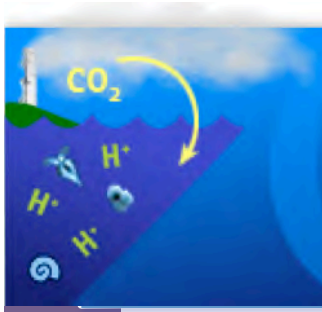


Ocean Acidification

Studying ocean acidification's effects on marine ecosystems and biogeochemistry

BIOGEOCHEMISTRY & MODELING

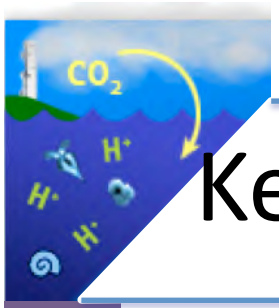
Synthesis of Modeling & Algorithm Development Projects

Ocean Carbon and Biogeochemistry
Principal Investigators' Meeting
March 24, 2011
Presented by Sarah Cooley

Algorithm development

BIOGEOCHEMISTRY & MODELING

- Observation-based
  - Saturation state algorithm (O_2, T, hydrography) (Feely/Alin/Juranek) (Cascadia Margin, Oregon Coast, S. Calif. Bight, NE Subarctic Pacific)
  - pH, pCO2 climatologies (Takahashi) (Global)
- Satellite-based
  - Surface saturation state (Gledhill) (Greater Caribbean)
  - Phys/BGC interplay (Signorini) (Nordic Seas)
  - OA & eutrophication (Cai/Lohrenz) (Mississippi/Gulf)
- Other
  - Geochemical proxies: larval pH exposure (Levin/Tanner) (Mussels & Squid)
  - CO2calc (Robbins) (Global)



Key categories being parameterized

BIOGEOCHEMISTRY & MODELING

Geochemistry affecting biology

- Saturation state/ hydrography algorithm
- Takahashi climatology

Baseline determination

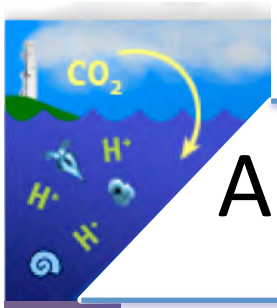
Biology resulting from (?) geochemistry

- Satellite algorithms
  - Caribbean
  - Gulf of Mexico
  - Nordic Seas

Multi-layered processes

- Larval history/geochemistry

Significance of chemistry to biology



Algorithm "coverage" of water column

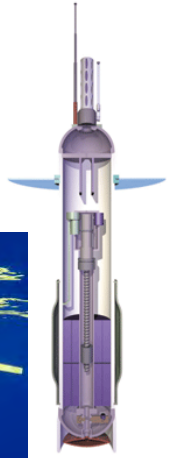
BIOGEOCHEMISTRY & MODELING

Gledhill
Cai/Lohrenz
Signorini

Levin/Tanner
Alin
Cai/Lohrenz

Feely
Juranek
Alin
Takahashi

Robbins (CO2Calc)

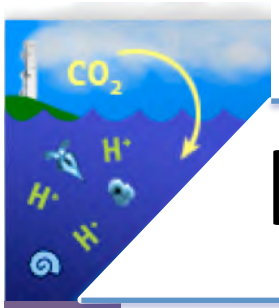


Juranek

Modeling projects

BIOGEOCHEMISTRY & MODELING

- Biogeochemistry
  - Coupled ocean models
    - CESM (Doney); OA forecasts, variability, model-data/skill testing
      - + Satellites: Biogeographic niche of calcifiers (Glover)
    - OCMIP-2 (Kwon/Sarmiento); carbonate pump strength change
    - GFDL/NOAA Ocean BGC model development (Dunne); anth. change effects on global-local cycles
    - HAMOCC (Zeebe); OA forecasts, effects on marine calcifiers
  - Box models
    - LOSCAR (Zeebe); behavior of paleo-ocean in prior CO2 releases
  - Baseline assessment: Monitoring/modeling W. FL shelf carbonate chemistry (Robbins)
- Ecosystem/individual-based
  - (SLAM) Lifecycle model/direct & indirect effects on dungeness crabs (McElhany)
  - (ECOPATH/ECOSIM) Ecosystem effects of OA on Puget Sound food web (Busch)
  - Stage-based model on population (Waldbusser)
- Physical
  - OA effects on sound transmission: sensitivity, frequencies (Joseph)
- Human communities
  - Socioeconomic effects of OA (Cooley)
  - Economic effects of OA on reefs (Palardy)



