Project number	
Project acronym	
Project title	CalVal Support System
Deliverable No.	D11
Short description	Required information on the sensor for running 6S
Version	0.0
Author(s) and affiliation(s)	R. Santer for Brockman Consultant
Author(s) of the contributions	
Modification history	05/04/2007: Preliminary draft
	16/05/07: this version
Distribution	Internal

1. *Introduction*

The 6S code is the reference code for calval activities of the VOS. This note first describes the pieces of information needed for a given satellite sensor to use 6S. Then, we will provide, in dedicated annexes, this information for:

(i) MERIS. We rely on the BEAM functionalities to provide TOA reflectances as well as the meteorological date from the auxiliary parameters.

(ii) AATSR for which BEAM plays a similar role than for MERIS.

(iii) For ALOS (P. Goryl personal communication), we need to transform the TOA radiance into TOA reflectance that why, we provide the mean solar irradiance for each spectral bands. Thuillez et al irradiance values are used.

(iv) The same approach than for ALOS is conducted for FORMOSAT (CNES personal communication) and KOMPSAT (P. Goryl personal communication).

(v) There is certainly the need to consolidate our preliminary approach for CHRIS. The spectral responses are taken as rectangular. The different spectral configurations are taken from .We also suppose the CHRIS PROBA team will (has) provide us with the solar irradiances to be used.

All the above pieces of information are used for implementation in 6S, namely the spectral responses for the sensors of concerned. In our 6S version, MERIS and AATSR are already implemented. For the time being, CHRIS will be entered as an user option with a rectangular filter function. We indicate in an annex how to incorporate ALOS (PRISM and AVNIR), FORMOSAT and KOMPSAT.

2. *Sensor required information to run 6S*

2.1 Geometrical information

We use the 6S option "0 ": "user condition". The geometrical conditions are provided as an auxiliary product. The 6S required pieces of information are: the solar zenith angle (SZA), the solar azimuth angle (SAA), the view zenith angle (VZA) and the view azimuth angle (VAA).

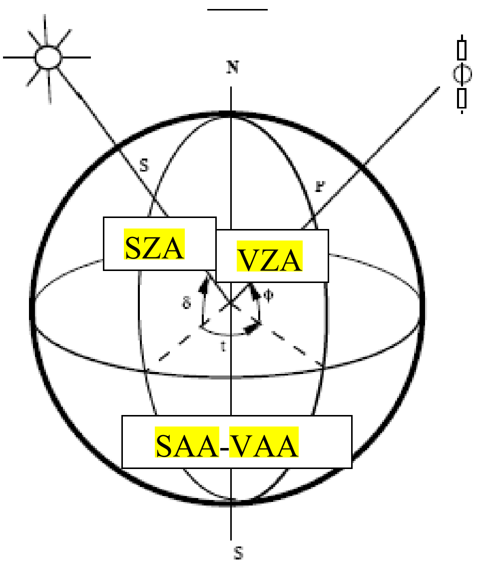
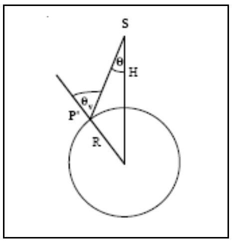


Figure 1: geometrical parameters

View zenith angle:



The VZA should correspond to the view angle from the local vertical:

IVZA=1;

if VZA at platform, then IVZA=0

Difference in azimuth:

The 6S convention in azimuth corresponds to figure 1: the backscattering corresponds to SAA-VAA=0°. IAA=1.

The other convention corresponds a vector representation of the two directions. This convention is used in most of the radiative transfer code. The backscattering corresponds to SAA-VAA=+/-180°. IAA=0.

2.2 Meteorological auxiliary file

In numerous sensors, an auxiliary data file is attached to the product. The following pieces of information are needed:

Type of grid

Table of meteorological product relevant for 6S and corresponding unit: TMAF

2.3 Spectral response

The number of spectral bands is the first input: IWL.

3 options are available in 6S to account for the spectral response:

(i) the monochromatic computation refers to the effective wavelength (µm): EWL

(ii) the rectangular response refers to the bandwidth (µm): BWL

(iii) the spectral response SWL is provided between SWINF (µm) and SWSUP (µm) with a step of 0.0025 (µm).

3. Sensor required information to compare to 6S outputs

The basic 6S output is a reflectance. If a given sensor produces reflectance, IREF=1, there is no need to know specifically the solar irradiance. The 6S irradiance values are relevant.

If IREF=0, then the conversion between radiance and reflectance require to attach solar irradiance values. By internal consistency, these irradiance values are those used to perform the radiometric calibration of the instrument..

