Level 3 Gridding Experience from the PATMOS-x Project

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What is PATMOS-x

-An AVHRR based cloud climatology. We run algorithms that share much physical consistency with the MODIS Atmospheres Team where possible.

-Data record spans from 1981 to the present and should extend to 2020.

- Effort underway to go back in time on AVHRR/1 (back to 1978) and forward in time on NPOESS VIIRS.

- Level-3 products are generated at 0.5 degree resolution using an equal-area (ISCCP-like) grid.

http://cimss.ssec.wisc.edu/patmosx/

Definitions

LEVEL-2b = *sub-sampled and regularly gridded LEVEL-2*

old way

LEVEL-1b → LEVEL-2 → LEVEL-3

new way

LEVEL-1b → LEVEL-2 → *minimal* LEVEL-3

LEVEL-2 → LEVEL-2b → *application*
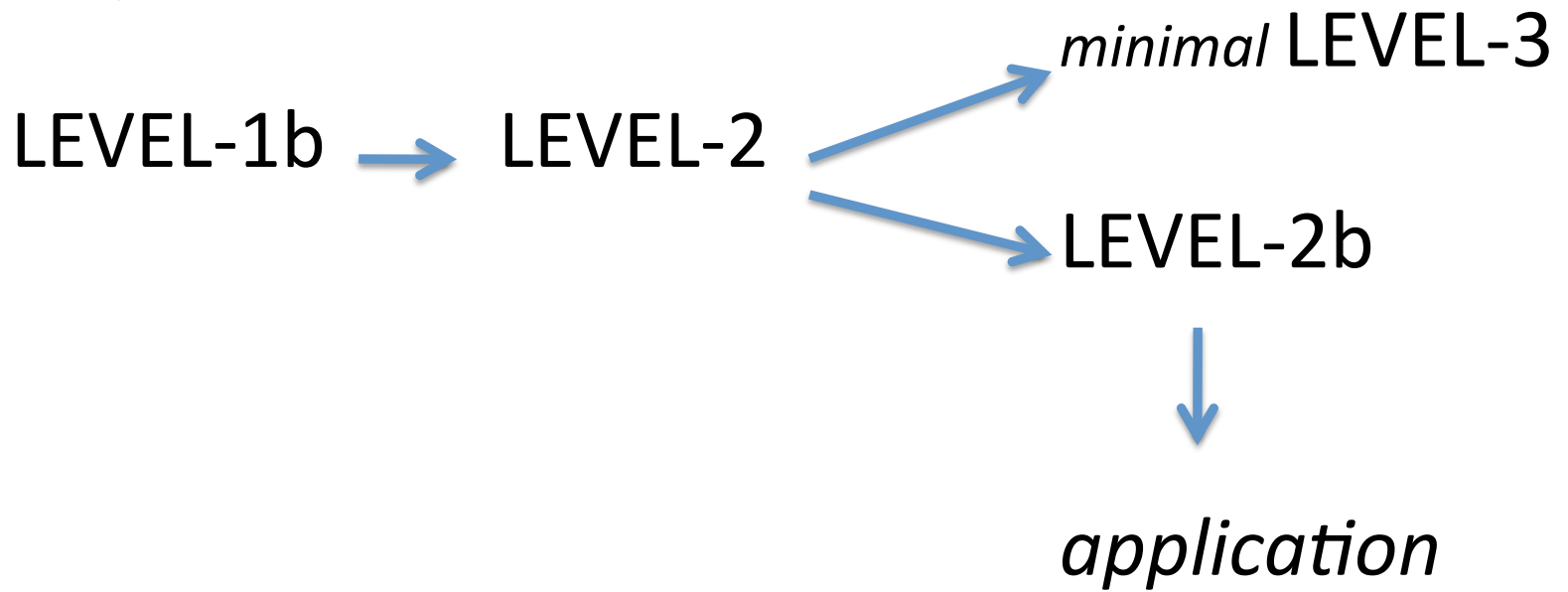
Motivation for Level-2b

➤ The averaging done in Level-3 data is not optimal for many cloud studies (*PATMOS-x level-3 did not contain the histograms in MYD08*).

➤ Evolving Level-3 requirements for the GEWEX Cloud Climatology Assessment Reports required more flexibility than offered by standard PATMOS-x level-3

➤ We do not have the resources to store level-2 archive.

➤ Therefore level-2b developed to
  ➤ maintain flexibility to make a level-3 on-the-fly optimized for the question being posed.
  ➤ maintain ability to conduct cloud remote sensing studies
  ➤ have a data small enough to serve in its entirety.

