Exoplanet Spectra with WFIRST Cool Planets, Exciting Sciences

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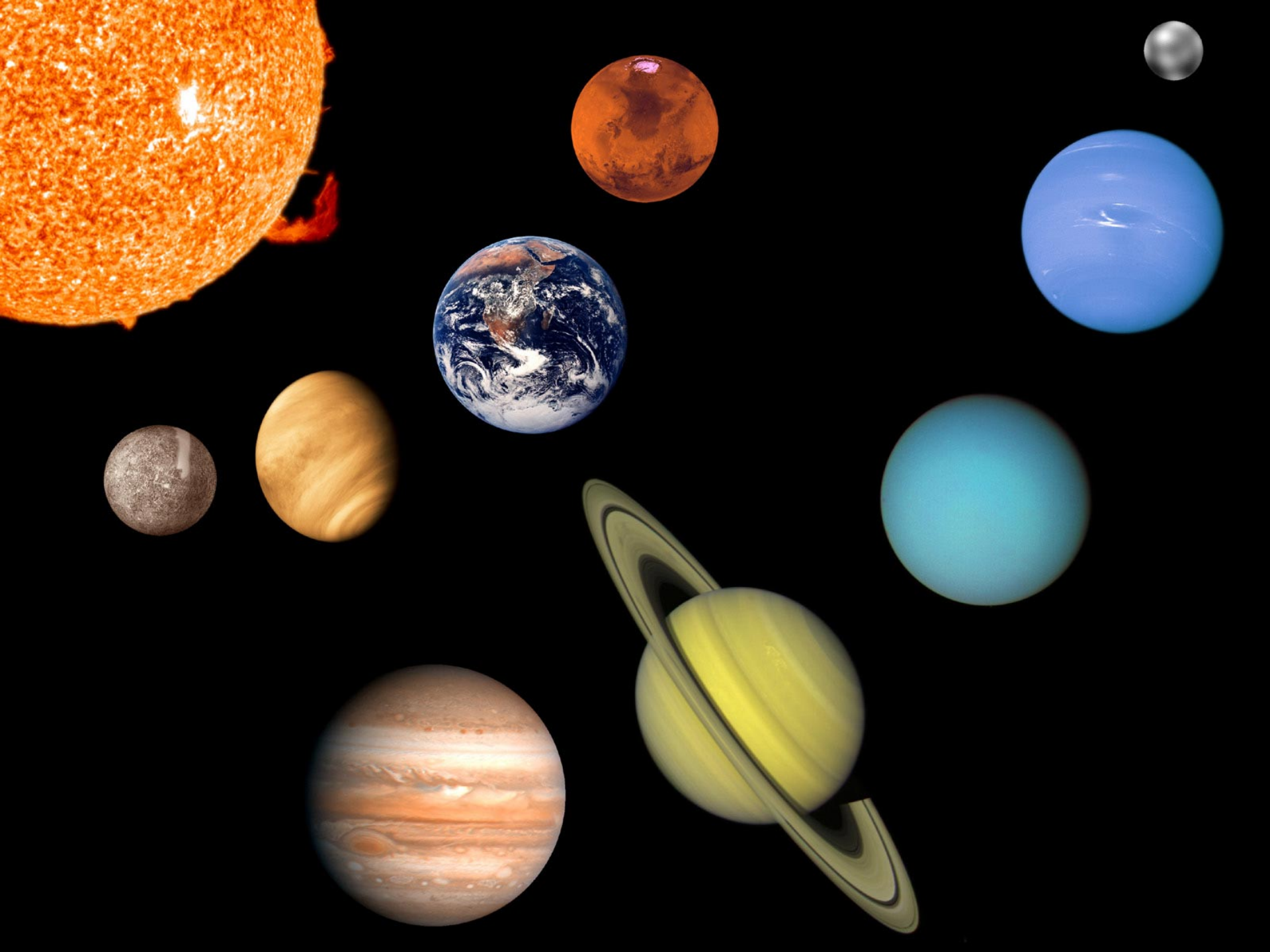
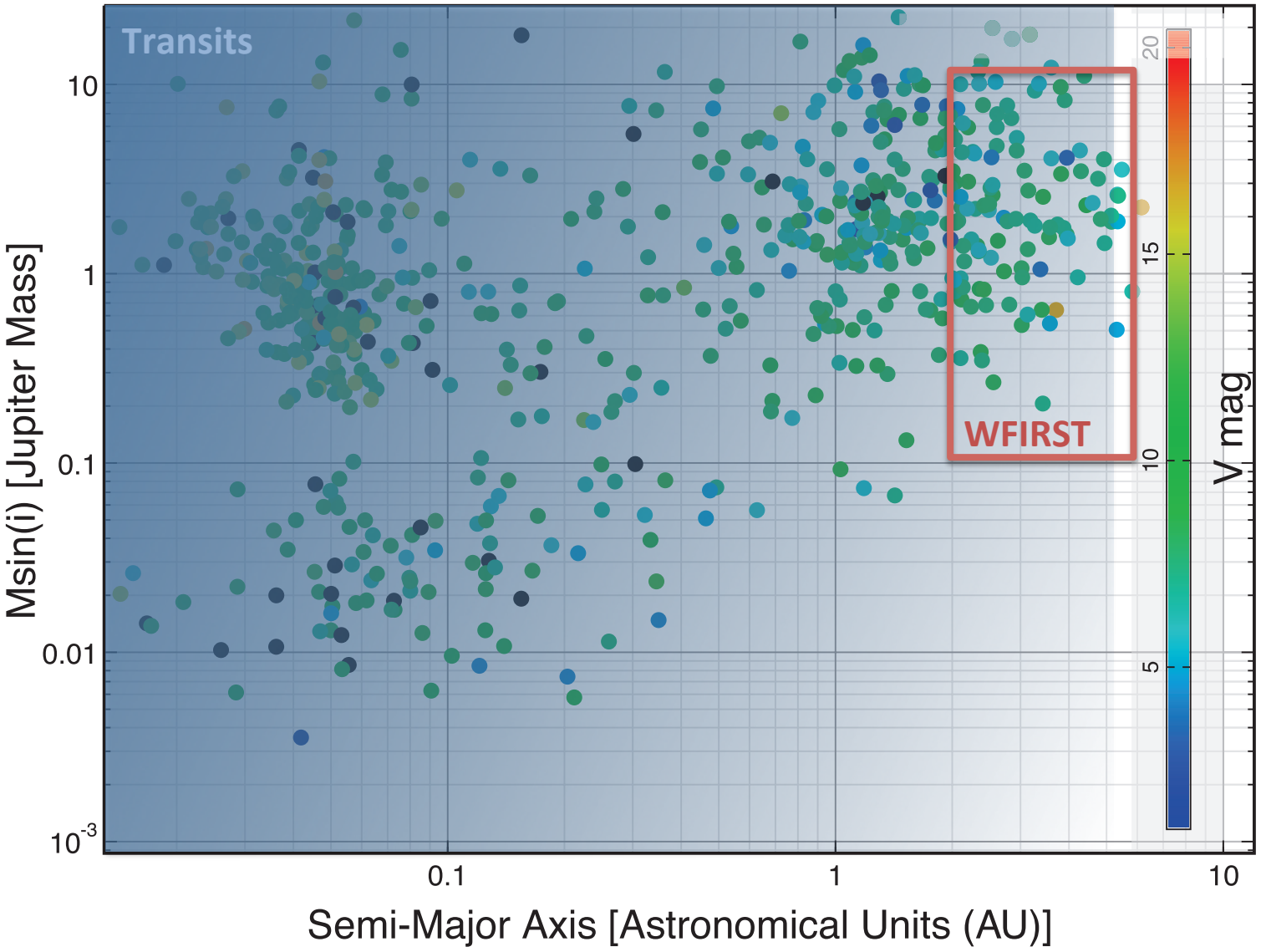
Jet Propulsion Laboratory

