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IN SCIENCE AND TECHNOLOGY

DEPARTMENT OF EARTH AND
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The COST733class circulation type software: An example for surface ozone concentrations in Central Europe

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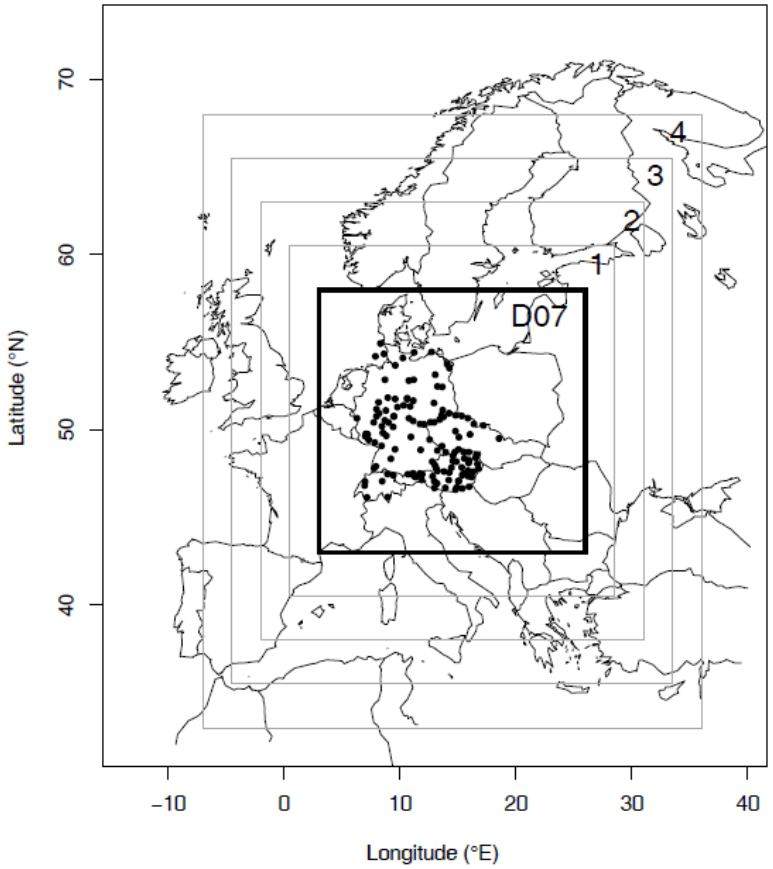
Goal of this work

To provide insight the functionalities of the COST733class software tool developed in WG2 of COST733, using surface ozone concentrations in Central Europe

Why ozone?

- Large number of measurements available throughout Europe (AIRBASE) on an hourly basis (working with the max. 8 hourly mean ozone concentrations used in the European Air Quality Guidelines).
- Data is taken for the period 1996-2002, longest continuous period available covering measurements of rural background stations in Germany, Switzerland, Austria and the Czech Republic.



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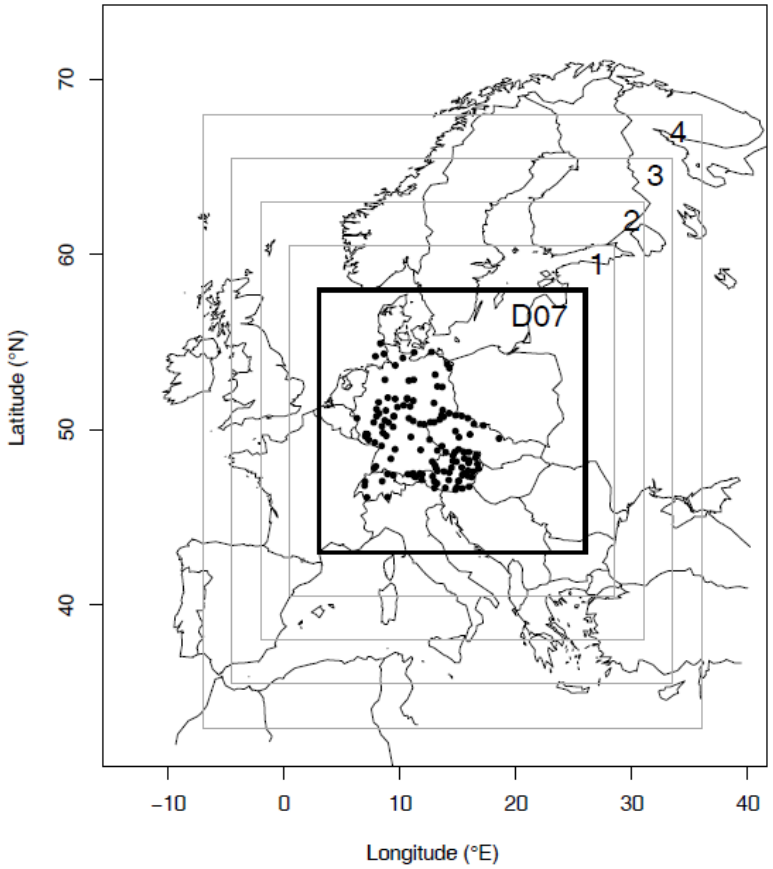

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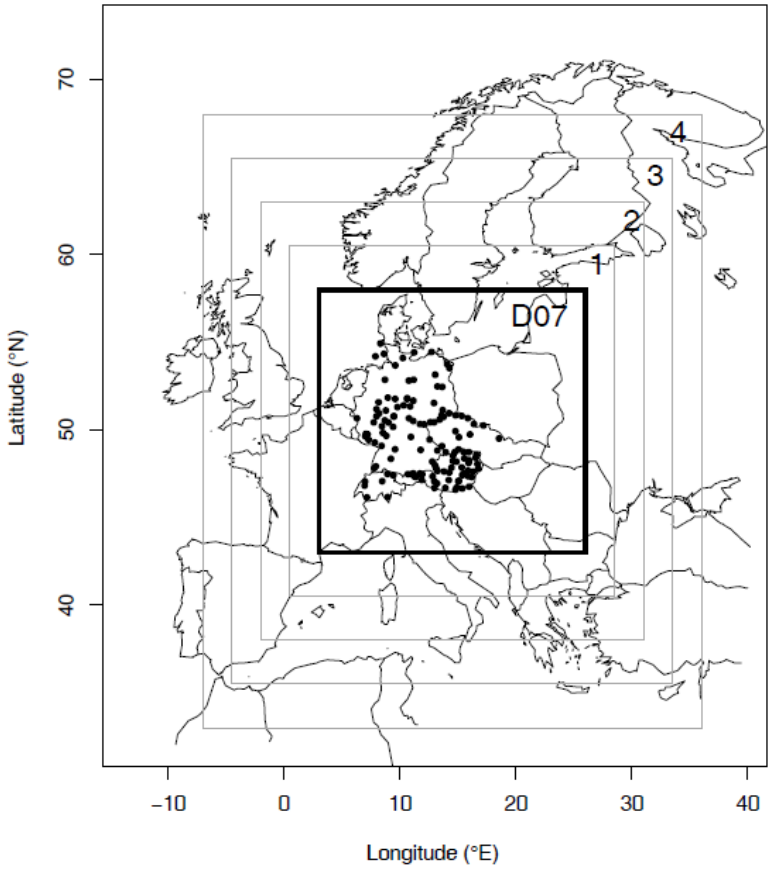