MERIS

IVZA=1

IAA=1

Type of grid: 16pixels* 16 pixels

TMAF

	Ozone	Water vapour	Pressure	Wind speed 1	Wind speed 2
unit	cm.atm	cm	hPa	m/s	m/s

NB: W1 meridian wind

W2 longitudinal wind

IWL=15

See excel file for spectral responses

IREF=1

AATSR

IVZA=1

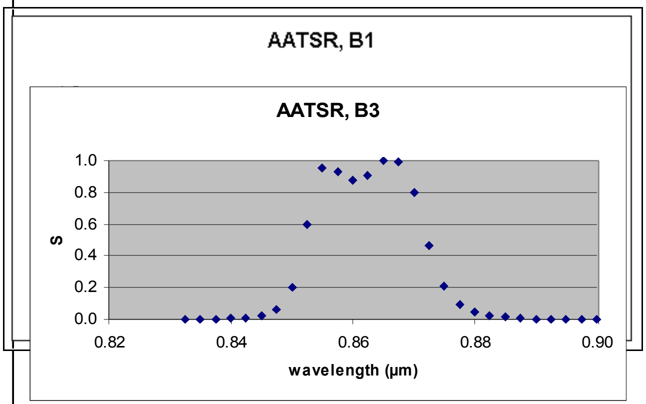
IAA=1

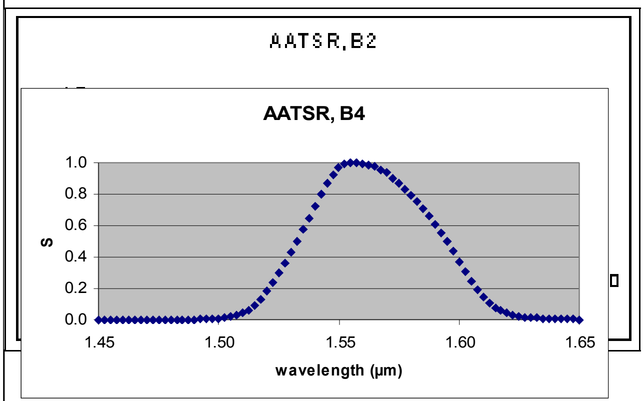
Type of grid: TBD

TMAF: TBD

IWL=4

See excel file for spectral responses





IREF=1

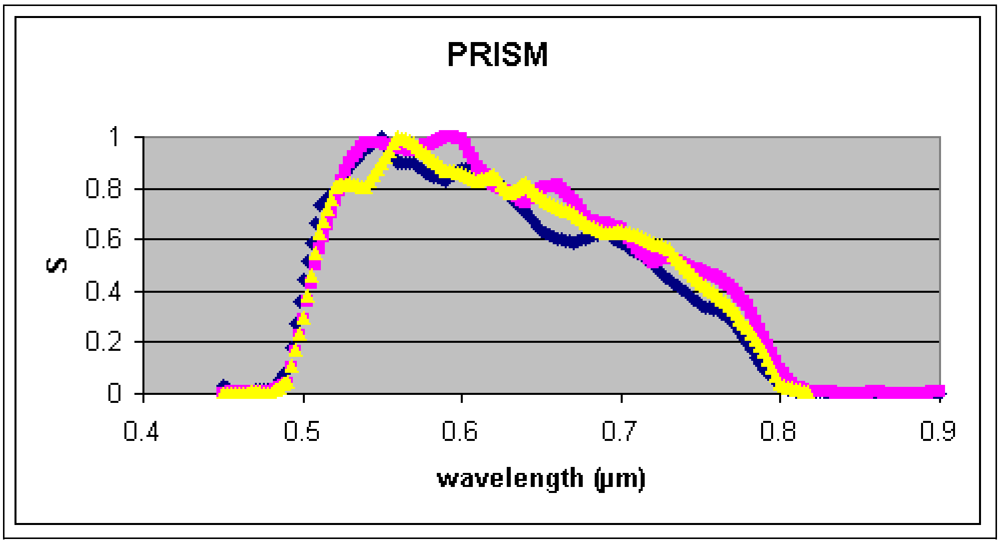
PRISM on ALOS

IVZA=1

IAA=1

IWL=3

There are 3 PRISM instruments for stereoscopic view: PRISM_B (backward), PRISM_F (forward) and PRISM_N (nadir)



See excel file for spectral responses

IREF=0

Solar irradiances to be used for L to RO conversion:

