Retrieval of GHG from interferogram : exploration, comparison with spectra retrieval

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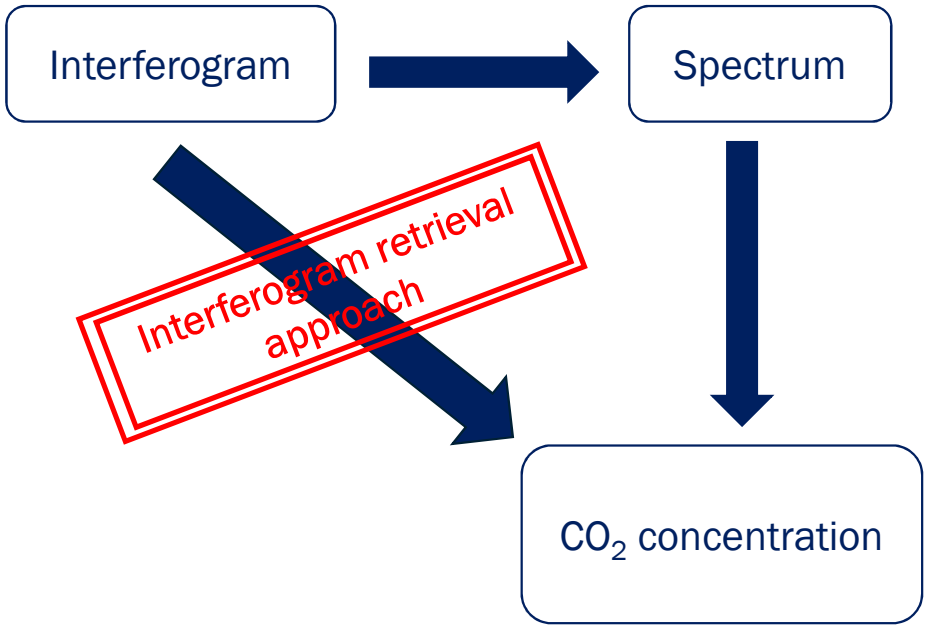
Context

- Retrieval from interferogram : a very old (forgot (?) story°
- Interest demonstrated for the atmospheric trace components retrieval(CO_2, CO, CH_4 and N_2O) [Kyles 1977, Fortunato 1978]
- Information concentrated in a small portion of the interferogram[Serio 2011, Grieco 2012]
- New instrumental concept based on partial interferogram ; **assessment of XCO_2 and XCH_4 retrieval performance** [Dogniaux, et al.]
- Partial interferogram : complex → start with more simple use case
- Comparison spectra vs. interferogram performances ?

- Application : FTIR
- New missions (MTG-IRS, IASI-NG…)
  - Increased data quantity
  - Time consuming retrieval
- IA / NN methods acceleration



