

An Operator for VIS/NIR Satellite Radiances

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LMU: Robert Buras, Bernhard Mayer, Martin Weissmann

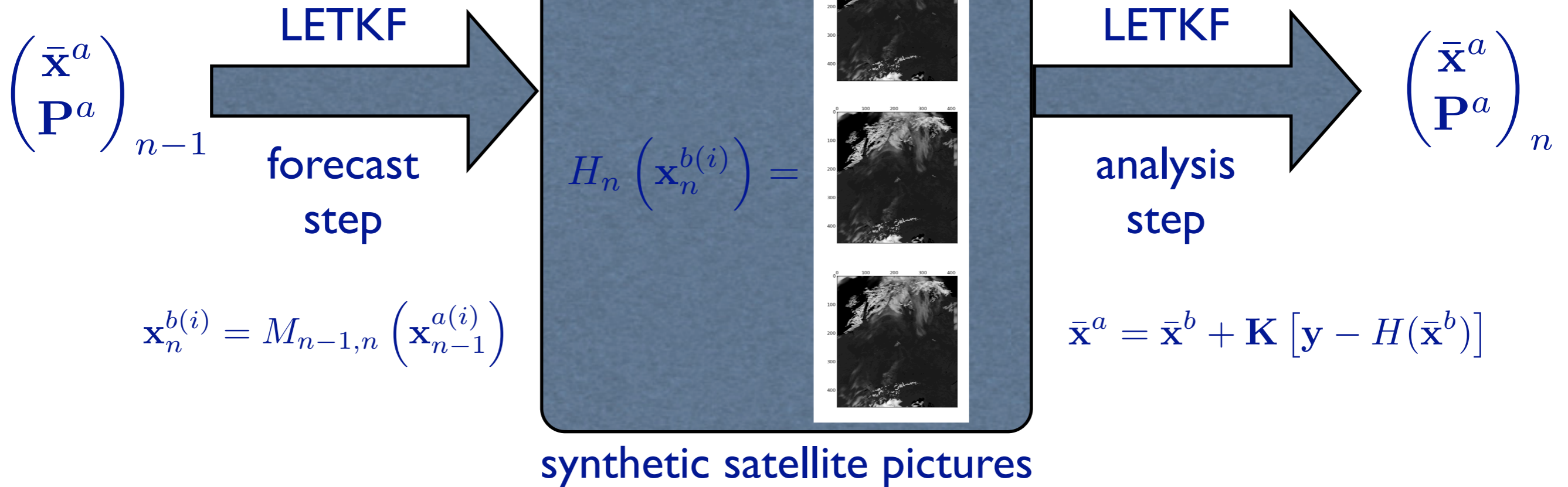
DWD: Robin Faulwetter, Christina Köpken-Watts, Annika Schomburg, Olaf Stiller

Hans-Ertel-Zentrum für Datenassimilation

HErZ Meeting LMU Munich, 20.01.2012

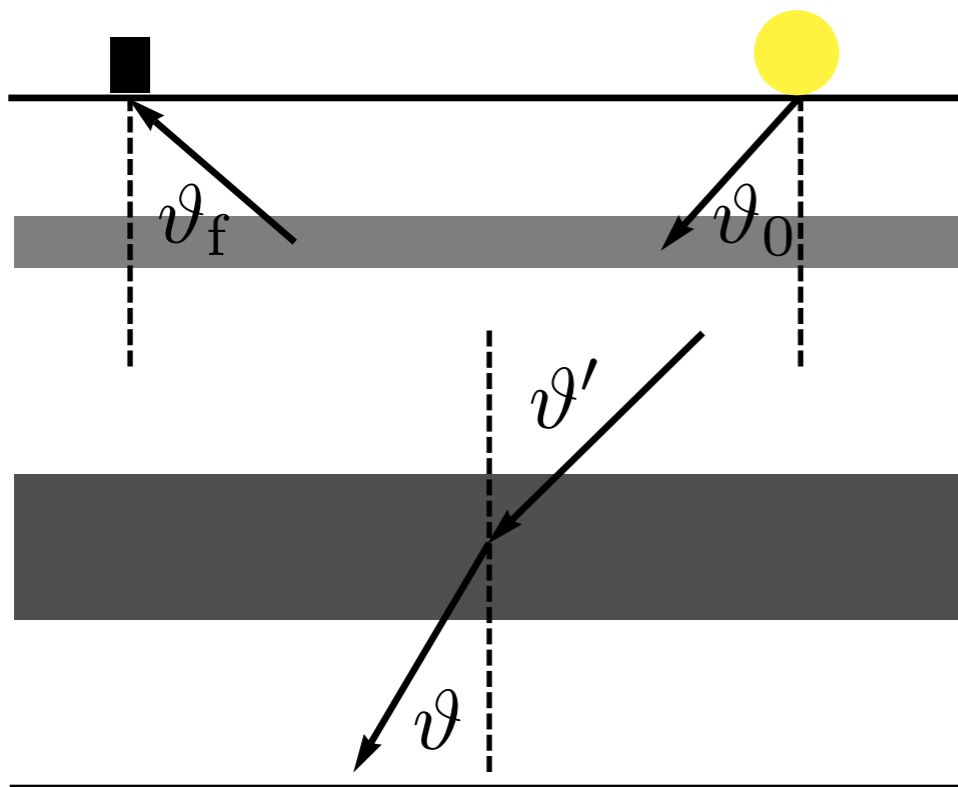
Project: Ensemble Data Assimilation

Meteosat-8 RSS radiances



Radiative Transfer Solver DISORT

[Stamnes et al. 1988]



