Stability and reproducibility evaluation of different windspeed spatial interpolation models to assist pesticide dispersion estimates.

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Thesis Paper

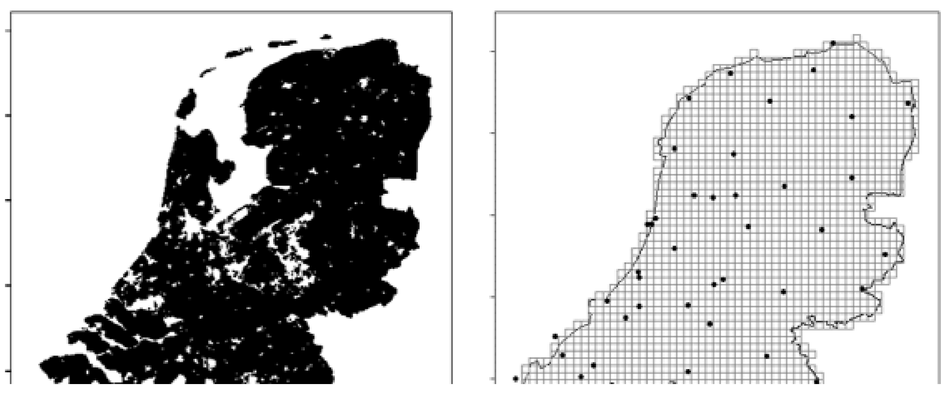
INTRODUCTION

Prolonged pesticide exposure is known to **raise health risks** to respiratory, reproductive, neurological, endocrine, and circulatory systems. A mixed model (**OBOmod**) was **previously developed by** Utrecht University's Institute of Risk Assessment Sciences (**IRAS**) which considers many variables to **estimate pesticide exposure** near households in the Netherlands.

The effect of including **windspeed estimates** alongside the **Gaussian plume-based pesticide dispersion model** part of OBOmod has **not** been **studied** yet, which this project attended to assist in.

This project compared **seven** spatial interpolation **models** using a total of **ten metrics** and **recommended** the use of a **hyperbolic trend surface model** which **minimized bias** caused by **random error and trends** in estimates **the most**, which Gaussian plume models are **known to be most sensitive** to.

PROCEDURE

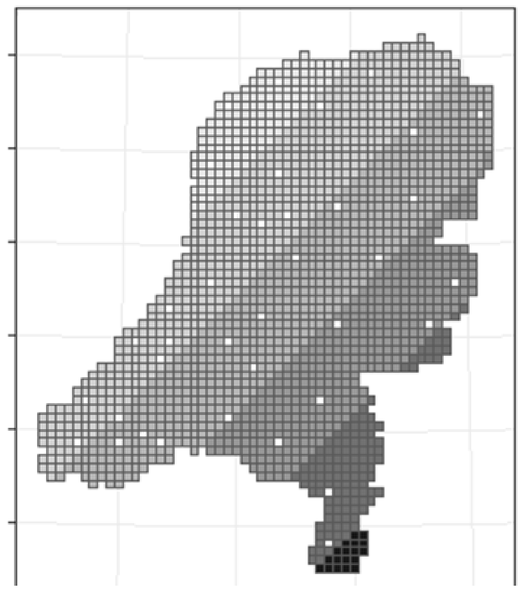


1. **Daily** windspeed measurements where sourced from **KNMI weather stations** in the year **2017**.
2. **Tesselation** was used to to create a **5km² square grid** of cells with **cell centroids** representing **receptors**, based on a **reference map** (country outline) and the **CRS** of a **source map**.
3. **SLOO-CV** was used to **calculate** the **RMSE** of the models.
4. **Bayesian optimization** with a **logarithmic loss function** was used to **train models** with **annually optimized hyper-parameters**.
5. **Metrics** which **evaluate** the **degree of bias** caused by extreme outliers, roughness, trends, local, and random error **in model estimates** have been used to recommend a suitable model.

