

EMPIRICAL CORRELATION BETWEEN SURFACE DETERIORATION, IRI AND GRIP DATA FOR COSTA RICA



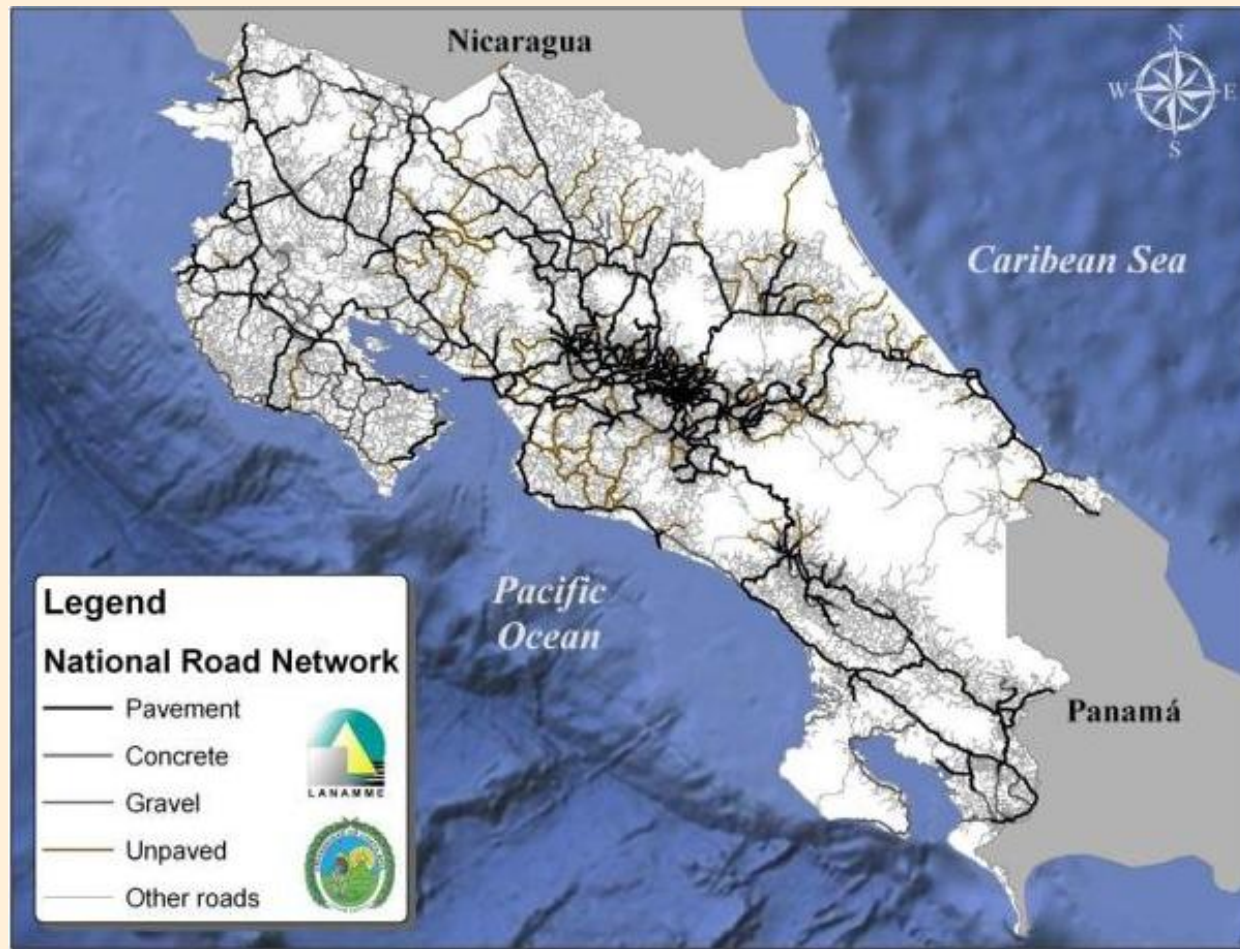
**José Francisco Garro, Civil Eng.,
Jairo Sanabria, Civil Eng.,
Roy Barrantes, Civil Eng.,
University of Costa Rica**



Introduction

- **Costa Rican National Road Network has 4700 miles in length: 60% paved roads, the rest are gravel or dirt roads.**
- **About 14% of the Road Network (27500 miles) are managed by local governments.**
- **Almost all the network don't present a formal design or scheduled maintenance.**
- **There are mostly narrow roads with high steps, and a countless presence of small bridges and water passages.**

