



Climate Change Tower



A platform for interdisciplinary studies of the different processes involved in the Arctic region climate change.

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RATIONALE & GOALS



- Since the 90' a significant development of both observational and modeling activities in the Arctic occurred. The key element of these efforts is the consciousness that a multidisciplinary approach is fundamental
- In the last years consistent signs of a general warming in the Arctic region have been observed.
- The most apparent ones are the reduced extension of sea ice during the winter and summer and the cover and increased greenness of tundra
- The final goal should be to improve the parameterization schemes in circulation and climate models in order to reduce the uncertainties of these models.
- An intense experimental activity will be implemented through the installation of an observatory based at the Italian station "Dirigibile Italia" .
- The research activity should last a period of 5-10 years to achieve the results we want to get .



Sea Ice in the Arctic



Arctic Sea Ice Summer 2007 (white)
Long term average (pink line)

Is receding more rapidly than predicted by models

Our understanding is limited !

Environmental, Political and Socio-economical consequences are difficult to predict.



How Much Time is Left for Arctic Sea Ice?





How to answer to this question



Deepening our knowledge of the complex interactions/processes connecting different element of the Arctic system.

Investigating physico-chemical processes and feedbacks characterising the snow-air interface and the Planetary Boundary Layer.

Improving the parameterization in climate models.

Increase the experimental: measuring and monitoring the large number parameters for a sufficient long time.



The strategy



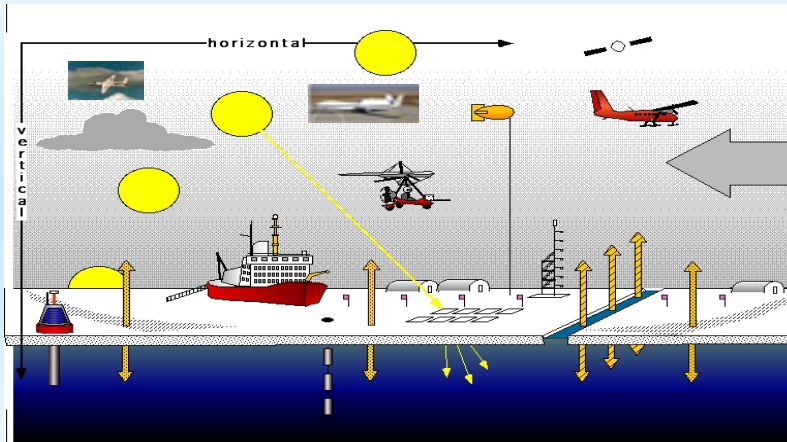
1 - Intensive Large Campaigns

2 - Thematic Networks

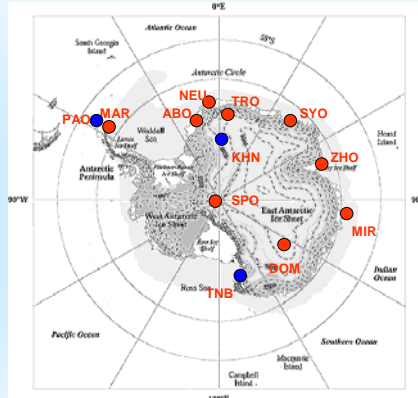
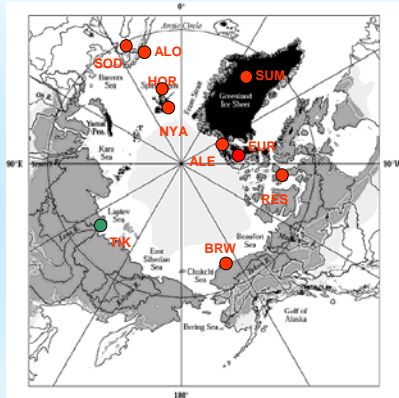
3 - Sites for long-term process studies



