



## Joint Science Meeting for TEMPO, GeoXO ACX, & TOLNet

May 1-5, 2023

Location: Shelby Center, University of Alabama in Huntsville  
301 Sparkman Drive, Huntsville, AL 35899

Virtual Platform Option: Zoom

*\*Participants will receive login details & instructions closer to the event date*

### **Description:**

A joint science meeting for the [TEMPO](#), [GeoXO ACX](#) (Atmospheric Composition Instrument), and [TOLNet](#) programs will be held at the University of Alabama in Huntsville (UAH) from May 1-5, 2023, themed "Building the Pathway from TEMPO to GeoXO." The joint meeting will bring together the TEMPO Science Team and Early Adopters Program along with the GeoXO and TOLNet Science Teams to facilitate the coordination and long-term planning of air quality observations over North America from Geostationary Earth Orbit, with TEMPO scheduled for launch in April 2023 and GeoXO ACX expected to launch in the early 2030s. Hourly temporal resolution of both trace gases and aerosols from the TEMPO and GeoXO ACX missions are set to significantly advance our capabilities to understand, monitor, and predict air quality, weather, and climate over the next few decades.

The meeting format will be organized into discussion sessions involving designated moderators and panelists, with topics (non-exhaustive) on [TEMPO Green Paper](#) "special" experiments, the GeoXO mission, TEMPO validation, correlative campaigns, science studies, and applications, in addition to a week-long poster session with two designated viewing times during the week. Hands-on training sessions focused on TEMPO proxy data will also be offered at the meeting. A detailed meeting agenda is shown below.

Everyone, including virtual participants, is encouraged to bring a poster. UAH is providing the ability to print in house (at UAH) these posters for you, free of charge. UAH printing will include putting it on display as well.

We will accommodate everyone in both physical meeting rooms on the UAH campus and with Zoom access. There will be planned outings on Tuesday evening at Burritt Museum (with buffet dinner), on Wednesday at the Space and Rocket Center (sit-down dinner under the Saturn V rocket in the Davison Center), and a buffet lunch at the Huntsville Botanical Gardens on Thursday

This meeting is open to individuals who are interested in the TEMPO, GeoXO ACX, and TOLNet Programs. We especially welcome students and early-career professionals to attend the meeting.

Virtual and in-person participants will have live access to all discussions including verbal and Zoom chat. Moderators will solicit and compile all slides / visualizations for the discussion sessions.

### Objectives:

1. Develop a robust strategy for implementing the TEMPO “Green Paper” science experiments and coordinating and enhancing the special operation data from the TEMPO mission.
2. Scope out a long-term plan between the TEMPO and GeoXO missions for maximizing science and applications from geostationary air quality observations into the future.
3. Advance the science and validation facets of the TEMPO mission through organized discussions involving multiple programs, paving the way for GeoXO.
4. Better understand the end-user and stakeholder needs of geostationary air quality data, with a special focus on the TEMPO special operations, near real-time data, and value-added products.
5. Provide hands-on training using TEMPO proxy data to facilitate the use of operational TEMPO data and prepare the community for the future of geostationary air quality data.



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# Schedule At A Glance

All Times in Central Daylight Time (CDT)

**\*All sessions are open to all meeting participants\***

Session Types	Color Code
TEMPO Science Team	
TEMPO Early Adopter	
TEMPO Green Paper	
GeoXO ACX Science Team	
TOLNet Science Team	

