SYNOPSIS

NASA Goddard Space Flight Center is hereby soliciting information from potential sources for flight Microwave Radiometers for potential future AtmOS acquisition.

The National Aeronautics and Space Administration (NASA) GSFC is seeking capability statements from all interested parties, including all socioeconomic categories of Small Businesses and Historically Black Colleges and Universities (HBCU)/Minority Institutions (MI), for the purposes of determining the appropriate level of competition and/or small business subcontracting goals for flight Microwave Radiometers for potential future AtmOS acquisition. The Government reserves the right to consider a Small, 8(a), Women-owned (WOSB), Service Disabled Veteran (SD-VOSB), Economically Disadvantaged Women-owned Small Business (EDWOSB) or HUBZone business set-aside based on responses received.

No solicitation exists; therefore, do not request a copy of the solicitation. If a solicitation is released, it will be synopsized on SAM.gov. Interested firms are responsible for monitoring this website for the release of any solicitation or synopsis.

Interested firms having the required capabilities necessary to meet the requirements described herein should submit a capability statement of no more than 25 pages indicating the ability to perform all aspects of the effort.

Please advise if the requirement is considered to be a commercial or commercial-type product. A commercial item is defined in FAR 2.101.

This synopsis is for information and planning purposes only and is not to be construed as a commitment by the Government nor will the Government pay for information solicited. Respondents will not be notified of the results of the evaluation.

AtmOS BACKGROUND

The Atmosphere Observing System (AtmOS) was established by the NASA Science Mission Directorate Earth Science Division to fulfill the science needs proffered in the 2017 Earth Science Decadal Survey for the combined Designated Observables: Aerosols and Clouds, Convection and Precipitation (ACCP). The AtmOS Constellation Architecture is the result of a 2.5 year ACCP Architecture Study. The ACCP Architecture Study concluded in February 2021 and the mission was authorized to move into Pre-Phase A on May 23, 2021. The respondent may find information on the study results including the Science and Applications Traceability Matrix at the ACCP Architecture Study website: *https://vac.gsfc.nasa.gov*.

The AtmOS Constellation will make measurements of the aerosol and cloud microphysical properties as well as the measurements of the vertical velocity of convection, aerosol redistribution and precipitation to understand the processes which drive the Earth's atmosphere. By employing a multi-satellite architecture, AtmOS will be able to cover the relevant temporal and spatial scales, thereby transforming our understanding of this critical part of the Earth System. As part of pre-formulation and formulation activities, the AtmOS team is performing trade studies to determine options to make measurements and achieve sampling to meet as many of the AtmOS science objectives as possible within cost and schedule constraints. Through this RFI, the AtmOS team seeks information on Microwave

Radiometer approaches to further refine the payload assignments, spacecraft needs, and mission concept of operations necessary to meet the science objectives.

The selected AtmOS architecture is illustrated in Figure 1**Error! Reference source not found.**. This architecture encompasses flight assets in two orbit planes: (1) Polar: Sun-Synchronous Orbit, 450 km, and 1330 Ascending Node and (2) Inclined: Nominally 50 to 65 Degree Inclination, 407 km. Within the AtmOS Constellation, Inclined Plane assets will be launched first to achieve earliest possible science with instruments that will make advancements in the understanding aerosol and cloud properties and target the **dynamics** of the cloud processes and precipitation on sub-daily to sub-minute time scales. The polar plane will follow a year or two later with more advanced measurements targeting the seasonal, global scale microphysical properties of clouds and aerosol and their linkage to atmospheric radiation and longer-term climate **change**. The constellation targets understanding the dynamics of the Earth's Atmosphere and the processes that drive change over time.

