Thinking outside the grid: aggregating data into information

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and in conversation with

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Smith, N., Menzel, W.P., Weisz, E., Heidinger, A.K. & B.A.Baum (2012) A uniform space-time gridding algorithm for comparison of satellite data products: characterization and sensitivity study. JAMC (in press), online:
http://journals.ametsoc.org/doi/abs/10.1175/JAMC-D-12-031.1

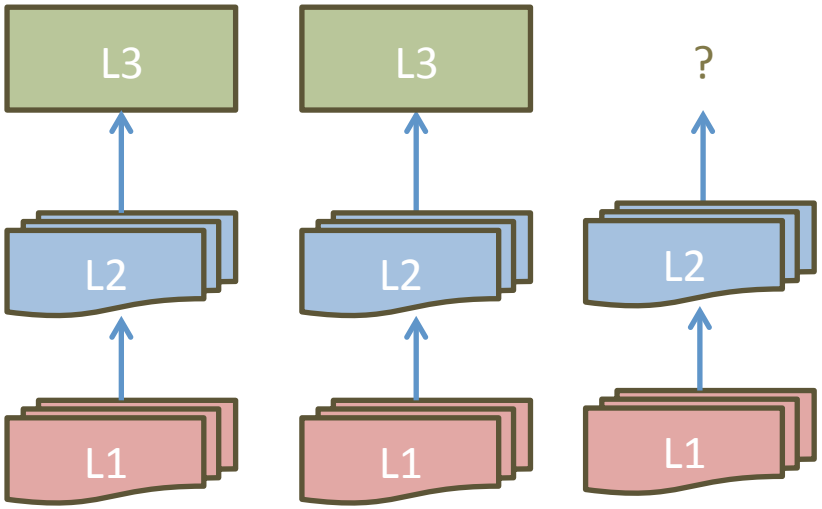
Aggregating Data into Information

- It's not (only) about visualization and data reduction
- Its about performing analysis in a uniform space.
- It's about doing science in a regularized data environment
- It's about a neutralizing instrument differences.
- Composite data products
- Higher level information – environmental monitoring, indicators of change, etc.

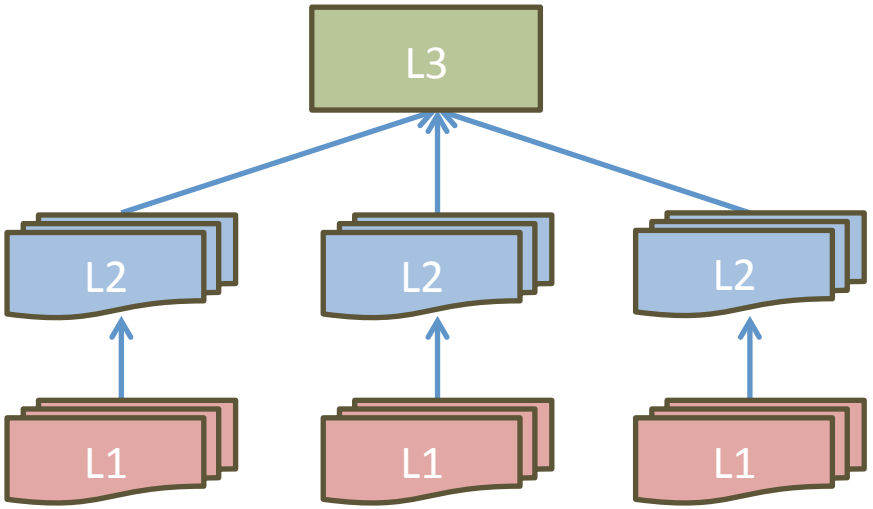
What are the goals of space-time-grid (STG) framework?

- **Reproducibility**
- Instrument independent (sounders, imagers, etc.)
- **Flexibility**; research specific outcomes
- Allowing both linear and non-linear statistical analysis
- **Data exploration** on a global scale
- Fast/**simple** processing of global data
- Support **research** in grid space

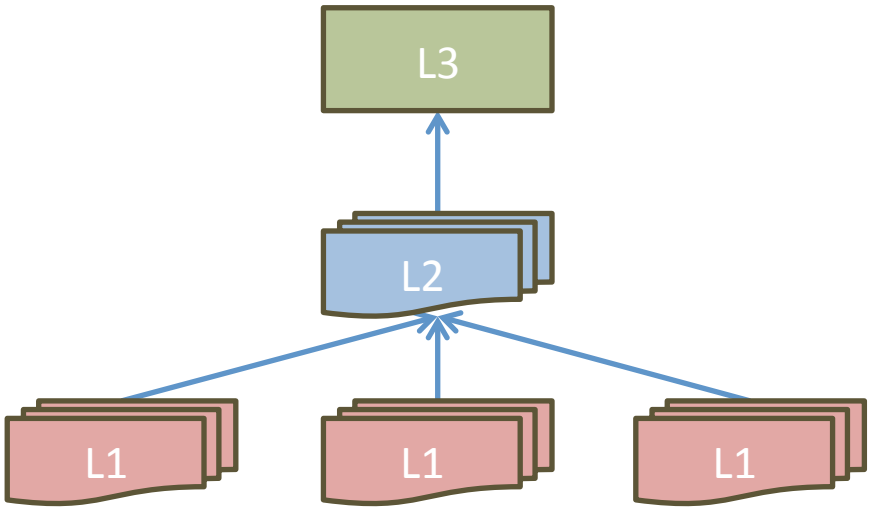
Traditional approach:
Instrument specific algorithms & L2/3 products



