Multi-angle Imaging SpectroRadiometer

EOS AM Spacecraft MISR

Use of Multiangle Satellite Observations To Retrieve Aerosol Properties and Ocean Color

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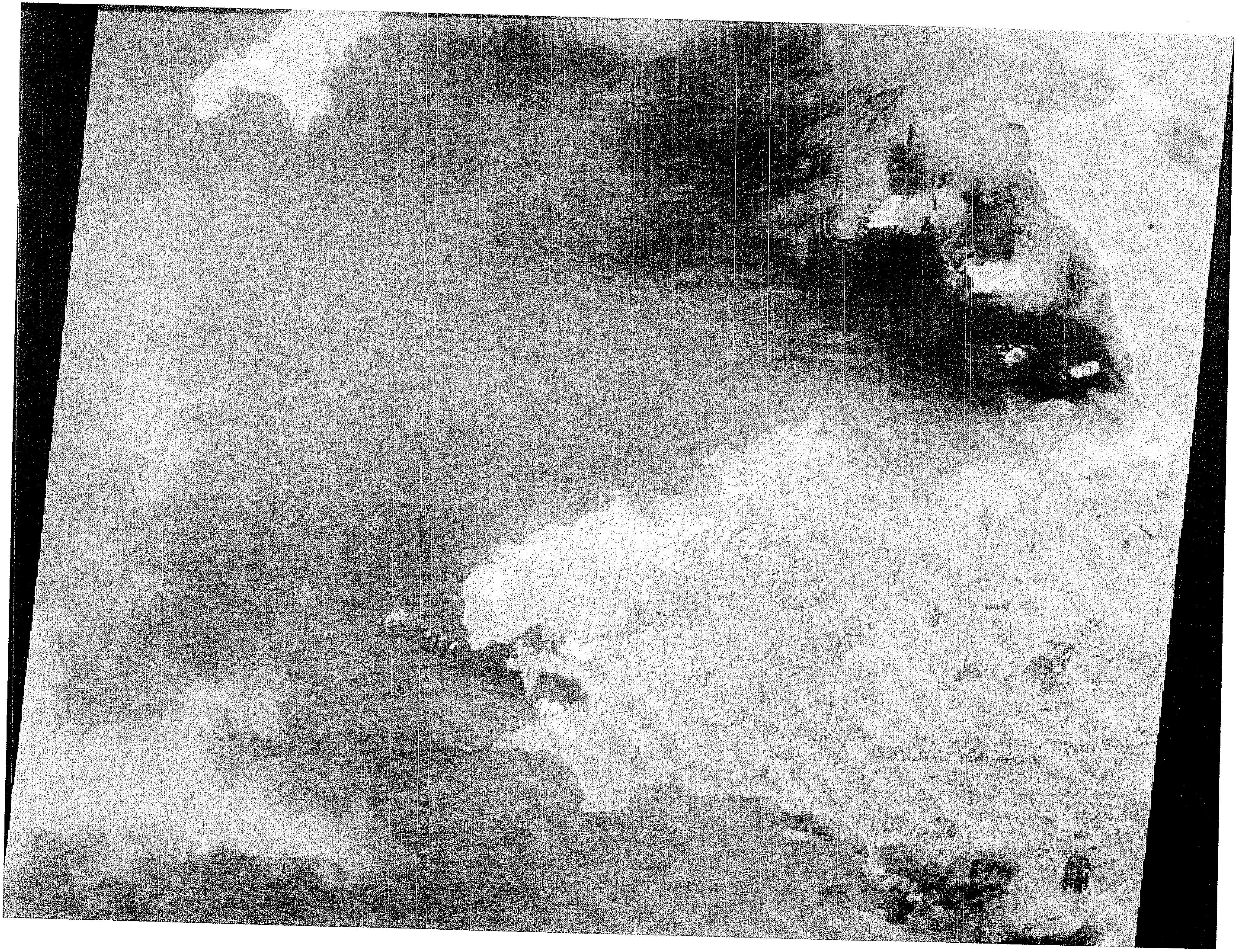
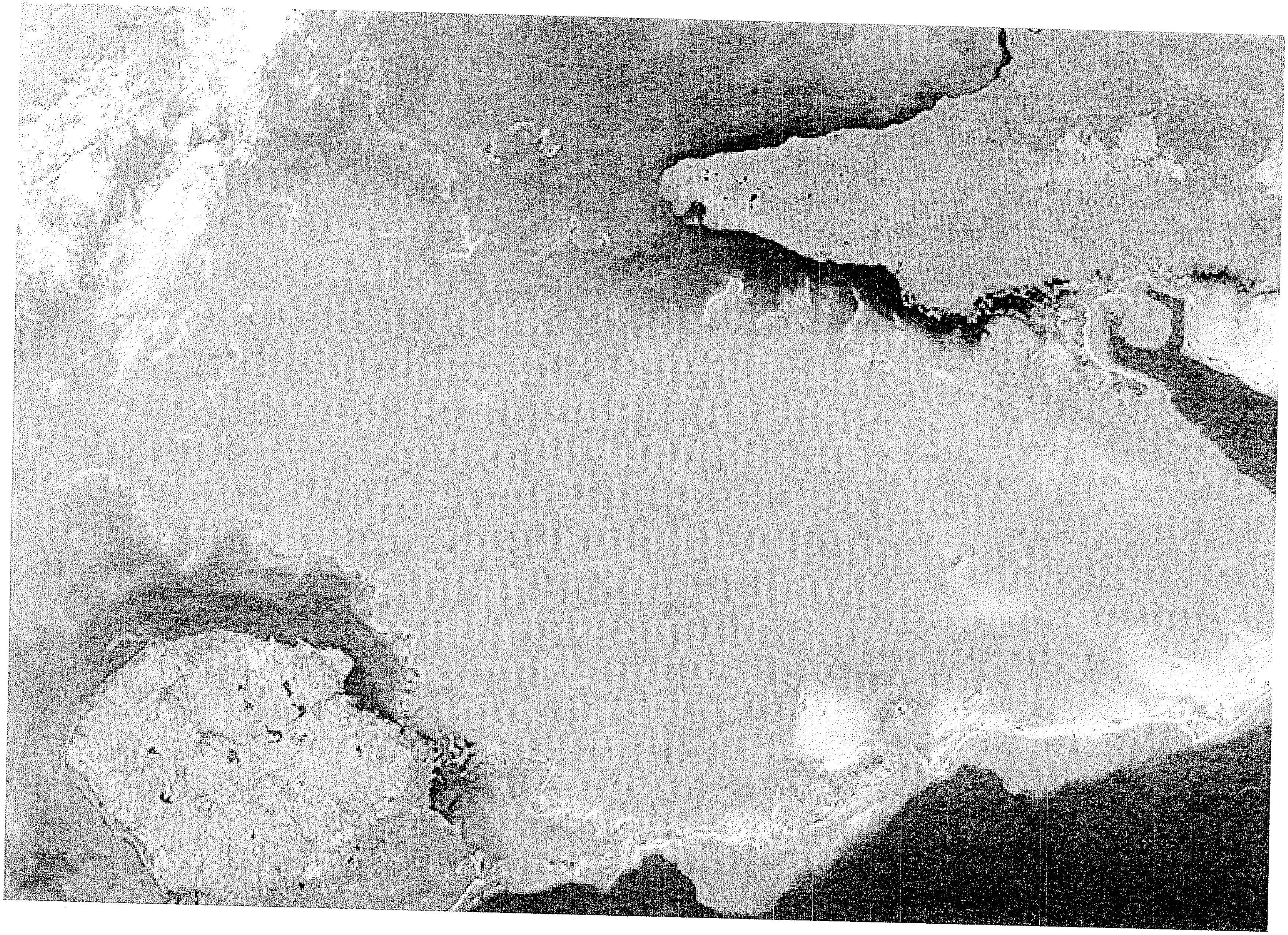
Retrieval of aerosol optical depth over ocean is routinely performed by many different single-view satellite instruments. Because most of the ocean surface is sufficiently black in the red and near-IR, its reflectance at these wavelengths can be conveniently ignored, which greatly simplifies the retrieval process. Once the aerosol properties are determined using these wavelengths, the scene can then be atmospherically corrected to determine the amount of water-leaving radiance in all the visible spectral bands of the instrument (i.e., the ocean color). It is this particular surface information which can be analyzed to determine aspects of the biological and chemical content of the water. However, there are many regions where this black water criterion is not met, particularly in coastal waters with continental runoff and areas with heavy phytoplankton bloom. In these situations, aerosol retrievals become much more difficult and the ocean color more uncertain.

