The June 2013 Alberta flooding event : Climatology, synoptic conditions and precipitation fields

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CCRN Canmore Workshop
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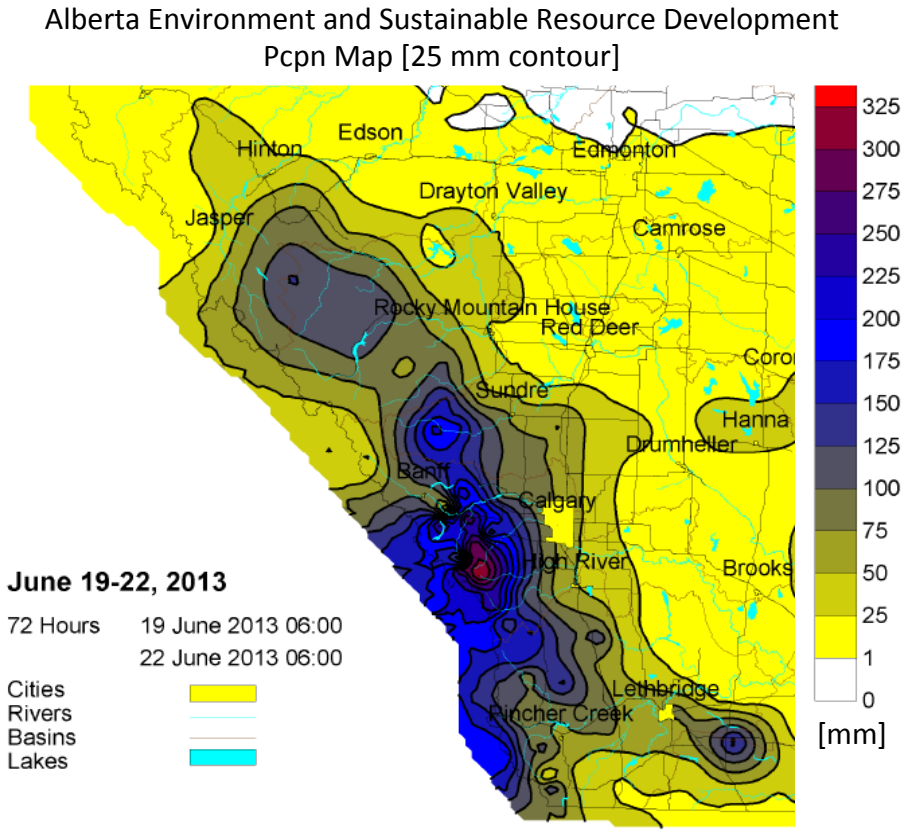
Introduction

- One of the most catastrophic event in the province history
- Produced more than 200 mm over a large area with localized maximum amount of > 300 mm
- Associated with severe weather in south-east Alberta



Goal of the presentation

- What is the climatology of precipitation occurrence in the Banff and Calgary Area ?
  - Accumulated precipitation
  - Number of days associated with $>$ 20 mm and 10 mm

- What happened during this event ?
  - Jet stream (250 hPa) and associate surface low pressure system analysis
  - Heaviest precipitation 00-06 UTC 20 June 2013
  - Temporal and spatial evolution of temperature and precipitation type fields

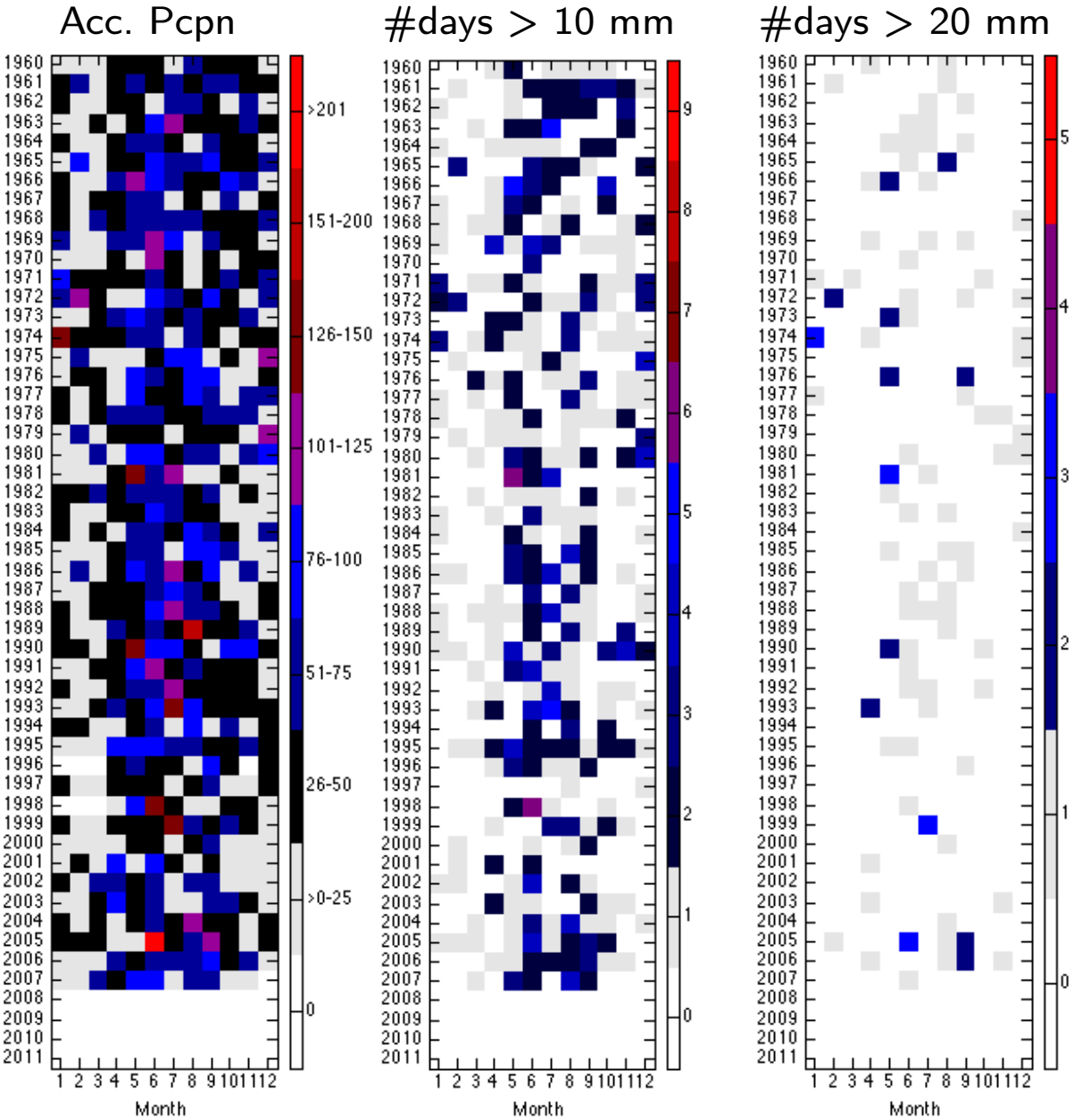
Climatology : Banff, Alberta

Banff, Alberta

Climatology [June 1971-2000]

Accumulated Precipitation :
61.7 mm
Daily Extreme Rainfall :
50 mm

June 2005 →



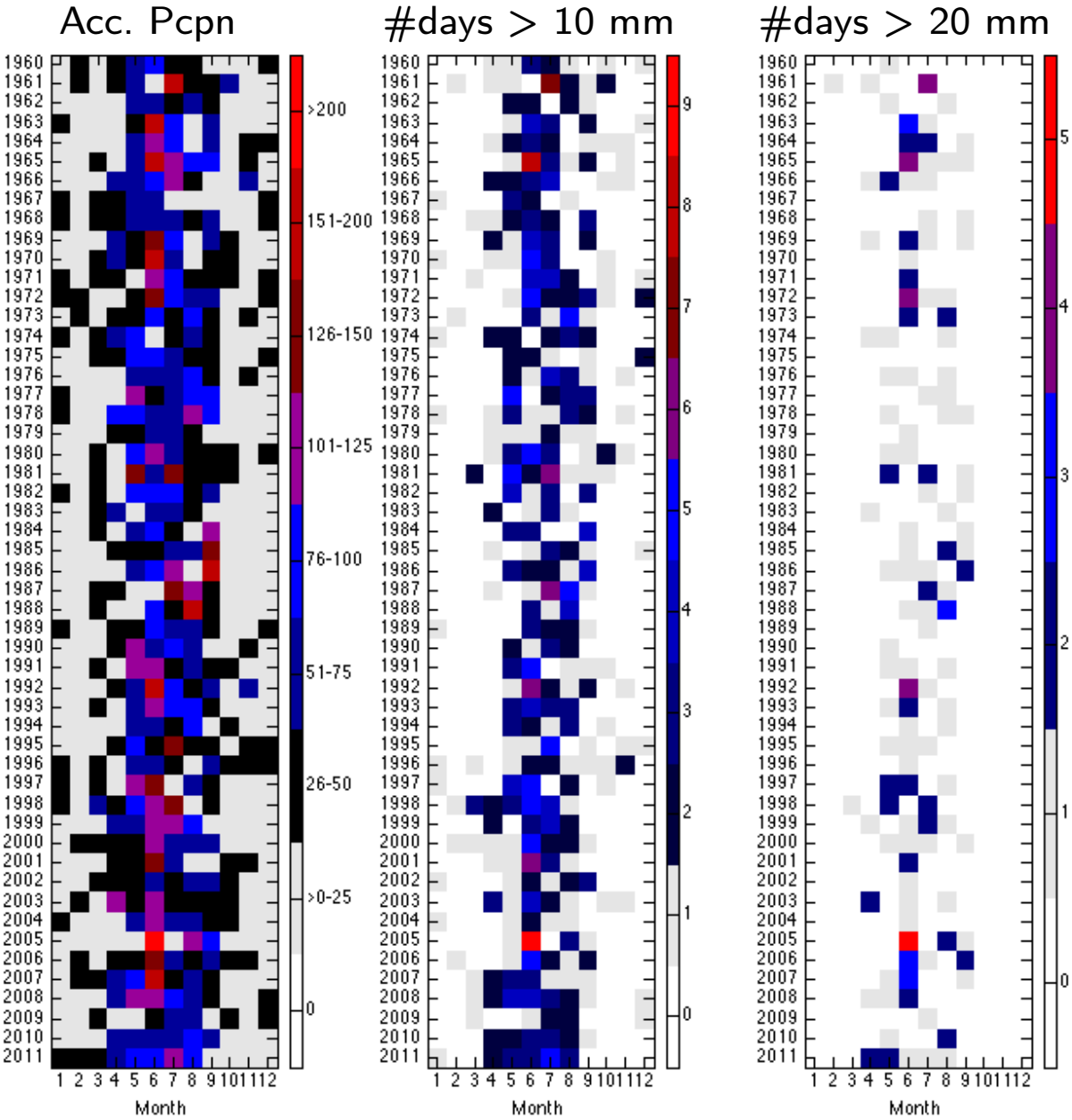
Climatology : Calgary, Alberta

Calgary, Alberta

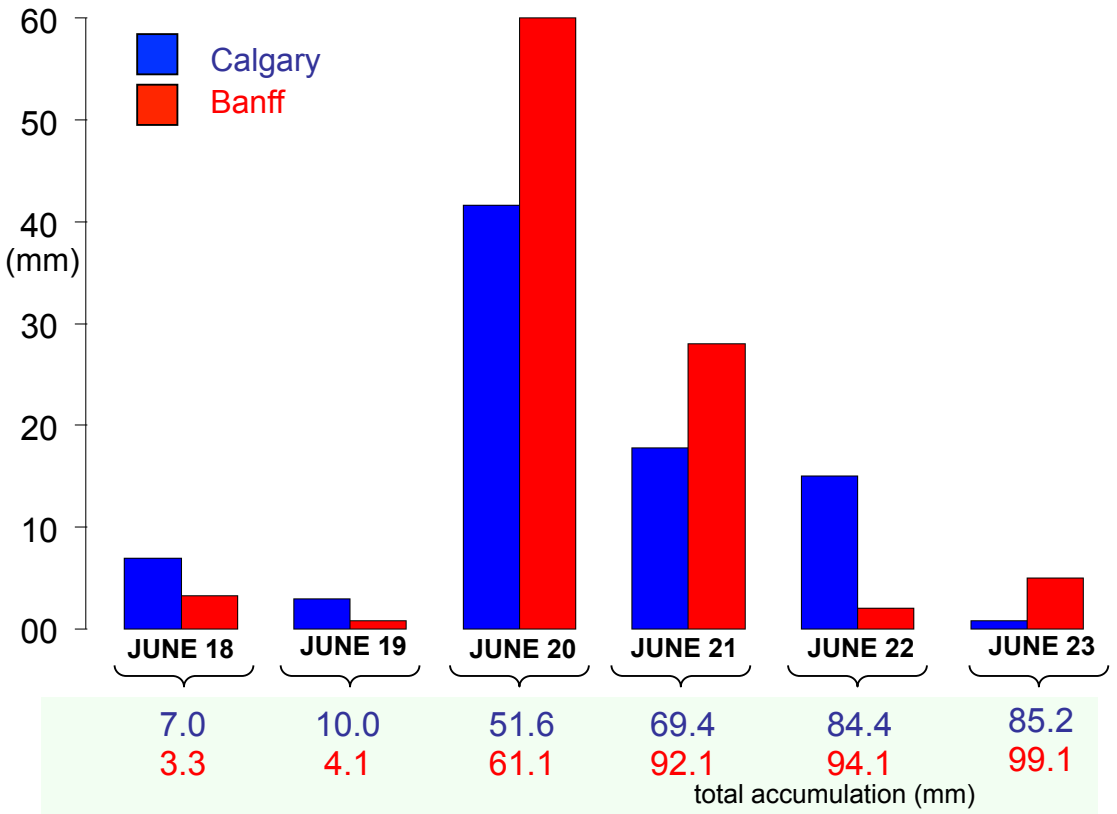
Climatology [June 1971-2000]

