… on the utility and importance of IR soundings in atmospheric chemistry and trace gas retrievals (based on my vast experience with IASI)

Cathy Clerbaux, CNRS, Paris

Cathy.clerbaux@latmos.ipsl.fr

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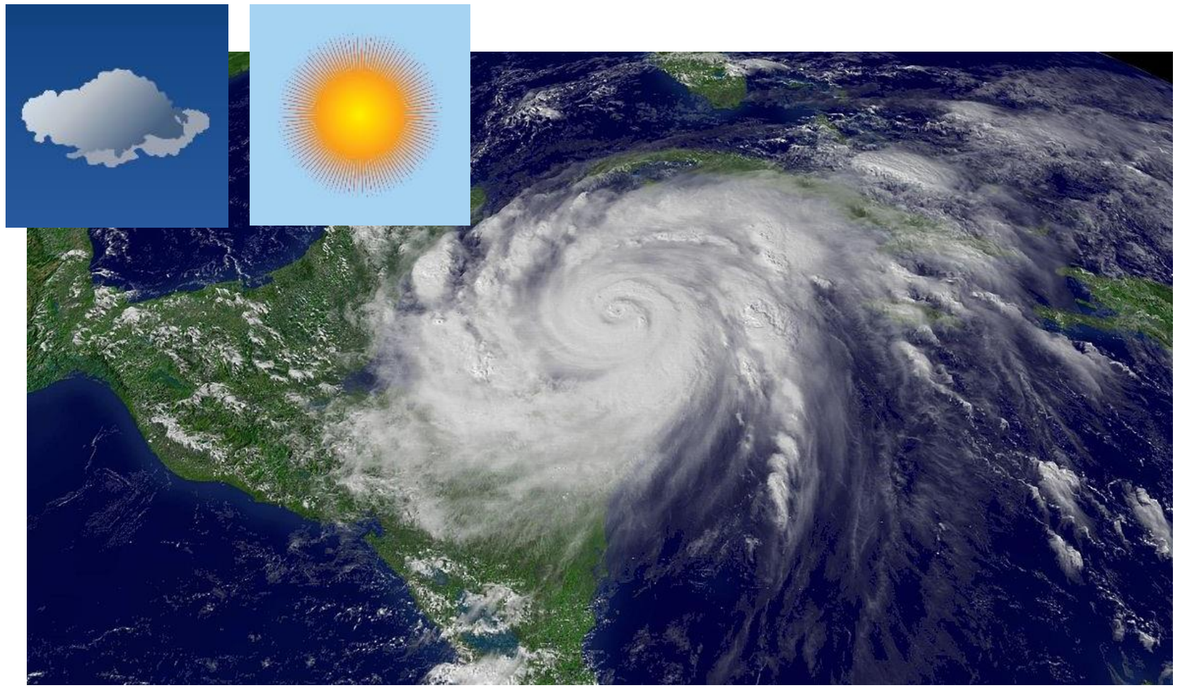
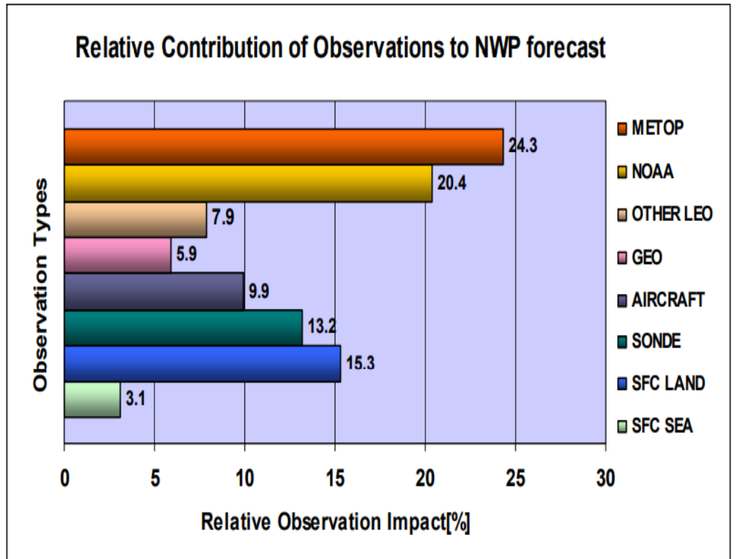
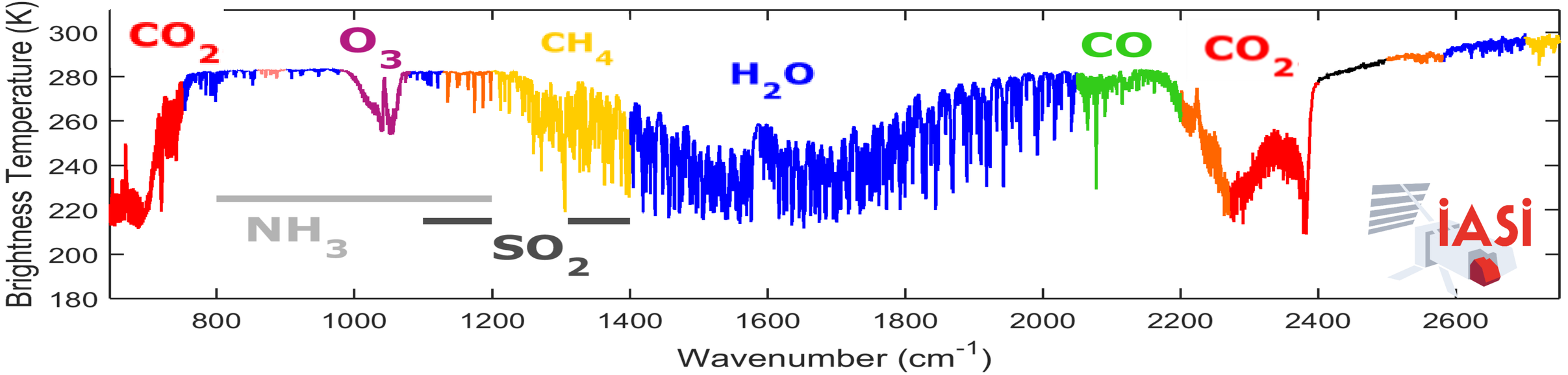


