



**A NEW APPROACH FOR
GEOGRAPHICAL INFORMATION SYSTEM-SUPPORTED
MAPPING OF TRAFFIC ACCIDENT DATA**

Dr. Ismail Bulent GUNDOGDU

Selcuk University, Engineering and Architecture Faculty
Geodesy and Photogrammetry Dept.
Konya, TURKEY

bgundogdu@selcuk.edu.tr



FIG Working Week 2008 in Stockholm, Sweden 14-19 June 2008
Author's name(s) (Ismail Bulent GUNDOGDU, Fatih SARI, Omur ESEN)

16 June 2008

1

Contents:

- ✓ **What is the aim?**
- ✓ **The importance of traffic accidents**
- ✓ **World Health Organisation(WHO) and World Bank Questionares**
- ✓ **What is Hot Spot?**
- ✓ **Hot Pieces (HPCS) Method**
- ✓ **Probable Hot Spots (PRHS)**
- ✓ **Data Evaluation**
- ✓ **Results**

2

The Importance of Traffic Accidents....

- Increasing world population and corresponding vehicle count create new problems in traffic-flow.



3



- Rapidly-increasing mortality and injury from traffic accidents now have a notable priority.

4

According to WHO and WB, on road traffic accidents and injuries estimated

1.2 million people are killed in road crashes

50 million are injured worldwide (Rathinam et al.,2007)

each year....

Estimation of the World Bank, traffic accidents will be the third reason of death in **2020**.

5

A questionnaire done by 800 people whose relatives lost their lives in traffic accidents in **European countries**:

- **37%** of those had tendency to commit a suicide
- **64%** of those had depression in subsequent 3 years

Another questionnaire done by 240 people in **Turkey**

- **50%** of 240 people suffered from insomnia ,
- **39.2%** suffered from hysteria in addition to depression

6

The main reasons of traffic accidents :

- **straight roads speed**
- **sleepiness and inattention**
- **substantially curved roads with a limited view or in forest**
- **or sloping areas.**
- **weather conditions...**

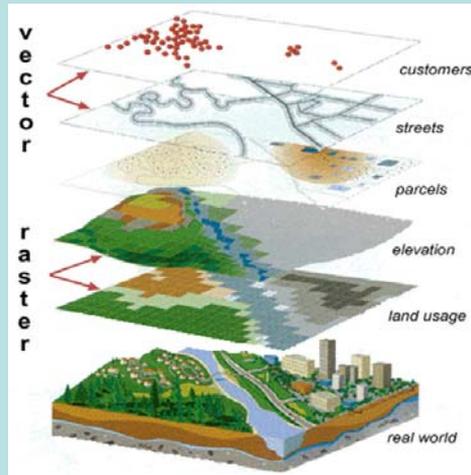


What is Hot Spot?

The significantly different areas detected by the applied statistics (usually termed LISA: Local Indicators of Spatial Autocorrelation) are traditionally termed hotspots, hotpoints or occasionally hotbeds

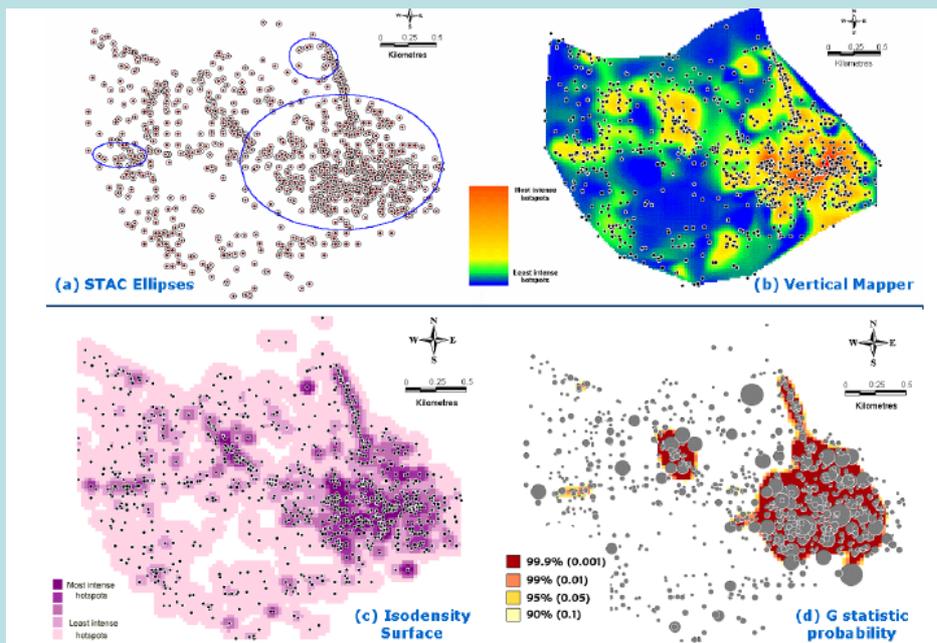
The importance of GIS

Geographic Information System GIS is the most effective way of examining and evaluating the results of analyses which use a multitude of data and different criteria.



9

Determining and illustrating Hot spots.



