PFAS
State of the Science and Research Directions

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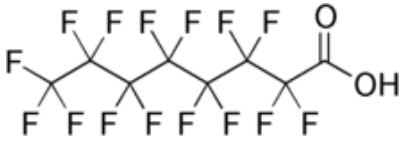
Current knowledge and regulations for PFAS

Poly- and perfluorinated alkyl substances (PFAS)

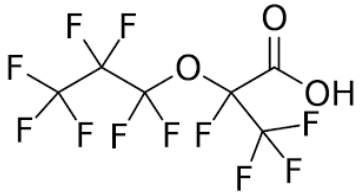
- Large group (4700+) of synthetic chemicals containing multiple F atoms on alkyl chain
- Most common: 4-14 carbon-chain carboxylic & sulfonic acids, e.g., 8-carbon PFOS & PFOA
- Other common PFAS include precursor compounds (e.g., telomer alcohols, sulfonamides)
- Also replacement products (e.g., Gen-X) including shorter-chain compounds (e.g., PFBS)

PFOS

PFOA



PFOSA



Gen-X

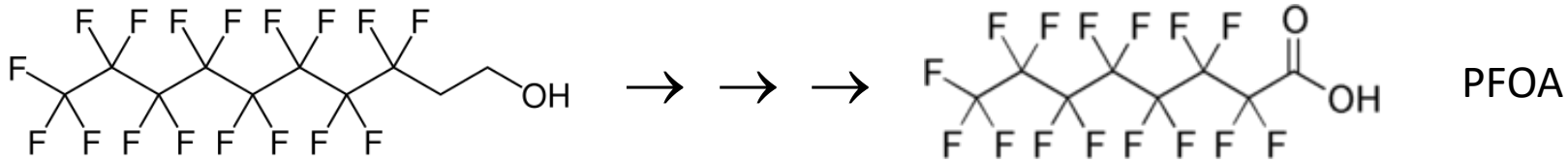
PFBS

Use of PFAS

- Wide range of uses due to resistance to oil, water, and heat
  - Industrial: firefighting foams, chemical manufacturing, electronics, metal coatings and plating, textiles, etc.
  - Consumer: food packaging, stain- and water-repellents, household goods, personal care products, etc.

PFAS as an environmental contaminant

- Properties making PFAS desirable also makes them an environmental problem
  - Strong carbon-fluorine bond = stable and environmentally persistent (“forever chemical”)
  - Very limited degradation, and that typically to other PFAS

8:2 FTOH  PFOA

- PFAS environmentally ubiquitous
  - Widespread use
  - Chemical persistence

PFAS management and regulations

- At federal level, EPA has several regulatory initiatives
  - Emphasis on research, restriction, and remediation
  - Current focus (e.g., thresholds, regulations) on drinking water
    - Proposed Maximum Contaminant Levels of 4 ng/L for PFOS, PFOA
  - Other ambient matrices not emphasized as much yet

- Approach in California is evolving
  - Current focus also on drinking water and its sources
    - Investigative orders on monitoring drinking water, groundwater near likely point-source contamination, wastewater
    - State Water Board issuing draft groundwater infiltration policy this spring
  - Focus may expand in future to other ambient matrices
    - CEC Expert Panels recommended PFAS in prioritizing CECs to monitor

Standardized methods are available

- EPA has several methods
  - 533 and 537.1 for drinking water
  - 8327 for non-drinking water (e.g., groundwater)
  - 1633 for ambient aqueous, porous media, biosolids, and tissue matrices
  - 1621 for screening total organic fluorine in water
- ASTM also has guidelines
  - D7979, D8421 for non-potable water (e.g., surface water, wastewater)

- While methods are mature, research continues
  - Lower detection limits
  - Less sample preparation
  - Identification (e.g., non-targeted) and quantification of new PFAS compounds

