

An aerial photograph of a lush green forest with a winding stream and a waterfall. The text is overlaid on the image in a bright yellow color.

Impact of broken and inhomogeneous clouds on satellite cloud-phase retrievals

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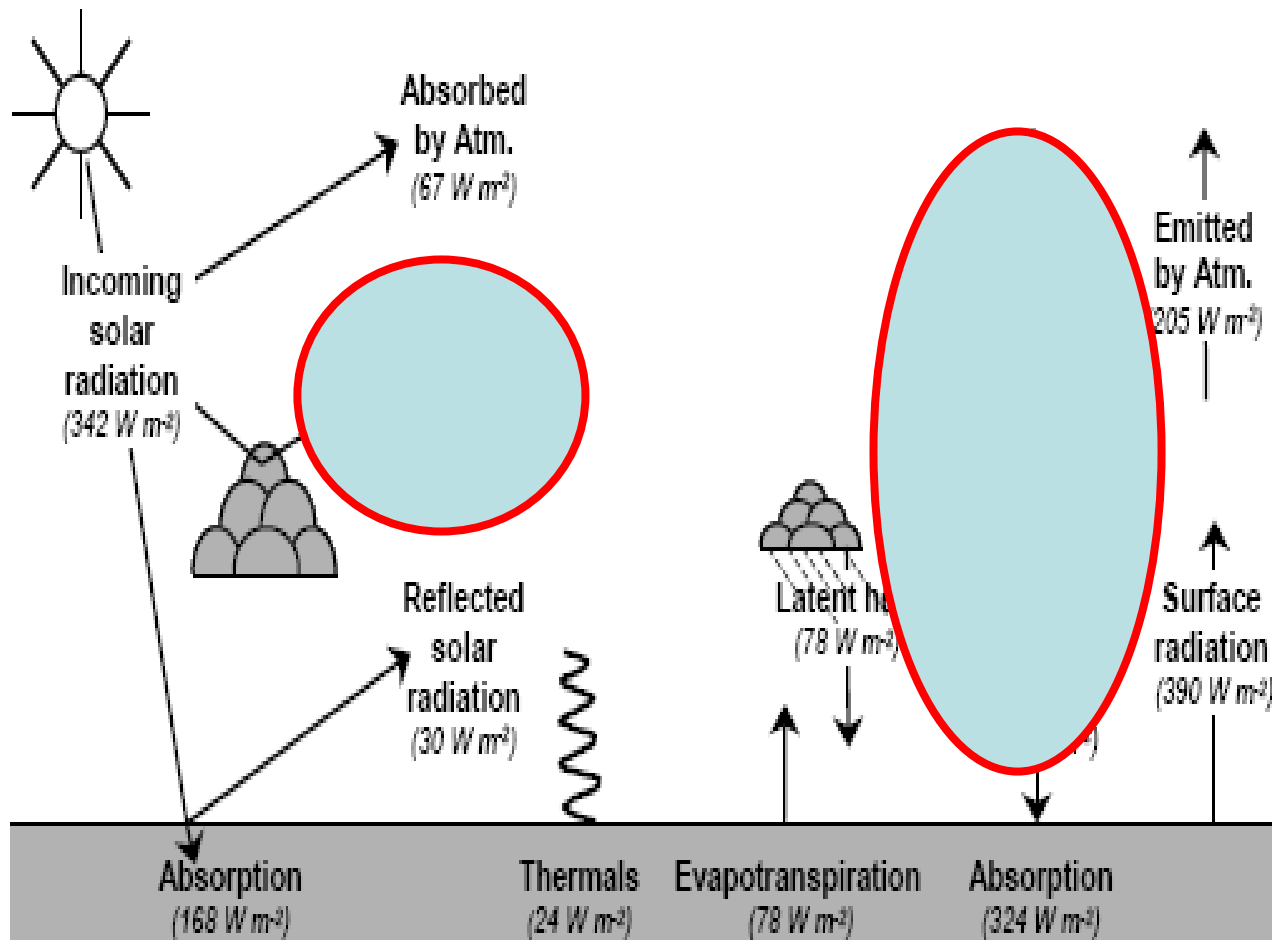
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- **Why study clouds?**
- **Satellite instruments**
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Clouds in the climate system

