Reference Solar Irradiance Spectrum - Previous CEOS WGCV IVOS Discussions

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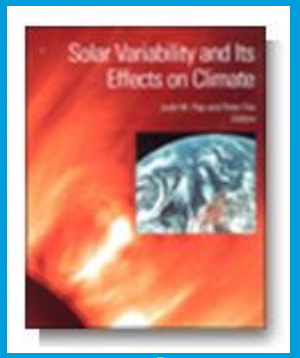

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WGCV IVOS

Background

From an IVOS perspective - Exo-atmospheric Solar spectral irradiance key parameter to link Earth Viewed radiances and reflectances (TOA and BOA)

- Band averaging, RT codes etc
- Spectral range (largely) ~400 – 2400 nm but also TIR
- linkage and comparison of products from different sensors will depend on choice & method of use of solar irradiance spectrum
- 2003 CEOS plenary adopted a resolution from WGCV to encourage agencies to use a common spectrum (based on a composite from Thuillier et al paper) or as a minimum to make clear what has, and how it has, been used.
- However, whilst significant agency uptake – not universal & is it still appropriate??
- Also interest from other groups: GSCIS & Atmospheric where UV important also from climate perspective - Drivers are different and more complex (e.g. solar cycle)

	B1	B2	B3	B4	B5	B6	B7	B8	B8a	B9	B10	B11	B12
Cent λ/nm	443	490	560	665	705	740	783	842	865	945	1375	1610	2190
Bandwidth/nm	20	65	35	30	15	15	20	115	20	20	30	90	180
% diff SORCE/Thuillier	0.5	0.9	2.1	0.4	2.2	1.2	0.2	0.3	0.6	1.0	1.7	1.4	1.7
% diff Kurucz/Thuillier	2.5	0.5	2.1	1.7	1.3	1.1	1.9	1.8	2.3	1.7	16.4	1.7	1.6

E.G. Impact on Sentinel 2

Methods for RadCalNet Data application

- Convert RapidEye Imagery to TOA Reflectance

$$REF(i) = RAD(i)\frac{\pi * SunDist^2}{EAI(i) * \cos(SolarZenith)}$$

Band	Chance Kurucz 1997	Thuillier 1997	SIRS	WRC	Kurucz 1997	New Kurucz 2005
Blue	1950 W/m²µm	2003 W/m²µm	1989 W/m²µm	1969 W/m²µm	2003 W/m²µm	1998 W/m²µm
Green	1815 W/m²µm	1824 W/m²µm	1848 W/m²µm	1853 W/m²µm	1816 W/m²µm	1863 W/m²µm
Red	1566 W/m²µm	1541 W/m²µm	1531 W/m²µm	1562 W/m²µm	1573 W/m²µm	1560 W/m²µm
Red-Edge	1352 W/m²µm	1399 W/m²µm	1362 W/m²µm	1387 W/m²µm	1392 W/m²µm	1395 W/m²µm
NIR	1121 W/m²µm	1117 W/m²µm	1100 W/m²µm	1127 W/m²µm	1121 W/m²µm	1124 W/m²µm

Extraterrestrial Irradiance (EAI), RapidEye

Discussion webex and conclusions (Oct 2013)

- 18+ attendees (inc commercial) No US Gov due to shut down.
- From inputs: Pre- & during meeting
  - ~ 75% used CEOS recommended Thuillier
    - IOCCG formally recommend/encourage use of CEOS spectrum
  - Kurucz used were high resolution is reqd e.g. FT spectrom also when integrated into other software packages (Modtran
  - Neckels and Labs also used (in 6S)
  - ISRO provides products utilising both Neck/Lab & Thuillier
  - Landsat uses Chukar
  - Eumetsat keen for spectrum to ~5 um most content 2.5 um
    - 380 nm enough for most IVOS but not Atmos Chem??
  - Agreed there is value in a common spectrum but difficult to achieve for all applications particularly non Land/Ocean but should aim for:
    - a few well defined spectra with accessible data via cal/val portal
    - a 'best practise for use/convolution with sensor/application characteristics
  - Note that for Atmos Chem there is significant solar irradiance variability in UV
    - Not as big an issue for Vis/SWIR
  - Thuillier also created a high resolution spectrum

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Mission	Launch	Applied Solar Spectrur
MOS-IRS	1996 Mar	Neckel & Labs (1984)
SeaWiFS	1997 Aug	Thuillier et al. (2003)
MODIS Terra	1999 Dec	Thuillier et al. (2003)
MODIS Aqua	2002 May	Thuillier et al. (2003)
MERIS	2002	Thuillier et al. (2003)
GLI	2002	Thuillier et al. (2001a)

e.g. from IOCCG

Two Webex meetings organised by D Doerling GSICS 2016/17:

- Increase scope/community dialogue and range of potential applications for recommended spectra
- Various options for spectrally continuous spectra using different normalisations to link sensors / models and obtain differing spectral resolution
  - Most used Thuiller observations (spectral shape) for VNIR/SWIR linked to Kurutz for IR extension
  - Absolute level normalised to TSI (1361 – 1366) (~0.4%)
- Is there merit and desire for a single continuous ref SSI for all applications? Probably in the long term but maybe pragmatic need in short term for Cal/Val (Land/Ocean type applications)
  - Preference for an early decision on a baseline and then to study further and consider options for an optimal for all applications
  - Is there a need to change Baseline from what we already have?
- What spectral resolution is needed? Real spectrum in observation space or fixed spectral intervals?
- Do we need to also agree on method for convolving SSI with instrument and potentially reflectance from other surfaces?
- Access to spectra