

# UCSanDiego

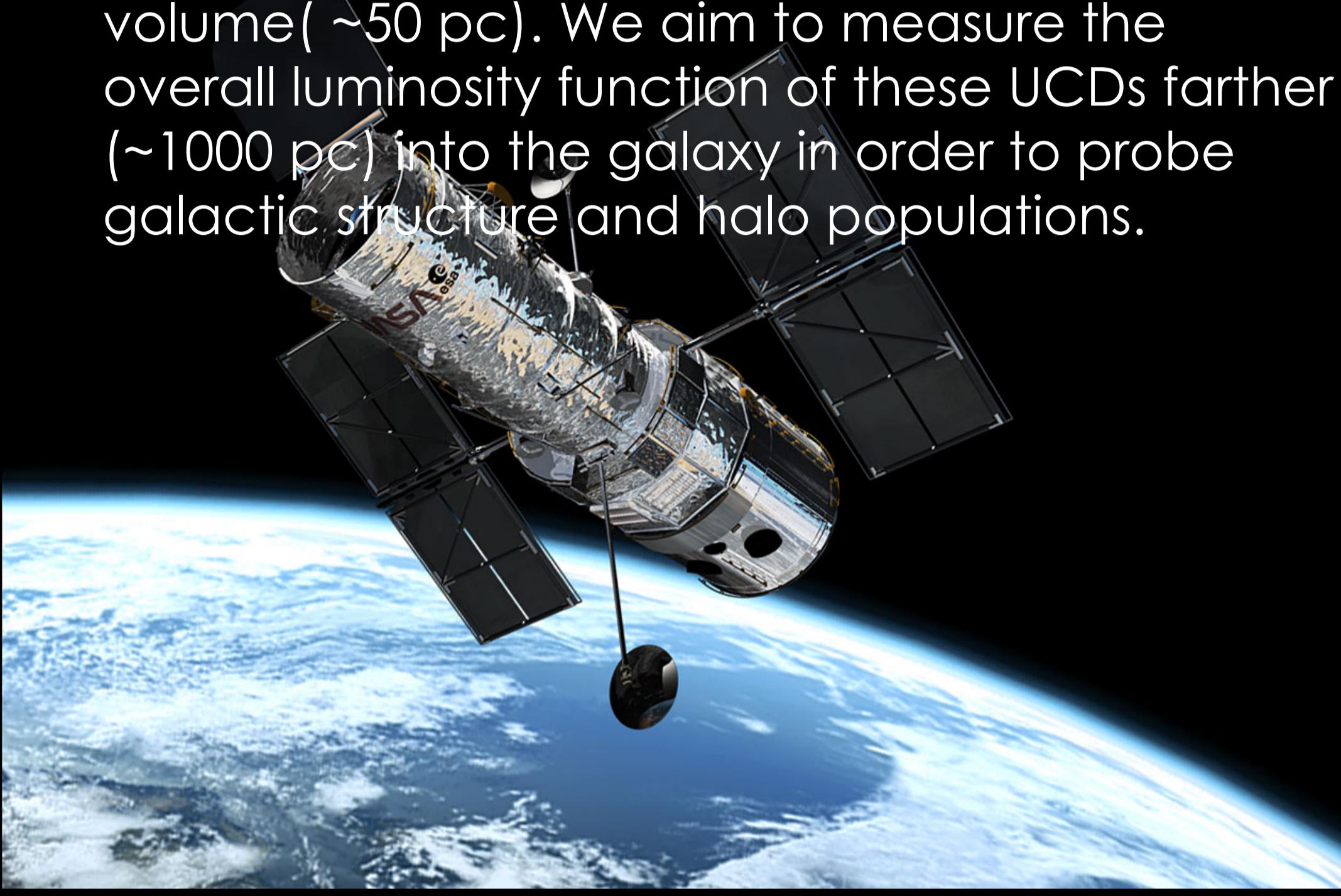
# Brown Dwarfs Beyond Gaia: A Deep Survey of late-M, L, T Dwarfs with HST-WFC3 Parallel Fields



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# BACKGROUND & PURPOSE

The local luminosity function of ultracool dwarfs (UCDs, M, L, T dwarfs) have been measured by previous surveys ( 2MASS: Cruz et al. 2007, Kirkpatrick et al. 2010; WISE: Kirkpatrick et al. 2011). These surveys only access a shallow volume( ~50 pc). We aim to measure the overall luminosity function of these UCDs farther (~1000 pc) into the galaxy in order to probe galactic structure and halo populations.

