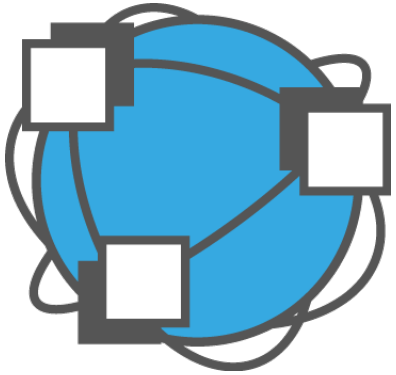
RadCalNet

RadCalNet

Status



M. Bouvet on behalf of the RadCalNet WG

Outline

- Why a network rather than independent instrumented sites for radiometric calibration?
- The context
- Who is involved in establishing RadCalNet?
- The shared vision of RadCalNet
- The sites
- RadCalNet input and output data
- The RadCalNet processing
- The data circulation
- The portal
- The data policy
- The intercomparison of RadCalNet sites using Landsat 8 and SPOT-5
- The next steps
    - From a prototype network to an operational network
    - Candidate sites => guidelines

Why RadCalNet?

Why a new network of instrumented sites dedicated to the radiometric calibration of EO optical sensors?

- To support the establishment of the Global Earth Observation System of Systems by providing measurements to verify the radiometric consistency between EO space sensors
- To collect surface and atmospheric data necessary for the simulation of observations by EO high spatial resolution optical sensors and thus verify their radiometric calibration
- To increase the number of matchups between in-situ measurements and space sensor observations and reduce the overall uncertainties (and reduce the efforts of individual agencies)
- To ensure traceability of the space sensor radiometry to the "Système International" (SI)
- To provide space organisations with an opportunity to calibrate their sensors in orbit when they do not have the resources to perform their own vicarious calibration activities
- To provide guidance on ensuring SI-traceability and developing instrumented ground sites for use in vicarious calibration

The context - GEOSS/GEO/QA4EO

QA4EO established at the request of GEO:

- Key principle is that "all EO data and derived products should have associated with them a quality indicator," based on a documented quantitative assessment of its traceability to internationally agreed upon reference standards (ideally SI units)

GEOSS requires:

- Traceability enables interoperability of data from EO systems.
- Calibration and characterisation of EO instruments, and in particular their relative radiometric biases, are vital to developing integrated GEOSS

The context – CEOS/WGCV/IVOS

RadCalNet has been on the CEOS/WGCV/IVOS WG agenda for years and it inherits from the earlier concepts such as GIANTS (Phil Teillet's approach to site characterisation)

In 2013, it was decided by the CEOS/WGCV/IVOS WG that sufficient resources could be put together to give it momentum. It was agreed to set up the RadCalNet WG.

The first RadCalNet WG meeting took place at ESTEC on 13th and 14th of January 2014.

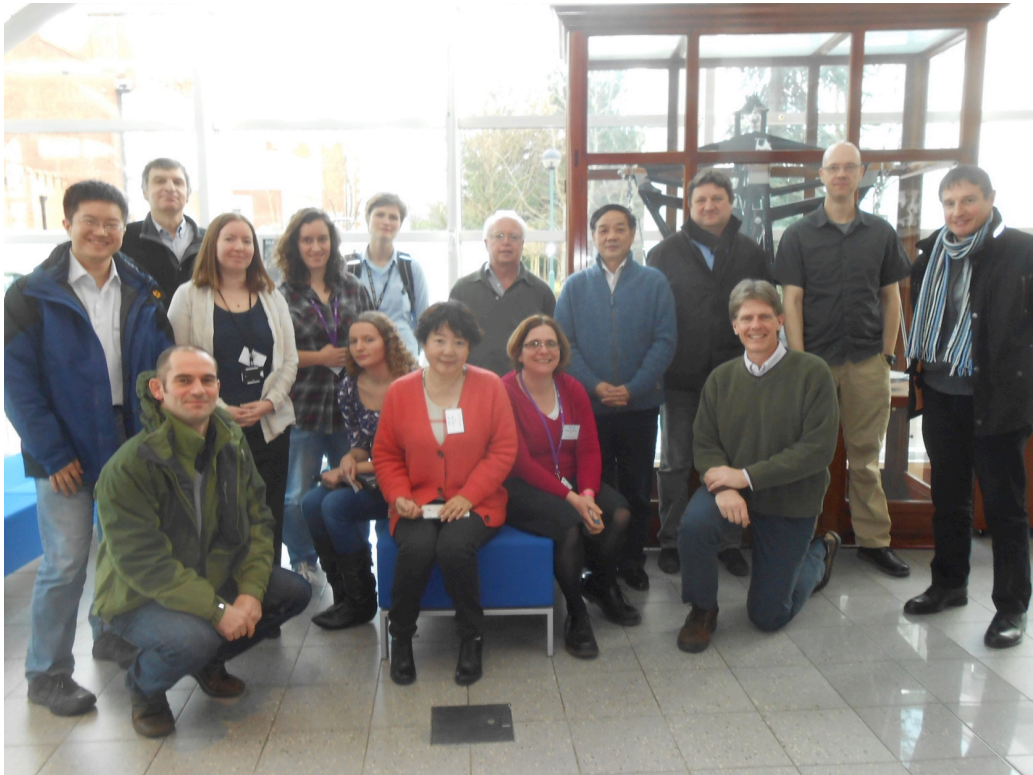
Who is involved in establishing RadCalNet?

RadCalNet WG objectives:

- Define the detailed architecture of RadCalNet
- Demonstrate RadCalNet operational concept with the currently available infrastructure and resources
- Provide recommendations to CEOS/WGCV/IVOS and CEOS/WGCV for evolution of RadCalNet towards an operational network

RadCalNet WG members at 3rd meeting (NPL, UK):

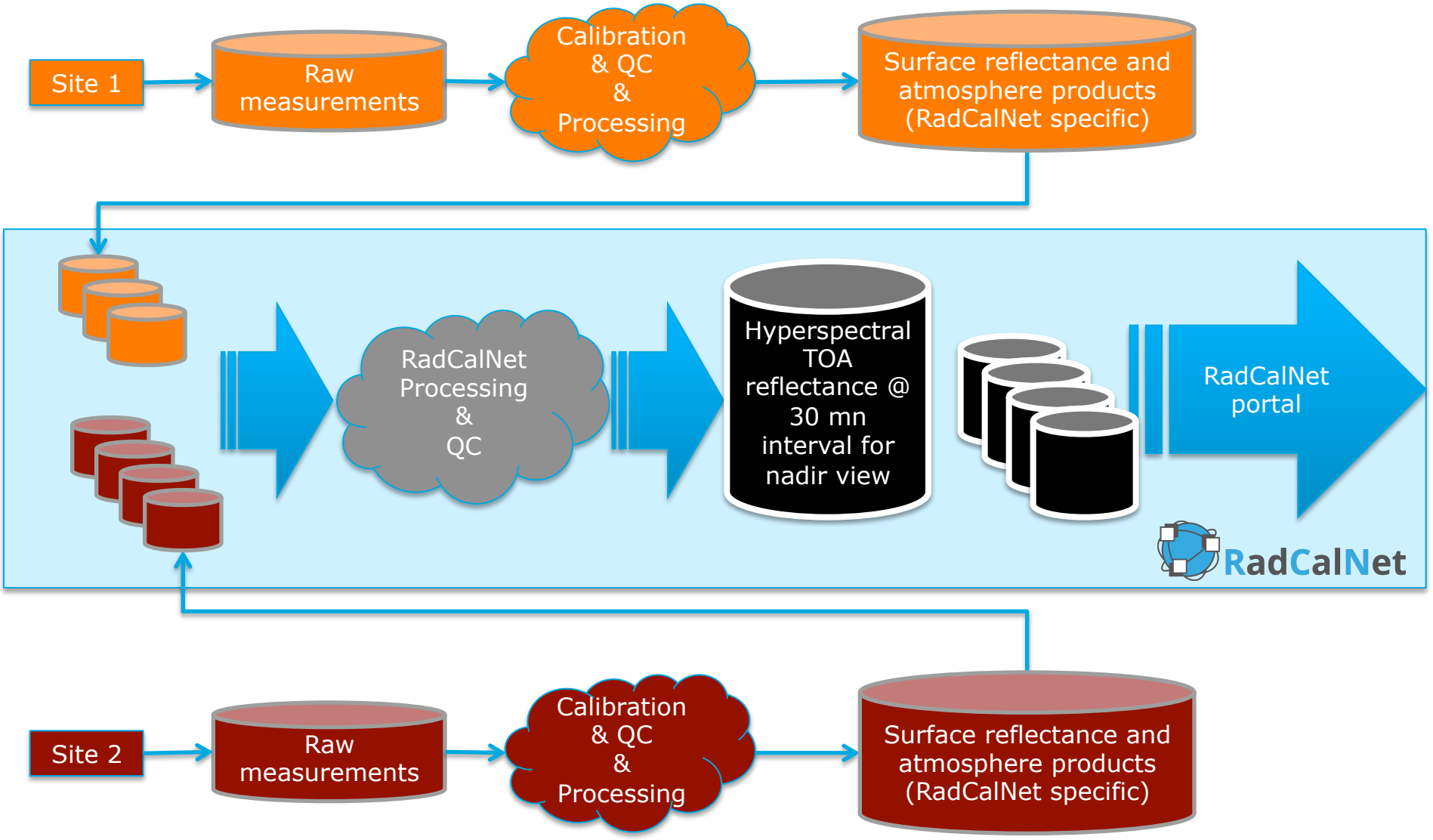
- AOE (China) (C. Li, L. Ma, L. Tang, N. Wang)
- CNES (P. Henry, A. Meygret)
- ESA (M. Bouvet, P. Goryl) supported by Magellium (B. Berthelot)
- NASA (K. Thome, B. Wenny) and University of Arizona (J. Czapla-Myers)
- NPL (N. Fox, E. Woolliams)