Since the Hot Spot concept started to appear in accident analysis, literature has cited many methods for detecting Hot Spots. These are as known commonly:

- Kernel Estimation Method
- Getis Ord Gi
- Tract or Grid Scanning
- Ellipsoid Scanning

In this study, Kernel Density Estimation and Getis Ord Gi methods has been used to determine Hot Spots..

Application



Total roads length: 2957km./ 61 939km

Konya highways: 724km.

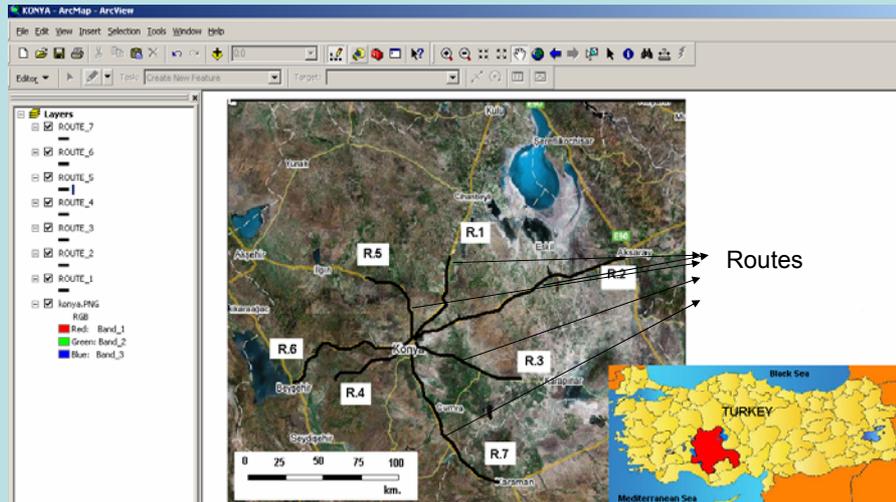
Junctions: 103

Accident: 2137

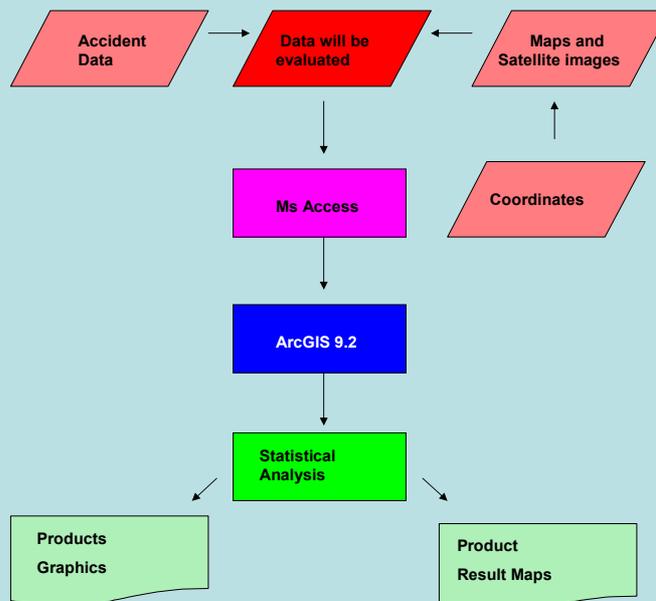
Accident rate: 8th

Mortality rate: 3th

Injury rate : 5th (from 2006 official statistics)



13



14

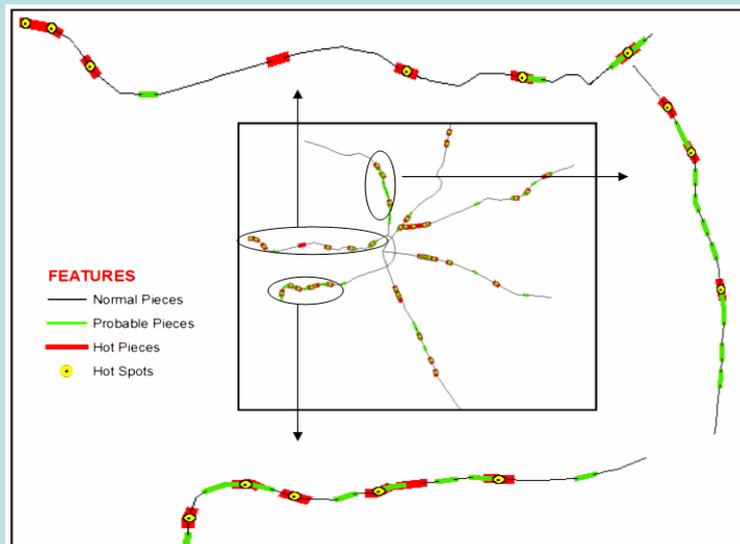
Differences of this study from the others

