Laboratoire d'Etudes en Géophysique et Océanographie Spatiales
UMR5566 (CNES-CNRS-IRD-UPS)

Observatoire Midi-Pyrénées

Lakes and Climate: The Role of Remote Sensing

Program draft

Day 1, June 1 2017

10:00-11:00 Introduction

Introduction – Programmatic context (Cherchali) 20 min

Current status on global lakes observations from satellites (Crétaux) 20 min

Presentation of SWOT mission for Hydrology (Pavelsky) 20 min

Session 1: Lakes and climate 11:00-12:30 (chair: Lemoigne, Dugay)

Lakes as sentinels of climate change, general overview (Brentrup) 30 min

Lakes and global models (Le Moigne) 20 min

Modelling lake thermal dynamics under climate change (Woolway) 20 min

Lake ice and climate in high latitude regions (Duguay) 20 min

12:30-14:00 lunch time

S1: **Lakes and climate 14:00-15:40 (chair: Lemoigne, Dugay)**

Lake and GhG emission (O'Reilly) 20 min

Lake and the carbon cycle (Cael) 20 min

Lakes in arid region, proxy for climate change in vulnerable ecosystems (Grippa) 20 min

Lake in mountain region (Abarca Del Rio) 20 min

Lake water color and biophysical parameters (Giardino) 20 min

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15:40-16:00 coffee break

Session 2: Observations of Lakes from Space in 2021 16:00-17:40 (Chair Benveniste, Rodriguez, Kerr)

Overview of the GPM mission: general objectives, benefits for lakes (Lettenmaier) 20 min

Overview of the Biomass mission: general objectives, benefits for lakes (Le Toan) 20 min

Overview of the future laser and radar nadir altimeters (ICESat-2, GEDI, Jason-CS/S6): general objectives, benefits for lakes (Birkett) 20 min

Overview of SMOS/SMAP mission: general objectives, benefits for lakes (Kerr) 20 min

High-resolution SAR, visible and NIR imagery: Venus, NISAR, Sentinel 1, Sentinel 2: general objectives, benefits for lakes:
Venus, Sentinel2 (Dedieu), 20 min

Day 2, June 2 2017

Session 2: Observations of Lakes from Space in 2021 9:00-10:10 (Chair Benveniste, Rodriguez, Kerr)

NISAR, SAR imagery (Pavelsky) 10 min

Thermal Remote Sensing of Inland Waters (Woolway) 20 min

Water color mission (Fichot) 20 min

SWOT lake products (Pottier) 20 min

10:10-10:30 coffee Break

10:30-12:40 Session 3: Lakes products from existing satellite missions and associated global databases (Chair: Picot, Groom)

ECVs for lakes and hydrolare, historical database and future work (Vuglinski) 20 min

Global lake data base for water level from satellite altimeters, G-REALM / HYDROWEB / DAHITI / RIVERS&LAKES (Birkett, Cretaux, Schwatke, Benveniste) 30 min

Measuring surface water extent from space (Peckel) 20 min

Global lake inventory: inclusion of water types and storage (Wang) 20 min

Global lake database for temperature and water color: globolake (Hunter) 20 min

Copernicus, Globland products for lakes (Groom&Dorandeu) 20 min

12:40-14:00 lunch

14:00-16:00 Round table on future work within the WG.

Chaired by: Cretaux, Pavelsky, Lettenmaier, Woolway, Ottle, Kouraev, Yesou

Issues:

1) is there a enough material available to write a state of the art paper on the role of satellite observations in understanding links between lakes and climate change?
   - To be published in a peer-reviewed journal
   - To serve as guideline for future work

2) What new sensor concepts can space agencies develop in the coming years that would improve our ability to understand changing lake environments?

3) Are there cases studies and projects to be initiated for future ROSES (US), TOSCA (France), NSERC (Canada), and NRC (UK) program?

4) Is there enough interest to simulate a set of satellite data products from different sensors mentioned in the conference to address questions reported in session 2? If so, how do we organize ourselves?

