Tutorial 03: fire spread in real-world fuel/terrain under constant/uniform wind

Tutorial 03 is similar to Tutorial 02 except we replace its idealized flat terrain and uniform/constant fuels with real-world fuels and topography. Transient wind and fuel moisture conditions remain the same as in Tutorial 02.

To simplify the process of obtaining real-world fuel, topography, weather, and fire perimeter data, ELMFIRE uses a collection of command line tools - collectively known as Cloudfire - to obtain GIS data for fire modeling from the cloud. These microservices use Google Remote Procedure Call (gRPC) and GNU Wget to pull GIS data from a Cloudfire server. If not already installed, it will be necessary to install wget and gRPC as follows:

```
sudo apt-get install wget
sudo pip3 install grpcio grpcio-tools
```

Once these packages are installed, fuel data can be obtained from Cloudfire's fuel/weather/ignition client using commands of the form:

```
fuel_wx_ign.py \
--do_wx=False --do_ignition=False \
--center_lon=-120.281 --center_lat=37.440 \
--fuel_source='landfire' --fuel_version='2.2.0' \
--outdir='./fuel' --name='tutorial03'
```

This will create the directory `fuel` (or more generally, a directory name specified by the `--outdir` flag) that will contain a file named `tutorial03.tar`, as specified by the `--name` flag. This tarball contains fuel and topography rasters but no weather or ignition data as specified by the first three flags.

The latitude and longitude of the center of the raster is specified by the command line arguments `--center_lon` and `--center_lat` as a location Northeast of Merced, CA (120.281 W, 37.440 N). The size of the raster defaults to 60 km by 60 km which is usually sufficient for fire modeling purposes. However, if a tile of a different size is desired, the flags `--`

`west_buffer`, `--east_buffer`, `--south_buffer`, and `--north_buffer` can be used to specify the distance, in km, between the tile center and its respective west, east, south, and north edges.

To simplify running of Tutorial 03, the command in the code block above is added to the script $ELMFIRE_BASE_DIR/tutorials/03-real-fuels/01-run.sh. This script sets up and runs a point ignition (corresponding to `--center_lon` and `--center_lat` identified above) under the same transient wind and fuel moisture conditions from Tutorial 02.

```
cd $ELMFIRE_BASE_DIR/tutorials/03-real-fuels
./01-run.sh
```

The Figure below shows modeled hourly isochrones (`outputs/hourly_isochrones.shp`) overlaid on satellite imagery (left) and surface fuel model (`inputs/fbfm40.tif`)) on the right. Note the similarities in the overall fire shape to Tutorial 02. Since the wind and fuel fields are the same in both tutorials, deviations from the idealized elliptical fire shape are due to differences primarily in fuels with a minor influence of topography. The shadowing effect of fuel breaks - in this case water bodies - is also apparent.