Government sponsorship acknowledged.

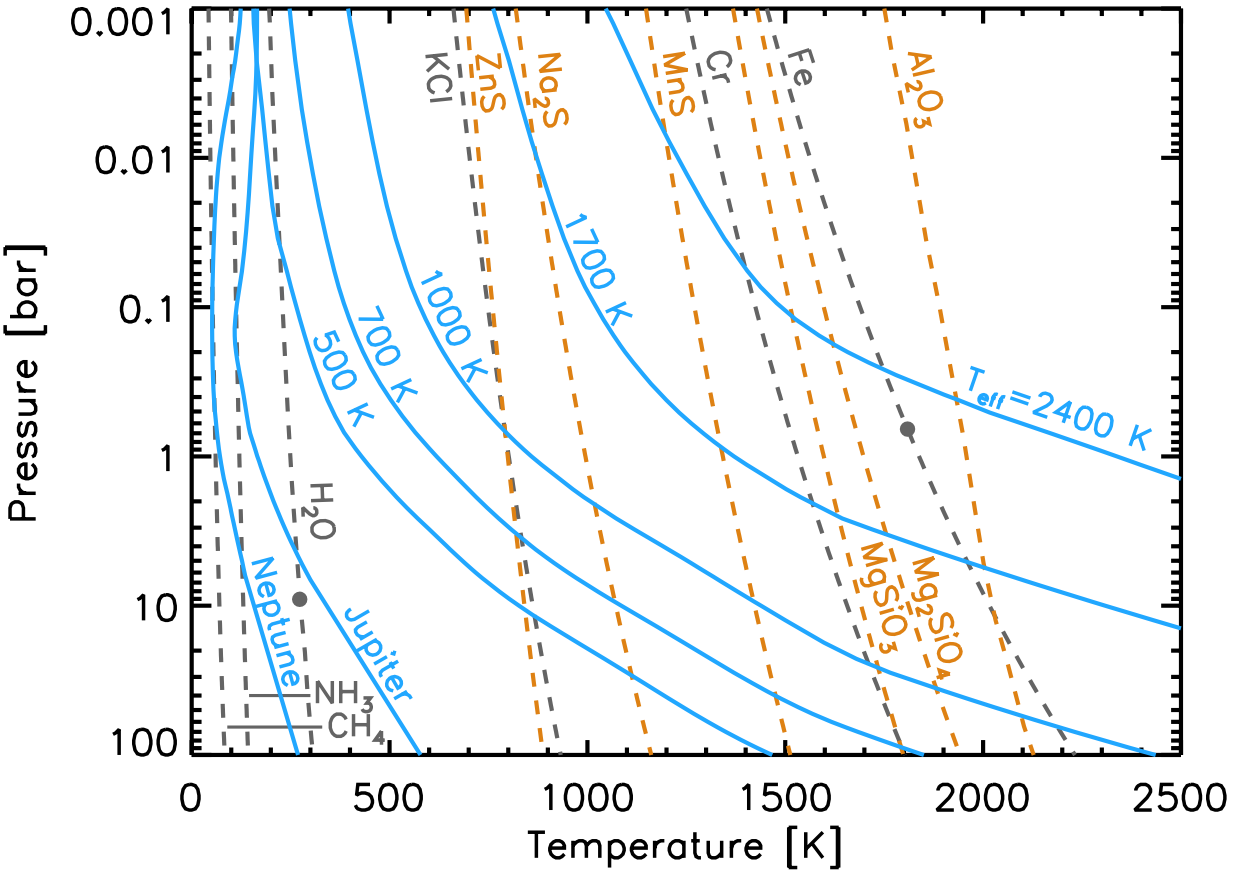


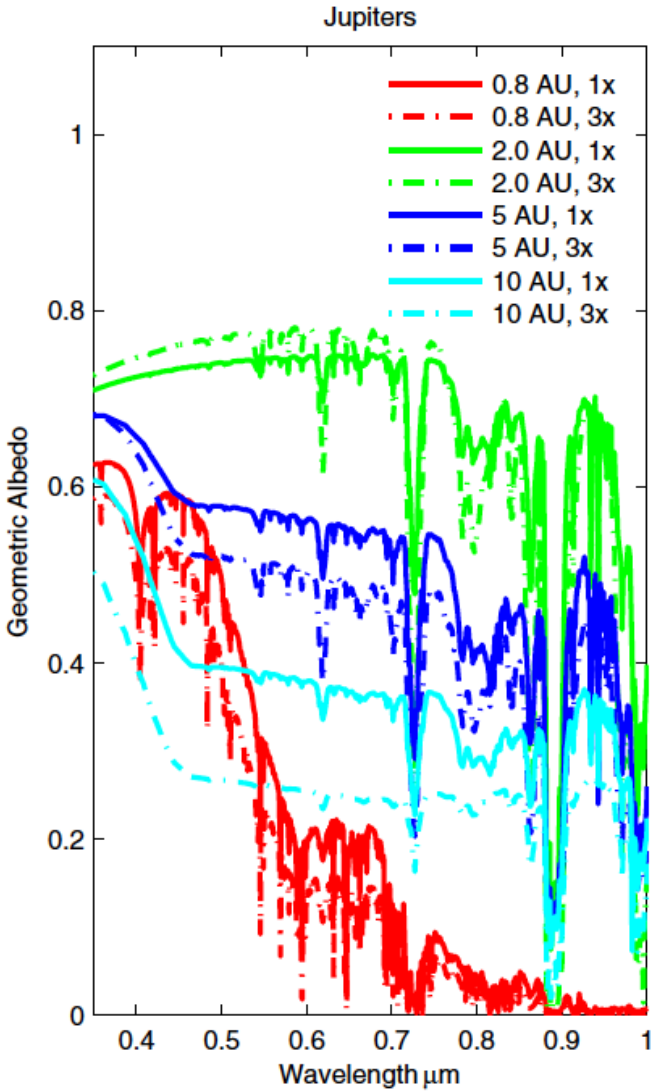
Cool, Gaseous Planets



Exoplanets.org, 8/8/2015