band	**B**	**F**	**N**
E_s (w/m^2/sr/µm)	1664.7	1643.5	1639.0

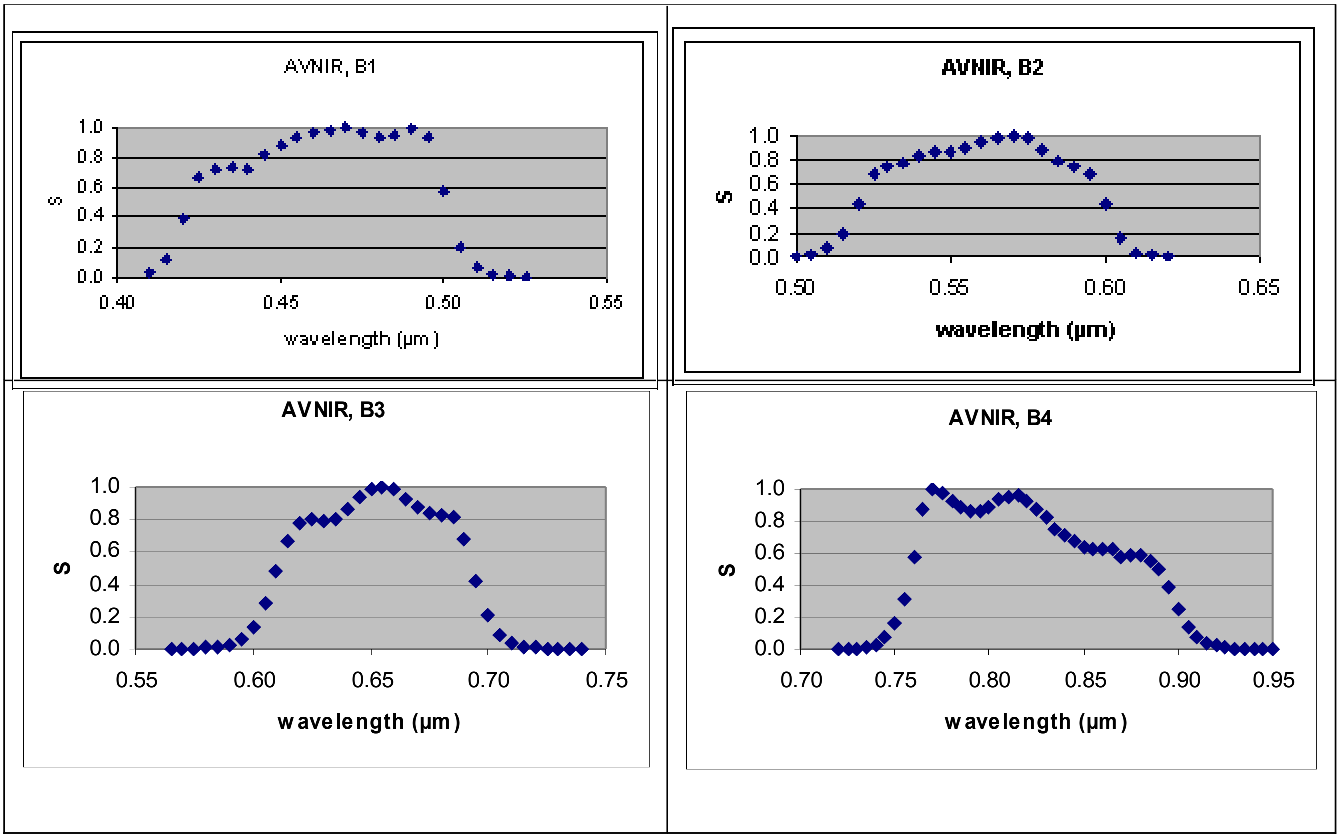
AVNIR

IVZA=1

IAA=1

IWL=4

See excel file for spectral responses



IREF=0

Solar irradiances to be used for L to RO conversion:

band	1	2	3	4
E_s (w/m^2/sr/µm)	1914.4	1842.7	1583.7	1087.0

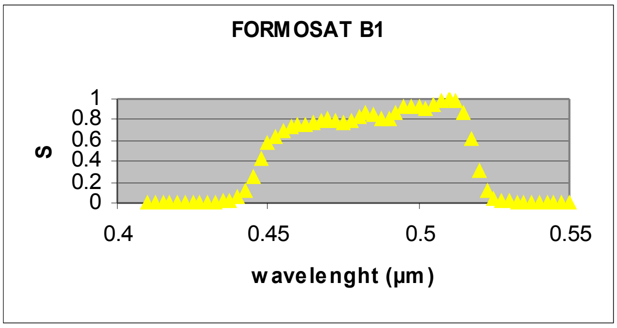
FORMOSAT

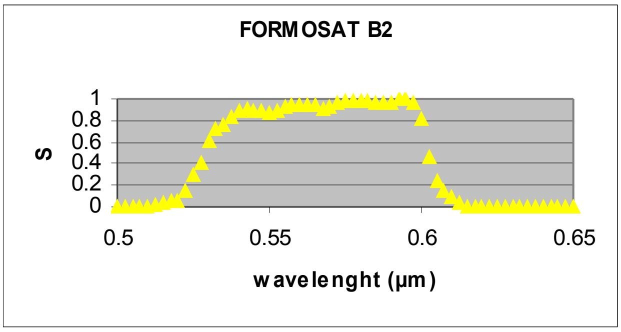
IVZA=1

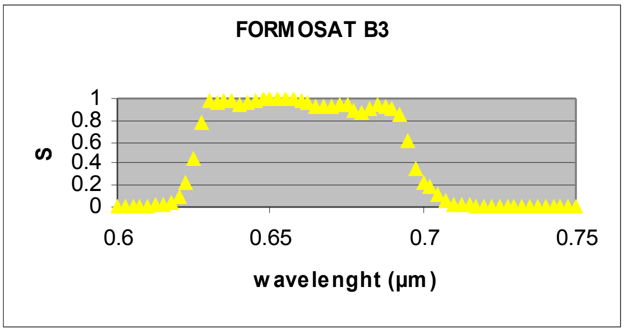
IAA=1

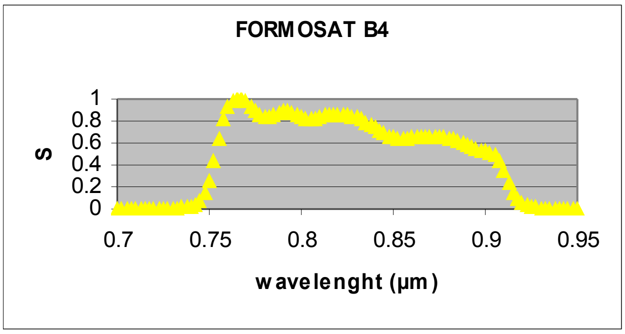
IWL=4

See excel file









IREF=0

Solar irradiances to be used for L to RO conversion:

band	**1**	**2**	**3**	**4**
E_s (w/m^2/sr/µm)	1953.4	1836.2	1553.6	1079.8

KOMPSAT-2

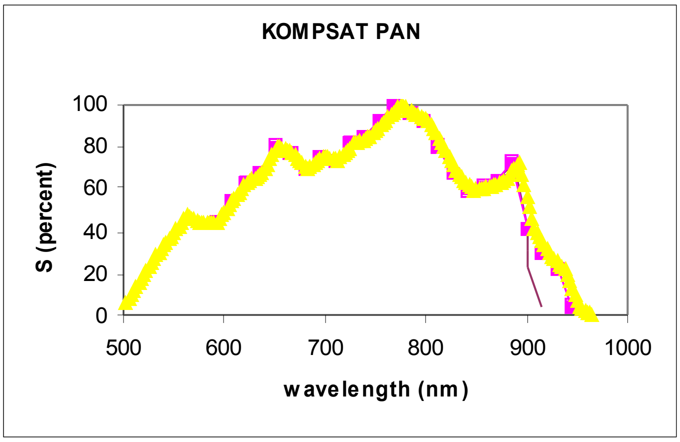
IVZA=1

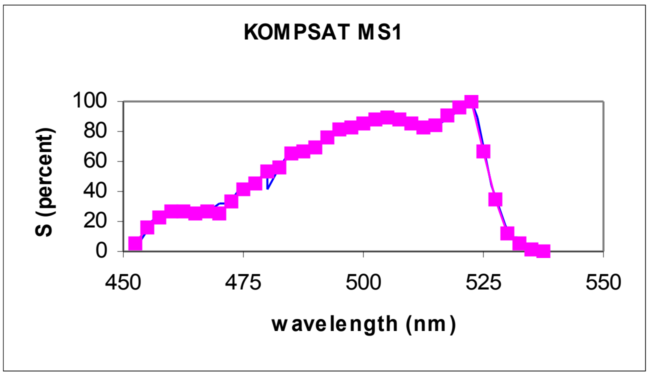
IAA=1

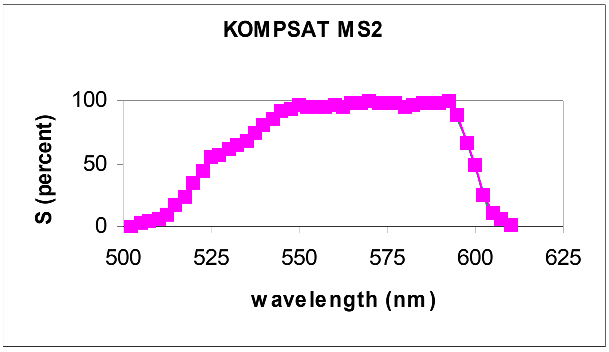
IWL=4

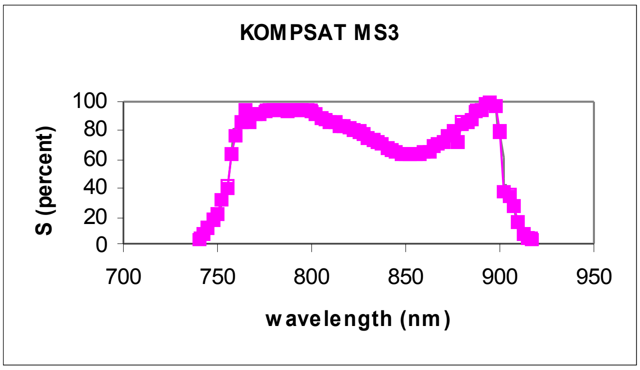
See excel file for spectral responses.

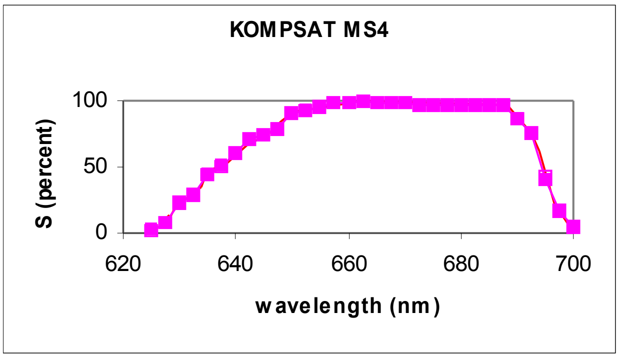
The filter responses provided by P. Goryll have been fitted with the 2.5 nm step required in 6S.











IREF=0

Solar irradiances to be used for L to RO conversion:

band	**PAN**	**1**	**2**	**3**	**4**
E_s (w/m^2/sr/µm)	1012.2	1918.6	1840.4	1073.5	1545.0

