APECS-ARICE Webinar: Atmospheric measururements aboard research ships

Research ship: a multi-disciplinary platform to close a gap



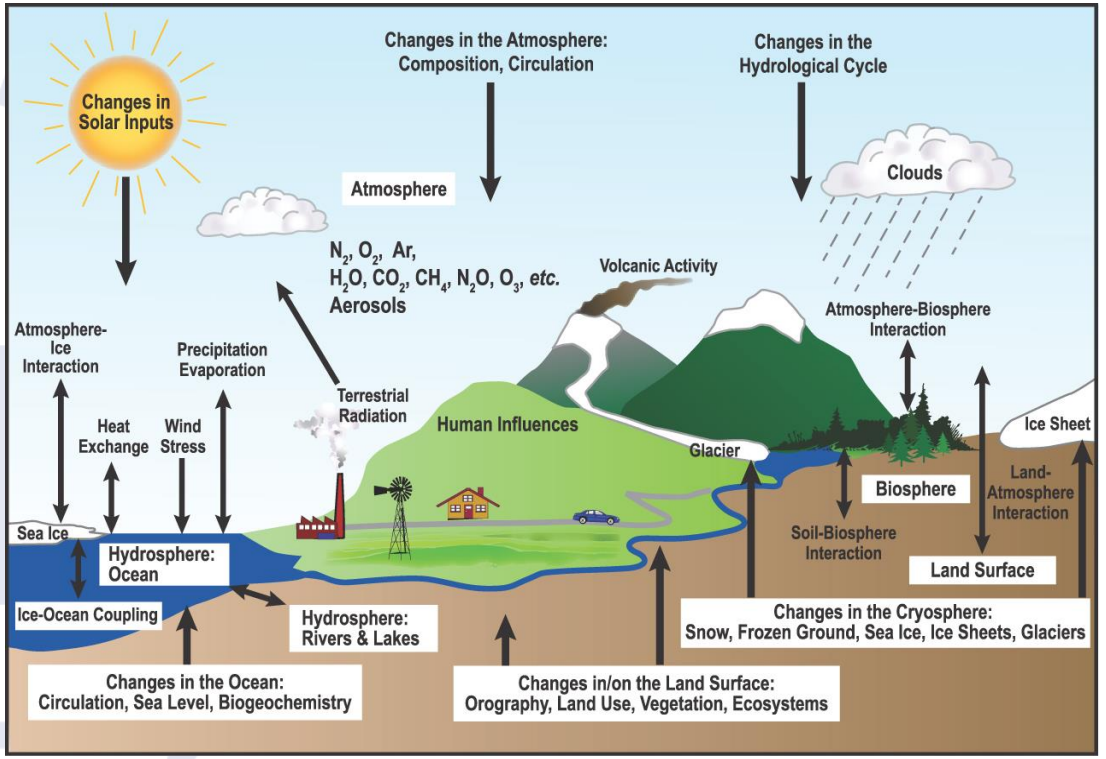



Vito Vitale

Consiglio Nazionale delle Ricerche (CNR)
Institute of Polar Sciences (ISP) – Bologna, Italy

1. Observe, understand, predict the climate system

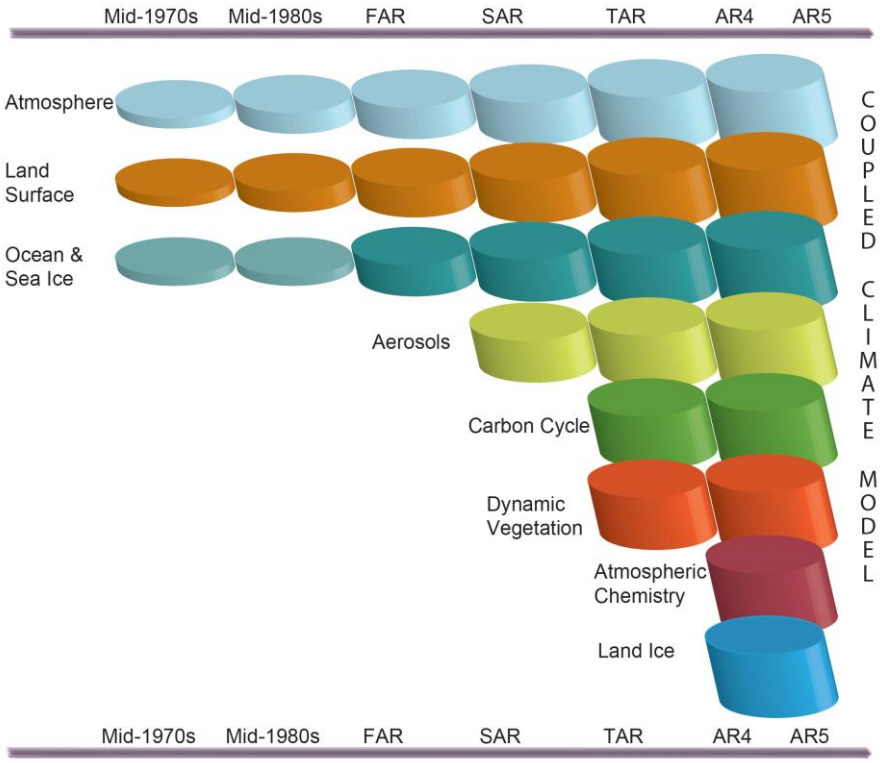
- Climate system is a “complex” system
- To understand and predict climate change we need to represent all relevant interaction processes among the different climate domains
- A fundamentally important aspect to understanding climate lies with the coupling between the ocean and the atmosphere.
- Above statement is very important at global as well as at regional scale



