Atmospheric properties from satellite data

Analysis of Calypso satellite data

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LAL

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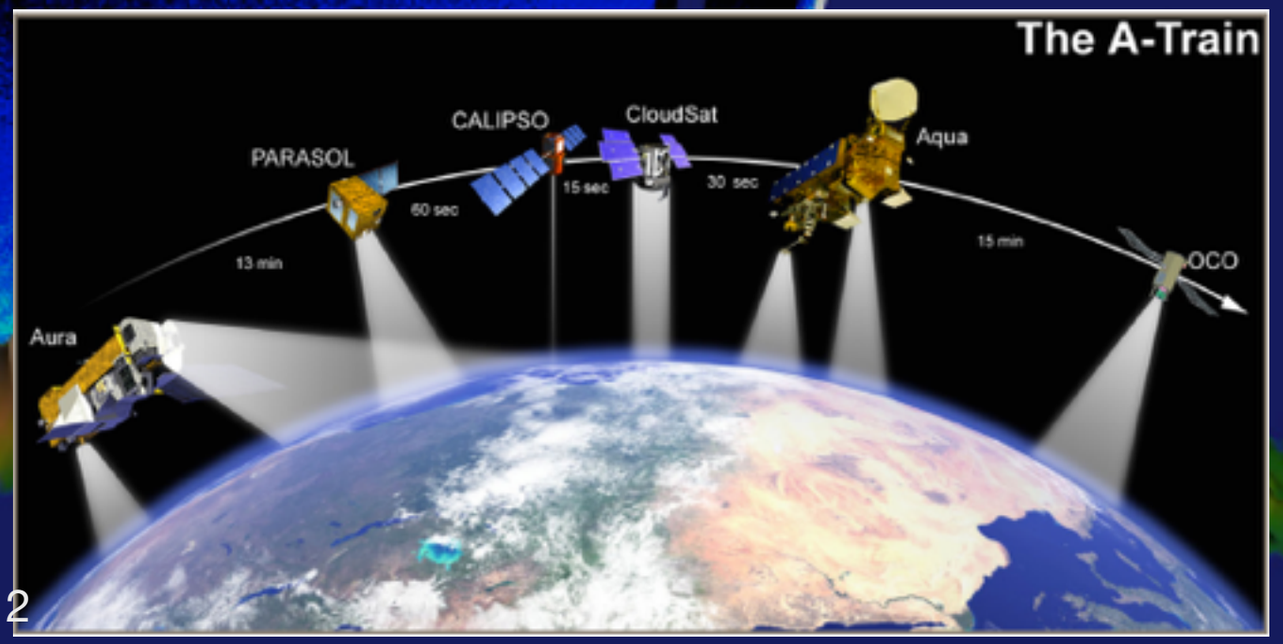
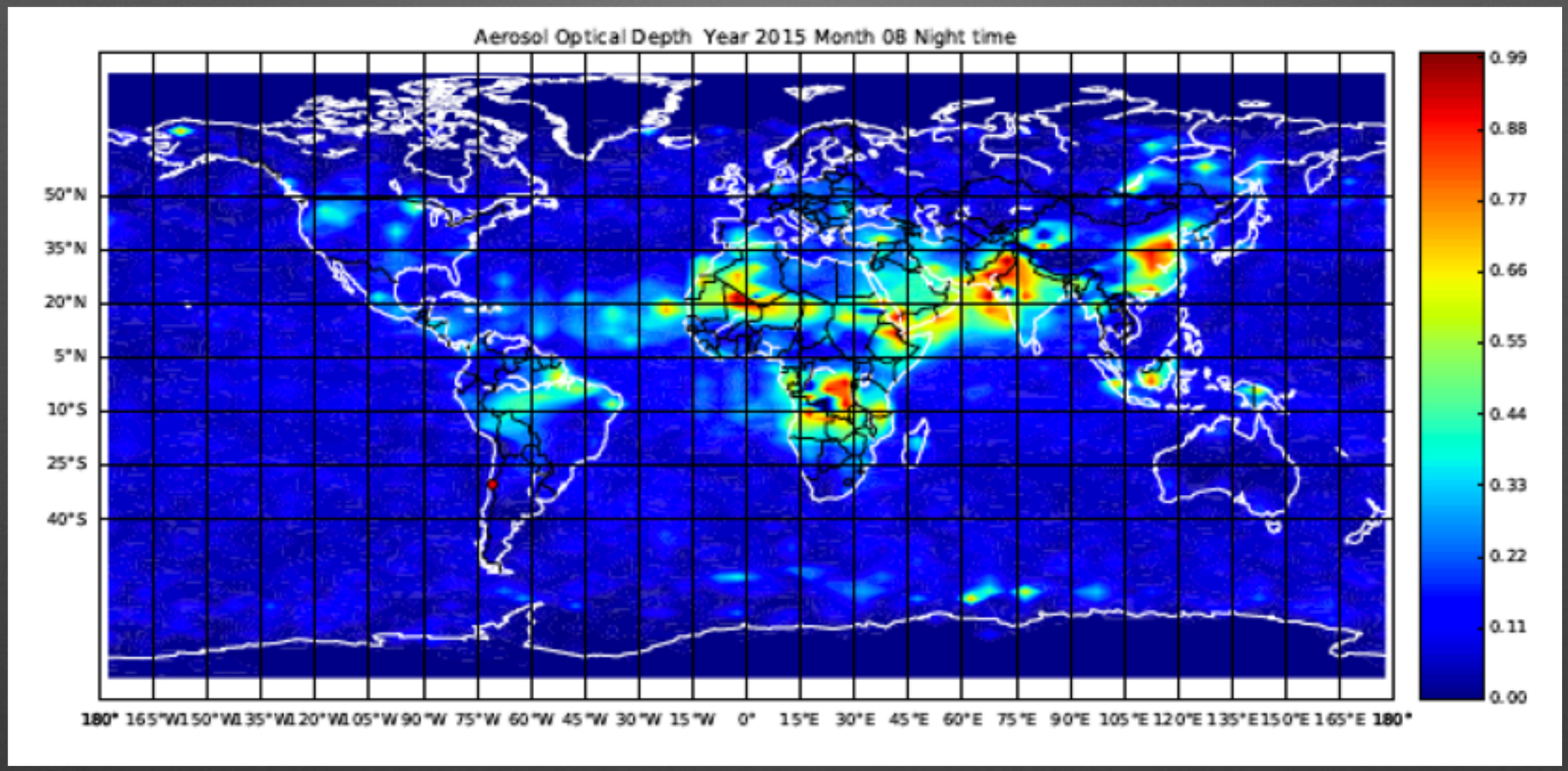
Introduction



