GROUP ON EARTH OBSERVATIONS

CEOS

QA4EO A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

Questionnaire for information regarding the CEOS WGCV IVOS subgroup Cal/Val test sites for land imager radiometric gain

QA4EO-WGCV-IVO-CSP-006

Name of site: Shizafon Playa, Negev, Israel

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Questionnaire for information regarding the CEOS WGCV IVOS subgroup Cal/Val test sites for land imager radiometric gain

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1. Abstract

This document provides the template to collect and present information to describe the characteristics of a Land based test site suitable for calibrating and validating the radiometric gain of an inflight satellite/aircraft imaging optical sensor. The template is structured as a series of questions to describe the sites, accessibility as well as its physical characteristics and their derivation. Test sites with varying characteristics have been used for many years for a variety of applications, however this template has been specifically designed for sites which are regularly instrumented and are or seek to be endorsed by the Committee on Earth Observation Satellites (CEOS) Working Group on Calibration and Validation (WGCV) as "reference standards". At present there are eight such sites but more are required to ensure a robust system to reliably underpin the needs of the Earth Observation (EO) community in the longer term. The template contained in this document should be completed by anyone seeking to have a site endorsed by CEOS to join this group. The current eight **CEOS instrumented reference standard test sites** are:

- **Railroad Valley Playa**, NV, USA, North America
- **Ivanpah**, NV/CA, USA, North America
- **Lspec Frenchman Flat**, NV, USA, North America
- **La Crau**, France, Europe
- **Dunhuang**, Gobi Desert, Gansu Province, China, Asia
- **Shizafon Playa, Negev**, Southern Israel, Asia
- **Tuz Golu**, Central Anatolia, Turkey, Asia
- **Dome C**, Antarctica

2. Scope

The scope of the template is to fully describe the characteristics of a test site so that those referring to its use or those seeking to use it can assess its suitability for their application. Once the template is complete it should be sent to the Infrared and Visible Optical Sensors (IVOS) subgroup chair who will arrange its review against CEOS defined criteria, before it is allocated a formal reference number and published on the Cal/Val portal as an endorsed site. At the time of issue of this template the most critical of these criteria is that it is regularly instrumented. However, these criteria are in the process of review and refinement and are likely to include other characteristics in the future. The template is structured (see table 1) to collate information

under a number of headings and whilst it is desirable to have all questions completed it is recognised that there may be some gaps in knowledge at the time of first submission.

It is also anticipated that as time progresses, data (particularly surface characterisation information) will increase and evolve, and may come from sources other than the nominal Point of Contact (POC). Provision is being made for this new information to be stored and linked to the template to improve the knowledge base. However, the POC should be made aware of such information as part of the submission process.

Table 1: Information content of questionnaires

Questionnaire Content Description
Site location
Logistic information
Site climatology
Site instrumentation
Measurement accuracy
Site usage
Contact information
Data availability
References

3. Process

The attached template (appendix 1) should be completed by an individual willing to serve as POC for a CEOS test site. In this role they are agreeing to ensure that the site is maintained to a level consistent with the data contained in the template or to change the data as appropriate. This confirmation will take place on an annual basis through an email exchange with CEOS WGCV IVOS chair and Quality Assurance Framework for Earth Observation (QA4EO) secretariat. Readers are directed to the view existing completed examples of the template for further guidance.

When the template is completed it should be returned to the CEOS IVOS chair (or other designated individual) to submit for review and to arrange for publication on the Cal/Val portal.

If approved, the template will then be assigned a reference number and placed on the Cal/Val portal (http://calvalportal.ceos.org/CalValPortal/welcome.do) and the information also

incorporated into the test site catalogue currently under development for CEOS WGCV by USGS (http://calval.cr.usgs.gov/sites_catalog_map.php).

Similar templates exist for non-land sites and also for non-instrumented land sites.

Appendix 1: Template for CEOS reference standard test site

CEOS Reference standard test site for Land radiometric gain

CEOS Reference: QA4EO-WGCV-IVO-CSP-xxx[1]

Name of site: Sizafon Playa, Negev, Israel

Point of contact:

Prof. Arnon Karnieli

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Jacob Blaustein Institutes for Desert Research

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Fax: +972-8-6596805

E-mail: karnieli@bgu.ac.il

[1] **to be completed by QA4EO secretariat**

1. Site location

1.1. Identification and characterisation

1.1.1. Site Name

Shizafon Playa, Negev, Israel

1.1.2. Location

Latitude: 30°06'47" N

Longitude: 35°00'34" E

1.1.3. Google Earth Image (1x1 degree around the site center)

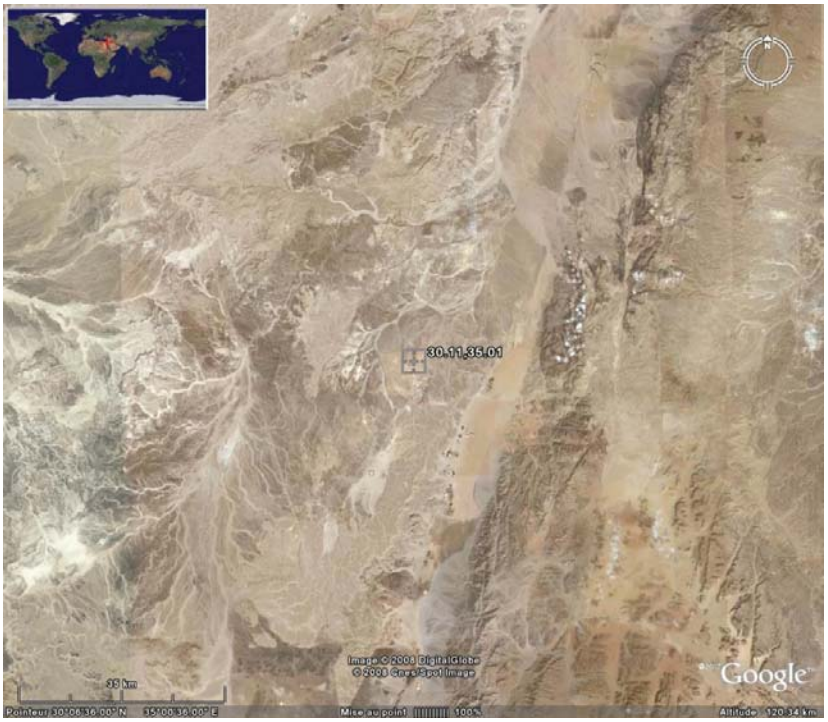


Figure 1: Location of Shizafon Playa in the Israeli Negev desert.

