Aerosol indirect effects: Assessments from satellite data

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Satellite instruments

POLDER-2

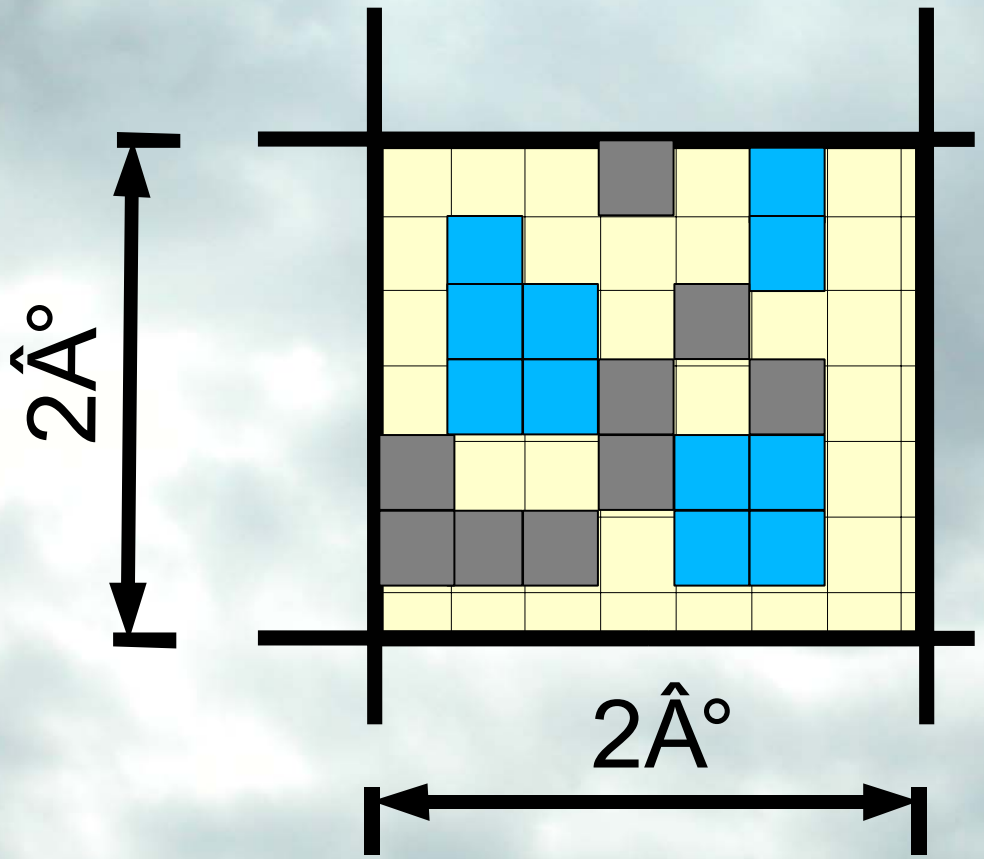
April-October **2003**
on ADEOS-2 (**10.30 a.m.**)
cloud and **aerosol** quantites

