



Two decades of AVHRR and MODIS satellite data records over Canadian Prairies at 250m-1km spatial resolution

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Goal of CCRS Project/Contribution to DRI

- Work is part of NRCan/ESS Program “ **E**nhan**C**ing **R**esilience in a **C**hanging **C**limate (**ERCC**)”
- It is a component of project **J35** “Earth Science for National Scale Characterization of Climate Change Impacts on Canada’s Landmass” of the **ERCC** Program
- Objectives/contribution are twofold:
 - provide DRI Science Team with long-term satellite data records suitable for characterization of droughts, model simulations and validation;
 - to learn from DRI science team, use results and new knowledge to achieve project objectives and deliver better products and information.





Parameters of terrestrial ecosystems required by Global Climate Observing System (GCOS) (2006) (GCOS-107, WMO/TD-1338)

Altogether, there are 16 parameters identified by GCOS that can be retrieved from satellite data from observations in optical, thermal and microwave bands. We are presently targeting 11 parameters listed in the Table below. Albedo is one the most fundamental parameters

| Parameter | Spatial resolution | Obs. cycle | Req. Accuracy | Min accuracy |
|-------------------------------------------------------------------------|--------------------|------------|-------------------|--------------------|
| Surface Albedo | 250m | 1day | 5% | 10% |
| Surface radiation budget (SW and LW) | 25km | 3h-1day | 5Wm ⁻² | 10Wm ⁻² |
| Land cover (incl. vegetation type) | 10m-1km | 1yr | 5% | 10% |
| Leaf Area Index (LAI) | 250m | 1day | 5% | 10% |
| Fraction of Absorbed Photosynthetically Active Radiation (fAPAR) | 0.1-2km | 10day | 5% | 10% |
| Snow/ice cover | 250m | 1day | 5% | 10% |
| Fire disturbance | 250m | 30d | 5% | 10% |
| Biomass | 250m | 1d | 5% | 10% |
| Wetland extent | 250m | 7d | 5% | 10% |
| Glaciers and ice caps extent * | 0.01-0.1km | 1yr | 5% | 10% |
| Lake level/extent* | 0.01-0.1km | 7d | 5% | 10% |

* Presently can be derived at 0.25-1km spatial resolution





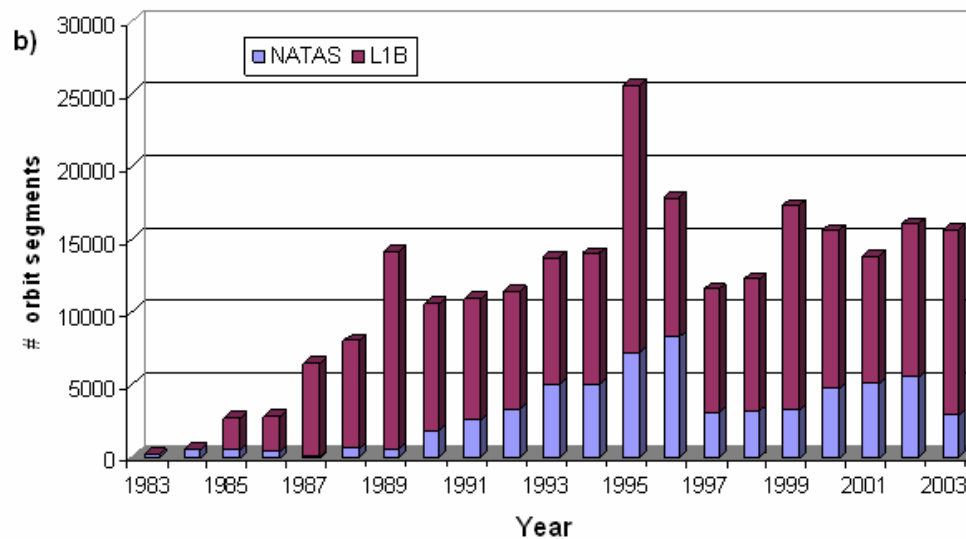
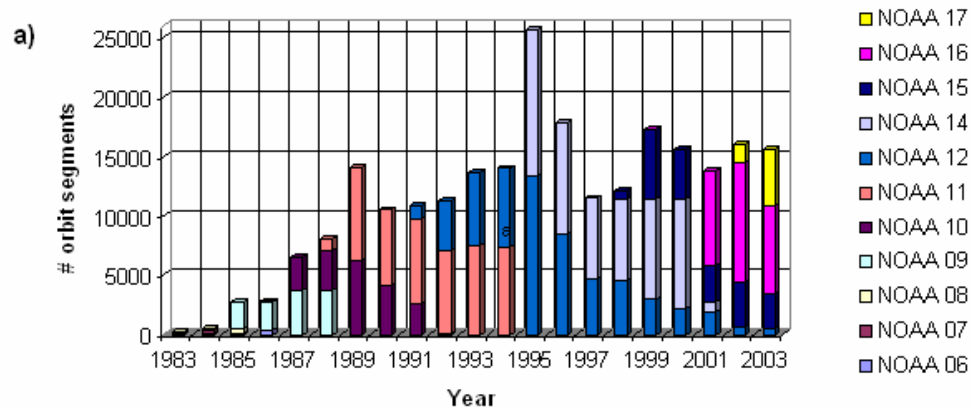
Major sources of data

- **Advanced Very High Resolution Radiometer (AVHRR)**
 - 5 or 6 channel radiometer (optical and thermal)
 - 1-km spatial resolution
 - Data available since 1979 (complete record since 1985), starting from NOAA-8 to NOAA-18 (and now on METOP)
- **Moderate Resolution Imaging Spectroradiometer (MODIS)**
 - 36 spectral channels,
 - 29 channels at 1km
 - 5 channels at 500m
 - 2 channels at 250m
- **Goal** – to produce long-term consistent satellite based time series of land products suitable for climate change impact studies. 30 year time span is required to produce climate norms.



