

# Case Study Development Guide

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There are various levels of learning: remembering; understanding; applying; analyzing; evaluating information and concepts; synthesizing concepts to create something new. Case studies provide perfect opportunities to foster learning at each of these levels.

Educational case studies can be descriptive or interactive. They are an effective means to teach about weather events, forecast processes, and data products. Descriptive case studies describe or analyze events, etc. while interactive case studies simulate the forecast environment and actively involve users in learning to use products or processes, etc. This Case Study Development Guide focuses on developing interactive case studies, since they can be particularly effective in fostering deep and lasting learning. The guide is intended for meteorology instructors at training centers and universities.

## Plan Your Case Study

Planning your case study before gathering the data and authoring it helps ensure that the case study is well-structured and that it meets the needs of the intended audience. Here's a checklist of tasks to address in the planning stage.

### Define the need or problem to be addressed

Are forecasters having trouble understanding or forecasting a type of weather event? Do they need to learn how to use new products? Answering these questions will help you determine what type of case study to create and define your goals (what you hope to achieve).

### Select the topic of your case study

Select a topic that addresses forecaster needs as defined above.

### Define your audience

Who is the case study intended for? This can be forecasters, students, scientists, or forecast users. You will need to find out what forecasting platforms, tools, and data they use so you present products like the ones they really use in their forecasting environments.

### Define the goals and objectives of your case study

Goals are broad, general statements about what you want learners to achieve. In contrast, objectives are specific, concrete, and measurable, and indicate what learners should know or be able to do in order to meet the goals. Objectives should be written for the learner, not the instructor. They should focus on what users will learn.

### Define the content

What information needs to be covered? Think about your learners. How much do they know about the topic? How much forecasting experience do they have in the topic area? How experienced are they in using the data that you want to present? The answers to these questions help you decide the type and amount of instruction that you will need to provide.

## ❑ Identify how the case study will be used

Case studies can be used in many different ways:

- As a lab exercise or lecture aid. If you're creating this type of case study, identify where it fits into the curriculum—the types of courses in which it can be used.
- As a self-paced learning program that users go through on their own—at their forecast offices or as part of a class. This type of program needs to be far more thorough and comprehensive than a lab exercise used in class with instructor support.
- As an assessment tool. For example, if you want to test competencies, you can present a case; ask learners to analyze the data, develop a forecast, and make decisions at key points; and then assess their performance.

This guide focuses on the development of self-paced learning cases, although the same process applies to the other types of cases.

## ❑ Define the presentation and delivery formats

There are many options, mostly dictated by the level of interactivity. You can create a PDF generated from a word processing program, such as Microsoft Word or Google Docs, or PowerPoint. Or you can create an interactive, HTML-based presentation using various web development tools and javascript libraries.

## ❑ Identify the specific case(s)

You can choose a case that's typical of the type of event—one that forecasters are likely to encounter. Or an extreme example that has a significant impact and that forecasters need practice handling. To simplify your efforts, look for cases for which the data are easy to obtain!

Although most case studies focus on one event, there are advantages to having two. You can show variations of the weather event—how it manifests itself in different areas and times. You can also "scaffold" the learning experience—provide structured, guided learning at the beginning and gradually reduce it, letting learners do more and more on their own. This is particularly useful when teaching a forecast process. The first case can be a "teaching" case where you present the process and guide learners through it. The second can be a "practice" case where learners apply the process on their own, accessing the background information or forecast process as needed.

## ❑ Identify the specific case data

Here are some guidelines:

- Present data that show the features of the weather situation and are critical for understanding it. Only include non-essential data if your goal is to help learners select appropriate data for particular weather situations. For initial learning about a phenomena or process, too much data can be confusing.
- Use data that learners have access to on the job—either now or in the near future.
- Use data that are available to users in the right time frame. Don't show data that forecasters cannot access in time to make their forecasts. For example, 12 UTC model data are not available at 12 UTC.
- If you want to introduce new data, provide the data that learners are accustomed to using along with the new data, so they learn how to integrate the two.

