

Brussel, 8 April 2008

**Experiments with perturbed
Hirlam analyses based on
Singular Vectors**

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KNMI

The Netherlands

Compute 10 perturbations for Hirlam analysis from:

- - Hirlam Singular Vectors (*Cape* norm or *Energy* norm)
- - error field of analysis

and make 11 forecasts

ECMWF scripts for perturbation computations were modified for use in the Hirlam system (*KNMI*)

- Adding perturbations to analysis in the Hirlam system performed by *Kai Sattler (DMI)*

Computation of perturbations

1) Compute singular vectors with Hirlam

2) scale amplitude with error field analysis

3) Gaussian sampling

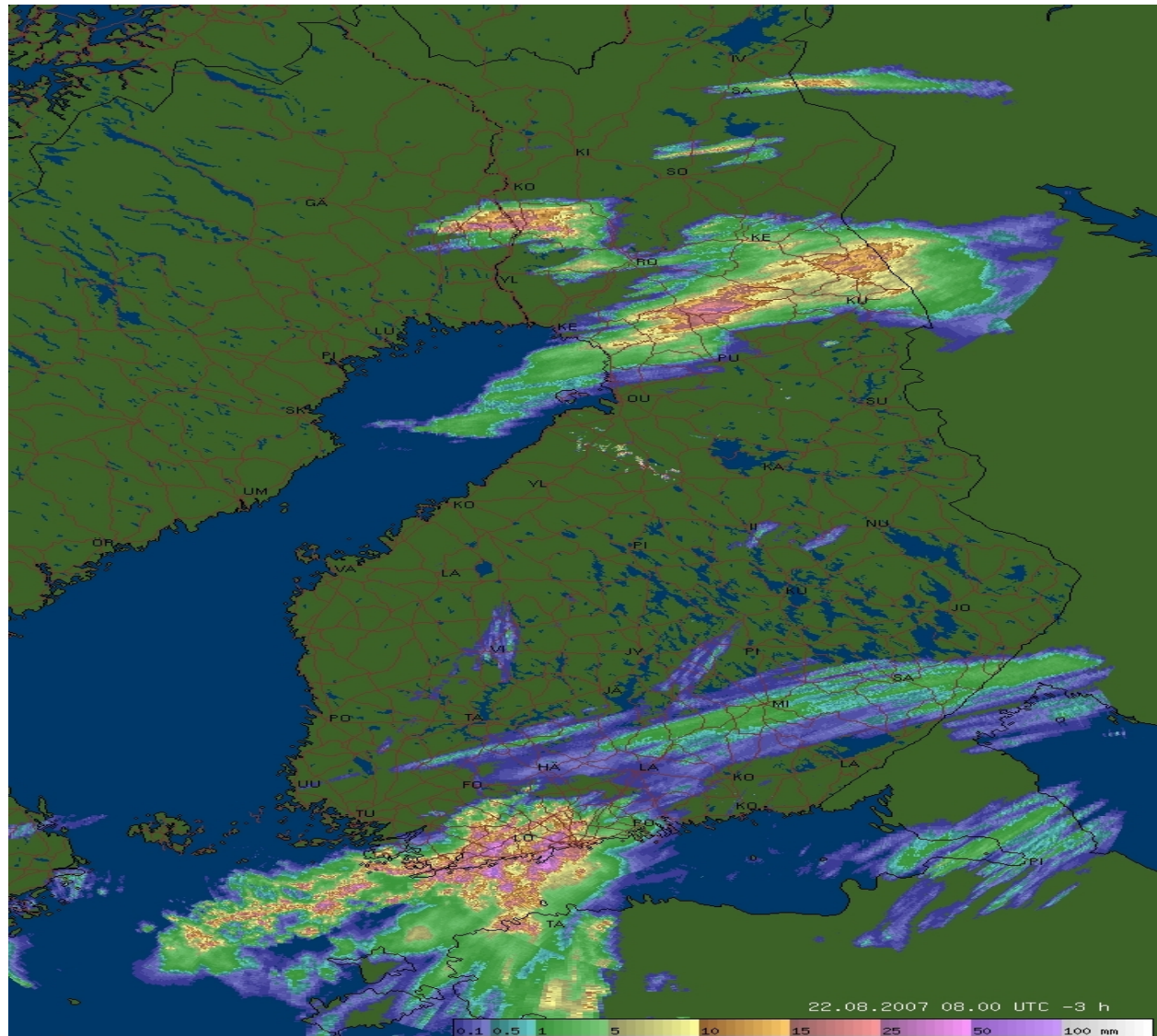
4) linear combination of perturbations

Case study:

- Convective activity over southern Finland missed by Hirlam (22 August 2007, 6 UTC)
- Perturbations of temperature and velocity fields