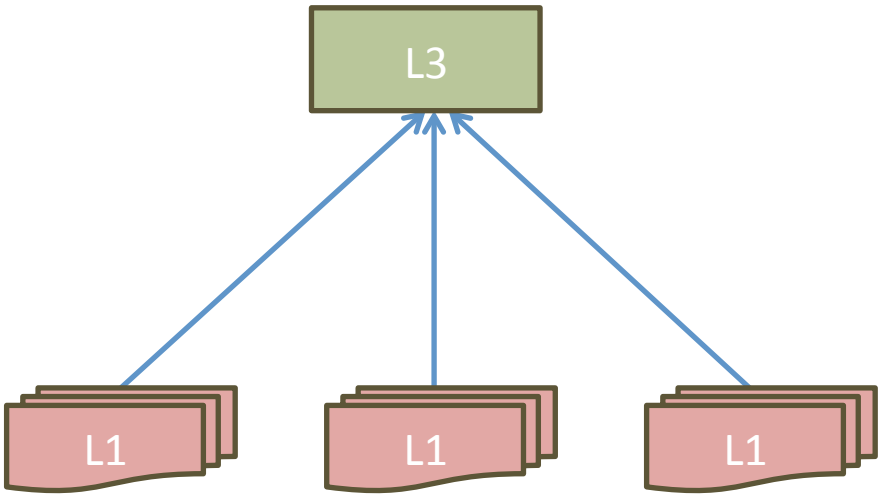
Single/shared aggregation algorithm



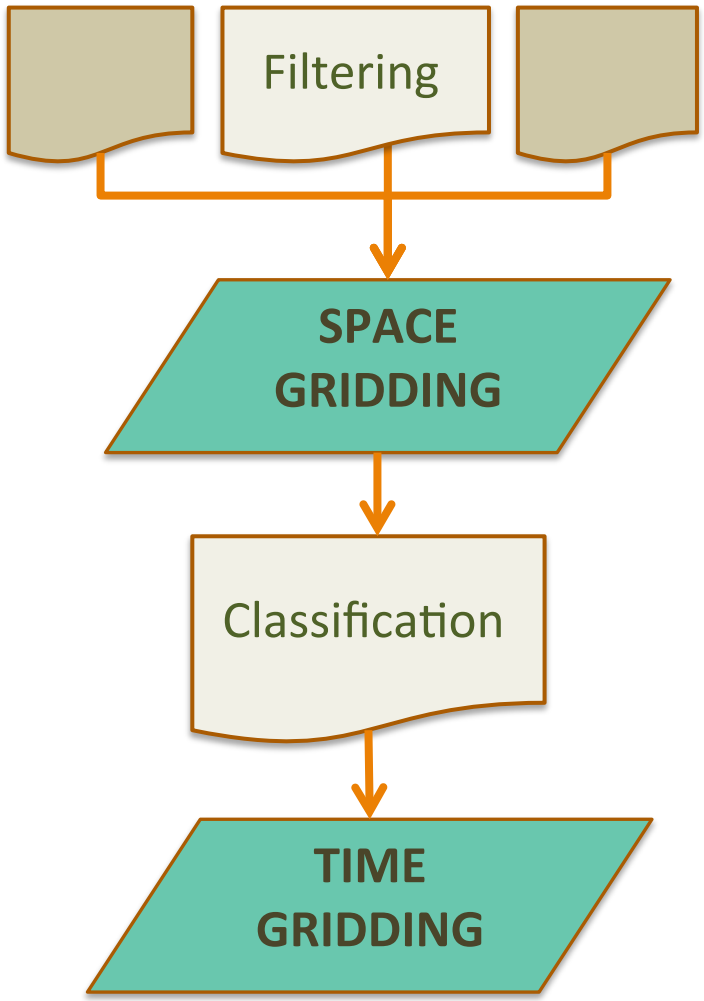
Single/shared retrieval and aggregation



Level 1 to Level 3 directly



Space-Time-Gridding: Data-to-Information flow



Geophysical sub-setting

Lat/Lon Binning,
equal-angle grid
Geo-Histogram

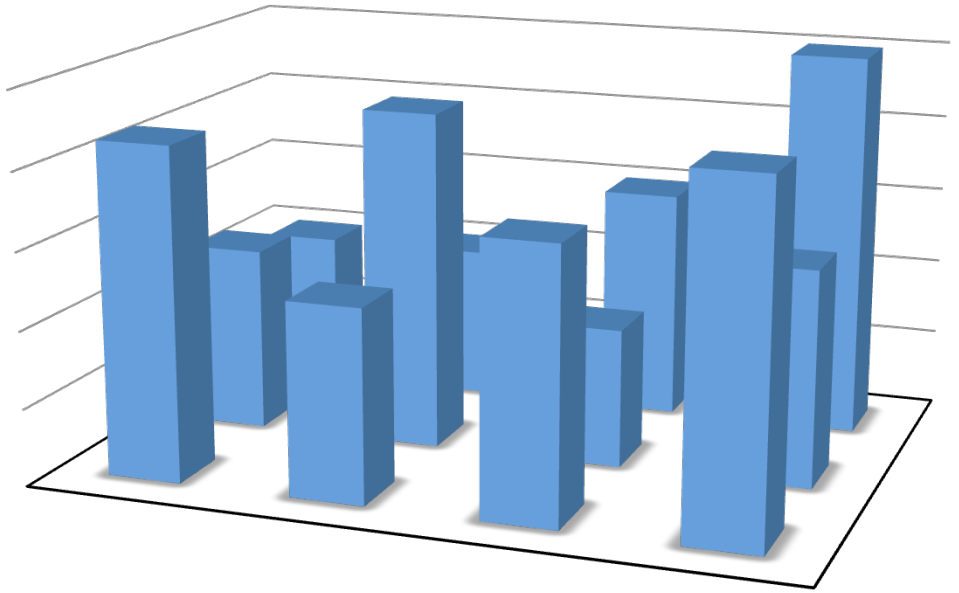
Nominal/Ordinal re-grouping

Statistical analysis

Two phases in the Space-Time-Gridding Framework

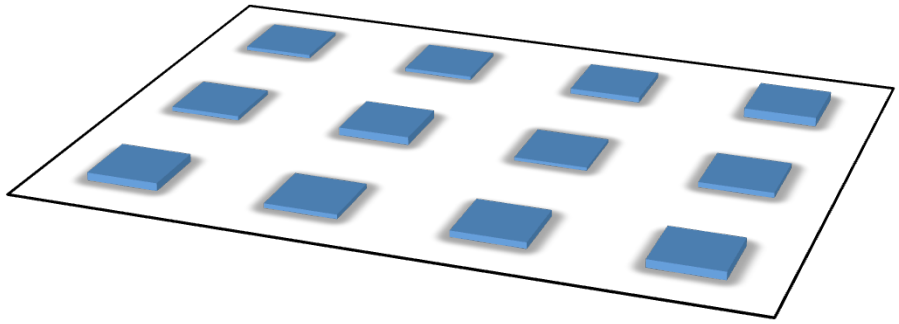
(1) **Space aggregation**

- Parameter filtering (based on ancillary data
- Physical data reduction
- Choice of grid size

