MODIS/NPOESS Direct Readout Active Fire Detection and Characterization

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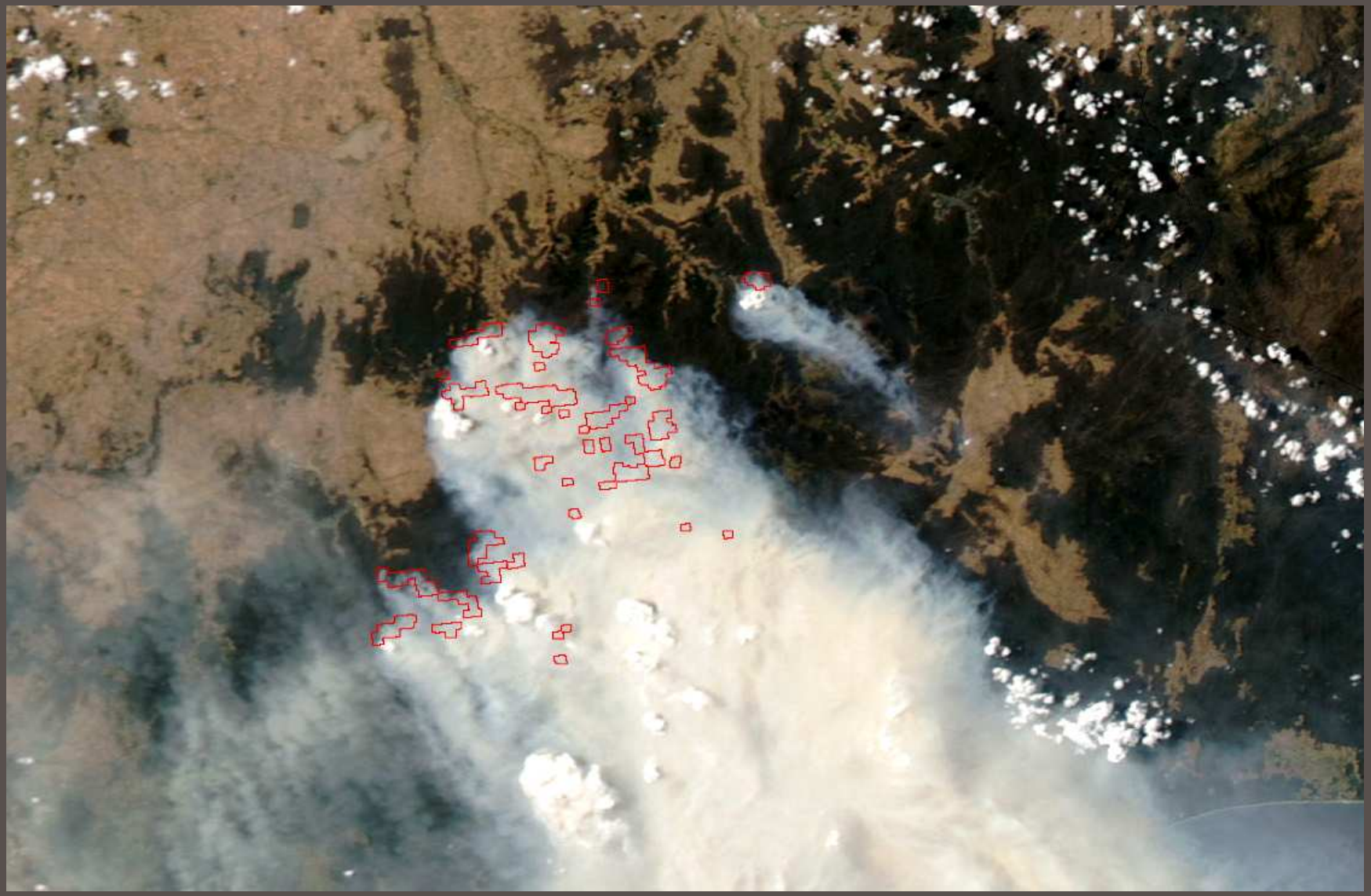
Discussion Topics

