Understanding the information content in diverse observations of forest carbon stocks and fluxes for data assimilation and ecological modelling

NERC CASE partnership with Forest Research

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Project overview

- Lack of understanding of the optimal set of observations for understanding the carbon balance of a forest.
- CASE partner: Climate Change Group at Forest Research.
- Working with Forest Research to help devise tools to plan measurement campaigns.

Flux tower at Forest Research site, Alice Holt.

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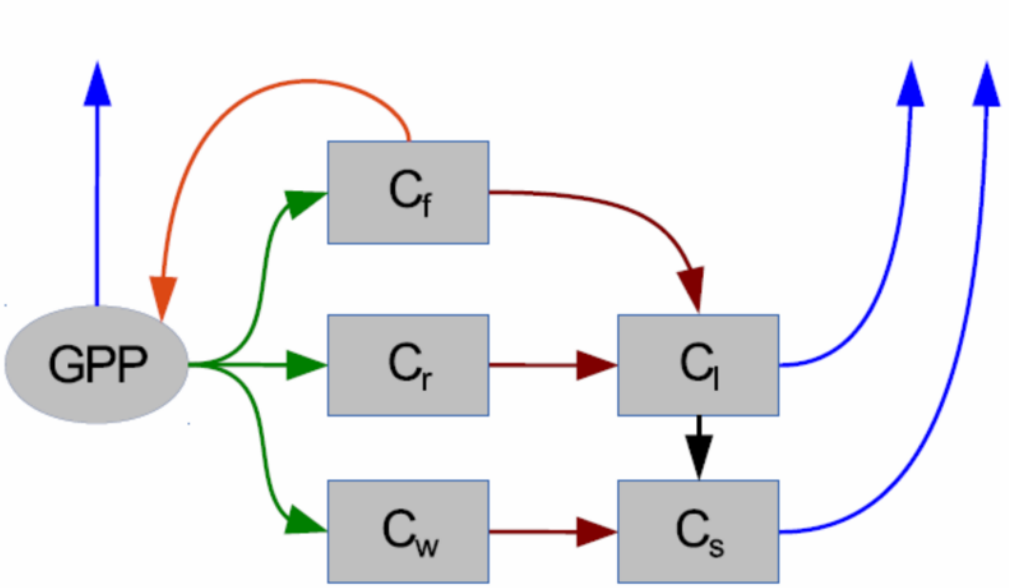
Science behind project

- Using DALEC as a simple model of carbon balance to interpret observations.
- DALEC captures the main processes that describe the carbon balance of a forest.



DALEC forest carbon balance model [1].

