onsiderations of Habit Effect in the re
ice cloud properties using satellit

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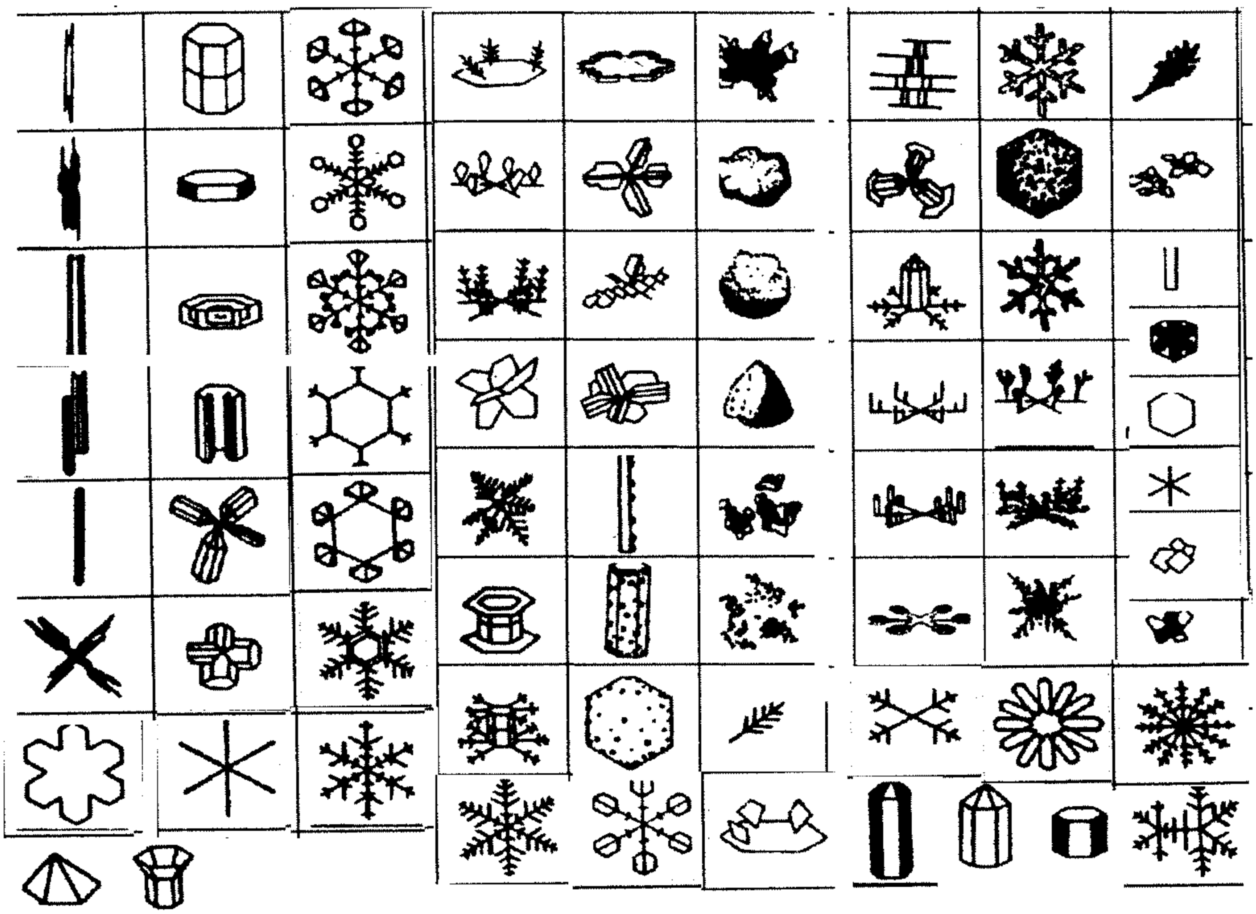
ABSTRACT

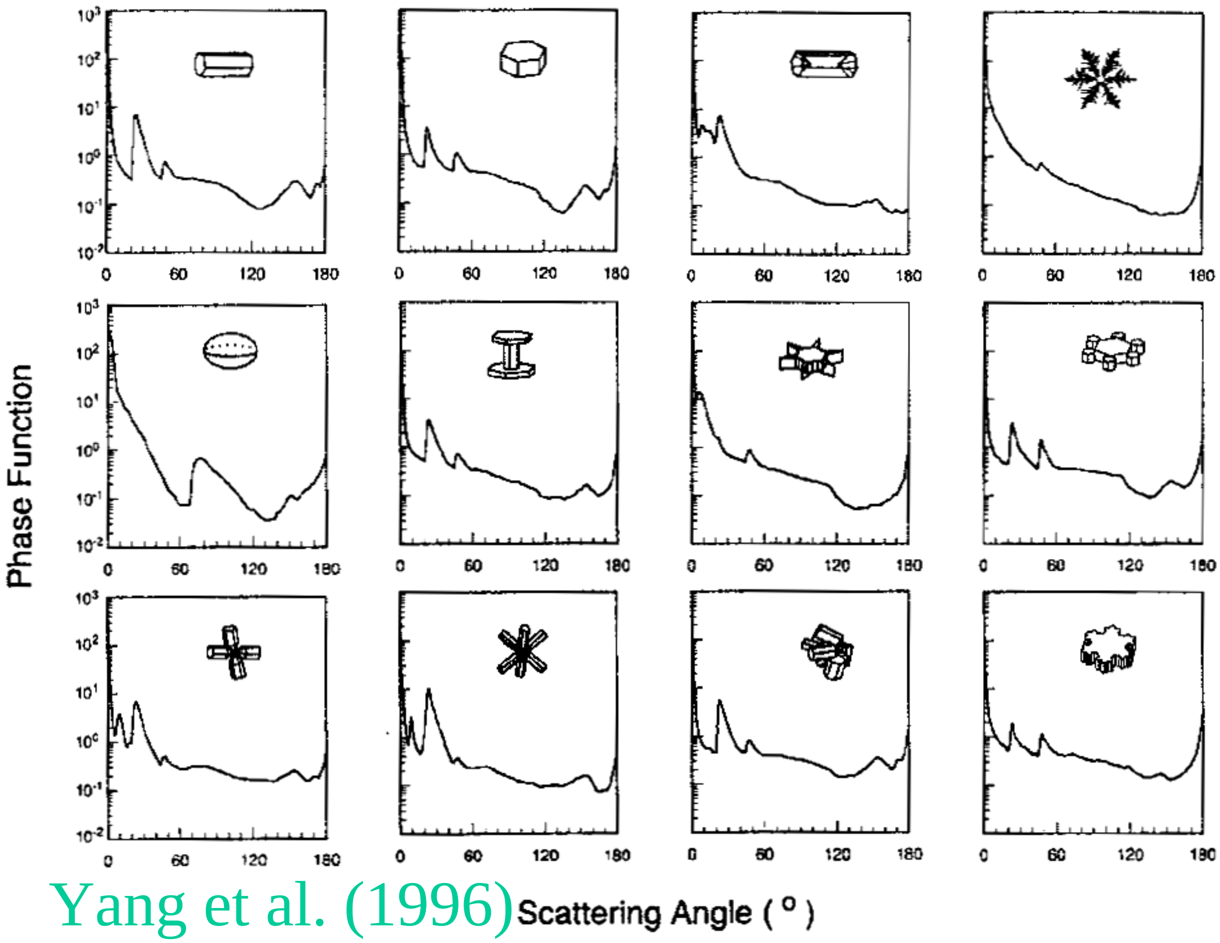
Uncertainties in radiative properties caused by ice crystal habits are significant, whose impacts are not restricted to remote sensing. This uncertainty influence areas such as ADM, cloud parameterization and results of in situ measurements. We have used different approaches to investigate ways of narrowing the uncertainties of ice crystal habits. The results show tha the CERES biaxial data is a very promising candidate.

