# The Atmospheric Waves Experiment (AWE)

A mission to investigates global gravity wave (GW) properties in the upper atmosphere and their impacts on the ionosphere-thermosphere-mesosphere (ITM)

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### **Atmospheric Waves Experiment (AWE)**

AWE is the first dedicated NASA mission to investigate global gravity wave (GW) properties in the upper atmosphere and their impacts on the ionospherethermosphere-mesosphere (ITM)

How does tropospheric weather influence space weather?



# **Atmospheric Waves Experiment (AWE)**

### **AWE Science Objectives**

**Objective 1**: Quantify the seasonal and regional variabilities and influences of GWs near the mesopause.

**Objective 2:** Identify the dominant dynamical processes controlling GWs.

**Objective 3:** Estimate the wider role of GWs in the ITM.

# AWE Launch (9 November 2023)



Credit Allison Bills

# AWE Installation on the ISS and First Light (Nov 22, 2023)



Credit NASA



Credit Allison Bills

### **Some AWE Preliminary Data**

3000 km



Intense gravity wave activity over the northern Atlantic Ocean on Nov 22, 2023

### **Some AWE Preliminary Data**



Concentric gravity wave activity generated by intense convection over Venezuela and the Caribbean Sea on Nov 22, 2023

### **Some AWE Preliminary Data**



Bore-like gravity wave event over the Atlantic Ocean on Nov 22, 2023

### **AWE Measurement Concept**

Four wide-field telescopes to measure the OH  $P_1(2)$ ,  $P_1(4)$ ,  $Q_1(1)$  emission lines as well as the background nearby.



# **AWE Advanced Mesospheric Temperature Mapper**

### **AWE Measurement Concept**



600 km

# **AWE 2-Year Mission on ISS**

- Nighttime measurements
- ~15 orbits per day
- Four-day full coverage ±55° latitude
- One temperature map every 1.1 second
- 600 km field-of-view
- 30-300 km GWs measurements at ~87 km
- State-of-the-art modeling
  - NAVGEM (NRL)
  - WACCM-X (NCAR)
  - MAGIC (ERAU)
  - CGCAM (GATS)...







### **AWE Data Levels**

Data level	Description	Number of files	Dimensions (px)	Processed by
LOa	Raw images	4 per 1.1 sec	320x256	MOC
LOb	Resized, calibrated, geolocated	nighttime 4 per 1.1 sec	256x256	MOC
L1a	Regridded, co-added	4 per 1.1 sec	300x300	SOC
L2a	Temperature images	1 per 1.1 sec	300x300	SOC
L2b	Band intensity images	1 per 1.1 sec	300x300	SOC
L3a	Temperature swaths	1 per orbit	~7,000x1,000	SOC
L3b	Band intensity swaths	1 per orbit	~7,000x1,000	SOC

### Levels 3a and 3b - Temperature and Band Intensity Swaths

• Collocate 4 columns from each L2a (L2b) image to create the swaths.



One band intensity swath per orbit = L3b

### L3a Projected on a Map

- ~7,500x300 pixels = 15,000 x 600 km
- Resolution 2 km/px
- ~15 similar files per 24 hours



# L3b Projected on a Map

- ~7,500x300 pixels = 15,000 x 600 km
- Resolution 2 km/px
- ~15 similar files per 24 hours

### One day of observations



### **Comparison With Ground-based Observations**



### **AWE Temperature vs BLO Temperature (For December/January)**



# **GW Activity During the Recent Sudden Stratospheric Warming Events**

From Jiarong Zhang's talk in yesterday's GW Grand Challenge Workshop

**AWE Radiance Variance** 60°N 2.8 50°N-2.4 2.0 -N°08 N°08 N°08 1.6 1.2 0.8 20°N 0.4 0.0 10°N **DEC 15 JAN 15 FEB 15 MAR 15** 2023-2024

Weakened GW activity in the Northern Hemisphere following the onset of SSWs.

### **AWE Status**

- Successful launch on November 9, 2023,
- Started to take data on November 22, 2023,
- >5M nighttime images obtained so far,
- Data processed to LOb at SDL, and up to L3 at USU,
- Temperature values in good agreement with ground-based measurements,
- Comparison with weather satellites to better understand relations between OH lines,
- Started to investigate different atmospheric phenomena (SSW, convective activity),
- Bob Stockwell from GATS (Boulder, CO) installed a server in the USU data center to measure GW parameters using S-transform algorithm.

### **Near Future:**

- Need more ground-based data and weather satellite comparison to improve temperature images,
- Analysis of GW events (S-transform),
- Data release to general public ~end of June 2024.

For more information: www.awemission.org

### Radiance



UtahStateUniversity -

SDL/24-1504 Rev. -

### Radiance



Data Min = 4.1, Max = 18.2

### UtahStateUniversity -

SDL/24-1504 Rev. -

### **Ground Systems**

