

*Supplementary Information***True Colour Classification of Natural Waters with Medium-Spectral Resolution Satellites: SeaWiFS, MODIS, MERIS and OLCI. *Sensors* 2015, 15, 25663-25680****Hendrik J. van der Woerd ^{1,2,*} and Marcel R. Wernand ^{1,*}**¹ Royal Netherlands Institute for Sea Research, Physical Oceanography, Marine Optics & Remote Sensing, PO box 59, Den Burg 1790AB, Texel, The Netherlands² Institute for Environmental Studies (IVM), VU University Amsterdam, De Boelelaan 1087, Amsterdam 1081HV, The Netherlands

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This document contains the band arithmetic to derive the hue angle and Forel-Ule number from multi-wavelength sensors MERIS, MODIS, SeaWiFS and OLCI.

The commands are adapted to the structure in the BEAM-VISAT software environment.

MERIS**X3**

$$2.957 \cdot \text{reflec_1} + 10.861 \cdot \text{reflec_2} + 3.744 \cdot \text{reflec_3} + 3.750 \cdot \text{reflec_4} + 34.687 \cdot \text{reflec_5} + 41.853 \cdot \text{reflec_6} + 7.619 \cdot \text{reflec_7} + 0.844 \cdot \text{reflec_8} + 0.189 \cdot \text{reflec_9}$$
Y3

$$0.112 \cdot \text{reflec_1} + 1.711 \cdot \text{reflec_2} + 5.672 \cdot \text{reflec_3} + 23.263 \cdot \text{reflec_4} + 48.791 \cdot \text{reflec_5} + 23.949 \cdot \text{reflec_6} + 2.944 \cdot \text{reflec_7} + 0.307 \cdot \text{reflec_8} + 0.068 \cdot \text{reflec_9}$$
Z3

$$14.354 \cdot \text{reflec_1} + 58.356 \cdot \text{reflec_2} + 28.227 \cdot \text{reflec_3} + 4.022 \cdot \text{reflec_4} + 0.618 \cdot \text{reflec_5} + 0.026 \cdot \text{reflec_6} + 0.000 \cdot \text{reflec_7} + 0.000 \cdot \text{reflec_8} + 0.000 \cdot \text{reflec_9}$$
Chrx

$$X3 / (X3 + Y3 + Z3)$$
Chry

$$Y3 / (X3 + Y3 + Z3)$$
HUEMERIS

$$((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}) < 0 ? ((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}) + 360 : ((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}))$$

HUEMERIS 100

HUEMERIS/100

POLYHueMERIS

$$-12.0506 * \text{pow}(\text{HUEMERIS } 100, 5) + 88.9325 * \text{pow}(\text{HUEMERIS } 100, 4) - 244.6960 * \text{pow}(\text{HUEMERIS } 100, 3) + 305.2361 * \text{pow}(\text{HUEMERIS } 100, 2) - 164.6960 * \text{HUEMERIS } 100 + 28.5255$$
HUEMERISPcorr

HUEnewMERIS + POLYHueMERIS

FUMERISPcorr

$$\begin{aligned} &(\text{HUEMERISPcorr} > 232? 0:\text{HUEMERISPcorr} > 227.168? 1:(\text{HUEMERISPcorr} > 220.977? \\ &2:(\text{HUEMERISPcorr} > 209.994? 3:(\text{HUEMERISPcorr} > 190.779? 4:(\text{HUEMERISPcorr} > 163.084? \\ &5:(\text{HUEMERISPcorr} > 132.999? 6:(\text{HUEMERISPcorr} > 109.054? 7:(\text{HUEMERISPcorr} > 94.037? \\ &8:(\text{HUEMERISPcorr} > 83.346? 9:(\text{HUEMERISPcorr} > 74.572? 10:(\text{HUEMERISPcorr} > 67.957? \\ &11:(\text{HUEMERISPcorr} > 62.186? 12:(\text{HUEMERISPcorr} > 56.435? 13:(\text{HUEMERISPcorr} > 50.665? \\ &14:(\text{HUEMERISPcorr} > 45.129? 15:(\text{HUEMERISPcorr} > 39.769? 16:(\text{HUEMERISPcorr} > 34.906? \\ &17:(\text{HUEMERISPcorr} > 30.439? 18:(\text{HUEMERISPcorr} > 26.337? 19:(\text{HUEMERISPcorr} > 22.741? \\ &20:(\text{HUEMERISPcorr} > 19? 21:(\text{HUEMERISPcorr} < 19? 21:0)))))))))))))))))) \end{aligned}$$
OLCI**X3**

$$0.154 * \text{reflec_1} + 2.957 * \text{reflec_2} + 10.861 * \text{reflec_3} + 3.744 * \text{reflec_4} + 3.750 * \text{reflec_5} + \\ 34.687 * \text{reflec_6} + 41.853 * \text{reflec_7} + 7.323 * \text{reflec_8} + 0.591 * \text{reflec_9} + 0.549 * \text{reflec_10} + \\ 0.189 * \text{reflec_11}$$
Y3