Part of the Observed Shapes in Ice Clouds



- **A wide variety of ice crystal shapes exists in ice clouds**

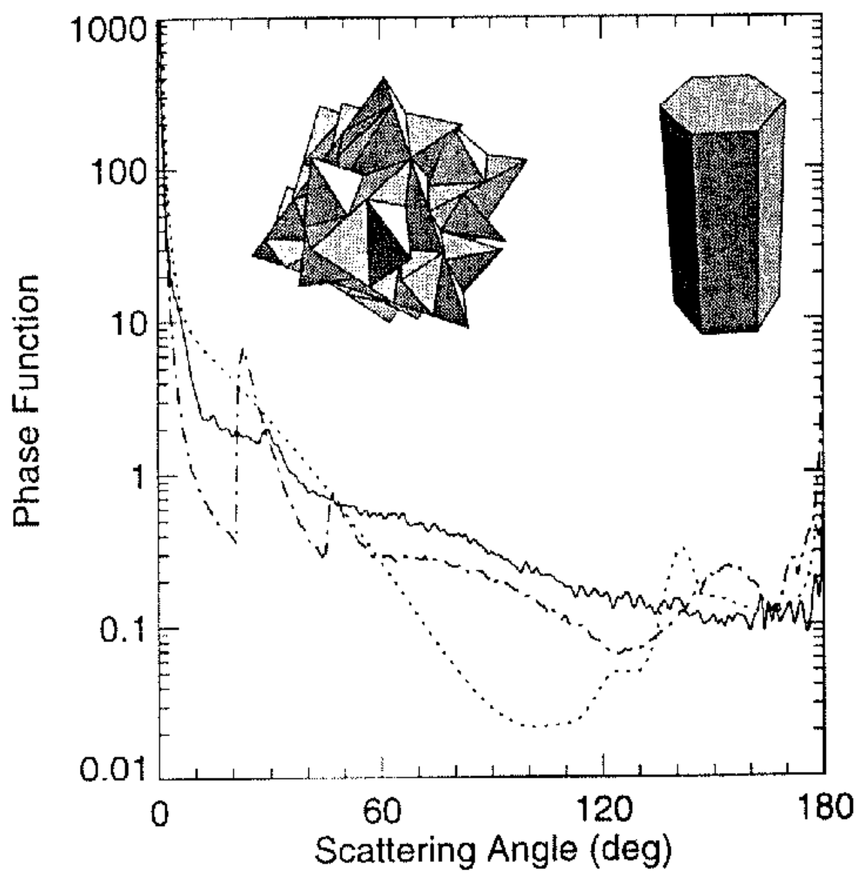
Significant advances have been made in calculating radiative properties of Non-spherical particles



Yang et al. (1996)

- **The problem is when to use which habit in applications**

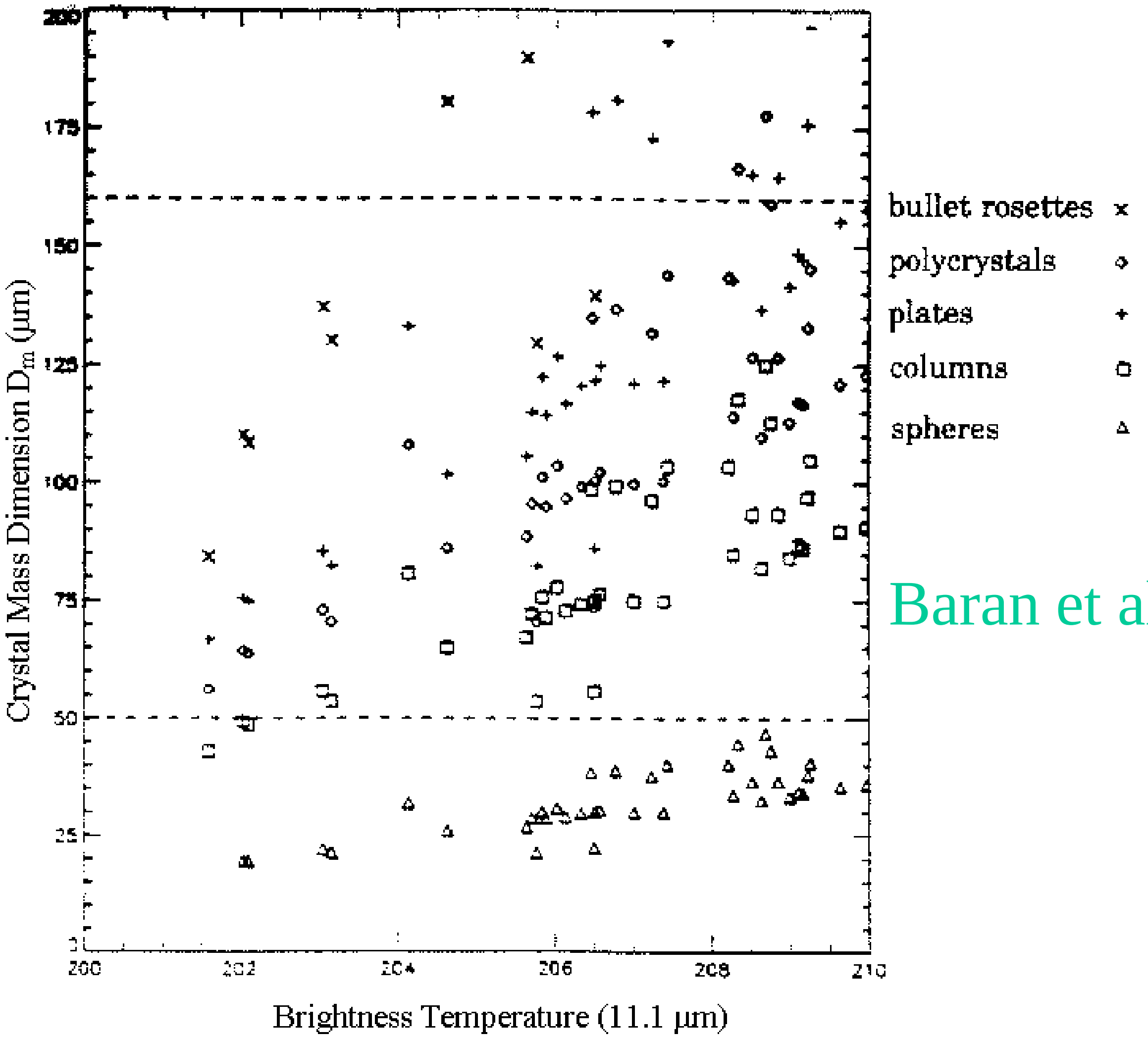
Variations in Habits cause difficulties in Remote Sensing(I



Mishchenko et al. (1996)

