Brown dwarf atmosphere science with PLATO

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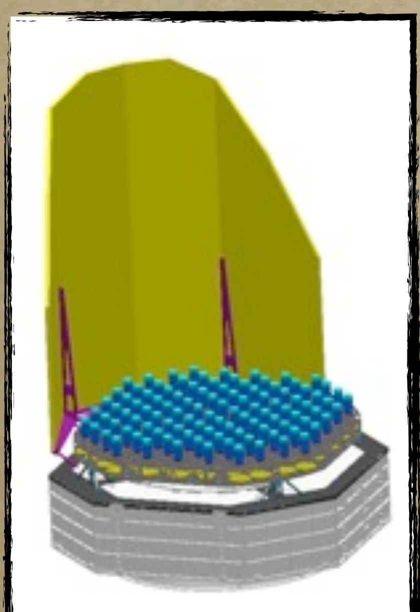
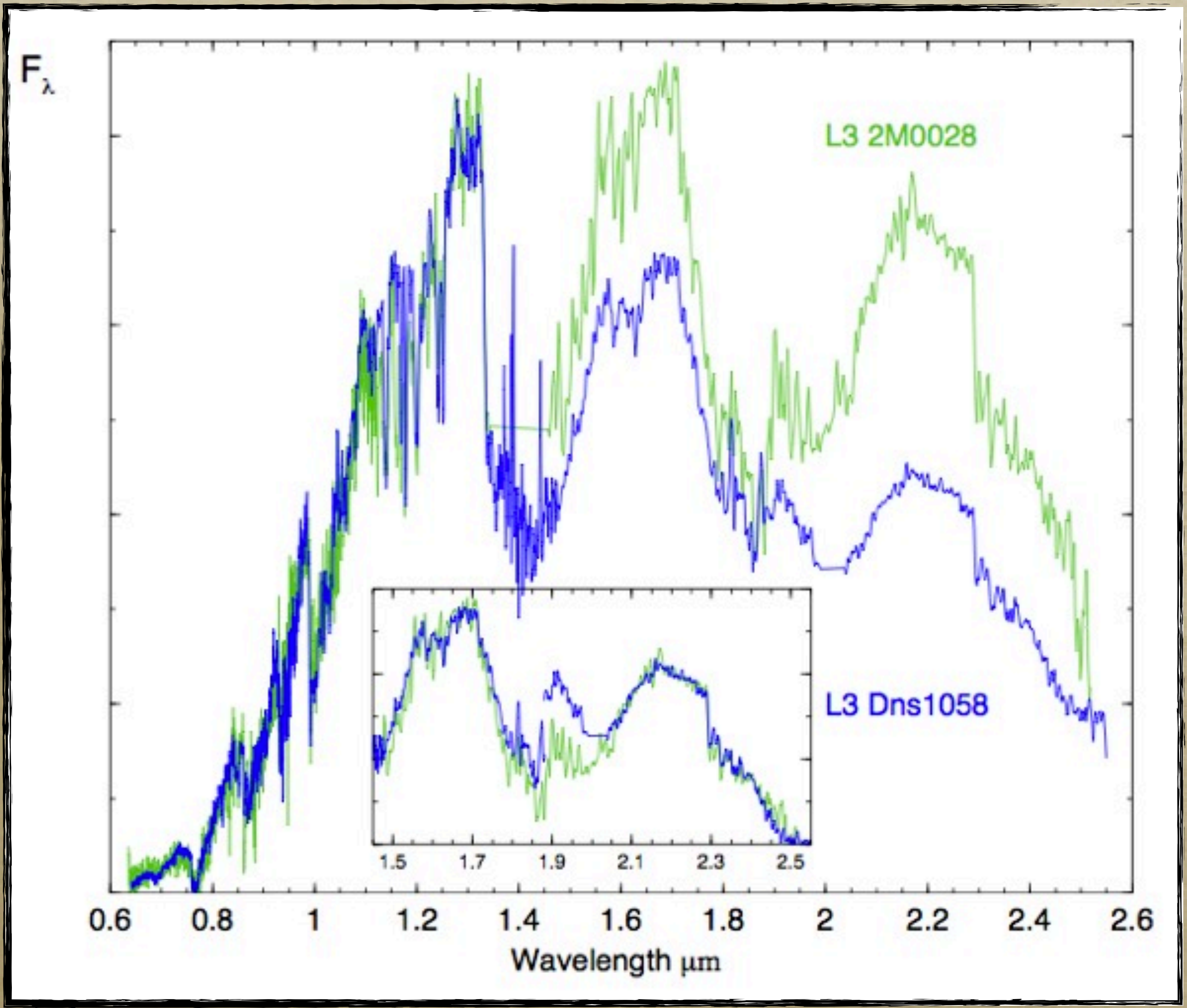
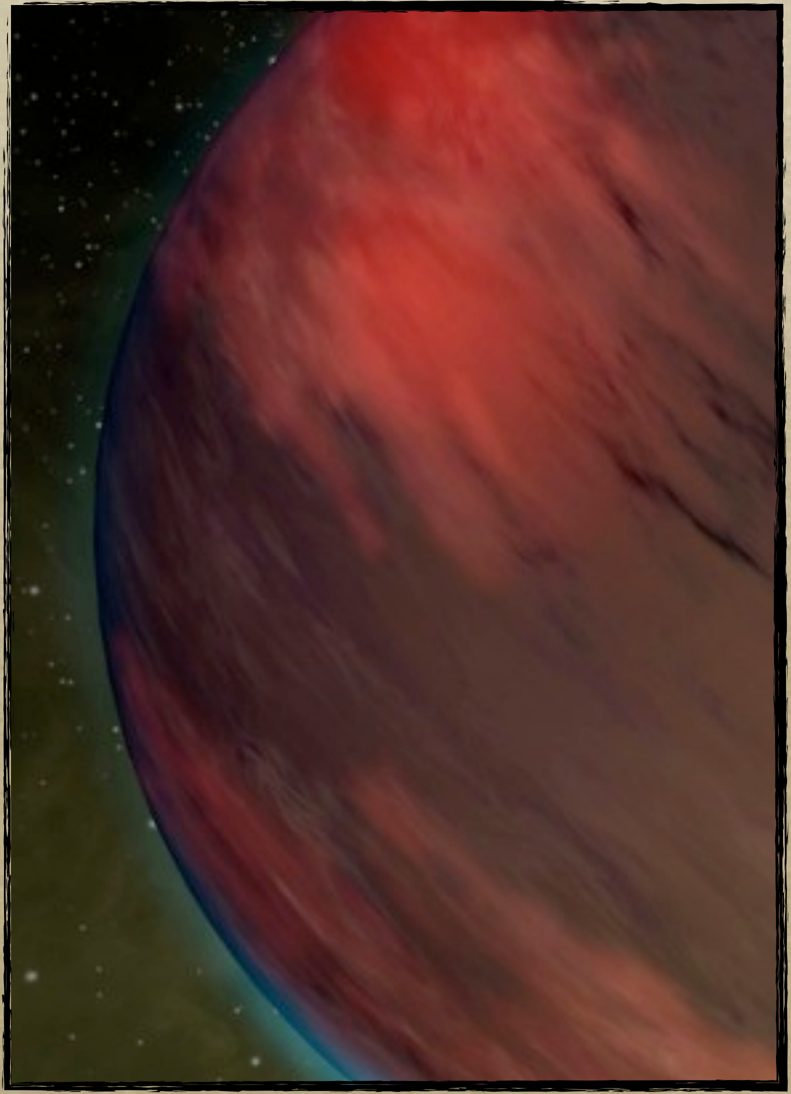


