INTOSPASS® INTERNATIONAL OUTER SPACE ASSOCIATION

Vision

"New Space Powered by Traditional Space Heritage"

Mission

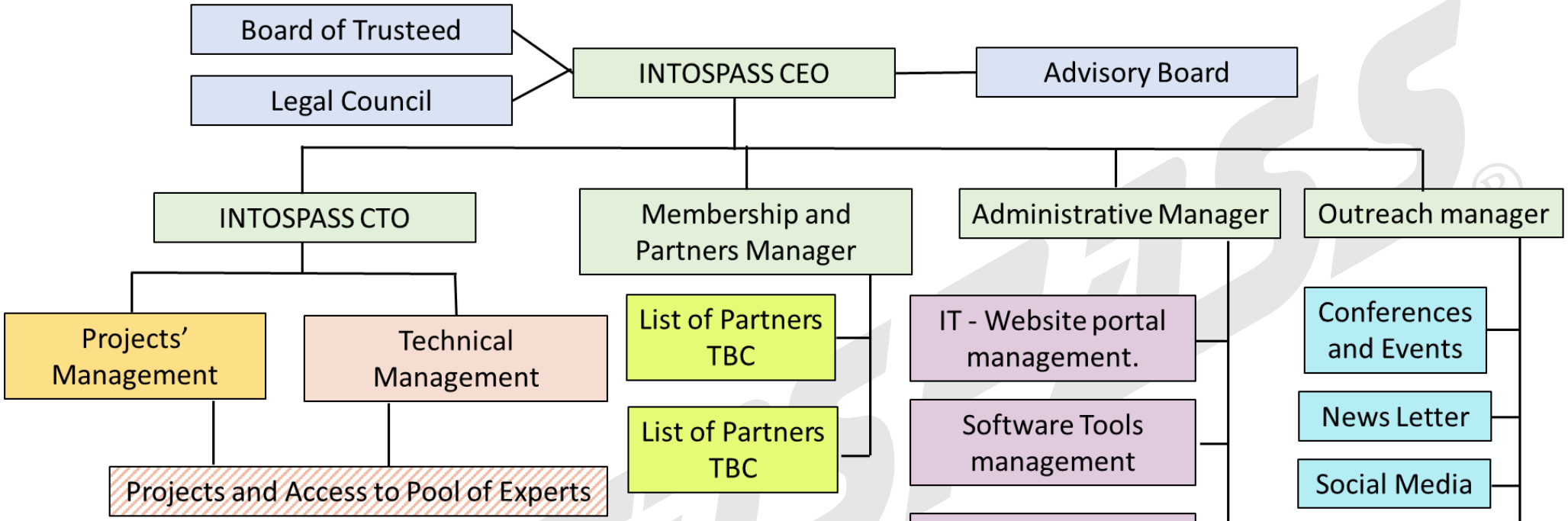
"To create an environment where "New Space" enterprises and entrepreneurs can have access to a community of seasoned Space science and technology experts and project opportunities that include international cooperation and collaboration focusing on terrestrial applications."

Objectives

- ❑ Blend "New Space" agility with "Traditional Space" resilience maintaining the advantages of fast Space missions' lead times and low cost while ensuring high reliability and availability.
- ❑ Promote collaboration at an international level to develop innovative Space projects, with a focus on helping solve environmental issues.
- ❑ Encouraging innovative practical applications by utilizing data generated by Space missions, with a focus on supporting a healthy green sustainable environment.
- ❑ Identify international funding opportunities and assist its members in accessing them.
- ❑ Arrange preferential rates access to world class Space facilities such as ground station, MAIT, environmental and radiation testing facilities offered by its Partners.

Services

- **Facilitate the exchanging knowhow and Expert Advice** - "**Interlink**". A virtual platform for its members to exchange knowledge on specific needs.
- **Support "New Space" enterprises and entrepreneurs** to succeed and grow by promoting them, providing them with advice and assisting them in identifying suitable partners.
- **Setting up Collaborative Innovative International Projects** and providing the required expertise through its "Expert Members".
- **Organising thematic calls for project proposals** that its members can participate in.
- **Facilitate access to facilities across the globe** that are offered through its "Partners".
- **Facilitate access to software tools** offered through its "Partners" e.g. for modelling and simulation
- **Set up a one stop virtual shop for developing Space missions** from payload requirements to satellite and CONOPS concepts.
- **Organising workshops, seminars, and conferences** as well as various outreach activities.



Experts who are willing to consider joining the Association as an "Expert Member", pending formal agreement and approval (Listed in Alphabetical order):
Avelino Adalid, Adriano Camps, Aquib Moin, Andrés Gómez Paz, Diogo Rodrigues, Chris Castelli, Chris Lee, Jose F. Moreno-Alvarez, Khaled Al Hashmi, Khaled Alawadhi, Martin Gee, Petr Bares, Richard Holdaway, Richard Peckham, Rafael Ponce, Raid M Suleiman, Ingemar Söderquist, Mohamed Amara, Mohamed Ibrahim, Mohamed Zayan, Satishchandra Wani, Wael El Dali.

