

Earthcast MCP

Environmental & Weather Data for AI Systems

What It Is

Model Context Protocol (MCP) server combining comprehensive global weather data with specialized environmental products from Earthcast Technologies API

Overview

Key Stats

- **17 Total Tools:** 15 weather tools + 2 Earthcast tools
- **9 New Products:** Specialized environmental and launch decision data
- **6+ Platforms:** Warp, Claude Desktop, Claude Code, Cline, Cursor, Grok (xAI)
- **Global Coverage:** Weather data worldwide + specialized US launch operations

Status

- ✓ **Production Ready** - All tools tested and documented
- 🎯 **DoD Ready** - Grok (xAI) support for defense deployment

Core Capabilities

Launch Decision Support

- **GO/NO-GO Evaluations** with customizable safety thresholds
- Real-time assessment of lightning, windshear, turbulence, radar
- Comprehensive launch weather analysis for Cape Canaveral, Vandenberg, etc.

Space Weather & Aviation

- **Neutral Atmospheric Density** (100-1000km altitude) - Satellite drag calculations
- **Ionospheric Density (VTEC)** - GPS/radio propagation, space weather
- **Contrail Formation** - Aviation condensation trail prediction
- **Multi-Level Windshear** - Low (5,000 ft) and high-altitude (30,000 ft)
- **Turbulence Forecasting** - Flight safety and passenger comfort

Complete Weather Coverage

Global Weather Data

- Global forecasts (1-16 days, NOAA + Open-Meteo)
- Current conditions, alerts, historical data (1940-present)
- Air quality, marine conditions, lightning, rivers, wildfires
- Location services with saved favorites

Technical Architecture

Integration Pattern

```
AI Assistant (Warp/Claude/Grok)
  ↓
MCP Protocol (stdio communication)
  ↓
Earthcast MCP Server
  ├── Earthcast Technologies API → Specialized environmental data
  ├── NOAA → US weather (detailed forecasts, alerts)
  ├── Open-Meteo → Global weather & historical (1940-present)
  ├── Nominatim (OpenStreetMap) → Global geocoding & location search
  ├── Blitzortung.org → Real-time lightning detection (global)
  ├── RainViewer → Precipitation radar imagery (global)
  ├── NIFC → Active wildfire perimeters (US)
  └── USGS → River conditions & flood status (US)
```

API Details

Core Weather Data

- **NOAA** (National Oceanic & Atmospheric Administration) - Official US weather service, no API key
- **Open-Meteo** - Global forecasts + 85 years of historical data (ERA5 reanalysis), no API key

Location Services

- **Nominatim** - OpenStreetMap geocoding with excellent coverage of small towns/villages worldwide

Specialized Services

- **Blitzortung.org** - Community-operated global lightning network via MQTT, real-time strike data
- **RainViewer** - Global precipitation radar with tile-based imagery system
- **NIFC** (National Interagency Fire Center) - ArcGIS service with current wildfire perimeters
- **USGS** - River gauges and water levels for flood monitoring

Key Features

- **Intelligent Caching** - 50-80% fewer API calls, <10ms cached responses
- **Retry Logic** - Exponential backoff with jitter for reliability
- **Multi-Source Fallback** - Automatic selection of best data source
- **Type Safety** - Full TypeScript implementation
- **Production Ready** - Comprehensive error handling and logging

Installation (One Command)

```
npx earthcast-mcp
```




No installation needed - works immediately with any MCP-compatible AI assistant

Real-World Applications

Launch Operations

Query: *"Is it safe to launch from Cape Canaveral today?"*

Result:

-  Lightning: 0.0 (threshold: 0.5) - **GO**
-  Windshear: 6.17 m/s (threshold: 15.0) - **GO**
- **OVERALL: GO FOR LAUNCH** 

Aviation Planning

Query: *"Compare surface winds with upper-level conditions at Houston"*

Result:

- Low-level windshear: 1.34 m/s (very calm)
- High-level windshear: 23.71 m/s (significant jet stream)
- Turbulence: Moderate (2.74)
- Contrail potential: 40.72 (moderate to high)

Space Weather Monitoring

Query: *"Get ionospheric density and neutral atmospheric density at 400km"*

Result:

- Ionospheric density: 12.38 TECU (moderate activity)
- Neutral density (100km): $3.54 \times 10^{-7} \text{ kg/m}^3$
- Impact analysis for satellite operations

DoD Weather Intelligence

Query: *"Combined weather and environmental analysis for operational planning"*

Result: NOAA standard weather + Earthcast specialized products + launch criteria

Historical & Archive Data

Comprehensive Historical Weather Archive

Data Coverage

Global weather data from 1940 to present - 85+ years of historical weather records

Recent Data (Last 7 Days) - US Only

- **Source:** NOAA Real-Time API
- **Resolution:** Detailed hourly observations from weather stations
- **Data Points:** Temperature, conditions, wind speed/direction, humidity, pressure, precipitation
- **Reliability:** High accuracy from official weather station networks
- **Use Cases:** Recent event analysis, trend verification, short-term pattern analysis

Archive Data (1940-Present) - Global

- **Source:** Open-Meteo Historical Weather API (ERA5 reanalysis)
- **Coverage:** Worldwide - any location on Earth
- **Resolution:** 9-25km grid, hourly or daily summaries
- **Data Points:** Temperature, precipitation, wind, humidity, pressure, cloud cover, snow depth
- **Time Ranges:**
 - Hourly data for ranges up to 31 days
 - Daily summaries for longer periods
- **Data Quality:** High-resolution reanalysis data validated against observations
- **Latency:** 5-day delay for most recent data (finalization period)

Real-World Applications

Climate Research & Analysis

- Long-term temperature trends and climate change studies
- Historical extreme weather events (hurricanes, floods, droughts)
- Seasonal pattern analysis across decades
- Climate model validation

Operational Planning

- Launch site historical weather conditions ("What was the weather on this date last year?")
- Site selection analysis ("Average wind conditions in January for the past 10 years")
- Risk assessment for operations
- Insurance and liability analysis

DoD Mission Planning

- Historical weather conditions for training scenarios
- Environmental baseline assessments for new installations
- Operational weather pattern analysis
- Post-mission weather reconstruction

Technical Details

- **Caching:** Archived data (>1 day old) cached indefinitely (never changes)
- **Performance:** Fast retrieval for any date in 85+ year archive
- **No Authentication Required:** Free access via Open-Meteo API
- **Global Coverage:** Works for any coordinate pair worldwide

Query Examples

"What was the weather in Paris on January 15, 2024?"

→ Returns: Temperature, precipitation, wind, cloud cover for that specific day

"Show me weather data for Tokyo from Jan 1 to Dec 31, 2020"

→ Returns: Full year of daily summaries with temperature ranges, precipitation totals

"What was the weather like at Cape Canaveral 3 days ago?"



→ Returns: Detailed hourly observations from NOAA (US location)

"Average February conditions at 45°N, 120°W for 2015–2024"

→ Returns: 10-year February weather climatology for that location

Summary

Earthcast MCP delivers:

1.  **Launch decision support** for space operations
2.  **Advanced environmental data** for aviation and satellites
3.  **Complete weather coverage** from proven foundation
4.  **Multi-platform support** including DoD-ready Grok integration
5.  **Production architecture** with caching, retry logic, error handling

Ready for Deployment

Ready for deployment across:

- Defense operations (DoD via Grok)
- Commercial space launch operations
- Aviation weather planning
- Research and environmental monitoring
- AI-assisted weather intelligence

Built on proven weather-mcp foundation + specialized Earthcast Technologies integration

Questions?

For more information, see README.md in the project repository