

Using Google Earth as a Flight Planning Coordination Tool for Developing Atmospheric River Reconnaissance Intensive Observation Period Mission Flight Tracks

SCRIPPS INSTITUTION OF OCEANOGRAPHY UC San Diego

Shawn Roj¹, Brian Kawzenuk¹, Alison Cobb¹, Anna Wilson¹, Samuel Bartlett¹, Jackson Ludtke¹, Kyle Hurley¹, F. Martin Ralph¹ ¹Center for Western Weather and Water Extremes, Scripps Institution of Oceanography, La Jolla, CA

Introduction

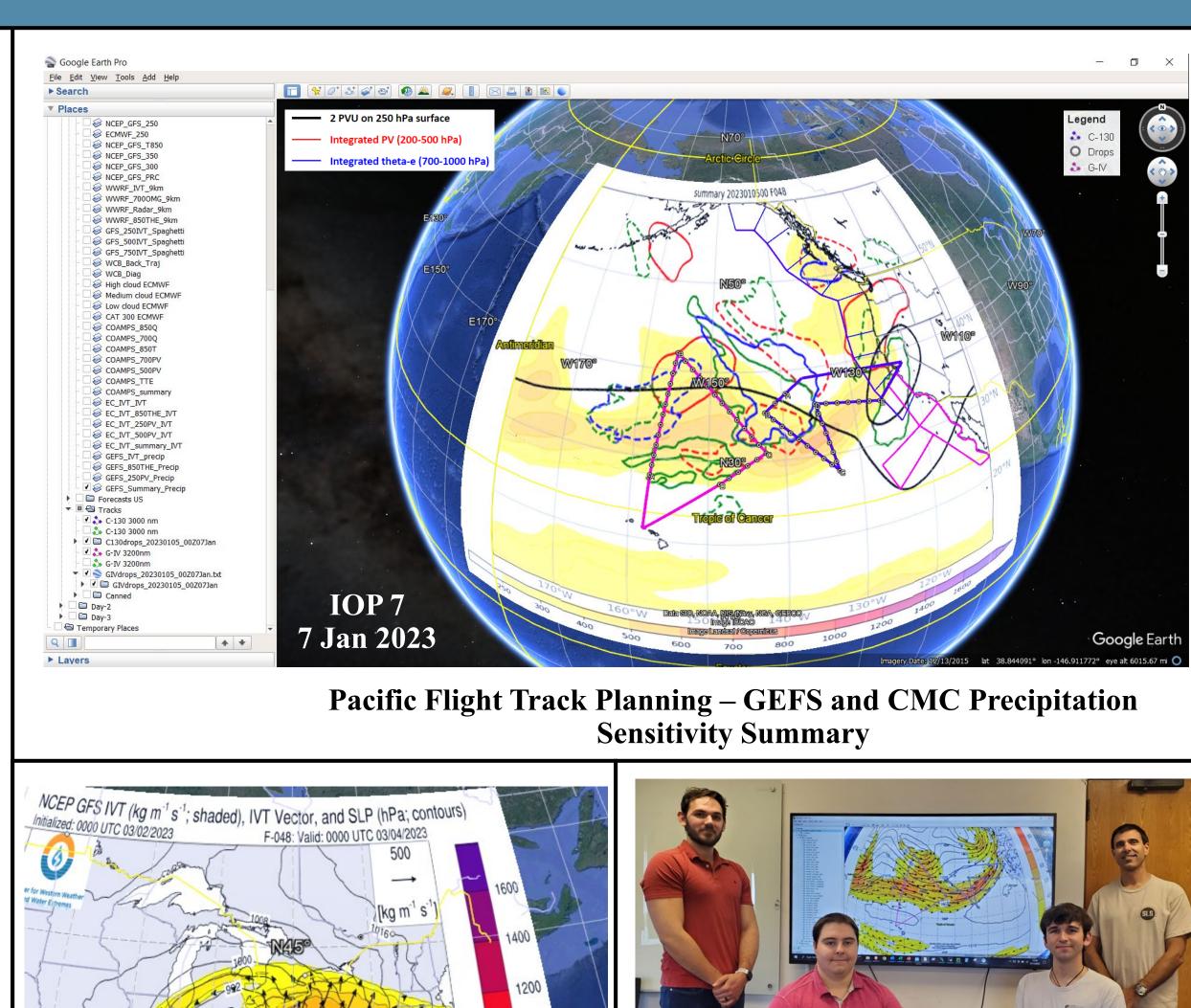
An atmospheric river (AR) is a long, narrow corridor of enhanced atmospheric moisture transport (Ralph et al., 2004) and can be responsible for nearly half of California's annual precipitation while causing flood damages throughout the western U.S. averaging \$1.1 billion annually. Recognizing this, The Center for Western Weather and Water Extremes (CW3E) has been developing the science and tools necessary to improve the prediction of landfalling ARs along the U.S. West Coast. One way this is done is through the Atmospheric River (AR) Reconnaissance (AR Recon) field campaign.

