Data User Guide

ER-2 X-Band Doppler Radar (EXRAD) EPOCH

Introduction

The ER-2 X-Band Doppler Radar (EXRAD) EPOCH dataset consists of radar reflectivity and Doppler velocity estimates collected by the EXRAD onboard the AV-6 Global Hawk Unmanned Aerial Vehicle research aircraft, though traditionally this instrument is flown on the NASA ER-2 aircraft. These data were gathered during the East Pacific Origins and Characteristics of Hurricanes (EPOCH) project. EPOCH was a NASA program manager training opportunity directed at training NASA young scientists in conceiving, planning, and executing a major airborne science field program. The goals of the EPOCH project were to sample tropical cyclogenesis or intensification of an Eastern Pacific hurricane and to train the next generation of NASA Airborne Science Program leadership. The EXRAD EPOCH dataset files are available from August 9, 2017 through August 31, 2017 in HDF-5 format.

Notice: The Global Hawk UAV aircraft did not operate each day of the campaign, therefore EXRAD data are only available for aircraft flight days.

Citation

McLinden, Matthew. 2021. ER-2 X-Band Doppler Radar (EXRAD) EPOCH [indicate subset used]. Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi:
http://dx.doi.org/10.5067/EPOCH/EXRAD/DATA101

Keywords:

NASA, GHRC, EPOCH, EXRAD, reflectivity, Doppler velocity, clouds, precipitation, X-band, nadir, scan, ER-2, radar

Project

The East Pacific Origins and Characteristics of Hurricanes (EPOCH) project was a NASA program manager training opportunity directed at training NASA young scientists in conceiving, planning, and executing a major airborne science field program. Combined with this goal the EPOCH project was to sample tropical cyclogenesis or intensification of an Eastern Pacific hurricane. The EPOCH project consists of three payload instruments, ER-2 X-band Radar (EXRAD), High Altitude Monolithic Microwave Integrated Circuit Sounding Radiometer (HAMSR), and Advanced Vertical Atmospheric Profiling System (AVAPS), onboard the AV-6 Global Hawk Unmanned Aerial Vehicle research aircraft. The launch site was at the Armstrong Flight Research Center located on Edwards Air Force Base in California. The launch/flight window consisted of up to six 24-hour science flights from August 1, 2017 through August 30, 2017 over the Pacific Ocean. More information about the EPOCH project can be found at NOAA UAS Program Participates in NASA's East Pacific Origins and Characteristics of Hurricanes (EPOCH) Project, Emory et al., 2015, and EPOCH: East Pacific Origins and Characteristics of Hurricanes | Earth.

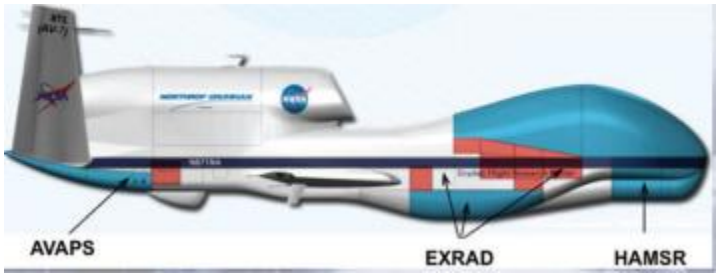

Figure 1: EPOCH airborne instrument suite
(Image source: Emory et al., 2015)

Instrument Description

The X-band Radar (EXRAD) is a single-frequency radar that measures radar backscatter at the X-band (9.6 GHz) frequency. This instrument was previously flown on the Global Hawk Unmanned Aerial Vehicle research aircraft during the EPOCH field campaign, though traditionally this instrument is flown on the NASA ER-2 aircraft. The EXRAD is less affected by signal attenuation from storms than other radars. The instrument has both a conical/cross-track scanning beam and a fixed nadir beam. More information about the EXRAD instrument is available at ER-2 Doppler Radar (EXRAD).

