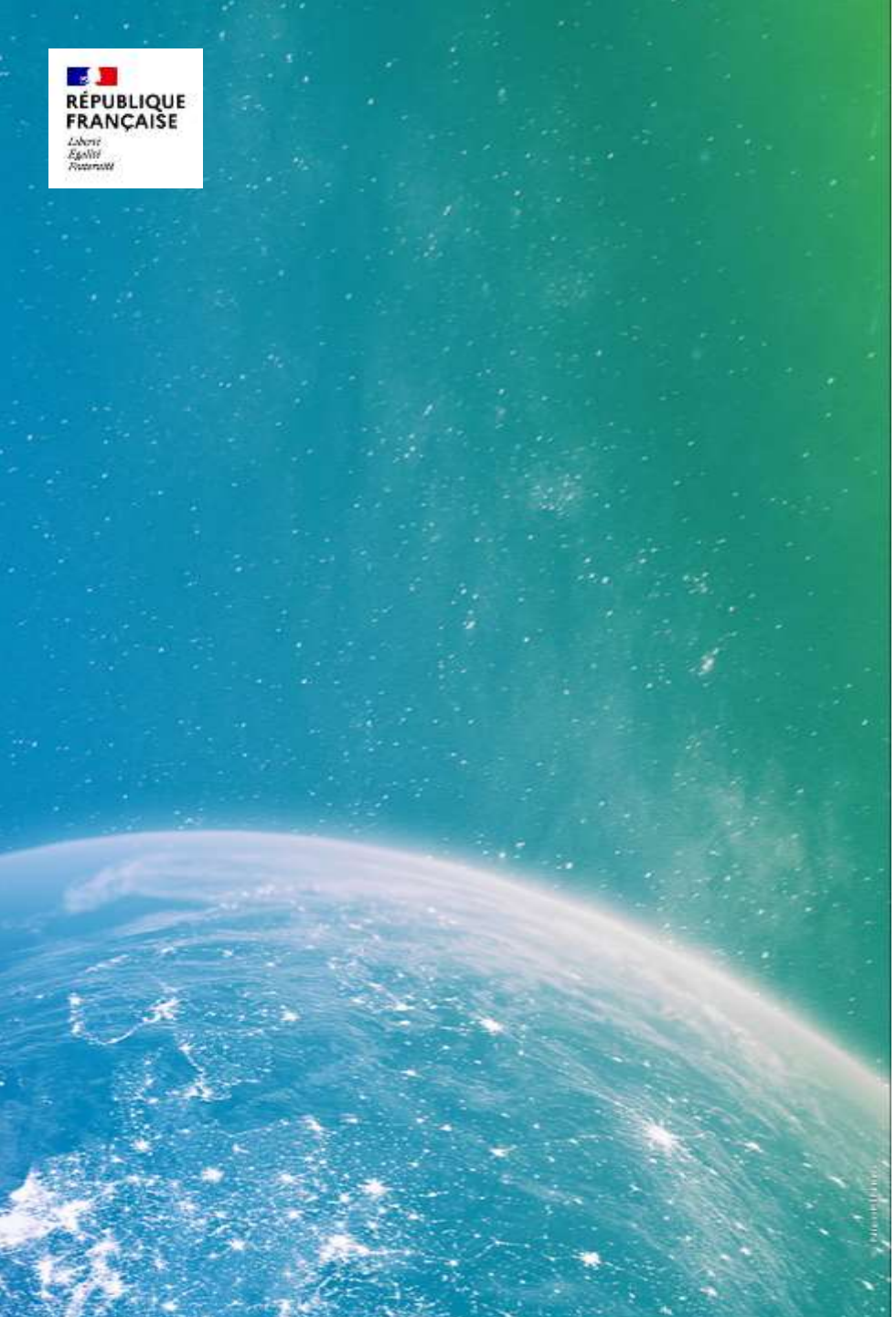


IASI-NG SYSTEM BUDGET

QUENTIN CEBE . IASI-NG PERFORMANCES MANAGER (1)
Yannick KANGAH (2)
Marie BOUILLON (2)
Carsten STANDFUSS (2)

(1) CENTRE NATIONAL D'ÉTUDES SPATIALES (TOULOUSE, FRANCE)
(2) SPASCIA (TOULOUSE, FRANCE)

