

# Working with CLIMCAPS trapezoids

How to calculate coarse-layer AKs on fine-layer RTA grid

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# Acronyms

- **fn** = file name
- **AK** = averaging kernel
- **nL** = number of retrieval (fine) layers above surface pressure at target scene
- **nj** = number of trapezoidal (coarse) layers above surface pressure at target scene
- **ifoot** = index of retrieval footprint along scanline. Each CLIMCAPS granule has 30 footprints in each scanline
- **iscan** = index of footprint across scanline. Each CLIMCAPS granule has 45 footprints across the scanlines
- **\*func\*** = trapezoidal basis function

# STEP 1: Read file and extract relevant fields then plot arrays using `calc_trapezoids_fmatrix.pro`

- Sample files
  - **fn1**='~/data/SNDR.J1.CRIMSS.20201230T2248.m06.g229.L2\_CLIMCAPS\_RE T.std.v02\_28.G.210203073025.nc'
  - **fn2**='~/data/SNDR.J1.CRIMSS.20190901T0336.m06.g037.L2\_CLIMCAPS\_RE T.std.v02\_28.G.200214174949.nc'
- lfoot=4, iscan=32 (target field-of-regard)
- Read these fields for CO<sub>2</sub>:
  - `co2_func_htop = 0`
  - `co2_func_hbot = 0`
  - `co2_func_indxs = [1, 22, 44, 55, 63, 69, 75, 85, 100] = 9 values depicting boundaries of coarse pressure layers for trapezoid basis functions`
  - `co2_ave_kern(*,*,lfoot,iscan) = [8 x 8]`
  - `Prior_surf_pres/100. -> fn1 = 1019.00 hPa, fn2 = 840.207 hPa`

**STEP 2:** Adjust vertical grids according to surface pressure at target scene [ifoot,iscan]

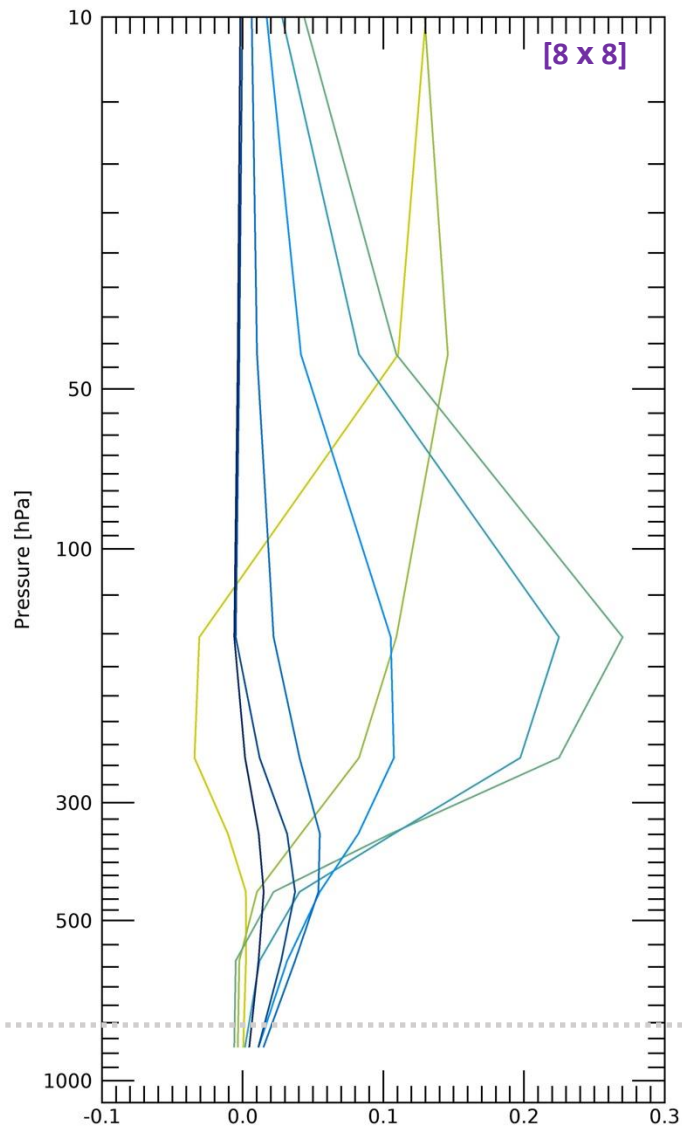
- `ak_nlev_scene = 9`
- `co2_func_idxxs` after surface adjustment
  - `fn1 = [1 22 44 55 63 69 75 85 98]`
  - `fn2 = [1 22 44 55 63 69 75 85 91]`

