

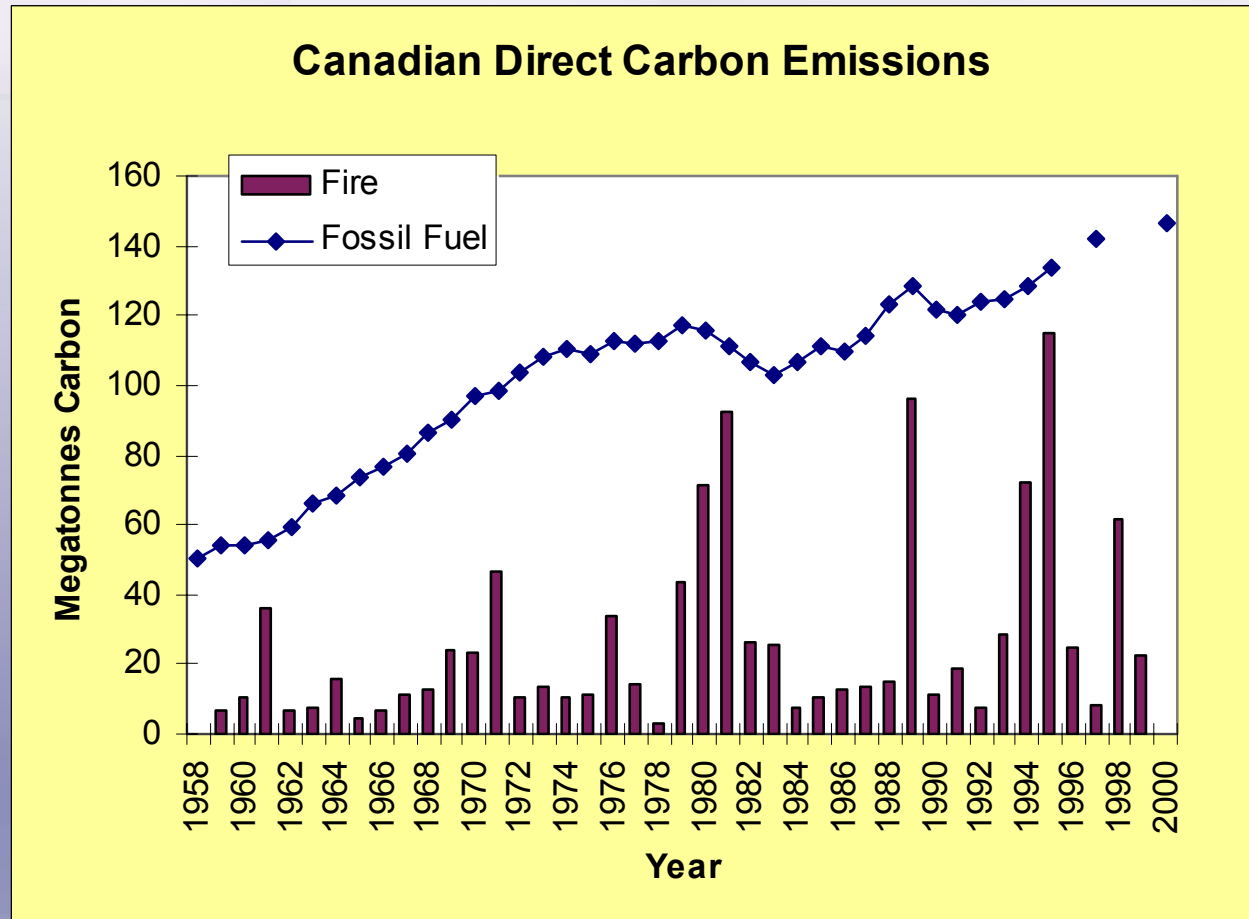
Validation of Hotspot Monitoring from MODIS, GOES, AVHRR and ATSR Sensors Over Canadian Wildfires in 2002-2003

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Canadian Forest Service

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Robert Landry
Earth Sciences Sector



Hotspots Aid Emissions Modeling



Sources:

Fossil fuels: www.nrcan.gc.ca/es/ceo/update.htm

Fire: Amiro, B.D. *et al.* 2001. *Can. J. For. Res.* 31: 512-525



Why Is Hotspot Monitoring Important?

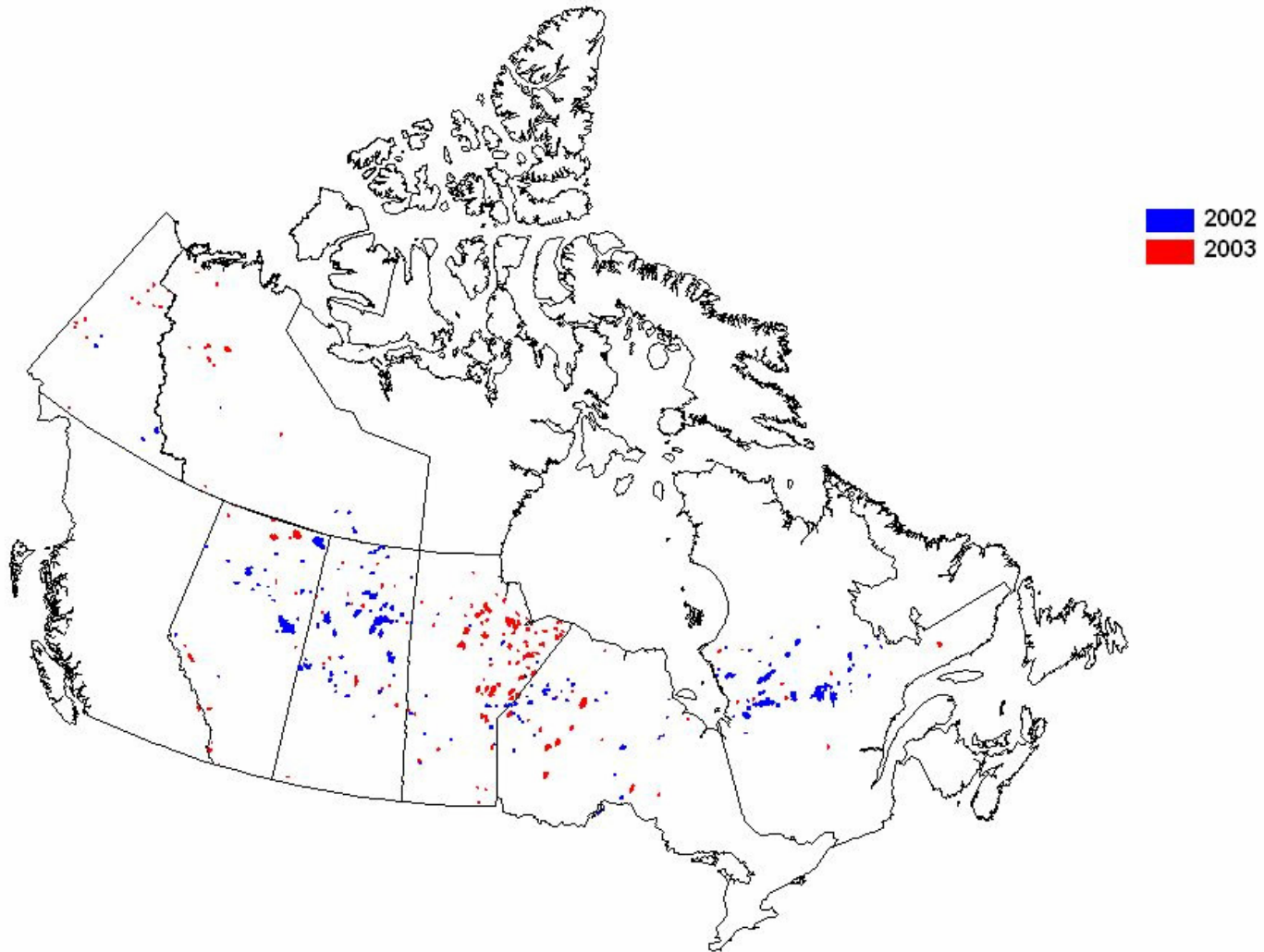
- shows the location of current fires
- confirms that a disturbance or landuse change is a fire
- places a date stamp on pixels that indicate fire
(may be necessary for completing emissions calculations)
- can be used to determine or confirm the rate of spread of a fire
- can be used to display the active parts of a fire



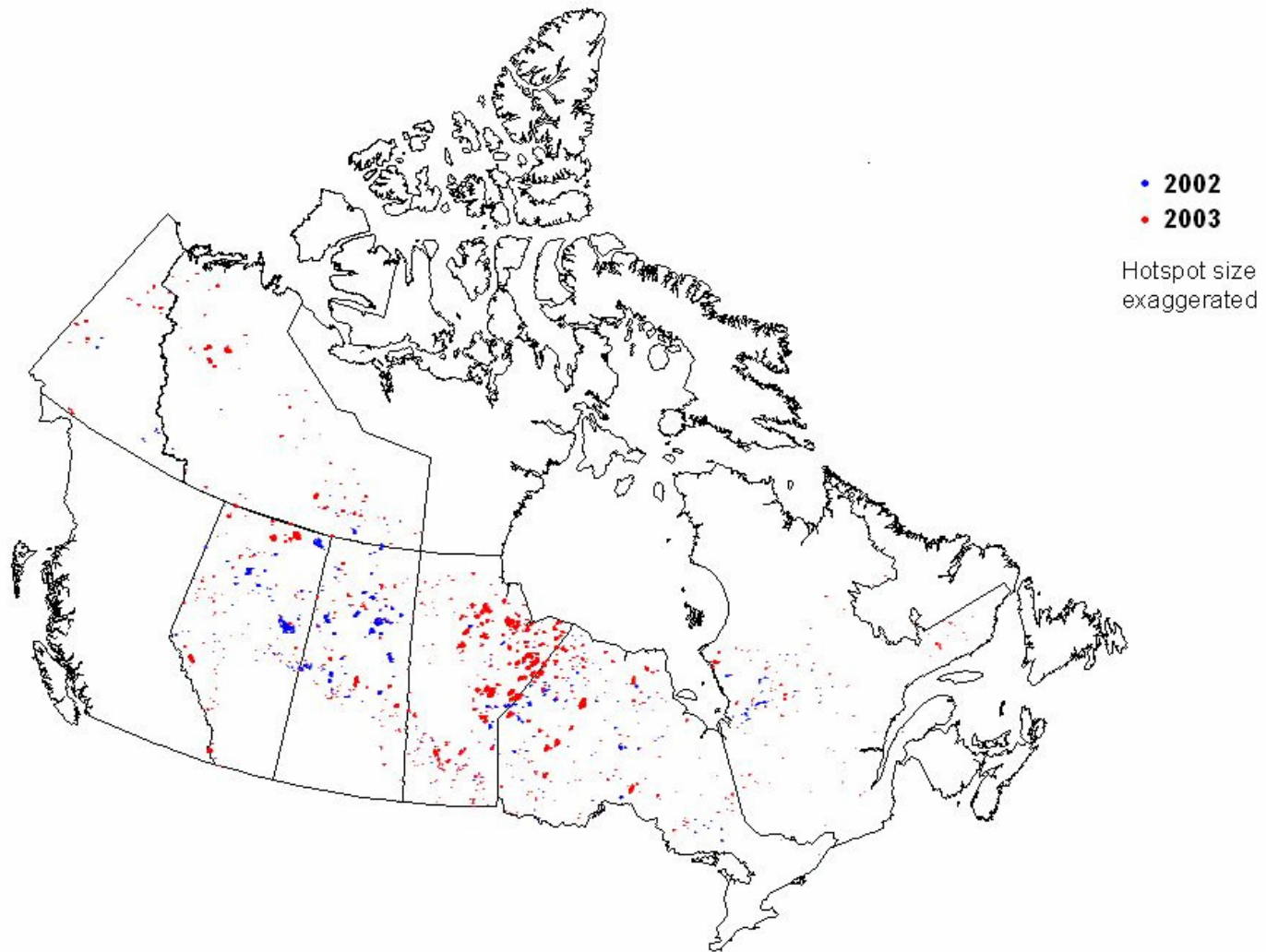
Objectives

1. to investigate the agreement between sensors and the fire polygons from fire management agencies,
2. to compare the detection sensitivity of the sensors, relative to each other,
3. to investigate the error of commission for each sensor,
4. "Do we need multiple sensors for detecting hotspots and mapping burned area?"
5. "Do the errors vary by land cover type?"