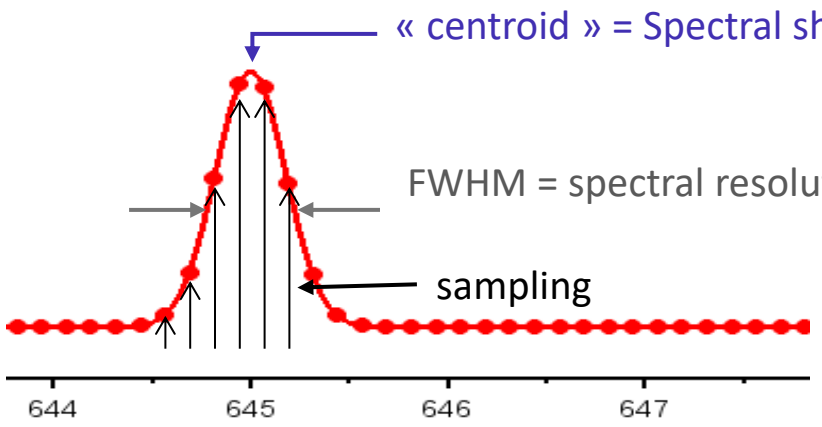
IASI CONFERENCE 2024

December 02 > 06 2024
NANCY

Major requirements of IASI-NG

SPECTRAL RESOLUTION	0.25 cm-1 (2 times better than IASI)
SPECTRAL SAMPLING	~17000 Spectral Channels (2 times better than IASI)
SPECTRAL CALIBRATION ERROR	$d\sigma/\sigma=10^{-6}$ (2 times better than IASI)
SOUNDING PIXEL SIZE DIAMETER	12 km = Same as IASI
RADIOMETRIC CALIBRATION	Bias ~ 0.25K (2 times better than IASI)
RADIOMETRIC NOISE	NedT ~ 0.1K (2 times better than IASI)

ISRF : Instrument Spectral Response Function



$\sigma = 1/\lambda$

645 cm^{-1} = 15,5 µm

NedT : Noise Equivalent Delta Temperature

$$NedT(\sigma) = \frac{NedL(\sigma)}{\partial Planck\,(T_{sc})/\partial\, T}$$

T_{sc}: scene temp

$$NedT(\sigma) = \frac{Planck(T_{sc})}{\frac{\partial Planck(T_{sc})}{\partial T}.snr}$$

1

SPECTRAL SHIFT

EVALUATION AT SYSTEM LEVEL

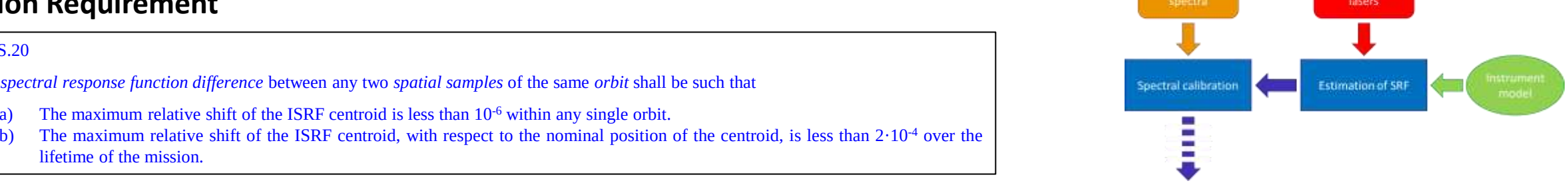
SHIFT OF THE ISRF

Mission Requirement

SRD_IAS.20

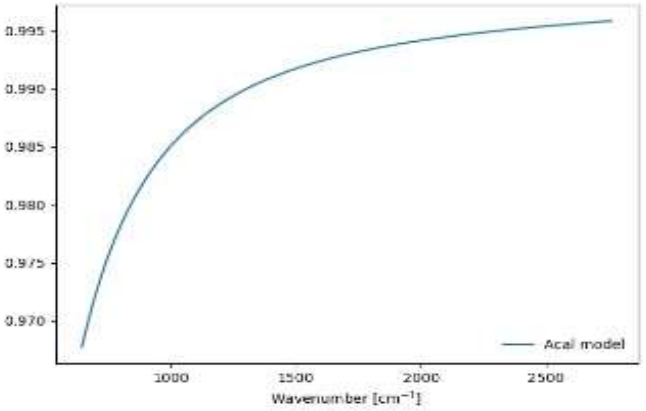
The IAS *spectral response function difference* between any two *spatial samples* of the same *orbit* shall be such that

a) The maximum relative shift of the ISRF centroid is less than 10^{-6} within any single orbit.
b) The maximum relative shift of the ISRF centroid, with respect to the nominal position of the centroid, is less than $2 \cdot 10^{-4}$ over the lifetime of the mission.

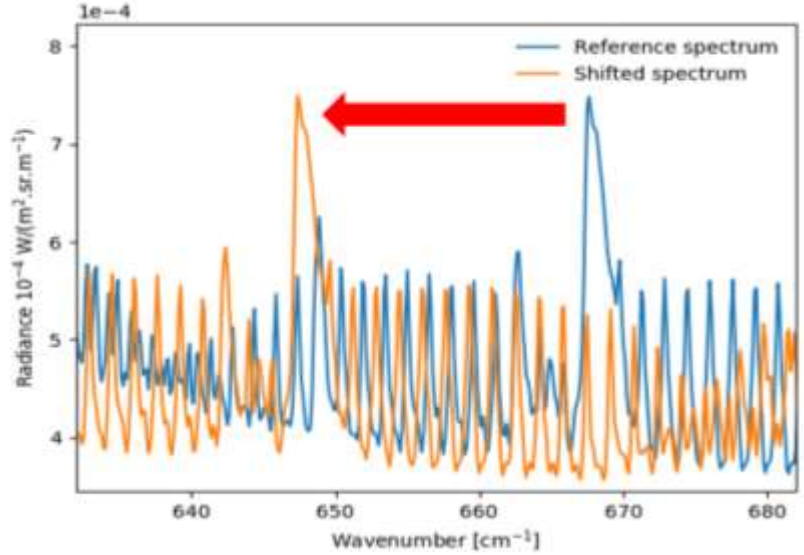


At 1000cm^{-1} equivalent to $^{8}/_{1000}$ of a sample

Primary suspect : **refraction index** (chromatic effect)



$$\frac{(1+\alpha).\sqrt{n(\sigma)^2-\left(\vec{r}_{field}\wedge\vec{N}\right)^2}-\left(\vec{r}_{field}.\vec{N}\right)^2}{(1+\alpha).\sqrt{n(\sigma_{met})^2-\left(\vec{r}^{met}_{field}\wedge\vec{N}\right)^2}-\left(\vec{r}^{met}_{field}.\vec{N}\right)^2}$$