- COSMO-DE: humidity, cloud water, ice, snow, cloud-cover, cloud height, albedo, (pressure, temperature,...)
- rain and graupel neglected
- output: satellite radiances

absorption

scattering

incoming

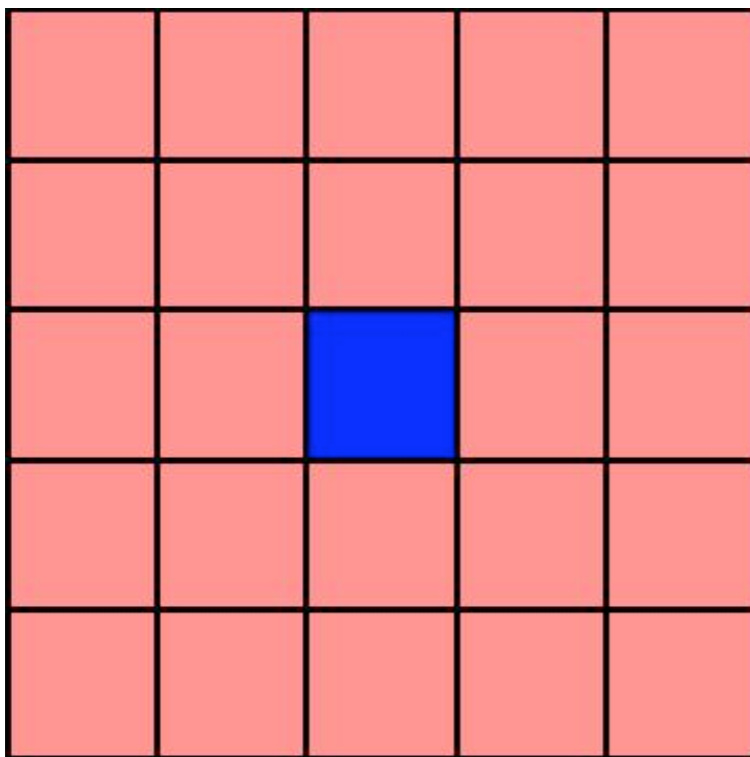
emission

$$\mu \frac{dI}{d\tau} = -I + \frac{\omega}{4\pi} \int d\varphi' d\mu' \mathcal{P}(\dots) I(\dots) + \frac{\omega}{4\pi} \mathcal{P}_0(\dots) S_0 e^{-\tau/\mu_0} + (1 - \omega) B(\tau)$$

Status of the Operator:

- cloud microphysics accounted for [Zinner et al. 2008; Wyser 1998]
- model snow partly treated as cloud ice (10%) [Seifert, private communication]
- **implemented faster operator (cluster: 5-10 min.)**
- **wavelength-dependent albedo values (MODIS)**
- **sub-gridscale stratiform and convective clouds** [Tiedtke 1989]

Faster Operator (ipa_3d)