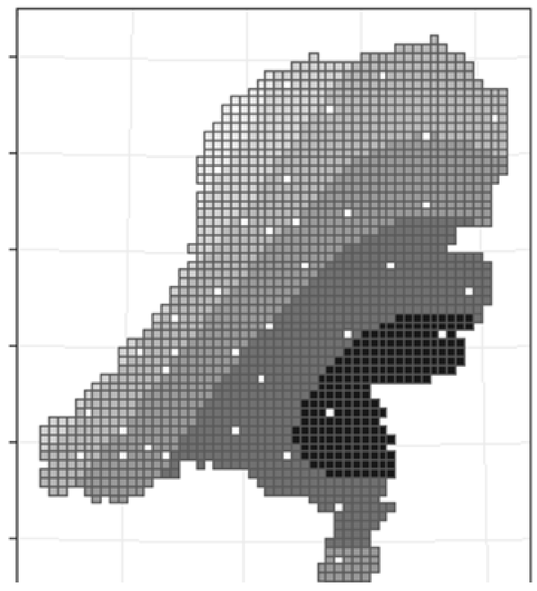
Stability metric		Surface metric	
Abbreviation	**Name**	**Abbreviation**	**Name**
SAV	Seasonal-annual variability	MaxSR	Maximum surface roughness
SSV	Seasonal-seasonal variability	MedSR	Median surface roughness
ARV	Annual-random variability	MadSR	MAD surface roughness
RRV	Random-random variability	MiMaSD	Minimum-maximum surface deviation
GLV	Global-local variability	MadSD	MAD surface deviation

MODEL ESTIMATES

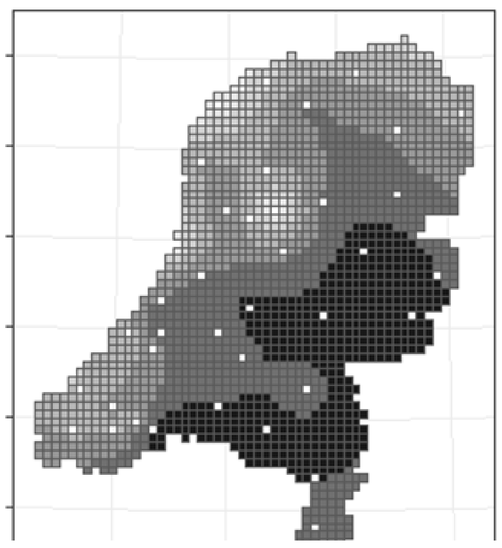
Trend surface (1st order)
[best_case]



Trend surface (3rd order)
[best_case]

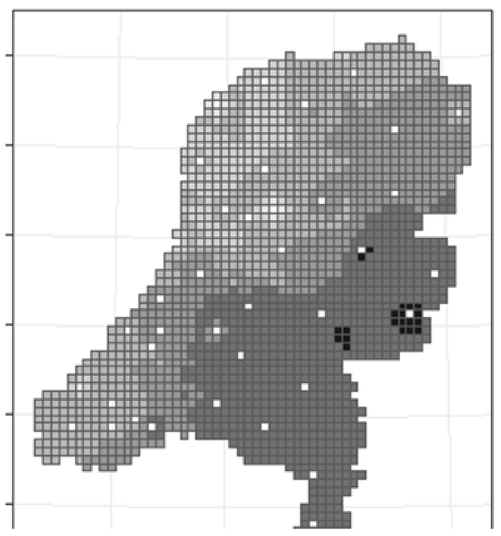


MQ-RBF
[best_case]

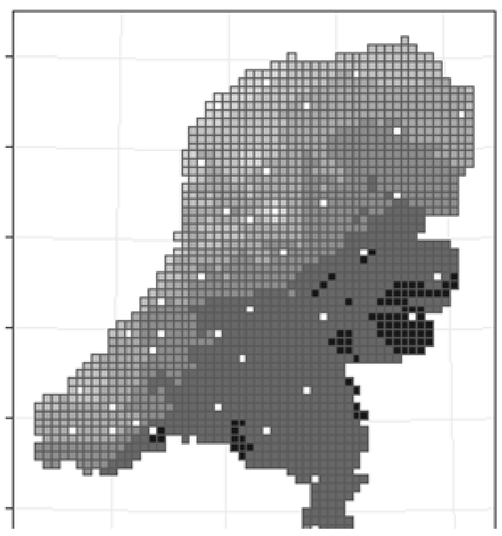


IDW
[best_case]

Ordinary Kriging
[best_case]



Universal Kriging (1st order)
[best_case]



RESULTS

Model	Total metric points					
	All metrics	Stability metrics	Surface metrics	SAV + SSV	GLV	ARV + RRV
TS1	34	25	9	8	5	12
TS3	40	28	12	13	2	13
MQ-RBF	37	15	22	8	1	6
IDW	40	14	26	3	6	5
OK	48	20	28	8	4	8
UK1	39	17	13	3	7	7
UK3	51	21	30	13	3	5
Max	70	35	35	14	7	14

Model	RMSE (BAP)	RMSE (NP)
TS1	12.23751	12.73446
TS3	12.38736	12.62145
MQ-RBF	13.4674	13.51874
IDW	13.9183	13.97534
OK	13.6232	13.71921
UK1	14.39231	14.41833
UK3	13.67724	13.67829