6S modifications

6S main

```
      program ssssss


      data etiq1/
     s '(1h*,22x,34h user defined conditions          ,t79,1h*)',

     s ' gli     30      ',' PRISM_B         ',                    !RS140507
     s ' PRISM_F         ',' PRISM_N         ',' AVNIR   1       ',! RS140507
     s ' AVNIR   2       ',' AVNIR   3       ',' AVNIR   4       ',!RS140507
     s ' FORMOSAT 1      ',' FORMOSAT 2      ',' FORMOSAT 3      ',!RS140507
     s ' FORMOSAT 4      ',' KOMPSAT_PAN     ',' KOMPSAT 1       ',!RS140507
     s ' KOMPSAT 2       ',' KOMPSAT 3       ',' KOMPSAT 4       ',!RS140507
     s/!RS140507

c**********************************************************************c
c      iwave input of the spectral conditions                          c
c            --------------------------------                          c
c       119  PRISM   band B          (PAN-2.5m)                  c!RS140507
c       120  PRISM   band F          (PAN-2.5m)                  c!RS140507
c       121  PRISM   band N          (PAN-2.5m)                  c!RS140507
c       122  AVNIR   band 1          (0.465-10m)                 c!RS140507
c       123  AVNIR   band 2          (0.560-10m)                 c!RS140507
c       124  AVNIR   band 3          (0.652-10m)                 c!RS140507
c       125  AVNIR   band 4          (0.819-10m)                 c!RS140507
c       126  FORMOSAT   B 1          (0.4847-8m)                 c!RS140507
c       127  FORMOSAT   B 2          (0.5659-8m)                 c!RS140507
c       128  FORMOSAT   B 3          (0.6598-8m)                 c!RS140507
c       129  FORMOSAT   B 4          (0.8195-8m)                 c!RS140507
c       130  KOMPSAT   PAN           (PAN.-2m)                   c!RS140507
c       130  KOMPSAT   MS 1          (0.46-4m)                   c!RS140507
c       131  KOMPSAT   MS 2          (0.56-4m)                   c!RS140507
c       132  KOMPSAT   MS 3          (0.82-4m)                   c!RS140507
c       133  KOMPSAT   MS 4          (0.-(-4m)                   c!RS140507
c  note: wl has to be in micrometer                              c
c**********************************************************************c
      do 38 l=iinf,isup
c       153     PRISM   band          (119,121)!RS140507
c       154     AVNIR   band          (122,125)!RS140507
c       155     FORMOSAT              (126,129)!RS140507
c       156     KOMPSAT               (130,134)!RS140507
   18 goto (110,
     s      111,
     s      112,112,
     s      114,114,114,114,114,114,114,114,114,114,114,114,
     s      118,118,118,118,118,118,118,118,
     s      121,121,121,121,121,121,
     s      127,127,127,127,
     s      128,128,128,128,128,128,128,
     s      129,129,129,129,129,129,129,129,
     s      130,130,130,130,
     s      131,131,131,131,131,131,131,131,
     s      113,113,113,113,113,113,113,113,
     s      150,150,150,150,
     s      151,151,151,151,151,151,151,151,
     s      151,151,151,151,151,151,151,
```

```
     s      152,152,152,152,152,152,152,152,152,152,
     s      152,152,152,152,152,152,152,152,152,152,
     s      152,152,152,152,152,152,152,152,152,152,
     s      153,153,153,         !RS
     s      154,154,154,154,  !RS
     s      155,155,155,155, !RS
     s      156,156,156,156,156 !RS
     s     ),iwave
110 read(iread,*) wlinf,wlsup
```

