



The Impact of Landform Structure on Fog Formation

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1. Introduction
2. Motivation
3. Background
4. Research Area
5. Results
6. Outlook

Research Training Group 437

Landform – a structured and variable boundary layer

Topic

Importance of the the earth`s surface on fog formation

Tools

Model LM-PAFOG

Aim

Improvement of fog prediction

High resolution fog prediction

Duration and intensity of fog period

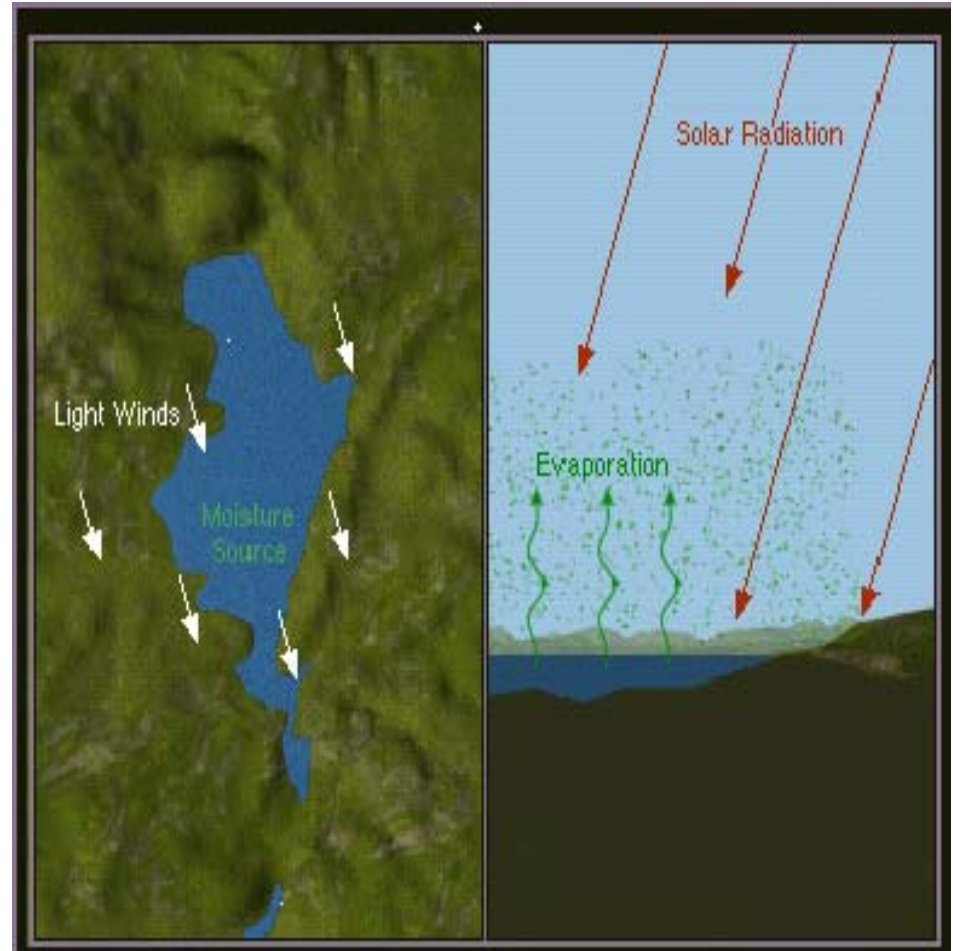
Spatio-temporal heterogeneity of fog

Key Ingredients required to generate fog are

moisture

rapid cooling

calm or light winds



www.meted.ucar.edu

Impacts on Fog Formation

Which Parameters?

Local Surface Influences

Soil type

Vegetation

Surface characteristics

Soil moisture

Terrain Influences

Topography

Mountain valley breeze

Accumulation of cool air

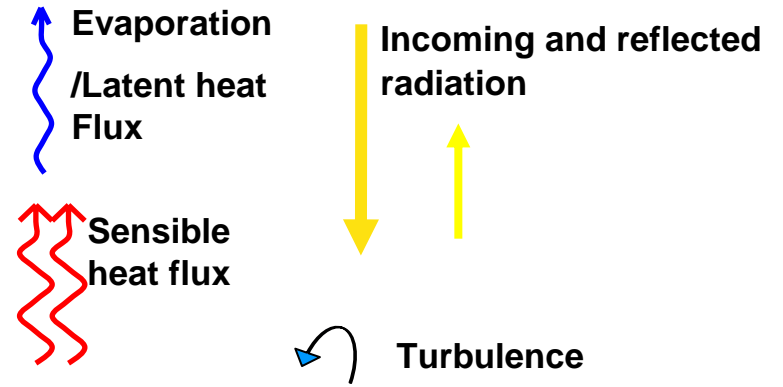
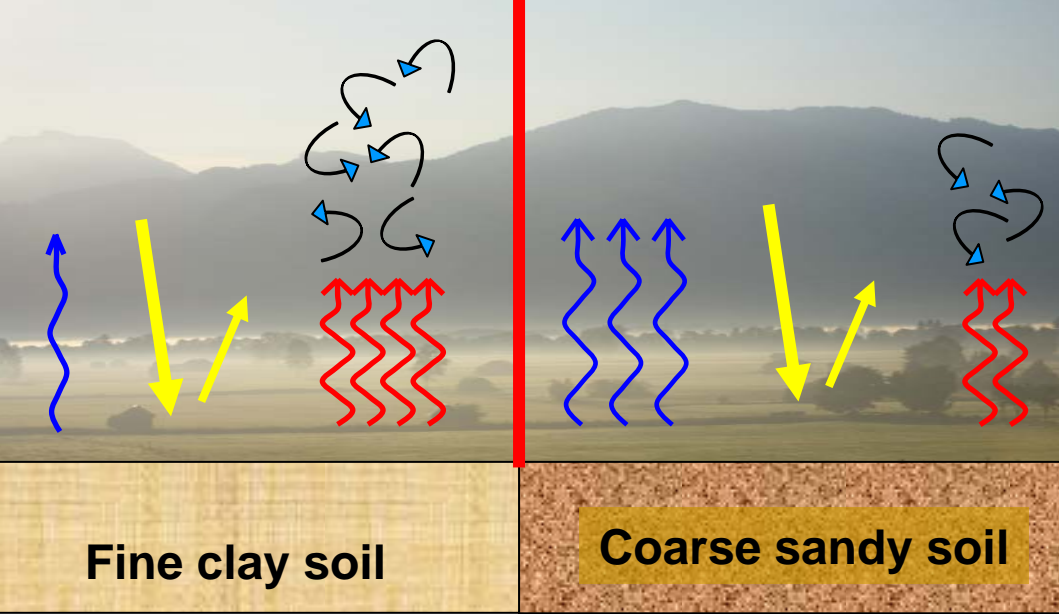
Which Processes?

Radiative cooling

Advection

Vertical mixing of heat and moisture

Heat and moisture transport in the soil



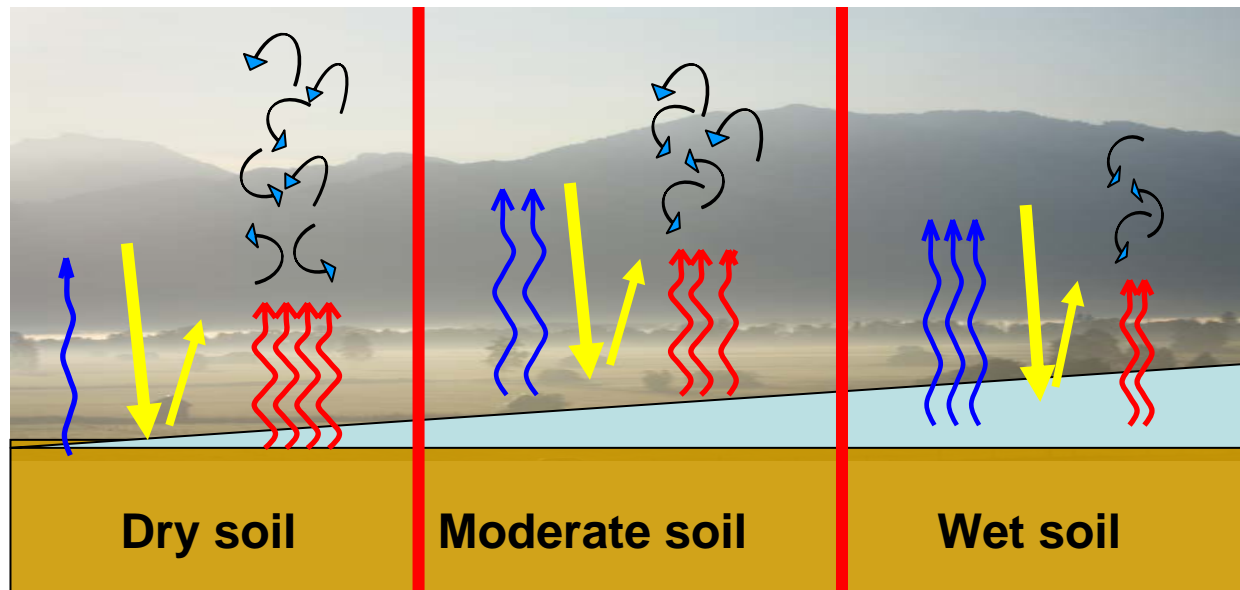
Soil Type

Influenced diurnal variation of Temperature ,Humidity and fluxes

Soil moisture

Soil moisture controls latent heat release at the surface

Surface fluxes influence near surface weather -> e.g. FOG



LM /LM-PAFOG needs

External Parameters to describe the earth's surface

Orography

Soil type

Vegetation



Surface roughness

Root depth

Plant cover

Leaf area index



To take the high heterogeneity into account:

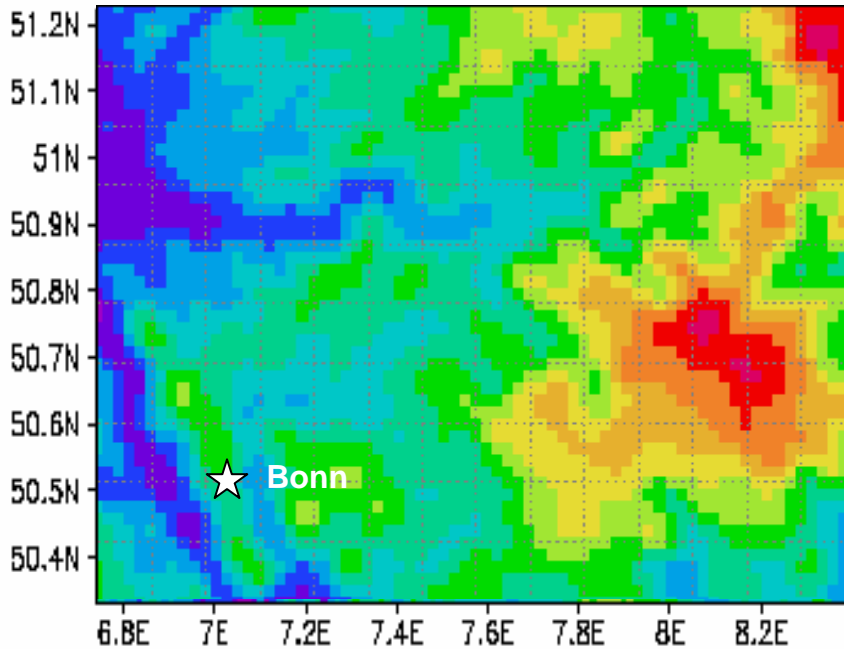
set of modified external parameters implemented into

LM-PAFOG; resolution 1 km

Topography

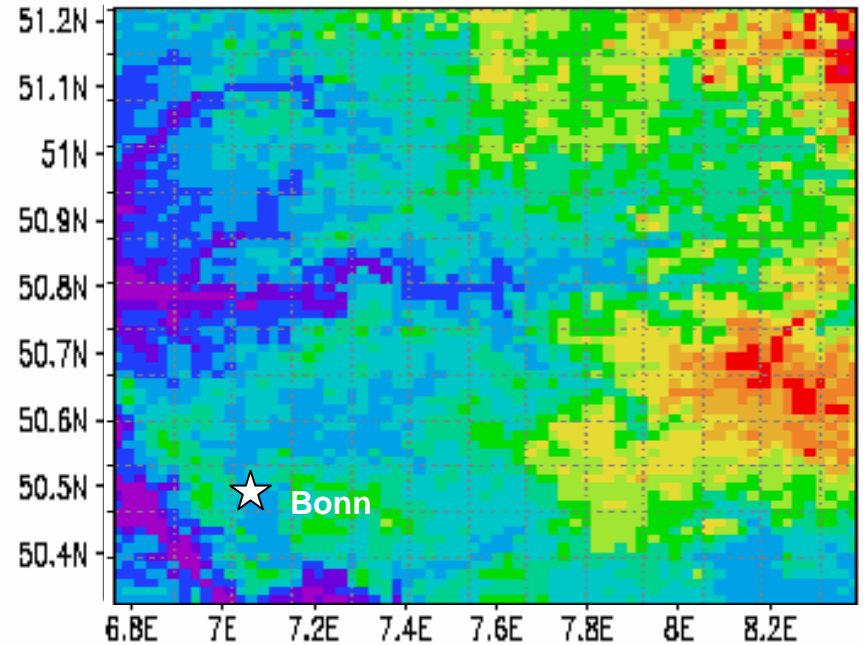
1 km Resolution

Topography LM

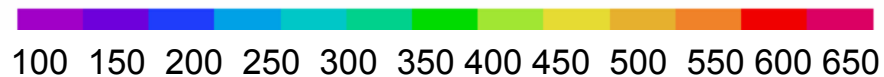


Source: GLOBE-NOAA/NGDC (National Oceanic and Atmospheric Administration; 1km)

