Remote Sensing of Radiative Heating Rates
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1. Why Radiative Heating Rates?
- Source term of Available Potential Energy (APE) (dominating on global scale)
- Important part of the atmosphere's engine
- APE and AAPE: functions of average values over pressure levels -> Satellite usage necessary
- MSG: high spatial and temporal resolution, 11 usable channels

2. Method
- Shortwave / Longwave Geometry
- Radiative Transfer Model STREAMER (Key and Schweiger, 1996)
- Radiance ToA by MSG / SEVIRI (11 channels)
- Profiles of Radiative Flux Divergence / Heating Rates
- Neural Network

3. Data Set
- Simulate Heating Rates (Shortwave, Longwave and Net) in three altitude levels and corresponding MSG radiances with Radiative Transfer Model Streamer
- Varying 12 variables (surface, atmospheric profiles, cloud geometry and physics, sun geometry, viewing geometry)
  - total of 2934900 profiles per viewing geometry
- Limitations:
  - Aerosols only as background
  - Emissivity of surface is constant with wavelength and surface type
  - Only single layer clouds
  - Use independent, random parts of dataset for
    - Training of Neural Networks
    - Verification
  - Limited size due to computer capacity

4. Neural Network
- 9 Independent Networks for
  - SW, LW, Net Heating Rate
  - Low, Medium, High Layer
- Input: 12 channels (IR039 solar / IR)
- Output: 1 Heating rate per net
  - 4-5 hidden layers,
  - 12-15 neurons each

5. Combination of Models
- Independent Models can be combined
- Error Minimizing with Combination Data Set (Linear Regression)

6. Accuracy
- Total accuracy:
  - low: 0.23 K/Day (19.28%)
  - med: 0.32 K/Day (14.32%)
  - high: 0.17 K/Day (11.94%)
- Over-/underestimation of low/high values

7. Application
- Written in IDL
- Reads input data in CineSat - Format
- Current Version too slow for operational usage (16 min for full disc)
- Useful as climate application (wanted by SAF on Climate Monitoring)
- Combination with other products possible (e.g. latent heat)