than Zone 2500-5000 and zone 5000-10000m both in Asian and European side of Strait
- Residential area in zone 0-2500m has been changed more than other two zones in 1986-2000 and 2000-2011,

# Conclusions

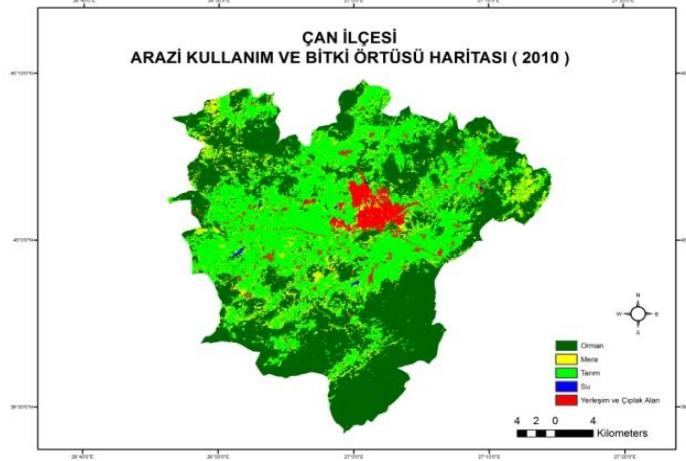
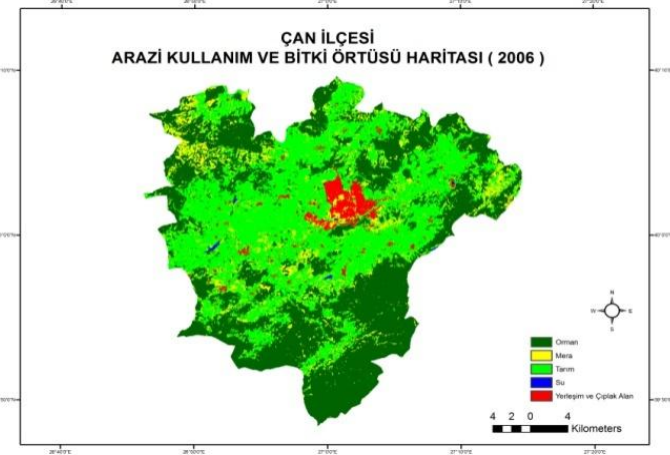
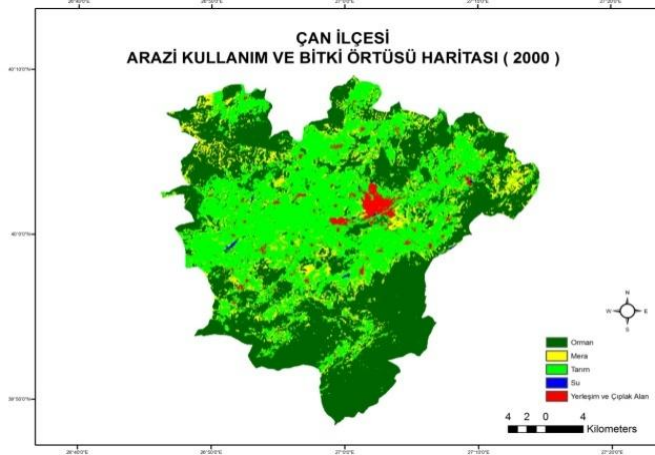
- Further study needed to understand what will be change especially after bridge build up
  - Climate and LULCC
  - Socioeconomic variabilities
  - Forest change on mountain areas of southern Marmara regions
  - Central government policy
  - Landsat 8 needed to study update change



