

Use of GLOBAL SOUNDING BALLOONS (GSBs) to augment over-ocean observations within and near Extreme Weather Events such as Atmospheric Rivers and Tropical Cyclones

Peter Black¹, Todd Hutchinson¹, Vijay Tallapragada², Xingren Wu², Anna Wilson³ and Jason Dunion⁴

¹Windborne Systems, Inc., Palo Alto, CA USA, ²NOAA, National Weather Service, National Center for Environmental Prediction, Environmental Modeling Center, USA ³Center for Western Weather and Water Extremes, Scripps Institution of Oceanography, University of California, La Jolla, CA USA and ⁴NOAA Hurricane Research Division, Cooperative Institute of Marine and Atmospheric Sciences, University of Miami, Miami, FL USA



AIM

- Global Sounding Balloons (GSB) observe temperature, humidity, wind speed and wind direction.
- Profile the atmosphere from the surface boundary layer (100 m) to the tropopause (20 km).
- Sounding interval: ~ every 3-hr for 5-6 days (7 profiles per day).

LOCATION/ TARGET

- GSBs deployed from Seoul, S. Korea and Maui, Hawaii during 2022 ARRecon season in the Central and Eastern North Pacific: 15 February to 21 April.
- GSBs deployed from from Cabo Verde, Puerto Rico and Gainesville, FL within and around tropical disturbances and Tropical Storms during 2022 Atlantic Hurricane season.

OBJECTIVES

- Deploy GSBs during complementary aircraft-based programs to augment the density of atmospheric soundings between aircraft deployed dropsonde clusters across Atmospheric Rivers and within Tropical Cyclone synoptic environments.
- Maintain situational awareness for deconflicting flight regions between GSBs, reconnaissance aircraft and dropsonde deployments.
- Enhance observations in highly uncertain regions, as indicated by ensemble sensitivity analysis of ensemble models.
- Reduce uncertainty and enhance forecast accuracy.

OBSERVATIONAL TOOLS

- AFRC WC-130J (Fig 1a) operating from Mathur Field, California and the NOAA GIVSP 9 (Fig 1b) operating from Hickam AFB Hawaii
- G-IV flights deployed ~35 NRD-94 sondes (Fig 1c) per flight, while WC-130J flights deployed ~25-30 RD-41 sondes.
- Deployed Windborne GSBs (Fig 1d and 1e) were then programed to sample the regions between the two aircraft flights.

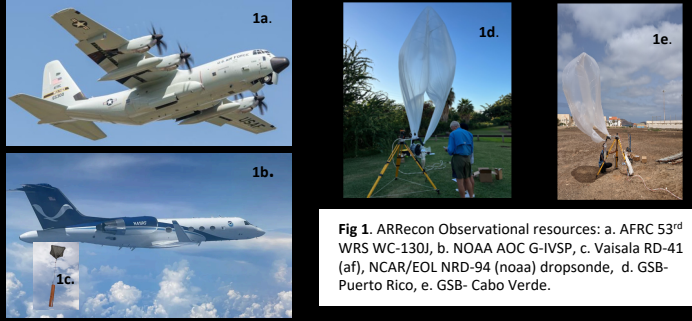
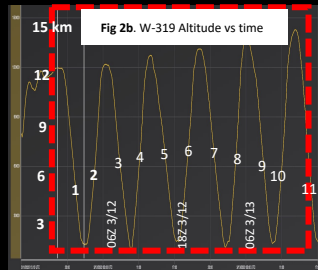
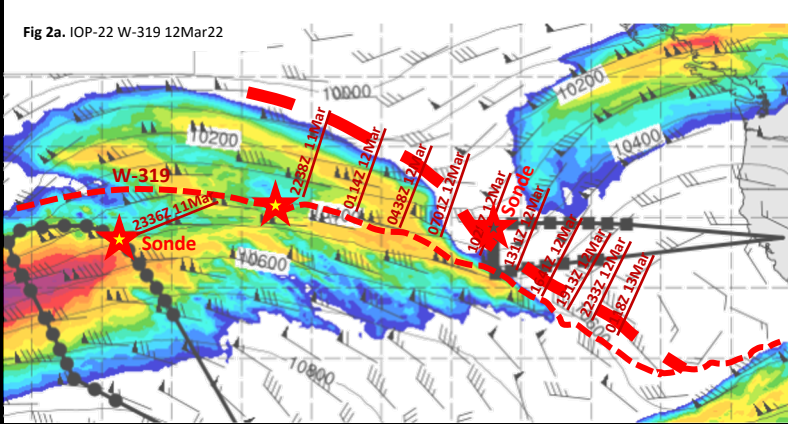