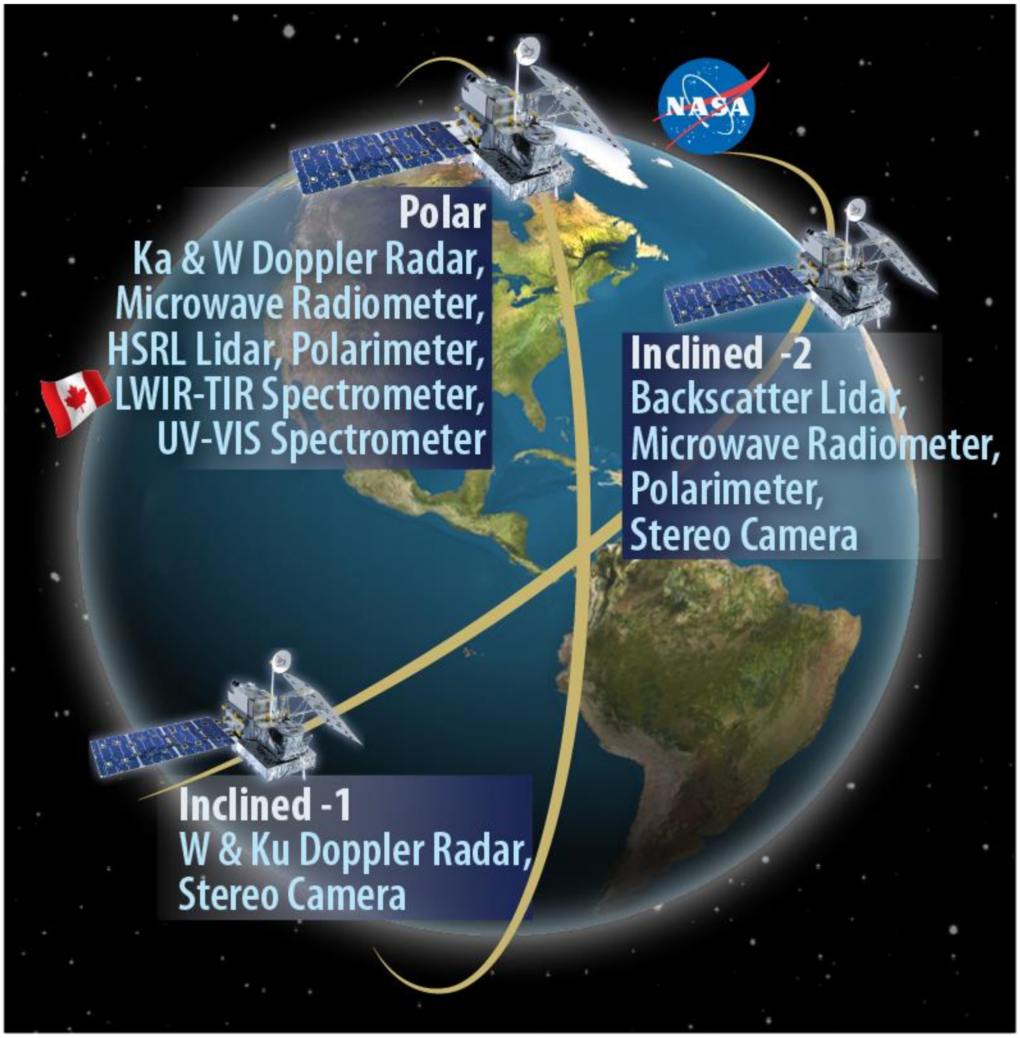

Figure 1 Preferred AtmOS Architecture Concept

While the concept illustrated in Figure 1**Error! Reference source not found.** accurately reflects the AtmOS intent, the number of spacecraft in the two orbit planes and the specific instrumentation assignment on the spacecraft remains under study during the pre-Phase A period.

The anticipated instrumentation suite for the AtmOS Constellation as assigned to the Inclined Orbit and the Polar Orbit is shown in Table 1. Note that some passive instrumentation/sensors (i.e. Polarimeter, Microwave Radiometer) are found in both orbit planes but their performance and spacecraft allocation needs may differ depending upon the assigned orbit plane.

Table 1 Anticipated AtmOS Science Instrumentation

Polar Orbit Plane Instrumentation	Inclined Orbit Plane Instrumentation	Acquisition Comment for Passive Instruments
---	W/Ku Band Doppler Radar	---
W/Ka Band Doppler Radar	---	---
---	Backscatter Lidar	---
High Spectral Resolution Lidar	---	---
LWIR-TIR Spectrometer	---	Proposed CSA Contribution
Microwave Radiometer	Microwave Radiometer	Subject of this AtmOS RFI
Polarimeter	Polarimeter	Subject of a separate AtmOS RFI
UV-VIS Spectrometer	---	Subject of a separate AtmOS RFI
---	Stereo Camera (Tandem Stereographic Cameras)	Subject of a separate AtmOS RFI

MICROWAVE RADIOMETER PERFORMANCE

Passive microwave radiometers provide vital information on surface and atmospheric phenomena of the Earth. Over this portion of the electromagnetic spectrum, these sensors view thermal emission from the surface and atmosphere that is modified through surface reflection and atmospheric absorption and scattering. Radiometers are particularly effective for cloud and precipitation sensing, with microwave heritage, including millimeter-wave (mmWave; 30–300 GHz) bands, in the Defense Meteorological Satellite Program's (DMSP) Special Sensor Microwave Imager (SSM/I) series and NASA's Tropical Rainfall Measurement Mission (TRMM) Microwave Imager (TMI) and Global Precipitation Measurement (GPM) Microwave Imager (GMI). Bands at mmWave and submillimeter (submm; 300+ GHz conventionally using microwave technology) wavelengths are sensitive to ice- and mixed-phase precipitation and clouds while still providing information at considerably higher optical depths than infrared or visible wavelengths. Given the applicability to clouds and precipitation, the 2017 Decadal Survey (DS) recommended the use of microwave radiometry, specifically submm sensor, for achieve the science goals of the Clouds, Convection, and Precipitation Designated Observable.