Preliminary studies indicate that simultaneous (or near-simultaneous) multiangle satellite observations (e.g., by MISR) of the ocean can help to provide more robust aerosol and ocean color retrievals. Here, the directional properties of the ocean color radiances (and not the lack of ocean color in the red and near-IR) can potentially supply the necessary surface constraint needed to perform a reasonably accurate aerosol and ocean color retrieval. As such, the applicability of this retrieval algorithm could extend over a much wider range of water conditions than is currently routinely attempted. An additional benefit of this approach is that it allows all spectral bands of the the multiangle instrument to be used by the algorithm, thus providing a more robust determination of aerosol properties.

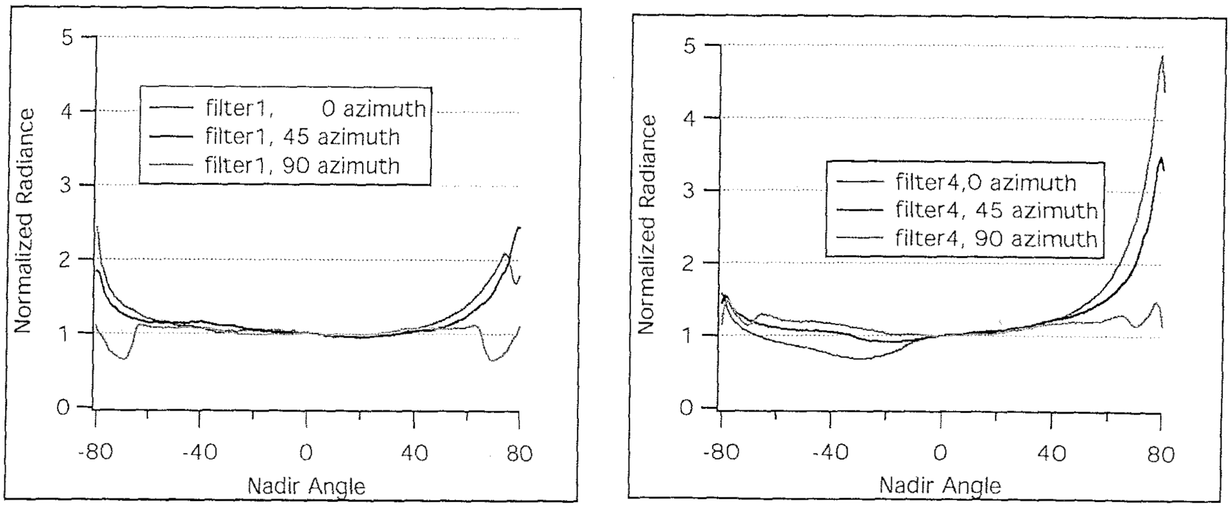
This poster shows some results of case studies using MISR data, performed over different water conditions (open ocean, coastal waters, blooms), and will assess the potential of using surface constraints based on the directional properties of water-leaving radiance.