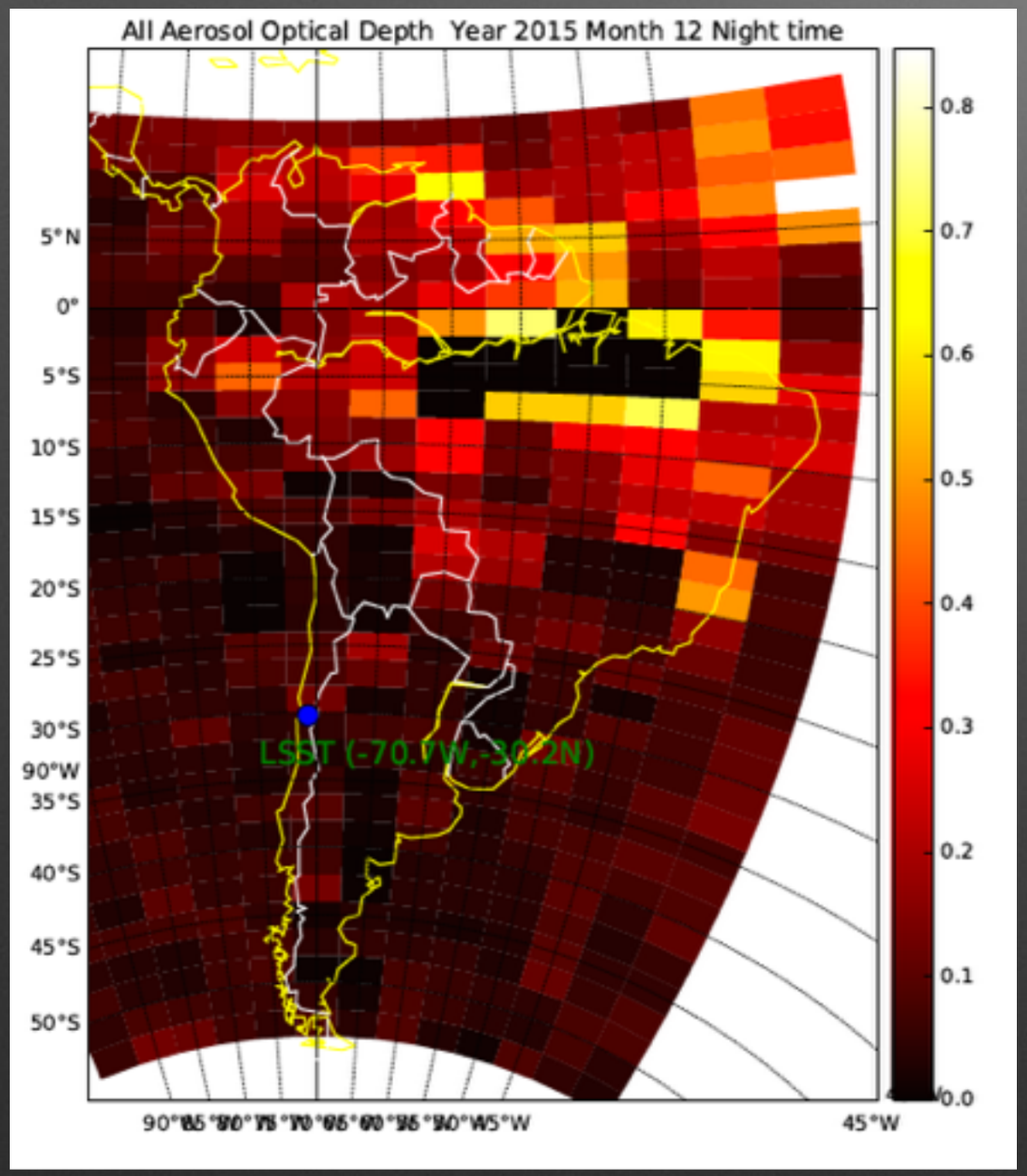
Aerosols world map



- L3 data : monthly averaged AOD at 532 nm
- Identification of aerosols types: Dust/pollution/smoke

- See huge pollution over China and India
- See dust over Saudi Arabia
- See deserts over Africa and tropical forest effect
- See forest files in Brazil contaminating South America sky