New run: 20070821 12 UTC + 36 h

Radar image

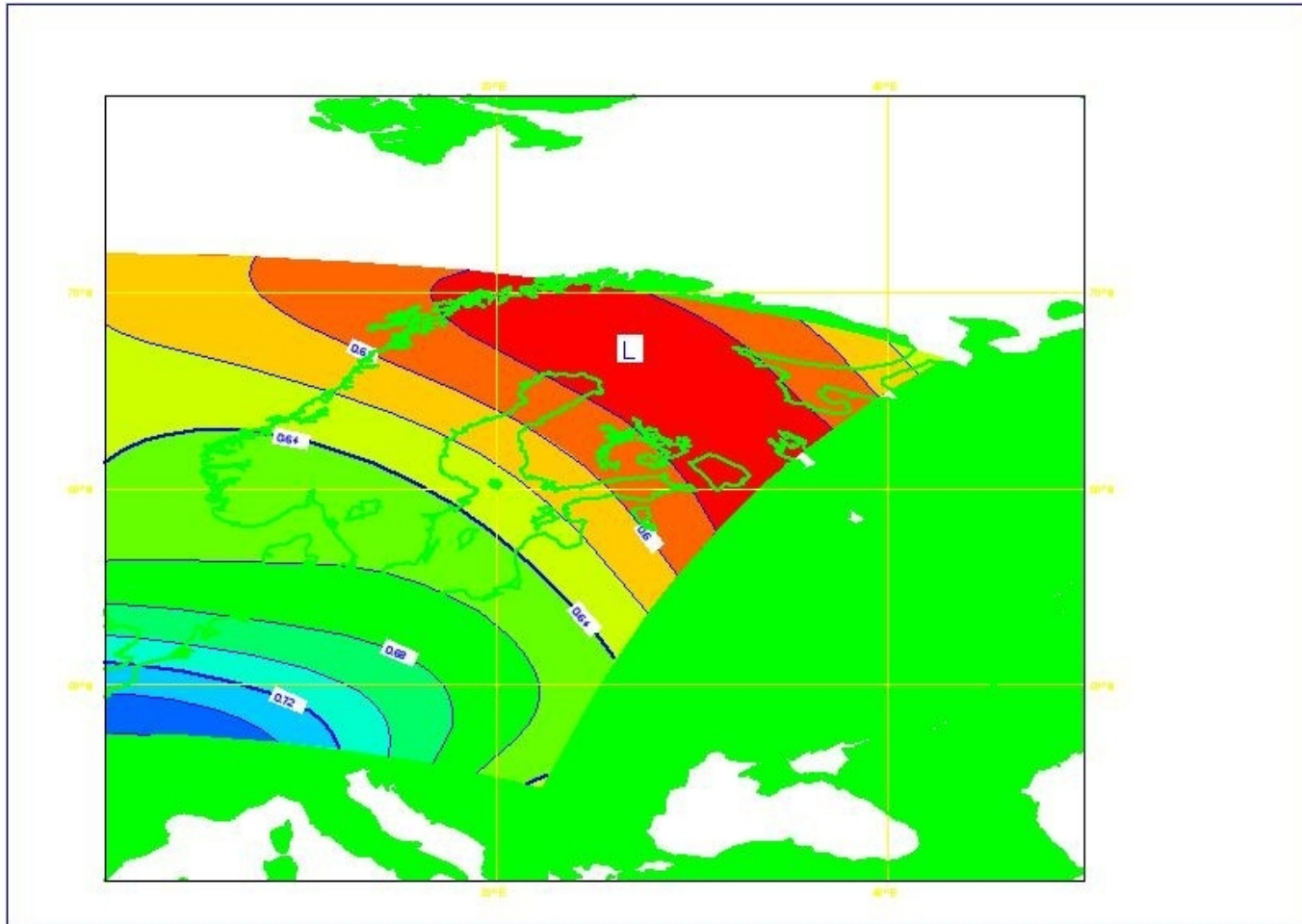


Resolution and domain:

- Resolution of Singular Vectors
0.5 degree (55 km)

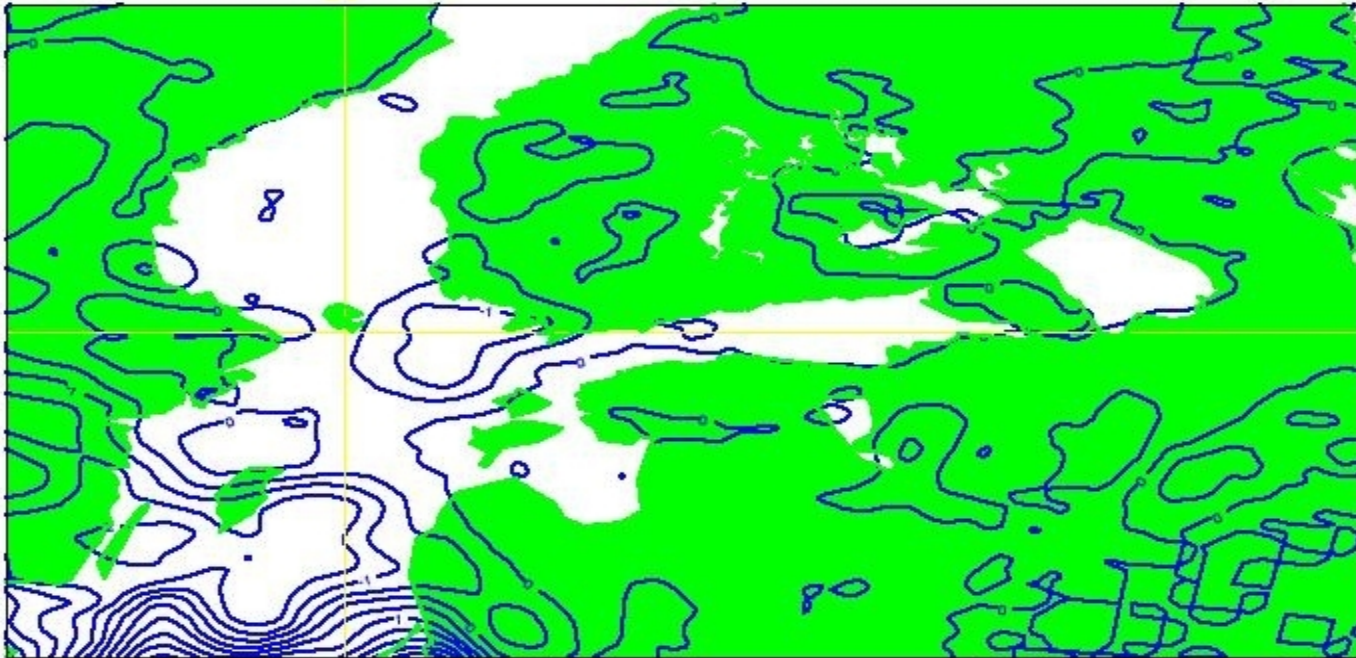
- Forecast domain:
0.2 degree (22 km)

Error fields analysis from 4D-VAR



Initial temperature perturbations at 850 hPa (CAPE norm) cntr 0.5 C. max. 3C

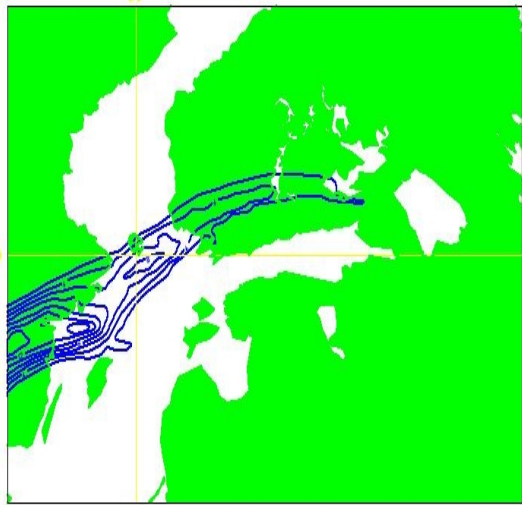
Analysis VT:Tuesday 21 August 2007 12UTC 850hPa **temperature



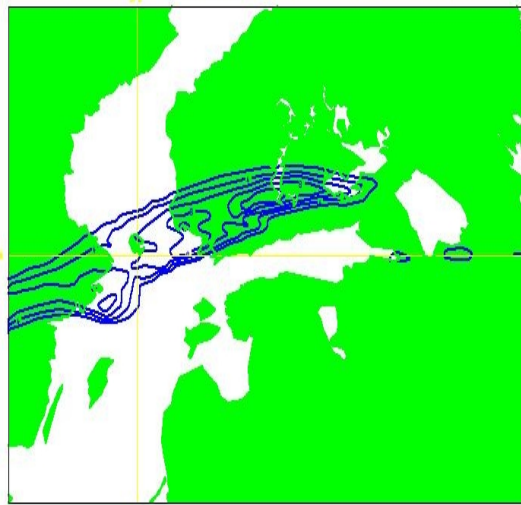
Precipitation fields (CAPE norm)

