

# Using Google Earth for fun and functionality

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start-up view  
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“It is often essential to view information in a spatial context in order to aid in understanding.”  
— Rebecca Moore, Software Engineer, Google Earth

**Google Earth** is a free internet tool that has opened the eyes of millions to the possibilities of digital geography. In essence, it's a “virtual globe” that allows even the casual user to zoom from space right down to street level, with images that in some places are sharp enough to show individual people. Besides viewing any place on Earth, viewers can go on a “tour of the world,” get driving directions from one place to another and fly (follow) the route, view the terrain of a place in 3D, and view locations and features created by other Google Earth users. Google

Earth's popularity with a growing number of scientists (and federal agencies) lies in the almost equal ease with which it lets them overlay their own spatial data on top of the Google Earth background imagery.

Google Earth maps the surface of the Earth by superimposing images from satellites and aerial photography. It depicts the Earth as if you were looking at it from an airplane or orbiting satellite. Google Earth can be downloaded for use on personal computers running Microsoft Windows 2000, XP, or Vista; Mac OS X 10.3.9 and above; Linux; and FreeBSD.

Google Earth is one of the most popular virtual globe applications; it has an audience of over 250 million regular users. This is quite possibly the largest audience for geospatial data in the world. When I first saw it live, it reminded me of the “ArcGlobe” demonstrations that I had seen at the ESRI (Environmental Systems Research Institute Inc.) conferences I have been to. Once installed, I found Google Earth very easy to use, and I confess to hours of viewing places I've seen in real life and places I hope to see in the future. In my opinion, Google Earth is the virtual globe program that the ESRI

people hoped ArcGlobe could have been. The ease of use and functionality make it a useful tool for novice geographers as well as professional cartographers and surveyors.

uses a "General Perspective" projection, which is similar to an orthographic projection, except that the point of perspective is a finite (near Earth) distance rather than an infinite (deep space) distance.

(which for a \$20 annual subscription fee includes features such as GPS integration, higher resolution, and customer support via e-mail), and Google Earth Pro, which for a \$400 annual fee has all the



**The City of Unalaska and the International Port of Dutch Harbor, Alaska**

## Facts and features

Google Earth was developed by Keyhole, Inc. and was initially known as "Earth Viewer." Google acquired Keyhole in 2004 and renamed the product Google Earth. It was formally launched in June of 2005.

The internal coordinate system uses geographic coordinates (latitude/longitude) on the WGS 84 (World Geodetic System of 1984) datum. Google Earth

works with two- and three-dimensional data, vector data, and a variety of geometric projections. The variety of imagery sources requires that the processing be done by both machine and humans. This results in a certain amount of inaccuracy.

The product is available under three different licenses: a free version with limited functionality; Google Earth Plus,

features of GE Plus including a GIS data importer, a tool for making movies and advanced printing modules.

## Resolution and accuracy

Most land areas, except for islands, are shown using satellite imagery with a resolution of about 15 meters per pixel or better. The 15-meter accuracy is the baseline for most areas of the application.

Some urban areas in the U.S., notably Las Vegas, NV, Cambridge, MA, and the Google Campus in Glendale, CA, can be viewed at 1 meter and even 0.15 meter resolutions. This is because ortho-photography, with several pixels per meter, was used in the tiling. You can literally read street signs and see individuals in these areas.

The other extreme is at places such as the poles: the Antarctic continent is reflected at very low resolution, with a few exceptions, and the Arctic polar ice caps are not shown at all.

Other ocean areas fall into this same category. The geographic North Pole is found floating in the Arctic Ocean, and it appears as the center of a blue kaleidoscope made-up of the converging tiles.

The Northwest Hawaiian Islands are shown using high-resolution IKONOS imagery; never mind that some features are incorrectly labeled as the "Midway Islands."

Most of the Aleutian Islands of Alaska, surprisingly, were captured on some almost cloud-free days. Google continues to resolve inaccuracies in the vector mapping, and frequently updates the typically three-year-old imagery.

### Ease of use

When you launch the Google Earth Home Page, you are presented with a view of the North American continent as it appears from space. (The stars that appear in the background aren't just for decoration; they were taken from astronomical charts and approximate their actual position.) If you click on "View" at the top, you are given options to display a compass and a latitude/longitude grid.

