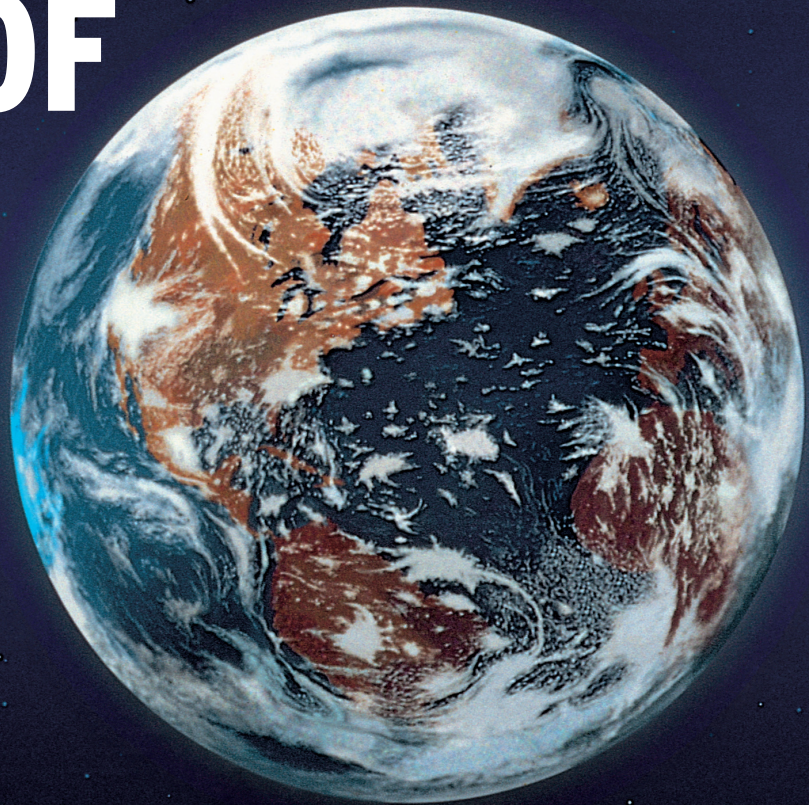Exploring Google Earth

SHOTS OF EARTH

Google Earth lets you view the world from space and zoom in on towns, roads, and buildings. We'll show you how to travel our planet's surface, its cities, and even the sky from your desktop. **BY CARSTEN SCHNOBER**

G oogle Earth [1] brings hi-res aerial views of the whole Earth to your computer desktop. Among other things, the latest full release, Google Earth 5, integrates satellite and aerial images with Wikipedia text [2], 3D models, and photos from Panoramio [3]. Version 5 works on Windows, Mac OS X, and Linux, but if you decide to integrate your own 3D model, Google Earth Pro is available only for Windows or Mac.

On Screen

The software does not ask too much of your computer: A CPU with a clock speed of 500MHz and 128MB of RAM are all it takes, although Google does recommend a 2.4GHz CPU and 512MB of RAM to avoid annoying screen refresh delays. Because Google Earth downloads the image data while you are using the tool, you also need a fast Internet connection. The box titled "Installation on Linux" tells you how to set up Google Earth on that operating system.

After launching Google Earth, you are immediately boosted into space, looking down on the Earth. To navigate, hold down the left mouse button to rotate the globe in any direction; the mouse wheel scales the visible selection up or down. If you hold down the right mouse button and drag, you zoom in to or out from the Earth's surface.

Basic Functions

To look for a specific location, type its name in the *Fly to* box at the top. This entry can be the name of a country, the name of a city, or even a house number and street name. To confirm, press Enter, and Google Earth flies you to your chosen destination; if your choice of destination is not unique, the program provides a list of matches, and you can double-click to select the right entry. In theory, you can fly directly to named geographic locations, such as Mount Everest or the Everglades.

