

Global estimates of the horizontal variability of total cloud optical thickness from MODIS Level-3 data

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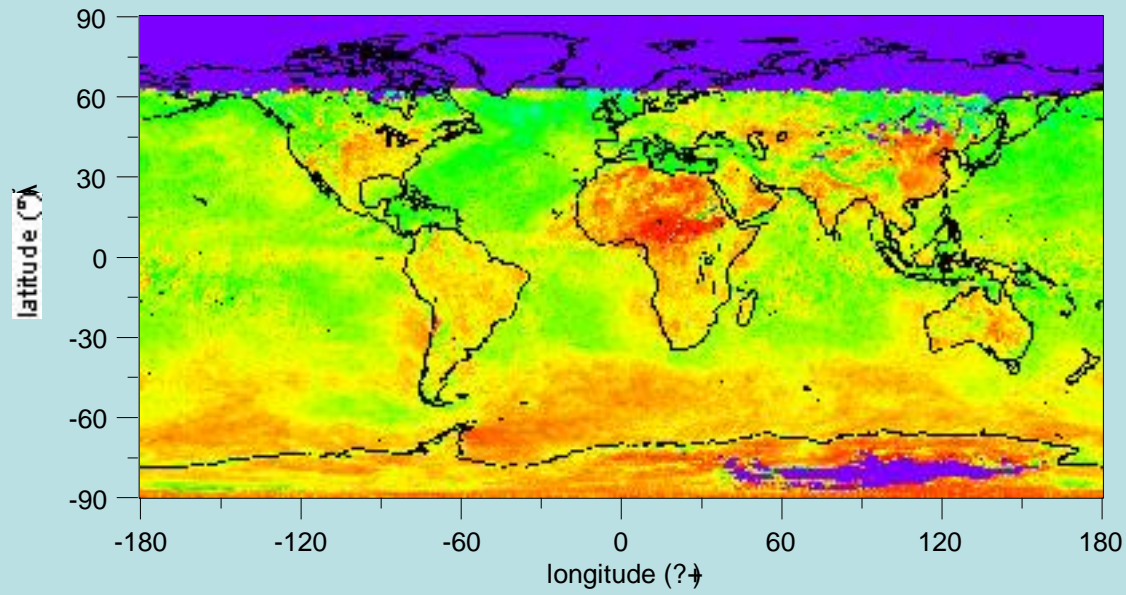
MODIS estimates of cloud inhomogeneity

- Level-3 gridded ($1^\circ \times 1^\circ$) daily (D3) data provide moments and histograms of integrated optical thickness (τ) and water path (W), based on ~ 1 km retrievals sampled at ~ 5 km

- This allows the estimation of:

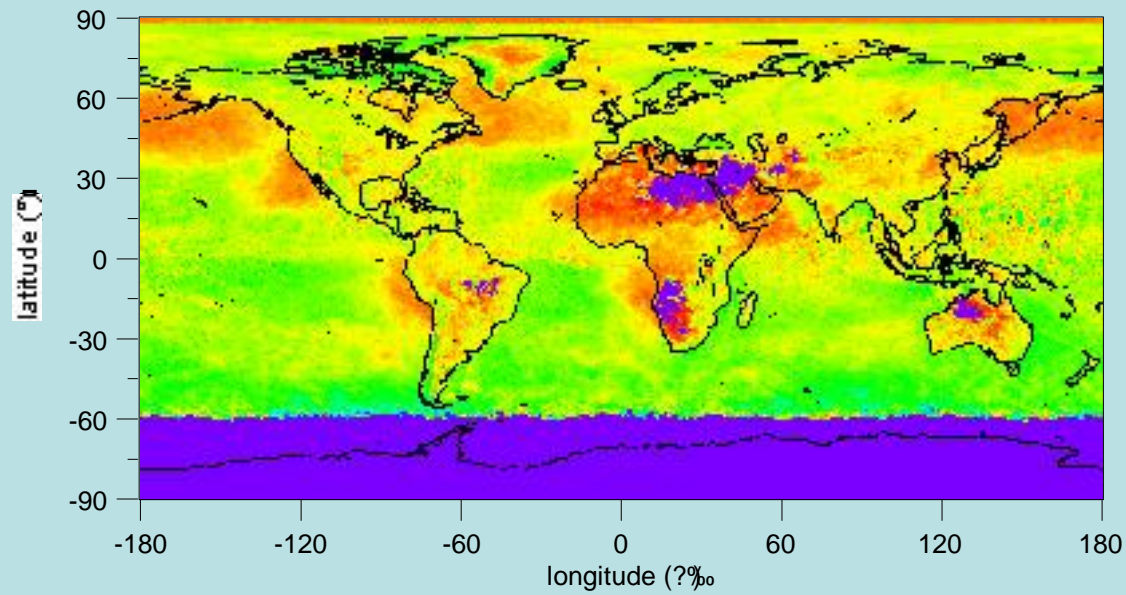
$$\begin{aligned}
 \text{MOM} &= \left(\frac{\overline{\tau^2}}{\overline{\tau}^2} \right)^2 & \text{MLE} &= \frac{1 + \sqrt{1 + 4y/3}}{4y} & (y &= \ln \overline{\tau^2} - \overline{\ln \tau}) & \chi &= \frac{e^{\overline{\ln \tau}}}{\overline{\tau}} & (q &= \tau \text{ or } W)
 \end{aligned}$$