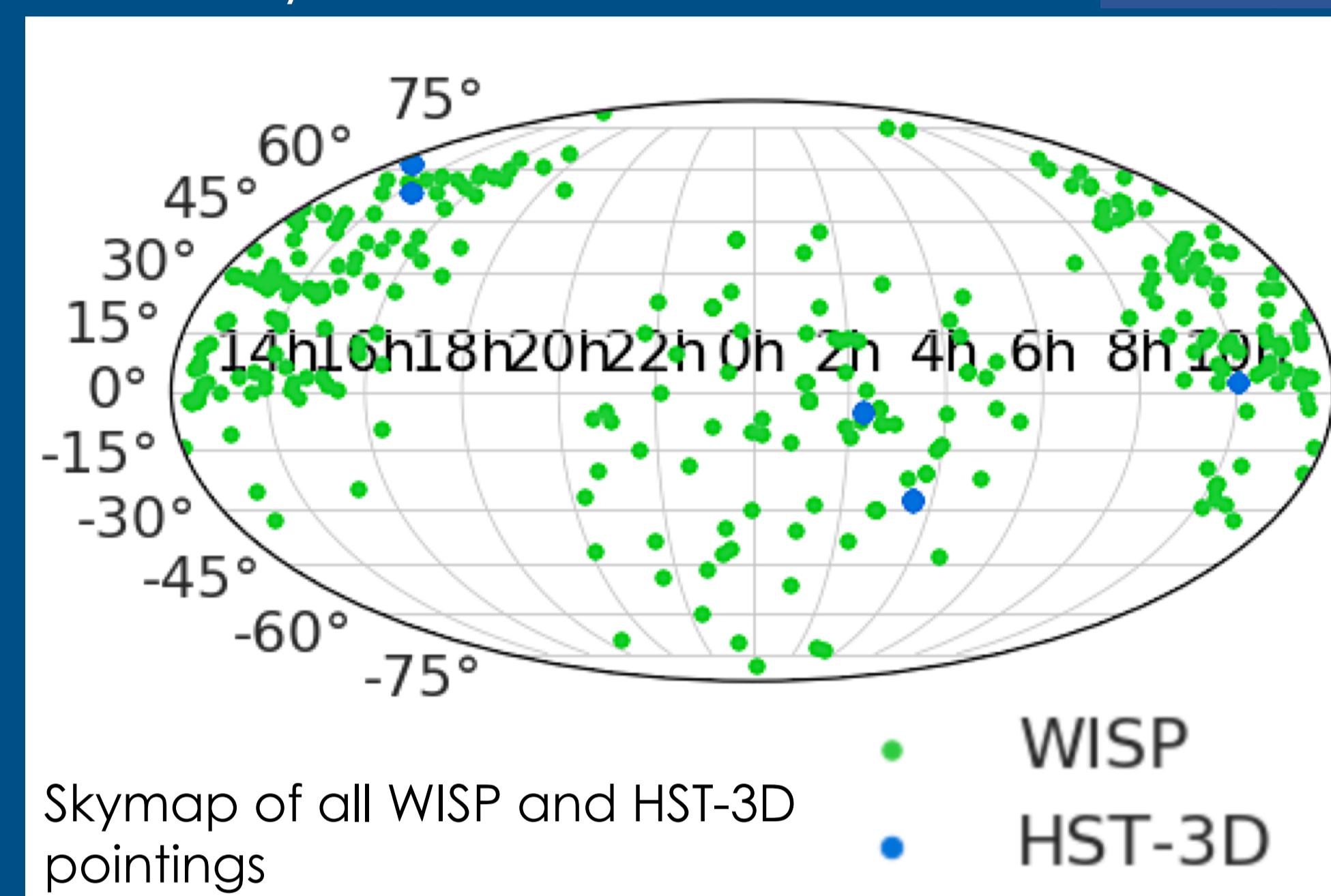


# WISP & 3D-HST SURVEYS

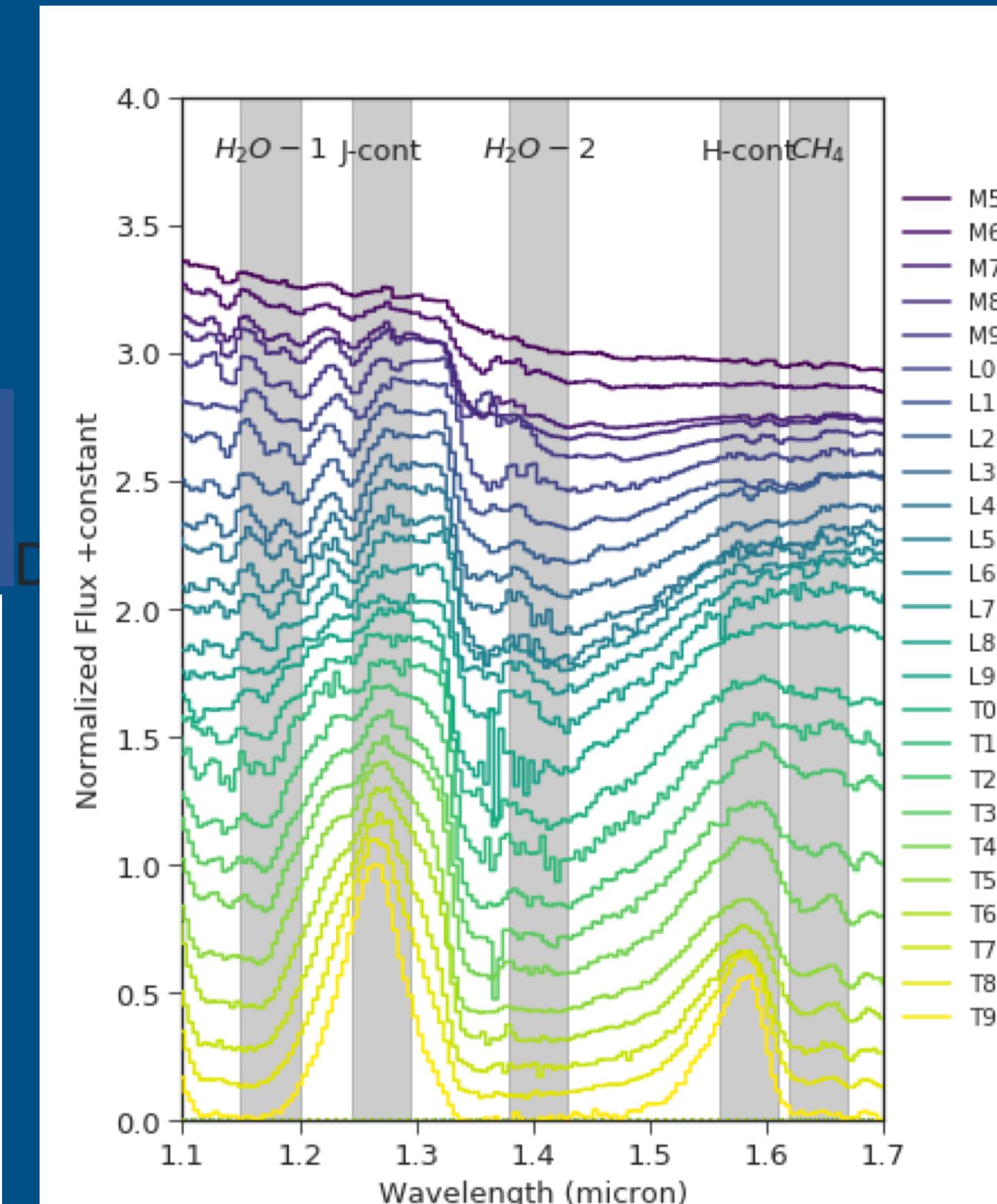
- The WFC3 Infrared Spectroscopic Parallel Survey (WISPS, Atek et al. 2010) and 3D-HST survey (Momcheva et al. 2016) look for high-z galaxies
  - WISP pointings: determined by observing programs accepted on the Cosmic Origins Spectrograph (COS) and Space Telescope Imaging Spectrograph (STIS)
  - 3D-HST pointings: GOODS (North and South), AEGIS, COSMOS and UDS
  - These surveys provide low-resolution ( $R \sim 130$ ) near-infrared (1.1-1.7 microns)
  - We examined WFC3 grism spectra of 200, 000+ sources and their F110W, F140W, F160W photometry

