DESIGN OF THE JPL LAND MODEL DATA ASSIMILATION APPROACH, VVUQ AND INTERFACE REQUIREMENTS WITH THE CALTECH CLIMA EARTH SYSTEM FRAMEWORK

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Program: Carbon and Water cycles

Project Objective:

Objective 1: Definition & design requirements for the JPL-CliMA land model for compliance & eventual implementation into the CLiMA data-informed Earth System model (ESM).

Objective 2: Prototyping and evaluation of the JPL-CliMA land model using the JPL CMS/CARDAMOM framework, through incorpororation of energy balance module and *a* river routing scheme (Yamazaki et al. 2011) to link the CARDAMOM terrestrial runoff outputs with continental river discharge estimates.

Objective 3: Bayesian estimation and uncertainty quantification of key carbon/water/energy processes and reservoirs using in-situ datasets (FLUXNET) and data from the satellite POR (including GRACE and OCO-2).

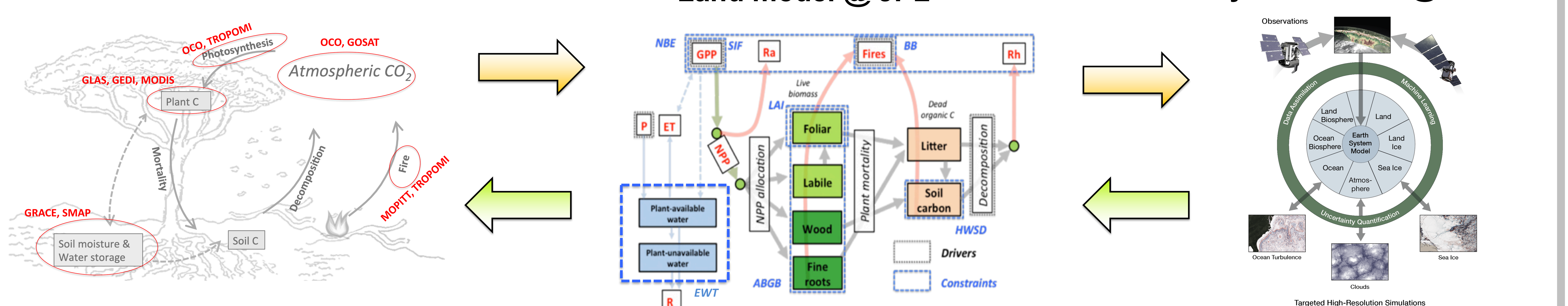

Figure 1. Overview: satellite EO record (left) critical for synergistic constraints on land carbon & water processes. Bayesian assimilation of these into a land model is critical for resolving present-day carbon water processes (middle). Earth system predictions require an explicit coupling between the land and the atmosphere, oceans and cryosphere (right), which is critical for quantifying and constrain land carbon-climate feedbacks (middle + right). The observation-informed analysis and prediction of the land carbon and water cycles can the be used to directly inform future satellite observation needs in the context of the existing satellite EO system.

