Applications of Satellite Remote Sensing Products for Monitoring and Conservation

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Ocean Data Bootcamp

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Image: NASA/US Geological Survey/Norman Kuring/Kathryn Hansen

Overview

- Introduction
- What do we mean by Remote Sensing?
- Why Satellite Remote Sensing?
  - For Monitoring
  - For Conservation
- Examples/Case Studies
- Questions

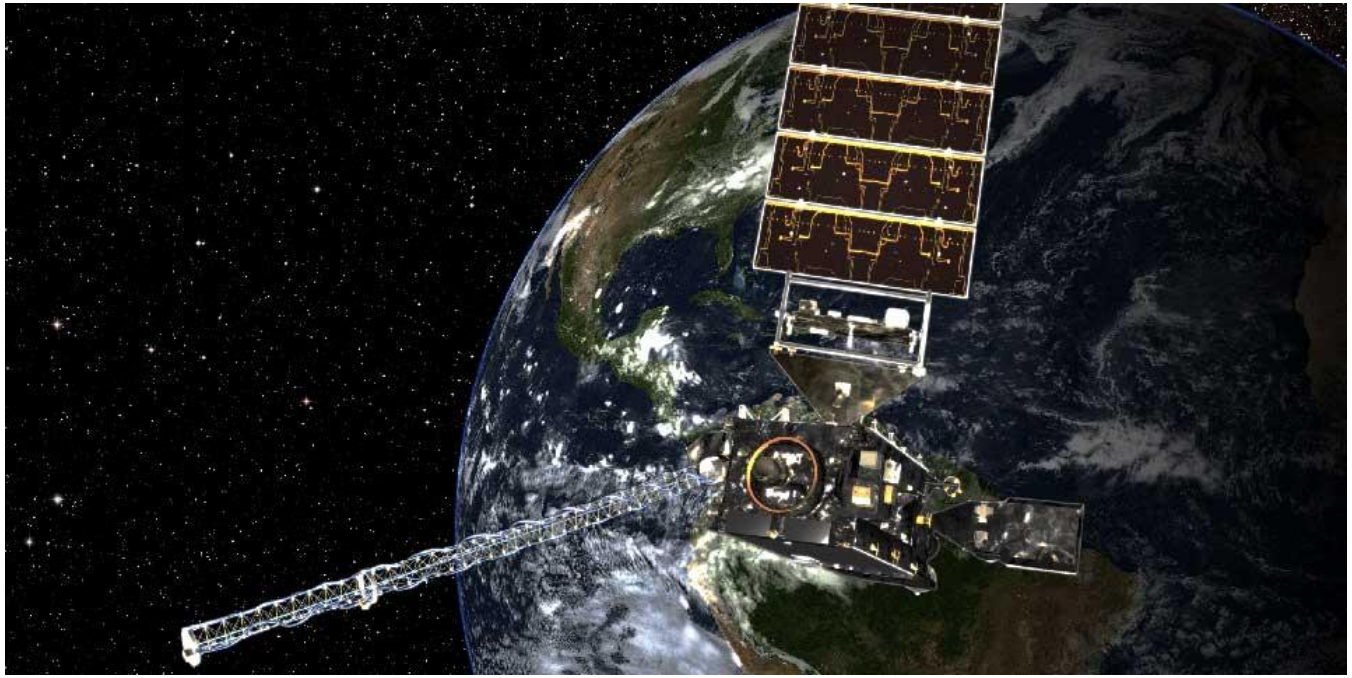


Image: GOES-16, NASA

What is it about the ocean that makes monitoring difficult?

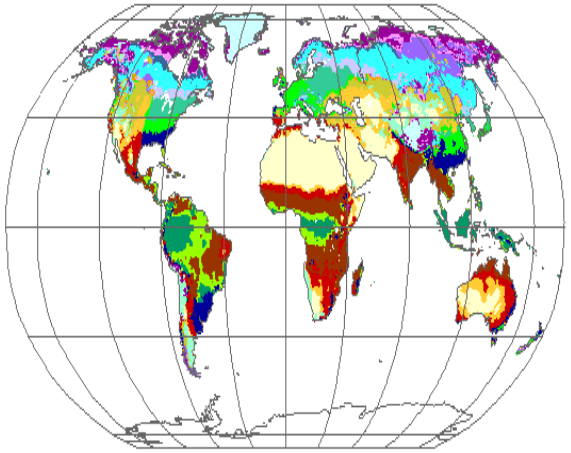
Ocean vs. Land

Primary Producers
(macro v. micro)

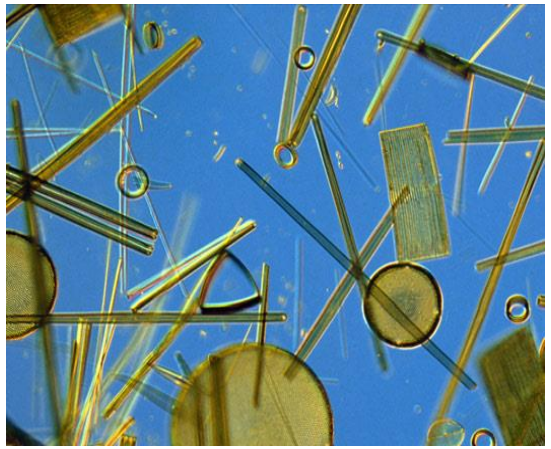
Time
(persistent v. ephemeral)