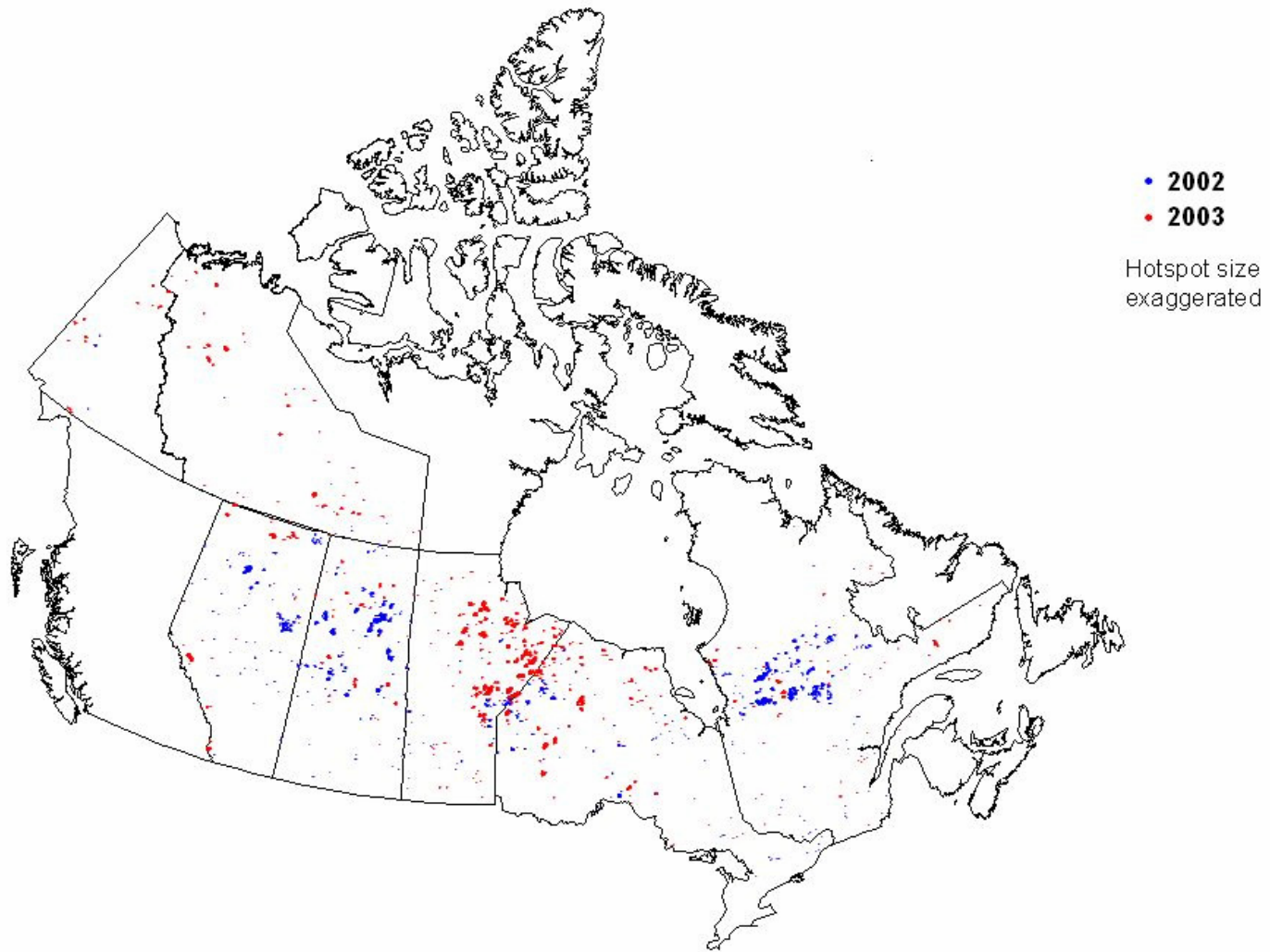
Fire polygons provided by each province

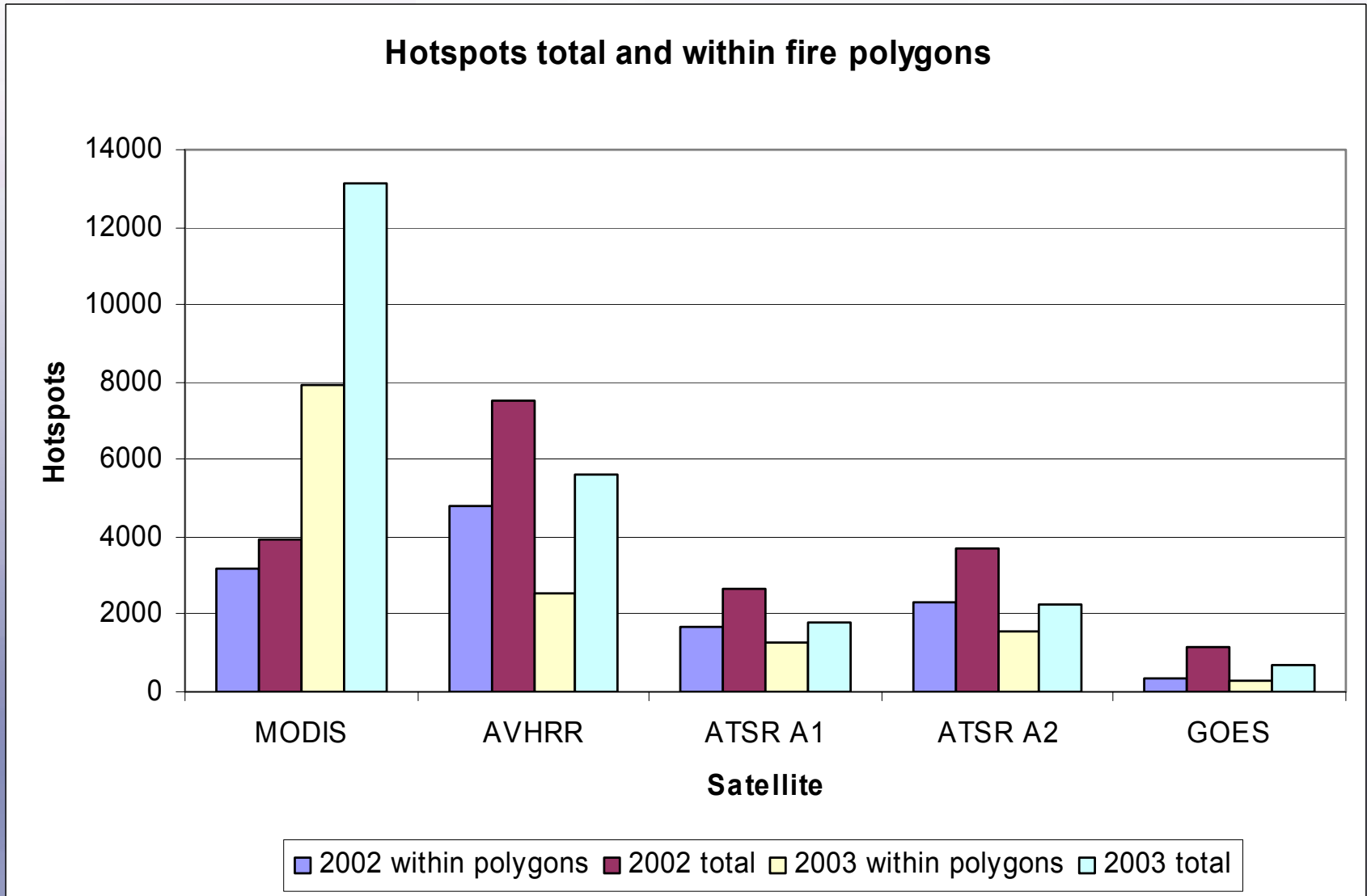


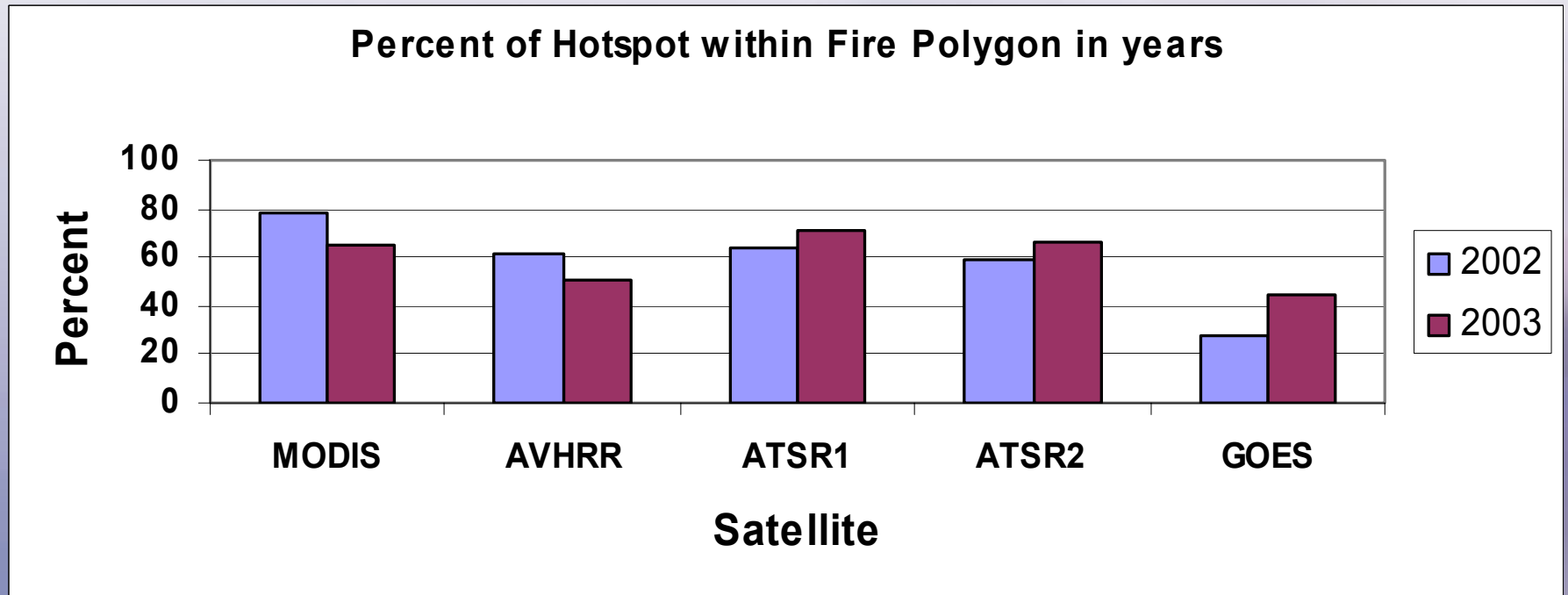
MODIS detected hotspots (except BC and Atlantic provinces)