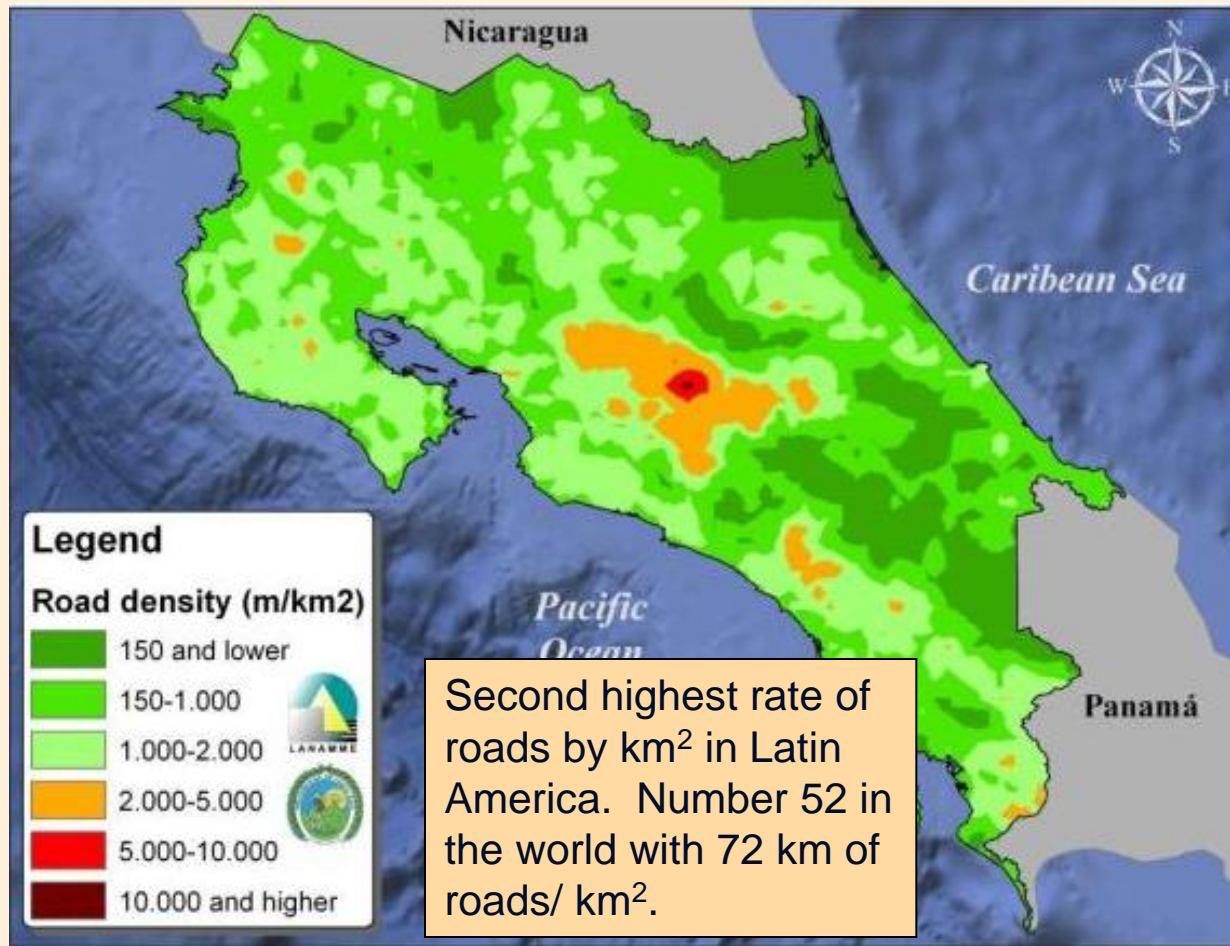
Extension of Costa Rican road network



Introduction

- **The network has experimented few changes in the last 30 years**
- **However, the vehicle fleet has growth without control: from 80.000 in the beginnings of the 90's to 1.300.000 in the year 2010, due to the used import car market.**
- **About 50% of population live in the central region or Great Metropolitan Area GAM (5% of territory), with the 78% of the vehicle fleet.**