The subsequent NASA study for the combined Aerosols and Clouds, Convection, and Precipitation (ACCP) Designated Observables solicited, through an initial request for information (RFI), hardware concepts for assessing potential architectures to address the science and application objectives defined by ACCP. Based on the responses, feasible accommodations, and the DS guidance, mmWave and submm sensors with bands at 89 GHz and higher were selected for further study. The architecture evaluations demonstrated significant information content regarding ice water path (IWP) over three orders of magnitude, ranging from moderately thin cirrus (10 g m^{-2}) to precipitating convective cloud (10^4 g m^{-2}). The radiometers also provide contextual swath for radars that only have either narrow or nadir-only fields of regard, specifically for cloud and total liquid water path (CLWP, TLWP), ice water content profiles (IWC.z), and surface precipitation rate (PR2D), albeit at coarser horizontal (and vertical) resolution. Thus, the microwave radiometers were determined to be core sensors by the ACCP study for AtmOS.

Importantly, through the architecture evaluations, the ACCP Science Impact Team (SIT) identified the radiometer characteristics necessary to meet the desired capabilities detailed in the science and applications traceability matrix (SATM). Given the wide scope of geophysical variables relevant to ACCP/AtmOS, the Science and Applications Leadership Team (SALT) prioritized observations of aerosols, cloud, precipitation, and their related motions. Other geophysical variables, such as temperature and humidity profiles, are available from the program of record (PoR), the existing and planned remote sensing measurements that can be leveraged to complement the mission-specific sensors selected by the ACCP study. Thus, the minimum set of mandatory channels have been chosen because they directly target cloud and precipitation geophysical variables. Additional channels have been prioritized to, first, enhance the cloud and precipitation capabilities and, second, provide supporting environmental information for reducing uncertainties relative to the PoR. The capabilities for each radiometer channel, or set of channels, trace back to the desired capabilities listed in the SATM, as detailed in

Table *2*. System capabilities and resource allocations are available in Table 3. A listing of definitions follows the requirements to ensure clear interpretation of this document. The targets here are provided as general guidance and are not requirements. The AtmOS team welcomes information on system capabilities that may not achieve the targeted performance. While instruments that provide the full set of mandatory channels are preferred, the AtmOS team is also interested in compact instruments or receivers that may provide a more limited channel set that may be combined to provide the necessary observations. Likewise, innovative concepts that include channels and/ or capabilities other than those listed below are welcome, but such channels and/or capabilities will be considered at the lowest priority level.

Table *2 Radiometer Target and Desired Capabilities*

Channel Definition	Frequencies	IFOV	Sampling	Radiometric Resolution	Long-Term Calibration Stability	SATM Driver(s)	Orbit Priority
Surface Channel	1 channel with center frequency or sideband offset within 89–113 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 0.5 K Target: 1.0 K	0.5 K	TLWP (O4) CLWP (O1, O8) PR2D (O6, O3,O4)	Polar: Important Inclined: Mandatory*
G-Band Water Vapor Channels	3 channels, DSB or SSB, with offsets between 1 and 11 GHz from 183.31 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.0 K Target: 1.5 K	0.5 K	IWP (O3) PR2D (O4)	Polar: Mandatory Inclined: Mandatory
Low Submm Water Vapor Channels	3 channels offset from 325.15 GHz++, similar weighting to 183 GHz bands	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.5 K Target: 2.0 K	0.5 K	IWP (O2, O4) IWC.z (O2)	Polar: Mandatory Inclined: Mandatory
Ice Cloud Channel	1 channel centered at atmospheric window within 640–700 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.5 K Target: 2.0 K	0.5 K	IWP (O2) IWC.z (O2)	Polar: Mandatory Inclined: Mandatory*
Dual-Pol Ice Cloud Channel	Matched frequency (640–700 GHz), orthogonal polarization to required ice cloud channel	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.5 K Target: 2.0 K	0.5 K	IWP (O2) Particl eshape (O4)	Polar: Important Inclined: Important
G-band Window Channel(s)	1 (or 2 orthogonal) channel(s), centered at atmospheric window between 150–170 GHz or 210–240 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.0 K Target: 1.5 K	0.5 K	IWP (O3) PR2D (O4) TLWP (O4)	Polar: Important Inclined: Helpful