1.1.4. Altitude

340 m

1.1.5. Description of the landscape

The calibration site is called Shizafon Playa. The playa is located at 30°06'47"N and 35°00'34"E. Elevation is 340 m above MSL. The total size of the playa is about 200,000 sq. m (0.2 sq. km). It is characterized by a very smooth and extremely homogeny surface. The playa's substrate consists of loamy silt with high percentage of clay and low percentage of sand.

1.1.6. Environment

The site is located in a hyper-arid environment. Long-term average precipitation is about 40 mm concentrated in a few events during the winter season (November - March). Consequently, no higher or lower (biological soil crust) vegetation exists on the playa and the soil moisture is extremely low. In addition, the area is characterized by low probability of cloud cover and clear air.

1.1.7. Topography

The playa is a flat terrain surrounded by relatively darker hilly terrain.

1.2. Site view

Figure 2: Site overview from the ground

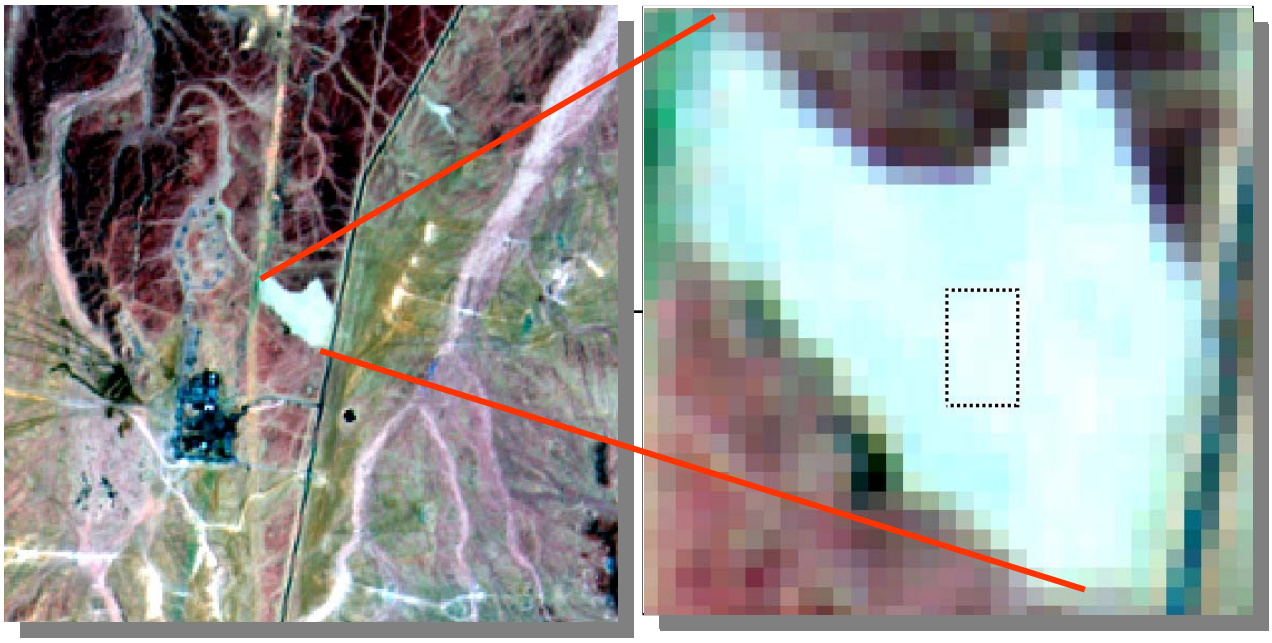


Figure 3: Site overview from the space (SPOT-4, false colour composite).

2. Logistic information

2.1. Site proximity from road

The site is located near a main highway No. 40 from Mitzpe Ramon to Elat.

2.2. Access

The site is very accessible. About 1 hr and 20 min drive from Sede Boker Campus of Ben Gurion University (122 km).

2.3. Nearest towns

Elat in the south (64 km, 45 min) and Mitzpe Ramon (91 km, 60 min) in the north.

2.4. Distance from nearest town/port

30 min to each of these towns.

2.5. Logistics (Hotel, Restaurant, etc.)

There are a several tens of hotels in Eilat, at different levels (http://www.eilat-guide.com/) and a large number of restaurants. Hotels and restaurants also exist in Mitzpe Ramon.

2.6. Access to Communications

Mobile phones are working in this region.

2.7. Owner

Ministry of Defence. A special permission to use the site was issued to the Remote Sensing Laboratory, Jacob Blaustein Institute for Desert Research, Ben Gurion University.

Figure 4: Geographic location of Shizafon Playa in the Israeli Negev desert.

3. Site Climatology

3.1. General atmospheric conditions: Meteorological conditions

3.1.1. Annual pluviometry

Precipitation is extremely low (few tens of millimeters per year), providing minimum change in soil moisture.

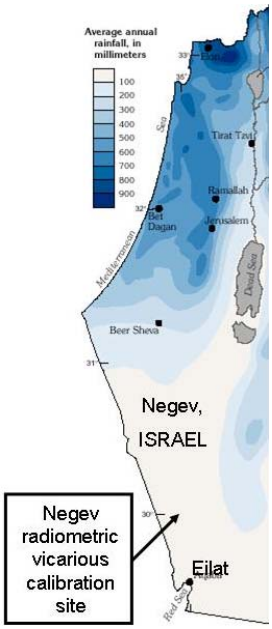


Figure 5: Precipitation map

3.1.2. Wind

The prevailing wind directions are west-north-west (Figure 6).

