

E-book atlases for tablet computers: the Atlas of the Columbia River Basin

Bernhard Jenny*, Jane E. Darbyshire, Nicholas D. Arnold, Brooke E. Marston, Darrell A. McGie, Kimberly L. Ogren, Charles A. Preppernau, Steven R. Schuetz, John R. Speece and Julie E. Watson

College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, USA

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More e-books than traditional paper books are sold today, and tablet computers have become ubiquitous in recent years. Digital cartographic atlases have replaced traditional paper atlases, but cartographers have not yet fully embraced the potential of multi-touch tablet computers, such as the iPad. This article explores the characteristics of e-book atlases, which are positioned between traditional printed atlases and digital atlas information systems. We document available hardware and software for creating interactive maps and atlases for tablet computers, and illustrate the steps in building an interactive e-book atlas using the Atlas of the Columbia River Basin as an example.

Keywords: digital atlas; e-book; eBook; tablet computer; tablet; iPad; iBooks Author; Atlas of the Columbia River Basin; atlas information systems

1. Tablet computers: A new medium for atlases

In 1981 the first digital atlas was developed, the Electronic Atlas of Canada (da Silva Ramos & Cartwright, 2006; Siekierska & Williams, 1996). While the first digital atlases were characterized by hardware and software limitations, they did offer a glimpse into what was to come – for example, the digital Atlas of Switzerland, which defined a standard for national atlases when its first interactive version was published in 2000 (Hurni, Bär, & Sieber, 1999). While the Atlas of Switzerland was distributed on CD-ROM, recent atlases use the Internet (da Silva Ramos & Cartwright, 2006; Peterson, 2003), or even smartphones (Nuñez, 2013) as a distribution medium.

In 2010, Apple launched the iPad, a tablet computer with an interface built around a multi-touch screen. Its debut popularized tablets into the consumer mainstream, resulting in a change in user behavior, as consumers are shifting away from PCs to tablets and smartphones (Gartner Research, 2013). It is predicted that in 2014, worldwide, more tablet computers will be sold than desk-based and notebook PCs combined (Gartner Research, 2013). This shift offers opportunities for cartographers creating atlases. After the transition from analog to digital production and the transition from paper to digital media, like CD-ROM, DVD, and the web, the next

*Corresponding author. Email: jennyb@geo.oregonstate.edu



logical move seems to be toward tablet computers. Atlases are well-suited to tablet computers, because these devices are primarily used for consuming content, such as video, news, social networks, or games ([Online Publisher Association, 2012](#)).

E-books (also known as electronic books and eBooks) are book-length publications in digital form, and are usually viewed with tablet computers or e-book readers. In 2011, fueled by the advancement and rapidly growing market of e-book readers and tablet computers, e-books outsold hardcover adult fiction books ([Kearney, 2012](#)). E-books can include video, audio, and interactivity, which makes them a relevant medium for cartography. Atlases in e-book format exist, but it can be argued that cartographers have not yet fully taken advantage of the interactive and animated capabilities of e-books.

1.1. *E-book atlas versus atlas information system*

An atlas usually has a central theme and an intentional combination of systematically arranged maps ([Alonso, 1968](#); [da Silva Ramos & Cartwright, 2006](#); [Kraak & Ormeling, 1996](#)). Various types of digital atlases exist ([Ormeling, 1995](#)). [Kraak and Ormeling \(1996\)](#) define digital atlases as ‘intentional combinations of specially processed spatial data sets, together with the software to produce maps from them’. They see the maps in digital atlases as an interface for an atlas database. The database (which can be file-based and accessed through an internet connection) contains cartographically treated data that the atlas information system loads and renders. Atlas information systems can offer a variety of functionality for data exploration and can be in the form of traditional software applications or browser-based web applications ([Jenny et al., 2006](#)). In these respects digital atlases resemble a Geographic Information System (GIS), but [Kraak and Ormeling \(1996\)](#) also point out the difference from a GIS, which is that ‘special care is taken to relate all data sets to each other, to allow them to be experienced as related, to let them tell, in conjunction, a specific story or narrative’. This narrative structure is seen as a cornerstone concept that defines both paper and digital atlases ([van Elzakker, 1993](#), cited in [Ormeling, 1995](#); [Kraak & Ormeling, 1996](#); [da Silva Ramos & Cartwright, 2006](#)).