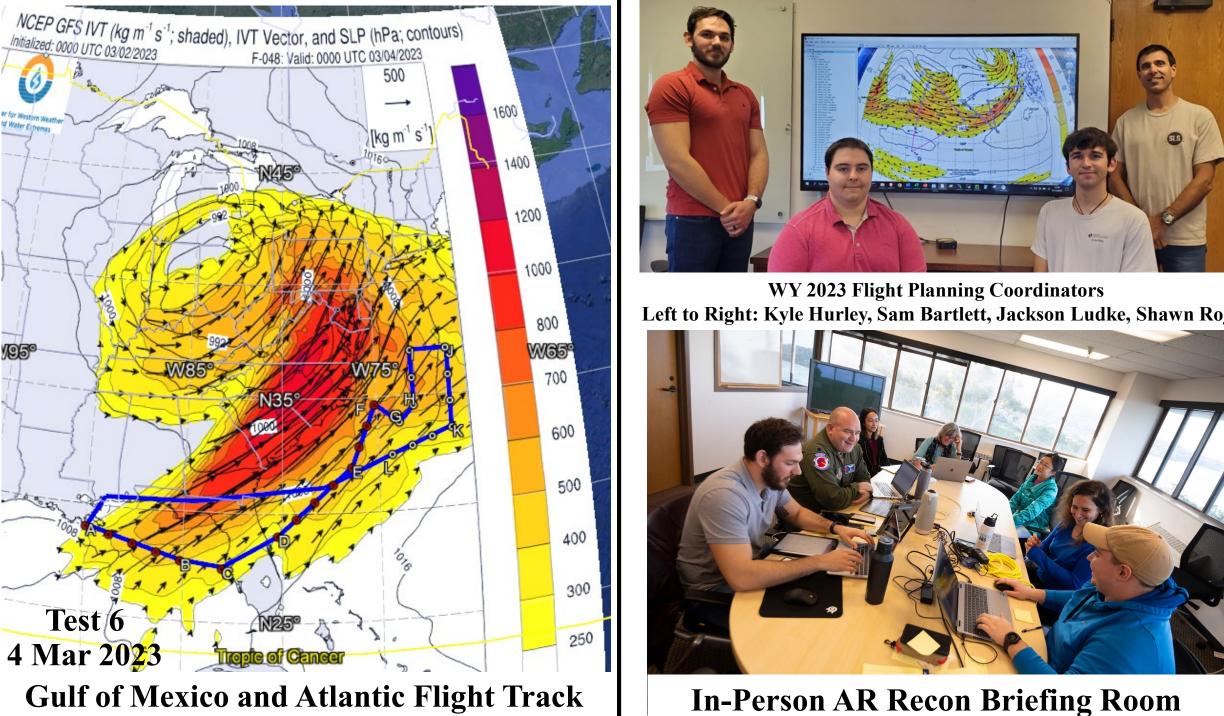
AR Recon goal: Support water management decisions and flood forecasting by developing and testing the potential of targeted airborne and buoy observations over the Northeast Pacific to improve forecasts of landfalling ARs at lead times of 1-5 days. Innovations in targeting methods, data assimilation and regional forecast skill requirements are pursued through collaborative, cross-disciplinary, science-based strategies.