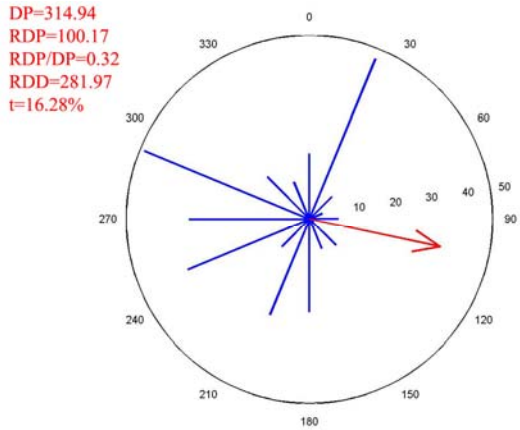


Figure 6: Winds rose diagram for the Shisafon Playa

3.1.3. Clear sky conditions

The site is characterized by clear sky conditions almost all year around.

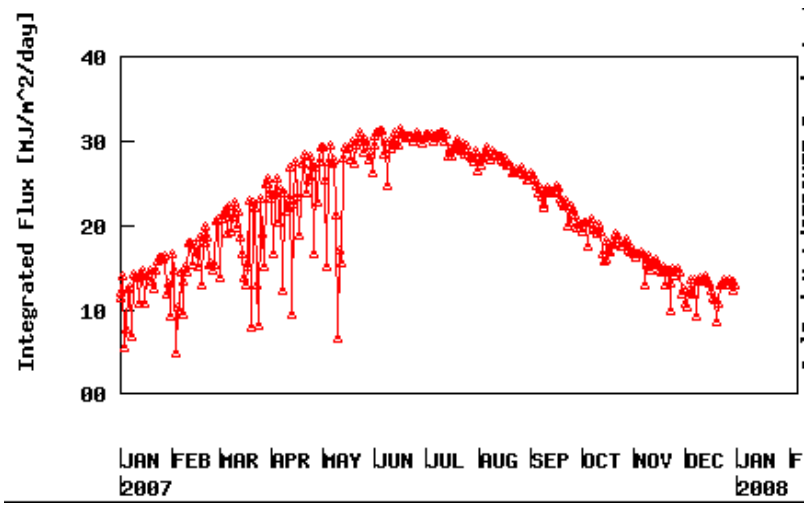


Figure 7: Integrated radiation flux at Sede Boker for 2008, retrieved from AERONRT data

3.2. Atmosphere characterisation

Presented here atmospheric characterisation of the Shizafon playa relies on well established atmospheric conditions in the Sede Boker long-term observational site.

3.2.1. Aerosol characteristics

The Shizafon playa is located about 122 km south of the Sede Boker site, which is a long term AERONET station operating since 1996 until the present time. In addition to the AERONET measurements, aerosol sampling on filters were conducted during ten years from 1996 to 2006 and chemistry of the sampled particles was consistently analyzed in Institute of Nuclear Sciences, Ghent University, Belgium. These aerosol measurements were subject of several research efforts and publications (Andreae et al., 2002; Derimian et al., 2006; Formenti et al., 2001a; Formenti et al., 2001b; Formenti et al., 2002a;Formenti et al., 2002b; Maenhaut et al., 1997; Maenhaut et al., 1999; Maenhaut et al., 1996; Sobanska et al., 2003; Derimian et al., 2008). Based on these expertises the aerosols in Shizafon playa are expected to be predominant by mineral dust originated in surrounding deserts with a minor contribution of anthropogenic pollution during the summer time (August). The mineral dust appears to contain moderate concentrations of iron oxides and is weakly absorbing. The anthropogenic aerosols, originated from urban/industrial sources, predominate by sulphates and despite presence of some “black carbon” are also weakly absorbing.

3.2.1.1. Seasonal variation of the aerosol

The Shizafon playa is located far from the sea and far from any local anthropogenic pollution source. The aerosol loads and type in the Negev desert follows to a quite determinable seasonal cycle. The region is usually affected by frequent dust storms during transition seasons (spring and fall) and sporadic aerosol events during the rest of the year. The synoptic spring (April and May) is more affected by dust. The northern and central Negev is influenced by anthropogenic pollution during the summer, which may affect the Shizafon playa as well. The summer time is characterised by large-scale synoptic conditions known as the “Persian trough” that leads to penetration of long-range transported anthropogenic pollution into the Negev desert (in August in particular). The maritime aerosols (sea-salt) may also reach the region in this season, however those contribution is expected to be negligible. The synoptic winter (mid November until end of March) is period of relatively clear atmospheric conditions, except for sporadic dust events. In addition, June persistently presents a window of clear conditions separating dusty spring and polluted summer.

