

Coral Bleaching Detection With High Resolution Multispectral Satellite Imagery

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Frequency of Coral Bleaching Has Increased Around the World

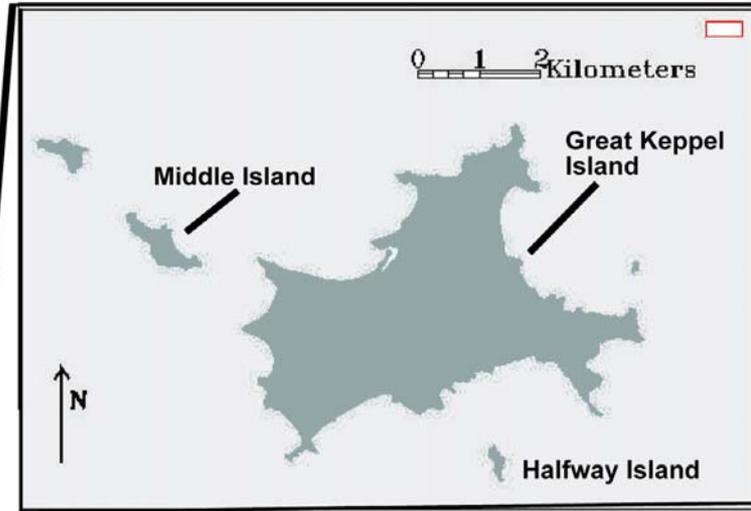
- Bleaching occurs when stressed coral polyps expel symbiotic algae that provide their color.
- Many of the events linked to prolonged thermal anomalies – possibly linked to global warming.
- NOAA's Coral Reef Watch (CRW) uses meteorological satellite data to track sea surface temperatures in reef areas around the world.
- CRW issues coral bleaching alerts and predictions.
- NGDC uses high resolution satellite imagery to confirm bleaching events.