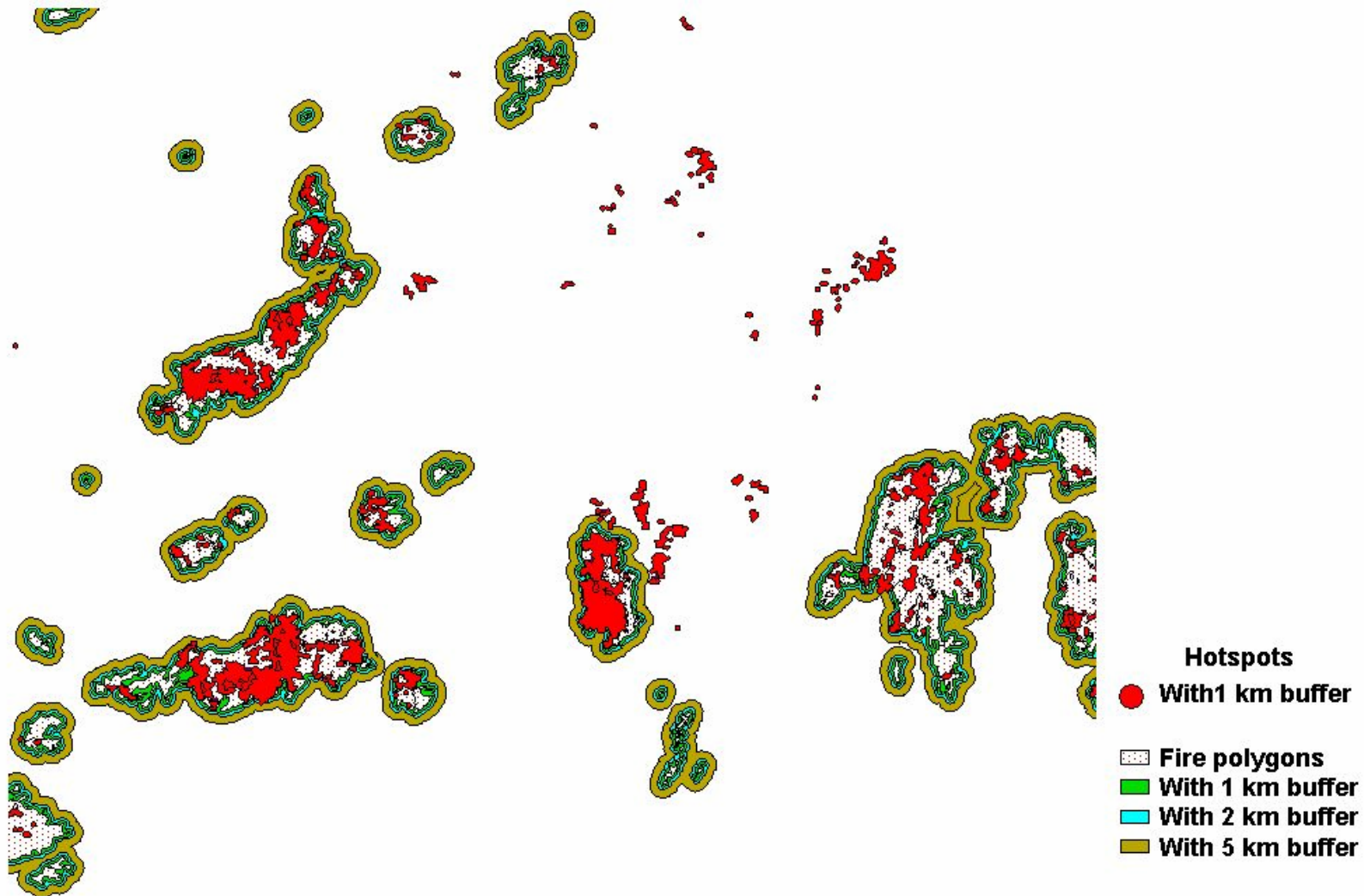
AVHRR detected hotspots (except BC and Atlantic provinces)



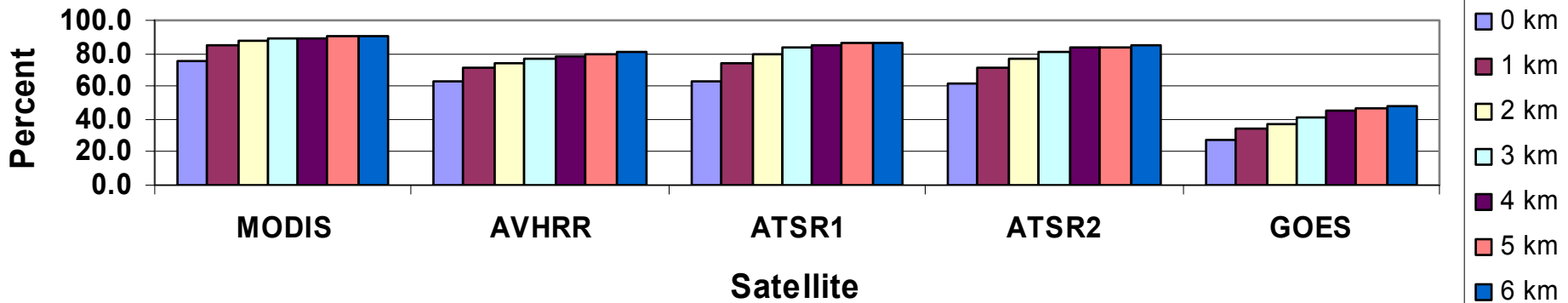




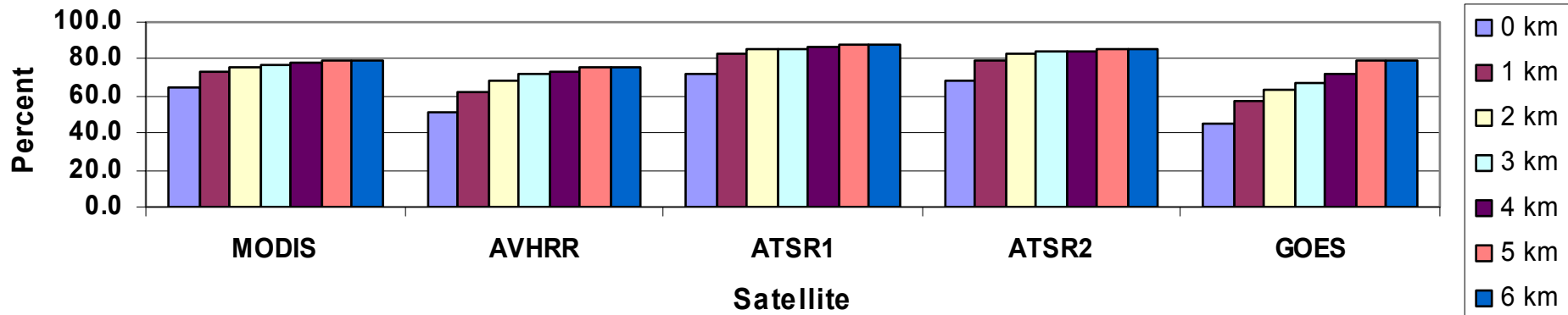
Fire polygon and hotspot buffer in 2022 (Zoom in Quebec)



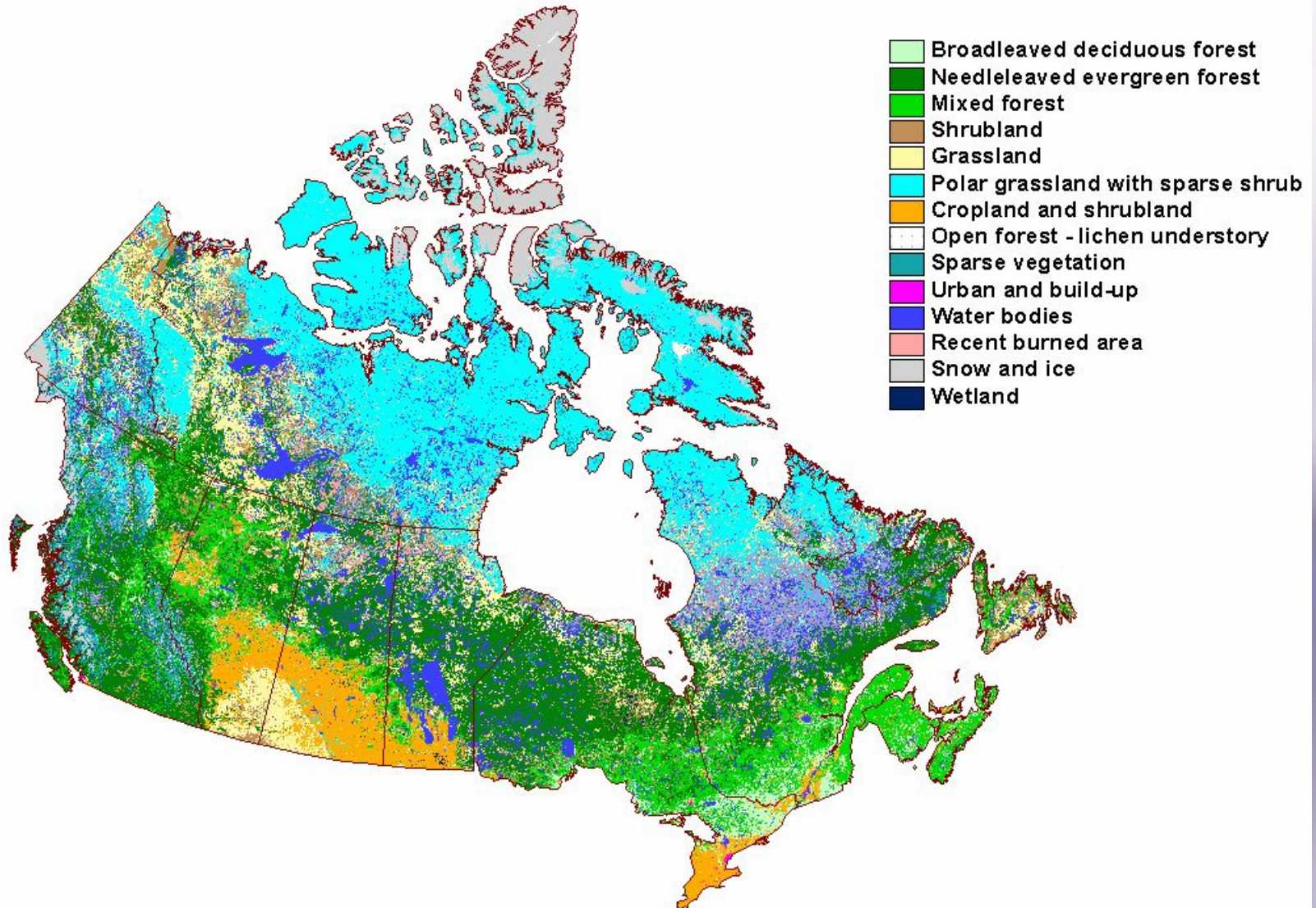
Percent of Hotspot within Buffered Fire Polygon vs. Satellite in 2002



