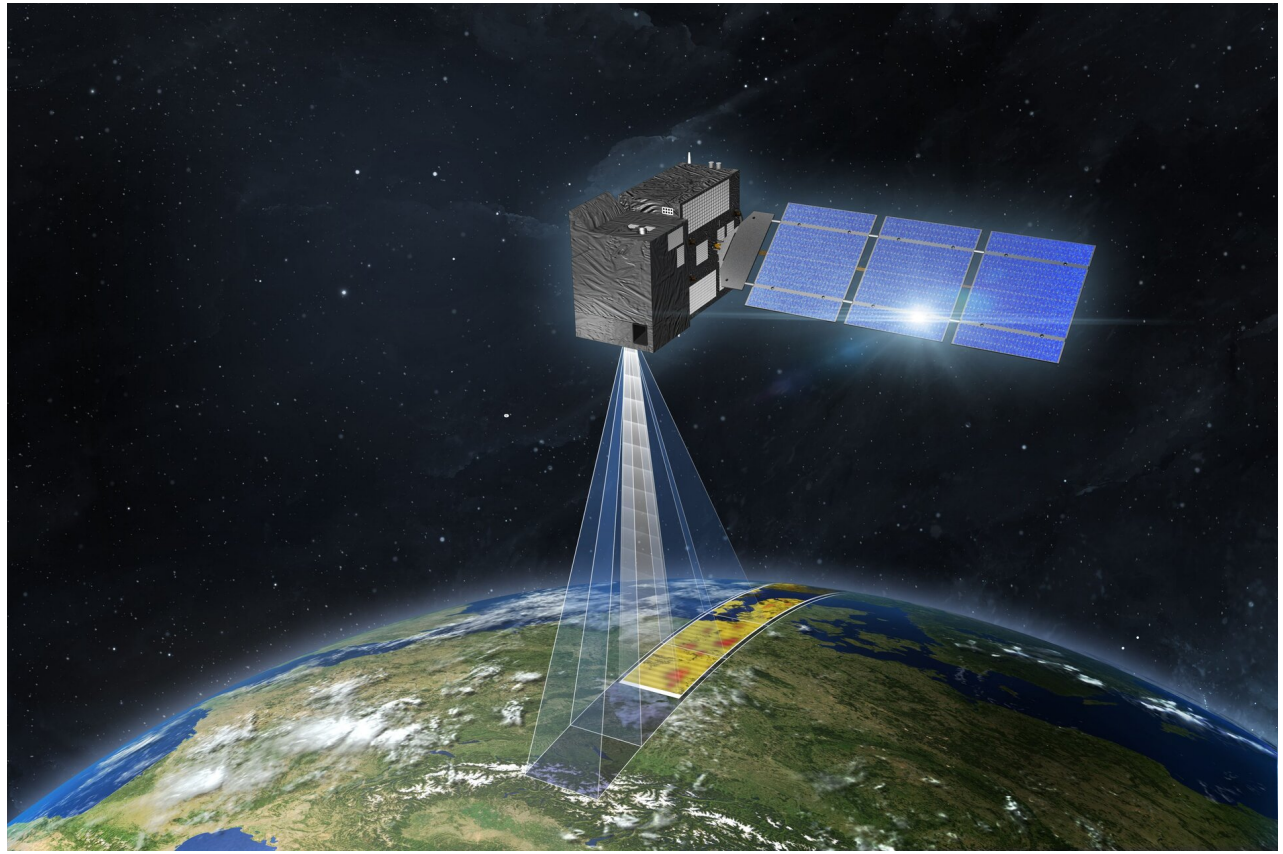
UNIVERSITY OF LEICESTER

Earth Observation Science

The University of Leicester full physics XCO2 retrieval: Expected performance with the CO2M mission

Antonio Di Noia[1], Hartmut Boesch[1,2], Oleg Dubovik[3], David Fuertes[4], Pavel Litvinov[4], Anton Lopatin[4]