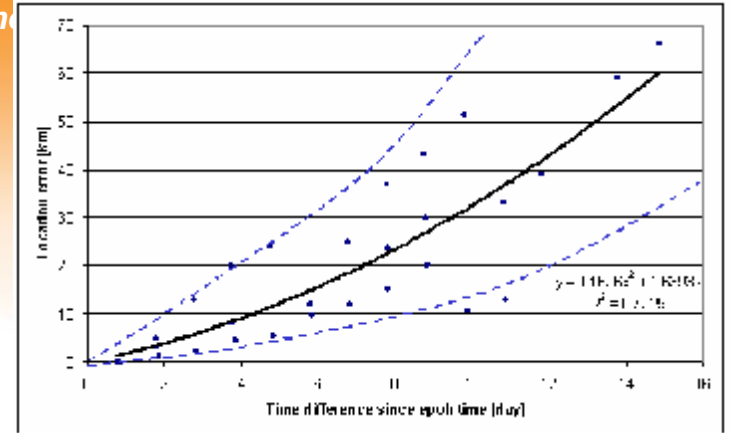
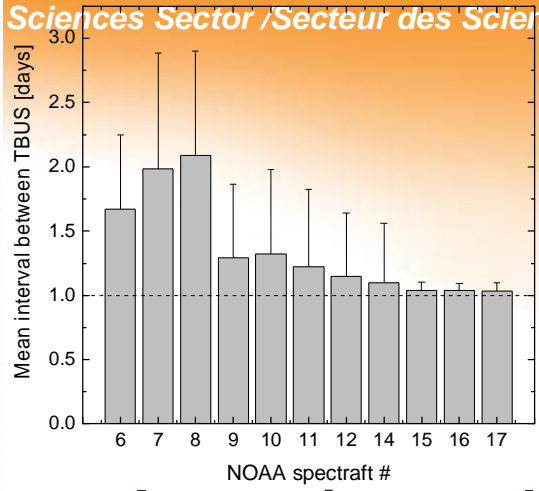
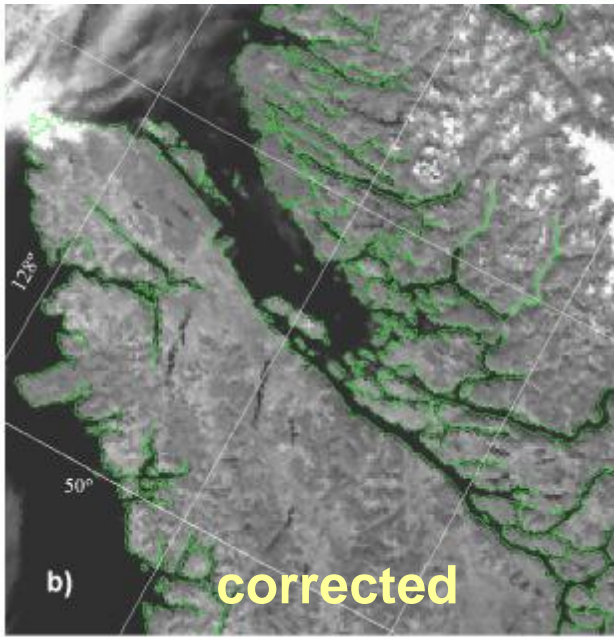
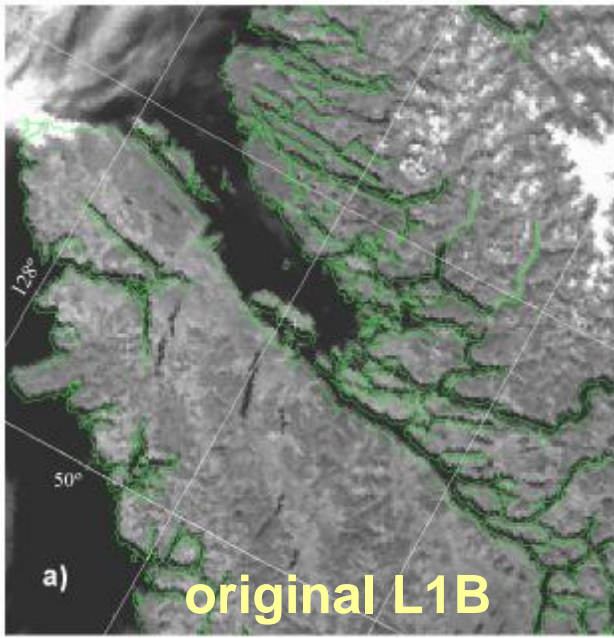


Data volume: >300,000 scenes over Canada

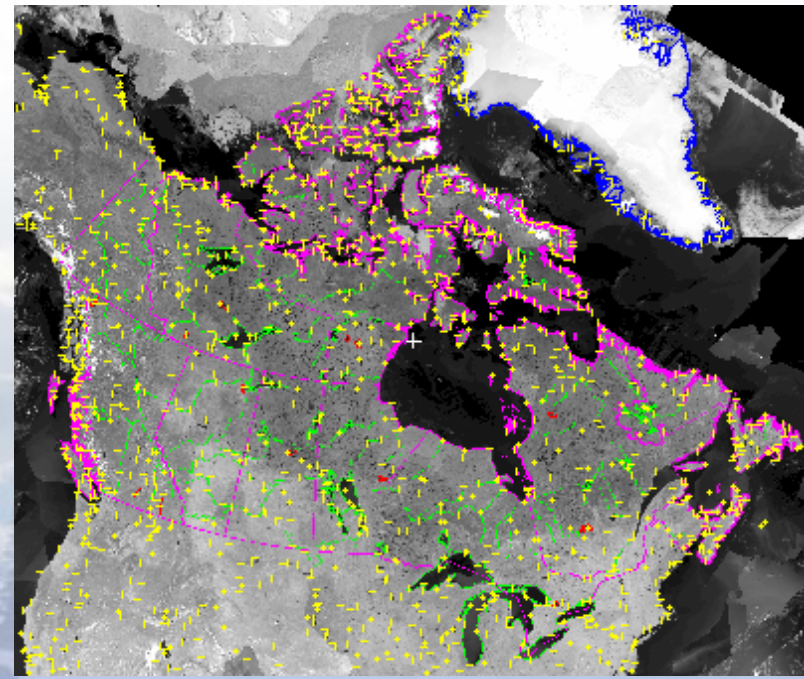


~ 20 TB of
raw/L1B data
processed with new
CCRS developed
data processing
system





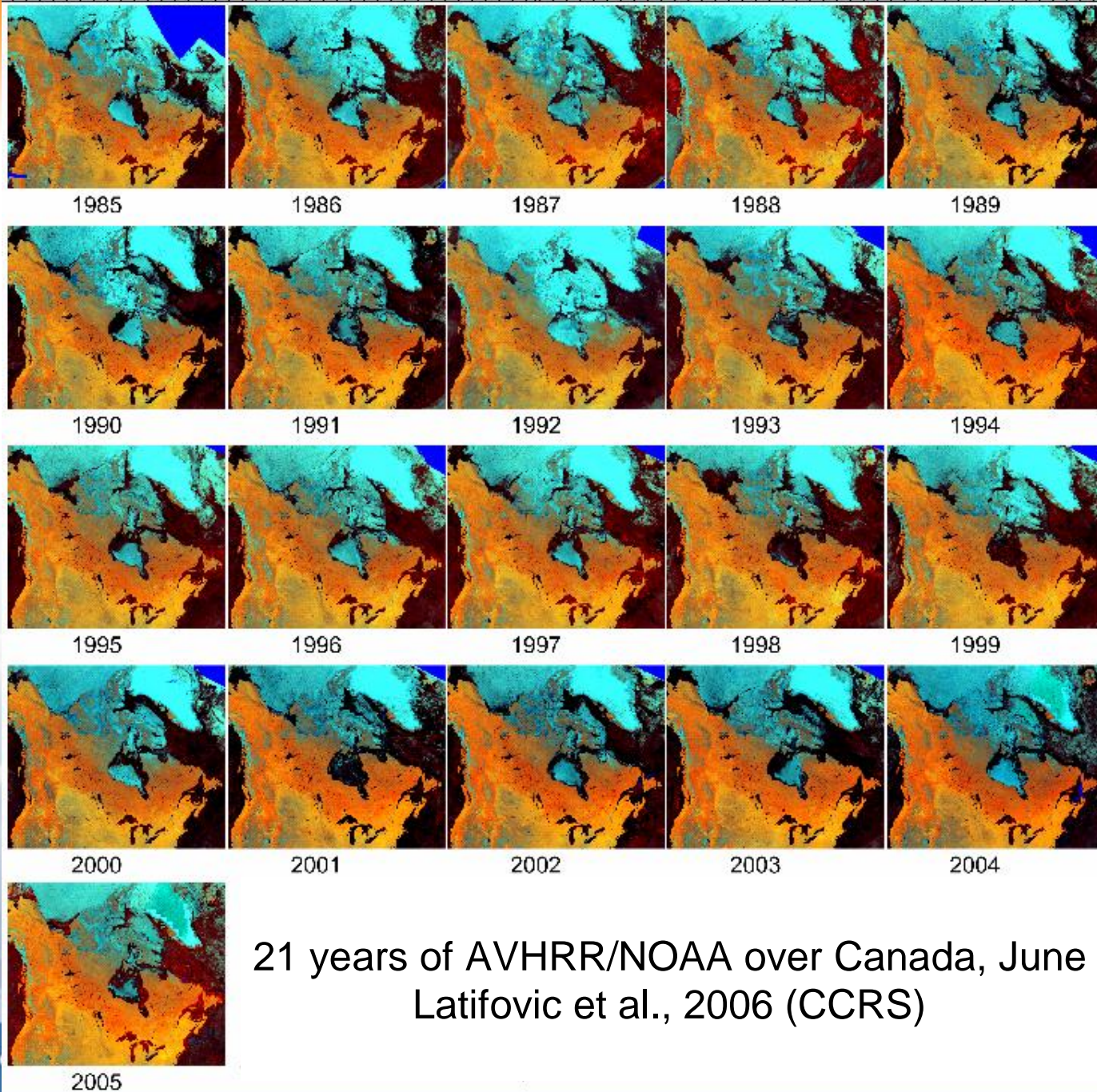
Improving geolocation accuracy: chip matching quadratic fit for every scene



