Processing of IASI cloudy Heterogeneous scenes using the AVHRR radiances analysis in an operational context

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Contents talks

- Most measurements from hight-spectral-resolution infrared sounders (IASI) are contaminated by clouds.
- The main objective of this work is to propose an approach to face up to cloudy processing with IASI.
- We studied two processes :
  - Simulations of cloudy radiances
  - Cloud clearing

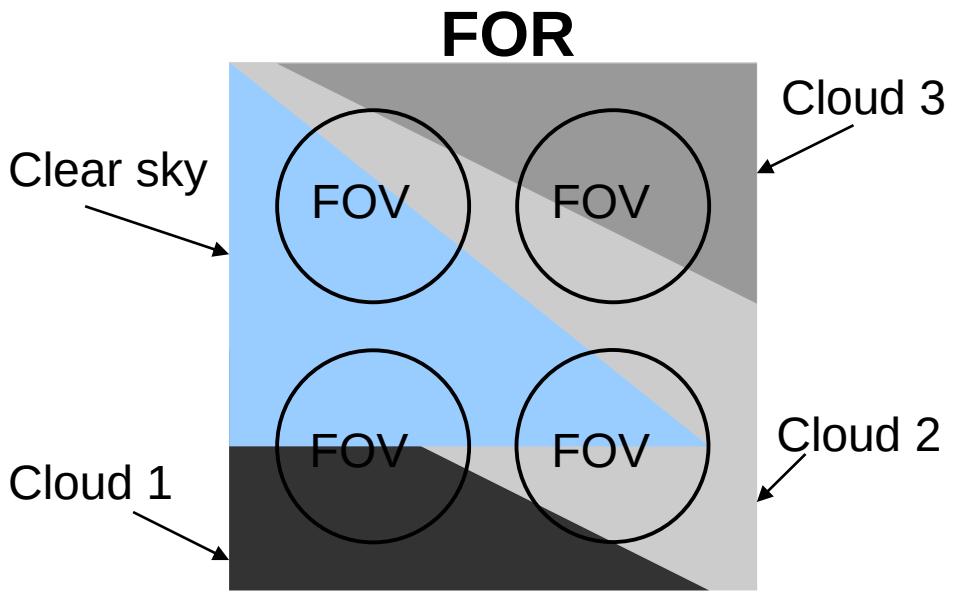
Objectives
&
Methods explications

Methods

- Two methods for processing cloudy heterogeneous scenes are considered in the IASI fov :
  - *The first method :* “cloudy radiances”, it ‘s a difference between calc. and obs.
  - *The second method :* It's a decomposition of cloudy IASI spectrum from four spectra corresponding to homogeneous layers in the IASI Field Of Regards. It's then possible to retrieve the corresponding atmospheric profile.

Cloud clearing (1)

- This method functions only if there is clear sky in one or more of four pixels of the IASI Field Of Regard.
- The objectif is to extract each homogeneous spectrum.



$$R^{k}_{obs}(i) = \Sigma\, \alpha^{k}(j) * R_{homo}(i,j)$$

Rhomo : homogeneous radiance
Robs : Observed radiance
I : IASI channel number
k : Pixel number (1 to 4)
J : Homogeneous spectrum number (1 to 4)
α : layer fraction

Cloud clearing (2)

- Quality of each homogeneous spectrum depends on a theoretical amplification coefficient
- This coefficient depends on layers fractions on each of four FOV (layers representativeness on each FOV)
- This coefficient will be considered in this work
- This method is extract from CNES software and design by NOVELTIS

DFS

- **D**egree of **F**reedom **S**ignal
- It provides an information on the number of independent IASI measurements, among 114 channels used
- This value depends on :
  - Covariance of measurement noise
  - Covariance of prior estimate error of x(T,Q)
  - Weighting function matrix
- **DFS is used for compare these two methods**