Keppel Islands, GBR Australia Reefs Bleached in Early 2002



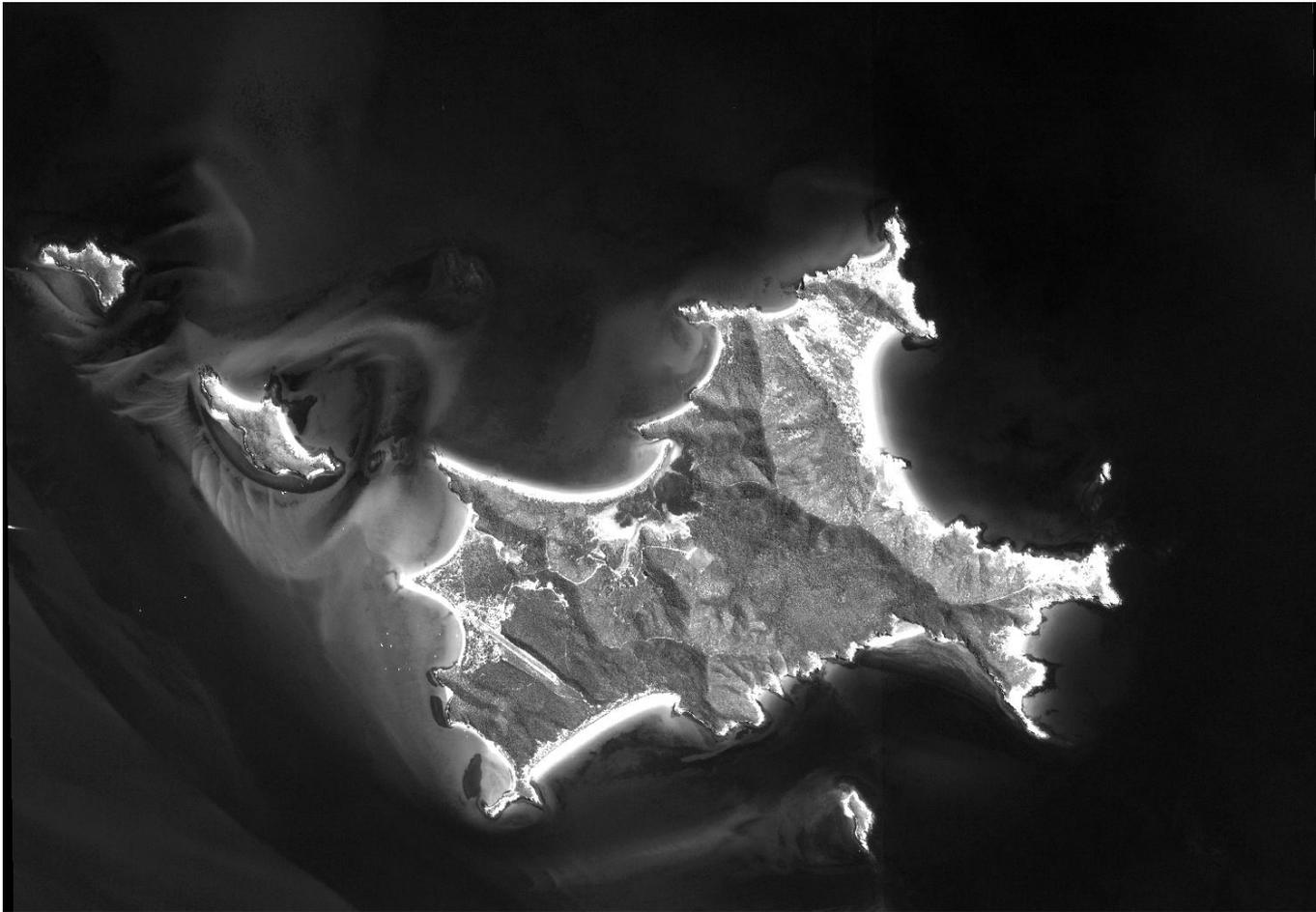
Keppel Islands

23.13 S 150.98 E

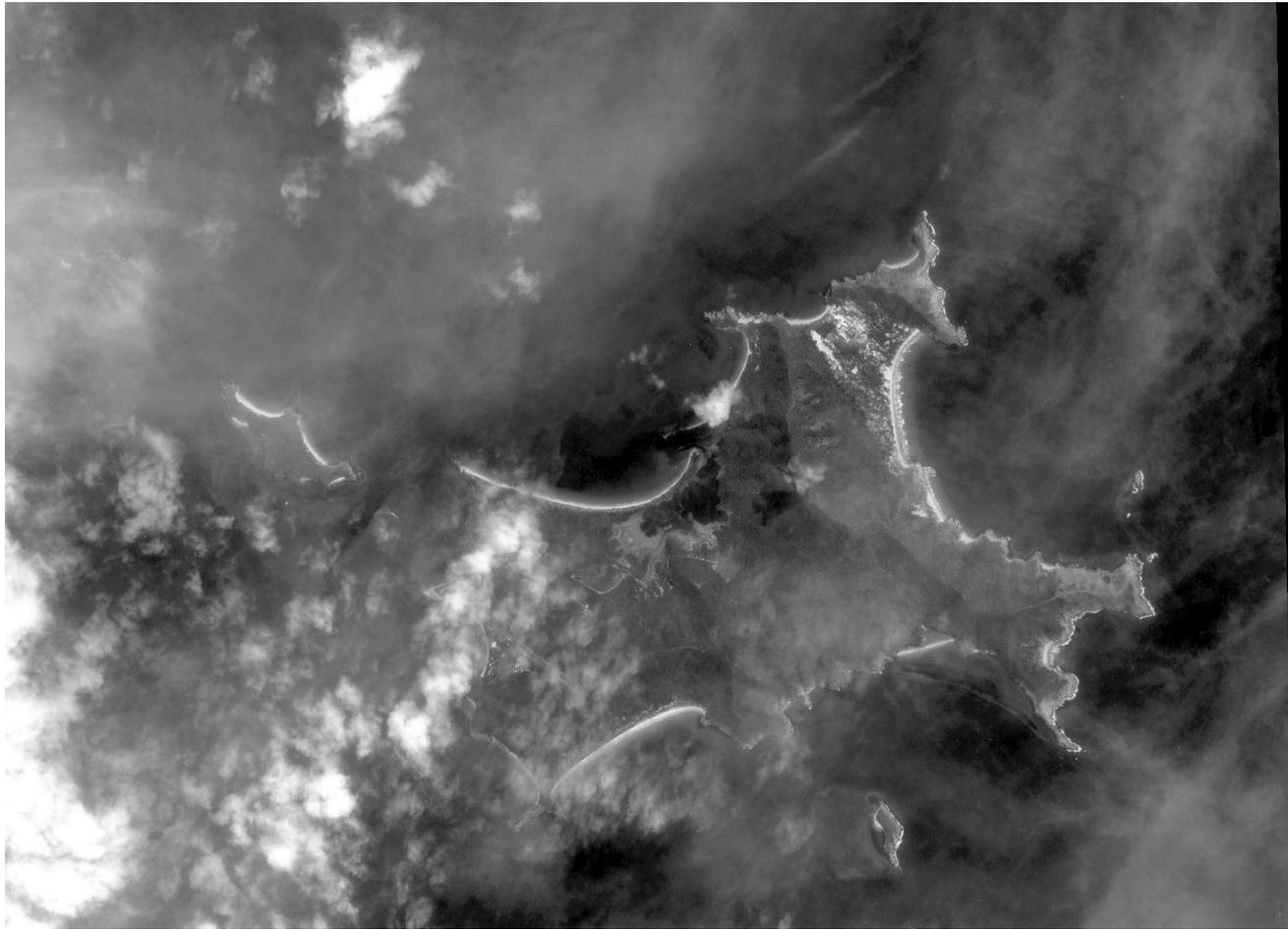