New:
 GCP database
 cloud detection
 compositing
 atm correction
 product algorithm
 60 CPU system



Enhancing Resilience in a Changing Climate/ Renforcer la résilience en face de changements climatiques



21 years of AVHRR/NOAA over Canada, June Latifovic et al., 2006 (CCRS)



Mapping Canada's territory at 250-m spatial scale from MODIS

CCRS product (under development)

- MODIS imagery covers entire country;
- It is generated at 10-day time intervals (better cloud screening) from L1B swath data (no ISIN projection);
- Contains 7 spectral bands: VIS and NIR [0.85 μm] + 5 more channels down-scaled from 500m to 250m. Very rich spectral and detailed spatial information for land cover classification;
- Product is generated from original swath imagery and retains all spatial details;
- Better cloud screening and improved atmospheric correction are under development;
- Objective: to generate 1-day and 10-day Canada-wide coverage at 250m spatial resolution for monitoring of land mass dynamics and land cover changes;
- 22800 x 19200 pixels (~825Mb for 1 layer): large data volume

Trishchenko et al *SPIE*, 6366, 2006





MODIS L1B swath data



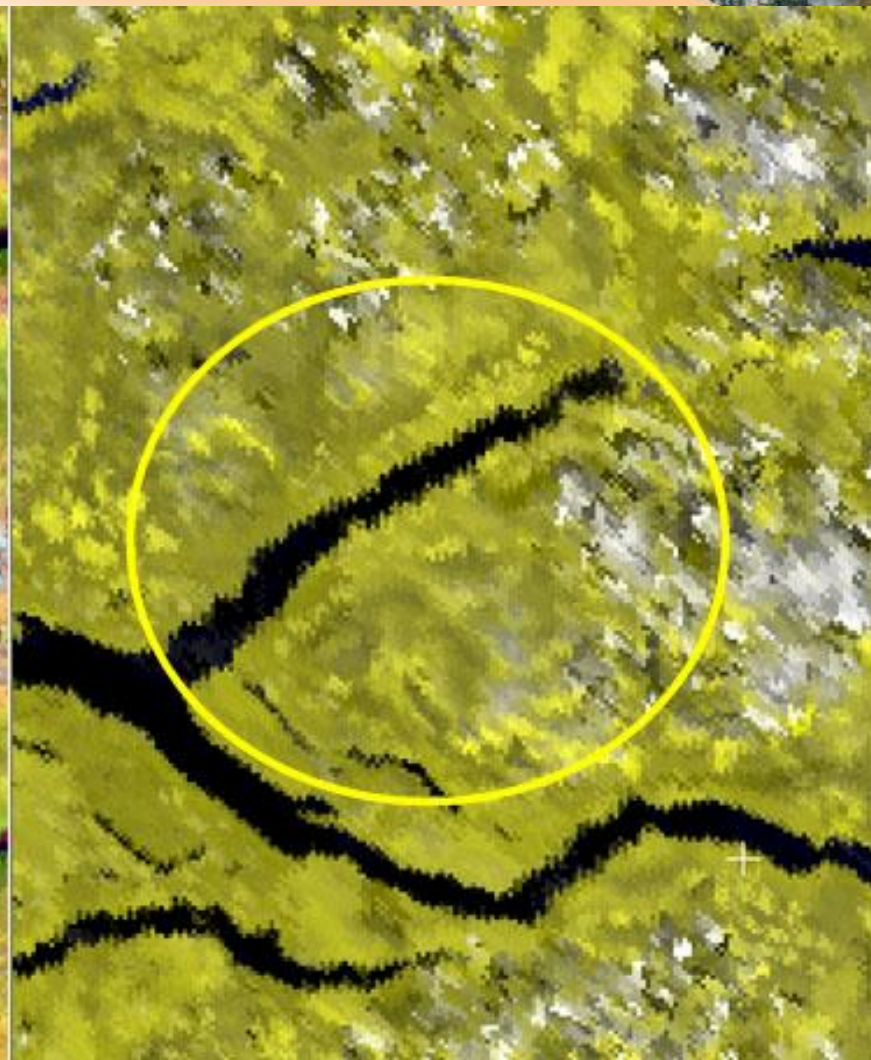
- 40 detectors scan at 250m
- 20 detectors scan at 500m
- 10 detectors scan at 1km