The *Find businesses* tab also helps you navigate. For instance, you can search a town for all the restaurants registered with Google. To do so, type a name or a

Installation on Linux

On the Google Earth website [1], click *Download* to transfer *GoogleEarth.bin*, the installer program, to your hard drive. Then pop up a terminal window, change to the directory in which you stored the file, and type *sh GoogleEarth.bin*.

If you run the installation script as root, it will create the Google Earth program in the directory */usr/local/google-earth*. The link to the command for launching the program, *googleearth*, is created in */usr/local/bin*. This folder is included in most users' search paths. If you do not have root privileges, or if you do not want to install Google Earth globally, you can run the installer as a normal user.

The program will ask you for a target directory and suggest creating a *google-earth* directory below your own home directory. In this case, you need to change directory to */home/user_name/google-earth* after the install and launch the program by entering *./googleearth*. After the installation, you will find a Google Earth start button in your application menu's *Internet* section.
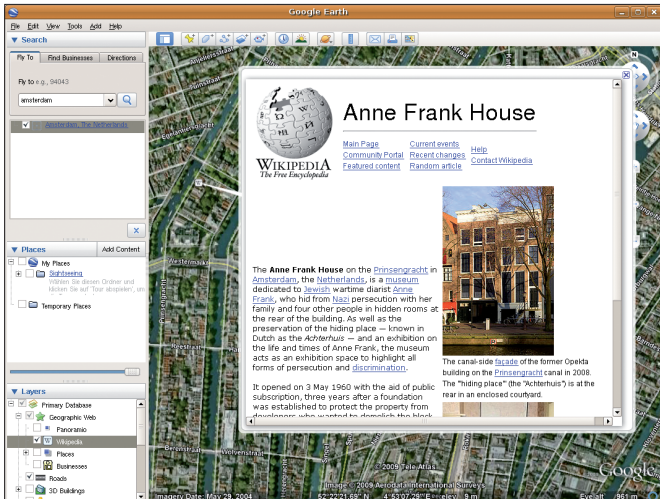
Figure 1: Google Earth relies on the Internet community to embed extra information via Wikipedia.
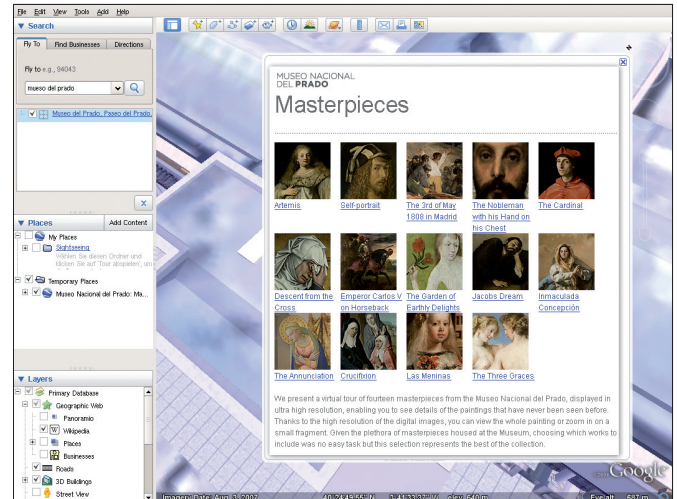

Figure 2: Courtesy of the Prado Museum in Madrid, Spain, users can see high-resolution images from their collection.

category, such as Hotels, in the *What* box. Then either select a location you have searched for previously in *Where* or enter the name of the city manually. Pressing Enter takes you to a list of matches, which the program highlights on the map.

Finally, the *Directions* tab lets you calculate a route between two locations. To start, type addresses in the *From* and *To* boxes. The program then displays the route on the map, pointing out important sites and major roads.

A humorous feature concerning this function has now been removed. In previous versions of Google Earth, if you entered a route that you could not travel by car, such as from England to the USA, Google Earth would take you to the seaside and then tell you to: "Swim across the Atlantic Ocean." Such incomputable

routes are no longer accepted by Google Earth.

What Else?

Google Earth offers users more than just a photographic map of the Earth. While you navigate the globe, you will stumble across icons that embed Panoramio [3] photos, local webcams, and Wikipedia entries (Figure 1), and this additional media displays at the click of your mouse.