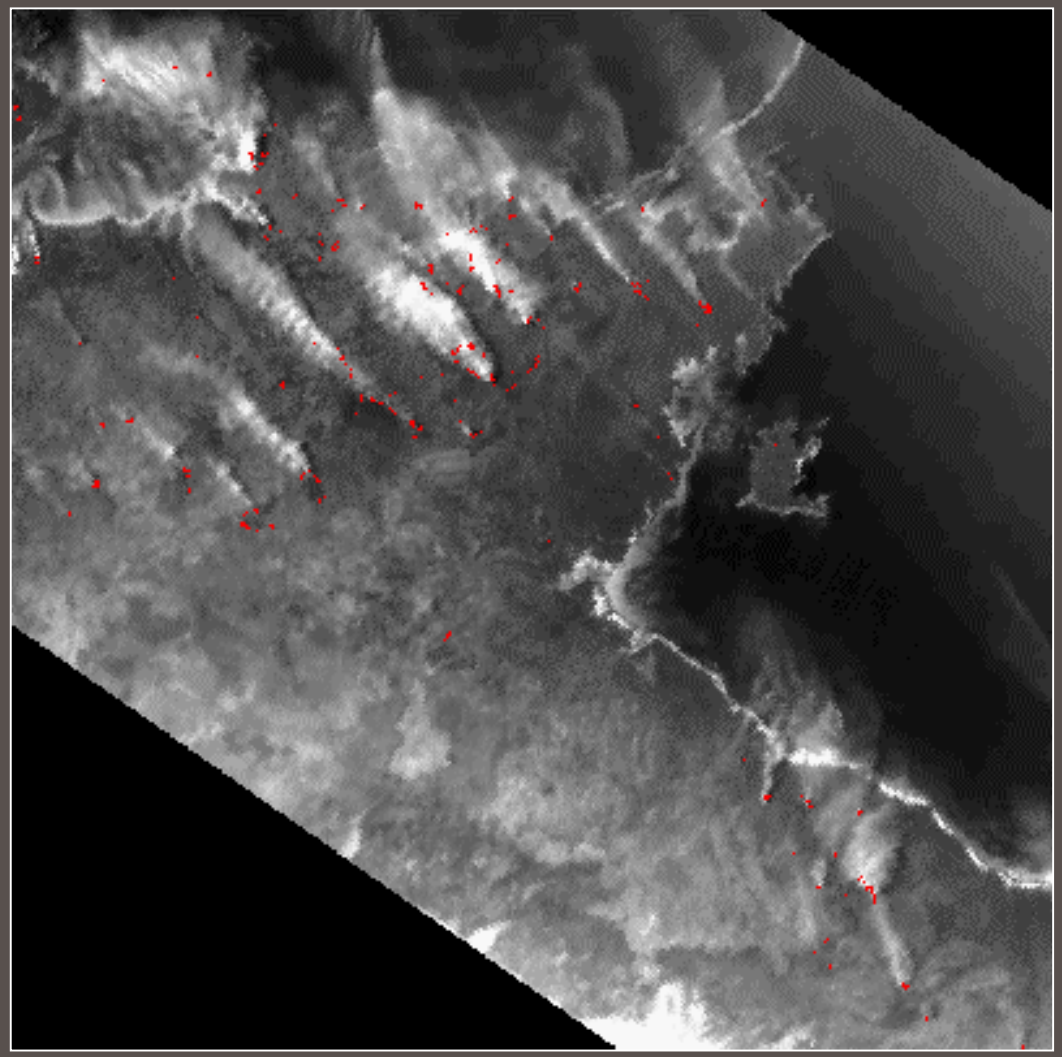
- Product description and current status
- Direct Readout implementation
- Validation
- Regional customization
- Caveats
- NPP/NPOESS VIIRS Active Fire Status

Satellite-Based Active Fire Products

- Identify **where** fires are actively burning at time of satellite overpass (and implicitly **when** they are burning)
- Possibly provide **additional information** about fires at time of satellite overpass
  - Intensity, average temperature, instantaneous size, rate of combustion, injection height, etc.