Interactive e-book atlases are positioned between printed atlases and digital atlas information systems. A main characteristic of e-books is that they have a beginning and an end. That is, they are bound by a cover page and an end page, and their book-like structure in chapters, sections, and pages guides the reader through the book topics. The book analogy of e-books is intensified by the skeuomorphic graphical user interface metaphors that some e-book readers use. These skeuomorphs emulate the physical appearance of paper books by, for example, animating the opening of the book board, displaying the book spine, animating the page turning initiated by swiping hand gestures, or showing closed books placed on a bookshelf.

Because e-book atlases have a book-like structure and appearance, it can be argued that readers expect e-book atlases to be organized like printed atlases. Printed atlases often present overview maps and introductory content in initial chapters, while more specialized content is placed toward the end of the atlas. This traditional structure of printed atlases creates a sequence of maps and pages that guides the reader through topics. Despite this guiding structure of both printed atlases and e-book atlases, readers will rarely study an atlas from the beginning to the end, but will more likely flip back and forth between chapters and pages. This type of navigation requires a table of contents, which – in the case of digital atlases – must be interactive for quick navigation.

Another characteristic of interactive e-book atlases is individually designed page layouts adapted to the content of each page. Atlas information systems differ in this respect, as they tend to use a single or a very limited number of different screen layouts. In atlas information systems, the maps, text, diagrams or other elements serve as placeholders for changing content, but they remain static in their size and arrangement.

Some database-based atlas information systems allow the user to combine and overlay map layers in arbitrary ways. They help the user navigate the system by grouping maps and functionality in a graphical interface. However, they are not able to offer a book-like experience. Despite their grouping of related maps in a user interface, they generally do not suggest a preferred or logical order for viewing the maps. For many atlas information systems this would be impossible due to their enormous number of maps. The loose navigational structure is not a disadvantage *per se*, as it invites users on a tour through unknown and potentially interesting information. However, users may sense that seeing all content or obtaining an overview of the atlas content is difficult, or even impossible, because an atlas information system does not generally have a predefined start and end – neither a cover page nor an end page are present. One can speculate that this could create a sense of being lost in atlas information space. In comparison, e-book atlases, which are structured in chapters and pages, might perhaps create a feeling of rewarding satisfaction and achievement when, for example, all pages of a chapter have been read.

To summarize, three major differences exist between an e-book atlas and an atlas information system: First, e-book atlases have a book-like structure with chapters, sections and pages, whereas atlas information systems use a map as an interface to a database. Second, e-book atlases use book-like navigation based on tables of contents, whereas atlas information systems have interfaces inspired by standard computer software. Third, each page of an e-book atlas has individual content and an individual layout, whereas atlas information systems use standardized arrangements.

In order to further explore the opportunities tablet computers and e-books offer as a medium for the distribution of atlases, the remainder of this section first provides an overview of current hardware, then compares the three principal technologies for creating and distributing atlases for tablet computers. Finally, current file formats for enhanced interactive e-books are discussed.

1.2. Tablet computers: A diversity of hardware

Apple is currently the tablet vendor with the largest market share, but they face the competition of several other companies producing tablet computers with capabilities and features that are similar to those of the iPad (IDC, 2013). Some tablets are designed and marketed as e-book readers, and some of these e-book readers have electronic paper displays with higher, more readable contrast than liquid-crystal display (LCD) monitors. These electronic paper displays are currently only available in black-and-white, and have very low refresh rates, which makes such devices unsuitable for interactive or video content. The division into tablet computers and e-book readers is not always useful, as a variety of intermediate devices exist, making it difficult to draw a neat line between the two groups.

Most tablet computers have multi-touch screens able to sense two or more fingers. A typical screen size is currently 1024×768 pixels at a resolution of around 130 PPI (pixels per inch). More expensive tablets have displays with higher screen resolution, reaching, for example, 2048×1536 pixels at around 250 PPI. Such resolutions are considerably higher than those of most current laptop and desktop monitors, and show images and text with a quality that is comparable to printed paper. (For more detailed and updated information see, for example, statcounter.com.)

1.3. Three options for creating and delivering atlases for tablet computers

An atlas author can choose between three options for distributing an atlas to tablet computers. The first option is the development of an app, which is a standalone software application that the users download and executes. Apps can access hardware features like GPS, or use operating system

functionality that may not be available with the two alternative options. App developers have many design choices, and can, for instance, include skeuomorphs that emulate the physical appearance of paper atlases, or build an atlas information system centered on a map that serves as an interface to a cartographic database. Developing an app, however, requires expertise in software development, and is therefore reserved to atlas authors with experience in this area.