Information of this kind can never be completely neutral because of the selection process, but the size of the Wikipedia community helps maintain objectivity. In the case of the Panoramio images, popularity determines which images finally make their way into Google Earth.

Friends of the arts will enjoy the cooperation between Google and cultural in-

stitutions such as the Prado in Madrid, Spain. With Google Earth, you can now view reproductions of the museum's masterpieces at an extremely high resolution of 14 gigapixels (Figure 2).

To do so, navigate to the Prado by entering *Madrid, Prado* into the *Fly* box. Enable 3D Buildings in the *Layers* panel to get access to the collection containing pictures by artists like Velasquez and Rembrandt.

House by House

Images taken by satellite and aircraft are two-dimensional by nature, which is particularly apparent if you try to view them at different angles. The standard for these kinds of images is a bird's eye view of the Earth. Another admirable function of Google Earth occurs when you press Shift and push the mouse
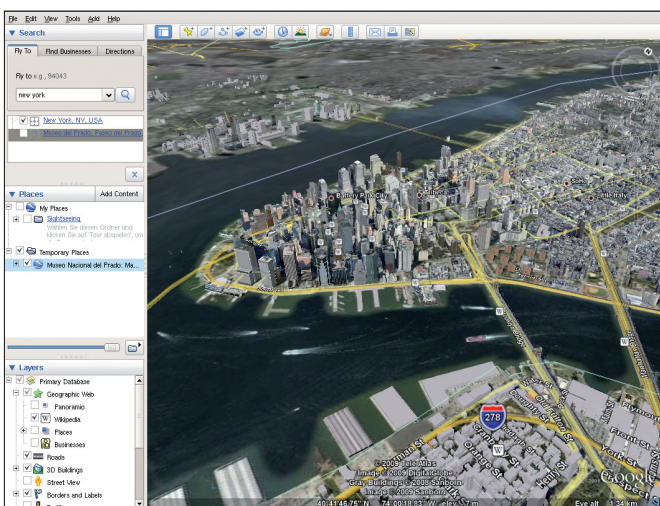

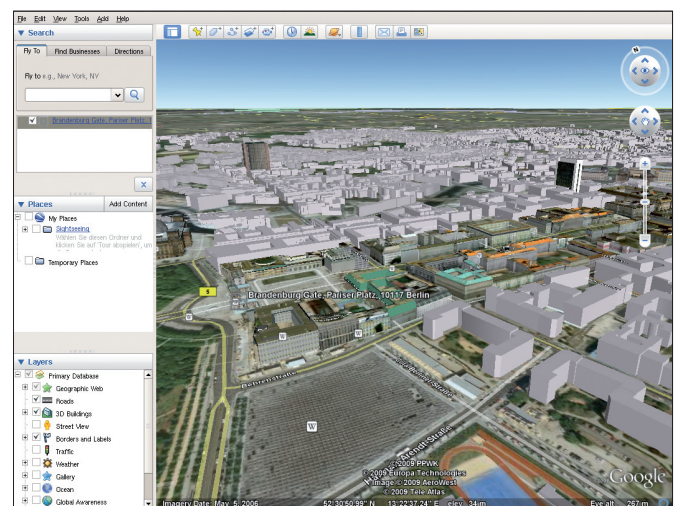**Figure 3: 3D modeling of buildings is quite advanced in the US in particular.**