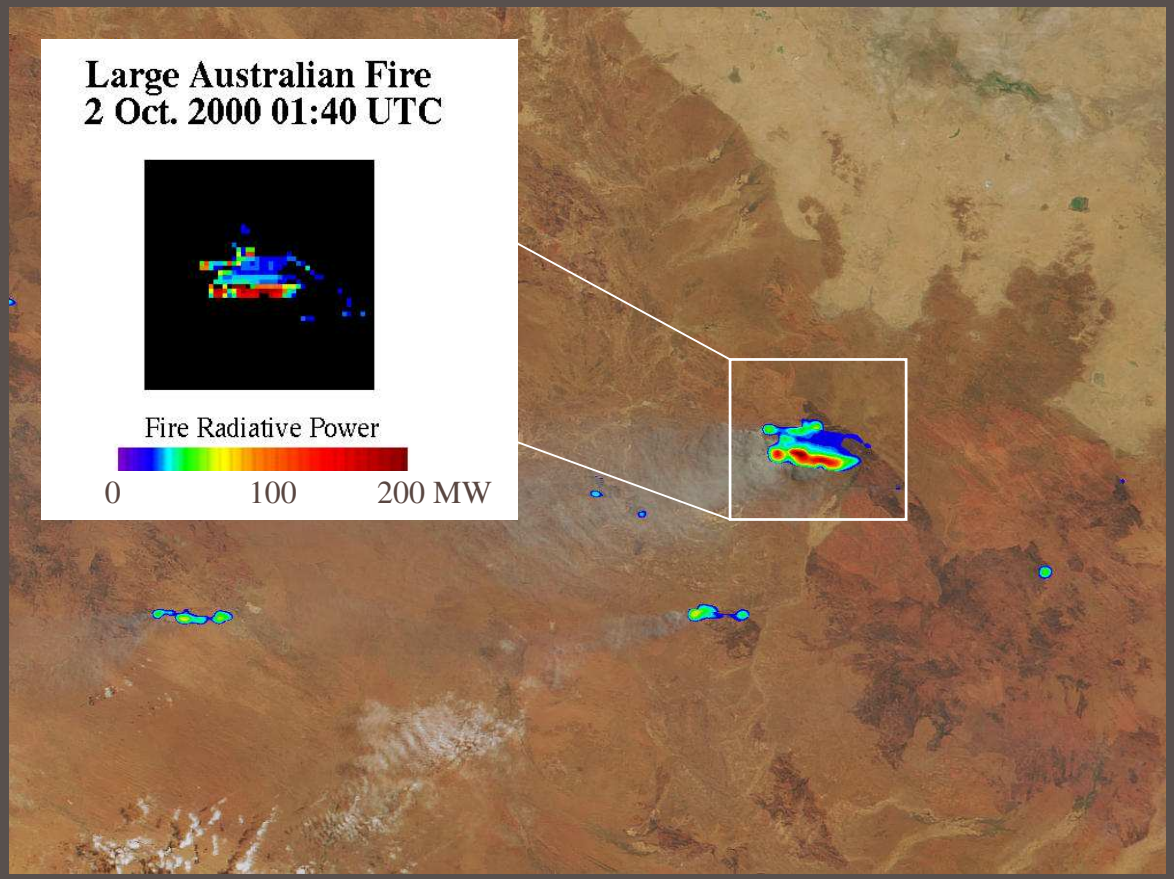
Southeast Australia, 10 Dec. 2006, 03:45 UTC MODIS Rapid Response System



