**How to construct the covariance matrices Sb for the variousmodel parameter uncertainties? Which contributions must be considered ? Systematic or random ?**

**Note**:

* if the model parameter b is a scalar (e.g., SZA), then Sb is the estimated variance of that parameter’s uncertainty; if the model parameter b is a n-dim vector (e.g., T-profile, ILS if taken from LINEFIT), then Sb is the full covariance (n x n) matrix of that parameter’s uncertainty
* if several sources exist, largest one should be taken
* the Table below is valid only for the parameters that are not fitted!

|  |  |  |
| --- | --- | --- |
| **Model parameter** | **Sources of uncertainty to be considered**  | **Systematic (S) or Random (R)** |
| SZA | * Uncertainty of the SZA due to uncertainty on the time of the spectrum and the ephemeris calculation
* solar tracker deviation from center of sun

Note: * the forward model does not account for SZA change during measurement integration time => this is a model error, not a model parameter error. Do we neglect it, do we estilate it or do we approximate it as an uncertainty on SZA ?
 | * S
* R or S or both
 |
| ILS / modulation and phase | * If ILS is taken from LINEFIT output: estimate uncertainty on ILS from successive cell measurements and associated LINEFIT analyses or from the differences obtained in the LINEFIT output when running it with variations in the parameters (like T) within their uncertainties
* Else ?

NOTE: * The uncertainty on ILS will depend strongly on the frequency with which cell measurements are being taken and the stability of the instrument (120M versus 120/125 HR; T-stability of the room; etc).
* ILS will be uncertain also due to variations in the solar intensity during the measurement time: how to account for this ? this is essentially a forward model error but could be approximated by an ILS error. However, it depends systematically on SZA and has a random component => how to account for it ?
 | R |
| Temperature profile | * Can be estimated from the comparison of 2 sources of T-profiles, e.g., NCEP versus ECMWF, NCEP versus radiosondes, etc.

The bias gives rise to a systematic component of the uncertainty due to T; the std gives rise to a random component of the uncertainty due to T | S and R component |
| Solar lines  | * If F. Hase solar linelist is used: 1% error for linestrength; 1E-6 error for line shift;

NOTE:~3% limb darkening, limb Doppler effect and observer Doppler effect uncertainties are part of the model errors => we don’t account for them | S |
| * differential wavenumber shift
* single wavenumber shift
* independent wavenumber shift
 | Estimates of uncertainty are in HITRAN | S |
| Simple phase error | ? |  |
|  |  |  |