- **Uncertainties in retrieved optical thickness is a factor of 3~4**

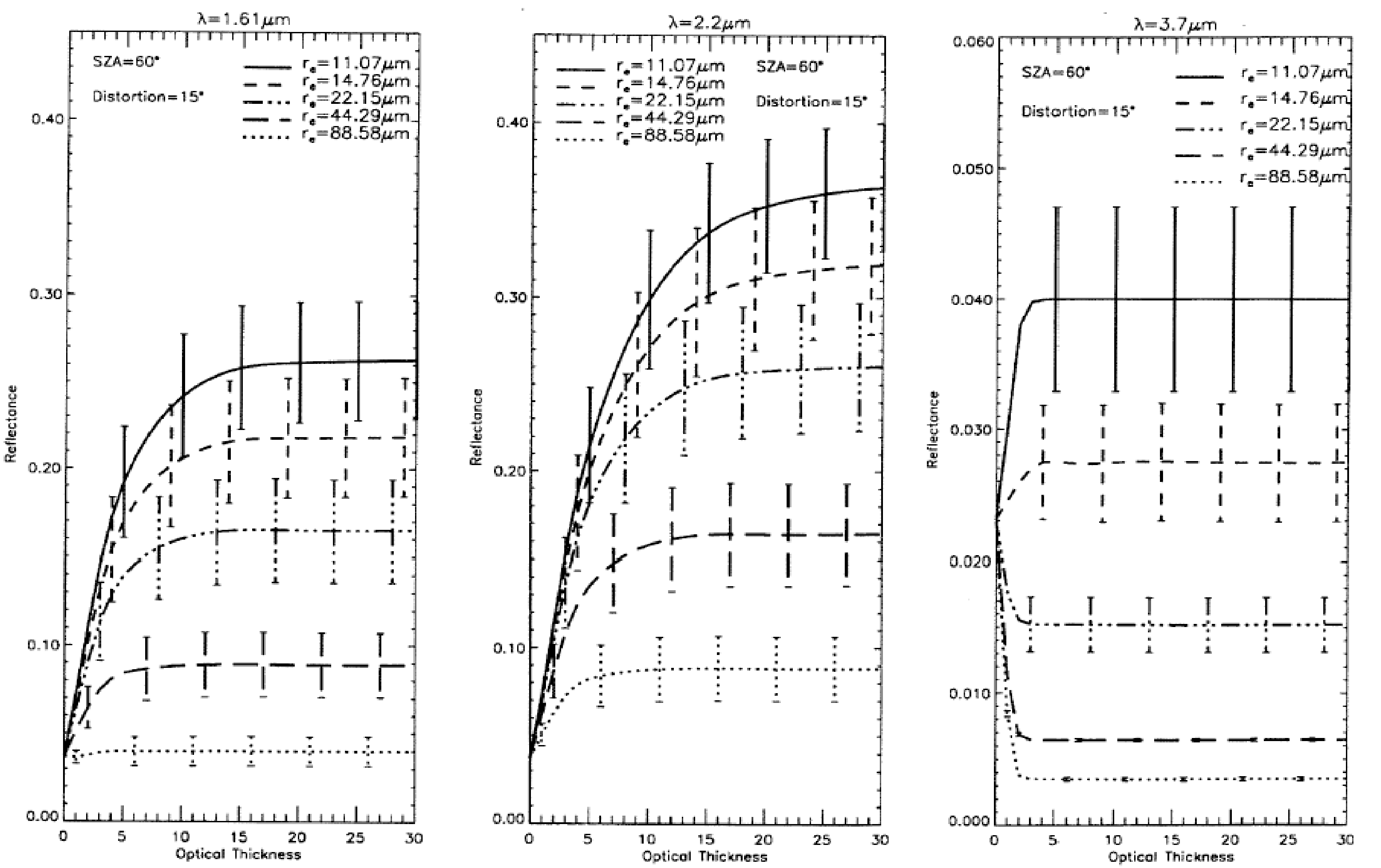
Habit assumption leads to uncertainties in Remote Sensing(II)



Baran et al. (1998)

- **Uncertainties of retrieved size using 8 and 11 μm are large**

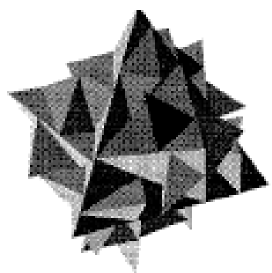
Habit assumption leads to uncertainties in Remote Sensing(I



- **Uncertainties of the retrieved r_e using 1.6, 2.2 and 3.7 μm**

What are habit assumptions used in satellite retrievals?

ISCCP



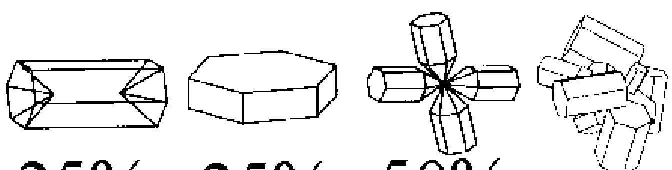
Rossow et al. (1996)

g: 0.75

POLDER: Modified VVP (Doutriaux-Boucher et al. 2000)

g: 0.75, 0.81

MODIS



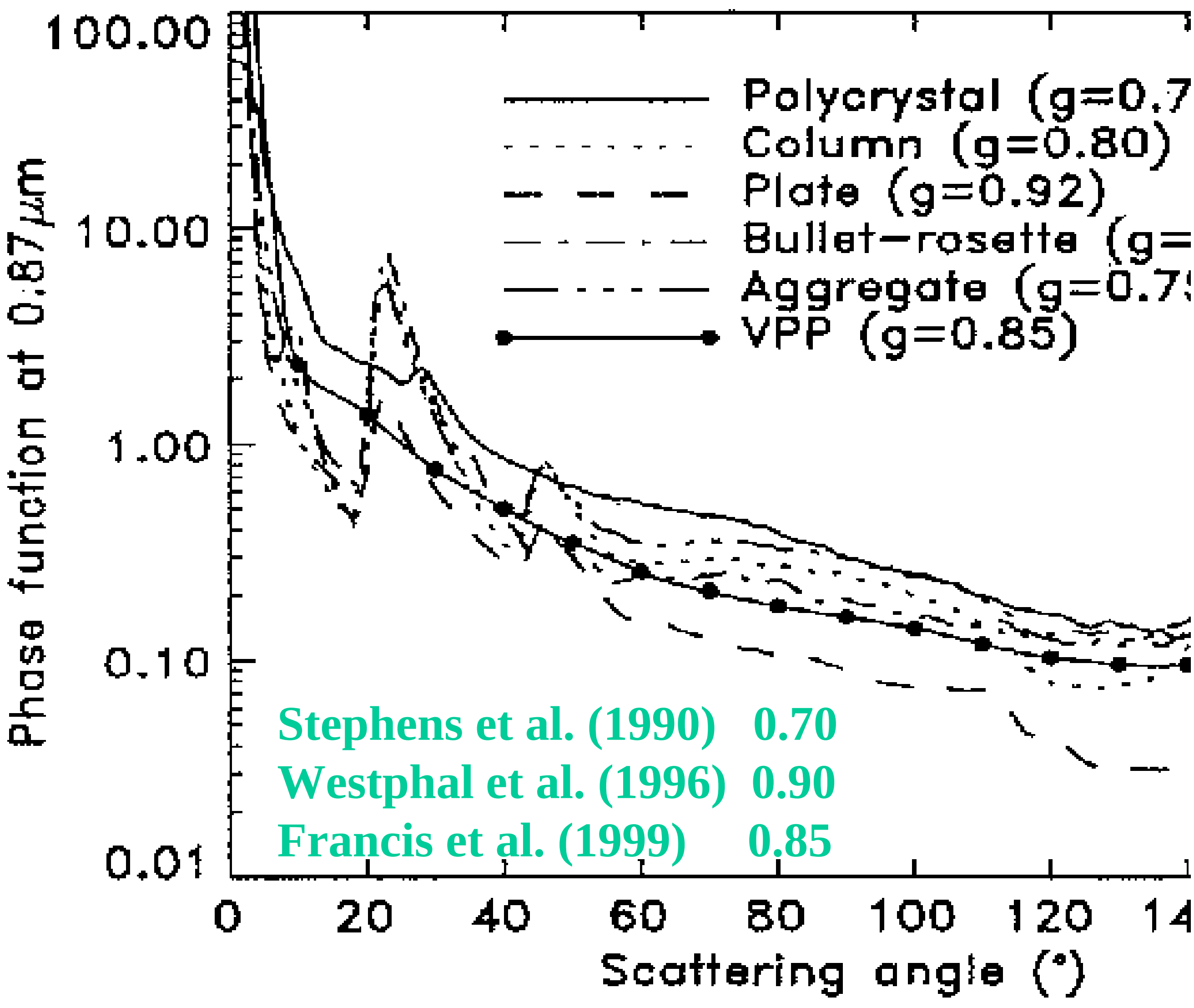
D<70 μm	25%	25%	50%	
D>70 μm	30%	20%	20%	30%