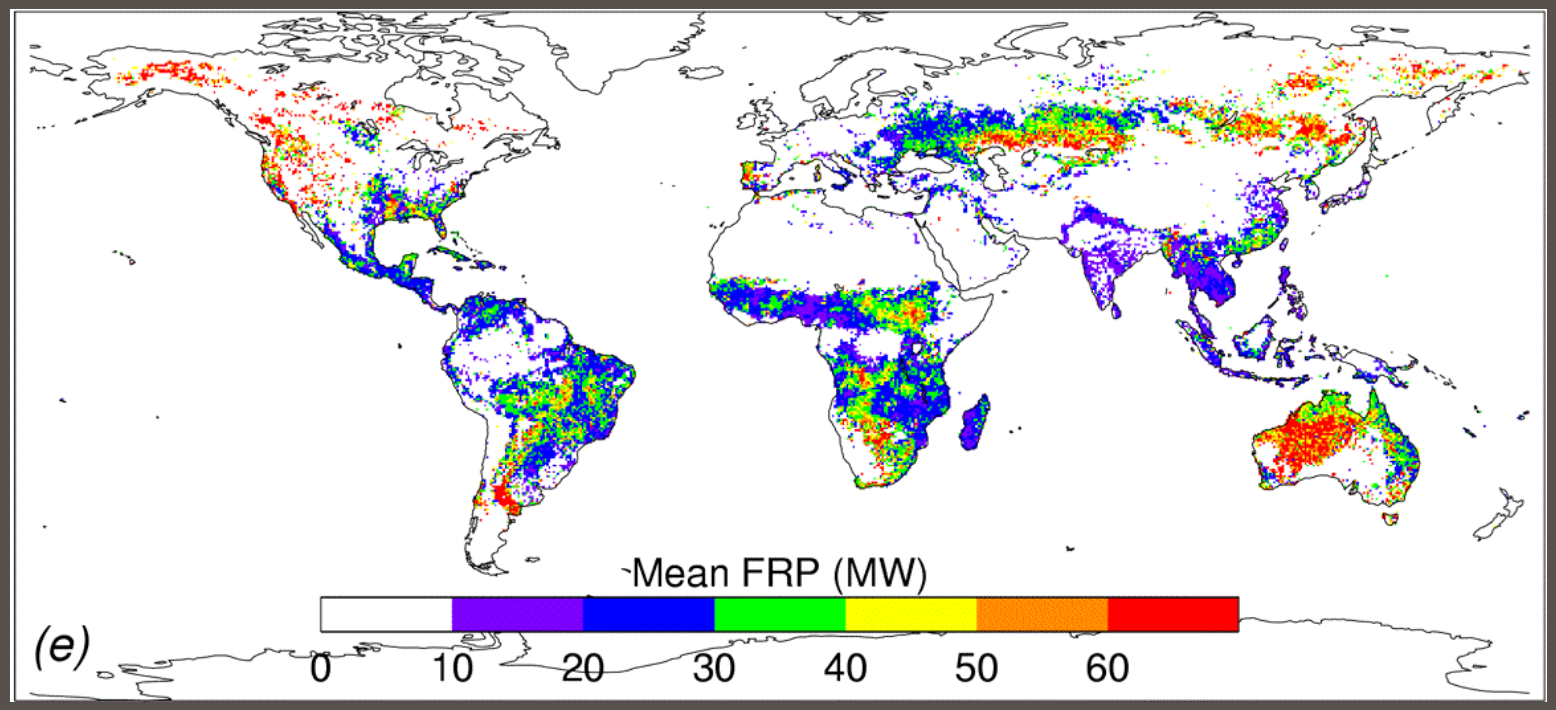
VIRS 0.63 µm
channel with
active fires in red

Northern Australia
29 August 1999

MODIS Fire Radiative Power



Mean Terra MODIS Fire Radiative Power



Giglio et al. (2006)

MODIS Direct Readout Active Fire Status

- Developed in the MODIS Rapid Response System (rapidfire.sci.gsfc.nasa.gov)
- Initial release ~2003 (Collection 3)
- Matches “official” MODIS fire detection algorithm (currently Collection 5)
- Refinements planned for possible Collection 6 and/or independent Direct-Readout/Rapid Response System release

Direct Readout Implementation

- Code written in C
- Stand alone, “non-ECS” version
  - SDP Toolkit, PCFs, run-time environment variables **not required**
- Not a pig
  - Fast (~1 minute/granule @ 1 GHz)
  - Small memory footprint (< 10 MB)
- Source code available from GSFC DRL
  - `http://directreadout.gsfc.nasa.gov/`

