Combining atmospheric modeling and data to understand New Zealand’s terrestrial and coastal carbon fluxes

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- Inferring fluxes from atmospheric data
- What can in situ data tell us?
- Lagrangian modeling
- Atmospheric and oceanic data
- Project outline
Atmospheric Inversions

Atmospheric surface observations
- Weekly flask measurements
- Continuous data

North American Basis Function, courtesy of Transcom

Response functions from atmos. transport model

A Priori estimates of land and ocean fluxes

Optimization Technique

Air-Land Fluxes

Air-Sea Fluxes
What can *in situ* analysers see at Baring Head?
Modeled Terrestrial Biosphere Atmospheric CO₂ Footprint at the Surface for 15 January 2008 (ppm)
Lagrangian Modeling

- Follows a group of particles as they move through the atmosphere; statistics over a large number of particles used to calculate dispersion
- Can be run backwards or forwards in time
- Use output from forecast or re-analysis products
- Computationally inexpensive to add additional sites
- We will be using the NAME model driven by meteorological output from two different forecast models
New Zealand Limited Area Model (NZLAM)

- State of the art data assimilating model
- 12Km and resolution
- Model output is available from 2005 to present
Weather Research and Forecasting Model (WRF)

- 9Km/ 27 km/ 81 Km nested resolution
- 1970’s to present
- Capability to extend boundaries to explore specific questions
NIWA Atmospheric Data

Modeled Terrestrial Biosphere Atmospheric CO₂ Footprint at the Surface for 15 January 2008 (ppm)

Rainbow
Baring Head
Lauder
Preliminary Data from RBM

1500hr CO2 for RBM, BHD, LDR July 2010 to present

- BHD
- LDR
- RBM
- BHD monthly mean
Constraining Coastal Fluxes

- ROMS regional ocean model
  - Ocean biogeochemistry from PISCES and CESM
- Very likely this year: underway ΔpCO₂ on the Tangaroa
Project Outline

- Characterize the transport at NIWA’s stations
- Use cluster analysis to group the atmospheric CO$_2$ data into transport regimes and establish relationships between changes in atmospheric CO$_2$ and different transport regimes
- Infer CO$_2$ fluxes from the atmospheric measurements
- Investigate relationships between inferred fluxes and climate parameters