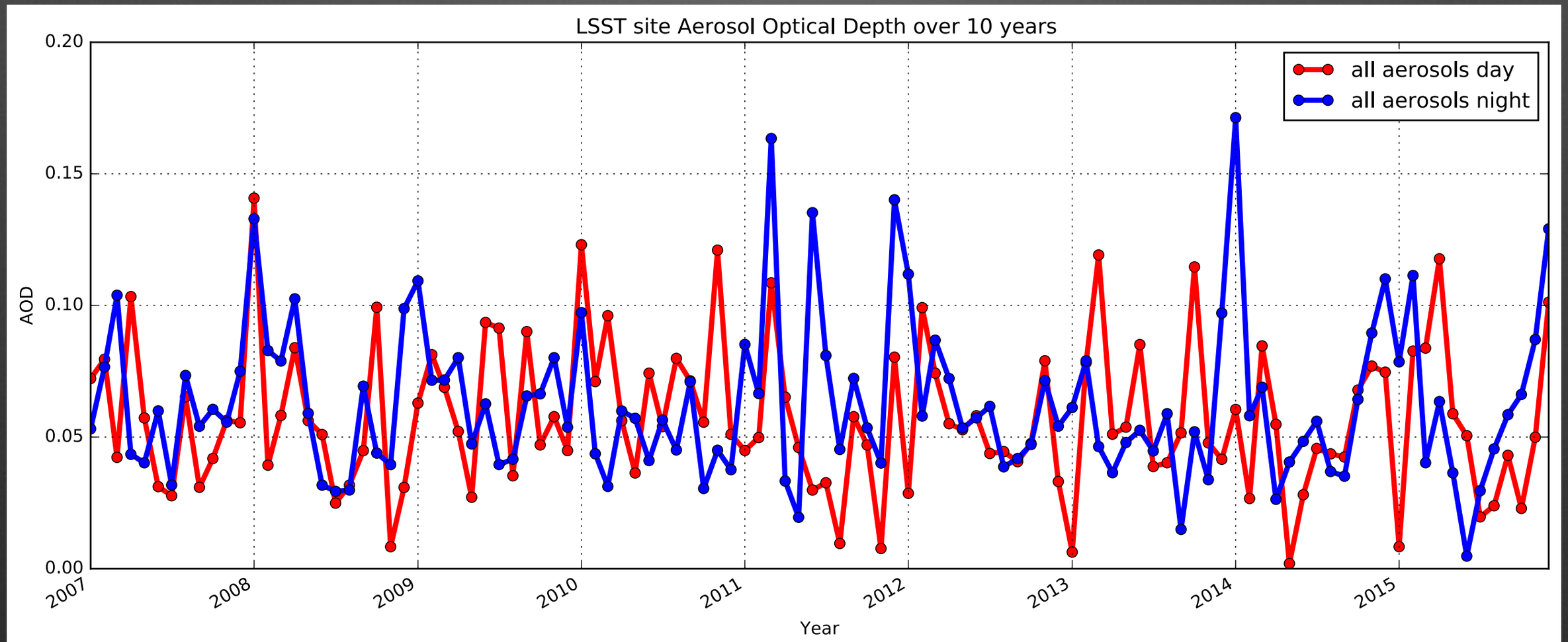
South america AOD map



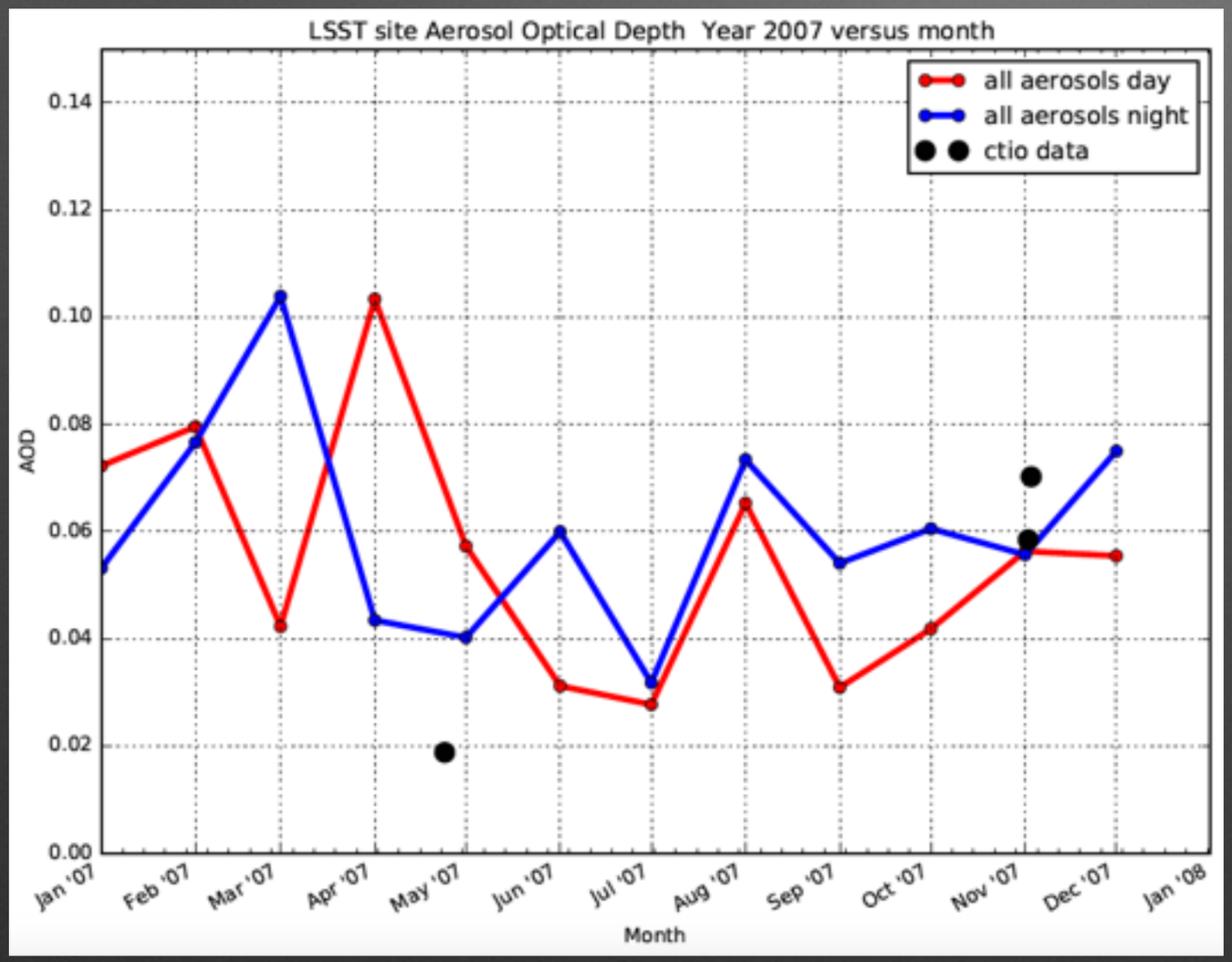
- Pixel map
  - 5° long (480 km at LSST)
  - 2° lat (220 km at LSST)
- The aerosols come mostly from forest burning in Brazil
- Other much smaller aerosols sources are not tagged by Callipso
- LSST site remains a relatively aerosol clean region