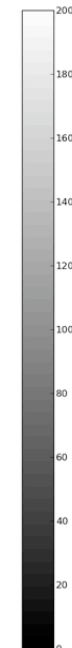
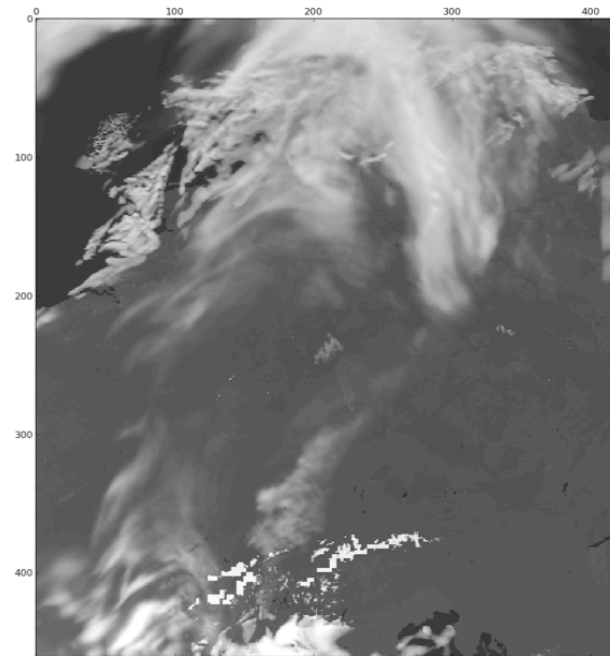
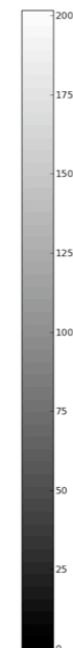
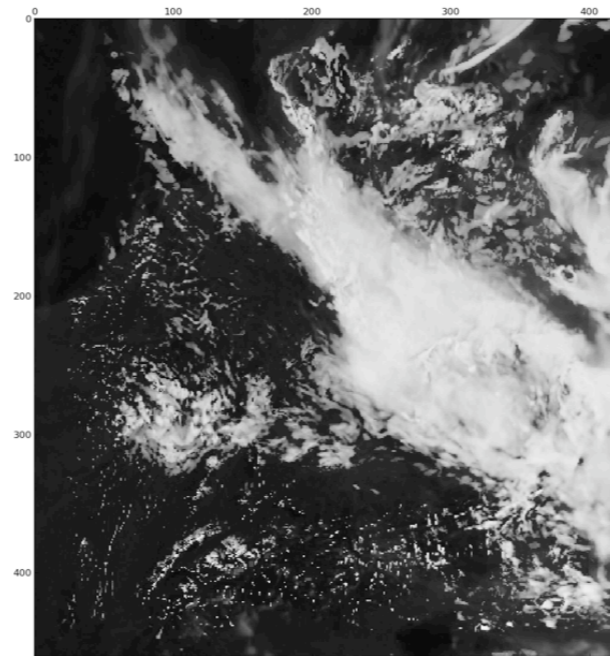
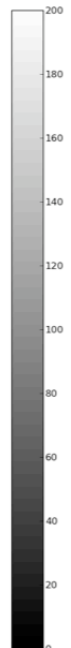
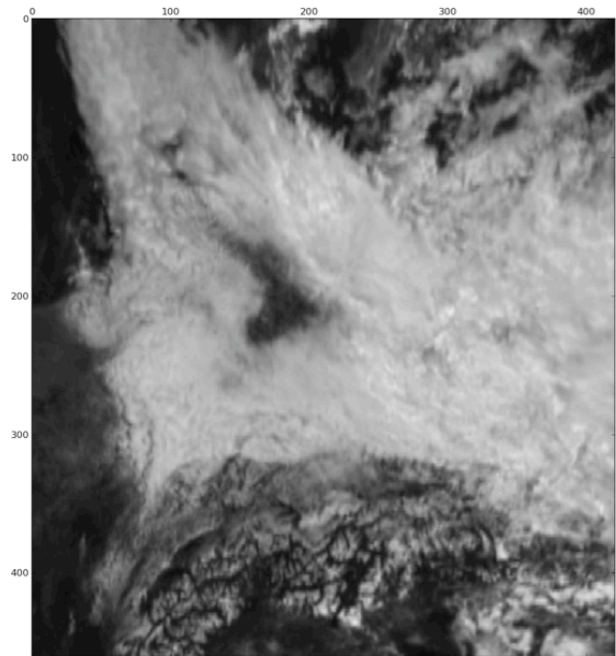
- initialization only once for 5x5 pixels
- setting up 3-dimensional cloud files
- accuracy loss: constant albedo and angles (mean relative difference $\sim 1\%$)
- speed gain: factor 4-6