Mean total precipitation intensity between 3 UTC and 9 UTC (mm / 6 h)

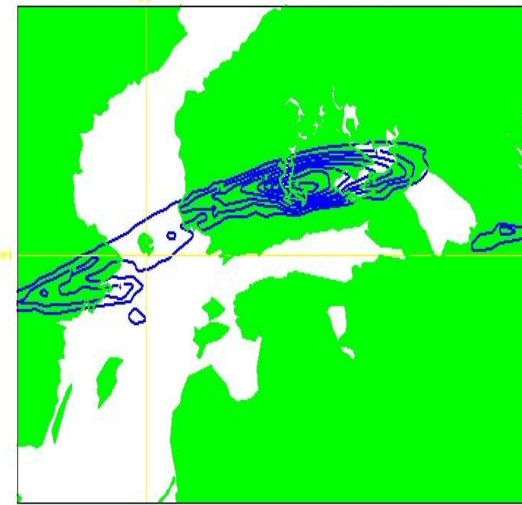
Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation



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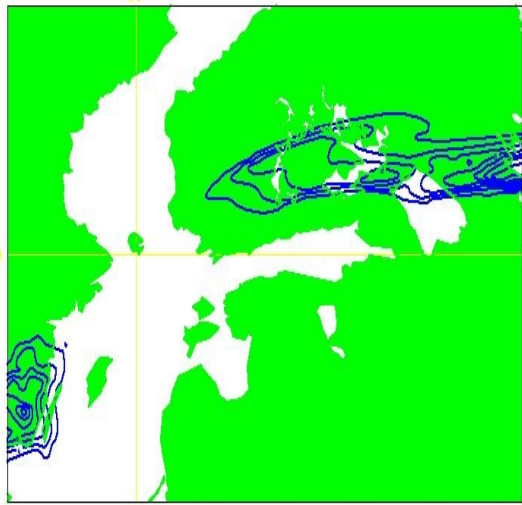


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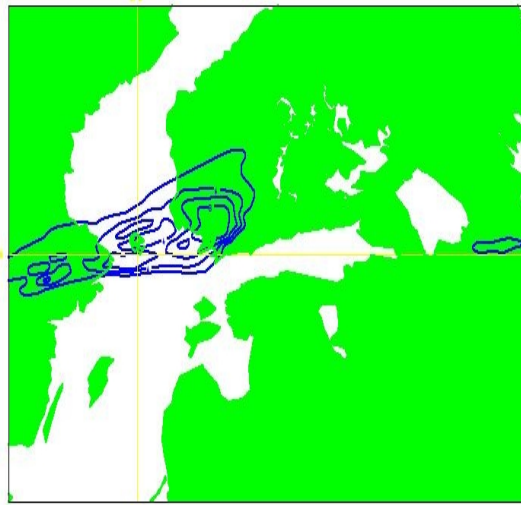


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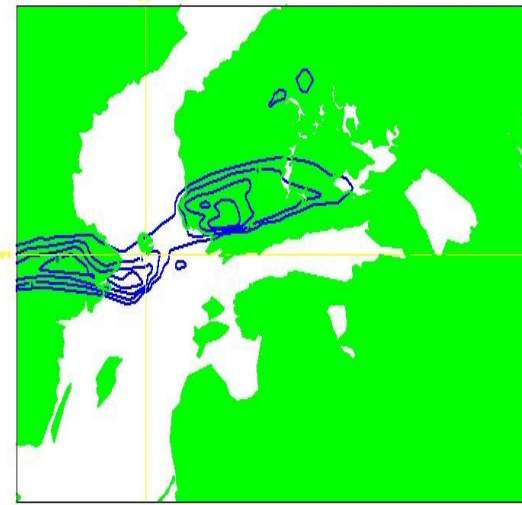
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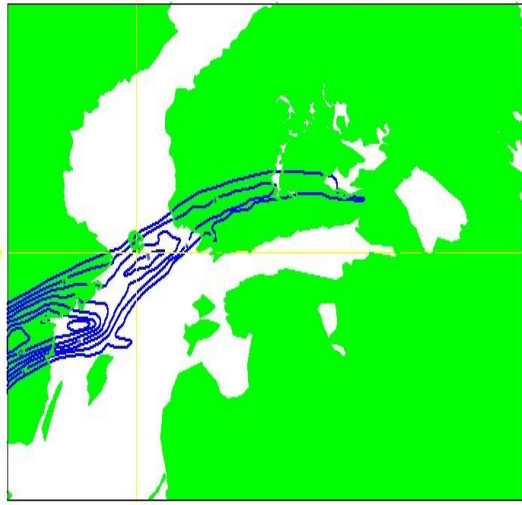
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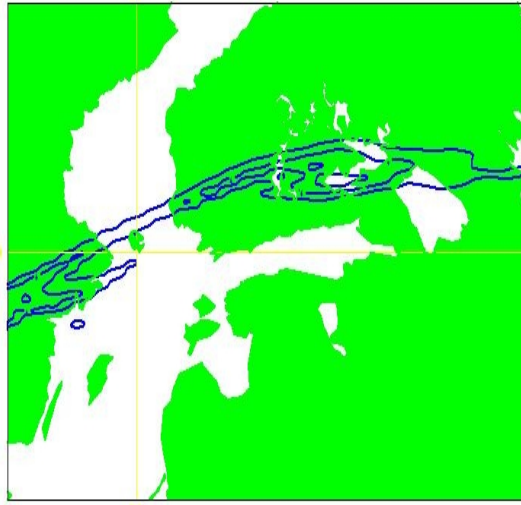
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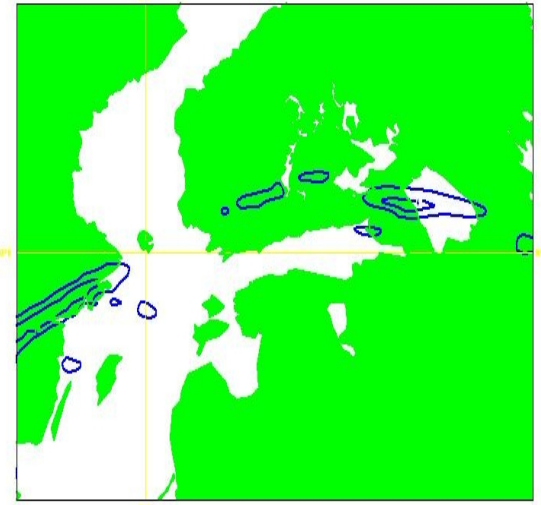
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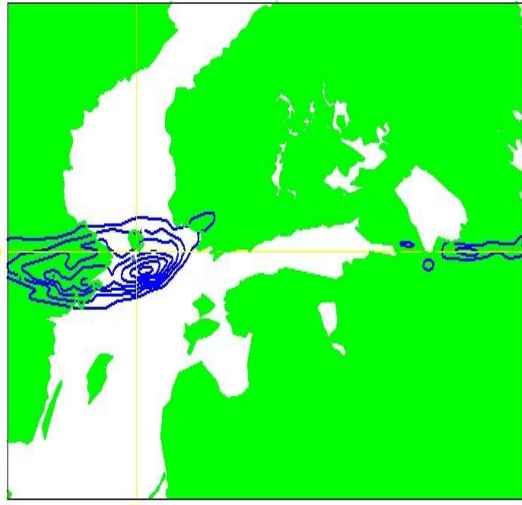