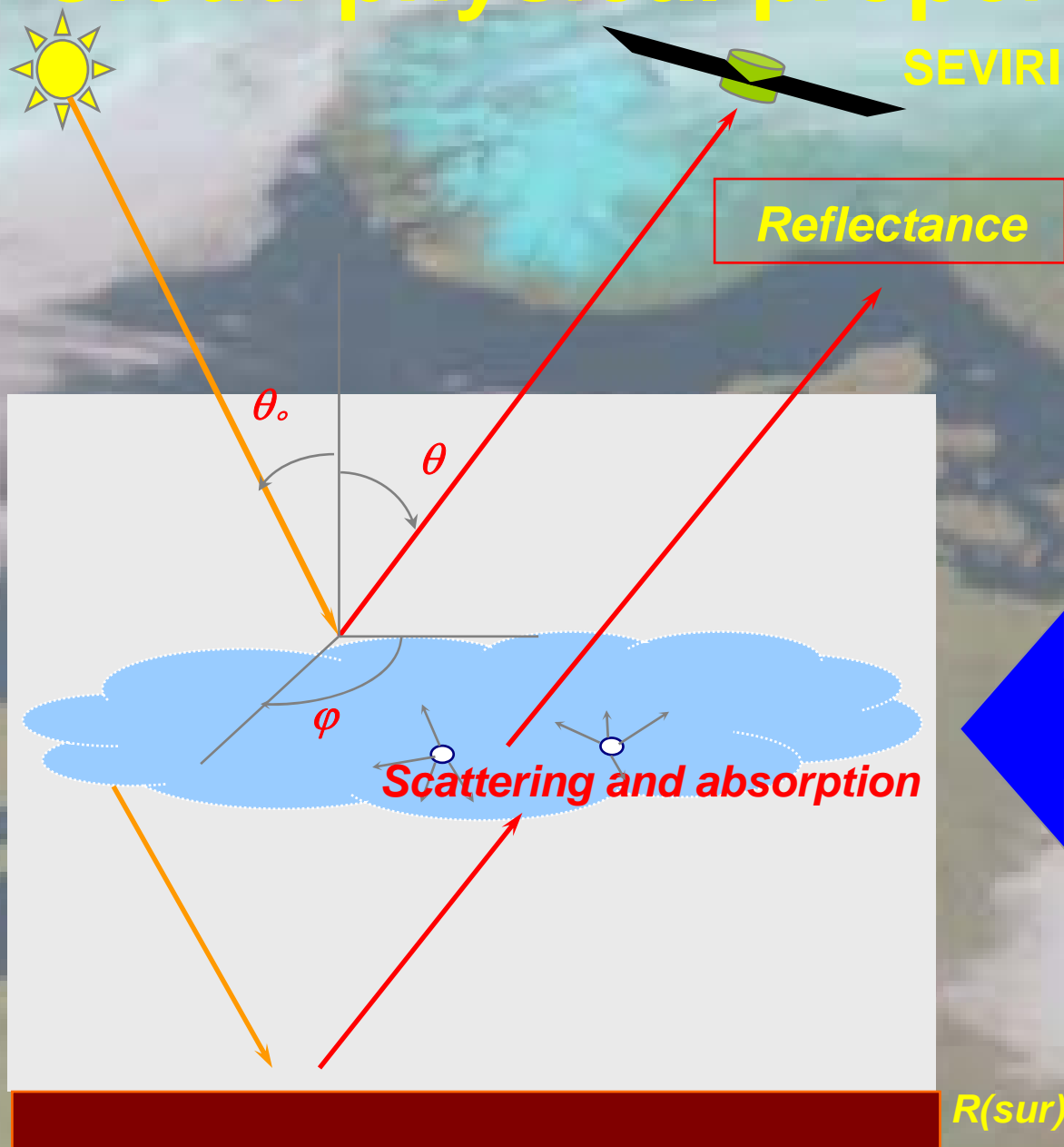


Sommerville et al. (2007)

Satellite instruments

- Measure reflected or emitted radiance at different wavelengths
- Cloud properties can be derived
- Geostationary (SEVIRI): coarse spatial resolution, high temporal resolution (15-30 min)
- Polar (MODIS): fine spatial resolution, poor temporal resolution