3.2.1.2. AOT_550: Historical data

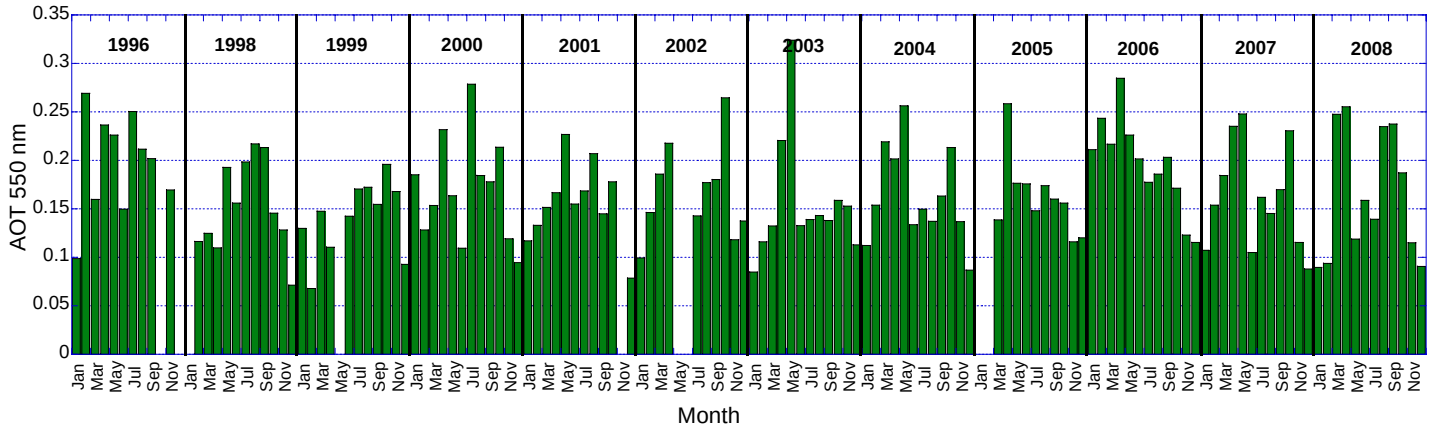


Figure 8: Seasonal and year-to-year variability of AOT at 550 nm (AOT at 550 nm is interpolated from AERONET nominal wavelengths).

3.2.1.3. Data from AERONET CIMEL network

Years of observations: 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009

Operating channel (nm): 1020, 870, 670, 500, 440, 380, 340, 500 (not interpolated), 1640

Table 2: Overall mean for 1996 – 2008 time-period

Aerosol optical depth at 500 nm (taua500), Angstrom exponent (alpha440-870), precipitable water (PW), the associated standard deviations (sigma), the number of days (N) and months (Month) in the observation periods.								
Overall Averages of	**tau_{a500}**	**sigma**	**$alpha_{440-870}$**	**sigma**	**PW**	**sigma**	***N***	**Month**
JAN	0.14	0.10	1.08	0.45	0.86	0.30	214	10
FEB	0.17	0.17	0.94	0.48	0.89	0.24	197	10
MAR	0.19	0.12	0.84	0.48	0.95	0.23	254	11
APR	0.26	0.17	0.66	0.43	1.10	0.29	223	11

Aerosol optical depth at 500 nm (taua500), Angstrom exponent (alpha440-870), precipitable water (PW), the associated standard deviations (sigma), the number of days (N) and months (Month) in the observation periods.								
MAY	0.26	0.19	0.61	0.37	1.32	0.30	244	9
JUN	0.17	0.08	0.94	0.37	1.40	0.30	233	10
JUL	0.20	0.11	1.08	0.32	1.58	0.33	279	10
AUG	0.21	0.08	1.15	0.30	1.77	0.36	294	11
SEP	0.19	0.08	0.94	0.34	1.75	0.33	291	11
OCT	0.22	0.11	0.97	0.36	1.74	0.36	259	10
NOV	0.15	0.08	0.96	0.37	1.21	0.33	231	10
DEC	0.12	0.07	1.04	0.40	1.01	0.32	190	10
YEAR	0.19	0.04	0.93	0.16	1.30	0.35	2909	123