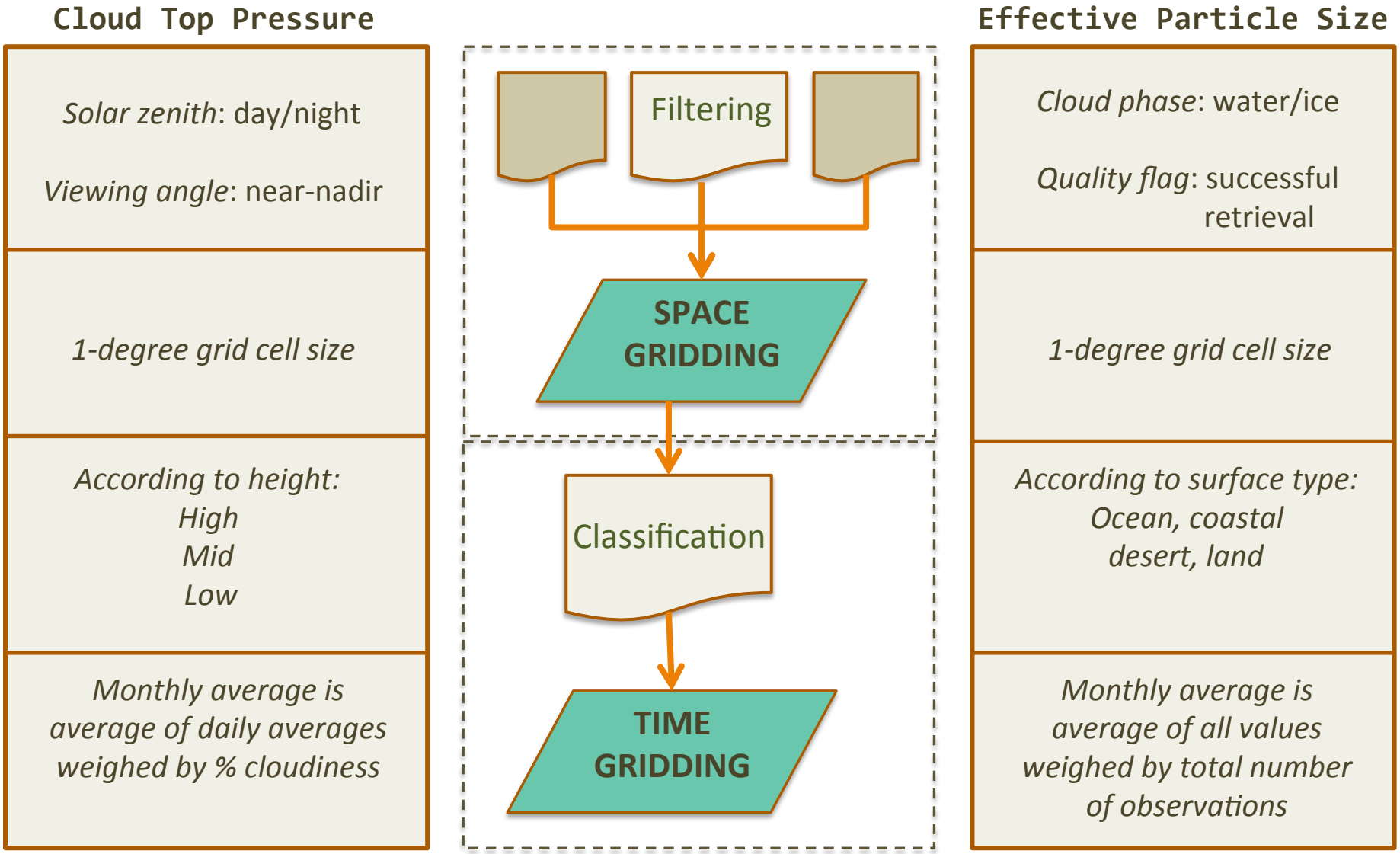


(2) **Time aggregation**

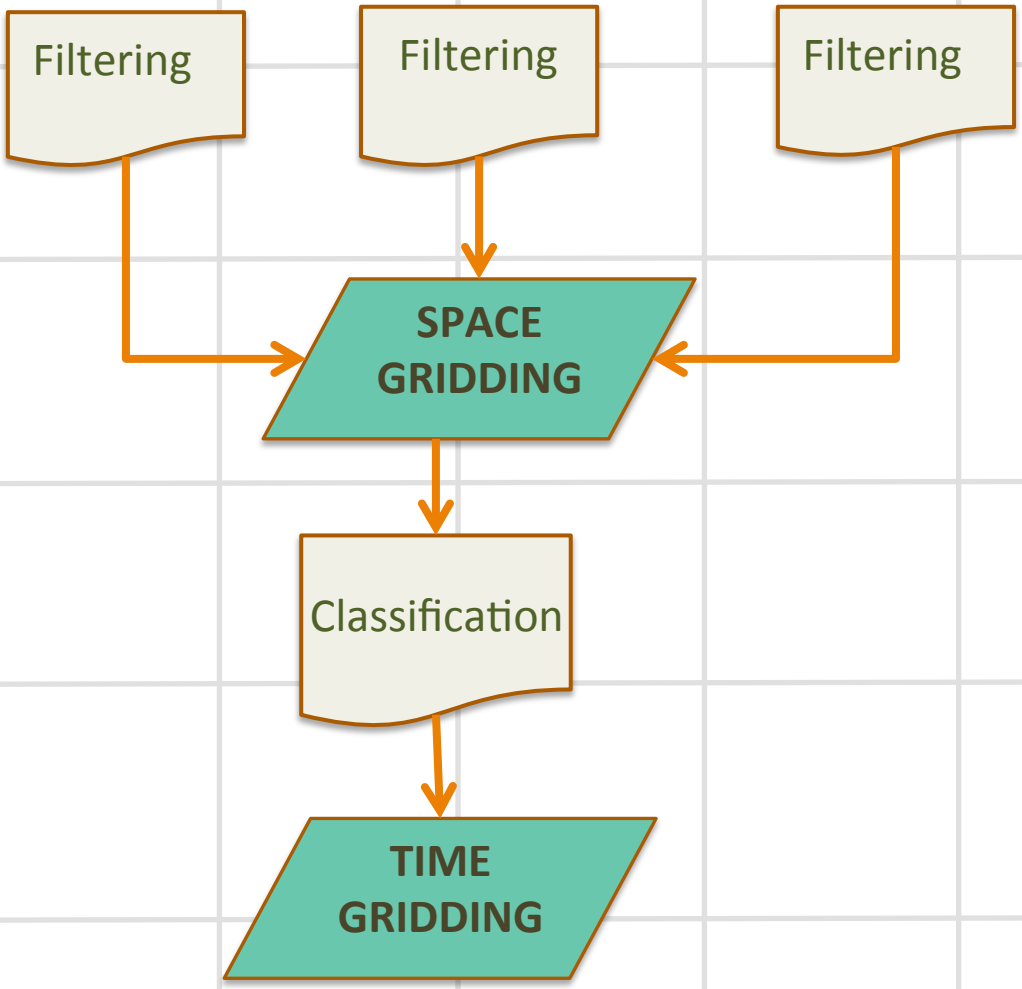
- Min sample size testing
- Data classification (e.g., nominal/ordinal scales)
- Statistical data reduction (mean, mode, std-dev, etc.)
- Daily gridded values/statistics aggregated into time. Choice of number of days.