**STEP 3:** Calculate transformation matrix (`f_matrix`) and its pseudo inverse

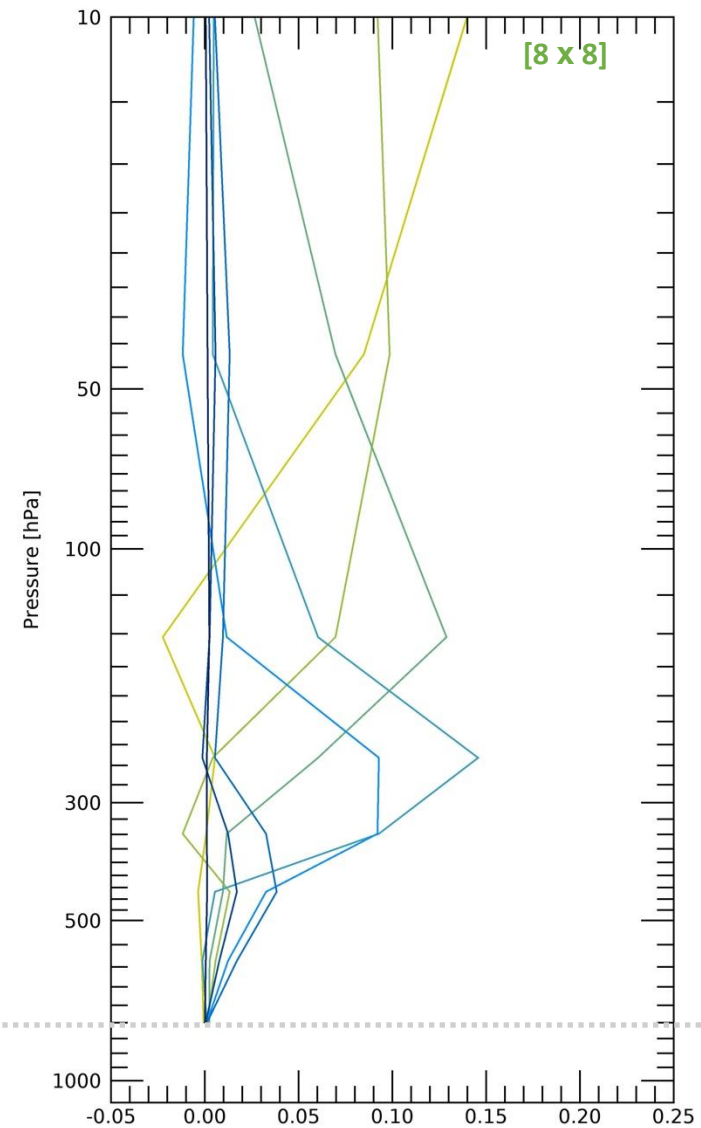
- `calc_trapezoids_fmatrix.pro` calls `calc_finv_mp.pro`, which depends on `slb2fin.pro`