6S new subroutines:

```
      subroutine prism(iwa)
      real s,wlinf,wlsup
      common /sixs_ffu/ s(1501),wlinf,wlsup
      real sr(1501),wli(1),wls(1)
      integer iwa,l,i

c band N of PRISM (panchromatic)
       DATA (SR(1,L),L=1,1501)/  80*0.
     A,0.0000,0.0020,0.0040,0.0060,0.0080,0.0072,0.0064,0.0056
     A,0.0049,0.0051,0.0054,0.0057,0.0061,0.0149,0.0239,0.0328
     A,0.0418,0.1037,0.1655,0.2274,0.2893,0.3584,0.4275,0.4967
     A,0.5659,0.6118,0.6578,0.7038,0.7498,0.7876,0.8254,0.8633
     A,0.9012,0.9207,0.9402,0.9598,0.9794,0.9780,0.9766,0.9753
     A,0.9740,0.9697,0.9655,0.9612,0.9570,0.95358,0.950,0.9467
     A,0.9433,0.9505,0.9578,0.9651,0.9724,0.9792,0.9861,0.9930
     A,1.0000,0.9984,0.9969,0.9953,0.9938,0.9668,0.9398,0.9129
     A,0.8860,0.8681,0.8502,0.8324,0.8146,0.8057,0.7968,0.7880
     A,0.7792,0.7706,0.7620,0.7535,0.7450,0.7581,0.7713,0.7845
     A,0.7978,0.8007,0.8038,0.8068,0.8099,0.7957,0.7815,0.7673
     A,0.7532,0.7322,0.7114,0.6905,0.6697,0.6679,0.6662,0.6645
     A,0.6628,0.6569,0.6510,0.6451,0.6393,0.6205,0.6017,0.5830
     A,0.5643,0.5505,0.5368,0.5231,0.5094,0.5150,0.5205,0.5261
     A,0.5317,0.5243,0.5169,0.5095,0.5022,0.4949,0.4878,0.4806
     A,0.4735,0.4688,0.4642,0.4596,0.4550,0.4429,0.4309,0.4188
     A,0.4068,0.3909,0.3751,0.3593,0.3435,0.3115,0.2795,0.2476
     A,0.2157,0.1845,0.1533,0.1222,0.0910,0.0745,0.0581,0.0416
     A,0.0252,0.0206,0.0160,0.0115,0.0070,0.0069,0.0068,0.0068
     A,0.0067,0.0052,0.0036,0.0021,0.0006,0.0005,0.0005,0.0005
     A,0.0006,0.0021,0.0037,0.0054,0.0070,0.0052,0.0035,0.0018
     A,0.0000,0.0000,0.0000,0.0000,0.0000,0.0006,0.0013,0.0019
     A,0.0026,0.0032,0.0039,0.0046,0.0053,0.0039,0.0026,0.0013
     A,1240*0./


      wli(1)=0.45
      wls(1)=0.9

      do 1 i=1,1501
      s(i)=sr(iwa,i)
    1 continue
      wlinf=wli(iwa)
      wlsup=wls(iwa)
      return
      end

      subroutine avnir(iwa)
      real s,wlinf,wlsup
      common /sixs_ffu/ s(1501),wlinf,wlsup
      real sr(4,1501),wli(4),wls(4)
      integer iwa,l,i

c band 1 of AVNIR (490 mic)
       DATA (SR(1,L),L=1,1501)/  59*0.,
    A0.0009,0.0017,0.0049,0.0080,0.0186,0.0293,0.0776,0.1260,0.2609,
    A0.3958,0.5314,0.6672,0.6947,0.7222,0.7261,0.7300,0.7272,0.7245,
    A0.7717,0.8189,0.8501,0.8814,0.9068,0.9321,0.9495,0.9669,0.9708,
    A0.9747,0.9873,1.,0.9849,0.9698,0.9507,0.9315,0.9365,0.9414,
    A0.9631,0.9848,0.9600,0.9351,0.7552,0.5754,0.3911,0.2068,0.1361,
```

```
     A0.0655,0.0440,0.0225,0.0150,0.0075,0.0046,0.0017,0.00089,
     A1389*0./

c band 2 of AVNIR (560 mic)
      DATA (SR(2,L),L=1,1501)/97*0,0.0007,0.0015,0.003,0.0045,
     A0.0124,0.0202,0.0471,0.0739,0.1358,0.1977,0.3205,0.4433,
     A0.5632,0.6831,0.7136,0.7441,0.7593,0.7746,0.8089,0.8431,
     A0.8575,0.8718,0.8721,0.8724,0.8872,0.9021,0.9253,0.9485,
     A0.9624,0.9763,0.9881,1.,0.9904,0.9808,0.9349,0.889,0.8366,
     A0.7843,0.765,0.7457,0.7155,0.6853,0.5639,0.4425,0.3005,
     A0.1585,0.0985,0.0384,0.0236,0.0087,0.0052,0.0017,0.0008
     A1351*0./

c band 3 of AVNIR (670 mic)
      DATA (SR(3,L),L=1,1501)/ 125*0.,
      A0.0008,0.0016,0.0025,0.0034,0.0043,0.0051,
      A0.0075,0.0099,0.0126,0.0153,0.0228,0.0303,0.0462,0.062,
      A0.0995,0.1369,0.2106,0.2843,0.3857,0.4870,0.5747,0.6624,
      A0.7197,0.7770,0.7895,0.8020,0.7990,0.7959,0.7988,0.8016,
      A0.8311,0.8606,0.8982,0.9359,0.9592,0.9825,0.9912,1.,0.9931,
      A0.9862,0.9568,0.9275,0.9046,0.8818,0.8606,0.8395,0.8344,
      A0.8293,0.8214,0.8136,0.7470,0.6804,0.5480,0.4157,0.3100,
      A0.2043,0.1470,0.0898,0.0633,0.0368,0.0273,0.0177,0.0135,
      A0.0092,0.0076,0.006,0.0045,0.0030,0.0020,0.0015,0.0015,0.0015,
      A0.0007,
      A1303*0./

c band 4 of AVNIR (860 mic)
      DATA (SR(4,L),L=1,1501)/ 187*0.,
     A0.0012,0.0023,0.0023,0.0022,0.0034,0.0045,0.0080,0.0115,0.0189,
     A0.0264,0.048,0.0703,0.1137,0.1572,0.2350,0.3129,0.4431,0.5732,
     A0.7243,0.8754,0.9377,1.,0.9884,0.9768,0.9528,0.9287,0.9090,
     A0.8893,0.8763,0.8632,0.8627,0.8622,0.8753,0.8885,0.9136,