Historical records for AOD over 10 years

- No obvious nights-days differences
- No obvious strong seasonal effect

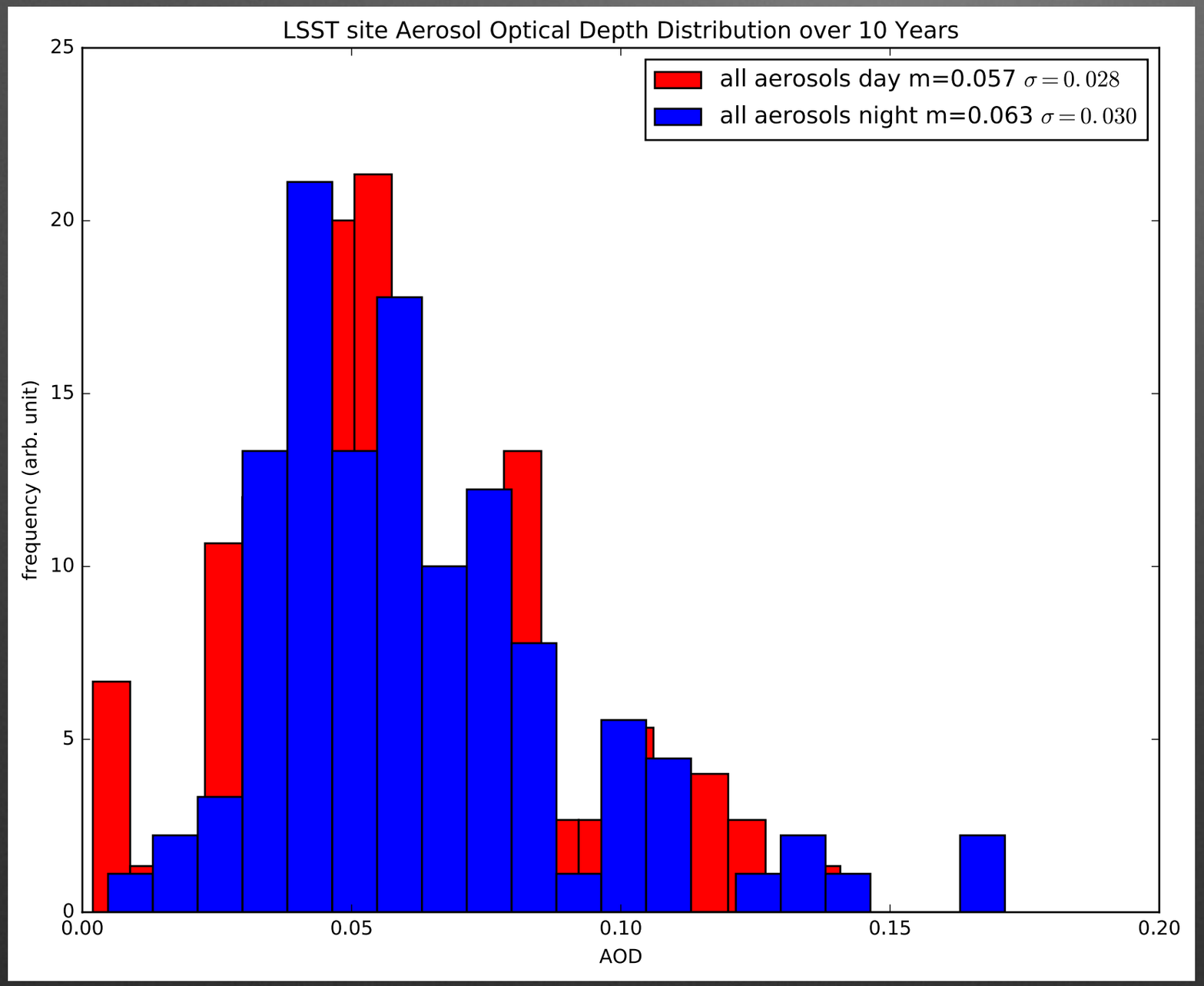


Comparison spectro-data/ satellite data



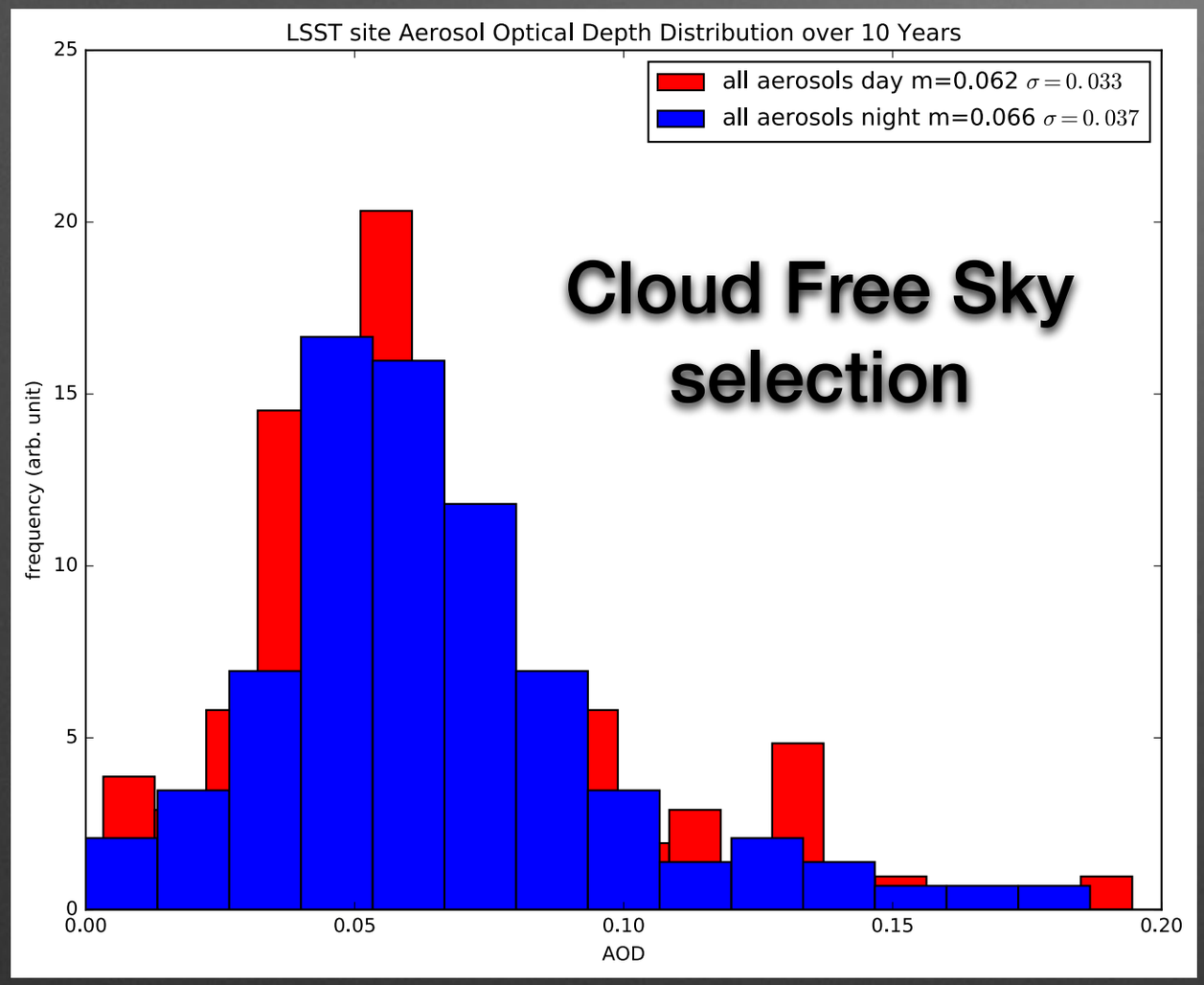
- Comparison to CTIO data (2007 & 2008 , D. Burke et al.)
- Data on aerosols optical depth extrapolated from 675 nm to 532 nm (calipso)
- In 2007 data are less than 1 standard deviation (0.02) on months averages
- In 2008, data are down by more than 1.5 standard deviation (0.03) on months averages

