Drought indices and reanalysis data

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Overview

- Drought indices
  - Standardized Precipitation Evapotranspiration Index (SPEI)
  - Palmer Drought Severity Index (PDSI)
- Precipitation
- Evapotranspiration
- Conclusions

Standardized Precipitation Evapotranspiration Index (SPEI)

- The Standardized Precipitation Evapotranspiration Index (SPEI) is an extension of the widely used Standardized Precipitation Index (SPI).
- The SPEI is designed to take into account both precipitation and potential evapotranspiration (PET) in determining drought.
- The SPEI can be calculated on a range of timescales from 1-48 months.

Source: Vicente-Serrano, Sergio M. & National Center for Atmospheric Research Staff (Eds). Last modified 18 Jul 2015. "The Climate Data Guide: Standardized Precipitation Evapotranspiration Index (SPEI)." Retrieved from https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-evapotranspiration-index-spei
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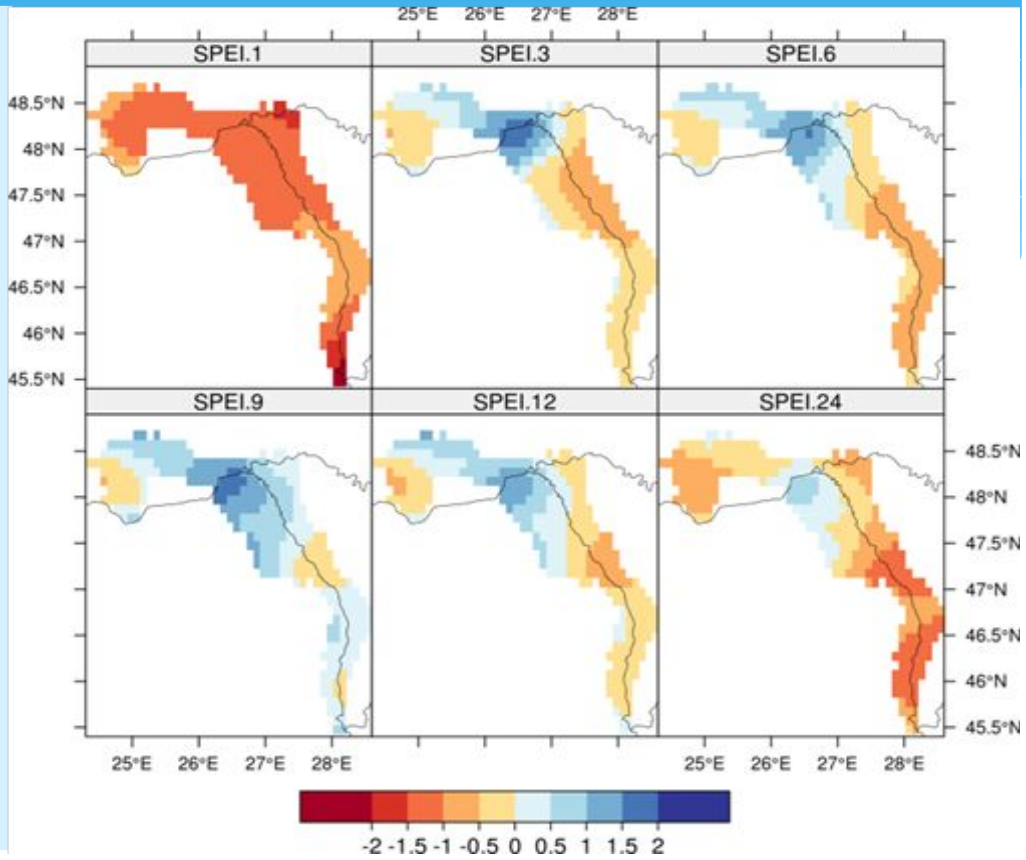
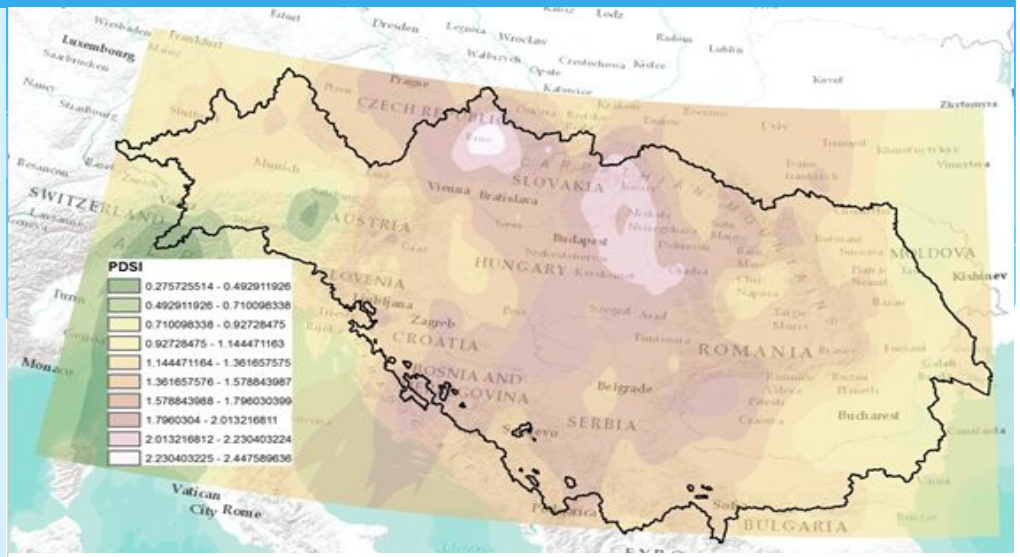