23.20 S 151.01 E

August 22, 2001 Image Used as Pre-Bleaching Reference

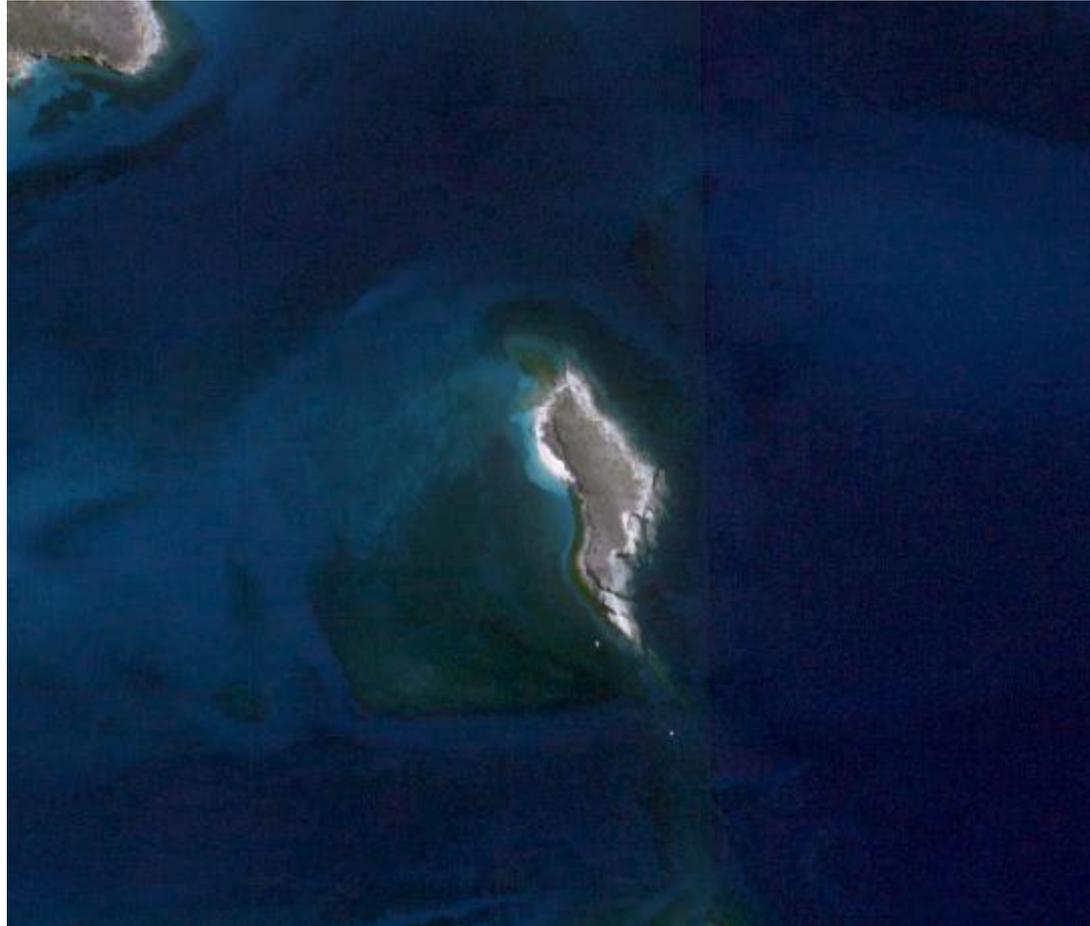


New Image Acquired April 15, 2002 during the bleaching event