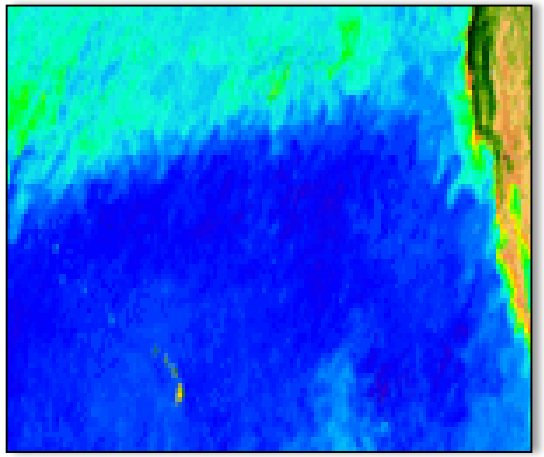
Boundaries
(static, strong v. dynamic, diffuse)

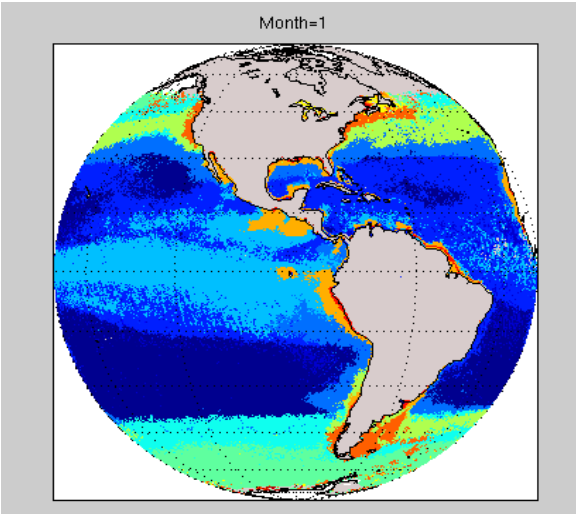
Land



Sea







Kavanaugh et al., assorted

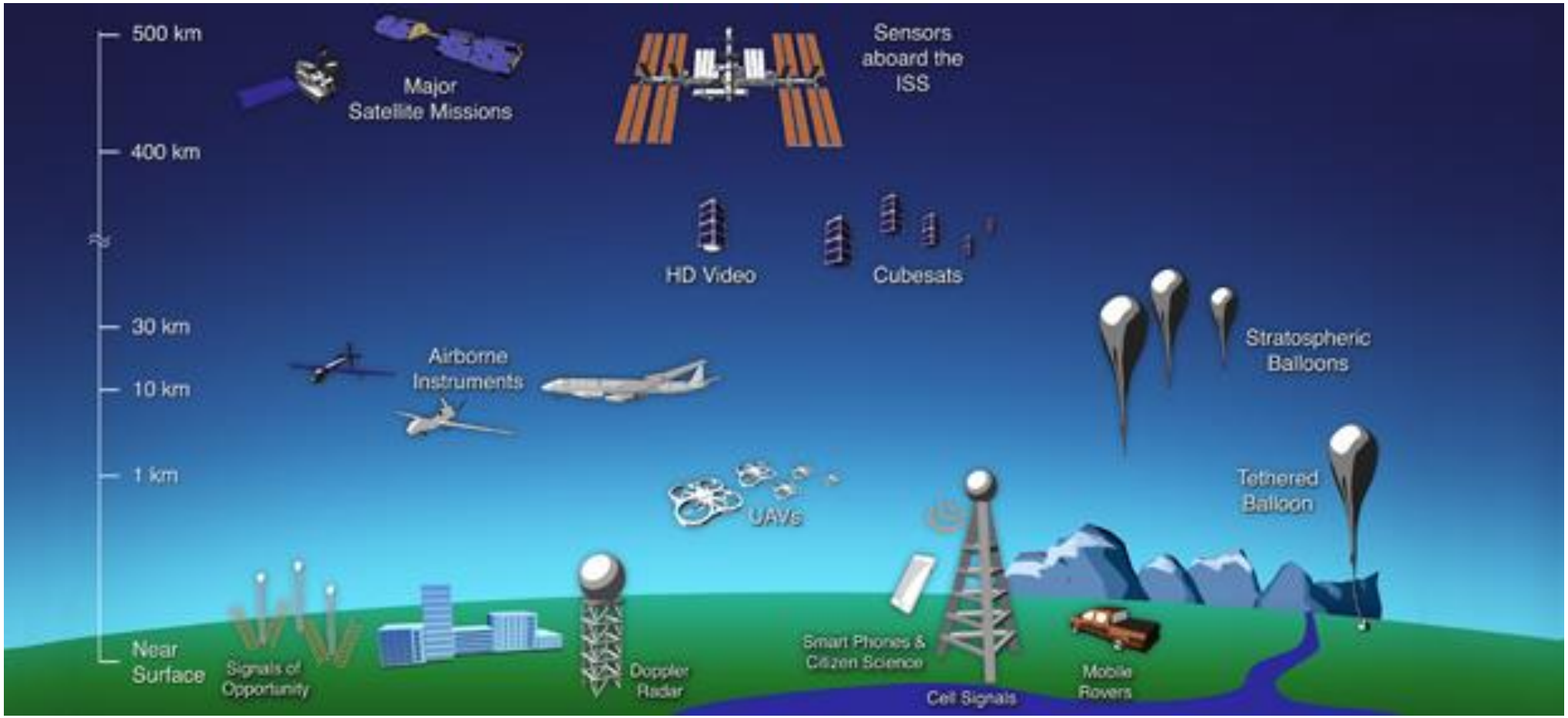
What is Remote Sensing?