# Averaging Kernels (AKs) on coarse grid

co2\_ave\_kern from **fn1**, psurf = 1019 hPa

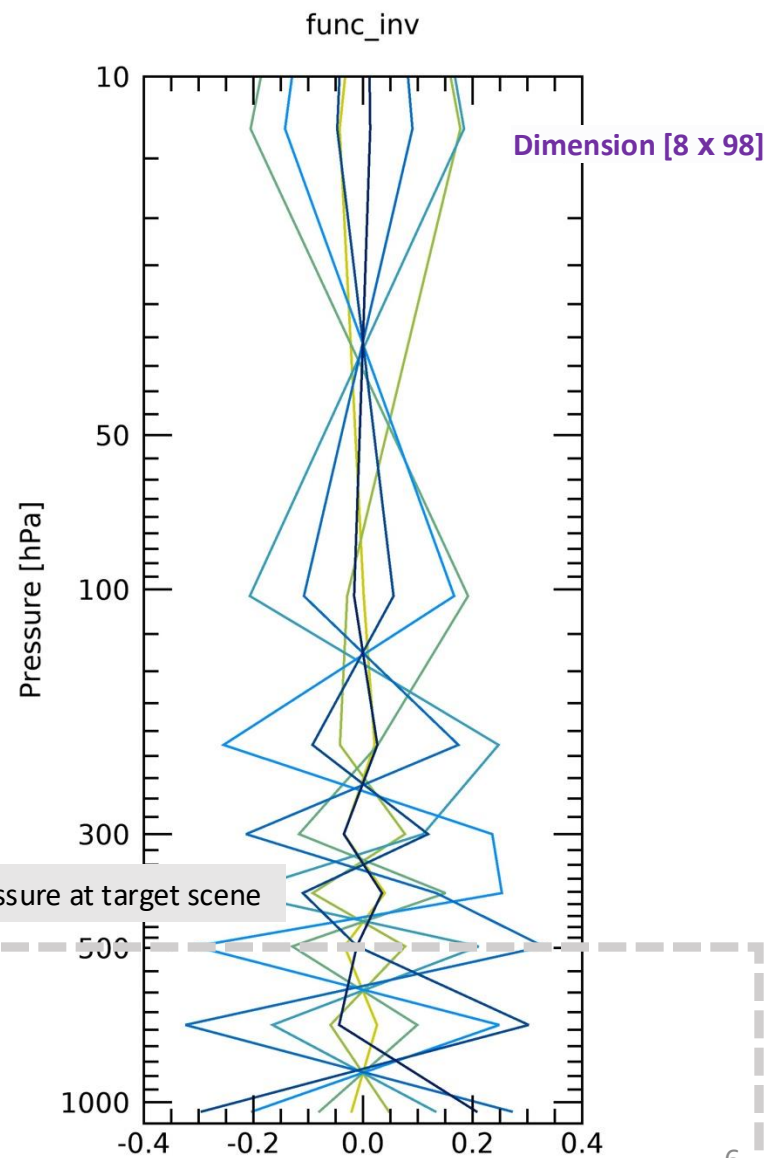
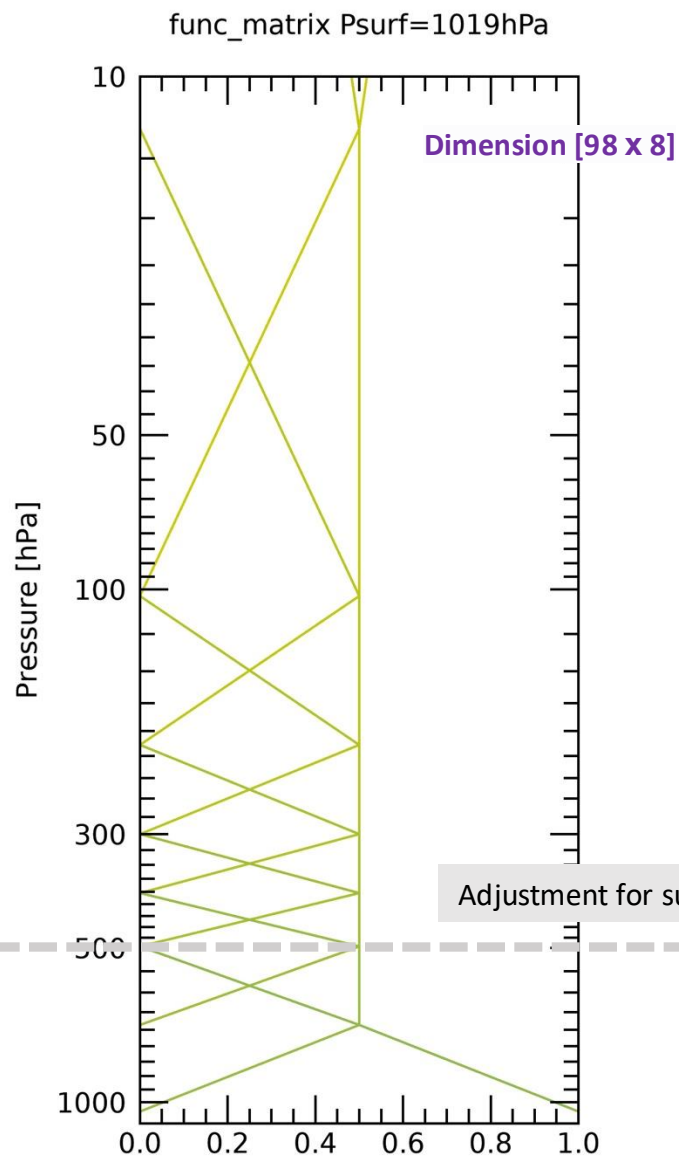