New Topography



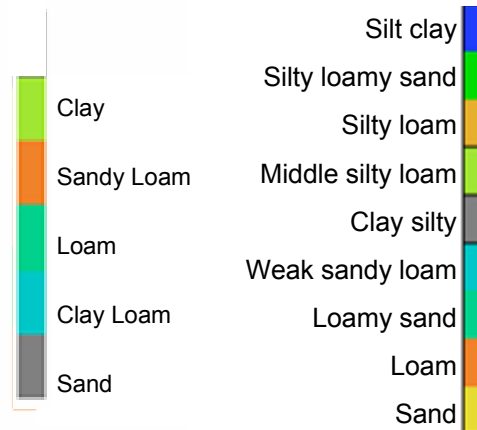
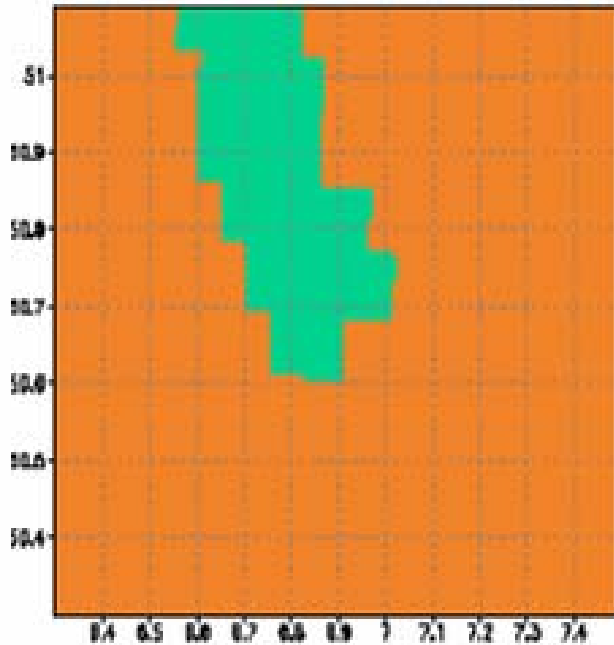
Source: NASA, SRTM 90 m



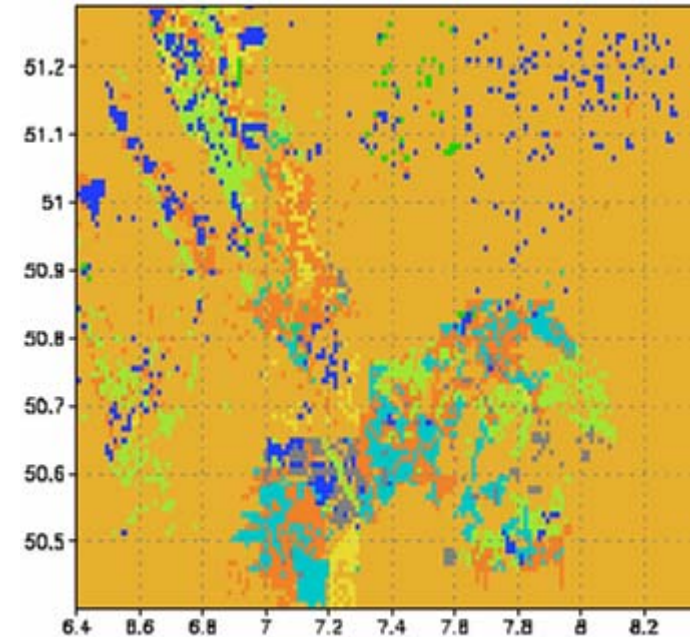
Soil Type

1 km Resolution

Soil Type LM



New Soil Type



Source: Geologisches Landesamt NRW, 100m Resolution

Source: FAO (Food and Agricultural Organization of UNO), 10 km Resolution

Model Setup

Initialization:	08.10.2005 15 UTC
Duration:	48 hours
Time Step:	10s
Version:	LM3.19 PAFOG

Observed fog period:

Köln/Bonn: October, 9th 2005: 02-06 UTC

Bad Marienberg: October, 9th 2005: 04-06 UTC

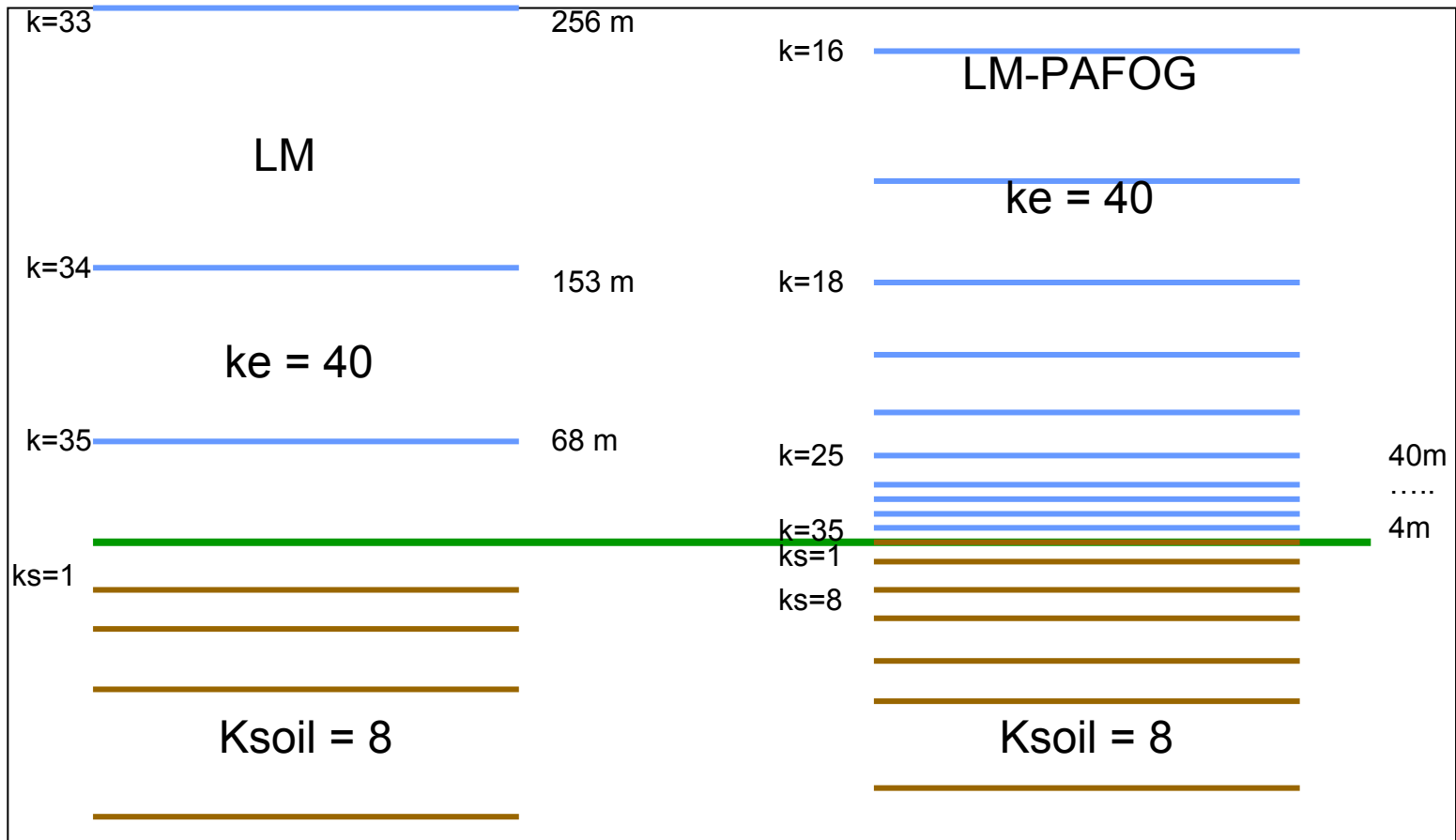
Resolution of LM-PAFOG

Horizontal Resolution : 100 x 80 pixels $\Delta xy = 1.0 \text{ km}$

Vertical Resolution : Atmosphere – 40 levels $\Delta z_{\min} = 4 \text{ m}$

25 levels in the lowest 2 000 m

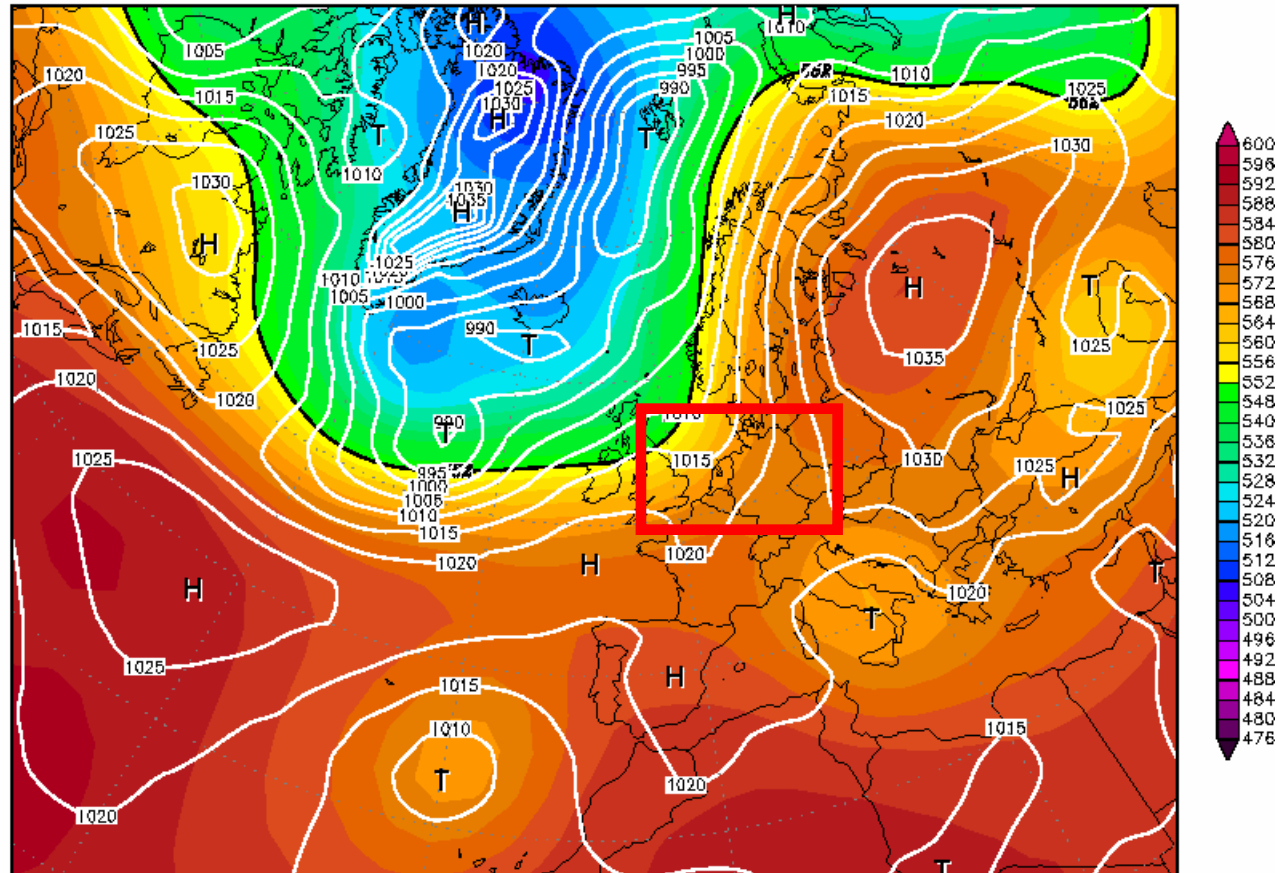
Soil - 8 levels



Synoptic situation 09.10.2005 00UTZ

09OCT2005 00Z

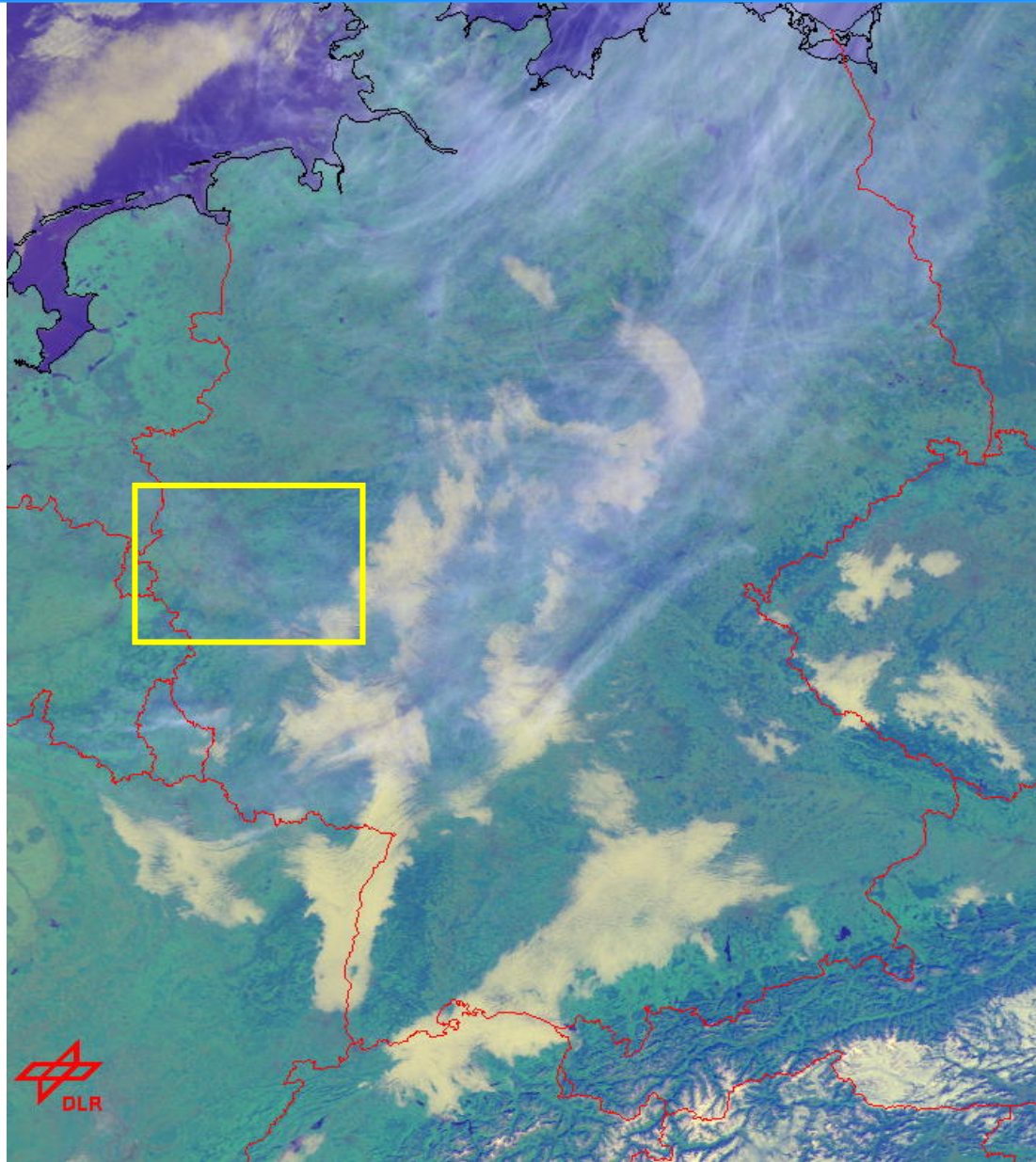
500 hPa Geopotential (gpm) und Bodendruck (hPa)



Daten: Reanalysis des NCEP
(C) Wetterzentrale
www.wetterzentrale.de

Synoptic Situation 09.10.2005 10:00 UTC

NOAA

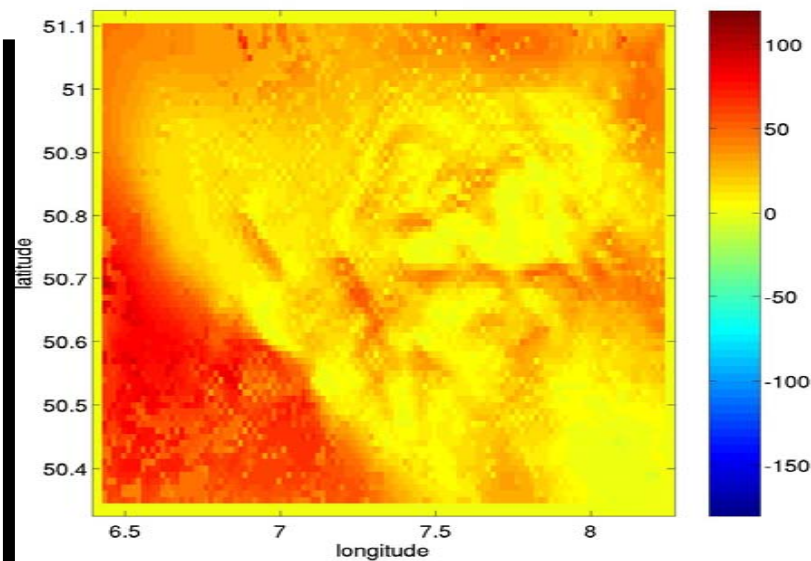
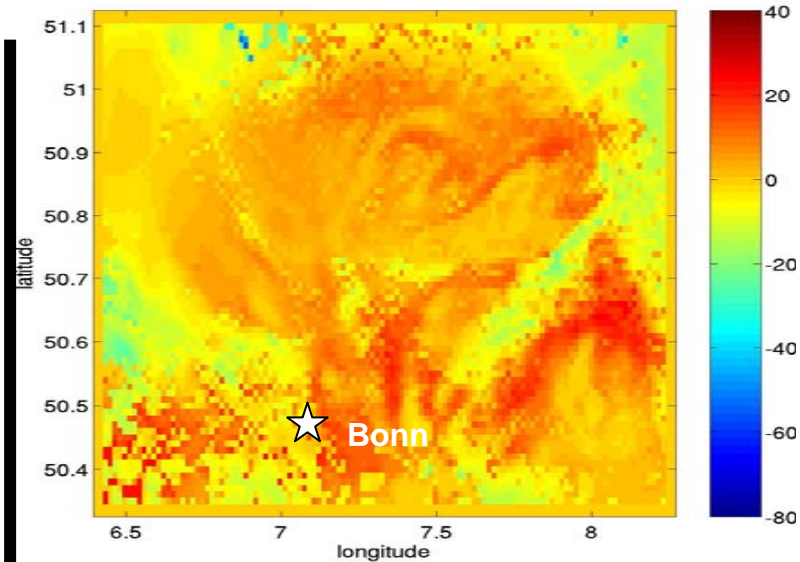


2 UTC

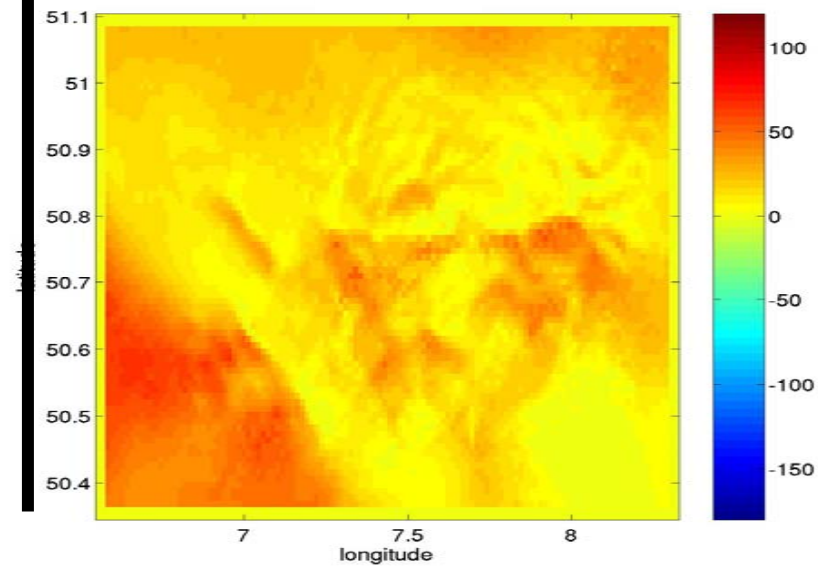
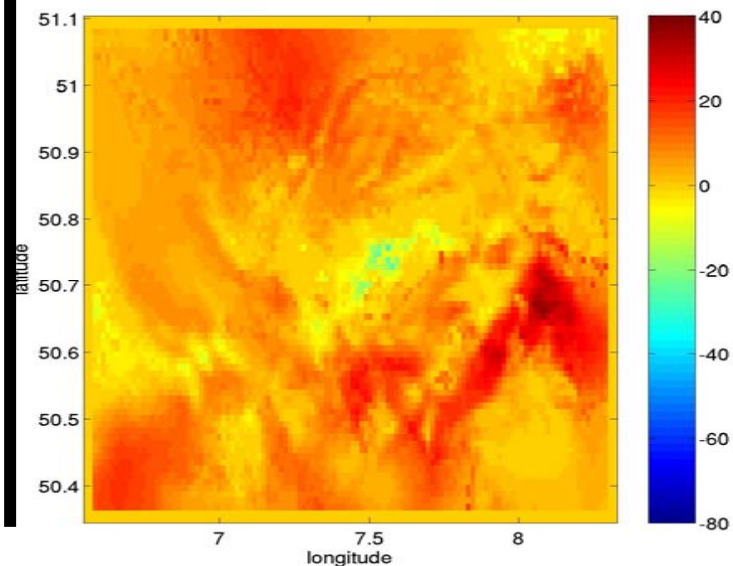
Latent Heat Fluxes W/m^2

Sensible Heat Fluxes W/m^2

Dataset
DWD



New
Dataset

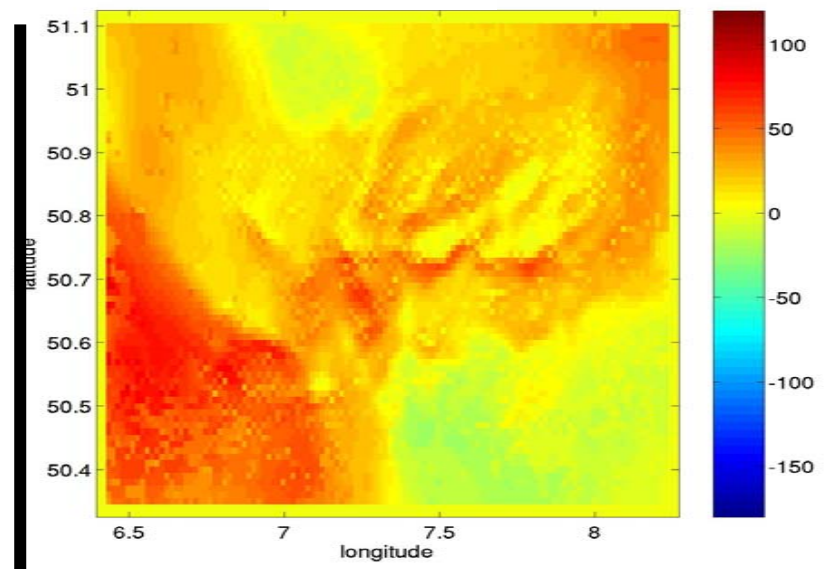
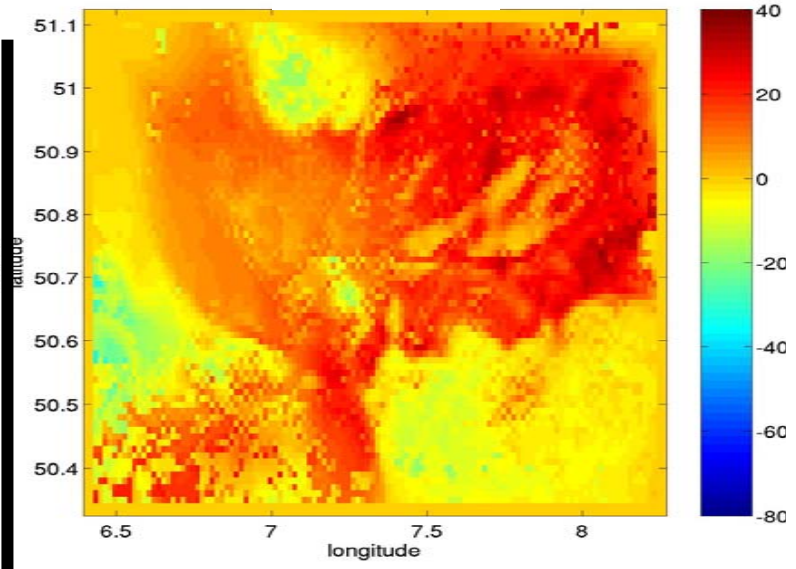