MSG SEVIRI

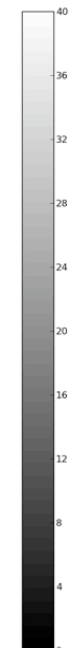
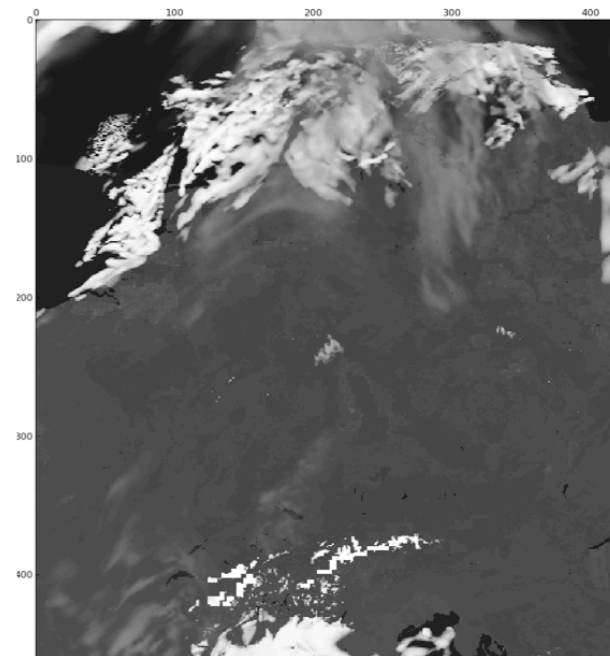
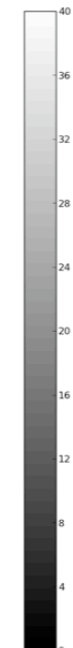
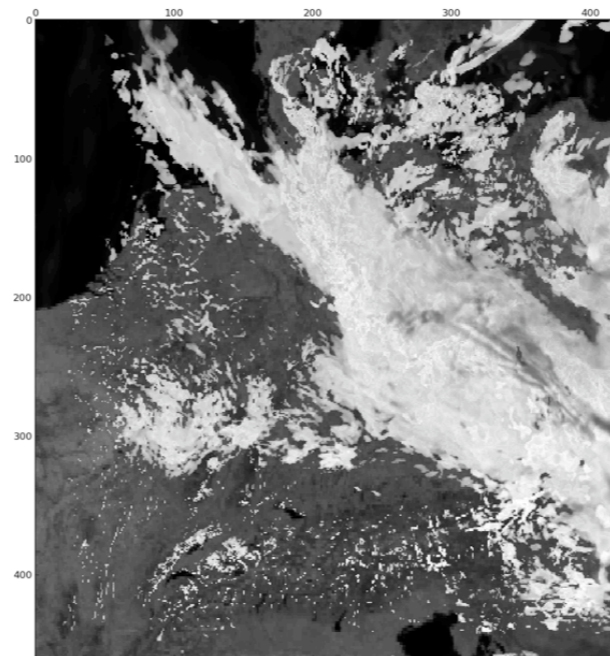
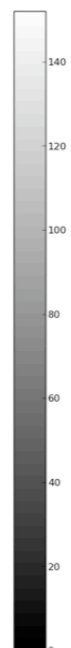
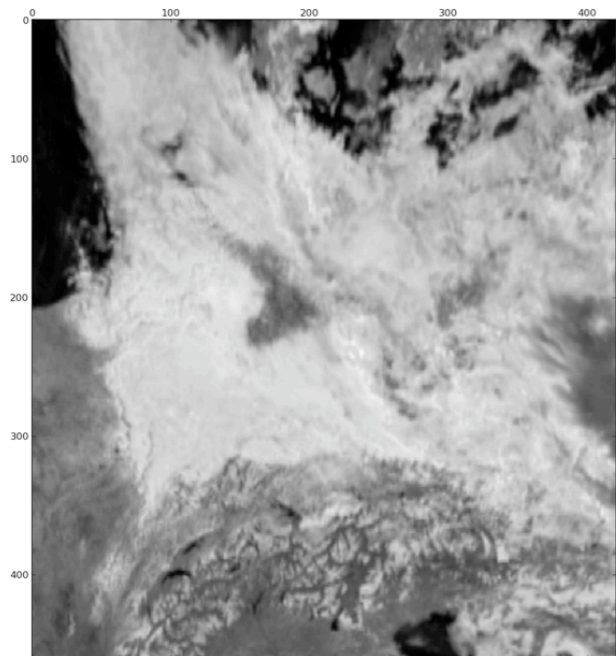
MODIS albedo