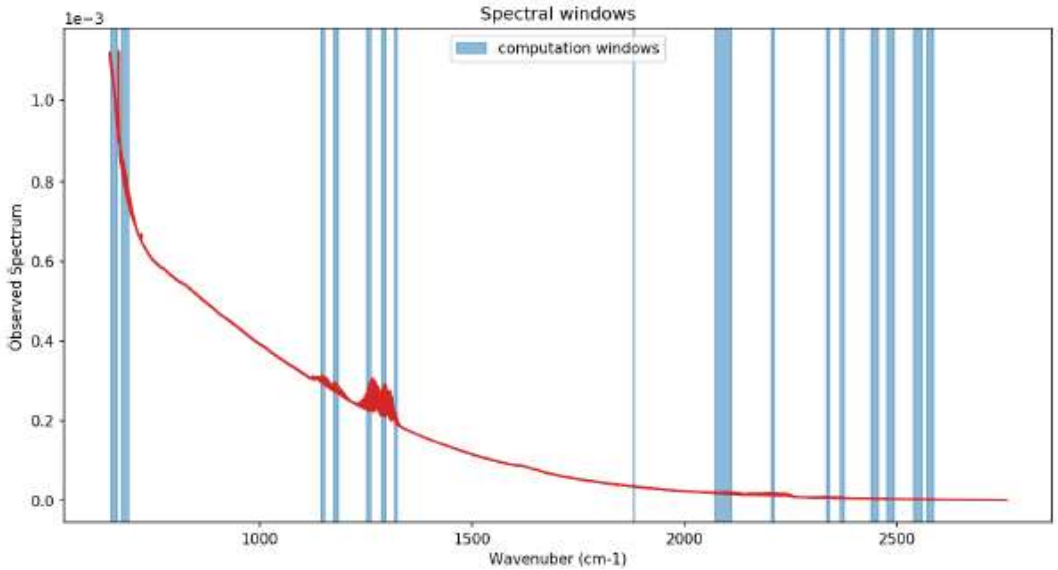


How to estimate remaining error

In-flight evaluation : Comparison between reference scene and observations

EVALUATION OF CENTROID SHIFT

During TVAC

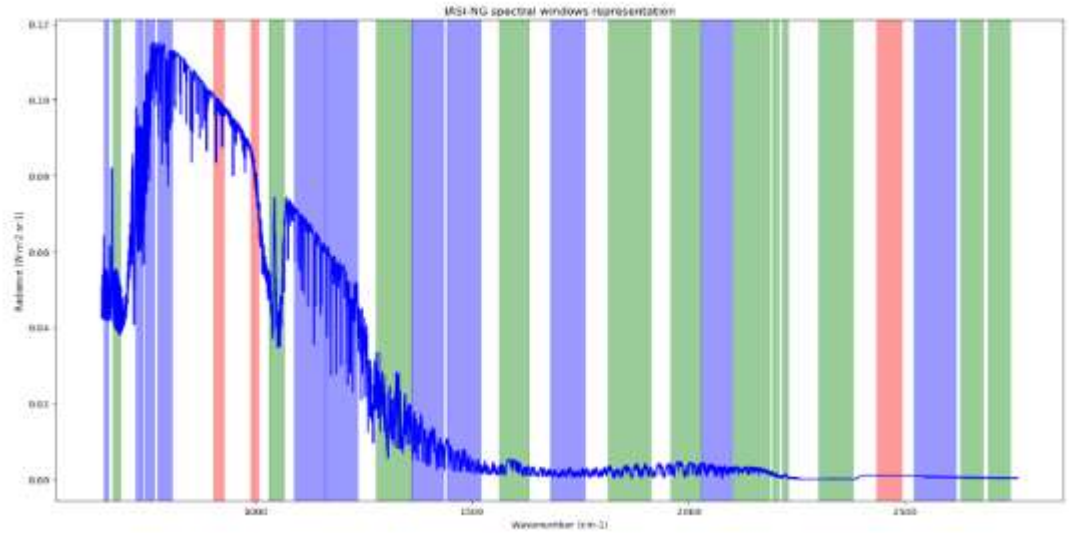


Gas Cells measurements

V

S

In-flight



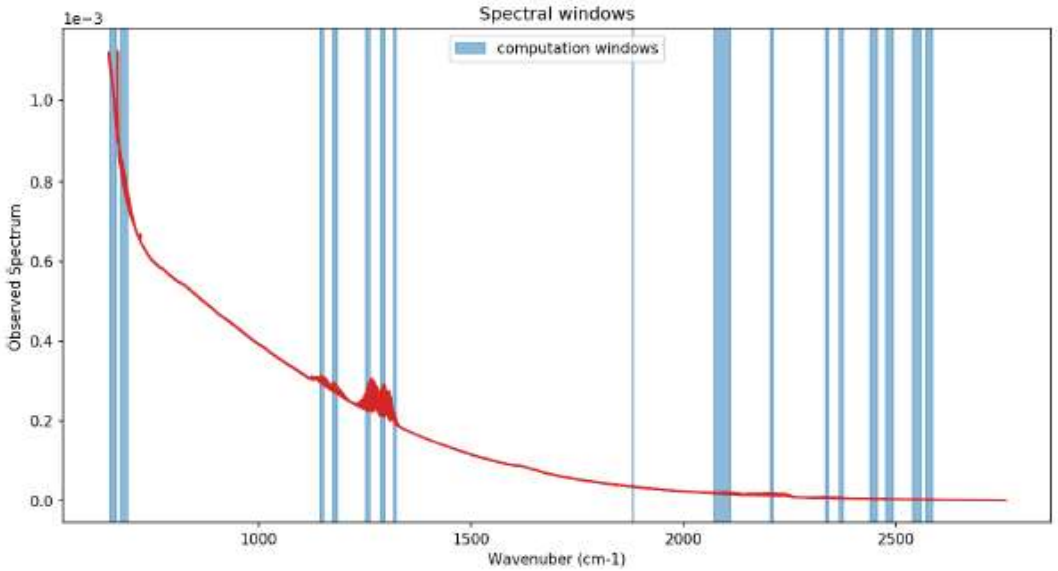
Atmospheric simulations

Performance obtained on Gas Cells measurement is **not representative of in-flight process**

Thus system performance estimation is done using simulation and analysis rather than direct measurements

EVALUATION OF CENTROID SHIFT

During TVAC



Gas Cells measurements

$$n(\sigma)^2 = A + \sum_{i=0}^{4} \frac{B(i)}{1 - C(i)^2 \times \sigma[\mu m^{-1}]^2}$$

However the analysis done on TVAC data is still important to ensure that the hypothesis upon which the operational procedure works is valid :

- The spectral shift is well modeled by the refractive index model
- That the evaluated function is smooth over the 4 bands
- That the evaluations have the same sensibilities to parameters between real measurements of gas cells and simulations of atmospheres