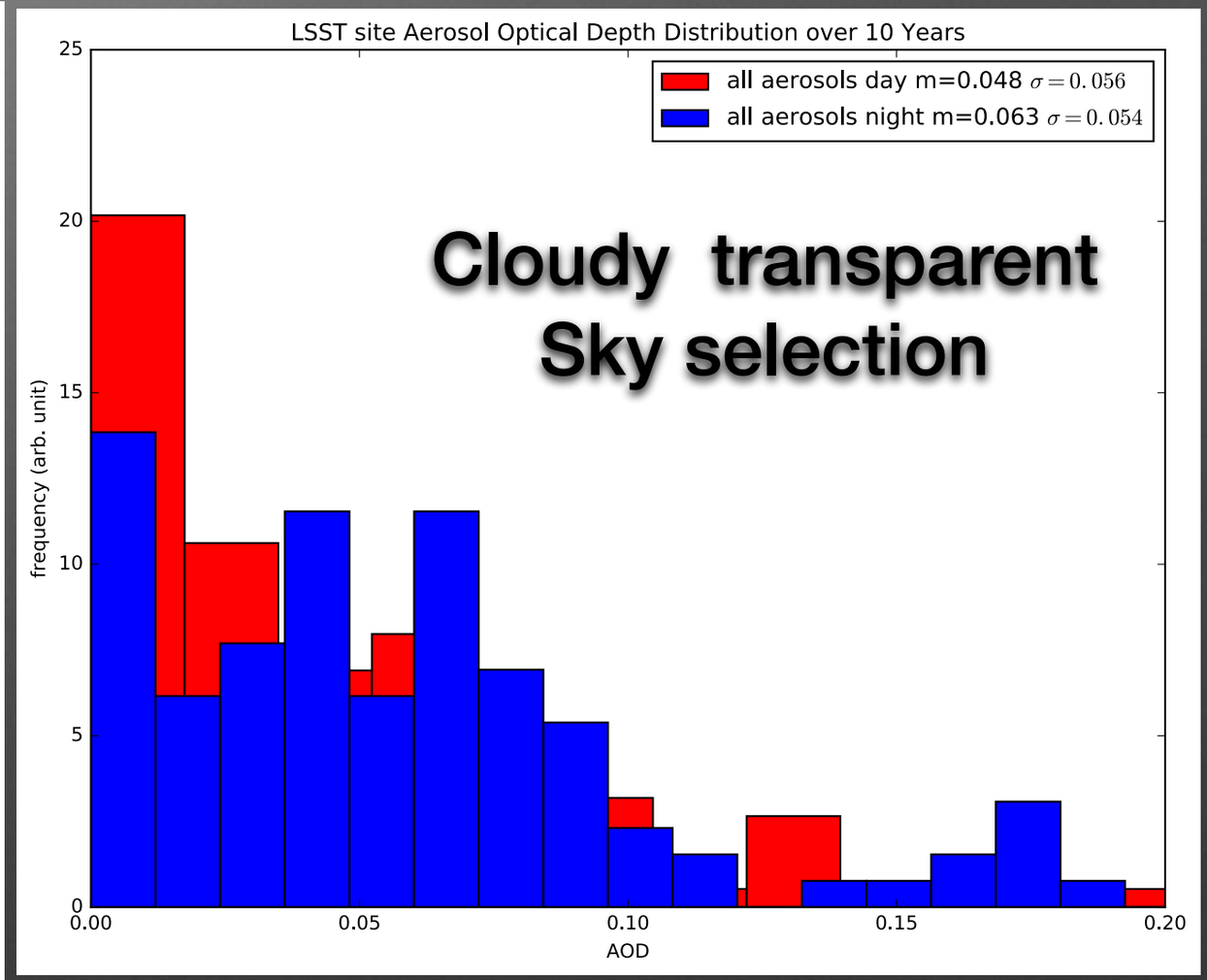
AOD distribution over 10 years



- All sky types:
- No particular selection on weather (cloudy or not)