Costa Rican road network density



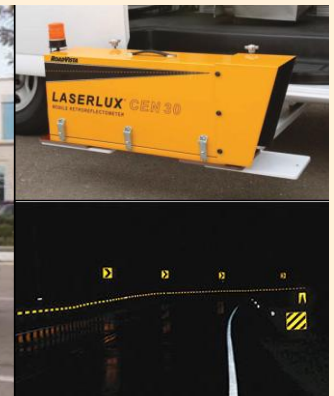
The role of LanammeUCR

- According to Law 8114, one of the main activities of the LanammeUCR is evaluate the condition of the National Road Network every 2 years.
- The main objective for this evaluation is to know the quality of the investment in rehabilitation / reconstruction and maintenance.
- One of the first tasks (year 2002): create an updated SIG file of the network and its basic data, using GPS technology

The role of LanammeUCR

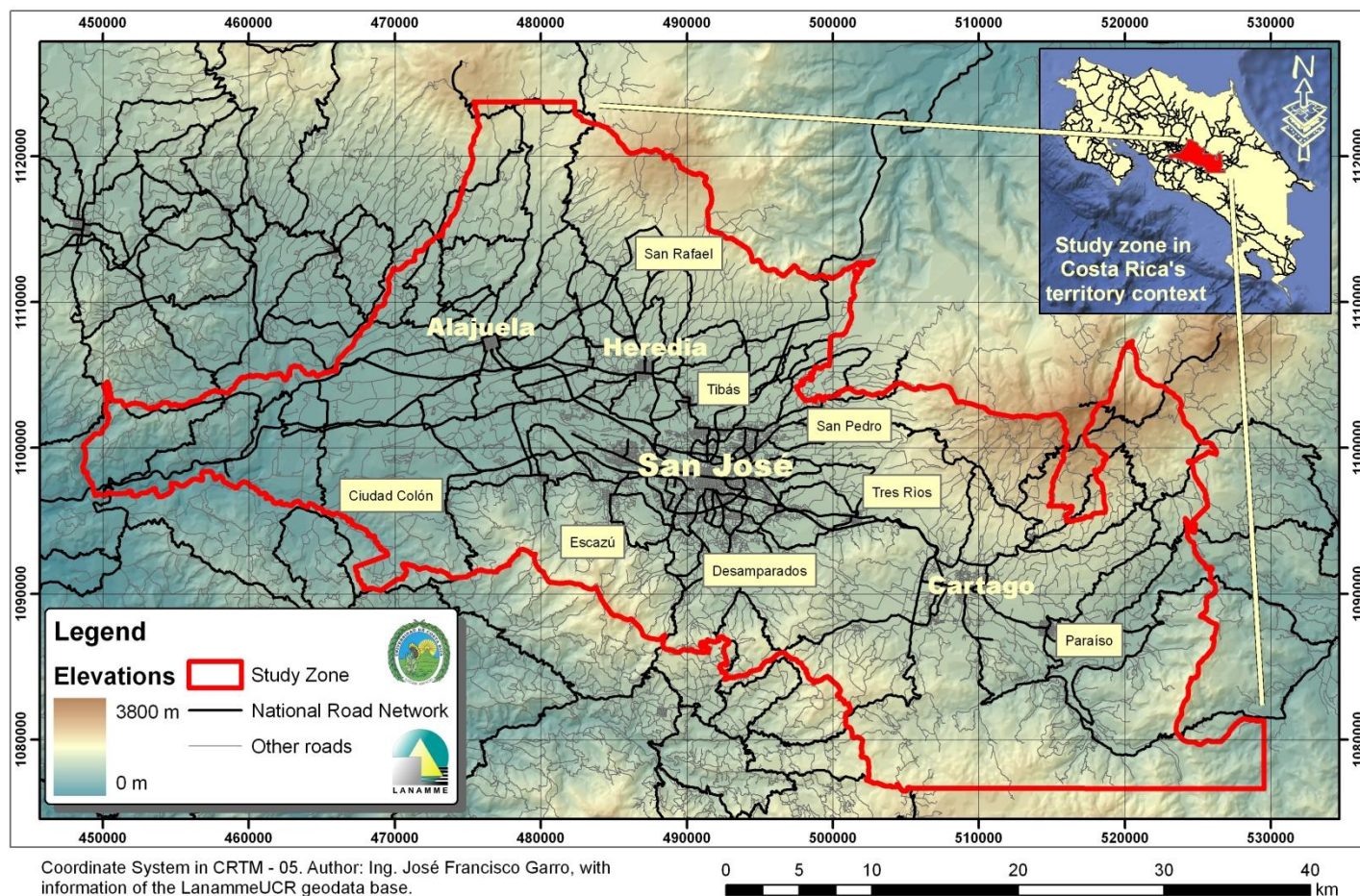
- **First evaluation equipment (2002): Impact Deflectometer for FWD evaluation, and Surface Laser Profiler for IRI campaigns.**
- **First complete paved network evaluation campaign: year 2004.**
- **First Surface Grip Tester campaign: 2008, for roads with a IRI number 4.0 or less**
- **First High Definition images and Retroreflector data of main highways: 2010**