In accordance with the National Winter Season Operations Plan (NWSOP) custom Air Force C-130 and NOAA G-IV flight tracks are designed in the North Pacific with targeted dropsonde locations that sample weather phenomena and atmospheric characteristics in and near ARs to maximize potential forecast improvements.

Preparation of flight tracks and dropsonde locations for an Intensive Observation Period (IOP) mission is done using free Google Earth software to display various CW3E forecast graphics and sensitivity plots. Flight track development occurs before and during CW3E weather briefings that are held when potentially impactful ARs are within flight range. The tool remains a work in progress with continued optimizations for efficiency and automation.

Google Earth Coordination Tool 7 Jan 2023 **Typical Warning Areas and Flight Distance Rings** NOAA G-IV - Hawaii Flight track 3200 nm Drop track length 2000 nm C-130 - Mather AFB Flight track 3000 nm Drop track length 1800 nm IOP 7 7 Jan 2023 Pacific Flight Track Planning – GFS IVT





AR Recon Flight Coordinator Flowchart Prior to AR Forecast Briefing ➤ During AR Forecast Briefing CW3E 1, 2 and 3-day Guidance and flight Preliminary approval by US lead time forecast track revision from AR \longrightarrow Air Force and/or NOAA graphics Flight Directors (In person) Recon team in real time Sensitivity Products Drop window identified After AR Forecast Briefing ECMWF Cloud and Dropsonde locations generated Excel spreadsheet of dropsondes Turbulence Forecasts using an IDL script to space and flight track image emailed them evenly along each leg of to team for final approval the dropsonde window Warm Conveyor Belt NOAA G-IV Aircraft takeoff time and final confirmation for the IOP mission are relayed to the team and the mission can be flown Preliminary flight tracks with AF C-130 guidance from the *Flight Planning* lead target specific key areas of the Per the NWSOP, the NCEP Central Operations Senior Duty Meteorologist is the final approval authority for customized tracks AR and regions most sensitive to This season, AR Recon was successful in demonstrating two changes in forecast conditions custom flight tracks in the Gulf of Mexico and the Western Atlantic

WY 2023 Results and Future Work

- 39 Pacific IOPS flown with two test flights in the Gulf of Mexico and W. Atlantic
- 380 dropsondes released in the Pacific and 39 dropped in the Gulf and W. Atlantic
- Incorporate predicted satellite overpass track and swath information that may tell us where gaps in satellite data retrieval are located
- Improve automatic updates of sensitivity products. These are currently updated in Google Earth manually each AR Recon day
- Improve dropsonde location script for more automation. Spreadsheets are currently created manually
- Save .kmz as a snapshot in time so images do not update after the briefing

References/Acknowledgements

Neiman, P. J., & Wick, G. A. (2004): Satellite and CALJET aircraft observations of atmospheric rivers over the eastern North Pacific Ocean during the winter of 1997/98, Monthly Weather Review, 132(7), 1721-1745.

Many thanks go out to the entire CW3E AR Recon team for allowing me to expand upon the Flight Track Coordination Tool during the WY 2023 AR Recon season. This year, we employed two UCSD undergraduate students, Jackson Ludtke and Kyle Hurley, to help lead the tool during AR Recon briefings. Their help in streamlining certain aspects of the tool and willingness to lead under a fast-paced environment proved to be invaluable during this extremely busy season.

In addition, we would like to acknowledge and congratulate Jackson Ludtke for being a 2023 UCSD Student Employee of the Year for his role in AR Recon.