- Two months (July 2003, January 2004) analyzed
- Both Aqua and Terra
- Separately for each cloud phase
- Average daily values to monthly scales
- Main shortcoming: variability of total column optical thickness instead of cloud layer variability needed by LSMs; still invaluable for validation
- J. of Climate paper under revision

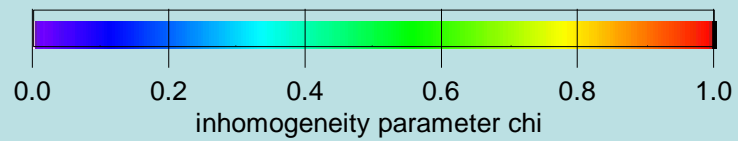


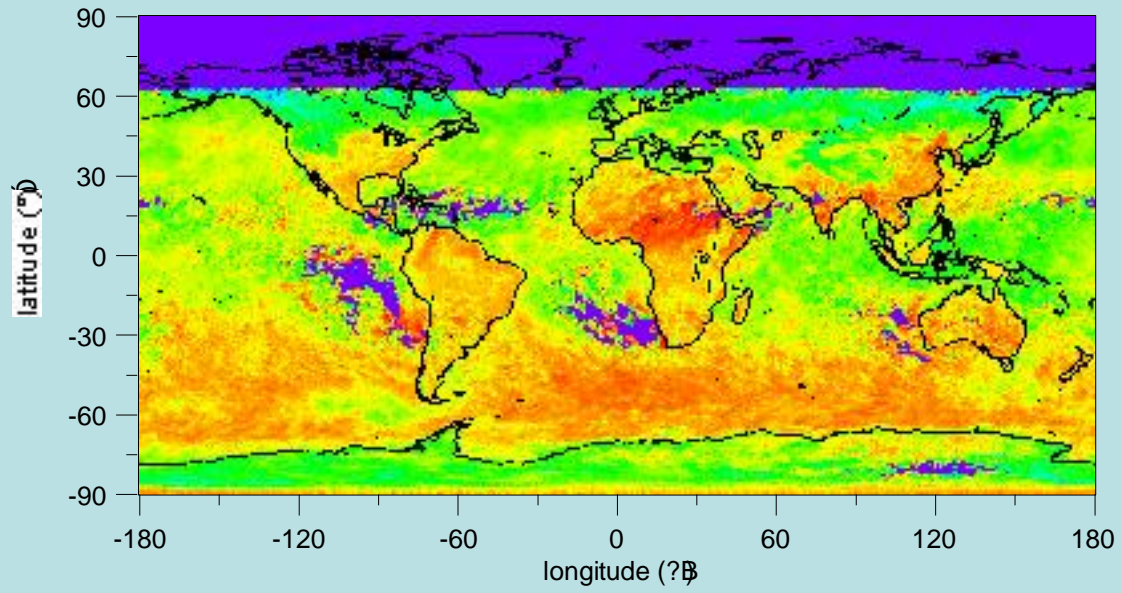
January

Terra, liquid clouds



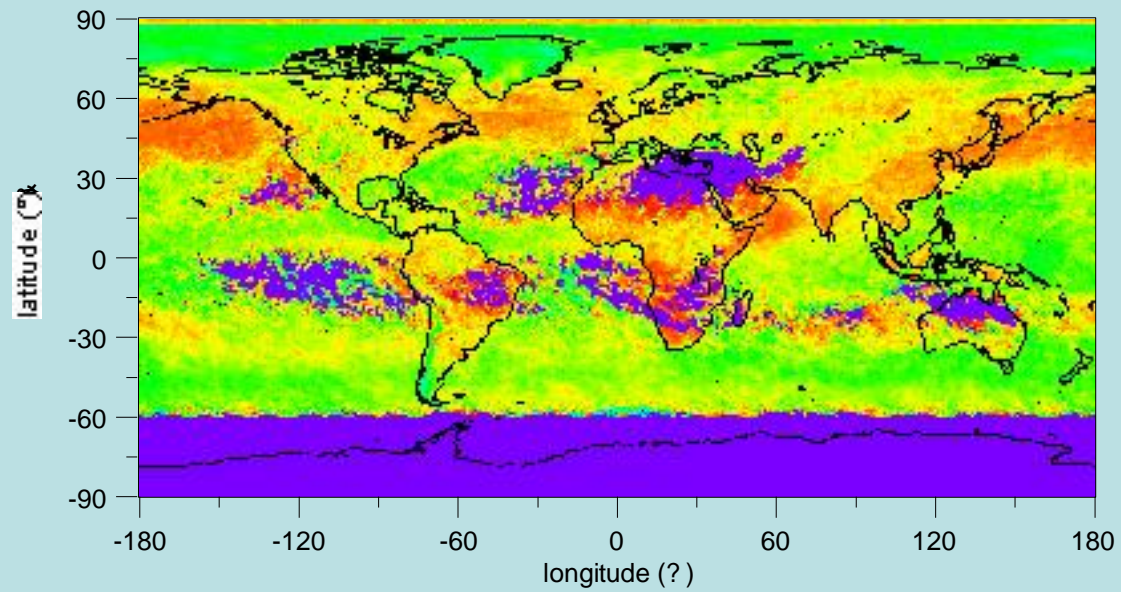
July



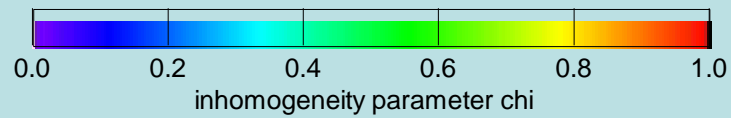


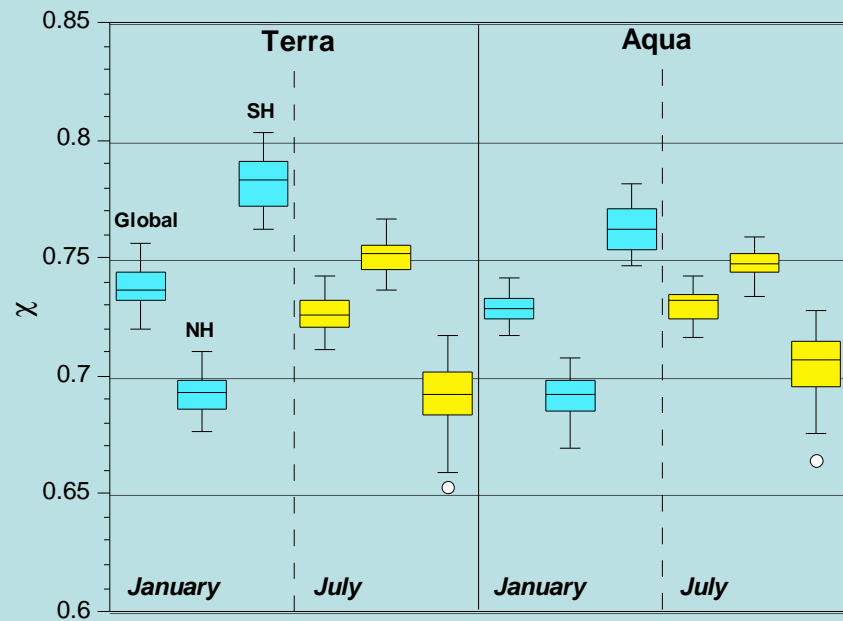
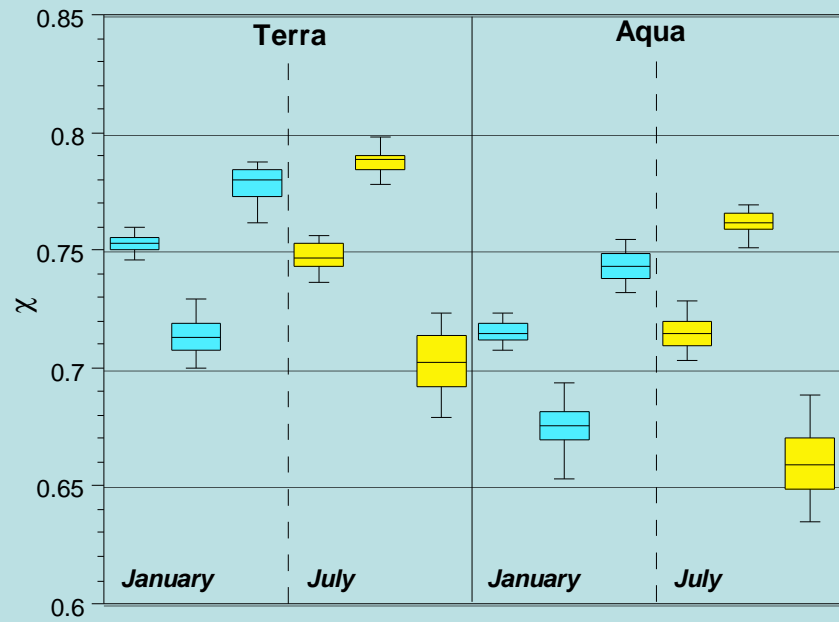
January