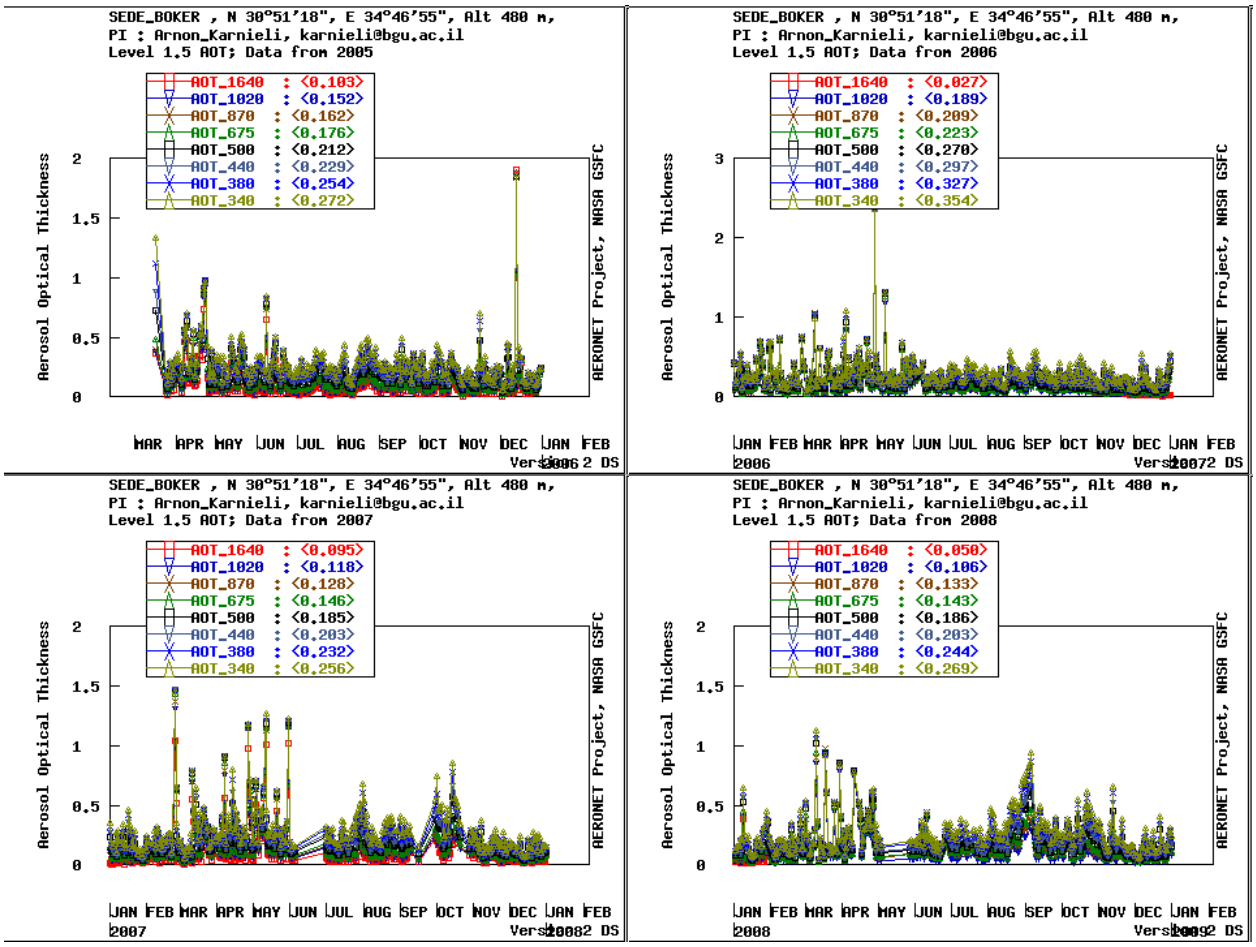


Figure 9: Variability of spectral AOT during last four years (2005 - 2008) a snapshot from the AERONET site.

3.2.1.4. Nominal values of AOT at 450, 550, 650, 850 nm

Table 3: Overall mean values (interpolated from AERONET operational wavelengths)

Wavelength, nm	450	550	650	850
AOT	0.18	0.17	0.16	0.13

3.2.1.5. Absolute error of AOT at 450, 550, 650, 850 nm

The AOT uncertainty is approximately 0.01 - 0.02 (wavelength dependent), which is result of calibration uncertainty.

3.2.1.6. Model of aerosol used

3.2.1.6.1. Granulometry

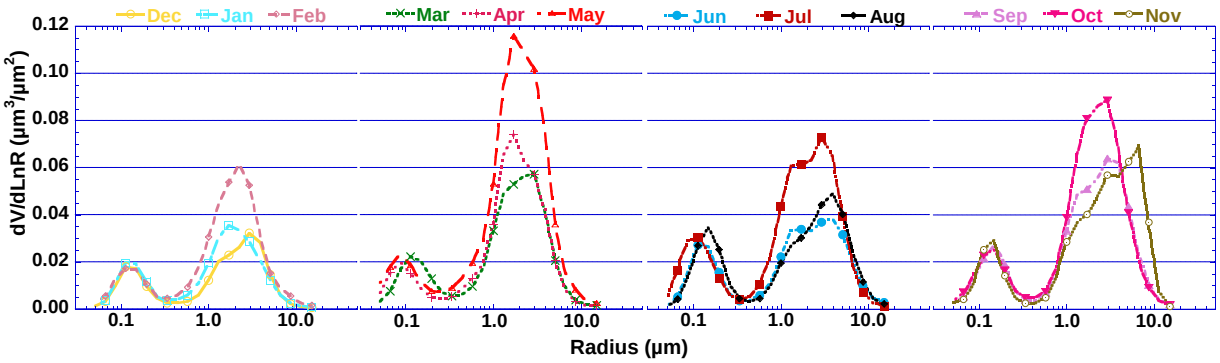
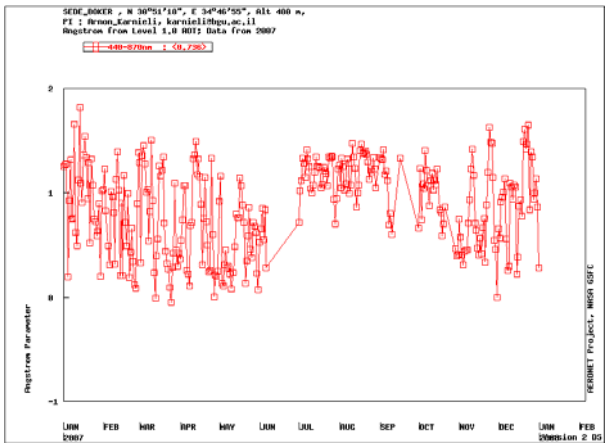


Figure 10: Monthly mean aerosol size distributions computed for the period of 1996 to 2003 based on the AERONET retrievals. The mean values were calculated by weighting them by AOT. More details in (Derimian et al., 2006).

3.2.1.6.2. Refraction index used

Mean estimated values are: 1.5-i*0.001 (for desert dust); 1.48-i*0.005 (for anthropogenic pollution)

3.2.1.7. Angstrom exponent (440 – 870 nm) (alpha)



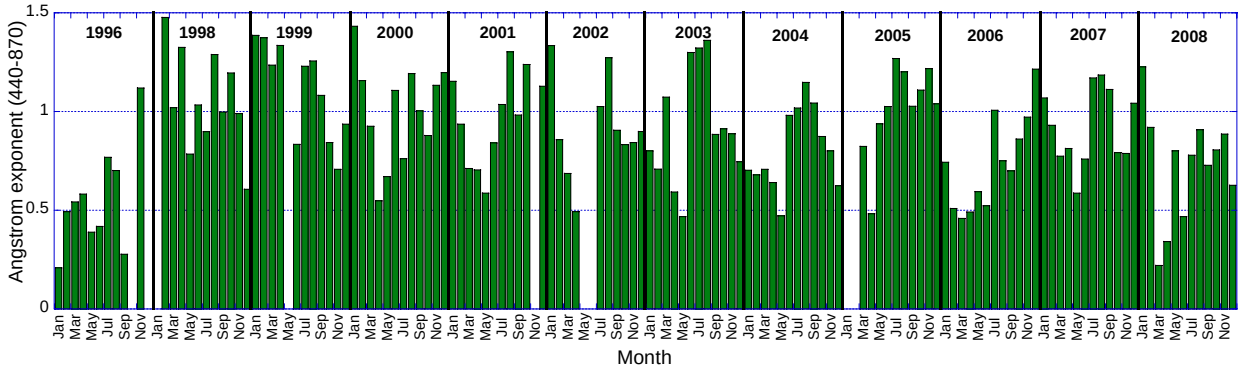


Figure 11: Seasonal (upper panel) and year-to-year variability (lower panel) of Angstrom exponent (processed from the AERONET data).