MODIS

here: for **2003**
on TERRA (**10.30 a.m.**)
cloud and **aerosol** quantities

daily and 1°x1° spatial resolutions

Relating aerosols and clouds



Aerosol measurements

Cloud measurements

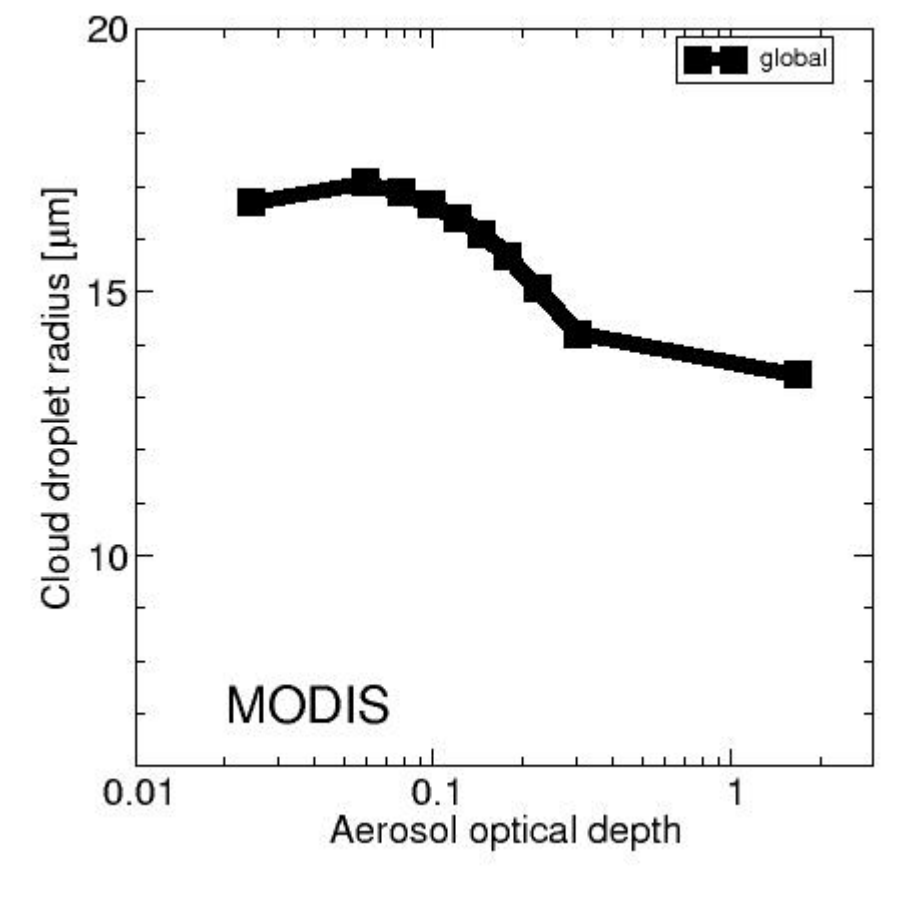
No retrieval

Method adopted:
relate aerosol and cloud quantities within a 2°x2° gridbox (daily values)

