1. THE PROBLEM

The delineation of precipitation areas using cloud properties derived from optical satellite data has been successfully shown (Nauss and Kokhanovsky 2006). The method is based on the conceptual model, that precipitating clouds must have both a large enough vertical extent and large enough droplets (see figure 1). With MSG SEVIRI the delineation scheme as well as the cloud properties retrieval algorithm has been ported to a geostationary platform for the first time. Furthermore with the enhanced spectral resolution of MSG SEVIRI a more accurate discrimination between different rainfall intensities, due to distinct precipitation processes, has become possible. This forms the basis for a more precise process oriented rainfall rate assignment.

Figure 1: Conceptual model for the delineation of rainfall areas based on cloud properties (adapted from Lensky & Rosenfeld 2003).
2. APPROACH

2.1 CLOUD PROPERTIES RETRIEVAL

Figure 2 displays an overview of the scheme for a process oriented rainfall rate assignment. The cloud properties for the first step have been retrieved by the fast computing but still very accurate Semi-Analytical CloUd Retrieval Algorithm SACURA (Kokhanovsky et al., 2003; Nauss et al., 2005; Kokhanovsky and Nauss, 2005), which has been adapted to MSG SEVIRI. Figure 3 to 5 show the SACURA-derived values for the effective droplet radius ($a_{ef}$) and the optical thickness ($\tau$) as well as the liquid water path ($\text{lwp}$), which can be calculated from the other two parameters, for a precipitation event over Germany between 21 and 26 May 2004.

![Figure 2: Scheme for a process oriented rainfall rate assignment.](image-url)
Figure 3: SACURA derived effective droplet radius (µm), 21 May 2004, 9:00 UTC.

Figure 4: SACURA derived optical thickness, 21 May 2004, 9:00 UTC.

Figure 5: SACURA derived liquid water path (g/m²), 21 May 2004, 9:00 UTC.
2.2 DELINEATION BETWEEN DIFFERENT RADAR REFLECTIVITY CLASSES

The reflectivity classes identified by the weather radar are directly associated with different rainfall intensities, due to distinct precipitation processes. Thus, a discrimination between these classes using cloud properties derived from optical satellite data permits the identification of areas characterized by diverse precipitation processes and intensities.

Figure 6 depicts the probabilities for different \( a_{\text{eff}} - \tau \) combinations for radar classes greater equal 1, 2 and 3 respectively, derived from the comparison of both values with radar network data from the German Weather service for a precipitation period between 21 and 26 May 2004. The separation between the classes regarding the probability is identifiable. As can be seen higher radar reflectivities and higher rainfall intensities are accompanied by a concentration of the probability for higher values of \( a_{\text{eff}} \) and \( \tau \) which point to a possible discrimination between the radar classes.

In order to derive a threshold value (THV) for the delineation between the different reflectivity classes, the spatial distribution of lwp values has been compared to corresponding ground based radar data from the German weather service for each scene during the precipitation period between 21 and 26 May 2004. The optimum THV for the lwp has been determined by minimizing the difference between the rainfall area encircled by variable lwp values and each radar class.

3. RESULTS

The classification result for the 21 May 2004, 9:00 UTC is depicted in figure 7. Figure 8 displays the corresponding radar image. Based on the classification a preliminary rainfall rate has been assigned to each identified class using an adapted regression equation from Csiszár et al. (1997) which involves \( a_{\text{eff}} \), \( \tau \), lwp and 11\( \mu \)m brightness temperature (see figure 9).

Compared to the radar data the delineated rain area shows a slight overestimation. This is specially true for class 1. Concerning the separation between the classes some misclassifications are visible. In this case the saturation of the effective droplet radius for values higher than 50 \( \mu \)m hampers a more accurate differentiation between the classes (see figure 3).

Nevertheless, the first results of the presented technique are encouraging, suggesting that a identification of different precipitation processes and resulting intensities using cloud properties is possible. However, the scheme is under ongoing development. Especially the problematic of saturated effective droplet radius for values higher than 50 \( \mu \)m and potential collocation errors between radar and satellite data has to be investigated in more detail.
Figure 7: Classification result obtained with derived optimum lwp-THV, 21 May 2004, 9:00 UTC, Class 1 (200 g/m² < lwp > 800 g/m²), Class 2 (800 g/m² < lwp > 1400 g/m²), Class 3 (1400 g/m² < lwp > 2000 g/m²).

Figure 8: Radar network data from the German weather service, 21 May 2004, 9:00 UTC.
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