L. Maresi – European Space Agency
W. Van Der Meulen – Netherland Space Office
J. de Vries – Dutch Space

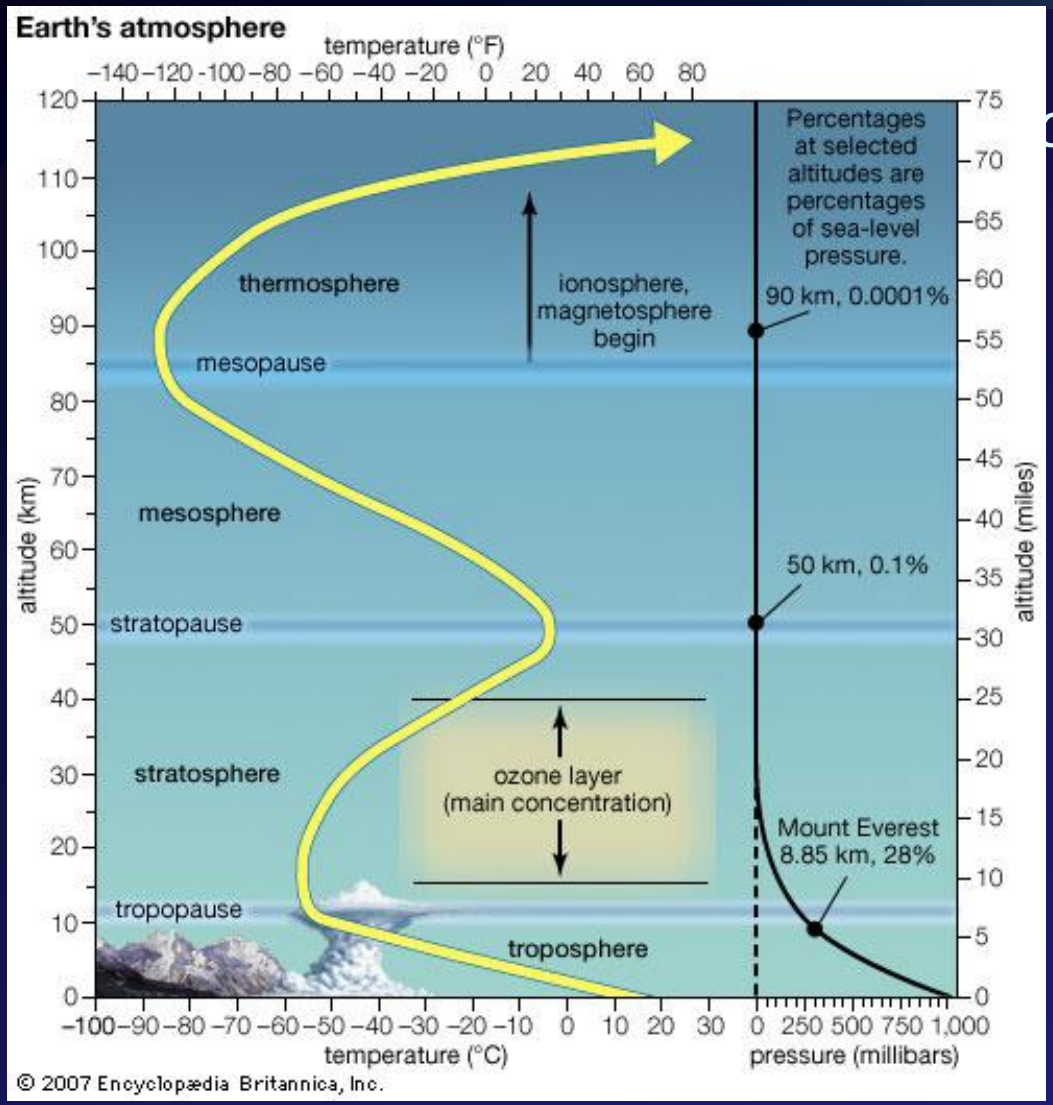
htB
hostile takeover Bank

Two layers of communication

- *Engineers ➔ Technology solutions & innovations*
- *Project & Line Managers ➔Tailoring project and resources*

TROPOMI, mission objectives

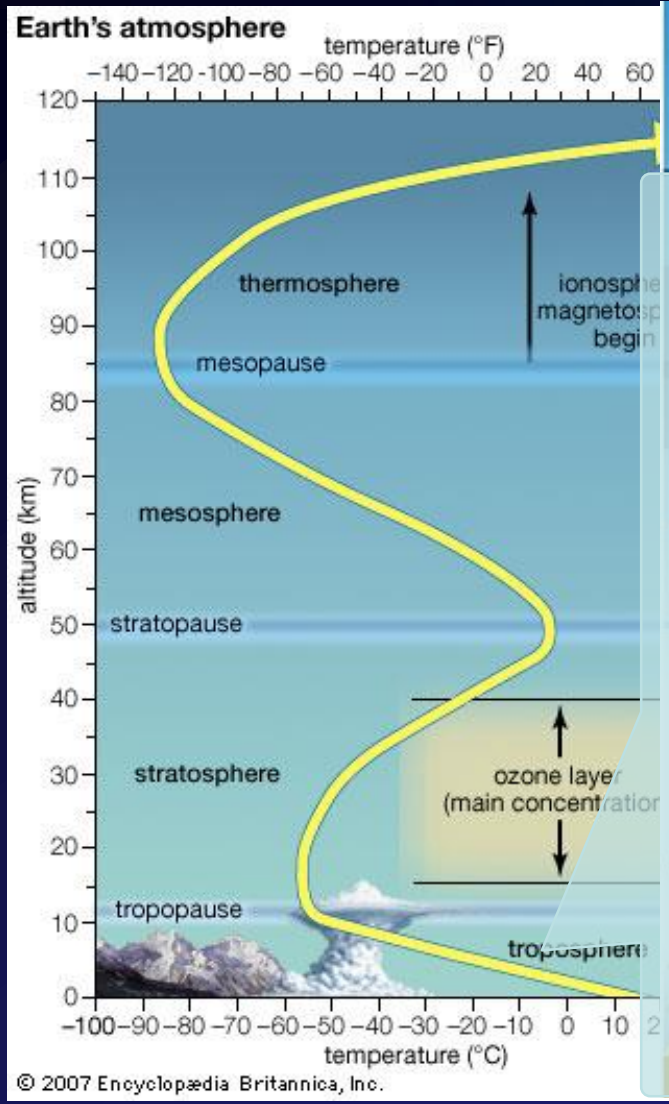
TROPOMI = Troposhere and Ozone Monitoring Instrument

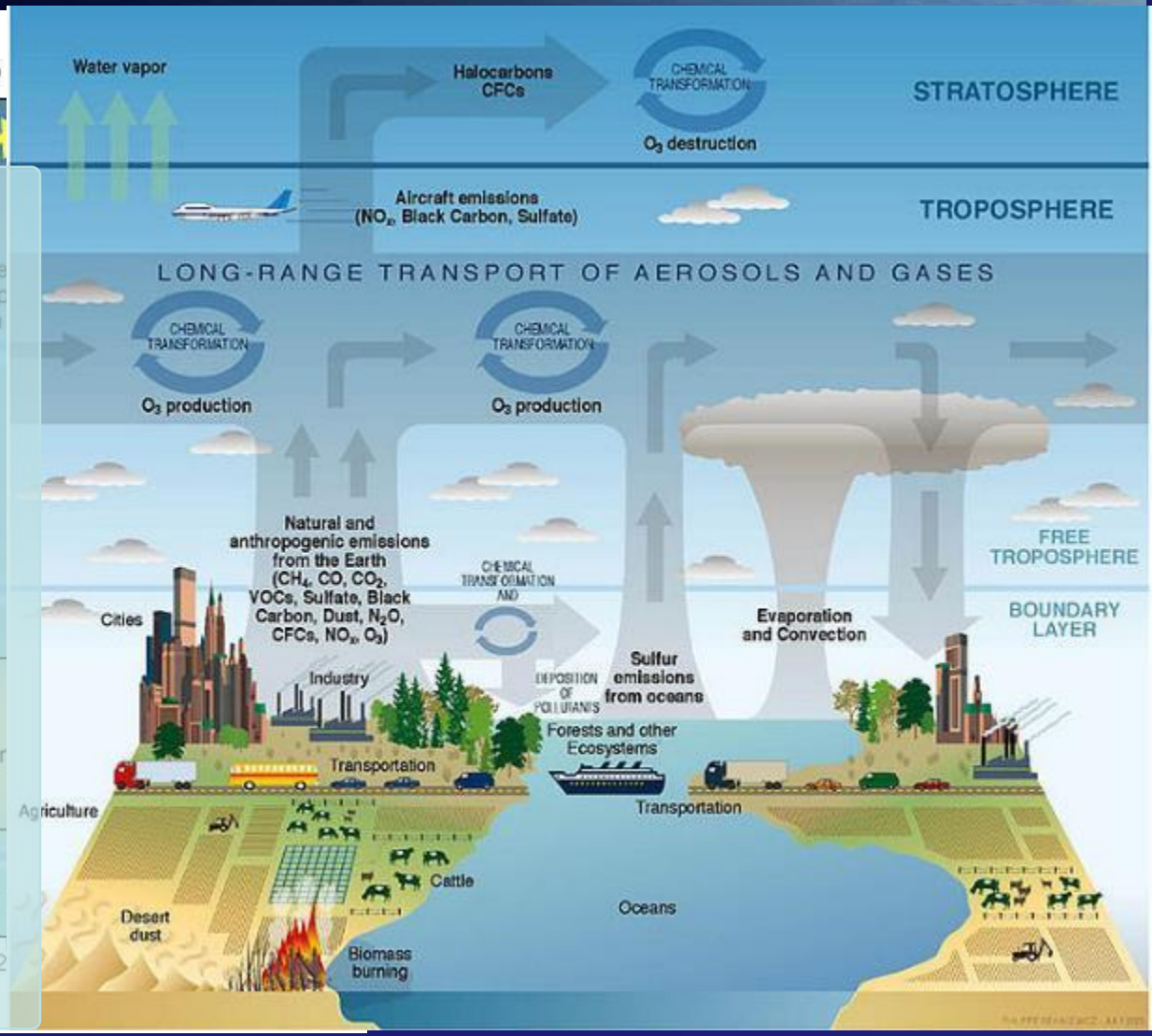


one Monitoring Instrument

TROPOMI, mission objectives

European Space Agency





TROPOMI, mission objectives

*Spatial & Temporal Evolution of **Trace Gases & aerosols***

TROPOMI, mission objectives

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Air quality: Air quality forecasts & enforcement of international protocols