Fig 1. ARRecon Observational resources: a. AFRC 53rd WRS WC-130J, b. NOAA AOC G-IVSP, c. Vaisala RD-41 (af), NCAR/EOL NRD-94 (noaa) dropsonde, d. GSB- Puerto Rico, e. GSB- Cabo Verde.

Fig 2a. IOP-22 W-319 12Mar22



GSB SOUNDING AUGMENTATION: TC EARL

- GSBs were used to augment dropsondes in TDs such as pre-Earl on 31 Aug and 5 Sep shown in Figs 3a and 3b.
- 4 GSBs launched from PR were flown in deconfliction mode away from P3 sonde pattern near TD inner core. These GSBs obtained data on TD environmental dry air.
- Excellent profile agreement is shown in Skew-T plot insets for W-425 and W-427.
- GSBs launched from PR on 5 Sep (Fig 3b) obtained nearly 15 soundings along outflow trajectories from two GSBs (W-430 and W-436).

ARRecon OBSERVATIONAL STRATEGY

- During IOP 22 on 12 March (Fig 2a), 4 GSBs were deployed from Seoul over 2 days operated in navigation mode to traverse the region to the dropsonde arrays, transitioning to sounding mode (7-8 per day) between the two aircraft dropsonde arrays (Fig 2a for W-319).
- W-319 passed from the G-IV pattern, in which 23 sondes were deployed along 2 legs indicated by black circles, across the IVT and jet maximum to the western extent of the WC-130J pattern where 17 drops are indicated by black squares.
- The two dropsonde deployments were connected with a string of 11 GSB soundings over a 26-hr period, a feat duplicated by three other GSB's during this same period of time. Fig 2b illustrates the time series of altitude changes for the 11 W-391 descent and ascent soundings.

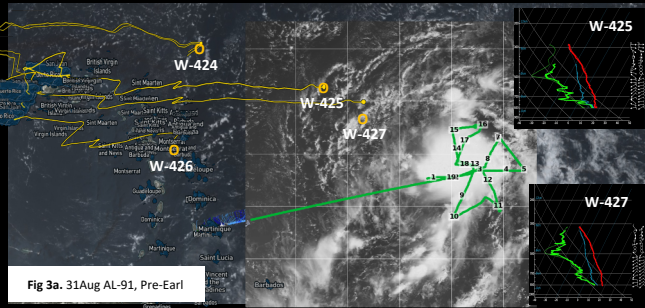


Fig 3a. 31Aug AL-91, Pre-Earl

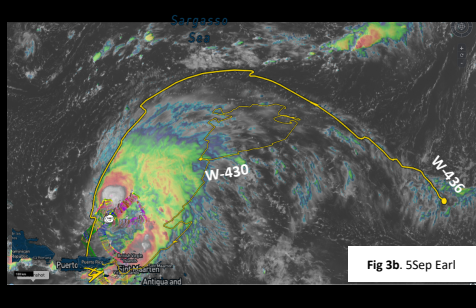


Fig 3b. 5Sep Earl



Fig 4a. H. Ian 27-29 Sep22

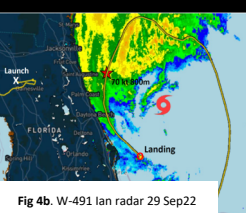


Fig 4b. W-491 Ian radar 29 Sep22

GSB INNER CORE AND ENVIRONMENT SOUNDINGS IN IAN 2022

- GSBs launched from Gainesville entered Ian's inner core off the FL east coast and gathered valuable inner core sounding data (Fig 4a).
- GSB W-491 entered the eyewall as shown by 88-D radar (Fig 4b) and provided valuable eye and eyewall sounding data before ending its mission and landing in the Gulf Stream.
- Maximum winds of 70 kt at 800 m altitude were measured, proving to be some of the most worthwhile GSB observations of the season.