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BUT

on the other hand, composite maps of circulation patterns are able to hold some degree of physical meaning, in other words reflecting high ozone peak meteorological characteristics

The COST733class software

- Written in fortran90
- The code is available under a GNU GPL license V3, meaning that you are free to do with the software whatever you want…

  …but not to allowed to distribute (or sell) (part of the) program without publishing the source code under GPL.
- Can be compiled under linux, windows or mac
- Can read .txt and .netcdf file formats as input
- Includes a variety of circulation pattern classification methodologies (18 in total) based on different algorithms (k-means, PCA, self organised mapping, …)
- A large variety of evaluation metrics are implemented (EV, Pseudo-F, WSD, FSIL, SIL, …)

Strategy?

First, test the **'simple' baseline circulation patterns**

SLP, domain D07 (Central Europe), with number of classes 09, 18, 27, derived for the whole year but only JJA selected.

Then, test the following:

- Own decision of domain of interest (also domain size)
- Test surplus value of more than 1 input variable
- Methods can be run for a selective season only
- Sequencing is introduced (to allow for extended classifications of whole sequence of days)
- Use conditioned CTs with weights for "a" specific input variables, e.g. **1**x SLP, **10** x 2 meter Air Temperature

Evaluation methodology

- To evaluate the occurrence of the daily maximum 8 hourly ozone concentration for the (non-) exceedance of the 120 µg/m³ threshold depending on a prevailing circulation pattern, we use the use the Brier Skill score (Schiemann and Frei, 2009):

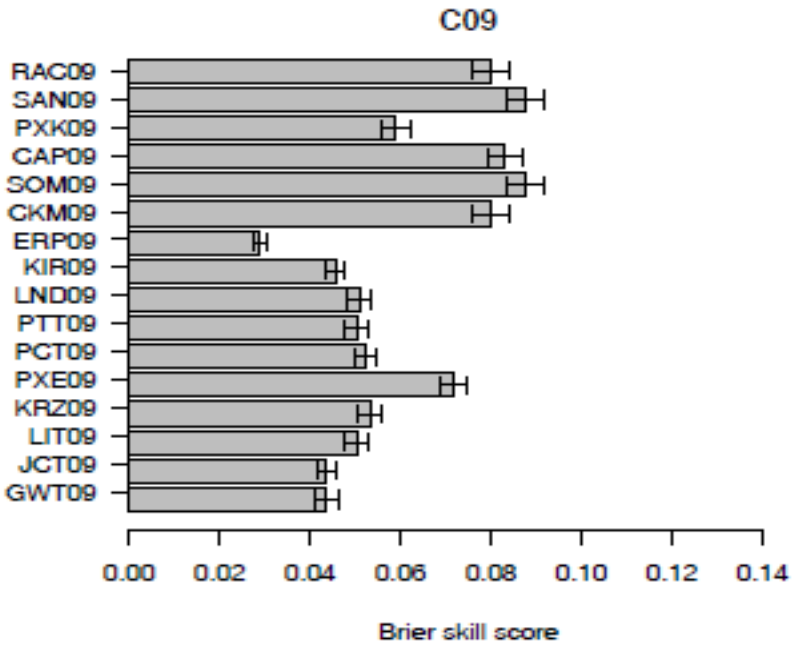
$$BSS = \frac{\frac{1}{N}\sum_{k=1}^{N} N_i(y_i - \bar{o})}{\bar{o}(1-\bar{o})}$$

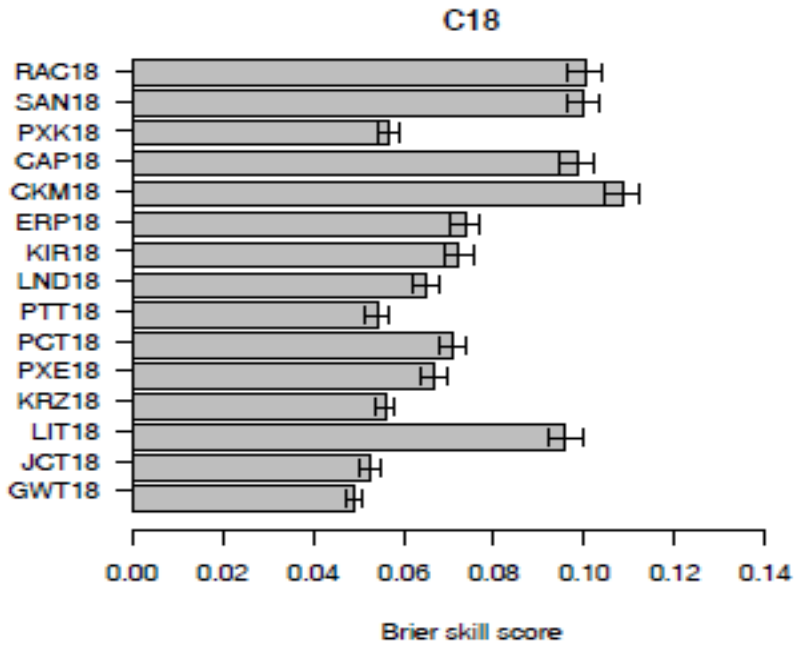
- This score varies between 0 and 1, with the larger the value, the better the skill

