

Removal of ship mast contribution from MAGIC Total Sky Imager fractional sky cover retrievals



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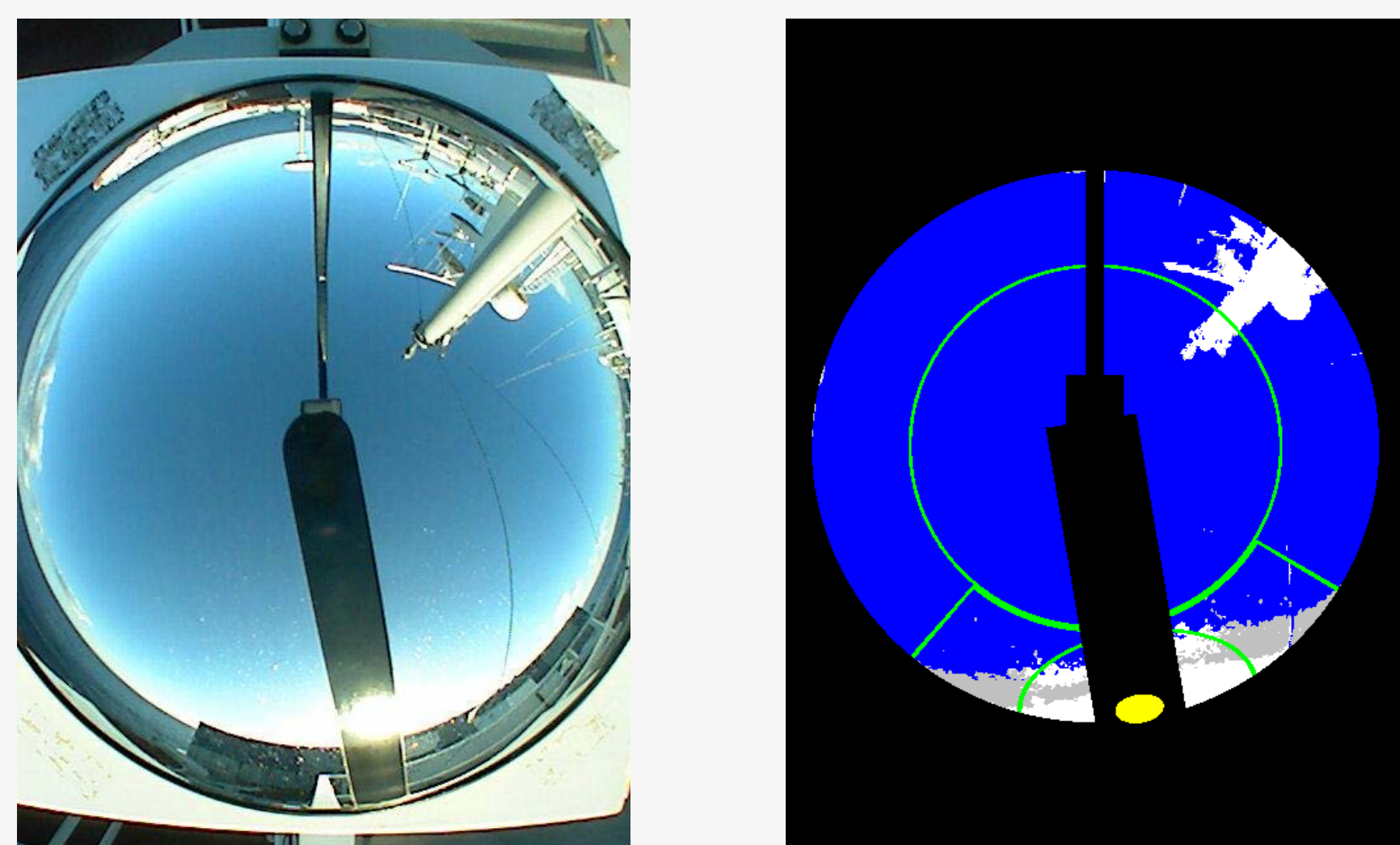
Introduction

The Marine ARM GPCI Investigation of Clouds (MAGIC) aimed to improve observations of the stratocumulus to shallow trade-wind cumulus transition. These subtropical marine boundary layer clouds play an important role in the earth's radiative balance, albedo, and surface evaporation.