1. HPCS (Hot Pieces) Representation Method
2. PRHS (Probable Hot Spot) or Probable Pieces Representation Method

15

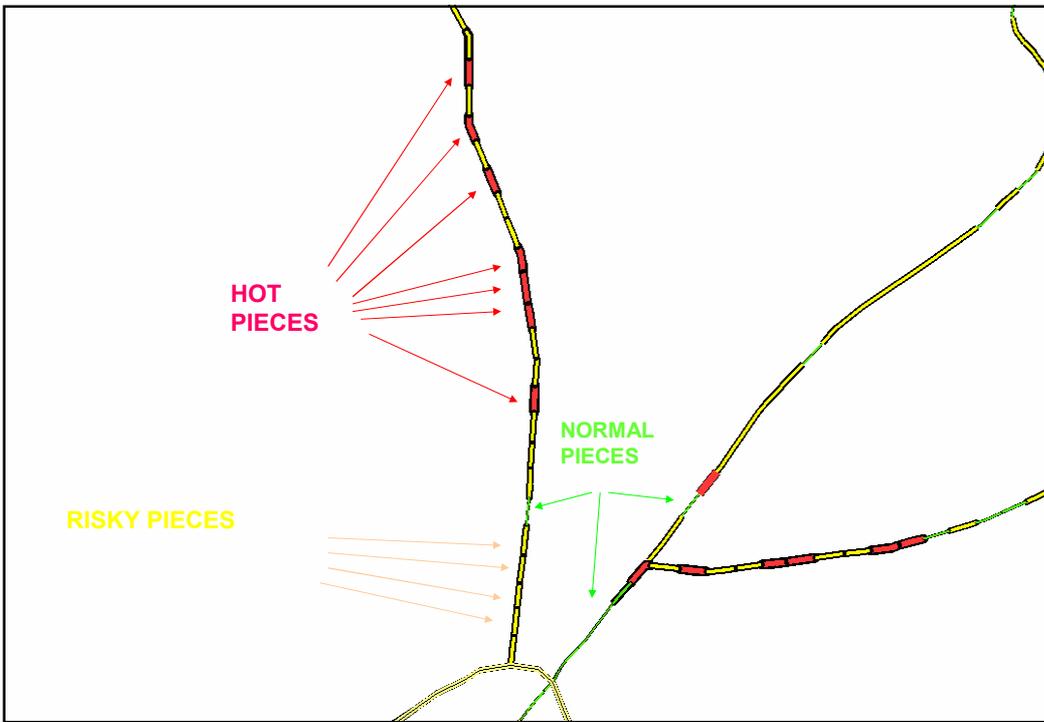
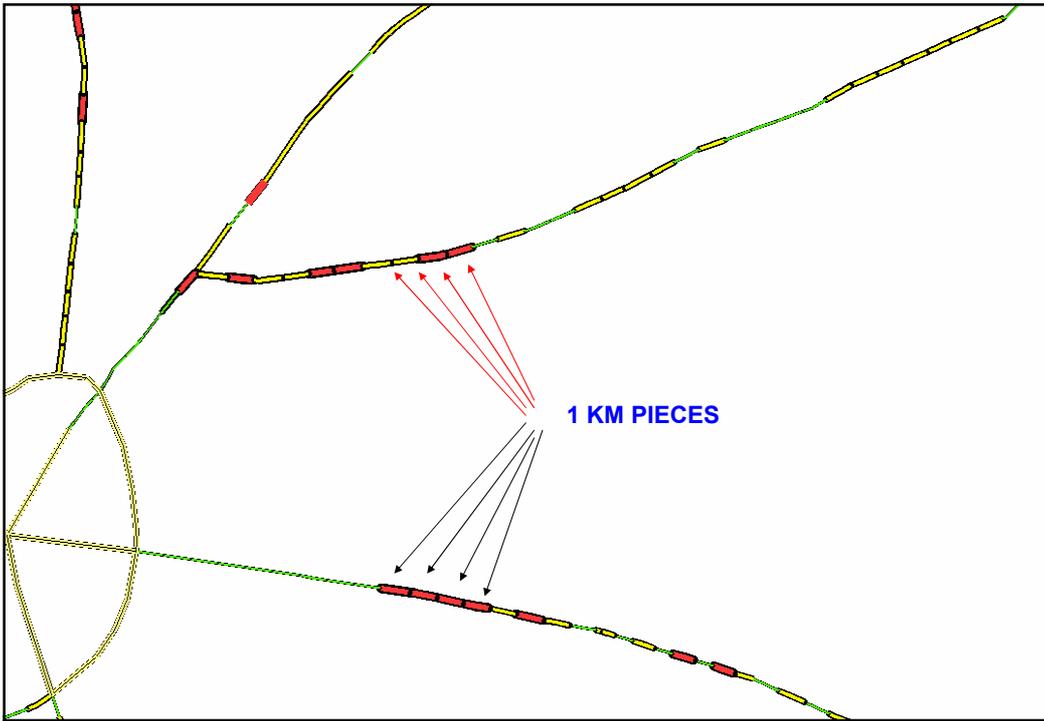
HPCS METHOD