Future study

# Land Use Land Cover Change on forest and mining areas, Çan Municipal Boundary

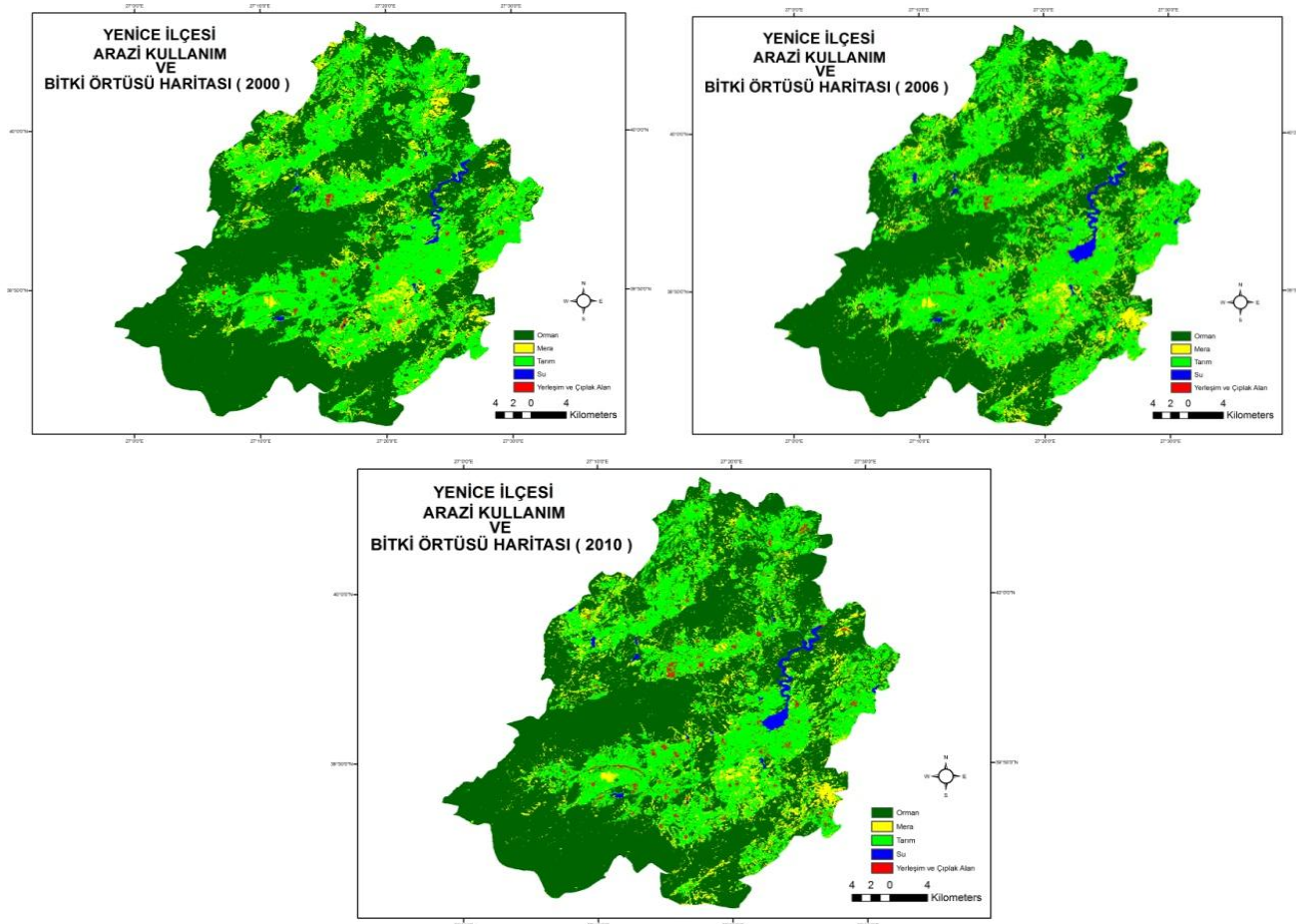
Özge Sayı and Levent Genc, 2013



ÇAN Municipal boundry	2000		2006		2010	
	Area(Ha)	Area(%)	Area(Ha)	Area(%)	Area(Ha)	Area(%)
Forest	42731.800	48.35	39089.070	44.23	42053.310	47.59
Grassland	8826.700	9.99	8309.430	9.40	7452.050	8.43
Agriculture	34561.800	39.10	38049.480	43.05	35084.160	39.70
Water	129.330	0.15	131.760	0.15	136.800	0.15
Urban and Bare Soil	2131.000	2.41	2800.890	3.17	3654.310	4.13
Total land	88380.630	100.00	88380.630	100.00	88380.630	100.00

# Land Use Land Cover Change in Yenice Municipal Boundary

Özge Sayı and Levent Genc, 2013



Yenice Municipal Boundary	2000		2006		2010	
	Area(Ha)	Area(%)	Area(Ha)	Area(%)	Area(Ha)	Area(%)
Forest	74784.130	57.56	70736.470	54.44	79088.090	60.87
Grassland	10753.850	8.28	11716.520	9.02	11011.370	8.47
Agriculture	42725.690	32.88	45190.880	34.78	36659.600	28.22
Water	664.840	0.51	1298.410	1.00	1165.680	0.90
Urban and Bare Soil	996.300	0.77	982.530	0.76	2000.070	1.54
Total land	129924.810	100.00	129924.810	100.00	129924.810	100.00

# Forest and Agriculture land cover change study area