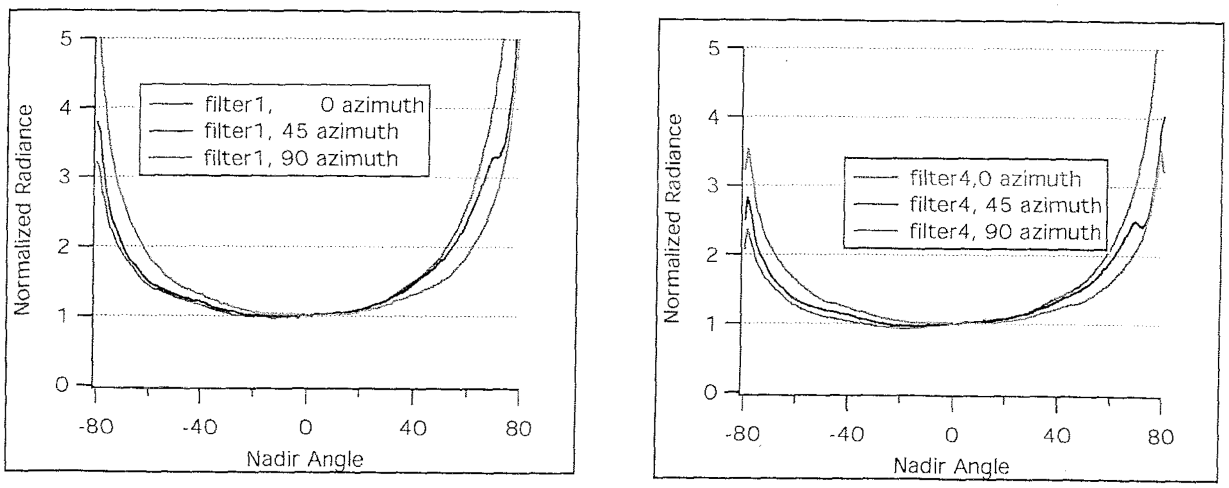
Phytoplankton blooms in the Atlantic Ocean off the coast of Normandy



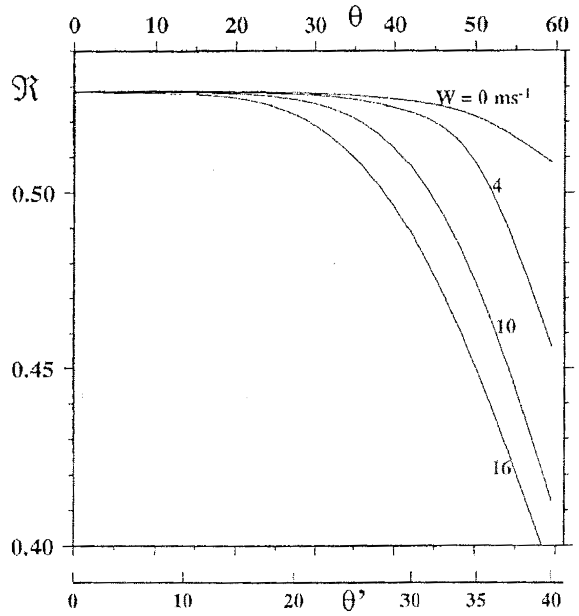
Case 2 waters off the coast of Cuba



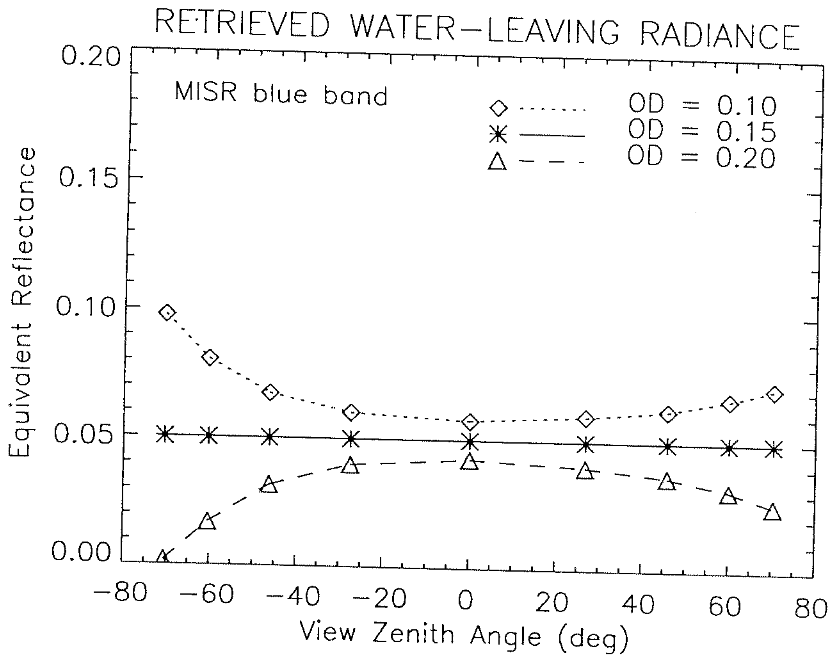
Normalized upward-directed subsurface radiance at 450 nm (left) and 650 nm (right) for a chlorophyll concentration of 0.14 mg m^{-3}. The solar zenith angle is 29°. (Voss, 2003).

