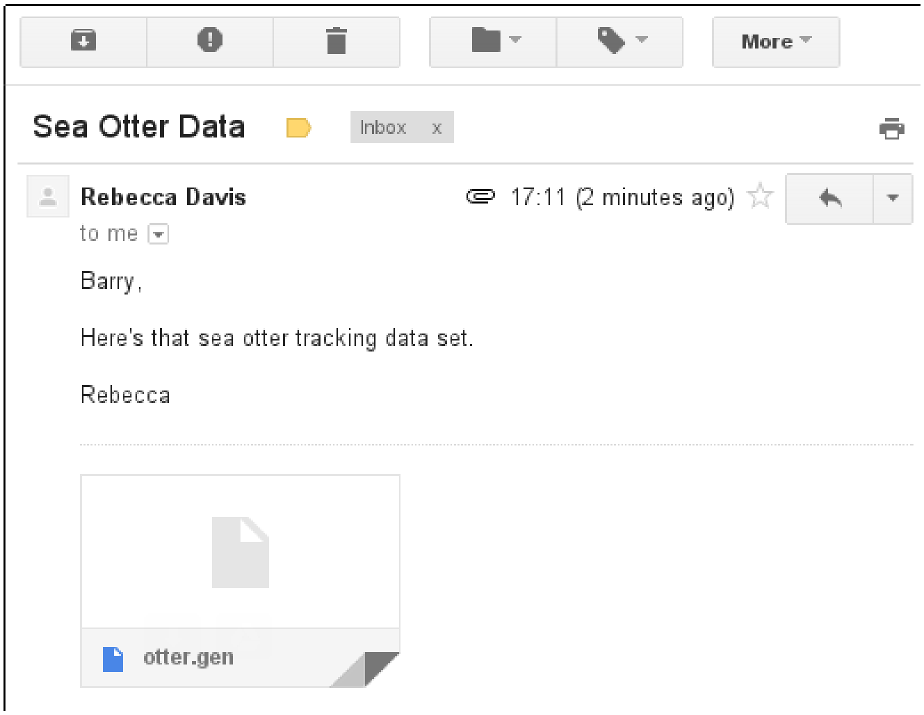
Geostat Summer School

Unix Shell Programming

Your toolkit to an easier life…

A little story…



Sea Otter Data

Rebecca Davis
to me

17:11 (2 minutes ago)

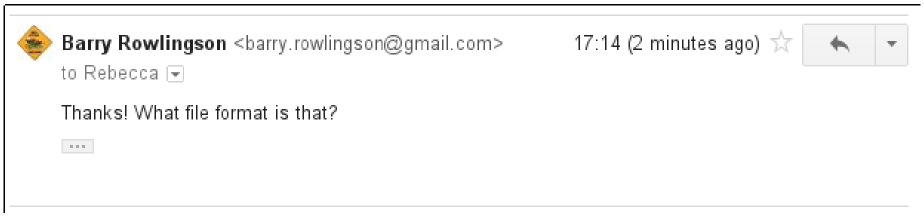
Barry,

Here's that sea otter tracking data set.

Rebecca

otter.gen

A little story…

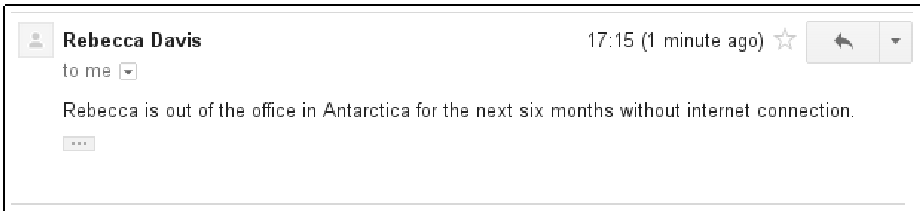


Barry Rowlingson <barry.rowlingson@gmail.com>
to Rebecca

17:14 (2 minutes ago)

Thanks! What file format is that?

A little story...



Rebecca Davis

Rebecca is out of the office in Antarctica for the next six months without internet connection.

What To Do

Now what?

What's the first thing you do when you get an unknown file?