Level-2b Employs Nearest Neighbor Sampling on a Equal-Angle Grid

level-2 grid

Level-2b grid

Level-2b point

Nearest Level-2 point
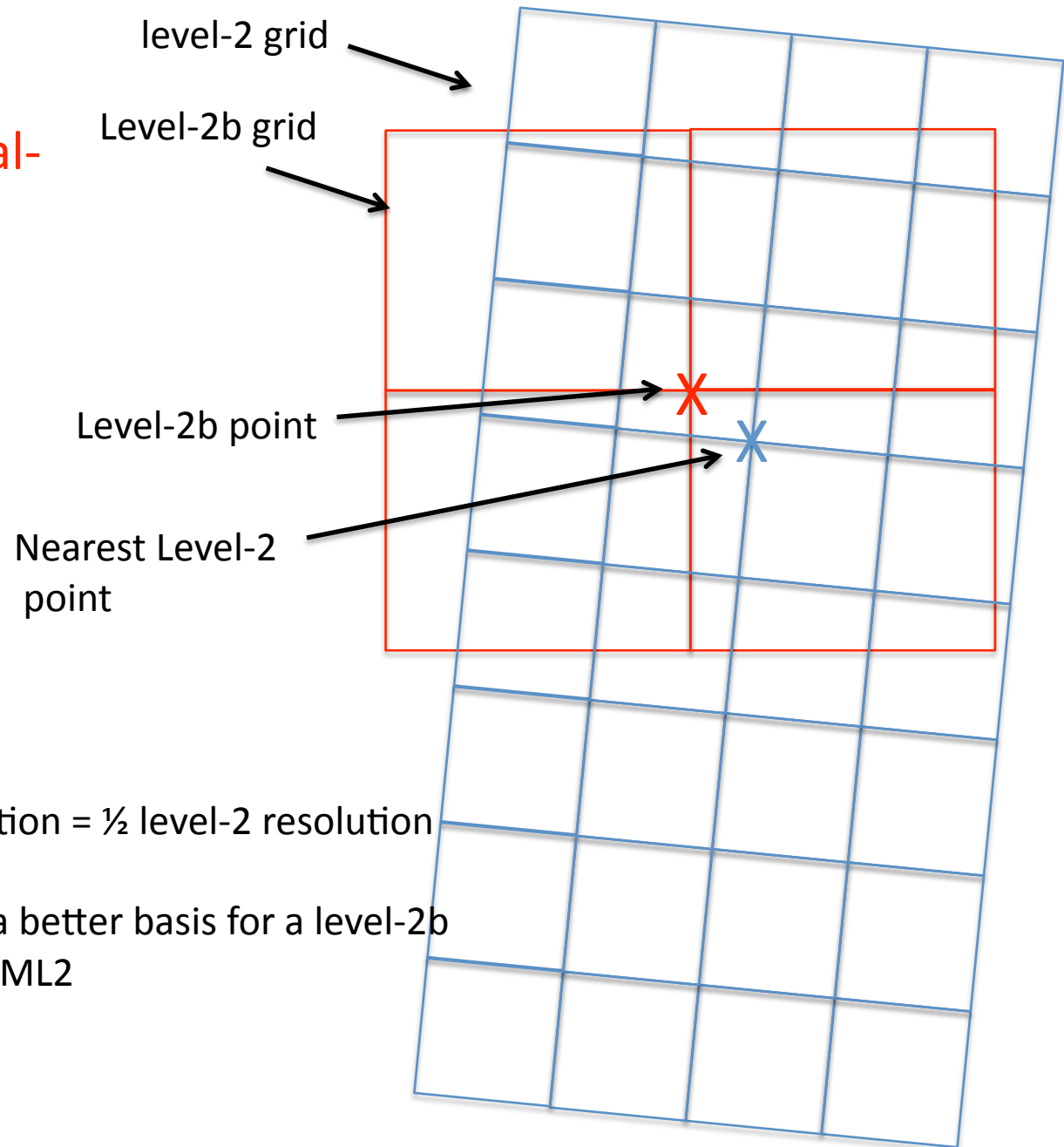
Max error in geolocation = ½ level-2 resolution

Therefore MYD06 is a better basis for a level-2b data set than MYDATML2

Contents of a PATMOS-x Level2b

longitude
latitude
scan_line_time
sensor_zenith
solar_zenith
relative_azimuth
solar_azimuth
cloud_type
packed_land_cover
cld_top_pressure
cld_top_temperature
cld_emissivity
cld_beta_11_12
cld_optical_depth
cld_effective_radius

emissivity_11um_tropopause
Aerosol_optical_depth_063_micron
quality_flags_1
quality_flags_2
063_micron_reflectance
086_micron_reflectance
375-11_micron_temperature_difference
11_micron_temperature
11-12_micron_temperature_difference
11_micron_temperature_std_dev_3x3
ndvi_sfc
surface_temperature
remote_sensing_reflectance
Bayesian_cloud_probability
cloud_albedo
cloud_transmission

Product listed constrained by size and by analysis we want to do. Number of level-2b parameters much smaller than level-3. No need for statistics (mean and std dev) for properties stratified by phase (ice, water).