IASI on Metop has the largest single impact of any instrument on any satellite

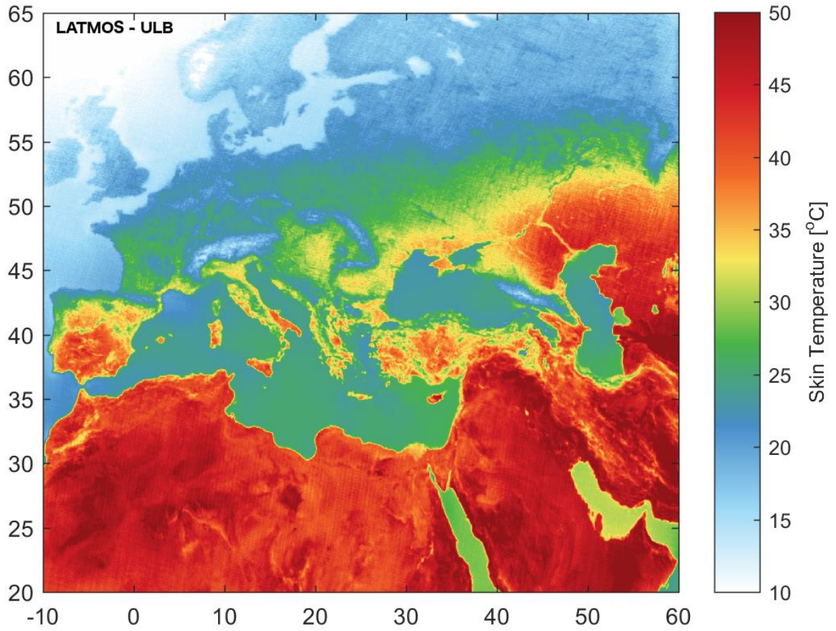


Greenhouse gases and ozone-related substances (13)	H_2O, CO_2, CH_4, N_2O, O_3, HNO_3, CFC-11, CFC-12, HCFC-22, CF_4, *SF_6*, *CCl_4*, *HFC-134a*
Air quality and VOCs (12)	CO, CH_3OH, HCOOH, CH_3COOH, CH_3COCH_3, C_2H_2, C_2H_4, NH_3, HCN, PAN, SO_2, OCS
Concentrated plumes (6)	HCl, H_2S, C_3H_6, C_4H_4O, HONO, *HCHO*

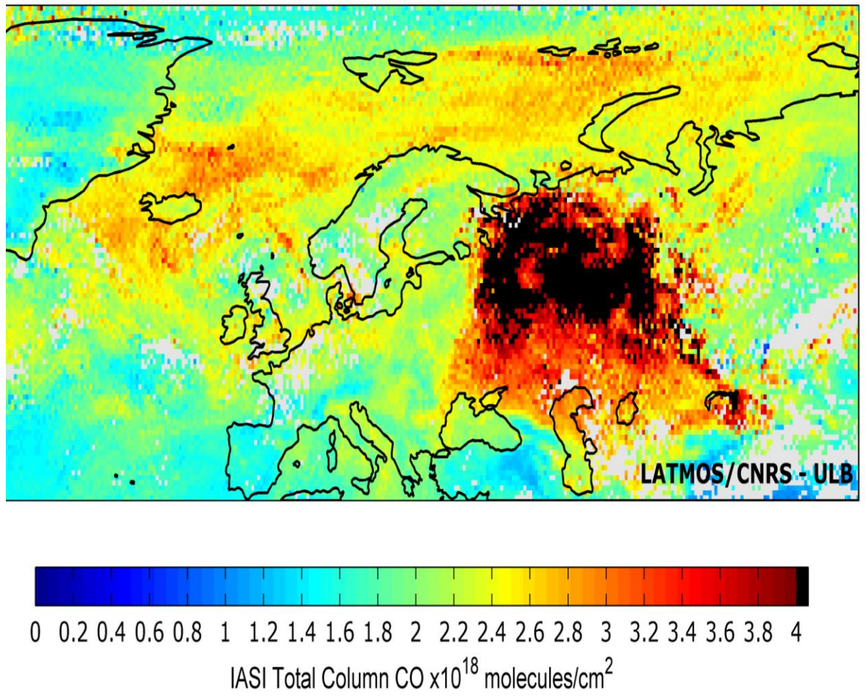
1. Which wavelengths are most important for atmospheric chemistry retrievals from IR sounders like IASI



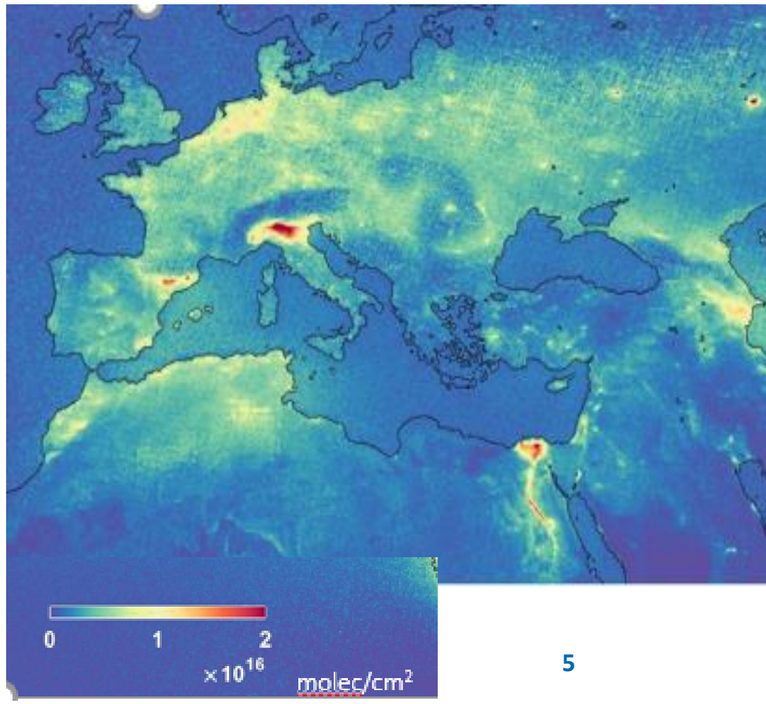
Temperature



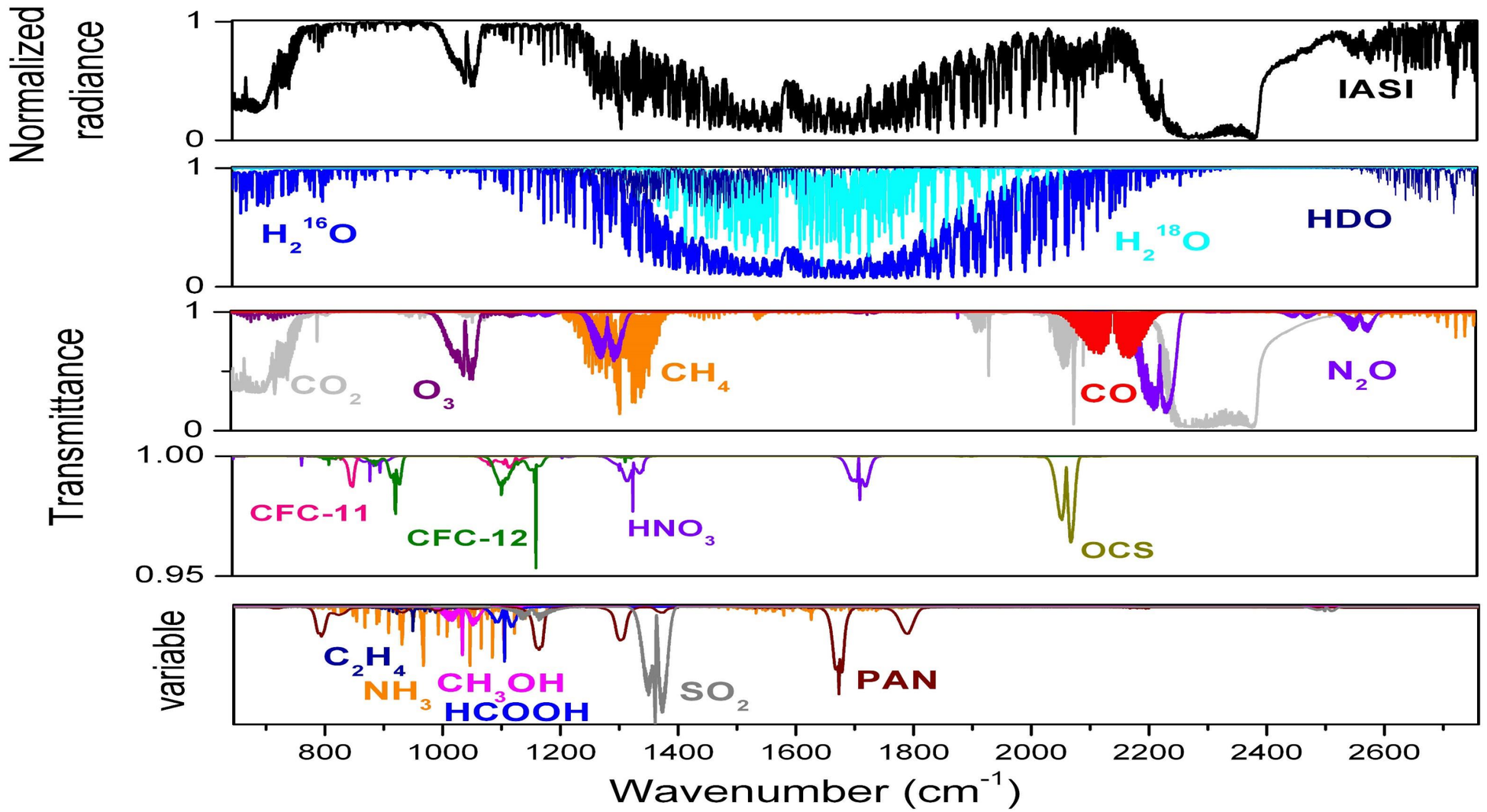
Carbon monoxide (CO)



