



IMPACT OF WIND GUSTS  
ON  
SEA SURFACE HEIGHT  
IN  
STORM SURGE  
MODELING

Rikke van der Grinten  
**Hans de Vries**  
Huib de Swart

KNMI, Weather Service – R&D  
University of Utrecht – IMAU



## Input for storm surge model

Wind and pressure, every 1/3/6 hours

$$\vec{\tau} = \rho C_d \|\vec{u}\| \vec{u}$$

Variations on short time scales (*gustiness*)?

$$u_t = u_m + u', \quad \overline{u'} = 0$$

$$\overline{\tau(u_m + u')} > \tau(u_m)$$



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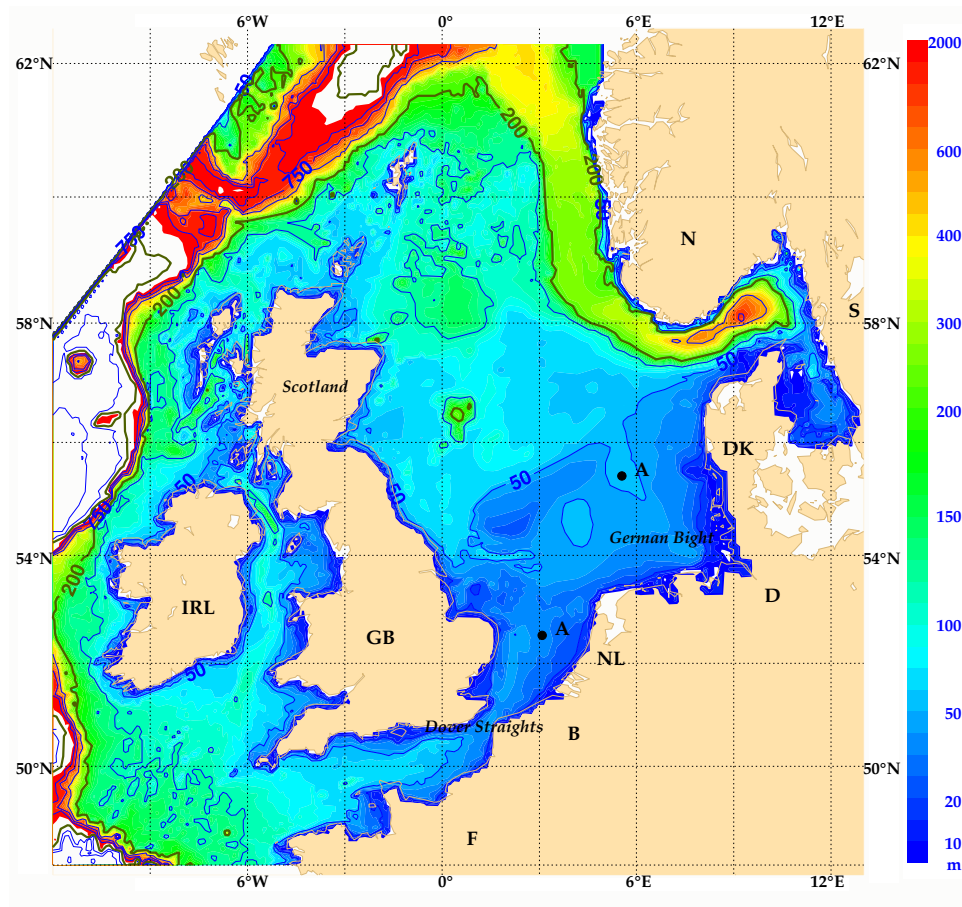
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$$\overline{\tau(u_m + u')} > \tau(u_m)$$

**Can explicit inclusion of gustiness  
reduce model errors?**

# Storm surge model



WAQUA/DCSMv5

Rijkswaterstaat/Deltares/KNMI

$\frac{1}{8}^{\circ} \times \frac{1}{12}^{\circ}$  ( $\sim 8$  km)