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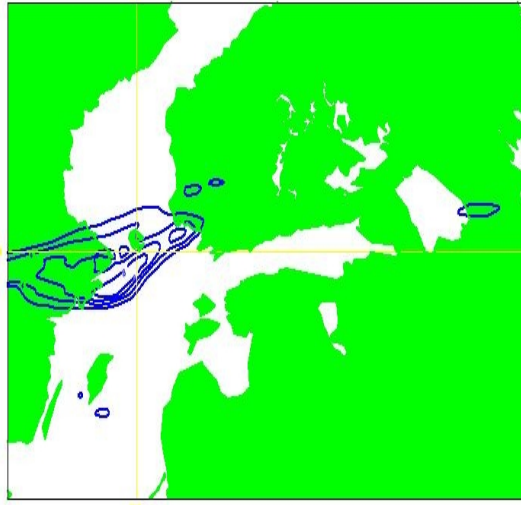


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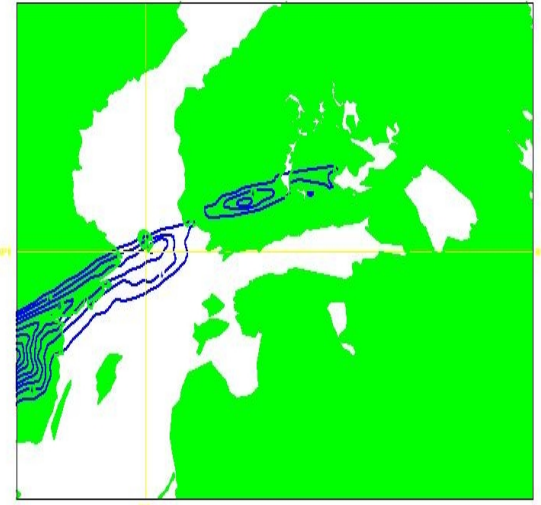
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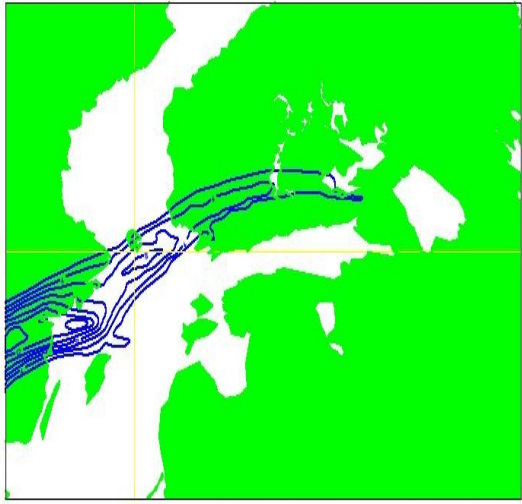
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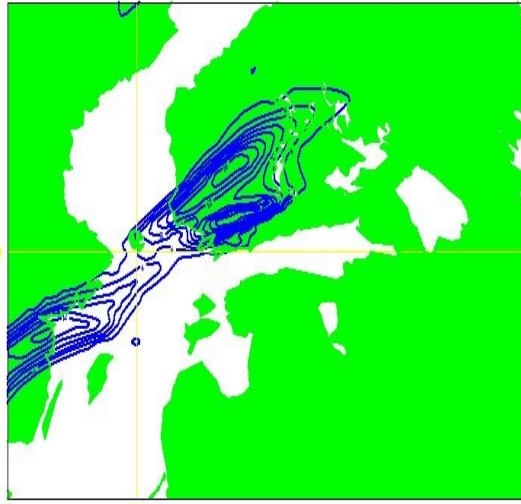
Precipitation fields (energy norm)

Mean total precipitation intensity between 3 UTC and 9 UTC (mm / 6 h)

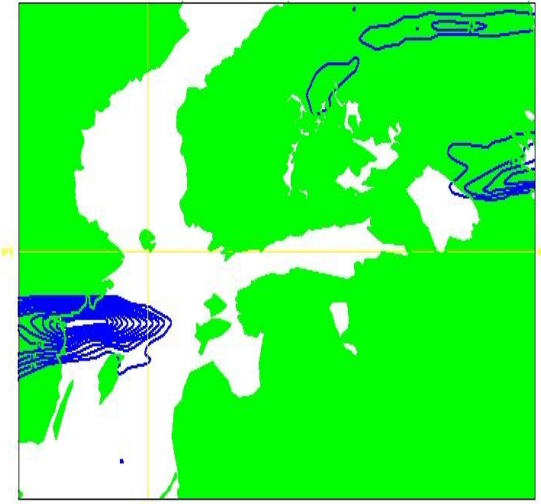
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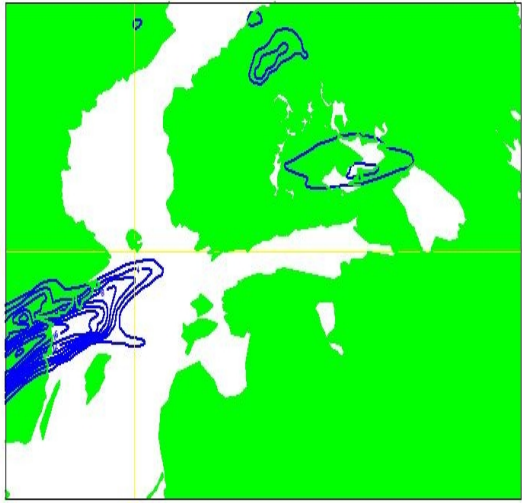


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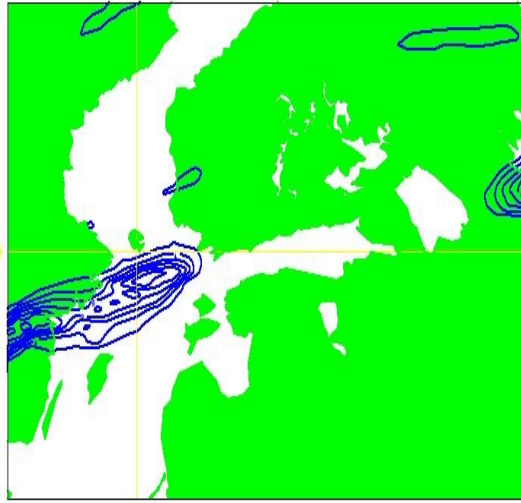