AOD Comparison clear sky/ transparent clouds

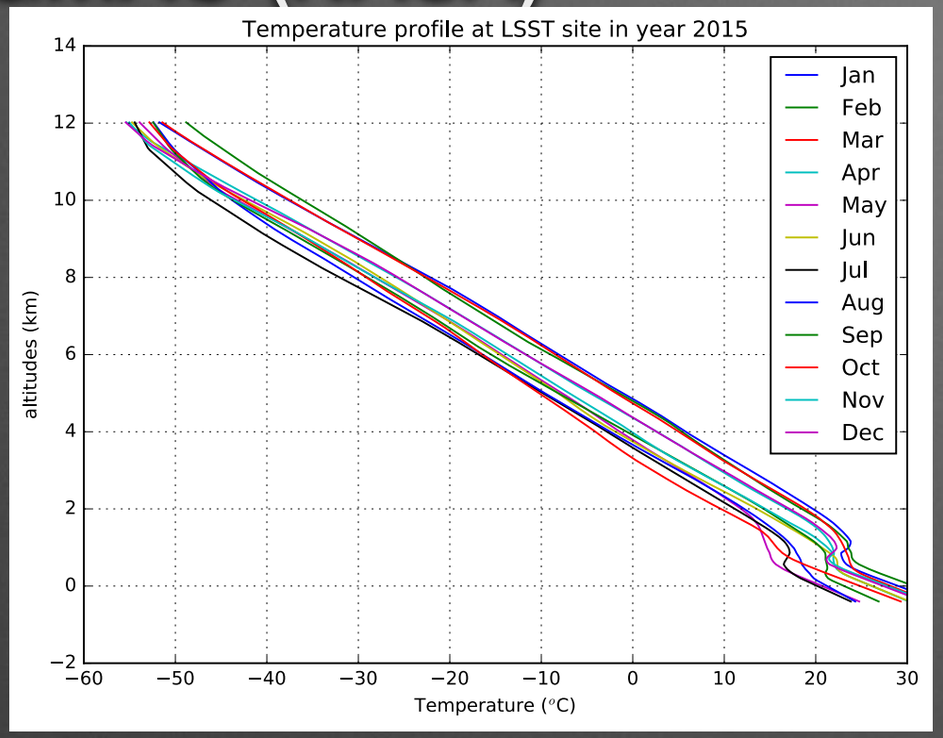


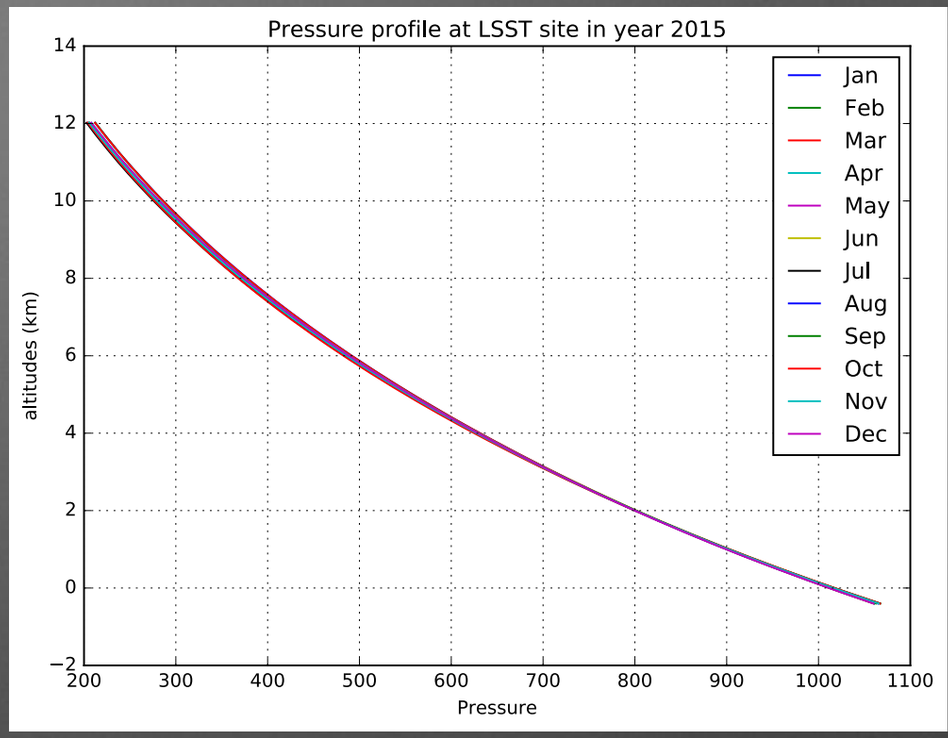


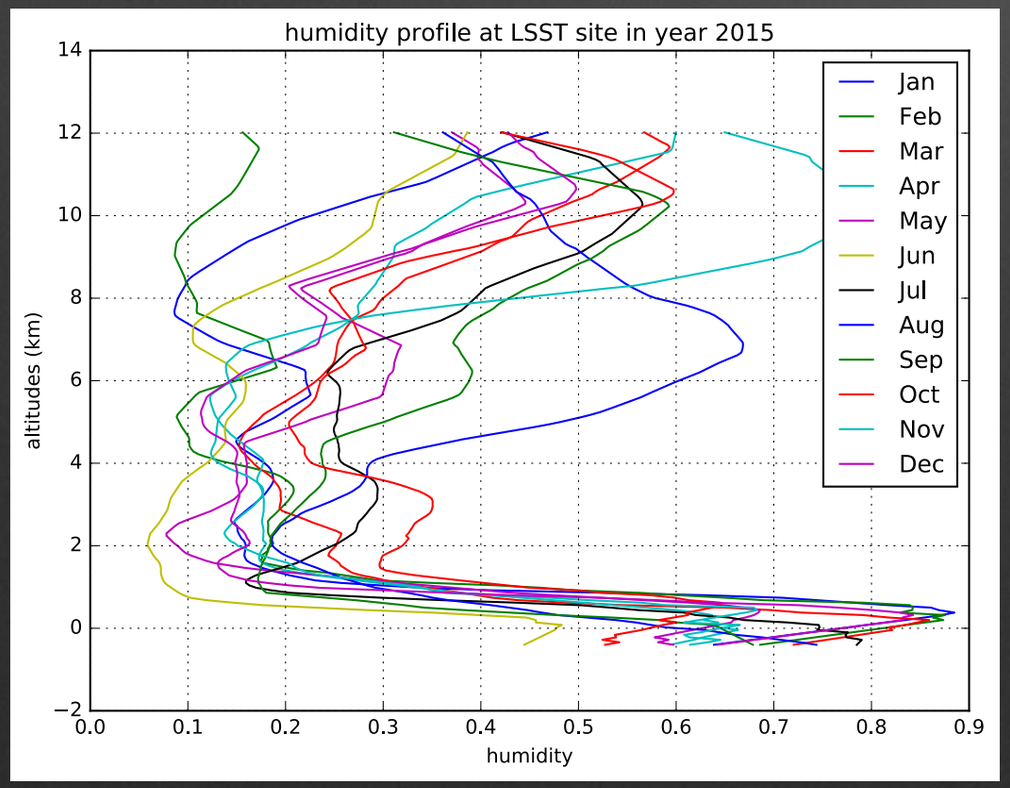
- May be a tiny difference in AOD distribution and its spread in case of transparent clouds

Work on precipitable water vapour

- Data not measured by Calypso but included in L3 data from GMAO (NASA)