The University Of Sheffield.

Queen's University Belfast

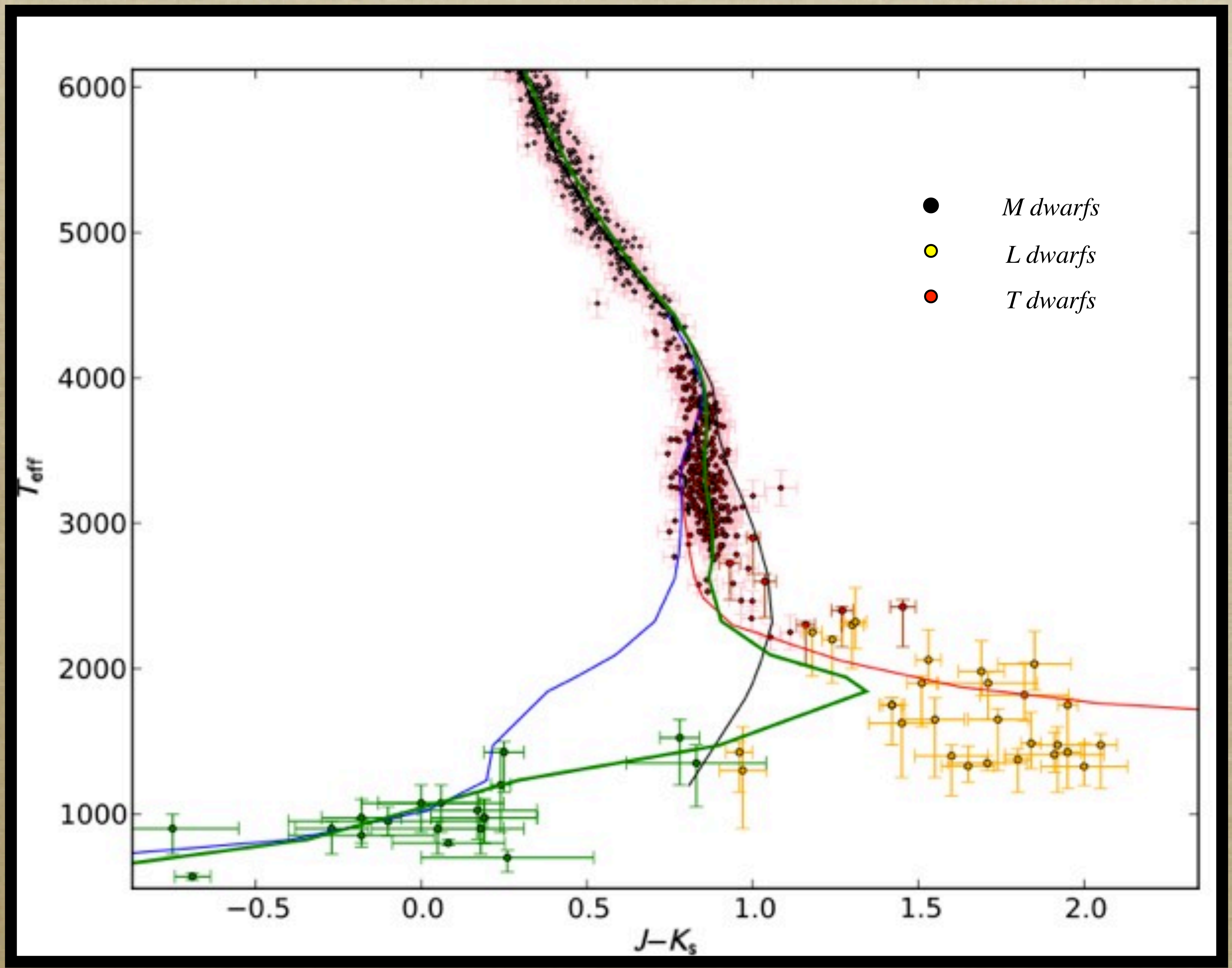
The limiting effect of **dust**





Leggett et al (Cool Stars 12: 2001)

