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# Experience with a strong outflow case in HARMONE

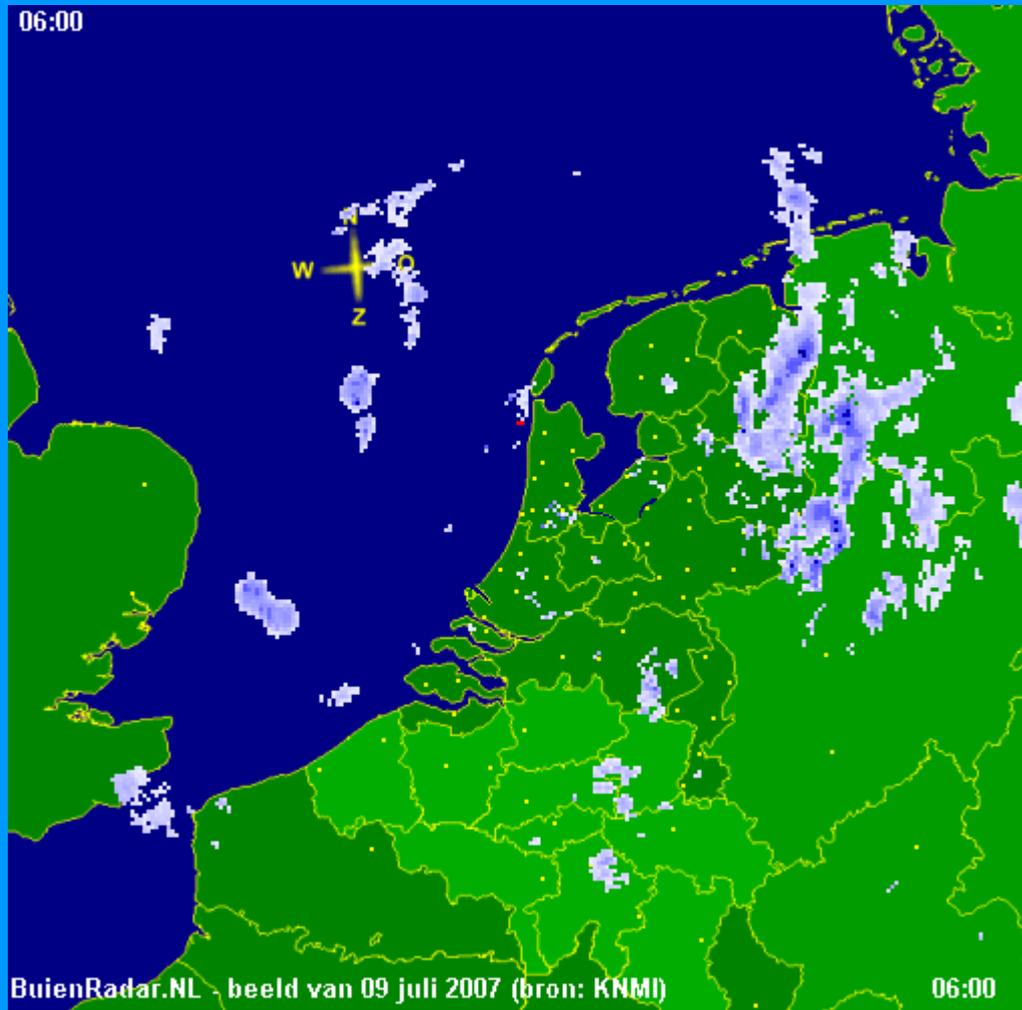
ALADN/HRLAM meeting  
12-15 May 2009

Jan Barkmeijer  
KNMI

Acknowledgements: Lisa Bengtsson, Radmila  
Brozkova, Mariano Hortal, Sylvie Marandel, Toon  
Moene, Yann Seity, Sander Tijn

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# 1 hour accumulated precipitation during 9 July 2007 6-14 UTC

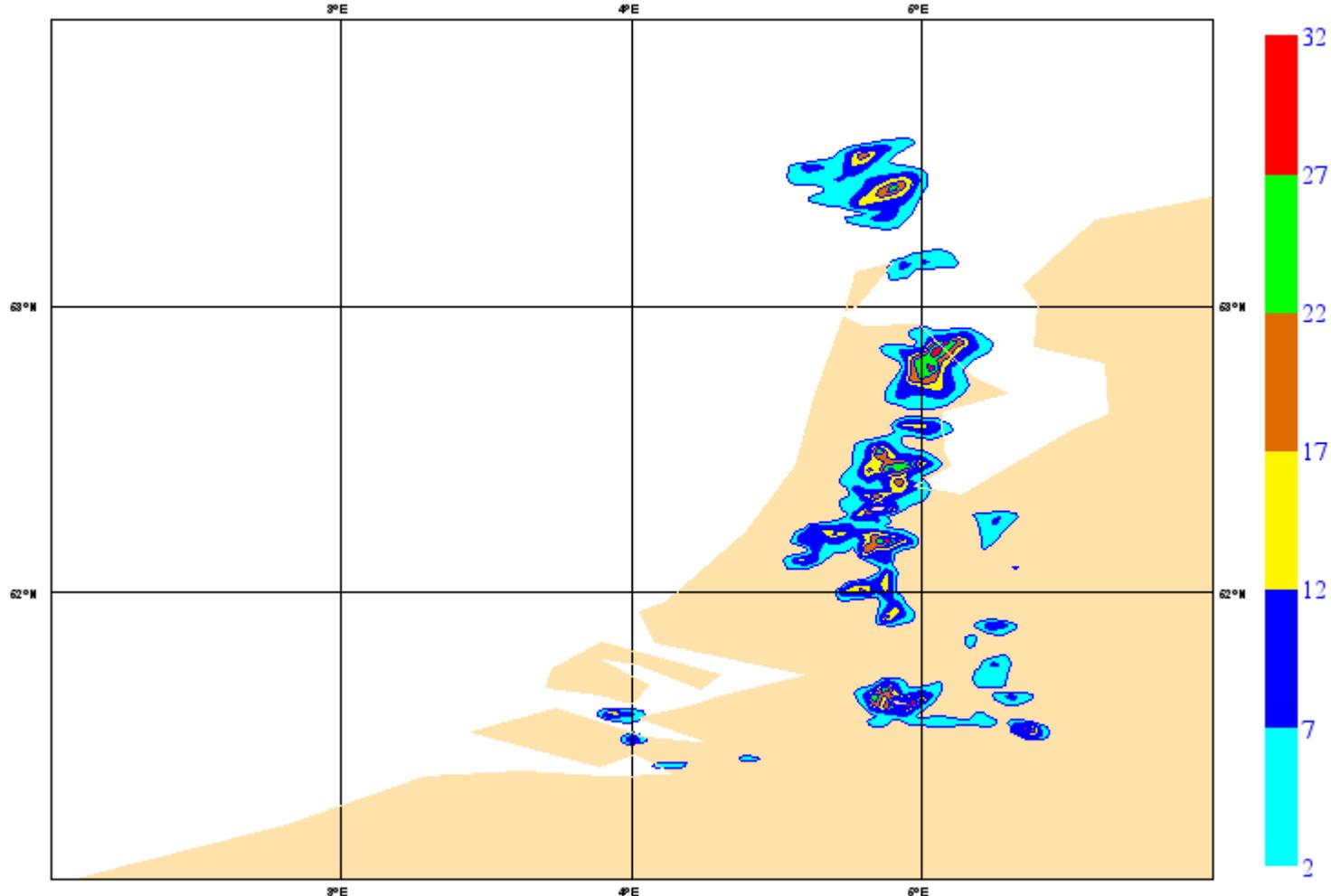


# Harm onie t+12h forecast from 2007070900

- 33h1 nested in Harm
- L40, grid=2.5km, area=120x100 (lat-lon)

