

A Comparison of High-Resolution Mesoscale Simulations using MM5 and WRF-ARW for the 2006 Winter Olympics

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The Pennsylvania State University

Objectives

- Run MM5 and WRF-ARW for six case periods during the Winter Olympics using similar configurations
- Perform a statistical analysis on the finest domain (1.333-km resolution)
- Perform a subjective analysis of model results from both models

Case Descriptions

Case 1	00 UTC, 13 Feb 2006 - 00 UTC, 14 Feb 2006	Dry
Case 2	12 UTC, 17 Feb 2006 - 12 UTC, 18 Feb 2006	Precip/Wind in Mountains
Case 3	00 UTC, 18 Feb 2006 - 00 UTC, 19 Feb 2006	Precip in Mountains
Case 4	12 UTC, 19 Feb 2006 - 12 UTC, 20 Feb 2006	Precip in Mountains and on Plains
Case 5	00 UTC, 22 Feb 2006 - 00 UTC, 23 Feb 2006	Precip on Plains
Case 6	12 UTC, 25 Feb 2006 - 12 UTC, 26 Feb 2006	Light Precip in Mountains and on Plains

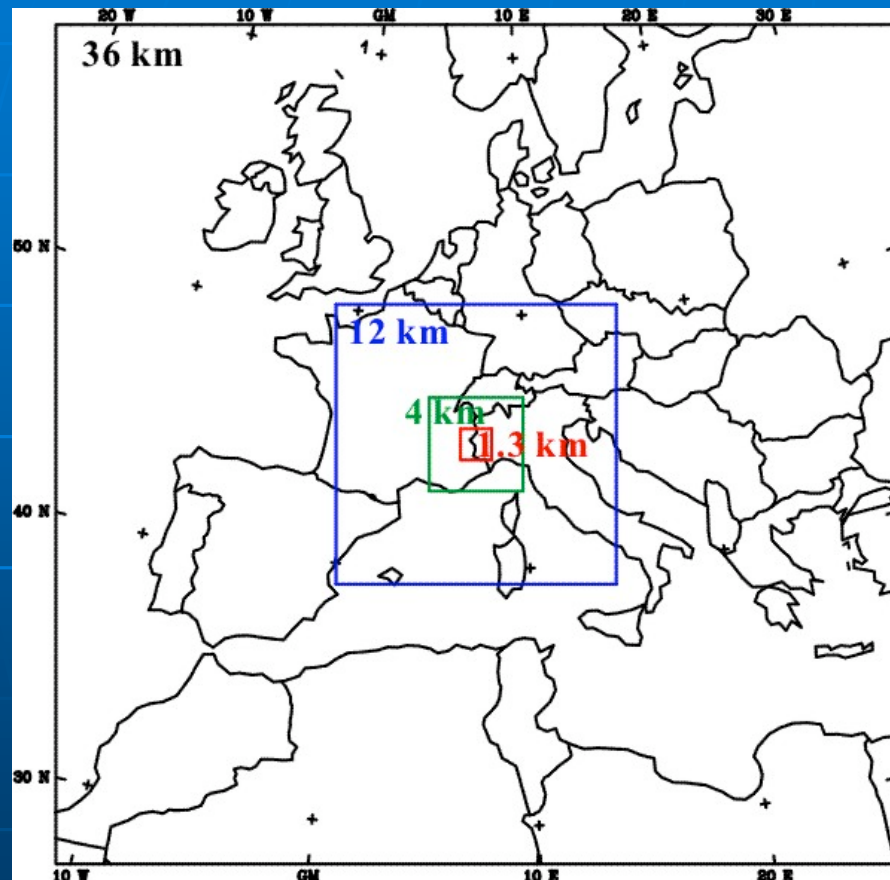
MM5 and WRF Experimental Design

Exp. Name	PBL Physics	Microphysics	CPS (36/12 km)	Radiation	Dynamic Initialization
Realtime MM5	GS TKE	Simple Ice	KF2	LW: RRTM SW: Dudhia	DI
MM5 BASELINE	M-Y Eta TKE PBL	Simple Ice	KF2	LW: RRTM SW: Dudhia	None
WRF BASELINE	M-Y-J Eta TKE PBL	WSM 3-class simple ice scheme	KF2	LW: RRTM SW: Dudhia	None

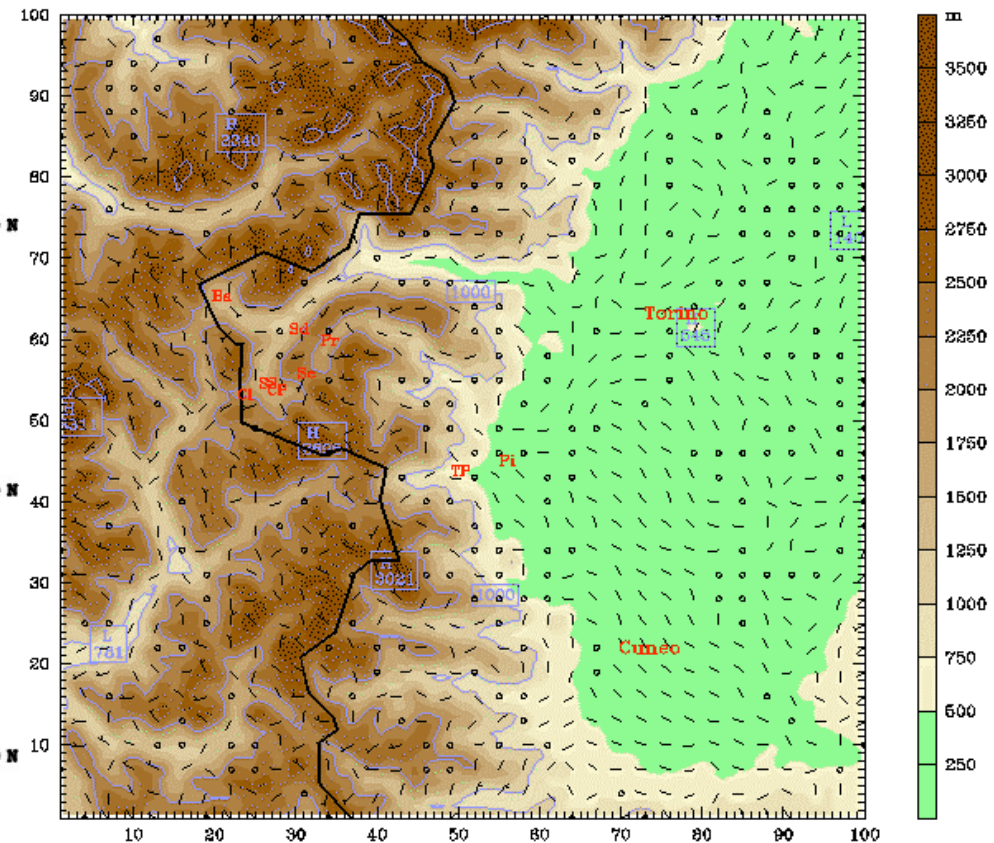
Starting: -12h

Ending: +24h

Domain Configuration & Terrain



Four one-way nested domains using
down steps



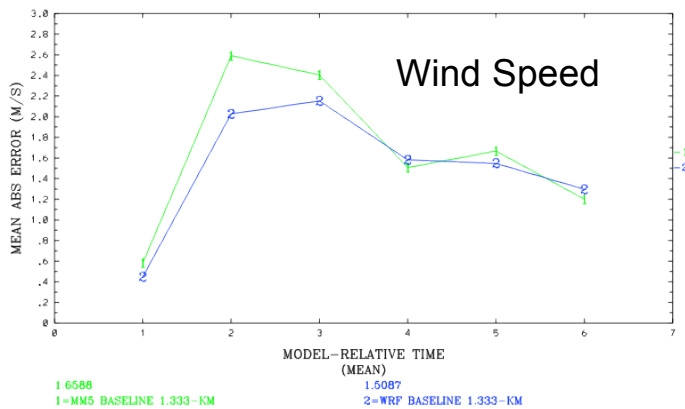
1.333-km domain terrain

Statistical Evaluation

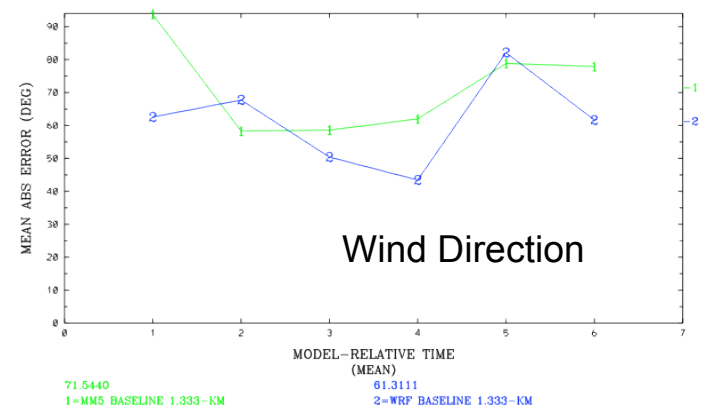
- Mean Absolute Error (MAE) calculated for wind speed, direction, temperature and mixing ratio on the 1.333-km domain
- Time series statistics
 - Individual case averages
 - Average of all six cases
- Vertical profile statistics
 - All vertical levels
 - Six-case average

1.333-km Grid Surface-Layer MAE

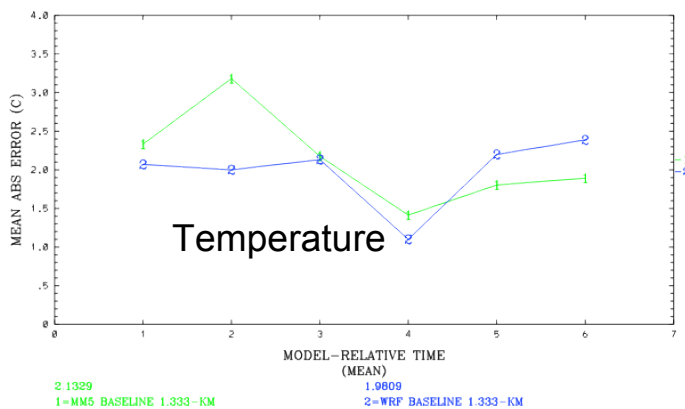
MEAN ABS ERROR OF WIND SPEED (M/S) VS. TIME
LAYER= sfc layer (58m) AGL
DATE/TIME RANGE= 11 FEB 2006, 0000Z-26 FEB 2006, 0000Z AND SUBDOMAIN = 1



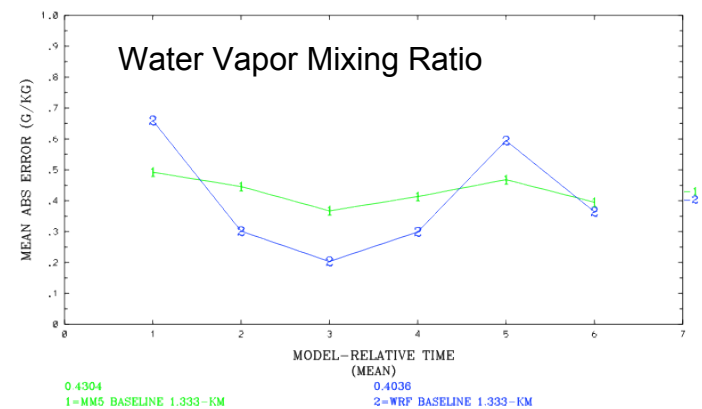
MEAN ABS ERROR OF WIND DIRECTION (DEG) VS. TIME
LAYER= sfc layer (58m) AGL
DATE/TIME RANGE= 11 FEB 2006, 0000Z-26 FEB 2006, 0000Z AND SUBDOMAIN = 1



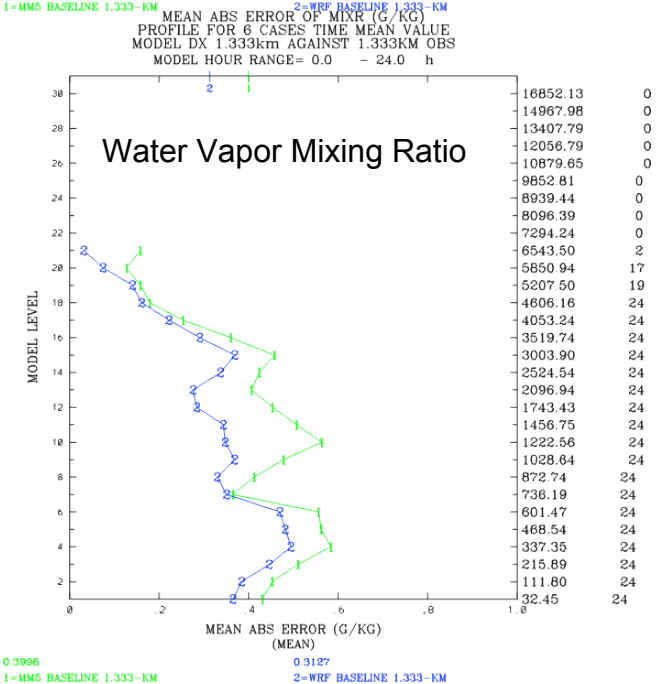
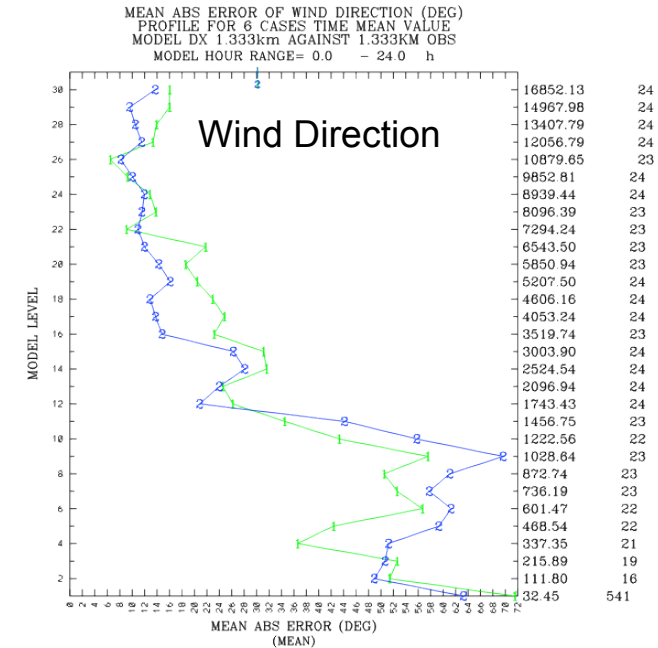
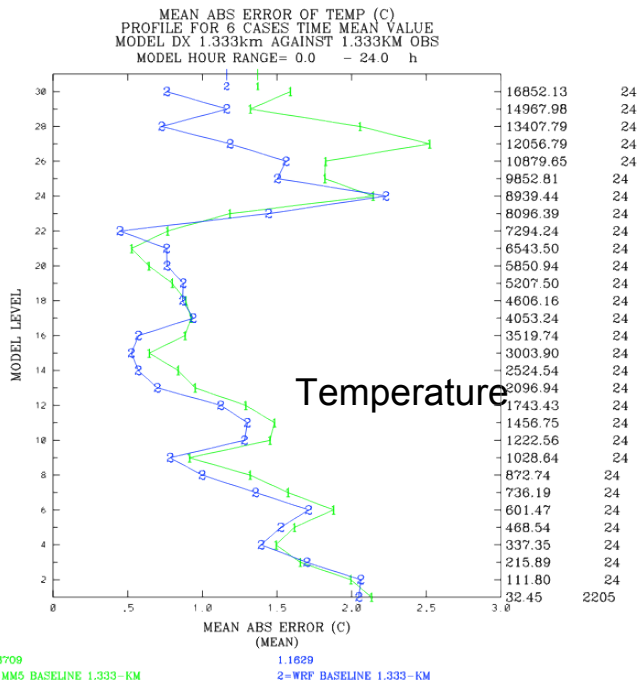
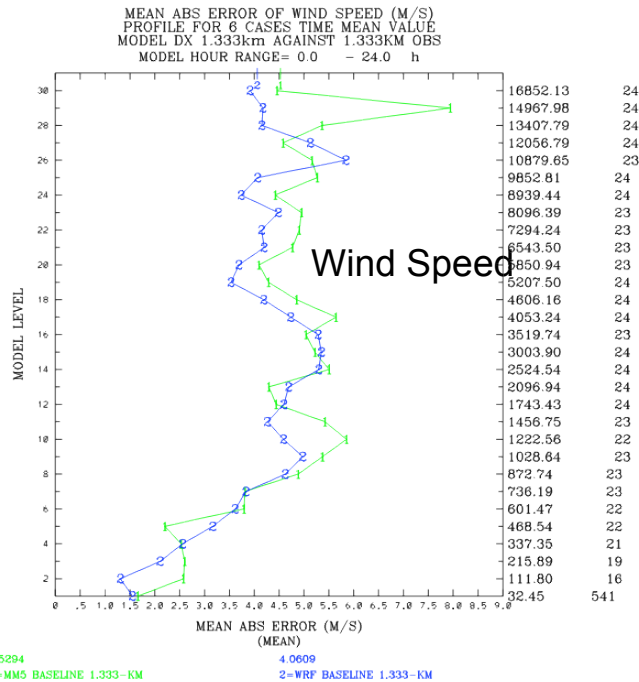
MEAN ABS ERROR OF TEMP (C) VS. TIME
LAYER= sfc layer (58m) AGL
DATE/TIME RANGE= 11 FEB 2006, 0000Z-26 FEB 2006, 0000Z AND SUBDOMAIN = 1



MEAN ABS ERROR OF MIXR (G/KG) VS. TIME
LAYER= sfc layer (58m) AGL
DATE/TIME RANGE= 11 FEB 2006, 0000Z-26 FEB 2006, 0000Z AND SUBDOMAIN = 1



MAE 1.333-km



Statistical Results

- Six-case average stats show:
 - WRF-ARW has a slight statistical advantage over MM5 at the surface on the 1.333-km domain (significance not tested)
 - WRF-ARW also has a slight statistical advantage in the vertical, especially for mixing ratio.
- Case by case, neither model has a distinct advantage for all variables

Subjective Comparisons

- MM5 vs WRF-ARW
 - WRF consistently has less spatial precipitation coverage
 - WRF has unrealistic spikes in precipitation amounts along the lateral boundaries that do not exist in MM5 (occurs when using one-way nests with ndown steps)
- WRF-ARW v2.1 vs. WRF-ARW v2.2
 - More pronounced boundary noise in v2.2

Case 2

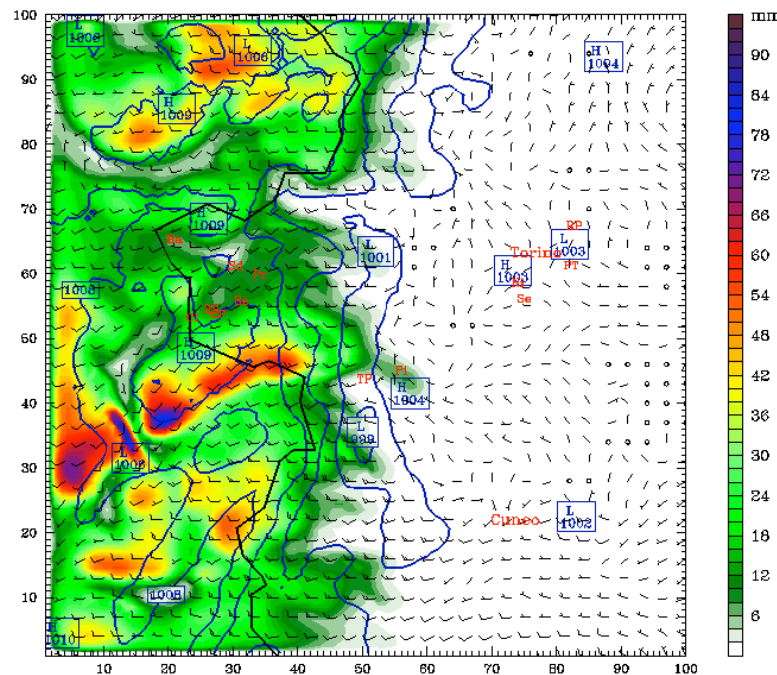
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

Realtime MM5

OBS

Dataset: MM5 1.33km grid RIP: mm5 realtime rto Init: 0900 UTC Fri 17 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



ARPA Piemonte - The weather and snow service at the Games

Data observed in the single venues: last update on 18/02/2006 at 15:00 local time

Venues	Sky	Temp.(°C)	Umidity (%)	Wind (m/s)	Total Precipitations (mm)	Last 24h new snow (cm)	Web Cam
Pinerolo palaghiaccio		8.4	70	NNE 1.80	-	-	
Cesana San Siro		1.1	64	SSW 2.30	-	5	
Sauze d'Oulx-Jovencaux		3.0	79	SSW 2.30	-	3	
Pragelato		2.6	60	WSW 1.70	-	1	
Sestriere Borgata		2.2	51	S 2.90	-	2	
Sestriere Colle		0.7	44	W 5.70	-	3	
Cesana Pariol		2.7	61	SSW 2.30	-	5	
Torino esposizioni		5.0	91	N 1.90	-	-	
Bardonecchia		4.4	41	WSW 2.90	-	9	
Pragelato Plan		2.0	62	NNW 1.20	-	1	
San Siro Fraitave		-0.8	68	W 5.10	-	6	

View of the Italian side from the French border

24-h Total Precip

Case 2

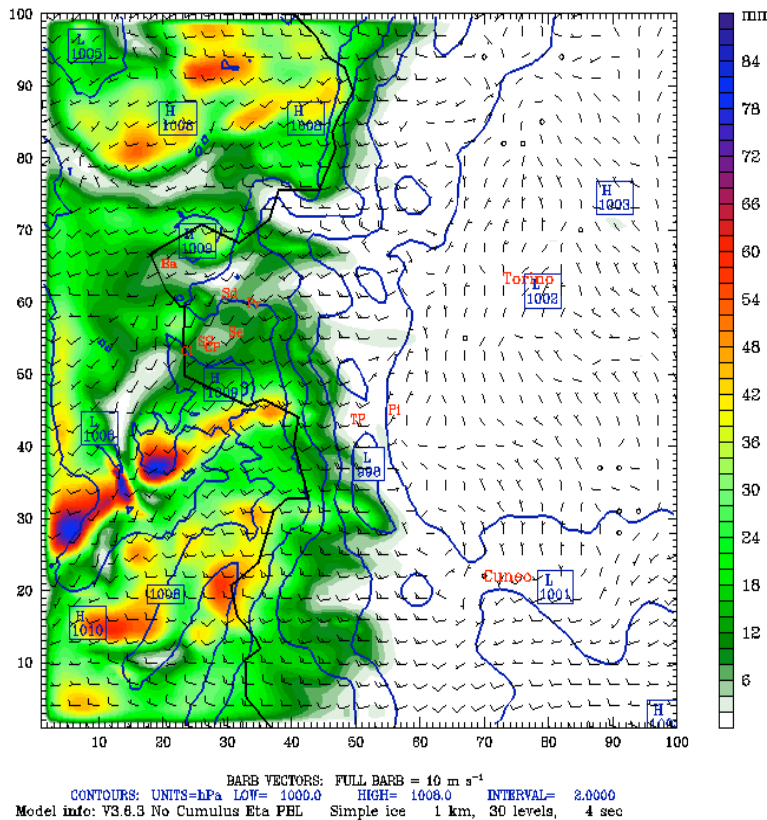
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

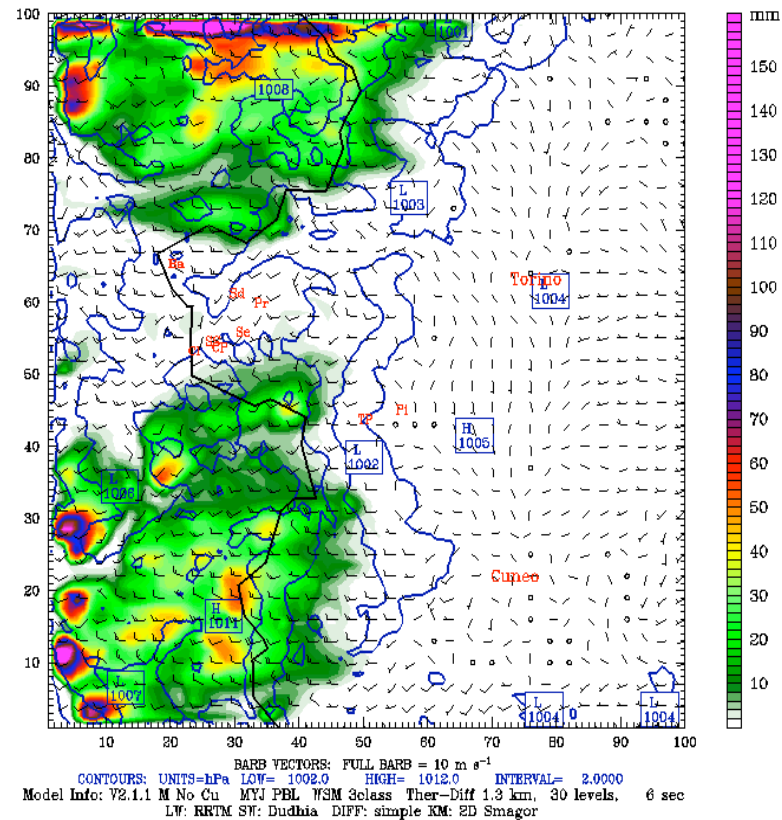
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 0900 UTC Fri 17 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 0900 UTC Fri 17 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 2

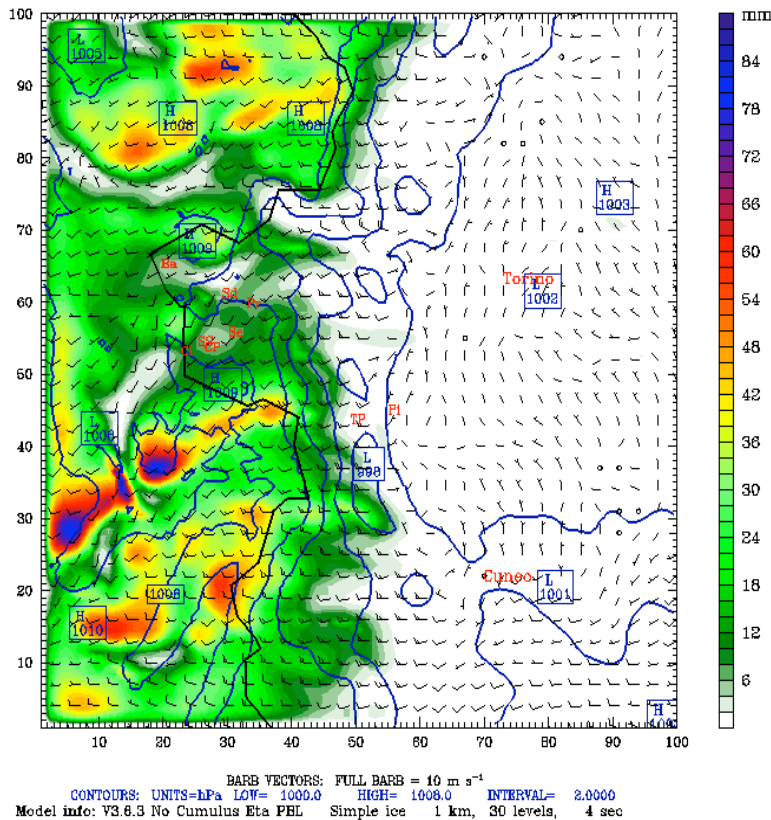
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