Figure 4: Outside the US, photos of the façades of many buildings are missing.
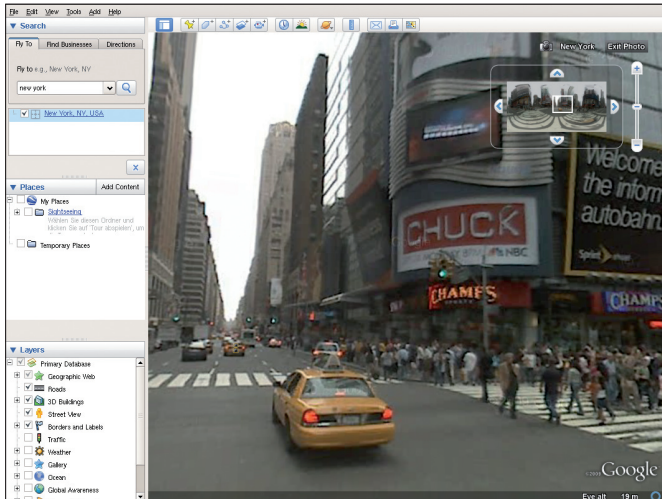
Figure 5: Google Street View lets you cruise many cities in photo mode.

Figure 6: Following the same principle as Google Maps, Google Sky lets you explore the heavens in your web browser.

wheel: The angle of elevation changes to a flatter view of your target.

The default setting gives buildings an unnaturally flat appearance in this view. But if you enable the 3D Buildings item in the list below *Layers*, the façades of the buildings that have already been recorded take on a more realistic 3D appearance.

Of course, displaying buildings in three dimensions involves far more effort than just photographing them from above. The software needs a model of each building to calculate its proportions relative to the current perspective. Most US cities have made fair progress here, although the information is mainly restricted to downtown areas (Figure 3). Additionally, photos of the façades of many buildings are missing, and this means that the outer walls of some 3D building models are rendered in plain white (Figure 4).

Community Contributions

If you are not satisfied with the 3D buildings that Google Earth officially integrates, the product homepage has a *3D Buildings* link that takes you to buildings contributed by Google users. To download one of the *.kmz* or *.kml* files in *Google 3D Warehouse* and open it in Google Earth, select *File | Open*. Now you see additional 3D buildings of many types in various regions of the world.

The Google Earth homepage also has a couple of files in *Recommendations* with the coordinates and optional descriptions of sights and other points of interest. Google is not the only site to provide *.kmz* files: In fact, users can exchange information about points of interest in this way. For example, some resourceful Google Earth users have published their discoveries [4], offering access to spectacular photos of vehicles, houses, or military installations.

Publication of military installations in particular has brought Google Earth some criticism from various governments. Anti-terrorism forces fear that enemies could exploit the photos to plan attacks. In response to this criticism, Google has reduced the resolution of various images of military bases and government buildings until just a rough pixelated image remains.

To get an even closer impression of many cities, Google Earth provides the "Street View" mode (Figure 5). When you have activated the *Street View* checkbox in the *Layers* pane, you will see camera icons in the areas that have
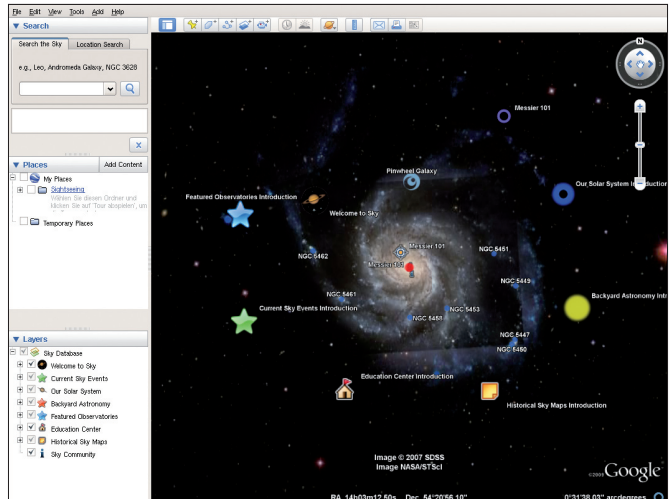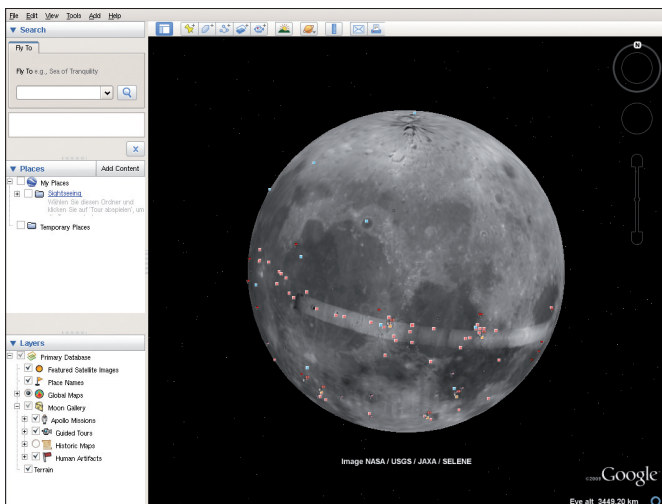