Lanamme's road network evaluation equipment



All the data is saved and
proceesed in SIG databases and
software

Selection of analysis area: GAM



Selection of analysis area: GAM

- **5% of territory extension.**
- **50% of national population.**
- **$\frac{3}{4}$ of the vehicle fleet.**
- **Uniform weather and temperatures.**
- **Main national cities and economic & cultural centers.**
- **Complete 2008 & 2010 IRI and GRIP data for all 700 miles of national roads in this area.**

2008 Evaluation Campaign results

Table 1 – IRI results for the GAM, 2008

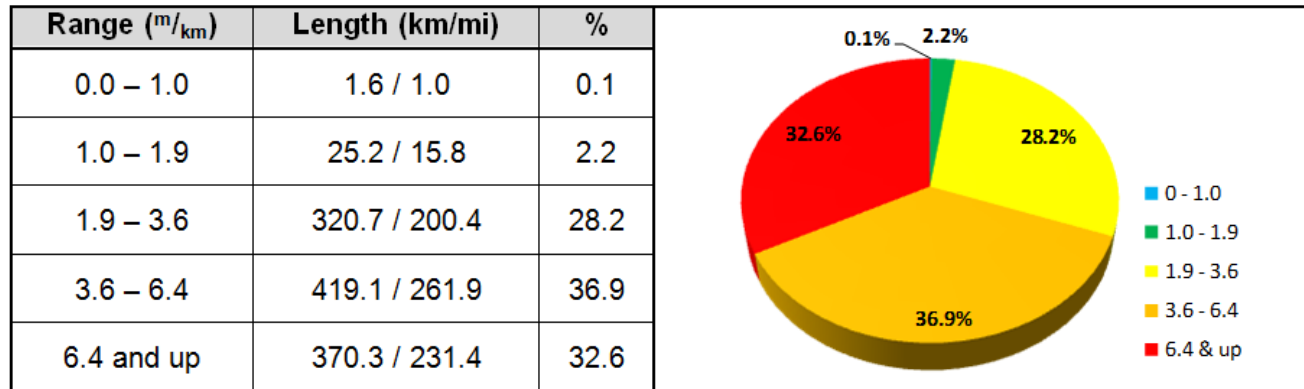
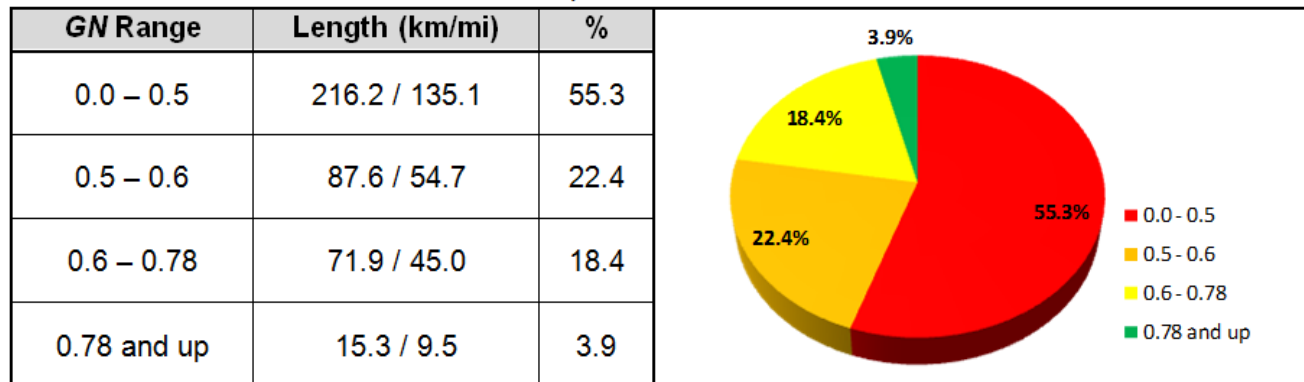


