



# AIRS Observations for CMIP5 Simulations and AIRS V6 L3 Development

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In Memory of  
Tian, Hong Fang  
田洪芳  
1938-2011



In Memory of Dr. Moustafa T. Chahine  
1935-2011



# AIRS Observations for CMIP5 Simulations



# Motivation

- The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, AR5, will rely on peer reviewed analysis of model outputs from the Coupled Model Intercomparison Project Phase 5 (CMIP5) experiments, which are now being delivered to the Earth System Grid (ESG). NASA has identified several sets of satellite observations that correspond to some of these model outputs, which can be used to evaluate the experiments.
- AIRS monthly mean tropospheric temperature and water vapor profiles were identified as one of such important data sets.

# Description of AIRS/CMIP5 Data Product

- This data product starts from standard AIRS V5 L3 data product.
- This data product is a regularly gridded, monthly averaged air temperature ( $t_a$ , Kelvin) and specific humidity ( $h_{us}$ , kg/kg) measured by AIRS/AMSU during 2002-2010. The product contains temporal and geometric fields (time, latitude, longitude, and vertical pressure levels) and atmospheric parameter ( $t_a$  or  $h_{us}$ ). The time is given in terms of Julian day for the start of the month. The latitude ( $lat$ ) and longitude ( $long$ ) are regularly gridded in a 1 degree by 1 degree box. The longitude starts at 0.5 degree and ends at 359.5 degree. The latitude starts at -89.5 degree and ends at 89.5 degree. The vertical pressure levels ( $plev$ ) include all the CMIP5 mandatory levels from 1000 hPa to 10 hPa. However, we only provide the data up to 300 hPa.
- The technical note describing strengths/weaknesses, uncertainties, and critical caveats of the AIRS data was provided for users.
- The AIRS data, the first of such test data sets, were staged at the JPL/ESG gateway for restricted access since June 2010.



## Key Differences between AIRS/CMIP5 and Standard AIRS V5 L3

- Single monthly mean values were reported instead of two separate ascending and descending monthly mean values in L3.
- Specific humidity values are reported in pressure levels instead of pressure layers in L3.
- NetCDF format with Climate and Forecast (CF) metadata convention (<http://cf-pcmdi.llnl.gov/>) was used instead of EOS-HDF format in L3.



# AIRS V6 L3 Development

- To identify issues in V5
- To propose improvements in V6.

## Issues in V5

- Different QCs were used for different variables (e.g., temperature and water vapor) and different vertical levels (e.g., 200 hPa and 850 hPa). As a result, the current V5 L3 products at each 1x1 grid and at each specific time may not represent a thermodynamically consistent atmospheric state.
- Temperature was reported on pressure levels but water vapor and trace gases were reported on pressure layers.
- Do we need daily mean products in addition to ascending and descending products separately?
- Any new variables needed?

# Issues in V5

- Do we want AIRS V6 L3 with CF compliant NetCDF format?
- CH4 and CO need to be updated to match the changes in L2.
- L3 quant:
  - a) Add more fields to L3 quant? Right now L3 quant only includes info on fields used in the clustering process.
  - b) Remove QC, asc/desc, and land/water from clustering variables
  - c) Handle high terrain. Right now the clustering needs values for T & q for all levels, and no values are present for 100 hPa for high terrain so these cases are excluded. Should we use sigma levels?
- Should we build AIRS/CMIP5 directly from AIRS L2 products?
- Do we want to spread the retrieval from a single AMSU FOV over 9 grid squares.

## Proposed Improvements in V6

- Apply the same QC for all variables (Temperature, water vapor, and trace gases) except for clouds/OLR products and at all pressure levels ( $P_{\text{Good}}=P_{\text{surf}}$ ). We should add new grids such as ascending\_unified, descending\_unified in addition to the existing grids of location, ascending, descending.
- Report water vapor and trace gases on pressure levels.
- Add a daily\_mean grid in addition to ascending and descending grids.
- Add some new fields: cloud particle size, boundary layer height?



## Proposed Improvements in V6

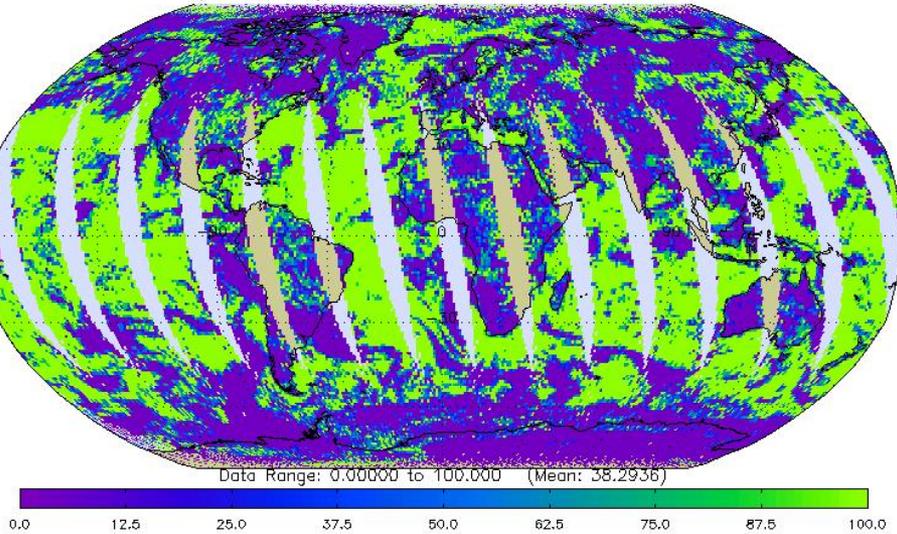
- Use the CF compliant NetCDF format.
- Report CH<sub>4</sub> and CO in 10 layers to match the changes in L2.
- Build AIRS/CMIP5 directly from AIRS L2 products.
- Spread the retrieval from a single AMSU FOV to all 9 AIRS FOVs.



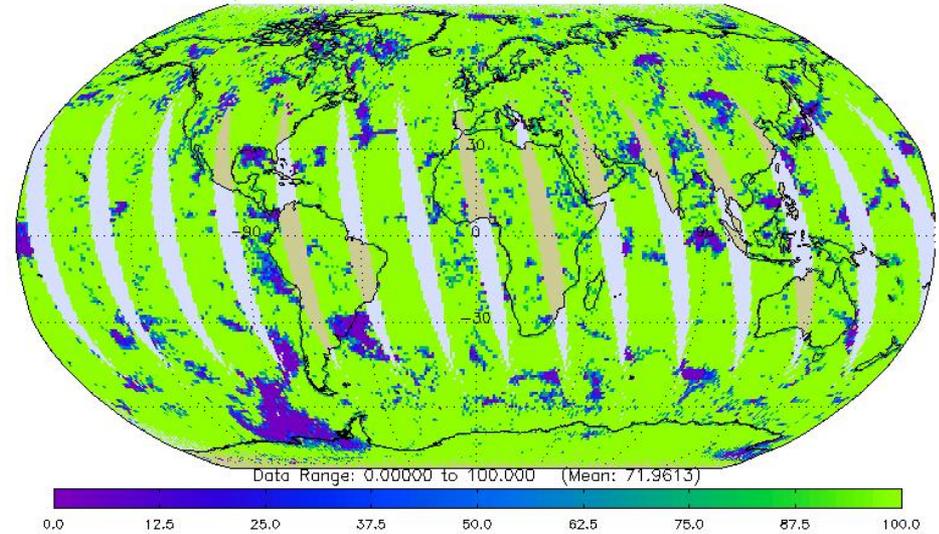
Your comments and suggestions are welcome.

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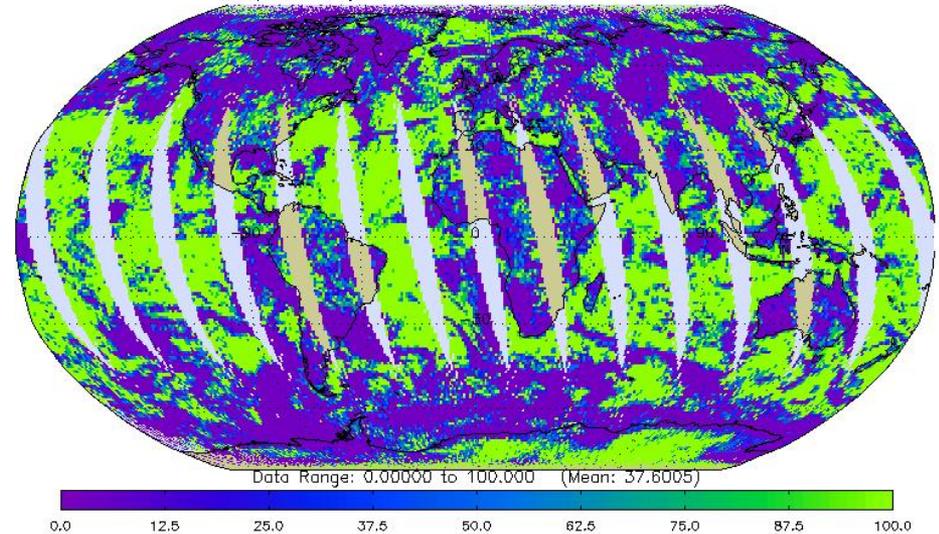


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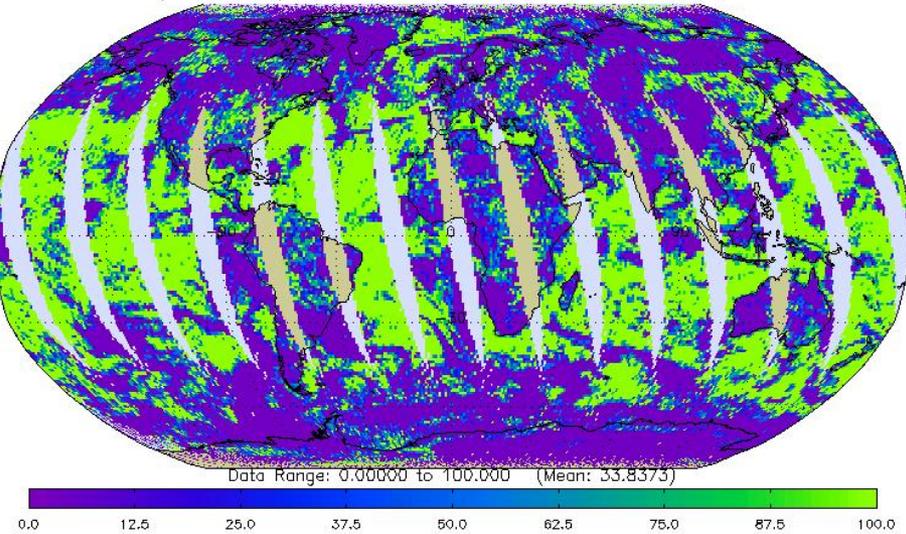


- The yields for Temperature at different levels are different (see above two figures).
- The yields for Temperature and water vapor at the same level are different (see right two figures).