Input from

- Synthetic
- ECMWF
- (Hirlam)

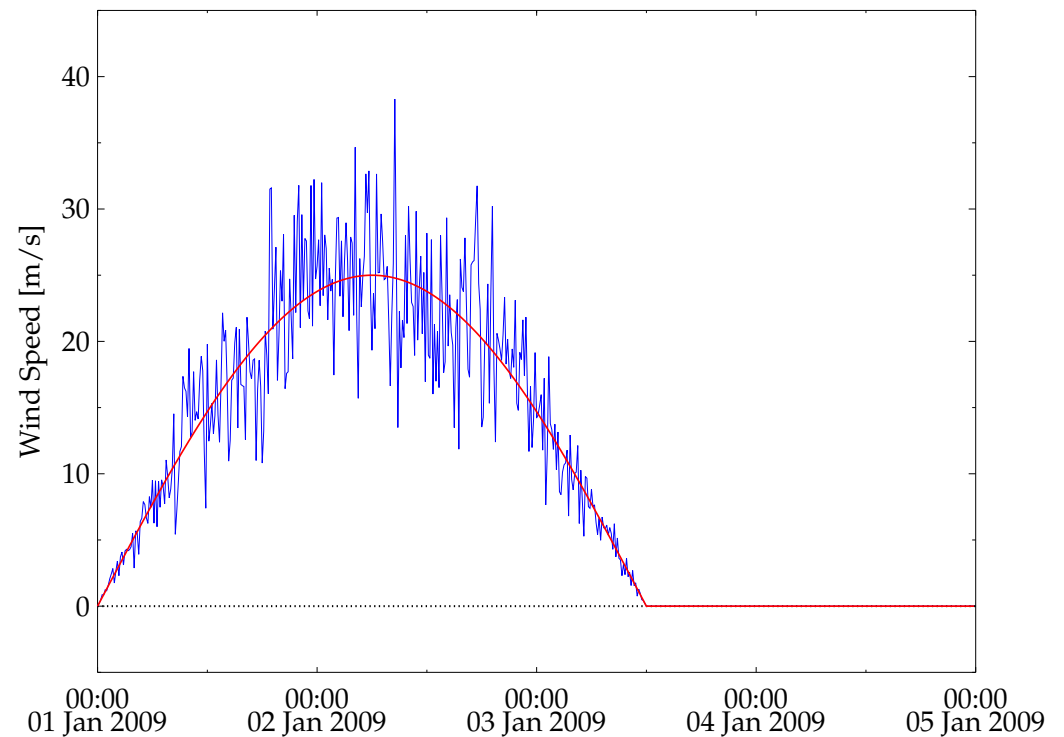
# Monte Carlo experiments