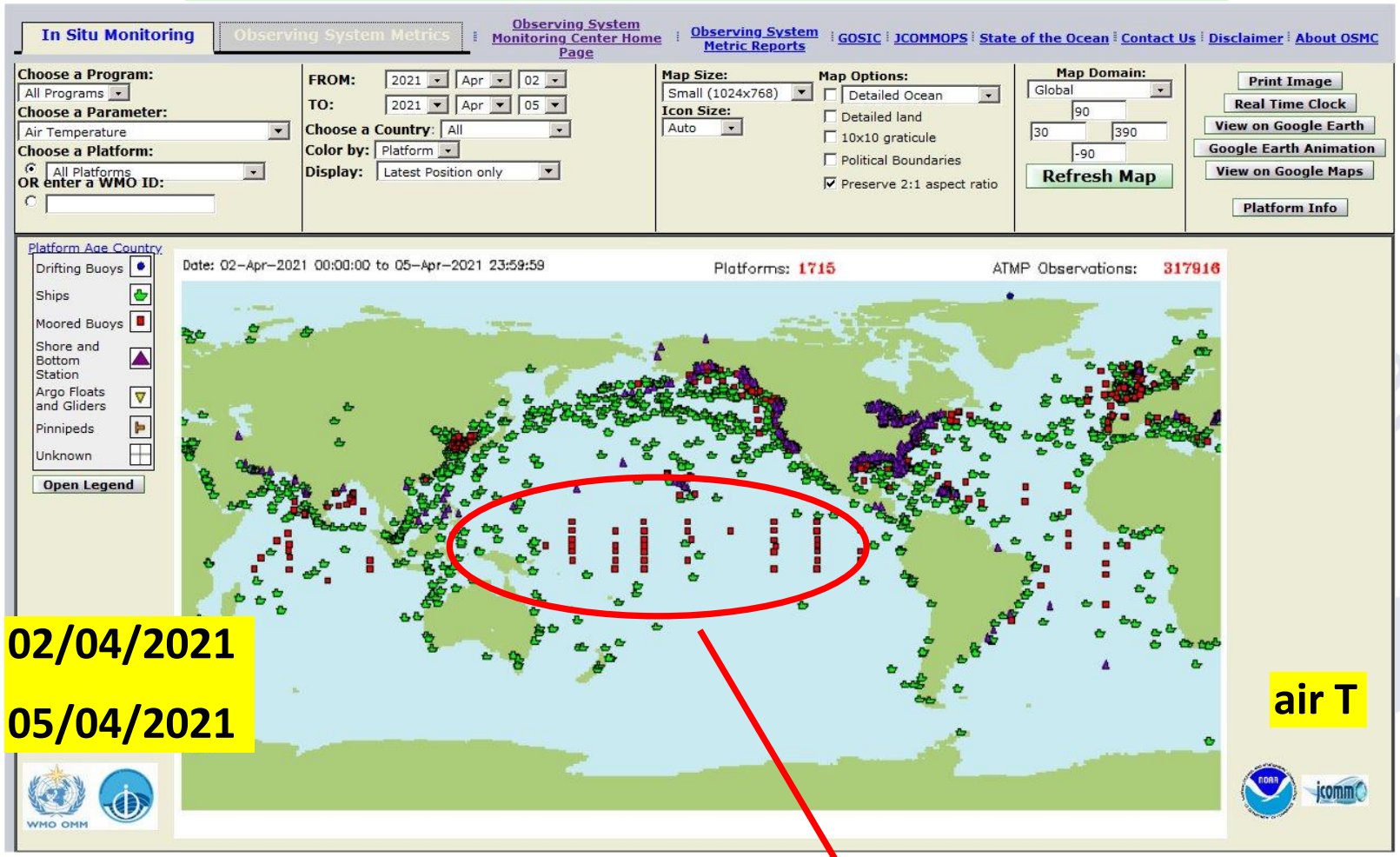
1. Observe, understand, predict the climate system

- Despite the great efforts made to build families of coupled models, moving rapidly from Global Circulation models (CGCMs) to Earth System models (ESMs), very poor efforts were made to transfer this concept in the realm of observations

- Looking the status of atmospheric ground-based measurements over the seas we can say that atmospheric and marine observations are largely “de-coupled”, in particular at high latitudes. And satellite can’t simply completely recover this weakness.