Level-2b includes enough observations to make RGB images to help diagnose and verify analysis

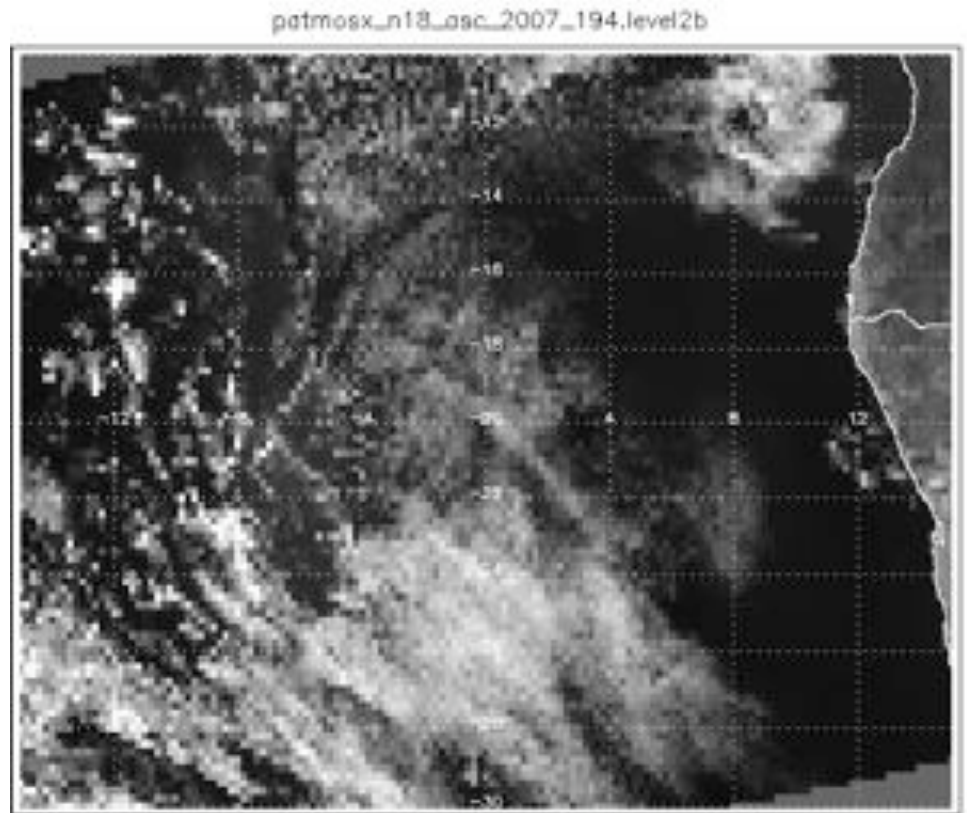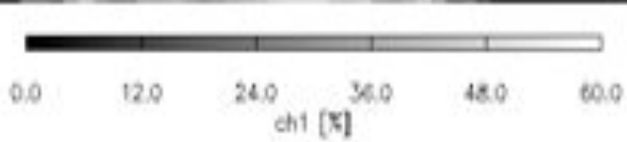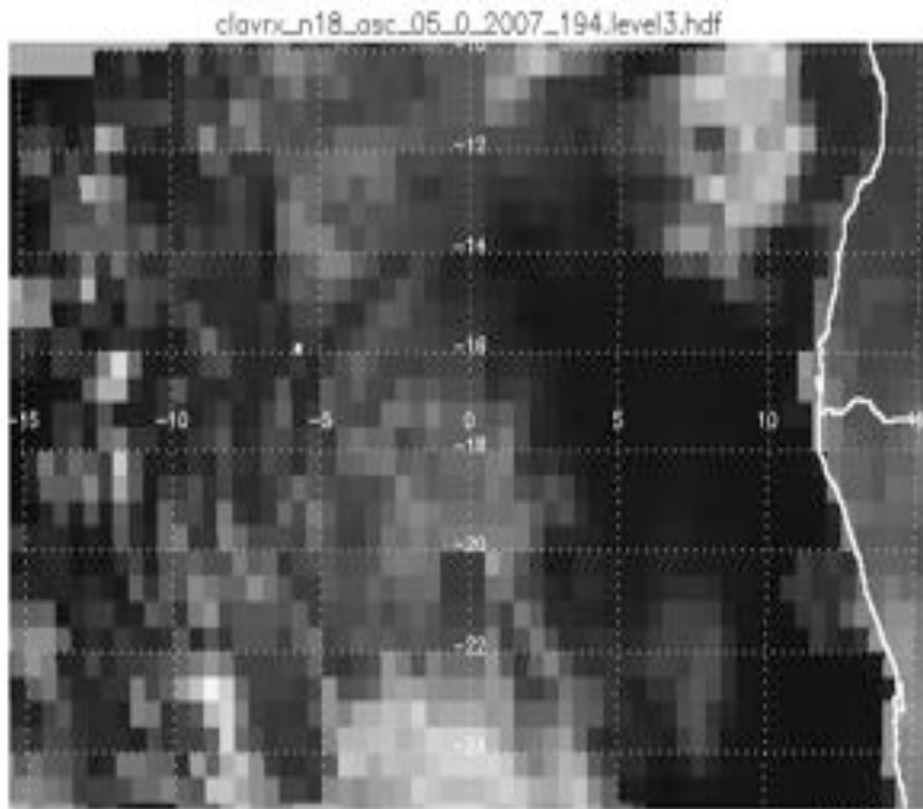Level-2b 0.2 degree 60S-60N products are now available.