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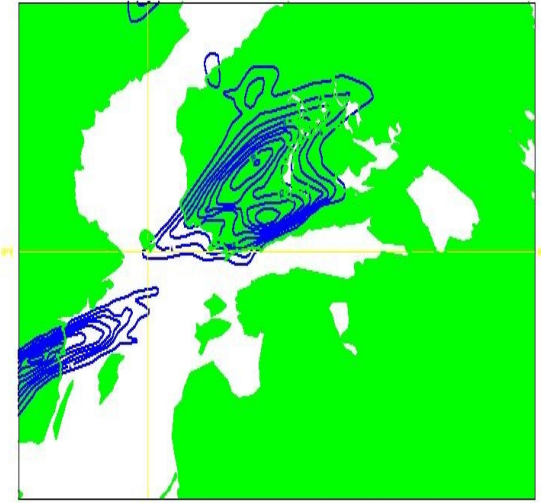
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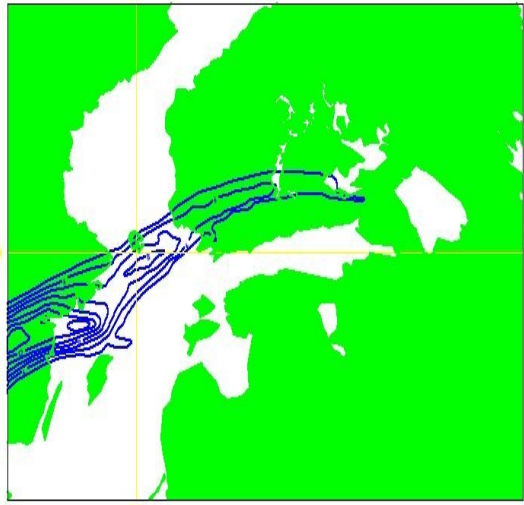
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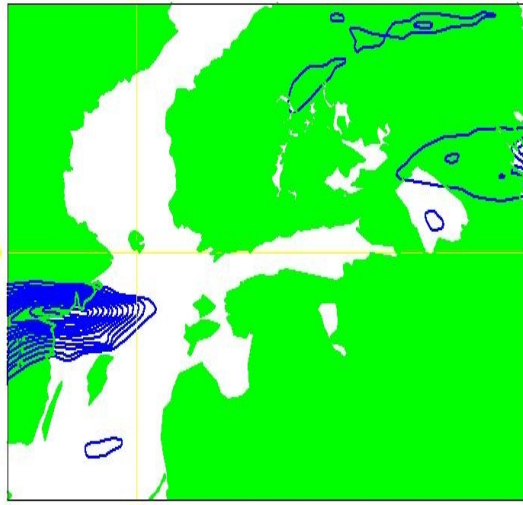
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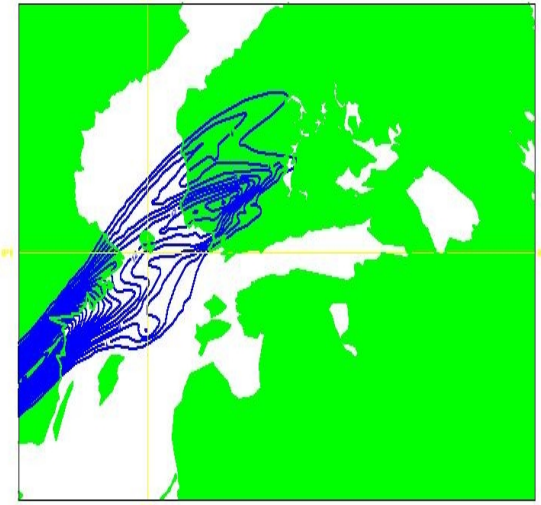
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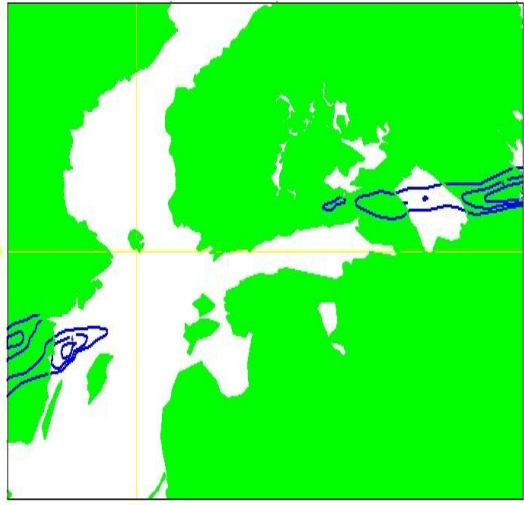


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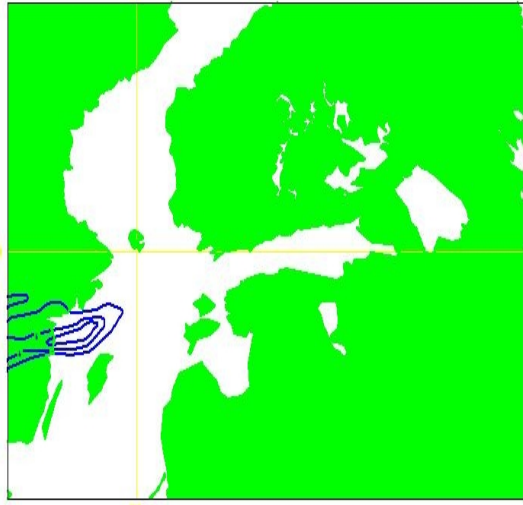