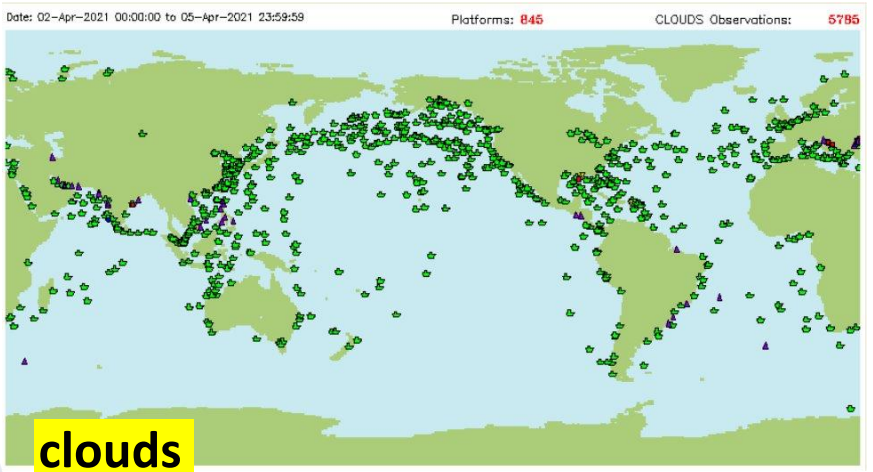


the GOOS observing system monitoring center (OSMC)
http://osmc.noaa.gov/Monitor/OSMC/OSMC.html

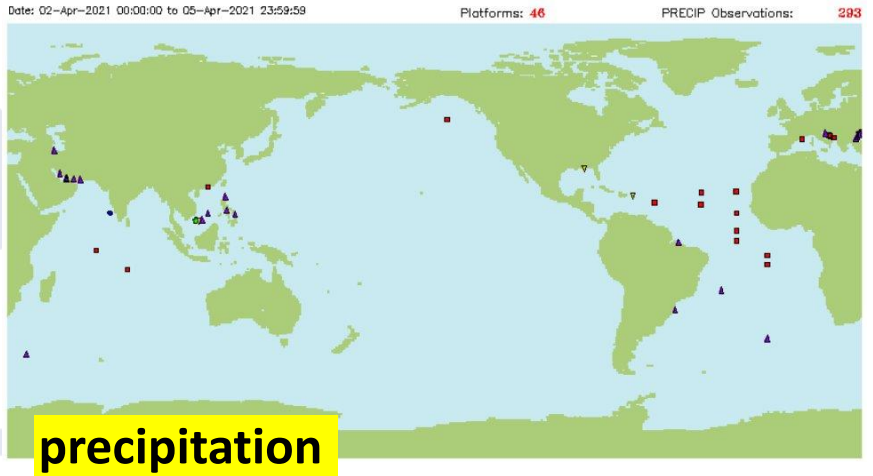


02/04/2021

05/04/2021



clouds



precipitation

air T

Atmospheric measurements stored in GOOS

T, p, wind, cloud, precipitation

TAO/TRITON array

https://tao.ndbc.noaa.gov/

Atmospheric measurements
T, p, RH, wind, all 70 buoys
radiation at 5 flux reference sites

ARCTIC

Platforms 152

ATMOSPHERIC X | DAVIS STRAIT X | BERING SEA X | GREENLAND SEA X | NORWEGIAN SEA X | WHITE SEA X | BARENTSZ SEA X | KARA SEA X | LAPTEV SEA X | EAST SIBERIAN SEA X | CHUKCHI SEA X | LINCOLN SEA X | BEAUFORT SEA X | ARCTIC OCEAN X

NORTHWESTERN PASSAGES X | BAFFIN BAY X | LABRADOR SEA X | GULF OF ST-LAWRENCE X | SKAGGERAK X | NORTH SEA X

https://www.ndbc.noaa.gov/

Bering Sea
East Siberian Sea
Laptev Sea
Arctic Ocean
Northwestern Passages
Arctic Ocean
Kara Sea
Baffin Bay
Barentsz Sea
Davis Strait
Labrador Sea
Norwegian Sea
North Sea

