Numlab goes OpenIFS

Heikki Järvinen, Olle Räty, Oleg Stepanyuk, Juha Lento, Victoria Sinclair, Jouni Räisänen

+

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Numlab 2015 students

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Numlab 2015

- Numlab is a traditional meteorology course since 1970's
- Relevant job skills
- So far, a new model every time (>> high starting overhead)

- Year 2015, and for the time being, the model is OpenIFS
- Numlab materials will be stored and re-used (a few variants)

- Supportive communities :: ECMWF and Academic groups
- Links closely to EC-Earth and Harmonie

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OpenIFS

- Global atmospheric model of ECMWF
- OpenIFS is a portable, up-to-date version for Academic use

The corner stone of all operational activities of the Centre:

- Data-assimilation
- High-resolution medium-range weather forecasting
- Ensemble prediction
- Seasonal prediction
- Copernicus Atmosphere Monitoring Services

- www.ecmwf.int >> research >> projects >> openifs

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Numlab using OpenIFS

High-performance computing

- Modern computing architectures
- File systems
- Batch queue systems and scripts

Running the model

- Compile and run OpenIFS
- Post-process model output
- Visualise meteorological fields

Group work

- One topic per group
- Design of experiments
- Execution and reporting

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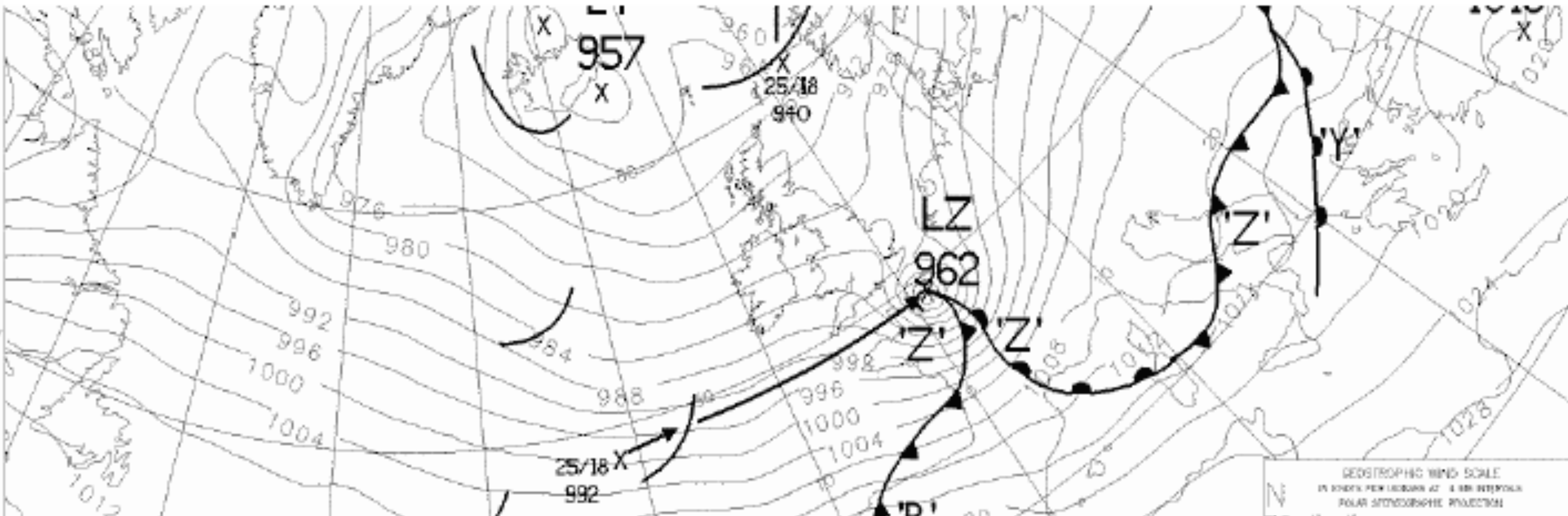
Numlab using OpenIFS

- The topic this year :: The Lothar storm in December 1999
- A wind storm that hit France and Germany
- Lothar was (and is) very difficult to predict (1-2 day advance)



- Next :: group presentions

Numlab groups

Group 1 (Alexandr Bibov, Vladimir Shemyakin, Uni. Lappeenranta)

Group 2 (Evgeny Kadantsev, Nina Karusto, Mikko Laapas, Ville Siiskonen)

Group 3 (Matti Kämäräinen, Jutta Kesti, Meri Virman, Oleg Stepanyuk)

Group 4 (Teija Seitola, Mona Kurppa, Ville Ilkka, Olle Räty)

Group 5 (Ilari Lehtonen, Sini Myllyviita, Minttu Tuononen, Mika Rantanen)

