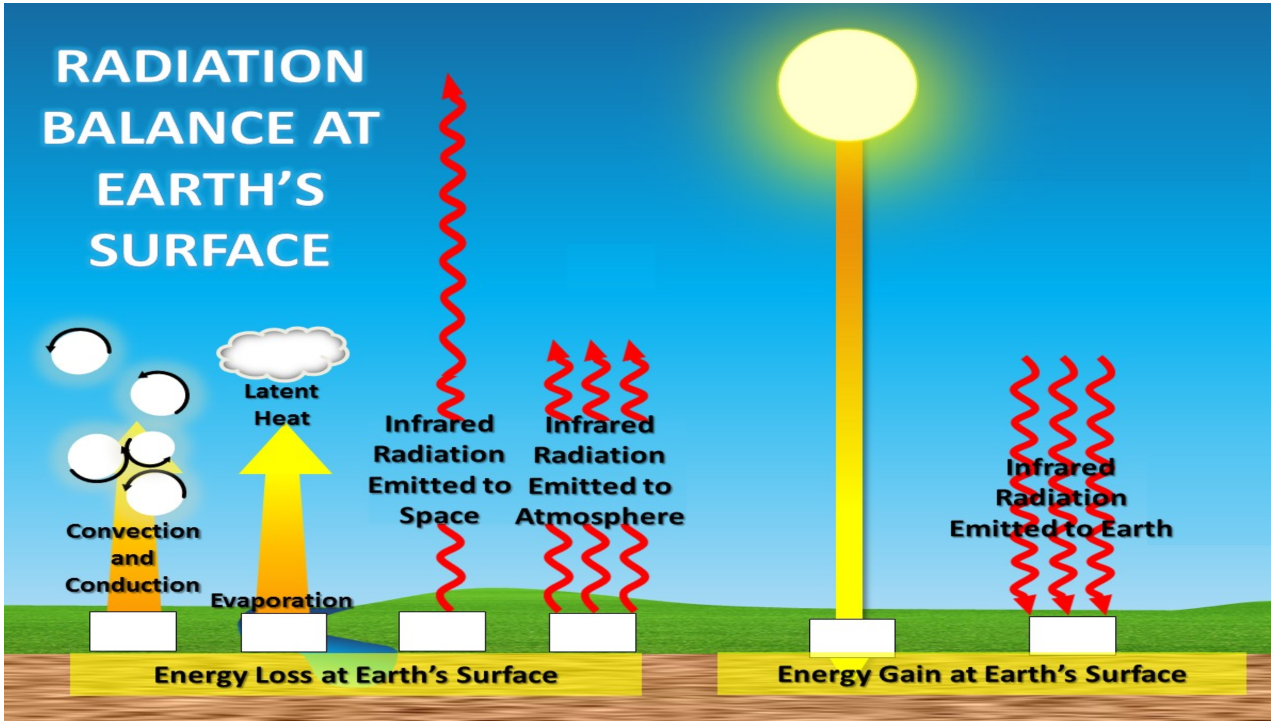
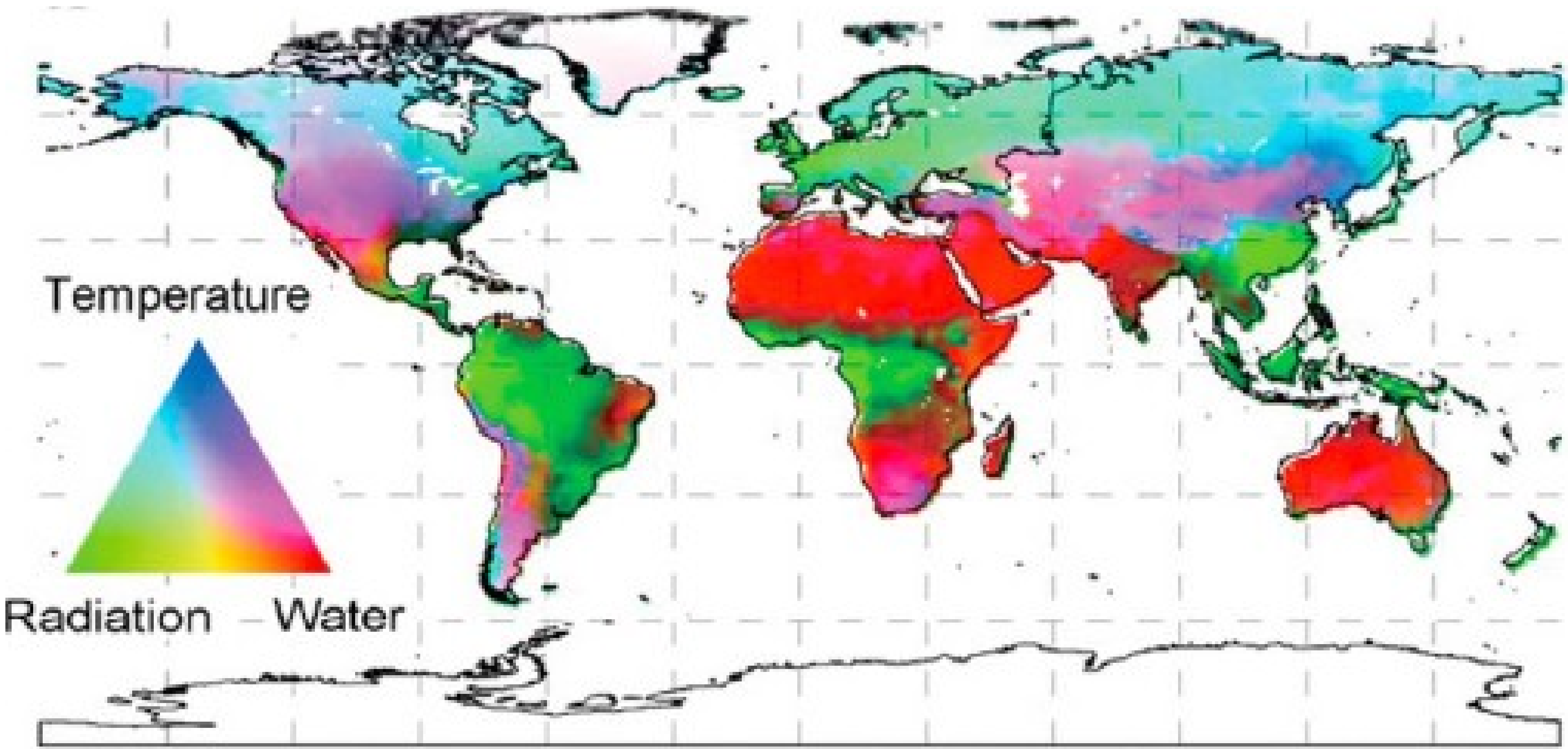
Remote sensing of the surface latent heat flux