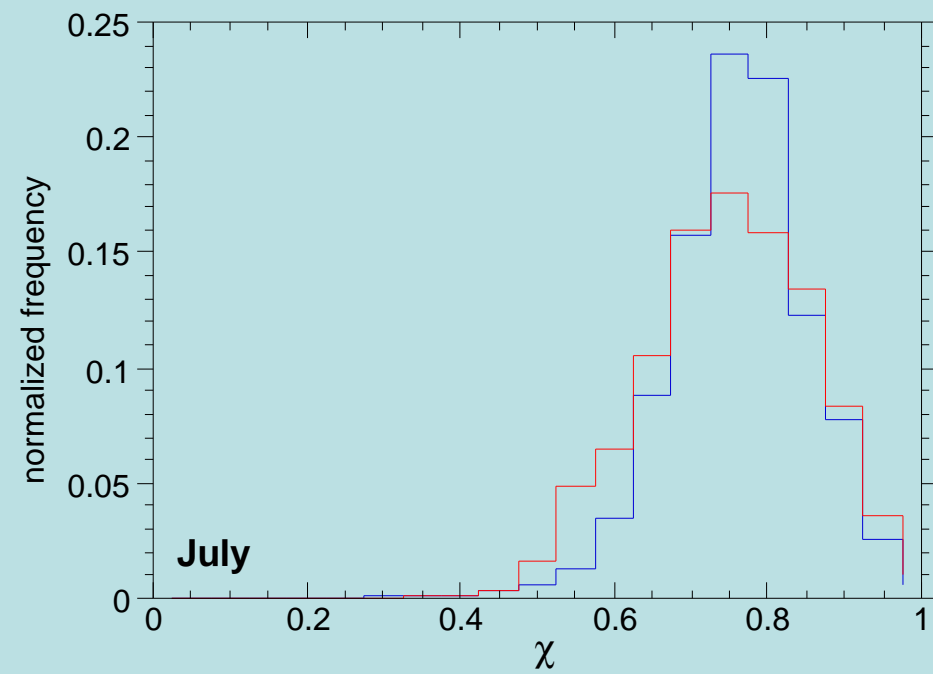
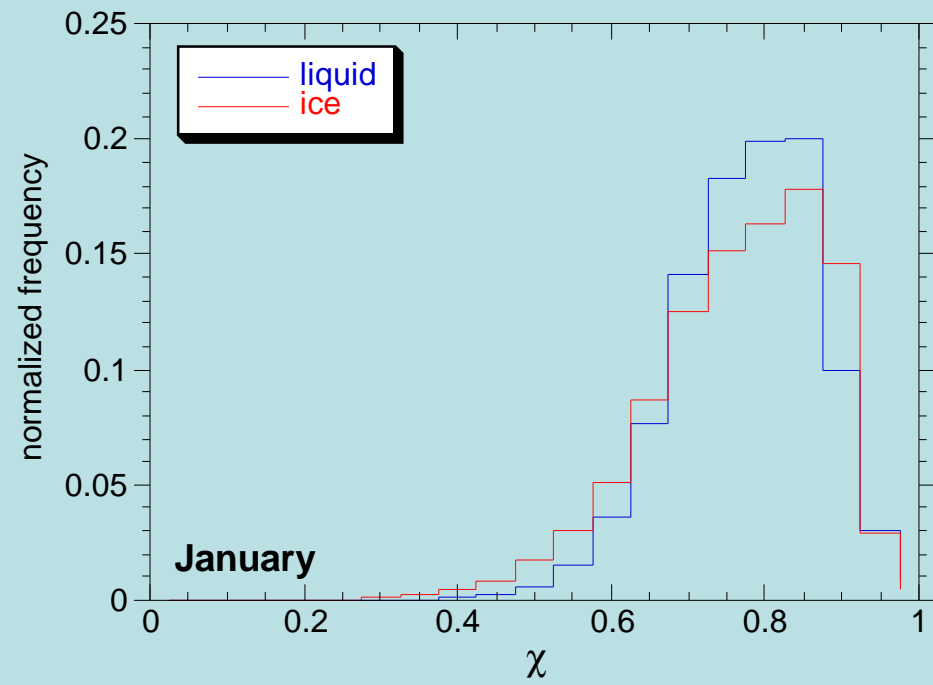
Terra, ice clouds