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TROPOMI, mission objectives

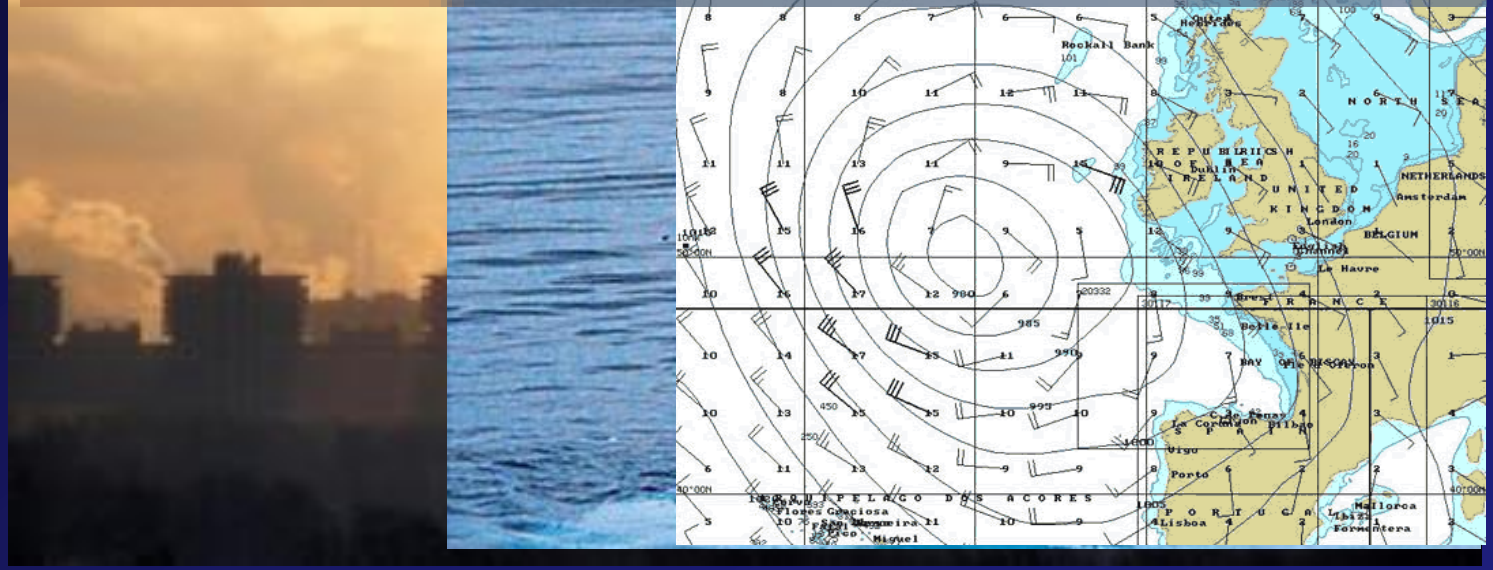
*Spatial & Temporal Evolution of **Trace Gases & aerosols***

Air quality: Air quality forecasts & enforcement of international protocols

Climate: Heat forcing generated by green houses gases (among which methane)

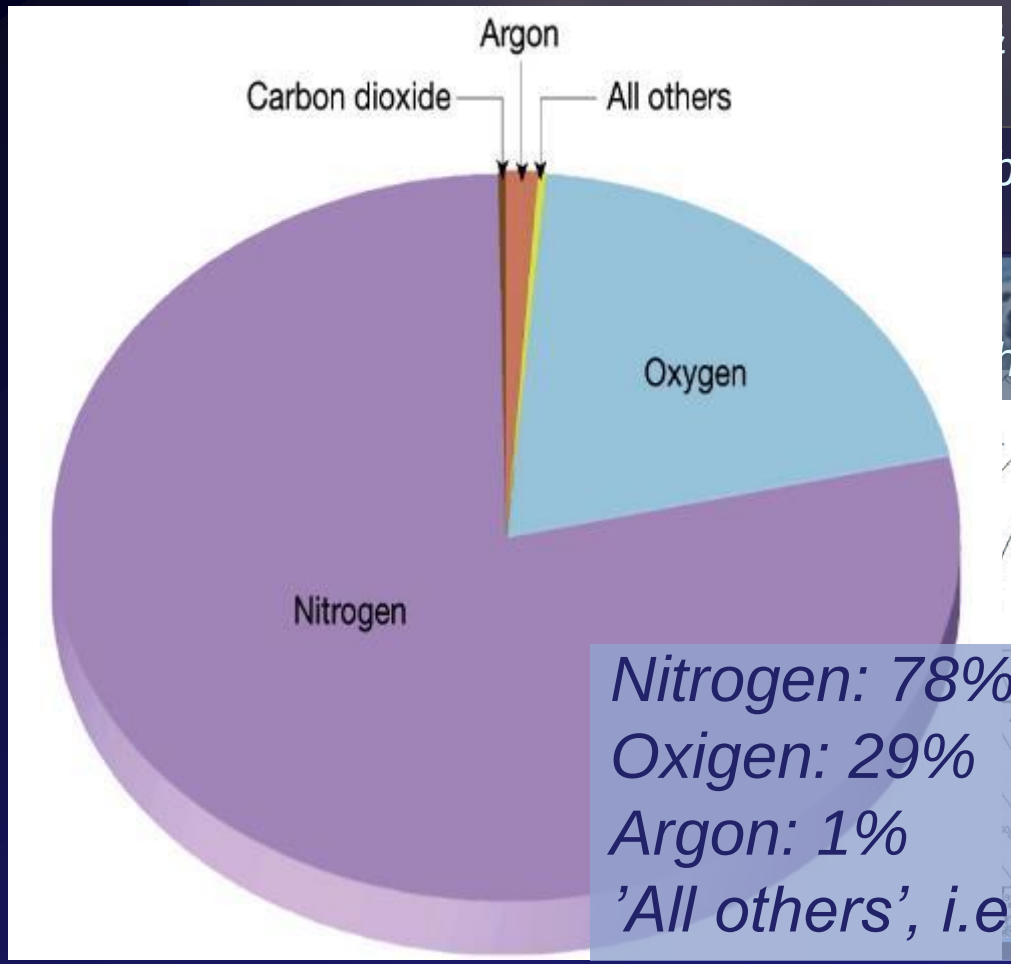
Weather Forecasts:

Effects of chemical processes on the weather



TROPOMI, mission objectives

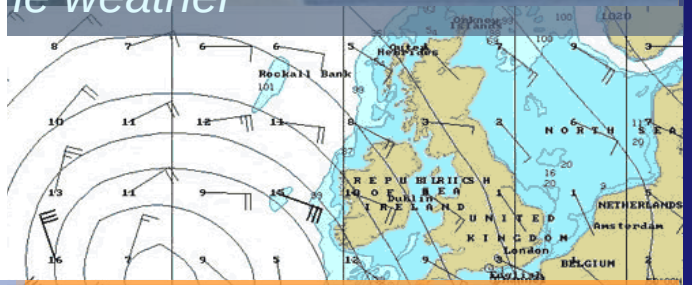
*Spatial & Temporal Evolution of **Trace Gases & aerosols***



enforcement of international

by green houses gases

he weather



Nitrogen: 78%
Oxigen: 29%
Argon: 1%
'All others', i.e. Trace Gases" < 2%

TROPOMI, mission objectives

Level 2 Data Products	Concentration
Sulphur Dioxide (SO2)	20 ppb
Nitrogen Dioxide (NO2)	30 ppb
Carbon Monoxide (CO)	0.1 ppm
Methane (CH4)	1.8 ppm
Glyoxal (CHOCHO)	1 ppb
Formaldehyde (HCHO)	1 ppb
Bromine Monoxide (BrO)	10 ppt

TROPOMI, mission objectives

1 ppm: 1 Gallon in an Olympic swimming pool

TROPOMI, mission objectives

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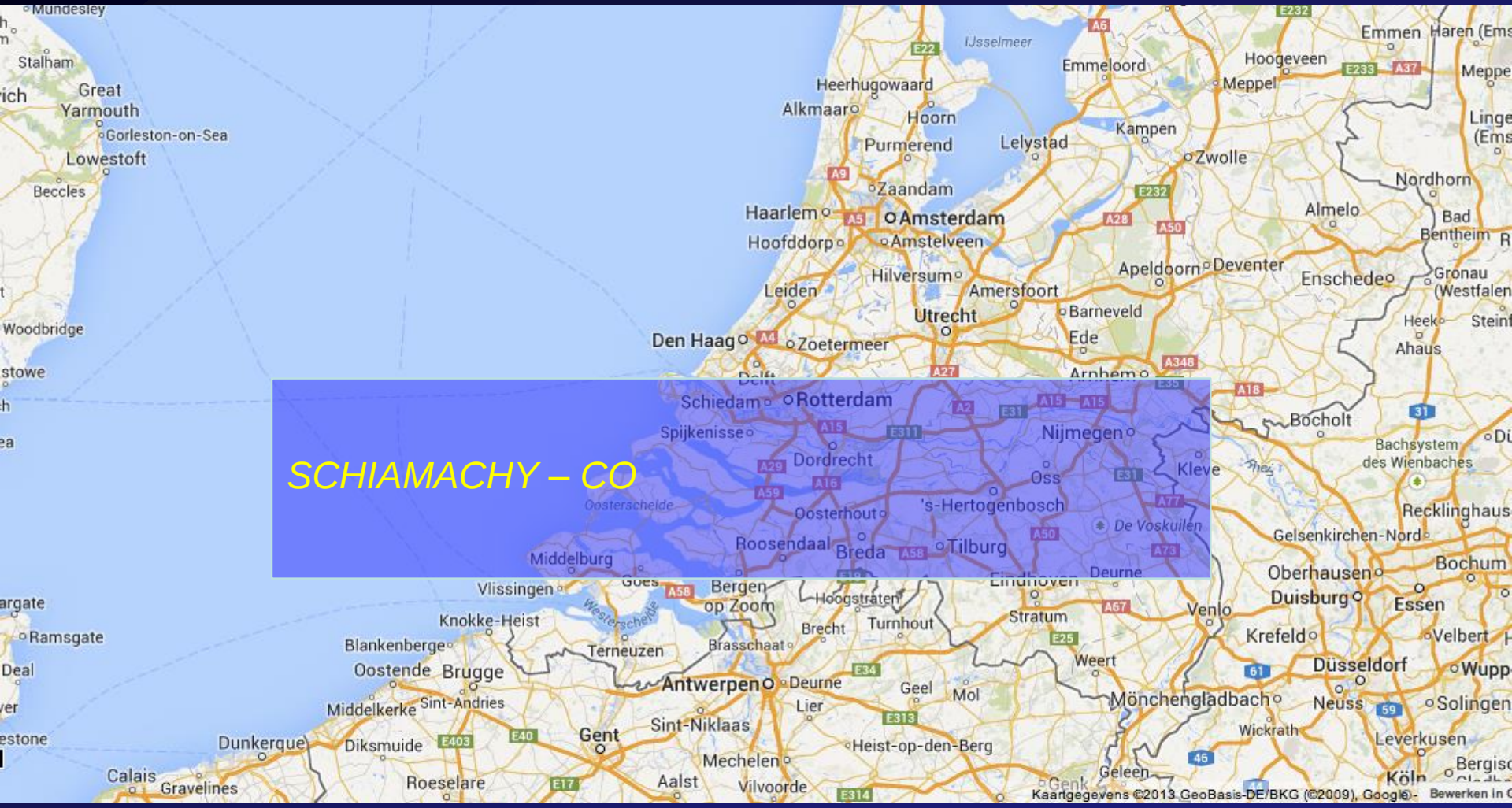
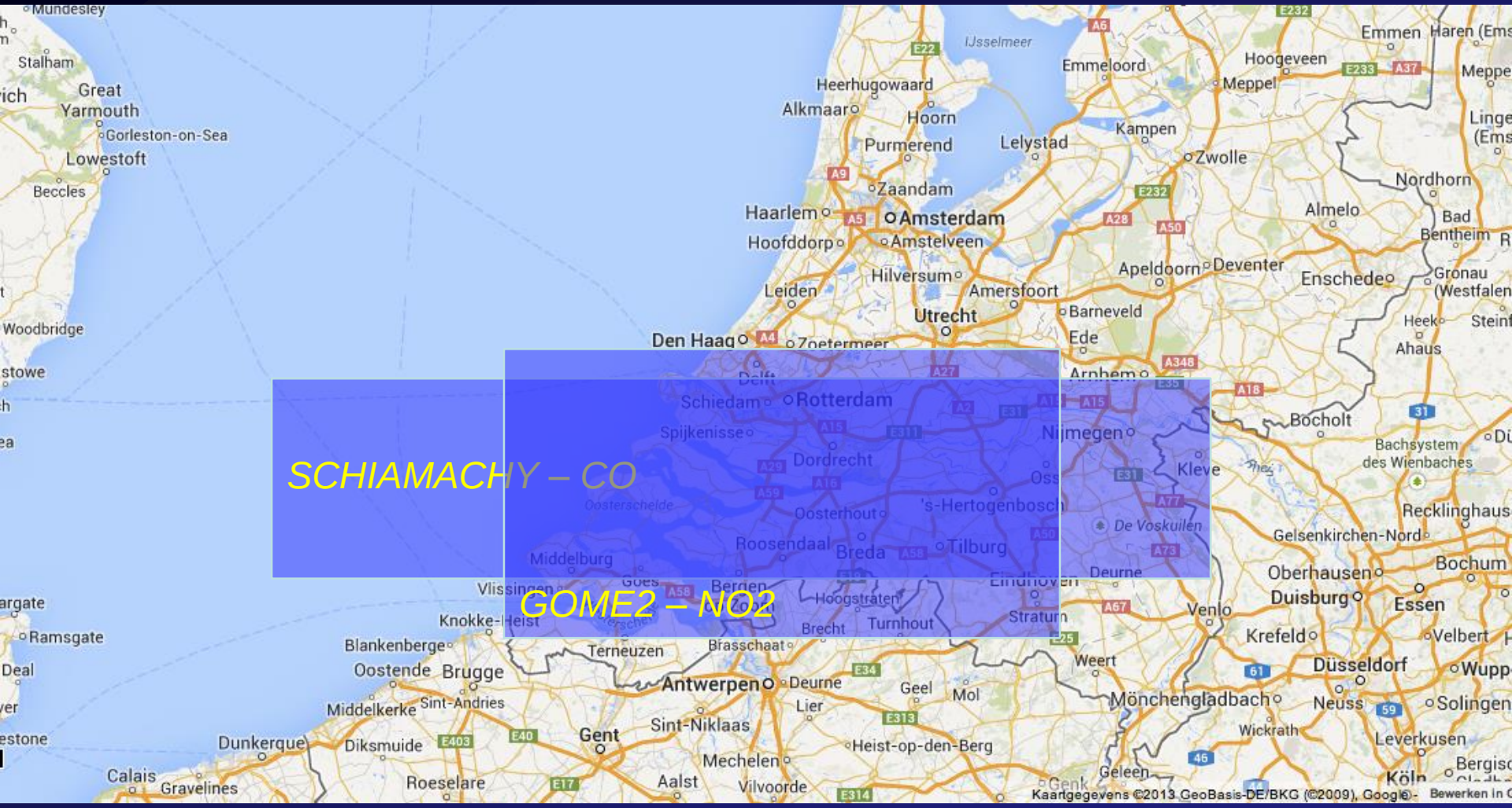
TROPOMI, instrument overview