- Double-click it and hope?
- Load it into Excel?
- Load it into Word?
- Search for the extension on the internet?

basic file ops

- Run `file` on it

  ```
  $ file otter.gen
  otter.gen: ASCII text
  ```

- Check its size

  ```
  $ ls -l otter.gen
  -rw-r--r-- 1 rowlings rowlings 2341 Apr 24 17:24 otter.gen
  ```

- Human-readable size...

  ```
  $ ls -lh otter.gen
  -rw-r--r-- 1 rowlings rowlings 2.3K Apr 24 17:24 otter.gen
  ```

- Word, line, character count

  ```
  $ wc otter.gen
   130  251 2341 otter.gen
  ```

See the contents…

- Run `head` on it

  ```
  $ head otter.gen
  1
  -145.8953 60.63951
  -145.8936 60.63902
  -145.8931 60.63774
  -145.8941 60.63768
  -145.8922 60.63676
  -145.8941 60.63651
  -145.8976 60.63645
  -145.8972 60.63480
  -145.8955 60.63450
  ```

- Run `tail` on it

  ```
  $ tail -5 otter.gen
  -145.8901 60.62465
  -145.8901 60.62465
  END
  END
  ```

What are those `END` lines doing there?

Paging Mr File

`more (or less)`

```
$ more otter.gen
1
-145.8953 60.63951
-145.8936 60.63902
-145.8931 60.63774
...
-145.8962 60.63878
-145.8965 60.64031
-145.8926 60.64104
END
2
-145.9652 60.61914
-145.9634 60.61841
```

```
-145.9599 60.61731
-145.9587 60.61780
-145.9587 60.61878
-145.9599 60.61902
-145.9587 60.61988
-145.9565 60.61939
-145.9577 60.61865
-145.9560 60.61792
-145.9595 60.61731
--More--(34%)
```

Then hit `space` for next page, `q` to quit, `/` to find, `h` for help.

`less` is an alternative pager to `more` with more features.

Search

The oddly-named `grep` command

```
$ grep END otter.gen
END
END
END
END
```

With matching line numbers

```
$ grep -n END otter.gen
33:END
89:END
128:END
129:END
```

Filter output to input

```
$ grep END otter.gen | wc -l
4
```

Stream Filtering

`grep` is great for filtering HUGE files

- Match a pattern:

```
$ grep ^LA1 postcodes.txt > LA1-codes.txt
```

- Chain filters in a pipe:

```
$ grep ^LA1 cases.txt | tr '[a-z]' '[A-Z]'  | sed 's/FEMAIL/FEMALE/' | grep FEMALE > cl
```

- Sort and count unique lines:

```
$ sort cases.txt | uniq -c
      1 LA1 Femail
      2 LA1 Female
      1 LA1 Male
      1 LA2 Femail
      1 LA2 Female
      1 LA2 Maile
```

Database joins

Add postcode data to individual data

- Postcode data file:

```
LA1 34243,22310
LA2 77394,12848
LA3 66100,26230
```

- Sorted individual data file:

```
LA1 Femail
LA1 Female
LA1 Female
LA1 Male
LA2 Femail
LA2 Female
LA2 Maile
```

- Use `join`:

```
$ join sort-cases.txt LA1-codes.txt
LA1 Femail 34243,22310
LA1 Female 34243,22310
LA1 Female 34243,22310
LA1 Male 34243,22310
LA2 Femail 77394,12848
LA2 Female 77394,12848
LA2 Maile 77394,12848
```

Format hypothesis

For each otter track:

- ID number
- lat-long pair
- END mark

Then an END mark

awk

- `awk` is a very useful text-file stream processing language
- read a line at a time, split line into fields
- each line of the language is `pattern {action}`
- if the pattern expression is true, the action is run
- the default pattern is always true, the default action is print this line

Print all lines that don't have two fields:

```
$ awk 'NF!=2' otter.gen
1
END
2
END
3
END
END
```

Print message where second field is greater than some value:

```
$ awk '$2 > 60.64 {print NR," large Y ",$0}' otter.gen
31  large Y  -145.8965 60.64031
32  large Y  -145.8926 60.64104
98  large Y  -145.9250 60.64104
99  large Y  -145.9233 60.64153
```

More awk

How many points in each line?