5) Organization of annual sessions on lakes and remote sensing at AGU and or EGU (note: session on Remote Sensing of Rivers and Lakes planned for Fall 2017 AGU meeting).

Some practical informations:

Address : CESBIO, 13 avenue du Colonel Roch, 31400 Toulouse

The conference room is next to the main entrance

By public transportation from the center of Toulouse:

Metro line B, direction to Ramonville, stop at station Faculté de Pharmacie, then take bus 78 to St Orens, stop at station LAAS.

some links to find the place:

https://www.google.fr/maps/place/Centre+d'Etudes+Spatiales+de+la+Biosph%C3%A8re,+31400+Toulouse/@43.5626773,1.4765846,18z/data=!4m5!3m4!1s0x12aebc319211da9f:0x553bcd41c5a6226a!8m2!3d43.5622662!4d1.476669

https://www.google.com/maps/d/viewer?ll=43.56219385654946%2C1.4769528306884467&spn=0.042292%2C0.076475&hl=fr&t=h&msa=0&z=15&ie=UTF8&mid=1FyQJIsagIGUQbzrj8A6QMWHF7YY

http://www.cesbio.ups-tlse.fr/index_us.htm

https://jsi2015.sciencesconf.org/conference/jsi2015/pages/plan_metro_tram.pdf

Turism office with a list of some hotels: http://www.toulouse-visit.com/

1- SWOT Mission Objectives

The Surface Water and Ocean Topography (SWOT) mission has been recommended by the National Research Council decadal survey "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond" for implementation by NASA. The SWOT mission is a partnership between two communities, physical oceanography and hydrology, to share high vertical accuracy and high spatial resolution topography data produced by payload configuration, whose principal instrument is the Ka-band Radar Interferometer (KaRIN) for making swath measurement of the elevation of land surface water and ocean surface topography. The SWOT mission will provide a transition from the conventional profile altimeter to swath altimeter for both oceanographic and hydrologic applications in the future. The broad scientific objectives specified by the NRC decadal review have been refined by community involvement in open workshops and the guidance of an informal science team before the missions' Phase A, and further improved by the missions' Science Definition Team during Phase A. A summary of the scientific objectives in hydrology is given below:

The SWOT mission will provide measurements of water storage changes in terrestrial surface water bodies and will provide estimates of discharge in large (wider than 100 m (baseline) or 170 m (threshold)) rivers, globally. NASA has been developing missions for the global measurement of the water cycle: the Global Precipitation Mission (GPM) will measure precipitation globally, the Soil Moisture Active Passive mission (SMAP) will measure near-surface soil moisture, and the GRACE Follow-On mission will measure the changes in continental water masses. The SWOT measurements will provide a key complement to these measurements by directly measuring the surface water (lakes, reservoirs, rivers, and wetlands) component of the water cycle. The hydrologic science measurement objectives of the SWOT mission are:

1. **To provide a global inventory of all terrestrial surface water bodies whose surface area exceeds $(250m)^2$ (goal: $(100m)^2$, threshold: $1km^2$) (lakes, reservoirs, wetlands) and rivers whose width exceeds 100m (goal: 50m, threshold: 170m).**
2. **To measure the global storage change in terrestrial surface water bodies at sub-monthly, seasonal, and annual time scales.**
3. **To estimate the global change in river discharge at sub-monthly, seasonal, and annual time scales.**

The primary hydrologic objectives of the SWOT mission are to characterize the spatial and temporal variations in surface waters, globally, and thus address the following hydrologic science questions:

What are the temporal and spatial scales of the hydrologic processes controlling surface water storage and transport across the world's continents?

What are the spatially distributed impacts of humans on surface water, for example through water impoundment behind dams, withdrawals and releases to rivers and lakes, trans-boundary water sharing agreements, diversions, levees, and other structures?

What are the regional- to global-scale sensitivities of surface water storages and transport to climate, antecedent floodplain conditions, land cover, extreme droughts, and the cryosphere?

