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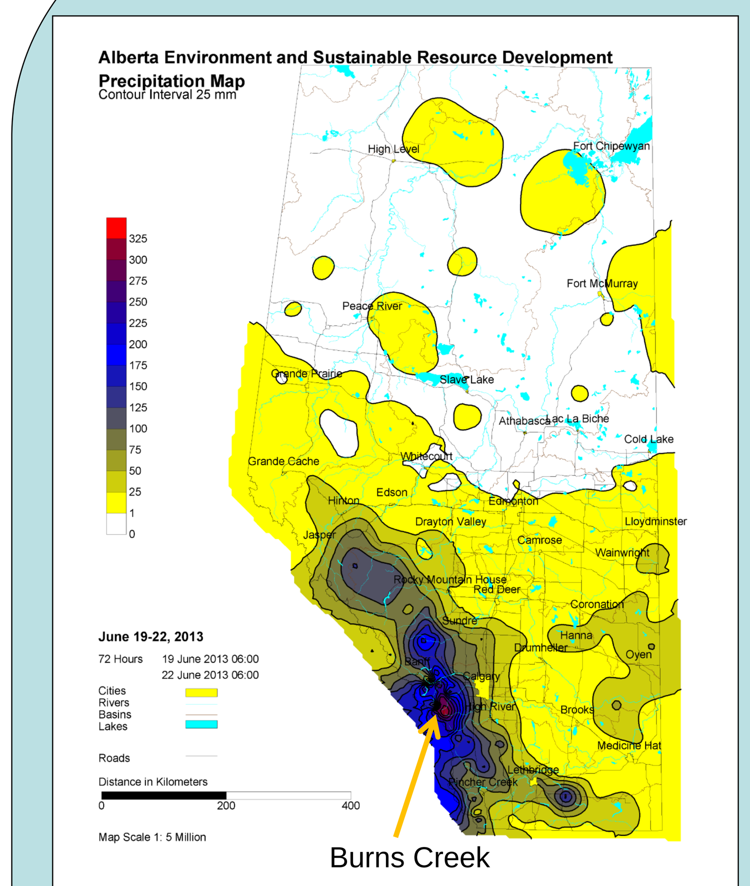
Some Unique Features Associated with the June 2013 Southern Alberta Flooding:

Precipitation, Atmospheric River and Evapotranspiration

Anthony Q. Liu, Curtis Mooney, Bob Kochtubajda, Ron Goodson

Environment and Climate Change Canada, Edmonton, Alberta, Canada

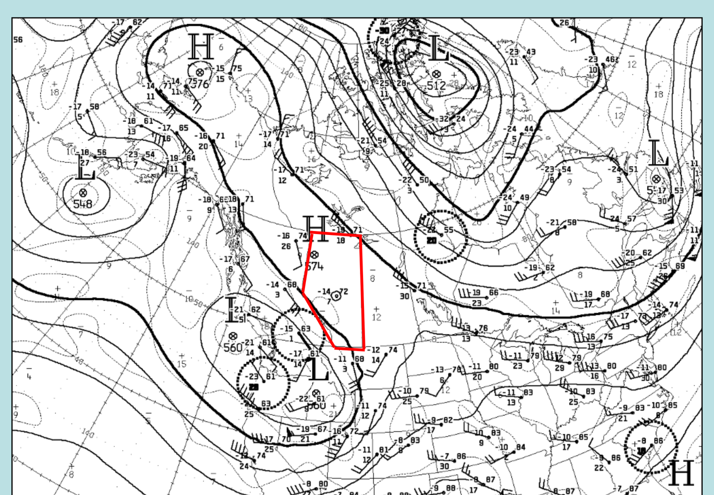
Precipitation

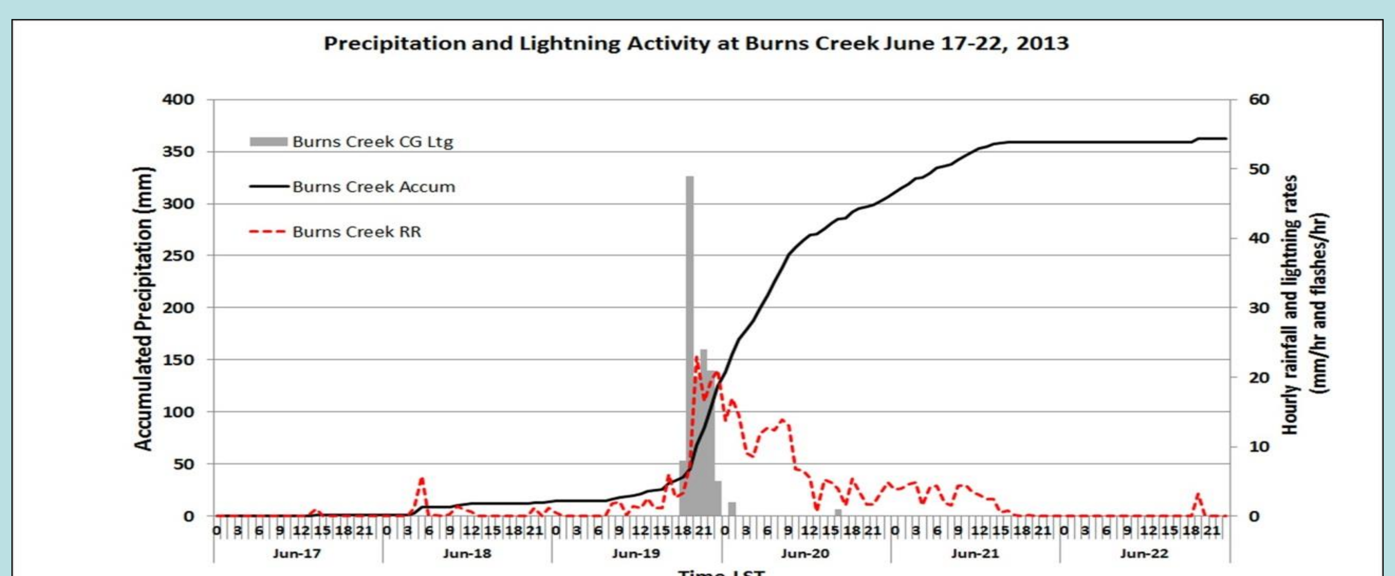


Southern AB extreme rainfall June 19-22, 2013

Heavy precipitation began on 19 June 2013 and continued for two days, with many stations in southern Alberta recording substantial amounts of rain. A large area in the foothills received over 100 mm of rainfall, with over 300 mm recorded at the Burns Creek station.

The 500 hPa height analysis shows a broad trough along the west coast, with an elongated cold low over southern BC, Washington and Montana, and an upper ridge extending from the central Great Plains into Alaska. Southern Alberta is under the right entrance region of a minor jet core, as well as under strong diffluent flows aloft, providing favourable conditions for severe thunderstorm development.


CMC 500mb analysis map at 00Z 20 June 2013. 500mb geopotential height in solid line, 1000-500mb thickness in dashed line.



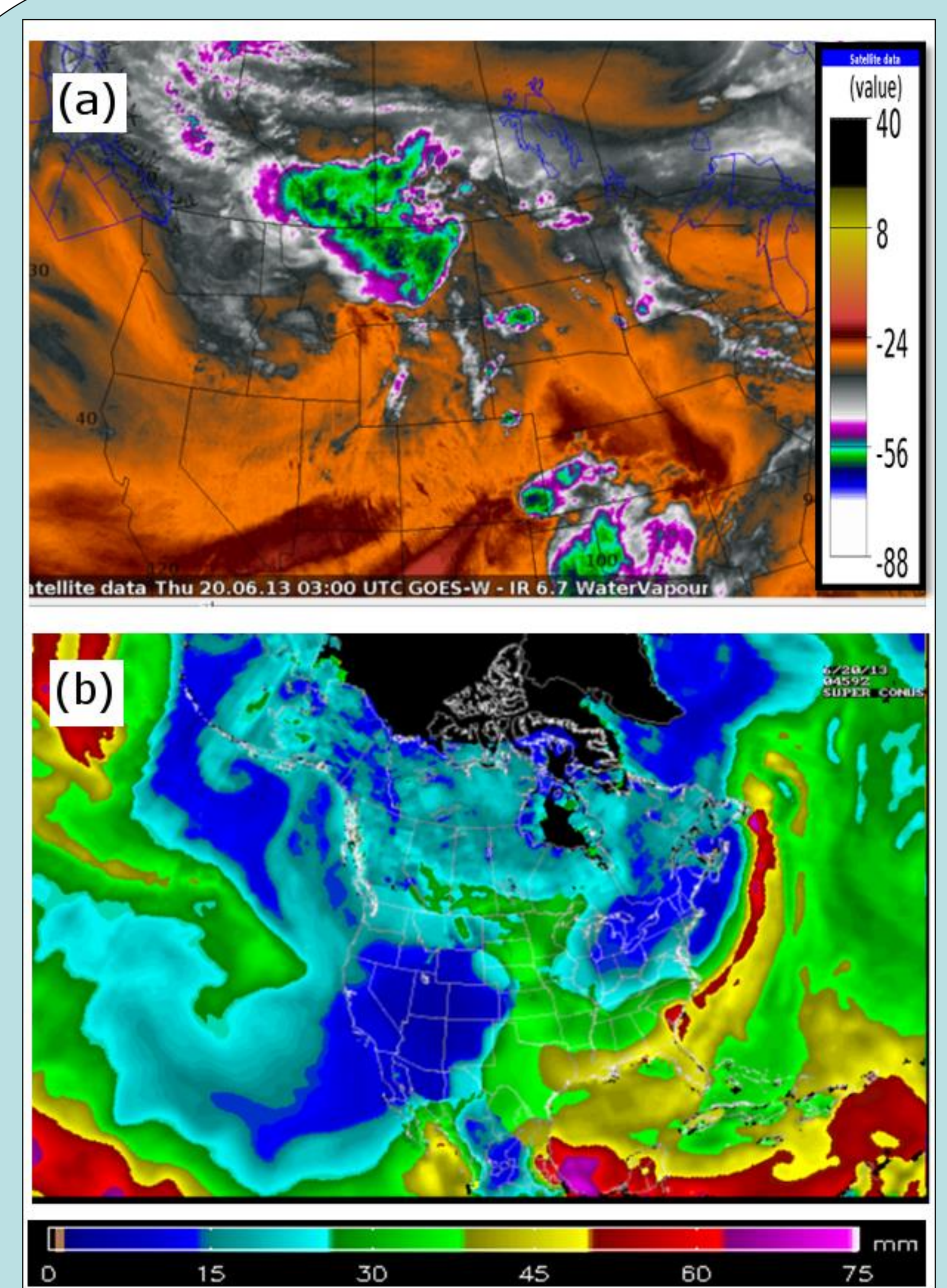
Precipitation and thunderstorm activity at Burns Creek station June17-22, 2013

