

Torrential Rains and Flash Flooding in Québec's Outaouais Region on June 23-24th 2011

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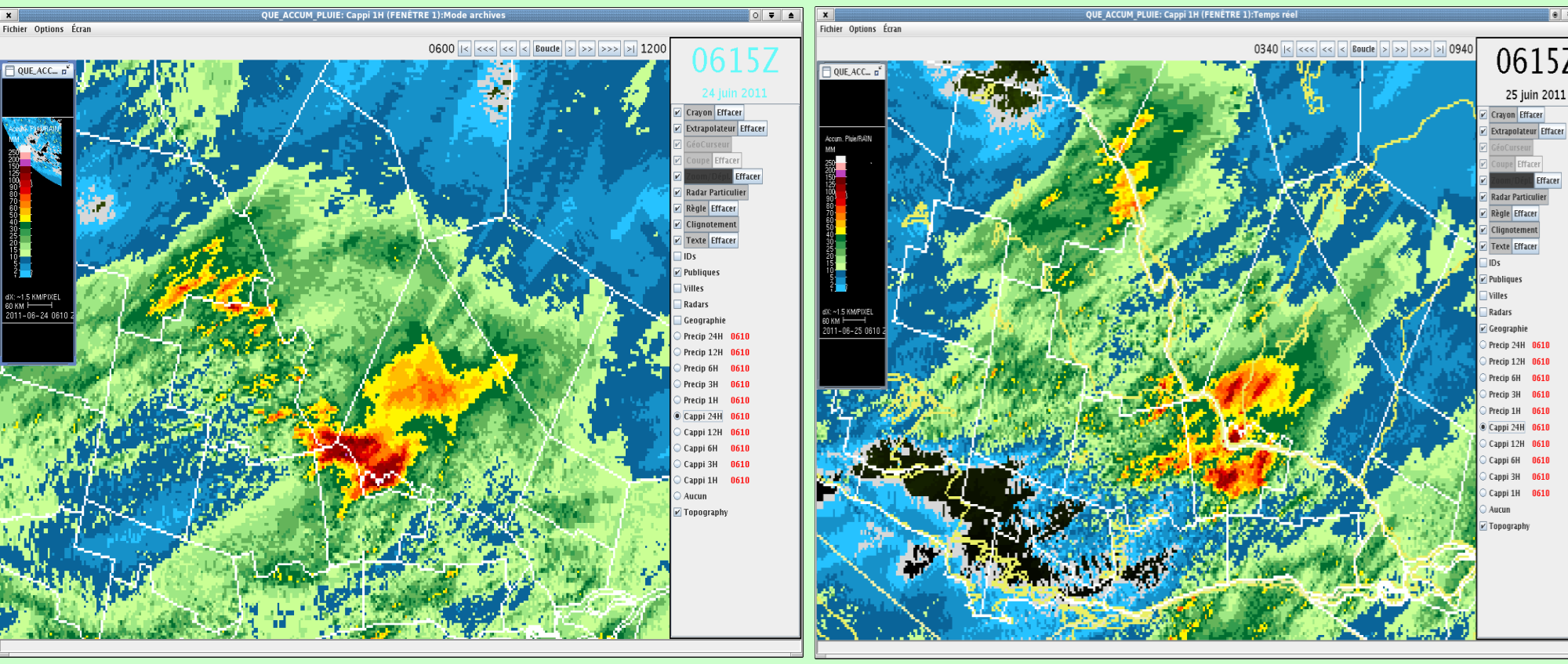
Environnement Canada Environment Canada

Summary of Events

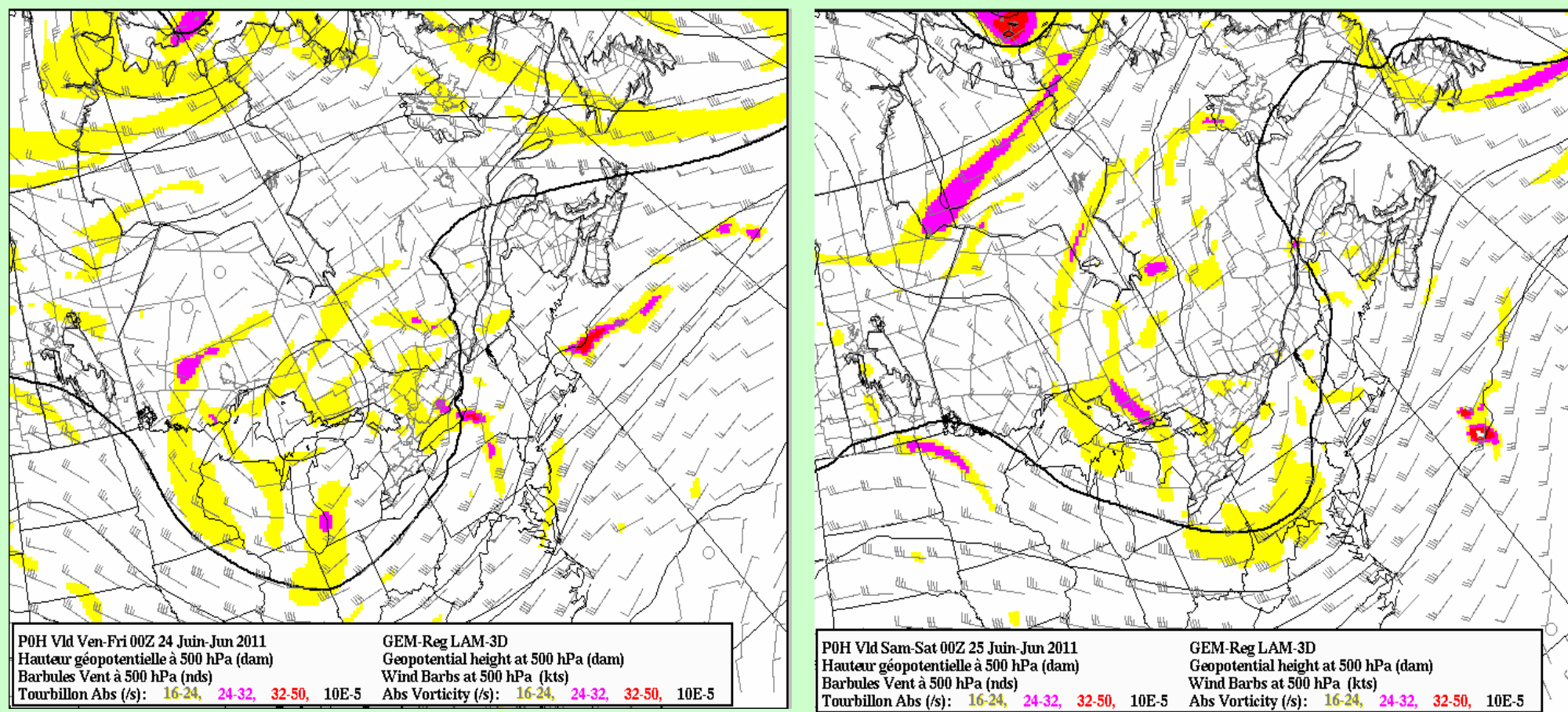
- A series of moisture charged thunderstorms affected a number of municipalities in Québec's Outaouais region along the Ottawa River Valley, including the City of Gatineau, Chelsea, Cantley and Pontiac.
- The first line of thunderstorms happened in the evening of June 23rd and the second line of thunderstorms hit the same region in the afternoon and evening of June 24th.
- According to Québec civil security, 23 landslides occurred in the municipalities of Chelsea, Cantley and Gatineau.
- Flooding closed highway 148 between Gatineau and Pontiac in Luskville.
- 9 people had to be evacuated from their residences.