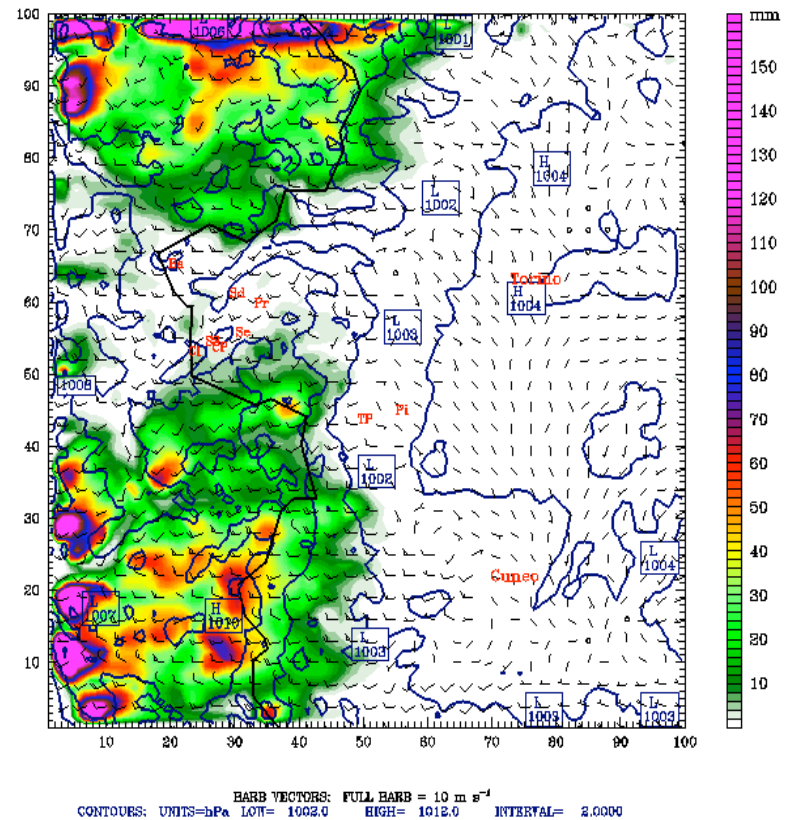
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 0900 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime rtotsh0 Init: 1200 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Total precip. since h 3
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 5

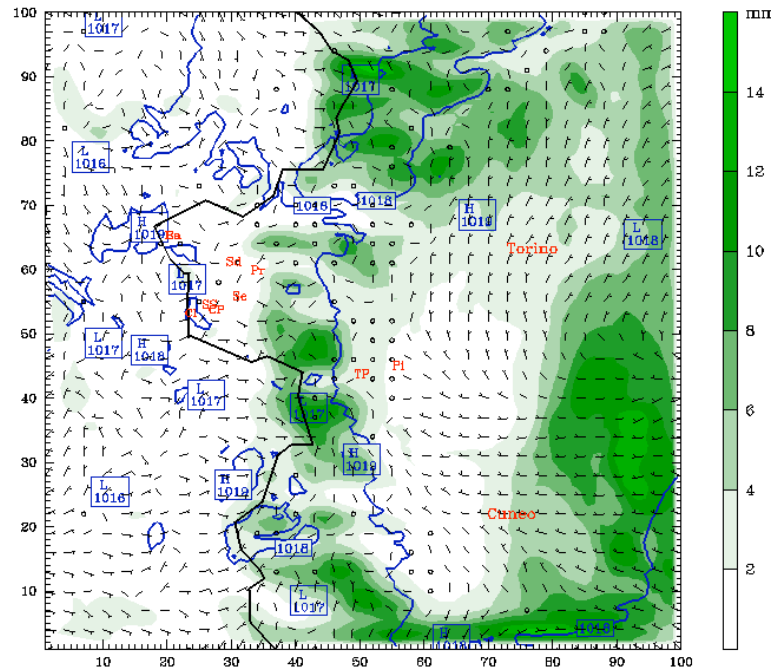
00UTC 22 Feb - 00UTC 23 Feb

Precip on Plains

Realtime MM5

OBS

Dataset: MM5 1.33km grid R1P: mm5 realtime rto Init: 2100 UTC Tue 21 Feb 06
 Fcst: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
 CONTOURS: UNITS=hPa LOW= 1018.0 HIGH= 1018.0 INTERVAL= 2.0000
 Model info: V3.6.3 No Cumulus GSPBL Simple ice 1 km, 30 levels, 4 sec

Weather data belong to Arpa Piemonte. Use allowed mentioning the source.

Data observed in the single venues: last update on 23/02/2006 at 02:00 local time

Venues	Sky	Temp.(°C)	Umidity (%)	Wind (m/s)	Total Precipitations (mm)	Last 24h new snow (cm)	Web Cam
Pinerolo		3.7	92	N 1.00	-	-	
palaghiaccio		-5.0	85	SW 1.60	-	-	
Cesana San Sicario		-1.9	100	SW 1.60	-	-	
Sauze d'Oulx-Jovençaux		-3.4	87	SE 0.40	-	-	
Pragelato		-5.5	79	SSE 0.70	-	-	
Sestriere Borgata		-7.0	84	NE 1.40	-	1	
Sestriere Colle		-5.8	99	SW 1.60	-	-	
Cesana Pariol		5.1	84	S 0.30	-	-	
Torino esposizioni		-4.2	79	SSW 0.70	-	-	
Bardonecchia		-4.2	99	SE 0.70	-	-	
Pragelato Plan		-6.7	85	ENE 2.90	-	1	
San Sicario							
Frateve							

View of the Italian side from the French border

Pinerolo palaghiaccio

24-h Total Precip

Case 5

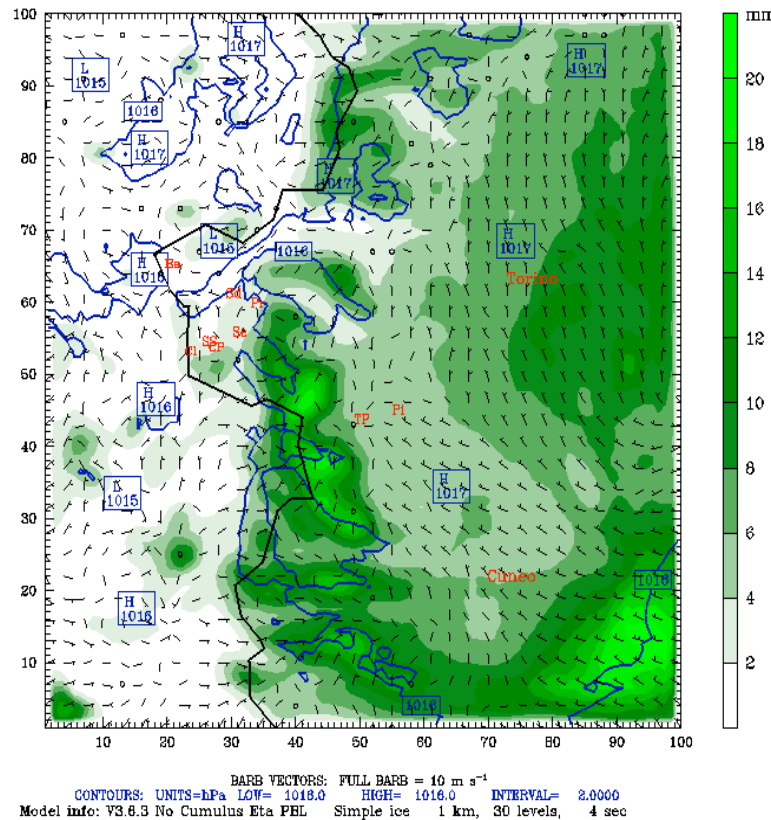
00UTC 22 Feb - 00UTC 23 Feb

Precip on Plains

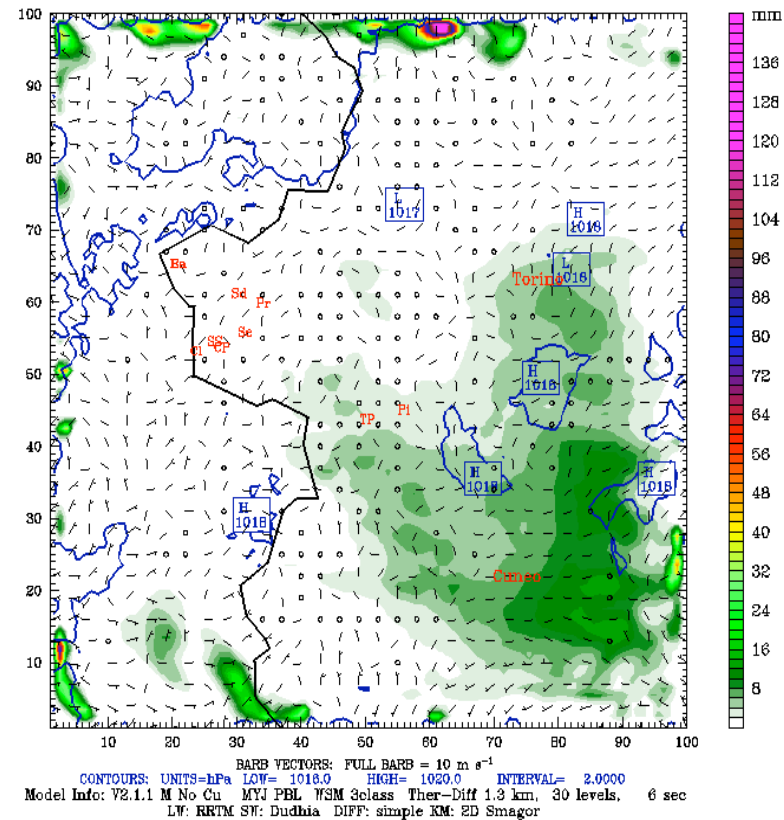
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Tue 21 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 2100 UTC Tue 21 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 5

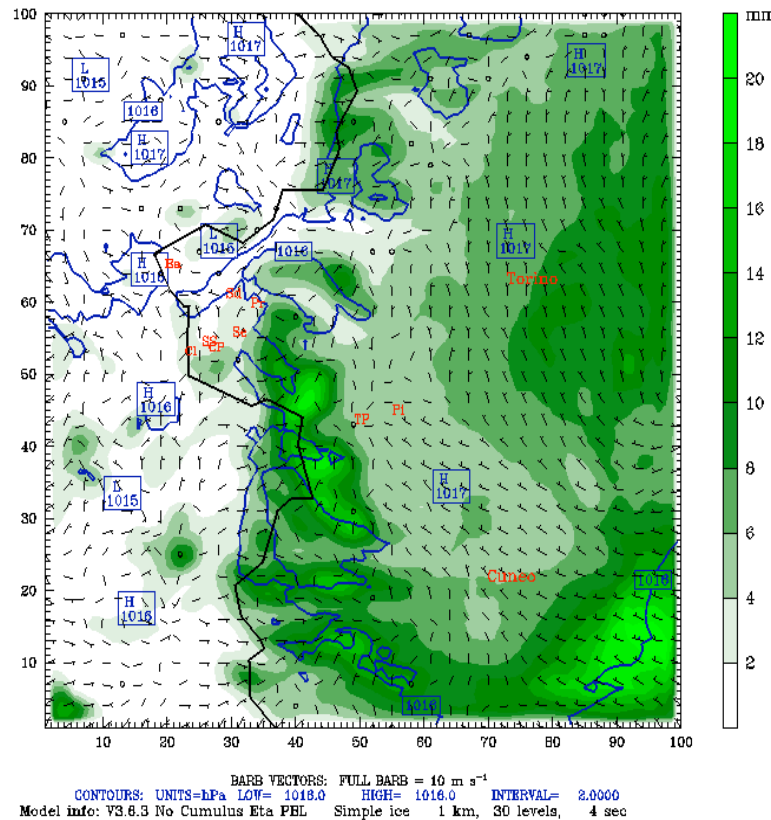
00UTC 22 Feb - 00UTC 23 Feb

Precip on Plains

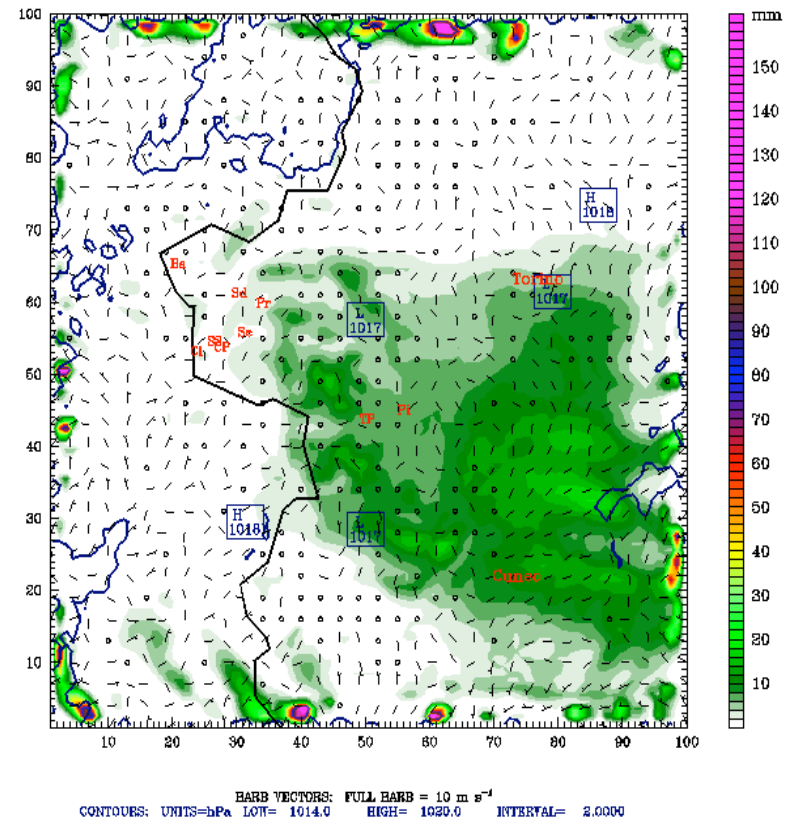
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Tue 21 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime rtotsh0 Init: 0000 UTC Wed 22 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
 Total precip. since h 3
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

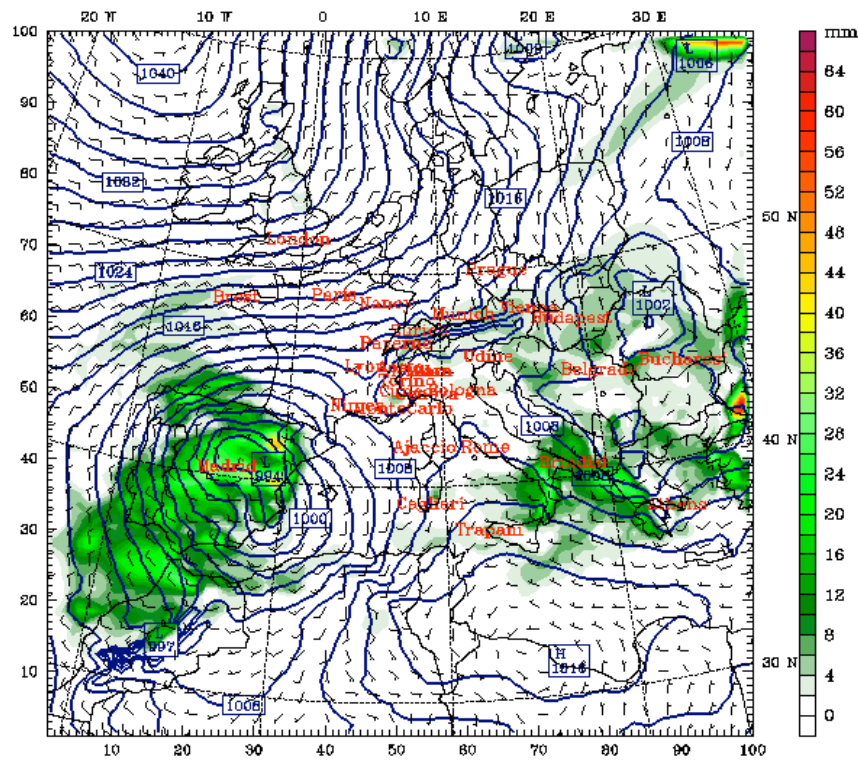
Why does this noise exist?

- Tests were performed with Case 6 to isolate the problem
 - Run all four domains with ndown
 - Run all four domains in the same job (with no feedback)

36-km Grid

without ndown

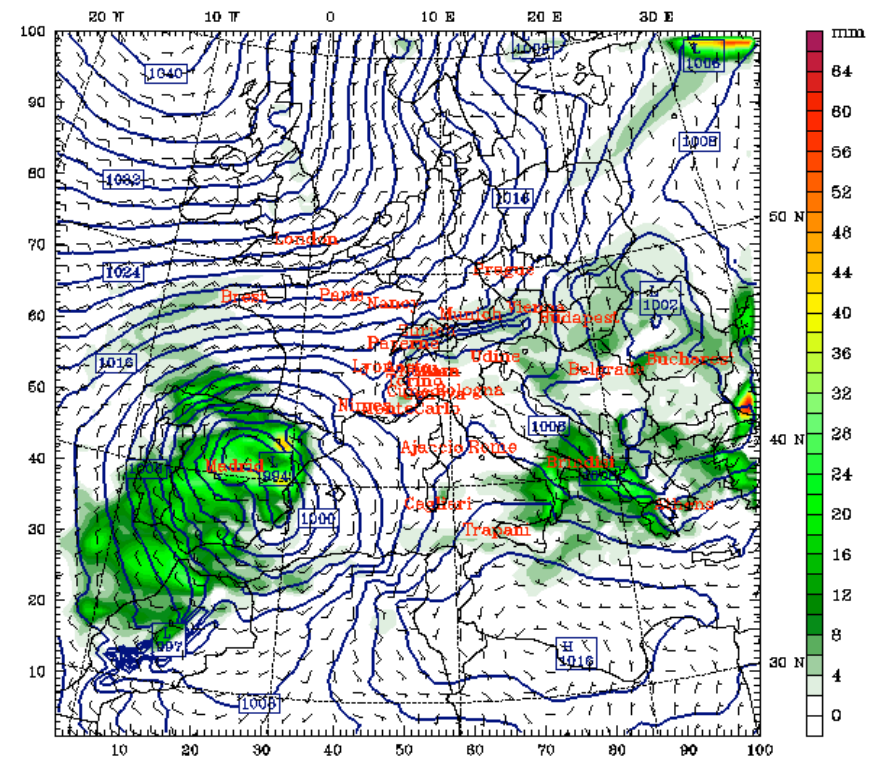
Dataset: d01 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 996.00 HIGH= 1040.0 INTERVAL= 2.0000

with ndown

Dataset: d01 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30

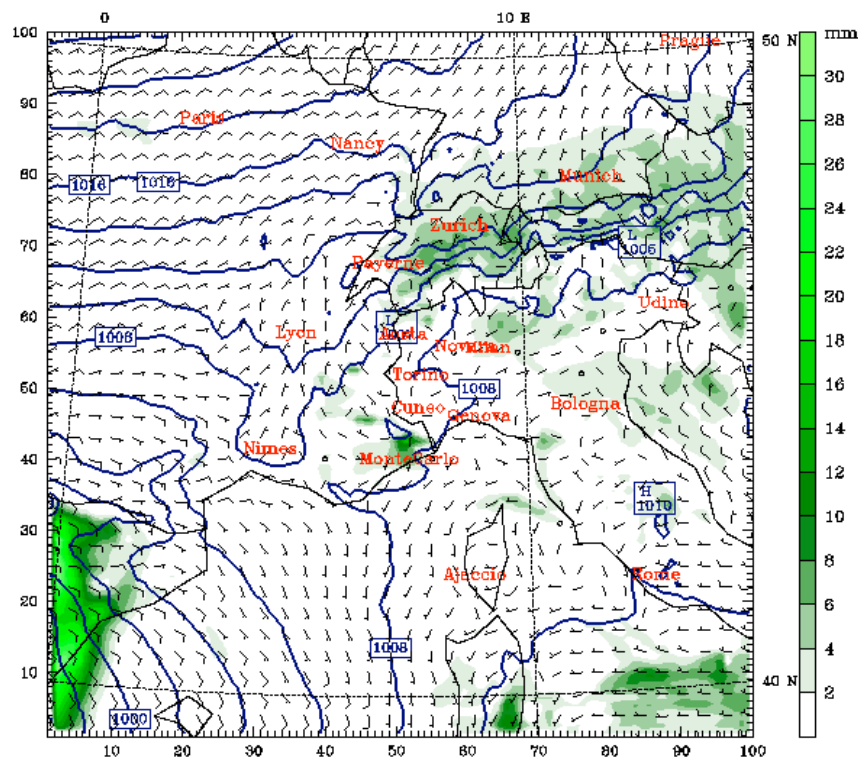


BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 996.00 HIGH= 1040.0 INTERVAL= 2.0000

12-km Grid

without ndown

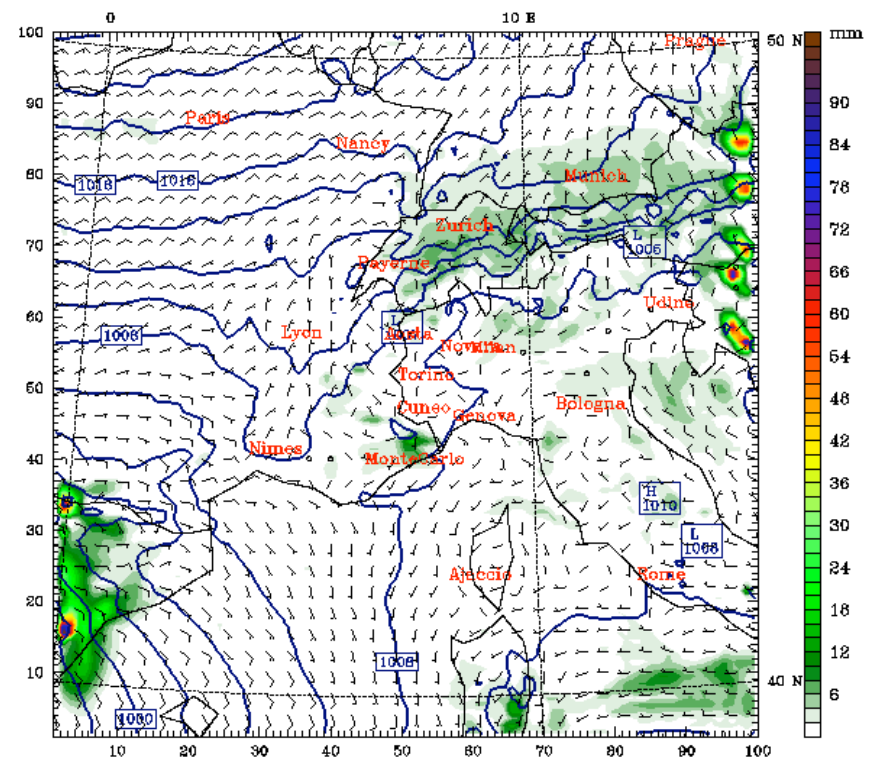
Dataset: d02 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 998.00 HIGH= 1022.0 INTERVAL= 2.0000

with ndown

Dataset: d02 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30

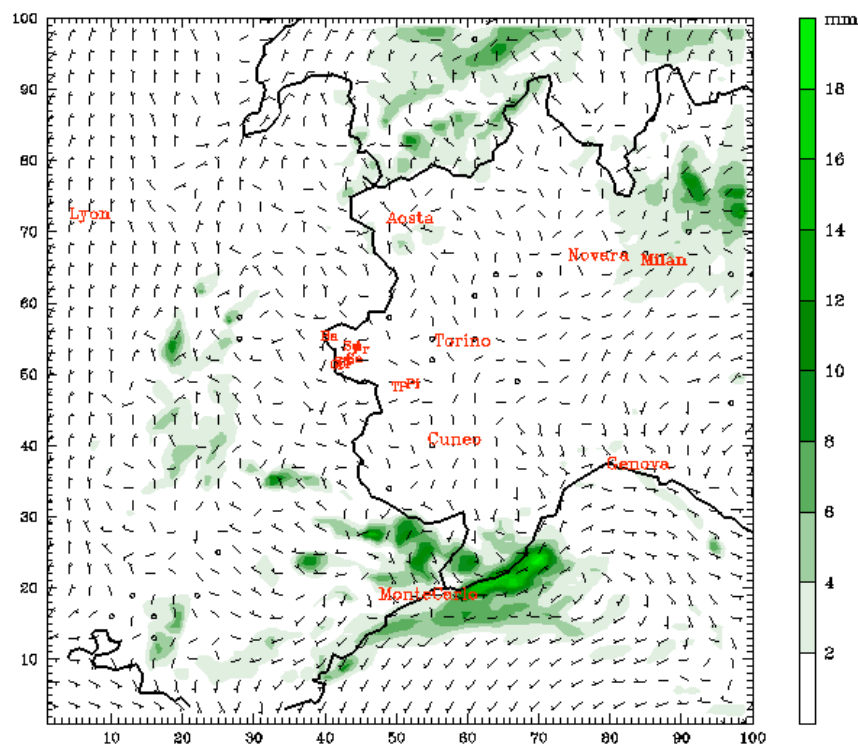


BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 998.00 HIGH= 1022.0 INTERVAL= 2.0000