The initial contributions to RadCalNet

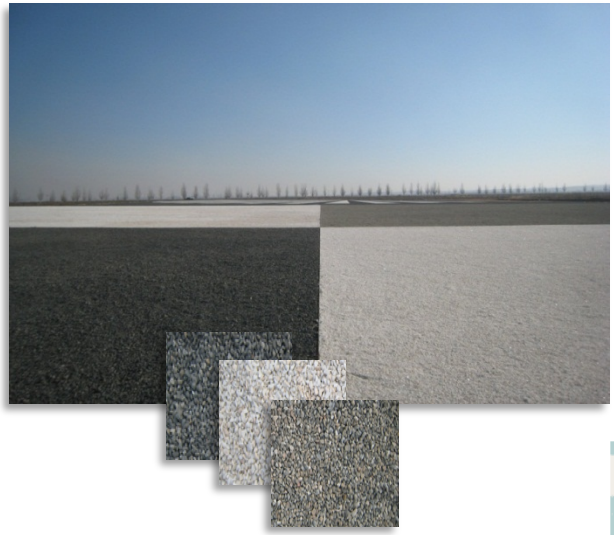
- NASA, CNES and AOE offered each a site
- CNES and made study to define a methodology for the identification at global scale of the best locations for RadCalNet-like sites
- Magellium) to:
  - ✓ Identify, characterise and equip a 4th site jointly operated by ESA and CNES.
  - ✓ Support the emergence of a prototype RadCalNet: data circulation, portal, support to the RadCalNet WG
- NASA offered to host the processing of the in-situ surface and atmosphere data into TOA reflectance
- NPL offered support across the RadCalNet sites owner writh respect to harmonization, traceability of the measurement protocol, instrument calibration and QA4EO => uncertainty budgets

The shared vision of RadCalNet



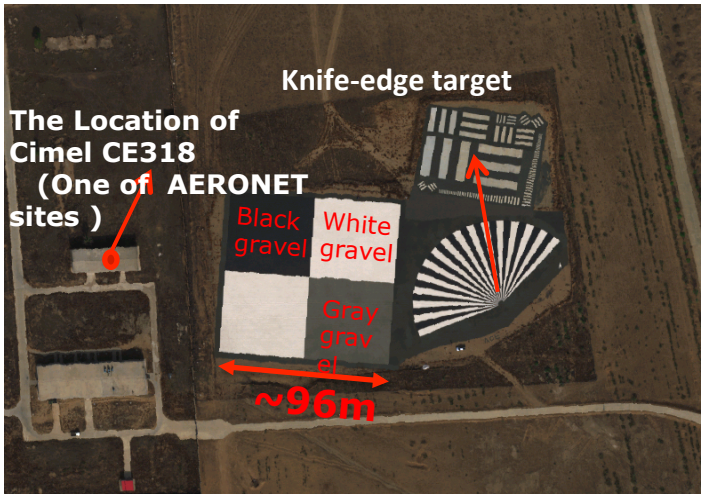
The sites

- Currently 3 instrumented are providing data to RadCalNet:
  - ✓ Baotou (China)
  - ✓ La Crau (France)
  - ✓ Railroad Valley Playa (US)



Baotou

- Three automated reflectance spectrum measurement systems have been installed + sun photometer
- Artificial target (3 colours)
- All the data from these three systems is being transferred directly to Beijing since OCT 25, 2015.
- Uncertainty analysis ongoing.



