Operational Precipitation from GPCP: PERSIANN

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Project Description

- PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks) algorithm is used to produce more than 30-year of daily precipitation data (1979-current time). Global monthly GPCP precipitation data is used to adjust daily PERSIANN rainfall. The adjusted daily PERSIANN is consistent to the GPCP rainfall at monthly scale.

- **Inputs:**
  - GridSat-B1 CDR Data (IRWIN)
  - GPCP monthly v2.2

- **Output:**
  - GPCP adjusted PERSIANN precipitation
    - Resolution: Daily, 0.25°x0.25° Lat-Lon scale
    - Coverage: Near global coverage 60°S to 60°N

- **Output format:** NetCDF-4 to allow for metadata and the global grid (480 rows x 1440 cols).
# Project Description

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Production Approach

- Infrared data (GridSat-B1) at 7km global every 3 hours is converted to 0.25 deg geographic projection and input to PERSIANN. Output is 0.25 deg precipitation in mm/hr and accumulated to daily.

- Daily PERSIANN data is accumulated to monthly and 2.5 deg to compare to GPCP for bias adjustment. These monthly bias adjustments are then used to adjust each daily 0.25-degree PERSIANN pixel.

- Adjusted daily PERSIANN data grids will then be converted to NetCDF-4 format with the appropriate metadata to be added to the CDR.

- Production requires that the IR data be run through the PERSIANN model for a complete month for GPCP adjustment.

- Challenges: Data volume and flow management. Large volumes of data are required for input and generated on output. Input data must be checked for problems and errors. Neither GridSat-B1 nor GPCP are produced on a regular basis and some errors have been found in GridSat-B1.
**Bias Adjustment of PERSIANN Estimates**

**Satellite Data**

- **Global IR**
- **TRMM, DMSP, NOAA Satellites**
- **High Temporal-Spatial Res. Cloud Infrared Images**
- **Instantaneous PMW Rain Estimates**

**PERSIANN structure in a simple scheme**

- **Parameter Adjustment**
- **Feedback**

**Products**

- **PERSIANN Hourly Rainfall** (0.25°x0.25°)
- **PERSIANN Monthly Rainfall** (2.5°x2.5°)
- **GPCP Monthly Precipitation** (2.5°x2.5°)

**PERSIANN Adjusted (Monthly Scale)**

- **Adjusted PERSIANN Hourly Rainfall** (0.25°x0.25°)
- **Bias Adjustment**
Bias Adjustment of PERSIANN Estimates

- Comparison of GPCP monthly rainfall with PERSIANN rainfall before and after bias adjustment
- Bias estimates of PERSIANN rainfall at various spatial and temporal scales are adjusted using GPCP data.

Top: GPCP Monthly, 2.5°, Middle: Original PERSIANN Monthly 0.25°, Bottom: Adjusted PERSIANN Monthly 0.25°
Input Data: GridSat-B1 CDR Data (IRWIN)

- International Satellite Cloud Climatology Project (ISCCP)
  1979 to present
  10-km and 3-hour intervals

1. U.S. Geostationary Operational Environmental Satellite (GOES)
2. European Meteorological satellite (Meteosat) series
3. Japanese Geostationary Meteorological Satellite (GMS)
4. The Chinese Fen-yung 2C (FY2) series.
Input Data: GPCP Monthly Precipitation Data

- **Global Precipitation Climatology Project (GPCP)**

- **GPCP Version 2.2 Combined Precipitation Data Set**
  - Global Precipitation Climatology Project monthly precipitation dataset from 1979-present combines observations and satellite precipitation data into 2.5° x 2.5° global grids.
PERSIANN Estimates (Before & After GPCP Precipitation Adjustment)

- PERSIANN before and after GPCP monthly rainfall adjustment
- Spatial resolution: 0.25° x 0.25° Lat-Long
- Temporal resolution: daily