INTOSPASS Organisation Chart

The MEASMA Observatory Projects

"Middle East & Africa Space-based Monitoring of Atmospheric-pollution"

مشاريع راصد المياسما

"المراصد الفضائية لمراقبة التلوث الجوي فوق الشرق الاوسط وافريقيا "

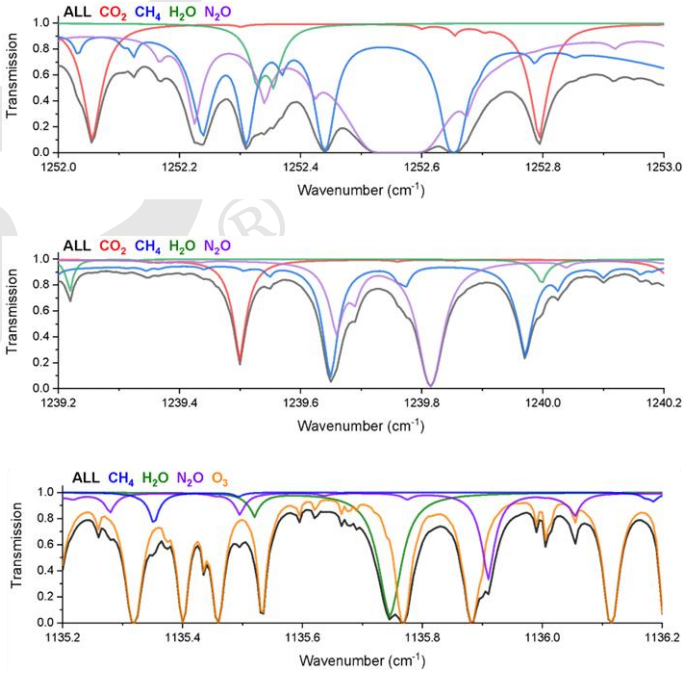
- **MISO-IOD and MISO-XL LEO Constellation:** An RAL-Space unique and innovative remote sensing payload for measuring and monitoring constituents of atmospheric layers from 6km up to 80km in Altitude, with vertical spatial resolution <3km. INTOSPASS to provide support by identifying partners that can provide CubeSAT platform(s) and support mission(s) through bilateral agreements.
- **MEASMA Observatory GEO Instrument:** Is an INTOSPASS initiative that aims to deploy a UV/VIS hyperspectral monitoring instrument developed by Ball Aerospace (being acquired by BAE), based on NASA's TEMPO and KARI/NIER's GEMS. It will measure the principal elements of tropospheric air pollution over the Middle East and Africa.

MISO IOD and XL LEO Satellite Projects

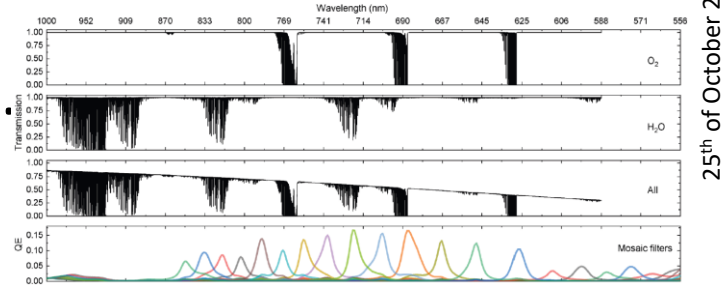
"The Monitoring of atmospheric constituents and their Isotopologues by Solar Occultation"

MISO Science Overview:

- ❑ High-resolution Atmospheric transmittance spectroscopy.
- ❑ Monitoring composition of both the Upper Troposphere (UTS) and Stratosphere: radiatively active gases, stratosphere-troposphere Exchanges tracers, ozone chemistry gases, aerosols and clouds, as well as their precursors.
- ❑ The UTS being the most sensitive to climate change.
- ❑ High Spectral resolution: O, O2, O3, N2, N2O, NNO, H2O, HDO, CH3D, CH4, and COC
- ❑ Vertical spatial resolution <3km over an altitude of 6km to 80km.
- ❑ Capable of measuring rapid vertical and horizontal variations in the abundances of trace gases and aerosol around the tropopause



TIR (8-12 µm) laser heterodyne spectro-radiometry MISO-XL Spectral Coverage



VIS/NIR (588 – 870 nm) hyperspectral imager Spectral bands

MISO Applications Overview:

- Atmospheric composition used as a strong indicator of anthropogenic emissions of greenhouse gases and pollution precursors.
- Will help resolve challenges in trend detection with a knock-on effect on estimates of their climate impact.
- MISO Will help answer:
  - How does water vapor in the UTS responding to climate change and impact on climate?
  - How does climate change affect stratospheric ozone and its recovery?
  - How can surface emission estimates of GHG and surface ozone be improved by improving their UTS representation?
  - How does the composition of the tropical UTS and its response to increasing anthropogenic and natural emissions change?

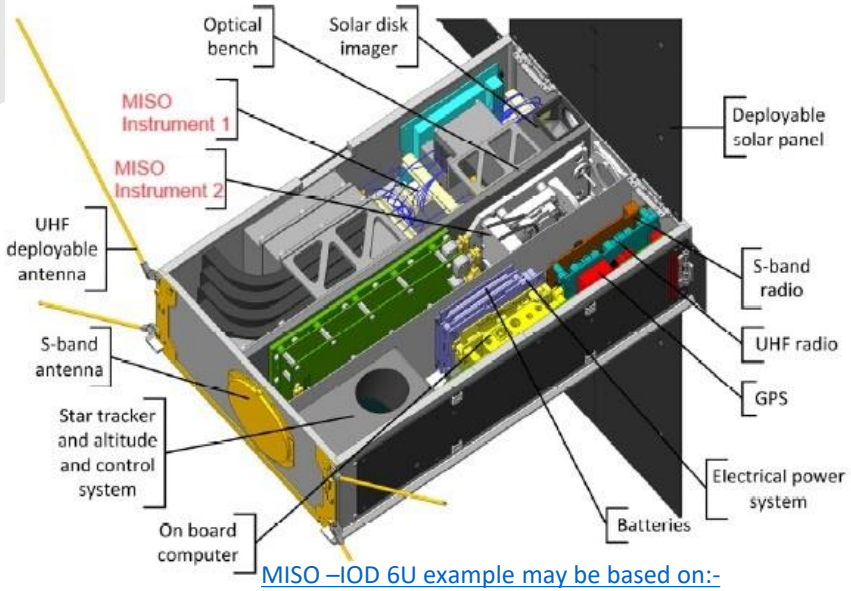
MISO IOD and XL LEO Satellite Projects

"The Monitoring of atmospheric constituents and their Isotopologues by Solar Occultation"