Surface layer parameterization and the effect of roughness length modification

Laboratory Course in Numerical Meteorology 2015

Evgeny Kadantsev, Nina Karusto, Mikko Laapas, Ville Siiskonen

Experimental design

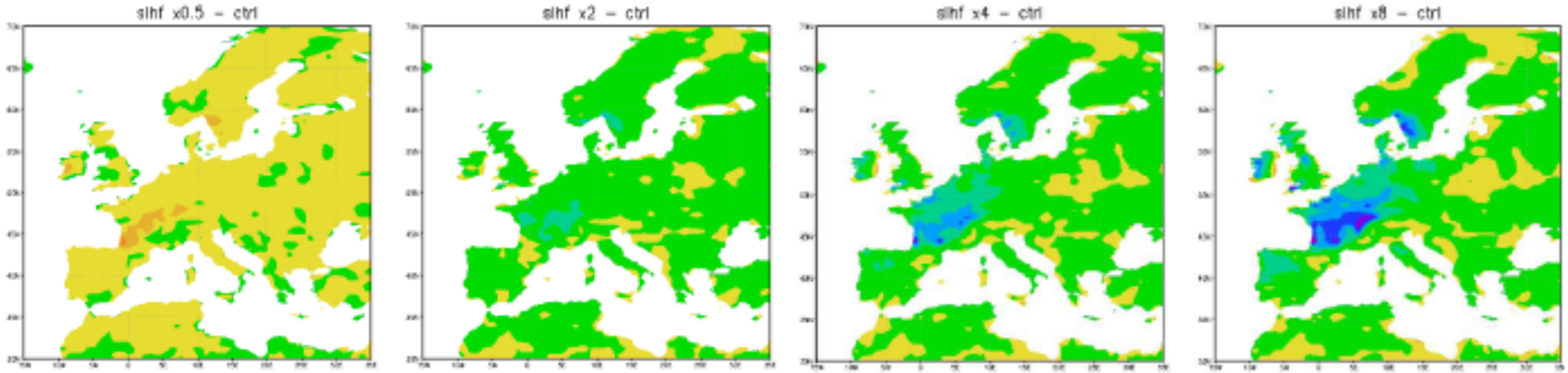
- Lothar storm event: 12 UTC 26.12.1999
- 1 day, 2 day, 3 day and 4 day forecasts
- 20 minutes time step
- 80 km horizontal resolution, 60 vertical levels
- Roughness length:
  - Control run (unmodified)
  - Halved (x0.5)
  - Doubled (x2)
  - Quadruple (x4)
  - Eightfold (x8)

Table 11.4 *Roughness lengths for momentum and heat associated with high and low vegetation types.*

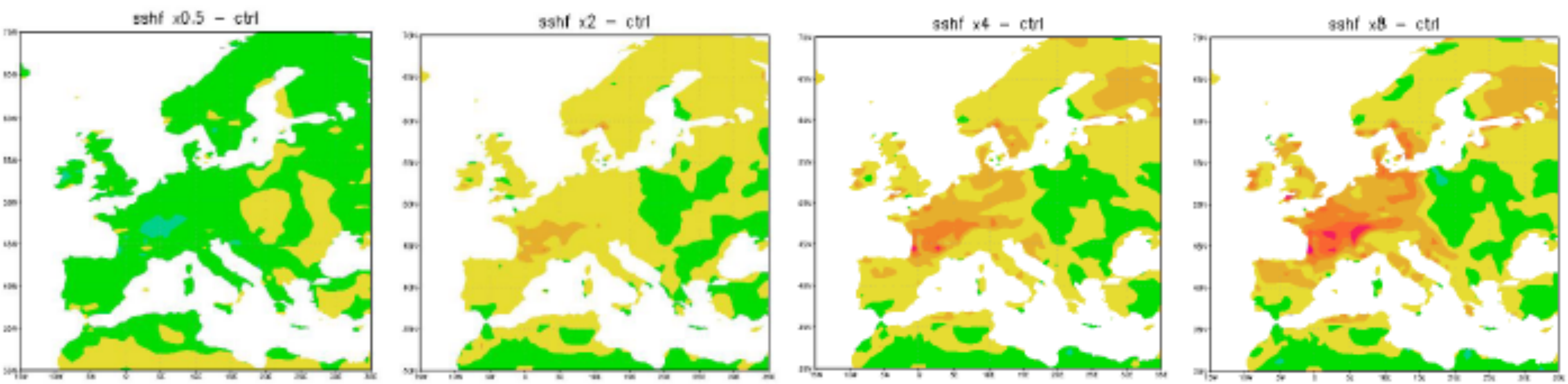
Index	Vegetation type	H/L veg	z_{0m}	z_{0h}
1	Crops, mixed farming	L	0.25	$0.25\ 10^{-2}$
2	Short grass	L	0.2	$0.2\ 10^{-2}$
3	Evergreen needleleaf trees	H	2.0	2.0
4	Deciduous needleleaf trees	H	2.0	2.0
5	Deciduous broadleaf trees	H	2.0	2.0
6	Evergreen broadleaf trees	H	2.0	2.0
7	Tall grass	L	0.47	$0.47\ 10^{-2}$
8	Desert	–	0.013	$0.013\ 10^{-2}$
9	Tundra	L	0.034	$0.034\ 10^{-2}$
10	Irrigated crops	L	0.5	$0.5\ 10^{-2}$
11	Semidesert	L	0.17	$0.17\ 10^{-2}$
12	Ice caps and glaciers	–	$1.3\ 10^{-3}$	$1.3\ 10^{-4}$
13	Bogs and marshes	L	0.83	$0.83\ 10^{-2}$
14	Inland water	–	–	–
15	Ocean	–	–	–
16	Evergreen shrubs	L	0.100	$0.1\ 10^{-2}$
17	Deciduous shrubs	L	0.25	$0.25\ 10^{-2}$
18	Mixed forest/woodland	H	2.0	2.0
19	Interrupted forest	H	1.1	1.1
20	Water and land mixtures	L	–	–

