Thorpex Montreal 2004

How can we best combine forecasts for added value?

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2. Pembroke College, Oxford, UK

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How can we best combine forecasts for added value?

How might we use TIGGE?

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Motivation

Motivation

Overview

Combining

Evaluation

Example

Forecast improvement can be achieved in two ways:

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Evaluation

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Forecast improvement can be achieved in two ways:

- improving the models (strategic)

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Overview

Combining

Evaluation

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Forecast improvement can be achieved in two ways:

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Combining

Evaluation

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THORPEX:

> “THORPEX will develop, demonstrate and evaluate a multi-model, multi-analysis and multi-national ensemble prediction system, referred to as TIGGE.”

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Motivation

Overview

Combining

Evaluation

Example

- Combining Simulations
- Evaluation
  - skill scores $\longrightarrow$ Broecker
  - bootstrapping and meaningful skill comparison
- Example - combining ECMWF and NCEP

Inputs

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Overview

Combining

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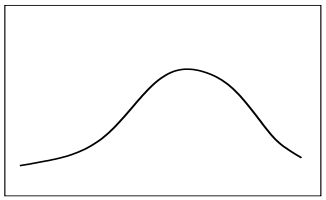
Climatological Distribution



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Motivation

Overview

Combining

Evaluation

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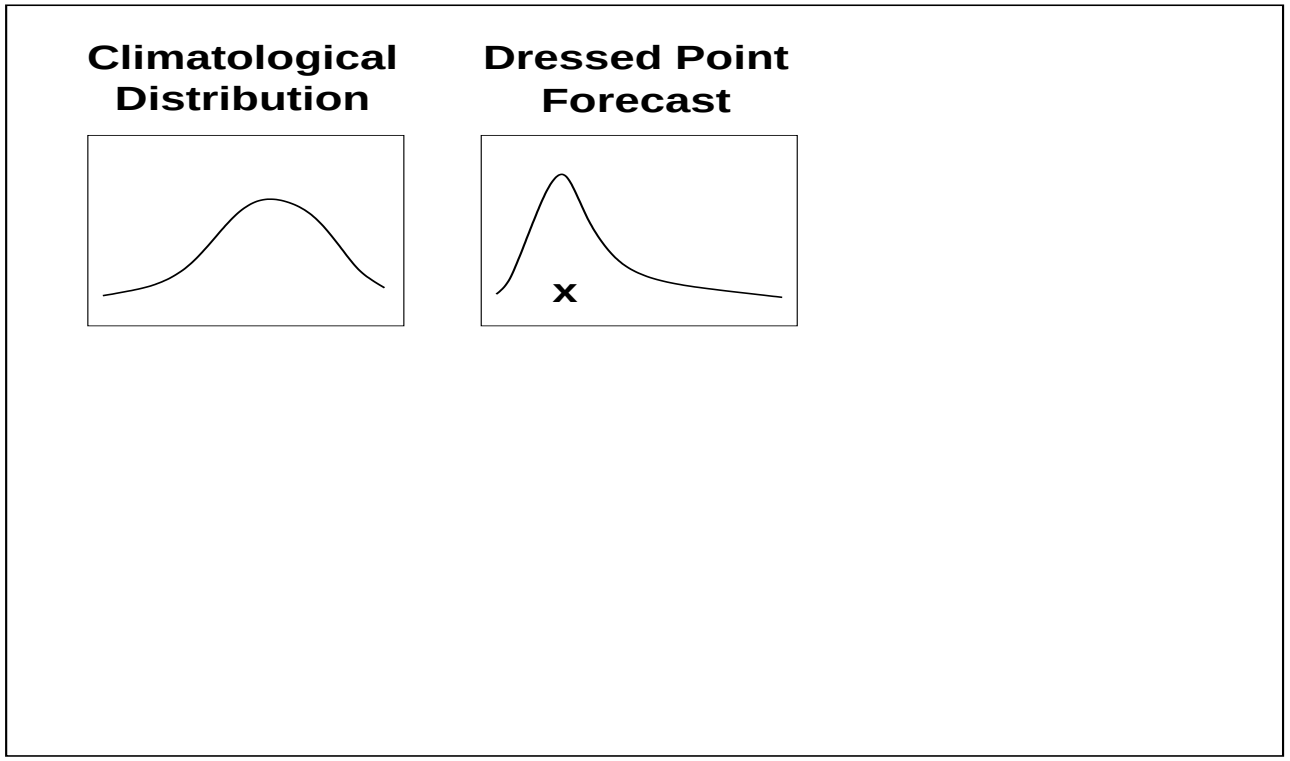