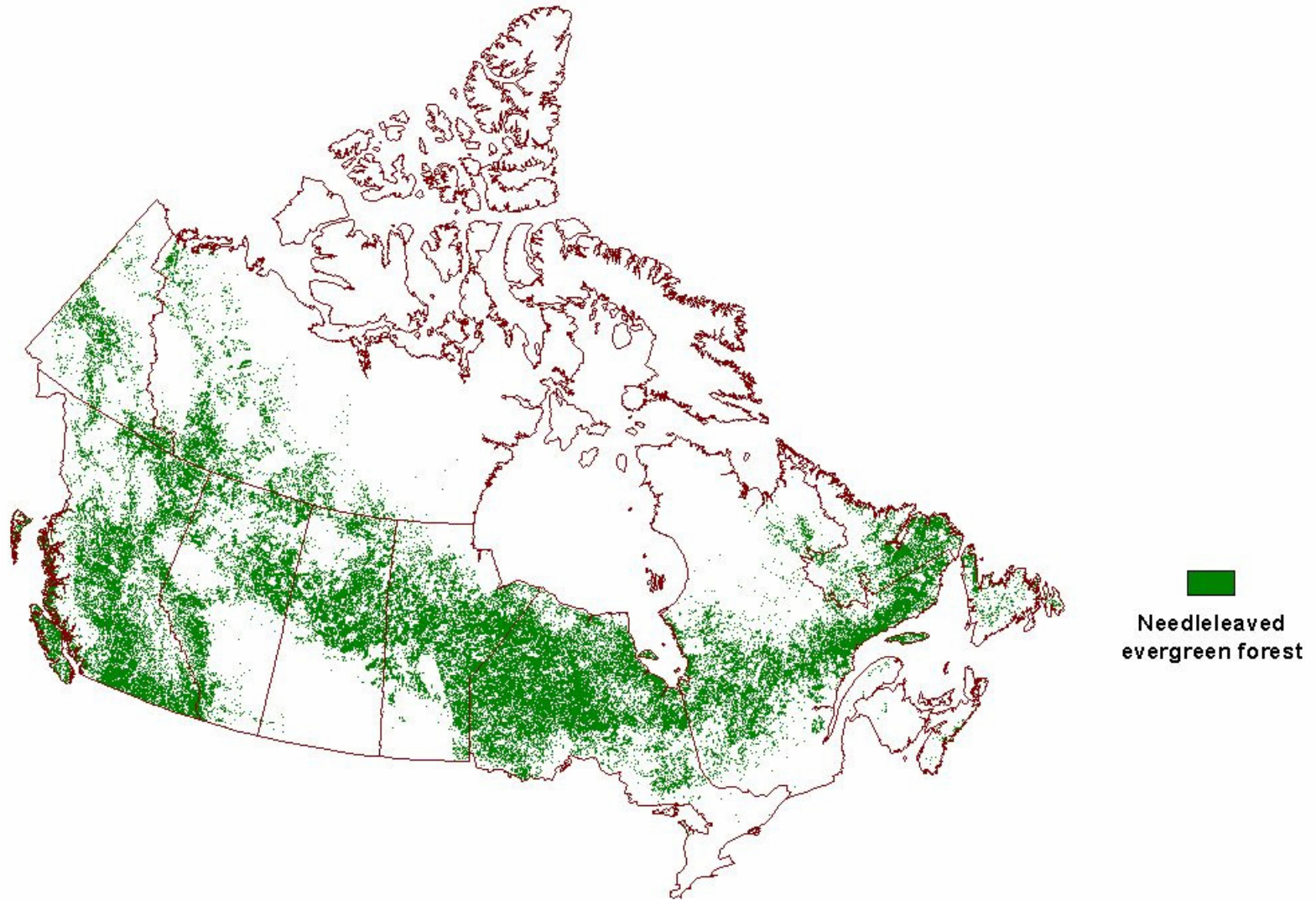
Percent of Hotspot within Buffered Fire Polygon vs. Satellite in 2003



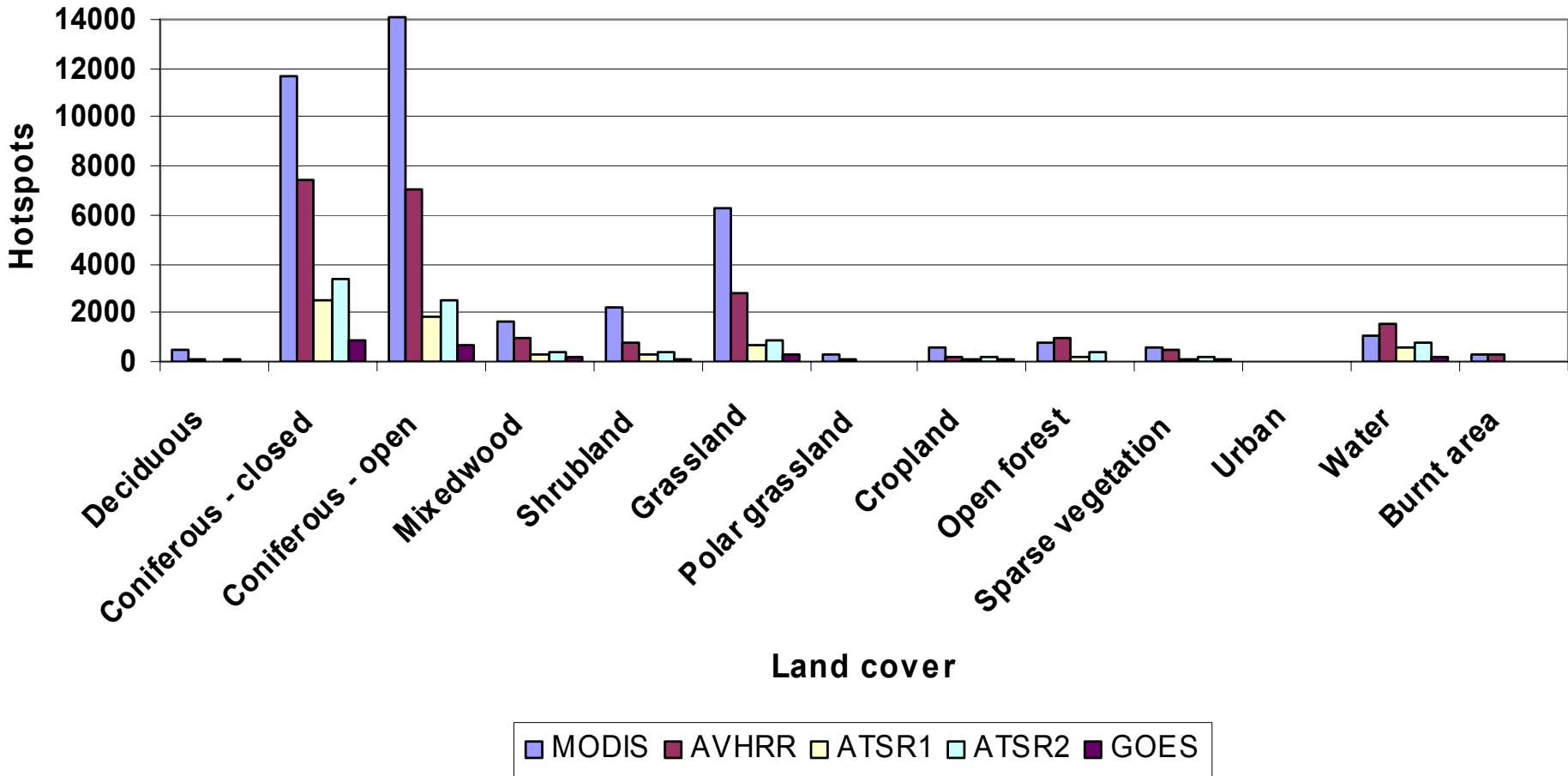
Land Cover by Spot VGT 2000 (modified)



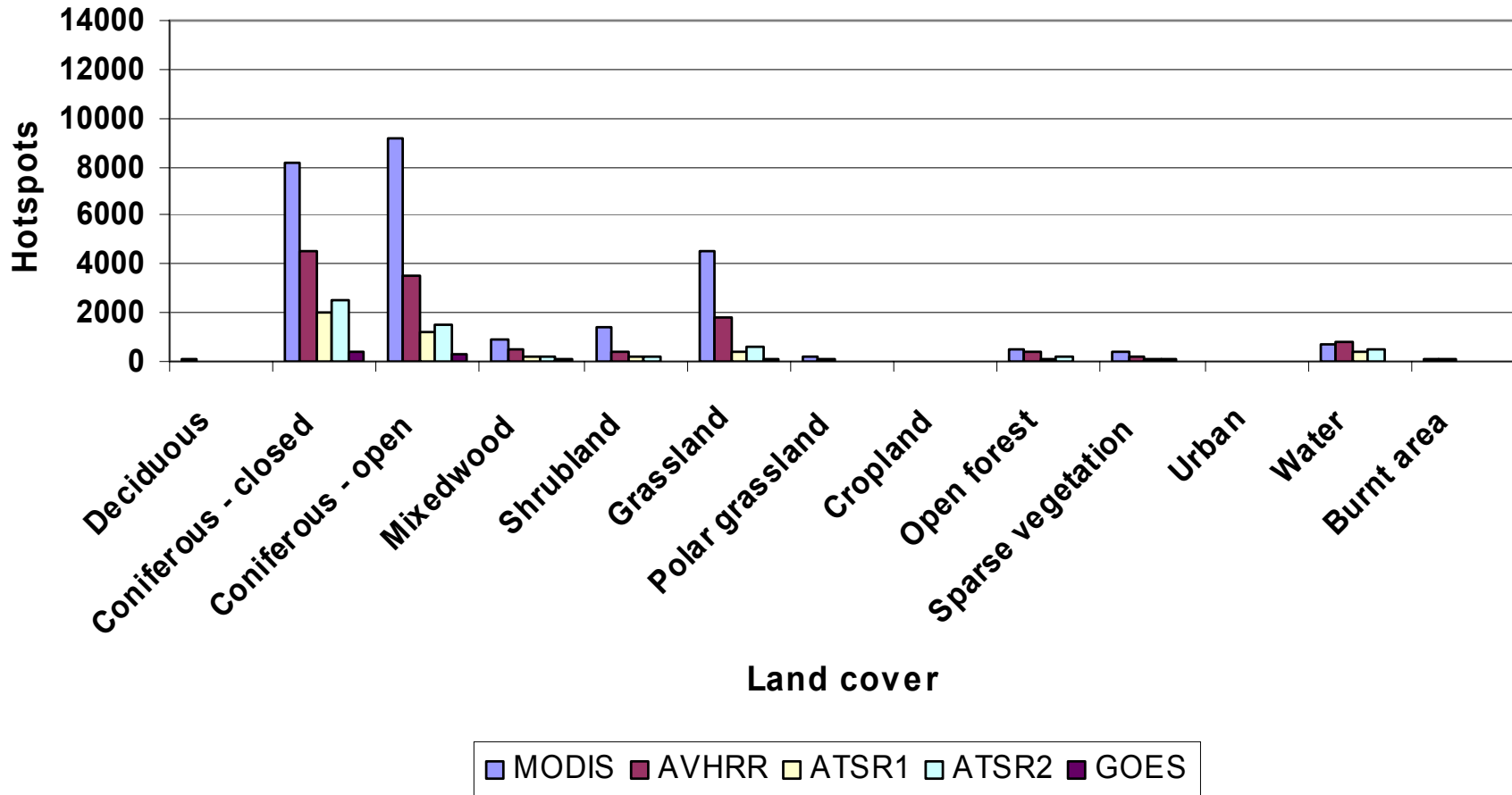
Land Cover: Needleleaved evergreen forest



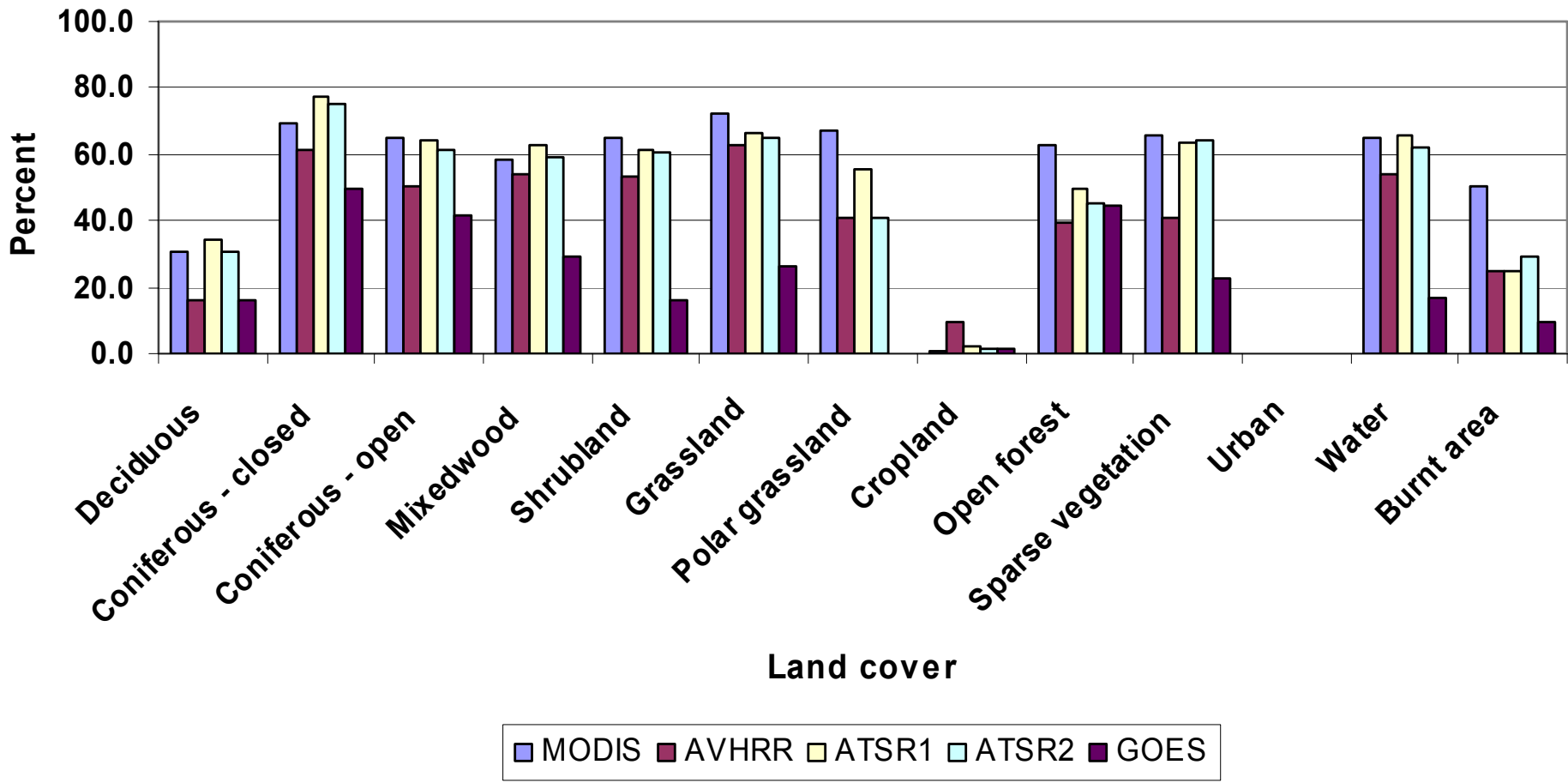
Hotspot Distribution in Land Covers in 2002 and 2003



