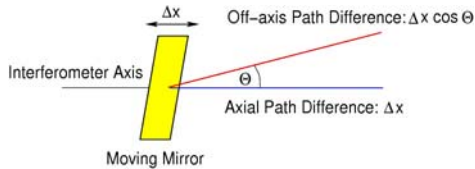


# Impact of Thermal Scene Inhomogeneities on IASI Spectral Response and its Correction

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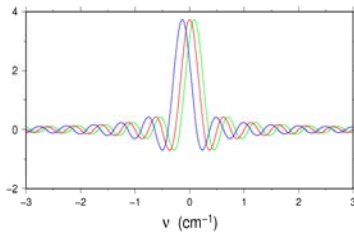
## Off-axis Path Difference



The off-axis path difference is less than the axial one, implying two effects:

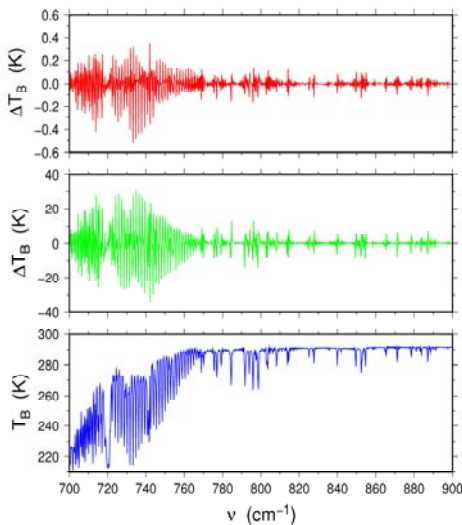
- Broadening of the spectral response function due to the reduced maximum optical path difference: factor  $1/\cos \Theta$
- Shift of spectral response function from  $\nu_0$  to  $\nu_0 \cos \Theta$  due to linearity of Fourier transform

## Shift of Spectral Response Function



Three response functions are shown for the centre of an IFOV (red), the IFOV border closest to the interferometer axis (blue), and the IFOV border farthest from the interferometer axis (green).

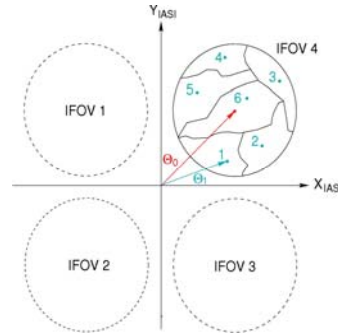
## Variation of Measured Spectra across IFOV



Homogeneous scene:

- Brightness temperature spectrum at IFOV centre
- Difference between spectra measured at inner and outer border of IFOV
- Difference between spectra at IFOV centre and average over IFOV

## Scene Inhomogeneity



IFOV 4 contains 6 different homogeneous scenes, with an indication of their centres of gravity. The interferometer axis is in the centre of the  $X_{IASI}, Y_{IASI}$ -plane.

## Correction of Spectra

Radiance in channel  $i$  for  $n=1, \dots, N$  cloud/surface formations within IFOV:

$$R_i = \sum_{n=1}^N \int_{\nu=0}^{\infty} d\nu \iint_{IFOV} R_{\nu,n}(x, y) \Phi(\nu, \nu_0, x, y) dx dy$$

Fractional cloud/surface formations within FOV:

$$\alpha_n = \iint_{FOV(n)} dx dy / \iint_{IFOV} dx dy$$

ISRF of cloud/surface fraction  $f_n$ :

$$f_n = f(\bar{\theta}) + \frac{\partial f}{\partial \nu} \frac{\partial \nu}{\partial \cos \theta} \Delta \nu$$

Correction for radiance in channel  $i$ :

$$\varepsilon_i = \sum_{n=1}^N \alpha_n (\cos \theta_n - \cos \bar{\theta}) \int_{\nu_i - \Delta \nu / 2}^{\nu_i + \Delta \nu / 2} R_{n,i}(\nu') \frac{\partial \Phi(\nu' - \nu_i)}{\partial \nu'} d\nu'$$

Discretisation:

$$\varepsilon_i \approx \sum_{n=1}^N \alpha_n (\cos \theta_n - \cos \bar{\theta}) \sum_{l=i-30}^{i+30} R_{n,l} \frac{\partial \Phi_i(l)}{\partial \nu} \Delta \nu$$

Approximation using AVHRR Ch.4 mean cluster radiance:

$$R_{n,l} \approx B_l(T_{AVHRR,n}) \quad \text{if } T_{b,l} > \min(T_{AVHRR,n}, n=1, \dots, N)$$

$$R_{n,l} \approx 0 \quad \text{else.}$$