Ammonia (NH_3)



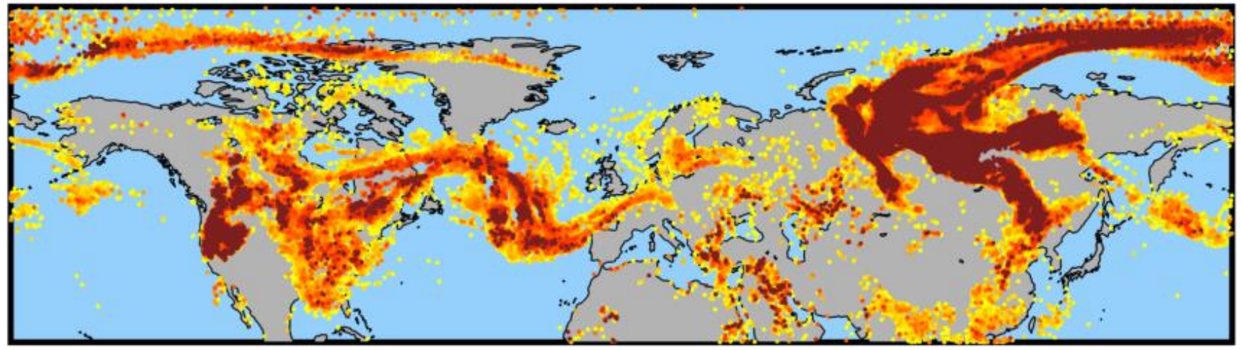
Infrared absorbers



Clerbaux et al., ACP 2009

2. How are these products derived?

2021 08 06



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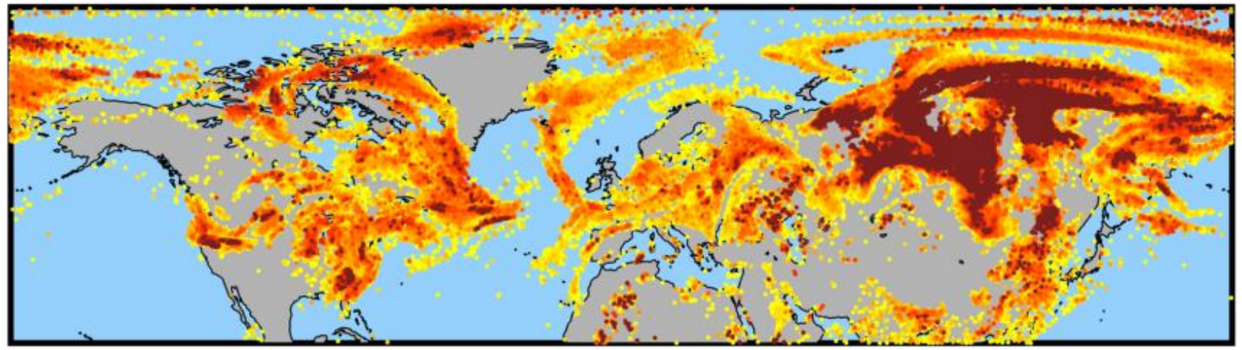

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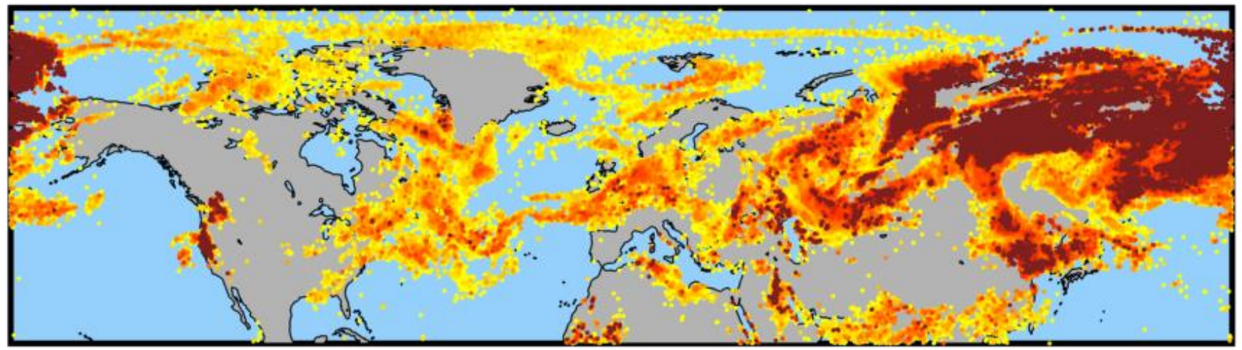
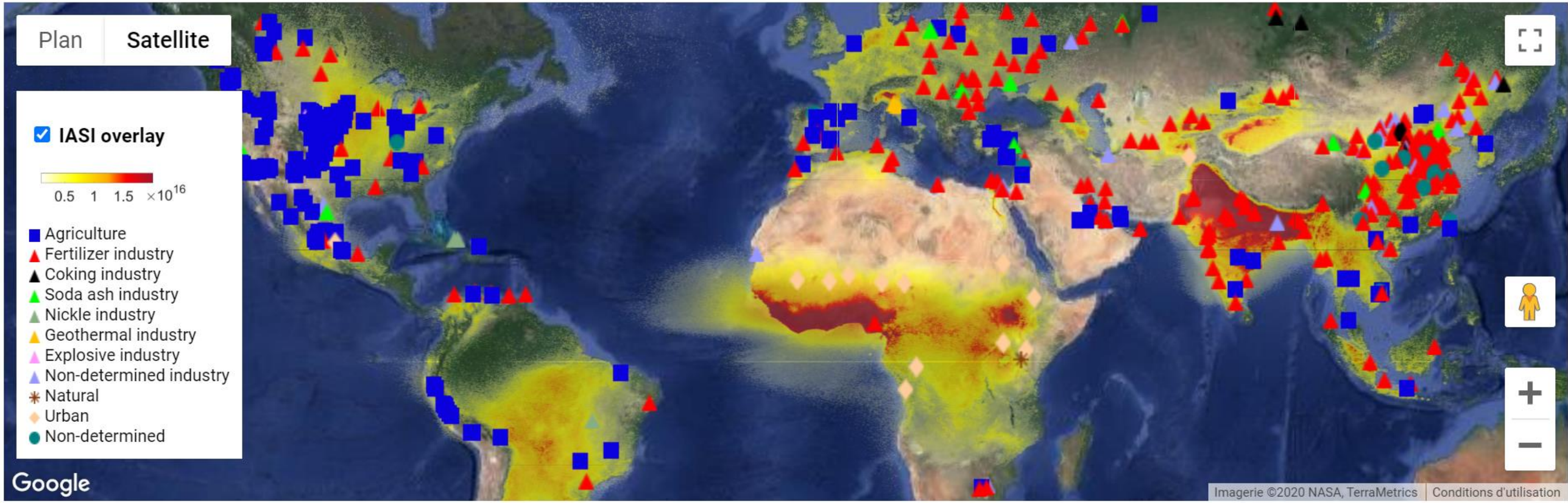