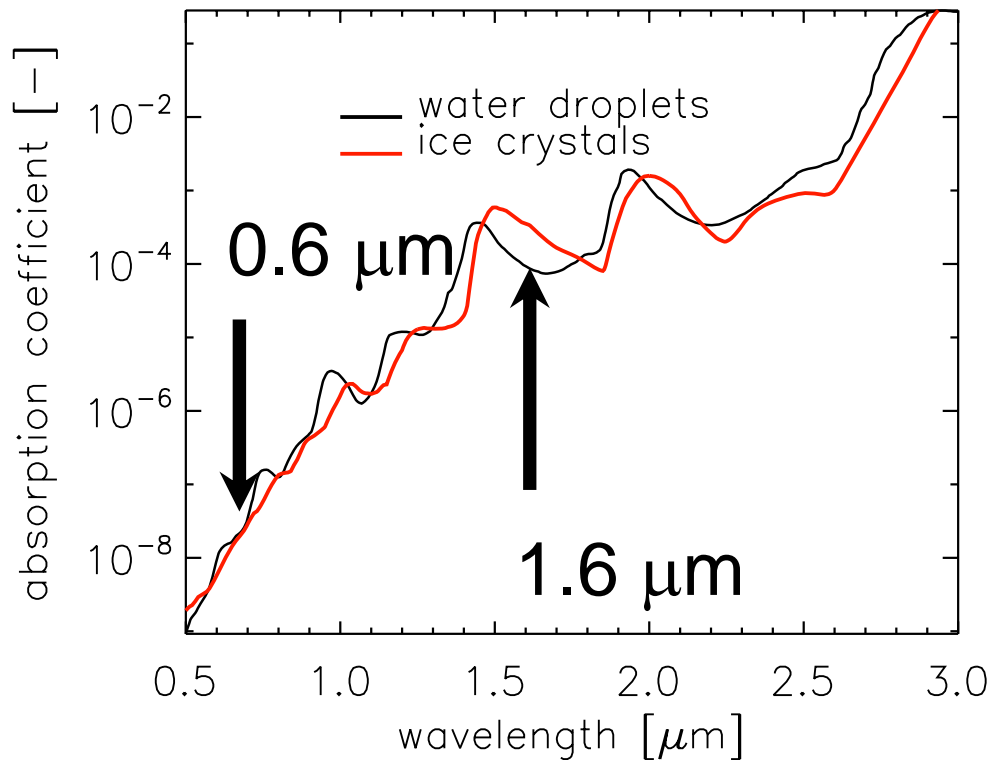
Cloud physical property retrieval



Cloud properties

- *Thermodynamic phase*
- *Optical thickness*
- *Effective radius*

Retrieval principle - cloud phase



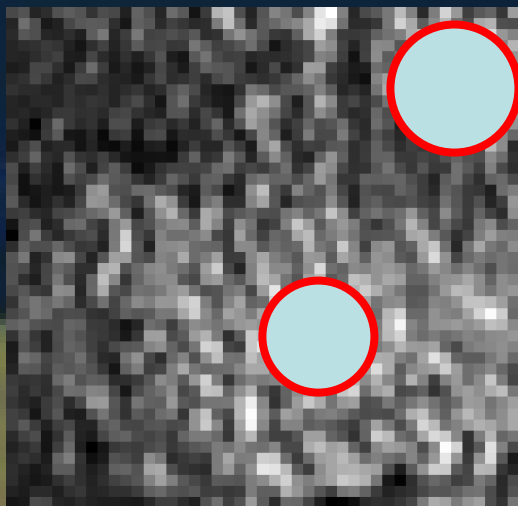
➤ $R_{0.6}$ determines τ and $R_{1.6}$ determines r_{eff}

➤ Ice crystals absorb more than water droplets at 1.6 μm

➤ This principle is used to discriminate water from ice clouds

The problem

- SEVIRI resolution coarse compared to MODIS (3x3 vs 1x1 km)
- Broken cloudiness and inhomogeneity is not always seen by SEVIRI
- To what extent is cloud-phase retrieval influenced by these (non-linear) effects?