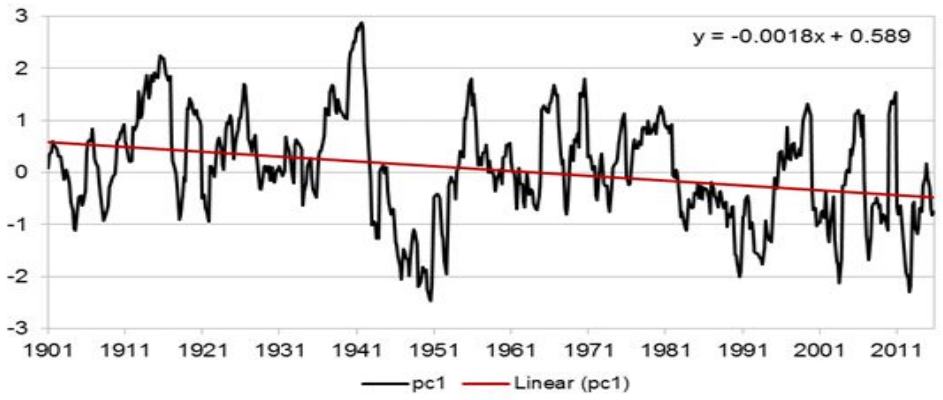
SPEI values in the Prut river basin in August 2010 computed from observations (spatial resolution 0.1° x 0.1°). From imdroflood.meteoromania.ro

Standardized Precipitation Evapotranspiration Index (SPEI)

- The Palmer Drought Severity Index (PDSI) uses readily available temperature, precipitation, potential evapotranspiration data to estimate relative dryness.
- It is a standardized index that spans -10 (dry) to +10 (wet).
- By using surface air temperature and a physical water balance model, the PDSI takes into account the basic effect of global warming through potential evapotranspiration.
- Does not account for snow or ice (delayed runoff); assumes precipitation is immediately available