TROPOMI, instrument overview



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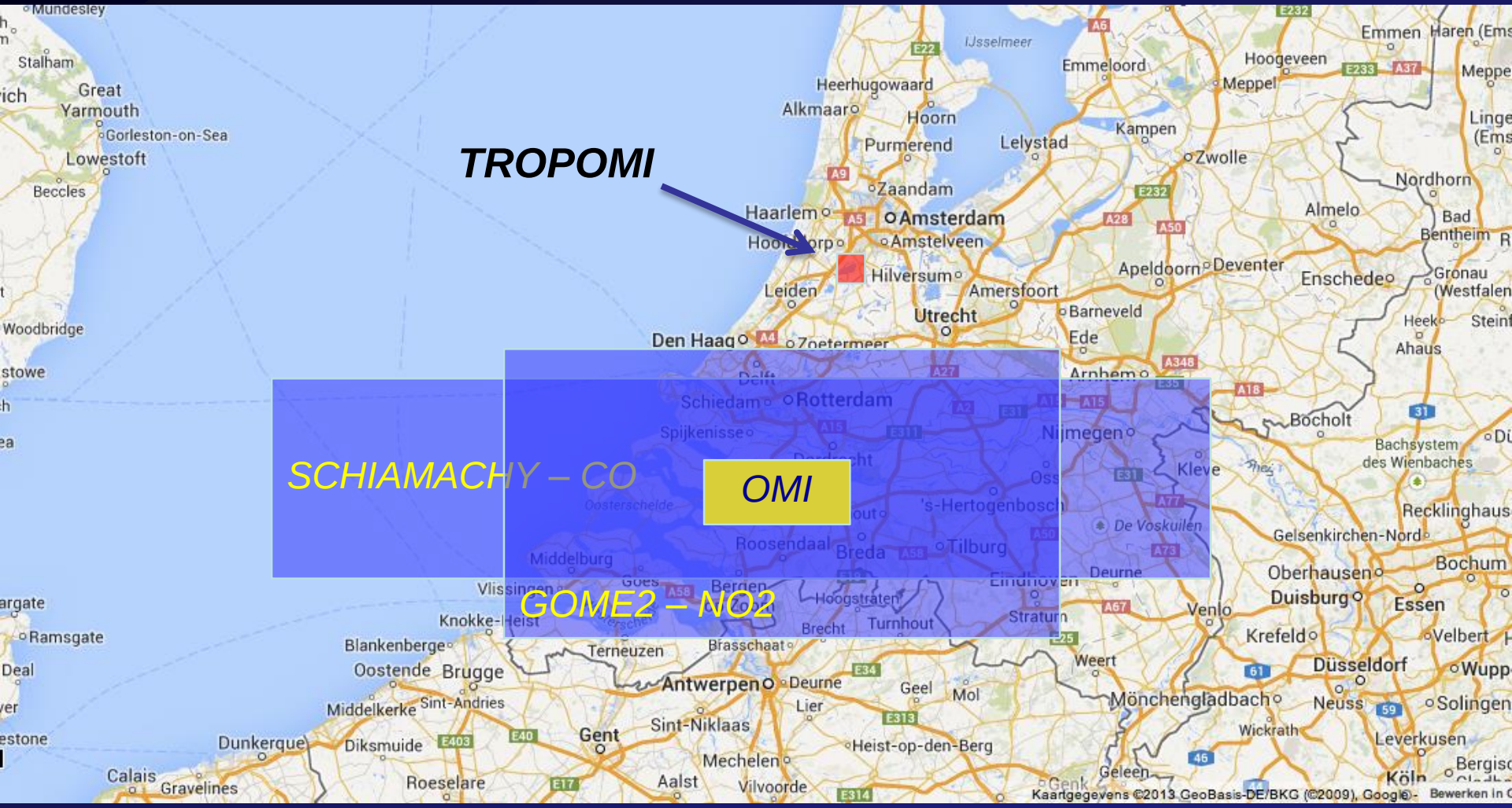

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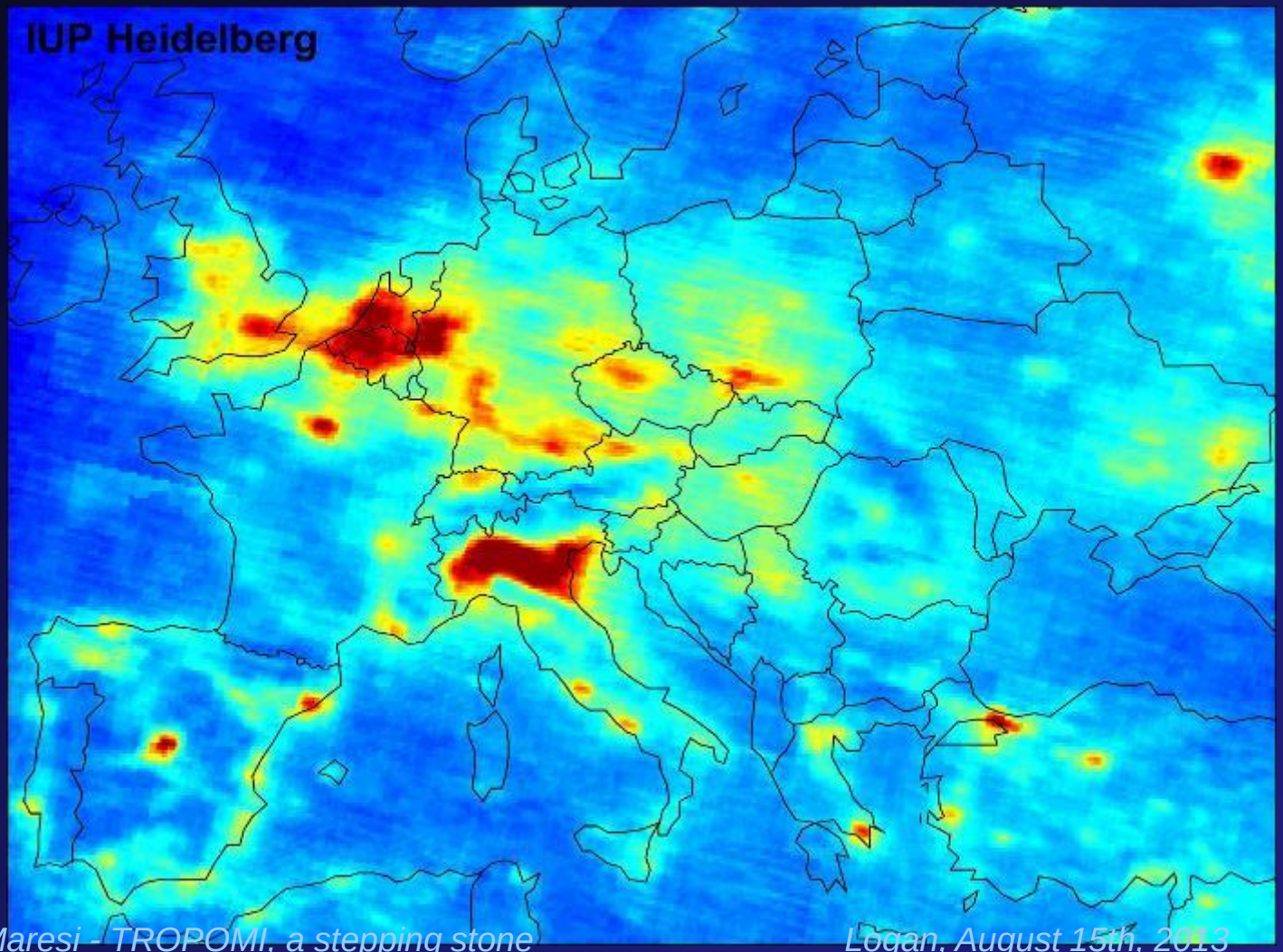

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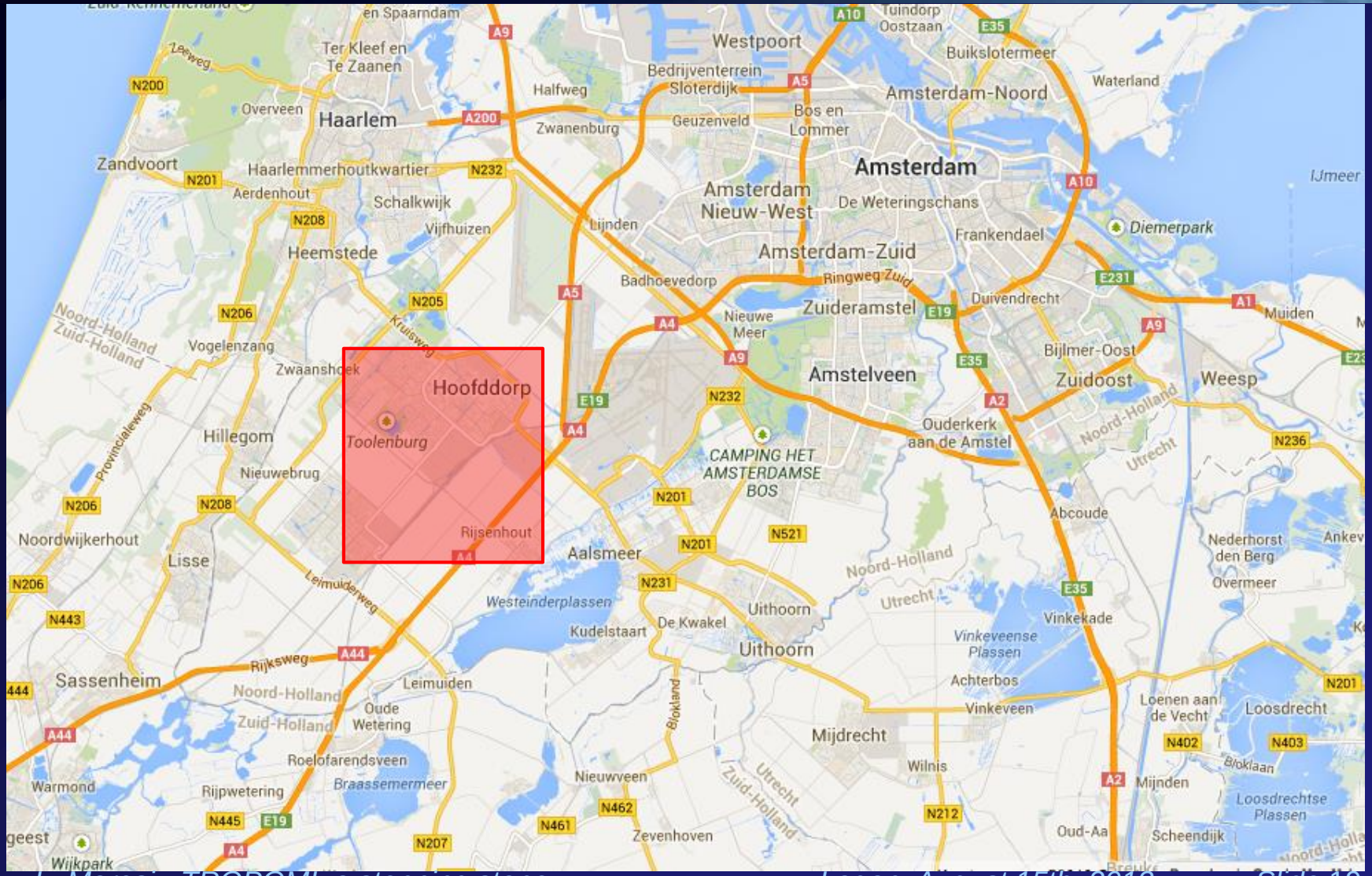