Remote sensing is the **science of obtaining information** about objects or areas from a distance, typically from aircraft or satellites.

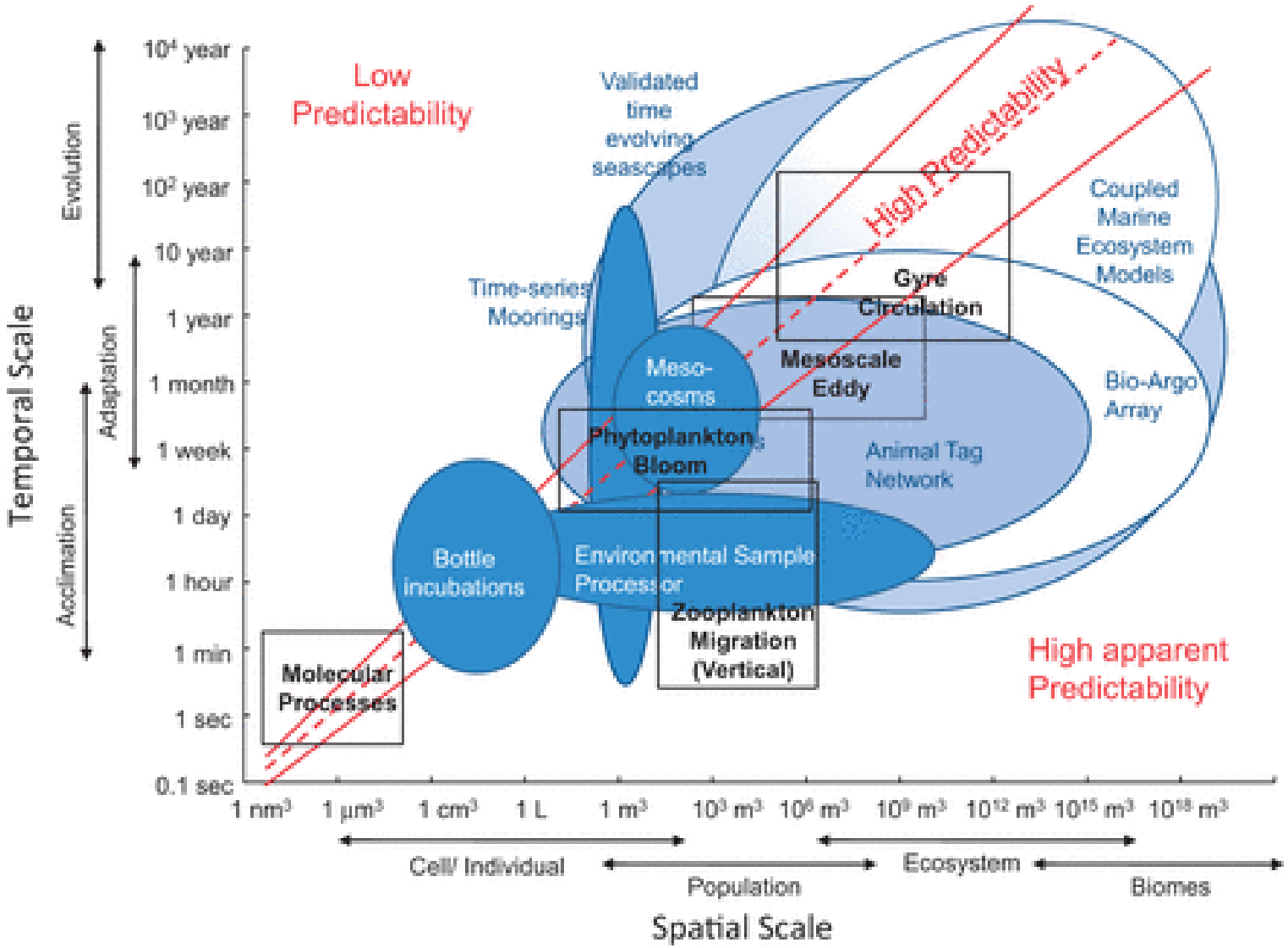
Known Applications in:

- Coastal Environments
- Ocean Environments
- Hazard/Risk Assessments
- Natural Resource/Use Management