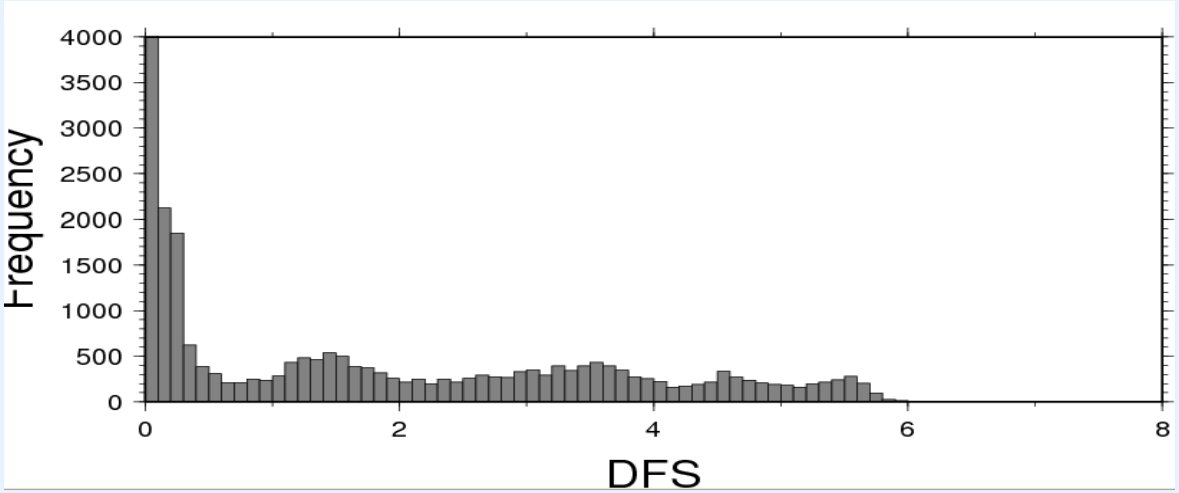
Precisions of the experience

- At the maximum, 114 channels are used for the 1dVar
- 65 levels
- All situations are on the sea surface (North Atlantic)
- The length of experience is 24 hours
- Weight functions are taken at the bottom of the atmosphere

Results

DFS histograms

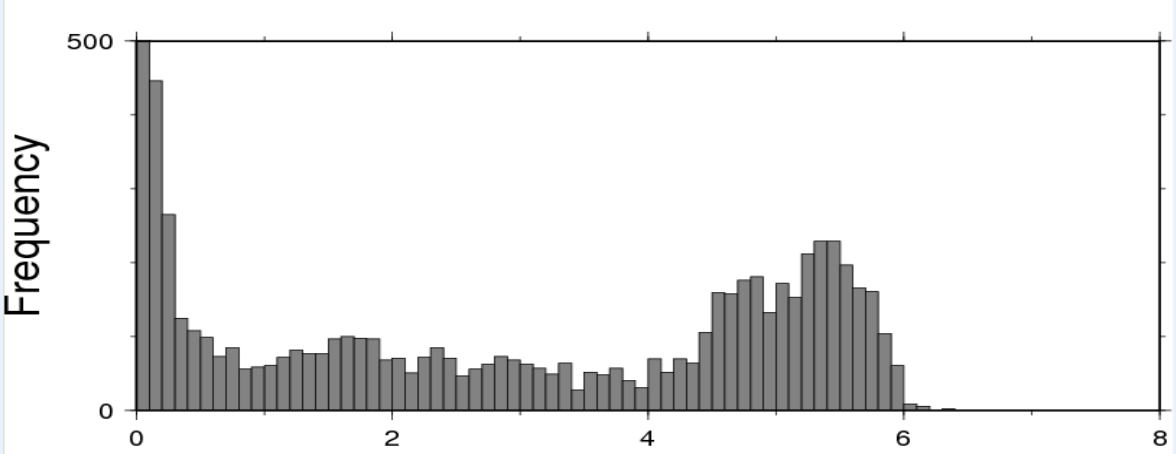
DFS histogram of cloudy radiances :



DFS average : 1.80

A large standard deviation !