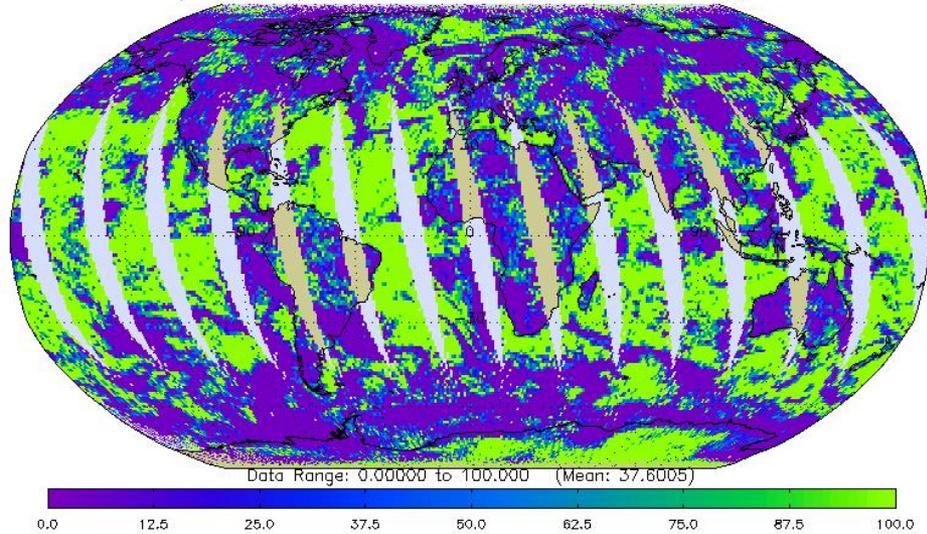
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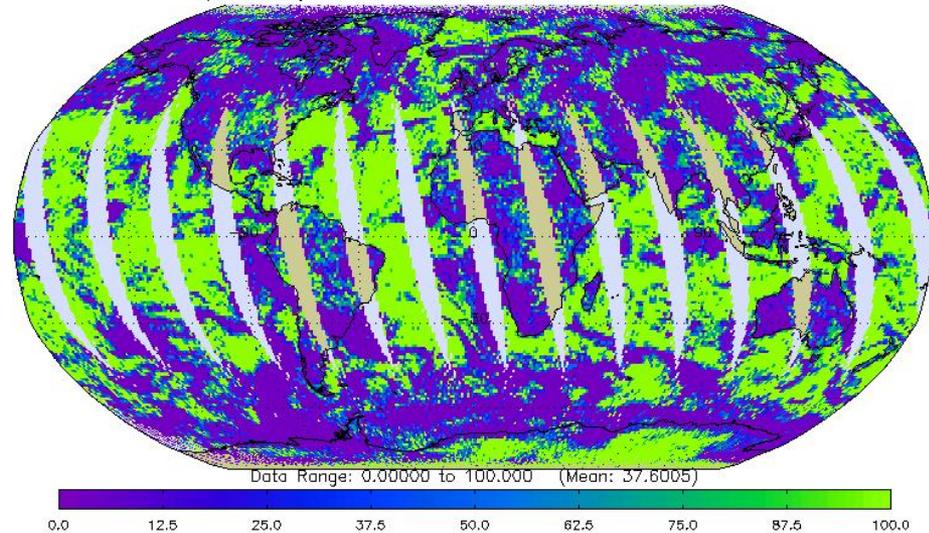


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- The yields for Temperature at different levels are same (see above two figures).
- The yields for Temperature and water vapor at the same level are same (see right two figures).

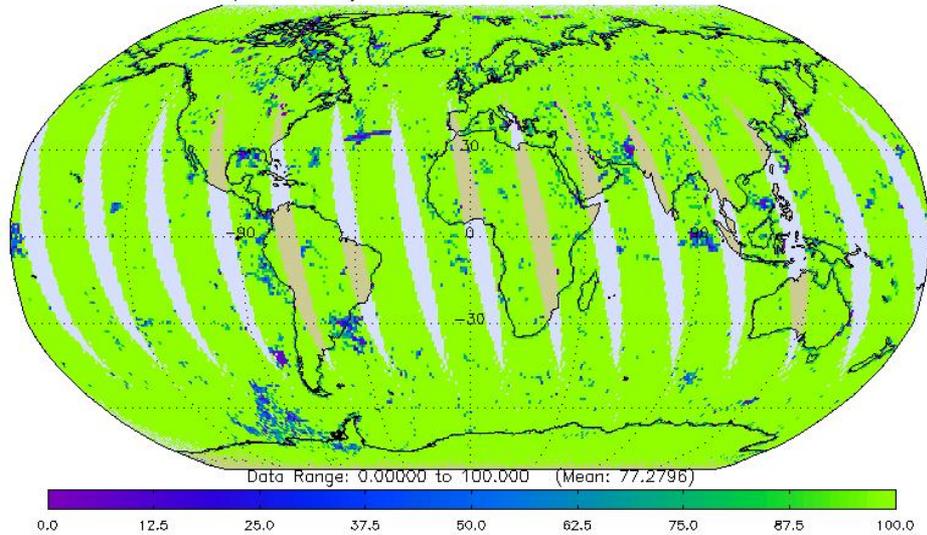
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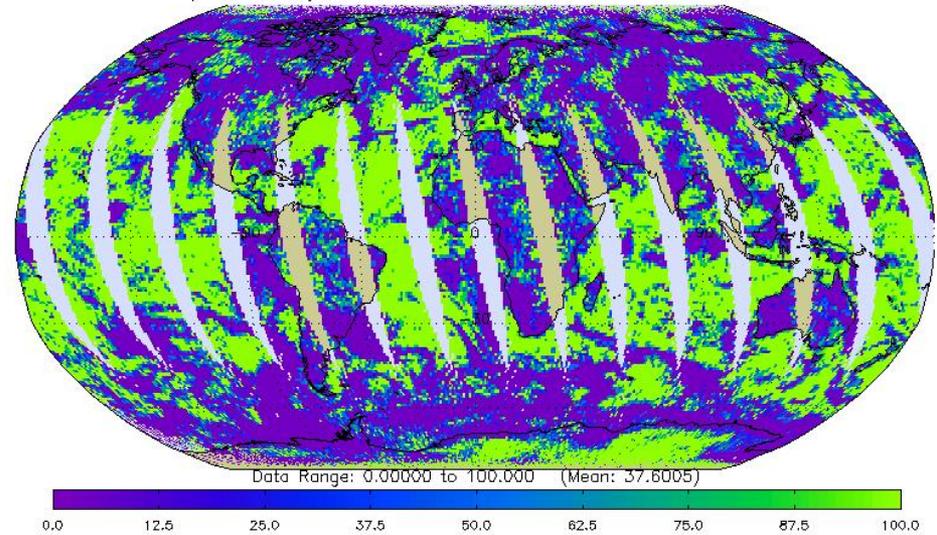
## Yields with Unified QC in V6

- The yields of Temperature are reduced especially in the stratosphere. The higher the altitude, the more the reduction.
- The yields of trace gases, such as TotO<sub>3</sub>, CO, and CH<sub>4</sub>, are reduced.
- The yields of tropopause properties, such as TropHeight, TropPres, and TropTemp, are reduced.
- There is no change in the yield of H<sub>2</sub>O Vap MMR, TotH<sub>2</sub>O Vap, RelHumid and RelHumidLiq because of tight QC used for water vapor product in V5