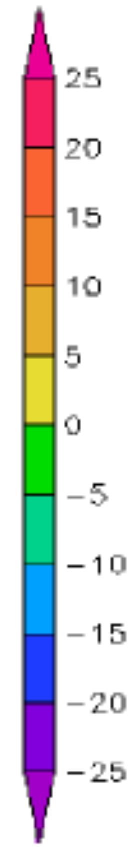
Surface heat fluxes [W/m2] at 26.12.1999 12 UTC
24 hours forecast

Latent heat flux



Sensible heat flux

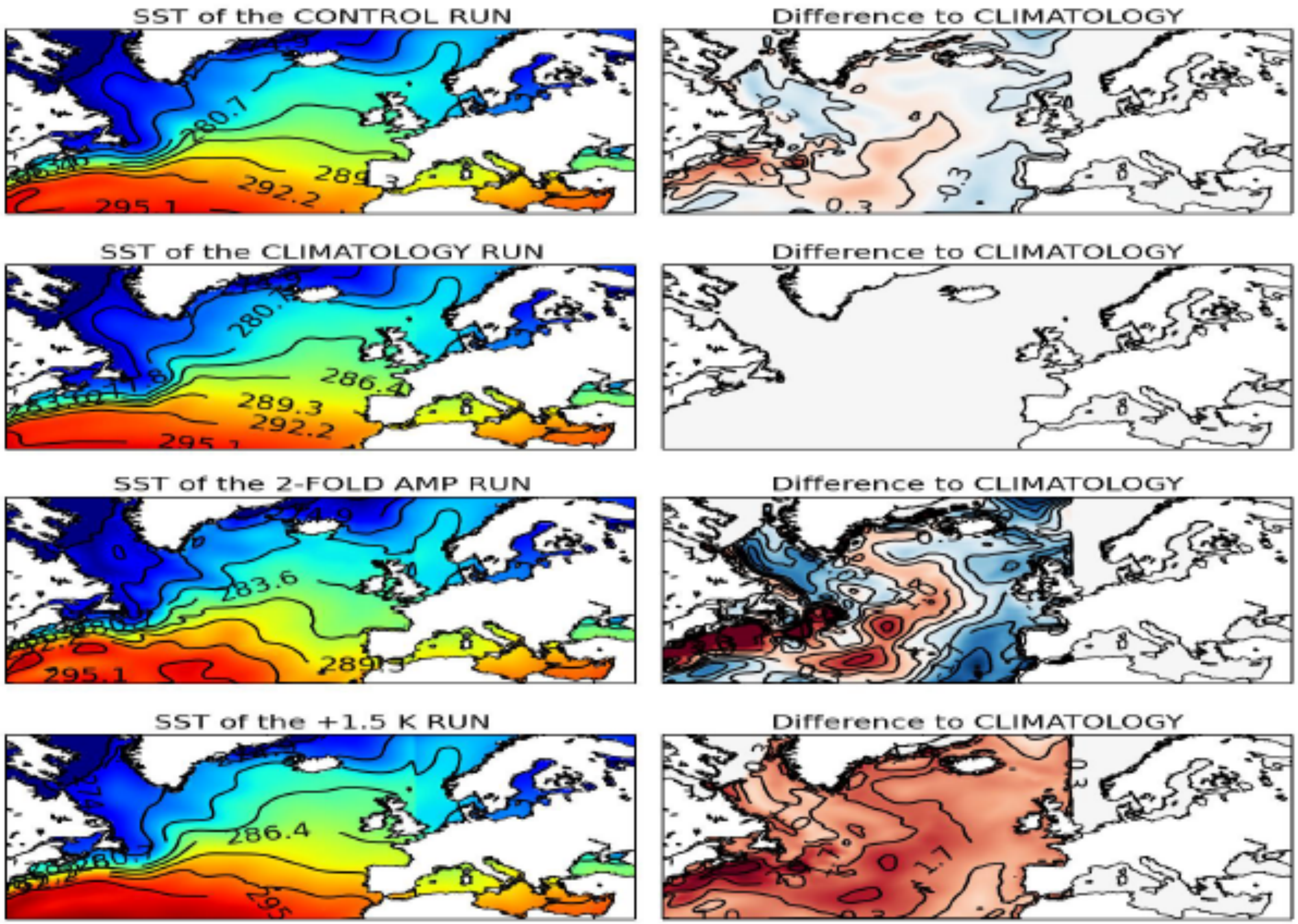




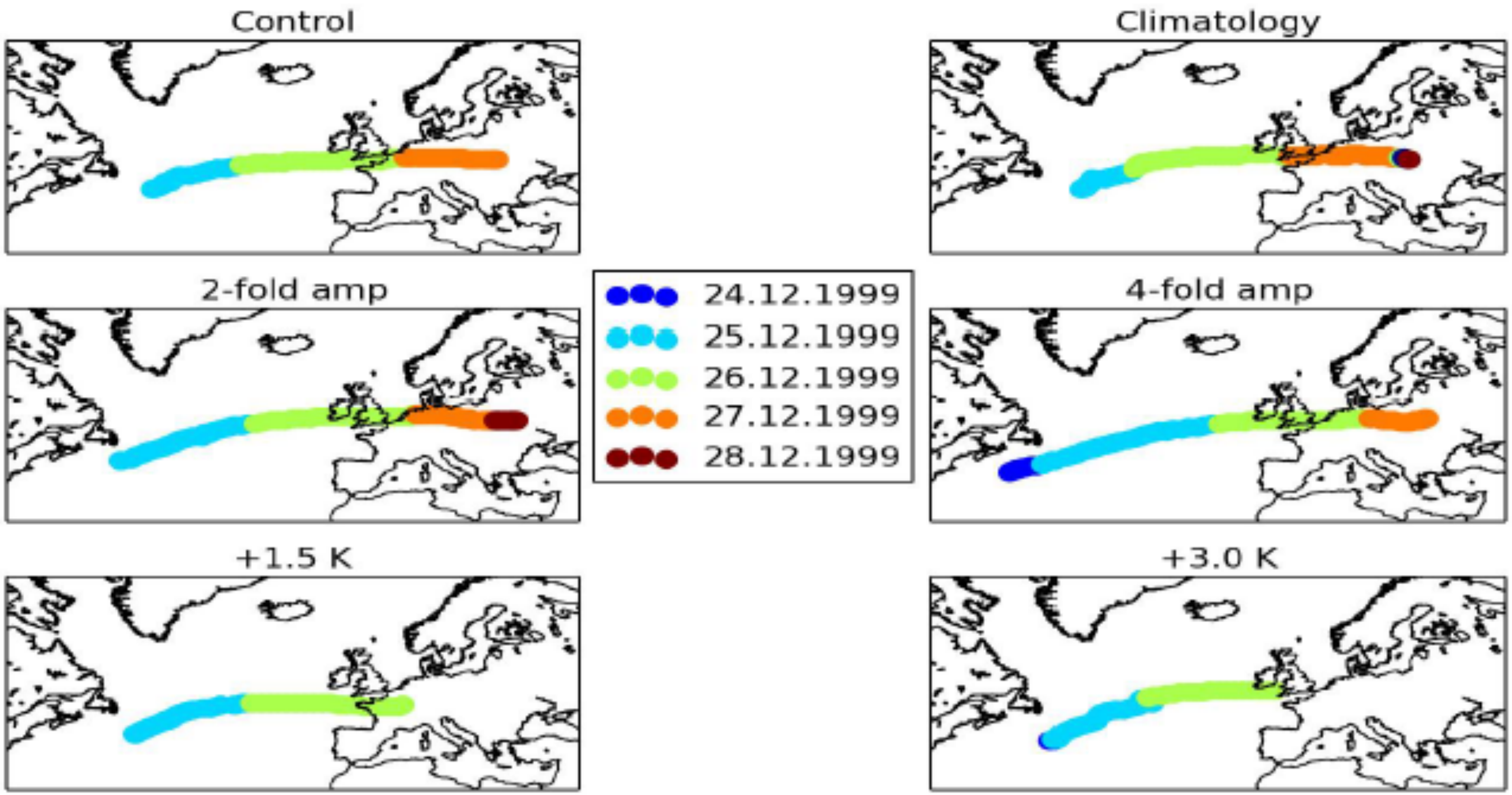
Difference between modified and control runs