State of the art cloud models



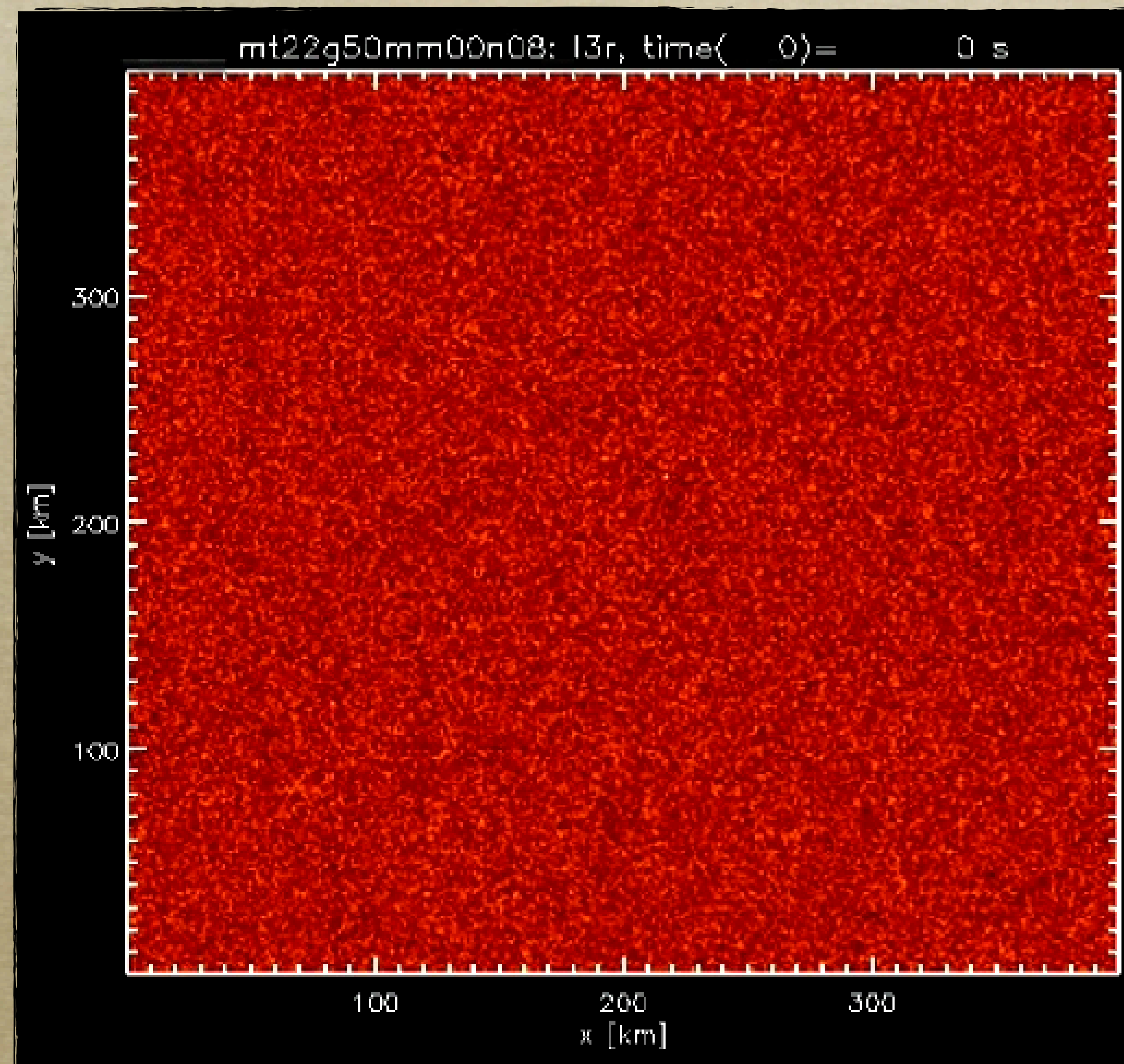
Allard, Homeier & Freytag (astro-ph:1011.5405)