     A0.9387,0.9436,0.9486,0.9530,0.9575,0.9411,0.9246,0.8968,
     A0.8690,0.8466,0.8241,0.7893,0.7545,0.7331,0.7117,0.6910,
     A0.6704,0.6559,0.6414,0.6356,0.6299,0.6258,0.6216,0.6227,
     A0.6237,0.6024,0.5811,0.5842,0.5873,0.5866,0.5859,0.5696,
     A0.5532,0.5250,0.4969,0.4438,0.3908,0.3191,0.2475,0.1906,
     A0.1338,0.1032,0.0727,0.0543,0.0359,0.02917,0.0224,0.0160,
     A0.0096,0.0068,0.0039,0.0037,0.00363,0.0030,0.0025,0.0024,
     A0.0023,0.0015,0.0007,0.0003,0            0.0003,0.0006,0.0006,0.0006,
     A0.0006,0.0005,0.0002,
     A1211*0./

      wli(1)=0.3975
      wls(1)=0.5275
      wli(2)=0.4925
      wls(2)=0.6225
      wli(3)=0.5625
      wls(3)=0.7425
      wli(4)=0.7425
      wls(4)=0.9725
      do 1 i=1,1501
      s(i)=sr(iwa,i)
    1 continue
      wlinf=wli(iwa)
      wlsup=wls(iwa)
      return
      end
      subroutine formosat(iwa)
```

```
      real s,wlinf,wlsup
      common /sixs_ffu/ s(1501),wlinf,wlsup
      real sr(4,1501),wli(4),wls(4)
      integer iwa,l,i

c band 1 (490 mic)
       DATA (SR(1,L),L=1,1501)/  64*0.,
     A,0.0001,0.0001,0.0002,0.0003,0.0005,0.0007,0.0012,0.002
     A,0.0039,0.0072,0.0144,0.0284,0.0583,0.1201,0.249,0.4271
     A,0.5717,0.6417,0.6867,0.7287,0.7554,0.7558,0.7646,0.793
     A,0.8067,0.7797,0.7648,0.7873,0.8341,0.8561,0.8385,0.8026
     A,0.8005,0.8662,0.9135,0.9225,0.9168,0.9115,0.9352,0.983
     A,1.0000,0.9785,0.8694,0.6064,0.305,0.1142,0.0478,0.0242
     A,0.0102,0.0047,0.003,0.0022,0.0012,0.0007,0.0005,0.0004
     A,0.0003,0.0002,0.0001,0.0002,0.0001,0.0001,0,0.0001
     A,1373*0./

c band 2  (560 mic)
      DATA (SR(2,L),L=1,1501)/90*0
     A,0.0001,0,0,0.0001,0.0002,0.0003,0.0008           ,0.0007
     A,0.0006,0.0016,0.0038,0.0028,0.0045,0.007,0.007,0.0126
     A,0.032           ,0.0463,0.0606,0.1522       ,0.2961,0.4151,0.6149,0.726
     A,0.7637,0.8325,0.8845,0.9006,0.8941,0.8797,0.8739,0.8945
     A,0.9298,0.9471,0.9451,0.9456,0.9361,0.9137,0.919,0.9599
     A,0.9847,0.9871,0.9826,0.9746,0.9641,0.9593,0.9683,0.992
     A,0.9919,0.955,0.8104,0.4719,0.238,0.1512,0.0984,0.0327
     A,0.0088,0.0029,0.0014,0.0011,0.0011,0.0015,0.0018       ,0.0009
     A,0.0004,0.0002,0.0001
     A,1344*0./

c band 3  (670 mic)
      DATA (SR(3,L),L=1,1501)/ 140*0.
     A,0.0004,0.0004,0.0007,0.0016,0.0043,0.0122,0.0224       ,0.0407
     A,0.0894,0.2145,0.4352,0.7735,0.9864,0.9664,0.9833       ,0.9781
     A,0.9407,0.9541,0.985,0.9943    ,0.9958,0.9996,0.9992,0.9974
     A,0.9857,0.9581,0.9309,0.9173  ,0.9257,0.9439,0.9367,0.8962
     A,0.8676,0.9014,0.9401,0.9221  ,0.8988,0.8553,0.6057,0.3426
     A,0.2298,0.1871,0.1142,0.0514  ,0.0255,0.017,0.0118,0.0072
     A,0.004           ,0.0026,0.0019,0.0017       ,0.0016,0.0013,0.001,0.0006
     A,0.0003,0.0003,0.0002
      A,1302*0./
c band 4  (860 mic)
      DATA (SR(4,L),L=1,1501)/ 192*0.
     A,0.004           ,0.0059,0.0091,0.0147       ,0.0243,0.0432,0.0781,0.1409
     A,0.2508,0.4297,0.6415,0.8219,0.9294,0.9804,0.9969,0.9971
     A,0.9759,0.9323,0.886,0.8504   ,0.8314,0.8361,0.8521,0.871
     A,0.8851,0.8848,0.8717,0.8533,0.8302,0.8215,0.8206       ,0.8263
     A,0.8379,0.8509,0.8597,0.8635,0.862,0.8583,0.8514,0.841
     A,0.8283,0.8112,0.7887,0.7643,0.7365,0.7083,0.6836       ,0.6621
     A,0.6478,0.6408,0.6389,0.6399,0.6465,0.65,0.6553,0.6607
     A,0.6596,0.6612,0.6558,0.6573,0.6423,0.6304,0.615,0.597
     A,0.5779,0.5586,0.5436,0.5338  ,0.5278,0.517,0.4897,0.4317
     A,0.343           ,0.2382,0.1494,0.0861       ,0.0485,0.0285,0.017,0.0104
     A,0.0065,0.0044,0.0033,0.0023  ,0.0016,0.0012,0.0009       ,0.0007
     A,0.0005,0.0004,0.0003,0.0003  ,0.0002,0.0002,0.0001
     A,1214*0./

      wli(1)=0.41
      wls(1)=0.5675
      wli(2)=0.475
```

```
      wls(2)=0.64
      wli(3)=0.6
      wls(3)=0.745
      wli(4)=0.73
      wls(4)=0.965
      do 1 i=1,1501
      s(i)=sr(iwa,i)
    1 continue
      wlinf=wli(iwa)
      wlsup=wls(iwa)
      return
      end

      subroutine kompsat(iwa)
      real s,wlinf,wlsup
      common /sixs_ffu/ s(1501),wlinf,wlsup