Latent Heat Fluxes

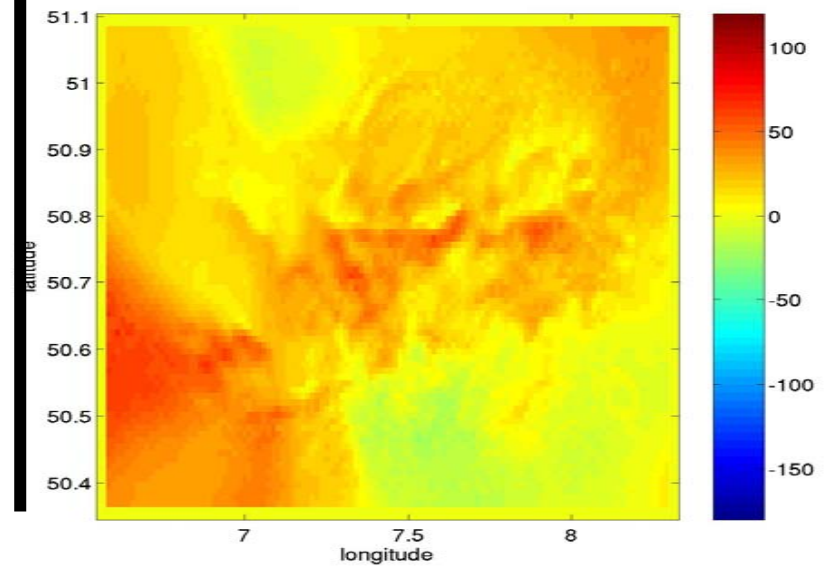
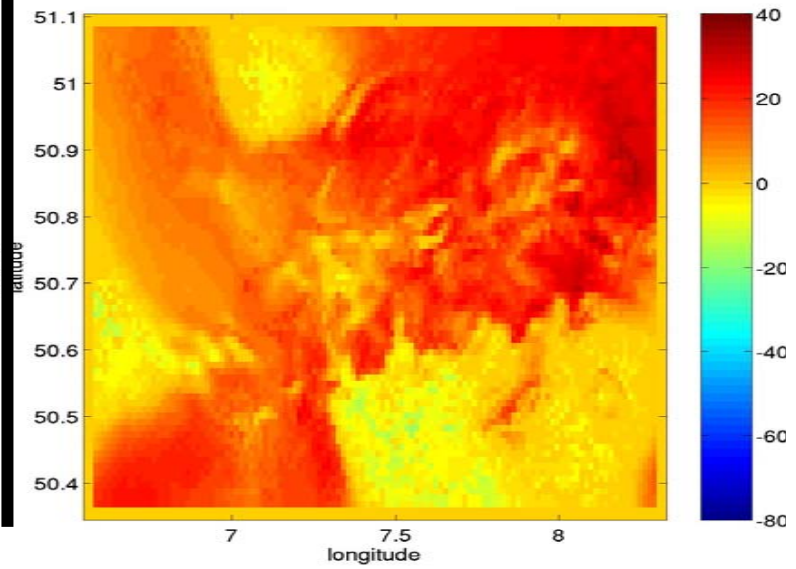
Sensible Heat Fluxes

4 UTC

Dataset
DWD



New
Dataset

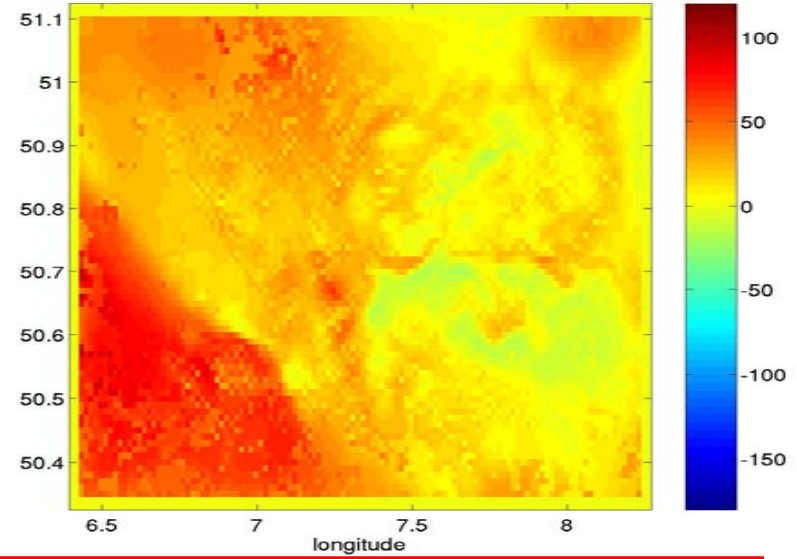
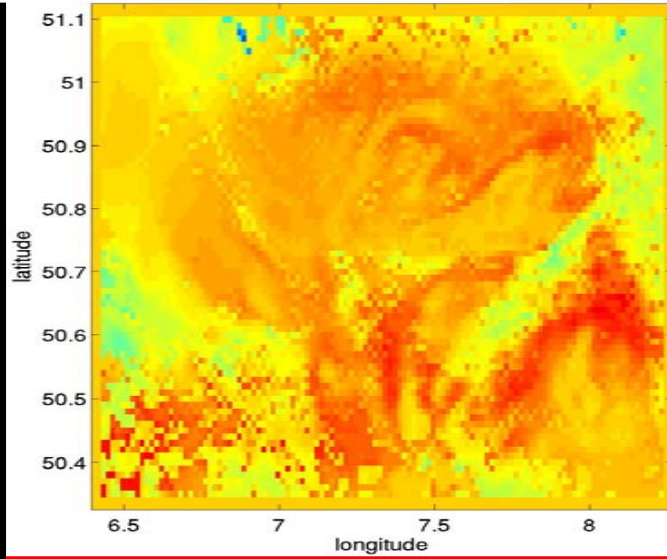


6 UTC

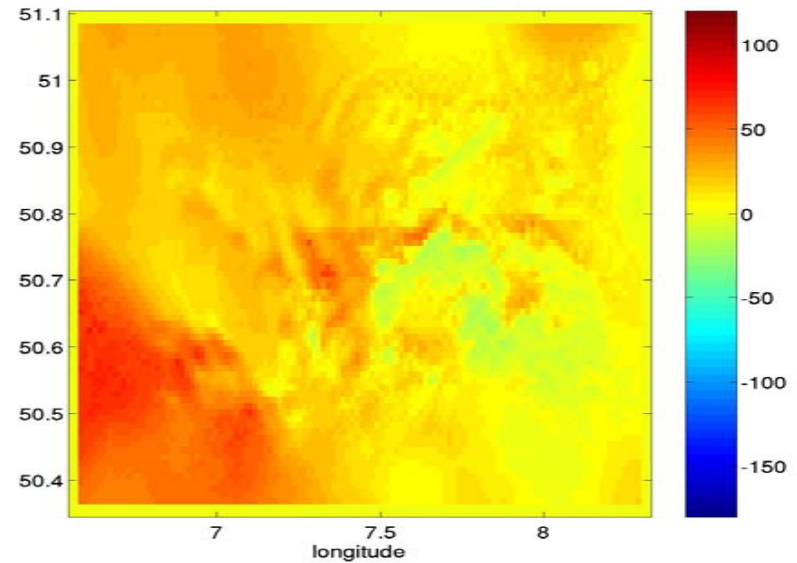
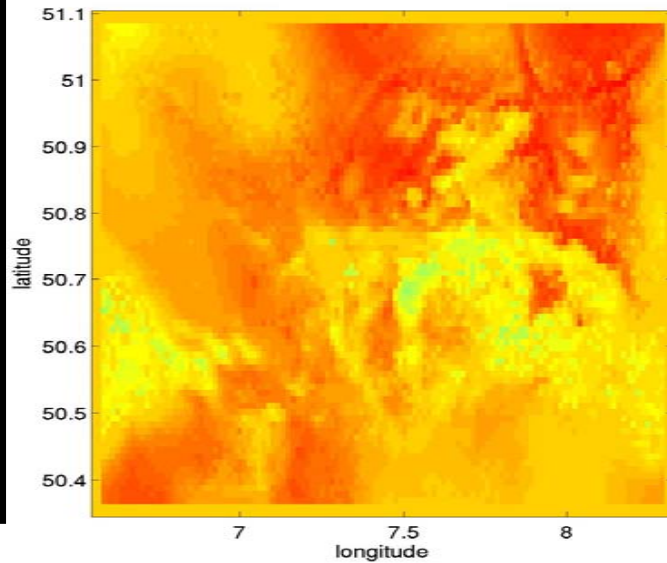
Latent Heat Fluxes W/m^2

Sensible Heat Fluxes W/m^2

Dataset
DWD



New
Dataset

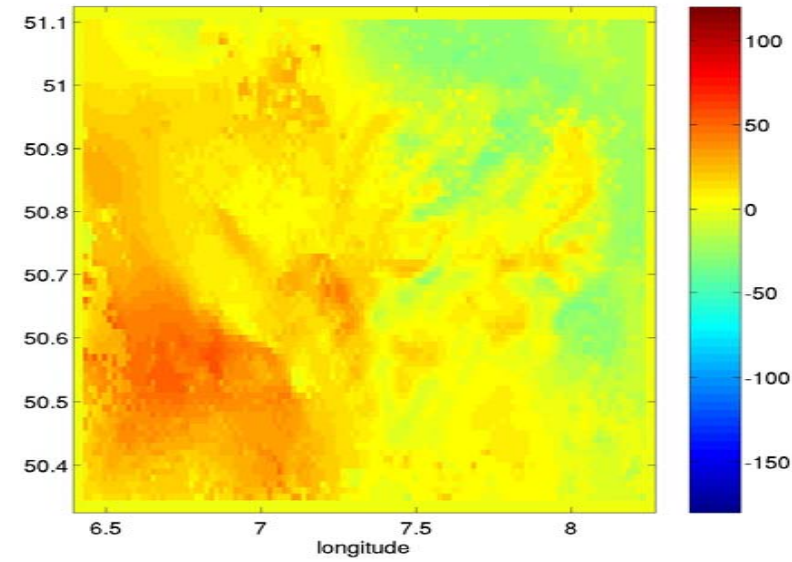
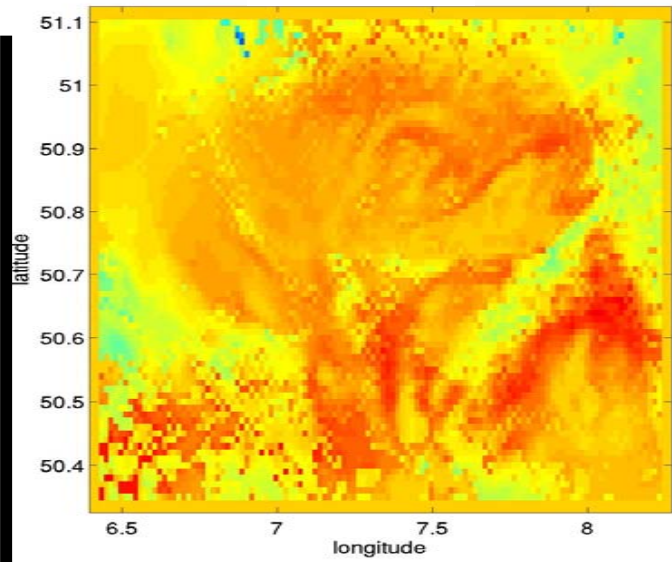


