CCPR-K6.2010 Update
May 2012

Since our last report in November 2011, transmittance measurements of all 15 filter sets, plus the filter set #19 from the previous CCPR-K6 have been carried out approximately monthly.

Results

Rather than present summary information as in previous reports, this time we have decided to present the task group with all of the measurement results obtained so far. The results of all tests are shown in the accompanying appendix. The figures show the relative change in transmittance of a particular filter type at a particular wavelength. Each trace in the figure corresponds to a filter from a different set (a total of 16 sets). Four sets have been monitored since November 2010 and the remaining 11 sets have been monitored since July 2011. The change in transmittance charted is relative to the transmittance measured in July 2011.

A discussion of the origin of the changes being observed can be found in the NewRad proceedings (Metrologia **49** (2012) S68-S72). But this issue is not part of this discussion.

In each figure, the black trace is that of filter set #19 from the previous CCPR-K6. We observe that these filters generally display good stability over the time of measurements. The dotted horizontal lines show the median total uncertainty (k=1) reported by participants for that particular filter at that wavelength in the previous comparison.

It should be noted that while the filter types (BK7, NG11, NG5, NG4, NG3) are the same as those used to manufacture the filters of the previous comparison, the spectral shape is not identical, and therefore the absolute transmittances are somewhat different at several wavelengths.

The BK7 (filter 1) and NG11 (filter 2) appear to have similar spectral shapes to the previous filters, noting that the NG11 filter has been manufactured thicker this time (2.5 mm instead of 1.5 mm). The NG5, NG4 and NG3 (filters 3, 4, and 5) on the other hand while exhibiting the same nominal transmittance as the previous filters at 546 nm, diverge at the short and long wavelengths by up to a factor of two in both positive and negative senses. At 380 nm however, filter 5 exhibits almost an order of magnitude lower transmittance than the corresponding filter from the previous comparison. It appears that the NG type filters have variable composition batch to batch.

It is not possible to adjust the uncertainties reported in the previous comparison to suit the absolute values of the current filters without more knowledge of how the uncertainty budgets were formed, so the dotted lines shown should be considered indicative only.

Discussion

From looking at the complete set of data it seems clear to us that there is no way to predict how the filters will behave over the next six months or even 12 months. At several points it appears to us that guaranteed stability will not be possible within a reasonable time frame. If we proceed with the filters as they are, however, there are likely to be some points at which the filter stability will dominate the uncertainty of the degrees of equivalence. Each of the 40

comparison points must be considered independently with reference to the uncertainty levels that participating NMIs are hoping to achieve.

We may consider the primary purpose of the comparison as being to establish mutual confidence in the equivalence of our measurement scales. This is accomplished in practice by using the results of the comparison to substantiate CMC claims. The decision as to whether or not to proceed with the comparison then rests on the answer to the following question:

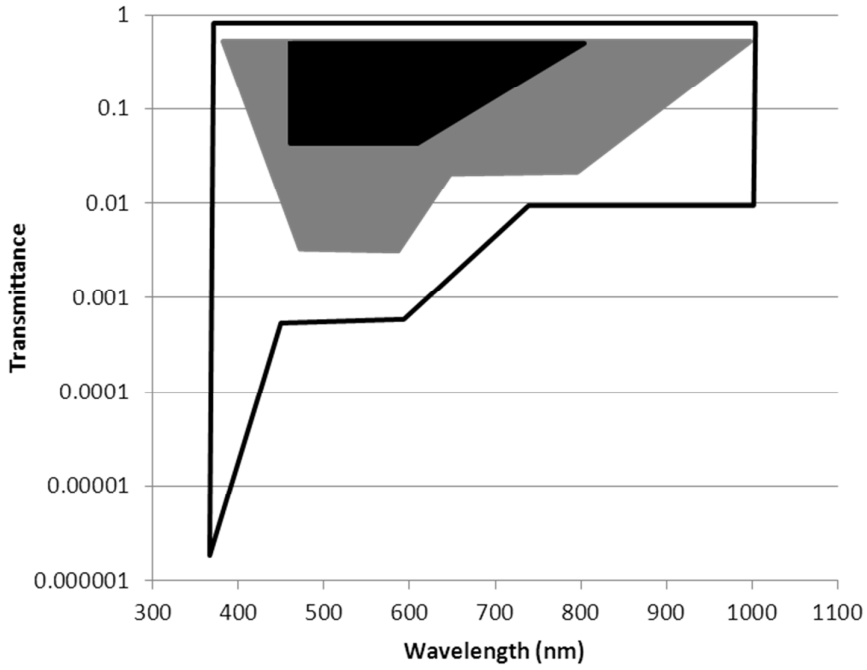
Which of the 40 comparison points will form a set sufficient to substantiate CMC claims over the entire area?