Roulston & Smith, Tellus **55** 2003

Raftery et al. Univ. Washington Dept. of Stat. Tech. Report 440 2003

Inputs

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- Combining
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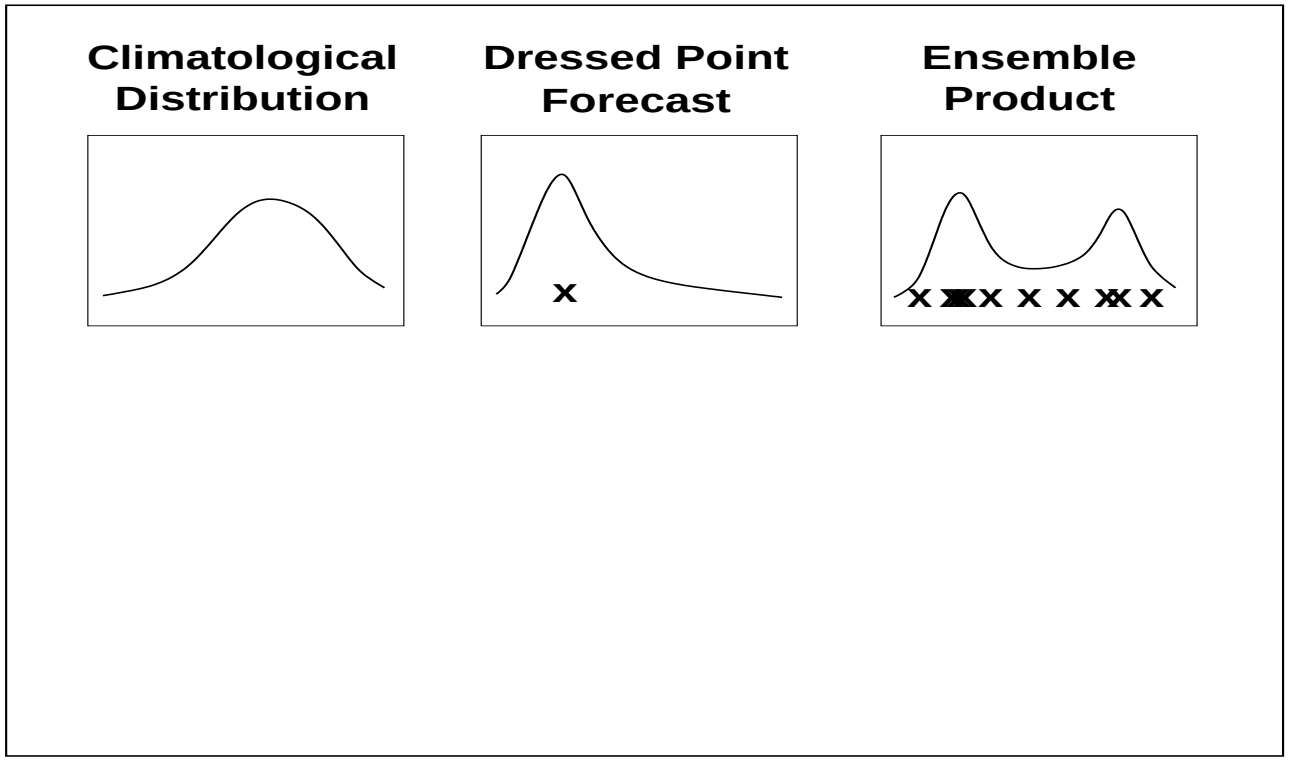

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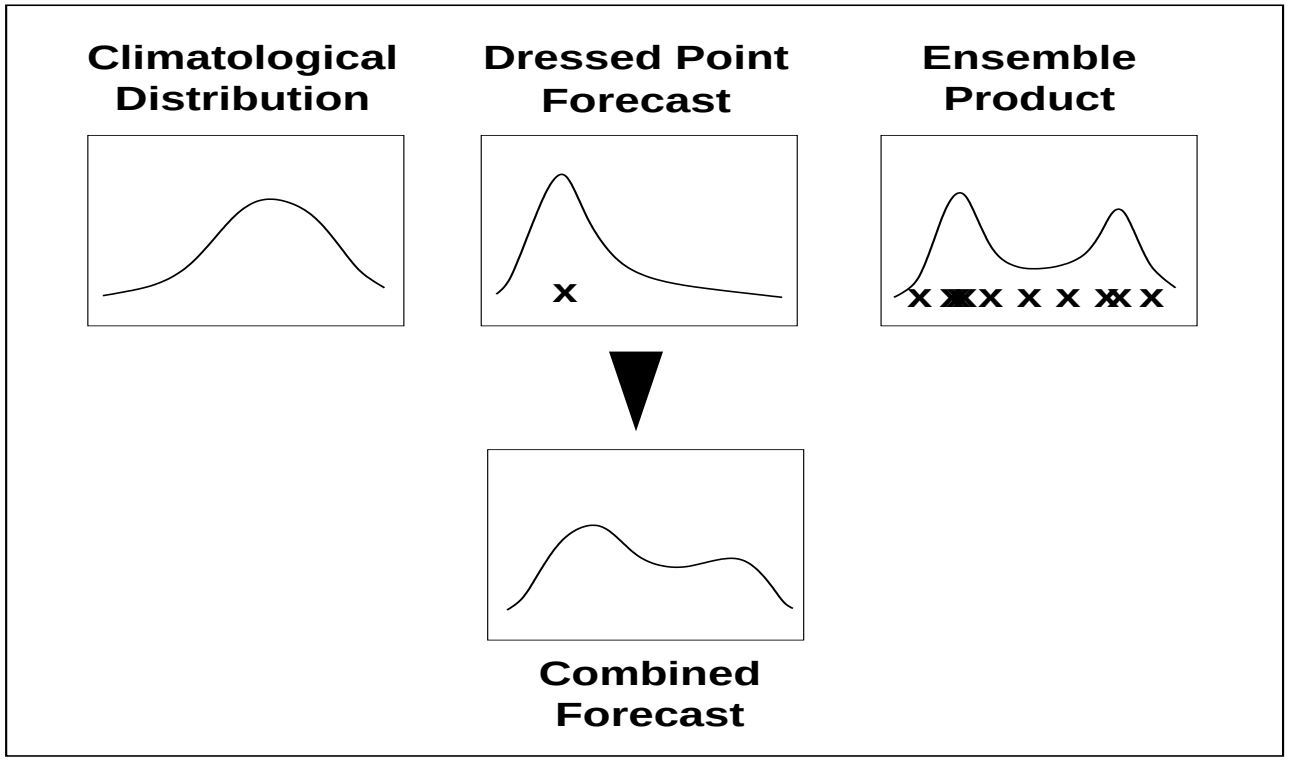