New CCRS product

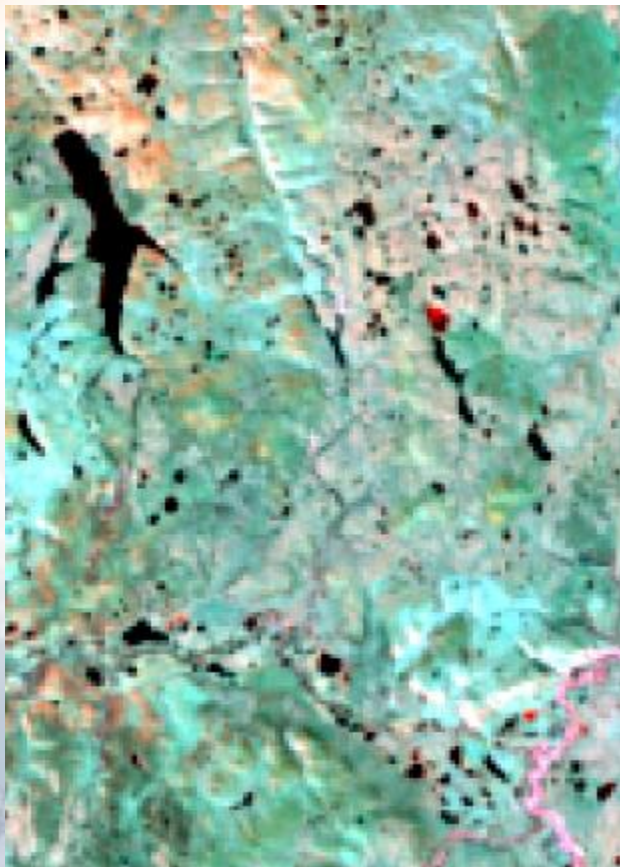
Standard Product



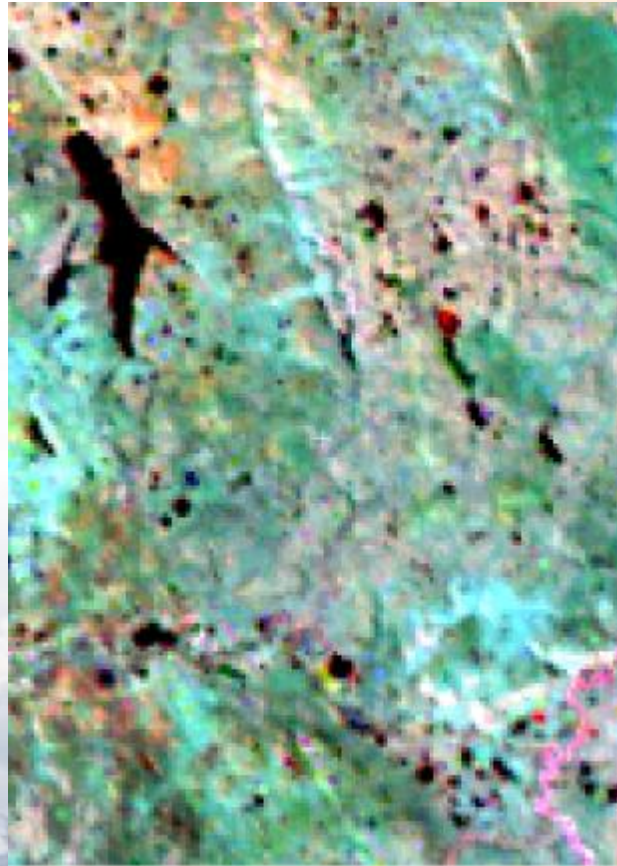


Comparison MODIS-Landsat

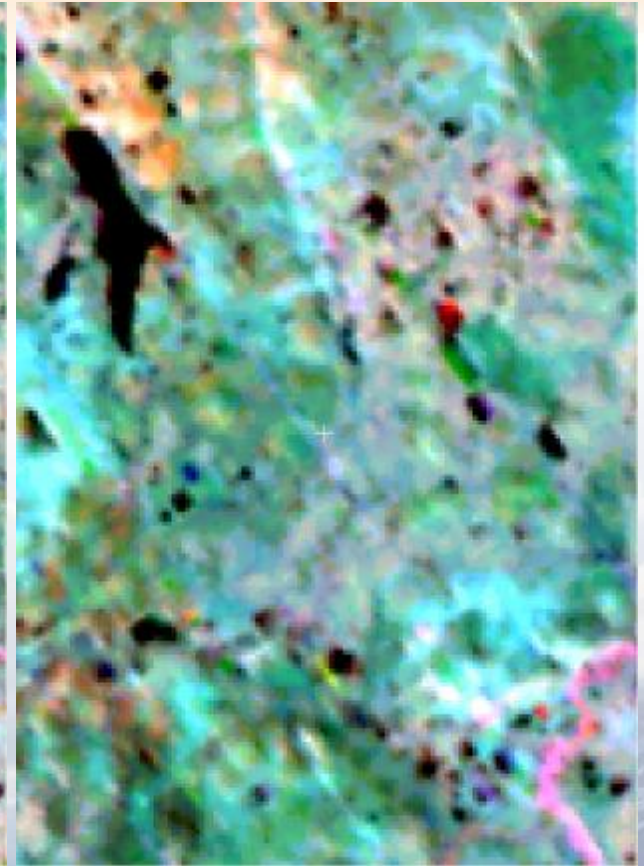
Landsat aggregated to 250m



MODIS 250m

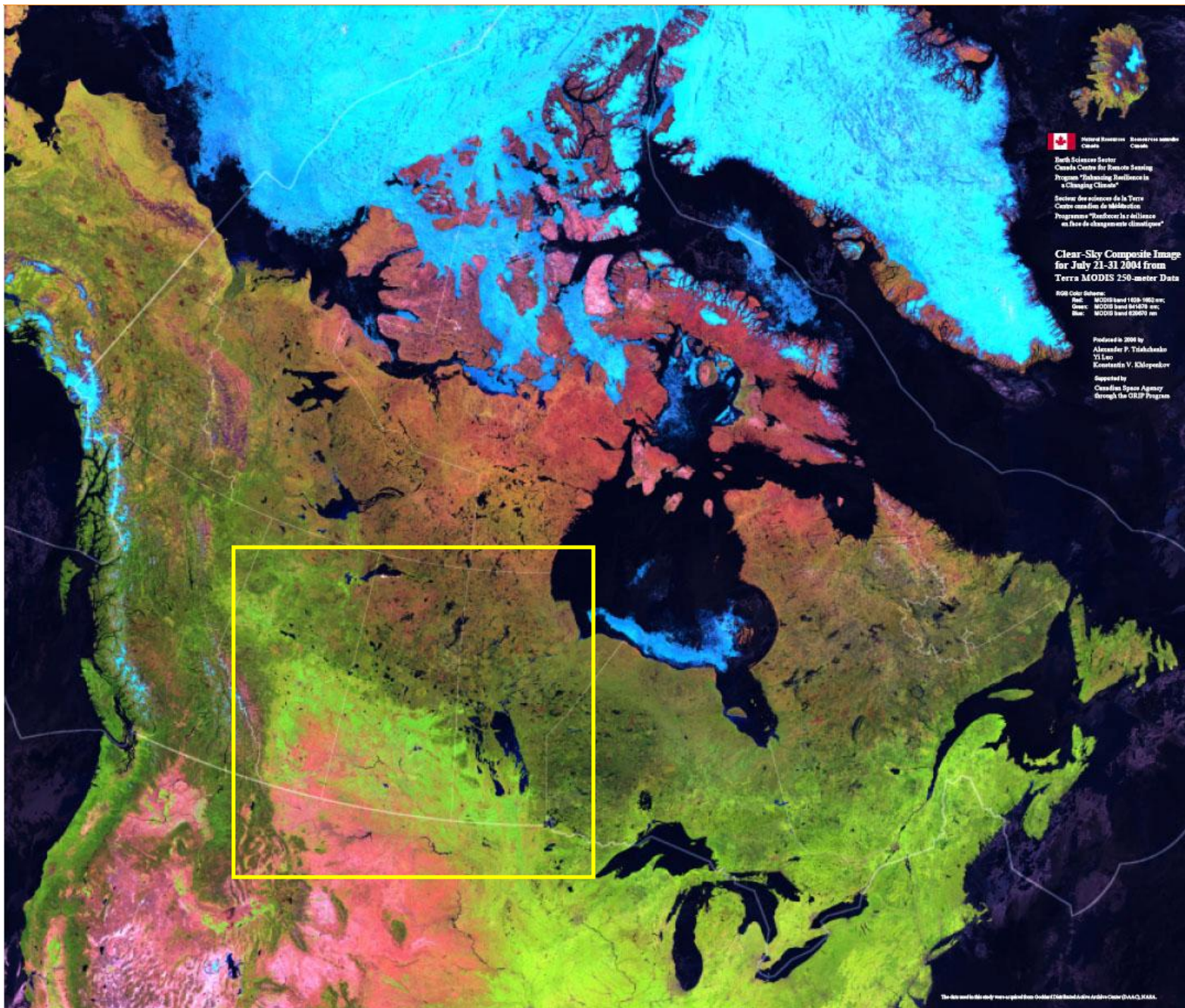


MODIS 500m



R-B4 (0.55 μ m) G-B6 (1.6 μ m) B-B7 (2.1 μ m)





Natural Resources Canada / Ressources naturelles Canada

Earth Science Sector
Canada Centre for Remote Sensing
Program "Understanding Resilience in a Changing Climate"
Service des sciences de la Terre
Centre canadien de télédétection
Programme "Resilience in a Changing Climate"
en face de changements climatiques"

Clear-Sky Composite Image
for July 21-31 2004 from
Terra MODIS 250-meter Data

RGB Color Scheme:
Red: MODIS band 1 (630-1000 nm)
Green: MODIS band 2 (645-865 nm)
Blue: MODIS band 3 (660-870 nm)