COSMO albedo

VIS
006



NIR
016

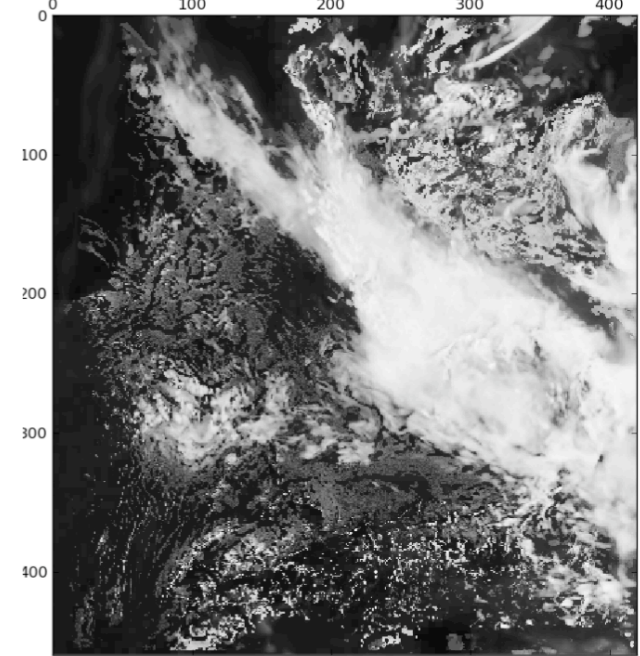
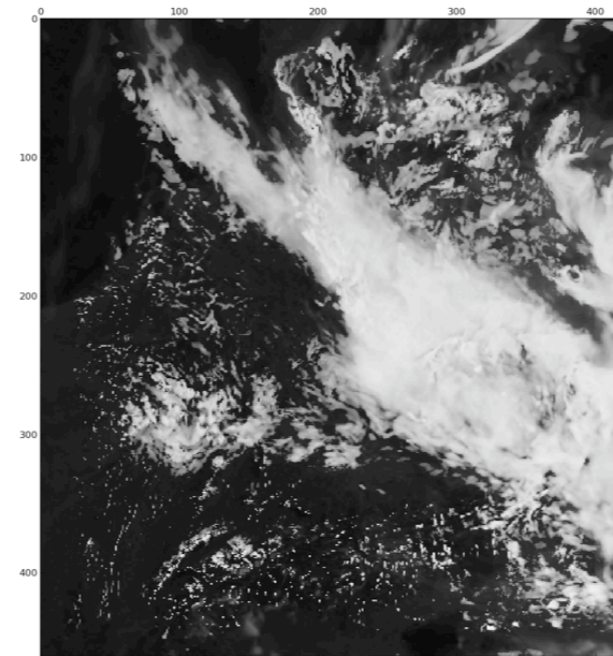
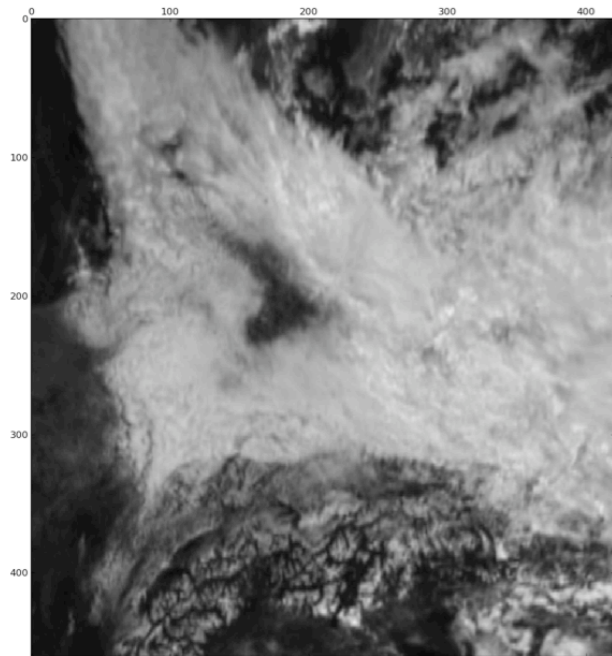