Intensive Large Campaigns

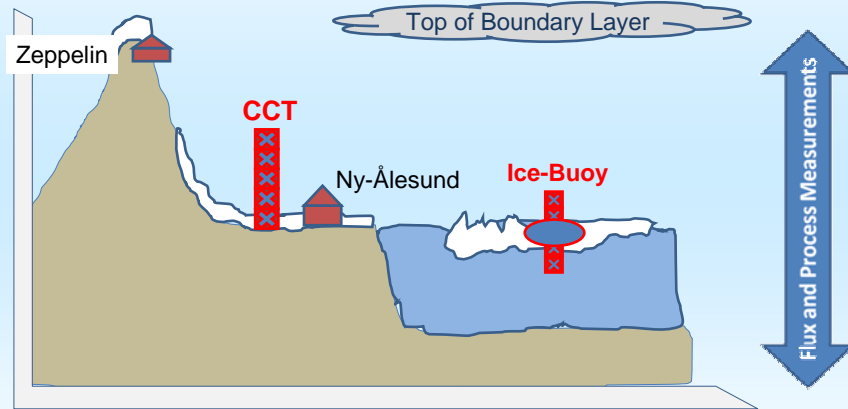


Thematic networks





Super - site for long-term process studies



CCT as Part of Ny-Ålesund B.L. Energy Balance Study



Climate Change Tower integrated project



- The Climate Change Tower integrated project (CCT) goes in the direction of this interdisciplinary strategy .

The objectives

- Create a scientific *platform* complementary to the existing research activities provided by other international research groups already present at Ny Alesund .
 - Establish a connection with the activities which are actually carried on by other Italian and international research groups
 - Contribute to reduce the fragmentation of measurements, by integrating and finalizing them to the most important scientific question related to the climate of the Arctic region.
- AND**
- Obtain new information on physical characteristics/parameters determining the start of the snow-melting in spring, their inter-annual variability and dependency from cloudiness and aerosol load.
 - Define, by measurements in the PBL the role of the turbulence and dynamics in the transport mechanisms and characterize the climatology of the basic meteorological parameters.
 - Allow, by the related research activities on the permafrost and soil characteristics, to monitor and evaluate the energy transfer into the soil at dozens meters of depth and evaluate how the surface climatic variability can affect the lower layers.



Topics to deepen



- Energy balance in the fundamental surface layer (-30 m to 50 m)
dependency from cloud coverage, aerosols, surface characteristics (with influence on the reflectivity features).

Whole spectrum as well as different spectral regions (UV, VIS, IR).

- Physico-chemical processes at the surface and fluxes of trace gases, aerosols, pollutants (upward and downward)
- Dynamic and thermal structure characteristics of boundary layer.
- Complete characterization of the 500 m layer from the surface up to Zeppelin.



CTT-IP EXPERIMENTS



- Chemical nitrogen fluxes at the snow
- Heat transfer processes and energy budget at the surface
- Radiation budget at the surface
- Stratospheric gases detection
- Vertical fluxes of gas at the air-snow interface
- PBL processes and meteorological vertical profiles
- Long time evolution of the PBL parameters
- Aerosol vertical profiles in the PBL and upper layer
- Aerosol characterisation and deposition processes
- Gaseous substances at the air-snow-terrain interface

- **SOME OF THESE ARE ALREADY RUNNING OTHERS WILL START OTHER WILL BE NEW**



Spectral UV measurements at Ny Alesund



At the beginning of May 2008 have been installed an UV-RAD radiometer to carry out spectral measurements in the range between 300 and 400 nm and supply ozone content, UV flux and other parameters along the whole day. Instrument is hosted by NILU in the Norwegian station

Narrowband filter radiometer for ground-based measurements of global ultraviolet solar irradiance and total ozone