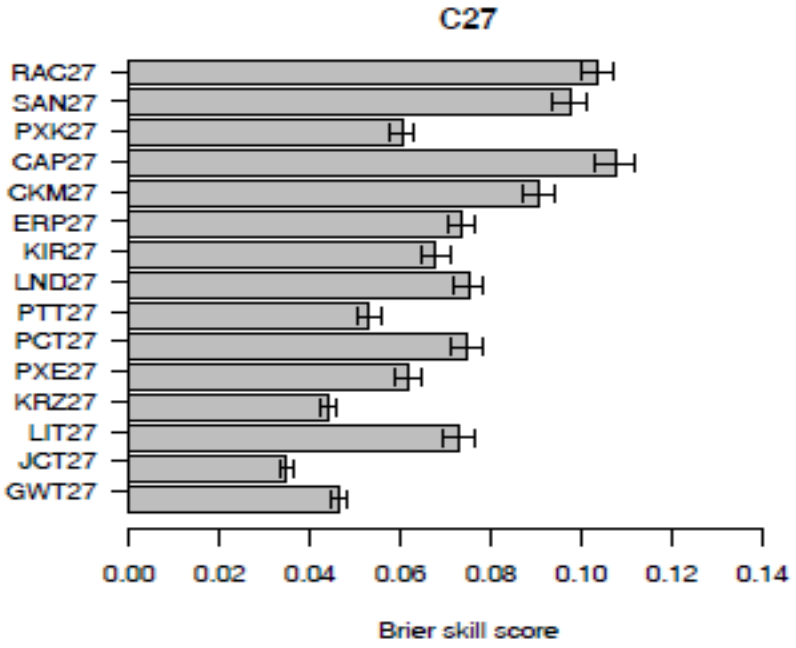
  meaning:

  the better explanatory power of a circulation classification method with respect to high daily ozone concentrations.

