Smoke Dispersion modelling

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Bureau of Meteorology

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

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The Objectives

1. Include bushfire smoke in air quality modelling systems
   - Emissions
   - Verification of the dispersion
   - Exploration of potential for remote sensing
2. Process
   - Case studies of extensive fires

3. Human health impacts
   1. Exposure (integration with fire DST)
   2. Health impacts (Epidemiologists PhD candidate)

4. Improving current estimates of PM and GHG emission factors
5. Tools for planning of burning programs

Programs and Deliverables

- 3 Case Studies
  - 2006/7 Alpine fires (Complete)
  - Kilmore East (Black Saturday) and scenarios (Complete)
  - Regeneration burning in the Huon Valley (TAPM complete)
  - (2003 alpine fires)

- EF studies
  - Pyrotron simulations (Complete, data analysis)
  - 1 field measurement set (Complete)
- Health Impacts
  - PhD is progressing well
  - Exposure: Fire DST
- Technology transfer
  - How to use the current systems

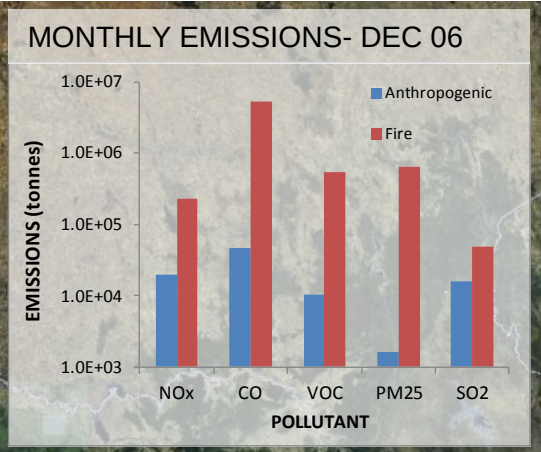
Deliverables

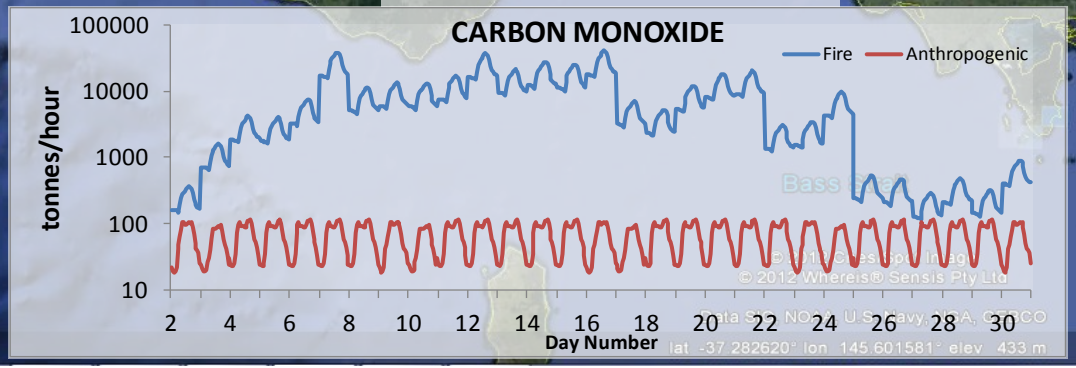
- 3 Papers
  - 1 complete, 2 are in draft
- Firenotes
  - 3 are in near complete drafts.
- Reviews and reports
  - Review of models is complete
  - EF studies delayed and now progressing
  - Technology transfer reports
    - Configuring TAPM
    - Inverse modelling to assess relative risk of impact for different source locations

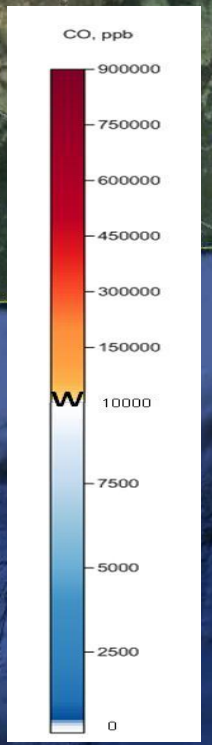
FIRE EMISSIONS METHODOLOGY

Fire area: daily area burnt; DSE
Fuel load: VAST 1.5 (litter, coarse-wd);
Efficiency: NGGI factors;
Diurnal : Parameterised;
Emission Factors: Literature;