Figure 7: Moon mode shows information about the moon, including information from US and Soviet moon missions.
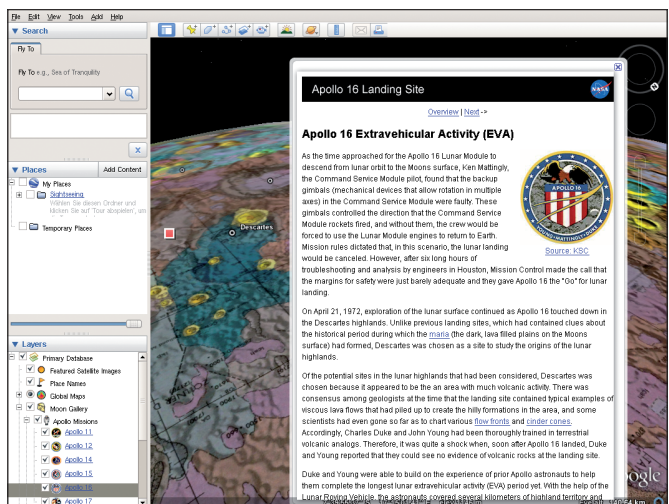

Figure 8: Google Moon shows information on moon landings. NASA used existing maps at the time to plan the famous Apollo missions.

been photographed by the Google Street View cars, which have been seen in many cities around the world during the past couple of years. Not all of these photos are available in Google Earth yet, but most US cities and many others can be cruised in photo mode.

Google Earth provides still more options that you can explore. For example, using the *Record a tour* button, you can make a film reconstructing your tour through the world and, if you have a microphone, record you own comments. The "Show historical imagery" button brings up a timeline that lets you move back in time. With this feature, you can see how the Earth looked back in the old days – if usable material is available.

Aiming for the Sky

Those whose thirst for knowledge is not satisfied, even by the seemingly endless material of the Earth, can use Google Earth to explore the sky. Just click on the planet icon in the Google Earth toolbar, choose *Sky*, and begin your journey into space (Figure 6).

The sky mode is controlled much like the Earth mode described previously. To navigate, either click with the left mouse button and drag or use the arrows in the navigation bar at the top right of the screen. The vertical bar just below lets you scale the current view, or you can use the mouse wheel for this. If you are looking for a specific astronomical object, you can type its name in the search bar. For example, you can search for a single heavenly body like Neptune, a whole constellation like Libra, or a whole galaxy like the Milky Way.

At the start screen is a list of ready-to-take tours. For example, if you click *Featured Observatories Introduction*, you can select the *Hubble Showcase*, where you are treated to a selection of particularly impressive shots from the telescope in Earth orbit [5], such as the Carina Nebula, including a description of its region in space.

Some of the tours contain multimedia material like podcasts. With this spoken word collection you can discover, for example, how water first appeared on the

Earth, how lunar eclipses occur, and whether Neptune might have oceans in about eight billion years.

Moon Travel

In recent years, science has made considerable progress in exploring the heavenly bodies closest to the Earth, with the most details available for the moon, our closest neighbor. If you click the planet icon in the toolbar and choose *Moon*, you are beamed to this companion of the Earth (Figure 7).