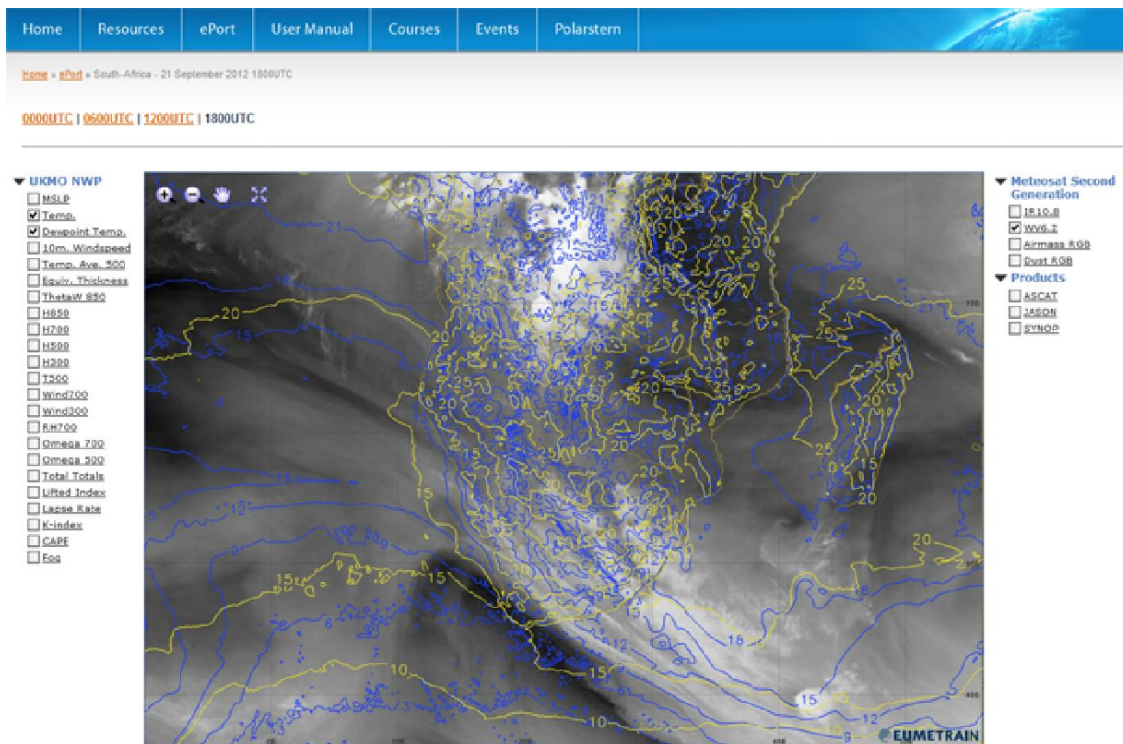
The biggest challenge in creating a case study is usually related to the data—not being able to get the right dates or types of data, or having trouble processing them. This makes it critical to identify your cases and gather and process the data before investing a lot of time on writing up the case study. Without good data, don't bother.

## ❑ Identify how to best present the data

There are various options:

1. Use an existing, online data viewer that contains all of the data for each forecast period. When you're on a page and want learners to examine data, instruct them to access the viewer and tell them which products to look at, unless you want them to figure it out on their own. The data viewer can be used with any format of case study (online, PDF, or PPT) as long as learners can access the website.

**Example: ePort** (<http://eumetrain.org/eport.html>) is a EUMETRAIN data viewer that lets users view EUMETSAT images and products and overlay numerical model fields and other data. There are different areas of focus: Atlantic (including Africa), Southern Africa, Middle East, Europe, and Polar. New areas are added periodically so check to see if your area is covered. Note that the data are archived, making it a good place to look for cases. Use ePort to serve the data for your case study or to capture graphics to use as part of your document.



2. If you're creating an online case study, you'll want to use some sort of HTML-based data viewer. Here's an example of an animation embedded on the page of a COMET MetEd lesson using iframes (login required):

[https://www.meted.ucar.edu/asmet/e\\_africa\\_a8/navmenu.php?tab=1&page=4-2-1&type=flash](https://www.meted.ucar.edu/asmet/e_africa_a8/navmenu.php?tab=1&page=4-2-1&type=flash)

The individual data viewers are in separate html directories:

[https://www.meted.ucar.edu/asmet/e\\_africa\\_a8/media/loops/MSLP\\_1-13/index.htm](https://www.meted.ucar.edu/asmet/e_africa_a8/media/loops/MSLP_1-13/index.htm)

A web developer with basic skills should be able to work with the source code to build their own loops using their own data. A copy is available for [download here](#).