MSG SEVIRI

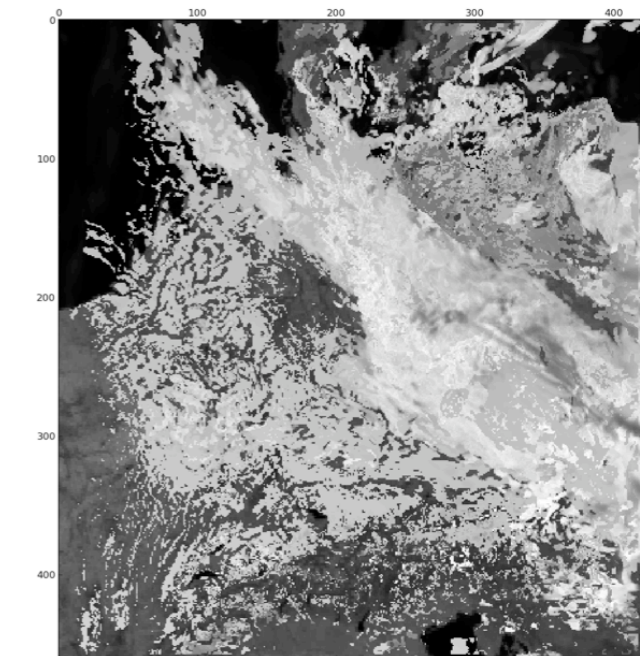
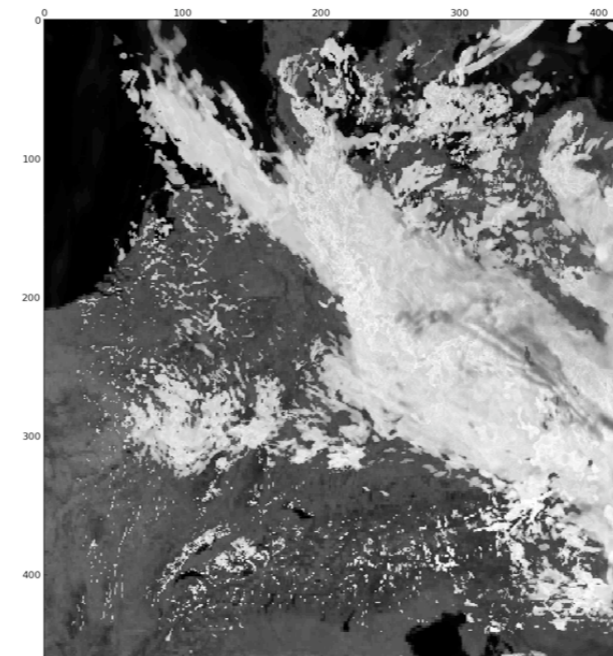
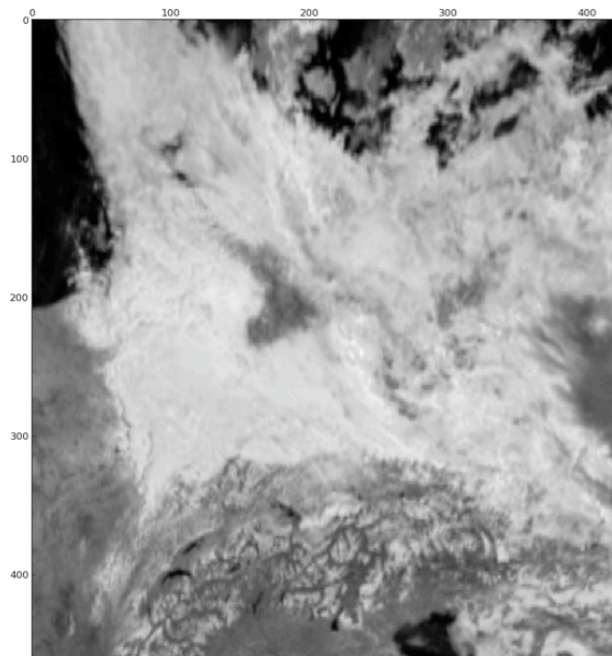
no shallow convection