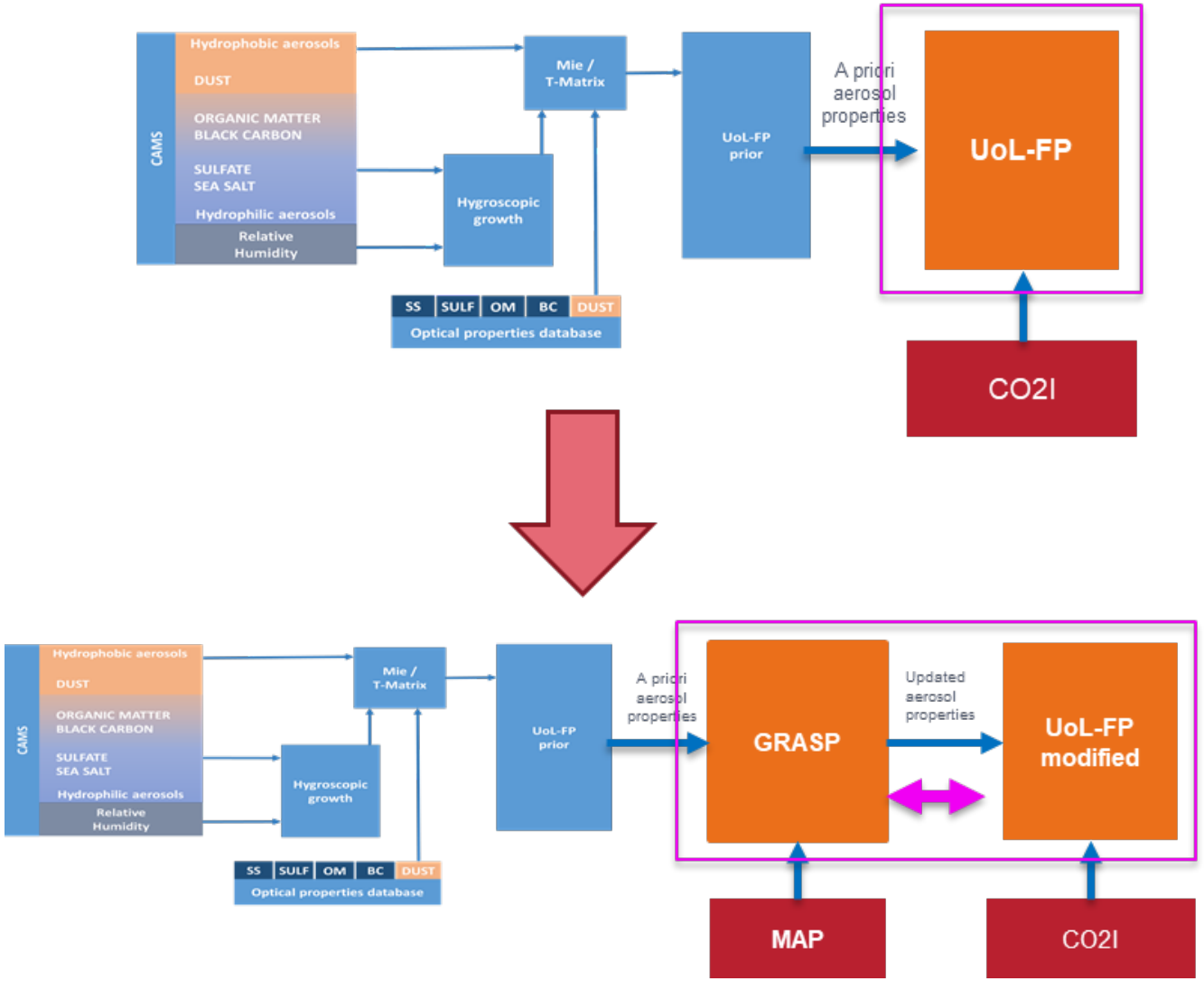
[1] EOS Group, University of Leicester, [2] National Centre for Earth Observation, [3] University of Lille 1, [4] GRASP SAS



- CO2M: monitoring human CO2 emissions from space
- Synergistic look at Earth's atmosphere
  - CO2I spectrometer (CO2 monitoring)
  - Multi-angle polarimeter (MAP)
  - Cloud imager (CLIM)
  - NO2 monitoring instrument
- Improved aerosol characterization in CO2 retrievals

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

The UoL-FP full physics CO2 retrieval: Adaptation to CO2M



Current setup (no MAP)

- ❑ Aerosol a priori from CAMS
- ❑ Applied to existing satellite missions (GOSAT, TanSat)