Source: NASA



Source: GIS Geography



Source: Kavanaugh et al., 2016

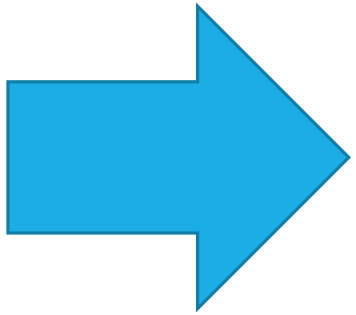
In Oceanography

Sea Surface Temperature

Ocean Color

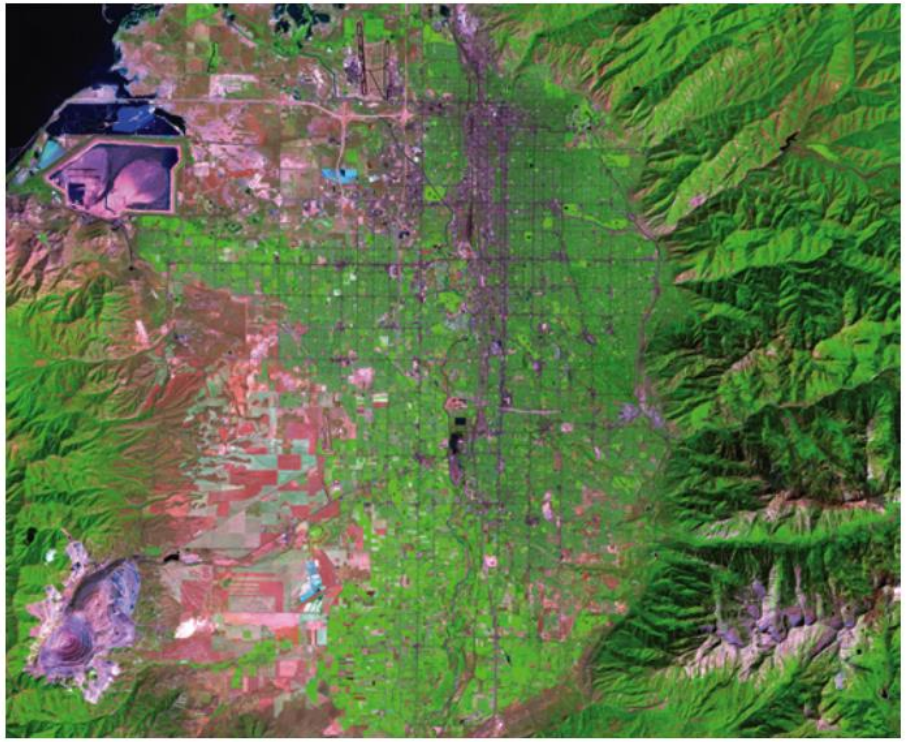
- Algal Blooms
- Chl-A
- Submerged Aquatic Vegetation

Sea Surface Height



A unique opportunity to observe changes at multiple spatial and temporal scales!

Remote Sensing: Monitoring

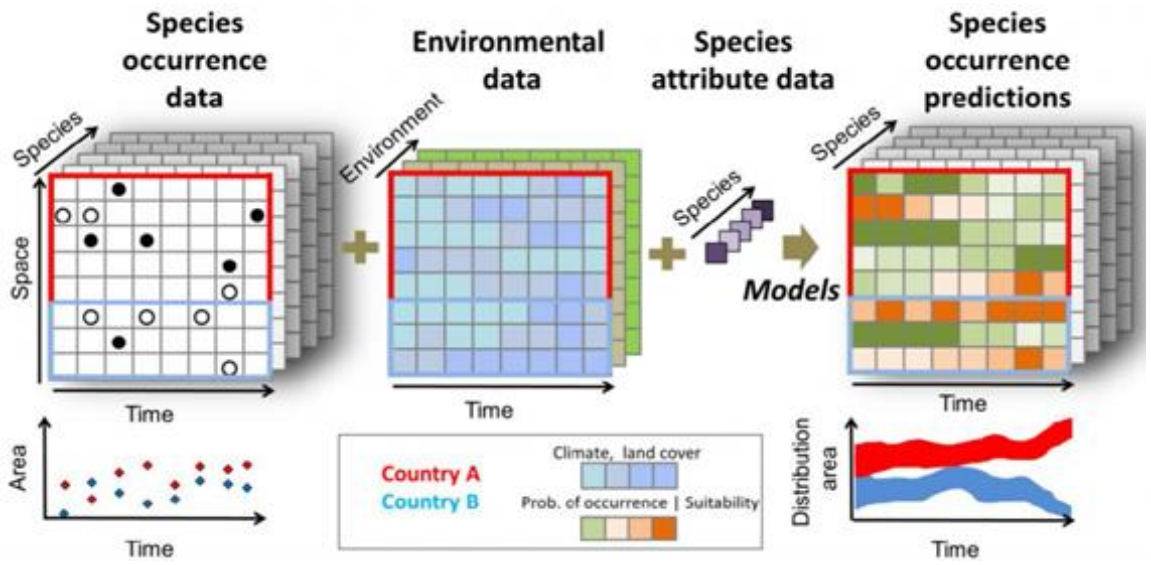


Landsat 5, Salt Lake City, Utah, August 31, 1985.

Landsat 8, Salt Lake City, Utah, September 19, 2015.

Source: USGS

Remote Sensing: Conservation



Inputs:

Abiotic Data

Biotic Data

Species Occurrences

Plants

Animals

Outputs:

a ‘best-fit mathematical relationship’ between a response (dependent) variable — typically species occurrence — and a vector of predictor (independent) variables — typically environmental data (climatic, biophysical, geophysical, etc.)