IASI CO total column (x 10^{18} molec./cm^2)

3.5 4 4.5 5 5.5 6

Optimal interpolation (Rodgers)

Profile on 19 layers
+ Avgk
+ errors
+ quality flags

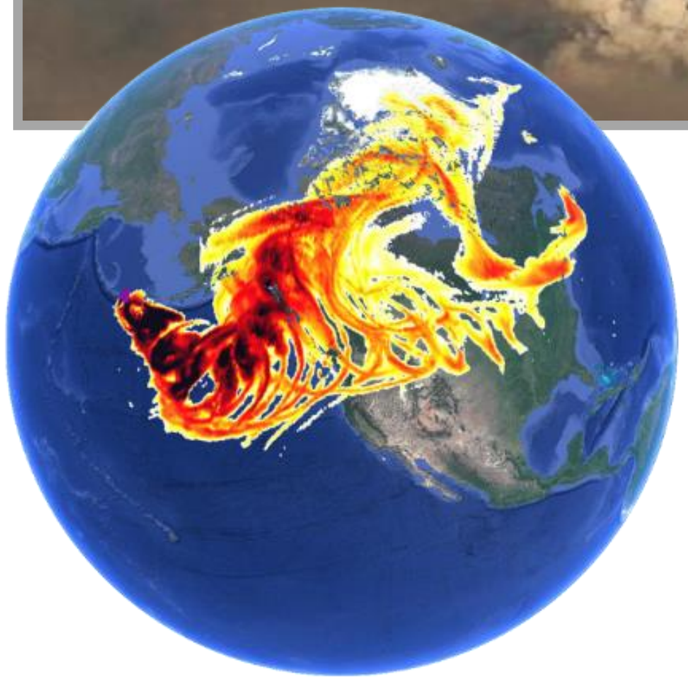


Global ammonia point sources as seen by IASI satellite instruments

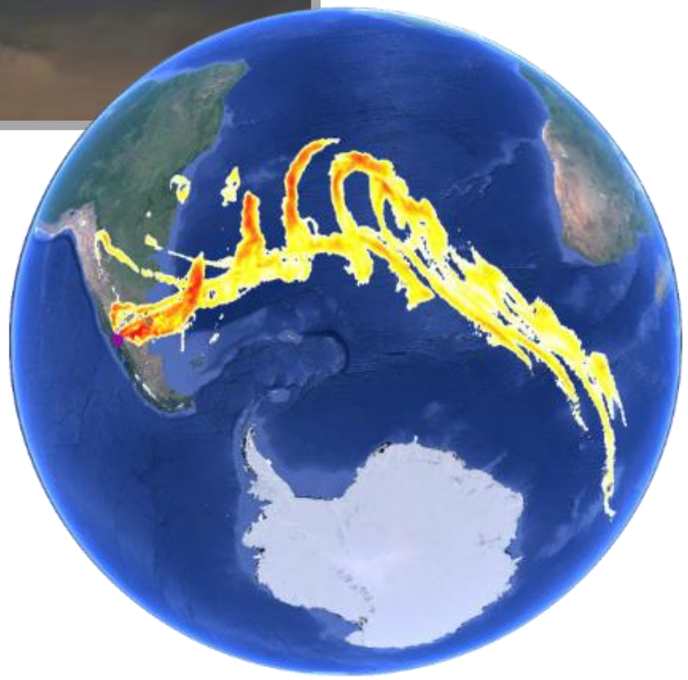
https://www2.ulb.ac.be/cpm/NH3-IASI.html

Van Damme, M., Clarisse, L., Whitburn, S., Hadji-Lazaro, J., Hurtmans, D., Clerbaux, C., Coheur, P.-F. **Industrial and agricultural ammonia point sources exposed**. *Nature* **564**, 99-103, doi: 10.1038/s41586-018-0747-1, 2018