Dual-Pol Surface Channel	Matched frequency (89–113 GHz), orthogonal polarization to required surface channel	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 0.5 K Target: 1.0 K	0.5 K	TLWP (O4) CLWP (O1, O8) PR2D (O6, O3,O4)	Polar: Helpful Inclined: Important
mmWave Oxygen Channels	3 DSB channels, centered at 118.75 GHz with offsets at ±1, ±1.5, and ±2 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 0.5 K Target: 1.0 K	0.5 K	IWP (O3) PR2D (O4)	Polar: Helpful Inclined:Low
High Ice Cloud Channel	1 channel centered at atmospheric window within 820–890 GHz	Desired: ≤10 km Target: ≤20 km	Desired: Nyquist Target: Nyquist along scan, contiguous along track	Desired: 1.5 K Target: 2.0 K	0.5 K	IWP (O2) IWC.z (O2)	Polar: Low Inclined:Low

**An open trade exists for the inclined orbit to decide priority of surface and ice cloud channels if both cannot be accommodated.*

++If necessary as a descope option, two of the three 325.15 GHz channels closest to the line can be moved to the 380.2 GHz water vapor line, as long as the weighting functions are matched to the analogous 183.31 GHz bands, and contamination by the oxygen transition at 368.5 GHz is avoided.

MICROWAVE RADIOMETER RESOURCE ALLOCATION TARGETS

The AtmOS team has developed target spacecraft resource allocations for the Microwave Radiometer based on information gathered during the ACCP Mission Concept Study Phase, including information gathered from an instrumentation Request for Information submitted during that period. From this information the mission systems team developed spacecraft concepts commensurate with allocations as found in

Table 3. The Respondent should provide both their Current Best Estimate and Maximum Expected Value resource needs in the attached spreadsheet under tab labeled 'Spacecraft Accommodation.' Note: The values in the table below are not requirements but rather for informational purposes to provide the respondent with the notional resources needs currently envisioned by the AtmOS team. Exceedance of these values are acceptable and expected, especially in the event of enhanced performance capability.

Table 3 Microwave Radiometer Target Resource Allocations (with Scan Type and Swath Coverage)

Radiometer Specification	Inclined Targets	Polar Targets
Swath	>750 km	>750 km
Scan Type	Conical or cross-track	Conical or cross-track
Data Rate (bps)^	$1.6x10^5$	$1.6x10^5$
Power (W)	45	20
Mass (kg)	40	10
Envelope Dimensions in Operational Configuration: LxWxH (cm)	80 x 45 x 45	35 x 20 x 40
		Please provide both the current best estimate (CBE) and the maximum expected value (MEV) for these resources. MEV = [(100 + XX)/100] CBE where XX is contingency in percent.

^Radiometer data rate will not be driving any mission resource, and exceedance from the target is welcome if it enables improved science.

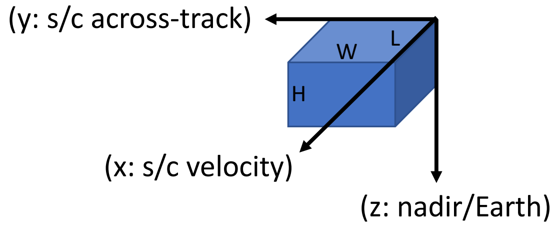

Figure 2 Instrument reference coordinate system.

DEFINITIONS AND DISCUSSION

Channel definition describes the radiometer channel, or set of channels, based on location in the electromagnetic spectrum and surface or atmospheric sensitivity.

Frequency states specific details of the channel spectral location, including acceptable frequency range. For channels targeting molecular transition lines (i.e., water vapor or oxygen transitions), offsets are provided based on analysis by the SIT that determined optimal sub-band center frequency for cloud and precipitation sensing.

Instantaneous field of view (IFOV) is the diameter of a circle with area equal to that of the ellipse defined by the 3 dB contour of the antenna pattern projected on the Earth's surface:

$$\text{IFOV} = (AB)^{\frac{1}{2}} \quad (1)$$

where A and B are the length of the major and minor axes of the 3 dB ellipse of the antenna footprint on the Earth surface. A smaller-than-required IFOV is desirable to the extent that it does not reduce the sample spacing below the approximate Nyquist coverage. For cross-track scanning radiometers, to encourage wide swath coverage, the IFOV should be calculated using (1) at the edge of target swath listed in

Table 3 , allowing footprint growth for wider swaths.