Max. # points:
MODIS: 180x90x365 = 6×10^6
POLDER: 180x90x214 = 3×10^6

Choice of 2° resolution:
- typical for GCMs
- res. of POLDER CDR retrieval

Droplet radius - AOD



MODIS cloud data:
- quality-assured
- for liquid clouds

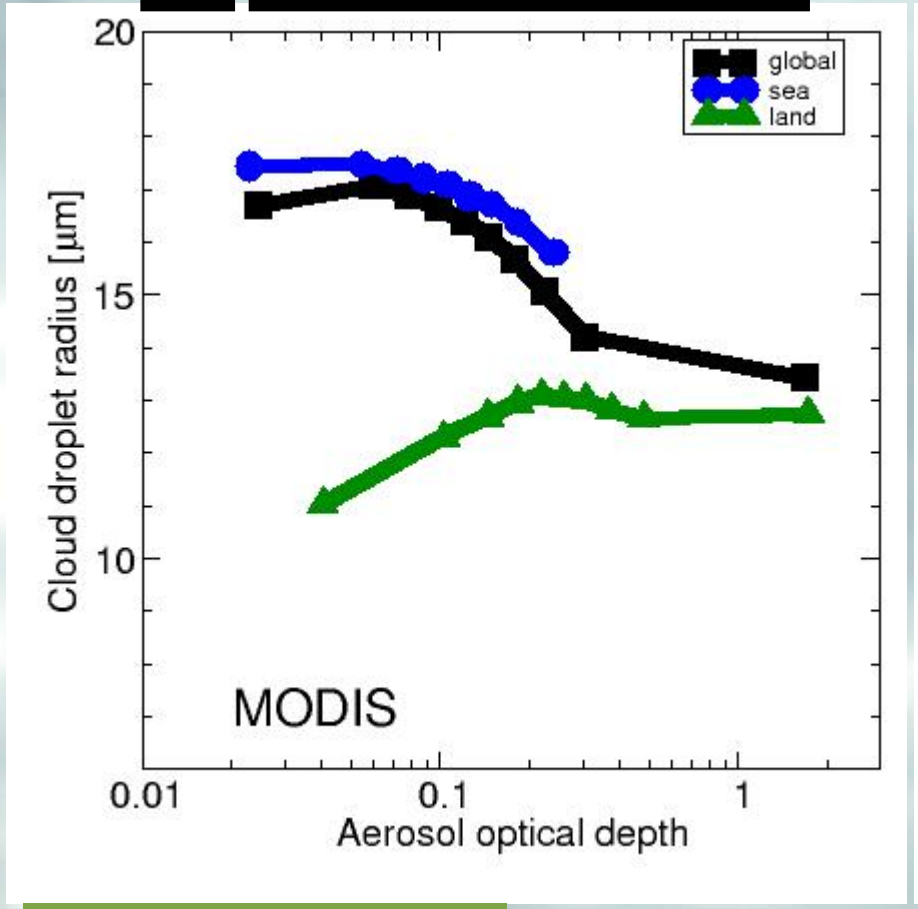
MODIS aerosol data:
- quality-assured
- AOD @ 550nm

Relation cloud – AOD
- 10 AOD bins
- chosen so that equal # of retrievals within each bin

Where and when
do we find correlations between aerosol and cloud properties?