The second option is the creation of an HTML website that is accessed and rendered by a web browser running on the tablet computer. Compared to the first option, less technological hurdles exist with this option, because the development of web pages and interactive web maps is less convoluted.

The third option is creating an interactive e-book. Specialized authoring software is available for creating interactive e-books. With e-books including interactive features, and apps imitating the appearance of physical books, the borders between e-books and book-like apps sometimes blur from a consumer’s point of view.

Table 1 summarizes the main differences between atlases based on app or e-book technology (central column), and atlases using HTML web technology (right column). The table combines apps and e-books because they are distributed in very similar ways, and because apps can have an e-book-like structure and appearance. Differences between apps and e-books as opposed to HTML exist in the way an atlas is distributed to tablet computers; how clients buy and install an atlas; how updates are delivered; and in supported platforms.

1.4. File formats for E-books

A variety of file formats exist for e-books. The majority of these formats are limited to text and static images. To facilitate the exchange among platforms, the International Digital Publishing Forum (IDPF) defined the standardized EPUB format for electronic books and other document types. The EPUB format is designed for page-oriented fixed-layout books or reflowable content. A reflowable document adjusts to the display size and allows the user to customize typeface and font size. The EPUB standard can include raster and vector images, as well as video content. An advanced level of interactivity for e-books, such as can be found on websites, is possible with the recent EPUB 3 standard (Garrish, 2011). However, despite the standardization efforts that led to the development of different versions of the EPUB standard, most tablet computers support only a subset of these standards and many rely on proprietary formats. Specifically, enhanced e-book formats with touch-interactive features are not currently exchangeable among platforms. As of 2014, aside from the EPUB 3 standard, other enhanced interactive e-book formats are the proprietary iBook format by Apple (also based on EPUB, but not supported by other devices), and the proprietary Kindle Format 8 (KF8) for the Amazon Kindle Fire device.

Table 1. Comparison of E-books/apps and HTML-based interactive atlases.

	E-book and App	HTML Website
Distribution	App: Application store E-book: Online bookstore or web	Web server
Payment and installation	Payment and installation through online store	Payment and access control by publisher, no installation
Updates	Updates must pass a reviewing process by the online store	Available immediately
Platforms	Platform-dependent formats	All

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2. The Atlas of the Columbia River Basin

2.1. Designing an E-book Atlas

To explore the potential and limitations for building and designing an interactive atlas in e-book format, students enrolled in the Computer-Assisted Cartography course at Oregon State University were given the assignment to create an e-book atlas. The 17 atlas authors are a mix of undergraduate and graduate students, most of them geography majors with varying expertise in cartography and almost no experience in programming. Based on student interest and expertise, the class decided to create the Atlas of the Columbia River Basin (Ogren et al., 2013). Students developed a chapter structure and determined the content of the atlas, with a focus on basin-wide topics. The class determined the structure of the atlas by identifying common themes that defined the chapters of the atlas. The sequence of chapters and the order of the 30 atlas pages follow the example of traditional printed atlases, that is, from general overview topics to more detailed and specialized content. The Atlas of the Columbia River Basin starts with an introductory chapter covering, for example, topography and climate, followed by more specialized chapters and pages, for instance, the spatial distribution of salmon species, or local topics, such as the Hanford nuclear production complex (Figure 1).

Designing the Atlas of the Columbia River Basin was not fundamentally different from designing web pages. Relevant differences are that the reactive surfaces of buttons and other finger-touchable elements have to be larger for touchscreens than for mouse clicks; the page size is limited to the dimensions of the tablet display; and that book-like interactive tables of contents are used to navigate among chapters and sections (Figure 2).

