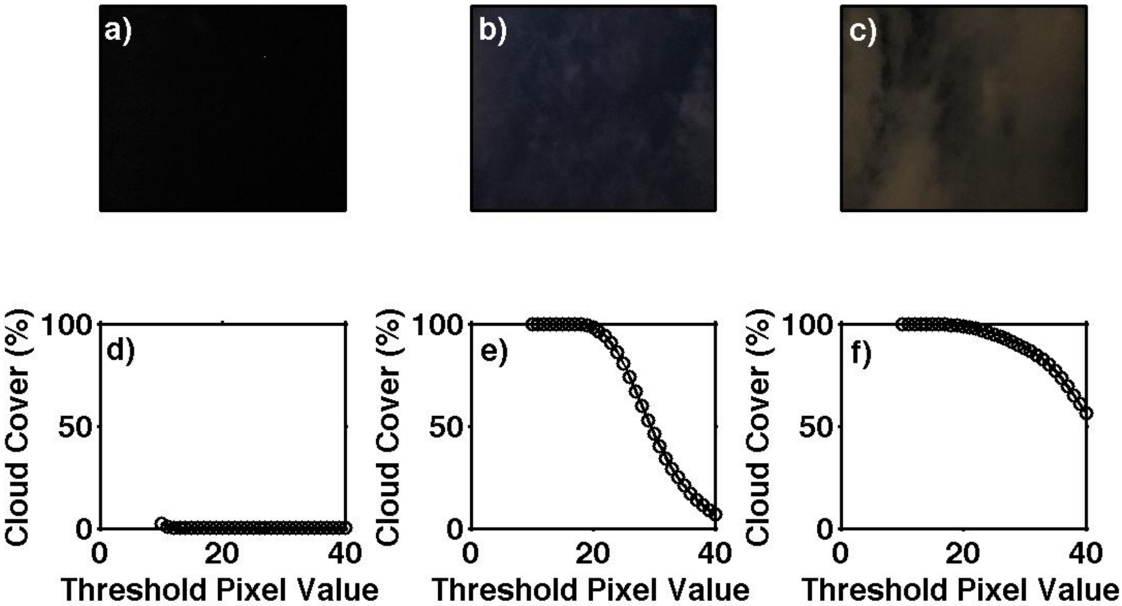
Observations of night time cloud cover sensitivity measurements with changes in threshold pixel values

*Nofel DelaCruz Lagrosas[1,2], Glenn Franco Barroso Gacal[1,2]

1.Manila Observatory , 2.Ateneo de Manila University

Detection of night time clouds is carried out in Manila Observatory (14.64N, 121.07E) for the purpose of measuring cloud cover at night time since late of 2014. A digital camera (Canon A2300 Powershot) is used to take images of sky every 5 minutes. Images are taken at 5s exposure time. The digital images, which are in standard RGB format, are converted to grayscale format for cloud detection analysis. Cloud detection is possible by setting a threshold pixel value that discriminates clear from cloudy sky. Previous study has shown that a threshold pixel value of 17 can be used for cloud detection (Gacal, et al, 2014). Cloud cover is defined as the ratio of the sum of the number of pixels identified as having cloud signals to the sum of the total number of pixels in the image. Cloud cover measurement has impacts on the radiation budget in the atmosphere even during night time. High cloud cover of thick clouds covering majority of the sky tend to reflect back radiation from the earth’s surface. Thin clouds, on the other hand, may transmit earth’s radiation to space and reflect less. In an ordinary image of night sky, the image may contain thick and thin clouds. In this work, we define a thick cloud in the image as cloud without any clear dark background. The images of thin clouds have visible dark background. For the purpose of quantifying cloud cover from thin and thick clouds, we present in this study the effects of varying threshold pixel value used in cloud detection algorithm on the calculation of night time cloud cover. Figs. 1a-c show images of clear sky, thin cloud and thick clouds taken on 12 January 2016 at 03:05, 22 December 2015 at 05:40 and 16 January 2016 21:15 local time, respectively. Local time is 8 hours ahead of coordinated universal time (UTC). Histogram of pixel values of clear sky image shows that maximum pixel value is 16 and can be used as a threshold value for discriminating clear from cloudy skies in the cloud detection algorithm. When this threshold value is changed from 10 to 40, cloud cover values also change. At threshold pixel value of 10, cloud detection algorithm applied to clear sky outputs ~3% cloud cover but rapidly decreases to zero for higher pixel values (Fig. 1d). When the algorithm is applied to thin cloud image, a sharp decrease of cloud cover values is observed for threshold pixel value > 20 but almost 100% cloud cover for threshold pixel value < 20 (Fig. 1e). From visual inspection of the image, a near 100% cloud cover is evident. The near exponential decrease of cloud cover values is a common characteristic when threshold pixel value is changed for images with thin clouds. Thus, without any idea of the image, this exponential decrease of cloud cover trend can be used to indicate that the image is dominated by thin clouds. When threshold pixel values are changed in the cloud detection algorithm and applied to images with thick clouds, the decrease of cloud cover values is not as sharp as in the case of thin clouds. Fig. 1f shows the non-exponential decrease of cloud cover values with threshold pixel value change. The graph shown is Fig. 1f is also a characteristic graph for thick clouds. Thus, the non-exponential decrease can be used for determining presence of thick clouds in the image without inspecting at the image. Images of rain clouds are extreme examples of thick clouds. When images of these types of clouds are processed using the same algorithm and changing threshold pixel value from 10 to 40, resulting cloud cover values do not change and are at 100%. This is expected since pixel values of thick clouds are usually in the range of 47 to 111.

Keywords: Night time clouds, Pixel value, Cloud cover


a)
b)
c)
d)
e)
f)
Cloud Cover (%)
100
50
0
0
20
40
Threshold Pixel Value