The Space Science and Engineering Center at the University of Wisconsin also has several viewers and source code available for download:

<http://www.ssec.wisc.edu/hanis/>

<http://www.ssec.wisc.edu/~billb/jsani/>

Most model and data display tools provide export utilities to create video loops or animated GIFs of data loops. UCAR Unidata's Integrated Data Viewer (IDV)

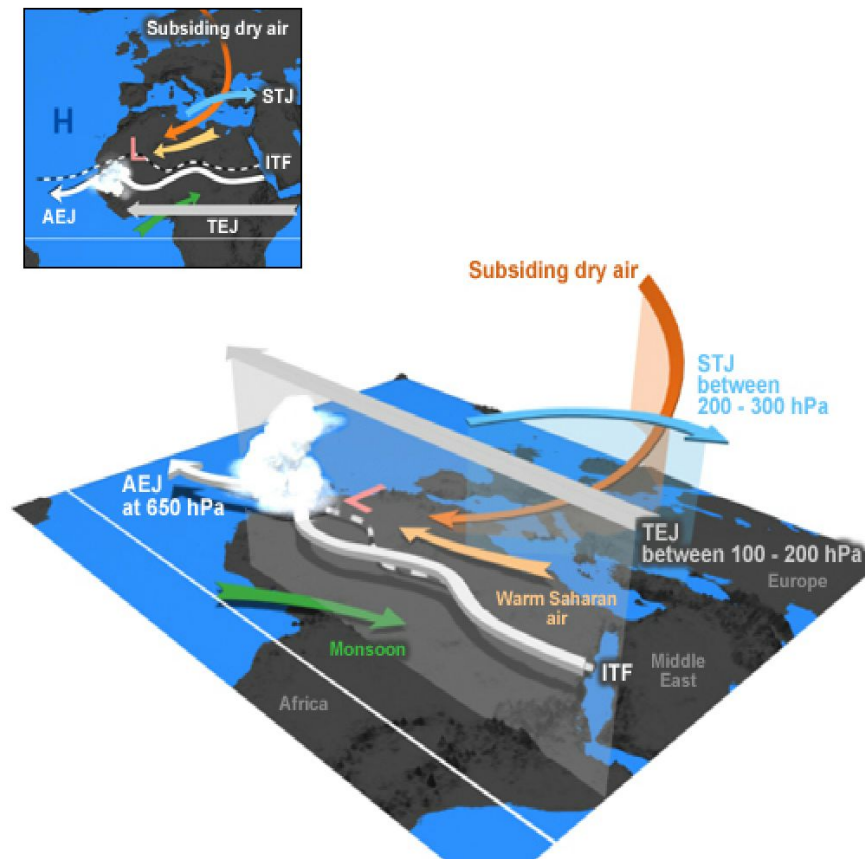
(<http://www.unidata.ucar.edu/software/idv/>) is a good example of a freely available, powerful tool for analyzing and exporting data loops.

3. If you're delivering the case study as a PDF or other static document format, you can display some of the graphics right on the page. But the animations usually need to be opened in a separate application. Link to each separate video or animated GIF hosted somewhere online, or consolidate such loops in an accompanying PowerPoint file.

### ❑ Identify other supporting media

Graphics and animations that depict physical processes, such as conceptual graphics, are extremely effective in helping learners understand scientific processes.

Here's an example of a conceptual graphic that shows key features that contribute to convective systems in West Africa. The graphic serves as the basis for the background information section as well as the features monitored in a case.



MetEd has a large collection of conceptual images that are free for reuse. Use the site's search tool or conduct an advanced search using Google or other search engines.

Although most case studies are text based, audio narration can be a nice addition. For example, it lets learners focus on the features in an animation as it's being described, which is easier than trying to read the description and watch the animation.

You can also include interviews with forecasters or forecast users, something that can bring a case to life. The interviews can, for example, discuss the impacts of a weather event or the challenges faced by the forecasters who worked it. The interviews can be presented as audio or video segments, or you can provide transcripts or text responses to questionnaires. COMET's Community Tsunami Preparedness lesson ([https://www.meted.ucar.edu/training\\_module.php?id=897](https://www.meted.ucar.edu/training_module.php?id=897)) makes use of such interviews.

#### **❑ Identify how to assess learner understanding**

You can embed "check for understanding" questions throughout the case to support the learning process. A graded, culminating assessment can be used to measure overall learning.

#### **❑ Identify the project development team**

Creating a case study requires skills in writing, data gathering/processing, and converting the script into its final format, be it a PDF or interactive HTML lesson. Make sure your team has the skills and time to properly support the development of the case study. Don't forget to identify experts to review the case as it is being developed and when it is complete to assure its scientific and operational integrity.

#### **❑ Set a development schedule**

Is there a deadline? If so, you will want to assign milestones for each step to help keep the project on track.

# Structure Your Case Study

Case studies can be structured in different ways. Here is a suggested outline:

## Introduction

- An overview of the lesson. This describes the intended audience, objectives, related competencies (if applicable), prerequisite knowledge, and placement within the curriculum.
- An overview of the case. This describes the phenomena of interest and the forecasting challenges, provides an overview of the case, describes its location (including geography and climatology), and gives the time frame.

