Evaluation of the Two-Way Nesting Version of LM at HNMS

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1 Introduction

Athens Olympics of 2004 provide with an outstanding opportunity for test, and consequently operational use, of local non-hydrostatic numeric weather prediction models of very high resolution (< 3 km). Based on the first version of the two-way nesting version of the Local Model (LM2WN) [Ref. 1], some representative cases are examined for the wider Attica area at the horizontal grid of 2.3 Km against the results of the latest operational version of LM at 7 Km horizontal grid as well as observations. All the runs were performed at ECMWF using the IBM supercomputing system based on the POWER 4 processor.

2 Code outline and results

The main idea of the LM2WN code is based on the parallel run of the LM both for one coarse and one (or more) horizontally finer grid domains "nested" within this coarse domain. A numerical feedback between the results enters after the finite number n of integration time steps t/n of the fine domain equals the integration time step t of the coarse grid domain. In our tests, we took $t = 30 \ sec$ and $n = 3$. Also the horizontal grid size for the coarse domain was $x_{coarse} = 7$ Km and for the fine domain was $x_{fine} = 2.3$ Km. In Figure 1, we present the algorithm flowchart of the LM2WN following Rimann [Ref. 1] where a detailed description of the method is given. The numerical scheme is based on the MM5 two-way nesting option as described in [Ref. 2]. The coarse grid domain given in Figure 2a covers the wider area of
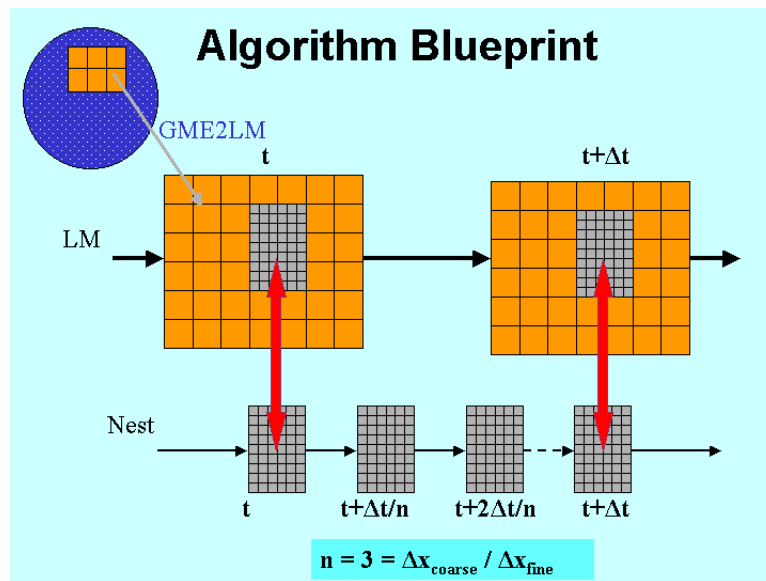

Figure 1: Algorithm flowchart

Greece as it stems from 7 Km horizontal grid. The blue frame defines the fine grid domain

(a)   (b)