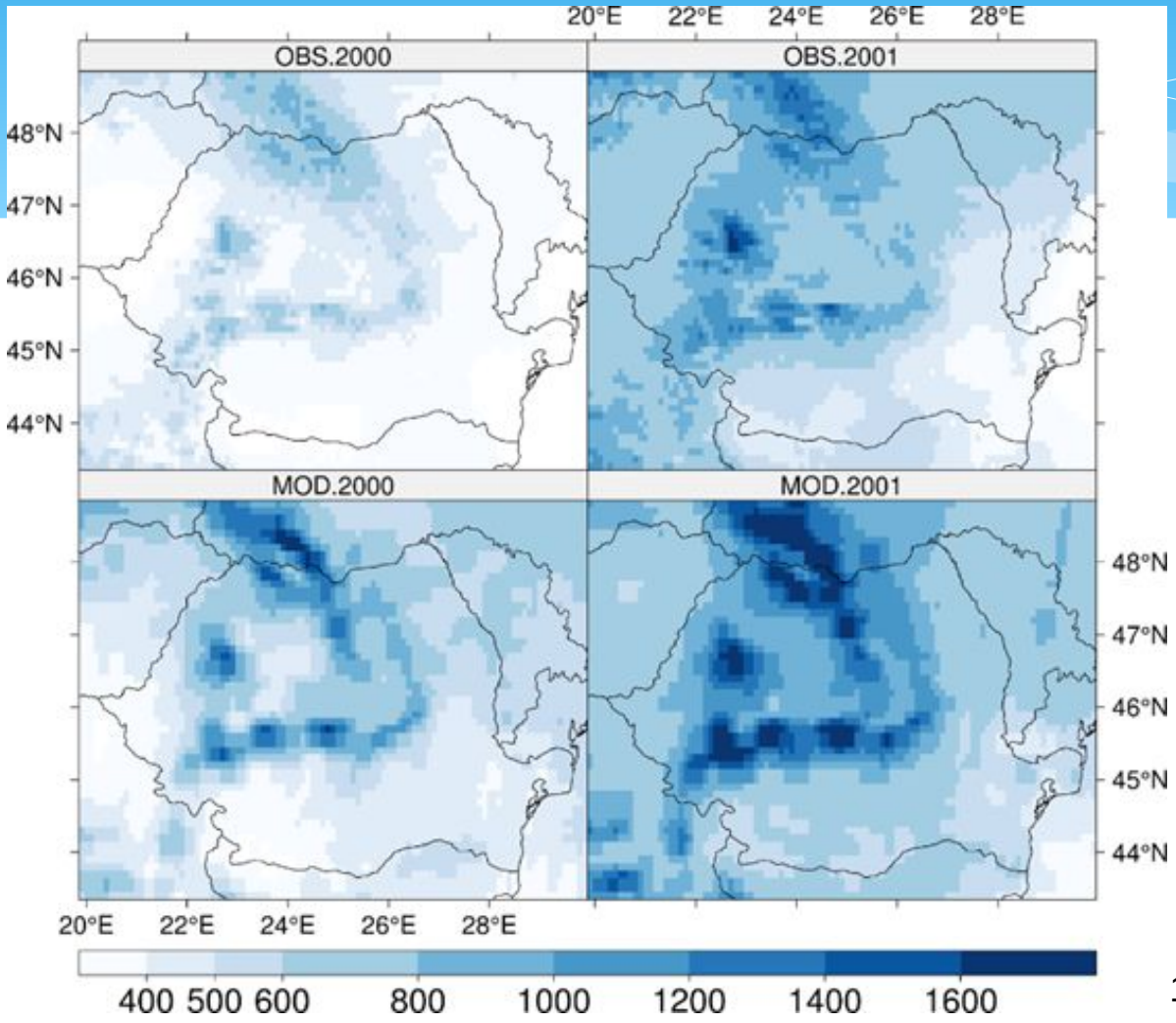
Source: Dai, Aiguo & National Center for Atmospheric Research Staff (Eds). Last modified 12 Jul 2017. "The Climate Data Guide: Palmer Drought Severity Index (PDSI)." Retrieved from https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi .





1st EOF mode of PDSI in the Danube basin computed from observations in the interval 1951-2015 (spatial resolution 0.5° x 0.5°) (Bojariu et al., 2017)