patmosx_n18_asc_2008_180.level2b

patmosx_n18_asc_2008_180.level2b
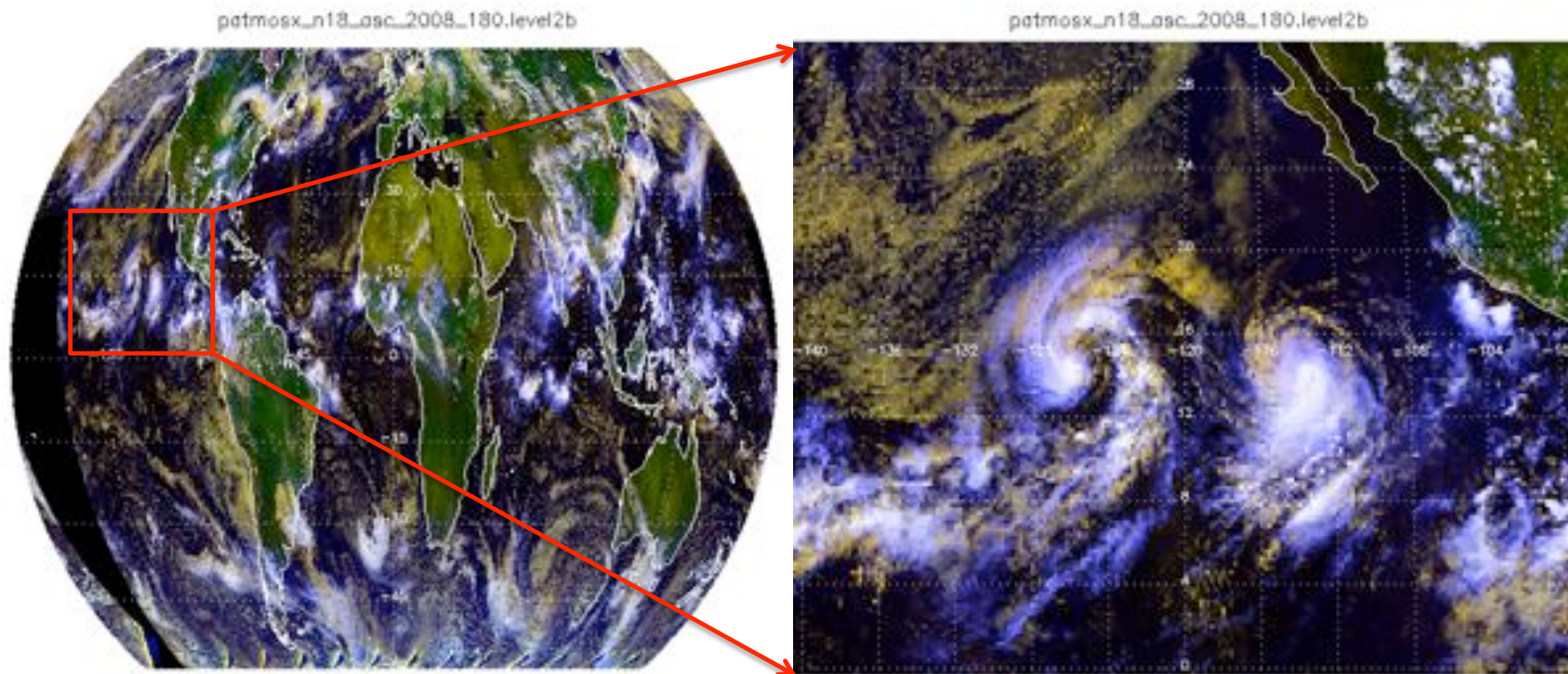
False Color Image
Red=0.63μm, Green = 0.86μm, Blue = 11μm (reversed)