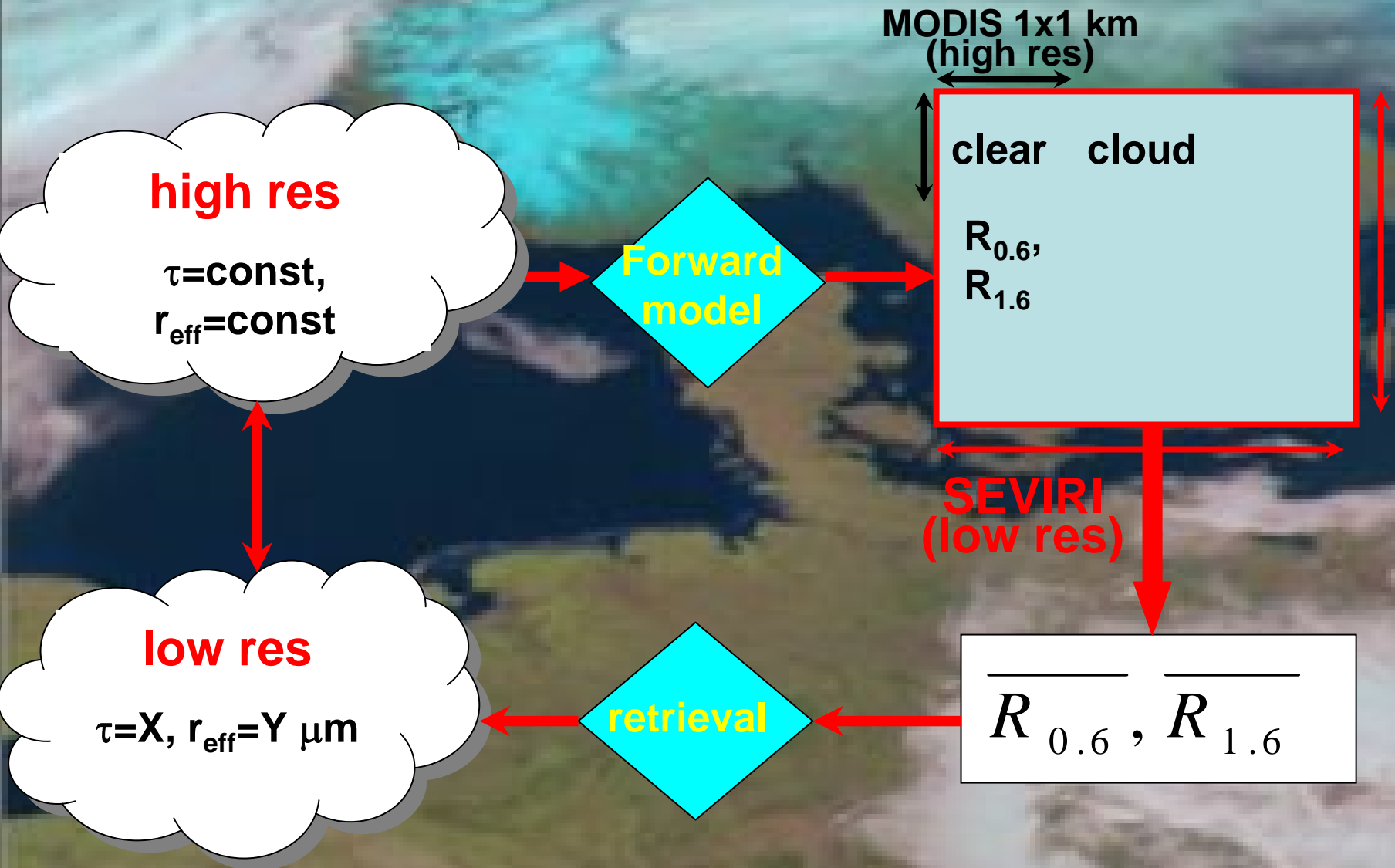


MODIS resolution
(1x1 km)