Use the result of `grep -n END otter.gen` to get the line numbers:

```
$ grep -n END otter.gen
33:END
89:END
128:END
129:END
```

Use two awk rules:

- `BEGIN {n=0}` runs before the first line, and sets `n` to 0.
- `{print $1 - n; n=$1 }` runs on every line and prints the difference between `n` and the first field. It then updates `n` to that value:

```
$ grep -n END otter.gen | awk -F: 'BEGIN {n=0} ; {print $1 - n; n=$1 } '
33
56
39
1
```

Path Length

Compute the path length for each otter track...

```
$0=="END" && id != "END" {print id,dist}
NF==1 {dist=0; first=1; id=$1}
NF==2 && first==1 {
  x1=$1
  y1=$2
  first = 0
}
NF==2 {x2=$1
 y2=$2
 dist = dist + sqrt((x2-x1)^2 + (y2-y1)^2)
 y1 = y2
 x1 = x2
}
```

Then run:

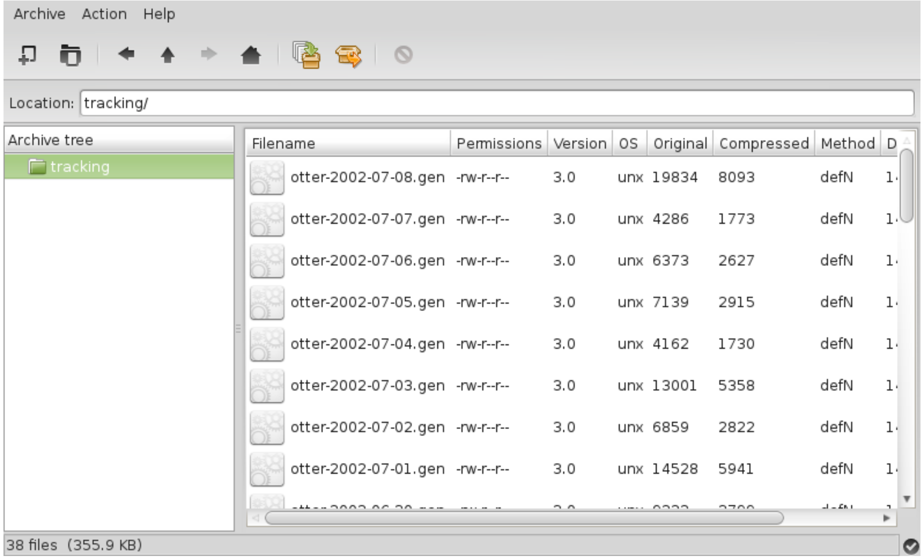
```
$ awk -f pathlength.awk otter.gen
1 0.070923
2 0.102671
3 0.110943
```

You’ve got mail!

From: rebecca davis

Subject: otter data

Just checking email before getting on plane to South Pole. Data is in Arc/Info Ungenerate format. Here’s the full set of 38 track files.