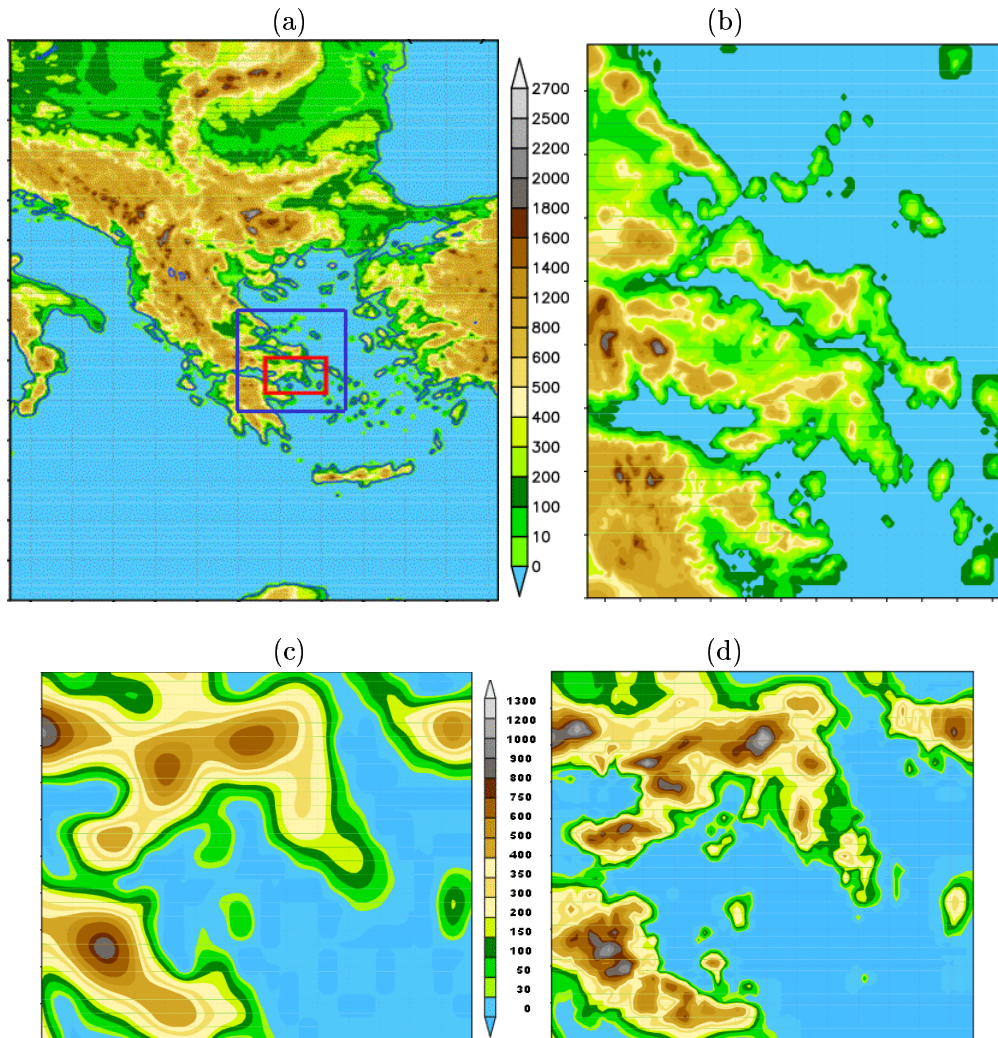(c)   (d)

Figure 2: Domain orography for Greece (a), Attica (c) in 7 Km grid size and for Nest (b) and Attica (d) in 2.3 Km grid size.

that encloses Attica, which is the main area of interest and is enclosed with the red frame. In Figure 2b, the fine grid domain is given with orography at 2.3 Km horizontal grid size. In Figures 2c and 2d, we present the orography of Attica at 7 Km and 2.3 Km horizontal grid size respectively.
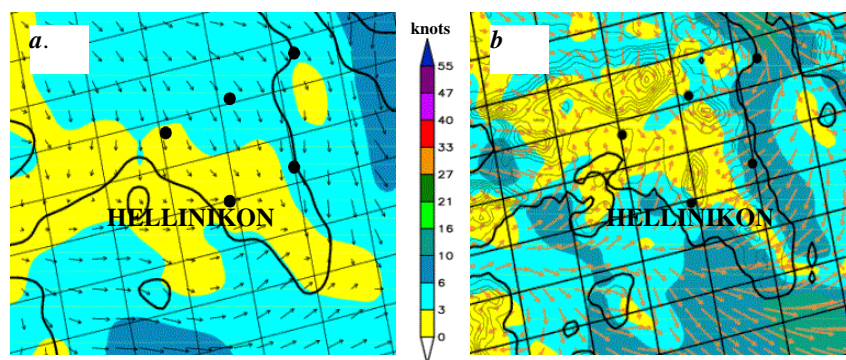

Figure 3: 10–meter winds for August 25 2003 in Attica, (a) coarse grib, (b) fine grid.

