

OASIS

Ocean-Atmosphere-Sea Ice-Snowpack interactions in Polar regions.

Jan W. Bottenheim

Meteorological Service of Canada, Toronto ON, Canada

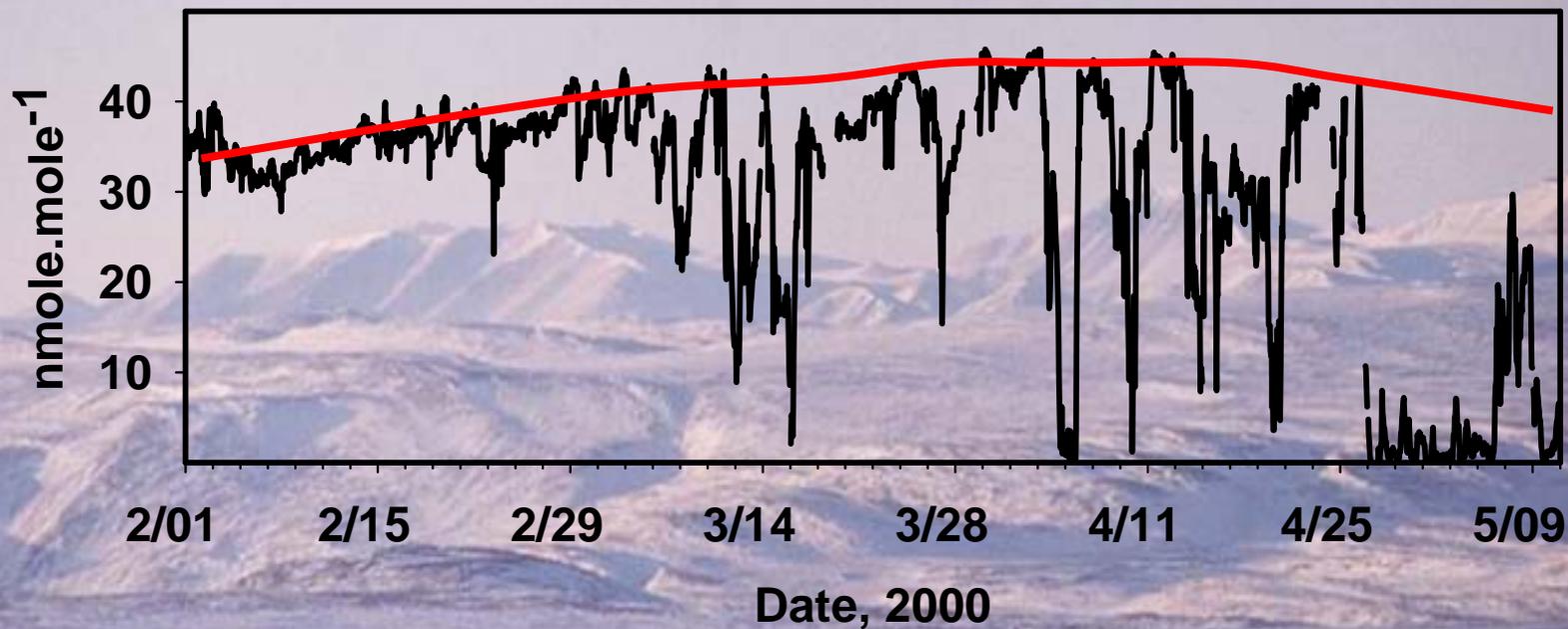
17 coauthors from North America, Europe and Australia in physics, chemistry, oceanography, biology