The controls work the same way as for the Earth. Of course, the quality of these images can't compete with images of the Earth. Despite the relative proximity of the moon, most images do not give scientifically perfect results.

Different layers are available showing specific material. For example, activating the *Apollo Missions* checkbox marks the places on the moon where US astronauts landed on the surface of the moon during Apollo missions 11 through 17 between 1969 and 1972. Apollo 13 is missing from this series because of an acci-

dent that prevented this mission from making its planned moon landing.

If you click one of the landing sites, an information window gives you an overview of the data for the mission in question, such as the landing and return dates, and the names of the astronauts on board (Figure 8).

To discover more detail about a particular mission, zoom in to each mark. The mission details include photos taken by the astronauts, as well as descriptions of the rocks they found and of objects the moon travelers left behind on the surface. The photos are combined to gain a 360-degree view and enable you to navigate just as in Google Street View on Earth – but of course, with very limited coverage.

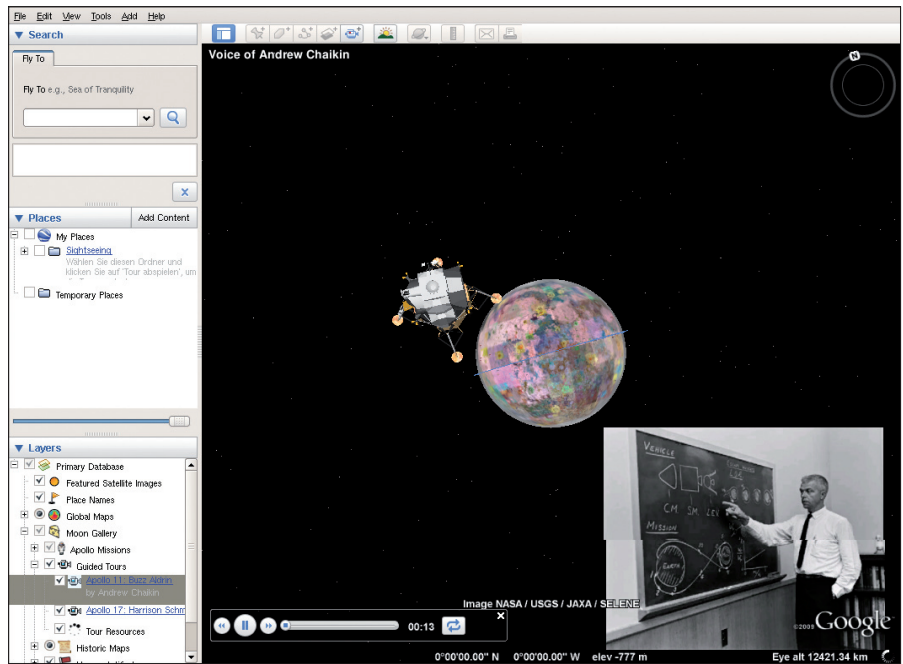The other layers provide you with information about the moon from other

Figure 9: Learn about several space missions in guided tours with multimedia material.

sources. These include the unmanned Soviet moon missions, historical maps, and satellite detail photos. In the *Guided Tours* section, you will find videos made with Google Earth that document some of the Apollo missions, including historical photographs and other informative material (Figure 9).

Mars

The planet icon in the toolbar provides one more mode: *Mars*. Again, the controls stay the same. Turning on various layers provides the corresponding photos. *Featured Satellite Images* brings up a selection of special-interest pictures. To increase the number of available photos, activate the layer *Spacecraft Imagery*.