Produced in 2006 by
Alexander P. Trishchenko
111 Ave
Konstantin V. Khlopenkov
Supported by
Canadian Space Agency
through the ORIP Program

Canada-wide coverage is available now at 250m spatial resolution using MODIS data processing at CCRS July 21-31, 2004

Trishchenko et al., 2006



Natural Resources Canada

Ressources naturelles Canada

Canada

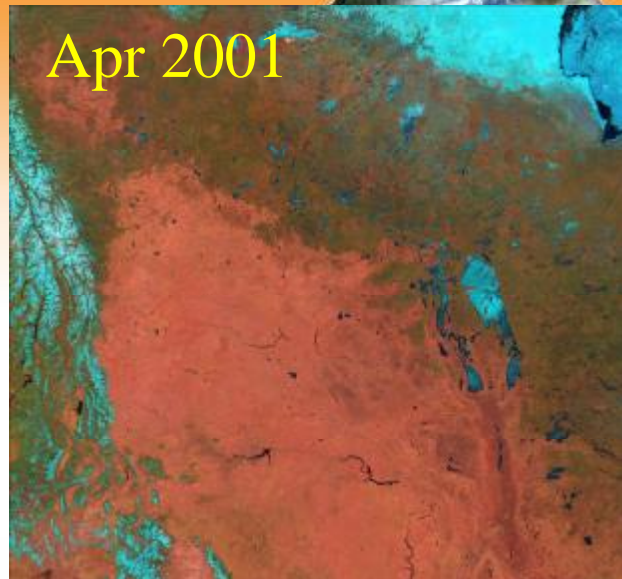
Feb 2001



Mar 2001

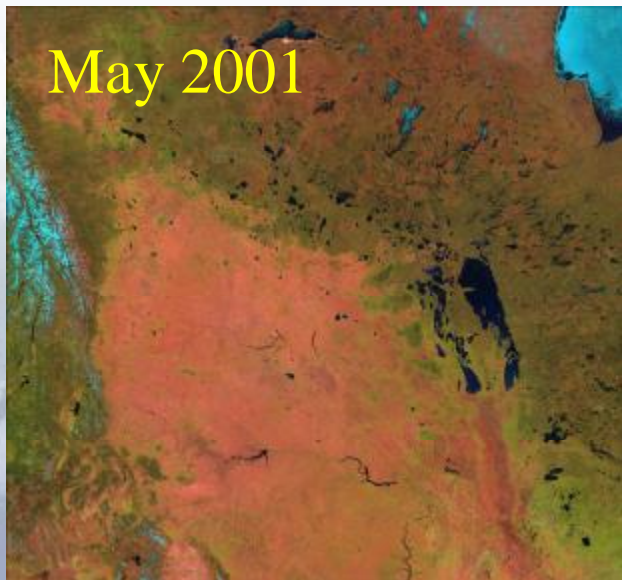