MISO Mission Overview:

- Primary Instrument: TIR (8-12 µm) laser heterodyne spectro-radiometry.
- Secondary Instrument: VIS/NIR (588 – 870 nm) hyperspectral imager.
- Highly miniaturization optical system and electronics.
- MISO IOD and XL constellation are respectively compatible with typical LEO 6U and 12U CubeSat platform's volume, mass and power (with deployable solar panels).

MISO-XL 12U example may be based on: https://www.spiedigitallibrary.org/conference-proceedings-of-spie/11530/115300U/Cubesats-for-monitoring-atmospheric-processes-CubeMAP--a-constellation-mission/10.1117/12.2573727.short

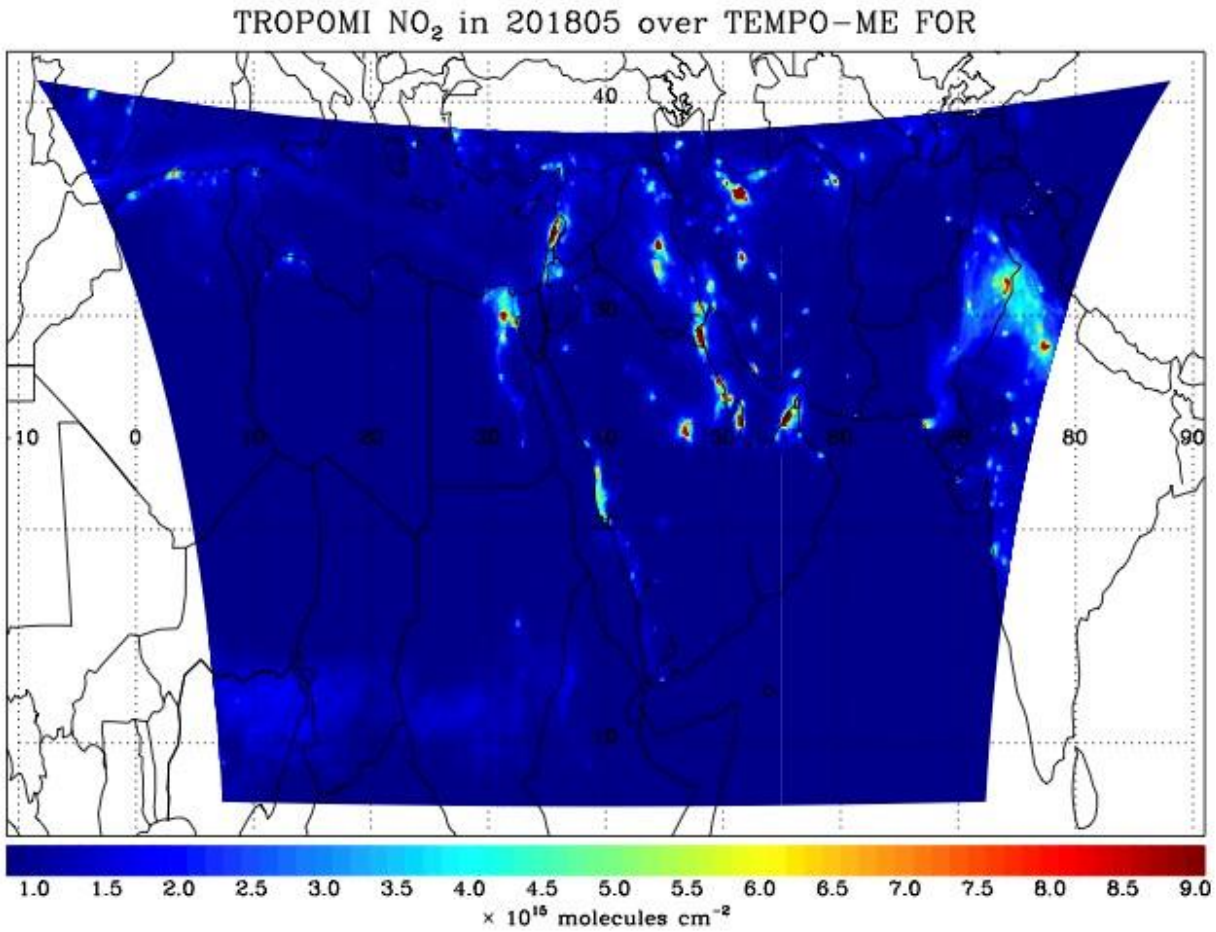


MISO –IOD 6U example may be based on:- https://www.mdpi.com/journal/remotesensing

MEASMA Observatory GEO Project

"Middle East & Africa Space-based Monitoring of Atmospheric-pollution"

- **MEASMA Observatory GEO Instrument:** Is an INTOSPASS initiative, inspired and based on a scientific paper written by **Dr. Raid Suleiman**, Atomic and Molecular Physics Division - Center for Astrophysics at Harvard & Smithsonian, that was published by **ArSCO**, in their Arabian Journal of Scientific Research - Volume 2021, Issue 2 in October 2021. It is a geostationary orbit (GEO-belt) hosted instrument is based on GEMS and TEMPO developed by Ball Aerospace.