In total, close to 250 mm fell over certain sectors.
Radar accumulations for the events of June 23rd. (left)
Radar accumulations for the events of June 24th. (right)

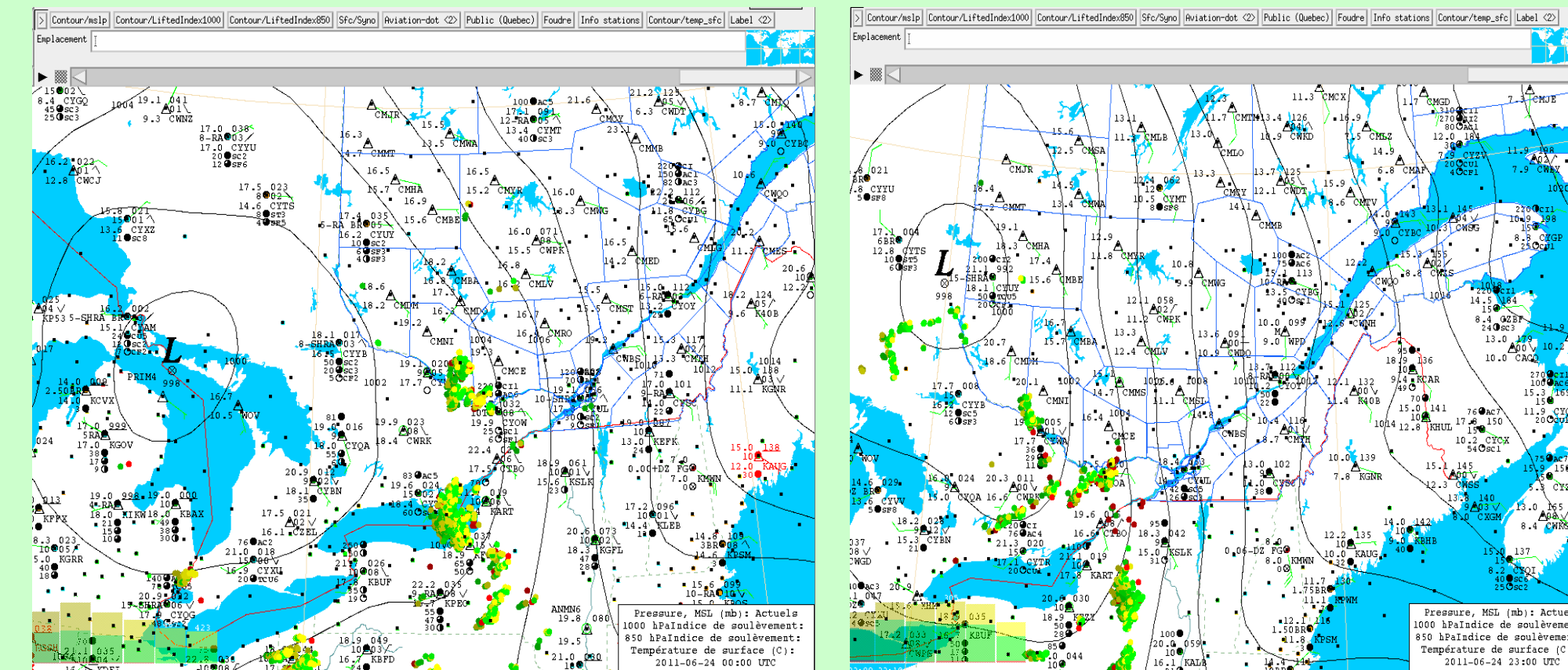


Using the Forecast Guide - 1



Slow moving weather system.