As a rough guide the stability of the filters has been assessed relative to the mean uncertainties from the previous comparison and the two figures below have been constructed. It would seem that of the 40 points,

- at **six** points the comparison uncertainty will be dominated by the artefact instability regardless of how the comparison is run (black),
- a further **nine** points could yield uncertainties on the degrees of equivalence low enough to be meaningful if the comparison measurements are completed within approximately six months (grey) and
- the remaining **24** points will probably be useful for determining equivalence of measurement scales even if the comparison takes the full 12 months of measurement time allotted (white).

If the set of points covered in white, or the set of points covered in white and grey are sufficient to substantiate CMC claims over the entire area, then it is likely that it is worthwhile to go ahead with the comparison. The final result will of course depend on the level of uncertainty claimed by participants and the actual stability of the filters during the comparison.

Filter	380 nm	400 nm	500 nm	600 nm	700 nm	800 nm	900 nm	1000 nm
1								
2								
3								
4								
5								



Recommendations

In order to decide which of the options below will be appropriate, the question posed earlier in the discussion section should be answered. It would be easiest if each member of the task group would respond to the following two questions, **remembering that the 'white' and 'grey' areas may change during the comparison**, for example if uncertainty levels reported by participants are decreased relative to the previous comparison, or the stability levels change:

1. Is the set of points covered in white sufficient?
2. If no, is the set of points covered in white and grey sufficient?

If the consensus is 'No' to both questions, then the only option is:

a. Continue monitoring until all filters are stable at all wavelengths. We suggest that the time required if we wait may be more than 12 months.

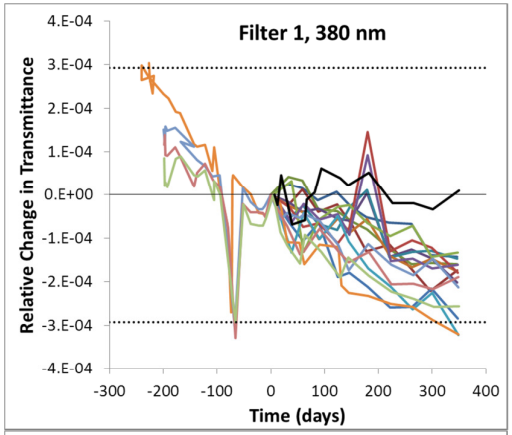
If the consensus is 'No' to question 1 and 'Yes' to question 2 then the best option is:

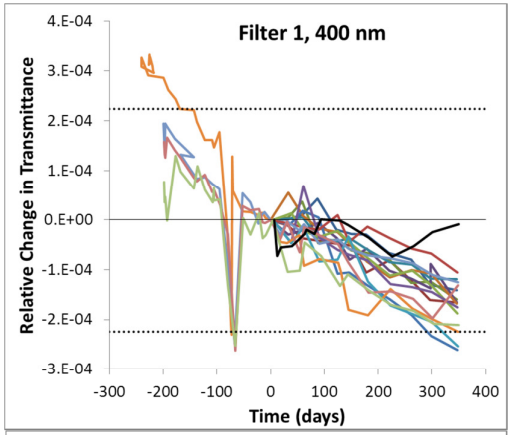
b. Start the comparison now and urge (require?) participants to make each round of measurements within a month.