ARCTIC HAZE

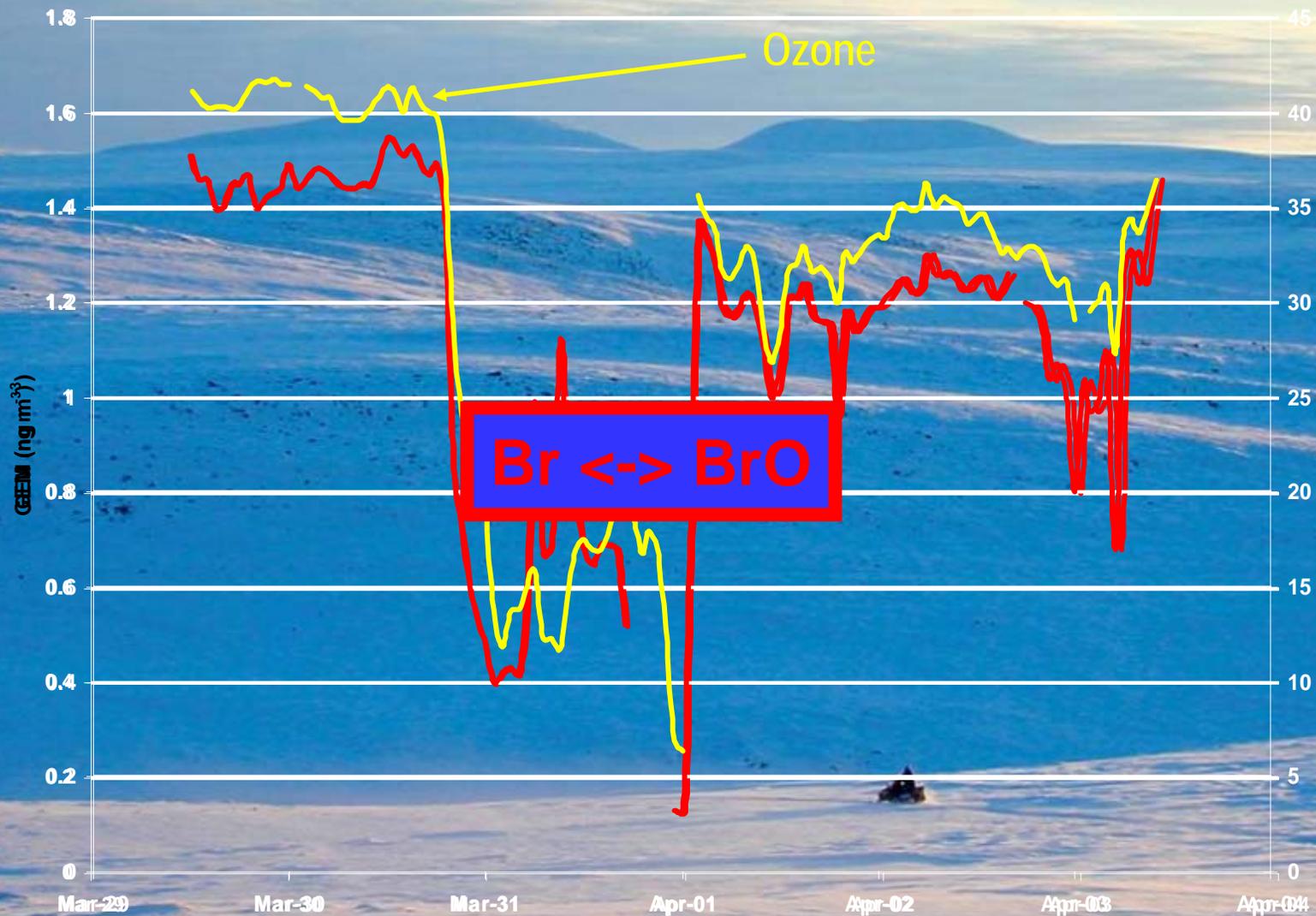


Photo: Glenn Shaw; from AMAP, 1998)

BOUNDARY LAYER OZONE DEPLETION



Gaseous Mercury depletion



CHEMISTRY IN THE SNOW PACK

Conversion of unreactive halogen ions into reactive halogen molecules

Conversion of unreactive nitrate into reactive nitrogen oxide

Production of reactive carbonyl compounds

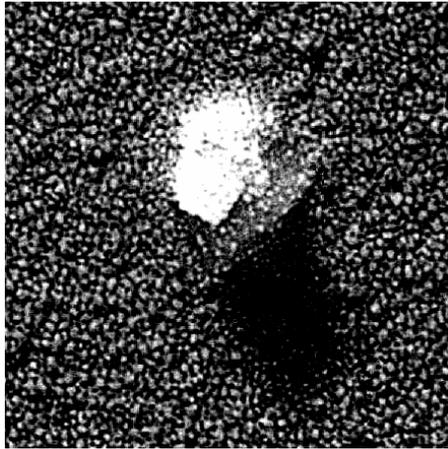


PHOTOCHEMICAL REACTIONS OCCUR IN SNOW



Airborne particles like those in the microlayer

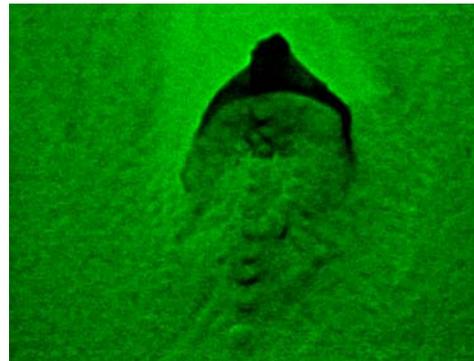
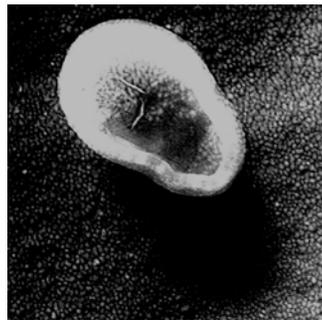
Small angular particles
20-50nm. Viruses?