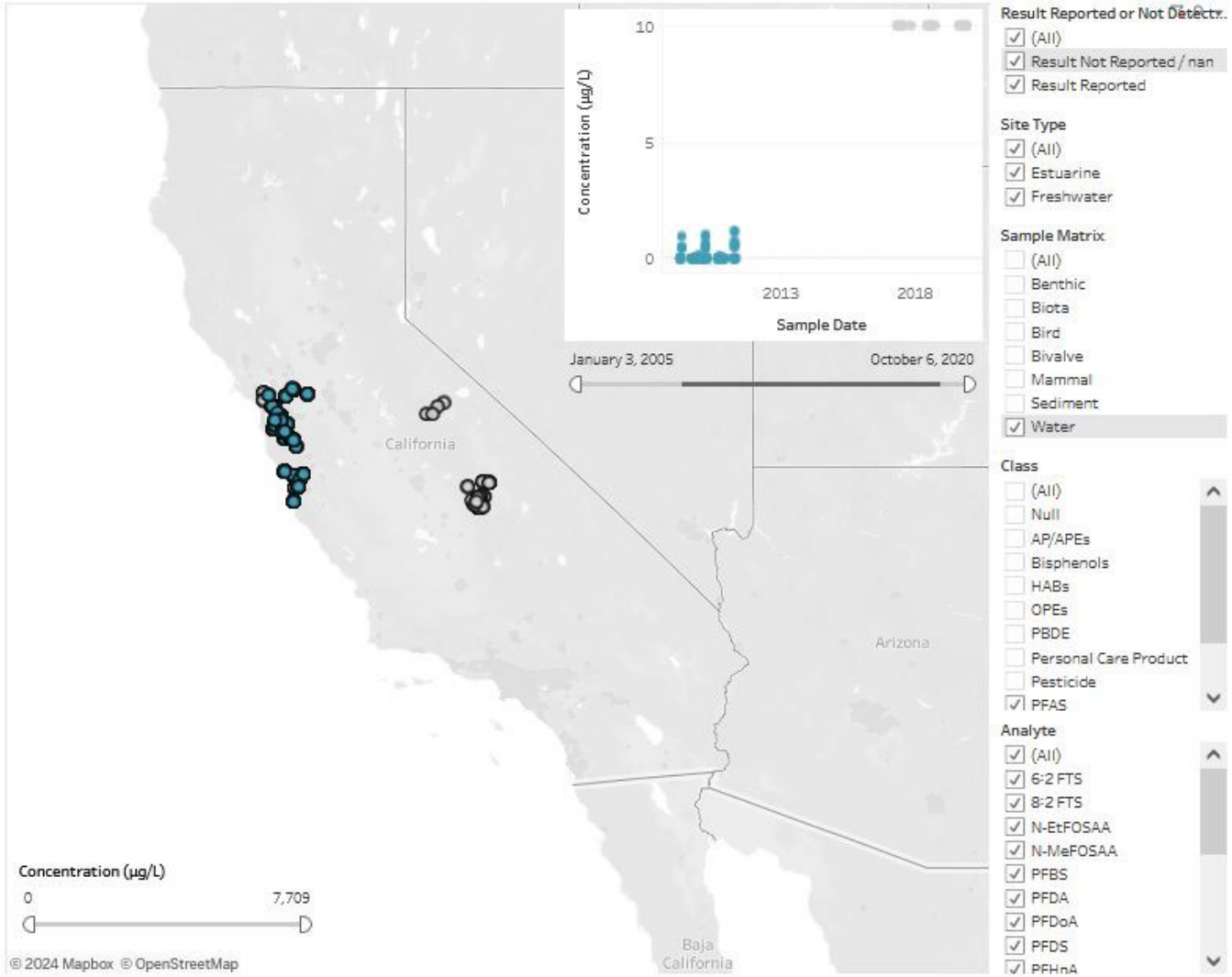
Exposure assessment

- Much data on PFAS environmental occurrence
  - Peer-reviewed literature and grey-literature reports
  - Publicly available interactive maps exist on a number of matrices

- Some data gaps exist
  - Compound (typically PFOS/PFOA and related acids, less other PFAS)
  - Spatial and matrix (uneven in coverage)
  - Data quality (bad data can spoil otherwise good data)