The second ARM Mobile Facility (AMF2) was deployed aboard the Horizon Lines cargo ship *Spirit* to gather atmospheric observations on transit routes between Los Angeles, California and Honolulu, Hawaii from October 2012 to September 2013. Among the suite of instruments deployed, the Total Sky Imager (TSI) captured hemispheric images of the sky every 30 seconds during ship transit times, and calculated the image-based fractional sky cover.

Motivation

- The ship's mast was clearly visible in the images
- The mast was erroneously identified as a cloud and contributed to the sky cover retrievals



An example clear-sky image captured 24 December 2012 at 01:48 UTC (left) and the processed cloud mask image indicating 10.4% total sky cover (right).

Objectives

- Identification of pixels that represent the ship's mast
- Removal of mast contribution on the fractional sky cover estimates for thin and opaque clouds
- Corrected data set made available to the ARM Data Archive

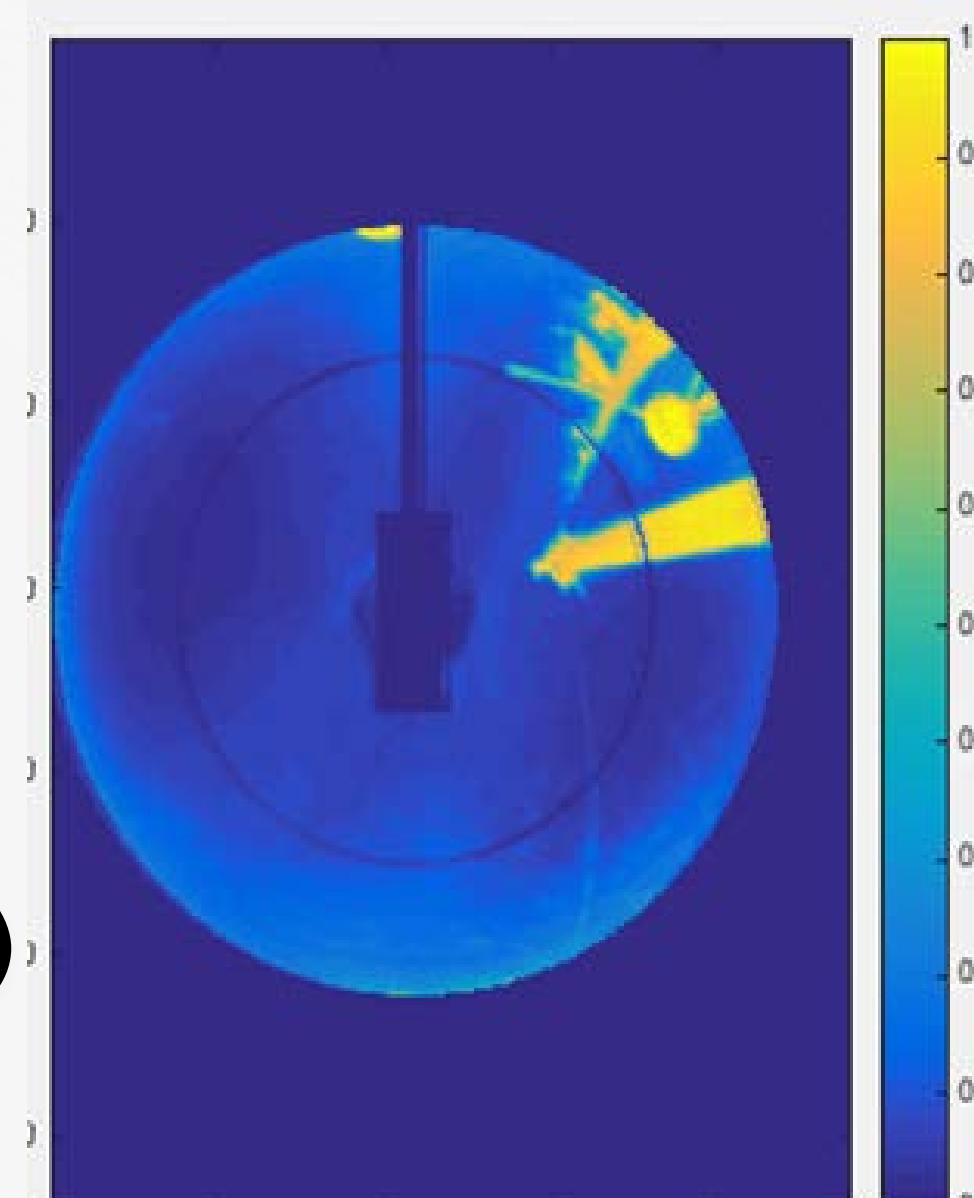
TSI Installation



Total Sky Imager installed on the Horizon Lines *Spirit* for MAGIC.

Method

- Compute mean heat map image of opaque pixels from partly cloudy days (excluding images when mast was obscured by shadowband)
- Identify mast region in mean image (pixels with opaque frequency greater than 23%)
- Remove mast pixels from processed image (using morphological image dilation)
- Determine thin and opaque fractional sky cover ($f_{cloud} = \frac{N_{pixels\ cloud}}{N_{pixels\ total}}$)
- Calculate adjusted sky cover for both 160° and 100° field-of-view regions



A time-averaged heat map of opaque cloud occurrence from 13 May to 29 September 2013.