Annual precipitation amount (in mm) in ROCADA and MO UN deterministic reanalysis



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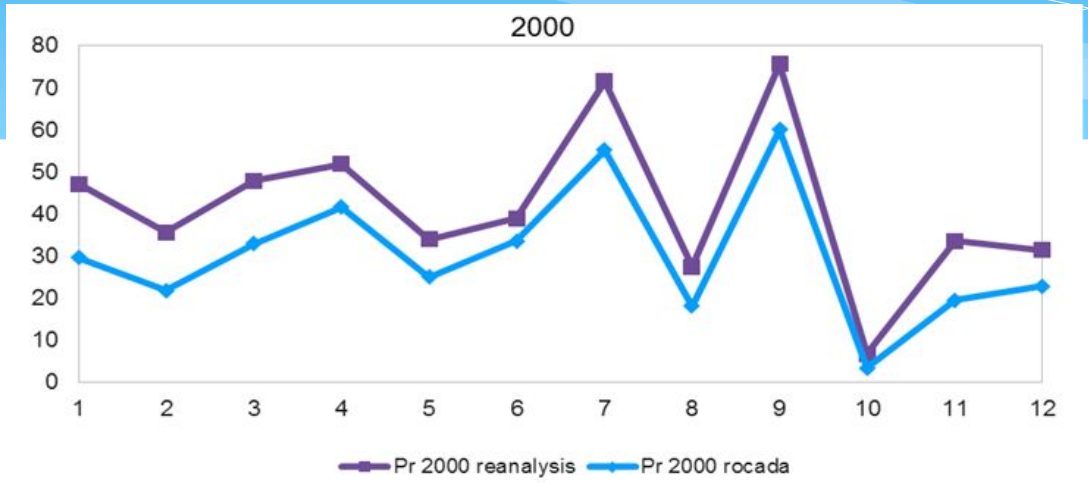
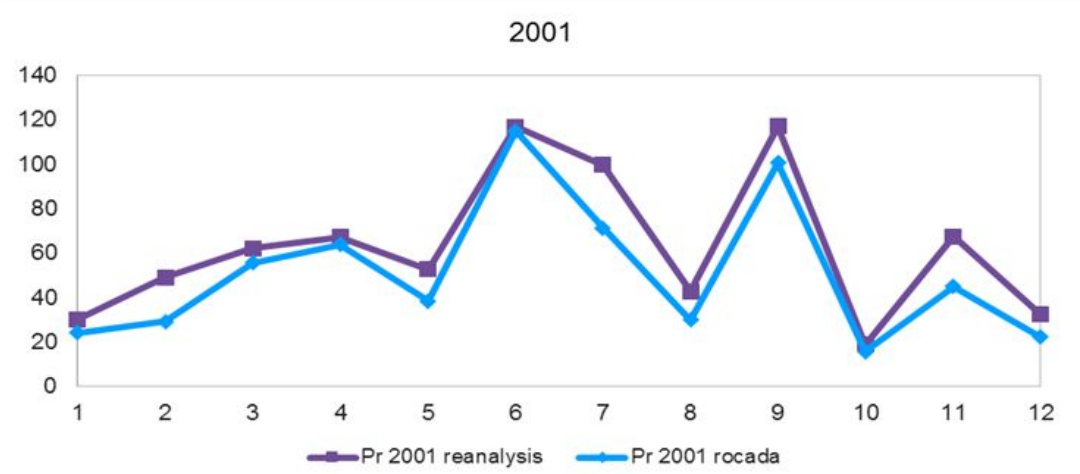
Monthly precipitation amount (in mm) in ROCADA and MO UN deterministic reanalysis Mountain grids (altitude > 500 m)