Hotspot within fire polygons Distribution in Land Covers in 2002 and 2003



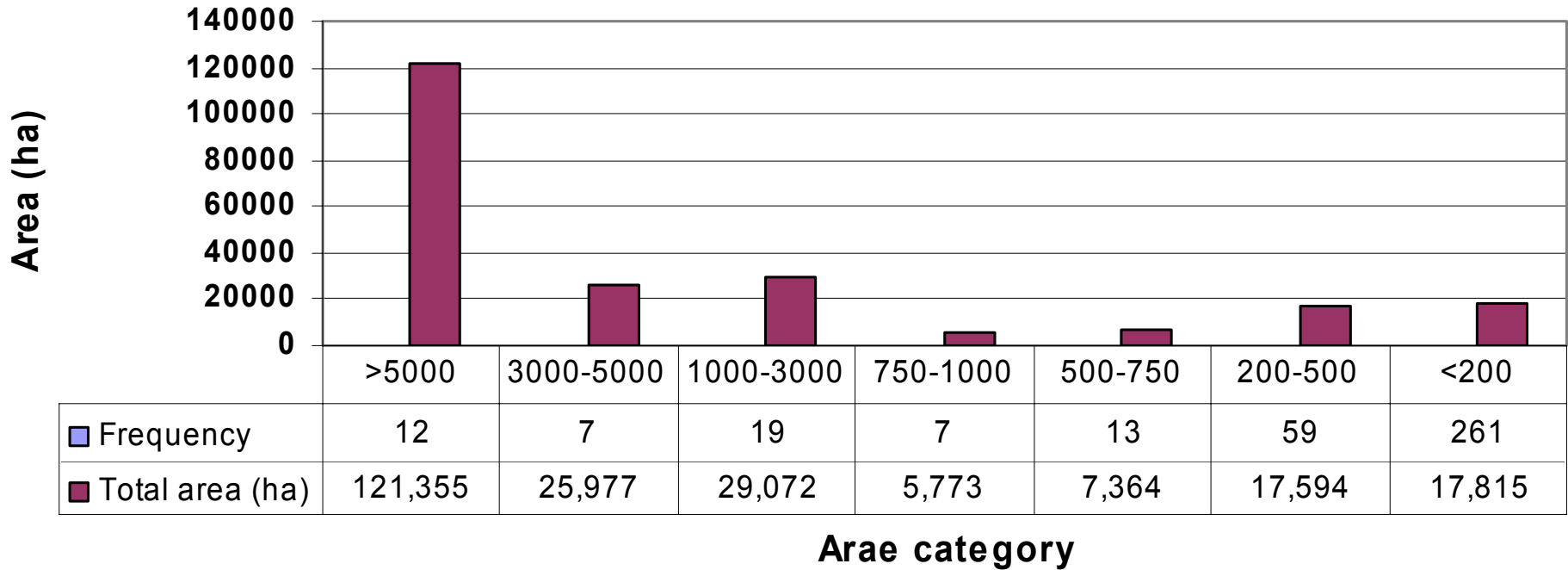
Percent of Hotspot within land cover vs. Satellite for 2002 and 2003



Commission error

Hotspots (with 1-km buffer)
falling outside Agency polygons (with 5-km buffer)

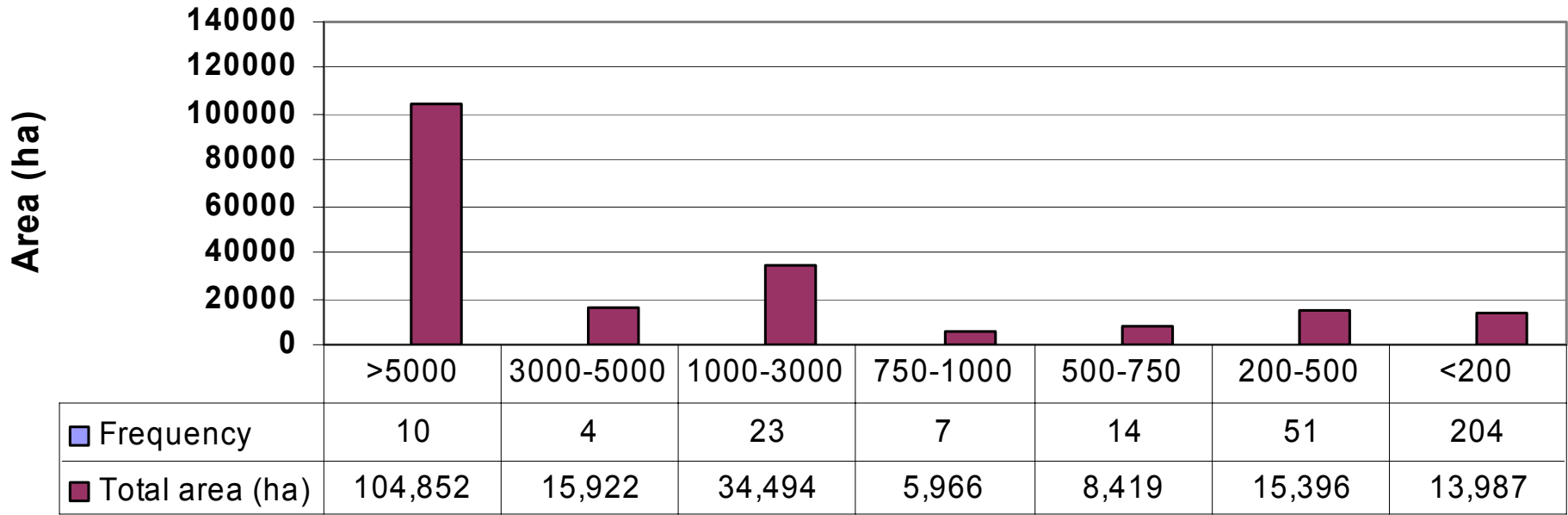
MODIS 2003



Commission error

Hotspots (with 1-km buffer)
falling outside Agency polygons (with 5-km buffer)

AVHRR 2003

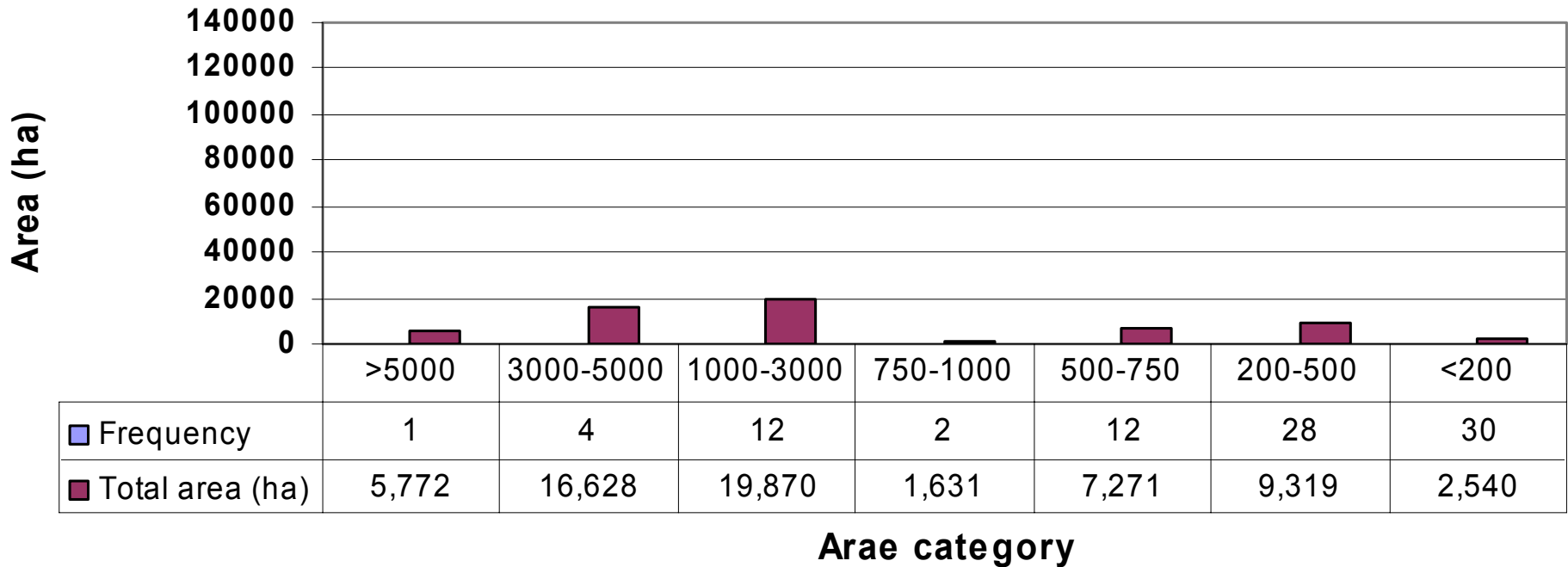


Area category

Commission error

Hotspots (with 1-km buffer)
falling outside Agency polygons (with 5-km buffer)