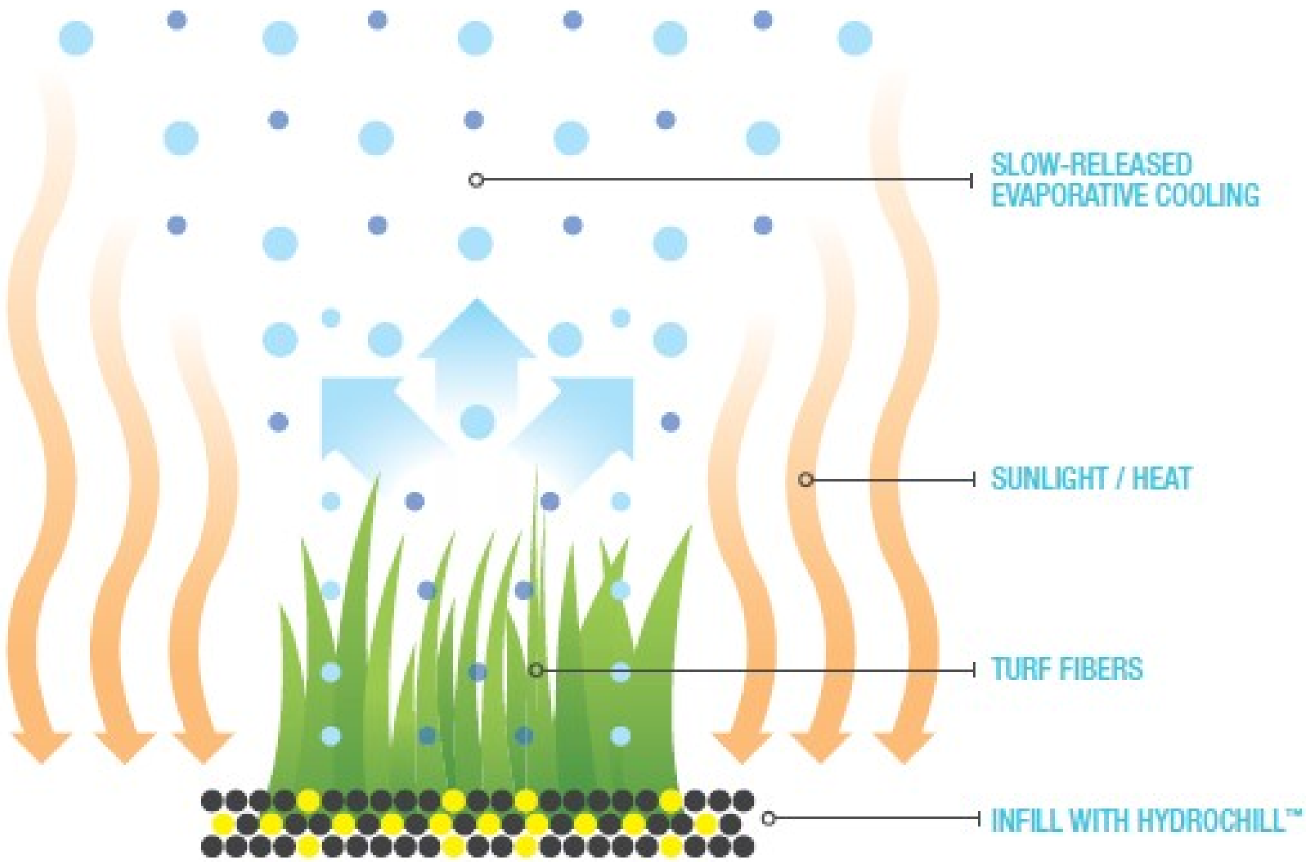
S. Dewitte - RMIB

ERB workshop, Reading, 18-21 Oct 2016

What limits evaporation of water ?