Bacteria – usually crumpled or exploded



Other creatures



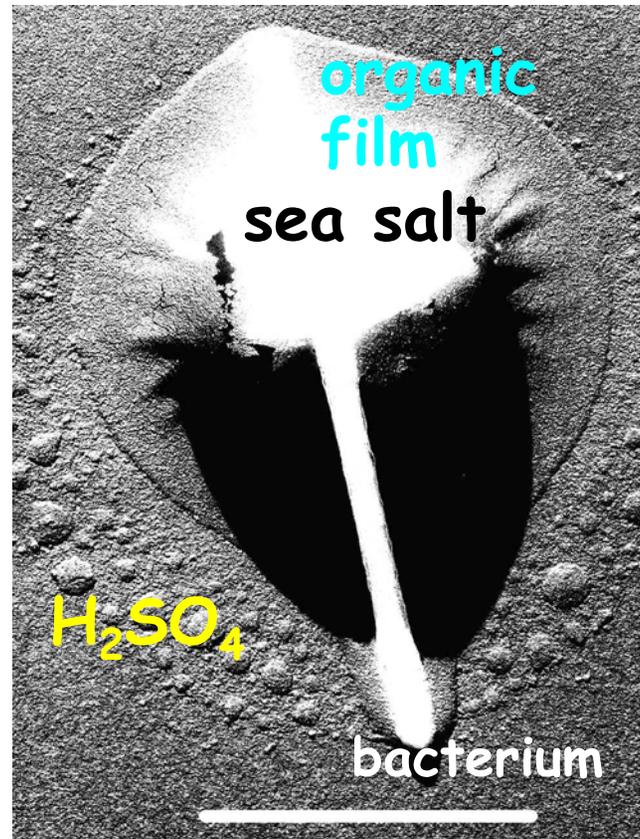
220nm

210nm

1 μ m

250nm

(from: Bigg, 2002)