3.2.2. Water vapour content characteristics

3.2.2.1. Water vapour content origin

The expected origins are long-range transport from the Mediterranean sea and evapotranspiration. Figure 6 (see below) presents seasonal peaks of the water vapour content during summer time. During the summer period moist air masses can reach the Negev desert, also temperature reaches maxima in this period that strongly stimulating evapotranspiration.

3.2.2.2. Seasonal variation of the water vapour content

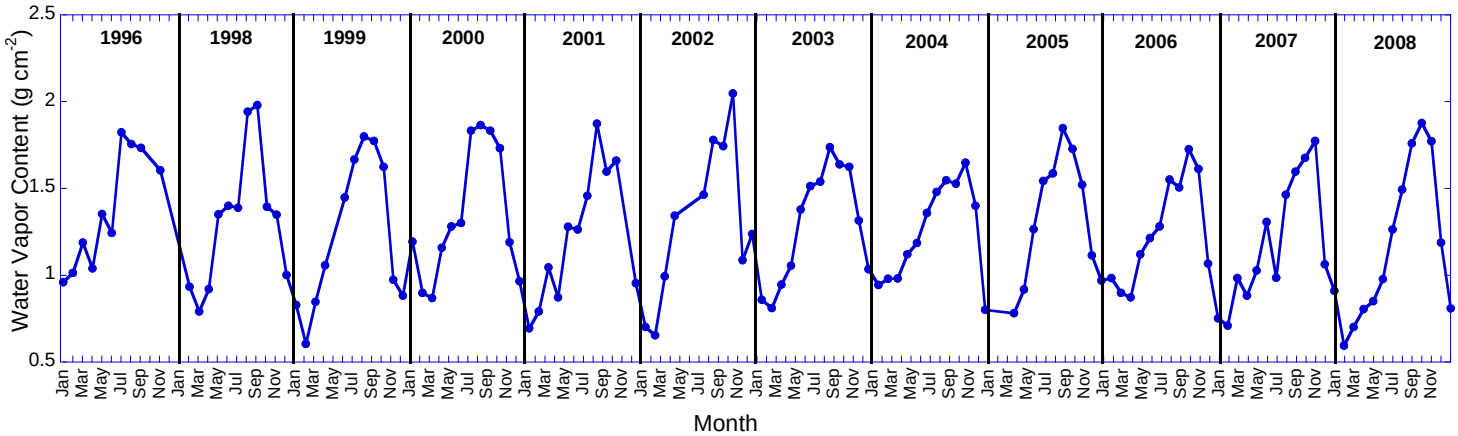


Figure 12: Seasonal and year-to-year variability of water vapour content as retrieved from the AERONET measurements at 935 nm.

3.2.2.3. Mean and accuracy

Overall mean of water vapour content is 1.3±0.35 (±Std Error).

3.3. Surface characterisation

3.3.1. Surface albedo characteristics

The surface albedo of Shisafon Playa is 0.41. Albedo was calculated by algorithm published in Liang (2004).

3.3.2. Surface reflectance characteristics

3.3.2.1. Instrumentation used for characterisation

- Analytical Apectral Devices (ASD) spectrometer
- Licor LI-1800
- BRDF apparatus

3.3.2.2. Route of traceability

The reflectance values over the Shizafon Playa hardly change throughout the year due to minimal amounts of rains and absence of vegetation.

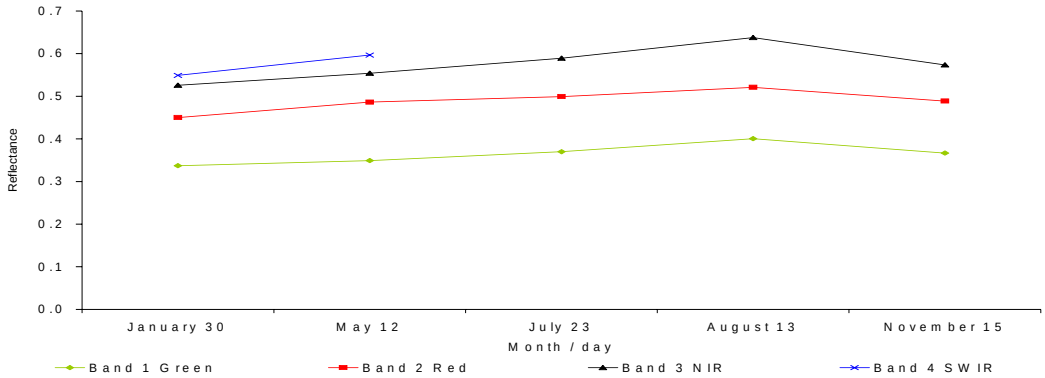


Figure 13: Monthly variation of reflectance at Shizafon Playa as retrieved for SPOT-4 bands.

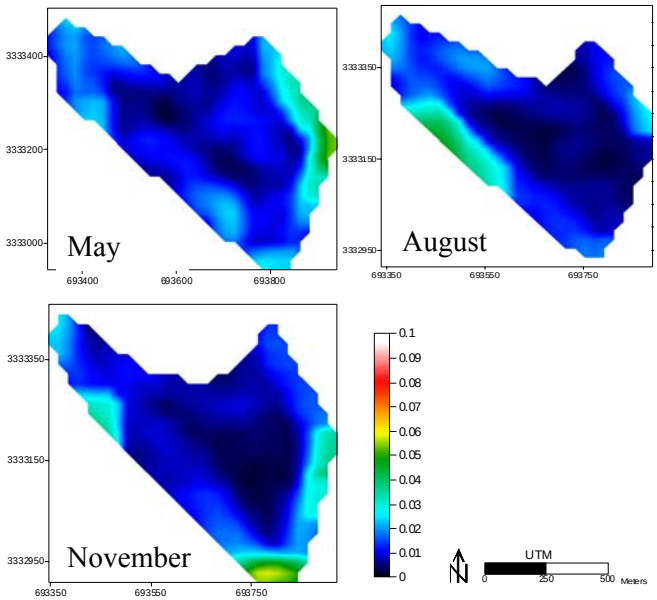


Figure 14: Spatial variability of reflectance at Shizafon Playa for SPOT-4 band 3.