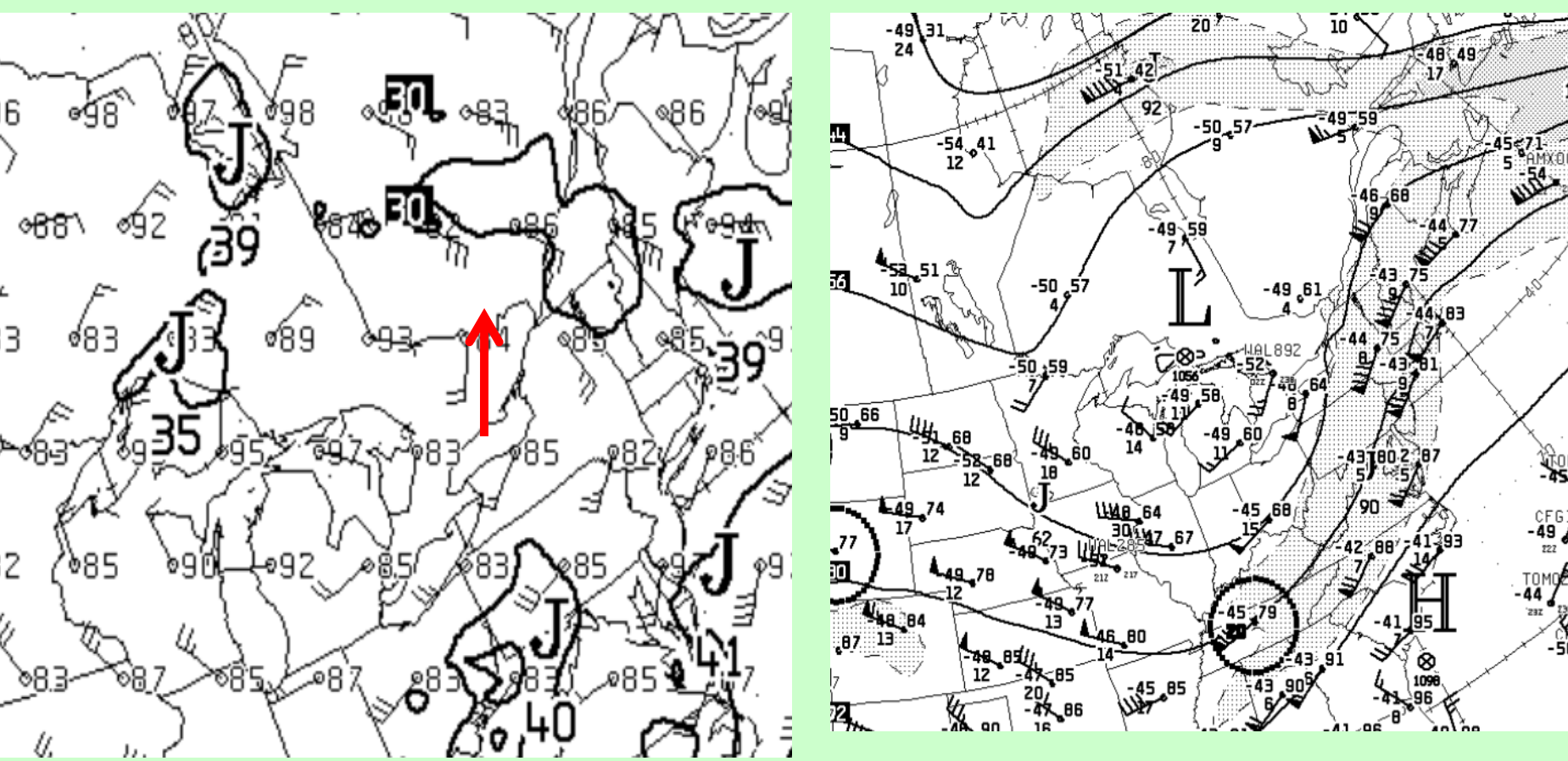
- There is little change in the system at 500 mb between the evenings of June 23rd (top left) and 24th (right).
- At the surface, the system only migrates slightly northward in 24 hours.



Forecasting Torrential Rain – The Operational Guide Used at the QSPC

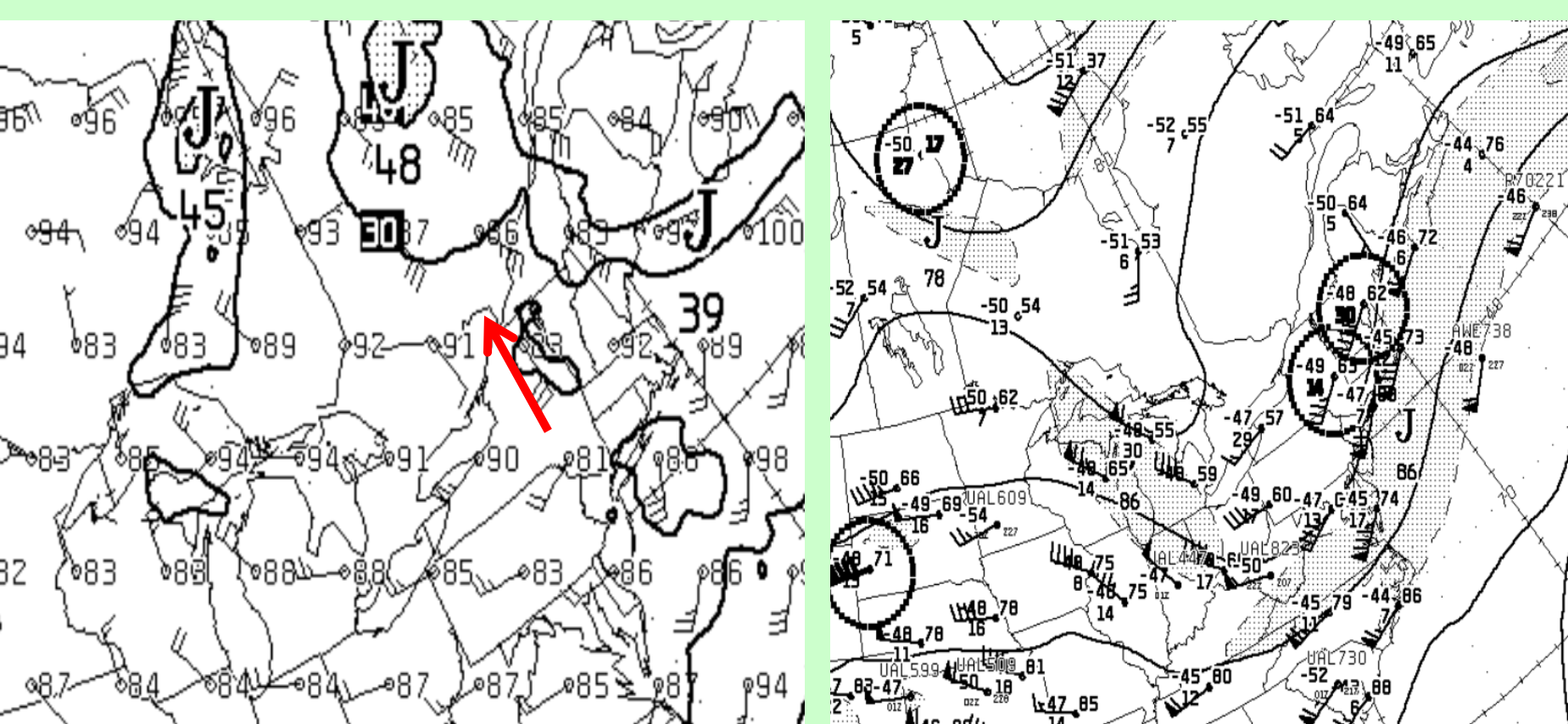
- In the Québec SPC we try to follow a forecast guide for torrential rain (TR) in the warm sector, defined as 50 mm or more in one hour. Since storms began and continued mostly in daylight hours, the daytime guide will be used.
- Conditions to look for:
 - A slow moving weather system
 - A moisture ridge with precipitable water greater than 35 mm.
 - CB generating an energy profile that is long and skinny
 - A K-index that is greater or equal to 34.
 - Weak to moderate wind shear.
 - A low level jet, it can be relatively weak, that is slow moving and cuts a trof or a thermal gradient.
 - Low level jet should be parallel or within 30 degrees of the upper level jet.
 - In the absence of a clear upper jet, look for low level convergence zones.