Baum et al. 2000

g: 0.75 – 0.85

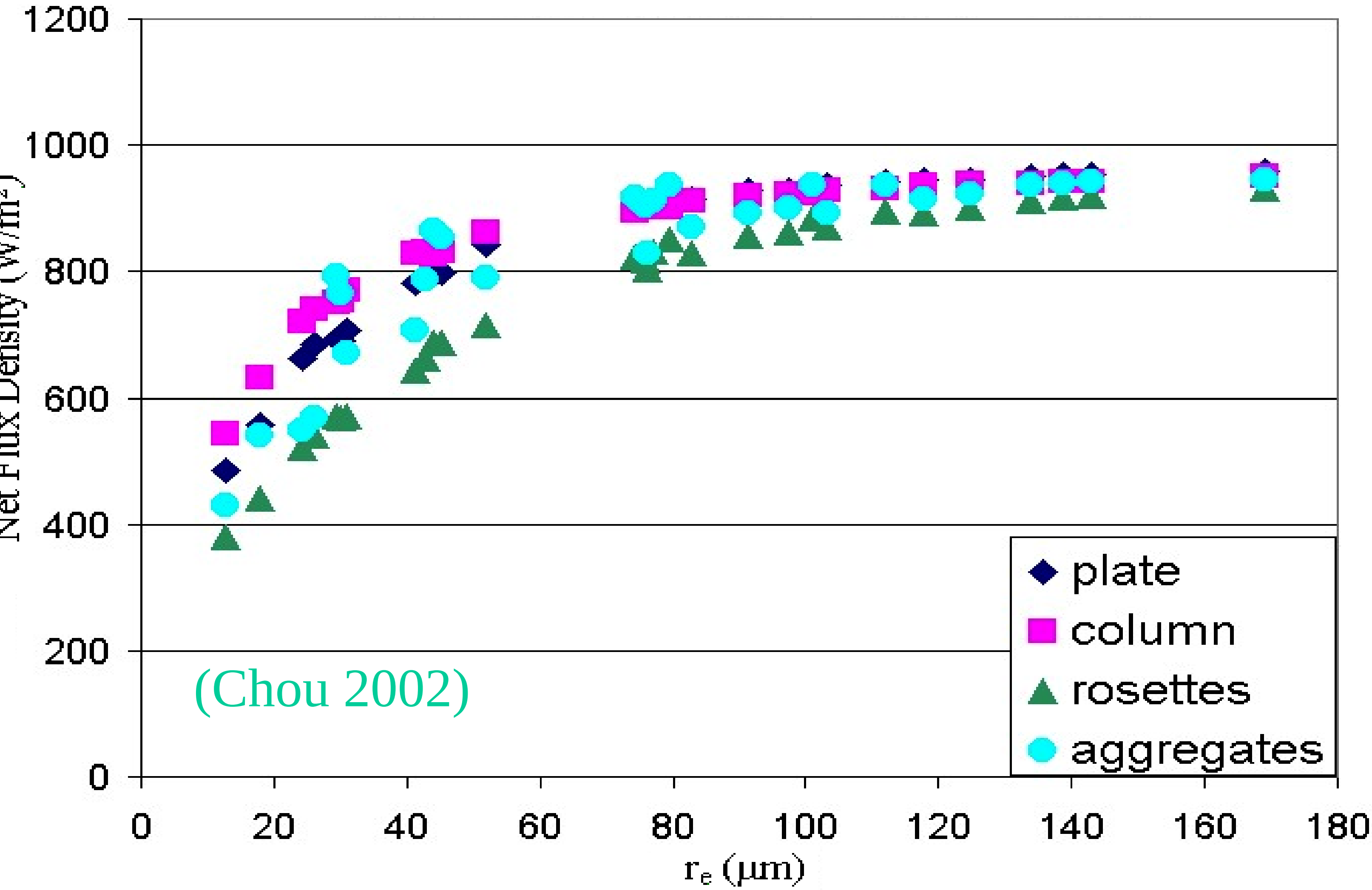
• In all algorithms, one habit assumption is used for all ice-clouds

Habit variations in mid-latitude regions



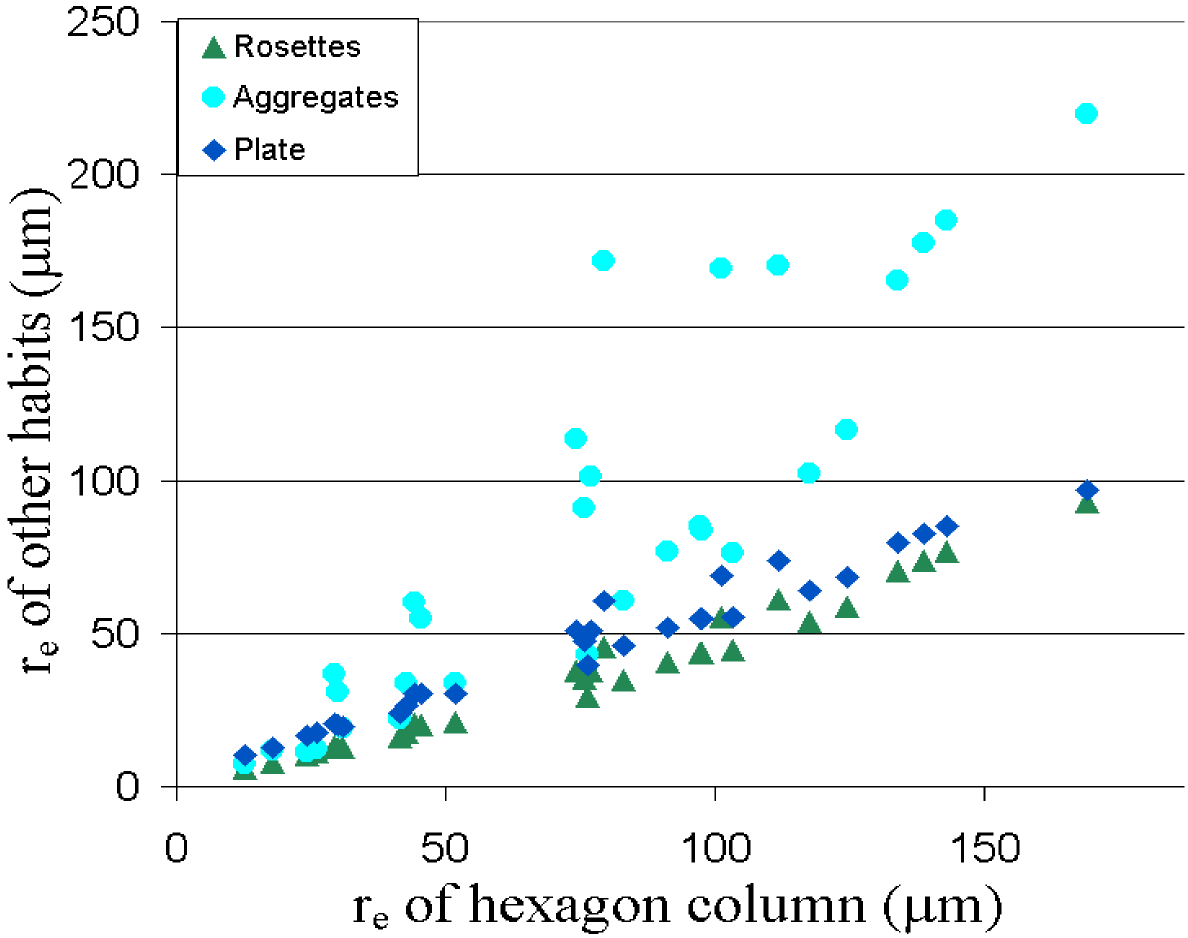
- Even for midlatitude, the habit variation range is large