Sampling is defined independently of averaging and noise equivalent differential temperature (NEΔT). Radiometric brightness temperature of the scene should be sampled at minimum twice per 3 dB beamwidth (approximately Nyquist) in the cross-track dimension. Brightness temperature should also be sampled twice per 3 dB beamwidth in the along-track dimension. In the case that scanning mechanisms cannot achieve sufficient scanning speed to achieve two samples per 3 dB beamwidth in the along-track direction, sampling should not be less than contiguous (one sample per 3 dB beamwidth). Nyquist sampling is preferable over a narrower IFOV within the limits of the IFOV requirement for all frequencies.

Radiometric resolution (i.e, NEΔT) is defined as

$$\mathrm{NE\Delta T} = T_{sys}\left[\frac{1}{B\tau} + \left(\frac{\Delta G}{G}\right)^2\right]^{\frac{1}{2}} \quad (2)$$

where *Tsys* is the system brightness temperature including an estimated scene brightness temperature of 300 K Kelvin, B is the channel bandwidth, τ is the integration time, and Δ*G/G* is the ratio of the system gain fluctuation to the overall gain. Knowledge of NEΔT with and without the Δ*G/G* factor, then, is vital for understanding the stability of the radiometer.

The integration time τ may include multiple scans, and is defined here as the total integration time associated with scanning over the IFOV requirement. With this definition, a scanning total power radiometer would have an integration time of

$$\tau = \frac{\pi \mathrm{IFOV}^2}{4v_{scan}} \frac{\phi}{v_{sc}} \quad (3)$$

where IFOV is defined in (1), v_{scan} is the magnitude of the scan velocity at the surface in m s^{-1}, φ is the scan rate s^{-1}, and v_{sc} is the magnitude of the spacecraft ground velocity (assume 7200 m s^{-1}). This definition effectively normalizes the integration time across multiple beam sizes and scan geometries, while allowing for along-track averaging with rapid Nyquist scanning.

Long-term calibration stability is the calibration drift over the lifetime of the mission.

SATM drivers are the geophysical variables from the SATM to which the requirements can be traced, including the ACCP objective(s) for which the radiometer channel is relevant. Objective 1 (O1) encapsulates low clouds, including boundary layer clouds; objective 2 (O2) addresses high clouds, namely anvil and cirrus clouds; objective 3 (O3) is focused on convection from shallow to deep; objective 4 (O4) covers cold precipitation, including snowfall and high-lati- tude precipitation.

Orbit priority provides the priority (mandatory/important/helpful/low) for both inclined and polar orbit segments.

Mandatory refers to any channel that is necessary to meet the threshold science and applications requirements as detailed by the current SATM.

Important refers to any channel that, while needed to achieve baseline AtmOS science and applications requirements, can be descoped without impacting the ability to meet threshold science and applications requirements.

Helpful refers to any capability that can improve or enhance AtmOS science and applications, e.g., reduces uncertainties in essential GVs, but is not necessary to meet requirements.

Low refers to the minimum priority for a capability. If the capability is offered without impacting the ability to accommodate the radiometer, then it will be accepted. Low priority capabilities will be the first to be descoped, assuming such a descope does not impact threshold capabilities.

Target refers to minimum capabilities needed to meet the threshold science and applications requirements as listed in the current SATM.

Desired refers to enhance capabilities that can enable baseline science and applications requirements.

All radiometer channels should be linearly polarized. For conical scanning sensors, the electric field vector should be oriented either parallel (vertical polarization) to the plane of incidence or perpendicular (horizontal polarization) to the plane of incidence. For cross-track scanning sensors, fixed-polarization basis is preferred, with the linear polarization either parallel or perpendicular to the scan plane. If the polarization cannot be fixed across the scan, for a single polarization band the electric field vector for any one channel should be parallel or perpendicular to the scan plane at nadir. For bands with dual polarization, the electric field vectors should be either perpendicular or parallel to the scan plane at ±45º relative to nadir with the two polarization, where the sign of the angle, relative to the flight direction, is arbitrary.