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Combining: Skill Scores

Motivation

Overview

Combining

Evaluation

Example

The combination is based on the skill of the final forecast

$$s = \mathcal{S}(f, o)$$

f	forecast distribution
o	verifying observation
$\mathcal{S}$	skill score
s	skill of forecast f

Combining

Motivation

Overview

Combining

Evaluation

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One combination method is to take a weighted sum of the component distributions

$$f = \sum \alpha_i f_i$$

Choose α_i that maximises the skill score

$$\langle s \rangle = \max \langle \mathcal{S}(f, o) \rangle$$

over a set of historical forecast-verification pairs

$$\text{Ignorance}: \; s = -\log p(o)$$

Evaluation:Bootstrapping

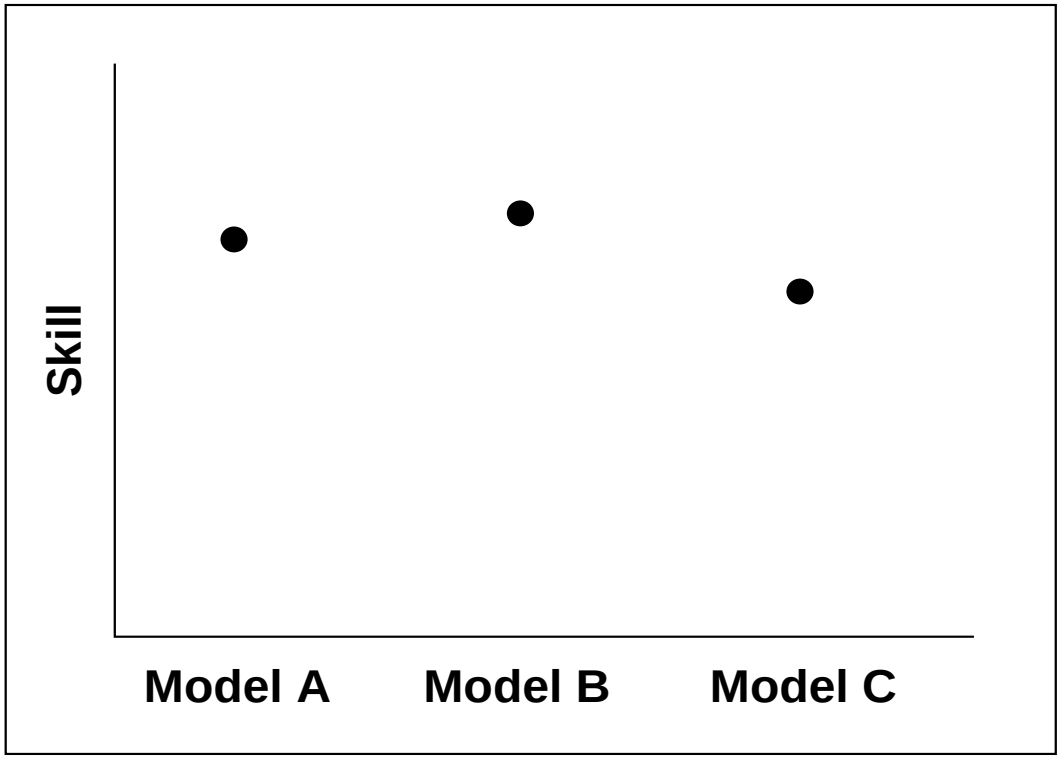
Motivation

Overview

Combining

Evaluation

Example



Out of sample, particular location, particular lead time, particular target

