Surface Heat Flux ECVs

Atmosphere

Surface

- Precipitation
- Pressure
- Radiation budget
- Temperature
- Water vapour
- Wind speed and direction

Upper-air

- Earth radiation budget
- Lightning
- Temperature
- Water vapor
- Wind speed and direction

Atmospheric Composition

- Aerosol and ozone precursors
- Aerosols properties
- Carbon dioxide, methane and other greenhouse gases
- Cloud properties
- Ozone

Land

Hydrosphere

- Groundwater
- Lakes
- River discharge

Cryosphere

- Glaciers
- Ice sheets and ice shelves
- Permafrost
- Snow

Biosphere

- Above-ground biomass
- Albedo
- Evaporation from land
- Fire
- Fraction of absorbed photosynthetically active radiation (FAPAR)
- Land cover
- Land surface temperature
- Leaf area index
- Soil carbon
- Soil moisture

Anthroposphere

- Anthropogenic Greenhouse gas fluxes
- Anthropogenic water use

Ocean

Physical

- Ocean surface heat flux
- Sea ice
- Sea level
- Sea state
- Sea surface currents
- Sea surface salinity
- Sea surface stress
- Sea surface temperature
- Subsurface currents
- Subsurface salinity
- Subsurface temperature

Biogeochemical

- Inorganic carbon
- Nitrous oxide
- Nutrients
- Ocean colour
- Oxygen
- Transient tracers

Biological/ecosystems

- Marine habitat properties
- Plankton

https://gcos.wmo.int/en/essential-climate-variables/ecv-factsheets

Surface Heat Flux ECVs

Atmosphere

Surface

- Precipitation
- Pressure
- Radiation budget
- Temperature
- Water vapour
- Wind speed and direction

Upper-air

- Earth radiation budget
- Lightning
- Temperature
- Water vapor
- Wind speed and direction

Atmospheric Composition

- Aerosol and ozone precursors
- Aerosols properties
- Carbon dioxide, methane and other greenhouse gases
- Cloud properties
- Ozone

Land

Hydrosphere

- Groundwater
- Lakes
- River discharge

Cryosphere

- Glaciers
- Ice sheets and ice shelves
- Permafrost
- Snow

Biosphere

- Above-ground biomass
- Albedo
- Evaporation from land
- Fire
- Fraction of absorbed photosynthetically active radiation (FAPAR)
- Land cover
- Land surface temperature
- Leaf area index
- Soil carbon
- Soil moisture

Anthroposphere

- Anthropogenic Greenhouse gas fluxes
- Anthropogenic water use

Ocean

Physical

- Ocean surface heat flux
- Sea ice
- Sea level
- Sea state
- Sea surface currents
- Sea surface salinity
- Sea surface stress
- Sea surface temperature
- Subsurface currents
- Subsurface salinity
- Subsurface temperature

Biogeochemical

- Inorganic carbon
- Nitrous oxide
- Nutrients
- Ocean colour
- Oxygen
- Transient tracers

