WX 365 Exam 2—Take-Home Project, Fall 2025—Due: Monday, November 10, 2025.

Read Carefully and follow ALL instructions! The exam must be uploaded as a SINGLE PowerPoint file…no paper copies. It is recommended that you create a folder or directory on your computer in Onedrive for this exam with a separate subfolder for each question that contains all your satellite imagery and documentation. Then you should create a PowerPoint document to present all your materials for each question—ultimately this will be uploaded to Canvas. Your completed exam should include the following:

- ❑ **A cover page with your name.**
- ❑ **The checklist (see below) for questions 1-10, and all items checked off (if they were completed).**
- ❑ **Each question must be clearly labeled with its question number.**
- ❑ **TIME STAMPS MUST BE EVIDENT ON ALL IMAGES AND DOCUMENTATION.**

This is a take-home exam involving **real-time imagery (i.e., *not* archived or someone else's imagery from outside the exam time-window).** There are 10 questions. You may discuss your results with others in the class, but ultimately, **the work you turn in MUST be your own**.

This exam consists of identifying features in **real-time current** satellite imagery (the clock starts today, Monday, October 20, 2025), downloading and labeling the imagery, and providing sufficient documentation and annotations for me to evaluate what you have done. The time and date of the image **must** be evident somewhere on the image.

Regarding sources of satellite imagery, you may use any Internet source of realtime satellite imagery with the exception of questions that require a specific source, (or if you are familiar with AWIPS or linux programs like NMAP, McIDAS, IDV, etc. you may use those).

You must CLEARLY identify the specific area(s) of each image showing the phenomenon in question by circling and labeling the location—be specific: large circles that include everything don't demonstrate that you can recognize the phenomenon.. **Documentation consists of whatever information is required to take the guesswork out of the image interpretation; in general, use maps of OBSERVED variables, NOT FORECAST maps to document the phenomenon**. You may use the same source image or source maps for different questions, but you must make **separate copies for each question**, **CLEARLY identifying which question you are answering!**

*** **Important!** Please do NOT cram all your images and documentation for a question onto one page. I prefer large images on separate pages so I can see what's going on, rather than several small images on one page.*****

Suggested procedure:

- Make liberal use of the Snipping Tool—it is one of the easiest and best ways to copy parts of images or documention that you need.
- Make a WX365 Exam 2 "folder" on Onedrive to keep all your image and documentation files, then make subfolders for each question to keep your data organized. If you are not using Onedrive, **KEEP BACKUPS OF ALL YOUR WORK.**
- Read the questions carefully, several times if necessary
- Work one question at a time—thoroughly understand the instructions and required documentation for that question. Each question can be thought of as a 10 point "mini-exam" on that particular topic.
- Start the question by simply reading the checklist to get an idea in your mind what the "deliverables" for this question are.

- Read the notes and study the examples provided in the notes to learn pattern recognition for each kind of feature to thoroughly understand the phenomenon BEFORE you start to look for imagery. If you don't understand the patterns to look for, ask me!
- Look at lots of imagery to find the **best** examples; don't "force" something that is not really there.
- Look in appropriate locations (e.g. mountain waves require mountains, post-frontal open cell convection happens in cold, high latitude locations **over the ocean**, **NOT in the subtropics**). Keep in mind GOES-East and -West provide full disk imagery every 10 minutes, so don't limit yourself to the CONUS unless you need documentation from the CONUS to complete the question. Consider the southern hemisphere; in the RAMMB Slider the Himawari satellite is also available for Asia, as long as you can also provide necessary documentation for your image location. "Earth" should not be your first choice, but if traditional sources of meteorological documentation are not available it can provide the information you need to document some phenomena.
- Look first in a larger scale view, then get a zoomed view, if appropriate, to better see/show it—sometimes you may want to present both. **Use appropriate zoom factors** for the phenomenon in the question. Use your best judgment about what works well to show the phenomenon—if a feature is too small it may be hard to see, but if you are too zoomed in you may not be able to show all of it. Every case is different, so once you have pasted images into PowerPoint, ask yourself am I showing this phenomenon in a clear, readable scale and format?
- Copy/paste/insert images into your PowerPoint document.
- Label/highlight images—best using PowerPoint image tools.
- Actively use your checklist for each question. Experience shows that many point losses are checklist-related, i.e., students ignore it!
- **Upload via Canvas.**