$$0.004 * \text{reflec_1} + 0.112 * \text{reflec_2} + 1.711 * \text{reflec_3} + 5.672 * \text{reflec_4} + 23.263 * \text{reflec_5} + \\ 48.791 * \text{reflec_6} + 23.949 * \text{reflec_7} + 2.836 * \text{reflec_8} + 0.216 * \text{reflec_9} + 0.199 * \text{reflec_10} + \\ 0.068 * \text{reflec_11}$$
Z3

$$0.731 * \text{reflec_1} + 14.354 * \text{reflec_2} + 58.356 * \text{reflec_3} + 28.227 * \text{reflec_4} + 4.022 * \text{reflec_5} + \\ 0.618 * \text{reflec_6} + 0.026 * \text{reflec_7} + 0.000 * \text{reflec_8} + 0.000 * \text{reflec_9} + 0.000 * \text{reflec_10} + \\ 0.000 * \text{reflec_11}$$
Chrx

$$X3 / (X3 + Y3 + Z3)$$
Chry

$$Y3 / (X3 + Y3 + Z3)$$
HUESentinel3

$$((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}) < 0? ((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}) + 360 : ((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}))$$
HUESentinel3 100

HUESentinel3/100

POLYHueSentinel3

$$-12.5076 * \text{pow}(\text{HUESentinel3 } 100, 5) + 91.6345 * \text{pow}(\text{HUESentinel3 } 100, 4) \\ -249.8480 * \text{pow}(\text{HUESentinel3 } 100, 3) + 308.6561 * \text{pow}(\text{HUESentinel3 } 100, 2) - 165.4818 * \\ \text{HUESentinel3 } 100 + 28.5608$$
HUESentinel3Pcorr

$$\text{HUEnewSentinel3} + \text{POLYHueSentinel3}$$
FUSentinel3Pcorr

$$(\text{HUESentinel3Pcorr} > 232? 0:\text{HUESentinel3Pcorr} > 227.168? 1:(\text{HUESentinel3Pcorr} > 220.977? \\ 2:(\text{HUESentinel3Pcorr} > 209.994? 3:(\text{HUESentinel3Pcorr} > 190.779? 4:(\text{HUESentinel3Pcorr} > \\ 163.084? 5:(\text{HUESentinel3Pcorr} > 132.999? 6:(\text{HUESentinel3Pcorr} > 109.054? 7:(\text{HUESentinel3Pcorr} \\ > 94.037? 8:(\text{HUESentinel3Pcorr} > 83.346? 9:(\text{HUESentinel3Pcorr} > 74.572? 10:(\text{HUESentinel3Pcorr} \\ > 67.957? 11:(\text{HUESentinel3Pcorr} > 62.186? 12:(\text{HUESentinel3Pcorr} > 56.435? \\ 13:(\text{HUESentinel3Pcorr} > 50.665? 14:(\text{HUESentinel3Pcorr} > 45.129? 15:(\text{HUESentinel3Pcorr} > \\ 39.769? 16:(\text{HUESentinel3Pcorr} > 34.906? 17:(\text{HUESentinel3Pcorr} > 30.439? 18:(\text{HUESentinel3Pcorr} \\ > 26.337? 19:(\text{HUESentinel3Pcorr} > 22.741? 20:(\text{HUESentinel3Pcorr} > 19? 21:(\text{HUESentinel3Pcorr} < \\ 19? 21:0))))))))))))))))))$$
MODIS**X3**

$$2.957 * \text{Rrs_412} + 10.861 * \text{Rrs_443} + 4.031 * \text{Rrs_488} + 3.989 * \text{Rrs_531} + 49.037 * \text{Rrs_555} + \\ 34.586 * \text{Rrs_667} + 0.829 * \text{Rrs_678}$$
Y3

$$0.112 * \text{Rrs_412} + 1.711 * \text{Rrs_443} + 11.106 * \text{Rrs_488} + 22.579 * \text{Rrs_531} + 51.477 * \text{Rrs_555} + \\ 19.452 * \text{Rrs_667} + 0.301 * \text{Rrs_678}$$
Z3

$$14.354 * \text{Rrs_412} + 58.356 * \text{Rrs_443} + 29.993 * \text{Rrs_488} + 2.618 * \text{Rrs_531} + 0.262 * \text{Rrs_555} + \\ 0.000 * \text{Rrs_667} + 0.000 * \text{Rrs_678}$$
Chrx

$$\text{X3}/(\text{X3} + \text{Y3} + \text{Z3})$$
Chry

$$\text{Y3}/(\text{X3} + \text{Y3} + \text{Z3})$$
HUEMODISa

$$((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180/\text{PI}) < 0? ((\text{atan2}((\text{Chry} - 0.333333), \\ (\text{Chrx} - 0.333333))) * 180/\text{PI}) + 360:((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180/\text{PI})$$
HUEMODISa 100

$$\text{HUEMODISa}/100$$
POLYHueMODISa

$$-48.0880 * \text{pow}(\text{HUEMODISa } 100, 5) + 362.6179 * \text{pow}(\text{HUEMODISa } 100, 4) - \\ 1011.7151 * \text{pow}(\text{HUEMODISa } 100, 3) + 1262.0348 * \text{pow}(\text{HUEMODISa } 100, 2) - 666.5981 * \\ \text{HUEMODISa } 100 + 113.9215$$