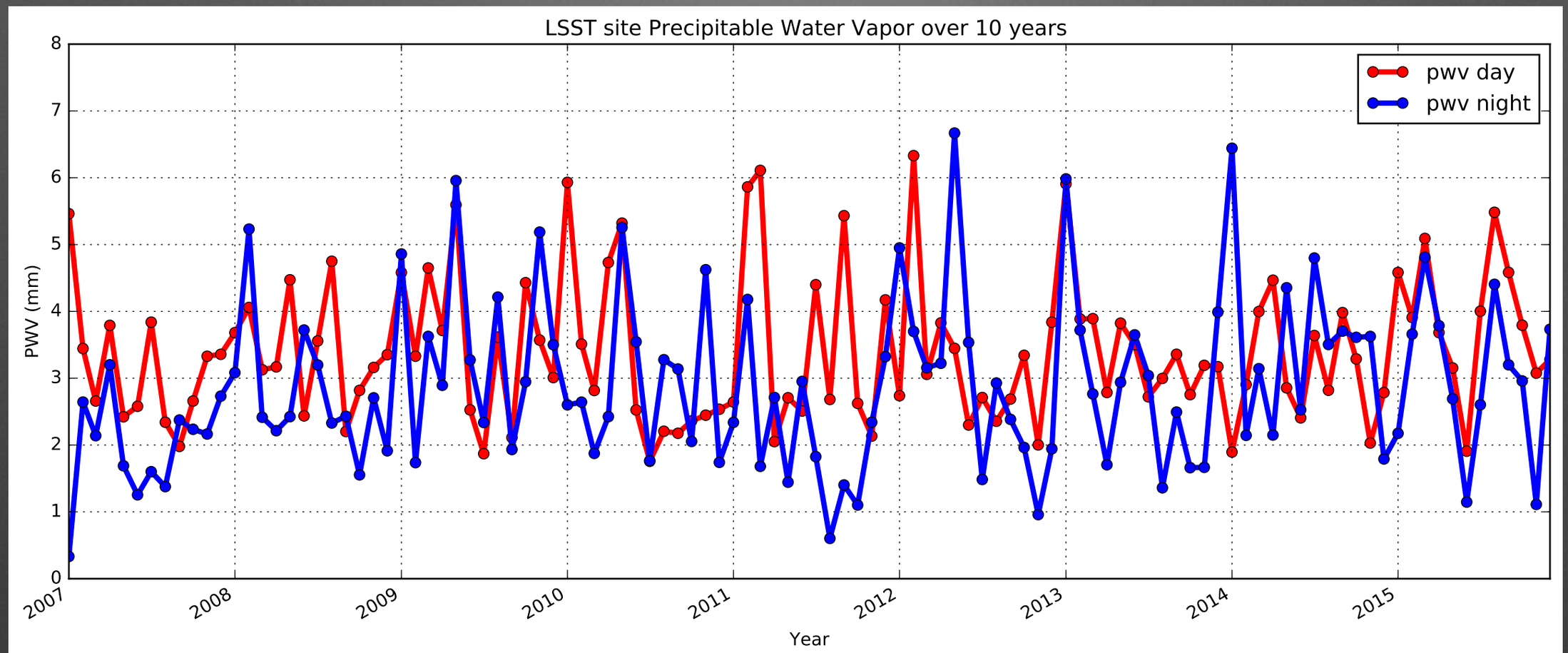






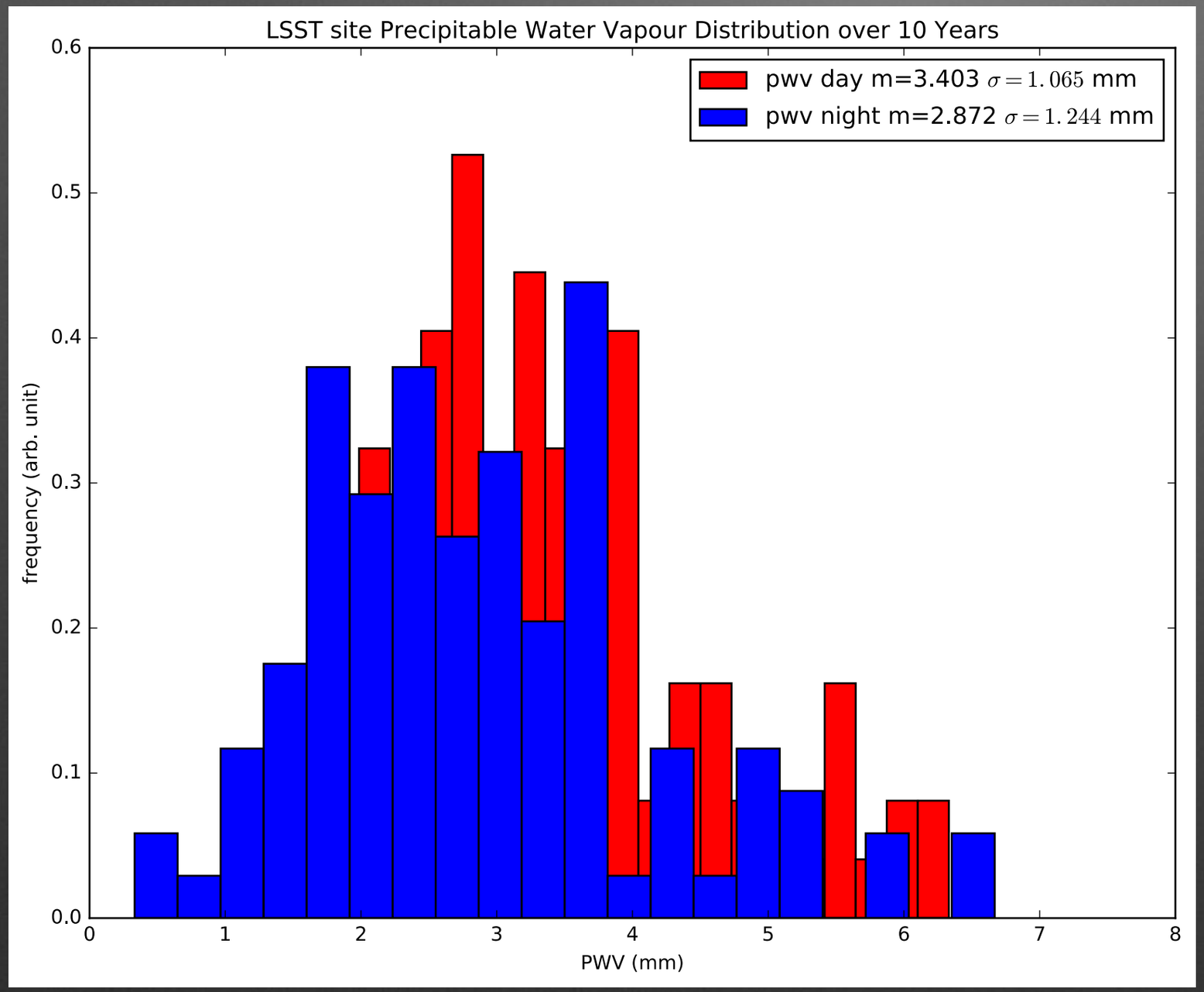
- External data provided freely by global model assimulation office:
  - http://gmao.gsfc.nasa.gov/
  - These 3 profiles allowed me to convert in precipitable water vapour in the whole air column depth