DFS Histogram of clouds clearing :

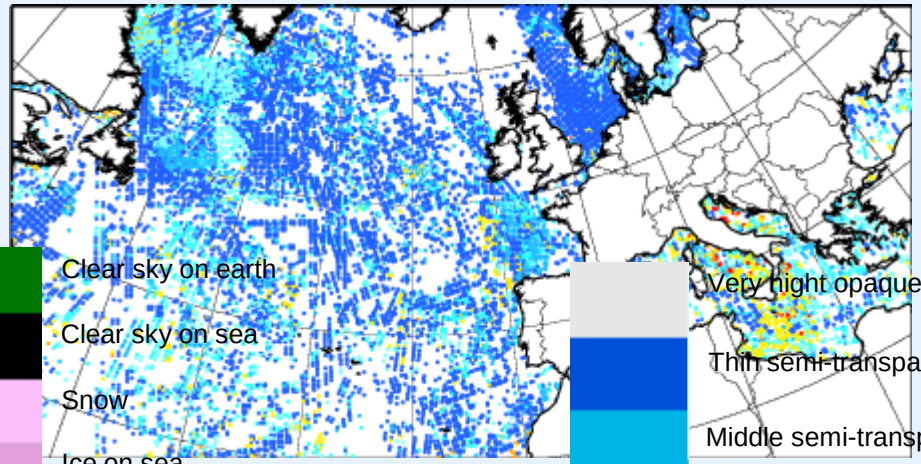


DFS average : 2.48

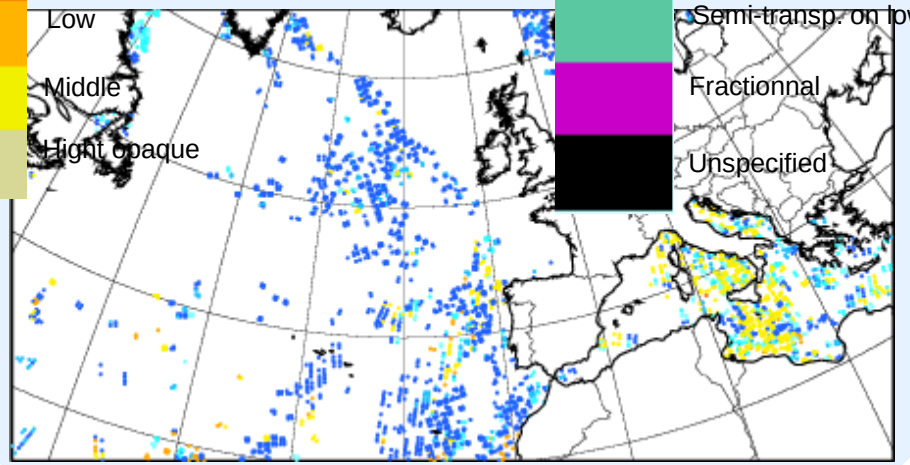
A large standard deviation !