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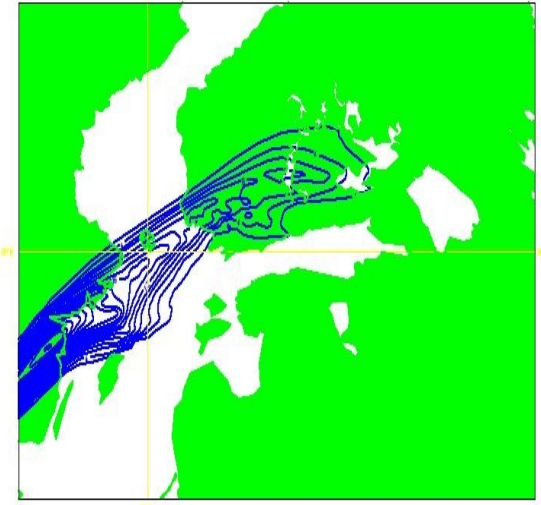
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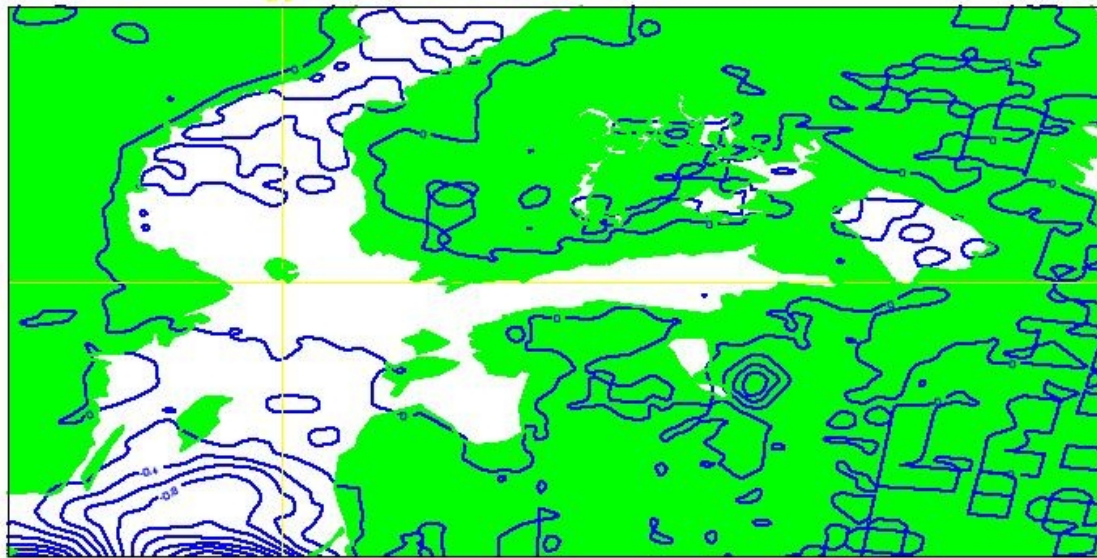


Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation



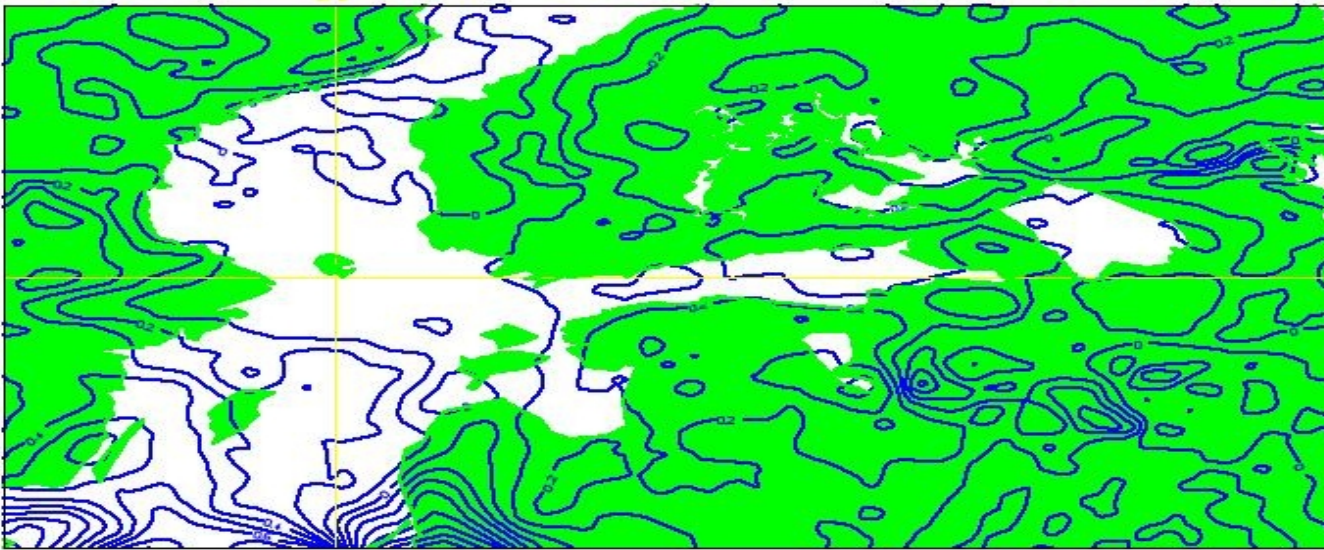
Smaller initial temperature
perturbation (CAPE norm,
smaller amplitude, cntr 0.2 C,max 1.8 C)

Analysis VT:Tuesday 21 August 2007 12UTC 850hPa **temperature



Smaller initial velocity perturbations (CAPE norm, cntr 0.1 m/s, max. 0.7 m/s)

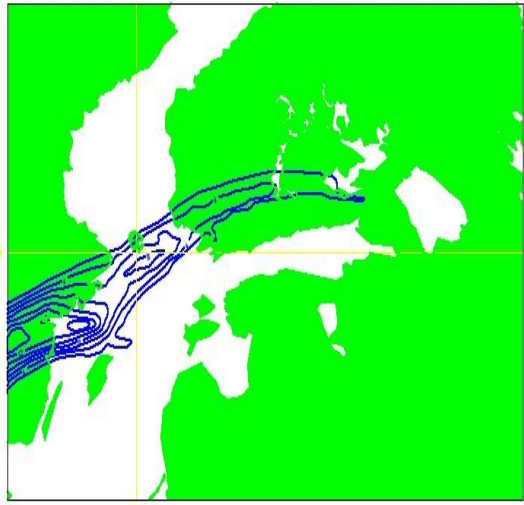
Analysis VT:Tuesday 21 August 2007 12UTC 850hPa **u-component of wind



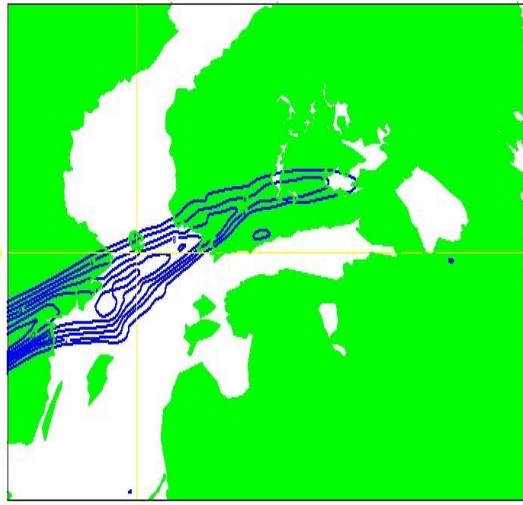
Precipitation fields (Cape norm)

Mean total precipitation intensity between 3 UTC and 9 UTC (mm / 6 h)