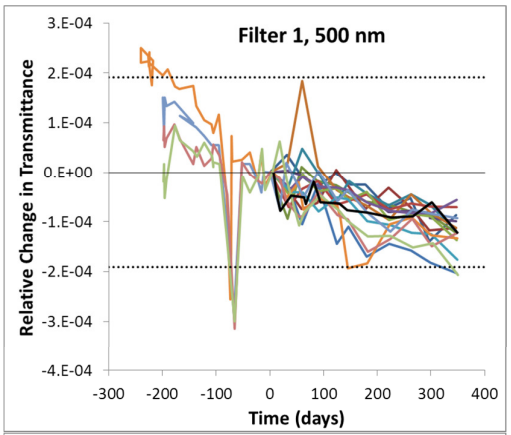
If the consensus is 'Yes' to question 1 then we may:

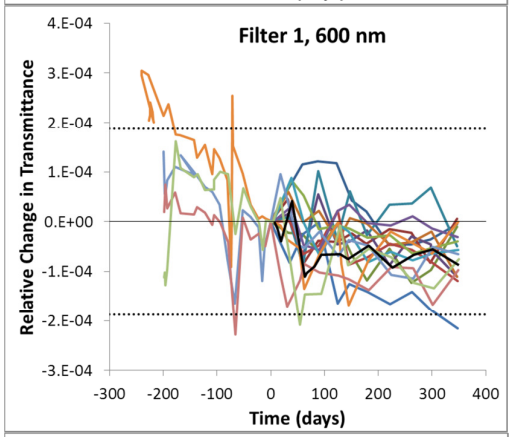
c. Start the comparison now and leave the measurement times as per the technical protocol (i.e. three months per measurement round).

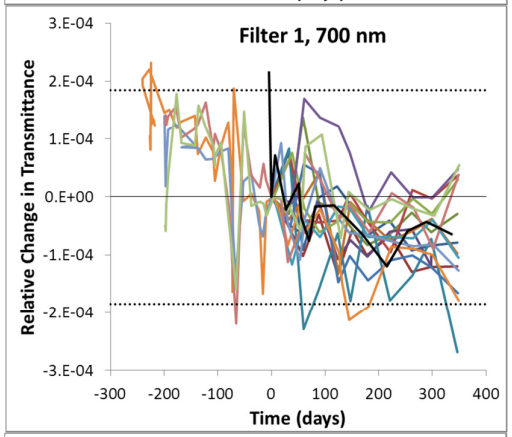
Appendix A.1
Relative change in transmittance of Filter 1.
Coloured traces – filters from sets manufactured for CCPR-K6.2010
Black trace – filter from Set #19, previous CCPR-K6 comparison
Dotted lines – median total uncertainty reported for previous CCPR-K6 comparison

