Vesta Mk2 Comparison

Comparison predicted FROS between Vesta Mk 2 models in Amicus and FireBehaviourCalcs_Australia (FBCalc)

Executive Summary

- The current version of FireBehaviourCalcs_Australia_20211202 has an error in the formula for Vesta Mk 2 Phase II ROS.
- Once corrected there is aceptable agreement between the rates of spread predicted by FireBehaviourCalcs_Australia_20211202 and Amicus.
- Predicted ROS from FireBehaviourCalcs_Australia_20211202 shows a slightly smaller range (smaller peaks, shallower troughs) than Amicus which is only partly explained by differences in the calculated moisture content.

Data sets compared:

- Lach Lamond Point Forecast20211219 - 20211226
- Kempsey AWS 20191107 - 20191113
- Deans Gap Point Forecast 20130107 - 20130110

Analysis using PyroPy

In [ ]:
```
from pyropy import firebehaviour as fb
from pyropy import weatherdata as wd
import matplotlib.pyplot as plt
```

Set up the input dictionaries and date time formats to accomodate the different sources:

- define aws dictionary for Kempsey
- for Lach Lamond use `gridded_to_df()`
- for Deans Gap use `gridded_to_df()` but set `header = 3`

In [ ]:
```
# input into PyroPy
aws = {
    'date_time': 'Date/Time (EDT)',
    'temp': 'Temp (deg C)',
    'humidity': 'RH (%)',
    'wind_dir': 'Wind Direction',
    'wind_speed': 'Wind Speed (km/h)',
    'drought': 'DF',
}

# export compatible with FBCalc
fbcalc = {
    'date': 'Date',
    'time': 'Time',
    'temp': 'Temp (deg C)',
    'humidity': 'RH (%)',
    'wind_dir': 'Wind Direction',
```

```
    'wind_speed': 'Wind Speed (km/h)',
    'drought': 'DF',
}

#date time formats
aws_dt_format = '%Y/%m/%d %H:%M'
fbcalc_dt_format = "%d/%m/%Y %H:%M"
```

import the Lach Lamond weather stream then export to FBCalc and Amicus compatible formats note: there seems to be an issue with the encoding of the degree symbol for Amicus csv files so the Amicus data should be copied and pasted rather than using the import csv function.

In [ ]:
```
lach_lamond_weather = wd.gridded_to_df('Loch_Lamond2112.csv')
wd.df_to_weather(lach_lamond_weather, 'lach_lamond_to_fbc.csv', col_names=fbcalc, 
wd.df_to_amicus(lach_lamond_weather, 'lach_lamond_to_amicus.csv');
```

create the `PyroPy Incident`

In [ ]:
```
lach_lamond_2112 = fb.Incident(lach_lamond_weather)
```

Compare with FBCalc and Amicus prediction.

At this stage there is no way to automate the Amicus andFBCalc predictions so you need to open Amicus and FBCalc, paste in the weather data, then build the models. The FBCalc output will be read back directly from the spreadsheet but the Amicus output needs to be saved to a cvs file.

In [ ]:
```
lach_lamond_2112.compare_fbcalc('lach_lamond_fbcalc.xlsm', ['vesta2'])
lach_lamond_2112.compare_amicus('lach_lamond_amicus_vesta2.csv', 'vesta2')
```

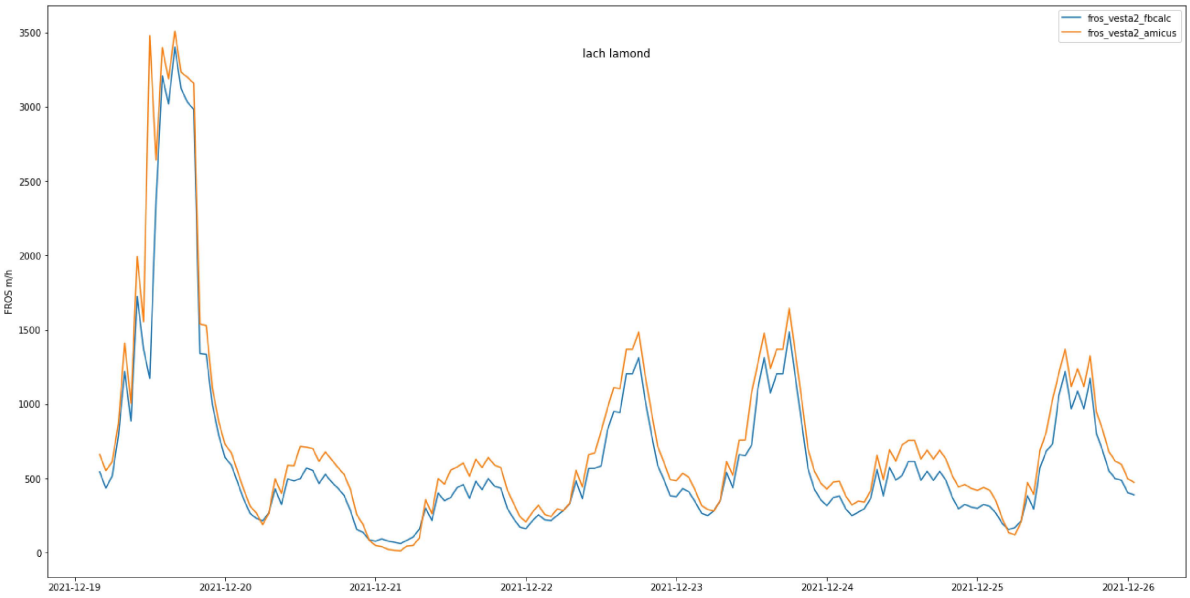
...and plot!