	Monday	Tuesday	Wednesday	Thursday	Friday	
	Date: 5/1/2023	Date: 5/2/2023	Date: 5/3/2023	Date: 5/4/2023	Date: 5/5/2023	
7:30 AM		Breakfast	Breakfast	Breakfast	Breakfast	
8:00 AM	Breakfast					
8:30 AM		Session I: TEMPO & GEMS Mission Updates	Session I: Air Quality Modeling	Session I: TEMPO / TOLNet Joint Panel	TOLNet Science Team Workshop	Session I: Air Quality & Health
9:00 AM	Session I: TEMPO Green Paper Experiments					Break (15 min)
9:30 AM		Break	Break	Session II: Poster Viewing	Session II: TEMPO Data	
10:00 AM		Session II: TEMPO Green Paper Experiments	Session II: TEMPO Validation			
10:30 AM				Lunch Botanical Gardens	Lunch	
11:00 AM						
11:30 AM						
12:00 PM	Lunch	Lunch	Lunch			
12:30 PM					Session III: TEMPO Training	
1:00 PM	Session II: GeoXO ACX Introduction & Status	Session III: TEMPO / GeoXO Joint Panel	Session III: Steep Gradients	Session III: TEMPO Early Adopters / Science Team Joint Panel		
1:30 PM						
2:00 PM			Break (15 min)	Session IV: TEMPO Early Adopters / Science Team Joint Panel (End @ 3:50 PM)		
2:30 PM				Break (End @ 4:10 PM)		
3:00 PM	Break	Session IV: Posters	Session IV: Emissions	Session V: TEMPO Early Adopters / Science Team Joint Panel		
3:30 PM	Session III: GeoXO Value Studies		Session V(a): Aerosols	Session V(b): Land & Ocean Monitoring		
4:00 PM						
4:30 PM						
5:00 PM		Dinner Burritt Museum	Museum Viewing & Dinner Space and Rocket Center			
5:30 PM						
6:00 PM						
6:30 PM						

# Agenda

All Times in Central Daylight Time (CDT)

**\*All sessions are open to all meeting participants\***

## Monday, May 1: TEMPO Green Paper & GeoXO ACX Science Team

Start	ΔTime	Description	Speaker / Moderator / Panelists
<b>Session I: TEMPO Green Paper Experiments - Moderator: Aaron Naeger (NASA / UAH)</b>			
8:00 AM	:50	Breakfast served @ Shelby Center	
8:50 AM	:10	Check-In & Audio Check	
9:00 AM	:10	Welcome & Overview of Special Operations	Aaron Naeger (NASA / UAH)
9:10 AM	1:00	Green Paper Experiments: Lightning Talks	Susan Alexander, Doug Boyer, Steve Brown, Jim Carr, Elaine Cimino, Xiaomeng Jin, Ralph Kahn, Emma Knowland, Chris McLinden, Gary Morris, Michael Newchurch, Ken Pickering, Masudur Rahman, Ryan Stauffer, Helen Wang, Dan Welsh, Carrie Womack
10:10 AM	:10	Break	
10:20 AM	:40	Panel Discussion <ul style="list-style-type: none"> <li>Needs for special operations</li> <li>Coordination and synergy between experiments</li> <li>Notice of event to special operations mode</li> </ul>	David Flittner Laura Judd Barry Lefer Xiong Liu Michael Newchurch

		• Data latency requirements	Raid Suleiman
11:00 AM	:30	Questions & Discussion	All
11:30 AM	1:30	Lunch	
<b>GeoXO ACX Science Team Meeting</b>			
<b>Session II: GeoXO ACX Introduction &amp; Status</b>			
1:00 PM	:30	Welcome and GeoXO Program	Andrew Heidinger (NOAA)
1:30 PM	:15	GeoXO ACX Instrument Studies	Joanna Joiner (NASA)
1:45 PM	:15	GeoXO Algorithm and Product Development Plans	Shobha Kondragunta (NOAA)
2:00 PM	:15	Atmospheric Composition Applications of ACX using TEMPO as a proxy	Greg Frost (NOAA)
2:15 PM	:15	Introduction to GeoXO ACX Science Team	Greg Frost (NOAA)
2:30 PM	:30	Questions & Discussion	All
3:00 PM	:15	Break	
<b>Session III: GeoXO Value Studies</b>			
3:15 PM	:15	NOAA Value Assessment Studies Background	Monika Kopacz (NOAA)
3:30 PM	:15	Aerosol Product Study	Shobha Kondragunta (NOAA)
3:45 PM	:15	Trace Gas Emission Updates Study	Brian McDonald (NOAA)
4:00 PM	:15	Health Impact Study	Susan Anenberg (GWU)
4:15 PM	:45	Round Table with GeoXO ACX Science Team	ACX Science Team (Closed Door)
<b>Adjourn @ 5:00 PM</b>			