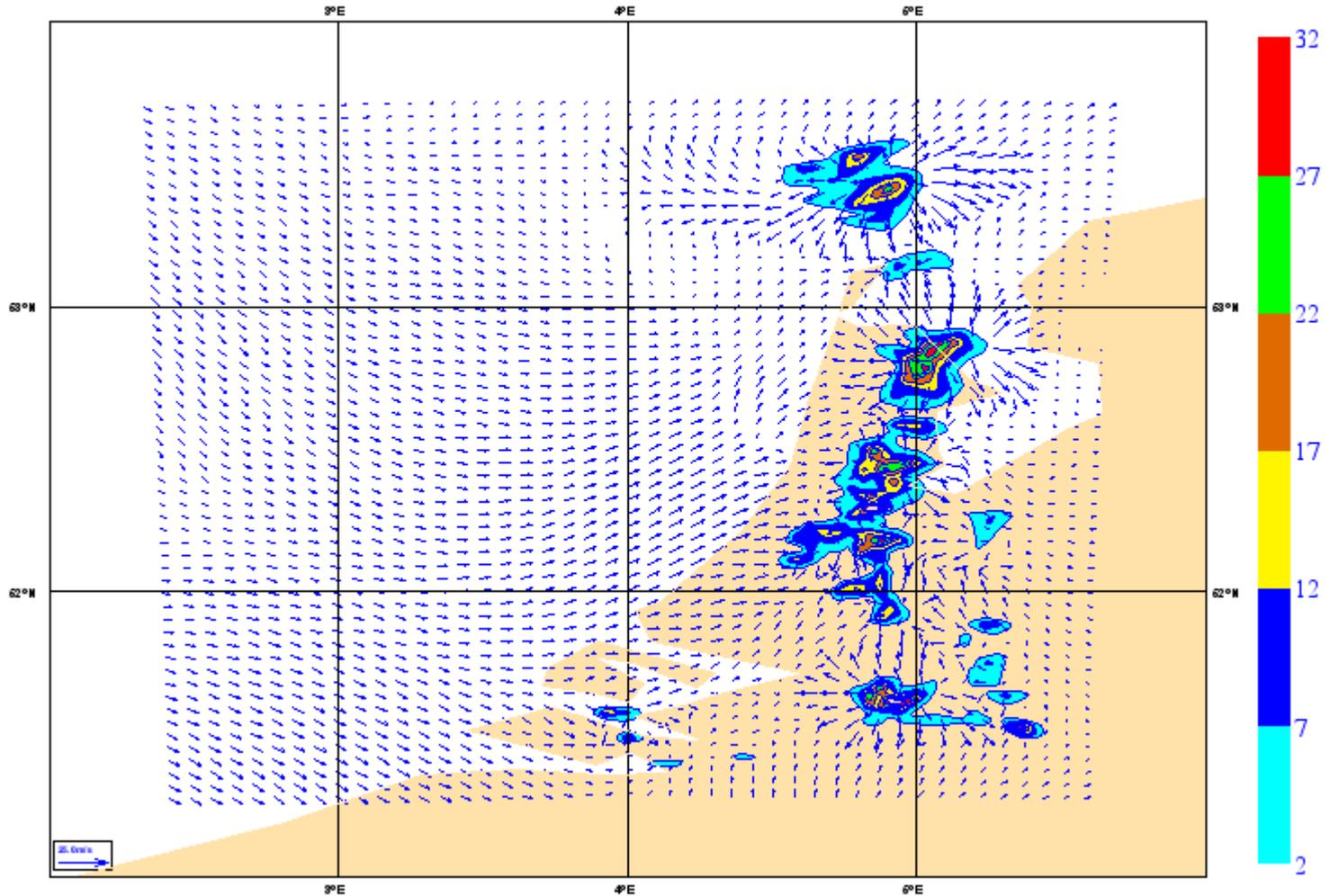


Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT: Monday 9 July 2007 12UTC 0m \*\*large scale precip



# Strong outflow

Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT: Monday 9 July 2007 12UTC Model Level 40 u-component of wind/v-component of wind  
Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT: Monday 9 July 2007 12UTC 0m <sup>ms</sup>large scale precip



# Impact of horizontal diffusion



32h3                      33h1                      HIGH1                      HIGH2

平均内プレシ	5	20	0.5	0.2
平均内プレシ	1	20	0.5	0.2
平均内プレ	5	20	0.5	0.2
平均内プレ	5	20	0.5	0.2
平均内プレ	1	20	0.5	0.2
平均内プレ	5	200,000	200,000	200,000

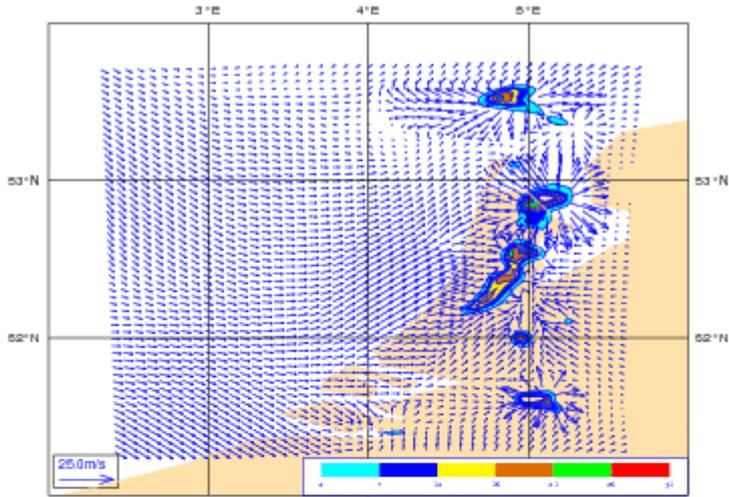
**N B . Lower values > Higher diffusion**



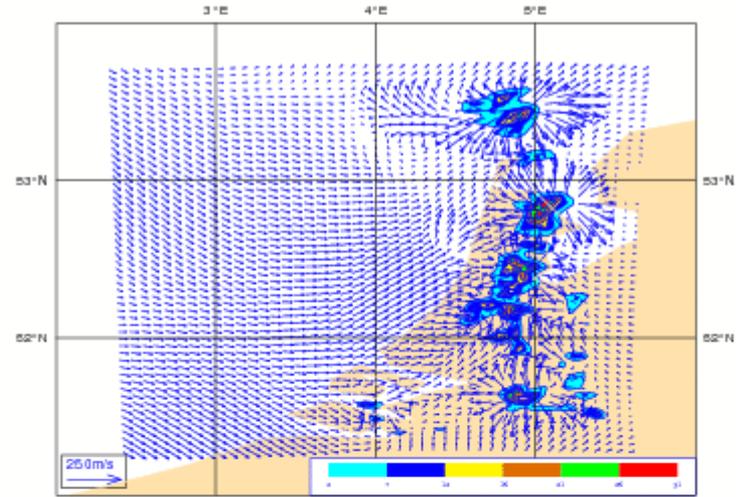
32h3

33h1

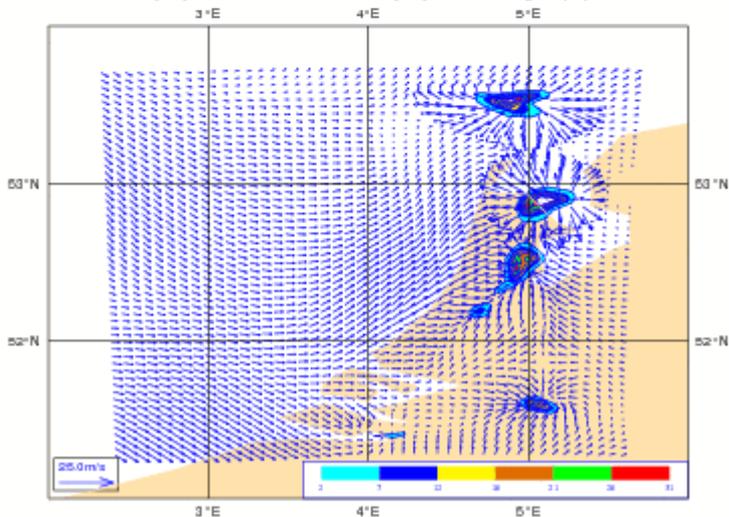
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC Model Level 40 u-component of wind  
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC On "big scale precip



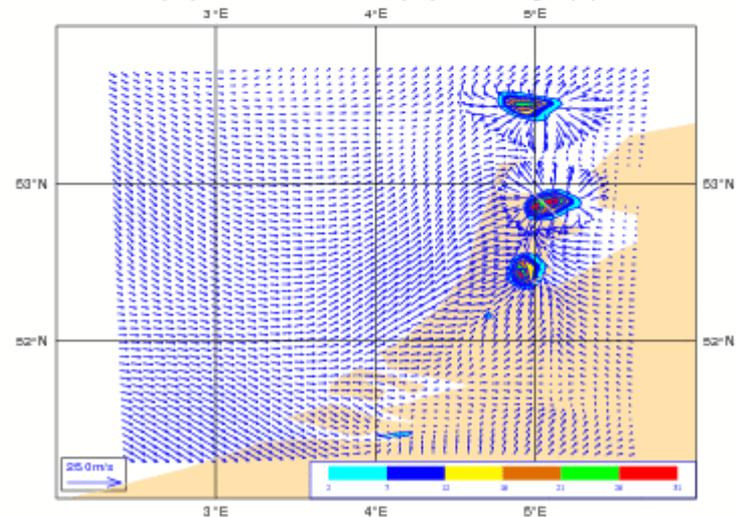
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC Model Level 40 u-component of wind  
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Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC Model Level 40 v-component of wind  
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC On "big scale precip



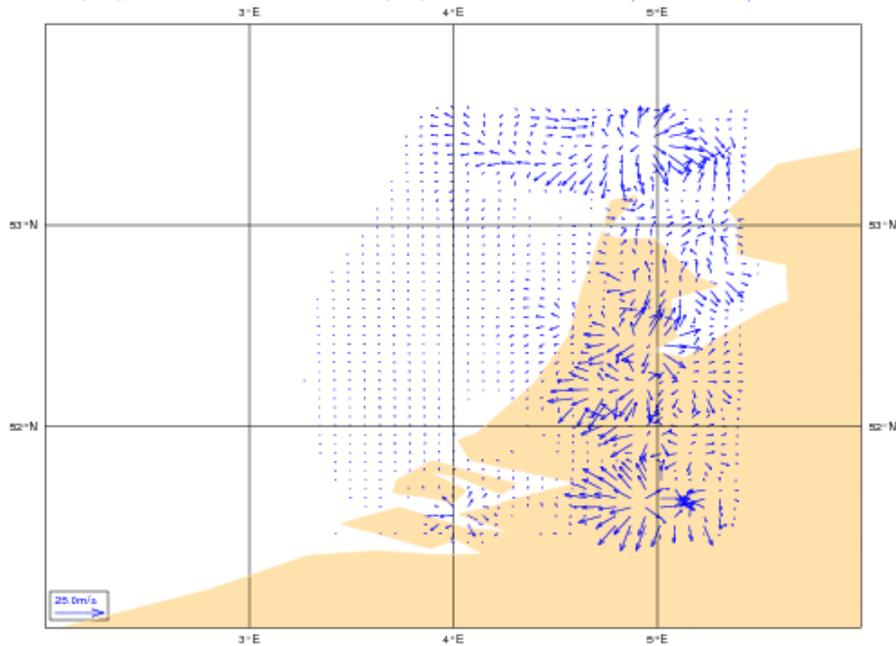
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC Model Level 40 v-component of wind  
Monday 9 July 2007 00UTC ATHE N Forecast is 12 VT Monday 9 July 2007 00UTC On "big scale precip