Apr 2001

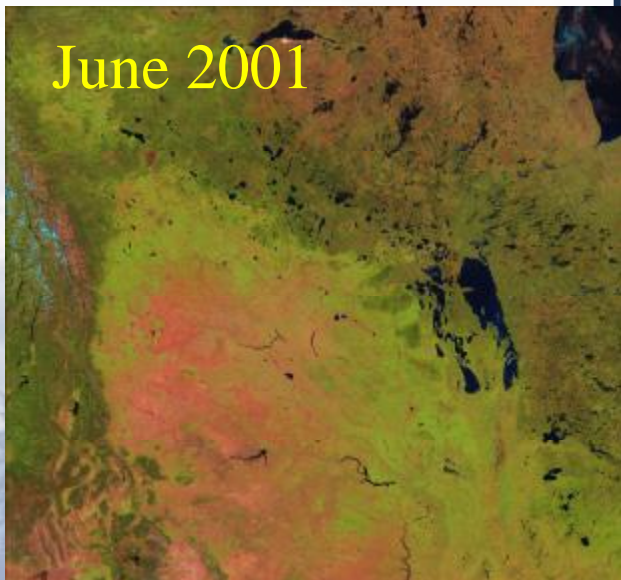


Prairies from MODIS at 250m spatial resolution

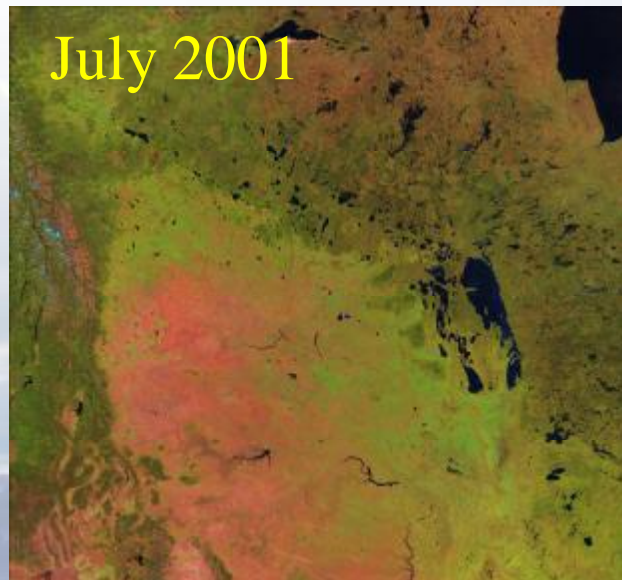
May 2001



June 2001



July 2001

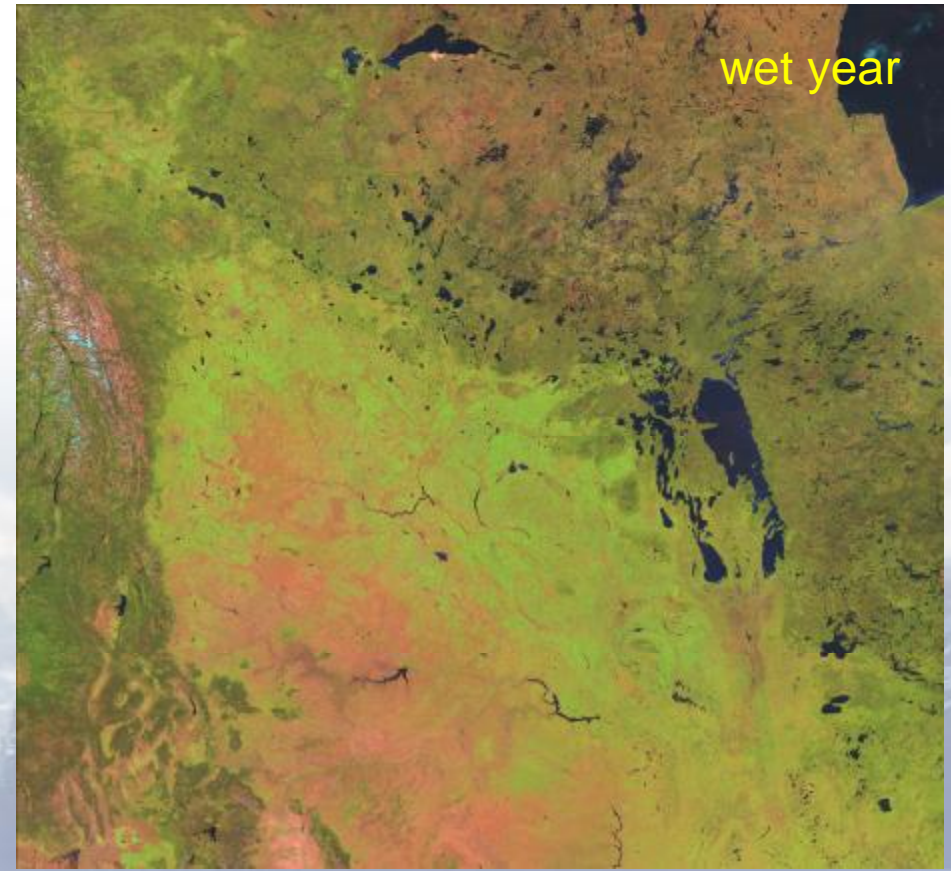
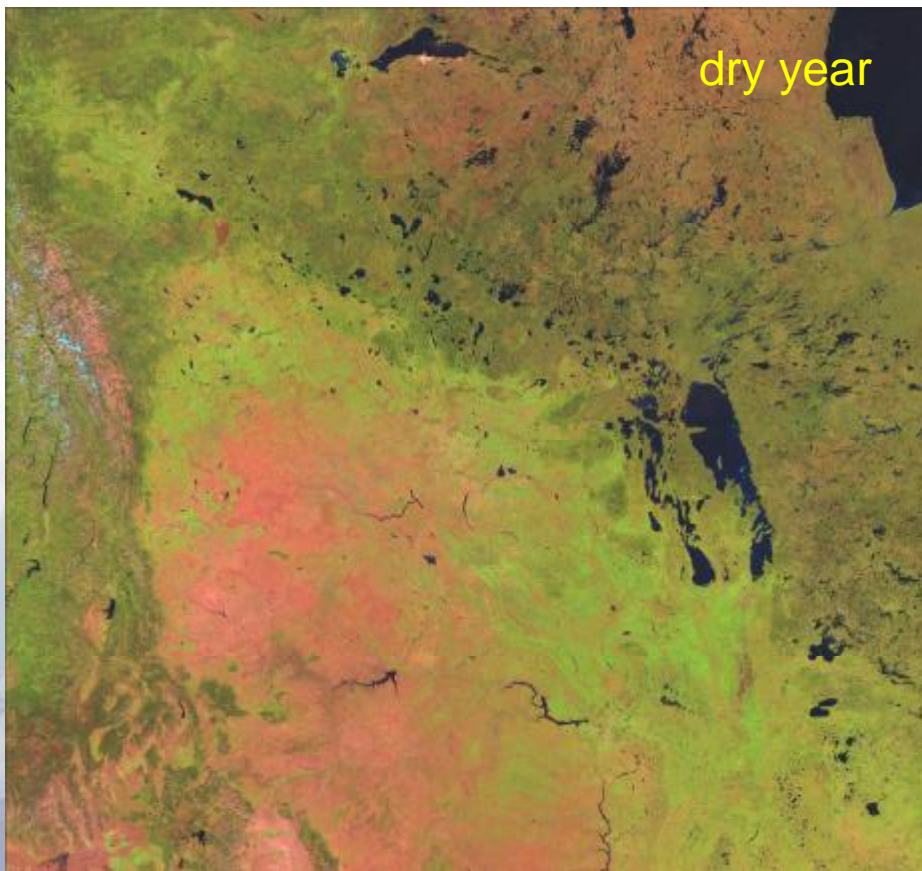




MODIS 250-m imagery

July 10-21, 2001

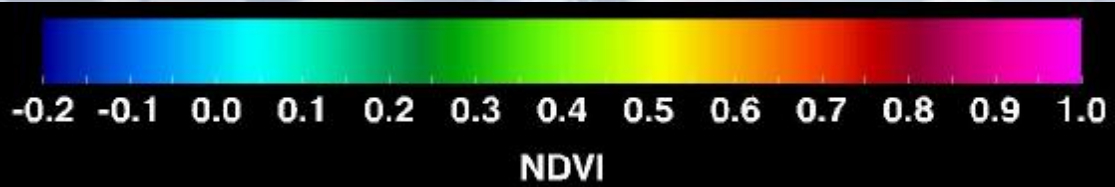
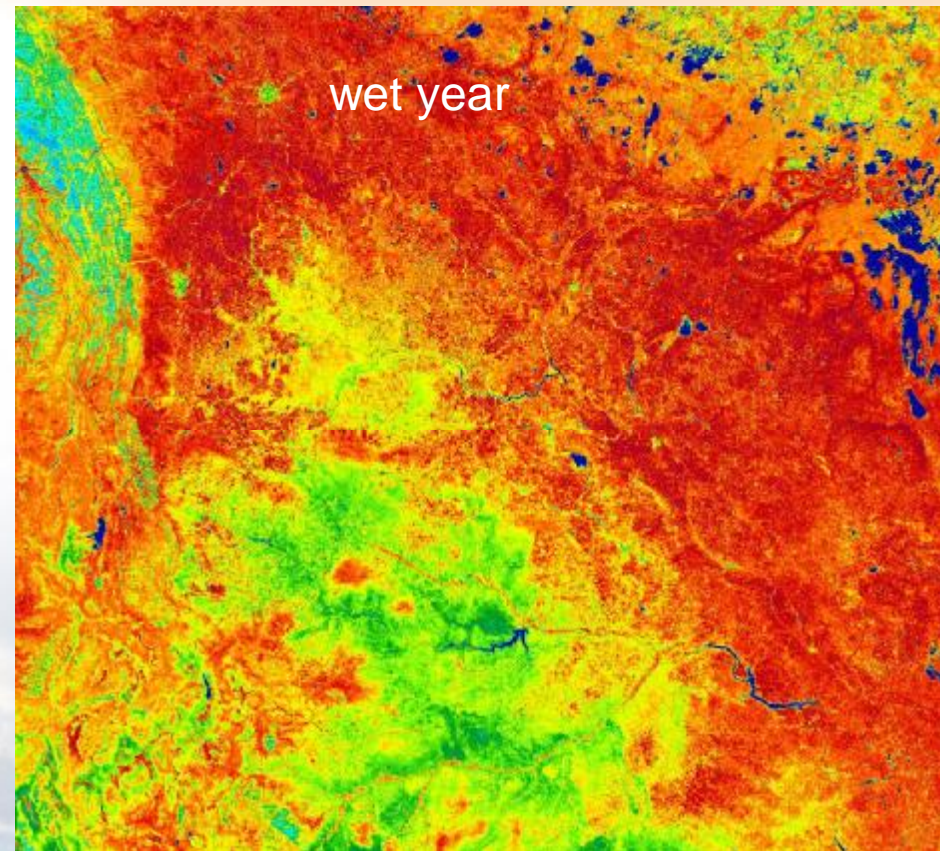
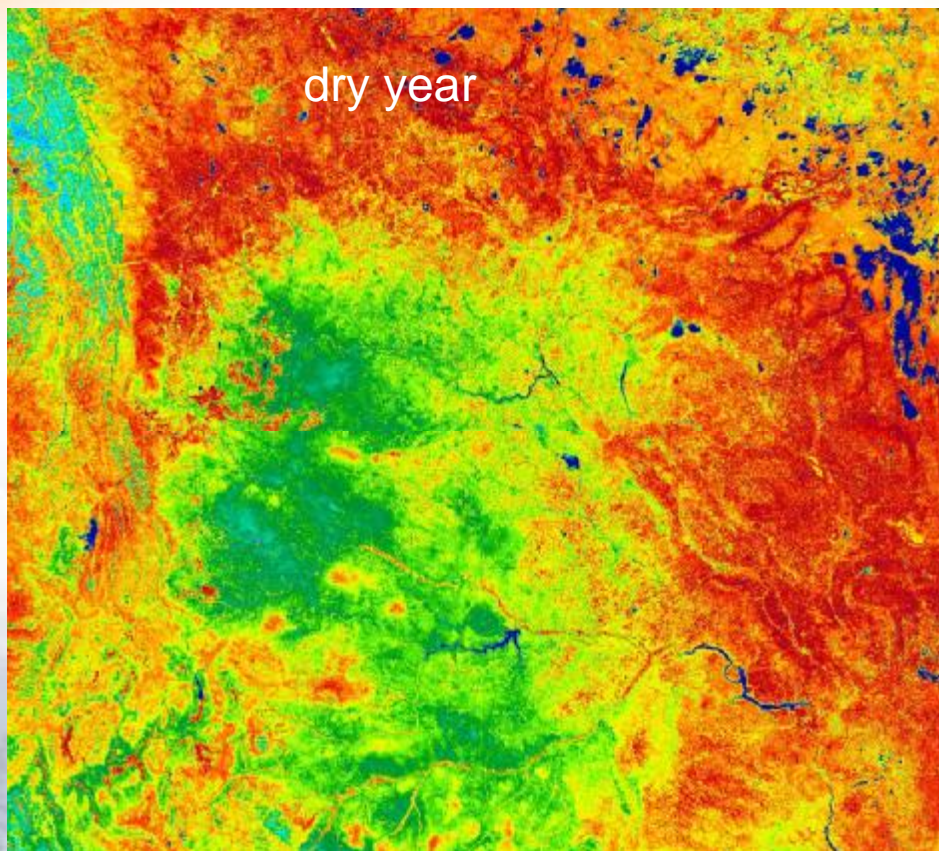
July 10-21, 2006





