Lesson Plan: Writing an Abstract

Martin Leach
Department of Meteorology and Climate Science
San José State University

Lesson: Writing an Abstract

Timeframe: 75 minutes

Target Audience: Upper-division university students and/or graduate-level university students

Materials needed: laptop, sample abstracts, handout with outline of the lesson, summary of a current professional journal article

Objectives: After the lesson, the students will be able to

- understand the purpose of an abstract;
- know the structure of an abstract;
- understand the steps in writing an abstract;
- know how to identify the key components of an abstract from current examples;
- be able to write an abstract.

Background: This lesson is one component of a course in how to prepare technical reports and journal articles, as well as how to make professional presentations. Students who take this course are expected to have demonstrated skill in the basics of writing, including grammar, punctuation, sentence structure, and paragraph structure. However, each class session starts with a brief review of basic grammar and punctuation concepts. The primary purpose of the course is for the students to learn the characteristics of good technical writing, including the essential components of a technical paper. This individual lesson plan focuses on writing an abstract.

The first several weeks of the course are spent breaking apart the components of a technical paper, including the introduction, background, methodology or experiment design, results, and summary or conclusion. This lesson demonstrates how writing an abstract incorporates the essence of those components.

Introduction to Lesson [5 minutes]:

1. Provide an overview of the objectives for the day (as listed above).
2. Begin the PowerPoint presentation.
3. Review the first slide, which provides the basic definition of an abstract.
4. Review the second slide, which outlines the "Primary Components of a Technical Report."

5. Introduce the basic concept of writing an abstract, using the information provided on the first few PowerPoint slides.

Procedures [65 minutes]:

Step 1: Writing an Abstract [10 minutes]

1. Review the third and fourth PowerPoint slides in more detail.
2. Emphasize that an abstract will make sense all by itself.
3. Explain that a good abstract will achieve the following goals:
    a. it will sell your work;
    b. it will convince the reader to continue reading or to obtain the article.
4. Explain that an abstract must include the following components:
    a. Why? (motivation)
    b. What? (problem statement)
    c. How? (approach or methodology)
    d. What is the answer? (results)
    e. What are the implications? (conclusions)

Step 2: Group Activity #1 [15 minutes]

1. Hand out abstracts from the literature.
2. Display the fifth PowerPoint slide and review it.
3. Split students up into pairs.
    a. Ask the students to identify the components of the abstracts with their partners.
    b. Ask them to "grade" the abstracts when they are done.
4. Discuss the quality of the abstracts in a full class discussion. Ask about the "grades" that they would give each abstract. Make sure that they can explain their reasoning based upon what they already know about abstracts.

Step 3: Two Types of Abstract [10 minutes]

1. Display the sixth PowerPoint slide and review it.
2. Explain that there are two types of abstracts – *audience* will determine which type to use.

    a. The Informational Abstract
        i. communicates the content of reports;
        ii. includes purpose, methods, scope, results, conclusions, and recommendations;
        iii. highlights essential points;

iv. is short—from a paragraph to a page or two, depending upon the length of the report (American Met Society guideline is 250 words);
v. allows readers to decide whether they want to read the report.

b. The Descriptive Abstract
   i. tells what the report contains;
   ii. includes purpose, methods, scope, but NOT results, conclusions, and recommendations;
   iii. is always very short— usually under 100 words;
   iv. introduces the subject to readers, who must then read the report to learn the results of the study.

Step 4: Simple Prescription for an Informational Abstract [15 minutes]

1. Display the eighth PowerPoint slide and review it.
2. Offer the simple prescription for an informational abstract.
3. Aim to write ***one*** sentence for each of the following sections:

   a. Introduce the topic. Phrase it in a way that your reader will understand.

      i. If you're writing a thesis, your readers are the examiners – assume they are familiar with the general field of research, so be specific.
      ii. If you're writing a scientific paper, the readers are the peer reviewers, so again, be specific.
      iii. If you're writing a more general essay, the readers need more background.

   b. State the problem that you are tackling. What is the key research question?

      iv. Build on the first sentence.
      v. Focus on ***one*** key question within the topic: if you can't do it in one sentence, then you don't understand the topic.

   c. Summarize why nobody else has adequately answered the research question yet.

      vi. Condense your literature review into one sentence.
      vii. Do *not* try to cover all the various ways in which people have tried and failed.
      viii. Explain that there's this one particular approach that nobody else has tried yet. Use a phrase such as "previous work has failed to address the source material" to express what's missing.

d. Explain how you tackled the research question. What's your new idea?

e. Explain how you proceeded in doing the research that follows from your big idea.

    ix. Did you run experiments?
    x. Did you build a piece of software?
    xi. Did you carry out case studies?

f. State the key impact of your research.

    xii. Remember that this sentence is ***not*** a summary.
    xiii. Explain the implications: What conclusions did you draw? Why should anyone care?