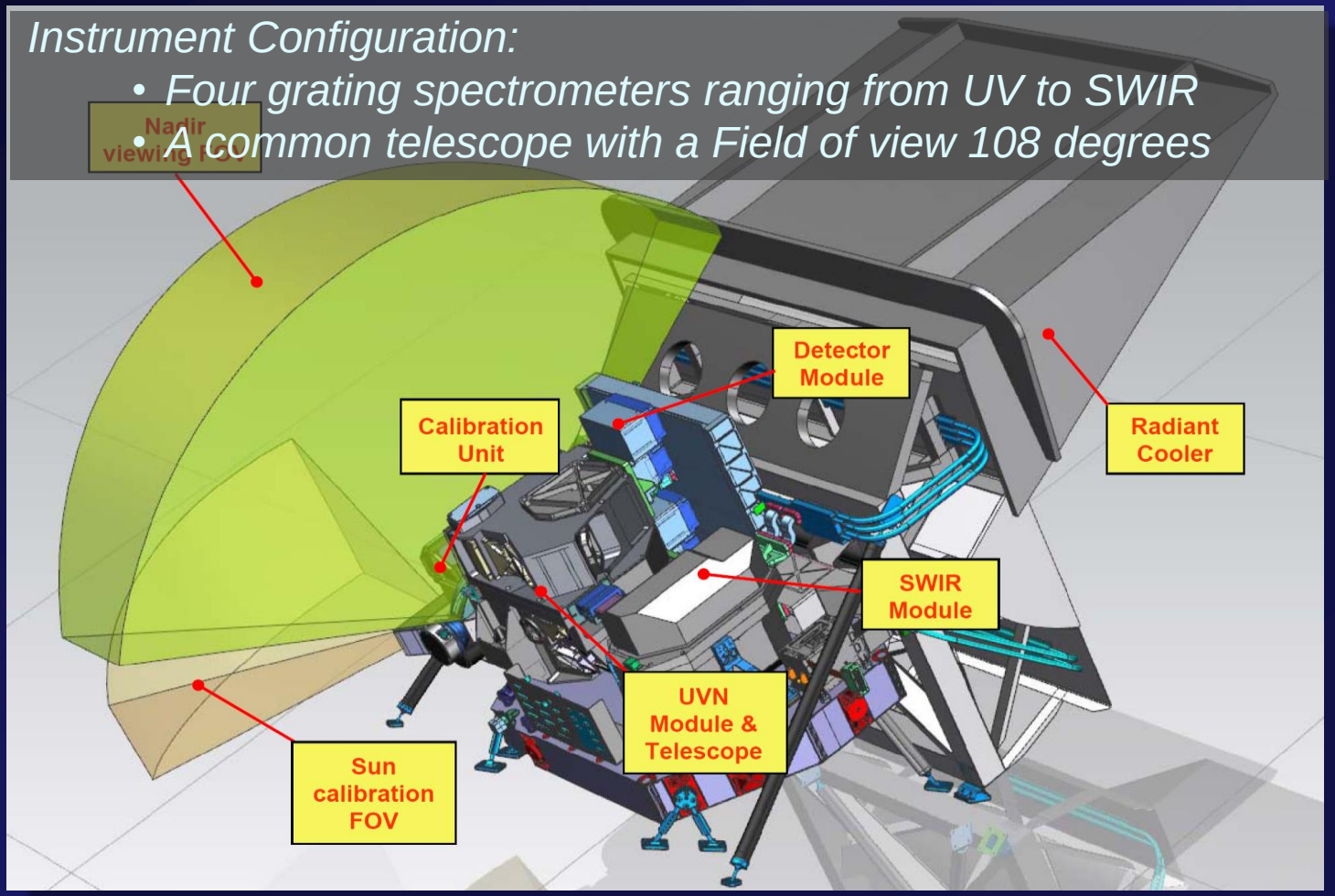
Measurement Method: Differential Optical Absorption Spectroradiometry

TROPOMI, instrument overview

Measurement Method: Differential Optical Absorption Spectroradiometry

Instrument Configuration:

- *Four grating spectrometers ranging from UV to SWIR*
- *A common telescope with a Field of view 108 degrees*

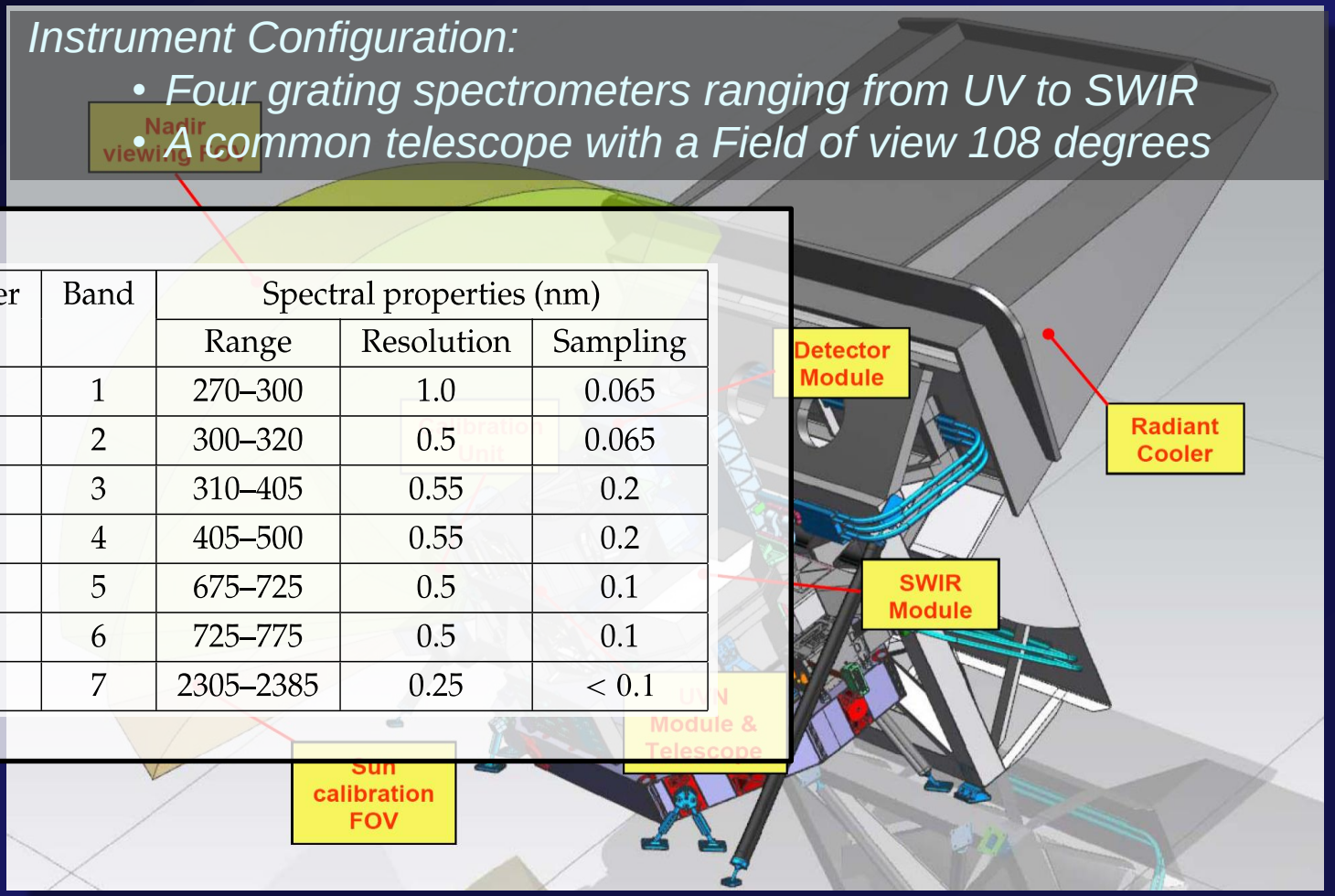


Measurement Method: Differential Optical Absorption Spectroradiometry

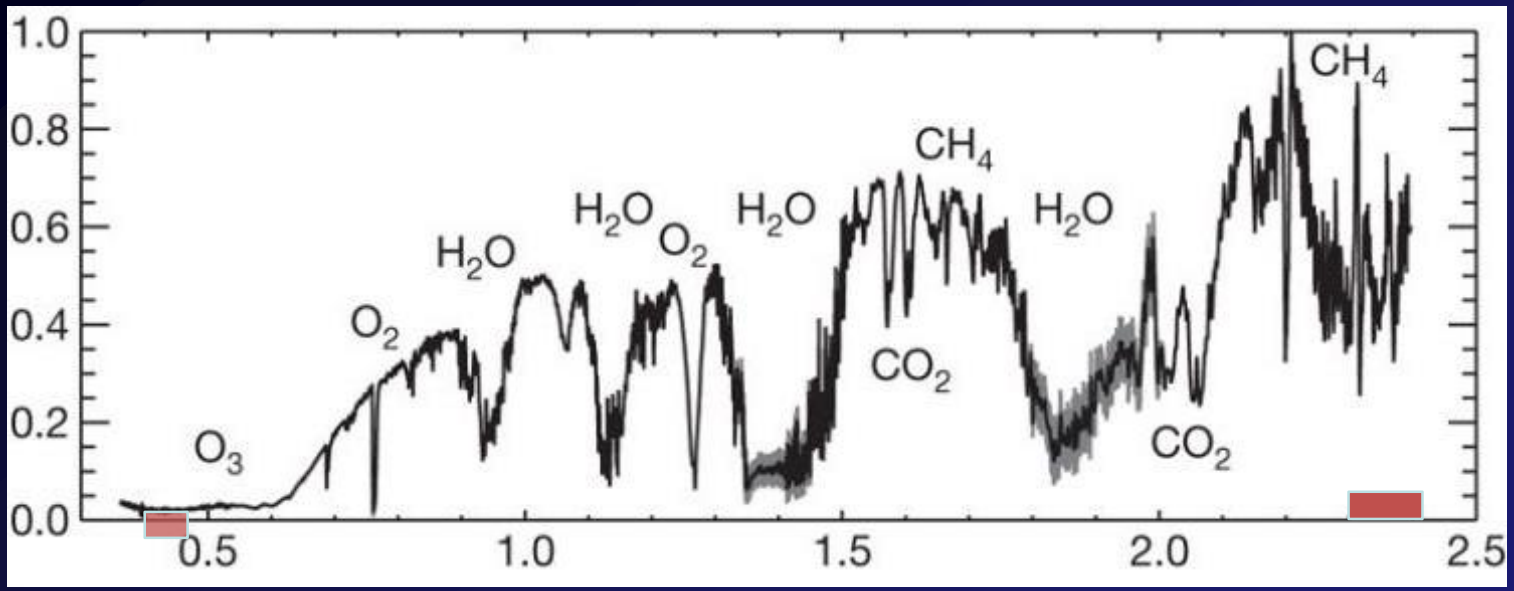
Instrument Configuration:

- *Four grating spectrometers ranging from UV to SWIR*
- *A common telescope with a Field of view 108 degrees*

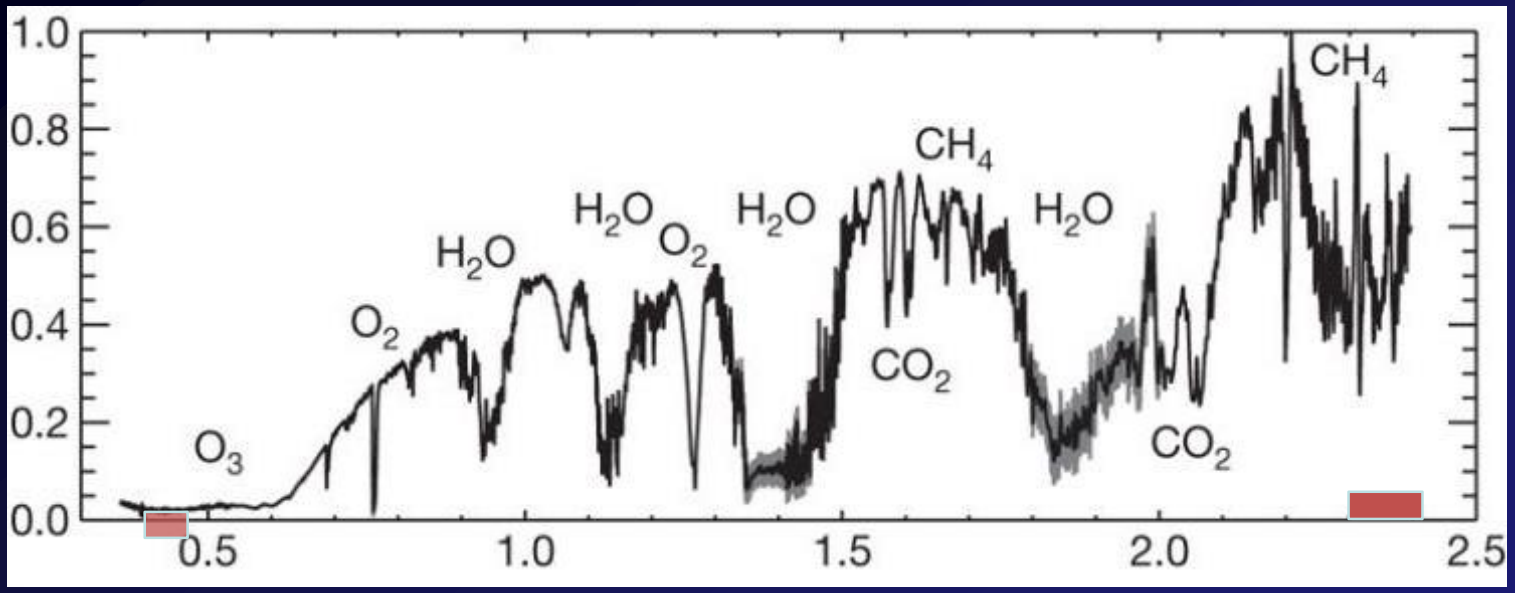
Spectrometer	Band	Spectral properties (nm)		
		Range	Resolution	Sampling
UV	1	270–300	1.0	0.065
	2	300–320	0.5	0.065
UVIS	3	310–405	0.55	0.2
	4	405–500	0.55	0.2
NIR	5	675–725	0.5	0.1
	6	725–775	0.5	0.1
SWIR	7	2305–2385	0.25	< 0.1