False Color Image
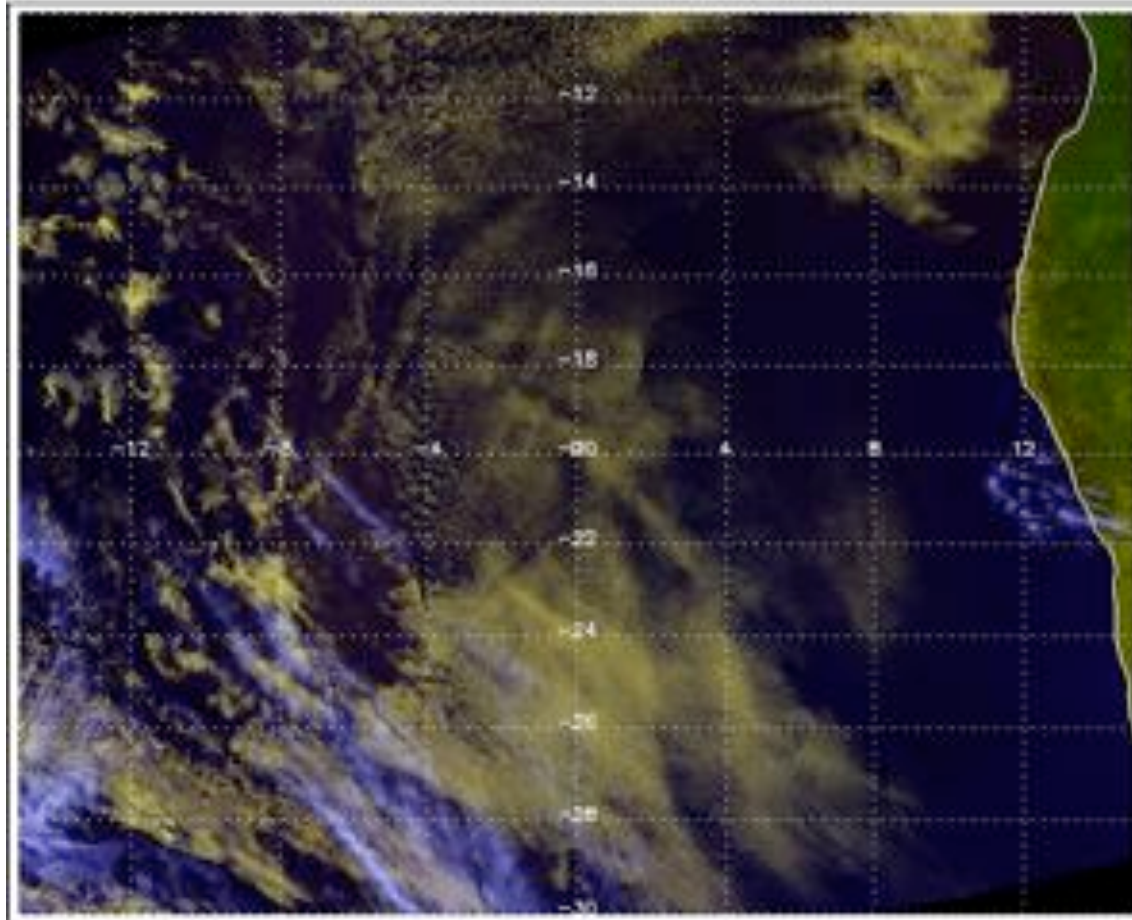Red=0.63μm, Green = 0.86μm, Blue = 11μm (reversed)

Level-2b Size

- 0.2 degree = 1.62 million points. An I2 field = 3.24 mb

- A PATMOS-x level-2b file = 58 mb uncompressed = 25mb compressed

- Entire Record = 2 daily for 64 satellite years = 1.2 Tb (1978-2010)

- We also have some level-1b subsets for certain regions that allow us to go from level-1b to level-2b from 1978 to 2010 in under a week. Very helpful for data set verification.

Example visual comparison of 1x1 degree Level-3 and 0.2 degree Level-2b

clavrx_n18_asc_05_0_2007_194.level3.hdf

patmosx_n18_asc_2007_194.level2b

CLAVR-x

ch1 [%]

ch1_reflectance

EXAMPLE 0.05 Level-2b Image

patmosx_n18_asc_2007_194.level2b

False Color Image

Red=0.63μm, Green = 0.86μm, Blue = 11μm (reversed)

