converted to PAR and integrated from dawn to dusk on each day, i.e. total daily PAR insolation just below the sea-surface in the case of no clouds.

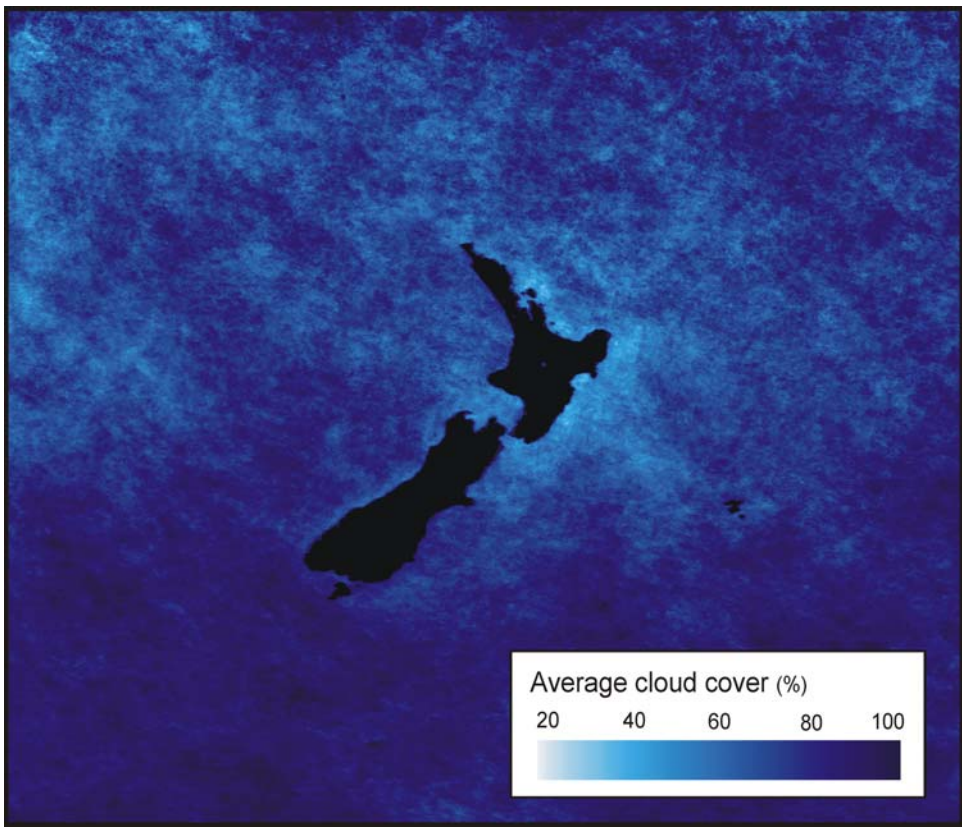

Figure 4.2. 8-day average cloud cover for Interval #1 (1–8 January).

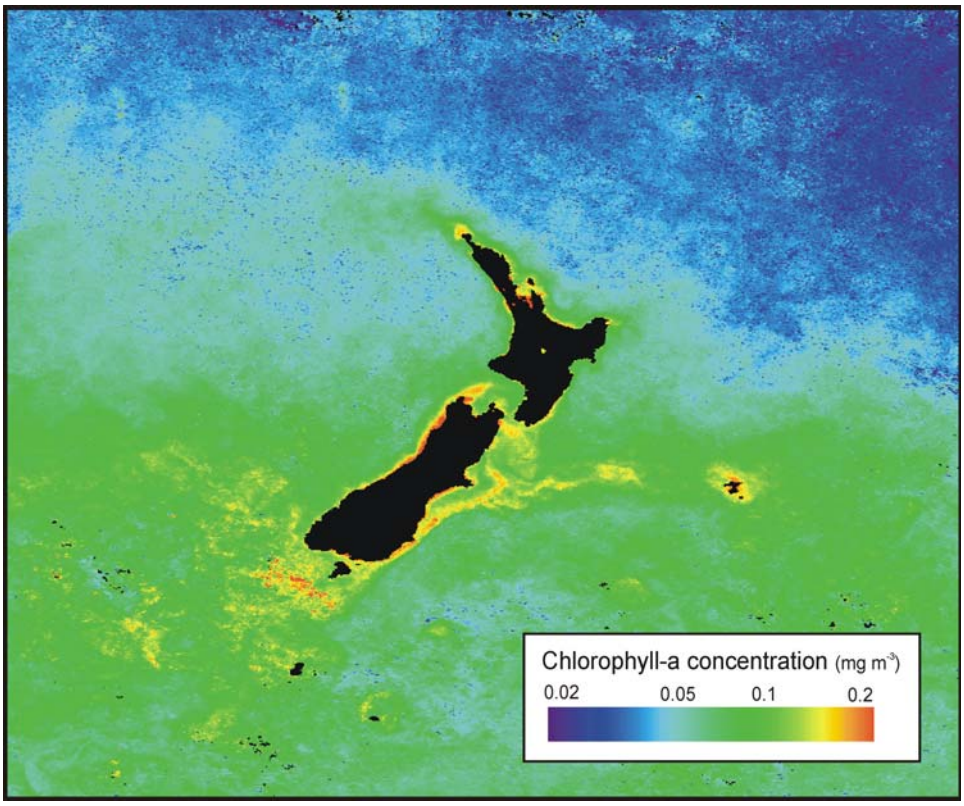

Figure 4.3. Average surface chlorophyll for Interval #1 (1–8 January).