Geographical location

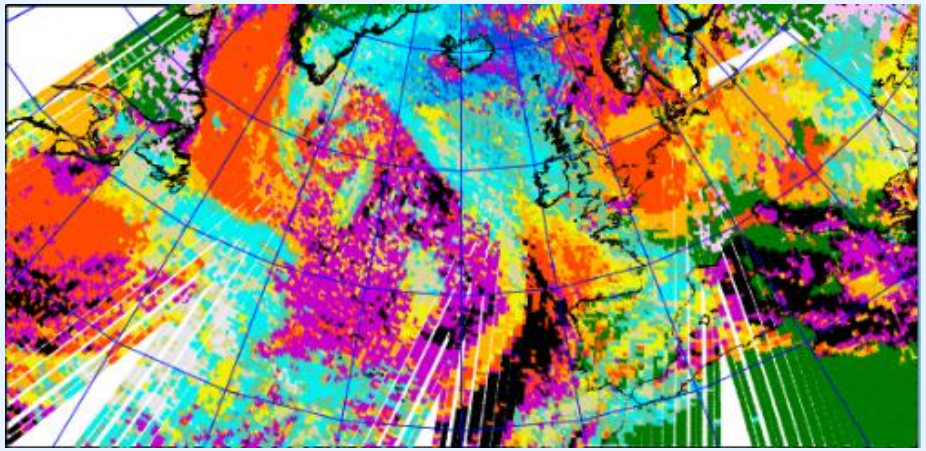
Cloudy radiances DFS location



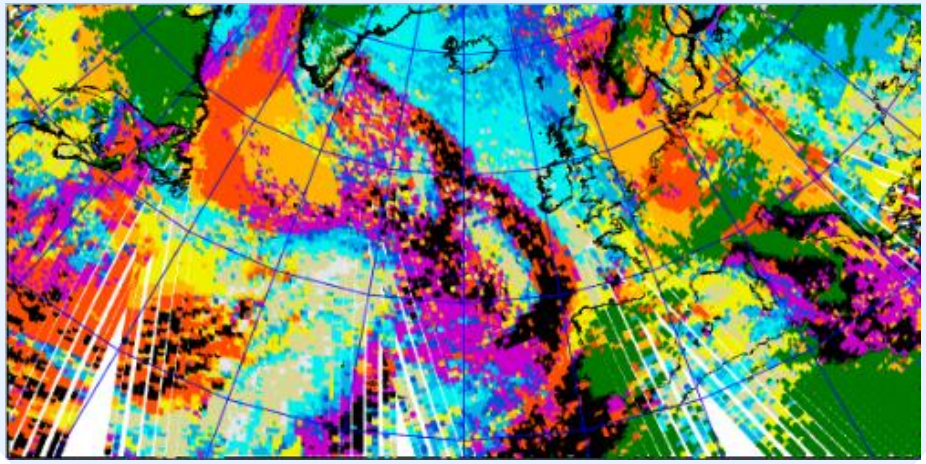
Cloud clearing DFS on



Cloudy mask (morning)

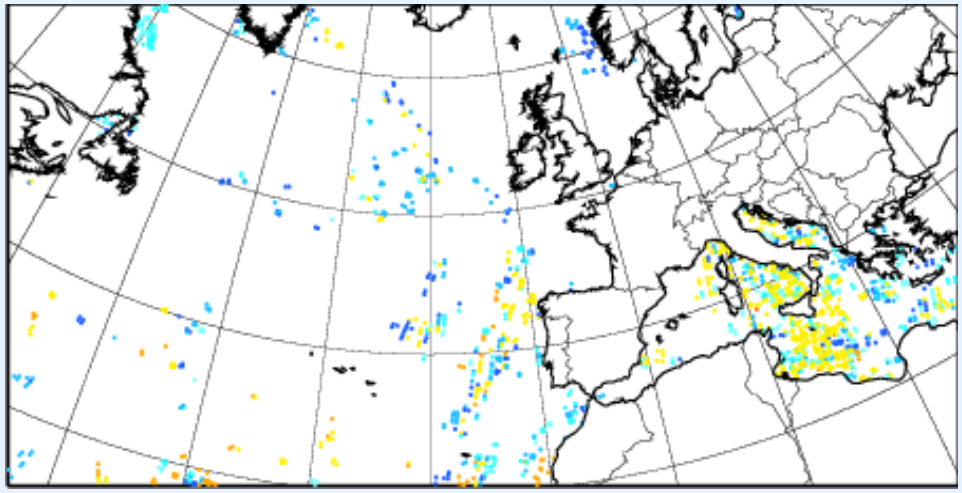


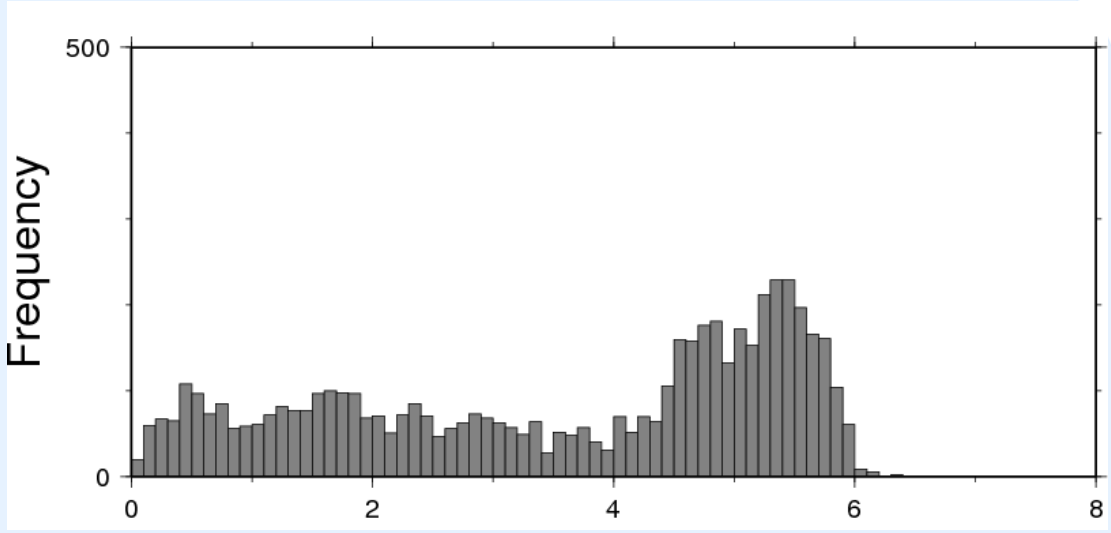
Cloudy mask (afternoon)



