Explaining Natural Phenomena with the aid of Near Infrared Light

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1. Introduction

Infrared radiation (also called infrared light) is electromagnetic radiation with longer wavelengths than those of visible light as it covers a range from 300GHz to 400THz (1mm-750nm). One of its spectral regions is the so called Near-infrared covering from 120-400THz (1.100-700 nm). The infrared light that we observe in this region is also thermal (due to heat radiation), so the objects are studied on how they reflect, transmit and absorb the Suns' Near-infrared radiation to observe health of vegetation, soil composition [2] or to even make new discoveries such as the Infrared rainbow (Robert Greenler, 1971). This research focused on the reflectance of Near-infrared radiation and experiments were carried out with a digital camera that was suitably converted so as to be sensitive solely to the NIR spectrum and not to the visible light. The aim of the study was to observe and examine phenomena that are otherwise invisible to the human eye.

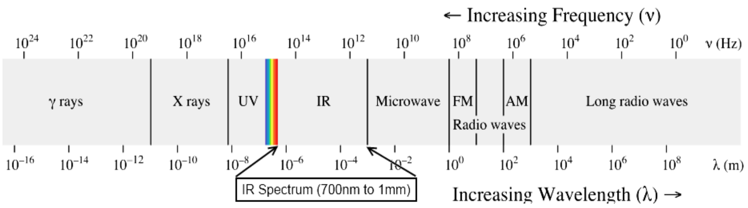

Figure 1-The electromagnetic spectrum

2. Research Methods

Near IR can be easily detected by spectrometers, by many types of solid state sensors for infrared photography and by photographic film. In this study a Samsung ES15 (10,2 Mp) was initially used to capture and analyze infrared photographs after having removed the infrared filter located in the front of the sensor and replacing it with a piece of exposed negative photographic film, thereby allowing infrared wavelengths to pass through the lens to the imaging sensor. With the aid of this camera we can easily discern the presence of plants, the infrared portion of the rainbow or objects of high temperature (in utter darkness), whose temperature is the cause of their electromagnetic radiation or just thermal radiation.

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3. Results

Leaf and Canopy reflectance: The reflectivity of plants is due to the properties of their foliage, their internal structure and their biochemical components. In the Near-infrared spectrum, where absorption by photosynthetic pigments such as chlorophyll and carotenoid is declined, the reflectance magnitude is dominated by structural discontinuities found in the leaf. Part of the light energy absorbed for photosynthesis is converted to fluorescence and heat [1]. Changes in the photosynthetic rate cause alterations in fluorescence emission, thus making it possible for us to access the plant's photochemical efficiency and photosynthetic performance, which entails its health and productivity [3]. Healthy vegetation absorbs blue- and red-light energy to fuel photosynthesis and create chlorophyll. A plant with bigger concentration of chlorophyll implies bigger reflection of NIR energy than an unhealthy plant [2], [4].

Thermal radiation of objects: Any object that radiates heat emits infrared radiation. The wavelength at which an object radiates the most depends on its temperature. According to Wien's law of displacement the smaller the temperature of the object, the bigger the wavelength (smaller frequencies). Therefore, knowing that our camera records the NIR light, we speculate the temperature of the recorded object.

4. Conclusion

Spectral reflectance of Near-infrared radiation can provide an alternative way of assessing pigment composition to diagnose possible stress conditions or determine the amount of pest-, pathogen-induced damage or to detect even celestial objects like red dwarfs and red giants or exoplanets due to their emitted heat.

5. References

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