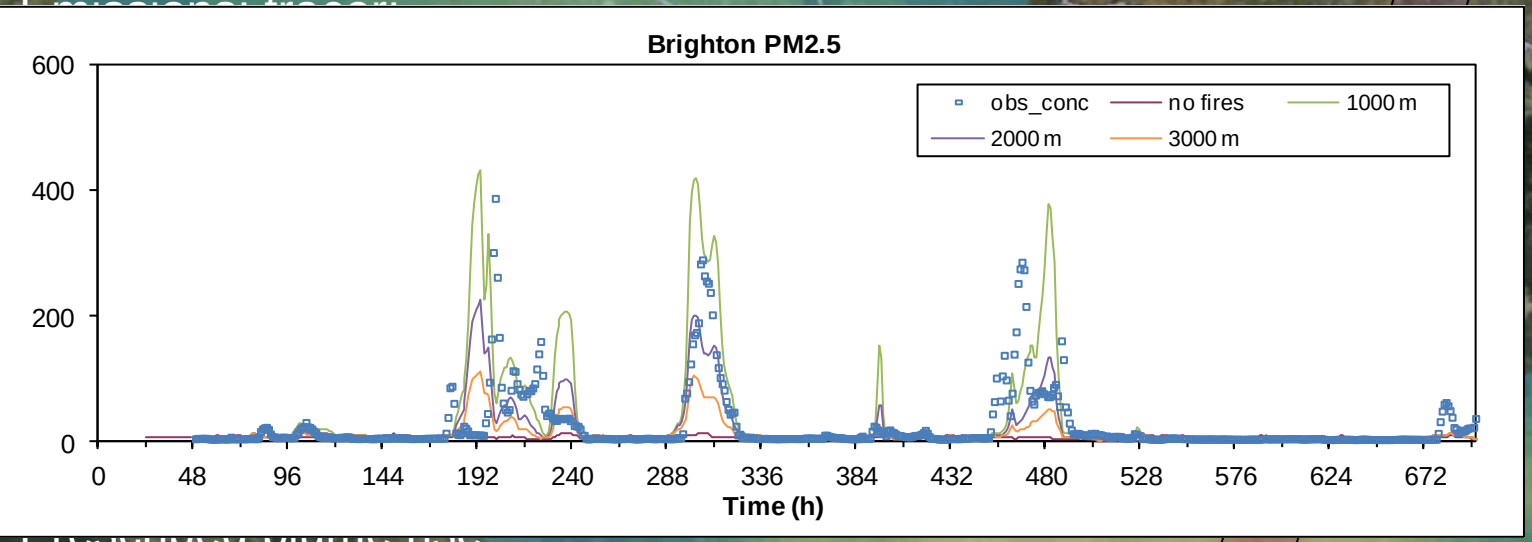
Plume Rise: prescribed



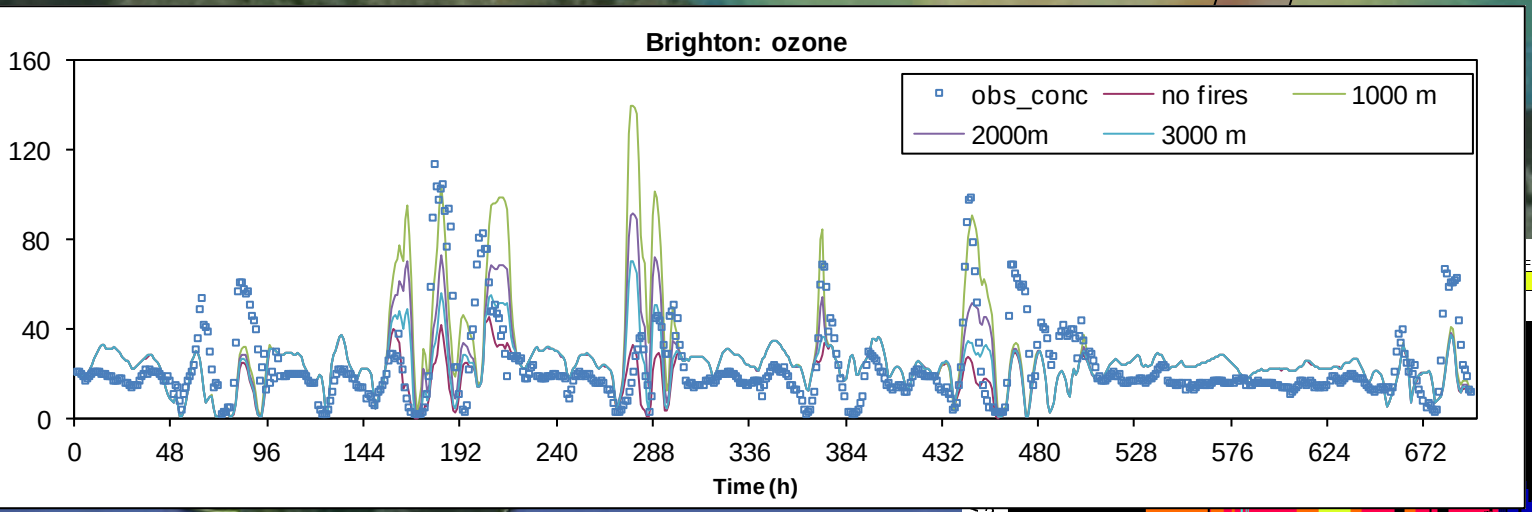


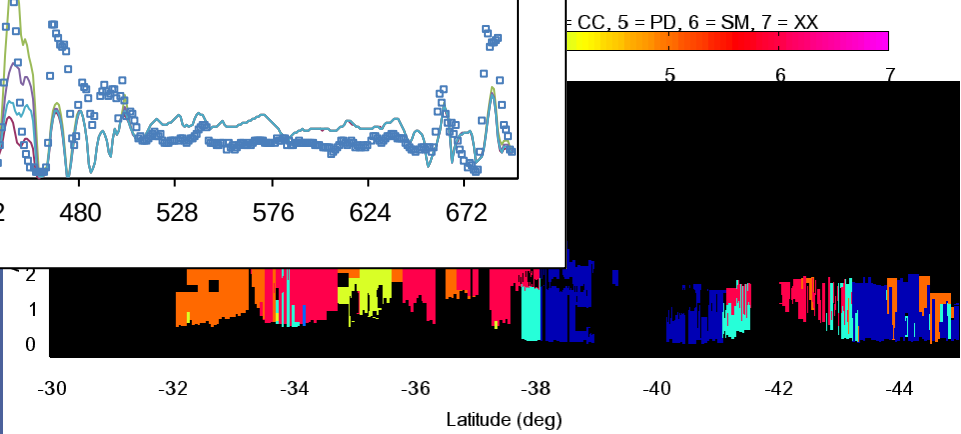


TRANSPORT MODELLING METHODOLOGY