shallow convection

VIS
006

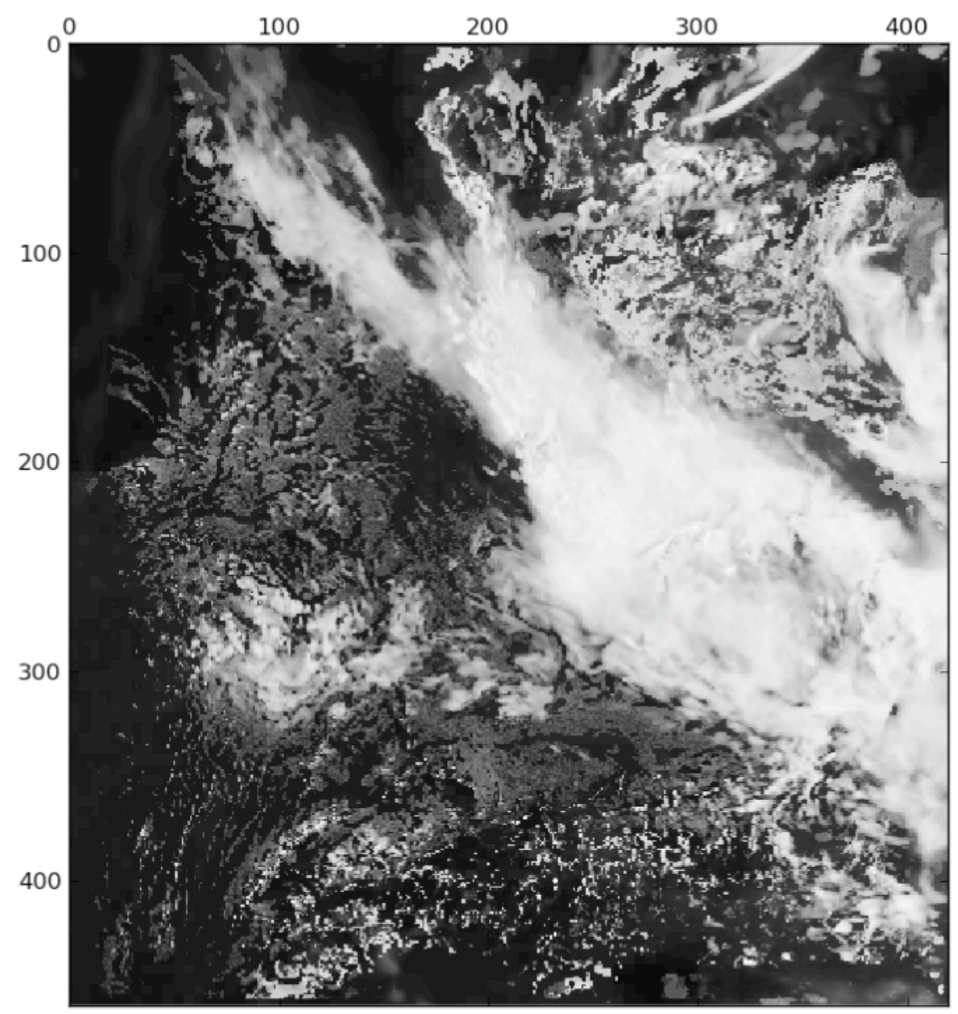


NIR
016

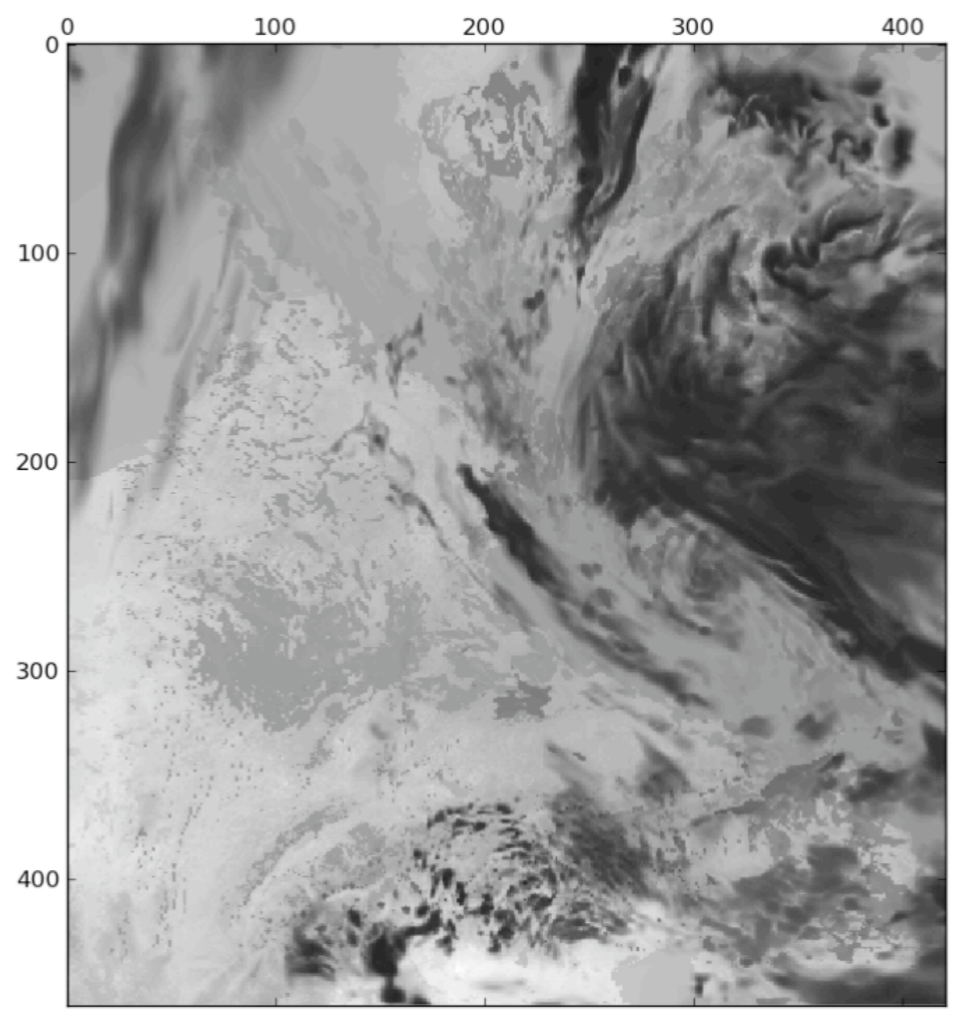


Comparison VIS006 - IR087

(31.07.2011, 12h UTC)