Dinner: Self-organized

**Tuesday, May 2: Joint TEMPO Science Team, TEMPO Green Paper, & GeoXO ACX**

Start	ΔTime	Description	Speaker / Moderator / Panelists
<b>TEMPO Science Team Meeting Day 1</b>			
<b>Session I: GEO Air Quality Constellation Updates - Moderator: Michael Newchurch (UAH)</b>			
7:30 AM	:50	Breakfast served @ Shelby Center	
8:20 AM	:10	Check-In & Audio Check	
8:30 AM	:5	UAH Welcome	TBD
8:35 AM	:10	Greeting & Congratulatory Remark	Barry Lefer (NASA) & Director General Myung Soo Yoo (NIER)
8:45 AM	:10	Introduction & TEMPO Program Status	Xiong Liu (SAO)
8:55 AM	:10	TEMPO Commissioning Update	Kevin Daugherty (NASA)
9:05 AM	:10	TEMPO Inflight Operations	Raid Suleiman (SAO)
9:15 AM	:10	TEMPO Product Updates	Xiong Liu (SAO)
9:25 AM	:10	TEMPO Data Distribution	Hazem Mahmoud (NASA)
9:35 AM	:15	GEMS Mission & Product Updates	Jhoon Kim (Yonsei Univ.)
9:50 AM	:15	Sentinel-4 operational products	Diego Loyola (DLR)
10:05 AM	:10	Satellite Needs Working Group	Pontus Olofsson (NASA)
10:15 AM	:10	Questions & Discussion	All
10:25 AM	:20	Break	
<b>Session II: TEMPO Green Paper Experiments - Moderator: Aaron Naeger (NASA / UAH)</b>			
10:45 AM	:55	<p><i>Enhancing TEMPO Science &amp; Applications Using Special Operations Data</i></p> <ul style="list-style-type: none"> <li>• Coordination plans with users</li> <li>• Observations outside nominal Field of Regard</li> <li>• Special operations during commissioning phase</li> </ul>	Michael Geigert Ralph Kahn Chris McLinden Sally Pusede Barkley Sive Ryan Stauffer Dan Welsh

		<ul style="list-style-type: none"> <li>• Data dissemination</li> <li>• Other science applications not yet in Green Paper</li> </ul>	
11:40 AM	:20	Questions & Discussion	All
12:00 PM	1:00	Lunch served @ Shelby Center	
<b>Session III: TEMPO / GeoXO Joint Panel - Moderator: Michael Newchurch (UAH)</b>			
1:00 PM	1:30	<p><i>Paving the Future of Geostationary Air Quality Observations</i></p> <ul style="list-style-type: none"> <li>• Research-to-Operations</li> <li>• New science to be addressed</li> <li>• Early adopters to Pathfinders</li> <li>• Future partnerships</li> <li>• TEMPO Continuity Instrument (TEMPO-CI)</li> </ul>	David Edwards Greg Frost Michel Grutter Kat Hawley Andrew Heidinger Daniel Jacob Jhoon Kim Diego Loyola Diego Barry Lefer Aaron Naeger Dennis Nicks Brad Pierce Jim Szykman
2:30 PM	:30	Questions & Discussion	All
<b>Session IV: Posters - Host: Michael Newchurch (UAH)</b>			
3:00 PM	2:00	General Poster Viewing Session	<a href="#">Poster Author List</a>
<b>Adjourn @ 5:00 PM</b>			

Dinner: @ Burritt Museum immediately following the meeting. Transportation from meeting venue to dinner to hotel.