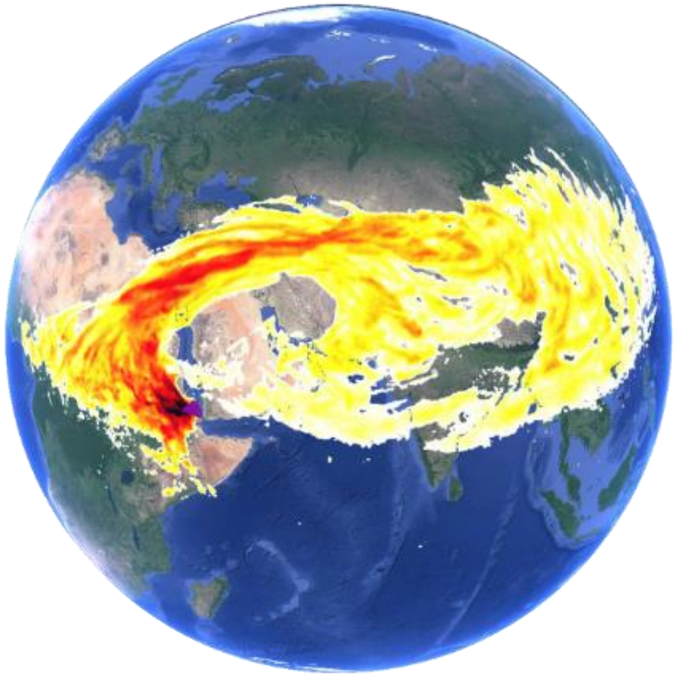
SO_2 plumes



Kasatoshi
Aug. 2008

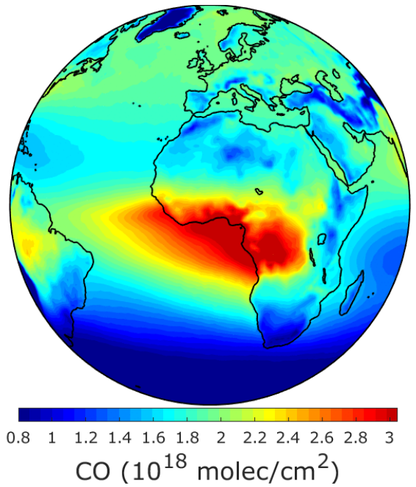


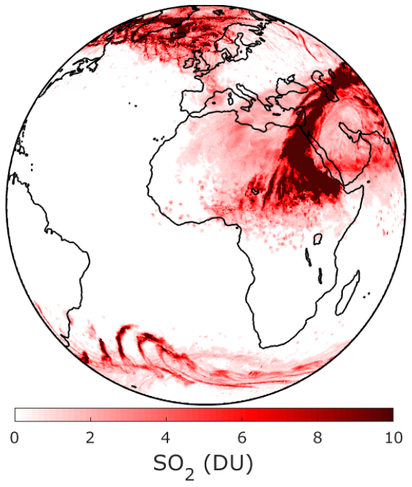
Puhehue
June 2011

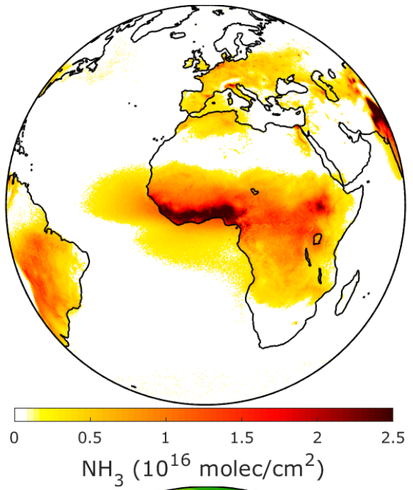


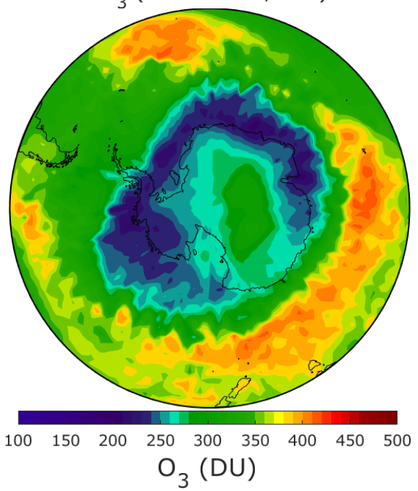
Nabro
June 2011

3. Who are the users of these IR derived products and how are they used? (e.g. NWP centers, CAMS program, ozone at the poles during polar night time etc.)









CO : assimilated in CAMS

Ozone : C3S

SO_2/ash : VAACs

NH_3 : PM forecast

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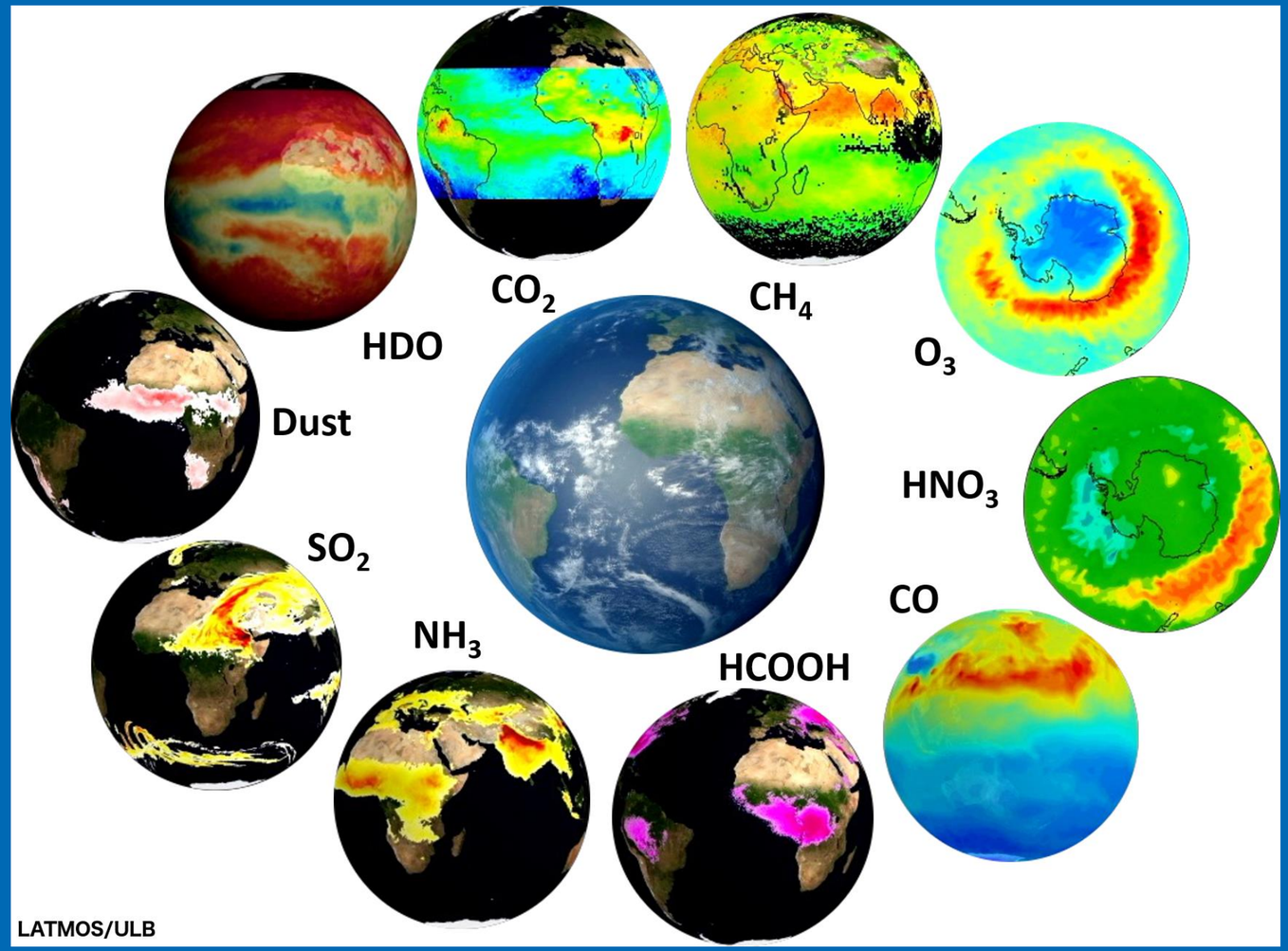
ATMOSPHERIC COMPOSITION MONITORING