Surface channel provides sensitivity to the entire atmospheric column and to the surface, and it is important for surface precipitation estimates. AtmOS requires one surface channel centered within the range of 89 to 113 GHz. Lower frequencies are preferred as long as they do not compromise the IFOV requirement. A double sideband (DSB) 118 GHz ± 5 GHz channel is acceptable for this purpose.
**An open trade exists for the inclined orbit to decide priority of surface and ice cloud channels if both cannot be accommodated.*

G-band water vapor channels provide information on falling snow and graupel. Additionally, when paired with similarly-weighted bands near the 325.15-GHz transition, these channels will help with separation of water vapor, ice-phase precipitation, and ice-phase clouds. AtmOS requires at least three single-sideband (SSB) or DSB channels around the 183.31 GHz water vapor transition with offsets between 1 and 11 GHz. If SSB, the channels should be offset to frequencies lower that 183.31 GHz.

Low submm water vapor channels provide information on falling snow, graupel and cloud ice. Pairing with bands at 183.31 GHz provides additional advantage in discriminating habits and separating water vapor. AtmOS requires at least three SSB or DSB around the 325.15-GHz water vapor transition. Ideally, these channels should be tuned to provide comparable clear sky weighting functions to the G-band water vapor channels.
++If necessary as a descope option, two of the three 325.15 GHz channels closest to the line can be moved to the 380.2 GHz water vapor line, as long as the weighting functions are matched to the analogous 183.31 GHz bands, and contamination by the oxygen transition at 368.5 GHz is avoided.

Ice cloud channel provides sensitivity to smaller ice cloud particles and IWP >10 g m-2. AtmOS requires a single RF channel centered between 640 and 700 GHz. The polarization should be either horizontal or vertical for a conical-scanning radiometer.
**An open trade exists for the inclined orbit to decide priority of surface and ice cloud channels if both cannot be accommodated.*

Dual polarization ice cloud channel is the highest priority additional radiometer capability desired by AtmOS. This channel should match the center frequency and have orthogonal polarization (horizontal or vertical) to the required ice cloud channel. Collocated beams are not required as long as beamwidths are matched and can be combined in post-processing.

G-band window channel(s) provide additional information over the full atmospheric column, particularly for ice-phase precipitation and mixed-phase clouds. A number of implementations would be acceptable, including a single channel centered within 150–170 GHz or 210–240 GHz. Alternatively, a DSB channel located at 183 GHz ± 11 GHz would be acceptable. Dual polarization is preferred.

Dual polarization surface channel provides additional information regarding precipitation and for separation of surface and atmospheric contributions to the signal. This channel should match the center frequency and have orthogonal polarization (horizontal or vertical) to the required ice cloud channel. Collocated beams are not required as long as beamwidths are matched and can be combined in post-processing.

mmWave oxygen channels provide additional information on ice-phase precipitation at or near the surface. Additionally, these bands provide thermodynamic profile information that can reduce the uncertainty from relying on ancillary data for atmospheric temperature. AtmOS desires three DSB channels with center frequency of 118.75 GHz with offsets at ±1, ±1.5, and ±2 GHz.

High ice cloud channel will increase the sensitivity to thinner cirrus clouds with IWP ranging from 10 to 50 g m–2. AtmOS desires one channel with center frequency between 820 and 890 GHz.

INSTRUMENT MATURITY

The respondent is encouraged to use the narrative section of the response to describe the technical maturity and supporting basis for the instrument use in spaceflight. In addition to the narrative, the respondent should address the itemized requests within the spreadsheet on technology readiness assessment.

Suitable instrument candidates must be no less than Technology Readiness Level (TRL) 6 by the Microwave Radiometer Preliminary Design Review (PDR), see Table 4. TRL definitions can be found in the NASA Systems Engineering Handbook, and they apply to the relevant, intended environment (e.g. airborne instrument demonstrated in that environment would be considered TRL 6, but would not be considered TRL 6 if they were intended for a spaceflight environment for AtmOS).

If the candidate instrument is not currently at TRL 6 for the intended environment, the response should include the following:

a) An estimate of current TRL, using the TRL definitions in Appendix G of the NASA Systems Engineering Handbook (NASA SP-2016-6105 Rev. 2, 2016).
b) A technology maturation plan that outlines the approach and timeline to achieve TRL 6
c) Identification of the external funding source(s) supporting the effort to achieve TRL 6 and qualify the hardware for the intended environment

COST ESTIMATE

The AtmOS Constellation is cost-constrained. The AtmOS team requests a rough-order-of-magnitude estimate on the total cost in 2021 dollars for the Microwave Radiometer. For purposes of cost estimation and planning, the respondent should consider award of the instrument Phase A contract NET March 2022. Award of an instrument delivery contract should occur sometime in Phase B for Phase C-E. Phase B is expected to start NET March 2023. The respondent should assume that the instrument is delivered to a spacecraft provider for integration and testing at observatory-level and for delivery to the launch site for launch and a follow-on period of on-orbit checkout. For purposes of developing the Cost Estimate, the respondent should assume the following draft AtmOS milestone schedule found in Table 4.