Accumulated Precipitation :
79.8 mm
Daily Extreme Rainfall :
79.2 mm

June 2005 →



Precipitation accumulation



From Jason Milbrandt and Marcel Vallée

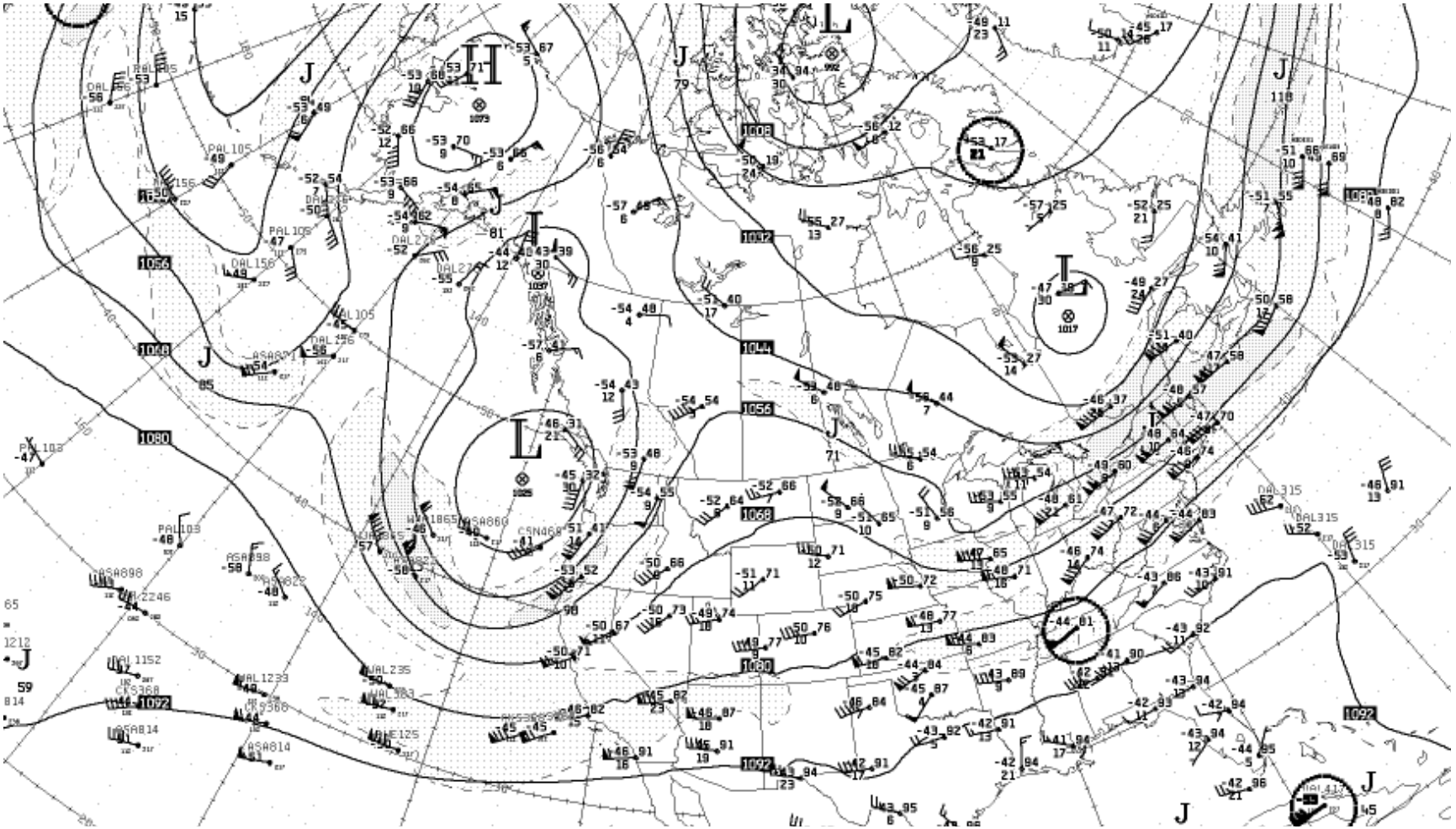
	Acc. Pcpn	> 10 mm	> 20 mm
Banff	99.1 mm	2	2
Calgary	85.2 mm	3	1

What happened during this event ?

Preliminary analysis was conducted :

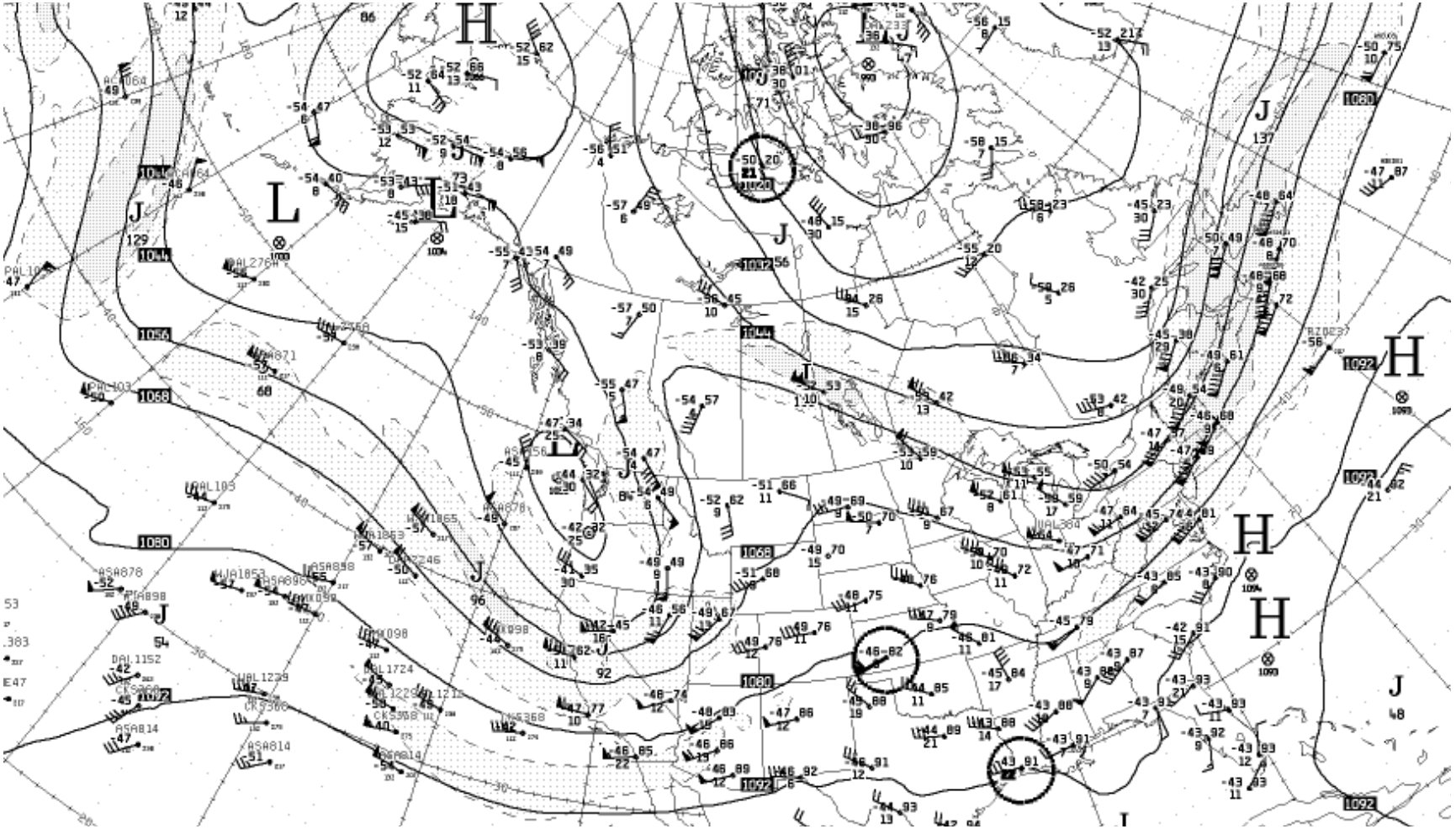
- 250 hPa conditions
- the propagation of the surface low pressure system
- vertical cross-section of the temperature and precipitation types

1200 UTC 18 June 2013 - 250 hPa



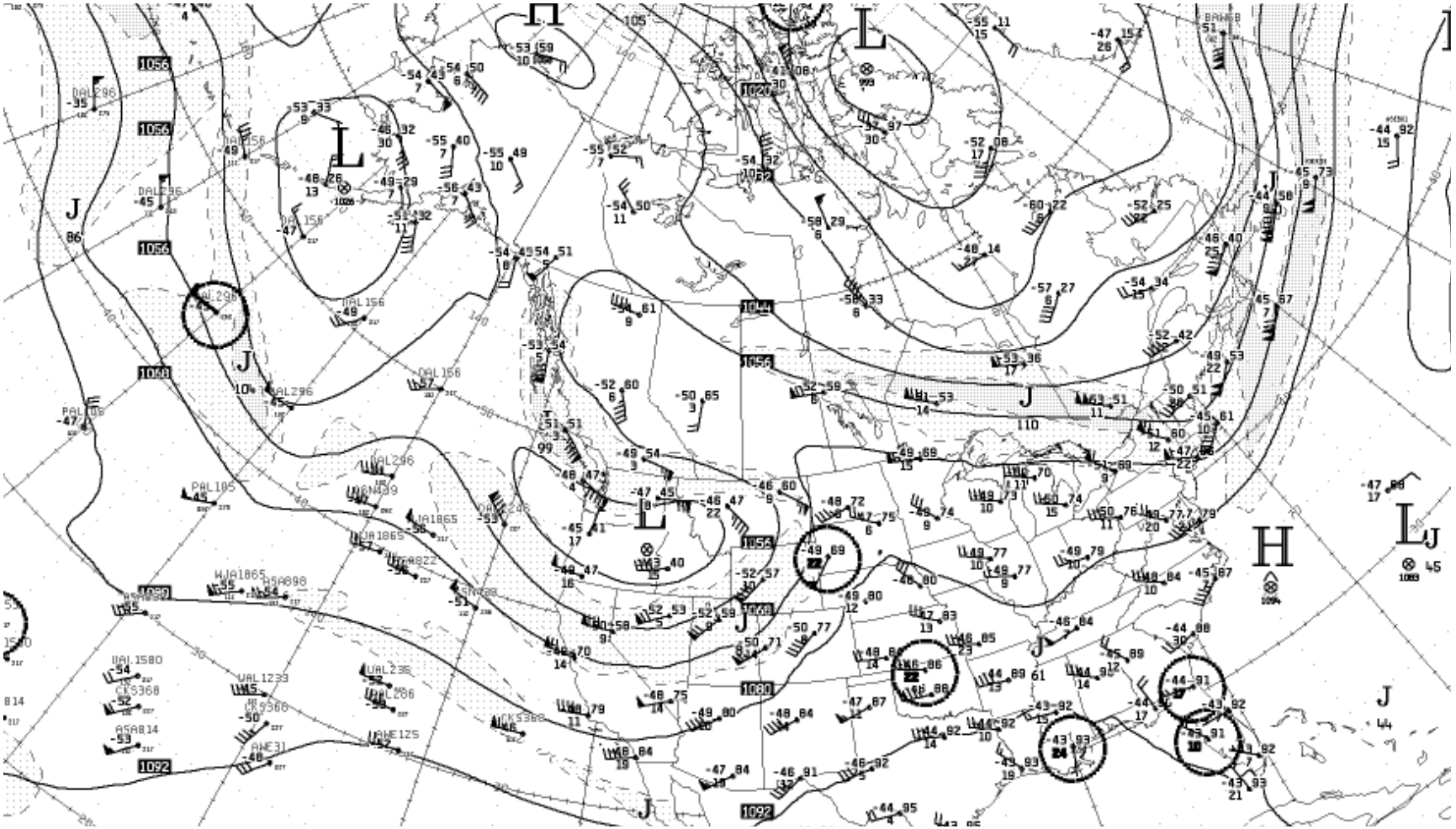
- Jet Streak on the upstream (downstream) of the trough will dig the trough (propagate trough northward).

1200 UTC 19 June 2013 - 250 hPa



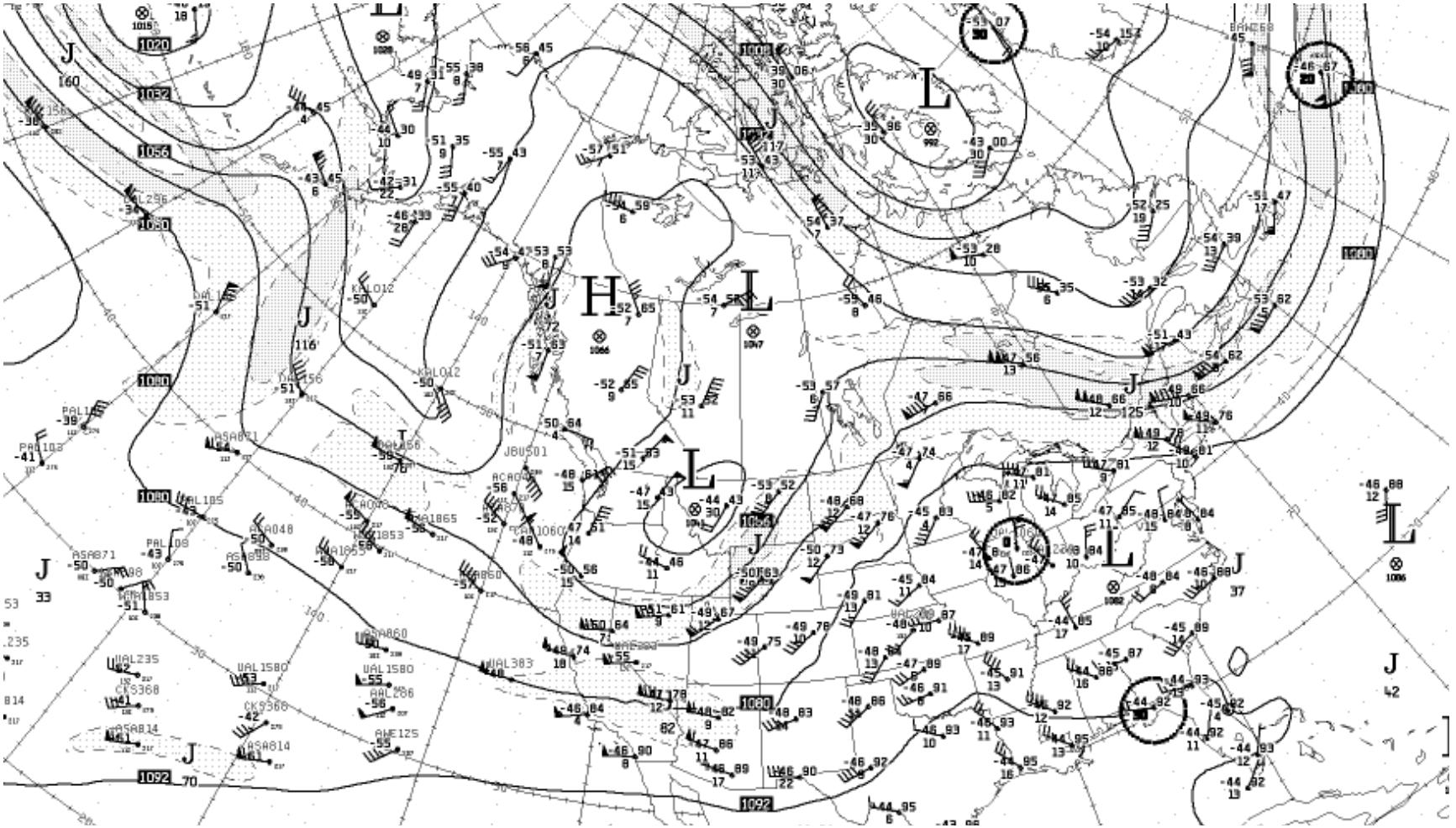
- Jet Streak downstream of the trough. The surface low pressure system south of Idaho.