Evaporation of water causes surface cooling.



Used data

MSG LSA SAF data, March 2015

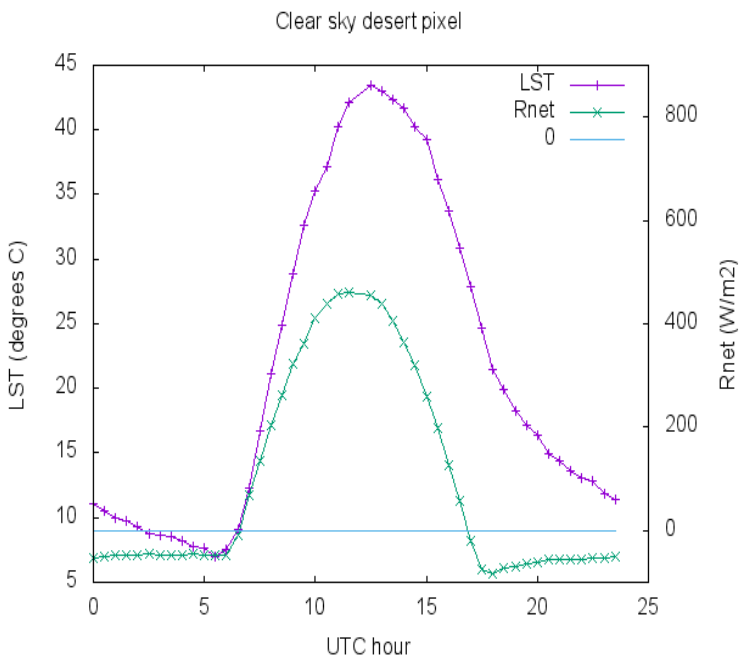
LSA parameters: FSWdown, albedo, FLWdown, LST (clearksy), BB emissivity -> net radiation Rnet

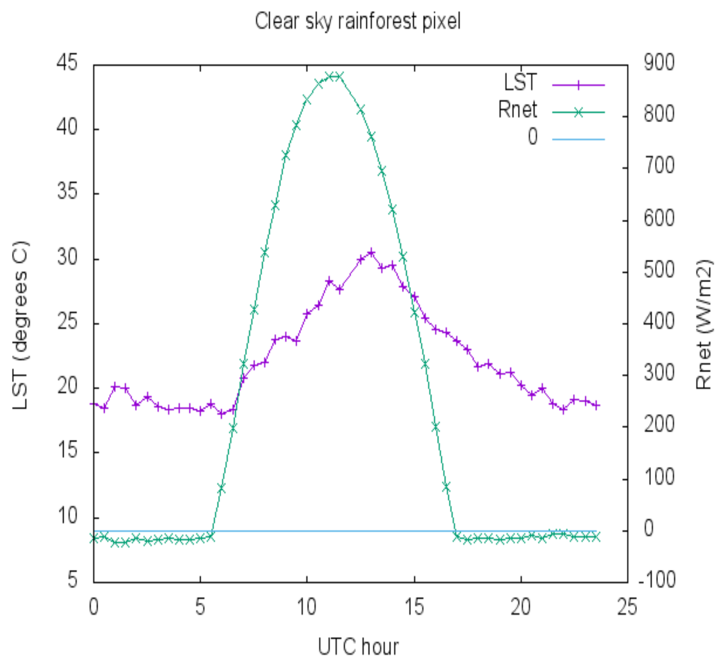
Monthly clear sky average diurnal cycle:

Rnet(h)=mean over clear sky days Rnet(d,h)

LST(h)=mean over clear sky days LST(d,h)

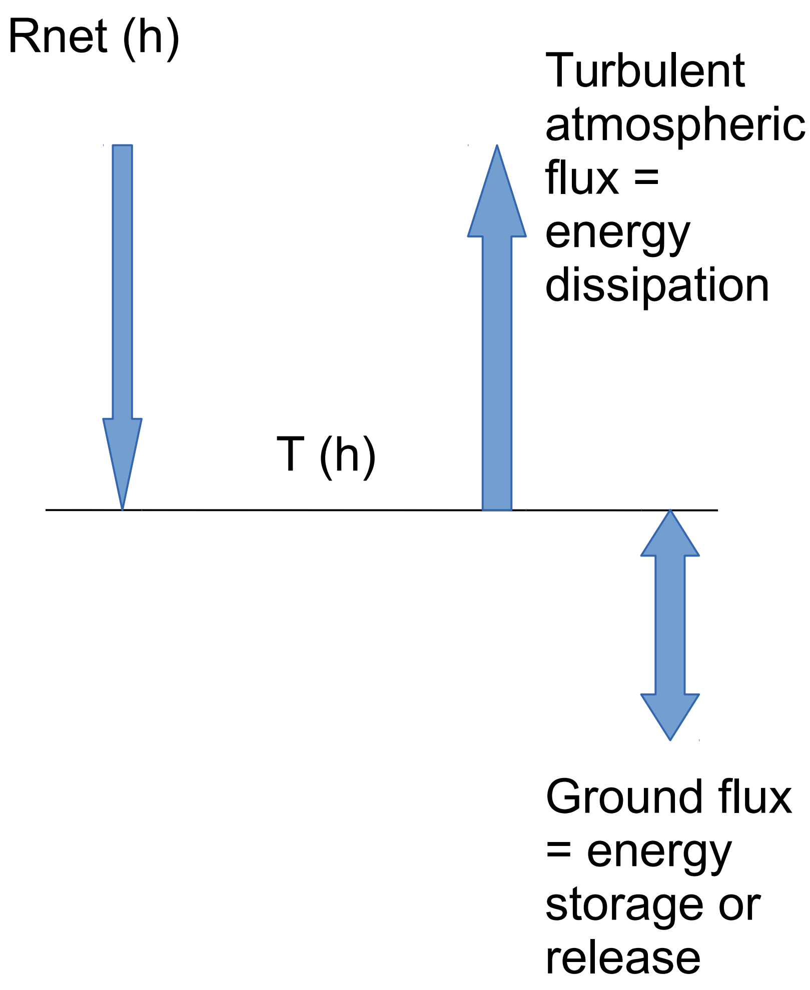
Empirical first order relation Rnet & LST