Table 4 Draft AtmOS Milestone Schedule

Milestone	Date
Mission Concept Review	2/1/22
Microwave Radiometer System Requirements Review	10/1/22
Mission Systems Requirements Review	12/1/22
Microwave Radiometer Preliminary Design Review	4/1/24
Mission Preliminary Design Review	6/1/24
Microwave Radiometer Critical Design Review	4/1/25
Mission Critical Design Review	6/1/25
Inclined Orbit Plane Systems Integration Review	6/1/26
Polar Orbit Plane Integration Review	6/1/27
Inclined Systems Integration Review	6/1/26
Polar Systems Integration Review	6/1/27
Inclined Launch	3/1/28
Inclined On-Obit Checkout Complete/Operations Commence	6/1/28
Polar Launch	3/1/29
Polar On-Obit Checkout Complete/Operations Commence	6/1/29

MISSION ASSUMPTIONS AND SPACECRAFT INTERFACE ASSUMPTIONS

When developing their response, the respondent should consider the following Mission and Spacecraft Interface assumptions detailed in Table 5.

Table 5 Mission and Spacecraft (MSC) Interface Assumptions

Identifier	Category	Polar, Inclined, or Common	Mission Parameters and Spacecraft Interface: Driving/Key Assumptions
MSC1	Orbit	Polar	450 km +/-10 km altitude, Sun Synchronous Polar Orbit, Ascending Node: 1330
MSC2	Orbit	Inclined	407 km +/- 10 km altitude, 50 to 65 degree inclination
MSC3	Orbit and Thermal Interface	Inclined	For thermal purposes, the Inclined Spacecraft will perform approximately 9 to 12 180-degree yaw maneuvers per year to maintain a consistent 'cold side' to the spacecraft. The responder should note any instrument performance or functional concerns with this inclined ConOps assumption.
MSC4	Launch Date	Inclined	See Table
MSC5	Launch Date	Polar	See Table
MSC6	Instrument Design Life	Polar	Minimum 3 Years, accommodate 5 years for any consumable.
MSC7	Instrument Design Life	Inclined	Minimum 3 Years, accommodate 5 years for any consumable.
MSC8	Instrument Risk Classification	Common	Risk Class C per NASA 8705.4A
MSC9	Launch Vehicle	Common	Assume environment envelope of the following launch vehicles: Falcon 9, Blue Origin New Glenn, and ULA Vulcan Centaur.

Identifier	Category	Polar, Inclined, or Common	Mission Parameters and Spacecraft Interface: Driving/Key Assumptions
MSC10	Deployments	Common	Deployments for initial instrument configuration are acceptable. and should be noted by the vendor. For example, this might include protective aperture covers or release mechanisms for a system locked during launch.
MSC11	Orbital Debris Reduction	Common	The instrument should retain with the instrument any deployed hardware. No hardware is to be released into orbit.
MSC12	Thermal Interface	Common	Instrument is responsible for its own thermal management, including any cryocoolers, operational heaters, thermal radiators, thermal straps, and heat pipes. Assume that spacecraft will accommodate field of view for instrument radiators with view to a 'cold side' of the spacecraft. Conductive heat transfer between instrument and mounting interface will be restricted.
MSC13	Survival Power	Common	Spacecraft will provide dedicated power feed for survival heaters from nominal 28 V DC power service. Instrument is responsible for its own survival heaters and control (e.g. thermostats).
MSC14	Operational Power Service	Common	Assume nominal 28 V DC power service from spacecraft battery system, notionally 23 V to 32 V DC range of variation.
MSC15	Spacecraft Attitude Control System	Common	The spacecraft will maintain a fixed nadir-pointing attitude during operations.
MSC16	Science Data Management	Common	Instrument need not provide its own data storage system. Assume spacecraft will provide adequately sized data recorder to store instrument science, telemetry, housekeeping for periodic spacecraft downlinking.
MSC17	Science Data Management	Common	Data Rate values provided in the targeted resource allocation are for uncompressed data. Assume that the spacecraft will not implement any data compression on the instrument science data. The instruments may wish to implement data compression (lossy or lossless) algorithms prior to transfer to the spacecraft.