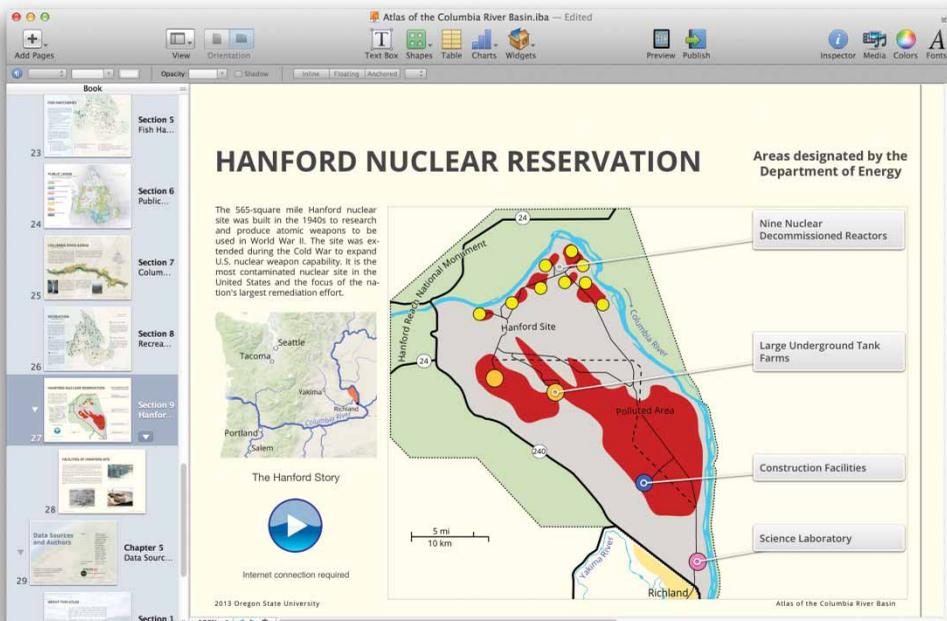


Figure 1. Authoring software for creating an e-book atlas. Interactive labels, descriptions, and a movie are combined with a map and text (software: Apple iBooks Author, map by D. A. McGie, Atlas of Columbia River Basin).

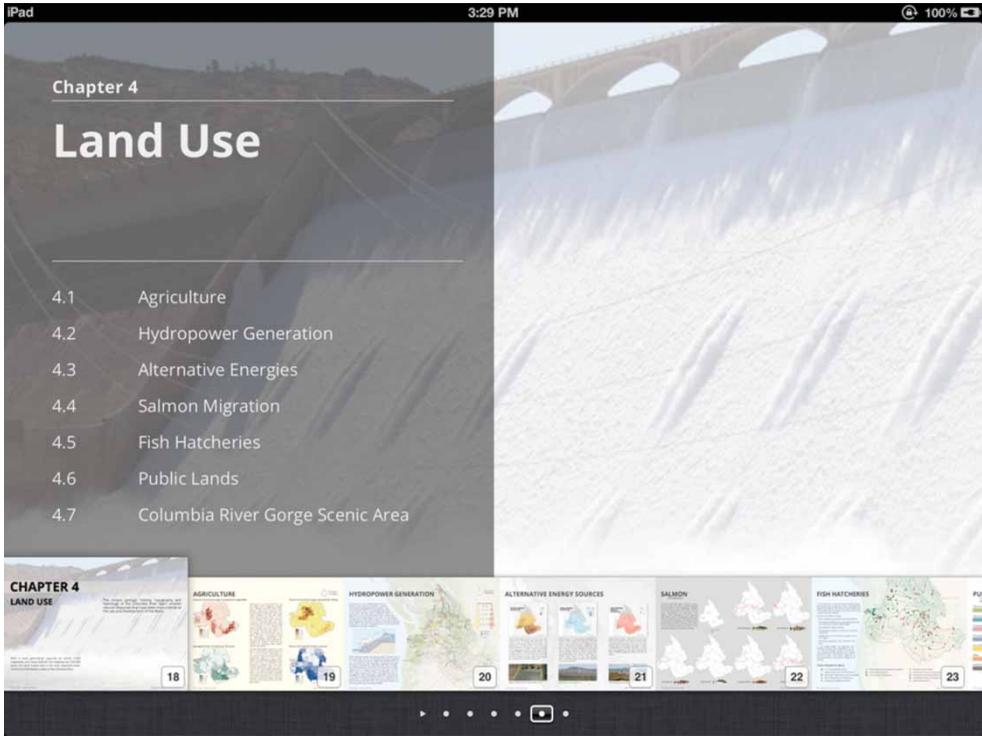


Figure 2. Interactive table of contents for a book chapter (screen capture of Atlas of the Columbia River Basin on iPad).