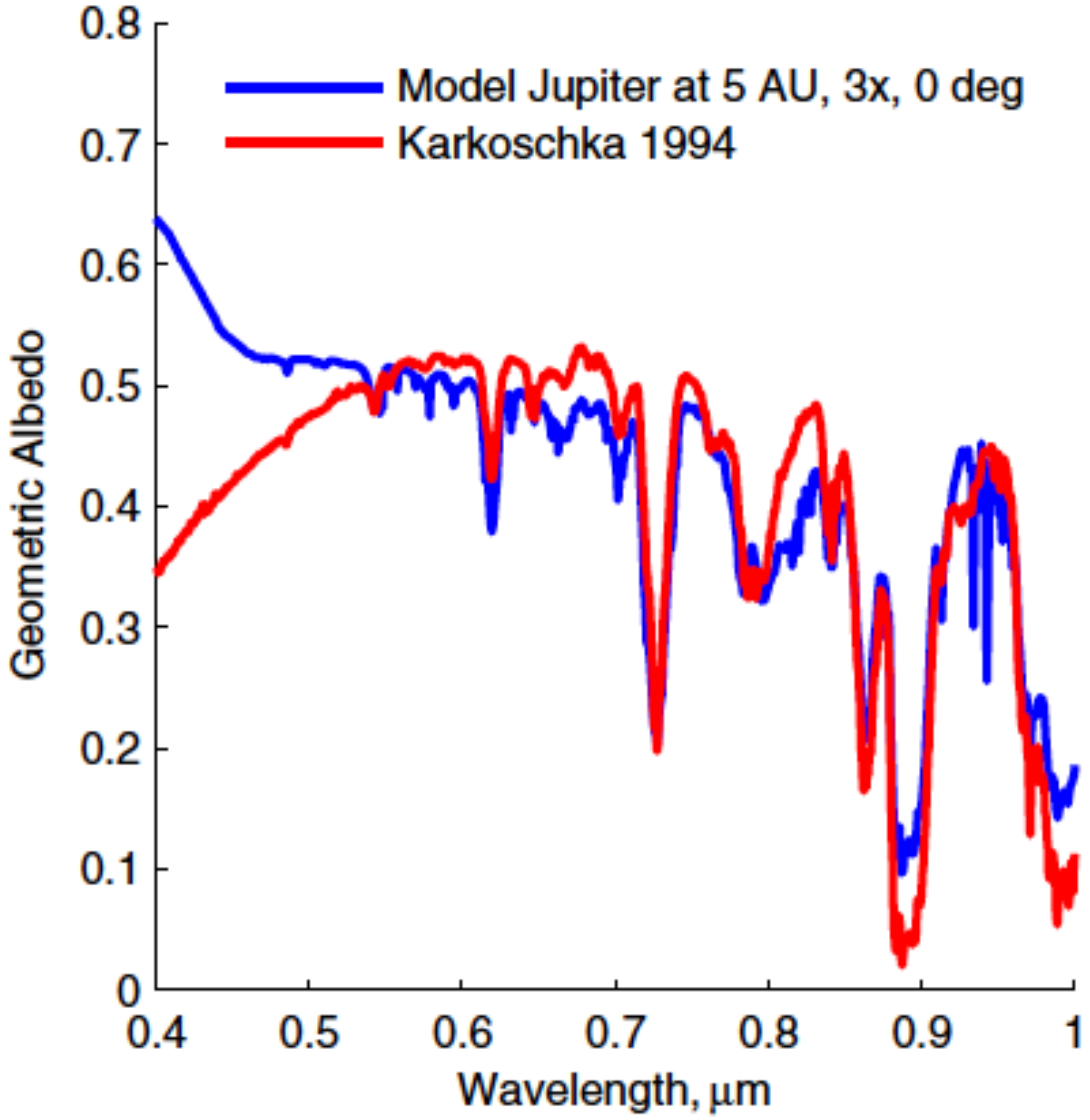
Reflection from Gas and Clouds





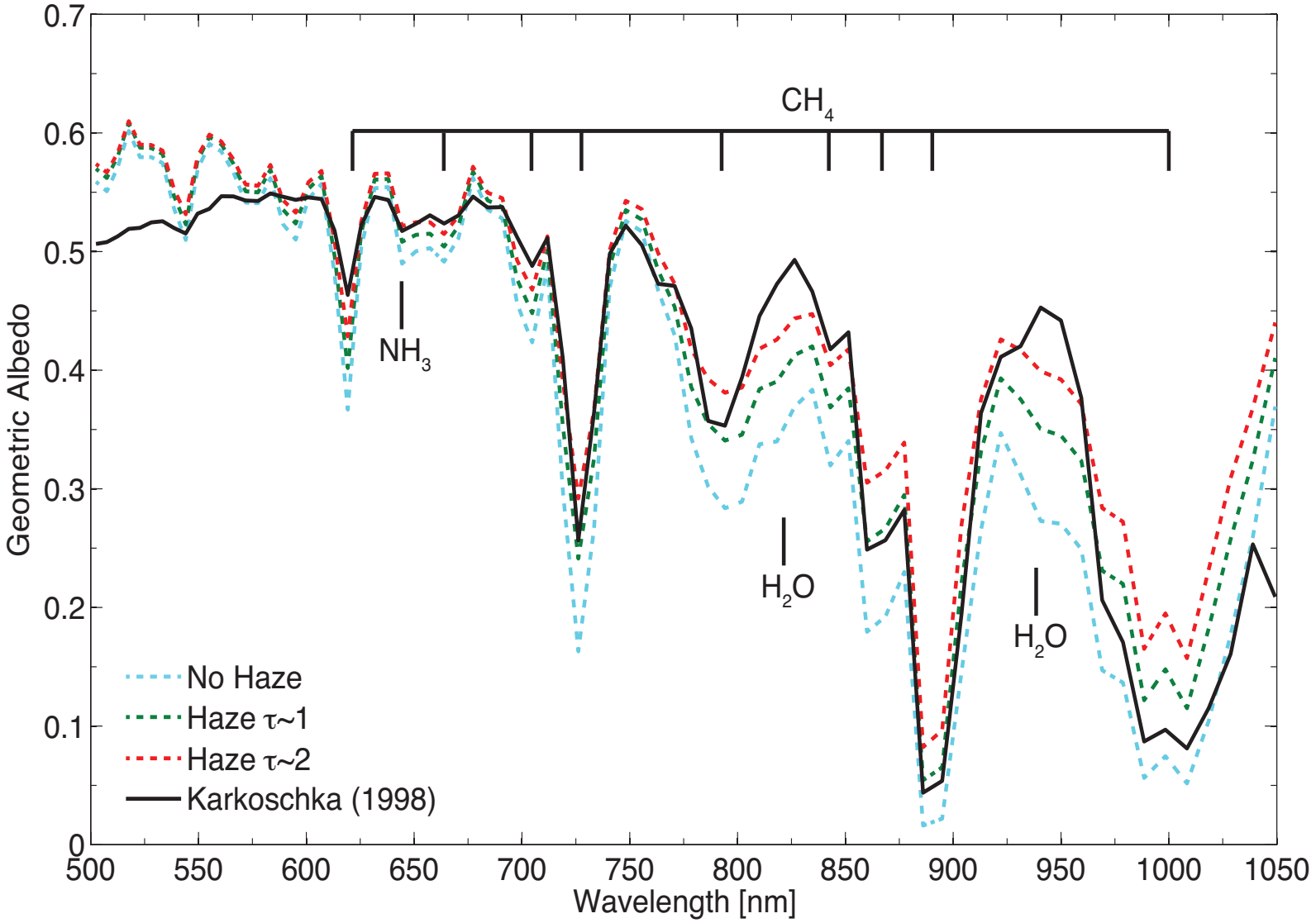
Burrows et al. 1997; Sudarsky et al. 2000; Cahoy et al. 2010; Marley et al. 2014