co2\_ave\_kern **fn2**, psurf = 840 hPa



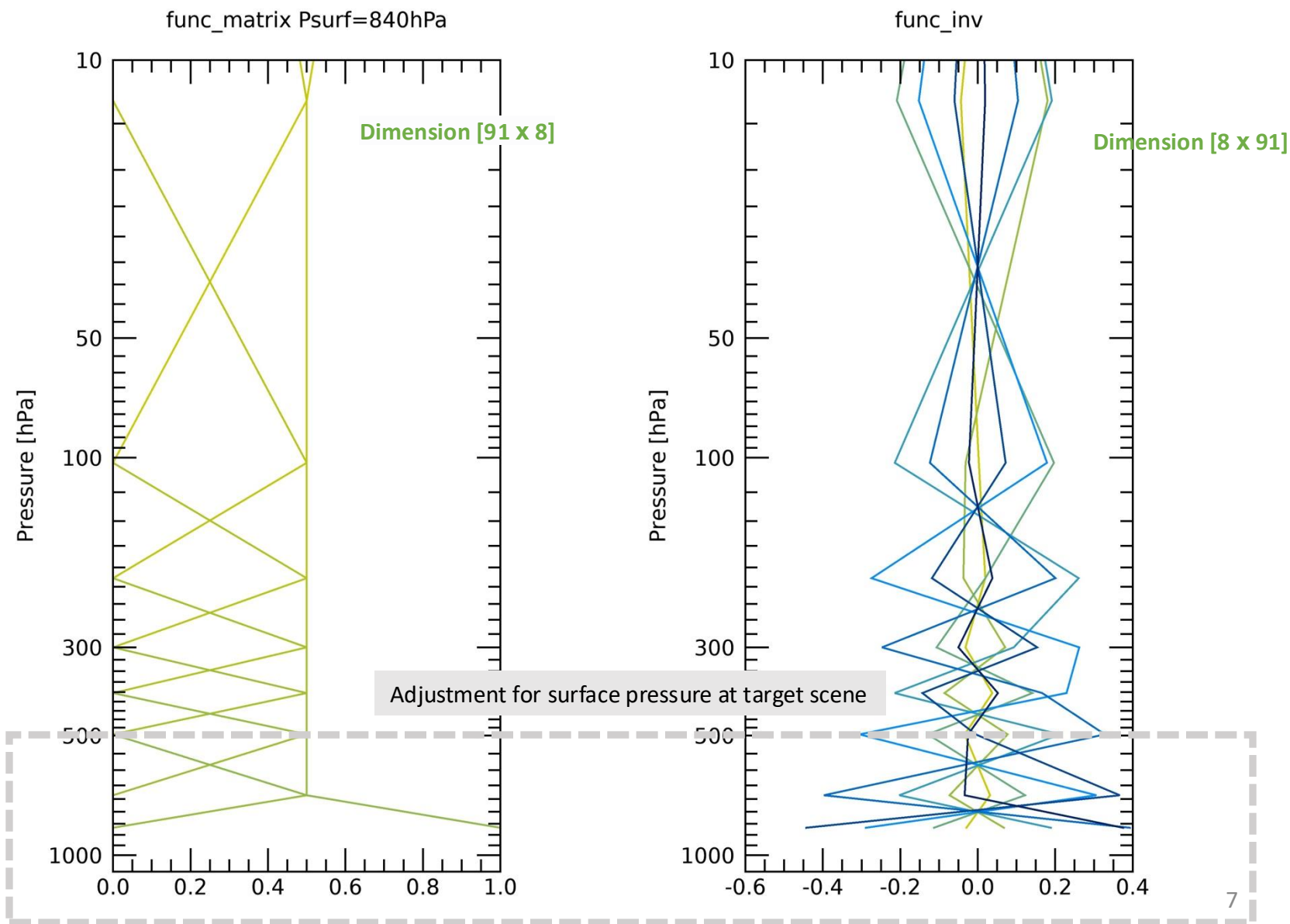
# Func\_matrix and its inverse for fn1

Eq. 11 Maddy & Barnet 2008