1200 UTC 20 June 2013 - 250 hPa



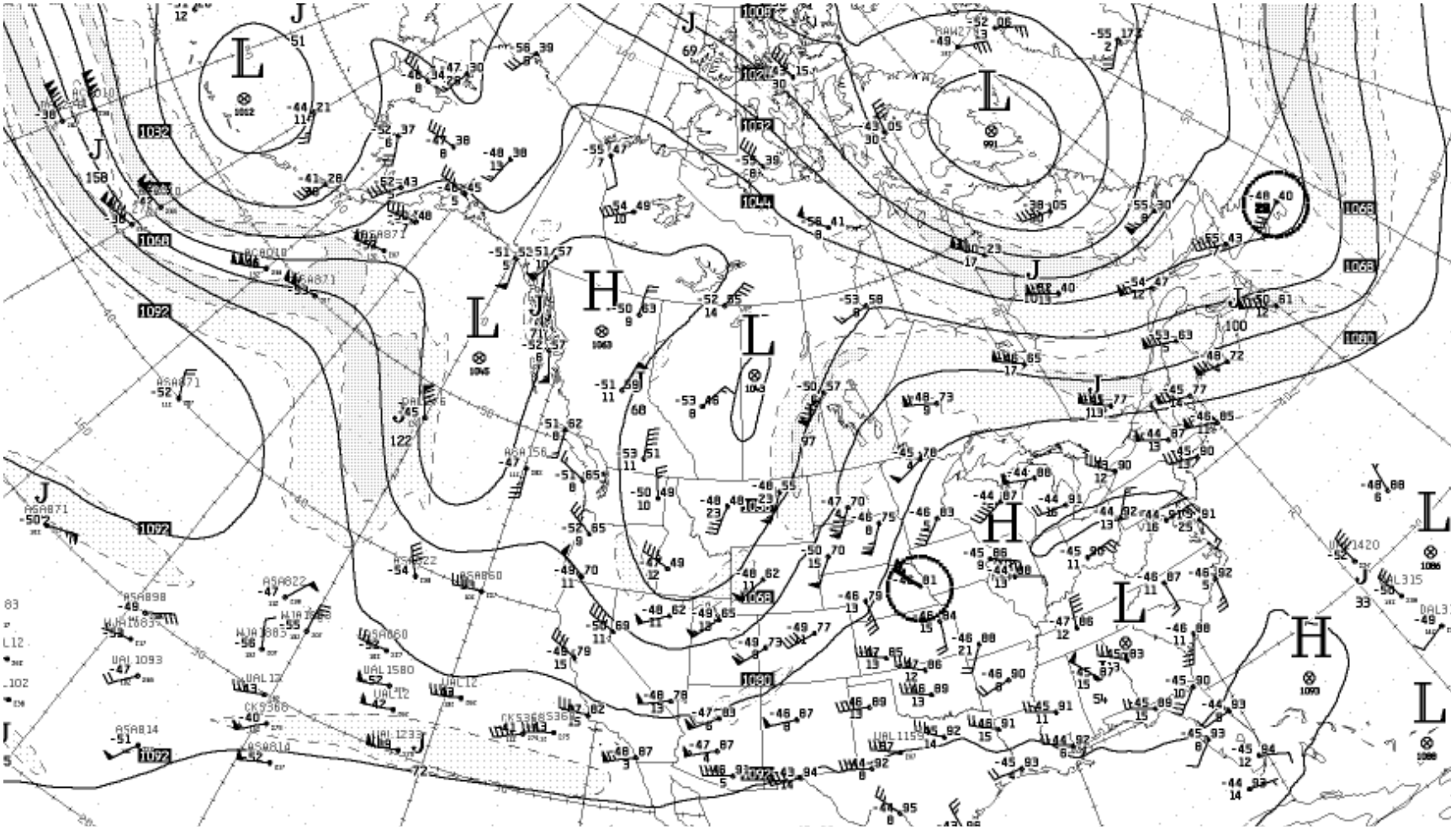
- Favorable synoptic forcing for ascent southeast of the Rocky Mountains. Heavy precipitation started at 0000 UTC 20 June 2013.

1200 UTC 21 June 2013 - 250 hPa



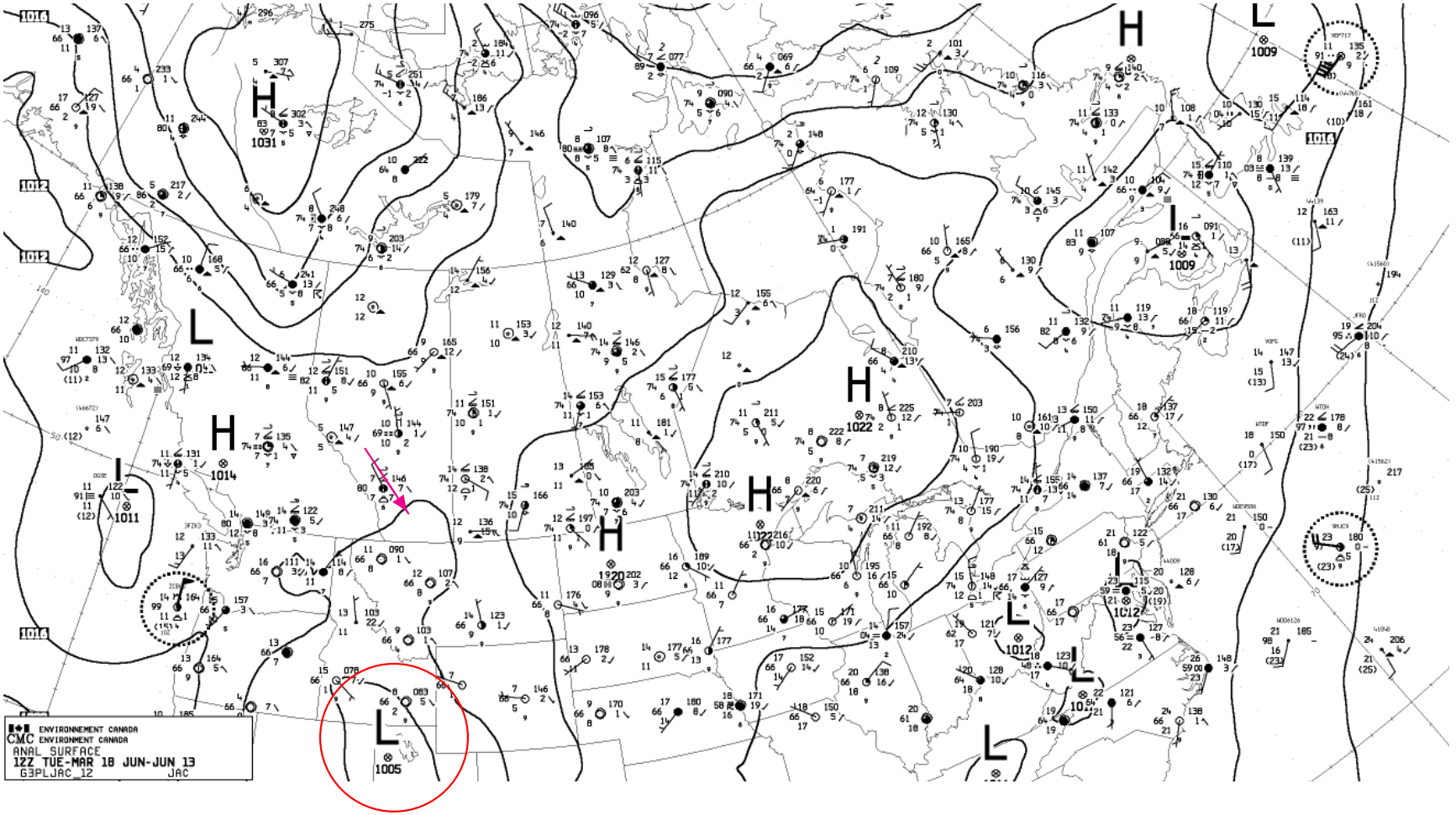
- Synoptic scale forcing aloft is decreasing over the area because it is now located under anticyclonic vorticity advection.

1200 UTC 22 June 2013 - 250 hPa



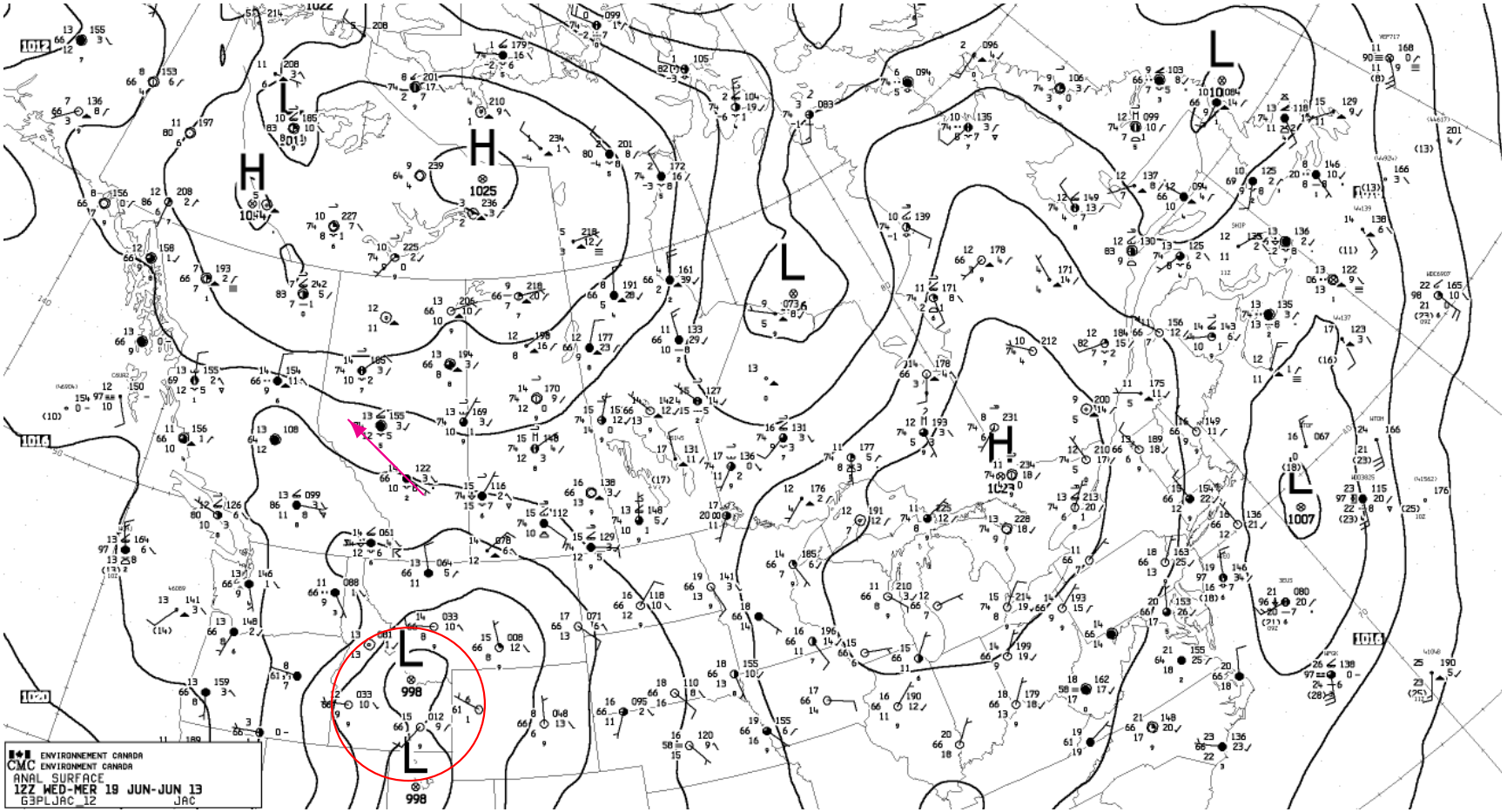
- Weather systems nearly stationary due to the long wavelength that increases the effect of planetary vorticity advection .

