

A Non-linear Method for IASI Channel Selection

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The IASI instrument measures top of the atmosphere (TOA) radiances in 8641 channels. In many cases it is difficult to transmit, store and assimilate such a large amount of data [1]. A practical solution is to select a few hundred channels based on those with the highest information content.

Mutual Information (MI) measures information content as the change in entropy when the observations are assimilated. When the observation operator is linearized and the error distributions are all Gaussian, MI has a known analytical form. This linear approximation to MI has been used in previous studies of channel selection (e.g. [2]). However, if we wish to allow for the non-linear relationship between the state vector (profiles of temperature and humidity) and the TOA radiances then no analytical form for MI can be given.

We present a sampling method to calculate MI which is free from assumptions about the linearity of the observation operator and the structure of the posterior distribution, as such providing a more accurate estimate of the information content. This approximation of MI is seen to lead to very different estimates of the information content compared to the linear approximation for some individual channels. Furthermore differences are also seen in the value of MI for one channel relative to another giving a change in the order of channel selection.

We conclude this study by looking at the efficiency of the non-linear method. This method can be seen to suffer from under-sampling as the channel selection progresses and the region of high posterior probability is focused. Resampling from the posterior distribution after each channel is selected is shown to alleviate this problem.

References

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