## Synthetic storm

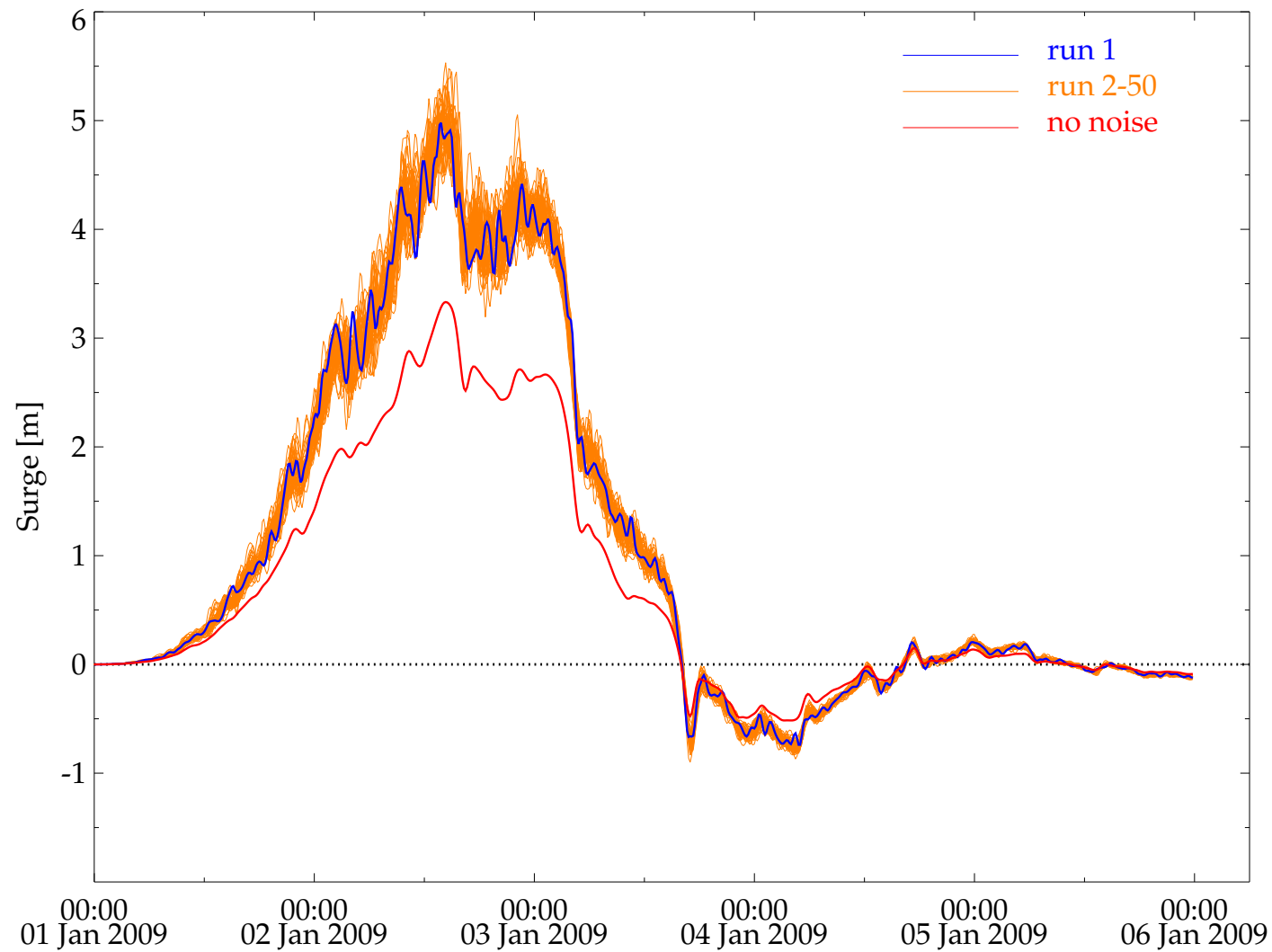
- Uniform NW wind
- Sinusoidal  $u_m = 0 - 25\text{m/s}$