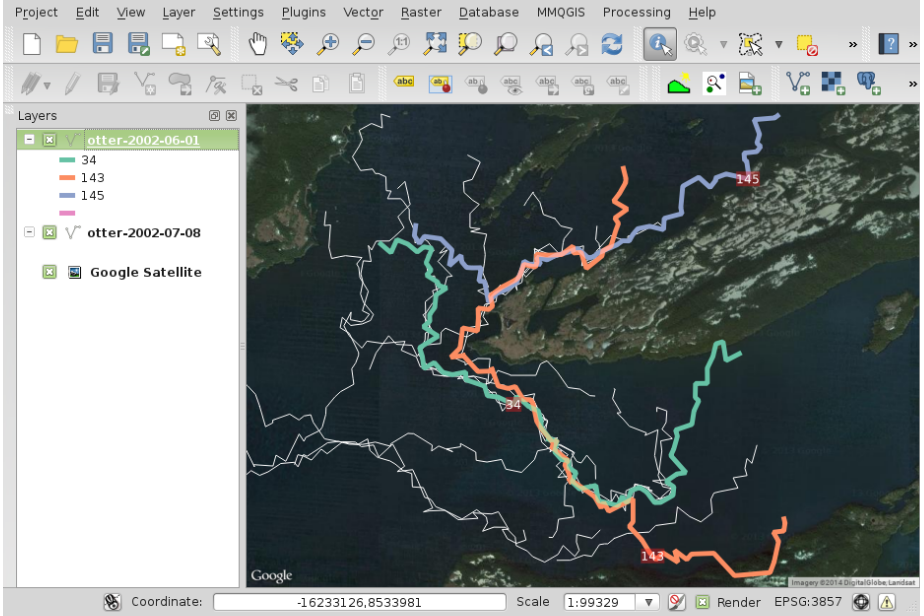
Location: tracking/

Filename	Permissions	Version	OS	Original	Compressed	Method	D
otter-2002-07-08.gen	-rw-r--r--	3.0	unx	19834	8093	defN	1
otter-2002-07-07.gen	-rw-r--r--	3.0	unx	4286	1773	defN	1
otter-2002-07-06.gen	-rw-r--r--	3.0	unx	6373	2627	defN	1
otter-2002-07-05.gen	-rw-r--r--	3.0	unx	7139	2915	defN	1
otter-2002-07-04.gen	-rw-r--r--	3.0	unx	4162	1730	defN	1
otter-2002-07-03.gen	-rw-r--r--	3.0	unx	13001	5358	defN	1
otter-2002-07-02.gen	-rw-r--r--	3.0	unx	6859	2822	defN	1
otter-2002-07-01.gen	-rw-r--r--	3.0	unx	14528	5941	defN	1

38 files (355.9 KB)

GDAL/OGR

Load straight into QGIS…


Project Edit View Layer Settings Plugins Vector Raster Database MMQGIS Processing Help
Layers
otter-2002-06-01
34
143
145
otter-2002-07-08
Google Satellite
145
34
143
Google
Imagery ©2014 DigitalGlobe, Landsat
Render

Coordinate: -16233126,8533981 Scale 1:99329 EPSG:3857

Ungenerate Format

Arc/Info Ungenerate Format

- Can be read by OGR/GDAL utilities
- Basic info:

```
$ ogrinfo otter.gen
Had to open data source read-only.
INFO: Open of `otter.gen'
      using driver `ARCGEN' successful.
1: otter (Line String)
```

- Summary info, all layers:

```
$ ogrinfo -so -al otter.gen
Had to open data source read-only.
INFO: Open of `otter.gen'
```

```
      using driver `ARCGEN' successful.

Layer name: otter
Geometry: Line String
Feature Count: 3
Extent: (-145.965700, 60.615840) - (-145.890100, 60.641530)
Layer SRS WKT:
(unknown)
ID: Integer (0.0)
```

ogrinfo

ogrinfo

```
$ ogrinfo -al otter.gen
Had to open data source read-only.
INFO: Open of `otter.gen'
      using driver `ARCGEN' successful.

Layer name: otter
Geometry: Line String
Feature Count: 3
Extent: (-145.965700, 60.615840) - (-145.890100, 60.641530)
Layer SRS WKT:
(unknown)
ID: Integer (0.0)
OGRFeature(otter):0
  ID (Integer) = 1
  LINESTRING (-145.8953 60.63951,-145.8936 60.63902,...1,-145.8926 60.64104)
OGRFeature(otter):1
  ID (Integer) = 2
  LINESTRING (-145.9652 60.61914,-145.9634 60.61841,....
...
```

ogr2ogr conversion

Command-line geodata conversion

```
$ ogr2ogr -s_srs "+init=epsg:4326" -t_srs "+init=epsg:4326" otter.shp otter.gen

$ ogrinfo -so -al otter.shp
```

```
INFO: Open of `otter.shp'
      using driver `ESRI Shapefile' successful.

Layer name: otter
Geometry: Line String
Feature Count: 3
Extent: (-145.965700, 60.615840) - (-145.890100, 60.641530)
Layer SRS WKT:
GEOGCS["GCS_WGS_1984",
    DATUM["WGS_1984",
        SPHEROID["WGS_84",6378137,298.257223563]],
    PRIMEM["Greenwich",0],
    UNIT["Degree",0.017453292519943295]]
ID: Integer (10.0)
```

- Want to do:

  ```
  $ ogr2ogr -s_srs "+init=epsg:4326" -t_srs "+init=epsg:4326" otter.shp otter.gen
  ```

  for each “generate” file…

Loops and variables

Command-line loops

Use `echo` to print things:

```
$ echo "Hello World"
Hello World

$ echo $HOME
/home/rowlings
```

Loop over files and print name:

```
$ for f in *.gen ; do echo $f ; done
otter-2002-06-01.gen
otter-2002-06-02.gen
otter-2002-06-03.gen
otter-2002-06-04.gen
otter-2002-06-05.gen
...
```

How do we create the output shapefile name?