## Wednesday, May 3: TEMPO Science Team

Start	ΔTime	Description	Speaker / Moderator / Panelists
<b>TEMPO Science Team Meeting Day 2</b>			
<b>Session I: Air Quality Modeling - Moderator: Matthew Johnson (NASA)</b>			
7:30 AM	:50	Breakfast served @ Shelby Center	
8:20 AM	:10	Check-In & Audio Check	
8:30 AM	1:10	<p><i>Preparing Air Quality Modeling Systems for TEMPO Data</i></p> <ul style="list-style-type: none"> <li>• Consistent validation coordinate system               <ul style="list-style-type: none"> <li>○ GEOS-CF</li> <li>○ NOAA's National AQ Forecast Capabilities</li> <li>○ RAQMS</li> <li>○ GEOS-Chem</li> </ul> </li> <li>• Assimilation methods for forecasting</li> </ul>	Brad Pierce Gabi Pfister Arthur Mizzi Emma Knowland Barron Henderson Daniel Jacob
9:40 AM	:20	Questions & Discussion	All
10:00 AM	:30	Break & Helicopter Landing	
<b>Session II: TEMPO Validation - Moderator: John Sullivan (NASA)</b>			
10:30 AM	:45	<p><i>TEMPO Validation Components and Plans</i></p> <ul style="list-style-type: none"> <li>• Pandora</li> <li>• TOLNet</li> <li>• EPA</li> <li>• AERONET</li> <li>• GCAS/HSRL2/SeaRey/DC8</li> <li>• Funded Campaigns (Summer 2023)               <ul style="list-style-type: none"> <li>○ STAQS</li> <li>○ AEROMMA</li> <li>○ GOTHAM</li> <li>○ CUPiDS</li> </ul> </li> <li>• Future campaign ideas (Summer 2024 and beyond)</li> <li>• International partners (Mexico, Canada, Puerto Rico, EU, Korea)</li> </ul>	Steve Brown Ron Cohen Michel Grutter Pawan Gupta Laura Judd Xiong Liu Jim Szykman Chris McLinden



11:15 AM	:30	Questions & Discussion	All
11:45 AM	1:15	Group photo, then Lunch served @ Shelby Center	
<b>Session III: Steep Gradients - Moderator: Ron Cohen (UC Berkeley)</b>			
1:00 PM	1:10	<i>Resolving Steep Gradients with TEMPO</i> <ul style="list-style-type: none"> <li>• Diurnal / SZA limits</li> <li>• Urban / Rural</li> <li>• Coastlines</li> <li>• Lakeshores</li> <li>• PBL free troposphere</li> <li>• Urban gradients</li> </ul>	Gonzalo González Abad Angie Dickens Jeff Geddes Chi Li Mike Newchurch Sally Pusede Jun Wang Kai Yang
2:10 PM	:20	Questions & Discussion	All
2:30 PM	:15	Break	
<b>Session IV: Emissions - Moderator: Randall Martin (WashU)</b>			
2:45 PM	:50	<i>Assessing Diurnal Emissions with TEMPO</i> <ul style="list-style-type: none"> <li>• Lightning</li> <li>• Agriculture</li> <li>• Transportation</li> <li>• Industry</li> <li>• Volcanoes</li> <li>• Wildland fires</li> <li>• Dust</li> </ul>	Ralph Kahn Fangjun Li Barron Henderson Xiaomeng Jin Brian McDonald Ken Pickering Daniel Tong
3:35 PM	:25	Questions & Discussion	All
<b>Parallel Sessions V</b>			
<b>Session V(a): Aerosols - Moderators: Shobha Kondragunta (NOAA)</b>			
4:00 PM	:40	<i>Developments and Expectations of Aerosols from TEMPO</i> <ul style="list-style-type: none"> <li>• Aerosol product suite and resolution</li> <li>• TEMPO/GOES enhanced products</li> </ul>	Pubu Ciren Pawan Gupta Jhoon Kim Omar Torres Jun Wang

		<ul style="list-style-type: none"> <li>NASA and NOAA coordination and product developments</li> <li>Future value-added products</li> </ul>	
4:40 PM	:20	Questions & Discussion	All
<b>Session V(b): Land &amp; Ocean Monitoring - Moderator: Joanna Joiner (NASA)</b>			
4:00 PM	:40	<i>Spatiotemporal Land and Ocean Monitoring with TEMPO</i> <ul style="list-style-type: none"> <li>TEMPO products for land and ocean monitoring</li> <li>SIF and vegetation stress early detection</li> <li>Drought responses</li> <li>Red tide detection</li> <li>TEMPO-GLIMR synergy</li> </ul>	Dirk Aurin Nickolay Krotkov Alexei Lyapustin Antonio Mannino Maria Tzortziou Peter Zoogman
4:40 PM	:20	Questions & Discussion	All
<b>Adjourn @ 5:00 PM</b>			

Museum viewing & then Dinner: @ Space and Rocket Center immediately following the meeting. Transportation from meeting venue to dinner to hotel.