## Add gaussian noise:

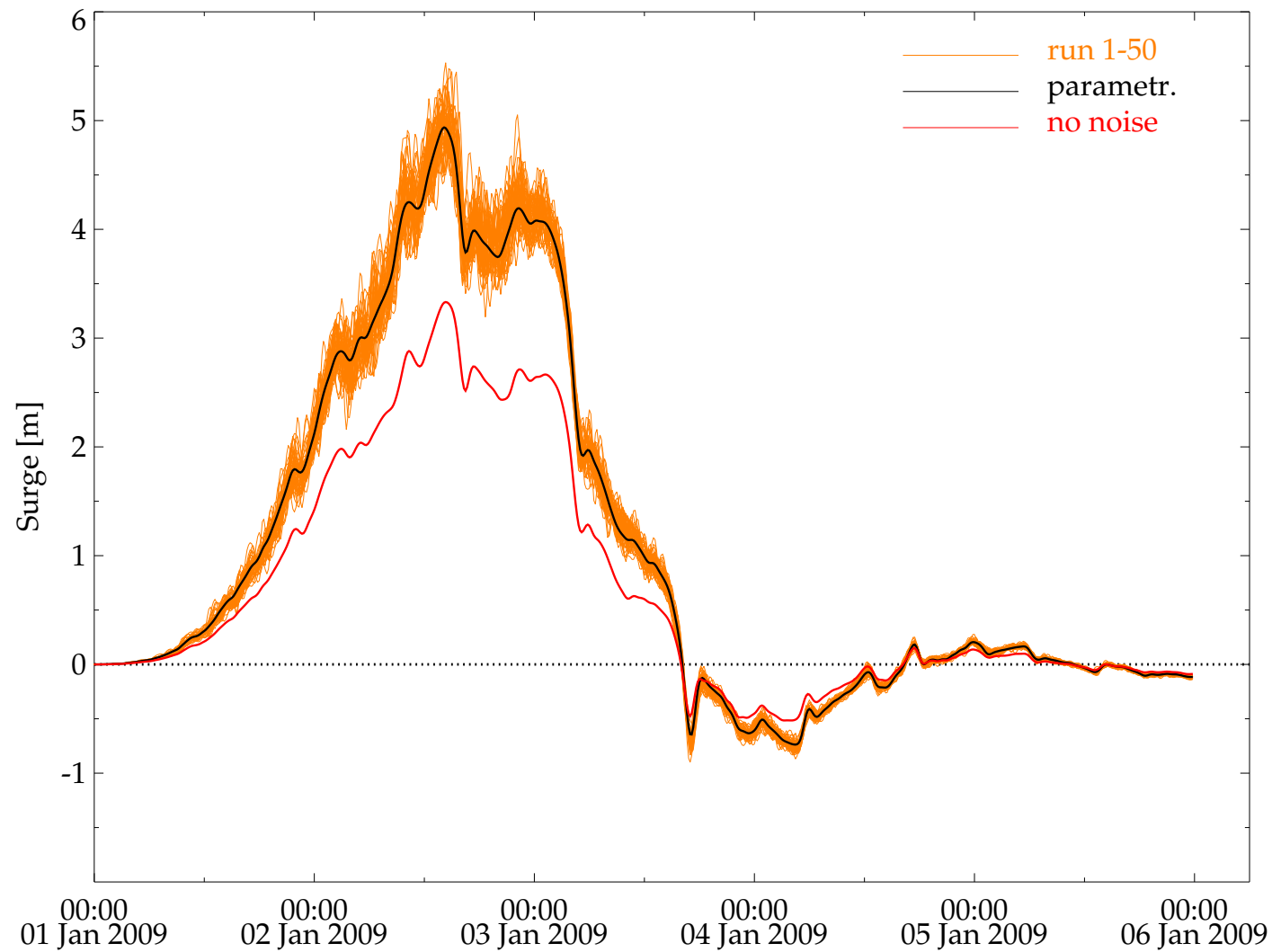
- $\overline{u'} = 0$
- $\sigma_{u'} = 0.4 \cdot u_m$
- Time step 10 min
- 50 realisations