Cloud clearing method

- The amplication coefficient is considered in the covariance measurement noise matrix.
- Filtering of values who are higher than 1.3

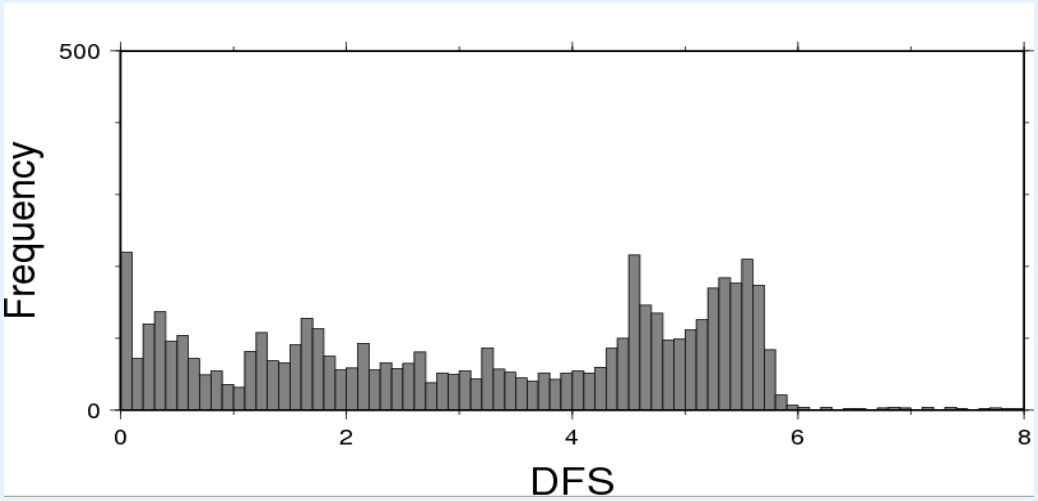




DFS average : 3.72

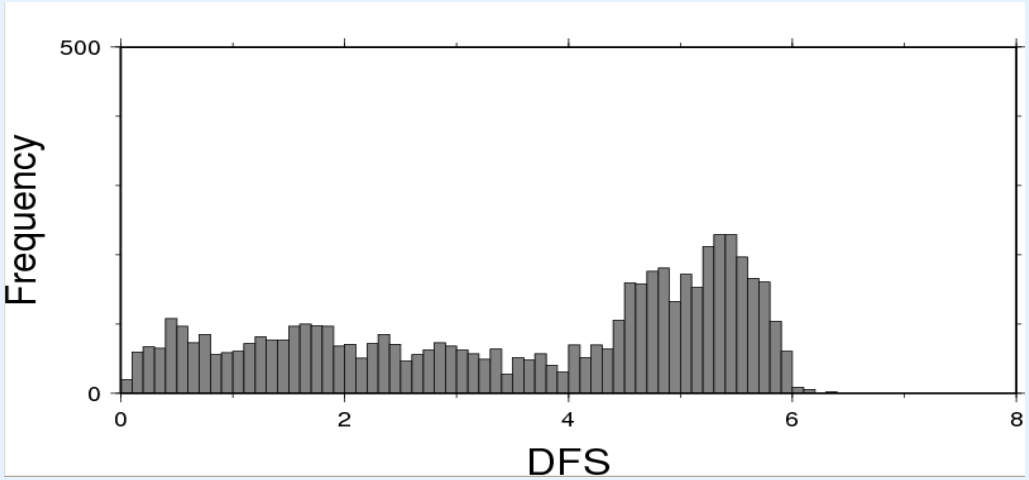
DFS histograms for same pixels

DFS histogram of cloudy radiances :