# SPECTRAL INDICES

- We defined spectral indices that trace water and methane absorption features found in cold L and T dwarfs (Kirkpatrick 2005 , Burgasser et al. 2006 ) to select and initially classify sources)



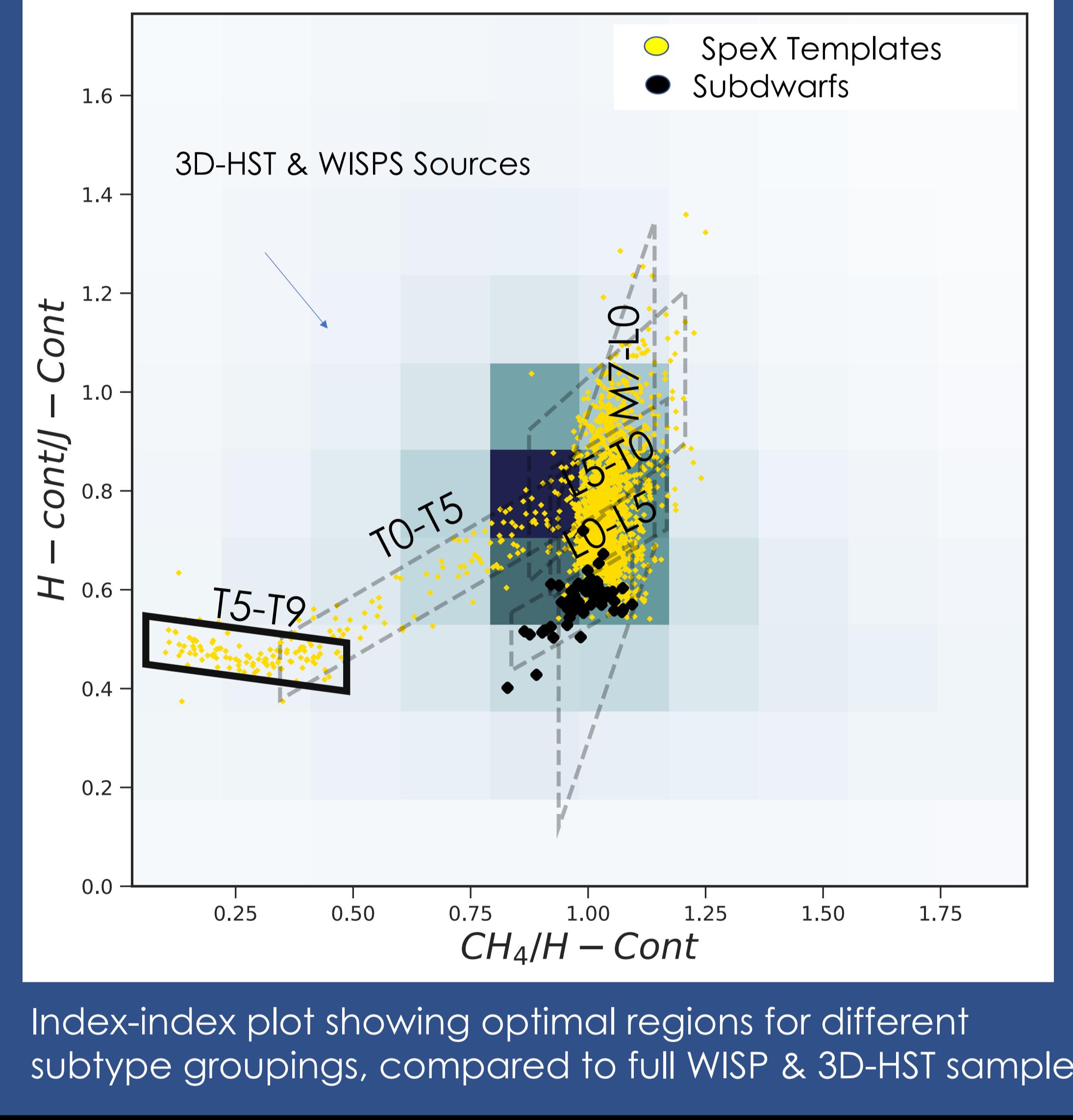
Skymap of all WISP and HST-3D pointings