SOLICITATION

The AtmOS team will conduct a Pre-Acquisition Strategy Meeting with NASA Headquarters and Earth Science Division (ESD) in late Summer 2021 and a final Acquisition Strategy Meeting during Phase A. The purpose of this solicitation is to help inform the AtmOS team in preparation for those Acquisition Strategy meetings. NASA Headquarters Earth Science Division (ESD) will make the final determination as to the acquisition approach including a determination if the Microwave Radiometer will be commercially competed.

The Key Decision Point (KDP) A for AtmOS is expected to be no earlier than 3/2022. If solicited, the Microwave Radiometer solicitation will be posted no earlier than first quarter CY 2022.

DATA SECURITY

The information provided will be maintained on GSFC-maintained secure servers, and accessed only by civil servants, or contractors that have signed Non-Disclosure Agreements (NDAs) that preserve vendor proprietary and competition sensitive data.

It is not NASA's intent to publicly disclose vendor proprietary information obtained during this solicitation, including any cost estimates provided. To the full extent that it is protected pursuant to the Freedom of Information Act and other laws and regulations, information identified by a respondent as "Proprietary or Confidential" will be kept confidential.

The North American Industry Classification System (NAICS) code for this procurement is 336419, Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing, with a size standard of 1,000 employees.

RESPONSE CONTENT REQUIREMENTS

This RFI is to solicit specific capability information from any experienced source and promote collaboration and competition. The RFI seeks responses that provide the technical resource footprint, science performance, and vendor capability statements for the Microwave Radiometer. The description of the Microwave Radiometer should include any relevant laboratory, sub-orbital, or spaceflight information regarding the hardware configuration as previously demonstrated and the science returned, as well as the instrument calibration and data validation methods.

Interested offerors/vendors having the required specialized capabilities to meet the intended application should submit a capability statement indicating the ability to perform all aspects of the effort described herein. Responders are invited to submit a narrative and to fill out the attached. Microwave Radiometer spreadsheet. The narrative should not exceed 25 pages. Science publications and other relevant information can be referenced in the narrative to provide examples of the source's expertise, facilities, and prior work, especially regarding hardware and/or test results for the Microwave Radiometer. The respondent should include within the narrative a description of the Microwave Radiometer operating principles within the larger AtmOS operational concept including any measurement synergies enabled by the instrument. The respondent is encouraged to use the narrative to include an instrument functional block diagram, technology readiness assessment basis, identification of any long-lead components or subsystems, and any potential risks (cost, technology, or schedule) envisioned for the Microwave Radiometer based on the AtmOS schedule and flight architecture.

The attached AtmOS Microwave Radiometer spreadsheet offers a convenient and concise means of addressing the anticipated Microwave Radiometer performance, spacecraft resource, and mission operational concept needs. The spreadsheet includes the technical information necessary to support Mission Concept development/pre-formulation. The spreadsheet includes separate tabs for General Information, Radiometer Performance, Supplemental Information, Spacecraft Accommodation, Orbit and Attitude, and TRL. Please complete one spreadsheet for each candidate instrument submitted.

Responses must also include the following: name and address of firm, size of business; average annual revenue for past 3 years and number of employees; ownership; whether they are large, small, small disadvantaged, 8(a), Woman-owned, Veteran Owned, Service-Disabled Veteran Owned, Historically Underutilized Business Zone and Historically Black Colleges and Universities/Minority Institutions and number of years in business. Also include affiliate information: parent company, joint venture partners, potential teaming partners, prime contractor (if potential sub) or subcontractors (if potential prime), list of customers covering the past five years (highlight relevant work performed, contract numbers, contract type, dollar value of each procurement; and point of contact - address and phone number).

This synopsis is for information and planning purposes and is not to be construed as a commitment by the Government nor will the Government pay for information solicited. Respondents will not be notified of the results of the evaluation.

Technical questions should be directed to: Vickie Moran at Vickie.E.Moran@nasa.gov.

Procurement related questions should be directed to: Craig Keish at craig.f.keish@nasa.gov.

Interested offerors shall address the requirements of this RFI in written format as described in the previous paragraphs by electronic mail to: Vickie Moran at Vickie.E.Moran@nasa.gov by July 21,2021. Responses can be submitted via email. The subject line of the submission should be "RFI for AtmOS Microwave Radiometer," and attachments should be in Microsoft WORD, POWERPOINT, EXCEL or PDF format. The email text must give a point-of-contact and provide his/her name, address, telephone/fax numbers, and email address.

Contracting Office Address:
NASA/Goddard Space Flight Center
Greenbelt, Maryland 20771

Primary Point of Contact:
Craig Keish
craig.f.keish@nasa.gov
Phone: 240-285-0839