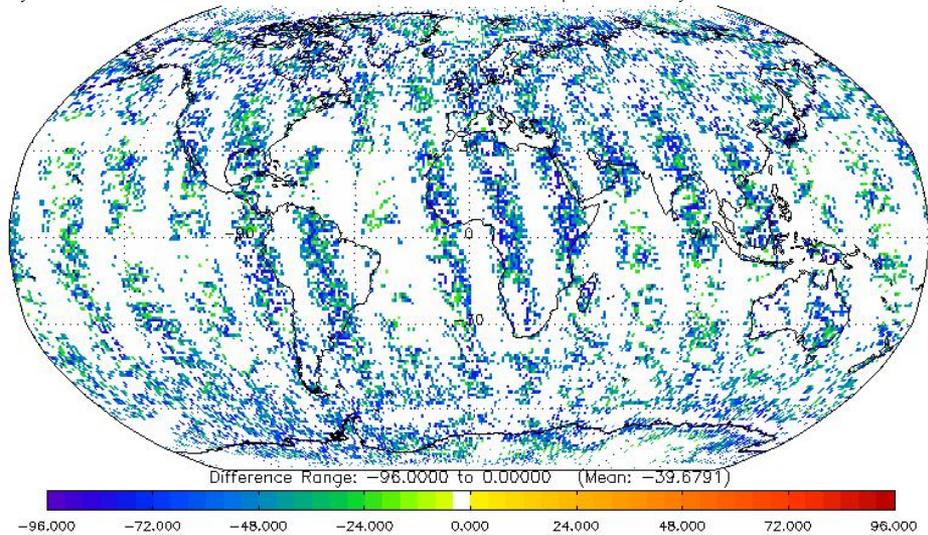
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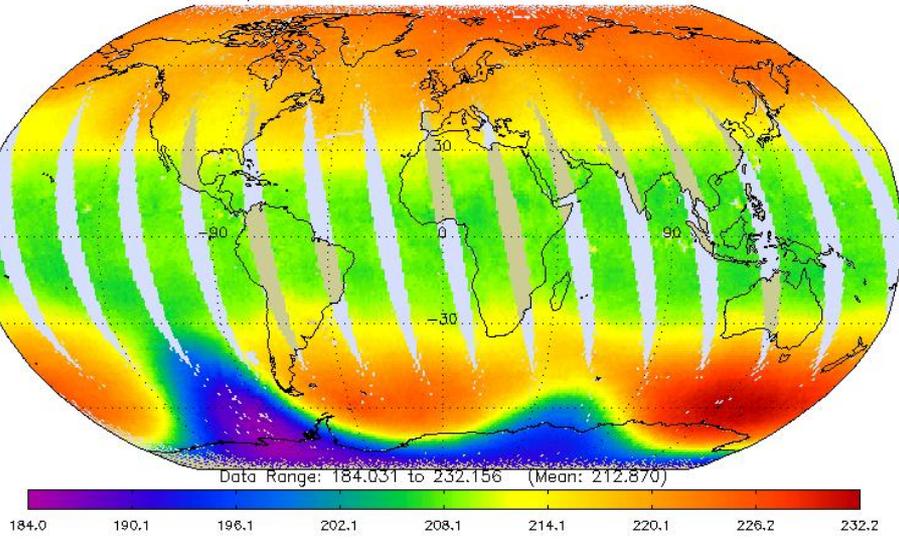
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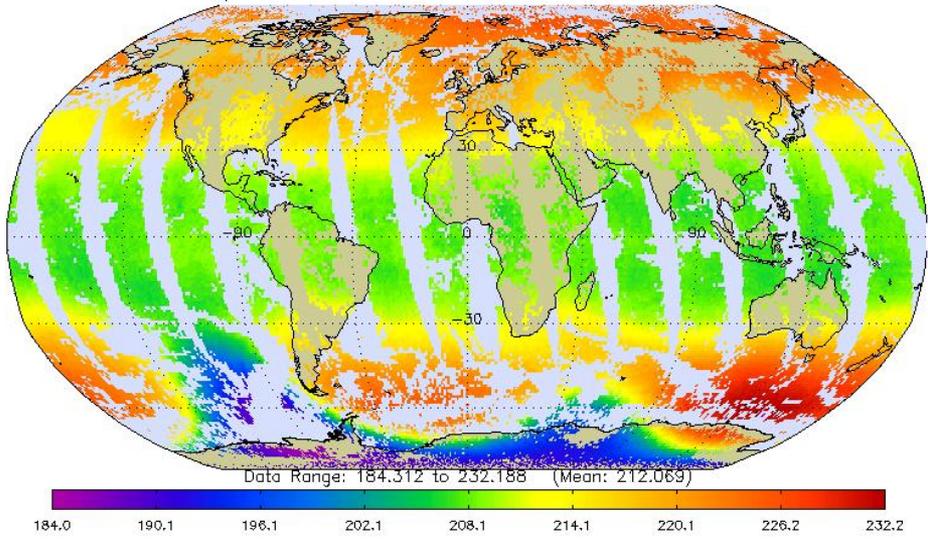
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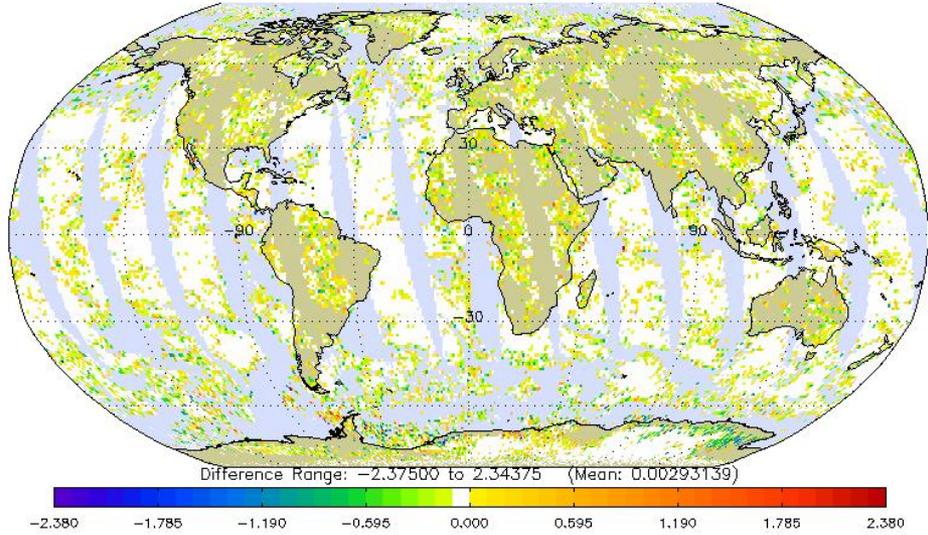
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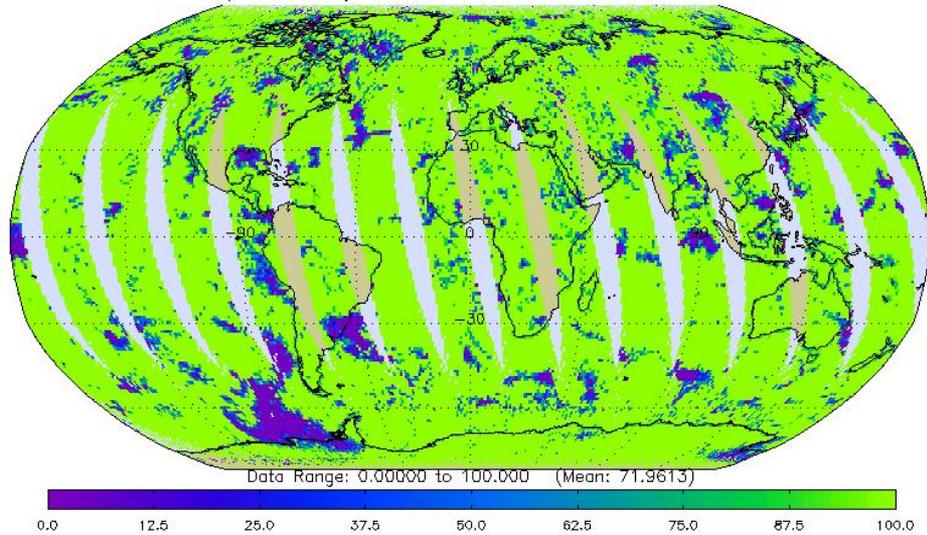
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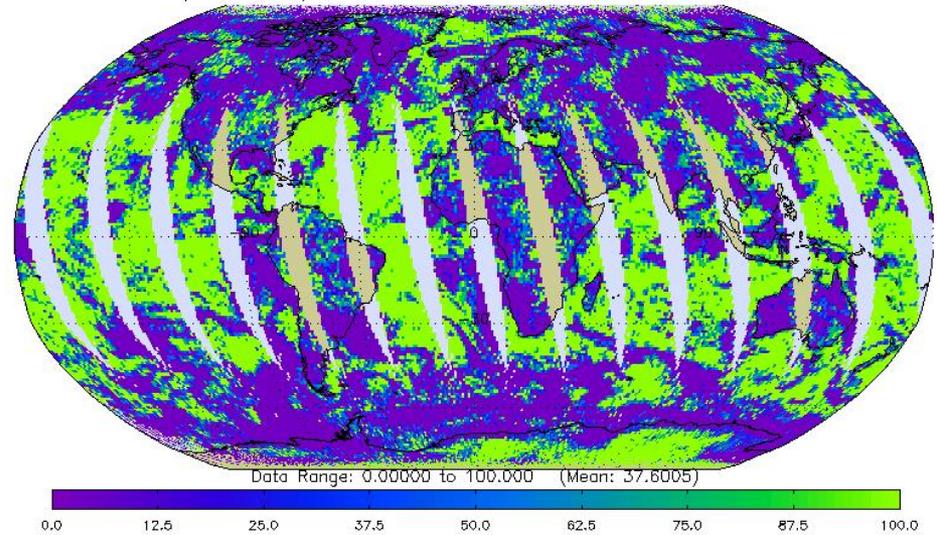
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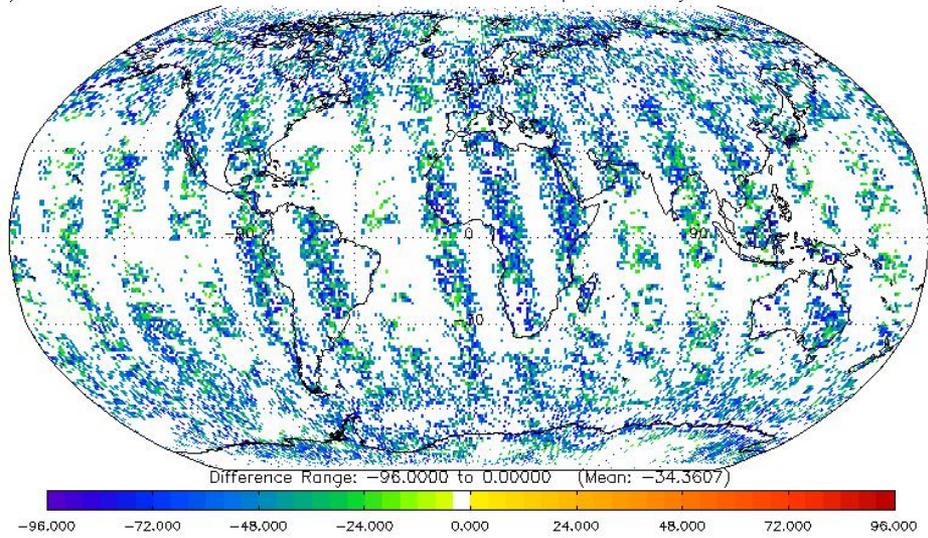
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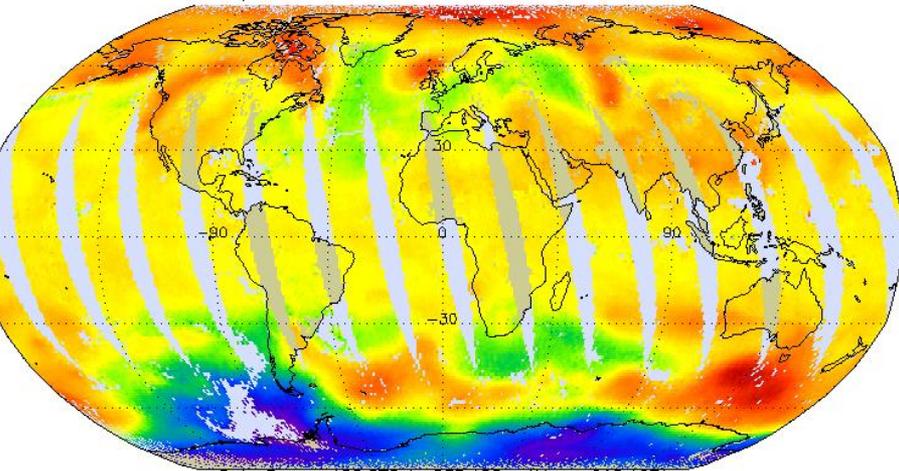
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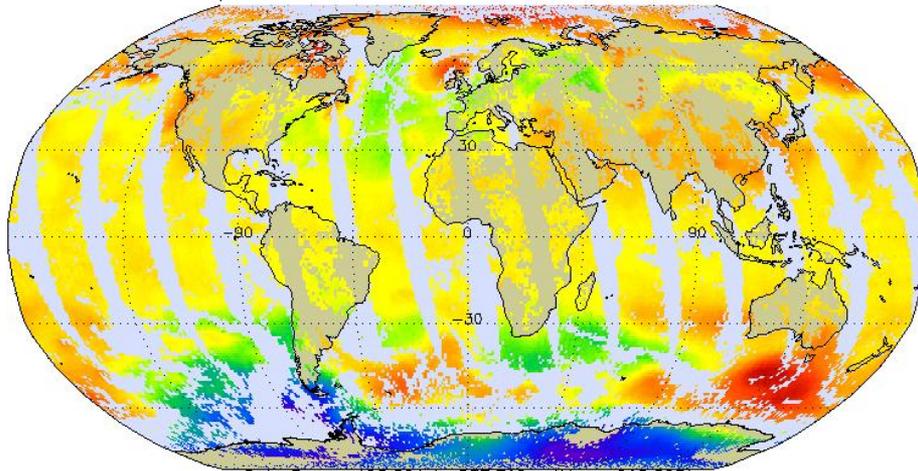
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Data Range: 188.875 to 238.188 (Mean: 218.107)