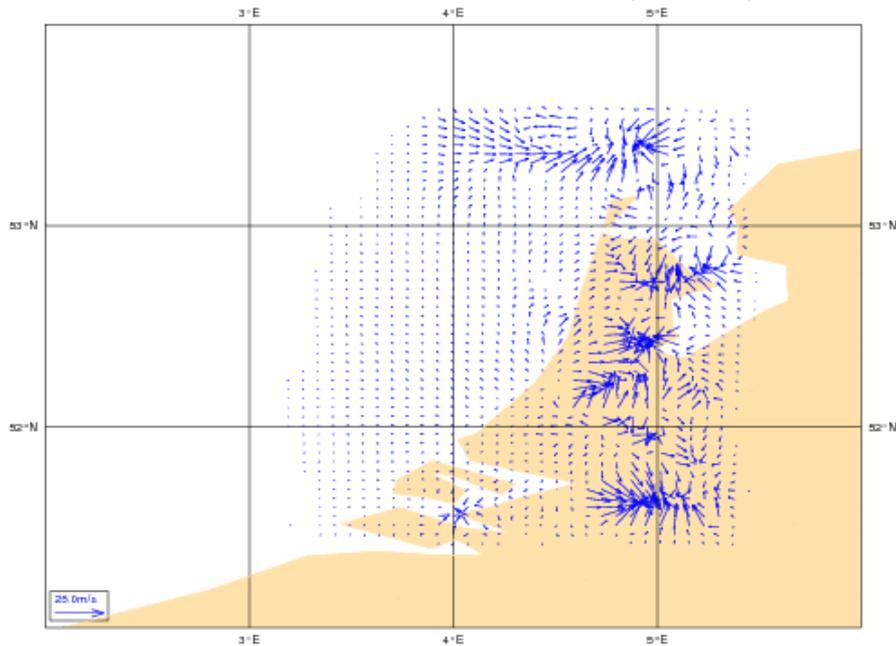
HIGH 1

HIGH 2

Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT: Monday 9 July 2007 12UTC Model Level 40 "u-component of wind"/v-component of wind



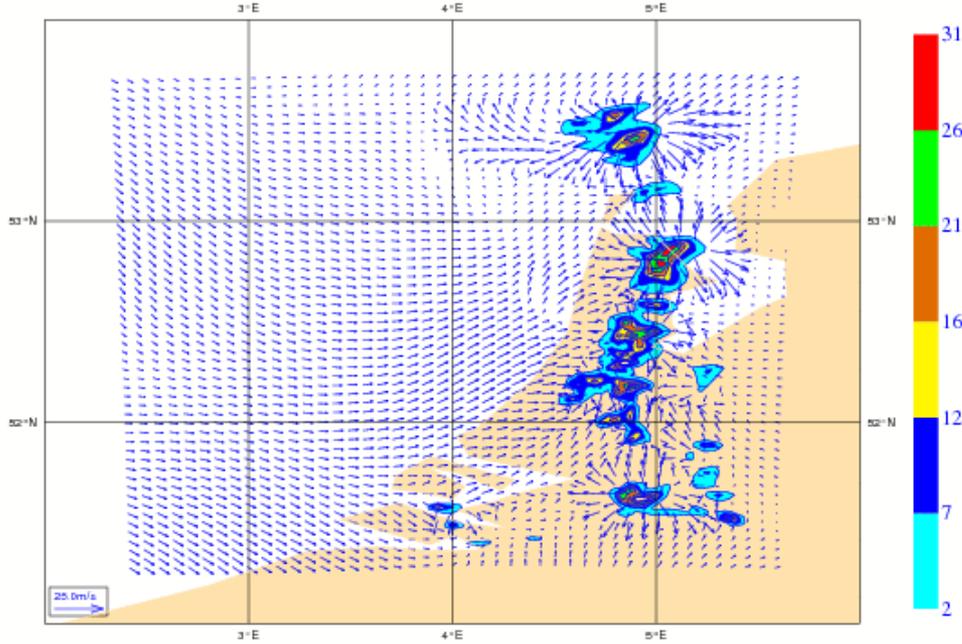
Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT: Monday 9 July 2007 12UTC Model Level 40 "u-component of wind"/v-component of wind



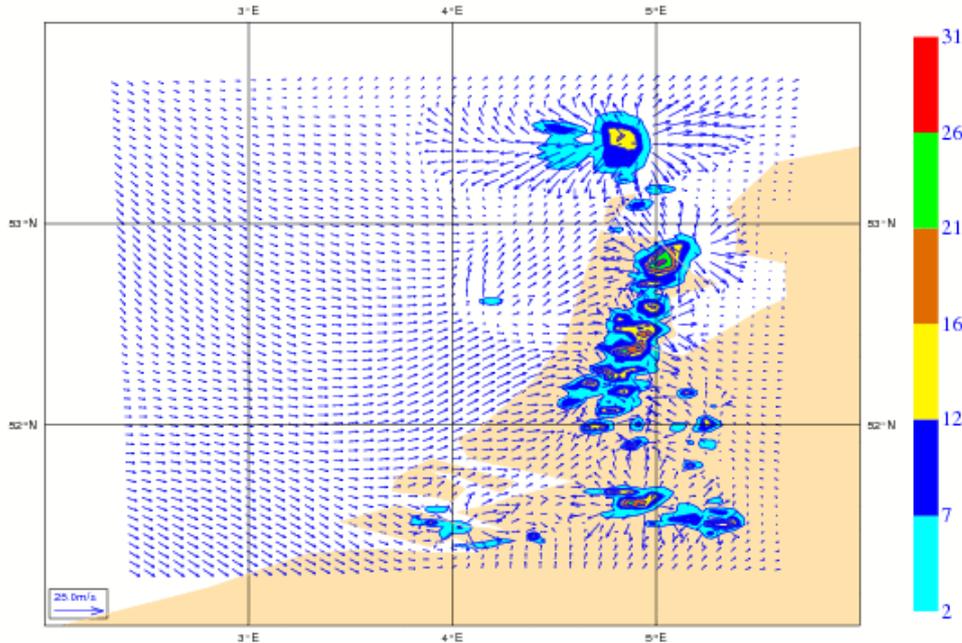
**difference plot  
L40 w indvector**

**33h1 – 32h1**

**HIGH 1 – 32h1**



33h1

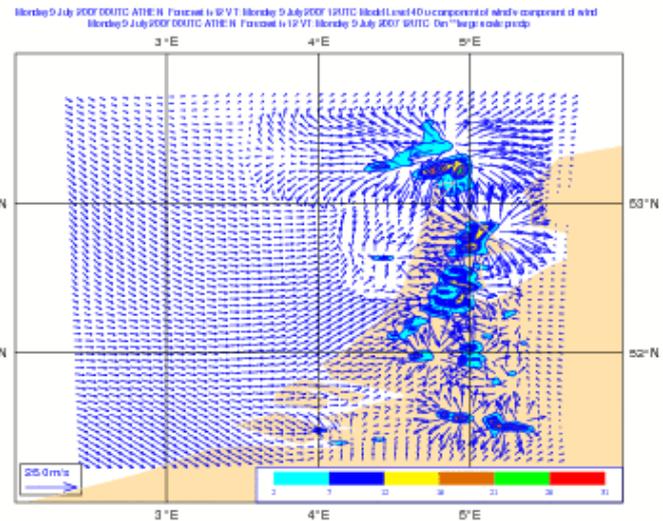
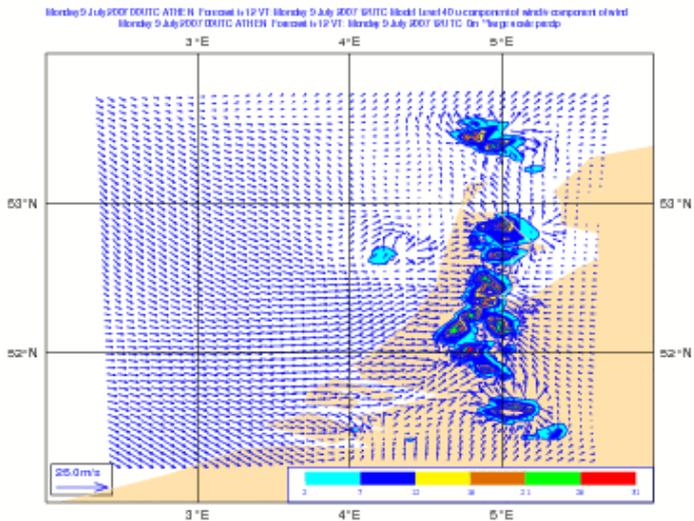
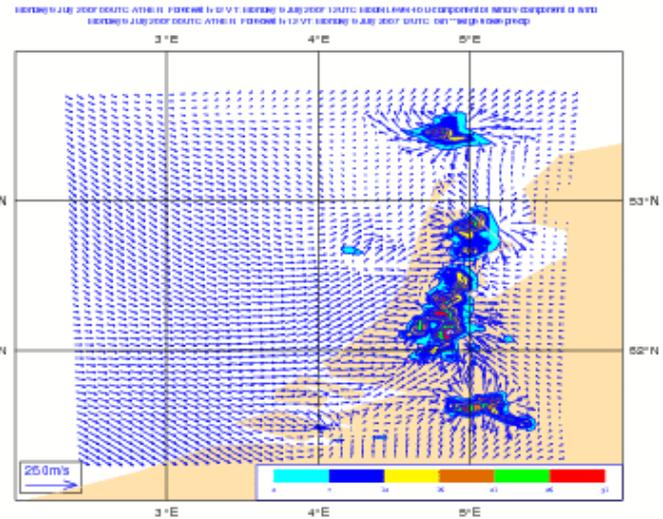
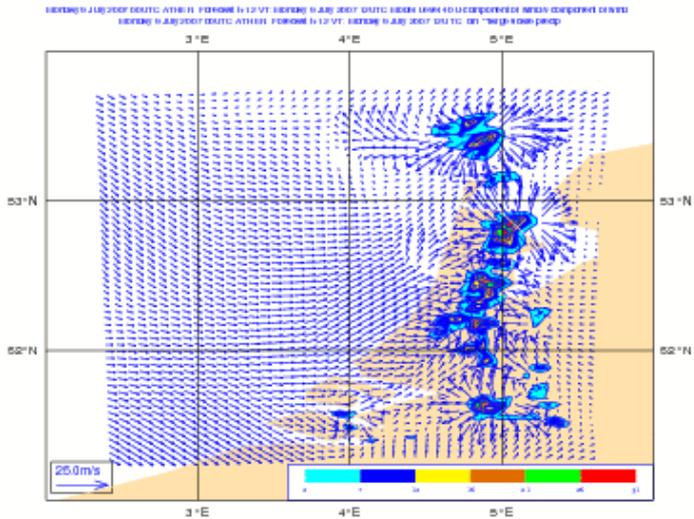