State of the art models

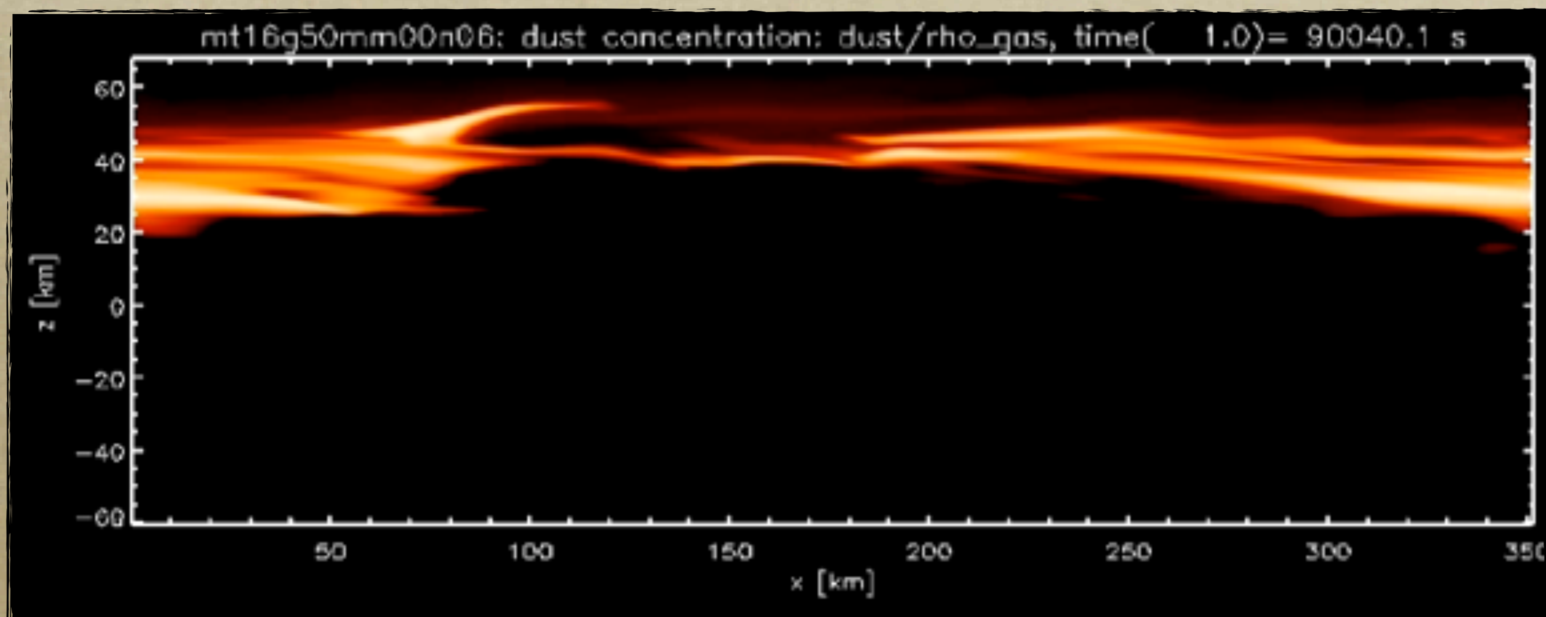
Teff = 1600K

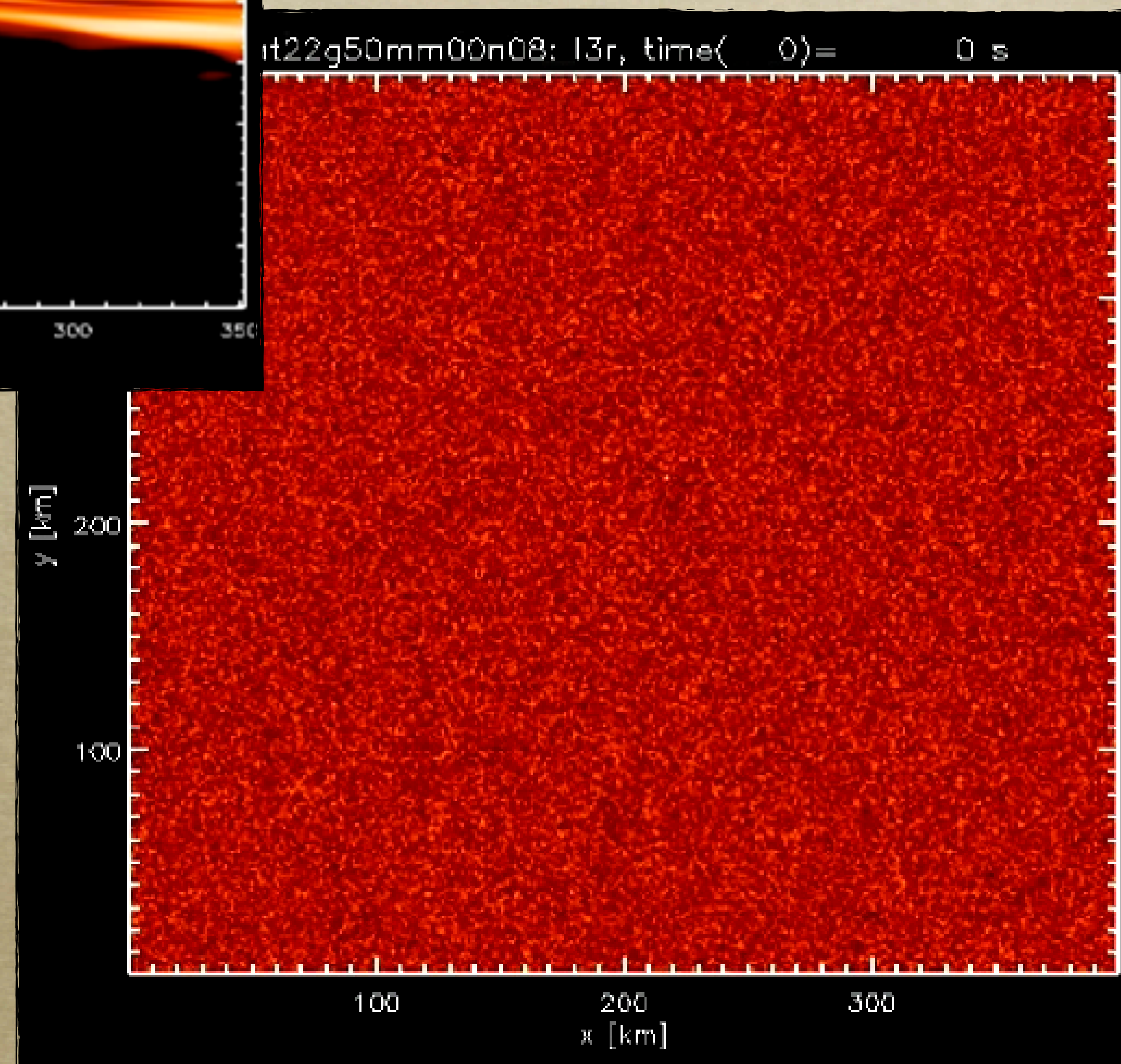
Simulations courtesy of Bernd Freytag

see e.g. Freytag et al (2009, Mem SA It, 80, 670)



