

Contents

List of Tables	ix
List of Figures	x
1. Introduction	1
1.1. Content of this document	3
1.2. Hypothesis of this Work	3
1.3. Main Objective	3
1.4. Specific Objectives	3
2. State of the Art	5
3. Background	8
3.1. Aerosols	8
3.2. Radiation in the Atmosphere	9
3.2.1. The Electromagnetic Spectrum	10
3.2.2. Radiation physics	12
3.2.3. Scattering and absorption physics in atmosphere.	15
3.3. AOD measurement instruments.	20
3.3.1. LIDAR	20
3.3.2. Satellite Radiometer	21
3.3.3. Sun Photometers.	22
4. Methodology	24
4.1. Instrument development.	25
4.1.1. Conceptual schematic design and subsystem definition.	26
4.1.2. Subsystems prototyping and operational verification of them.	27
4.1.3. Instrument Design	27
4.1.4. Instrument prototype	28
4.1.5. Instrument improvement	30
4.2. Components of the Sun Photometer.	30
4.2.1. Sun Photometer sensor.	31
4.2.2. Robotic Arm Shield	32
4.2.3. Logger Shield and Arduino Uno Controller.	33
4.3. Measurement protocol of an instrument.	33
4.4. Comparison with Toledo et al. (2018) instrument.	34

4.5.	Measurement procedure	34
4.5.1.	Langley plot procedure	36
4.5.2.	Parameter fitting with Cimel measurements	37
4.6.	Measurement campaigns	39
5.	Results	41
5.1.	Langley plot and Calibration Results Comparison.	41
5.2.	Measurement's errors characterization.	43
5.2.1.	Measurement errors compared with Cimel.	43
5.2.2.	Consistency among all our instruments.	44
5.3.	Measurement Campaigns.	48
6.	Discussion	57
6.1.	Instrument's calibration and consistency.	57
6.2.	Distributed measurement discussion.	59
6.3.	Challenges and future considerations.	60
6.3.1.	Ångström exponent estimation error.	61
6.3.2.	Increasing the robustness of the instrument.	62
	Conclusion	64
	Bibliography	66