

Personal Exposure Assessment for Transportation Modes

La Paz, Bolivia

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Sustainable Development Goals (SDGs)

- Revised version of Millennium Development Goals (MGDs) written in 2000
- UN Member State directive to improve sustainability and quality of life



SDG Indicator: Urban Air Quality

- Calls for the monitoring of $PM_{2.5}$ in all urban areas with a population of or exceeding 250,000
 - $PM_{2.5}$ = Particulate Matter with a diameter less than or equal to 2.5 microns



SDG Indicator: Urban Air Quality

- Estimated that over 1 million premature deaths can be attributed to urban ambient air pollution
- Monitoring is cost prohibitive for many municipalities, particularly those in Lower to Middle Income Countries (LMICs)

Circumstances in La Paz, Bolivia

- One of three cities over the SDG population threshold (>250,000)
 - Total population over 800,000
- Other cities quickly approaching threshold
- Limited access to the resources needed to implement monitoring networks





Our Partners

- Universidad Mayor de San Andres (UMSA)
- Informed us that traffic and point source pollution are the largest factors affecting air quality in La Paz



Research Interests

- Compare personal exposure levels on a variety of transport modes in La Paz
- Measure pollutant concentrations linked to transit
 - Particulate Matter (PM)
 - Black Carbon (BC)
 - Carbon Monoxide (CO)
- Focus on low cost measuring devices

Low Cost Equipment

Particulate Matter: Dylos



- Price: \$425
- Reference Price: \$5,000+
- Limitations: Measures bin sizes >0.5 μm and >2.5 μm

Black Carbon: MicroAeth



- Price: \$6,000
- Reference Price: \$20,000+
- Limitations: decrease of sensitivity with particle build-up on filter

Carbon Monoxide: Lascar EL USB



- Price: \$125
- Reference Price: \$4,000+
- Limitations: 0.5 ppm detection limit

Limitations

- Time and equipment availability was limited
- All modes of transportation could not be simultaneously assessed with only two sets of monitoring equipment
- Battery life limited the length of experimentation