Because of the long history of humans observing Mars, numerous historical maps of the planet are available, which are shown when you activate the corresponding layer. Additionally, Google Earth shows itself prepared for future space tourism with the *Traveler's Guide to Mars*, which presents photographs of

Listing 1: Simple KML File

```
01 ?xml version='1.0'
   encoding='UTF-8'?>
02 <kml xmlns='http://earth.google.
            com/kml/2.2'>
03 <Placemark>
04 <name>KML-samplefile</name>
05 <description><![CDATA[Created with
   <a href="http://sketchup.google.
   com">Google SketchUp</a>]]>
   </description>
06 <DocumentSource>SketchUp
   </DocumentSource>
07 <Style id='default'>
08 </Style>
09 <Model>
10 <altitudeMode>relativeToGround
   </altitudeMode>
11 <Location>
12 <longitude>11.62404755064788
   </longitude>
13 <latitude>48.21799407992902
   </latitude>
14 <altitude>0.000000000000</altitude>
15 </Location>
16 <Orientation>
17 <heading>0</heading>
18 <tilt>0</tilt>
19 <roll>0</roll>
20 </Orientation>
21 <Scale>
22 <x>14.0</x>
23 <y>14.0</y>
24 <z>14.0</z>
25 </Scale>
26 <Link>
27 <href>models/sample.dae</href>
28 </Link>
29 </Model>
30 </Placemark>
31 </kml>
```

Building Your Own

Browsing through hundreds of splendid Google Earth creations from your desktop is easy, but what if you want to create your own 3D objects? While checking out some of the possible alternatives for building and editing 3D models for Google Earth, I found that the options are currently quite limited.

SketchUp

Google provides an application called SketchUp [10], powerful 3D modeling software with which you can build and edit 3D objects; however, it currently only supports the Windows XP and Vista operating systems and Mac OS X.

In Linux, you can start SketchUp in Wine. However, problems remain with incorrectly rendered menus and buttons, as well as occasional crashes. Although some of the 3D features seem to work – users can draw, rotate, and move objects –

the tool isn't much fun without the buttons and menus that go with it.

LandXplorer

Some organizations, authorities, and institutions use commercial programs by third-party manufacturers to create complex 3D worlds. One promising candidate is LandXplorer by 3D Geo.

The city of Berlin used LandXplorer to build the first realistic and comprehensive city-sized 3D model, which is much more detailed than the one integrated into Google Earth (Figure 4) [11]. This massive creation comprises 40,000 buildings, five of which you can enter virtually [12].

LandXplorer is available for Windows only. The vendor said the software is written in .NET and it might be possible to run it on Linux with the use of Mono, but they have no plans to do this right now for lack of demand.
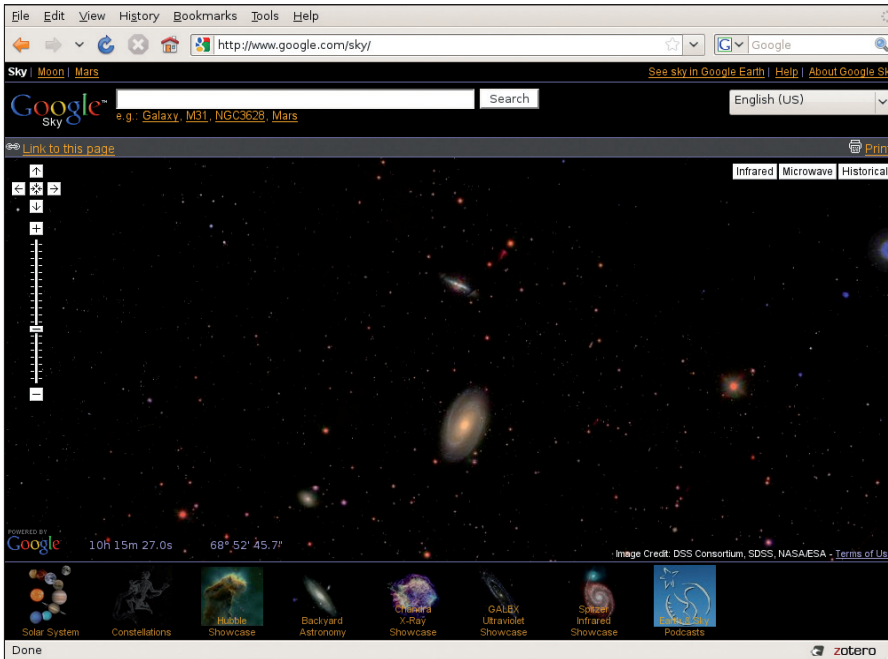
Figure 10: Much of the data presented in Google Earth can also be accessed in a web browser.

spectacular geological formations worth visiting.

