Characterizing Climate and Human Influences on Coastal Margin Carbon Dynamics Using Integrated Land-Ocean Modeling Approaches

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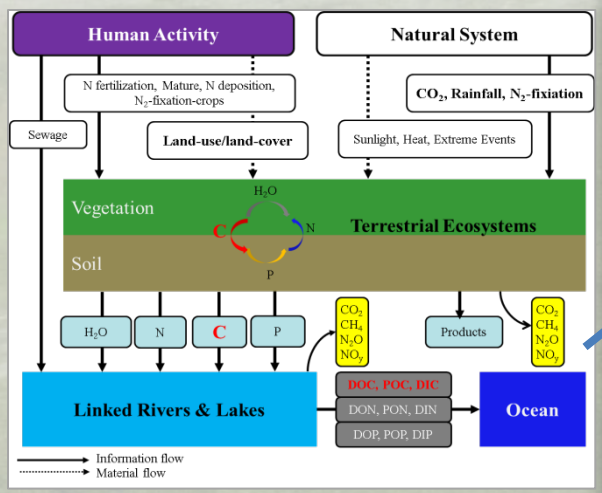
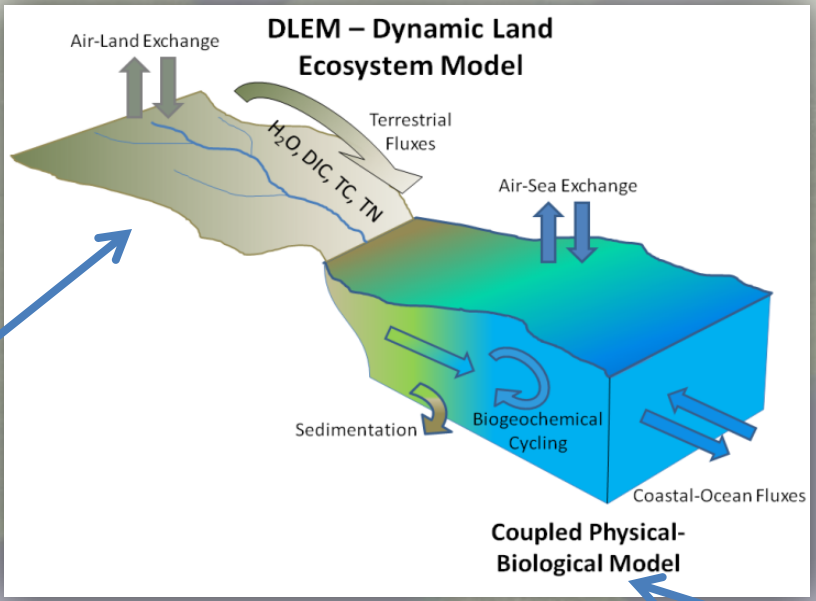
Approach: Coupled Terrestrial-Ocean Models



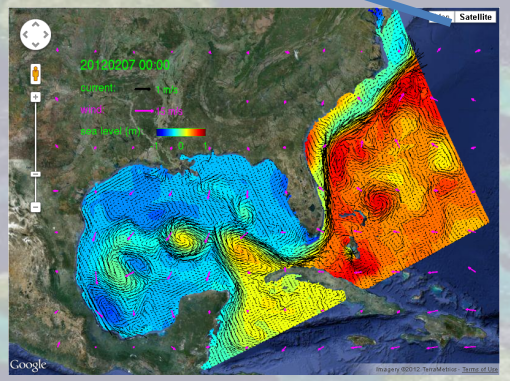


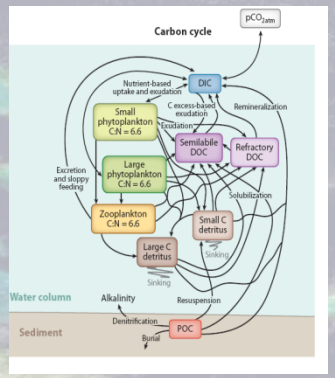
DLEM terrestrial outputs linked to a physical-biogeochemical model (SABGOM) to characterize coastal carbon fluxes and ecosystem dynamics

Dynamic Land Ecosystem Model (v2.0) used to estimate spatial and temporal patterns of land-air carbon fluxes and lateral transport of water, carbon, and nitrogen

Tian et al., 2010a,b; Tian et al.,2011; Tian et al.,2012 ; Zhang et al., 2012; Tao et al., 2014; Ren et al., 2015; Tian et al., 2015

Modeling efforts supported by field survey-based and satellite-based observations of carbon fluxes and other biogeochemical processes