Habit Influence on the downward net flux density



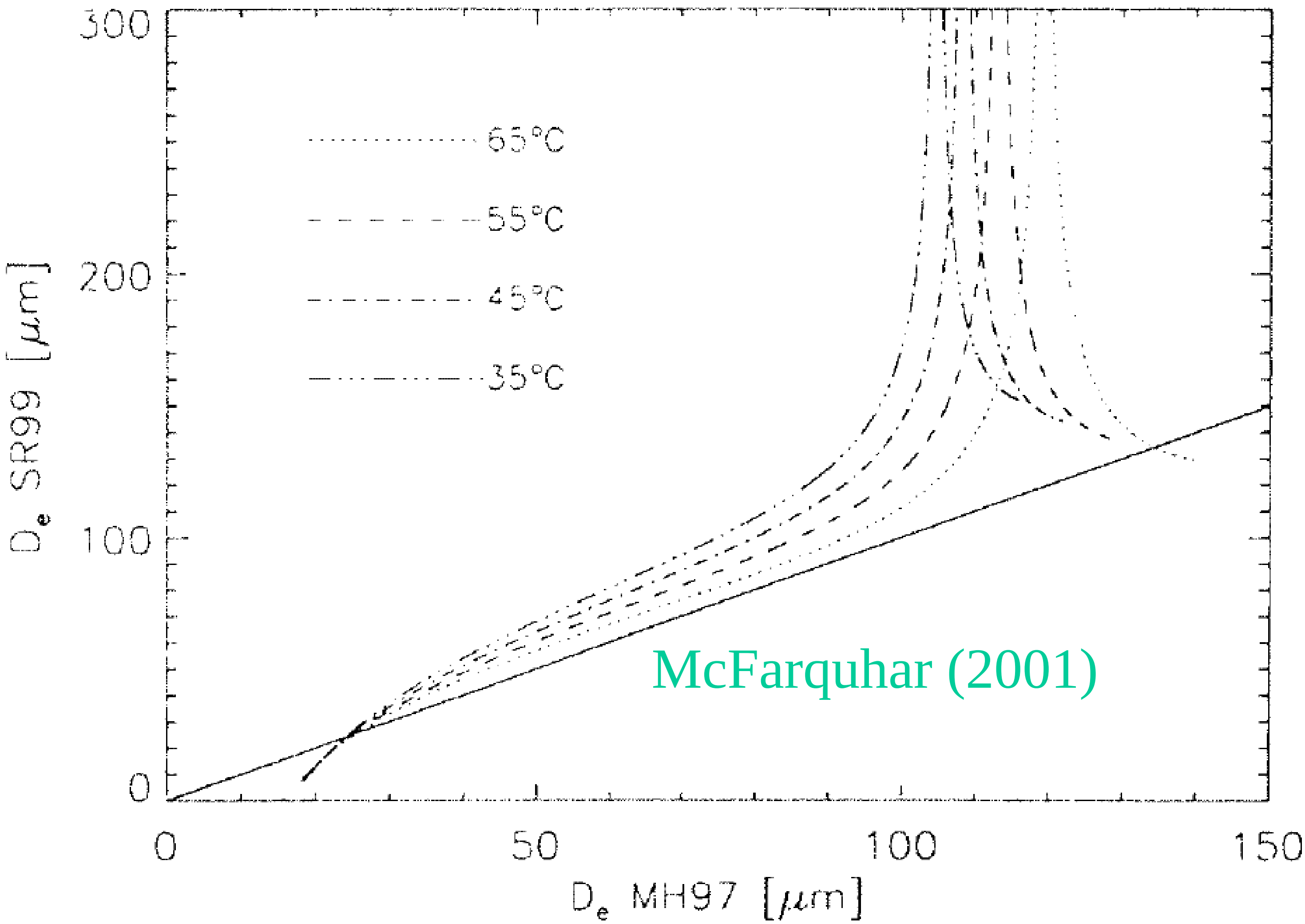
- **The uncertainties of downward net flux density for given r_e.are around 200 W/m^2**

r_e as a function of different habit for 30 sample cloud mode



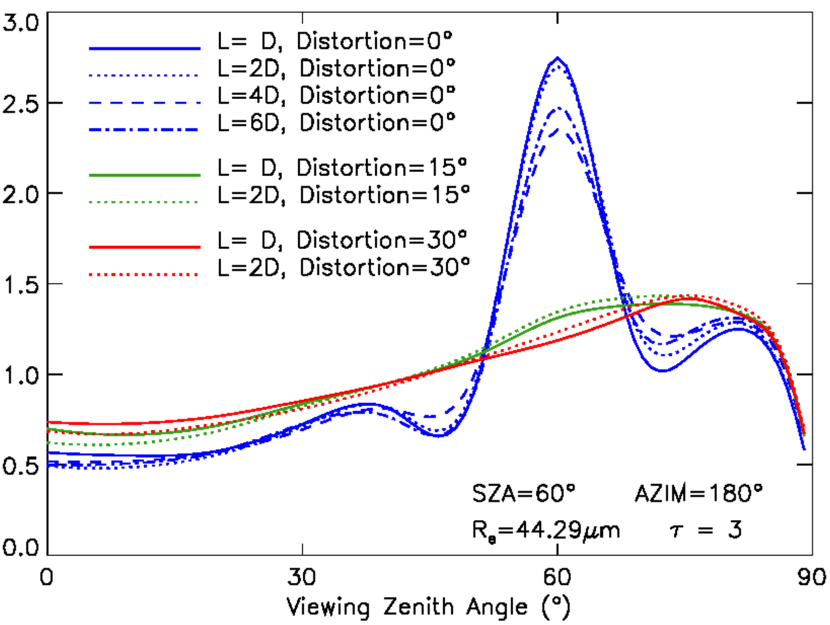
- **Different assumptions of habits lead to different r_e**
- **Using sample cloud models leads to multiple solution in r_e**

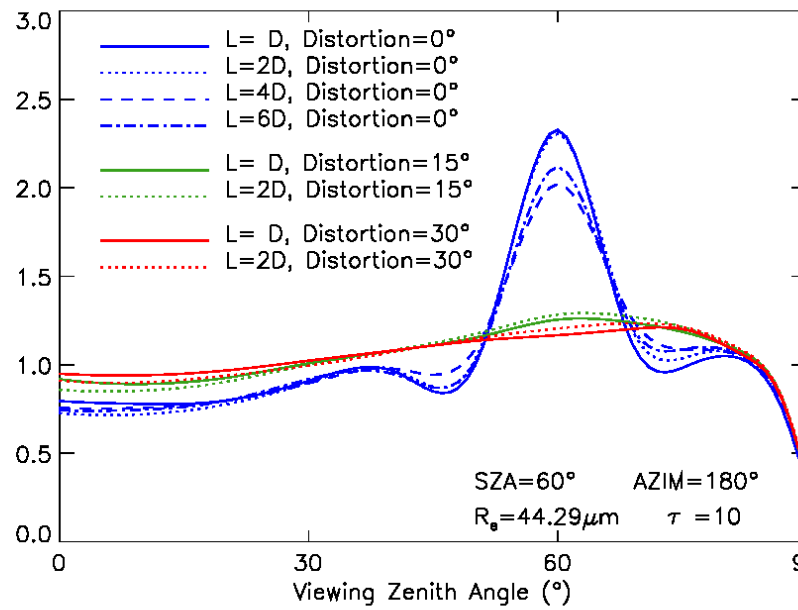
Comparison of particle size for two definitions