4-km Grid

without ndown

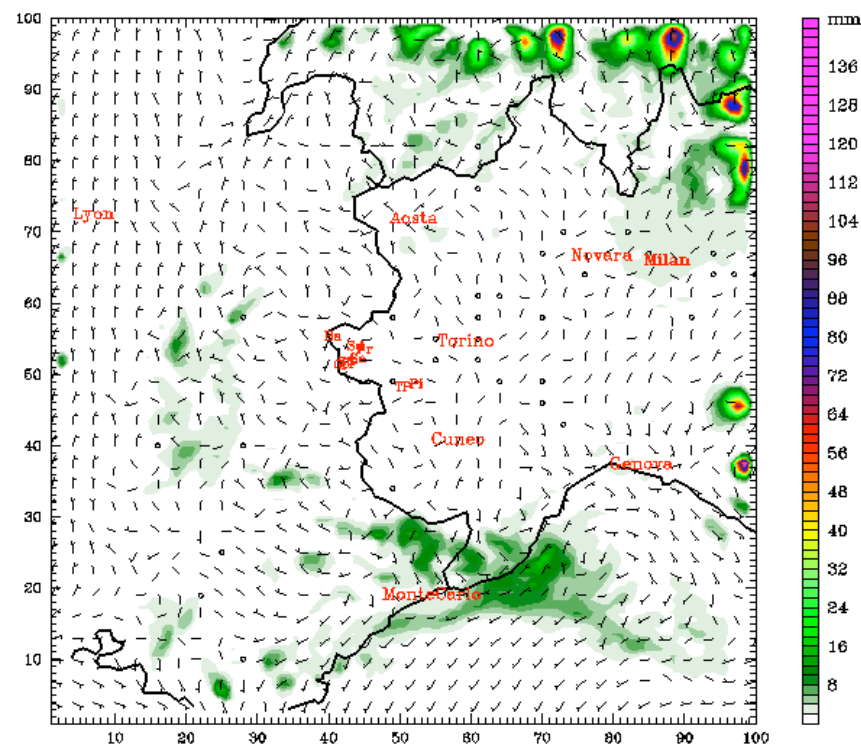
Dataset: d03 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹

with ndown

Dataset: d03 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Horizontal wind vectors at k-index = 30

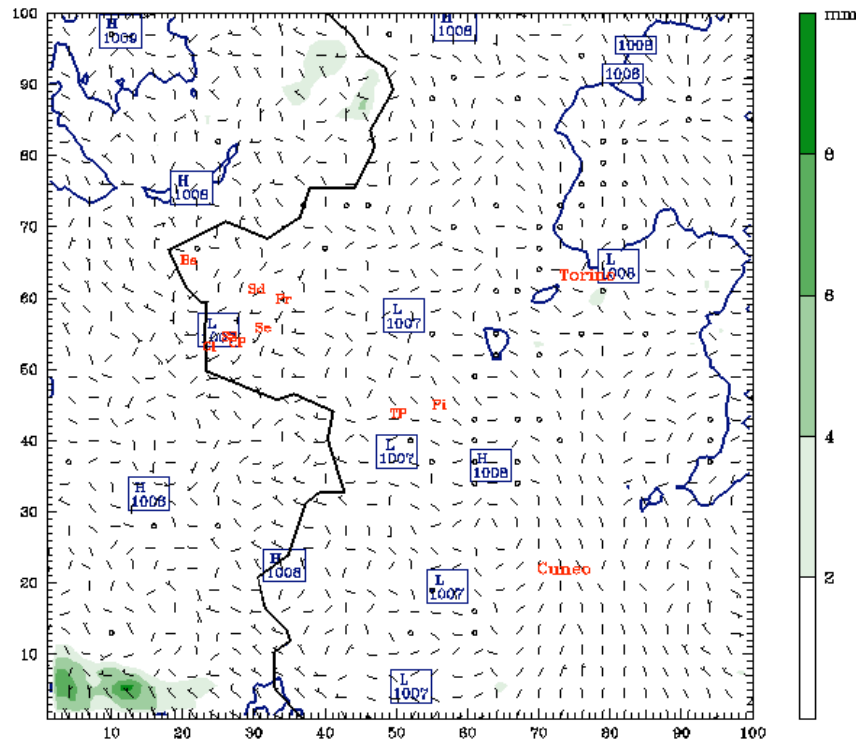


BARB VECTORS: FULL BARB = 10 m s⁻¹

1.33-km Grid

without ndown

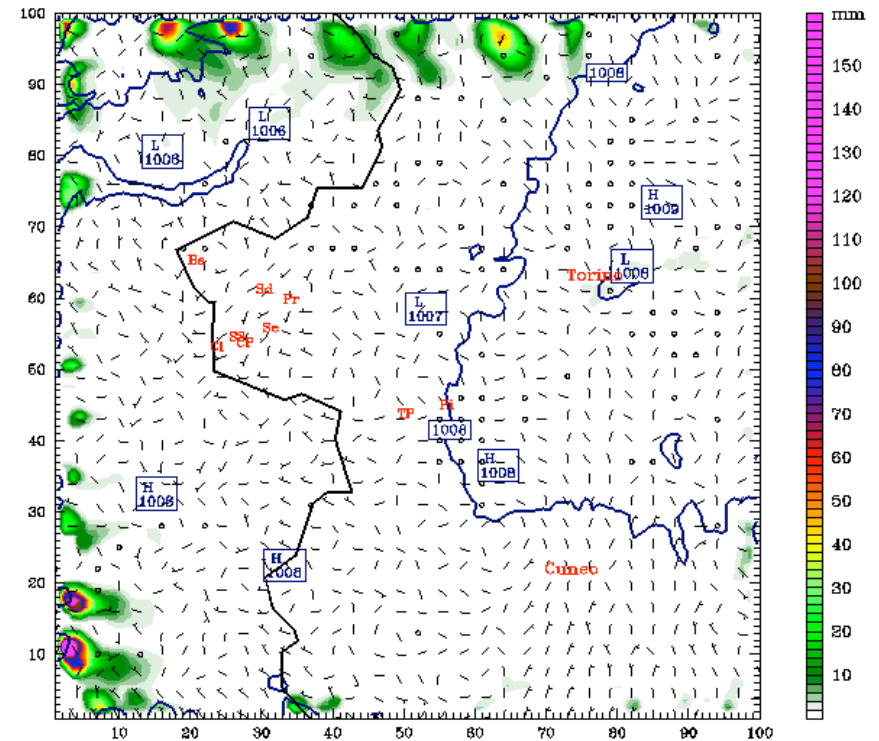
Dataset: d04 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 1006.0 HIGH= 1008.0 INTERVAL= 2.0000

with ndown

Dataset: d04 RIP: realtime rtotsh0 Init: 1200 UTC Sat 25 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
Total precip. since h 12
Sea-level pressure
Horizontal wind vectors
at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 1006.0 HIGH= 1010.0 INTERVAL= 2.0000

Conclusions

- Statistics show that WRF-ARW has a slight advantage over MM5 averaged over all six cases
 - Note: Statistics are calculated well within the domain, away from the lateral boundary noise
- In general, WRF-ARW predicts less spatial coverage of precipitation than MM5
 - Is this due to mass conservation within the domain?
- Subjective analysis shows noise in the precipitation field around the lateral boundaries
 - This is only a problem with one-way nests using ndown steps
 - This problem is known, and is being investigated by NCAR

Questions



Supplemental Slides

Case 2

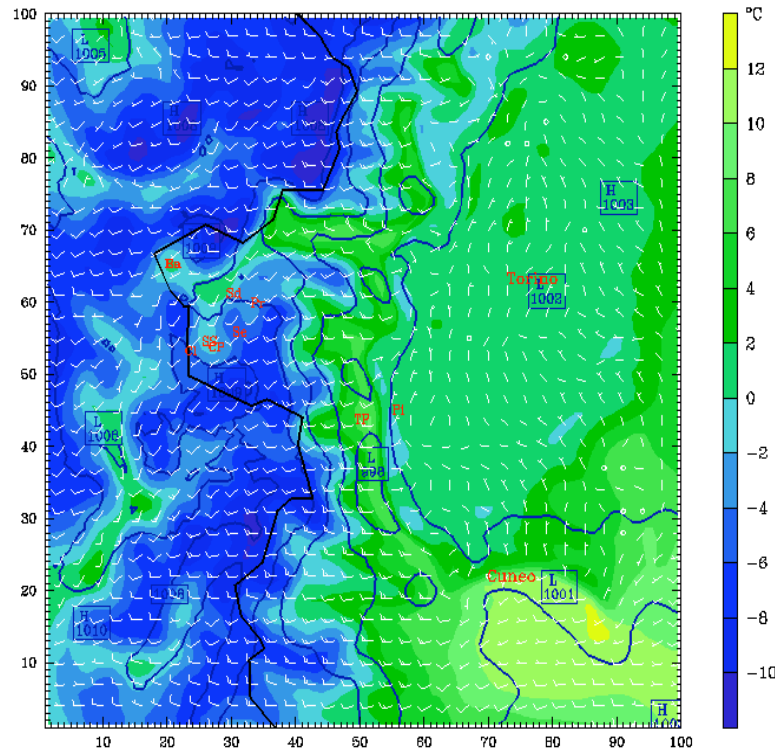
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

MM5

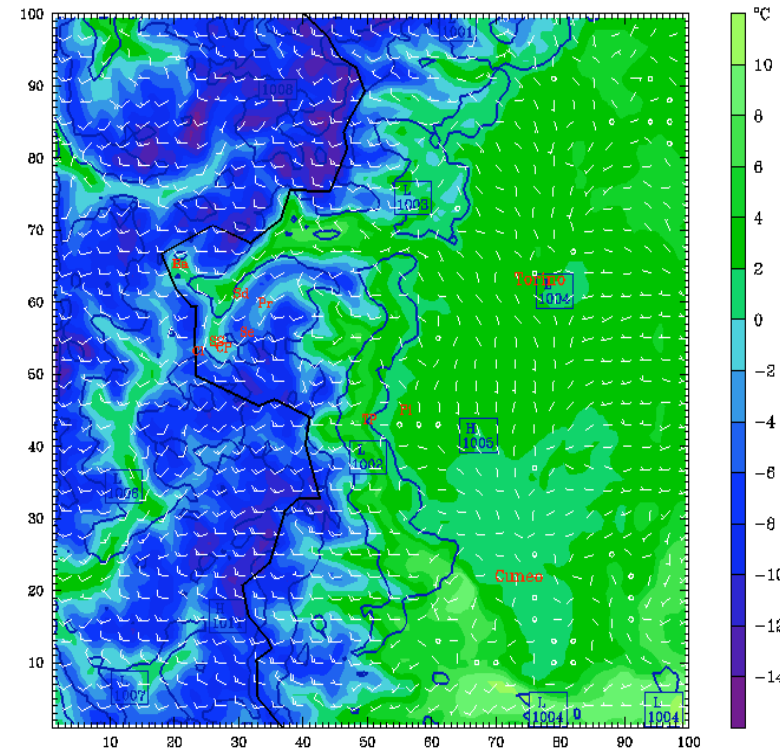
WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Fri 17 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s^{-1}
 CONTOURS: UNITS=hPa LOW= 1000.0 HIGH= 1008.0 INTERVAL= 2.0000
 Model info: V3.6.3 No Cumulus Eta PBL Simple ice 1 km, 30 levels, 4 sec

Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 0900 UTC Fri 17 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s^{-1}
 CONTOURS: UNITS=hPa LOW= 1002.0 HIGH= 1012.0 INTERVAL= 2.0000
 Model Info: V2.1.1 M No Cu MYJ PBL WSM 3class Ther-Diff 1.3 km, 30 levels, 6 sec
 LV: RRTM SN: Dudhia DIFF: simple KM: 2D Smagor

Surface Layer Temperature

Case 2

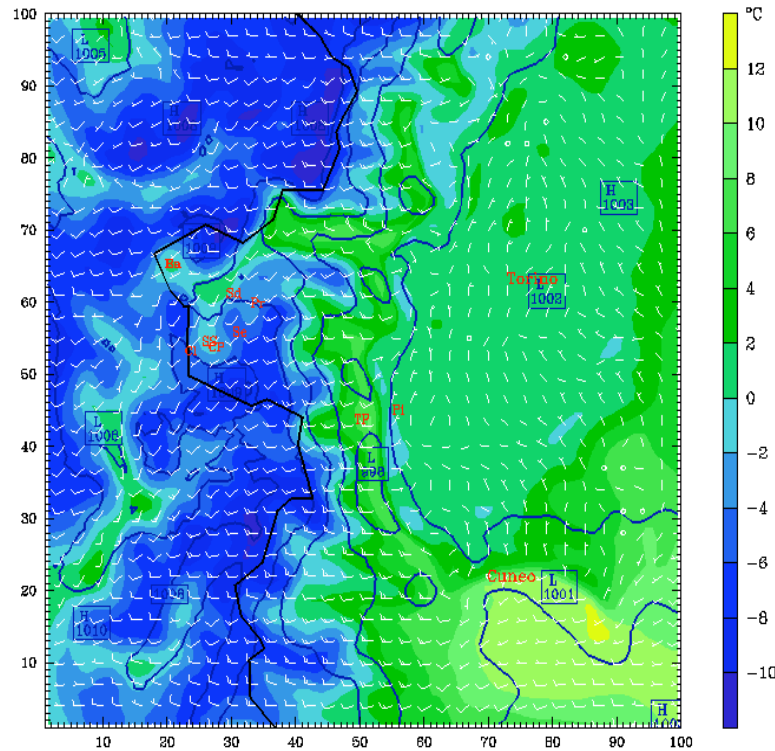
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

MM5

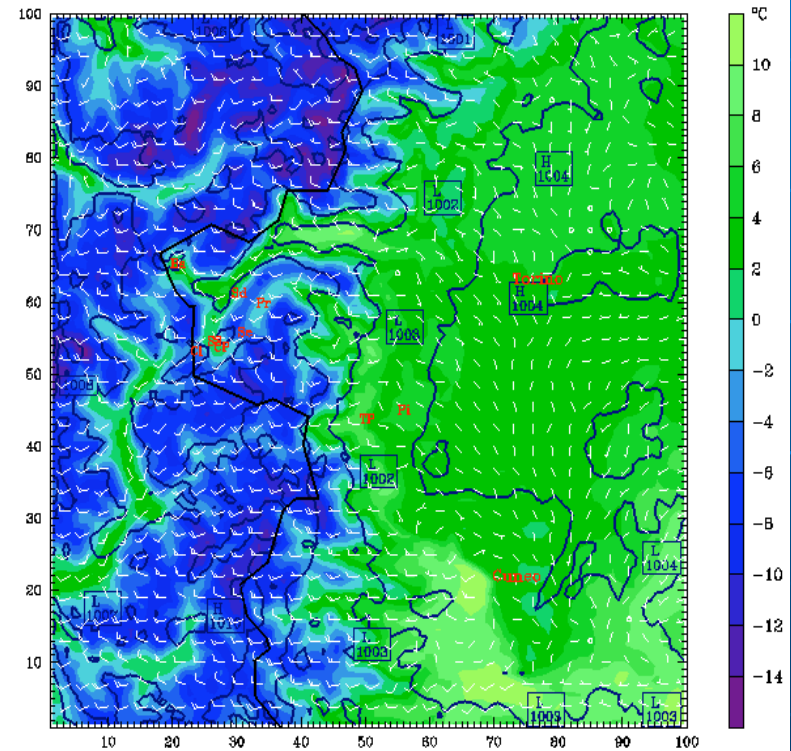
WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
 CONTOURS: UNITS=hPa LOW= 1000.0 HIGH= 1008.0 INTERVAL= 2.0000
 Model info: V3.6.3 No Cumulus Eta PBL Simple ice 1 km, 30 levels, 4 sec

Dataset: d04 RIP: realtime sfc Init: 1200 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
 CONTOURS: UNITS=hPa LOW= 1002.0 HIGH= 1012.0 INTERVAL= 2.0000

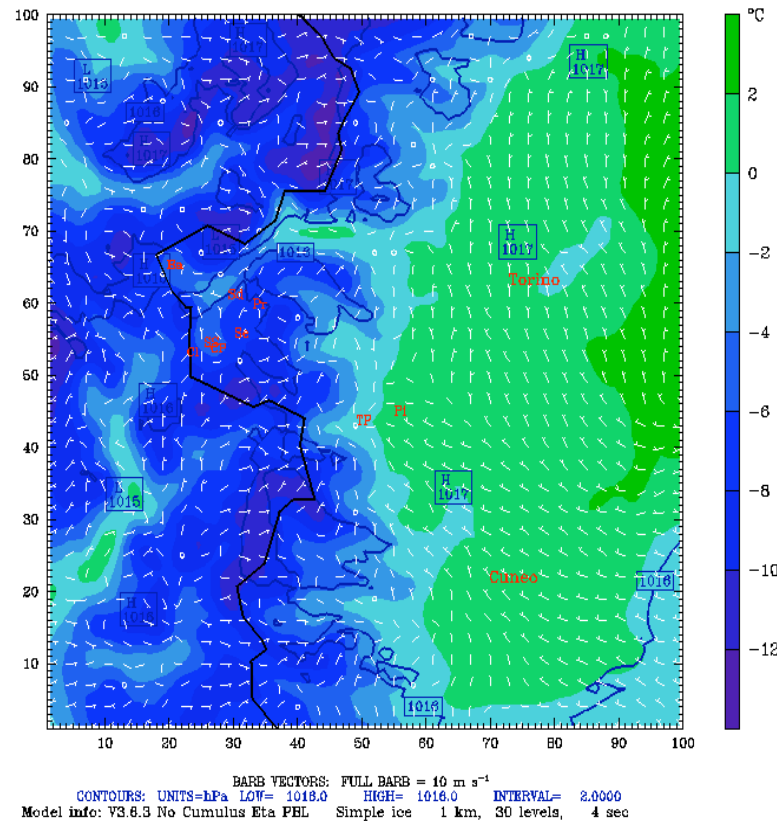
Surface Layer Temperature

00UTC 22 Feb - 00UTC 23 Feb
Precip on Plains

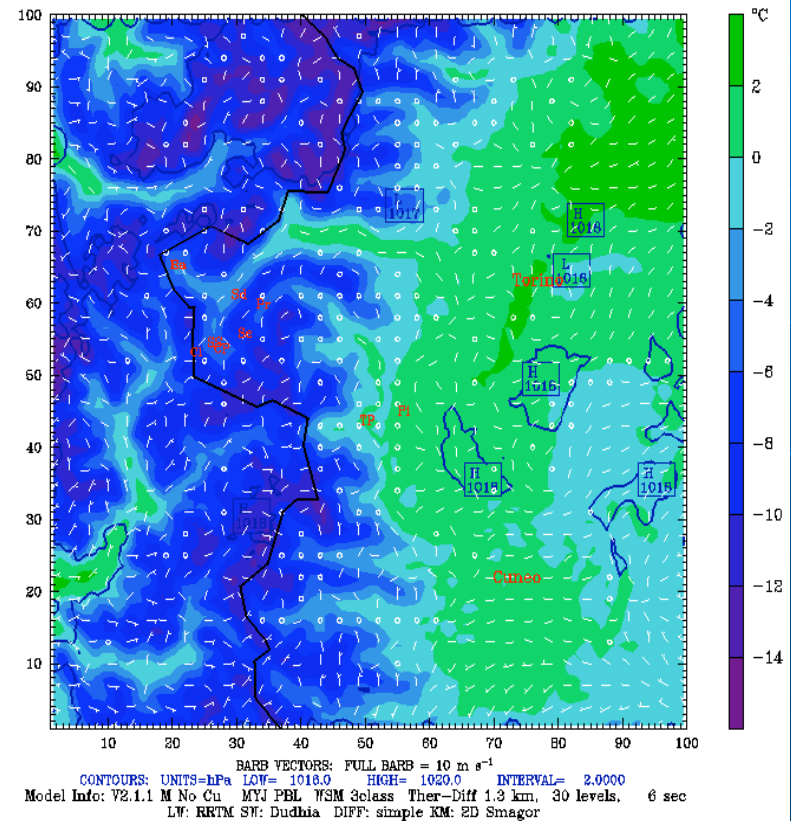
MM5

WRF2.1

Dataset: mm5 d4 R/P: mm5 realtime sfc Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Temperature at k-index = 30
[Sea-level pressure](#)
Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Temperature at k-index = 30
[Sea-level pressure](#)
Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 5

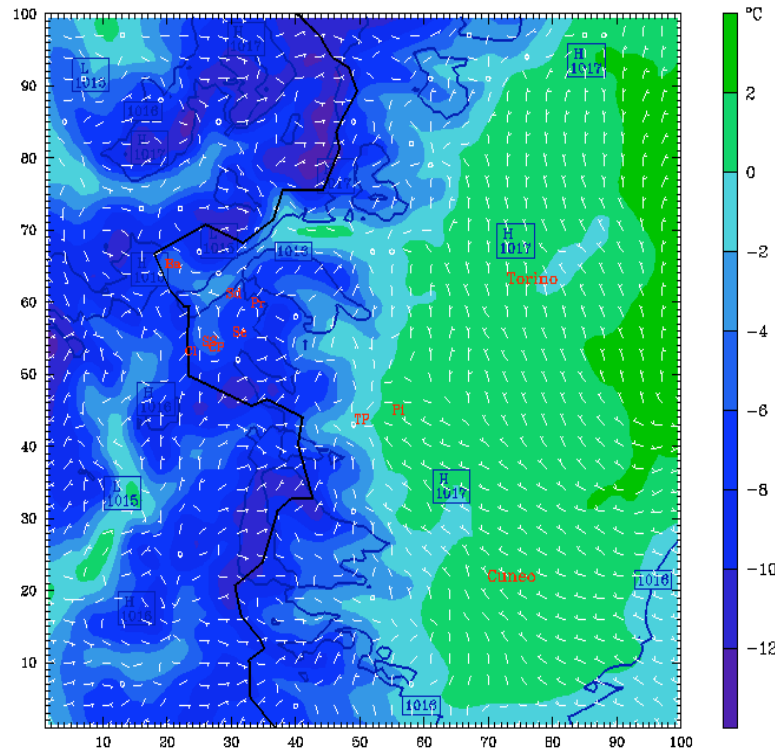
00UTC 22 Feb - 00UTC 23 Feb

Precip on Plains

MM5

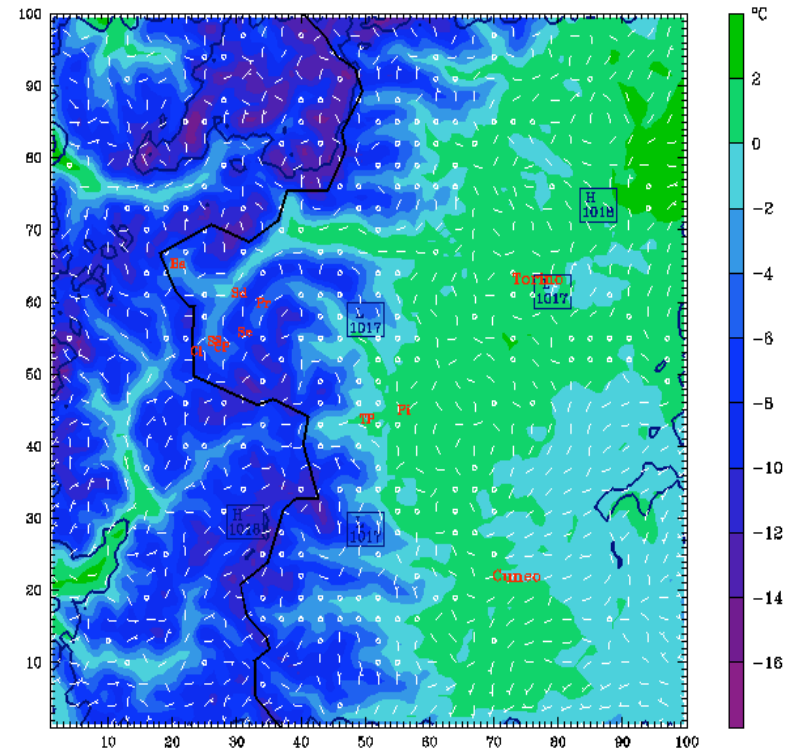
WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 1013.0 HIGH= 1019.0 INTERVAL= 2.0000
Model info: V3.6.3 No Cumulus Eta PBL Simple ice 1 km, 30 levels, 4 sec

Dataset: d04 RIP: realtime sfc Init: 0000 UTC Wed 22 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30



BARB VECTORS: FULL BARB = 10 m s⁻¹
CONTOURS: UNITS=hPa LOW= 1014.0 HIGH= 1020.0 INTERVAL= 2.0000

Surface Layer Temperature

Case 6

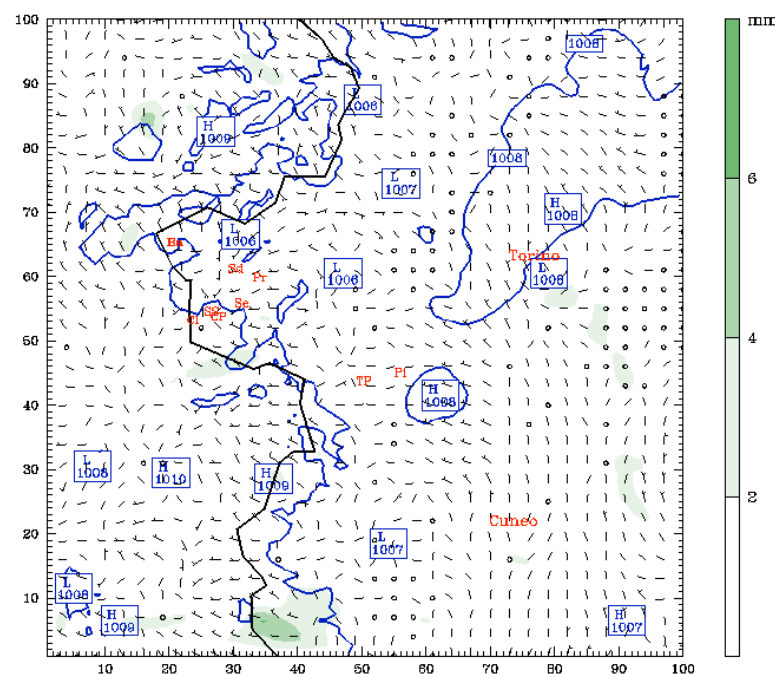
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

Realtime MM5

OBS

Dataset: MM5 1.33km grid RIF: mm5 realtime rto Init: 0900 UTC Sat 25 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



ARPA Piemonte - The weather and snow service at the Games

Weather data belong to Arpa Piemonte. Use allowed mentioning the source.