Using the Forecast Guide - 2

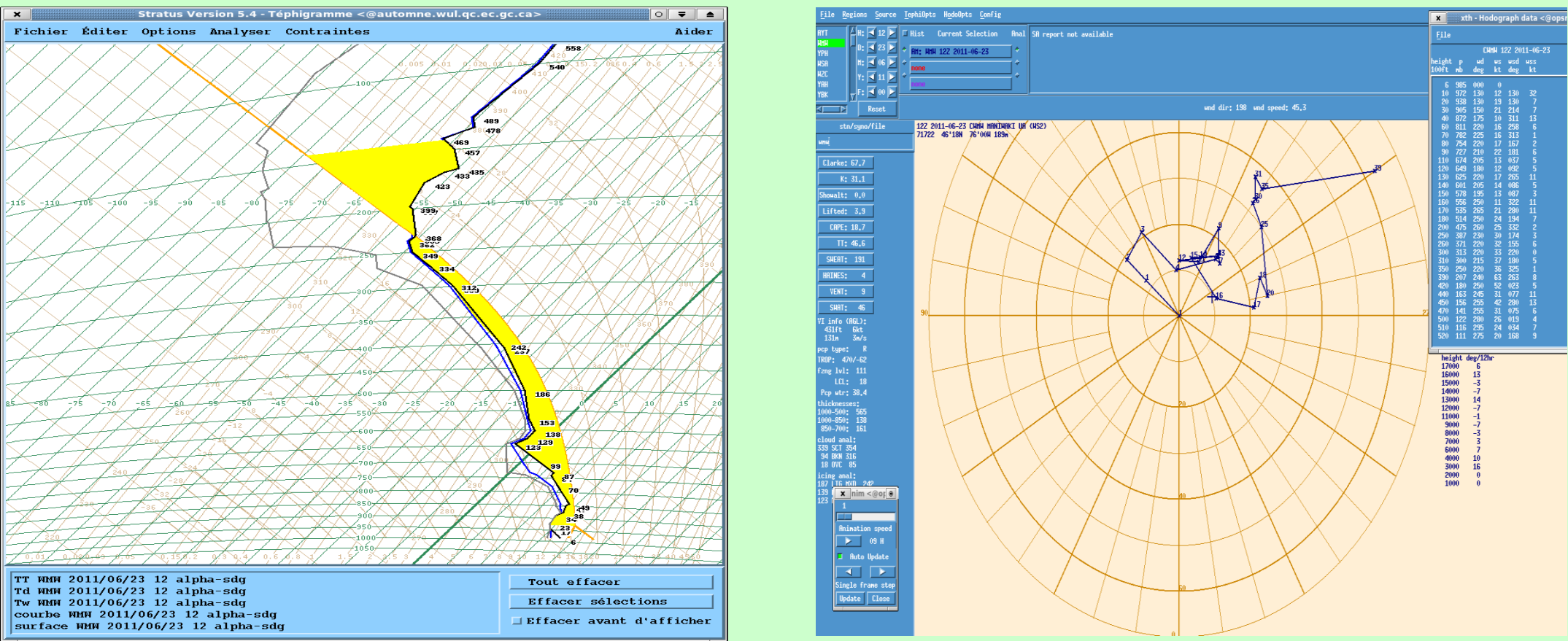


Slow moving and parallel jets

- At 00z on the 24th, we have a 20kt south-westerly LLJ (top left) near Ottawa, and it is fairly parallel to the ULJ at 250 mb (top right). GEM-REG 12Z 23 June 2011.
- On the 25th at 00z, both the LLJ (bottom left), and ULJ (bottom right) have migrated only slightly to the East. GEM-REG 12Z June 24 2011.