Elemental Carbon



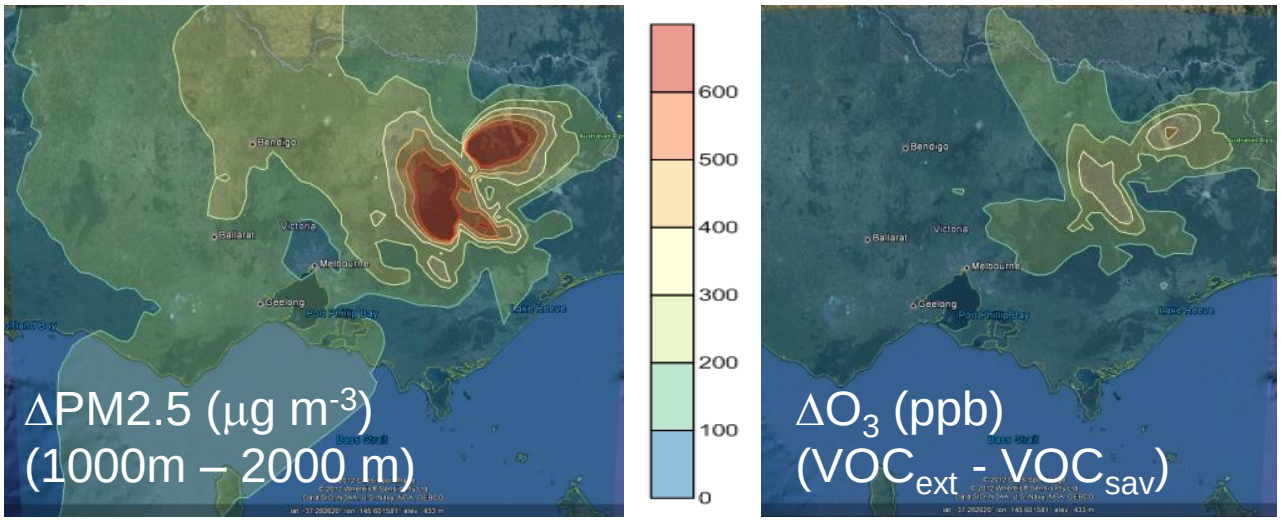


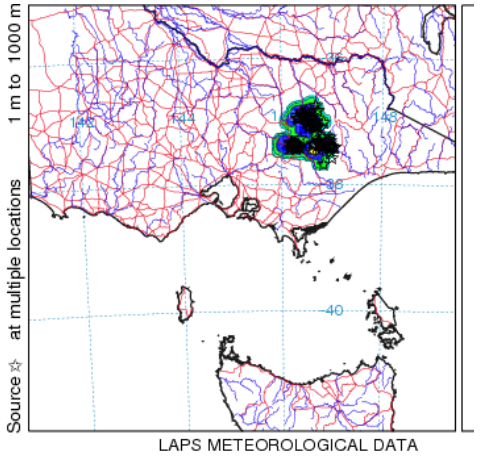
MODEL SENSITIVIES

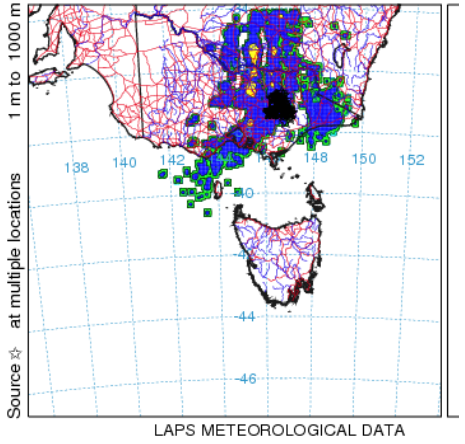
Plume Rise (transport)

Emissions

Persistence







$PM_{2.5}$ – peak daily for December 2006
O_3- peak 1-h for December 2006
Hysplit- Hour 14 UTC 8th December 2006