Step 5: Group Activity #2 [15 minutes]

1. Display the ninth PowerPoint slide and review it.
2. Split the students into small groups (or use the same student pairs from the first group activity).
3. Provide copies of a summary of a paper that has appeared in a professional journal.
4. Ask the students to write an abstract as a group.
5. After the groups have completed this activity, compare these new abstracts to the abstract that was written.

Closure/Evaluation [5 minutes]:

1. Summarize why an abstract is written.
2. Summarize the key components of an abstract, including the steps to create a first draft.
3. Ask the students to take home the abstracts that they started in class (if necessary) and complete and polish them before the next class session.

Lesson Analysis: Writing an abstract is a critical piece of a good technical paper or report, a piece that students often misunderstand. I first review the components of a technical paper so that they have the starting point for composing the abstract. After providing the motivation and purpose of the abstract, I go through the parts of a good abstract. The first group activity is for students to review abstracts from the published literature to see if they can identify the parts, including the motivation and purpose. I then provide the students with a recipe for writing an abstract. Finally, for the second group activity, I give the students a brief summary of a paper that is published and ask them to compose an abstract based on the summary.

I realize that I tried to cover too much in one class session. The target audience is advanced undergraduates and beginning graduate students who have demonstrated writing competency. However, the concept of an abstract may still be new to many students. Because of the importance of composing a good abstract, the material should be covered thoroughly. For future classes, I will break this lesson into two sessions.

As an example of where I would expand, I would break the first group activity into two parts. Before handing out abstracts to the students, I would initially go through one abstract with the entire class. In an interactive format, the class as a whole would identify the key components. After that exercise, I would distribute abstracts to the students in teams of two or three. When the teams finish, I would choose a few examples for the class as a whole to examine briefly.

Sources:

Easterbrook, S. (n.d). Serendipity. *How to write an Abstract in Six Easy Steps*. Retrieved May 31, 2012 from http://www.easterbrook.ca/steve/?p=1279

Kretchmer, P. (n.d.). Scientific, Medical and General Proofreading and Editing. *Ten Steps to writing an Effective Abstract*. Retrieved May 31, 2012 from www.sfedit.net/abstract.pdf

The University of California at Berkeley. 2003. UC Day in Sacramento Undergraduate Research Poster Presentation. *How to write an Abstract.* Retrieved May 31, 2012 from http://research.berkeley.edu/ucday/abstract.html

The University of North Carolina at Chapel Hill. 2011. The Writing Center. *Abstracts*. Retrieved May 31, 2012 from http://writingcenter.unc.edu/resources/handouts-demos/specific-writing-assignments/abstracts

Lock, Sarah-Jane, Heinz-Werner Bitzer, Alison Coals, Alan Gadian, Stephen Mobbs, 2012: Demonstration of a Cut-Cell Representation of 3D Orography for Studies of Atmospheric Flows over Very Steep Hills. *Mon. Wea. Rev.*, **140**, 411–424.

Advances in computing are enabling atmospheric models to operate at increasingly fine resolution, giving rise to more variations in the underlying orography being captured by the model grid. Consequently, high-resolution models must overcome the problems associated with traditional terrain-following approaches of spurious winds and instabilities generated in the vicinity of steep and complex terrain.

Cut-cell representations of orography present atmospheric models with an alternative to terrain-following vertical coordinates. This work explores the capabilities of a cut-cell representation of orography for idealized orographically forced flows. The orographic surface is represented within the model by continuous piecewise bilinear surfaces that intersect the regular Cartesian grid creating cut cells. An approximate finite-volume method for use with advection-form governing equations is implemented to solve flows through the resulting irregularly shaped grid boxes.

Comparison with a benchmark orographic test case for nonhydrostatic flow shows very good results. Further tests demonstrate the cut-cell method for flow around 3D isolated hills and stably resolving flows over very steep orography.

