

# **Carbon Dioxide and Water Flux Responses to Extreme Weather and Climate Anomalies: A *Fluxnet* Synthesis**

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Ecosystem responses to weather extremes and climate anomalies present one of the more challenging and less studied aspects of the two-way coupling between ecosystems and the atmosphere. Land-atmosphere exchanges of carbon dioxide and water are at the core of this interaction. As the global network of ecosystem-atmosphere flux measurements matures, data are being integrated, standardized, and shared, making it now possible to perform comprehensive, network-wide analyses of these ecosystem-climate connections. This proposal details a plan to use the flux observatory in conjunction with remote sensing of land surface states to investigate the degree to which hurricanes, droughts, floods, and severe thunderstorms perturb land-atmosphere water and carbon dioxide fluxes.

The work is motivated by the need for 1) adequate characterization of terrestrial biosphere responses to weather and climate anomalies, 2) novel methods of scaling point observations to larger scales, as well as 3) Fluxnet integration and synthesis. The underlying hypothesis is that the network of site-level fluxes are more than simply a collection of independent behaviors, but rather reflect a higher level of organization through functionally coherent patterns of response to weather and climate. The following questions would be addressed:

- 1) *How large are ecosystem-atmosphere water and carbon dioxide flux responses to weather and climate extremes?*
- 2) *Does the tower network indicate functional coherence in terrestrial carbon dioxide and water fluxes responding to weather extremes or climate anomalies?*
- 3) *How persistent are the effects of weather or climate extremes?*
- 4) *Do biophysical models adequately characterize water and carbon dioxide flux responses, if any, to weather and climate extremes?*

The general methodological approach involves selection of anomalous weather and climate events to be examined as case studies, the collection of flux, weather, and remotely sensed surface data, analysis to determine across-site ecosystem functional responses to weather/climate anomalies, and assessment of whether a set of land surface models reproduce observed surface flux anomalies, if any. Integrated analyses will focus on documenting the relative magnitude of fluxes and land surface states before, during, and after a targeted weather or climate event, as well as across-site consistency in responses to anomalous events of a type (e.g. hurricanes). There may also be the opportunity for paired-site analyses comparing fluxes between a set of sites that did and did not experience a particular anomalous weather/climate event.

Anomalous weather and climate events will be identified and selected for analysis based on web-available databases, for example, NOAA's National Climatic Data Center (NCDC), which maintains one of the world's largest weather data archives and produces detailed synopses of Worldwide Weather and Climate Extremes, as well as Extreme Weather and Climate Events. Their analyses will be the initial source for determining which Fluxnet sites should be included in analyzing effects of a particular event. The proposed work would lead to a set of papers, perhaps one on each event type (hurricanes, droughts, floods, severe thunderstorms), including analysis of surface state and flux anomalies as seen by Fluxnet and remote sensing, as well as results of model-data comparison.

We will request the privilege of data use and invite participation from site PIs for each of the event-based analyses if a site has: 1) measured fluxes during the occurrence of one of the event-types under study; 2) a flux record that spans at least 4 to 5 years enabling a 'background control' from which event-related flux anomalies will be assessed, unless a paired approach permits shorter records to be included. Data providers will be sent draft versions of results and manuscripts so that they are aware of how their data are being used before being submitted for review/publication in a peer-reviewed journal. If at any time during the data analysis and manuscript review processes, a data provider decides to disallow the use of his/her data, that restriction will be honored and the data will not be used in these analyses.

Co-authorship rules will be as follows. All the data providers will be invited to give intellectual input, meaning ideas for methodology, original analyses, insights for discussion, or original authorship of part of a paper. Email and / or phone contact will be made with each of the data providers to solicit this intellectual input as well as to discuss details and nuances of individual site records as necessary. Before submission, data contributors will be informed of the lead investigators intention regarding authorship on a manuscript and will be invited to comment and make a request for inclusion or exclusion from authorship on a particular manuscript. In the very unlikely event of an apparent conflict regarding authorship, which will anyway be liberal by the nature of a synthesis, we will request mediation or suggestion from the Scientific Moderation Committee. Finally, this approach may be improved upon and we welcome suggestions of how we might do so.