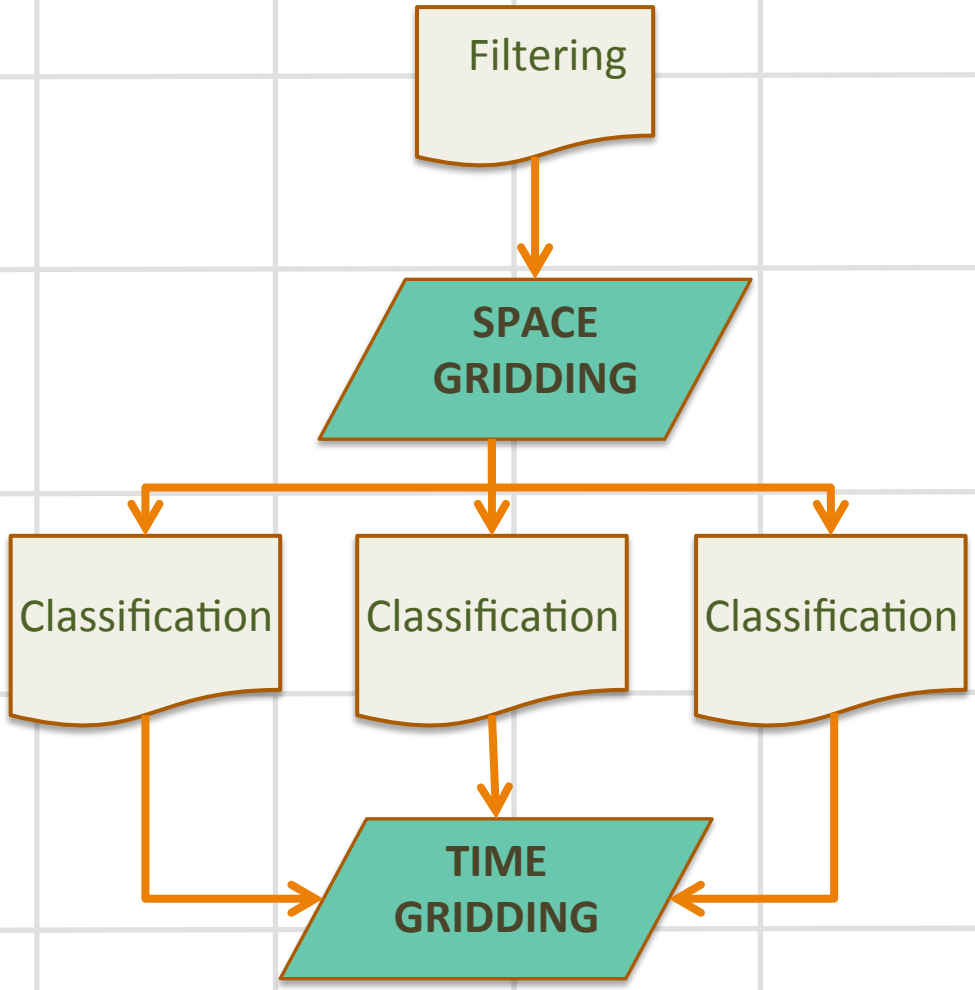
STG requirements for two Cloud Properties