Petkov B., Vitale, V. et al., *Applied Optics*, 2006

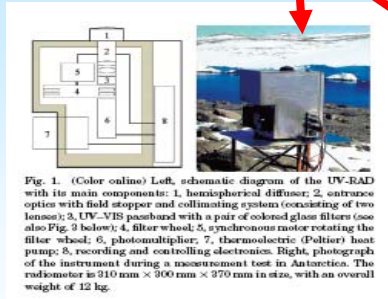
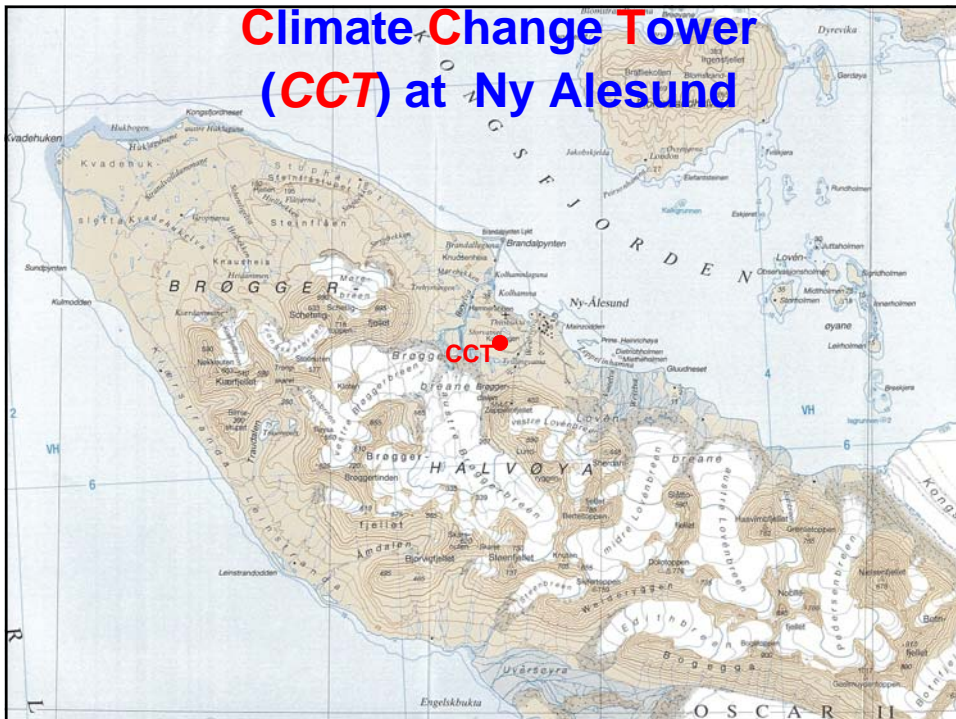
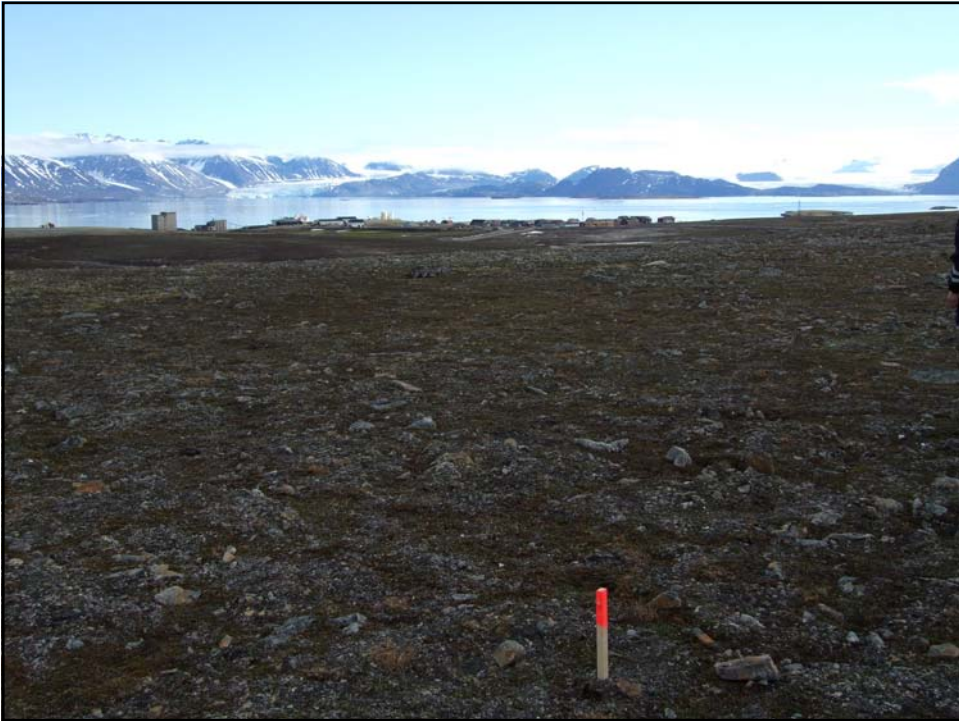