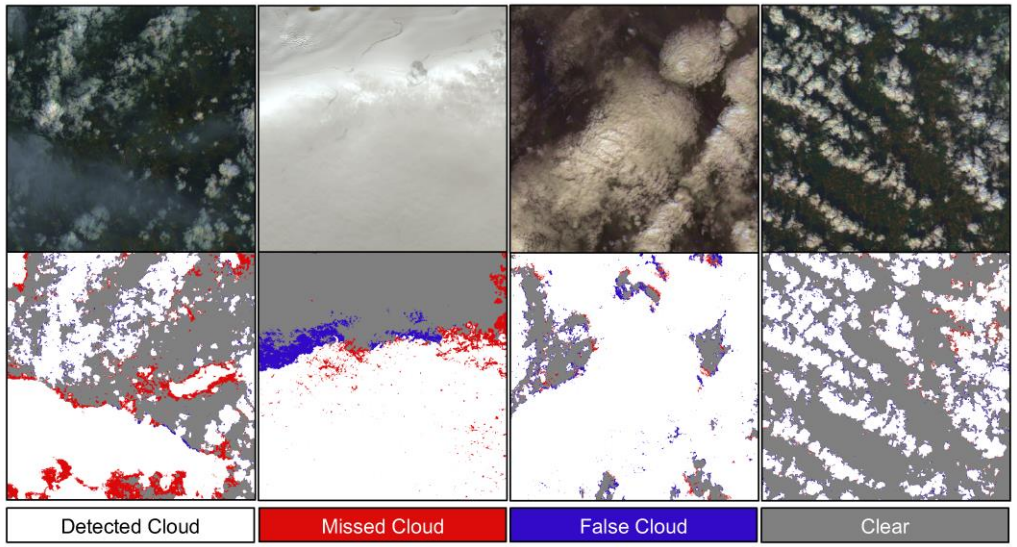
Source: Chris Williams

Considerations/Limitations

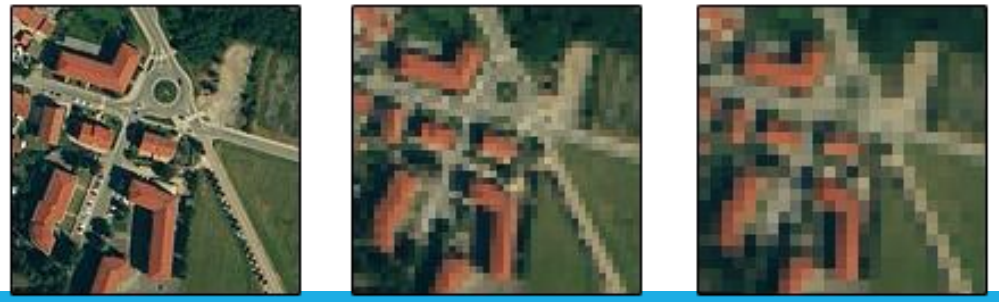
Scale mismatch

Resolution availability

- Spatial
- Temporal
- Processing effort

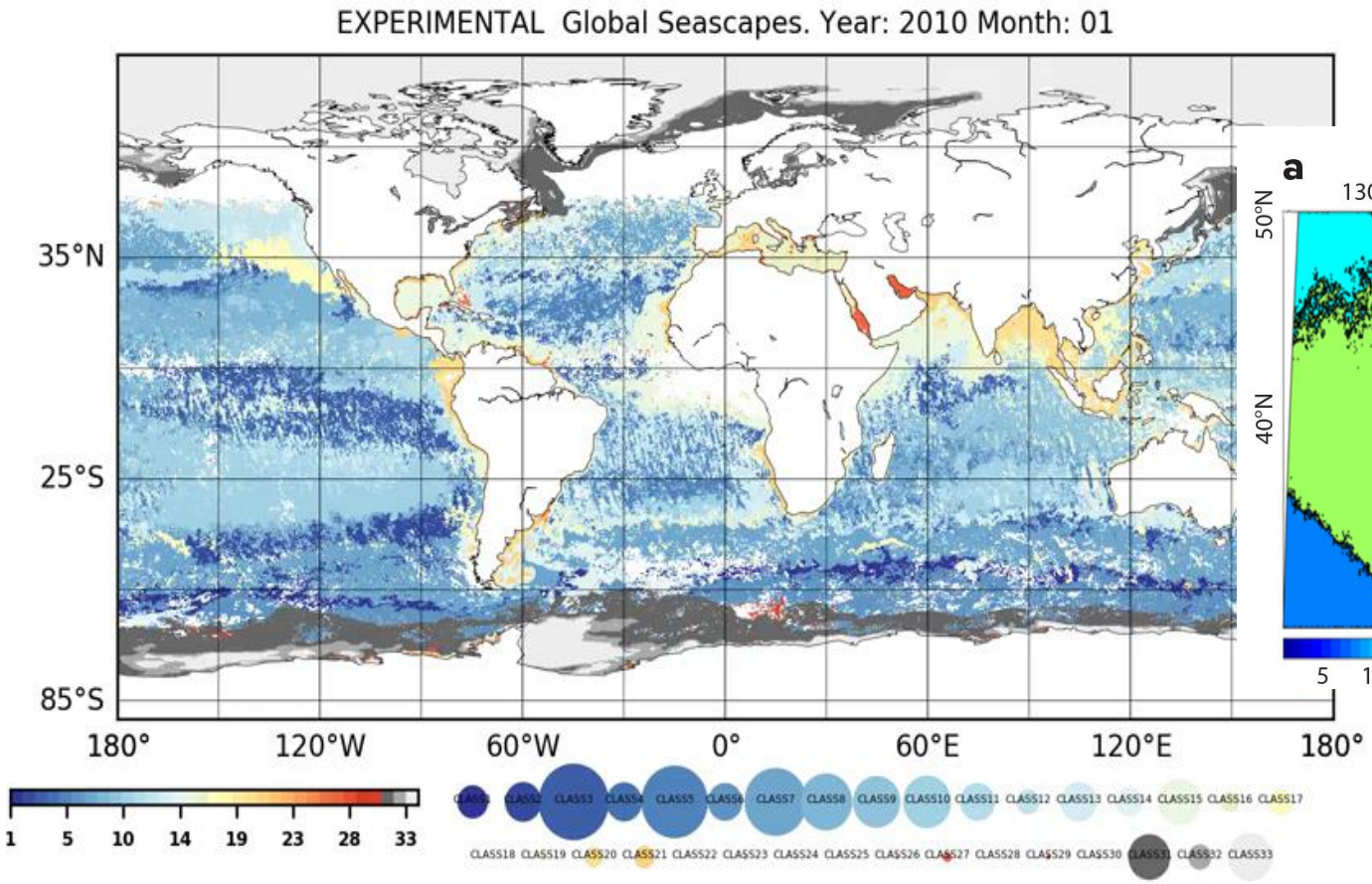


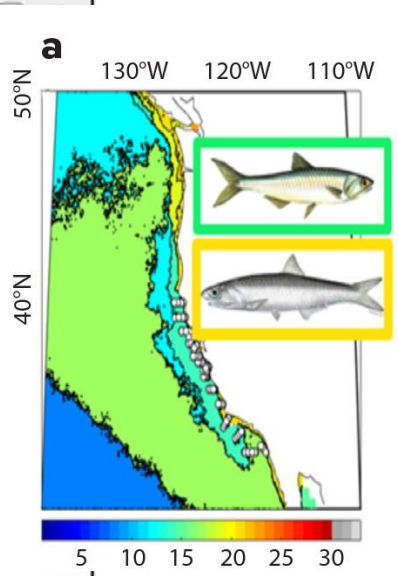
- Ask yourself: “what information do we need to track the processes that affect our goals?”

