

**SSEC/CIMSS  
Seminar**

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AOS, UW-Madison

**A Short Introduction to Constrained  
Optimal Estimation and its Potential  
Applicability in Remote Sensing**

Most quantitative remote sensing retrieval methods are based on some variant of optimal estimation (OE), in which a linear retrieval operator is chosen so as to minimize the total root-mean-square error of the retrieved variable. In practice, this error consists of two contributions -- (1) a random component due to the non-orthogonality of the operator to various noise sources (instrument and geophysical) and (2) a systematic component due to incorrect scaling of the retrieved variable -- i.e., a unit change in the true value does not correspond to a unit change in the retrieved value. Traditional OE achieves the minimum RMS error by trading scaling errors against noise errors. The result is invariably an algorithm that underestimates large values and overestimates small (or negative) values. For some variables, such as precipitation, only positive values (relative to the background mean) are significant; in such cases, OE invariably leads to a serious low bias in climatological means, especially when geophysical noise is large.

An alternative error minimization criteria called constrained optimal estimation (COE) is well-known in signal processing but virtually unknown in atmospheric remote sensing. COE minimizes the contribution of random noise to errors in the retrieved variable subject to the constraint that correct scaling be preserved. In this talk, I will outline the similarities and key differences between OE and COE and give examples of retrieval problems in which COE may be a preferable alternative.

**Thursday, 11 February 2010**

**11:00 a.m.**

**Room AOSS 351**