# Func\_matrix and its inverse for fn2

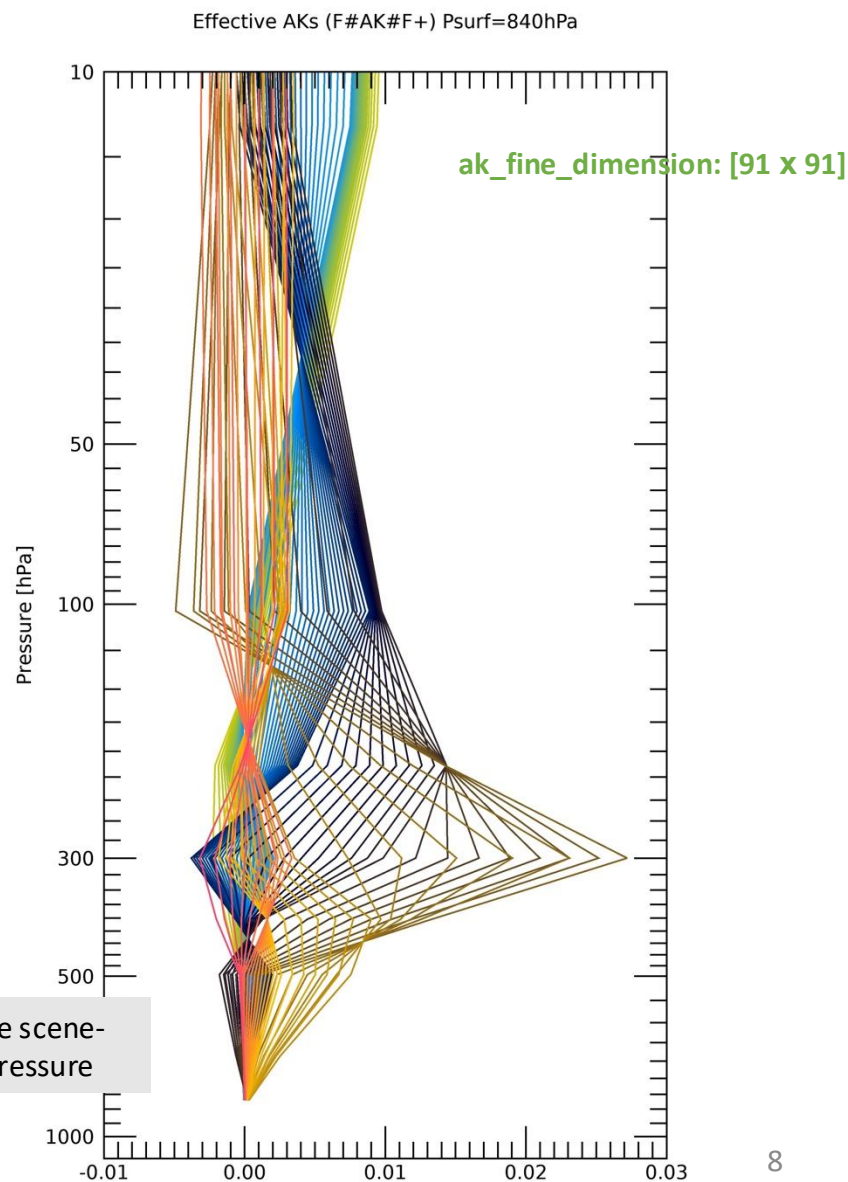
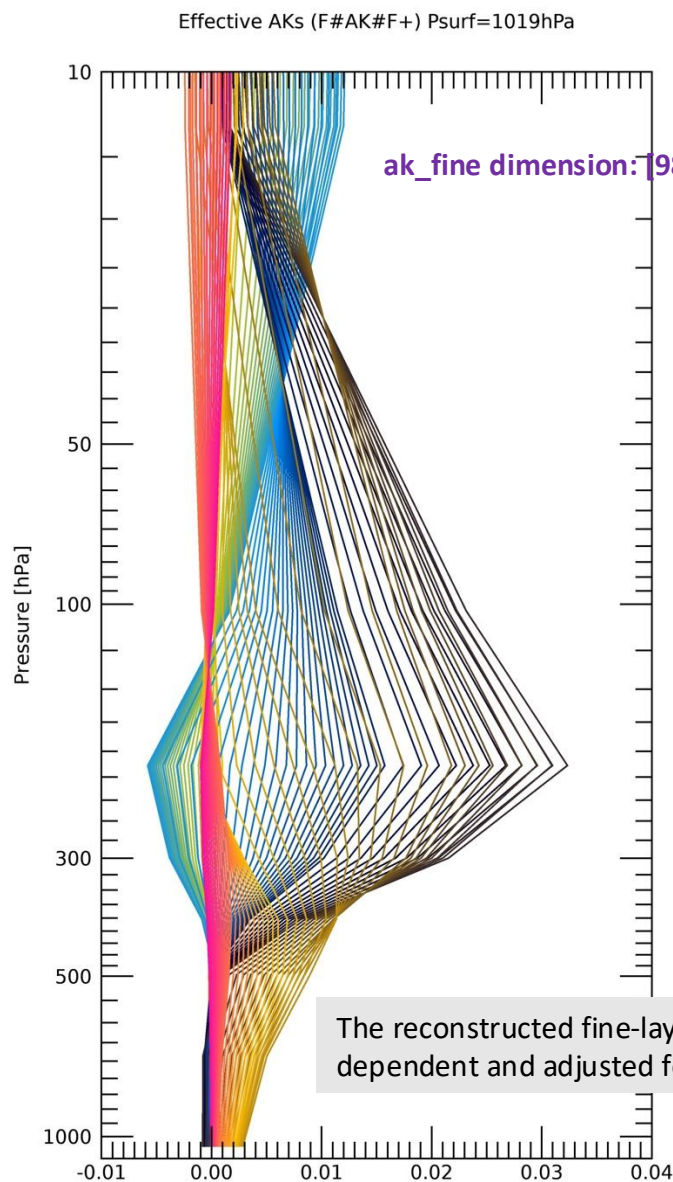
Eq. 11 Maddy & Barnet 2008