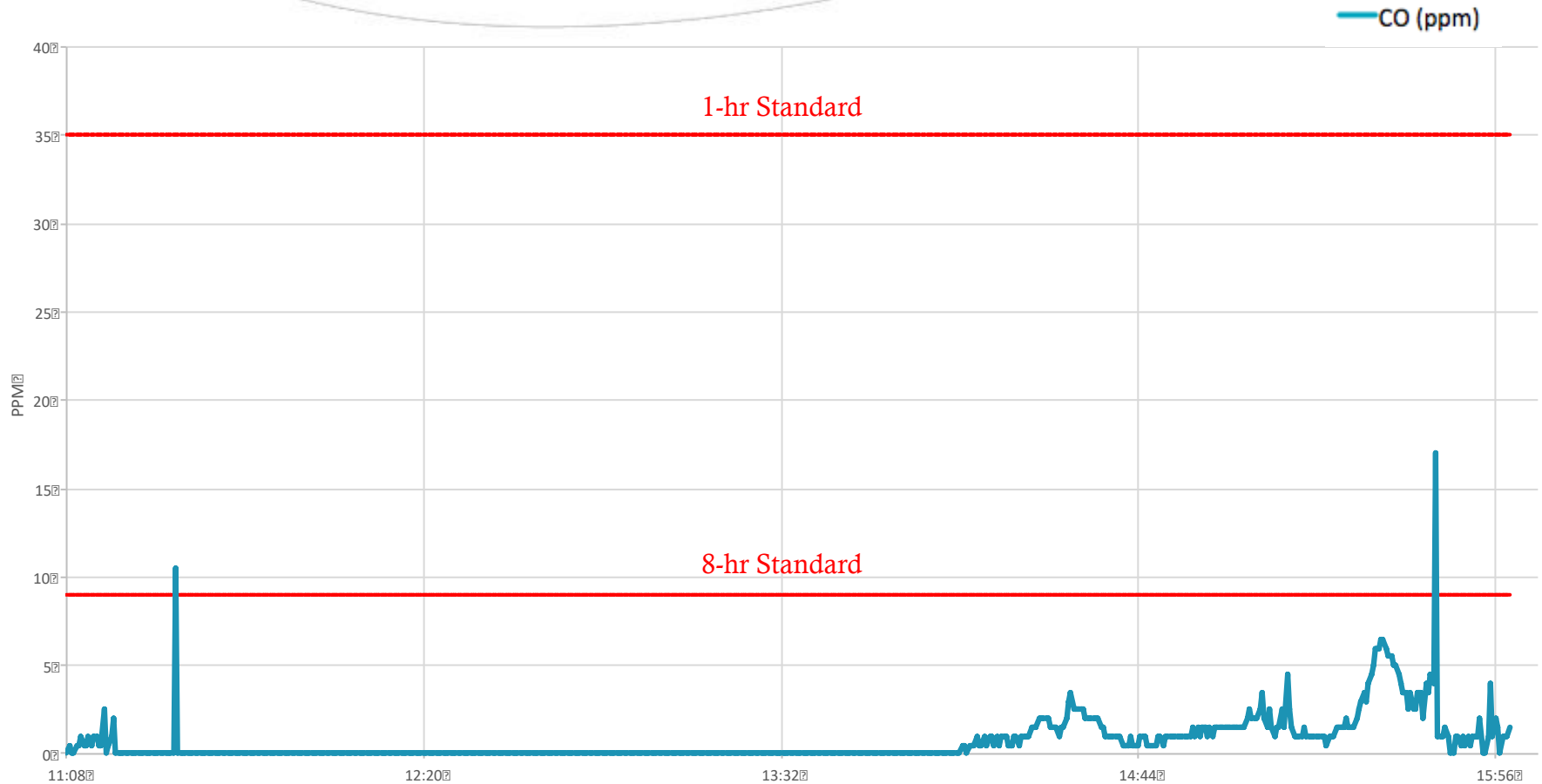








Chacaltaya CO Graph



Comparing Modes of Transportation

Ground Transportation



Teleférico



Teleférico



- La Paz located in a bowl with residential El Alto on the rim
- Popular commute from El Alto to La Paz
- Teleférico runs between the two cities
- Currently three lines: yellow, green and red
 - Focused on yellow line, which commuters use to travel between La Paz and El Alto