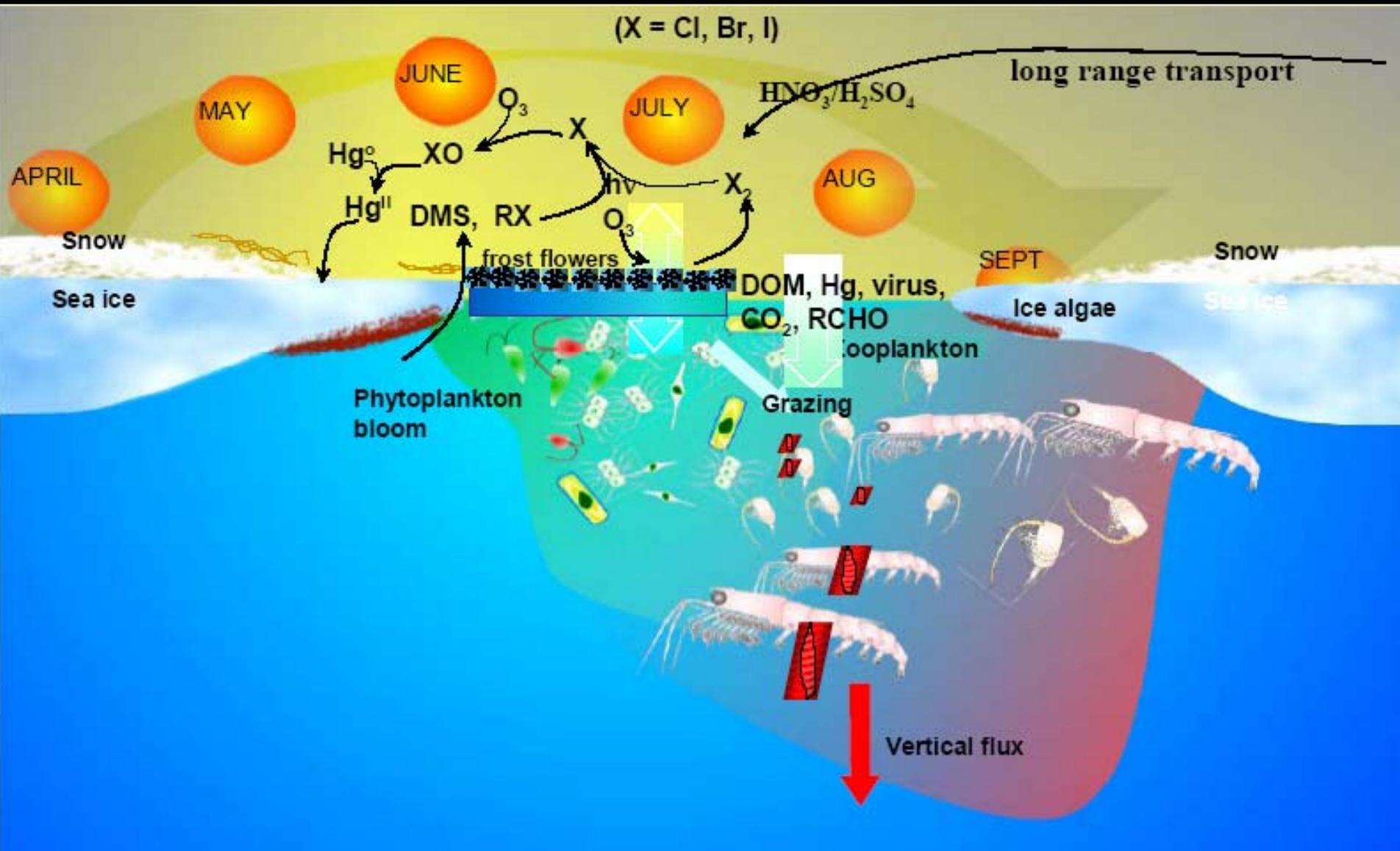


✿ How does the chemistry of the aerosol multiphase system influence formation and evolution of the cloud droplet population ?

(from: Bigg and Leck, 2002)

ARE FROST FLOWERS IMPORTANT ?





(X = Cl, Br, I)

long range transport

JUNE

JULY

AUG

MAY

APRIL

SEPT

Snow

Sea ice

Snow

Sea ice

Hg^0

Hg^{II}

O_3

XO

X

HNO_3/H_2SO_4

DMS, RX

frost flowers

$h\nu$

X_2

DOM, Hg, virus,

CO_2 , RCHO

Phytoplankton bloom

Grazing

Ice algae

Vertical flux

zooplankton

What is the solar influence on OASIS chemical exchange processes in the Arctic ?

physical, chemical, and biologically-mediated processes involving halogens, DMS, NO_x, O₃, VOCs, POPs, Hg, S-constituents, particulate matter, and CO₂

What is the importance of OASIS exchange processes on climate change ?

chemistry, physics and biology of airborne aerosol particles and cloud/snow formation
will the processes constitute a positive or negative climate feedback

What is the impact of seasonal and climatic changes on OASIS chemical exchange ?

changes in ocean, ice and snow cover characteristics
how important are frost flowers

What is the impact of long term changes of environmental pollution on OASIS exchange?

is Hg deposition increasing due to increased reactive bromine production?
do deposited contaminant (Hg, POPs) undergo chemical processing?

OASIS: WHERE?

YEAR-TO-YEAR VARIATIONS OF SPRING TIME POLAR TROPOSPHERIC BrO AS SEEN BY GOME (in press, 2004)

J. Hollwedel¹, M. Wenig², S. Beirle¹, S. Kraus¹, S. Kühl¹, W. Wilms-Grabe¹, U. Platt¹, and T. Wagner¹

¹Institut für Umweltphysik, Universität Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg, Germany