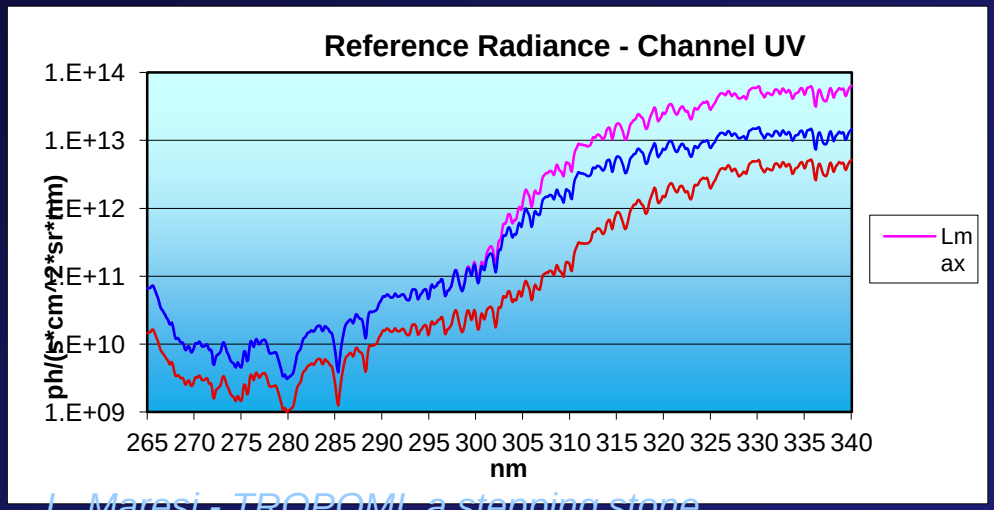


TROPOMI, instrument overview

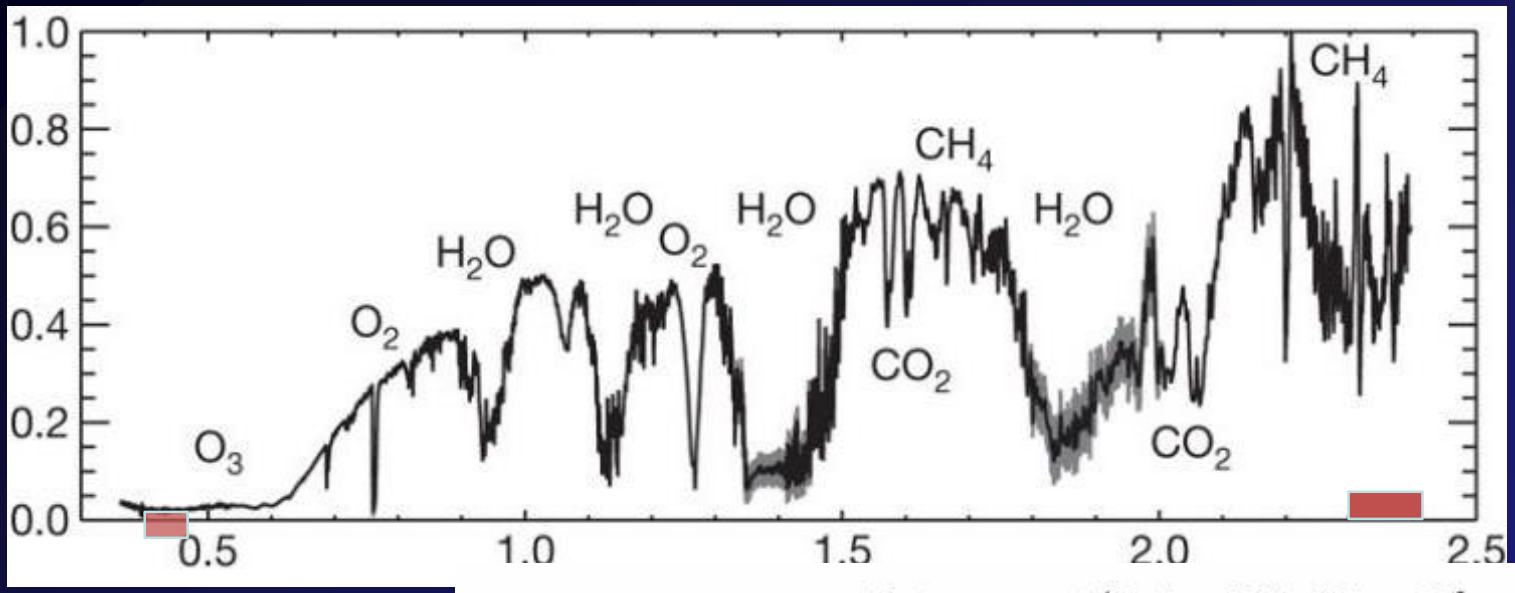


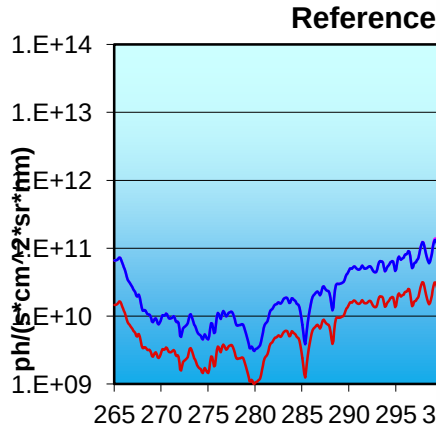
TROPOMI, instrument overview

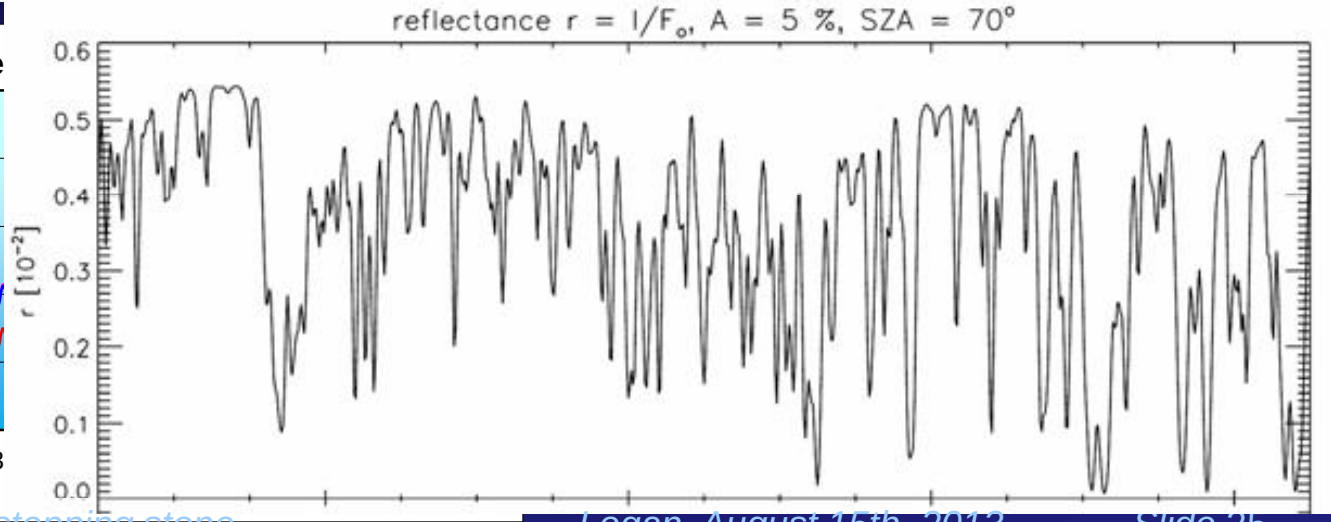




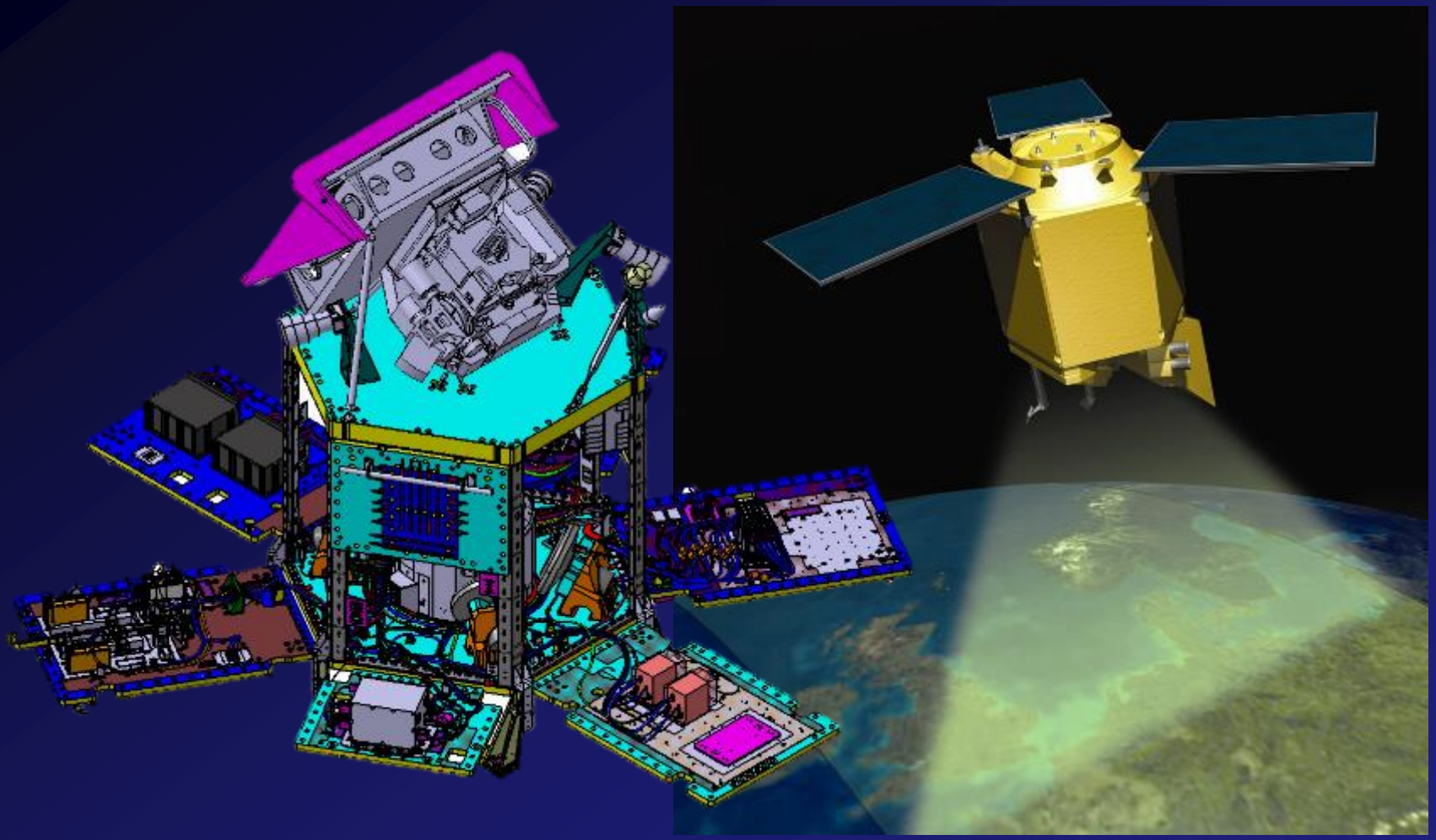
TROPOMI, instrument overview







The Astrium AstroBus 250 on a 820 Km Polar Orbit



PROTFLIGHT Approach

Launch

Aug '15

P/L–S/C Integration

Sept. 2014

Calibration

May 2014

MAIV

July 2013

CDR

Scientific Objectives

Mission Definition

Scientific Objectives

Mission Definition

Payload

Thermal Control & Str.

Telescope

SWIR

UV/VIS/NIR

Electronics

Electronics

I/F Control Unit

Scientific Objectives

Mission Definition

Satellite

S/S Procurement

Ground Segment

Infrastructure

Ground Processing

Payload

Thermal Control & Str.