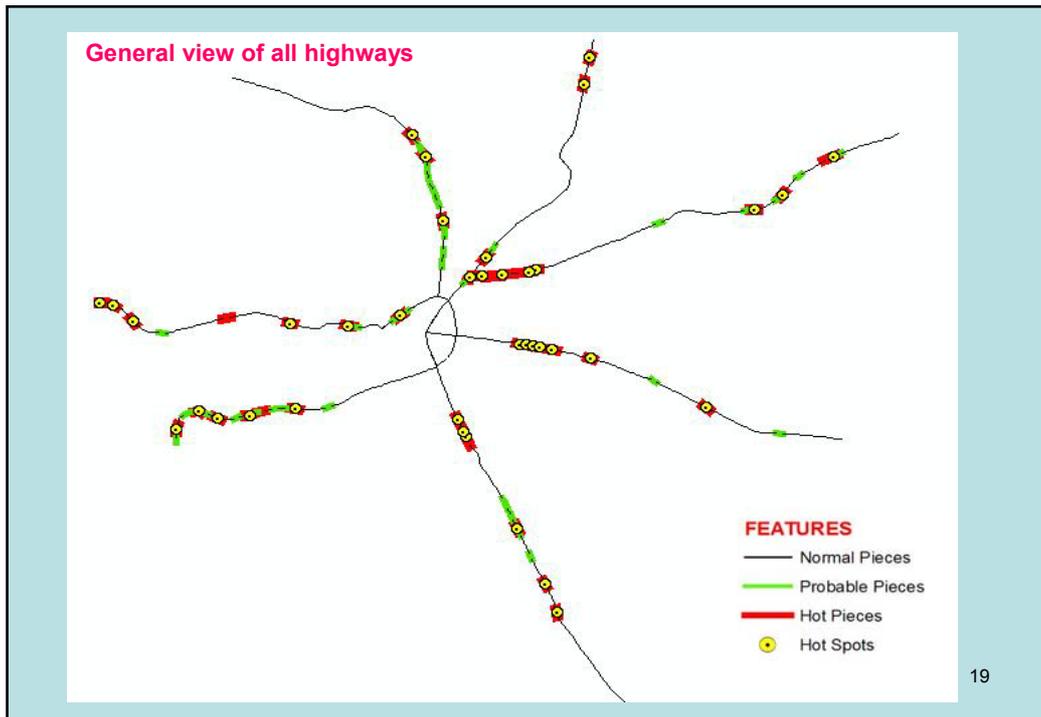
Each piece is 1 km.



Total pieces number= 724

16





PRHS METHOD (Probable Hot Spot illustration)

One of the most vital and important innovations of this study is Probable Hot Spots (PRHS). The basic goal of PRHS is to anticipate and prevent premature accidents.

Two Methods are used to determine PRHS

1. Getis ord Gi
2. Kernel Density Estimation

GETIS ORD Gi*

The statistics G_i and G_i^* , introduced by Getis and Ord (1992) for the study of local patterns in spatial data, were extended and re-written in 1995.

$$G_i^*(d) = \frac{\sum_j w_{ij}(d)x_j - W_i^* \bar{x}^*}{s^* \left\{ \left[(nS_{li}^*) - W_i^{*2} \right] / (n-1) \right\}^{1/2}}$$

Where $w_{ij}(d)$ is a spatial weight vector

W_i^* is the sum of weights,

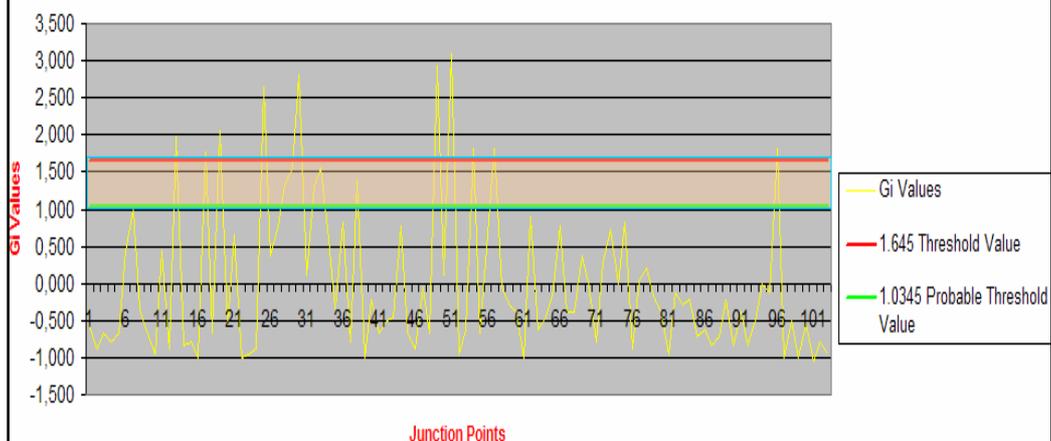
S_{li}^* is the sum of squared weights and

s^* is the standard deviation of the data in the cells.