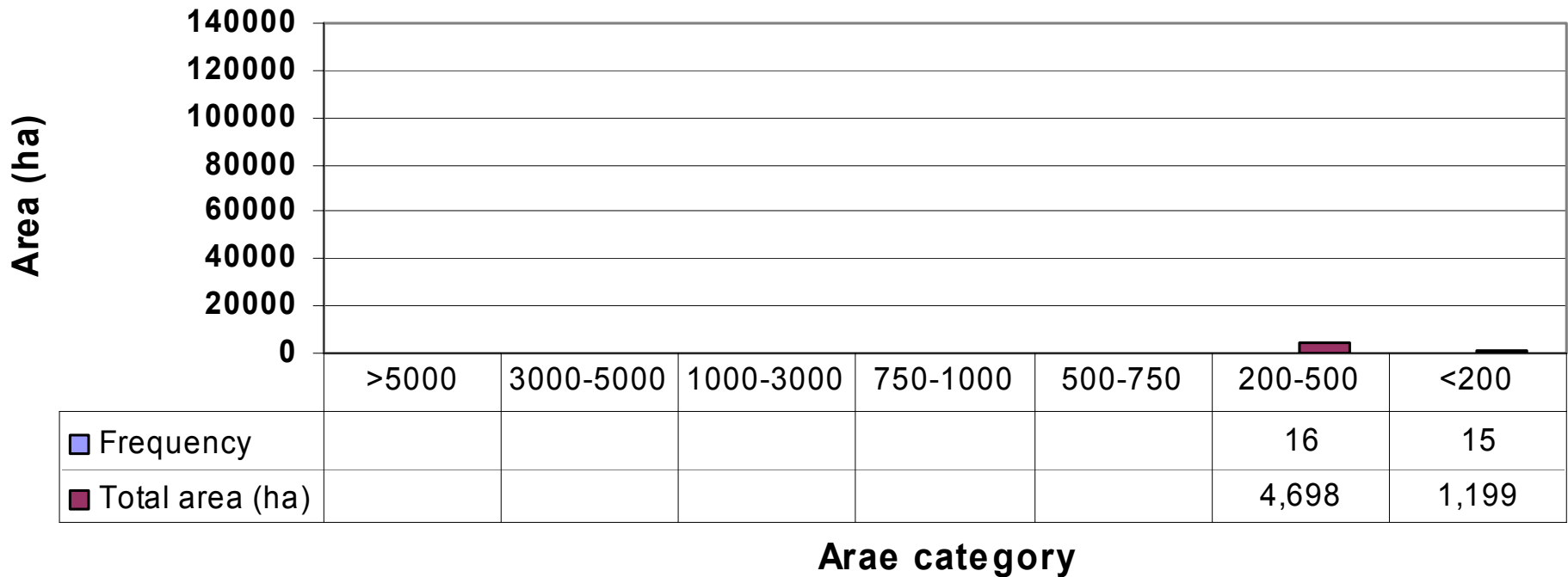
ATSR2 2003



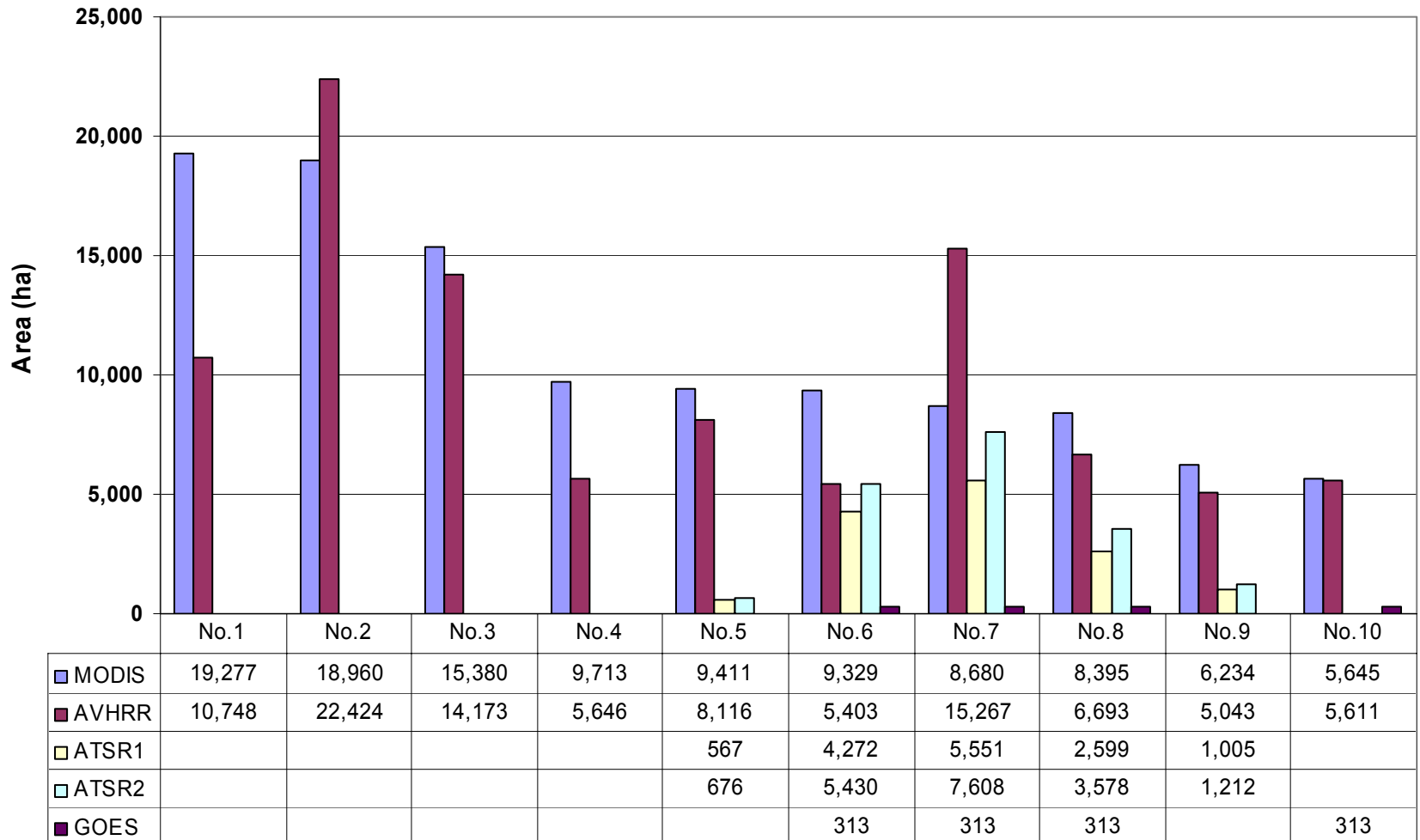
Commission error

Hotspots (with 1-km buffer)
falling outside Agency polygons (with 5-km buffer)

GOES 2003

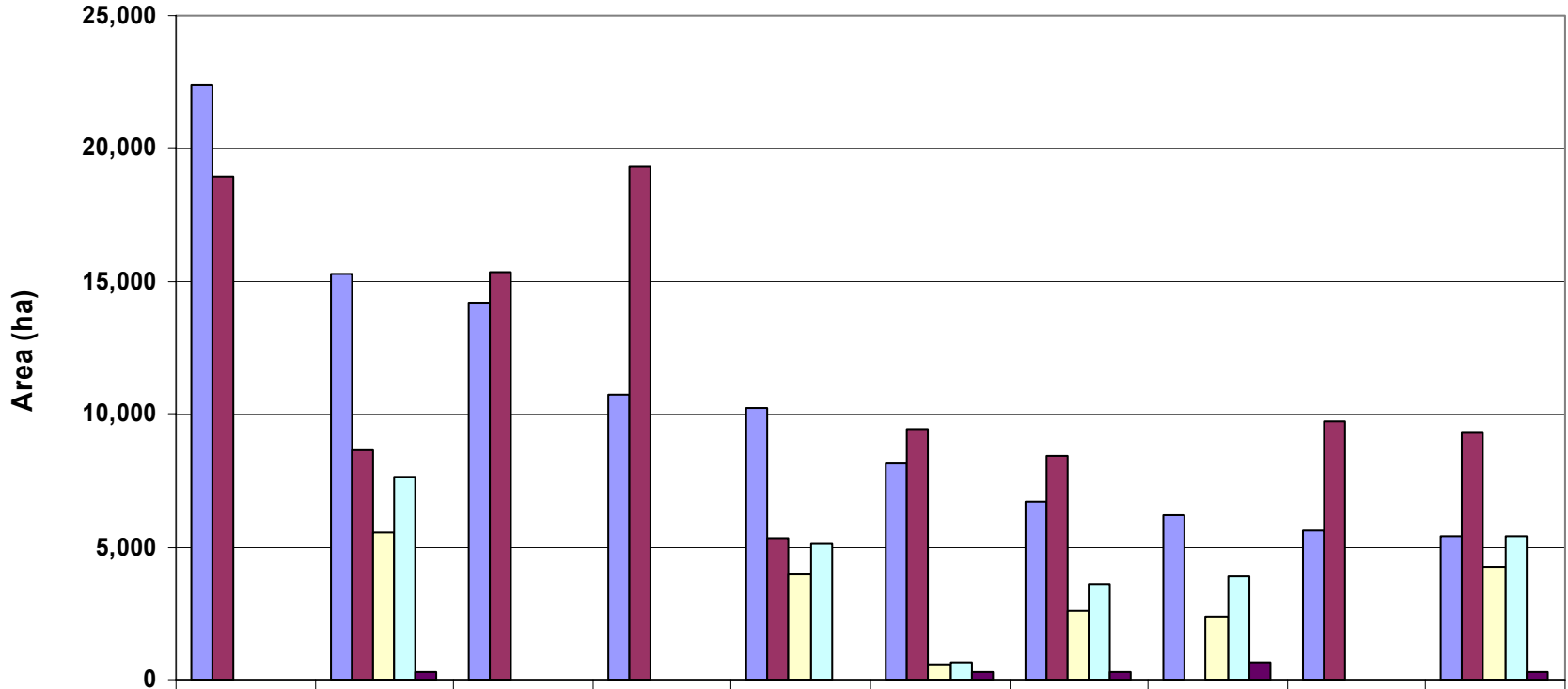


Top 10 clusters off fire polygons, based on MODIS hotspots



MODIS AVHRR ATSR1 ATSR2 GOES

Top 10 clusters off fire polygons, based on AVHRR hotspots

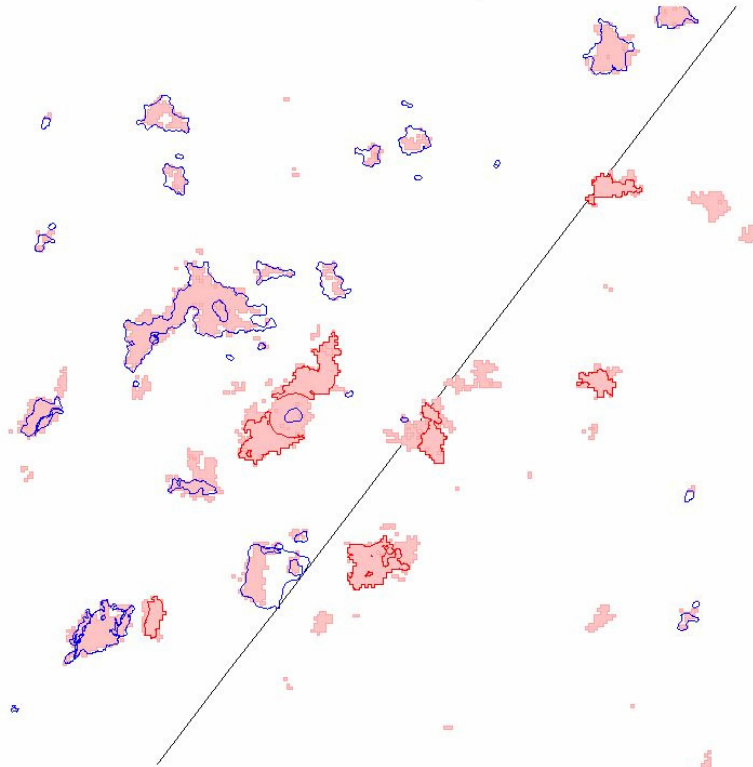


	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10
AVHRR	22,424	15,267	14,173	10,748	10,201	8,116	6,693	6,179	5,646	5,403
MODIS	18,960	8,680	15,380	19,277	5,311	9,411	8,395		9,713	9,329
ATSR1		5,551			3,932	567	2,599	2,382		4,272
ATSR2		7,608			5,127	676	3,578	3,891		5,430
GOES		313				313	313	624		313