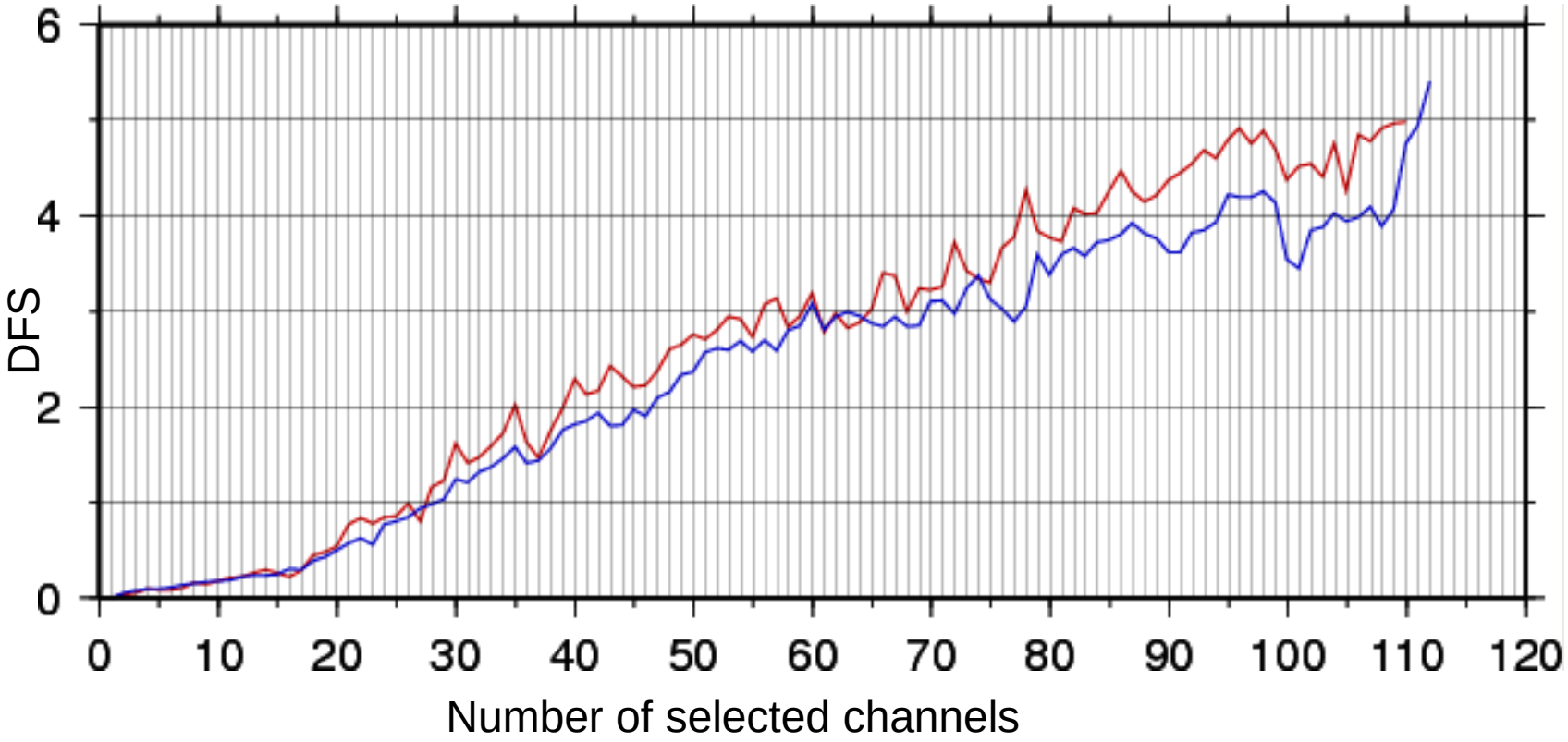
DFS average : 3.09

DFS Histogram of clouds clearing :



DFS average : 3.72

Relation between selected channels and DFS



For the same number of selected channels, the DFS is higher with cloud clearing method

Conclusions and future work

- We get better results with cloud clearing method, but these results are limited, we can't applied it everywhere.
- Improve cloudy radiances method by considering a larger list of clouds characteristics to improve the DFS :
  - Cloud phase
  - Cloud optical depth
  - Effective particle size
- Next step 1Dvar with ConcordIASI campaign

Thank you for listening!