Telescope

SWIR

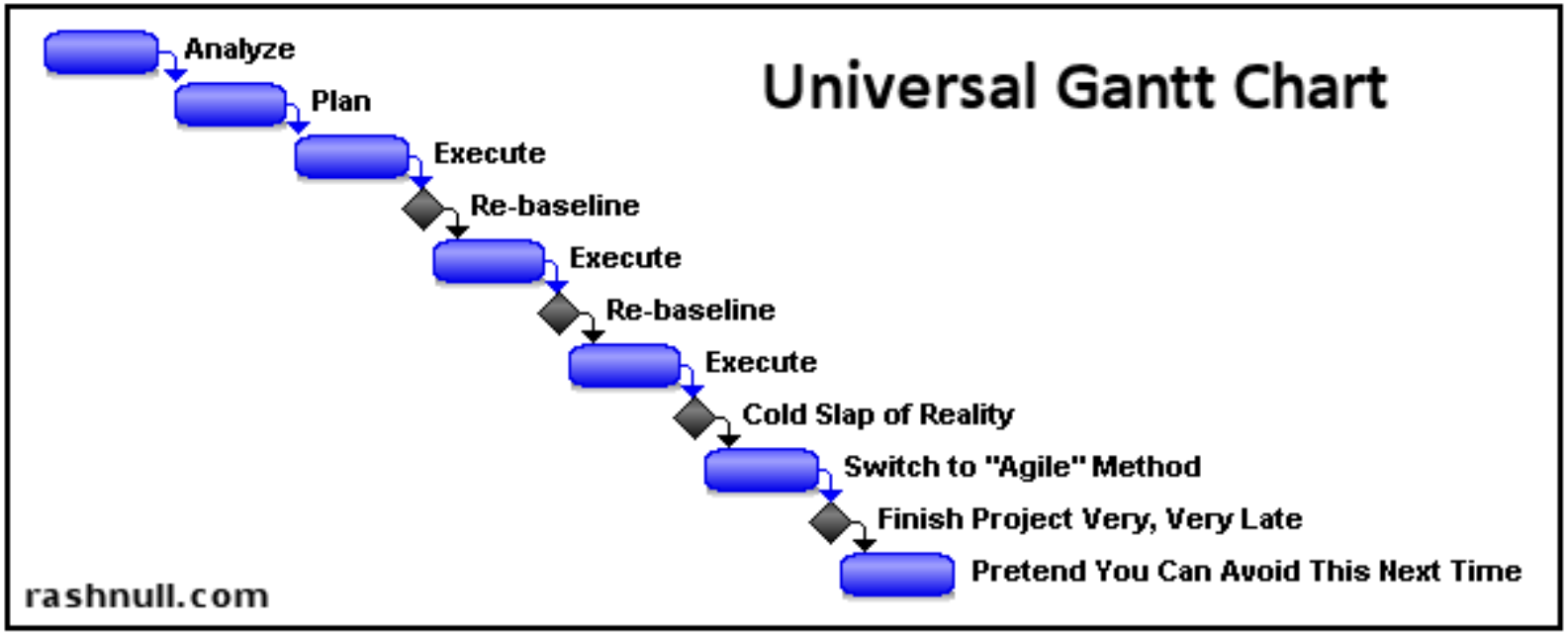
UV/VIS/NIR

Electronics

Electronics

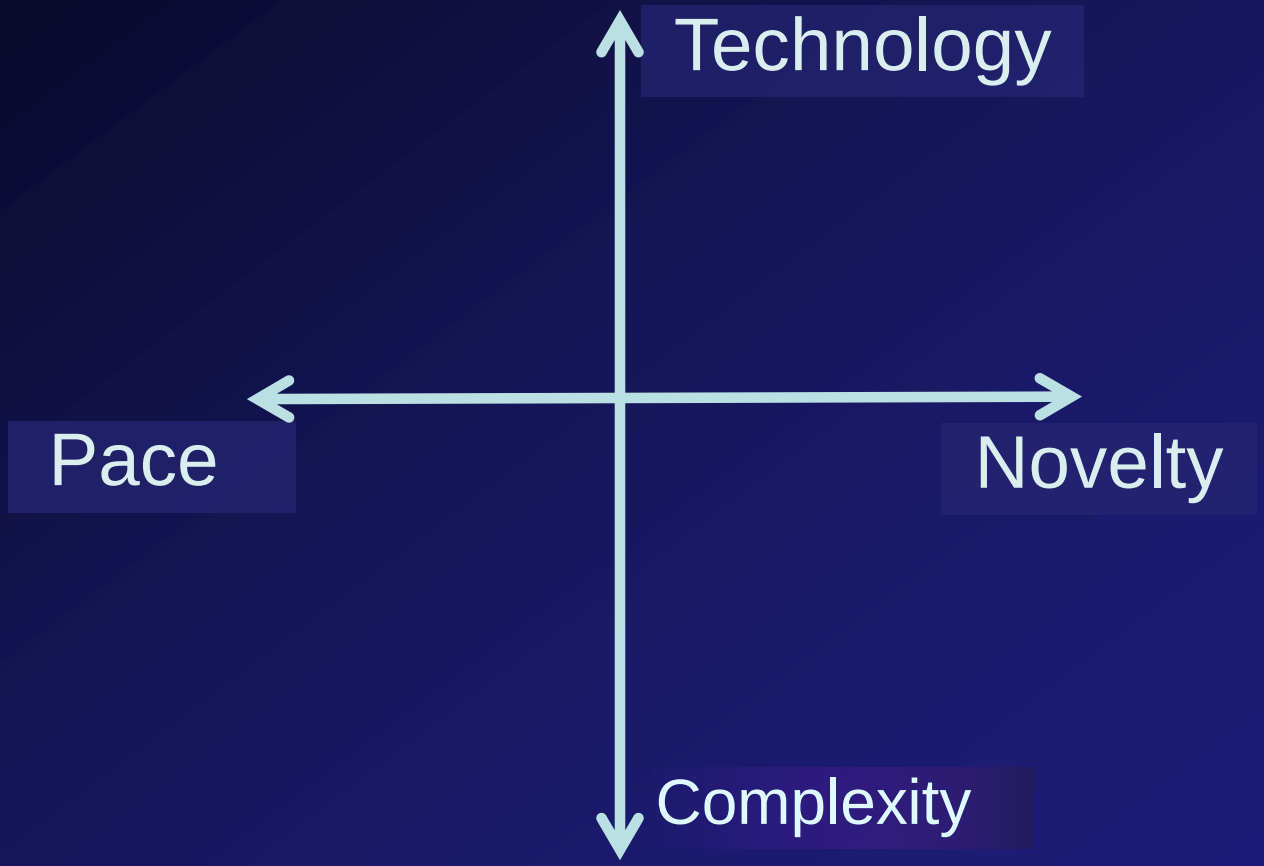
I/F Control Unit

Universal Gantt Chart



Project Jumpstarting: lessons learned from TROPOMI

The NTCP Reference Frame



Project Jumpstarting: lessons learned from TROPOMI

The NTCP Reference Frame

Technology

Pace

Novelty

Complexity

Project Jumpstarting: lessons learned from TROPOMI

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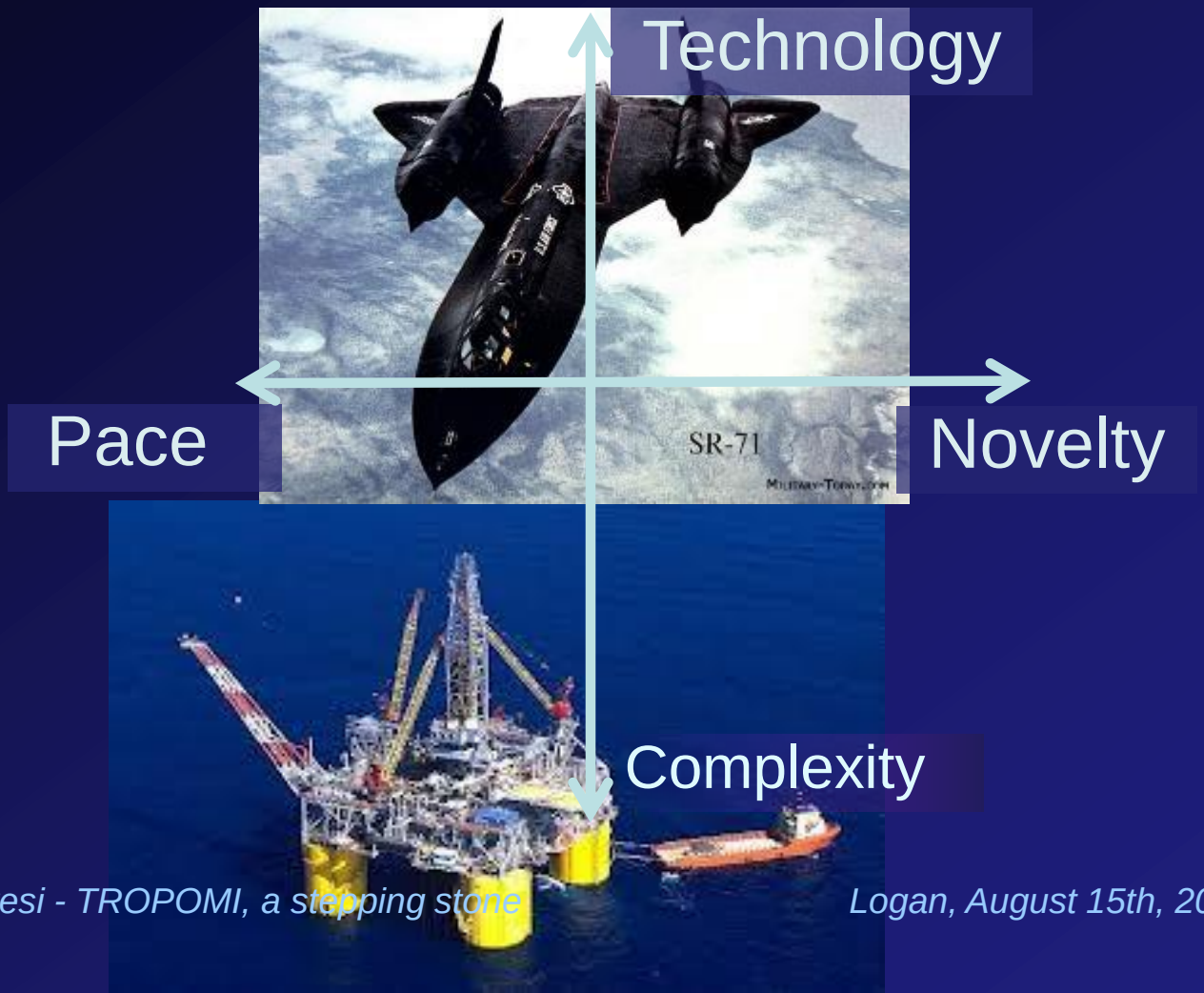

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Novelty

Complexity

"Life is really simple, but we insist on making it complicated." — Confucius

"Life is really simple, but we insist on making it complicated." — Confucius

"Atmospheric Chemistry is really complicated, but we insist in making it simple"
- Harry Foerster

"Life is really simple, but we insist on making it complicated." — Confucius

"Atmospheric Chemistry is really complicated, but we insist in making it simple"
- Harry Foerster

"This project has only two speed: forward and fast forward" – Kevin McMullan

Technology Platform & Technology Evolution.

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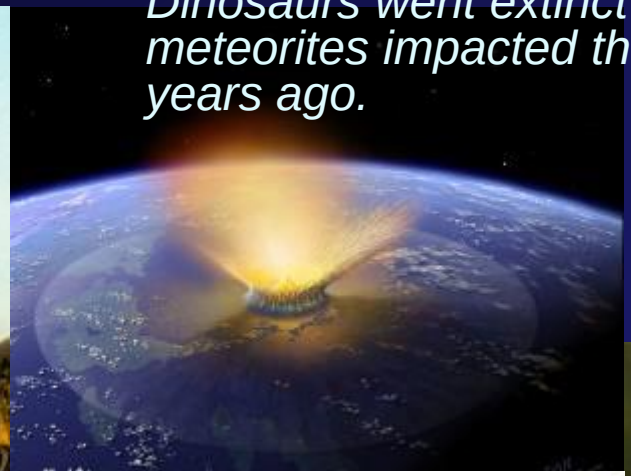
*Dinosaurs went extinct 31,000 years **after** a meteorites impacted the Earth 65 million years ago.*

Technology Platform & Technology Evolution.



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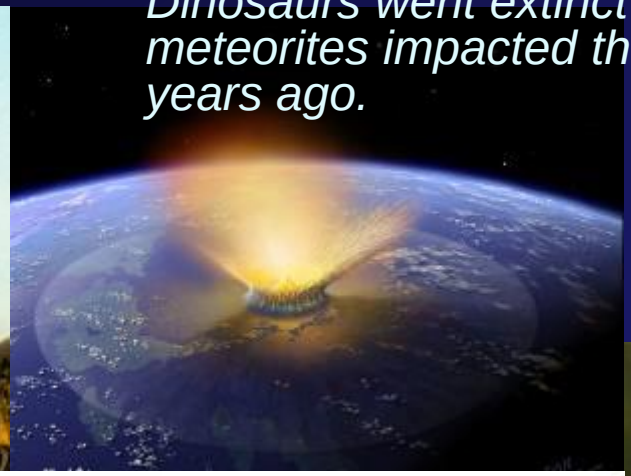
Technology Platform & Technology Evolution.



*Dinosaurs went extinct 31,000 years **after** a meteorites impacted the Earth 65 million years ago.*

Palm went out of business 31 months after its peak market success.

Q#1: What is our competitive advantage?

Q#2: What can we reuse for the next generation?

Q#3: What technologies may will make the design obsolete?

➔*What is our Technology Platform?*

TROPOMI, a stepping stone

The Technology Platform of TROPOMI is a stepping stone for future atmospheric chemistry missions

TROPOMI, a stepping stone

The Technology Platform of TROPOMI is a stepping stone for future atmospheric chemistry missions

OMI was launched on 2004, first data on SO_2 were released in 2008.

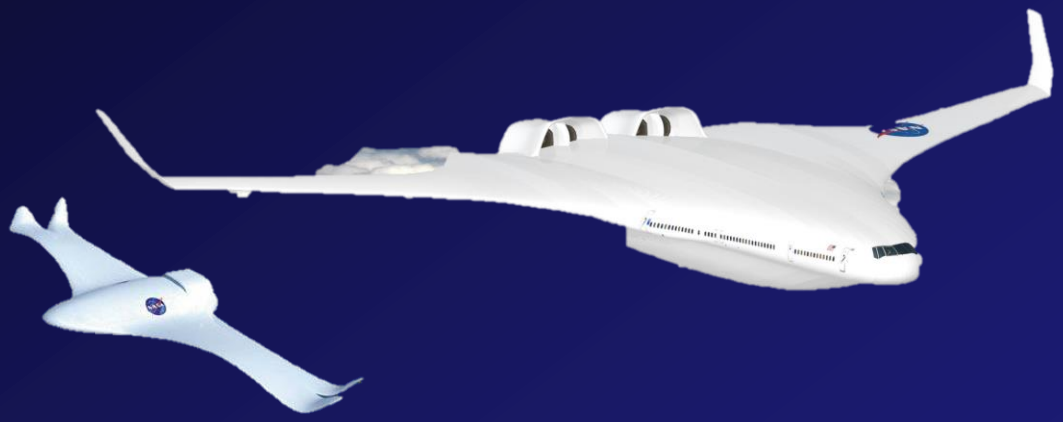
➔ *Atmospheric Chemistry is still in his infancy*

Which direction to go?

Which direction to go?

Bigger & Better

Smaller & Smarter



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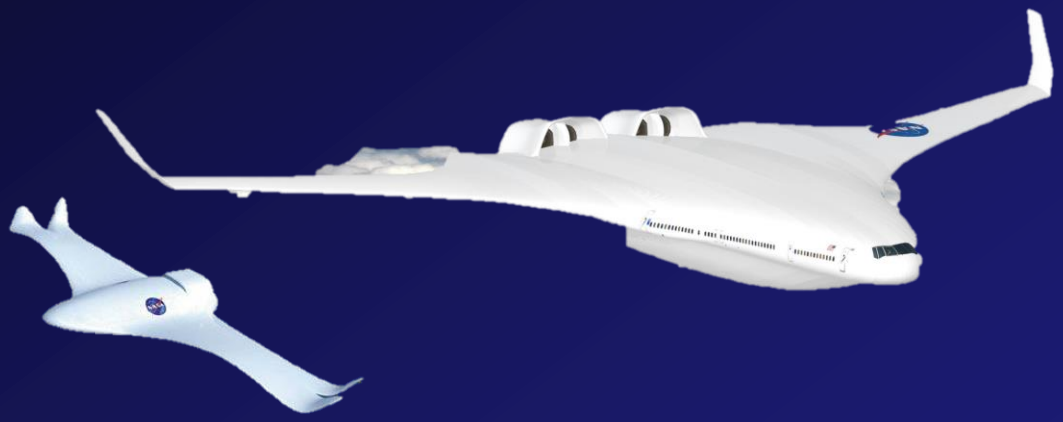
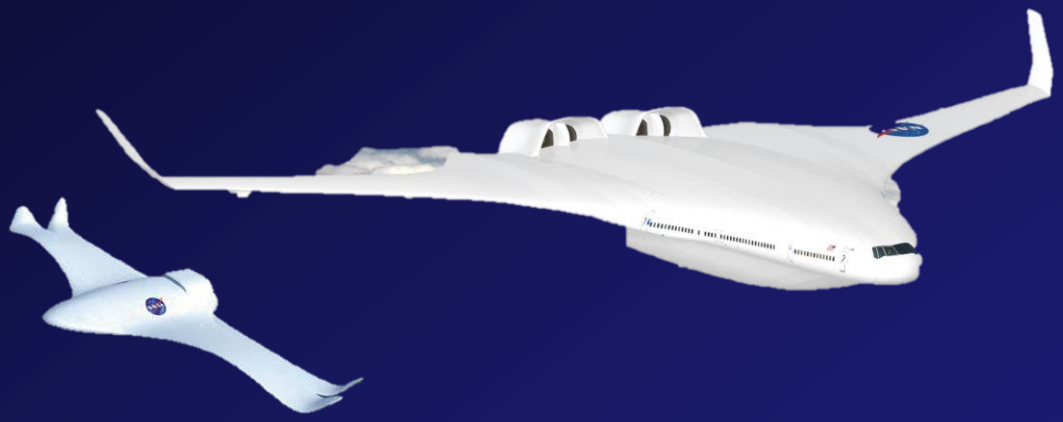


"It's too complicated, too different, you won't have any users. Come back with something standard" - comment of an app developer to the new Palm OS

Which direction to go?

