Meteorological drought monitoring based on satellite rainfall estimates: A case study on the Andean Rapel River Basin (Chile)

“Coping with Droughts”, MWAR-LAC, Santiago, Chile

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Daily precipitation: spatial distribution

25 raingauges (DGA): \(\sim 1\) each 550 km\(^2\) (0-1500 msnm)
Daily precipitation: little data at high elevations

≈ 31% of the area without observations (highest precipitation values)
Daily precipitation: ~short records, with gaps

N° de días con información por año, en cada estación pluviométrica
Cuenca del Río Rapel

SPI-TRMM 3B43.V7-MWAR-LAC 2014
Issues for traditional drought monitoring:

- **Short** or **incomplete** historical records $\rightarrow$ gap filling (from other incomplete historical records).
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Decision-making under uncertainty:

Difficulties for planning ahead and implementation of *ad-hoc* mitigation policies.
To assess the suitability of the satellite-based TRMM 3B43.V7 data as a free and publicly available precipitation data source for meteorological drought monitoring in data-scarce areas, in particular in the Rapel River Basin in the central Chilean Andes (33°51’ - 35°01’ S).
Tropical Rainfall Measuring Mission (TRMM)  Huffman et al. 2007

- Quasi-global and near-real-time satellite rainfall estimates (SRE) (50°N - 50°S), from different satellite-borne sensors.
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- Temporal resolution: every 3 hrs (since 01-Jan-1998).
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- Available products: near-real-time (3B42RT), daily (3B42) and monthly (3B43).
TRMM: Instruments

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- **Cloud and Earth Radiant Energy Sensor (CERES).**

- **Lightning Imaging Sensor (LIS).**
Methodology

Assessment of TRMM 3B43.V7 SRFE against ground raingauges (DGA):

1. Download TRMM 3B43.V7 satellite data (Huffman et al., 2010).
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SPI computations:

1. carried out with the SPEI R package (Beguería and Vicente-Serrano, 2014).
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2. SPI computed for each grid cell at 1-, 3-, 6-, 9-, 12- and 24-month time scales.
1 Motivation
2 Objective
3 Tropical Rainfall Measuring Mission (TRMM)
4 Methodology
5 Results
   - Point-to-pixel comparisons
     - SPI: time series
     - SPI: Spatial distribution
6 Conclusions
Estación Coltauco

Estación P05: Coltauco
Cod.BNA: 06012003–K. Altitud: 280 [m snm]
Estación San Fernando - DCP

Estación P08: San Fernando–DCP
Cod.BNA: 06016004–K. Altitud: 350 [m snm]
Temas

1. Motivation
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SPI-12 at station P05. Nombre: Coltauco

SPI-12 at station P08. Nombre: San Fernando–DCP
SPI-12 at station P11. Nombre: Pichidegua

SPI-12 at station P12. Nombre: La Rufina
Altitud: 735. Cod.BNA: 06027003–1. ID: P12
SPI–24 at station P11. Nombre: Pichidegua

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SPI-12 values based on TRMM 3B42v7
Rapel River Basin


Motivation Objectives TRMM Methodology Results Conclusions References
SPI-24 values based on TRMM 3B42v7
Rapel River Basin

- Apr.2013
- May.2013
- Jun.2013
- Jul.2013
- Aug.2013
- Sep.2013
- Oct.2013
- Nov.2013
- Dec.2013
- Jan.2014
- Feb.2014
- Mar.2014
- Apr.2014
- May.2014
- Jun.2014
- Jul.2014
SPI values based on TRMM 3B42v7 (Jul–2014)
Rapel River Basin
Conclusions

1. Monthly TRMM 3B43.V7 values correctly reproduced the shape of the observed signal and the amount of precipitation registered at 9 raingauges (DGA).

2. The validity of the aforementioned comparison is limited by the lack of observed data above 1500 m asl.


4. Negative values of SPI-12 and SPI-24 all over the basin (July 2014) indicate that a decreasing trend of precipitation is ongoing.

5. SPI values were lower in high elevation areas (no raingauges!) → likely severe negative impacts on agriculture, reservoirs and groundwater levels.

6. The proposed approach might be used as a cost-effective solution to support decision-making or as a first step towards an early warning system in data-scarse regions in LAC.

7. Future improvements: SPEI instead of SPI...
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