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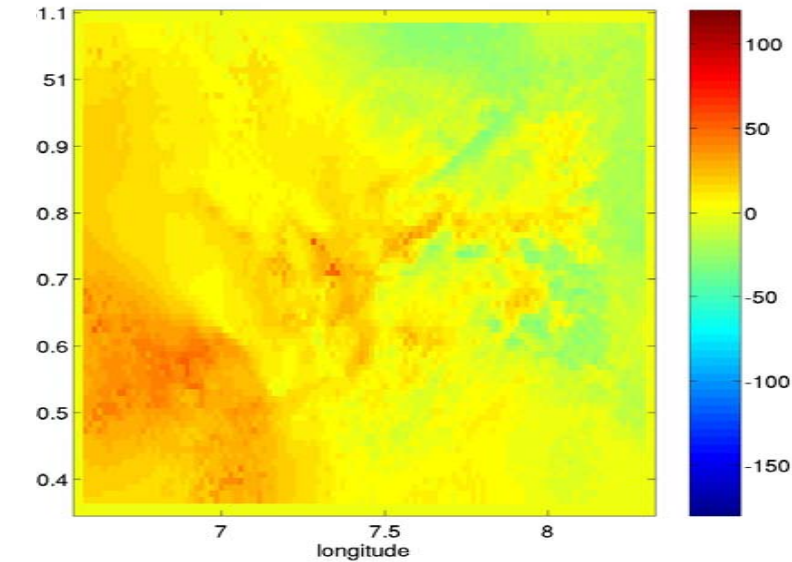
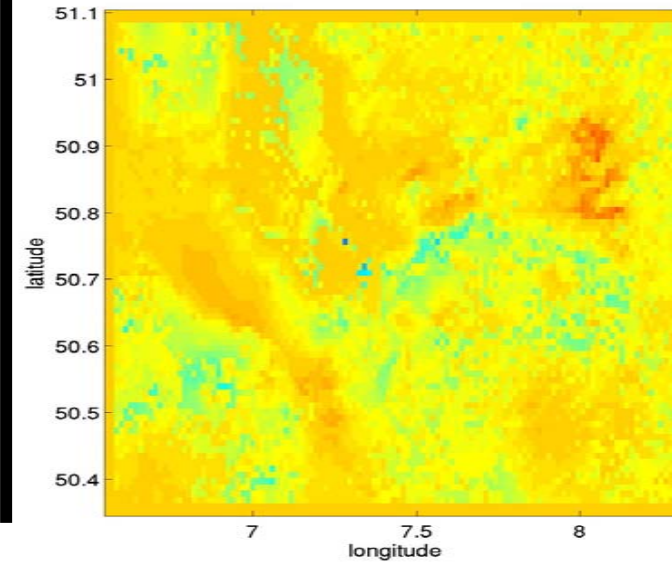
Latent Heat Fluxes W/m^2

Sensible Heat Fluxes W/m^2

Dataset
DWD



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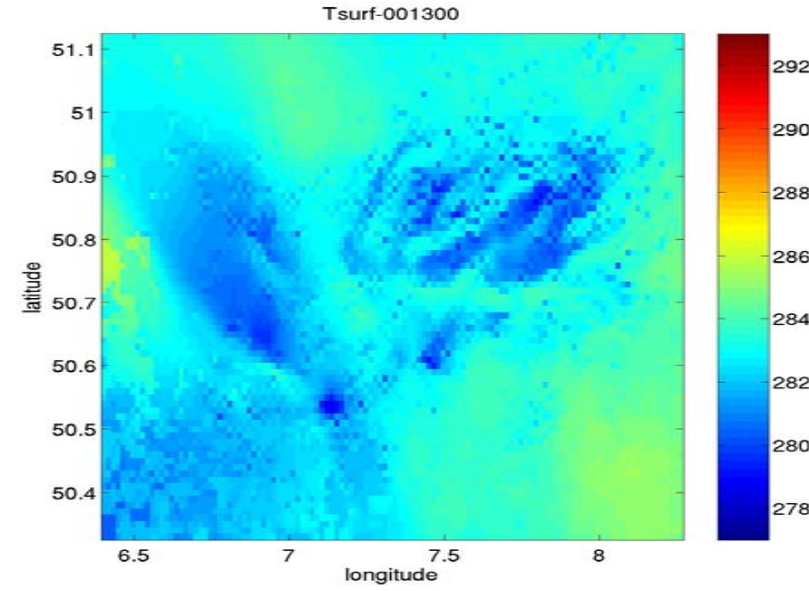
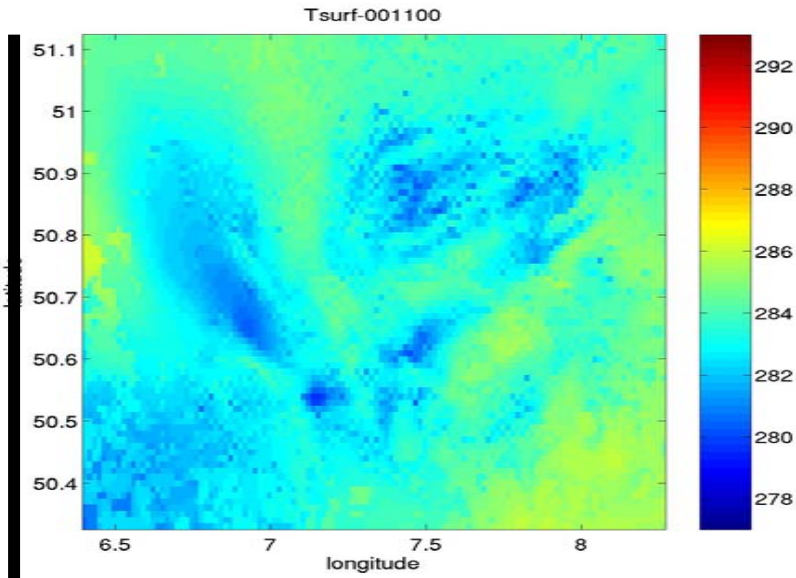


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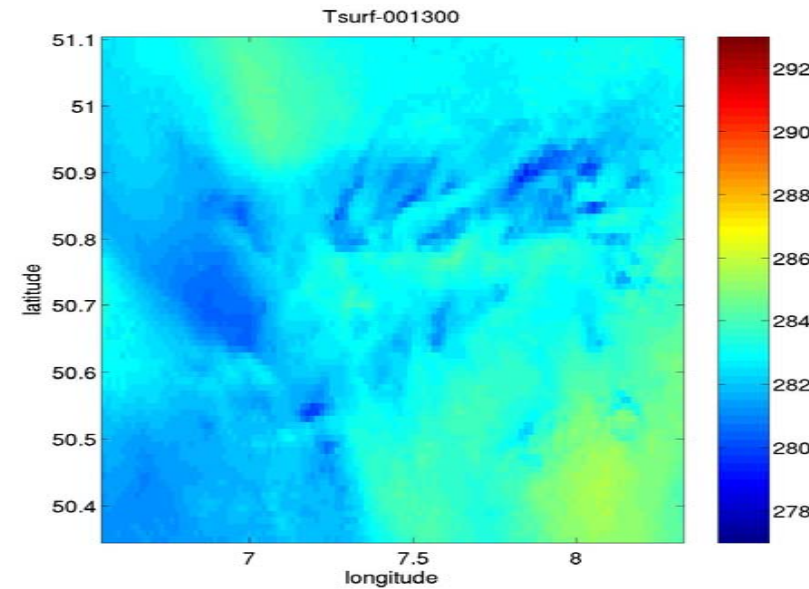
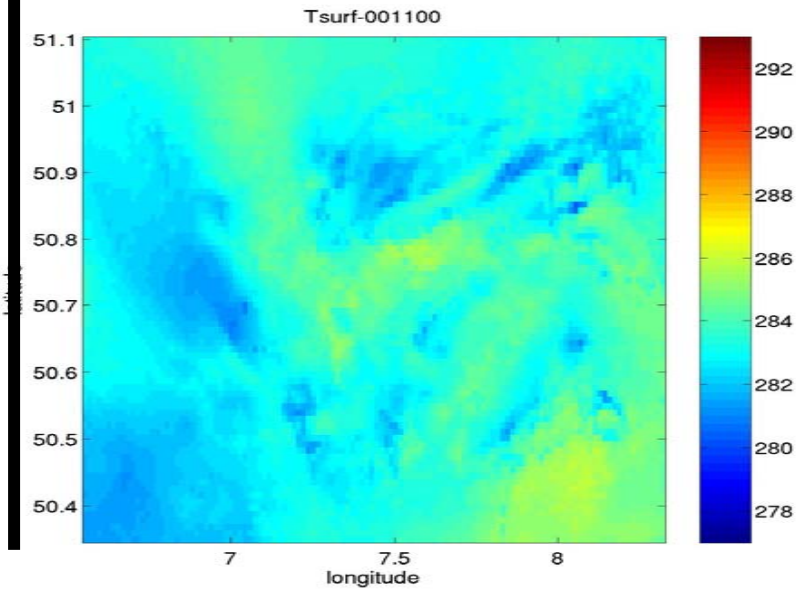
Soil Temperature K

4 UTC

Dataset
DWD



New
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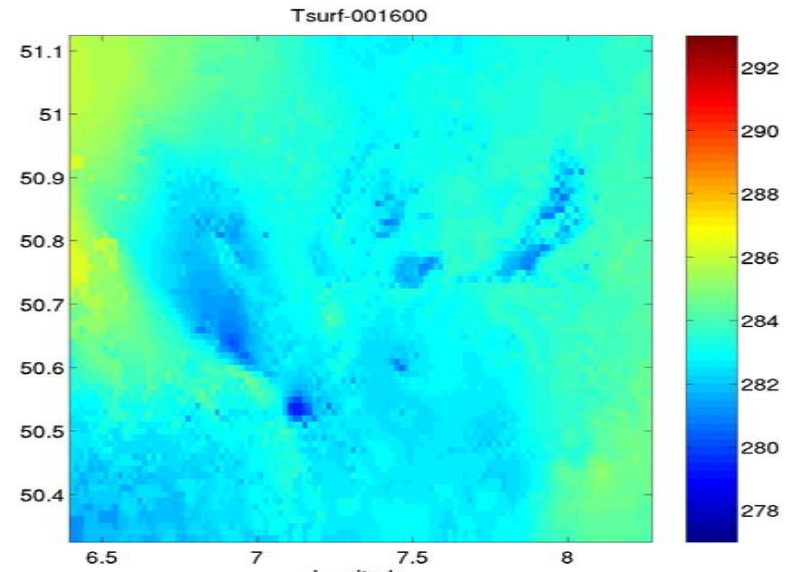
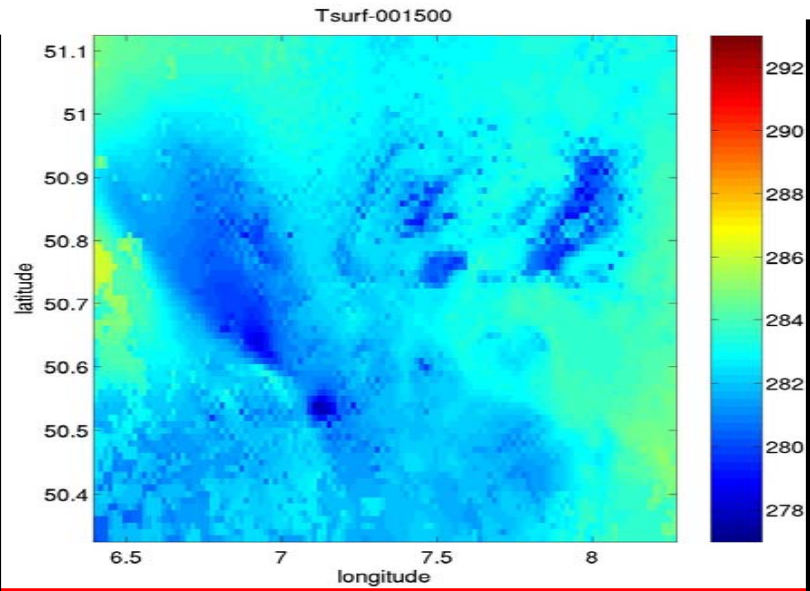


Soil Temperature K

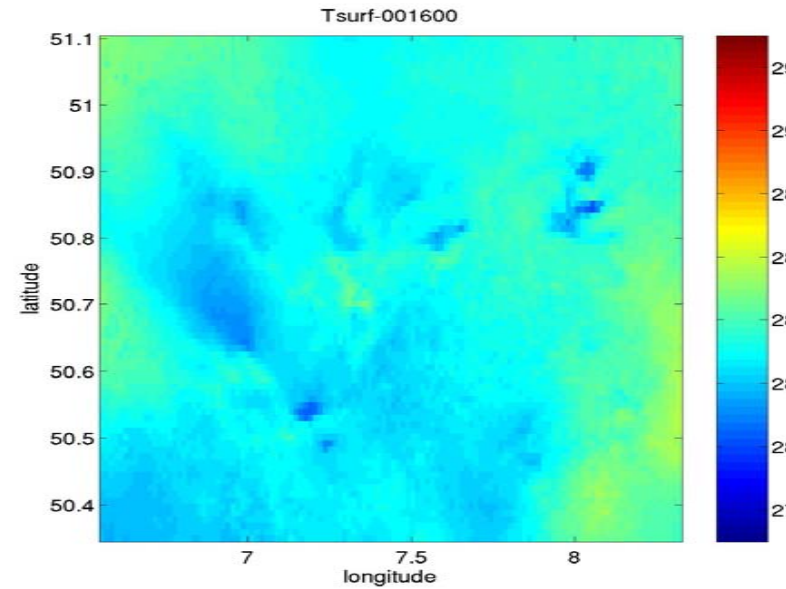
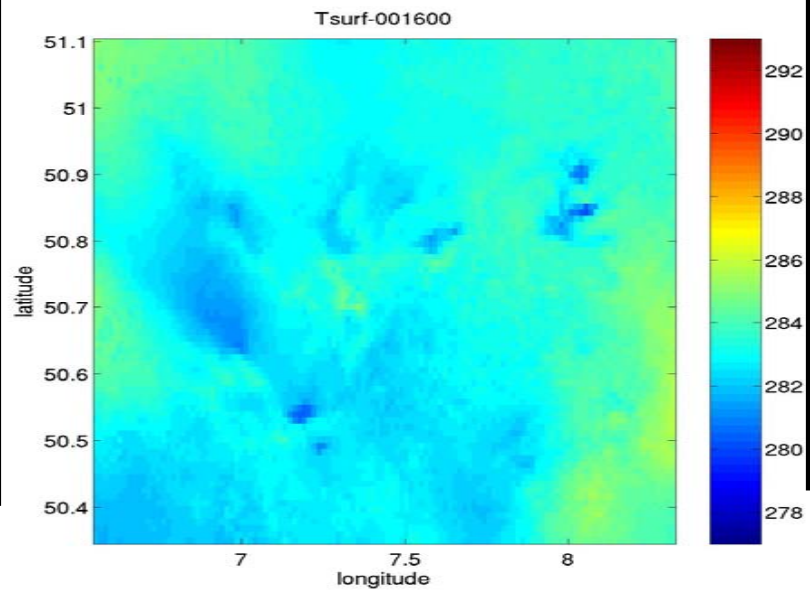
6 UTC