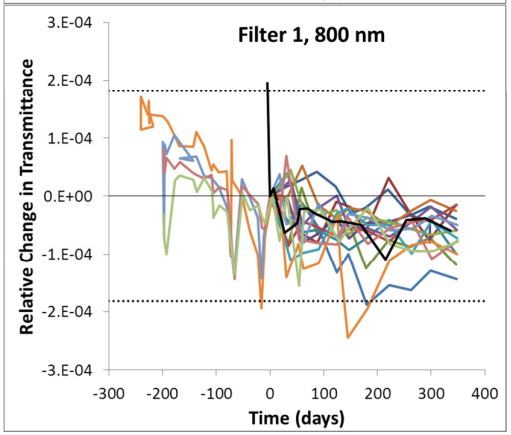


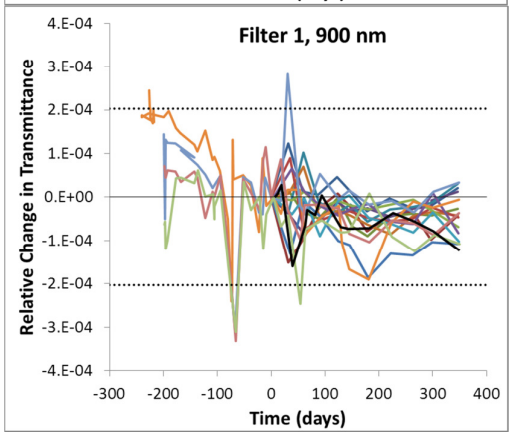


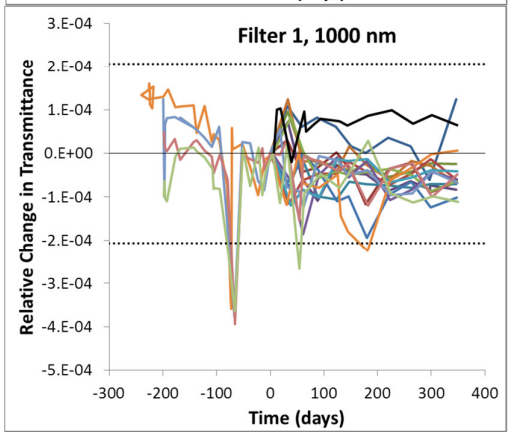




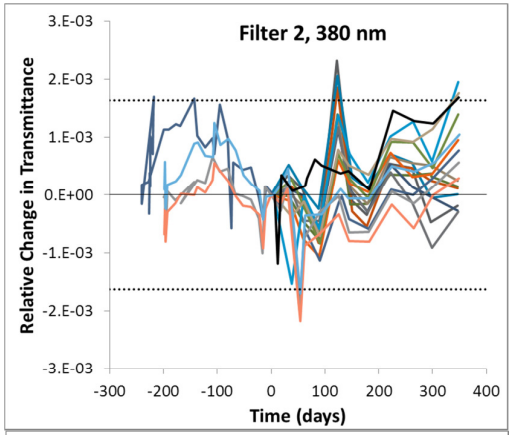


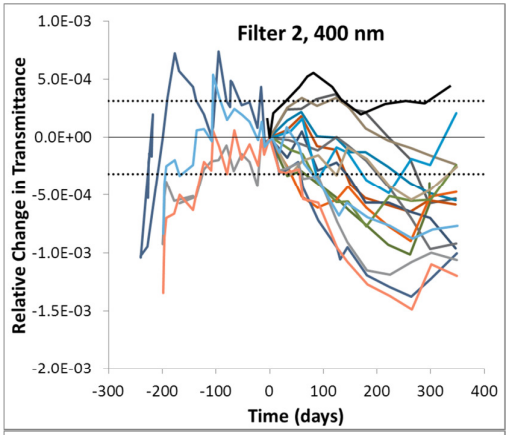


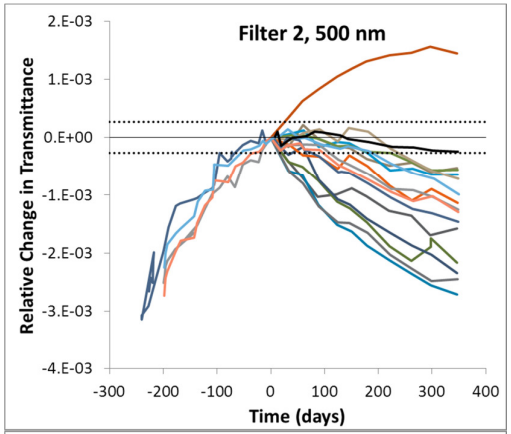


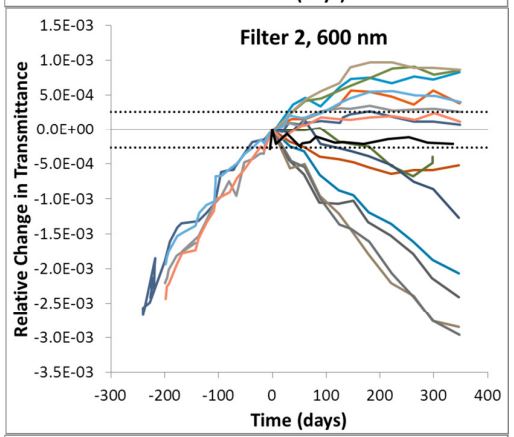


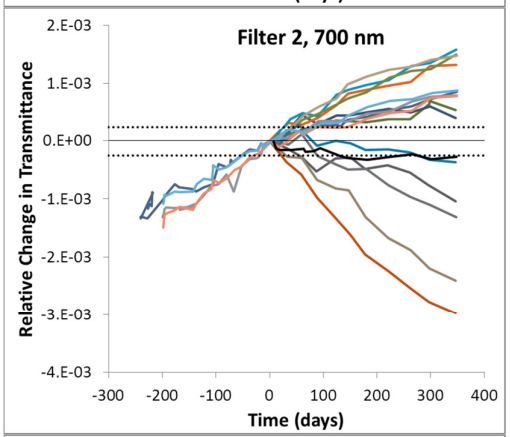
Appendix A.2
Relative change in transmittance of Filter 2.
Coloured traces – filters from sets manufactured for CCPR-K6.2010
Black trace – filter from Set #19, previous CCPR-K6 comparison
Dotted lines – median total uncertainty reported for previous CCPR-K6 comparison