AERIS

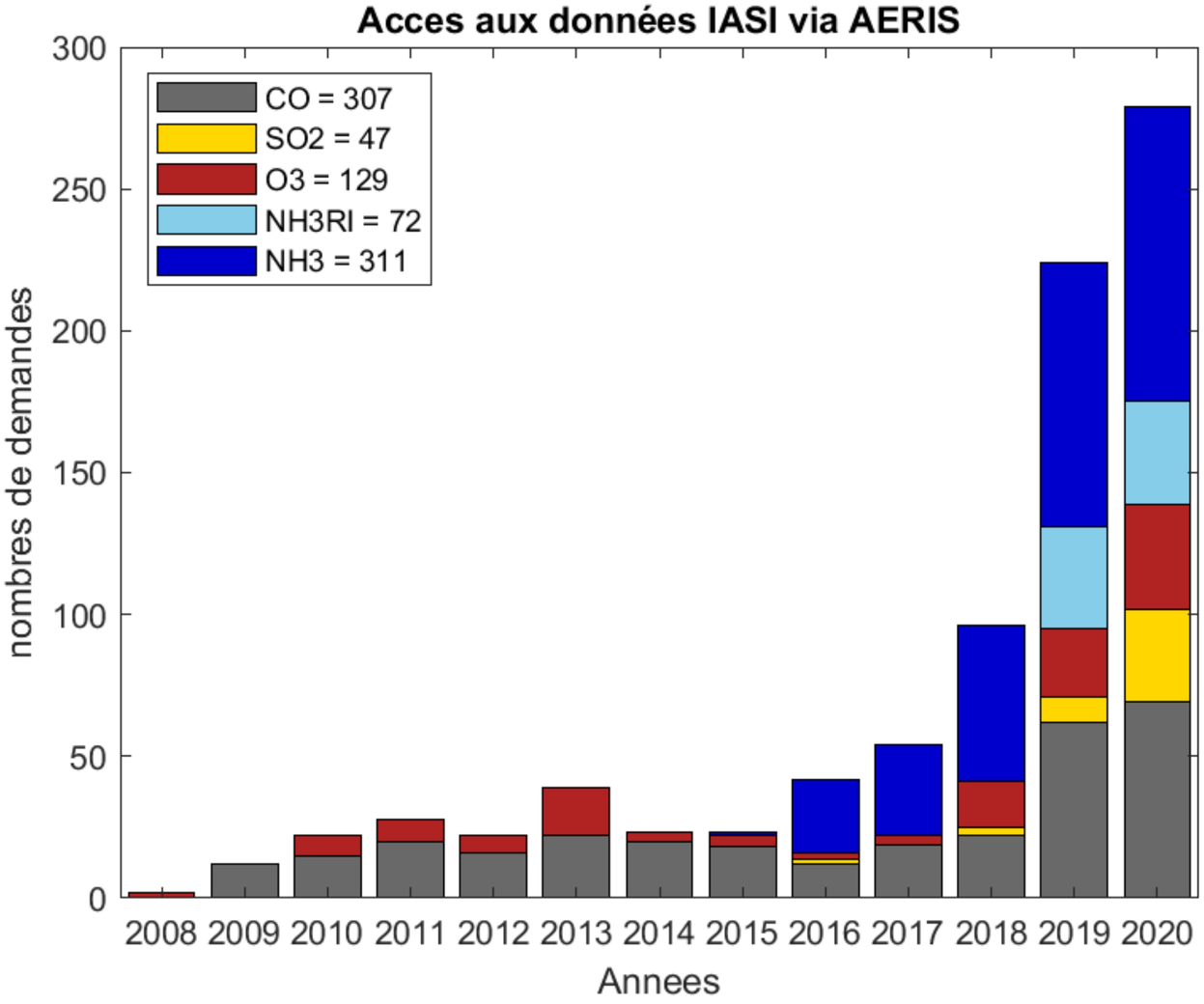


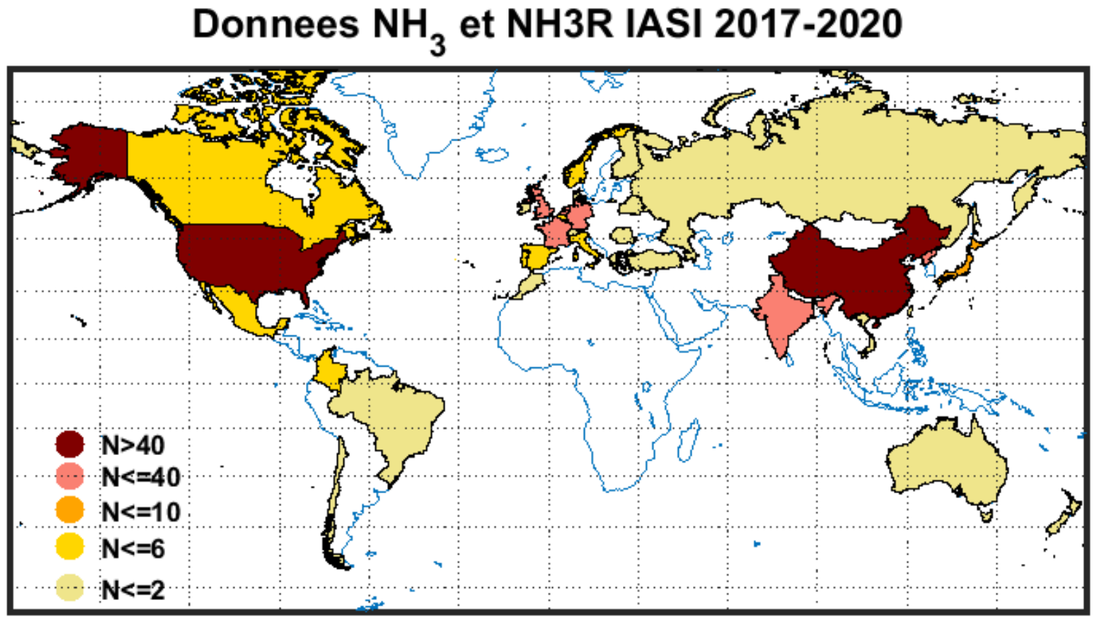
IASI

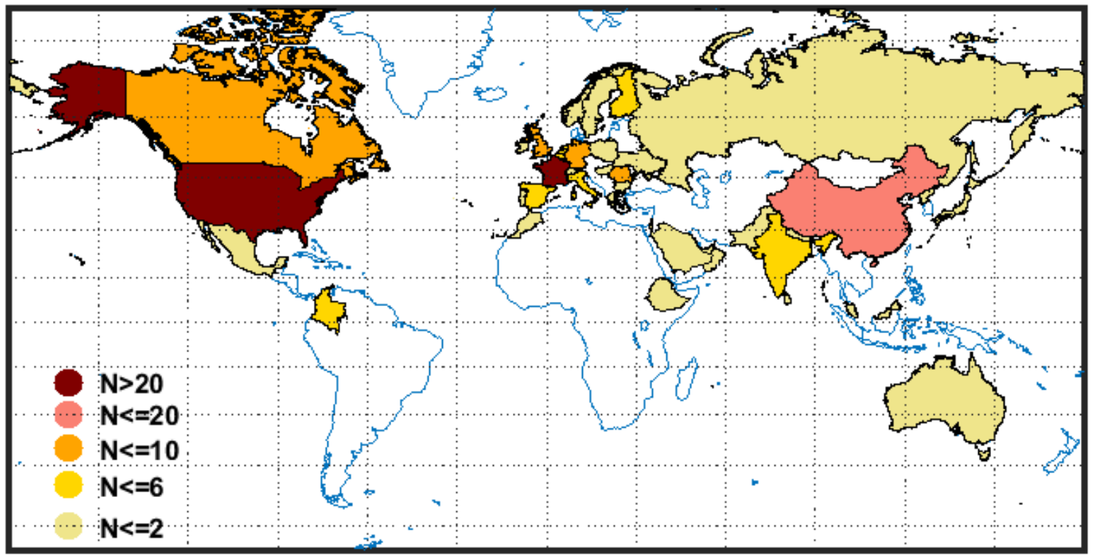
https://iasi.aeris-data.fr/XX

XX= CH4, CO, O3, O3_iasgo2, NH3, NH3RI, SO2, HCOOH, dust, cloud

AERIS – IASI users

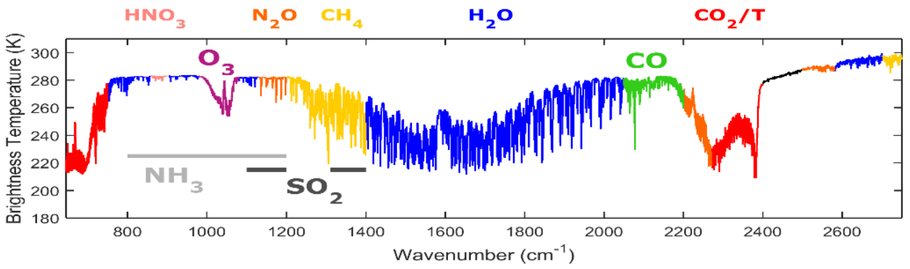


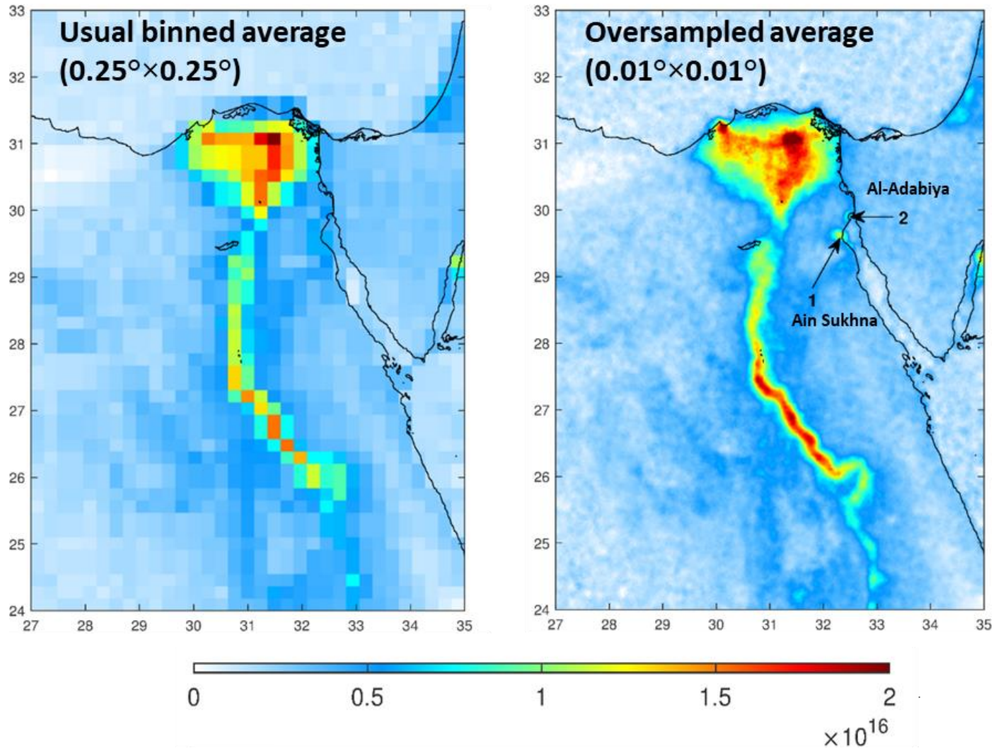


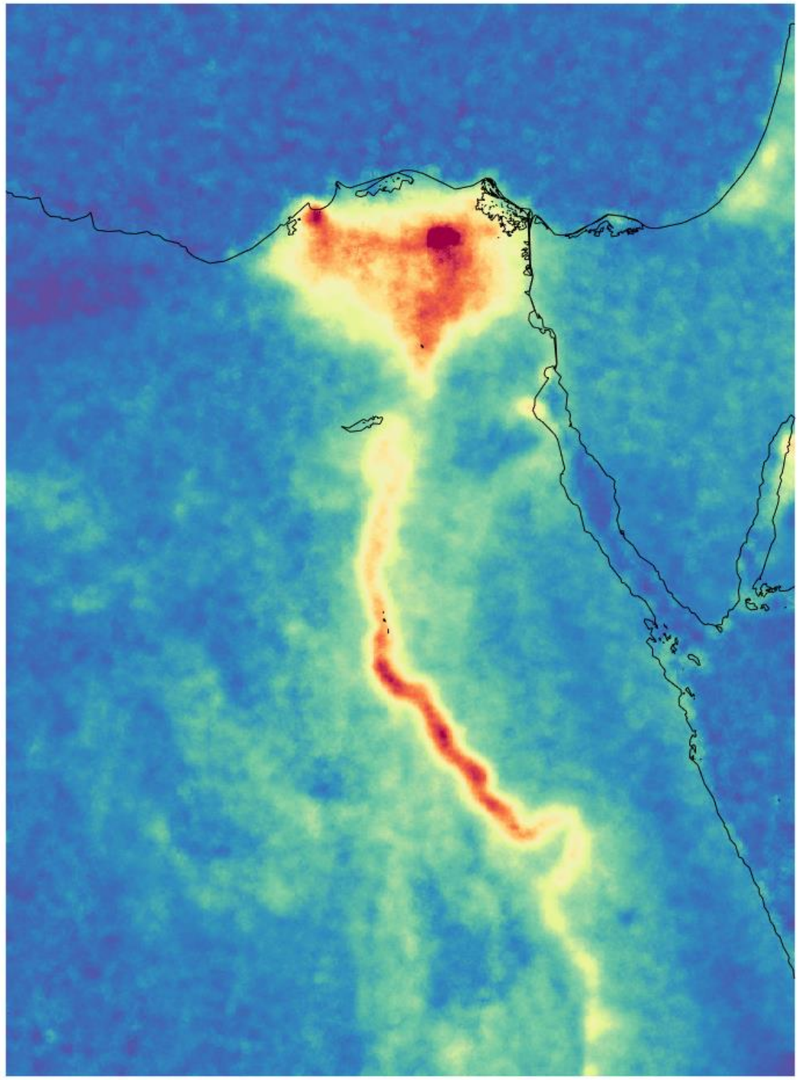


4. Are there any temporal, spectral, and spatial improvements that are needed for trace gas retrievals from IR sounders?

Averaging on longer time periods



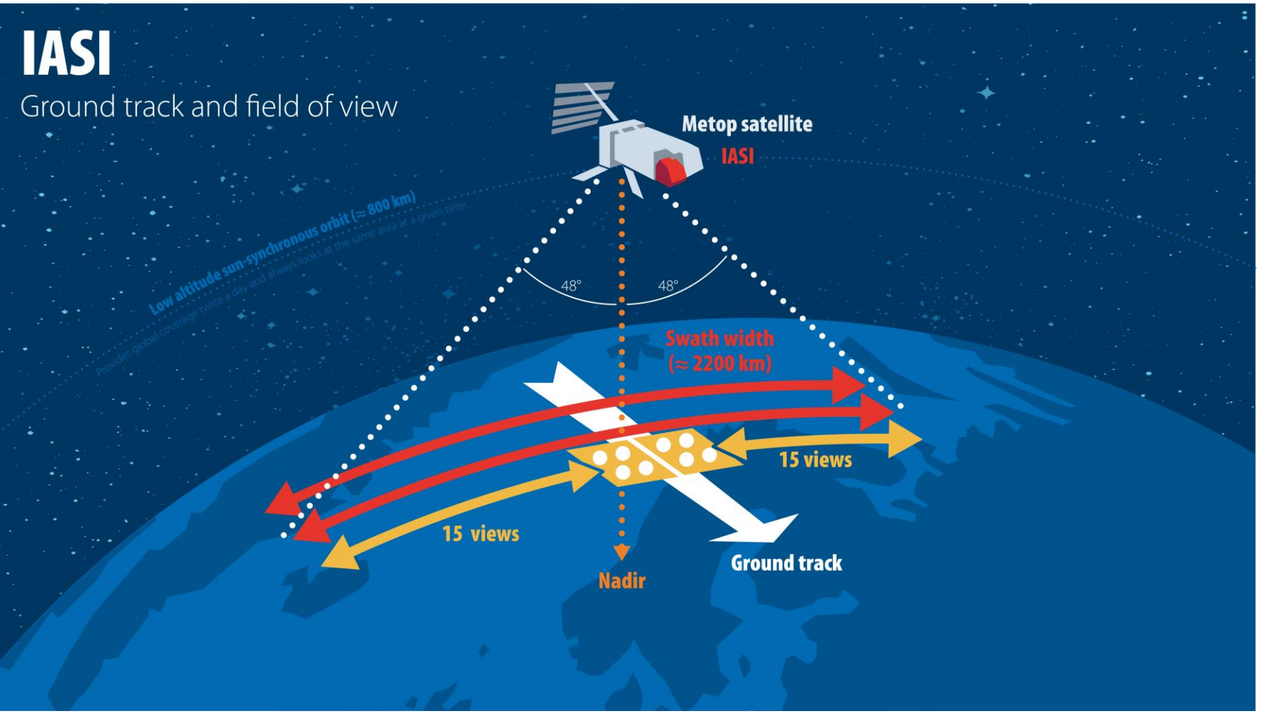