Variables and substitutions

Substitutions

```
$ for f in *.gen ; do echo ${f%.gen}.shp ${f:6:10} ; done
otter-2002-06-01.shp 2002-06-01
otter-2002-06-02.shp 2002-06-02
otter-2002-06-03.shp 2002-06-03
otter-2002-06-04.shp 2002-06-04
otter-2002-06-05.shp 2002-06-05
otter-2002-06-06.shp 2002-06-06
otter-2002-06-07.shp 2002-06-07
...
```

Batch Converting

Batch Conversion

- Want to do:

  ```
  $ ogr2ogr -s_srs "+init=epsg:4326" -t_srs "+init=epsg:4326" otter.shp otter.gen
  ```

  for each "generate" file…
- So the loop is:

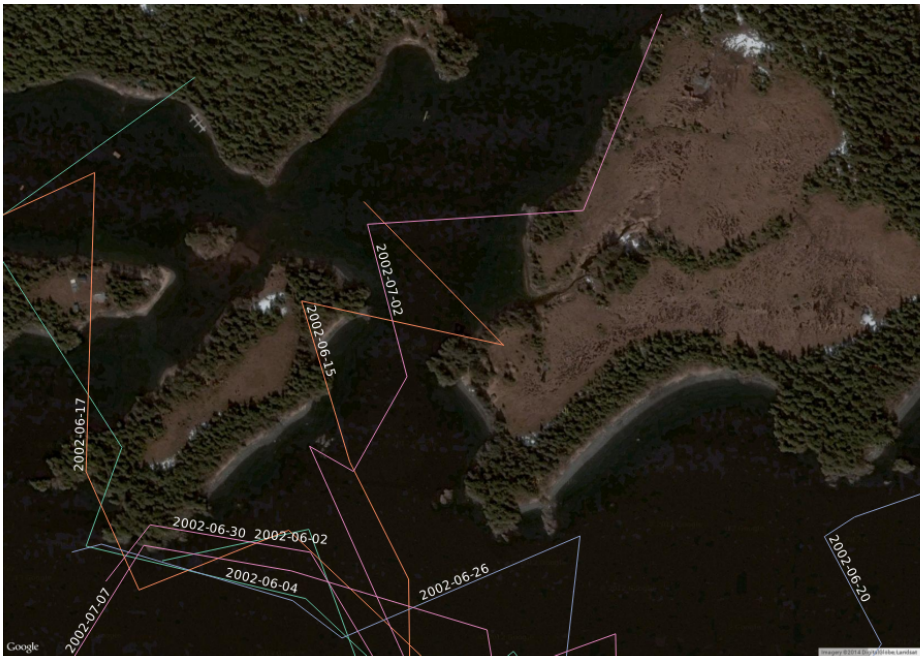
  ```
  $ for f in *.gen ; do
  >   ogr2ogr -s_srs "+init=epsg:4326" -t_srs "+init=epsg:4326" ${f%.gen}.shp $f
  >   done
  ```

- Now we have a shapefile for each input file.

Adding Attributes

We want to:

- Merge all the data into one shapefile
- Add the date to each feature



ogrinfo tricks

- Add a new field:

```
$ ogrinfo otter-2002-06-01.shp -sql "ALTER TABLE  otter-2002-06-01  ADD COLUMN day char
```

- Add date to field:

```
$ ogrinfo otter-2002-06-01.shp -dialect SQLite -sql "UPDATE 'otter-2002-06-01' SET day=
```

- We now have:

```
$ ogrinfo -geom=NO  -al otter-2002-06-01.shp
INFO: Open of `otter-2002-06-01.shp'
      using driver `ESRI Shapefile' successful.

Layer name: otter-2002-06-01
Geometry: Line String
Feature Count: 3
[etc]
ID: Integer (10.0)
day: String (15.0)
```

```
OGRFeature(otter-2002-06-01):0
  ID (Integer) = 34
  day (String) = 2002-06-01

OGRFeature(otter-2002-06-01):1
  ID (Integer) = 143
  day (String) = 2002-06-01

OGRFeature(otter-2002-06-01):2
  ID (Integer) = 145
  day (String) = 2002-06-01
```

All Together Now

Scripted

```
for genfile in *.gen ; do

  echo "Processing " $genfile

  layer="${genfile%.gen}"
  shapefile="${layer}.shp"
  day="${genfile:6:10}"

  ogr2ogr -s_srs "+init=epsg:4326" -t_srs "+init=epsg:4326" $shapefile $genfile

  ogrinfo $shapefile -sql "ALTER TABLE $layer ADD COLUMN day character(15)"
  ogrinfo $shapefile -dialect SQLite -sql "UPDATE '$layer' SET day='$day'"

done
```

- Now we have all the shapefiles, with the date as a field in each
- Next step: merge all the shapefiles