Evaluation:Bootstrapping

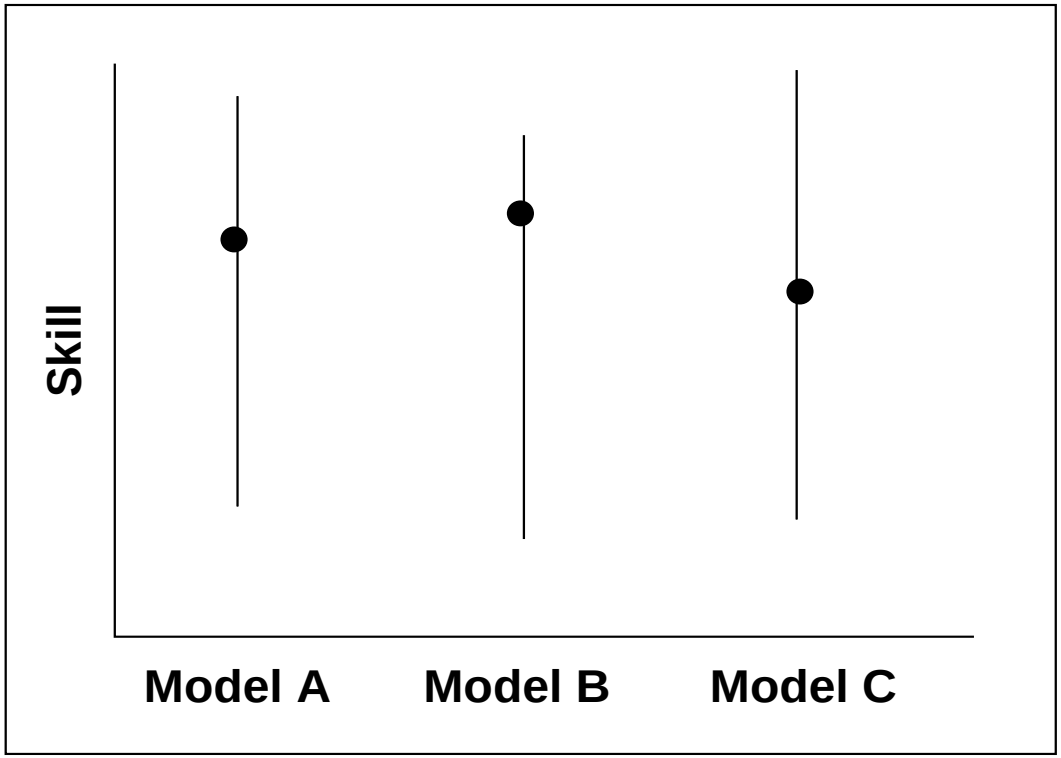
Motivation

Overview

Combining

Evaluation

Example



Out of sample, particular location, particular lead time, particular target

The Right Comparison

Motivation

Overview

Combining

Evaluation

Example

We do not want to compare the uncertainty in the average performance of two models.

We want the uncertainty in the comparative performance of the models to each other.

Bootstrap the difference: $\langle s_A - s_B \rangle_{BS}$

Not the difference of the bootstraps: $\langle s_A \rangle_{BS} - \langle s_B \rangle_{BS}$

Comparative Skill

Motivation

Overview

Combining

Evaluation

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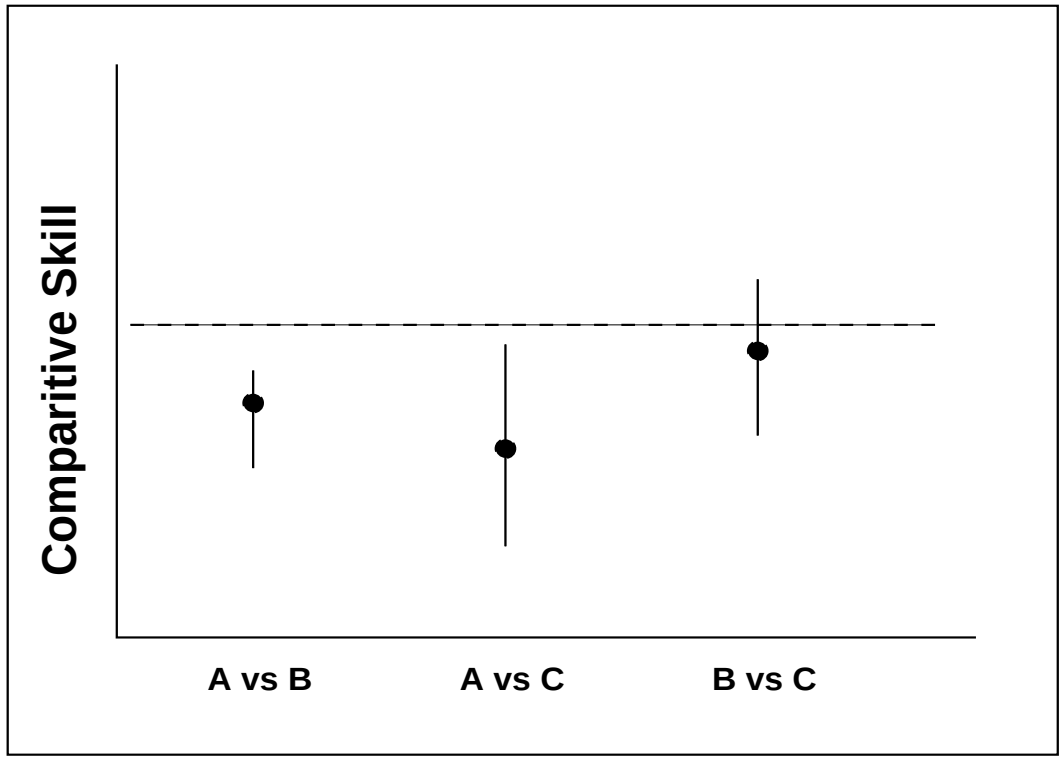

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Motivation

Overview

Combining

Evaluation

Example

Predicting temperature at Heathrow.