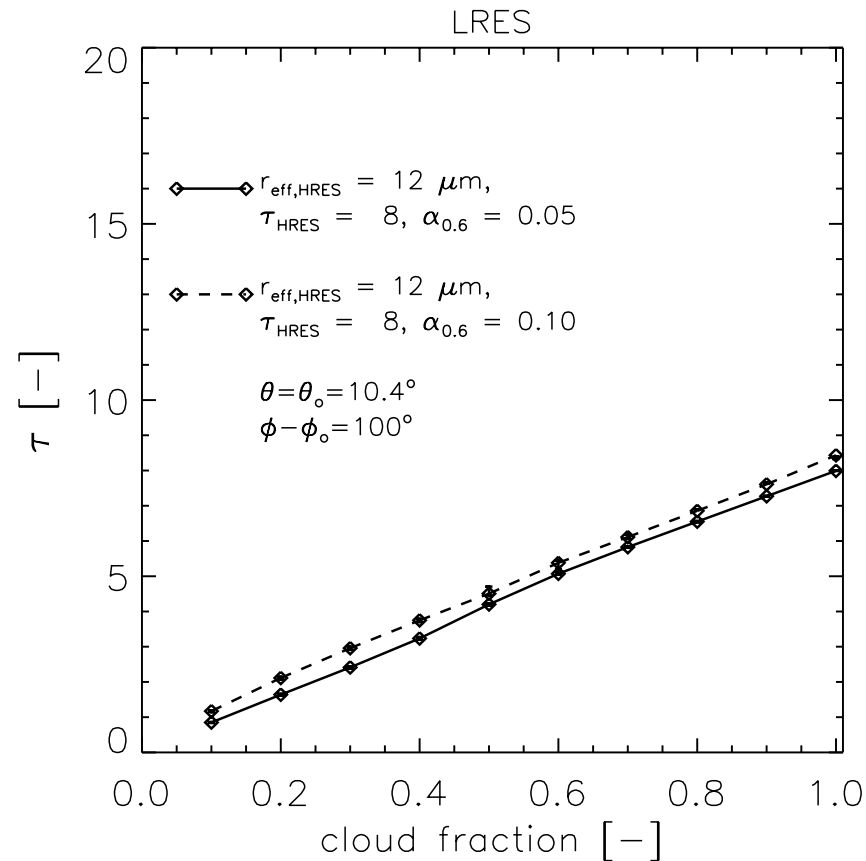


SEVIRI resolution
(3x3 km)