$$Rnet\ (h) = G(T(h)-To) + CdT(h)/dt$$

Interpretation



G(T(h)-To) = Turbulent atmospheric flux

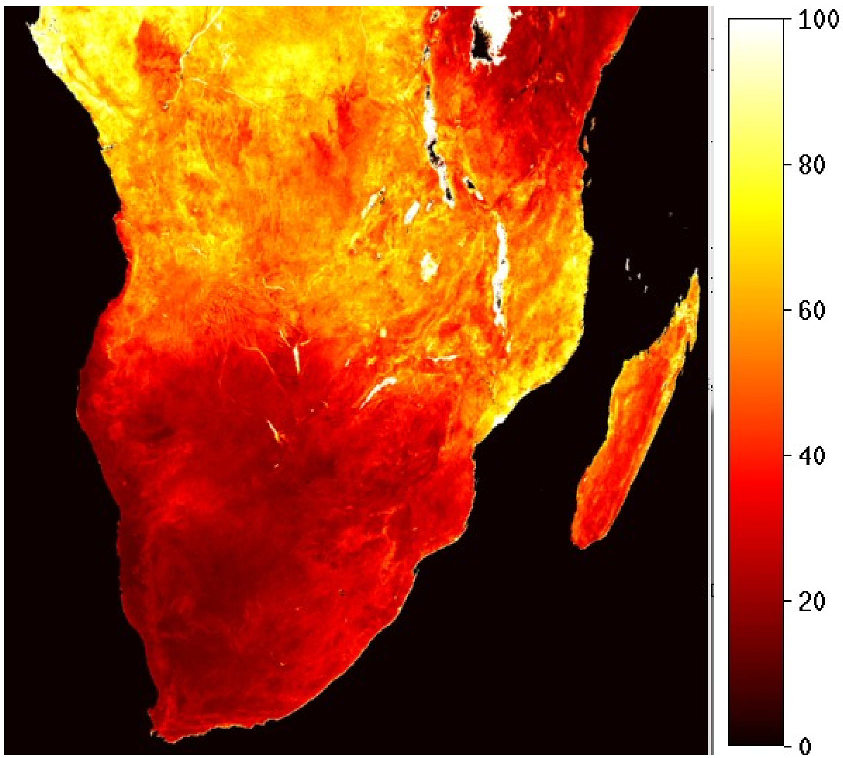
CdT(h)/dt = Ground flux

$$Rnet(h) = G(T(h) - T_o) + C\,dT(h)/dt$$

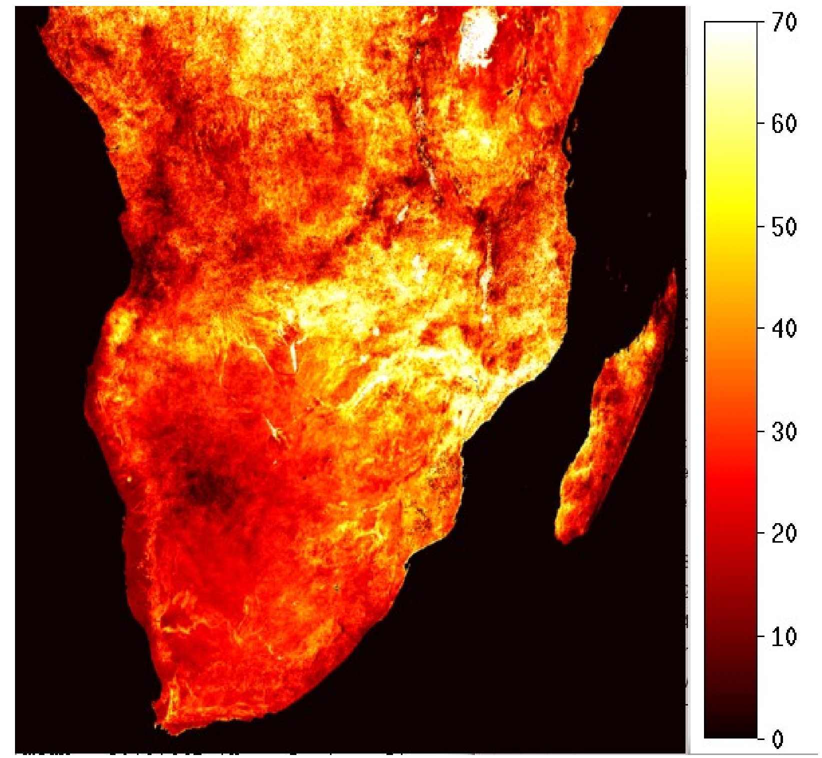
- Input measurements:
  Rnet(h): Net radiation
  T(h): Land Surface Temperature
- Retrieved parameters:
  To: equilibrium temperature
  G: thermal conductance
  C: thermal capacity