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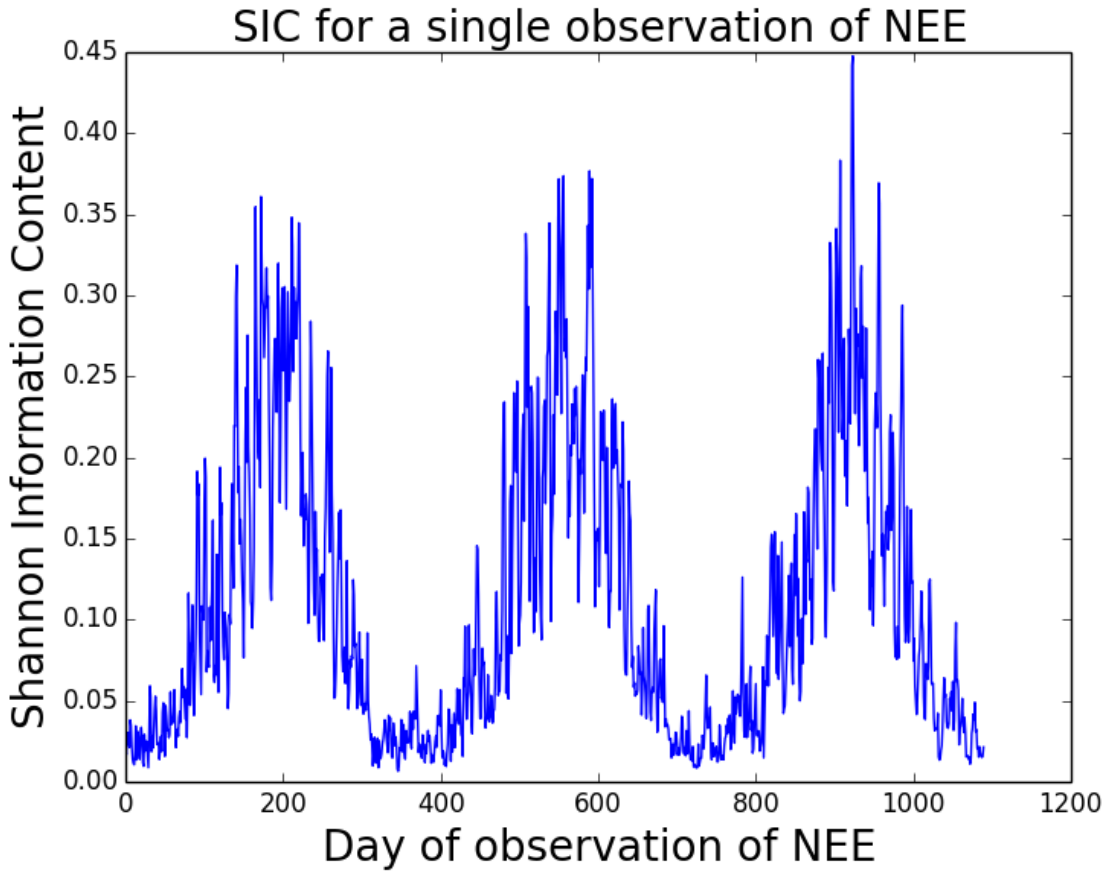
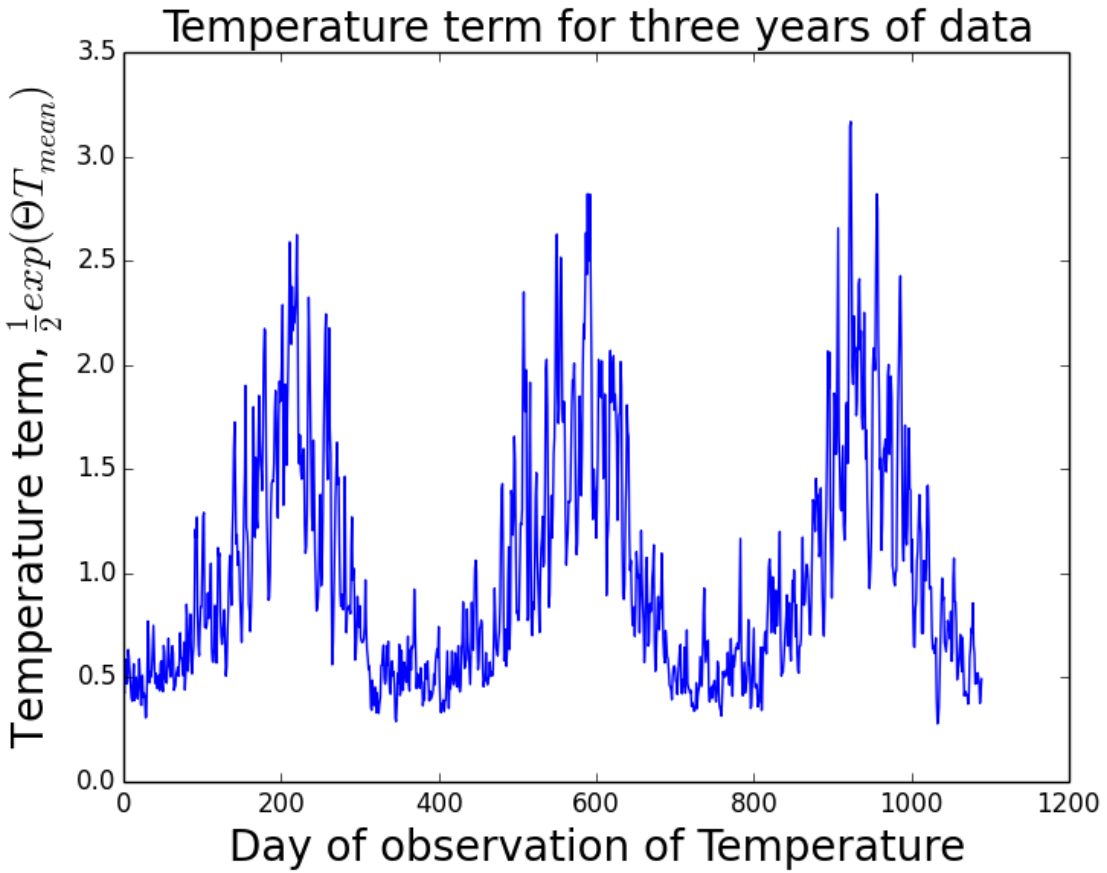
Science behind project

- Shannon Information Content (SIC) [2].
- B represents uncertainty in the model, A represents the uncertainty in our model after observations have been assimilated.

$$SIC = \frac{1}{2}\ln\frac{|\mathbf{B}|}{|\mathbf{A}|}.$$





(Left) SIC for three years of NEE observations, (Right) value of DALEC temperature term for the same data.

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Experience with Forest Research

- Spend one day a week at Forest Research.
- Collecting measurements that form part of a pre-existing measurement campaign.
- Learning relevant skills for PhD and helping Forest Research with measurements they require.

Tree chamber at Alice Holt.