Photochemical Haze



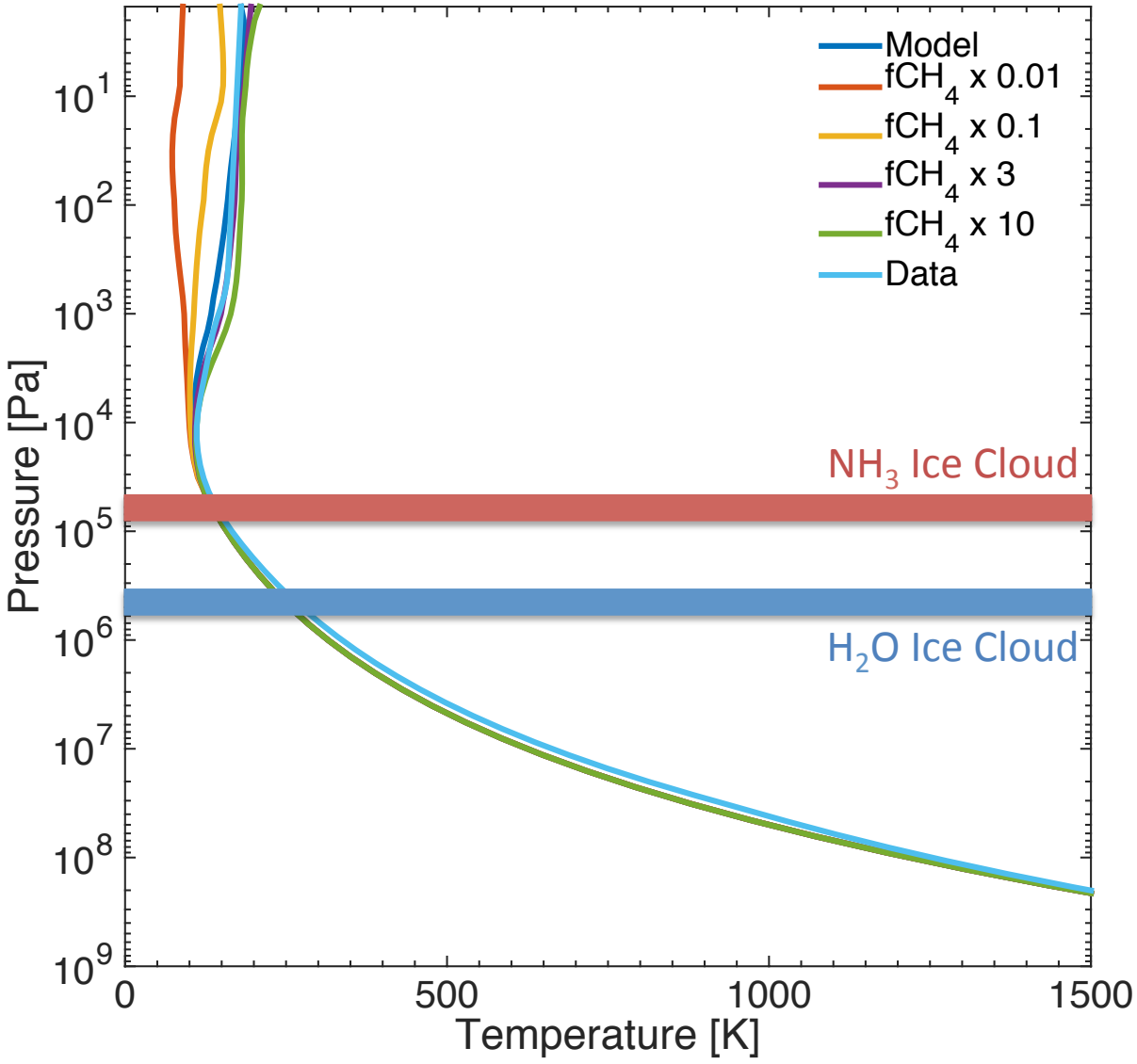
Cahoy et al. 2010

Photochemical Haze



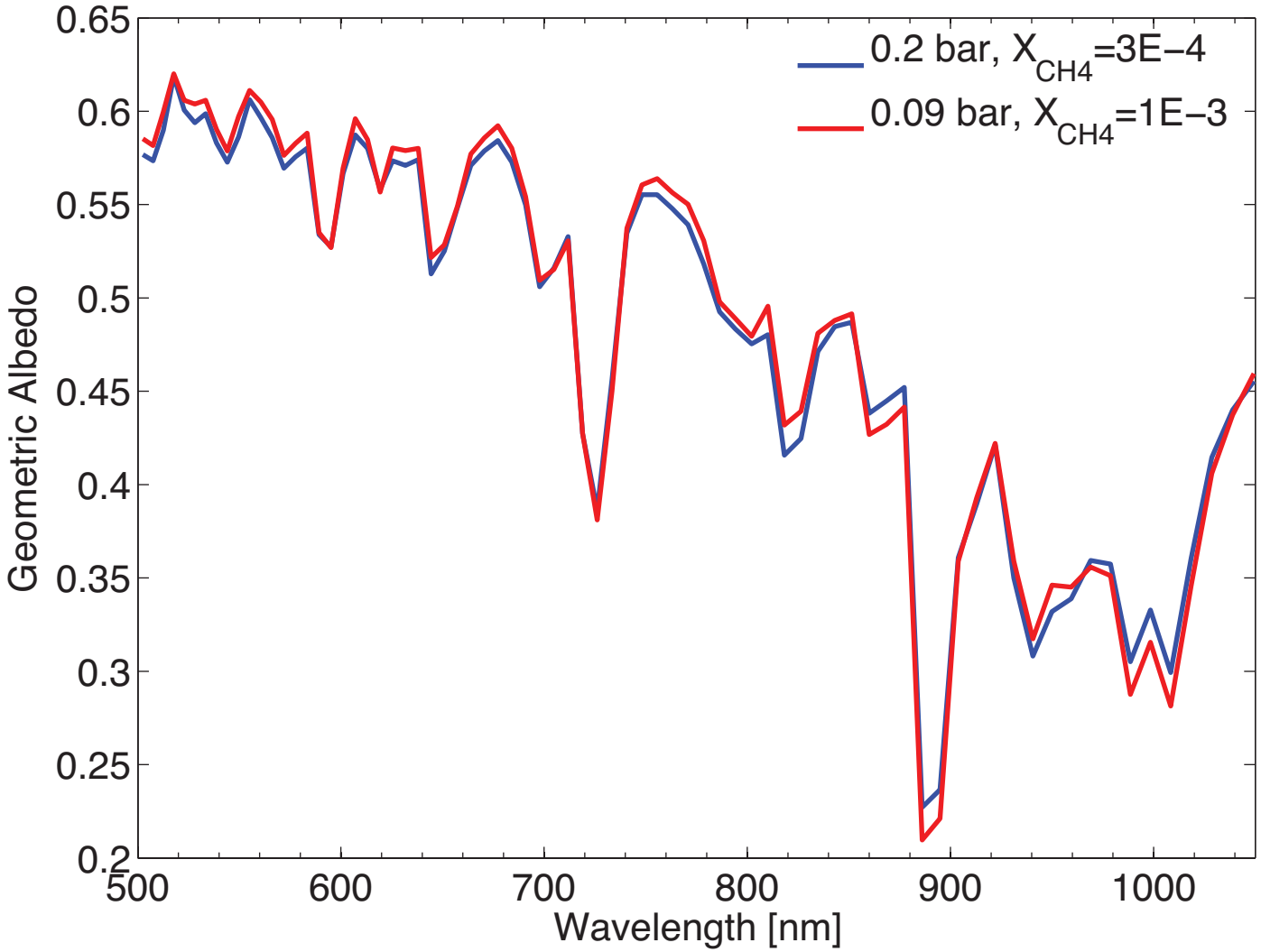
