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Fiducial Reference Measurements for validation of Surface Temperature from Satellites (FRM4STS)

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D140 Appendix A: Linked evidence to support the Field Intercomparison database

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D140 Appendix A: Linked evidence to support the Field Intercomparison database

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DOCUMENT MANAGEMENT

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DOCUMENT APPROVAL

Contractor Approval

Name	Role in Project	Signature & Date (dd/mm/yyyy)
Dr Nigel Fox	Technical Leader	
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CUSTOMER APPROVAL

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APPLICABLE DOCUMENTS

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EOP-SM/2642	1	Fiducial Reference Measurements for Thermal Infrared Satellite Validation (FRM4STS) Statement of Work

INTRODUCTION:

The FRM4STS project coordinated a series of Field Intercomparison experiments which compared the performance of different radiometers used in the measurement of the surface temperature of sea/water, land and ice. The results and data collected by these experiments needs to be documented and stored in an appropriate database that can be used by teams or groups having an interest in scrutinising the performance of different radiometer systems used to collect FRM data for use in satellite validation activities.

For this purpose, the Statement of Work of the FRM4STS project requires:

i. The establishment of a FICE database (FICE-DB). This database will be hosted in collaboration with the CEOS WGCV and relevant CEOS virtual constellations. The database will be used to manage and provide community access to the results of the FICE as they progress.
ii. The FICE database will be updated with new results as they become available during the FRM4STS project.

This report describes the approach which was be followed, the implementation of the D-140 A Field inter-comparison experiment database (FICE-DB), how users will interact, access data and contribute to the database.

Summaries of all data provided by all participants will be available on the FRM4STS website and will be accessible by all who wish to access the data. Full details of the same data will be stored on an FTP database which will be manged by NPL. Data stored on the FTP site will be available to be accessed by everybody who has an appropriate password. All institutions which participated in the FRM4STS comparisons will be provided with the FTP site password and are thus be able to access this data freely.

The summary data stored on the website will be in excel spreadsheets and structured so that it can be added to with future results from other comparison exercises.

The CEOS comparison results database is will be divided into six main sections which have initially been populated from the results of the current round of comparisons which are listed below:

i. Laboratory comparison of radiometers
ii. Laboratory comparison of blackbodies
iii. Water Surface Temperature (WST) comparison at Wraysbury reservoir.
iv. Land Surface Temperature (LST) comparison at NPL.
v. Land Surface Temperature (LST) comparison in Namibia.
vi. Ice Surface Temperature (IST) comparison in the Arctic.

The full content, column headers, of the database is shown in Appendix A, at the end of this document.

The front end of the database will consist of searchable fields identifying the participant organisation, date of any comparison (overall set of comparisons for a given exercise), type of comparison, location of comparison activity, type of instrument and unique ID, brightness temperature range (could be several values if appropriate e.g. for a laboratory exercise), percent difference to any comparison defined reference (could be a different participant and for an exercise with many participants a separate entry indicating any bias for each participant will be included), uncertainty of participant, uncertainty of comparison, comments and link to evidence (see Appendix A). It is intended that going forward the database will be added to and times series of bi-lateral comparisons identified.

APPENDIX A

FRM4STS COMPARISON OF RADIOMETERS AND BLACKBODIES OF PARTICIPANTS.

This Appendix describes the data spreadsheets which are contained in the website of the FRM4STS (results section) summarising the results of completed comparisons. The Section is subdivided into six sub-Sections, one dealing with laboratory comparison of blackbodies, a second dealing with the laboratory comparison of radiometers, the third dealing with the water surface temperature comparison at Wraysbury reservoir, the fourth dealing with the land surface temperature comparison carried out on the NPL campus, the fifth dealing with the land surface temperature comparison in Namibia, while the sixth subsection deals with the ice surface temperature comparison in the Arctic.

A1. LABORATORY COMPARISON OF RADIOMETERS AND BLACKBODIES

A1.1 The laboratory comparison of radiometers

This Section of the website consists of a spreadsheet summarising the results of the radiometer laboratory comparison, in this case measuring the radiance temperature of the NPL ammonia heat-pipe blackbody. Measurements were carried out at seven different blackbody temperatures (-30 ^{o}C, -15 ^{o}C, 0 ^{o}C, 10 ^{o}C, 20 ^{o}C, 30 ^{o}C and 45 ^{o}C) so the spreadsheet is sub-divided into seven sheets, each corresponding to one of these temperatures. Data in each sheet is presented in an identical fashion. Each sheet will start with title indicating the blackbody temperature at which the measurements listed in this sheet correspond to. The date at which the sheet was last updated will also be clearly shown at the top of each sheet. For subsequent comparisons this can easily be updated with appropriate identifiers.