7 UTC

Dataset
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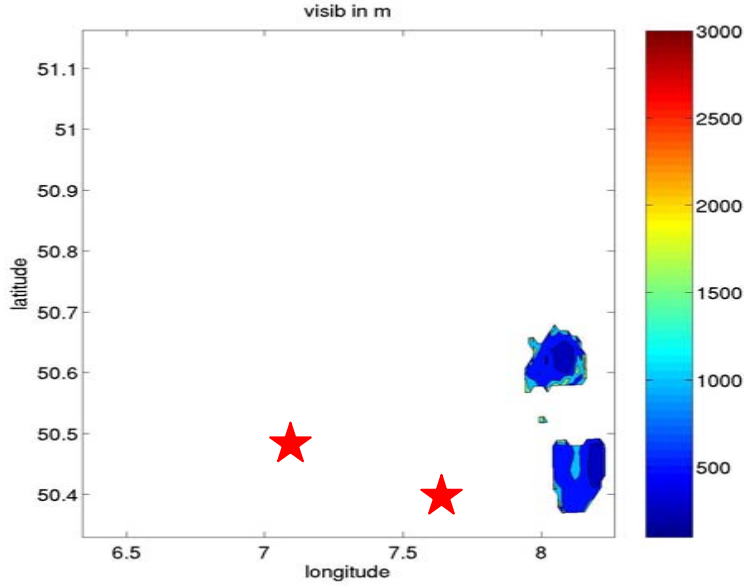
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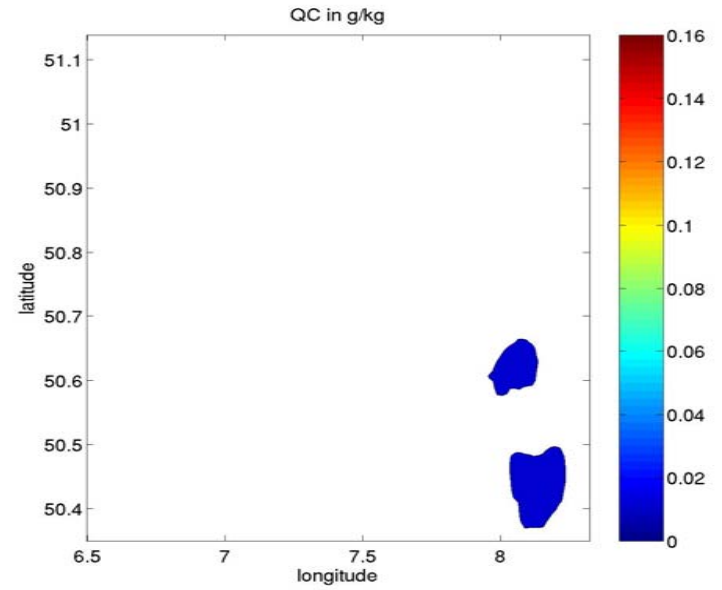
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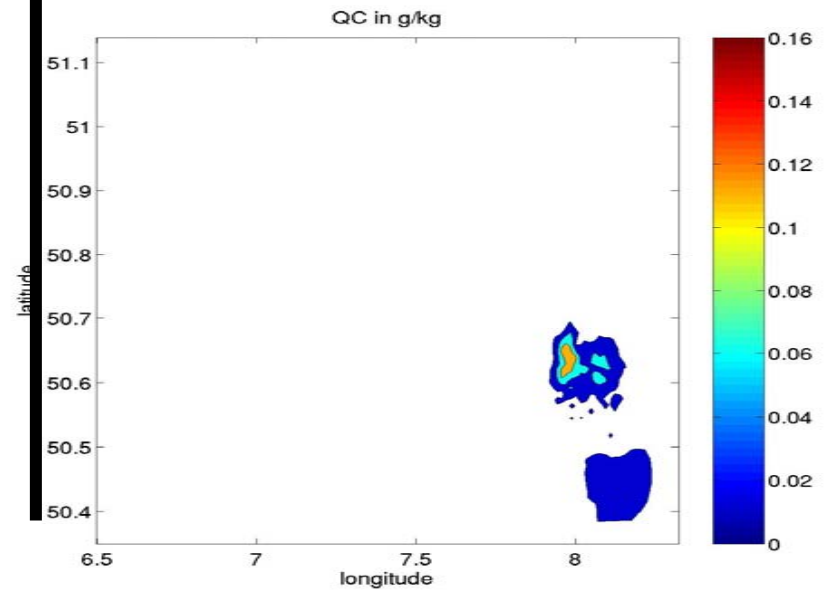
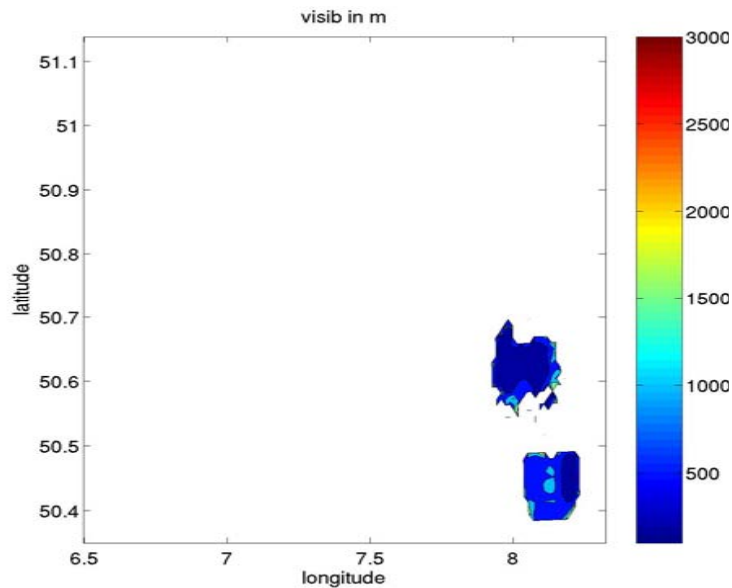
Visibility in m



QC g/kg



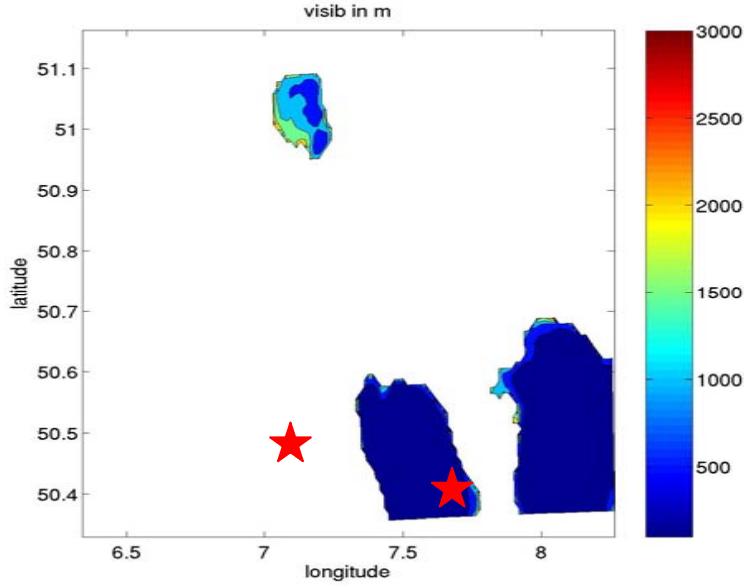
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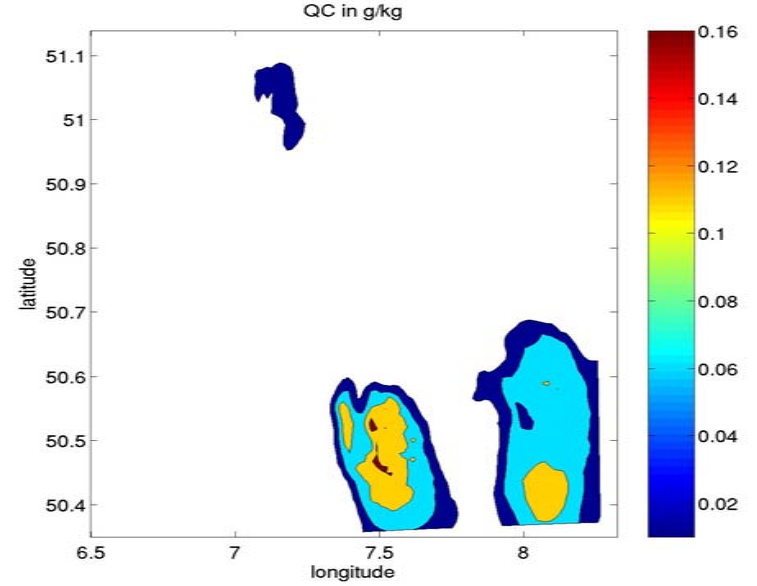
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Dataset
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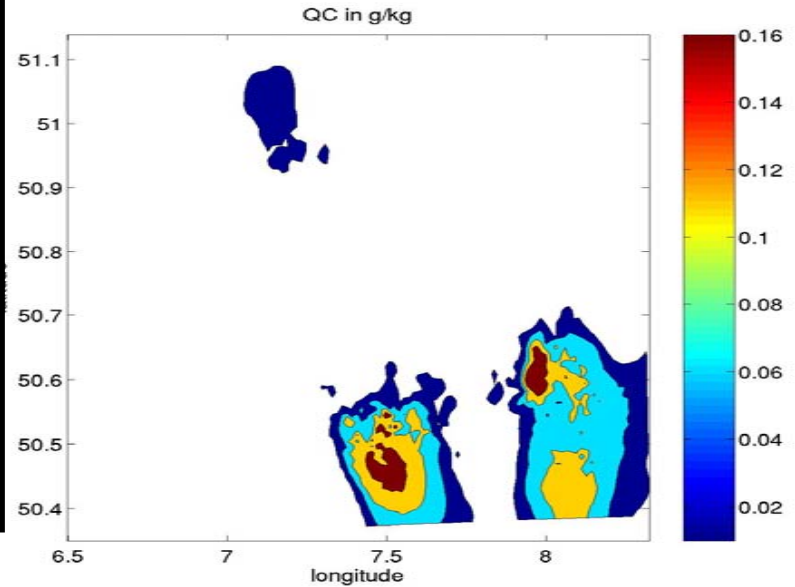
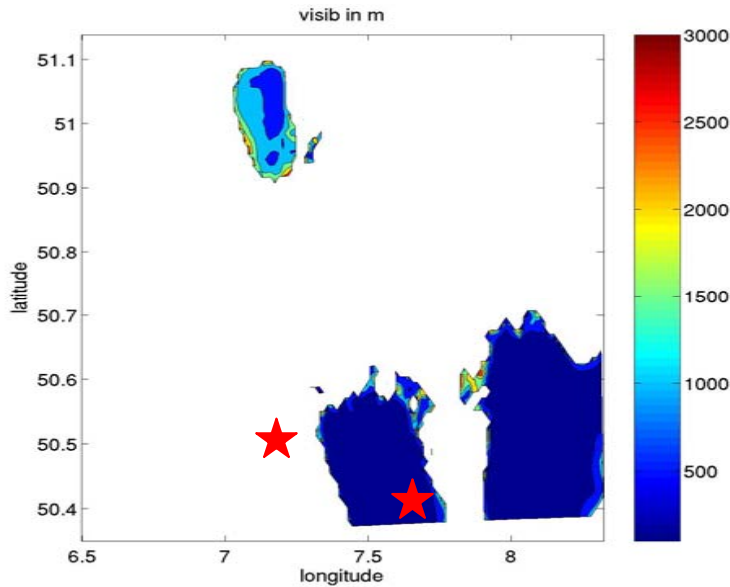
Visibility in m