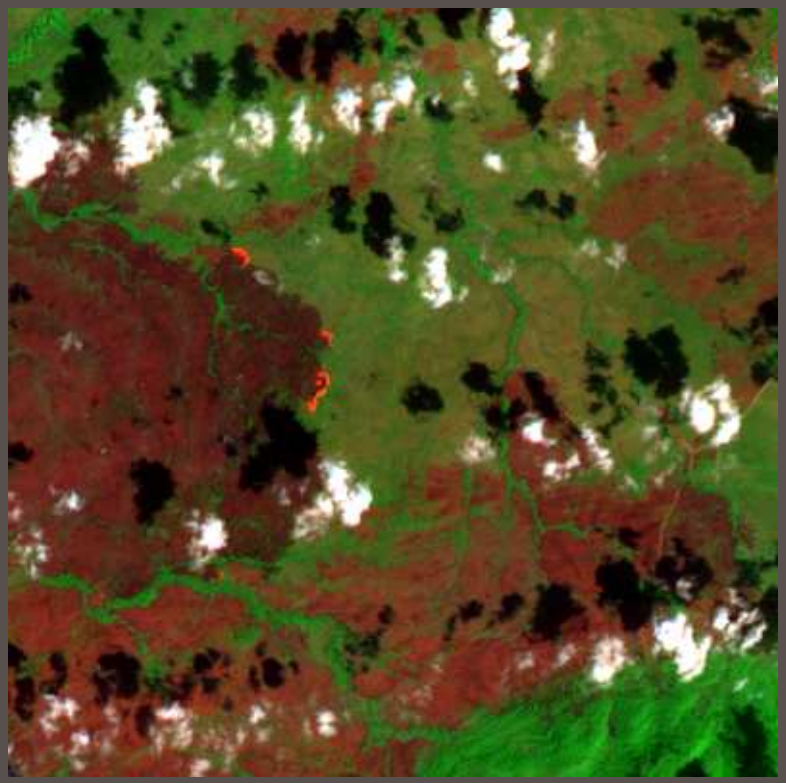
MODIS Fire Algorithm Validation

- Primary method is to use coincident, high-resolution ASTER imagery
- "Advanced Spaceborne Thermal Emission and Reflection Radiometer"
- Terra only (no Aqua ASTER)
- 14 high-resolution channels
  - 15 m, 30 m, 90 m
  - **None ideal for observing fires**

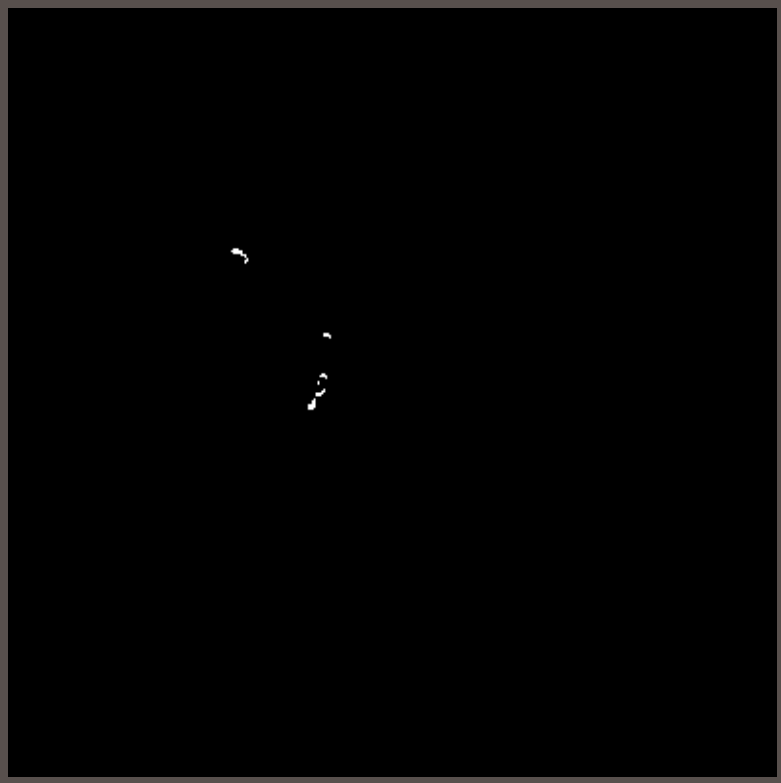
ASTER Fire Detection Approach

- Use two reflective bands
  - One **sensitive** to emissive radiation from fires
    - SWIR band 8 (2.3 μm)
  - One **insensitive** to emissive radiation from fires
    - NIR band 3N (0.86 μm)
  - Otherwise highly correlated and **sensitive** to reflective, non-fire radiation
- Approach is reasonable for small ASTER pixels, but useless at coarser spatial resolution

