Forecasting the Dst index from L5 in-situ data using PREDSTORM: Accuracy and Applicability

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Mapping L5 data to L1: STEREO-B as L5 proxy

- Assume what is seen at L5 (60° angle diff) will arrive later at Earth
- ST-B was near L5 around 2009/2010 —> good proxy for testing!
- Using solar rotation speed and angle difference between ST-B and Earth, adjust time for solar wind to rotate from ST-B to Earth (Thomas+2018)
- Also adjust for expansion due to different distances from Sun (Simunac+2009)

--> Result: forecast of ambient solar wind at L1 for the next 4.5 days!
Prediction of Dst: Application

- ST-B data mapped to Earth can be treated as L1 data —> **predict Dst**

- Temerin-Li-2006 method for **L1 solar wind to Dst forecast**

- Dst calculated for time range **2007 - 2012** (ST-B varied between 0 - 100° from the Earth).

- —> compare models for validation analysis!
Prediction of Dst: Accuracy

- Evaluate accuracy of Dst forecast from ST-B in comparison to L1 measurements and 27-day persistence

- **Correlation coefficient** (top, PCC) and **root-mean-square-error** (bottom, RMSE) vary over angle difference (Δlon) from Earth, decreasing with increasing distance

- ST-B shifted data *performs better than basic persistence* up until Δlon ∼ 80/90°
Prediction of Dst: Real-time Application

- Predictions for the next days made in real-time using STEREO-A data
- Show NOAA real-time L1 data (past) and next 5 days (future forecast) with time-shifted ST-A data
- Dst calculated from real-time L1 and time-shifted data for comparison
- Forecast available online at https://www.helioforecast.space/solarwind
Results

- Solar wind measurements near L5 can be time-shifted to Earth assuming corotation of solar wind structures
- STEREO-B used as a proxy for L5
- Results of Dst predicted from t-shifted ST-B solar wind data near L5 performs better than 27-day persistence
- Code: https://github.com/helioforecast/Predstorm

References