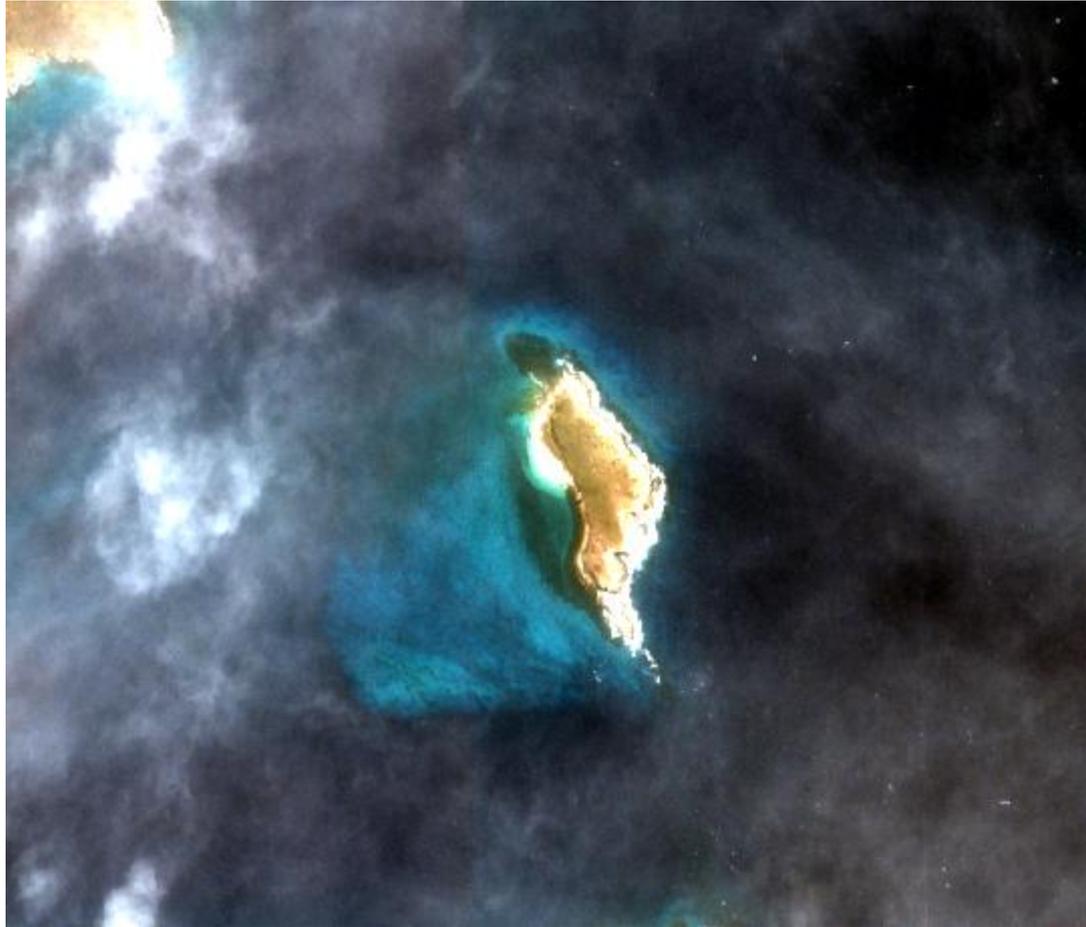


2002 image was radiometrically normalized to the 2001 Image and then a set of band difference images were generated.