Aerial image acquired in Baotou site October 17, 2015

Stationary system in black and white targets

Rotatory system in gray target

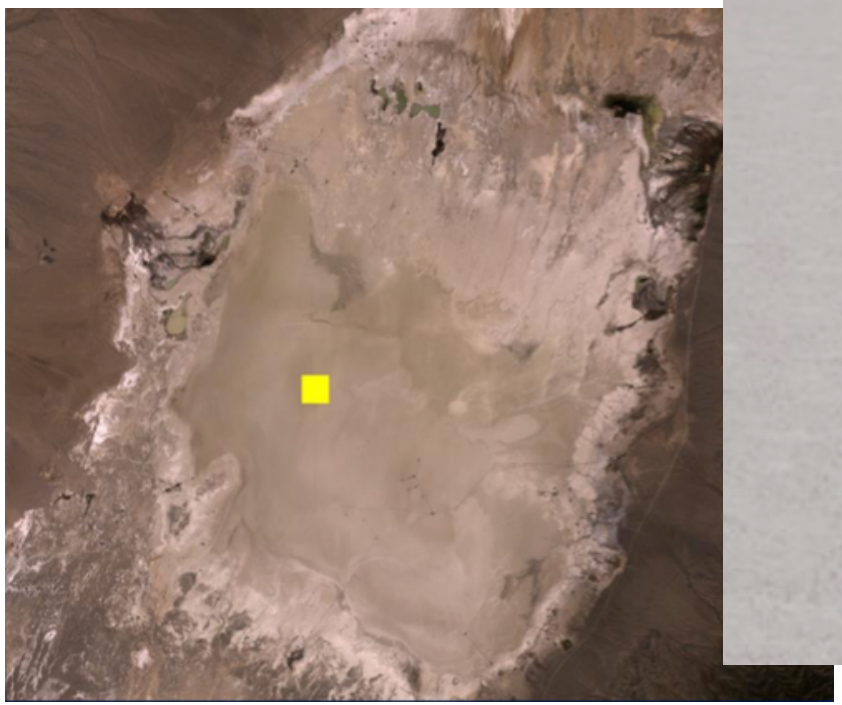
La Crau

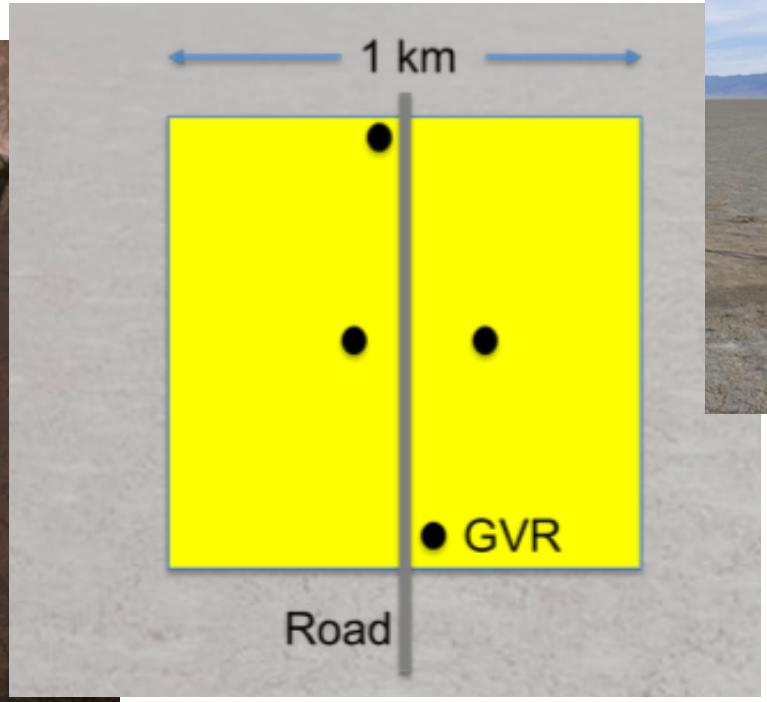
- Instrument: CIMEL photometer (12 bands)
- Surface type: pebbles and low vegetation
- Site used since 1987 for calibration and instrumented since 1997.
- Running operationally

Railroad Valley Playa

RadCalNet

- 4 radiometers (GVRs) + sun photometer + met station
- Surface type: dry lakebed
- UoA has 20+ years working experience on the site
- Site operational with data set via sat link





The sites

- Since the beginning of the WG activities, significant efforts dedicated to:
  - ✓ Operationally running the sites
  - ✓ Defining measurement uncertainties: NPL supports the RadCalNet sites in terms of harmonization, traceability of the measurement protocol, instrument calibration and QA4EO

The sites: a fourth site

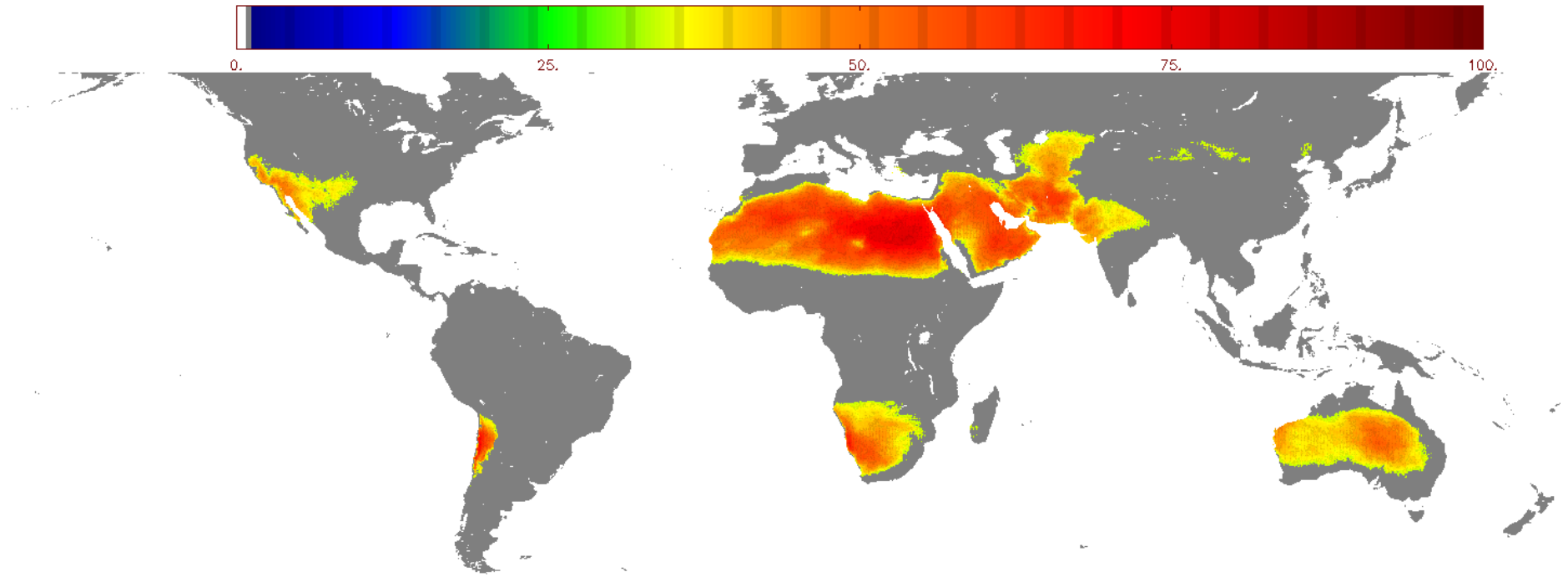
- A European contribution to RadCalNet: ESA/CNES will contribute this site supported by NPL.

- Site identification was based on a methodology developed through a CNES contract with MAGELLIUM (France) (Final report: Test site identification for radiometric calibration, B. Berthelot, E. Hillairet, 2013) a set of global criteria were defined to identify a fourth ESA/CNES site:
  - ✓ At least 30 % of clear sky days (based on ECMWF data)
  - ✓ Terrain slope < 2 % within 10 km x 10 km (SRTM DEM)
  - ✓ Spatial homogeneity within 10 km x 10 km < ~ 3 % (based on MODIS White sky albedo data in NIR)
  - ✓ Additionally, other parameters were collected: aerosol load, altitude
- Regionally then, spatial homogeneity within 1 km x 1 km < ~ 3 % (based on 1 year of OLI data)

The sites: a fourth site

RadCalNet

% of cloud free days in the period July 2012 to June 2013 (original data from ECMWF Total Cloud Cover, courtesy S. Marcq (CNES)). Map thresholded at 30%



The sites: a fourth site

We have focused on regions:

- Australia
- Chile

  Morocco
- Saudi Arabia
- Tunisia
- Turkey

  South Africa / Namibia

⇒ >20 TB of data (essentially L8) resulted into reports for each region

⇒ Then boiled down to 87 sites for which full details where compiled: cloudiness, flatness, altitude, spatial homogeneity…. BUT also closest city, accessibility, GSM coverage.