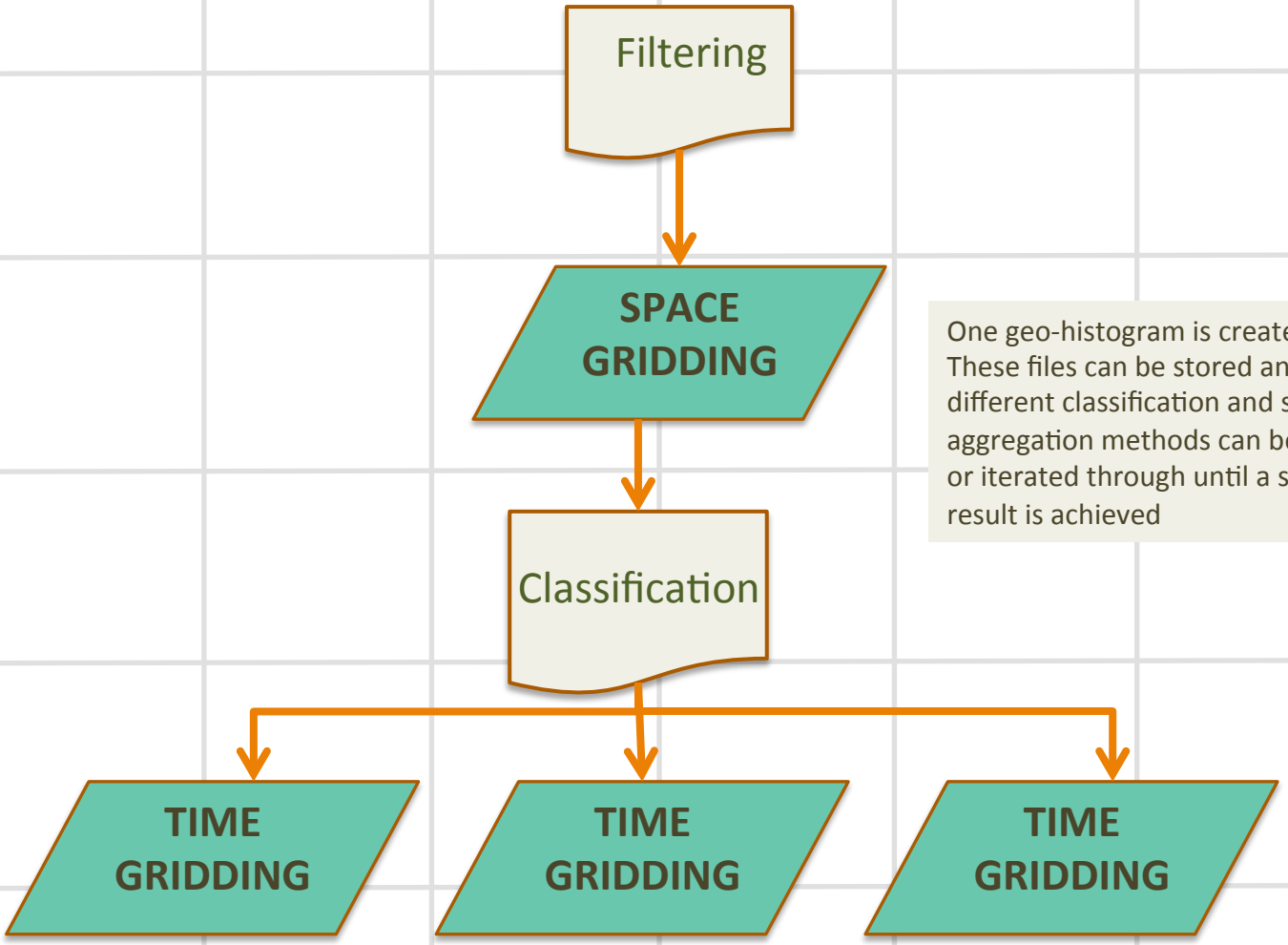
Different approaches to STG



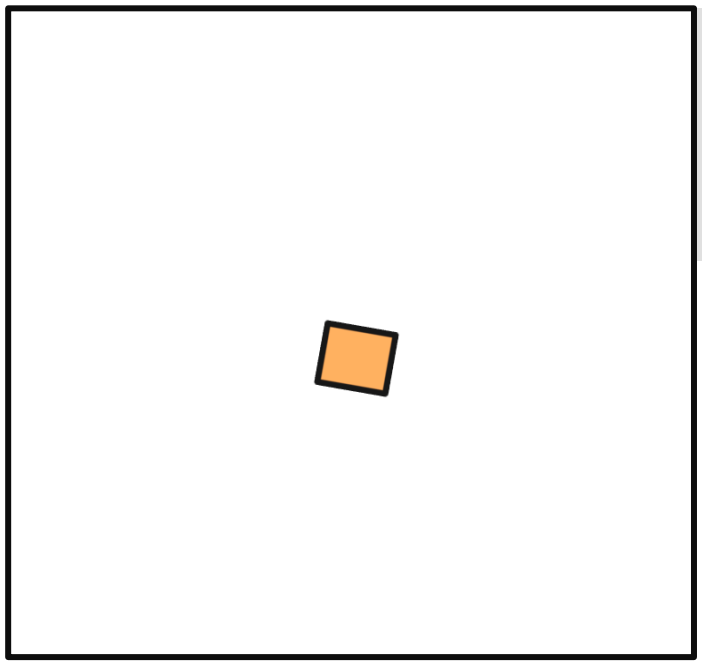
Different approaches to STG



Different approaches to STG

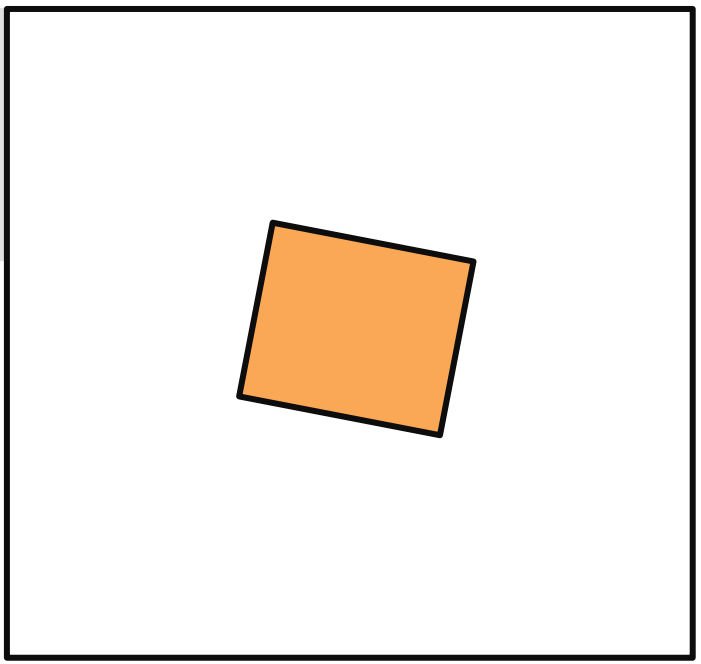


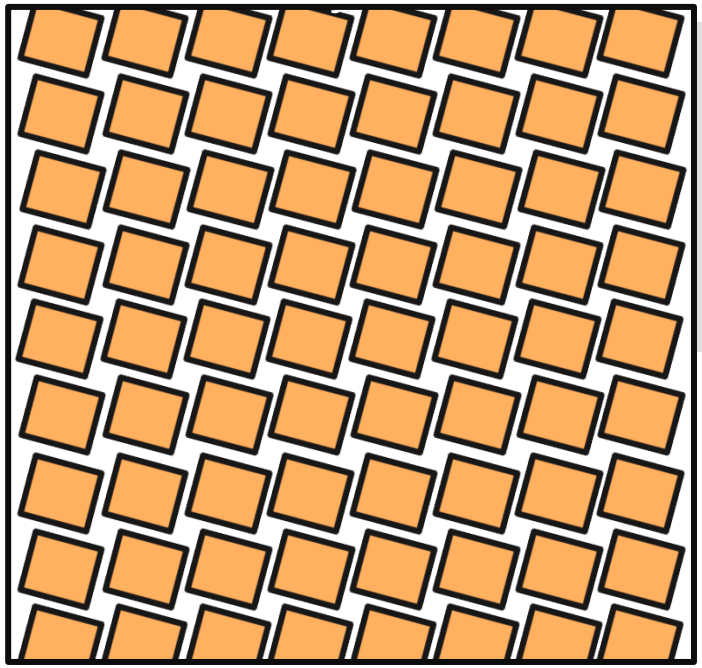
One geo-histogram is created per day. These files can be stored and a number of different classification and statistical aggregation methods can be implemented or iterated through until a suitable final result is achieved