Acknowledgements

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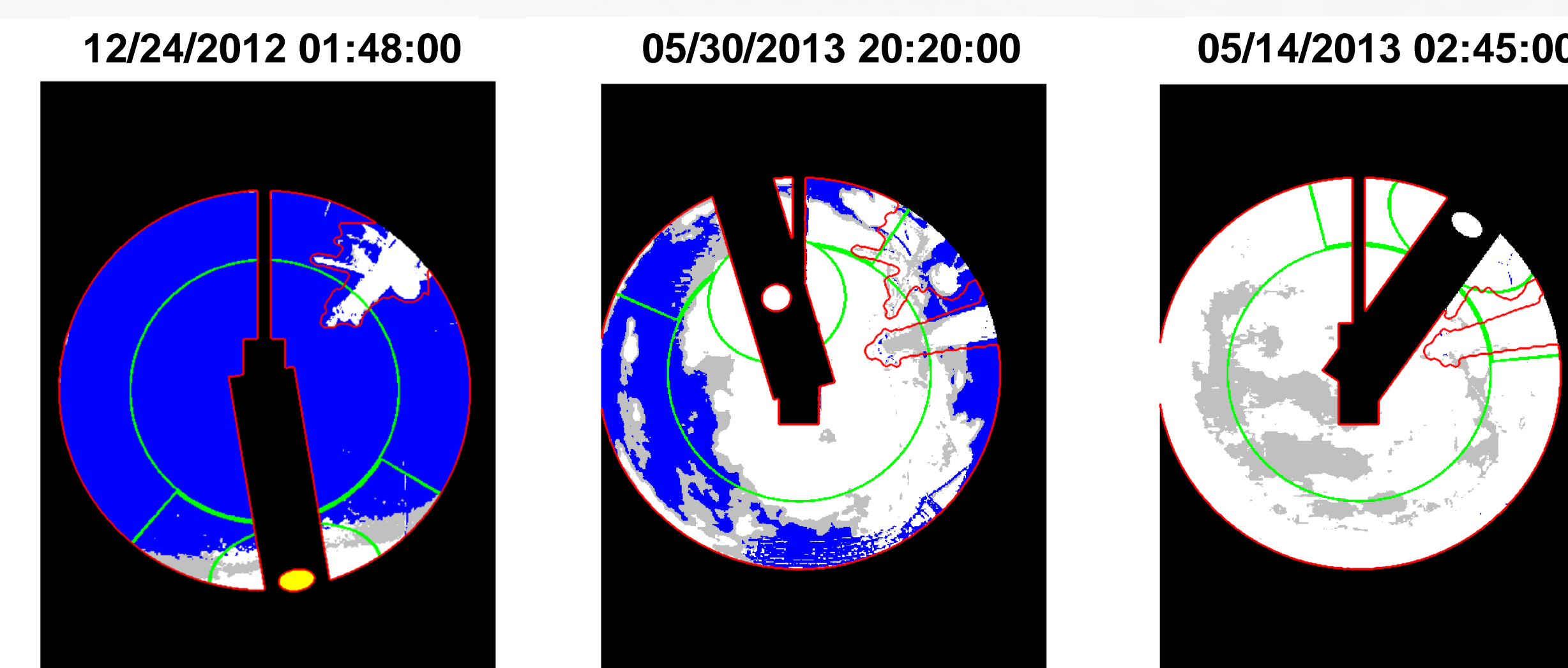