SPECTRAL SHIFT PERFORMANCE IN-ORBIT

		B1	B2	B3	B4
Algorithm Error		$0.766\ 10^{-6}$	$0.362\ 10^{-6}$	$0.345\ 10^{-6}$	$0.257\ 10^{-6}$
Refraction index representability	Chromatic LOS	$0.25\ 10^{-6}$			
	dOPD estimation error residual	$0.3\ 10^{-6}$			
Doppler residual		$0.02\ 10^{-6}$			
Centroid shift stability		$0.243\ 10^{-6}$		$0.504\ 10^{-6}$	
Radiative Transfer Model		$0.45\ 10^{-6}$			
Total		**$1.00\ 10^{-6}$**	**$0.74\ 10^{-6}$**	**$0.85\ 10^{-6}$**	**$0.82\ 10^{-6}$**

Post-calibration error within one orbit

2

RADIOMETRIC PERFORMANCES

IMPACT ON ATMOSPHERIC SCENES

MODELISATION ON ATMOSPHERIC SCENES

Portrait of Tycho Brahe
unknown author

The best path to knowledge is direct measurement.

Most of the budget is directly measured at “instrument level” which is **after spectral and radiometric calibration**, as IASI-NG performances **cannot be evaluated without this processing**. For radiometric budgets, the measurements are taken on a Black Body during **Thermal Vacuum Tests**.