Intense convective rainfall associated with thunderstorms occurred on the 19th and 20th when surface temperature/moisture and atmospheric total precipitable water (TPW) over southern Alberta peaked.

Abstract

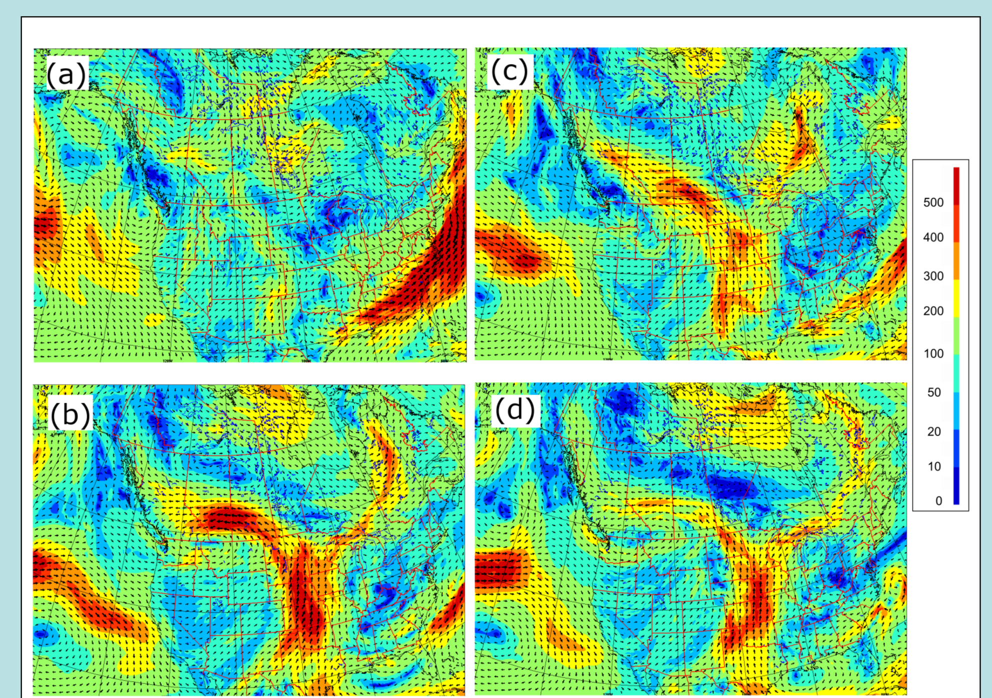
Excessive rainfall associated with an intense weather system triggered severe flooding in southern Alberta in June 2013. The event was characterized by a slow-moving upper level low pressure system west of Alberta, blocked by an upper level ridge, while an associated surface low pressure system kept southern Alberta, especially the eastern slopes of the Rocky Mountains, in continuous precipitation for up to two days. The event was first dominated by significant thunderstorm activity, and then evolved to mainly continuous stratiform precipitation. The large-scale circulation associated with the blocking pattern enabled an atmospheric river-like long-distance transport of moisture from the central Great Plains into southern Alberta. Evapotranspiration from the Great Plains and southern Prairies provided sufficient moisture to support the heavy precipitation during this event.