²now at NASA Goddard Space Flight Center, Code 916, Greenbelt, MD 20771, USA

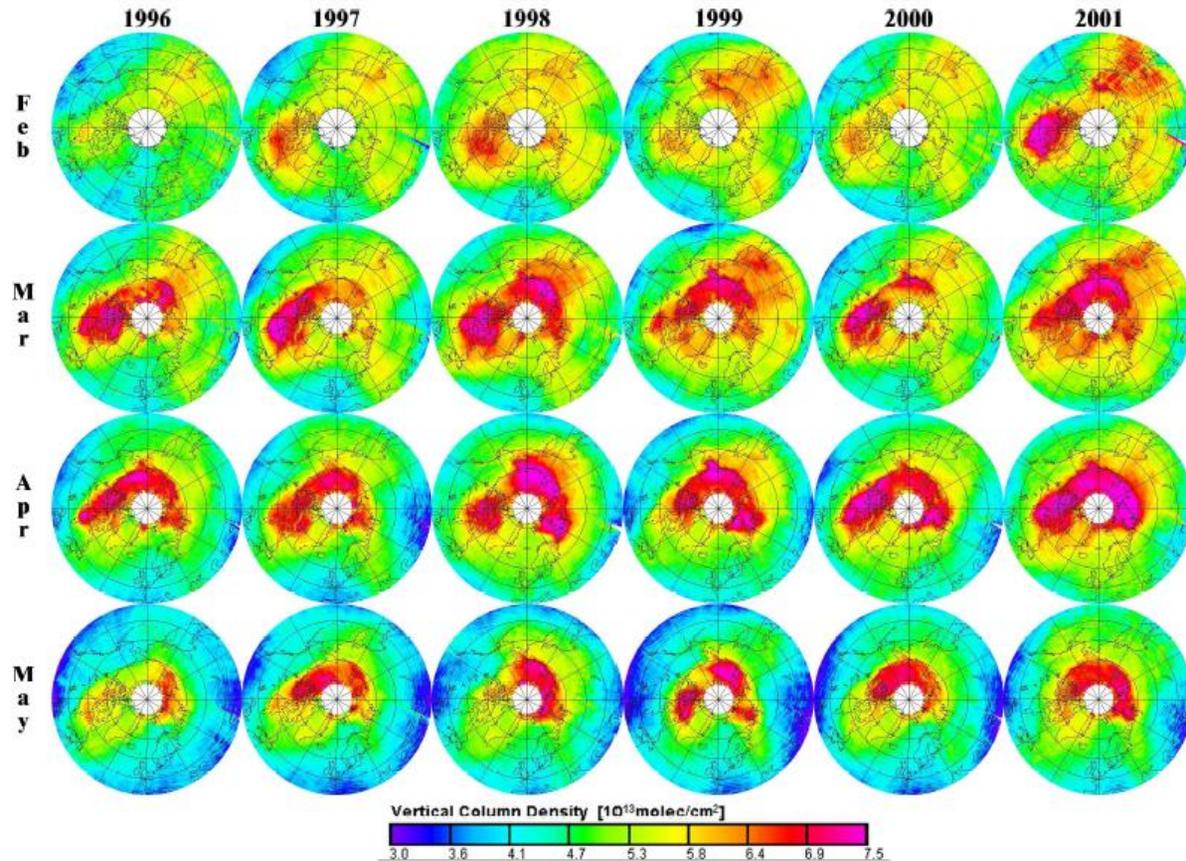
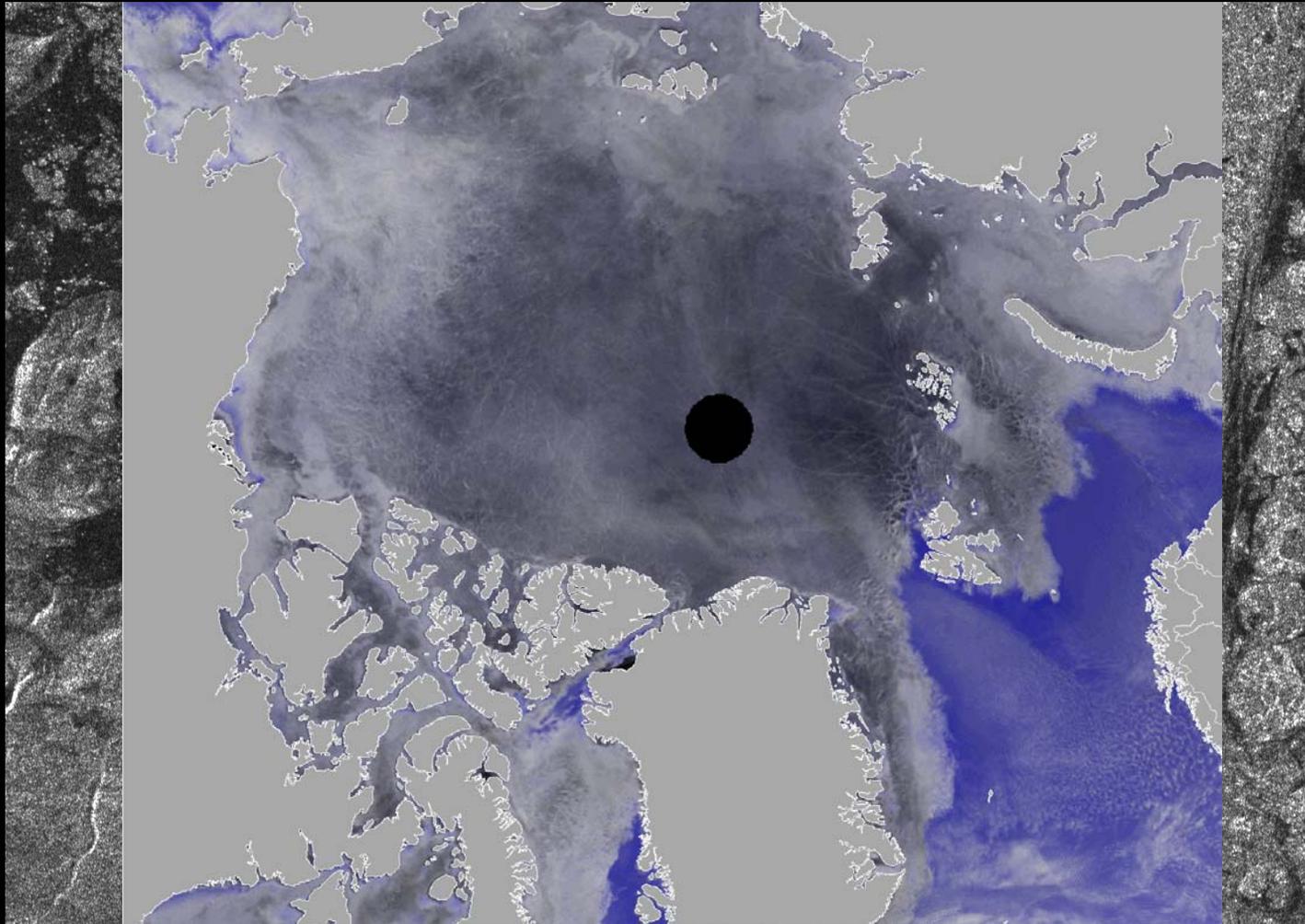