Key processes being modeled

BIOGEOCHEMISTRY & MODELING

Chemistry forecasts

- Ω/pH/[CO_3^{2-}] & variability
- Response dynamics

Calcifiers

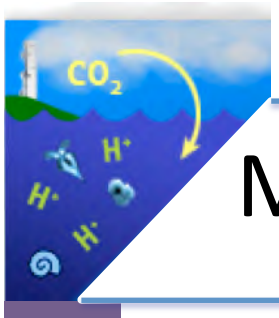
- Model-data comparison, model improvement
- Carbonate dissolution/ export

Multicellular organisms

- Population effects (crabs, bivalves)
- Ecosystem behavior

Human communities

- OA's effects on marine ecosystem services
  - Food security
  - Economic opportunities

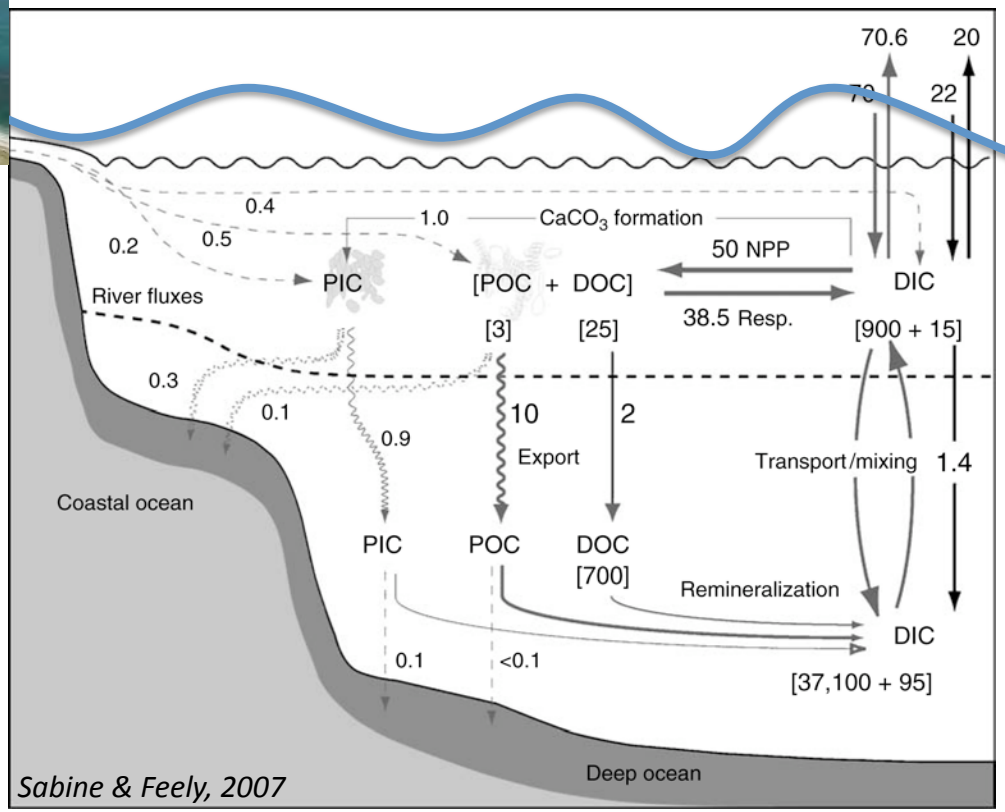


Modeling"coverage" of water column

BIOGEOCHEMISTRY & MODELING

Coastal conditions
Robbins
McElhany
Busch
Waldbusser

People Models
Palardy
Cooley



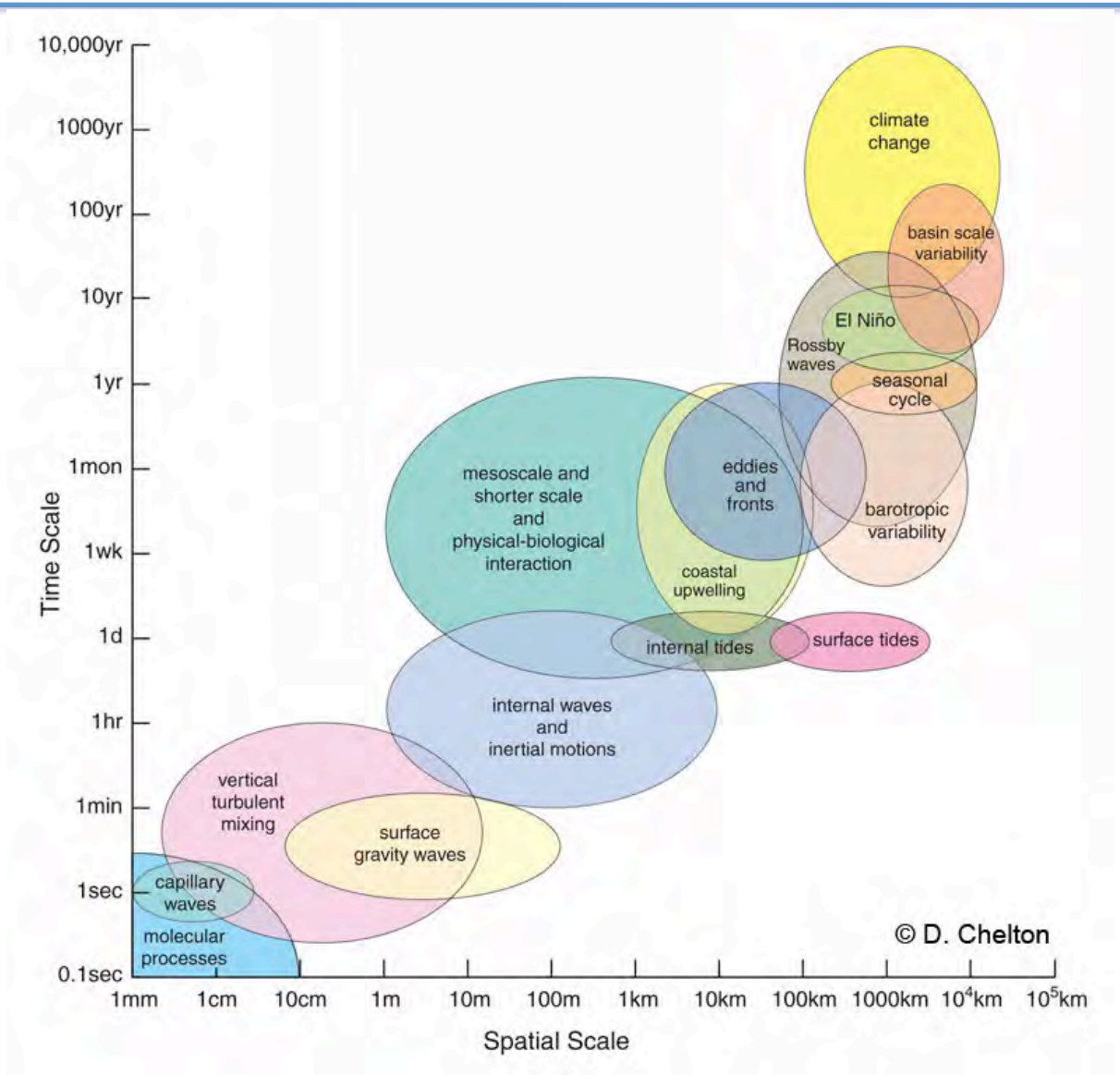
Satellite/Ocean
Cai/Lohrenz
Signorini
Glover