1200 UTC 18 June 2013 - Surface Analysis



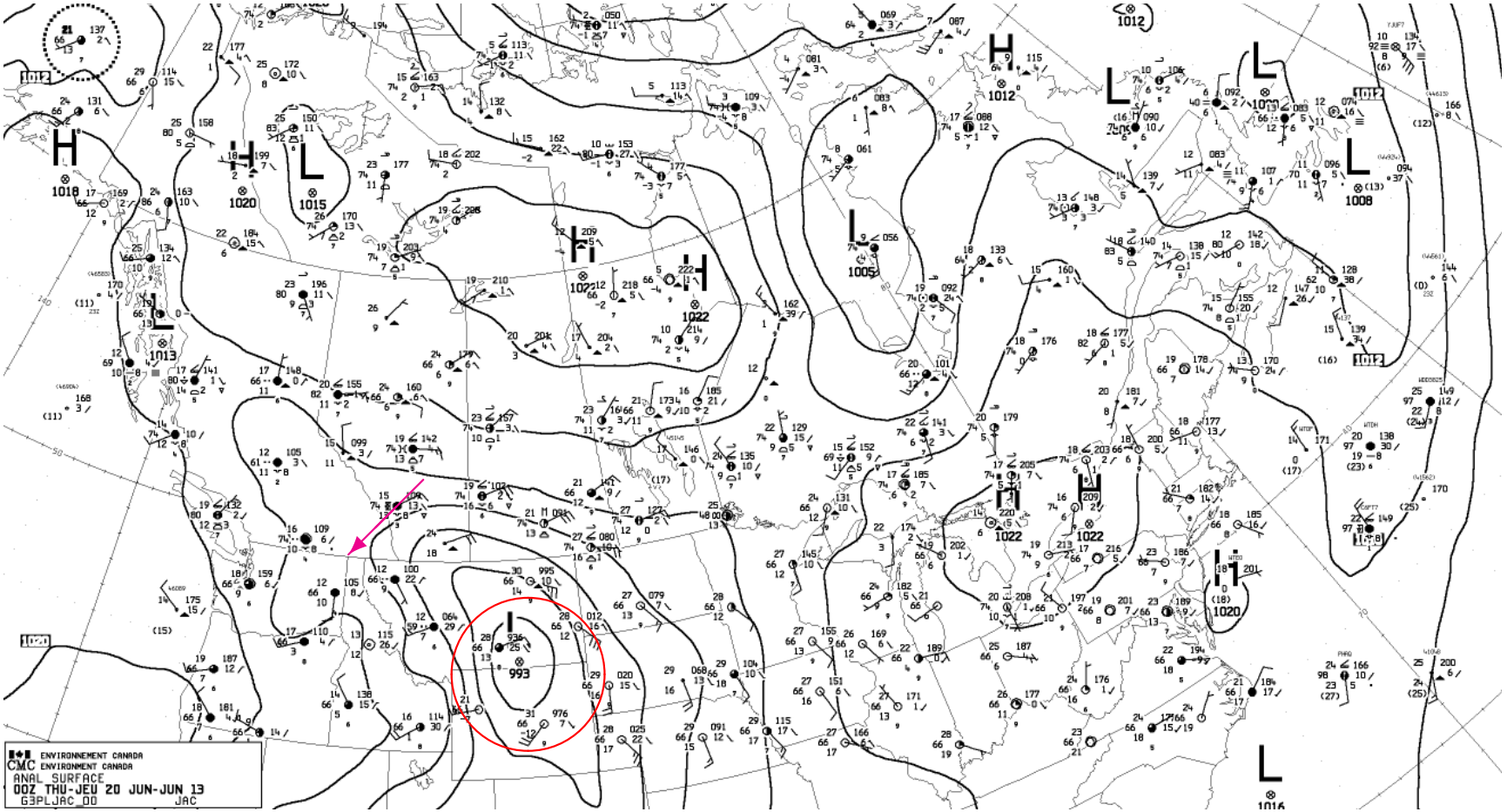
- Low pressure system south of Idaho.
- North-weasterly flow on the lee side of the Rocky Mountains.

1200 UTC 19 June 2013 - Surface Analysis



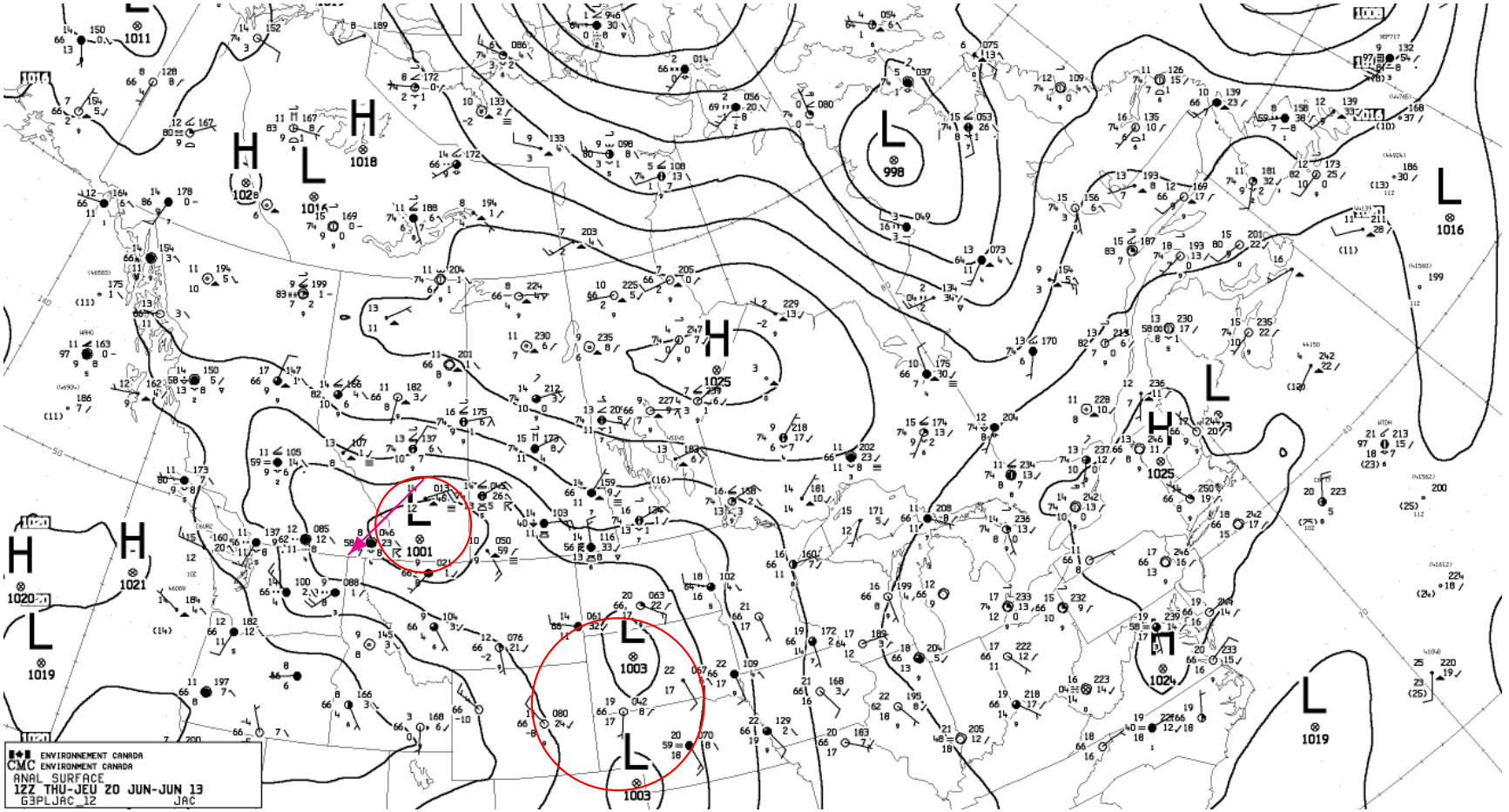
- Low pressure system $\rightarrow$ deepened + propagated Northward
- Wind shifted $\rightarrow$ South-easterly

0000 UTC 20 June 2013 - Surface Analysis



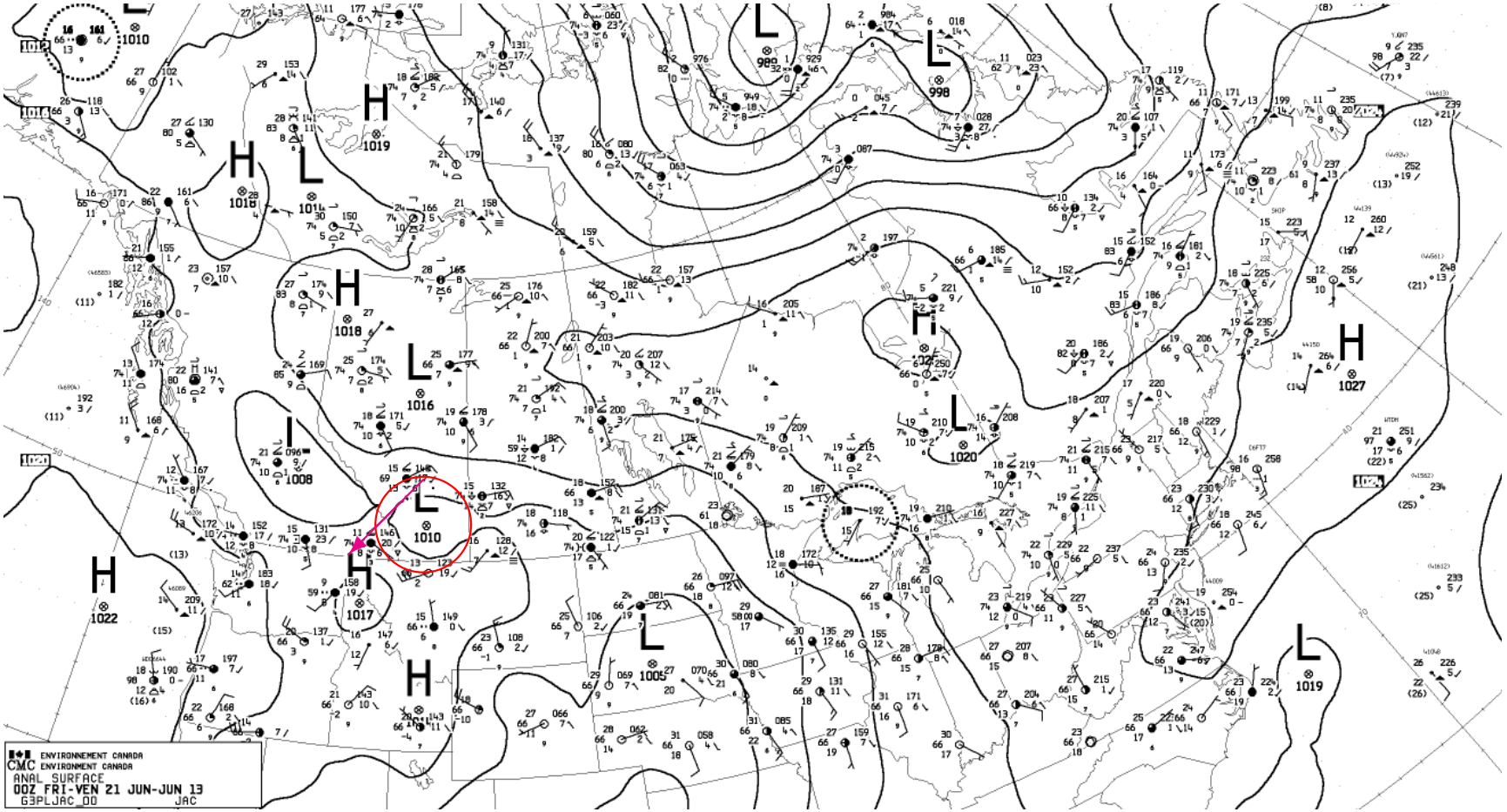
- Low pressure system $\rightarrow$ deepened + propagated Eastward
- Wind shifted $\rightarrow$ North-easterly [Precipitation started]

1200 UTC 20 June 2013 - Surface Analysis



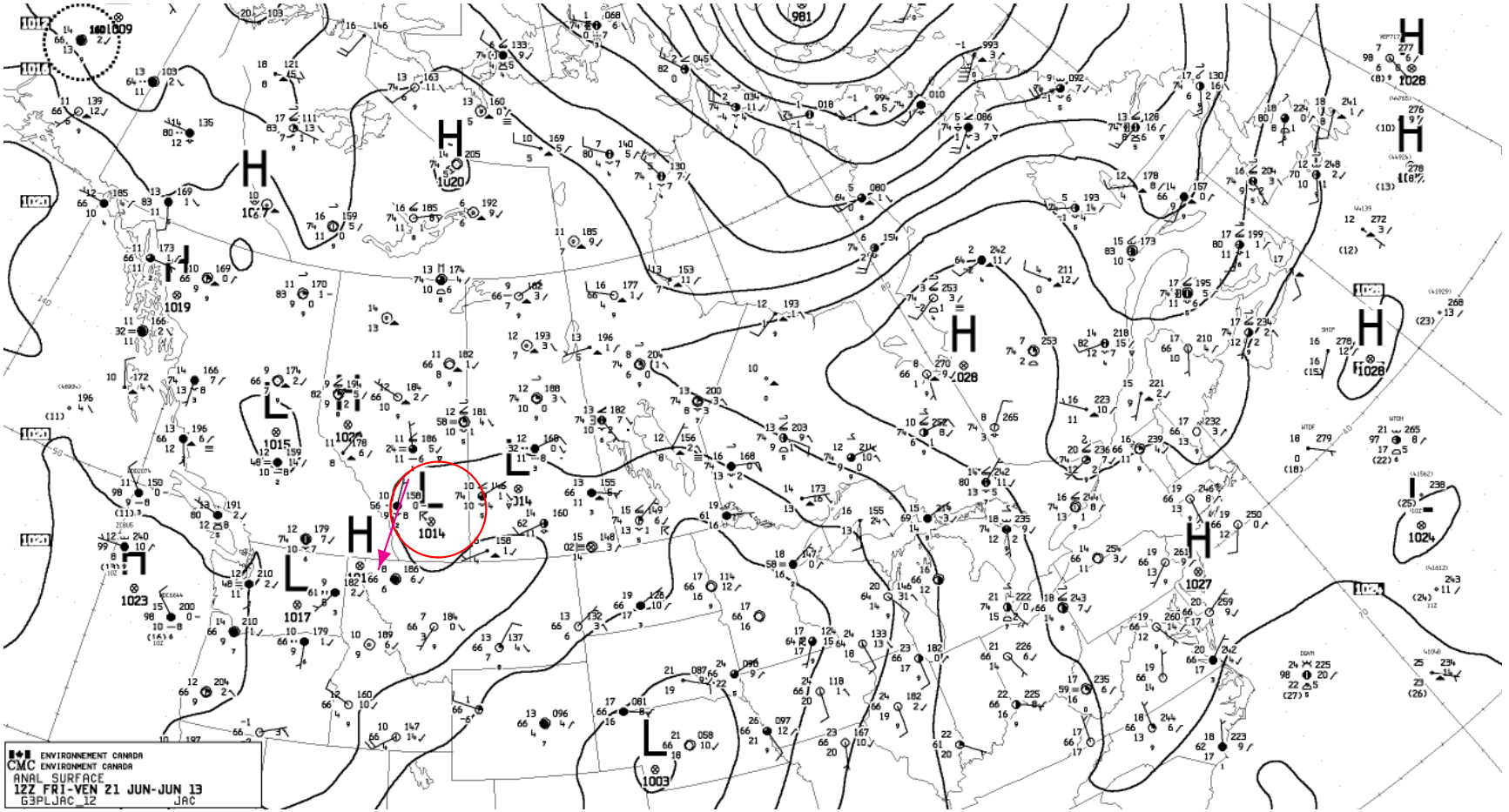
- Low pressure system split in 2 $\rightarrow$ one located Southeast Alberta
- North-easterly wind [Heaviest precipitation : 0000-0600 UTC]