A 11 diffusion values  
set to 200,000  
(no diffusion case)

# Impact of evaporation

33h1

evap/10



No evaporation

evap\*10

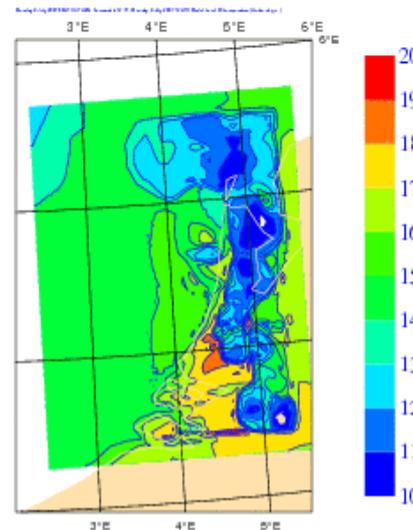
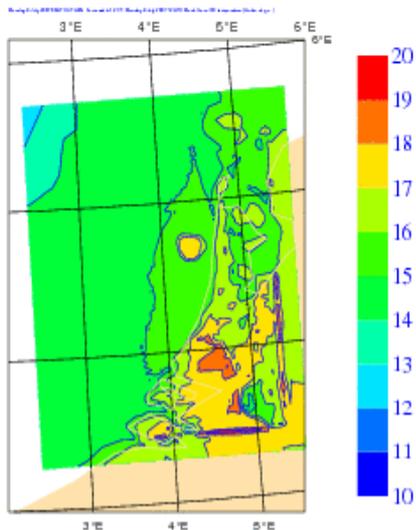
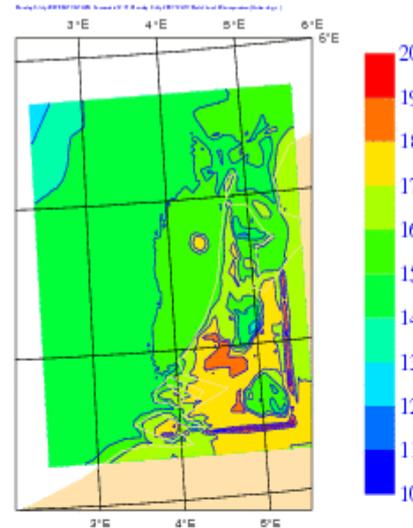
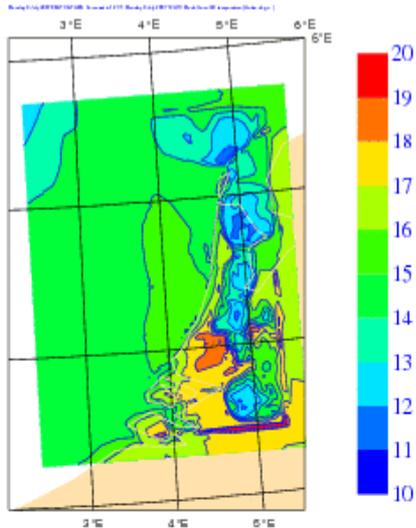
# Impact of evaporation (2)