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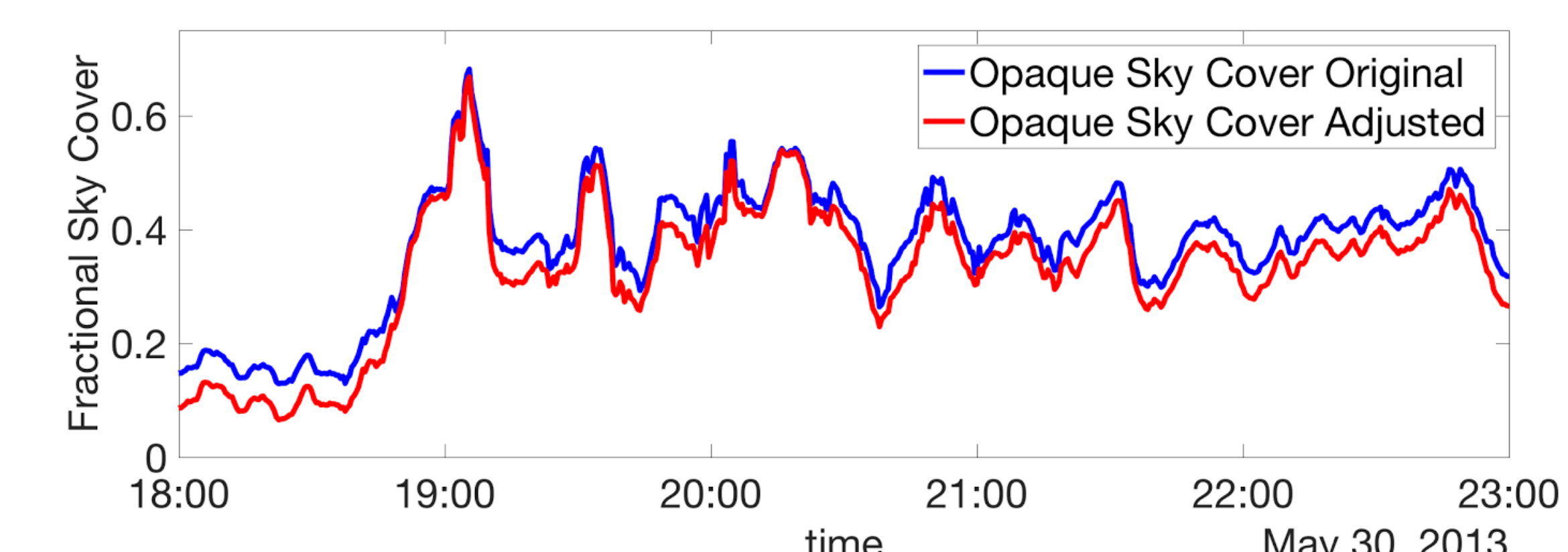
Summary