152 PLATFORMS:

75 argo profiler

48 drift buoys

24 moorings

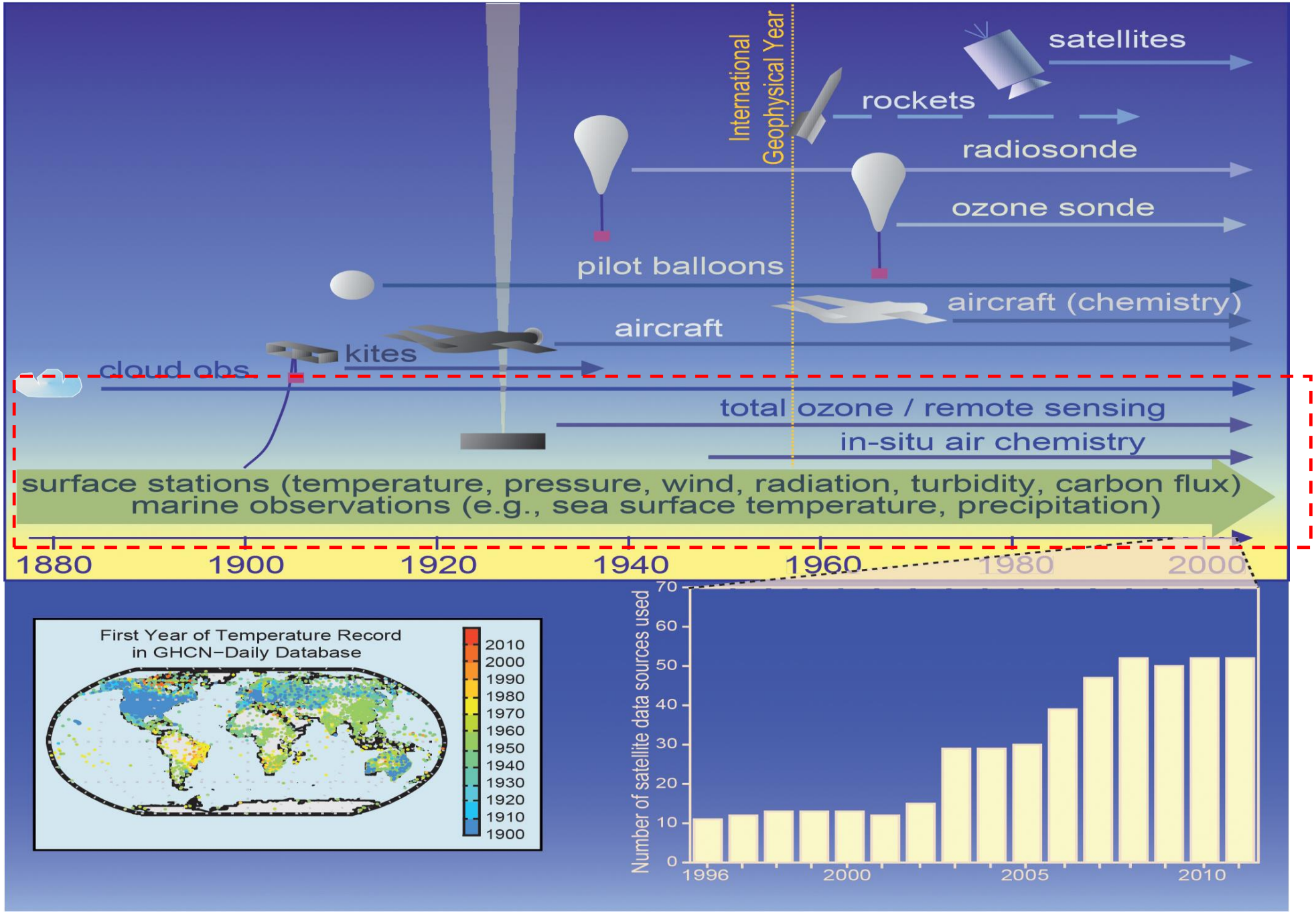
2 ferrybox

https://arctic.emodnet-physics.eu/

TIME FILTER: **LAST 60 DAYS**

+

−



Atmospheric observation capabilities/needs

Number of satellite instruments assimilated in ECMWF operational Forecast Runs

Atmosphere

Stratosphere

Cooling Stratospheric temperature (Chapter 2.4).

Changes in winter polar vortex strength (Chapter 2.7).

?

Troposphere

Warming from the surface through much of the troposphere (Chapter 2.4).

Long-term changes in the large-scale atmospheric circulation, including a poleward shift of jet streams (Chapter 2.7).

Increasing concentration of CO_2 and other greenhouse gases from human activities (Chapter 2.2).

Changes in cloud cover (Chapter 2.5).

Increasing tropospheric water vapour (Chapter 2.5).

Changes in aerosole burden and ozone concentrations (Chapter 2.2)