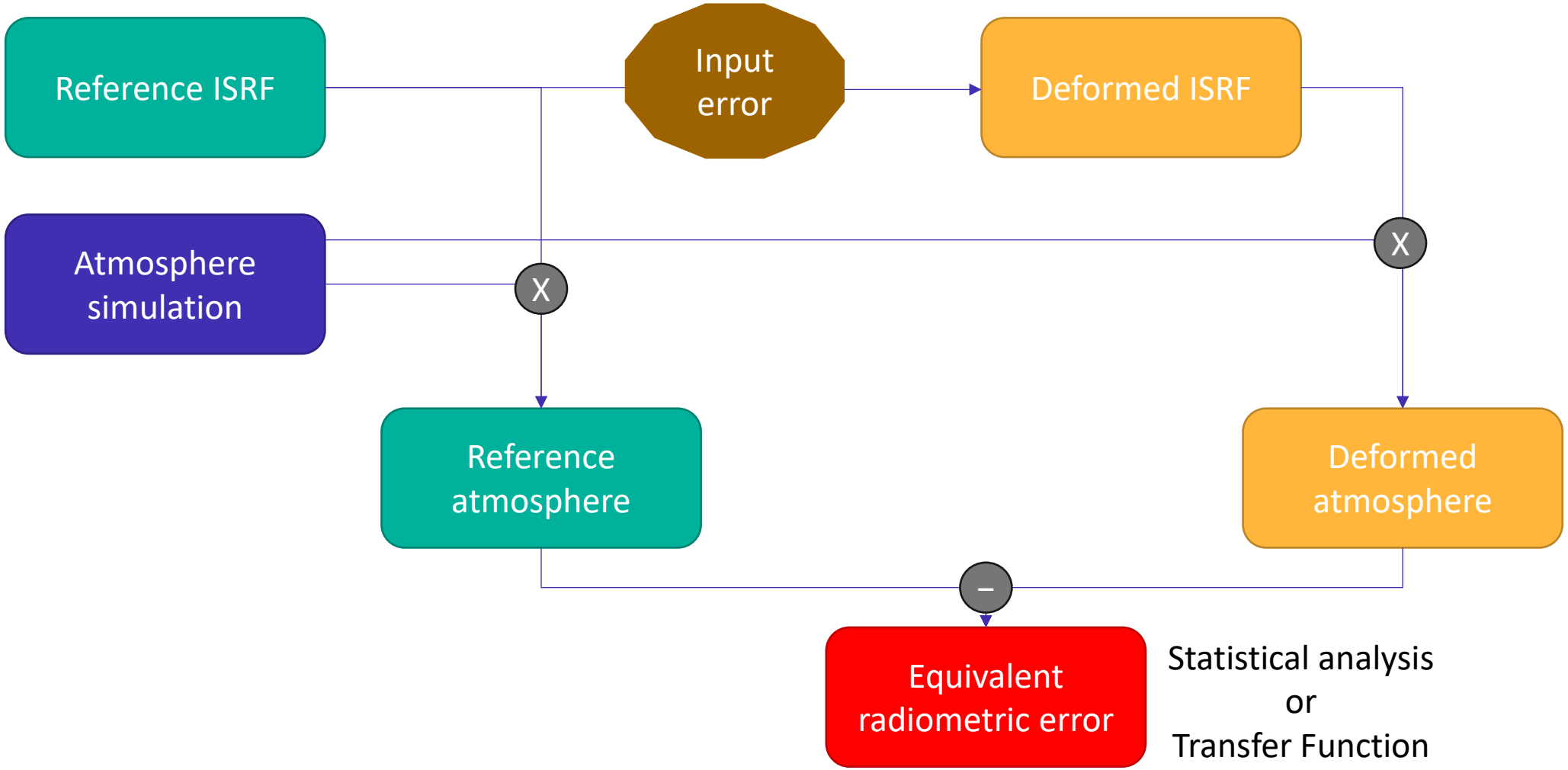
Complex optical design → **Complex ISRF retrieval** → **ISRF specifications**

These other specifications are also evaluated from specific measurements during TVAC ; but we add a process to evaluate their impact in terms of radiometry

Additional verification that the specifications are adequate

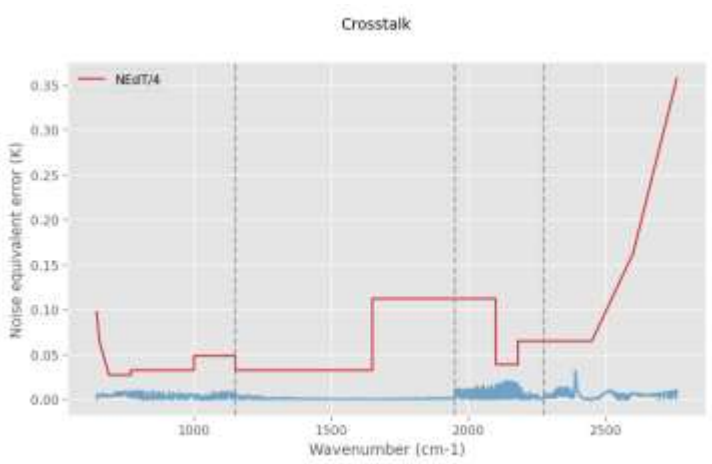
Evaluation of the effect in case of exceeded requirements