Table 2 – Grip results for the GAM, 2008



2010 Evaluation Campaign results

Table 3 – IRI results for the GAM, 2010

Range (m/km)	Length (km/mi)	%
0.0 – 1.0	7.3 / 4.6	0.7
1.0 – 1.9	66.4 / 41.5	5.9
1.9 – 3.6	268.3 / 167.7	23.9
3.6 – 6.4	407.0 / 254.4	36.3
6.4 and up	371.8 / 232.4	33.2

0.7% 5.9%

23.9%

36.3%

33.2%

- 0 - 1.0
- 1.0 - 1.9
- 1.9 - 3.6
- 3.6 - 6.4
- 6.4 & up

Table 4 – GRIP results for the GAM, 2010

Range GN	Length (km/mi)	%
0.0 – 0.5	40.5 / 25.3	16.7
0.5 – 0.6	45.4 / 28.4	18.7
0.6 – 0.78	77.9 / 48.7	32.0
0.78 and up	79.4 / 49.6	32.6

16.7%

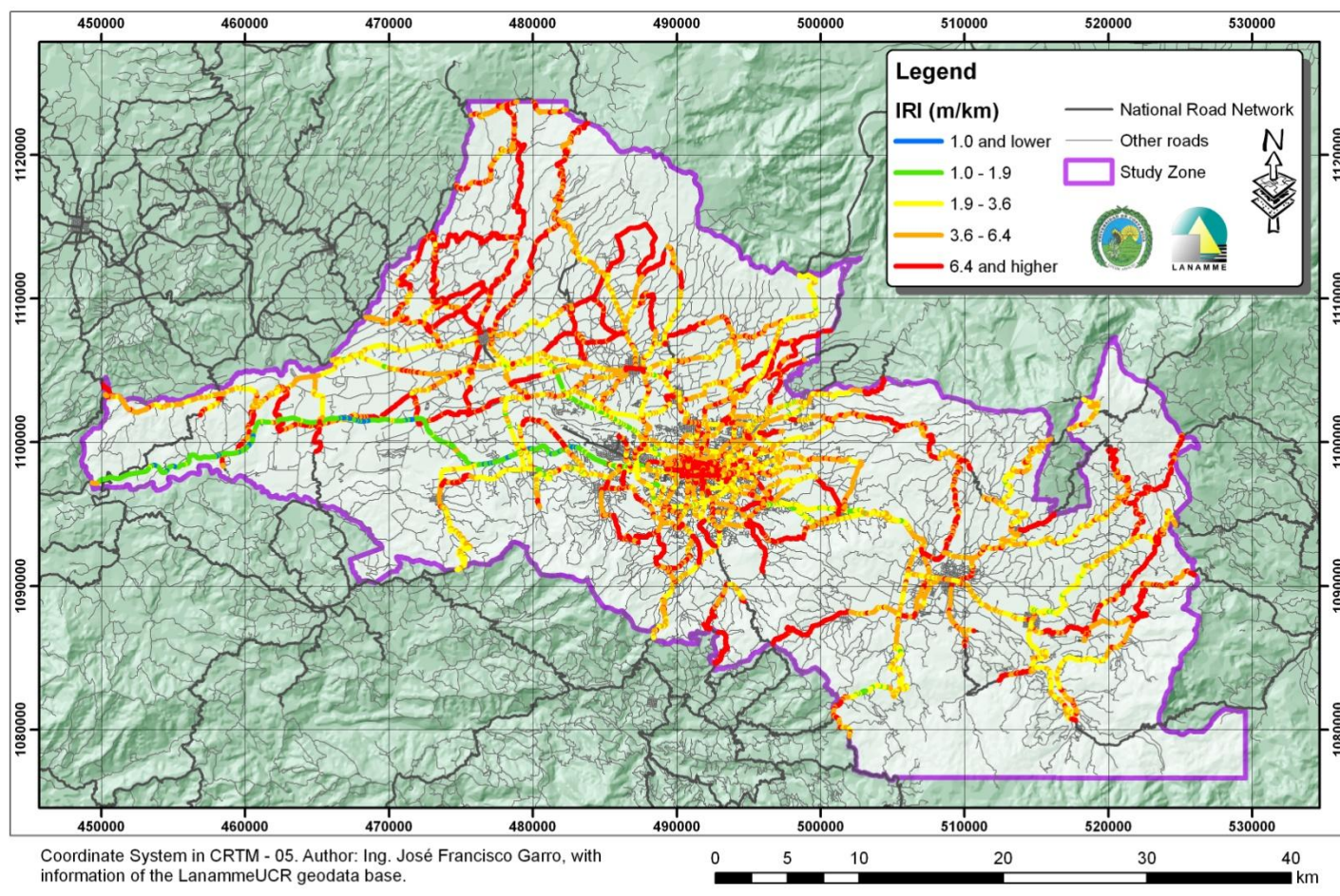
18.7%

32.0%

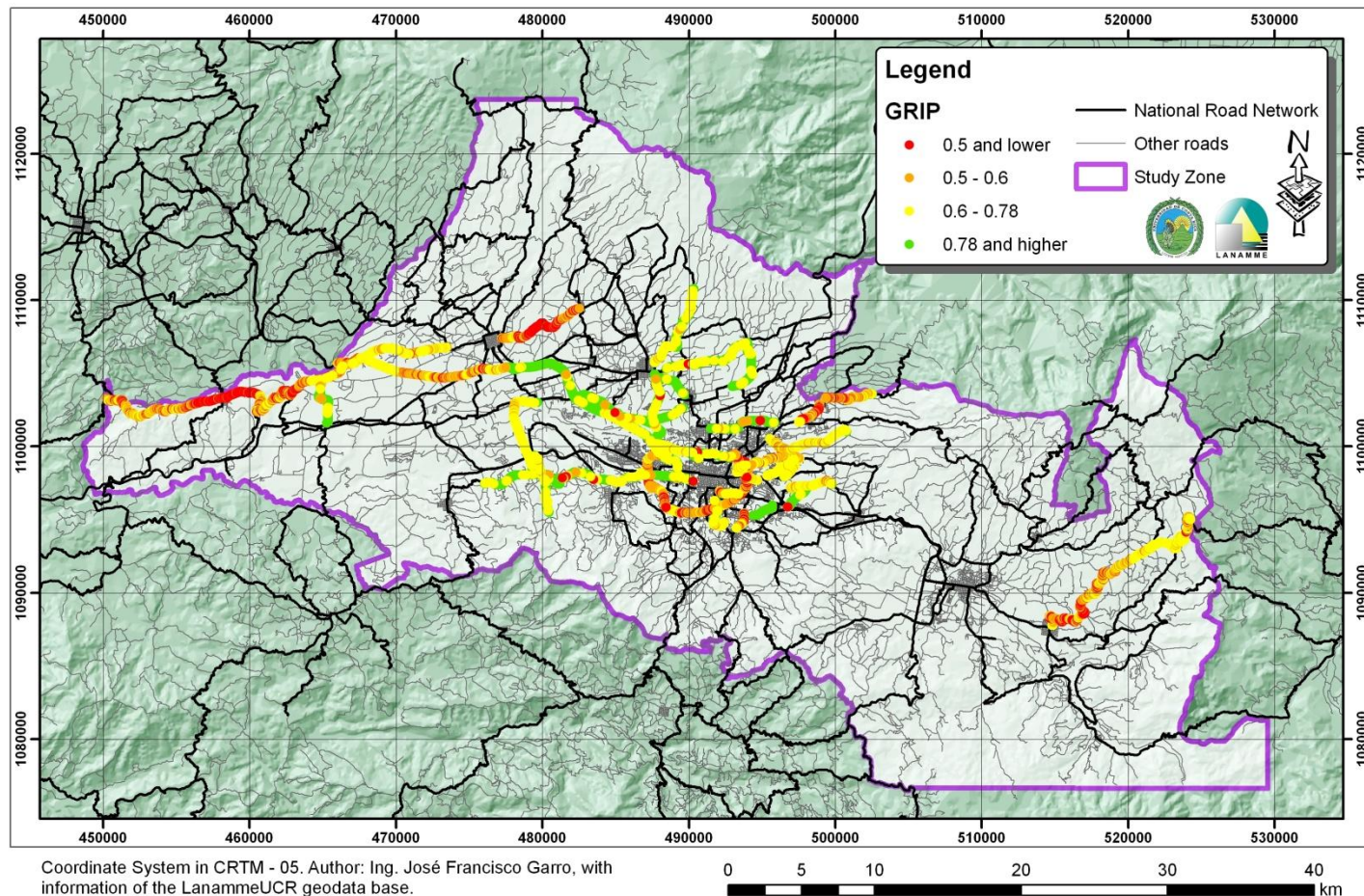
32.6%

- 0.0 - 0.5
- 0.5 - 0.6
- 0.6 - 0.78
- 0.78 and up

2010 Evaluation Campaign results



2010 Evaluation Campaign results



Results

- **Comparing data of 2008 & 2010 evaluation campaigns, it is revealed a slight change in IRI levels, always with a tendency towards deterioration of the road network.**
- **However, and despite the few maintenance interventions made in this period, this network shows drastic changes in GRIP levels as seen in the graphics shown.**
- **The SIG data generated confirmed this, with big improvements of grip levels in many roads evaluated, and massive loss in a small percentage.**