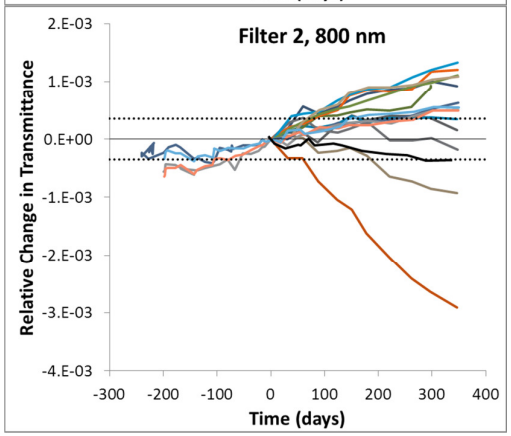


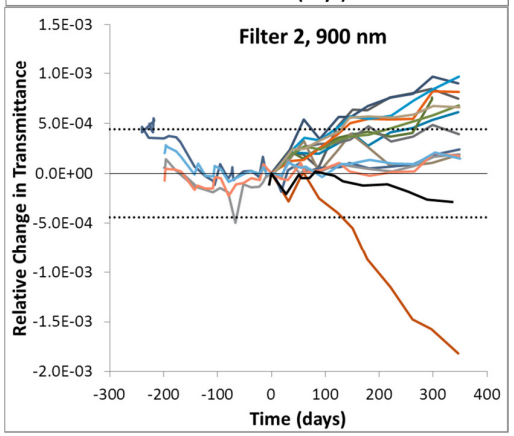


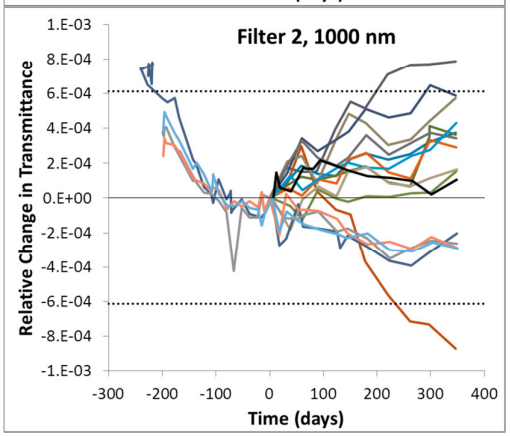




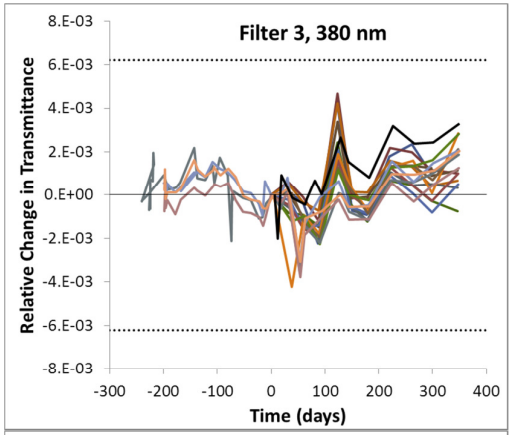


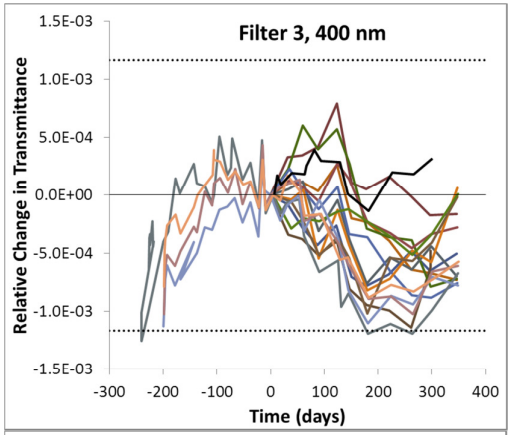


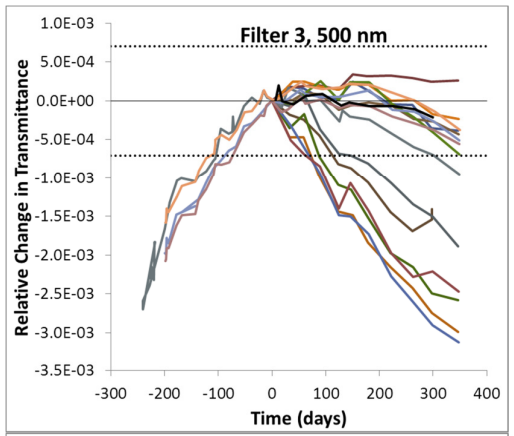


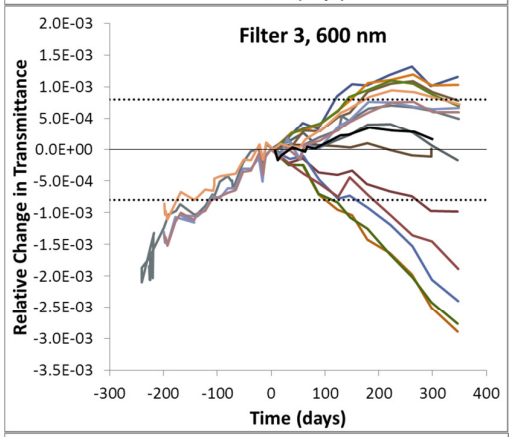


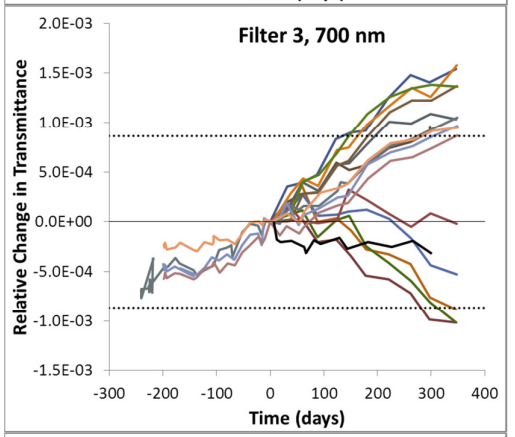
Appendix A.3
Relative change in transmittance of Filter 3.
Coloured traces – filters from sets manufactured for CCPR-K6.2010
Black trace – filter from Set #19, previous CCPR-K6 comparison
Dotted lines – median total uncertainty reported for previous CCPR-K6 comparison