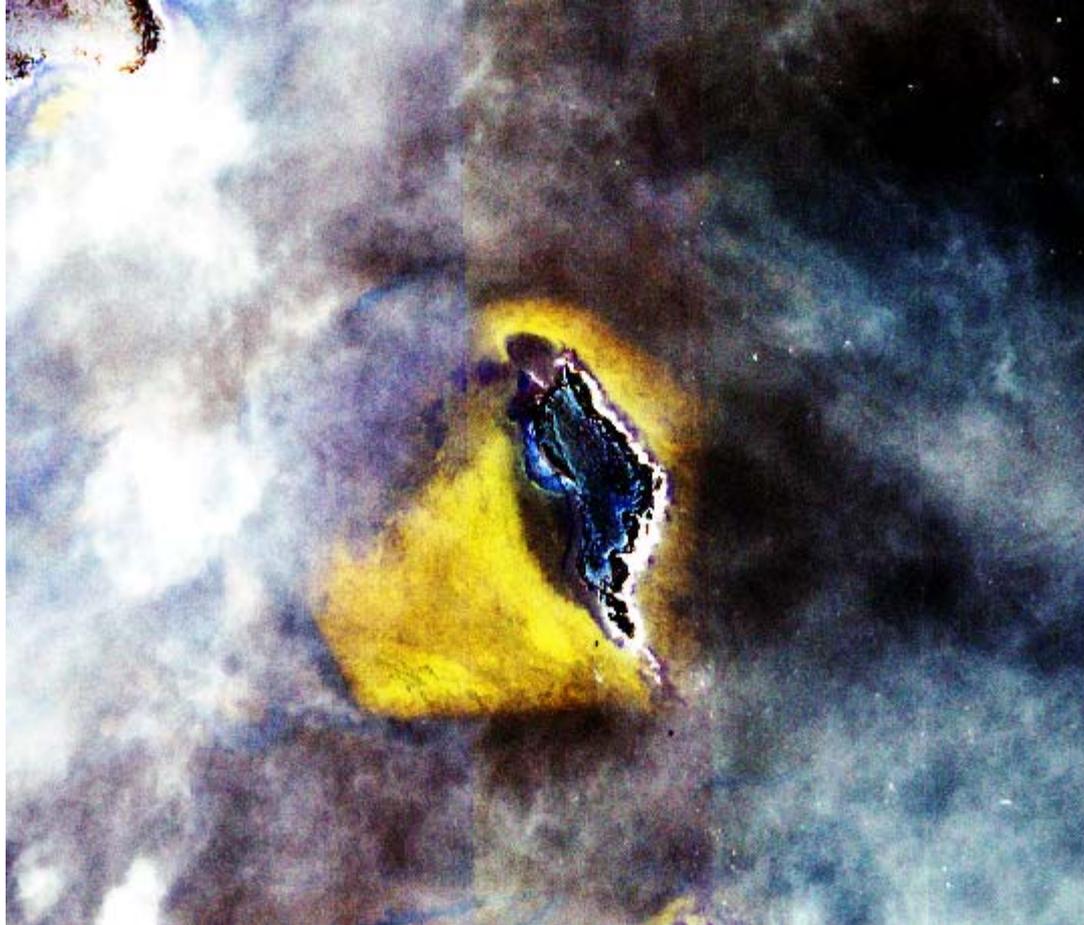
2001 Image – Halfway Island



2002 Image – Halfway Island



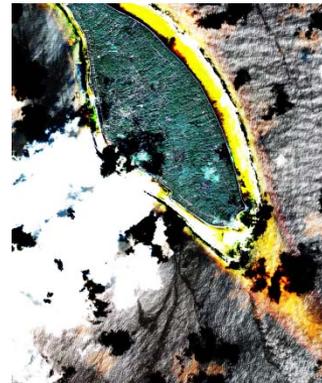
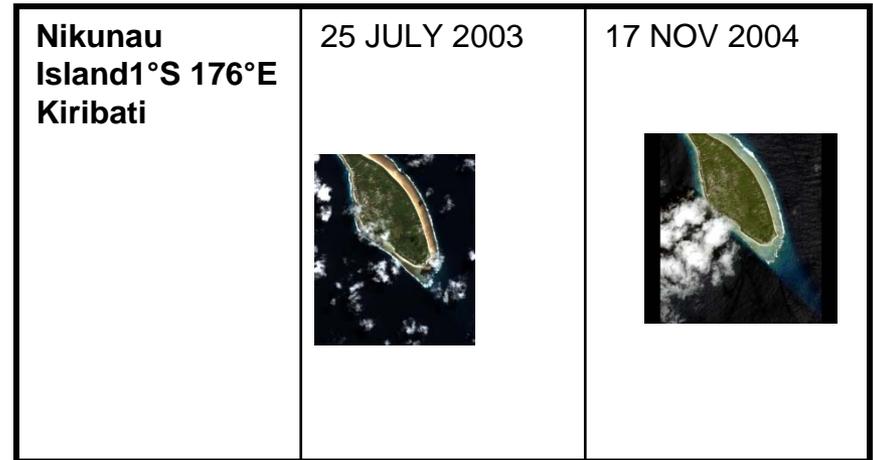
Halfway Island Band Difference Image



