FRM4SOC Phase 2 laboratory comparison.

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Overview

Importance of laboratory comparisons

Progress report: D-13 Lab cal/char comparison exercise

US loop finished, transfer radiometers at the NPL

Ending comparison at TO

Evaluation of comparison results

Draft A Report

Conclusions

Transfer radiometers

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Importance of laboratory comparisons

Measurement comparisons are the main tool to establish the measurements' compatibility between different laboratories or different measurement methods.

Measurement comparisons demonstrate:

- equivalence of lab measurement standards and equipment
- correctness of the SI traceability
- correctness of uncertainty statements
- correctness of the used methods and procedures
- operators' competence

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Initial time schedule

Loop 1

1. NIVA (1. – 26. February, weeks 5 - 8)
2. DLR / CHB (27. February – 26. March, weeks 9 – 12)
3. TO (27. March – 23. April, weeks 13 – 16)

	Weeks												
	4	5	6	7	8	9	10	11	12	13	14	15	16
TO	■												
1.1 NIVA		■	■	■	■								
1.2 DLR / CHB						■	■	■	■				
TO										■	■	■	■

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Loop 2

1. Sea-Bird Scientific (1. - 21. May, weeks 18 - 20)
2. MLML (22. May – 11. June, weeks 21 - 23)
3. NOAA/NESDIS (12. June – 2. July, weeks 24 - 26)
4. NPL (3. – 23. July, weeks 27 - 29)
5. TO (24. July – 20. August, weeks 30 -33)

	Weeks															
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
TO	■															
2.1 Sea-Bird Scientific		■	■	■												
2.2 MLML					■	■	■									
2.3 NOAA / NESDIS								■	■	■						
2.4 NPL											■	■	■			
TO														■	■	■

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D-13, Lab cal/char comparison exercise

Measurements have been performed at:

- TO in January
- NIVA in February-March
- TO in April
- Sea-Bird Scientific in June
- National Oceanic and Atmospheric Administration (NOAA) in August
- Moss Landing Marine Laboratories (MLML) in October
- NPL in November.
- TO in December 2022.

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Analysis of comparison results

Comparison analysis will be started after obtaining the results from all participants including final measurements at TO.

As a first step, results submitted by participants shall be corrected at least for:

- Temperature differences during calibration
- Non-linearity errors
- Temporal drift of radiometers

Corrections can be calculated basing to the reports from all participants.

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Compatibility evaluation

According to VIM, *the compatibility is a property of a set of measurement results for a specified measurand, such that the absolute value of the difference of any pair of measured quantity values from two different measurement results is smaller than some chosen multiple of the standard measurement uncertainty of that difference*.

The comparison results are evaluated by the normalized error E_n, defined as:

$$E_n = \frac{x_L - x_{ref}}{U\left(x_L - x_{ref}\right)}$$

where x_L is the value of a laboratory, x_{ref} is the reference value and $U\left(x_L - x_{ref}\right)$ is the expanded uncertainty of the difference. The compatibility condition is satisfied when $|E_n| \leq 1$.

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Direct and indirect comparisons

During FRM4SOC-2 Project, participants didn't show any interest in characterization comparisons needed for validation of characterization methods and procedures.

To validate characterization methods, indirect comparison with former published results can be used, where the compared results are obtained by using different instruments.

An example from an indirect comparison is shown in next slide showing comparison of results obtained on the same instruments but with significant time difference.