33h1

evap/10



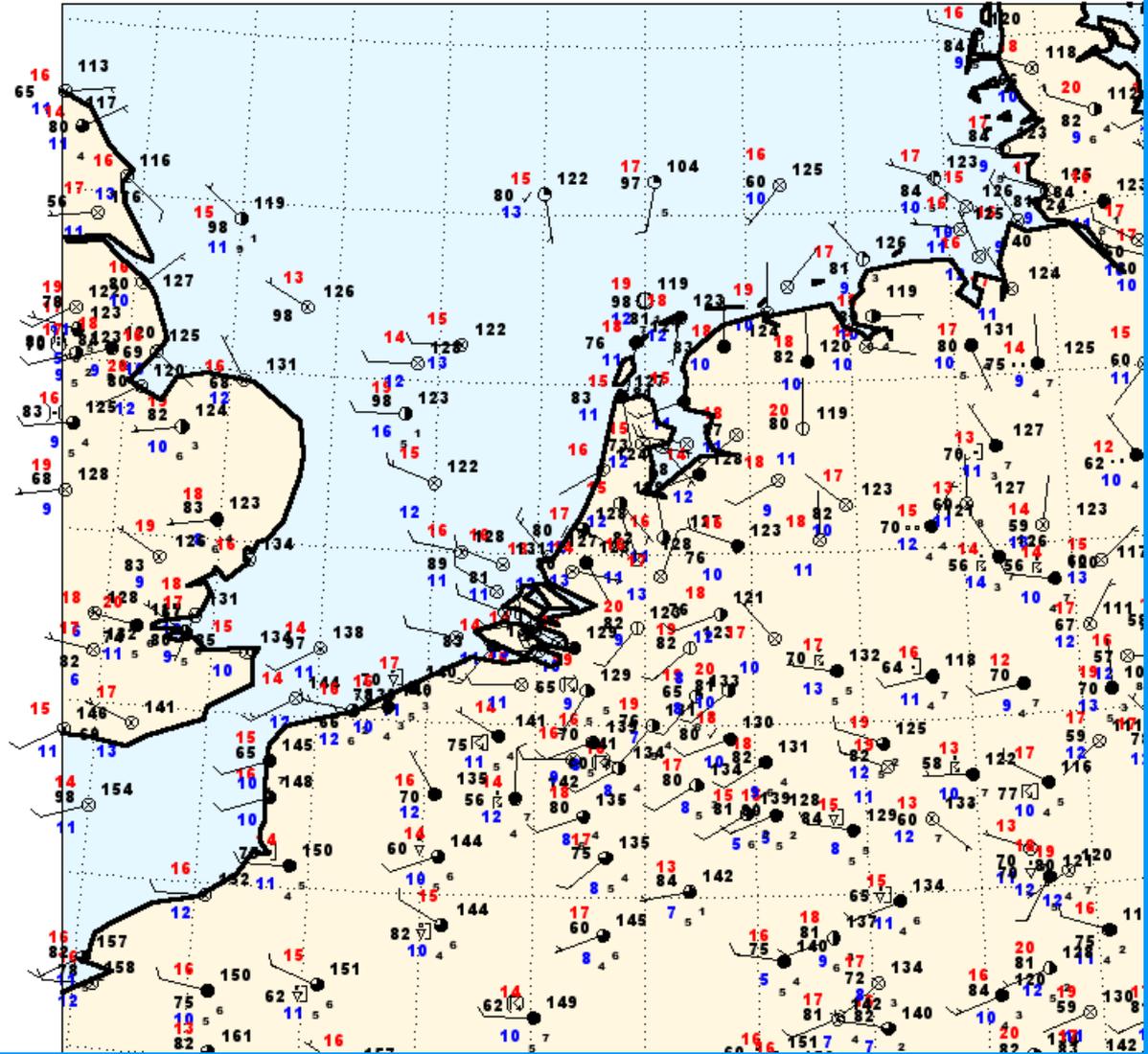
L40  
temperature



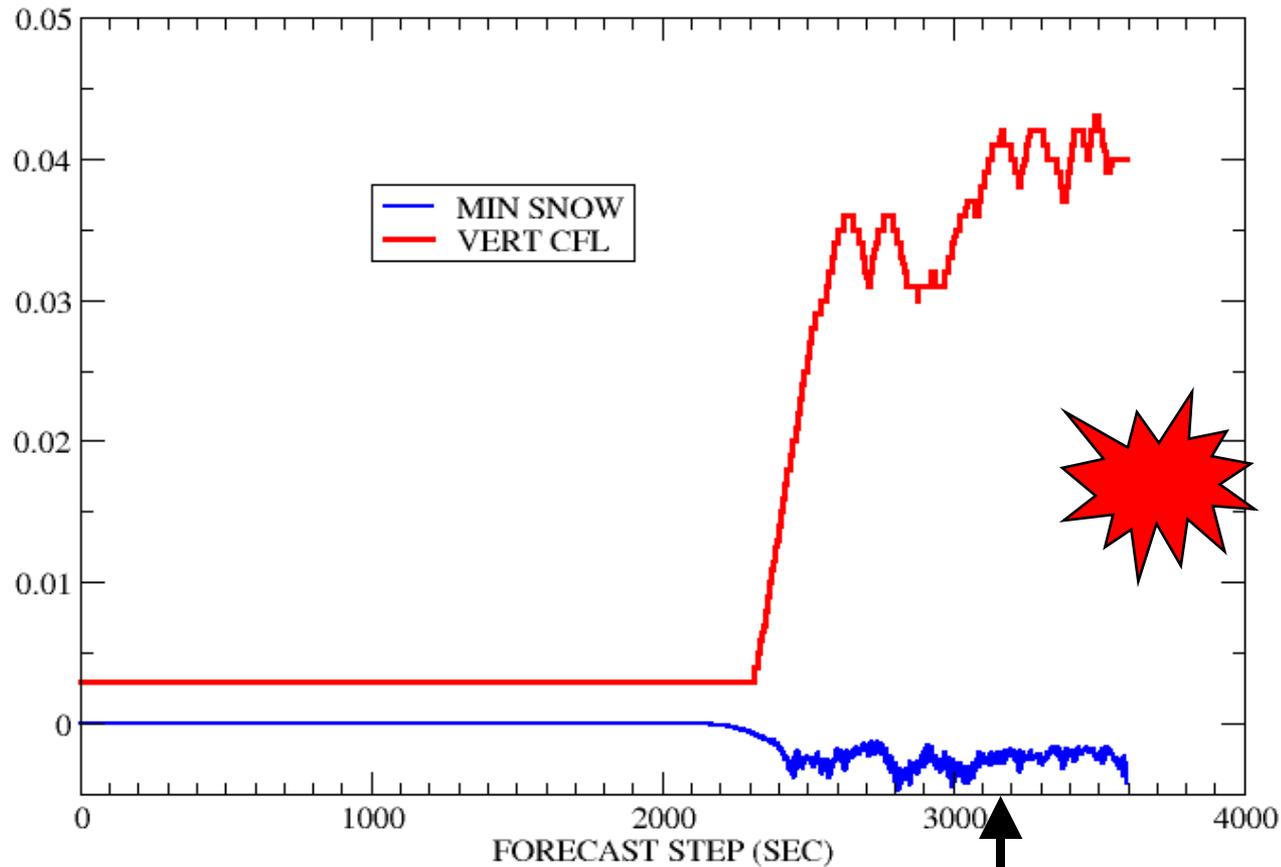
No evaporation

evap\*10

# Observations on 20070709 at 12 UTC

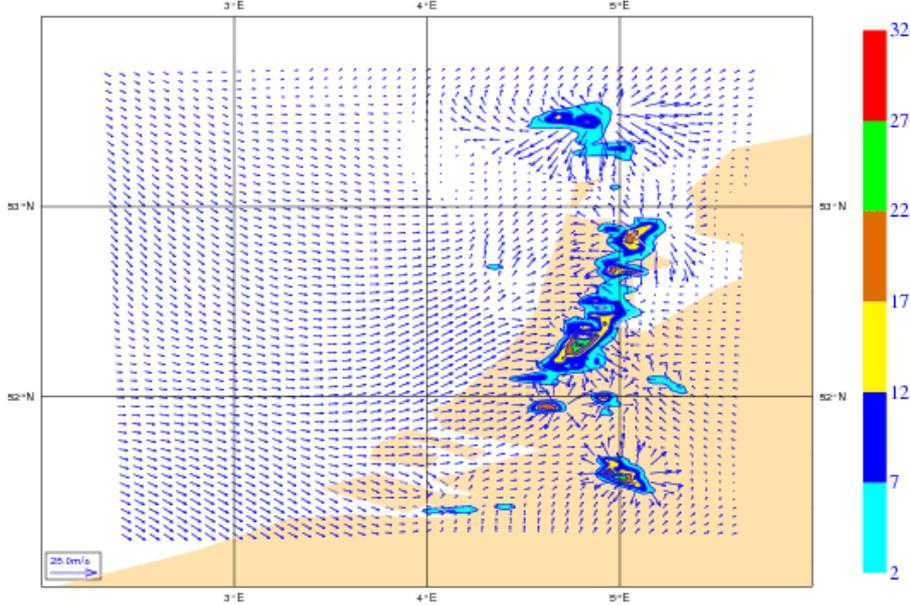


# Eulerian run with 33h1

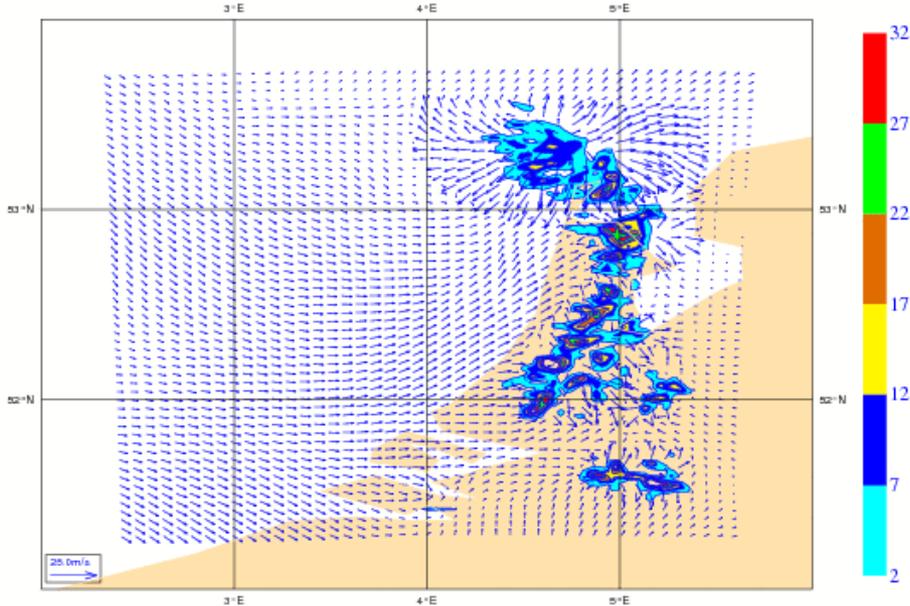


Negative values for snow /rain/graupel

Monday 9 July 2007 00UTC ATHEN Forecast 1-12 VT: Monday 9 July 2007 12UTC Modal Level 40 u-component of wind  
Monday 9 July 2007 00UTC ATHEN Forecast 1-12 VT: Monday 9 July 2007 12UTC 0m "large scale precip



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Monday 9 July 2007 00UTC ATHEN Forecast 1-12 VT: Monday 9 July 2007 12UTC 0m "large scale precip