Using

- NCEP high resolution
- NCEP ensemble
- ECMWF high resolution
- ECMWF ensemble

Evaluating using Ignorance - out of sample

Example - one lead time

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Overview

Combining

Evaluation

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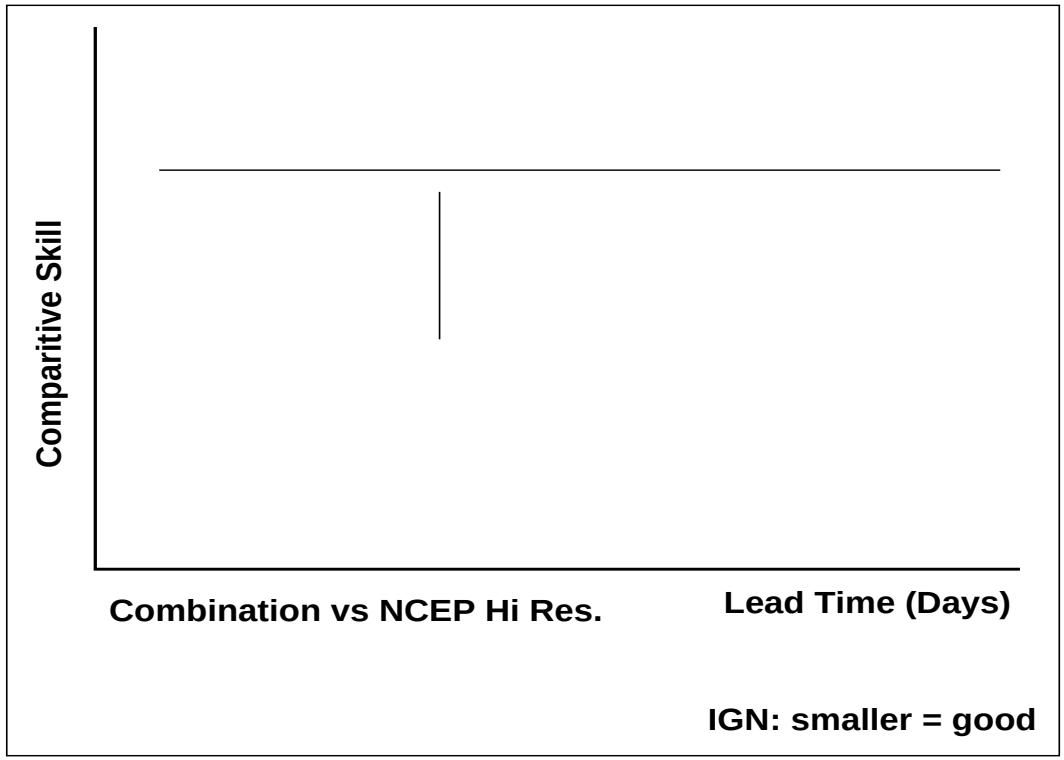
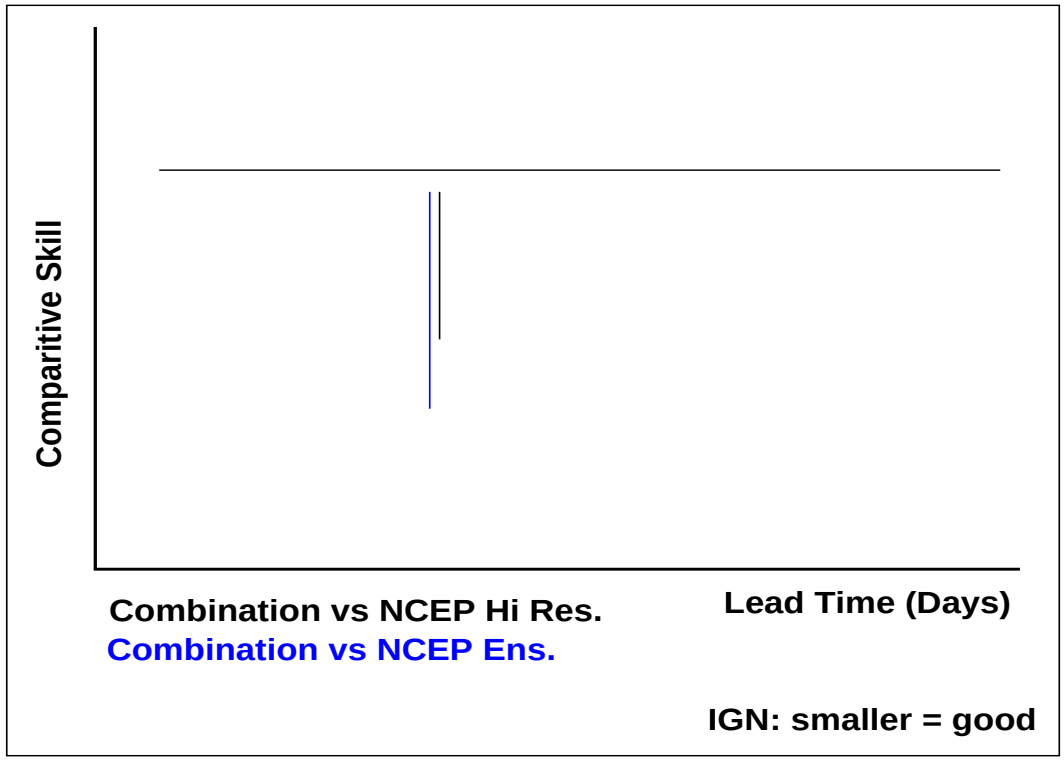