Hu 2014

Beyond the Solar Composition



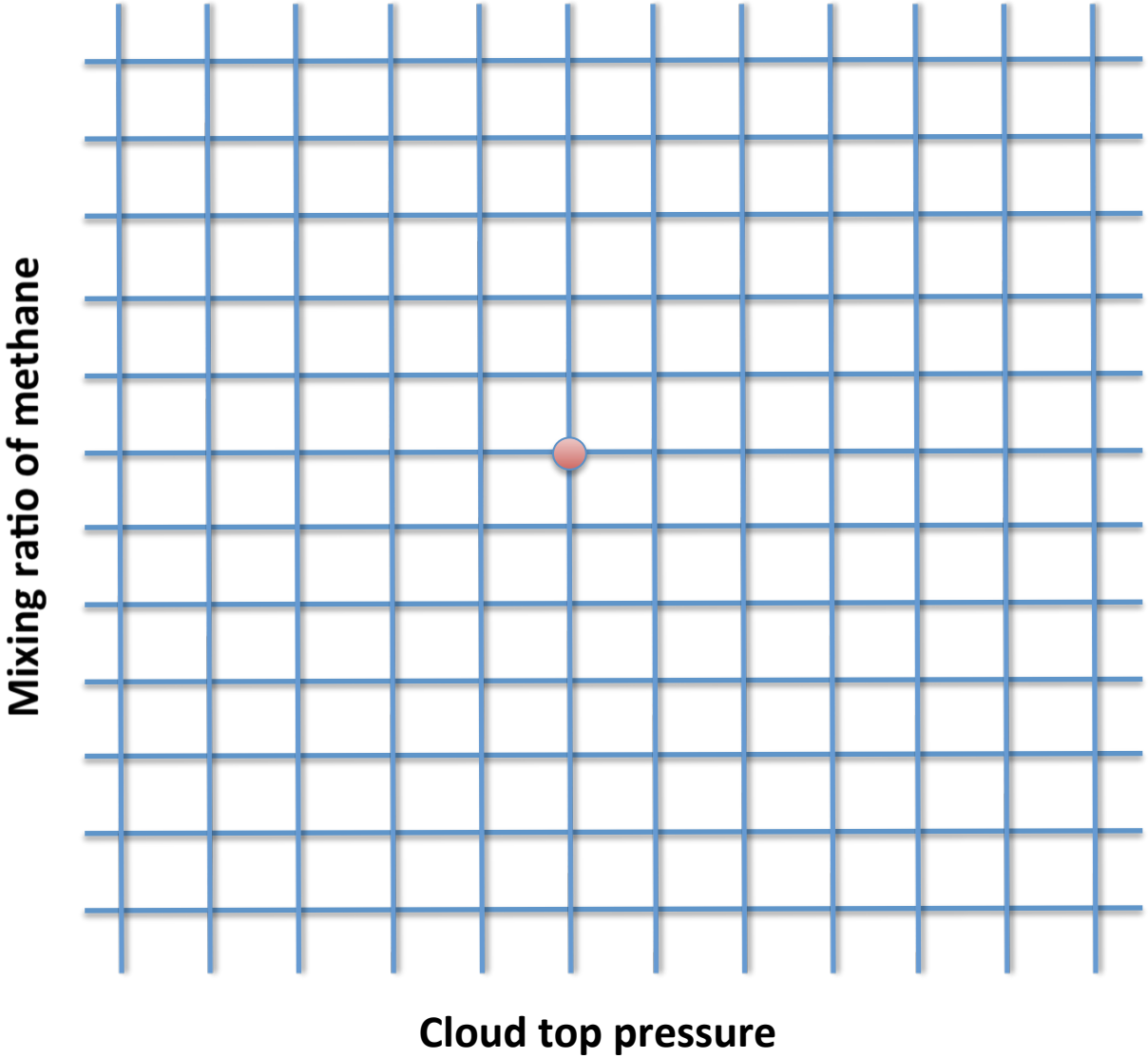
Hu 2016, in prep.

Degeneracy!