# Effective Averaging Kernels (fine levels)

Similar to left panels in Figure 4 of Maddy & Barnett 2008 – Effective Averaging Kernels = func\_matrix # (coarse AKs) # func\_inv



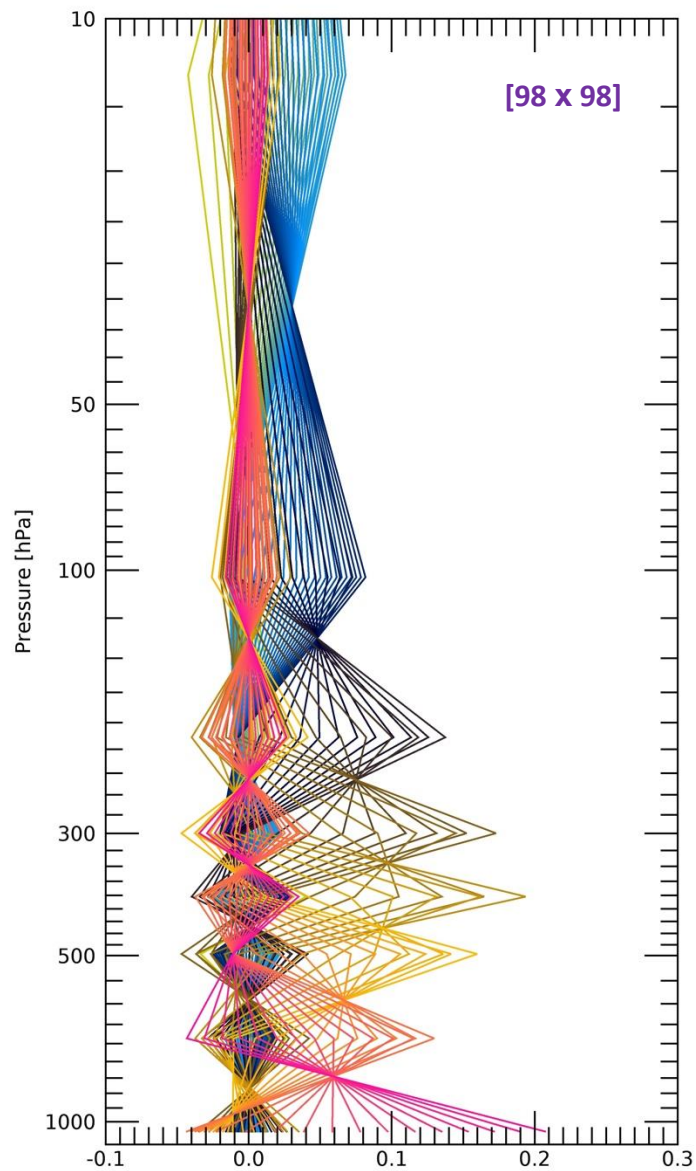
The reconstructed fine-layered AKs are scene-dependent and adjusted for surface pressure



# Smoothing Kernels (fine layers)

Similar to right panels in Figure 4 of Maddy & Barnet 2008 – Smoothing Kernels = `func_matrix # func_inv`

Smoothing Kernels (F#F+) Psurf=1019hPa



Smoothing Kernels (F#F+) Psurf=840hPa