## Background

- Provides background information that is essential for analyzing the case. Topics could include: conceptual material that describes the weather phenomena or event; the forecast process related to the case; the setting, such as geographic information and climatology; any nuances or peculiarities regarding the case data.

## Case

- How you present the case is partly related to your objectives. If you want to simulate a real forecast situation, present the case as if it's unfolding in real time. Ask learners to analyze the data and make decisions as they go through the forecast steps.
- To make a case seem realistic, you can talk directly to your learners as if they are forecasters on the job. Write in the second person, as in: "You've examined yesterday's satellite imagery. Now it's time for you to compare it to the model analysis." To see an example of a case study presented this way, go to COMET's Flood Forecasting Case Study at [https://www.meted.ucar.edu/training\\_module.php?id=807](https://www.meted.ucar.edu/training_module.php?id=807).

## Impacts

- Describes the outcome of the case and any impacts. For example, if it's aviation-related, you can discuss how aviation operations were affected by the weather event, including delayed flights, airport closings, missed approaches, etc.

## Summary

- Highlights the main points. If you've presented information that can serve as a reference guide, provide it as a PDF that learners can download and use on the job.

Here are several outlines of COMET/MetEd case study lessons. Review them, noticing how they're similar to or different from the one above. You can use any of these outlines, adjusting them as needed, or you can develop your own.

### Alberta Clipper

([www.meted.ucar.edu/training\\_module.php?id=557](http://www.meted.ucar.edu/training_module.php?id=557))

Objectives:

1. Recognize the key synoptic ingredients that can lead to the development of an Alberta Clipper.
2. Determine the track of an Alberta Clipper.
3. Assess snowfall amounts associated with a clipper.
4. Identify signals in the satellite and radar imagery and NWP data that can be associated with these systems.

Lesson outline:

1. Case Profile
  - Geographic setting; local climatology; climatology of the phenomena; synoptic setup; area forecast discussion; notable model features; more area forecast discussions
2. Case Challenge
  - Current setting; forecasting issues; synoptic conditions; time periods (for each period, learners analyze satellite imagery, model forecasts, radar imagery, and other observational data)
3. Post-Event Analysis (a review of what occurred and how the models performed)

### **BoM Aviation Fog Case Exercise**

([https://www.meted.ucar.edu/training\\_module.php?id=515](https://www.meted.ucar.edu/training_module.php?id=515))

Objectives:

1. Identify the possibility and classification of fog from the preconditions using synoptic charts and observations. Assess fog potential parameters in the short term and forecast the trends in the next 12-24 hours.
2. Utilize and access relevant fog forecasting tools and assess their usefulness and limitations.
3. Identify fog using a range of available tools.

Lesson outline:

1. Case Profile
  - Case overview, including case location, time frame, phenomena of interest, forecasting challenges; geographic setting and local influences; local airports of concern; climatology; local fog aids; forecast scenario; current forecast situation
2. Case Challenge
  - This is divided into several time periods. Each has an overview followed by a series of pages in which learners analyze different types of data and predict what will happen. Each product has questions for learners to answer.
3. Summary
4. Supporting Topics (maps; fog theory and processes; forecasting process; monitoring tools)

### **Caribbean Radar Cases**

([https://www.meted.ucar.edu/training\\_module.php?id=968](https://www.meted.ucar.edu/training_module.php?id=968))

Objectives:

1. Apply conceptual models of weather phenomena to interpret radar imagery
2. Describe aviation hazards associated with specific weather phenomena



3. Identify locations likely to be affected by mesoscale convective systems and heavy rainfall using radar imagery

Lesson outline:

1. Case Profile and Introduction
2. Local Topography and Climatology
3. Conceptual Models of Weather Phenomena
4. Case Challenge
5. Assessing Impacts
6. Post-Event Analysis
7. References

## Tips to Increase Effectiveness

### Address the Forecast Process

Integrating a well-defined forecast process will improve the learning gained from a case study. Here are general tips for developing a forecast process:

- Follow the forecast funnel. Start by examining large-scale synoptic features and move down to small-scale mesoscale features.
- Model the forecast process used by forecasters in operations.
- Organize the case study by time period, following the progress of the event. Decide when to begin the case (how far back to go) and how long to follow it. Of course, this depends on the nature of the event. You'll follow a tropical cyclone much longer than a brief thunderstorm.
- Since different models can produce different forecasts, it's important to teach learners how to evaluate and use them intelligently.
- Discuss the benefits and weaknesses of the different types of data.