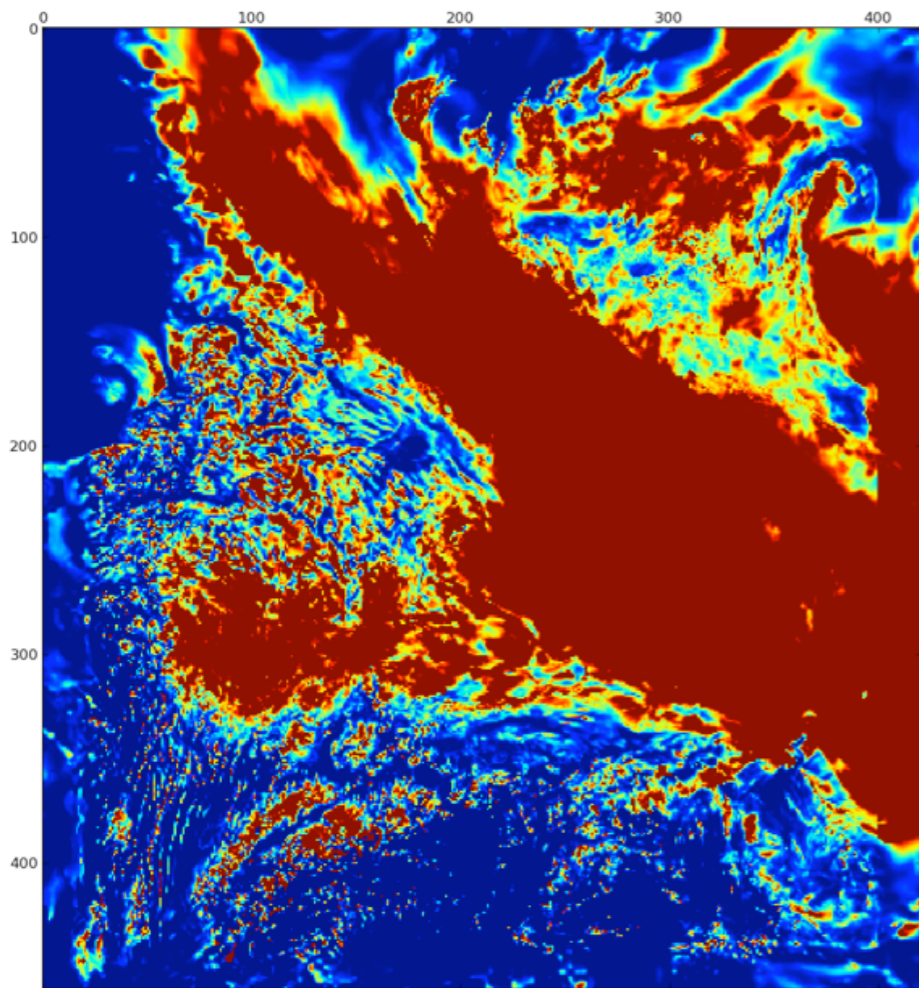
DISORT



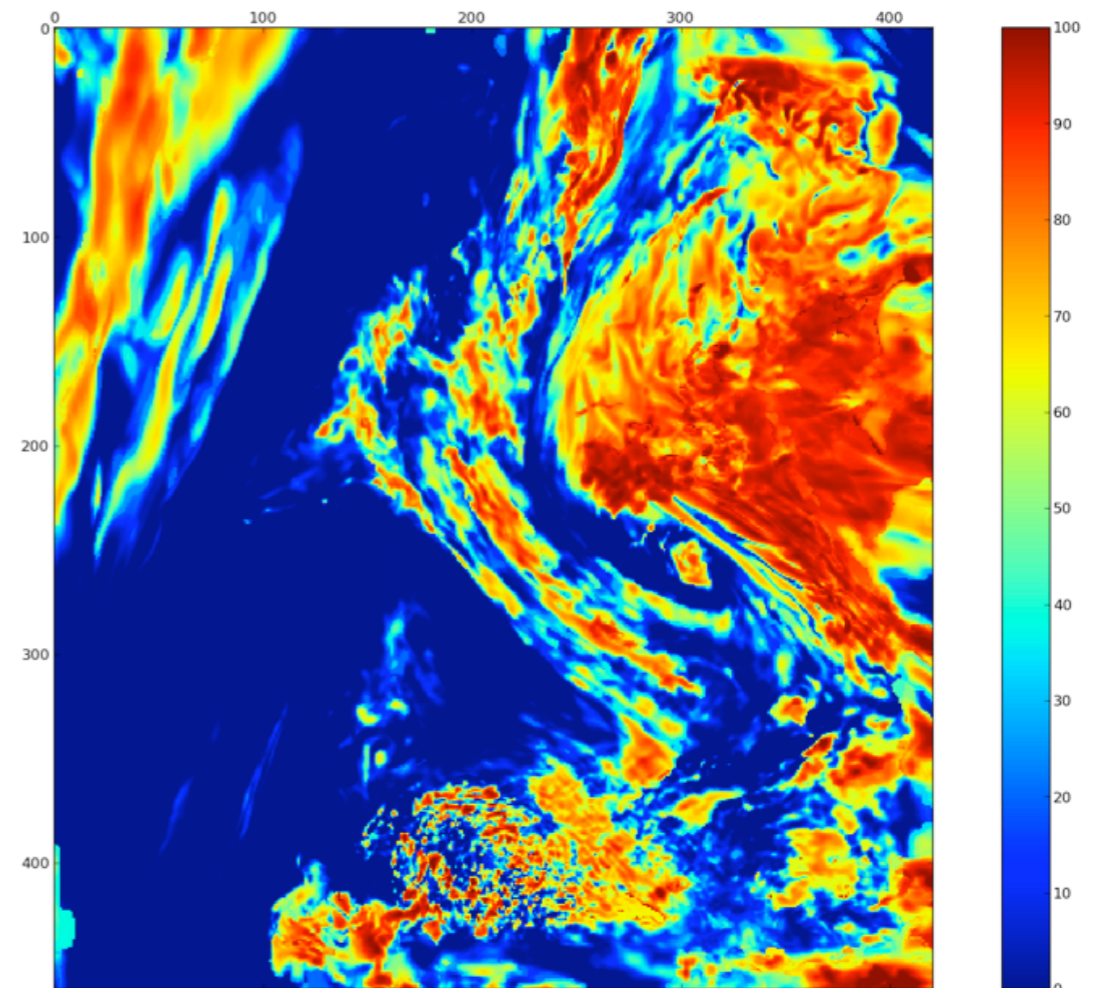
RTTOV

Cloud-Cover in the Model

(31.07.2011, 12h UTC)



low (> 800 hPa)



high (< 400 hPa)

Next Steps:

- apply operator to selected set of test-cases (Annika)
- assessment of operator accuracy
- include and test in KENDA (interpolation to obs. space)
- accelerate operator (hybrid operator + lookup-table, ...)