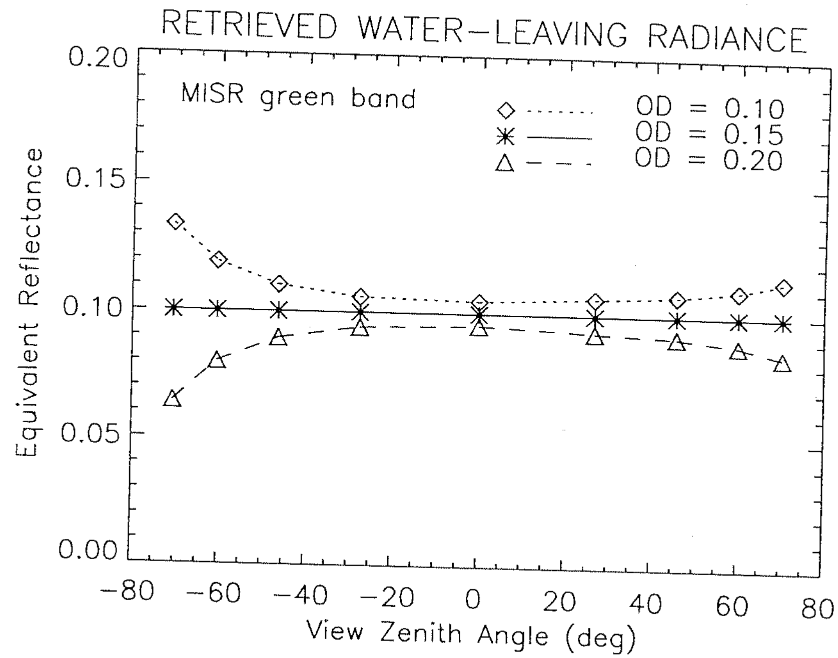


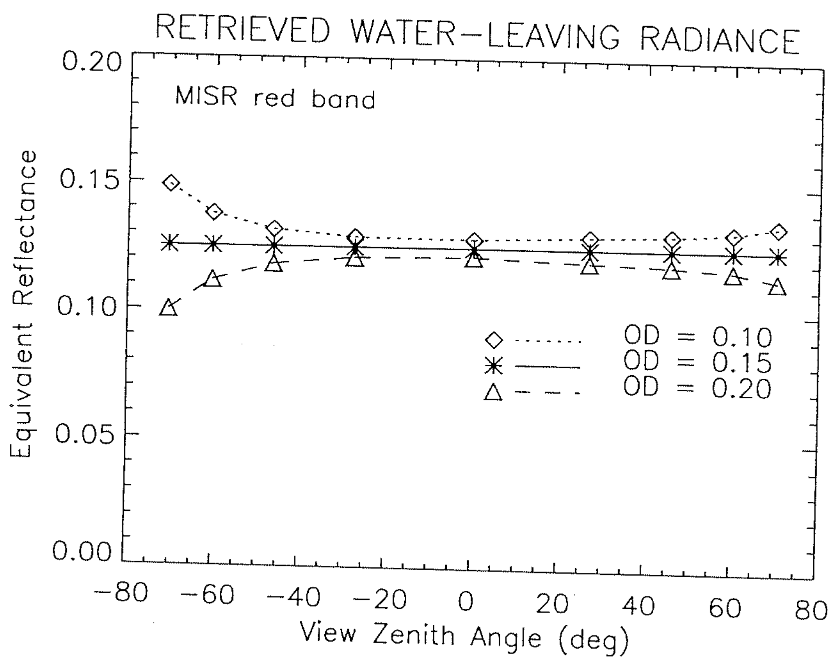
Normalized upward-directed subsurface radiance at 450 nm (left) and 650 nm (right) for a chlorophyll concentration of 4.88 mg m^{-3}. The solar zenith angle is 29°. (Voss, 2003).