See http://calvalportal.ceos.org/test-sites/radcalnet-prototyping

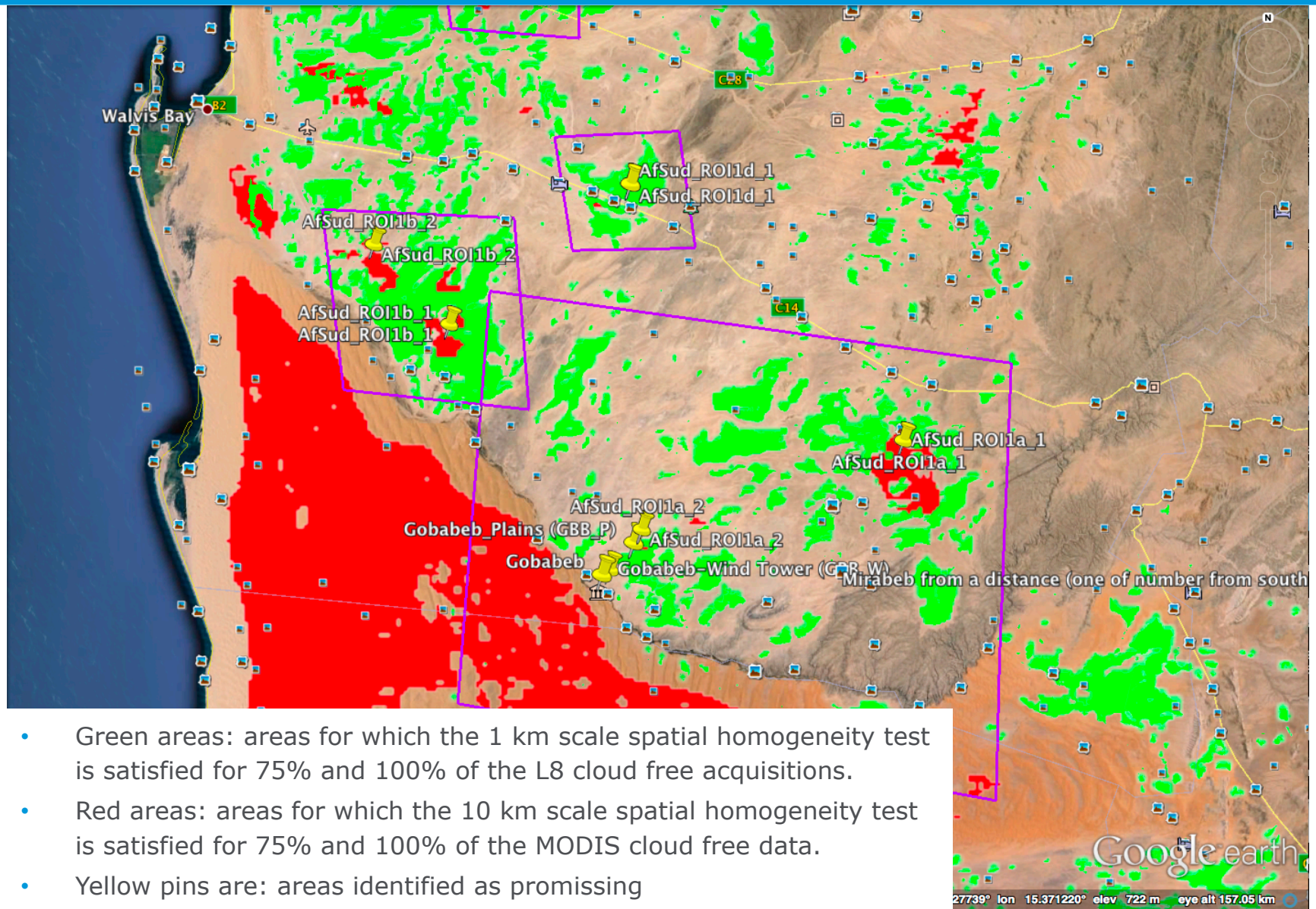
The sites: a fourth site

RadCalNet

Site name	Site Location		Aerosol score					Spatial homogeneity - Score 1km						Score 10km					
ROI	Lat	lon	Score /AOT(550) < 0.2	Score /AOT(550) < 0.	Score /Tau(550) < 0. no dust event	Score /Tau(550) < 0 no dust event	% clear days	Relative Score (%)	Absolute Score	mean B5	sdt B5	mean B2	sdt B2	Score 10k (%)	Altitude (m)	Road	City proximity	comment	GSM
AfNord_ROI10_1	34.532056	7.984069	39.89071	49.453552	37.15847	44.535519	31.58	83	5	0.473746	0.007194	0.205159	0.007047	80.43	581	2km to N16	130 km to Gafsa		Yes
AfNord_ROI1a_1	33.80262	-1.909856	36.885246	53.005464	36.885246	51.912568	23.03	81	9	0.377331	0.037251	0.143324	0.008762	84.78	1058	7.7 km to N17	400 km to Fes		Yes
AfNord_ROI1a_2	33.542966	-2.577059	38.52459	58.196721	38.52459	56.830601	25.53	100	11	0.42558	0.028474	0.179282	0.009622	93.48	1161	27 km to N19	300 km to Fes		Yes
AfNord_ROI1a_3	33.307539	-2.542488	38.52459	58.196721	38.52459	56.830601	25.66	90	10	0.419797	0.020513	0.169605	0.005417	82.61	1238	5.43 km to N19	300 km to Fes		Yes
AfNord_ROI1b_1	33.201737	-3.6662	39.617486	54.098361	39.344262	53.278689	21.58	100	11	0.502587	0.016589	0.213185	0.00604	86.96	911	1.5km to P5110/ 15km to N15	250 km to Fes		Yes
AfNord_ROI2_1	31.709623	-4.791703	54.371585	68.032787	53.551913	65.846995	32.24	69	9	0.370378	0.021607	0.158565	0.006411	73.91	1009	6.2 km to N10	250 km to Ouarzazate		Yes
AfNord_ROI2_2	31.798826	-4.465344	54.371585	68.032787	53.551913	65.846995	32.63	76	10	0.388498	0.022079	0.16186	0.005806	78.26	1197	11 km to N10	280 km to Ouarzazate		Yes
AfNord_ROI3_1	31.144459	-6.788094	56.830601	68.306011	56.830601	66.393443	29.08	100	14	0.208359	0.013806	0.138641	0.005569	0	1366	2.4 km to R307	25 km to Ouarzazate		Yes
AfNord_ROI3_2	31.14204	-6.674458	56.830601	68.306011	56.830601	66.393443	29.08	100	14	0.231555	0.013927	0.141486	0.005146	0	1376	16 km toN10	23 km to Ouarzazate		Yes
AfNord_ROI3_3	31.108351	-7.017436	59.562842	72.404372	58.743169	68.032787	31.45	92	13	0.396844	0.011273	0.178806	0.004917	0	1346	20 km to N9	28 km to Ouarzazate		Yes
AfNord_ROI4a_1	32.087626	-7.766432	43.169399	62.295082	42.349727	56.830601	31.84	70	7	0.374209	0.072684	0.189151	0.032507	0	405	5.5 km to P2118	55 km to Marrakesh	cours d'eau	Yes
AfNord_ROI4a_2	32.150937	-7.894974	43.169399	62.295082	42.349727	56.830601	28.68	80	8	0.322092	0.035137	0.155894	0.015994	0	446	6km to N9	60km to Marrakech		Yes
AfNord_ROI4b_1	31.612799	-8.5174	37.431694	55.191257	37.431694	52.459016	31.32	100	10	0.360062	0.041934	0.168941	0.016442	17.39	350	1km to P2005	55 km to Marrakech		Yes
AfNord_ROI4b_2	31.677735	-8.670955	37.431694	55.191257	37.431694	52.459016	31.71	90	9	0.383177	0.031356	0.180412	0.014447	0	280	4 km to N8	70 km to Marrakech		Yes
AfNord_ROI4c_1	31.511844	-8.90162	37.431694	55.191257	37.431694	52.459016	32.37	90	9	0.415095	0.028809	0.183299	0.015615	36.96	442	6km to R207	90 km to Marrakech		Yes
AfNord_ROI5a_1	30.224731	-4.973372	59.836066	72.677596	57.377049	69.398907	48.68	93	15	0.409044	0.019421	0.158072	0.006011	73.91	722	55 km to N12	300 km to Marrakech		Yes
AfNord_ROI5b_1	29.635039	-5.260697	56.010929	69.125683	54.918033	66.120219	51.58	100	16	0.394199	0.006094	0.170558	0.00241	89.13	590	50 km to N50	Algeria - 400 km to Bechar		No
AfNord_ROI6_1	28.236188	-8.015385	45.081967	60.655738	44.808743	59.016393	50.53	92	13	0.407167	0.01269	0.180331	0.004363	100	500	28 km to N50	Algeria - 800 km to Bechar		No
AfNord_ROI7_1	33.165978	9.515342	45.628415	68.852459	40.163934	50	43.16	100	9	0.57819	0.011706	0.205547	0.002839	82.61	178	23 km to C11	130 km to Gabes		Yes
AfNord_ROI7_2	32.778964	9.69136	50.273224	71.584699	48.360656	66.939891	46.18	88	8	0.519368	0.021369	0.183676	0.007872	97.83	255	3 km to C11	150 km to Gabes		Yes
AfNord_ROI8_1	35.599916	10.346891	22.404372	50	21.311475	41.803279	25.26	77	7	0.3069	0.018602	0.186988	0.014907	0	31	9.5km to P12	40 km to Souss		Yes
AfNord_ROI8_2	35.813381	10.250526	22.404372	50	21.311475	41.803279	24.34	77	7	0.279049	0.020264	0.15732	0.00924	0	20	6 km to P2	50 km to Souss		Yes
AfNord_ROI9_1	32.577116	11.156981	33.879781	58.743169	26.775956	42.896175	42.24	90	10	0.508702	0.011256	0.186595	0.006898	86.96	114	24 km to C203	200 km to Gabes		TBC
AfSud_ROI1a_1	-23.39055	15.446147	84.42623	89.89071	74.863388	77.595628	60.26	100	16	0.301949	0.015164	0.169341	0.003565	86.96	790	10km to M36	60 km to Gobabev		Yes
AfSud_ROI1a_2	-23.50123	15.09454	84.42623	89.89071	74.863388	77.595628	50.92	100	16	0.375148	0.014072	0.216726	0.007935	86.96	470	5 km to D2186/15 km to Gobabev/	120 km to walvis Bay		Yes
AfSud_ROI1b_1	-23.24577	14.833526	30.874317	58.196721	14.754098	28.415301	30.79	100	16	0.373814	0.014608	0.215527	0.007125	95.65	277	30 km to Walvis Bay	30 km to Walvis Bay		Yes