Nearest Neighbor (NN)

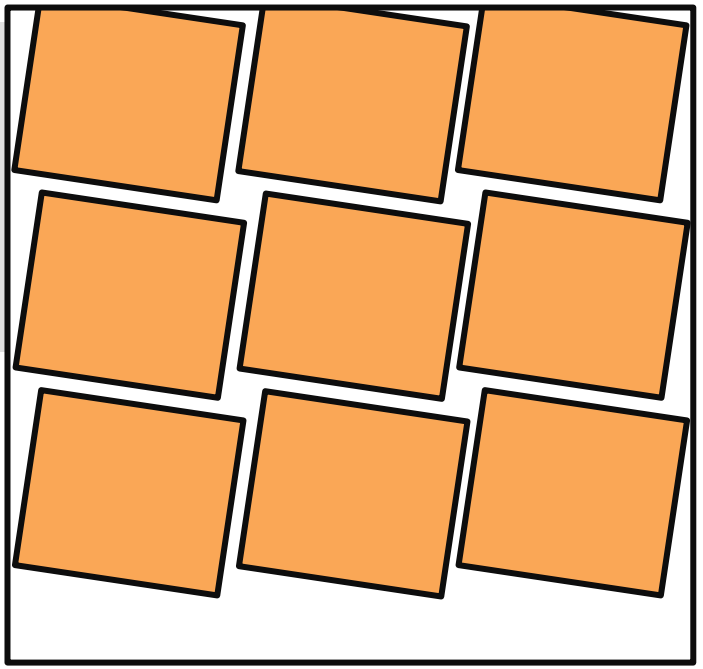
Finding a way to compare instruments with different instrument resolutions





Space Time Gridding (STG)

Accumulating a sample of measurements per grid cell allows statistical comparison/analysis