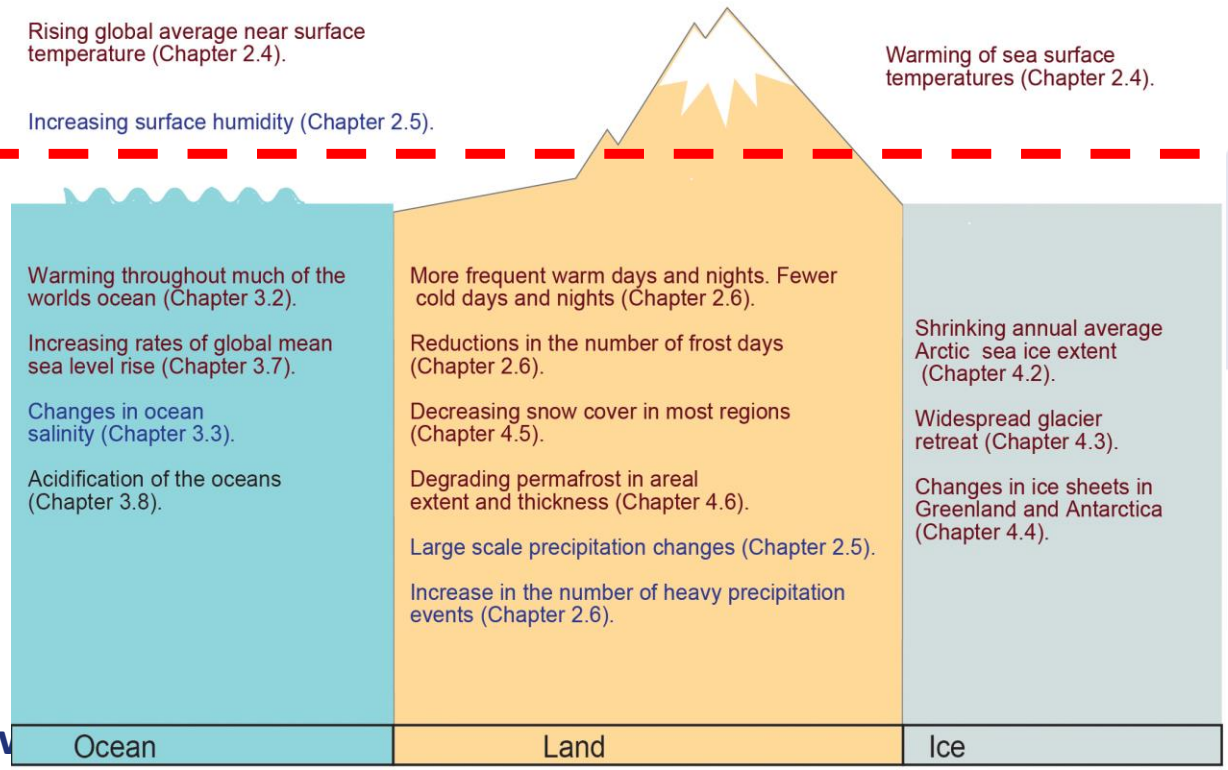
Observations of Climate Changes from AR4 (points to AR5)

Near Surface

Rising global average near surface temperature (Chapter 2.4).

Increasing surface humidity (Chapter 2.5).

Warming of sea surface temperatures (Chapter 2.4).



Warming throughout much of the worlds ocean (Chapter 3.2).

Increasing rates of global mean sea level rise (Chapter 3.7).

Changes in ocean salinity (Chapter 3.3).

Acidification of the oceans (Chapter 3.8).

More frequent warm days and nights. Fewer cold days and nights (Chapter 2.6).

Reductions in the number of frost days (Chapter 2.6).

Decreasing snow cover in most regions (Chapter 4.5).

Degrading permafrost in areal extent and thickness (Chapter 4.6).

Large scale precipitation changes (Chapter 2.5).

Increase in the number of heavy precipitation events (Chapter 2.6).

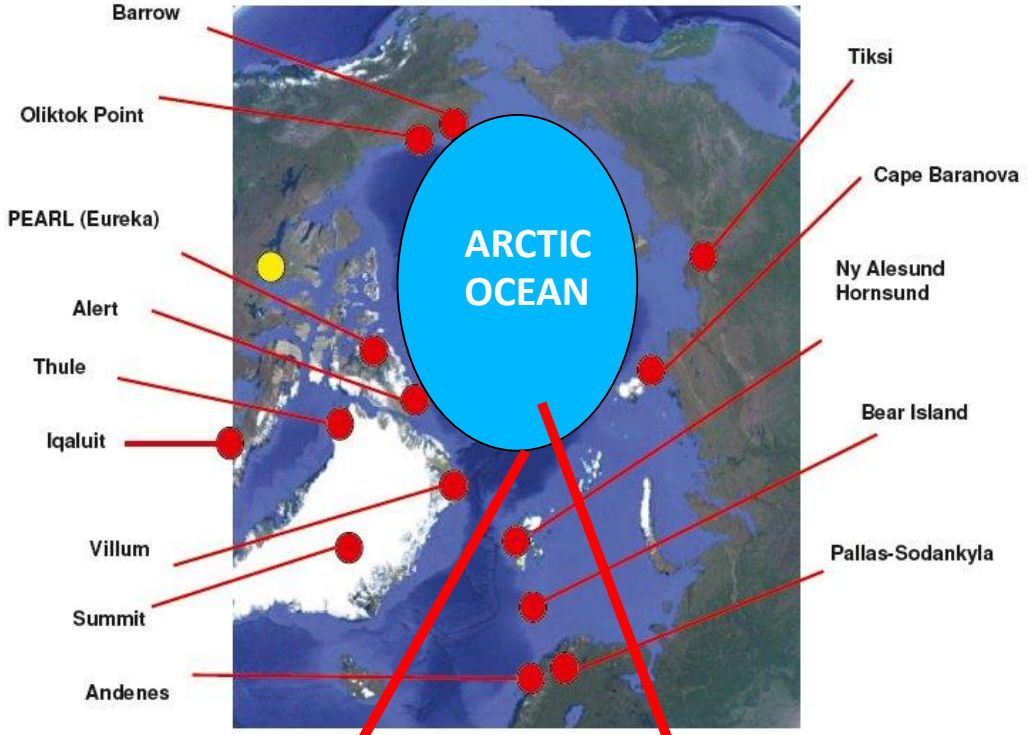
Shrinking annual average Arctic sea ice extent (Chapter 4.2).

Widespread glacier retreat (Chapter 4.3).