As for the selection of elements that are to react to finger touches, some argue that for interactive e-books, ‘we’re still at the phase of irrational enthusiasm for littering every page with six different interactive things, whether they make any sense or not’ (Theodor Gray, in Webb, 2013). When designing the Atlas of the Columbia River Basin, the goal was to avoid interactivity for its own sake, and limit its use to communicating information, or to use interactivity for the purpose of simplifying a page layout. Figure 3 shows an example of an atlas page that displays explanatory text when the user taps the colored legend fields. While the first version of this map displayed static text for each legend entry, it was later decided to simplify the layout and use interactive pop-over elements. An icon was added that informs readers about the interactive elements reacting on finger touches. How to inform readers about interactivity was an issue for many other interactive elements throughout the atlas. A few established visual standards exist for showing interactivity, for instance, buttons with a three-dimensional appearance, or a right-pointing triangle to play movies (as in Figure 1). With less commonly used elements that do not use a button design, such as the legend in Figure 3, no established standards currently exist to indicate the presence of interactivity to the reader. The authors chose a cautious approach and added the mentioned touch-finger icons throughout the atlas to indicate the presence of interactivity.

A related issue is how to inform readers about the type of interactivity hidden behind a touchable element. In fact, the reader does not know what to expect when touching the colored legend fields in Figure 3 – will the atlas display additional text or images, start a movie, or open a web page in an external browser? Consistency in interface design by providing similar interactivity in

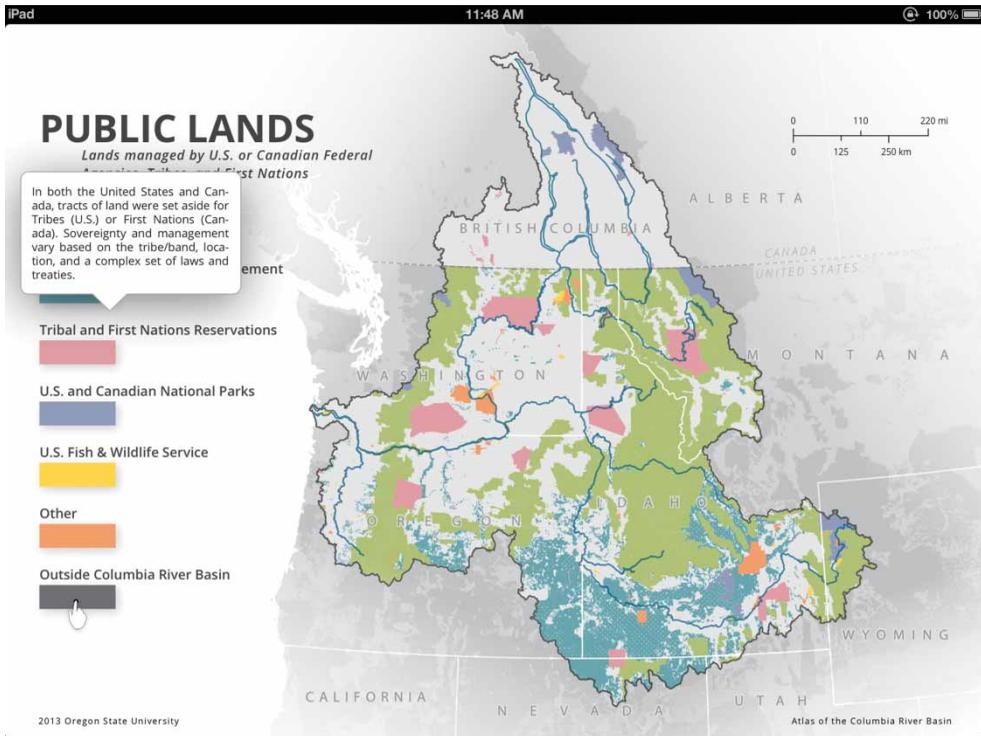


Figure 3. E-book atlas with an interactive pop-over (map by J. E. Watson, Atlas of Columbia River Basin).

similar situations, as well as adherence to conventions (for instance, indicating the presence of an animation with a play button) should give readers the feeling of being in control, and provide them the confidence to be able to use the interface. As Wardlaw (2010) points out, trial and error learning is frustrating, and users do not like surprises.

The workflow for creating the Atlas of the Columbia River Basin is not radically different from creating interactive web maps. The workflow consists of first creating maps with GIS and graphics editor software; these are exported to PDF or raster graphics formats, then placed in the authoring software – Apple’s iBooks Author in our case – and combined with interactive features. Text, diagrams, and other elements are added and laid out in the authoring software. For e-books that are accessible to readers with various forms of visual impairment, text elements should be placed with the authoring software and not be embedded in graphics. The e-book reader software can then read the text aloud or render it with increased visibility for those with visual impairments.

