Mapping of coral bottoms from different high resolution satellite images

We have investigated the value of several high spatial resolution satellite sensors for mapping of coral bottoms in Belize, C. A. (Fig. 1.) The sensors were evaluated for the possibility to map cover type and changes of coral bottoms with respect to their spectral and spatial properties. Comparisons between different sensors with similar wavelengths have shown that almost all main structures (reef, coral sand, etc) show up remarkably well even in lower spatial resolution (30 m cf. 4 m), but the character within each object is much better in the higher resolution. Unsupervised classification was applied and higher spatial resolution gave better separation of classes within the reef, but what sensor to use was dependant upon the purpose of the classification.

Figure 1. Map of the coverage of the Belize image.

The better quantisation of the Landsat and SPOT versus IRS showed up as sharper images. SPOT and IKONOS data verified our earlier detection of coral bleaching in Belize.
The following sensors were used (Table 1-2).

Table 1. The satellite sensors used

Satellite	Sensor	Track/ frame	Date	Sun elev	Resampl. method	Aq. quant. (bits)
Landsat	TM	19/48	870221	44	CC	8
Landsat	TM	19/49	950518	-		8
Landsat	TM	19/48	991129		NN	Best 8 of 9
IRS 1C	LISS3	283/06100	980228	57	NN	7
IRS 1D	LISS3	292/06100	980831	71	CC	7
SPOT	HRV 2	K612/J318	980910			8
IKONOS	MSS	*) 364625 E	010313	-		11
IKONOS	PAN	*) 1823470 N	010313	-		11

*) UL co-ordinates in UTM

The LISS-III sensors on the IRS satellites have two channels in the visible part of the spectrum (Table 2). Unfortunately they lack a blue wavelength band, but the green channel covers approximately the same wavelength as channels in TM and SPOT.

Table 2. Wavelengths and spatial resolutions of the sensors

Band	Landsat 5 TM Wave-length (µm)	Re-solu-tion (m)	Landsat7 TM Wave-length (µm)	Re-solu-tion (m)	LISS III IRS1C,D Wave-length (µm)	Re-solu-tion (m)	IKONOS Wave-length (µm)	Re-solu tion (m)	SPOT 2 Wave-length (µm)	Re-solu tion (m)
1	0.45-0.515	30	0.45-0.515	30	-	-	0.45-0.52	4	-	-
2	0.525-0.605	30	0.525-0.605	30	0.52-0.59	23.5	0.53-0.61	4	0.50-0.59	20
3	0.63-0.69	30	0.63-0.69	30	0.62-0.68	23.5	0.64-0.72	4	0.61-0.68	20
4	0.76-0.90	30	0.75-0.90	30	0.77-0.86	23.5	0.77-0.88	4	0.79-0.89	20
5	1.55-1.75	30	1.55-1.75	30	-	-	0.45-1.7	1	-	-
6	10.4-12.5	120	10.4-12.5	60	-	-	-	-	-	-
7	2.08-2.35	30	2.08-2.35	30	-	-	-	-	-	-

If the purpose is only to get a coral map over a large area, Landsat or SPOT is less time consuming and less costly than IKONOS and often of sufficient quality. For small areas and details IKONOS is better. More narrow spectral bands are required in order to more accurately separate reef species and to distinguish between bleached corals and other bottoms or between dead corals invaded by algae and living corals.

From this study we can conclude that the IKONOS could be used for certain mapping tasks and monitoring of bleaching. We still need a better spectral resolution in order to define the type of change. The cost for IKONOS makes it difficult to use in global surveys. Landsat-7 could be used for coarser mapping and updating purposes, but in the future we need a more specific reef sensor with a few selected narrow bands and a good spatial and temporal resolution.

A follow up of the coral bleaching study including also SPOT and IKONOS indicates that many bleachings were in accordance with field observations having different spectral properties than unaffected areas and thus verified our earlier findings.

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