MODELISATION ON ATMOSPHERIC SCENES

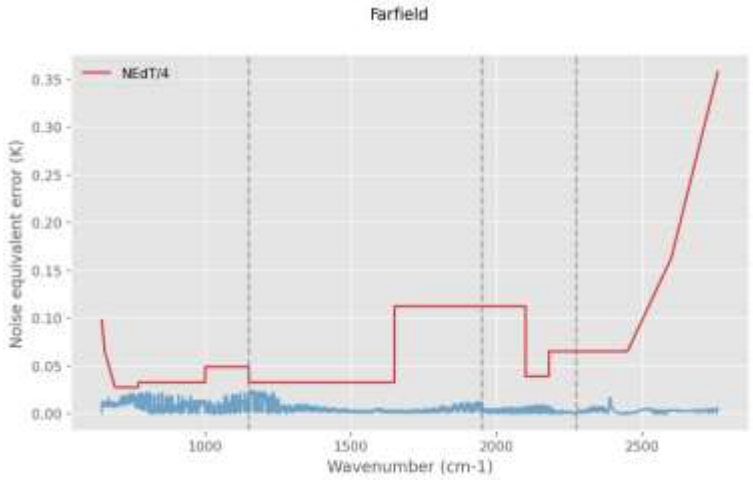


VARIABLE EFFECT OF CONTRIBUTORS ERROR

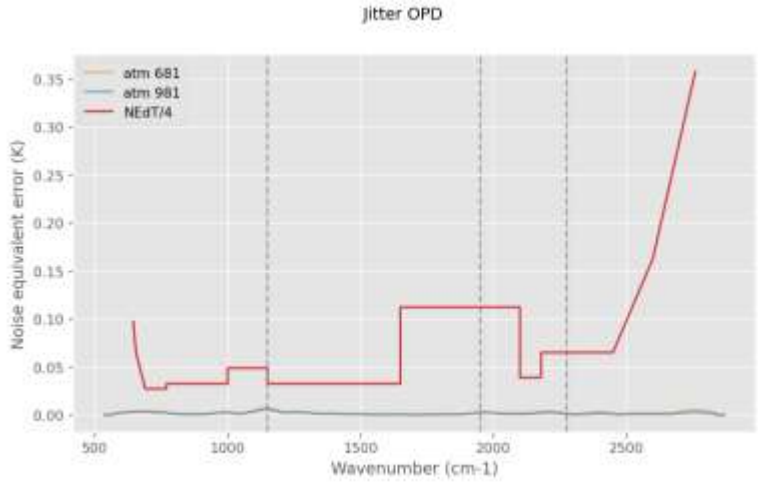
CROSS-TALK



FAR-FIELD

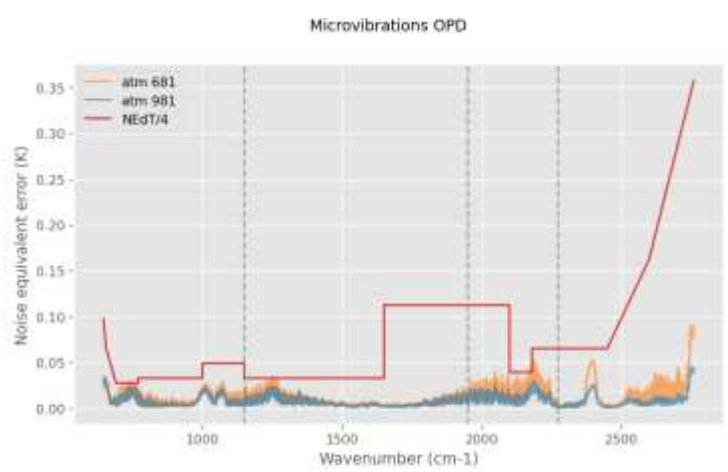


JITTER

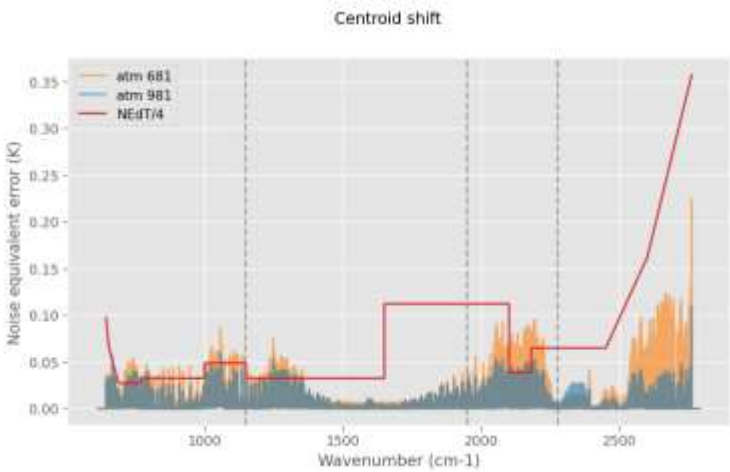


VARIABLE EFFECT OF CONTRIBUTORS ERROR