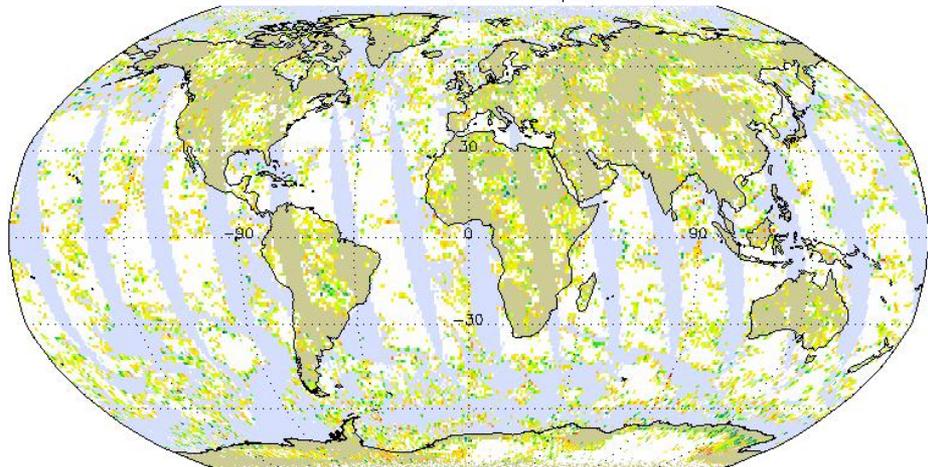
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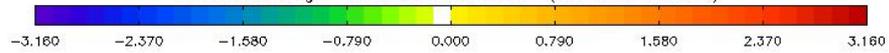
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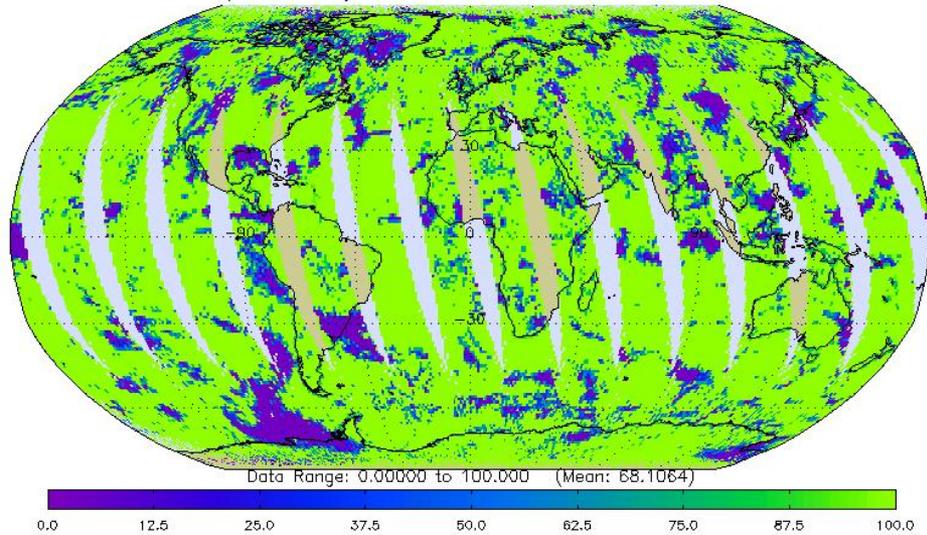
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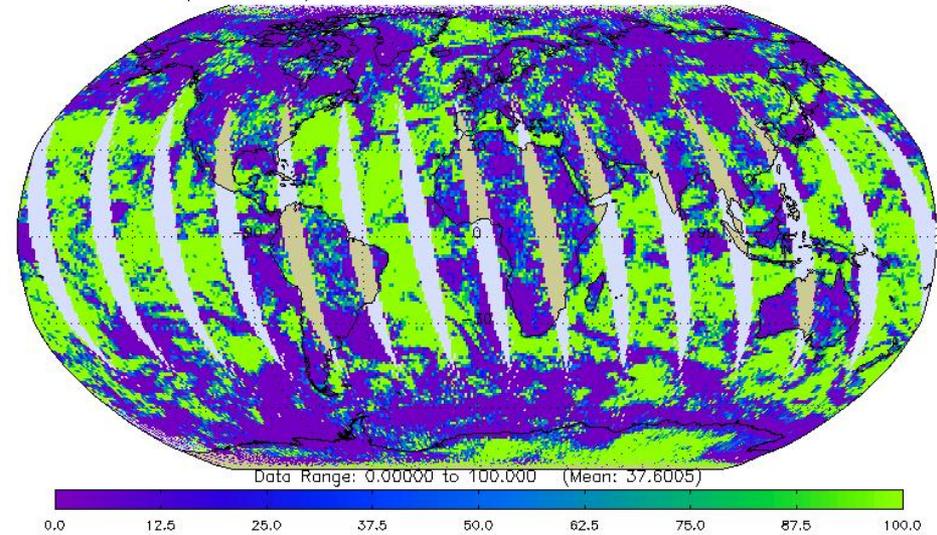
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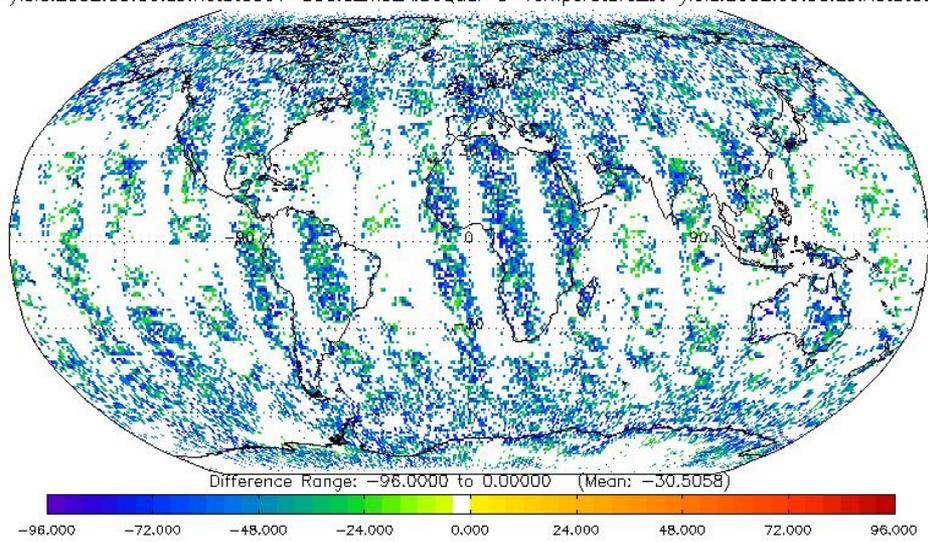
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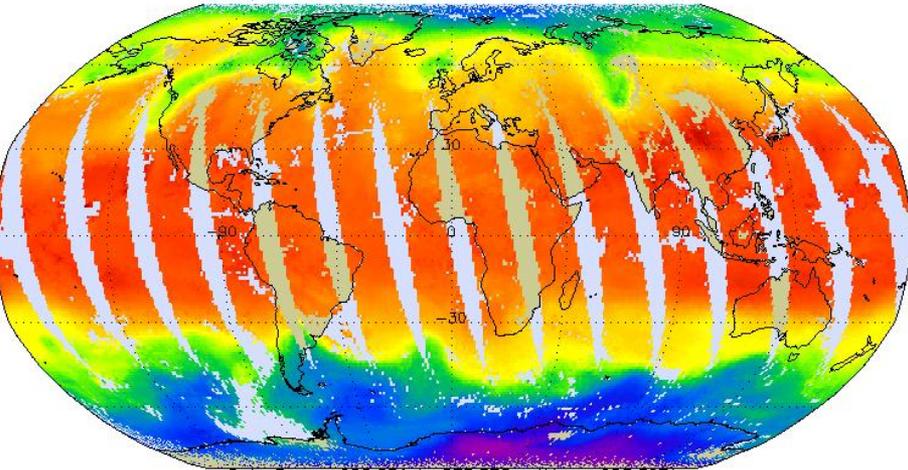
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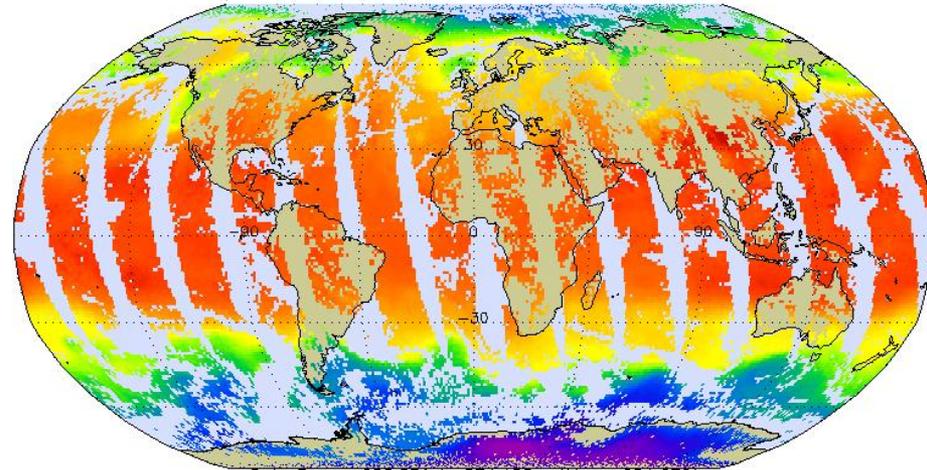
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Data Range: 222.531 to 275.375 (Mean: 253.327)