Design for JPL-CliMA ESM-compliant land-surface & land-biosphere model

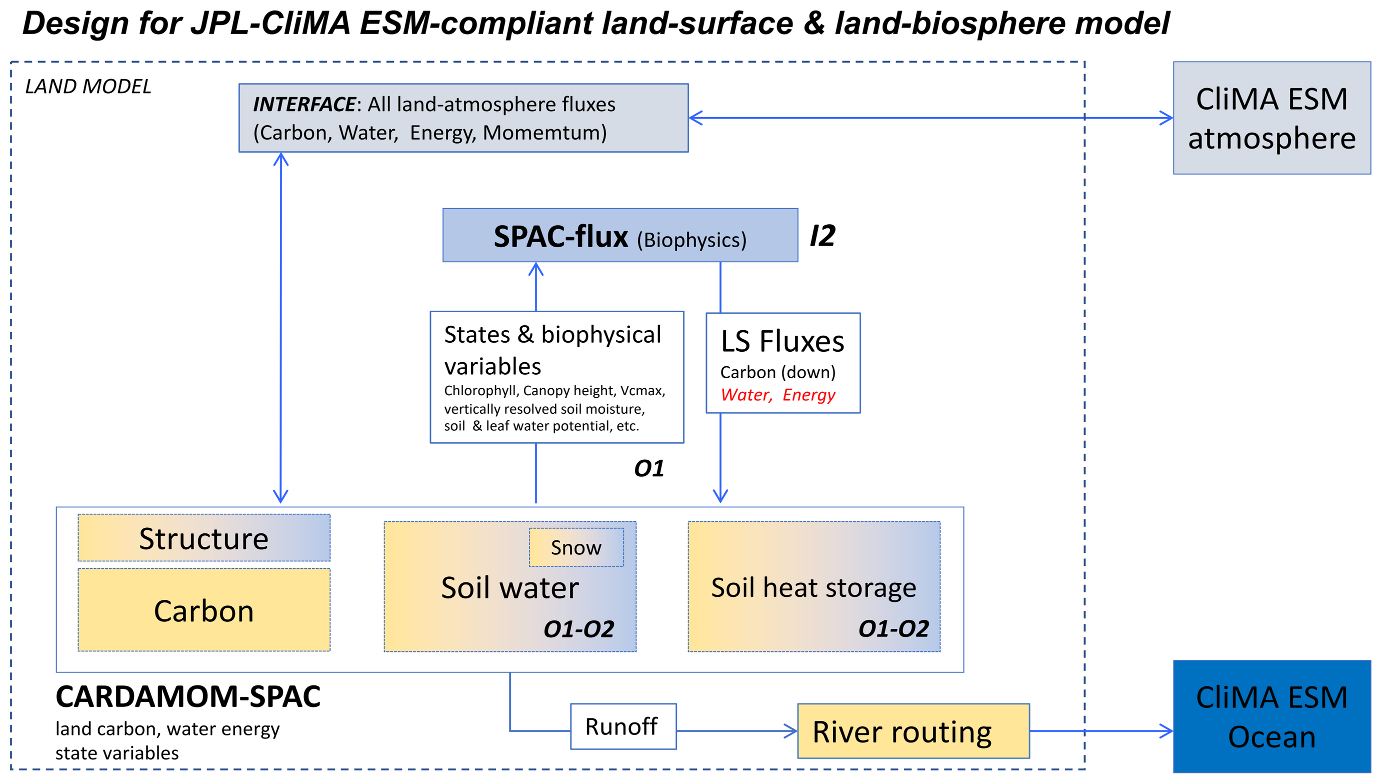

Figure 2. Design effort for the JPL-CliMA land model. The primary land-atmosphere interface (see box titled "INTERFACE") calls the CARDAMOM-SPAC model. Subsequently, land-atmosphere fluxes are estimated using the "SPAC-Flux" module. Blue boxes represent the Caltech-CliMA led module development; yellow boxes denote JPL-led module development; blue-yellow boxes denote joint development activities.