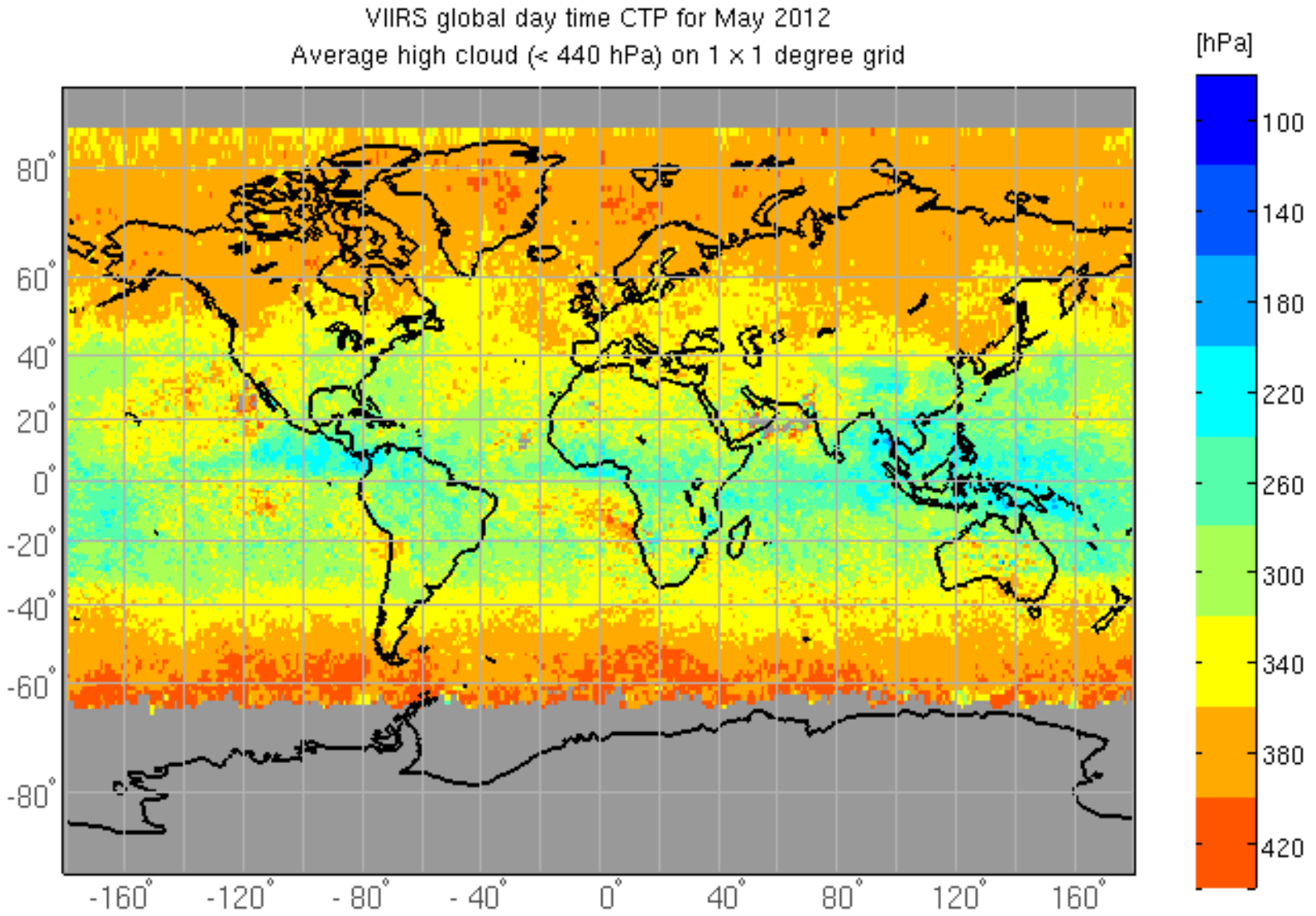


STG Processing: 1 day of global data

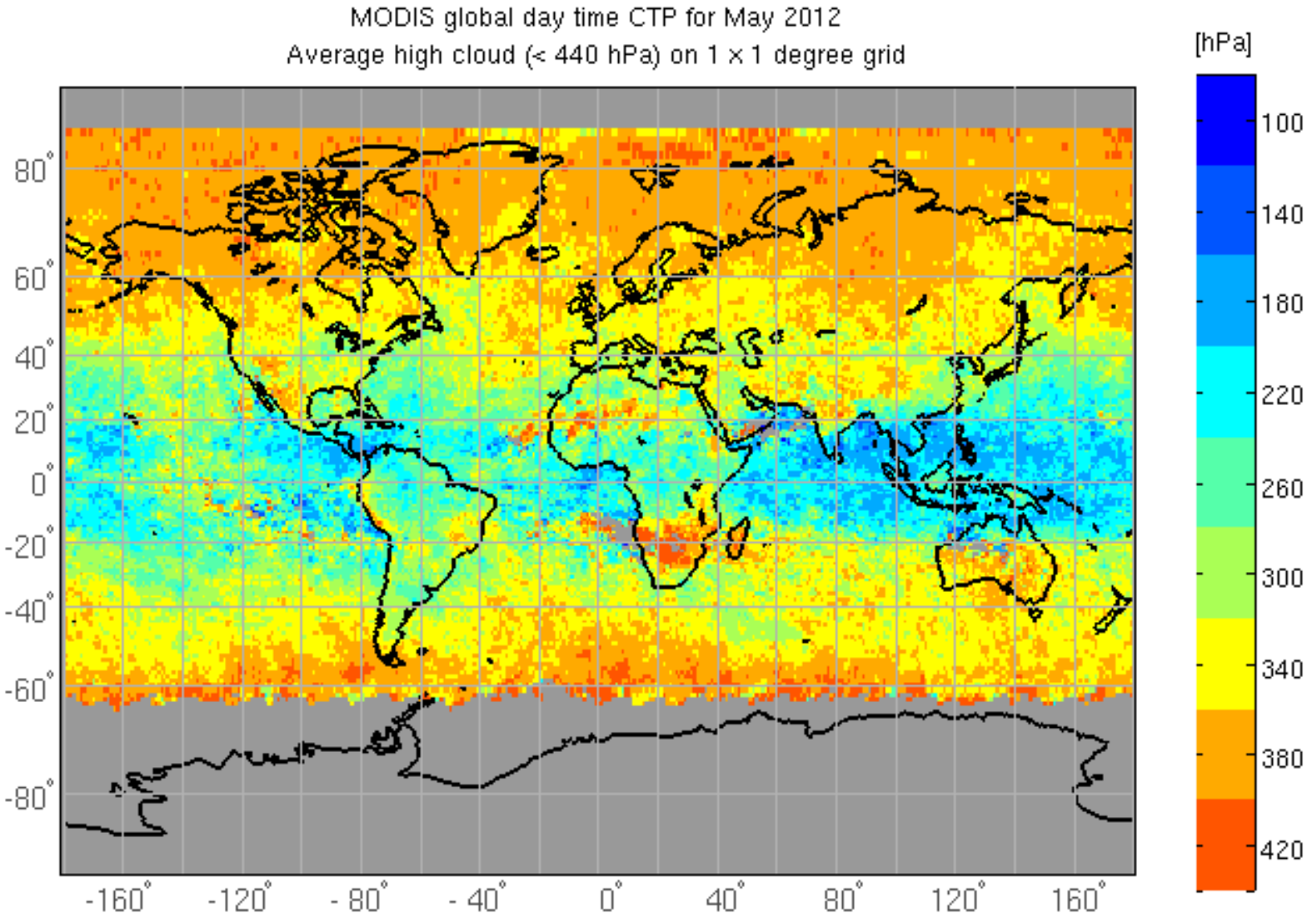
File size = 20-80MB

Instrument	Gridding approach	Native resolution	Grid resolution	Processing time
MODIS	NN	5km 284 granules/day	1x1 degree [180 x 360]	13 min
MODIS	STG	5km 284 granules/day	1x1 degree [180 x 360 x 500]	20 min
VIIRS	STG	5km 1014 granules/day	1x1 degree [180 x 360 x 1000]	60 min
CrIS	STG	14km 180 granules/day	1x1 degree [180 x 360 x 100]	15 min

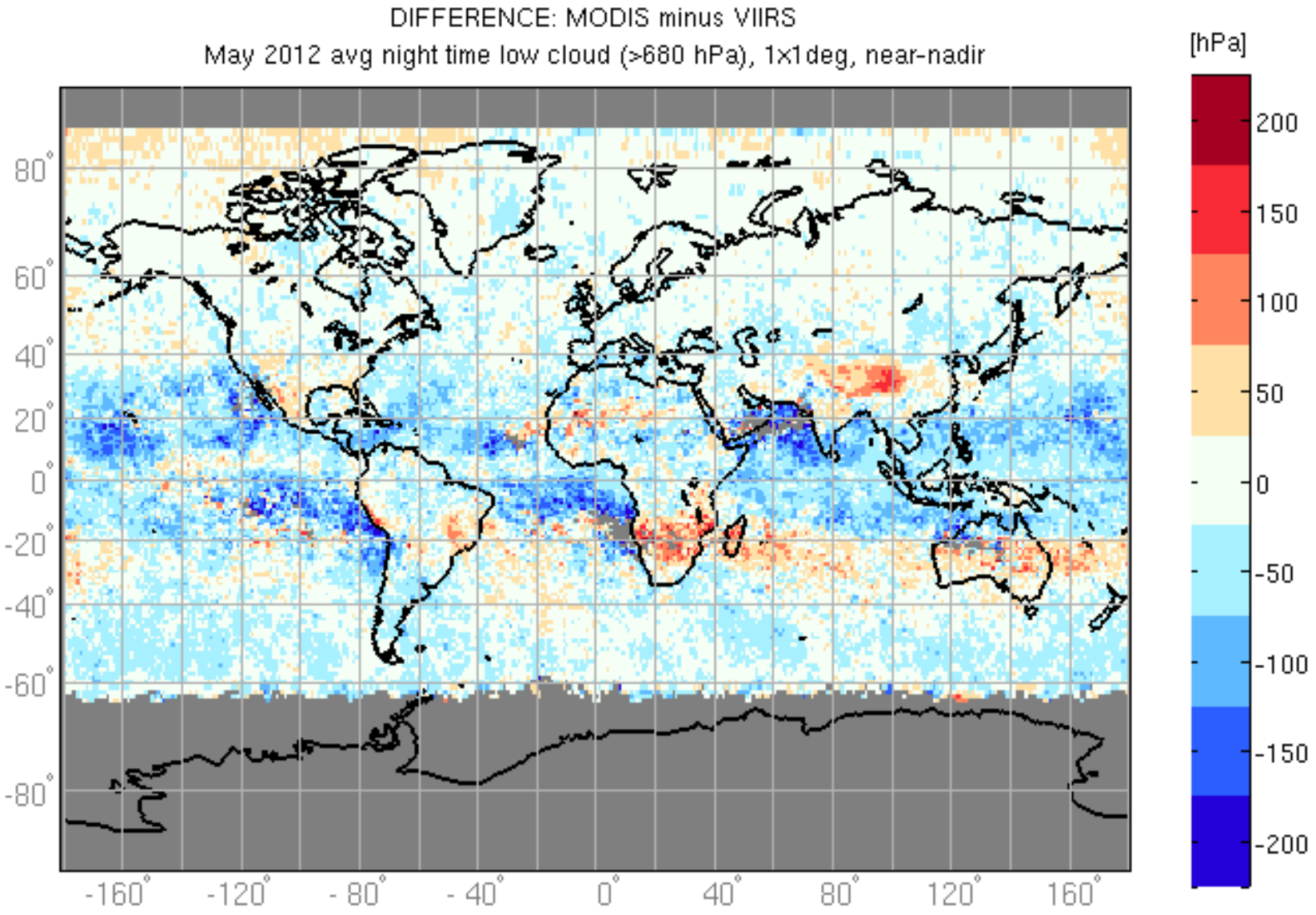
VIIRS EDR: Daytime near-nadir CTP average for May 2012