Coupled & Box Models
Kwon
Zeebe
Doney

Acoustical Models
Joseph

Algorithm & Model Scales

BIOGEOCHEMISTRY & MODELING



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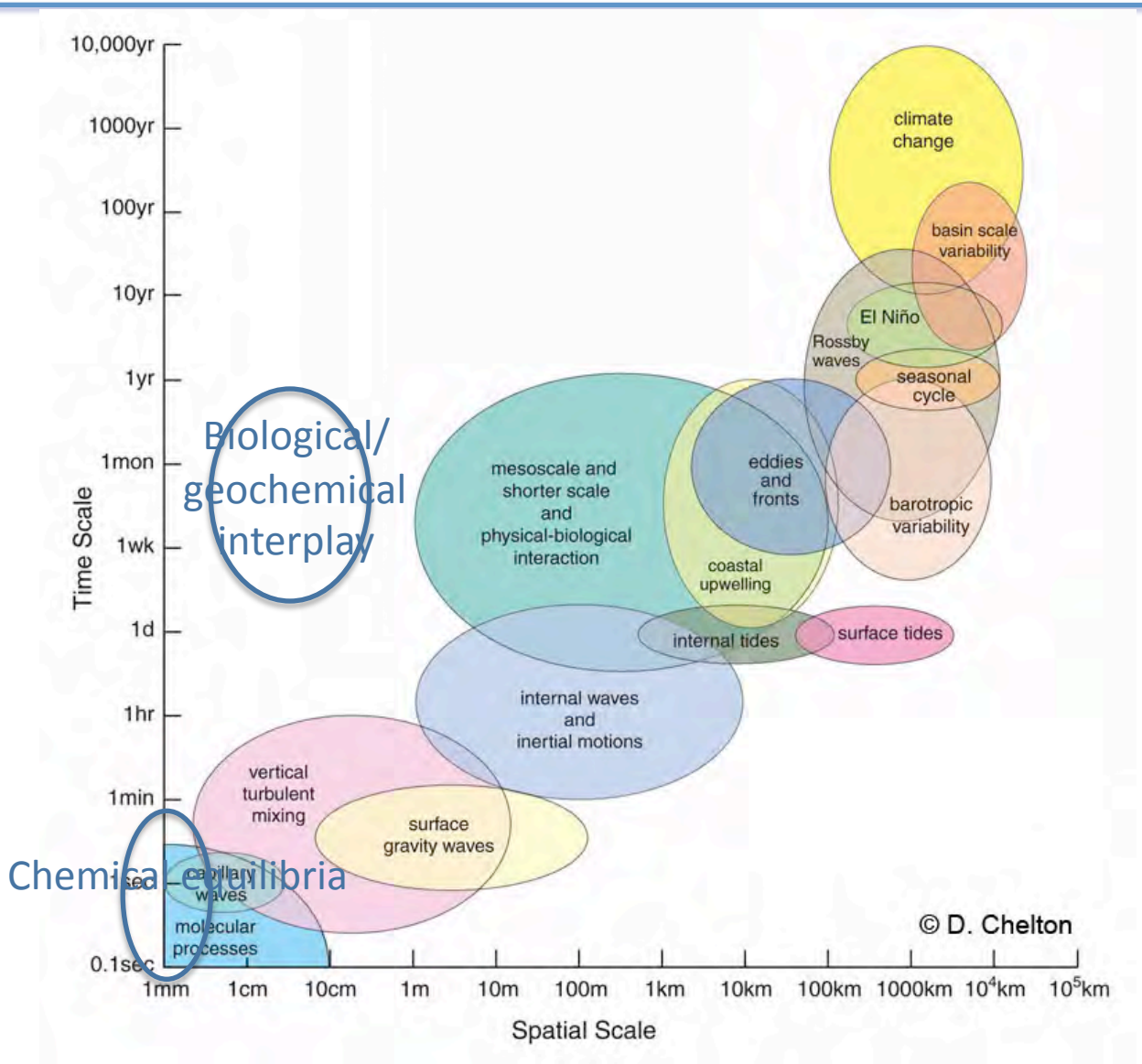
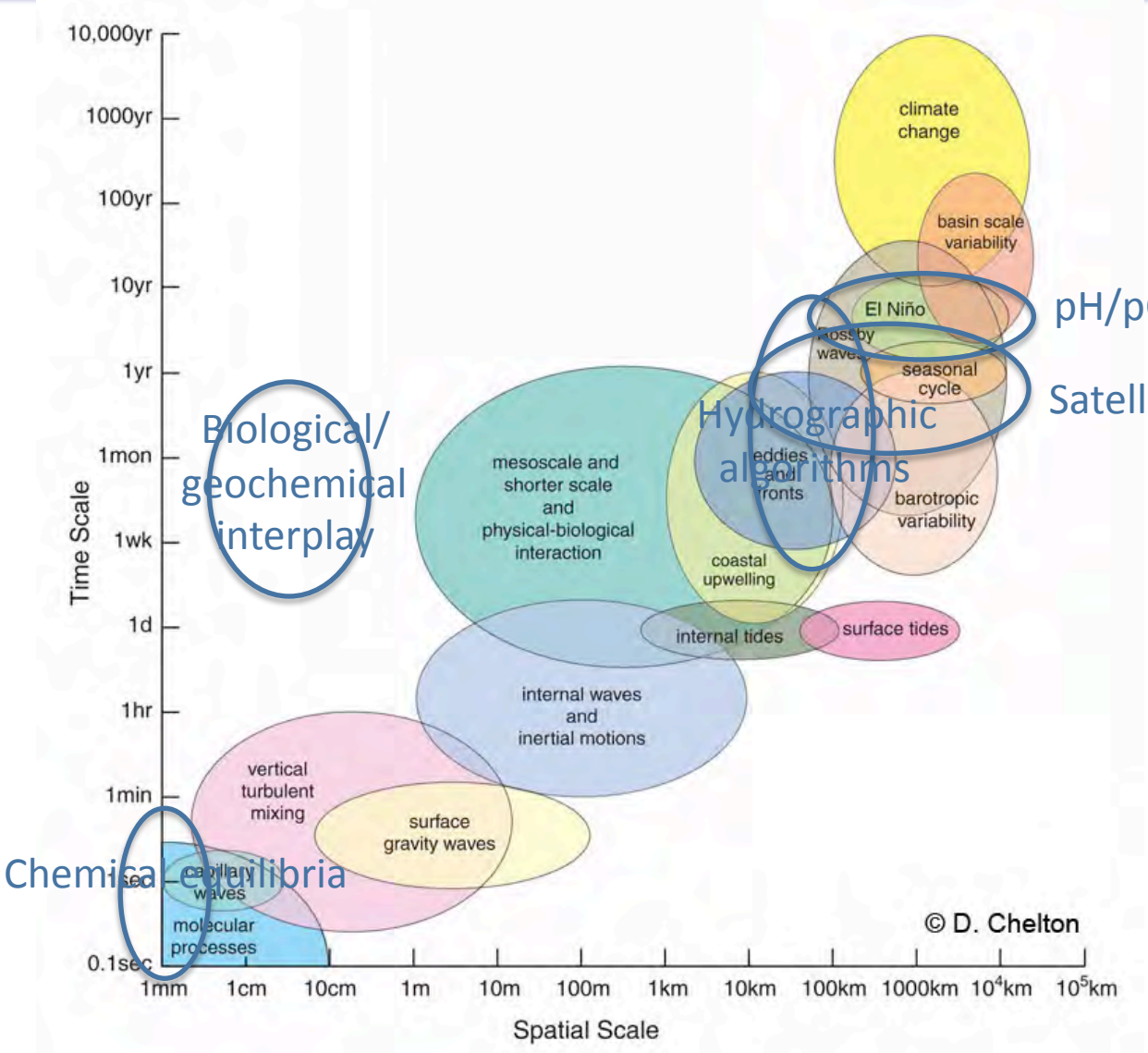
Algorithm & Model Scales