Data observed in the single venues: last update on 26/02/2006 at 13:00 local time

Venues	Sky	Temp.(°C)	Umidity (%)	Wind (m/s)	Total Precipitations (mm)	Last 24h new snow (cm)	Web Cam
Pinerolo palaghiaccio		6.8	67	S 2.00	-	-	
Cesana San Siro		-	-	SW 2.40	-	2	
Sauze d'Oulx-Jovenceaux		5.3	27	SW 2.40	-	2	
Pragelato		3.1	26	SW 3.10	-	2	
Sestriere Borgata		1.1	26	SSW 3.10	24	2	
Sestriere Colle		-1.3	44	W 4.40	-	2	
Cesana Pariol		-	-	SW 2.40	-	2	
Torino esposizioni		7.4	63	S 1.70	-	-	
Bardonecchia		2.2	25	WSW 1.70	2	1	
Pragelato Plan		1.4	30	SSW 5.80	-	2	
San Sicario Fraiteve		-0.7	34	SW 5.30	-	2	

View of the Italian side from the French border

24-h Total Precip

Case 6

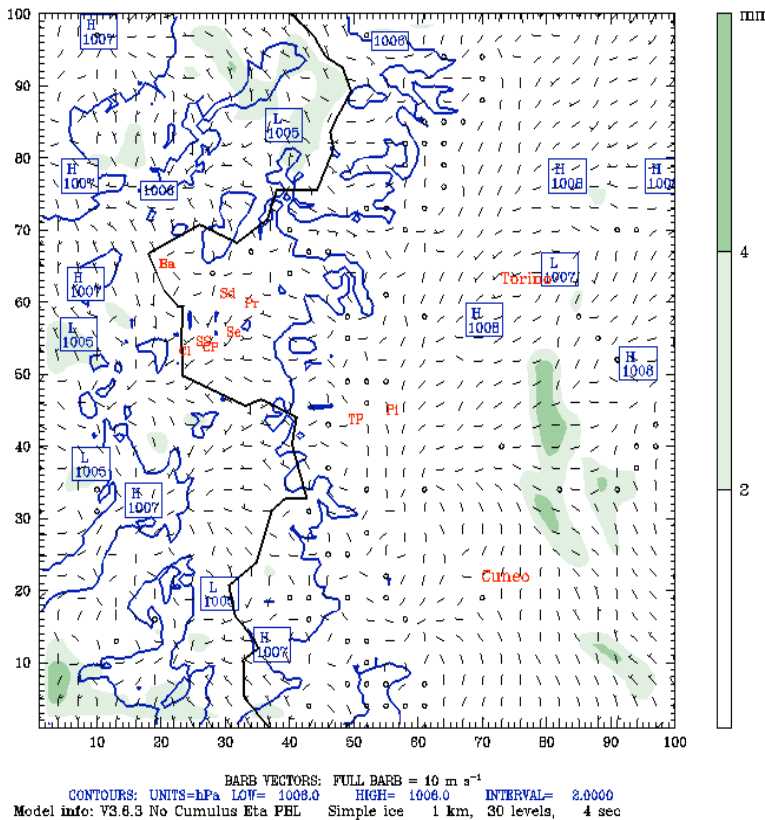
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

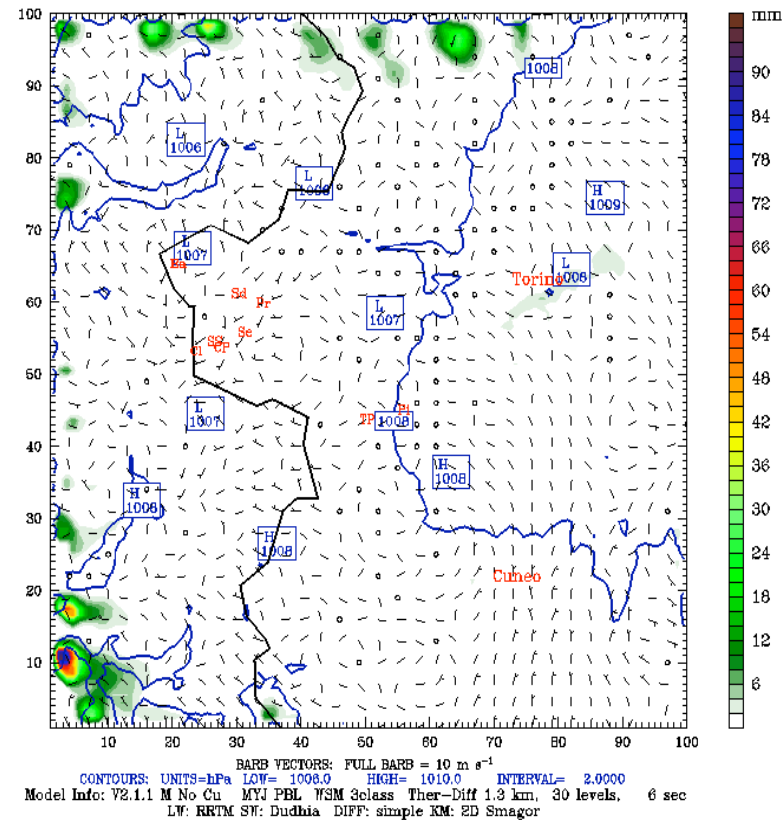
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

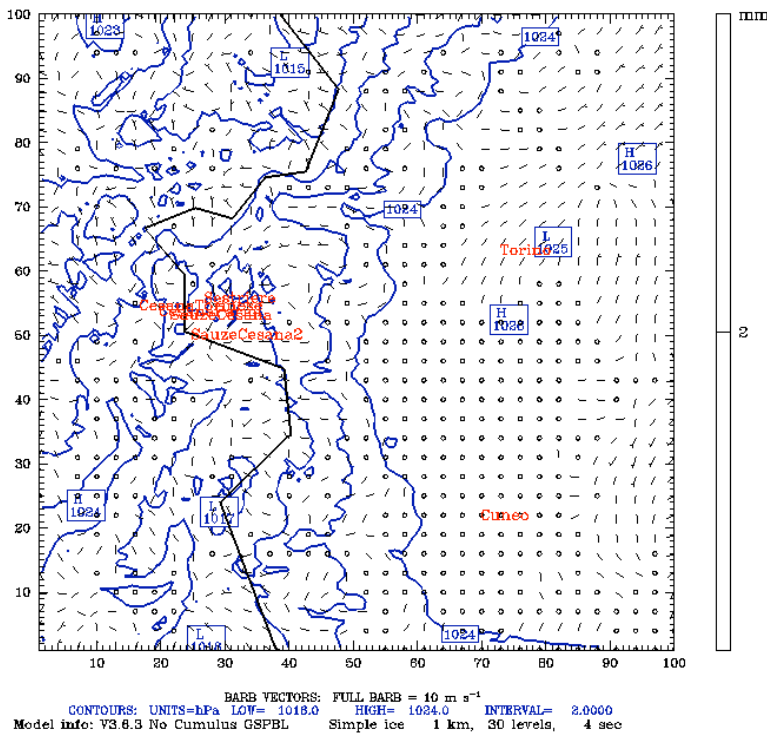
Case 1

00UTC 13 Feb - 00UTC 14 Feb

Dry

Realtime MM5

Dataset: MM5 1.33km grid RIP: mm5 realtime rto Init: 2100 UTC Sun 12 Feb 06
Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30



No Precipitation

24-h Total Precip

Case 1

00UTC 13 Feb - 00UTC 14 Feb

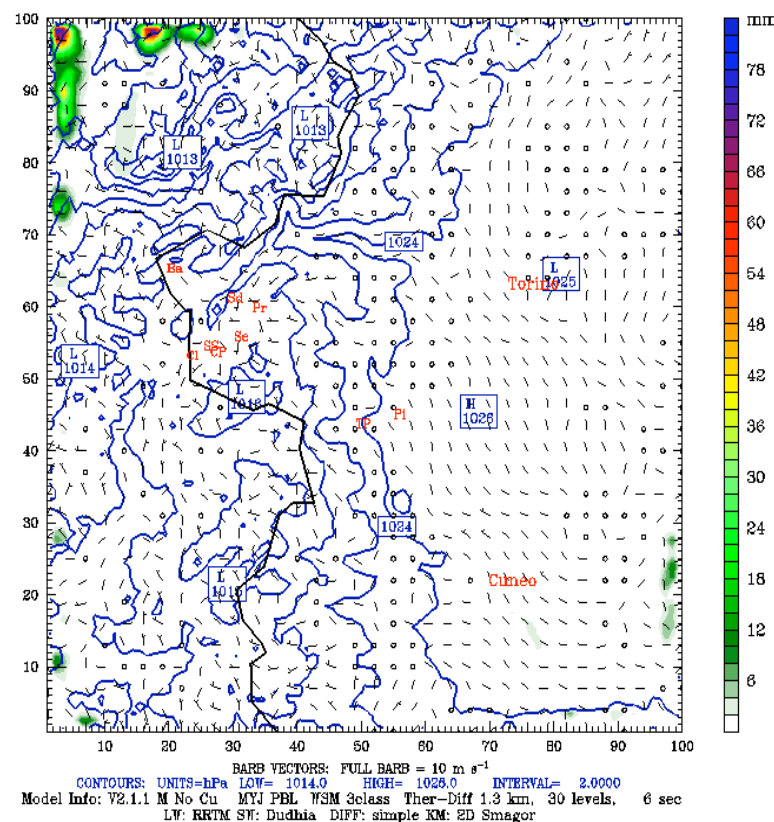
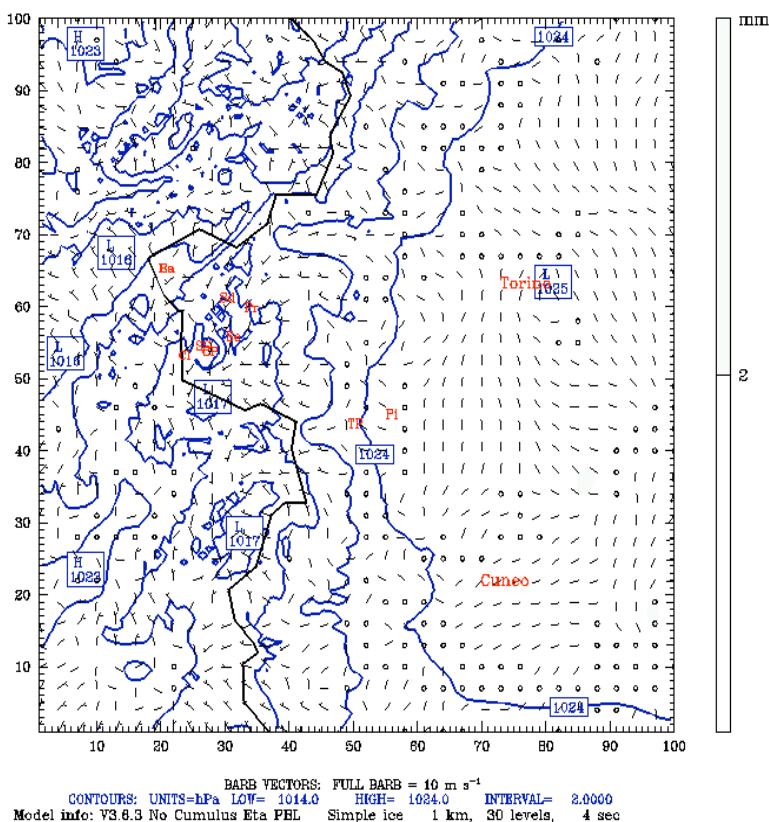
Dry

MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 1

00UTC 13 Feb - 00UTC 14 Feb

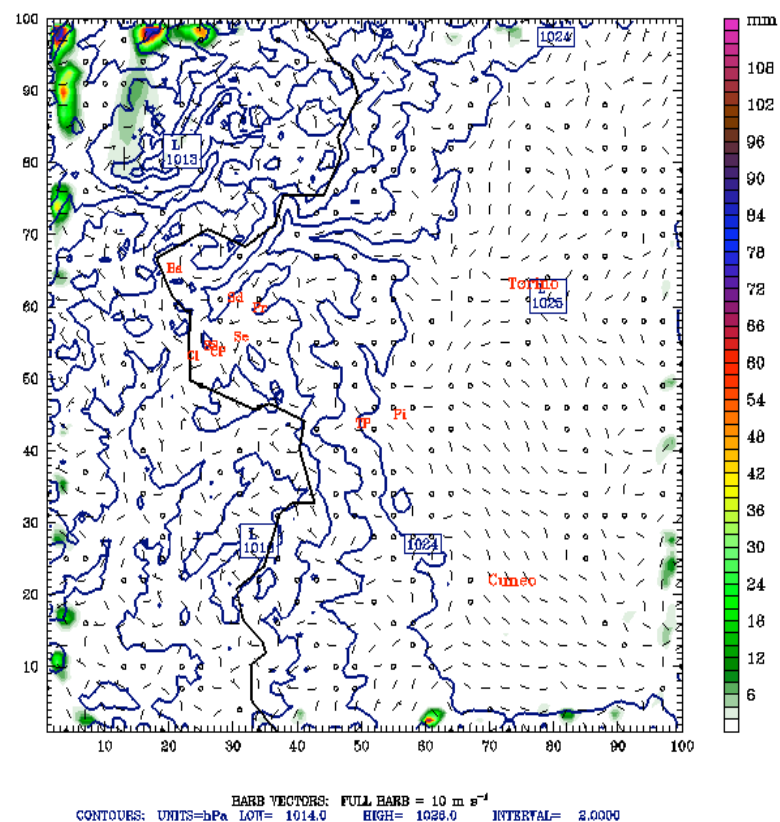
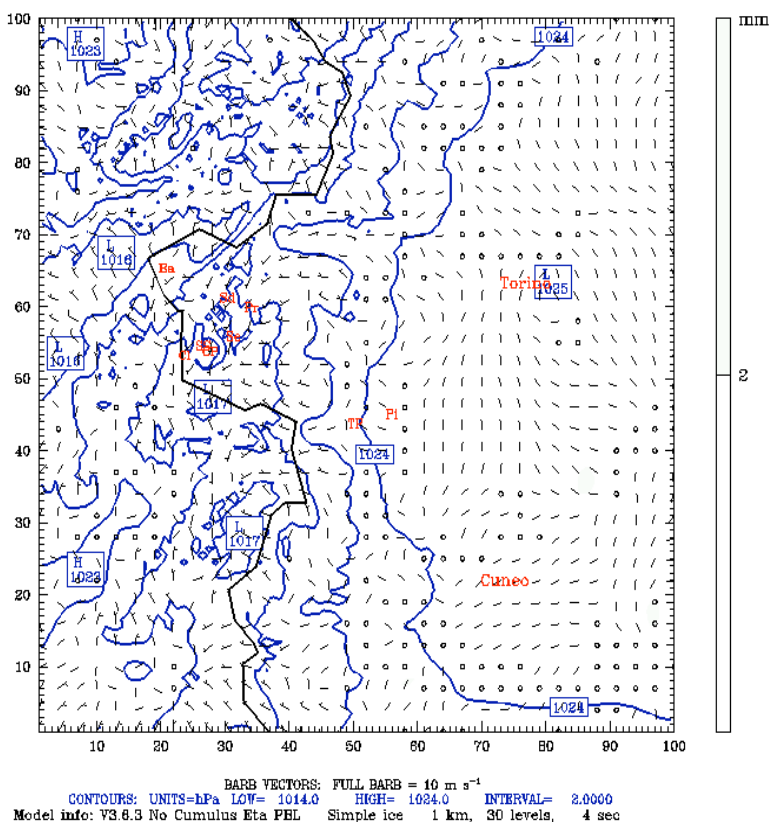
Dry

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime rtotsh0 Init: 0000 UTC Mon 13 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Total precip. since h 3
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 1

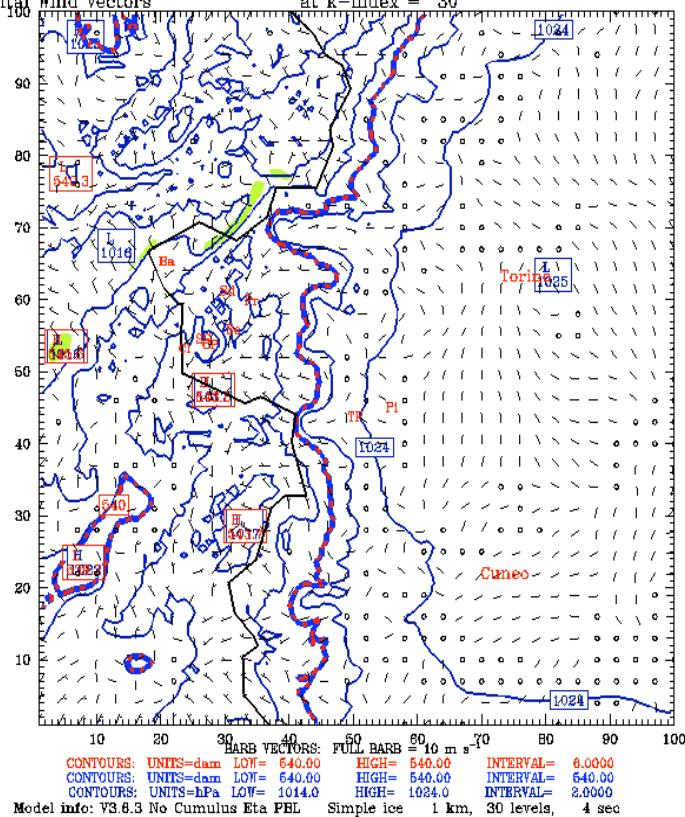
00UTC 13 Feb - 00UTC 14 Feb

Dry

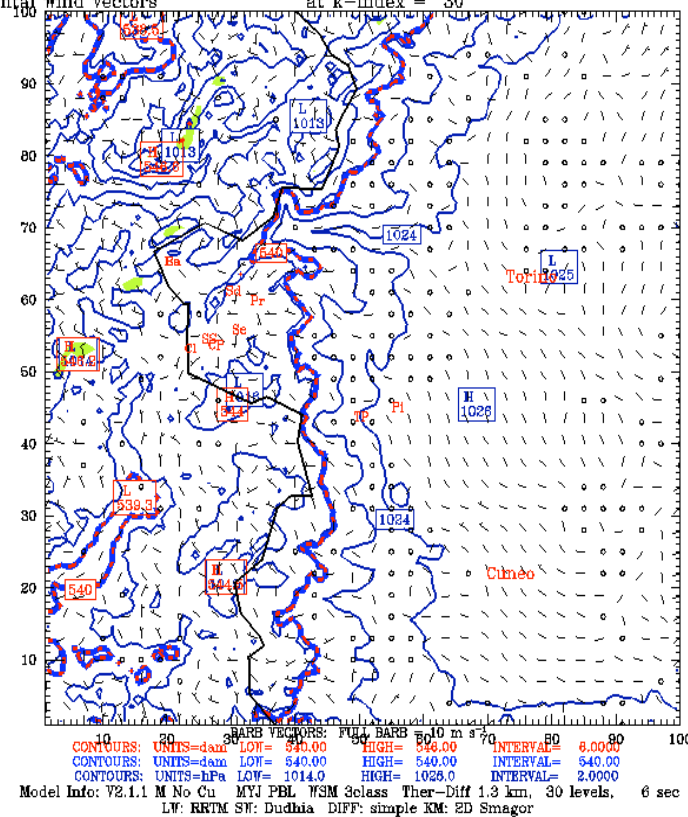
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Sun 12 Feb 06
 Fcst: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 2100 UTC Sun 12 Feb 06
 Fcst: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 1

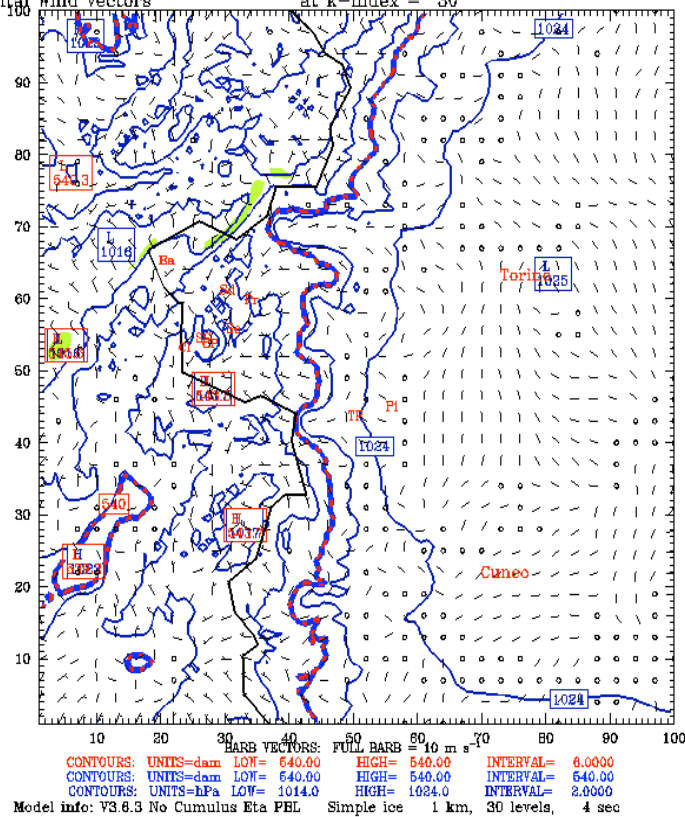
00UTC 13 Feb - 00UTC 14 Feb

Dry

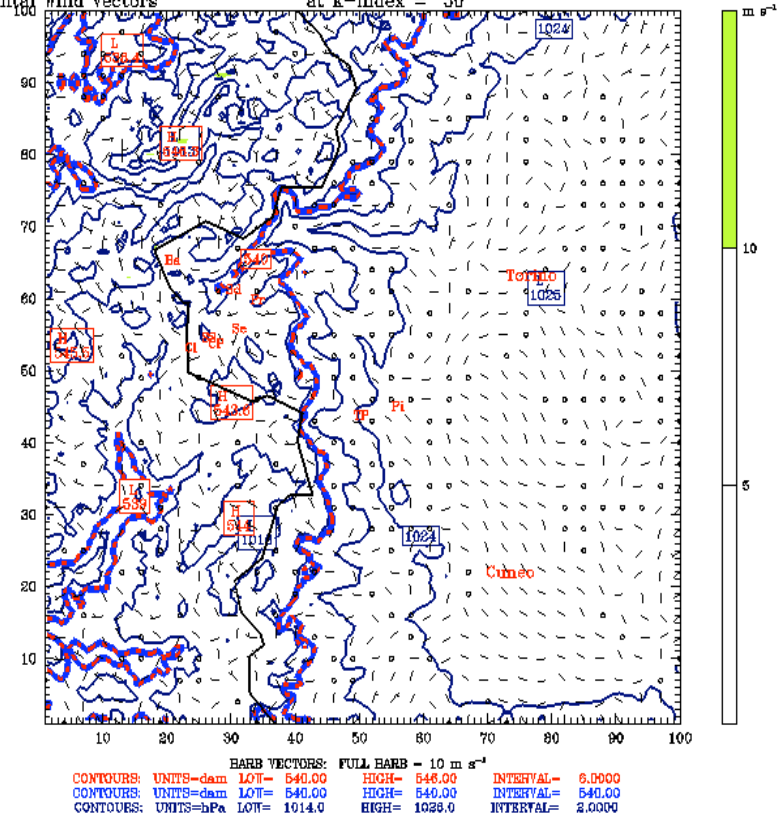
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime thick Init: 0000 UTC Mon 13 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 1

00UTC 13 Feb - 00UTC 14 Feb

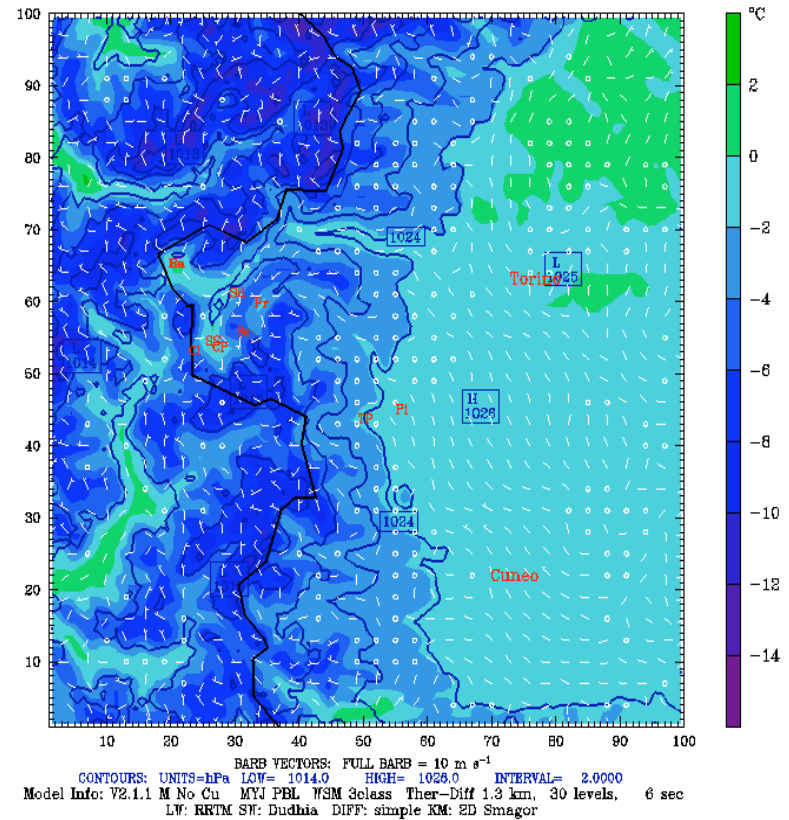
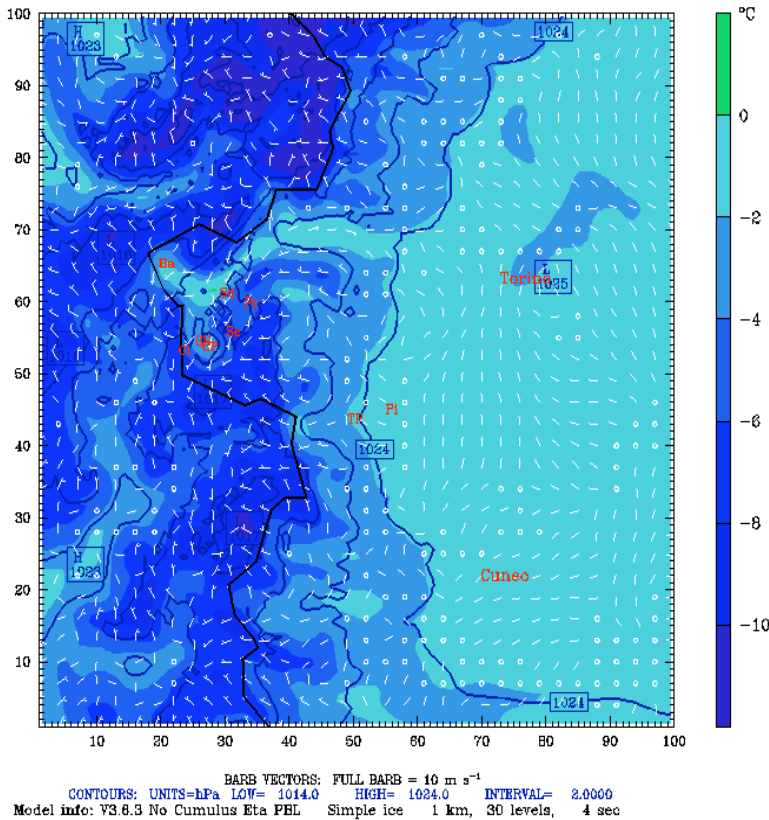
Dry

MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 1

00UTC 13 Feb - 00UTC 14 Feb

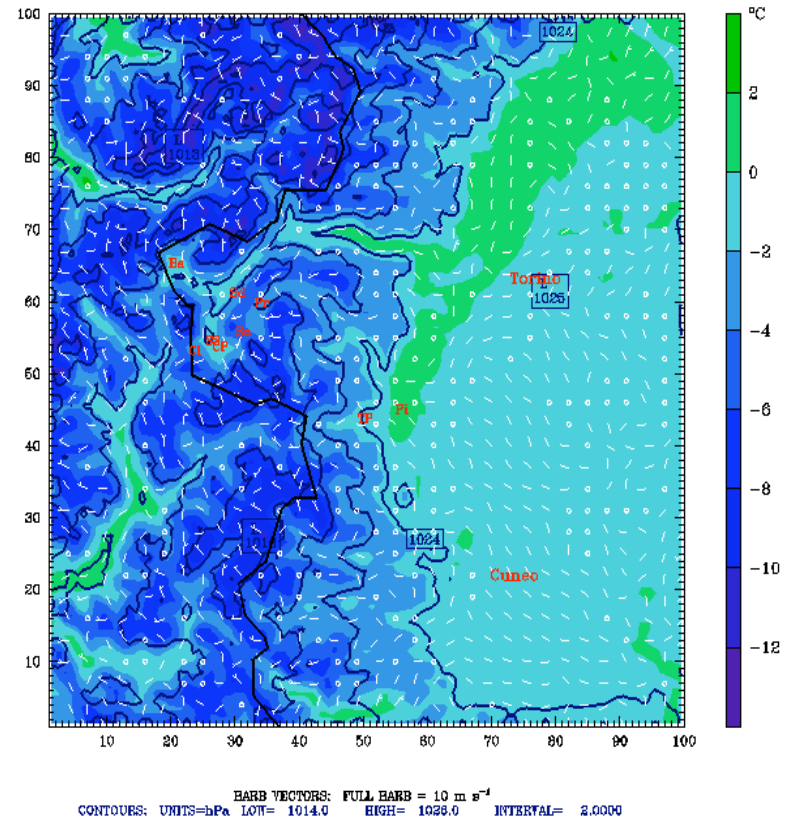
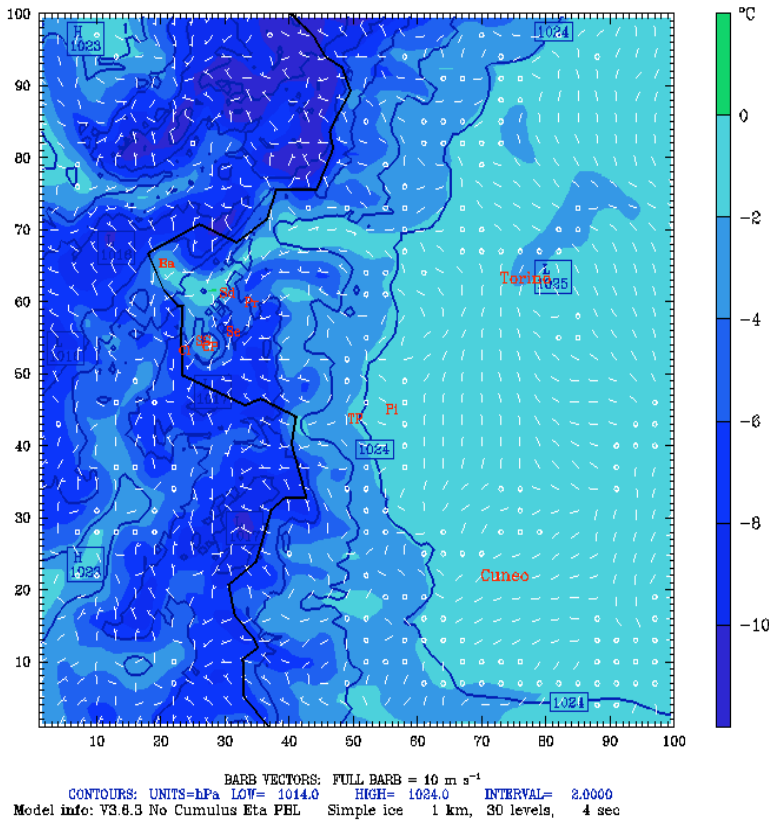
Dry

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 2100 UTC Sun 12 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime sfc Init: 0000 UTC Mon 13 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Tue 14 Feb 06 (0100 LST Tue 14 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 2

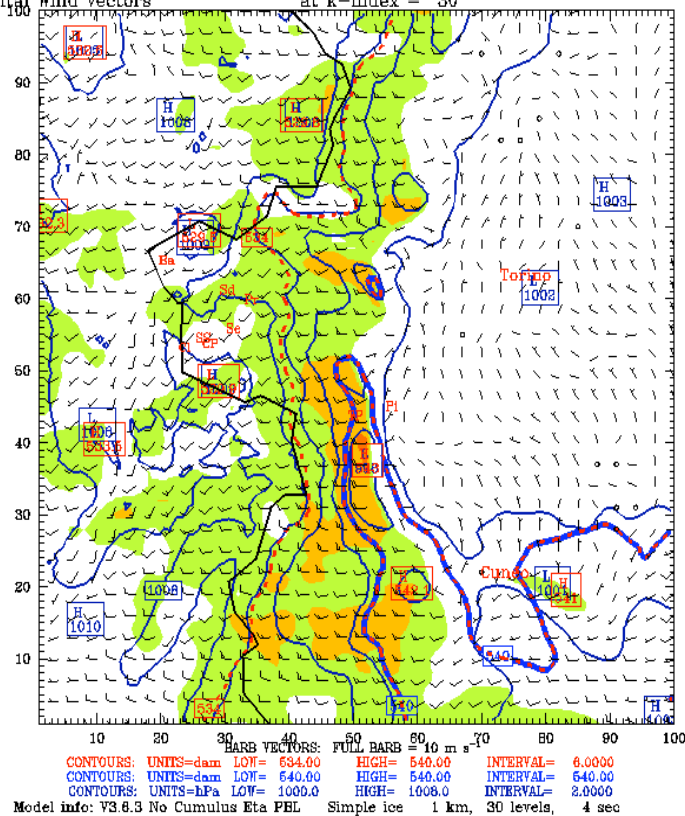
12UTC 17 Feb - 12UTC 18 Feb

Precip/Wind in Mountains

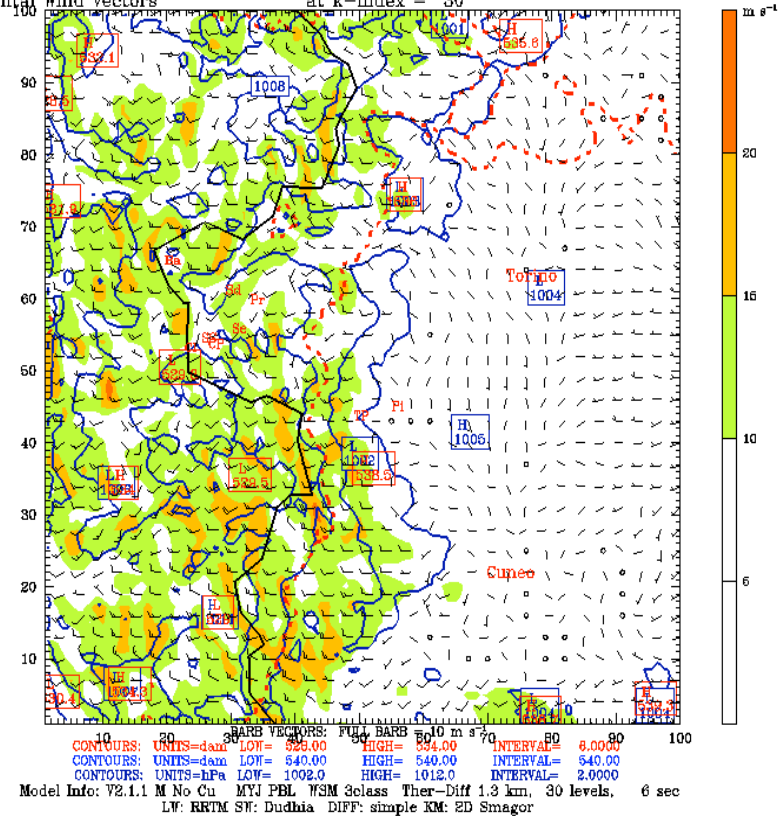
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Fri 17 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 0900 UTC Fri 17 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



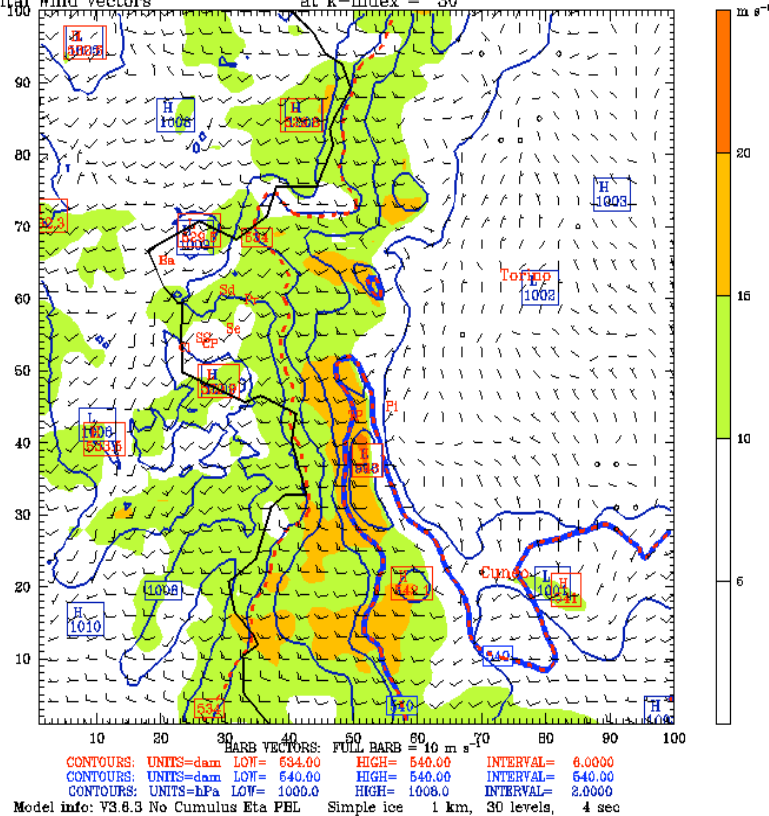
Wind Speed and 1000-500hPa Thickness

12UTC 17 Feb - 12UTC 18 Feb
Precip/Wind in Mountains

MM5

WRF2.2

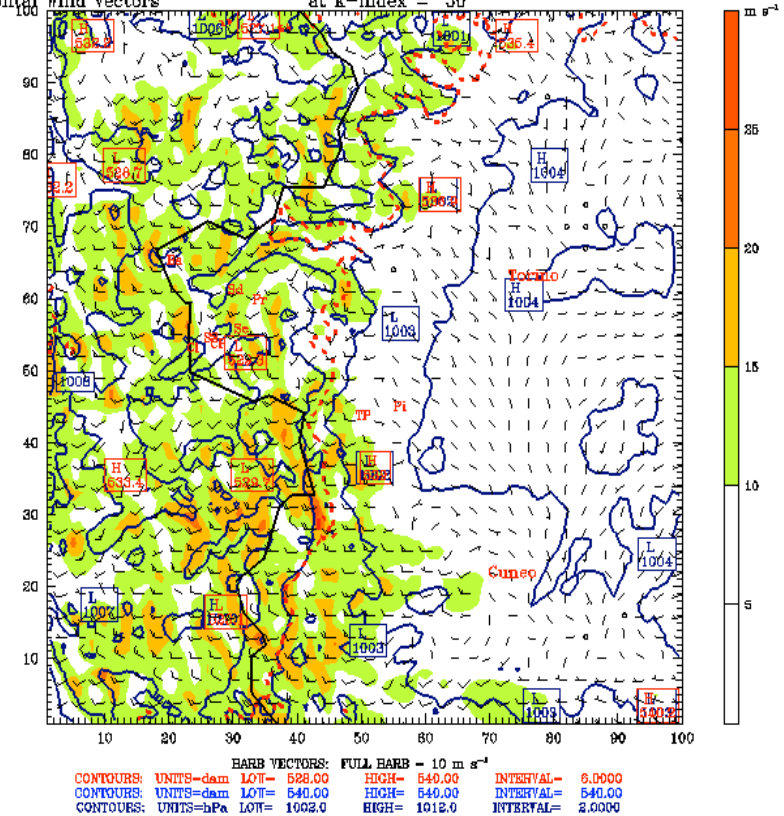
Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Fri 17 Feb 06
Fest: 24.00 h Valid: 1200 UTC Sat 18 Feb 06 (1300 LST Sat 18 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



```

Dataset: d04  RIP: realtime thick                               Init: 1200 UTC Fri 17 Feb 08
Fest: 24.00 h          Valid: 1200 UTC Sat 18 Feb 08 (1300 LST Sat 18 Feb 08)
Horizontal wind speed          at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors          at k-index = 30

```



Wind Speed and 1000-500hPa Thickness

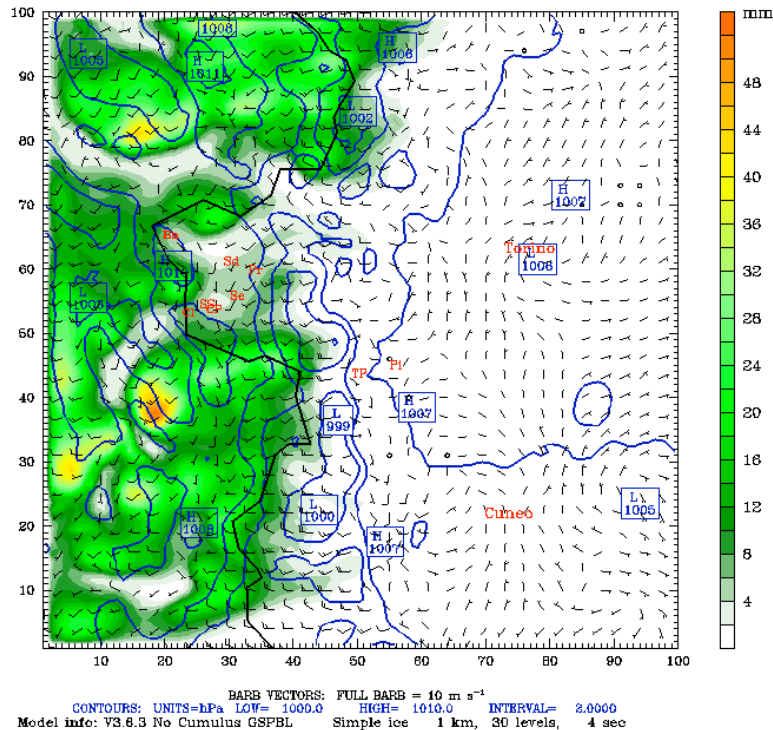
Case 3

00UTC 18 Feb - 00UTC 19 Feb

Precip in Mountains

Realtime MM5
OBS

Dataset: MM5 1.33km grid RIP: mm5 realtime rto Init: 2100 UTC Fri 17 Feb 06
Fcst: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30



Weather data belong to Arpa Piemonte. Use allowed mentioning the source.

Data observed in the single venues: last update on 19/02/2006 at 00:00 local time

Venues	Sky Temp.(°C)	Umidity (%)	Wind (m/s)	Total Precipitations (mm)	Last 24h new snow (cm)	Web Cam
Pinerolo	3.6	92	W 1.40	-	-	
palaghiaccio	-1.8	67	WSW 2.00	-	7	
Cesana San Sicario	0.5	67	S 1.60	-	11	
Sauze d'Oulx-Jovençaux	-2.2	66	SW 0.80	-	5	
Pragelato	-4.2	68	SW 1.70	-	6	
Sestriere Borgata	-5.7	69	W 2.80	-	6	
Sestriere Colle	-2.1	79	WSW 2.00	-	5	
Cesana Pariol	3.4	93	ENE 0.70	-	-	
Torino esposizioni	-2.9	79	E 0.70	-	12	
Bardonecchia	-2.7	71	S 4.10	-	5	
Pragelato Plan	-6.5	89	SW 3.90	-	12	
San Sicario						
Fraitoeve						

View of the Italian side from the French border

24-h Total Precip

Case 3

00UTC 18 Feb - 00UTC 19 Feb

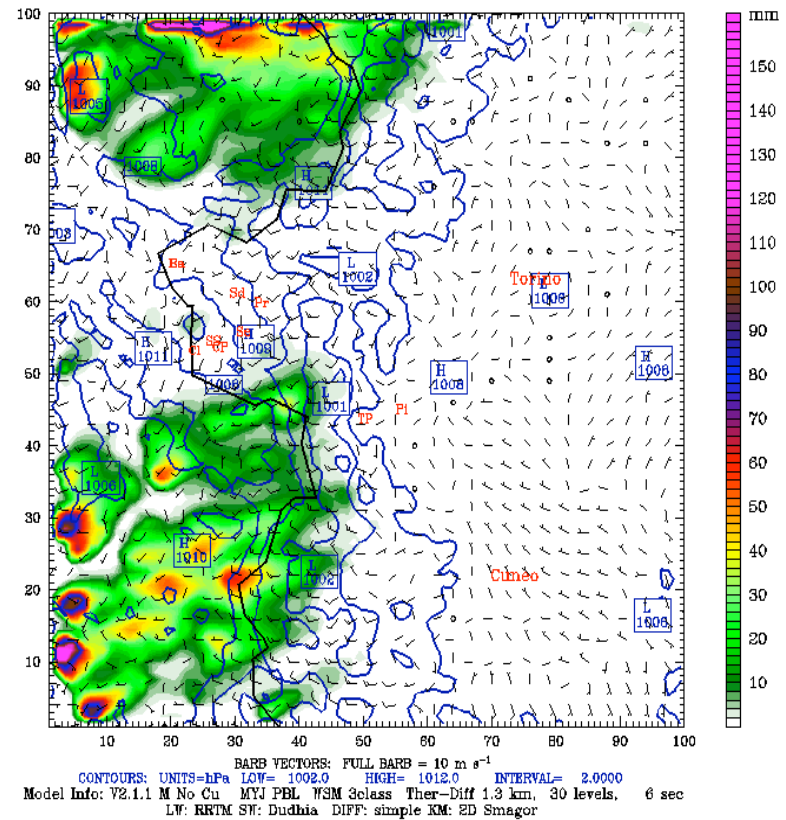
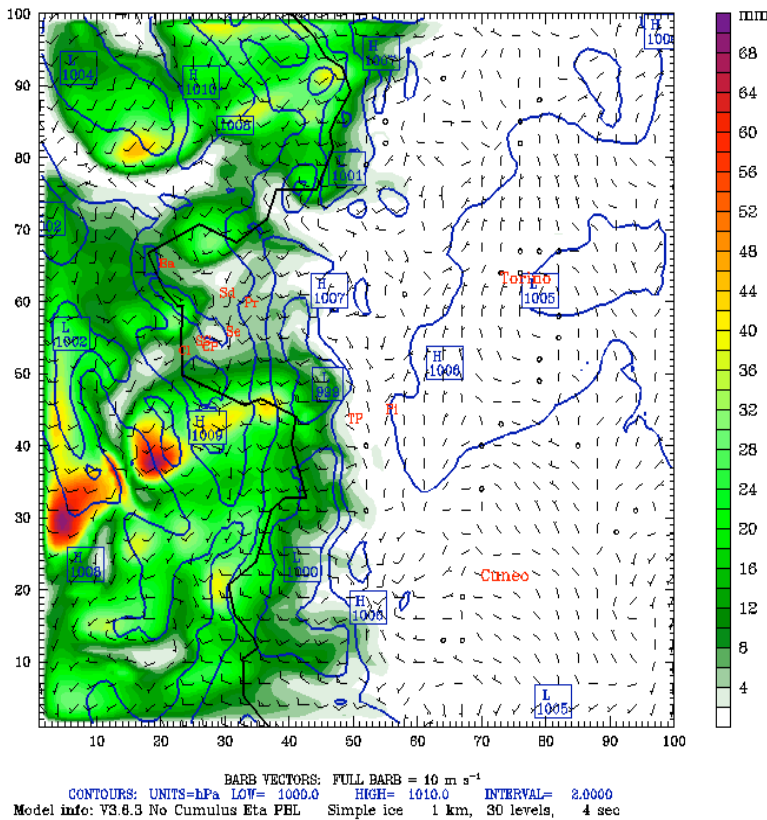
Precip in Mountains

MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 3

00UTC 18 Feb - 00UTC 19 Feb

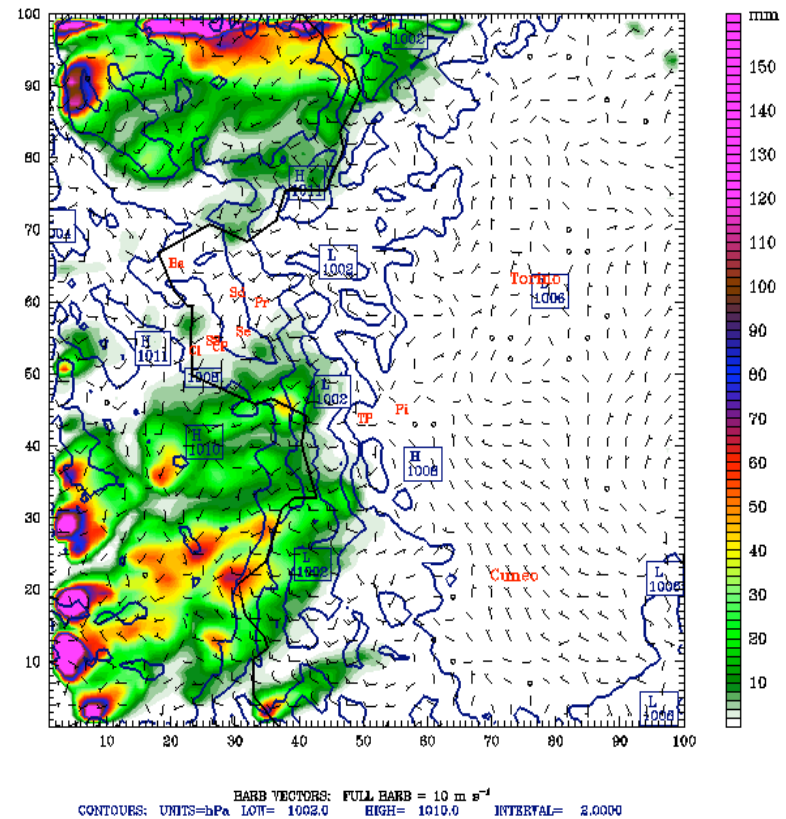
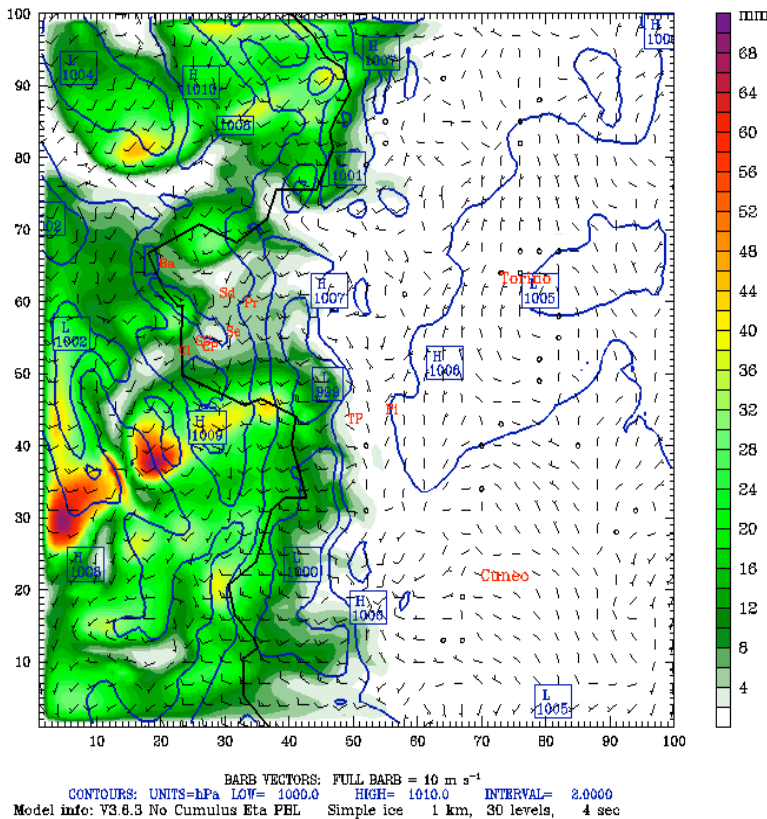
Precip in Mountains

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime rtotsh0 Init: 0000 UTC Sat 18 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Total precip. since h 3
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 3