$$z = (x_i - \bar{x}_0) / s$$

21

Gi values on junctions calculated by accident number



22

Kernel Density Estimation

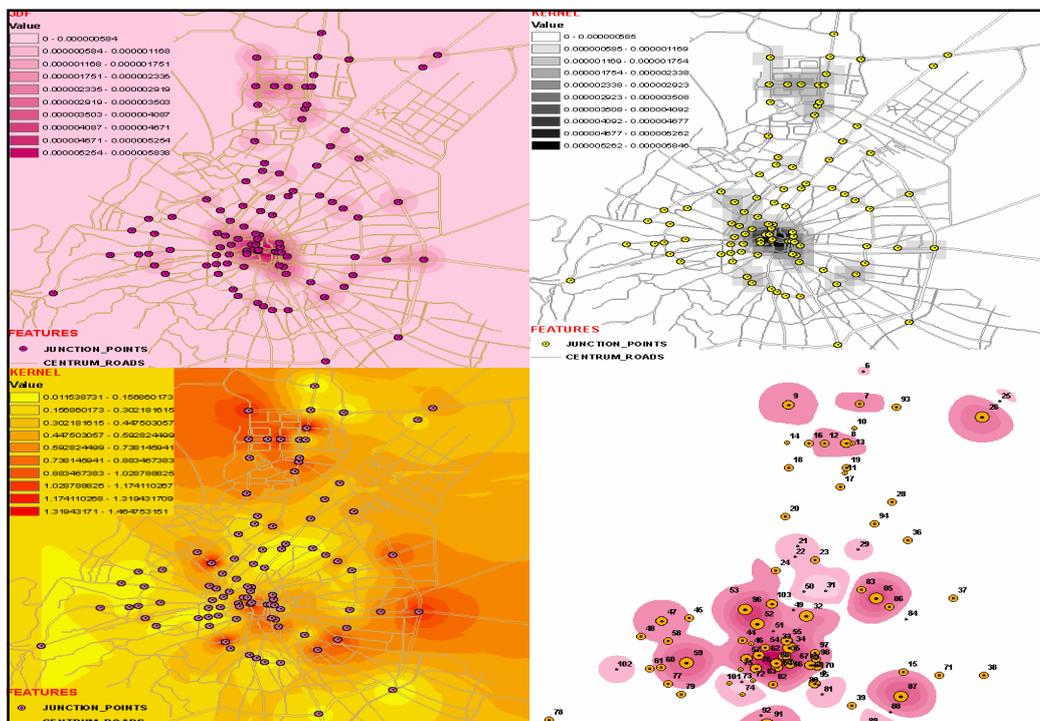
The Kernel method introduced by Rosenblatt (1956) has received considerable attention in nonparametric estimation of probability densities

$$\hat{p}(x) = \frac{1}{N} \sum_{i=1}^N K_{\sigma}(x - x_i)$$

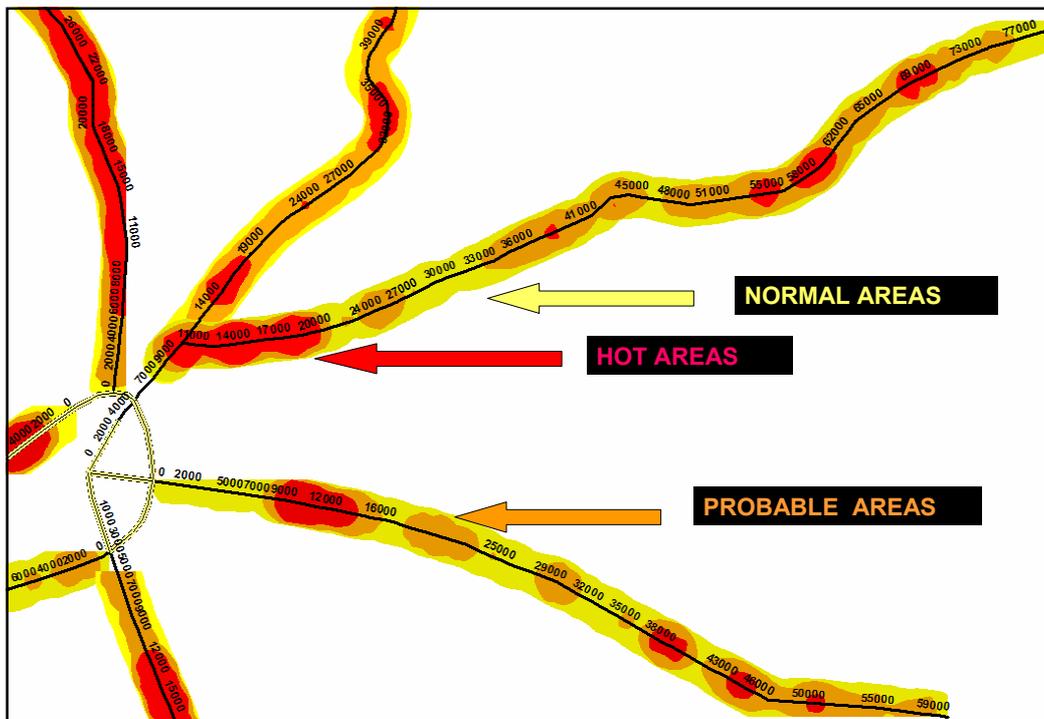
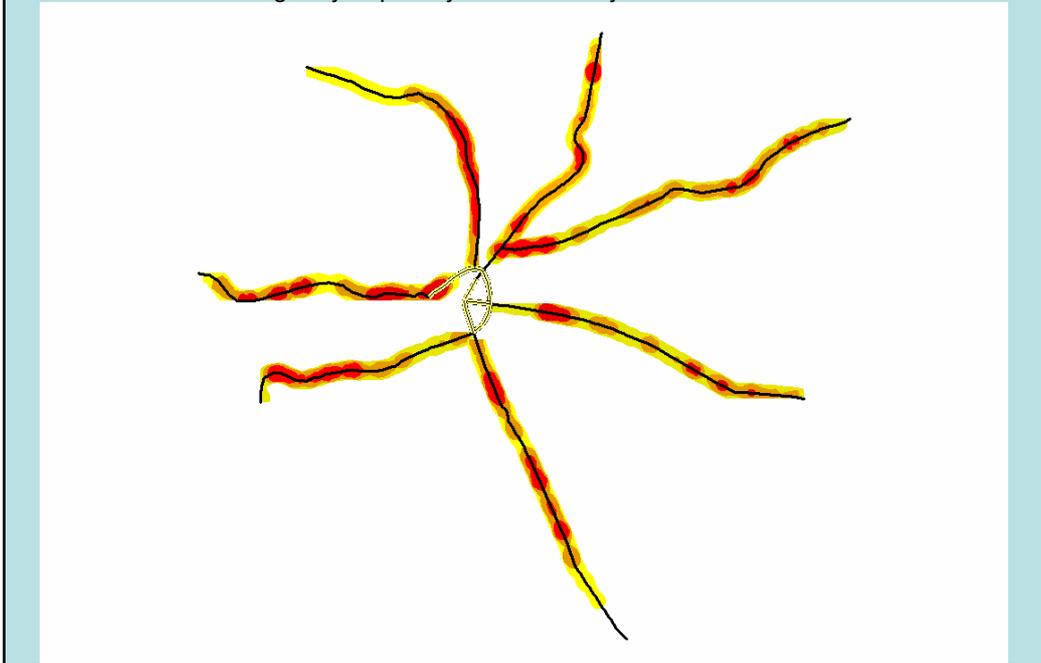
Kernel; Distribution with density function $p(x)$, an estimate $\hat{p}(x)$ of the density at x can be calculated by the formula