In [ ]:
```
fig, (ax_lach_lamond) = plt.subplots(1,1, sharex=False,constrained_layout=True, fig

ax_dict = {
    'lach lamond': [ax_lach_lamond, lach_lamond_2112],
}

# fields = ['fros_vesta2', 'fros_vesta2_fbcalc', 'fros_vesta2_amicus']
fields = ['fros_vesta2_fbcalc', 'fros_vesta2_amicus']

for label, [ax, inc] in ax_dict.items():
    for f in fields:
        ax.plot(inc.df['date_time'],inc.df[f], label=f)
    ax.set_ylabel('FROS m/h')
    ax.set_title(label, y=0.9)
    ax.legend(loc='upper right')
# plt.xticks(rotation=90)
plt.show()
```



The graph above shows consistently lower values for FROS from FBCalc than from Amicus. This was eventually tracked down to an error in the formula the the phase 2 rate of spread (column U in FBCalc). The formula used was:

$$R(II)_A d = a(U_2 - 1)^b W_s{}^c h_u{}^d$$

```
(0.19591*(I14-1)^0.82569*
(($E$6+$E$7)/10)^0.46722)*$C$10^0.495*1000*R14*S14
```

when it should have been:

$$R(II)_A d = a U_2^b W_s{}^c h_u{}^d$$

```
(0.19591*I14^0.82569*(($E$6+$E$7)/10)^0.46722)*$C$10^0.495*1000*R14*S14
```

This error was corrected and comparison re-run.

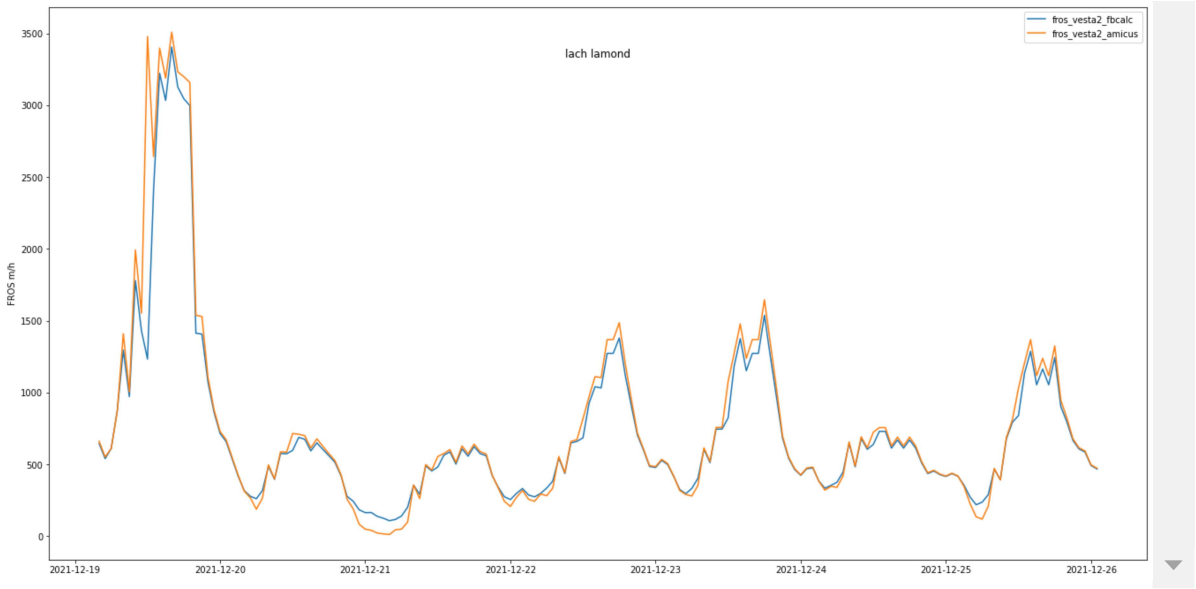
In [ ]:
```
lach_lamond_2112.compare_fbcalc('lach_lamond_fbcalc_mod.xlsm', ['vesta2', 'mc_v'])
fig, (ax_lach_lamond) = plt.subplots(1,1, sharex=False,constrained_layout=True, fig

ax_dict = {
    'lach lamond': [ax_lach_lamond, lach_lamond_2112],
}

# fields = ['fros_vesta2', 'fros_vesta2_fbcalc', 'fros_vesta2_amicus']
fields = ['fros_vesta2_fbcalc', 'fros_vesta2_amicus']

for label, [ax, inc] in ax_dict.items():
    for f in fields:
        ax.plot(inc.df['date_time'],inc.df[f], label=f)
    ax.set_ylabel('FROS m/h')
    ax.set_title(label, y=0.9)
    ax.legend(loc='upper right')
# plt.xticks(rotation=90)
plt.show()
```

```
c:\Users\geoffg\Documents\FBTC_Projects\Vesta2\.venv_vesta2\lib\site-packages\o
penpyxl\reader\drawings.py:59: UserWarning: wmf image format is not supported s
o the image is being dropped
  warn(msg)
```