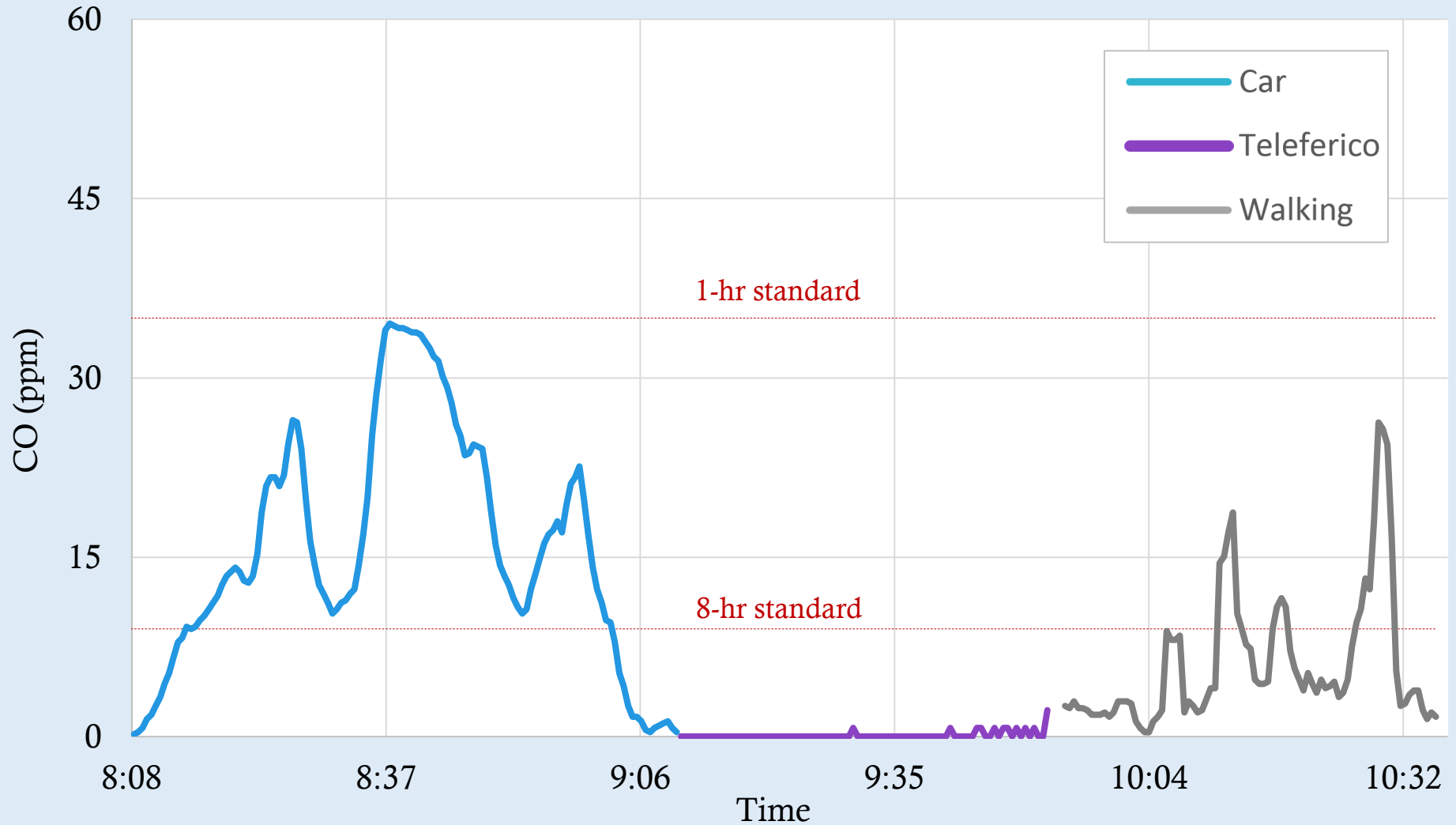


Comparing Personal Exposure

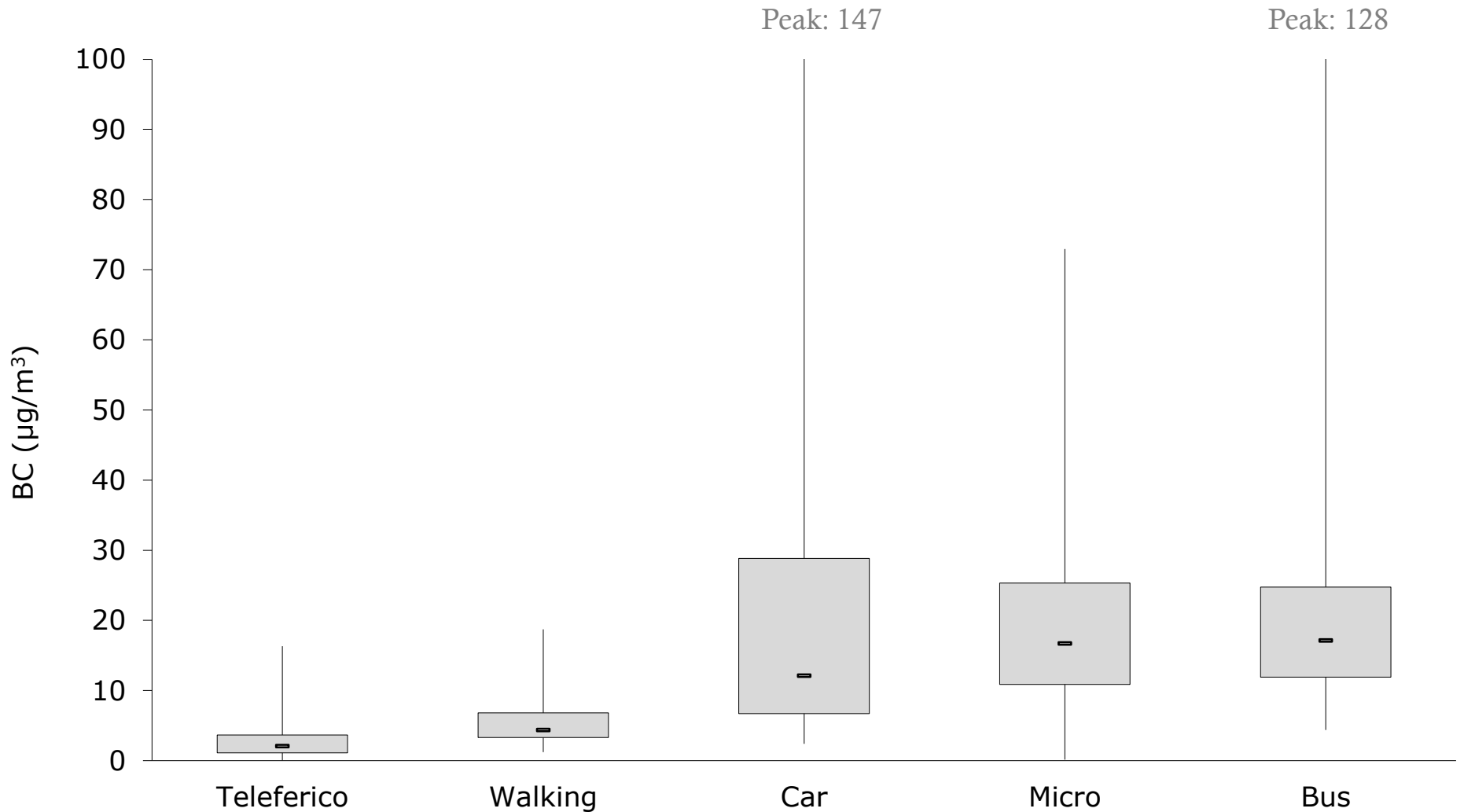
- Major transit forms:
 - Teleférico
 - Walking
 - Car
 - Microbus
 - Diesel Bus
- Measuring commuter exposure to PM, CO, BC
 - Focus on morning and evening rush hours