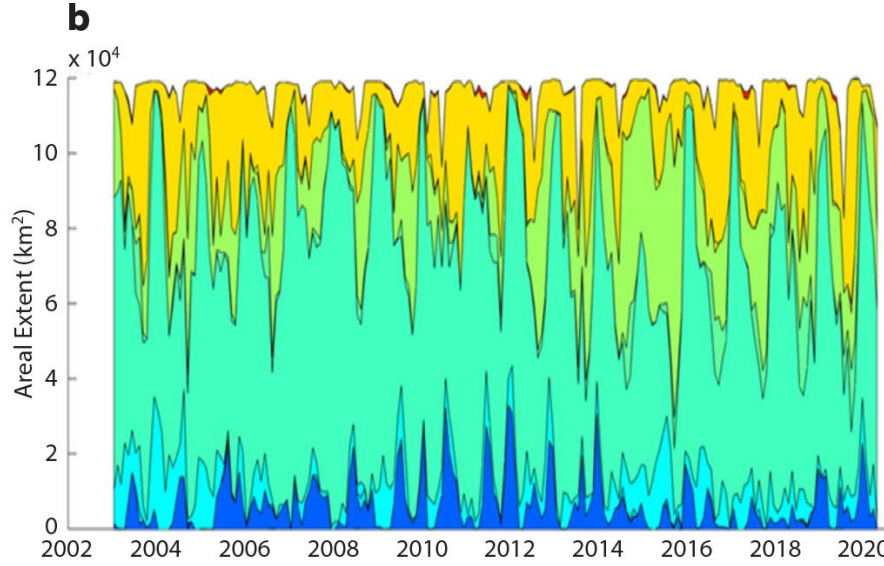


Source: GIS Geography

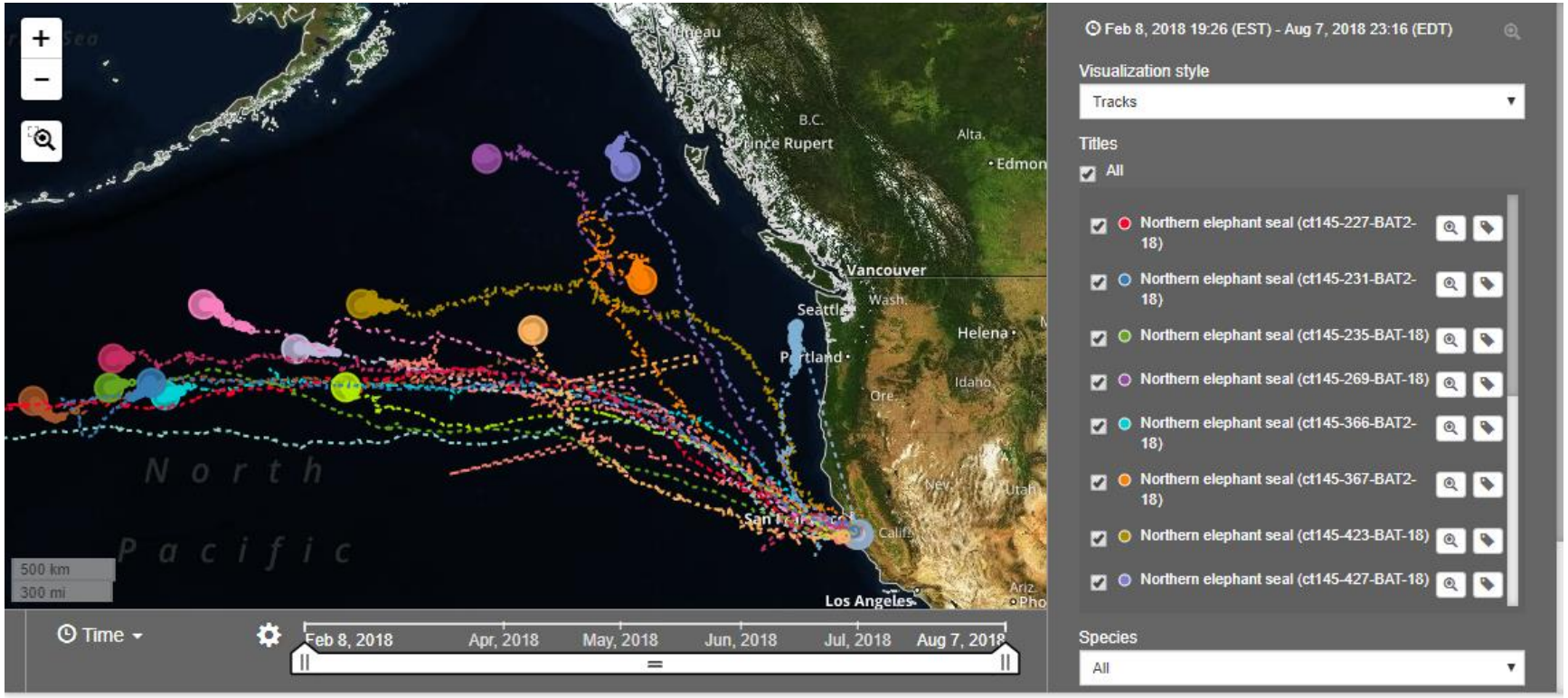
Case Study: Dynamic Seascapes



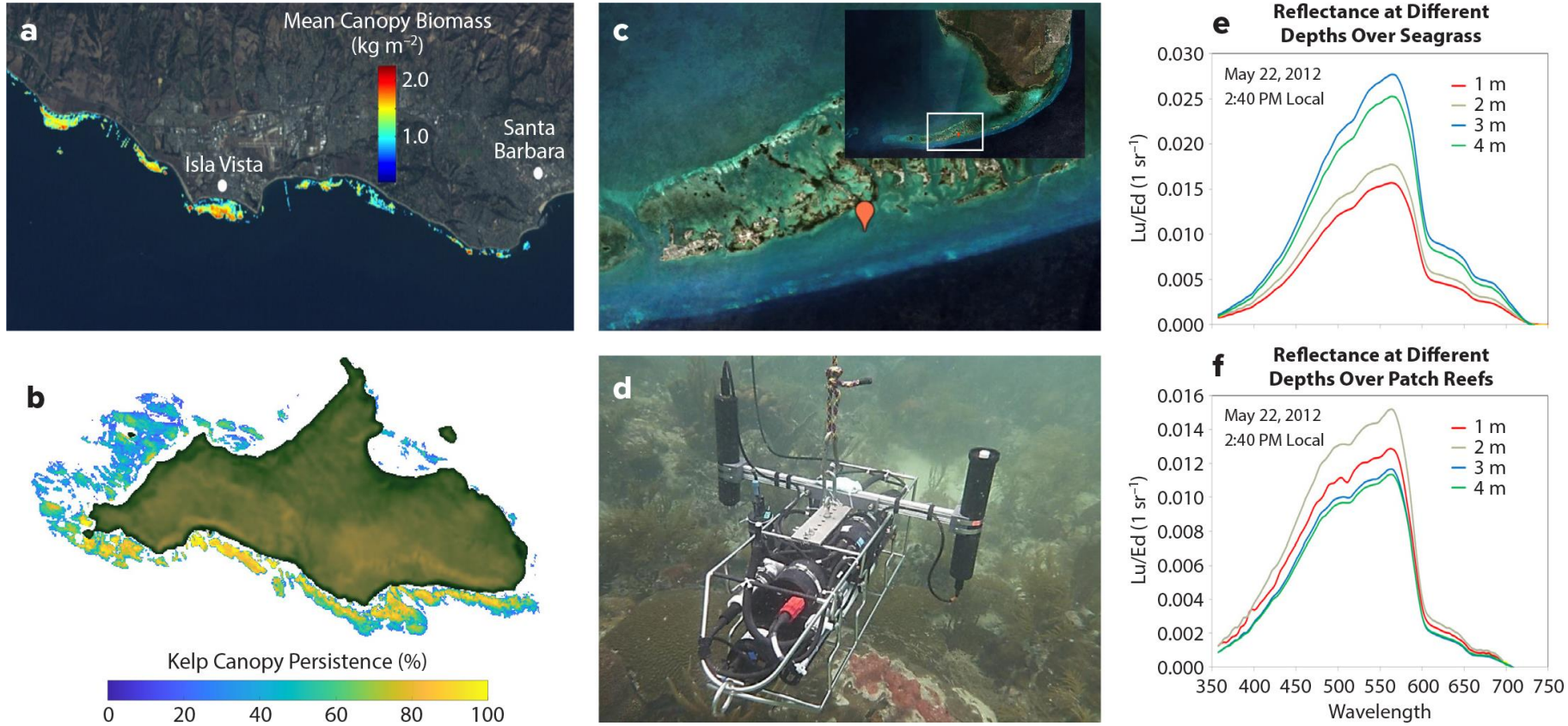




Case Study: Animal Telemetry Network



Case Study: Mapping of Foundation Species



Source: Kavanaugh et al., 2021

Application: Indicator Development

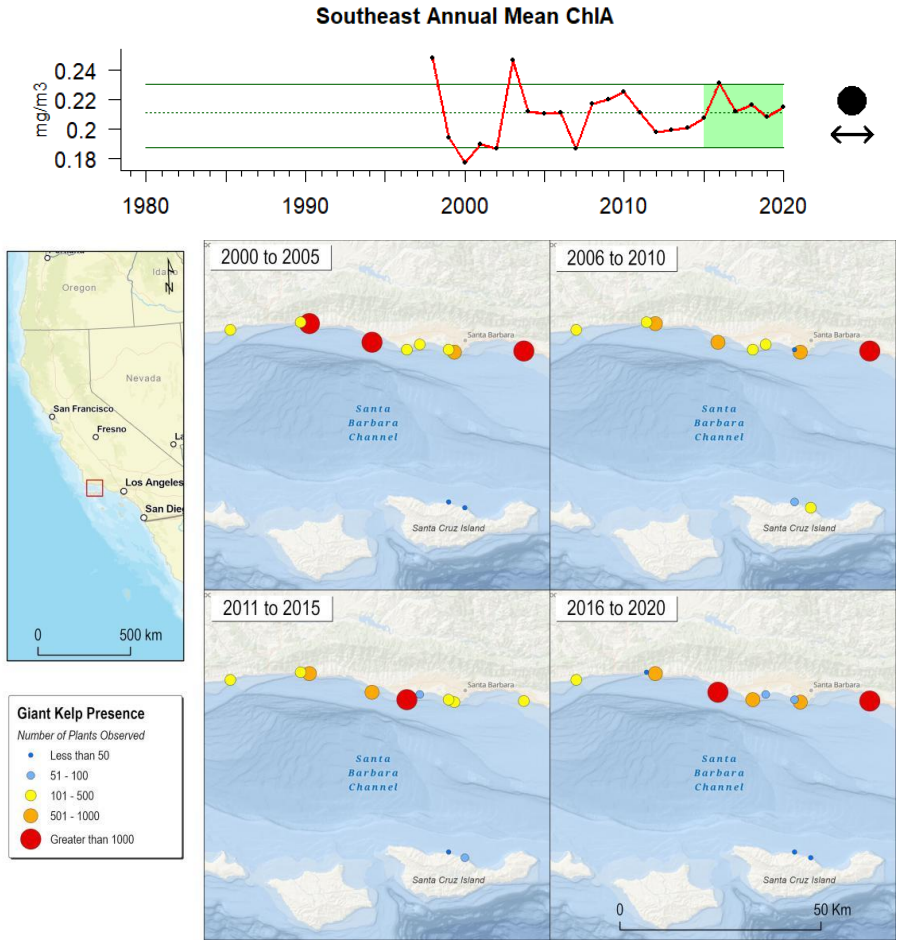
Quantitative and/or qualitative measures of key components of the ecosystem