Band 1 = red
Band 2 = green
Band 3 = blue

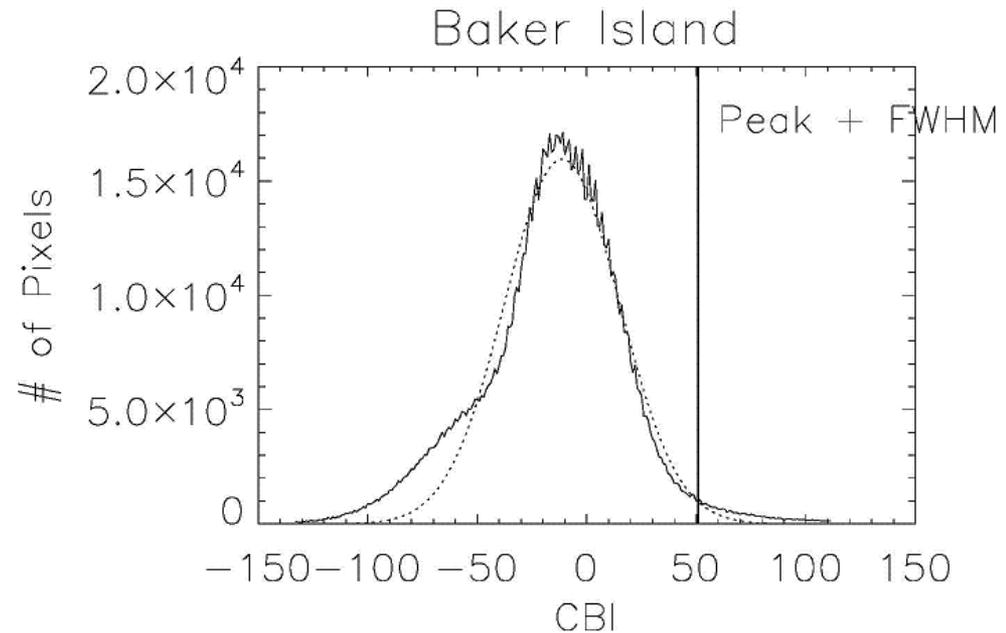
Coral Bleaching Index

- Select reference image and acquire image during suspected bleaching event (i.e. sustained elevated SST)
- Normalize Images
- Create “Difference Image”
- Define Coral Bleaching Index (CBI) as $CBI = B + 2G - 3R$
- Create histogram of CBI



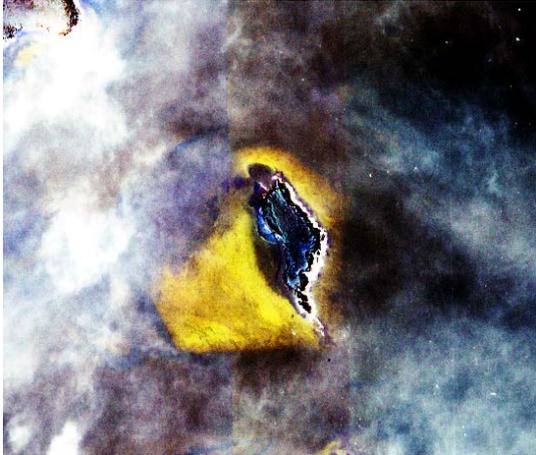
Analysis

- Fit Gaussian to CBI histogram
- FWHM is expected variation, whereas peak + FWHM is presumed to be bleaching.
- *Intensity* of bleaching is how far the positive wing extends beyond the threshold
- *Spread* is the number of pixels in the positive wing relative to the number in the corresponding negative wing.



Results

Halfway Island 23°S 150°E Great Barrier Reef



REEF SYSTEM	INTENSITY	SPREAD
Howland Island	19.4	2.6
Nikumau Island (Nov 04)	22.2	3.1
Nikumau Island (Oct 04)	10.3	0.3
Arorae Island (Dec 04)	9.3	0.6
Halfway Island	8.5	2.7
Middle Island	6.8	2.6
East Keppel Island	6.2	0.6
Baker Island	5.2	0.4
Arorae Island (Nov 04)	5.0	0.1
Buck Island	1.0	7.4

CBI image corresponds to qualitative identification of bleaching.