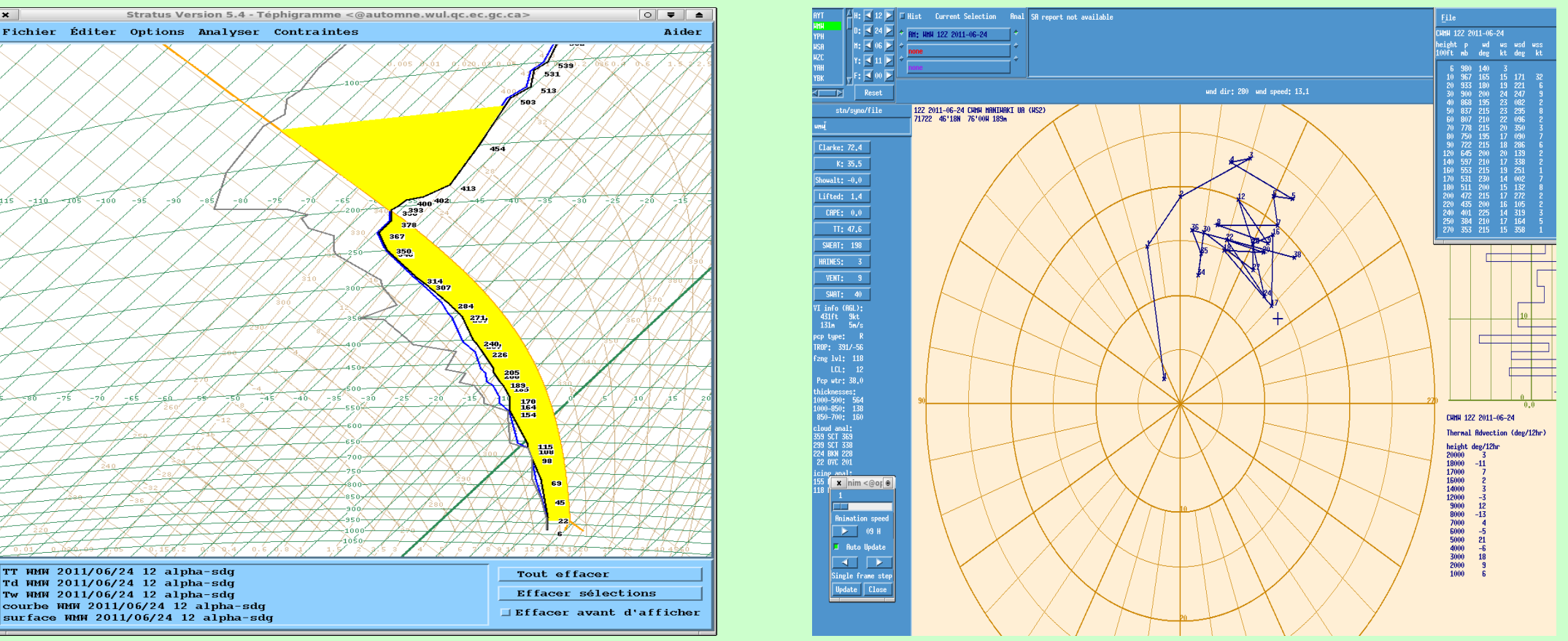


Using the Forecast Guide - 3

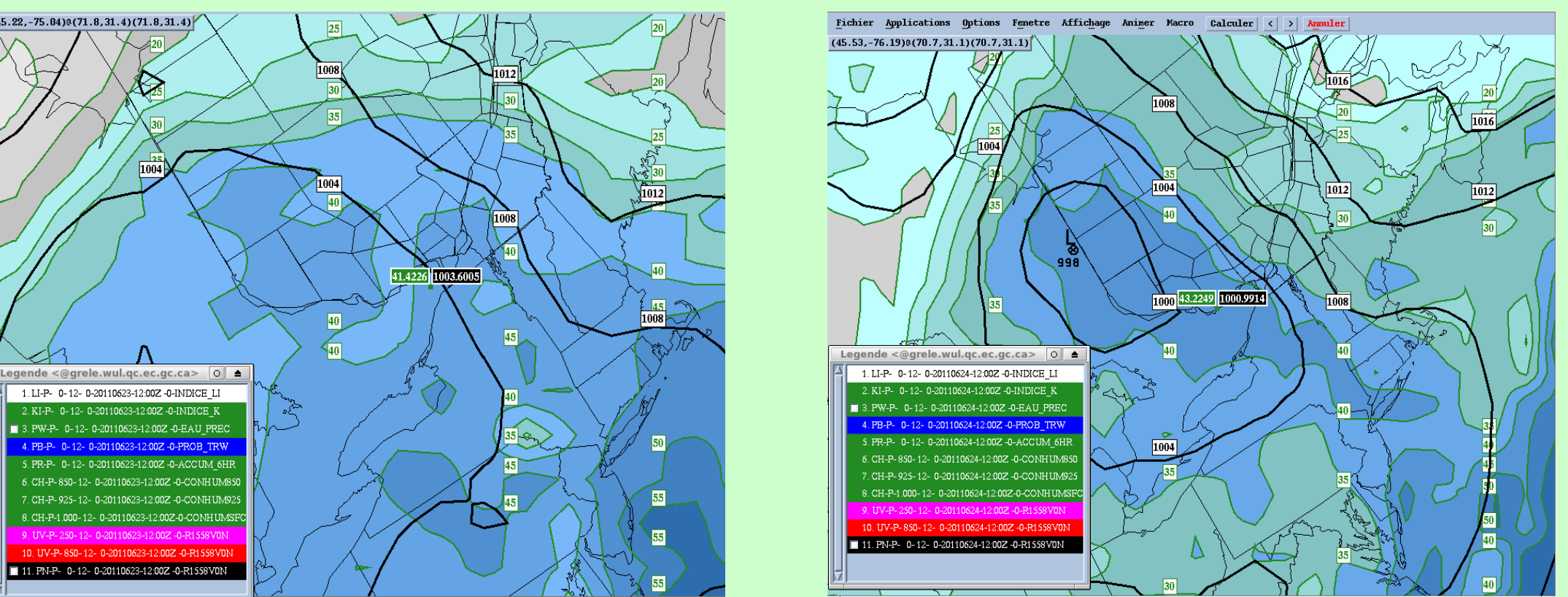


Energy profile and wind shear

- The modified morning tephigram for Maniwaki 12Z June 23rd (top left). Cb 46000 ft with T_{max}=23C, T_d=19C
- The hodograph (top right) shows only minimal shear. Directional shear yes, but almost no speed shear. Max wind at lolvl = 21 kts Southerly at 3000 ft.
- The modified morning tephigram for Maniwaki 12Z June 24rd (bottom left). Cb 48000 ft with T_{max}=23C, T_d=20C
- The hodograph shows light to moderate shear. (bottom right) max lolvl winds 24 kts Southerly at 3000 ft.