      real sr(5,1501),wli(5),wls(5)
      integer iwa,l,i

c band pan
       DATA (SR(1,L),L=1,1501)/  101*0.
     a,0.0623,0.0813,0.1004,0.1194,0.1384,0.1574,0.1765,0.1955
     a,0.2145,0.2336,0.2526,0.2716,0.2906,0.3056,0.3205,0.3355
     a,0.3505,0.3654,0.3804,0.3967,0.4130,0.4292,0.4455,0.4618
     a,0.4781,0.4720,0.4659,0.4598,0.4537,0.4476,0.4415,0.4422
     a,0.4429,0.4435,0.4442,0.4449,0.4455,0.4618,0.4781,0.4944
     a,0.5107,0.5270,0.5433,0.5582,0.5732,0.5881,0.6031,0.6180
     a,0.6330,0.6405,0.6480,0.6554,0.6629,0.6704,0.6779,0.6989
     a,0.7200,0.7410,0.7621,0.7831,0.8042,0.7994,0.7947,0.7899
     a,0.7851,0.7804,0.7756,0.7627,0.7498,0.7369,0.7240,0.7111
     a,0.9820,0.7083,0.7185,0.7287,0.7389,0.7491,0.7593,0.7559
     a,0.7526,0.7492,0.7458,0.7424,0.7391,0.7501,0.7612,0.7722
     a,0.7833,0.7944,0.8165,0.8165,0.8226,0.8287,0.8348,0.8409
     a,0.8470,0.8531,0.8653,0.8775,0.8898,0.9020,0.9143,0.9265
     a,0.9388,0.9510,0.9633,0.9755,0.9878,1.0000,0.9938,0.9877
     a,0.9754,0.9692,0.9631,0.9563,0.9496,0.9428,0.9361,0.9293
     a,0.9225,0.9028,0.8831,0.8634,0.8436,0.8239,0.8042,0.7818
     a,0.7593,0.7369,0.7144,0.6920,0.6696,0.6574,0.6452,0.6330
     a,0.6208,0.6086,0.5965,0.5992,0.6019,0.6046,0.6073,0.6100
     a,0.6127,0.6175,0.6223,0.6270,0.6318,0.6366,0.6413,0.6556
     a,0.6698,0.6840,0.6983,0.7125,0.7267,0.6744,0.6221,0.5699
     a,0.5176,0.4653,0.4130,0.3939,0.3749,0.3559,0.3368,0.3178
     a,0.2988,0.2865,0.2743,0.2621,0.2499,0.2376,0.2254,0.1955
     a,0.1656,0.1357,0.1058,0.0759,0.0460,0.0384,0.0307,0.0230
     a,0.0153,0.0077,1214*,0./

c band ms1
       DATA (SR(1,L),L=1,1501)/  81*0.
     a,0.0500     ,0.1603  ,0.2300  ,0.2649  ,0.2672  ,0.2585  ,0.2672  ,0.2585
     a,0.3370     ,0.4090  ,0.4500  ,0.5332  ,0.5595  ,0.6489  ,0.6641  ,0.6968
     a,0.7644     ,0.8190  ,0.8255  ,0.8473  ,0.8822  ,0.8953  ,0.8866  ,0.8517
     a,0.8321     ,0.8342  ,0.9019  ,0.9564  ,1.0000  ,0.6663  ,0.3500  ,0.1200
     a,0.0600     ,0.0200
     A,1386*,0./

c band MS2
      DATA (SR(2,L),L=1,1501)/102*0
     a,0.0300     ,0.0418  ,0.0589  ,0.0950  ,0.1760  ,0.2377  ,0.3500  ,0.4400
     a,0.5571     ,0.5784  ,0.6169  ,0.6464  ,0.6827  ,0.7465  ,0.8019  ,0.8500
     a,0.9191     ,0.9404  ,0.9617  ,0.9500  ,0.9600  ,0.9600  ,0.9650  ,0.9490
```

```
    a,0.9785       ,0.9874  ,0.9958  ,0.9800  ,0.9871  ,0.9871  ,0.9574  ,0.9700
    a,0.9800       ,0.9900  ,0.9900  1.0000   ,0.8873  ,0.6600  ,0.5486  ,0.2484
    a,0.1100       ,0.0589  ,0.0100
    A1356*,0.0./

c band MS3
     DATA (SR(3,L),L=1,1501)/ 196*0.
    a,0.0400       ,0.0800  ,0.1255  ,0.1800  ,0.2158  ,0.3200  ,0.3964  ,0.6432
    a,0.7664       ,0.8545  ,0.9381  ,0.8545  ,0.9118  ,0.9227  ,0.9250  ,0.9381
    a,0.9403       ,0.9381  ,0.9381  ,0.9337  ,0.9425  ,0.9425  ,0.9425  ,0.9425
    a,0.9337       ,0.9118  ,0.8875  ,0.8742  ,0.8546  ,0.8546  ,0.8369  ,0.8281
    a,0.8214       ,0.8038  ,0.7971  ,0.7797  ,0.7500  ,0.7355  ,0.7246  ,0.7137
    a,0.6783       ,0.6607  ,0.6498  ,0.6410  ,0.6343  ,0.6343  ,0.6388  ,0.6388
    a,0.6520       ,0.6564  ,0.6915  ,0.7070  ,0.7268  ,0.7620  ,0.7886  ,0.7268
    a,0.8502       ,0.8590  ,0.8766  ,0.9251  ,0.9471  ,0.9823  ,0.9978  ,0.9779
    a,0.7863       ,0.3788  ,0.3480  ,0.2819  ,0.1652  ,0.0800  ,0.0573  ,0.0440
     A,1233*,0./

c band MS4
     DATA (SR(4,L),L=1,1501)/ 149*0.
    a,0.0200       ,0.0800  ,0.2300  ,0.2900  ,0.4400  ,0.5000  ,0.6029  ,0.7085
    a,0.7400       ,0.7910  ,0.9148  ,0.9300  ,0.9537  ,0.9862  ,0.9883  ,1.0000
    a,0.9862       ,0.9862  ,0.9800  ,0.9700  ,0.9700  ,0.9700  ,0.9700  ,0.9700
    a,0.9700       ,0.9700  ,0.8645  ,0.7567  ,0.4080  ,0.1625  ,0.0400,1321*,0./

     wli(1)=,0.5025
     wls(1)=,0.965
     wli(2)=,0.4525
     wls(2)=,0.535
     wli(3)=,0.505
     wls(3)=,0.6100
     wli(4)=,0.74
     wls(4)=,0.9175
     wli(5)=,0.6225
     wls(5)=0.6975

     do 1 i=1,1501
     s(i)=sr(iwa,i)
    1 continue
     wlinf=wli(iwa)
     wlsup=wls(iwa)
     return
     end
```