New approach

- ❑ Sequential retrieval: aerosol a priori from MAP (GRASP aerosol retrieval code)
- ❑ Joint development with GRASP / Univ. Lille (in progress)

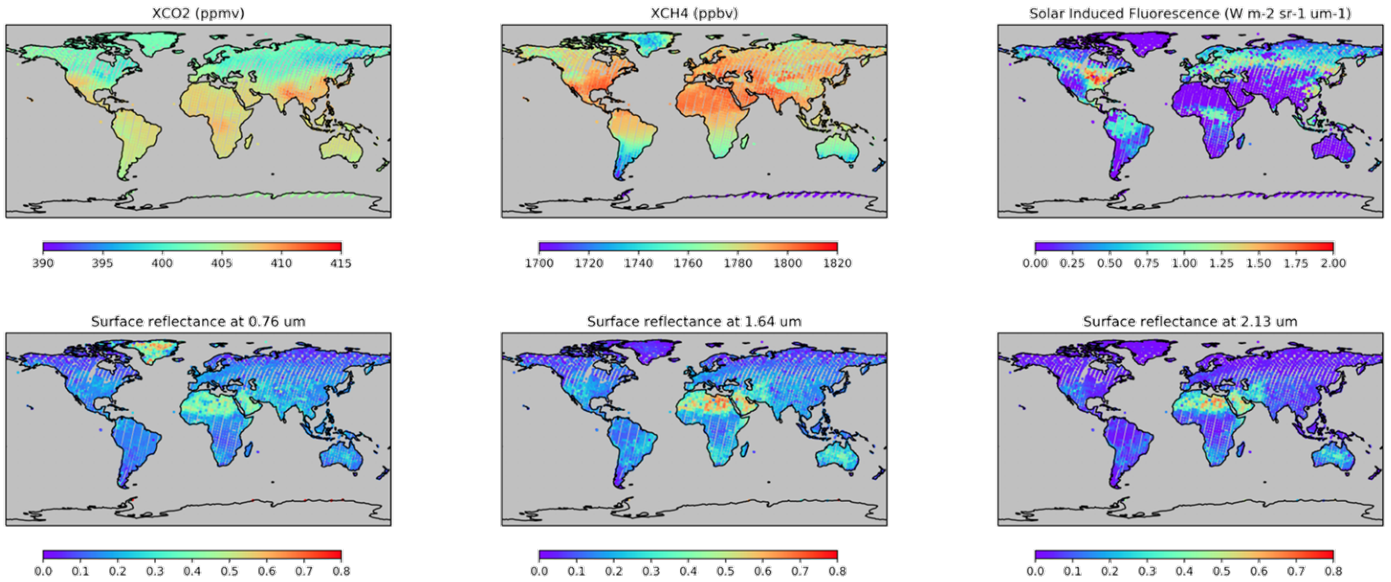
Synthetic dataset and retrieval setup

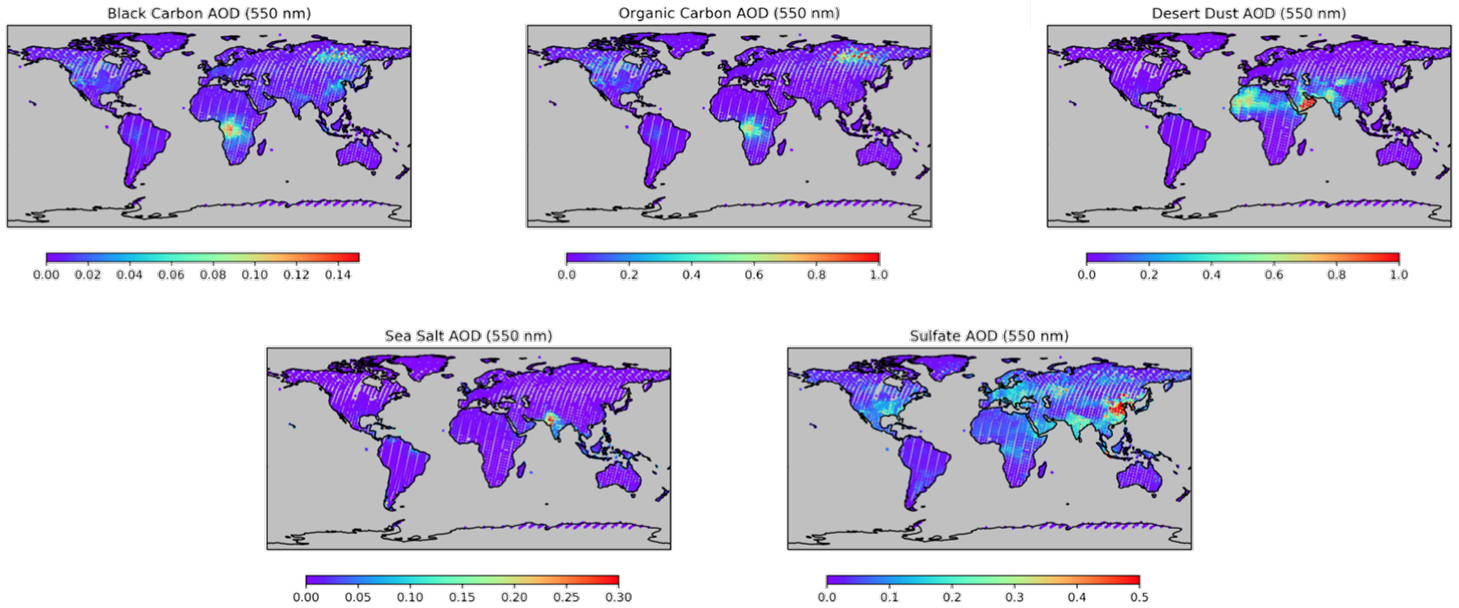
Variable	Simulated dataset	Retrieval a priori
Surface pressure	ERA-5	ERA-Interim
Temperature profile	ERA-5	ERA-Interim
CO2 profile	CarbonTracker	MACC-II (2009-2016)
CH4 profile	CAMS	MACC-II/TOMCAT
H2O profile	CAMS	ERA-Interim
Aerosol profiles	MERRA-2	CAMS climatology
Surface albedo	MODIS-Terra MOD09CMG (monthly minimum)	Estimated from L1B radiances
Solar induced fluorescence	MODIS-OCO-2 SIF data	Dedicated retrieval

- New approach to be evaluated on synthetic data
- Realistic dataset with broad range of geophysical situation
- Inconsistencies between synthetic reality and retrieval a priori accounted for

Simulated input fields

- ❑ Only land scenes considered
- ❑ July as reference month for input scenarios
- ❑ Summer-winter XCO2 gradients
- ❑ MAP simulations still in progress