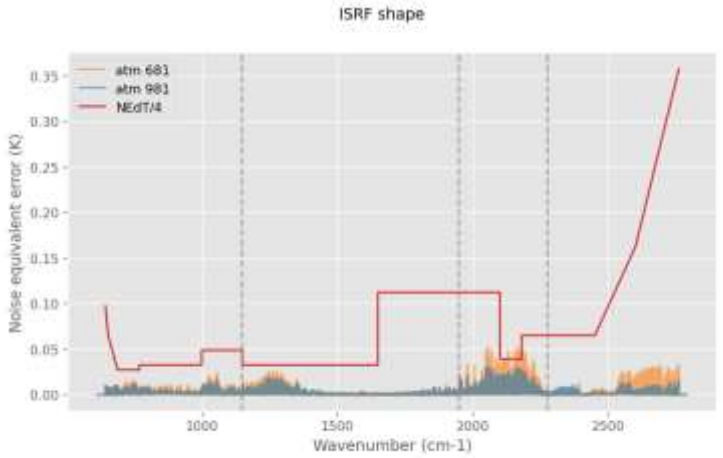
MICRO-VIBRATIONS



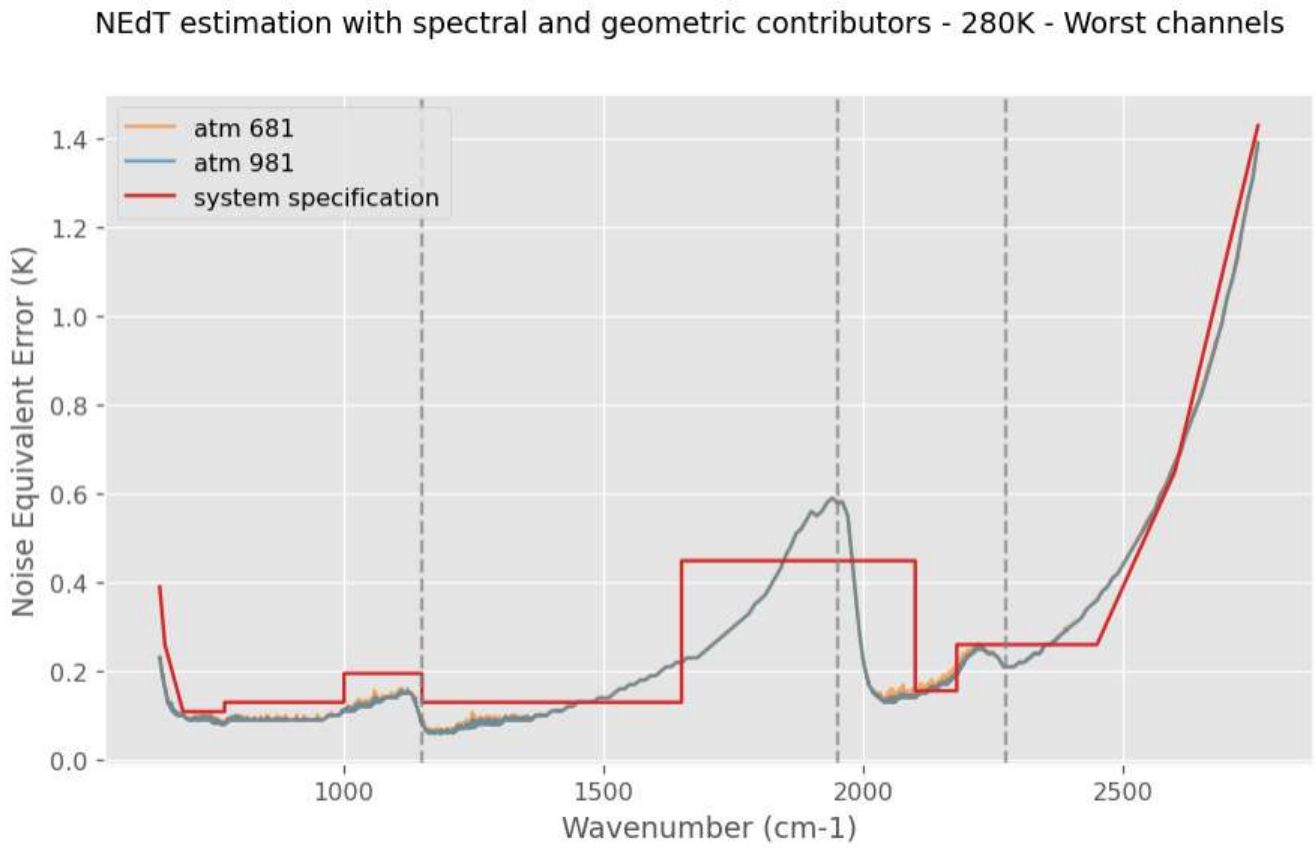
CENTROID SHIFT



SHAPE ERROR INDEX

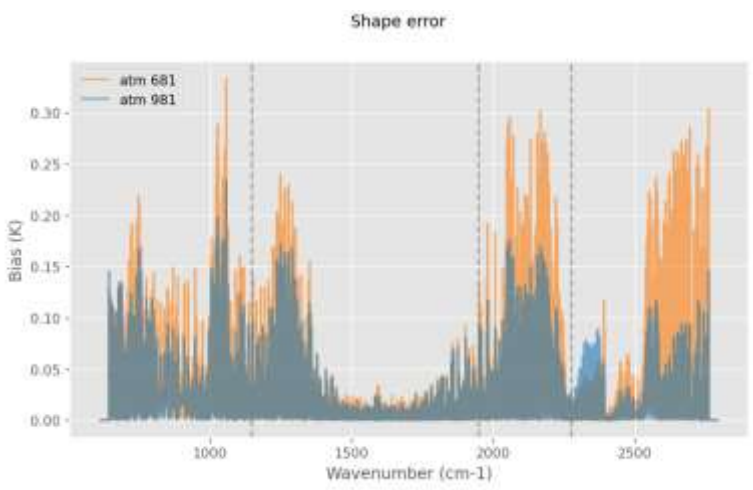


SENSIBILITY TO ATMOSPHERIC LINES IN NEDT BUDGET

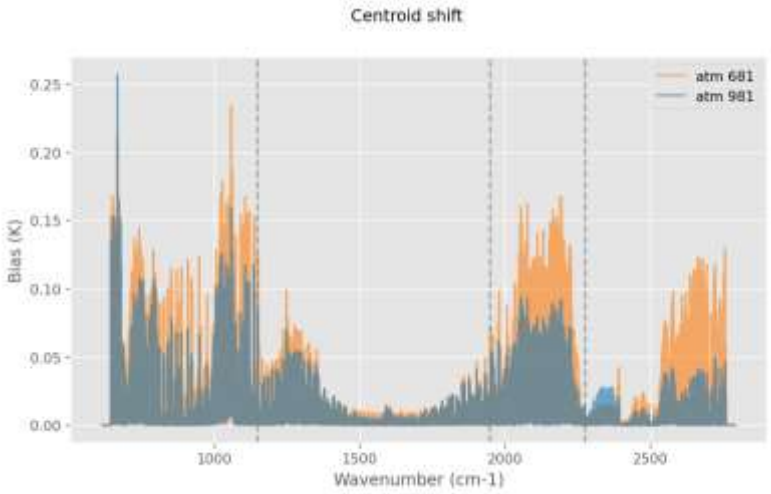


ABSOLUTE MEAN OF CONTRIBUTORS ERROR