Can regional and global extents of floodable land be quantified through combining remotely sensed river surface heights, widths, slopes, and inundation edge with coordinated flood modeling?

What are the hydraulic geometries and three-dimensional spatial structures of rivers globally, knowledge of which will improve our understanding of water flow?

Requirements related to lakes:

The lake, reservoir, and wetland height accuracy of the Level-2 data (requirement 2.6.3.a) shall be (1) 10 cm (1σ) or better, for water bodies whose surface area exceeds 1 km^2 and (2) 25 cm or better for water bodies whose surface area is between (250m)^2 and 1 km^2.

To measure storage change, only relative changes in water level are required. The (250m)^2 size requirement is consistent with the river precision requirement, 2.8.4, and is expected to capture up to 65% of lake storage changes, which will be a significant advance compared with the current capability, which is estimated to capture only 15% of the storage variability. The 1km^2 lake area threshold requirement will capture an estimated 50% of storage variability and still represents a significant improvement over current knowledge. The baseline 100 m river width requirement is for resolving river basins larger than 50,000 km^2 at 70% globally, which will be a significant advance beyond the current capability. The 170 m threshold river width requirement is for resolving river basins larger than 150,000 km^2 at 70 % globally. Observations at this level of performance would still improve on the historical gauge network, especially in areas like the Congo basin that are currently poorly observed.

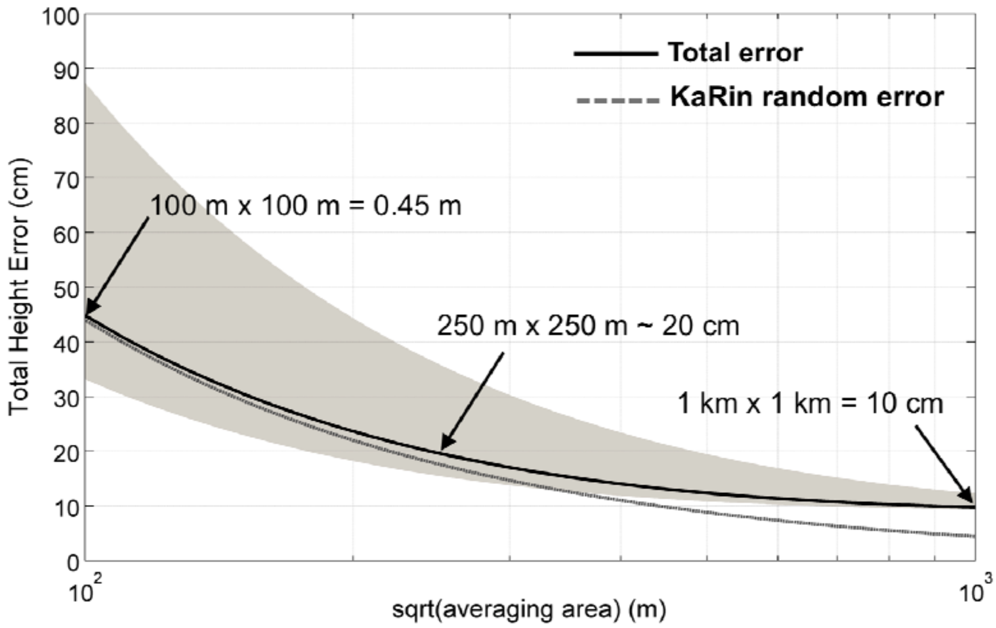

Figure 1: *Estimated water body total height accuracy for water-only pixels as a function of averaging area used to form the estimate (solid curve). Shown, for reference, is the KaRIN random error only contribution to the height accuracy (dashed curve). The total height accuracy is 10 cm for an equivalent water area of 1 km^2, 21 cm for (250 m)^2, and 50 cm for (100 m)^2. Due to changes in spatial resolution and signal-to-noise-ratio, the performance will vary across the swath. The shaded area shows the expected variability in performance as a function of the averaging area.*