Historical records for PWV over 10 years



- Calculated by integrating water densities in atmospheric layers above LSST altitudes
- No seasonal variation ? perhaps limited peak humidity in summers

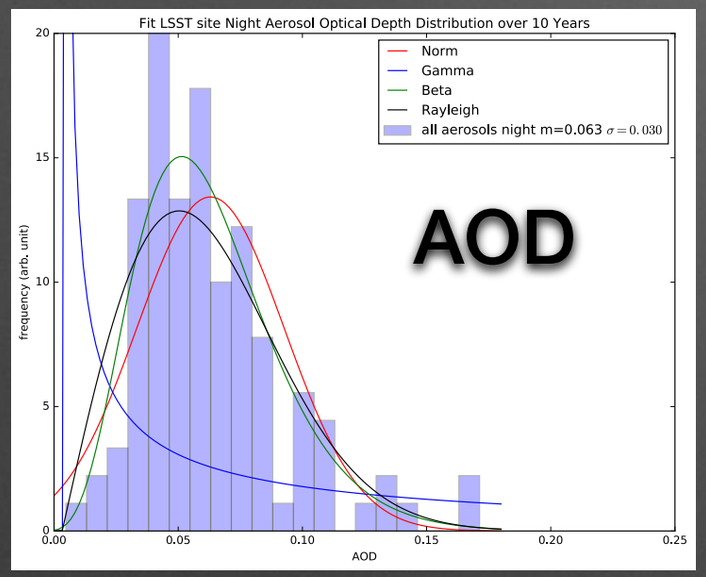
PWV distribution over 10 years

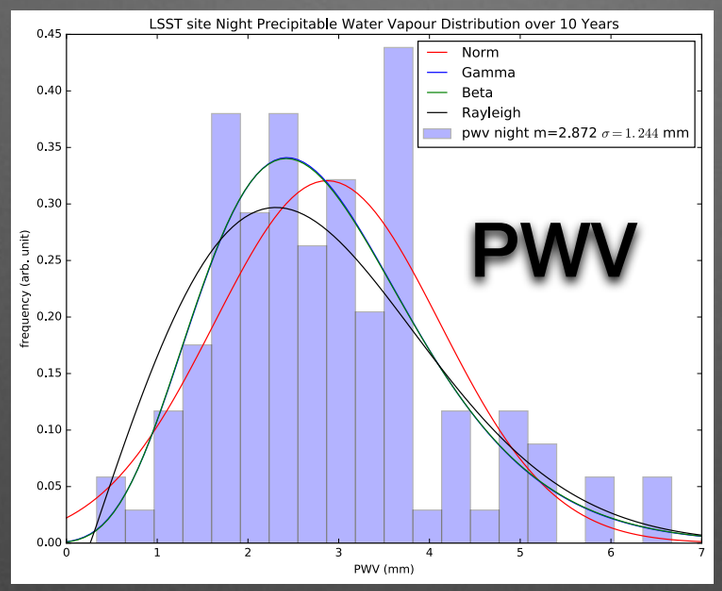


- get some idea about typical LSST atmosphere before taking our own data
- days are slightly more humid than nights
- typical pwv = 3 mm +/- 1 mm

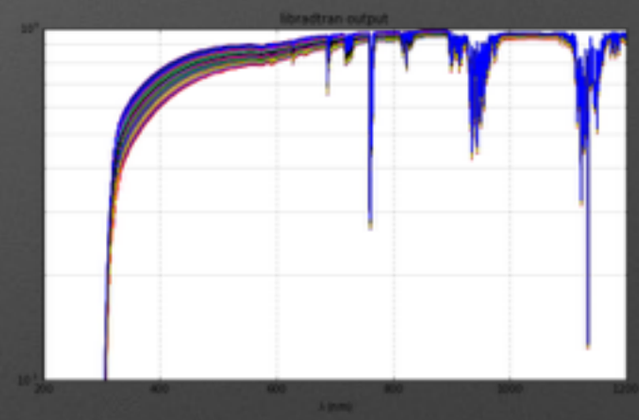
Next steps with external atmospheric data

- Fit adhoc models to simulate realistic LSST transparencies S_{atm} (standard) and S_{atm}(obs)





Including P,T,
elements densities profiles



- Find more precise data for LSST site with GMAO

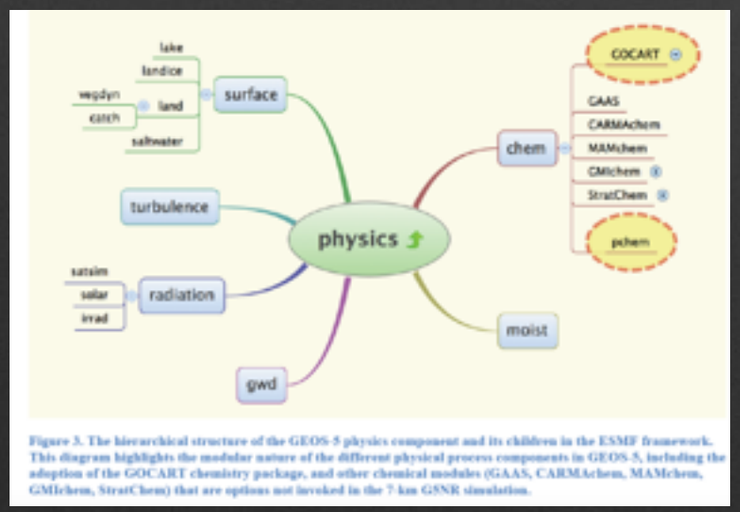


Figure 3. The hierarchical structure of the GEOS-5 physics component and its children in the ESMF framework. This diagram highlights the modular nature of the different physical process components in GEOS-5, including the adoption of the GOCART chemistry package, and other chemical modules (GAAS, CARMAchem, MAMchem, GMIchem, StratChem) that are options not invoked in the 7 km G5NR simulation.

The GMAO system mix world wide data collected from satellites and weather stations with earth-atmosphere simulation to predict any physical quantities in 3D, anywhere with resolutions of
- 7 km
- 30 minutes

The data of interest for us (P,T, densities, AOD) can be downloaded one by one easily.

More steps

- Easy to extract similar data for Flagstaff and Observatoire de Haute Provence

- It is interesting to know better LSST atmosphere in advance (before site characterisation early) to prepare the physics analysis (including calibration task).

- However this is not an urgent task by now to go further (for Oxford LSST collaboration meeting).