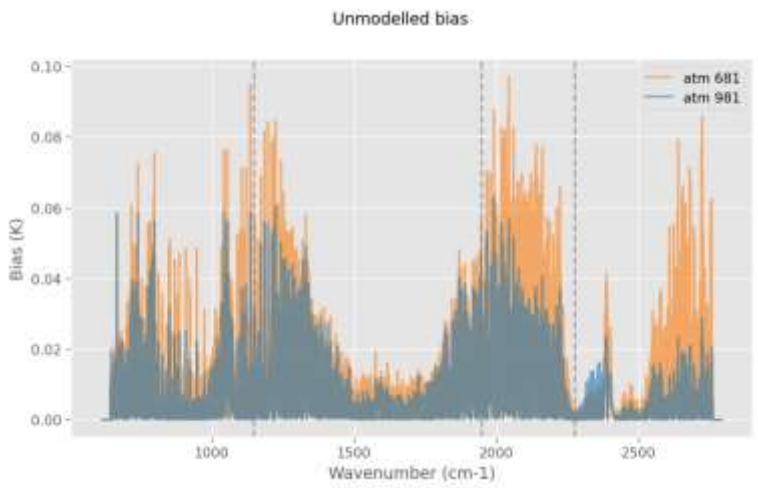
ISRF SHAPE



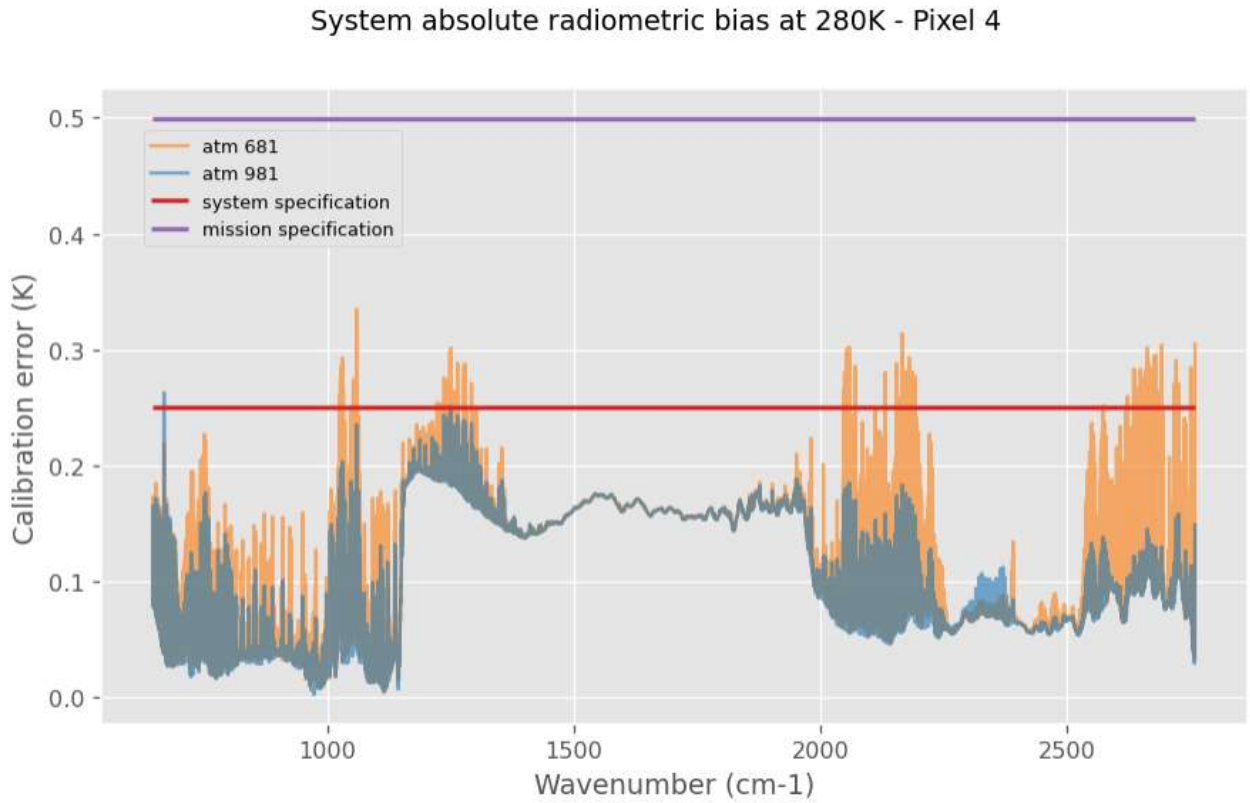
CENTROID SHIFT



“UNMODELLED” PERTUBATIONS



SENSIBILITY TO ATMOSPHERIC LINES IN ABSOLUTE RADIOMETRIC BUDGET



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THANK YOU FOR YOUR ATTENTION

IASI NG
A more precise look on the Earth Atmosphere