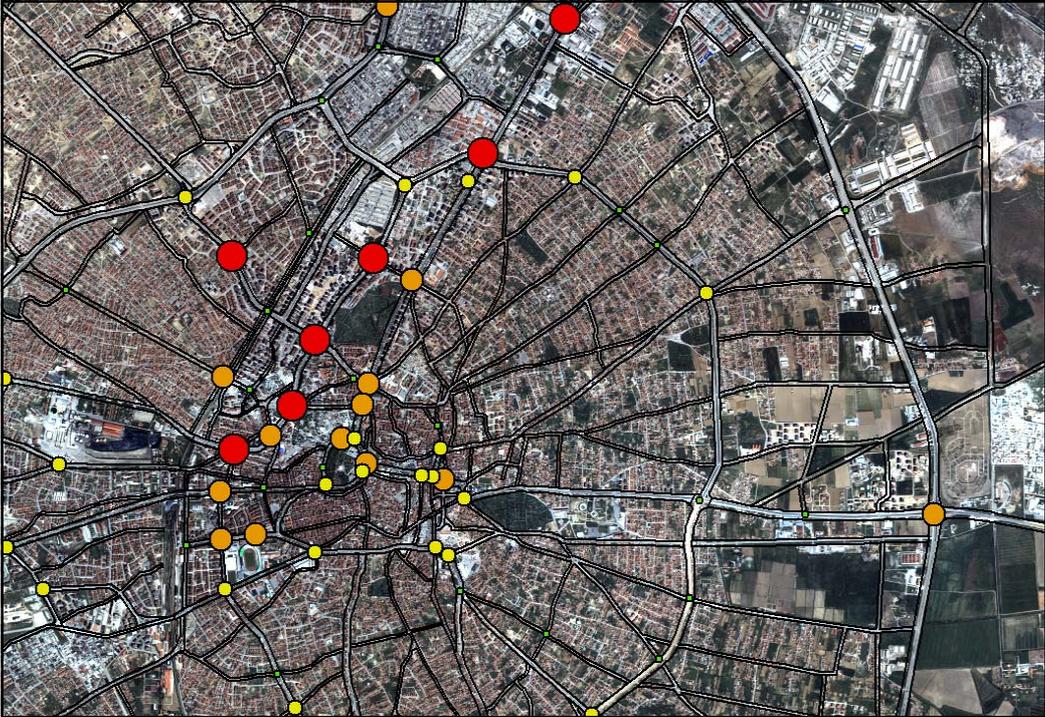
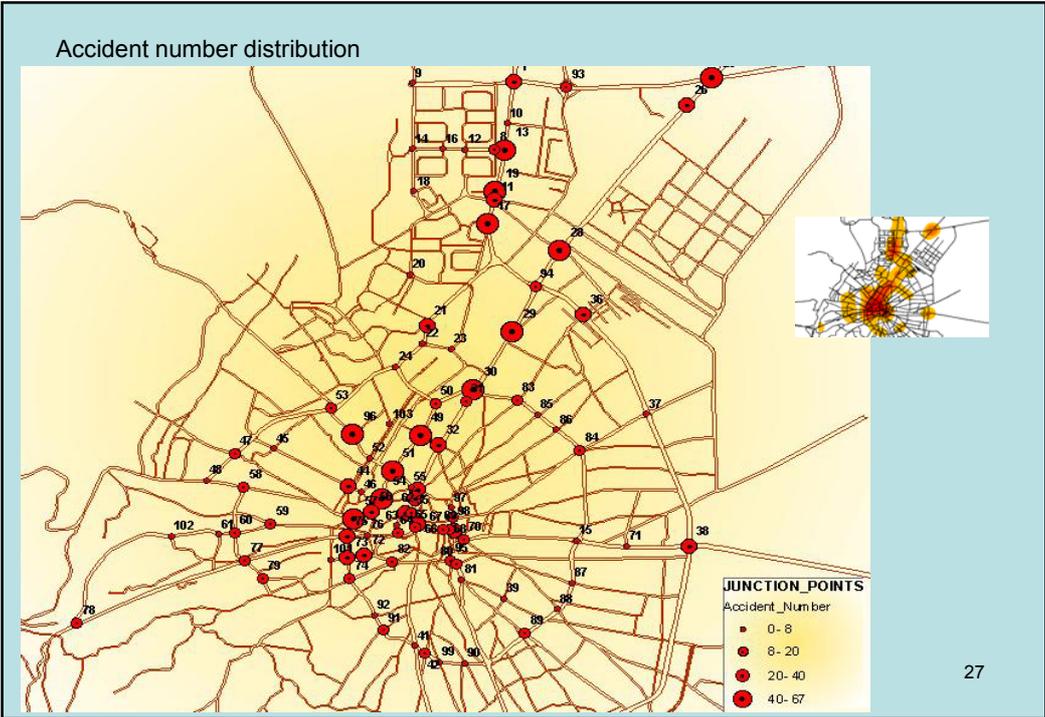
Where K_{σ} is a “Kernel function” with a bandwidth (scale) σ .

