

GROUND BASED MEASUREMENTS
OF ATMOSPHERIC INFRARED
RADIATION FROM CLEAR AND
CLOUDY SKIES

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THESIS

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IN THE NAME OF ALLAH, MOSTMERCIFUL MOST COMPASSION

DEDICATION

THIS THESIS IS DEDICATED TO

THE

MEMORY OF MY MOTHER, WHO PASSED AWAY

NOVEMBER 2006,

BEFORE I COULD COMPLETE THIS THESIS

TO MY FATHER

TO MY WIFE FATEN AND MY TWINS, ABDUL MAJEED AND

MARAWA

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Originality Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Signed Dated.....9/05/2007...

Abdullrahman H. Maghrabi BSc, MSc

ABSTRACT

This thesis presents results for the infrared (IR) sky temperature measurements using IR thermopile detectors (wavelength peak at 10 μm) at 6 locations around the globe: Adelaide; Australia, Riyadh, Jeddah, Abha and Tabouk; Saudi Arabia, and the Piere Auger observatory site; Argentina. Based on these measurements empirical models for predicting hourly night-time IR sky temperatures clear skies have been developed.

These models showed very good performance and better prediction to the measured sky temperatures. Some of these new models showed excellent predictive power for the presence of the cloud over the site. It was found that under some extreme conditions other factors, e.g. aerosols, have great influence on the atmospheric radiation and need to be accounted for. MODTRAN software was used to give the theoretical justifications for the proposed models and was used to investigate some of these factors. A unified model for clear sky temperature from all the sites was found. The applicability of some existing clear sky models to the sites was also tested. While some of them were adequate for estimating IR sky temperatures, others were not.

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Nomenclature

Some of the variables used throughout this thesis are, occasionally, defined and abbreviated differently from one place to another. In order to make the definitions of these variables clearer and help the reader to remember them, the author has therefore added this section. The most commonly used variables in the thesis which are used with different symbols are:

- $T_{sky}, T_{sky}, T_{-sky}$. \rightarrow Sky Temperature.
- $Sqrt(eo)$ or \sqrt{eo} \rightarrow where eo refers to the vapor pressure, ground level vapor pressure, water vapor pressure or screen level vapor pressure.
- $T_{air}, Ta, T, T_{air}, T_a$ \rightarrow Air temperature alternatively referred to as screen level air temperature, or ground level temperature.