QC g/kg



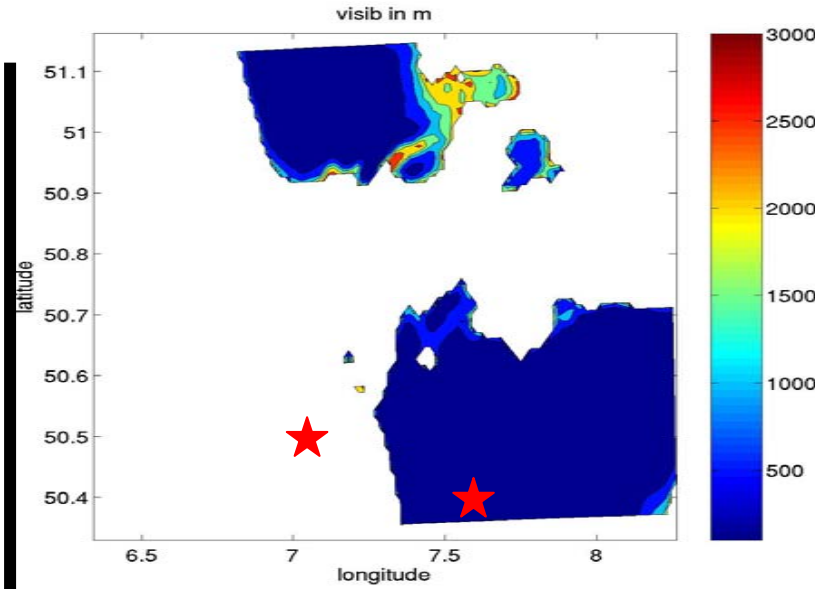
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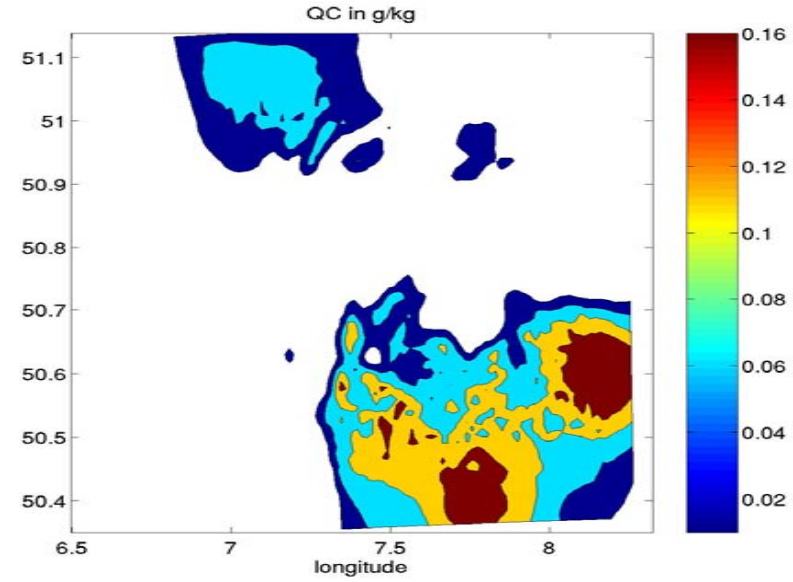
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Dataset
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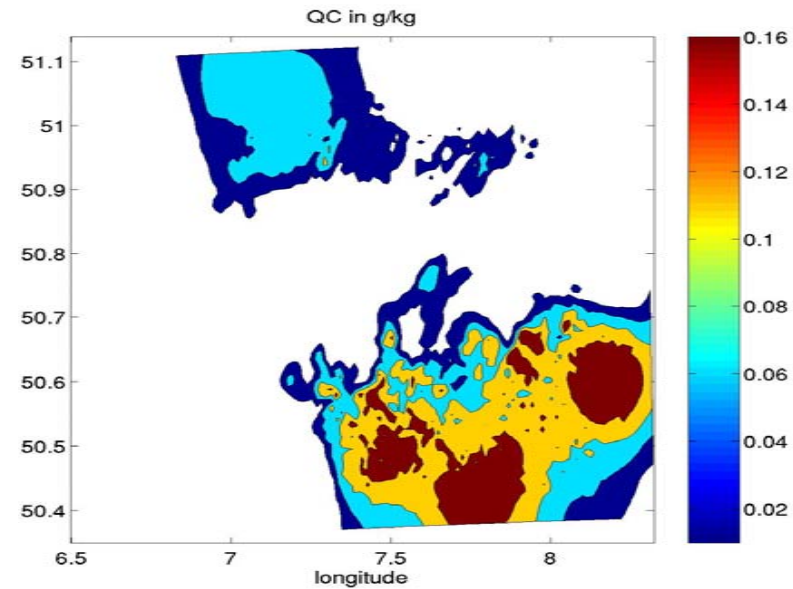
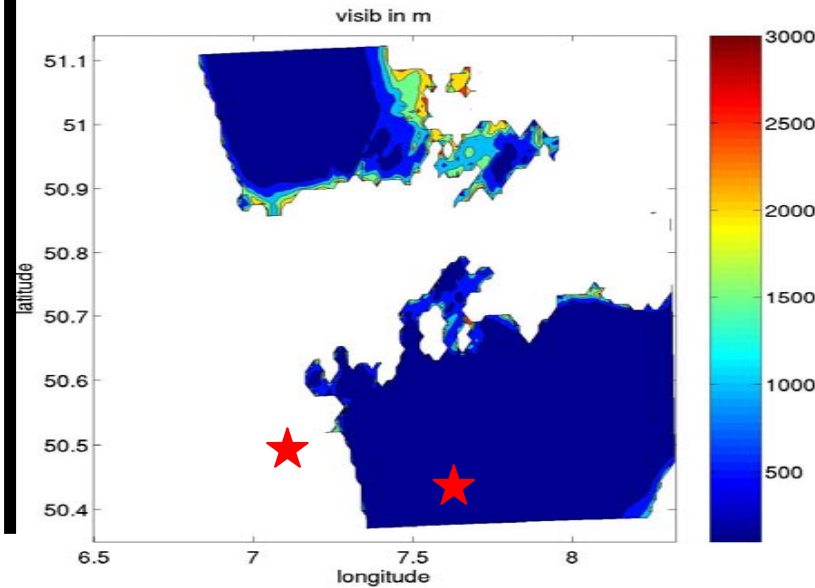
Visibility in m



QC g/kg



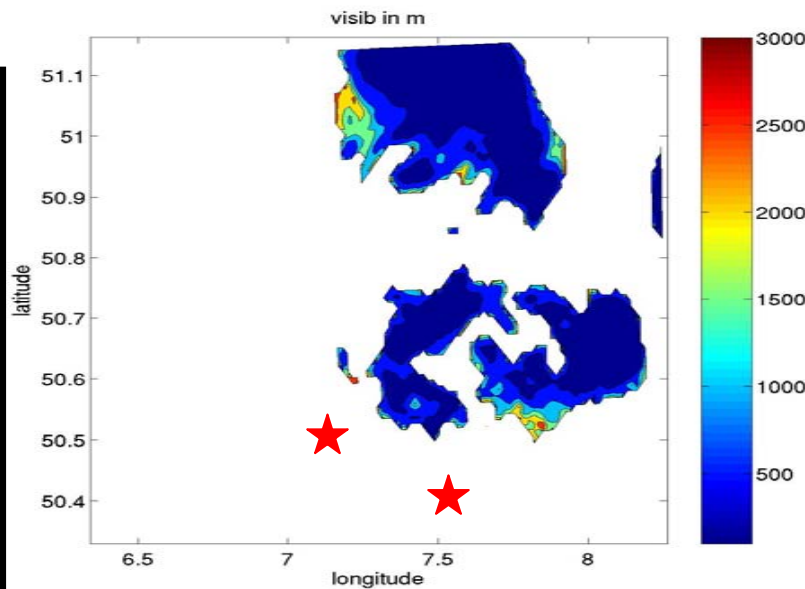
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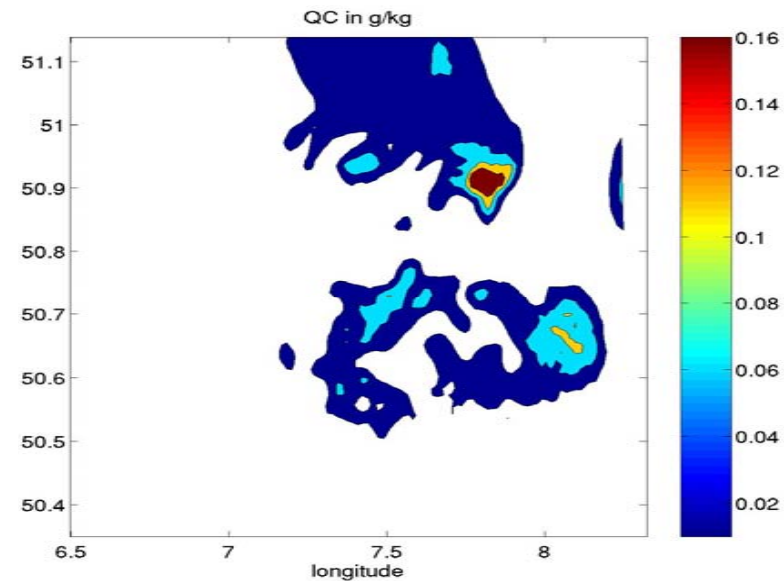
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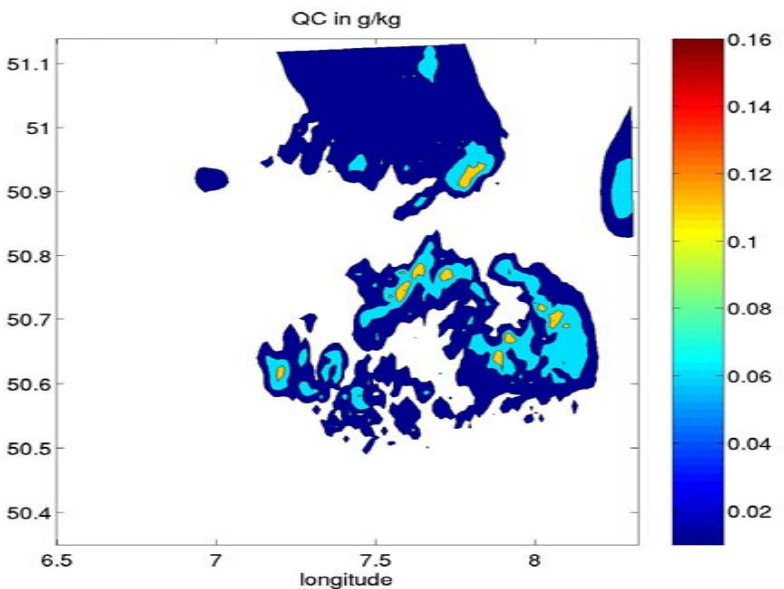
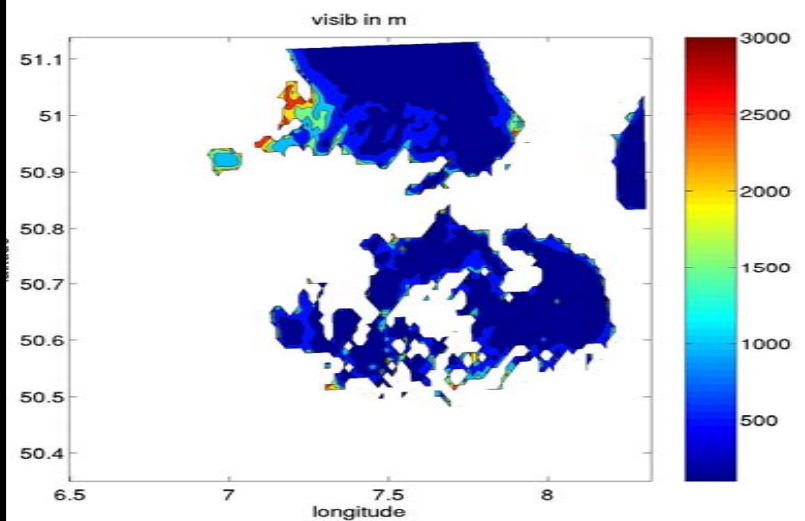
Visibility in m