points per 1°x1° cell = 441

EXAMPLE 0.1 Level-2b Image

patmosx_n18_asc_2007_194.level2b
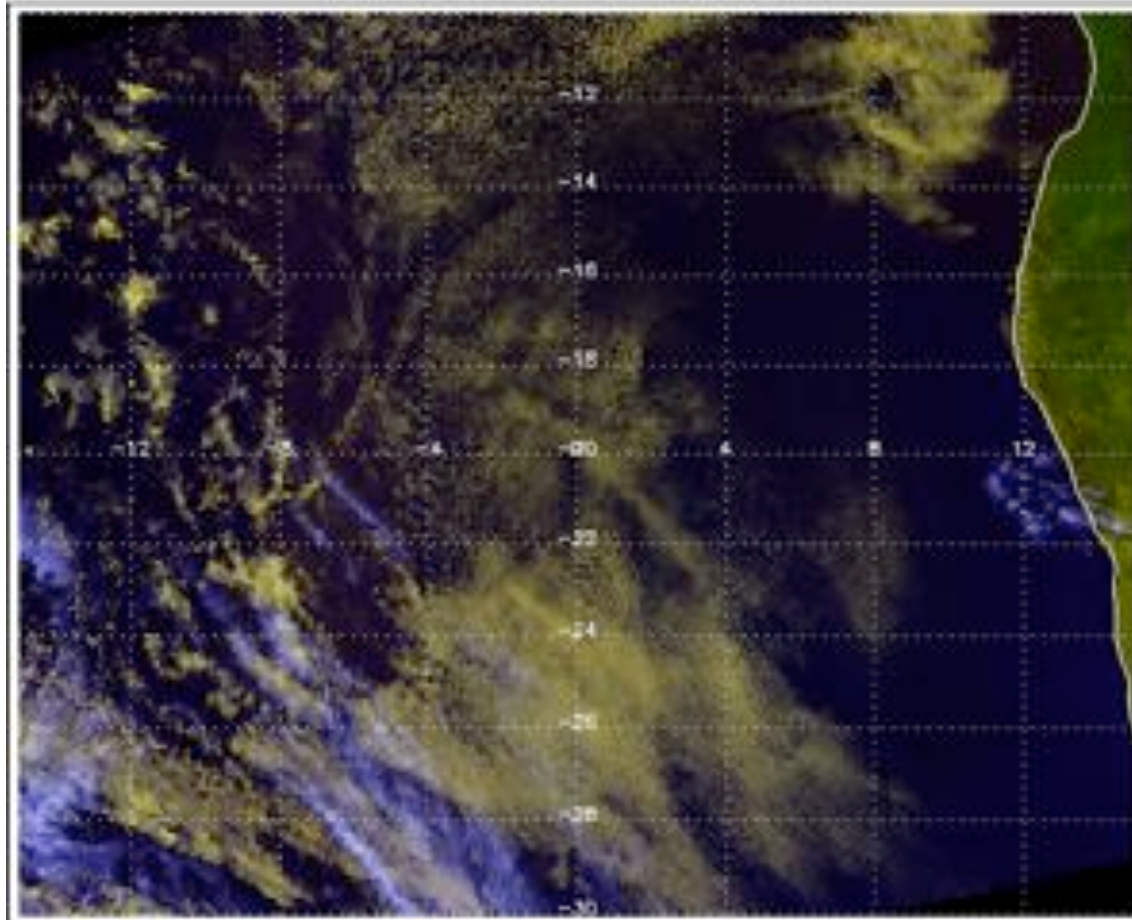
False Color Image
Red=0.63μm, Green = 0.86μm, Blue = 11μm (reversed)

points per 1°x1° cell = 121

EXAMPLE 0.2 Level-2b Image

patmosx_n18_asc_2007_194.level2b
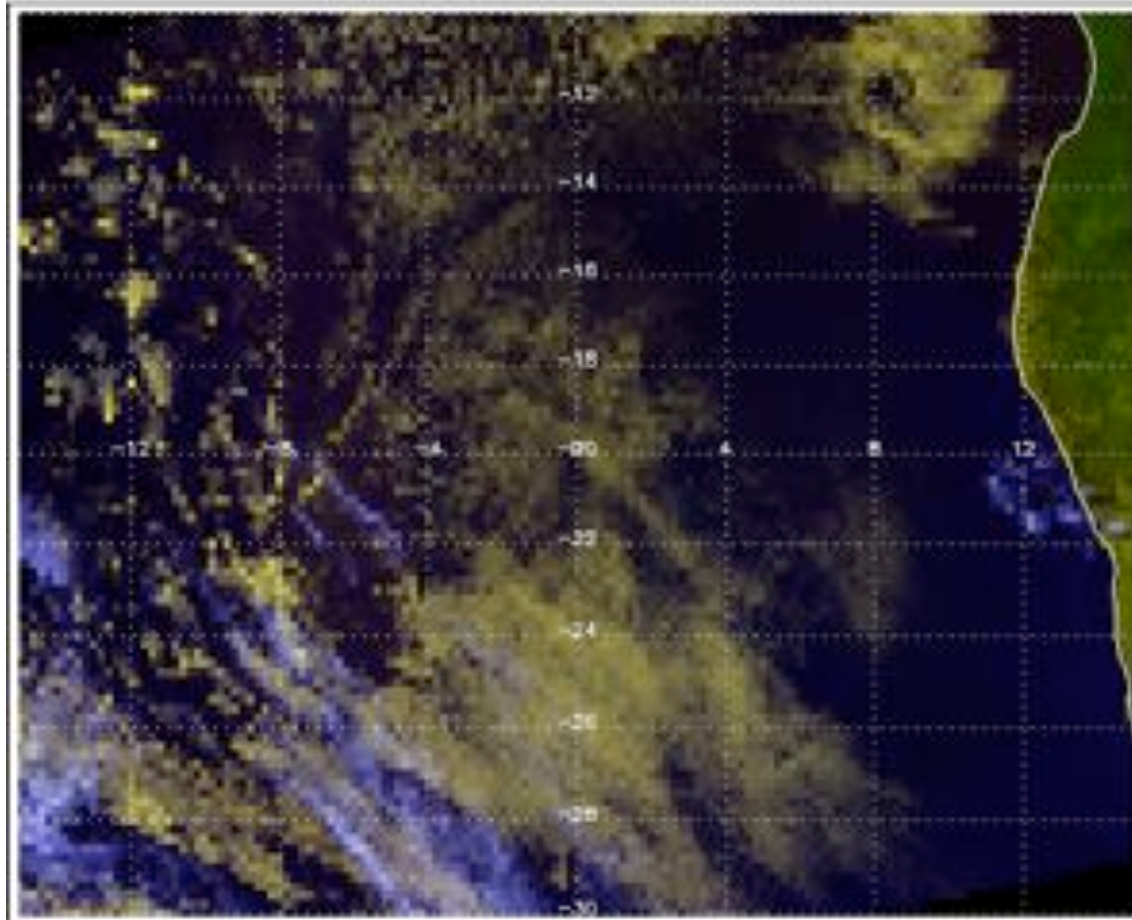
False Color Image