Time Issues

The enormous distances in space cause virtually unsolvable problems in this kind of cartography. For example, images showing a galaxy that is a million light years away can only show you what the heavenly body looked like a million years ago.

Physical obstacles make it impossible to map space just in visible light. For this reason, modern telescopes also record waves from other frequency bands. Google provides images taken with these technologies, but you will need to use your web browser.

Google Sky [6] (Figure 10) is fully usable in your web browser. Just click on the infrared or the microwave buttons at the top right of the browser window. Infrared images are provided by the Infrared Astronomical Satellite (IRAS) space telescope, which has been in orbit since 1983. It was the first satellite to record mid-distance to far infrared waves from space.

Besides Google Sky, you can access the data used in the other modes of Google Earth in your browser. Surf to Google Maps [7], Google Moon [8], and Google Mars [9], respectively to get to the images. These sites generally provide reduced functionality; however, they are very useful if you don't have Google

Earth installed and just want to take a quick look, for example, to calculate the best route from one place to another.

For Experts

If you want to use Google Earth as a professional helper, consider the Google Earth Pro variant, which is only open to users of Windows and Mac OS X. For a charge of US$ 400 per year, you can automatically generate KML files and export flights to video files. Additionally, Google Earth Pro supports GPS (Global Positioning System) coordinates. The price also includes professional support by email and the ability to print hi-res images.

Another option you have when you modify Google Earth 3D models in Linux is tweaking the XML directly. Google Earth uses XML files in KML or KMZ format to import objects. KML stands for Keyhole Markup Language, an XML 1.0 variant designed specifically for the exchange of data with Google Earth. KML files can contain references to 3D models, which in turn reference image files as textures.

If you have a zipped collection of KML files, the archive will have a *.kmz* file extension. Google Earth loads the file without unpacking it beforehand and displays the 3D objects it contains at the right position. Whereas *.kml* files contain data on an object and only reference 3D models, KMZ archives include a *.kml*

file, subdirectories, and a *.dae* file with a description of a 3D object in Collada format [13].

Listing 1 is an example of a simple KML file that uses a *.kmz* file from Google's 3D Warehouse [12]. The file, which I downloaded and unpacked, was obviously created with SketchUp, and it contains a link to a file called *sample. dae*. Once you open the file in XML form, you can modify some of the settings with the use of a text editor. An extensive tutorial is available on the Google website [14] that describes permitted tags and covers advanced features of KML 2.2.

Other Tools

Google Earth sources promise compatibility with the Collada XML-based graphics standard; however, neither Blender nor the commercial Maya software was able to download a 3D model from the Google database or directly import an object into Google Earth [15]. ■

INFO
[1] Google Earth: *http://earth.google.com*
[2] Wikipedia: *http://en.wikipedia.org*
[3] Panoramio: *http://www.panoramio.com*
[4] Google Earth Community: *http://bbs.keyhole.com*
[5] Hubble space telescope: *http://www. nasa.gov/mission_pages/hubble*
[6] Google Sky: *http://www.google.com/sky*
[7] Google Maps: *http://maps.google.com*
[8] Google Moon: *http://www.google.com/moon*
[9] Google Mars: *http://www.google.com/mars*
[10] SketchUp: *http://sketchup.google.com/*
[11] Berlin's 3D city model: *http://www. 3d-stadtmodell-berlin.de/3d/en/ seite0.jsp*
[12] Google's 3D Warehouse: *http:// sketchup.google.com/3dwarehouse*
[13] Collada format: *http://www.collada.org*
[14] KML HOWTO: *http://code.google. com/apis/kml/documentation*
[15] Importing KML and KMZ into Blender: *http://www.blendernation. com/import-sketchup-and-google- earth-files-into-blender/*