When one selects the "Status Bar," the latitude and longitude of the pointer is tracked and displayed in the lower left corner, and the "Eye altitude" is displayed in the lower right. You can also display an overview map of the world, a

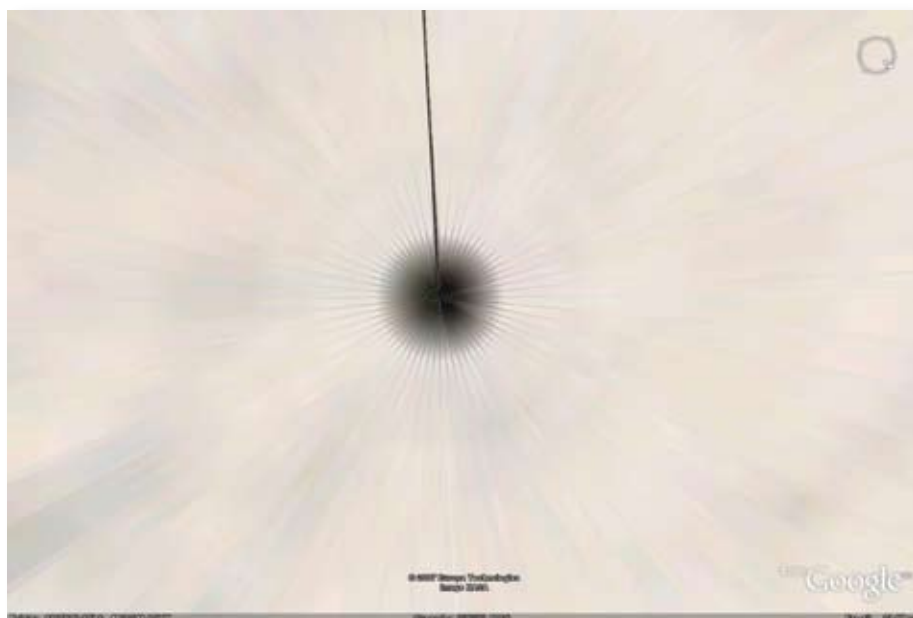
scale legend, and the atmosphere, which gives off a blue halo effect.

Also in "View" is the Tool Bar. Along with the usual print option and to view/hide the sidebar, you can access the ruler tool for measuring distances between places, and a "Placemark" tool for saving specific locales. More functionality is offered with the "Add Polygon," "Add Path" (for adding a line or lines) and the "Add Image Overlay" tools.

The "Tools" offered on the drop-down menu include opening a web browser, a

include viewing intense geography such as the Grand Canyon and Mount Everest, and flying through downtown Manhattan!

The sidebar on the left is divided into three categories: Search, Places, and Layers. The Search tab prompts the viewer to "Fly To" a destination of their choice. You can also "Find Businesses" or get driving "Directions" similar to the Google Maps application. I had a chuckle when I asked for directions from New York City to Paris, France. After directing me from NYC to Boston, I was instructed



The South Pole as seen on Google Earth

second access to the ruler, and the GPS integrator (functions only on GE Plus).

The "Play Tour" tool will fly to the selections checked on your "My Places" list, and the "Options" tab brings up a whole suite of possibilities. These are mostly for customizing your "3-D View," the memory cache, the speed of your flying and driving tours, and the speed of your mouse wheel.

In the upper right corner are the "Navigation" controls. If your mouse doesn't have a roller-ball, this is where you can elect to rotate the view as well as "tilt" to view the terrain or buildings that are in 3-D. Fun things to do with the tilt option