Example - one lead time

- Motivation
- Overview
- Combining
- Evaluation
- Example



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- Overview
- Combining
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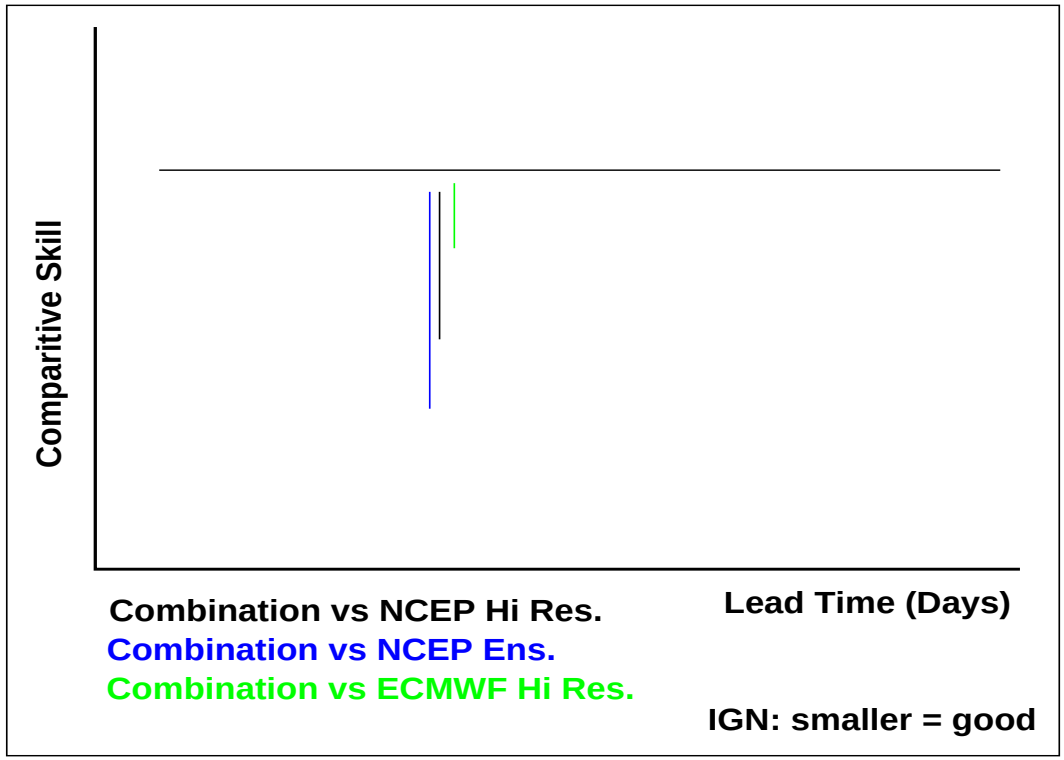

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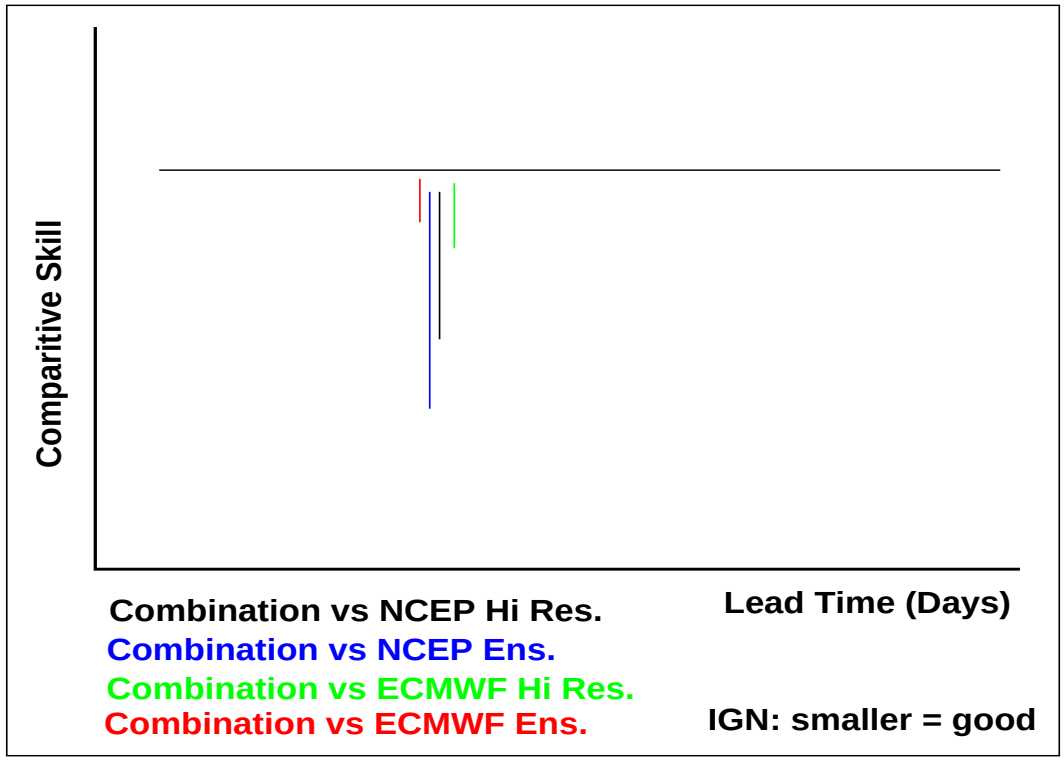

