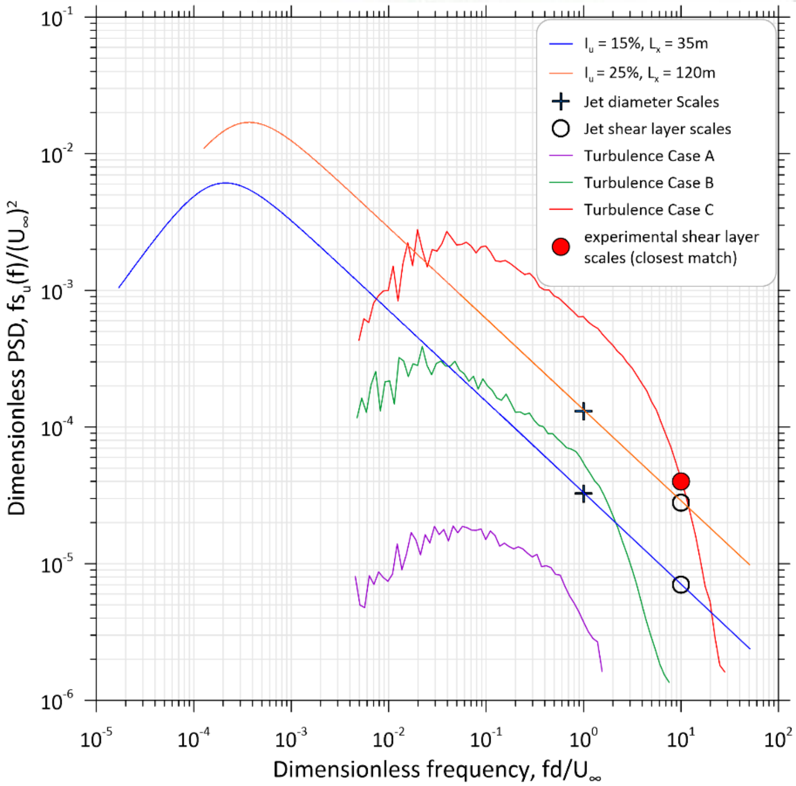
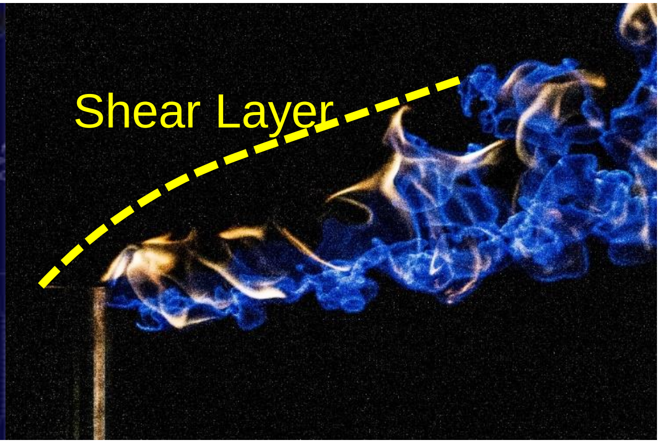
Investigation of Methane Emissions from Flares in a Turbulent Crosswind

- Global flaring volume: ~150 billion m^3 each year *(World Bank, 2020)*
    - 23% increase in U.S. from 2018-2019
- >90% of global flaring is at upstream oil and gas production sites *(Elvidge et al., 2016)*
    - Generally simple designs / pipe flares
    - Limited representative data to accurately predict methane emissions
    - Flares in a turbulent crosswind
- Crosswind turbulence at scales matching the shear layer has potential to augment stripping of unburned fuel