July

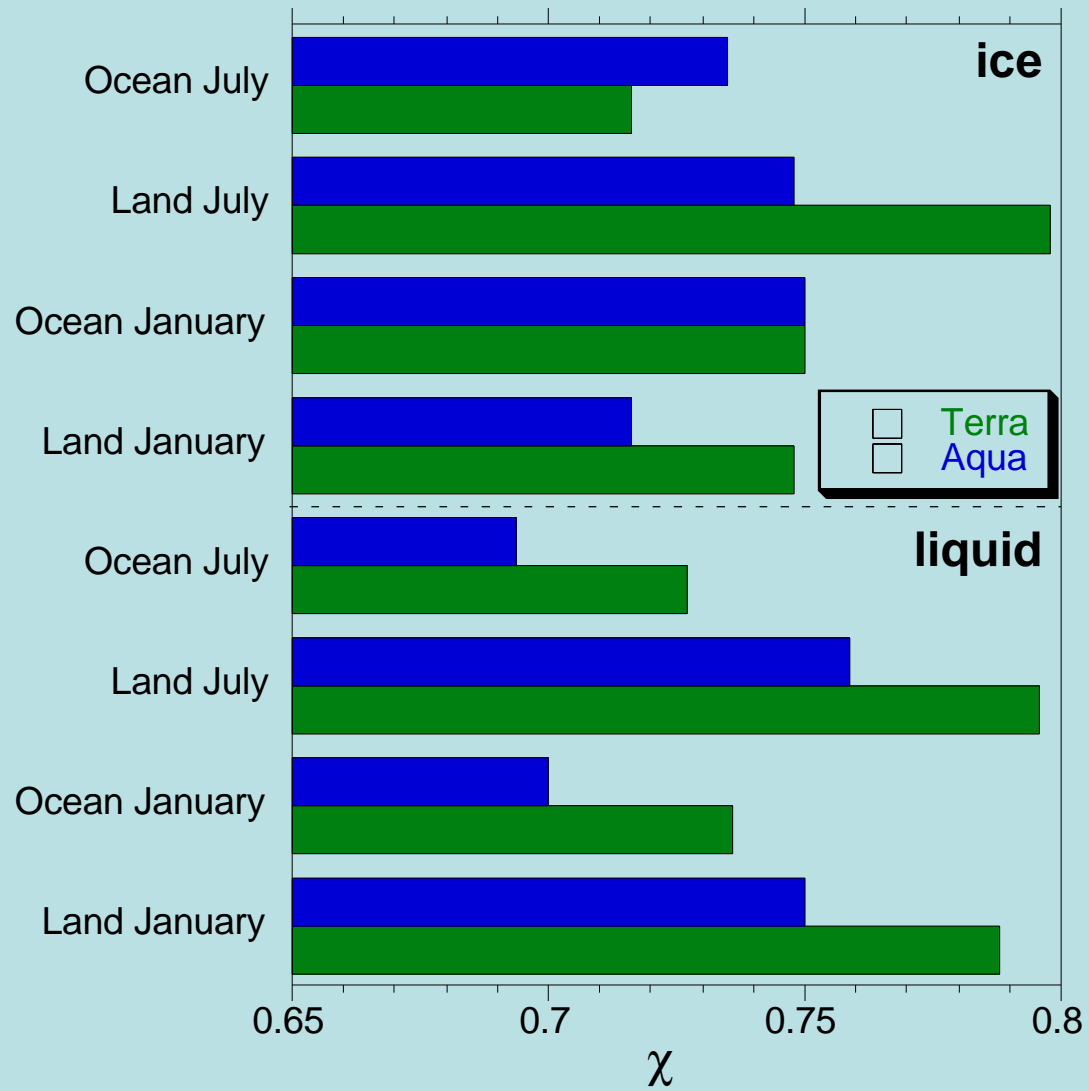




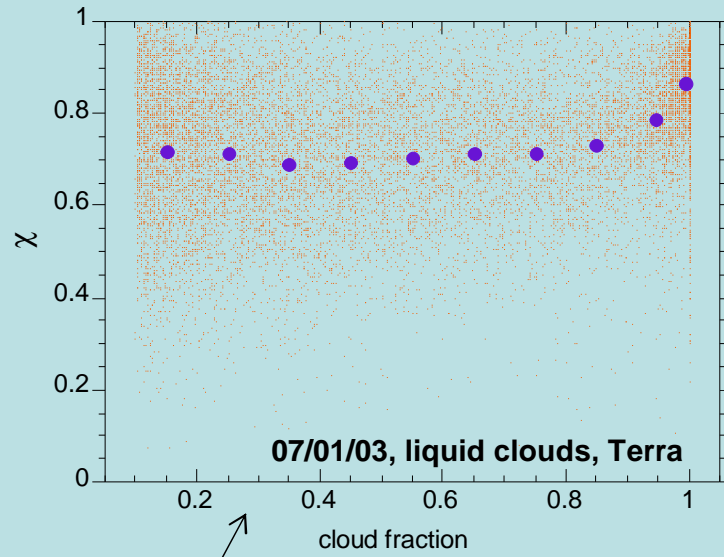


Terra

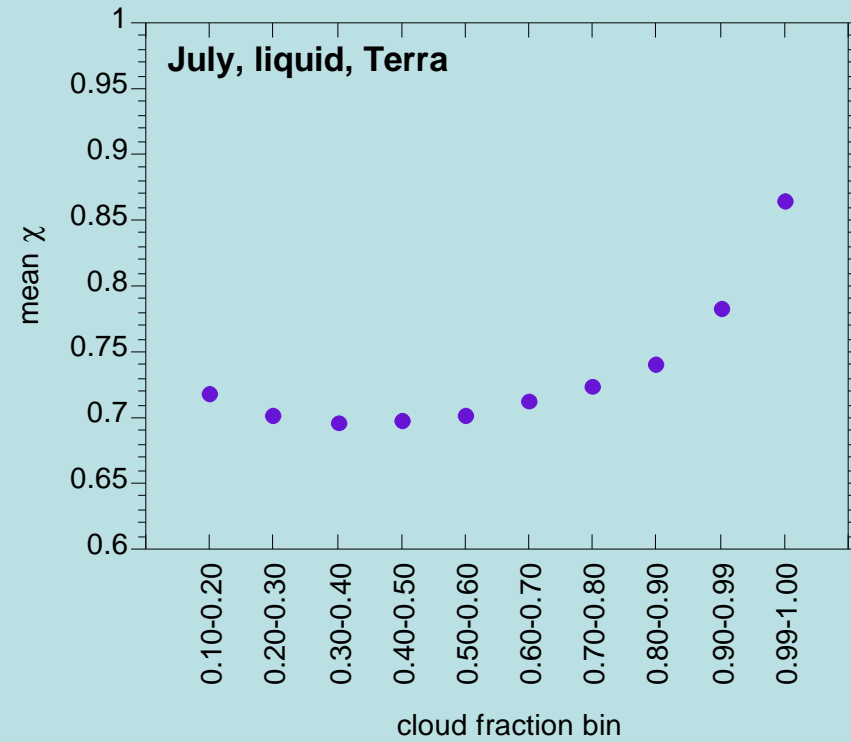
Land/Ocean and Terra/Aqua contrast



Inhomogeneity and cloud fraction



Single day



Monthly ensemble

Summary of findings

- ü Winter clouds more heterogeneous than summer clouds
- ü Marine clouds more heterogeneous than continental (liquid clouds)
- ü Afternoon clouds more heterogeneous than morning clouds (except marine ice clouds)
- ü Ice clouds greater range of inhomogeneity than water clouds
- ü Nearly overcast or overcast scenes more homogeneous