Lewellen, D. C., 2012: Analytic Solutions for Evolving Size Distributions of Spherical Crystals or Droplets Undergoing Diffusional Growth in Different Regimes. *J. Atmos. Sci.*, **69**, 417–434.

Motivated by simulations of slow-growing contrail cirrus, the solution of the diffusional growth equations for a population of spherical ice crystals or water droplets is reexamined. For forcing specified by the evolution of the total water content above saturation within a parcel (whether driven by vertical motions, radiative heating, turbulent mixing, etc.) three behavior regimes are identified: “very fast growth” that cannot equilibrate, “fast growth” with a narrowing size spectrum, and “slow growth” with a broadening spectrum. The boundaries between regimes, time scales involved, and evolution of the condensate mass, number, and supersaturation are determined. The slow-growth regime represents an example of “spectral ripening,” with crystal or droplet numbers falling in time because of surface tension effects. Surprisingly the diffusional growth equations for the size spectrum evolution can be solved exactly in this case: in appropriate coordinates the spectral shape becomes steady, crystal or droplet numbers fall as a forcing-dependent power law, and the mean particle mass grows linearly with time. Dependence on different physical variables, fluctuating forcing, and modifications due to kinetic theory corrections are all considered. In the limit of zero external forcing on the parcel the size-spectrum solution is mathematically equivalent to a classic result in the theory of Ostwald ripening of solid solutions. It is argued that the slow-growth regime may be important in the evolution of contrail cirrus and perhaps in setting upper limits on droplet number densities in stratiform boundary layer clouds. The theoretical results are compared with parcel model simulations for illustration and to study numerical issues in binned microphysics models.

Crétat, Julien, Benjamin Pohl, 2012: How Physical Parameterizations Can Modulate Internal Variability in a Regional Climate Model. *J. Atmos. Sci.*, **69**, 714–724.

The authors analyze to what extent the internal variability simulated by a regional climate model is sensitive to its physical parameterizations. The influence of two convection schemes is quantified over southern Africa, where convective rainfall predominates. Internal variability is much larger with the Kain–Fritsch scheme than for the Grell–Dévényi scheme at the seasonal, intraseasonal, and daily time scales, and from the regional to the local (grid point) spatial scales. Phenomenological analyses reveal that the core (periphery) of the rain-bearing systems tends to be highly (weakly) reproducible, showing that it is their morphological features that induce the largest internal variability in the model. In addition to the domain settings and the lateral forcing conditions extensively analyzed in the literature, the physical package appears thus as a key factor that modulates the reproducible and irreproducible components of regional climate variability.

Cerruti, Brian J., Steven G. Decker, 2012: A Statistical Forecast Model of Weather-Related Damage to a Major Electric Utility. *J. Appl. Meteor. Climatol.*, **51**, 191–204.

A generalized linear model (GLM) has been developed to relate meteorological conditions to damages incurred by the outdoor electrical equipment of Public Service Electric and Gas, the largest public utility in New Jersey. Utilizing a perfect-prognosis approach, the model consists of equations derived from a backward-eliminated multiple-linear-regression analysis of observed electrical equipment damage as the predictand and corresponding surface observations from a variety of sources including local storm reports as the predictors. Weather modes, defined objectively by surface observations, provided stratification of the data and served to increase correlations between the predictand and predictors. The resulting regression equations produced coefficients of determination up to 0.855, with the lowest values for the heat and cold modes, and the highest values for the thunderstorm and mix modes. The appropriate GLM equations were applied to an independent dataset for model validation, and the GLM shows skill [i.e., Heidke skill score (HSS) values greater than 0] at predicting various thresholds of total accumulated equipment damage. The GLM shows higher HSS values relative to a climatological approach and a baseline regression model. Two case studies analyzed to critique model performance yielded insight into GLM shortcomings, with lightning information and wind duration being found to be important missing predictors under certain circumstances.

Hicks, Bruce B., William J. Callahan, William R. Pendergrass, Ronald J. Dobosy, Elena Novakovskaia, 2012: Urban Turbulence in Space and in Time. *J. Appl. Meteor. Climatol.*, **51**, 205–218.