3.3.2.3. Mean reflectance at Nadir (full spectrum)

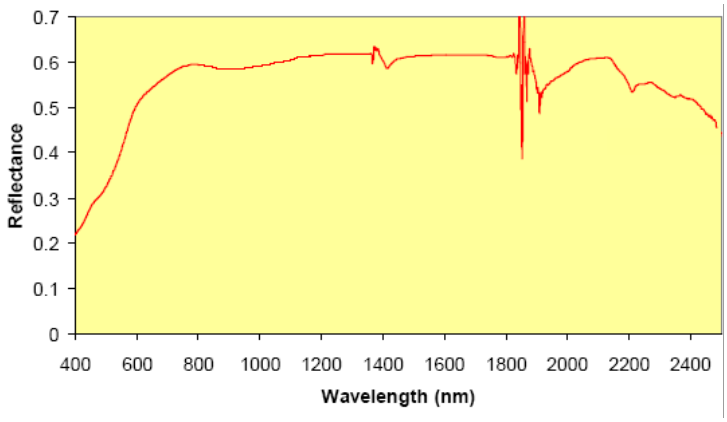


Figure 15: Spectral variability of the reflectance, note the high and flat reflectance values throughout the spectrum.

3.3.2.4. Uncertainty of reflectance (please give breakdown of uncertainty contributions)

3.3.2.5. Mean reflectance at Nadir at 450, 550, 650, 850 nm

3.3.2.6. Δρ at 450 nm, 550, 650, 850 nm

3.3.3. BRDF (or specific angles)

Since the surface is very smooth, the BRDF is symmetric in all solar zenith angles.

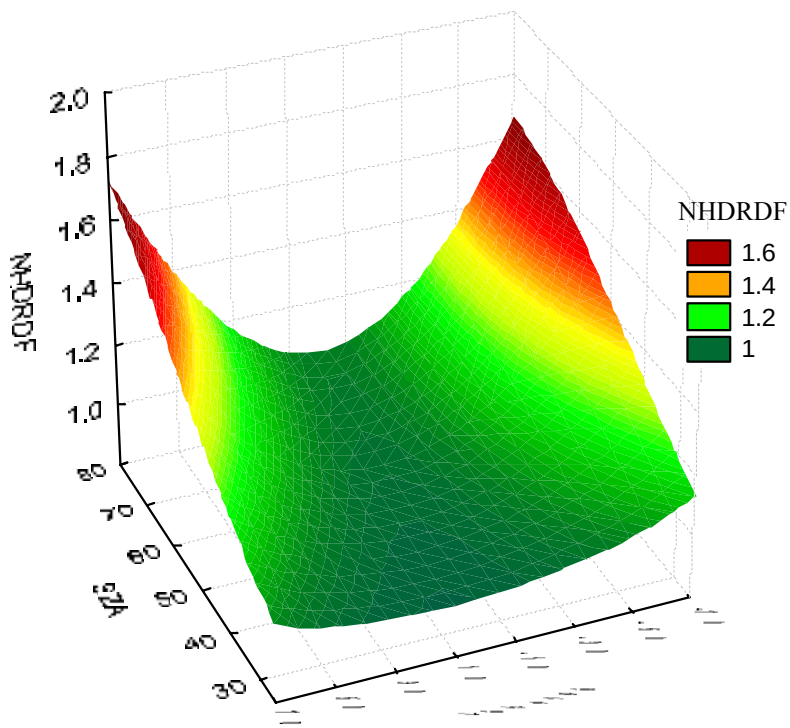


Figure 16: Variation of the normalized hemispherical–directional reflectance distribution function (NHRDF) at the solar principle plain for 500-590 nm. Note the symmetry at all SZAs.

3.3.3.1. Instrument used

3.3.3.2. Relative error on BRDF correction at θs=45 degreeş, θv=30 degrees

3.3.4. Surface reflectance – variability across site (uniformity) (%)

100 * 100 m =

500 * 500 m =

1000 * 1000 m =

4. Site instrumentation (Nominal)

4.1. Meteorological instrumentation (list)

4.1.1. Meteo station (Temperature, pressure, humidity)

A full-equipped meteorological station is located about 10 km from the site. Measurements include rainfall, temperature, wind, pressure, humidity and more.

4.1.2. Pluviometer

See 4.1.1 above

4.1.3. Anemometer

See 4.1.1 above

4.2. Atmospheric instrumentation

4.2.1. Instrument used for aerosol characterisation

4.2.1.1. Instrument used

Sun photometer sites (CIMEL/AERONET) are located in Sede Boker and in Elat. *In-situ* Micotops-II is operated during vicarious calibration operations.

4.2.1.2. Route of traceability

On demand.

4.2.1.3. Measurement protocol

4.2.1.3.1. Scanning mode

In-situ Microtops-II measurements are made at the end of each segment (Figure 17). Microtops measurements are compared with to that of the CIMELs in Sede Boker and Elat.

4.2.1.3.2. Spectral characteristics

CIMEL operating channel: 1020, 870, 670, 500, 440, 380, 340, 500 (not interpolated), 1640 nm;

Microtops-II: 500, 675, 870, 936, and 1020 nm,

4.2.1.3.3. Frequency of measurements

Aeronet sites are operated continuously. Microtops-II is operated on demand.