“Baseline” evaluation







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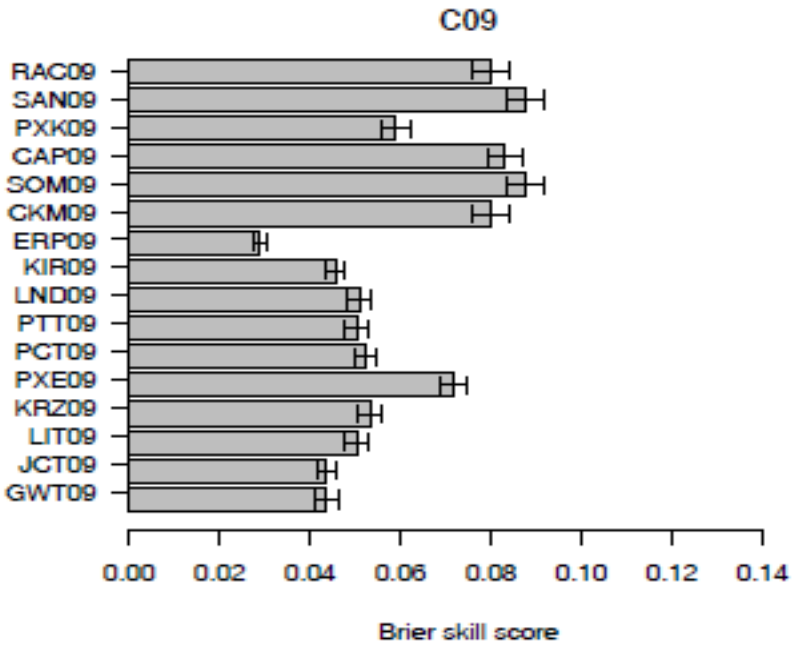
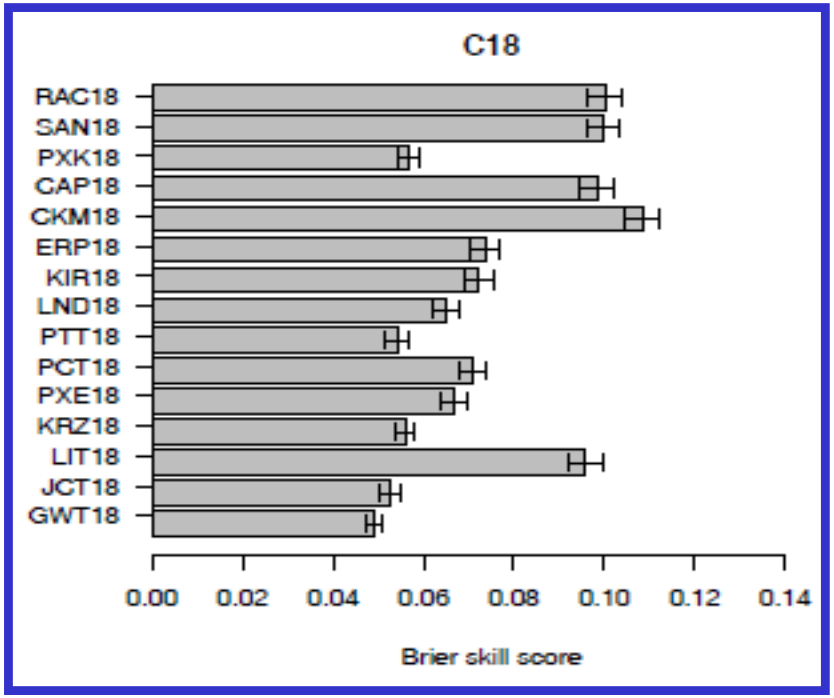