AfSud_ROI1b_2	-23.14553	14.730584	30.874317	58.196721	14.754098	28.415301	30.79	56	9	0.341225	0.011212	0.206842	0.00478	91.3	205	20 km to Rooibank	40 km to Walvis Bay		Yes
AfSud_ROI1c_1	-22.78576	14.905859	29.234973	46.721311	22.677596	32.786885	42.11	100	16	0.301949	0.015164	0.169341	0.003565	97.83	316	3 km to C28	40 km to Swakopmund		Yes
AfSud_ROI1d_1	-23.07464	15.078817	84.42623	89.89071	74.863388	77.595628	48.29	100	16	0.375148	0.014072	0.216726	0.007935	0	564	0.6km to M36	60 km to Walvis Bay		Yes
AfSud_ROI2_1	-26.1242	15.501907	68.852459	85.519126	52.73224	59.562842	56.45	88	16	0.332736	0.034727	0.148212	0.007211	100	635	22 km to pist	100 to Luderitz	not accessible	Yes
AfSud_ROI3_1	-29.36724	19.204992	70.218579	82.513661	66.939891	75.956284	50.66	100	18	0.347562	0.011365	0.141971	0.003981	93.48	1016	6km to large pist	40 km to Aggeneys		Yes
AfSud_ROI4a_1	-15.36893	12.308916	37.704918	53.005464	33.333333	40.163934	14.74	30	3	0.322706	0.018656	0.176893	0.022393	84.78	306	5km to pist	35 km to Namibe		No
AfSud_ROI4b_1	-15.64647	12.112374	37.704918	53.005464	33.333333	40.163934	14.74	90	9	0.339362	0.011886	0.189199	0.004033	84.78	139	2 km to National road	60 km to Namibe		No
AfSud_ROI4c_1	-15.87443	12.040558	37.704918	53.005464	33.333333	40.163934	14.74	100	10	0.417642	0.011344	0.21189	0.003157	93.48	105	15 km to National road	85 km to Namibe	not accessible	No
AmSud_ROI1_1	-20.08487	-67.628039	39.617486	40.710383	39.617486	40.710383	33.55	100	18	0.753543	0.072974	0.698676	0.074703	26.09	3665	18 km to road 603	320 km to Potosi		Yes
AmSud_ROI10_1	-22.54665	-68.740938	57.923497	65.846995	56.010929	61.202186	56.05	100	19	0.260676	0.012343	0.167675	0.008295	0	2542	20 km to Calama			Yes
AmSud_ROI10_2	-22.49197	-68.78414	57.923497	65.846995	56.010929	61.202186	56.05	100	19	0.392126	0.013853	0.228305	0.009942	0	2465	13 km to Calama			Yes
AmSud_ROI11_1	-20.30603	-69.464934	60.382514	69.945355	54.371585	59.562842	35.79	100	14	0.201544	0.006226	0.156117	0.003701	73.91	1191	6 km to pist	80 km to Iquique		Yes
AmSud_ROI12_1	-23.39198	-69.845204	45.355191	58.469945	42.622951	50.546448	48.29	100	17	0.317901	0.015877	0.204073	0.006288	2.17	1213	5km to I5	70 km to Antofagasta		Yes
AmSud_ROI13_1	-24.27601	-69.708664	62.295082	73.497268	54.098361	58.469945	65.13	100	20	0.288242	0.006683	0.180921	0.006247	0	1268	22 km to pist	130 km to Antofagasta		No
AmSud_ROI14_1	-26.09912	-70.030095	85.79235	93.442623	84.699454	89.071038	51.18	95	20	0.242403	0.007417	0.14121	0.004161	0	1026	1 km to C15S-B	120 km to Chanaral		Yes
AmSud_ROI15_1	-26.57156	-69.937663	84.699454	93.715847	83.333333	89.89071	59.87	100	21	0.215399	0.010728	0.137495	0.006672	0	1246	3 km to C17	100 km to Chanaral		Yes
AmSud_ROI16_1	-22.5389	-69.643872	48.087432	57.377049	43.442623	46.994536	51.97	100	17	0.378641	0.021401	0.224354	0.009022	0	1387	6km to I5	105 km to Tocopilla		Yes
AmSud_ROI17_1	-22.96291	-69.253731	48.087432	57.377049	43.442623	46.994536	61.32	94	16	0.302975	0.01951	0.204668	0.007325	0	1749	10 km to I25	80 km to Calama		No
AmSud_ROI18_1	-23.86854	-69.81026	45.355191	58.469945	42.622951	50.546448	39.08	88	15	0.324943	0.031896	0.201343	0.047522	39.13	804	20 km to B55	100 km to Antofagasta		No
AmSud_ROI2_1	-19.78193	-69.734755	56.284153	62.568306	53.278689	56.010929	2.11	85	12	0.211023	0.015431	0.166108	0.013698	78.26	1204	11 km to I5	36 km to Huara		Yes
AmSud_ROI3_1	-20.9278	-69.412741	60.382514	69.945355	54.371585	59.562842	33.68	100	14	0.190037	0.008188	0.138404	0.005407	89.13	1056	12 km to A85	180 km to Iquique		Yes
AmSud_ROI4_1	-21.74157	-69.387329	52.459016	62.021858	48.360656	53.278689	35.39	87	14	0.31385	0.011813	0.19528	0.006402	82.61	1123	12 km to I5	110 km to Tocopilla		No
AmSud_ROI5_1	-23.54287	-68.247098	64.20765	72.131148	61.202186	65.300546	56.58	100	19	0.286739	0.033127	0.196284	0.021525	86.96	2306	27 km to I23	170 km to Calama	15 km to airpo	Yes
AmSud_ROI6_1	-24.62114	-69.006042	62.295082	73.497268	54.098361	58.469945	62.37	100	19	0.22895	0.036611	0.150192	0.014939	0	2955	50 km to B55	220 km to Antofagasta		No
AmSud_ROI7_1	-28.15683	-70.698644	72.95082	81.693989	70.218579	75.409836	26.05	83	5	0.248955	0.010935	0.15228	0.004227	17.39	422	5km to I5	55 km to Vallenar		Yes
AmSud_ROI8_1	-29.3918	-69.289325	63.387978	65.300546	62.84153	64.20765	45.92	100	18	0.217044	0.012366	0.155094	0.008962	0	2987	Inaccessible by road			No

http://calvalportal.ceos.org/test-sites/radcalnet-prototyping

The sites: a fourth site



- Green areas: areas for which the 1 km scale spatial homogeneity test is satisfied for 75% and 100% of the L8 cloud free acquisitions.
- Red areas: areas for which the 10 km scale spatial homogeneity test is satisfied for 75% and 100% of the MODIS cloud free data.
- Yellow pins are: areas identified as promissing