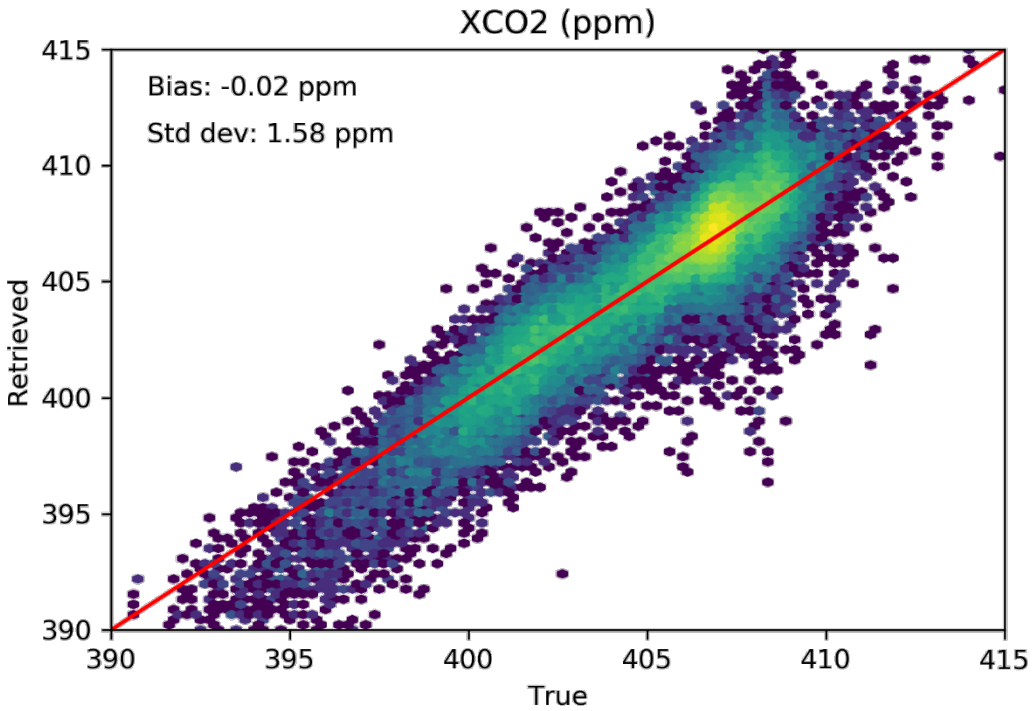


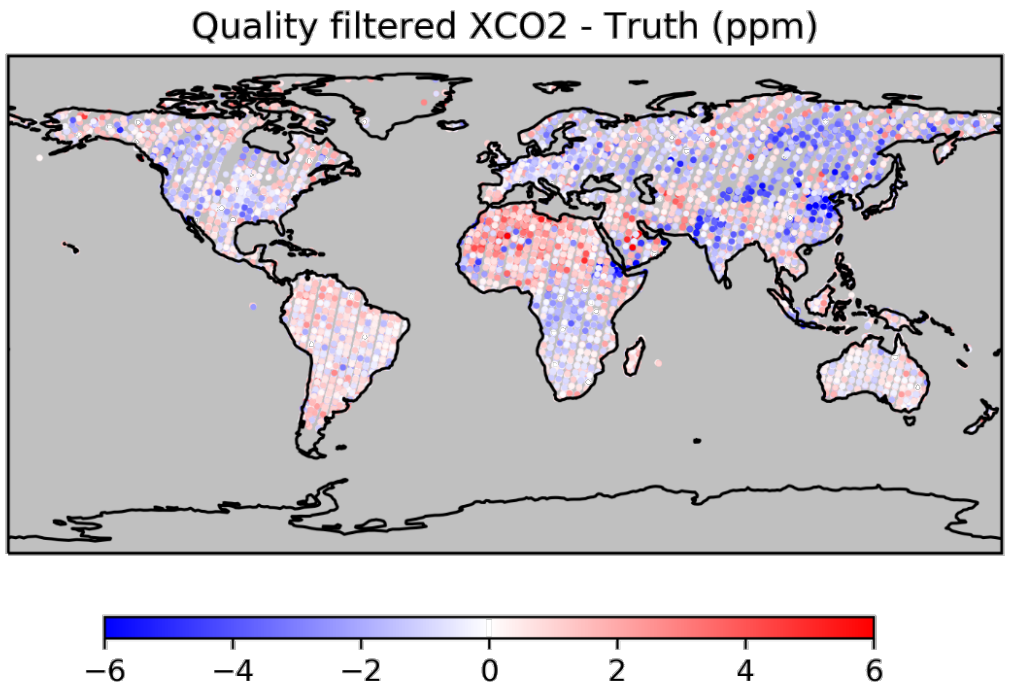
Broad range of aerosol scenarios

- ❑ Biomass burning (central Africa)
- ❑ Forest fires (Siberia)
- ❑ Industrial aerosols (China, India, Eur/USA)
- ❑ Desert dust
- ❑ Monsoon-advected sea salt (India/Pakistan)