Example Scene: Eastern Cambodia



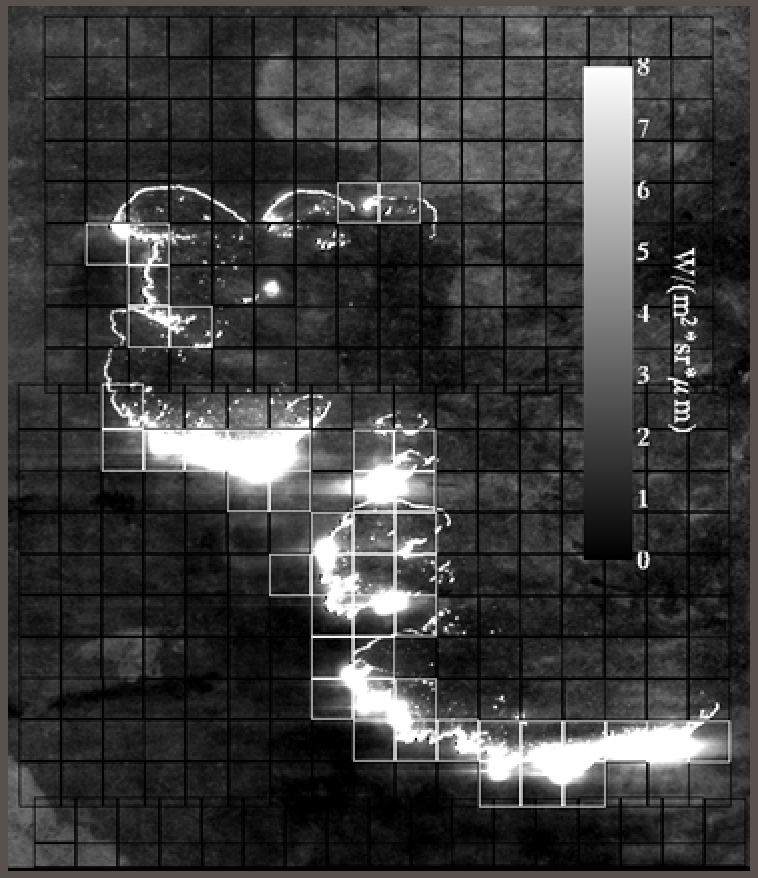
ASTER Bands 8 (2.33 µm),
3N (0.82 µm), 1 (0.56 µm)