Merge

Start with a first shapefile, update and append:

```
ogr2ogr alltracks.shp part-1.shp
ogr2ogr -update -append alltracks.shp part-2.shp -nln alltracks
ogr2ogr -update -append alltracks.shp part-3.shp -nln alltracks
ogr2ogr -update -append alltracks.shp part-4.shp -nln alltracks
...
```

Automate this…

Merge

Use append and update

```
for f in *.shp ; do
    if [ -f alltracks.shp ] ; then
    echo merging $f
    ogr2ogr -update -append alltracks.shp $f -nln alltracks
    else
    echo starting with $f
    ogr2ogr  alltracks.shp $f
    fi
done
```

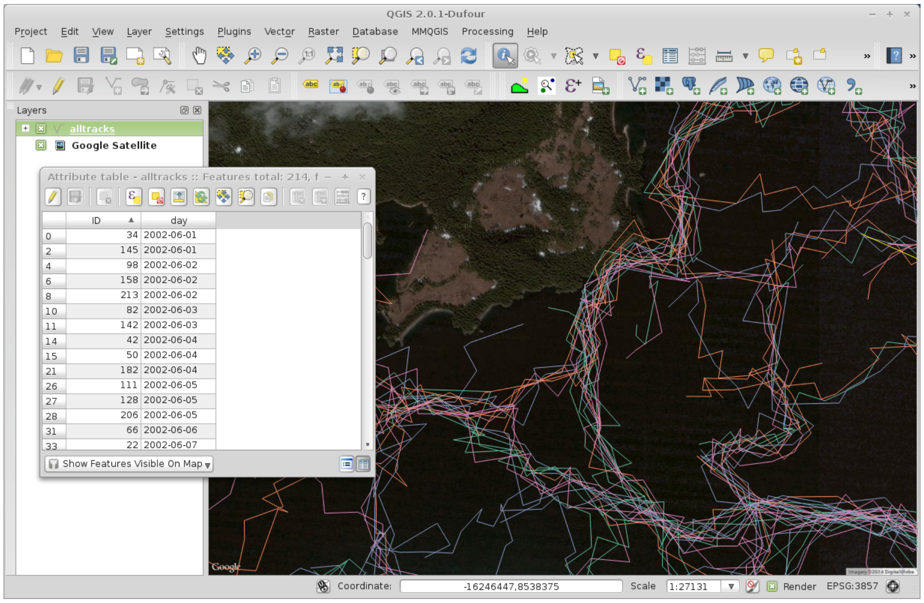
Final output

So we get…

```
$ ogrinfo -geom=NO -al alltracks.shp | more
INFO: Open of `alltracks.shp'
      using driver `ESRI Shapefile' successful.

Layer name: alltracks
Geometry: Line String
Feature Count: 214
Extent: (-145.981367, 60.586132) - (-145.817827, 60.649236)
Layer SRS WKT:
GEOGCS["GCS_WGS_1984",
    DATUM["WGS_1984",
        SPHEROID["WGS_84",6378137,298.257223563]],
    PRIMEM["Greenwich",0],
    UNIT["Degree",0.017453292519943295]]
ID: Integer (10.0)
day: String (15.0)
OGRFeature(alltracks):0
  ID (Integer) = 34
  day (String) = 2002-06-01

OGRFeature(alltracks):1
  ID (Integer) = 143
  day (String) = 2002-06-01

OGRFeature(alltracks):2
  ID (Integer) = 145
  day (String) = 2002-06-01
...
```

Mapped

Tracks and table



QGIS 2.0.1-Dufour
Project Edit View Layer Settings Plugins Vector Raster Database MMQGIS Processing Help
Layers
alltracks
Google Satellite
Attribute table - alltracks :: Features total: 214, f
Show Features Visible On Map
Google
Coordinate: -16246447,8538375
Scale 1:27131
Render
EPSG:3857

	ID	day
0	34	2002-06-01
2	145	2002-06-01
4	98	2002-06-02
6	158	2002-06-02
8	213	2002-06-02
10	82	2002-06-03
11	142	2002-06-03
14	42	2002-06-04
15	50	2002-06-04
21	182	2002-06-04
26	111	2002-06-05
27	128	2002-06-05
28	206	2002-06-05
31	66	2002-06-06
33	22	2002-06-07

Summary

Summary

- Use the shell
- Get file info
- Summarise file properties
- Extract/Transform
- Command-Line Geospatial Tools