The utility of aggregating data from near-surface meteorological networks for initiating dispersion models is examined by using data from the “WeatherBug” network that is operated by Earth Networks, Inc. WeatherBug instruments are typically mounted 2–3 m above the eaves of buildings and thus are more representative of the immediate surroundings than of conditions over the broader area. This study focuses on subnetworks of WeatherBug sites that are within circles of varying radius about selected stations of the DCNet program. DCNet is a Washington, D.C., research program of the NOAA Air Resources Laboratory. The aggregation of data within varying-sized circles of 3–10-km radius yields average velocities and velocity-component standard deviations that are largely independent of the number of stations reporting—provided that number exceeds about 10. Given this finding, variances of wind components are aggregated from arrays of WeatherBug stations within a 5-km radius of selected central DCNet locations, with on average 11 WeatherBug stations per array. The total variance of wind components from the surface (WeatherBug) subnetworks is taken to be the sum of two parts: the *temporal* variance is the average of the conventional wind-component variances at each site and the *spatial* variance is based on the velocity-component averages of the individual sites. These two variances (and the standard deviations derived from them) are found to be similar. Moreover, the total wind-component variance is comparable to that observed at the DCNet reference stations. The near-surface rooftop wind velocities are about 35% of the magnitudes of the DCNet measurements. Limited additional data indicate that these results can be extended to New York City.

Urban Aerosol Impacts on Downwind Convective Storms

Susan C. van der Heever and William R. Cotton

Introduction

Experiments suggest that large urban areas influence precipitation and convective activity over and downwind of such regions. Numerous hypotheses have been proposed, including

1. Aerosols act as cloud condensation nuclei
2. The increased surface roughness enhances surface convergence
3. The urban canopy diverts thunderstorms around urban regions
4. The urban regions act as a source of elevated moisture
5. Sensible and latent heat fluxes within the urban area, together with thermal perturbations of boundary layer air by the urban heat island affects both dry and moist convection

It has not yet been determined which of these dominates or under what conditions one may dominate.

Case Study

Simulations using the Regional Atmospheric Modeling System (RAMS) were compared to observations from an individual convective storm event. The event chosen was from June 8, 1999 in the St. Louis, MO area. The case was chosen due to weak large scale forcing, but with a conditionally unstable atmosphere. Observations in the St. Louis region suggest that thunderstorm occur 116% more frequently downwind of St. Louis in similar conditions.

Model and experiment setup

RAMS capabilities for simulating the dynamics aspects of the atmosphere are well documented. For this study state of the science subroutines for the surface and turbulence representations are added. The model includes a very detailed aerosol-cloud nucleation algorithm.

The experiment consisted of a series of simulations, using three nested grids in RAMS centered over St. Louis. Sensitivity studies varying the aerosol concentration and the land use category. The aerosol concentration is varied by adding an urban source term to high and low rural background values. The dynamic effect of the urban area is assessed by replacing the urban elements with values consistent with cropland.

Higher background aerosol concentration results

Urban land use has a greater impact that does the presence of high background and urban-enhanced aerosol amounts on convective development downwind of an urban region. If the surface and roughness effects of the urban area are removed, very little convection develops. The presence of high background aerosol concentration, enhanced by urban aerosol, impacts the timing of development and the microphysical structure of the storms. The enhanced microphysical activity leads to stronger updrafts and increased surface precipitation.

Lower background aerosol concentration results

The results are similar to and consistent with the higher background simulations. However, the differences between the lower and higher background aerosol concentration cases are more significant. A lack of urban dynamics effects suppresses storm development, as in the higher background concentration. With the dynamics effects included, the presence of the urban aerosol becomes more important in the eventual storm development. The differences between the simulations with urban aerosols included and without urban enhancement are much greater than in the higher background case. This suggests that the dynamics are important, but once the dynamics are active, the aerosol-cloud interaction is also important.

Conclusions

Urban enhanced aerosols have numerous effects on the microphysics and downwind convective storms. However, without the forcing due to the presence of the urban area, the development of convective storms downwind is significantly reduced. The interaction of microphysics and dynamics is especially important for the development of the deep convection that leads to cloud electrification and lightning.

WRITING AN ABSTRACT

An **abstract** is a brief summary of a thesis, review, research article, conference proceedings, or any in-depth analysis of a particular subject or discipline. The abstract is often used to help the reader <u>quickly ascertain the purpose of a report.</u>

The Primary Components of a Technical Report

- Introduction
- Methods
  - Experimental design
  - Numerical algorithms
  - Statistical techniques
- Results
- Summary
- Conclusion

We have not yet addressed the abstract.