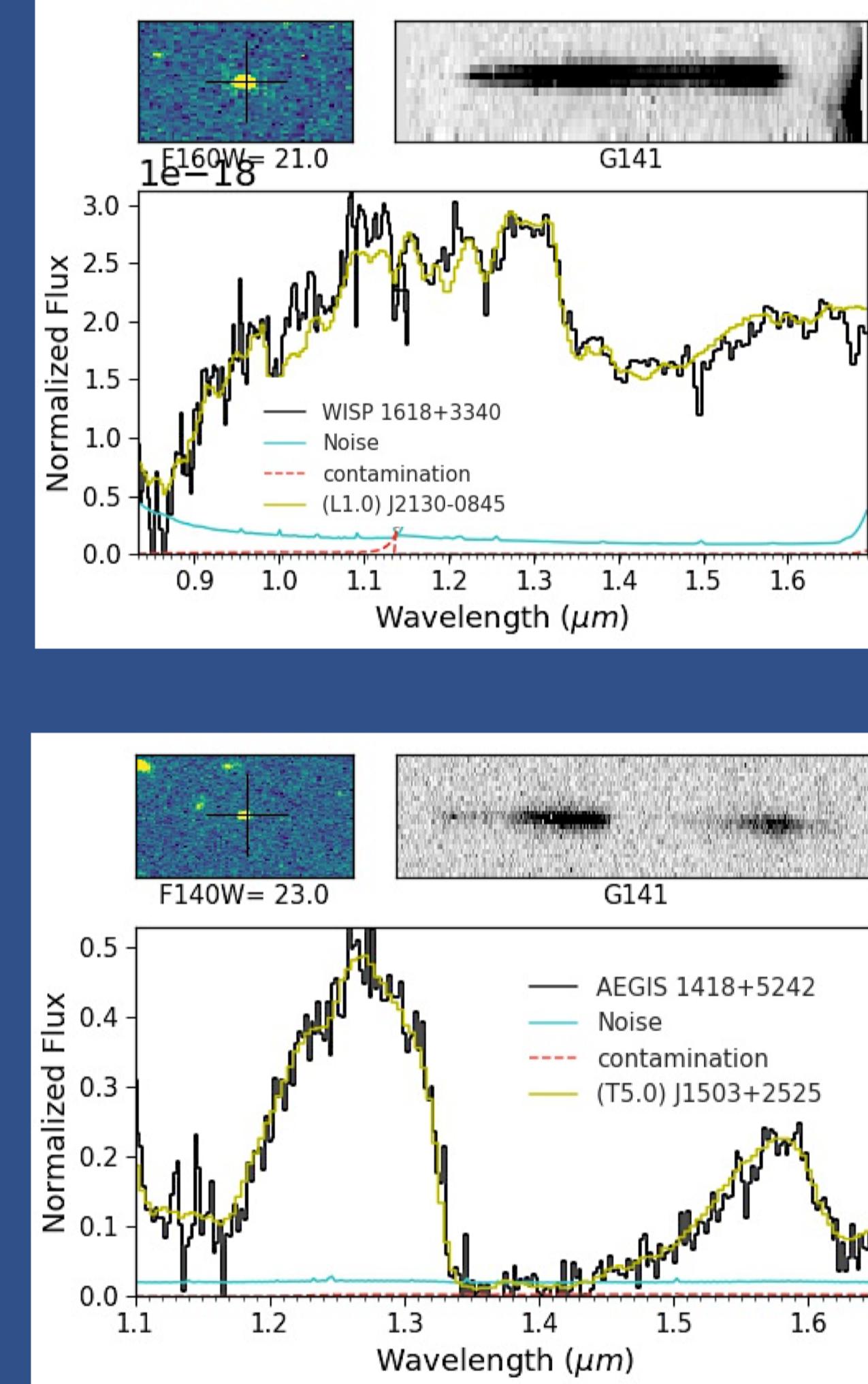
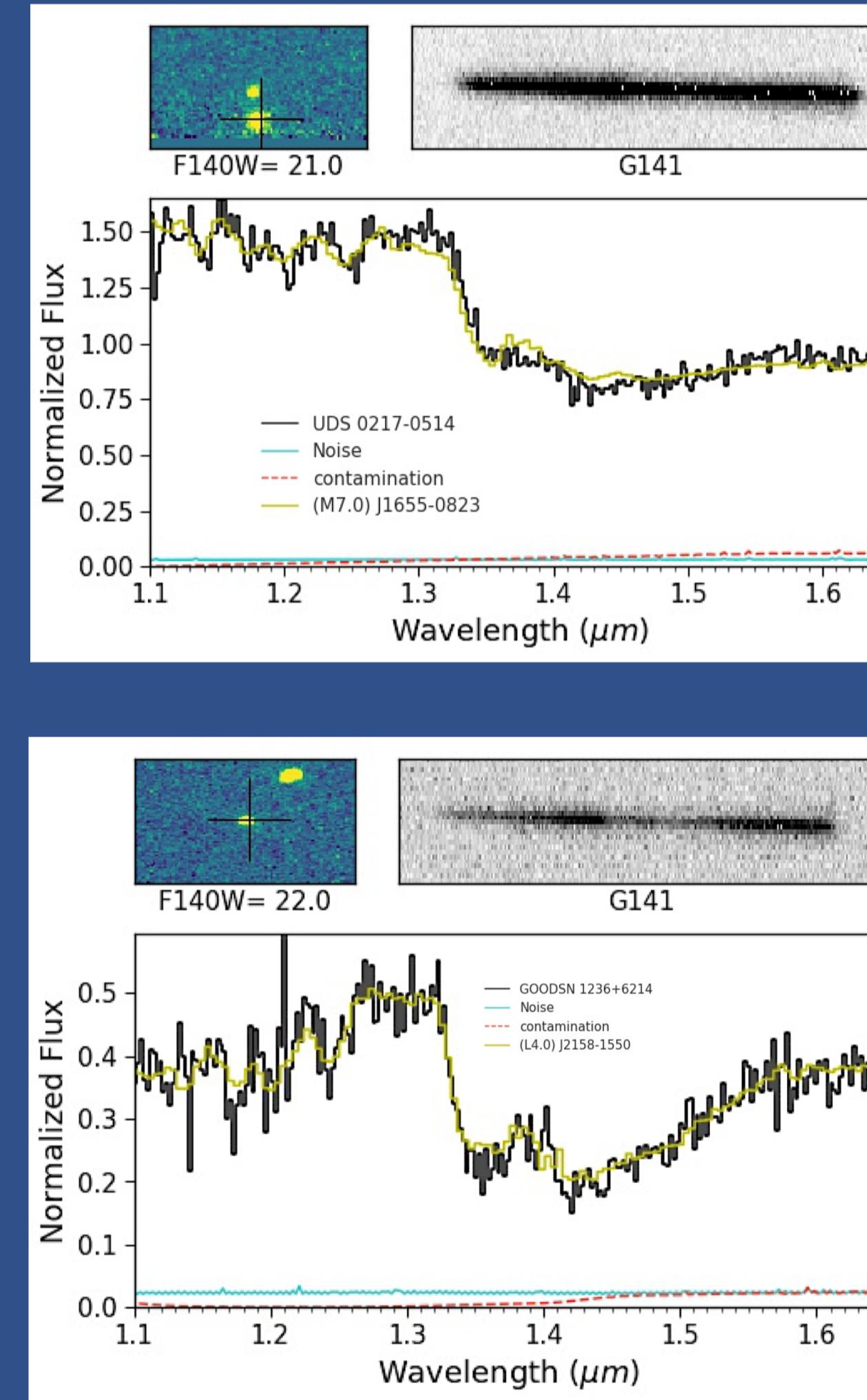
# Near-Infrared spectral sequence of UCDs in the WFC3 bandpasses based on SPL data

