

the observed scatter in the data, as evaluated from a narrow latitude band centered around the equator where atmospheric variability is often smaller than elsewhere, or as obtained from a comparison between ascending and descending coincident MLS profiles. The scatter in MLS data and in simulated MLS retrievals (using noise-free radiances) becomes smaller than the theoretical precision (given in the Level 2 files) in the upper stratosphere and mesosphere, where there is a larger impact of *a priori* and smoothing constraints. The HCl precision values increase rapidly at pressures less than 0.2 hPa, and are generally flagged negative (or zero) at pressures less than 0.1 hPa; this indicates an increasing influence from the *a priori* (with poorer measurement sensitivity and reliability).

3.10.5 Accuracy

The accuracy estimates in the Table came from a quantification of the combined effects of possible systematic errors in MLS calibration, spectroscopy, etc. on the HCl retrievals; there are several error sources (mostly from radiometric calibration components) that contribute significantly to the total error. These values are intended to represent 2σ estimates of accuracy. For more details, see the MLS validation paper by Froidevaux *et al.* [2008a]. For v4.2x (as for v3.3x and v3.4x), given the trend issues affecting the (band 14) standard HCl product in the upper stratosphere and lower mesosphere, we have recommended an accuracy estimate of no better than 10% in this region (or about 0.3 ppbv). For the lower stratosphere, given the agreement between the two bands' retrievals as well as some trend studies (for the standard product), we use the more formal accuracy estimates (see Table 3.10.1).

3.10.6 Data screening

Pressure range: 100 – 0.32 hPa

Values outside this range are not recommended for scientific use. We note that the MLS values at 147 hPa are biased high, at least at low to mid-latitudes – and these values are not recommended (particularly equatorward of about 40°). Also, although the vertical range at the top end is recommended up to 0.32 hPa, users should note the significant issues relating to HCl trend estimates in the upper stratosphere and lower mesosphere; average profiles in this region can be used for studies not involving trends (or accuracy requirements not as tight as 10%).

Estimated precision: Only use values for which the estimated precision is a positive number.

Values where the *a priori* information has a strong influence are flagged with negative or zero precision, and should not be used in scientific analyses (see Section 1.5).

Status flag: Only use profiles for which the **Status** field is an even number.

Odd values of Status indicate that the profile should not be used in scientific studies. See Section 1.6 for more information on the interpretation of the Status field.

Quality field: Only profiles with a value of the **Quality** field *greater* than 1.2 should be used.

This criterion removes profiles with the poorest radiance fits, typically less than 0.1% of the daily profiles. For HCl (and for other 640 GHz MLS products), this screening correlates well with the poorly converged sets of profiles (see below); we recommend the use of both the Quality and Convergence fields for data screening.

Convergence field: Only profiles with a value of the **Convergence** field *less* than 1.05 should be used.

For the vast majority of profiles (99% or more for most days), this field is less than 1.05. Nevertheless, on occasion, sets of profiles (typically one or more groups of ten profiles, retrieved as a “chunk”) have this Convergence field set to larger values, and should be discarded.

Clouds: Thick clouds can add significant artifacts (mainly in the tropics, statistically), with total systematic errors potentially as large as 0.5 ppbv at 100 hPa and even larger at 147 hPa. Studies in this region could