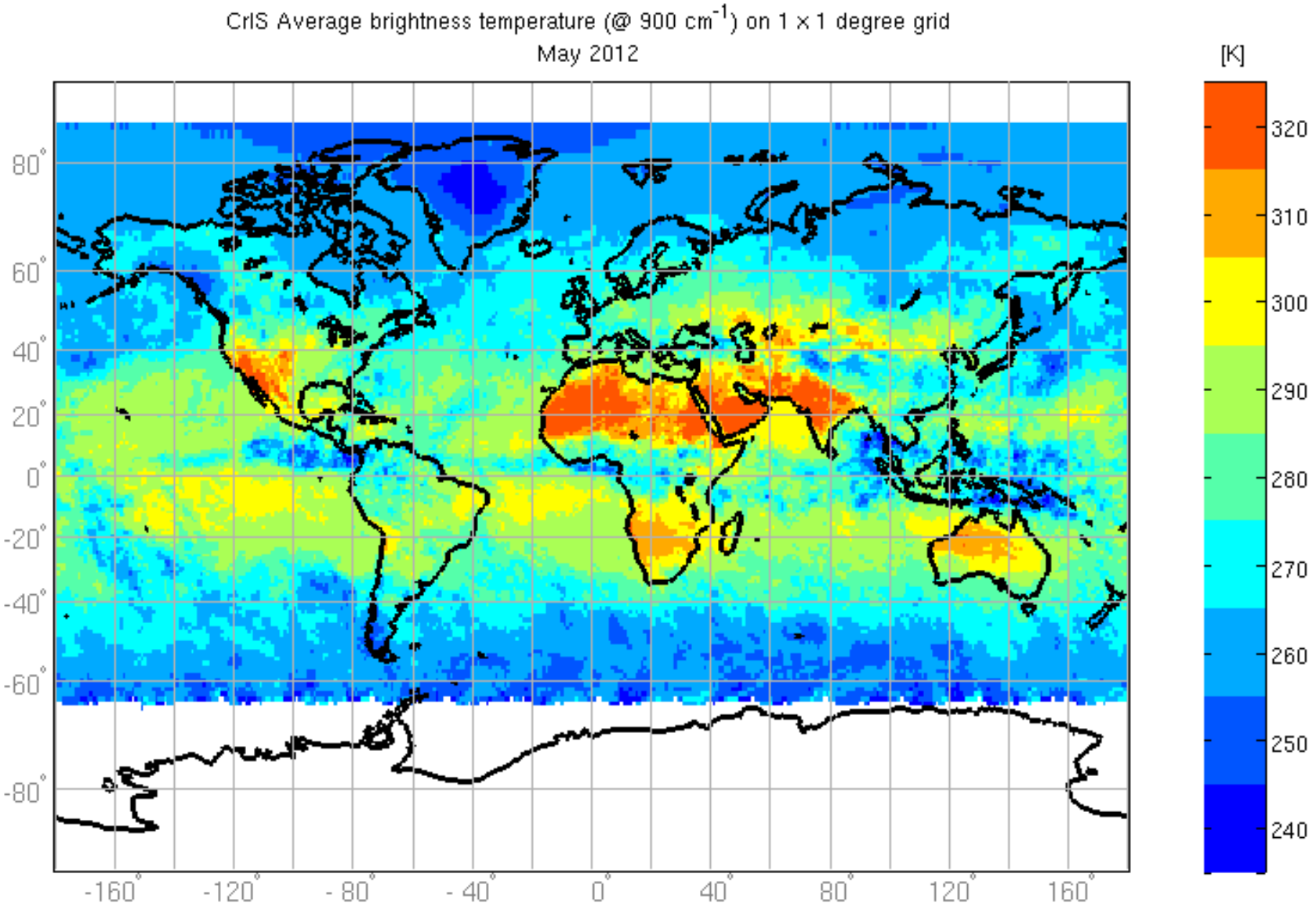
MODIS C6: Daytime near-nadir CTP average for May 2012



Difference: MODIS-C6 minus VIIRS EDR



CrIS: Daytime near-nadir BT @ 900 cm^{-1} avg for May 2012



Current STG work and collaborations

Cloud Retrieval Evaluation Workshop (**CREW**): Evaluation of different L3 aggregation methods with **EUMETSAT**, **KNMI**, **SMHI** (and us at CIMSS) (preparation for CREW-4)

Supporting VIIRS science teams (**NASA**); implementation on the **PEATE**

Shaima Nasiri and Katie Pitts (**Texas A&M**) are studying how differences between MODIS and VIIRS cloud retrievals affect the vertical distribution of liquid water and ice clouds (AMS 2013 poster presentation)

Helen de Klerk (**Stellenbosch University**, South Africa) is studying how biomass burning and CO emissions correlate in space given data from imagers and sounders (Fynbos Forum presentation)