# SELECTION CRITERIA

- We used a sample of 2029 low resolution M5-T9 spectra from the SpexPrism Library (SPL, Burgasser 2014 )
  - Selection criteria are boxes in the index-index spaces that contain subtype groupings of objects with >80% completeness (# sample selected/ total #) and minimum contamination
  - We selected a total of 228 M7-T9 ultracool dwarfs after visual inspection
  - Distances were estimated from photometry using absolute magnitude-spectral type relations (Dupuy et al 2012)

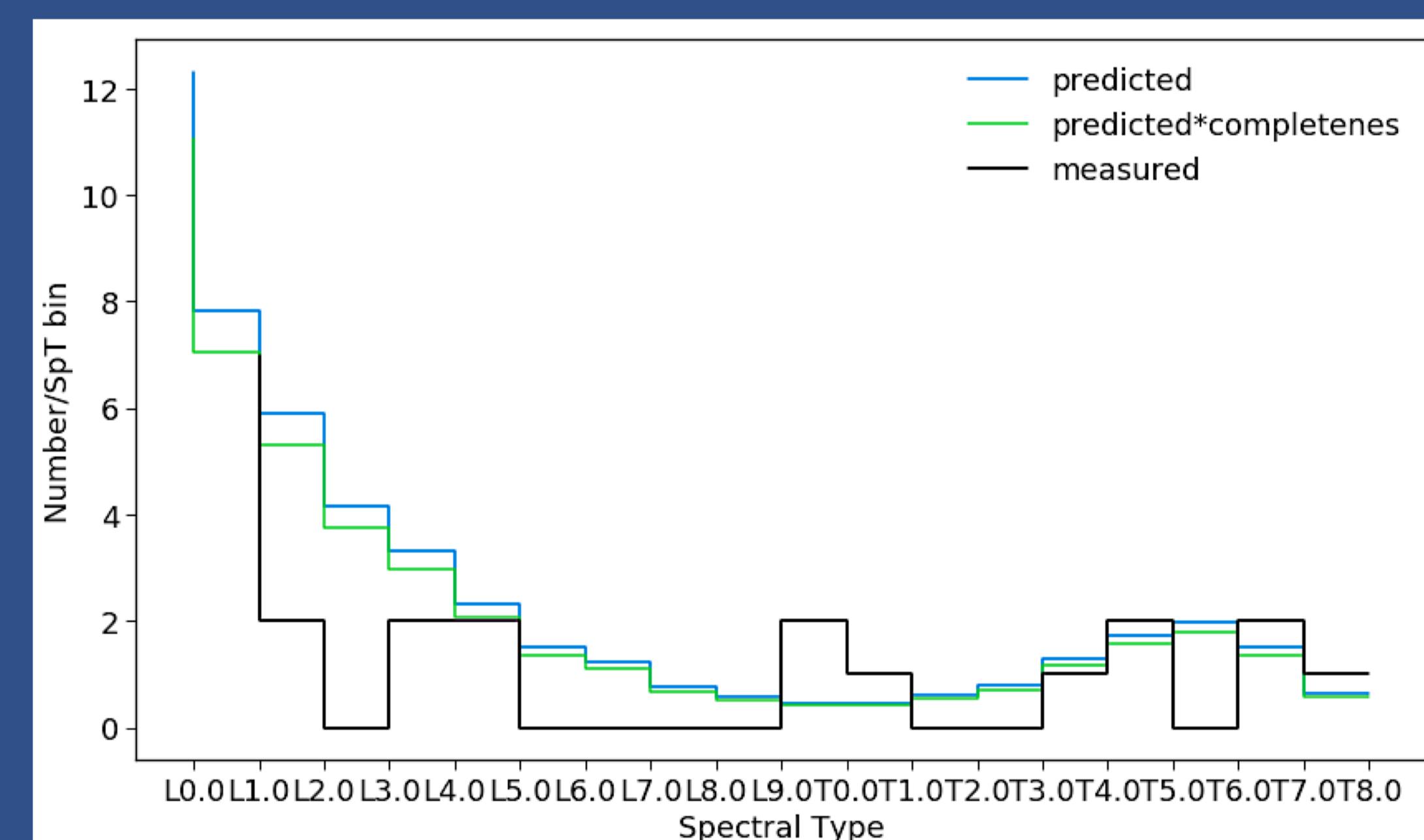


# EXAMPLES OF SELECTED ULTRACOOL DWARFS

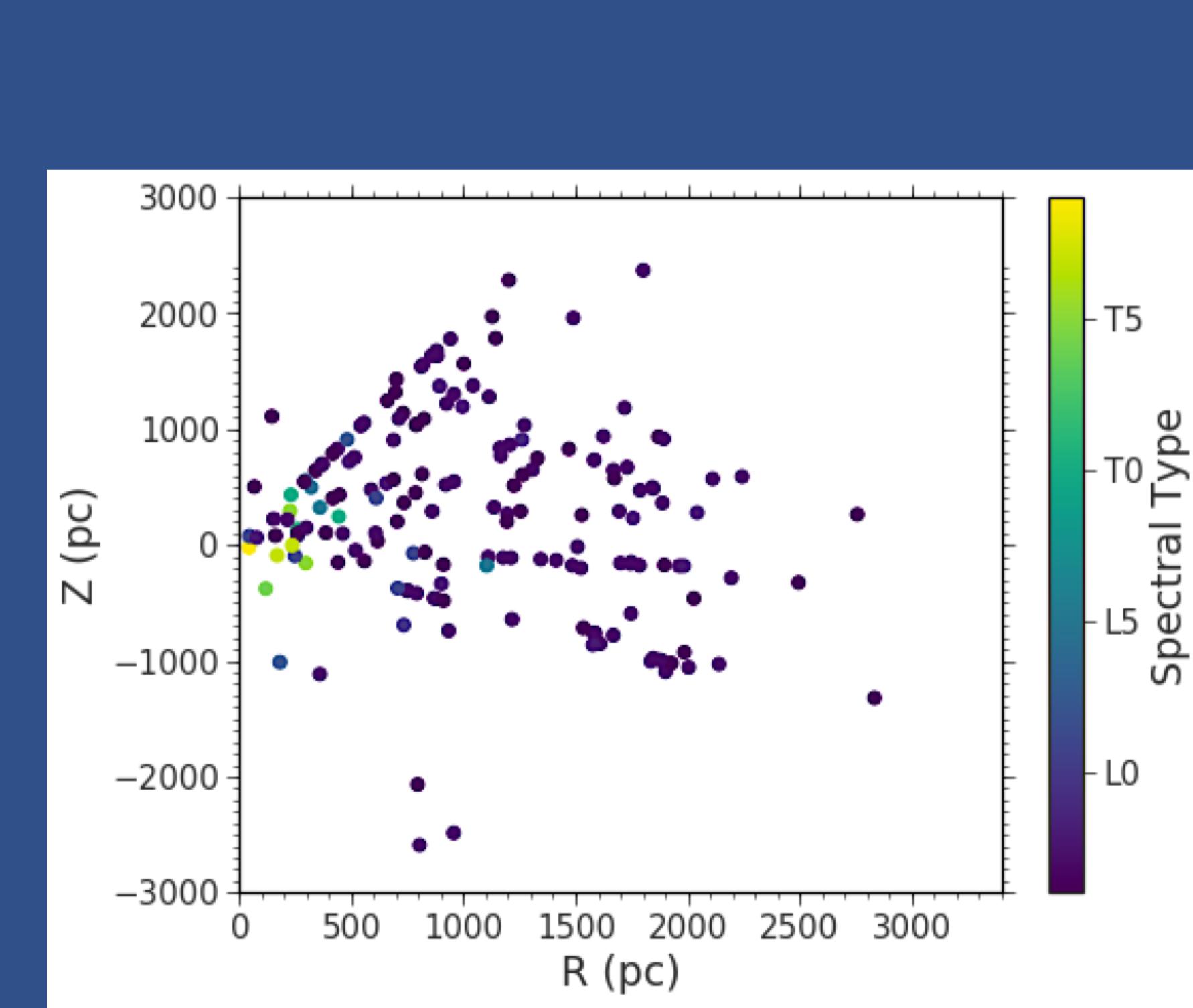


# SURFACE DENSITY ESTIMATION

- Using a semi-empirical luminosity function(Burgasser 2007 ) scaled to match the galactic structure (Juric et al 2009), we compute the estimated number densities given limiting magnitudes of all the pointings.
  - The predicted numbers match our observations except for missing early L dwarfs & a slight bump for early T dwarfs distributions
  - These low yields in simulations may be due to underestimations of limiting magnitudes
  - This excess in T dwarfs may be an effect of small number statistics



# Number counts predicted and observed in all WISP & HST-3D



# Distribution of UCD discoveries in Galactic coordinates

# FUTURE WORK

- Re-evaluate our completeness, seek to understand the discrepancy between predictions and observations
  - Optimize selection criteria using the current sample
  - Re-compute the simulation using a purely empirical luminosity function ( Bardalez-Gagliuffi et al. 2018, in prep) and variable structure model
  - Explore age effects on the expected yields
  - Include subdwarfs in the analysis
  - Using these densities, we will constrain disk, halo parameters in an MCMC routine

# ACKNOWLEDGEMENTS

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