222.0 228.7 235.4 242.0 248.7 255.4 262.0 268.7 275.4

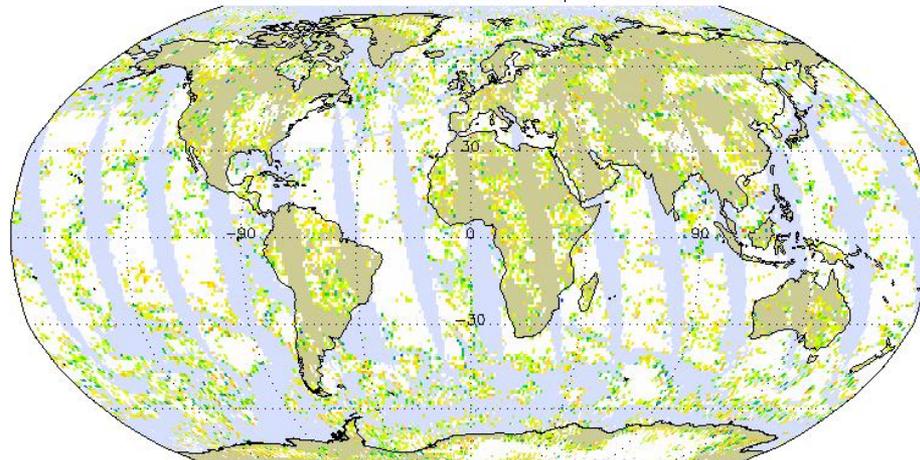
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Data Range: 222.031 to 274.188 (Mean: 254.679)

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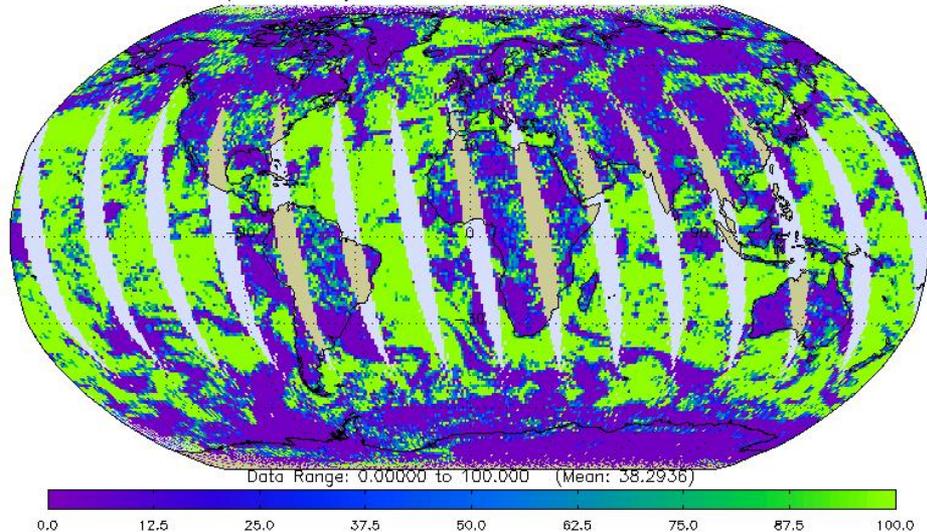
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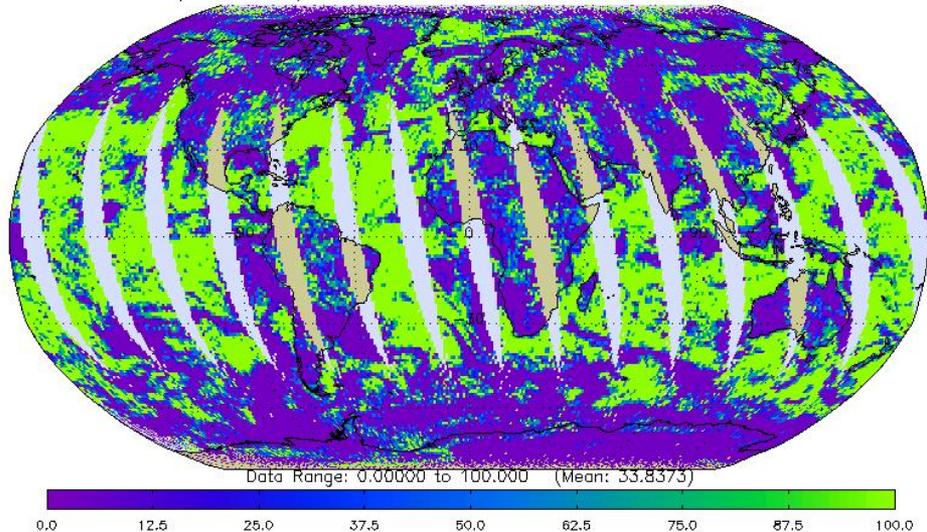
Difference Range: -3.15625 to 2.62500 (Mean: -0.0276640)