Although reservations have been raised regarding the status of LM2WN [Refs 4 and 6], it has been considered of interest to test the code under some weather patterns developed in

the area of Attica during the summer period. In Figures 3a and 3b, we show the 10-meter winds for August 25 2003 at 12 UTC from the regular LM at 7 Km and the LM2WN at 2.3 Km grid respectively (24 hours forecast). During this day see breeze conditions in the area of Hellinikon were developed. The hourly 10-meter wind sequence is presented in Figure 4.
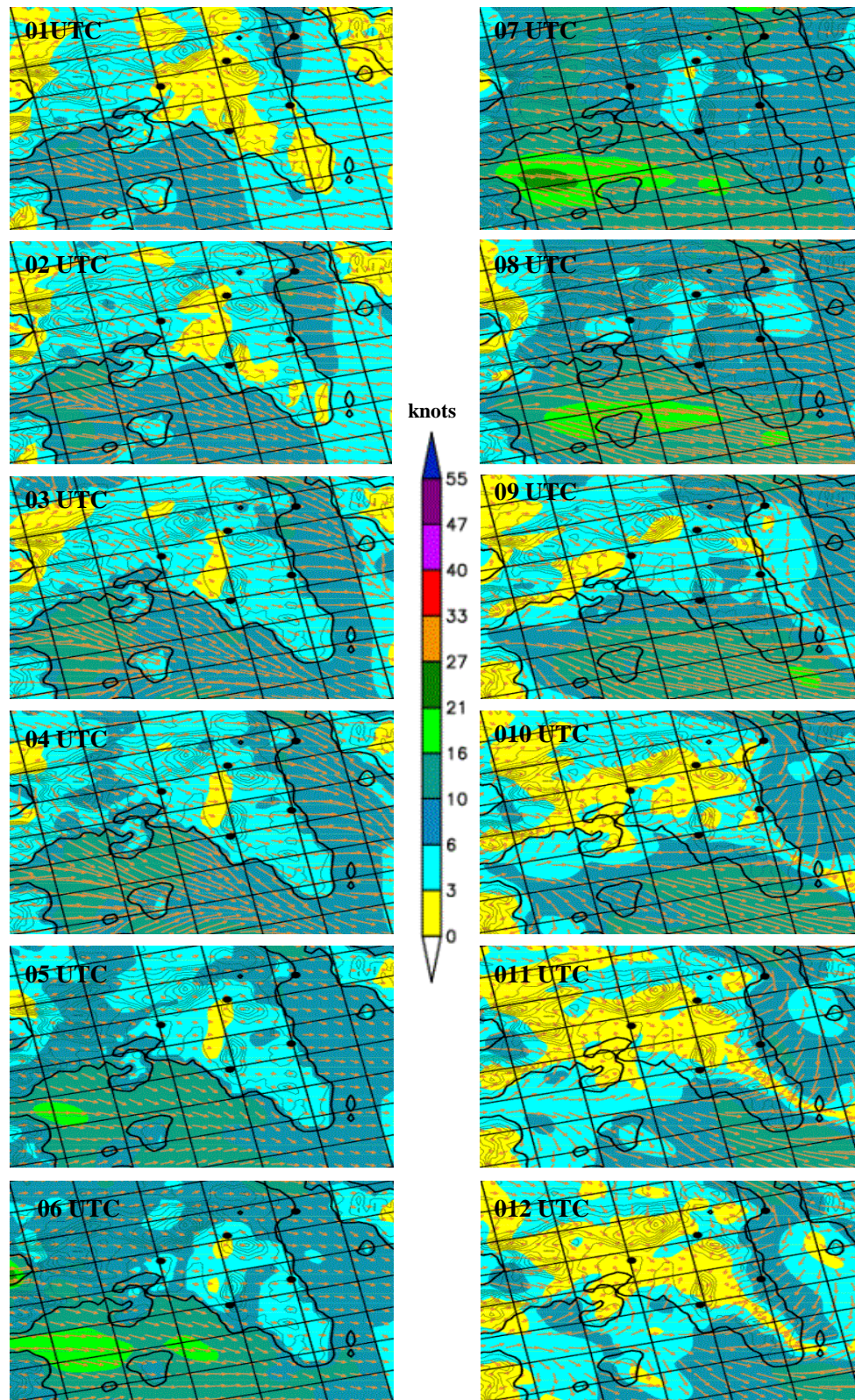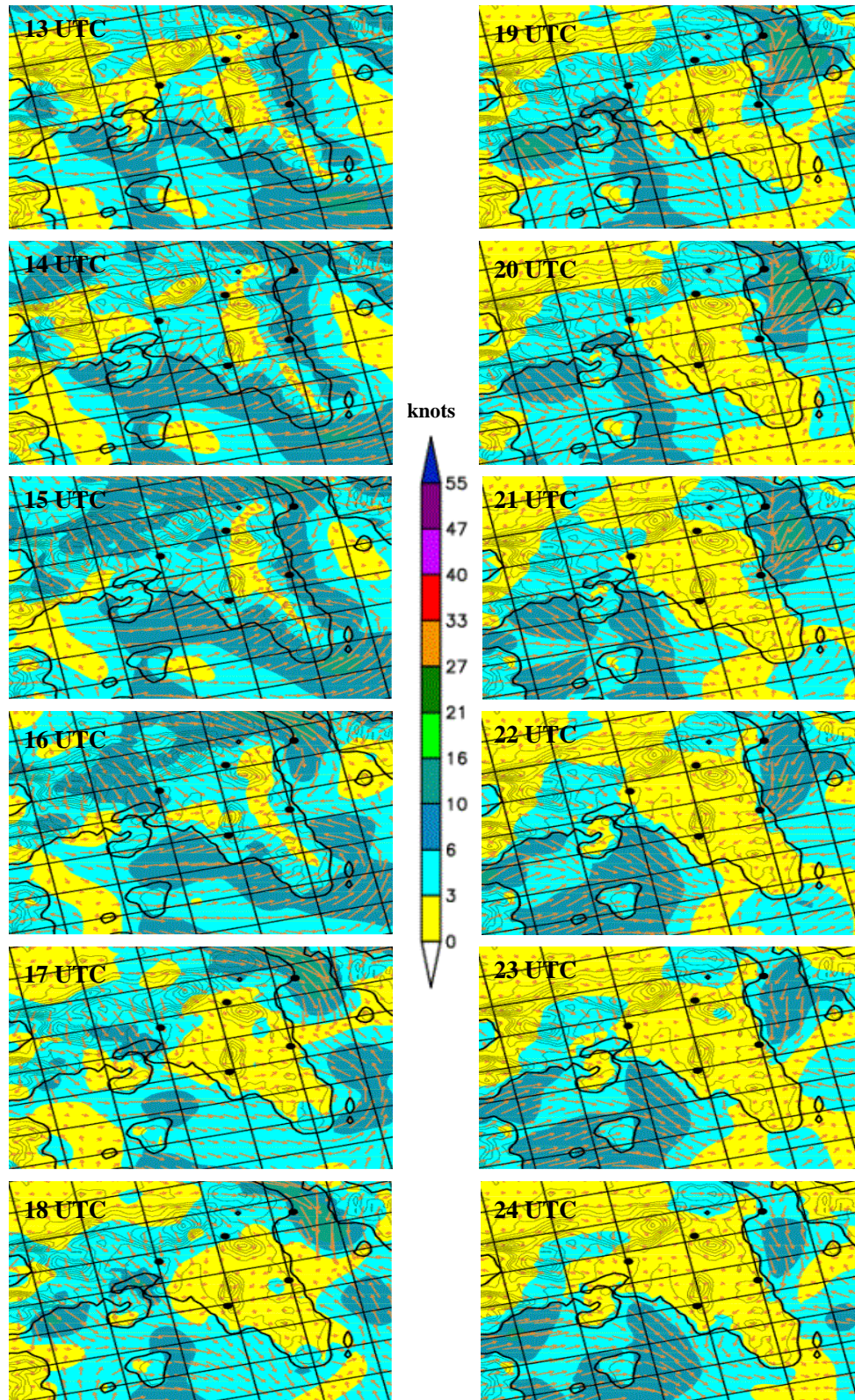