Fit results Southern Africa: G,C

G: W/m^{2}K

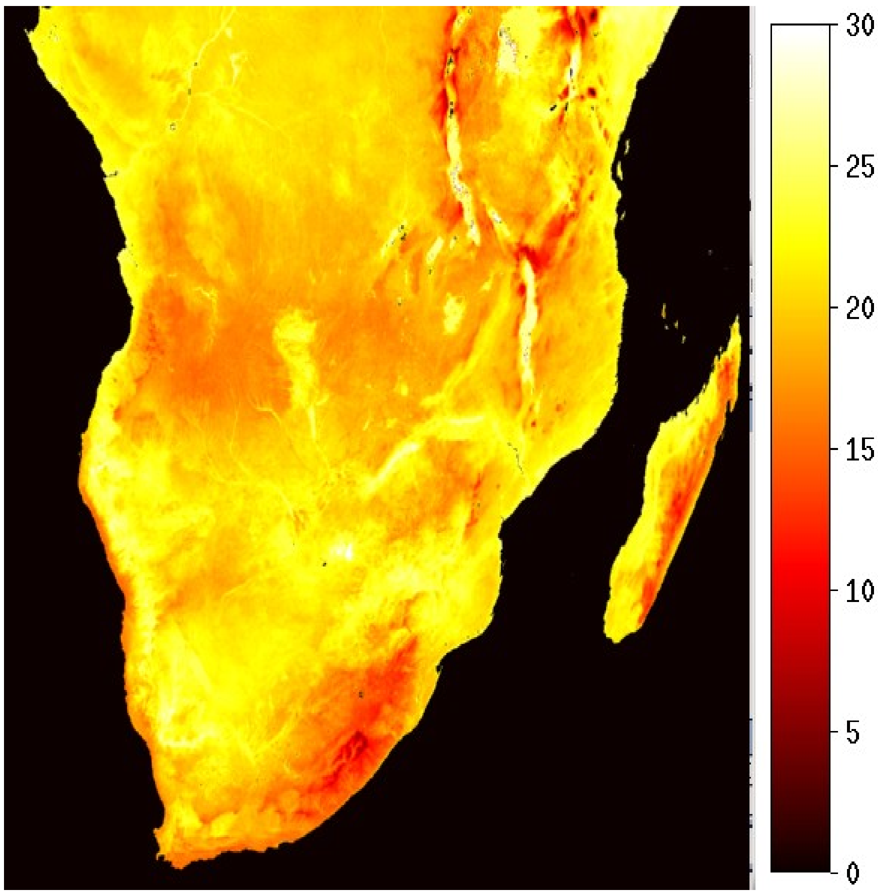


c: Wh/m^{2}K

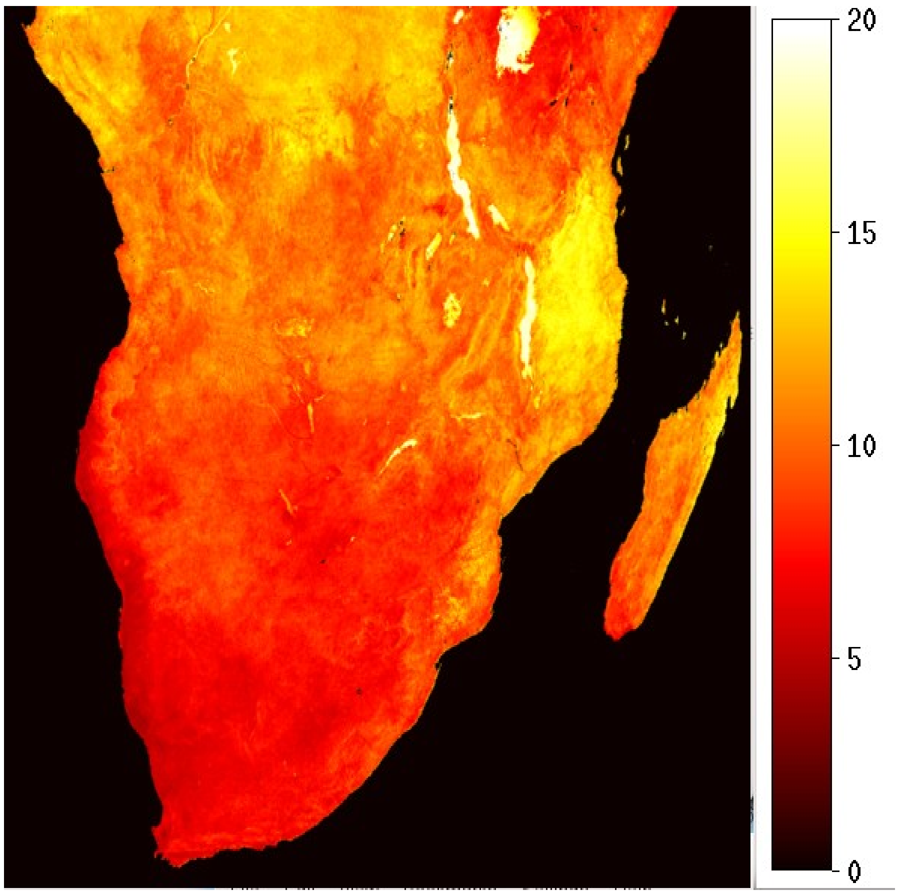


Fit results Southern Africa: To,RMSE

To: Deg. Celsius



RMSE: W/m²