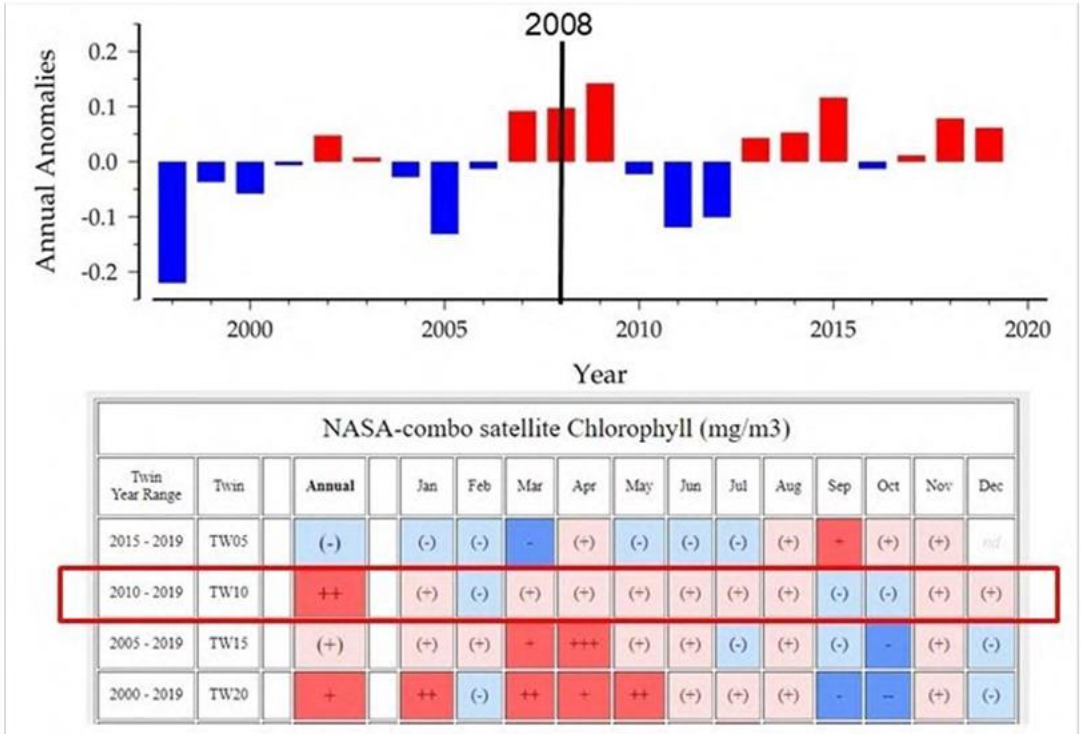
Remote sensing technology allows for:

- Long term monitoring
- At multiple scales
- Can be directly in line with conservation and management goals

SST, Chl-a, Sea Level, Marine Heatwaves, algal blooms, species movement, submerged aquatic vegetation, etc

Example: Remotely Sensed Indicators





NASA-combo satellite Chlorophyll (mg/m3)

Twin Year Range	Twin	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015 - 2019	TW05	(-)	(-)	(-)	-	(+)	(-)	(-)	(-)	(+)	-	(+)	(+)	nd
2010 - 2019	TW10	++	(+)	(-)	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(+)	(+)
2005 - 2019	TW15	(+)	(+)	(+)	-	+++	(+)	(+)	(-)	(+)	(-)	-	(+)	(-)
2000 - 2019	TW20	+	++	(-)	++	+	++	(+)	(+)	(+)	-	--	(+)	(-)

Questions?

Thank you

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