CLOUD CHARACTERISTICS AND CHANNEL SELECTION FOR IASI RADIANCES IN THE METEOROLOGICALLY SENSITIVE AREAS

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Cloud characteristics in meteorologically sensitive areas
• IASI-Infrared Atmospheric Sounding Interferometer developed by CNES-EUMETSAT
• Sensitive areas: where small changes in the analysis can drastically change the forecast. IASI can resolve some of the small structures identified by sensitivity studies (Rabier et al., 1996, Prunet et al., 1998, Collard, 1998).
• McNally (2002) showed with ECMWF model clouds that sensitive areas are widely covered by high-level and low-level clouds.
• Is it true for clouds seen by the imager AVHRR in the IASI pixel? MAIA (Mask AVHRR for Inversion ATOVS) method used for FASTEX cases.

Sensitive areas
Diagnostic function: forecast of the mean sea level pressure over the region of interest on 19 Feb 1997 12 UTC

Example for IOP 17 (UTC 18/2/97)
Cloud top pressure of the simulated IASI pixels

Overview over 8 FASTEX cases.

Conclusions
• The simulated IASI pixels located in the sensitive areas are usually covered by low-level clouds and by high-level clouds
• Channel selection of Rabier et al. 2002 study compared with two method derived from targeting strategy (sensitivity to observation and Kalman filter sensitivity). Iterative method based on Entropy Reduction (ER) shares few channels with the two other ones but is quite robust even for highly sensitive profiles. Constant channel set computed from an independent set of atmospheric profiles leads to a significant improvement of the analysis compared with the background even if the analysis error is larger than the one obtained with an optimal channel set.

Channel selections in the sensitive areas
• Advanced IR sounders
  - large volume of data, prohibitive in operational NWP
  - reduced channel set used in operational context.
• Selection of individual channels
  - At each step, one channel is picked. It is the most informative channel among those which have not been previously selected.
• The analysis error covariance matrix is then updated
• Iterative Method (Rodgers, 1996 and Rabier et al., 2002) or Entropy Reduction (ER) method
  - This method is a step by step iterative selection scheme, based on information content wrt the background information.
  - The selection criterion is ER
    - ER=1/2 log-det(AB⁻¹)
    - Where B= background and A= analysis error covariance
• «Constant» selection obtained by averaging the ranks of the channels
  - Cst selection = Ave (Selection)

Channel selections based on targeting strategy
• Sensitivity to observations (Baker and Daley, 2000; Doerenbecher and Bergot, 2001)
  - Channel selected wrt the maximization of the sensitivity to observations \( \nabla^r J \)
  - \( \nabla^r J = \delta \sigma_{11} \delta J \)
  - Where \( J \) is the vector corresponding to a line of the Jacobian matrix, \( \delta \sigma_{11} \) is the sensitivity to initial conditions
• Kalman Filter Sensitivity (Bergot and Doerenbecher, 2002)
  - Channel selected wrt the maximum decrease of the variance of the error on a given scalar function of the forecast \( \delta \sigma_{11} \).

Future work
• Taking into account the clouds in the radiative transfer model for the channel selection
• Assimilation of the IASI radiances in the NWP assimilation scheme → test of the actual impact of the different channel selection on the forecast score.

References
• Doerenbecher A. and Bergot T., 2001; Sensitivity to observations applied to FASTEX cases. Non-linear Processes in Geophysics, 8(6), 467-481.