- **Cloud parameterization schemes are habit specific**

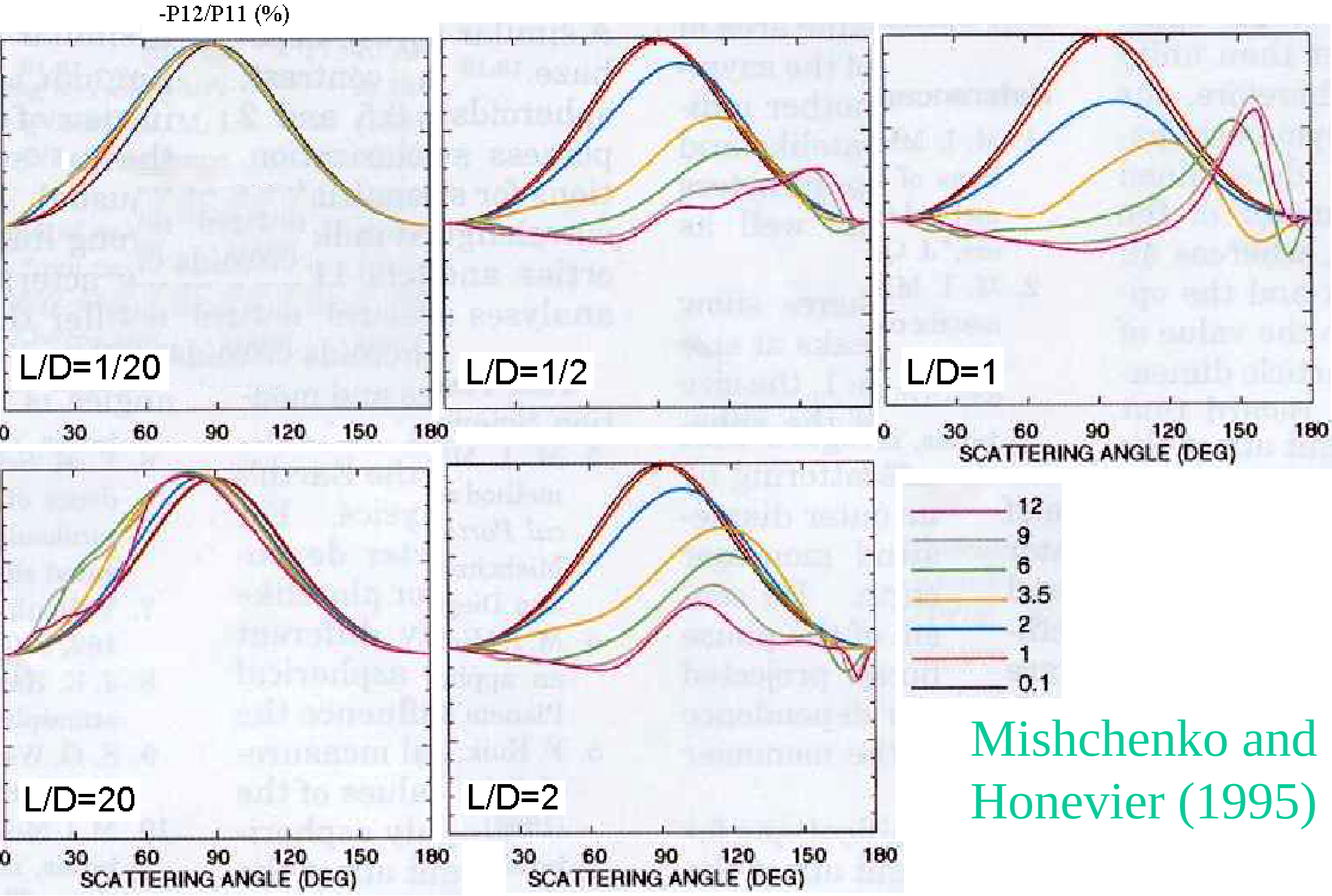
Anisotropic factors for a given τ and r_e





For the two common habits, the range of variation in nisotropic factors is larger than that caused by optical hickness

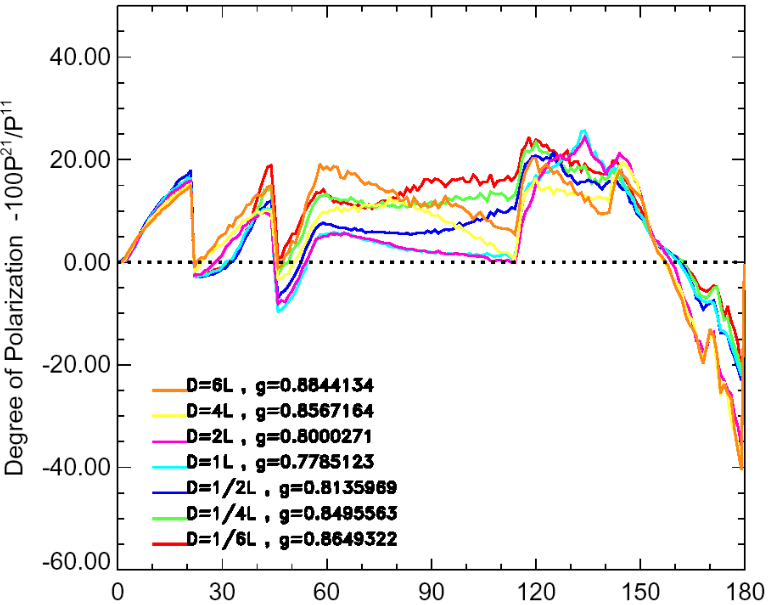
Can we detect crystal habits ?
- Degree of Polarization (I)

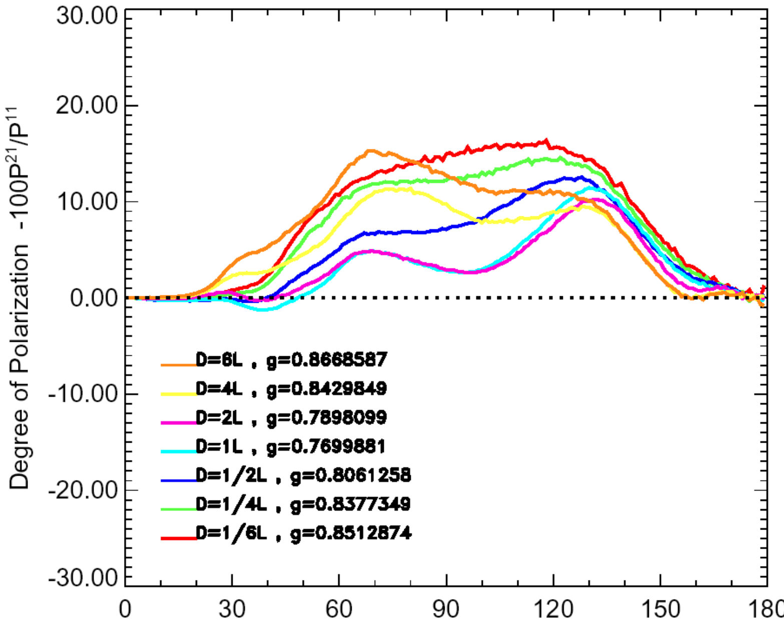


Mishchenko and Honevier (1995)