Effect of SST on the evolution of the Lothar storm

Matti Kämäräinen, Jutta Kesti, Oleg Stepanyuk and Meri Virman
22.4.2015

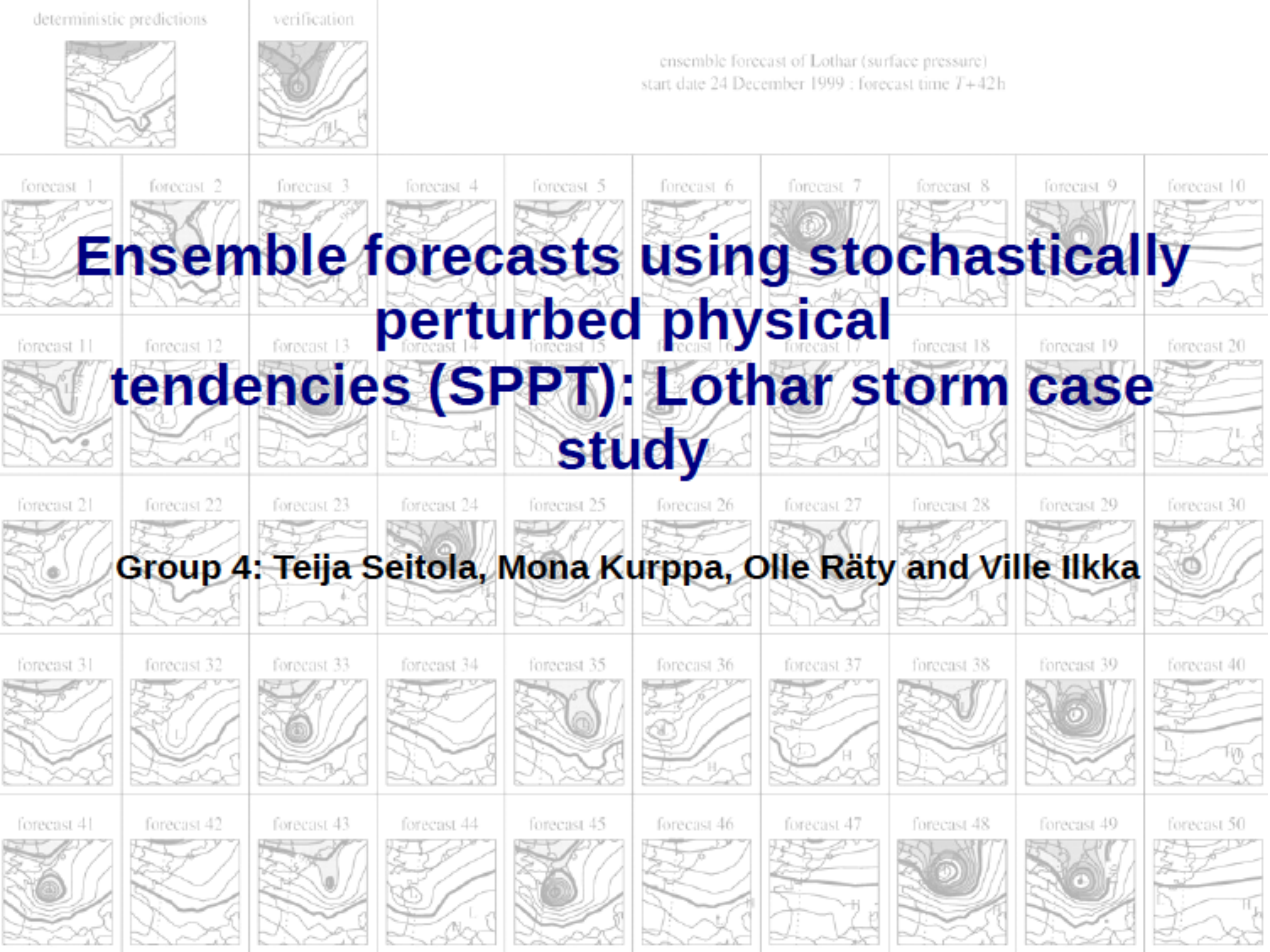

SST of the CONTROL RUN
Difference to CLIMATOLOGY
SST of the CLIMATOLOGY RUN
Difference to CLIMATOLOGY
SST of the 2-FOLD AMP RUN
Difference to CLIMATOLOGY
SST of the +1.5 K RUN
Difference to CLIMATOLOGY