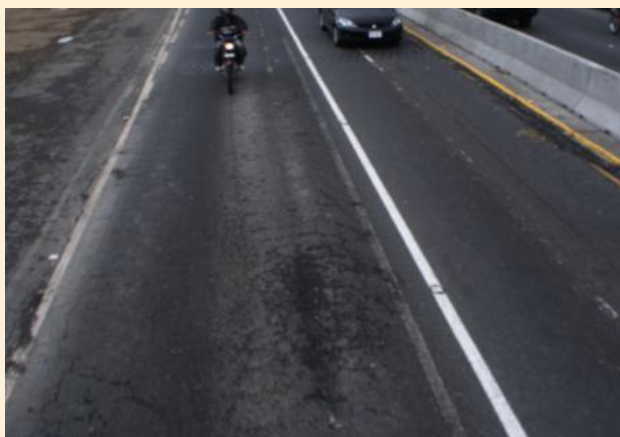
Results

- **Using the SIG databases created for both 2008 and 2010 campaigns, it was possible to identify roads with this drastic changes in GRIP levels.**
- **The data was uploaded to the GPS handhelds, and field trips were made for assess the local and real deterioration levels.**
- **A total of 45 points were visited, choosed randomly, and the results were documented in a new geodatabase for future studies and tracing.**

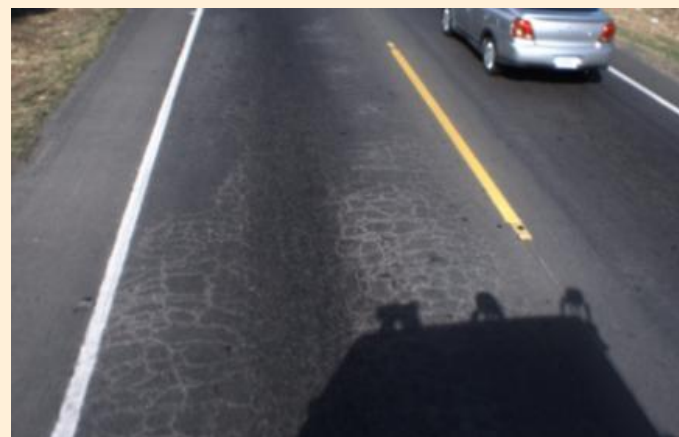
1. Deterioration & improve in GRIP levels

- **The findings made, reveals advanced deterioration levels in 33 sites visited, covering:**
 - **Small density cracking in large areas,**
 - **Medium to high density cracking in some spots,**
 - **Stripping of aggregates, &**
 - **Raveling of aggregates**
- **Thus, the improve in GRIP levels are artificial and temporary, moustly due to the increase of the functional deterioration than to improvements in the quality of the road surface.**

Deterioration and improve in GRIP levels



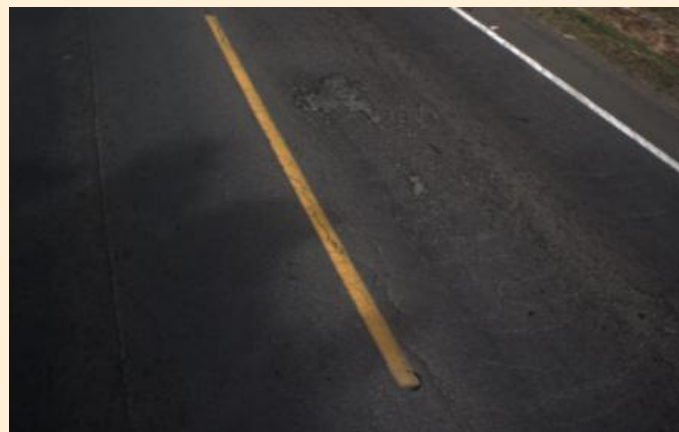
Severe cracking, stripping and raveling in only 1 lane



