AURA BIAS DETECTION AND CORRECTION: A NEUROLOGICAL APPROACH

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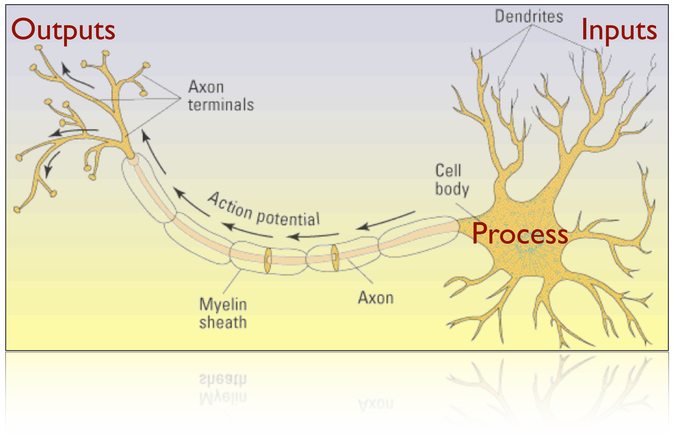
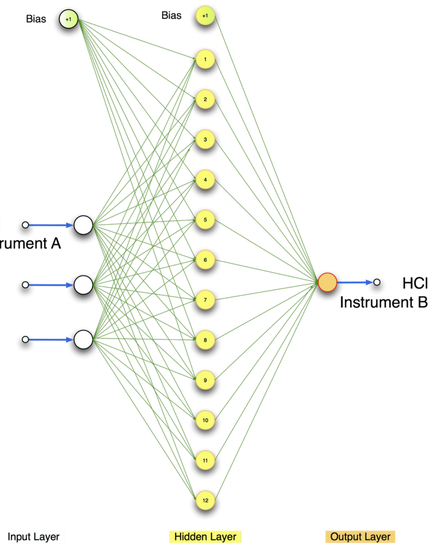
Abstract. Probability distribution functions (PDFs) can be used to assist in the validation of trace gas retrievals made by satellites. A major advantage of this approach is that large statistical samples are used that do not require correlative measurements to be co-located in space and time. This approach is also useful to evaluate the consistency among Aura instruments as well as their agreement with other data sets. A key feature of this work is putting the observations of Aura in their long-term historical context via statistical comparisons with previous datasets collected over more than a decade. To validate the Aura data, we use data from a variety of platforms including solar occultation (Canadian ACE) and limb sounder satellite instruments, ozone sondes (WOUDC), lidar (NDSC), and aircraft instruments (AVE, PAVE and MOZAIC). The width of the trace gas PDFs can be used to accurately estimate the atmospheric spatial variability (or representativeness uncertainty) of trace gases as a function of time and location. This statistical analysis is also being used as preparation for full Kalman filter chemical assimilations. The analysis is presented online at http://www.PDFCentral.info/.

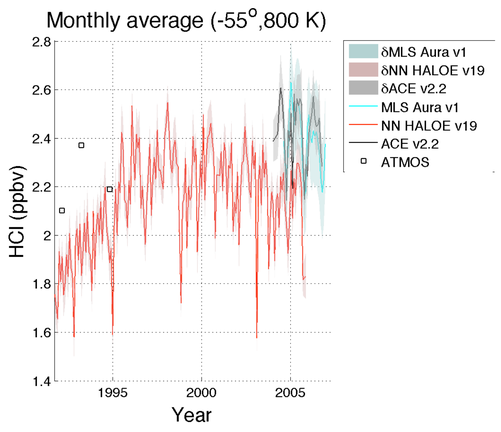
The difference in the median values of two instrument PDFs for a given flow tracking region and month can be taken as an estimate of the bias between these two instruments. This bias is really only significant if it is larger than the atmospheric variability in the Lagrangian region we are considering. We can use a single scatter diagram to compare all the overlaps globally for all the months observed by each pair of instruments. Such a scatter diagram has the advantage of a huge sample size, it encompasses the entire period that a pair of instruments were making contemporaneous observations. The scatter diagram is intended as a big picture summary for all contemporaneous observations made globally.