# Monte Carlo experiments



# Parameterisation



$$u_t = u_m \sqrt{1 + \beta \left( \frac{\sigma_{u'}}{u_m} \right)^2}$$

$$\beta = 2.2$$

## Input from ECMWF model

### Wind forecasts

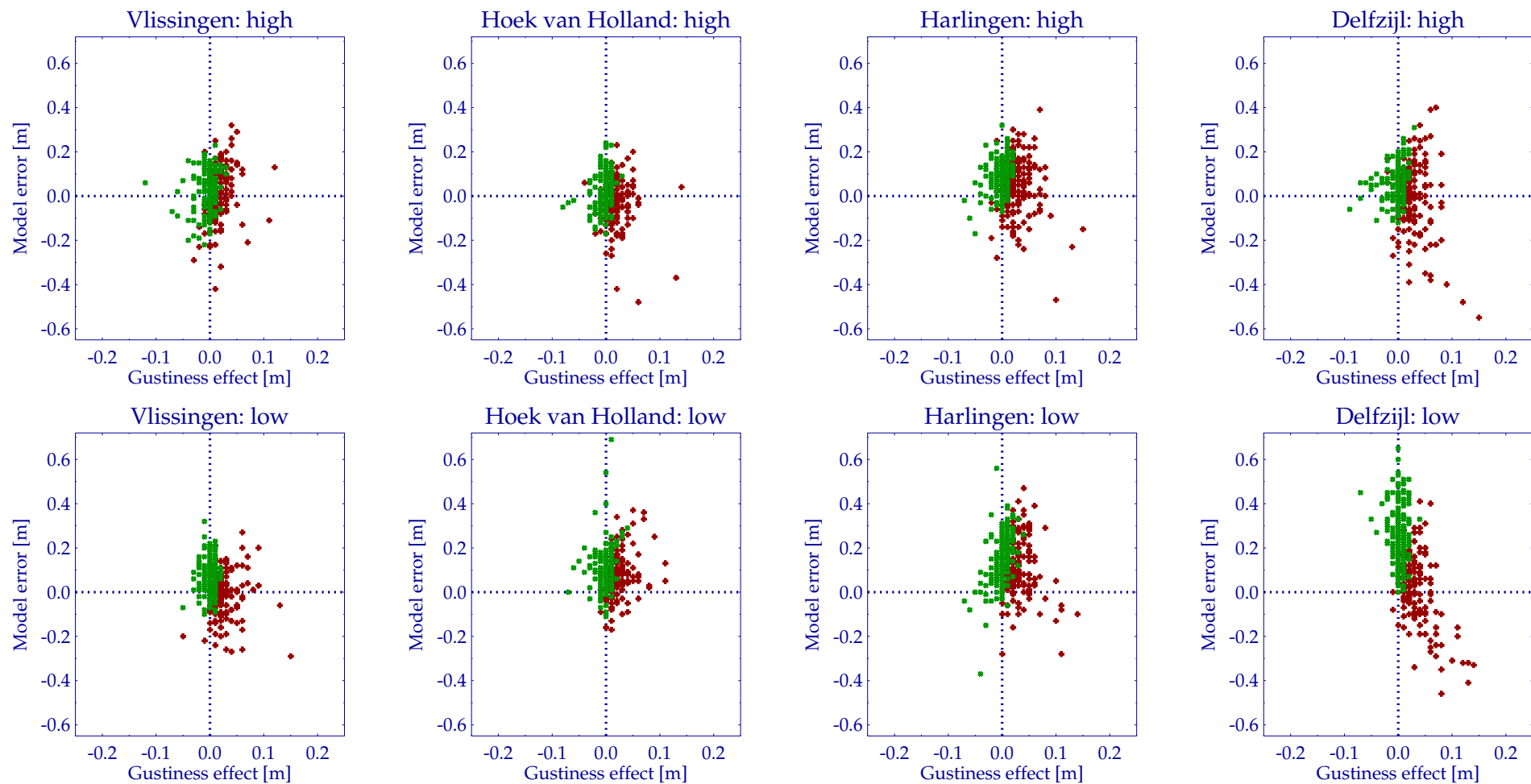
- 10-m wind  $\vec{u}_{10}$
- Gust  $G = u_{10} + g \cdot \sigma_w$ ,

$$g = \left\{ 2 \ln \left( \frac{T}{\tau} \frac{1}{\sqrt{2\pi \ln\left(\frac{1}{1-P}\right)}} \right) \right\}^{\frac{1}{2}} = 2.93$$

*The maximum three-second wind speed to occur within a 3 hour interval at a height of 10 meters*



# ECMWF input: 1 Sep 2007 – 1 April 2008



## Conclusions

- Gustiness can enhance storm surges
- Average is included in tuning of the model
- Gustiness can be parameterised
- Small effect on storm surge model errors



*Thank  
you*





# Real case