Synthetic datasets – broken clouds



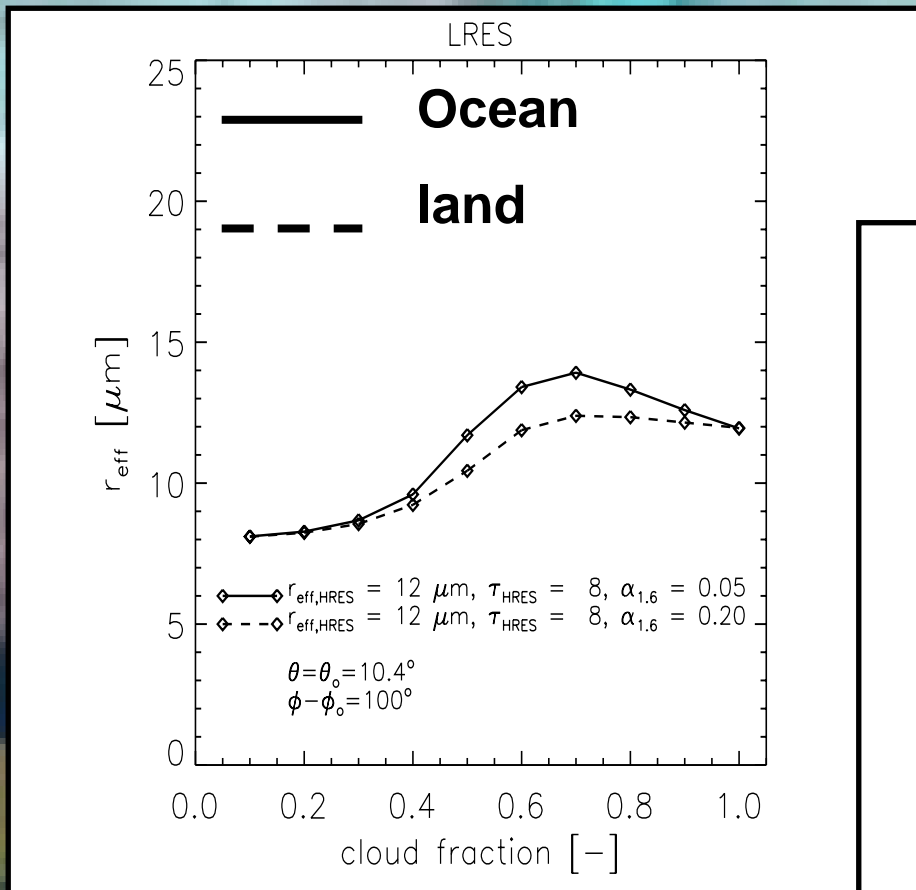
Results broken clouds - 1



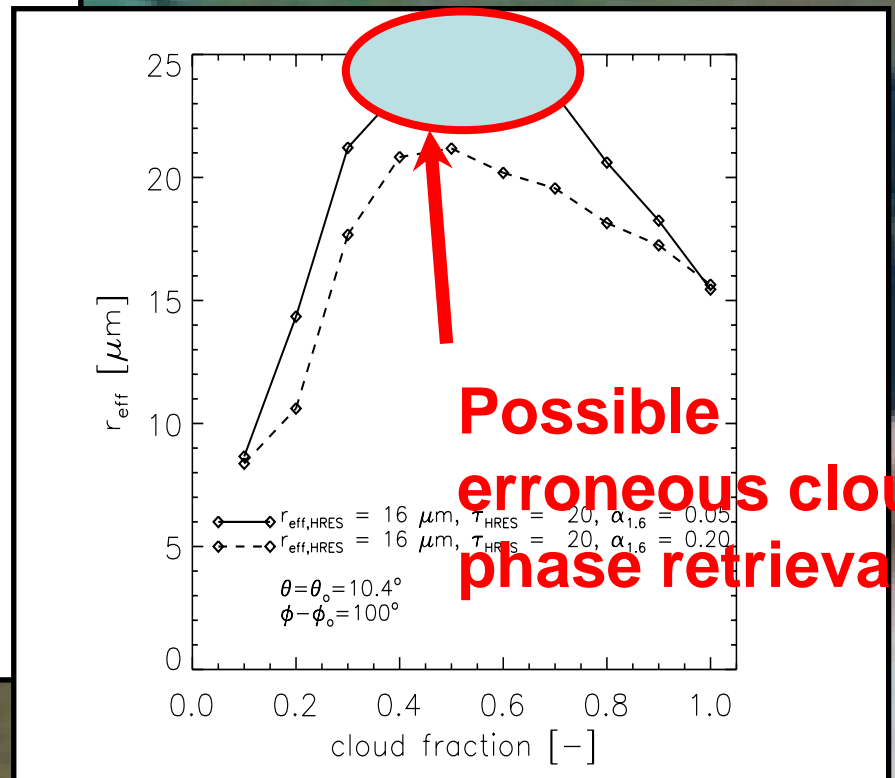
➤ Averaged reflectance decreases with decreasing cloud fraction