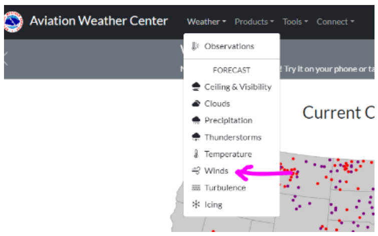
For the purposes of this exam:

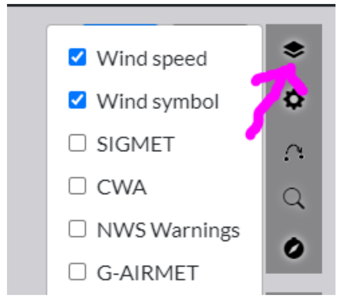
Visible = 0.64 µm GOES Channel 2, or a "true" color RGB composite. Note that Geocolor is only "visible" in the daylight sector, but fills in with IR info in the nighttime sector.
IR = 10.3 µm Channel 13 clean longwave window (or 11.2 µm Channel 14 window)
Water vapor = 6.2 µm Channel 8 upper level water vapor (or Ch. 9 or Ch. 10).

Identify the following in **real-time current** satellite imagery:

1. Mountain waves in high resolution visible imagery or water vapor imagery and possible association with turbulence (it may or may not be present).

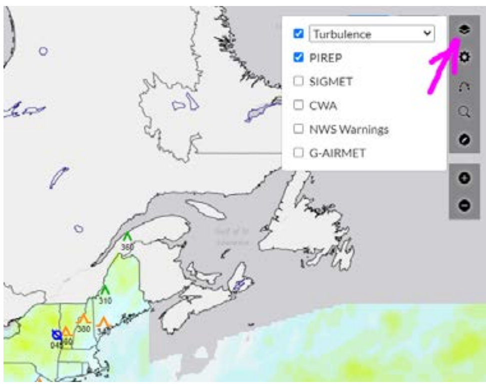
- ❑ Visible **or** water vapor image(s), appropriately labeled.
- ❑ An appropriate map of the region showing **mountain-top (NOT SURFACE!!!)** level winds blowing **perpendicular** to waves (If in the U.S. go to https://aviationweather.gov/, then click on the Weather dropdown >Winds.





Select an appropriate Flight Level, and eliminate clutter using the Select active layers icon in the upper right. You can use Earth for locations not covered by other data sources.

- ❑ **SIMULTANEOUS** map of turbulence **reports** (you must use turbulence **reports**, NOT forecasts, i.e., **NO** airmets/sigmets or Sig Wx progs) showing that there was or was not turbulence being reported at that time. (Go to https://aviationweather.gov/gfa/#turb, then click the Select Active Layers button in the upper right corner and uncheck everything except Turbulence and PIREP to eliminate clutter:



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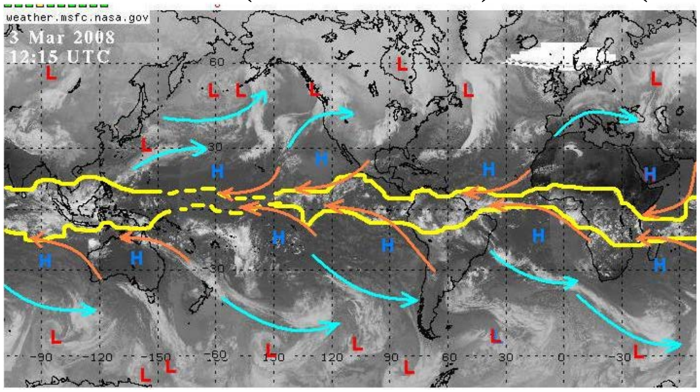
2. Cloud streets in high resolution visible imagery.