- TSI fractional sky cover was corrected to remove the ship mast contribution
- Thin and opaque cloud cover was calculated for both hemispheric and zenith regions
- Cloud cover was reduced an average of 4% in non-overcast images
- Corrected data available from the ARM Data Archive

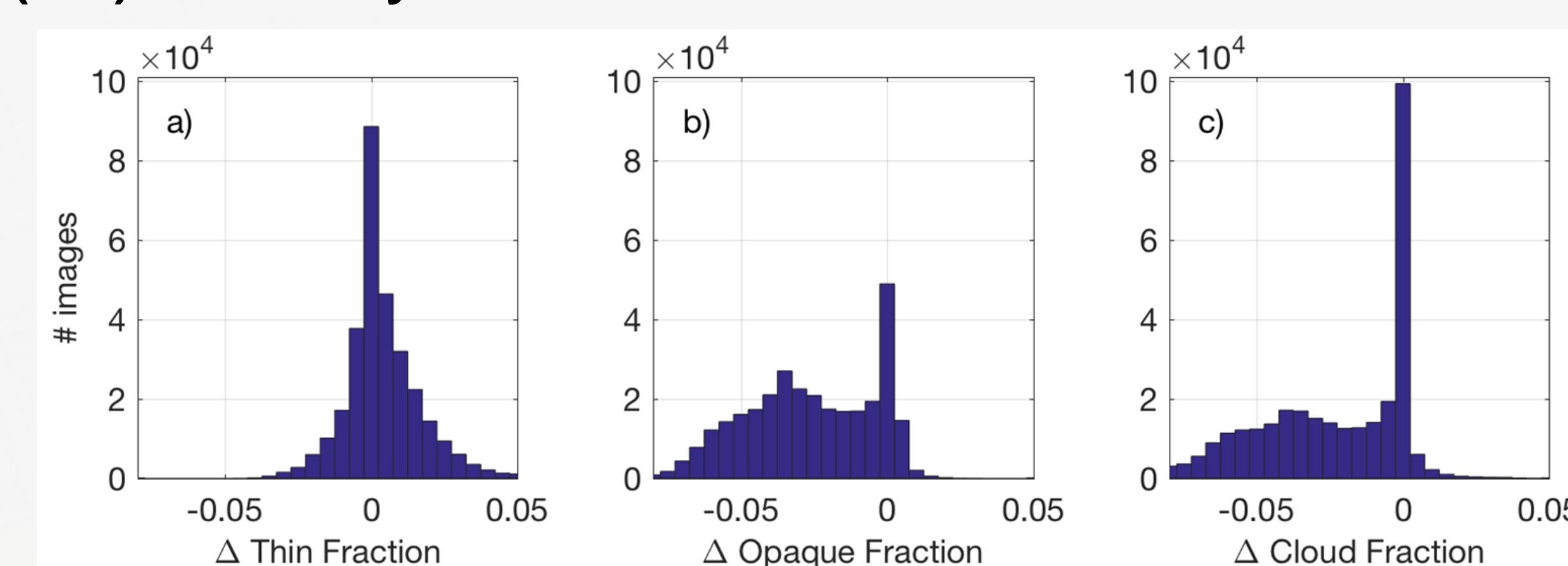
Results



Cloud mask images depicting region removed, outlined in red, for clear (left), partly cloudy (center), and overcast (right) sky. (During campaign, mast was in six locations relative to TSI position.)



Time series comparison of fractional sky cover by opaque clouds from the original image (blue) and after mast removal (red) for 30 May 2013.



Histograms of the change in cloud fraction, adjusted minus original, after removal of pixels containing the ship mast for thin (left), opaque (center) and total (right) clouds over entire campaign period.