State of the art models





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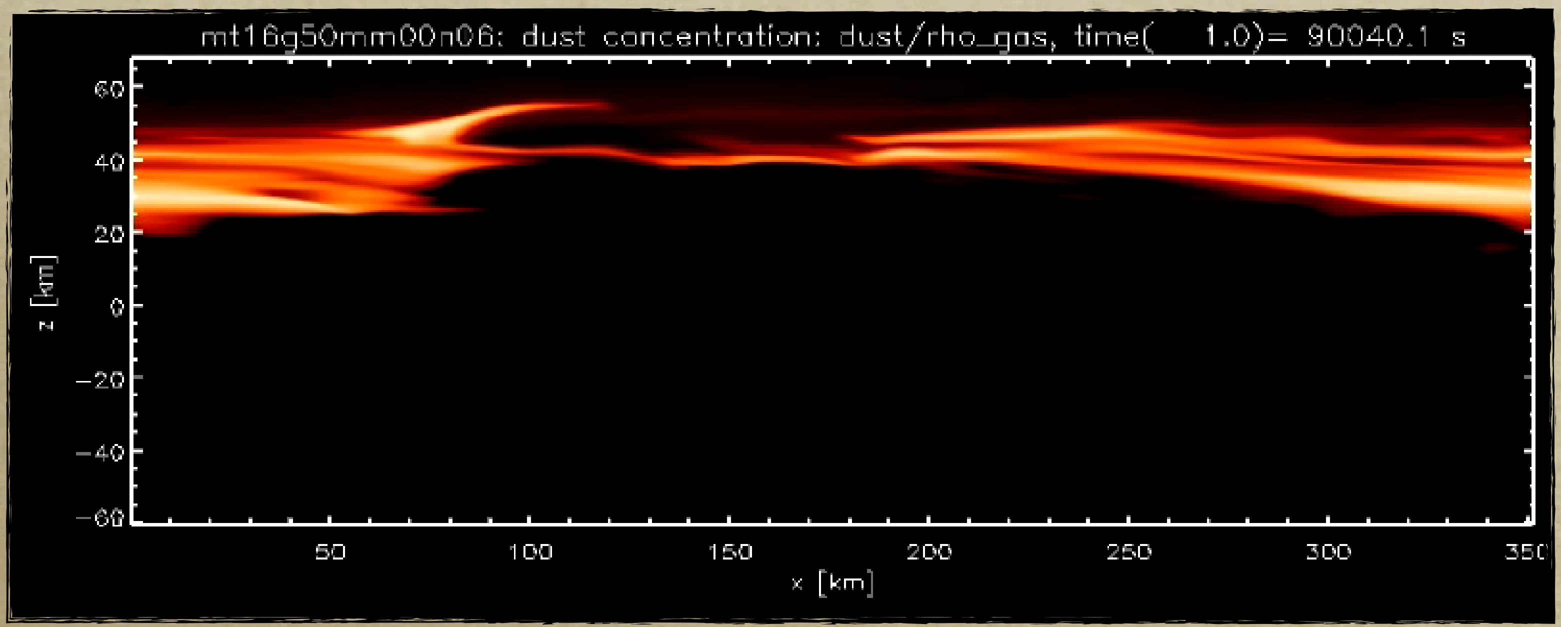
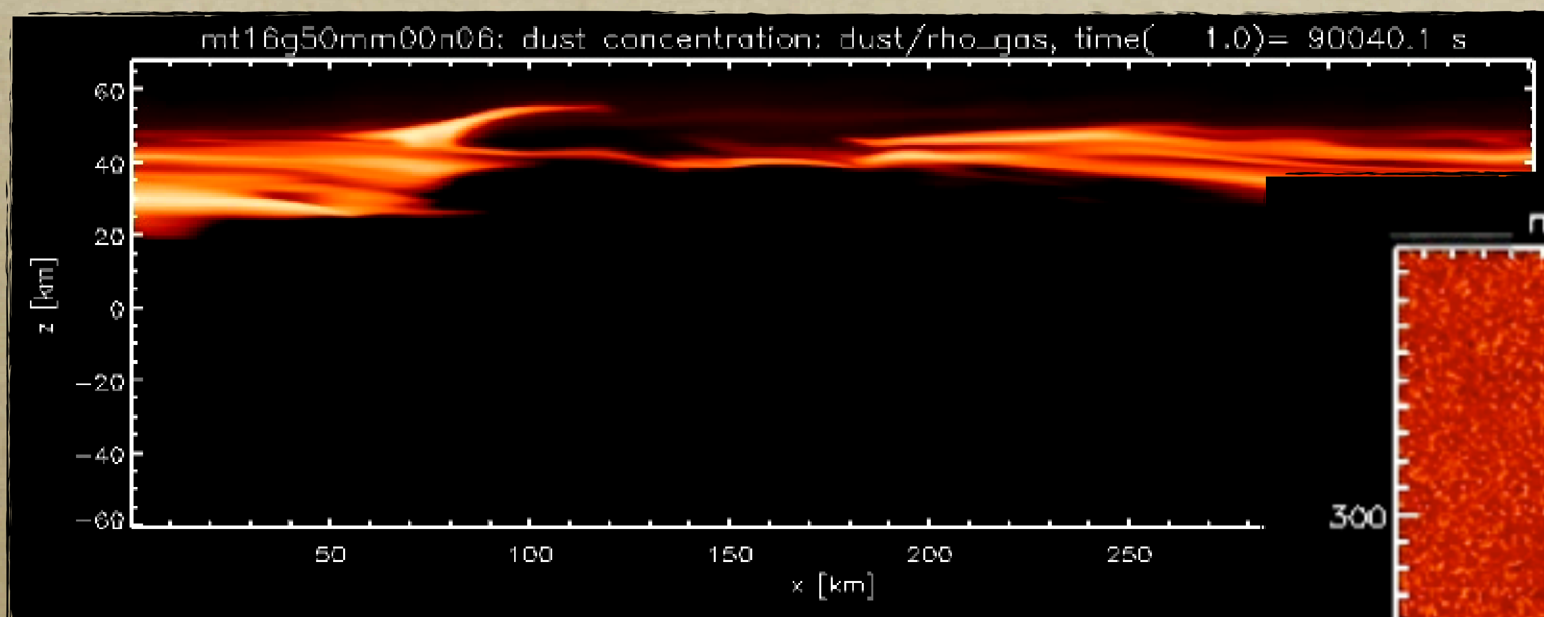