## Thursday, May 4: Joint Sessions w/ TEMPO Science Team, Early Adopters, TOLNet

Start	ΔTime	Description	Speaker / Moderator / Panelists
<b>10<sup>th</sup> Annual NASA TOLNet Science Team Workshop Day 1</b>			
<b>Session I: TEMPO / TOLNet Joint Panel - Moderator: John Sullivan (NASA)</b>			
7:30 AM	:50	Breakfast served @ Shelby Center	
8:20 AM	:10	Check-In & Audio Check	
8:30 AM	1:10	<p><i>TOLNet for Improved TEMPO Validation and Science Results</i></p> <ul style="list-style-type: none"> <li>• Vertical and temporal gradients</li> <li>• Air-quality processes</li> <li>• Times and places for TEMPO / TOLNet synergy</li> <li>• Horizontal scans across gradients</li> <li>• Nocturnal boundary layer and jets</li> </ul>	Claudia Bernier Ruben Delgado Matthew Johnson Shi Kuang Andrew Langford Thierry Leblanc Fred Moshary
9:40 AM	:20	Questions & Discussion	All
<b>Session II: Poster Viewing - Host: Michael Newchurch (UAH)</b>			
10:00 AM	1:00	Shelby Building Grand Lobby	<a href="#">Poster Author List</a>
11:00 AM	2:00	<b>Lunch @ Huntsville Botanical Gardens</b> (Transportation provided)	
<b>TEMPO Early Adopters Workshop Day 1</b>			
1:00 PM	:10	Greeting from Applied Sciences Program	John Haynes (NASA)
<b>Session III: TEMPO Early Adopters / Science Team Joint Panel - Moderator: Aaron Naeger (NASA / UAH)</b>			
1:10 PM	1:00	<p><i>TEMPO Data for Extreme Events and Disasters</i></p> <ul style="list-style-type: none"> <li>• Wildland fires</li> </ul>	Dov Bensimon Nathan Eckstein Greg Frost

		<ul style="list-style-type: none"> <li>• Volcanoes</li> <li>• Dust storms</li> <li>• Industrial accidents</li> <li>• Extreme weather events</li> <li>• Operational models</li> <li>• Product and latency needs</li> </ul>	Ivanka Stajner Daniel Tong Mary Uhl Jean-Paul Vernier Kris White
2:10 PM	:20	Questions & Discussion	All
<b>Session IV: TEMPO Early Adopters / Science Team Joint Panel - Moderator: Allan Just (Mount Sinai)</b>			
2:30 PM	1:00	<i>Advancements in Environmental Health Applications with TEMPO</i> <ul style="list-style-type: none"> <li>• Public health</li> <li>• Environmental justice</li> <li>• Vegetation health</li> <li>• Harmful algal blooms</li> <li>• Product and latency needs</li> </ul>	Susan Alexander Susan Anenberg Jesse Bell Mary Angelique Demetillo Dan Goldberg Shobha Kondragunta
3:30 PM	:20	Questions & Discussion	All
3:50 PM	:20	Break	
<b>Session V: TEMPO Early Adopters / Science Team Joint Panel - Moderator: Aaron Naeger (NASA / UAH)</b>			
4:10 PM	1:00	<i>Cross-Mission &amp; Program Synergy for Enhanced Applications</i> <ul style="list-style-type: none"> <li>• GLIMR</li> <li>• MAIA</li> <li>• PACE</li> <li>• TROPICS</li> <li>• NACHOS</li> <li>• NASA SERVIR</li> <li>• NASA Disasters</li> <li>• NOAA Pathfinder Initiative</li> </ul>	Patrick Duran Vanessa Escobar Jordan Gerth Erin Jephson Abbey Nastan Betzy Sandoval Maria Tzortziou
5:10 PM	:20	Questions & Discussion	All
<b>Adjourn @ 5:30 PM</b>			