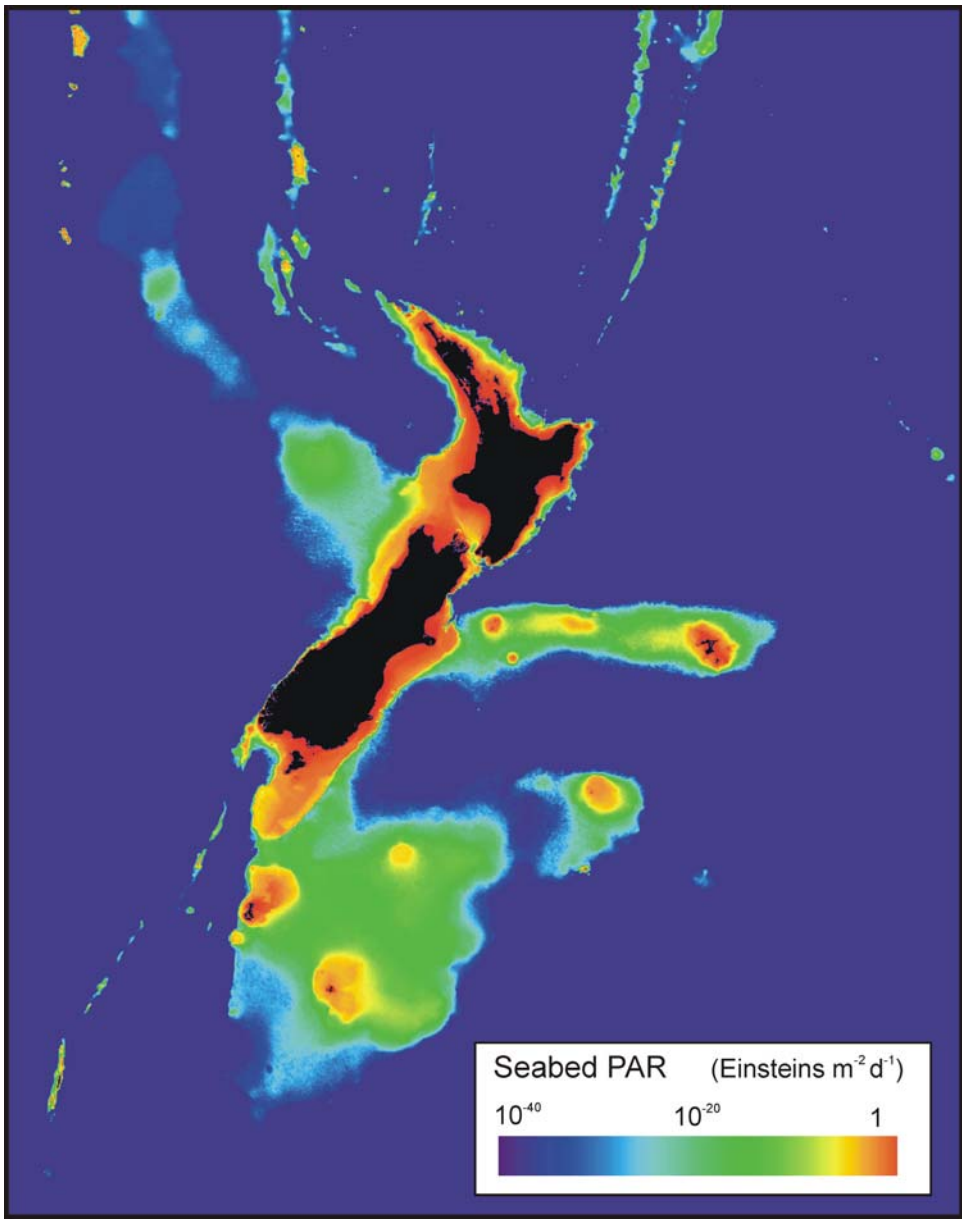

Figure 4.4. Annual-average downwelling PAR irradiance at the sea-bed (plotted on log colour scale).

4.9 Conclusions

Our estimates of seabed PAR have not been validated, but are qualitatively and quantitatively reasonable. There is a considerable amount of international research aimed at estimating visible downwelling irradiance at the sea surface, which was a key part of the research described here. Much of this international research will be relevant

to ongoing work aimed at predicting incident (sea-surface) and underwater irradiance around New Zealand. In particular, the method we have used for estimating the effect of clouds on surface irradiance should be considered preliminary, and more sophisticated methods developed overseas could be used in the future. It is not known currently how similar the optical properties of aerosols and clouds around New Zealand are to those in other parts of the world. NIWA intends to measure multispectral incident irradiance from the Research Vessel Tangaroa over an extended period at high temporal resolution. This data set will facilitate a significant improvement in our ability to estimate incident light at the sea surface, and hence at the seabed. Data collection will start in 2005, and continue for at least a year.

Most of the values of light at the seabed are extremely small. As an indication, marine phytoplankton from the midpoint of the euphotic zone of the Sargasso Sea reach their maximum photosynthetic rate at approximately 500 μEinsteins m^{-2} s^{-1} (Kirk 1994). As a rough indication, assuming a 12 hour day with constant irradiance through the day, this is equivalent to an irradiance of ~20 Einsteins m^{-2} d^{-1}. As expected, our results suggest that the New Zealand seabed is too dark for photosynthesis except in shallow waters close to land (shallower than ~200 m). It is in these regions that the Sea-bed PAR layer may prove to be most useful within the Marine Environment Classification.

5. References

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