Algorithm & Model Scales

BIOGEOCHEMISTRY & MODELING



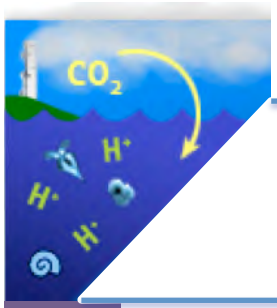
Biological/ geochemical interplay

Hydrographic algorithms

pH/pCO2 climatologies

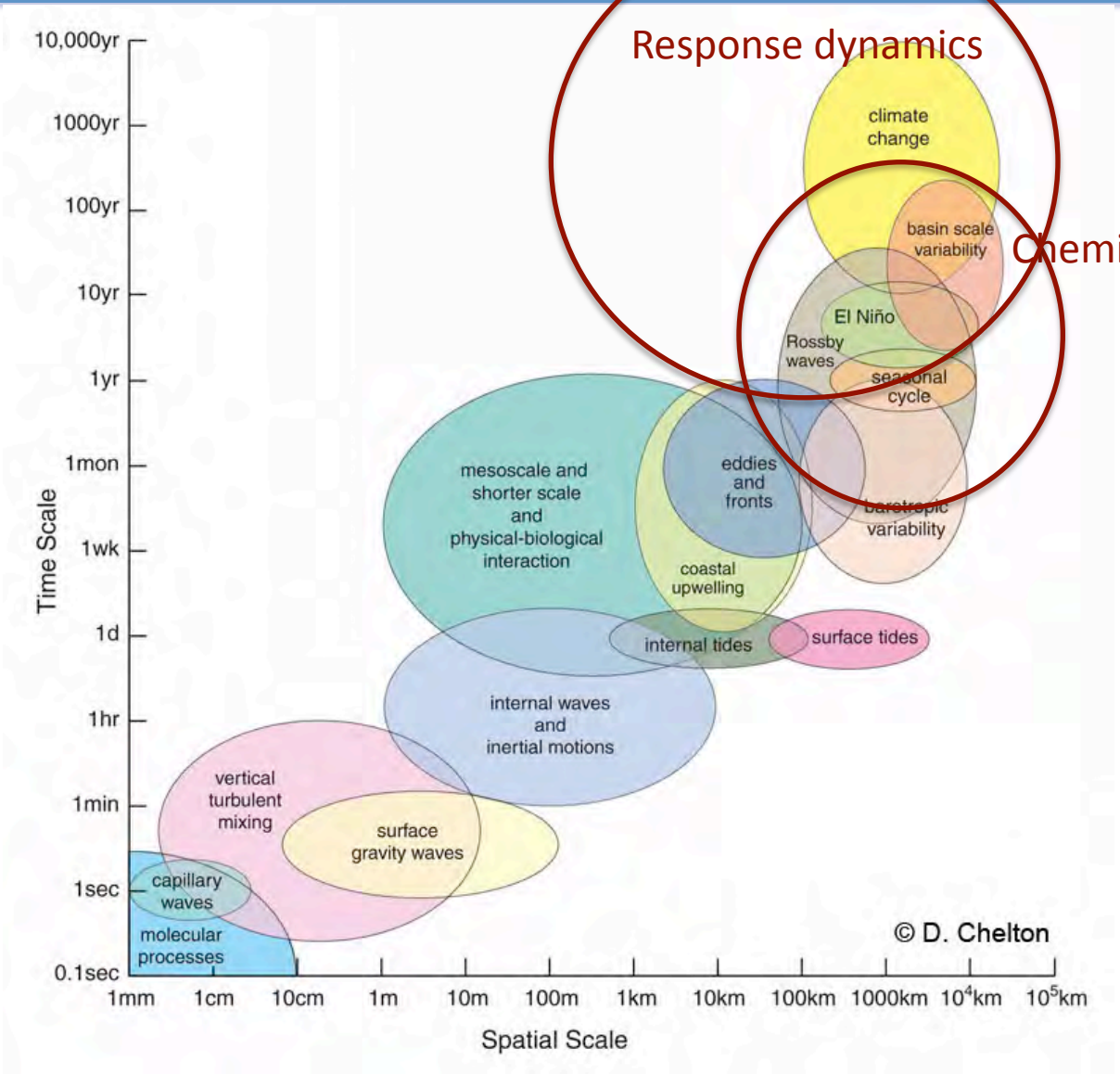
Satellite algorithms

Chemical equilibria



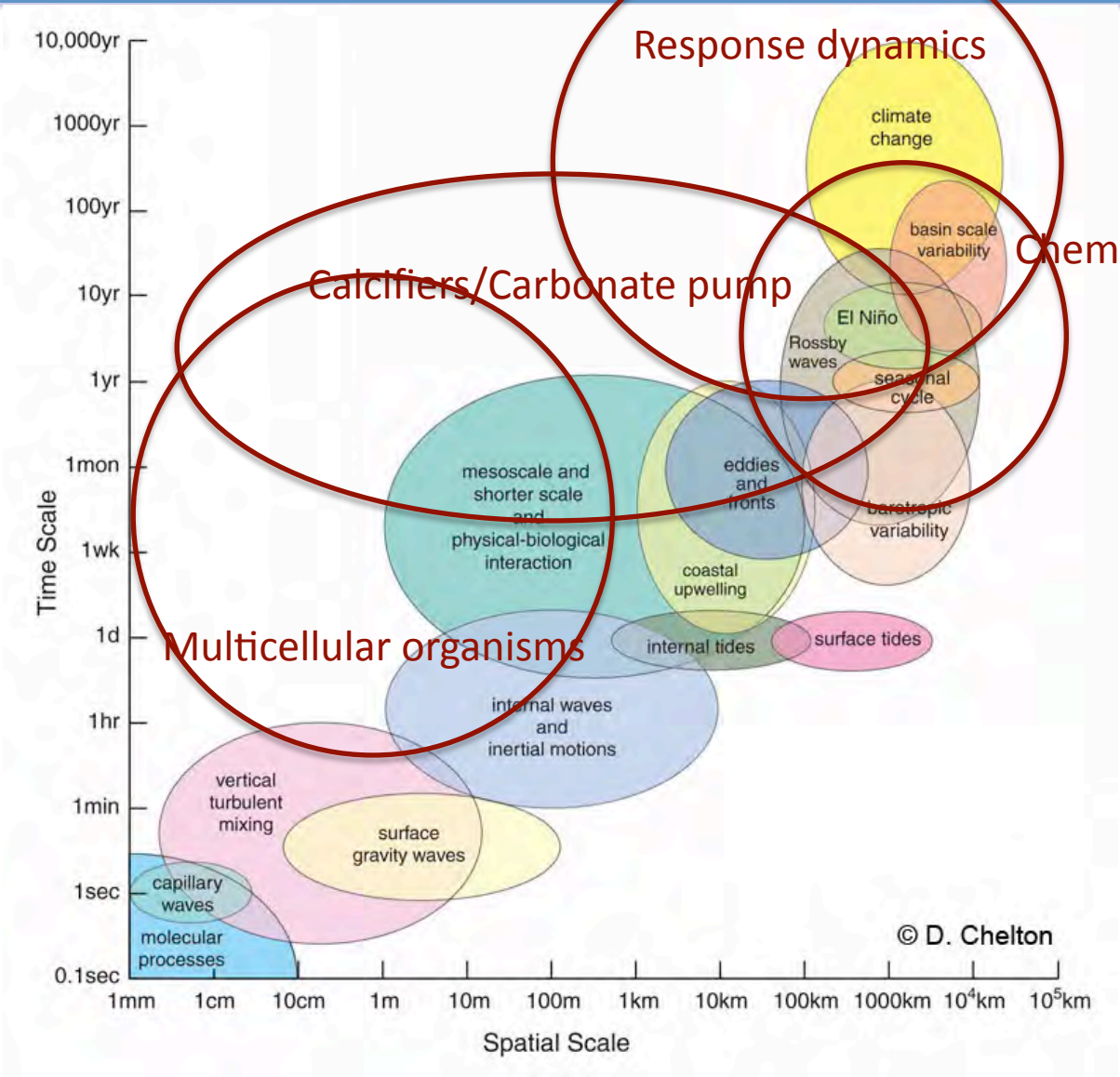