Fig. 1. (Color online) Left, schematic diagram of the UV-RAD with its main components: 1, hemispherical diffuser; 2, entrance optic with field stopper and collimating system (consisting of two lenses); 3, UV-VIS passband with a pair of colored glass filters (see also Fig. 2 below); 4, filter wheel; 5, synchronous motor rotating the filter wheel; 6, photomultiplier; 7, thermoelectric (Peltier) heat pump; 8, recording and controlling electronics. Right, photograph of the instrument during a measurement test in Antarctica. The radiometer is 310 mm × 300 mm × 370 mm in size, with an overall weight of 12 kg.

Climate Change Tower (CCT) at Ny Alesund







The Tower at Dome-C



The Tower at Dome-C





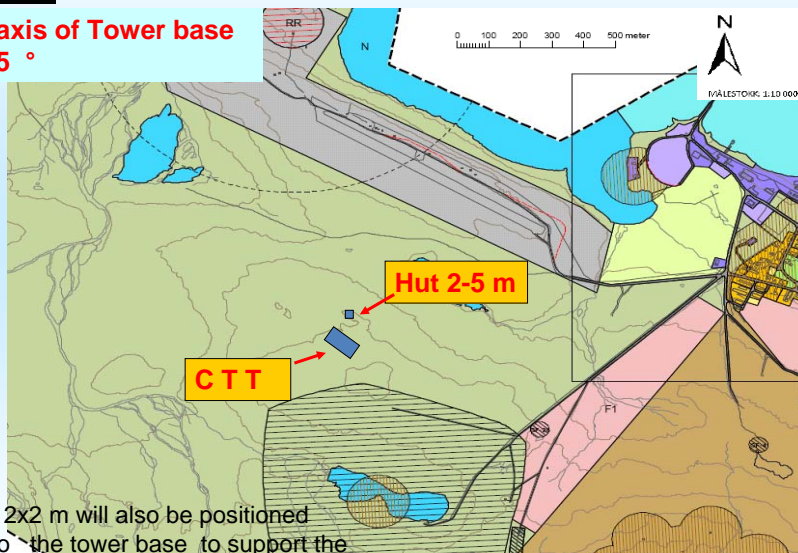
Prevailing wind at NYA



CCT orientation



Main axis of Tower base at 115 °



A hut 2x2 m will also be positioned close to the tower base to support the data acquisition systems



CCT Instrumentation



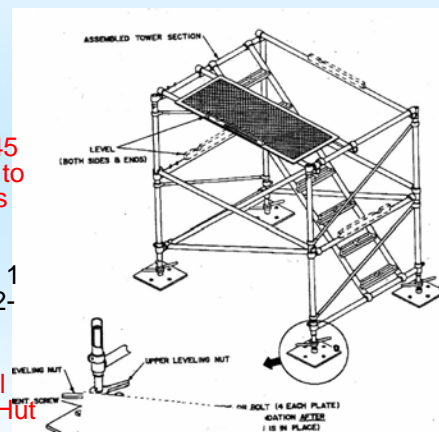
- Sensors up to six level
- Conventional meteorological sensor
- Sonic anemometers
- Aspirated thermometers
- Minilidar for PBL measurements
- Net radiometer for radiation budget
- Albedometer
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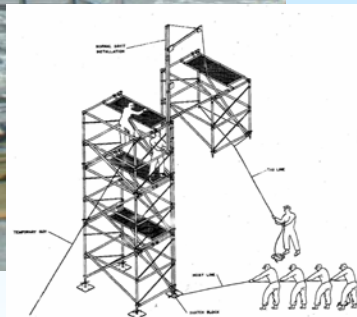


Technical aspects



- The platform is composed by 17 modules
- Each module is 1.4 x 1.8 m; H = 1.8 m
- Patch boxes will be mounted every three floors for the power supply.
- On these boxes also data socket RJ45 and 9 pin connectors will be mounted to provide the data transfer to the devices in the HUT at the base of the platform
- The 9 pin plugs will have a connection 1 to 1 to allow transfer of digital (RS232-RS485) and analogical output signals
- A dedicated optical fibre connection will be used for the data transfer from the HUT to Dirigibile Italia.