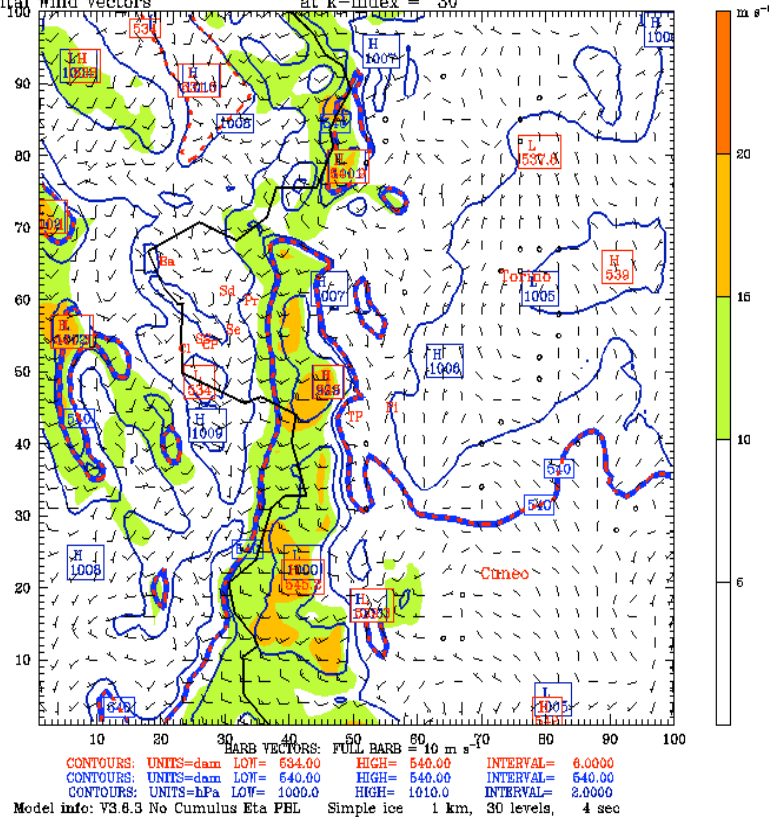
00UTC 18 Feb - 00UTC 19 Feb

Precip in Mountains

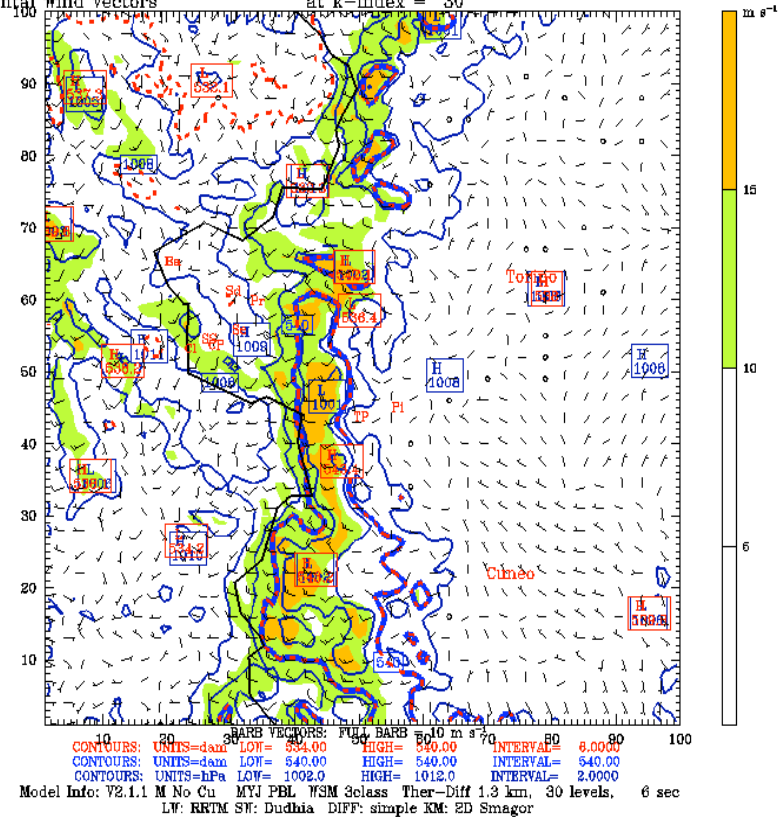
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 3

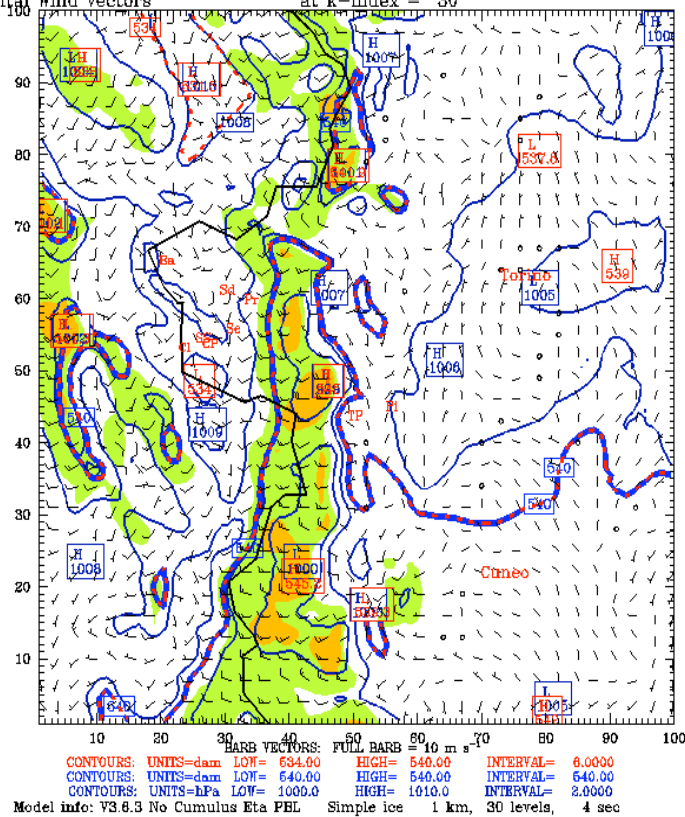
00UTC 18 Feb - 00UTC 19 Feb

Precip in Mountains

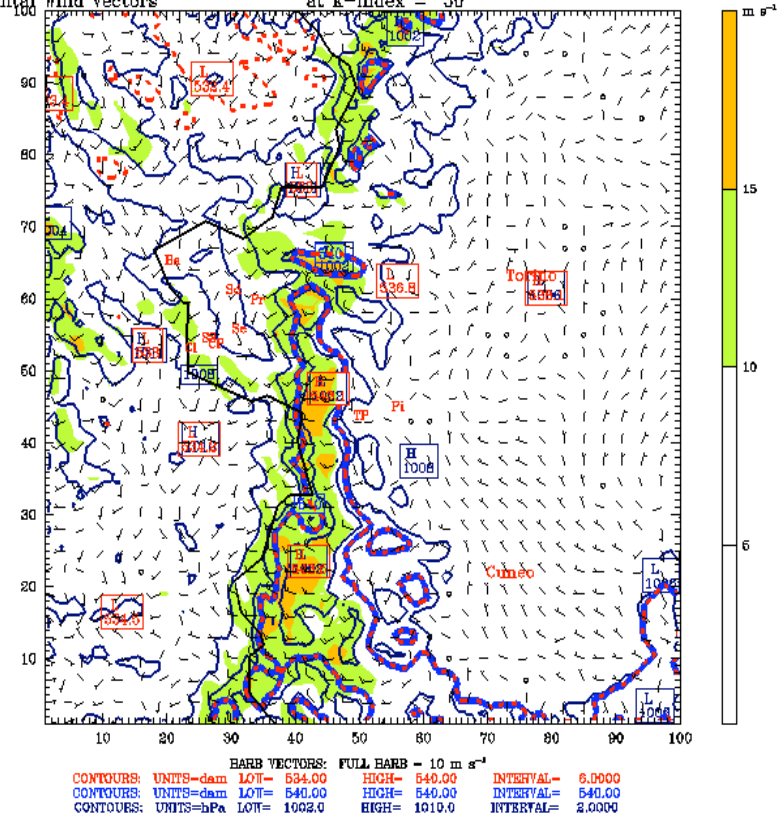
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime thick Init: 0000 UTC Sat 18 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

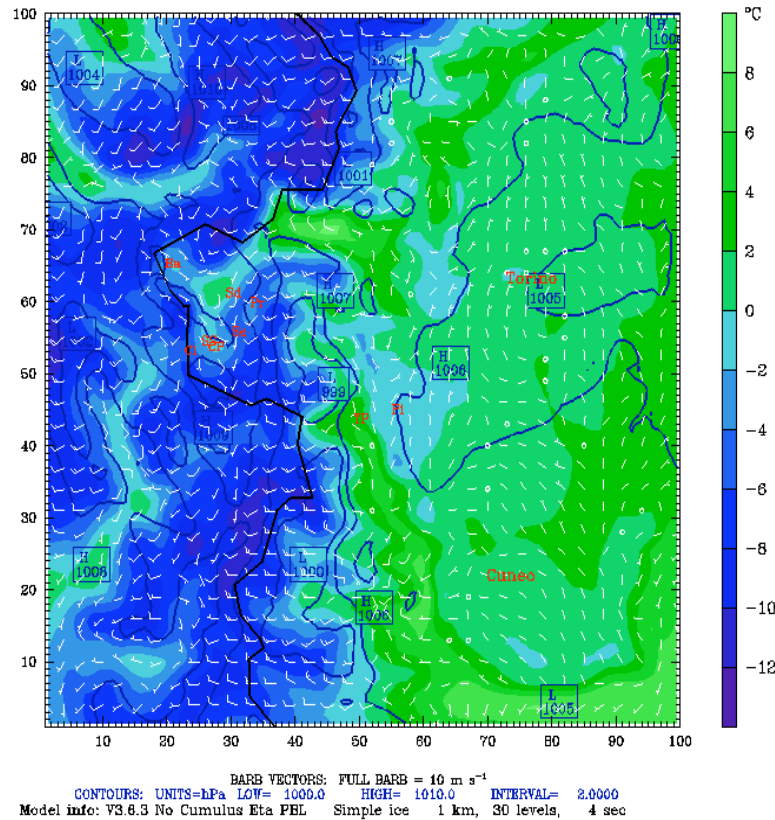
Case 3

00UTC 18 Feb - 00UTC 19 Feb

Precip in Mountains

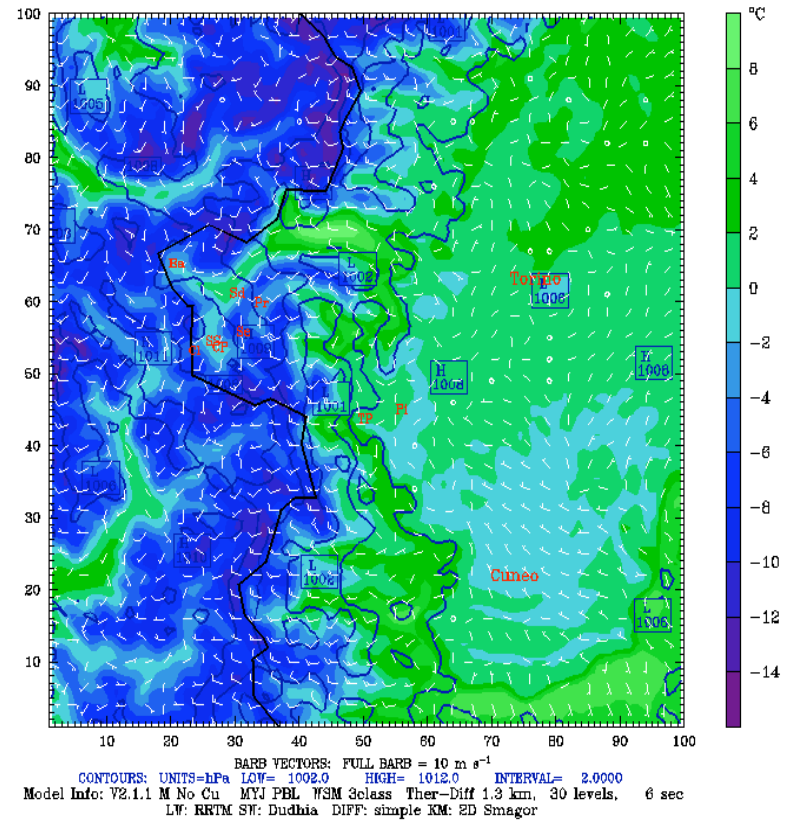
MM5

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



WRF2.1

Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 3

00UTC 18 Feb - 00UTC 19 Feb

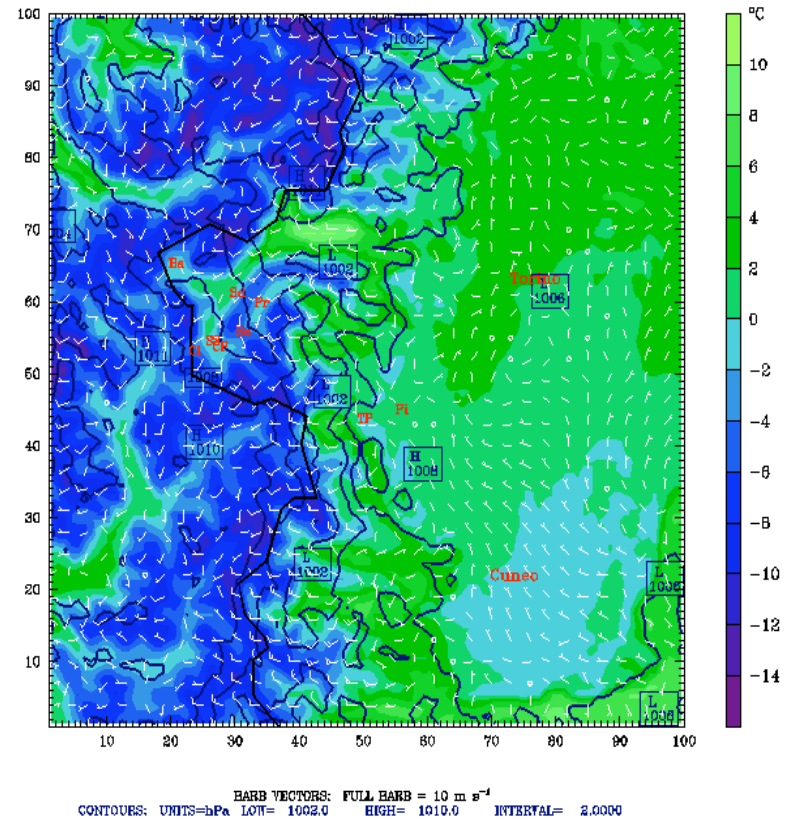
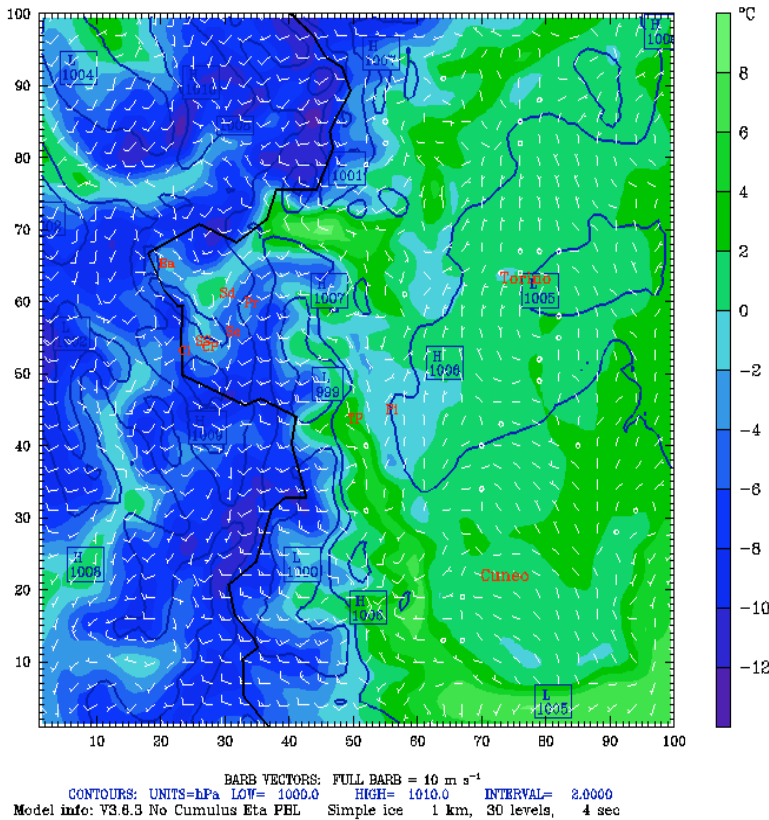
Precip in Mountains

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 2100 UTC Fri 17 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime sfc Init: 0000 UTC Sat 18 Feb 06
 Fest: 24.00 h Valid: 0000 UTC Sun 19 Feb 06 (0100 LST Sun 19 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 4

12UTC 19 Feb - 12UTC 20 Feb

Precip in Mountains and on Plains

Realtime MM5

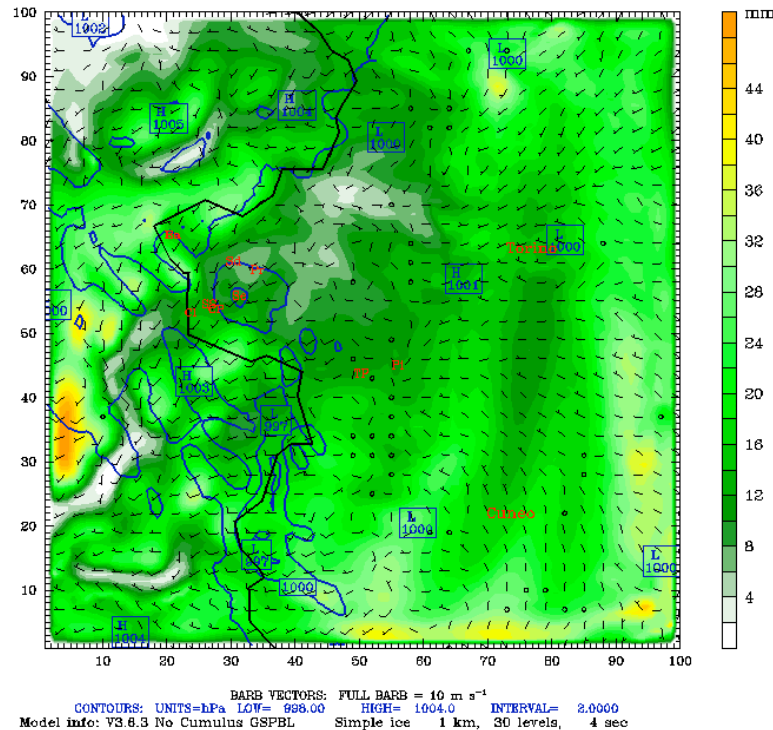
OBS

ARPA Piemonte - The weather and snow service at the Games

Weather data belong to Arpa Piemonte. Use allowed mentioning the source.

Data observed in the single venues: last update on 20/02/2006 at 14:00 local time

Dataset: MM5 1.33km grid RIP: mm5 realtime rto Init: 0900 UTC Sun 19 Feb 06
 Fcst: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
 Total precip. since h 0
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Venues	Sky	Temp.(°C)	Umidity (%)	Wind (m/s)	Total Precipitations (mm)	Last 24h new snow (cm)	Web Cam
Pinerolo palaghiaccio		5.7	81	E 1.80	-	-	
Cesana San Suario		0.5	60	N 1.00	-	25	
Sauze d'Oulx-Jovenceaux		4.7	62	N 1.00	-	16	
Pragelato		3.0	71	N 1.10	-	15	
Sestriere Borgata		1.3	52	SSW 1.40	-	18	
Sestriere Colle		-1.3	96	W 2.70	-	20	
Cesana Pariol		1.9	56	N 1.00	-	25	
Torino esposizioni		3.5	88	SSW 1.70	-	-	
Bardonecchia		1.8	65	W 1.20	-	18	
Pragelato Plan		3.9	48	SSE 1.30	-	15	
San Suario Fraiteve		-0.2	59	WSW 3.90	-	25	

View of the Italian side from the French border

24-h Total Precip

Case 4

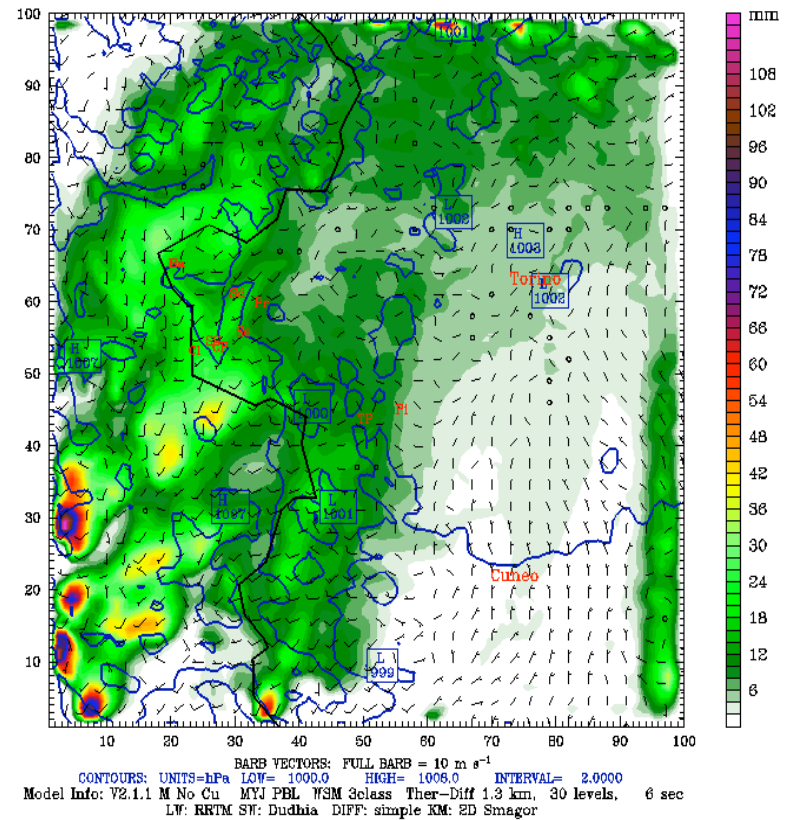
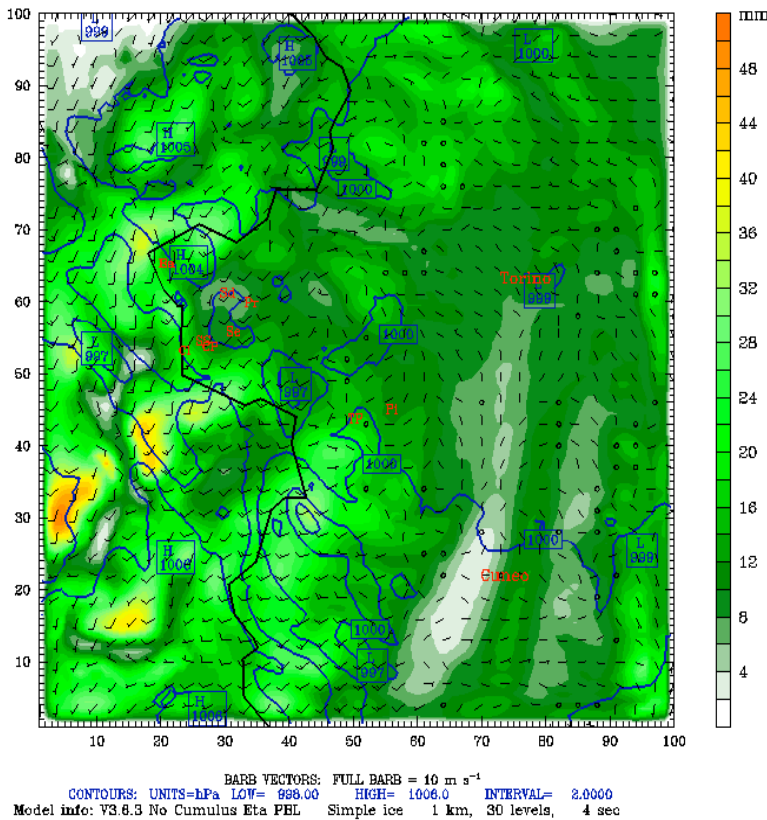
12UTC 19 Feb - 12UTC 20 Feb
Precip in Mountains and on Plains

MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30

Dataset: WRF 1.33km grid RIP: wrf realtime rto Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 4

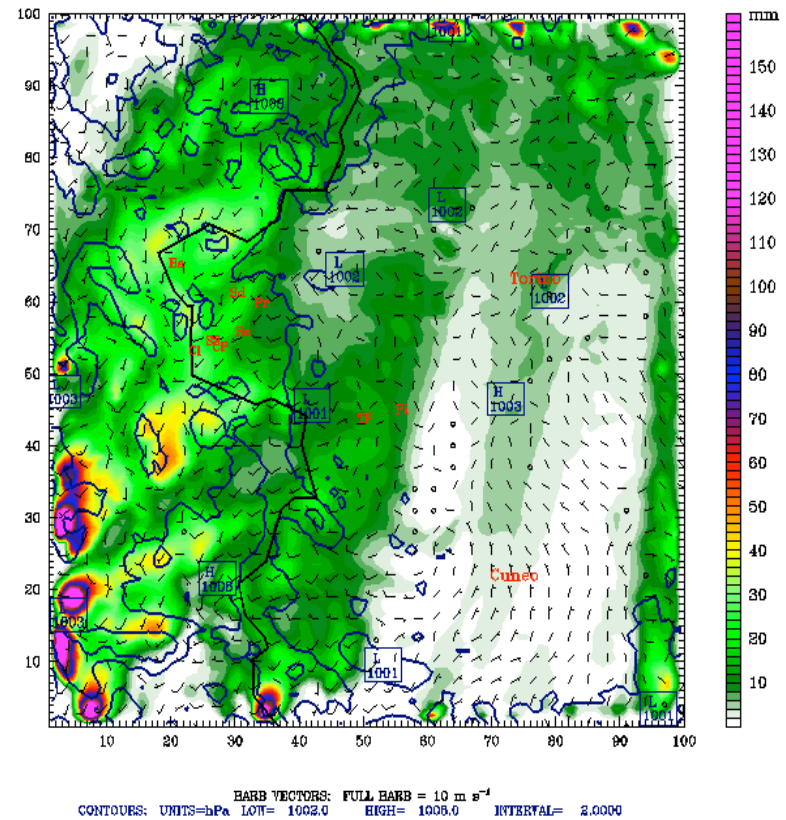
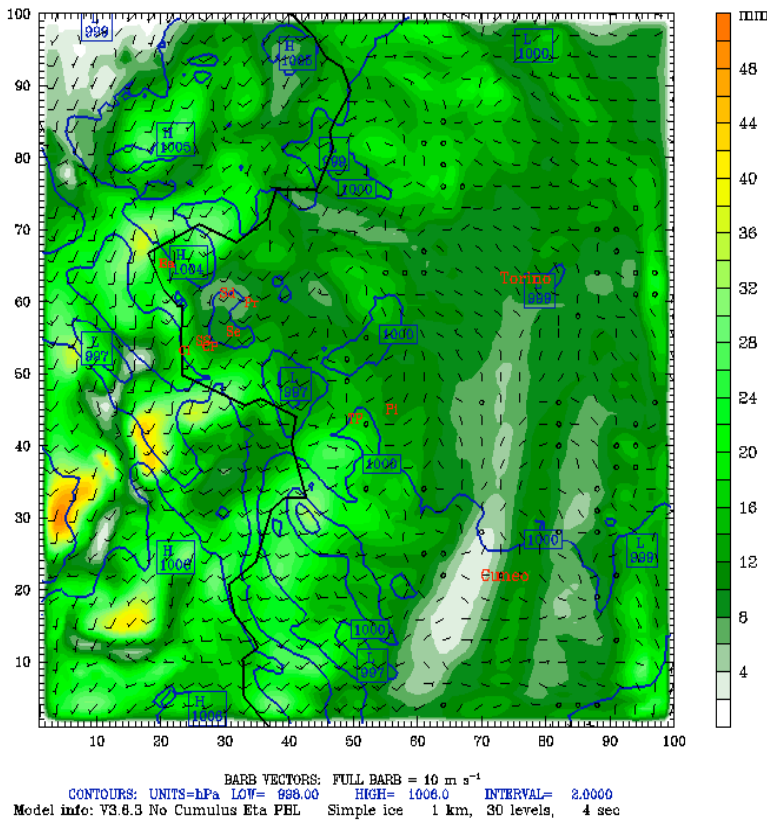
12UTC 19 Feb - 12UTC 20 Feb
Precip in Mountains and on Plains