QC g/kg



New
Dataset

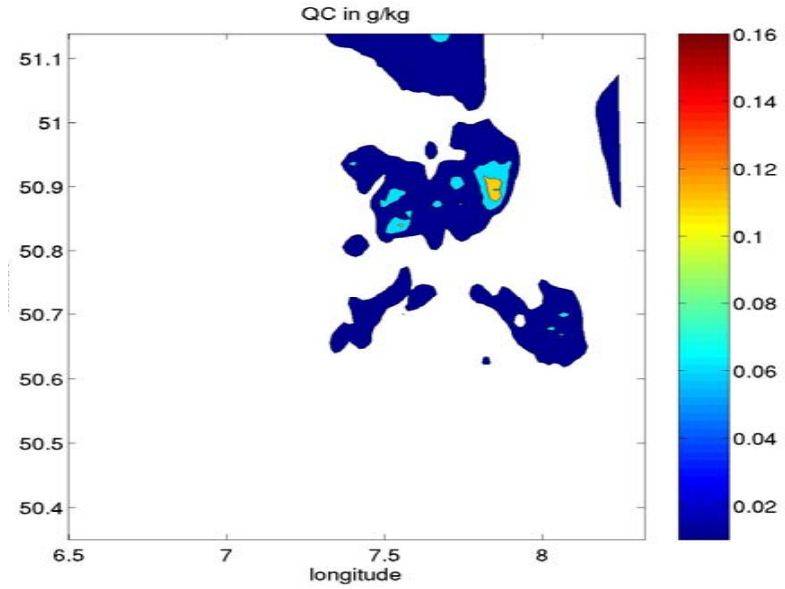
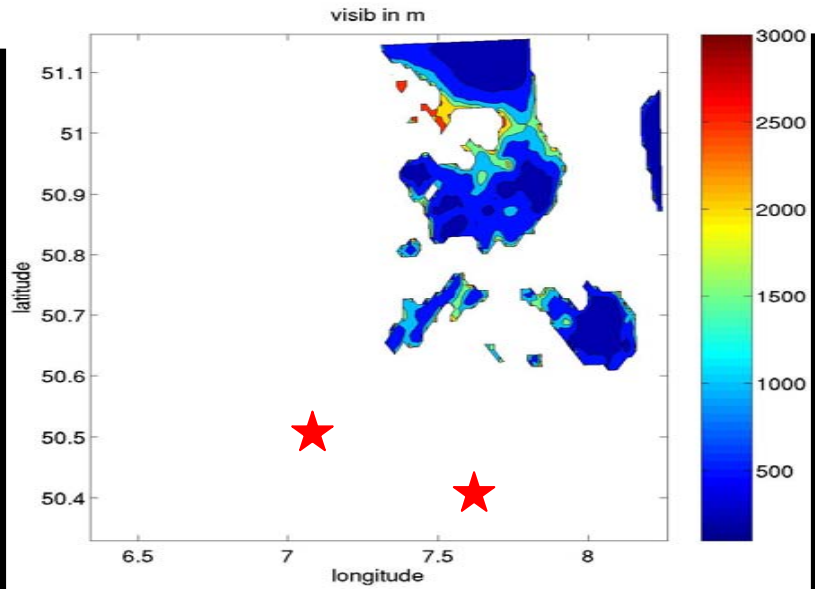


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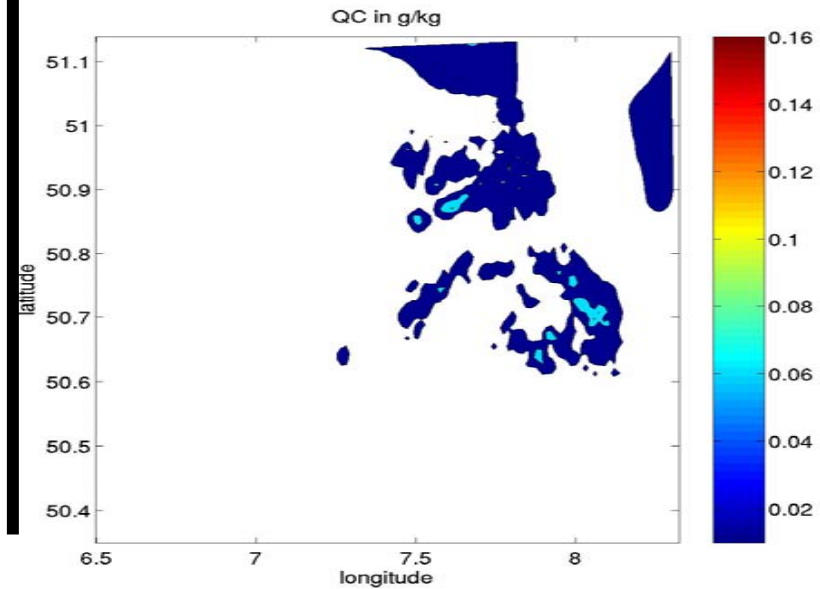
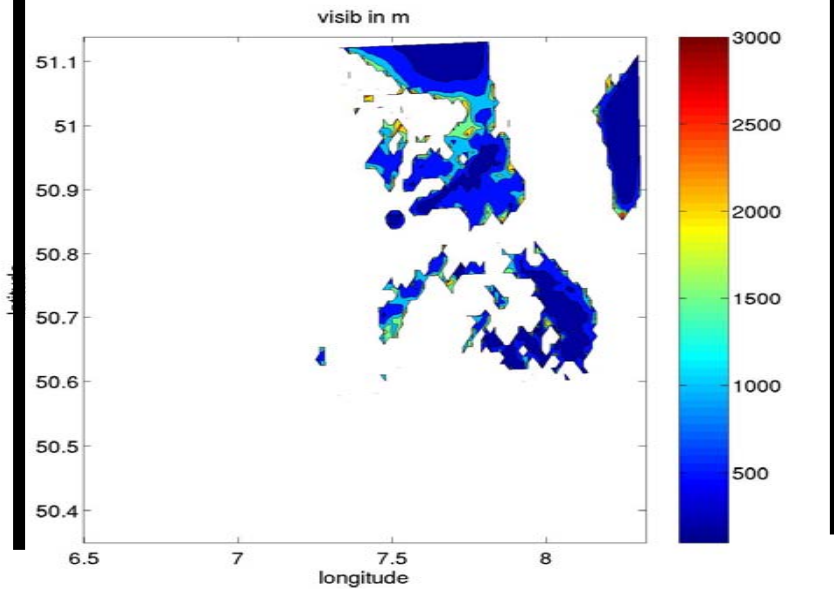
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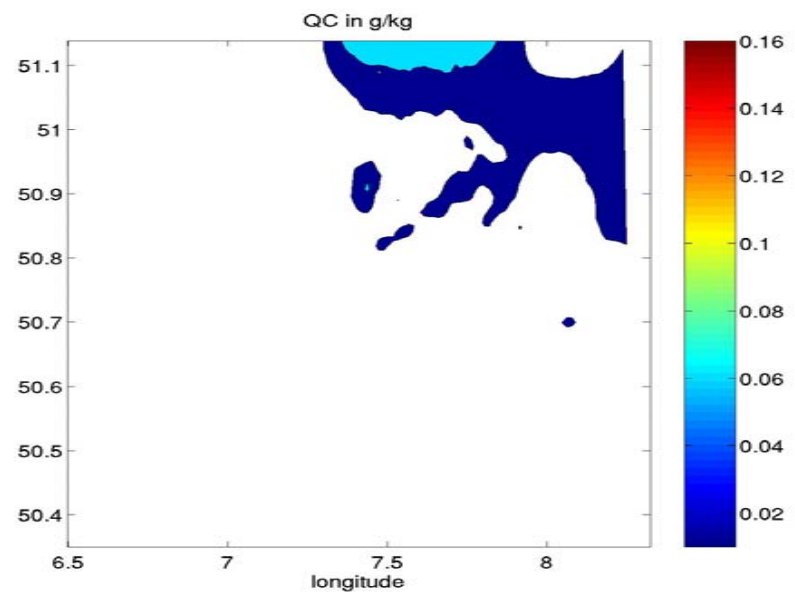
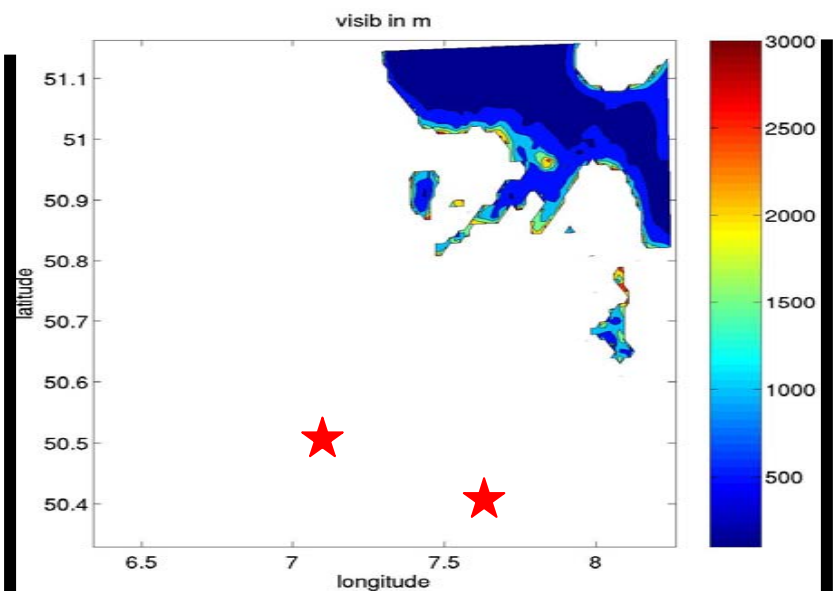


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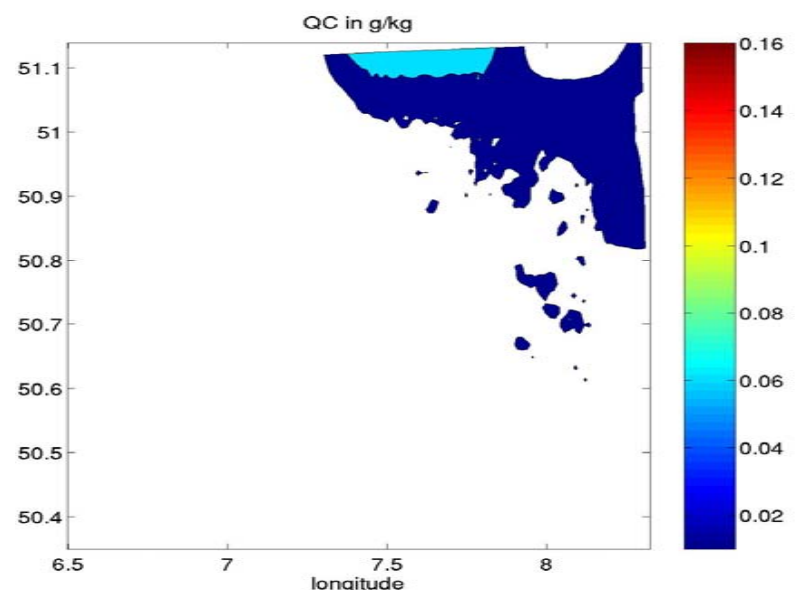
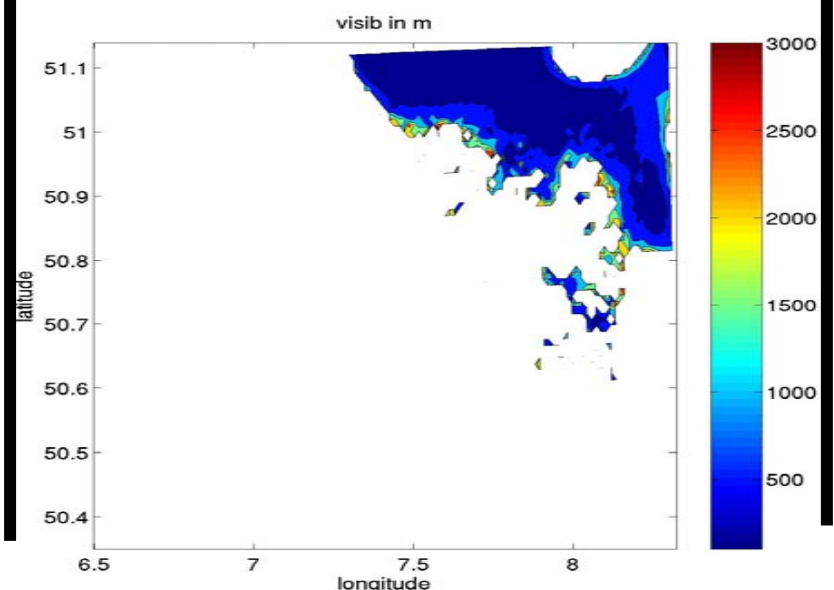
Visibility in m

QC g/kg

Dataset
DWD



New
Dataset



Conclusion and Outlook

Impact of the new implemented surface parameter is visible;

Characteristic **patterns correspond**, in detail are differences visible;

Simulation **produces fog** during the **observed fog period**, but not at the same place;

Up to now: just new topography and a new set of soil types implemented;

In near future: **Vegetation** will be take into consideration;

Vegetation Scheme ->

LM-PAFOG-VEGETATION

A misty landscape with rolling hills and trees, with a large tree silhouette on the right side.

THANK YOU