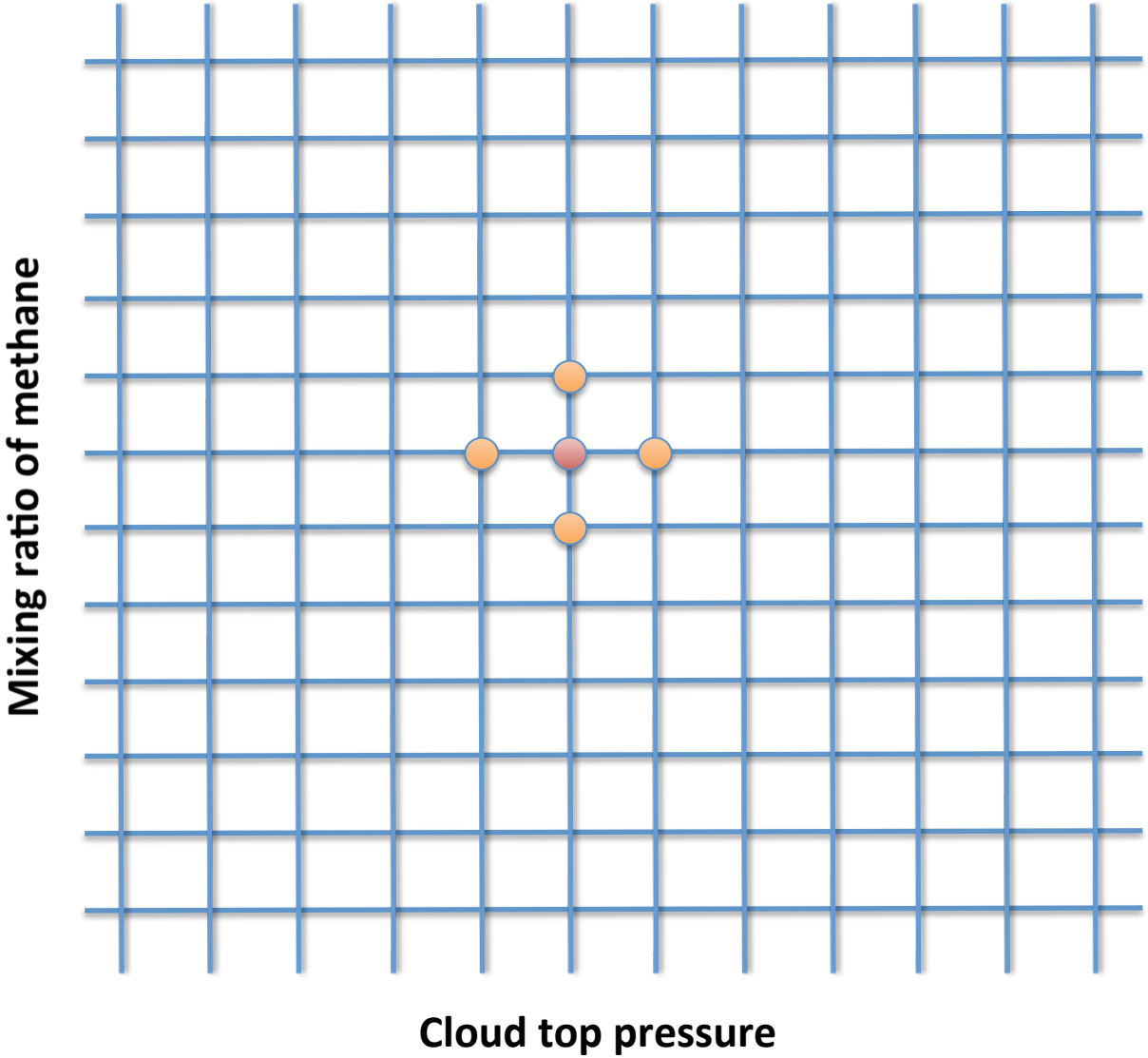
Hu 2014

Detectability of Cloud and Gas



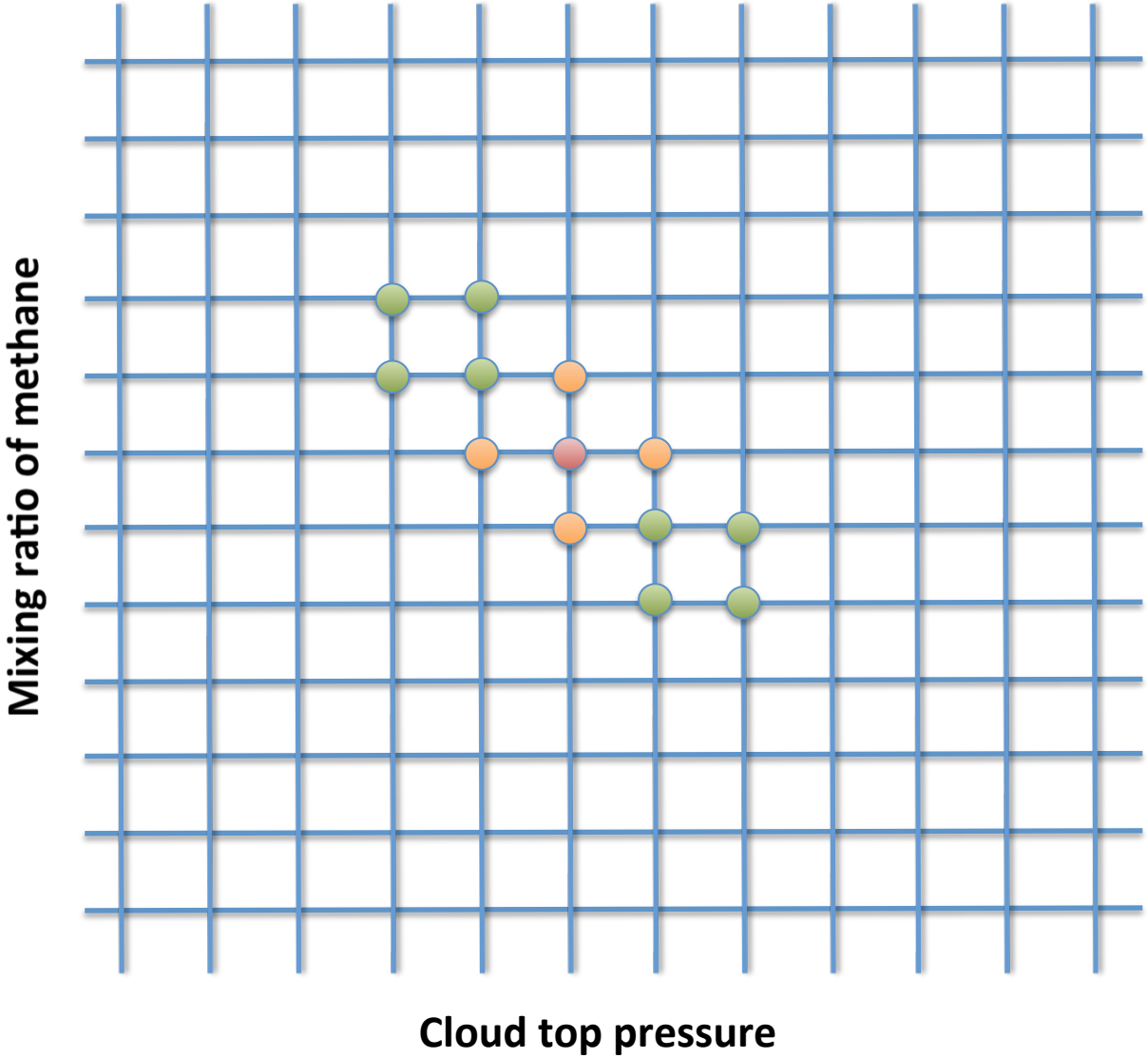
Hu 2014

Detectability of Cloud and Gas



Hu 2014