Figure 4: continued

Figure 4: Hourly 10–meter wind development for Attica (fine grid) in August 25 2003.

In Figures 5a and 5b, we show the 10-meter winds for August 07 2003 at 12 UTC from regular LM at 7 Km and the LM2WN at 2.3 Km grids respectively (24 hours forecast). During this day, northern winds (Etesians) with range up to 20 knots prevailed over the whole Attica area. Comparisons of the nearest point results with METAR observations are

given in Tables 1 and 2 for Hellinikon and Schinias Meteorological Stations respectively and for 24 hour forecast. The parameters considered are 10-meter wind direction (DIR) and intensity (SPD) as well as 2m Temperature (2T). In each column forecasted/observed values are listed.
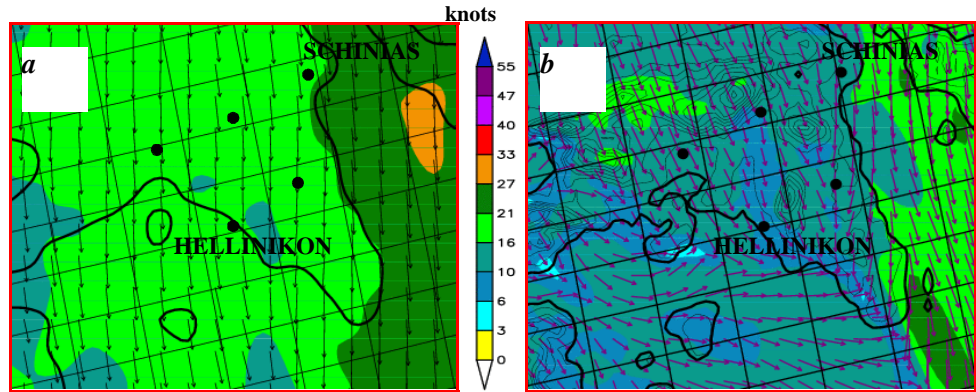

Figure 5: 10–meter winds for August 25 2003 in Attica, (a) coarse grid, (b) fine grid.

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   HELLINIKON 2003 AUGUST 07
       00 UTC + HOUR
[HOUR][DIR(degs)][SPD(kts)][2T(°C)]
   00   [335/360]  [08/11]  [25/27]
   01   [340/360]  [06/16]  [22/27]
   02   [355/360]  [05/13]  [20/27]
   03   [345/360]  [04/11]  [19/27]
   04   [350/360]  [04/12]  [17/26]
   05   [355/010]  [05/14]  [18/27]
   06   [345/010]  [05/12]  [22/28]
   07   [335/360]  [07/18]  [26/30]
   08   [335/020]  [07/15]  [29/31]
   09   [330/020]  [07/18]  [31/32]
   10   [320/010]  [07/20]  [34/32]
   11   [325/020]  [07/18]  [35/33]
   12   [335/360]  [09/16]  [35/33]
   13   [340/360]  [09/15]  [35/33]
   14   [340/030]  [09/12]  [34/33]
   15   [340/020]  [08/14]  [32/32]
   16   [350/020]  [07/14]  [30/31]
   17   [360/360]  [06/15]  [27/30]
   18   [005/010]  [06/13]  [23/29]
   19   [005/350]  [07/11]  [21/28]
   20   [360/360]  [07/12]  [20/28]
   21   [360/360]  [06/13]  [19/28]
   22   [005/360]  [06/17]  [18/27]
   23   [005/360]  [06/15]  [17/27]
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Table 1