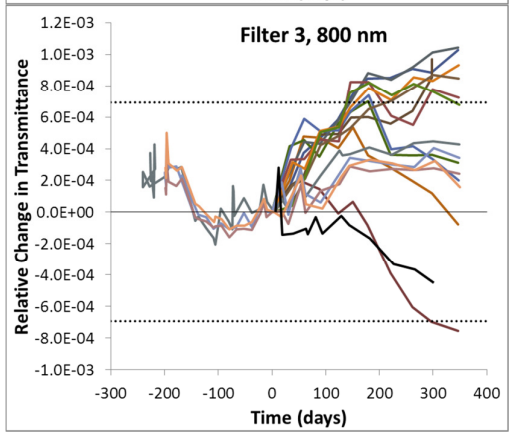


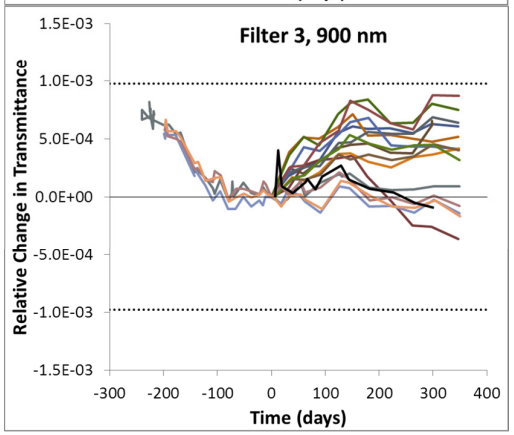


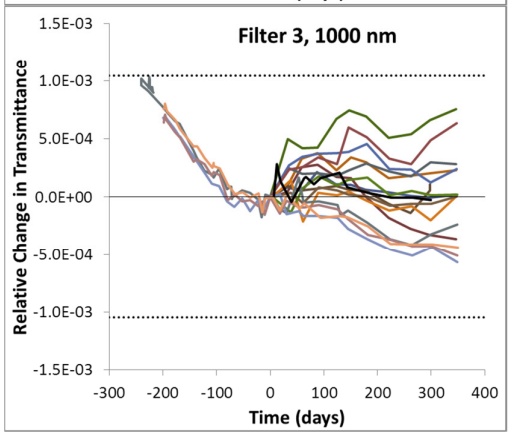




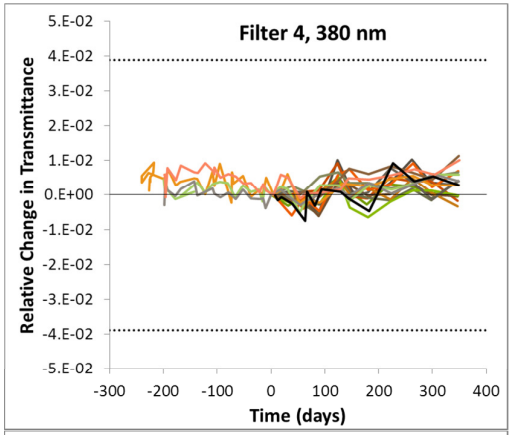


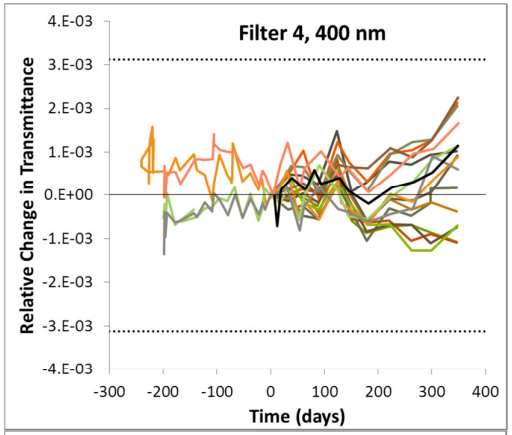


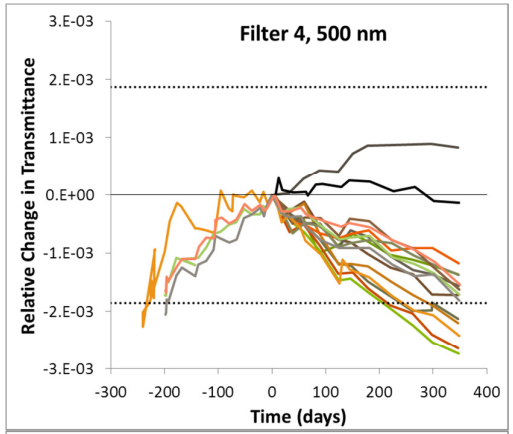


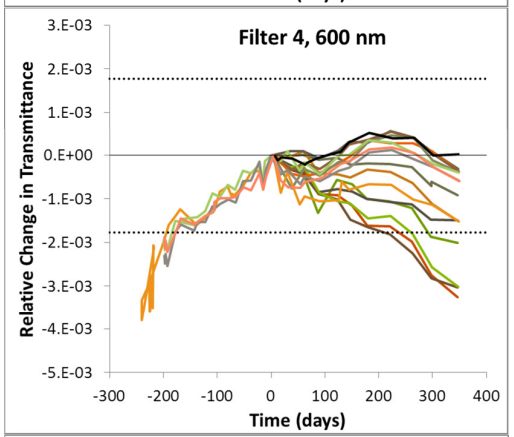


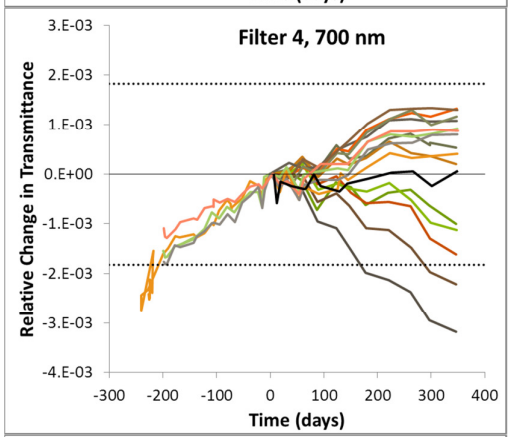
Appendix A.4
Relative change in transmittance of Filter 4.
Coloured traces – filters from sets manufactured for CCPR-K6.2010
Black trace – filter from Set #19, previous CCPR-K6 comparison