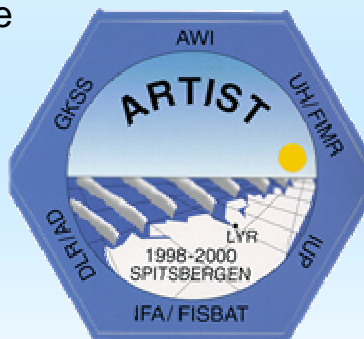




Review of a past project



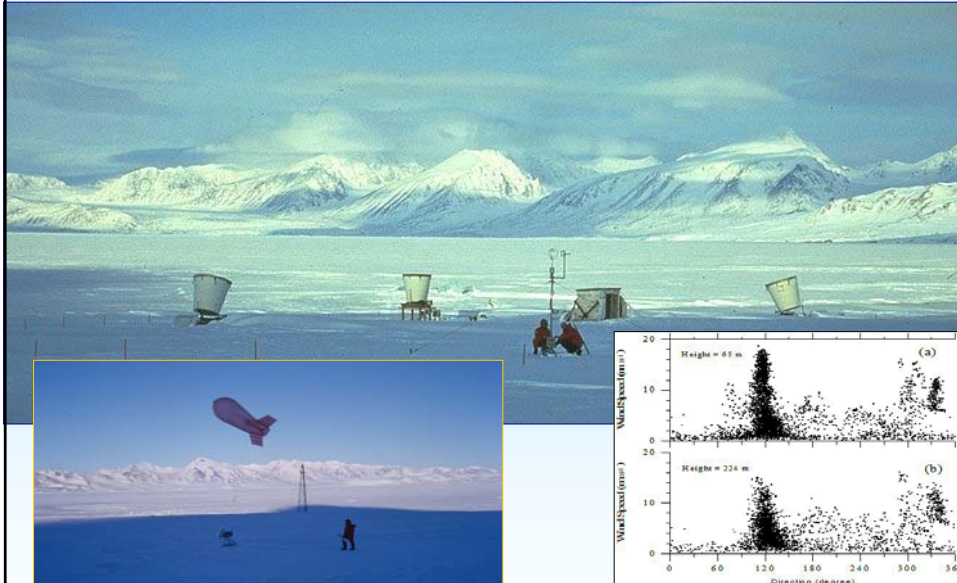
- Turbulent fluxes at the surface
- Sodar 3-D wind profiles
- Radiation and energy budget
- Tethered balloon soundings
- Airborne measurements



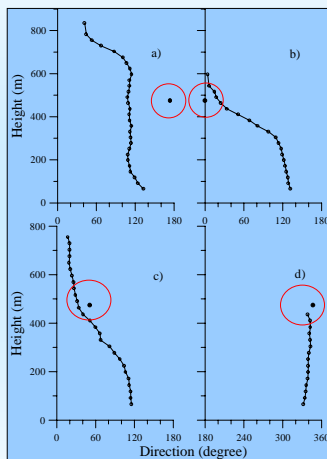
Hartmann et al. 1999: Arctic Radiation and Turbulence Study, Report on polar research 305/1999.