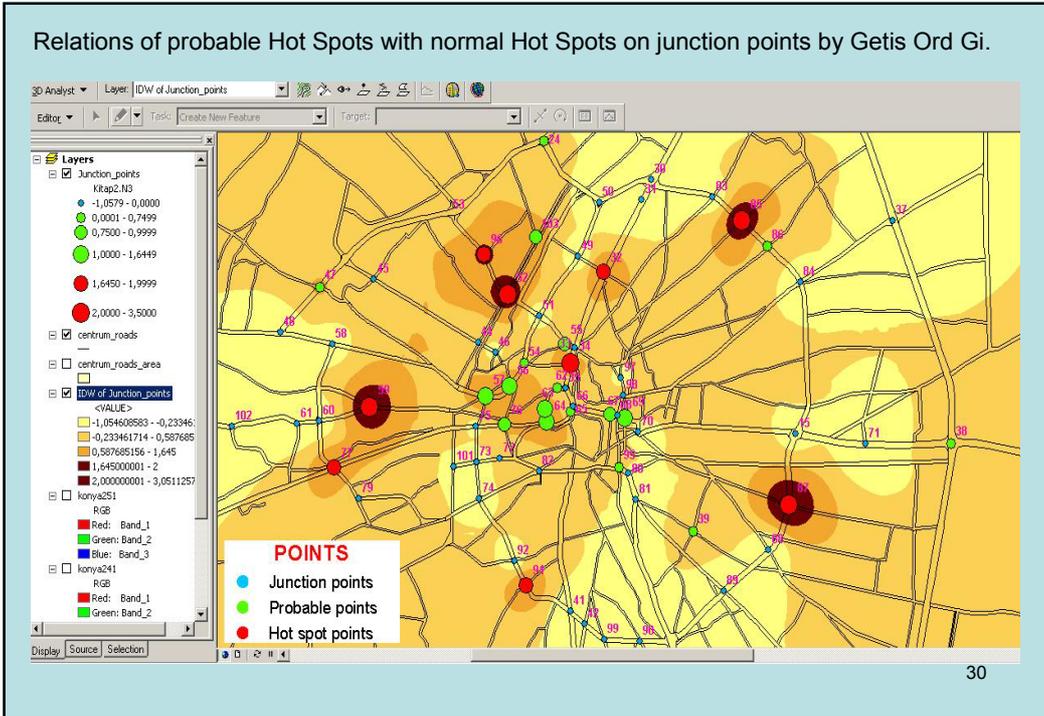
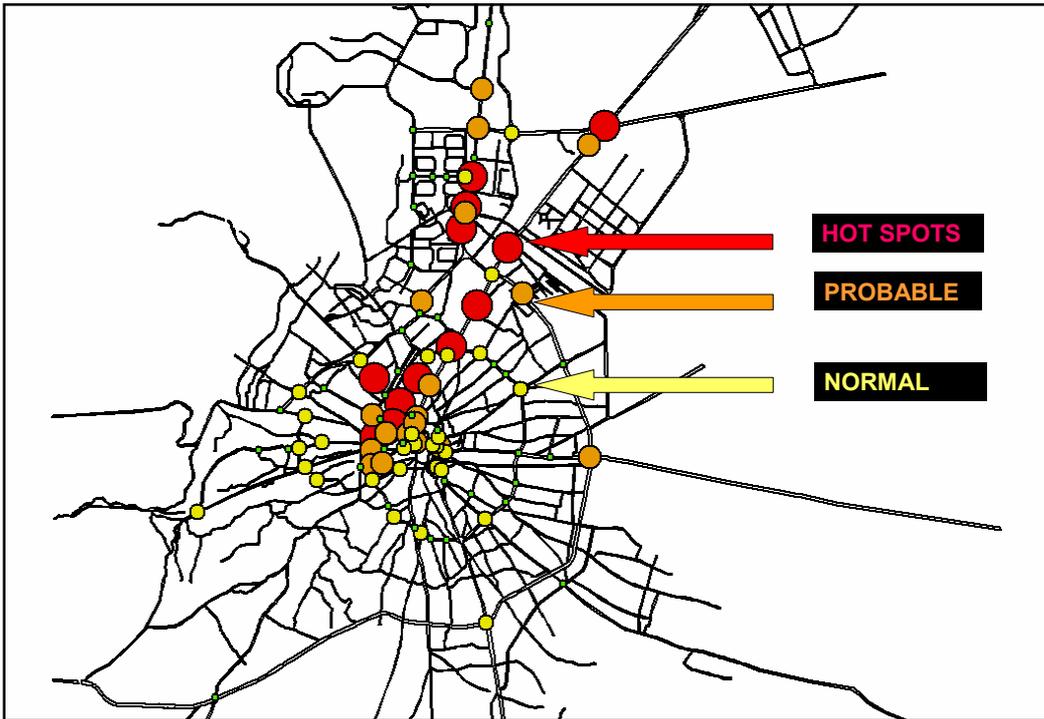
23