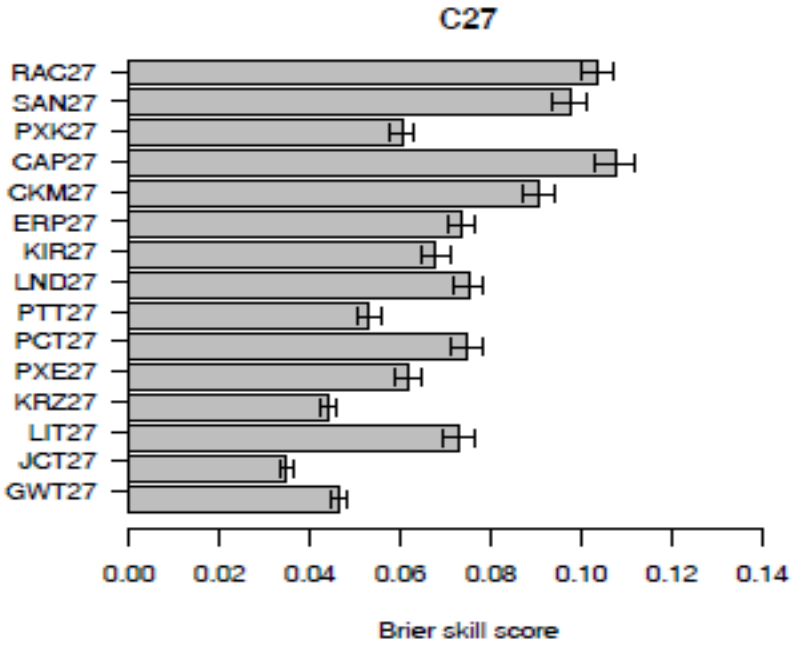
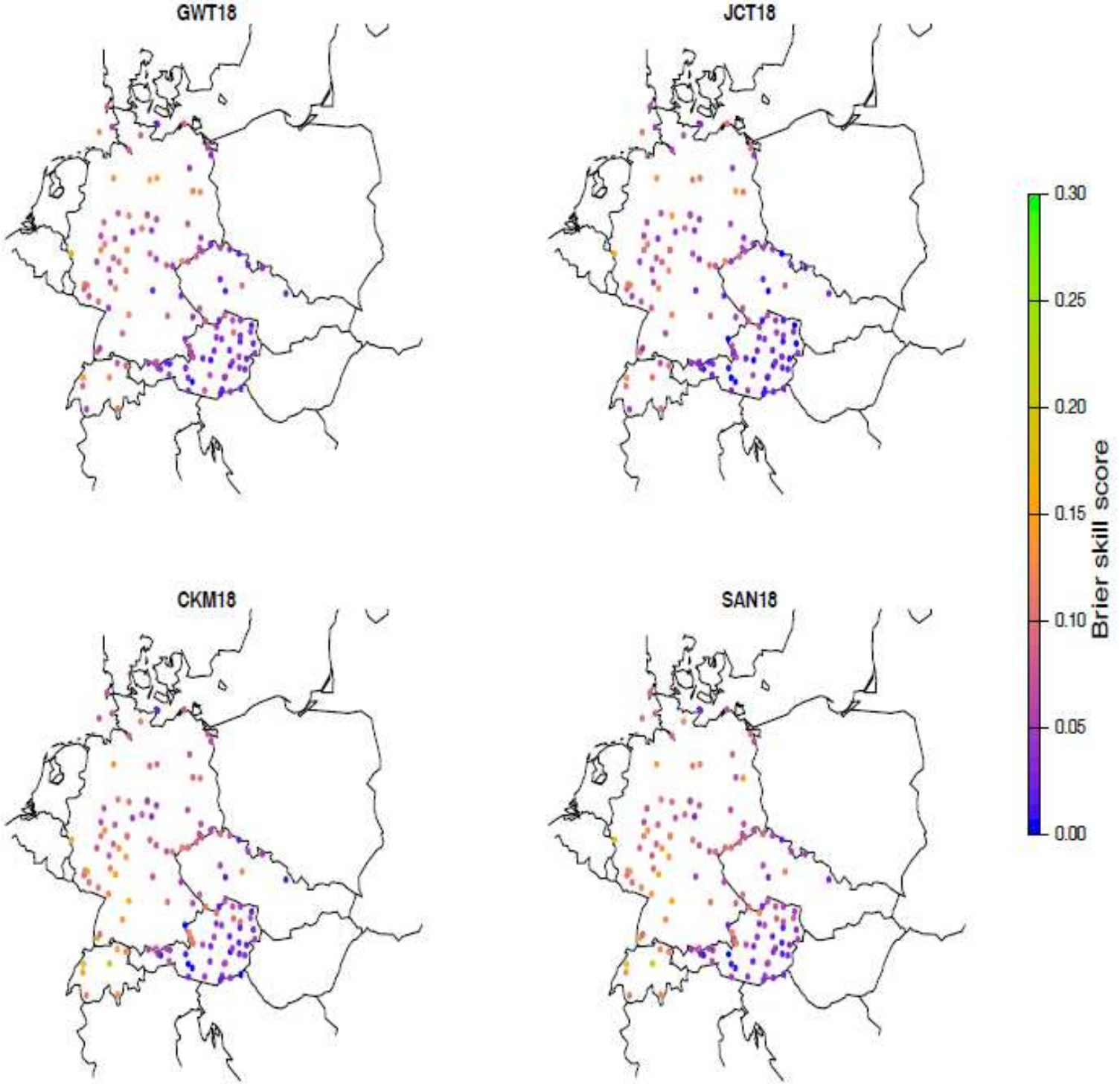
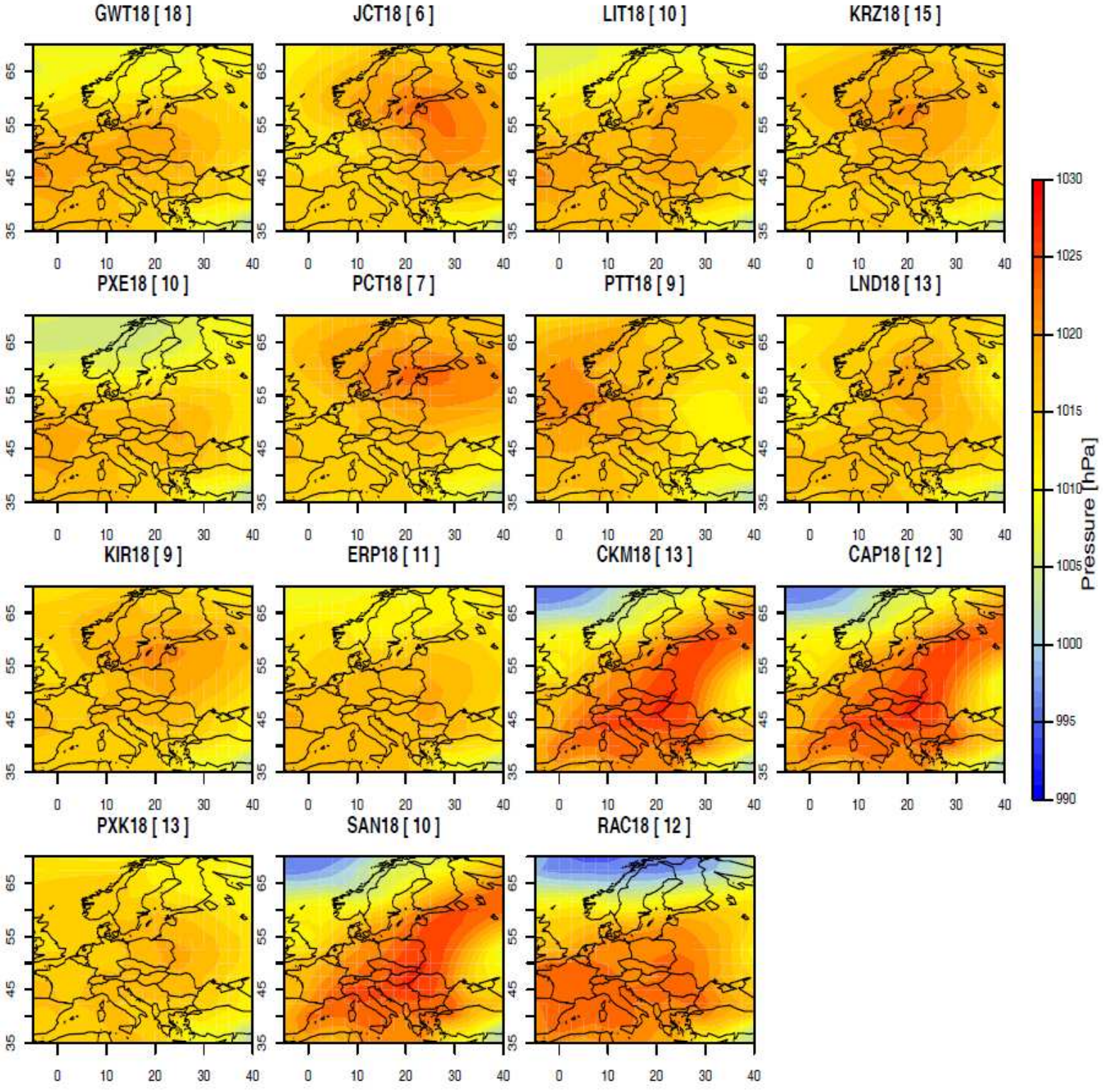