The sites: a fourth site

RadCalNet

Gobabeb (Namibian desert)

- 51 % of clear days
- 85% of days with AOT < 0.2
- Altitude 470 m
- Cover type: sparse dry grass and gravel/sand

The sites: a fourth site

The sites: a fourth site

Instrumentation:

- A photometer (model similar to La Crau) was purchased and fully characterised by NPL (spectral, absolute radiometric, temporal stability, temperature stability, geometric)
- Additionally: met station

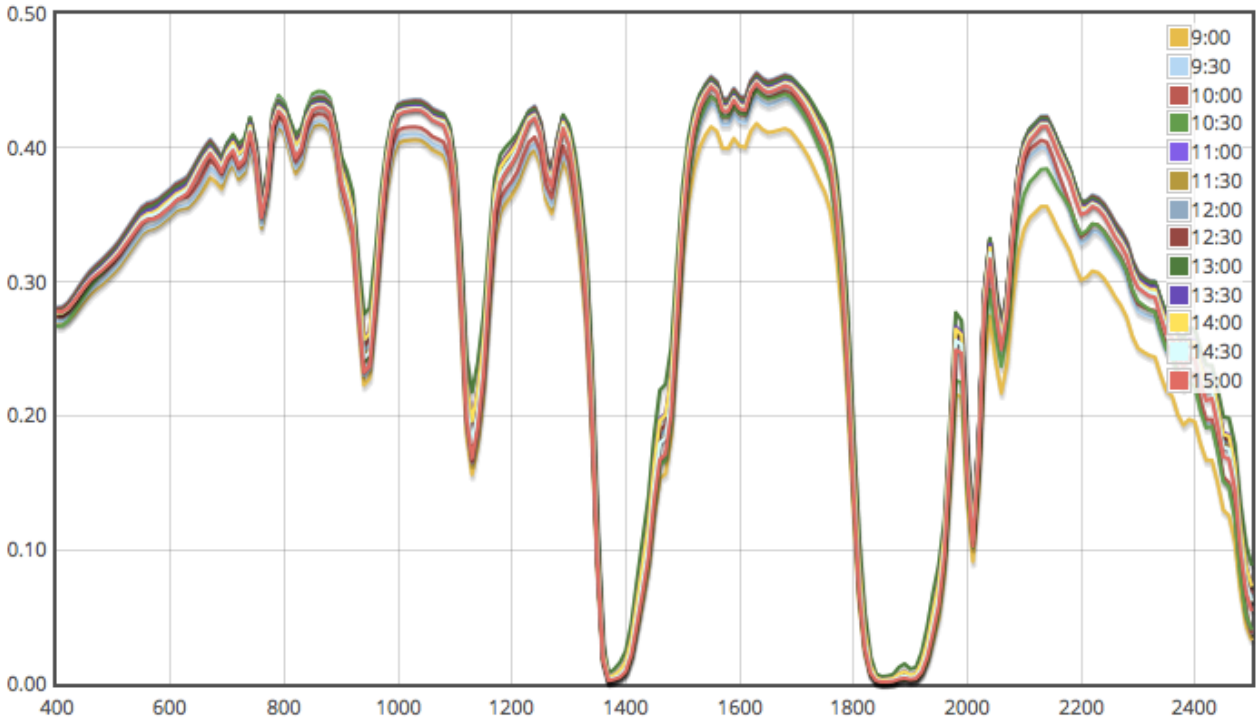
The plan at Gobabeb is to:

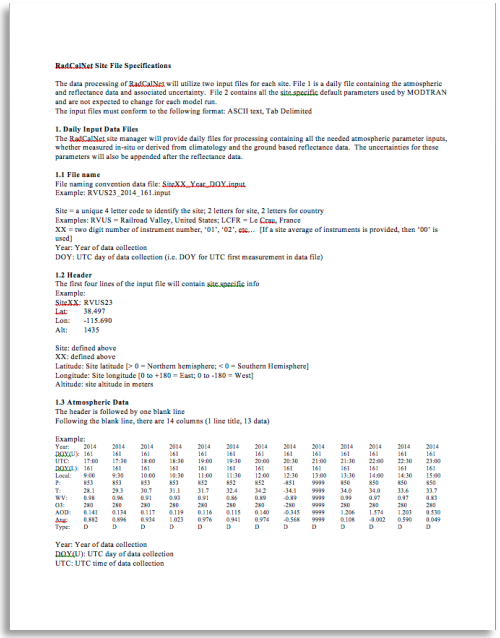
- Characterise the site (NPL + CNES team) => 23rd of Nov. 2015
- Set up the instrumentation + mast (Q2 2016)

RadCalNet output data

RadCalNet output is the TOA reflectance:

- 30 minute intervals
- 9 am to 3 pm local standard time
- Nadir view only
- 10-nm intervals at least between 400 nm and 1000 nm and possibly can beyond (up to 2500 nm)





RadCalNet Site File Specifications

The data processing of RadCalNet will utilize two input files for each site. File 1 is a daily file containing the atmospheric and reflectance data and associated uncertainty. File 2 contains all the site specific default parameters used by MODTRAN and are not expected to change for each model run.
The input files must conform to the following format: ASCII text, Tab Delimited

1. Daily Input Data Files
The RadCalNet site manager will provide daily files for processing containing all the needed atmospheric parameter inputs, whether measured in-situ or derived from climatology and the ground based reflectance data. The uncertainties for these parameters will also be appended after the reflectance data.

1.1 File name
File naming convention data file: SiteXX_Year_DOY.input
Example: RVUS23_2014_161.input

Site = a unique 4 letter code to identify the site; 2 letters for site, 2 letters for country
Examples: RVUS = Railroad Valley, United States; LCFR = Le Creu, France
XX = two digit number of instrument number, '01', '02', etc... [If a site average of instruments is provided, then '00' is used]
Year: Year of data collection
DOY: UTC day of data collection (i.e. DOY for UTC first measurement in data file)

1.2 Header
The first four lines of the input file will contain site specific info
Example:
SiteXX: RVUS23
Lat: 38.497
Lon: -115.690
Alt: 1435

Site: defined above
XX: defined above
Latitude: Site latitude [> 0 = Northern hemisphere; < 0 = Southern Hemisphere]
Longitude: Site longitude [0 to +180 = East; 0 to -180 = West]
Altitude: site altitude in meters

1.3 Atmospheric Data
The header is followed by one blank line
Following the blank line, there are 14 columns (1 line title, 13 data)

Example:

Year:	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014
DOY(J):	161	161	161	161	161	161	161	161	161	161	161	161	161
UTC:	17:00	17:30	18:00	18:30	19:00	19:30	20:00	20:30	21:00	21:30	22:00	22:30	23:00
DOY(J):	161	161	161	161	161	161	161	161	161	161	161	161	161
Local:	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00
P:	853	853	853	853	852	852	852	851	9999	850	850	850	850
T:	28.1	29.3	30.7	31.1	31.7	32.4	34.2	-34.1	9999	34.0	34.0	33.6	33.7
WV:	0.98	0.96	0.91	0.93	0.91	0.86	0.89	-0.49	9999	0.99	0.97	0.87	0.83
O3:	280	280	280	280	280	280	280	-240	9999	280	280	280	280
AOD:	0.141	0.134	0.117	0.119	0.116	0.115	0.140	-0.345	9999	1.206	1.074	1.203	0.530
Asy:	0.882	0.886	0.934	1.023	0.976	0.941	0.974	-0.568	9999	0.108	-0.002	0.590	0.049
Type:	D	D	D	D	D	D	D	D	D	D	D	D	D