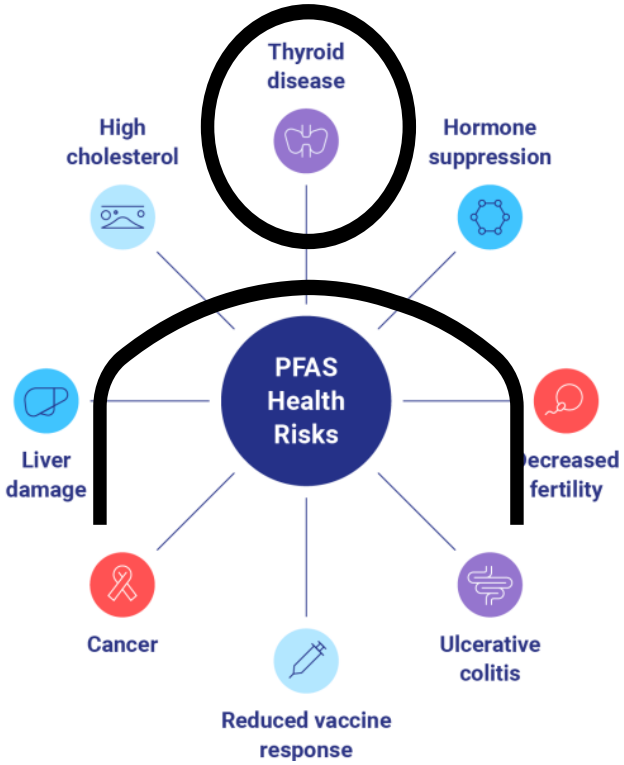
PFAS in surface ambient waters

- State Water Board CEC Program
  - https://www.waterboards.ca.gov/water_issues/programs/cec/cec_datasets.html



Health effects associated with PFAS exposure

- Limited knowledge of PFAS effects
  - Evidence of bioaccumulation in blood and tissues
  - But limited understanding of adverse health effects for most PFAS compounds
- Research suggests some impacts on human health
  - Thyroid disease, high cholesterol
  - Testicular cancer
  - Developmental anomalies in newborns due to maternal transfer