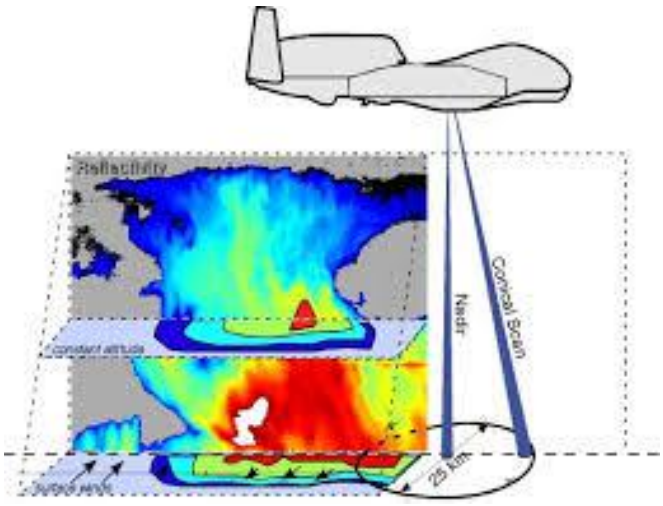

Figure 2: Image of the measurement concept of EXRAD
Image credit: First Flights of ER-2 X-band Radar - EXRAD

Investigators

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Data Characteristics

The EXRAD EPOCH dataset consists of calibrated radar products stored in HDF-5 files. These data are available at a Level 1B processing level and stored in netCDF-4 format. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 2 below.

Table 2: Data Characteristics

Characteristic	Description
Platform	Global Hawk Unmanned Aerial Vehicle research aircraft
Instrument	EXRAD
Spatial Coverage	N: 34.908, S: 16.603, E: -83.612, W: -124.717 (Pacific Ocean)
Spatial Resolution	300 m
Temporal Coverage	August 9, 2017 - August 31, 2017
Temporal Resolution	Hourly -< Daily
Sampling Frequency	0.25 seconds
Parameter	Reflectivity, Doppler velocity
Version	1
Processing Level	1B

File Naming Convention

The EXRAD IMPACTS dataset files are available in HDF-5 format and named using the following convention:

Data files:
EPOCH_2017_EXRAD_[NADIR|SCAN]_Level1B_V03_<start time>_to_<end time>_###.h5

Table 3: File naming convention variables

Variable	Description
[NADIR|SCAN]	Conical scan or NADIR file
<start time>	Start scan time in YYYYMMDDThhmmss format where: YYYY: Four-digit year MM: Two-digit month DD: Two-digit day hh: Two-digit hours in UTC mm: Two-digit minutes in UTC ss: Two-digit seconds in UTC
<end time>	End scan time in YYYYMMDDThhmmss format where: YYYY: Four-digit year MM: Two-digit month DD: Two-digit day hh: Two-digit hours in UTC mm: Two-digit minutes in UTC ss: Two-digit seconds in UTC
###	Scan number
.h5	HDF-5 format

Data Format and Parameters

The EXRAD EPOCH dataset is stored in HDF-5 files. The EXRAD HDF-5 data field descriptions are listed in Table 4 below.

Table 4: EXRAD HDF-5 File Data Fields

Field Name	Unit
AntennaAzimuth	degrees
AntennaElevation	m
Averages	-
CPUsec	s
CPUusec	ms
DataAltitudeMeters	m
DataAzimuthOffTrack	degrees
DataElevationOffNadir	m

DataLatitude	Degrees North
DataLatitudeDelta_mDegrees	Degrees North
DataLongitude	Degrees East
DataLongitudeDelta_mDegrees	Degrees East
DataPositionHeight	m
DataPositionX	-
DataPositionY	-
DataPositionZ	-
dBZ	dBZ
dBZ_NoiseMask	dBZ
dBZ_QCMask	dBZ
DopplerVelocity	m/s
DopplerVelocity_NoiseMask	m/s
DopplerVelocity_QCMask	m/s
HousekeepingacqStatus	-
HousekeepingAltSq	-
HousekeepingAntAmpTS	-
HousekeepingAntPwr	-
HousekeepingBodyI	-
HousekeepingBodyOIFault	-
HousekeepingCathI	-
HousekeepingCathOIFault	-
HousekeepingCathV	-
HousekeepingDataSysTS1	-
HousekeepingDataSysTS2	-
HousekeepingDigiRxTmp	-
HousekeepingDROAlarm	-
HousekeepingDROTemp	-
HousekeepingFastFault	-
HousekeepingFaultFount	-
Housekeepingfaults	-
HousekeepingHeaterFault	-
HousekeepingHvPressure	-
HousekeepingHvTemp	-
HousekeepingMainPwrOn	-
HousekeepingNotify	-
HousekeepingPilotPwr	-
HousekeepingPilotTx	-
HousekeepingPort0	-
HousekeepingPort1	-