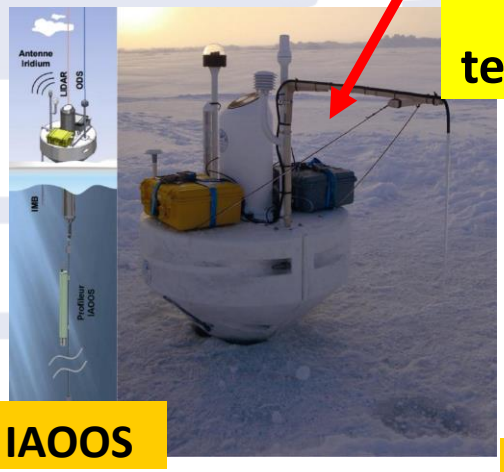
Changes in ice sheets in Greenland and Antarctica (Chapter 4.4).

Ocean | Land | Ice

Map of stations with a year long monitoring program devoted to aerosols



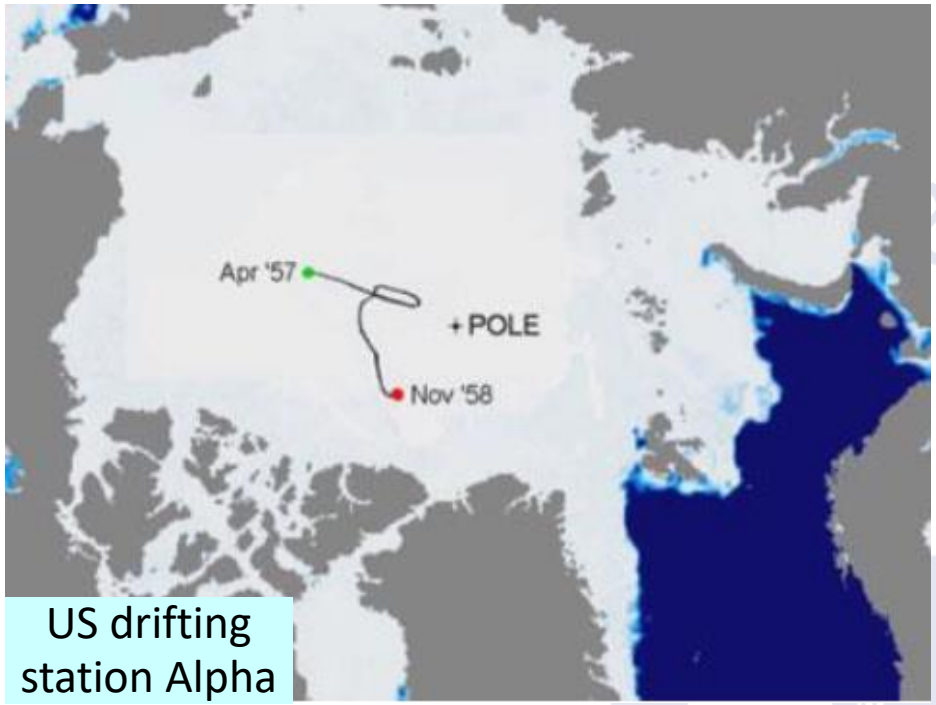
new technologies



IAOOS

SATICE buoy (ICE-ARC)

2. The drifting STATION approach (1893-2015)



US drifting station Alpha

NP-1 1937

NP-41 2015

US operated several drifting stations from 1952 until 1974. Some of them where installed on a large ice island named T-3 (or Fletcher's Island)

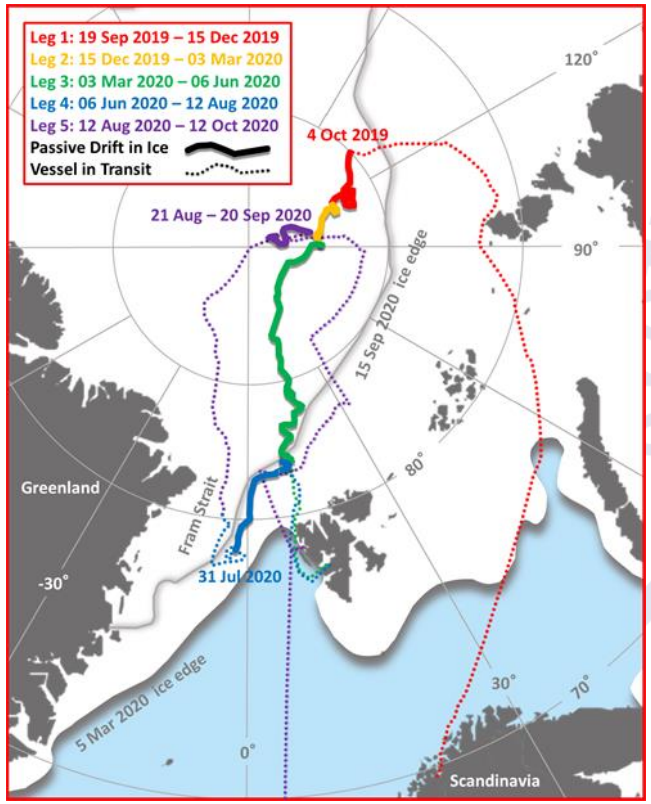
a very large year-round experiment SHEBA carried out from 10/1997 till 10/1998

the FRAM Expedition 1893-1896

Russia operated 41 drifting stations from 1937 until 2015, named North Pole NP-1 till NP-41. The large amount of data, they are being transferred in digital format