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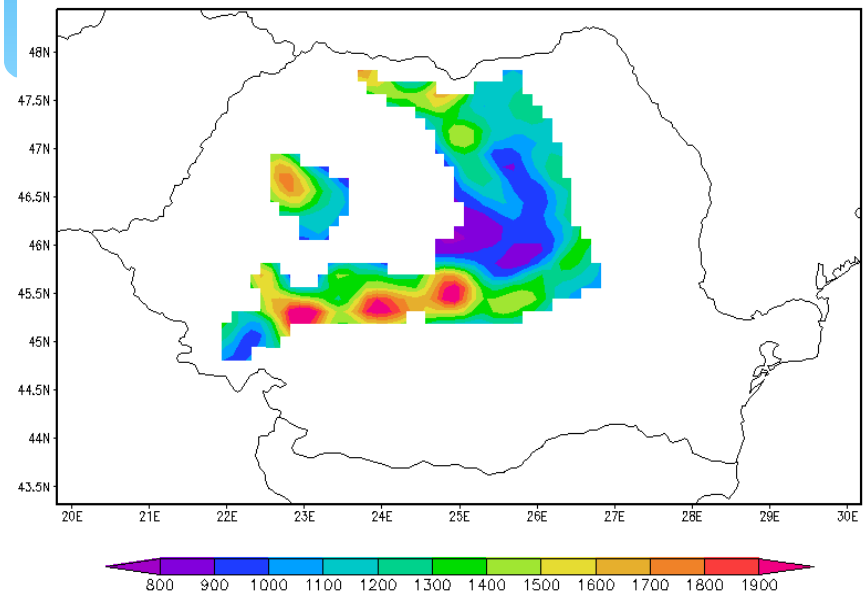
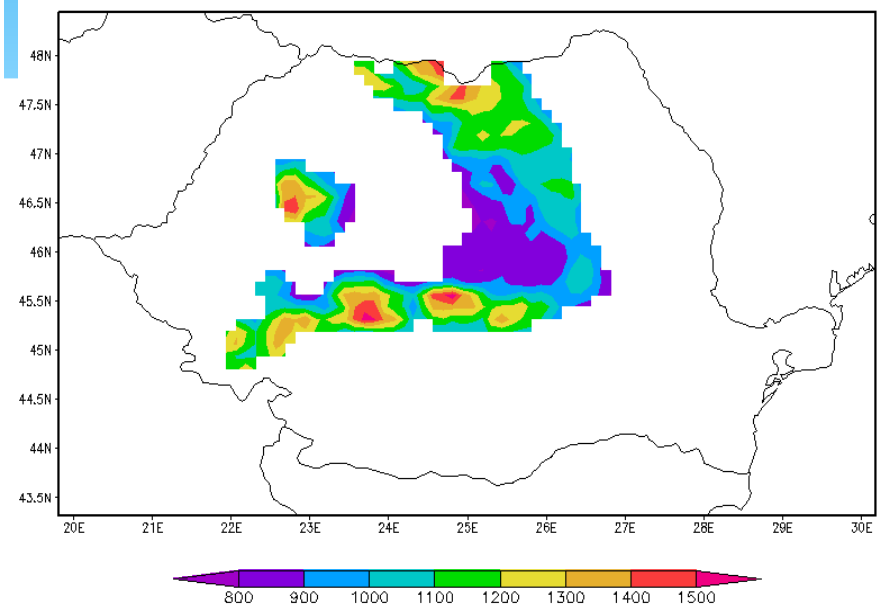
Monthly precipitation amount (in mm) in ROCADA and MO UN deterministic reanalysis 2010
Mountain grids (altitude > 500 m)