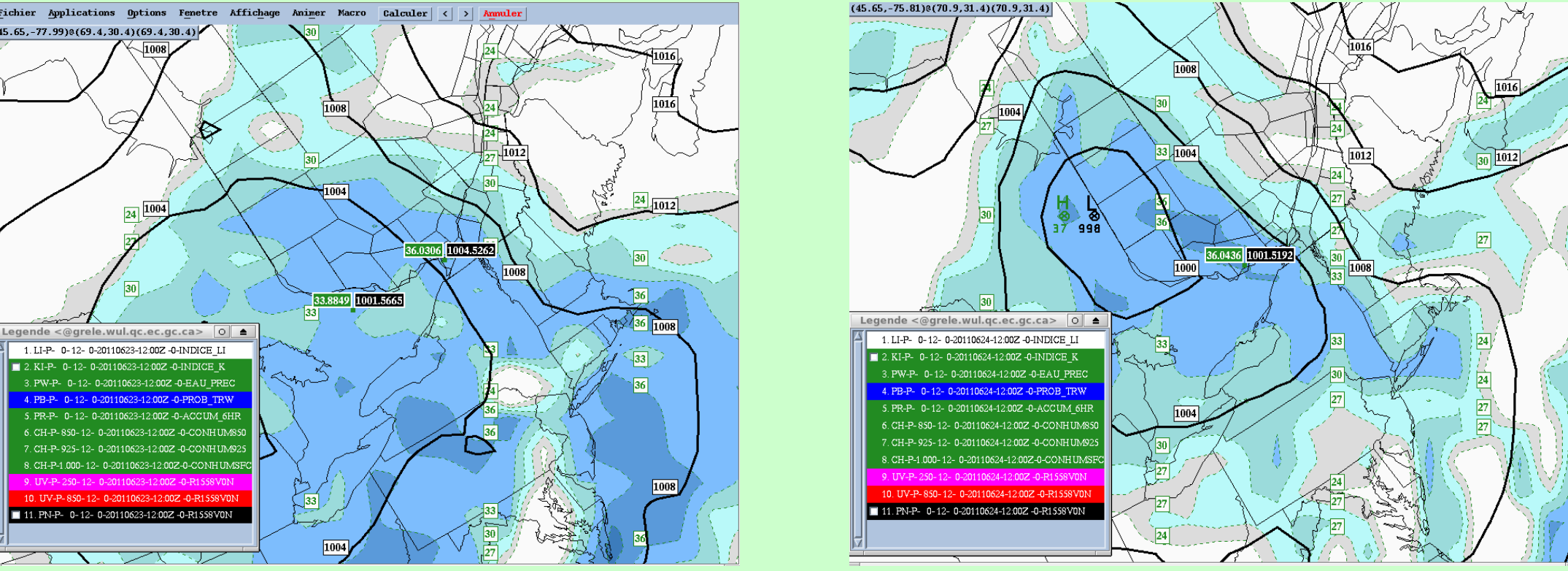


Using the Forecast Guide - 4



Precipitable water and K-Index

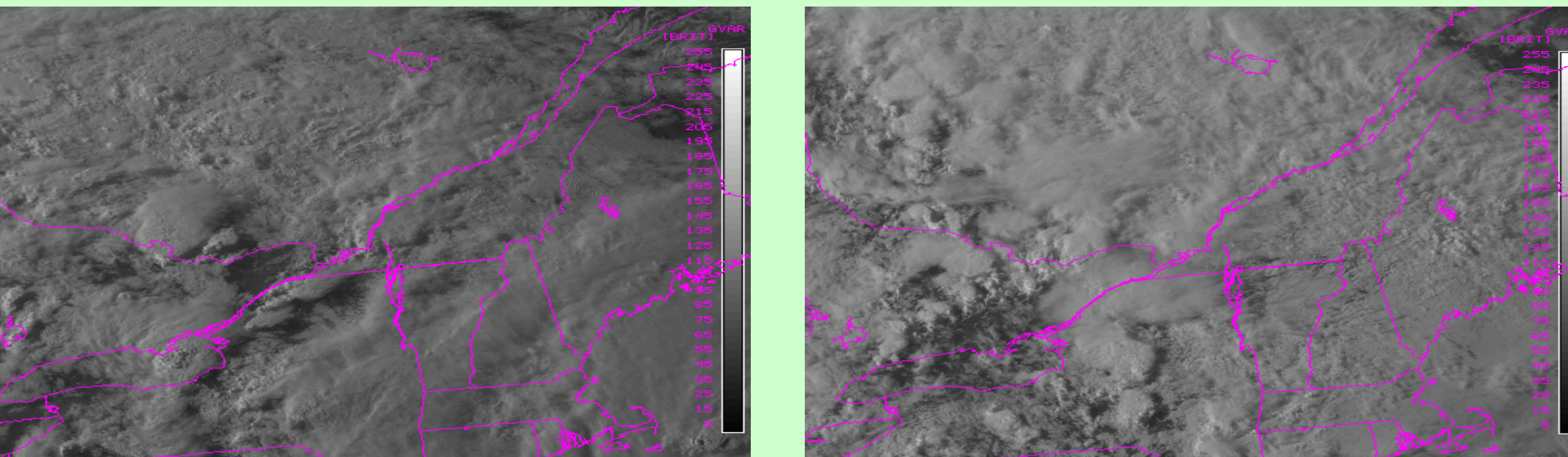
- Precipitable water for 00Z on the 24th (top left) and 00Z on the 25th (top right). GEM-REG 12Z 23rd and 24th June 2011. Values between 40 and 45 mm in the Ottawa River Valley both days.
- The K-index for 00Z the 24th (bottom left) and 00Z the 25th (bottom right). GEM-REG 12Z 23rd and 24th June 2011. Both days show values in the Ottawa Valley around 36.