0000 UTC 21 June 2013 - Surface Analysis



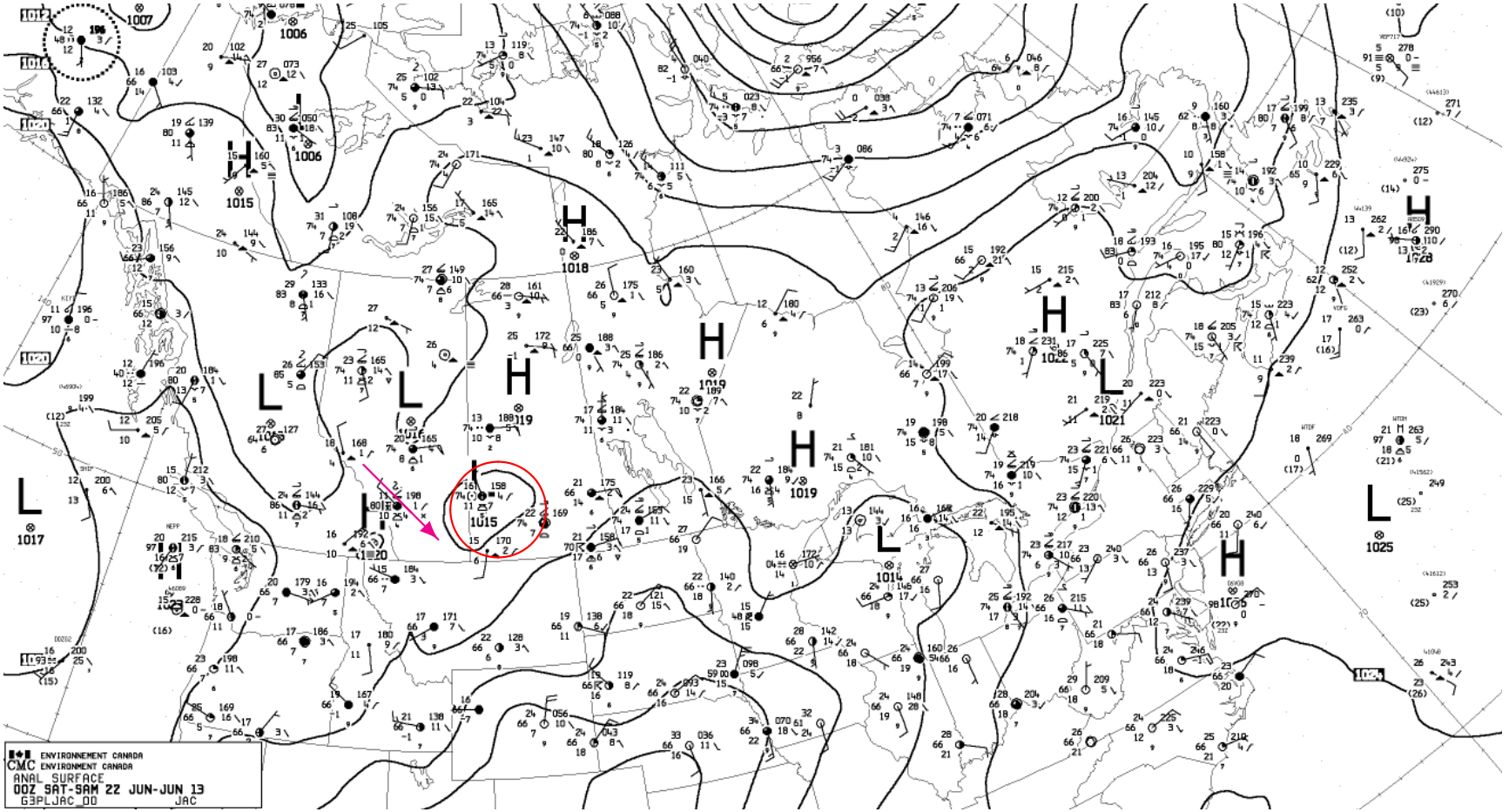
- Low pressure system located Southeast Alberta
- North-easterly wind

1200 UTC 21 June 2013 - Surface Analysis



- Low pressure system weaken $\rightarrow$ synoptic forcing decreased aloft
- Wind shifted $\rightarrow$ Northerly

0000 UTC 22 June 2013 - Surface Analysis

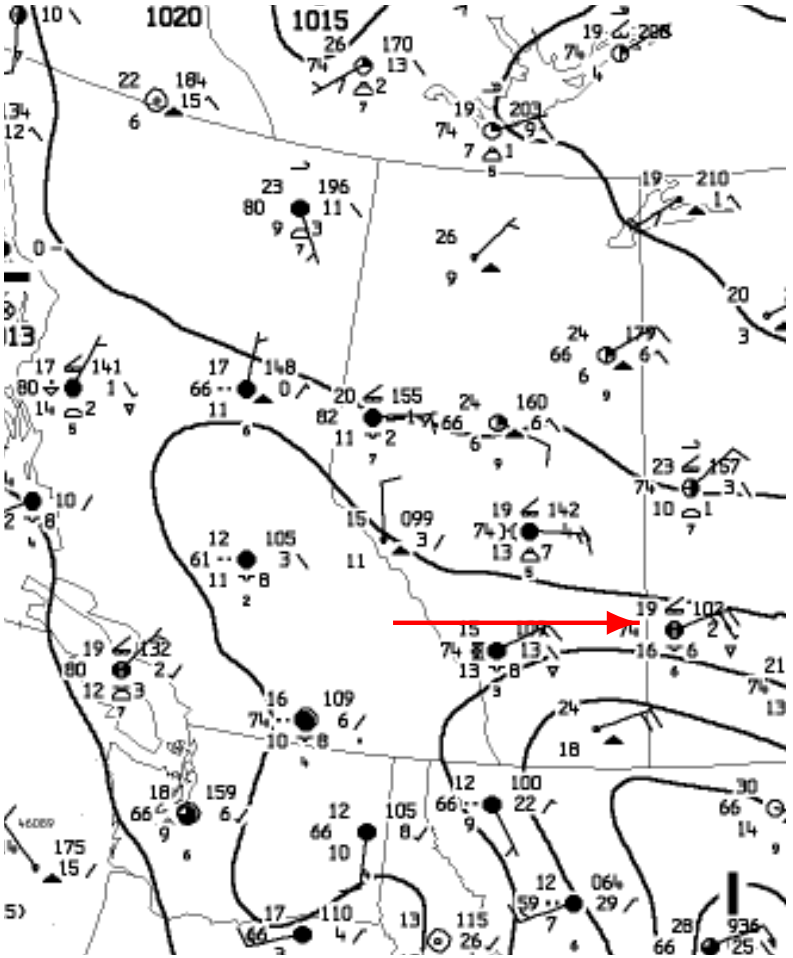


- Low pressure system weaken → synoptic forcing decreased aloft
- Wind shifted → Northwesterly

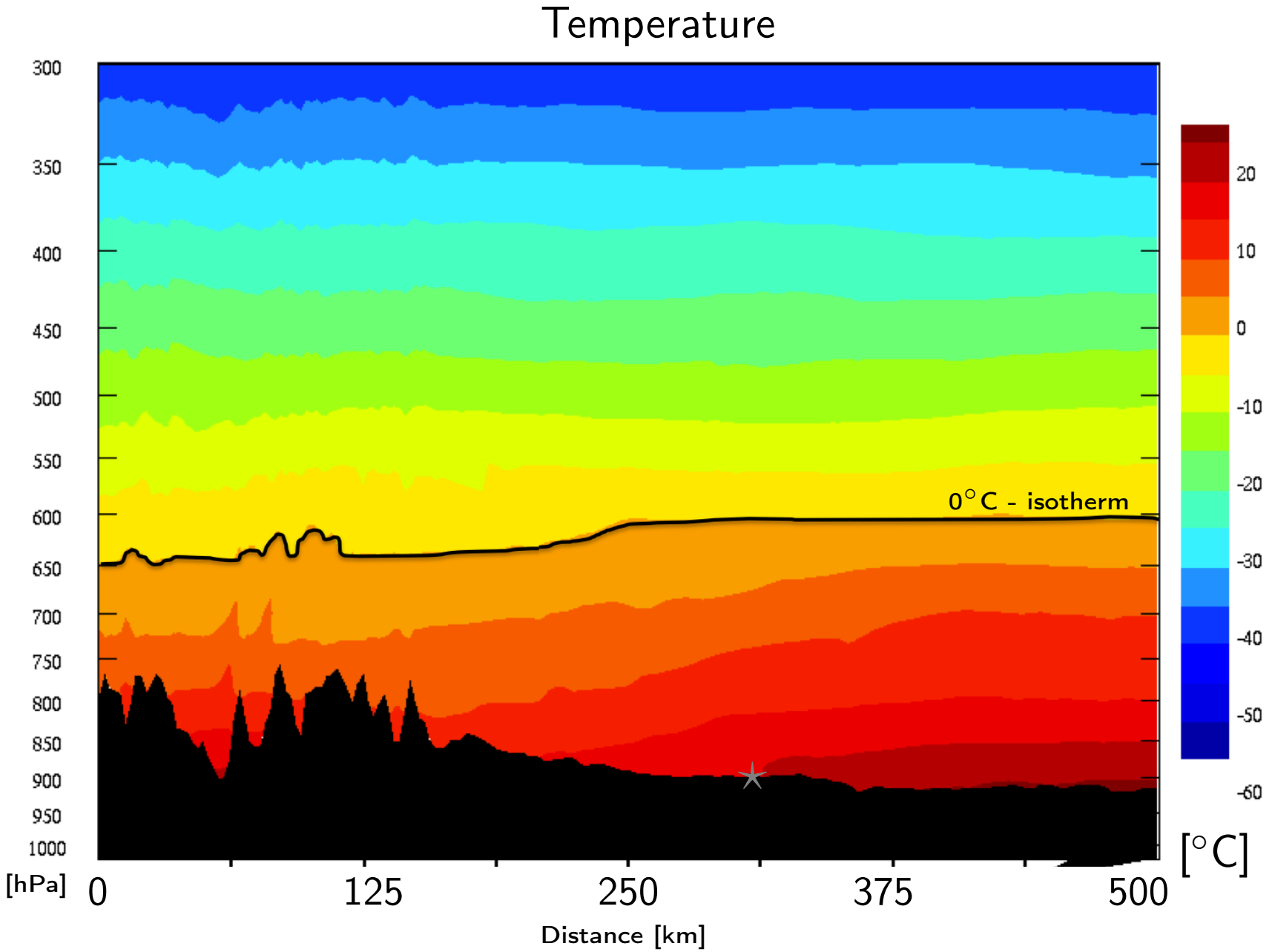
Temperature and precipitation type fields

- Used GEM LAM 2.5 km forecasts
- Analyzed vertical cross-sections along the lee side of the mountain
  - Evolution of the 0°C-isotherm and precipitation type formed
  - Focused at 0000-0600 UTC where the heaviest precipitation was recorded
- Compared precipitation fields with radar reflectivity