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime rtotsh0 Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Total precip. since h 0
Sea-level pressure
Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime rtotsh0 Init: 1200 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Total precip. since h 3
Sea-level pressure
Horizontal wind vectors at k-index = 30



24-h Total Precip

Case 4

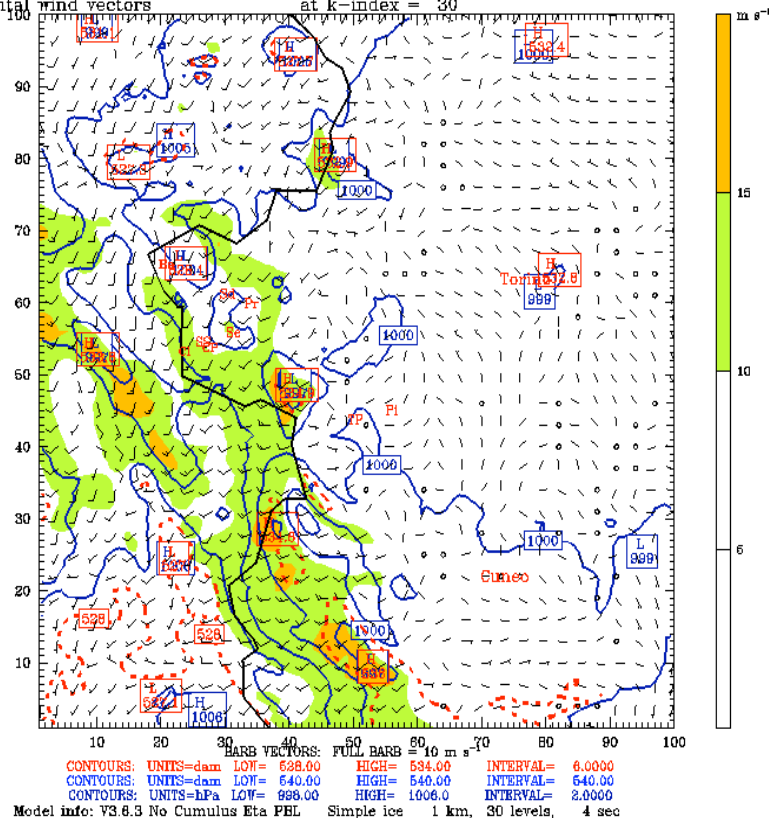
12UTC 19 Feb - 12UTC 20 Feb

Precip in Mountains and on Plains

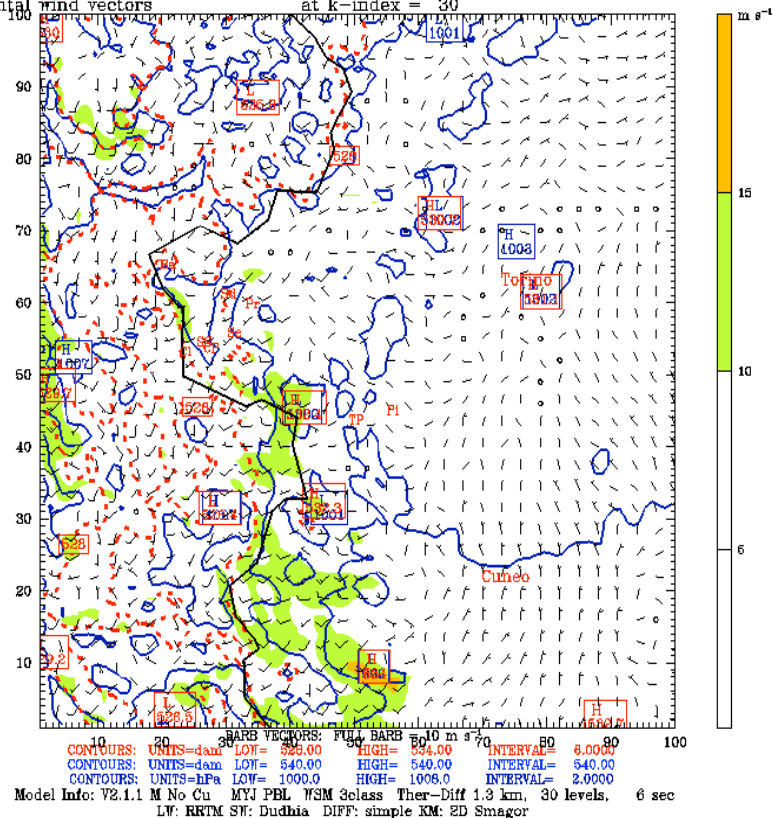
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Sun 19 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 0900 UTC Sun 19 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

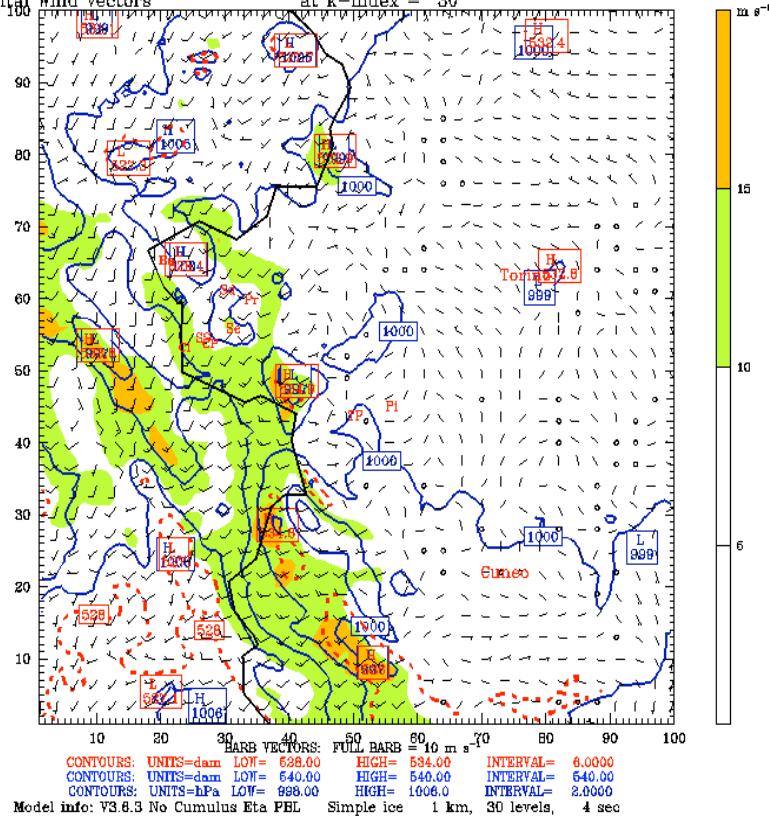
Case 4

12UTC 19 Feb - 12UTC 20 Feb
Precip in Mountains and on Plains

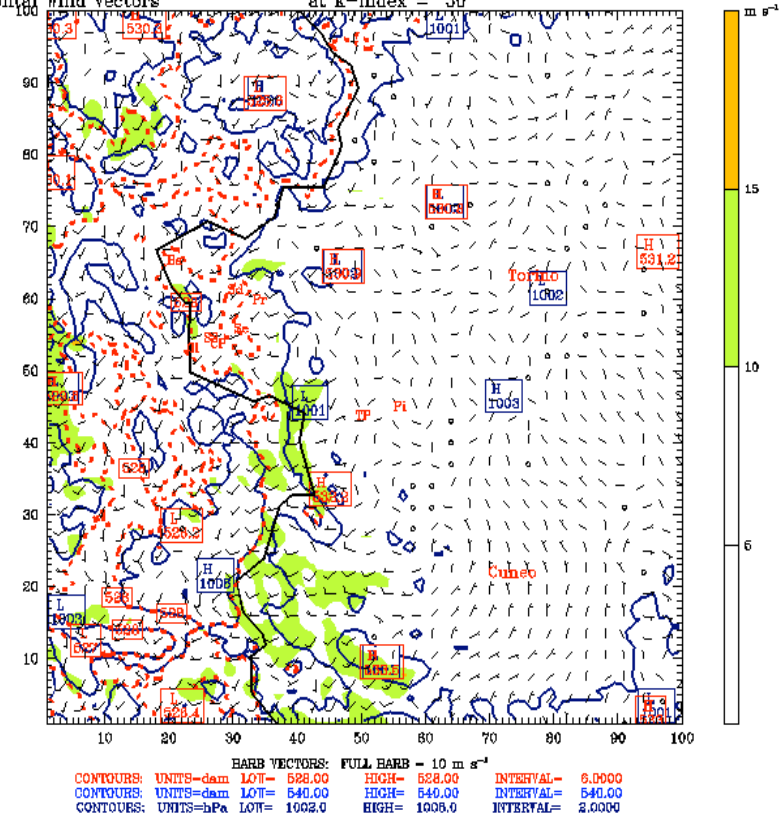
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime thick Init: 1200 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 4

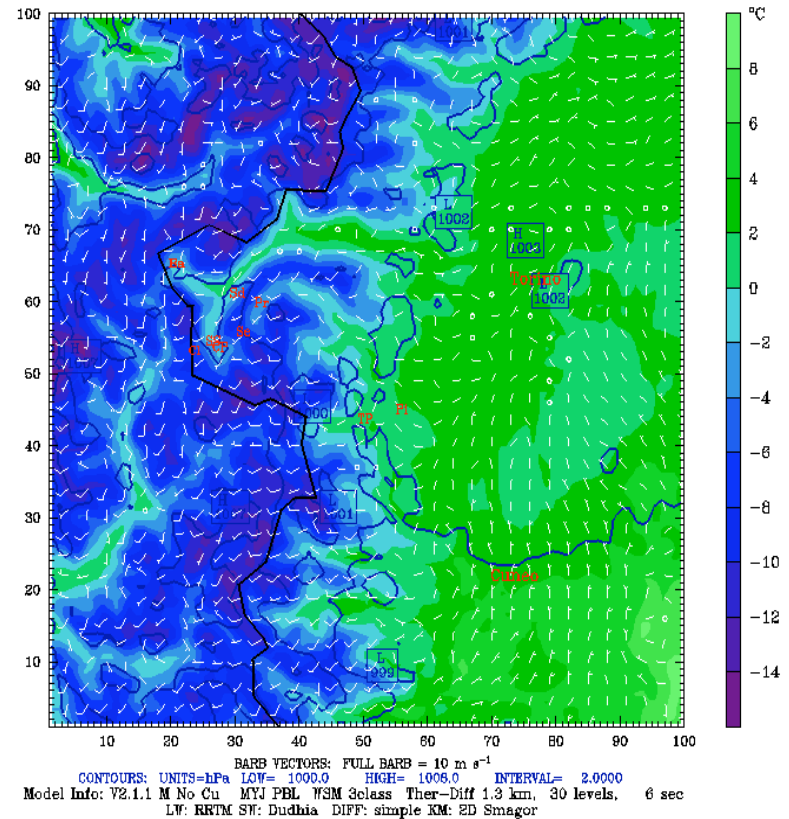
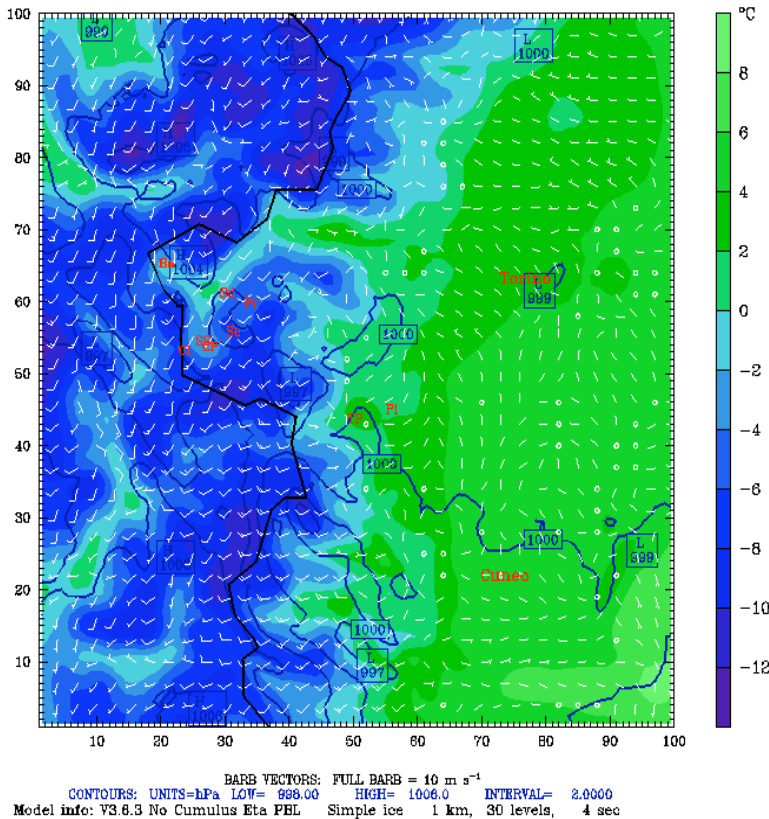
12UTC 19 Feb - 12UTC 20 Feb
Precip in Mountains and on Plains

MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30

Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 4

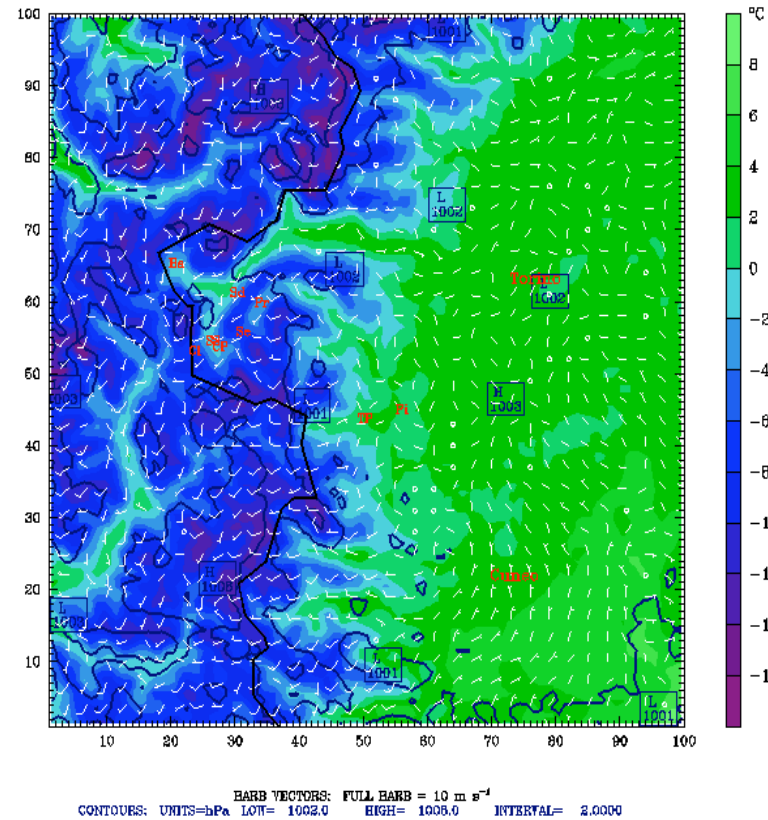
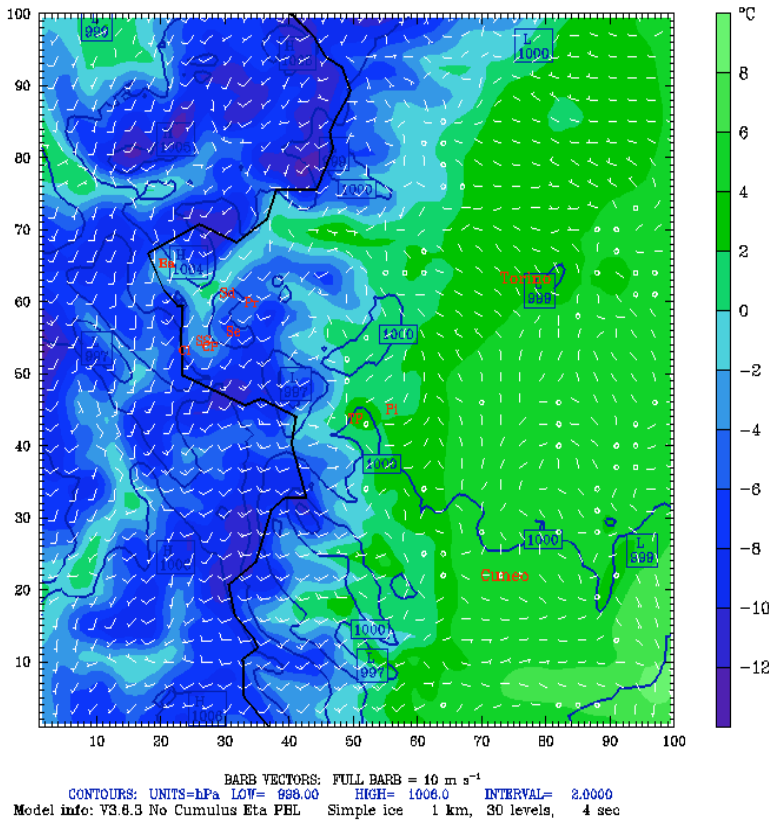
12UTC 19 Feb - 12UTC 20 Feb
Precip in Mountains and on Plains

MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30

Dataset: d04 RIP: realtime sfc Init: 1200 UTC Sun 19 Feb 06
Fest: 24.00 h Valid: 1200 UTC Mon 20 Feb 06 (1300 LST Mon 20 Feb 06)
Temperature at k-index = 30
Sea-level pressure
Horizontal wind vectors at k-index = 30



Surface Layer Temperature

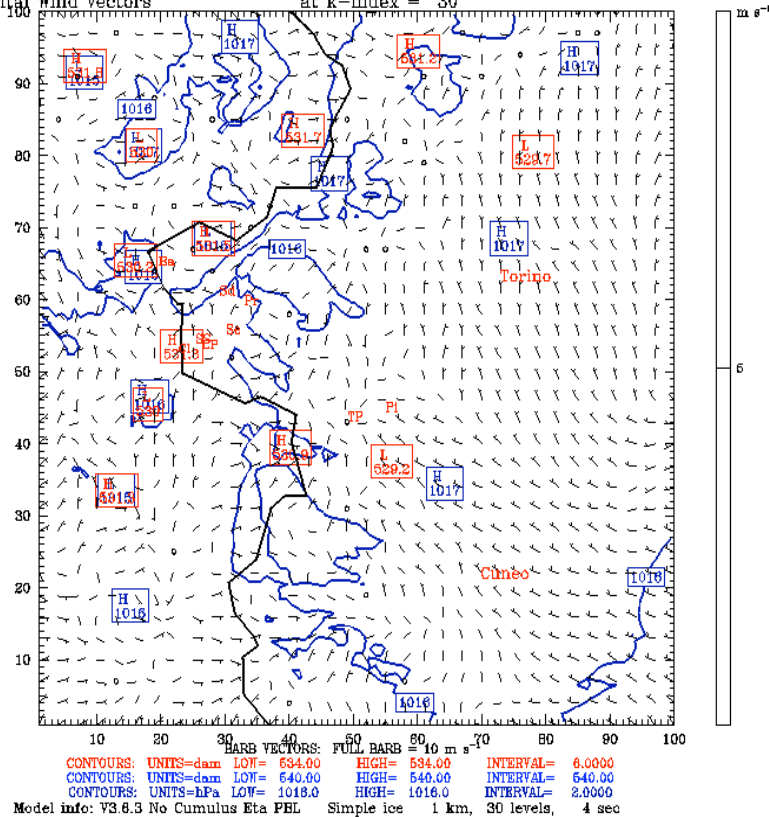
Case 5

00UTC 22 Feb - 00UTC 23 Feb
Precip on Plains

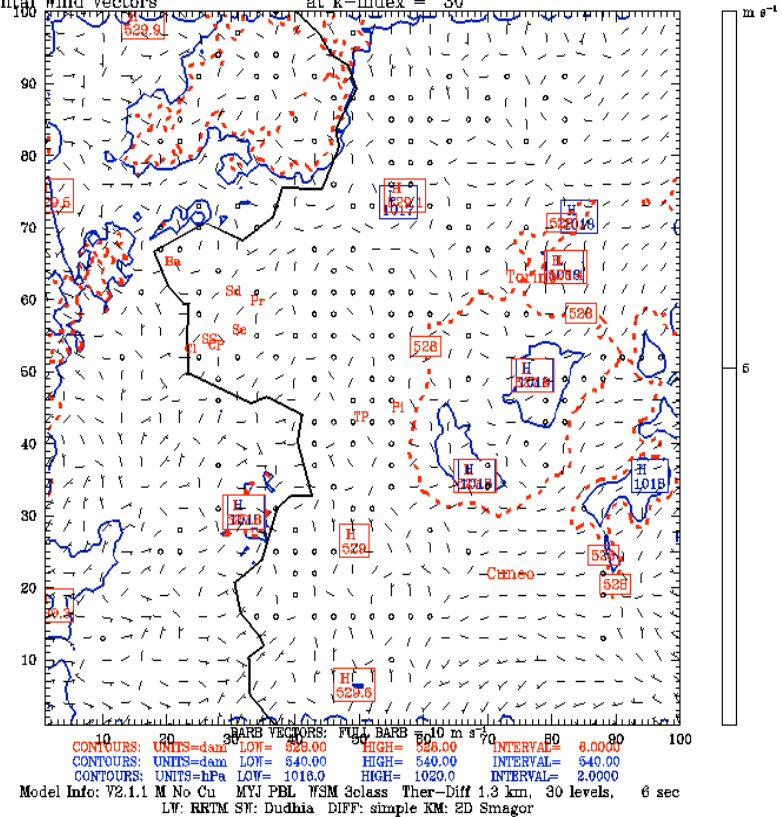
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



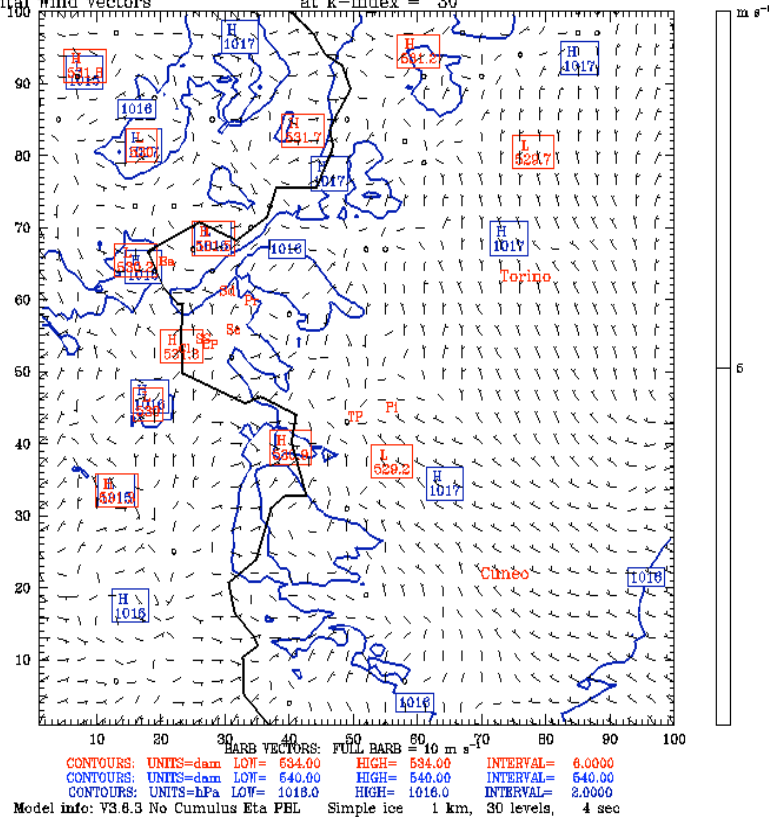
Wind Speed and 1000-500hPa Thickness

00UTC 22 Feb - 00UTC 23 Feb
Precip on Plains

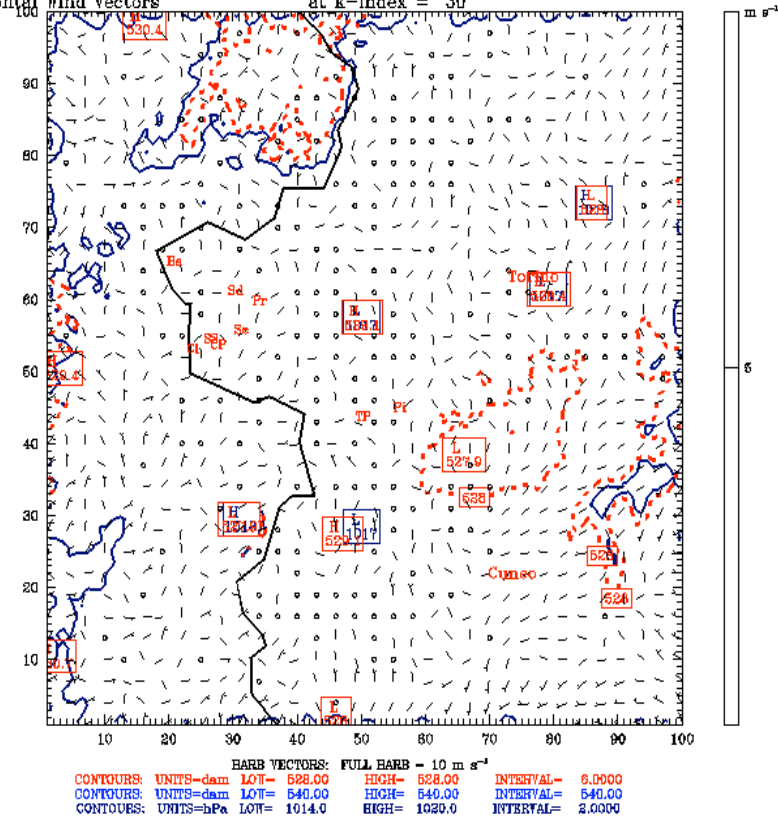
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 2100 UTC Tue 21 Feb 06
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime thick Init: 0000 UTC Wed 22 Feb 08
Fest: 24.00 h Valid: 0000 UTC Thu 23 Feb 06 (0100 LST Thu 23 Feb 06)
Horizontal wind speed at k-index = 30
Sea-level pressure
1000 to 0500 hPa thickness
1000 to 0500 hPa thickness
Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 6