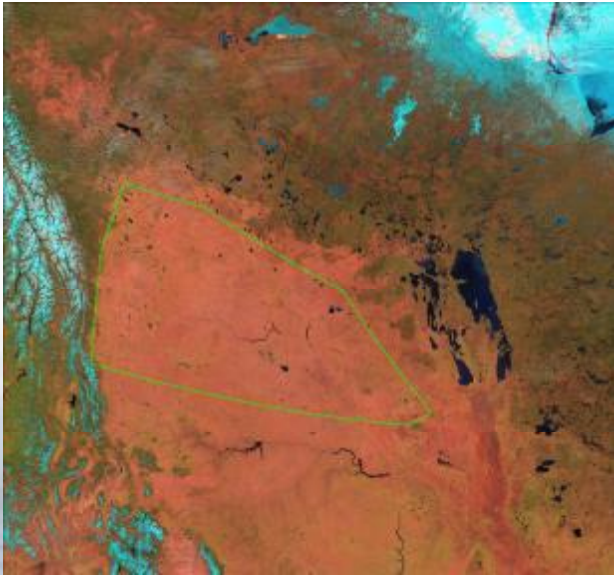
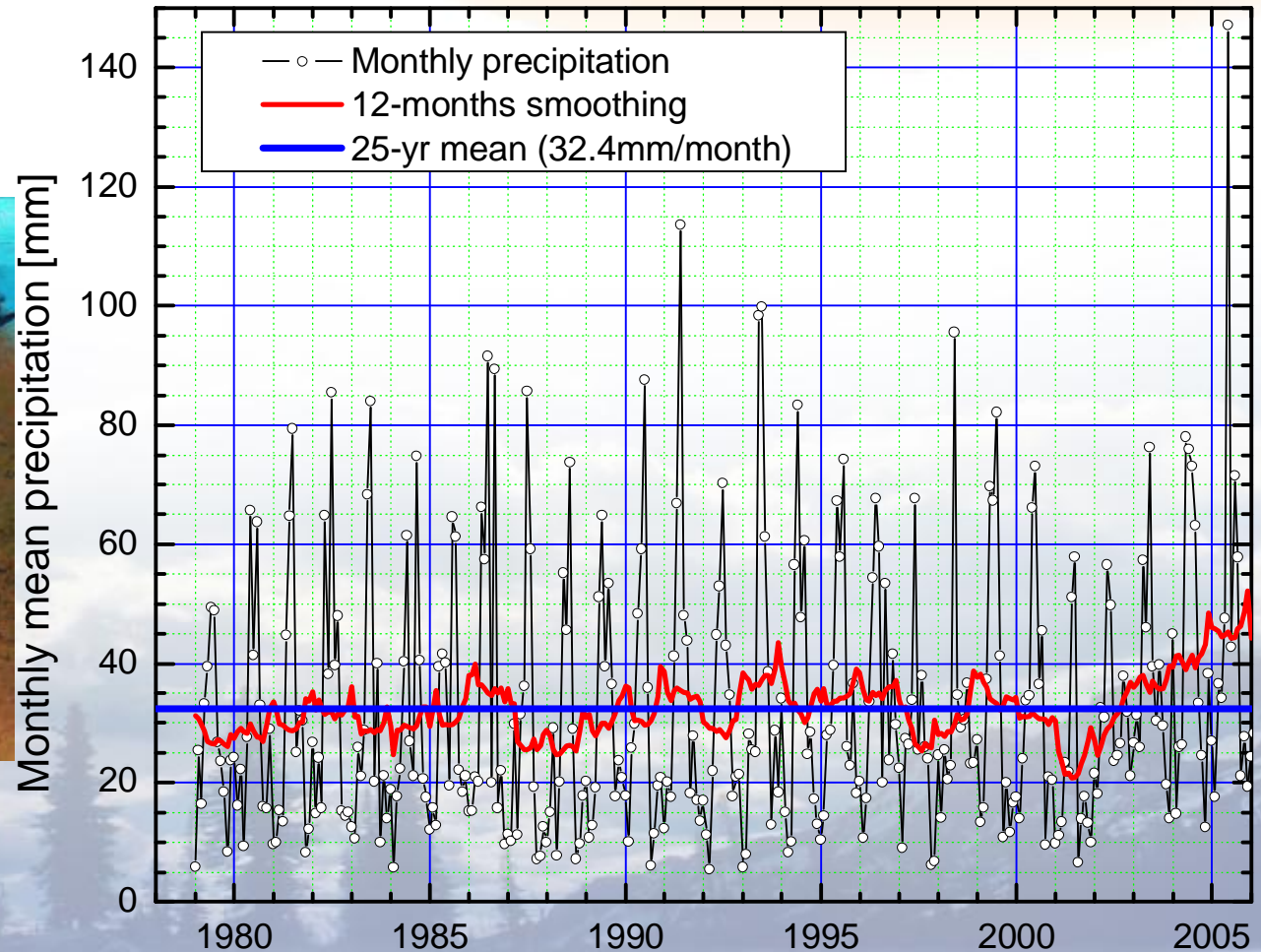
July 10-21, 2001