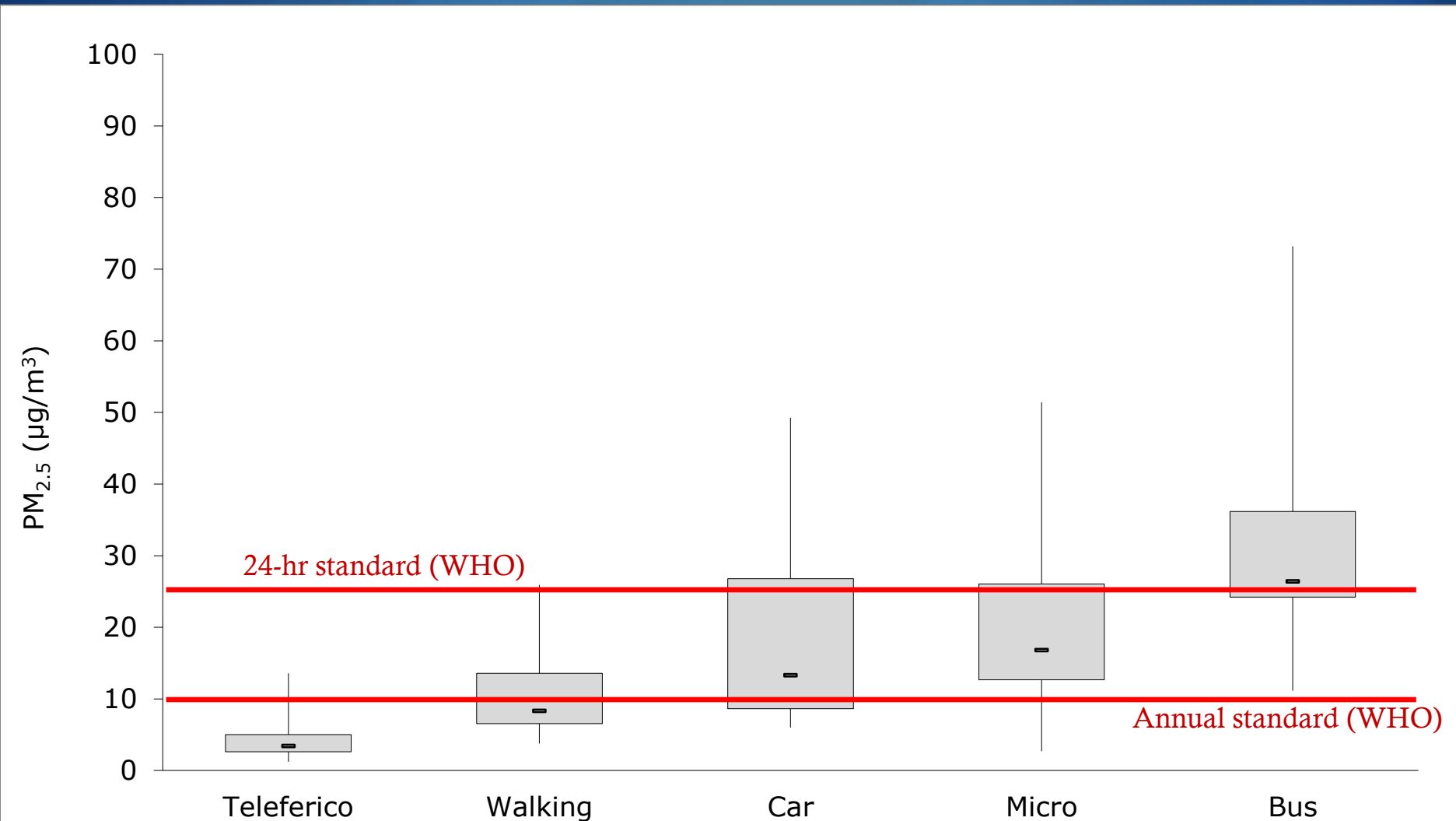
Transportation Comparison: CO Concentrations



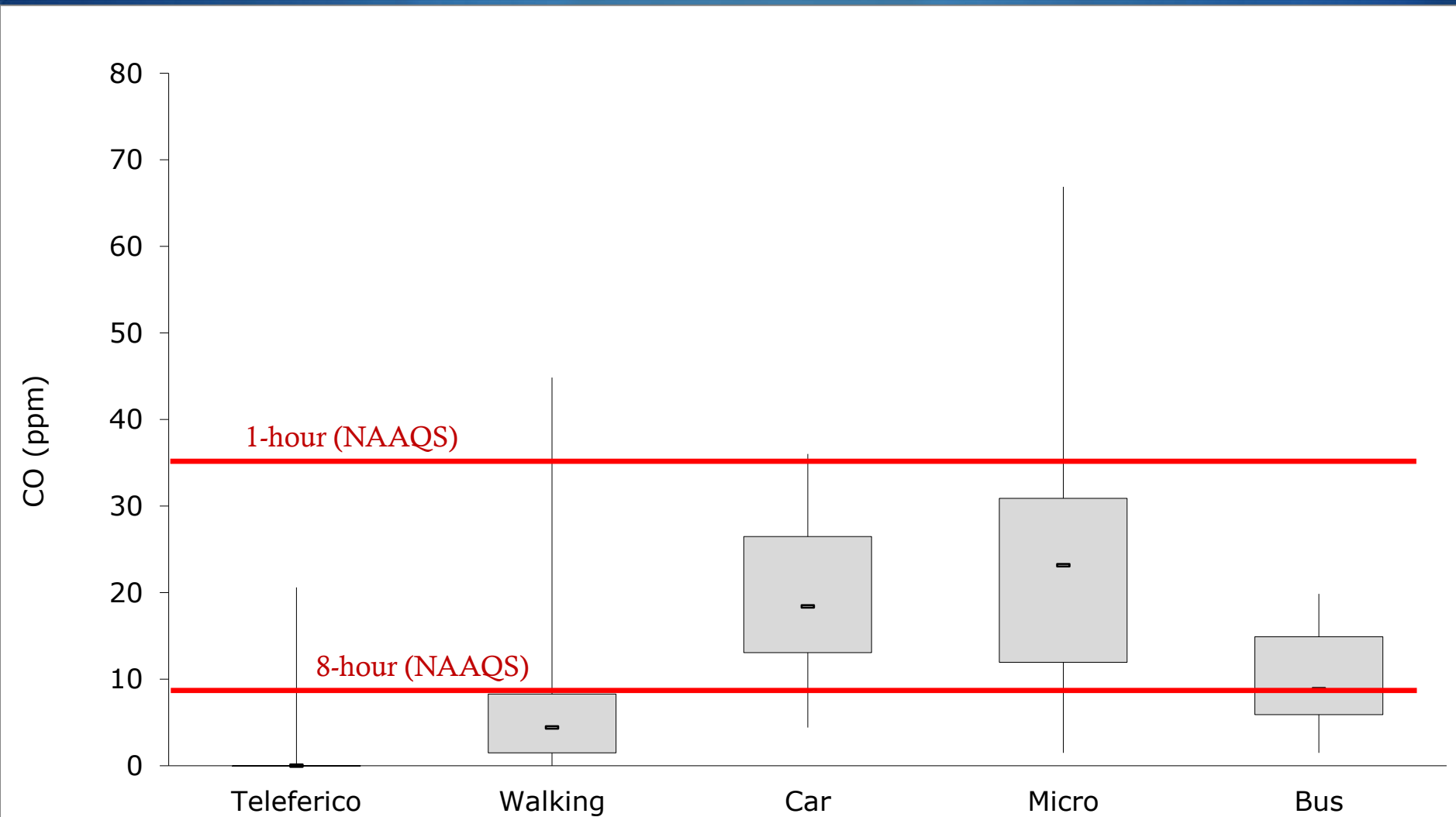
Black Carbon Concentrations by Mode of Transport