In 2004 the federal archive in Tacoma Park, Maryland was looking for a NOAA site to receive and store pallets of NOAA related records. NGDC volunteered – but had no idea what was contained on the pallets.

In the warehouse up the hill....



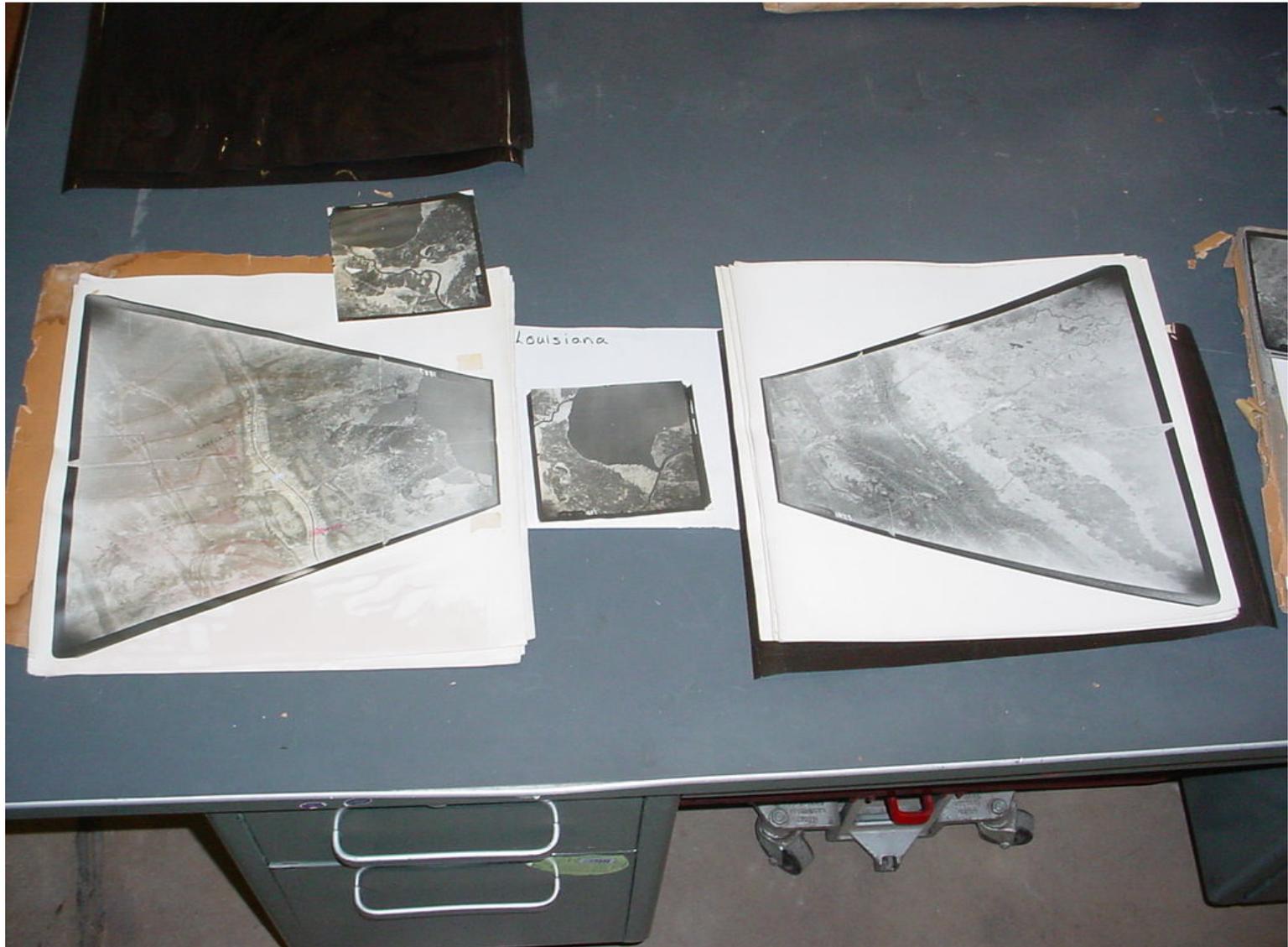
Who left that pallet in the aisle?