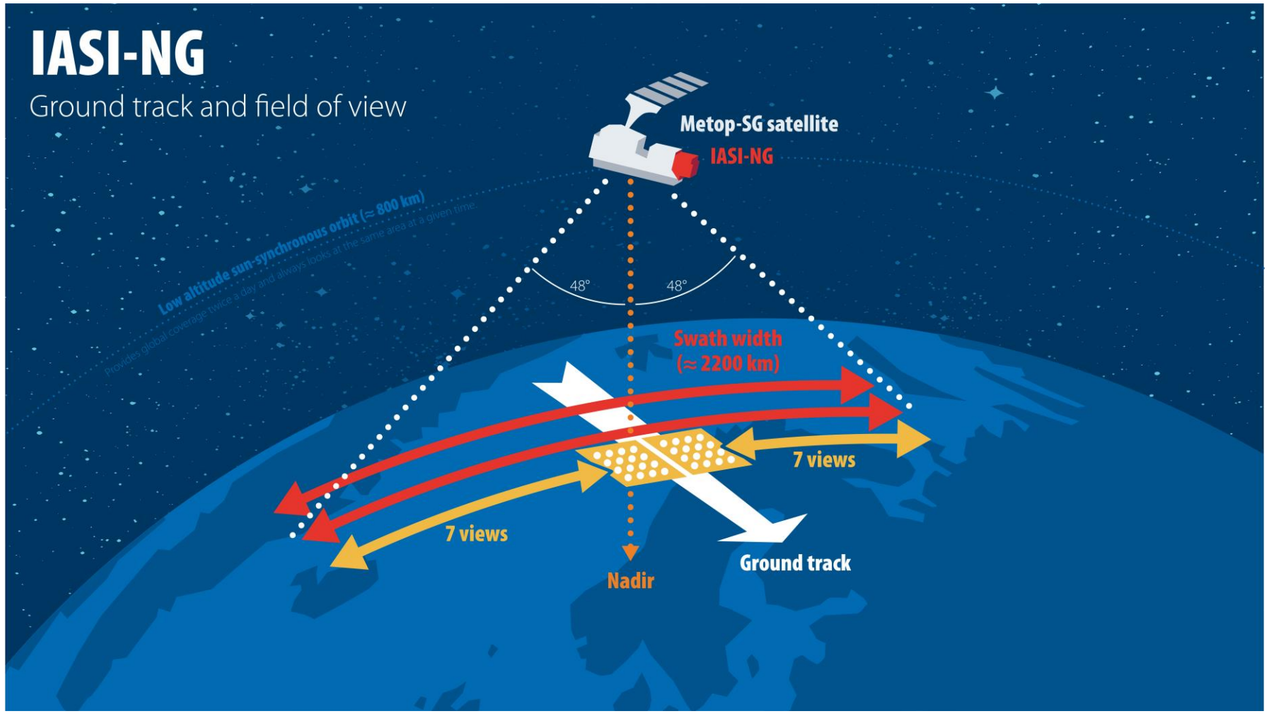


10 years

Credit Martin Van Damme, Lieven Clarisse (ULB)

5. What are current challenges and future opportunities for trace gas retrievals from IR sounders? (e.g. IASI vs IASI-NG)





Spectral resolution x 2
Signal/noise x 2

IASI vs IASI-NG

	IASI		IASI-NG		
Chemistry	***DOFs***	***Error (%)***	***DOFs***	***Error (%)***	***What the 'NG' brings***
O_3	3-4	PBL : 60% Tropo : 11%	4-5	PBL : 40% Tropo : 8%	More information in PBL
CO	1-2	PBL : 16% Tropo : 8%	2-3	PBL : 10% Tropo : 6%	More information in PBL
HNO_3	1 or less		2		Both tropo and strato
NH_3[a]	detected	-	measured	-	> instrumental noise
Methanol[a]	detected	-	measured	-	> instrumental noise
C_2H_4[a]	detected	-	measured	-	> instrumental noise
SO_2-volcanos	If > 2DU	-	If > 1 DU	-	+ Altitude of the plume
Climate	***DOFs***	***Error (%)***	***DOFs***	***Error (%)***	***What the 'NG' brings***
H_2O	5-6	~13%	6-7	~10%	Error improved by 1.5
T	6	~0.6K	12	~0.45 K	Error improved by 2.5
CO_2	1 or less	~1%	1-2	<1%	Low troposphere
CH_4	1or less	~3%	1-2		Less interferences
N_2O	detected	-	measured	-	
Aerosols	dust				More types
Emissivity		0,04 @4µm		0,02 @4µm	