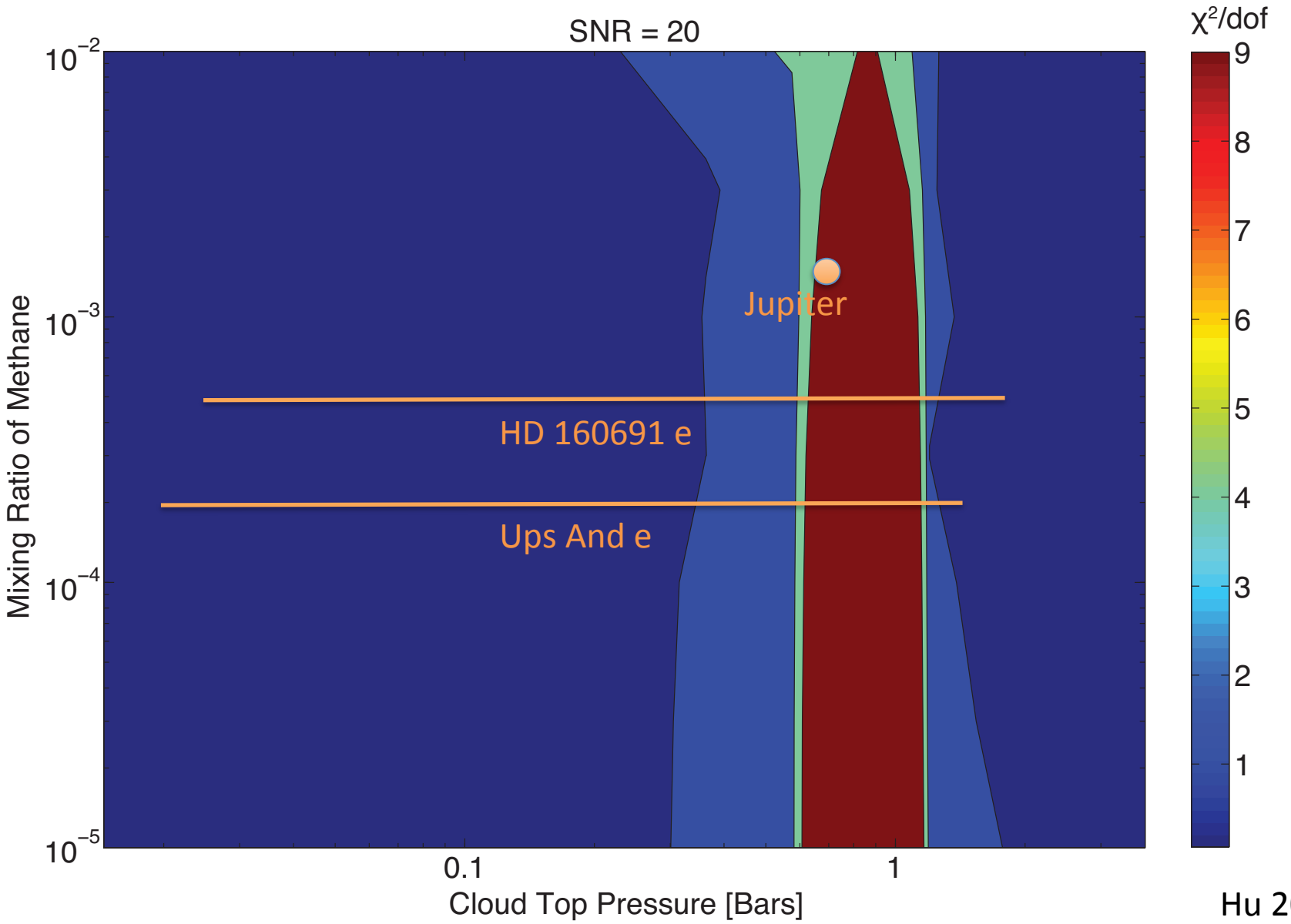
Detectability of Cloud and Gas



χ^2 can be defined as the difference between a model and all adjacent models, for specified spectral resolution and SNR