- **DOP is not a good indicator of particle shapes for small sizes**

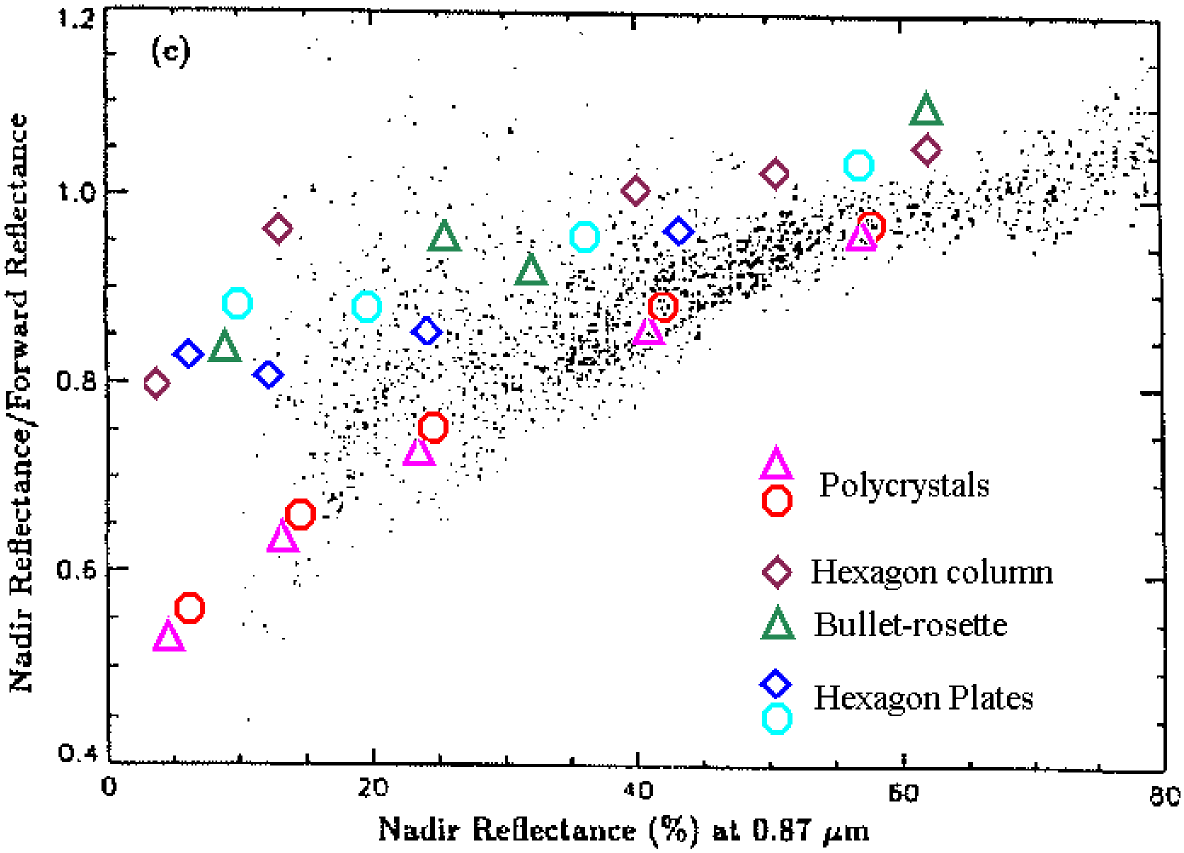
Can we detect crystal habits ?
- Degree of Polarization (II)





- **DOP measurement may distinguish smooth and rough particles at certain angles**

Can we detect crystal habits ?
- Multiangle observations (I)