Here's a sample forecast process. Although it applies to creating TAFs, the process is general enough to be applicable to other forecast situations. (Recall that a TAF is a Terminal Aerodrome Forecast that reports weather forecast information as it relates to aviation.)

1. Review observations and satellite images, using the forecast funnel (from larger to smaller scales) to create a conceptual model of the current state of the atmosphere.
2. Compare the conceptual model to the NWP analysis.
3. If they are in agreement, examine the model forecast to determine the onset of weather events; the duration and type/strength of precipitation (if any); ceiling heights and visibility; and wind values.
4. If they are not in agreement, adjust the guidance that the model is giving to better represent the observed data.
5. Combine the conceptual model and NWP forecast to write a TAF.

6. Monitor the weather situation and issue amendments if needed.

### **Storyboarding and Scripting**

For projects like those developed at COMET, we take the time to carefully write and review a storyboard—and script, if narration is going to be used—before developing the case study as an interactive web site. Considerable effort is devoted to web development and we want to make sure that the content is well edited and complete before being developed.

The storyboard is used to specify what content will be placed on each page of the case study site - the text, graphics (data or conceptual), and interactions (when appropriate). This an iterative process and we incorporate several reviews to fine-tune the content and flow.

### **Writing Style**

Every culture has its own style and approach to learning. In turn, the most effective writing style will be dictated by culture and language. Regardless of these factors, here are some tips to keep in mind:

- Use clear, concise language. Avoid jargon and overly technical language. Make sure that you define terms that may not be familiar to all users.
- "Chunk" your content. Don't put too much content on one page. One concept or process step at a time.
- Consider including optional background pages or highlights for related concepts that are assumed knowledge.
- Describe the media. Use captions and detailed descriptions of the imagery, animations, and data products. The more the learner knows about these elements, the more she can use them to understand concepts and analyze the data.

### **Include a Lot of Interactions**

Actively involving the learner via interactions will provide cognitive engagement and more effective learning. Just reading an overview of a case will not provide the engagement needed to learn about proper process, data analysis, and forecasting. Interactions—which can range from questions that ask learners to evaluate situations or interpret data, to simulations that show cause and effects—lead to deeper understanding. Wherever possible, align the questions with an operationally relevant context.

### **Include a Culminating Assessment**

For each objective, write one or two questions that assess whether learners have achieved the level of performance indicated by the action verb (remember, understand, apply, analyze, evaluate, or create).

Consider this objective: "Learners will be able to analyze upper level wind data to determine locations of turbulence." Since it involves data analysis, you will need to present data and ask learners to analyze data in the quiz. It's best to show data that learners haven't seen before so have a second case with similar characteristics available for use in the quiz. If that's not possible, you can reuse the case data. Just be sure to ask different questions.

If you don't have access to a learning management system, assessments can be authored and made available through tools such as Google Forms (<https://www.google.com/forms>) and Survey Monkey (<https://www.surveymonkey.com>).

### **Review Before Use**

Engage a subject matter expert to review the case study and assessment. Here are some suggested guidelines for their review:

- Is the content accurate and clearly explained?
- Is it thorough enough to meet the goals and objectives?
- Is it well organized?
- Is there a good level of quality interactivity?

Ask the reviewers to assess to make sure the menus, navigation system, and interactions work properly and that links lead to the right place and open in the right windows. Test the case in the browsers and platforms that your audience will use. If the program will be on hard media such as CDs, burn a test CD and try/check it before distributing.

If the case study is a PDF or other type of document, upload the case study folder to an online site or put it on a CD or other form of hard media. Then copy and distribute it to your audience.

## **Share and Evaluate Your Case Study**

Once the case study is finished, make it available to your intended audience. It's important to collect user evaluations to measure impact and to identify any issues. Here are some commonly asked survey questions.

1. In general, I liked this case study.  
[Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree]
2. The format was effective for learning (including navigation, media, interactions).  
[Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree]
3. The content was relevant to my work or studies.  
[Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree]
4. The case study increased my understanding of the topic.  
[Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree]
5. What did you like most about the case study? Tell us about what you learned that was most interesting and useful, how it will help you, how it was presented.  
[Text entry field]
6. What did you like least about this case study? How could it be improved?  
[Text entry field]
7. Would you recommend this case study to others? Why or why not?  
[Text entry field]

If you don't have access to a learning management system, surveys can be collected through tools such as Google Forms (<https://www.google.com/forms>) and Survey Monkey (<https://www.surveymonkey.com>).