HUEMODISaPcorr

HUEnewMODISa + POLYHueMODISa

FUMODISaPcorr

(HUEMODISaPcorr > 232? 0:HUEMODISaPcorr > 227.168? 1:(HUEMODISaPcorr > 220.977?
2:(HUEMODISaPcorr > 209.994? 3:(HUEMODISaPcorr > 190.779? 4:(HUEMODISaPcorr >
163.084? 5:(HUEMODISaPcorr > 132.999? 6:(HUEMODISaPcorr > 109.054? 7:(HUEMODISaPcorr
> 94.037? 8:(HUEMODISaPcorr > 83.346? 9:(HUEMODISaPcorr > 74.572? 10:(HUEMODISaPcorr
> 67.957? 11:(HUEMODISaPcorr > 62.186? 12:(HUEMODISaPcorr > 56.435?
13:(HUEMODISaPcorr > 50.665? 14:(HUEMODISaPcorr > 45.129? 15:(HUEMODISaPcorr >
39.769? 16:(HUEMODISaPcorr > 34.906? 17:(HUEMODISaPcorr > 30.439? 18:(HUEMODISaPcorr
> 26.337? 19:(HUEMODISaPcorr > 22.741? 20:(HUEMODISaPcorr > 19? 21:(HUEMODISaPcorr <
19? 21:0))))))))))))))))))

SeaWiFS**X3**

2.957*Rrs_412 + 10.861*Rrs_443 + 3.744*Rrs_490 + 3.455*Rrs_510 + 52.304*Rrs_555 +
32.825*Rrs_670

Y3

0.112*Rrs_412 + 1.711*Rrs_443 + 5.672*Rrs_490 + 21.929*Rrs_510 + 59.454*Rrs_555 +
17.810*Rrs_670

Z3

14.354*Rrs_412 + 58.356*Rrs_443 + 28.227*Rrs_490 + 3.967*Rrs_510 + 0.682*Rrs_555 +
0.018*Rrs_670

Chrx

$X3/(X3 + Y3 + Z3)$

Chry

$Y3/(X3 + Y3 + Z3)$

HUESeaWiFS

$((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI}) < 0 ? ((\text{atan2}((\text{Chry} - 0.333333),$
 $(\text{Chrx} - 0.333333))) * 180 / \text{PI}) + 360 : ((\text{atan2}((\text{Chry} - 0.333333), (\text{Chrx} - 0.333333))) * 180 / \text{PI})$

HUESeaWiFS 100

HUESeaWiFS/100

POLYHueSeaWiFS

$-49.4377 * \text{pow}(\text{HUESeaWiFS } 100, 5) + 363.2770 * \text{pow}(\text{HUESeaWiFS } 100, 4) -$
 $978.1648 * \text{pow}(\text{HUESeaWiFS } 100, 3) + 1154.6030 * \text{pow}(\text{HUESeaWiFS } 100, 2) -$
 $552.2701 * \text{HUESeaWiFS } 100 + 78.2940$

HUESeaWiFSPcorr

HUEnewSeaWiFS + POLYHueSeaWiFS

FUSeaWiFSPcorr

(HUESeaWiFSPcorr > 232? 0:HUESeaWiFSPcorr > 227.168? 1:(HUESeaWiFSPcorr > 220.977?
2:(HUESeaWiFSPcorr > 209.994? 3:(HUESeaWiFSPcorr > 190.779? 4:(HUESeaWiFSPcorr >

163.084? 5:(HUESeaWiFSPcorr > 132.999? 6:(HUESeaWiFSPcorr > 109.054? 7:(HUESeaWiFSPcorr > 94.037? 8:(HUESeaWiFSPcorr > 83.346? 9:(HUESeaWiFSPcorr > 74.572? 10:(HUESeaWiFSPcorr > 67.957? 11:(HUESeaWiFSPcorr > 62.186? 12:(HUESeaWiFSPcorr > 56.435? 13:(HUESeaWiFSPcorr > 50.665? 14:(HUESeaWiFSPcorr > 45.129? 15:(HUESeaWiFSPcorr > 39.769? 16:(HUESeaWiFSPcorr > 34.906? 17:(HUESeaWiFSPcorr > 30.439? 18:(HUESeaWiFSPcorr > 26.337? 19:(HUESeaWiFSPcorr > 22.741? 20:(HUESeaWiFSPcorr > 19? 21:(HUESeaWiFSPcorr < 19? 21:0))))))))))))))))))))))

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