i. The first column of each sheet indicates a spreadsheet identifier for each of the channels (and therefore the measurements) made by a particular radiometer or separate radiometers from the same participant.
ii. The second column indicates the name of the participant operating the radiometer to which the measurements correspond to.
iii. The third column of the sheet indicates the date on which these measurements were done.
iv. The fourth column of the sheet indicates the peak wavelength or the range of wavelengths over which the radiometer will be operating during the acquisition of this data.
v. The fifth column of the sheet indicates the location where these measurements were done.
vi. The sixth column of the sheet indicates the radiometer type and unique ID (if provided) with which these measurements were done.
vii. The seventh column of the sheet indicates the nominal brightness temperature of the ammonia fixed-point blackbody when these measurements were done.
viii. The eighth column of the sheet indicates the absolute difference in the radiance temperature measured by the participating radiometer (averaged over the defined time period of measurement) and the radiance temperature of the cavity of the ammonia heat-pipe blackbody averaged over the same time period.
ix. The ninth column of the sheet indicates the value indicated in the eighth column expressed as a percentage.

x. The tenth column of the sheet indicates the absolute standard uncertainty (k=1) expressed in mK of the temperature measurements provided by the participants.
xi. The eleventh column of the sheet indicates the combined absolute standard uncertainty (k=1) expressed in mK of the comparison.
xii. The twelfth column of the sheet includes supporting evidence for the data shown in that particular row.
xiii. The thirteenth column of the sheet includes any comments relevant to the data shown in that particular row.

A1.2 The laboratory comparison of blackbodies of participants

This Section of the website consists of a spreadsheet summarising the results of the blackbody laboratory comparison i.e. the radiance temperature of participating blackbodies in this case being measured by the NPL AMBER radiometer and the PTB infrared radiometer.

Measurements are carried out at a number of different blackbody temperatures ranging from 0 °C to 75 °C and the spreadsheets will reflect this. The spreadsheet corresponding to this comparison in a similar way to the othes will start with title indicating the comparison to which the data correspond to. The date at which the spreadsheet was last updated will also be clearly shown at the top of each sheet.

i. The first column of each sheet provides a spreadsheet identifier for corresponding to each a nominal test blackbody temperature for which the participants blackbody was measured.
ii. The second column indicates the name of the participant operating the blackbody to which the measurements shown in that row correspond to.
iii. The third column of the sheet indicates the date on which the measurements of the test blackbody made by the reference (NPL AMBER) radiometer were done.
iv. The fourth column of the sheet indicates the date on which the measurements of the test blackbody made by any second reference 'in this case the PTB infrared radiometer' were done.
v. The fifth column of the sheet indicates the location where these measurements were done.
vi. The sixth column of the sheet indicates the blackbody type and unique ID (if provided) on which these measurements were done.
vii. The seventh column of the sheet indicates the nominal temperature of the test blackbody when these measurements were done.
viii. The eighth column of the spreadsheet indicates the absolute difference in the radiance temperature of the cavity of the test blackbody (reported by the participant) averaged over the defined measurement period and the corresponding measurement provided by the NPL AMBER radiometer (averaged over the defined time period of measurement).
ix. The ninth column of the spreadsheet indicates the absolute difference in the radiance temperature of the cavity of the test blackbody (reported by the participant) averaged over the defined measurement period and the corresponding measurement provided by the PTB infrared radiometer (averaged over the defined time period of measurement).
x. The tenth column of the sheet indicates the value indicated in the eighth and ninth columns expressed as a percentage.
xi. The eleventh column of the sheet indicates the absolute standard uncertainty (k=1) expressed in mK of the temperature measurements of the test blackbody provided by the participant.
xii. The twelfth column of the sheet indicates the combined absolute standard uncertainty (k=1) expressed in mK of the comparison against the first reference, the NPL AMBER radiometer.

xiii. The thirteenth column of the sheet indicates the combined absolute standard uncertainty (k=1) expressed in mK of the comparison against the second reference, the PTB infrared radiometer.
xiv. The fourteenth column shows any supporting evidence corresponding to the data shown in that particular row.
xv. The fifteenth column of the sheet includes any comments relevant to the data shown in that particular row.
xvi. The sixteenth column indicates the name of the participant operating the blackbody to which the measurements shown in that row correspond to.