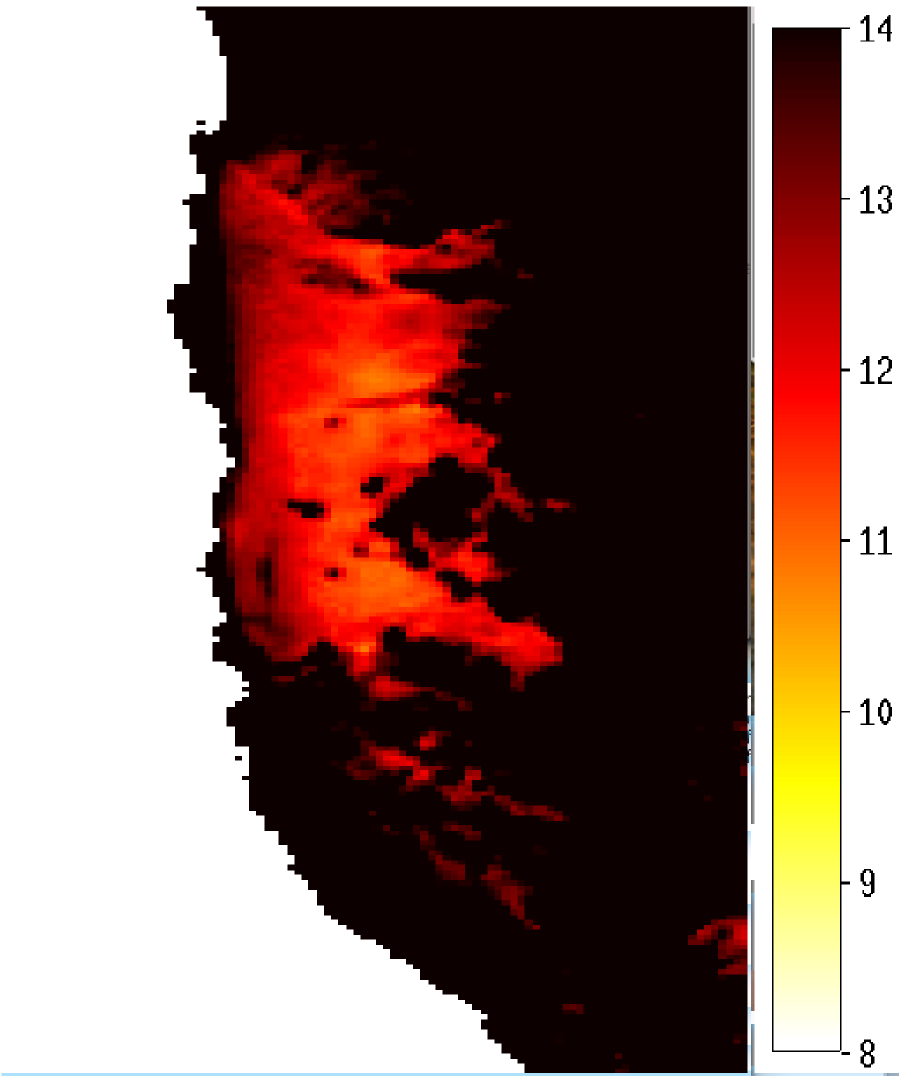


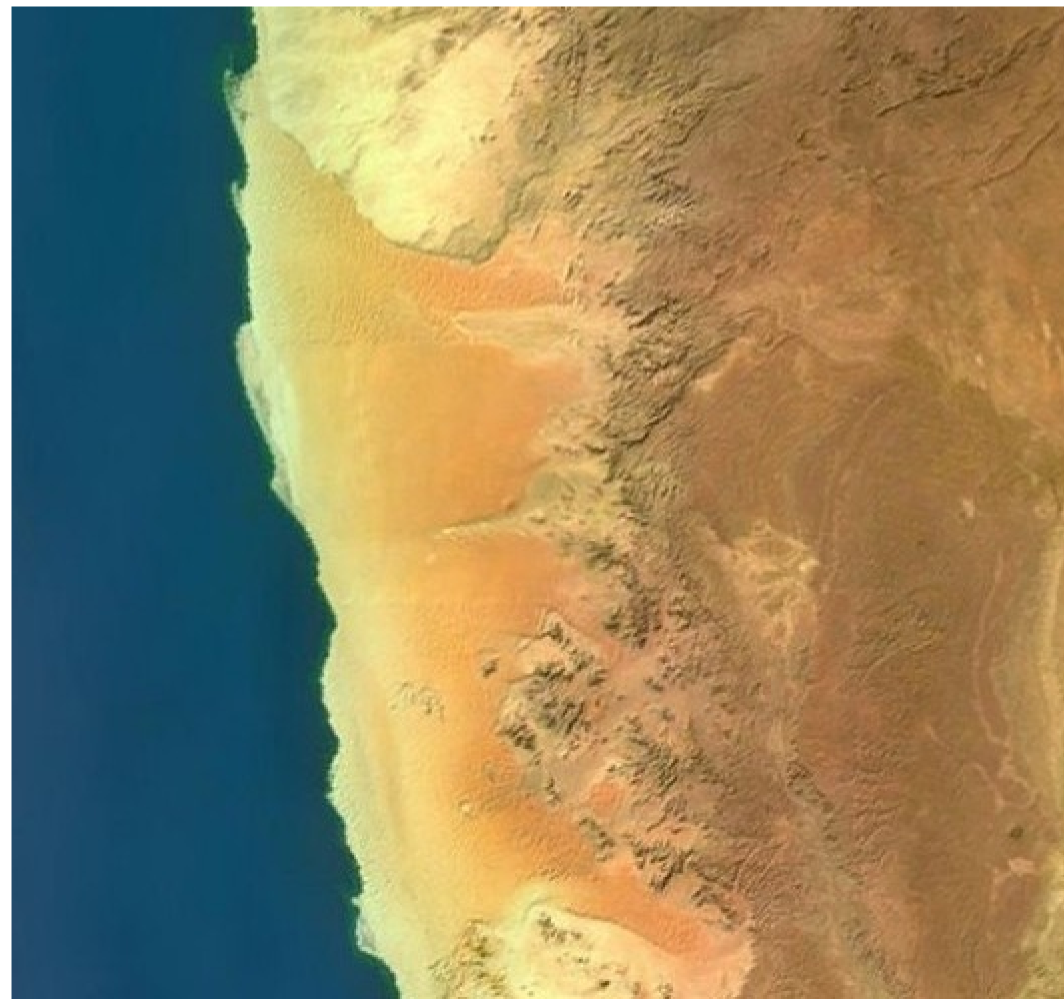
Separation sensible and latent heat flux

- G(T(h)-To) = L + H
- Calibration = small desert
  L=0
  H=Gmin(T(h)-To)
- General case
  H=Gmin(T(h)-To)