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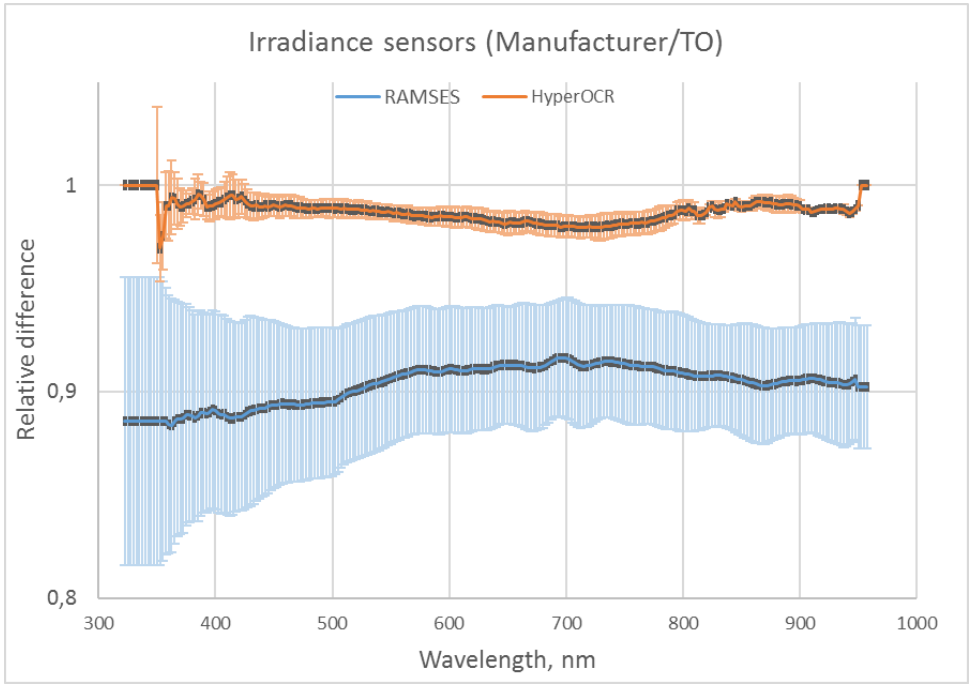
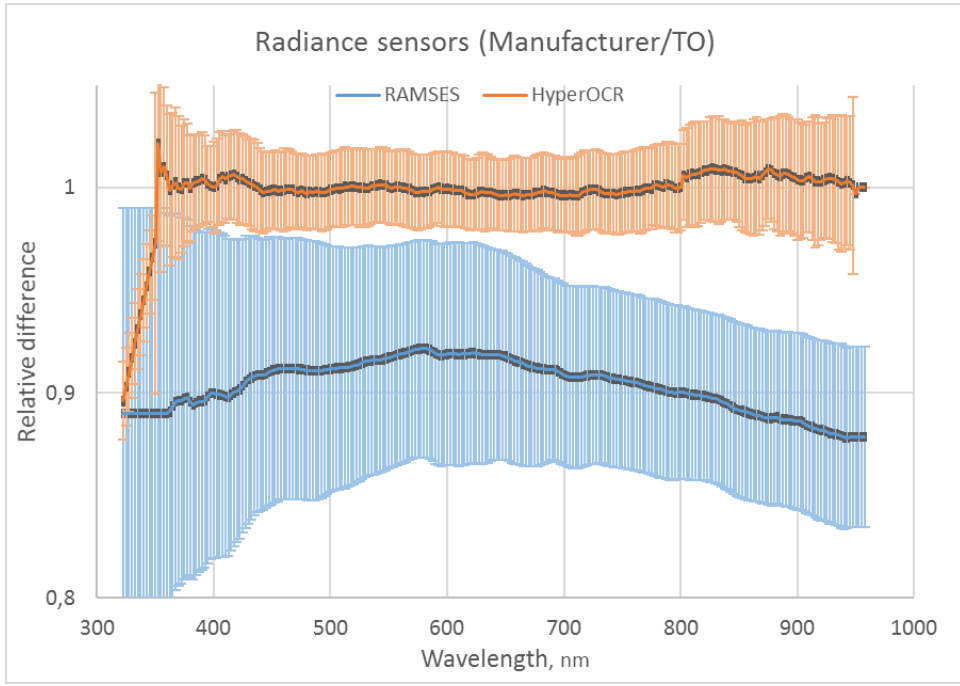
Indirect comparison of calibration results (manufacturer/TO)

The Ratio of calibration coefficients (manufacturer/TO) with standard deviation over all ratios.





Regarding present situation

Interest in comparison measurement for validation of characterization techniques has been low; number of candidate labs is limited, number of methods needing validation large.

Characterisation methods are not sufficiently tested and discussed by community, for successful comparison extended preparatory work is needed.

For technically complicated fields (most of charaterisations), likely starting with bilateral comparisons is preferable.

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Types of laboratory comparisons

A bilateral comparison is well suited with a reference lab and with another lab whose capabilities have to be verified. Reference lab shall provide also the comparison reference values.

A multilateral comparison is more suitable for a group of labs also without a clear reference lab. The comparison reference values are derived from the results of all labs as consensus values. It is much more time consuming and more difficult to arrange.

Although bilateral comparison is easier to arrange, without a good reference lab it is less effective for compatibility evaluation.

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Regarding planning of comparison

For international comparisons, technical barriers during transportation of transfer standards can cause rather significant time delays.

In spite of prepared measurement protocol, participant's reports are not in the same format.

For characterisations detailed agreement of procedures is needed, and much more measurement time and flexibility should be planned.

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Conclusions

- Lab comparison exercise of secondary labs is close to end.
- Transfer standards are at the NPL, UK.
- Reporting is going on.
- Draft A report will be prepared to the end January, 2023.
- Lab comparison exercise involved only radiometric calibration.
- Validation of characterization methods and procedures by laboratory comparisons is also needed.

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