1. Total / Sea / Land
2. Globe / NH / Tropics / SH
3. MODIS / POLDER

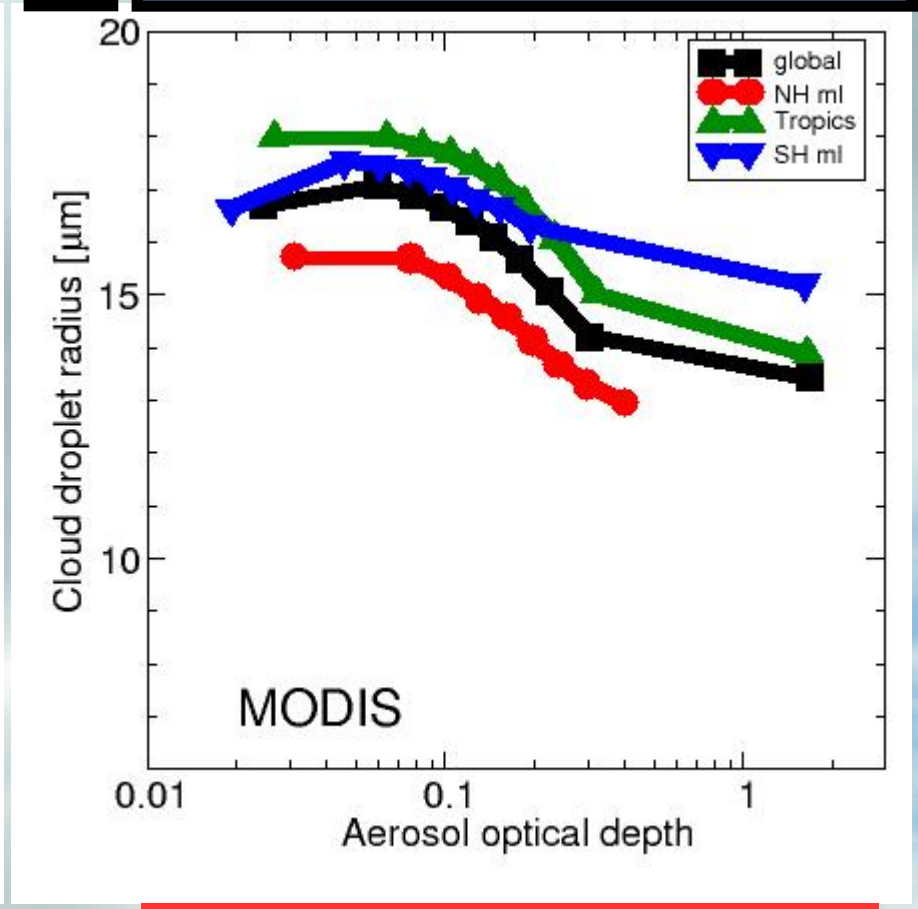
1. Total / Sea / Land



Land: 2×10^5 points

Sea: 8×10^5 points

2. Globe / NH / Tropics / SH