Atmospheric River



(a) GOES water vapour image valid at 03 UTC, 20 June (°C); (b) blended TPW product valid at 04 UTC 20 June.

A generally east-west oriented band of mid-level moisture over the southern Prairies impinged on the Rocky Mountains, and deep convection developed over southern Alberta and western Montana. A band of high TPW was advected into southern Alberta and Saskatchewan from the central Great Plains, as confirmed by the simulated moisture fluxes.



RDPS analyzed vertically integrated moisture flux (kg m s^{-1}) at a) 00 UTC 19 June; b) 00 UTC 20 June; c) 12 UTC 20 June; d) 00 UTC 21 June.

References & Acknowledgements

Kochtubajda B, Stewart RE, Boodoo S, Thériault JM, Li Y, Liu A, Mooney C, Goodson R, , Szeto K. 2016. The June 2013 Alberta catastrophic flooding event: Part 2 – Fine-scale precipitation and associated features. *Hydrological Processes*. In Press, (DOI:10.1002-hyp.10855).

Liu A, Mooney C, Szeto K, Thériault JM, Kochtubajda B, Stewart RE, Boodoo S, Goodson R, Li Y, Pomeroy, J. 2016. The June 2013 Alberta Catastrophic Flooding Event: Part 1 – Climatological aspects and hydrometeorological features. *Hydrological Processes*. In Press, (DOI:10.1002-hyp.10906).

Li Y, Szeto K, Stewart RE, Thériault JM, Chen L, Kochtubajda B, Liu A, Boodoo S, Goodson, R, Mooney C. 2016. A numerical study of the June 2013 flood-producing extreme rainstorm over southern Alberta. Journal of Hydrometeorology. In Review.