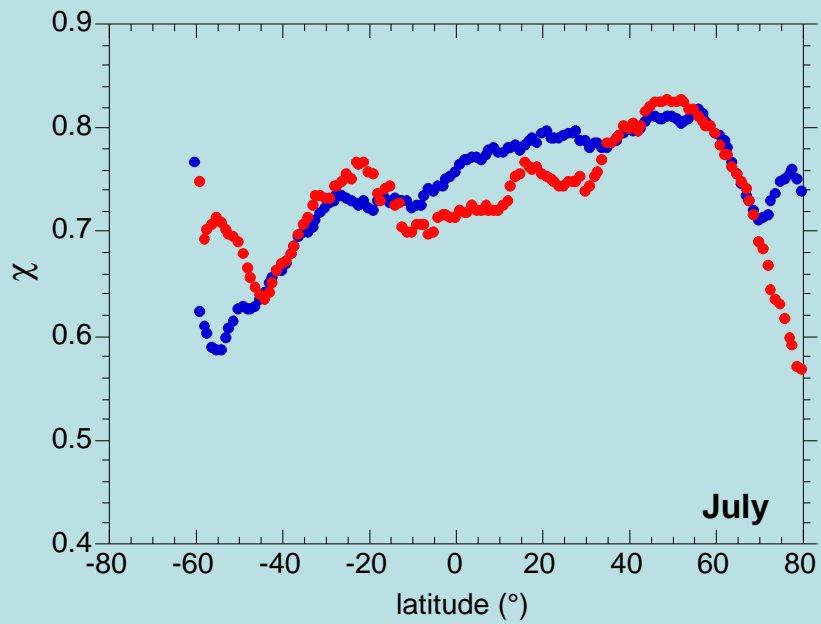
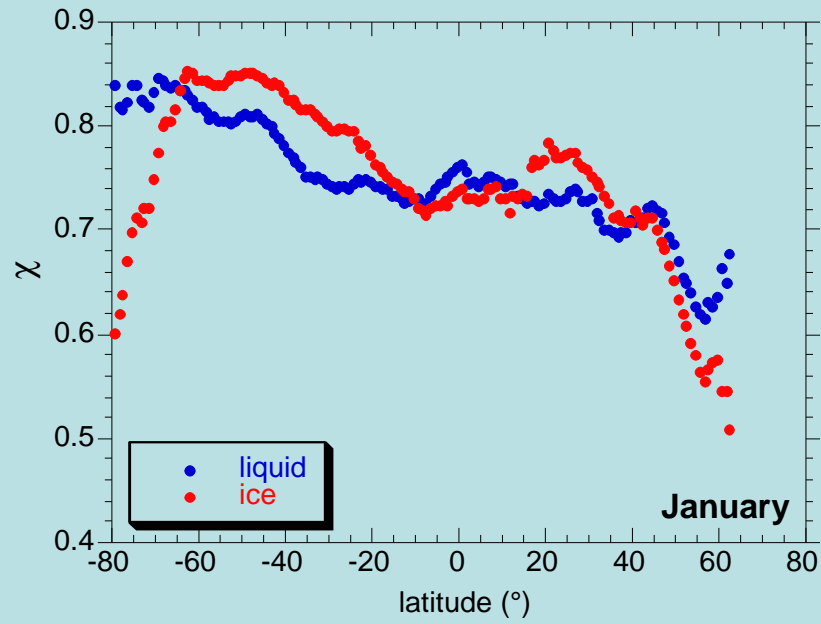
More things to do

§ Analysis of a full annual cycle

§ Detailed examination of regions of special interest

§ Composites of inhomogeneity in different dynamical regimes

§ Estimate global radiative bias of homogeneous approximation



Terra