- **Its aim is to deploy a UV/VIS hyperspectral monitoring instrument developed by Ball Aerospace (being acquired by BAE), based on NASA's TEMPO and KARI/NIER's GEMS. It will measure the principal elements of tropospheric air pollution over the Middle East and Africa.**

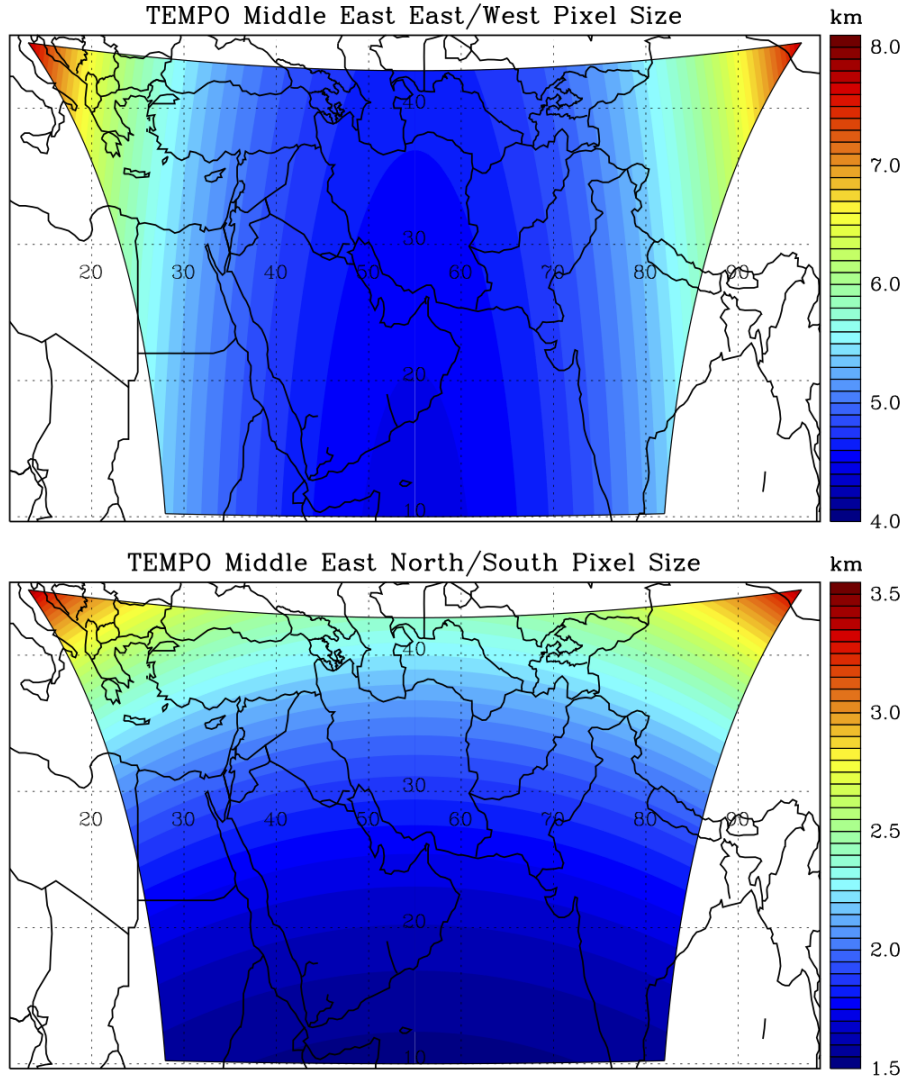
MEASMA Observatory GEO Project

"Middle East & Africa Space-based Monitoring of Atmospheric-pollution"

MEASMA Observatory GEO Instrument Footprint (GEO at 51º E):

Location	N/S (km)	E/W (km)	GSA (km^2)
25ºN, 51ºE	1.74	4.52	7.87
Mecca	1.75	4.52	7.91
Doha	1.74	4.52	7.87
Riyadh	1.74	4.60	10.2
Jerusalem	1.99	5.05	9.73
Cairo	1.97	5.26	9.90
Istanbul	2.52	5.57	12.77
New Delhi	1.91	5.15	9.48