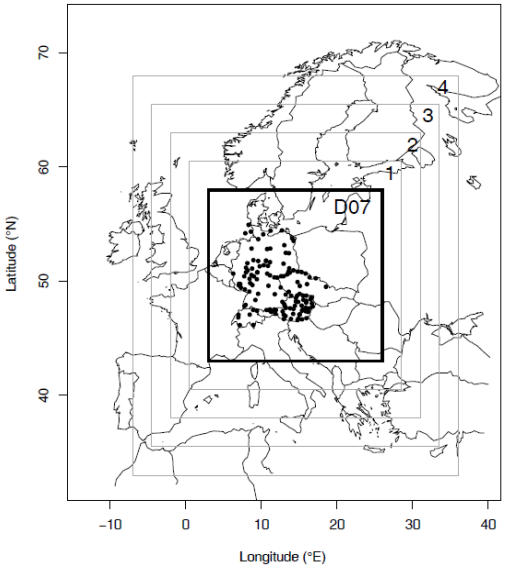


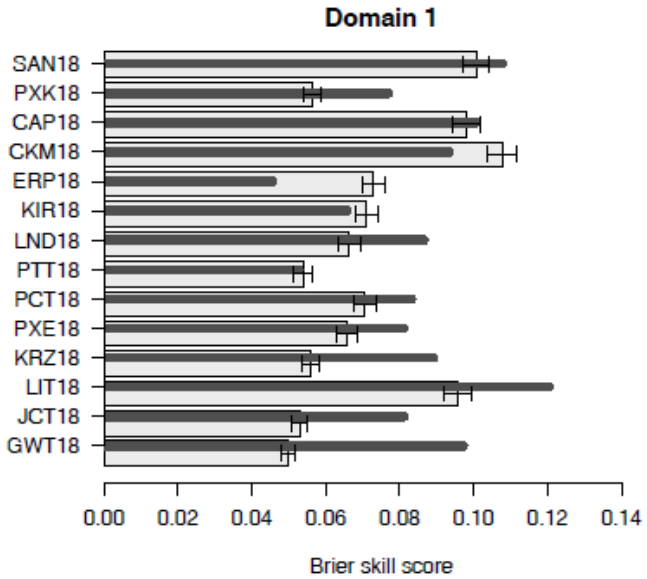

GWT18
JCT18
CKM18
SAN18
Brier skill score
0.30
0.25
0.20
0.15
0.10
0.05
0.00

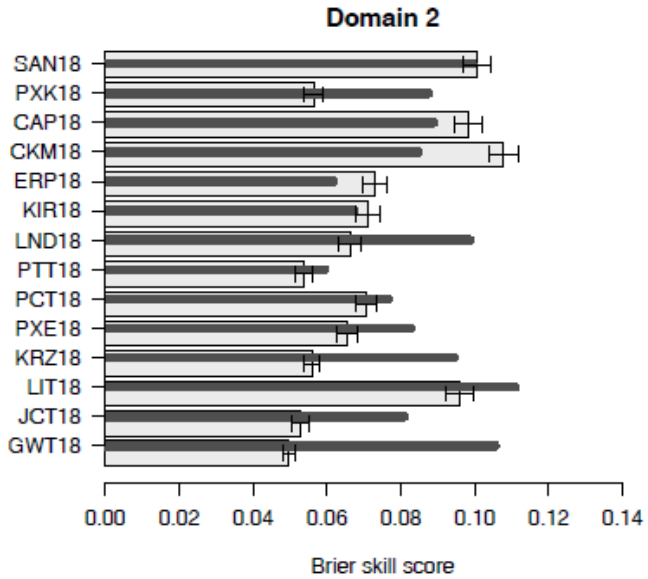

GWT18 [18]
JCT18 [6]
LIT18 [10]
KRZ18 [15]
PXE18 [10]
PCT18 [7]
PTT18 [9]
LND18 [13]
KIR18 [9]
ERP18 [11]
CKM18 [13]
CAP18 [12]
PXK18 [13]
SAN18 [10]
RAC18 [12]
Pressure [hPa]
1030
1025
1020
1015
1010
1005
1000
995
990