Daily Rainfall

Before GPCP Adjustment

After GPCP Adjustment
Quality Assurance Approach

- Test using CPC-IR grid data and GridSat-B1 CDR Data (IRWIN) to generate PERSIANN estimates and evaluate PERSIANN estimates (before and after GPCP monthly precipitation adjustment)

- Compare PERSIANN with GPCP 1DD daily estimation for the period of 1997—2009

- Compare PERSIANN with stage IV radar/gauge estimates over CONUS.
Generate PERSIANN Precipitation from CPC Grid IR and GridSat-B1 CDR Data

**GPCP adjusted PERSIANN Daily Rainfall Estimation: DOY 202, 2005**

**CPC IR Generated PERSIANN Rainfall**

**ISCCP B1 IR Generated PERSIANN Rainfall**

**After GPCP adjustment**

CORR = 0.929

RMSE = 3.437

BIAS = 0.281
GPCC and PERSIANN Precipitation (0–30°)

- Mean Areal Precipitation (MAP) for Northern and Southern hemisphere (0-30°).
- The GPCP adjusted PERSIANN matches GPCP monthly rainfall.
Comparison of the PERSIANN and Bias-Adjusted PERSIANN with Daily GPCP product (1-DD)
Bias-Adjusted PERSIANN estimates are consistent with the GPCP Daily (1-DD) estimates.
PERSIANN and Stage IV Estimates

- NCEP gauge adjusted radar rainfall is used to evaluate PERSIANN rainfall
- Day-by-day evaluation statistics (CORR, RMSE, and BIAS) are listed
- With adjustment from GPCP monthly rainfall, evaluation statistics (RMSE and BIAS) are improved from non-adjusted PERSIANN rainfall

### Daily Correlation Coefficient (May 2007)

- **PERSIANN** (avg= 0.546)
- **Adj. PERS** (avg= 0.546)

### Daily Root Mean Square Error (May 2007)

- **PERSIANN** (avg= 7.673)
- **Adj. PERS** (avg= 7.477)

### Daily Bias Estimates (May 2007)

- **PERSIANN** (avg= -0.738)
- **Adj. PERS** (avg= -0.645)
Applications: Water Focus

- **Applications:**
  - Water resources systems planning and management
  - Extreme events analysis (intensity, frequencies, and duration of floods & droughts)

- **Users:**
  - Dept. of Water Resources (DWR), State and National Water Agencies
  - USGS, NWS, WMO UNESCO-IHP
  - International partners to validate the products: Taiwan, India, Israel, Italy, Thailand, Namibia...
PERSIANN CDR for Hydro-climatological Application

Applications

Drought Management

Flood Forecasting

Water Resources
Extreme Event Analysis: Floods (intensity, frequency, duration...)

Pakistan Flood
Extreme Event Analysis: Drought Monitoring (intensity, frequency, duration...)

SPI Estimates: PERSIANN Satellite Precipitation Data

1-Month SPI Index; June 2007

3-Month SPI Index; April-June 2007

6-Month SPI Index; January-June 2007

SPI Estimates: NCDC Gauge Precipitation Data

1-Month SPI Index; June 2007

3-Month SPI Index; April-June 2007

6-Month SPI Index; January-June 2007
Schedule & Issues

- **State project current status**
  - Downloaded and processed Grid-B1 CDR Data (IRWIN)
  - Run and test PERSAINN and GPCP adjusted PERSIANN codes
  - Download GPCP monthly rainfall 1970~2010
  - Generated multi-year PERSIANN data: 1980~2010

- **Plans for next phase of the project**
  - Evaluate products (Local, regional, and global evaluation using gauge, radar, and other better quality data sources)
  - Examine data quality and reprocess/remove data with problems
  - Quantify the uncertainty of estimates

- **Risks or concerns**
  - Our product updates are dependent on input data sources (Grid-B1 and GPCP).
  - GridSat-B1 is completed through year 2009 and has some errors/problems required further attention. The data from 2010~current time is not ready.
  - GPCP v2.2 completed through year 2010. The data from 2010~current time is not ready.
Known issues on GridSat-B1

- Some data under the Meteosat coverage are not assigned correctly