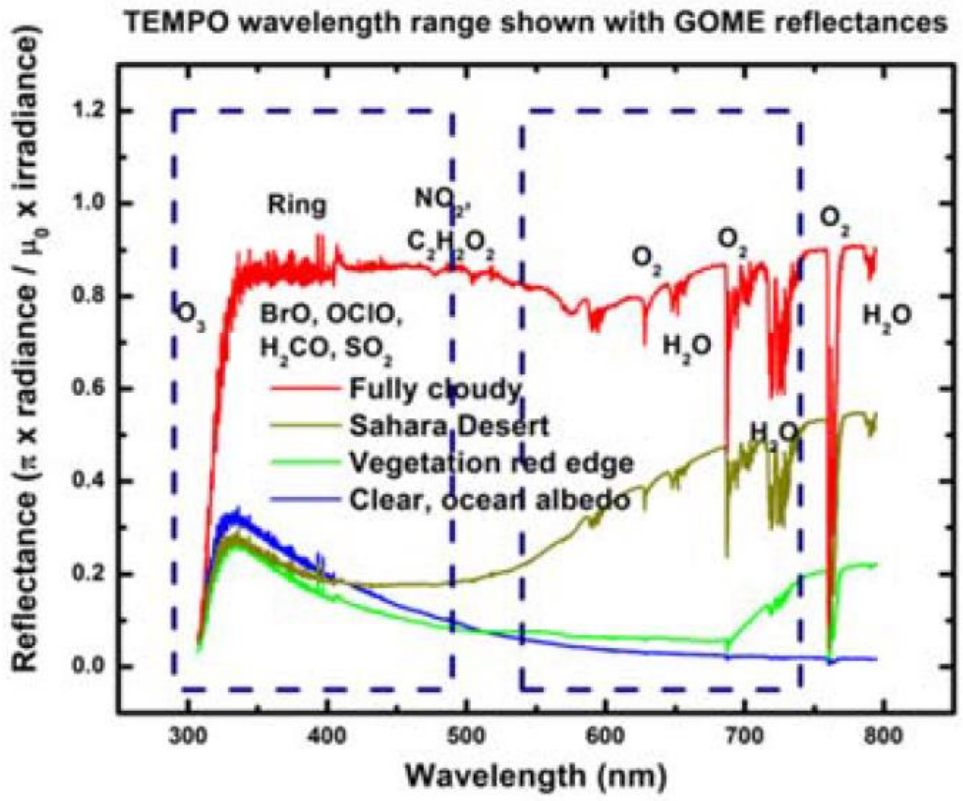
Assumes 2000 N/S pixels



Images on left curtesy of: https://iopscience.iop.org/article/10.1088/1742-6596/869/1/012085

MEASMA Observatory GEO Instrument Baseline and Threshold Data Products:

Species/Products	Required Precision	Temporal Revisit
0-2 km O_3 (Selected Scenes) Baseline only	10 ppbv	2 hour
Tropospheric O_3	10 ppbv	1 hour
Total O_3	3%	1 hour
Tropospheric NO_2	1.0×10^{15} molecules cm^{-2}	1 hour
Tropospheric H_2CO	1.0×10^{16} molecules cm^{-2}	3 hour
Tropospheric SO_2	1.0×10^{16} molecules cm^{-2}	3 hour
Tropospheric $C_2H_2O_2$	4.0×10^{14} molecules cm^{-2}	3 hour
Aerosol Optical Depth	0.10	1 hour



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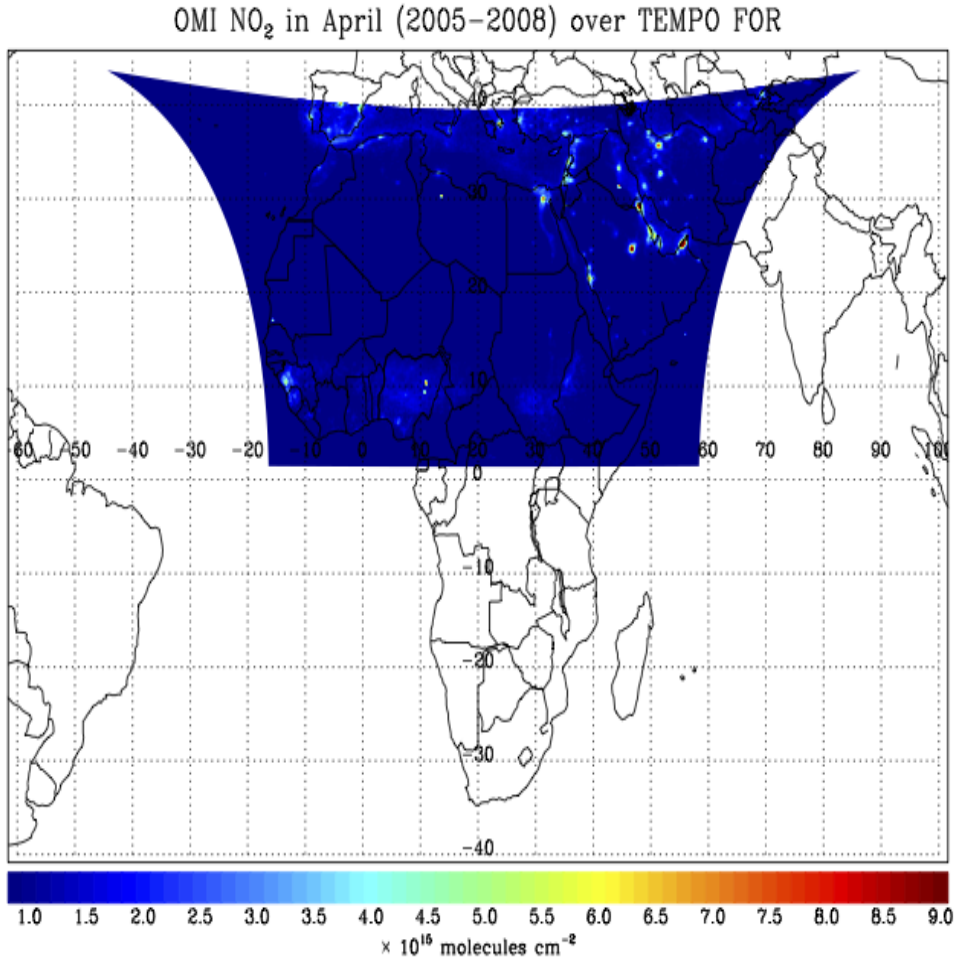
MEASMA Observatory GEO Instrument Science Overview:

- What are the temporal and spatial variations of emissions of gases and aerosols important for air quality and climate?
- How do physical, chemical, and dynamical processes determine tropospheric composition and air quality over scales ranging from urban to continental, diurnally to seasonally?
- How does air pollution drive climate forcing and how does climate change affect air quality on a continental scale?
- How can observations from space improve air quality forecasts and assessments for societal benefit?
- How does intercontinental transport affect air quality?
- How do episodic events, such as wild fires, dust outbreaks, and volcanic eruptions, affect atmospheric composition and air quality?