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Future Plans

- Implementing fieldwork campaign designed using modelling and mathematical work.
- Outputs will be scientific papers written with the partner and a software tool that will allow Forest Research to assess the value of introducing new observations into their existing data streams.

Straits Inclosure, CO_2 flux measurement site, Alice Holt

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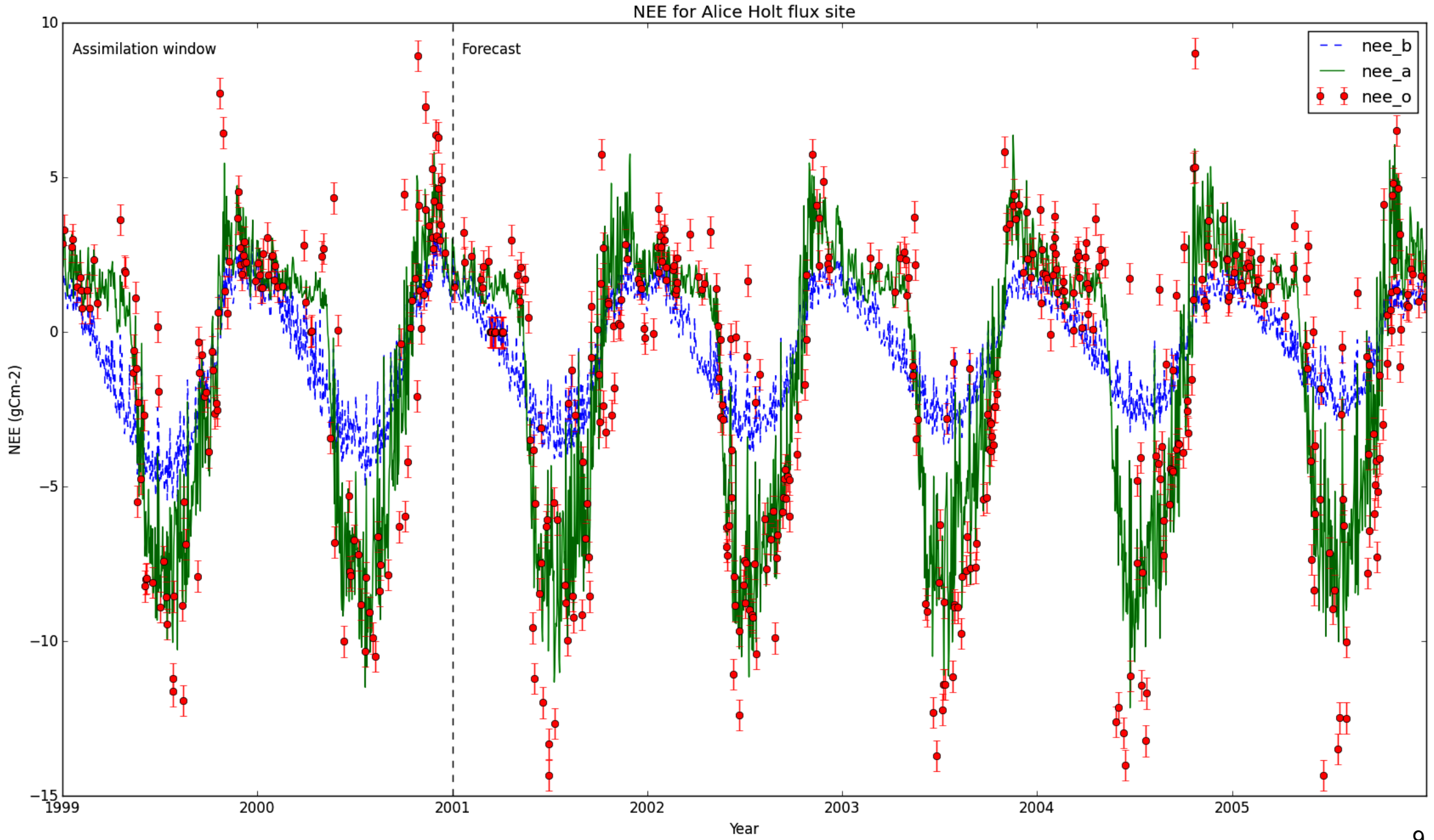
References

1. Sylvain Delahaies, Ian Roulstone, and Nancy Nichols. A regularization of the carbon cycle data-fusion problem. In EGU General Assembly Conference Abstracts, volume 15, page 4087, 2013.
2. Clive D Rodgers and Others. Inverse methods for atmospheric sounding: Theory and practice, volume 2. World scientific Singapore, 2000.


NEE for Alice Holt flux site
Assimilation window
Forecast
nee_b
nee_a
nee_o
NEE (gCm-2)
Year
10
5
0
−5
−10
−15
1999
2000
2001
2002
2003
2004
2005