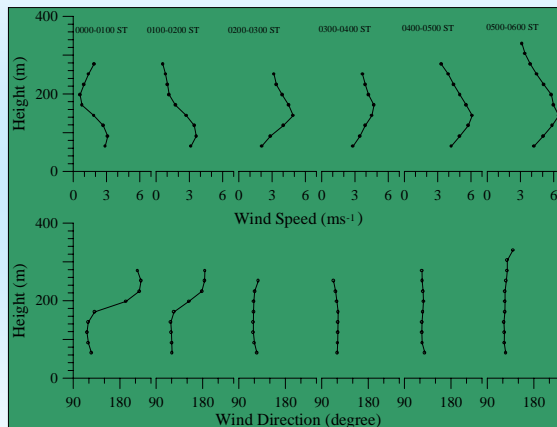
ARTIST EXPERIMENT



wind profiles



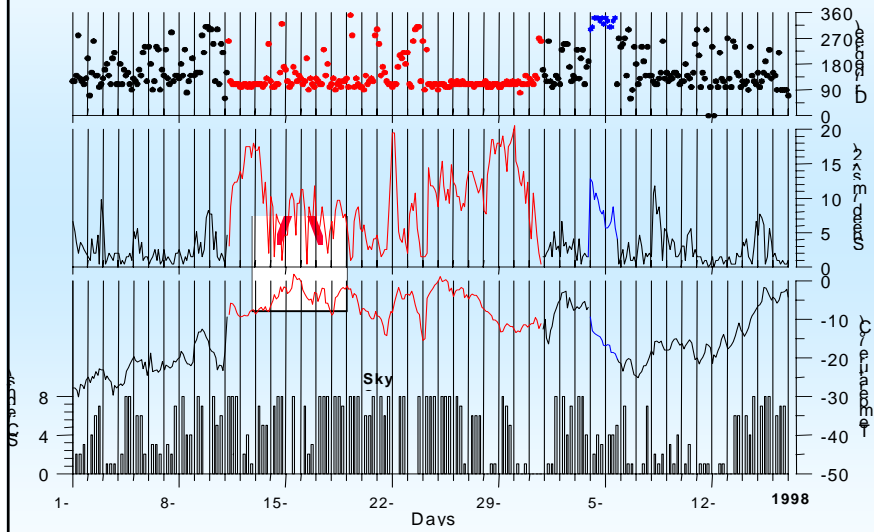
Wind at Zeppelin station



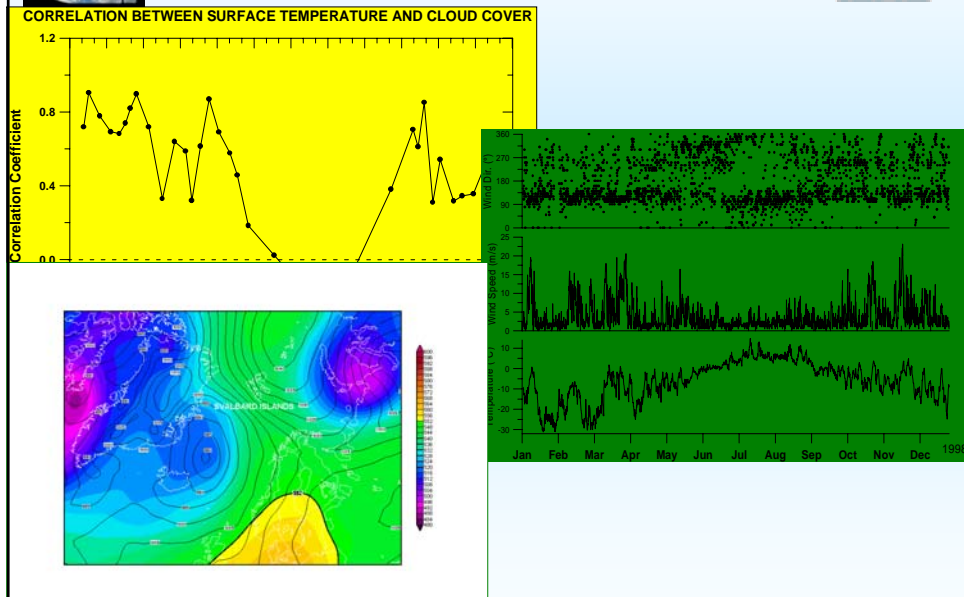
Katabatic wind shape in Kongsfjorden



Anomalous warming



Anomalous warming





PLANNING



- Time schedule
- Policy and rules
- Management and organization
- Costs and fundings
- Collaborations