Dotted lines – median total uncertainty reported for previous CCPR-K6 comparison

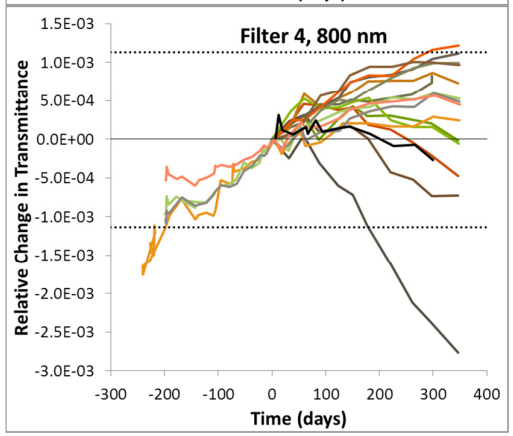


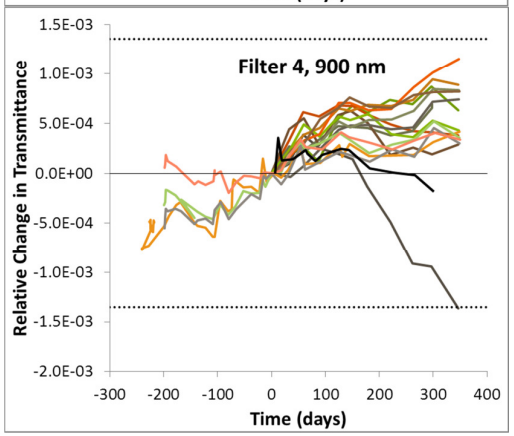


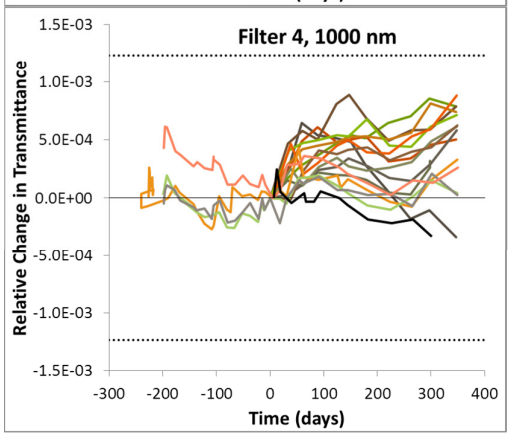












Appendix A.5
Relative change in transmittance of Filter 5.
Coloured traces – filters from sets manufactured for CCPR-K6.2010
Black trace – filter from Set #19, previous CCPR-K6 comparison
Dotted lines – median total uncertainty reported for previous CCPR-K6 comparison