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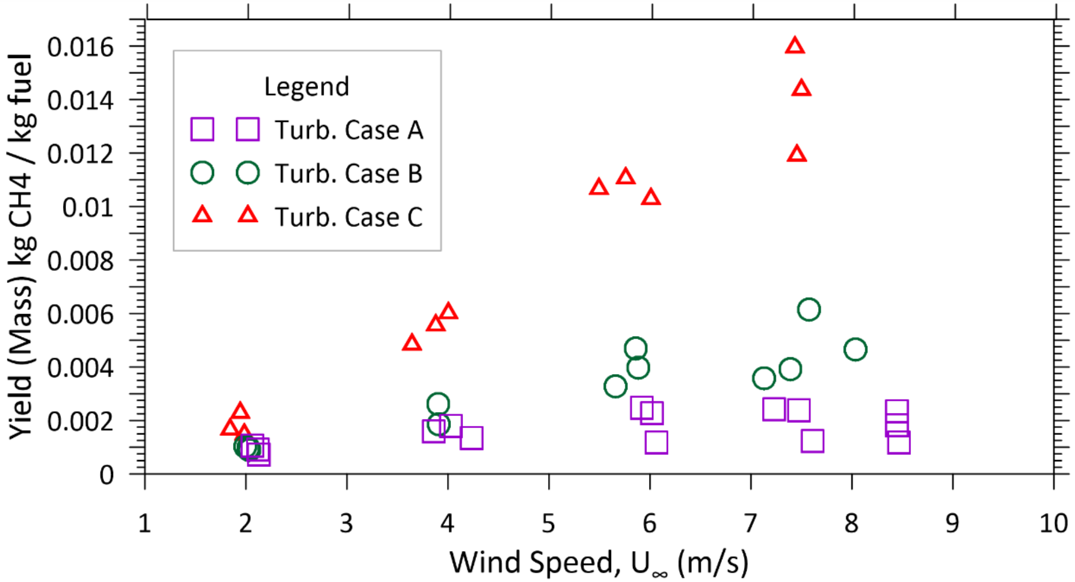
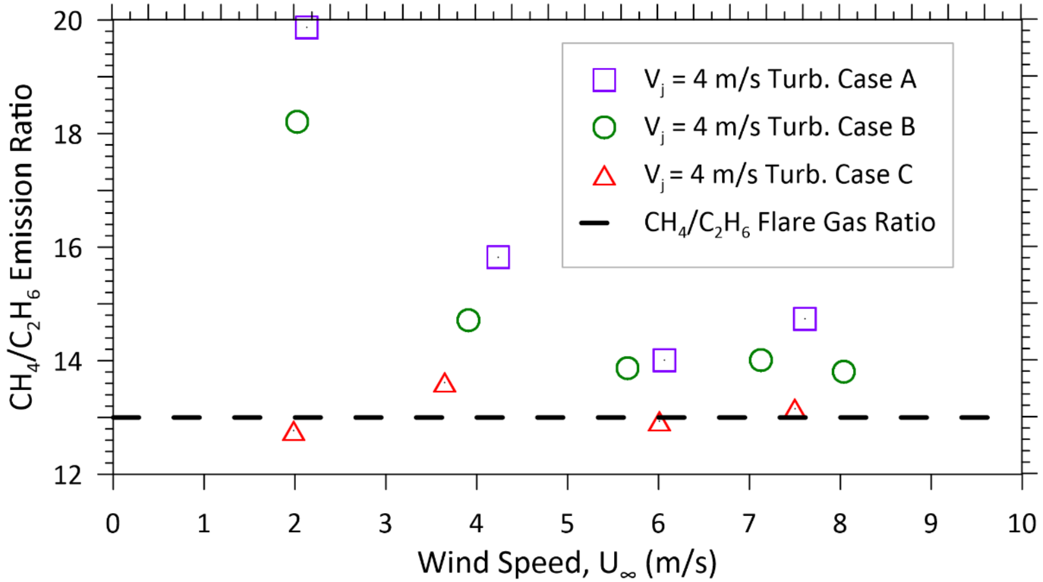
- Several times increase of methane emissions with introduction of a turbulent crosswind
- As wind speeds, turbulence increase:
  - Emissions increase
  - CH_4 - C_2H_6 ratio in plume approaches ratio in flare gas
- Suggests emitted hydrocarbons have same structure as unburned fuel





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- Atmospheric turbulence strongly influences the efficiency and emissions of flares in crosswind
  - Length scales similar to the flame shear layer have greatest potential to strip fuel away from the flame
- Emissions trends, methane-ethane ratio data, and VOC sampling all suggest that flare inefficiency is primarily driven by fuel stripping
  - Methane rich flare gas leads to methane-rich emissions
- Future work will use an active turbulence grid to generate turbulence on the shear layer scale