AVHRR MODIS ATSR1 ATSR2 GOES

MODIS Top 10 Clusters off Fire Polygons

Near boundary of Manitoba and Ontario



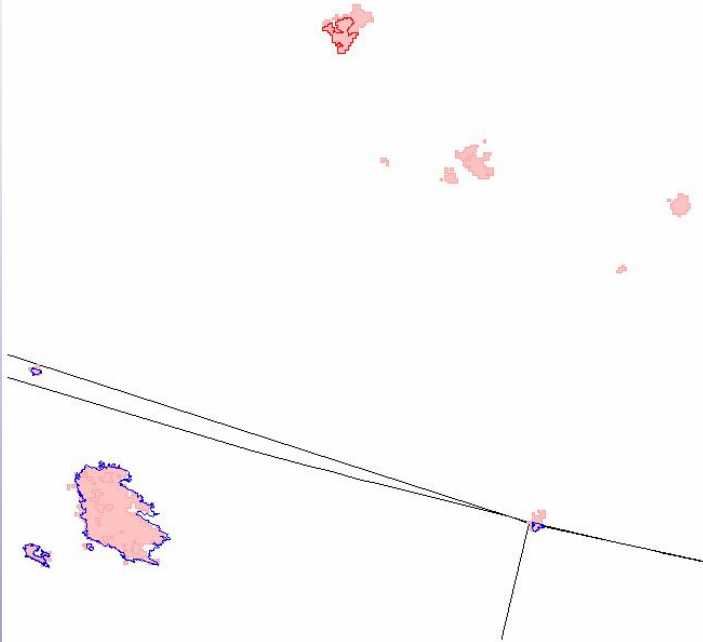
AVHRR top 10 Clusters off Fire Polygons

Near boundary of Manitoba and Ontario



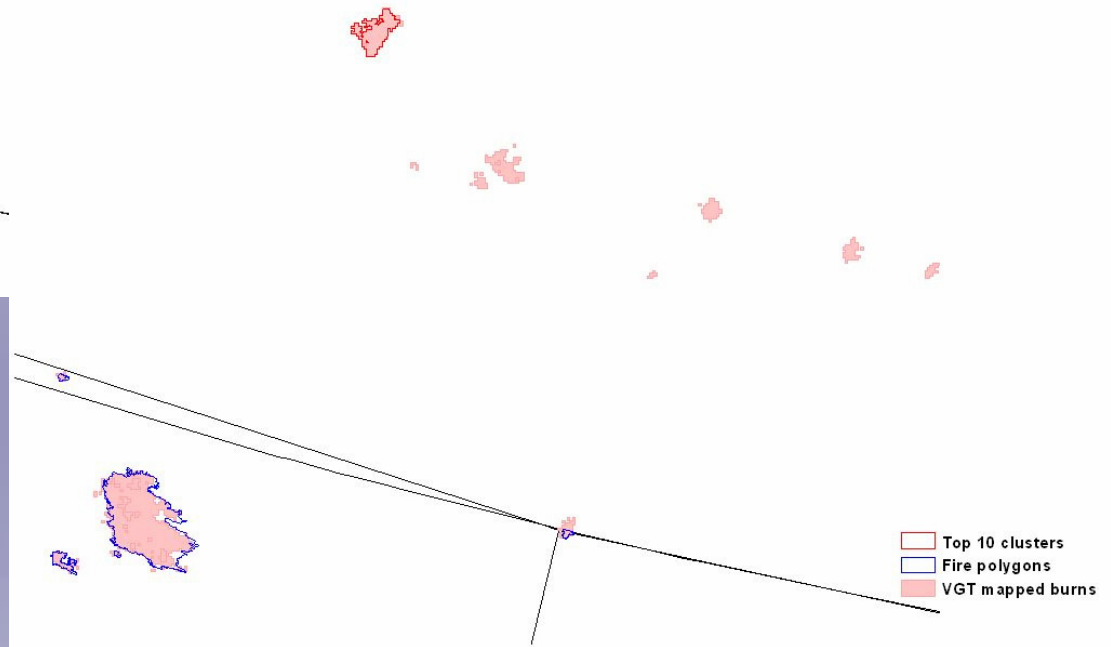
MODIS Top 10 Clusters off Fire Polygons

Near boundary of Alberta and NWT



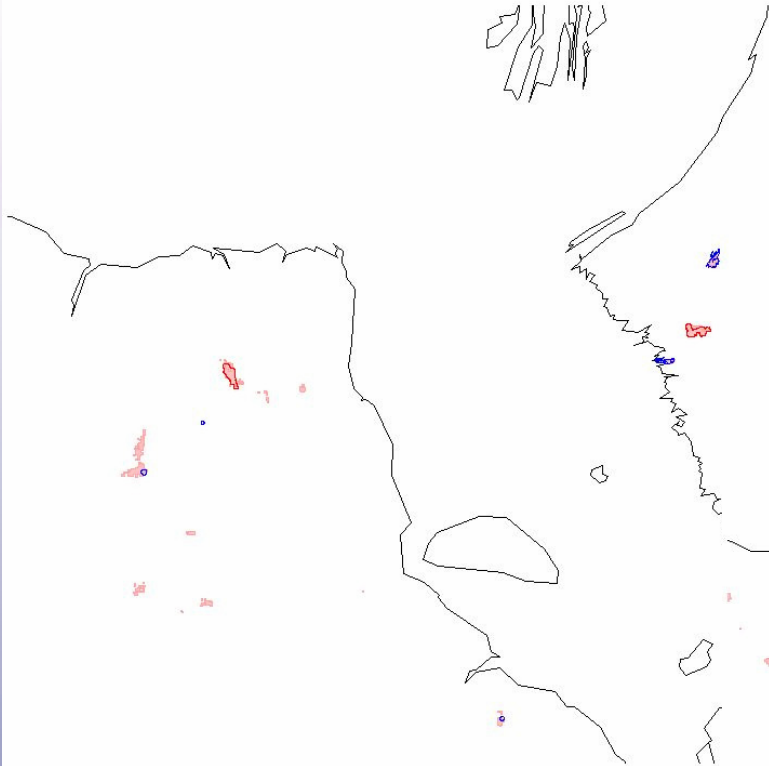
AVHRR top 10 Clusters off Fire Polygons

Near boundary of Manitoba and Ontario



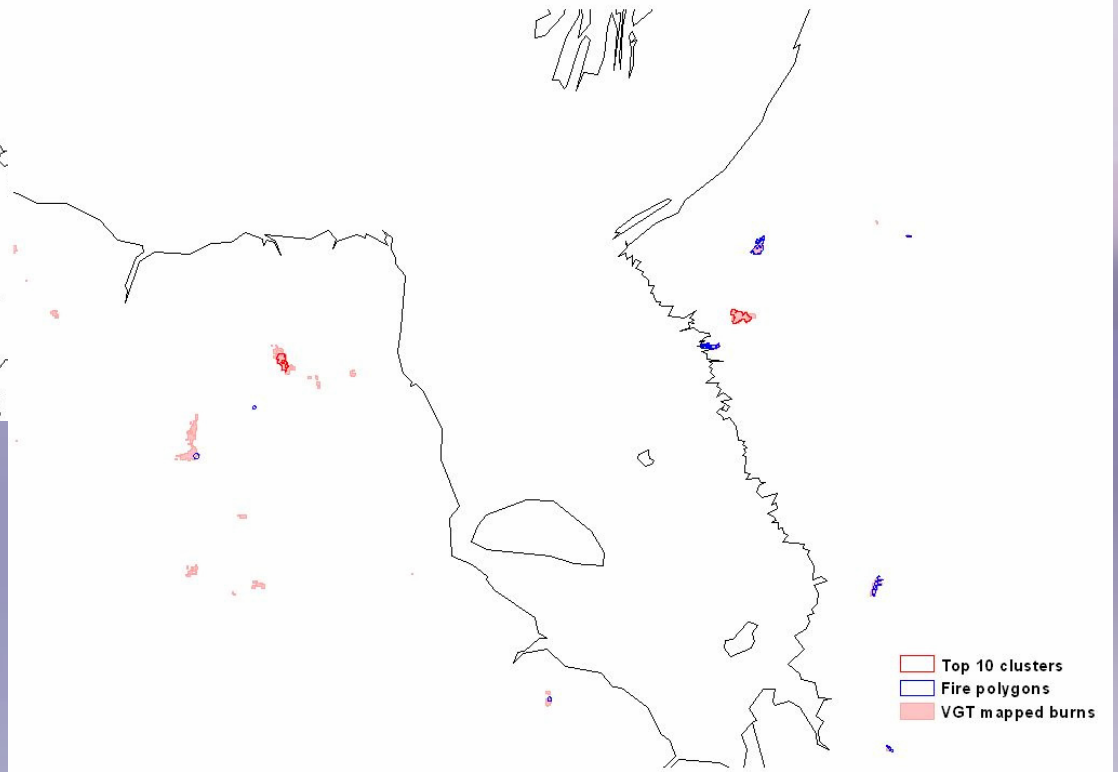
MODIS Top 10 Clusters off Fire Polygons

Ontario and Quebec

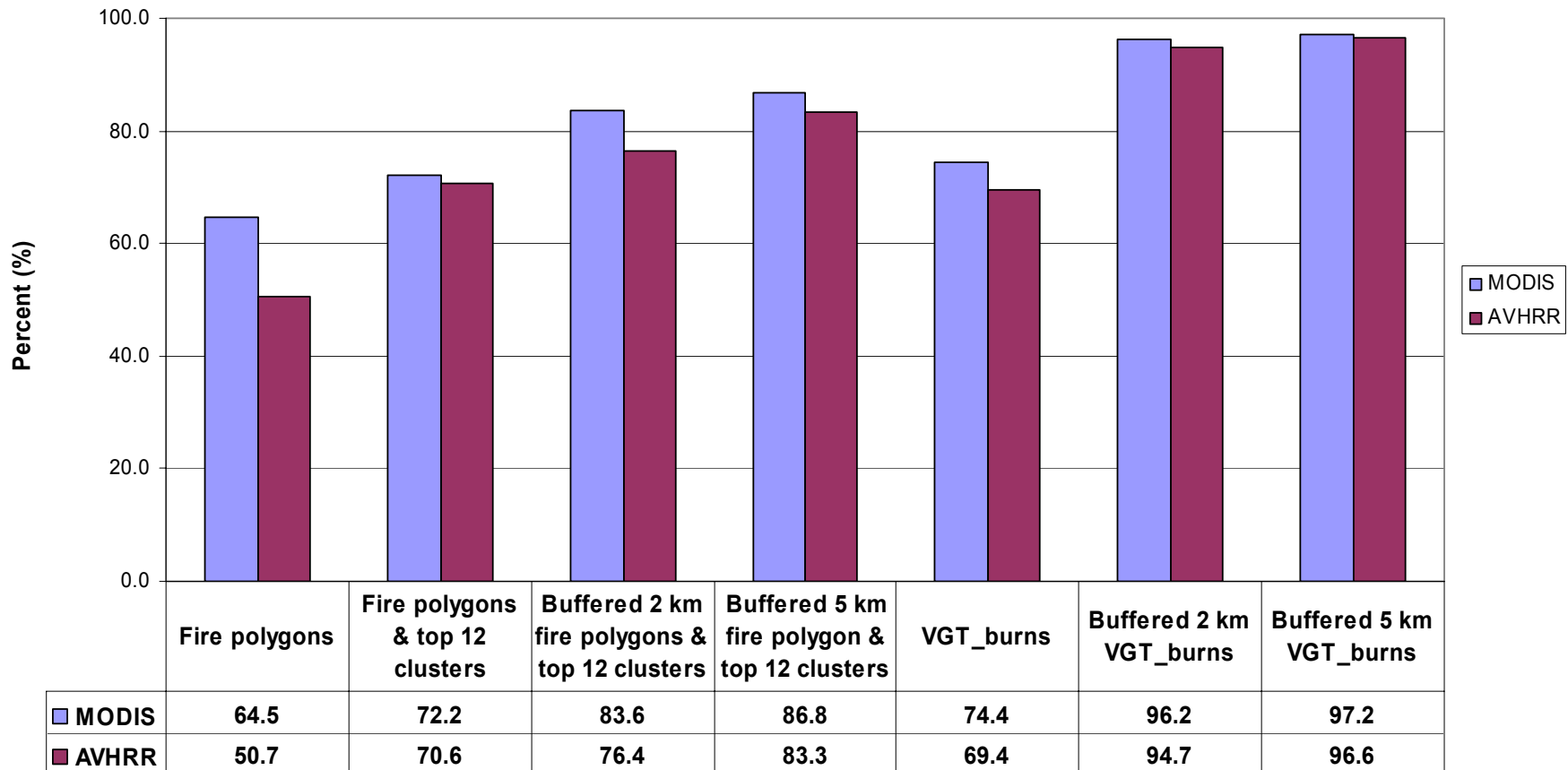


AVHRR top 10 Clusters off Fire Polygons

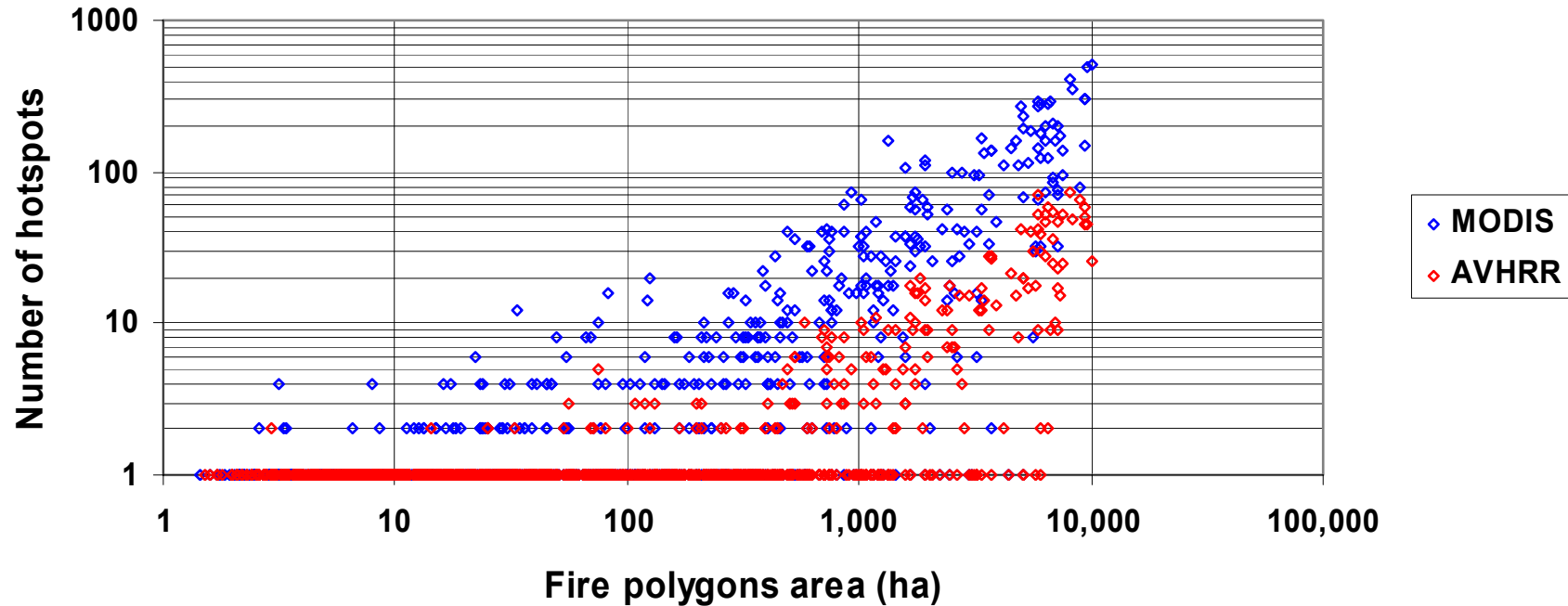
Ontario and Quebec



Hotspots (%) within fire polygons or VGT burns for MODIS and AVHRR in 2003



Fire polygons area vs. Hotspots for MODIS and AVHRR in 2003



Conclusions

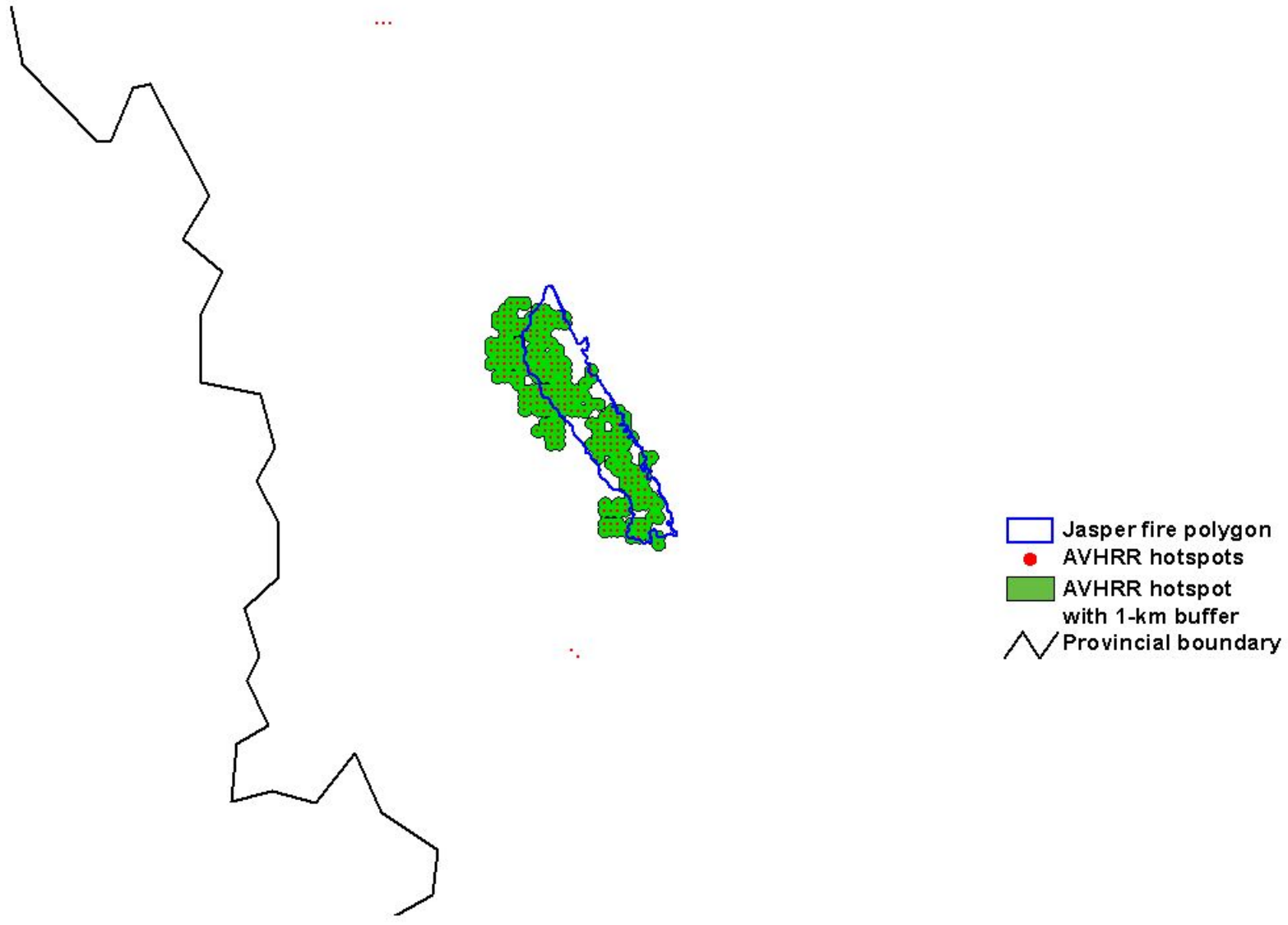
1. Commission errors in the large size classes is an indication that large fire polygons are missing (we found 650,000 ha of missing fire polygons in 2003).