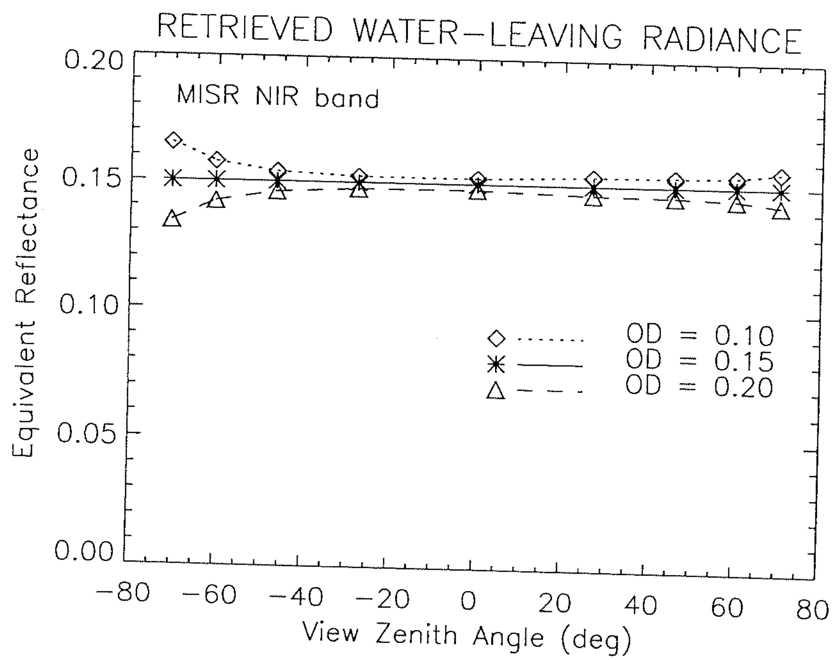


Transmittance of the subsurface radiance through the water-air interface as a function of windspeed and zenith angle (θ' in water, θ in air).(Morel and Gentili,1996).


RETRIEVED WATER-LEAVING RADIANCE
MISR blue band
OD = 0.10
OD = 0.15
OD = 0.20
Equivalent Reflectance
0.20
0.15
0.10
0.05
0.00
-80 -60 -40 -20 0 20 40 60 80
View Zenith Angle (deg)


RETRIEVED WATER-LEAVING RADIANCE
MISR green band
OD = 0.10
OD = 0.15
OD = 0.20
Equivalent Reflectance
0.20
0.15
0.10
0.05
0.00
-80 -60 -40 -20 0 20 40 60 80
View Zenith Angle (deg)


RETRIEVED WATER-LEAVING RADIANCE
MISR red band
OD = 0.10
OD = 0.15
OD = 0.20
Equivalent Reflectance
0.20
0.15
0.10
0.05
0.00
-80 -60 -40 -20 0 20 40 60 80
View Zenith Angle (deg)


RETRIEVED WATER-LEAVING RADIANCE
MISR NIR band
OD = 0.10
OD = 0.15
OD = 0.20
Equivalent Reflectance
0.20
0.15
0.10
0.05
0.00
-80 -60 -40 -20 0 20 40 60 80
View Zenith Angle (deg)

Retrieval of water-leaving radiance (WLR) using simulated MISR data. The correct WLR was assumed to be Lambertian with equivalent reflectance values of 0.05, 0.10, 0.125, and 0.15 in the MISR blue, green, red and NIR bands, respectively. The optical depth (OD) of the aerosol in the green band is 0.15. Use of an incorrect value (0.10 or 0.20) results in the retrieval of distinctly non-Lambertian WLR.