- ❑ Visible image(s), appropriately labeled.
- ❑ A **surface or low-level** map showing wind or general flow directions **parallel** to "streets;" approximately 3000-6000 feet altitude is probably best, as convective clouds are *above* the surface (see #1 above for getting winds at a level from the Aviation Weather Center)

3. Measure the effect of parallax error using Google Earth, and nearly-simultaneous .kmz images from GOES-East and GOES-West. See Question 3 instuctions document on the Modules page under Exam 2.

- ❑ Global scale Google Earth IR images of GOES-East and GOES-West identifying region of parallax error (two images).
- ❑ Moderately zoomed Google Earth IR images of GOES-East and GOES-West showing specific feature to be used for measuring parallax error (two images).
- ❑ Highly zoomed Google Earth IR images of GOES-East and GOES-West containing ruler showing actual displacement distance (two images).
- ❑ "Displacement Error = ______" inserted at beginning of question # 3 in your powerpoint containing your measurement for displacement error.
- ❑ Should contain a total of **6 images**: **two low-zoom** images, **two moderately zoomed** images, and **two very highly zoomed** images, all using Google Earth (**see the Question 3 Instructions document**).

4. Obtain a global LW Infrared (~12.0 µm) composite image from NOAA (click on this link, any image from second column) and create an analysis of specific weather features that can be related to the features of the general circulation using the similar image from the course notes on the General Circulation (from 3 March 2008) as a model (see below, also).



Clearly identify and label each of the following:

- ITCZ (Note: draw lines showing exact northern and southern extent of associated convection)
- subtropical highs
- subpolar (i.e., midlatitude cyclonic) lows
- westerlies.
- NE Tradewinds
- SE Tradewinds

5. Post-frontal open cell convection. **Clearly identify the location of the open cells.**
Remember: Open cell convection is primarily a high latitude and mid-latitude phenomenon found BEHIND a cold front, not a tropical or subtropical phenomenon.

- Image showing open cells (visible is usually best for this).
- Unified Surface Analysis (note: click region to zoom in) or other documentation showing the cold front and from which it can be inferred that there is cold air over relatively warmer water.

6. IR or water vapor image of transverse waves in a jet stream (usually enhanced IR is best).

- IR or WV image.
- Transverse bands labeled on image.
- 300 mb or high level wind map showing wind flow/jet stream **perpendicular** to transverse bands.

7. Comma Cloud and Surface Low Pressure

Find a comma cloud in visible or IR imagery. Include a surface analysis showing that your comma cloud is associated with a low pressure center with fronts, that is, an extratropical cyclone. Mark the position of the surface low on the satellite image and identify the "warm conveyor belt," the "cold conveyor belt," and the dry slot regions. You may use the Unified Surface Analysis to document the low pressure center with fronts. Be sure to click on the map to get a higher resolution version than the default view.

- Visible or IR image of comma cloud with required annotations.
- Surface analysis showing low associated with comma cloud.

8. Make an animation using true color (daylight sector only) or channel 2 visible imagery to identify outflow boundaries (arc cloud lines/gust fronts). Use a very high level of zoom in enough to see them clearly.

- ❑ Visible image animation of outflow boundaries emerging from a thunderstorm.
- ❑ An arrow or some powerpoint shape inserted over the animation (or any kind of drawn annotation) to indicate the approximate position of the outflow boundary.

9. Use the RAMMB Slider to obtain high resolution visible (either geocolor or red visible) and longwave IR imagery of overshooting thunderstorm tops. **Clearly indicate the positions of the overshooting tops on the image.** Again, be sure to zoom in enough to see the features clearly. Use the visible to show the shadow being cast (early morning or late afternoon is best for this). Use the IR to show that the overshooting tops are colder than the anvil.

- ❑ Visible image with overshooting tops casting shadows.
- ❑ IR image with cold overshooting tops.

10. High resolution visible imagery of cumulus convection in conjunction with sea breezes. **Clearly indicate the position of the sea breeze front with a line at the EXACT position; remember, the sea breeze front cannot be over the ocean!** More than one image or an animation may be helpful to show the inland penetration of the sea breeze.

- ❑ Visible images or animation of sea breeze front.
- ❑ Sea breeze front drawn on image, marked by a line showing the exact boundary between marine air and land air, clearly labeled.