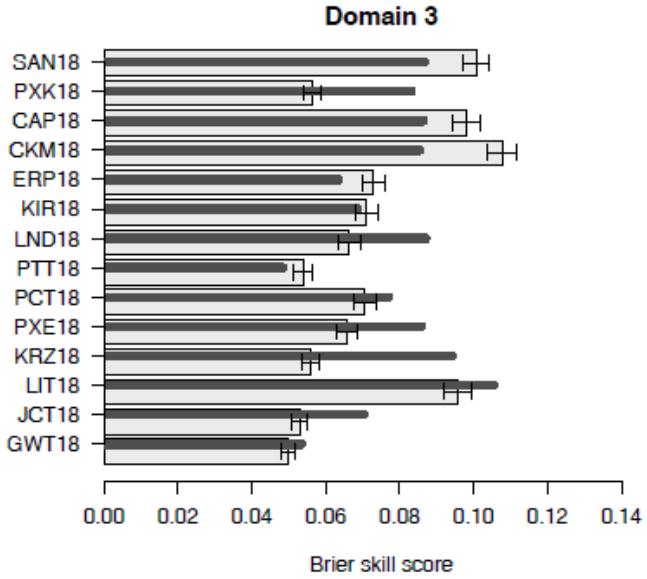
Sensitivity experiments

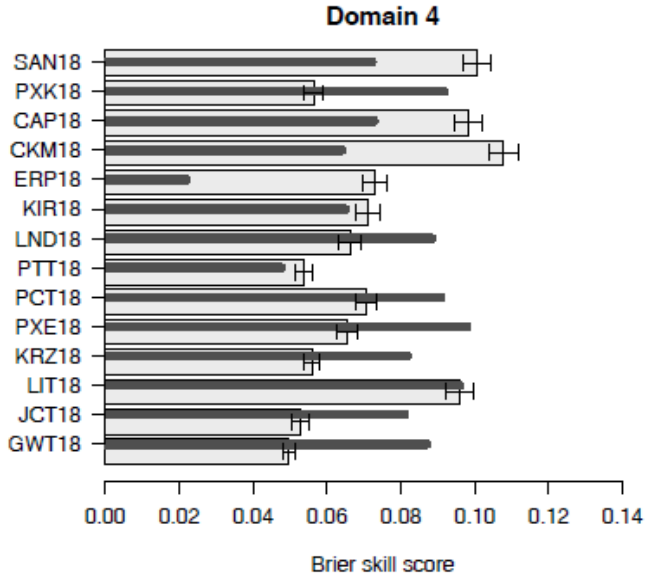
A) Domain Size







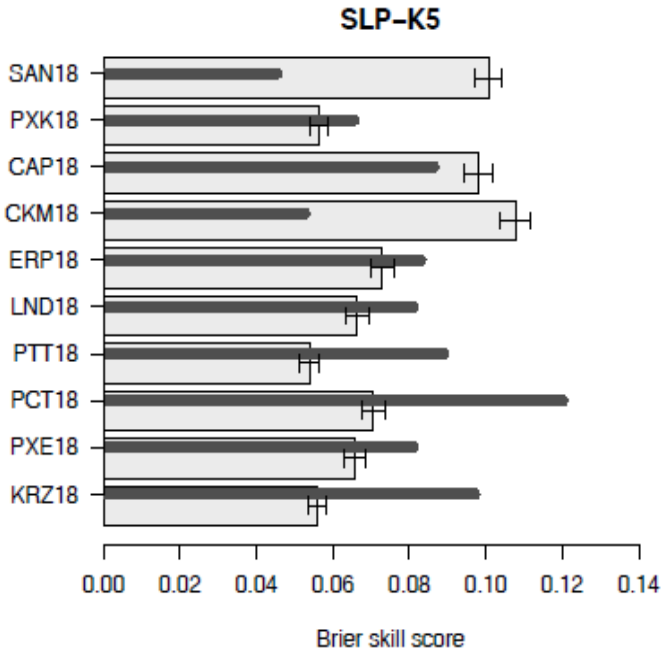


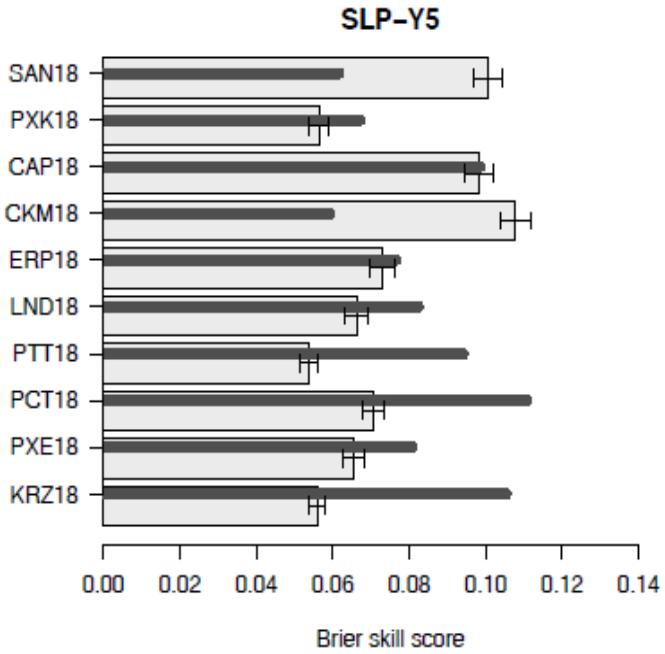


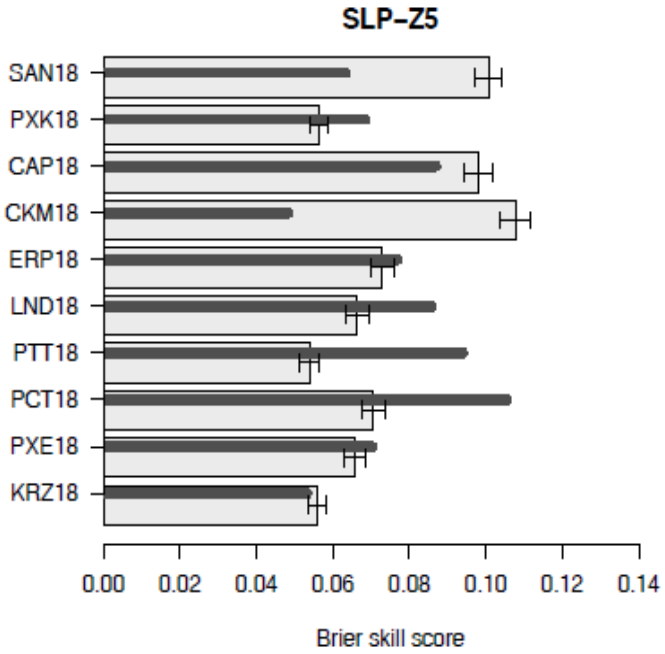
Sensitivity experiments

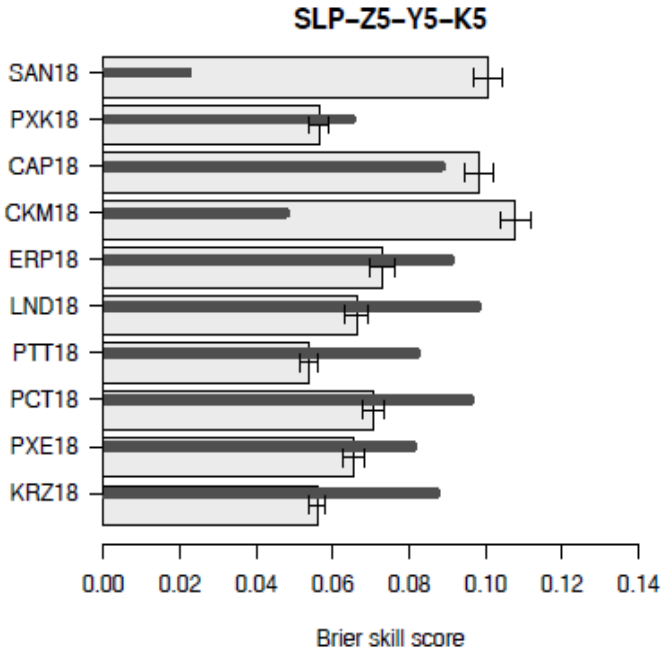
B) Input variables

K5 = Thickness between 500 – 800 hPa
Y5 = Vorticity at 500 hPa
Z5 = 500 hPa geopotential height