Results

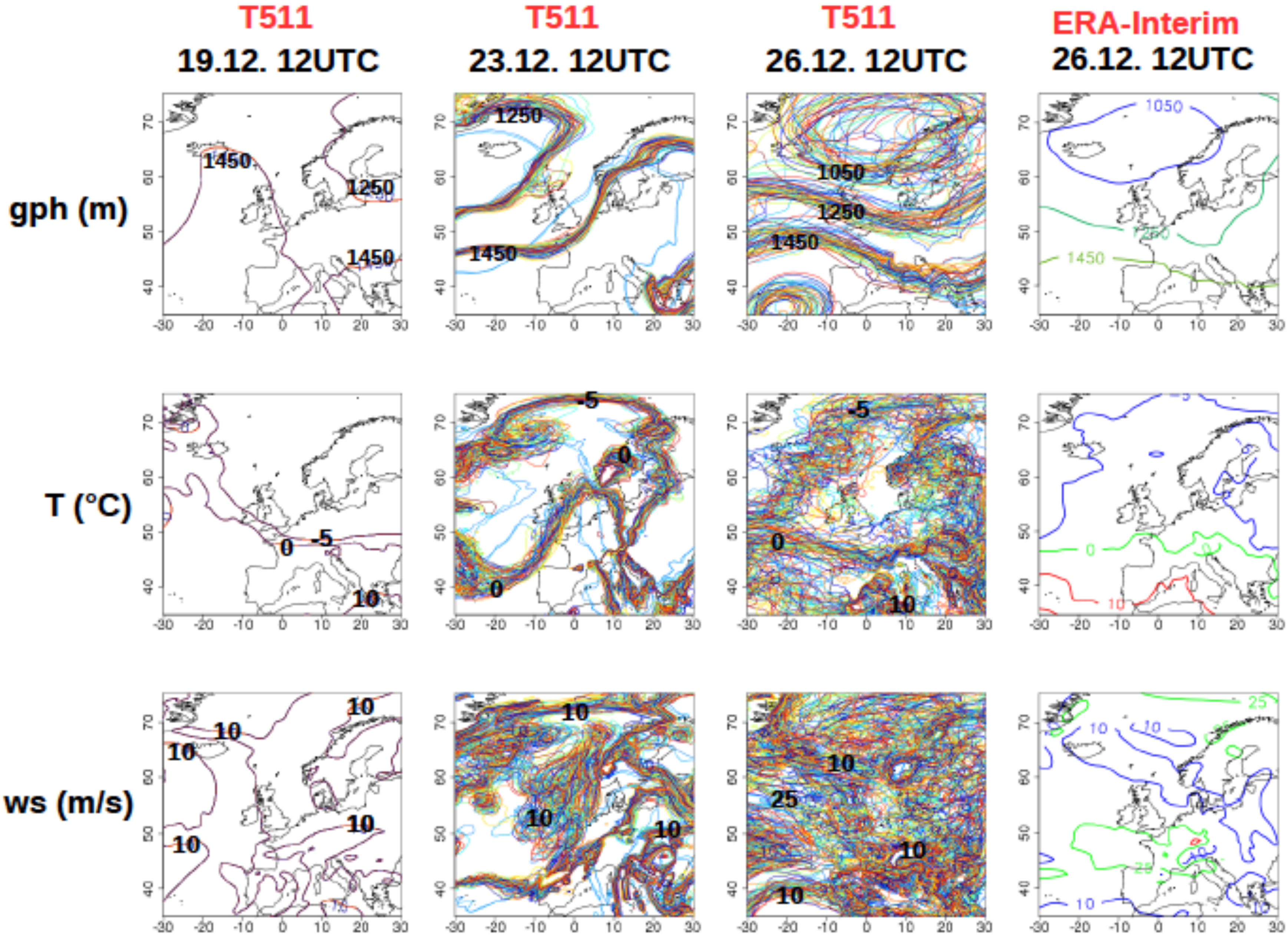

Control
Climatology
2-fold amp
4-fold amp
+1.5 K
+3.0 K
24.12.1999
25.12.1999
26.12.1999
27.12.1999
28.12.1999

Ensemble forecasts using stochastically perturbed physical tendencies (SPPT): Lothar storm case study