Fig. 1. Monthly mean VCDs of BrO ($\text{SZA} \leq 90^\circ$, AMF for std. strat. profile) in the northern hemisphere during spring (February-May (from top to bottom)) for the years 1996-2001 (from left to right); the color scale ranges from $3 \cdot 10^{13}$ to $7.5 \cdot 10^{13}$ molecules/ cm^2 .

Satellite data will be used as guidance where to go

SAR, Alert environment, 22 April 2004

Advance Microwave Sensor Radiometer (AMSR)



OASIS, HOW? ICE ISLAND ON THE FROZEN OCEAN



OTHER OPTION: ICE BREAKER FOR OVERWINTERING



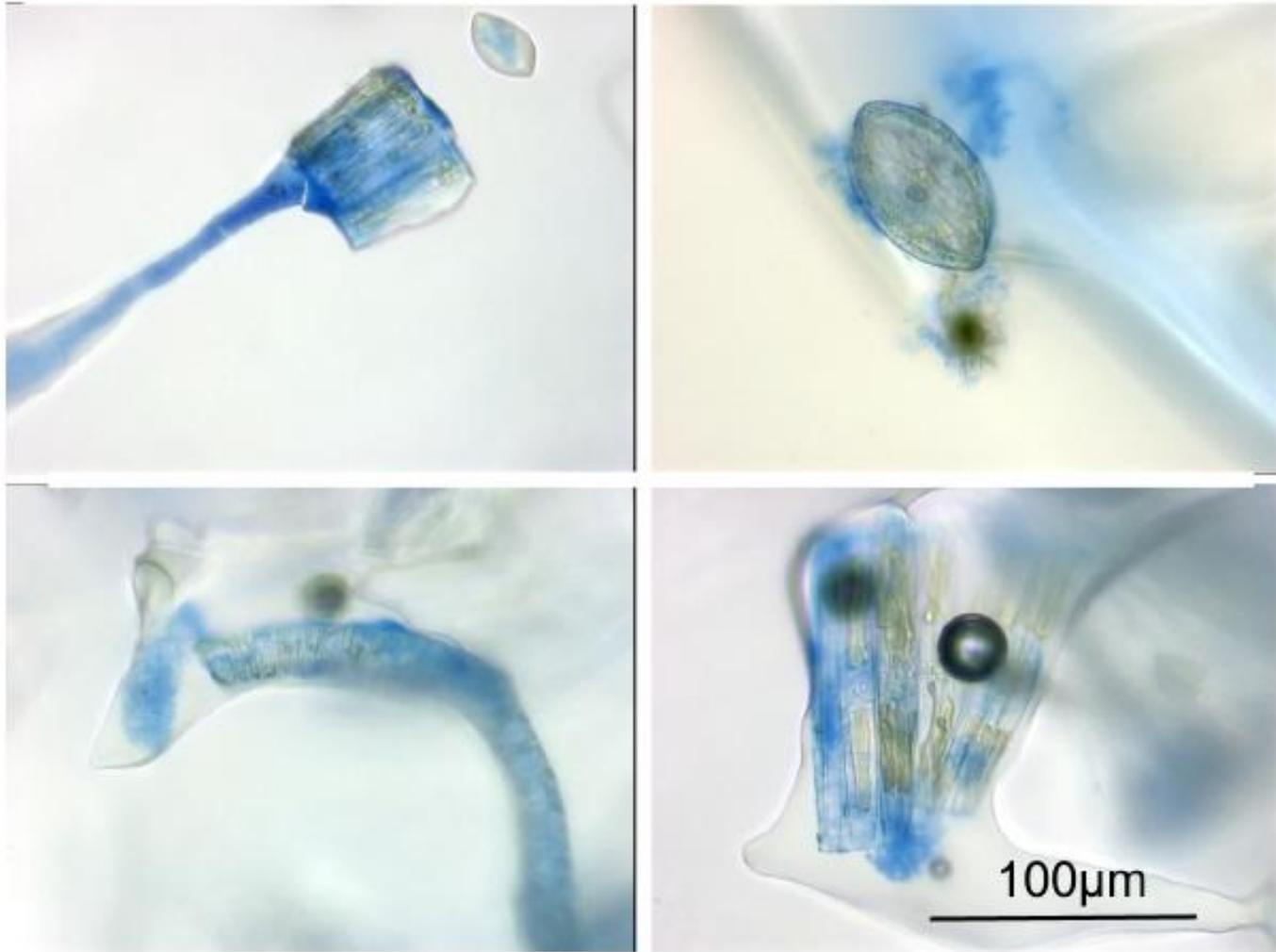
OASIS: MICROSCOPY OF SNOW





Microbial exopolymeric substances, a potential significant link between the Arctic ocean organic carbon budget and sea-ice physical processes.

Field observations in Barrow March 2002 at -10°C



OASIS REQUIRES NEW 3-D CHEMICAL TRANSPORT MODELS

boundary layer model (extreme stability)
gas and aerosol chemical model
snow layer model with OASIS specific physics and chemistry
coupling between ice and underlying ocean
chemical flux between OASIS

WHY IS THIS IMPORTANT?

CLIMATE CHANGE IS HAPPENING

THE OASIS INTERFACE IS REACTIVE

WE DON'T KNOW HOW THIS WORKS

IMPLICATIONS ARE UNKNOWN

WHAT IS ITS ROLE FOR RADIATIVE FORCING ?

WHAT IS THE IMPACT FOR THE BIOSPHERE ?

???

**OASIS IS AN OFFICIAL ACTIVITY OF TWO PROGRAMS OF
THE IGBP:**

**IGAC (International Global Atmospheric Chemistry)
SOLAS (Surface Ocean - Lower Atmosphere Study)**

PROPOSED AS IPY ACTIVITY TO ICSU

OASIS is proposed as IPY activity by

***Jonathan Abbatt* University of Toronto, Toronto ON, Canada**

***Harald Beine* CNR, Rome, Italy**

***Torunn Berg* NILU, Kjeller, Norway**

***Keith Bigg* Antarctic Society of Australia, Sidney, Australia**

***Jan Bottenheim* Meteorological Service of Canada, Toronto ON, Canada**

***Florent Domine* CNRS, Grenoble, France**

***Caroline Leck* University of Stockholm, Stockholm, Sweden**

***Steve Lindberg* Oak Ridge National Laboratory, Oak Ridge TN, USA**

***Patricia Matrai* Bigelow Laboratory for Ocean Science, W Boothbay Harbor ME, USA**

***Robie MacDonald* Institute for Ocean Science, Sidney BC, Canada**

***John McConnell* York University, Toronto ON, Canada**

***Ulrich Platt* University of Heidelberg, Heidelberg, Germany**

***Oleg Raspopov* SPbF IZMIRWAN, St Petersburg, Russian Federation**

***Paul Shepson* Purdue University, W Lafayette IN, USA**

***Oleg Shuminov* Polar Geophysical Institute, Murmansk Region, Russian Federation**

***Jochen Stutz* University of California at Los Angeles, Los Angeles CA, USA**

***Eric Wolff* British Antarctic Survey, Cambridge, United Kingdom**



Welcome to the
Ocean-**A**tmosphere-**S**ea Ice-**S**nowpack

(OASIS)