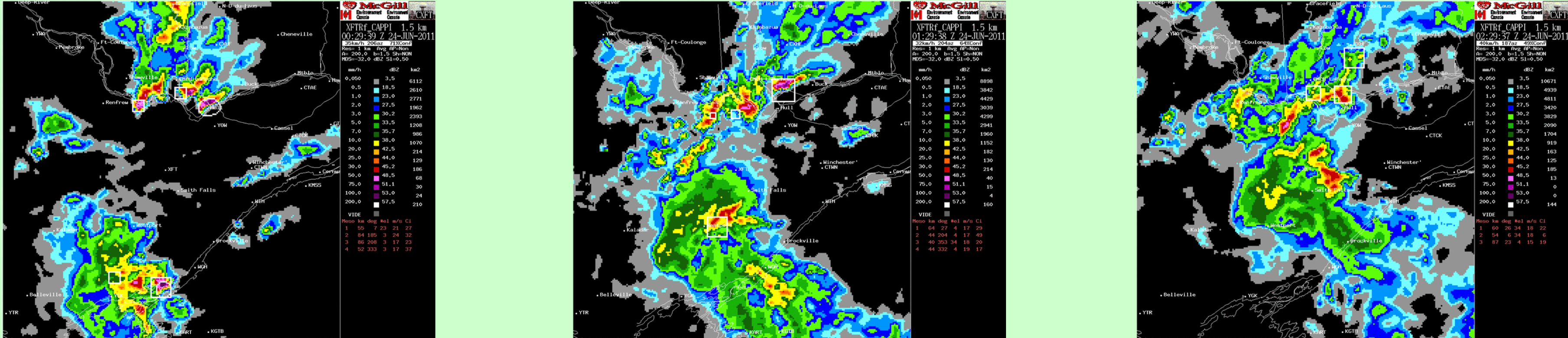
Using the Forecast Guide - 5

Thermal gradient due to cloud cover

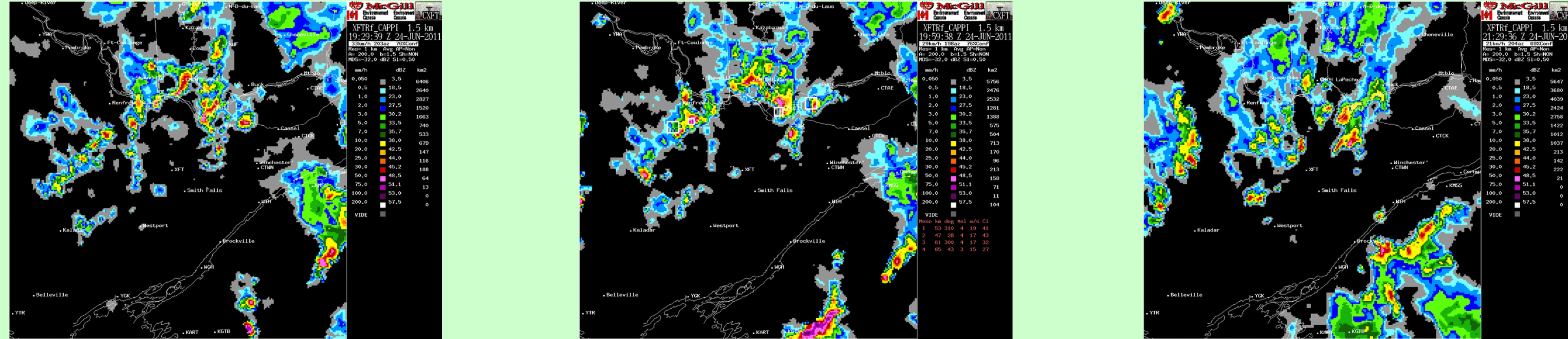
- Earlier in the afternoon both days there were sunny spots in eastern Ontario, creating a thermal gradient cut by the weak Southerly LLJ. 23Z on the 23rd (left) 22Z on the 24th (right).



Radar Images of the Event



Thunderstorms formed and repeatedly passed over the same sectors north of the Ottawa River on the evening of June 23rd (above) and again on the afternoon of June 24th (below).



Back to the Forecast Guide

- Overall the guide checklist seems to point to torrential rain in this case. There is an addition to the guide that narrows the extent and amount of rain:

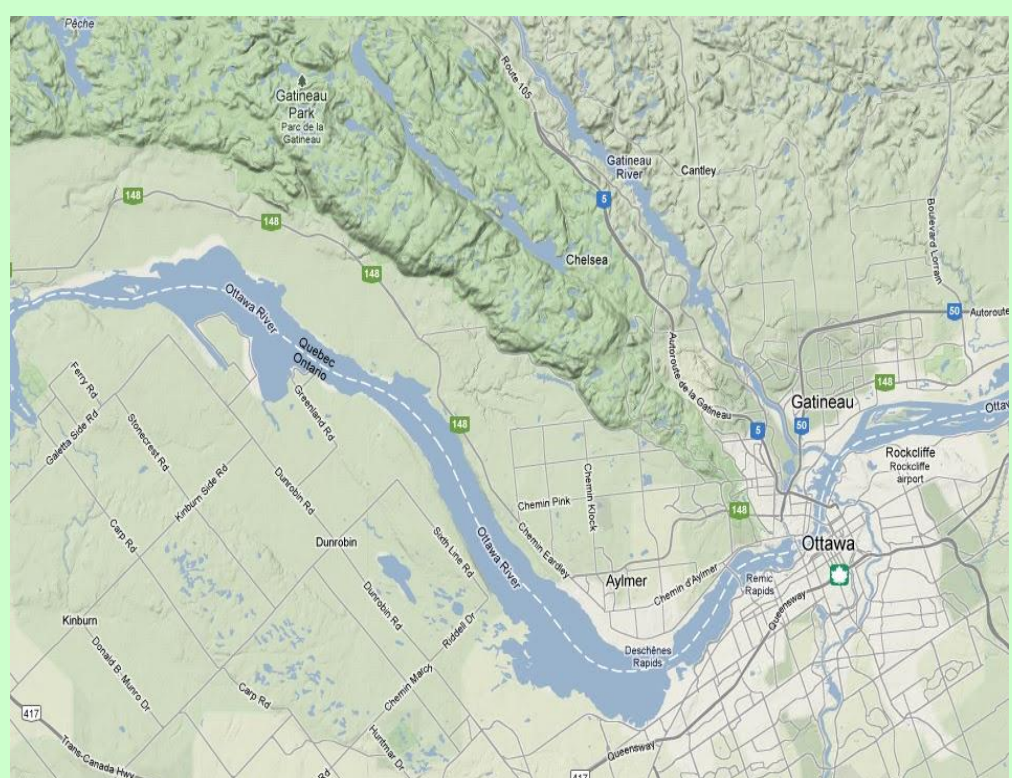
1	Slow moving low level jet	+ Low level jet ≥ 35 kt	+ K index ≥ 34	= Small or large extent of TR (TR $\gg 50$ mm possible)
2	Slow moving low level jet	+ Low level jet ≤ 30 kt	+ K index ≥ 34	= Small extent of TR if the PWAT is ≥ 50 mm then large extent of TR (and TR $\gg 50$ mm possible)
3	Average moving low level jet	+ Low level jet ≥ 35 kt	+ K index ≥ 34	= Small extent of TR
4	Slow moving low level jet	+ $30 \leq K < 34$		= Local TR only