Severe cracking and loss of aggregate in 1 lane only



Cracking and covered pot holes

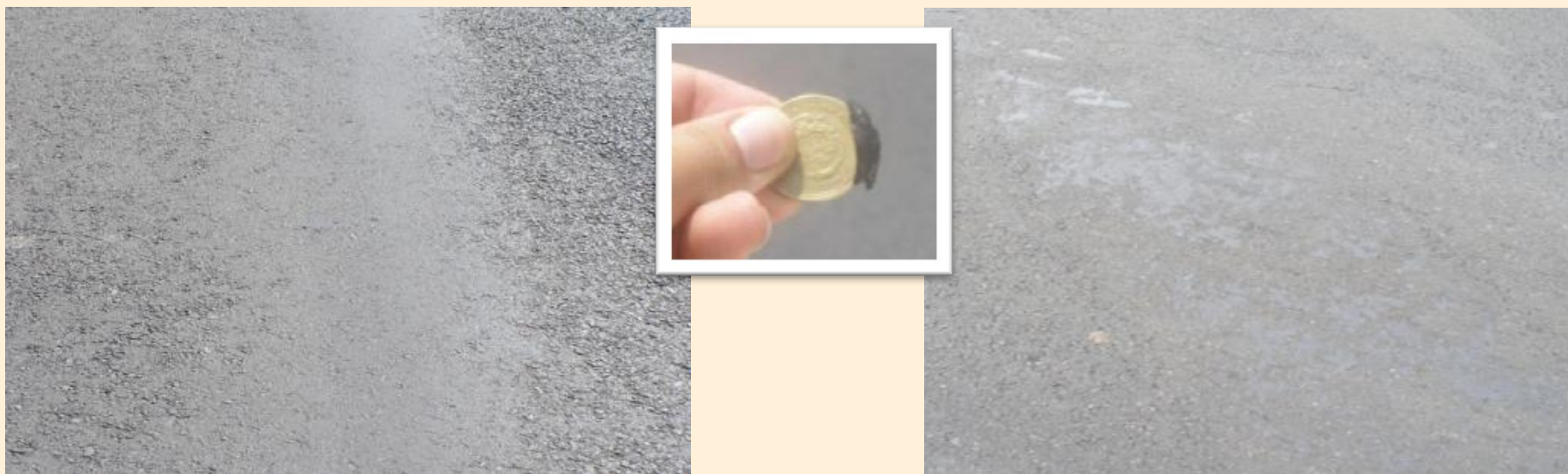


Cracking, stripping and raveling, incipient pot holes

Deterioration and reduction in GRIP levels

- **The findings made in the others 12 sites, indicates advanced deterioration levels, covering:**
 - **Bleeding, &**
 - **Exhudation in many levels**
- **This creates high levels of danger for the vehicles and their users, because of the slipery surface and the high probability of accidents associated, specially with rainy conditions so normal in Costa Rica**

Deterioration and reduction in GRIP levels



Severe bleeding and exudation. Route 27.

Conclusions

- **With the comparison of the IRI data for the 2008 and 2010 IRI campaigns, the GAM National Road Network present a slight tendency toward deterioration.**
- **However, in the same period, an important part of this network shows changes in GRIP levels, despite a lack of maintenance / reconstruction records for the same time.**
- **Most of the changes observed, show an improvement in the GRIP levels, when comparing 2010 data with the 2008 data**

Conclusions

- **Using SIG databases, these roads were tagged and field trips made.**
- **As observed, the major part of these roads shows deterioration levels only seen in much older roads.**
- **Cracking due to fatigue, stripping and raveling of aggregates improves (temporary) grip levels.**
- **Bleeding and exudation decrease.**

Conclusions

- **According to LanammeUCR investigations, the main causes could be:**
 - **Bad asphaltic mix design**
 - **Bad materials choice (aggregate type, granulometry)**
 - **Bad mixing techniques at the plant**
 - **Inadequate constructive techniques**
 - **Lack of runoff water control structures in almost all national roads**

Recomendations

- **Because this is the first comparison between 2 consecutive GRIP evaluation campaigns, this study was made for determine the main causes of the changes in grip levels, in an empirical way.**
- **Actually, the 2012 National Road Network evaluation campaign is being performed by the LanammeUCR**

Recomendations

- **With the database created with this project, and the most recent data of the 2012 campaign, the roads tagged will be monitored in a statistical way, as part of a formal investigation work.**
- **This as a tool for improve the maintenance practices made by the Administration on the National Road Network.**

Thanks!

Questions
Comments