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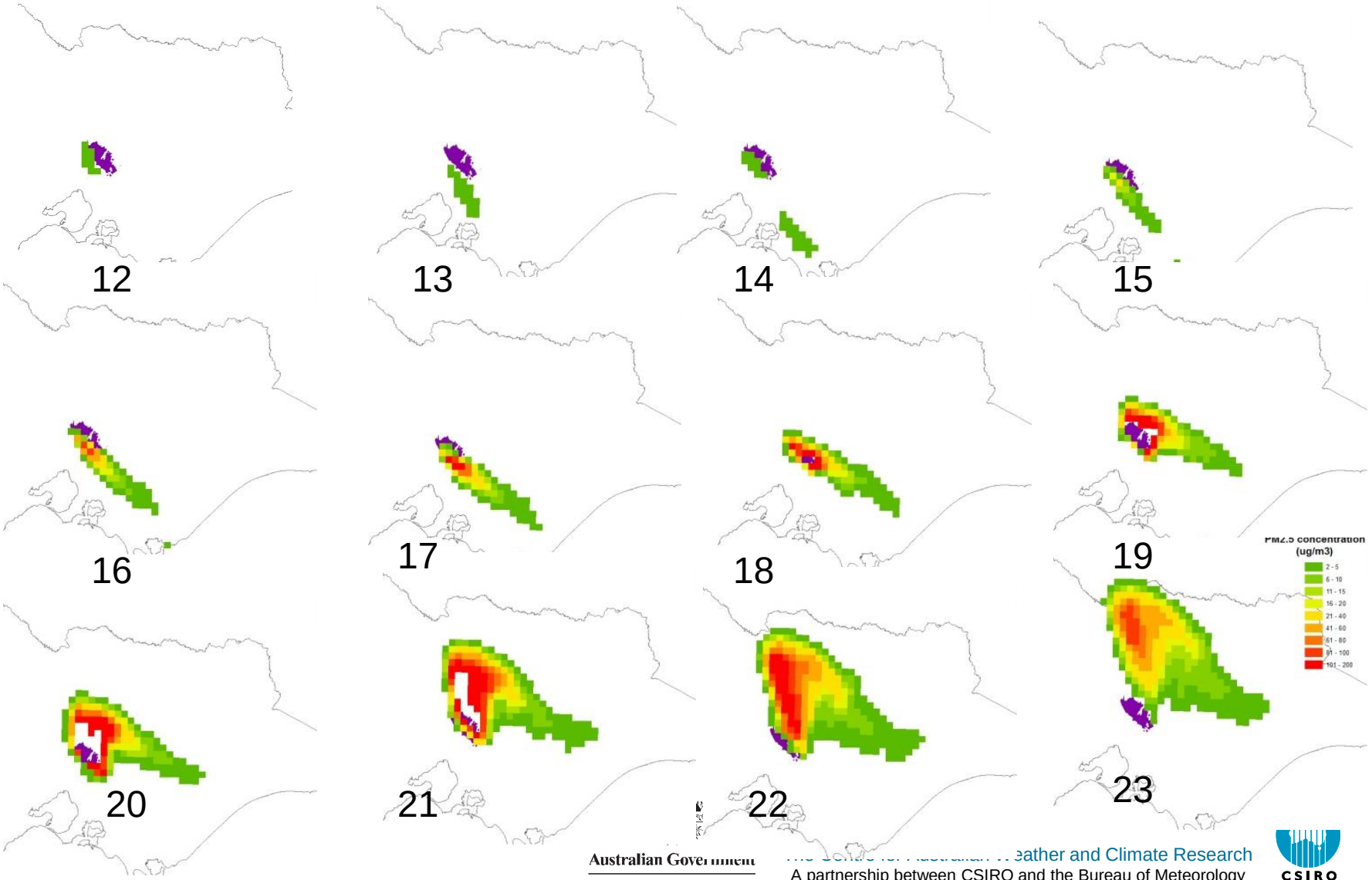
Smoke Dispersion from Kilmore East