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https://iopscience.iop.org/article/10.1088/1742-6596/869/1/012085

MEASMA Observatory GEO Instrument Applications:

- ❑ Mapping NO_2 and SO_2 dry deposition at high resolution
- ❑ Halogen oxide studies in coastal and lake regions
- ❑ Tidal effects on estuarine circulation and outflow plumes
- ❑ Night light measurements resolving lighting type
- ❑ Socio-economic studies and National pollution inventories
- ❑ Air pollution from oil and gas fields
- ❑ Ship tracks, drilling platform plumes, and other concentrated sources
- ❑ Air quality and health
- ❑ Ultraviolet exposure
- ❑ Water vapor studies
- ❑ Sea breeze studies
- ❑ Dust transport

- ❑ Soil NOx after fertilizer application and after rainfall
- ❑ Crop and forest damage from ground-level ozone
- ❑ Solar-induced fluorescence from chlorophyll
- ❑ Biomass burning
- ❑ Foliage studies

MEASMA Observatory GEO Project

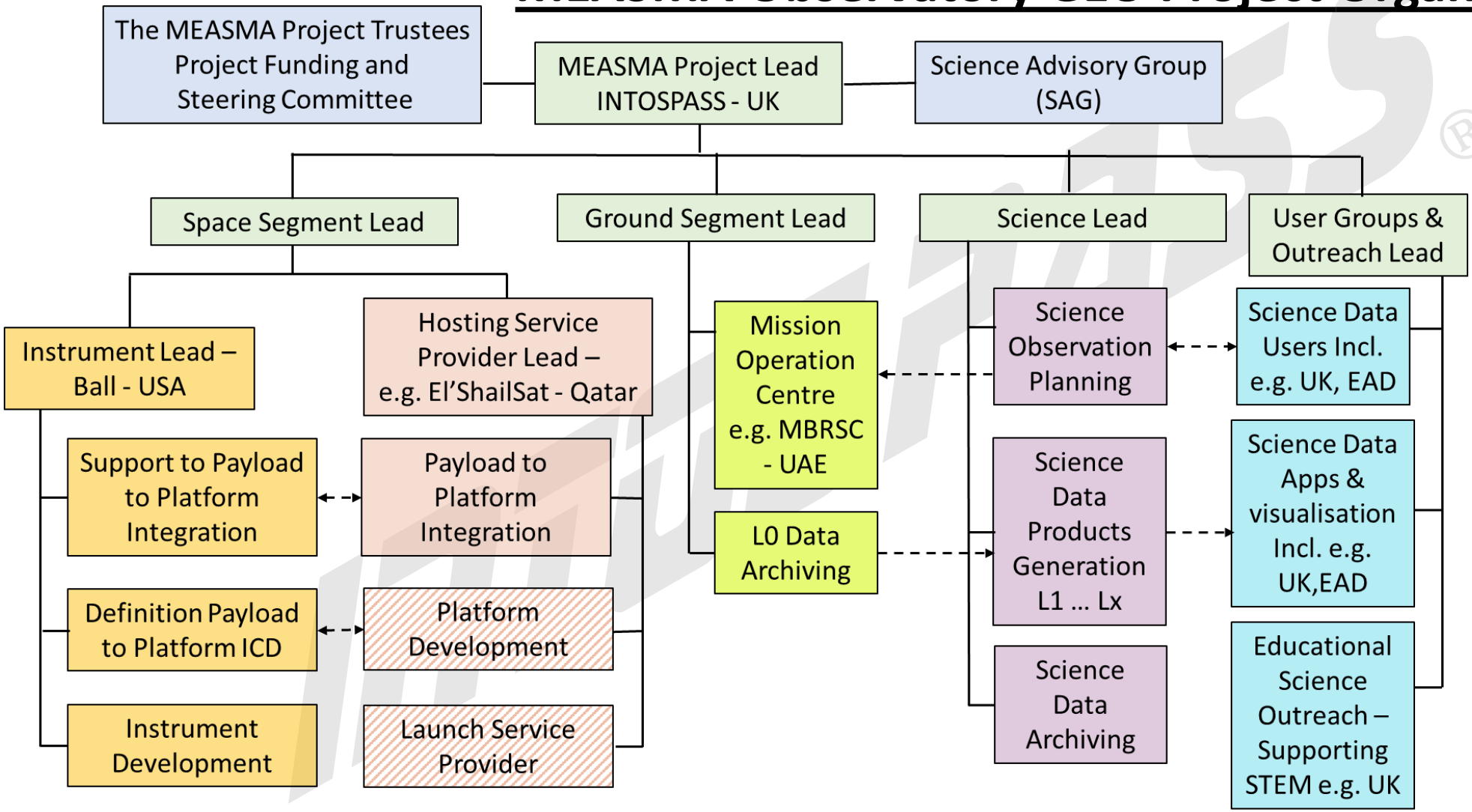
"Middle East & Africa Space-based Monitoring of Atmospheric-pollution"

MEASMA Observatory GEO Instrument Misson Overview:

- Instrument based on Ball Aerospace's TEMPO and GEMS proven technology (https://www.ball.com/aerospace/programs/earth-science-weather/gems-tempo).
- Hosted on a Geo-Stationary Orbit (GEO) satellite.
- High Reliability and Cost Effective.
- Independent Pointing system from hosting platform.
- Independent command and control.
- Mass 150kg
- Dimensions ~ $1m^3$
- Power 100 – 200 W depending on mode of operation.