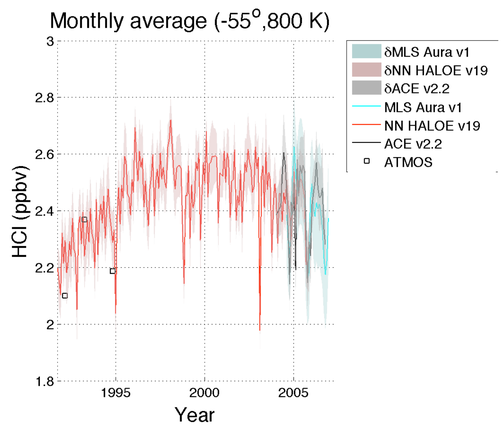
Neurological algorithms



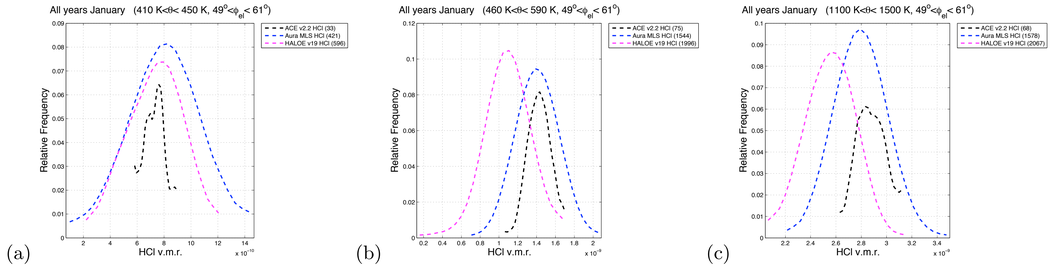


Applied Neural Network Re-calibration to HALOE

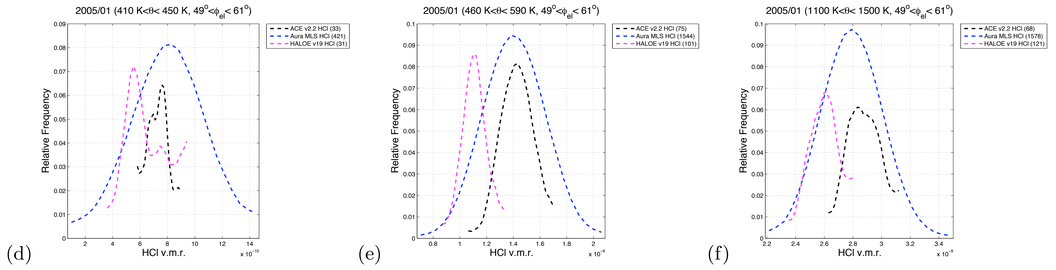




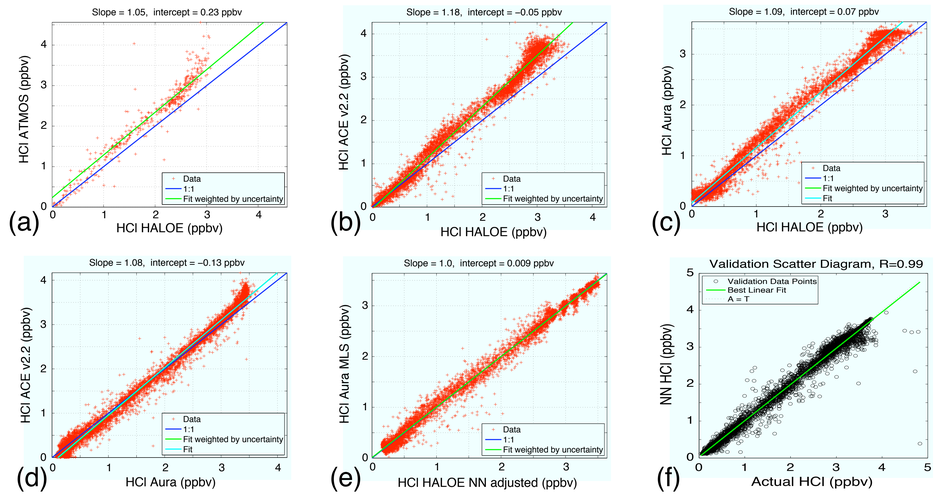
January of all years



January 2005



Panels (a) to (c) show example HCl PDFs for the three instruments HALOE, ACE and Aura MLS. In each case the PDFs are for all observations made by that instrument in a Lagrangian region for three isentropic levels centered on an equivalent latitude of 55°N during all the January's that the instrument observed. For ACE the plots include January 2004-6, for HALOE 2004-5, for MLS 2005-6. For panel (a) we plot a PDF for all observations in the range 410 K<θ<450 K (70 mb<P< 110 mb), 49°<ϕ_{el}<61°. For panel (b) we plot a PDF for all observations in the range 460 K<θ<590 K (30 mb<P< 60 mb), 49°<ϕ_{el}<61°. For panel (c) we plot a PDF for all observations in the range 1100 K<θ< 1500 K (2 mb<P< 4 mb), 49°<ϕ_{el}<61°. Panels (d) to (f) are analogous to (a) to (c) for the observations made only during January 2005. The number of observations used to form each PDF is shown in parenthesis in the legend. The plots in panels (a) to (c) are available online at `http://www.pdfcentral.info/HCl/all/01/all_01_nh.html` and for panels (d) to (f) at `http://www.pdfcentral.info/HCl/2005/01/2005_01_nh.html`



Panels (a) to (d) show scatter plots of all contemporaneous observations of HCl made by HALOE, ATMOS, ACE and MLS Aura. In panels (a) to (c) HALOE is shown on the x-axis. Panel (e) correspond to panel (c) except that it uses the neural network 'adjusted' HALOE HCl values. Panel (f) shows the validation scatter diagram of the neural network estimate of $Cl_y \approx HCl + ClONO_2 + ClO + HOCl$ versus the actual Cl_y for a totally independent data sample *not* used in training the neural network.