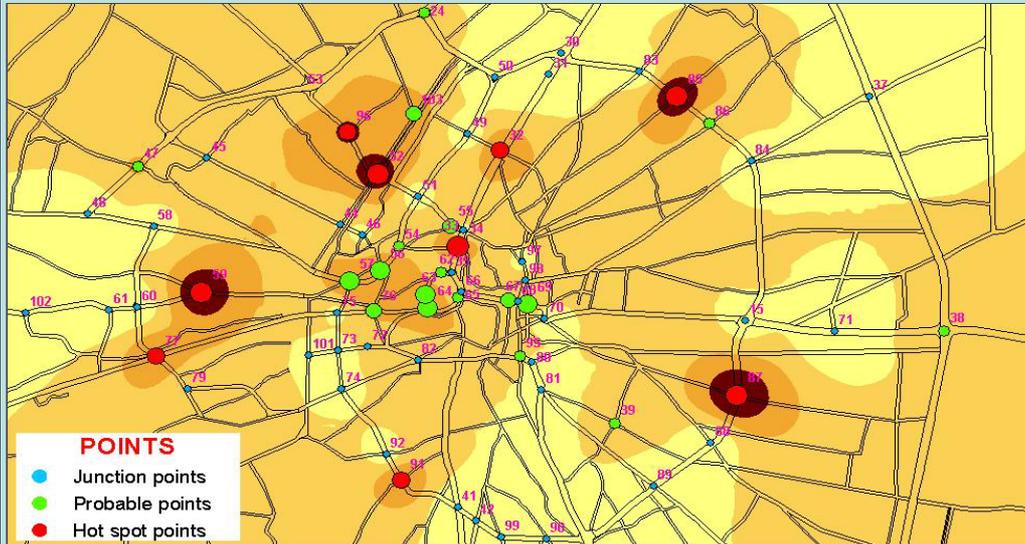
General view of all highway's spots by Kernel Density Estimation







Result Map

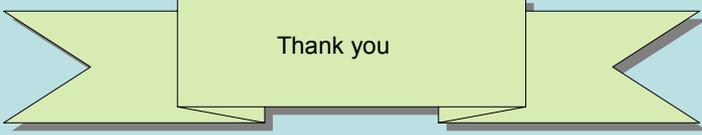


31

RESULT TABLE

Necessary accident number to be Hot Spot																
PRHS Number	Urban area junctions		Route 1		Route 2		Route 3		Route 4		Route 5		Route 6		Route 7	
	1 th priority	2 th	1 th	2 th												
1		1	1	1	2		2	2		1	1	2	1		1	
2	1	1		1					1		1		1			4
3					1	1		1	1		1			1		
4				1					1							
5										1						
Total	1	2	1	3	3	1	2	3	3	2	3	2	2	1	1	4

32



Thank you

bgundogdu@selcuk.edu.tr

<http://www.bgundogdu.selcuk.edu.tr>