Algorithm & Model Scales

BIOGEOCHEMISTRY & MODELING



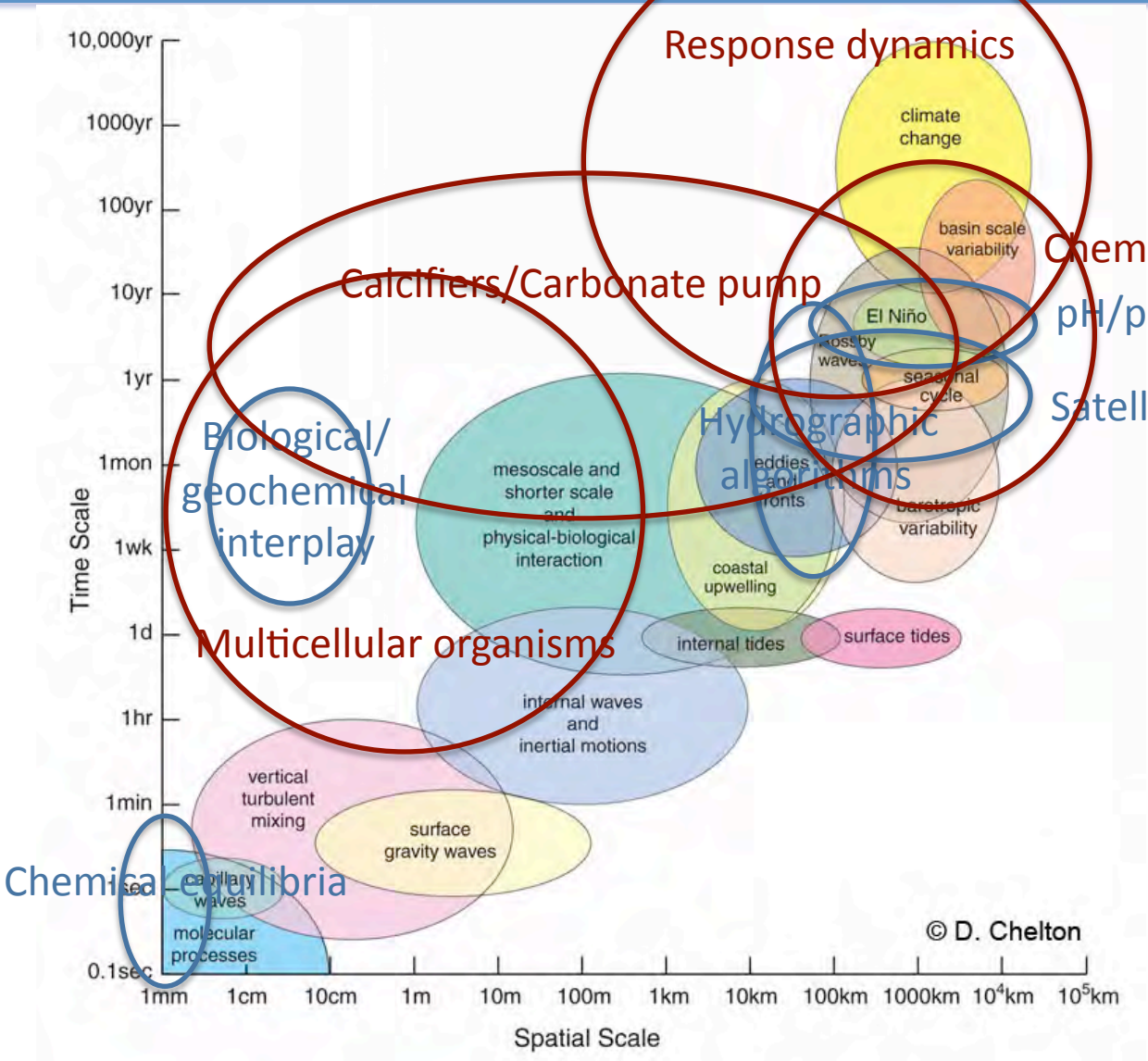
Algorithm & Model Scales

BIOGEOCHEMISTRY & MODELING



BIOGEOCHEMISTRY & MODELING

Algorithm & Model Scales



Discussion questions

BIOGEOCHEMISTRY & MODELING

- Can we extend existing observational data in more ways with other climatologies & multiparameter algorithms? Obstacles?
- What obstacles prevent more model-data comparisons?
- Obstacles preventing development of high-res models? New geographically specific algorithms or datasets needed?
- Challenges to overcome to merge BGC and ecological models? Steps to bring in human communities?