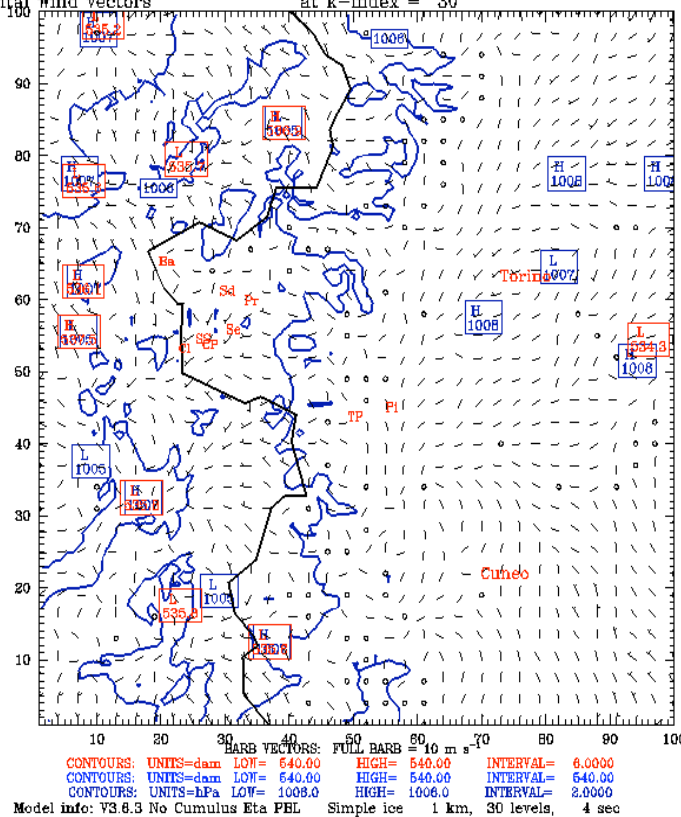
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

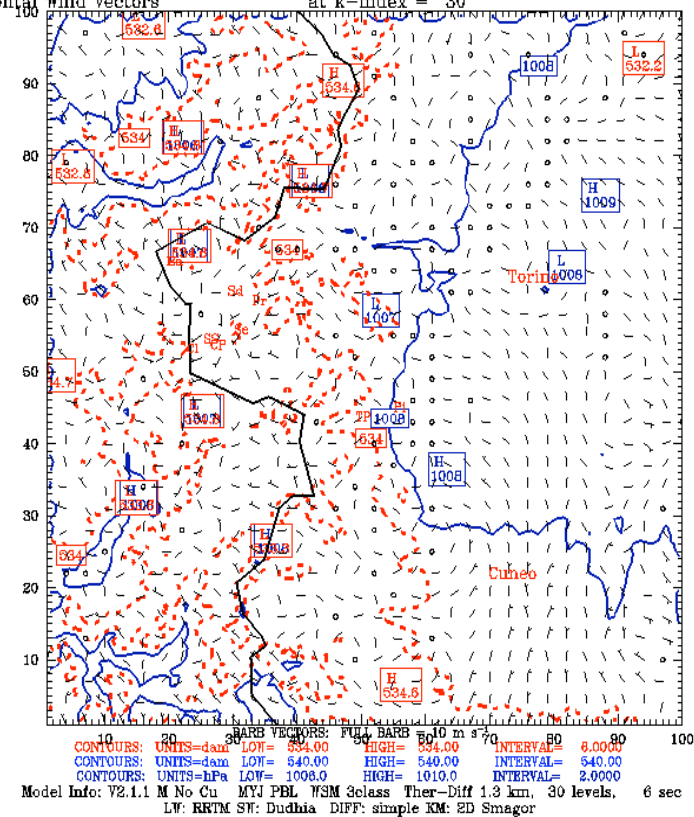
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime thi Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 6

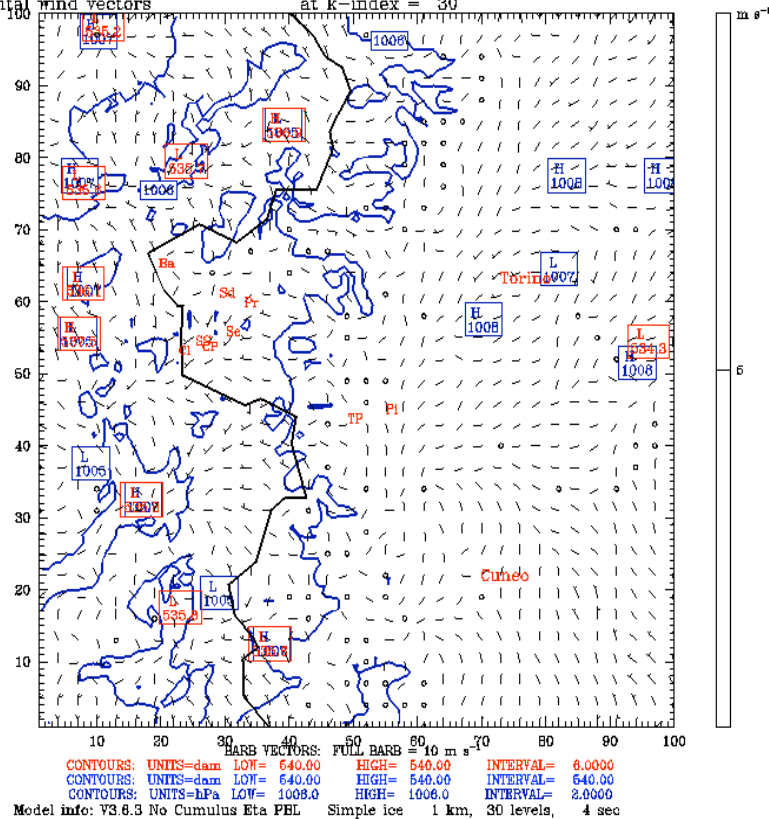
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

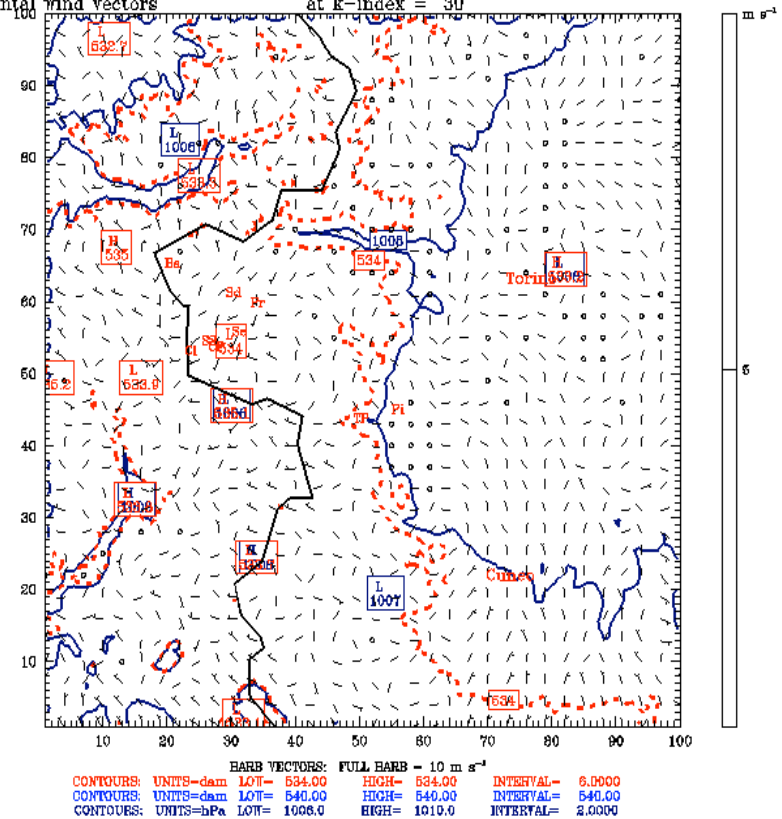
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime thick Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Dataset: d04 RIP: realtime thick Init: 1200 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Horizontal wind speed at k-index = 30
 Sea-level pressure
 1000 to 0500 hPa thickness
 1000 to 0500 hPa thickness
 Horizontal wind vectors at k-index = 30



Wind Speed and 1000-500hPa Thickness

Case 6

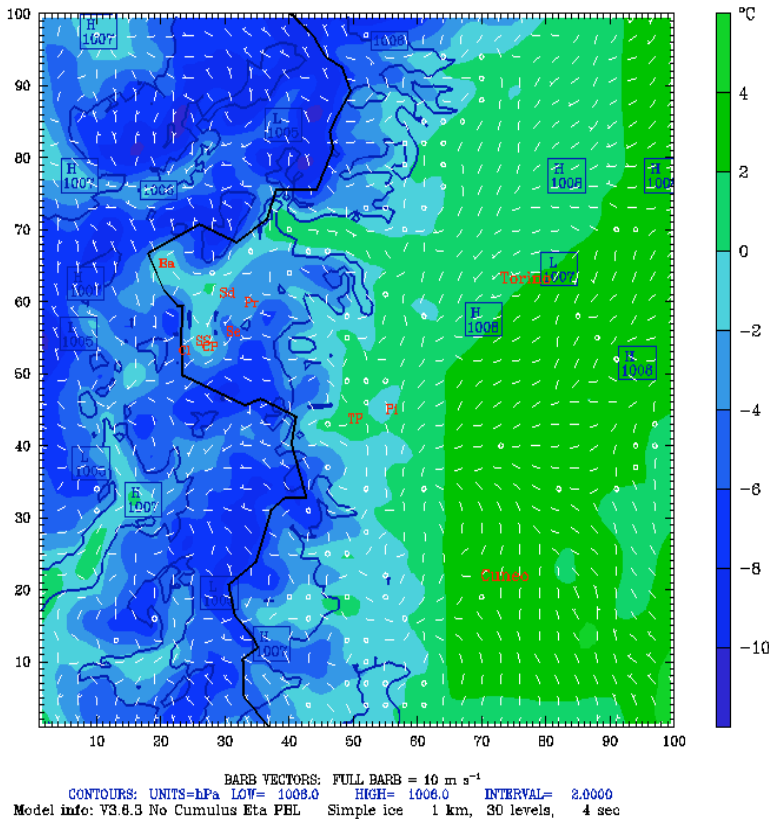
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

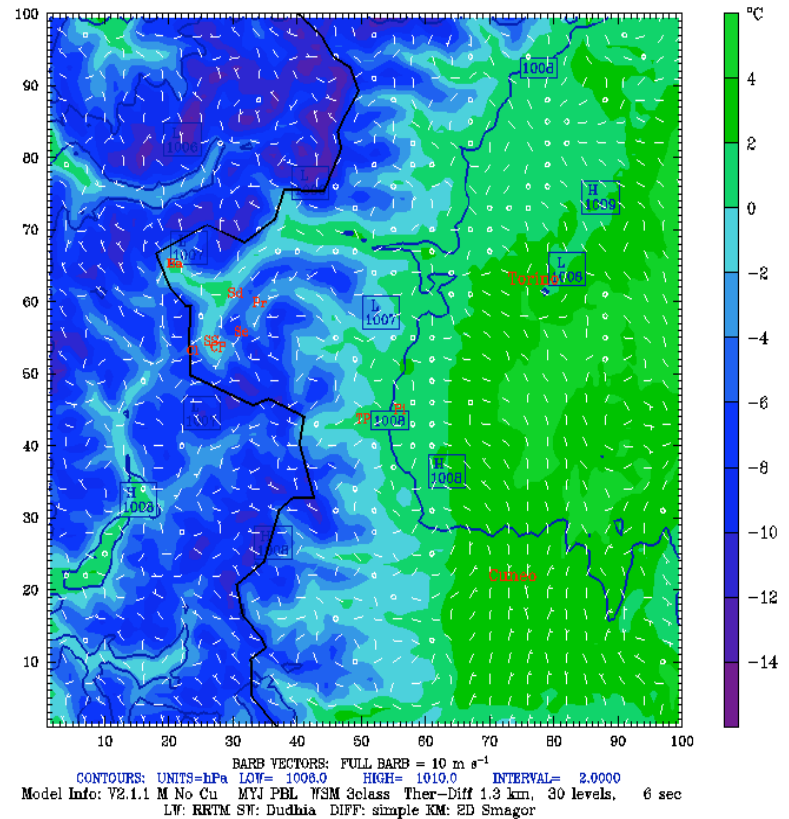
MM5

WRF2.1

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Dataset: WRF 1.33km grid RIP: wrf realtime sfc Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



Surface Layer Temperature

Case 6

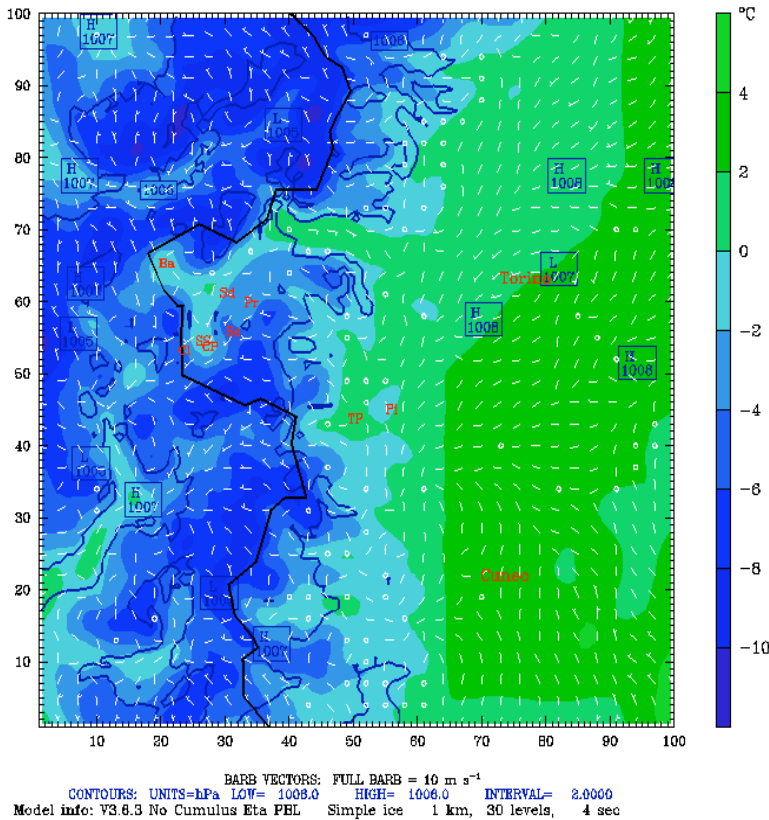
12UTC 25 Feb - 12UTC 26 Feb

Light Precip in Mountains and on Plains

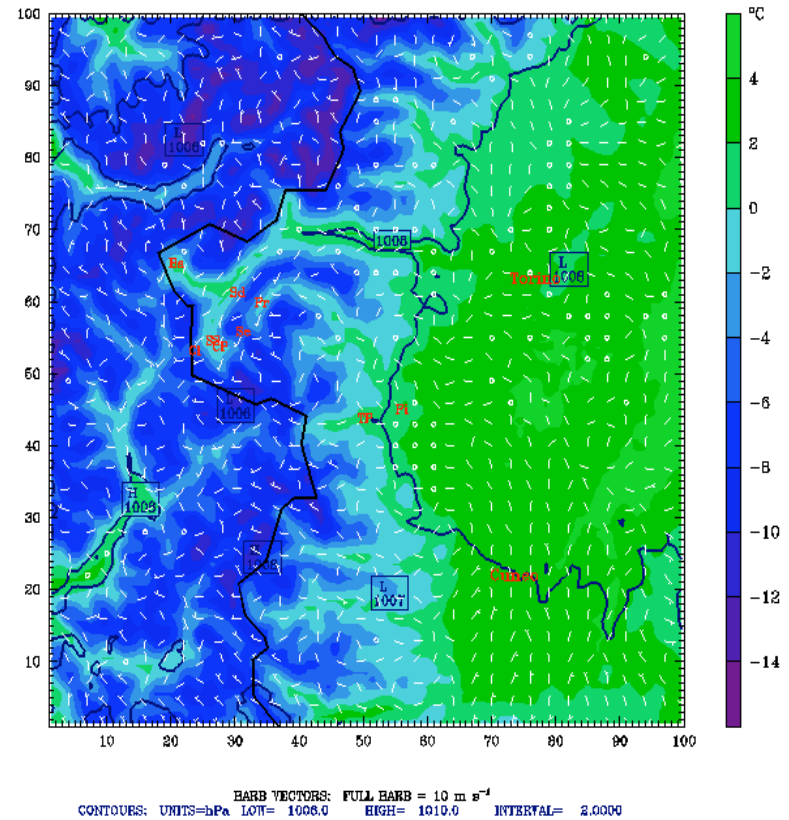
MM5

WRF2.2

Dataset: mm5 d4 RIP: mm5 realtime sfc Init: 0900 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30

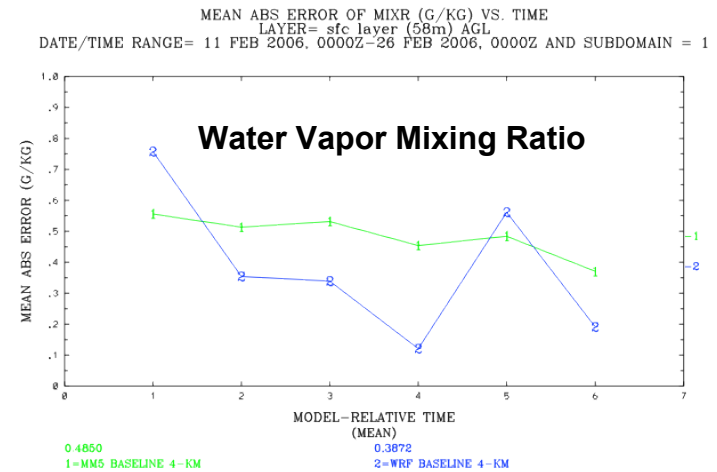
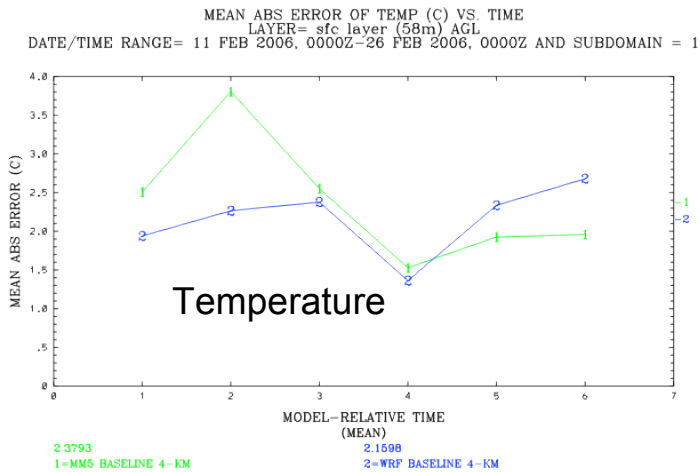
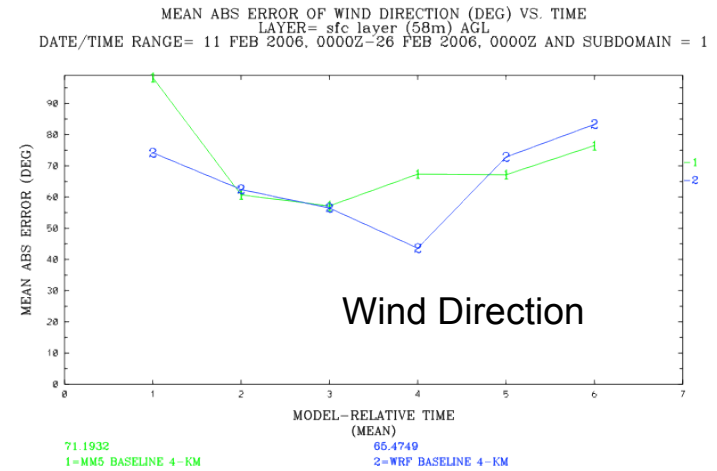
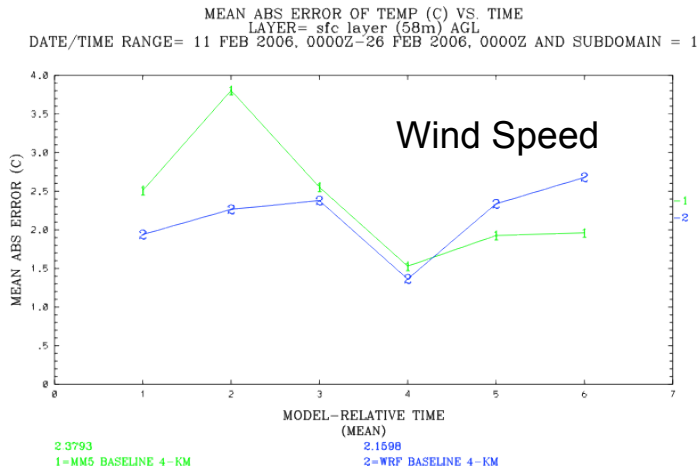


Dataset: d04 RIP: realtime sfc Init: 1200 UTC Sat 25 Feb 06
 Fest: 24.00 h Valid: 1200 UTC Sun 26 Feb 06 (1300 LST Sun 26 Feb 06)
 Temperature at k-index = 30
 Sea-level pressure
 Horizontal wind vectors at k-index = 30



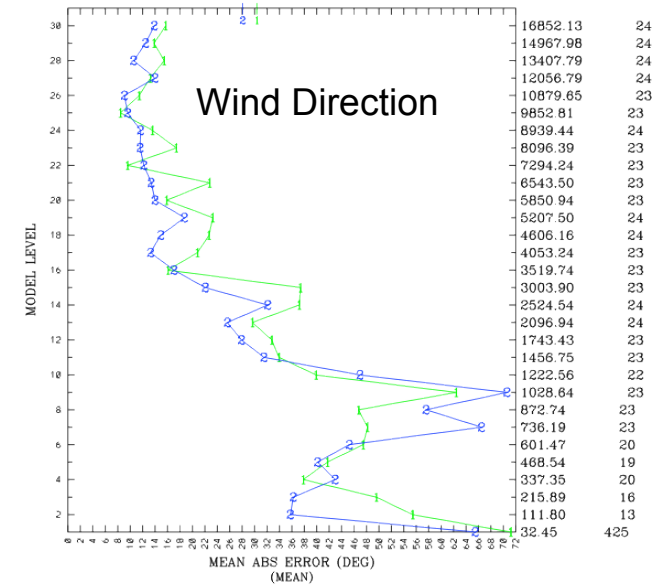
Surface Layer Temperature

4-km Grid Surface-Layer MAE

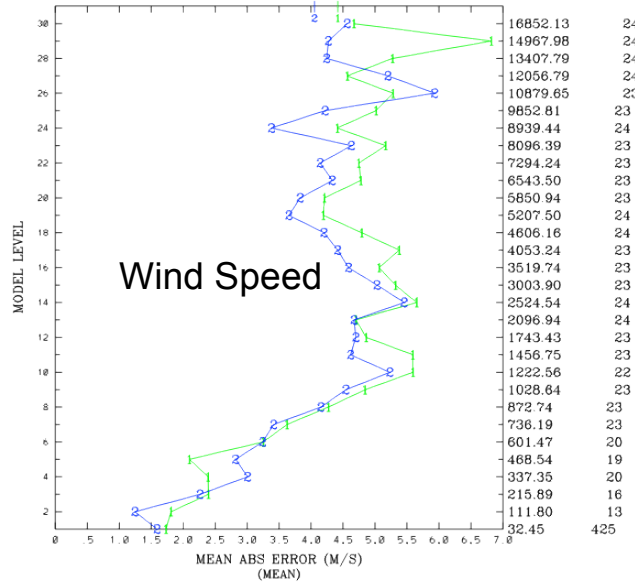


MAE 4-km

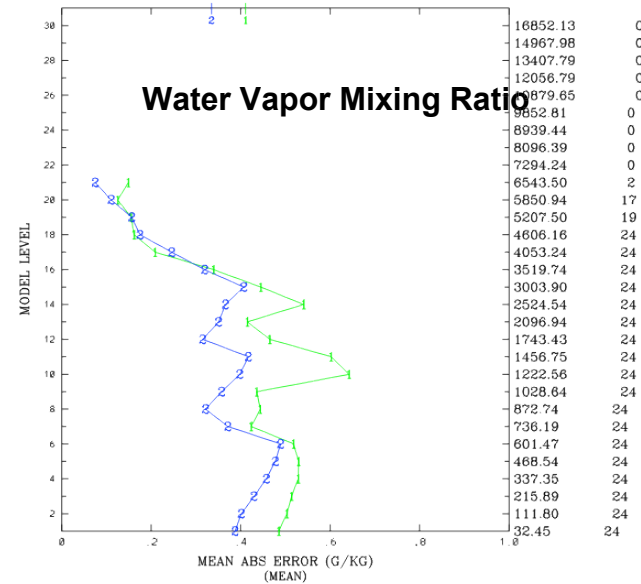
MEAN ABS ERROR OF WIND DIRECTION (DEG)
PROFILE FOR 6 CASES TIME MEAN VALUE
MODEL DX 4km AGAINST 1.333KM OBS
MODEL HOUR RANGE= 0.0 - 24.0 h



MEAN ABS ERROR OF WIND SPEED (M/S)
PROFILE FOR 6 CASES TIME MEAN VALUE
MODEL DX 4km AGAINST 1.333KM OBS
MODEL HOUR RANGE= 0.0 - 24.0 h



MEAN ABS ERROR OF MIXR (G/KG)
PROFILE FOR 6 CASES TIME MEAN VALUE
MODEL DX 4km AGAINST 1.333KM OBS
MODEL HOUR RANGE= 0.0 - 24.0 h



MEAN ABS ERROR OF TEMP (C)
PROFILE FOR 6 CASES TIME MEAN VALUE
MODEL DX 4km AGAINST 1.333KM OBS
MODEL HOUR RANGE= 0.0 - 24.0 h