2. GOES agreement is the lowest of all satellites and may be due to:
 - the coarse pixel res. (4 km or larger),
 - oblique viewing angle of fires above 55°N,
 - a requirement for algorithm tuning for boreal fires.
3. MODIS has the highest agreement among the satellite sensors.

Conclusions (cont'd)

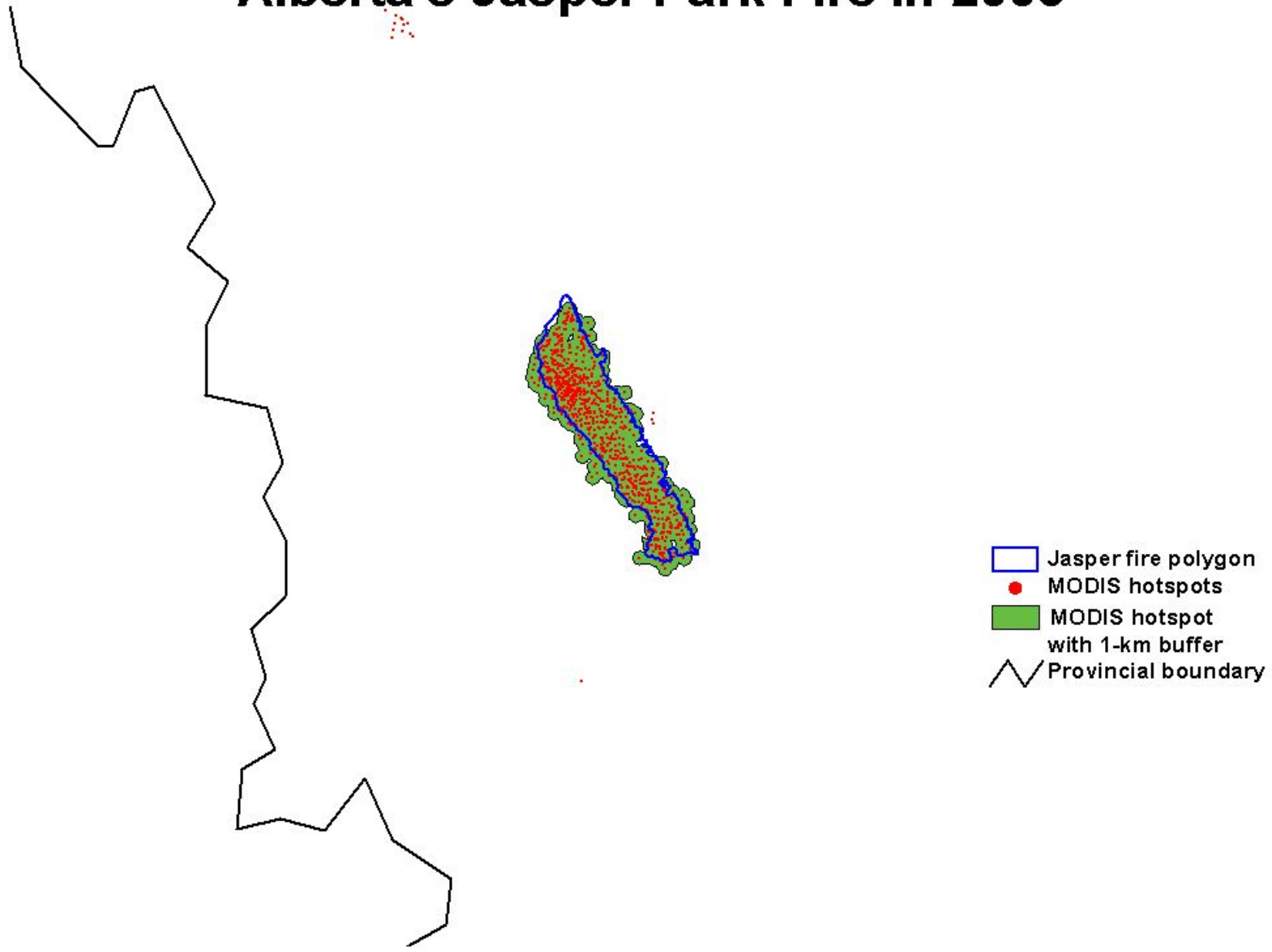
4. AVHRR has a greater commission error than MODIS that might be due to geoprocessing of the raw data.



Alberta's Jasper Park Fire in 2003



Alberta's Jasper Park Fire in 2003



Conclusions (cont'd)

5. ATSR has a low commission error, similar to MODIS, but its lower revisit time delivers higher omission errors than MODIS or AVHRR.
6. For Canada, the minimum strategy for hotspot monitoring should include MODIS, AVHRR, and ATSR.
7. Due to attractive repeat coverage offered by GOES, we are continuing to look at its utility.
8. The errors do not appear to vary between the major land cover types.