4.2.2. Instrument used for surface irradiance characterisation

4.2.2.1. Instrument used

Cosine receptor of Analytical Spectral Devices (ASD) FieldSpec, and the cosine receptor of Licor 1800.

Spectralon white reference plate.

4.2.2.2. Route of traceability

On demand

4.2.2.3. Measurement protocol

A sample of white reference is made at the end of each segment (Figure 17)

4.2.3. Instrument used for water vapour content characterisation

4.2.3.1. Instrument used

Sun photometer sites (CIMEL/AERONET) are located in Sede Boker and in Elat. Micotops-II is operated during vicarious calibration operations.

4.2.3.2. Route of traceability

On demand.

4.2.3.3. Measurement protocol

In-situ Microtops-II measurements are made at the end of each segment (Figure 17). Microtops measurements are compared with to that of the CIMELs in Sede Boker and Elat.

4.3. Surface instrumentation

4.3.1. Instrument used for reflectance/radiance characterisation

4.3.1.1. Instrument used

Analytic Spectral Devices (ASD) FiledSpec, and Licor-1800 spectrometers.

4.3.1.2. Route of traceability

On demand.

4.3.1.3. Measurement protocol

4.3.1.3.1. Scanning mode

The *in-situ* measurements were held at the most homogenous area of the site. For the *in-situ* data collection, a 120x80 m was chosen. The size and shape of the area used for the data collection was a function of available homogenous area and satellite pixel size. However, the area had to be of such size that it could be fully examined in the time frame of the satellite overpass (approximately 20 minutes before and 20 minutes after overpass; total 40 minutes), to prevent change in atmospheric conditions and directional reflectance caused by changing sun angles.

In order to conduct the measurements in an organized manner, the selected area within the site was marked and divided to 20x20 m segments – similar to pixel size (figure 6.2a). During the satellite overpass, samples were collected by an Analytical Spectral Devices (ASD) - a portable field spectrometer, with a 0.35-2.5 µm spectral range, 10 nm spectral resolution, and a 25º field of view. Each sample taken by the ASD is the average of 20 consecutive spectra. On each horizontal line (Figure 17) 8 samples were collected. A sample of white reference was made at the end of each segment. On the average, more than 100 samples composed of more than 2000 spectra are usually collected.

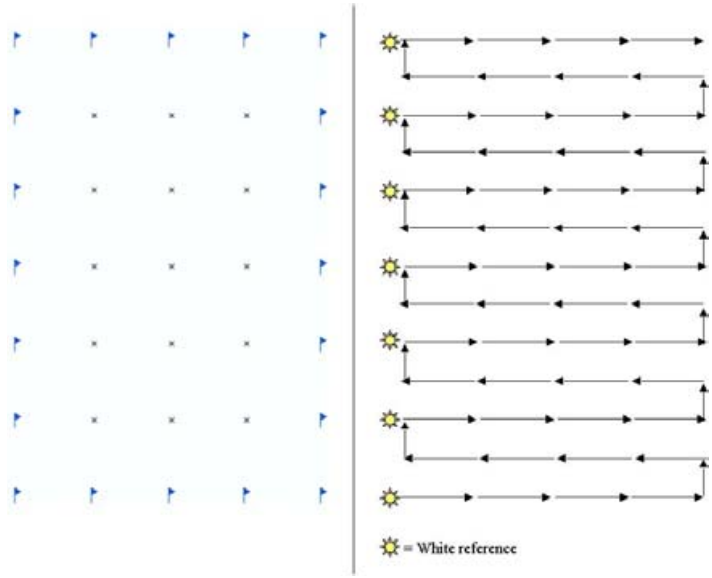


Figure 17: Site division for measurements. Left: Segmentation of the site; Right: the path of data collection. Sun signs mark the places for white reference and aeroosols measurements.

4.3.1.3.2. Spectral characteristics

ASD: 350 – 2500 nanometer

Licor-1800: 300 – 1100 nanometer

4.3.1.3.3. Frequency of measurements

Only during calibration activities.

4.3.2. Instrument used for BRDF characterisation

4.3.2.1. Instrument used

Licor-1800 spectrometer attached to BRDF apparatus.

4.3.2.2. Route of traceability

On demand.

4.3.2.3. Measurement protocol

4.3.2.3.1. Scanning mode

BRDF measurements are carried out three times during a calibration operation – 20 min before overpass, during overpass, and 20 min after overpass.

4.3.2.3.2. Spectral characteristics

300 – 1100 nanometer.

4.3.2.3.3. Frequency of measurements

Only during calibration activities.

5. Current status of the site

5.1. Instrumented

A full equipped meteorological station is located 10 km from the site. AERONET sites are located in Sede Boker (122 km) and Elat (64 km). Other instruments are available only on demand.

5.2. Maintained (source and commitment of funding)

No source and commitment of funding.

5.3. Regularly visited (state frequency)

- Human – on demand
- Satellite – on demand
- Aircraft – on demand
- Automated – on demand

6. Site usage

6.1. Historical record of comparisons (ground, aircraft and satellite)

Intensive field campaigns have already conducted in the potential vicarious calibration sites of the Israeli Negev Desert

12 May 04 SPOT 4

13 May 04 SPOT 4

10 Jun 06 SPOT 4

16 Jun 06 SPOT 4

24 Nov 06 SPOT 4

09 Dec 06 SPOT 4

6.2. Date / sensor / location of results

6.3. Regularity of satellite data (if known)

6.4. Satellite and sensor ID

7. Contact information

7.1. Point of Contact (Name and address)

Prof. Arnon Karnieli

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7.2. Instrumentation maintenance

The Remote Sensing Laboratory, Sede Boker campus.

8. Dataset availability and owner

8.1. Dataset

8.2. Owner

Prof. Arnon Karnieli.

8.3. Availability

On demand.

9. References

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9.1.3. Description of the instrumentation

9.1.4. Description of applications for vicarious calibration

9.2. Site Web

RSL web site: http://www.bgu.ac.il/BIDR/research/phys/remote/index.html