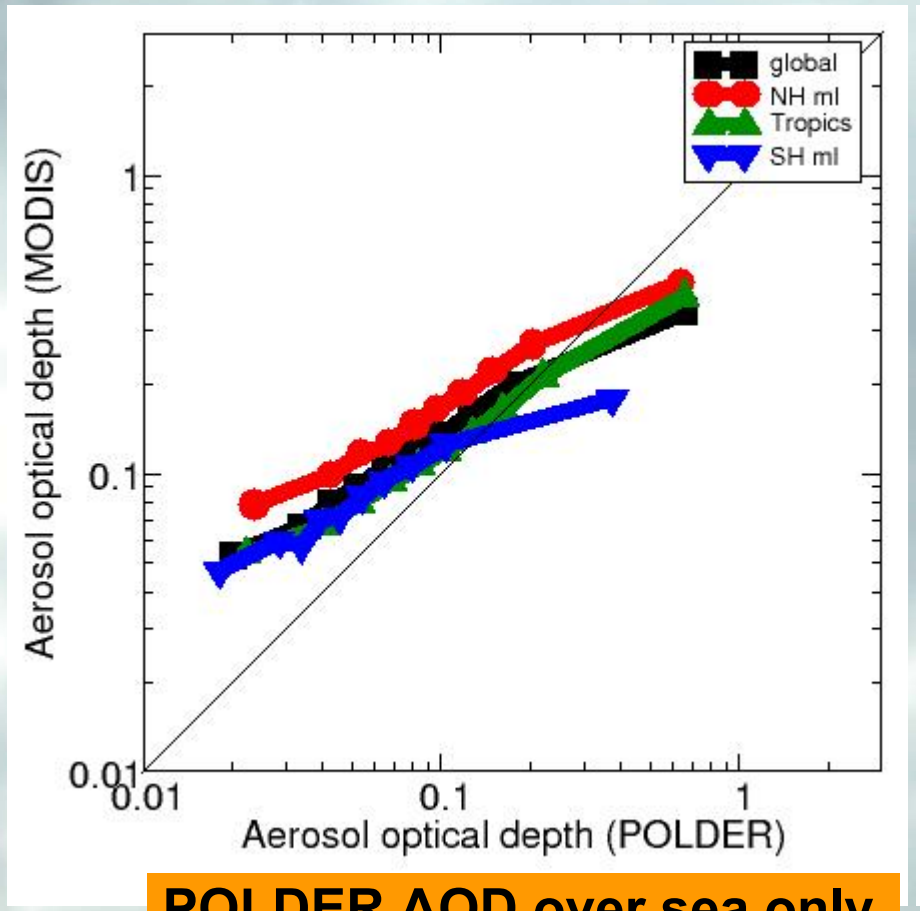


NHml (30-60N): 3×10^5 points

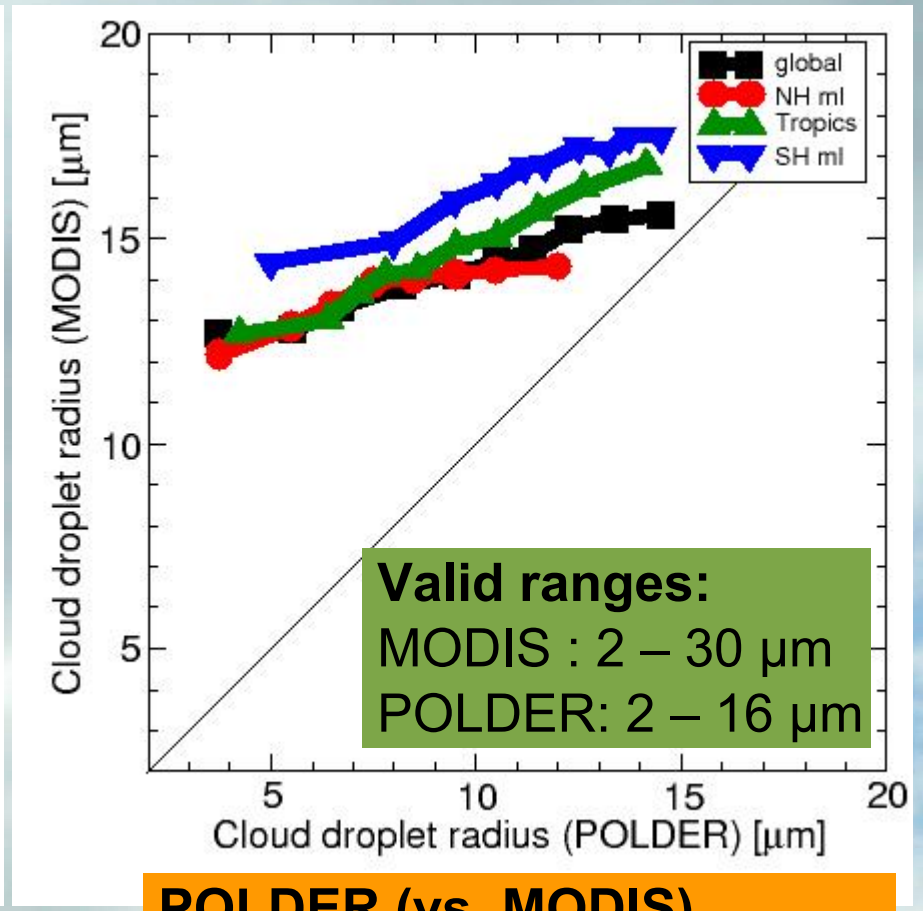
Tropics (30S-30N): 3×10^5 pts

SHml (60-30S): 3×10^5 points

3. MODIS / POLDER / combined

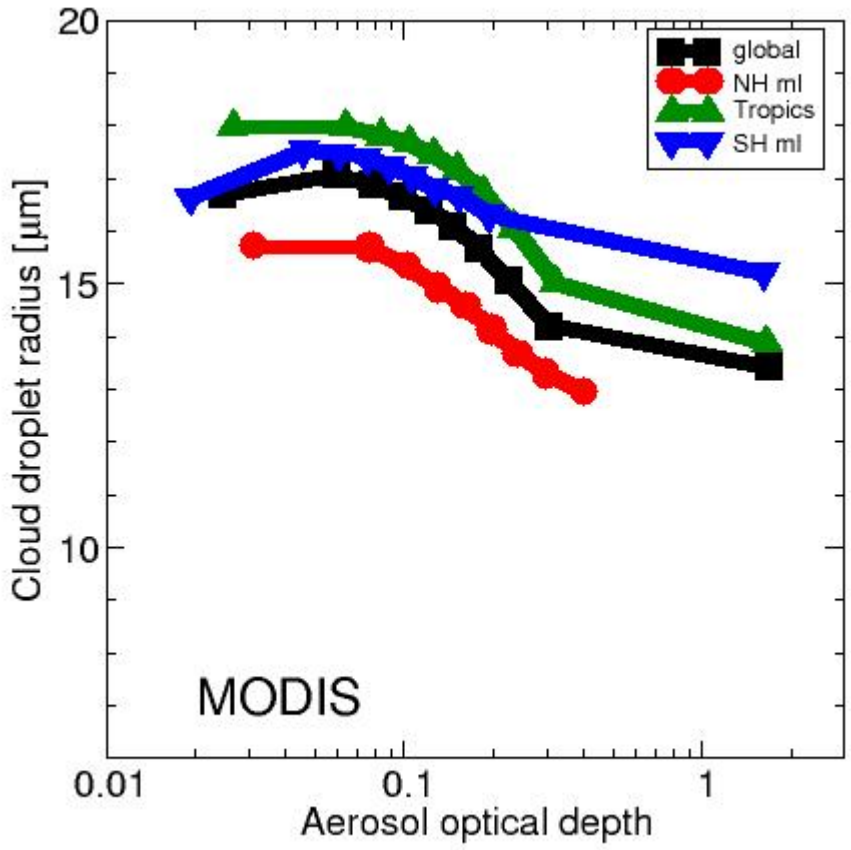


