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A non-linear method for IASI channel selection

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There is a vast amount of information about the atmospheric state available form instruments on board satellites orbiting the earth. These instruments observe top of the atmosphere radiances, originating and interacting with the whole column of the atmosphere. It has therefore been of interest to objectively thin this wealth of data, by way of a channel selection, to make the process of assimilating the data more efficient.
The nature of the satellite data means that it is often a highly non-linear function, represented by the observation operator, of the atmospheric state variables of interest. We present results studying the effect of linearising the observation operator on the information content of the observed radiances, as measured by mutual information. Mutual information defines the information content as the change in entropy of the atmospheric state when the observations are assimilated.
We use a fast radiative transfer model (RTTOV) to compare the mutual information when simulated observations from IASI (Infrared Atmospheric Sounding Inferometer) are assimilated using the traditional variational technique and a new non-linear sampling technique. This highlights cases when the linear assumption has a large impact on the estimated information content of the observation. These results prove to be consistent with other measures of linearisation error.
We conclude this study by investigating how this error in the estimate of information content affects channel selection. Although the sampling method is free from linearisation it does suffer from the 'curse of dimensionality' when performing the channel selection for the 8000 plus channels of IASI. We present ways to make the sampling estimate of mutual information and the channel selection process as efficient as possible without compromising the non-linearity of the observation operator.