UNIVERSITY OF LEICESTER

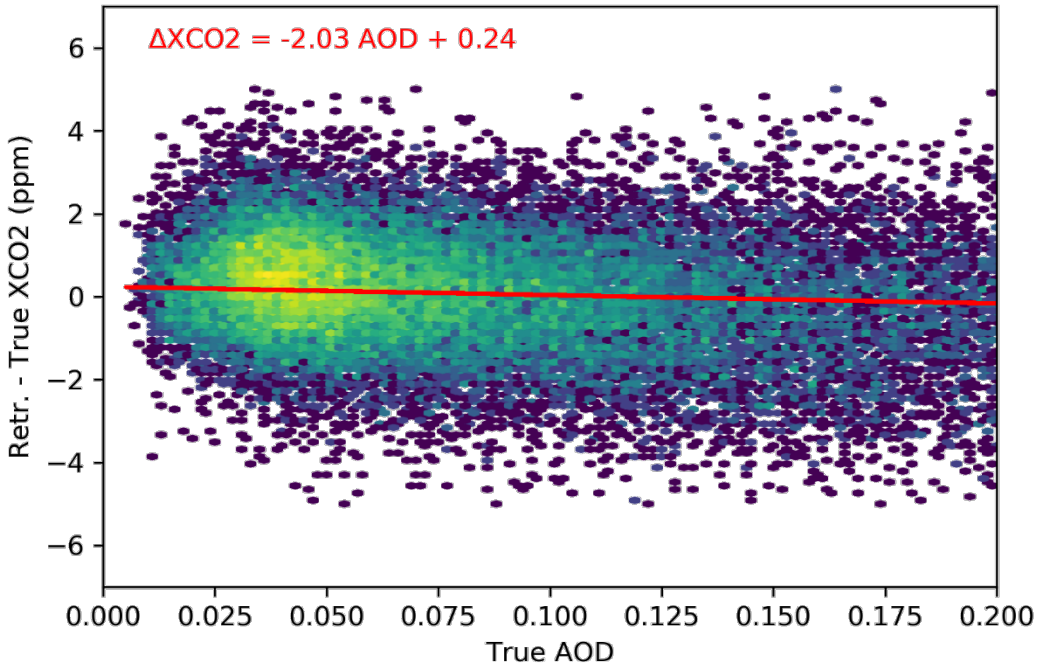
Retrieval results (CO2I only)

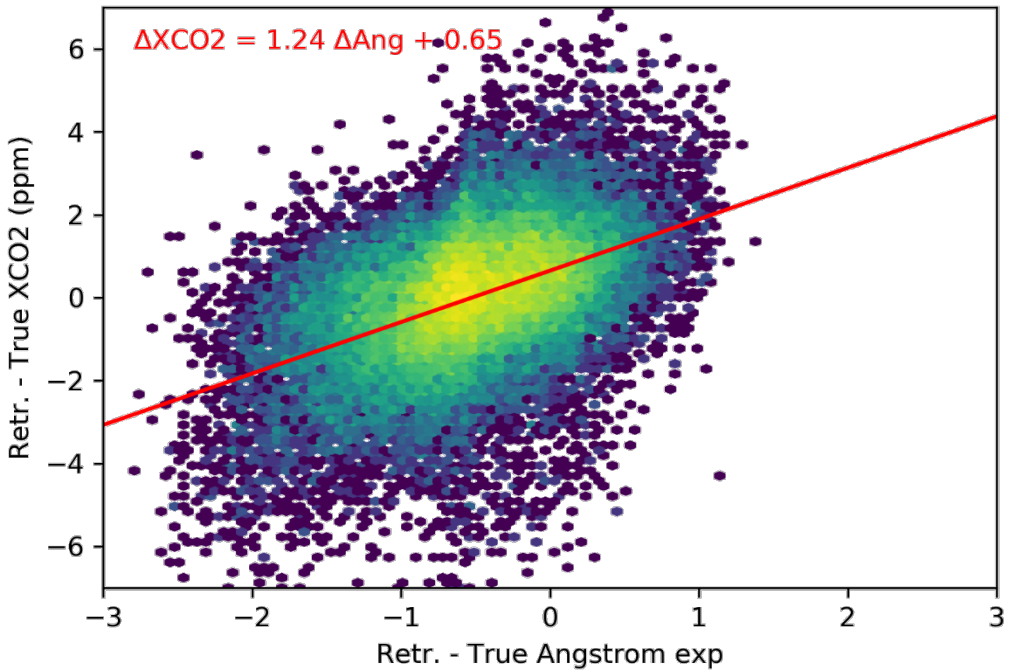




- Results on noisified synthetic spectra (CO2M-specific noise model)
- No aerosol filtering applied (to better investigate aerosol sensitivity)
- Bias spatial patterns related to main aerosol regions

XCO2 sensitivity to aerosols





- Incorrect assumptions on aerosol properties cause biases in retrieved XCO2
- MAP measurements to provide better a priori for aerosols (experiments in progress)
- Ongoing study in collaboration with GRASP / Univ. Lille 1

UNIVERSITY OF LEICESTER