3. The drifting STATION approach in a changing Arctic

- More difficult to find multy-year ice floes or ice islands, summer very challenging
- Ship necessary to support expedition safety before of year-round activities

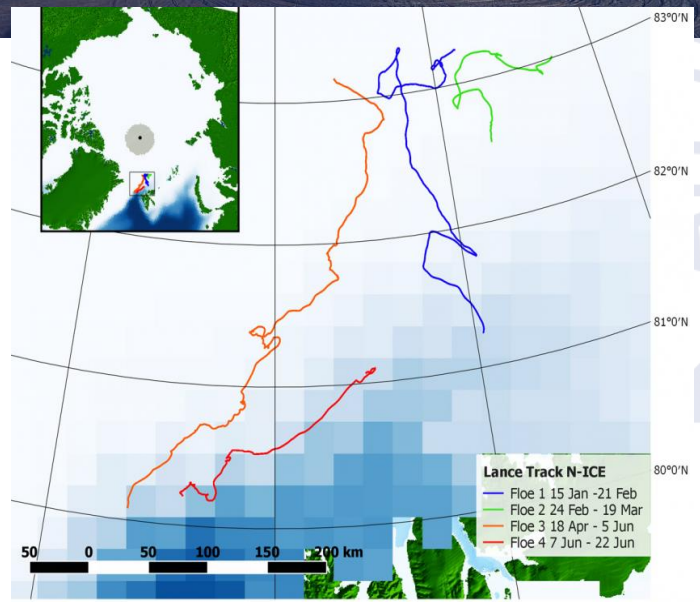


MOSAIC EXPEDITION:

- very comprehensive and integrated science plan
- a great success from many point of view

3. The drifting STATION approach in a changing Arctic

N-ICE2015, Norwegian young sea ICE 2015.



- Very expensive
- Not very synergic with routine activities of marine community
- oriented to investigate processes and interactions
- limitations in coverage area and challenges in a scenario of ice reduction

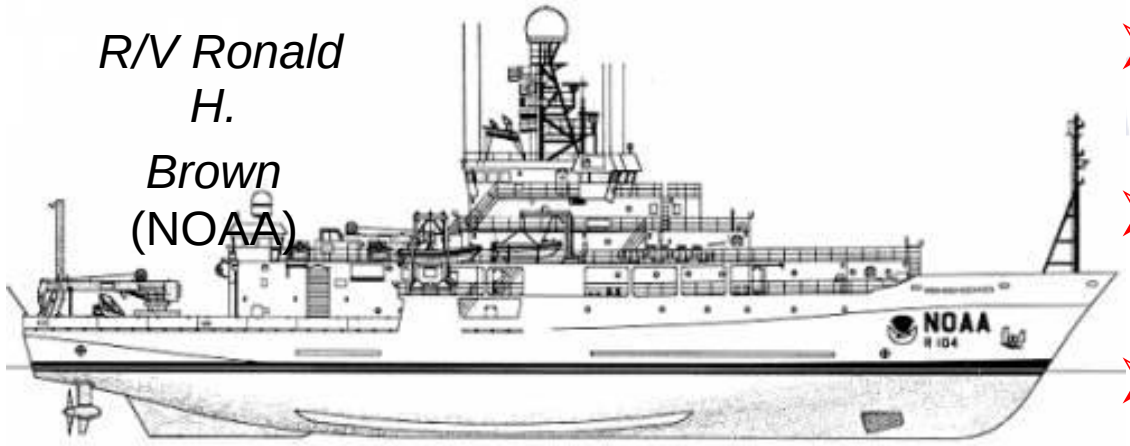
A new platform Roshydromet committed

long-endurance (up to 2 years)