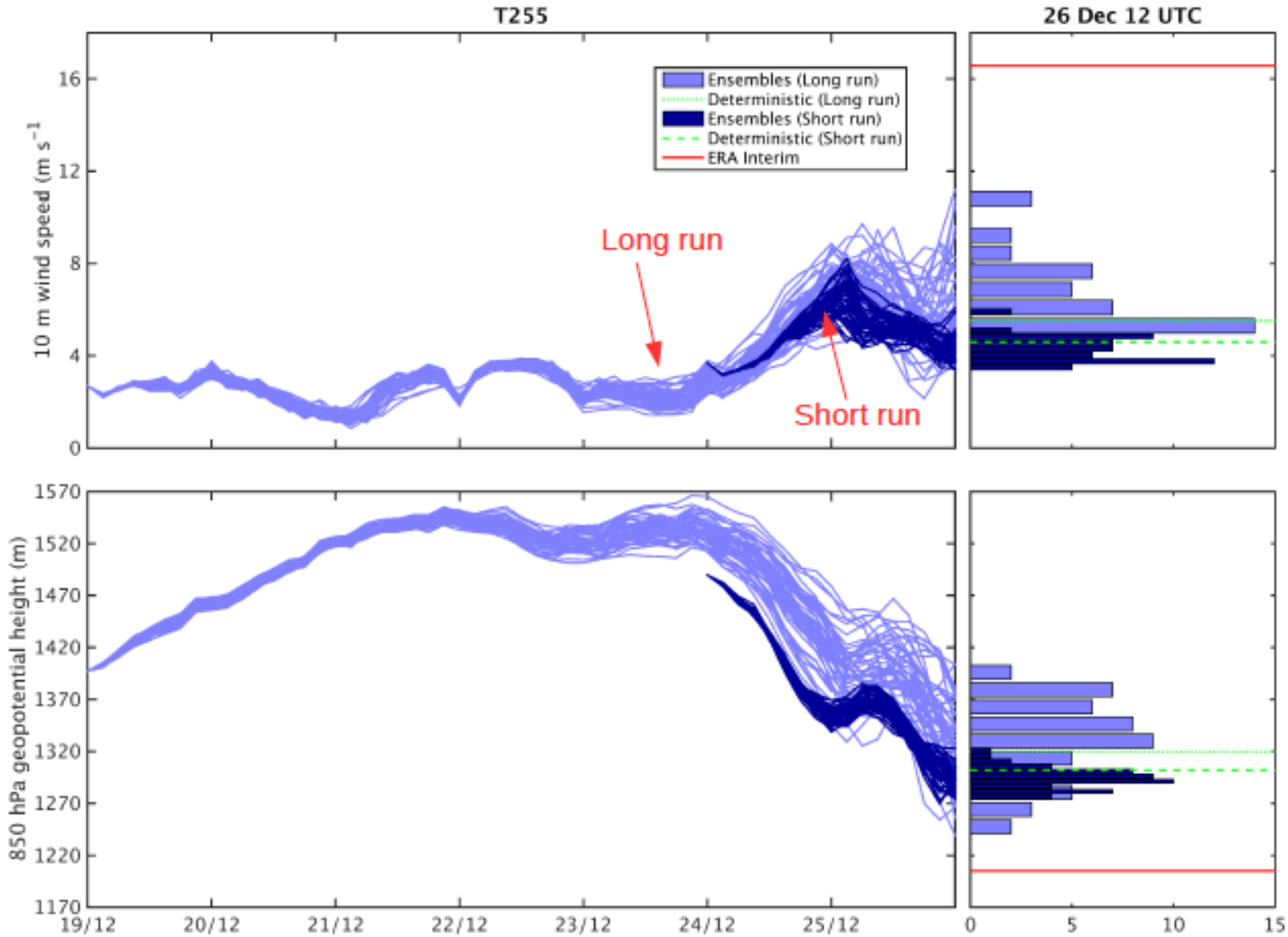
Group 4: Teija Seitola, Mona Kurppa, Olle Räty and Ville Ilkka



Evolution of the 7-day ensemble forecast at 850 hPa



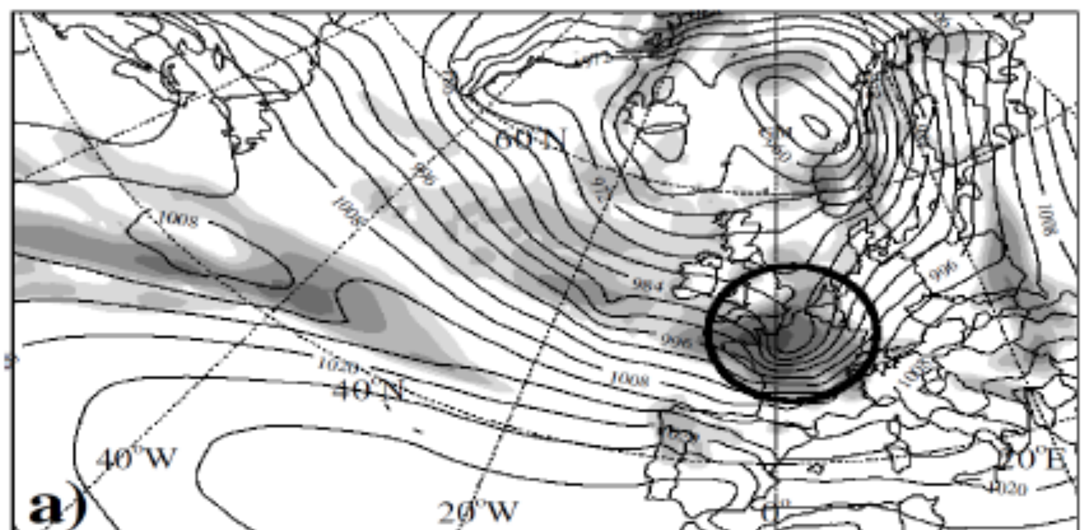
Distribution of forecast at 47-50 N, 8-11 E



High resolution simulations of Lothar storm

Group 5

Ilari Lehtonen, Sini Myllyviita, Mika Rantanen and Minttu Tuononen



26.12.1999 06 UTC

Source: Dynamical aspects of the life cycle of the winter storm 'Lothar' (Wernli etc., 2002)

Motivation:

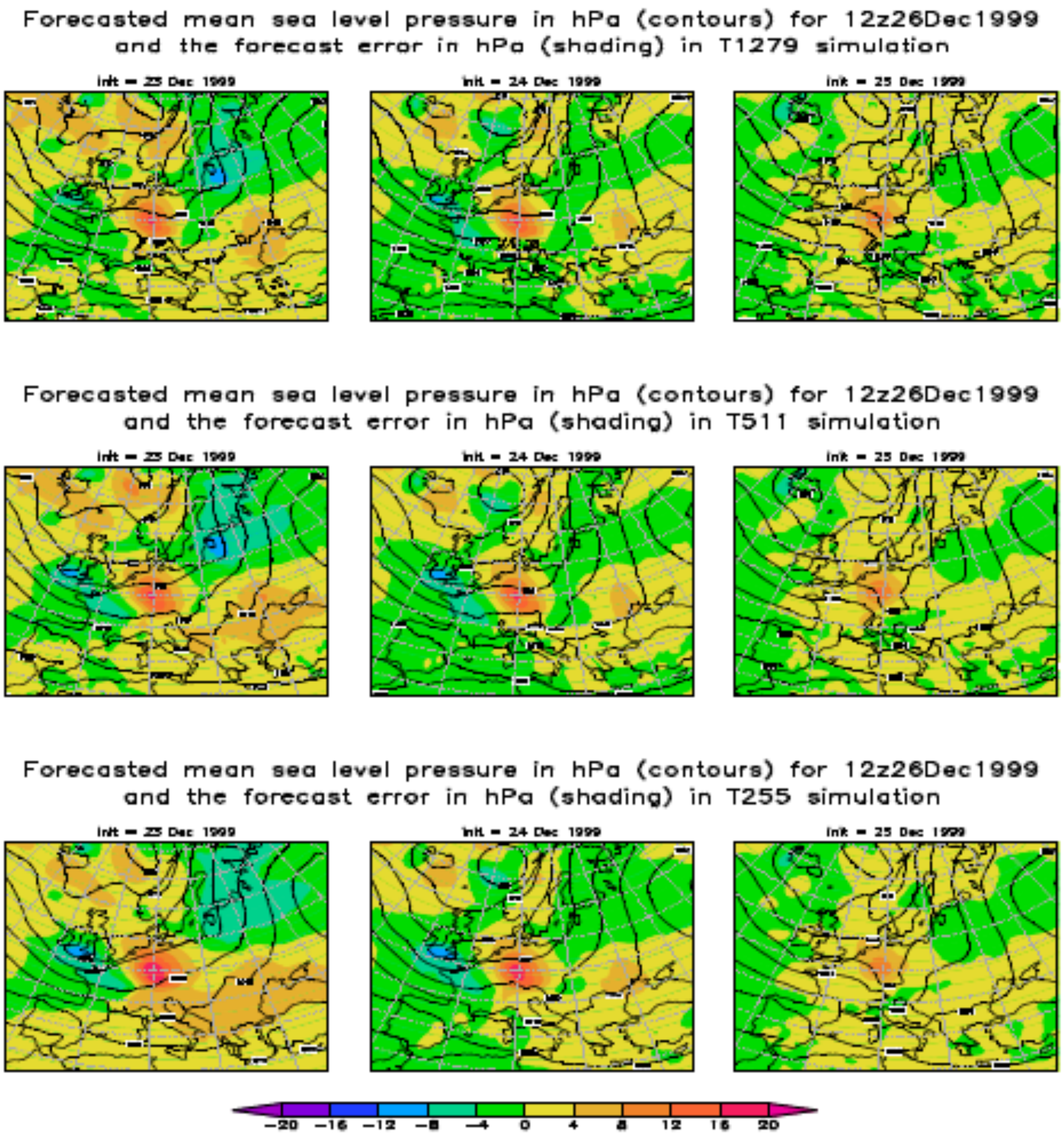
Is Lothar simulated better in the higher resolution models?

Simulations:

- Low resolution: T255, L60
  - Horizontal grid resolution ~ 80 km, vertical resolution 60 levels
  - Timestep 20 minutes
  - 1 day, 2 days and 3 days forecasts

- Medium resolution: T511, L60
  - Horizontal grid resolution ~ 40 km, vertical resolution 60 levels
  - Timestep 10 minutes
  - 1 day, 2 days and 3 days forecasts

- High resolution: T1279, L60
  - Horizontal grid resolution ~ 16 km, vertical resolution 60 levels
  - Timestep 10 minutes
  - 1 day, 2 days and 3 days forecasts



Forecasted MSLP and the forecast error

Left: 3 day forecasts
Middle: 2 day forecasts
Right: 1 day forecasts

- Large scale errors are very similar among the T1279, T511 and T255 simulations
- There are more small-scale structure visible in high resolution simulations

Remarks

- We are happy with OpenIFS - fit for purpose
- Mixture of GRIB1/2 and gg/sh obstacles
- Metview installation – we used mostly Grads
- Students have variable skills in Linux, scripts, etc.
- Lothar weakly predictable – could try with a more predictable system (St Jude)
- New topics jointly :: tropical meteorology, numerical synoptics, general circulation