Introduction

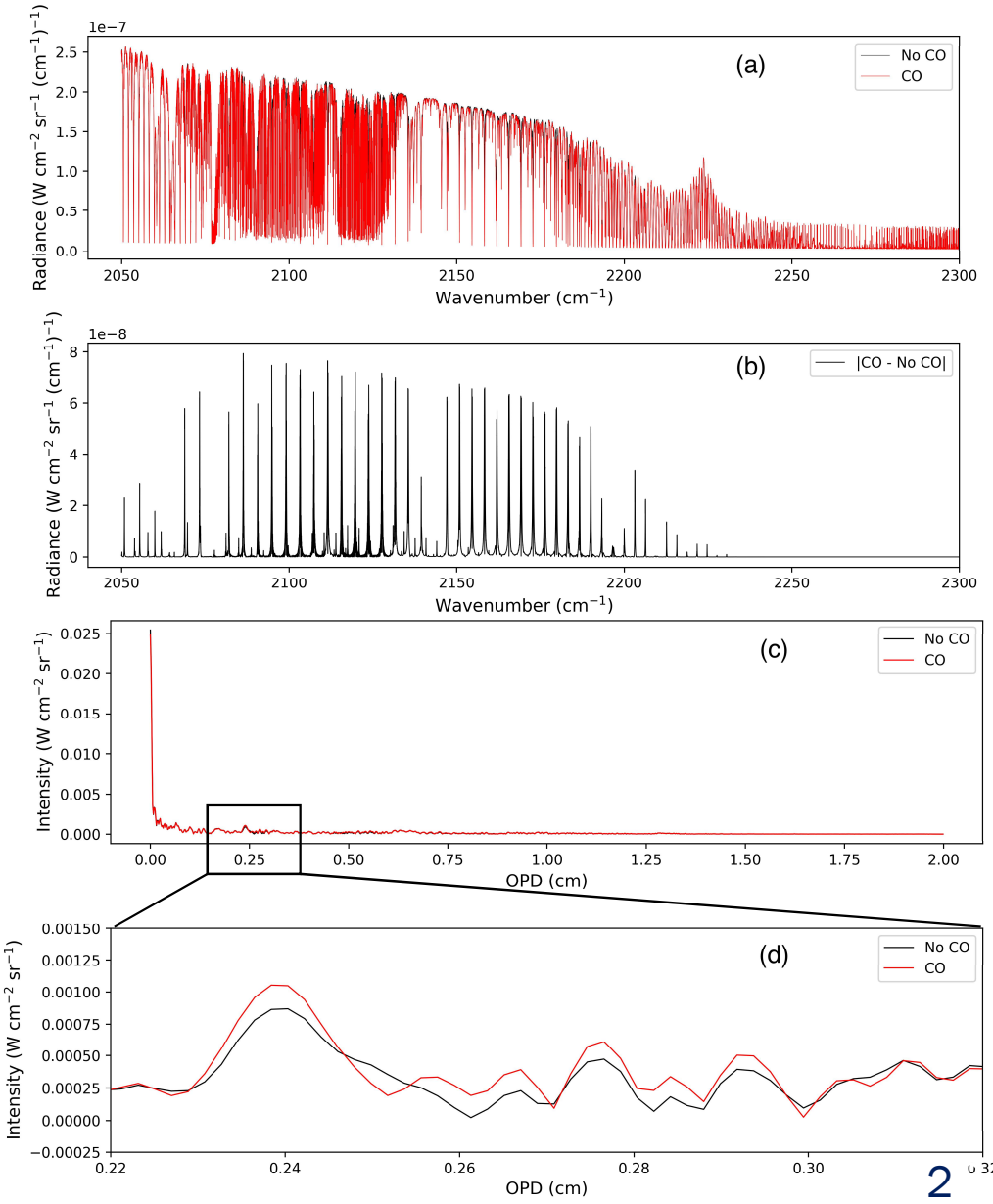
- Information concentrated in a small portion of the interferogram[2]
- Interest demonstrated for the atmospheric trace components (CO_2, CO, CH_4 and N_2O)[3]
- CO periodic signature
  - Spectrum $\sim 4\ cm^{-1}$
  - Interferogram $\sim 0.25\ cm$
- Fourier transform function

Spectra

CO spectral signature

Interferogram

Partial interferogram



2. [Kyles 1977, Fortunato 1978]
3. [Serio 2011, Grieco 2012]

Strategy

input

- 2311 TIGR* atmospheric states
- 7 surface temperatures
- 4 profiles of
  - CO_2
  - CH_4
  - N_2O
  - CO
- 64708 geophysical cases
- IASI-like spectra