Bigger & Better

Smaller & Smarter

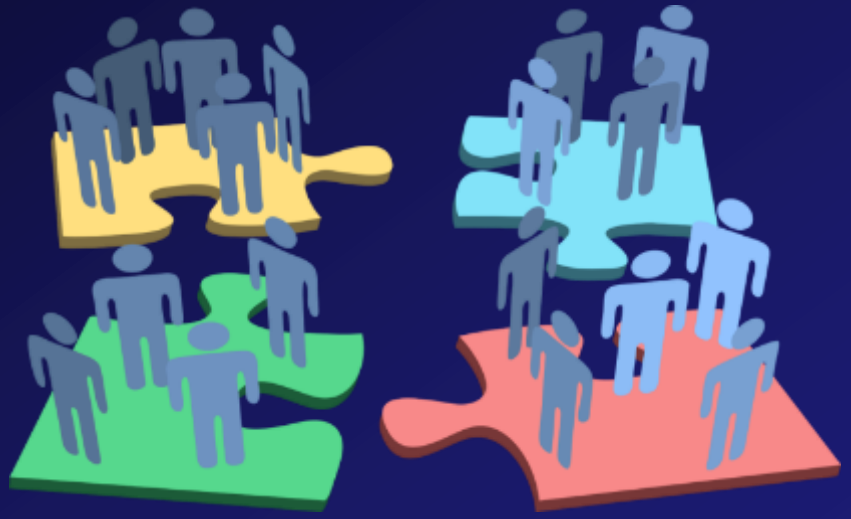


A simplified 'entry level' version of TROPOMI will have a larger user base and will to ensure continuity to the cluster of expertise.

Stakeholder analysis

Industry will have less margin

Engineers don't see it challenging



National Agencies & ESA won't break the news with a simpler instrument.

The Scientist not interested in an instrument with similar performance.

➔ *nobody is interested in supporting a more affordable instrument:*

TROPOMI, next step

Smaller and simpler?

Convincing arguments WANTED!!

QUESTIONS

“If you're not confused, you were not paying attention.” — Tom Peters,

QUESTIONS

"If you're not confused, you were not paying attention." — Tom Peters,

Netherlands Space Office

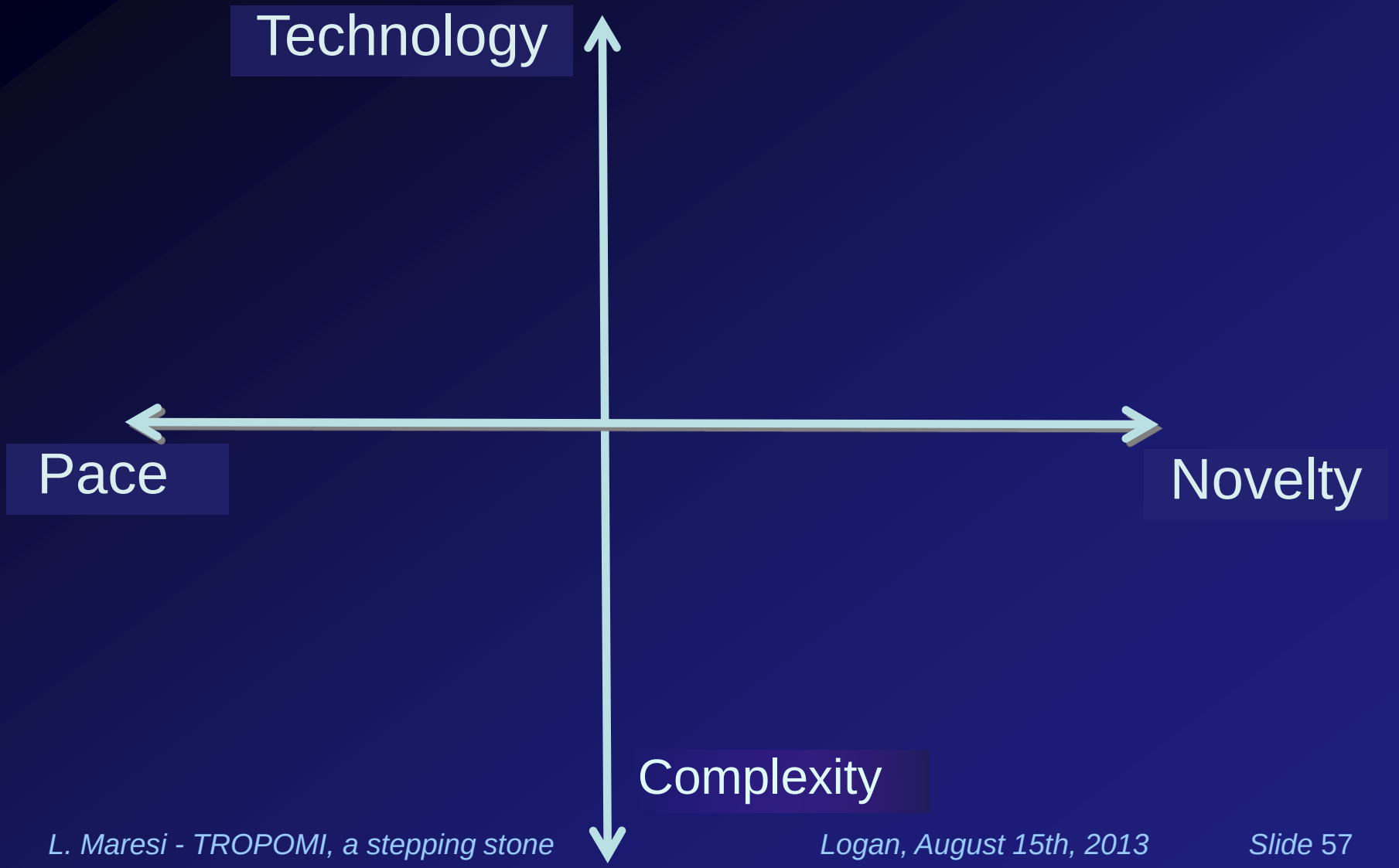
TROPOMI

Dutch Space

SRON

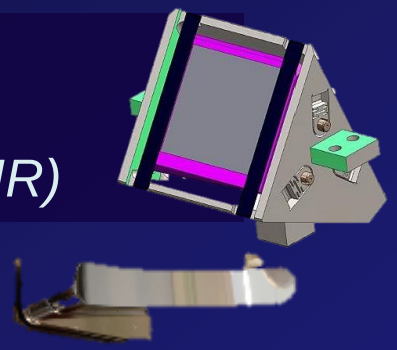
TNO innovation for life

"The real discovery is not in finding new lands but in seeing with new eyes." – Marcel Proust


Technology
Pace
Novelty
Complexity

Technology

Freeform Telescope
Immerse Grating (SWIR)
Detectors (UV/VIS & SWIR)



Pace

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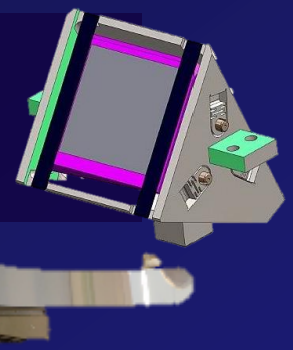

Pace

Novelty

Novel product retrieval, not yet used in NWP, first instrument to retrieve CH4

Complexity

Technology

Freeform Telescope
Immerse Grating (SWIR)
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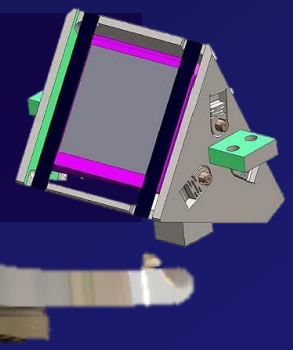


Pace

Novelty

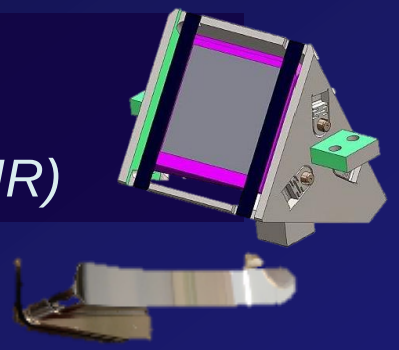
Novel product retrieval, not yet used in NWP, first instrument to retrieve CH4

Procurement Constraints

Complexity

Technology

Freeform Telescope
Immerse Grating (SWIR)
Detectors (UV/VIS & SWIR)



Precursor Mission

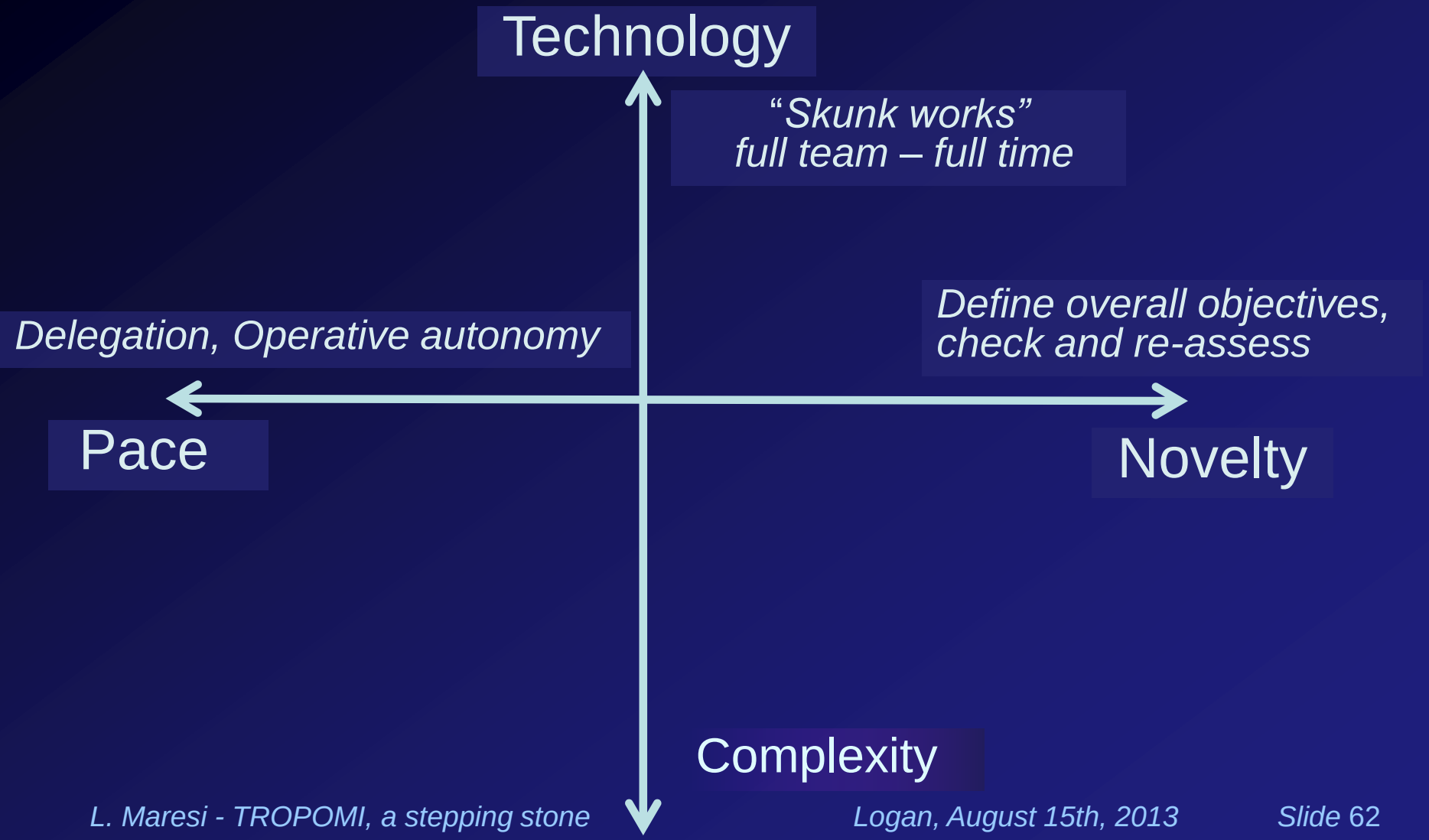
Pace

Novelty

Novel product retrieval, not yet used in NWP, first instrument to retrieve CH4

Procurement Constraints

Complexity


Technology
"Skunk works"
full team – full time
Define overall objectives,
check and re-assess
Delegation, Operative autonomy
Pace
Novelty
Complexity