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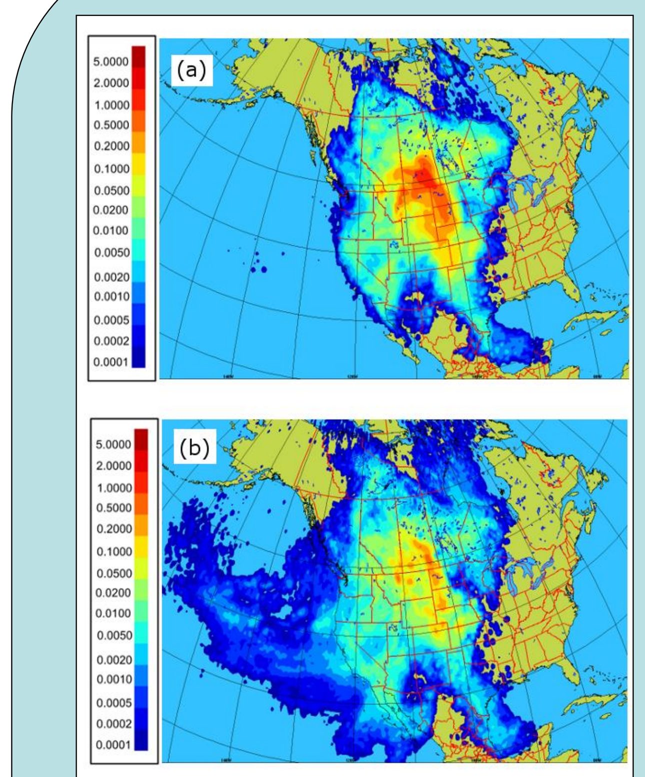
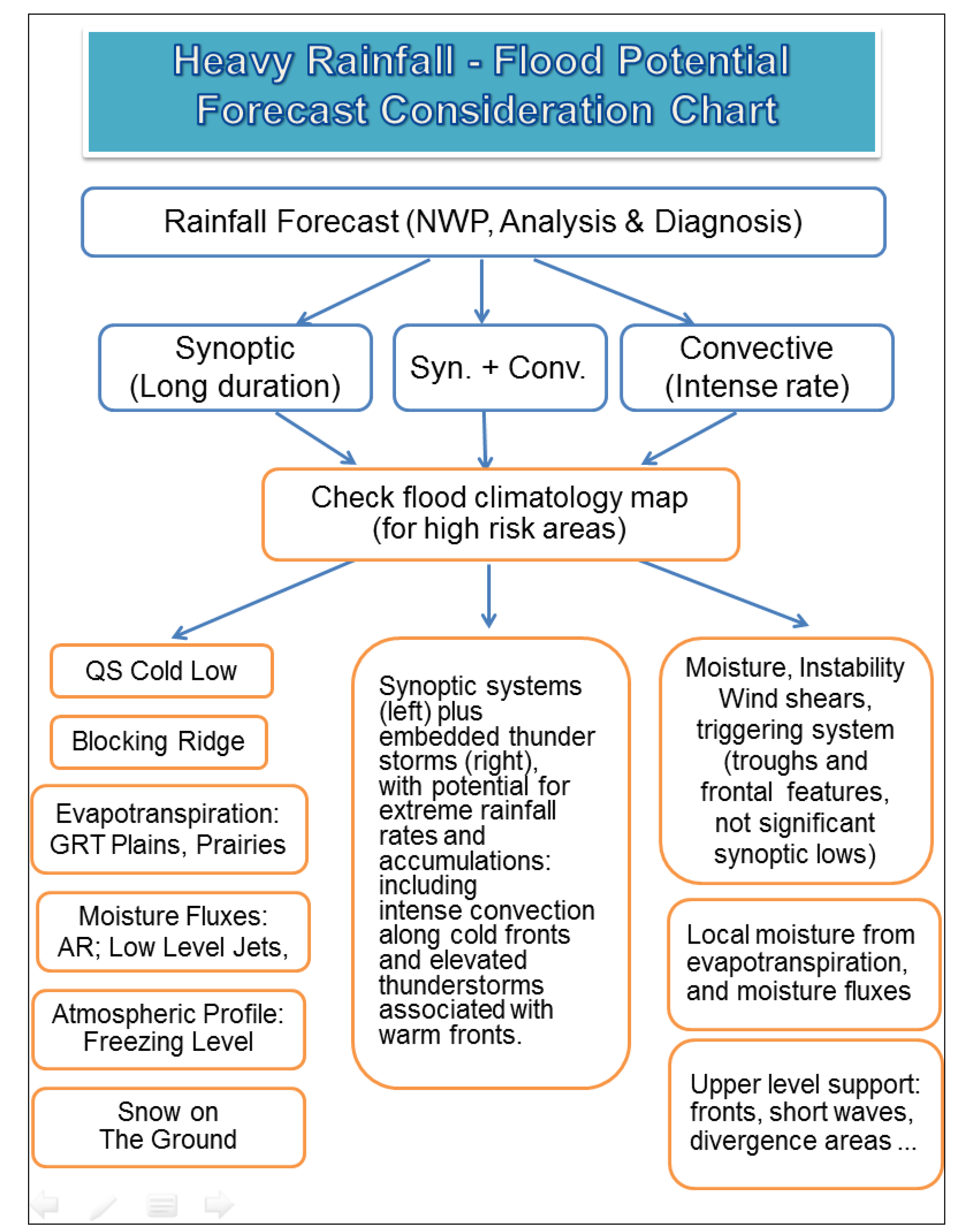
Evapotranspiration



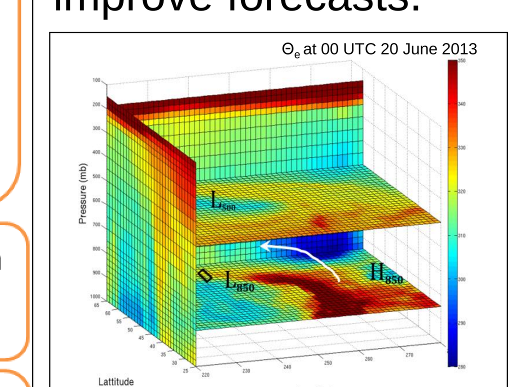
Moisture sources for precipitation over the target area: (a) from the atmospheric boundary layer; b) above the boundary layer. Units: mm 6hr^{-1}

Moisture source analysis using a trajectory model shows significant boundary layer moisture uptake over the Great Plains, suggesting that evapotranspiration from the central Great Plains played an important role in providing moisture to support the excessive precipitation that triggered the flooding. Strong interactions and feedbacks exist between the Great Plains and the atmosphere above. For example, moisture from the Gulf of Mexico may fall as precipitation as it moves northward and subsequently be evaporated back into the atmosphere.

Forecast Applications



A conceptual model and chart was developed to describe the large-scale hydro-meteorological processes associated with severe flooding in the southern Prairies. Use of this chart could contribute to increased understanding of flood events and help improve forecasts.


A schematic display of atmospheric circulation and associated mass and moisture transport for the event.