2.2. Adding cartographic interactivity to an E-book Atlas

The predefined set of ready-to-use interactive features in iBooks Author can be extended by developing customized HTML pages. Figure 4 shows a screenshot of the iBooks Author application used to embed a custom interactive HTML map in an e-book atlas. When the reader touches the map image in the final e-book, the interactive map displays detailed information for the selected proportional circle symbols. Web-mapping libraries, such as Leaflet or OpenLayers, can be included with this technique (Lienert, Jenny, Schnabel, & Humni, 2012; Neutze,

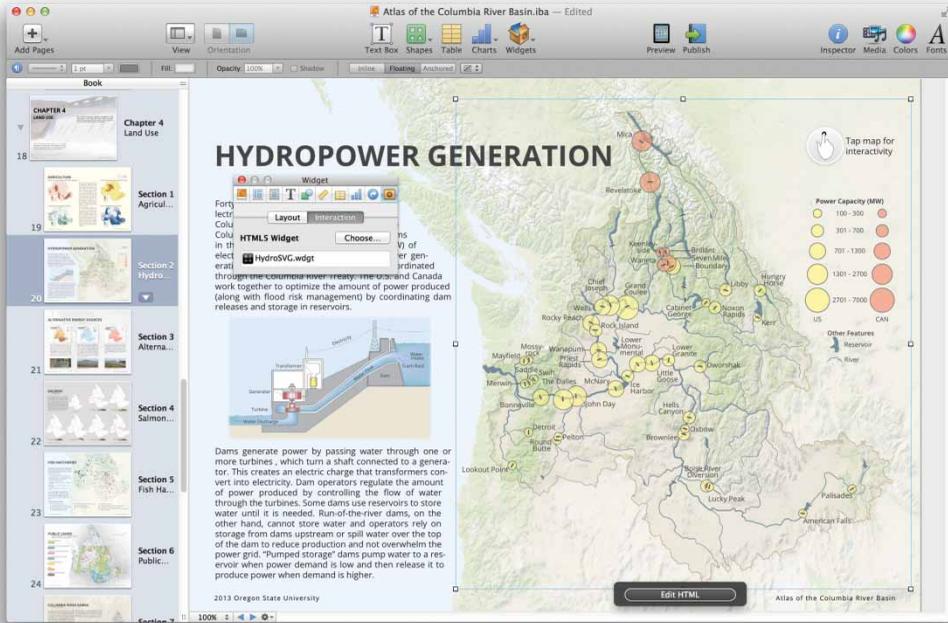


Figure 4. HTML content placed on an atlas page. By tapping the map, an HTML/SVG version of the map opens with interactive circle diagrams (software: Apple iBooks Author, map by K. L. Ogren).

2012). The map in Figure 4 uses a combination of JavaScript and SVG (Scalable Vector Graphics), an HTML standard for vector images (Neumann & Winter, 2003).

3. Conclusions

Tablet computers and e-book readers are a relevant medium for atlases, as it is likely that more tablets will be sold than PCs in the near future. Currently, three different approaches are available to publish an interactive atlas for tablet computers. The approaches are developing an app, creating a website, or creating an e-book. The authors explored the creation of an interactive atlas in e-book format using the example of the Atlas of the Columbia River Basin. Interactive e-book atlases are found to be simple to build with specialized authoring software, which enables authors without programming experience to design atlases with interactive features. For custom cartographic interactivity, JavaScript and HTML programming are required.

The main limitation for authors of e-book atlases is the lack of authoring software capable of exporting e-books to multiple platforms. This limitation requires creating multiple versions of an e-book for different bookstores and e-book formats. Interactive atlases would probably become more common if cartographic authoring software was available that could export an interactive atlas to different e-book formats, or alternatively create multi-platform apps or web pages.

Software

The individually designed pages of interactive e-book atlases could be created using a text editor only, but this approach would be tedious and error-prone, and requires programming experience.

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Specialized what-you-see-is-what-you-get (WYSIWYG) authoring software can greatly simplify the creation of e-books with individual page layouts. Apple's iBooks Author was used for creating the Atlas of the Columbia River Basin. This software application has a page-based user interface that is similar to presentation software for the creation of slide shows. As of July 2014, iBooks Author is the only WYSIWYG editor for creating interactive multi-touch atlases. It offers the most interactive features and the most complete support for the web in e-books, but only creates books for Apple's proprietary e-book format (Neutze, 2012). Interactive elements that can be added to book pages with this particular software include call-outs with text, panning and zooming images, photo galleries, scrolling sidebars, pop-over windows, video, touch-rotatable 3D models, and embedded HTML pages. Interactive tables of contents for navigating among chapters and sections are automatically created by iBooks Author (Figure 2).

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