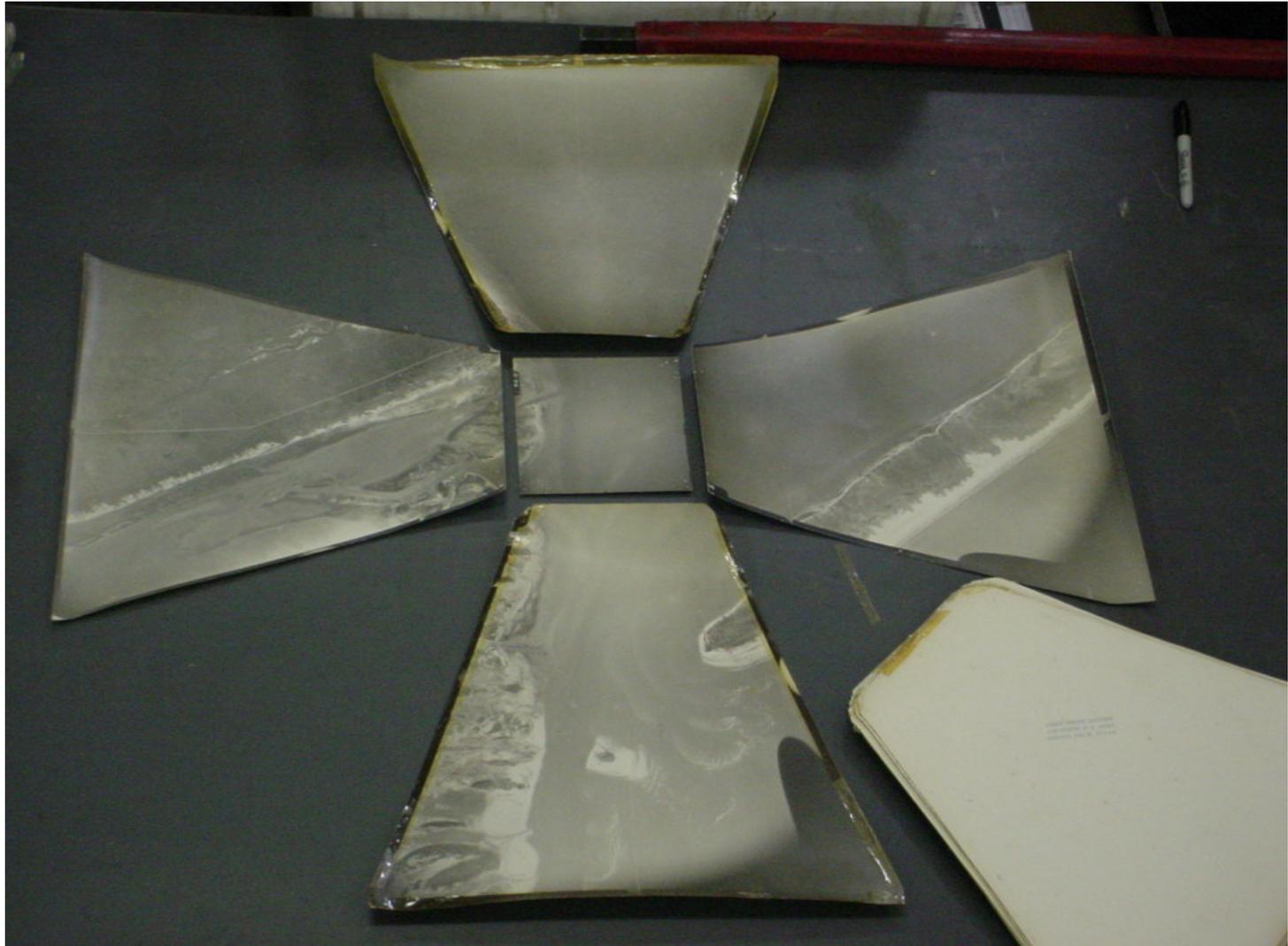
I see someone knows how to stack bundles.



Do you remember the days of multilens cameras?



Five lens cameras frame set.



We have 92 boxes of these?



There are some index mosaics.....



Film mosaic from nine lens camera.....



NGDC contacted NOAA-NOS-NGS Remote Sensing Division

- They have an operational mission to map the US shoreline and its' features.
- Multilens cameras were widely used from the 1920's to the 1960's.
- The original film was not designed for shelf life and had been discarded.
- What NGDC had were second generation films and prints.
- The collection likely contains one of the best records of the shorelines, coastal land cover, and development for the mid-20th century.
- NGDC and NGS are proposing that the film be scanned under NOAA's Climate Data Modernization Program.