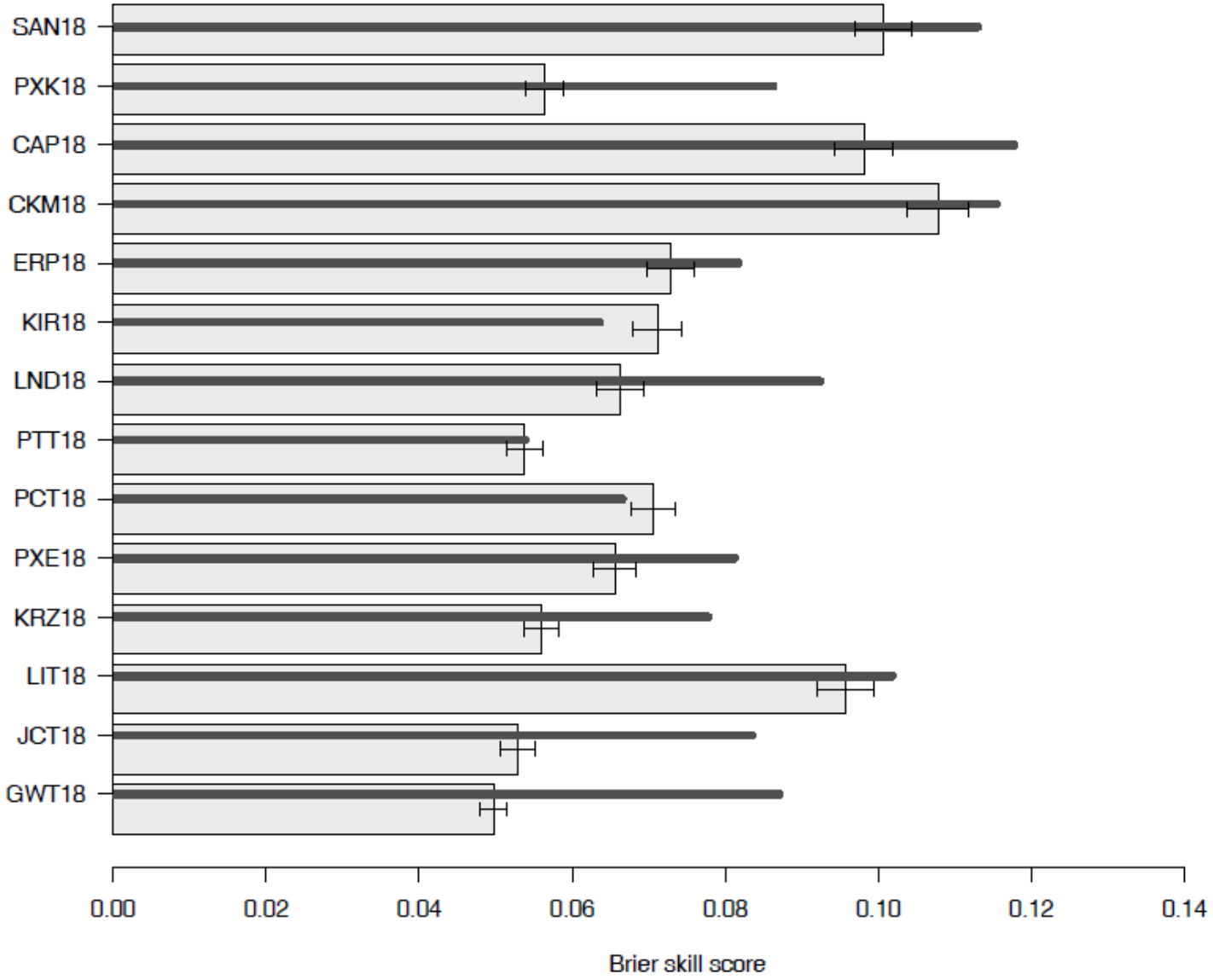






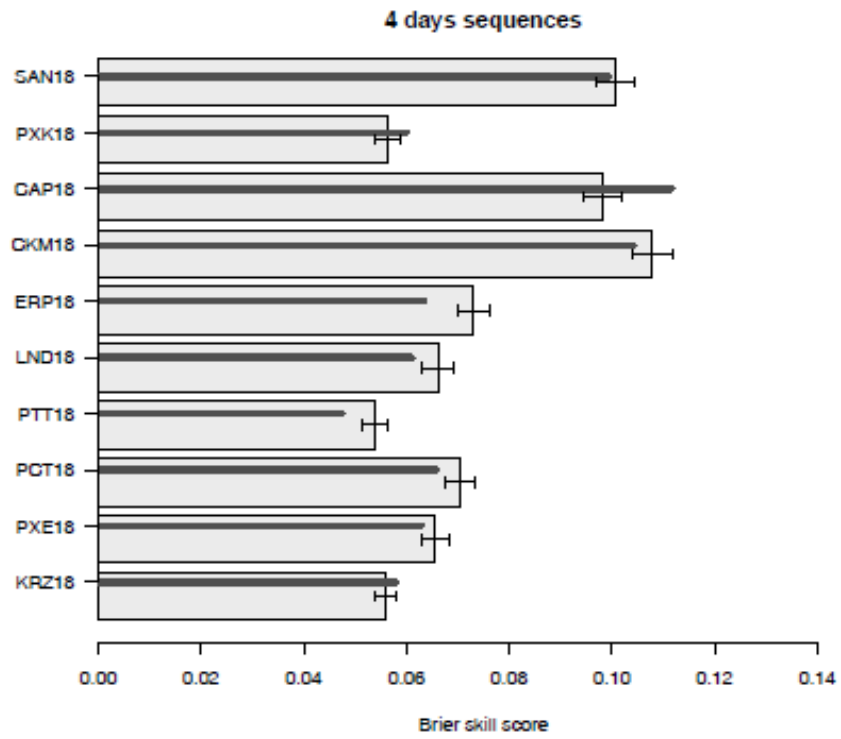
Sensitivity experiments

C) Seasonality

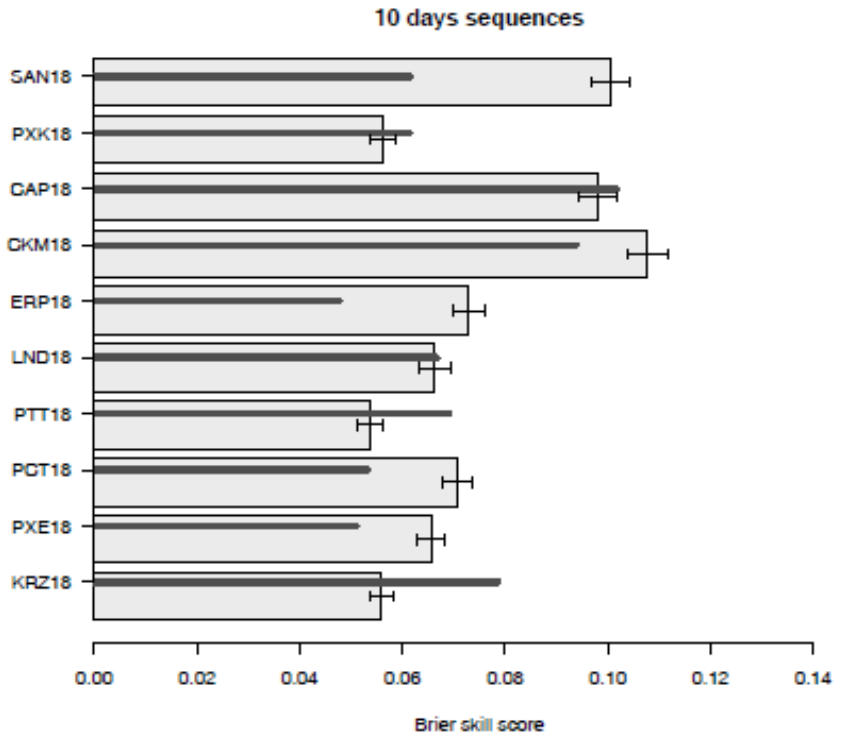


Sensitivity experiments

D) Sequencing



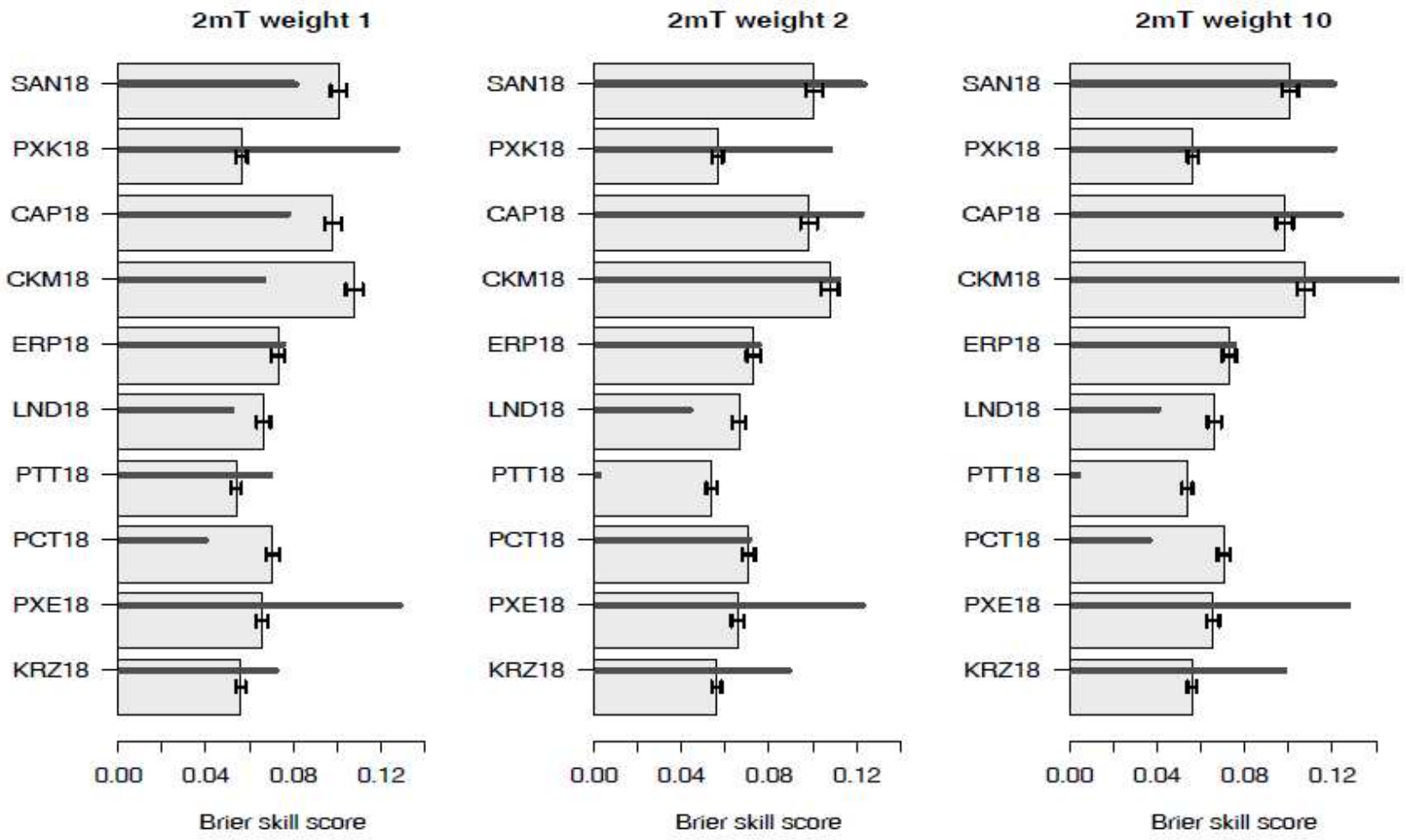
(a) 4 day sequences



(b) 10 day sequences

Sensitivity experiments

E) Conditioning



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- Nevertheless, this methodology is straightforward and provides good insight in the differences between the classification methodologies.
- It is hard to draw any conclusions that are overall valid for all experiments: depending on the number of clusters and methodology, some methods improve their skills whilst others deteriorate

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- The software has additional interesting features such as classifying multiple variables, sequencing, weighting …
- Can be compiled at any possible time step (hours, daily, monthly…)
- Is user-friendly, can be compiled on various platforms and comes with an extensive user-guide.

More information….

Can be found on / in …

- www.cost733.org
- http://geo21.geo.uni-augsburg.de/cost733wiki/Cost733Software
- Demuzere, M., Kassomenos P., Philipp, A.,200x, The explanatory power of circulation patterns on ozone concentrations in Central Europe. Theoretical and applied climatology (under review).