35h1

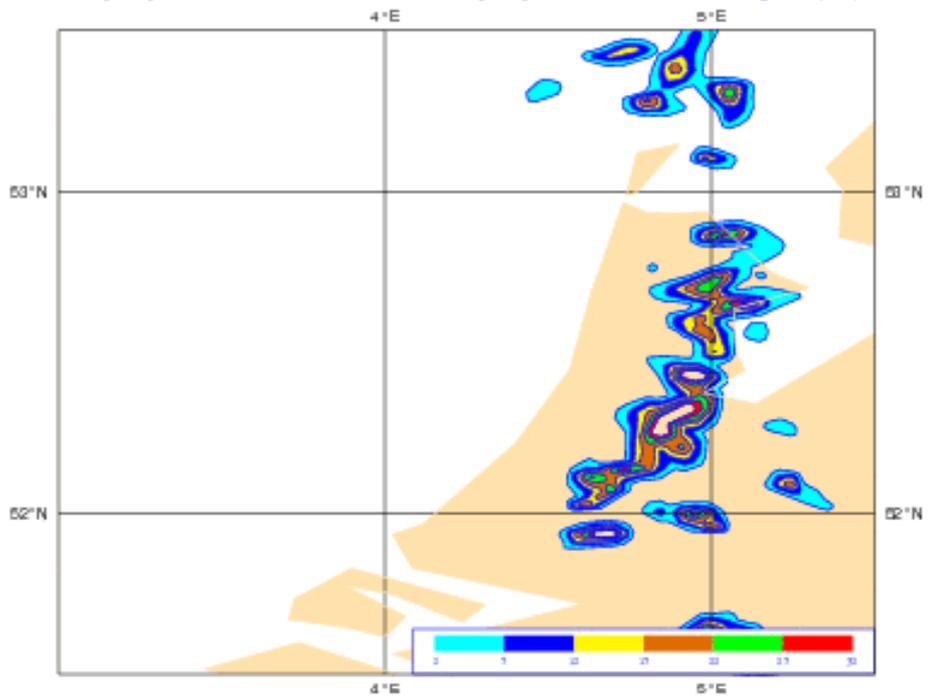
Eulerian  
T in estep=10 s

# Eulerian: more granular, small-scale structures in rain rate

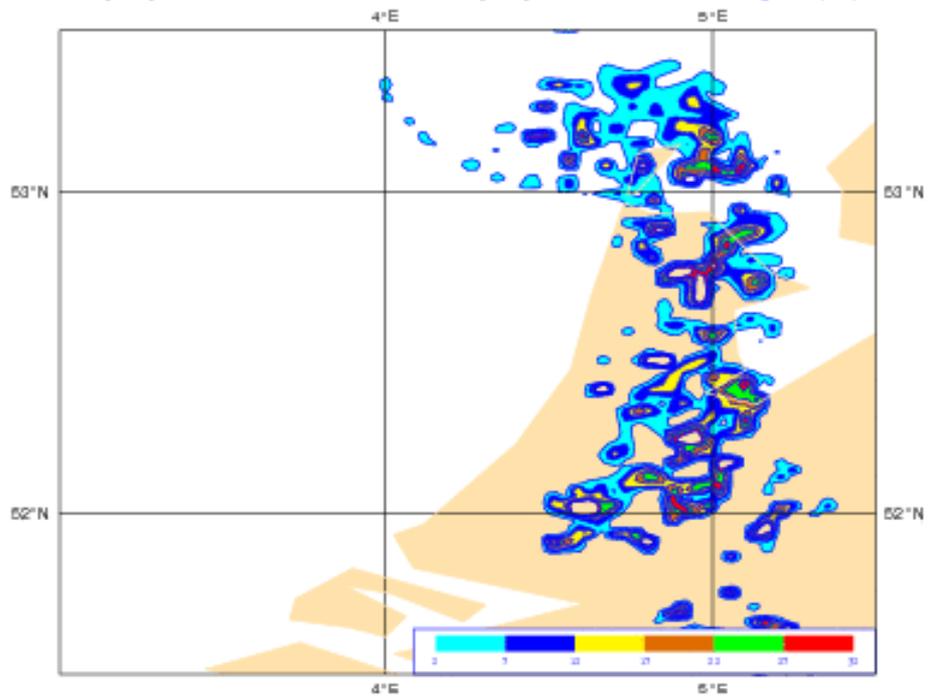
35h1 SL

Eulerian

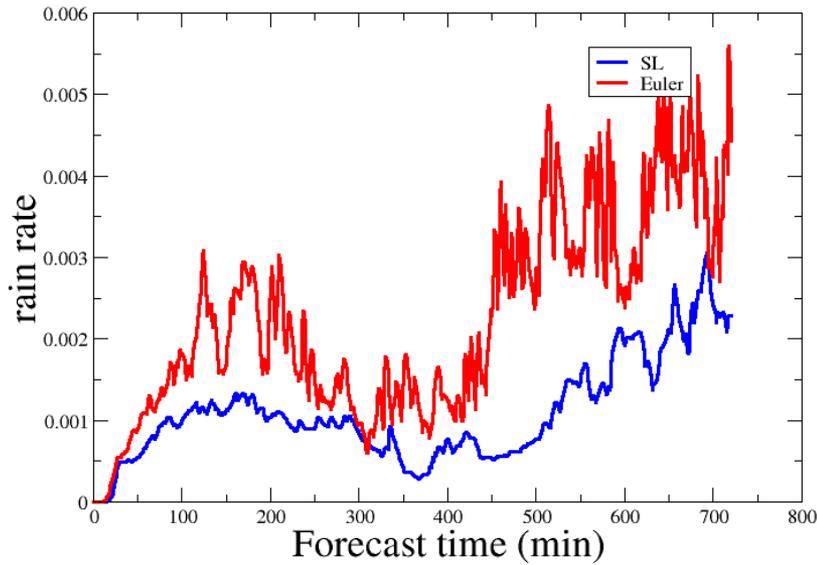
Monday 9 July 2007 00UTC ATHEN Forecast 1-12 VT: Monday 9 July 2007 12UTC Model Level 40 "Target scale precip



Monday 9 July 2007 00UTC ATHEN Forecast 1-12 VT: Monday 9 July 2007 12UTC Model Level 40 "Target scale precip



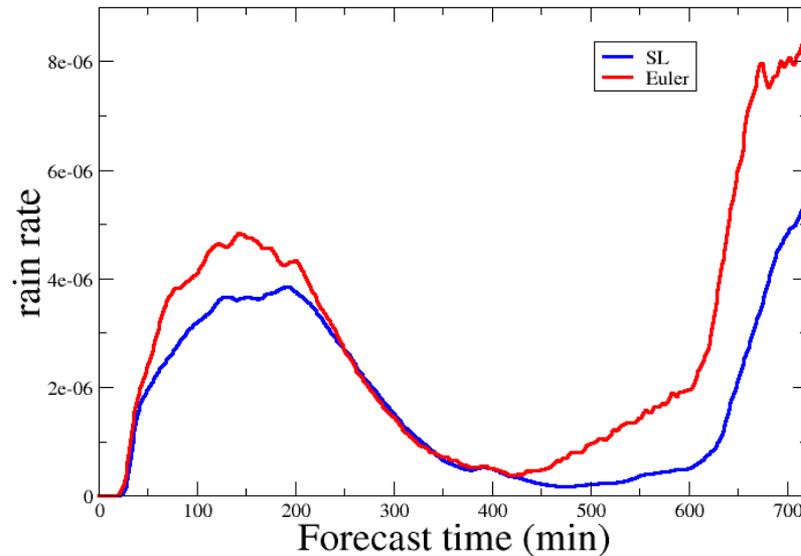
Max rain rate for SL and Euler run



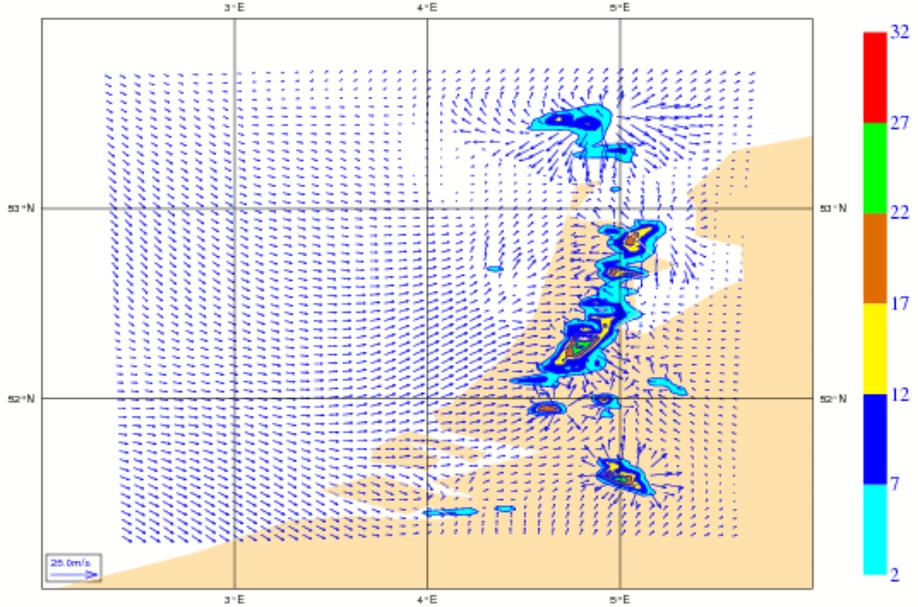
**Eulerian :**

**Also more intense precipitation**

average rain rate for SL and Euler run



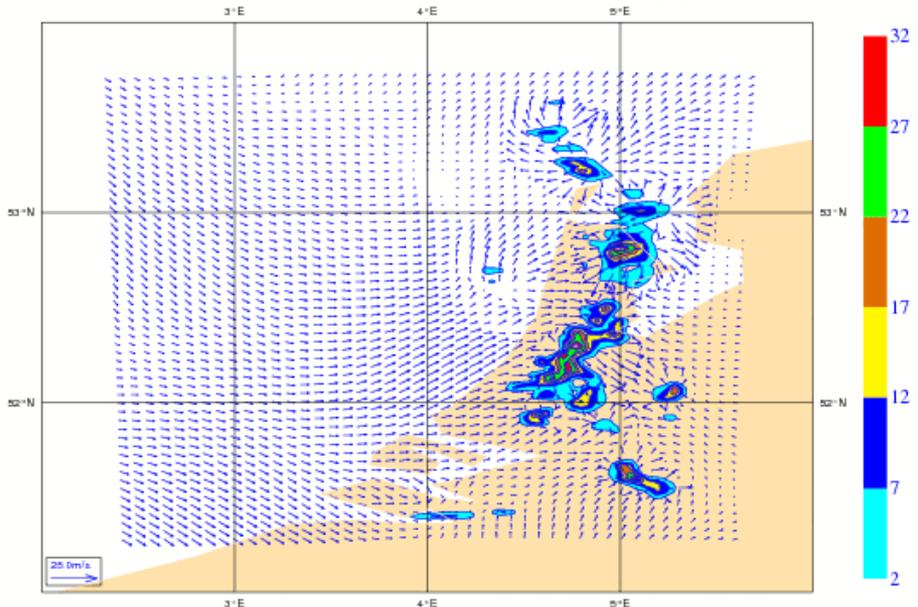
Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT Monday 9 July 2007 12UTC Modal Level 40 u-component of wind/y-component of wind  
Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT Monday 9 July 2007 12UTC 0m "large scale precip



**35h1 SL  
default setting**



Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT Monday 9 July 2007 12UTC Modal Level 40 u-component of wind/y-component of wind  
Monday 9 July 2007 00UTC ATHEN Forecast t+12 VT Monday 9 July 2007 12UTC 0m "large scale precip