HousekeepingPreAmp0TxPr	-
HousekeepingPreAmp1HvPr	-
HousekeepingPreAmp2TxTmp	-
HousekeepingPreAmp3HvTmp	-
HousekeepingPreAmpTmp	-
HousekeepingRFStretPwr	-
HousekeepingTotalFaults	-
HousekeepingTWTReady	-
HousekeepingTxFault	-
HousekeepingTxFaultPG	-
HousekeepingTxOnStatus	-
HousekeepingTxPressure	-
HousekeepingTxTemp	-
L0_Process_Date	-
L1A_Process_Date	-
NavigationDriftINSPVA	-
NavigationEastVelocityINSPVA	m/s
NavigationGroundSpeedINSPVA	m/s
NavigationHeadingINSPVA	degrees
NavigationHeightINSPVA	m
NavigationLatitudeINSPVA	Degrees North
NavigationLongitudeINSPVA	Degrees East
NavigationNorthVelocityINSPVA	m/s
NavigationPitchINSPVA	degrees
NavigationRollINSPVA	degrees
NavigationSecondsINSPVA	s
NavigationTrackINSPVA	degrees
NavigationUpVelocityINSPVA	m/s
NavigationWeekINSPVA	-
RangeMeters	m
sigma0	-

Algorithm

High-resolution cross-sections of vertical air motions within precipitation regions of a storm are calculated by factoring out hydrometeor fallspeeds and aircraft motions from the EXRAD nadir beam measurements. The instrument's dual-beam technology can also provide measurements of horizontal air motions and assist with attenuation estimates. More information about EXRAD measurement capabilities is described in Heymsfield et al. (1996).

Quality Assessment

Meteorological targets are usually distorted by the radar antenna main- and sidelobes, especially in sharp hydrometeor gradient areas. More information about errors in radar measurements is available in Heymsfield et al., 2000 and Caylor et al., 1997.

Software

No special software is required to read these data, however, NASA Panoply can be used to easily open and view the HDF-5 files.

Known Issues or Missing Data

The aircraft did not operate each day of the campaign, therefore EXRAD data are only available for aircraft flight days.

References

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https://doi.org/10.1175/1520-0450(2001)040%3C2080:TPRRPA%3E2.0.CO;2

NASA Earth Sciences: EPOCH: East Pacific Origins and Characteristics of Hurricanes.
https://earth.gsfc.nasa.gov/meso/campaigns/epoch

NOAA UAS, 2017: Program Participates in NASA's East Pacific Origins and Characteristics of Hurricanes (EPOCH) Project.
https://uas.noaa.gov/News/Articles/ArtMID/6699/ArticleID/401/NOAA-UAS-Program-Participates-in-NASAs-East-Pacific-Origins-and-Characteristics-of-Hurricanes-EPOCH-Project

Related Data

All other datasets collected as part of the EPOCH campaign are considered related and can be located by searching the term "EPOCH" in the GHRC HyDRO2.0 search tool. Other EXRAD datasets can be located by searching the term "EXRAD" in HyDRO2.0 and are listed below.

ER-2 X-Band Doppler Radar (EXRAD) IMPACTS
(http://dx.doi.org/10.5067/IMPACTS/EXRAD/DATA101)

GPM Ground Validation ER-2 X-band Radar (EXRAD) IPHEx
(http://dx.doi.org/10.5067/GPMGV/IPHEX/EXRAD/DATA101)

Contact Information

To order these data or for further information, please contact:

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