Home Page

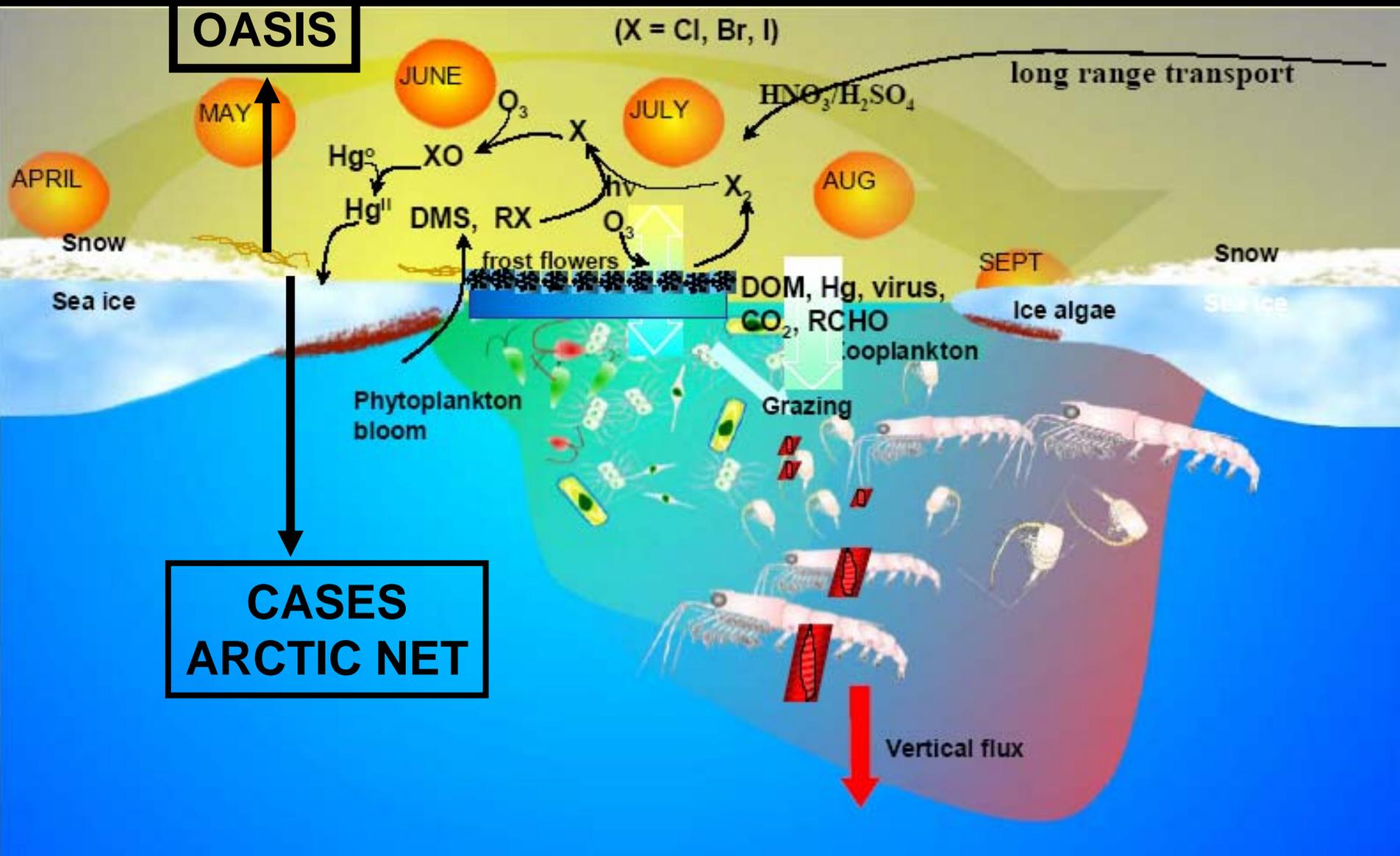
Please provide input to the OASIS Science Plan!!!

Send edits (to johnson@purdue.edu) via Track Changes mode

in the downloadable Word File:

[Science Plan 15](#)

www.chem.purdue.edu/arctic/OASISHomePage.htm



YEAR-TO-YEAR VARIATIONS OF SPRING TIME
POLAR TROPOSPHERIC BrO AS SEEN BY GOME
(in press, 2004)

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BrO VCD > 5.5 10^{13} molec/cm² in Northern Hemisphere