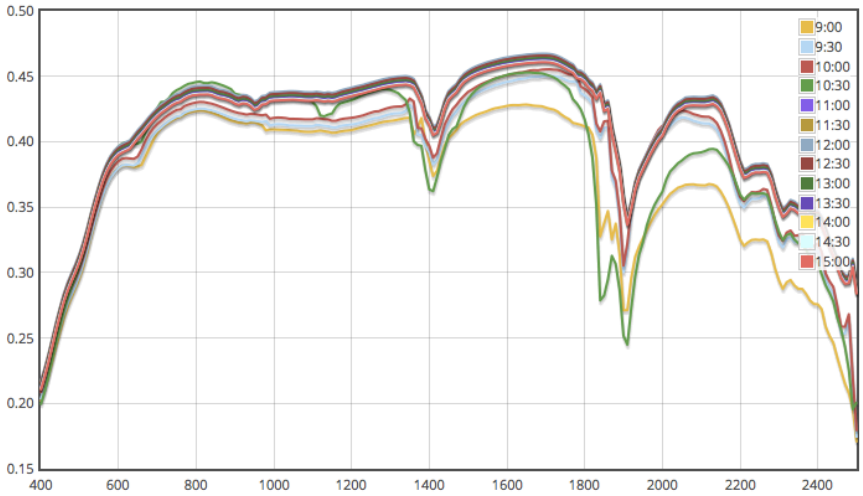
Year: Year of data collection
DOY(J): UTC day of data collection
UTC: UTC time of data collection

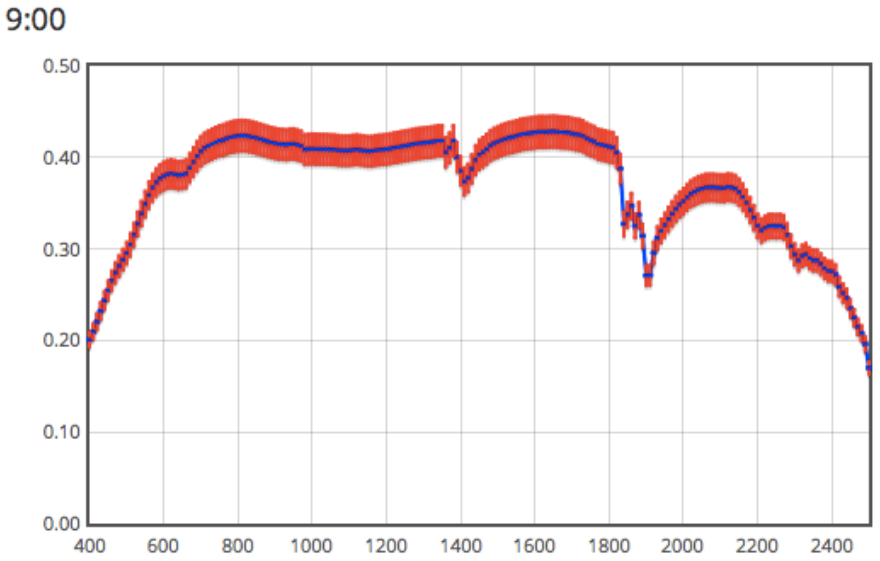
RadCalNet input data

RadCalNet inputs are:

1. The surface reflectance:

- 30 minute intervals
- 9 am to 3 pm local standard time
- Nadir view only
- 10 nm intervals from 400 nm to 2500 nm (=goal) or at least between 400 nm and 1000 nm + uncertainty

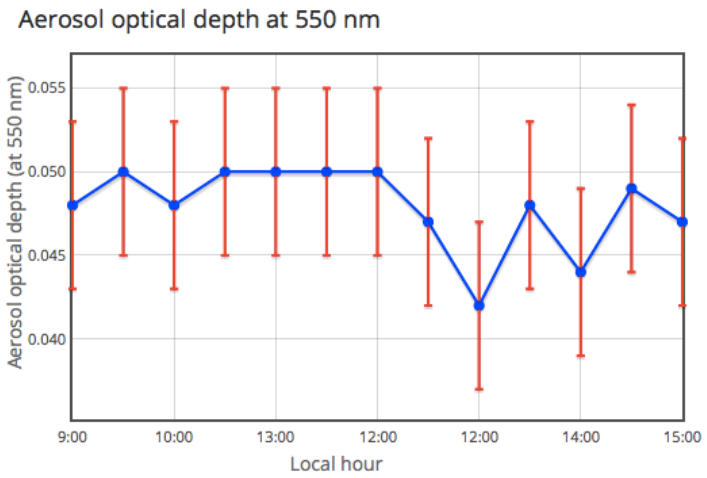


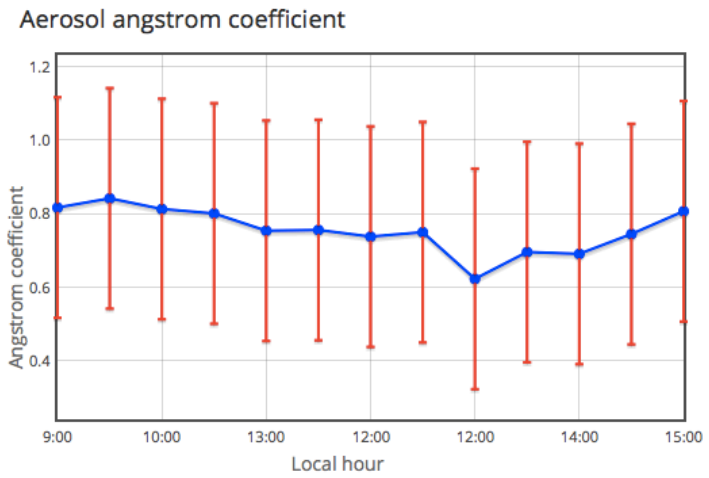


RadCalNet input data

2. Concomitant atmosphere data for the TOA propagation:

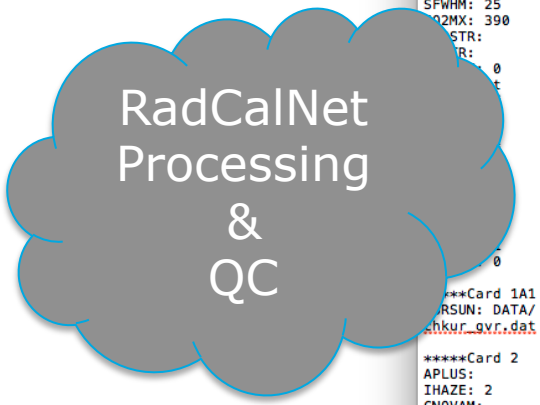
- Pressure + uncertainty
- Temperature + uncertainty
- Total column water vapour + uncertainty
- Total column ozone + uncertainty
- Aerosol optical thickness + uncertainty
- Aerosol Angstrom exponent + uncertainty
- Aerosol Type (following MODTRAN options)

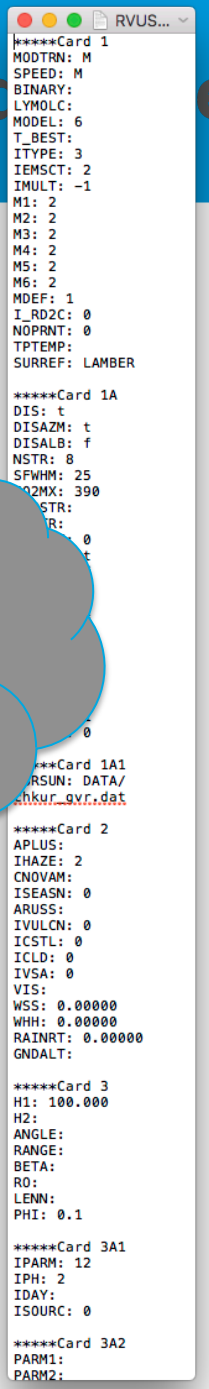




The RadCalNet processing

- Hosted by NASA/GSFC and based on Modtran 5
- Parameterisation of the code will be fully documented
- Key assumptions of the RadCalNet processing:
  - Lambertian surface
  - Aerosol optical properties based on pre-defined types
  - Pre-defined atmospheric profiles
- On-going work on how to propagate the surface / atmosphere uncertainties to TOA uncertainties
- QC mostly inherited from site .input files

