

3. Data analysis

All calculations used in this report are shown in Annex 4.

NO DATA

Areas obscured by cloud or otherwise lacking data due to poor satellite coverage or low-quality images were coded as “no data” in both the land-cover and land-use polygons. Cloud-affected and shadow-affected imagery was most common in the tropics (Ju and Roy, 2008; Asner, 2001); about 9 percent of the 4 016 tropical sample sites had no data for 2005. Where possible, areas obscured by cloud or shadow were re-coded manually based on an examination of the same location using images recorded at later or earlier dates, or by using national datasets, Google Earth® or local knowledge.

“No data” areas were considered an unbiased loss of information. If not resolved using the methods above, a “no data” classification encountered in one time period was passed to the land-cover and land-use label in all other time periods during analysis to ensure that only areas with viable data concurrent to all survey periods were analysed. Survey sites missing a Landsat acquisition for any of the time periods were removed from the analysis. Ultimately, 13 066 sites were processed to generate the results after all “no data” sites had been accounted for (Figure 6 and Annex 2).

The proportion of forest and gross gains and losses were calculated relative to the total area of all viable image objects, or “good land”. Good land was considered to be any object not classified as water or “no data” (Annex 4, equation 1).

ADJUSTMENT FOR LATITUDE AND AREA WEIGHTING

Due to the curvature of the Earth, the actual area represented by a latitude/longitude grid sample decreases with latitude. Analyses of forest area and forest-area change must take this into account by applying a correction to area measurements (Annex 4, equation 2).

Sites were also given a weight equivalent to the proportion of the total surveyed area represented by the site. Both latitude and area weights were incorporated in the survey analysis (Annex 4, equation 3).

FIGURE 6
Final 13 066 sites used in RSS 2010 analysis



Note: The large gap in the eastern part of the Russian Federation is due to a lack of Landsat imagery availability for 1990.

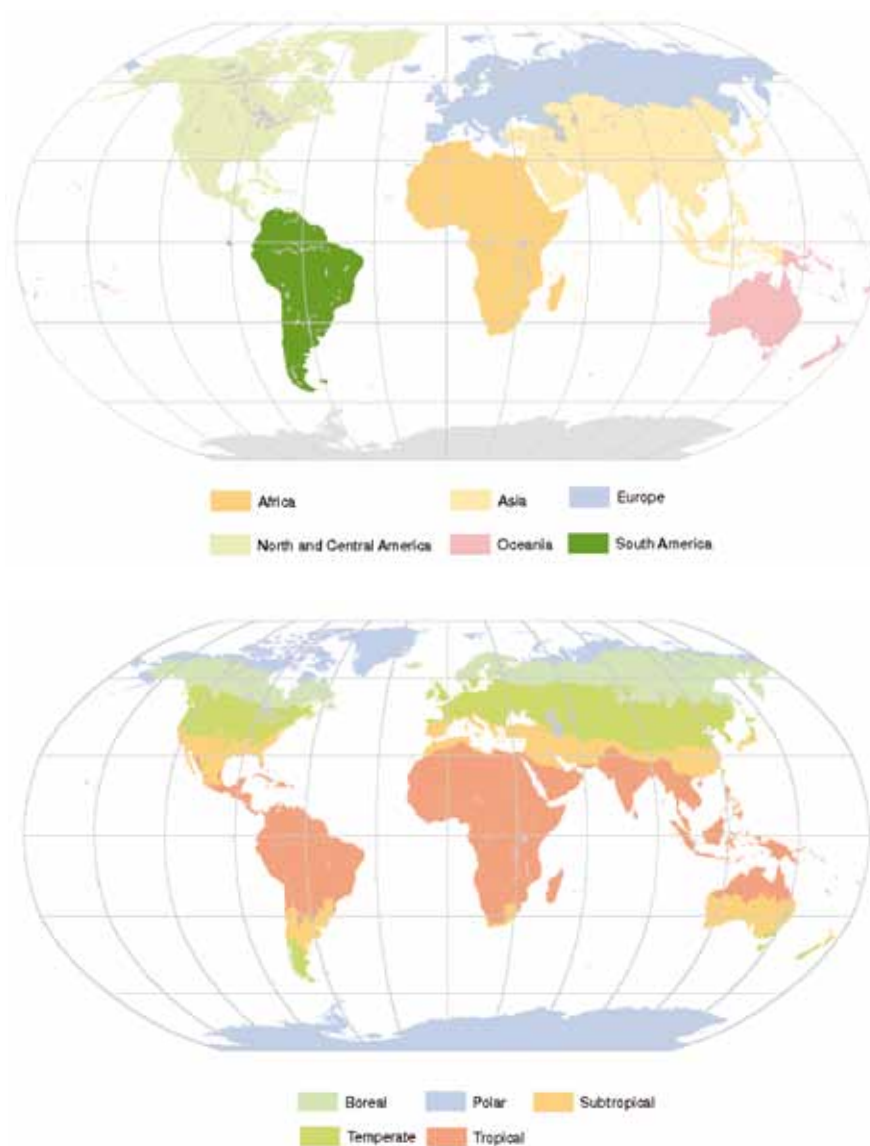
AGGREGATION FOR REGIONAL AND CLIMATIC DOMAIN ANALYSIS

Land-use classifications were summarized on a per plot basis and aggregated by FRA region and FAO climatic domain (Figure 7) (FAO 2012). Each survey site was assigned to the FRA region and FAO climatic domain within which the majority of the site was located. Survey data were analysed using the statistical software packages R (2.12.2) and Systat (Ver. 13).