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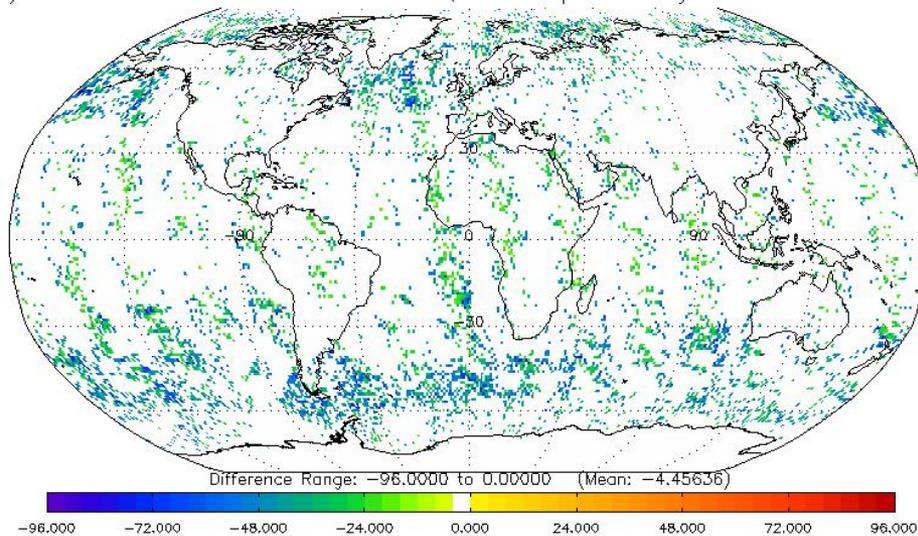
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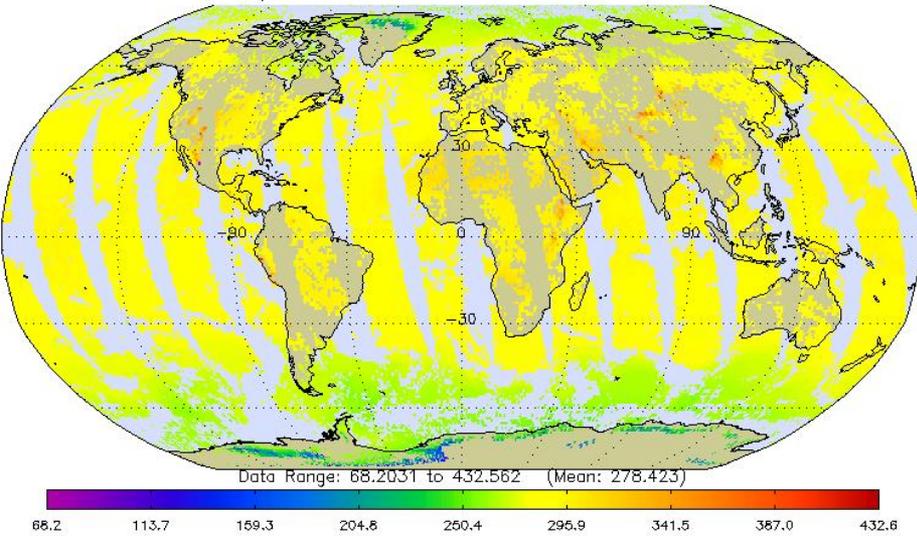
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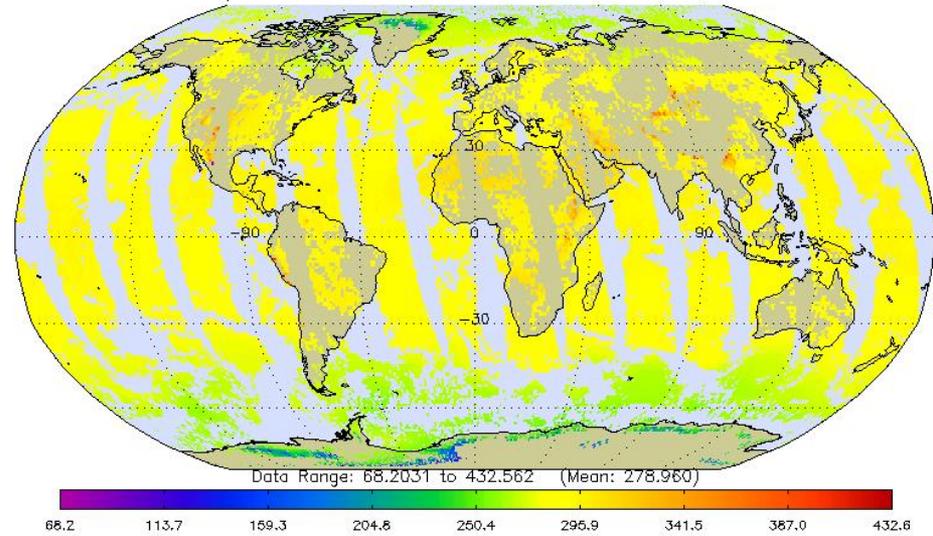
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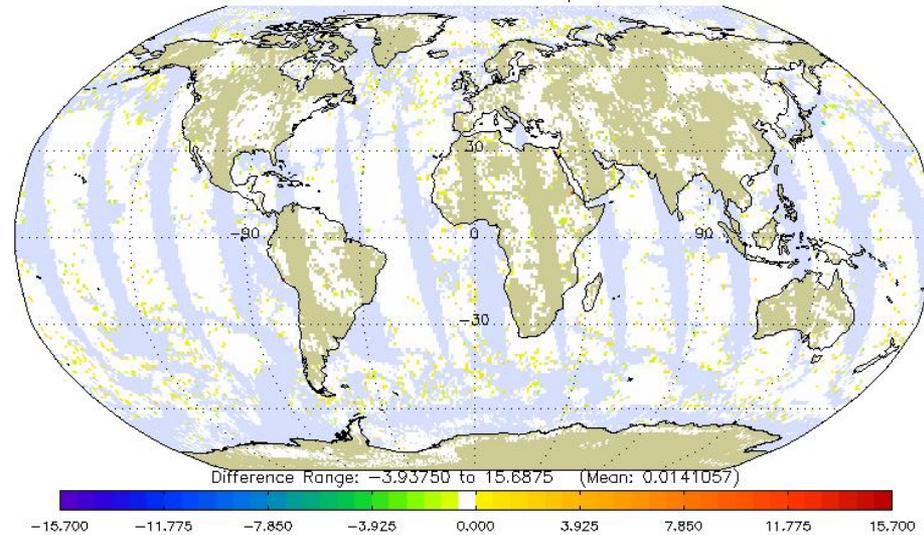
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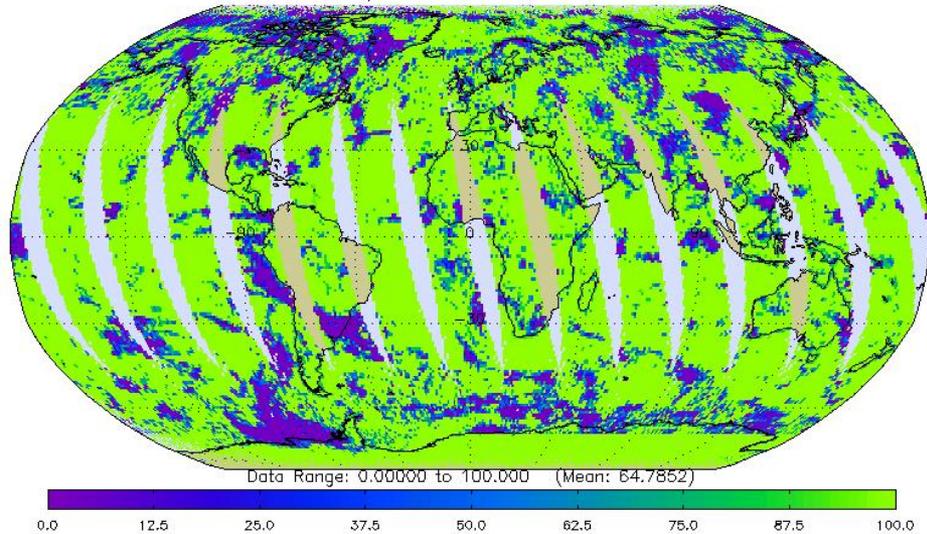
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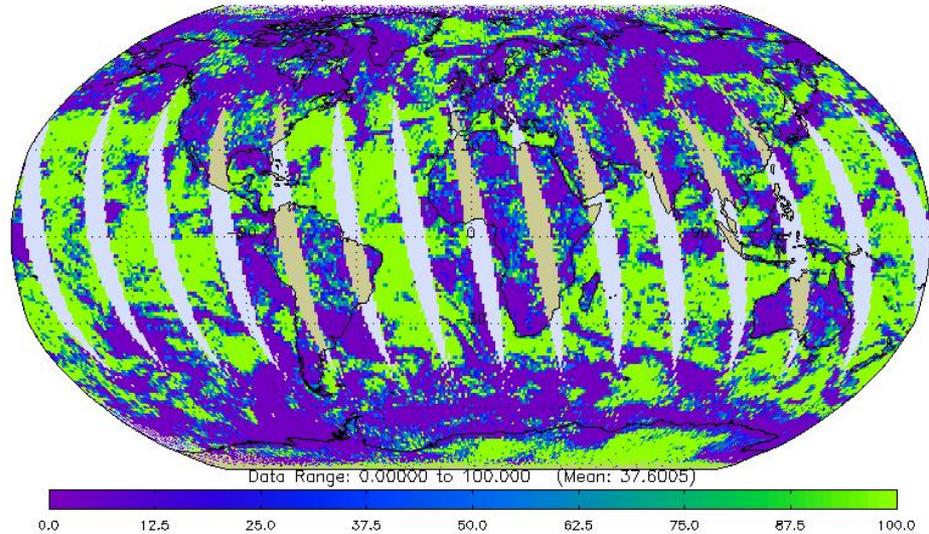
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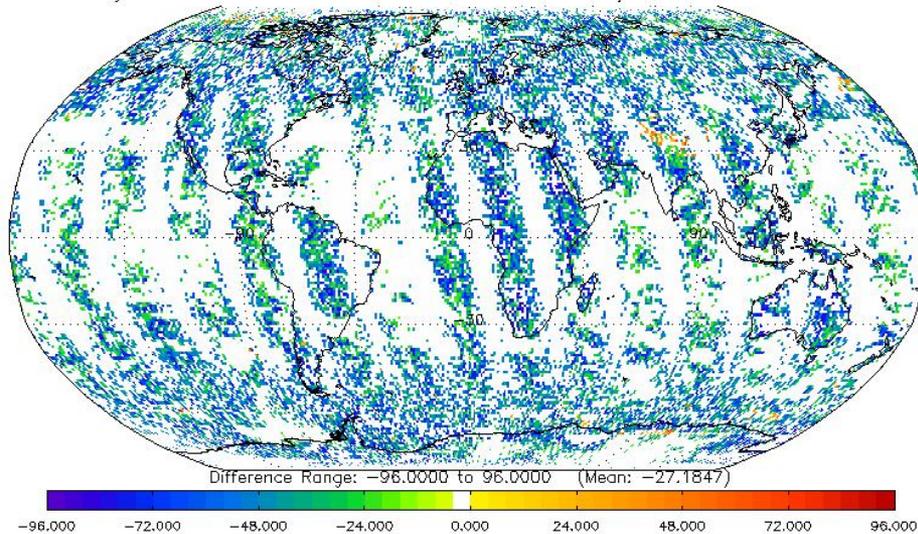
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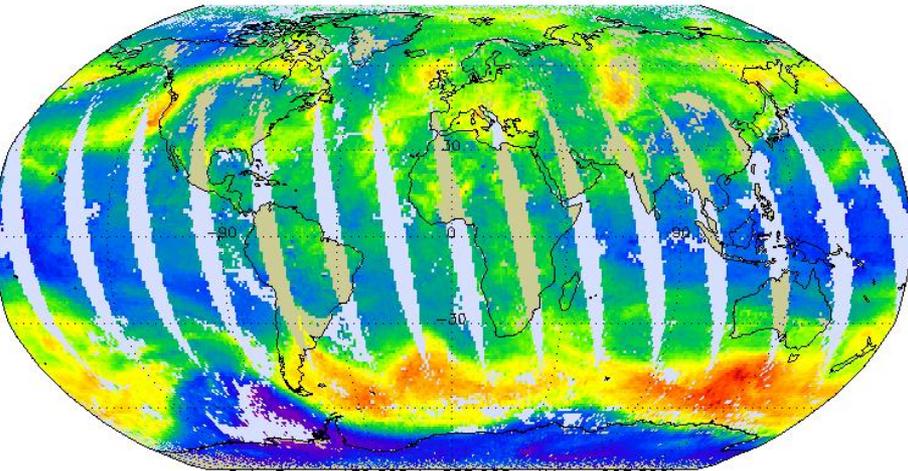