July 10-21, 2005



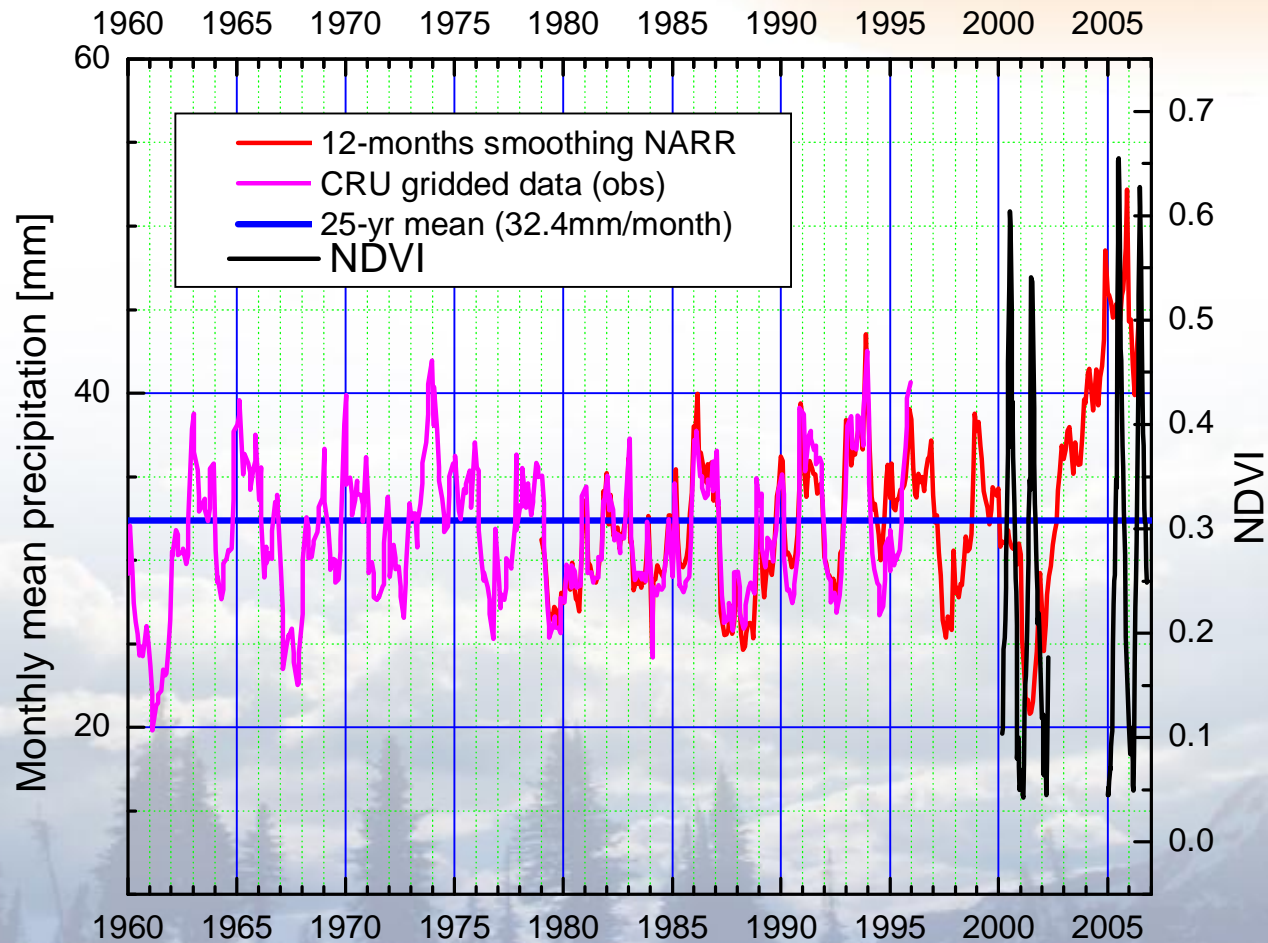


North American Regional Reanalysis NARR Precipitation over Prairie region

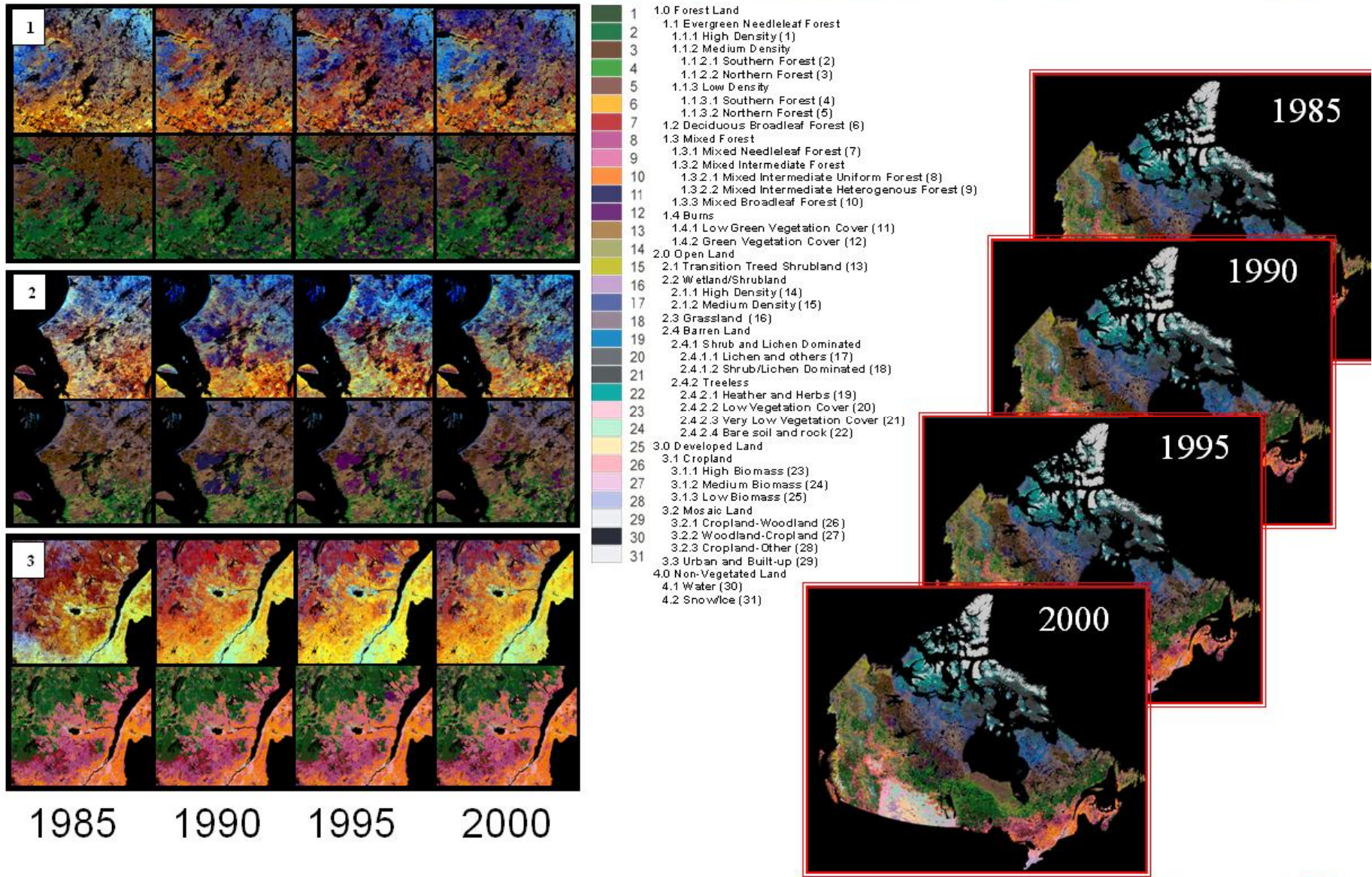




NARR vs CRU (obs.) gridded data



Temporal land cover mapping and change detection: Transition from 1-km to 250m mapping





Conclusions

- 25 years of AVHRR data over Prairie region are available. Some work on re-calibration is still required
- MODIS data are available since March 2000 (ver. 5). 2000, 2001, part of 2002, 2005, and 2006 composites are completed. Rest of 2002 and 2003-04 to be completed once v.5 processing results are available
- Data are available as a standard HDF format files
ftp://ftp.ccrs.nrcan.gc.ca/Trishchenko_DRI
- Satellite imagery is a great source of information for studying droughts in Prairie region

Acknowledgements

- Contribution from R.Latifovic, Y.Luo, K.Khlopenkov. B.Park, S.Wang and S.Guo is gratefully acknowledged.
- Some AVHRR and all original MODIS (L1B) data were acquired from the NOAA and NASA archives.
- Work is supported by the CSA under the GRIP Program.