Location of the vertical cross-section



GEM LAM 2.5 km - 18 h forecast valid at 0000 UTC 20 june 2013



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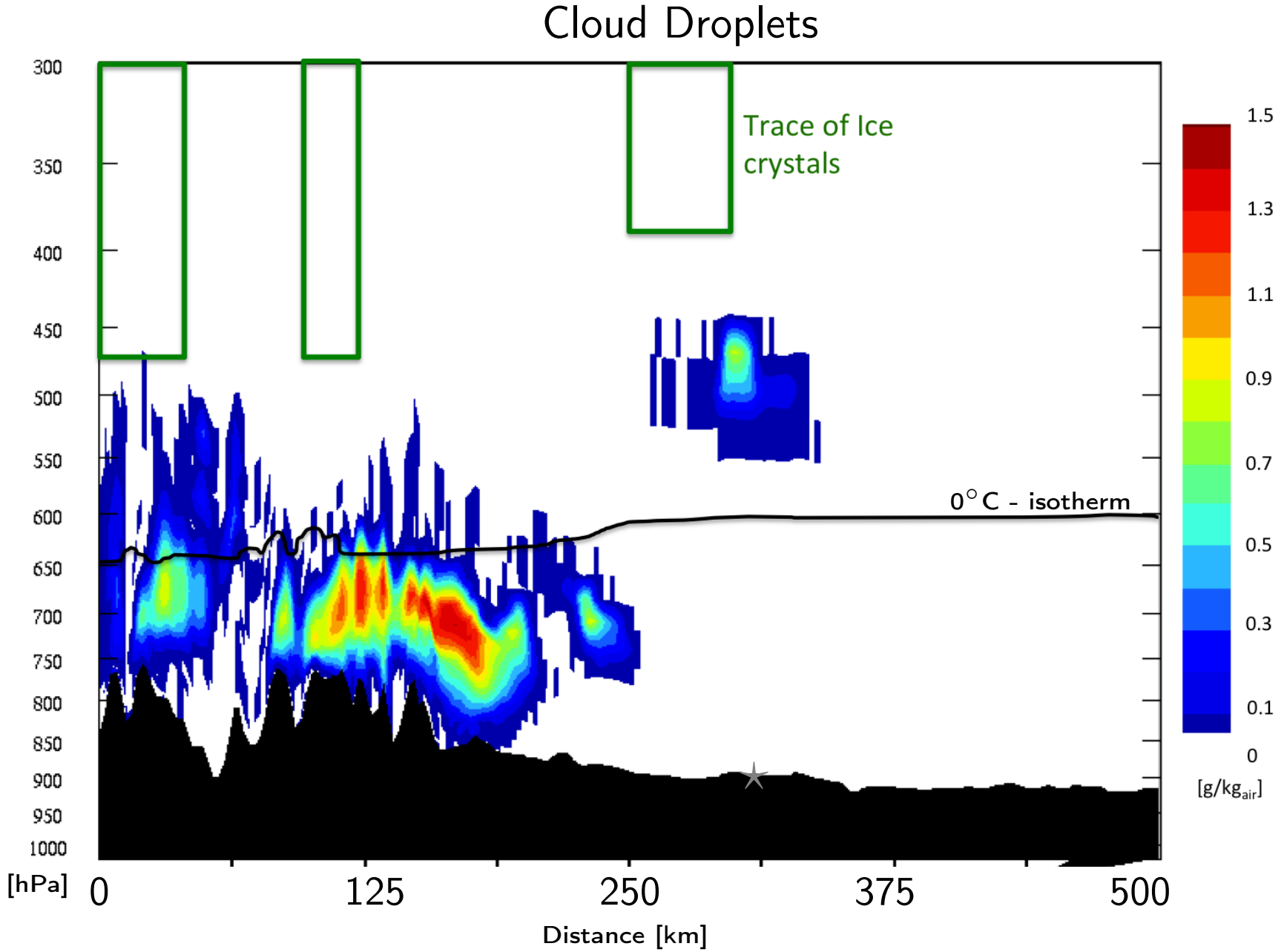
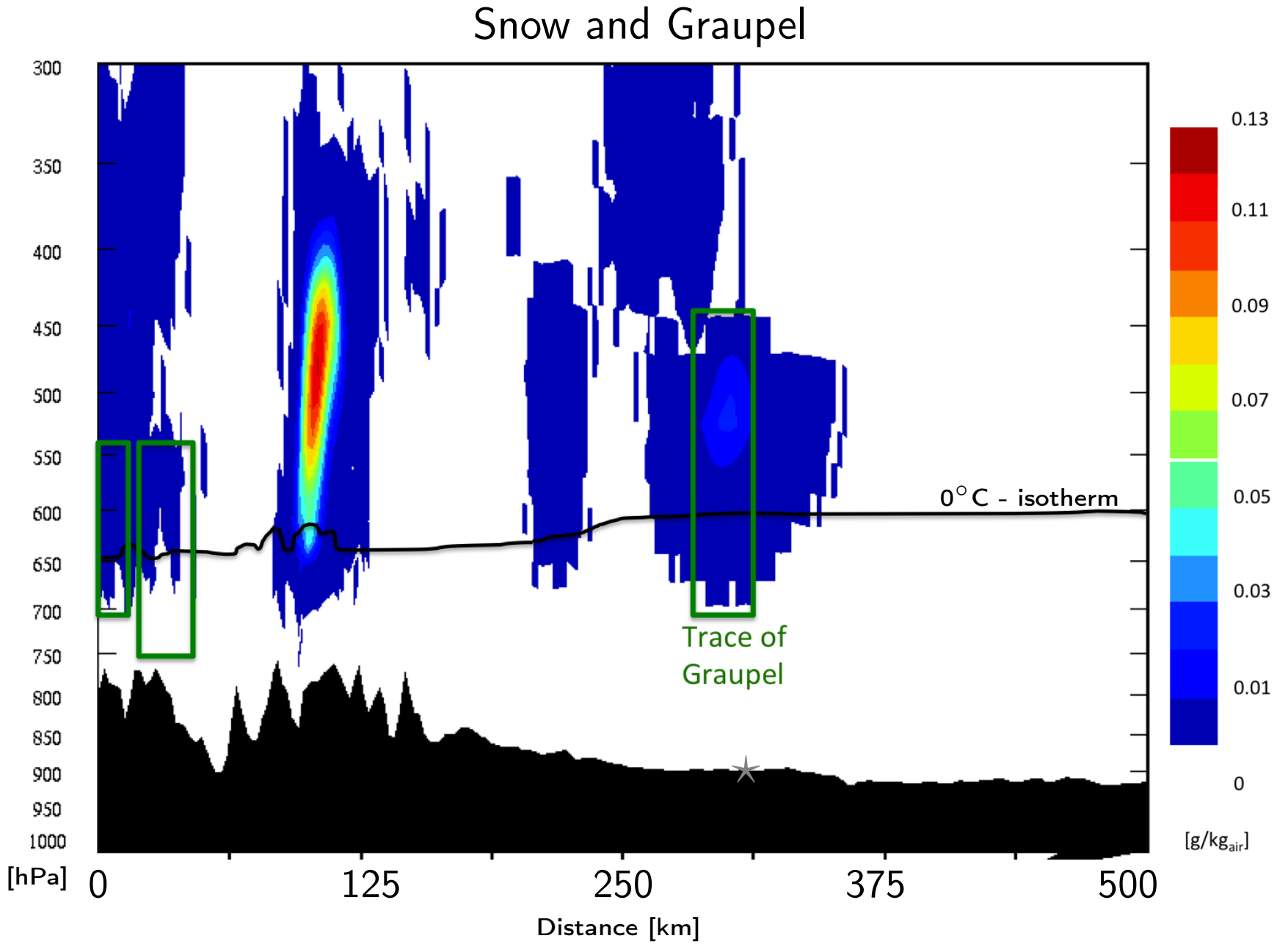
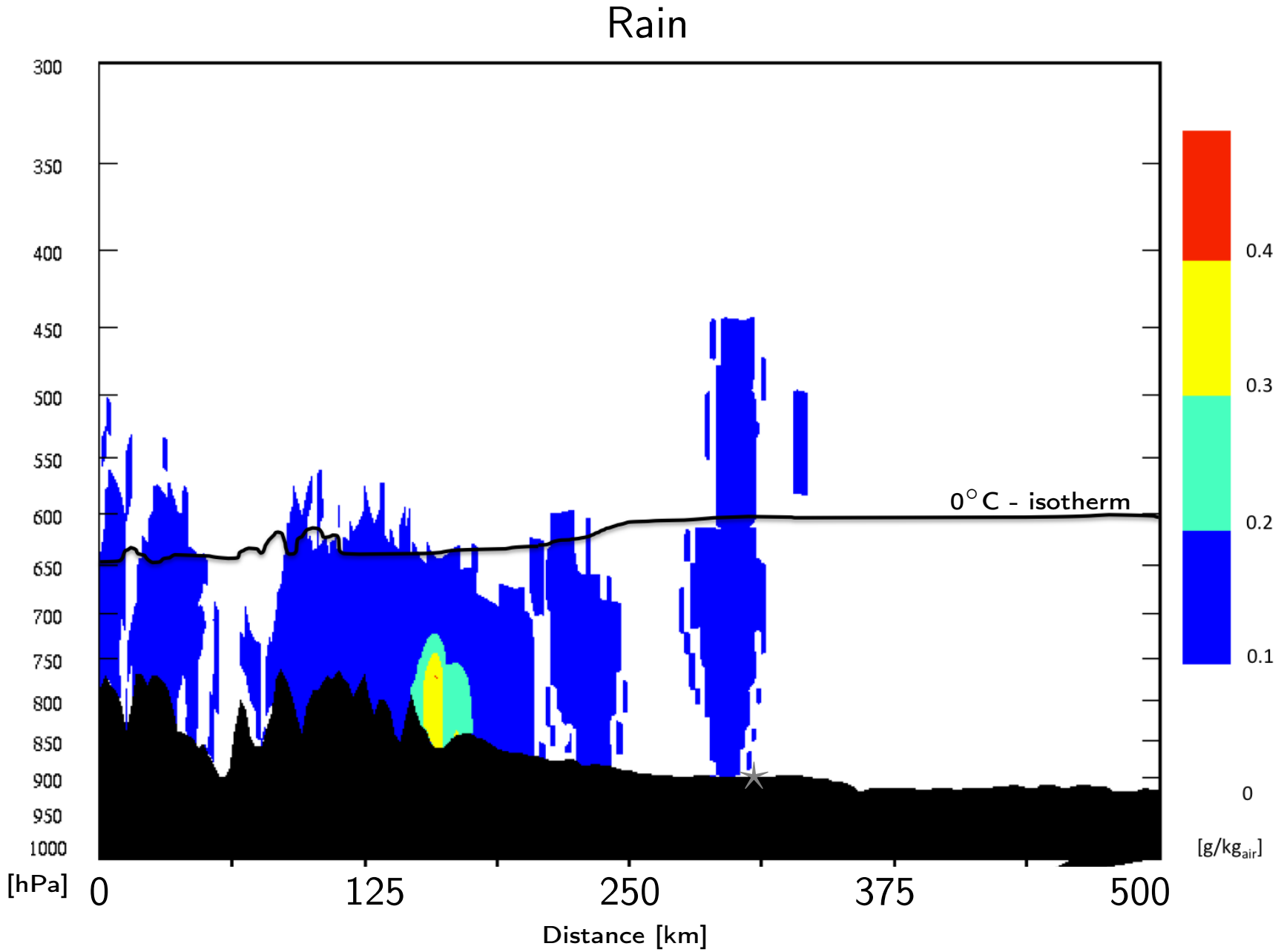


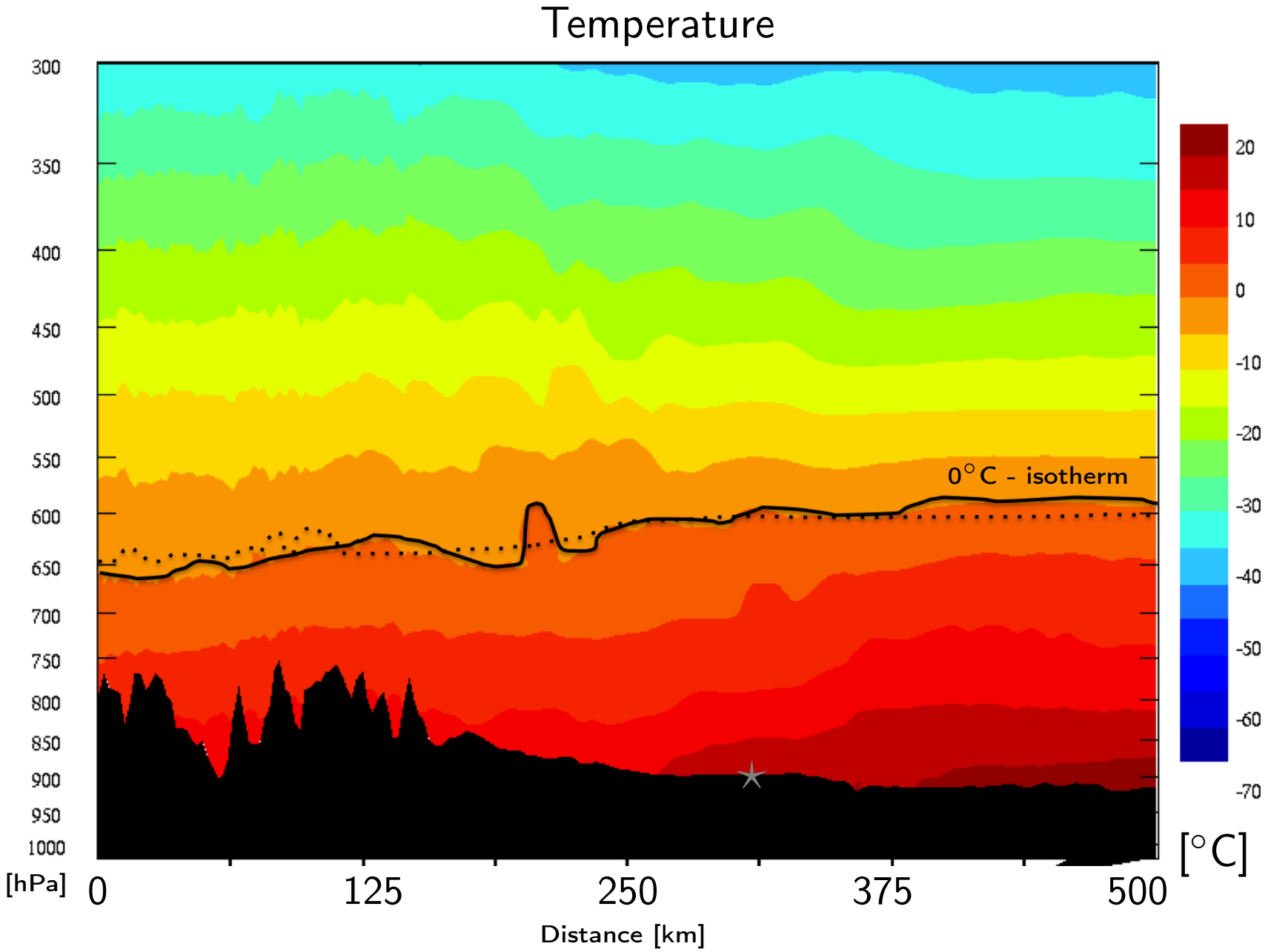
GEM LAM 2.5 km - 18 h forecast valid at 0000 UTC 20 june 2013