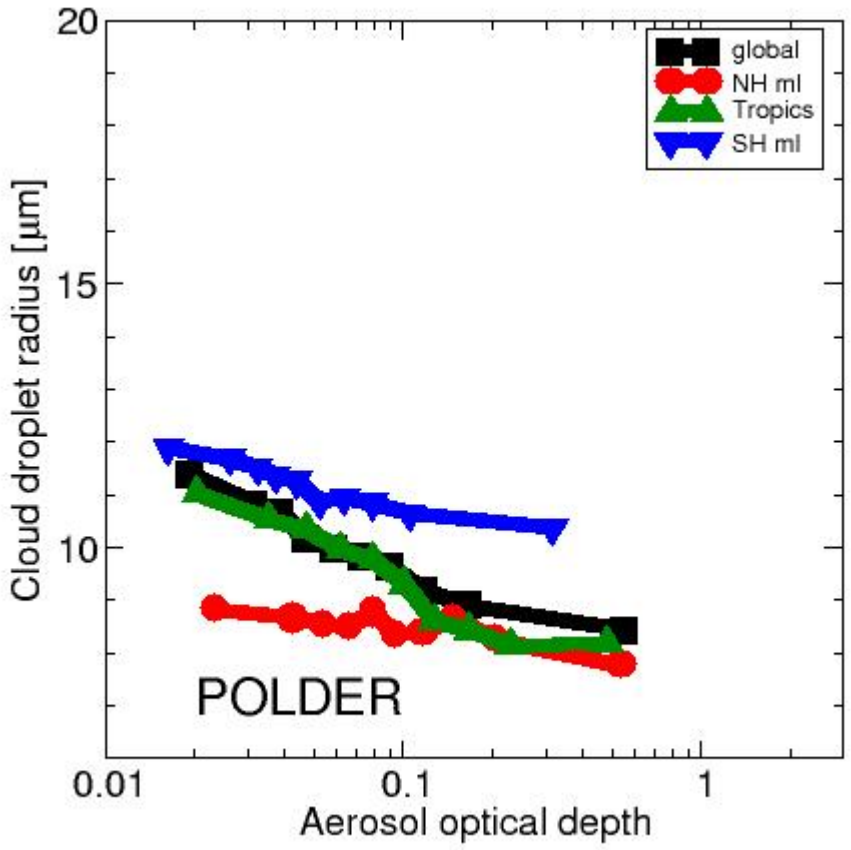
POLDER AOD over sea only



Valid ranges:
MODIS : 2 – 30 µm
POLDER: 2 – 16 µm

POLDER (vs. MODIS)
+ definitely only liquid droplets
- only homogeneous clouds @150x150 km²