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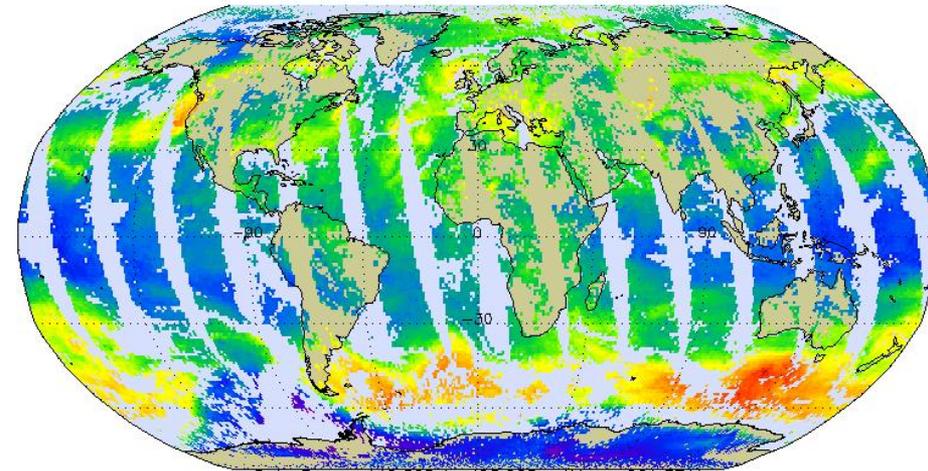
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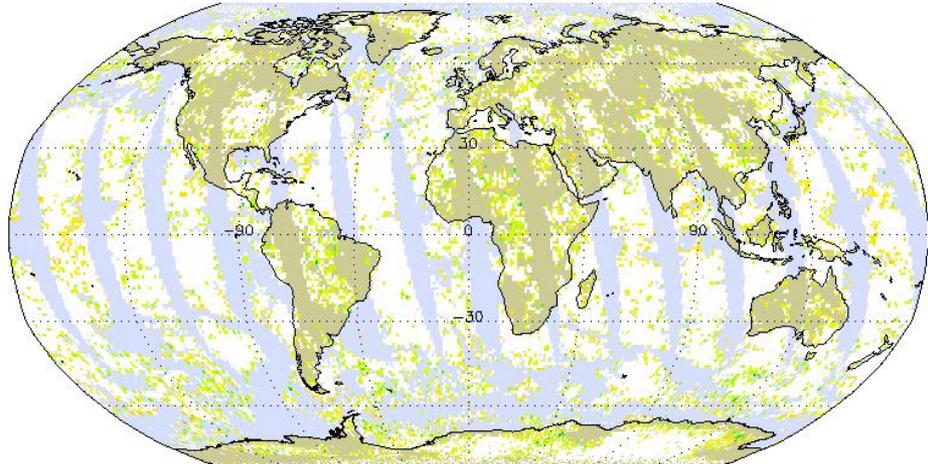
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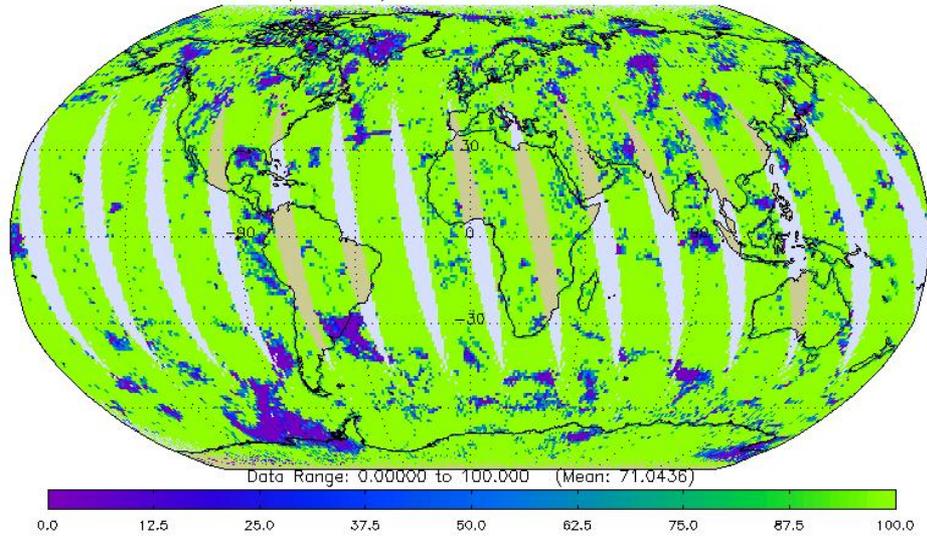
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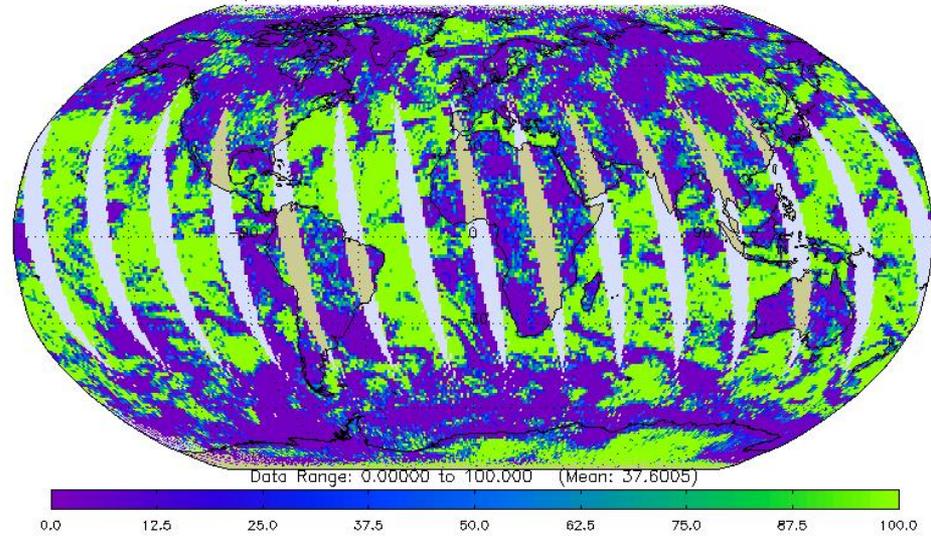
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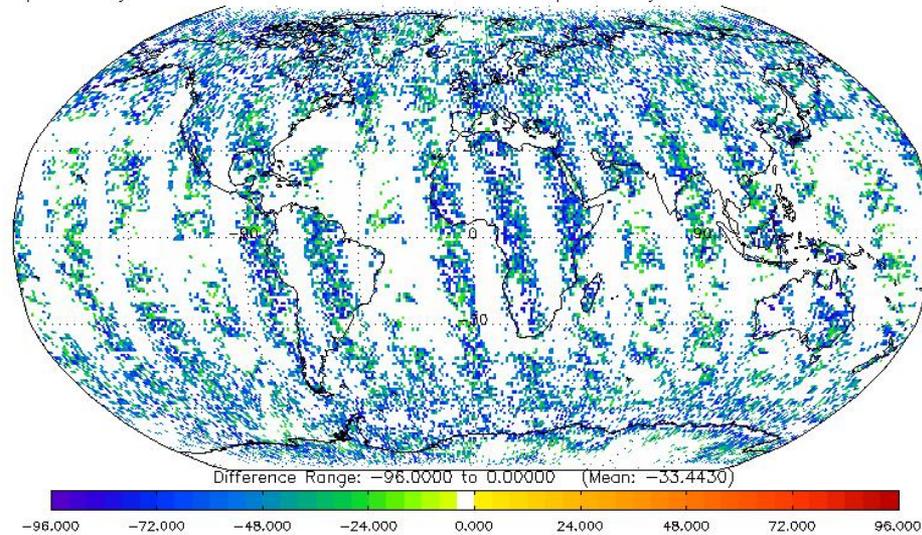
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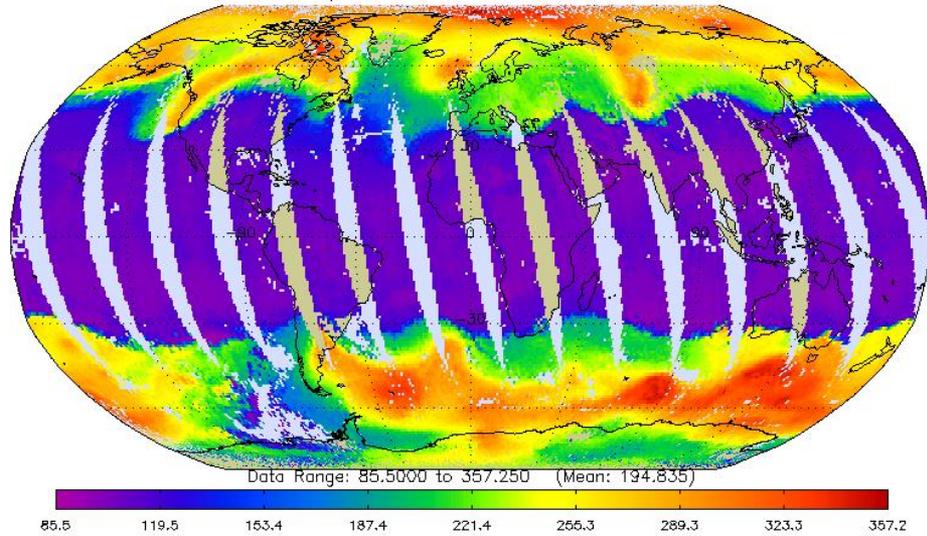
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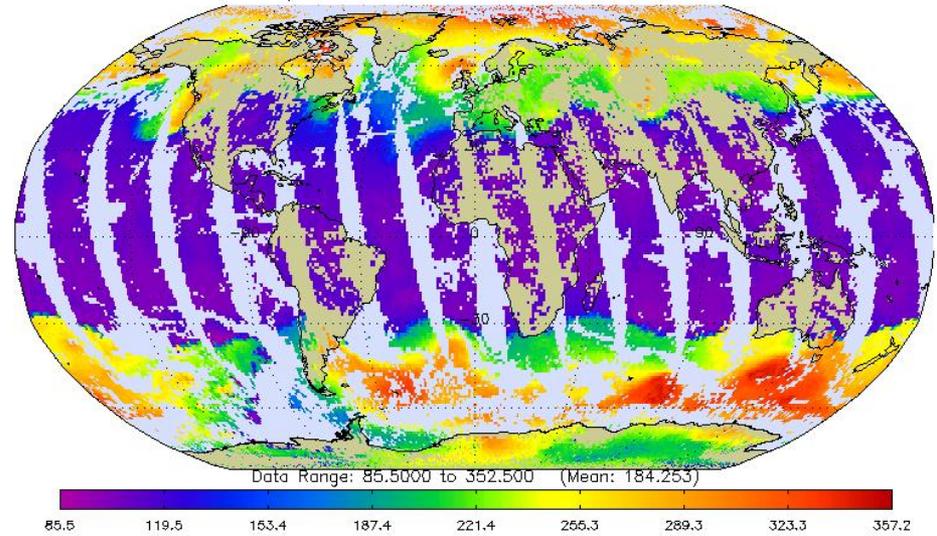
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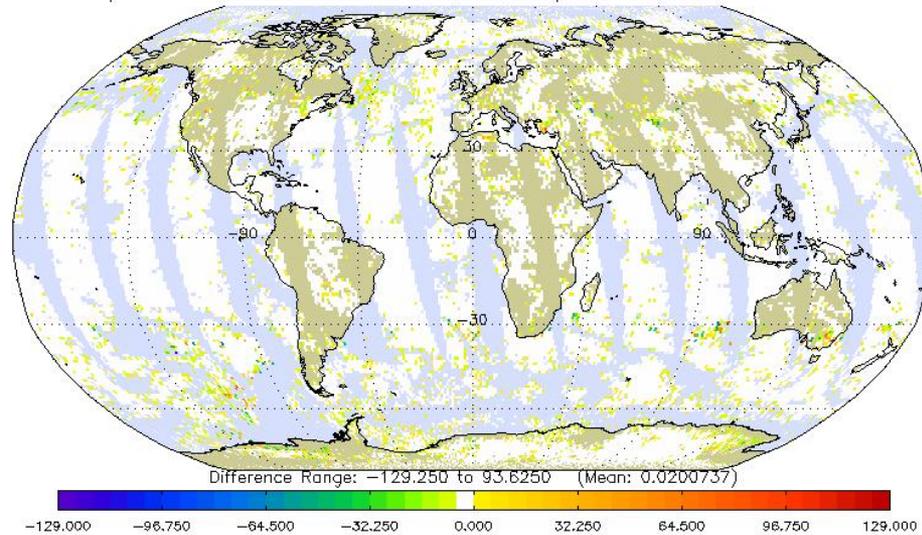