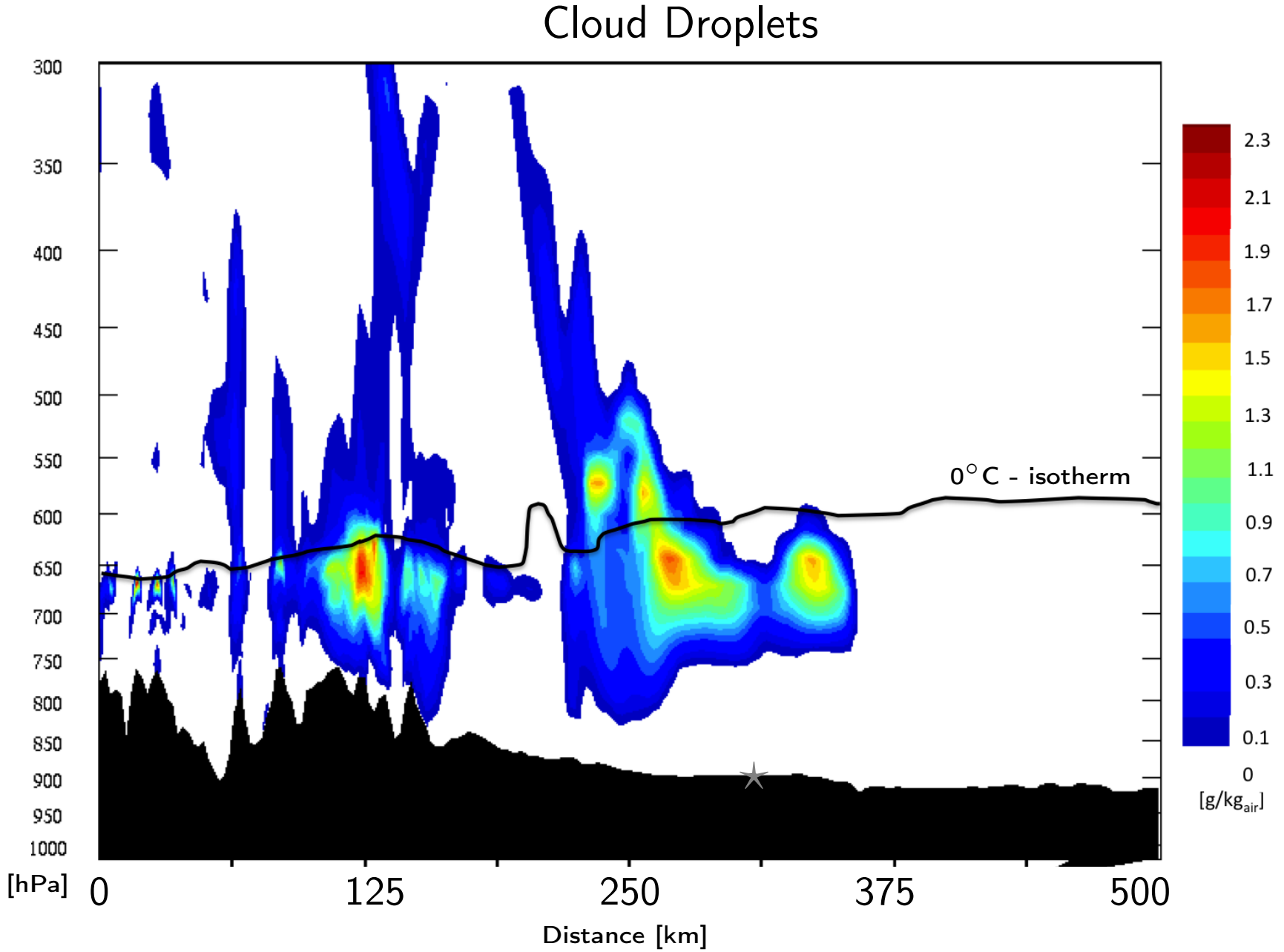
GEM LAM 2.5 km - 18 h forecast valid at 0000 UTC 20 june 2013



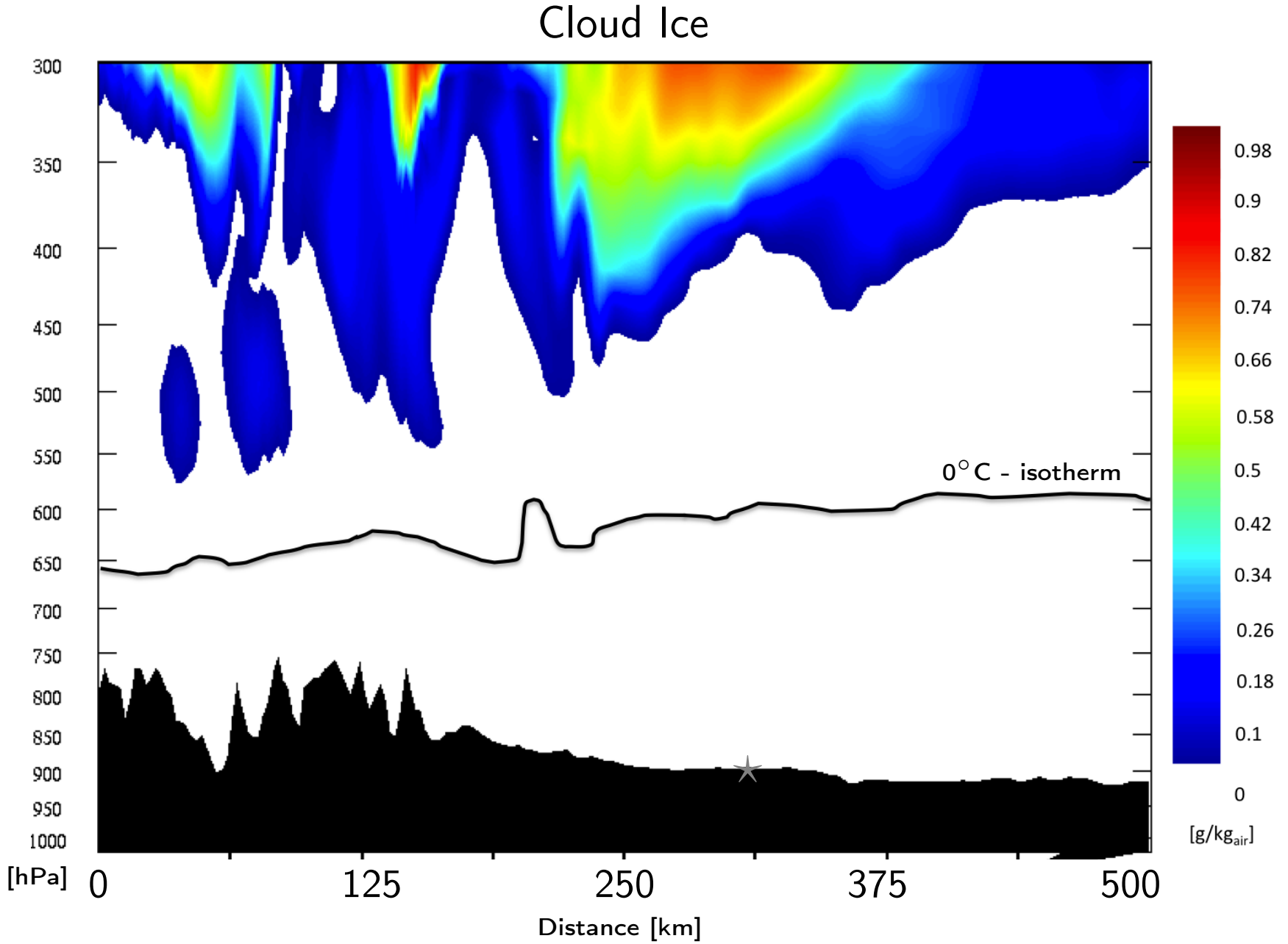
GEM LAM 2.5 km - 24 h forecast valid at 0600 UTC 20 june 2013



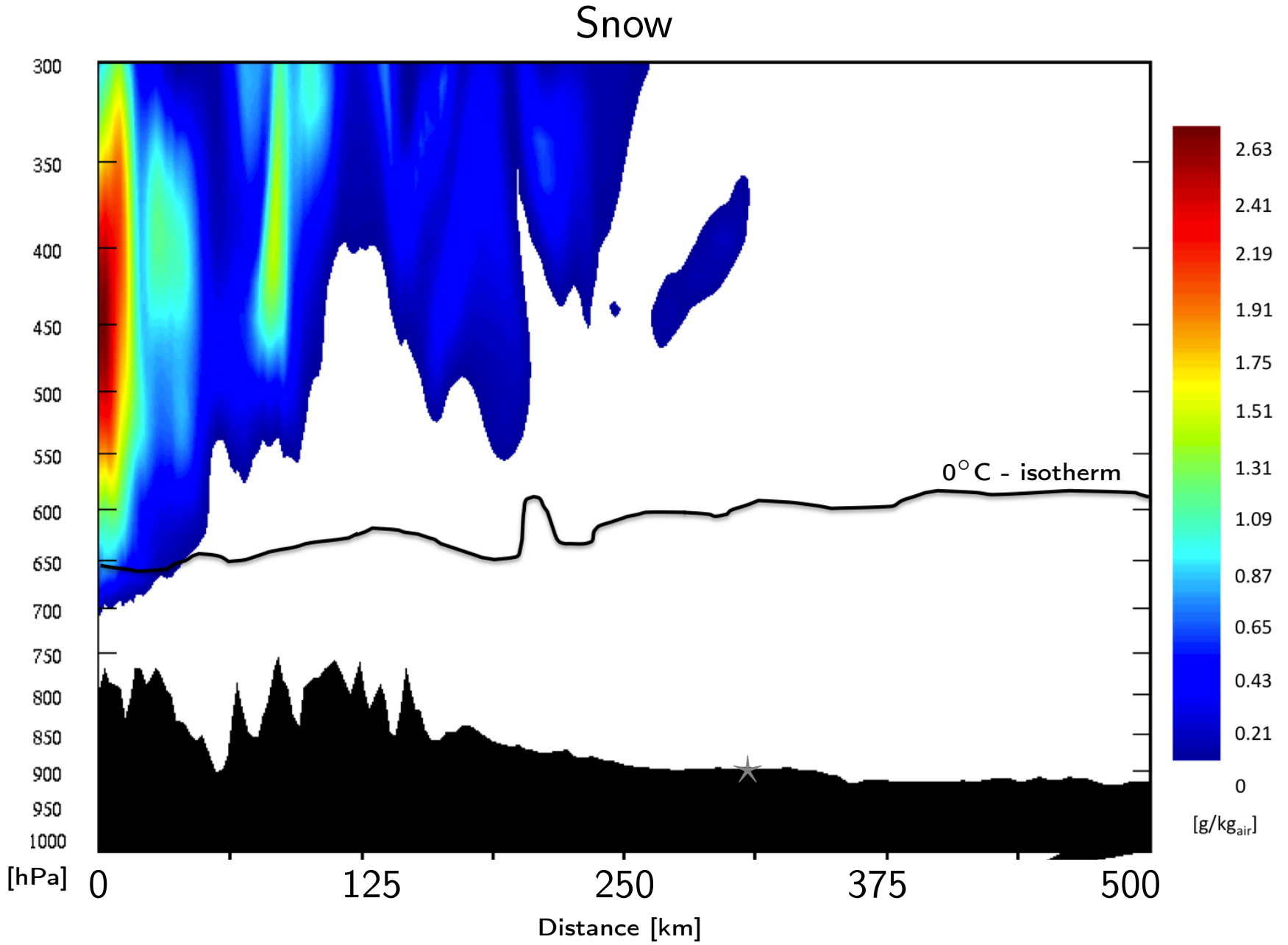
GEM LAM 2.5 km - 24 h forecast valid at 0600 UTC 20 june 2013



GEM LAM 2.5 km - 24 h forecast valid at 0600 UTC 20 june 2013



GEM LAM 2.5 km - 24 h forecast valid at 0600 UTC 20 june 2013



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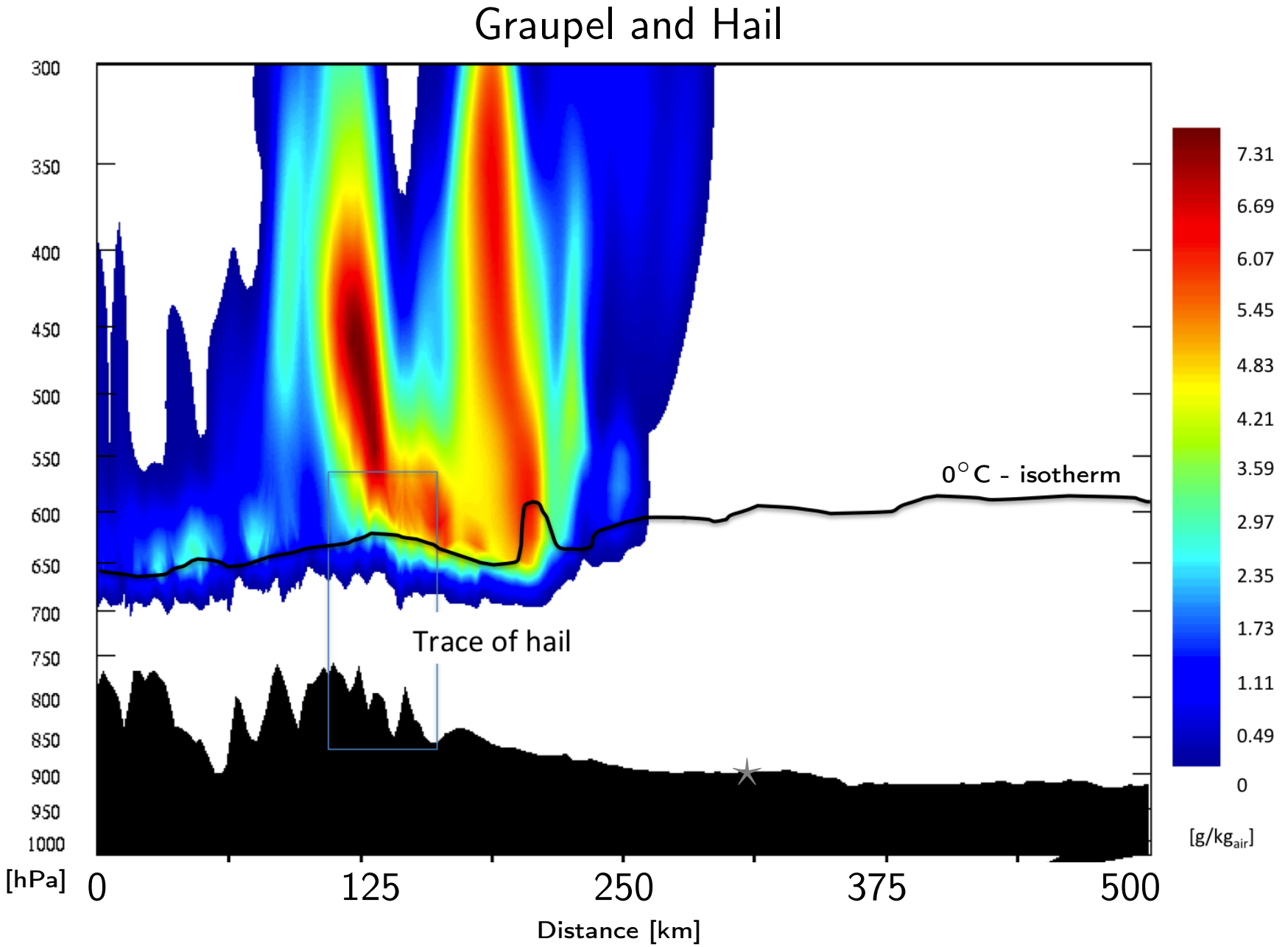