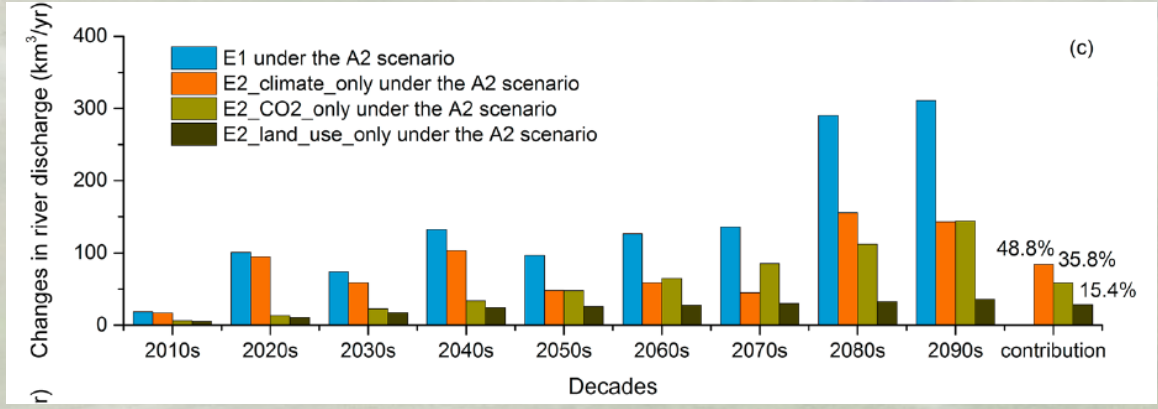




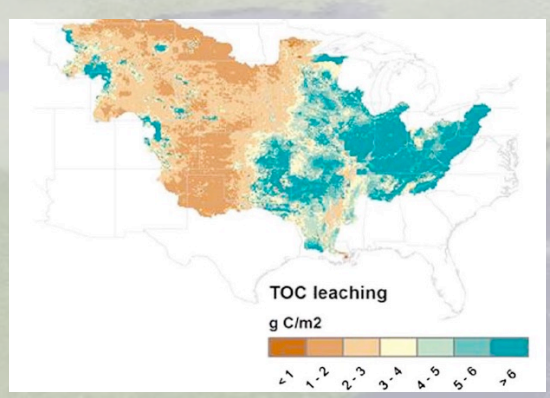
Hyun and He (2010); Xue et al., 2013, 2016

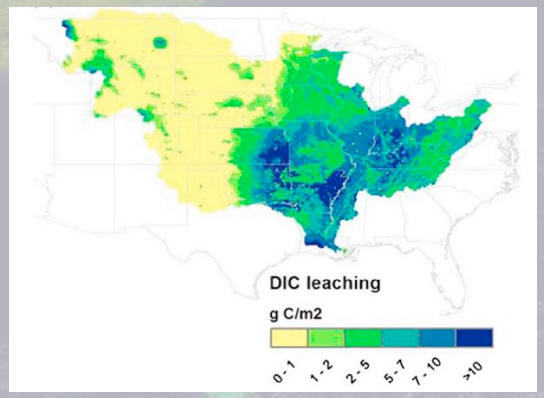
Hoffman et al., Ann. Rev., 2011; Fennel et al., 2011, 2013

Dynamic Land Ecosystem Model Results

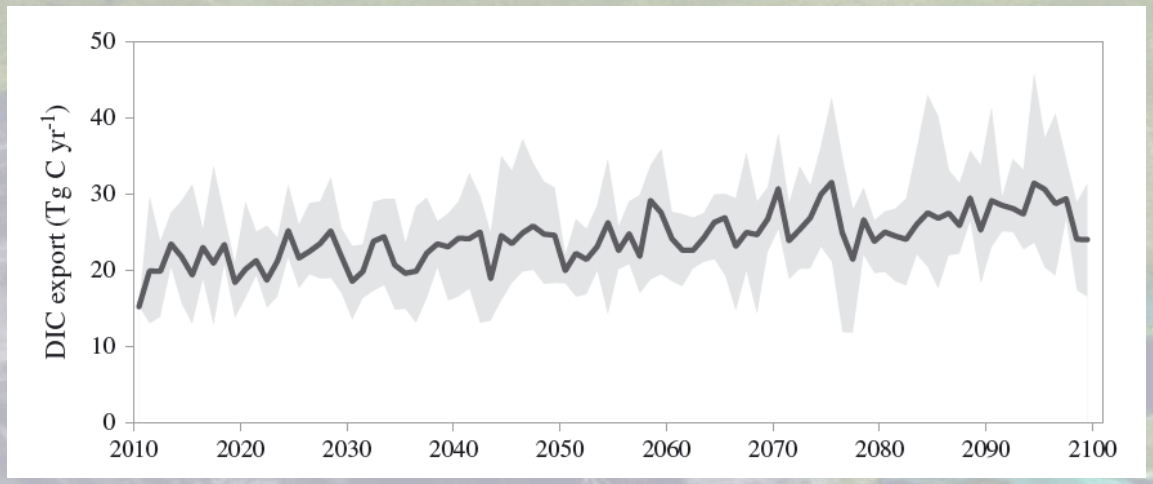


Increasing River Discharge - Projected Mississippi river discharge over the 21st century and its environmental controls under high emission scenario (A2) (Tao et al., GRL, 2014)