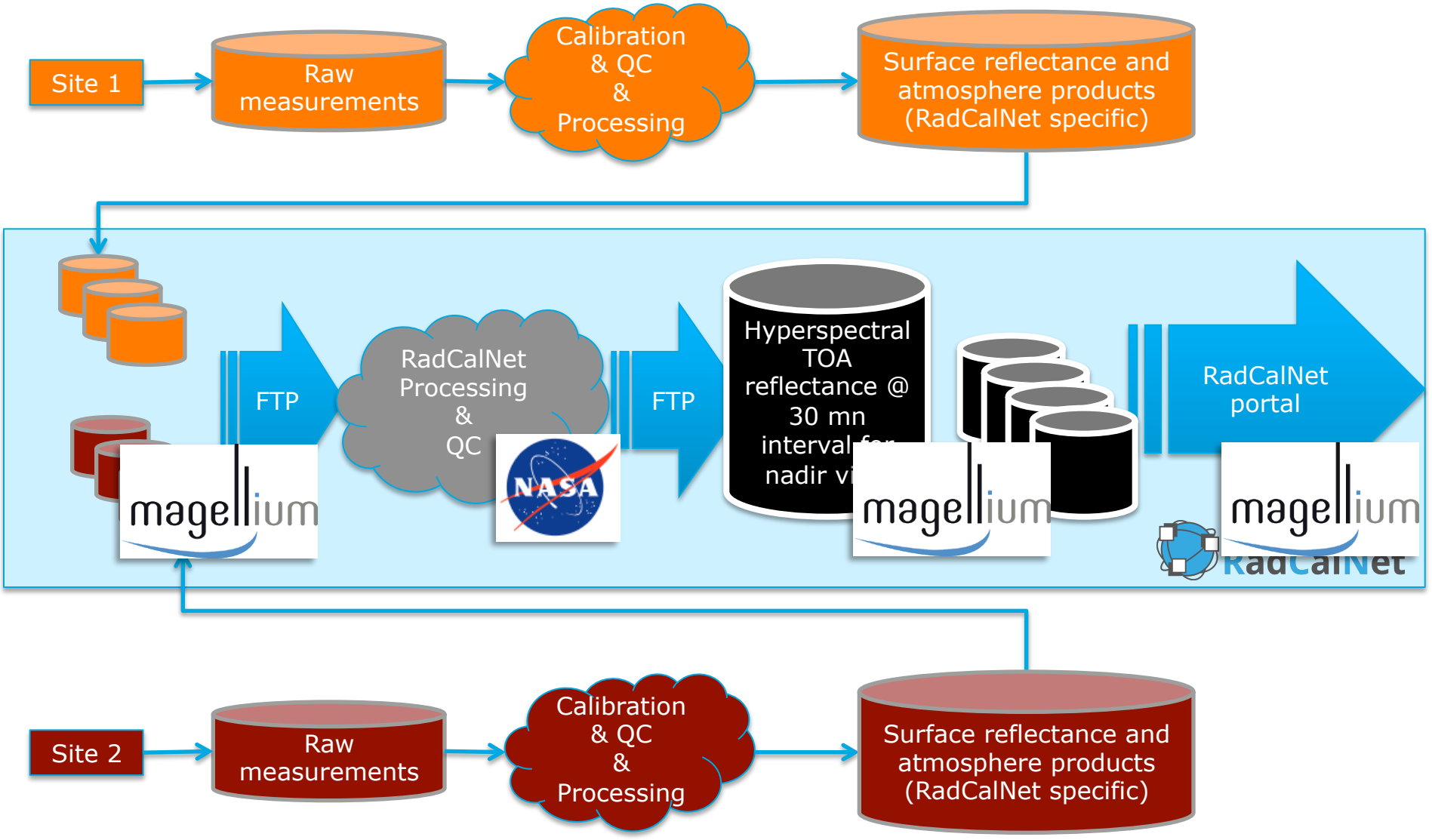



RVUS...

```
*****Card 1
MODTRN: M
SPEED: M
BINARY:
LYMOLC:
MODEL: 6
T_BEST:
ITYPE: 3
IEMSCT: 2
IMULT: -1
M1: 2
M2: 2
M3: 2
M4: 2
M5: 2
M6: 2
MDEF: 1
I_RD2C: 0
NOPRNT: 0
TPTEMP:
SURREF: LAMBER

*****Card 1A
DIS: t
DISAZM: t
DISALB: f
NSTR: 8
SFWHM: 25
O2MX: 390
STR:
R:
0
t
0
***Card 1A1
RSUN: DATA/
hkur_gyr.dat

*****Card 2
APLUS:
IHAZE: 2
CNOVAM:
ISEASN: 0
ARUSS:
IVULCN: 0
ICSTL: 0
ICLD: 0
IVSA: 0
VIS:
WSS: 0.00000
WHH: 0.00000
RAINRT: 0.00000
GNDALT:

*****Card 3
H1: 100.000
H2:
ANGLE:
RANGE:
BETA:
RO:
LENN:
PHI: 0.1

*****Card 3A1
IPARM: 12
IPH: 2
IDAY:
ISOURC: 0

*****Card 3A2
PARM1:
PARM2:
```

The data circulation… today in practice

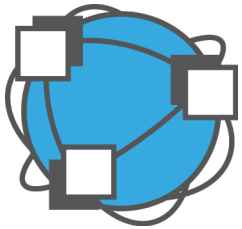
RadCalNet



The portal

RadCalNet

Not open to public yet!



Data policy

- Publically available
- Free
- Acknowledgment of RadCalNet and site owners

RadCalNet membership for new sites (draft criteria)

- Surface and atmosphere measurements shall be carried out operationally at the site
- A minimum amount of data (days) shall be provided (to be defined).
- Sites should be at least 45 x 45 m2
- Site providers must provide documented description of their characteristics, and ideally should follow examples on the RadCalNet site: measurement protocols, instrument description, calibration (SI traceability) strategy and detailed uncertainty
- Site providers should be prepared to have documents subjected to peer review and also to ensure consistency with other RadCalNet sites by participation in comparisons through use of travelling reference standards (e.g. reflectance panels)
- Instrumentation: must enable representative hyper-spectral surface reflectance @ 10 nm intervals, at nadir, on a 30 minute cycle (+/_ 3 hrs of local noon) over at least the spectral range 400 to 1000 nm and delivered at least daily to the RadCalNet FTP site.
- Instrumentation (continued): aerosol optical thickness and Angstrom exponent, air temperature, pressure, total column water vapour and total column ozone.
- Site providers must adhere to the data format specified by RadCalNet (available on the portal)
- Sites must be offered to RadCalNet for a minimum of 5 yrs.

The intercomparison of RadCalNet sites using SPOT-5 and Landsat-8

RadCalNet

- An intercomparison is being done between:
  - ✓ Remote sensing TOA data: Landsat-8 /SPOT-5 (Take-5) / Sentinel-2
  - ✓ TOA simulations from the sites (from RadCalNet and from site owners own TOA simulation tools)

- Objective:
  - ✓ Demonstrate the RadCalNet concept
  - ✓ Identify site-to-site differences using the space sensors as transfer radiometers

Next steps

- Consolidate RadCalNet building blocks (4th site, processing, data circulation, portal)
- Consolidated the documentation: site documentation, processing description, data format, data policy, membership criteria, a reference RadCalNet paper
- Intercomparison of the RadCalNet sites using Landsat-8/ SPOT-5/Sentinel-2
- Open the portal to beta users (Q3 2016)
- Go operational (Q1 2017)
- Open the network to new sites

RadCalNet

Questions?