The modified version of FBCalc shows improved agreement with Amicus but there are still discrepancies, specifically FBCalc has a smaller range (shallower troughs and lower peaks). This pattern is also evident in comparisons between the modified version of FBCalc and Amicus for the Kempsey and Deans Gap weather streams.

In [ ]:
```
kempsey_weather = wd.weather_to_df('Kempsey_AWS_7to13Nov19.csv', col_names=aws, dat
deans_gap_weather = wd.gridded_to_df('Deans_Gap_IgnitionPoint_Fcst.csv', header=3)
wd.df_to_weather(kempsey_weather, 'kempsey_to_fbc.csv', col_names=fbcalc, datetime_
wd.df_to_amicus(kempsey_weather, 'kempsey_to_amicus.csv')
wd.df_to_weather(deans_gap_weather, 'deans_gap_to_fbc.csv', col_names=fbcalc, datet
wd.df_to_amicus(deans_gap_weather, 'deans_gap_to_amicus.csv');
kempsey_1911 = fb.Incident(kempsey_weather)
deans_gap_1301 = fb.Incident(deans_gap_weather)
```

In [ ]:
```
kempsey_1911 = fb.Incident(kempsey_weather)
deans_gap_1301 = fb.Incident(deans_gap_weather)
```

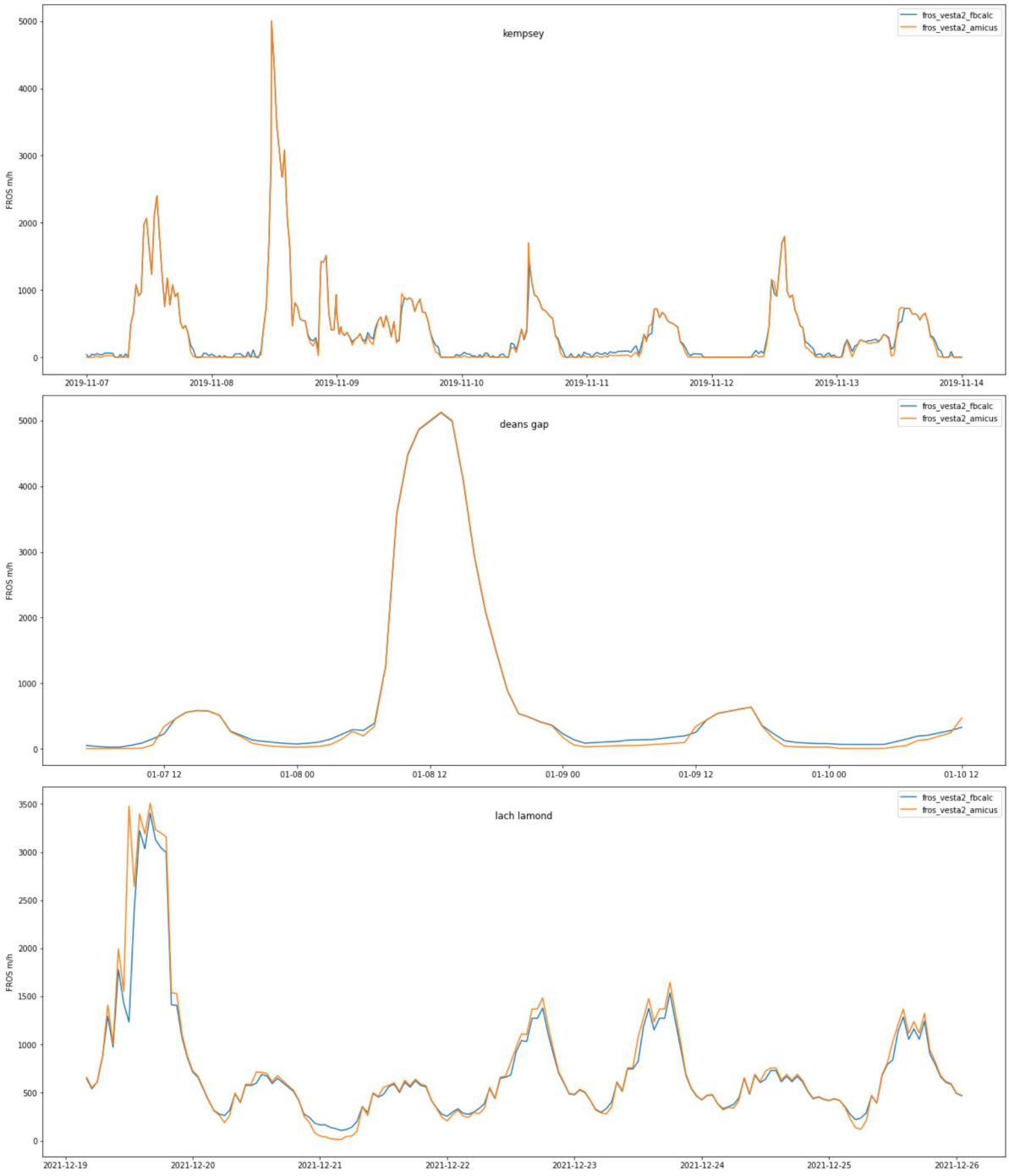
In [ ]:
```
kempsey_1911.compare_fbcalc('kempsey_fbcalc.xlsm', ['vesta2'])
kempsey_1911.compare_amicus('kempsey_amicus_vesta2.csv', 'vesta2')
deans_gap_1301.compare_fbcalc('deans_gap_fbcalc.xlsm', ['vesta2'])
deans_gap_1301.compare_amicus('deans_gap_amicus_vesta2.csv', 'vesta2')
```