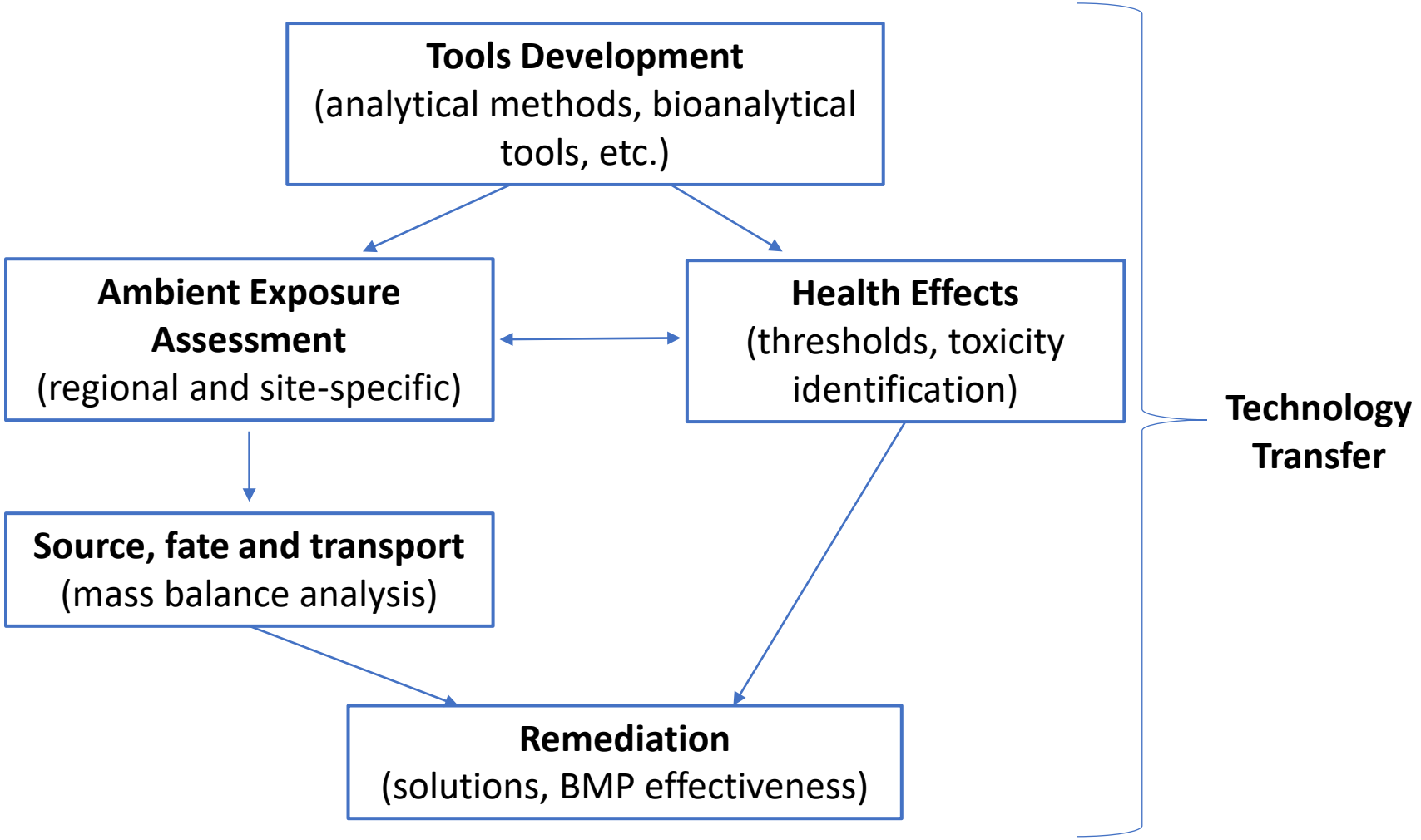


Ecologically relevant health effects

- PFAS have been detected in tissues of various organisms
  - But the significance remains unclear
- Interpreting the impacts of PFAS occurrence in aquatic habitats remains challenging
  - Little to no toxicity data for most PFAS
  - Available data limited to a few species/taxa
  - Few field studies documenting PFAS related adverse effects
- Hence, not enough data to derive thresholds and interpret occurrence data