➤ Low resolution optical thickness decreases

Results broken clouds - 2

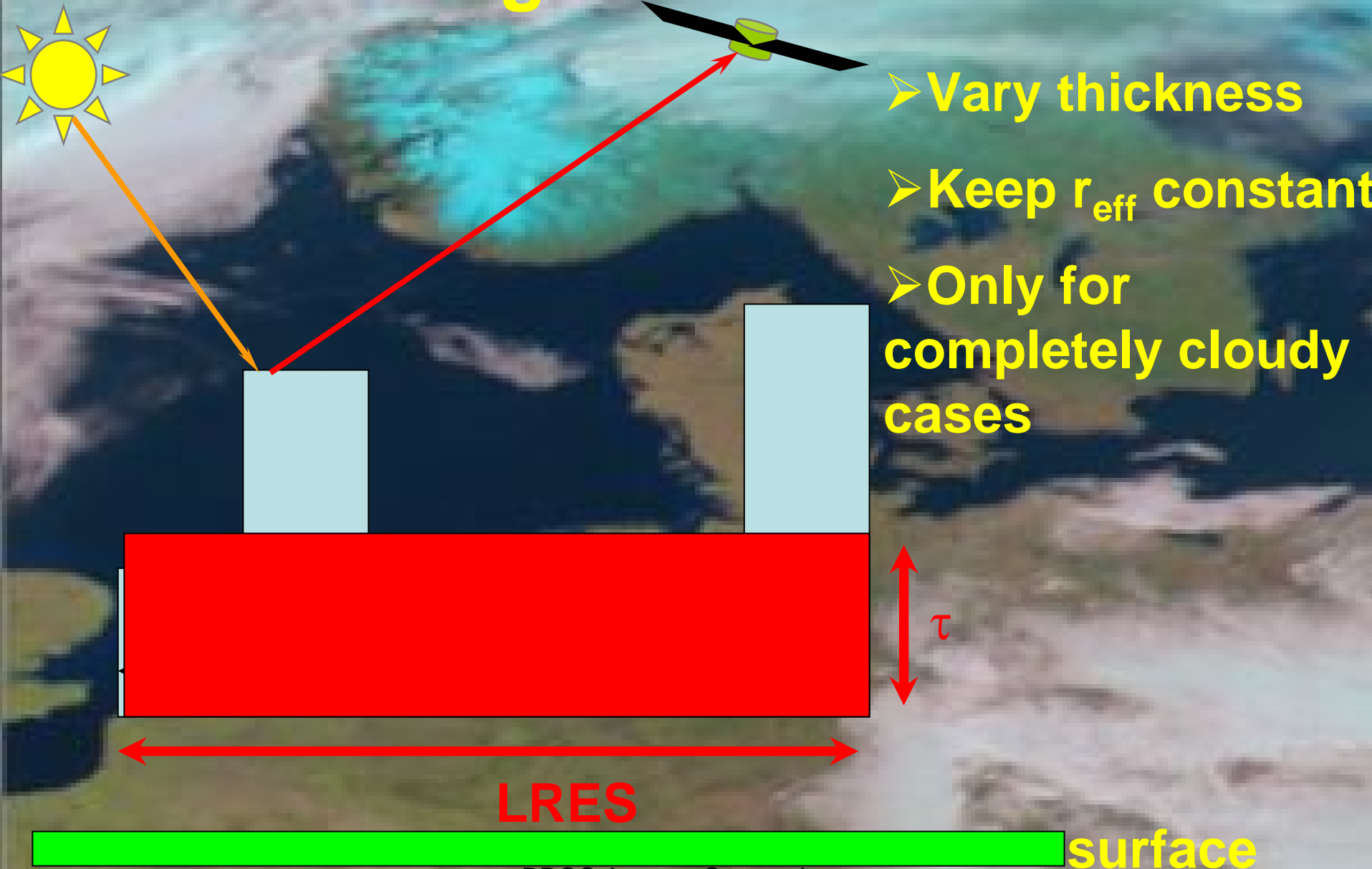


Thin clouds

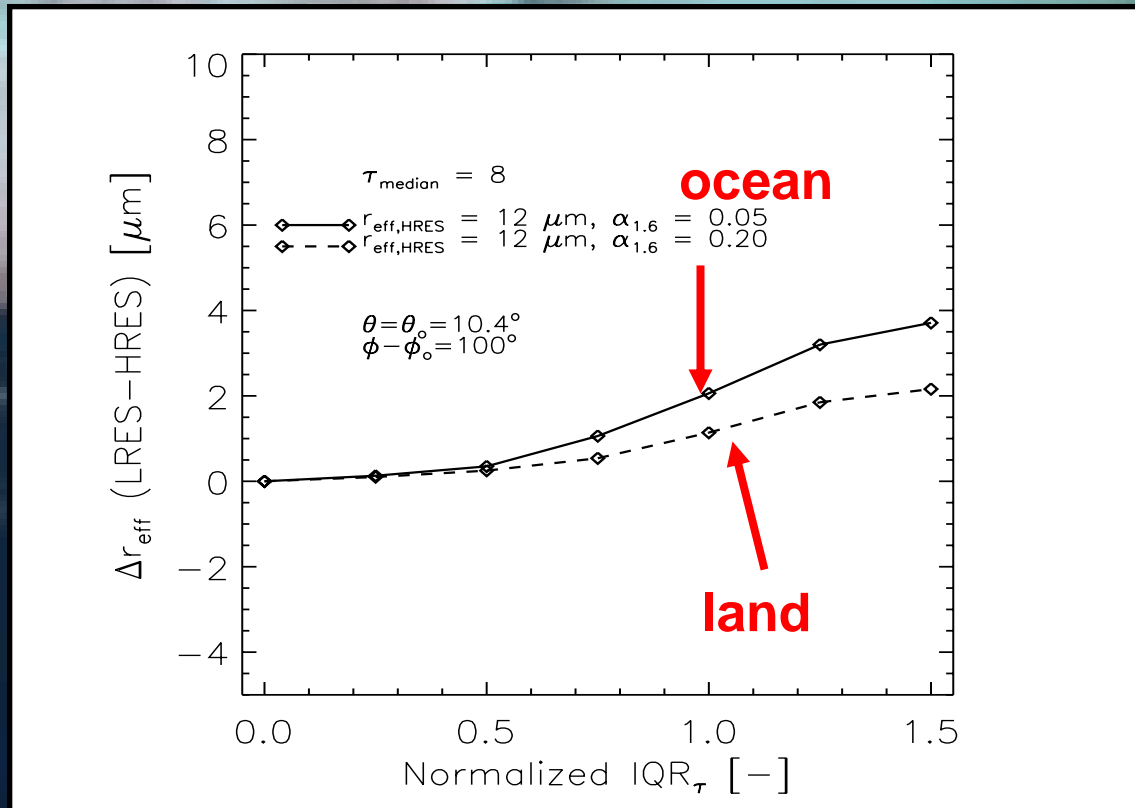


Thick clouds

Inhomogeneous clouds

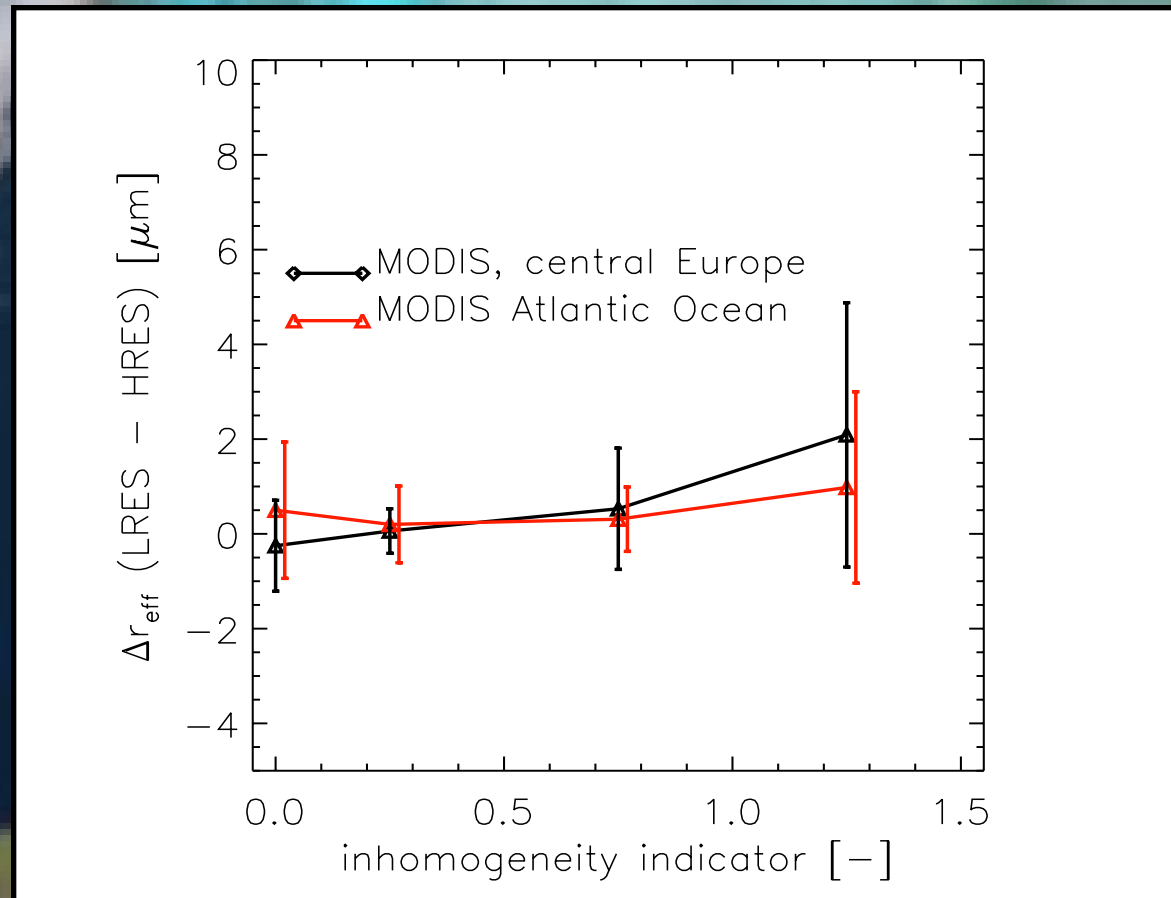


Results – inhomogeneous clouds



- Droplets appear larger for inhomogeneous clouds
- Strongest effect over dark surface
- Might lead to erroneous cloud-phase retrieval at low resolution

Results - MODIS low-resolution



Inhomogeneous clouds

Summary and outlook

- **Simulations show effect on optical thickness and effective radius retrieval for broken and inhomogeneous clouds**
- **Effects are less than expected for MODIS retrievals**
- **Further research required to explain differences between simulations and reality**
- **Total effect on cloud-phase retrieval to be quantified...**

An aerial photograph of a coastal landscape. A winding path or road cuts through a green, hilly area. The path starts from the bottom left and curves towards the top right. The terrain is a mix of green grass and brownish soil. In the background, there's a body of water with a white sandy beach. The overall scene is bright and clear.

Thank you!

BBOS Autumn Symposium,
Texel, 24 October 2008

Papers

- Wolters, E.L.A., R.A. Roebeling, and A.J. Feijt, Evaluation of cloud-phase retrieval methods for SEVIRI on Meteosat-8 using ground-based cloud radar and lidar data, *Journ. Appl. Meteor. Clim.*, **47**, 1723-1738, 2008
- Wolters, E.L.A., H.M. Deneke, B.J.J.M. van den Hurk, J.F. Meirink, and R.A. Roebeling, Quantification of broken and inhomogeneous cloud impact on satellite cloud-phase retrieval, *to be submitted to J. Geophys. Res.*
- H.M. Deneke, R.A. Roebeling, E.L.A. Wolters, A.J. Feijt, and C. Simmer, On the sensitivity of satellite-derived cloud properties to sensor resolution and broken clouds, *in preparation.*