In [ ]:
```
fig, (ax_kempsey, ax_deans_gap, ax_lach_lamond) = plt.subplots(3,1, sharex=False,c

ax_dict = {
    'kempsey': [ax_kempsey, kempsey_1911],
    'deans gap': [ax_deans_gap, deans_gap_1301],
    'lach lamond': [ax_lach_lamond, lach_lamond_2112],
}

# fields = ['fros_vesta2', 'fros_vesta2_fbcalc', 'fros_vesta2_amicus']
fields = ['fros_vesta2_fbcalc', 'fros_vesta2_amicus']

for label, [ax, inc] in ax_dict.items():
    for f in fields:
        ax.plot(inc.df['date_time'],inc.df[f], label=f)
    ax.set_ylabel('FROS m/h')
    ax.set_title(label, y=0.9)
    ax.legend(loc='upper right')
# plt.xticks(rotation=90)
plt.show()
```



The biggest discrepancies are evident in the Lach Lamond data for 20211219. A detailed look at the Lach Lamond dataset on the 19th revealed that this is partly due to differences in the way the moisture content is calculated.

note: the difference in the way the moisture content is calculated is due to whether the end points of the time ranges are included or excluded. for example the daytime moisture calcutation is for the period 12:00 to 17:00. This could be variously interpreted as:

$$12:00 < p < 17:00$$

$$12:00 <= p < 17:00$$

$$12:00 < p <= 17:00$$

$$12:00 <= p <= 17:00$$

In [ ]:
```
#trim the data to just the 19th
```

```
start = "20211219 00:00"
end = "20211220 00:00"
lach_lamond_20211219 = lach_lamond_2112.copy()
lach_lamond_20211219.trim_by_datetime(start, end)
```

In [ ]:
```
fig, (ax_lach_lamond, ax_mc) = plt.subplots(2,1, sharex=True,constrained_layout=Tru

ax_dict = {
    'FROS km/h': [ax_lach_lamond, ('fros_vesta2_fbcalc', 'fros_vesta2_amicus')],
    'MC %': [ax_mc, ('mc_v', 'mc_amicus')]
}

for label, [ax, fields] in ax_dict.items():
    for field in fields:
        ax.plot(lach_lamond_20211219.df['date_time'],lach_lamond_20211219.df[field
    ax.set_ylabel(label)
    ax.set_title(label, y=0.9)
    ax.legend(loc='upper right')


plt.show()
```

Conclusion

Once corrected, the Vesta MkII models of FireBehaviourCalcs_Australia_20211202 and Amicus agree with an error that is well below the level of uncertainty in any fire behaviour prediction. This version of FBCalc is therefore a suitable basis to develop protocils around the use of Vesta MkII for operational predictions.