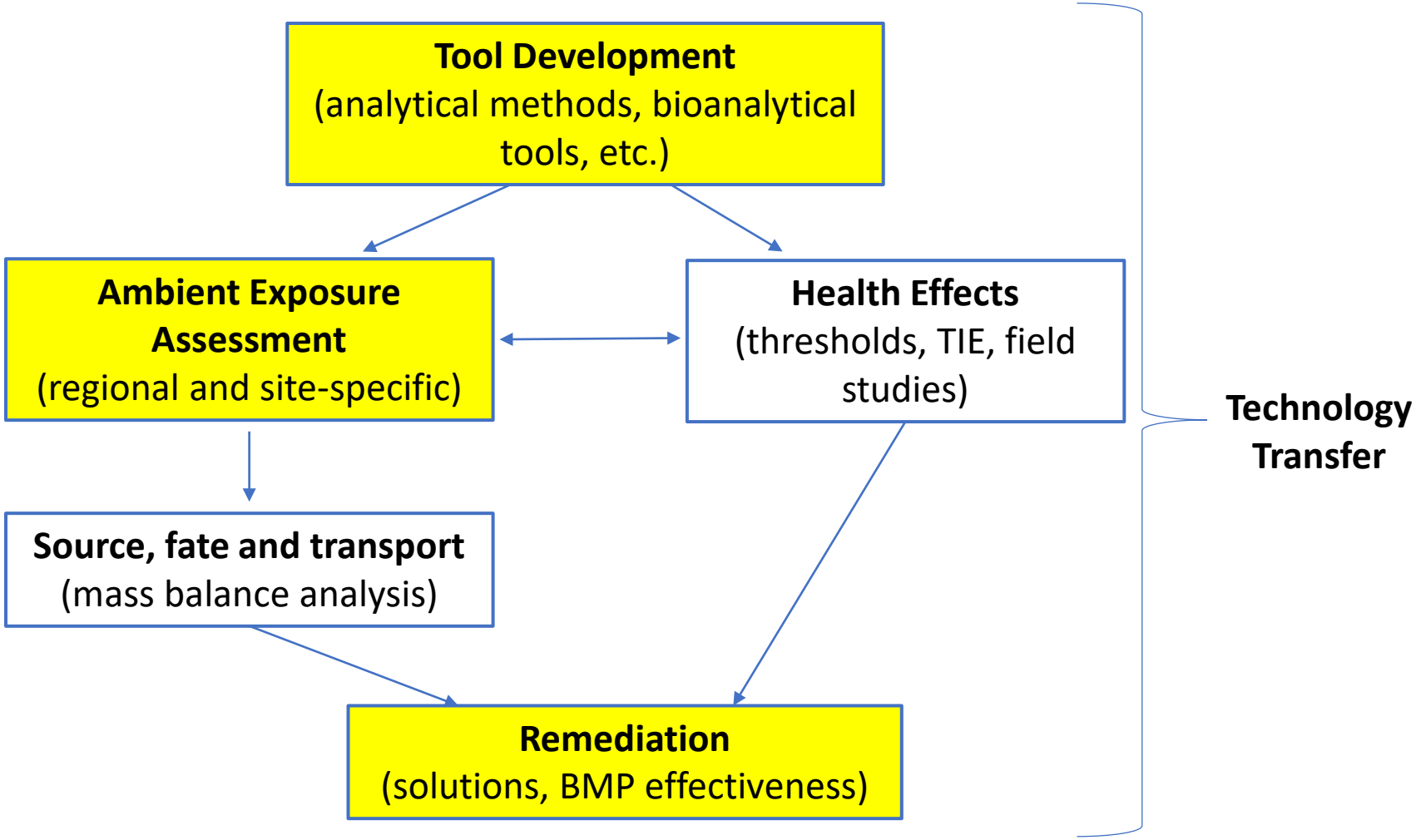
SCCWRP Research on PFAS

CEC conceptual framework



Opportunistic approach to assessing PFAS

- Not prioritized during the last intersessional
- Projects based on our skills and funding available



Tools to assess PFAS mixtures

- Bioanalytical screening tools for rapid evaluation of sublethal effects of PFAS mixtures

- Investigating commercially available cell lines responding to PFAS
  - Funded by State Water Board
  - Testing of different PFAS at environmental concentrations

PFAS occurrence in California aquatic habitats

- Freshwater habitats
  - Supporting SWAMP to measure CEC concentrations in surface water, effluents, sediment and fish tissues
  - PFOS and occasionally PFOA
  - Geographically limited to individual regional boards (RB4, RB8, RB1)

- Coastal and marine habitats
  - PFOS and PFOA included in Bight‘23 sediment and shellfish
  - Collaborating NOAA Mussel Watch

Remediation

- Current emphasis is on stormwater runoff
- Quantifying PFAS removal (via sorption) by different media and building a model to predict BMP performance
  - In partnership with State Waterboard and SMC
  - Bench-scale study and field verification
- Evaluating potential for PFAS to infiltrate from BMPs into surrounding soils
  - Led by LACPW

Technology transfer

- Assisting CA laboratory accreditation program (ELAP)
  - Familiarize ELAP and third-party assessors on EPA PFAS methods
  - Including EPA 533 and 537.1 for drinking water

- Scheduled for May 2024 at SCCWRP
  - With participation of member agencies that have experience measuring PFAS

SCCWRP research on PFAS moving forward

- CTAG members agree with our current opportunistic approach
- SCCWRP will not actively seek out PFAS-related projects
- Instead, we will work on individual projects at the request of member agencies