Red=0.63μm, Green = 0.86μm, Blue = 11μm (reversed)

points per 1°x1° cell = 36

COMPARISON OF ERRORS IN MEAN REFLECTANCE
DUE TO LEVEL-2b SAMPLING
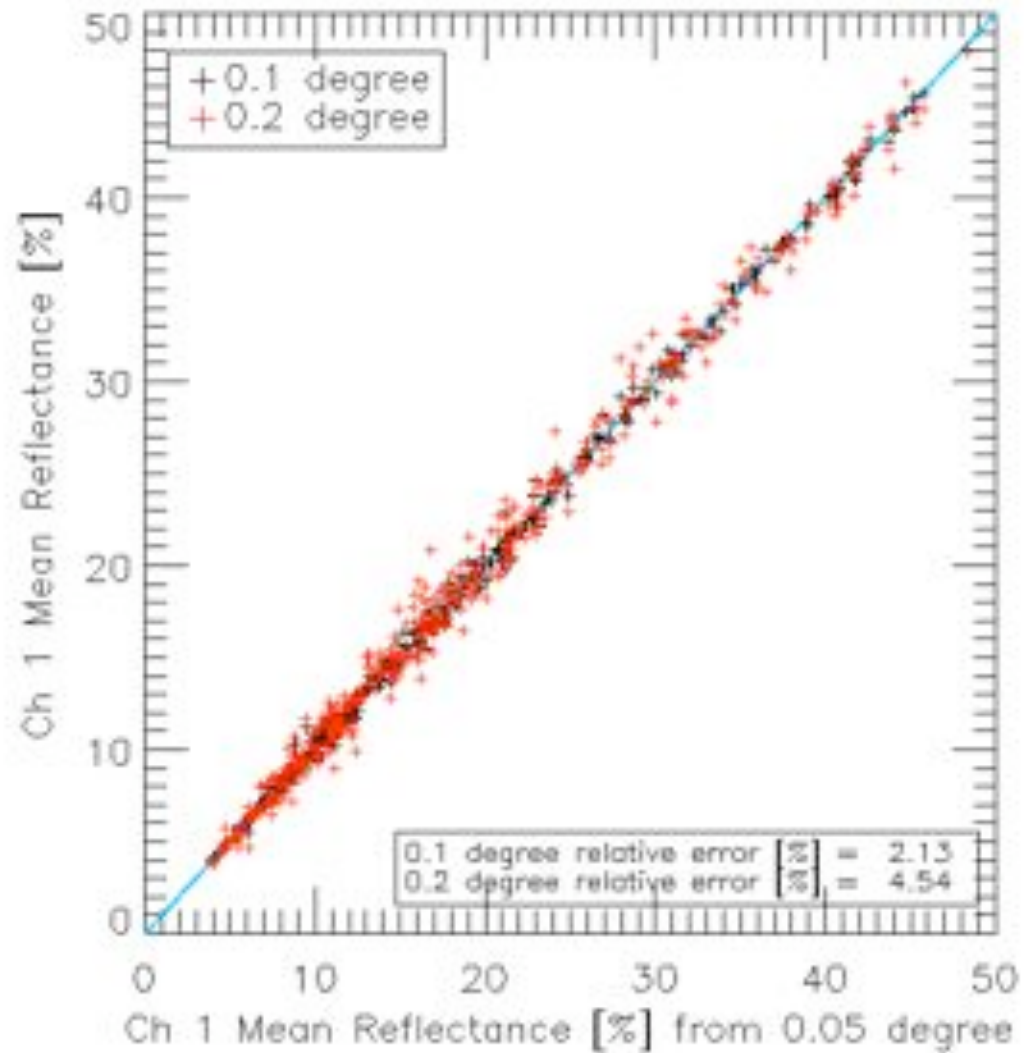
points per 1°x1° : 0.05° = 441; 0.1° = 121; 0.2° = 36