Reanalysis 2010

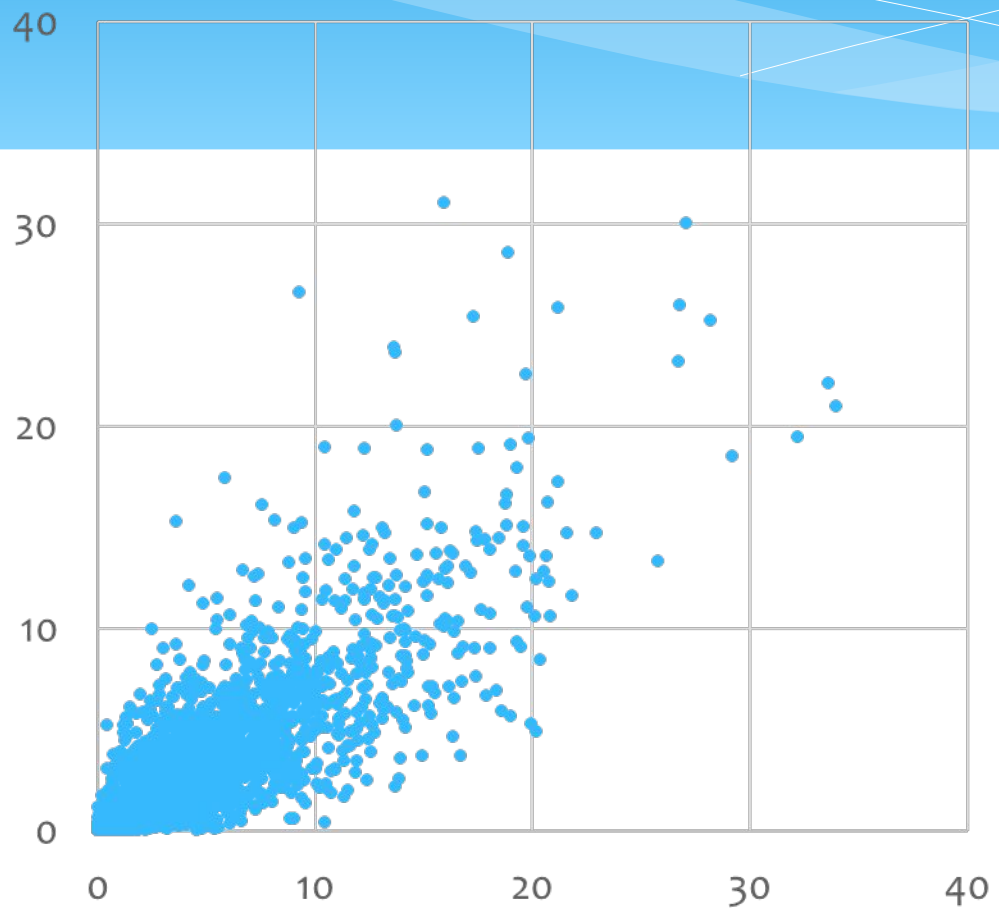


ROCADA 2010



UERRA
Uncertainties in Ensembles of Regional ReAnalyses

Daily precipitation at mountain grids (altitude > 500 m) ROCADA vs. MO UN deterministic reanalysis 1979-1990 R=0.84