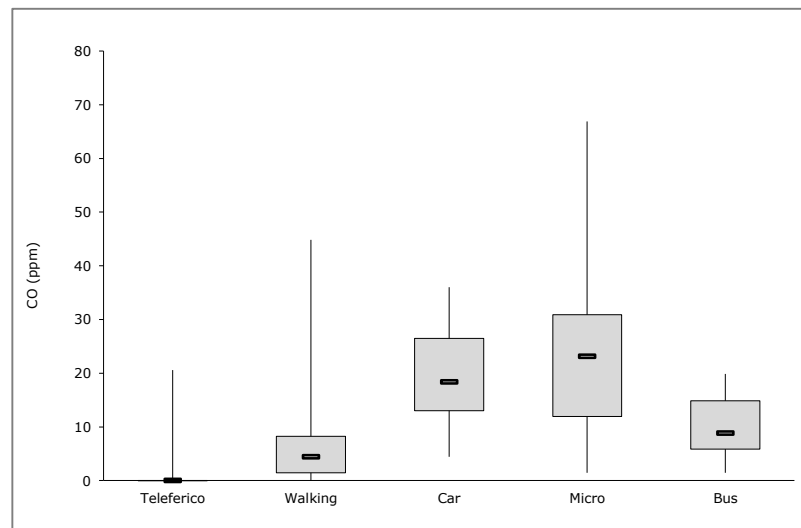
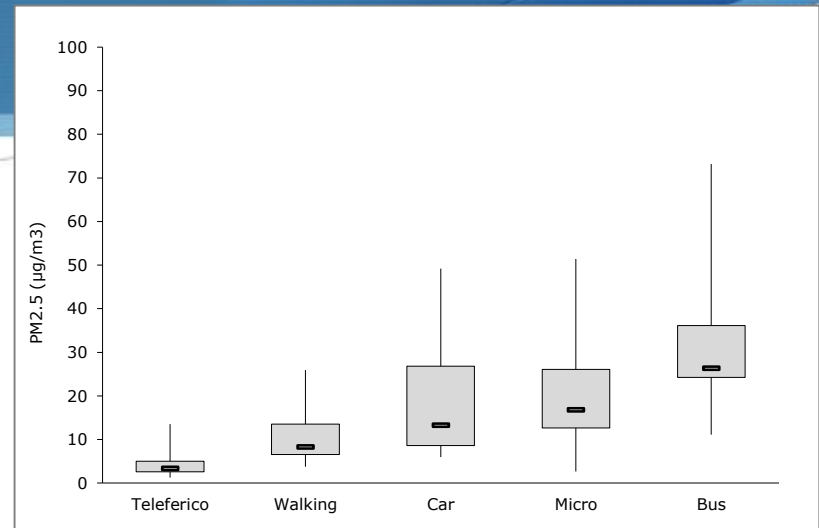
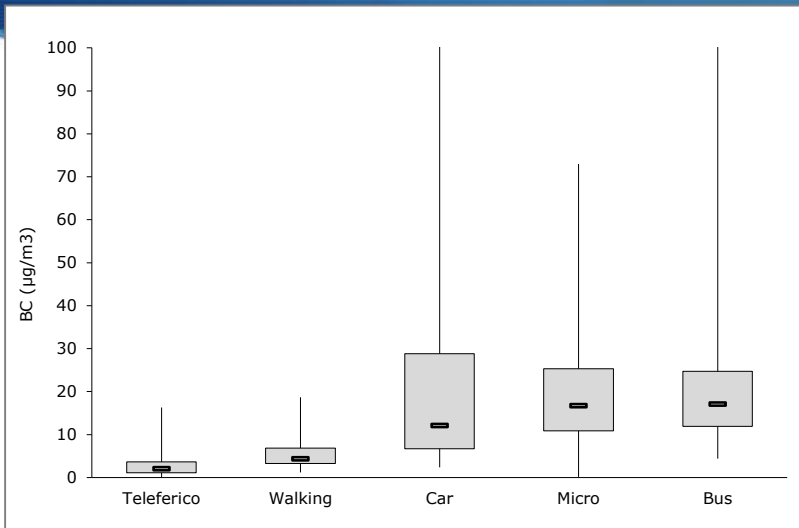
Particulate Matter Concentrations by Mode of Transport