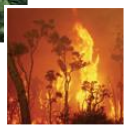


Emission factor sampling

Pyrotron

Woozle

Backpacks



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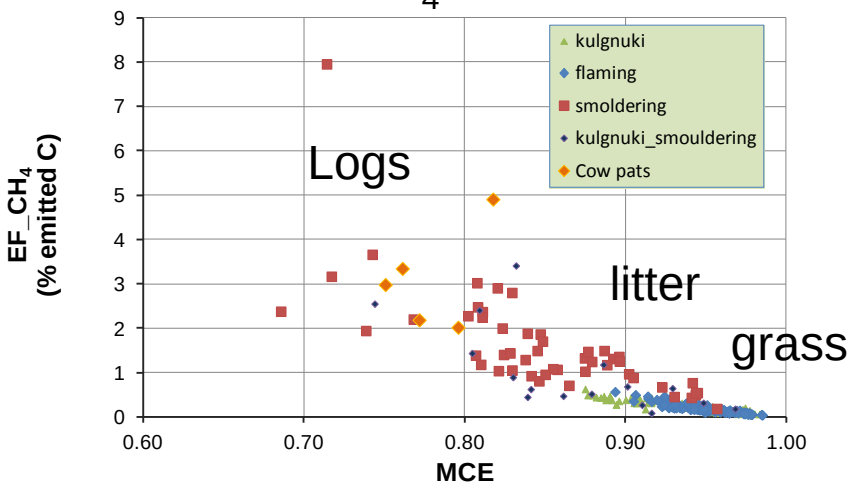
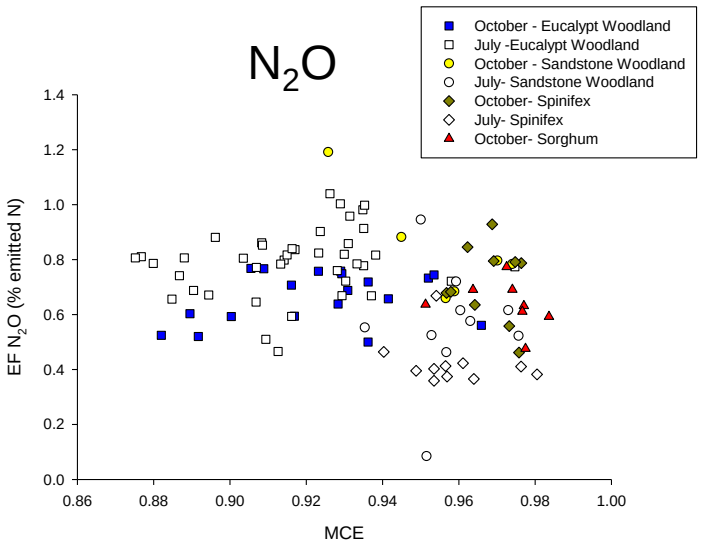
EFs