20
15
10
Cloud droplet radius [µm]
global
NH ml
Tropics
SH ml
MODIS
0.01
0.1
1
Aerosol optical depth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Cloud droplet radius [µm]
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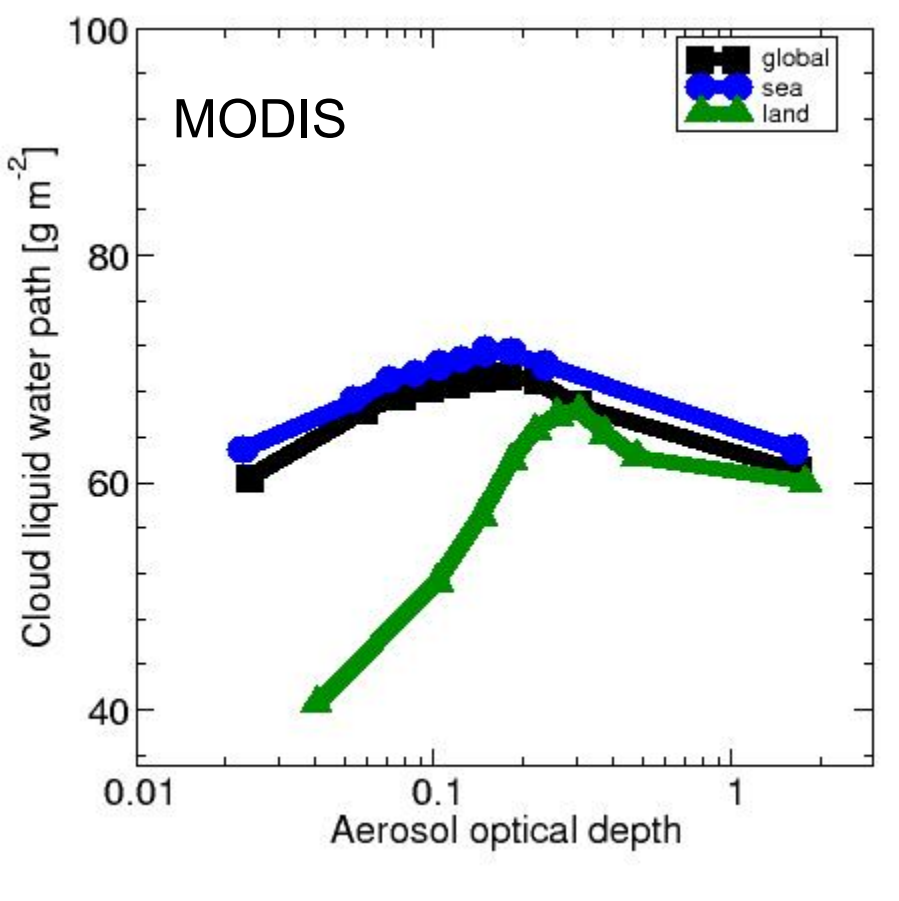
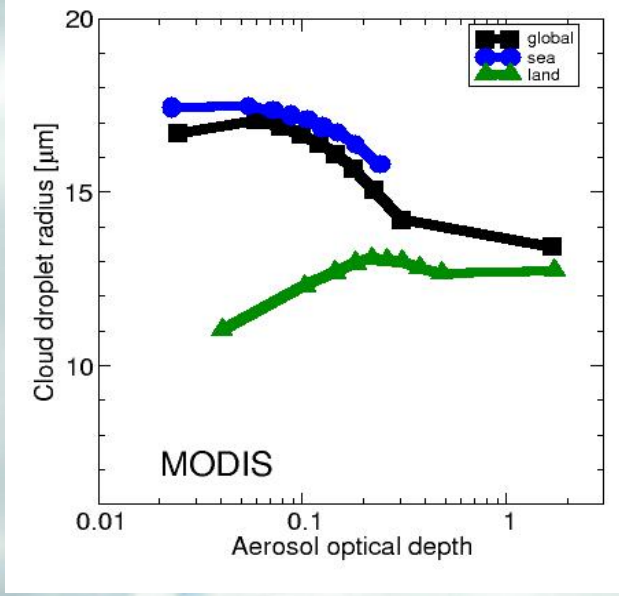
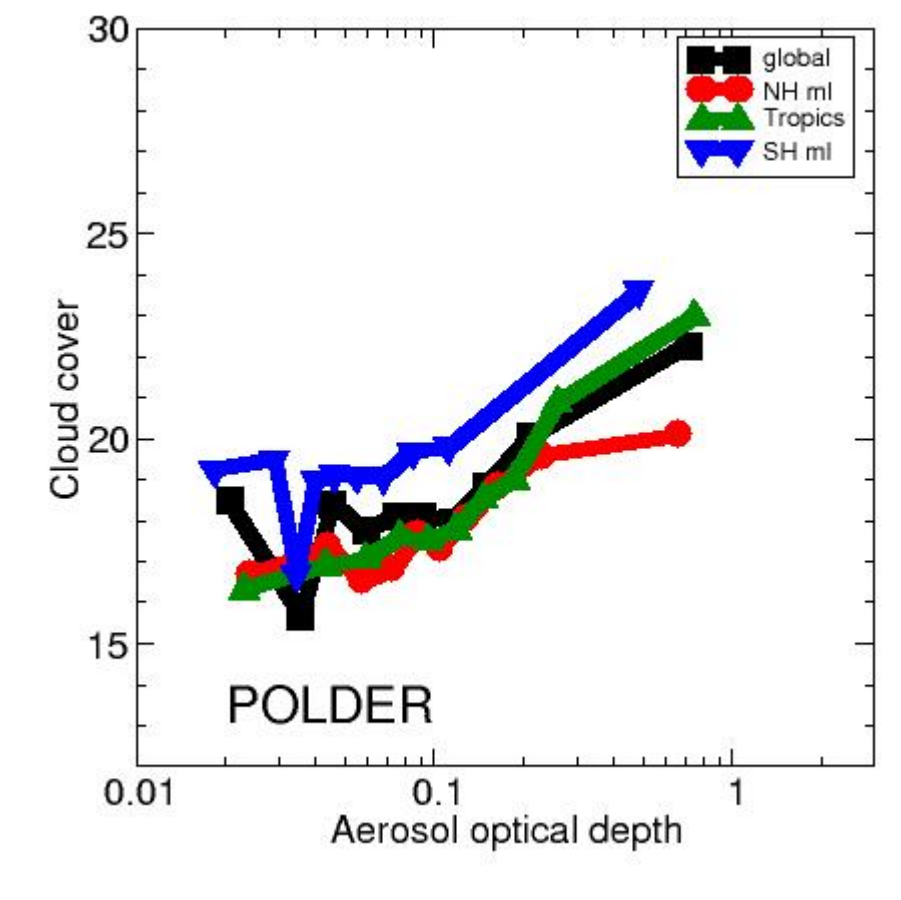


Second indirect effect?

- much steeper increase over land!
- reason for increasing CDR over land?





Second indirect effect?

Conclusions

MODIS

- **CDR – AOD**: negative relationship over oceans (positive over land and for very small AOD)

POLDER

AOD : MODIS > POLDER (except for very large AOD)
CDR : MODIS >> POLDER (strongest for small CDR)

CDR – AOD: Always negative relations (over oceans, also for small AOD)

MODIS

LWP – AOD: Positive relationship (especially over land! Explanation for positive CDR-AOD relation?)

POLDE

R**CC – AOD**: Positive relationship (except for small AOD, SH)

2nd AIE?

Next steps:

Confirmation for LWP-AOD relationship from other data?

Modeling studies: LWP-AOD and CC-AOD relationships due to **2nd indirect effect**?

Satellite data / Combination of satellite-model: Estimate of **radiative forcings**

Thank you.

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