What Is the Function of an Abstract?

- Provides an overview of your research.
- Highlights and sells your work.
- Convinces the reader to continue or to obtain the article.

An abstract is often the last piece written in a technical report.

What an Abstract Does

- Motivates
- States the problem
- Describes your method
- Highlights your result
- Proposes implications

- Why?
- What?
- How?
- What is the answer?
- What are the implications?

GROUP ACTIVITY #1

I will hand out abstracts and ask you to work in pairs. Can you answer the following questions?

- Why do the authors address the issue?
- What is the issue?
- How did the authors proceed?
- What is their result?
- What does the result imply?

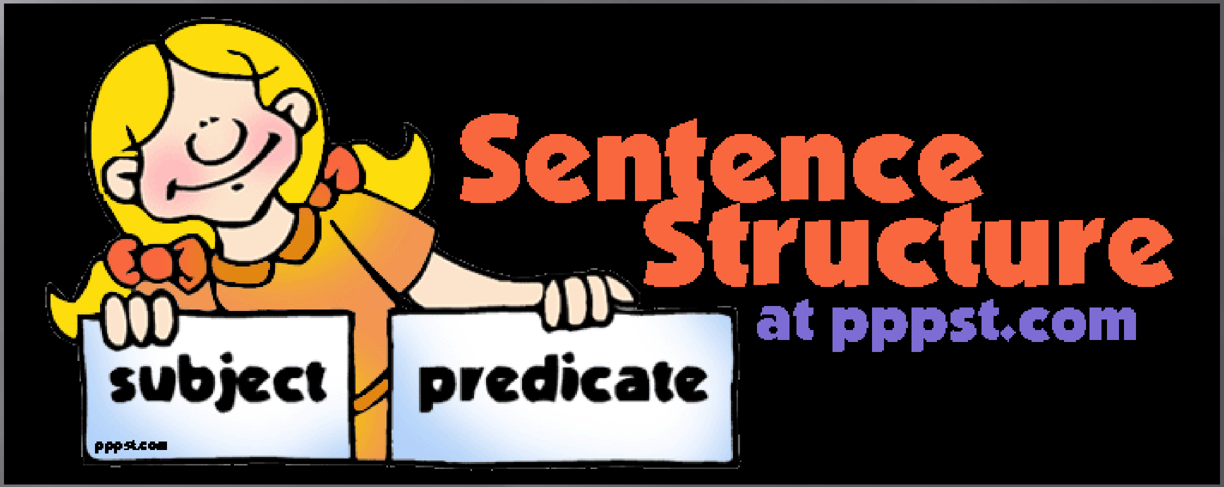
Two Types of Abstracts

- An informational abstract is most common.
  - It is intended for experts.
  - It encourages readers to read the report.
  - It tells the reader what the report contains.
  - It summarizes the major sections of the report.
  - It highlights the essential points and findings in the report.
- A descriptive abstract is less common.
  - It is intended for a more general audience.
  - It contains less detail than the informational abstract.
  - It is often very short.


STEPS
©dreamstime.com

Six Sentences

- Introduce the topic.
- State the problem.
- Summarize the “holes” in current research.
- Explain the approach.
- Explain the method.
- State the impact.



GROUP ACTIVITY #2

- Examine the summary of the technical paper by van den Heever and Cotton.
- Take five minutes in small groups to formulate the parts of an abstract.
- Try to write an abstract as a class.
- Compare the abstracts created in class to the abstract that was written.

Sources

- Easterbrook, S. (n.d). Serendipity. *How to write an Abstract in Six Easy Steps*. retrieved May 31, 2012 from http://www.easterbrook.ca/steve/?p=1279
- Kretchmer, P. (n.d.) Scientific, Medical and General Proofreading and Editing. *Ten Steps to writing an Effective Abstract*. retrieved May 31, 2012 from www.sfedit.net/abstract.pdf
- The University of California at Berkeley. 2003. UC Day in Sacramento Undergraduate Research Poster Presentation. *How to write an Abstract.* retrieved May 31, 2012 from http://research.berkeley.edu/ucday/abstract.html
- The University of North Carolina at Chapel Hill. 2011. The Writing Center. *Abstracts*. retrieved May 31, 2012 from http://writingcenter.unc.edu/resources/handouts-demos/specific-writing-assignments/abstracts