  L=(G-Gmin)*(T(h)-To)
- Validation = tropical rain forest
  Check (G-Gmin)*(T(h)-To) = latent heat for potential evaporation

Calibration Gmin over Namib desert

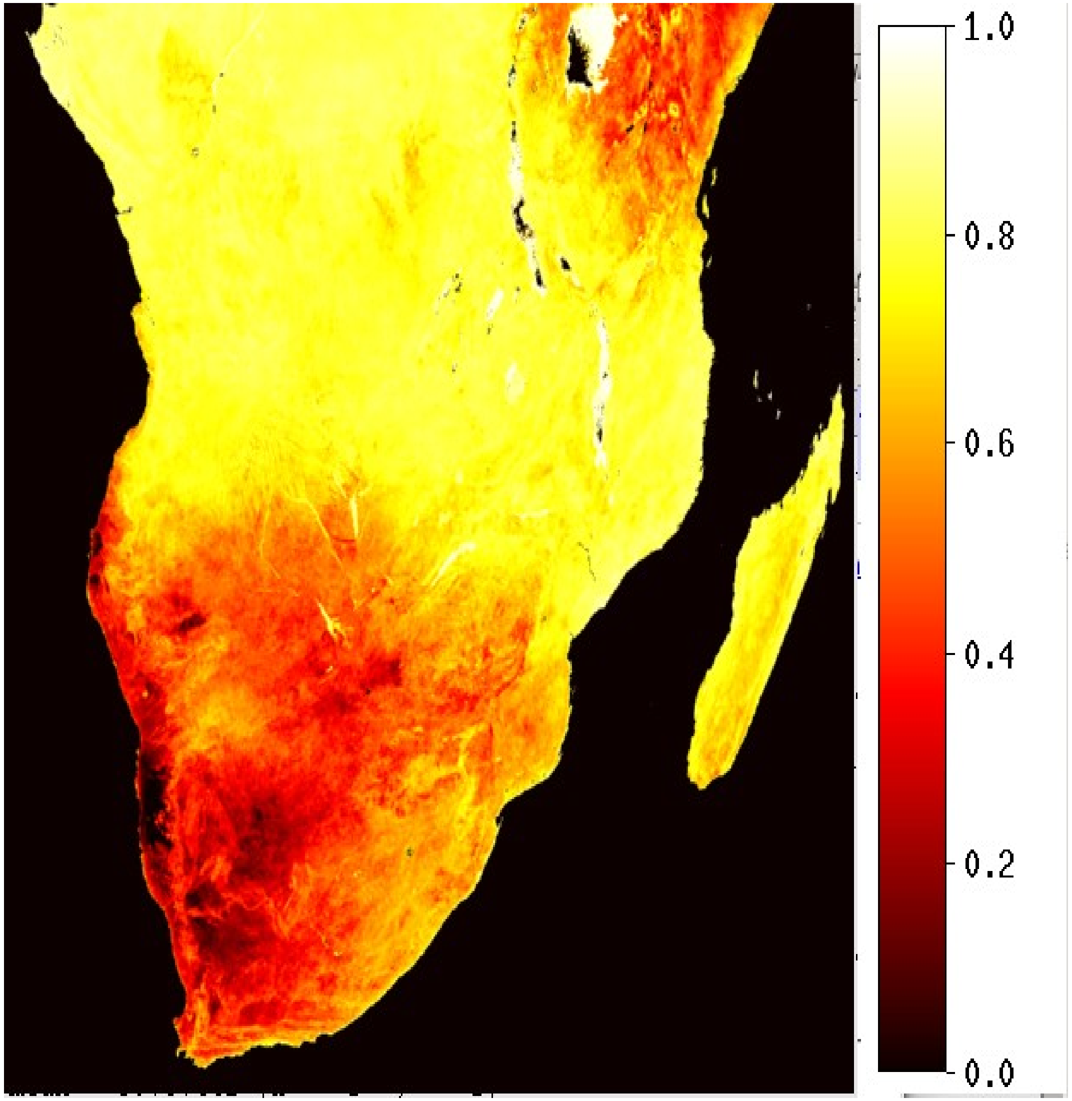
G (W/m²K):