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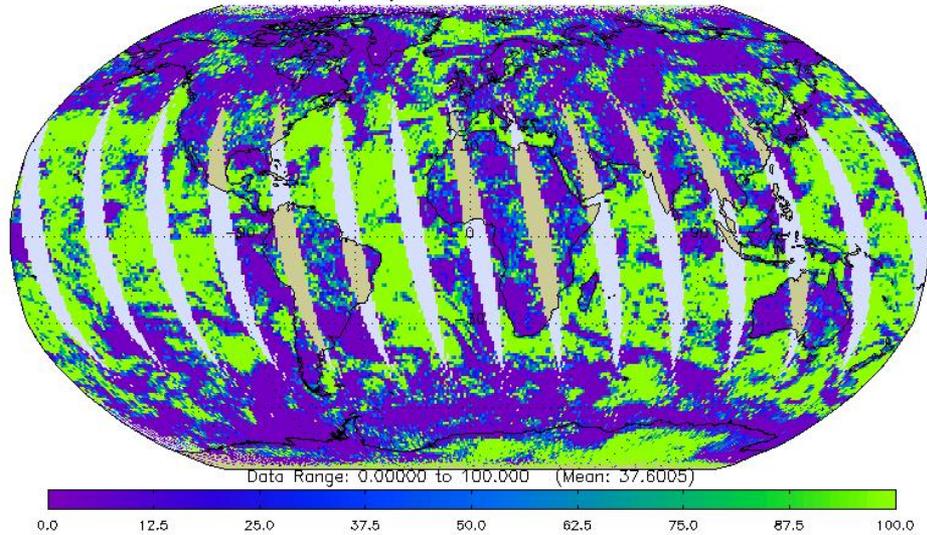
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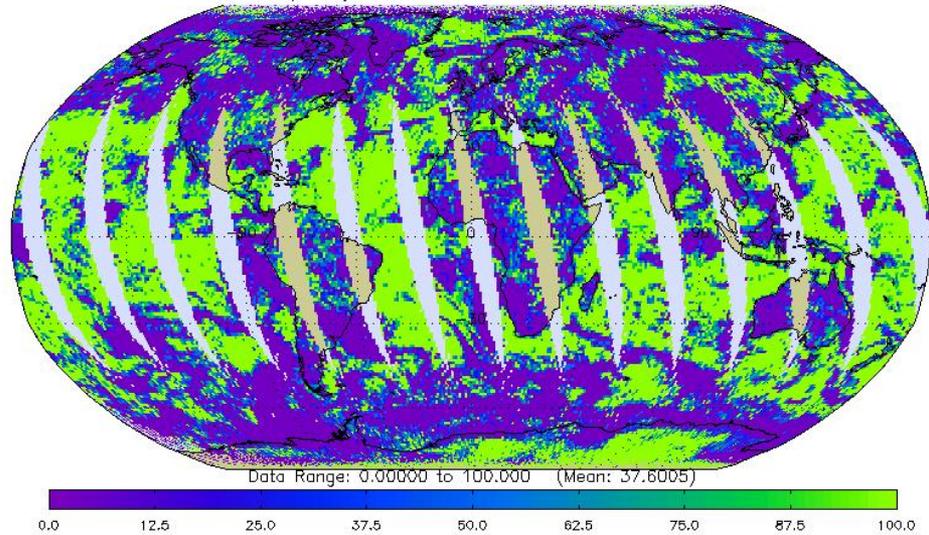
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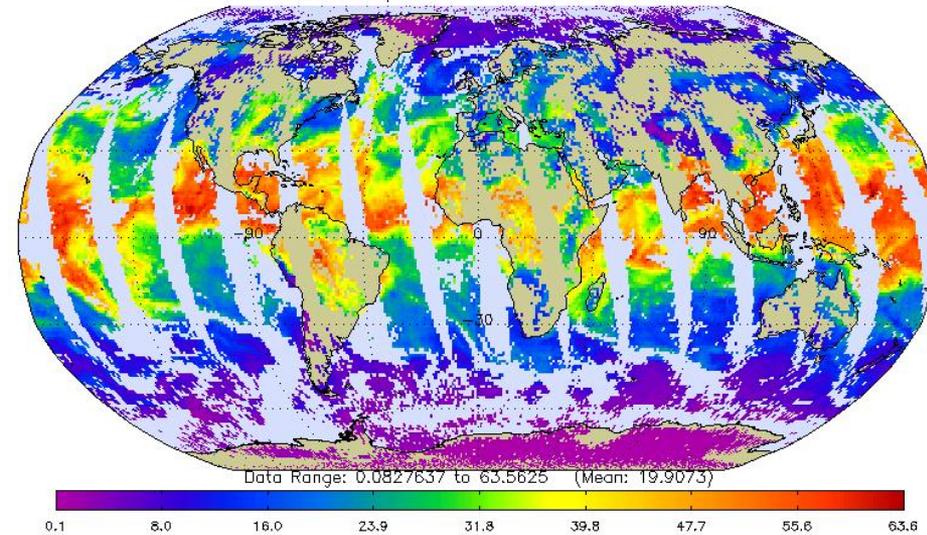
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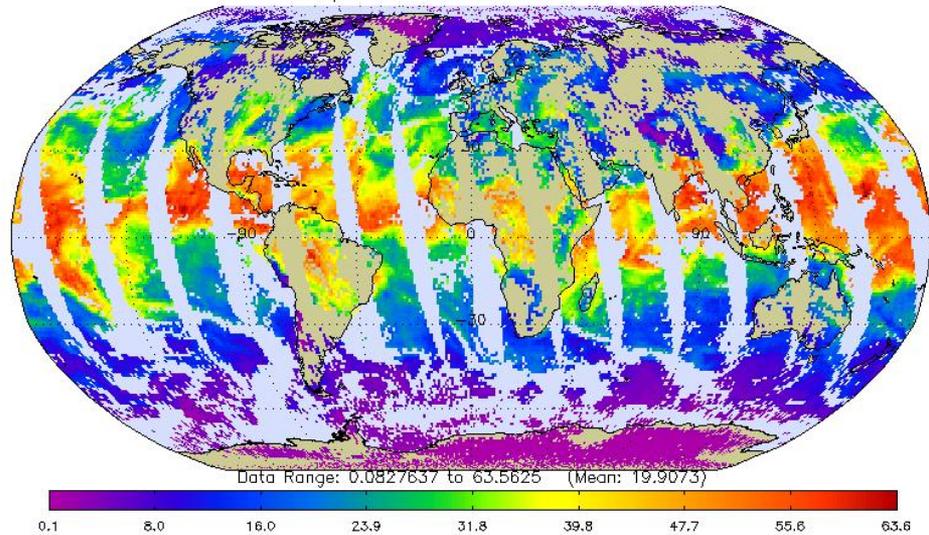
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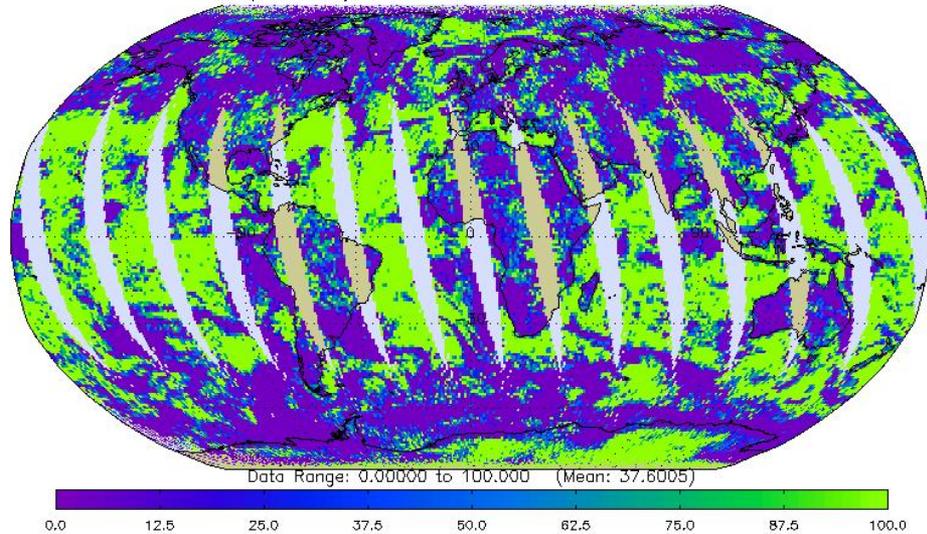
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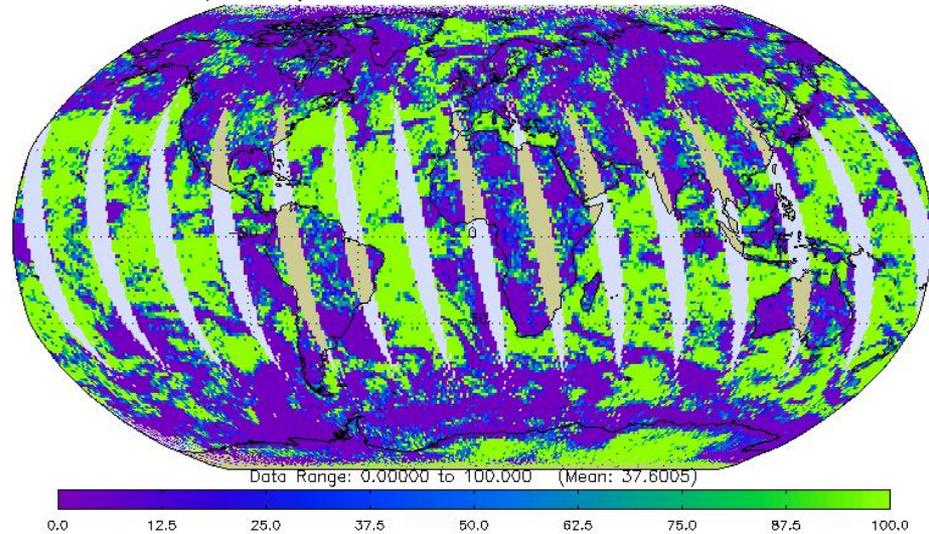
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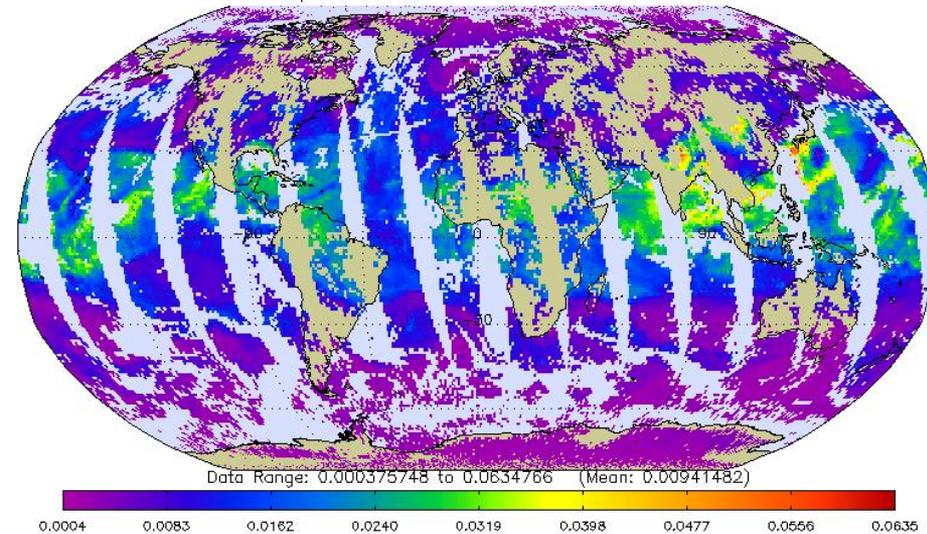
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H2OVapMMR.2002.09.06.L3.RetStd001-200.0\_mb\_A



H2OVapMMR.2002.09.06.L3.RetStd001-200.0\_mb\_A:DoQual-0