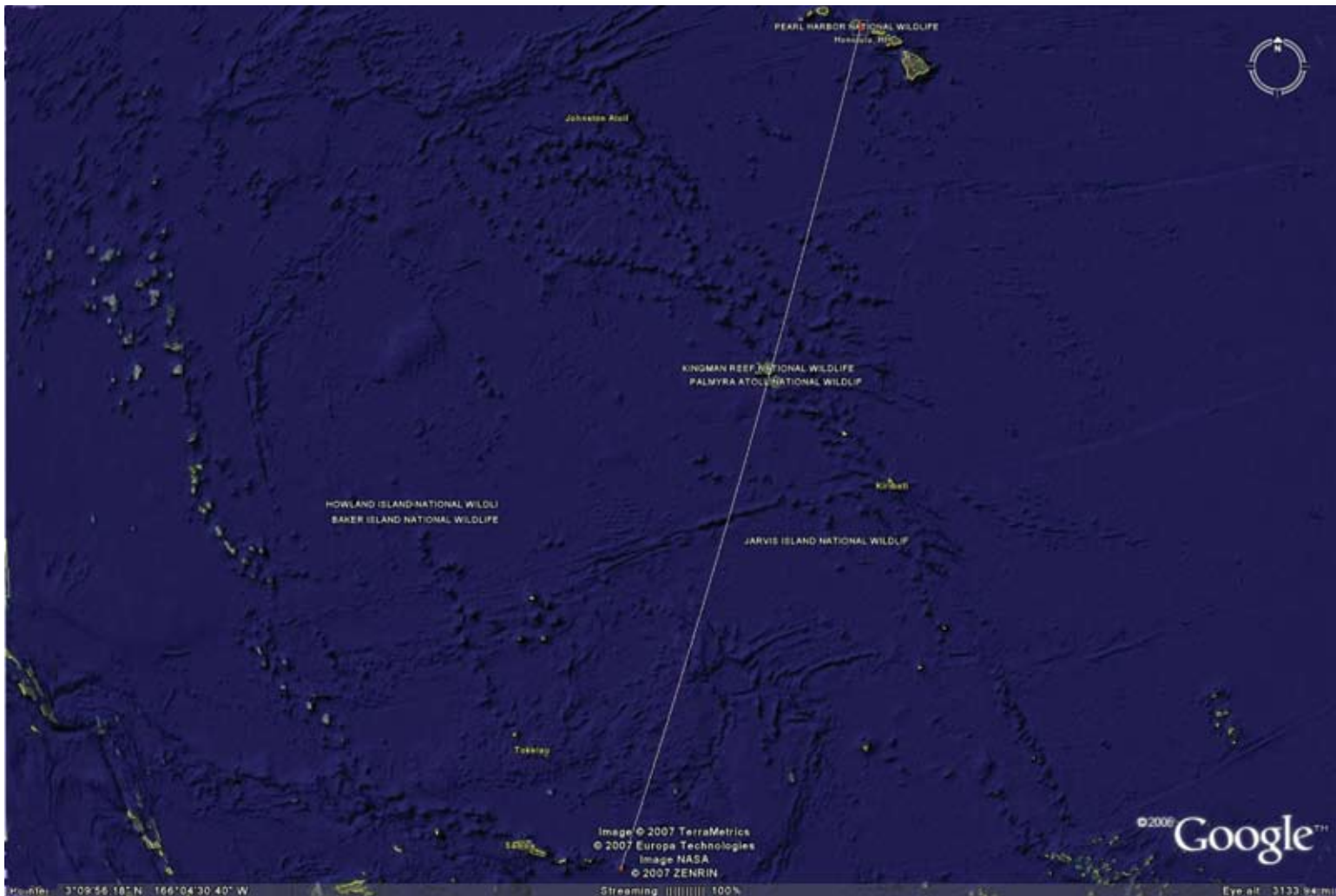
to "Swim across the Atlantic Ocean entering France" with a distance estimated at 3,462 miles.

The "Places" tab is where you store all of your favorite destinations. It's also where you store any imported data.

### Available layers

The "Layers" tab presents many different data sets that you can add to the viewer. The number of available layers seemingly increases every time I visit Google Earth.

The expected layers include roads, populated places, transportation, as well as dining, lodging, shopping, and travel and tourism. But you can also view Con-



Using the ruler tool to measure the distance between Honolulu, Hawaii, and Rose Atoll National Wildlife Refuge in American Samoa

gressional Districts, Postal Code boundaries, and City boundaries. You can also view indexes of imagery collected by DigitalGlobe between 2002 and 2007.

Under the “Primary Database” are “Featured Content” providers such as National Geographic, Discovery Networks, American Institute of Architects, Trimble Outdoors Trips, Yelp Reviews of restaurants, Tracks4Africa, the European Space Agency, and my personal favorite, the Rumsey Historical Maps.