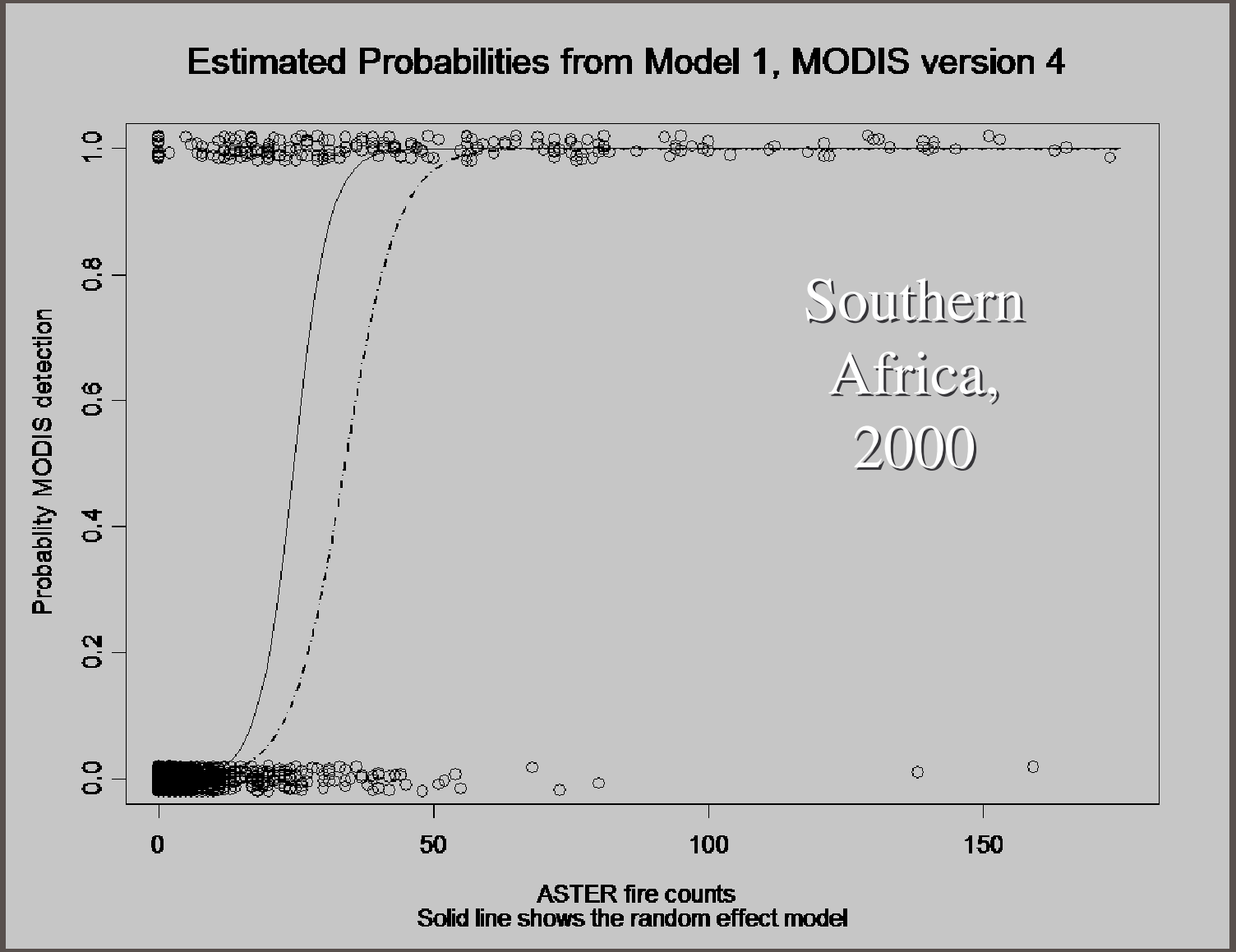
Active Fire Mask

ASTER Band 9

Grid delineates "edges" of 1-km MODIS pixels.



Southern Africa, 17 Aug. 2001



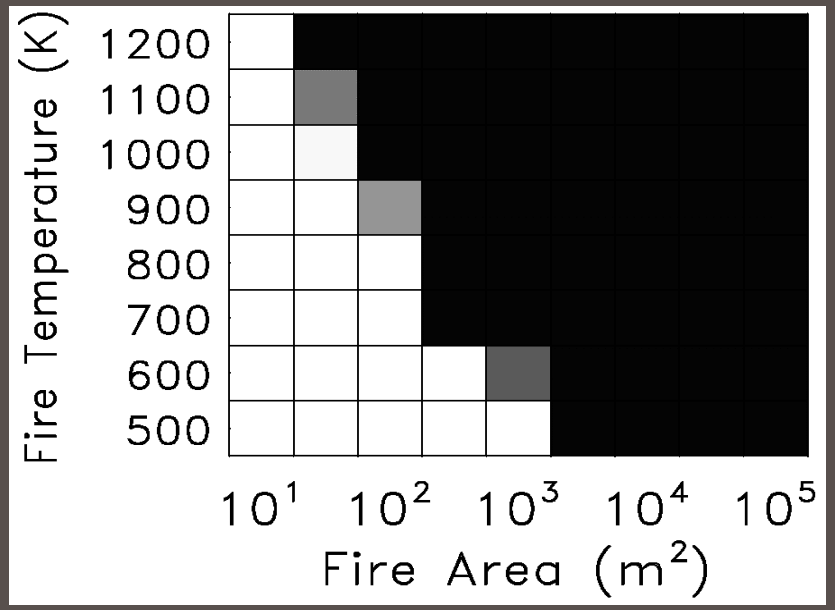
Morisette et al. (2005)

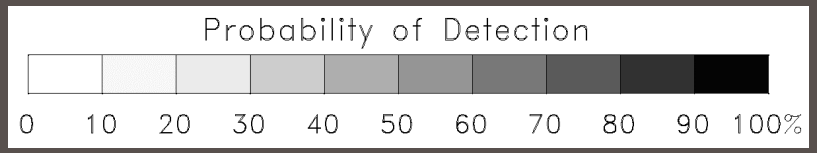
Current MODIS Active Fire Validation Efforts

- Fire mask using ASTER imagery
  - Sometimes degraded by frequent ASTER saturation
- Fire radiative power retrieval using ASTER
  - Cannot use simple middle-infrared band approach used for MODIS with ASTER
  - Often degraded by frequent ASTER saturation
- Simulated MODIS imagery

Example Simulation Results

- MODIS
- Temperate deciduous rainforest
- Night
- 0° scan angle
- Summer
- No background fires





Planned & Possible Refinements

- Optional compact fire location output file
- Algorithm improvements
  - Reduce false alarms in problem areas
  - Recognize optically thick smoke (vs. cloud)
  - Improve detection confidence estimate (again)
- Regional customization