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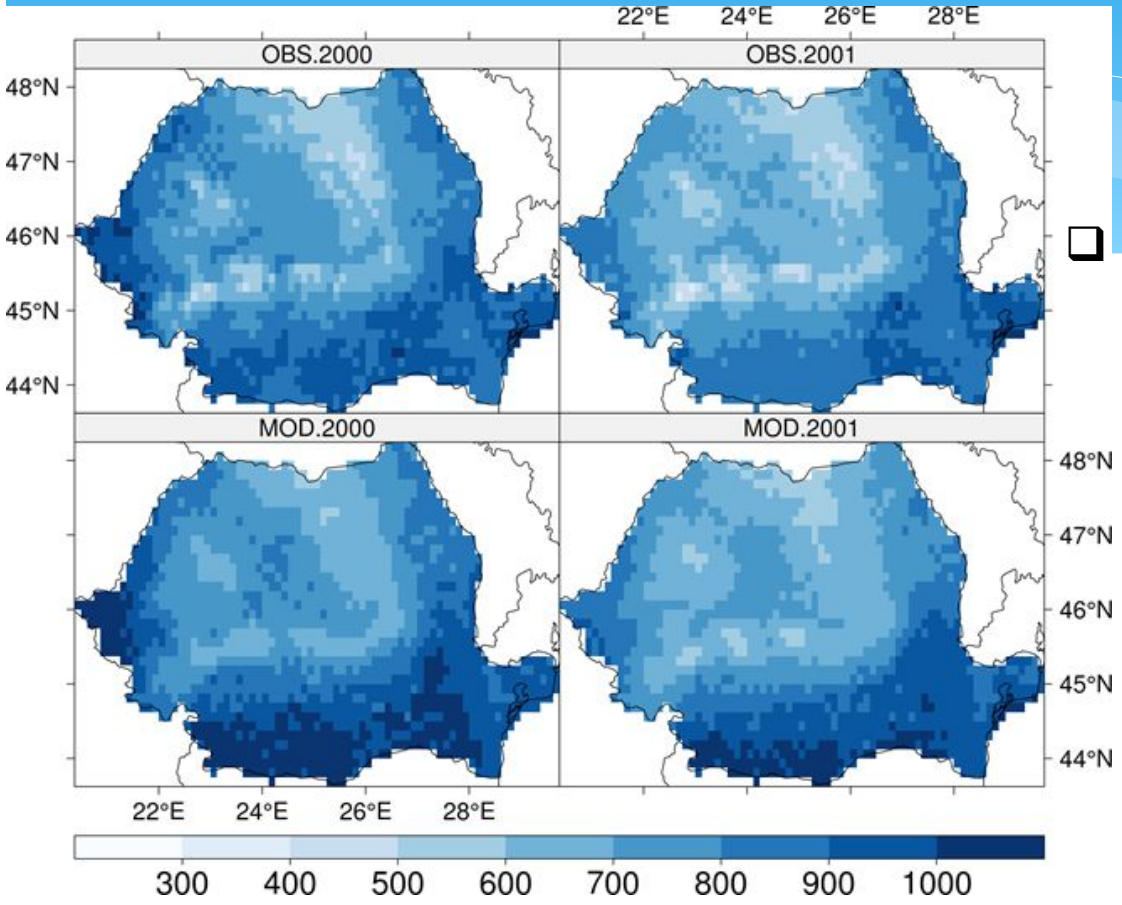
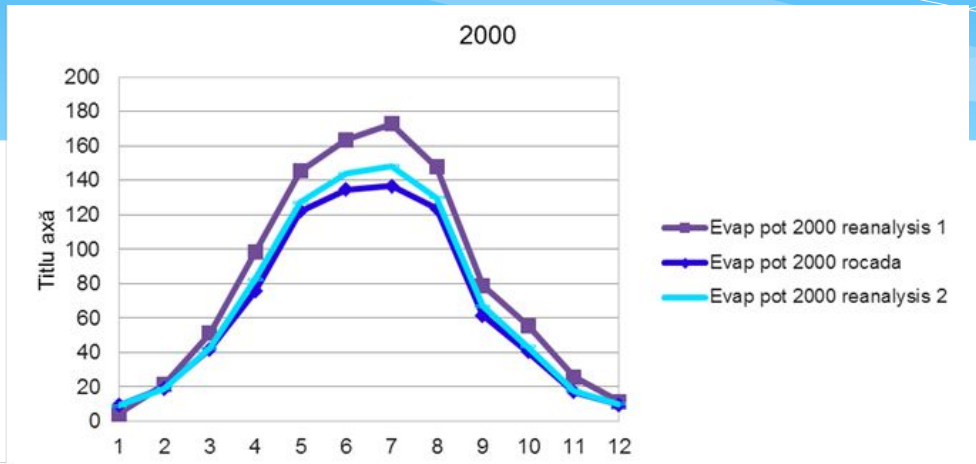
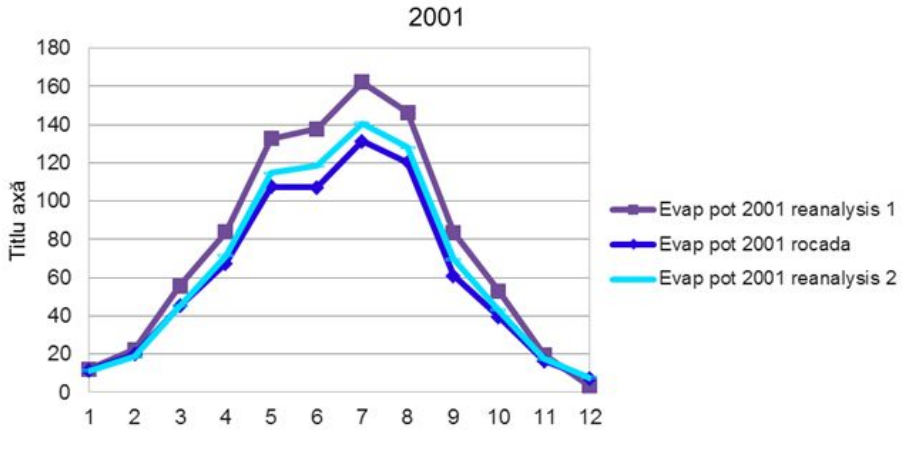
Annual potential evapotranspiration (in mm) in ROCADA and MO UN deterministic reanalysis



- Evapotranspiration
  - Thornthwaite formulation
  - **Penmann – Montheith formulation**

Monthly potential evapotranspiration (in mm) in ROCADA and MO UN deterministic reanalysis





Preliminary conclusions

1. Both precipitation and evapotranspiration are overestimated in the MO UN deterministic reanalysis.
2. Spatial features are quite well captured by the reanalysis.
3. Temporal evolutions correlates quite well on monthly and daily time scales.
4. Spatial and temporal agreement between reanalysis and observed precipitation and potential evapotranspiration data makes feasible the use of reanalysis in the standardized drought indices such as SPEI and self-calibrated PDSI.
5. The physical consistency between reanalysis variables enables the easy use of Penman – Montheith formulation in the potential evapotranspiration and the use of standardized drought indices under climate change.