Carbon Monoxide Concentrations by Mode of Transport



Comparison of Pollutant Concentrations







Mi Teleférico
UNIENDO NUESTRAS VIDAS



Inicio



Institución



Recursos Humanos



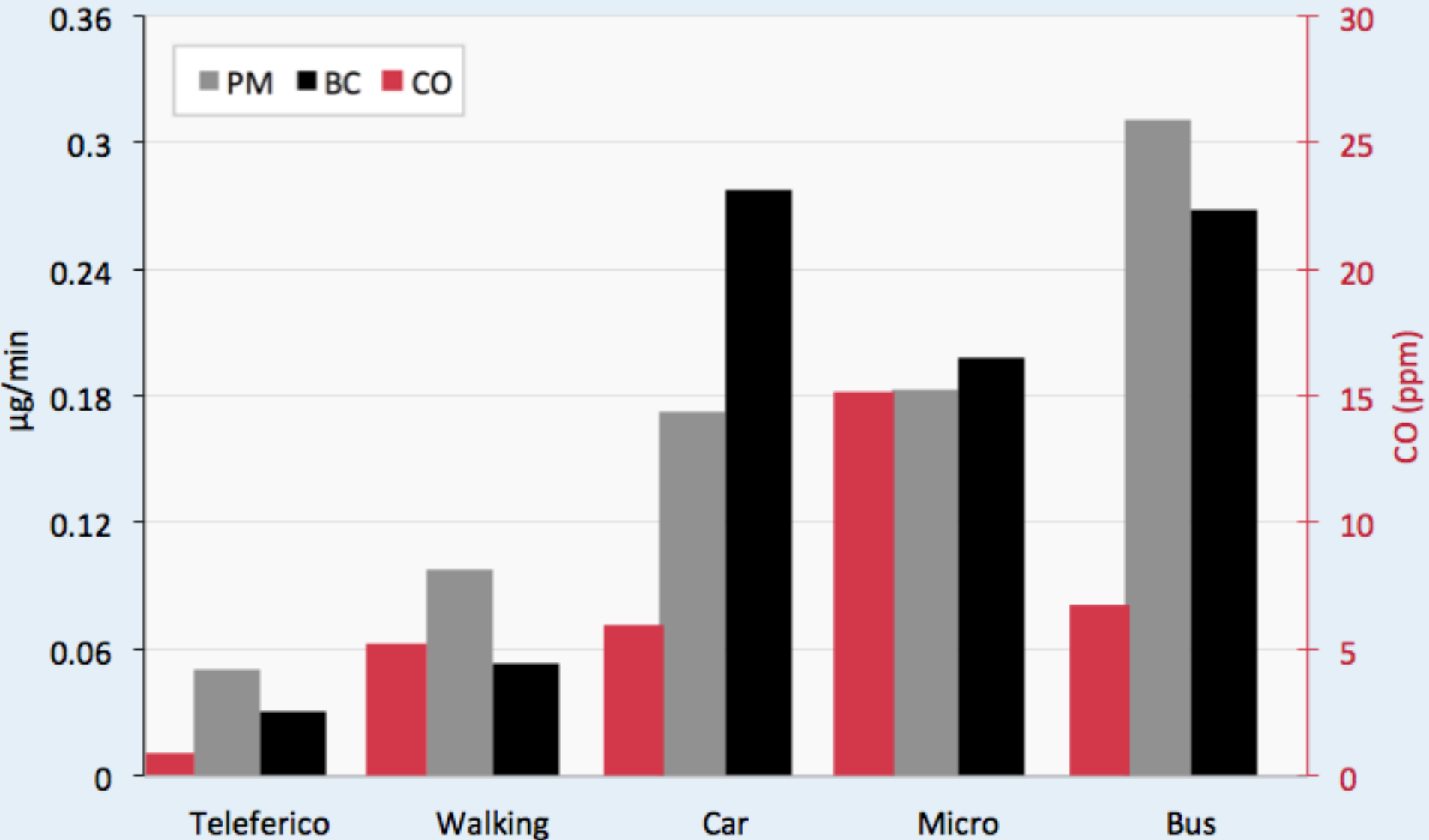
Contáctanos



EN MI TELEFÉRICO SE RESPIRA AIRE MÁS LIMPIO

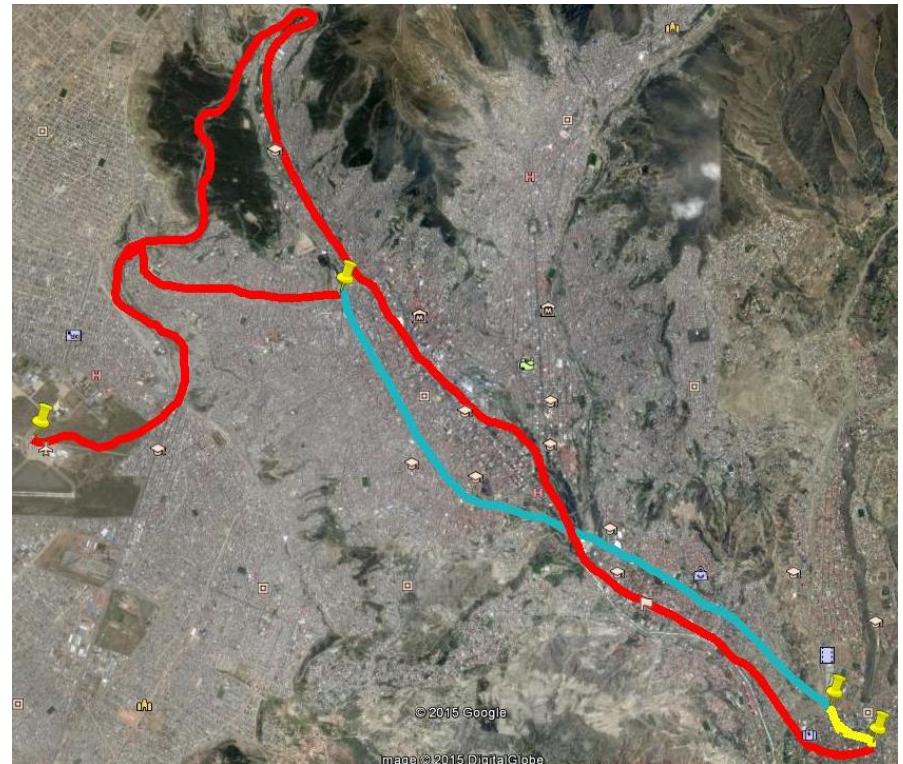
El Laboratorio de Física de la Atmósfera de la UMSA, junto a una universidad de Estados Unidos, llevó adelante un estudio piloto en Mi Teleférico sobre contaminación urbana para conservar la salud de la población....[Leer más](#)