Teff = 2200K

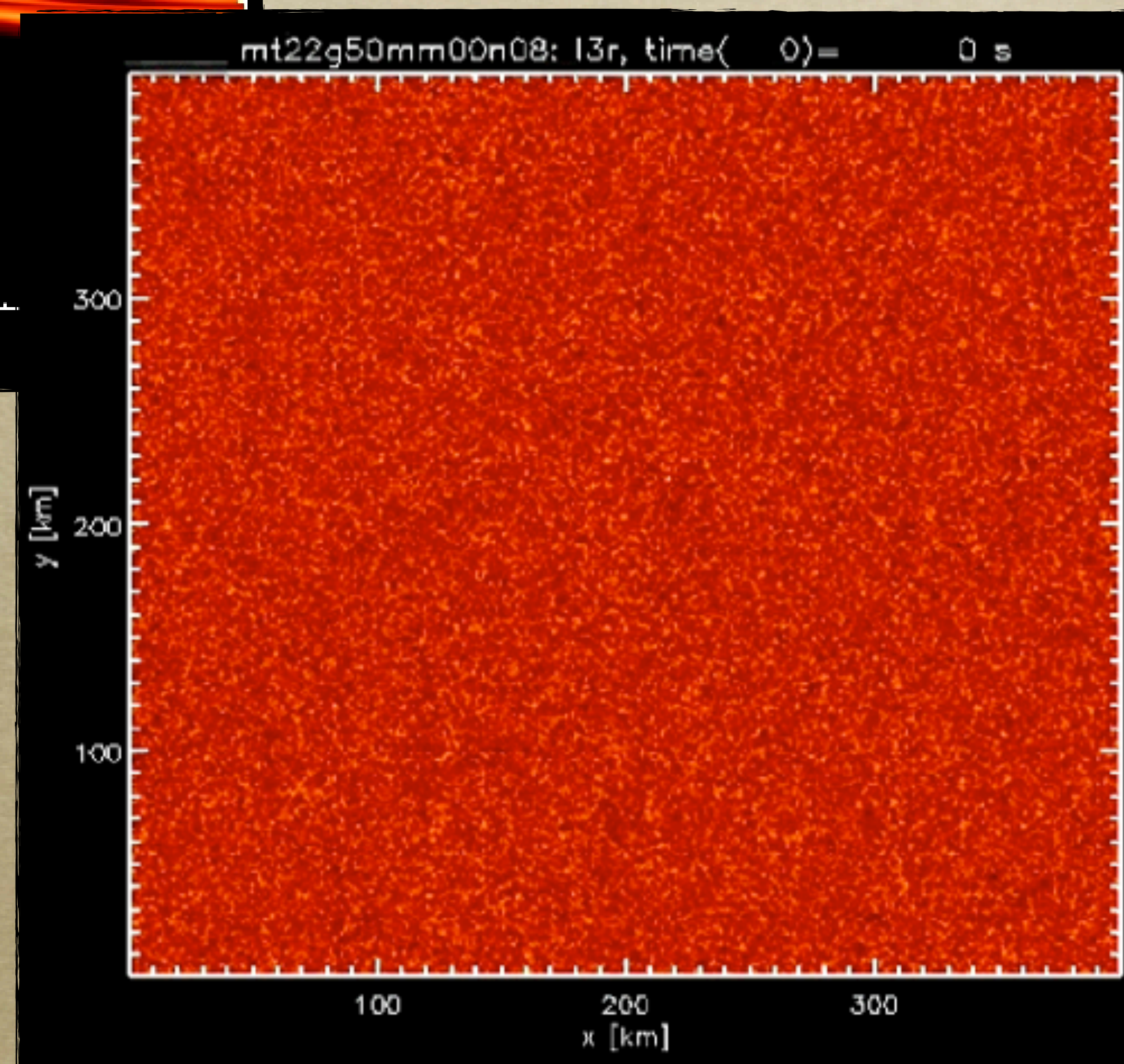
Simulations courtesy of Bernd Freytag

see e.g. Freytag et al (2009, Mem SA It, 80, 670)

State of the art models



Teff = 2200K



Simulations courtesy of Bernd Freytag

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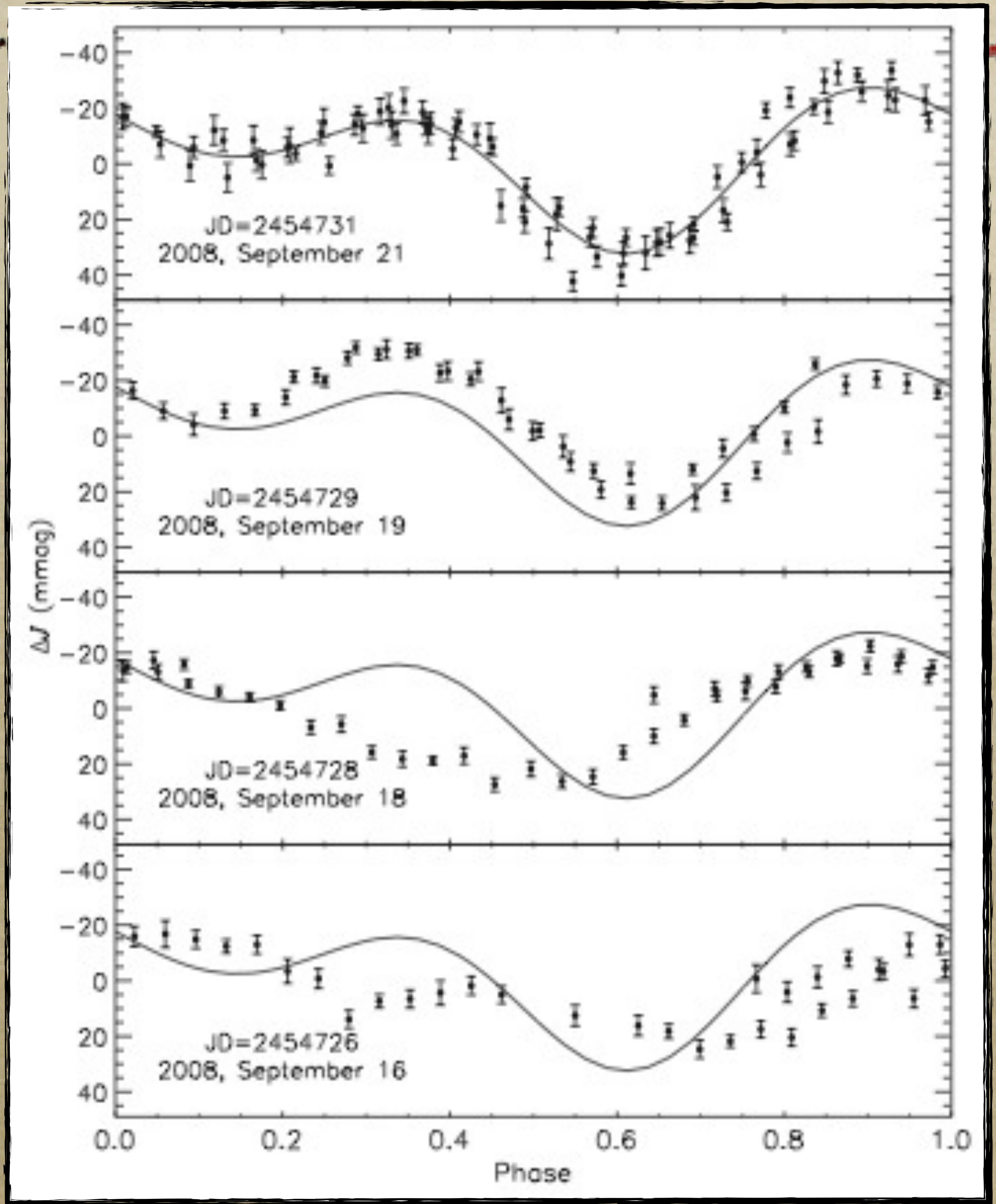
Variability as constraint

- *Variability can tell us:*
  - *T_{eff} of cloud formation/settling*
  - *uniformity of cloud deck*
  - *lifetimes of clouds*
    - *both as function of Spectral Type*