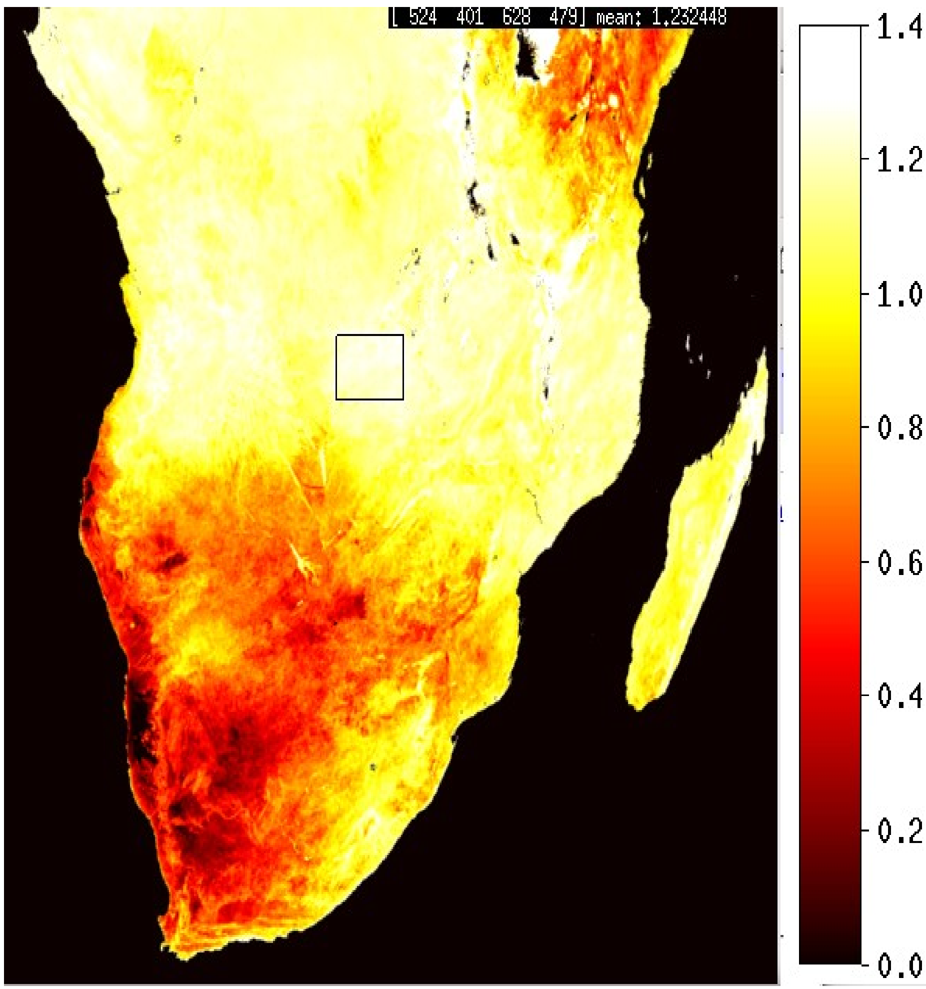


Gmin = 12 W/m²K

EF=(G-Gmin)/G



Validation: comparison with potential evapotranspiration



[Priestley, Taylor, 1972]:

α_{PT}=EF/(δ/(δ+γ))

Over rectangle:

Rel max α_{PT}=1.23 agrees well with expectation for potential EF

Conclusions

A remote sensing method for the retrieval of latent heat has been outlined based on the empirical first order relation between clear-sky net radiation and Land Surface Temperature.

Calibration of the sensible heat conductance is done over the Namib desert.

Validation is done over tropical rainforest.