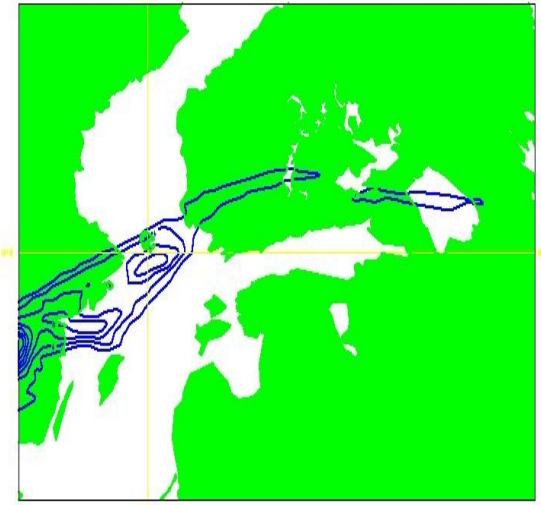
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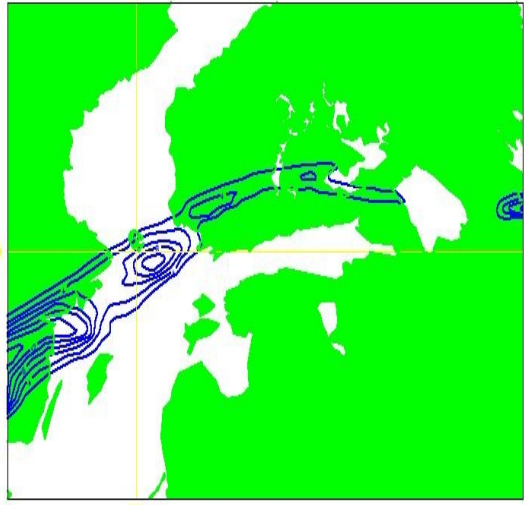
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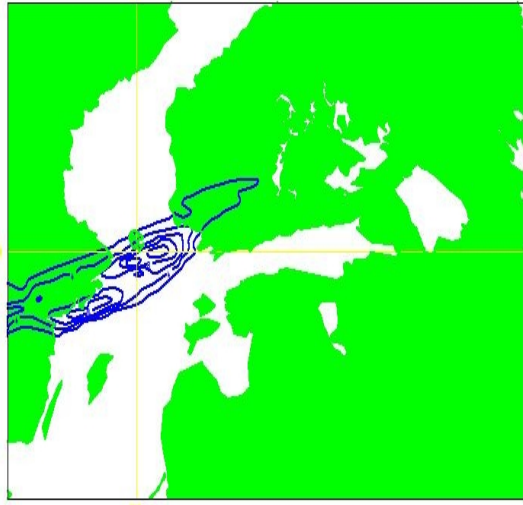
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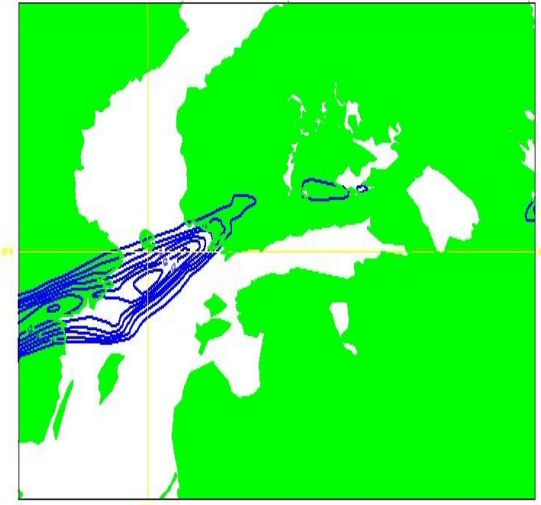
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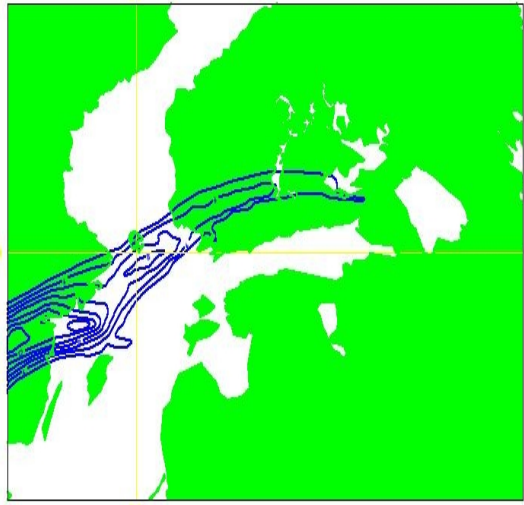
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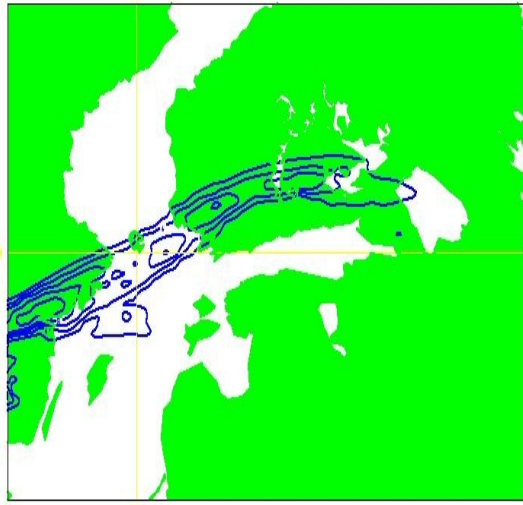
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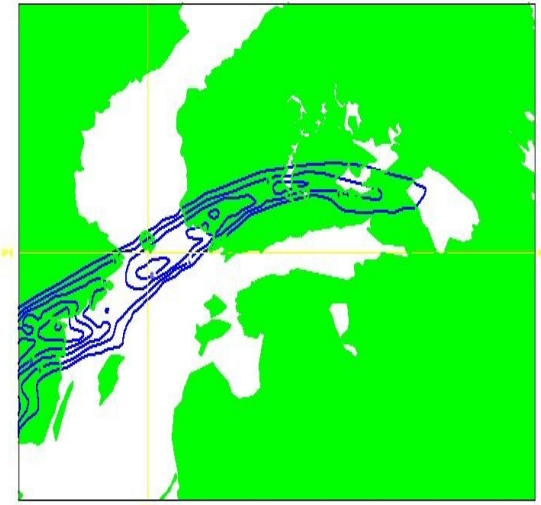
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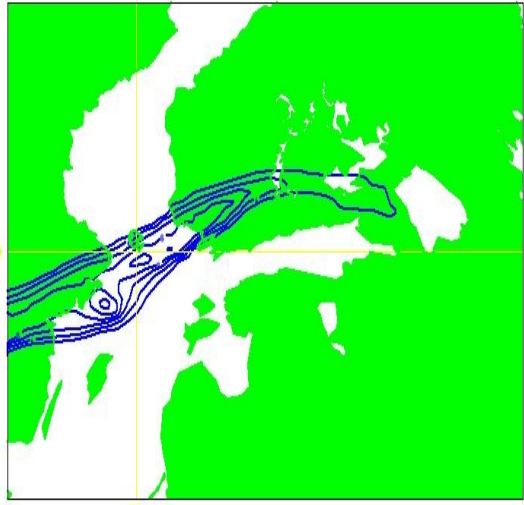
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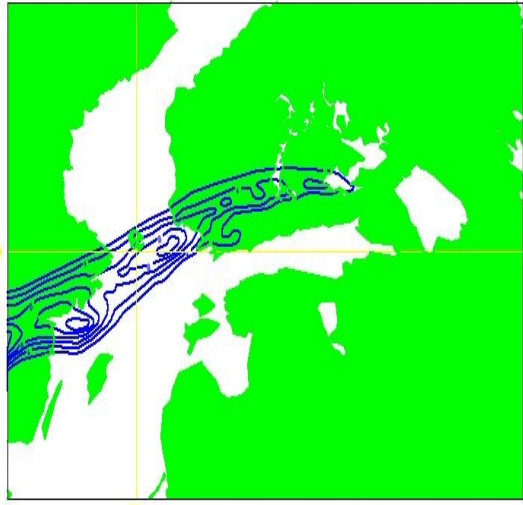
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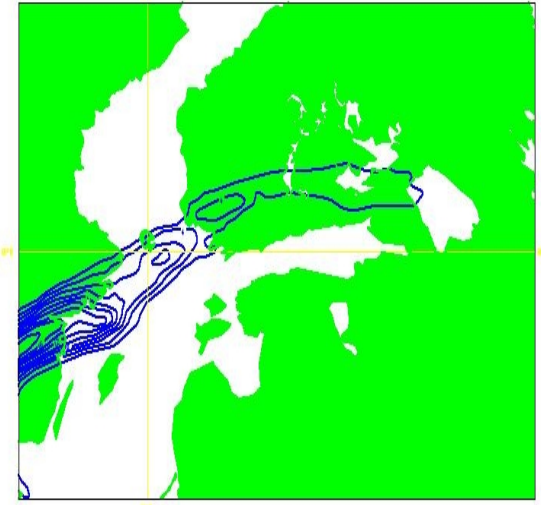
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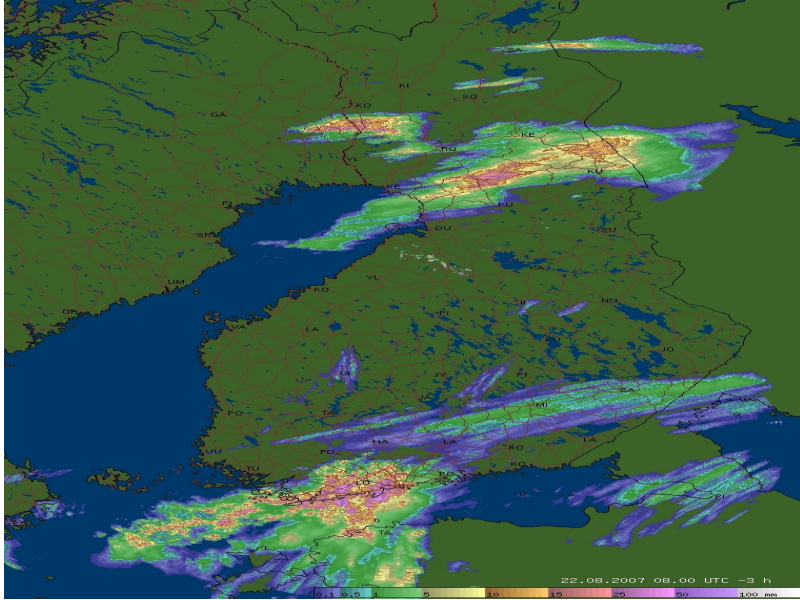


Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation

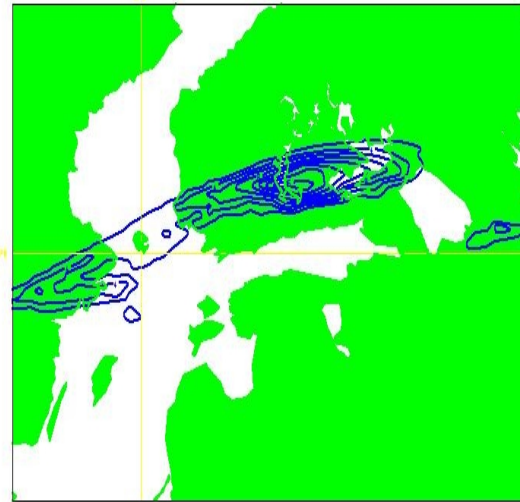


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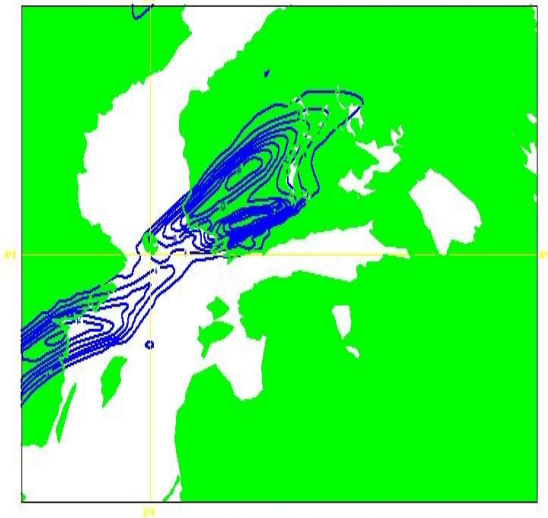


Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation



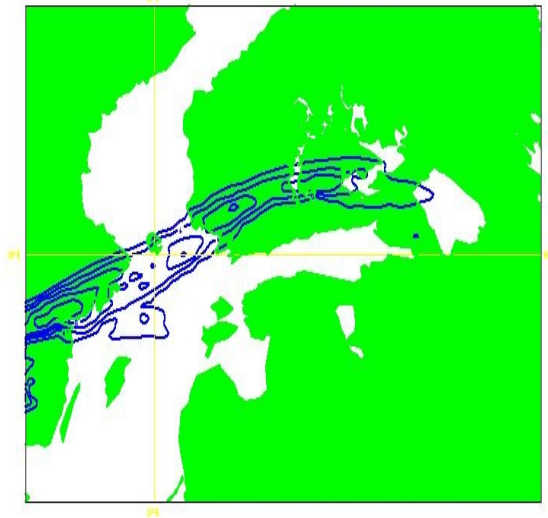
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Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation



E

Accumulation of 0 Forecasts VT:12UTC 21 August 2007 to 09UTC 22 August 2007 0hPa total precipitation



C
S

- all members: strongest precipitation
in reality more to the south than in
the model
- stronger perturbations cause
more precipitation

Conclusions drawn from these preliminary experiments:

- 1) Perturbation amplitude maybe too high in first experiments
- 2) Both singular vectors based on *energy norm* and based on *CAPE norm* are able to trigger increased precipitation over Southern Finland (convection?)
- 3) lower amplitude with CAPE norm shows less pronounced extra precipitation

Further steps:

- Look at additional model variables
- Compute analysis error field with Hirlam model
 - More testing and more case studies
- Make Hirlam ensemble forecasting operational