A2. WATER SURFACE TEMPERATURE (WST) COMPARISON

This Section of the website consists of a spreadsheet summarising the results of the radiometer water surface temperature comparison completed at Wraysbury reservoir in 2016. Data in the spreadsheet start with title indicating the comparison to which the measurements listed in this spreadsheet correspond to. The date at which the spreadsheet was last updated is also clearly shown at the top of each sheet.

i. The first column of each sheet indicates a spreadsheet (participant) reference number for each of the radiometers taking part in this comparison (i.e. if a participant has more than one radiometer).
ii. The second column indicates the name of the participant operating the radiometer to which the measurements in that particular row correspond to.
iii. The third column of the sheet indicates the dates/duration over which these measurements will be done.
iv. The fourth column of the sheet indicates the peak wavelength or the range of wavelengths over which that particular radiometer operated during the acquisition of this data.
v. The fifth column of the sheet indicates the location where these measurements were done.
vi. The sixth column of the sheet indicates the radiometer type and unique ID (if provided) with which these measurements were done.
vii. The seventh column of the sheet indicates the range of brightness temperature values measured by the radiometer during the duration of the WST comparison.
viii. The eighth column of the sheet indicates the absolute difference (in mK) between the water surface temperature measured by the participating radiometer (averaged over the entire duration of the comparison) and the mean of the WST temperature measured by the different radiometers, averaged over the same time period. In order to be able to do that, measurements of the water surface temperature reported by participants are interpolated so that WST values are available at the same points in time.
ix. The ninth column of the sheet will indicate the value indicated in the eighth column expressed as a percentage.
x. The tenth column of the sheet will indicate the absolute standard uncertainty (k=1) estimated by each participant, expressed in mK, of the temperature measurements provided by the participants.
xi. The eleventh column of the sheet includes supporting evidence for the data shown in that particular row.
xii. The twelfth column of the sheet includes any comments relevant to the data shown in that particular row.
xiii. The thirteenth column indicates the name of the participant operating the radiometer to which the measurements shown in that particular row correspond to.

A3. LAND SURFACE TEMPERATURE (LST) COMPARISON AT NPL

This Section of the website consists of a spreadsheet summarising the results of the radiometer land surface temperature comparison completed at NPL in July 2016. Measurements were be carried out for a number of different "targets" and in general consisted of simultaneous measurements by different radiometers viewing the same target. The targets were: short grass, clover, soil, sand, gravel and tarmac/asphalt. The spreadsheet includes six sheets, each indicating the results of the comparison corresponding to the six different "targets". Data in each sheet is presented in an identical fashion. Each sheet corresponding to a particular target will start with a title indicating the comparison to which the data correspond to. The date at which the sheet was last updated will also be clearly shown at the top of each sheet.

i. The first column of each sheet indicates a spreadsheet reference number for each test radiometers (and or channel) with which measurements were done for that particular target.
ii. The second column indicates the name of the participant operating the test radiometer to which the measurements shown in that row correspond to.
iii. The third column of the sheet indicates the date on which the measurements were completed on that target by that particular test radiometer.
iv. The fourth column of the sheet indicates the range of wavelengths over which that particular radiometer operated during the acquisition of this data
v. The fifth column of the sheet indicates the location where these measurements were done.
vi. The sixth column of the sheet indicates the radiometer type and unique ID (if provided) with which these measurements were done.
vii. The seventh column of the sheet indicates the range of land surface temperature values measured by the test radiometer during the duration of the comparison of that particular target.
viii. The eighth column of the sheet indicates the absolute difference (in mK) between the target surface temperature measured by the participating radiometer (averaged over the entire duration of the comparison) and the mean of the target surface temperature measured by the different radiometers, averaged over the same time period. In order to be able to do that, measurements of the target surface temperature reported by participants is interpolated so that target surface temperature values are available at the same points in time.
ix. The ninth column of the sheet indicates the value indicated in the eighth column expressed as a percentage.
x. The tenth column of the sheet indicates the absolute standard uncertainty (k=1) expressed in mK of the target surface temperature which is provided by the participant for that particular target measurement.
xi. The eleventh row shows any supporting evidence corresponding to the data reported by the participants.
xii. The fifteenth column of the sheet includes any comments relevant to the data shown in that particular row.
xiii. The sixteenth column indicates the name of the participant operating the radiometer to which the measurements shown in that row correspond to.

A4. LAND SURFACE TEMPERATURE (LST) COMPARISON IN NAMIBIA

The website for this part of the comparison will be very similar to that for the LST comparison at NPL (see Section A3 of this Appendix).

A5. ICE SURFACE TEMPERATURE (LST) COMPARISON IN THE ARCTIC

The website for this part of the comparison will be very similar to that for the LST comparison at NPL (see Section A3 of this Appendix)