- ❖ According to the previous table, this case would be number 2: Slow moving LLJ + LLJ < 30 knots + K index > 34, giving a small extent of TR with PWAT under 50 mm.
- ❖ Both days received at least twice the guide amount, so other local effects were probably at play.

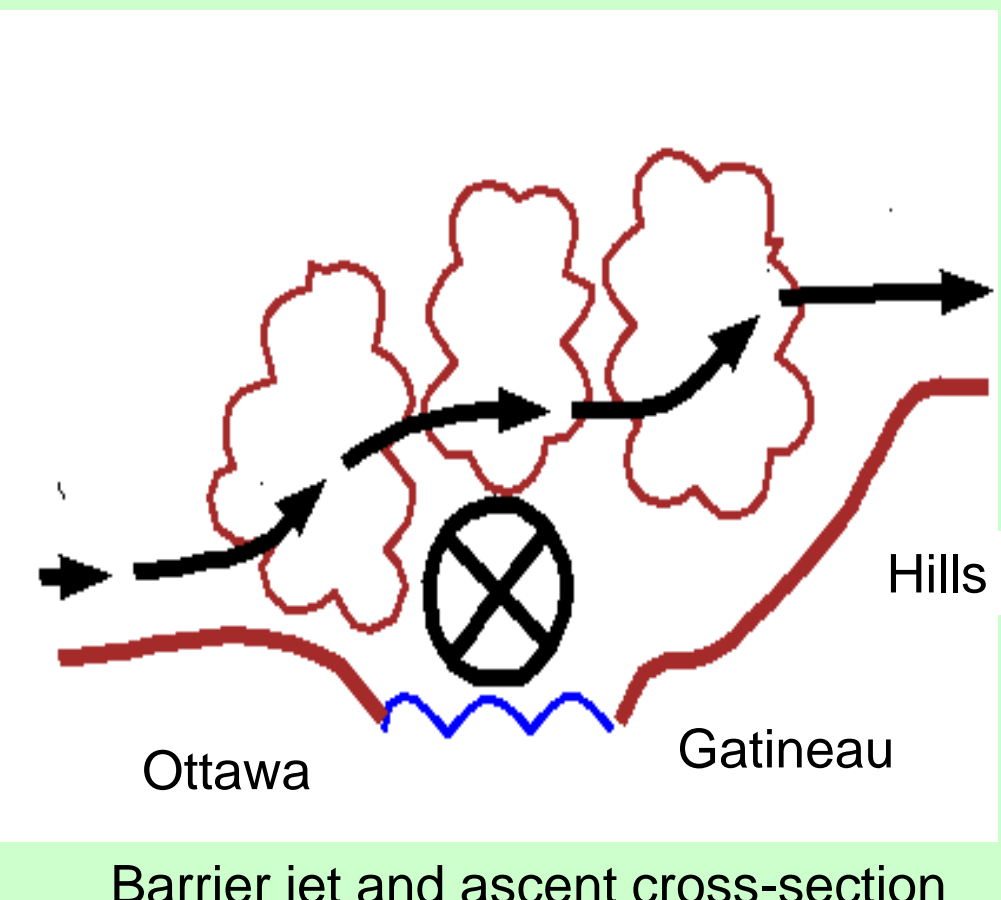
Other Effects

Local Barrier Jet and Ascent

- It is possible that the Gatineau Hills helped create a barrier jet in the Ottawa Valley.
- The synoptic southerly flow would be forced above the local easterly jet at the surface enhancing convection near this barrier jet.
- On the other side of the river, the Gatineau Hills also provide additional orographic lift.



Google map of the Ottawa River Valley



Other Effects

Local Convergence

- Also of note, although the synoptic flow was southerly, at the surface in the Ottawa River Valley winds were easterly, enhancing convergence locally.
- Gatineau airport (CYND) metar data for June 23rd (top) and June 24th (bottom)

Données suivantes du jeudi juin 23 2011
SPECI CYND 222200Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 222200Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= SPECI CYND 232200Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= SPECI CYND 232200Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS=

Données suivantes du vendredi juin 24 2011
METAR CYND 240000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 240000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 240000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 240000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS=

Données suivantes du samedi juin 25 2011
METAR CYND 250000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 250000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 250000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS= METAR CYND 250000Z 10010610KT 150M SCT012 BKN0250U RMK SCAT010 SKYBS=

Conclusion

- The thunderstorms on the evening of June 23rd and the afternoon of June 24th 2011 had resulted in significant damaging torrential rain in and along and north of the Ottawa River Valley from Gatineau to Pontiac.
- There were many ingredients pointing to the possibility of torrential rain as seen in the forecast guide.
- Local effects such as convergence, the barrier jet and orographic lift may have also played a role in the severity of the event.

References

Mainville, S. 2004. **Heavy convective rain events over Québec: a forecasting tool.** preprint AMS 22nd Conference on Severe Local Storms, P8.7.