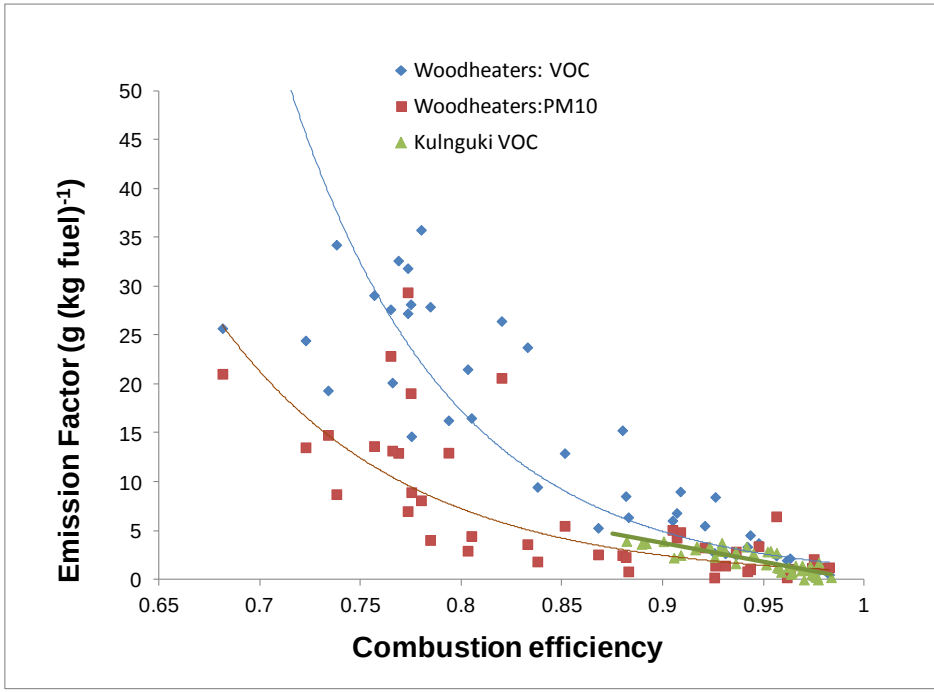
CH_4



N_2O



PM, total VOC



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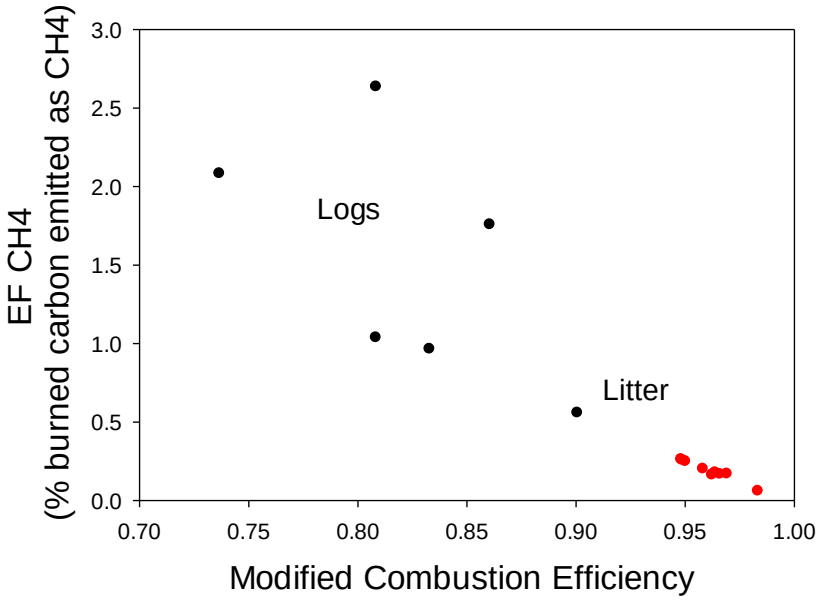
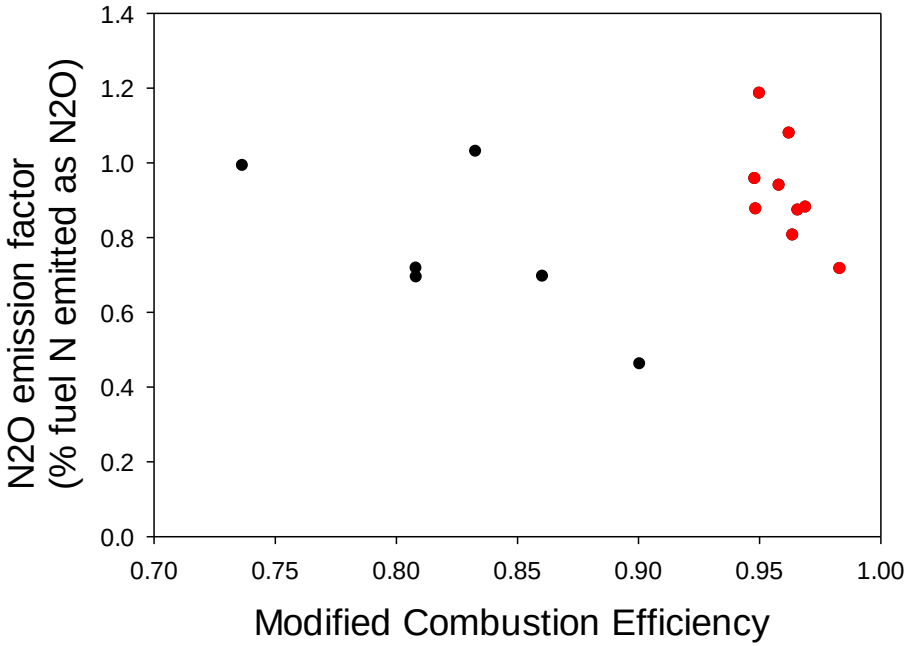
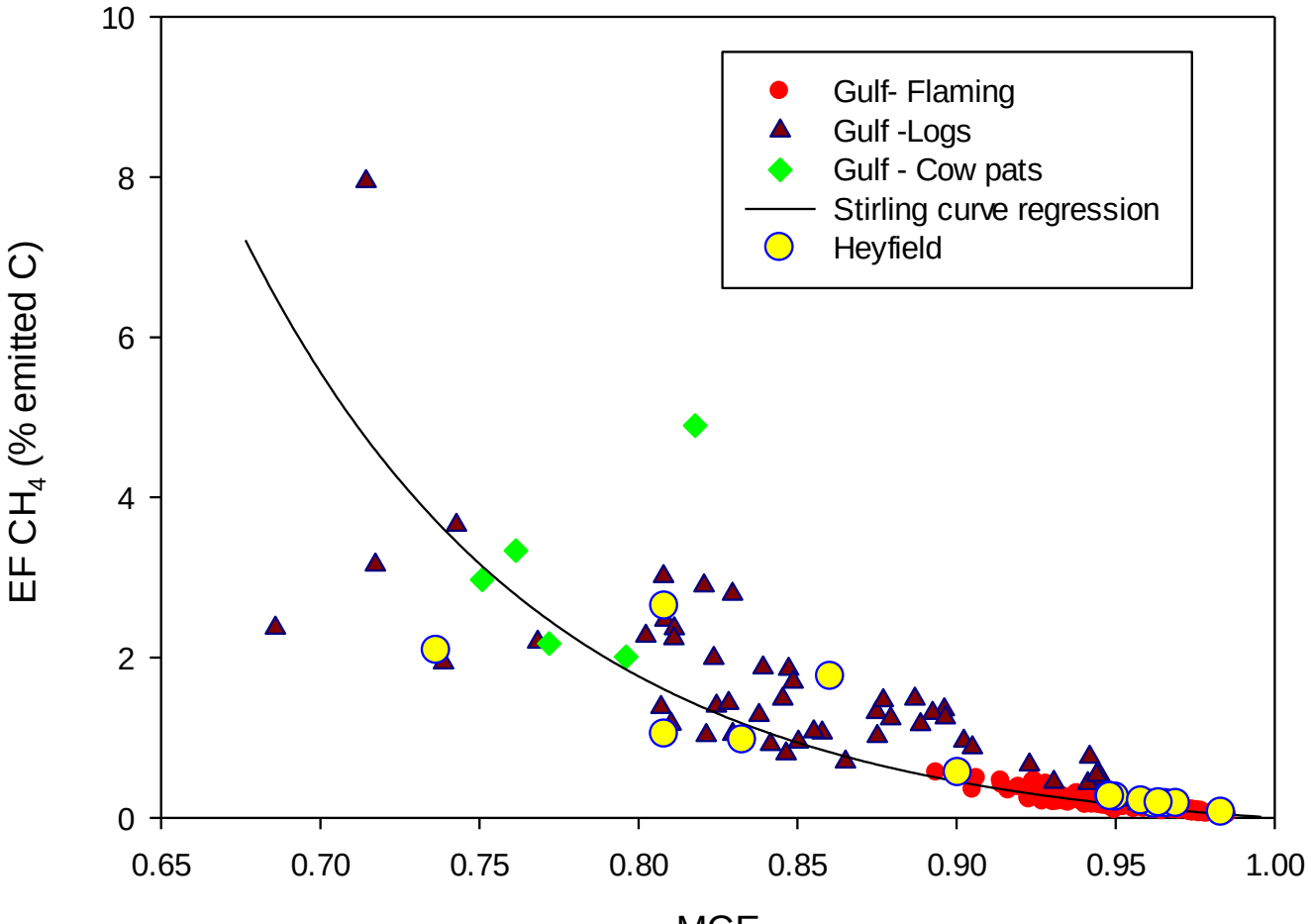
Field Measurements Heyfield



MCE ~ EF CO



Heyfield compares with Savanna



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Lessons Learned

1. The models perform well
2. The challenge is to link the components of a system together
   - Incompatible input & output formats
   - Range of models with different strengths an weaknesses
3. The model run slowly/ require large computing power
   - Need a large UNIX cluster (~1000 processor machine)

4. Output from the review of models was that the Bluesky framework was worth exploring further.