to restart drifting programme in a safe way

4. The ship as a multi-disciplinary platform

THE CHALLENGES TO IMPLEMENT ATMOSPHERIC MESUREMENTS



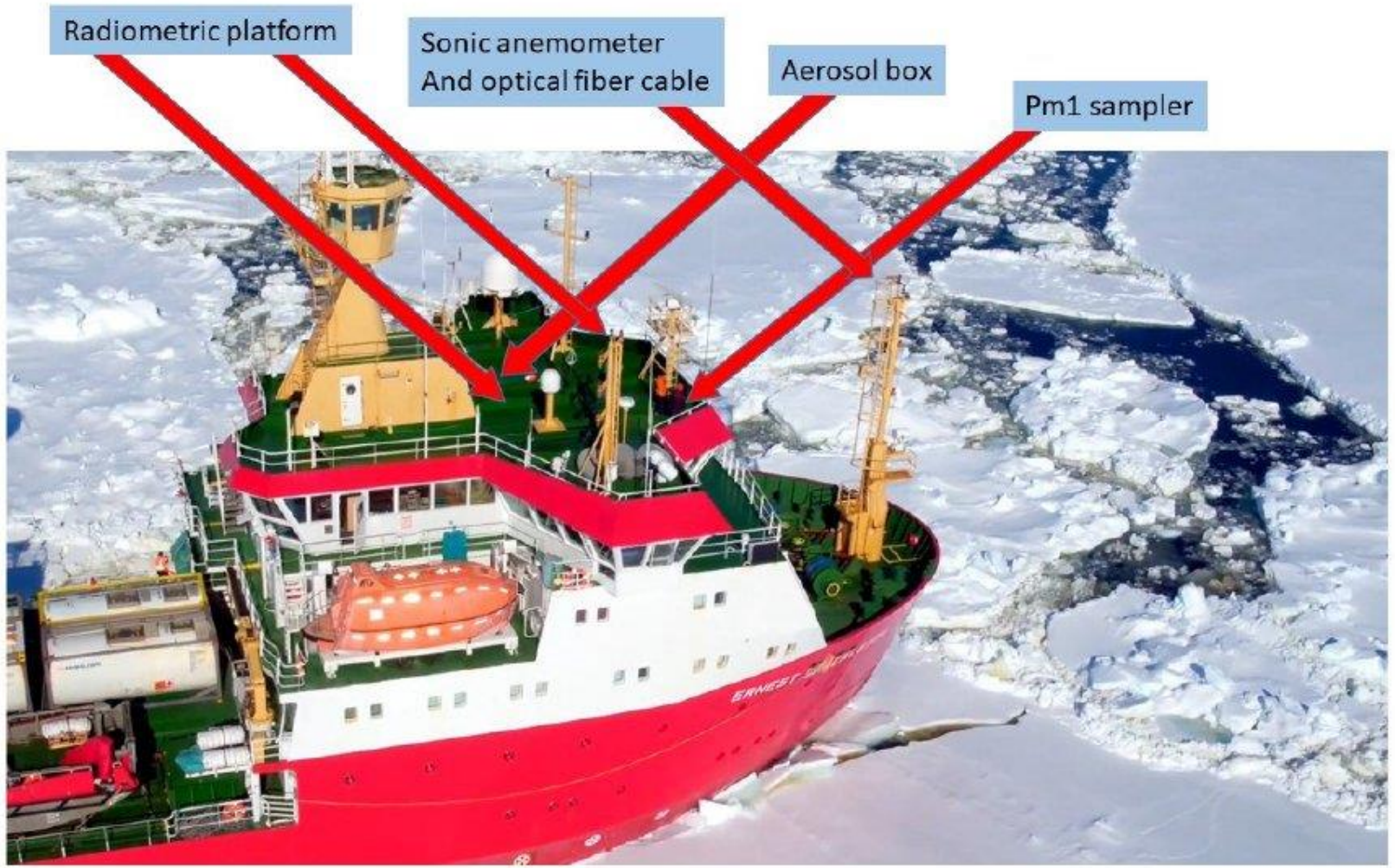
R/V Ronald H. Brown (NOAA)

the new australian icebreaker RSV *Nuyina*

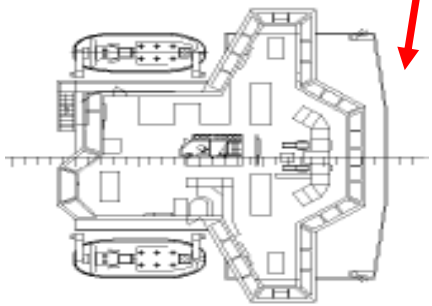
- a complex profile that introduce horizon obstructions, shadows, and turbulence
- a large source of pollution represented by ship engines and smokestack
- pitch and roll produce an unstable horizontal plane for atmospheric sensors
- analysis methodologies who use regularities guaranteed by a fixed site need adjustment. Complex sun geometry due to ship route.
- routine sensors maintenance can be not an easy task
- design of old ships was usually made not considering atmospheric measurements

4. The ship as a multi-disciplinary platform

A POSSIBLE IMPLEMENTATION ON R/V LAURA BASSI



possibility/plans to install instrumentation for atmospheric measurements (aerosol, radiation, marine boundary layer)



5. Audience, interest, evaluation

- It is really important for us to make the most of a large and meaningful sample you are.
- If you have not already done so, please fill out the audience survey at the link

  https://forms.gle/ydRZ7yxKmLQuMFkb6
- And above all at the end of this webinar we would be grateful if you could also fill out an evaluation survey at the link

  https://forms.gle/9uhLmUjvVKzA9gRBA
- The final discussion section will open with a third small survey (there are only 5 questions with fixed answers) which aims to focus on the interest that prompted you to participate.
- We thank you in advance for all the answers and information you will give us in this way. All polls are strictly anonymous

APECS-ARICE Webinar: Atmospheric measururements aboard research ships

Thank you for your attention






Arctic Research Icebreaker Cons.
ARICE

An international collaboration strategy for meeting the needs of marine based research in the Arctic

Webinar recording will be available on arice.eu and on the APECS website

Home | About | News | Outreach | Training | Apply for Ship Time | Call Results | Intranet