

## MODIS Chlorophyll Fluorescence (MOD 20)

### Product Description

This Level 2 product contains several parameters describing ocean chlorophyll fluorescence properties. Fluorescence line height is a relative measure of the amount of radiance leaving the sea surface at the fluorescence wavelength of 683 nm. Fluorescence Efficiency provides a relative measure of the absorption of PAR and its emission as chlorophyll fluorescence. The third parameter is Fluorescence Line Curvature. The spatial resolution will be 1 km for chlorophyll levels greater than 1.5 mg/m<sup>3</sup> and 5 × 5 km for values less than 1.5. The Level 2 product is produced daily, and Level 3 is gridded and produced daily, 8-day weekly, monthly, and yearly.

### Research and Applications

Solar-stimulated chlorophyll fluorescence is a measure of the current photophysiology of phytoplankton, in contrast to the biomass estimate provided by chlorophyll. The product quantifies the level of photosynthesis by phytoplankton in the ocean. Historically, the coupling between fluorescence and chlorophyll has been studied extensively, and recent research has focused on the use of Sun-stimulated fluorescence to estimate primary productivity (Kiefer and Reynolds, 1992). Basic fluorometric measurements are made using an instrument described by Holm-Hansen *et al.* (1965) that uses blue-light stimulation; this method has been used unchanged for 30 years. Gower and Borstad (1990) was among the first to attempt to use sun-stimulated radiance at 683 nm to estimate chlorophyll concentrations from aircraft and satellites.

### Data Set Evolution

Inputs to the algorithm are chlorophyll concentration (within MOD 19), Absorbed Radiation by Phytoplankton (ARP) (within MOD 22), and Water-Leaving Radiance (MOD 18). Water-leaving radiance for MODIS bands 13 (667 nm), 14 (678 nm), and 15 (748 nm) are used in the algorithm. The algorithm is applied to the daily input standard-product data sets and is remapped into standard Level 3 grids. The validation approach will be to compare the fluorescence results with other MODIS data products (e.g., Chlorophyll *a*), with surface measurements, and with other

satellite-based estimates of the same products. The products are produced only for non-cloud, glint-free ocean pixels during daylight hours.

### Suggested Reading

- Abbott, M.R. *et al.*, 1982.
- Abbott, M.R., and R.M. Letelier, 1998.
- Chamberlin, W.S., and J. Marra, 1992.
- Gower, F.J.R., and G.A. Borstad, 1990.
- Holm-Hansen, O. *et al.*, 1965.
- Kiefer, D.A., and R.A. Reynolds, 1992.
- Letelier, R.M. *et al.*, 1997.
- Topliss, B.J., and T. Platt, 1986.

### MODIS Chlorophyll Fluorescence Summary

**Coverage:** Global ocean surface, clear-sky only

**Spatial/Temporal Characteristics:** 1 km for chlorophyll levels greater than 2.0 mg/m<sup>3</sup>/daily, (Level 2); 4.6 km, 36 km, 1°/8-day, monthly, yearly (Level 3)

**Key Science Applications:** Ocean chlorophyll, ocean productivity

**Key Geophysical Parameters:** Chlorophyll fluorescence (fluorescence line height, fluorescence efficiency, fluorescence line curvature)

**Processing Level:** 2, 3

**Product Type:** Standard, at-launch

**Maximum File Size:** 102 MB (Level 2); 640 MB binned, 134 MB mapped (Level 3)

**File Frequency:** 144/day (Daily Level 2); 3/day (Daily Level 3), 3/week (Weekly Level 3), 3/month (Monthly Level 3), 3/year (Yearly Level 3)

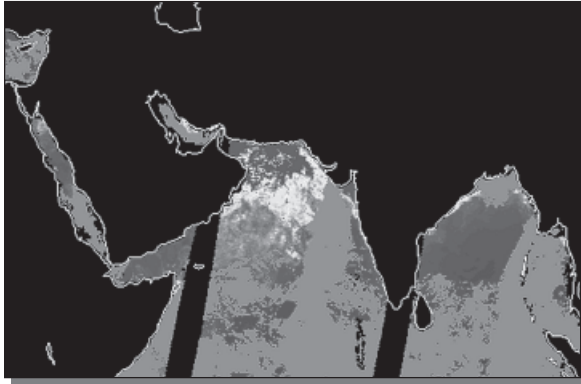
**Primary Data Format:** HDF-EOS

**Additional Product Information:**  
<http://modis-ocean.gsfc.nasa.gov/dataproduct.html>

**DAAC:** NASA Goddard Space Flight Center

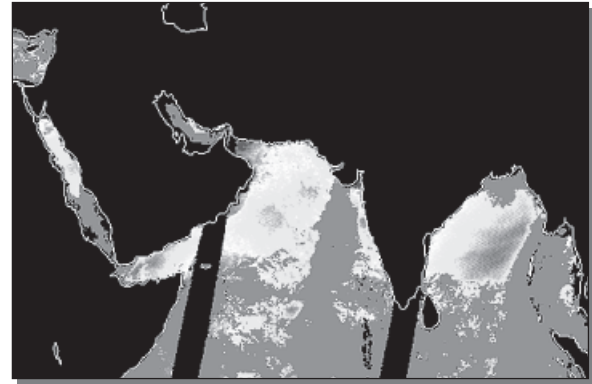
**Science Team Contact:**  
M. Abbott

### Chlorophyll *a* (Chl)



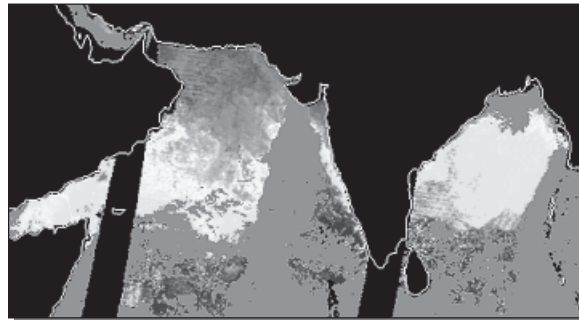
Chlorophyll *a* Concentrations (MOD 21) as measured by MODIS in the Indian Ocean on March 1, 2000. Chlorophyll, the green pigment in plants and phytoplankton, absorbs sunlight for use in photosynthesis. Note the high concentrations (light grays) in the Arabian Sea and relatively low concentrations (dark grays) in the Bay of Bengal. The black color in the image represents land areas and gaps between successive satellite orbits, and the gray “stripes” indicate where clouds or sun glint prevented accurate measurements.

### Fluorescence Line Height (FLH)



Chlorophyll Fluorescence (MOD 20) as measured from the Terra MODIS instrument on March 1, 2000. Phytoplankton re-emit some of the light that is captured by chlorophyll as fluorescence. The amount of fluorescence is roughly proportional to the amount of chlorophyll, so in this image, for example, high fluorescence can be found in the Arabian Sea.

### FLH/Chl Ratio



Ratio of Chlorophyll Fluorescence (MOD 20) to Chlorophyll *a* Concentration (MOD 21), illustrating the considerable variability in the amount of fluorescence per unit of chlorophyll. This variability is largely a function of the health of the phytoplankton. A high ratio implies lower growth rates, as the light captured by phytoplankton is being re-emitted as fluorescence rather than being used for photosynthesis. Phytoplankton in the Arabian Sea are probably growing more rapidly than elsewhere, perhaps in response to dust inputs (which are rich in iron) from the Arabian Peninsula.