Full Physics high resolution spectra

CO2, CH4, N2O, CO

interferogram

Spectra

% Instrumental noised Cst
→ truth \ observation

X = T, H_2O, GHG

Retrieval of Spectra

Retrieval of interferogram

$X_{interfero}^{\acute{}}$

$X_{spectra}^{\acute{}}$

comparison

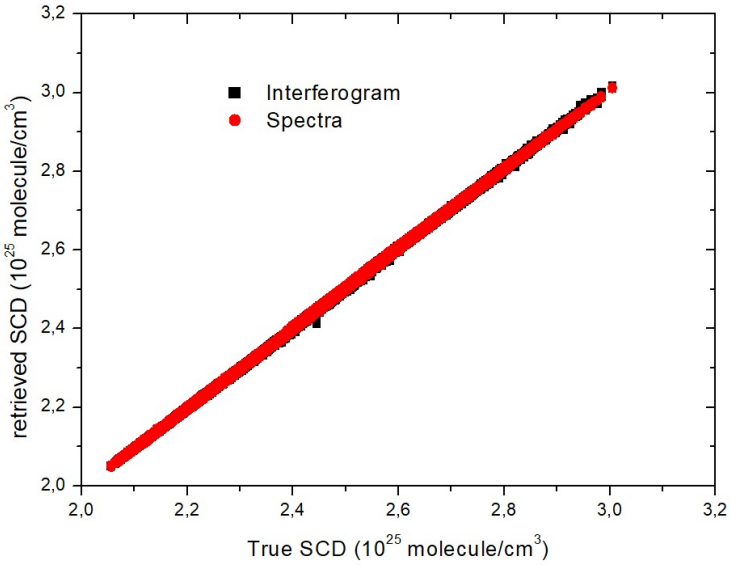
First results: IASI-Like : CH_4

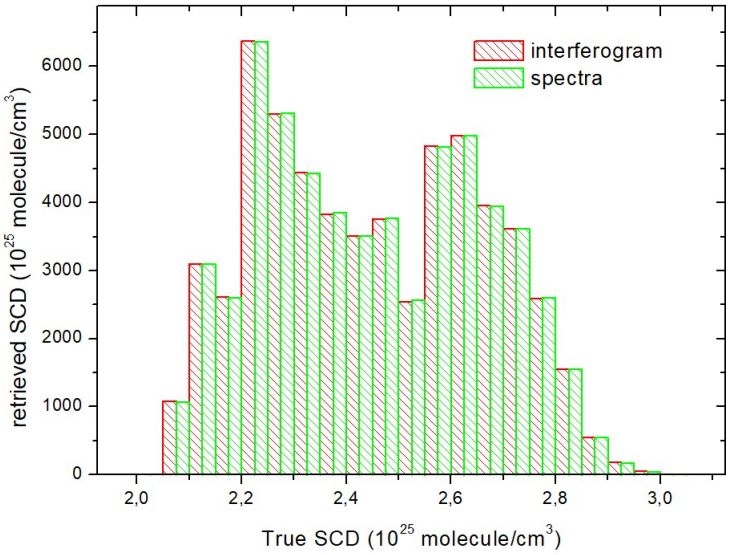
- Very close RMS results of (X_{true} – $X_{retrieved}$)

- T_{surf} :
- interferogram : 0.016 K
- Spectra 0.009 K

- Ch_4 SCD
  - Interferogram 4.447×10^{25} molecule/cm^3
  - Spectra 4.531×10^{25} molecule/cm^3

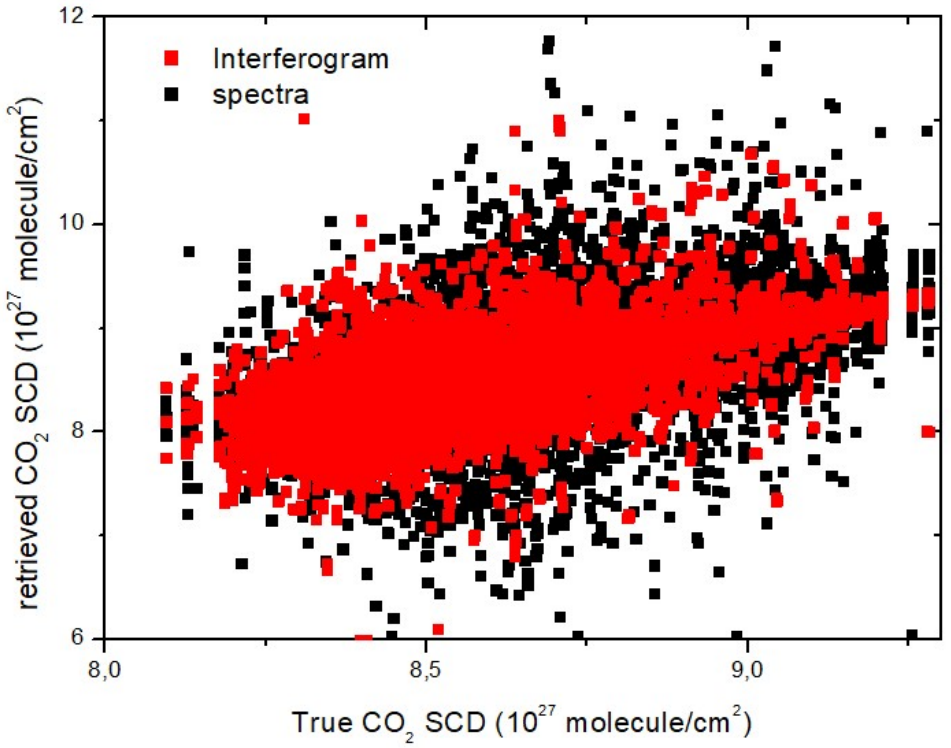
- Non significant differences





2.
3.

First results: IASI-Like : CO_2



- Different RMS results of (X_{true} – $X_{retrieved}$)
- CO_2 SCD
  - Interferogram 1.843x10^{25} molecule/cm^3
  - Spectra 2.080x10^{26} molecule/cm^3
- BUT :
  - non optimal window for CO2 :
    - 900-950 cm^{-1}
  - spread and inaccurate results
    → filter to apply ?
- Difficult to conclude from this results

Outlook

Preliminary Results

- SCD retrieval from interferogram : it works ! (from simulations)
- For Ideal use case
- Information content : close AVK
- No significant differences for CH_4
- Results to be consolidate for CO_2

And to continue

- Perform uncertainties comparison
- Impact of thermal contrast to be done
- Toward SWIR
- Filter for CO_2 retrieval
- Noise and a priori covariance impact

To Do next

This Study	Remain to do
« Full interferogram »	Partial interferogram (noise)
Module of Interferogram	Include Phase modulation
No aerosol	include Aerosol
« simple » Sa and Se	Realistic Sa and Se
Nadir and same emissivity	Oblique nadir, various emissivity
Simulation	True observation • Ground FTIR (TCOON, EM27) • IASI
Full physic	Classification, NN, …

To be continued …

Thank you