COMPARISON OF ERRORS IN STANDARD DEVIATION REFLECTANCE DUE TO LEVEL-2b SAMPLING
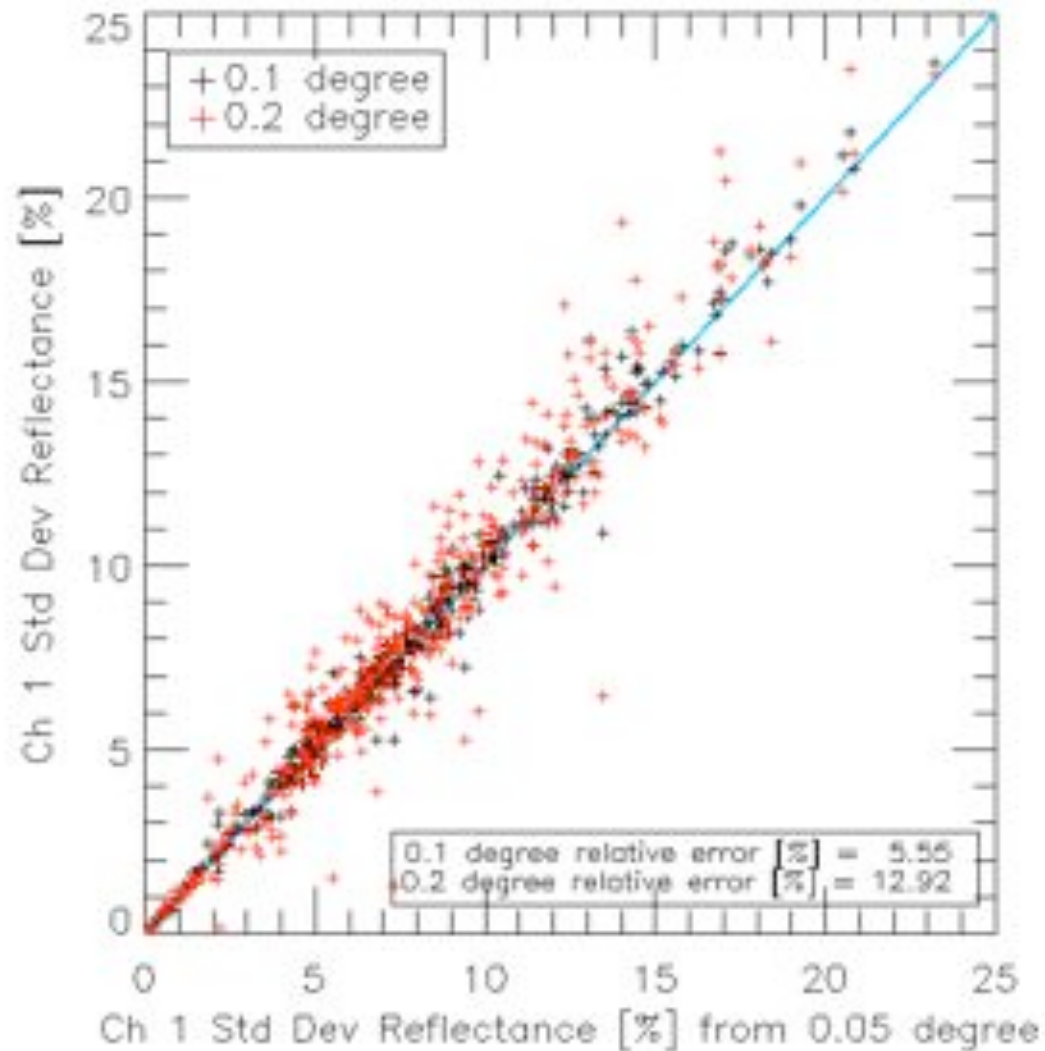
points per 1°x1° : 0.05° = 441; 0.1° = 121; 0.2° = 36

Concluding Points

• A climate data set has to be small enough to be down loaded in its entirety by a large number of users.

• PATMOS-x can be used to extend MODIS science back in time, so lets end up with the same level-2b format and naming conventions.

• Equal-area grids offer obvious advantages but it is hard to beat the convenience of equal-angle grids for analysis.

•We have found that making smaller regional-scale level-2b data are very effective data-sets.