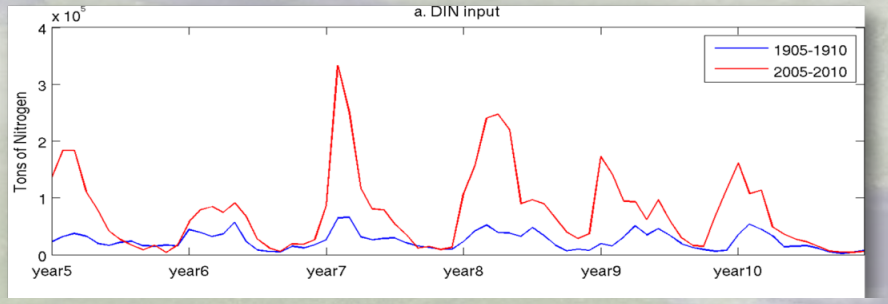
Carbon Leaching Patterns - Spatial distribution of yearly total organic carbon (TOC) and dissolved inorganic carbon leaching in the MARB averaged during 2001-2010 (Tian et al., GBC, 2015)

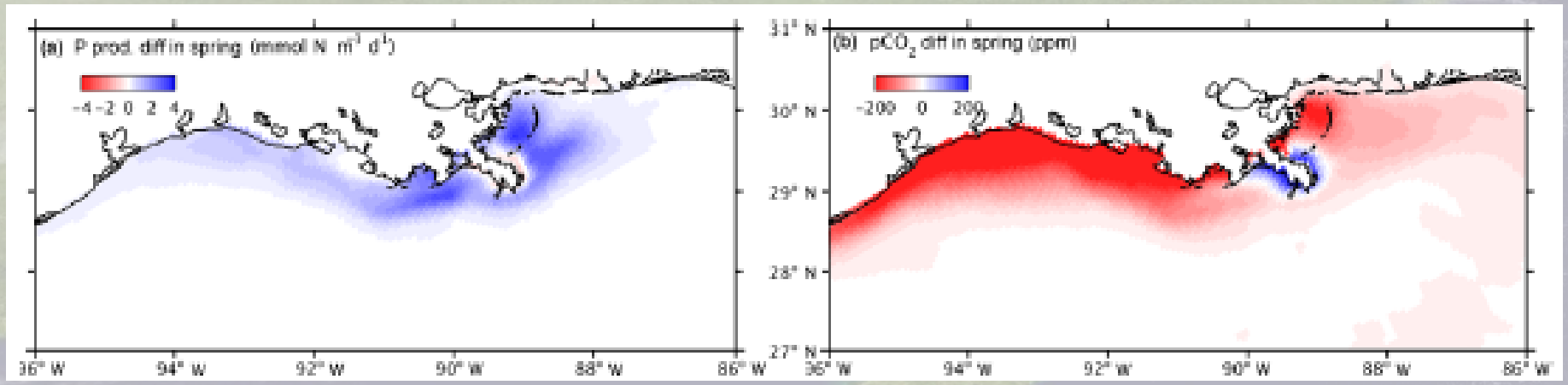


Increasing Trend in DIC - Annual changes in export of dissolved inorganic carbon (DIC, Tg C yr1) from the Mississippi River basin to the Gulf of Mexico over the 21st century (Ren et al., JGR-B, 2015)

Coupled Model Simulations: 1904-1910 vs. 2004-2010

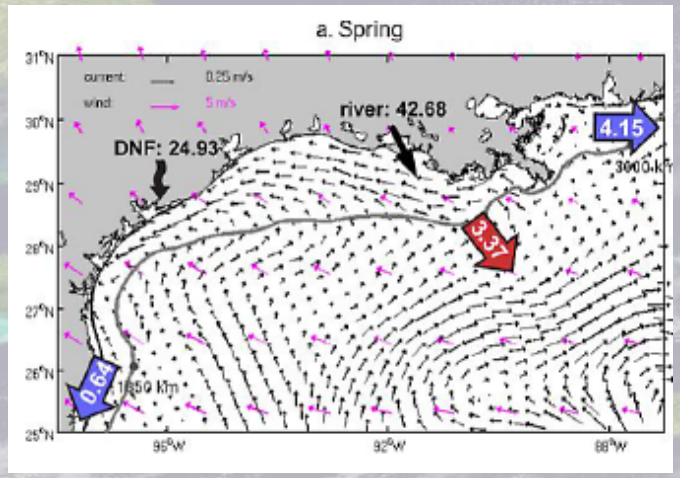
- Increase in DLEM-simulated DIN export from MARB from 1904-1910 compared to 2004-2010
- Significant increase in simulated ocean primary production, and decrease in pCO_2 as a result of increased river inputs





- Ocean model also provides estimate of along- and cross-shelf transport of dissolved inorganic nitrogen for the 2004-2010 period

Xue et al., 2013, 2016



Summary: Understanding Climate and Human Impacts on Terrestrial-Coastal Fluxes

- Integrated modeling approaches can be useful in understanding how climate and weather-related forcing in conjunction with changing human activity can alter the transfer of water, carbon and nutrients through various terrestrial reservoirs into rivers, estuaries, and coastal ocean waters
- Coastal margins may be particularly sensitive to such changes, which can alter biogeochemistry of the coastal ocean and have implications for carbon sequestration, eutrophication, hypoxia, and ocean acidification
- Model products can provide decision support for carbon management, water quality, and ecosystem sustainability