Under the “Global Awareness” category can be found spatial data reflecting the crisis in Darfur, the World Wildlife Federation Conservation Project, and Jane Goodall’s Gombe Chimpanzee Blog.

### New layers

Recently, the National Park Service and the U.S. Forest Service were successful in contributing their spatial data to Google Earth. They are found under the “Parks and Recreation” layer tab. When the National Park or National Forest layer is made active, users can click on a park or forest on the globe (or zoom to it) and view a pop-up window showing a postcard-like photograph and a brief description of the park or forest, including a link to the corresponding website. Similar efforts are also underway with the Natural Resources Conservation Service, the Bureau of Land Management, and (hopefully!) the U.S. Fish and Wildlife Service to display their spatial data.

### KML and Google Earth

As a long-time user of the ESRI ArcGIS suite of products, I was excited to learn that an enterprising GIS Specialist working for the City of Portland, Oregon, had written a program to convert ESRI shapefiles to the KML format. This program, Export to KML, can be downloaded from the ESRI website (<http://arcscripts.esri.com/details.asp?dbid=14273>), and it is installed as a tool in the ArcMap application.

I converted the boundaries of all 547 National Wildlife Refuges to the KML format and was delighted with the result. Using Google Earth, I am able to quickly view the geography within and surround-



A historical map from the Rumsey Collection draped over the Google Earth globe

ing the wildlife refuges, and have put it to practical use. For example, I examined the shorelines of our 174 coastal refuges to see which of these contain waterways that were potentially tidally influenced; viewed existing dams at the Balcones Canyonlands refuge in Texas; used the ruler tool to quickly derive miles of refuge boundaries that straddle the US-Mexico border, and to quickly calculate the distance from major cities to some of our remote refuges (Rose Atoll NWR is 2,559 miles from Honolulu, where the administration office is located).

While importing this much additional data into Google Earth, I've discovered a few hitches. 1) Loading 547 additional KML files on Google Earth increases the time it takes to launch. 2) The Export to KML program converts the name of the refuge (stored as an attribute in the shapefile) to text which hovers over the refuge polygons, resulting in many lines of text (the

refuge names) being seen all over North America. This issue is alleviated as soon as I start to zoom in, as the refuge polygons soon become much larger than the text.

### Virtual Globe mania

More virtual globe applications are appearing that mimic the Google Earth environment to some extent. MSN Virtual Earth, Leica Virtual Explorer, NASA World Wind, and ArcGIS Online (the supposed "Google Earth killer") are all unique for some of their additional data. NASA World Wind, for example, has extraterrestrial data sets such as Mars, Venus and Jupiter. ArcGIS Online has maps and globes to import into specific mapping projects. I look forward to trying all of these virtual globes. I fully expect that the functionality will improve, and the cost to drop, as the public becomes more aware of their potential to educate and improve our everyday life. ■

### ArcGIS Explorer

This unique application lets you connect directly to a variety of ready-to-use globes hosted by ESRI and extend the power of web-based services by fusing them with your local data. Says Bern Szukalski, ArcGIS Explorer product manager, "You can unlock the power of GIS for others when you author your own content and tasks and deliver access to these using ArcGIS Explorer. With this free application, you can publish ArcGIS Server capabilities within your organization or to anyone on the web." On startup of the free download, ArcGIS Explorer opens a satellite globe. In addition to imagery, you can access other free globes including worldwide streets, terrain, boundaries and labels, political maps, and physiography. These globes are served to ArcGIS Explorer via ArcGIS Online, which is

currently in beta. ArcGIS Online gives you access to high-resolution premium imagery at no cost and includes a seamless mosaic of 1 m resolution aerial imagery for the contiguous United States and satellite imagery for the world at 500 m and 15 m resolutions. The high-resolution imagery is a color mosaic of recent commercial imagery for metropolitan areas and best available government imagery for other areas. At the end of the ArcGIS Online beta program, ArcGIS users will be able to subscribe to the premium high-resolution imagery service. Other basic data will continue to be free. ArcGIS Explorer also includes a software developer kit (SDK) that can be used to extend tasks or implement custom tasks that are driven by other web services. Download ArcGIS Explorer at [www.esri.com/arcgisexplorer](http://www.esri.com/arcgisexplorer). ■