VVUQ: monthly modelled land-atmosphere carbon-water cycle exchanges

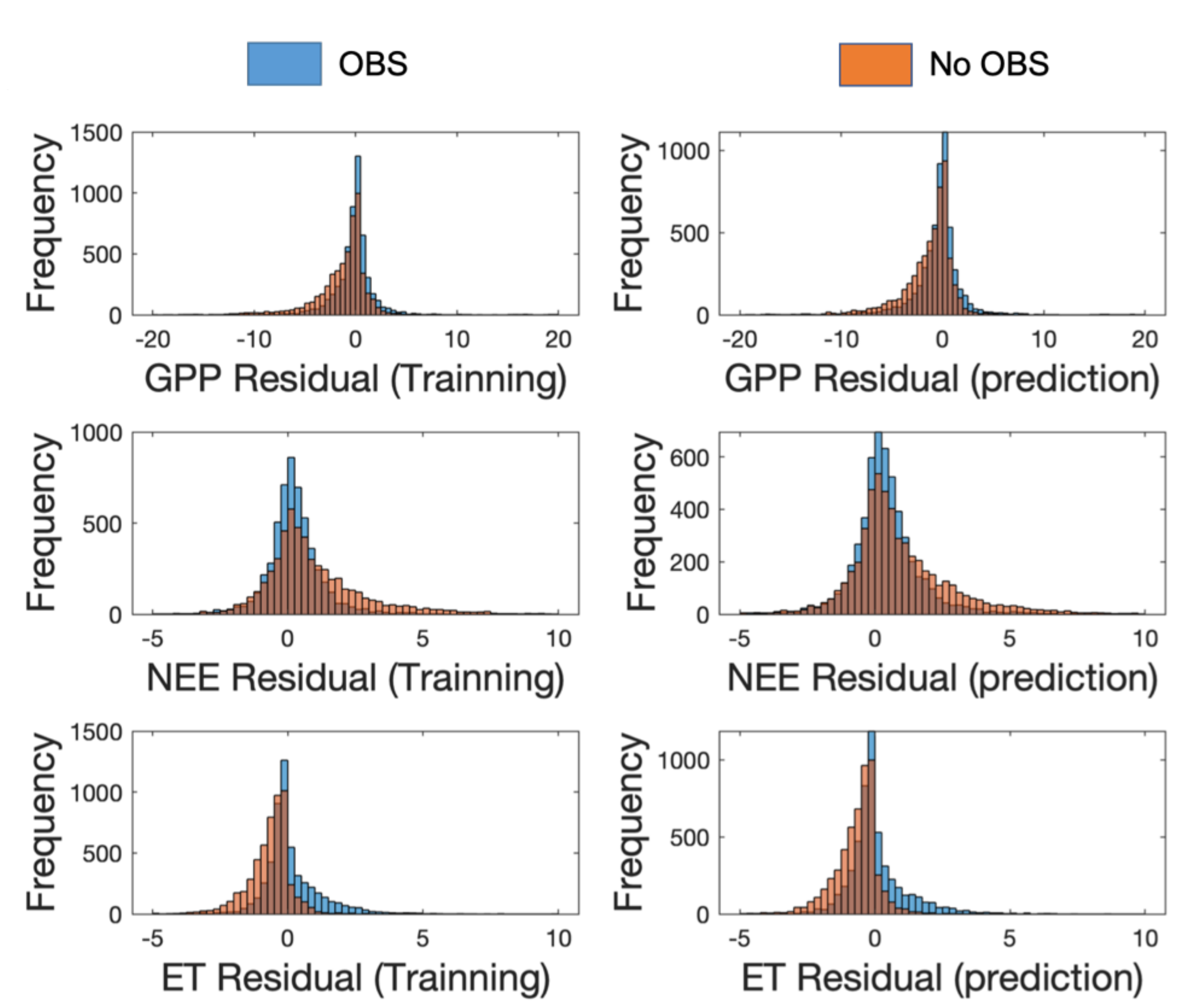

Figure 4. Assimilation and prediction of carbon and water fluxes, namely gross uptake of CO2 (GPP) net ecosystem CO2 exchange (NEE) and evapotranspiration (ET), with and without observations across the global FLUXNET in-situ network. Ability to improve representation of carbon and water fluxes (left column), and subsequent use of quantitative insight to improve prediction, i.e. through both bias reduction and improved precision (right column) for multi-year predictions are a critical requirement for decadal- timescale land model structure within the JPL-CliMA framework.

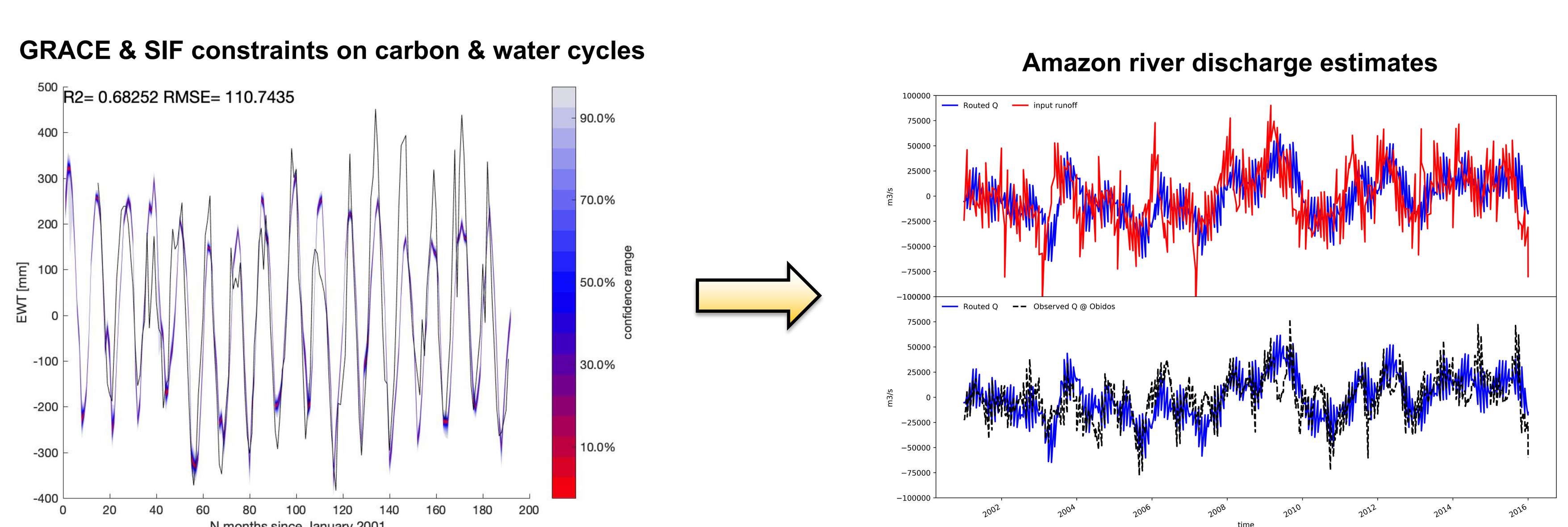

Figure 3. Figure 3. River discharge estimates for GRACE-informed land model (CARDAMOM) runoff produced at a monthly 0.5 degree resolution across the Amazon river basin (top panel), and evaluated against the ORE-HYBAM river gauge network (bottom panel). The river routing scheme used here (Yamazaki et al., 2011) is an integral part of the eventual interface between the JPL land model and the CLiMA Earth System model framework. Comparison against in-situ datasets (black likne) also provides a critical component of the JPL-CliMA VVUQ strategy.

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