Dinner: Self-organized

**Friday, May 5: Parallel TOLNet and TEMPO Early Adopters Workshops**

Start	ΔTime	Description	Speaker / Moderator / Panelists
<b>10<sup>th</sup> Annual NASA TOLNet Science Team Workshop Day 2</b>			
7:30 AM	:50	Breakfast served @ Shelby Center	
8:20 AM	:10	Check-In & Audio Check	
8:30 AM	:10	TOLNet Introduction	Michael Newchurch (UAH)
8:40 AM	1:00	TOLNet Station Updates (LaRC, GSFC, CCNY, ECCC, Hampton) 10 minute / 2 slides	Tim Berkoff (NASA), John Sullivan (NASA), Fred Moshary (CCNY), Kevin Strawbridge (ECCC), Ruben Delgado (Hampton U.)
9:40 AM	:20	Break	
10:00 AM	:45	TOLNet Station Updates (UAH, NOAA, JPL/TMF, Ames) 10 minute / 2 slides	Thierry Leblanc (NASA), Andy Langford (NOAA), Chris Senff (NOAA), Shi Kuang (UAH), Matthew Johnson (NASA)
10:45 AM	:15	Data LaRC Update on Archive/Merge to Earthdata	Michael Shook (NASA), Crystal Gummo (NASA), Gao Chen (NASA)
11:00 AM	1:00	TOLNet Data Discussion for the Future <ul style="list-style-type: none"> <li>• Update: Centralized Processing for TEMPO</li> <li>• Update: SMOL</li> <li>• Website 2.0 Launch (API, graphical capabilities)</li> </ul>	All
<b>TOLNET Science Team Workshop - Adjourn @ 12:00 PM</b>			

## TEMPO Early Adopters Workshop Day 2

7:30 AM	:50	Breakfast served @ Shelby Center	
8:20 AM	:10	Check-In & Audio Check	
<b>Session I: Air Quality &amp; Health Applications - Moderator: Barron Henderson (EPA)</b>			
8:30 AM	1:00	<p><i>Accelerating Use of TEMPO Data at Air Quality &amp; Health Agencies</i></p> <ul style="list-style-type: none"> <li>• Exceptional event demonstrations</li> <li>• Air quality emissions &amp; monitoring</li> <li>• Air quality forecasting</li> <li>• Long-term pollutant trends</li> <li>• Health assessments</li> </ul>	<p>Joel Dreessen Brian McDonald Ron Pope Sara Strachan Dan Welsh Dave Westenbarger</p>
9:30 AM	:15	Questions & Discussion	All
9:45 AM	:15	Break	
<b>Session II: TEMPO Data Distribution &amp; Proxy Data - Moderator: Daniel Kaufman (NASA)</b>			
10:00 AM	:45	<p><i>Distribution of TEMPO Data and Proxy Data Developments</i></p> <ul style="list-style-type: none"> <li>• Operational data updates</li> <li>• NASA ASDC updates</li> <li>• EPA RSIG gateway</li> <li>• TEMPO proxy data</li> <li>• NASA SPoRT initiatives</li> </ul>	<p>Aaron Naeger Matthew Tisdale Luke Valin</p>
10:45 AM	:15	Questions & Discussion	All
11:00 AM	1:00	Lunch served @ Shelby Center	
<b>Session III: TEMPO Training</b>			
12:00 PM	2:30	<p><i>TEMPO Proxy Data Access, Tools, and Demonstrations</i></p> <ul style="list-style-type: none"> <li>• TEMPO proxy data briefing</li> <li>• Earthdata walkthrough</li> <li>• ArcGIS Dashboard</li> <li>• Tools for processing and analyzing TEMPO data</li> <li>• Hands-on training examples</li> </ul>	<p>Aaron Naeger Matthew Tisdale Barron Henderson</p>