Example - all lead times

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- Overview
- Combining
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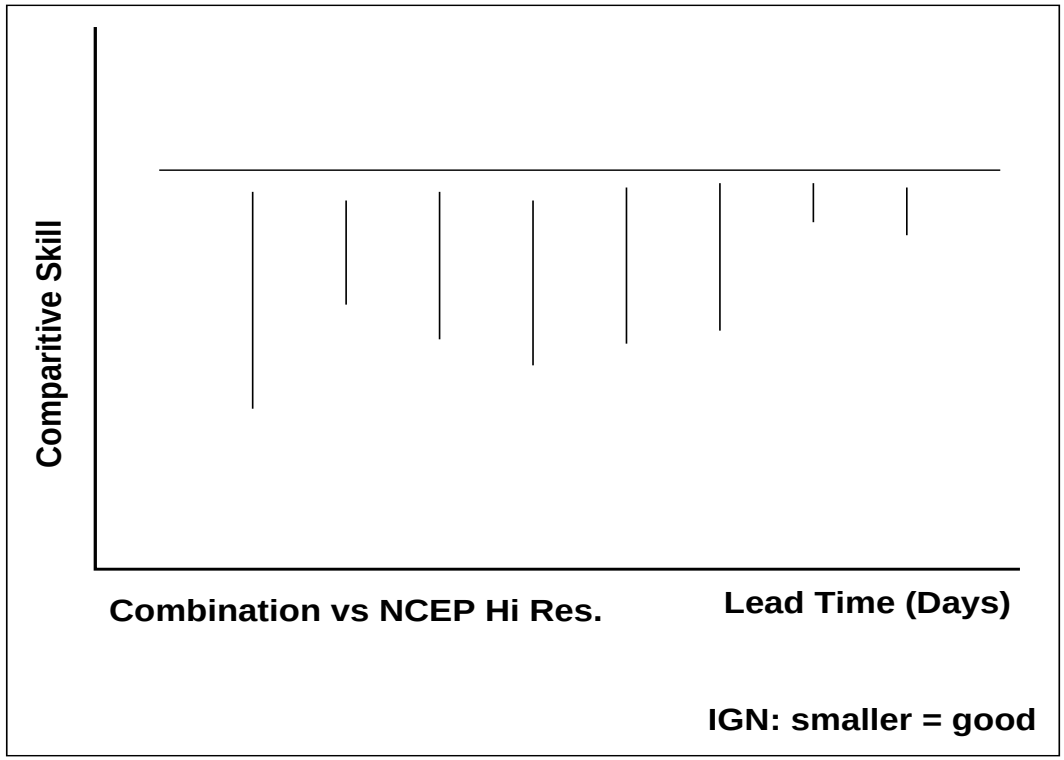
- Example