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   SCHINIAS 2003 AUGUST 07
       00 UTC + HOUR
[HOUR][DIR(degs)][SPD(kts)][2T(°C)]
   00   [345/350]  [10/14]  [25/26]
   01   [335/350]  [09/14]  [22/26]
   02   [340/360]  [08/13]  [21/26]
   03   [345/360]  [09/11]  [19/26]
   04   [335/360]  [08/11]  [19/25]
   05   [325/360]  [07/14]  [19/26]
   06   [325/360]  [09/13]  [23/27]
   07   [340/360]  [12/14]  [27/28]
   08   [345/010]  [14/16]  [29/29]
   09   [350/010]  [14/17]  [30/29]
   10   [345/010]  [13/17]  [31/30]
   11   [350/360]  [13/13]  [32/30]
   12   [350/020]  [14/18]  [33/30]
   13   [355/020]  [14/17]  [32/30]
   14   [355/010]  [14/14]  [31/30]
   15   [360/350]  [13/14]  [30/30]
   16   [005/360]  [12/13]  [28/29]
   17   [005/350]  [12/13]  [25/29]
   18   [005/350]  [11/13]  [22/28]
   19   [005/350]  [11/12]  [20/28]
   20   [360/360]  [10/11]  [19/27]
   21   [355/350]  [09/12]  [18/27]
   22   [345/350]  [08/11]  [18/26]
   23   [340/360]  [07/11]  [17/26]
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Table 2

Finally, we present in Figures 6a and 6b the total accumulated precipitation 06-18UTC for August 18 2002 from regular LM at 7 Km and LM2WN at 2.3 Km grid size respectively (24 hours forecast) along with the observed values in mm.

3. Conclusions

From those cases as well as from several others that have been evaluated, mainly over the last year, LM2WN should be used cautiously for operational purposes. At this stage, from the test cases examined and from the issues raised in References 4 and 6, further insight needs to be gained both to the numerics and to the physics of the code.
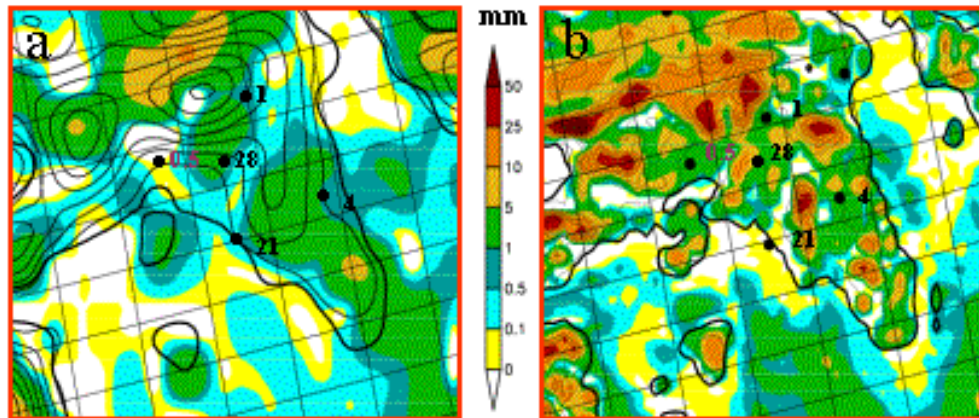
Figure 6: Accumulated precipitation (06–18) UTC for August 18 2002 in Attica, (a) coarse grid, (b) fine grid.

4. References

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