Unit Personal Exposure

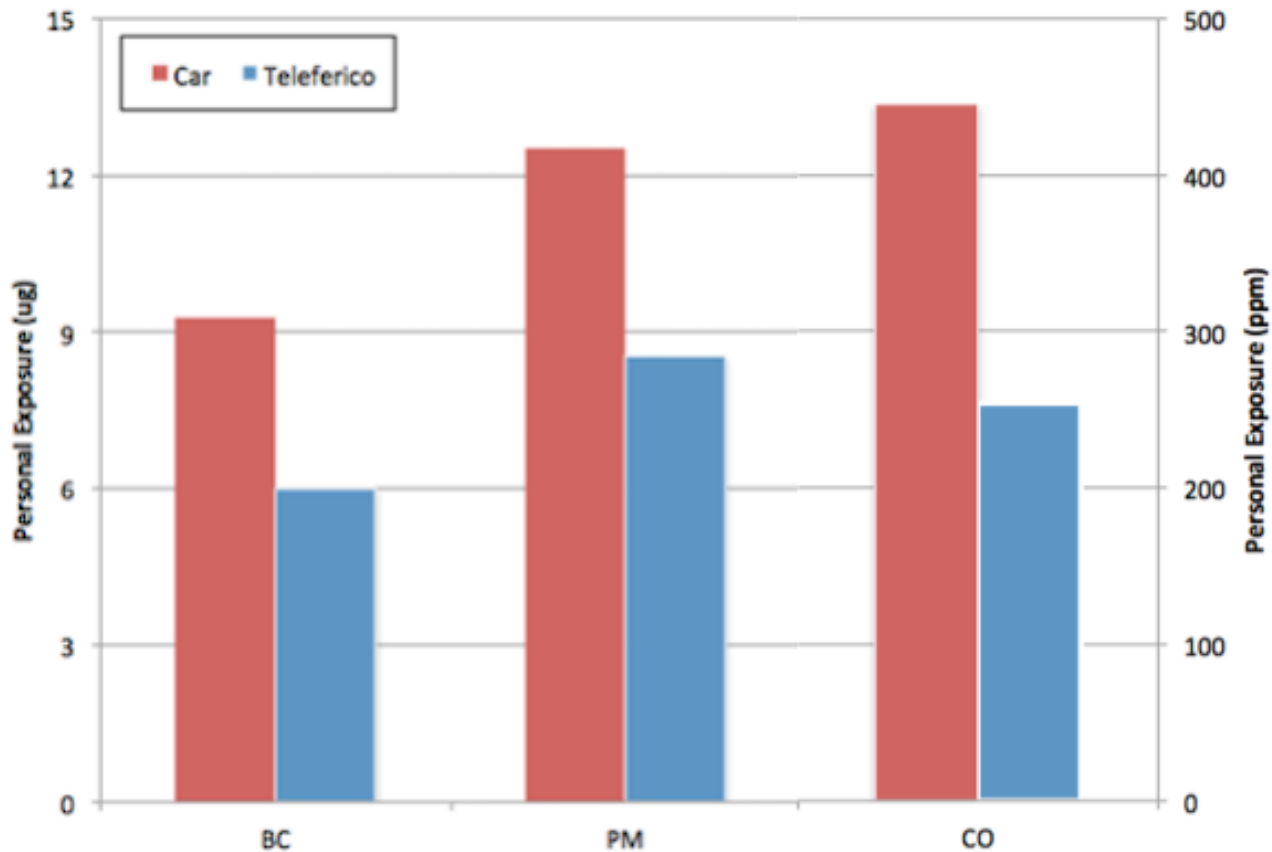


Commute Comparison: La Paz to El Alto

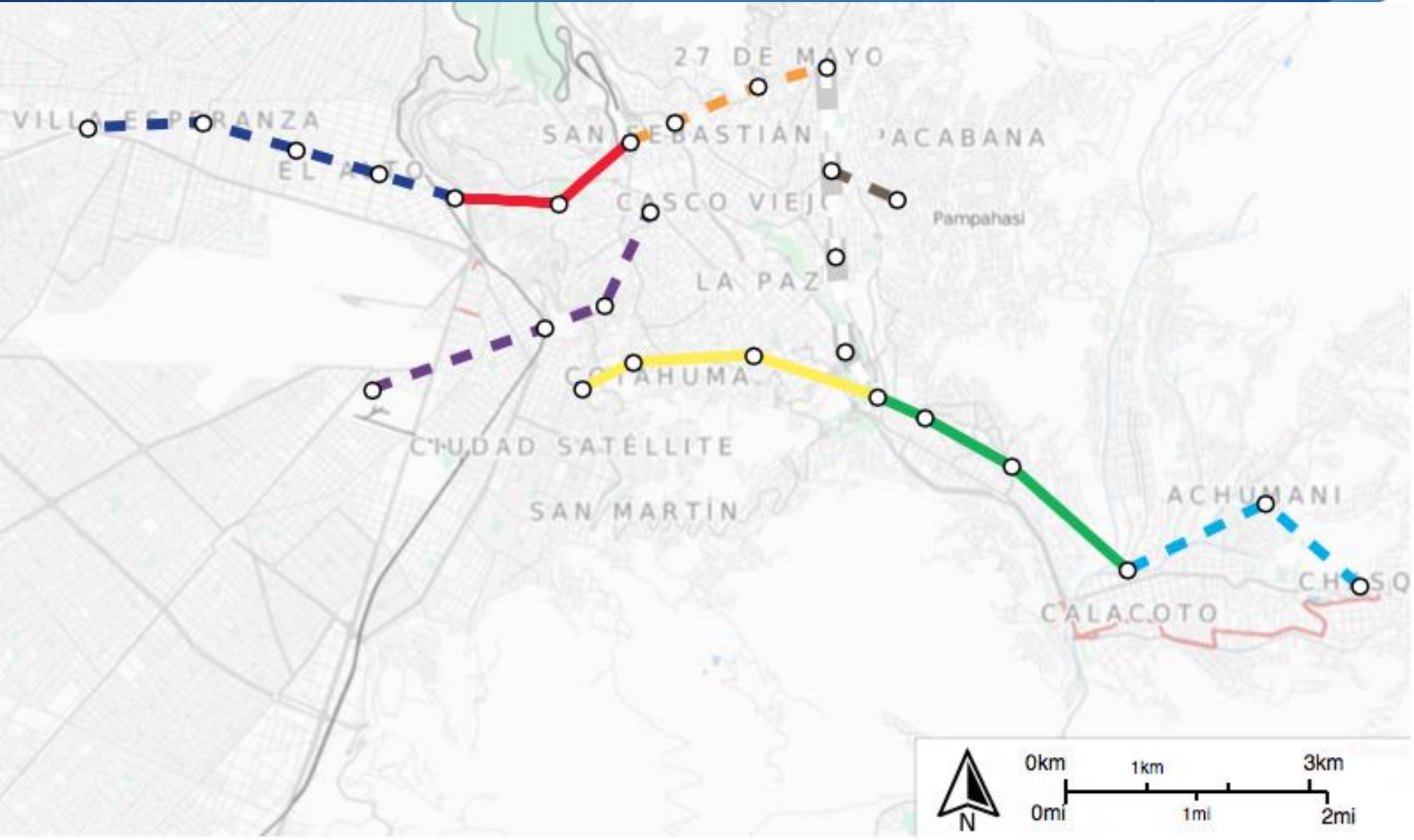
- **START:** Hotel Calacoto
- **END:** El Alto International Airport
 - **Car**
 - 35 minutes driving time
 - **Teleférico**
 - 4 minutes of walking
 - 34 minutes on Teleférico
 - 18 minutes driving time



Commute Comparison: La Paz to El Alto



Teleférico Expansion



Acknowledgements

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Questions?

