

# Kennis voor Klimaat Knowledge for Climate



## IMPACT

The impact of climate change on  
the critical weather conditions at  
Schiphol airport

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KvK Midterm Assessment  
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## Schiphol airport and climate change



### What we know

1. Schiphol airport and the surrounding area are vulnerable to climate change.
2. The impact of climate change on the airport is largely determined by the effect that the future weather has on the airport operation.
3. Inaccurate information on future weather events will lead to increasing costs and may even threaten safety.
4. Present day climate models have shown that extreme weather events, such as summer rain showers and periods of heat and drought, will occur more frequently and are becoming more intense.



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### What we do not know (and this is actually our problem)

We don't know how climate change affects the weather on local scales (and these local scales are important for Schiphol airport)

- Our present day models do not provide enough spatial differentiation (poor model resolution)
- The physical description of the land-atmosphere interaction in the models is not adequate (poor model physics)
- Local weather events have a limited predictability

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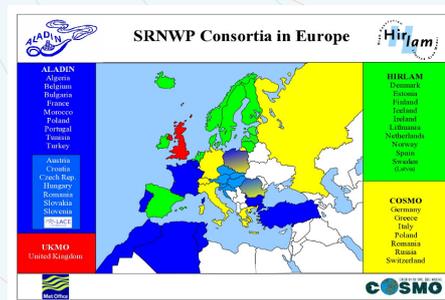
## Schiphol airport and climate change



### The solution for Schiphol airport is:

In Impact we introduced the new generation weather and climate model **HARMONIE**:

- It has a high resolution: 1 – 2 km
- It has improved physics
- It is non-hydrostatic: this means that vertical movements are solved explicitly by the model, which is important for the simulation of extreme weather such as strong vertical winds and thunderstorms, but also for clouds.



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## The main objectives of IMPACT



1. To demonstrate the potential of HARMONIE to provide an improved and more detailed weather prediction for Schiphol airport
2. To demonstrate how HARMONIE can be used to compute the effect of climate change on local critical weather conditions at Schiphol airport (use as downscaling tool)

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## IMPACT Approach



### Inventory:

- Identify and bring together the demands on weather information from Schiphol stakeholders (AAS, LVNL and KLM) and what we can offer from science and technology. (overview weather conditions that are critical)

### High resolution 3D model Harmonie:

- Get insight in the quality and applicability of the model w.r.t. forecasting weather parameter that are critical for Schiphol operation.
- Simulate high resolution local weather forecasts for **Past and Present Weather** events at the airport and compare them to HiRLAM and local observations.
- Study how certain weather events would evolve in a future climate, due to e.g. changes in the climatological circumstances such as e.g. an increase in sea-surface temperature → **Future Weather**.

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## IMPACT Results



### Harmonie

- The model is better than HiRLAM in forecasting storms: The higher resolution results in a more detailed picture of the wind and small regions with very high wind speeds are simulated much better.
- Precipitation intensity, patterns and timing are much better than with HiRLAM. But, for organized summer showers (convective events) this requires to run the model on a large domain (e.g. 1000 x 1000 km).
- HARMONIE has the capability to model the urban heat island effect. But, the model output is sensitive to data that specifies the land-use.

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## IMPACT Results

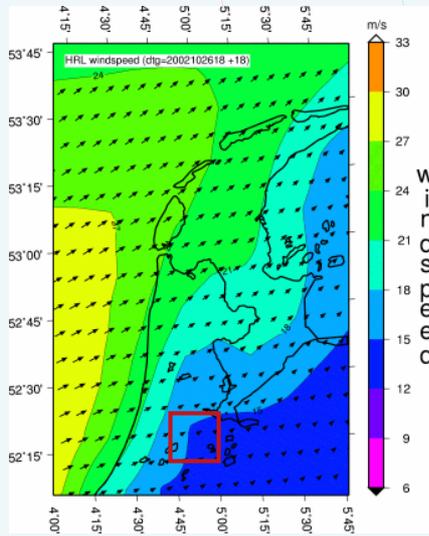


### Problems with HARMONIE

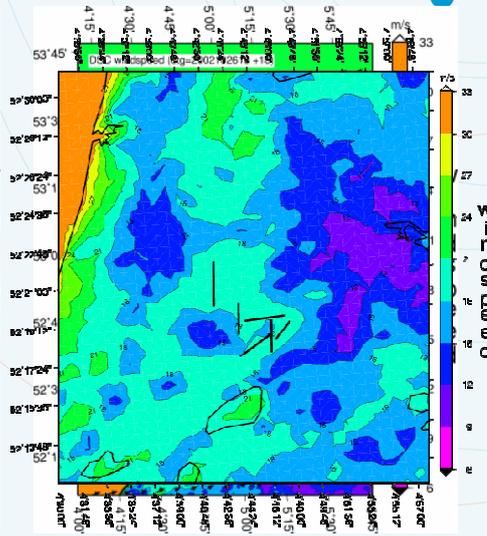
- Fog over the North Sea is overestimated.
- Cloud base of low clouds is often too low.
- Shallow clouds are underpredicted. Sometimes they vanish in the model when they get really shallow compared to the vertical resolution in the model.
- Monthly precipitation amounts in HARMONIE are too high. There seems to be a problem with the evaporation in the model at the surface.

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## The effect of a low and high model resolution on the wind



Model resolution: 10 x 10 km



Model resolution: 1 x 1 km

## Critical weather conditions at Schiphol



- Low visibility (fog) and low clouds
- Heavy wind and wind gusts
- Heavy showers with extreme precipitation amounts
- Wintery precipitation such as snow and black ice
- Special weather events such as severe thunderstorm, lightning, hail, downbursts
- Since a few years ago also volcanic ash

## Influence of the size of the model domain on the timing of precipitation

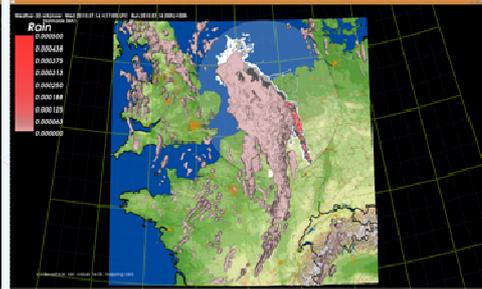
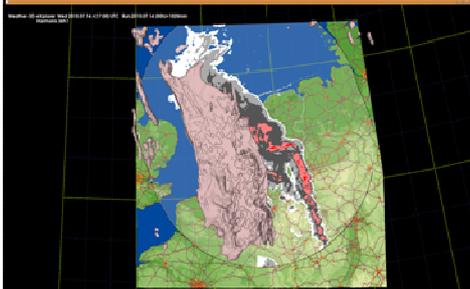


Weather event 14 July 2010: Severe thunderstorm with heavy precipitation, originating from the southwest of France

Harmonie resolution: 2.5 x 2.5 km

Small domain

Large domain



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