Images on left curtesy of:
TEMPO Instrument Project and
Intelsat IS40e (TEMPO Hosting Satellite Platform)
https://g.co/kgs/QeYVmL

MEASMA Observatory GEO Project Organisation Chart

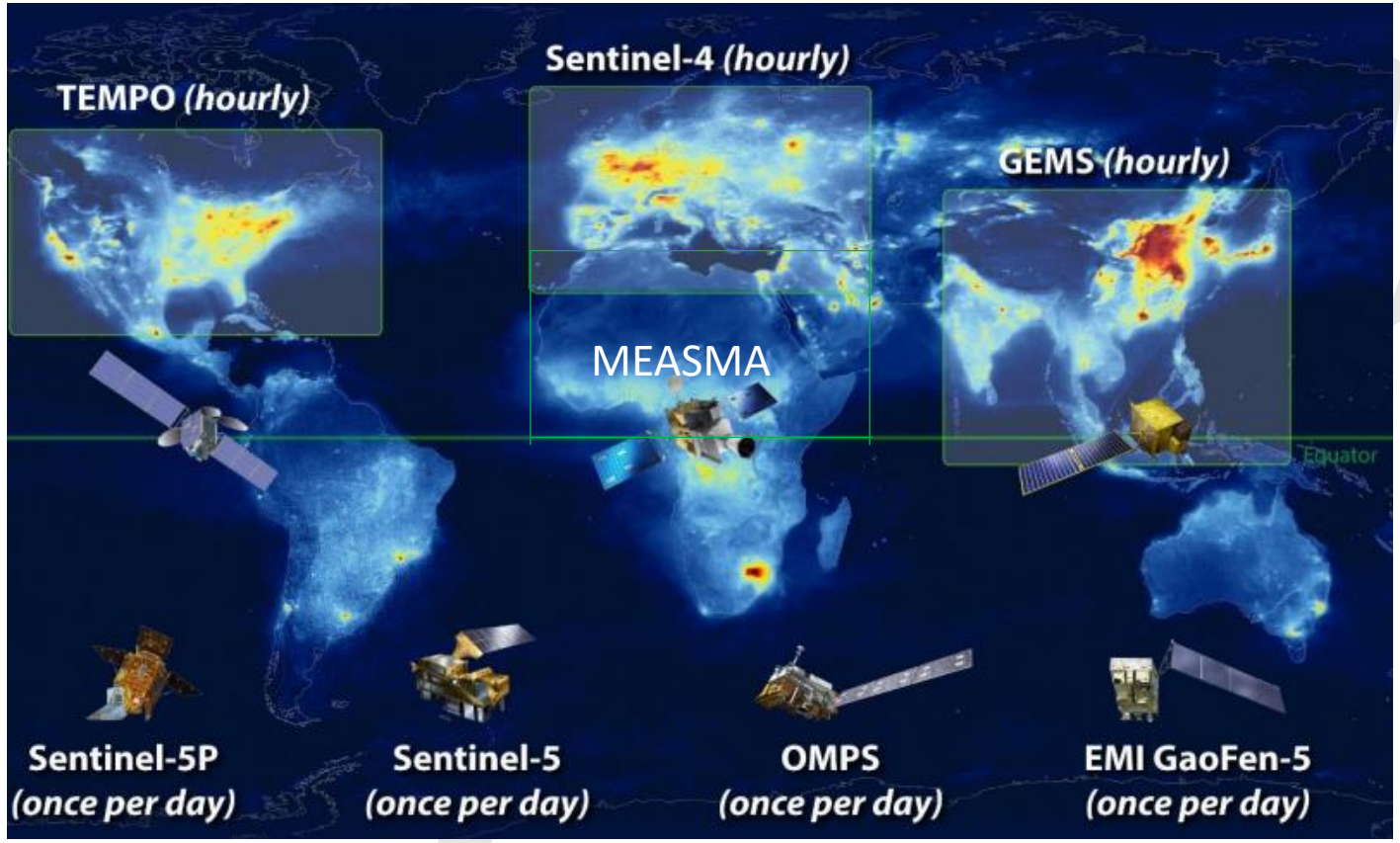


MEASMA Observatory GEO Project

"Middle East & Africa Space-based Monitoring of Atmospheric-pollution"

MEASMA Observatory GEO Instrument Filling the Gap in Global Atmospheric Prolusion Monitoring

The MEASMA Observatory will compliment NASA's TEMPO that covers North America, and KARI/NIER's GEMS that covers the Far-East, and ESA's Sentinel-4. The aim is to be part of a global virtual network that will provide atmospheric pollution data across the globe that can be shared freely for the benefit of all mankind as outlined by the whitepaper published by CEOS.