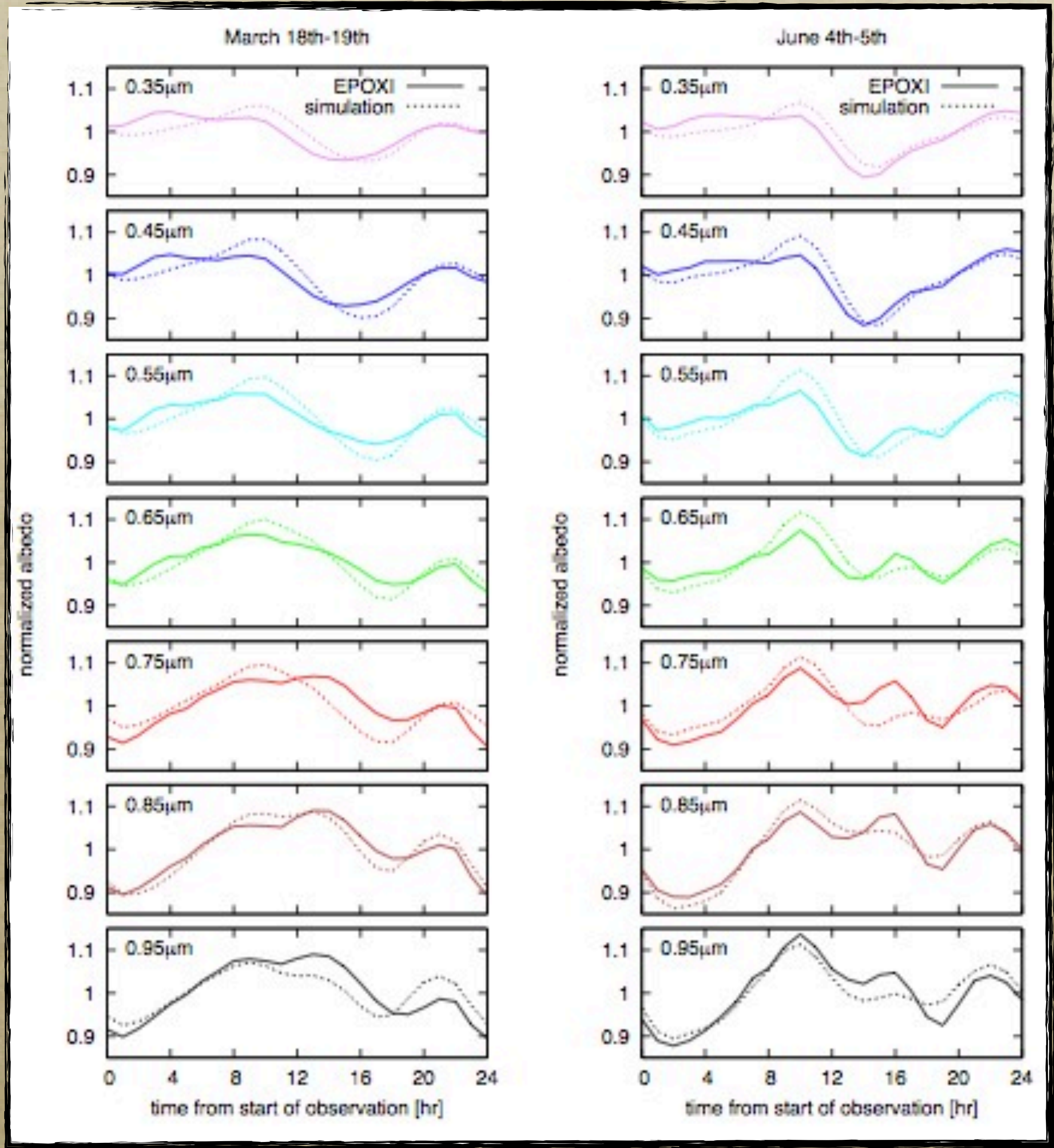
Example 1: SIMPJ0136

- 20 mmag variability in J and K_s bands
- Cloud structure evolves on timescales of days
- Cloudy regions are ~100K warmer than photosphere



Artigau et al (2009, ApJ, 701, 1534)

Example II: Earth



Fujii et al (2011, astro-ph:1102.3625)

Why PLATO?

- *Ground-based photometry lacks necessary **precision**.*

  *Majority of objects **not** variable at >2-10 mmag level*

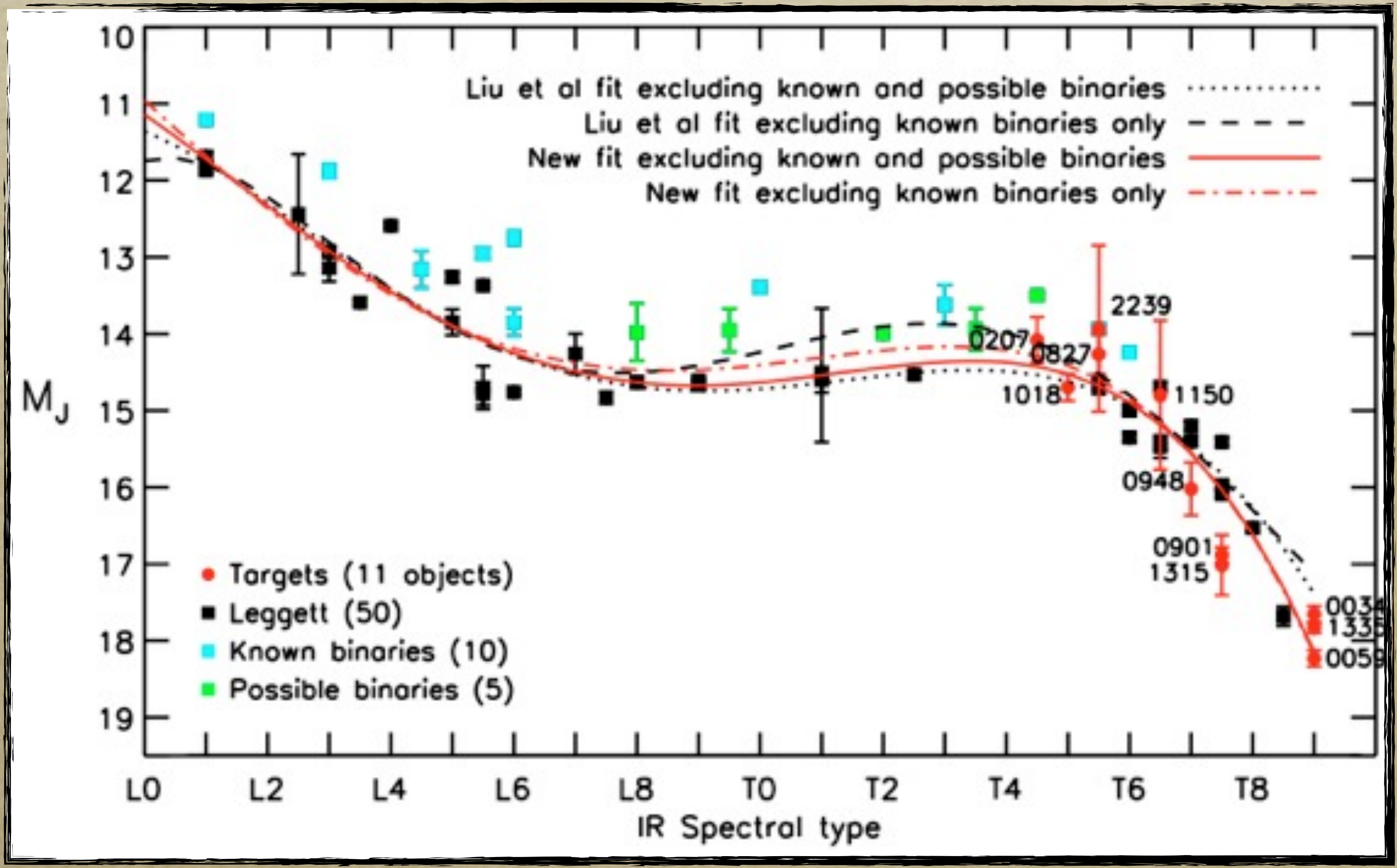
- *Robust detections of variability (e.g SIMP J0136) are extremely rare*