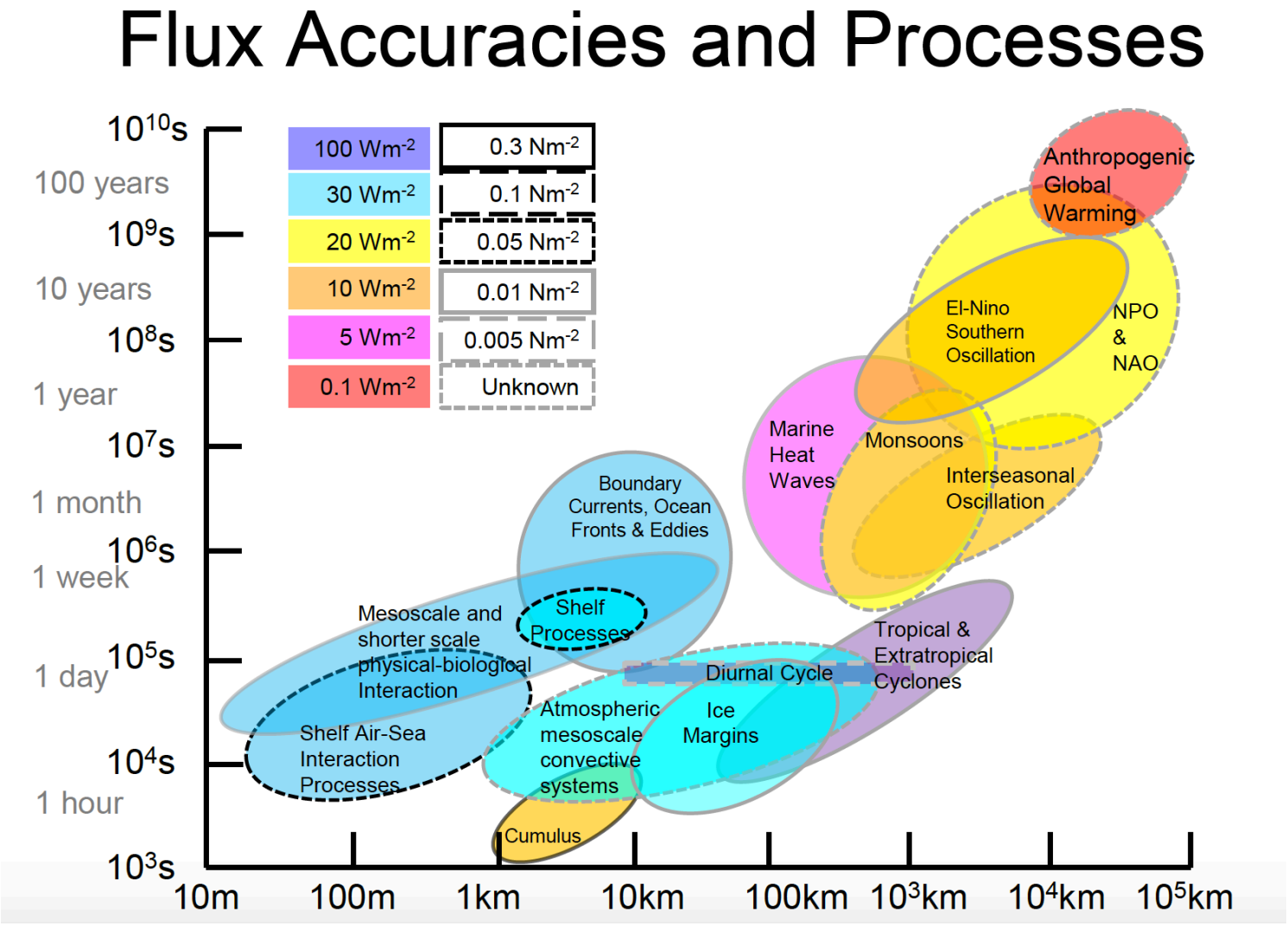
Biological/ecosystems

- Marine habitat properties
- Plankton

Some of these are also Carbon Flux ECVs

Carbon & Heat fluxes can be measured from same platform in many cases

https://gcos.wmo.int/en/essential-climate-variables/ecv-factsheets



Cronin et al. (2019) Air-Sea Fluxes with focus on Heat and Momentum. For FMS OceanObs19 special issue.

Goals for 2030:

Gridded Air-Sea fluxes with 1-day random uncertainties of:

15 W m^{-2} (5%) & 0.01 N m^{-2} (5%)

And Biases less than:

5 W m^{-2} & 0.005 N m^{-2}

For: 3-hourly at 25 km

Aspirational goal: 1-hrly at 10km

Flux EOV/ECV	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Bulk SST	Partially met												Adequate
Skin Temperature	Partially met												Adequate
Wind Speed and Direction	Partially met												Adequate
Air Temperature	Not met												Adequate
Humidity	Not met												Adequate
Bulk Surface Currents	Partially met												Adequate
Skin Surface Currents	Not met												Adequate
Surface Solar Radiation	Partially met												Adequate
Surface Longwave Radiation	Partially met												Adequate
Albedo	Partially met												Met
Sea State	Requirement Unknown											Requirement Known	

	Requirement not met / inadequate
	Requirement partially met / threshold
	Requirement adequately met / breakthrough
	Requirement fully met / ideal goal

Surface **Energy Cycle** requires understanding of Surface Heat and Momentum Fluxes

Surface Heat Fluxes requires understanding of evaporation (**Water Cycle**).

Surface Flux of Carbon (**Carbon Cycle**) associated with similar turbulent processes.

Who needs this

- Better surface fluxes needed to understand ocean influence on weather and climate. Better fluxes could lead to improved predictions on time scales of hurricanes, to atmospheric rivers, to El Nino, to decadal oscillations.
- Better fluxes (coupled feedbacks) could help improve climate projections and their impacts.
- Surface flux ECVs distributed across every GCOS/GOOS panel.
- Research community must be involved: WCRP
- This is an activity called for by Concept-Heat
- UN Decade of the Ocean for Sustainable Development could provide a window of opportunity.

Action Items

- Caterina Tassone (GCOS) liaison with WCRP to coordinate with existing WCRP ocean & land-base flux groups (WDAC, Surflux Task Team, GEWEX, SOLAS…).
- Liz Kent (AOPC) and Rainer Hollman (AOPC) will discuss with AOPC feasibility of remotely-sensed humidity & temperature profiles, optimized for surface boundary layer.
- Bob Weller (OOPC) will work with Christian Lanconelli (BSRN) to set up workshop on a global (ocean & land-based) radiation network, and develop best practices for surface radiation.
- Matt Palmer (OOPC) will liaison with WMO/WGNE & WCRP/WGCM
- Meghan Cronin (OOPC) will help coordinate a vision paper for broader community, beyond OceanObs19.
- Scoping of a SCOR Working Group Proposal for organizing/implementing near-term goals?