This project and the data it will generate will be of great value to support the efforts of the United Nation/UNOOSA, CEOS, GEO and Eye on earth, as well as all environmental and meteorological agencies/orgainsations including academic and research organizations across the globe.

https://ceos.org/document_management/Virtual_Constellations/ACC/Documents/GEO%20AQ%20Constellation%20Geophysical%20Validation%20Needs%201.1%202Oct2019.pdf

MEASMA Observatory Projects

Letters of Support

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O +1 303 939 4000
ball.com/aerospace

October 6, 2023
CS.23.CLC.01-MEASMA

Dr. Omar Emam - Director / CEO
INTOSPASS - International Outer Space Association Ltd
27 Angotts Mead
Stevenage, SG1 2NJ
England - UK

Re: Letter of support for the Middle East & Africa Space-based-camera for Monitoring Atmospheric Pollution (MEASMA Observatory)

Dear Dr. Emam,

We have discussed internally the options to work with you on INTOSPASS's proposal to develop, launch, and operate an instrument similar to TEMPO to cover the Middle East / North Africa (MENA) region. We think there are several areas where we could partner. Upon receipt of appropriate funding, Ball Aerospace is committed to providing a re-build of the TEMPO sensor for the MEASMA Observatory. However, we are also keen to explore other roles and ways Ball Aerospace can further contribute.

At Ball Aerospace we have a fundamental belief that you can't manage what you don't measure. We have a strong interest in developing satellite concepts to measure air quality in new and valuable ways. This has led to deployment of the Geostationary Environment Monitoring Spectrometer (GEMS) sensor for the South Korean Government, and the Tropospheric Emissions: Monitoring of Pollution (TEMPO) sensor for NASA. These satellites collect information on Ozone, NOX, SOX, PM2.5 and PM10 (inferred from aerosol optical depth) and other greenhouse gases.

Combined with the Sentinel-4 satellite, many parts of the globe have – or will soon have – excellent air quality data and information. But significant gaps remain, particularly over the Middle East and Africa. Solutions like TEMPO are fundamental tools in helping combat air pollution, and we are extremely excited to support INTOSPASS's vision to develop an integrated air quality observation system for this region, which can form part of the atmospheric monitoring virtual space-based network, along the lines proposed by CEOS.

We recognize the unique role that INTOSPASS can play in leading this initiative. This project would enable better knowledge of air quality information but also support regional Science, Technology, Engineering, and Math (STEM) development in the region and Ball Aerospace is excited to support such activities.

Sincerely,

Alberto Conti
Vice President and General Manager, Civil Space
Ball Aerospace & Technologies Corp.

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

Date :15/09/2023
Ref :EAD/EISOM/2023/1048

EAD/EISOM/2023/1048

To whom it may concern

Salutation

Subject: Middle East & Africa Space-based-camera for Monitoring Atmospheric- Pollution

Recognising:

1. The transboundary nature of atmospheric pollution
2. The requirement for high temporal resolution monitoring
3. The potential of UV/VIS hyperspectral instruments for monitoring atmospheric conditions
4. The proposed instrument will make significant contribution toward closing this scientific knowledge gaps identified in the *Environmental Research Needs Register* for the emirate of Abu Dhabi, *inter-alia*:

21-1B.3-05	How to forecast sand and dust storms for the next days?
21-1B.3-06	How to forecast air quality to effectively inform population?
21-1B.3-08	How to investigate the origin of emissions in cases of emergencies/non-compliance?

Then:

The Environment Agency - Abu Dhabi (EAD), in its capacity as the designated competent authority for the environment within the government of the Emirate of Abu Dhabi, is pleased to express its support to the MEASMA Observatory (Middle East & Africa Space-based-camera for Monitoring Atmospheric- pollution) led by Dr Omar Emam of International Outer Space Association Ltd.

EAD further expresses its willingness to contribute, at its discretion, regional subject matter expertise and data to the initiative.

This letter is issued without obligation on the part of EAD. Specifically, this letter does not commit to or imply any financial contribution.

Regards

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

Ahmed Abdulmuttaleb Abdulla Baharoon
Executive Director - Environmental Information, Science, and Outreach Management Sector

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RAL Space

23rd October 2023

To Whom it may concern,

This is to confirm that Dr Omar Al-Emam has been working as a contracted employee within the Space Engineering and Technology division of the Rutherford Appleton Laboratory for Space (RAL Space) since the beginning of October 2021.

Dr Omar Al-Emam provided technical expertise to deliver critical design and development activities for a European Space Agency (ESA) funded scientific mission as part of the ESA Scout framework. Scout is a new component of ESA's Earth Observation FutureEO programme focused on small satellites delivering value-added science, either by miniaturising existing space technologies or by demonstrating new observing techniques. Dr Omar Al-Emam was also the payload electronics team leader for this project.

Dr Omar Al-Emam continues his consultancy role by providing technical support to the project team in the next phase of the scientific payload development. He is also in discussions to identify potential partner organisations in the MENA region that can potentially be engaged with RAL-Space to jointly develop a Space mission and satellite to launch the payload on a medium sized cubesat.

RAL Space is a UK Government national laboratory with over 50 years of experience and expertise in space programmes with significant involvement in more than 210 space missions. RAL Space is part of the United Kingdom Science and Technology Facilities Council, a United Kingdom government agency that carries out research in science and engineering and funds UK research in areas including particle physics, nuclear physics, space science and astronomy.

Your sincerely,

Digitally signed by David Northfield
Date: 2023.10.23 10:43:05 +01'00'

David Northfield
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Science and Technology Facilities Council
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RAL Space is a department of the Science and Technology Facilities Council which is a part of United Kingdom Research and Innovation.

Science and Technology Facilities Council

INTOSPASS® INTERNATIONAL OUTER SPACE ASSOCIATION

THANK YOU FOR YOUR PARTICIPATION

You are invited to join the MEASMA Observatory GEO Instrument

1st Working Group Meeting

Hybrid meeting planned for 30th November 2023 to consider with

COP28 in Dubai - UAE

For further details please contact

Dr Omar Emam

Email: omar.emam@intospass.org

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