**35h1 SL but with  
Eulerian setting, in  
particular:**

**No advection of  
hydrometeors, apart  
from q**

# 2.5km H irlam runs



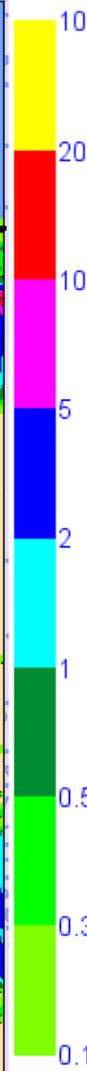
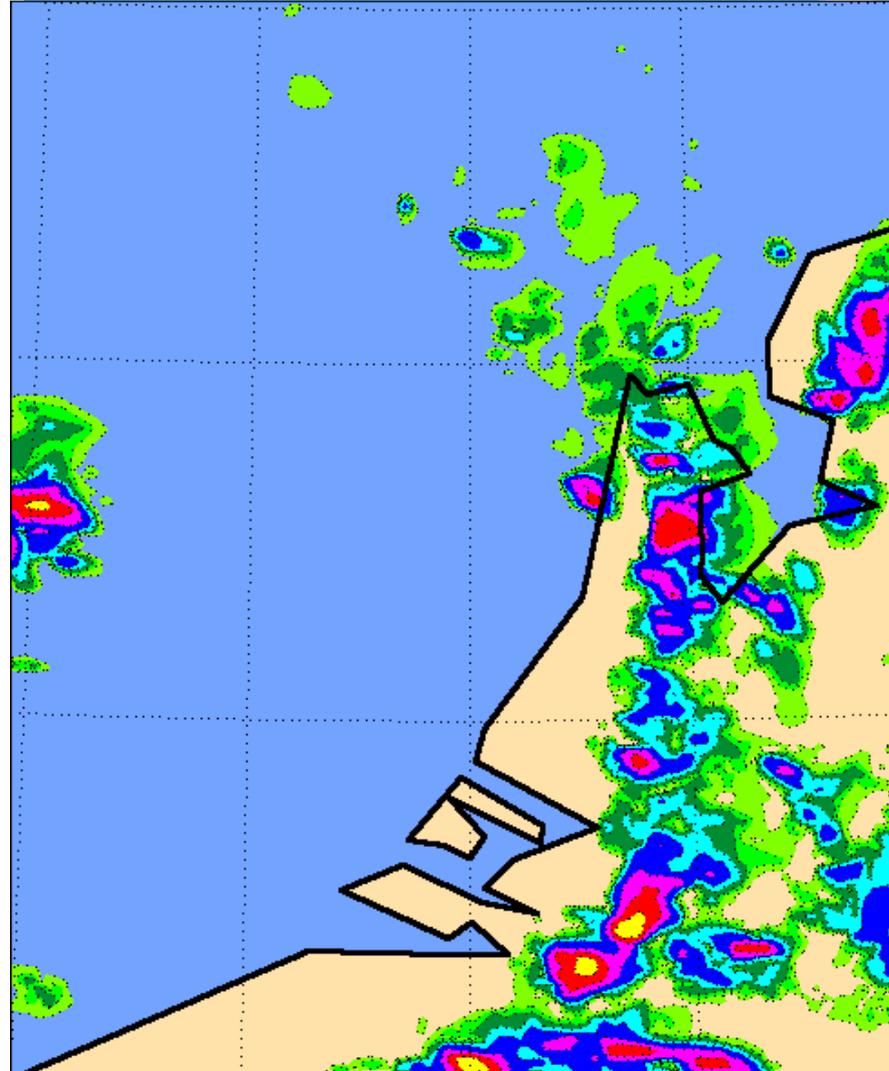
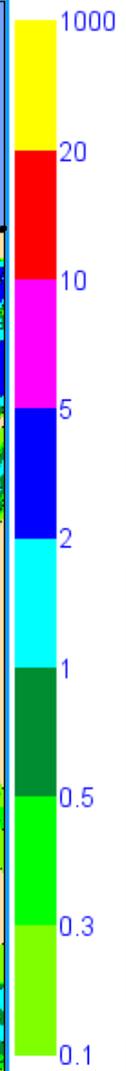
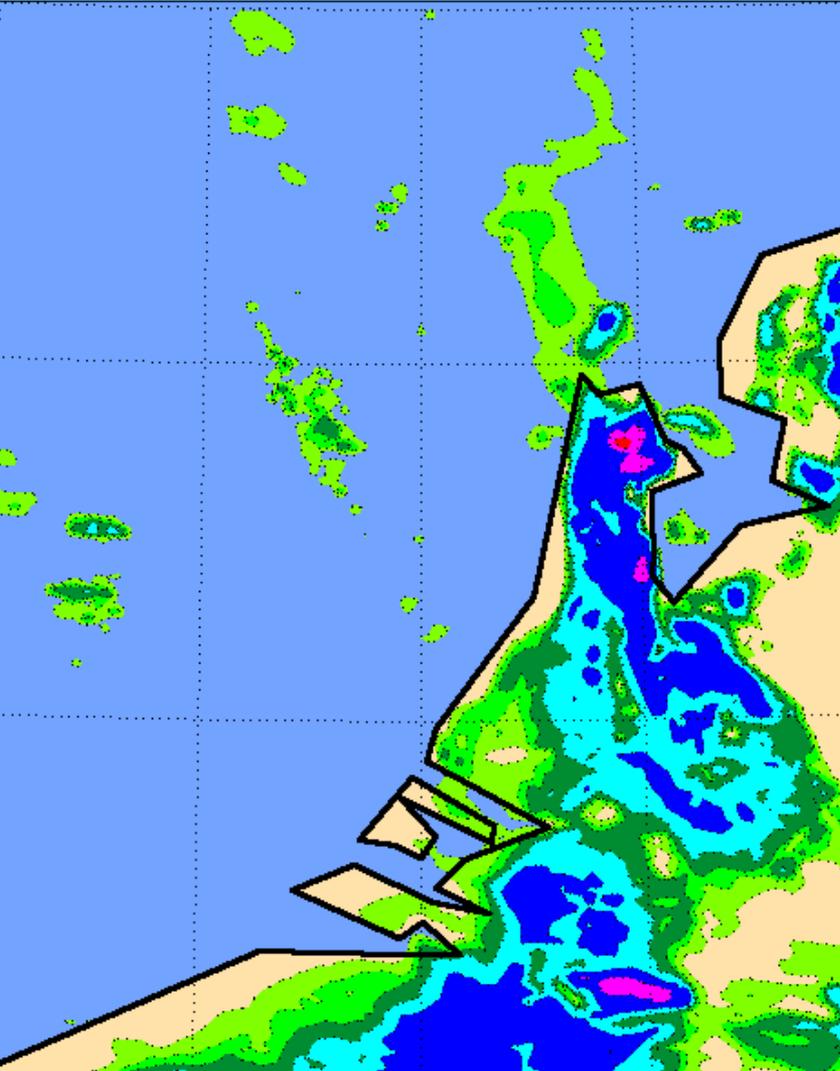
Koninklijk

Default

No Kain-Fritsch

Accumulation of 0 - Forecasts W: 00UT 6 8 July 2007 to 18UT 6 8 July 2007. 0h Partial precipitation

Accumulation of 0 - Forecasts W: 00UT 6 8 July 2007 to 18UT 6 8 July 2007. 0h Partial precipitation



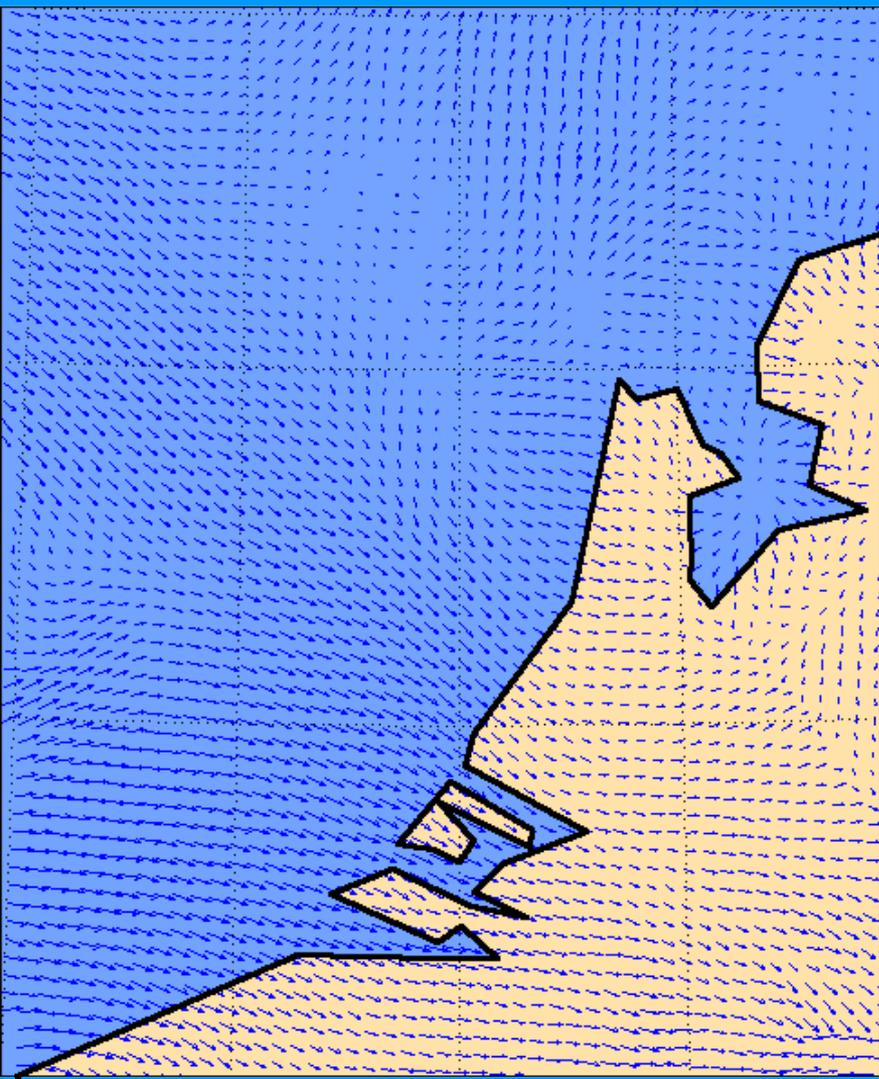


# Default



# No Kan-Fritsch

Monday 3 July 2007 00 UTC - Forecast 1-12 WT - Monday 3 July 2007 12 UTC 10 m u-component of wind / component of wind