FOREST AREA: GAINS AND LOSSES

Total forest area was determined using the Horvitz-Thompson direct estimator following Eva *et al.* (2010) – that is, by calculating the mean proportion of forest (Annex 4, equation 4) over all sample sites within a region or climatic domain and multiplying this figure by the total land area of the region. Forest area for each site was calculated at the nominal date of image acquisition, i.e. without taking the real acquisition date into account. Global forest area totals were calculated by summing the total forest area per region. This was done because confidence intervals for regional totals were smaller than for climatic

FIGURE 7
Regions (a) and climatic domains (b) used for aggregation and analysis



domains (Table 2). A similar approach was used to calculate gross and net forest area gains and losses. All calculations were made using the Mollweide equal area map projection.

ANNUALIZING FOREST-AREA CHANGE

The satellite imagery used in the survey, while nominally representing 1990, 2000 and 2005, was acquired over a range of dates around the target year (Figure 8). Changes were calculated as mean annual changes, based on the date range represented by the imagery acquisition date at each site (Annex 4, equation 5).

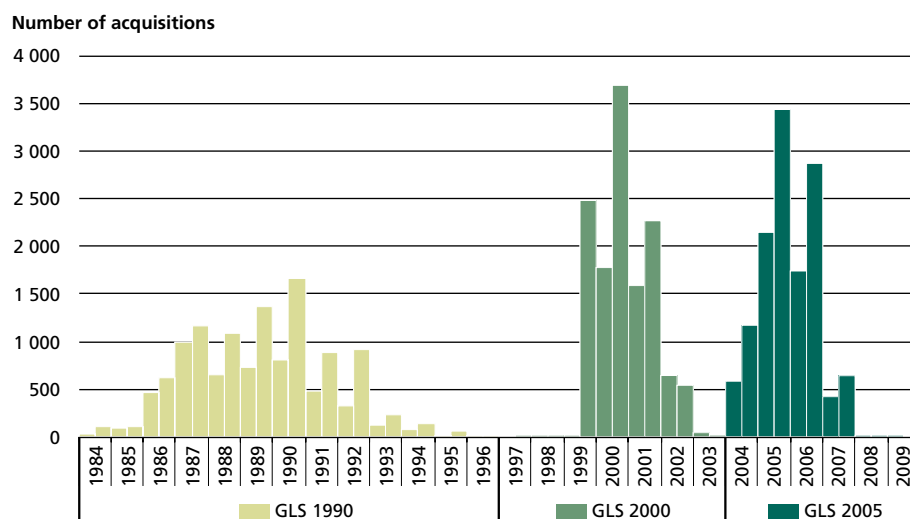
TABLE 2

Mean forest area ('000 ha $\pm$ confidence interval) by region and climatic domain, 1990, 2000 and 2005

Region	n	Forest area ('000 ha)					
		1990		2000		2005	
Africa	2 322	520 000	$\pm 7\%$	510 000	$\pm 7\%$	490 000	$\pm 8\%$
Asia	2 863	500 000	$\pm 7\%$	510 000	$\pm 7\%$	510 000	$\pm 7\%$
Europe	907	1 080 000	$\pm 5\%$	1 070 000	$\pm 5\%$	1 070 000	$\pm 5\%$
North and Central America	4 833	790 000	$\pm 3\%$	800 000	$\pm 3\%$	800 000	$\pm 3\%$
Oceania	769	120 000	$\pm 14\%$	120 000	$\pm 14\%$	120 000	$\pm 14\%$
South America	1 372	860 000	$\pm 5\%$	820 000	$\pm 5\%$	800 000	$\pm 5\%$
World	13 066	3 860 000	$\pm 2\%$	3 820 000	$\pm 2\%$	3 790 000	$\pm 2\%$
Climatic domain	n	1990		2000		2005	
Boreal	3 092	1 180 000	$\pm 3\%$	1 190 000	$\pm 3\%$	1 200 000	$\pm 3\%$
Subtropical	1 958	320 000	$\pm 8\%$	330 000	$\pm 8\%$	330 000	$\pm 8\%$
Temperate	3 831	560 000	$\pm 5\%$	570 000	$\pm 5\%$	570 000	$\pm 5\%$
Tropical	4 185	1 730 000	$\pm 4\%$	1 670 000	$\pm 4\%$	1 620 000	$\pm 4\%$

Note: n = number of sample sites. The sum of the forest areas of all regions was used as the global forest area total.

FIGURE 8
Range of dates of satellite imagery used for each survey period



	GLS 1990	GLS 2000	GLS 2005
Min	17/04/84	22/06/96	14/08/03
Max	22/08/96	22/05/03	11/05/09
Average	15/08/89	06/11/00	28/11/05
Median	07/08/89	12/09/00	01/10/05

Note: The table lists the earliest, latest, average and median dates for each survey period.

ERROR

The statistical precision of all estimates are reported as the values from the 95 percent confidence interval expressed as percent of the mean (Annex 4, equations 6–8). Reported errors are sampling errors only and do not account for classification errors or other sources of error.