We follow the general formula for error propagation (Taylor 1982) when deriving uncertainties in binned irradiance (in wavelength) or in averaged irradiance (in time). Using the terminology of Taylor (1982), for a function *q*(*x*,…,*z*) computed from the measured variables *x* through *z* with associated (independent and random) uncertainties *δx* through *δz*, the uncertainty in *q* is

|  |  |  |
| --- | --- | --- |
|  |  | A.i |

and, never larger than the ordinary sum

|  |  |  |
| --- | --- | --- |
|  |  | A.ii |

The solar spectral irradiance (SSI) and total solar irradiance (TSI) and associated uncertainties are a function of time and, in the case of SSI, of (variable) bandwidth.

Example 1: *Binning Irradiances into broader wavelength bands*

This example illustrates the resulting error propagation when the SSI is binned into broader bands (i.e. the ultraviolet, visible, and near infrared ranges).

Let *q* be the binned SSI from *λ1* to *λ2*

|  |  |  |
| --- | --- | --- |
|  |  | A.1.a |

Per equation A.i the associated uncertainty (for random and independent uncertainties in the SSI) in *q*(*t*) is

|  |  |  |
| --- | --- | --- |
|  |  | A.1.b |

And per equation A.ii, the associated uncertainty in *q*(*t*) is never larger than

|  |  |  |
| --- | --- | --- |
|  |  | A.1.c |

Example 2: *Time-Averaging Irradiances*

This example illustrates the resulting error propagation when the SSI or TSI is averaged over time (i.e. a solar maximum or minimum period). The equations shown in this example are specific to SSI.

Let *q* be the time-averaged SSI from *t = 1,…,N*.

|  |  |  |
| --- | --- | --- |
|  |  | A.2.a |

Per equation A.i the associated uncertainty (for random and independent uncertainties in the SSI) in *q*(*λ*) is

|  |  |  |
| --- | --- | --- |
|  |  | A.2.b |

And per equation A.ii, the associated uncertainty in *q*(*λ*) is never larger than

|  |  |  |
| --- | --- | --- |
|  |  | A.2.c |

Example 3: *Differences in* *Time-Averaging Irradiances*

This example illustrates the resulting error propagation when differences are taken of the SSI or TSI that has been averaged over time (i.e. a solar maximum minus a solar minimum period). The equations shown in this example are specific to SSI.

Let *q* be the differences in time-averaged SSI. Let be the averaged irradiance for time period ‘A’ (from elements *t = 1,…,N*) and be the averaged irradiance for time period ‘B’ (from elements *t = 1,…,M*) as derived using A.2.a. Let and be the associated uncertainties derived using A.2.b or A.2.c

|  |  |  |
| --- | --- | --- |
|  |  | A.3.a |

Per equation A.i the associated uncertainty (for random and independent uncertainties in the respective time-averaged irradiances) in *q*(*λ*) is

|  |  |  |
| --- | --- | --- |
|  |  | A.3.b |

And per equation A.ii, the associated uncertainty in *q*(*λ*) is never larger than

|  |  |  |
| --- | --- | --- |
|  |  | A.3.c |

Example 4: *Ratios of* *Time-Averaging Irradiances*

This example illustrates the resulting error propagation when ratios are taken of the SSI or TSI that has been averaged over time (i.e. a solar maximum divided by a solar minimum period). The equations shown in this example are specific to SSI.

Let *q* be the ratios in time-averaged SSI. Let be the averaged irradiance for time period ‘A’ (from elements *t = 1,…,N*) and be the averaged irradiance for time period ‘B’ (from elements *t = 1,…,M*) as derived using A.2.a. Let and be the associated uncertainties derived using A.2.b or A.2.c.

|  |  |  |
| --- | --- | --- |
|  |  | A.4.a |

Per equation A.i the associated uncertainty (for random and independent uncertainties in the respective time-averaged irradiances) in *q*(*λ*) is

|  |  |  |
| --- | --- | --- |
|  |  | A.4.b |

And per equation A.ii, the associated uncertainty in *q*(*λ*) is never larger than

|  |  |  |
| --- | --- | --- |
|  |  | A.4.c |

Reference

Taylor, J.A., 1982: *An Introduction to Error Analysis*. 2nd ed., University Science Books.