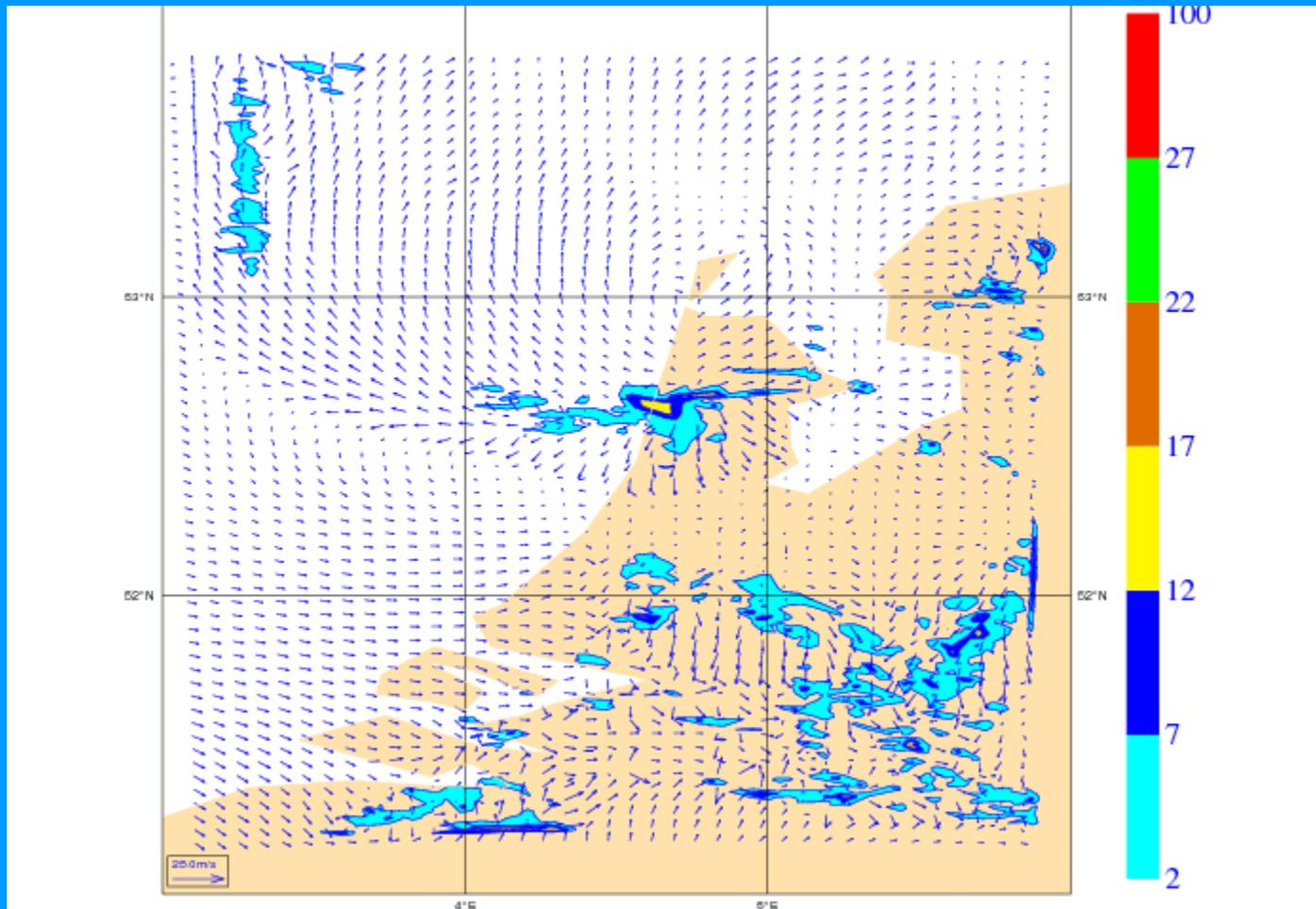
Monday 3 July 2007 00 UTC - Forecast 1-12 WT - Monday 3 July 2007 12 UTC 10 m u-component of wind / component of wind



# 500m H armonie run



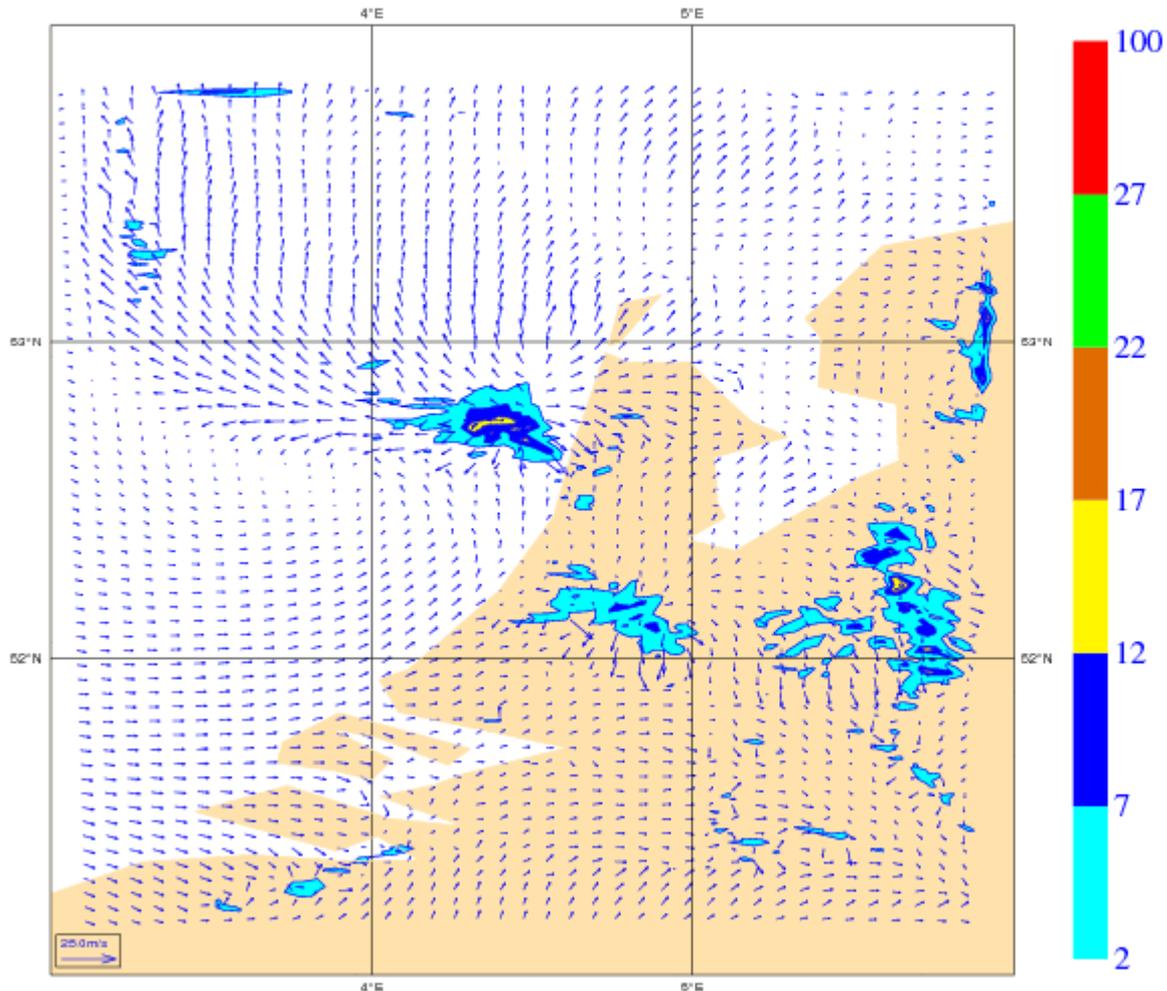
- time step = 10s
- special namelist to prevent instabilities



•••• **t+11h forecast from 20070709 00U T C**



Monday 9 July 2007 00UTC ATHEN Forecast t+11 VT: Monday 9 July 2007 11UTC Model Level 40 u-component of wind  
Monday 9 July 2007 00UTC ATHEN Forecast t+11 VT: Monday 9 July 2007 11UTC 0m \*\*large scale precip



# CONCLUSIONS

- Decreasing (increasing) horizontal diffusion seems to increase (decrease) the extent of the outflow .
- Modifying evaporation yields stronger (weaker) outflow when increased (decreased)
- Eulerian run shows larger outflow (less diffusive), and a distinctively different rain pattern than the SL run: more small-scale structures and more intense.
- SL run with advection of hydrometeors switched off ( apart from specific humidity  $q$ , as in the Eulerian run) seems to weaken the outflow .
- Precipitation in the 500m run is strongly reduced and shows an entirely different wind vector pattern at  $t+12h$ , as compared to a 2500m run.