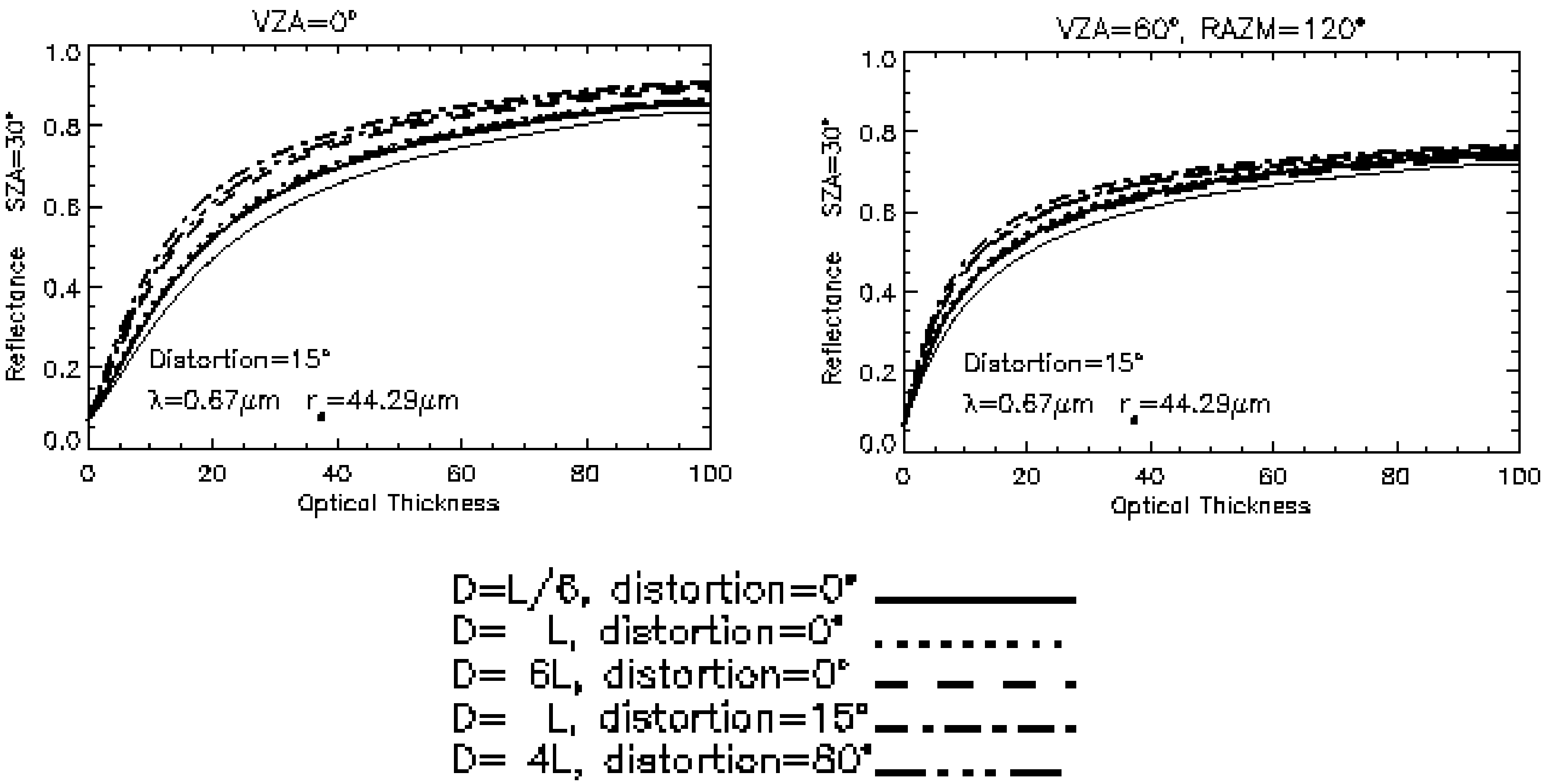


Baran et al. (19

ATSR data

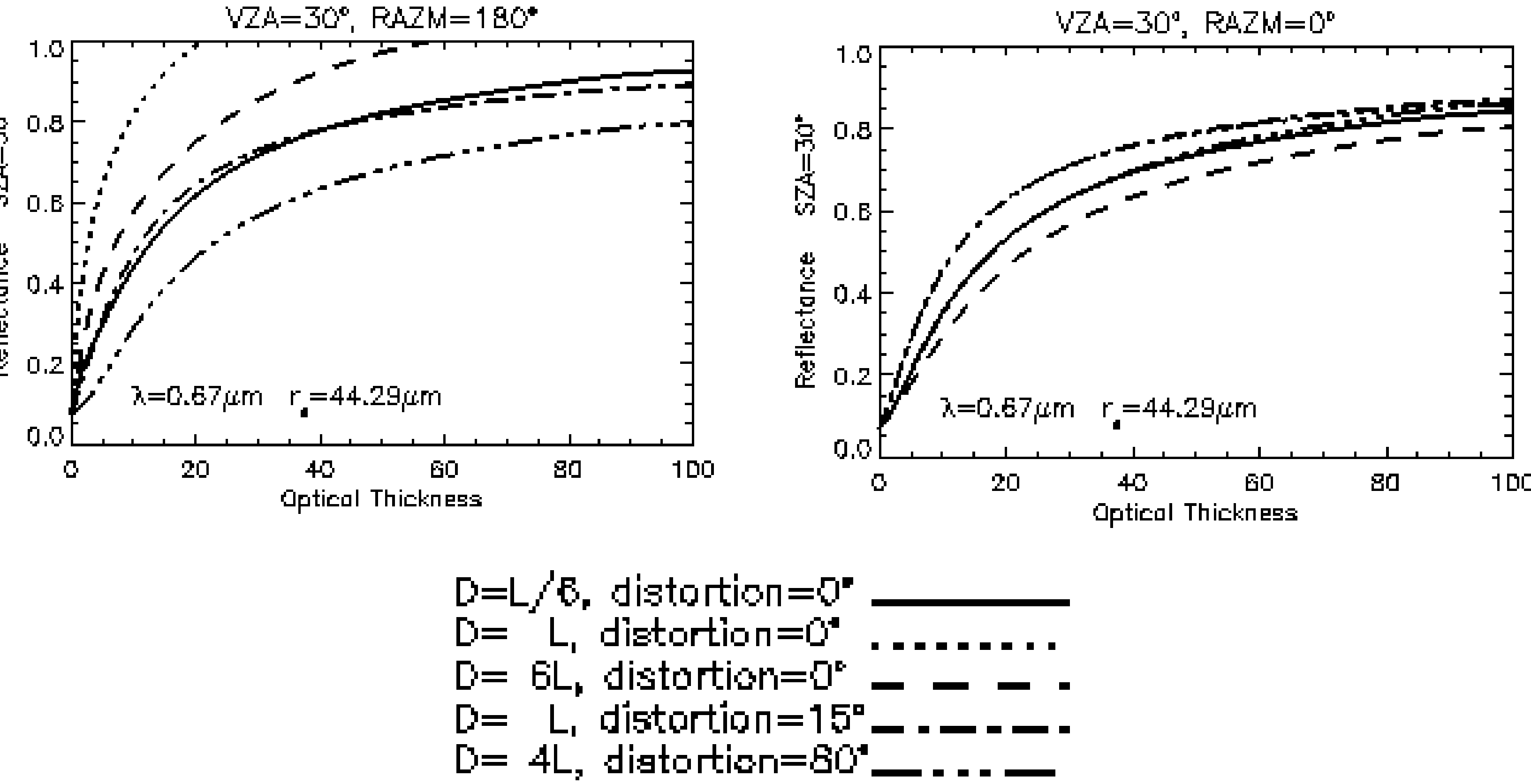
- **Dual angle observations are used to distinguish polycrystals**
- **All crystals are assumed to be the same habits**

Can we detect crystal habits ?
- Multiangle observations (II)



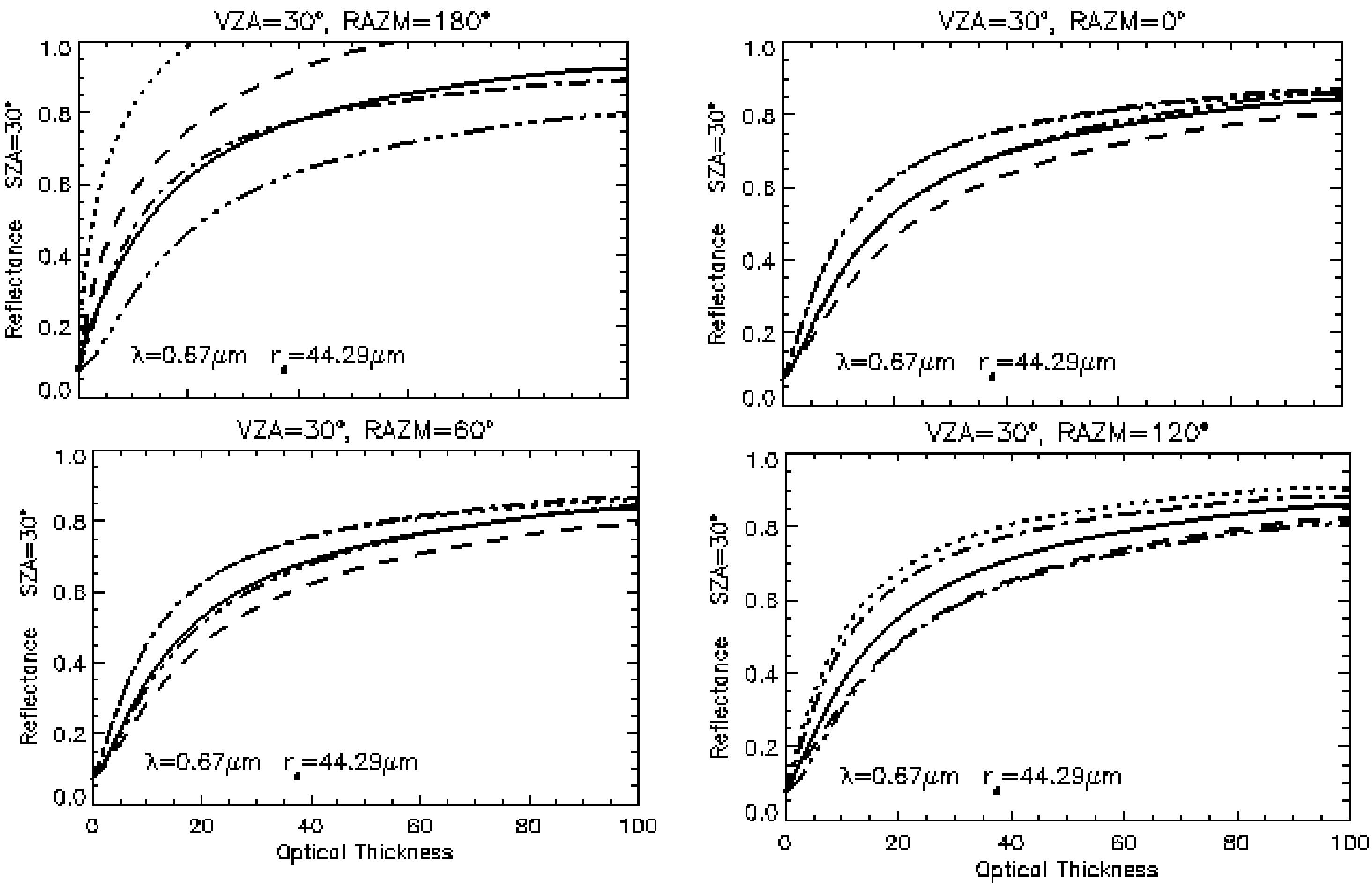
• **Similarities of signals in dual angles of ASTR restrict the ability of detecting crystal habits**

Can we detect crystal habits ?
- Multiangle observations (III)



• **Reflections at backscattering direction are significantly affected by particle shapes.**

Can we detect crystal habits ?
- Multiangle observations (IV)



• **Multiangle observations enable more details of particle shape detection**

Summary

- Uncertainty caused by particle shapes has impacts on remote sensing as well as on ADM, cloud parameterization and results of in situ measurements. Information of crystal habits is critical in these fields.

- The CERES biaxial data is a promising candidate for developing such an ability.