Hu 2014

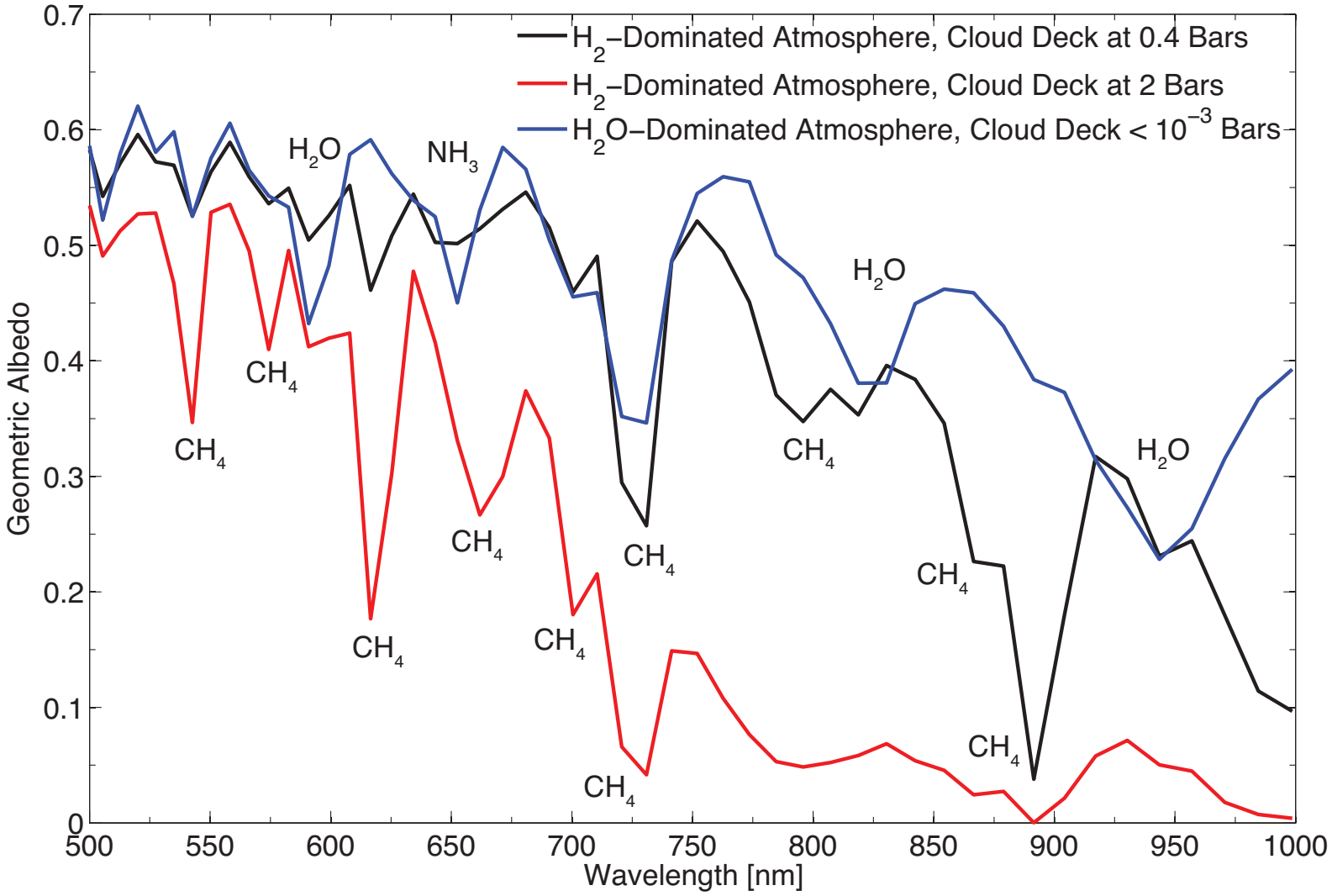
Detectability of Cloud and Gas



Hu 2014

Towards Imaging (Super-)Earths

Cool H_2O-rich Super Earths



Hu 2016, in prep.

Conclusion

Exciting scientific discoveries can be anticipated from imaging and characterizing cool, gaseous exoplanets by WFIRST.

Modeling groundwork is ongoing to fully recognize the science potential.

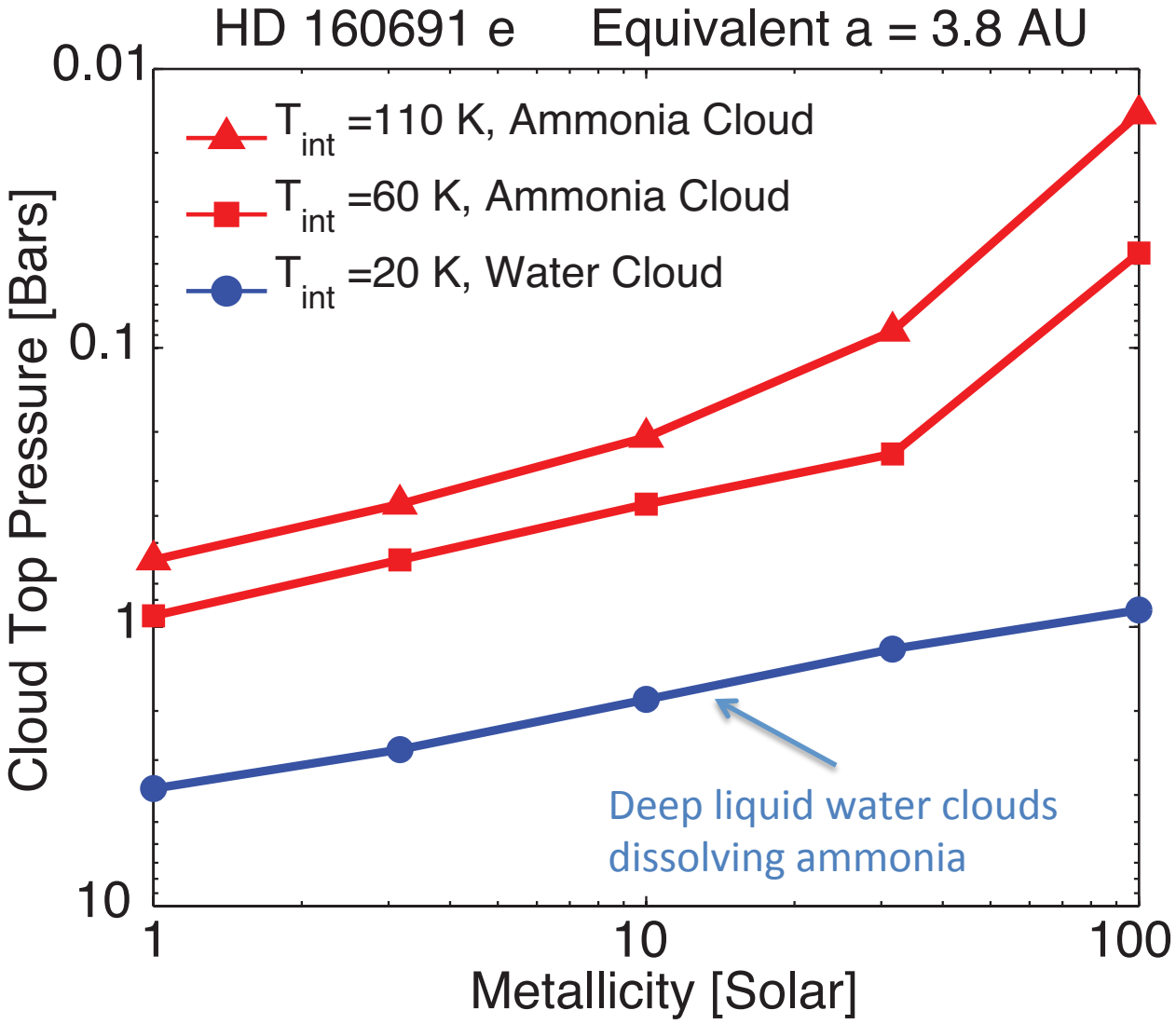
- Interplay between clouds and C, N, O abundances
- Haze Production in Photochemical Processes
- Evolved Neptunes and H_2O-rich Super Earths
- Spectral Degeneracies and Information Content
- ?

Adam Burrows, 2014, **Scientific Return of Coronagraphic Exoplanet Imaging and Spectroscopy Using WFIRST**, arXiv: 1412.6097

Renyu Hu, 2014, **Ammonia, Water Clouds and Methane Abundances of Giant Exoplanets and Opportunities for Super-Earth Exoplanets**, arXiv:1412.7582

Mark Marley et al., 2014, **A Quick Study of the Characterization of Radial Velocity Giant Planets in Reflected Light by Forward and Inverse Modeling**, arXiv: 1412.8440

Thermal Evolution from the Cloud Pressure



Type and location of clouds depend on

- Atmospheric composition
- Thermal evolution history

and beyond 1-D models

- Updraft and downdraft

Hu 2016, in prep.