- *Even here; detection required luck, as variability absent in 2010.*

- *Both problems solved by PLATO*

Feasibility

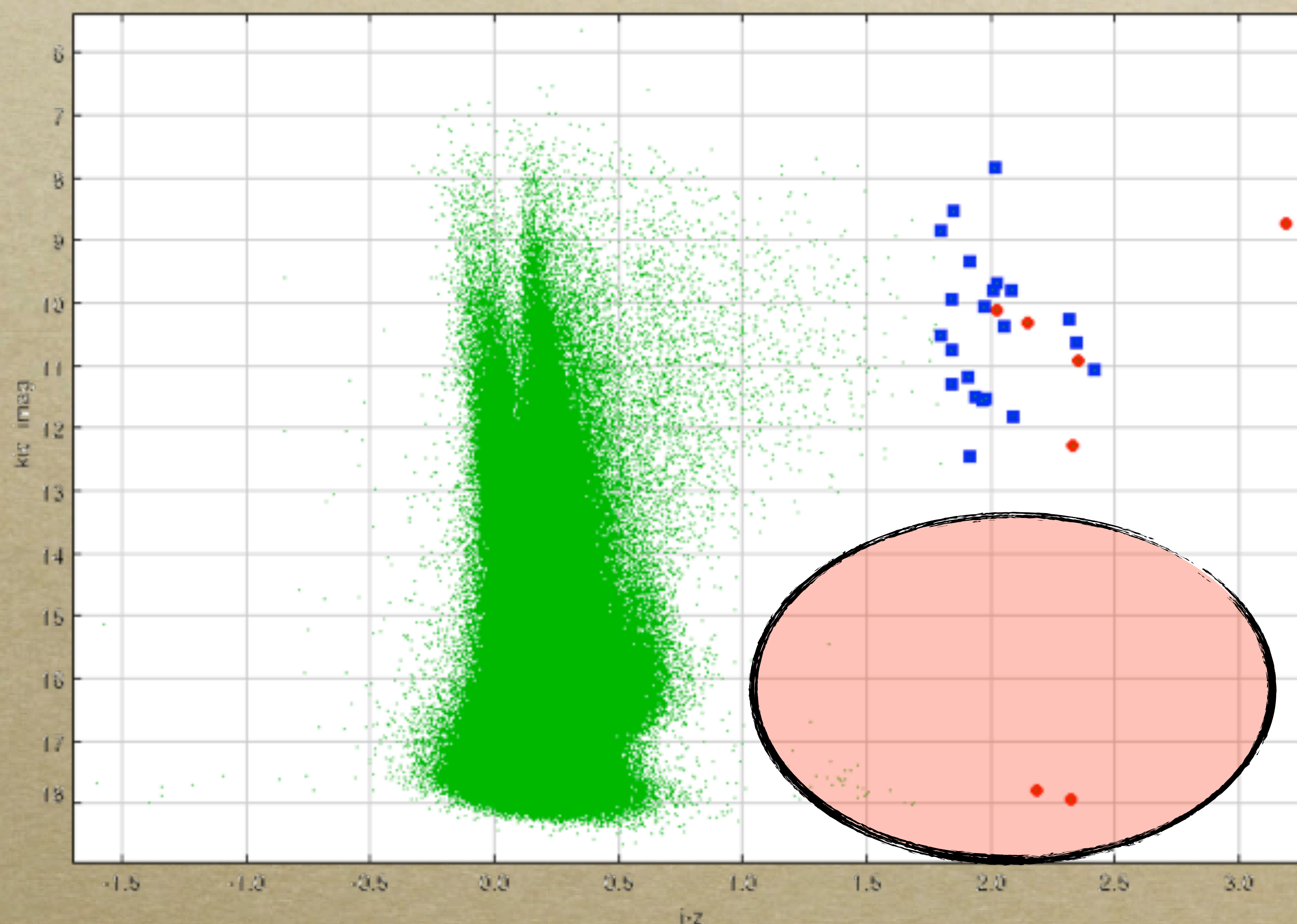
- *PLATO easily delivers required photometric accuracy up to brightness limit ($m_I \sim 16$: H. Rauer's talk)*
- *Only M/L-type objects feasible*
- *Targets need to be 20-40 pc or closer*
- *~500 objects over 50% of sky*



Marocco et al (2010, A&A, 524, 38)

The best things in life are free...

- *Greatly benefit from red-sensitivity (>800 nm)*
- *Input catalog needs careful attention so we don't miss targets*
- *Gaia should find our targets...*



Kepler Input Catalog

Summary

- *Variability can be very powerful test of cloud models*
- *Essential for understanding brown dwarf atmospheres…*
- *..and giant planets.*
- *PLATO provides baseline and accuracy to greatly advance field for small number of nearby objects*