Exploitation of high resolution reanalyses concerning renewable energy applications

Regional Reanalyses
- Developed within the Hans-Ertel-Centre for Weather Research (HERZ)
- Two COSMO-based reanalyses
  - COSMO-REA6
    - CORDEX EUR-11 domain
    - 20 years (1995 – 2014)
    - 6 km horizontal res., 40 vertical layers
  - COSMO-REA2
    - Extended COSMO-DE domain
    - 6 years (2007 – 2014)
    - 2 km horizontal res., 50 vertical layers
- Data Assimilation
  - Nudging scheme: SYNOP, SHIP, PILOT, TEMP, AIREP, AMDAR, ...
  - REA2 contains additional latent heat nudging (LHN) of weather RADAR
- Output: 150 atm. and surface variables
  - Interval: 15 min (2D), 60 min (3D)
  - Physically consistent variables in space and time
  - Central Question: Added value of regional reanalyses for renewable energy applications?
    - Weather conditions exert strong influences on dispatch of power plants as well as on electricity infrastructure
    - Regional reanalyses provide relevant quantities at high spatiotemporal resolution

Wind
- General approach to estimate energy potential $P$
  $$ P = 0.5 c_p \rho \pi R^2 v^3 $$
- Use German mean values for power coefficient $c_p$ and blade radius $R$
- Air density $\rho$ and wind speed $v$ are interpolated from model layers to hub height

Key Objective:
Quantify the theoretical potential for renewable energy
- Temporal and spatial dependencies
- Natural limits of renewable energy

Solar
- Development of a double diode model to “estimate” power production
- Cooperation with Bonn-Rhein-Sieg University of Applied Sciences
- Input variables: Direct, diffuse radiation up and down
- Particularly suitable for silicon PV modules
- Investigate availability of solar energy on various spatio-temporal scales
- Compare estimates of REA-6, REA-2 and ERA Interim
- Evaluate with atmospheric supersites (JOYCE), synop stations and “solar consumptions”

Outlook
- Study availability of renewable energy limited by weather related risks, e.g., non-resolving stratus clouds, snowfall, wind extremes
  - Compound events especially threatening, e.g., simultaneous reduction of solar, wind and water energy production
- Evaluate risks of high-impact weather
  - Identify critical weather constellations and assess their likelihood
- Investigate extreme weather events and their impact on energy potential
- Define constraints for European market
  - Robustness of market/system wrt impact of severe weather events
  - Cooperation with Institute of Energy Economics (EWI)