Example - all lead times

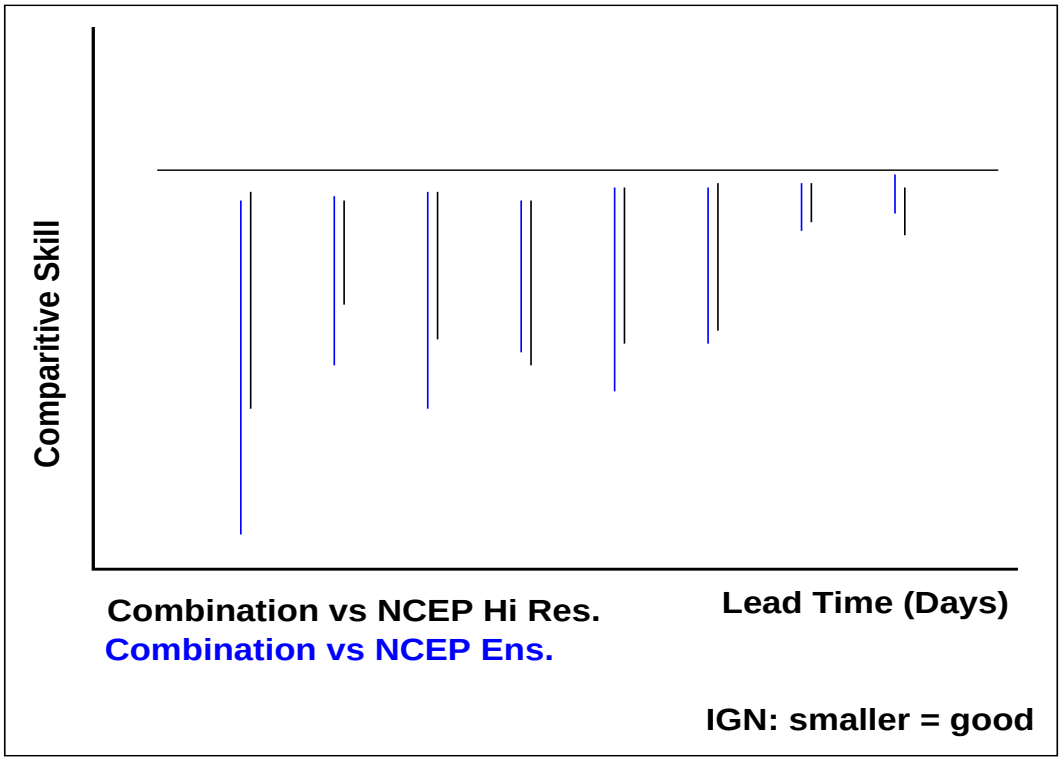
Motivation

Overview

Combining

Evaluation

Example



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- Overview
- Combining
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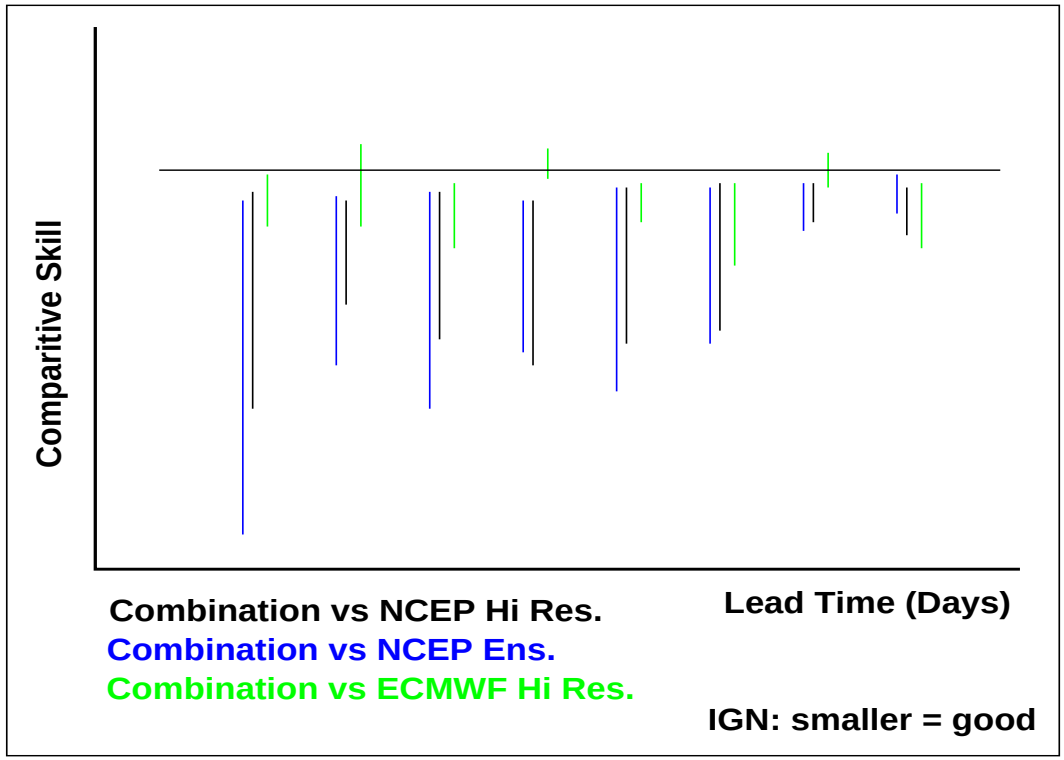

Example - all lead times

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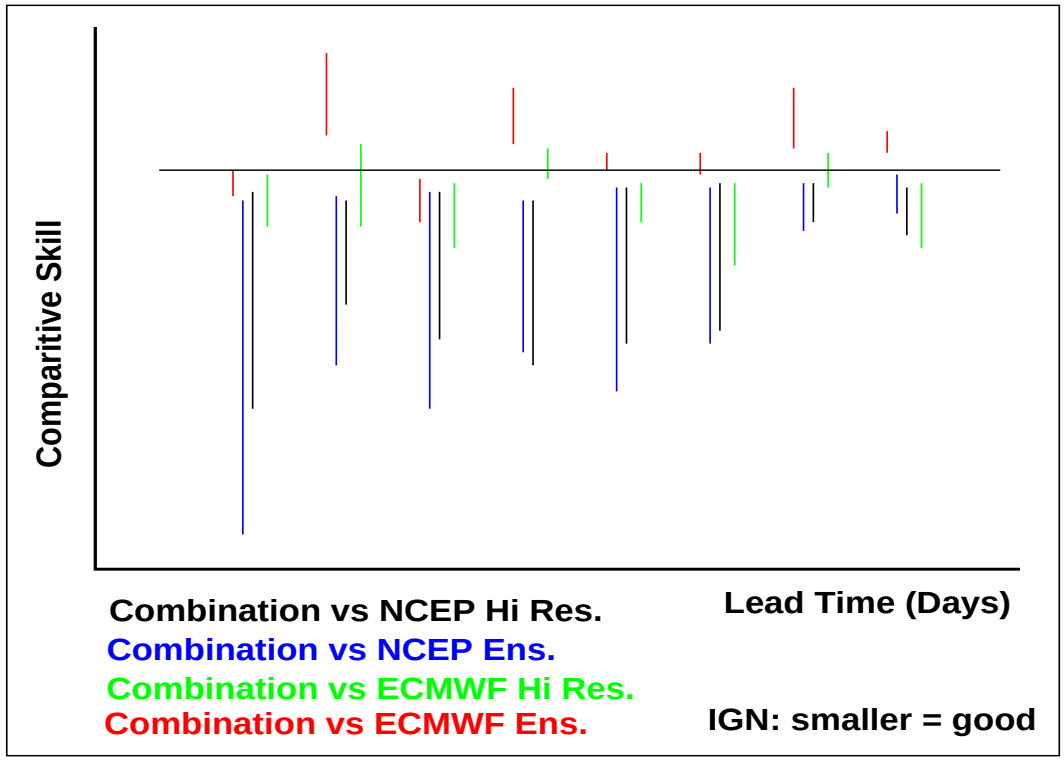
- Overview
- Combining
- Evaluation
- Example



Summary

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Overview

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We have:

- presented a user-orientated methodology for combining simulations
- whatever combination method, the evaluation must be robust
- dressing method, combination method and size of forecast-verifi cation archive affects performance
- potential relevance to TIGGE, provides a framework for allowing users to extract the forecast information most relevant to them