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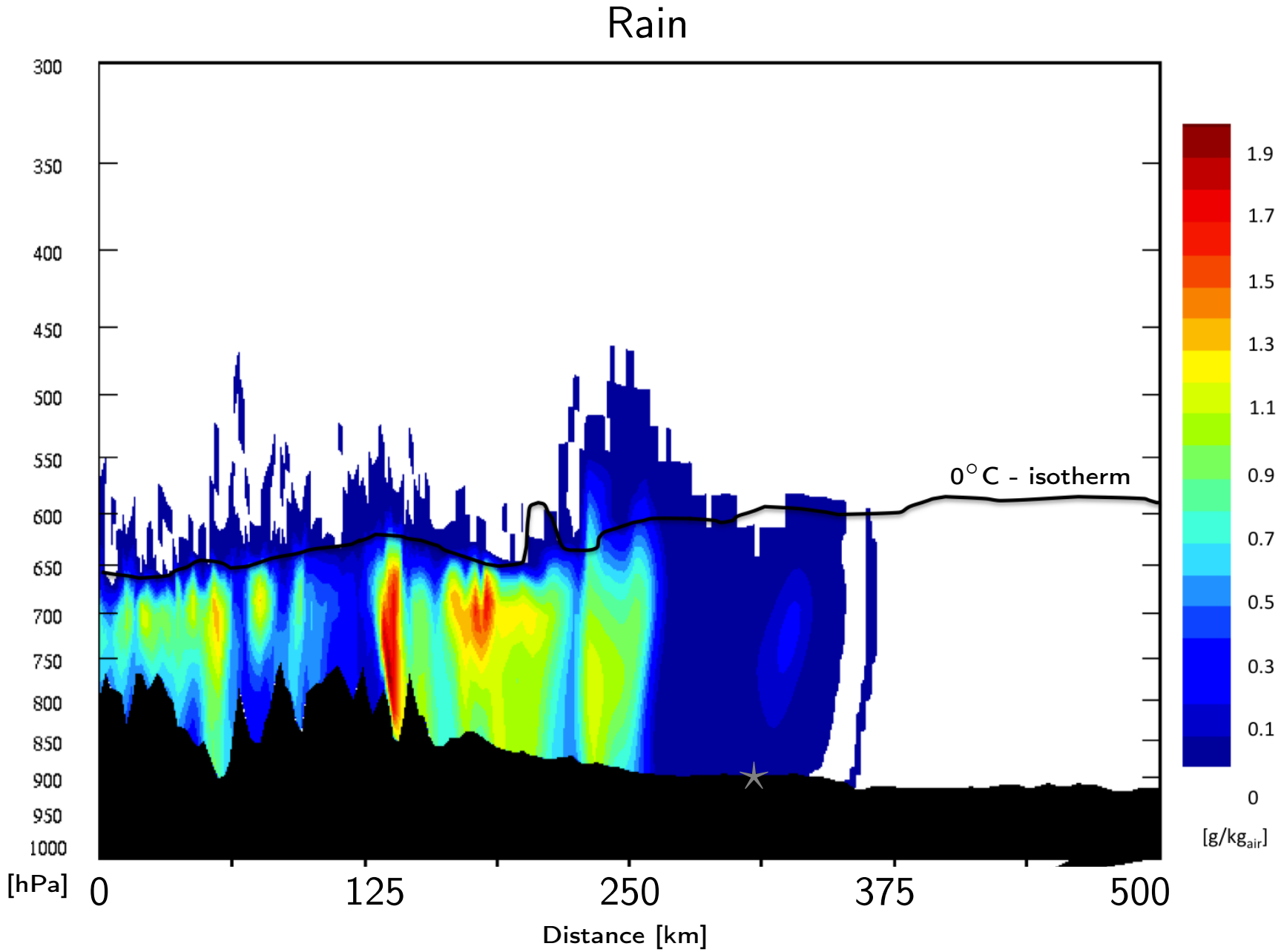
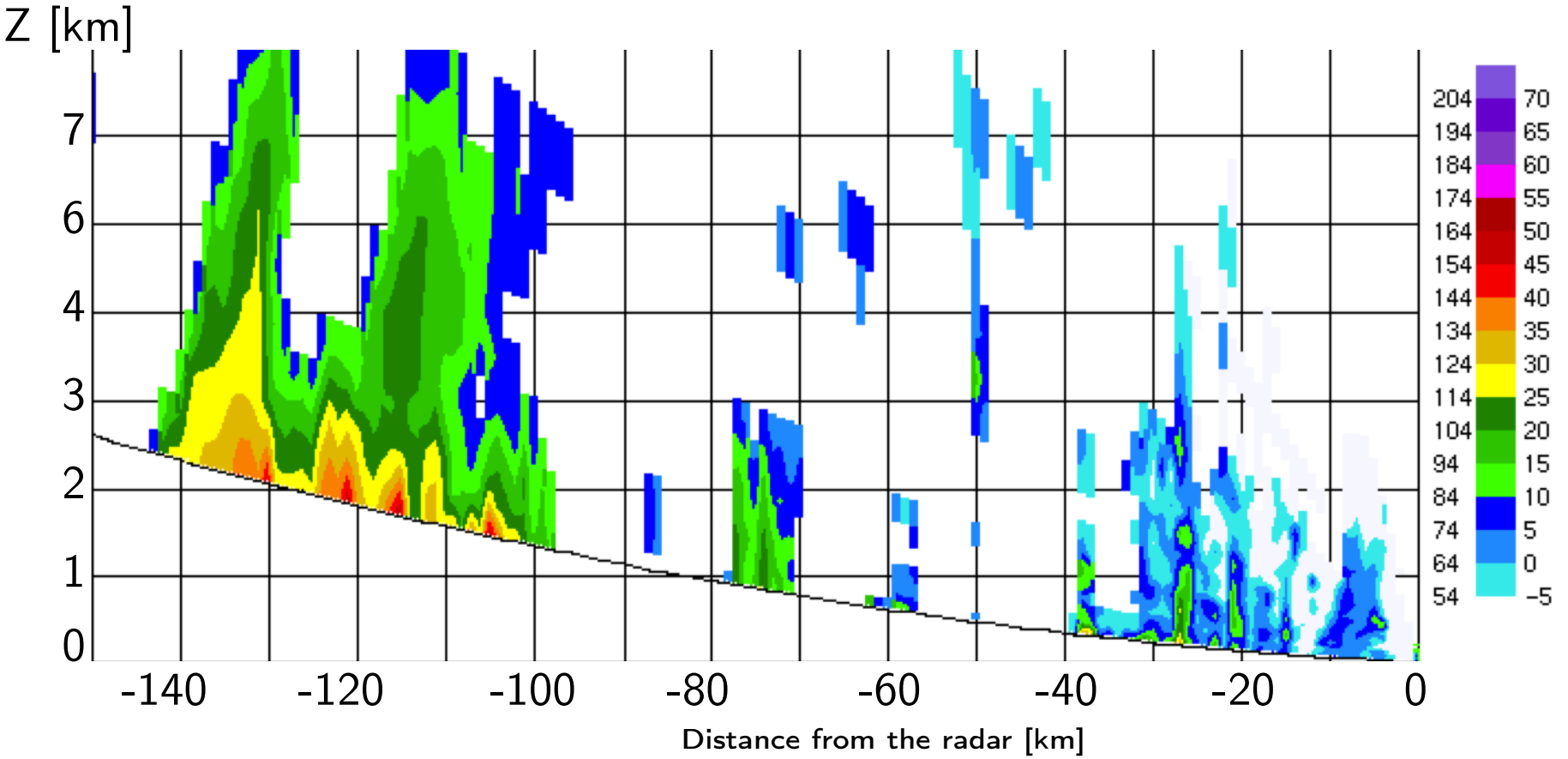


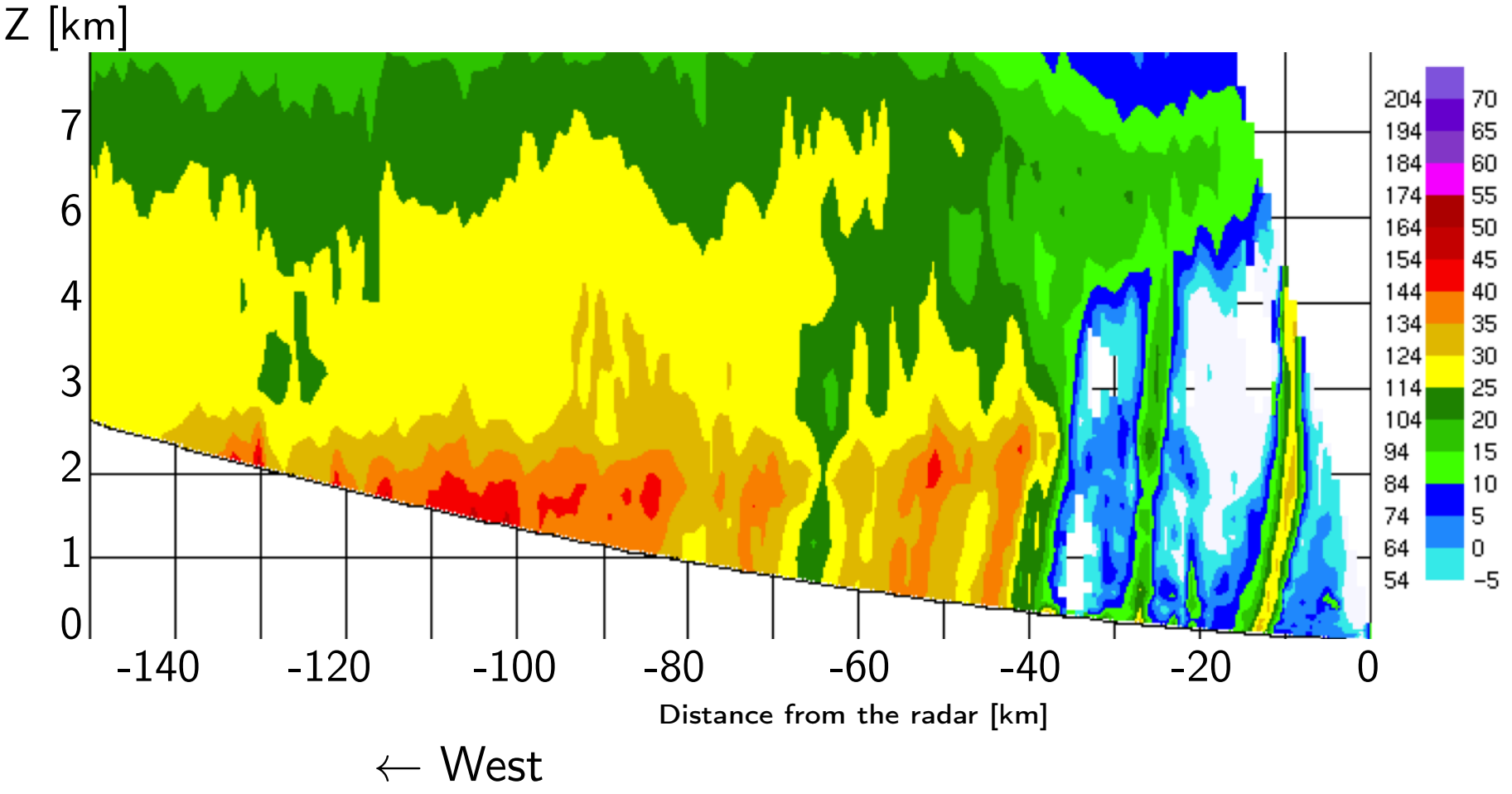
Comparison with Radar Reflectivity – 0000 UTC



← West

- High reflectivity values over the mountain - rain and cloud droplets were forecasted by the model

Comparison with Radar Reflectivity – 0600 UTC



- Precipitation is present along the mountainside - rain, snow and graupel were forecasted by the model

Preliminary conclusions

Climatology

- The maximum accumulated precipitation recorded in both Banff and Calgary was in June 2005 [Calgary : 9 days $>$ 10 mm and 4 days $>$ 20 mm].
- During the June 2013 event, accumulated precipitation from June 18-22 was more than monthly average.

Weather conditions

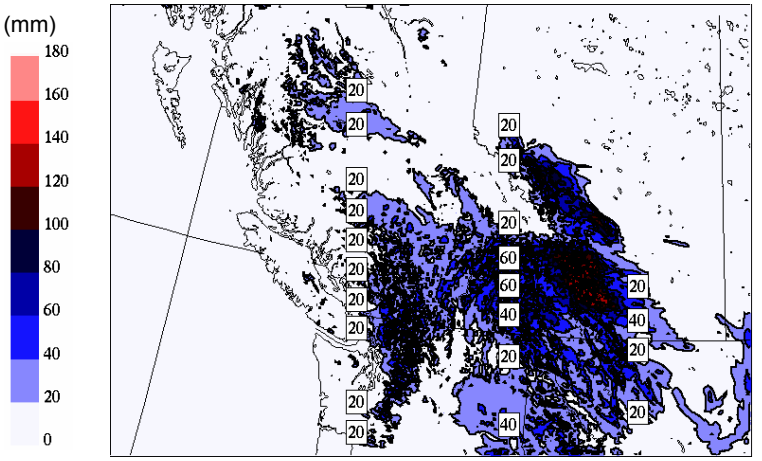
- Large scale forcing aloft produced favorable conditions for the formation of a surface low pressure system that produced upslope flow that persisted for 36 h.
- The height of the 0°C-isotherm stayed at 650 hPa during the event, which allowed complete melting of precipitation before reaching the surface.
- GEM LAM suggested rain at lower elevation and snow at higher elevation at 0000 UTC. The upslope flow produced cloud droplets that enhanced the conversion from snow to graupel.
- The location of maximum in radar reflectivity values correlated with the precipitation fields.

Questions

- Does the GEM-LAM 2.5 km forecasted the storm/flood accurately ? If not, what was missing and why ?

- What is the relative role of the other factors such as seasonal snow accumulation, height of the 0°C-isotherm, location of the snow-line on the severity of that event ?

- How comparable was this event to other major event (June 2005, 2002) ?



24 hours rainfall accumulation SHDPS forecasts valid for June 20

From J. Milbrandt and M. Vallée